Natural Breaks: A New Framework for Place-Based Sea Level Rise Adaptation in SF Bay

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Many efforts are underway to assess the Bay Area's vulnerability to climate change, but so far there hasn't been a coherent, compelling science-based framework for guiding and evaluating which strategies will be appropriate for our shoreline's many different settings — from wetlands to recreational attractions to industrial sites.

SFEI and SPUR are working together to develop the concept of operational landscape units for the Bay: using defensible science to define different segments or "units" of the shoreline so that we can develop integrated adaptation strategies specific to each one. Operational landscape units are segments of shoreline that work as a system and have the potential to support ecological systems suited to the given place, along with the physical processes needed to sustain them, such as freshwater flows, tidal range and sediment inputs. Operational landscape units may cross jurisdictions and other traditional decision-making boundaries; they are defined primarily by physical setting and drivers such as watershed boundaries, groundwater basins, wave energy and tidal processes, then refined by consideration of social and cultural boundaries such as land use, population and job density, existing flood protection and infrastructure. Each unit is envisioned — eventually — to have a single coherent adaptation strategy that may include both engineered and policy solutions to increase long-term resilience for that place. These strategies could include structural or engineered measures as well as policy and planning tools that address long-term flood risk while protecting people and ecological systems. The final product of this effort will be a framework and guidebook for use in city, county, and regional planning processes that address risk, vulnerability, development, and restoration on the Bay shoreline.

In this presentation, SFEI and SPUR will present methods for defining operational landscape units, along with preliminary maps and a discussion of criteria for pairing these units with adaptation strategies.

Keywords: sea level rise, adaptation, operational landscape units, place-based strategies, planning

Session Title: Science Innovations for Sea Level Rise Adaptation

Speaker Biographies:

Julie Beagle: Julie Beagle joined SFEI in 2010 as a geomorphologist in the Resilient Landscape program. Her work focuses on fluvial and tidal geomorphic processes in Bay Area rivers and wetlands, and she is particularly interested in the physical and biological responses to sea level rise and climate change. Her work also examines how landscapes have changed since European contact, and uses this information to guide landscape-scale restoration strategies in Bay Area watersheds and the Delta. She received a master's degree from UC Berkeley in Environmental Planning in 2010 focusing on geomorphology and watershed management. Previously, Julie

worked at the California Land Stewardship Institute and served as a Peace Corps Volunteer in agroforestry in West Africa. She has a bachelor of arts in history and environmental science from Barnard College, Columbia University.

Laura Tam: Laura Tam directs SPUR's work on water, energy, climate change, adaptation and resilience. Since 2007, she has developed and advanced SPUR's policy agenda for sustainability by convening task forces, writing major research reports, presenting research to key audiences, and conducting policy advocacy. Her work focuses on city and regional strategies for sea level rise, water efficiency and reuse, green infrastructure and reducing climate-change emissions. Laura currently serves on the executive board of the Resilient by Design Bay Area Challenge and on the advisory committee of the Bay Restoration Authority. Prior to working at SPUR, she worked for the U.S. Environmental Protection Agency. She has a Master's degree in environmental management from the Yale School of Forestry and Environmental Studies and a BA in geography from Dartmouth College.

Adapting Tidal Marshes for Climate Change: Coarse Material Placement and High Tide Refuge Enhancement for Wildlife

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Recovery of endangered wildlife in SF Bay depends on finding new, feasible methods for large-scale regeneration of failing high marsh habitats and actively enhancing processes that can help to sustain them. This new project is focused on building natural shoreline systems and internal marsh features that emulate and reinforce the processes that can sustain high marsh habitats during accelerated sea level rise and tidal marsh retreat. We seek to test new nature-based methods for 1) establishing resilient and sustainable high marsh vegetation structure, and 2) beachface nourishment along wave-eroded marsh edges to slow erosion and trigger natural high marsh building processes. These methods are based on nearly extinct historical salt marsh features; i.e., connections to streams that delivered riparian woody debris to salt marshes and gravel and sand beaches fringing the bay edges of many salt marshes. This project uses reintroduction of a native endangered salt marsh plant as a tool to enhance habitat for endangered salt marsh wildlife species. California sea-blite (*Suaeda californica*) was extirpated from San Francisco Bay in the 1950s, but has new potential importance for habitat restoration in the context of seal level rise in the 21st Century. Specifically, this project is 1) directly manipulating high elevation salt marsh vegetation canopy structure, exploiting the interaction of added woody debris "arbors" and natural climbing growth habits of both common (pickleweed) and endangered (CA sea-blite) salt marsh shrubs, and 2) developing designs for coarse mixed beach sediment nourishment of erosional bay shorelines (marsh erosion scarps and marsh-fringing beaches with added bay gravel and sand) to support "self-constructing" natural processes that slow marsh retreat and trigger growth of high marsh berms and growth of vegetation providing high tide refuge habitat. Further, the project seeks to increase local and regional awareness of sea-level rise adaptation through engagement of underserved youth.

Keywords: shoreline, resilience, sea-blite, pickleweed, sand, arbor, high tide refuge

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Speaker Biography: A professor at San Francisco State's Romberg Tiburon Center since 2004, Dr. Katharyn Boyer has pioneered science-informed restoration of seagrass beds and tidal marshes, experimentally evaluating methodologies that can increase restoration success. She is the lead scientist for the first Living Shorelines project in San Francisco Bay, a multi-institution effort to use habitat restoration in the service of shoreline protection. She is actively involved in working groups to advance the science of restoring shoreline features that can buffer wave energy, sequester

carbon, and ameliorate ocean acidification. She is lead author on a chapter in the new book "Living Shorelines: The Science and Management of Nature-Based Coastal Protection". She teaches courses in restoration and wetlands ecology, and has mentored eighteen students to completion of master's theses. She received her B.S. in Zoology at the University of Maryland, her M.S. in Ecology at San Diego State and her Ph.D. in Ecology at UCLA.

The Beneficial Reuse of Dredged Sediments to Construct Ecotone Levees: Challenges and Results from Lower Novato Creek

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There is a much increased awareness in recent years of the importance of beneficial reuse of dredged sediments to prepare for sea level rise (so called "sediment capital"). Across many vulnerable areas around the Bay there is almost certainly a deficit of sediment to raise shoreline elevations and construct ecotone levees for habitat and sea level rise. However, in practice this goal has been very difficult to achieve given a number of technical, economic and permitting challenges. In Fall 2016, Marin County Flood Control District #1 performed their quadrennial creek dredge from Middle and Lower Novato Creek. Instead of hauling the dredged sediments to the landfill or uplands as typically done in the past, the District worked closely with the RWQCB (especially Christina Toms) as well as other permitting agencies to place these sediments along the alignment of future sea level rise ecotone levees within jurisdictional wetlands in order to prepare these areas for restoration to full tidal conditions. The Districts goal was to place these sediments cost-effectively and without mitigation. The District completed the project construction in November 2016 and placed several thousand yards of dredged sediments both for the levee core as well as the ecotone levee slope.

The challenges and results of this design and permitting process will be show along with the results of several approaches to slurring and hydraulically placing dredged sediments transported by truck to the placement area and a discussion of constructability. This talk will present a very straightforward presentation of the practical obstacles to beneficial sediment reuse from the perspective of a practitioner in local government.

Keywords: sea level rise, dredged sediment, beneficial reuse

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Speaker Biography: Roger Leventhal, P.E. is a Senior Engineer with the Marin County Public Works Flood Control Division. He has a MS from U.C. Berkeley in Hydraulics and Coastal Engineering and worked for over 24 years as a private engineering consultant specializing in creek/tidal wetlands restoration prior to coming to Marin County. He has particular expertise in the beneficial reuse of dredged sediments by leading the Montezuma Wetlands project and as a technical advisor to the USACE on the Hamilton Wetlands project. He has helped design and build several innovative projects that use natural systems to provide flood protection with habitat; especially tidal wetlands and coarse-grained bay beach systems. He is currently working closely with County planning staff to develop sea level rise adaptation alternatives that use both these "soft" engineering approaches to flood protection, such as wetlands and beaches, with more traditional "hard" engineering measures.

Community-Based Visioning For Resilience in Richmond

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There is a growing understanding of the importance of community engagement in building resilience. Lessons from the environmental justice and social science communities provide a broad array of best practices and lessons learned. The N. Richmond Community Visioning process was recently undertaken by a broad coalition of local and regional government, non-profit, and community service agencies. The purpose of the Vision is to integrate climate equity and advanced understanding of shoreline processes in an implementable plan for the N. Richmond shoreline. The project explores innovative practices by uniting an approach dedicated to rigorous shoreline analysis as well as equity-focused community engagement.

The community of North Richmond is at a critical juncture. Since the 1980's, the community has been in the national spotlight for effective environmental justice organizing. Richmond residents have won significant victories for the safety, protection and conservation of their community. However, residents still face disproportionate exposure to environmental pollutants and toxins. They are now grappling with an uncertain future for their shoreline due to predicted flooding and sea level rise. Since the early 1900's, Richmond, CA (just north of Berkeley, CA) has been an industrial city with several refineries in close proximity to local residents, primarily people of color. A local study completed by the Association of Bay Area Governments ranked the area within the highest "Community Vulnerability" category based on 10 indicators related to housing, transportation, education, and racial/cultural composition.

This presentation will highlight the mapping methodology and community engagement approach as well as overall findings and strategies identified in the Shoreline Vision. It will also cover some of the unique benefits of linking environmental justice in natural shoreline assessments.

Keywords: shoreline resilience, sea level rise, equity, planning, Richmond, transition zone

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Speaker Biography: Heidi Nutters, Environmental Planner leads the Comprehensive Conservation Management Plan (CCMP) process and supports climate resiliency efforts. Prior to joining the Partnership, she managed the Coastal Training Program for the San Francisco Bay National Estuarine Research Reserve. In her role there, she supported regional collaborative science, communication, training and strategic planning efforts. Heidi was previously a NOAA Coastal Management Fellow with the San Francisco Bay Conservation and Development Commission. She received a B.A. in Cultural and Interdisciplinary Studies from Antioch College and a M.A. in Environmental Studies from Brown University.