









Native American Migration











San Francisco Estuary Institute

- Clean Water
- Resilient Landscapes
- Environmental Informatics
- Science Communications



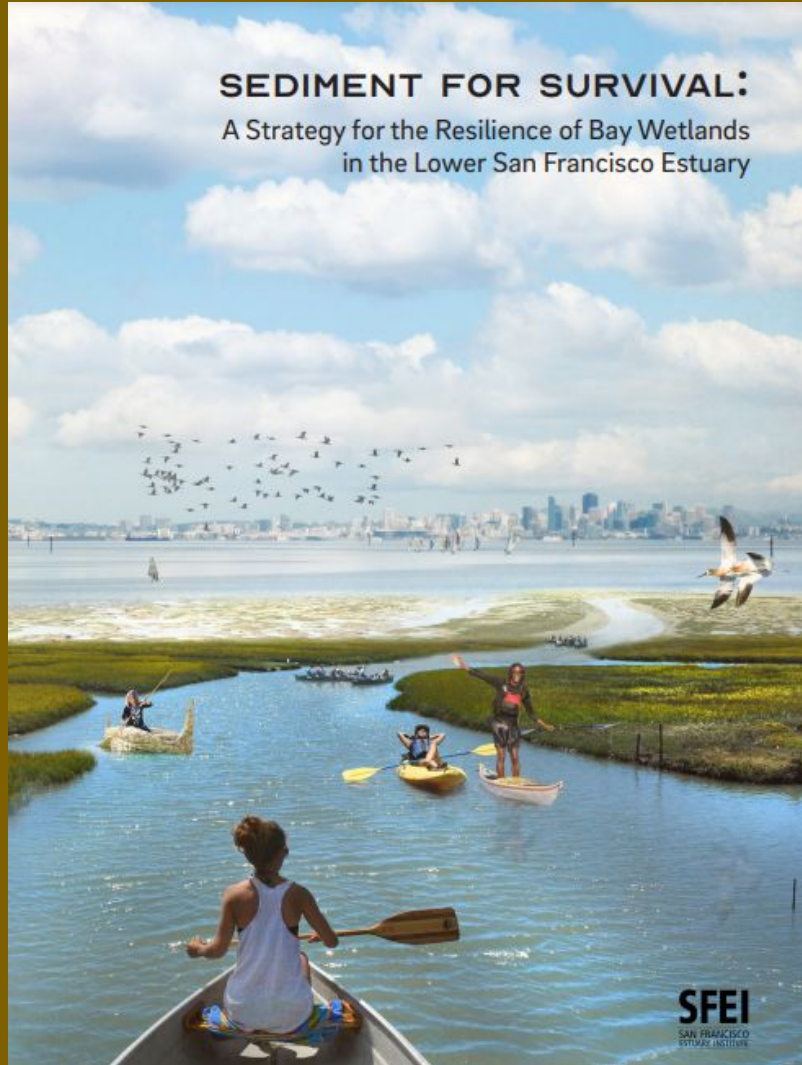


S.F. Bay Water Quality

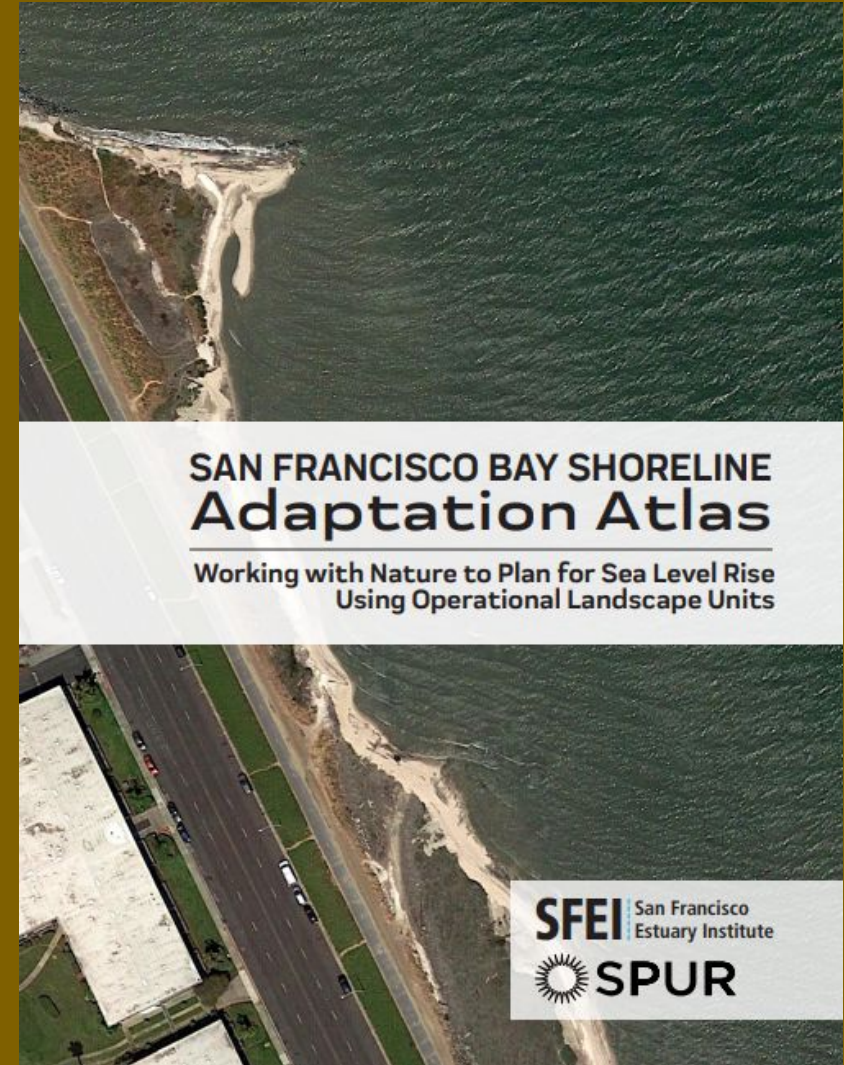


Nutrients & Algal Blooms

SFEI Reports



[Report PDF](#)



[Report PDF](#)

Needed Sediment: 477M Cubic Yards

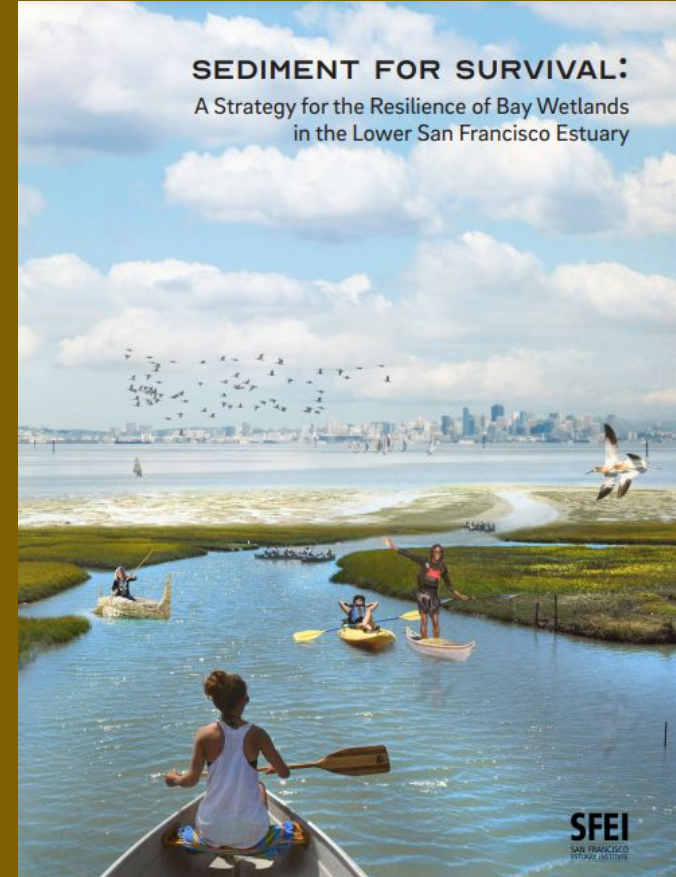
VOLUME OF SEDIMENT
NEEDED FOR TIDAL WETLANDS
AND MUDFLATS BY 2100

Amount of sediment that can be
supplied by nature and current
management approaches

The sediment need that could be met by
changing management practices to access
more in-bay and watershed sediment

SEDIMENT FOR SURVIVAL:

A Strategy for the Resilience of Bay Wetlands
in the Lower San Francisco Estuary



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SAN FRANCISCO
ESTUARY ECOSYSTEM
INSTITUTE

San Jose Mercury News



Photograph by Shira Bezael (SFEI)

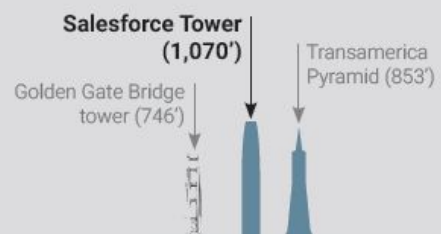
VOLUME COMPARISON

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AMOUNT OF SEDIMENT NEEDED

HEIGHT **1,089** feet
RADIUS **3,036** feet
VOLUME **477,000,000** cubic yards



SALESFORCE TOWER (San Francisco)

HEIGHT **1,070** feet
VOLUME **711,000** cubic yards



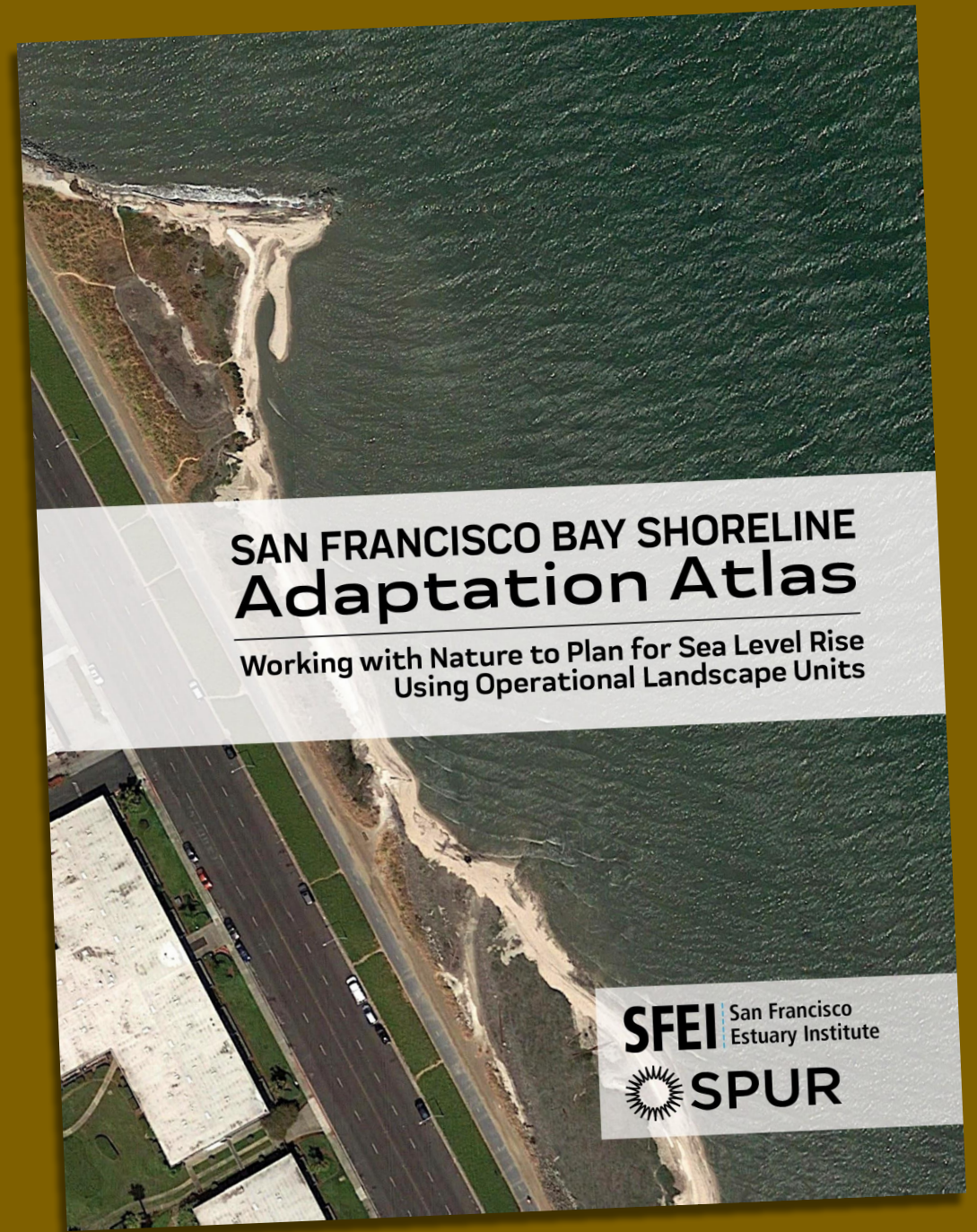


Natekaufman@berkeley.edu

S.F. Bay Shoreline Adaptation Atlas

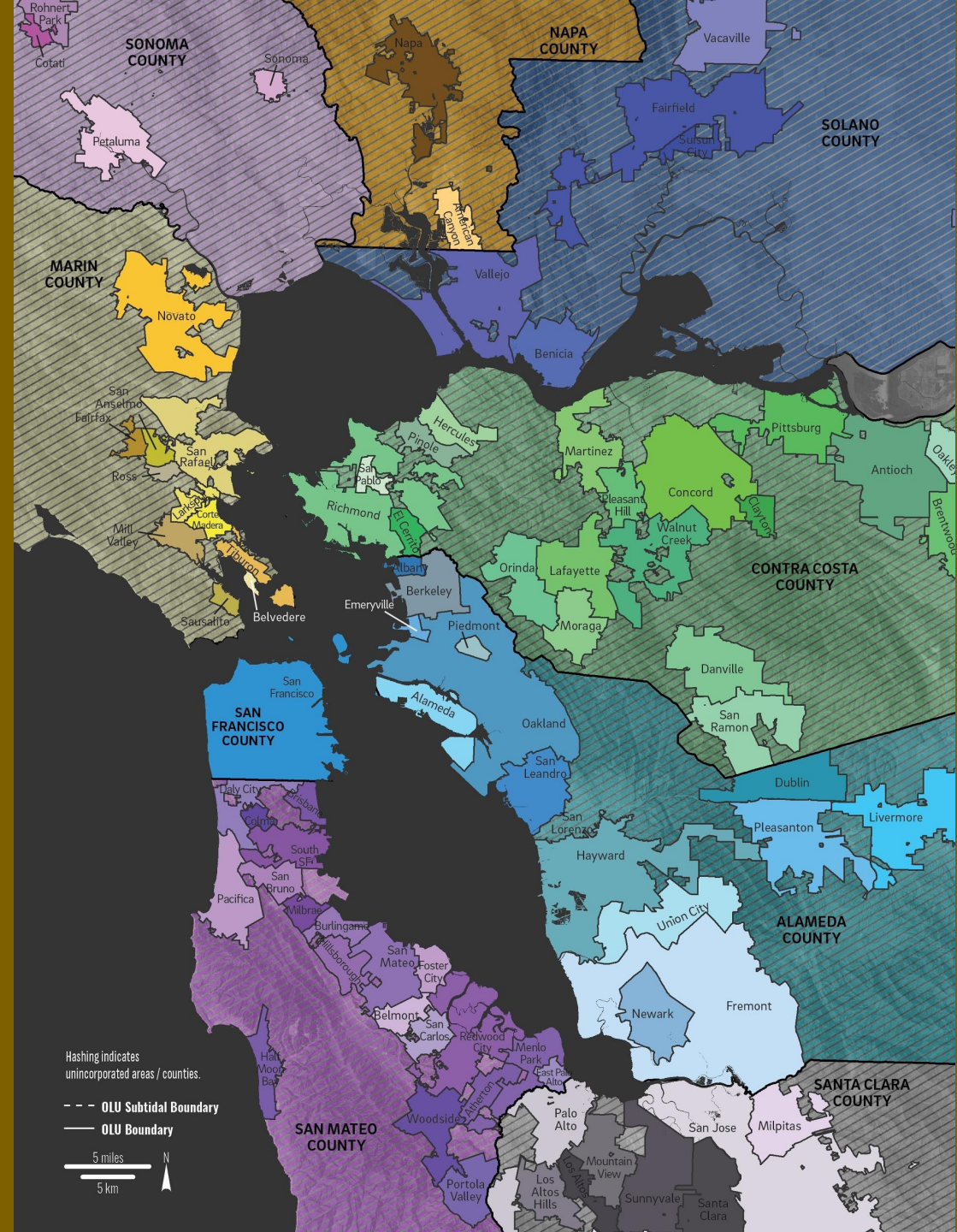
Nature-based science for
climate adaptation

Report PDF



Bay Area Jurisdictions

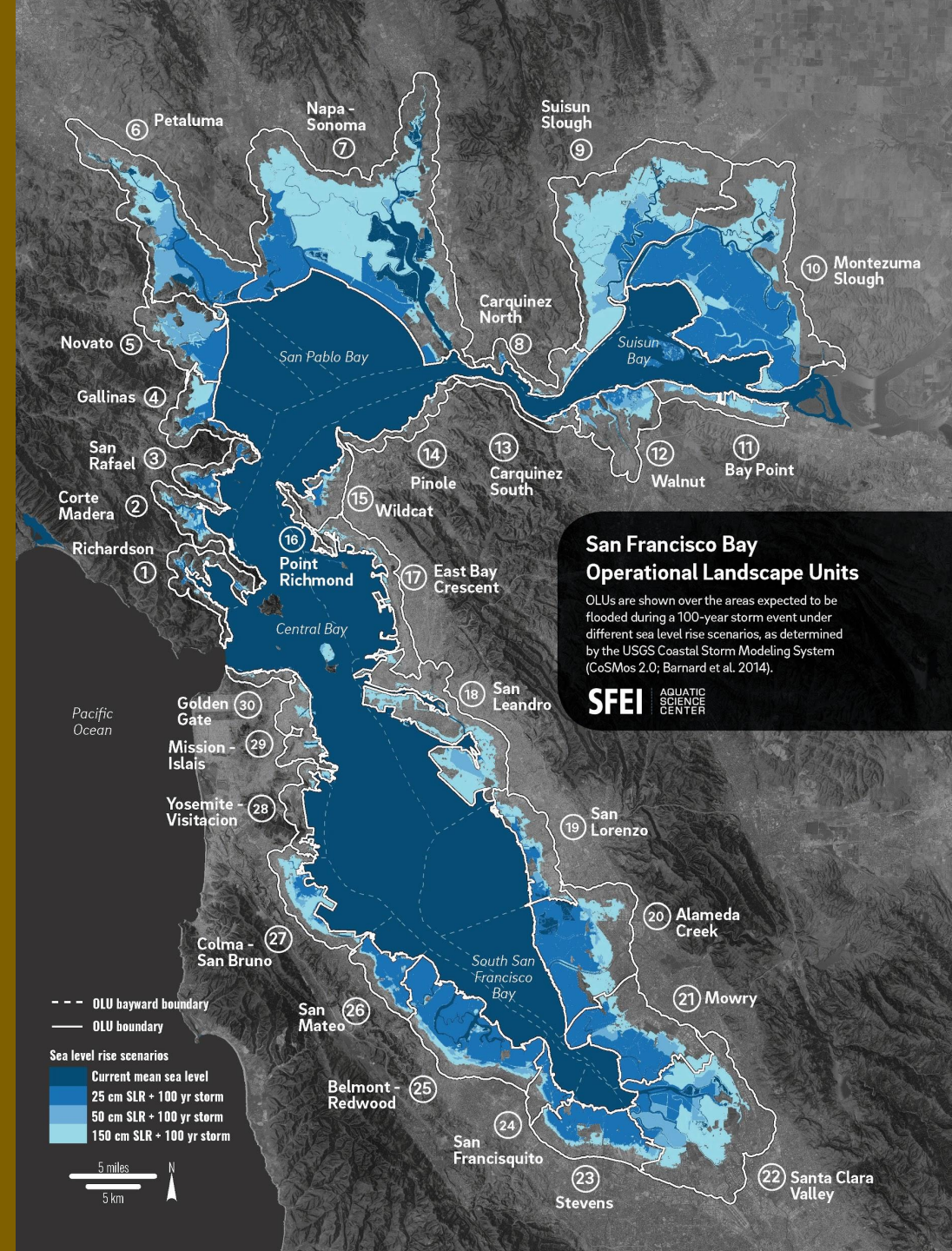
- 9 counties
- 101 cities
- Multiple special districts
- Regulatory jurisdictions
- Frontline communities in low-lying areas



Nature's Boundaries

Operational Landscape Units

Areas with shared geophysical and land use characteristics suited for a particular suite of nature-based measures

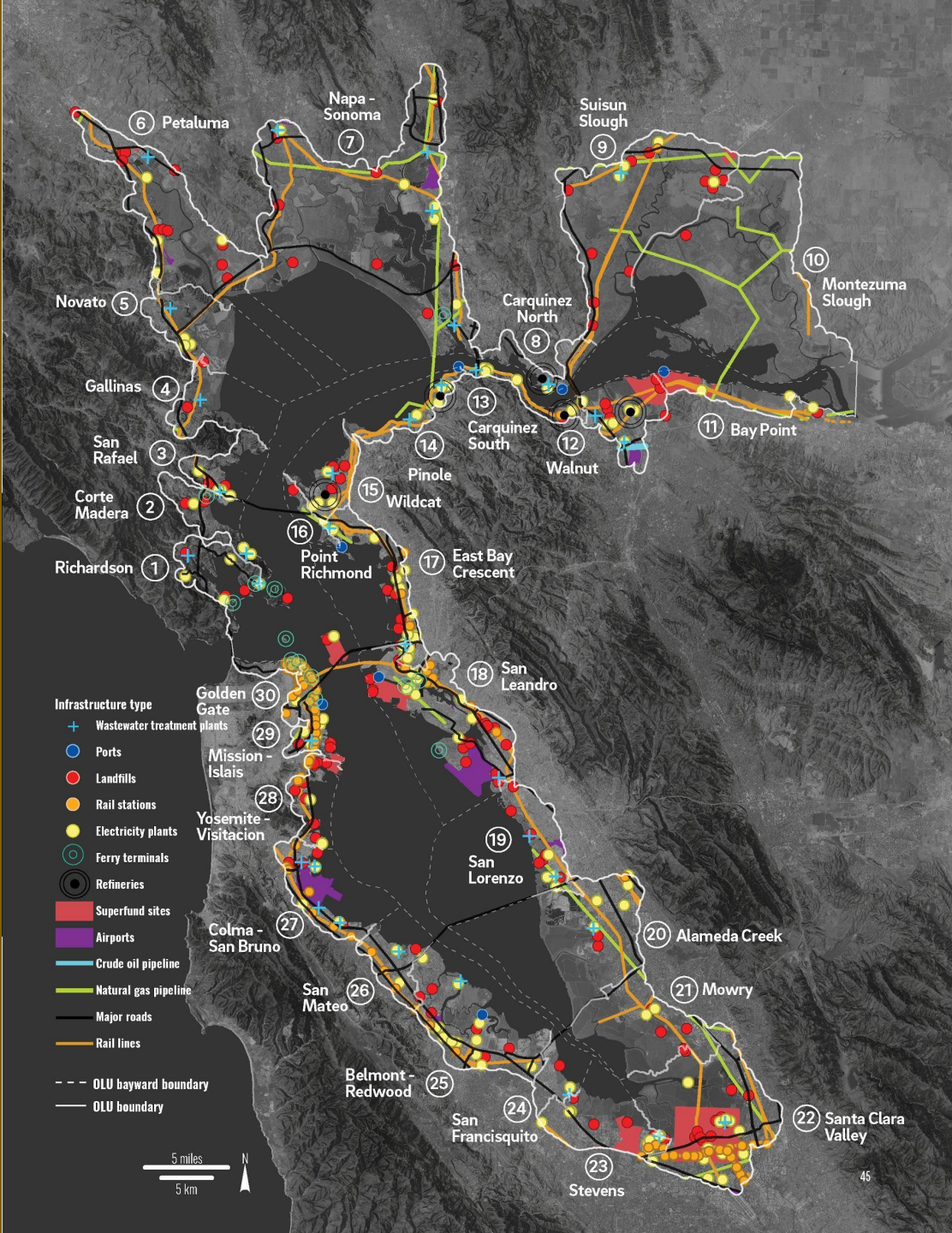


Operational Landscape Units



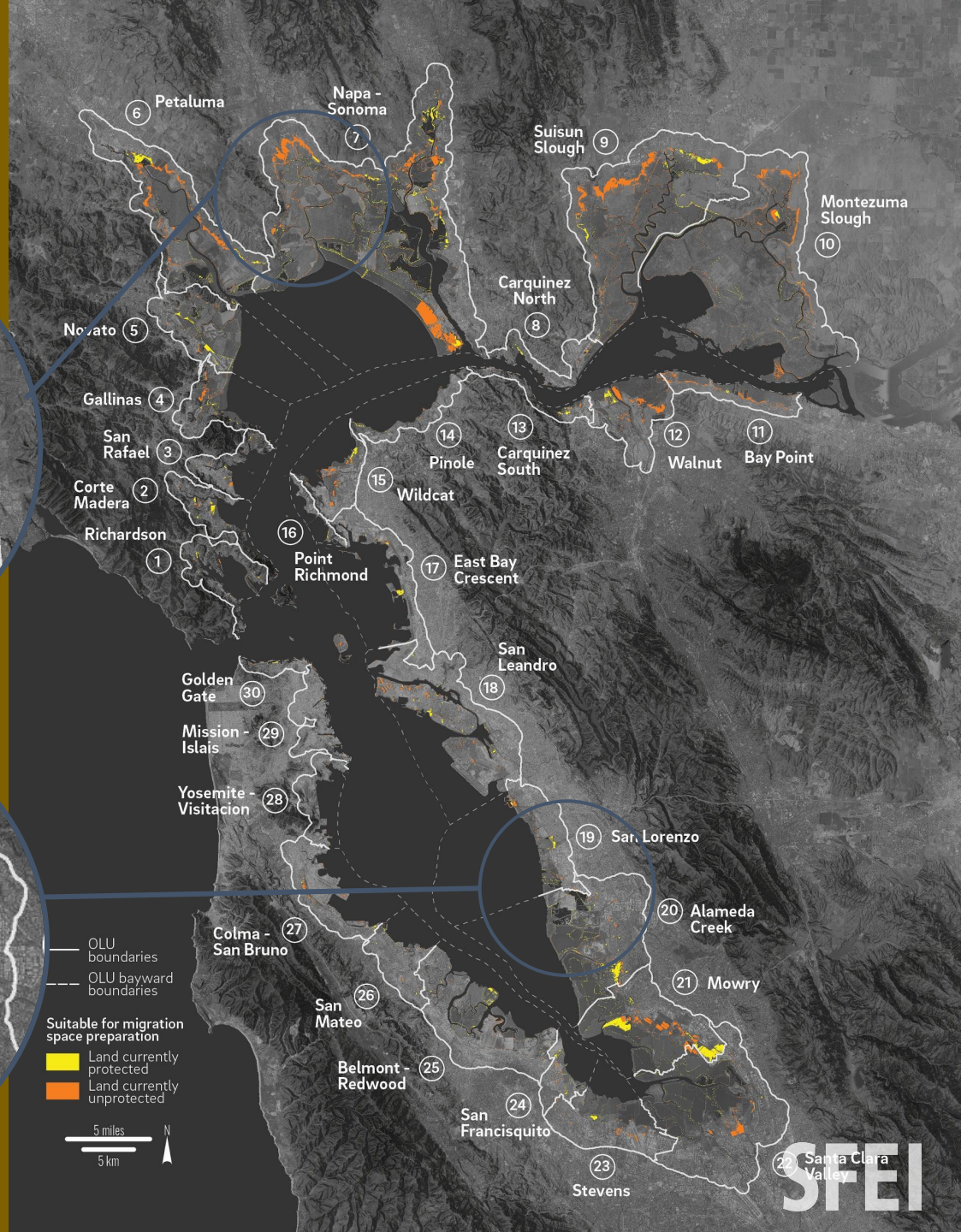
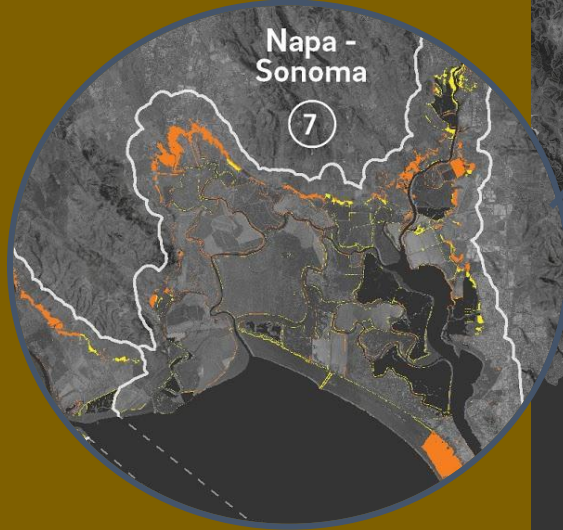
Selected infrastructure

- Ports
- Landfills
- Airports
- Pipelines
- Wastewater plants



Migration space

 Protected
 Unprotected



Adaptation measures

Nature-based




- **Nearshore reefs**
- **Beaches**
- **Tidal marshes**
- **Ecotone levees**
- **Migration space preparation**
- **Creek-to-bayland reconnections**
- **Green stormwater infrastructure**







































































Regulatory & policy

- **Zoning**
- **Setbacks, buffers,**
- **Building codes**
- **Rebuilding restrictions**
- **Conservation easements**
- **Tax incentives**
- **Geologic Hazard Districts**
- **Buyouts**

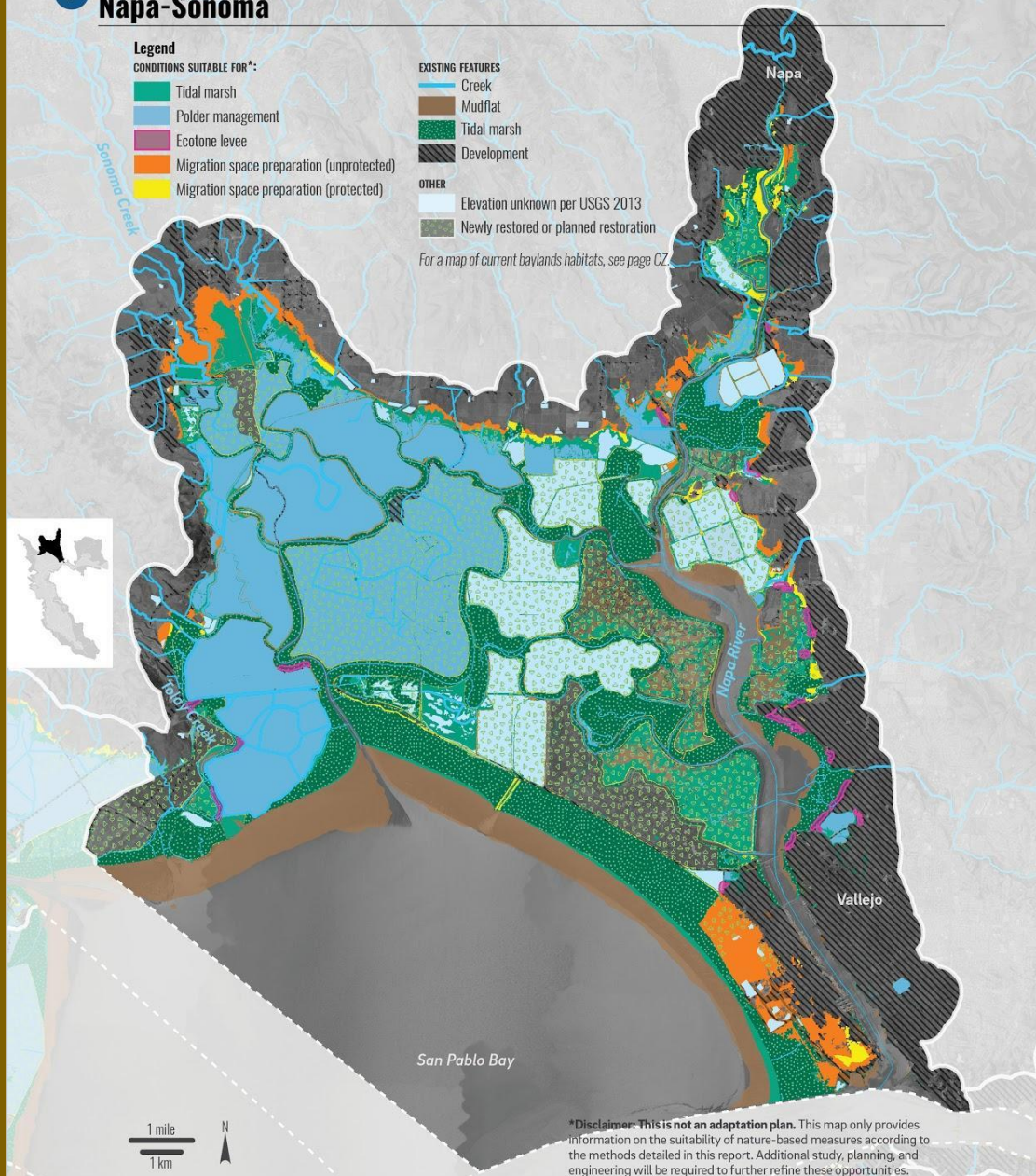
Suitability of nature-based measures

Suitability Rating

-  Limited suitability
-  Some suitability
-  High suitability

| | Nearshore reefs (p. 66) | Submerged aquatic vegetation (eelgrass) (p. 68) | Beaches (p. 72) | Tidal marshes (p. 76) | Polder management (p. 80) |
|----------------------|---|---|---|---|---|
| 1. Richardson |  |  |  |  |  |
| 2. Corte Madera |  |  |  |  |  |
| 3. San Rafael |  |  |  |  |  |
| 4. Gallinas |  |  |  |  |  |
| 5. Novato |  |  |  |  |  |
| 6. Petaluma |  |  |  |  |  |
| 7. Napa - Sonoma |  |  |  |  |  |
| 8. Carquinez North |  |  |  |  |  |
| 9. Suisun Slough |  |  |  |  |  |
| 10. Montezuma Slough |  |  |  |  |  |
| 11. Bay Point |  |  |  |  |  |
| 12. Walnut |  |  |  |  |  |
| 13. Carquinez South |  |  |  |  |  |
| 14. Pinole |  |  |  |  |  |

7 NATURE-BASED ADAPTATION OPPORTUNITIES MAP
Napa-Sonoma



7 NAPA - SONOMA

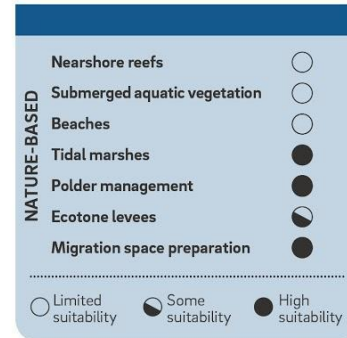
Nature-based Adaptation Measures

In the Napa-Sonoma OLU there has been significant landscape-scale marsh restoration in areas such as the Napa-Sonoma Salt Ponds and along the Napa River. There are considerable opportunities to restore large connected patches of tidal marsh in the remaining diked baylands closer to Sonoma Creek. Road and rail corridors that cross the marshes are considerable constraints to the restoration of the marshes; they need existing levees to protect them from flooding, their creek crossings are narrow, and the levee barriers across the wetland-upland transition zone. All of the existing levees are in need of repair and the migration space for the marsh to move upland as sea level rises. The majority of migration space opportunity is on unprotected land, much of it being managed as vineyards. Acquiring and protecting these areas will be key to the success of the new wetlands. Existing tidal marsh is adjacent to the creeks and is disconnected from undeveloped migration space by large and deep polders such as Skaggs Island. If raised in intertidal elevations, these polders could be converted to tidal marsh. In some areas, raising the polders and realigning the shoreline may be more feasible. Significant opportunities exist to improve the delivery of freshwater, nutrients, and sediment from Sonoma Creek and the Napa River to build better elevation capital closer to upland in these subsided baylands, and to reduce flooding issues. There are also opportunities for widening the bridge crossings at Sonoma Creek and Tolay Creek if Highway 37 is raised on some combination of embankment and pilings. Ecotone levee creation is less critical in this OLU due to limited presence of development in need of protection, but ecotone levees could be incorporated into the design of embankments to raise Highway 37 or the railroads.

Other Adaptation Opportunities

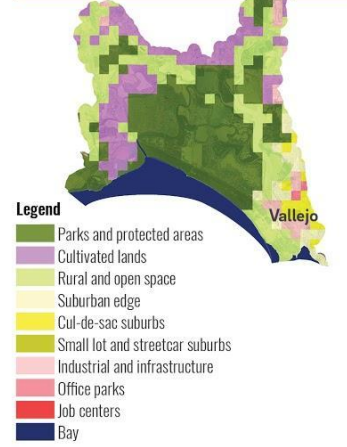
Like Petaluma, the very large Napa-Sonoma OLU—by far the largest of all OLUs—is comprised of 85% rural and open space uses, predominantly agriculture. This makes it a good candidate for adaptation measures that allow flooding to occur and that facilitate transition from recreational and agricultural uses to habitat or other uses. Adaptation transitions could include zone acquisition, and realigning public access. This OLU is not a good place to intensify development or to harden the shoreline; rather, should be managed to increase nature-based solutions. A few other adaptation transitions could include conservation easements or voluntary buyouts. For the suburban areas of the OLU that may experience sea level rise further in the future, buyouts, relocation, and other measures could be suitable alternatives to relocation or voluntary buyouts, depending on what the community wants to do. Elevating Highway 37 to allow tidal action to pass under it could significantly support the large areas of restoration possible in this OLU.

Elevating roadways



Aerial view looking downstream of the Napa River towards the Napa-Sonoma baylands (Photo by WineCountry Media, CC BY 2.0)

Place Types Map







FEAR

HOPE

Triple Challenge

- Sea Level Rise
- Groundwater
- Lowland Flooding



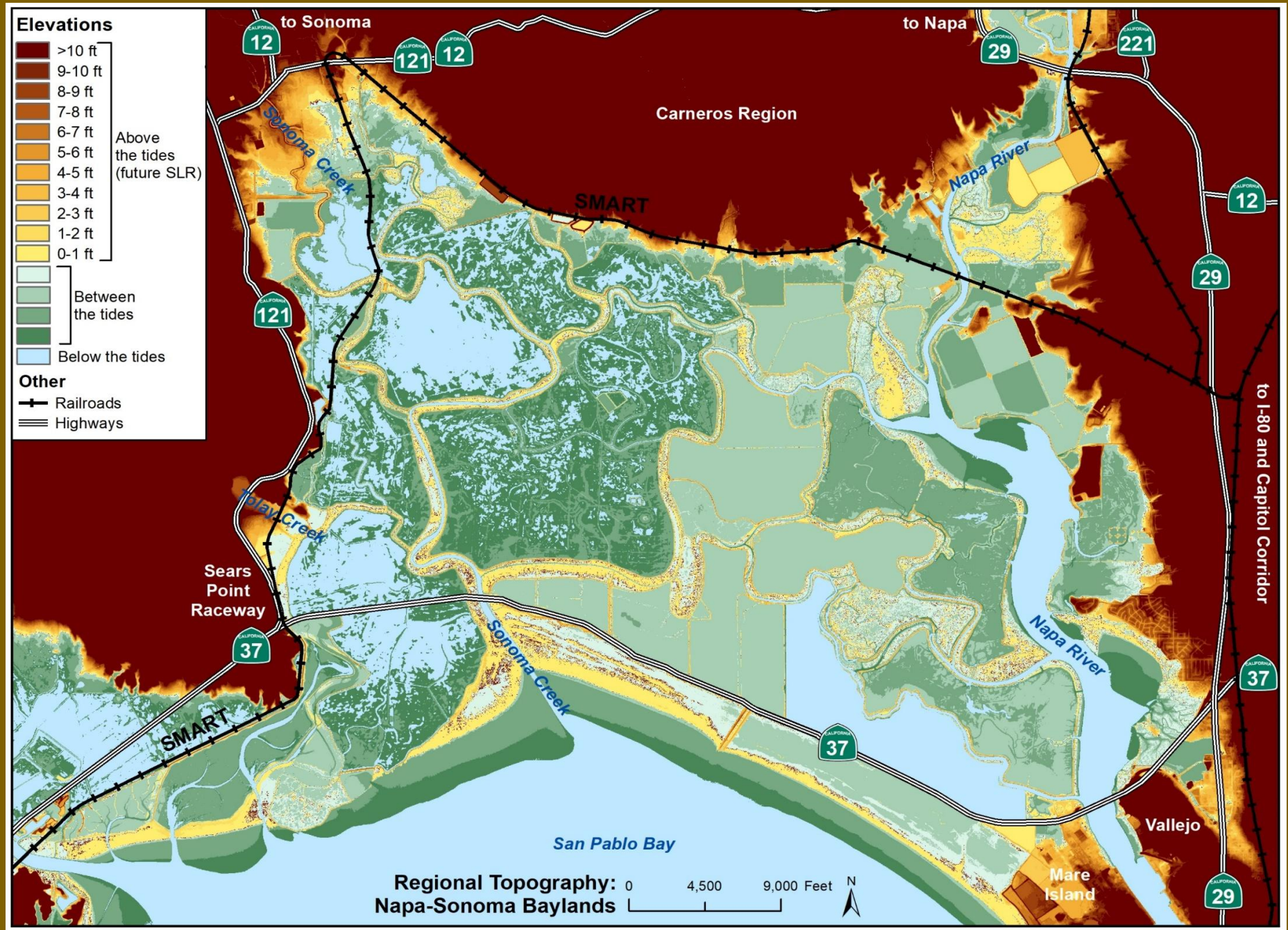
Hwy 37 Novato to Vallejo



Hwy 37

Nature-based Solutions...

...Integrated vs. Mitigation



The “\$110 Billion” Report

Sea Level Rise Adaptation Funding and Investment Framework

Report PDF



Sea Level Rise Adaptation Funding and Investment Framework Final Report

Metropolitan Transportation Commission / Association of Bay Area Governments
and the San Francisco Bay Conservation and Development Commission

July 2023

Adaptation Needs by 2050

\$110 Billion

- \$52B: Planned Projects
- \$54B: Estimated Projects
- \$3B: Sediment Needs

Assets at Risk

\$236 Billion

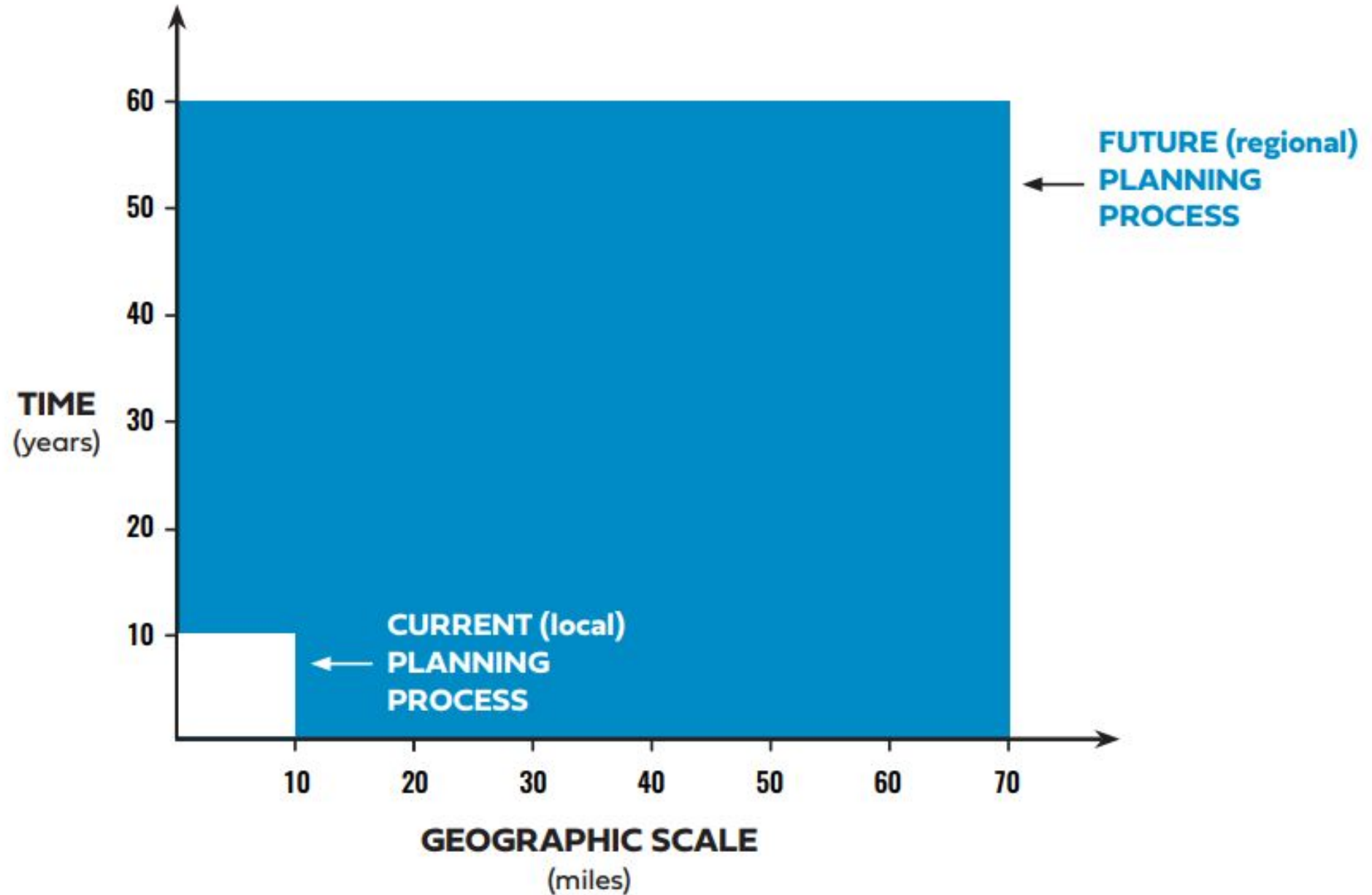
- \$85B: Parcels
- \$151B: Roadways

- [The Inventory Map: What & Where](#)
- [The Technical Report: Assumptions & Methods](#)





Adaptation Planning



ARCCA

Alliance of Regional Collaboratives for Climate Adaptation



Funding Sources



| Grant Program | Organization | Category | Description |
|--|--|---|--|
| <input type="checkbox"/> Grant program ▼ | Organization ▼ | Category ▼ | Description ▼ |
| 11 Climate Pollution Reduction Implementation Grants (Phase 2) | Environmental Protection Agency (EPA) | <ul style="list-style-type: none"> Air Quality Climate resilience Climate justice | The Climate Pollution Reduction Grants (CPRG) program will provide grants to states, local governments, tribes, and territories to develop and implement plans for reducing greenhouse gas emissions and other harmful air pollution. EPA... |
| 12 Measure AA Grant Rounds | San Francisco Bay Restoration Authority | <ul style="list-style-type: none"> Coastal resilience Conservation / restoration Climate resilience Waste | The San Francisco Bay Restoration Authority is a regional government agency whose purpose is to raise and allocate funds for the restoration and enjoyment of wetland and wildlife habitat along the San Francisco Bay shoreline. Funds are raise... |
| 13 Community Grants | San Francisco Bay Restoration Authority | <ul style="list-style-type: none"> Climate resilience Coastal resilience Urban greening Water | For the Community Grants Program, we are looking for projects that meet the Measure AA requirements and do the following: -Support community visioning aimed at developing conceptu... |
| 14 Extreme Heat and Community Resilience Grant Program | CA Office of Planning and Research (OPR) | <ul style="list-style-type: none"> Climate resilience Health | ICARP's Extreme Heat and Community Resilience Program coordinates the state's comprehensive response to this climate impact and builds capacity for heat action planning -- creating... |

Funding - Additional Resources

- **ARCCA - Alliance of Regional Collaboratives for Climate Adaptation**
[CA Climate Resilience Grant Program Tracker](#)
- **San Francisco Bay Joint Venture**
[Funding Guide](#)
- **Governor's Office of Planning and Research**
[ICARP – Integrated CA Adaptation and Resiliency Program Grants](#)



Pajaro

79% Yes Vote
For \$1.2M/Yr.

To Leverage \$400M in
State & Federal Funds

Santa Cruz Sentinel
6-9-22



Stockton*

58% Yes Vote for a
\$14 Million Tax

To leverage a
\$1.2 Billion Project

*Property Owners Vote

News Release

6-21-23





LIVE EDGE ADAPTATION PROJECT

This is a constructed wetland. LEAP is an endeavor to provide habitat with dynamic habitat and human spaces in addition to providing an invaluable flood protection infrastructure. Tracing natural systems and processes is a key strategy for future societal resilience to a changing world.

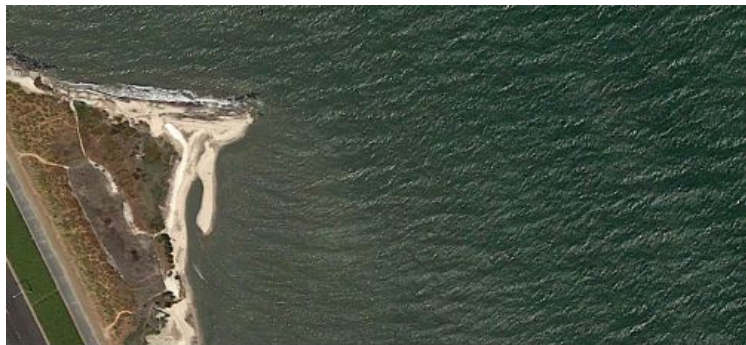




A wide-angle photograph of the San Francisco skyline at dusk. The Golden Gate Bridge is illuminated with warm lights, stretching across the water. The city skyline is visible in the background, with numerous buildings lit up. The sky is a deep blue, and the water is dark. The foreground shows a dark, rocky shoreline.

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SAN FRANCISCO BAY SHORELINE Adaptation Atlas

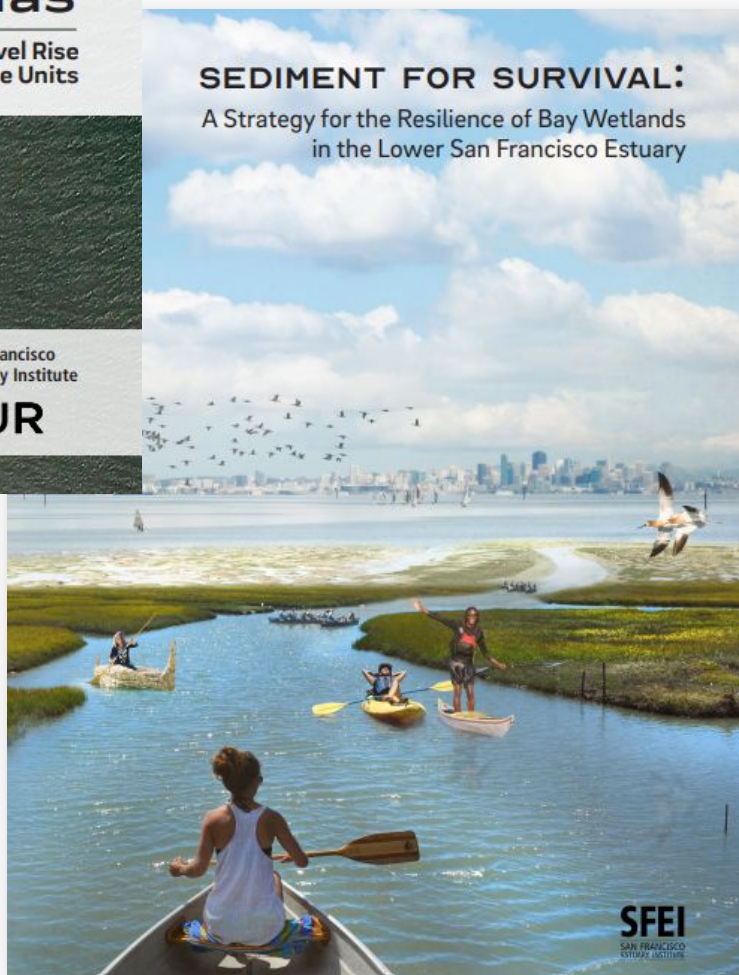
Working with Nature to Plan for Sea Level Rise
Using Operational Landscape Units



SFEI San Francisco
Estuary Institute
 **SPUR**

SEDIMENT FOR SURVIVAL:

A Strategy for the Resilience of Bay Wetlands
in the Lower San Francisco Estuary



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