SF ESTUARY
Wetlands
Regional
Monitoring
Program

People & Wetlands Management Questions Proposal

Date: June 15, 2023

To: WRMP Steering Committee

From: WRMP Staff

Subject: Proposal to adopt new Management Questions developed by the People & Wetlands Workgroup

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Background on the People & Wetlands Workgroup

WRMP staff proposed formation of the People & Wetlands Workgroup in March 2022 to further develop the human dimensions of the WRMP under new funding from an EPA Wetland Program Development Grant. The WRMP Plan articulates the Program's interest in monitoring the interactions between people and wetlands under Guiding Question 5: "How do projects to protect and restore tidal marshes affect public health, safety and recreation?" Management Questions under this Guiding Question were initially developed to focus on mosquito and disease vector control to address the public health aspect, while also stating that "the WRMP intends to assess other aspects of the relationship between tidal marsh restoration and human health and safety and recreation, including appropriate access to open space and flood management benefits and risks, with special regard for environmental justice and social equity considerations."

Further developing the questions and indicators under Guiding Question 5 can help the WRMP connect to communities and understand the broader ways of assessing wetland health, processes, and functions. In addition, developing indicators and Standard Operating Procedures for monitoring interactions between people and wetlands opens up new lines of potential funding opportunities for the WRMP that would otherwise be inaccessible to the program. Data on human-wetland connections can support advocacy for additional regional funding, inform design and adaptive management of wetland projects, provide new perspective on the effectiveness of efforts to sustain healthy aquatic habitats and resources, and more.

Adding indicators to measure wetland benefits that communities and Tribes value can enable the WRMP to evaluate whether these benefits are being provided equitably. Furthermore, community and Tribal knowledge will help us better understand the Estuary's wetlands. An increasing focus on equity and human connections to wetlands aligns with the more holistic ways that other regional entities and programs are beginning to view restoration and management, such as the inclusion of benefits to economically disadvantaged communities and involvement by youth and volunteers in the San Francisco Bay Restoration Authority's Performance Measures for restoration projects.

The People & Wetlands Workgroup was approved by the Steering Committee in March 2022 to pursue the following:

- Re-evaluate the Guiding and Management Questions associated with human/wetland interactions. Suggest revisions and additions as needed to reflect interactions with people.

Consider the driving forces of WRMP monitoring, such as connections to SFBRA Performance Measures and information needs of decision-makers.

- Identify priority monitoring questions and indicators for understanding the connections between people and wetlands.
- Determine metrics and data collection protocols and/or standards for monitoring the priority indicators.
- Increase the inclusion of different forms and sources of knowledge and identify ways to serve the information needs of different groups. How will information about indicators important to frontline communities and Tribes be communicated to those audiences?

Following Steering Committee approval, WRMP staff began recruiting workgroup members and reviewing scientific literature and other monitoring programs to inform development of indicators for the WRMP. The workgroup has met five times since October 2022.

Workgroup Composition

The People & Wetlands Workgroup comprises experts in environmental justice, environmental education, regulatory agencies, social science, and more. Workgroup members include Steering Committee and Technical Advisory Committee representatives in addition to external experts. The full roster is available here.

The workgroup is co-facilitated by Keta Price (Hood Planning Group) and Denise Walker (SFEI), with planning and coordination by WRMP staff.

Proposed Management Questions

The workgroup proposes revision of one existing Management Question and adoption of two new Management Questions, to be incorporated through a limited revision of the Program Plan (relevant section attached). Text under Guiding Question 5 will be revised to ensure inclusion of the following key benefits identified by the workgroup: shoreline protection; water quality; public access; and opportunities for stewardship, knowledge production & transmission, and cultural & spiritual experiences. Proposed revised and new Management Questions are below:

1. Proposed revision to Management Question 5B (changes in blue): *"What monitoring data and/or analyses are needed to ~~optimize~~ improve our understanding of the relationships, if any, between tidal marsh restoration, fish and wildlife support, ~~and~~ mosquito and vector control, and public access?"* This revision directs the WRMP to identify and include relevant public access data (including recreation) in the data portal, and to help identify appropriate analyses. The proposed additions reflect several areas of interest for workgroup and Steering Committee members. For one, multiple agencies and organizations involved in wetland restoration expressed interest in identifying data useful for understanding the potential relationships between public access and other elements of restoration (fish and wildlife support, mosquito and vector control). In addition, the changes reflect the fact that data of interest may already exist, and that bringing those data into the WRMP data portal and identifying analyses would be a valuable role for the WRMP. Finally, the revisions recognize that while there may be

relationships between these elements of restoration, there may not be relationships between all of them.

2. Proposed new question, Management Question 5C: *"How are the benefits of wetlands [identified above] distributed regionally and among different demographic groups?"* This is an area of interest for WRMP partners because data products that address this question can help identify geographic areas where there may be a greater need for wetland projects providing certain benefits, and whether wetland benefits are being provided to communities equitably. Projects can then be identified to fill gaps, and/or efforts can be developed to improve equity (such as targeted outreach to improve access for underserved communities).
3. Proposed new question, Management Question 5D: *"How does the provision of benefits [identified above] progress over time at existing and restored wetland sites?"* This question asks about change over time in wetland benefits, which may be more intensively studied at Benchmark, Reference, and Monitoring Sites. Data that address this question can improve understanding of the time frames needed for certain benefits to begin to be provided, and can help managers understand whether actions taken have led to changes in benefits to people.

Contact

For questions about this workgroup, please contact Alex Thomsen (alexandra.thomsen@sfestuary.org).

1.5 Guiding and Management Questions

The SC adopted a set of goal statements, guiding questions, and management questions using a consensus-based decision process (see Appendix B). The WRMP will focus on the Guiding Questions in sequence, since the answers build on each other and are somewhat additive.

GUIDING QUESTION 1: Where are the region's tidal marsh ecosystems, including tidal marsh restoration projects, and what net changes in ecosystem area and condition are occurring?

More than 90 percent of the total acreage of historical tidal marshes of the Estuary has been lost since European colonization starting in the 18th century. Many entities are working diligently to achieve a regional goal of 100,000 acres of healthy marsh to secure ecological and social benefits, consistent with the directions set forth in BEHGU. The transition zone and shallow subtidal zone are not included in the tidal marsh acreage goals. It is expected that tidal marsh restoration will consider and include these adjacent areas as appropriate. The restoration work enjoys substantial investments of public monies from bonds, taxes, and the operating budgets of participating public agencies. It is essential to assess progress toward the regional goal, adjust restoration strategies if necessary, and report how the public investments benefit the Estuary's natural and built communities.

MANAGEMENT QUESTION 1A. What is the distribution, abundance, diversity, and condition of tidal marsh ecosystems, and how are they changing over time?

Integrated, regional management of tidal marshes requires an understanding of spatial and temporal trends in the extent, abundance, diversity, and condition of the complete tidal marsh ecosystem. Trends indicate both the direction (i.e., increases or decreases) and rate of change. Baseline regional assessment yields information against which future change can be measured. Tracking changes in the extent of habitats for threatened and endangered species can be especially important. Assessing transition zones (including upland, tidal, and subtidal) can also be especially important, given their broad range of ecological functions, such as protecting wildlife from extreme high tides, serving as safe corridors for wildlife dispersal and migration, processing nutrients, and lessening flood risks for the built environment. In the longer term, transition zones can provide space for the inland migration of tidal ecosystems as sea levels rise.

The remnants of historical, high-elevation, mature tidal marshes of the Estuary deserve special attention. They are rare at this time (Atwater, et al., 1979) and their great ecological value is well documented. The remnants support the greatest diversity of plant and animal species, including most of the rare, threatened, and endangered species (U.S. Fish and Wildlife Service, 2013). They serve as the models for the desired endpoints of tidal marsh restoration and are the source of most of the scientific research about the nature of tidal marsh ecosystems for the Estuary. Several recent studies have demonstrated their vulnerability to the combined effects of rapid sea level rise and diminished regional sediment supply (Stralberg, et al., 2011; Schile, et al., 2014; Takekawa, et al., 2013).

MANAGEMENT QUESTION 1B. Are changes in tidal marsh ecosystems impacting water quality?

Water quality is a complex concern for tidal marsh ecosystems, due in large part to the position of marshes at the boundary between the open embayments of the Estuary, rivers and streams, and agricultural and urban storm drains. Many studies have shown that marshes can help filter water to reduce pollutants and improve quality. This does not pertain to all forms of water pollution, however, and the filtering efficiency of tidal marshes for any pollutant can depend on many factors, including tidal elevation, salinity, vegetation type, marsh size, and pollutant load.

Management practices can have a range of deleterious effects on water quality. For example, the use of flood gates or other water control structures to mute the tidal range at a marsh, or to impound water on the marsh plain, can impair the water quality of the marsh. Grading and excavation of diked areas in preparation for restoration of tidal action can exhume legacy contaminants from onsite land uses that post-date diking, and from off-site uses that pre-date diking. In addition, dredging near a tidal marsh can release contaminants that can be transported into the marsh by the flood tides. Any increased contaminant load within a marsh can be transferred at least in part to other areas of the Estuary via tides and currents.

Methylmercury and dissolved oxygen are two regional, nearly ubiquitous, water quality concerns in the Estuary. Mercury is common in the shallow subtidal and intertidal zones, due to atmospheric deposition and its presence in sediment washed into the Estuary from historical mercury mines and gold mines. Diked areas of former tidelands can have high mercury concentrations due to the tidal deposition of abundant sediment from mines prior to diking and before the mining ceased. Some tidal marshes support methylation of mercury, depending on marsh elevation, salinity regime, vegetation type, and a variety of edaphic factors. The risk of natural or restored marshes generating enough methylmercury to contaminate marsh food webs or other estuarine food webs has resulted in the development of bio-sentinel indicators of intertidal food web exposure to methylmercury.

The WRMP may need to help address a variety of additional water quality issues in the future that are not covered by the current WRMP Plan. These include eutrophication, toxic algal blooms, water temperature, acidification, trash, new biological invasions, microplastics, and other contaminants of emerging concern.

GUIDING QUESTION 2: How are external drivers, such as accelerated sea level rise, development pressure, and changes in runoff and sediment supply, impacting tidal marsh ecosystems?

The WRMP will assess the regional, ambient conditions of tidal marsh ecosystems, and the relative influence of ambient conditions on projects, relative to project design and project management. This will help inform decisions about when and how to adjust project performance criteria, as ambient conditions change. A combination of periodic regional inventories, probabilistic surveys, and monitoring efforts that are scaled across space and time are needed to address this question. This may include intensive monitoring at Benchmark Sites and reference sites as well as project-level monitoring.

MANAGEMENT QUESTION 2A. How are tidal marshes and tidal flats, including restoration projects, changing in elevation and extent relative to local tidal datums?

Monitoring the tidal and geodetic elevation and lateral extent of the three main components of the tidal marsh ecosystem (the intertidal zone, shallow subtidal zone, and transition zone) is vital to assessing the degree to which habitats of these zones are migrating landward, maintaining themselves, or drowning and eroding due to sea level rise, diminished sediment supply, subsidence and settling, tectonic action, or a combination of all of these factors. The WRMP is collaborating with the Sediment Workgroup of the Bay RMP and the Tidal Marsh Remote Sensing Workgroup of the Montezuma Wetlands Project. These collaborations will determine the best ways to combine state-of-the-science remote sensing technologies, tidal datum determination, geodesy, and field-based measures of suspended sediment supply, inorganic sediment deposition, and autochthonous organic matter production to cost-effectively estimate net change in elevation and extent of the zones at regional and project scales. Additional recommendations are expected to cover monitoring the abundance, distribution, and size of tidal marsh pannes and major-dominant plant assemblages. The recommendations are likely to identify public agencies, NGOs, consultancies, and academic institutions that might collaborate on implementation.

MANAGEMENT QUESTION 2B. What are the regional differences in the sources and amounts of sediment available to support accretion in tidal marsh ecosystems?

As sea level rise accelerates, the reliance of tidal marsh ecosystems on fine inorganic sediment to naturally maintain their elevations substantially increases. Maintaining high-elevation mature tidal marshes is especially important. Preliminary estimates of existing supplies relative to anticipated future demands for tidal marsh protection and restoration indicate substantial deficits in supply, although these vary among local watersheds and OLUs. These estimates can initially guide understanding of which mature marshes and restoration projects have the greatest chances of survival and success. This information can in turn guide efforts by the WRMP to generate the monitoring data needed to further develop and calibrate the models used to estimate sediment supply and demand. For example, the WRMP is collaborating with the Sources, Pathways, & Loadings Workgroup of the Bay RMP, and the Sediment Workgroup of the Bay RMP to help determine the locations of the Benchmark Sites of the WRMP, and to identify the best methods to sample suspended sediment and estimate local sediment supplies.

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?

Management decisions can be enhanced by anticipating what kinds of lessons are important and ensuring that restoration projects are monitored consistently to create information that feeds back into decision-making. The WRMP Plan focuses on indicators that are likely to support projects as learning opportunities. There are many potentially important lessons about the siting, design, and management of tidal marsh restoration projects that can be anticipated. Some questions of high importance to decision-makers include: breach size, whether or not to excavate drainage systems, whether or not to plant vegetation, the use and design of wind-fetch breaks, what amount of topographic relief of constructed marsh plains is optimal, how to control the settling or compaction of dredged sediment used to elevate diked baylands, how to artificially increase sediment bulk density, the ideal thickness of thin lifts of sediment, and how to best nurture suspended sediment concentrations of flood tides. Many new questions will arise about the optimal sites, designs, and management practices for transition zone restoration, since there is relatively little experience in the region.

MANAGEMENT QUESTION 3A. Where and when can interventions, such as placement of dredged sediment, reconnection of restoration projects to watersheds, and construction of living shorelines, help to sustain or increase the quantity and quality of tidal marsh ecosystems?

The WRMP has prioritized the need to learn how project siting can help offset the dual threats of accelerated sea level rise and diminishing sediment supplies, as well as when intentional augmentation of sediment supplies is needed. Project siting is mainly about improving the connection between projects and local watershed yields of terrigenous sediment, as suspended load or bedload.

The WRMP will meet these information needs in four ways. First, the WRMP is working with the Sediment Workgroups of the Bay RMP and the Regional Sediment Management TAC of the Healthy Watersheds and Resilient Baylands Project to select candidate WRMP Benchmark Sites that are directly subjected to large yields of terrigenous sediment, and where validated rating curves to estimate the yields exist or are being developed, and where flow is also being monitored. This will assure that the Benchmark Sites, in aggregate, represent the full range of quantifiable suspended sediment supplies that might be provided by watersheds, in order to explore the correlation between sediment supply and the ability of tidal marshes to

maintain their tidal elevations. Second, the WRMP will employ methods to detect annual changes in tidal marsh elevation at the Benchmark Sites to detect any time lags between sediment yield from local watersheds and sediment supplies within local marshes. Potential land subsidence will also be considered through geodetic assessment. Third, the WRMP will monitor annual changes in the distribution and abundance of major-dominant assemblages of vegetation at the Benchmark Sites. This will enable statistical exploration of the vegetation community response to changes in the tidal elevations of the marshes, as affected by local sediment supplies. Finally, as these data accumulate, they will be used to identify thresholds in sediment supply corresponding to measurable decreases in tidal elevation of the marshes that in turn correspond to measurable shift changes in vegetation from high-marsh to low-marsh assemblages, and that could, therefore, prompt intervention to augment sediment supplies.

GUIDING QUESTION 4: How do projects to protect and restore tidal marshes affect the distribution, abundance, and health of plants and animals?

The most common goals of tidal marsh protection and restoration projects are to provide habitat to benefit tidal marsh-dependent wildlife and to increase the resilience of tidal marsh plant and animal communities to sea level rise and increasing storm frequency and intensity. To assess how well projects are providing these benefits and to improve best practices, wildlife response–including responses to public access and recreation in and around tidal marsh habitat–must be assessed and that information must be accessible. Too often, project-related wildlife monitoring is conducted only within the project footprint, if at all, and only for short periods, usually one to three years following implementation. In many cases, wildlife is not expected to respond to the restoration until many years later when there is no longer funding available for monitoring. Without wildlife response data we cannot learn how to improve restoration practices or incorporate design elements that provide benefits for desired species. Furthermore, comparing restoration practices among projects can be difficult to impossible when wildlife assessment methods are not standardized or the data are not accessible, which are often the case. The WRMP seeks to address these issues by: 1) developing or promoting standardized assessment methods; 2) providing a regional context for assessments through a network of sites that are monitored at regular intervals as described in the space-time framework; and 3) relating project-specific changes in wildlife and habitat indicators to the relevant indirect drivers.

MANAGEMENT QUESTION 4A. How are habitats for assemblages of resident species of fish and wildlife in tidal marsh ecosystems changing over time?

This management question involves physical and vegetation mapping and monitoring as it relates to habitat for fish and wildlife. First, monitoring efforts carried out by the WRMP will be informed by and build upon existing guidance and plans (including the Tidal Marsh Recovery Plan; see Table A). Important habitat features for many of the indicator species are already known. For example, gumplant (Grindelia stricta) is important for tidal marsh dependent bird species such as Ridgway's rail (Rallus obsoletus), song sparrow (Melospiza melodia), and common yellowthroat (Geothlypis trichas). Other vegetation metrics related to wildlife include plant richness and abundance, and plant height and vertical density (e.g., stem density at different heights). Measures of habitat connectivity, patch size and shape, elevation within the tidal frame (e.g., low, mid and high marsh), salinity, transition zone characteristics, and distance to urban areas can be important predictors for tidal marsh wildlife and will be considered in the WRMP's assessments of tidal marsh habitat quality. The WRMP will develop or promote standardized habitat assessment methods that incorporate the elements mentioned above at a network of sites as described in the space-time framework (Section 2 and Appendix D). When combined with the mapping efforts the on-the-ground vegetation measurements can be used to produce detailed maps of habitat extent and quality that relate directly to the needs of fish and wildlife. This process will be repeated at regular intervals, or in response to episodic events, to assess change over time and to evaluate how restoration projects are progressing relative to reference sites.

MANAGEMENT QUESTION 4B. How are the distribution and abundance of key resident species of fish and wildlife of tidal marsh ecosystems changing over time?

Some wildlife survey data may be characterized by high annual variation making it a challenge to distinguish a response to restoration actions from "normal" fluctuations. Critical for assessing response to restoration is understanding how fish and wildlife populations are changing over time and the associated drivers of those changes. For example, species abundance at a project site may fluctuate based more on foraging or breeding conditions outside the project area than on the enhancements within the project. In some instances, we may gain a greater understanding of restoration response when that response is evaluated in a regional or broader context. Without the regional context, it may be difficult to determine which restoration practices work best and which may cause more harm than good to the wildlife we aim to benefit.

The WRMP will track changes in fish and wildlife metrics over time at the network of sites to: 1) better understand how species respond to changes in the environment; and 2) facilitate the assessment of project-specific responses. Broader drivers and trends outside the Estuary will also inform these metrics. Tidal restoration in the Estuary has been largely successful in providing benefits to target wildlife but as climate change accelerates, this pattern may change. The "tried and true" restoration techniques we rely on may no longer provide the expected benefits. For this reason, restoration practitioners and funders are increasingly focused on implementing projects that increase fish and wildlife resilience to sea level rise and other climate change-related stressors. Rapidly developing and testing novel restoration and adaptation features are essential for building resilient ecosystems that provide benefits to fish and wildlife into the future.

GUIDING QUESTION 5: How do projects to protect and restore tidal marshes affect public health, safety and recreation?

Public support and investment in tidal marsh restoration require that projects benefit both the Bay's natural and built communities. This question pertains mainly to the regional effects and benefits of tidal wetland restoration and management on flood control, shoreline stability, water quality, public health (including mosquito abatement), public access and recreation, ~~and~~ aesthetics. One or more of these benefits are often cited as part of the justification for tidal marsh restoration. ~~At this time,~~ the WRMP's efforts related to public health and safety and recreation will ~~focus on~~ data and collaborations among agencies that are needed to efficiently control mosquitoes and other disease vectors that are associated with tidal marsh. In ~~the future~~, the WRMP intends to assess other aspects of the relationship between tidal marsh restoration and human health and safety and recreation, including appropriate access to open space and flood management benefits and risks, with special regard for environmental justice and social equity considerations.

MANAGEMENT QUESTION 5A. What mosquito and vector control strategies need to be considered in restoration design and management to understand the effects that restoration can have on mosquito and vector populations?

Mosquito populations are best controlled in wetland habitats by increasing tidal circulation (primarily through ditches) to enhance drainage between high tide cycles and introduce mosquito larvae predators. Areas of deeper open water are less attractive to mosquitoes because wind action agitates the water surface. Historically diked sites that have been recently breached and restored to tidal action generally result in deep ponds with relatively little mosquito production. However, these sites are expected to change over time, with changes in geomorphology and plant communities. Recently restored sites may have few mosquitoes initially, but abundance may increase over time as marsh elevations evolve. Longer term planning is needed to address the evolution of mosquito habitat and accompanying maintenance needs.

MANAGEMENT QUESTION 5B. What monitoring data are needed to optimize the relationship between tidal marsh restoration, fish and wildlife support, and mosquito and vector control?

Wetland monitoring data should include, but not be limited to, mosquito abundance, arbovirus prevalence, and landscape topography. A key factor for mosquito production is the hydroperiod – the frequency and duration of flooding, as well as the duration of drainage and surface drying. Flood duration is critical because juvenile mosquitoes need time to pass from egg to larvae to pupae while residing in water before emerging as biting adults. Dry surface duration is critical to allow egg conditioning that is needed for some species to hatch successfully. Ineffective management of hydrology and habitat features, such as vegetation and topography, can cause or contribute to increased mosquito abundance. Vegetation protects juvenile mosquitoes from waves, currents, and predators, and the degree of protection depends on plant community composition and density. As marshes accrete and the topography modifies, this can have an impact on the hydrology of the marsh and create low-lying areas where mosquitoes can breed. Wetland projects should be designed, monitored, and adapted in ways that reduce mosquito abundance so that risk to humans and wildlife is minimized.

Photo - Aimee Good