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## Wetlands Regional Monitoring Program

### Monitoring Plan Cover Letter

The Technical Advisory Committee (TAC) and Science staff of the WRMP would like to advance to the Steering Committee, the WRMP Monitoring Plan (v.1) for their consideration as a guiding framework for program development.

As described in the Executive Summary and Conclusion, the Monitoring Plan provides a holistic plan for monitoring the tidal wetlands of San Francisco Estuary in order to address the Guiding and Management questions of the WRMP, launch the program, and ultimately enable the WRMP to achieve its mission. This Plan will be implemented systematically over time as funding allows. Please see the Executive Summary and Conclusion below for context, rationale and recommendations.

#### Executive Summary

The health, diversity, and resilience of the San Francisco Estuary's (SFE) built and natural communities are to a large degree dependent on the distribution, abundance, and condition of the region's tidal wetlands and associated habitats. These habitats support native plants, fish, and wildlife, improve water quality, buffer shoreline communities from storms and floods, and provide recreational and public health benefits for the Bay Area's more than 7 million residents. Over the past 3 decades, the estuary's tidal wetland conservation community has invested hundreds of millions of dollars in the stewardship and restoration of these habitats (Rabari 2018; US EPA 2022; Rogers 2023).

Climate change poses an existential threat to the health, integrity, and resilience of these ecosystems. Accelerating sea level rise, more frequent and severe storms, and decreased sediment supplies threaten to drown and erode existing tidal wetlands, threaten wetland restoration progress that has been made to date, and increase the risk that new restoration projects will fail to develop and sustain their intended habitats. Effective tidal wetland conservation and restoration requires timely, accurate information to inform decision-making in support of project planning and design, permitting, and adaptive management. Historically, this information has been gathered through three mechanisms: (1) ambient monitoring, which tracks the long-term status and trends of key background (external to project) conditions; (2) project monitoring, which tracks select indicators according to provisions in permits and approvals granted by regulatory/resource agencies; and (3) special studies, which attempt to answer specific questions distinct from ambient and permit-driven analyses of status and trends. However, the overall absence of coordination between these types of monitoring efforts in SFE tidal baylands has made it challenging to turn monitoring data into useful information for decision-makers. Different monitoring efforts employ different techniques, operate at different spatial and temporal scales, and utilize different approaches for data analysis, management, and communication.



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The SFE Wetlands Regional Monitoring Program (WRMP) was created to coordinate and integrate these different monitoring approaches, and develop information to support a broad range of tidal wetland conservation and restoration decision makers, including land managers, funders, project proponents, and regulators. By re-aligning and leveraging the region's considerable investments in existing monitoring projects and programs, the WRMP aims to reduce the amount of time, money, and effort that restoration project implementers must invest in permit-required monitoring. The program aims to help the region's tidal wetland community fulfill regulatory requirements, understand the evolution of the estuary's existing bayland habitat restoration projects, support effective adaptive management in a changing estuary, and develop restoration projects that will be resilient to future conditions.

**The goals of this Monitoring Plan** are thus to identify and recommend a suite of monitoring actions that together encompass a holistic regional tidal wetland monitoring program. The Monitoring Plan is meant as a framework for monitoring that includes the essential activities for understanding the health, function and persistence of established and restoring tidal wetlands in the SFE. The plan identifies and explains monitoring activities that:

- encompasses regional (remote-sensed mapping data), subregional (data loggers in locations central to multiple WRMP Network sites), and site-based monitoring
- together lead, to information that can
  - answer the Program's Guiding and Management Questions
  - contextualize and potentially alleviate project monitoring
  - inform future restoration investment and adaptive management of existing wetlands
- can be initiated over time to build up to the holistic monitoring plan envisioned
- represent an ambitious Monitoring Plan for the region in a living document that will be regularly updated to reflect new methods and information needs

The geographic scope of the WRMP encompasses tidal baylands within the SFE, including subtidal areas to a depth of 12 ft below local Mean Lower Low Water (MLLW), channels, tidal flats, fully tidal and muted tidal marshes, and adjoining estuarine-terrestrial and estuarine-fluvial transition zones. The WRMP science framework is broadly described in the [WRMP Phase 1 Program Plan](#) (WRMP 2020a), and is based on the [Wetland and Riparian Area Monitoring Plan \(WRAMP\)](#) framework established by the [California Water Quality Monitoring Council](#). The WRAMP framework integrates cost-effective monitoring within local and regional contexts, based on management questions that have been articulated and prioritized by program participants (the [WRMP Monitoring Matrix](#) outlines these questions and translates them into actionable science). The framework describes how to integrate Level 1 (remote sensing), Level 2 (rapid field assessment), and Level 3 (intensive field assessment) data to develop information products that answer key questions from partners. The



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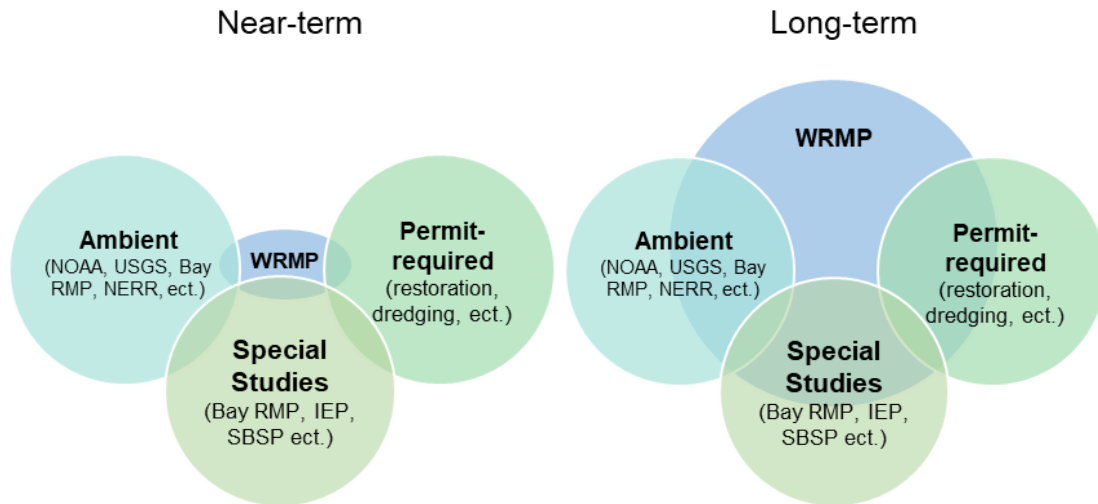
science framework utilizes conceptual models, empirical models, and best professional judgment to compare and contextualize observations across three types of monitoring sites: Benchmark Sites, which represent the estuary’s relict intact Holocene tidal wetlands; Reference Sites, maturing tidal marshes that represent interim target development conditions for restoration projects on the trajectory toward habitats commensurate with existing remnant Benchmark Sites; and Project Sites, which represent tidal wetland restoration projects with different ages and restoration techniques. The [Priority Monitoring Site Network Memo](#) (2023a) describes priority Operational Landscape Units (OLUs) for initial monitoring, and priority Benchmark, Reference, and Project sites within each of those OLU.

This first iteration of the WRMP Monitoring Plan operationalizes the WRMP science framework, and describes proposed monitoring activities over the very near-term (next 1-2 years) and near-term (next 3-5 years) time frames. The WRMP science team, including the WRMP Technical Advisory Committee (TAC) and its workgroups, produced this Monitoring Plan in parallel with standard operating procedures (SOPs) for data collection, analysis, synthesis, and interpretation. The WRMP has limited initial funds to implement very-near-term monitoring, and is primarily using these funds to leverage and add value to existing ambient monitoring, project-specific monitoring, and special studies (see Section 2.2 and Figure ES-1, left). Specifically, the WRMP is (1) utilizing existing NAIP imagery to develop the first iteration of the Baylands Change Basemap (see Section 3.2), (2) synthesizing historical CRAM (California Rapid Assessment Method) data and implementing a new round of CRAM monitoring at select WRMP priority monitoring sites (see Section 5.1), and (3) expanding the network of sediment elevation tables-marker horizons (SET-MHs) in the region (see Section 5.2). Over time, the WRMP will grow its implementation funding, help realign funding for existing monitoring projects and programs, work to align WRMP monitoring with permit-required monitoring, fund/implement an increasing proportion of ambient monitoring, project monitoring, and special studies, and coordinate these efforts at a regional scale (Figure ES-1, right).



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**Figure ES-1.** Near-term (left) and longer-term (right) vision of how the WRMP intends to fund, manage, and coordinate ambient monitoring, project monitoring, and special studies.

Consistent with the WRMP science framework, this Monitoring Plan proposes efforts at three spatial scales: regional, subregional, and site:

- **Regional** (Section 3): This Monitoring Plan proposes regional, estuary-wide remote sensing and mapping of the distribution and abundance of four key WRMP indicators:
  - Bayland habitats (including tidal wetlands, mudflats, and channels, shallow and deep subtidal waters, beaches, and non-tidal wetlands) and landscape features
  - Bayland elevations, including elevations relative to local tidal datums (elevation capital)
  - Bayland dominant vegetation alliances
  - Bayland shoreline change

These maps will serve as foundational science products of the WRMP; repeated remapping efforts will facilitate an understanding of status and trends across all of the region’s tidal baylands, including all Benchmark, Reference, and Project Sites. The new map of bayland habitats currently being developed is called the Baylands Change Basemap<sup>1</sup>, and is funded by the USEPA Region IX.

<sup>1</sup> Name subject to change



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- **Subregional** (Section 4): This Monitoring Plan proposes subregional monitoring in representative locations relevant for priority WRMP Monitoring Site Networks of key abiotic drivers of tidal bayland habitat distribution, abundance, and condition:
  - Water levels, inundation, and rates of sea level rise
  - Surface water salinity
  - Suspended sediment

Monitoring of these indicators is intended to capture conditions in tidal rivers, sloughs, and channels that serve as “feeder” channels to multiple WRMP monitoring sites. Information from subregional monitoring will enhance understanding of changes in ambient estuarine conditions over time, and allow for observations of dependent abiotic and biotic conditions in Benchmark, Reference, and Project sites to be appropriately contextualized. In most cases, WRMP monitoring of these indicators will be designed to fill key spatial and temporal gaps in existing monitoring programs that are implemented by program partners (e.g., USGS, NOAA, SFBNERR). The Monitoring Plan also discusses how the WRMP could build upon existing and proposed efforts to monitor dissolved oxygen in SFE baylands.

- **Site** (Section 5): This Monitoring Plan proposes site-scale monitoring of key biotic and abiotic indicators at select Benchmark, Reference, and Project sites:
  - California Rapid Assessment Method (CRAM) to capture changes in overall wetland condition, and the factors driving those changes
  - Sediment elevation tables with marker horizons (SET-MHs) to capture accretion and elevation change
  - Elevation transects to capture changes across key elevation gradients and ground-truth remotely sensed observations of elevation
  - Vegetation transects to capture changes across key gradients of elevation, inundation, and salinity, and ground-truth remotely sensed observations of dominant vegetation alliances
  - Fish and fish habitat monitoring to characterize the composition and abundance of estuarine fish communities, including the presence/absence of special-status species
  - Bird monitoring to characterize the composition and abundance of tidal marsh birds, shorebirds, and waterfowl

Site-scale monitoring efforts will be carefully coordinated and, where necessary, co-located to most efficiently and effectively monitor individual tidal baylands and gain an improved understanding of regional status and trends. Site-scale monitoring for mammals and carbon



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sequestration are included as additional indicators of interest to be further developed in the near future. Using conceptual models, empirical models, and best professional judgment, monitoring at priority WRMP sites can in some cases substitute for less coordinated, more ad hoc monitoring across a suite of locations. This can reduce and in some cases potentially eliminate the need for project proponents to fund and implement specific monitoring activities.

Where practicable, this Monitoring Plan provides cost estimates for proposed monitoring activities. In 2024, the WRMP science team, in conjunction with the WRMP Technical Advisory Committee (TAC) and Steering Committee (SC), will develop an Implementation Work Plan that will detail which subset of activities from this Monitoring Plan the WRMP has funding to implement, and how those activities will be implemented. The Monitoring Plan is a living document that will change over time as the WRMP grows, the science framework is ground truthed, and to reflect shifts in program science priorities, management information needs, funding resources, geographies, and other factors. The science team, with guidance from the TAC, will revise these documents in coordination with the Steering Committee, consistent with the [WRMP charter](#).

Overall, the Monitoring Plan provides many benefits that closely follow the goals and objectives of the WRMP. In summary, benefits include:

- A framework for answering the Guiding, Management and monitoring questions of interest to the WRMP (as stated within the Program Plan) by monitoring indicators at different spatial scales over time
- Identifying where there are key datagaps within the SFE and how the WRMP can help fill these gaps
- A brief summary of the methods the WRMP recommends for measuring metrics and a reference to the relevant WRMP SOP for more detailed information
- A summary data management plan, proposed data analyses, and resulting potential products to be created with monitoring data
- Rough costs estimates for monitoring



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### Conclusions and Next Steps

The initial WRMP Monitoring Plan (v.1), completed December 31, 2023 will serve as an initial guiding document for WRMP monitoring activities. This Monitoring Plan is intended as a framework for the program and provides a holistic vision for monitoring in the SFE to address WRMP Guiding and Management questions and enable the program to begin to systematically initiate monitoring activities to reach this goal. The Monitoring Plan is thus aspirational and inclusive of a large suite of potential monitoring activities, but also attempts to provide a holistic model that is achievable over time. Using this Monitoring Plan as a guiding framework, the WRMP science team in collaboration with the TAC and SC will next be developing a short-term Implementation Plan/work plan that will prioritize the monitoring activities identified in this Plan for early implementation.

The WRMP continues to strive for integration and coordination with regulatory agencies. Near-term work in this regard will be to increasingly incorporate findings from coordination with regulatory agencies into WRMP monitoring efforts and program development. We will continue work with agencies and project proponents to look for opportunities to align WRMP monitoring with permitting requirements, streamline monitoring efforts for projects, leverage historic monitoring data, and support restoration projects by providing regional context with the goal of alleviating monitoring requirements.

This Monitoring Plan is a living document that will be regularly updated and revised. In addition to the planned revisions in the coming phases of the WRMP grant cycles, the Monitoring Plan will be updated as new workgroups establish and identify monitoring protocols and plans (such as birds and mammals), as monitoring is initiated and existing SOPs need to be modified, as new technologies and approaches alter the best practices for accomplishing monitoring, as Guiding and Management questions are answered and new questions rise in priority, and as other unforeseen needs of the program emerge.

Read the full Monitoring Plan [here](#)