South Bay Salt Pond Restoration Project
Restoring the Wild Heart of the South Bay

To: **South Bay Salt Pond Restoration Project and South San Francisco Bay Shoreline Study Teams**

From: **Center for Collaborative Policy**

Re: **Outcomes from the September 8, 2016 Ecotone Charrette**

Background: Managers for the South Bay Salt Pond Restoration Project (SBSPR Project) and the South San Francisco Bay Shoreline Study (Shoreline Study) convened an ecotone charrette on September 8, 2016 from 9:00 a.m. to 3:00 p.m. at the Elihu M. Harris State Office Building in Oakland. The Charrette invited parties with comprehensive Bay Area restoration experience from a diverse range of expertise (e.g., ecology, resource management, engineering, construction, regulatory, policy, etc.) to provide input on the upcoming SBSPR Project and Shoreline Study ecotone projects.

Meeting Attendance: Attachment 1 lists meeting participants.

Meeting Materials: In advance of the charrette, participants were provided a meeting agenda and a two-page introduction to the charrette. At the meeting, participants received a handout with designs for a typical SBSPR Project ecotone (also referred to as a habitat transition zone, HTZ) and possible variations.

Attachments:

- Attachment 1 – List of Meeting Participants
- Attachment 2 – Presentation Slides

Substantive Meeting Outcomes:

1. Welcome, Introductions, and Agenda Review

John Bourgeois, SBSPR Executive Project Manager, welcomed attendees. He then led introductions and reviewed the meeting objectives:

- Gain shared understanding on the most effective, affordable, and flexible ways to design ecotones so they achieve the SBSPR Project ecological goals.
- Capture best thinking and technical guidance on how to design specific SBSPR and Shoreline Study ecotone projects.
- Identify any flaws, gaps, or missed opportunities in the tentative designs.

Ariel Ambruster, Center for Collaborative Policy Facilitator, referred participants to the agenda, which included:

- Key questions for today's charrette and assumptions on SBSPR Project ecotone goals and functions
- Bay Area ecotones to date – pop-up presentations
- Discussion on how to improve the ecotone designs to best achieve habitat needs

- Focus on constructability – pop-up presentations
- Discussion on how to best meet goals in context of tight money and constructability logistics

2. Key Questions and Assumptions on Project Ecotone Goals & Functions

John Bourgeois reviewed key questions to focus the group's thinking for the day:

- What design approaches will allow us to maximize habitat values and are feasible financially and logistically?
- How can we best achieve habitat goals in a way that is affordable and achievable?

He explained SBSPR Project and Shoreline Study teams acknowledge different viewpoints exist around ecotones in tidal marsh systems. This charrette will assume an "ecotone" is a terrestrial ecotone between land and the marsh. The charrette will not focus on mounds or islands. The function goals for this ecotone habitat include: protection to infrastructures behind it, refugia for marsh species, appropriate cover for the species, sufficient height, and adaptability.

3. Overview of Preliminary Ecotone Designs

John Bourgeois introduced David Halsing, AECOM; Nick Malasavage, U.S. Army Corps of Engineers (Army Corps); and Brenda Buxton, State Coastal Conservancy (the Conservancy); who will orient participants to the basic proposed ecotone design and preliminary variations.

SBSPR Project Mountain View & Ravenswood Ecotones

David Halsing, AECOM, provided an overview of the proposed Phase 2 restoration in SBSPR ponds, focusing on ecotones in the Mountain View Pond Complex (A1, A2W, and C1) and the Ravenswood Pond Complex (R3, R4, R5, and S5). He presented the design for a typical ecotone, which includes a 30:1 slope, a nine-foot top elevation and a planar surface. He also reviewed design variations with modified slope, edges, and other changes. He noted the ecotone design needed to satisfy regulatory agencies' (San Francisco Bay Conservation and Development Commission [BCDC] and the Regional Water Quality Control Board [RWQCB]) permitting criteria related to maximizing restoration benefits while minimizing loss of State waters. He also described possible experimental ecotones, such as varying slopes in Mountain View Pond A1, incorporating convex/concave portions on the Ravenswood All American Canal levee ecotone, and using treated wastewater at Eden Landing. He identified several remaining issues that will need to be addressed, including material quality and screening, haul routes, and avoiding double-handling of materials.

<u>Clarifying Questions for Mr. Halsing and project managers</u>:
Q: How did you arrive at 11.6 feet for the top ecotone height in one of the other ideas for ecotones designs?
A: The design engineer selected the elevation of an existing, adjacent levee to serve as a starting point for the idea.

Q: Does the material quality criteria include sediment contaminants and/or adaptive soil properties that best suit the desired vegetation and habitats?
A: We have yet to decide on the specific criteria.

Q: What is the purpose for using treated wastewater for the ecotone?
A: For example, the Oro Loma Sanitary District is using treated wastewater to irrigate vegetation on its ecotone. The occasional freshwater input may support a more brackish water habitat. It offers the District an additional benefit to use this water to support habitat rather than simply dumping the treated water.

Q: What would "varying the slope" for the experimental ecotone entail?
A: The ratio may oscillate (e.g., 30:1 to 12:1 to 20:1, etc.) over a large area. The proposed experimental ecotone should have similar sediment input regimes to help test whether changes in the slope affect sediment accretion rates, vegetation establishment, etc.

Q: Will the experimental ecotone incorporate an experimental design with replicates?
A: The constraints of the topography substantially dictate how we might design an experiment that could produce statistically significant results. However, we will want to further explore this opportunity.

Q: How far does the ecotone extend into the pond?
A: Generally a couple hundred feet. The volume may vary depending on the pond bottom – if there are borrow ditches, for example.

Q: How did you arrive at nine feet for the ecotone top height for the typical design and many of the other ecotone design ideas?
A: Nine feet represents a balance among several factors, such as expected available fill material and the height of adjacent trails. Nine feet is above the high tide line (HTL) for most areas in the South Bay. Many project permits set a height limit as well (refer to the Sonoma Creek presentation/discussion).

Suggestions/Comments:

- **Soil and Vegetation.** The material quality criteria should include soil properties that best suit native and resilient vegetation.
- **Experimental Design.** To the extent possible, standardize monitoring and design the ecotone to support quantitative comparisons among different variables of interest (e.g., slope, ecotone height, habitat complexity, soil composition, refugia quality, etc.).
- **Ideal ecotone elevation**. Nine feet elevation for the top of the ecotone seems insufficient to address sea level rise, however, it is preferable to launch and establish something now rather than wait for the ideal conditions for a more resilient ecotone.

Shoreline Study Alviso Ecotone

Nick Malasavage from the Army Corps reviewed the Corps' approach to developing the Shoreline Study Alviso ecotone and levees. The Shoreline Study ecotone will reduce tidal flooding and sea level rise threats and provide upland refugia for marsh species. The Corps timeline and cost estimate assumed it would dismantle the old berm, build the levee first (flood risk management), create a 50-foot sacrificial bench (for truck accessibility) next to the levee, and then build the ecotone on top of the bench. If the Corps builds the ecotone first,

Nick Malasavage suggested offsetting the ecotone by 15 feet from the sacrificial bench's base to ensure the ecotone fill does not affect future levee projects.

Brenda Buxton of the Conservancy presented two cross-sections showing alternative approaches to designing the ecotone habitats. In one, there is a longer and less steep toe, resulting in more low marsh habitat. In the other, a steeper initial slope leads to an ecotone with a larger area devoted to the higher alkali meadow habitat. The steeper initial slope therefore is more sea level rise-resilient, but the less steep option provides more low and mid-marsh habitat in the short term. She underscored that the Shoreline Study cost estimate ($40 million) is far beyond what SBSPR Project managers expect for their ecotone projects.

Clarifying Questions:
Q: If the Corps intends to breach and restore the ponds after the fill for the ecotone goes in, it does not need to build the "bench" feature prior to the fill, correct?
A: That is likely correct, but the sequencing has yet to be determined, as the Corps needs to consider impacts on birds and other wildlife.

Q: How many acres of habitat will the Shoreline Study ultimately create?
A: Approximately 100 acres of transitional habitat for the entire bench over Reach 1 and Reaches 4 and 5. The area below high tide is closer to 25 acres.
Q: Do you have an acreage estimate for the SBSPR Project ecotones?
A: Not yet.

Q: Do both ecotone options have a 30:1 slope?
A: The first design with a toe has a 30:1 slope; the second design without the toe has a 25:1 slope.

4. Bay Area Ecotone to Date & Habitat Needs – Pop-Up Presentations

John Bourgeois introduced the presenters who would briefly describe their experience with similar Bay Area ecotone projects and lessons learned.

Sears Point

Steve Carroll, Ducks Unlimited, provided an overview of the Sears Point ecotone in north San Pablo Bay, the largest ecotone to date that was restored without using outside fill and constructed on dry land. About 960 acres of new tidal wetlands were restored in fall 2015, taking two years to complete. A tidal channel runs through the center – we had to put stability fill on both sides of the embankment. The ecotone is on the tidal side of the channel. The top elevation is 10 feet, which is at mean high-high water [MHHW]. The stability berm is on the land side of the channel. The levee is 12-16 feet high and transitions down into the site at a 10:1 slope. Pannes were constructed on the flatter parts of the marsh; only the extreme high tides reach the pannes. A major lessons learned involved erosion on panne edges without vegetation. The pannes will require vegetation work to address erosion.

Clarifying Questions**:**
Q: What were the slopes for the marsh pannes?
A: 10:1 transitioned to 20:1. The tops are very narrow, like ridges.

Q: Were mosquitos an issue?
A: It was a concern, so we tried to maximize the vegetation to encourage water turbulence and discourage mosquito breeding.

Q: Did the levee experience erosion?
A: No erosion on the levee. However, there was erosion in the marsh pannes on the ridge.

Q: How do you plan to vegetate the upland transition edge?
A: A three to four-year cycle of planting using native seeds. No container planting.

Q: Is the area a mudflat at low tide?
A: The site is subsided; hence water is still present at low tide.

Inner Bair Island

Steve Carroll then reviewed restoration at Bair Island near Redwood City, wherein the landowner, the U.S. Fish and Wildlife Service's Don Edwards San Francisco Bay National Wildlife Refuge, obtained fill material at no direct cost. The site was originally severely subsided and took six years to complete, bringing in 1.3 million cubic yards of fill (estimated $10-15 million in value). The ecotone goes around the central part of the site in Area D. Mean high tide only reaches up to a third of the ecotone. It is only inundated under the most extreme high tides. Bryan Evans of Pacific States would go into further detail about the logistics for this project.

Clarifying Questions**:**
Q: Was the fill material free? What was the structure for that partnership?
A: The material was free for the Refuge; there was only a tipping fee charged to providers of fill. The process called for significant coordination among Pacific States, the Refuge and the non-profit California Wildlife Foundation that worked with the Refuge to solicit fill from construction projects, arrange transport and placing, etc.

Q: What were the transition zone slopes?
A: The slopes varied from 20:1 to 30:1.

Sonoma Creek

Meg Marriott of the U.S. Fish and Wildlife Service's San Pablo Bay National Wildlife Refuge provided an overview of the Sonoma Creek restoration project, which experienced a more difficult permitting process. The ecotone was built on marsh plain, not dry surface. The ecotone is not a true habitat transition zone; rather it is better described as a transition ramp. The Refuge first proposed a 25-acre transition ramp from the 10-foot high levee down to a 7.5-foot-high relic berm. Initially permitting agencies supported the project; however BCDC expressed concern that the project appeared to convert wetlands into uplands beyond the "minor fill" threshold. Ultimately the project scaled back to 10 acres for the transition ramp. The Refuge will monitor its performance for 25 years. Thus far, the ramp has been performing well and is entirely vegetated with over 15 species of native plants.

Clarifying Questions**:**

Q: How will you vegetate the transition ramp?
A: We will use container plants, not seeds.

Q: What is the jurisdiction limit for BCDC and the Army Corps?
A: Up to the high tide line, which was identified by the high tide limit of the wrack (BCDC's less preferred but cheaper option for identifying the HTL).

Petaluma Marsh & Hamilton

Mark Lindley, Environmental Science Associates (ESA), first reviewed the Petaluma Marsh restoration project (about 101 acres), which was designed in the early 2000s when sea level rise estimates were lower (i.e., one to two feet). It has a levee core with stability berms on either side (the tidal side berm is slightly higher). The berm has a 30:1 slope at the top and 10:1 closer to the marsh plain. Crews used borrow pits to construct the levee and stability berms. One major lesson learned included the effect of the dredged soil on vegetation – the upper portion of the bench (above MHHW) did not have robust vegetation establishment, possibly due to acidic dredged soils.

Mark Lindley then reviewed the Hamilton project, which also had assumed lower sea level rise estimates. It includes a wildlife corridor, which is more similar to a traditional ecotone with a slope extending from the levee down to the tidal marsh and tidal pannes along the edge. The initial design called for a relatively consistent 125:1 slope (a flatter slope because of a shorter ecotone height), but the Army Corps created low mounds and small coves for habitat variability. Crews shaped the wildlife corridor and seasonal ponds in the dry.

Clarifying Questions:
Q: Did the marsh pannes experience any erosion?
A: We created a low, overly-compacted area for water to flow in and out; however rills formed in some of the ponds. We will need to conduct remediation to address those rills and possibly plant some vegetation to address any erosion.

Q: Did you construct the seasonal pannes/ponds with sandy material?
A: The wildlife corridor consisted primarily of a sandy mixture, except for the planting mounds. Both the seasonal pannes and planting mounds consisted primarily of clay.

Suggestions:

- **Slope erosion.** Slopes of 10:1 and above did not appear to have any erosion issues.

Ridgway's Rail Needs

Joy Albertson of the Don Edwards Refuge described habitat needs of the endangered Ridgway's rail, such as sufficient cover during high tide including under sea level rise conditions. The amount of refugia highly depends on the ecotone's height and slope. Shelter must be year-round and relatively continuous. Trails on levees also pose disturbance threats if people walking their dogs allow the animals to run off-leash.

Clarifying Questions:

Q: Does the minimum elevation that must be higher than HTL refer to the substrate's elevation or the top of the vegetated canopy's elevation?
A: The substrate should be higher than the HTL, and the refugia should be high enough above the HTL to support more shrubby vegetation (better protection for the rail than grassy vegetation), but not tall enough to provide raptor perches. Of the two cross-sections presented, the one with more area devoted to alkali meadow would be preferable.

Q: Does the substrate elevation for the rail refugia need to be a certain elevation higher than king tides?
A: I'm unsure, but managers should consider that in the ecotone design. Tide levels also vary around the Bay.

Q: What is the ideal distance between the refugia and human activity?
A: The ideal distance ranges from several hundred feet if the activity is particularly noisy to less distance for lower disturbance such as walking. The more important factor is if the refugia is wide enough with enough cover for the rails to escape further from the disturbance.

Q: Is some refugia better than no refugia?
A: The rail would succeed better in intermittent, wide sections of refugia than in a monotypic, thin refugia.

Suggestions:

- **Extreme HTL and sea level rise**. Focus less on the appropriate elevation for the ecotone given sea level rise, and focus more on the area needs for extreme HTL given sea level rise.
- **Substrate elevation**. Be clear about whether the minimum elevation refers to the substrate elevation or the vegetation canopy cover elevation.

Salt Marsh Harvest Mouse Needs

Howard Shellhammer, San Jose State University, explained that the salt marsh harvest mouse has similar refugia needs as the rail. However, the mice are less mobile and risk genetic drift if the gaps between refugia are too large for the mice to cross. The mice need contiguous refugia habitat, while rails can adapt to more intermittent sections.

Clarifying Questions
Q: What distances can the mouse cross between refugia?
A: Mice can use vegetation at creek mouths but cannot swim very well. Typically they do not move more than 10-20 feet outside of their home range. As with Ridgway's rails, the size of the refugia substantially determines the quality of the refugia habitat. However, the rail has better mobility than the mouse, and thus can better compensate for noncontiguous refugia. The internal marsh area must also have refugia from high tides, as mice cannot travel quickly enough to fringe refugia.

Q: Does the mouse need contiguous marsh to avoid genetic drift or to have a continuous habitat transition zone?
A: Both.

Q: Are the species of concern using the refuge islands?
A: I'm unsure. We have anecdotal evidence that the Ridgway's rail uses the islands, and Point Blue has begun a study on rails' use of the islands. The study design does not include the mouse, and to my knowledge, we do not have data on mice's refuge island use.

5. Discussion: How Can We Improve Designs to Best Achieve Habitat Needs?

John Bourgeois invited input on any of the design concepts presented earlier, including the issues of deal-breaker constraints, missing design concepts and approaches to maximize desired outcomes. The group first listed topics of interest then focused on priority topics for discussion.

Topics of interest included:

- Deal-breakers/fatal flaws
- Prioritizing, trade-offs, optimizing resources
- Regulatory constraints
- Ecotone design
    - Optimal height
    - Heterogeneity
    - Refugia width
    - Habitat benefits of a bench versus a slope
    - Retrofitting
    - Extreme events and sea level rise
    - Substrate (e.g., soil properties) and (resilient) vegetation interaction
    - Mosquito breeding opportunities
- Sequencing
    - Phasing fill import
    - Build levee or ecotone first
- Context-dependent ecotone design
    - Trajectory of adjacent habitats and/or features (e.g., landfill)
    - Transition islands
    - Habitat matrix
- Adaptive management / monitoring
    - Experimental design

Comments/Suggestions/Considerations

Participants raised the following comments, suggestions, concerns, and other ideas for consideration:

Deal-Breakers/Fatal Flaws; Prioritizing, Trade-offs, and Optimizing Resources

- **Limited resources**. How can managers design, build, and manage ecotones to achieve desired outcomes if they have insufficient resources (funds, fill material, etc.)?

- **Ecotone height minimum**. Suggestion: An ecotone that does not extend much higher than the current HTL may not be worthwhile.
    - Comment: However, managers should explore options to plan around this factor to compensate (e.g., build near a landfill for easy retrofitting access).
- **Rationale for agencies**. Identifying specific deal-breakers will help regulatory and permitting agencies justify a minimum investment needed to achieve the ecotone goals. Designs need to demonstrate that the ecotone's unconventional approach for risk management and ecosystem restoration offer benefits that substantially justify agencies' support (e.g., is clearly consistent with existing policies) and potential revisions to existing policies.
    - For instance, an ecotone should provide *long-term* (>10 years) sea level rise resiliency benefits to endangered species.
    - Comment: Minimum thresholds often depend on the landscape and situation context. Thresholds rarely apply ubiquitously across the Bay.
    - Comment: Agencies should not judge the impact of a project based on the area covered in the project (e.g., a two-acre project could result in massive benefits that far exceeds its area boundaries). However, managers and experts must provide that evidence to convince agencies and outside interests.
- **Protect levee as minimum**. Suggestion: The minimum requirements for levees could be the actions and resources needed to protect the levee from erosion. Then, explore opportunities to optimize limited funds and resources, such as ecotone "fingers" that extend into the marsh to cut down on fill volume.
    - Comment: An ecotone with a 10:1 slope and vegetation is sufficient to attenuate wave energy and provide flood protection.
    - Concern: Ecotones with steep slopes like 10:1 offer little refugia for the rail and harvest mouse, especially if the ecotone design also includes a "toe."
- **Balancing site-specific needs**. We are also trying to balance ideals for resiliency against climate change impacts, endangered species refugia, public access, public health and safety, etc. For instance, if the ecotone rises to a levee with a trail on top, we set the ecotone height to be lower than the levee/trail to discourage people/dogs from disturbing endangered species in the ecotone refugia.

Regulatory Constraints

- **Drivers for policy change**. Resiliency to climate change and sea level rise will be the primary driver to change policies for many of the permitting and regulatory agencies.
    - Ecotone stability is a lower priority compared to sea level rise resiliency. Agencies would likely direct managers to redesign the ecotone before considering changing their policies.

Ecotone Design

- **Optimal height**. Suggestion: High enough to provide enough refugia for the mouse during extreme high tide events and sea level rise (e.g., king tides and El Nino more than ten years from now).
- **Heterogeneity**. Suggestion: Create habitat complexity (e.g., varying slopes, concave/convex inflection points, ridges, mounds, etc.) tort a more natural habitat (e.g., alluvial fan deposition) and decrease how much fill and/or compression forces may be needed.

- Resource: Refer to the San Francisco Estuary Institute (SFEI) historical ecology research as a model for opportunities to use the Bay's natural systems to create habitat complexity.
- Should the ecotone design explore a certain variable more extensively than others (e.g., primarily vary slope)?
- Concern: We lessen the ability to compare and analyze in a rigorous manner the more that we incorporate natural habitat complexity.
- Suggestion: Ecotone "fingers" will help decrease fill costs and represent the more-natural ecosystem. "Scalloping" may work better for vegetation establishment than "fingers" if the soil lacks stability.
- Complexity will naturally develop over time even with the ecotone "straight lines" due to soil compacting differently, creek outputs and tidal action, etc.
    - Comment: If you deliberately incorporate that complexity in alignment with the local natural processes, you may be able to further reduce the fill material costs up front (at the increased cost of the additional research and modelling though).

- **Refugia.** Introducing habitat complexity (e.g., "fingers") will help decrease fill costs, represent more natural systems, etc.; however the rail and mouse still need sufficient refugia area, width, and connectivity.
    - Concern: The plans for the Ravenswood ponds do not appear to provide the mouse or the rail with easily-accessible refugia, especially in the interior of Pond R4 along the All American Canal levee, from extreme high tide events during the time between now and once the marsh pond is fully restored. Interior refugia from channels/berms that will develop as the natural marsh evolves will not be ready for several years, putting these species at risk during high tide in the near term.
- **Bench vs. slope**. Consider the habitat benefits of constructing a bench versus a slope.
- **Retrofitting**. Identify and support opportunities for retrofitting (especially if the ecotone is not much higher than the current HTL).
    - For example, build ecotones near landfills.
- **Resiliency**. Suggestion: Design for extreme events and sea level rise (e.g., height, placement/orientation, topography, vegetation, etc.).
    - Consider the magnitude, duration, and frequency of events (e.g., flooding may last for weeks).
    - SBSPR projects should satisfy FEMA's 50-year sea level rise design criteria (Shoreline Study meets the 50-year criteria).
- **Substrate (soil properties) & vegetation interaction**. Suggestion: Consider the native plant community and suitable habitat for the desired vegetation.
    - Suggestion: Use vegetation early to protect constructed areas against erosion; erosion issues often occurred where vegetation was absent.
    - Suggestion: Evaluate resilient vegetation-soil by variables such as stem or shoot density, shoot height, soil sheer strength, etc.
    - Suggestion: Provide a substrate approximately 30 centimeters deep for the vegetation root zone (depending on the desired vegetation).

- Suggestion: Use soil selection criteria to avoid rocky soils that restrict rhizome penetration. Select soils and develop substrates that support clonal, sod-forming species with sufficient salt tolerance (shrubs are less salt-tolerant although they provide effective refugia).
- Concern: Gum plants provide refugia for the mouse, but gum plants died from this recent drought, which led to many mice drowning during El Niño storms.

- **Mosquito abatement**. Suggestion: Avoid mosquito breeding opportunities, especially in difficult-to-access areas like out in the marsh (we need specialized equipment to transport heavy volumes of pesticides). Seasonal wetlands possess the biggest risks; tidal marshes and salt pannes pose less risk. Two different species of mosquitos need treatments at different times of the year (i.e., when rain accumulates in the winter or after extreme high tide events).
  - Suggestion: Design the seasonal wetlands' alignment to promote water circulation and drainage.
  - Resource: Refer to wetlands management and mosquito abatement in the North Bay, which has many seasonal wetlands.

Sequencing

- **"Once and Done" approach**. Concern: "Once and done" avoids the uncertainty of future funding and materials sources, keeps cost down by minimizing double-handling fill, and makes sense for hard-to-access locations. However this approach limits learning and adjusting to maximize the site's potential, and may be insufficient to address sea level rise (necessitating managers to retrofit anyway).
  - Suggestion: Explore modifications to this paradigm to reconcile conflicting criteria (e.g., hybridize with thin lift sediment placement).
- **Phasing fill import**. Concern: Consider the impact on species if subsequent fill phases cause major disturbances to the habitat.
  - Resource: Refer to the feasibility research in the Hamilton/Novato Baylands on thin lift sediment placement (via hydraulic mechanisms) over time to gradually change the topography of dyke baylands, flood control levees, etc.
- **Build levee or ecotone first?** The Shoreline Study assumes the levee will be built first. However, if ecotone fill material is available in the near-term, consider how to optimize use of the available materials.
- **Accessibility**. Suggestion: If the ecotone is difficult to reach (e.g., "island" ecotones), up-front construction needs to occur.
- **Incorporate substrate criteria early**. Suggestion: Design in a substrate/soils selection criteria early in the design process for the desired vegetation that can provide refugia and erosion control. Then, explore whether this decreases the amount of fill needed.

Context-Dependent Ecotone Design

- **Habitat trajectories**. Suggestion: Design according to the expected trajectory of adjacent habitats and/or features (e.g., landfill). For example, design the ecotone differently if it is in a deeply-subsided pond, the ecotone is closer to upland elevation, managers have plans to reconnect creeks to the Bay, etc.

    - Suggestion: Develop a vision for how the ecotone complements the overall restoration vision for the site and surrounding area.
- **Transition islands**. Remember that transition islands are already included in the designs (islands are out of today's meeting scope).
- **Habitat matrix**. Suggestion: Ideally, the ecotone will transition into an upland to allow the two communities to mix.
    - Comment: Different types of ecotones may possess different priority objectives; each has their own value.
- **Site-specific priorities**. Suggestion: Set marshes that can support wide and high-marsh refugia as high-priority sites; use a different ecotone design criteria for other sites that are best-suited for flood protection and wave run-up prevention (even if that site may not provide much wildlife refugia).
    - Concern: Permitting agencies may have a greater challenge justifying projects that do not provide significant ecological benefits (i.e., too similar to development projects and filling in waters of the State).

Adaptive Management / Monitoring

- **Quantitative analyses**. Suggestion: Set realistic and quantitative goals to track performance. Keep experimental questions in mind as you design an ecotone.
    - Concern: Significant results may prove difficult to obtain because some marshes might not fully rehabilitate for decades (although pickleweed colonizes fairly quickly which may support relatively quick mouse colonization).
- **Adaptive approaches**. Suggestion: Using a thin lift sediment placement method offers opportunities (possibly more cost-efficient) to adjust topography without shocking the ecosystem.
- **Jurisdictional constraints.** One reason managers settled on the nine-foot ecotone elevation was due to jurisdictional limits. Shoreline Study and SBSPR projects occur next to several different cities, each of which is in different places with their sea level rise planning policies. Under current conditions, we cannot go higher than nine feet, but we selected areas where we have the potential to expand in the future if the opportunity arises.
    - Suggestion: Develop an adaptive management/phasing plan for ecotones that will be at or near the current HTL. Permitting agencies concerned about sea level rise will want this clearly laid out to feel confident the proposed project is resilient and worthwhile.

6. Focus on Constructability – Pop-Up Presentations

John Bourgeois introduced presenters for the second round of pop-up presentations, which would focus on ecotone construction logistics.

Oro Loma Sanitary District

Carlos Dias, ESA, explained how the Oro Loma Sanitary District's ecotone/horizontal levee project integrates equalization storage for the treatment plant, provides a denitrification step for treating wastewater, and helps protect against wave run-up. He noted the project is still in its construction phase, so he does not have many lessons learned to date. They

incorporated an extensive and robust monitoring program to help address questions about flow capacity, nutrient removal, water quality, etc. If successful, this design could help many water pollution control facilities diversify their wastewater disposal portfolio as well as offer a more holistic approach to flood protection and bayland ecosystem health.

Clarifying Questions:
Q: How did you wick moisture from the ecotone and levee fill?
A: Wicking moisture from the constructed levee was especially crucial. As we built the levee during the first phase, our monitoring of sediment pore pressures underneath the levee indicated the pore pressures were dissipating too slowly. We installed wick drains so the levee will be ready for completion this summer.
Comment: The Hamilton ecotone project involved an unusual approach for inducing soil compaction wherein trucks were purposefully sunk then removed. This is (hopefully) an anomaly, as this approach is not recommended.

Q: Is the ecotone toe above or below the water level?
A: Above water. Historically, it would have been below the water level.

Suggestions:

- **Expert resources**. Many of these ecotone designs are novel, underscoring the need for the appropriate equipment and expertise to optimize efforts.

Dirt Logistics

Bryan Evans, Pacific States, explained how his department in the construction company tracks soil throughout the Bay Area, including submittals, profiling, sampling, screening, and transport. He noted that one of the biggest challenges for the Bair Island restoration project was finding soil that met the project's specifications. Over the past five years, about 400 million cubic yards of soil moves throughout the Bay Area annually; 25% of which is contaminated. Pacific States rejected 50% of the soil that was submitted as possible sediment for Bair Island due to environmental concerns. Additionally, the first soil specifications proved too complicated and stringent; the original contractor could not find suitable material. After the soil criteria expanded, Pacific States found suitable material within nine months. Bryan Evans added that available material highly depends on the economy's health and the number of construction projects.

Clarifying Questions:
Q: What kind of contract did Pacific States have with the Refuge and what was the duration? Many federal and state agencies often exercise high caution with contracts and express concern over liability language.
A: The contract was for planning and specifications and went from 2009 to 2015. The first few years went slowly due to the recession, but we found soil very quickly as the economy recovered with more construction projects.

Q: What were the soil specifications criteria?
A: Criteria focused on geotechnical and environmentally-safe specifications. The site was so deeply-subsided that the majority of the fill went to raising the marsh to the desired elevation. The soil was not screened to specifically match with the desired vegetation.

Suggestions:

- **Soil selection matched with desired vegetation**. Select fine-grain soils for the top layer (three feet deep for perennial grasses) to better encourage vegetation establishment and success.
- **No-net soil change construction policies**. We lose opportunities to reuse massive amounts of soil because cities and counties have a no-net loss/input of soil. State and federal agencies need to work with local governments to relax these restrictions and reconcile this critical missed opportunity.

Cost Issues

Brenda Buxton of the Conservancy outlined basic funding constraints. She posed the following scenario: the SBSPR Project will almost certainly not have $40 million for its ecotone projects, so how should managers optimize ecotone construction if they only have about $20 million? She and John Bourgeois emphasized that they need to recreate the situation for Bair Island to the extent possible.

7. Discussion: How to Best Meet Goals in Context of Tight Money and Constructability?

John Bourgeois moderated the final discussion to explore how managers might design the ecotones to meet habitat and erosion protection goals in an affordable and efficient manner.

Topics raised during this discussion included:

- Considering trade-offs and prioritizing management actions
    - Ecotone objectives
    - Economic implications
    - Timelines
    - Provide high-quality refugia as soon as possible
    - Invest resources strategically
    - Action vs. perfection
    - Models
    - Funding sources
    - Rational for agencies
- Regulatory constraints/opportunities from RWQCB and BCDC's perspectives
- Ecotone Design
    - Translating ideal functions into quantitative specifics
    - Soil/sediment sources
        - Ecotone foundational material
        - Ecotone sediment cover layer
    - Slope modifications
    - Vegetation strategies
- Sequencing
    - Interim ecotone nodes
    - Thin lift fill placement

- Context-dependent ecotone design
    - Utilizing natural processes
- Adaptive management / monitoring
    - Demo, past, and current projects
    - Interim milestones

Comments/Suggestions/Considerations

Recurrent themes from earlier discussions/presentations that also arose during this discussion included:

- **Rationale for agencies**. Ensure ecotone goals align with regulatory/permitting agencies' policies.
- **Context-dependent ecotone design**. Consider site-specific context and habitat matrix to develop appropriate goals customized to that site's ecotone(s). Select sites where natural sediment transport can assist with sediment accretion.
- **Substrate-vegetation interaction**. Selecting appropriate soil properties (grain size, pH, etc.) plays a major role in ensuring successful vegetation establishment (e.g., sandy soils tend to support vegetation growing lower to the ground). Rapidly establishing vegetation will also help protect habitat integrity and avoid losing constructed habitat to erosion in-between construction phases.
- **Integrated ecotone design.** Determine and prioritize how best to integrate and design a heterogeneous ecotone that serves the species' needs in the landscape (e.g., consider soil properties, habitat complexity, hydrology, sediment transport, etc.). Integrate this ecosystem assembly sequencing with ecotone construction sequencing.
- **Thin lift fill import**. Thin lift has minimal impacts on species because placement falls within species' natural disturbance tolerance. Managers can hybridize using the thin lift approach with other methods to suit the needs and realities of available resources.
- **Changing local agencies' policies**. Work with local governments to relax "no net change in soil" restrictions and reconcile this critical missed opportunity to reuse soil.
- **Regulatory constraints and quantitative analyses**. Collect enough data and evidence to demonstrate to agencies how ecotones and broad marshes can provide flood protection at lower costs.

Beyond the ideas and input already provided during the previous discussion, participants raised the following additional input:

Prioritizing, Tradeoffs, and Optimizing Resources

- **Prioritize restoration/flood protection features**. Suggestion: Identify the goals and desired function for each pond at each site. Prioritize features with the greatest benefits and likelihood for success given limited funds/resources and scale the project accordingly. For example, perhaps focus on transition/refugia islands and ecotones near landfills, rather than the Pond A4 levee ecotone.

    - Concern: Managers must maintain the link between the levee function and the ecotone function for permitting agencies to support levee construction projects.
- **Adaptive to the economy**. Suggestion: Develop an adaptive construction/ management plan highly based on health of the economy (i.e., the availability of free material) to help select high-priority sites and material delivery.
- **Time until fully functional**. Suggestion: Consider the time needed for an activity/site to become fully functional when selecting and prioritizing use of resources (e.g., prioritize building an ecotone in a pond where rails or mice are present/nearby, and the pond is closer to the desired elevation, to establish refugia as soon as possible).
    - Concern: Conversely, one might advocate that we need to act on deeply subsided ponds now; otherwise these ponds will never catch up with sea level rise.
- **Near-term, high-quality refugia**. Suggestion: Managers may be unable to establish refugia everywhere in the ponds; however managers need to contribute towards developing high-quality habitat refugia as soon as possible because so little high-quality refugia exist now. Also remember to protect other species in addition to the rail and mouse.
- **Concentrate investments.** Suggestion: If managers lack enough material to fully complete an ecotone, consider what is the minimum investment needed for that ecotone to either be sufficiently effective and/or not degrade before subsequent construction activities (e.g., is it more worthwhile to ensure an ecotone at one site reaches 9 to 11 feet, rather than several ecotones built up to 2 feet).
- **Action vs. perfection**. Concern: Strategic design is important, but we should not allow perfection to block action; implement something as soon as possible.
- **Modeling simulations**. Suggestion: Use models to conduct simulations that consider factors like the hydrology of a site, different sequence of approaches, resiliency to extreme events, etc. to guide ecotone design, prioritization, and adaptive management.
- **Other funding sources**. Suggestion: Refer to the Hamilton/Novato Baylands project, which will use funds from Novato's flood control district and flood/property tax measure. The project will use sediment from the creek as cover, through slurry piping.
    - Suggestion: Identify existing and potential partners who may contribute ecotone funds or fill so the SBSPR Project does not need to pay for everything on its own.
- **Rationale for agencies**. Suggestion: Ensure the ecotone goals are aligned with the Baylands Ecosystem Habitat Goals Project.
    - Reference: Use the U.S. Fish and Wildlife Service's recovery plan for sensitive species like the salt marsh harvest mouse and Ridgway's rail.

Regulatory Constraints & Opportunities

- **RWQCB's permit policies**. RWQCB has a no-net-loss of Waters of the State policy; therefore its Board needs an equally-powerful justification for permitting a

project that appears to conflict with the Waters of the State policy, such as the need for preservation of endangered species. RWQCB recognizes that robust planning documents and guidance exist (e.g., the Baylands Ecosystem Habitat Goals Project) that support the species values that transition zones provide. Therefore, designing ecotones to ensure significant benefits for species will greatly assist the Board's justification to approve the permits (although RWQCB staff cannot guarantee the Board's decision). The Shoreline Study's proposed levees involve more fill than what RWQCB regulators normally feel comfortable permitting; hence the ecotone is essential for RWQCB to allow for the Shoreline levees.

- **BCDC's permit policies**. BCDC is looking at changes in policies in relation to sea level rise adaptation, but we are in the midst of that discussion and expect it will be another year before any changes might occur. BCDC's regulation approach adheres to several policies and statutes (e.g., MacAteer-Petris Act, Bay Plan policies, BCDC's tidal marsh and salt pond policies, etc.). Similar to RWQCB, BCDC's bay fill policies can conflict with its other policies that favor restoration. Marsh is considered part of the Bay. BCDC will conduct a permit analysis that will consider the benefits to the species, the marsh, the ecotone, etc. with the bay water loss. From one BCDC staff's perspective (the BCDC Commission may disagree), when looking at the proposed acreage for endangered species, it does not seem to be a lot of fill. We would have to balance what the beneficial uses would be for the species with our policies to minimize fill.

Ecotone Design

- **Describing ideal functions quantitatively**. How can managers translate ideal ecotone functions and outcomes into design specifics?
- **Soil/sediment sources**
    - **Ecotone foundational material.** Suggestion: Explore whether using on-site material will help reduce costs to obtain sediment for the ecotone.
        - Concern: The SBSPR ponds are too subsided for borrow pits. The soil also lacks structural stability because it is too salty.
    - **Ecotone sediment cover layer**. Suggestion: Identify areas around the Bay to obtain cover sediment.
        - Concern: Dredging in the South Bay may have limitations due to piping considerations. Using dredged material also still requires major mechanical systems to transport material up towards upland and wick out enough moisture.
        - Suggestion: Use on-site material only for the sediment cover layer. Usable material may be as shallow as two meters deep. Test the soil's pH before using though (possible high sulfur levels lead to increased acidity).
        - Suggestion: Work with the Santa Clara Valley Water District to reuse dredged riverine sediment.
        - Suggestion: Investigate benefits and concerns with using riverine sediment compared to bay muds.

        - Suggestion: Consider ways to enhance natural sediment movement, such as sediment sinks.

- **Slope modifications**. Suggestion: Use a toe at pond level to reduce the amount of fill and create a gradual slope for vegetation.
    - Comment: That "cliff" or toe will naturally evolve; it would be more costly to build in that cliff at the beginning than to obtain foundational material to cover the extra volume.
    - Suggestion: Include a toe to the SBSPR ecotone that also has a landward inflection point (an increase in slope) to discourage access by people and their dogs.
- **Vegetation strategies**. Suggestion: Explore methods and opportunities to rapidly establish vegetation (ideally that do not place the entire burden on a singular organization (Save The Bay) for all of the SBSPR and Shoreline Study projects).
    - Suggestion: Mix chopped-up rhizomes into the soil that will be used for the sediment cover layer. The North Bay projects did this accidentally. Managers will need to time this with the season for optimal rhizome growth.

Sequencing

- **Interim ecotone nodes**. Suggestion: Build the levee first. If managers lack enough soil to fully create the ecotone, use the remaining soil to build up an ecotone node (decreases wave energy) with a gap between the ecotone and the levee. Fill the gap over time as material becomes available. Provide access roads to ecotone nodes for subsequent fill applications.
    - Suggestion: Agencies and managers do not want to postpone breaching the outside pond levees. Construct the ecotone to the extent possible with available materials without postponing breaching.
    - Concern: Deter wildlife from inhabiting the interim ecotone node so the next round of fill will not disturb species and cause regulatory issues.
- **Thin lift fill placement**. Concern: Thin lift still requires a substantial initial investment to prepare conditions (e.g., establish foundational material) for subsequent thin lift applications. Managers will need to outline these pre-condition actions and resources needed.
    - Resource: Refer to other thin lift projects (e.g., Army Corps activities in Louisiana and the Seal Beach National Wildlife Refuge).
- **Present different geomorphic designs**. Suggestion: Rather than present an ecotone cross-section (which implies a monotypic ecotone for the entire site), provide discrete components of SBSPR and Shoreline Study projects that display multiple cross-sections, construction methods, substrate types, etc. specific to the location.

Context-Dependent Ecotone Design

- **Utilize natural processes**. Select sites exposed to tidal action to naturally erode the ecotone, creating micro-topographic variability.

Adaptive Management / Monitoring

- **Demo and past projects**. Suggestion: Implement smaller demo/pilot projects simultaneously with larger, high-priority projects to learn more about constructing

effective ecotones. Revisit or monitor past/existing/upcoming projects to optimize our learning (e.g., Petaluma mounds, Bahia, Point Blue's upcoming ecotone and restoration study, etc.).

- **Interim milestones**. Set interim points of what you hope to achieve after 10 years, 15 years, etc.

8. Next Steps

John Bourgeois thanked participants for such an insightful discussion and creative thinking. He said the Conservancy will send out a follow-up survey to elicit additional insight. Managers may schedule future meetings, but definitely plan to follow up with many individuals for their expert advice. Additionally, meeting participants are invited to contact him with questions and concerns at John.Bourgeois@scc.ca.gov.

Attachment 1: September 8, 2016 Meeting Attendance

Full Name	Organization
Joy Albertson	US Fish and Wildlife Service
Ariel Ambruster	Center for Collaborative Policy
Donna Ball	Save San Francisco Bay Association
Peter Baye	Consultant
Rechelle Blank	Santa Clara Valley Water District
John Bourgeois	State Coastal Conservancy
Alex Braud	SF Bay Conservation and Development Commission
Brenda Buxton	State Coastal Conservancy
Steve Carroll	Ducks Unlimited, Inc.
Laura Cholodenko	State Coastal Conservancy
Autumn Cleave	National Marine Fisheries Service
Terry Cooke	AECOM
Bill DeJager	US Army Corps of Engineers
Bryan Evans	Pacific States
Carlos Diaz	ESA
Ron Duke	HT Harvey
Megan Elrod	Point Blue
Naomi Feger	San Francisco Bay Regional Water Quality Control Board
Brenda Goeden	SF Bay Conservation and Development Commission
Colin Grant	US Fish and Wildlife Service
Eric Haas	Alameda County Mosquito Abatement
David Halsing	AECOM
Kelly Hardwicke	HT Harvey
Stephanie Horii	Center for Collaborative Policy
Conrad Jones	California Department of Fish and Wildlife
John Krause	California Department of Fish and Wildlife
Amy Larson	CA Wildlife Foundation
Mark Lindley	ESA

Jeremy Lowe	San Francisco Estuary Institute
Nick Malasavage	US Army Corps of Engineers
Mike Martin	Santa Clara Valley Water District
Meg Marriott	US Fish and Wildlife Service
John McKeon	National Marine Fisheries Service
Martin Michael	Santa Clara Valley Water District
Nadav Nur	Point Blue
Jessie Olson	Save San Francisco Bay Association
Michelle Orr	ESA
Howard Shellhammer	Formerly HT Harvey (ret.)
Renee Spenst	Ducks Unlimited, Inc.
Casey Stevenson	San Mateo County Mosquito and Vector Control District
Rachel Tertes	US Fish and Wildlife Service
Dave Thomson	San Francisco Bay Bird Observatory
James Ujah	Santa Clara Valley Water District
Luisa Valiela	US Environmental Protection Agency
Laura Valoppi	USGS
Brian Wines	San Francisco Bay Regional Water Quality Control Board
Julian Woods	Point Blue