Executive Summary: WRMP Priority Monitoring Site Networks

SF ESTUARY Wetlands Regional Monitoring Program

Date: January 25, 2023

To: WRMP Steering Committee

From: WRMP Staff and WRMP TAC

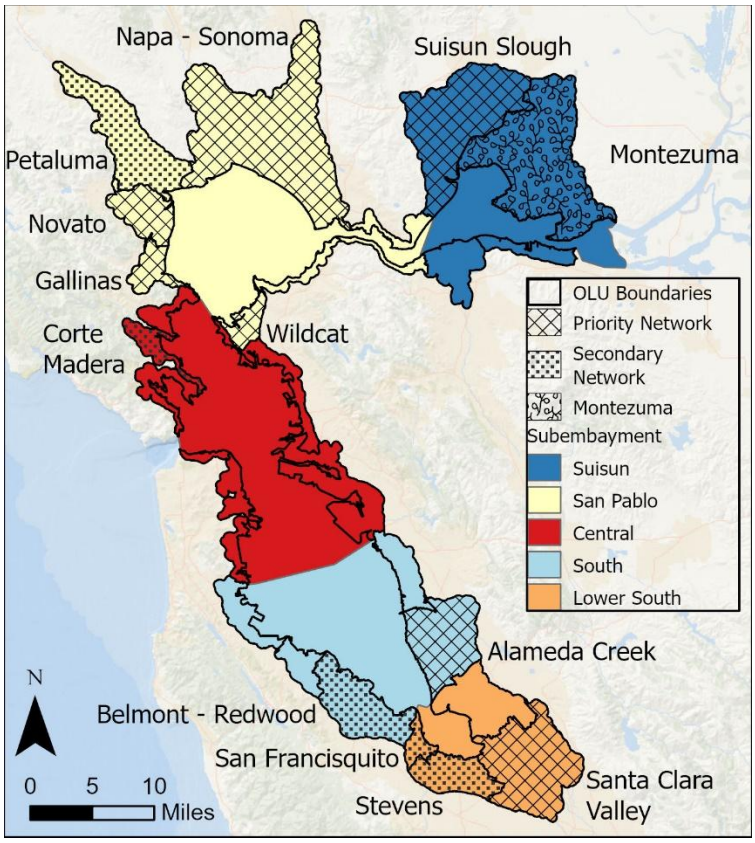
The April 2020 Program Plan of the San Francisco Estuary Wetlands Regional Monitoring Program (WRMP) describes five near-term science priorities (emphasis added):

1. Conduct regional baseline and subsequent routine surveys and inventories of the distribution, abundance, diversity, and condition of tidal wetlands throughout the region.
2. **Establish the WRMP Monitoring Site Network.**
3. Conduct repeated surveys (detect change) of living organisms and their habitats (indicators).
4. Analyze data on the relative roles of estuarine and upland/watershed sources of sediment.
5. Assess the broad range of interactions between people and wetlands.

In March 2021, the WRMP Steering Committee (SC) accepted a proposal from the WRMP Technical Advisory Committee (TAC) that designated a suite of Benchmark Sites throughout the estuary. This Benchmark Site Memo represented the first step of the TAC and SC towards addressing priority #2 listed above. In the attached Technical Memo, the TAC takes the next step, and proposes to the SC a series of priority monitoring site networks throughout the estuary built around particular Benchmark Sites. Each network includes one Benchmark Site and one or more Reference and Project sites. The Technical Memo describes the priority monitoring site networks, their technical justification, and the process the TAC utilized to develop these recommendations. In 2023, the TAC will develop a plan for initial WRMP monitoring implementation that will propose which Level 1, 2, and 3 indicators should be monitored (and, in the case of legacy data, synthesized) at the priority networks and sites.

The Technical Memo is the product of extensive research, coordination, review and revision by the WRMP core science staff, TAC, and key program stakeholders. Initially, the TAC was asked to provide input on an extensive list of potential sites. The core WRMP science team narrowed this list to a manageable suite of sites that met criteria derived from the WRMP Program Plan: networks and sites were selected to: a) distribute representation across the lower Estuary and within major estuarine subgradients, b) leverage existing data sources and monitoring programs, c) contribute to climate adaptation planning for underserved communities, d) inform existing and planned tidal wetland restoration efforts, and e) address the WRMP near-term science priorities. The science team developed a draft memo describing proposed sites and networks, and summarized key site characteristics in a supporting spreadsheet. The draft memo and spreadsheet were then reviewed by TAC members and key science partners, and revised by the core science team to produce a final deliverable. The details of the memo's review and revision process are captured in a Comment and Response document.

The memo proposes six priority monitoring site networks within key Operational Landscape Units (OLUs, see SFEI + SPUR 2019) in each Estuary subregion that can serve as a focus for near-term WRMP implementation, as well as the foundation for future build-out of the program:



- Suisun subregion: **Suisun Slough network**
- San Pablo Bay subregion: **Gallinas-Novato/West San Pablo Bay network**, **Napa-Sonoma network**, and **Wildcat Creek network**
- South Bay subregion: **Alameda Creek network**
- Lower South Bay subregion: **Santa Clara Valley network**

Though the Wildcat Creek network is technically within the San Pablo Bay subregion, it shares many significant characteristics (wave/tidal environment, degree of urbanization, nearshore geomorphology) with the Central Bay subregion, and the TAC believes it can reasonably represent both. The TAC identified a seventh priority region, **Montezuma – Delta,** which offers an opportunity to bridge the WRMP with tidal wetland restoration and monitoring efforts in the Sacramento – San Joaquin Delta. There are numerous technical and administrative challenges to establishing cohesive monitoring networks in this region, including its tremendous geographic/landscape heterogeneity and numerous stakeholders. The TAC plans to explore this opportunity with the Interagency Ecological Program Tidal Wetland Project Work Team and related Delta monitoring interests. Finally, the memo identifies four secondary priority networks (**Petaluma River OLU** (San Pablo Bay), **Corte Madera OLU** (Central Bay), **San Francisquito OLU - Stevens OLU** (South Bay - Lower South Bay), and **Belmont - Redwood OLU** (South Bay)) that could be established with additional program resources, a shift in WRMP science priorities, and/or planned implementation of additional tidal wetland restoration projects.

It is important to emphasize that TAC and SC adoption of this memo does not constitute a formal plan to initiate monitoring at any of the proposed monitoring sites/networks; it simply acknowledges that they collectively represent the best opportunity to implement the WRMP science framework in the near-term. This proposal does not preclude use of the WRMP framework to address other science needs, in regions or locations other than those prioritized for near-term monitoring site network establishment.

Technical Memorandum: WRMP Priority Monitoring Site Networks

Date: January 25, 2023

From: Christina Toms, WRMP TAC Chair; Donna Ball, WRMP TAC Co-Chair; Caitlin Crain, WRMP Lead Scientist

To: WRMP TAC and SC

Subject: WRMP Priority Monitoring Site Networks

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1. Introduction

The Technical Advisory Committee (TAC) of the San Francisco Estuary Wetlands Regional Monitoring Program (WRMP) provides scientific and technological advice to the Steering Committee (SC) of the WRMP. The purpose of this memo is to elevate to the SC a combined set of priority Benchmark, Reference, and Project Sites to form the WRMP's initial priority monitoring site network. This memo builds on the previous Benchmark Site Memo (WRMP TAC 2021), describes the draft priority monitoring site network recommendations, and briefly summarizes the technical justification for prioritizing this set of networks and sites. In 2023, the TAC will develop a plan for initial WRMP monitoring implementation that will propose which Level 1, 2, and 3 indicators should be monitored (and, in the case of legacy data, synthesized) at the priority networks and sites.

It is important to emphasize that TAC and SC adoption of this memo does not constitute a formal plan to initiate monitoring at any of these sites; it simply acknowledges that they collectively represent the best opportunity to support near-term implementation of the WRMP science framework. TAC development of the monitoring plan in 2023 will require discussions with site landowners and partners regarding access permissions, procedures, and related concerns.

2. Background

The overall work of the TAC is guided by the science framework articulated in the WRMP Phase 1 Program Plan (WRMP 2020), which is focused on developing information to answer the following Guiding Questions and associated Management Questions. Specific monitoring questions have been developed to tie into each of the Guiding and Management Questions and are expanded upon in the WRMP Master Matrix.

- Guiding Question 1: ***Where are the region's tidal wetland ecosystems, including tidal marsh restoration projects, and what net landscape changes in area and condition are occurring?***
- Guiding Question 2: ***How are external drivers, such as accelerated sea level rise, development pressure, and changes in runoff and sediment supply, impacting tidal wetlands?***
- Guiding Question 3: ***What new information do we need to better understand regional lessons from tidal marsh restoration projects, advance tidal marsh science, and ensure the continued success of restoration projects?***

- Guiding Question 4: ***How do policies, programs, and projects to protect and restore tidal marshes affect the distribution, abundance, and health of plants and animals?***
- Guiding Question 5: ***How do policies, programs, and projects to protect and restore tidal wetlands benefit and/or impact public health, safety, and recreation?***

Since the WRMP is a new program that is intended to grow in scope and scale over time, the Program Plan established numerous science priorities for near-term (3-5 year) implementation that reflect the WRMP Guiding Questions and build on each other:

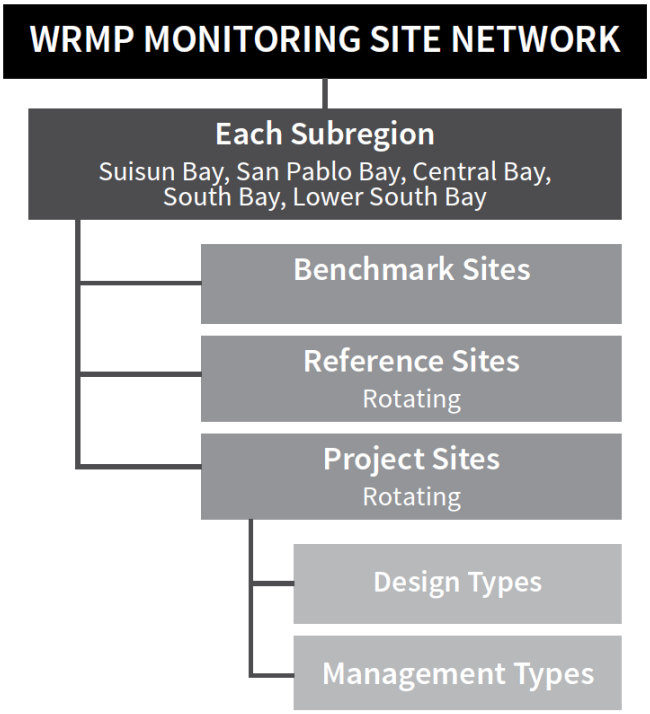
1. **Conduct regional baseline and subsequent routine surveys and inventories of the distribution, abundance, diversity, and condition of tidal wetlands throughout the region**, using existing tools and metrics to the extent practicable and new tools and metrics where necessary.
2. **Establish the WRMP Monitoring Site Network** to guide the collection of new data (and synthesis of existing data) to address the Guiding and Management Questions, especially science priorities 3-5 below**.**
3. **Conduct repeated surveys (detect change) of living organisms and their habitats (indicators)**, and standardize the metrics and reporting for indicators that are common to projects and baseline/subsequent ambient monitoring, across the range of project designs and restoration practices.
4. **Analyze data on the relative roles of estuarine and upland/watershed sources of sediment** to counter the threats of marsh drowning, mudflat loss, and shoreline erosion driven by sea level rise.
5. **Assess the broad range of interactions between people and wetlands** that should be monitored for the safety of people and the health of the wetlands. This process should ensure integration of flood control and mosquito and disease vector control into project planning and assessment, and similarly integrate wetland restoration into flood control planning. This science priority will be modified in the near future to include priorities identified through the People and Wetlands Workgroup, which will integrate the priorities of frontline communities and tribes.

3. WRMP Monitoring Site Networks

The WRMP aims to assess regional wetland status by tracking change in important indicators across wetland types that vary in their maturity and development in order to assess the full spectrum of potential impacts from external drivers.The WRMP science framework (detailed at length in the April 2020 Phase 1 WRMP Program Plan) is based on the following logic, informed by conceptual models of tidal wetland ecosystems (Appendix F of the Program Plan):

- Wetlands subject to different sources of fresh and marine water and sediment, and at different stages of evolution, respond differently to changing sea level and sediment supply, and to adaptive management designed to counteract undesired responses.
- Responses to external drivers occur at different space and time scales.
- Tracking responses at different scales is necessary to identify thresholds that trigger management actions.

Inherent in this logic is the assumption that the WRMP should support long term data collection of leading indicators that have a numerical threshold at which a management or regulatory action could be triggered, to prevent/minimize tidal wetland loss or otherwise enhance tidal wetland conservation and recovery. To identify these thresholds, and provide the minimum organization necessary to define non-linear relationships and changes in tidal marsh distribution, abundance, diversity, and condition at different scales of time, the science framework proposes monitoring networks composed of three types of tidal wetland monitoring sites (Figure 1): Benchmark Sites, Reference Sites, and Project Sites. Benchmark sites are historic, minimally modified mature tidal wetlands that represent pre-colonial ecosystems. Reference Sites comprise centennial infill/fringing wetlands, older restoration projects, and other mature marshes that represent feasible developmental endpoints for newer restoration projects. Project Sites are recently restored tidal wetlands that represent a variety of design and management approaches. Ideally, all WRMP sites selected for monitoring will share as many of the following attributes as feasible:



- They can be carefully correlated spatially and temporally with each other, based on relationships described by the WRMP's compendium of Conceptual Models. Correlations may be within and/or between monitoring site networks, and mediated by numerous factors such as landscape context and management interventions.
- Within each subregion and Operational Landscape Unit (OLU, see SFEI + SPUR 2019), each of these three types of sites can be strongly linked to each other based on empirical observation, simulation models, or consensus best professional judgment.
- They have current and/or historical datasets for one or more WRMP indicators, as described in the WRMP Master Matrix.

- They support, or have the potential to support, the morphology and functions of the "complete tidal wetland ecosystem" as defined by the Baylands Ecosystem Habitat Goals Update (Goals Project 2015).

Additional detail about each type of site is presented below. The pilot monitoring program will outline sampling protocols that may vary in frequency based on the site type and monitoring indicator. For instance, vegetation distribution is expected to change more rapidly at project sites and sampling intervals would be more frequent there than at Benchmark sites. On the other hand, leading indicators of climate change such as changes in water levels or plant productivity may have more significant signals at established marshes and therefore warrant more frequent sampling. The larger number of potential Reference and Project Sites will likely necessitate a phased approach (where increasing numbers of sites are monitored as additional projects come online and/or additional funds become available) and/or a rotating approach (where a select subset of sites within a network are monitored at appropriate intervals).[1] Site rotation may be more effective for monitoring some abiotic indicators than biotic indicators.

It is important to emphasize that the WRMP is a monitoring program, not a research program; due to resource limitations and to the highly modified and complex nature of the San Francisco Estuary it may not be possible to monitor all program indicators with equal statistical rigor. As the program's science framework matures, the TAC will advise the Steering Committee on data analysis and interpretation, including but not limited to situations where particular levels of statistical rigor are and are not necessary to address stakeholder information needs.

Benchmark Sites

Sites selected as Benchmark Sites are known or assumed to be in approximate equilibrium with existing sediment supplies, salinity regimes, and tidal regimes, such that changes in any of these parameters can be detected using WRMP indicators. The initial network of Benchmark Sites focuses on assessing three priorities: (1) the need to develop and calibrate indicators used to address Monitoring Questions, (2) the risk of mature marshes drowning or downshifting (converting from vegetated tidal marsh to unvegetated mudflat or open water), and (3) the need to inform the design of local tidal wetland restoration projects. Monitoring at Benchmark Sites will enable the detection of thresholds of wetland response to external factors driving wetland conditions, while revealing how these effects differ between multi-year dry and wet periods. This monitoring will contribute to a regional understanding of sediment dynamics in tidal wetlands, a key driver of wetland resilience to sea-level rise, and the relative importance of estuarine currents, wave-wind erosion of tidal flats, and runoff from local watersheds as sources and mechanisms of sediment delivery. Additional selection criteria for Benchmark Sites includes (1) their ability to represent a reasonably distinctive position along the main estuarine salinity gradient, with different tidal ranges, different sediment supply dynamics, and different plant and wildlife communities, and (2) an

[1] For example, consider a site network with 6 Project sites (Sites A, B, C, D, E, and F). Rotation could look like: Sites A and D monitored in Year 1, Sites B and E monitored in Year 2, Sites C and F monitored in Year 3, Sites A and D monitored again in Year 4, and so forth.

association with the complimentary network of stations proposed by the Bay RMP to monitor salinity, tides, and suspended sediment in the Bay's five major embayments. Due to the highly urbanized and modified nature of San Francisco Estuary, relatively few tidal wetlands are suitable candidates for Benchmark Sites. Additional detail about the Benchmark Sites selected by the TAC can be found in the March 2021 Benchmark Site Technical Memo.

Reference Sites

Reference Sites are mature tidal marshes that represent reasonable condition targets for new tidal wetland restoration projects. Due to the highly modified nature of the San Francisco Estuary and the accelerating influence of climate change, it is highly unlikely that most tidal wetland restoration projects in the region will achieve conditions similar to those observed at Benchmark Sites. Therefore, the WRMP defines Reference Sites as wetlands at late stages of development that may be used to identify a "reference envelope" of feasible conditions for restoration projects (i.e., a range of acceptable conditions), which may change over time. They can include centennial wetlands and older restoration projects (roughly more than 20 years old) that are more geomorphically evolved than Project Sites. Additional selection criteria for Reference Sites includes their ability to provide key ecosystem functions and services, including but not limited to:

- Providing habitat for special status species;
- Supporting especially diverse plant, fish, and wildlife communities;
- Buffering areas landward of a wetland from flooding and wave action; and
- Supporting water quality consistent with regulatory standards.

Project Sites

Project Sites include existing and planned tidal wetland restoration and compensatory mitigation projects[2] to recover tidal wetland acreages, functions, and values. Project Sites typically have current or legacy monitoring data that overlaps with WRMP indicators to fulfill permit requirements, support resource management, address research gaps, or otherwise provide information needed by decision-makers. To the extent that compensatory mitigation projects use the same indicators, metrics, and data management system recommended by the WRMP, they can be compared with voluntary restoration Project Sites over time, and their effect on ambient condition can be assessed. Project Sites should reflect a variety of restoration design and management approaches that reflect the continuing evolution of restoration science and regulation, as well as ongoing physical changes in the estuary. Examples of design factors that differ among projects include the beneficial reuse of dredged sediments, excavation of pilot channels, construction of wetland mounds and wind-wave berms, grading of outboard levees, invasive plant species management, transition zone planting and irrigation, and many more. Monitoring of project sites by the WRMP can help align permit requirements with the information needed to help

[2] Due to the unique nature and statutory requirements associated with compensatory mitigation projects, regulatory and resource agencies may require monitoring for compensatory mitigation sites that goes beyond that implemented by the WRMP.

identify the most effective restoration and management approaches, and improve the efficiency and cost-effectiveness of monitoring across multiple sites.

Data Management

The WRMP Phase 1 Program Plan describes a vision for WRMP data management that is collaborative, adaptive, transparent, and sustainable. As an initial step in developing a WRMP data management platform, the WRMP team is developing a Geospatial Data Catalog and Data Intake Form. The catalog initially will compile key geospatial datasets related to WRMP indicators such as habitats, vegetation, and elevation, as well as wetland attributes such as ownership, management, OLU classification, related watersheds, and more. The catalog will use clear metadata standards and a user-friendly interface to make it easy for WRMP stakeholders, as well as the general public, to find data of interest. Any uploaded datasets will be stored in SFEI's Regional Data Center. Over time, this catalog will be expanded to support the synthesis, analysis, and visualization of new WRMP data, as well as high-priority legacy datasets (see "Example Site Network Data Inventory" below). As of November 2022, the catalog is in beta testing, in preparation for launch in December 2022/early 2023.

Example Site Network Data Inventory

There is already a significant amount of monitoring data that has been collected in tidal wetlands throughout the estuary, and those datasets can provide a strong foundation for future monitoring efforts. Leveraging these data is a key goal of the WRMP. To illustrate the types of data that exist or may be collected for each network, legacy and ongoing monitoring efforts for the Gallinas and Novato OLUs are described below (Figure 1 and Table 1). These sites are described in more detail in Section 5 of this memo where a proposed Monitoring Site Network identifies China Camp as a Benchmark Site, Outer McInnis Marsh as a Reference Site, and Hamilton Wetlands as a Project Site.

Monitoring at China Camp has been primarily conducted by the San Francisco Bay National Estuarine Research Reserve (SF Bay NERR) since its designation in 2003, however, USGS, Point Blue, and other WRMP partners also regularly monitor the site. Philip William Associates (now Environmental Science Associates or ESA) and Dr. Phyllis Faber also regularly monitored China Camp from 1990 through 2003. The Hamilton Wetlands restoration project has been monitored by ESA, Tetra Tech and Avocet Research Associates since its 2014 breaching to tidal action; this monitoring is scheduled to continue through 2024. Figure 1 and Table 1 do not include every single monitoring activity implemented within the network, but represent the breadth of biotic and abiotic data that are available, and that may be analyzed across multiple scales of space and time to address WRMP monitoring, management, and guiding questions. As the TAC develops a Pilot Monitoring Plan for the WRMP to implement, it will identify priority datasets (from both legacy and current monitoring efforts) for inclusion in the WRMP data management framework, to support data analysis, visualization, and communication. In many cases, transforming legacy datasets into a format that can be utilized by the WRMP will take considerable time, effort, and resources to reconcile differing data formats, collection methodologies, and data gaps. However, as programs such as the Interagency Ecological Program (IEP) have recently

demonstrated,[3] investment in legacy data can produce tremendous returns by supporting genuinely regional, long-term data analysis that had previously been out of reach. Some WRMP workgroups, such as the Fish and Fish Habitat Workgroup and Geospatial Workgroup, have already begun to compile and process legacy and current datasets that could support WRMP data analysis. This work is expected to continue, to support development of the Pilot Monitoring Plan and related WRMP deliverables.

[3] See, for example, fish data synthesis at https://delta-stewardship-council.github.io/deltafish/

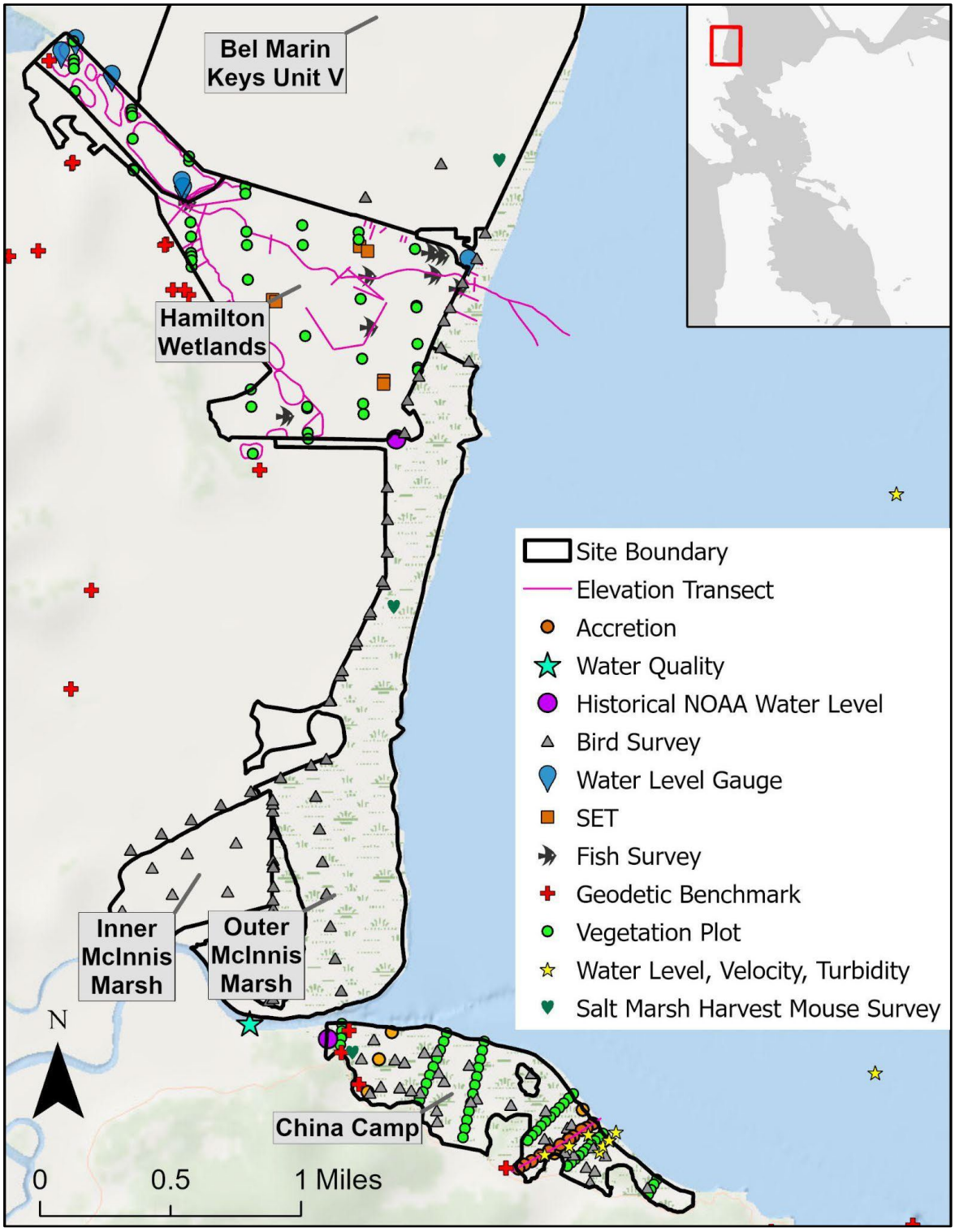


Figure 1. Example of data available within the Novato Gallinas network. China Camp is a Benchmark Site, Outer McInnis Marsh is a Reference Site and Hamilton Wetlands is a Project Site. Inner McInnis Marsh and Bel Marin Keys Unit V are planned restoration locations. Not all data known to be collected within these two sites is shown.

Table 1. Example of data available within China Camp and Hamilton Wetlands. The table further details the type of data collected at each site and the date range of data collection.

Site	Data type	Data Description	Date
China Camp	Vegetation Survey	Vegetation transects of type, percent cover, density	1990 - 2003 & 2013 - ongoing
	Elevation Surveys	Elevation taken along the same transect as the vegetation survey	1990 -2003
	Soil Accretion	Sediment plate	1991 - 1999
	Soil Accretion	Sediment core analysis with 210Pb and 137Cs	2008 - 2011
	Erosion Transects	Distance between vegetated marsh to unvegetated marshfront	1992 - 2003
	Water Quality	PO4, NH4, NO2, NO3, NO2+NO3, CHL A	2005 - ongoing
	Hydrodynamics	Water surface elevation, velocity, temperature	2013 - 2016
	Sediment processes	Turbidity	2013 - 2016
	Bird Survey	Bird Nest Survey, abundance, species richness, reproductive success	1996 - 2007 (survey, success), 1996 - ongoing (abundance, richness)
	Aerial Photographs	Black and white or color IR	1970, 1975, 1986, 1990, 1991, 1992, 1998
	Ground Photographs	Hand-held photographs at various locations	1990 - 2003
Hamilton	Vegetation Survey	Cover and composition	2015 -ongoing
	Elevation Surveys	Mix of RTK-GPS, survey-grade echosounder, bathymetric survey, and/or traditional total station	2015 - ongoing
	LiDAR	LiDAR DEM	2014 - ongoing
	Soil Accretion	RTK-GPS measurements at future SET location	2015 - ongoing
	Erosion Transects	Erosional channel thalweg survey	2014 - ongoing
	Hydrodynamics	Water level gauge	2014 - ongoing
	Bird Survey	Abundance and species composition site wide	2014 - ongoing
	Fish Survey	Seine and Trawl Survey	2015 - ongoing
	Aerial Photographs	Color NIR	2014 - ongoing
	Ground Photographs	Photos taken at set stations	2014 - ongoing

4. TAC Site Selection and Network Prioritization Process

In 2021, the TAC approved a preliminary suite of Benchmark Sites. In 2022, the TAC decided to designate Reference and Project sites and build site networks around the previously designated Benchmark Sites. As with Benchmark site designation, the TAC began this process by reviewing the site selection criteria presented in the WRMP Phase 1 Program Plan. In April 2022, the TAC Chair and Co-Chair requested feedback from the TAC on candidate Reference and Project Sites via a matrix that compared each potential site to the criteria presented in the Program Plan. When that approach became too unwieldy, a core group of TAC members, including the Chair and Co-Chair, decided to develop an initial site network proposal presented to the TAC in June 2022. Throughout the summer, this core group further fleshed out the networks and their justification, and presented a draft version of this memo to the full TAC in October 2022 for review and comment. The goal is for the core group to revise the memo, and submit for approval to the TAC in November 2022 in order to present the final draft to the WRMP Steering Committee in December 2022.

Because the WRMP is intended to grow in scale and scope over time, it is not necessary to establish comprehensive monitoring networks within every single OLU in the near term. The WRMP can only establish itself as a stable long-term monitoring program if it demonstrates near-term effectiveness at addressing the key information needs of tidal wetland stakeholders, community leaders, and the general public. As the science needs of the SFE tidal wetland restoration community are expected to shift over time, so too will the science priorities of the WRMP. It is important to note that the proposed near-term priority networks do not preclude use of the WRMP framework to address other science needs, in regions or locations other than those prioritized for near-term monitoring site network establishment. This memo is simply meant to describe where near-term WRMP investment in the collection of new data and synthesis of existing data is most likely to efficiently and effectively address key near-term information needs. To this end, we have identified priority site networks and secondary priority site networks. In addition, we call out the Montezuma site network as a special case that, given its location between the Bay and the Delta, is a priority site network that the WRMP will develop in coordination with the IEP Tidal Wetland Monitoring Project Work Team.

Priority Site Networks

The TAC identified six near-term priority monitoring site networks within key OLUs distributed across the estuary's five subembayments. These networks can serve as a near-term focus for WRMP implementation as well as a foundation for the future build-out of the network. The six near-term priority networks are mapped in Figure 2 and described in detail in Section 5 of this memo:

- Suisun subregion: **Suisun Slough network**, within the Suisun OLU
- San Pablo Bay subregion: **Gallinas-Novato network**, spanning the Gallinas and Novato OLUs, the **Napa-Sonoma network**, within the Napa-Sonoma OLU, and the **Wildcat Creek network**, within the Wildcat Creek OLU
- South Bay subregion: **Alameda Creek network**, within the Alameda Creek OLU
- Lower South Bay subregion: **Santa Clara Valley network**, within the Santa Clara Valley OLU

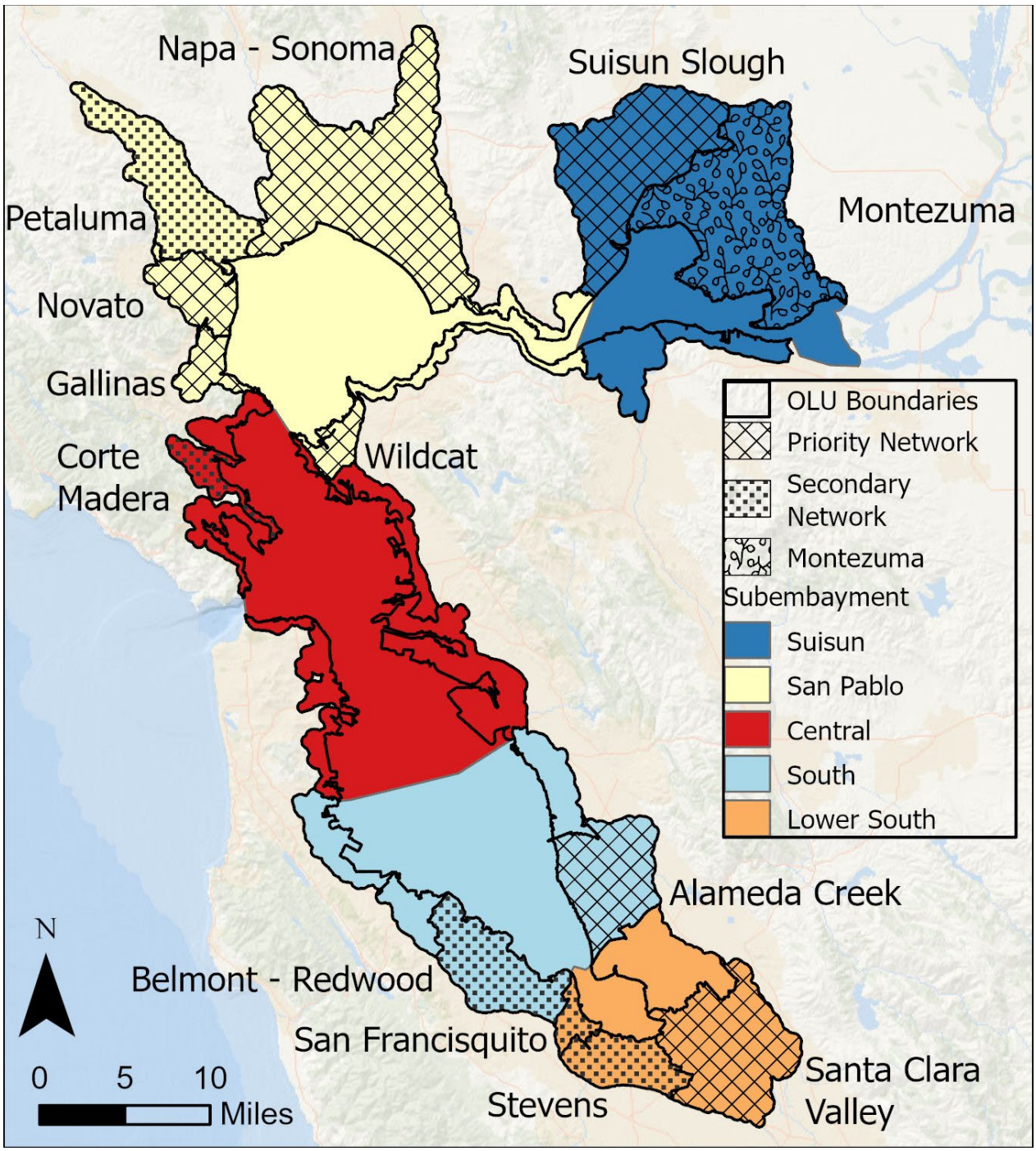


Figure 2. Priority monitoring networks proposed for near-term WRMP implementation, and secondary networks that may be established with additional program resources.

The TAC is proposing these priority monitoring site networks for near-term implementation for a number of reasons, including their ability to:

- Provide geographic coverage across the estuary, in key landscape positions, and within major estuarine subgradients
- Address the WRMP Guiding Questions and near-term science priorities
- Contribute to climate change adaptation planning for underserved communities such as Vallejo, Richmond, and Alviso
- Build upon and leverage historical and existing tidal wetland monitoring programs and projects such as those implemented by the SF Bay NERR, South Bay Salt Pond Restoration Project (SBSPRP), the Invasive Spartina Project (ISP), Delta interests (e.g., Delta Science Program, Interagency Ecological Program, Environmental Monitoring Program, Delta Regional Monitoring Program), CA Department of Fish and Wildlife (CDFW), U.S. Geological Survey (USGS), San Francisco Bay Regional Monitoring Program (RMP), and the Integrated Regional Wetland Monitoring Pilot Project (IRWM)
- Inform existing and planned tidal wetland restoration efforts, such as the SBSPRP,
- California EcoRestore, Strategy to Advance Flood protection, Ecosystems and Recreation along the San Francisco Bay (SAFER Bay), South San Francisco Bay Shoreline Project (SSFBSP), and implementation of restoration visions such as the Sonoma Creek Baylands Strategy, Novato Creek and Walnut Creek baylands in Flood Control 2.0, and Calabazas and San Tomas Aquino Creeks in Healthy Watersheds / Resilient Baylands
- Facilitate WRMP monitoring through cooperative landowners and safe, relatively straightforward access

Montezuma - Delta Region

The TAC identified a seventh priority region for monitoring that spans the eastern half of Suisun Marsh (Montezuma OLU) and down-estuary portions of the Sacramento-San Joaquin Delta. This large, diverse region includes numerous tidal wetland restoration projects that represent a range of design approaches within multiple distinct OLUs/subregions/restoration opportunity areas[4], including but not limited to:

- *Eastern Suisun/Montezuma Slough OLU:* Montezuma Wetlands, Wheeler Island, Blacklock, Arnold Slough, Bradmoor Island, Chipps Island, Tule Red

[4] Examples of the terminologies used to define geographic subregions in Suisun Marsh and the Delta include:
- Restoration Opportunity Areas and Conservation Zones from the (now defunct) *Bay-Delta Conservation Plan*: https://resources.ca.gov/CNRALegacyFiles/docs/Highlights_of_the_BDCP_FINAL_12-14-10_2361.pdf
- Regions from the *Delta Plan Habitat Restoration Amendment*: https://deltacouncil.ca.gov/pdf/delta-plan/2022-06-29-appendix-q3-identifying-mapping-and-quantifying-opportunities-for-landscape-scale-restoration.pdf
- Regions from the San Francisco Estuary Institute's *Delta Renewed* report: https://www.sfei.org/sites/default/files/biblio_files/DeltaRenewed_v1pt3_111516_lowres.pdf

- *Sacramento-SJ Delta*: Winter Island, Dutch Slough, Lindsey Slough, Lookout Slough, Lower Yolo Ranch, Liberty Island, Little Holland Tract

There are multiple challenges to establishing a cohesive WRMP monitoring network (or networks) in this region, especially the wide variety of landscape positions, tidal/fluvial flood regimes, and salinity regimes within which these sites sit. One potential solution could be to break out monitoring site subnetworks within distinct geographies, such as the Denverton-Nurse Slough complex, Cache Slough complex, West Delta, North Delta, and other subregions described above in footnote 4. Other challenges to site network establishment include the increasing abundance of invasive aquatic plant species in the region that affect ecosystem structure and function, 'take' issues associated with the potential impacts of certain monitoring activities on listed fish, and, crucially, the need to coordinate monitoring with IEP Tidal Wetland Monitoring Project Work Team and CDFW Fish Restoration Program. The IEP/FRP science framework and protocols are focused on the recovery of listed fish species (e.g., Delta smelt, Chinook salmon) and achieving the restoration acreage objectives associated with California's EcoRestore initiative as well as the Biological Opinions for operation of the federal and state water projects. Of course, the monitoring investments being made by IEP/FRP, Montezuma Wetlands, and other institutions also present tremendous opportunities to build a more unified science enterprise across this key portion of SFE. The TAC and SC can explore these opportunities with IEP/FRP in parallel with establishment of the priority networks described above, to support timely monitoring of the latter.

Secondary Priority Site Networks

Secondary priority site networks that could be established with additional program resources include:

- **Petaluma River OLU (San Pablo Bay):** This region includes the much-studied Petaluma River Marsh (Benchmark Site candidate, not designated) as well as a number of tidal wetland restoration projects, including Sonoma Baylands, Carl's Marsh, Green Point/Toy Marsh, Bahia peninsulas, Bahia Marsh, Mira Monte Marsh, Petaluma Marsh Expansion, and Grey's Ranch. This network was not prioritized for near-term implementation because (1) the TAC did not ultimately designate Petaluma River Marsh as a benchmark site, and (2) in contrast to other San Pablo Bay networks such as Napa-Sonoma and Gallinas-Novato, there are no tidal wetland restoration projects planned in the near future which the WRMP could inform. The development of the Petaluma River Baylands Strategy and implementation of Highway 37 improvements may shift the WRMP's focus in the future. The landscape positions of Sonoma Baylands and Carl's Marsh could justify their inclusion in the Gallinas-Novato/West San Pablo Bay network described below.
- **Corte Madera OLU (Central Bay):** This region includes a designated Benchmark Site at Heerdt Marsh, older (~40 years) tidal wetland restoration projects at Inner and Outer Muzzi Marsh, and newer tidal wetland restoration projects at Marta's Marsh, Corte Madera Ecological Reserve (Marin Audubon Society and Golden Gate Bridge and Transit District), and Triangle Marsh. The marshes largely sit at the mouth of Corte Madera Creek, which carries significant sediment loads, and past research from USGS has investigated the relationships between local wind waves and significant marsh scarp erosion in the region. This region was not prioritized for near-term

implementation due to the limited opportunities to inform further tidal wetland restoration in the area. However, USACE has considered these marshes as potential candidates for strategic sediment placement, so the WRMP may decide to shift its focus to this OLU should USACE move forward with its plans.

- **San Francisquito OLU - Stevens OLU (South Bay - Lower South Bay)**: This region includes a designated Benchmark Site at Laumeister Marsh as well as tidal wetland restoration projects at Cooley Landing, Faber Marsh, Lower San Francisquito Creek, and planned tidal wetland restoration at Ponds A1 and A2W. This region was not prioritized for near-term implementation because in contrast to other Lower South Bay networks (e.g. Santa Clara Valley), the timing of future restoration is more uncertain. Implementation of the SAFER Bay project in the southern portion of the region may shift the WRMP's focus in the future.
- **Belmont - Redwood OLU (South Bay):** This region includes a designated Benchmark Site at Greco Island, a potential reference site at Bird Island, existing tidal wetland restoration projects at Outer/Middle/Inner Bair Islands and (as of Dec. 2022) Pond R4, and planned tidal wetland restoration at Ponds R1 and R2. This network wasn't prioritized for near-term implementation because the SBSPRP sites within the Alameda Creek network have data for relatively more indicators consistent with the WRMP science framework, and require relatively less boat access. Again, as with the San Francisquito and Stevens OLUs, implementation of the SAFER Bay project may shift the WRMP's focus in the future.

5. High Priority Site Network Recommendations

High priority site networks are described below and summarized in the WRMP Priority Site Characteristics Table.

Suisun: Suisun Slough Network

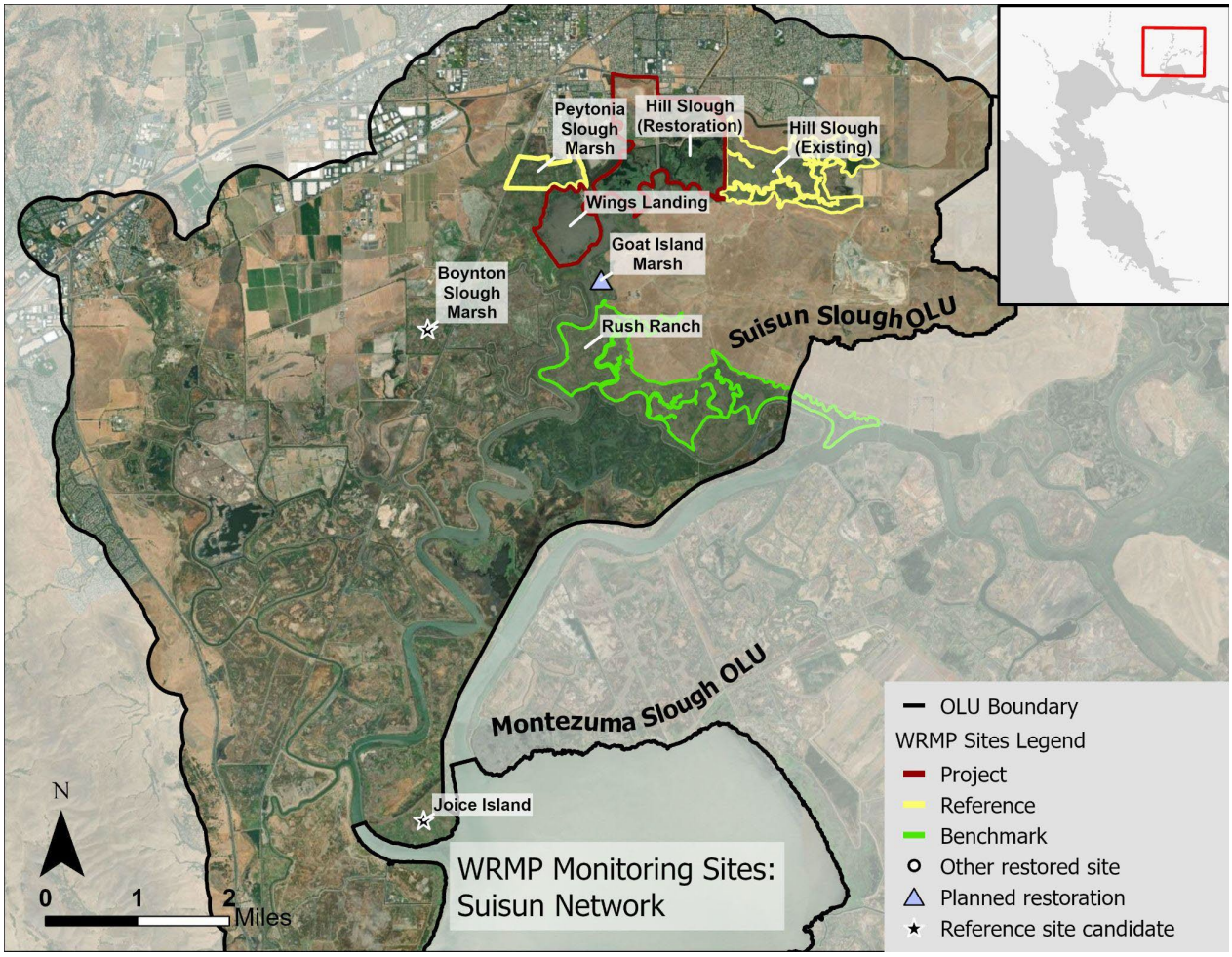


Figure 3. Proposed sites in the Suisun Slough OLU.

Network Name: Suisun Slough

[Site information folder]

Description: The Suisun Slough Network is built around the Benchmark Site of Rush Ranch, Reference Sites at Peytonia Slough Marsh and Hill Slough (Existing), and Project Sites at Wings Landing and Hill Slough (Restoration) (Figure 3). All of these sites are within the Suisun OLU. Suisun is a high priority network for multiple reasons, including but not limited to:

- It represents the largest brackish marsh on the West Coast
- It helps bridge the science communities and monitoring efforts in the lower (Bay) and upper (Delta) San Francisco Estuary
- It leverages abundant historical and ongoing monitoring at the NERR's Rush Ranch site, which includes intact and functional estuarine-terrestrial transition zones

- It is an area of considerable historical, current, and planned future investment in tidal wetland restoration and enhancement (EcoRestore, CDFW projects, etc.)
- It supports multiple active estuarine monitoring and research projects and programs by WRMP partners including the NERR, Delta Science Program, CDFW, USGS, UC Davis, and others

Establishing a site network along Suisun Slough will allow the WRMP to address multiple science priorities, including the ability of tidal wetlands to transgress over adjacent terrestrial and floodplain habitats (Rush Ranch, Hill Slough), and the effects on estuarine communities of drought, extreme flood events, duck club management, Delta water and Suisun salinity management, and saltwater intrusion from rising sea levels. WRMP monitoring of this network could help inform the design and management of multiple planned tidal restoration projects at Goat Island Marsh and elsewhere. WRMP monitoring in this region could potentially supplement and improve the temporal and spatial coverage of existing monitoring programs that address the effectiveness of regulations such as the estuary X2 standard, Suisun DO/mercury TMDL, and related policies.

Access to the sites in this network is managed through the NERR, CDFW, DWR, and the Suisun Resource Conservation District. All of the sites within this network may be accessed via public and private (duck club) roads, though access to more remote parts of Peytonia Slough Marsh and Wings Landing is only feasible with a boat.

It's important to note that due to different tidal, wave, and salinity environments between western and eastern Suisun, data collected and/or synthesized from this network may not lead to conclusions that can be broadly applied across all of Suisun Marsh. See discussion in Section 4 about opportunities to establish a separate monitoring network in the Montezuma Slough OLU.

Benchmark Site:

Rush Ranch is a benchmark site owned and managed by the Solano Land Trust as part of the Rush Ranch Open Space Preserve that represents the largest (1,050 acre) intact brackish tidal wetland within the San Francisco estuary. Tidal wetlands at Rush Ranch can be considered "complete" marshes (Goals Project 2015) with physical and ecological connectivity between subtidal, intertidal, and supratidal habitats, including extensive estuarine-terrestrial transition zones. Multiple listed fish and wildlife are known from the marsh, including Delta smelt, Sacramento splittail, California black rail, salt marsh song sparrow, salt marsh harvest mouse, Suisun shrew, and California tiger salamander. Listed or rare plants include Suisun thistle, soft bird's beak, Contra Costa goldfields, and Suisun marsh aster. Inclusion of this site in the network allows the WRMP to leverage existing, high-quality monitoring of multiple physical and ecological indicators through the NERR Reserve. Rush Ranch is hydraulically connected via Suisun Slough to proposed reference sites at Peytonia and Hill Sloughs and proposed project sites at Hill Slough and Wings Landing.

Reference Sites:

Hill Slough (Existing) is part of the roughly-1,700 acre CDFW Hill Slough Wildlife Area, a complex of brackish tidal wetlands, non-tidal managed marshes, sloughs, and grasslands along the north and south sides of Hill Slough. Though some portions of the existing tidal marsh were diked and drained in the past, and some channels transformed into linear drainage ditches, the complex's tidal marsh has largely retained its historical geomorphology. The marsh features a broad marsh plain bisected by dendritic channel networks, with high marsh pannes and extensive estuarine-terrestrial transition zones along both the northern (Lawler Ranch) and southern (Potrero Hills) limits of the marsh. The marsh hosts populations of rare and listed species such as soft birds-beak, Ridgway's rail, California black rail, salt marsh harvest mouse, and Suisun shrew. The marsh receives stormwater runoff from Suisun City through McCoy Creek, a perennial stream. Hill Slough (Existing) is located farther upstream along Suisun Slough from the Rush Ranch benchmark site and restoration projects at Wings Landing and Hill Slough (Restoration). Due to its mature geomorphology and support of listed species, the site served as a reference site for the design of the adjacent Hill Slough Restoration Project, a proposed Project Site.

Peytonia Slough Marsh comprises roughly 242 acres of formerly diked brackish tidal marsh habitat bounded by railroad tracks to the west, Suisun City to the north, Suisun Slough/Suisun City Channel to the east, and Peytonia Slough to the south. The 154-acre northern portion of the marsh is managed as an ecological reserve by CDFW, which also owns a conservation easement on the 88.5-acre southern portion of the marsh. Most of the marsh's tidal channels have been straightened into linear ditches that in some cases converge to form channel circuits. The marsh has limited estuarine-terrestrial transition zone, largely along its northern boundary near the Suisun Wildlife Center. Peytonia Slough Marsh is located upstream of the Rush Ranch benchmark site, and downstream of the Hill Slough reference and project sites. It receives moderate fluvial inputs from Ledgewood Creek, a perennial stream that drains a small watershed north of Suisun City (SF Bay NERR 2018).

Project Sites:

Wings Landing: This DWR EcoRestore project restored roughly 270 acres of formerly managed marsh (duck club) to tidal action; as of 2022 the site is largely intertidal/subtidal mudflat and open water with discrete patches of tidal marsh. Wings Landing is located at the confluence of Boynton, Peytonia, and Suisun Sloughs; it is across Peytonia Slough from Peytonia Marsh, across Suisun Slough from the northern limit of Rush Ranch, and is down-estuary from the Hill Slough complex.

Hill Slough (Restoration): DWR EcoRestore's 850-acre Hill Slough Tidal Restoration Project is located on CDFW Hill Slough Wildlife Area lands immediately adjacent to, and west of, the Hill Slough (Existing) reference site. Like Wings Landing, the project restored formerly managed

marsh to tidal action. As of 2022 the site is mostly tidal marsh dominated by cattails and tules with limited channels and a few large subtidal/intertidal open water ponds. It is hydraulically connected to Rush Ranch, Peytonia Slough Marsh, and Wings Landing via Hill, Suisun, and Peytonia Sloughs. Unlike Hill Slough (Existing), the site is separated from its estuarine-terrestrial transition zone by flood control levees that surround roughly 200 acres of mixed uplands and managed wetlands. The marsh also receives perennial stormwater runoff from Suisun City through McCoy Creek.

San Pablo Bay: Novato-Gallinas/West San Pablo Bay Network

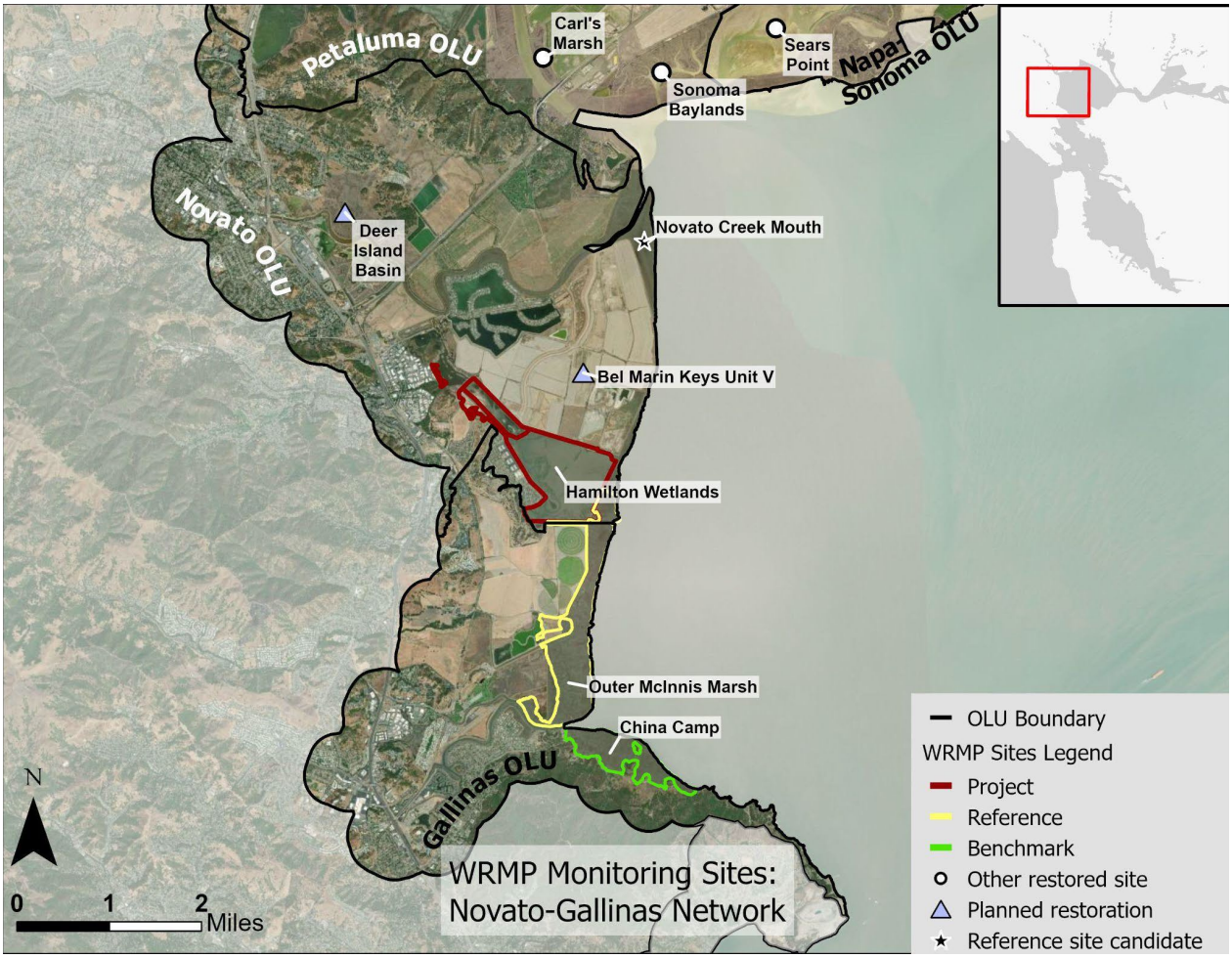


Figure 4. Proposed sites in the Novato and Gallinas OLUs.

Network Name: Novato-Gallinas

[Site information folder]

Description: Like the Suisun network, this network is built around a benchmark site that is also part of the NERR: the ancient tidal marsh at China Camp State Park. The network includes a reference site at the mouth of Gallinas Creek, Outer McInnis Marsh, a regionally significant tidal wetland restoration project at the former Hamilton Army Air Field, and planned tidal wetland restoration projects at Bel Marin Keys Unit V, Inner McInnis Marsh, and Deer Island Basin (Figure 4). For certain indicators, the WRMP may want to include restoration projects at Carl's Marsh, Sonoma Baylands, and Sears Point in this network, as they share similar landscape positions along the edge of San Pablo Bay with China Camp, Outer McInnis Marsh, and Hamilton Wetlands. All of these sites receive abundant estuarine-derived sediment from extensive mudflats offshore in San Pablo Bay. This is a high-priority network for multiple reasons, including but not limited to:

- It leverages historical and ongoing monitoring at the China Camp NERR site, which includes intact and functional estuarine-terrestrial transition zones
- It is an area of considerable historical, current, and planned future investment in tidal wetland restoration and enhancement
- It supports multiple active estuarine monitoring and research projects and programs by WRMP partners including the NERR, USGS, USACE, CDFW, and others
- It includes current and future restoration projects that represent a variety of design approaches, including the beneficial reuse of dredged sediment (Sonoma Baylands, Hamilton Wetlands, and potentially, Bel Marin Keys Unit V)

With the exception of China Camp, much of the baylands in the region have been heavily modified by diking, draining, and farming. Reclamation gradually crept bayward throughout the late 1800s and early 1900s on outboard "centennial" marshes established on sediments washed out of the Delta from the Gold Rush era. Now that that pulse of sediment has passed, deflation of mudflats within San Pablo Bay and sea level rise are in some locations contributing to rapid rates of marsh erosion and shoreline retreat, particularly around Hamilton Wetlands and Bel Marin Keys Unit V. Most of the agricultural baylands in the region have subsided to elevations at or below MLLW, so restoration projects typically require the construction of new flood control infrastructure (levees). Establishing a site network in this region will therefore allow the WRMP to address multiple science priorities, including how to effectively restore and manage wetlands in areas with rapid shoreline retreat, how to manage deeply subsided baylands (polders) so that they can support future tidal habitat restoration, and how to maximize deposition of estuarine-derived sediment. .

All of the sites within this network may be accessed via public roads and trails, with the exception of Carl's Marsh (access to which requires coordination with the Sonoma Land Trust or Sonoma Marina).

Benchmark Site:

China Camp: The 100-acre tidal marsh at China Camp State Park leverages existing monitoring and research through the NERR, the USGS, and other partners. The site features a broad, high marsh plain bisected by dendritic channel networks and connected in many locations to functional estuarine-terrestrial transition zones. Extensive intertidal and subtidal mudflats offshore provide suspended sediment to the marsh. In two locations (Back Ranch and Miwok Meadows), drainage from two small watersheds forms freshwater-brackish-salt marsh gradients, with separation between brackish and salt marshes mediated by the hydraulic barrier of San Pedro Road. Similar to Rush Ranch, many tidal wetlands at China Camp can be considered "complete" marshes (Goals Project 2015) with physical and ecological connectivity between subtidal, intertidal, and supratidal habitats. Multiple listed fish and wildlife are known from the marsh, including Chinook salmon, Sacramento splittail, Ridgway's rail, California black rail, salt marsh song sparrow, and salt marsh harvest mouse. Uncommon or rare plant communities at China Camp include extensive estuarine-terrestrial transition zones of basket sedge (*Carex*

barbarae) and similar clonal perennial graminoids, and long, linear patches of salt marsh gumplant (*Grindelia stricta*) along the banks of tidal channels. The marsh and surrounding uplands are used for traditional purposes by the Federated Indians of Graton Rancheria. China Camp is connected to other tidal wetlands in the region via San Pablo Bay.

Reference Sites:

McInnis Marsh (Existing): Ownership of this 310-acre tidal marsh is split between Marin County Parks and CDFW. The marsh is outboard (east) of 180 acres of diked non-tidal marsh planned for future tidal restoration (McInnis Marsh [Planned Restoration]). McInnis Marsh (Existing) is a mosaic of ancient and mature centennial marsh that has likely been influenced by historic diking, draining, and farming activities in the region, including the channelization and rerouting of Gallinas and Miller Creeks. Unlike many centennial marshes in the region (and similar to China Camp), it features multiple dendritic tidal channel networks, lined with marsh gumplant, connected to intertidal and subtidal mudflats and subtidal open water within San Pablo Bay. The marsh supports listed species such as Ridgway's rail and California black rail. It is hydraulically connected to China Camp via Gallinas Creek and San Pablo Bay, and is connected to Hamilton Wetlands via San Pablo Bay. McInnis Marsh (Existing) receives stormwater runoff from Gallinas and Miller Creeks.

Project Sites:

Hamilton Wetlands: The Hamilton Wetland Restoration Project is a collaboration between the State of California Coastal Conservancy (SCC) and US Army Corps of Engineers (USACE) that restored 644 acres of deeply subsided diked baylands to tidal action in 2014. The site was originally diked and drained for agriculture, and was subsequently used as an airfield. USACE used dredged sediment from the Port of Oakland to raise elevations prior to breaching of the outboard levee, as well as to construct seasonal wetlands at the site's north-west limits and an estuarine-terrestrial transition zone along much of its western edge. As of 2022, the site is primarily intertidal and subtidal mudflats and subtidal open water, with small patches of tidal marsh along wind-wave berms and broader areas of managed seasonal wetlands and estuarine-terrestrial transition zones. The site is monitored for multiple indicators consistent with the WRMP framework through 2024 (ten years post-breach). Eroding centennial strip marshes outboard of Hamilton may provide insight into the impacts of sea level rise and declining sediment supplies on existing marshes. The site is connected to China Camp and Outer McInnis Marsh via San Pablo Bay.

Sonoma Baylands (optional): The design and implementation of Hamilton Wetlands was inspired by the Sonoma Baylands project, which was the first tidal wetland restoration project in the region to "jump start" accretion via the beneficial reuse of dredged sediment. Led by USACE, SCC, and the Water Board, the project restored tidal action to 322 acres of formerly deeply

subsided baylands separated from San Pablo Bay by a broad, high centennial marsh. Though there are major differences between the Sonoma Baylands and Hamilton Wetlands projects (age, size, wave climates, post-breach hydrology, etc.), they are in broadly similar landscape positions (in diked baylands located landward of extensive San Pablo Bay mudflats). Breached in 1996, Sonoma Baylands has over 25 years of monitoring data, and there could be value in including this site in this network to specifically address management and monitoring questions related to beneficial reuse, accretion, and vegetation establishment.

Carl's Marsh (optional, also known as Petaluma River Marsh): Carl's Marsh is a 45-acre tidal wetland restoration site in the Petaluma OLU owned by CDFW that was breached to tidal action in 1994. Unlike Hamilton Wetlands and Sonoma Baylands, the marsh relied on natural accretion to raise substrate elevations in the formerly diked, subsided baylands; within ten years it had developed a mostly fully vegetated marsh plain. Carl's Marsh was one of the IRWM Pilot Project sites and has abundant legacy and existing data for numerous WRMP indicators, including accretion, vegetation establishment, and bird use.

Sears Point (optional): The roughly 960-acre Sears Point Tidal Wetland Restoration Project was breached to tidal action in 2015 and is now part of San Pablo Bay National Wildlife Refuge. The site is bordered to the west by the Sonoma Baylands tidal wetland restoration project, and to the east by restored tidal wetlands in the baylands of lower Tolay Creek. Like at Carl's Marsh, elevation recovery at the formerly deeply subsided site is dependent upon natural accretion of estuarine-derived sediment. Sears Point is also the location of an innovative bioengineered approach to arresting levee erosion. Both the tidal wetland restoration and levee protection projects are being monitored with the assistance of the SF Bay NERR, and have data consistent with numerous WRMP indicators including accretion and vegetation establishment.

Future Project Sites:

McInnis Marsh (planned restoration): This 180-acre diked wetland is owned by Marin County Parks and is part of McInnis Park; it separates McInnis Marsh (Existing) from a driving range and other recreational facilities at the park. The project has received SFBRA funding to support tidal wetland restoration design activities, and is under consideration by the BRRIT. Conceptual restoration plans for the site propose to beneficially reuse dredged sediment from the south fork of Gallinas Creek by placing it in thin lifts to raise substrate elevations prior to breaching. The project could also re-route Miller Creek into the site. The site would be connected to McInnis Marsh (Existing) via Gallinas Creek, and to China Camp and Hamilton Wetlands via San Pablo Bay.

Bel Marin Keys Unit V: Bel Marin Keys Unit V (BMKV) is a part of the Hamilton Wetlands Restoration Project designed to restore 1,146 acres of tidal marsh and non-tidal seasonal wetlands. The site is owned by the SCC (906 acres) and the State Lands Commission (240 acres). The project will be implemented in phases. The first phase of the project on the SCC parcel,

completed in 2020, built a new flood protection levee to protect the Bel Marin Keys housing development from future tidal flooding and to facilitate the dredge sediment placement needed to bring the site up to restoration elevations and eventual outboard levee breaching. The first phase also created 25 acres of seasonal wetland and seasonal alkali meadow habitats landward of the new levee. Future phases may use dredged sediment to raise substrate elevations in the site prior to breaching. The timing of future phases of restoration at the site is unclear, and will likely depend on the timing of large USACE dredging projects in the region. Similar to Hamilton Wetlands, the outboard levee at BMKV is eroding/retreating, likely in response to rising sea levels and decreased local sediment supplies.

San Pablo Bay: Napa-Sonoma Network

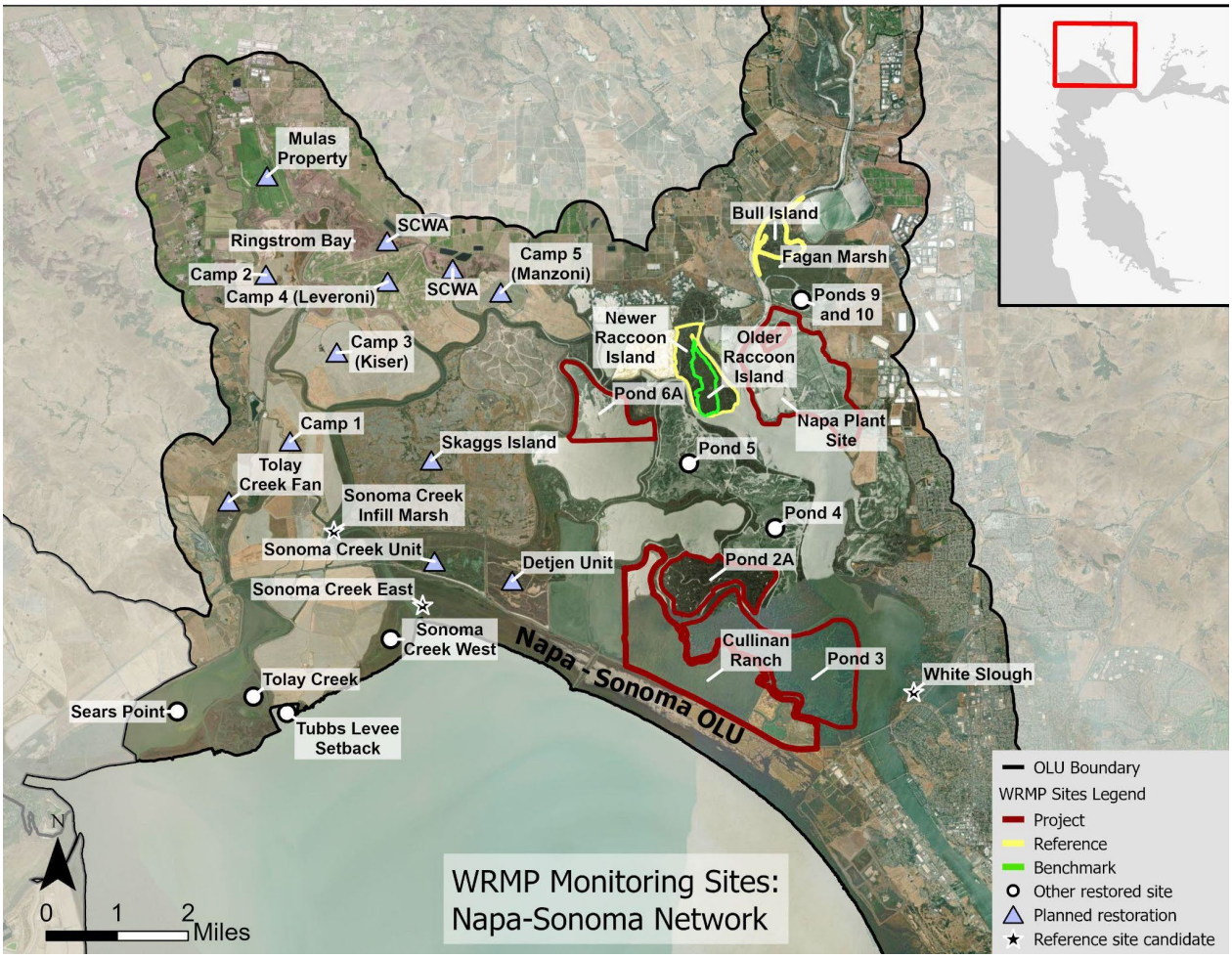


Figure 5. Proposed sites in the North Bay: Napa- Sonoma OLU.

Network Name: Napa-Sonoma

[Site information folder]

Description: The Napa-Sonoma OLU features abundant existing and restoring tidal wetlands across a major estuarine subgradient within the San Pablo Bay National Wildlife Refuge and CDFW Napa Sonoma Marshes Wildlife Area, as well as thousands of acres of planned tidal wetland restoration projects on lands currently or soon to be held by USFWS, CDFW, State Lands Commission, Sonoma Water, and Sonoma Land Trust (Figure 5). Ongoing planning activities related to the future of Highway 37 also have the potential to significantly influence the future of the region's tidal wetlands. Many of these projects have existing or historical monitoring data for WRMP indicators collected by CDFW, USFWS, USGS, and other WRMP partners. This subregion is a high priority for WRMP network establishment because it represents:

- The estuary's largest subgradient of fresh → brackish → saline tidal habitats, including tidal wetlands, due to watershed inputs of freshwater and sediment from the Napa River, Sonoma Creek, Tolay Creek, Carneros Creek, and other tributaries
- One of the largest areas of existing and future bayland habitat restoration (and related monitoring) in the lower estuary
- The OLU with the greatest adjacency between existing and potential future tidal wetlands, and undeveloped or minimally developed adjacent estuarine-terrestrial transition zones
- A broad variety of existing and restored wetlands across a spectrum of tidal/fluvial hydrology, salinity regimes, and stages of geomorphic/ecological evolution

This network will address numerous near-term WRMP science priorities, including the role of watershed flows of freshwater and sediment in supporting landscape-scale bayland habitat diversity and resilience, how sea level rise can drive the transgression of tidal wetlands across adjacent estuarine-terrestrial transition zones, and the effects of landscape position and restoration timing on habitat evolution at multiple scales. This network is expected to ultimately comprise two monitoring site subnetworks:

- **Napa:** A near-term monitoring subnetwork focused on Napa River baylands and tidally restored former salt ponds within the CDFW Napa Sonoma Marshes Wildlife Area (Napa Ponds, Napa Plant Site), as well as the USFWS Cullinan Ranch tidal wetland restoration project. The near-term Napa subnetwork is anchored by a benchmark site at Older Racoon Island, reference sites at Newer Racoon and Bull Islands, and five Project Sites that vary in restoration age and design approach. This variety in age and design approaches among the Napa project sites is especially important to help the WRMP assess how future restoration projects in the region may develop. Access to these sites must be managed through CDFW and USFWS.
- **Sonoma:** A future monitoring subnetwork will be developed focused on the baylands of Sonoma and Tolay Creeks, whose restoration is informed by the Sonoma Creek Baylands Strategy. Near-term restoration actions related to Highway 37 planning may accelerate the need to establish this monitoring subnetwork.

Napa Benchmark Site:

Older Raccoon Island:[5] Older Raccoon Island is the largest remaining ancient tidal marsh within the Napa baylands, and provides an opportunity to leverage numerous historic and ongoing monitoring projects such as the Integrated Regional Wetland Monitoring Program Pilot Project (IRWM, an early-2000s precursor to the WRMP). The wetland features a broad, high marsh plain drained by distinct dendritic tidal channel networks; a string of large pannes is present in the center of the island. Older Raccoon Island captures the influence of Napa River inflows of freshwater and sediment, and is hydraulically connected through the Napa River and its tributary

[5] The USGS place name for this site is "Coon Island"; however, due to that name's racist origin, the WRMP is using the name "Raccoon Island."

sloughs to the numerous restored former salt ponds within the CDFW Napa Sonoma Marshes Wildlife Area. Special-status wildlife including Ridgway's rail and salt marsh harvest mouse are known to inhabit the site. Newer Raccoon Island, to the north, is a more recently accreted (centennial) extension of Older Racoon Island habitats. This site is proposed as a benchmark site to address the role of watershed flows of freshwater and sediment in supporting diverse, resilient estuarine habitats.

Napa Reference Sites:

Newer Raccoon Island: Newer Raccoon Island is evident on USGS topo maps and NOAA navigational charts beginning in roughly the 1940s. What is now Newer Raccoon Island (including tidal wetlands to the north, across an old water control channel) was formerly a shallow open water/mudflat feature called Fly Bay[6]; it likely formed as a tidal marsh in response to rapid accretion rates driven by high supplies of both estuarine (Gold Rush) and watershed-derived (agricultural and related land use conversion) sediment. The site is connected terrestrially and hydraulically to Older Racoon Island but maintains a distinct vegetation community that is evident from remote sensing. Newer Raccoon Island features a high marsh plain (likely lower than Older Racoon Island) drained by numerous dendritic tidal channel networks, and is known to support special-status species such as Ridgway's rail and salt marsh harvest mice. The site provides an opportunity to leverage numerous historic and ongoing monitoring projects such as IRWM, captures the influence of Napa River inflows of freshwater and sediment, and is hydraulically connected through the Napa River and its tributary sloughs to the numerous restored former salt ponds within the CDFW Napa Sonoma Marshes Wildlife Area.

Bull Island: Bull Island is a 109-acre tidal wetland managed by CDFW as part of the Fagan Marsh Ecological Reserve, a sub-unit of the Napa Sonoma Marshes Wildlife Area (no hunting allowed). Originally reclaimed for agriculture in the 1860s, a 1954 flood on the Napa River breached a levee, which was never repaired. The marshes that have since established on the site are similar to those of Newer Racoon Island in their age, structure, and complexity, as well as their support for special-status species such as Ridgway's rail, salt marsh harvest mouse, California black rail, and salt marsh song sparrow. The high marsh plain is drained by a single dendritic tidal channel network; remnant levees support coyote bush and similar estuarine-terrestrial transition species. Like Newer and Older Racoon Island, the site provides an opportunity to leverage historical IRWM data, captures the influence of Napa River inflows of freshwater and sediment, and is hydraulically connected through the Napa River and its tributary sloughs to Raccoon Island and the numerous restored former salt ponds within the CDFW Napa Sonoma Marshes Wildlife Area.

Napa Project Sites: Due to the significant amount of historic and ongoing tidal restoration in the Napa baylands, there are multiple Project Site candidates in the region, and different sites may lend

[6] CDFW manages this portion of Raccoon Island as Fly Bay, within its Huichica Creek Unit within the Napa-Sonoma Marshes Wildlife Area.

themselves to being better-suited for monitoring different indicators. When the TAC develops a plan for monitoring implementation in 2023, that plan will specify which indicators will be monitored at which sites.

Napa Plant Site: CDFW acquired the 1,460-acre Napa Plant Site from Cargill in 2003. The former crystallizer salt ponds were restored to tidal action in three phases to minimize the impacts on local and regional salinities, following restoration of lower-salinity (non-crystallizer) ponds along the east and west sides of the river. Tidal restoration of the Napa Plant Site was completed in 2010, and as of 2022 the site is primarily intertidal mudflats and shallow open water with small patches of tidal marsh. Bare earthen levees within the site are used for nesting by the California least tern. The site is across the Napa River from Raccoon Island, and hydraulically connected to Bull Island and the rest of the region's tidally restoring former salt ponds via the river and a variety of tributary sloughs (South Slough, Dutchman Slough, etc.).

Pond 2A: 648-acre Pond 2A is the oldest of the tidally restored former Cargill salt ponds within the Napa Sonoma Marshes Wildlife Area, having been restored to tidal action by CDFW in 1995 and 1997. As of 2022, the marsh is dominated by relatively high marsh plain bisected by a dendritic channel network. The marsh is known or has been known to support special-status species such as Ridgway's rail, California black rail, salt marsh common yellowthroat, and salt marsh song sparrow. A PG&E boardwalk underneath high-voltage power lines traverses the site, making access to the marsh interior relatively straightforward. Like Older/Newer Raccoon Island and Bull Island, this site can also leverage historic monitoring by IRWM, Point Blue, and other programs. The site is connected to Raccoon Island and Bull Island via South Slough and the Napa River.

Pond 3: After Pond 2A, Pond 3 was the second of the former Cargill salt ponds to be restored to tidal action. The 1,344-acre pond was illicitly restored through a small (shovel-wide) breach to South Slough in August 2002; by June 2003, this breach had grown large enough to accommodate a survey boat. In 2007, CDFW installed additional breaches to South Slough and the Napa River; they installed further breaches to Dutchman's Slough in 2015 as part of the first phase of Cullinan Ranch restoration (see below). As of 2022, the site is a relatively even mix of intertidal mudflat/shallow open water and vegetated tidal marsh plain. Distinct tidal channel networks are establishing in the site's north-east quadrant. The site is hydraulically connected to Raccoon Island and Bull Island via the Napa River.

Pond 6A: 466-acre Pond 6A was accidentally restored to tidal action during the winter of 2016-2017 when the levee near a tidegate failed and was never repaired. The site is currently muted tidal and is connected to Pond 6 via a series of tide gates and a small breach through the levee that separates the two. Pond 6A is dominated by shallow open water with small patches of emergent intertidal mudflats. Pond 6A is included in this network because planned restoration of the Sonoma Creek baylands may alter tidal hydrology and sediment transport dynamics in and

near the pond. It is hydraulically connected to Raccoon Island and Bull Island via Napa Slough and then the Napa River.

Cullinan Ranch: The USFWS purchased Cullinan Ranch for inclusion in the San Pablo Bay National Wildlife Refuge in 1991, and in 2015 restored the 1,285-acre western portion of the property to tidal action through multiple breaches to South and Dutchman Sloughs to benefit federally listed species (e.g. Ridgway's rail, salt marsh harvest mouse, etc.). As of 2022, the site is dominated by shallow open water, broken up by remnant levees that form narrow bands of emergent islands used as roosting habitat by local waterfowl and shorebirds. The 290-acre eastern portion of the site is receiving dredged material from the Port of Oakland and other locations to raise substrate elevations prior to a planned breaching in 2030. Cullinan Ranch is hydraulically connected to Raccoon and Bull Islands via South and Dutchman Sloughs, then the Napa River.

Sonoma Benchmark Site:

Ringstrom Bay: CDFW's Ringstrom Bay Unit of the Napa Sonoma Marshes Wildlife Area comprises 396 acres of tidal and non-tidal (diked) wetlands along the upper Sonoma Creek baylands. The unit's tidal wetlands include a small remnant of ancient tidal marsh connected via Steamboat Slough to Sonoma Creek. As of 2022, this marsh is dominated by high marsh plain, drained by two small tidal channel networks. The marsh has been cut off from its former estuarine-terrestrial transition zone by levees and vineyard development.

Sonoma Reference Site:

Napa Slough Centennial: Centennial infill marsh along Napa Slough, in between the USFWS Skaggs Island and West End/Detjen Units of San Pablo Bay National Wildlife Refuge, likely represents one of the largest segments of infill marsh in the Sonoma Creek baylands. As of 2022, the marsh is dominated by high marsh plain drained by straight, narrow, largely unconnected tidal channels.

Sonoma Project Sites:

The Sonoma and Tolay Creek baylands feature numerous diked bayland parcels that are planned for acquisition and tidal restoration by numerous entities including CDFW, USFWS, and the Sonoma Land Trust. Tidal restoration opportunities are summarized in the Sonoma Creek Baylands Strategy, and include Camp 1, Camp 2/CDFW Wingo Unit, Camp 3/Kiser, Camp 4/Leveroni, USFWS Skaggs Island Unit, CDFW Tolay Creek Unit (North), and multiple properties owned by the Sonoma County Water Agency. The selection of WRMP Project Sites within this region will be determined by which areas are restored to tidal action at which time, as well as the need to assess particular WRMP science priorities such as the transport of freshwater and sediment from the Sonoma and Tolay Creek watersheds into their respective baylands.

San Pablo Bay/Central Bay: Wildcat Creek Network

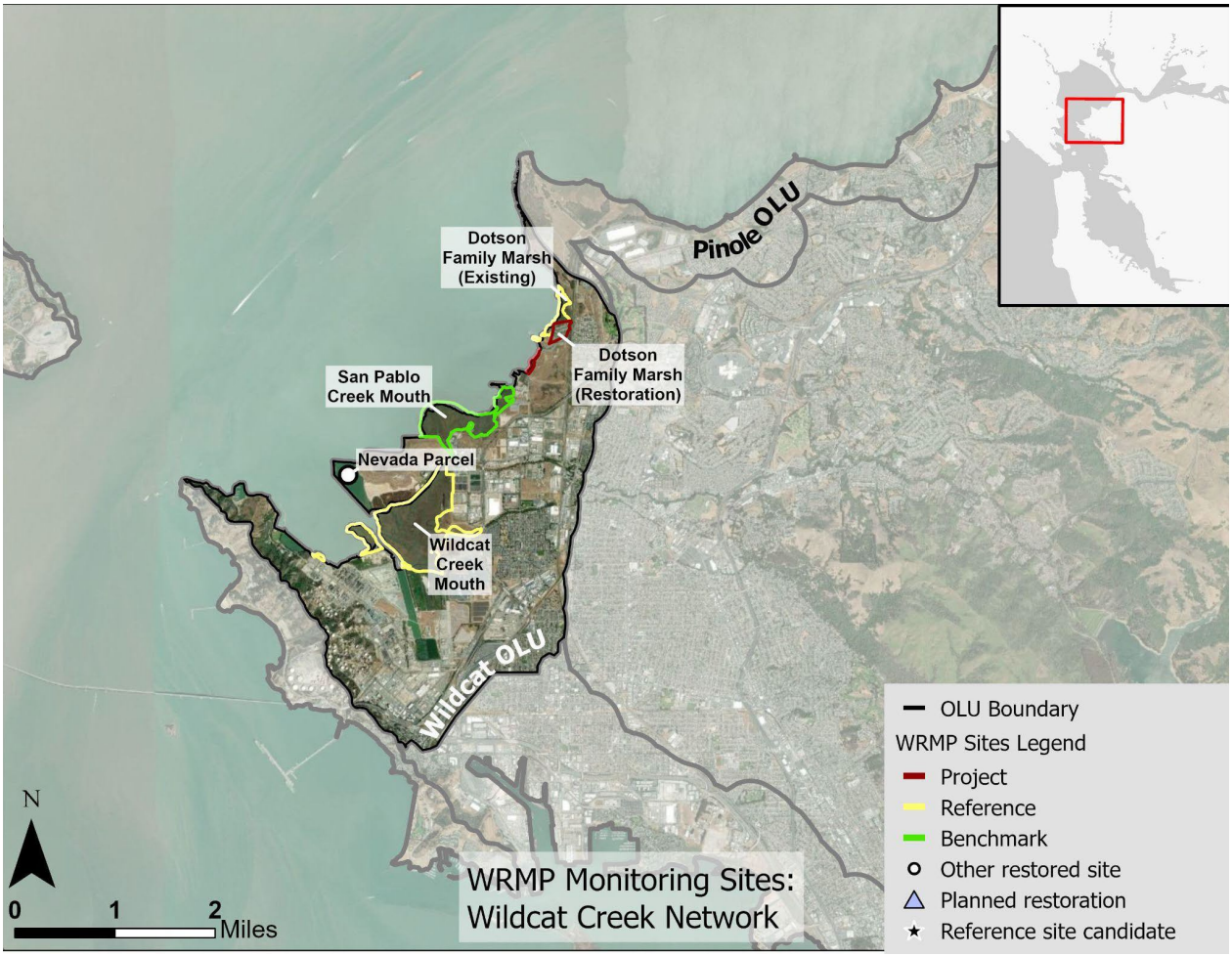


Figure 6. Proposed sites in the San Pablo Bay - Wildcat subregion.

Network Name: Wildcat Creek
Site information folder

Description: The Wildcat Creek network is located along the Richmond shoreline, in a region with a tremendous variety of coastal landforms (marsh, beaches, natural headlands, and artificial headlands) (Figure 6). Establishing this network is a high priority for the WRMP because it will address numerous science priorities, including the role of watershed-bayland reconnection in supporting coastal resilience (due to abundant watershed sediment delivery from Wildcat and San Pablo Creeks), and the ability to inform key environmental justice work and future planned restoration and adaptation projects in a historically marginalized and underserved community. In addition, the proposed network:

- Addresses a key geographic gap in regional environmental monitoring

- Is the only network within the WRMP that includes mature tidal marshes as well as recent restoration projects with robust physical and ecological connections to extensive offshore eelgrass beds and terrestrial habitats
- Provides an opportunity to understand how tidal wetland restoration combined with other nature-based climate adaptation approaches (e.g. eelgrass restoration, oyster restoration, coarse shorelines, and adaptively managed estuarine-terrestrial transition zones) can affect the health, diversity, and resilience of nearshore habitats
- Leverages legacy and ongoing monitoring and stewardship by the Invasive Spartina Project, The Watershed Project, Urban Creeks Council, and other community groups

The WRMP's People and Wetlands workgroup and local community-based organizations are expected to play a key role in the establishment and monitoring of this network. All of the sites within this network may be accessed via public roads.

It's important to note that while this OLU is technically classified within the San Pablo Bay subregion, it shares many significant characteristics (wave/tidal environment, degree of urbanization, nearshore geomorphology) with the Central Bay subregion. Therefore, for purposes of ensuring that the WRMP provides appropriate geographic coverage within SFE, this network provides at least partial representation for the Central Bay.

Benchmark Site:

San Pablo Creek Marsh. This 300-acre marsh is located at the delta of San Pablo Creek, north of the West County landfill and Wildcat Creek Marsh. Prior to development of the West County Landfill, Wildcat Creek Marsh and San Pablo Creek Marsh were part of a large, connected tidal wetland complex. As of 2022, the marsh is dominated by high marsh plain, with a single large artificial pond near its center. The marsh plain is bisected by the San Pablo Creek channel, but is largely disconnected from the channel itself due to levees constructed on either side of the channel in the early 1900s. East of the creek channel, numerous small dendritic tidal channel networks drain the marsh plain to an actively eroding (wave-exposed) north-east edge; a single tidal channel network drains the west side of the marsh to a similarly eroding north-west edge. One of the Bay's largest eelgrass beds is offshore of the marsh. Like Wildcat Creek Marsh, fill has been placed along the upland edge of San Pablo Creek Marsh. The marsh is known to support Ridgway's rail, black rail, and salt marsh harvest mouse. Upstream, San Pablo Creek has been the focus of numerous studies to address flood management, sediment transport, and floodplain restoration. The supply of freshwater and watershed-derived sediment to the marsh is limited by San Pablo Dam/Reservoir in the upper watershed of San Pablo Creek.

Reference Sites:

Wildcat Creek Marsh: This 387-acre wetland is the largest remaining tidal marsh along the Richmond shoreline. This site leverages past studies by the Bay RMP, Urban Creeks Council, Point Blue Conservation Science, and other WRMP stakeholders, and can help inform planned climate change adaptation efforts at the nearby West County Wastewater District treatment plant (which forms the marsh's eastern edge). Wildcat Creek Marsh was diked in the early 1900s, and fill was placed along its upland edges, but the marsh interior has retained much of its historic geomorphology. The marsh is dominated by a high marsh plain, drained to the north (towards the West County landfill) by a series of small dendritic channel networks. The marsh interior features a number of large ponds that retain water through the dry season. Wildcat Creek, which carries significant sediment loads from its watershed, forms the southern boundary of the marsh. The marsh has a small estuarine-terrestrial transition zone along its south-east corner, and large eelgrass beds offshore. Unlike San Pablo Creek Marsh, Wildcat Creek Marsh is largely sheltered from wave erosion of its edge. The marsh is known to support Ridgway's rail, black rail, salt marsh harvest mouse, and the San Pablo vole. Upstream, Wildcat Creek has been the focus of numerous studies to address flood management, sediment transport, and floodplain restoration. East Bay Regional Parks District (EBRPD) is currently considering significant modifications to Jewel Lake, upstream of Wildcat Creek Marsh, that will likely influence sediment supply to the marsh. Wildcat Creek Marsh can be an especially important Reference Site to assess the relative influences of watershed- and estuarine-derived sediment on tidal wetland health, diversity, and resilience.

Dotson Family Marsh (Existing): Dotson Family Marsh (formerly known as Giant Marsh) within Point Pinole Regional Shoreline (EBRPD) is roughly 26 acres in size. The marsh features a broad marsh plain bisected by channels that were likely straightened for mosquito control purposes sometime in the 1900s. The northern portion of the marsh features a broad estuarine-terrestrial transition zone as well as barrier beaches of sand and similar coarse material. In 2019, the Coastal Conservancy installed 180 reef balls offshore and planted eelgrass as part of a living shorelines project to enhance native oysters and eelgrass. Dotson Family Marsh (Existing) is located immediately adjacent to (and north of) Dotson Family Marsh (Restoration), and is connected to San Pablo Creek and Wildcat Creek marshes via San Pablo Bay.

Project Sites:

Dotson Family Marsh (Restoration): This marsh encompasses roughly 30 acres of formerly diked baylands, partially filled baylands within Point Pinole Regional Shoreline that were restored to tidal action in 2017. Restoration actions included site grading to reestablish tidal marsh plain elevations, create shallow depressions to enhance seasonal wetlands, and construct estuarine-terrestrial transition zone habitat. As of 2022, the site is a mosaic of intertidal mudflat, early successional tidal marsh, and upland habitats. Monitoring activities include a suite of indicators that are consistent with the WRMP framework. Dotson Family Marsh (Restoration) is located immediately adjacent to (and south of) Dotson Family Marsh (Existing), and is connected to San Pablo Creek and Wildcat Creek marshes via San Pablo Bay.

South Bay: Alameda Creek Network

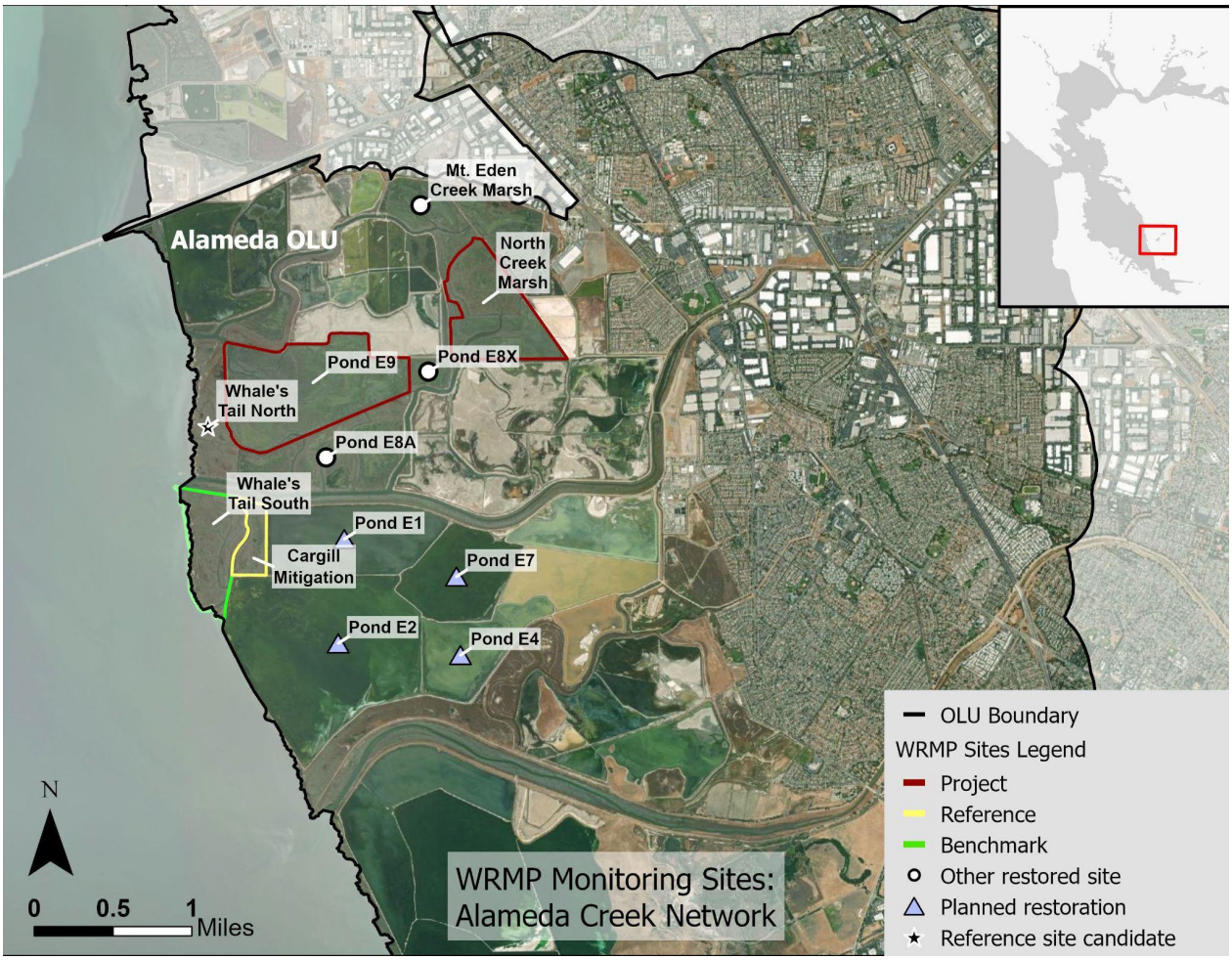


Figure 7. Proposed sites in the South Bay - Alameda Creek OLU.

Network Name: Alameda Creek

Site Information folder

Description: The Alameda Creek site network is focused on existing and restoring marshes within the 5,500-acre CDFW Eden Landing Ecological Reserve south of the San Mateo Bridge, within the Alameda Creek OLU (Figure 7). Establishing this network is a WRMP priority because it allows the program to:

- Leverage the significant monitoring investments related to the South Bay Salt Pond Restoration Project (SBSPRP) and Invasive Spartina Project, including existing and historical monitoring by USGS, USACE, and other WRMP partners
- Address numerous guiding and management questions that can inform future restoration and monitoring efforts within Eden Landing

Near-term WRMP science priorities addressed by this network include assessing the relative roles of estuarine- and watershed-derived sediment in supporting tidal wetland/mudflat evolution, the effects of wind waves on marsh accretion and edge retreat, and the effects of flood control and recreational activities on tidal wetland health and diversity.

Phase 1 of SBSPRP restored roughly 1,700 acres of former salt ponds north of the Old Alameda Creek channel to tidal action from 2006 through 2010; Phase 2 proposes to restore another 2,200 acres south of the creek to tidal action beginning in 2023. SBSPRP is actively monitoring numerous indicators such as tidal hydrology, sediment accretion, vegetation establishment, and fish and wildlife communities that are largely consistent with the WRMP science framework. Whale's Tail North and South are remnant ancient marshes that have recently been the focus of research by USGS on wave erosion of the marsh edge, and wave- and tidally-mediated sediment transport between the marshes and their outboard mudflats. In 2023, USACE is proposing to place approximately 100,000 cubic yards of clean dredged sediment in shallow waters offshore of Whale's Tail, as part of a pilot project to increase sediment delivery to existing and restoring tidal wetlands in Eden Landing. Monitoring from this effort, and related efforts to increase the beneficial reuse of dredged sediment in the region (e.g. the Regional Dredged Material Master Plan), can be leveraged by the WRMP. This region is influenced by watershed-derived sediment from Alameda Creek to the south (SFEI and SPUR 2019).

Access to the sites in this network is managed by CDFW and the SBSPRP. As Phase 2 of the SBSPRP proceeds and WRMP resources grow, those tidally restored ponds can be folded into this site network.

Benchmark Site:

> **Whale's Tail South:** This 254-acre tidal wetland is a process-focused Benchmark Site because it is the location of the USGS wave and sediment research described above. The Whale's Tail marshes were once diked for salt production, but were abandoned in the 1920s and restored to tidal action in 1930 (BEHGU 2015). As of 2022, the marsh is dominated by high marsh plain, drained almost entirely by a single dendritic tidal channel network. Small pannes are scattered throughout the marsh. Whale's Tail South's crenulate outboard edge is actively eroding, largely due to consistent summer wind waves across a broad fetch that drive shoreline retreat and deposit lenses of coarse (sand/shell) material along portions of the marsh edge.

Reference Site:

> **Cargill Mitigation:** This 49-acre tidal marsh immediately east of Whale's Tail South was restored to tidal action in the late 1990s to mitigate for impacts to tidal wetlands and waters from Cargill salt production operations. After restoration, Cargill was colonized by invasive hybrid *Spartina* which outcompeted other native vegetation to become a monoculture. The Invasive Spartina Project (ISP) removed the hybrid Spartina which essentially reset the site in terms of vegetation development. Due to a lack of local sources, the ISP Restoration Program conducted extensive

planting of native *Spartina foliosa* from 2013-16 which accelerated the trajectory of vegetation establishment. Now the marsh plain is transitioning to perennial pickleweed bisected by a still-developing network of dendritic tidal channels; portions of the marsh interior remain unvegetated intertidal mudflat.

Project Sites: There are multiple Project Site candidates in the region, and as in the Napa-Sonoma and Santa Clara Valley networks, different sites may lend themselves to being better-suited for monitoring different indicators. When the TAC develops a plan for monitoring implementation in 2023, that plan will specify which indicators will be monitored at which sites. For brevity's sake, this section only addresses two out of the many ponds at Eden Landing being restored by the SBSPRP; these were highlighted by SBSPRP staff as being especially useful to monitor and straightforward to access.

Pond E9: This 390-acre former salt pond immediately inland of Whale's Tail North was restored to tidal action in 2010. As of 2022, the site is predominantly a mosaic of emergent mudflat and shallow open water with small patches of low marsh scattered throughout the site, especially near remnant tidal channels. Pond E9 is hydraulically connected to the South Bay and Whale's Tail via breaches to Mount Eden Creek and Old Alameda Creek.

North Creek Marsh: This roughly 350-acre former salt pond in the interior of Eden Landing was restored to tidal action in 2006. As with Cargill Mitigation Marsh, the site was colonized immediately by invasive hybrid *Spartina* which was subsequently removed and replanted with native *Spartina foliosa* by the ISP restoration program from 2012-2016. As of 2022, North Creek Marsh is likely the most extensively vegetated of all the ponds restored as part of Phase 1 of the SBSPRP. It is still dominated by intertidal mudflat but supports a large area of tidal marsh, especially in more well-drained areas. Numerous tidal channel networks connect the marsh to both Mount Eden Creek and Old Alameda Creek. Ridgway's rails have been consistently detected at this site since 2019.

Lower South Bay: Santa Clara Valley Network

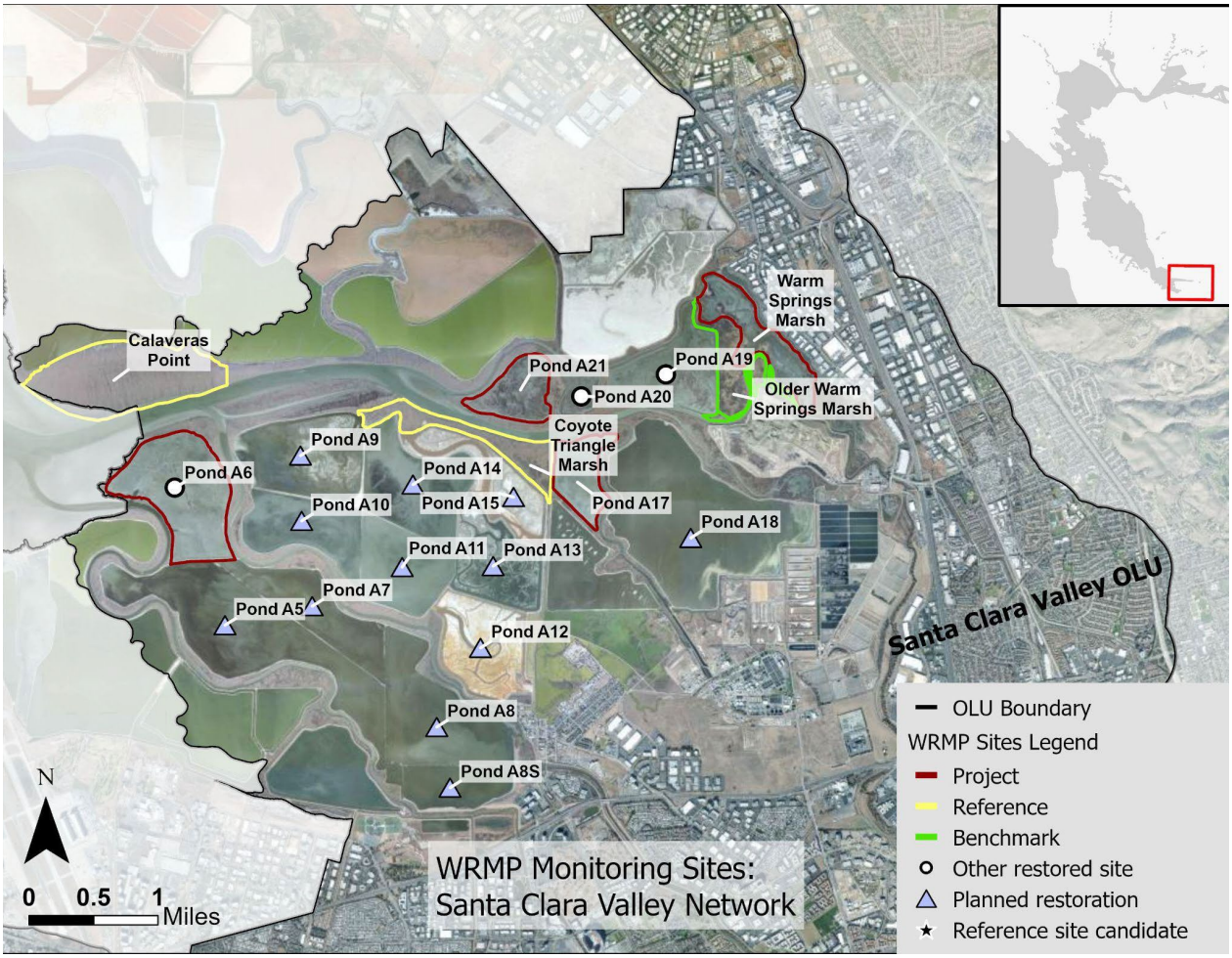


Figure 8. Proposed sites in the South Bay - Santa Clara Valley OLU.

Network Name: Santa Clara Valley

[Site information folder]

Description: The Santa Clara Valley network in the Lower South Bay comprises areas of existing and restoring tidal wetlands that are part of the SBSPRP and South Bay Shoreline Protection Project (Figure 8). Establishment of this network is a high priority for the WRMP for multiple reasons, including:

- Its location along a major estuarine sub-gradient due to the influence of Coyote Creek, Alviso Slough (freshwater input from the San Jose - Santa Clara Valley Water Pollution Control Plant), Guadalupe River, Calabazas Creek, San Tomas Aquino Creek, and other Lower South Bay tributaries
- Multiple tidal wetlands with a variety of salinity regimes at different stages of geomorphic and ecological evolution

- The opportunity to leverage the significant monitoring investments related to the SBSPRP, Invasive Spartina Project, SSFBSP, and related efforts

- Its ability to address numerous guiding and management questions that can inform future restoration and monitoring efforts in the region

Near-term WRMP science priorities addressed by this network include assessing the role of watershed flows of freshwater and sediment in supporting landscape-scale bayland habitat diversity and resilience, the effects of landscape position and restoration timing on habitat evolution at multiple scales, continuing impacts from invasive hybrid *Spartina*, and the effects of flood control and recreational activities on tidal wetland health and diversity.

This entire network is within the Santa Clara Valley OLU. As at the Alameda Creek network, SBSPRP is actively monitoring numerous indicators within this region, such as tidal hydrology, sediment accretion, vegetation establishment, and fish and wildlife communities that are largely consistent with the WRMP science framework. The Santa Clara Valley network can help assess how the OLU's considerable tide range, estuarine sediment supplies, and watershed inputs of freshwater and sediment from Coyote Creek influence bayland evolution at site- and landscape-scales. At Pond A8, the Santa Clara Valley network can also support study of how the reconnection of tidal baylands to their watersheds (in this case, San Tomas Aquino and Calabasas Creeks) can support multi-benefit flood management actions. One of the region's longest-running estuarine fish monitoring efforts has been implemented in the Coyote Creek and Alviso Slough region, adjacent to many of this network's sites.

Phase 1 of the SBSPRP restored 480 acres of tidal habitat within Ponds A19, A20, and A21 (the Island Ponds) in 2006, and 462 acres of tidal habitat within Ponds A6 and A17 in 2010 and 2012, respectively. Phase 2 of the SBSPRP proposes further enhancement of tidal connections at the Island Ponds, as well as tidal restoration of 710 acres of tidal habitat within Ponds A1 and A2W (within the Stevens OLU) beginning in 2023. The South Bay Shoreline Protection Project proposes to restore 2,900 acres of tidal habitats within Ponds A9 through A13, A15, and A18 over roughly 30 years.

All of the sites currently proposed for inclusion in this network are part of the Don Edwards San Francisco Bay National Wildlife Refuge. Access must be managed through USFWS and, in some cases, in partnership with Santa Clara County Parks, Valley Water, the San Jose - Santa Clara Regional Wastewater Facility, and other nearby landowners.

Benchmark Sites:

> **Older Warm Springs Marsh:** This roughly 104-acre marsh is the largest remnant of ancient tidal marsh in the region that has never been diked off or drained. However, it has still been influenced by the tremendous land use changes in the region, including significant regional subsidence due to groundwater withdrawal and impacts to watershed hydrology/sediment supplies due to upstream water resources development and flood control efforts. The marsh is

located along Coyote Creek, immediately east of Pond A19 and west of the Warm Springs Marsh Restoration. As such, it is a benchmark site that allows this site network to assess the influence of watershed inputs of freshwater and sediment on the region's tidal mudflats and marshes. The marsh is a relatively brackish system compared to many tidal wetland restoration sites farther downstream, such as the Island Ponds. Older Warm Springs Marsh features a high marsh plain drained by multiple dendritic tidal channel networks. It is hydraulically connected to the rest of the sites in this network via Coyote Creek.

Reference Site:

Calaveras Point: The roughly 460-acre tidal marsh at Calaveras Point has been accreting for roughly the past 40 years, gradually prograding towards the south thanks to locally high loads of suspended sediment from the Lower South Bay's extensive mudflats. Marsh progradation appears to have accelerated over the last 20 years; during that same time span, nearby Ogilvie Island accreted offshore. As of 2022, Calaveras Point is dominated by a high marsh plain with a comb-like pattern of dense, parallel, straight, narrow tidal channels draining south to Coyote Creek. In the last 10 years, increasing impoundment of salt water against the northern Cargill levee (presumably driven by high tides + limited drainage) has converted much of the northern edge of the marsh from vegetated tidal marsh into salt barrens. Due to the apparent sensitivity of this marsh to local sediment supplies and tide levels, data from this site could provide early indicators of changes in hydrology and sediment dynamics due to climate change, extreme events, and nearby restoration efforts.

Coyote Triangle Marsh. This roughly 100-acre marsh pinned between Coyote Creek, the Union Pacific railroad lines, and Pond A15 is another fragment of remnant ancient marsh in the region that appears never to have been diked or drained. However, similar to Older Warm Springs Marsh, the significant land use changes and reclamation in the region have impacted the site, and its tidal channel networks have apparently (from aerial photographs) shifted in response. The site is dominated by a high tidal marsh plain; a few small tidal channel networks drain north to Coyote Creek. Given its location, this site would likely serve as a useful example of target conditions for former salt ponds restored as part of the South Bay Shoreline Protection Project. Coyote Triangle Marsh is connected to Older Warm Springs Marsh and Calaveras Point via Coyote Creek.

Project Sites: There are multiple Project Site candidates in the region, and as in the Napa-Sonoma and Alameda Creek networks, different sites may lend themselves to being better-suited for monitoring different indicators. When the TAC develops a plan for monitoring implementation in 2023, that plan will specify which indicators will be monitored at which sites. Again, for brevity's sake, this section only addresses a few of the many ponds being restored by the SBSPRP; these were highlighted by SBSPRP staff as being especially useful to monitor and straightforward to access.)

Pond A21: 150-acre Pond A21 is the most vegetated of the Island Ponds that were initially breached by the SBSPRP to tidal action in 2006. The site is dominated by a mosaic of low and high tidal salt marsh, and bisected by numerous dendritic tidal channel networks that drain to former borrow ditches within the pond (which in turn drain to two breaches along Coyote Creek). The marsh is known to support Ridgway's rail and salt marsh harvest mouse, and aquatic surveys in nearby Coyote Creek frequently capture listed species such as longfin smelt. The historical community of Drawbridge is located adjacent to the Union Pacific Railroad (UPRR) between Ponds A21 and A20. Pond A21 is hydraulically connected to Older Warm Springs Marsh and Coyote Triangle Marsh via Coyote Creek.

Pond A6: Pond A6 (also known as the Knapp Tract) is 332 acres of shallow open water, mudflats, and tidal marsh that was breached to tidal flows in 2010. High sediment accumulation rates were observed in the first year post-breach, helping the site to establish a significant percent cover of vegetation (*Spartina foliosa*) in its eastern half as of 2022. The site's two tidal breaches are located near where Alviso and Guadalupe Sloughs drain into Coyote Creek, and is hydraulically connected to Older Warm Springs Marsh and Coyote Triangle Marsh via Coyote Creek.

Pond A17: 130-acre Pond A17 was restored to tidal action in 2012 as part of Phase 1 of the SBSPRP. As of 2022, the site is dominated by intertidal mudflat and appears to be developing a complex tidal channel network. The site is connected to Coyote Creek through a single breach to the north, is immediately east of the UPRR tracks and Coyote Triangle Marsh, and is across Coyote Creek from the Island Ponds.

Warm Springs Marsh Restoration: This 271-acre site (also called Coyote Creek Lagoon) is one of the earliest tidal wetland restoration projects in the entire lower estuary, having been restored to tidal action in 1986. Prior to breaching, the site had subsided more than 12 ft below sea level due to diking and draining, groundwater extraction, and being used as a borrow pit for adjacent commercial development. The restoration of this marsh has relied completely on natural processes, and has experienced a series of perturbations (changes in hydrology and vegetation communities) due to factors including the influence of Coyote Creek. As of 2022, the site is primarily intertidal mudflat, with a complex tidal channel network and fringing marsh along the site's higher edges. It is located immediately adjacent to Older Warm Springs Marsh, and is connected to Coyote Triangle Marsh via Coyote Creek.

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