

San Francisco Estuary Partnership

Stormchasing with Mercury in Mind

**A New Guide to Repairing
Delta Landscapes**

**Stress Test for Delta Species
Spotlights Pesticides**

Fighting Floods With Online Tools

An Engineering Fix for Cullinan

**Copper Still a Concern
in Hullfouling Paints**

High Hopes for Restoration Authority

SCIENCE • RESTORATION • WATERSHED • POLITICS • SPECIES • BAY

ESTUARY



NEWS

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Copper in Hull Paints Still Worrying

In July 2016, the EPA released their copper water quality draft criteria to a sixty day public comment period. It was their first update since 2007, offering a host of input parameters, like pH, temperature, and salinity, to estimate copper water content that isn't damaging to marine life.

Copper toxicity levels in California marinas have been a concern since the early 2000s. The primary perpetrator is copper-based anti-fouling paints (AFP) on the hulls of boats harbored in those marinas. Copper leaches from the paint and into the water system, affecting the organisms that inhabit it.

A statewide education effort is currently underway but the boating community is still reluctant to exchange the copper-based AFPs for less harmful products. Copper is a valuable biocide that prevents the accumulation of fouling organisms on the bottoms of boats; the growth of organisms like algae and barnacles on hulls can reduce fuel-inefficiency and degrade hulls.

Since the EPA only offers recommendations it is left to state organizations, such as the California Department of Pesticide Regulation (CDPR), to enforce regulations. They suggest a multi-pronged approach, such as copper-free alternatives, a reduction of in-water hull-cleaning, and capping the leach rate of AFP products.

These kinds of suggestions pose a problem to some boaters, however. Despite their well-to-do reputation, Thomas Dammrich of the National Marine Manufacturers Association maintains that recreational boaters are predominantly middle-class and lack the economic flexibility to move to a more costly alternative. They may wish to the right thing but can't or don't. "People get used to doing things a certain way," he says.

Education and outreach programs currently underway aim to promote alternatives. The San Francisco Estuary Partnership works directly with marinas and yacht harbors to reduce



Marina at Fort Mason on San Francisco Bay. Photo: Tira Okamoto

environmental impacts from recreational boating. "The toughest sell is getting individuals to understand the cumulative impact of pollutant discharge," says the Partnership's James Muller. "It always helps to hear the boater out and understand their frustrations. Only then can you have a mutually-respectful conversation where opinions can change."

At a March 9 information sharing session organized by the Bay Planning Coalition, which brought together industry and regulatory experts, a speaker from hull paint industry said copper-free alternatives have yet to measure up to the product they hope to replace. According to Tony Bulpin of Sea Hawk Paints, copper-free paints require more frequent and aggressive hull-cleaning which becomes comparatively costly for boat owners. "We do lots of research into alternatives," says Tony. "If there was one that compared, we'd produce it."

While California legislation is being proposed to regulate copper AFPs, the community remains divided on the issue. "All boaters want to do the right thing," says Dammrich. The challenge is they "don't often know what the right thing is. We have to make the best decision based on our information."

According to the CDPR, there appears to be little confusion: "Fifty-one percent of salt-water marinas exceed the California Toxics Rule's (CTR) chronic copper standard, and 30 percent exceed the acute standard."

In highly populated areas such as San Francisco Bay, maintaining CDPR standards appears challenging. CDPR's Charlotte Fadipe says "non-compliance with the CTR is a phenomenon that's isolated to densely-packed and poorly-flushed marinas." Such non-compliance suggests a rift remains between what is desirable and what is practical.

The stirrings of ecological push-back may already be present. According to a 2008 paper written by Jamie Gonzalez and Leigh Johnson of the University of California Division of Agriculture and Natural Resources, certain invasive fouling algae (such as *Watersipora subtorquata*) "can settle, survive, and grow in elevated concentrations of copper." This ability "may be evidence of an evolutionary process among ship-fouling organisms."

Those familiar with the non-native plants of the San Francisco Bay Area know the dangers of invasive species in ecosystems already under duress from human impact. It may end up that, in a kind of ecological arms race, copper-based anti-fouling paints are rendered obsolete by the very organisms they are meant to fight. **MHA**

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M O N I T O R I N G

The Second Signal

It was past midnight when Lester McKee pulled the plug. He'd been watching the weather for days on screen, looking for the perfect storm of conditions he needed to send his team out to sample the Guadalupe River in Santa Clara County. He knew there'd been enough rain already to saturate the soil and surpass annual averages. Zooming in on real-time sensors aimed at Santa Clara Valley Water District reservoirs, he could see they were full enough to spill downstream. On NOAA's weather site he found that ten inches of rain were projected to fall on the ridgeline of the Santa Cruz Mountains, and the state's water resources department was estimating peak flows of 9,000 cubic feet per second in the river. The intensity of storm also looked promising, exceeding two inches of rain in a six-hour period right over the middle of the watershed.

"I could see it was going to be what I call a hot moment, when the watershed gets enough rainfall that its mean side comes out," says McKee, an environmental scientist with the San Francisco Estuary Institute.

Of course 'hot' and 'mean' aren't really science terms. Together they just conjure up an image of a heavy-duty event with nasty side effects. In this case, the moment had all the signs of the kind

of rain, runoff, and flooding sequence that might only occur once every 10-20 years in California's Mediterranean climate. And all that water over time in the area of the historic mining district of the watershed was likely to shift some significant loads of sediment laced with mercury, chromium, and nickel down to the Bay. The last time McKee saw this kind of 'hot moment' was 14 years ago in December 2002.

Two scientists were on the receiving end of McKee's "good to go" text message on January 8, 2017. They climbed out of bed, hauled their equipment to a bridge over the river near the San Jose airport, set up a special crane, and started winching sample bottles in and out of the river every three hours.

Alicia Gilbreath and Sarah Pearce had already been out testing for PCBs and micro-plastics in the swelling river for a couple of days, trying to catch that first pollution signal from a storm that comes straight off impervious city surfaces. But by January 8 the more rural upper watershed had finally gotten wet enough to release



Flooding under bridge over Guadalupe River, where sampling took place. Photo: RMP

that unique second signal of mercury, chromium, and nickel. "It sounds geeky, but after 14 years, it was pretty exciting to be out there at that moment," says Gilbreath.

In the end, the hot moment lasted for five days straight. Indeed it lasted so long Gilbreath had to be relieved by colleague Ila Shimabuku so she could sample a second storm in a different watershed.

A big pulse of these contaminants coming through the Guadalupe may be an infrequent event due to California's variable climate continuum, but smaller amounts are the norm. There's mercury in most California watersheds. It drops down from atmospheric pollution, occurs in traces in various discharges, and crops up naturally in some soils. Likewise there are PCBs from old electrical transformers and building materials in most urban areas, despite bans. The Guadalupe, with its distinctly different rural top and urban bottom, offers scientists and regulators double insights into these two contaminants, which keep turning up in Bay-caught fish at levels harmful to human consumers.

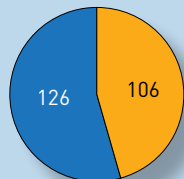
"Tracking PCBs and mercury, the two main drivers of Bay water quality regulation, has taught us about the two modes of flow from the Guadalupe," says McKee.

The two modes first revealed themselves in the winter of 2002-2003. Back then RMP scientists saw the lower watershed's urban runoff signal in November but didn't see the upper watershed's mercury signal until later in December. "Once it started, it didn't stop, and it eventually got bigger," says McKee, who had those lessons in mind when he designed the monitoring approach for 2017.

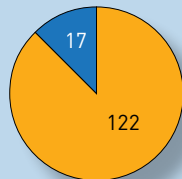
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GUADALUPE RIVER VITAL SIGNS

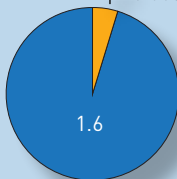
Area (square kilometers)



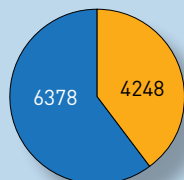
Total Mercury (kg)



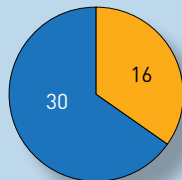
PCBs (kg)



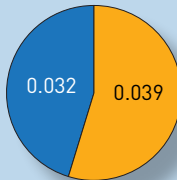
Suspended sediment (metric tonnes)



Methylmercury (g)



Dioxins+Furans (kg)



Guadalupe
■ Upper-rural
■ Lower-urban

Contrast between upper and lower Guadalupe River watershed outputs. Estimates based on averages over a period of climatic variability considered 'normal' (1981-2010) and then adjusted to reflect data available on each pollutant (2003-2014 for Hg and PCBs; 2003-2016 for sediment; 2010 for dioxins; 2005-2006 for PBDEs). Source: RMP



The San Francisco Estuary Institute's Sarah Pearce lowers the sampling bottle into the river. Photo: Ila Shimabuku

In the years between these two outsize storm events, the RMP has continued to learn about how mercury and PCBs behave in the Bay's watersheds. They have also compared local data with watersheds elsewhere in the world. This science has helped inform regulators, municipalities, and dischargers about the success and failure of various source control techniques. Regulators use it to track regional progress toward contaminant load reductions (TMDLs). Planners for South Bay salt pond restoration projects at the mouth of the Guadalupe use it to ensure their work isn't exacerbating the Bay's mercury problem (bacterial processes in restored wetlands can convert mercury into more harmful chemical forms).

"The Guadalupe is one of the few places in the world where there is enough instrumentation in the water to really study all inputs and outputs," says the San Francisco Bay Regional Water Quality Control Board's Carrie Austin. "We haven't had such a big storm with such high quality monitoring for a long time."

Of course the RMP has monitored more than two contaminants and two storms in the Guadalupe watershed. Through the intervening years, the

focus has shifted and adapted to different management questions about different contaminants – covering not just mercury and PCBs but also other trace metals, flame retardants, nutrients, dioxins, and pesticides.

Austin sees one glaring gap in the Guadalupe's data sets. However strong and long, they still don't include any baseline concentrations showing what runoff was like before 1990 when county agencies did some clean up and containment work around the mercury mining area. "Ideally you'd have before and after samples, but since we can't do that, we can only look out into the future at long term trends, and for that we have to capture the big storm events," she says.

Sadly the results from this January's sampling will be locked in labs and not yet ready for prime time until June. Clearly the first storm, or even the perfect storm, won't have the last word. And the word is wait and see.

ARO

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SPECIES SPOT

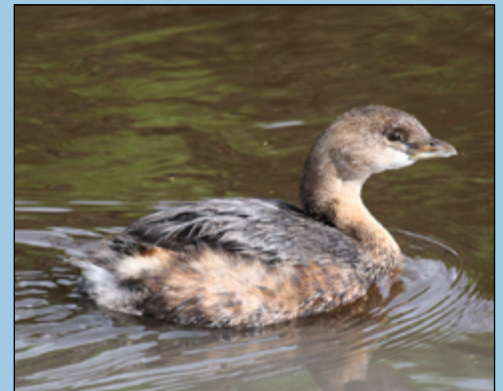
Futures on the Fly

A new study by scientists at the USGS Western Ecological Research Center finds that Central Valley wetlands, some of the most important overwintering habitats for waterfowl and shorebirds in North America, could be jeopardized by climate change. In this first study of its kind, researchers modeled 17 different future scenarios for these wetlands, taking into account climate, urbanization, water supply management, and wetland restoration for the years 2006-2099. Wetland types included managed wetlands, rice, and other winter-flooded crop fields.

The worst-case scenario in the model included the combination of a warmer, drier climate and water management changes resulting in less water supplied to wetlands and flooded fields. In that scenario, which

factored in only moderate urbanization, the amount of habitat would be reduced to as little as 33 percent of existing habitat in a given year, says Elliott Matchett with USGS, one of the study's two authors. Less water supply for wetlands in the summer would be particularly damaging. "Summer-irrigated wetlands produce a much greater abundance of wetland seeds that overwintering waterfowl need. A reduction in (water supply) priority for those habitats would exacerbate drought conditions."

The best-case scenario included more strategic, compact urban development combined with current water supply priority for wetlands plus additional wetland restoration efforts, and a less severe climate based on global changes in energy use and production. "We'll likely need global as well as local efforts to reduce impacts, plus continuing conservation," says Matchett. He stresses that preserving Central Valley wetlands also benefits many more species than waterfowl and shorebirds: the giant garter snake, western pond turtle, and many amphibians and songbirds rely on these



Pie-billed grebe. Photo: David Harper

habitats. These wetlands also give us important environmental services, he points out, including flood control, groundwater recharge and potentially better water quality, and recreational and economic benefits. **LOV**

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Read the full study at <http://climate.calcommons.org/bib/projected-impacts-climate-urbanization-water-management-and-wetland-restoration-waterbird>

C O N T A M I N A N T S

Delta Stress Test

At a recent UC Davis symposium on multiple stressors in the San Francisco Estuary, toxicologist Tracy Collier called for more monitoring in the Delta. “We don’t know what’s in the water,” he explains. And, as if in answer, hydrologist James Orlando presented early results from a new U.S. Geological Survey effort to help find out.

The mix of toxicants in the Delta likely differs from that in the Bay because much of the land is farmed. “I’ve been surprised to hear how little monitoring there is of agricultural water that is pumped back into the Delta from the islands,” says Collier, a member of the Delta Stewardship Council’s Delta Independent Science Board.

Tracking the Delta’s contaminants is key to protecting smelt, salmon and the other at-risk fish that live there or migrate through. Paying attention to multiple stressors is also critical: when combined, pesticides at sub-lethal levels can have deadly synergistic effects on fish. Add viruses and bacteria to the mix and it’s even worse. “When you expose salmon to chemicals at levels encountered in streams, they don’t die,” Collier says. “But when you put pathogens in the water, they die at a faster rate.”

Factor in other stresses, ranging from competition from invasive species to climate change, and it could be worse yet. “Global warming could increase the toxicity of pesticides in the Delta because rising temperatures make the effects of pathogens more pronounced,” he adds. Pesticides and other chemicals weaken the immune systems of salmon, making them more susceptible to pathogens. And when salmon migrate downstream from freshwater to the salty Delta and the Bay waters, they encounter a “whole new set of pathogens,” Collier says.

Salmon may also encounter a whole new set of pesticides. Inputs within the Delta are little known, however. “The Sacramento River and San Joaquin River have been monitored for years but historically there has been little monitoring in the Delta itself,” says Michelle Hladik, an environmental chemist who leads the USGS Pesticide Fate Research Group. “We need more

information on what is actually occurring in the Delta now.”

As part of the recently-launched Delta Regional Monitoring Program, the team is in its second year of checking agricultural and suburban runoff at five sites for more than 150 pesticides. “We’re monitoring a long list of pesticides including the new or understudied, such as those that have increased in use in the recent past but are not currently in other monitoring programs,” she says.

More than half of the pesticides applied in the Delta watershed are not routinely tracked. “It’s a moving target, there’s always something new coming along,” says the USGS’s Orlando, who is also a member of the Pesticide Fate Research Group. “The Delta watershed has had an average of nine new pesticide active ingredients introduced each year since 1995.”

In a series of recent studies, the team has detected a wide variety of insecticides, herbicides and fungicides in the Delta. Examples include pyrethroids, neurotoxins that have grown more popular as organophosphate use has waned; fipronil, which is used to control fleas on pets; and neonicotinoids, which are implicated in the honeybee decline. “It’s a soup out there,” Hladik says.

Benchmarks for toxicity to aquatic life are based on the effects of individual compounds. But that doesn’t reflect the reality for fish and other creatures that live-in Delta waterways. “You can see 30 different pesticides in a sample — how does that mixture affect living organisms?” Orlando says. “There’s not a lot of information on this because it’s so hard to test. Just testing one compound is hard enough.”

New research suggests that the impact of pesticides on the Delta’s fish could be greater than is recognized. In the December 2016 issue of *San Francisco Estuary & Watershed Science*, Stephanie Fong and colleagues reported that pyrethroid use correlates with declines in several species of fish in the Delta, including Delta smelt, Longfin smelt, Sacramento Splittail, American Shad, Threadfin Shad, and Striped Bass.



USGS collect water samples at Ulatis Creek. Photo: Matt De Parsia

Interestingly, the authors also found that “pyrethroid use was a more important determinant of abundance variability than flow” for all the species tested except Longfin Smelt. “We hesitate to say that pesticides are causing fish declines, yet we do say that flow causes declines,” the Delta Independent Science Board’s Collier comments. He’s glad to see the issue of contamination in the Delta is getting more attention: “It’s not really flows or any other stressor individually, it’s the combination and that’s hard to manage.” **RM**

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R E S T O R A T I O N

Back to the Bones of the Delta

Chris Rose likens a 500-acre farm in the northwest Delta to a bakery in downtown Manhattan. Each property has obvious characteristics that would be hard to replace. In the Delta it's some of the best water rights available and land that isn't so subsided and salty you can't grow good grass. In Manhattan, it's the chance to bake and sell comfort food in the heart of a city with a big appetite. Each property is prime real estate in terms of 'location, location, location' and each has intangible values to the families or communities that have long made a living from them.

"Most people might look at those farms and just see cattle grazing and think that's easy to do somewhere else, but it's not that simple," says Rose, executive director of the Solano Resource Conservation District.

Anyone who's been around debates about the Delta's highest and best uses for decades has seen a long train of plans touting this or that kind of restoration to save salmon, smelt, mice, birds and other endangered. What's

different about the San Francisco Estuary Institute's recently released *Delta Renewed* guide is that it finally puts all that's been learned together in one place in a mere 100 pages. Using science-based maps and metrics, it offers a strategic approach to ecosystem restoration in a landscape where thousands of acres of historic marsh have been reduced to a few hundred to make way for crops, cows, and people.

The guide divides the Delta into five major zones and recommends different tactics for different regions. In this context, guide co-author Julie Beagle will tell you that those 500-1,000-acre cow and sheep farms in the northwest Delta are valuable for a reason other than just location. For those scouting the Delta for places to replant riverbanks, restore marshes, and grow fish food, it's elevation, elevation, elevation that's the biggest draw.

"The Delta is not a blank slate," says Beagle, an environmental scientist. "You can engineer almost anything anywhere. But there are only a few places

where we can use the power of flows, tides, floods, erosion, and sediment movement to repair and renew habitats. In our guide, we've suggested what to look for and do when you find it."

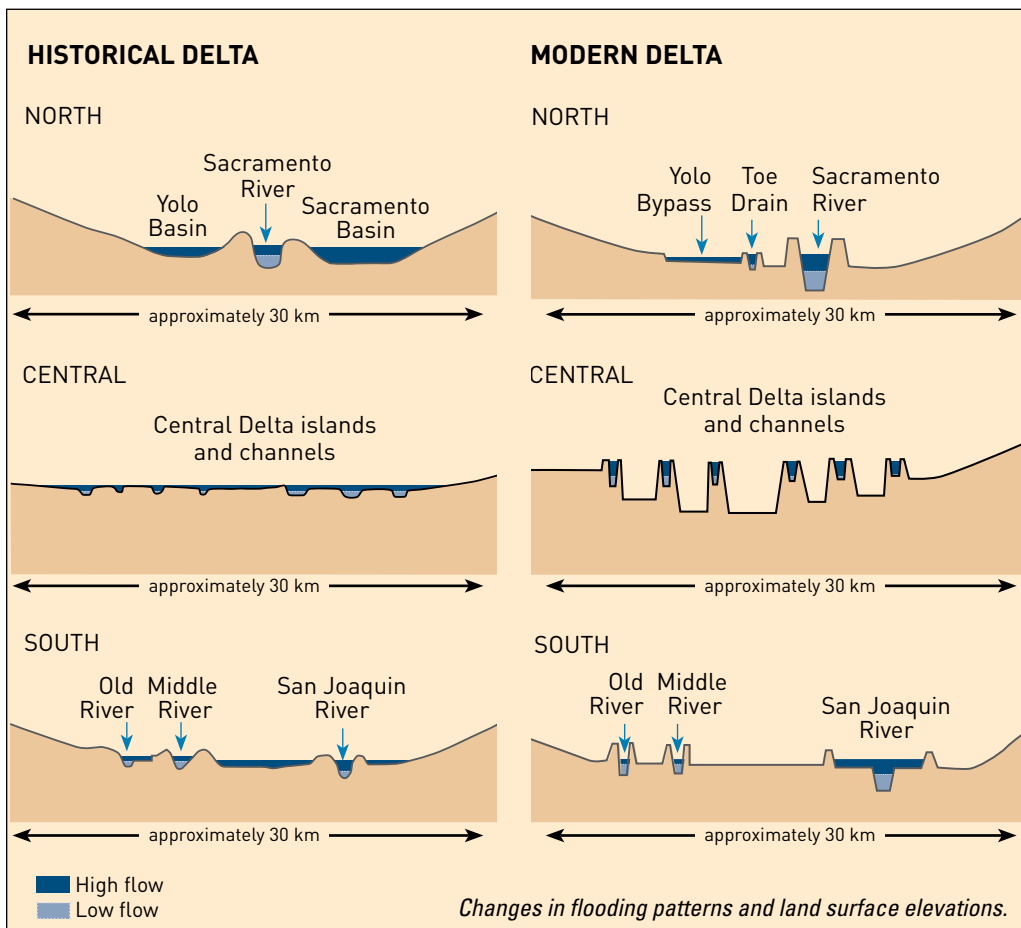
Some areas of the Delta, like the middle, are so sunk into a deep bowl below sea level that breaching any levee to reintroduce tidal action would simply result in new lakes filled with bass from Mississippi and weeds from Brazil. But on the periphery of the Delta, particularly on the northwest edge around Cache Slough and the northeast edge around the lower Cosumnes River, the landscapes are less subsided and more amenable to what Beagle calls "process-based" restoration.

"It really matters where in the landscape you are," says Beagle. "We can't go back to the historical Delta, but the bones are still there in terms of some of the geologic and hydrologic processes at work on the earth's surface. Opportunities still exist to reboot these processes and connect patches of habitat, we just have to do the right things in the right places."

The Right Places in the Right Sizes

When state and federal agencies began talking in the late 1990s about 90,000 acres of restoration in the Delta to rescue the most endangered species, it must have sounded like a lot to those who live, work and farm in this landscape. In a Delta of 500-700,000 acres, including the areas covered by water, that's a hefty chunk. The truth is these targets didn't amount to much over the years, however. Many planned restoration projects have been stuck between shifting permit requirements and political priorities for decades. Today's targets are more modest than those of decades past.

Under Eco-Restore, the state's most recent effort to advance ecosystem restoration and meet the basic requirements of various biological opinions and endangered species authorizations, targets include 10,000 acres of tidal, riparian and upland habitat restoration, an area about twice the size of San Francisco International Airport, as well as large areas of floodplain enhancement and subsidence reversal projects,



according to State Fish and Wildlife's Carl Wilcox (see table).

Along with the targets comes the need for local input into where and how these revived landscapes might best fit among the current pastures, rice fields, orchards and homesteads of the Delta. "Finding the sweet spot between effective restoration and agricultural sustainability and flood protection is the collaborative task ahead of us," says the Delta Conservancy's Campbell Ingram. "We are just beginning to engage counties and landowners in what promises to be a really rich conversation."

That conversation will be informed by both the *Delta Renewed* guide and a bigger picture state framework for conservation due later this year. Both will be the subject of ongoing workshops and outreach efforts organized by the Conservancy.

"Farmers want to be part of creating the vision, they don't want scientists doing their own thing without taking into account agricultural values," says Ingram.

"It all goes back to working with the locals," says Wilcox, who is in the midst of weaving stakeholder concerns into the state's forthcoming *Delta Conservation Framework*. "We're trying to produce a document they see themselves in," he says.

Two Promising Locations for Nature-Based Engineering

While landowners have long pointed out that the state should be restoring public property first, before asking farmers to take one for the team, both approaches may be necessary in an increasingly uncertain future.

"The scales we've been working on haven't been big enough to sustain both the species we care about and the processes that create their food and habitat," says Julie Beagle. To both create and maintain habitats, she says, we have to use the flow of water and sediment — nature's habitat builders — and innovative engineering to connect larger landscapes.

Two areas of the Delta are now emerging as the proving grounds for what the *Delta Renewed* team has in mind, as well as for connecting actions on both public and private property, whether it's growing bird-friendly crops or marshes. Insiders refer to these areas as the 'arc' and the 'corridor.'

The 'arc,' a term and a place first identified by UC Davis's Peter Moyle in earlier searches for good fish habitat, encompasses the lands around Cache Slough in the northwest Delta. If strategic spots on private lands in and around the slough were connected to the already habitat-rich public lands in Suisun Marsh

Current Delta Restoration Targets

17,500 acres of flood plain enhancement for fish (mostly Yolo Bypass)
8,000 acres tidal habitat restoration for smelt
1,000 acres of tidal habitat holdovers from CALFED Bay-Delta Program
3,500 acres of managed wetlands for carbon sequestration and subsidence reversal
1,000 acres of riparian and upland habitat

and Yolo Bypass, the area could form an arc in both in shape and purpose. Much like the refugees on Noah's Ark, this may be the last place various near-extinct fish species might survive, with a little help from humans.

The 'corridor' is a swath of river preserves and islands running from the northeast corner of the Delta at the mouth of the Cosumnes River out to sea. With recent purchases of several Delta islands by Southern California's Metropolitan Water District, a connected series of habitats mostly on "public" lands, but also including wildlife-friendly farms, suddenly seems doable.

"This winter's flood fight, when the Nature Conservancy had to work with state Water Resources and other neighbors in

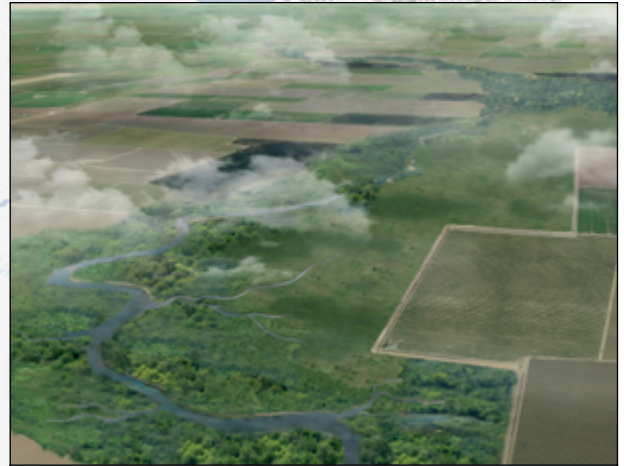
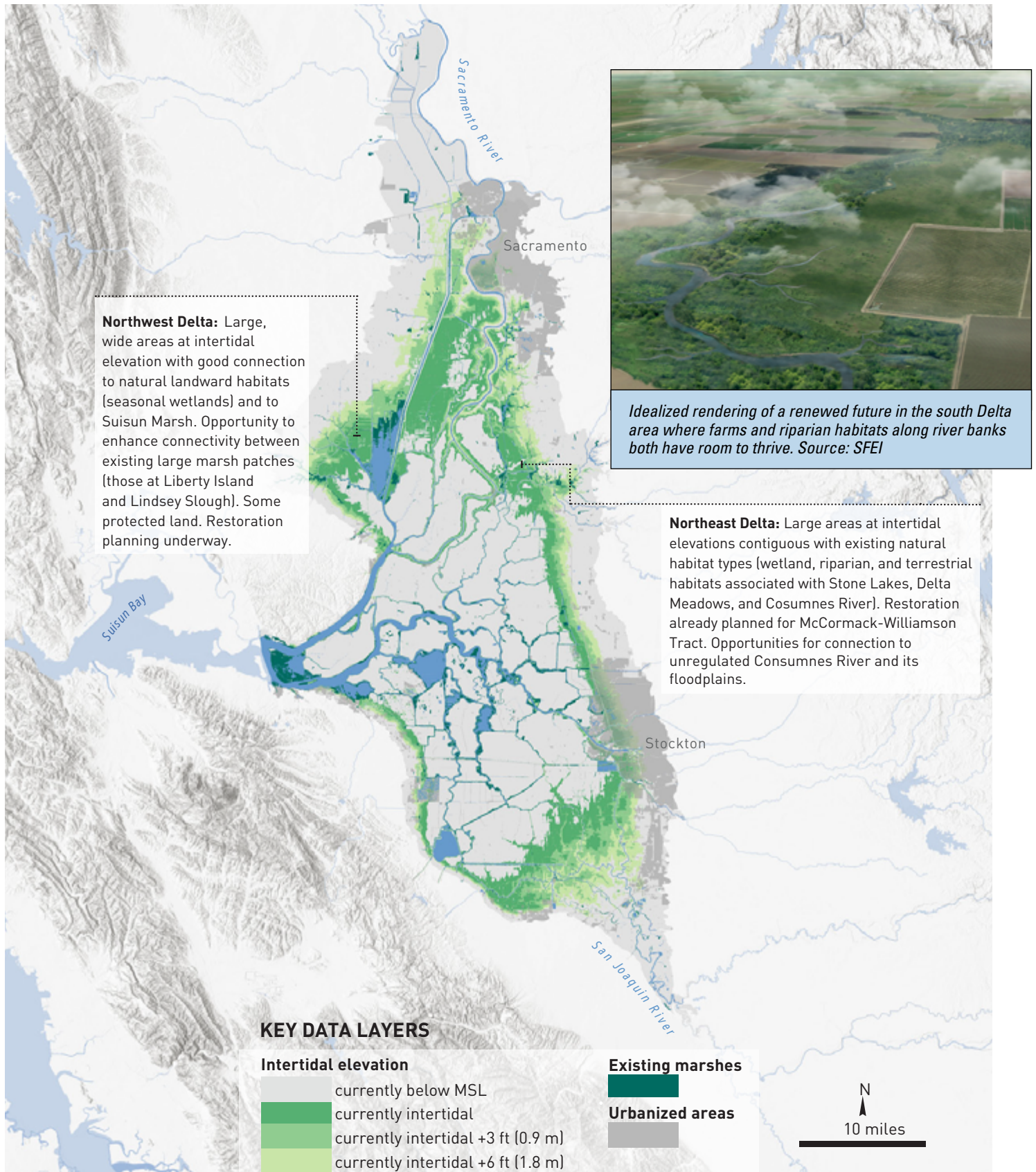
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Allowing flooding echoes processes that once delivered sediment and nutrients to delta habitats. Making room for more floodplain helps, as shown by this recent high water event on The Nature Conservancy's 500-acre floodplain restoration project at the Cosumnes River Preserve. The preserve is in the northeast delta at the top of the "corridor." Photos: Judah Grossman, The Nature Conservancy

Opportunities for Marsh

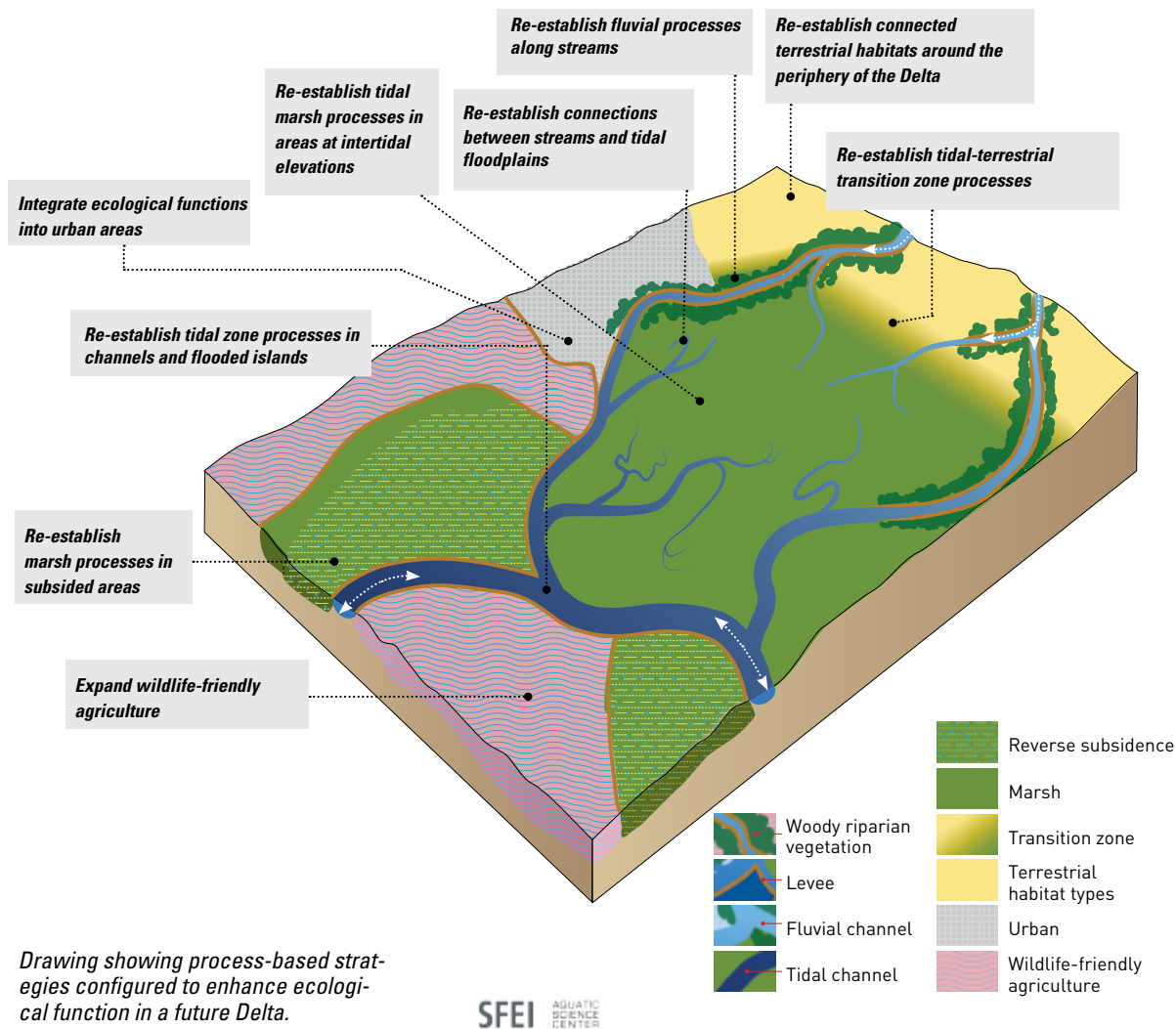
F O R G E T L O C A T I O N , L O C A T I O N , L O C A T I O N —



Idealized rendering of a renewed future in the south Delta area where farms and riparian habitats along river banks both have room to thrive. Source: SFEI

Restoration in the Delta

THINK ELEVATION, ELEVATION, ELEVATION!



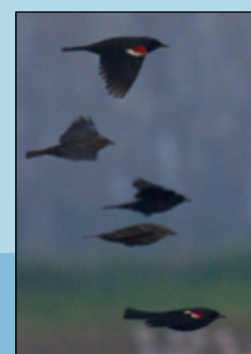
Drawing showing process-based strategies configured to enhance ecological function in a future Delta.



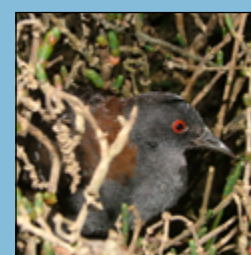
Sandhill cranes.
Photo: Rick Lewis



American bittern.
Photo: Rick Lewis



Tricolored blackbirds at the Merced Wildlife Refuge.
Photo: Rick Lewis

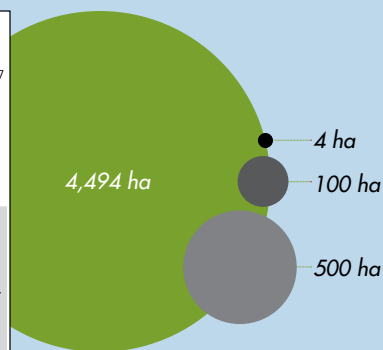


Black rail.
Photo: Danika Tsao

SCALE GUIDELINES

Big connected marshes make better habitat than small scattered patches

Reference values	<1 ha = 1 marsh patch size for Tricolored Blackbird nesting ¹⁶
	1 ha = minimum marsh patch size for California Black Rail occupancy ¹⁷
	100 ha = minimum marsh patch size for maximum Black Rail density ¹⁸
	500 ha = approximate marsh area for a full channel network ¹⁹ (based on historical landscape)
	4,494 ha = average historical patch size (SD = 17,956) ²⁰
	4 ha = average modern patch size (SD = 24) ²¹
	110,527 ha = maximum historical patch size ²²
	749 ha = maximum modern patch size ²³



the northeast Delta area on their common problem of managing high flows, shows the potential for collaboration in the corridor,” says Wilcox.

The buzz on the corridor is still in its infancy, but conversations about Cache Slough and the arc are farther along. The most recent push has involved five meetings organized by the Delta Conservancy and cautious conversations and negotiations.

“Having state agencies, reclamation districts, and counties representing farming interests all sitting in the same room and discussing what to do in the Cache Slough area is somewhat of a victory,” says Chris Rose.

One recent outcome is Delta Conservancy funding for Solano County agencies to work with federal advisors to evaluate and assess the land’s agricultural and other values and uses (LESA program). The idea is to know more about what’s being grown where and the location of supporting infrastructure such as crop processing facilities and water intakes before laying it over the new ecological opportunity maps.

Everyone then hopes landowners would actually come to the table and consider the on-the-ground synergies they might find on combined maps. In the past, a good turn out might have only come in protest of some new regulatory threat of takings. In the future, Rose, Ingram and Wilcox are doing their darndest to set up a more collaborative pathway to decision-making.

“It isn’t as if farmers don’t want habitats or don’t like the idea straight away,” says Rose. “It’s that it has to fit into their business. When you get a breakthrough, it’s because they want to see more raptors, or more songbirds, or that they’re not really using some piece of their land much anyway. It’s painful and it’s slow but I don’t know how else you can do it. Occasionally you hit a wall and there has to be some compromise to move forward.”

Compromises could also come from the sheer length of time required to achieve beneficial change. “When farmers hear ‘marsh restoration’ they often think ‘land conversion’, but restoration won’t happen overnight, there will be interim landscapes,” says Beagle. “It’s an evolving process, as sea level and groundwater rises, a particular farm could begin by engaging with wildlife friendly agricultural practices, then transition to different crops and habitats, and later allow some marsh restoration once the tides get too high.

Our approach takes the long view — it’s a 50-100 year timeline.”

In the meantime, Ingram hopes that by tying funding for some of these activities to the *Delta Renewed* guide and the state’s Delta Conservation Framework they’ll get more traction. Under Proposition 1, the Delta Conservancy has \$50 million and the Department of Fish and Wildlife \$87 million to invest in restoration. “When we’re soliciting proposals, we’re going to direct people to those documents and ask them if they’re incorporating the concepts in project level design,” he says.

The Prop 1 bankroll isn’t much of a carrot for Cache Slough farmers sitting on golden water rights and good grass, however. Fifty years ago they could have found a similar property elsewhere but nearby, just as Santa Clara Valley farmers moved to the Central Valley to make way for Silicon Valley. Today there are fewer choices.

“Without being able to offer similar property or a lot more money, it can be a hard sell,” says Rose.

But outright purchase isn’t the only option on the table for those who hope to promote restoration. “Just because it’s a wetland, doesn’t mean the state has to own it,” says Ingram.

Science That Primes the Pump

In today’s climate of short-term thinking and alternate realities, it is heartening to note the amount of painstaking effort and “fact-checking” that went into *A Delta Renewed*. It’s the last of three reports from the San Francisco Estuary Institute funded by the State Department of Fish and Wildlife with bond funds approved by voters for this purpose. The first report investigated the historical ecology of the Delta, and the second how humans changed it. This final guide is crammed with to do lists and detailed dissections of Delta geography and land uses, all based on the foundation of research that went before. This is science that allows people in the field — whether farmers, fisheries managers, wetland designers, or water engineers — to get on with the business of repairing and renewing the landscape confident that they now know enough to proceed.

“I remember well when we were all struggling with what the “natural” Delta must have been like, and whether there was more or less water going through it than now,” says US Geologi-

cal Survey climate scientist Mike Dettinger. “As I look at various important research papers just published, I believe that our ability to articulate what our species need, how the various water, sediment, and nutrient budgets of the Delta have changed, and what the missing elements of the Delta are today, has benefited immensely from the effort that culminated in *A Delta Renewed*. We cannot understand what is right in front of us without understanding where it all came from.”



Cattle on Sherman Island in part of the arc that links to Suisun Marsh.
Photo: Bird’s Eye View

Even if carried out on a serious scale, the recommendations in *A Delta Renewed* may not be enough to save every species from extinction (see www.sfestuary.org/orphans). But they could help get some of the natural processes necessary to sustain a healthy ecosystem going again, and thus support some native species. And they could help move water, mud, and fish through the Delta in ways less damaging to local communities, economies, and riverbanks than what we’ve witnessed below Oroville Dam post the most recent atmospheric river downpours.

Fifty years from now, if natural processes are still functional and science-based stewardship continues, there will still be birds to watch, ducks to hunt, and fish to catch. Whatever the reason we’re trying to save them, or the location or elevation, it’s a recipe for greatness that might actually have legs. **ARO**

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Control with Less Concrete

If nothing else, this winter has helped put the Bay Area's flood control infrastructure back in focus after an epic drought. It also ended a multi-year collaborative project among scientists, regulators, and flood control agencies called Flood Control 2.0 that proposes new ways of thinking about the connections between the region's creeks and the Bay.

Traditionally flood control was designed with a single use in mind—to get water out to the Bay as quickly as possible—which meant putting rivers and creeks into straight concrete channels. Over the years, the flow in those channels slowed because of sediment buildup, which necessitated expensive dredging to keep things moving.

"Most Bay Area flood channels were built in the 1950s and 1960s and they put creeks and rivers in trapezoidal channels or storm drains that went under streets and altered the way bay watersheds function," says San Francisco Bay Conservation and Development Commission (BCDC) Sediment Program Manager Brenda Goeden.

Today, this aging concrete infrastructure in the Bay's lower watersheds needs an update, especially in an era of sea level rise and erratic storm behavior due to climate change. Fixing the system, while trying to address environmental concerns and long-term effects on the region's marshes and riparian habitats, requires alternatives.

"We started with a step back," says environmental specialist Adrien Baudrimont, project manager of Flood Control 2.0, a four-year study led by the San Francisco Estuary Partnership. "We looked at how these channels behaved and worked historically in order to explore where we want to go in the future, and how to think about flood control in a different way."

Prior to intensive flood control, the Bay Area's streams and creeks connected to the region's baylands in a variety of ways. Some fed tidal marshes, while others supplied inland freshwater wetlands. Steep creeks connected directly to the Bay, while gentler, more meandering streams only served a seasonal purpose and never had a connection, instead recharging the

flats adjacent to the Bay intermittently. There was a lot of variability to the way the watershed functioned, and the delivery of water and sediment from the hills to the shoreline created diverse habitats.

"Historically these channels would come out of the hills and bring sediment to tidal marshes and baylands. That doesn't happen anymore in many places," says Scott Dusterhoff, lead geomorphologist at the San Francisco Estuary Institute (SFEI). "Not only have we lost tidal habitats, but some areas behind levees at the base of our watersheds are sinking fast."

To help flood control agencies and land managers make decisions that better balance flood protection with habitat needs, the Partnership launched Flood Control 2.0 in 2012 in collaboration with SFEI, BCDC, the San Francisco Bay Joint Venture, and Bay Area Flood Protection Agencies. EPA Region IX supported the project with a grant from the San Francisco Bay Water Quality Improvement Fund.

As the grant draws to a close, Flood Control 2.0 has completed a series of useful decision-making tools and made them available online. One of the tools is a channel analysis (which includes mapping historical rivers and creeks). Another is a related region-wide sediment study. The data collected can tell you how, when, and where sediment arrives and is stored in flood control channels.

Also part of the Flood Control 2.0 toolbox is a series of recommendations for Bay Area flood control regulators looking for ways to balance

flood safety with habitat creation and protection, keeping in mind the way the region's watershed functioned in the past.

"It's a step-by-step guide for doing a multi-benefit project in a flood control channel—everything you need to consider to start designing these projects, and everything you need to know about the relevant regulatory agencies and permitting process," Baudrimont says. Flood Control 2.0 has even completed recommendations for improving the cumbersome permitting process to facilitate multi-benefit flood control in the future.

Another interactive tool allows agencies to input their own data and compare the costs and benefits of existing single-use infrastructure with updated multi-use designs.

To develop the toolbox, the Flood Control 2.0 team partnered with local flood protection agencies to explore three implementation projects that could benefit from modifying the traditional flood channel design.

The project examined Lower Walnut Creek, Lower Novato Creek, and San Francisquito Creek for opportunities to show how restoring some of the historical channel function can increase ecological benefits, realign sediment budgets, and restore healthy marshes and wetlands, while reducing the need for routine dredging and creating a better buffer for rising seas.

In some ways these tools are simple, and easy to use," Baudrimont says referring to the results of the Flood Control 2.0 project. "But until now, they didn't exist." **DM**

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Humans long ago reshaped this shoreline near the mouth of Walnut Creek on the Carquinez Strait.

C R E E K S

Corte Madera's Flood Fight Goes On and On

If you peek through the chain link fence behind the Ross Post Office in Marin County, you will see a suburban creek that looks much like any other. Some sections of bank are armored with riprap and wire, others with concrete, and others not at all. Scattered alders grow at the edge of water that ripples over stone and around muddy bends.

The fate of this stretch of Corte Madera creek has been the subject of fierce debate since the 1960s, when the U.S. Army Corps of Engineers slated it for a flood-control design converting the stream bed to a deep, rectangular concrete channel. Before construction stalled, several downstream miles were modified, channelized, or reshaped to remove meanders or fill marshes. Nearly a mile of the creek was straightened and replaced with a concrete box channel that begins just a few hundred feet south of the Ross Post Office, at the entrance to Frederick S. Allen Park.

Half a century and reams of fix-it proposals later, the creek is still flooding. Mud-brown and swollen, the Corte Madera creek threatened to overtop its banks at least twice this winter. Forecasts of heavy rain sent owners of nearby homes and businesses scurrying for sandbags and rainboots, keeping their ears open for flood sirens.



Creek channel and fish ladder. Photo: Jacoba Charles

What's different this winter is that for the first time in decades, both public agencies and local advocates are in agreement that more can be done than just keeping the water at bay.

"We see significant opportunities here to not only improve flood performance but also make the creek an amenity for the community and the local ecosystem," says Christina Toms, Senior Environmental Scientist with the San Francisco Bay Regional Water Quality Control Board.

Toms is one of those responsible for issuing state permits for any flood control fixes for the creek and as a Marin resident she's watched the creek for years. The concrete portions of the creek are "legendary" in Bay Area flood control circles for their shortcomings, she says.

When designed, engineers assumed the concrete portion could contain the kind of flood that would occur once in 250 years but recent studies suggest it might be barely up to the challenges of a 5- and 10-year flood. In the last century, the creek has had eight floods that caused major damage, six of which occurred since the Corps improvements.

The original 1960s plan to extend the concrete channel through Fairfax — over five more miles — was scrapped decades ago. At one point, Marin residents faced down bulldozers to stop the project from moving forward. Work on the undeveloped stretch of the project that is called "Unit 4" was put on hold in 1972, and since then planning has stopped, started, and been revised many times—but no consensus has yet been reached, and no ground has been broken.

"It's outlived its life. It's got rusty rebar. It doesn't work. It is a disaster aesthetically, environmentally, and however you look at it," says Sandy Guldman of the nonprofit group Friends of Corte Madera Creek Watershed.

Different stakeholders prefer different aspects of the alternatives being discussed. Some homeowners have said they prefer the occasional flood to a wall or other change intruding on their backyard. Others feel the opposite. Environmental groups, along with agencies such as the Water Board, would like to maximize habitat and improve fish passage and see as much as possible of the existing concrete channel removed.

Over the years, the Army Corps has modernized many projects so they also promote ecosystem services such as habitat and fish passage. But the Corte Madera Creek project has been going on for so long that it is still operating under an old, narrowly-focused federal authorization issued in the 1960s.

"The challenge we are having is that it's hard for the Corps to propose project design measures that [my agency and other resource agencies] would be able to permit," Toms says. "We've been working really proactively with the Corps [to overcome the] considerable environmental shortcomings of the proposed alternatives."

Digging parts of the channel deeper, building up walls or berms to keep the water contained, elevating vulnerable homes, or some combination of these are options being considered. The plans don't call for more concrete channel to be built.

Removing the entire existing concrete channel isn't feasible, Guldman acknowledges. However, she hopes that intermediary stretches of the channel might be returned to a more natural state. It would be realistic, she thinks, to widen areas of the creek that are flanked by public property. Terraced public parks, with walking paths and landscaping, could double as a place for floodwaters to go.

"It wouldn't be like a real floodplain, but it would provide some structure, some little eddies," Guldman says. "It would really improve fish passage." **JC**

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See extended story online at www.sfestuary.org/estuary-news/

E N G I N E E R I N G

Hosing a Load Off

What's been missing for some hard-to-access wetland restoration sites around the Bay is a critical piece of equipment called an offloader. They're expensive to rent and hard to adapt to different sites without some creative engineering. But this winter the 1,575-acre Cullinan Ranch off Highway 37 took delivery of 200,000 cubic yards of material dredged from the Richmond Harbor via a new offloader crafted especially for the job by Curtin Maritime.

"[Curtin COO Steve Chew] realized that if he built an offloader, he would be very competitive with some of the dredging projects here in the Bay," says Beth Huning of the San Francisco Bay Joint Venture. "Now this section of Cullinan Ranch will be able to evolve much more quickly for species like the salt marsh harvest mouse and Ridgeway's rail."

Offloaders are nothing new. They are used to move dredged sediment off a scow — a flat-bottomed boat like a barge — over a levee, and onto subsided wetlands that need to be brought closer to sea level to grow marsh vegetation. The 2,400-acre Montezuma Wetland Restoration Project in the eastern Suisun Marsh has its own permanent offloader that allows dredgers from various projects to pull up and unload. But Cullinan Ranch has no such setup, leaving a critical gap in the beneficial reuse chain.

Mud dredged from local ports, harbors, and rivers often ends up at one of four in-bay disposal sites or out in the ocean. But that's like landfilling instead of recycling. From 2000 through 2015, dredgers scraped nearly 57 million cubic yards of sediment from San Francisco Bay waterways. Of that, they dumped 39 percent on the bay floor at designated "dispersal" locations along deep-water channels, where currents sweep it out to sea, and another 19 percent at the San Francisco Deep Ocean Disposal Site, 55 miles offshore.

The remaining 42 percent, or 23.7 million cubic yards, lived a second life through beneficial reuse, a category that includes applications in construction, agriculture, levee maintenance, beach nourishment, and, perhaps most critically, restoration work at sediment-starved wetlands. There, carefully placed mud can support marsh vegeta-

tion, wildlife habitat, and ecological processes — all while buffering shorelines against storm surges and sea-level rise — by raising subsided areas close to or above sea level, whether in island mounds or more evenly distributed fill.

The approach has proved successful at some of the region's most significant wetland restoration projects, including the 350-acre Sonoma Baylands, which received 1.7 million cubic yards from the Petaluma River and Port of Oakland in the mid-1990s, and the 1,000-acre Hamilton Wetlands, which received about six million yards in the late 2000s. Hamilton's offloader set up was a significant part of its price tag.



Late last year, recognizing both the need at Cullinan and the future potential, Long Beach-based Curtin offered to build an offloader as part of its bid for a new dredging contract at the Richmond Harbor. After winning the one-time contract, Curtin set out to create a custom offloader that met Cullinan's needs while also being flexible and modular enough to later deploy elsewhere, says Chew.

The custom offloader's key feature is a Denmark-made pump hung off the end of an excavator tractor (see photo), which itself is loaded on a barge anchored in nearby Dutchman Slough. When a scow full of water and mud pulls up alongside the barge, the excavator extends its arm, lowers the pump, and sucks the material out, then sends it to the future tidal marsh via a 300-foot-long hose.

Given the looming need for large quantities of sediment both at Cullinan and elsewhere, the Bay Area could sorely use a dedicated, potentially government-owned offloader to move from project to project and take material from various dredgers, Huning says: "There's more work than there is offloading equipment."

Such a system would also help reduce costs, bolstering beneficial reuse's case as a preferred alternative to dumping at sea or within the bay, says San Francisco Bay Conservation and Development Commission (BCDC) Sediment Program Manager Brenda Goeden. Federal policy requires the U.S. Army Corps of Engineers, which dredges large navigation channels like the Port of Oakland, to dispose of sediment using the cheapest option available.

This "least-cost" policy is often at odds with regional goals to restore damaged wetlands and help the bay shore adapt to rising sea levels. "It's a valuable natural resource that should be used," Goeden says. BCDC responded last September with a lawsuit that is still pending.

Meanwhile, Chew says Curtin Maritime would like to use its new offloader to continue supporting beneficial reuse at Cullinan by delivering mud from future dredges. The site needs 2.8 million cubic yards, only 200,000 of which have yet been delivered. "We're hoping to continue the relationship," he says. **NS**

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G O V E R N M E N T

Going Local Buys Future for Bayshore

When Bay Area voters approved Measure AA in June 2016 they not only created a significant new source of environmental funding, they also made California history, levying a parcel tax across the entire region for the first time. The measure was the result of a carefully planned and meticulously executed effort over more than a dozen years that offers lessons for other regions, and may be a catalyst for a regional approach to rising sea levels and other challenges.

The original impetus for Measure AA was the 1999 release of the *Baylands Habitat Ecosystem Goals* report, with its recommendation of re-establishing 100,000 acres of tidal marsh, and the 2003 acquisition of the South Bay salt ponds by the state and federal governments, according to David Lewis of Save The Bay, a driving force behind the measure. Although the government and several charitable foundations provided some money for initial stewardship and restoration, “we quickly realized that it was a fraction of what would be needed to actually restore the ponds,” says Lewis.

After an attempt to work with state legislators to find a quick way to raise local funding fizzled, environmentalists began creating a comprehensive case for Bay restoration and for regional funding to support it. As part of the process, Save The Bay projected costs for restoring shoreline that had already been acquired for that purpose. Concerned that sticker shock might undermine support, some wetland advocates

resisted the notion of publicizing the total cost. However, “we had to demonstrate need for more funding and the gap between the cost and what was currently trickling in from federal and state government,” says Lewis. Save the Bay also commissioned several public opinion polls which found that a large majority of Bay Area residents supported paying a small tax for Bay restoration.

In 2007 Save The Bay released *Greening the Bay*, a report that detailed the benefits of Bay restoration and the total estimated costs of restoring 36,176 acres of shoreline properties around the Bay—approximately \$1.43 billion over 50 years. The report included a policy recommendation that a regional special district be established to secure local funding for and to coordinate Bay restoration.

“We looked at different ways to make it possible to pursue regional funding, including giving additional powers to an existing agency or creating a joint powers agreement,” says Lewis.

“No existing agency had responsibility for getting Bay marsh restored and the power to propose taxes or assessments. Also, property to be restored is in the jurisdiction of many different, counties, cities, and landowner agencies. Creating a new agency turned out to be the best approach.”

The recommendations in *Greening the Bay* secured critical early support from elected officials such as Sen. Dianne Feinstein and the Bay Area business

community. Advocates worked with the lawmakers to draft legislation and in 2008 the state legislature approved AB 2954, creating the San Francisco Bay Restoration Authority and charging it with “raising and allocating resources for the restoration, enhancement, protection, and enjoyment of wetlands and wildlife habitat in the San Francisco Bay and along its shoreline.” The Association of Bay Area Governments appointed a Governing Board composed of local elected officials and recruited an Advisory Committee of stakeholders.

“We had taken two big steps over a four-year period: First, we defined the problem and made the case for what it would cost and second, we created an entity with the power to raise that money if voters agreed,” says Lewis.

The legislation creating the Restoration Authority did not include any funding, so Save The Bay, the California Coastal Conservancy and others volunteered staff time and resources to research legally and politically viable options they could propose to voters to raise money. They explored different geographical possibilities, different kinds of taxes and bonds, and different tax rates. They also conducted more public opinion polling and outreach to local elected officials as well as to the region’s business and philanthropy communities.

“This was something that our member companies quickly gravitated to as a way to make a difference for our environment, our communities and our economies,” says Carl Guardino of the



Photo: Rick Lewis

Silicon Valley Leadership Group, an early and energetic supporter of the Authority.

As support grew, and the Authority's Governing Board waded into planning, a voluntary committee began discussing how to develop consensus on a tax approach and build a successful political campaign.

The Authority ultimately settled on a \$12-per-parcel tax, which was seen as modest enough to garner widespread support and, crucially, unlikely to attract opposition from large property owners with deep pockets as a tax based on property value might have done. The other crucial choice was including all taxable parcels in the nine-county Bay Area, rather than carving out a narrower territory, such as only parcels close to the Bay, says Lewis. "That would have significantly reduced how much money the tax raises, but the cost of the campaign would potentially have been similar."

Timing was also critical, as periodic polling showed that support for a restoration tax waxed and waned with the economy. As 2016 approached the timing seemed right. "We decided to put in on the June ballot because it was less crowded than November and the money spent on the campaign would have more impact."

Placing the measure on the ballot in all nine counties simultaneously turned out to be somewhat challenging. To begin with there were the fees charged by registrars, which were initially estimated to total \$6 million. "We had to go back to the legislature and amend our enabling statute to say that the registrars could only charge us for the true incremental cost of including Measure AA in their ballots," recalls RA Governing Board Chair Dave Pine. That lowered the estimate to about \$2 million, which the RA borrowed from the Santa Clara Valley Water District, the Sonoma County Water Agency and the East Bay Regional Parks District.

The Restoration Authority also had to work with the registrars to ensure a common letter designation for the measure and make sure it appeared in the same place on all the ballots. "It was an enormous challenge to try to bring uniformity to the ballot process for a nine-county measure when this had never been done before," says Pine.

The efforts paid off, and Measure AA passed with 70 percent of the vote, comfortably more than the two-thirds margin required.

Measure AA will raise \$25 million per year over 20 years. That is far short of the total need identified in *Greening the Bay*, and restoration advocates emphasize that continued state and federal funding will remain crucial. Meeting with members of Congress and their staffs in March BCDC's Larry Goldzband argued that it's in the federal government's best interest to leverage federal environmental dollars by directing any available funds to communities that are spending their own money on restoration. "Our basic thrust is that if a community is willing to tax itself to do this and there are federal funds available for it, then direct those funds to those communities that have demonstrated that they have skin in the game," he says. However, whether such funds will be available during the next several years is far from certain, as the Trump Administration's proposed budget eliminates funding for marsh restoration in the Bay.

Under its mandate, Measure AA funds are to be used for water quality, habitat restoration, protection and monitoring, flood prevention and shoreline access projects. Although sea level rise was not a primary concern when the RA was initially conceived, the years since have brought into focus the threat it poses to communities and infrastructure all around the Bay. Projects that serve multiple objectives are now fundamental to the Restoration Authority's mission, says Dave Pine. "We've spent almost as much time talking about the flood control benefits as the ecosystem benefits of Measure AA."

The RA is preparing to release its first Request for Proposals in September. Its statute requires that projects be consistent with existing plans such as the *Estuary Blueprint* (CCMP), BCDC's *Bay Plan*, the Coastal Conservancy's San Francisco Bay Program, SF Bay Joint Venture's Implementation Strategy, and the Baylands Ecosystem Habitat Goals Update. "There is the intent to make this funding a tool for existing practitioners in the Bay that are already doing wetlands restoration with the long term view," says EPA Region 9's representative on the Advisory Committee, Luisa Valiela. Pine concurs. "Many of the people on our advisory committee were involved in preparing some of the region's foundational studies on wetland restoration priorities, so those voices will be integrated in the grant making process."

Some Bay advocates would like to see the RA step to the forefront on



Extreme rainstorms, extended droughts, and rising sea levels all promise to challenge our future in the Bay Area. Luckily the next generation will have the Restoration Authority to help them adapt. Photo: Jacoba Charles.

regional climate change adaptation. "I've heard people ask in public meetings, why can't the Restoration Authority be given more explicit authority to do climate adaptation and be very forward looking," says former Coastal Conservancy senior executive Marc Beyeler. "Climate adaptation activities are a natural extension of what we all want to do to build up natural resilient infrastructure. But the pace of climate change demands that we accelerate what we are doing."

Many people involved in the RA and Measure AA campaigns believe that they can provide valuable models for other regions and/or efforts to address other Bay Area regional challenges.

"We have regional traffic challenges that transcend a city's or even a county's borders," says SVLG's Gardino. "We believe that this might lead to conversations about more regional solutions to these challenges." Traffic will only be made worse by increased flooding on shoreline highways as the Bay expands.

"Measure AA sets an example for how we can do things across many counties," says Pine. "People's willingness to contemplate a regional tax for transportation has increased just because it has now been done."

Writer John Hart has watched the ebb and flow of regional thinking in the Bay Area since the 1960s "I think that these regional ideas keep arising again because they have to—events kind of beat us toward regional thinking," he says. **CHT**



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San Francisco Bay and the Sacramento-San Joaquin River Delta comprise one of 28 "estuaries of national significance" recognized in the federal Clean Water Act. The San Francisco Estuary Partnership, a National Estuary

www.sfestuary.org

Program, is partially funded by annual appropriations from Congress. The Partnership's mandate is to protect, restore, and enhance water quality and habitat in the Estuary. To accomplish this, the Partnership brings together resource agencies, non-profits, citizens, and scientists committed to the long-term health and preservation of this invaluable public resource. Our staff manages or oversees more than 50 projects ranging from supporting research into key water quality concerns to managing initiatives that prevent pollution, restore wetlands, or protect against the changes anticipated from climate change in our region. We have published *Estuary News* since 1993.

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Finagle Secures Watershed Ranch

A stunning former East Bay ranch will be preserved as open space thanks to creative dealmaking involving a water district, a land trust, a conservation bank, and donations from the general public.

Generations of the same family owned and grazed cattle on Carr Ranch for more than 120 years. Surrounded by East Bay Municipal Utility District lands on three sides, the 604-acre property served as a de-facto extension of the district's watershed lands. So when the ranch came up for sale several years ago, EBMUD badly wanted to buy it. Trouble was, the drought was hurting its income, plus the district needed to invest in its own infrastructure, leaving it unable to buy the land right then and there.

In stepped the John Muir Land Trust, which works to protect East Bay open space. The trust agreed to negotiate an option to purchase the ranch in three years, giving the district time to come up with the money.

In the meantime, EBMUD was nearing the end of an eight-year process to establish a conservation land bank in the Pinole Valley. Bought in the 1950s,

Oursan Ridge was no longer needed to expand regional water storage. Conservation credit sales from the 430-acre site, the district realized, would generate even more than the \$4.5 million EBMUD needed to purchase Carr Ranch.

"Together, this project has a net benefit of preserving about 1,000 acres, all without affecting ratepayers or consumers" says Richard Sykes, the district's Director of Water and Natural Resources.

The land trust raised the additional funds needed to afford the long term management cost of Carr Ranch. The land trust is creating trails and signage and hopes to open the property to the public as early as this fall.

"You'll be able to walk from the end of Camino Pablo all the way to Las Trampas, and see three or four different ridgelines along the way," Sykes says.

Sykes is still amazed that land that could have easily become tract housing will remain habitat for the likes of Alameda whipsnakes, badgers, and mountain lion forever. "When I came to speak at the ceremony yesterday, I stumbled for a moment at a loss for words. Then I turned around and spread my arms and said, do I even need to say why we want to preserve this? People got it." **KW**



Photo: EBMUD