Nature-based Solutions for Nutrient Management

BACWA Annual Mtng / May 5, 2023

BACWA BAY AREA CLEAN WATER AGENCIES

SFEI AQUATIC SCIENCE CENTER
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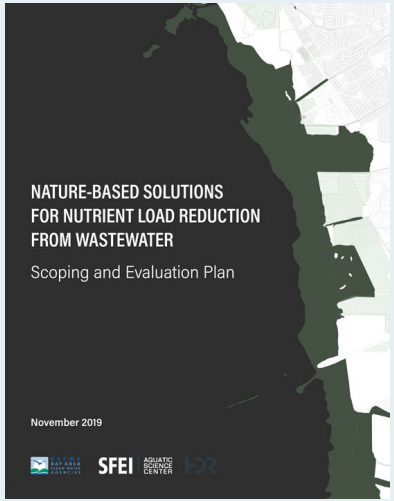
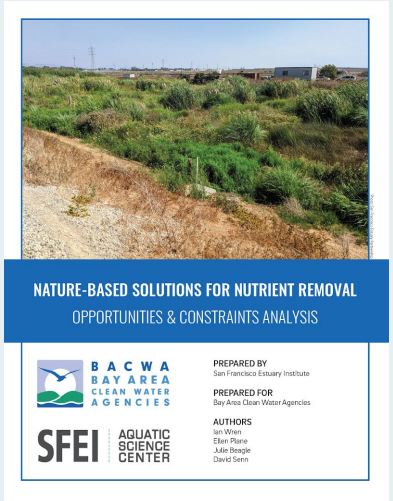
Phases of analysis

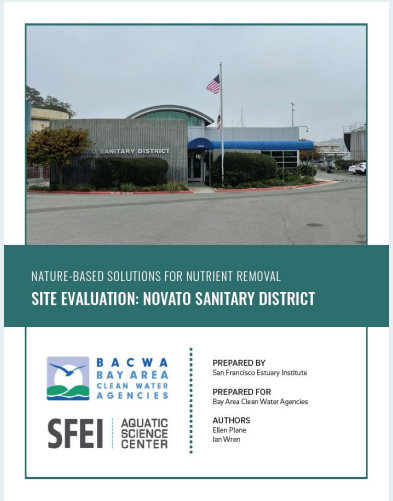
Scoping & Evaluation



Desktop screening (factsheets for 37 facilities)



Site evaluations for 8 high opportunity facilities



Cost estimates and concept designs for 3 facilities

[In progress]

Submittals for the July 1 Permit deadline

1. Agency Acceptance Letters - **please respond ASAP**
2. Region-wide desktop study (applicable to all)
3. Site-specific reports (applicable to 8 agencies)

CITY OF PALO ALTO

NATURE-BASED TREATMENT SOLUTIONS

The Palo Alto Wastewater Treatment Plant discharges nitrified effluent to Lower SF Bay. The facility serves a population of ~220,000 - with a dry weather permitted capacity of 39 mgd and average dry weather flow of ~ 20 mgd. The facility's existing 14-ac freshwater marsh receives treated effluent. Palo Alto has expressed interest in expanding NbS and recycled water deliveries to meet sustainability objectives.

Preliminary Findings

Several opportunities for both treatment types were identified, including some in close proximity to the Palo Alto facility. Together, the three highlighted open water wetland opportunities could reduce the nitrified TIN load by about 45%. The nearest horizontal levee opportunity could reduce TIN loads by about 19%.

Opportunities & Constraints

As a nitrifying facility with a high degree of future flood vulnerability, potential exists to partner on horizontal levees. Constraints include the adjacent airport, the dense urban landscape, and need for cooperation among diverse stakeholders and landowners. Lessons being learned through the current levee project will aid in future planning.

Photo courtesy of Google Earth

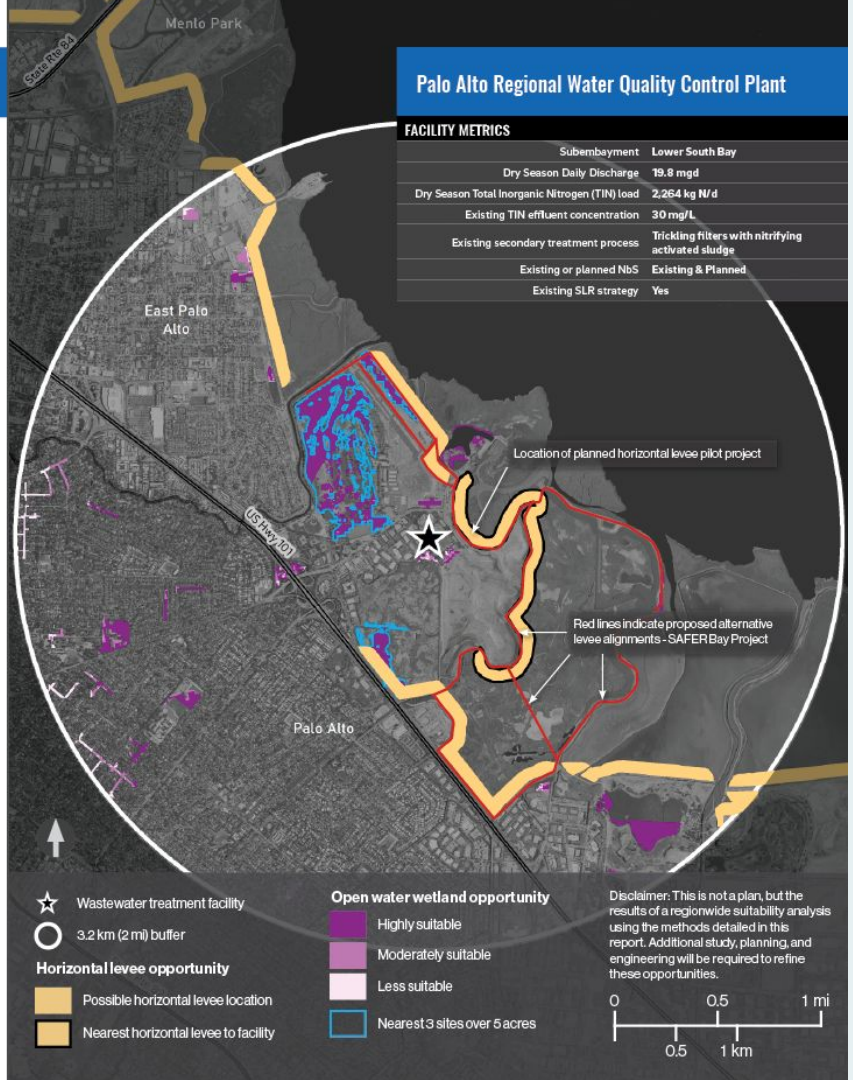
Refer to pages 14-15 for a key to interpreting the metrics in the following tables:

Overall suitability for nature-based treatment solutions	
Measure	**Suitability**
Open water wetlands	Moderate
Horizontal levees	High

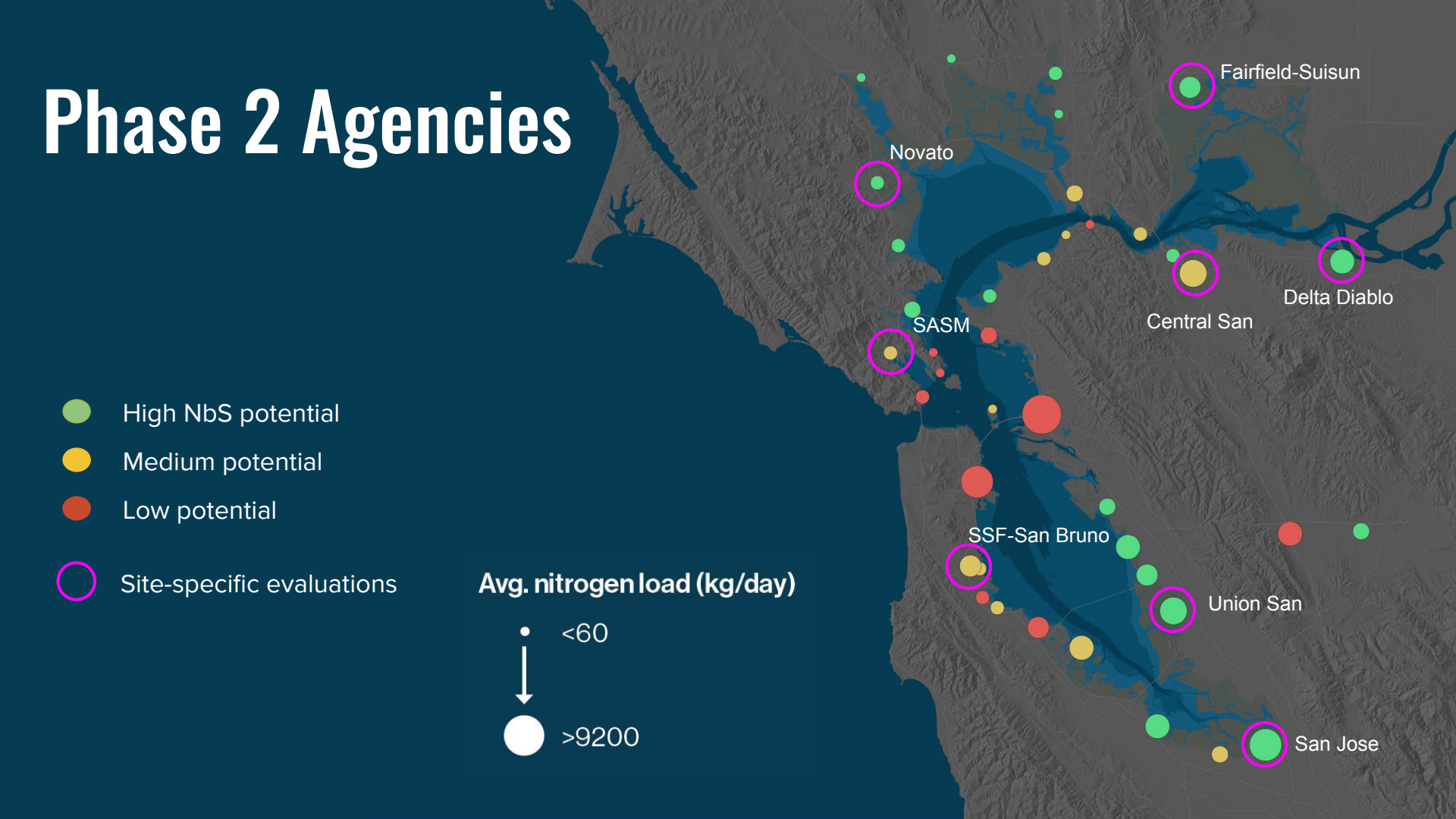
Open water wetland opportunities	*open water wetlands on map*
Within 2 miles of facility	
Total Potentially Suitable Area	182 acres
Nearby sites over 5 acres (highlighted in blue on map)	
Potentially Suitable Area	8 - 111 acres
Total Potential Flow Capacity	0.7 - 9.9 mgd
Total TIN Reduction Potential	80 - 1,130 kg/day
Facility-Specific TIN Reduction	3% - 45%

Horizontal levee opportunities	*horizontal levees on map*
Potentially Suitable Length	3.3 - 12.8 km
Total Potential Flow Capacity	5.6 - 21.8 mgd
Total TIN Reduction Potential	430 - 1,660 kg/day
Facility-Specific TIN Reduction	19% - 73%

Site opportunities and constraints	
Consideration	**Relative Magnitude**
Excess Treatment Capacity	Moderate
Land Use/Regulatory Conflicts	High



Phase 2 Agencies



Site-specific outreach

Figure 5. Infrastructure, recreation, & disadvantaged communities

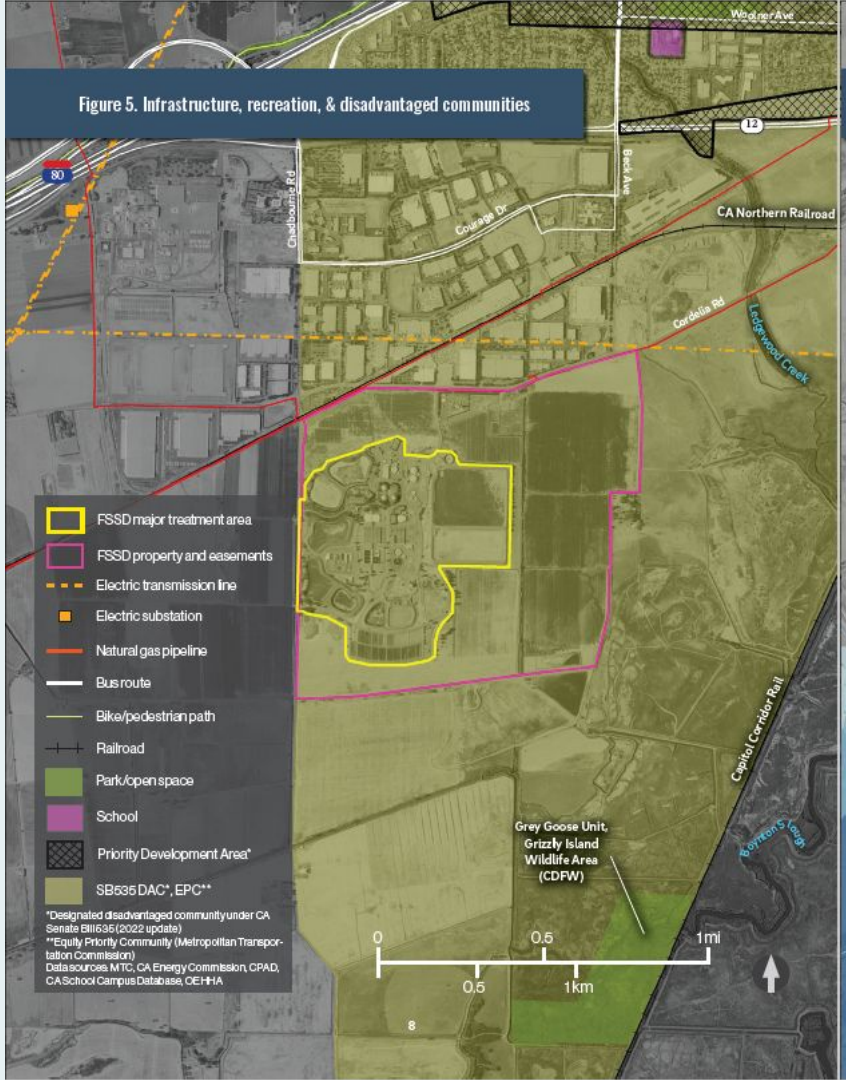
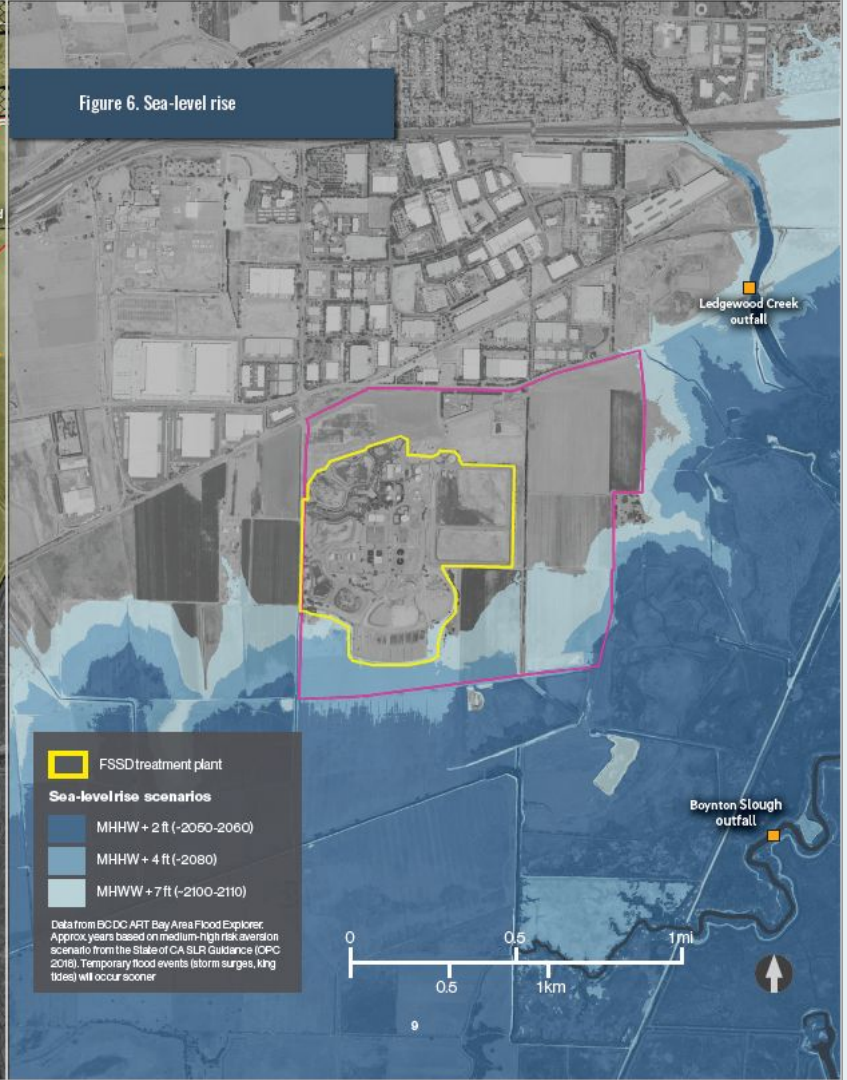


Figure 6. Sea-level rise



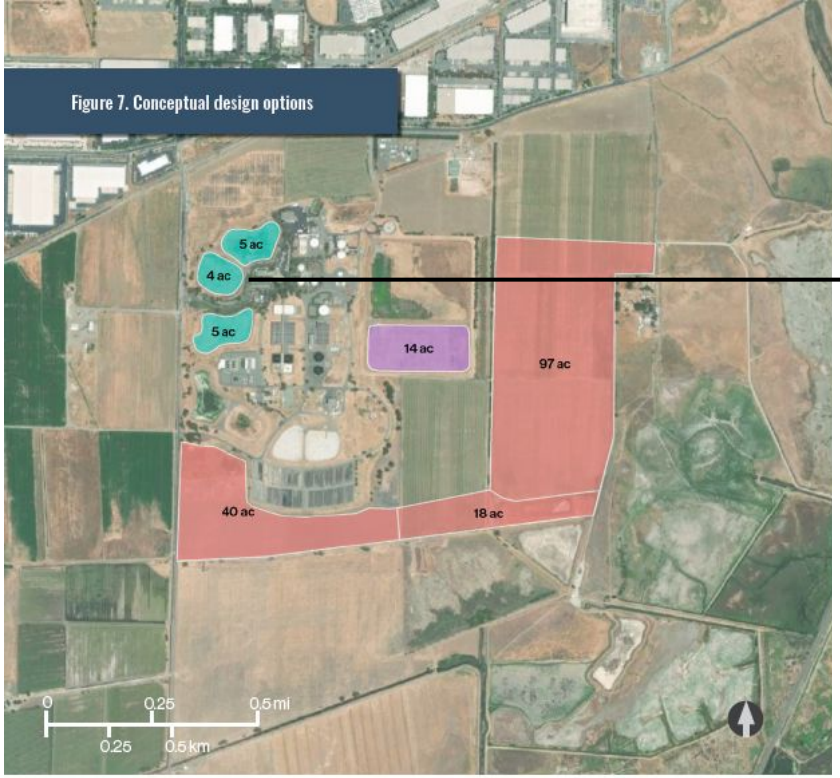
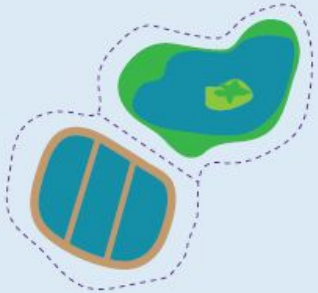


Figure 7. Conceptual design options

- Option 1: Convert former final effluent ponds into train of open water wetlands optimized for various purposes
- Option 2: Dual-purpose wet-weather equalization / open water treatment cell with seepage slope sides
- Option 3: Construct perimeter horizontal levee in phases. Eventually reconnect to restored tidal marsh (Option 4)
- Option 4: Convert the 97-acre parcel to a multi-benefit wastewater polishing wetland. Future phases may include construction of polishing wetlands in the parcels the south of the plant and partnerships with duck clubs to construct temporary freshwater wetlands to build peat (elevation) and prepare for future tidal restoration.

OPTION 1

Convert one or more of the effluent holding ponds in the northwest area of the plant to a train of ponds or segmented sections optimized separately for ecological enhancement and nutrient removal. These holding ponds are currently underutilized and could be repurposed to achieve multiple benefits. The train of ponds could provide a valuable recreational opportunity in an underserved area with minimal access to parks. This could include wildlife viewing opportunities as well as educational components including signage describing the design and purpose of each pond. The series could include 1-2 unvegetated ponds optimized for nutrient and contaminants of emerging concern (CEC) removal and 1-2 vegetated ponds optimized for waterbird habitat.

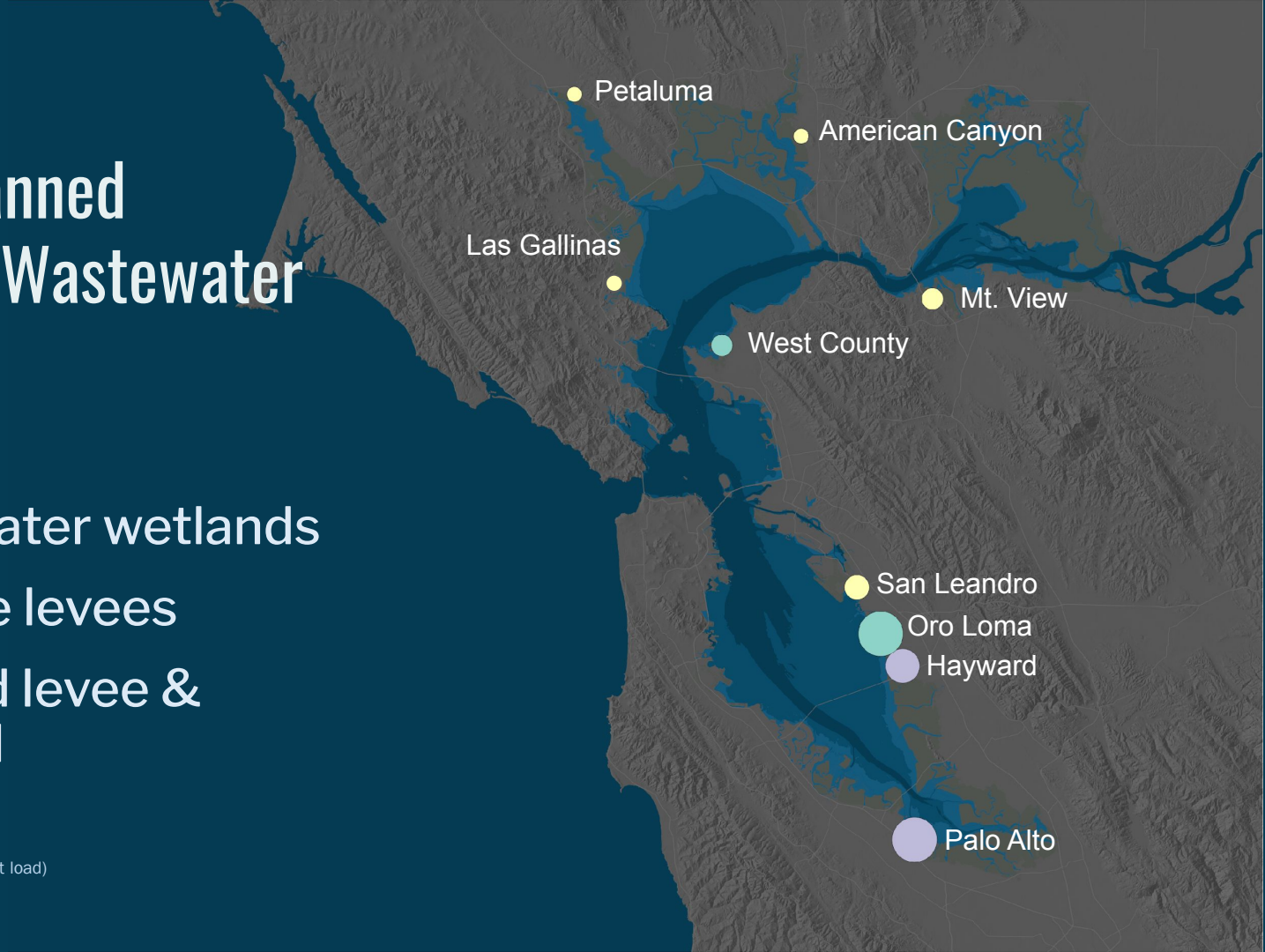


Example concept sketch demonstrating Option 1.
The open water treatment cell on the left is optimized for denitrification - with woodchip seepage slopes and baffles to minimize hydraulic short-circuiting. The pond on the right is a vegetated open water wetland with a habitat island. A trail with educational signage (purple dotted line) surrounds the two ponds.

Existing or Planned Nature-based Wastewater Treatment

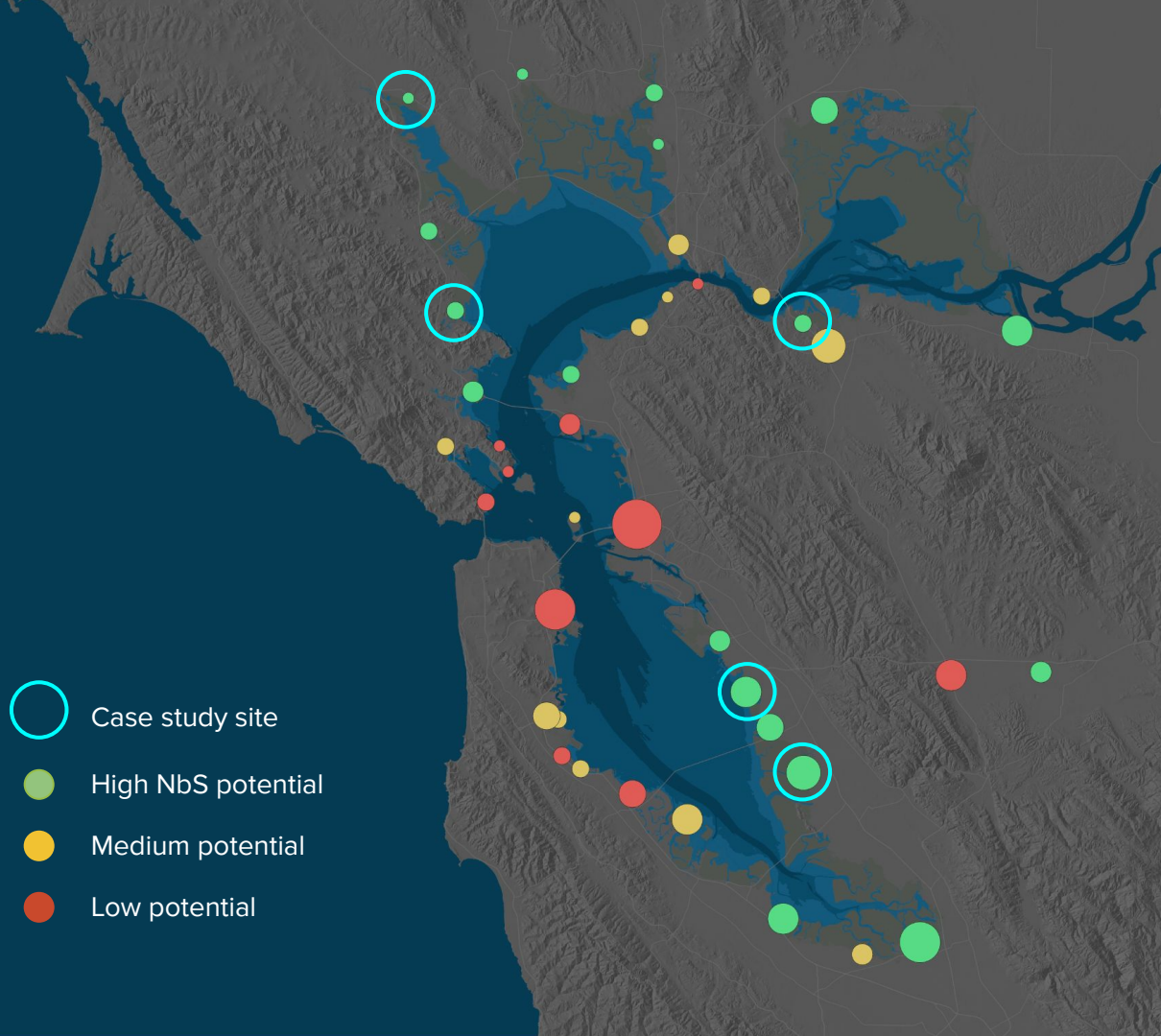
- Open water wetlands
- Ecotone levees
- Planned levee & wetland

(circles scaled to nutrient load)



Case Studies

1. Union San / Hayward Marsh
2. Petaluma
3. Las Gallinas
4. Mt. View
5. Oro Loma



Lessons Learned

- Interest in implementation where opportunities are greatest
- Internal champions are necessary
- Currently in a time of abundance for funding (short window)
- Wetland mitigation requirements the key regulatory issue
- Greatest opportunities lie in the conversion of EQ basins for dual-use & under-utilized upland spaces

Lessons Learned

- **Regional reductions at near-plant sites (individual actors) can likely yield 10-20% load reductions, on a regional scale**
- **Did not consider opportunities for trading/sub-regional cooperation**
- **Did not consider land application & irrigated agriculture**

THANK YOU

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