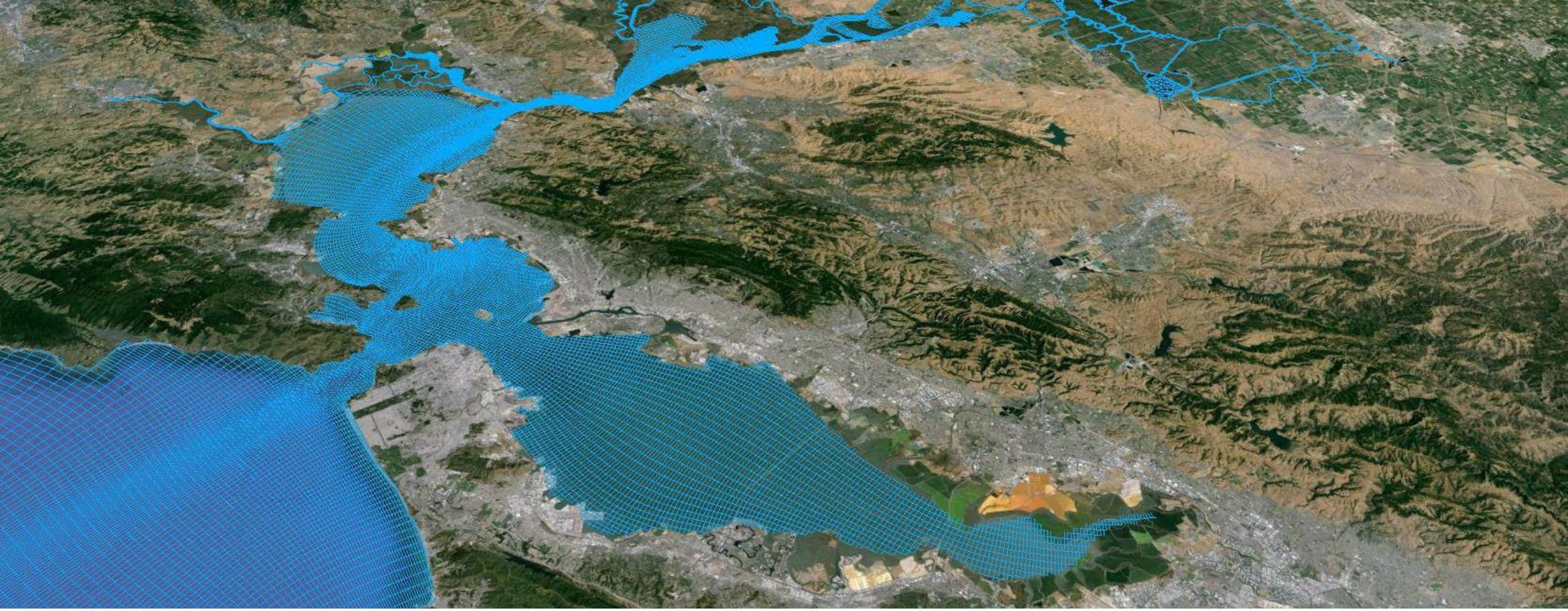
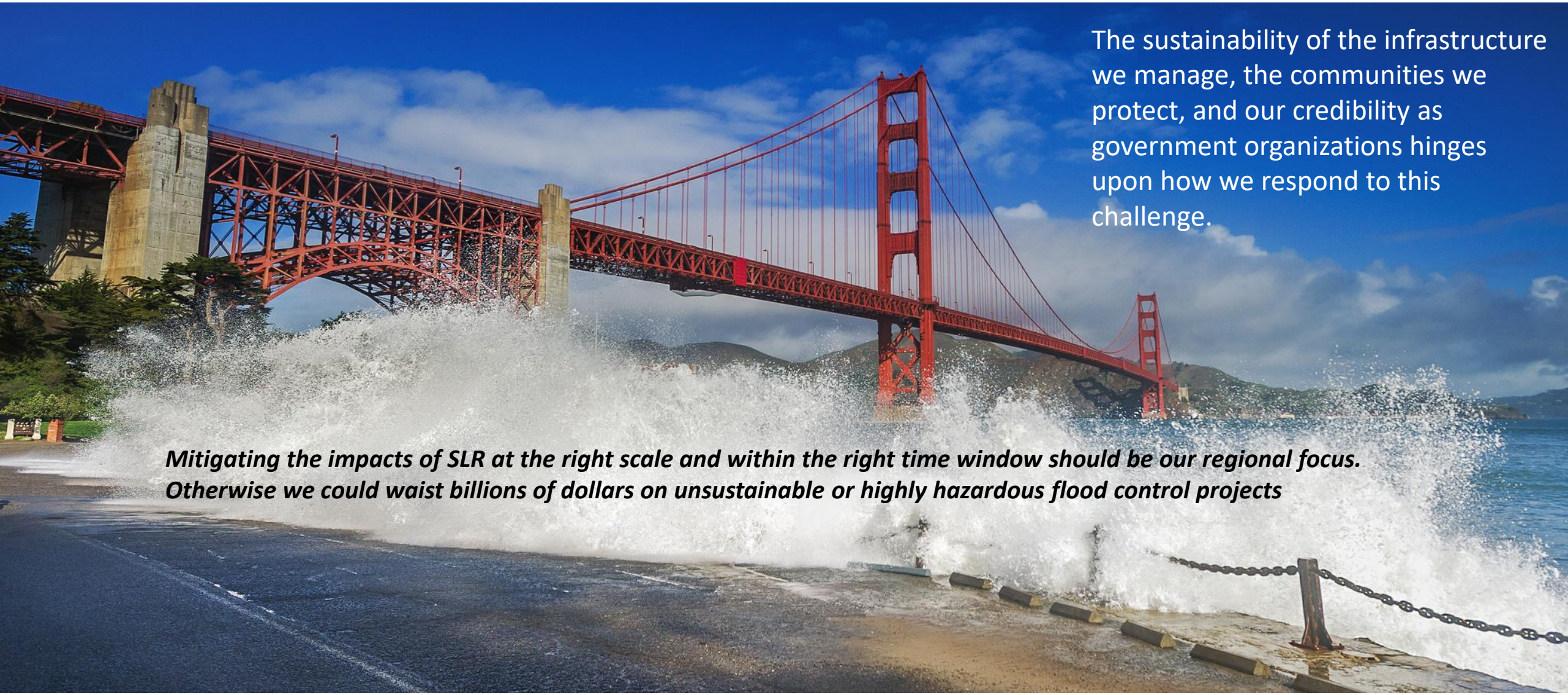
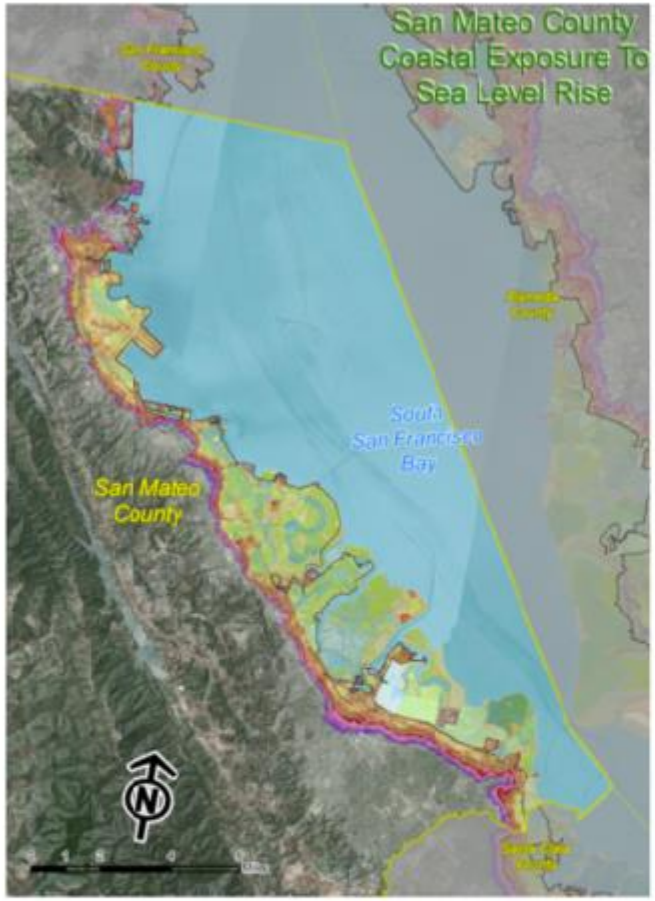


A ‘One Bay Solution’:
Tackling SLR at the Right Scale at the Right Time

Rohin Saleh, ACFCD/CHARG

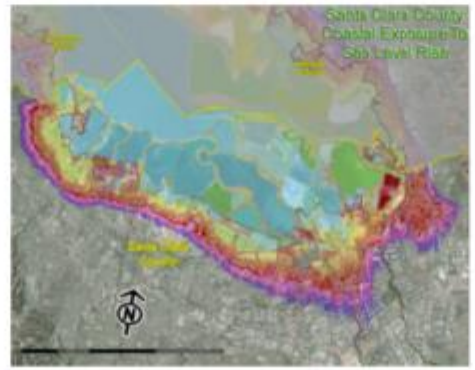
Climate change presents one of the biggest and most complex challenges in our lifetime and for future generations

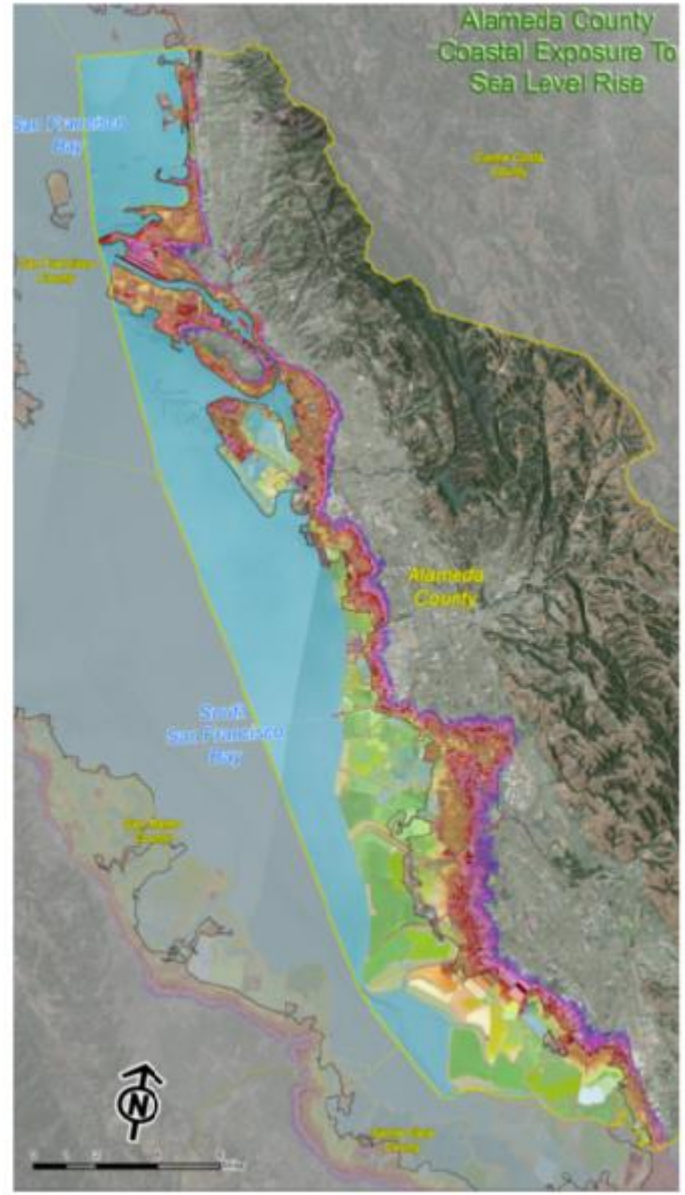




Sea Level Rise Exposure of Currently Urbanized Parts of Bay Area Counties

1-	Alameda	56 m^2
2-	San Mateo	42 m^2
3-	Santa Clara	22 m^2
4-	Contra Costa	17 m^2
5-	Marin	14 m^2
6-	Solano	11 m^2
7-	Sonoma	7 m^2
8-	San Francisco	6 m^2
9-	Napa	5 m^2





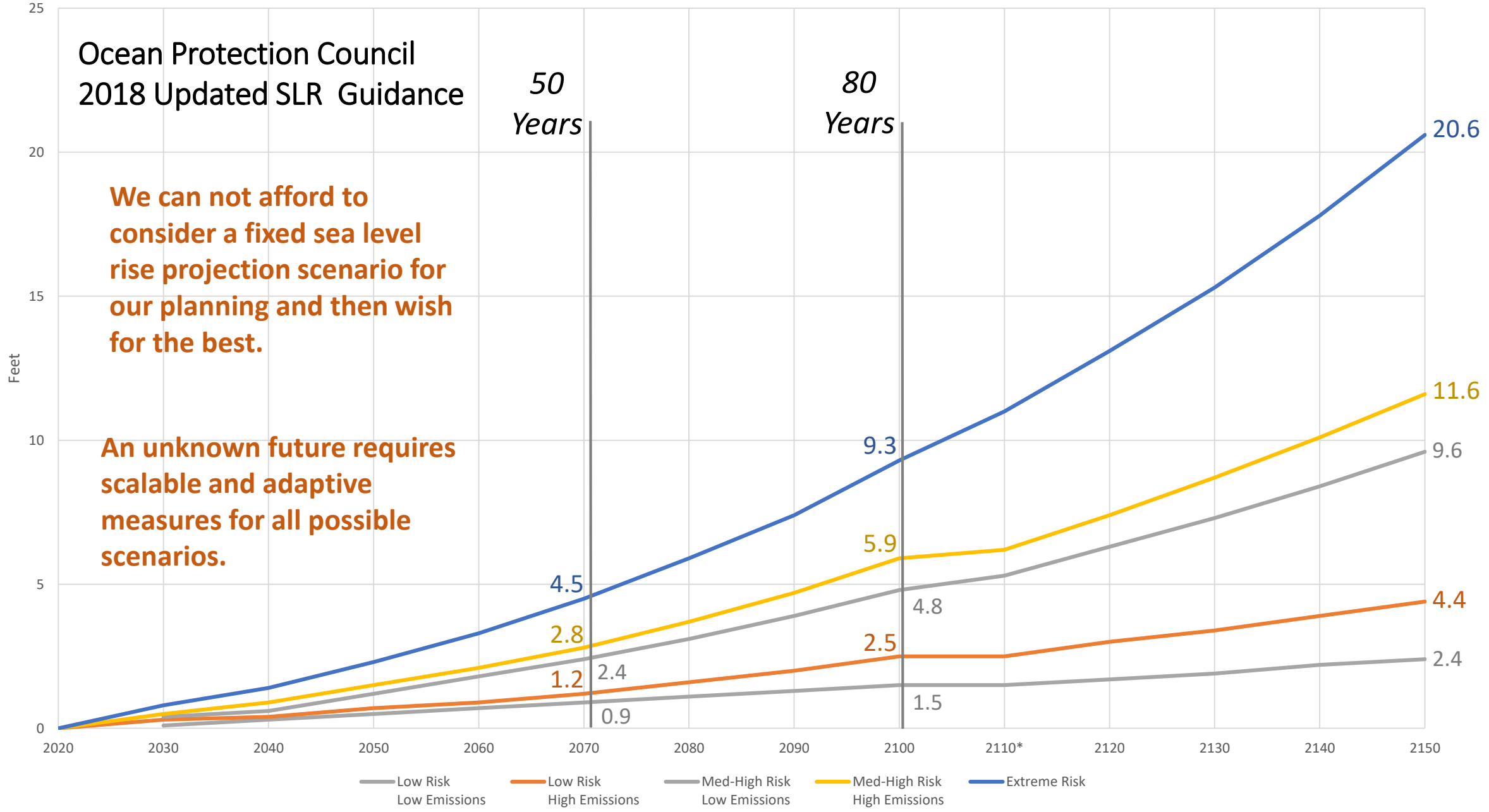
Approximately 180 Sq. miles of similarly urbanized coastal communities are at risk in San Francisco Bay

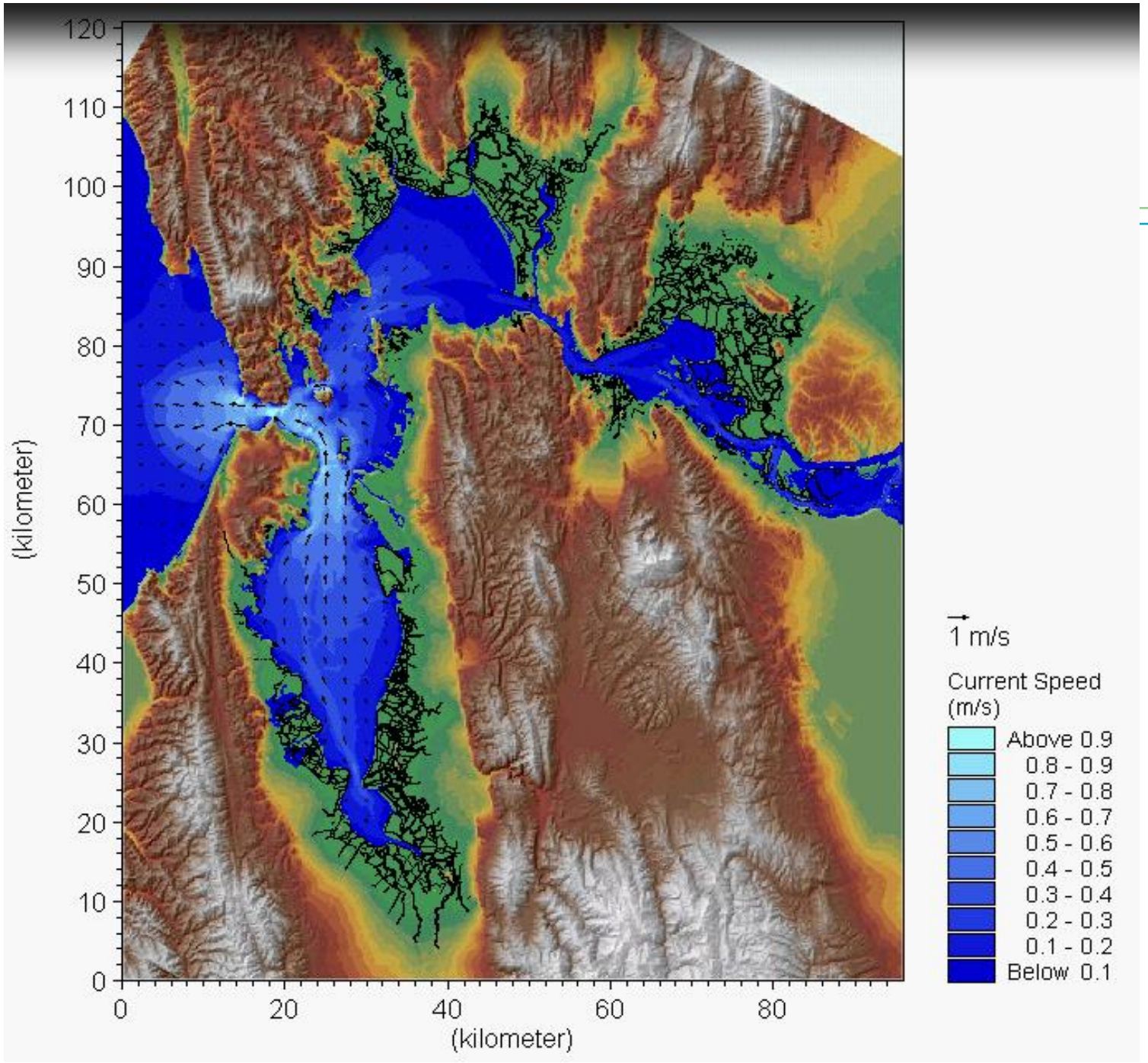
Flood Protection Common Practice in the US

- Most of our rivers and flood control channels are configured or designed to convey a 100 year (1% chance) flood; often there is no consideration for a Plan-B when this threshold is exceeded

- FEMA National Flood Insurance Maps and Studies are based on this guideline

- Nature always breaches this standard eventually and as a result we always have news of flooding and flood damages around the nation


Ocean Protection Council
2018 Updated SLR Guidance
50 Years
80 Years
We can not afford to consider a fixed sea level rise projection scenario for our planning and then wish for the best.
An unknown future requires scalable and adaptive measures for all possible scenarios.
Feet
25
20
15
10
5
0
2020
2030
2040
2050
2060
2070
2080
2090
2100
2110*
2120
2130
2140
2150
20.6
11.6
9.6
4.4
2.4
9.3
5.9
4.8
2.5
1.5
4.5
2.8
2.4
1.2
0.9
Low Risk Low Emissions
Low Risk High Emissions
Med-High Risk Low Emissions
Med-High Risk High Emissions
Extreme Risk



Understanding the Bay Hydrodynamics

Tides from Pacific Ocean enter and leave the Bay during tide cycles approximately twice every 24 hours.

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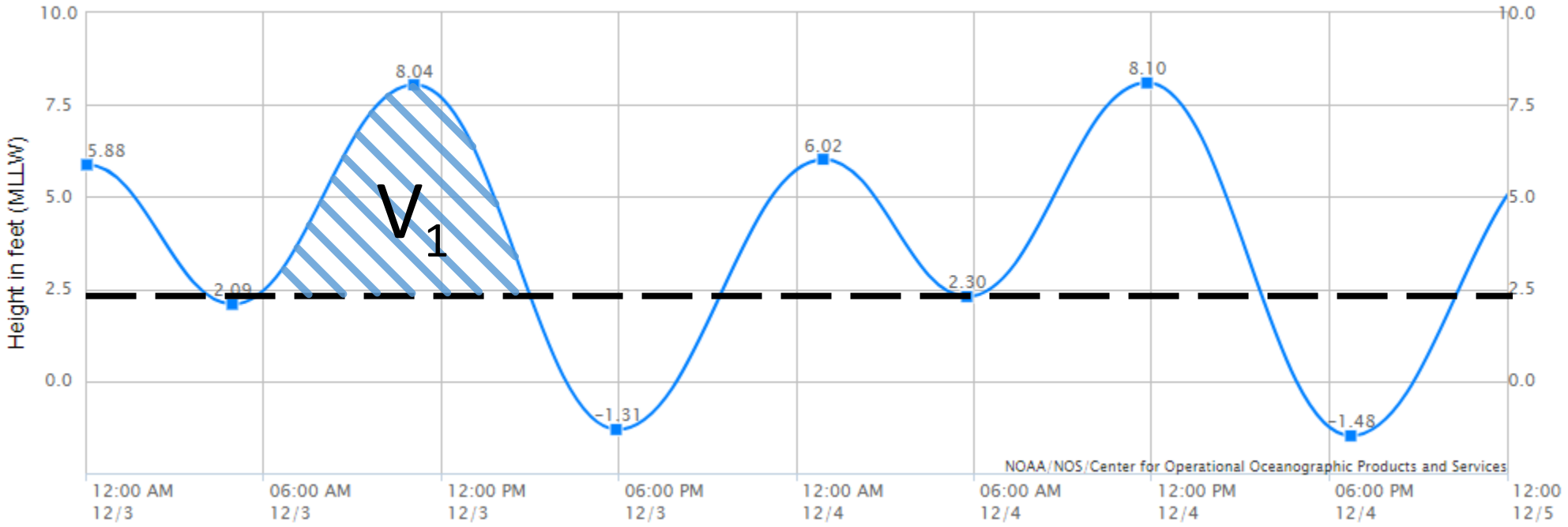
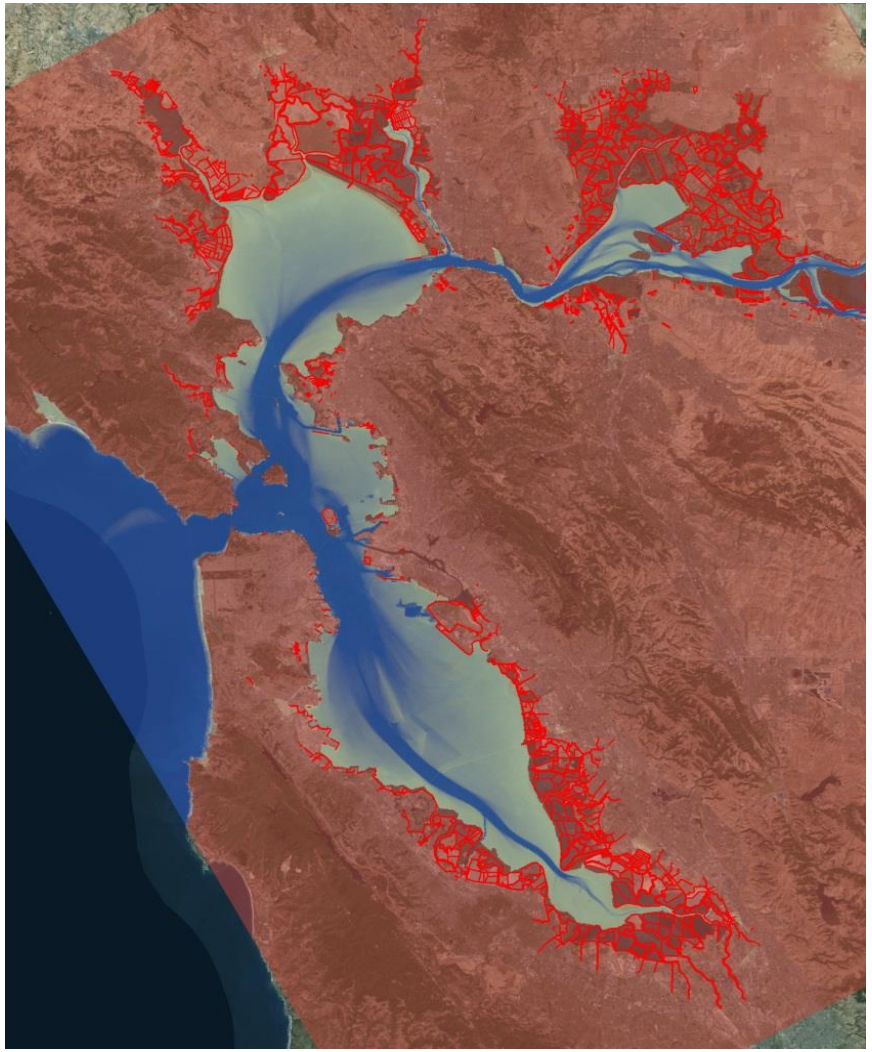
San Francisco Bay daily tide cycles

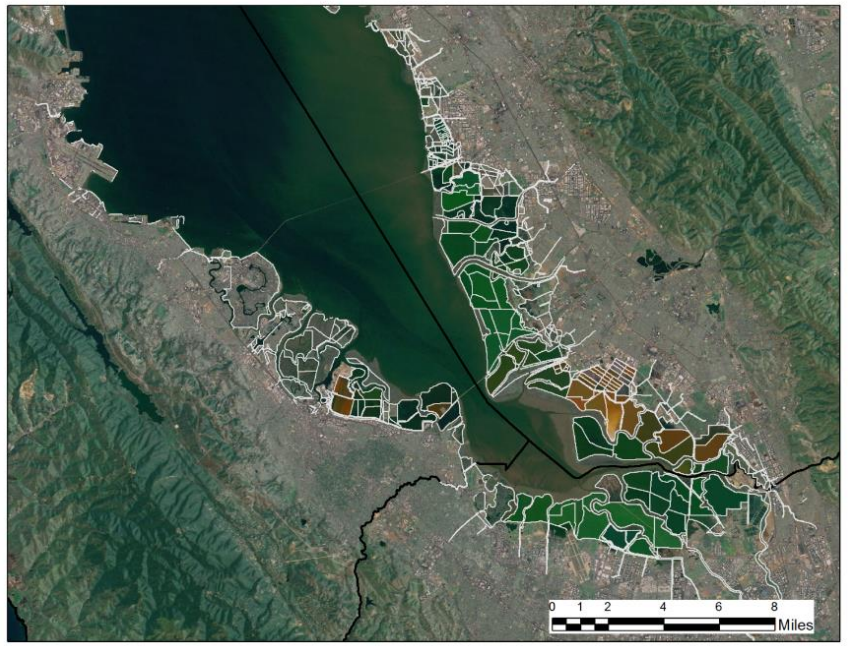


Deep and Shallow extents of the Bay

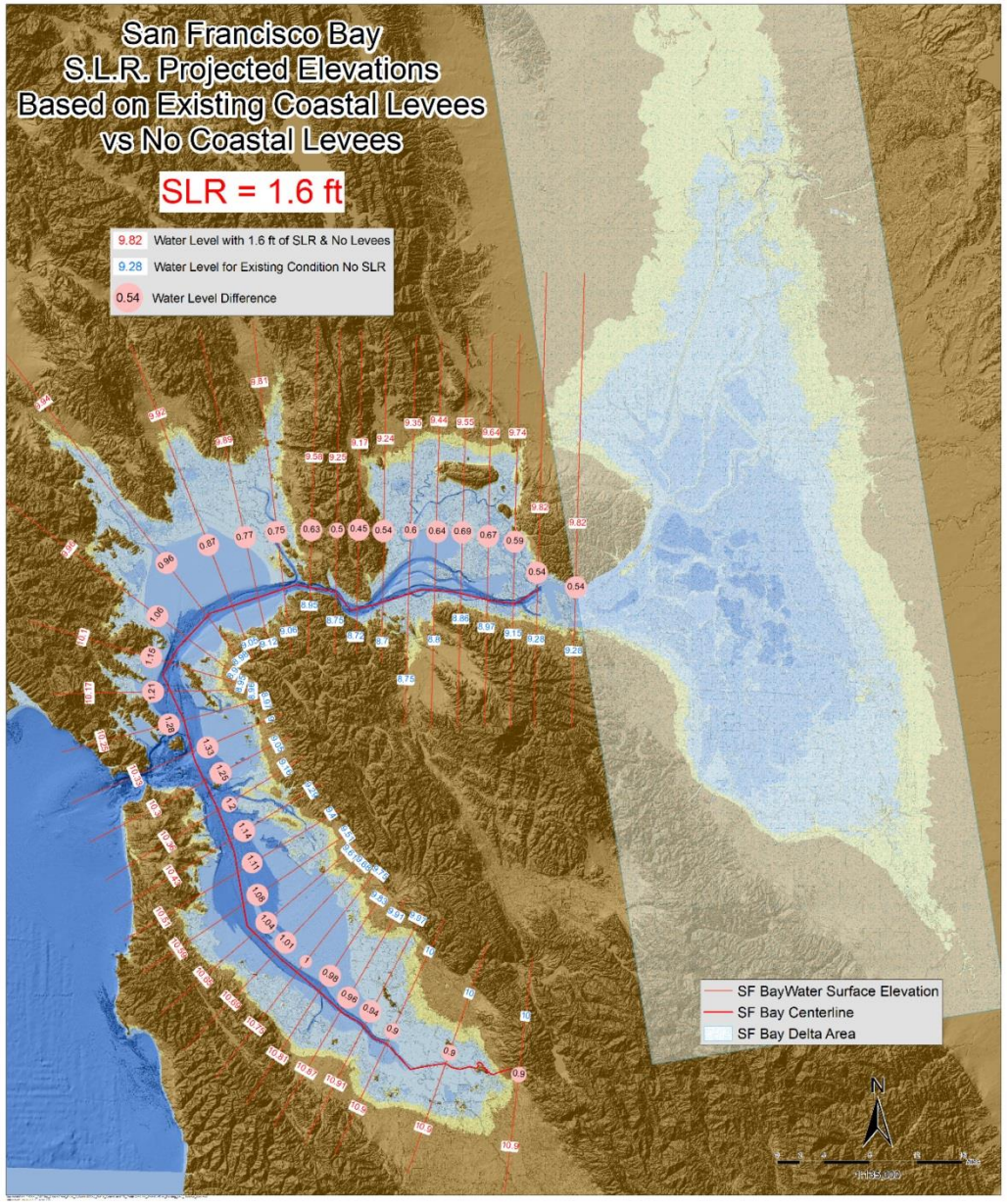


Under existing condition the Bay is generally contained within the deeper blue/light blue region.

Shallow extents of the Bay could provide measurable reductions to the sea level rises if it can be accessed.



Evaluation of Restoration Projects Impacts (1.6 ft. SLR at the Golden Gate)



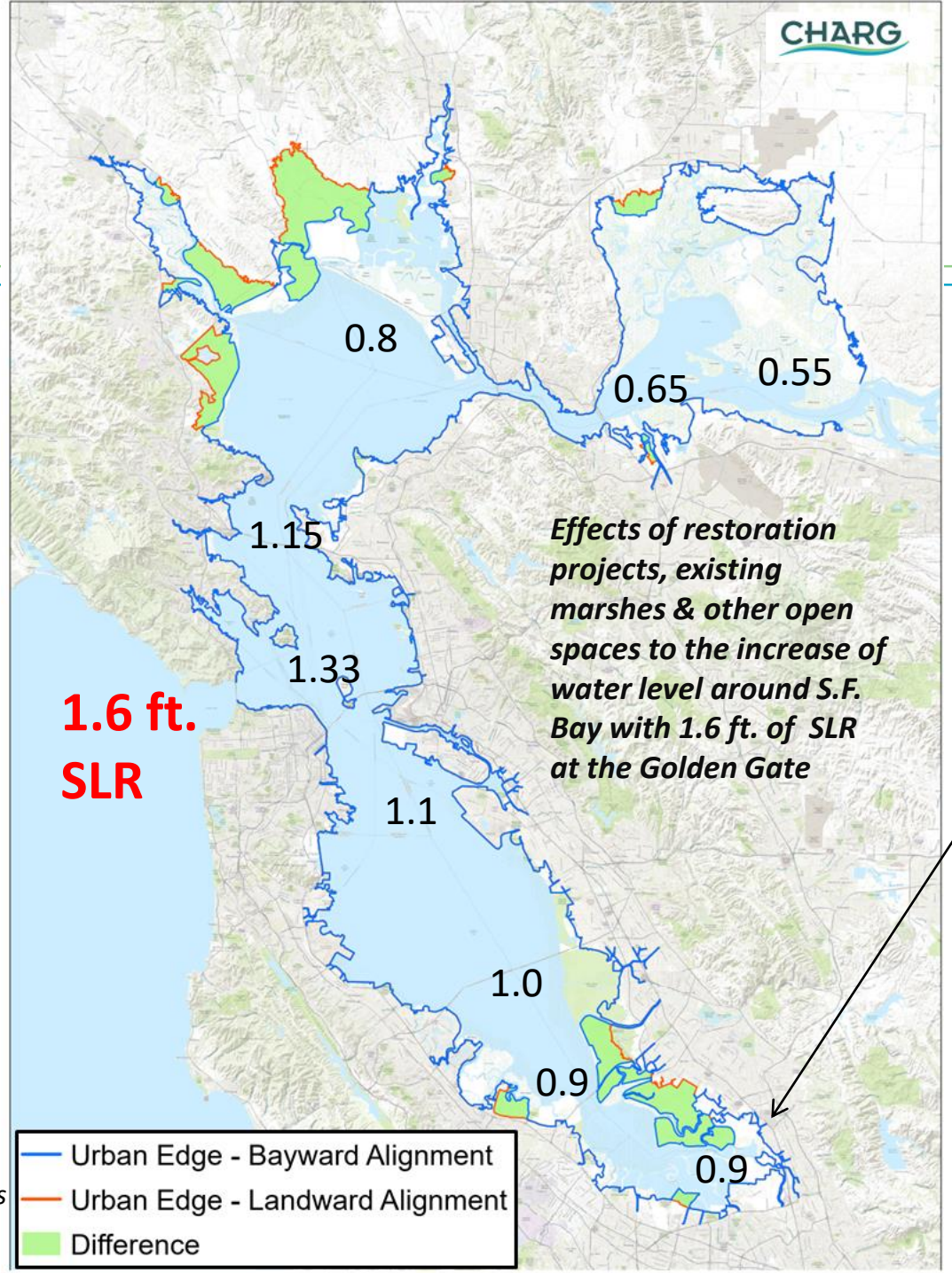
Alameda County Flood Control District has evaluated the effects of restoration projects and its water level reduction benefits due to various sea level rise projection at the Golden Gate.

The evolution was conducted using the FEMA SF Bay Regional Model.

However, the work is subject to additional verifications and the District is currently using DELFT 3D for confirmation.

Green Solutions (1st option)

Effects of restoration projects and tidal access to the existing open spaces around the Bay is measurable and therefore should be considered as a first option, but combined with other feasible alternatives.



"Urban Edge" refers to the two model boundaries used for this effort.

Restoration projects not only reduce the effects of the tidal amplifications in south S.F. Bay, but it also reduce the total water level increase due to SLR.

For example, if we restore most of the South Bay Salt Ponds, our model shows only ~0.9 ft. of increase in south bay while Golden Gate is subjected to 1.6 ft of SLR (a net reduction of 0.7 ft.).

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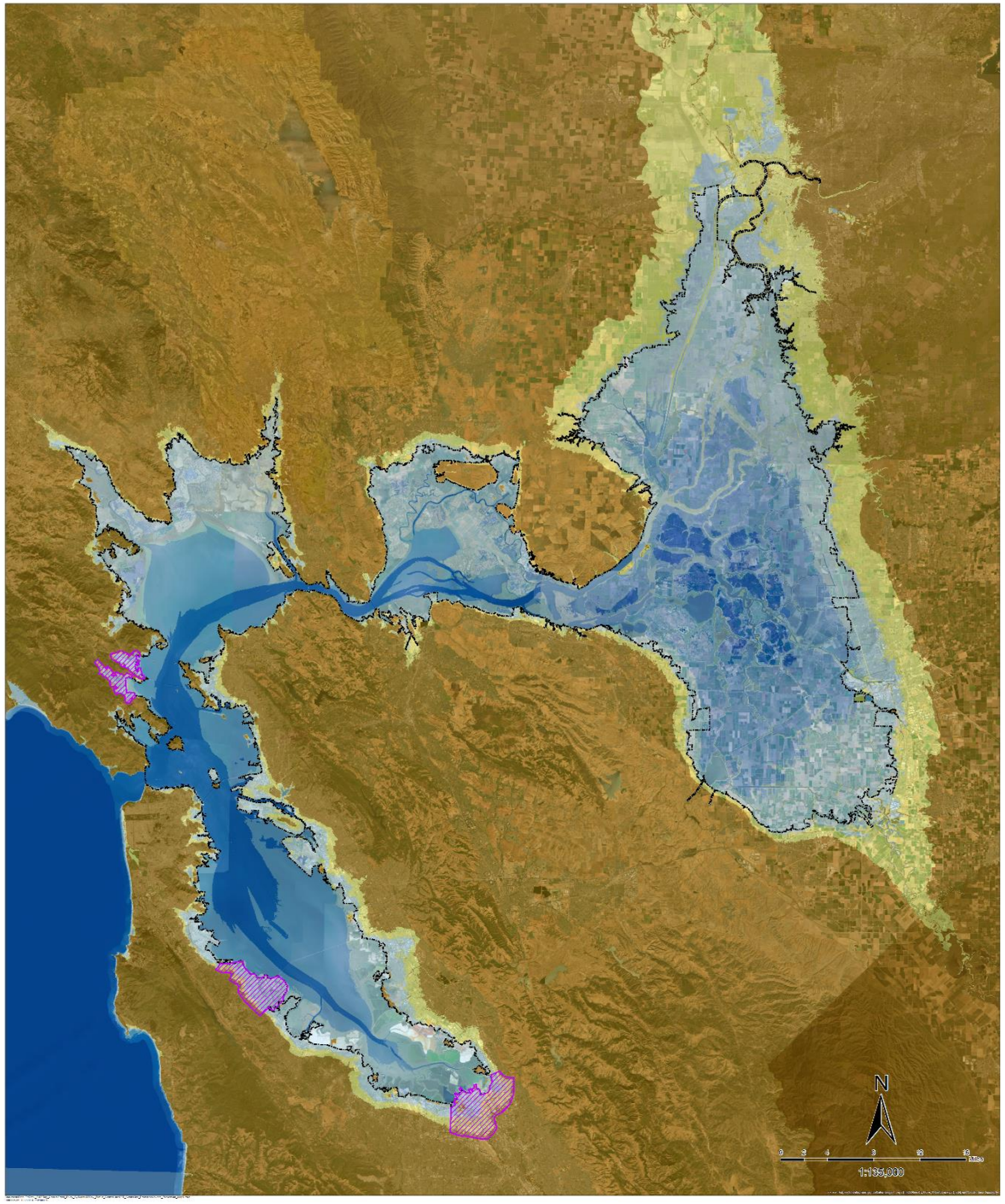
Local Alternatives

- **Seawalls**
- **Coastal Levees**
- **Landside Horizontal Levees**
- **Tide Gate Structures**
- **Pump Stations**

Local projects can protect a limited area on its landside but require sub regional coordination when the project limits are hydraulically connected to other jurisdictions.



Seawalls and Levees

Short seawalls and dikes can easily be adapted by coastal communities and will not substantially reduces public access to the shores.

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High Sea Walls & Coastal Dikes

High seawalls and coastal dikes can partially or fully restrict access to the Bay and separate it from every day life.

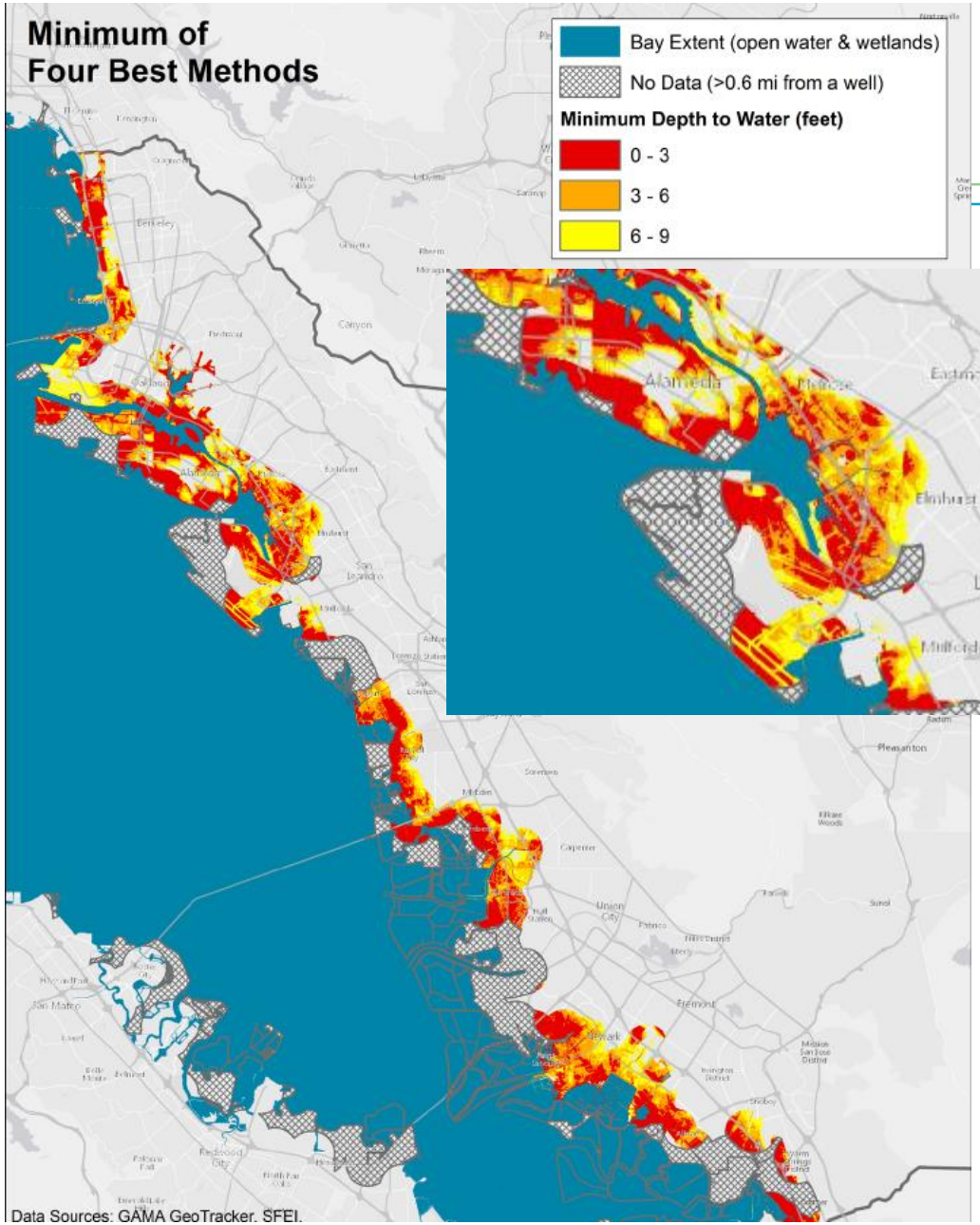
High seawalls and dikes cannot prevent the impacts of shallow ground water rises associated with sea level rises.

High seawalls can fail during and an earthquake and cause sudden and catastrophic flooding.

High Sea Walls

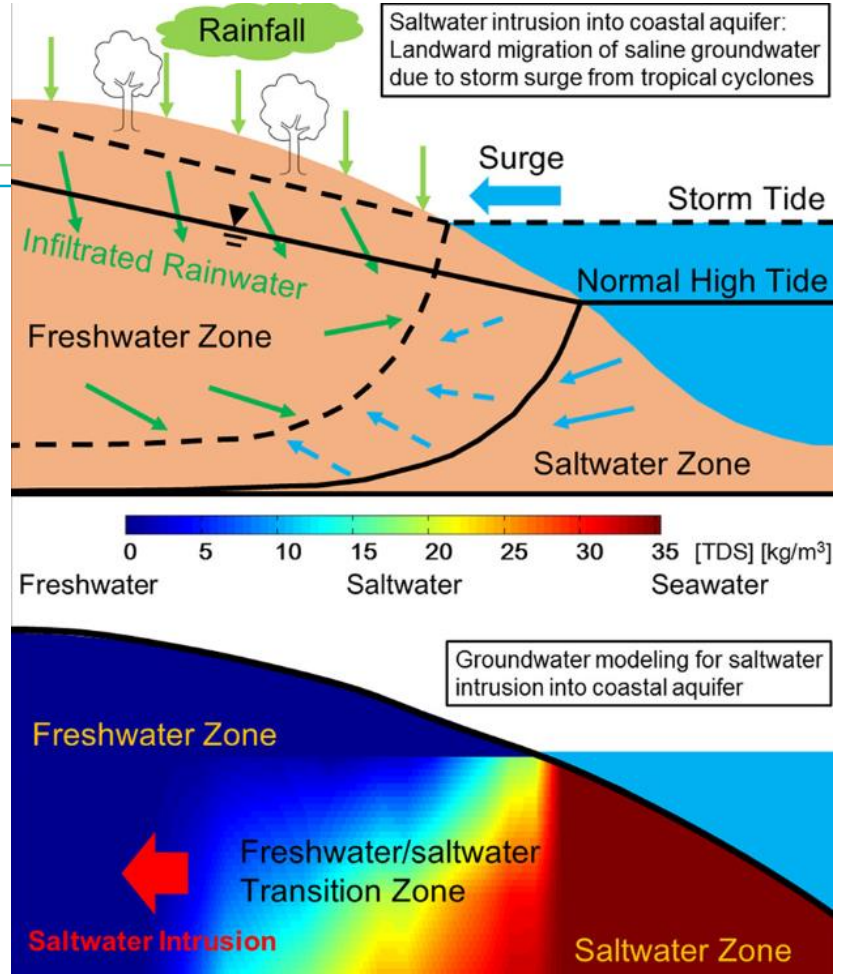
New Fukushima sea wall with a window to the shore

SLR Effects into the Groundwater Table



Shallow Ground Water Depth Study By U.C. Berkeley

- Ranges of existing shallow ground water depth between zero to 3 ft.
- Alameda County communities already experiencing roadways and infrastructure failures due to high shallow ground water.



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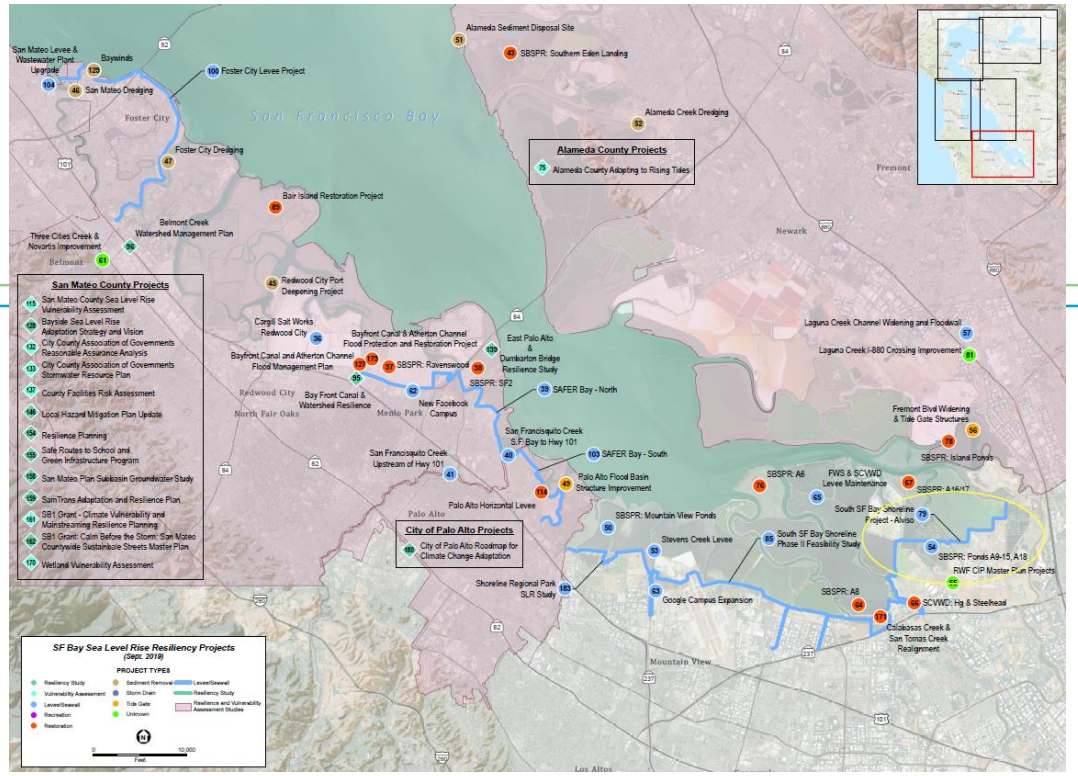
San Francisco Bay Liquefaction Zones



The seawall/levee maximum height shall be evaluated based on the following factors:

- Hydraulic Connectivity
- Failure and stability risk
- Groundwater thresholds
- Environmental impacts
- impact to the communities
- Cost and overall feasibility

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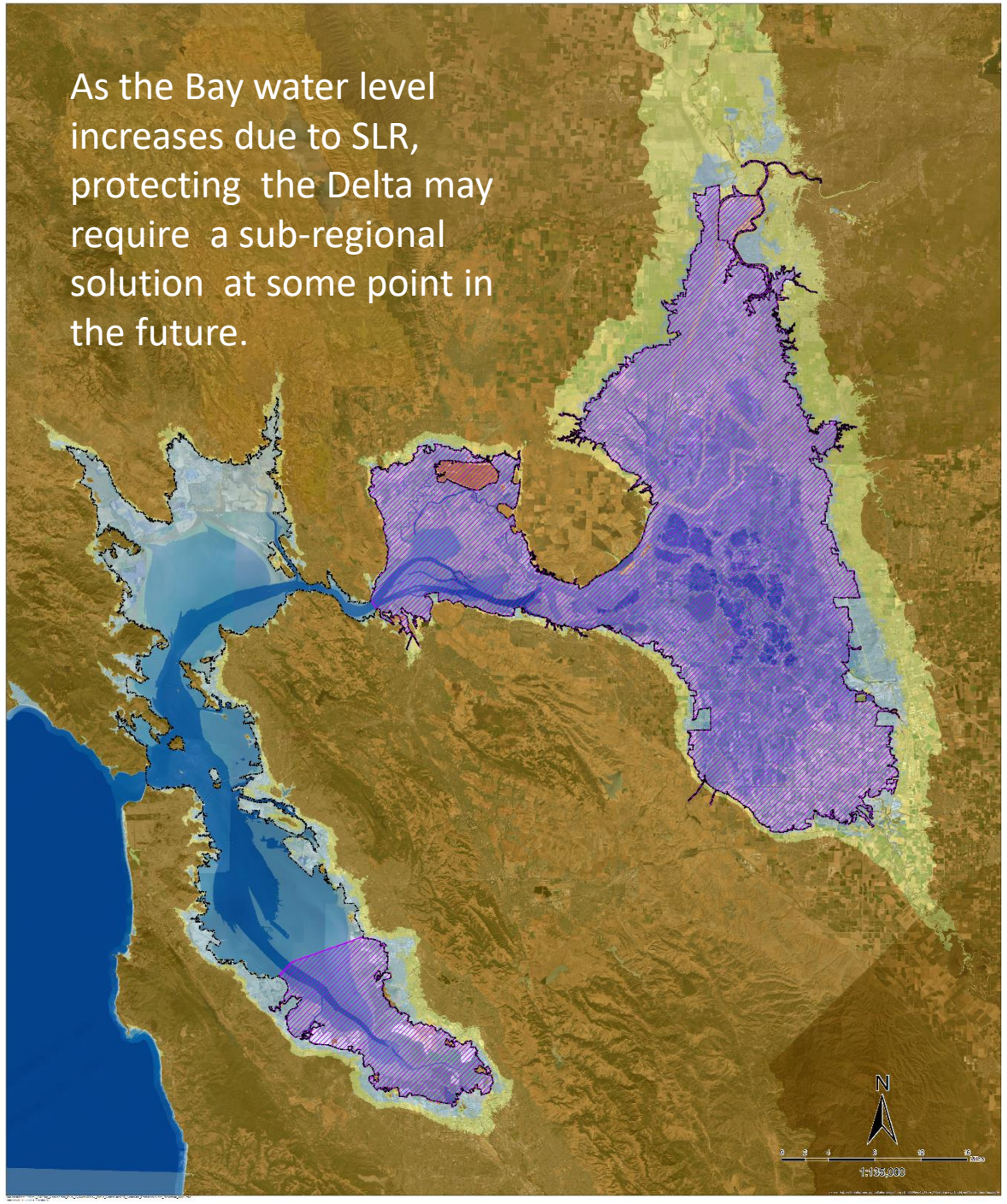
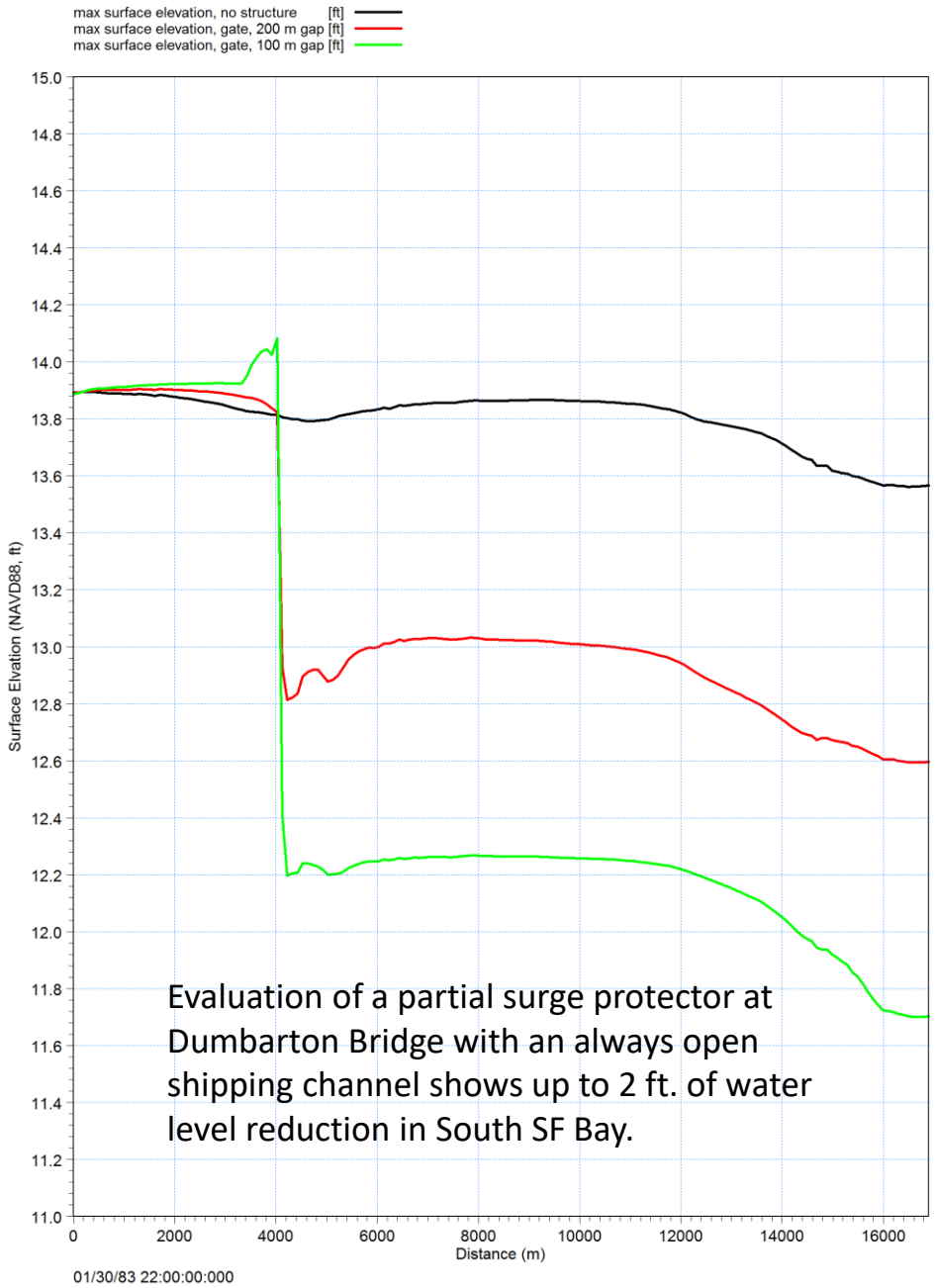
Sub-Regional Alternatives

- **Surge-triggered tide gate structures**
- **Mechanical gates**
- **Etc.**

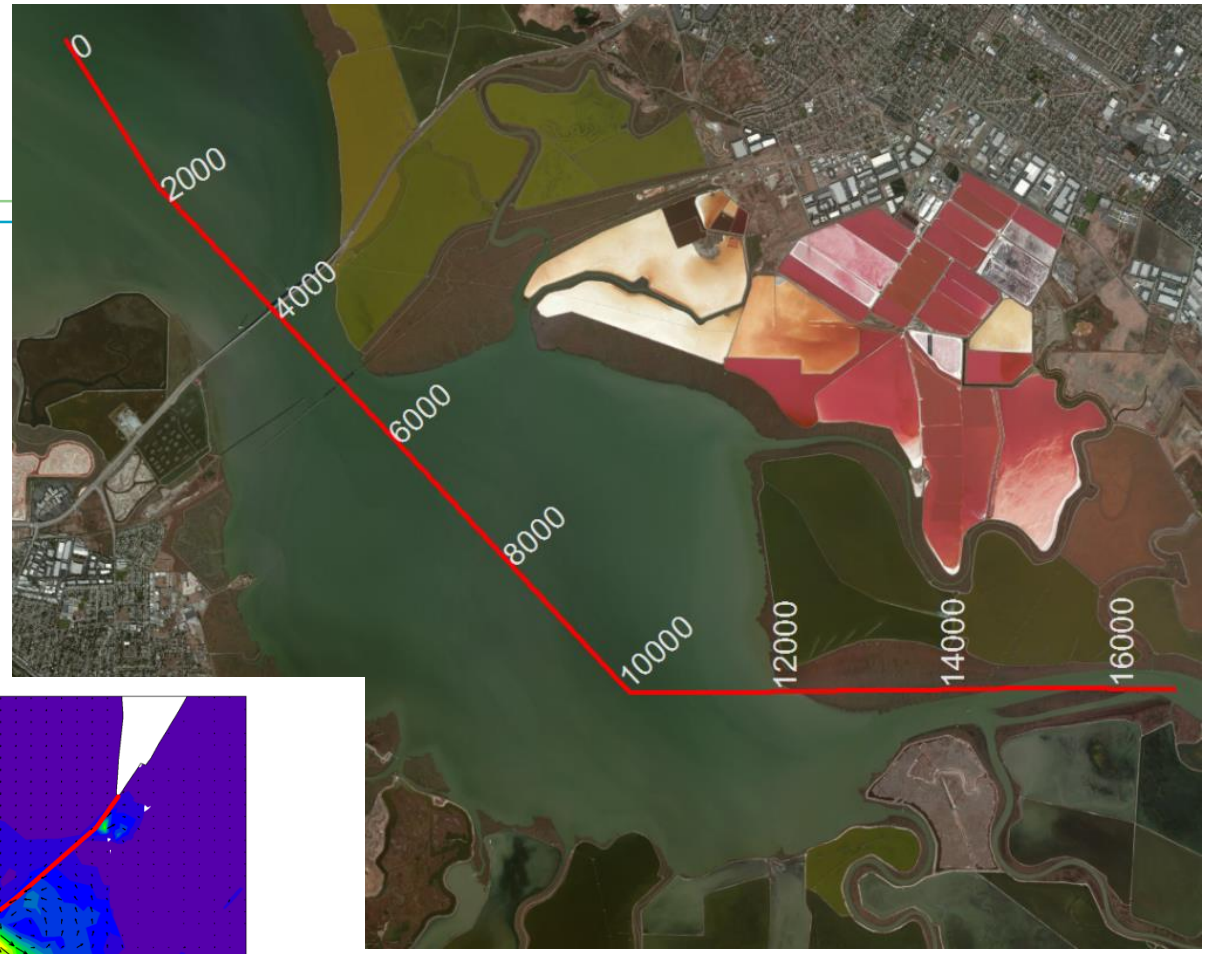
Sub regional projects can protect an entire region form sea level rise but will require optimization to minimize its potential environmental impacts.

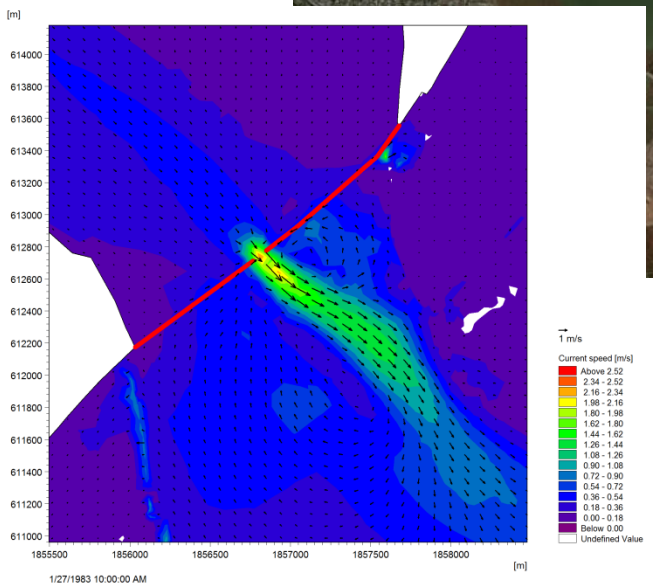


Sub Regional Surge Protectors



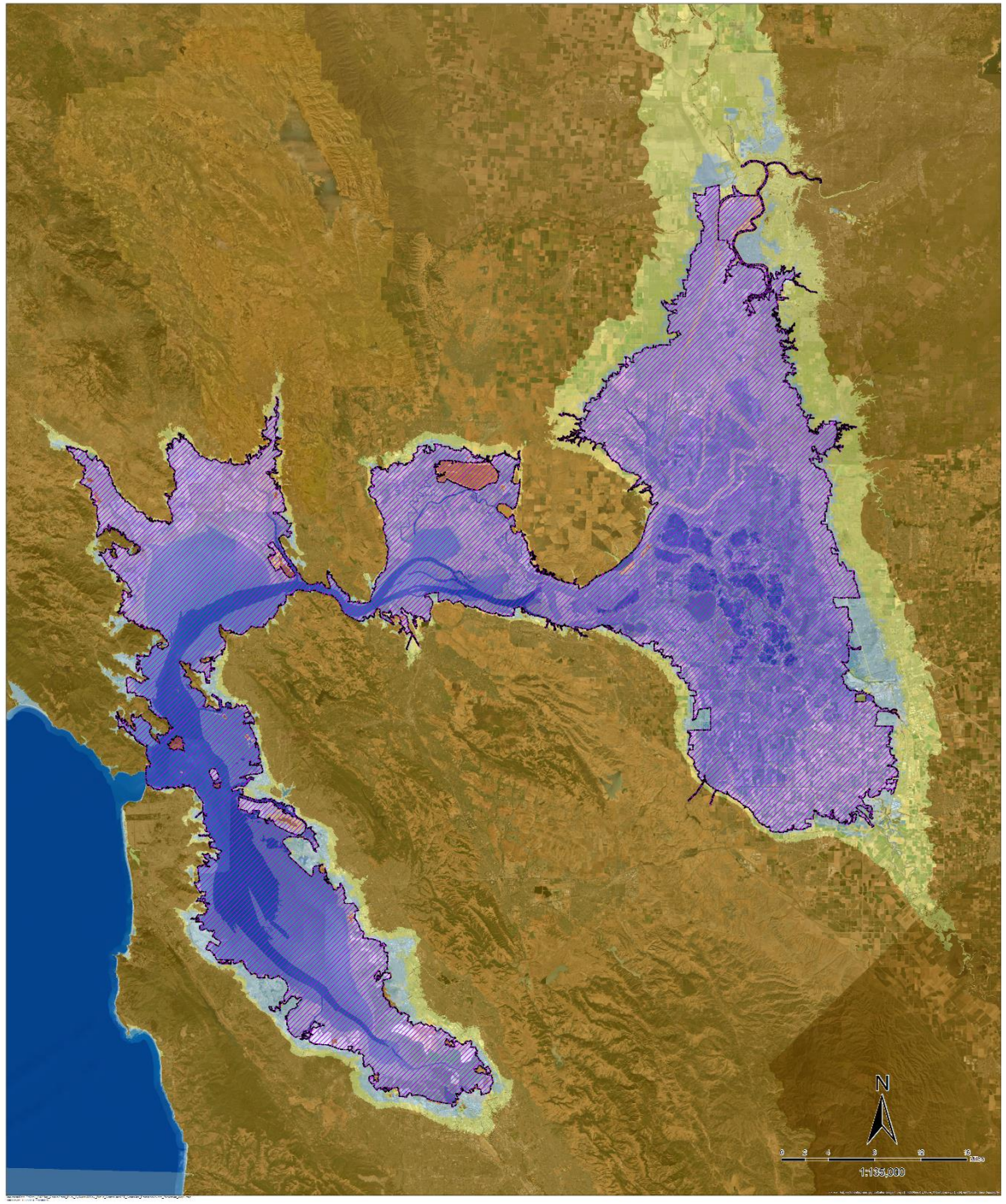
Evaluation of a partial surge protector at Dumbarton Bridge with an always open shipping channel shows up to 2 ft. of water level reduction in South SF Bay.





Bay wide Regional Alternatives

For higher SLR projections when green solutions such as restorations projects and gray solutions such as levees and sea walls are no longer feasible or effective, retreat or other regional alternatives may be the only solution.



It is important to note that while a partial urban retreat may be an option at some point and in some parts of the Bay, we must make sure that such retreat is not planned at a disproportionate cost to disadvantaged communities.

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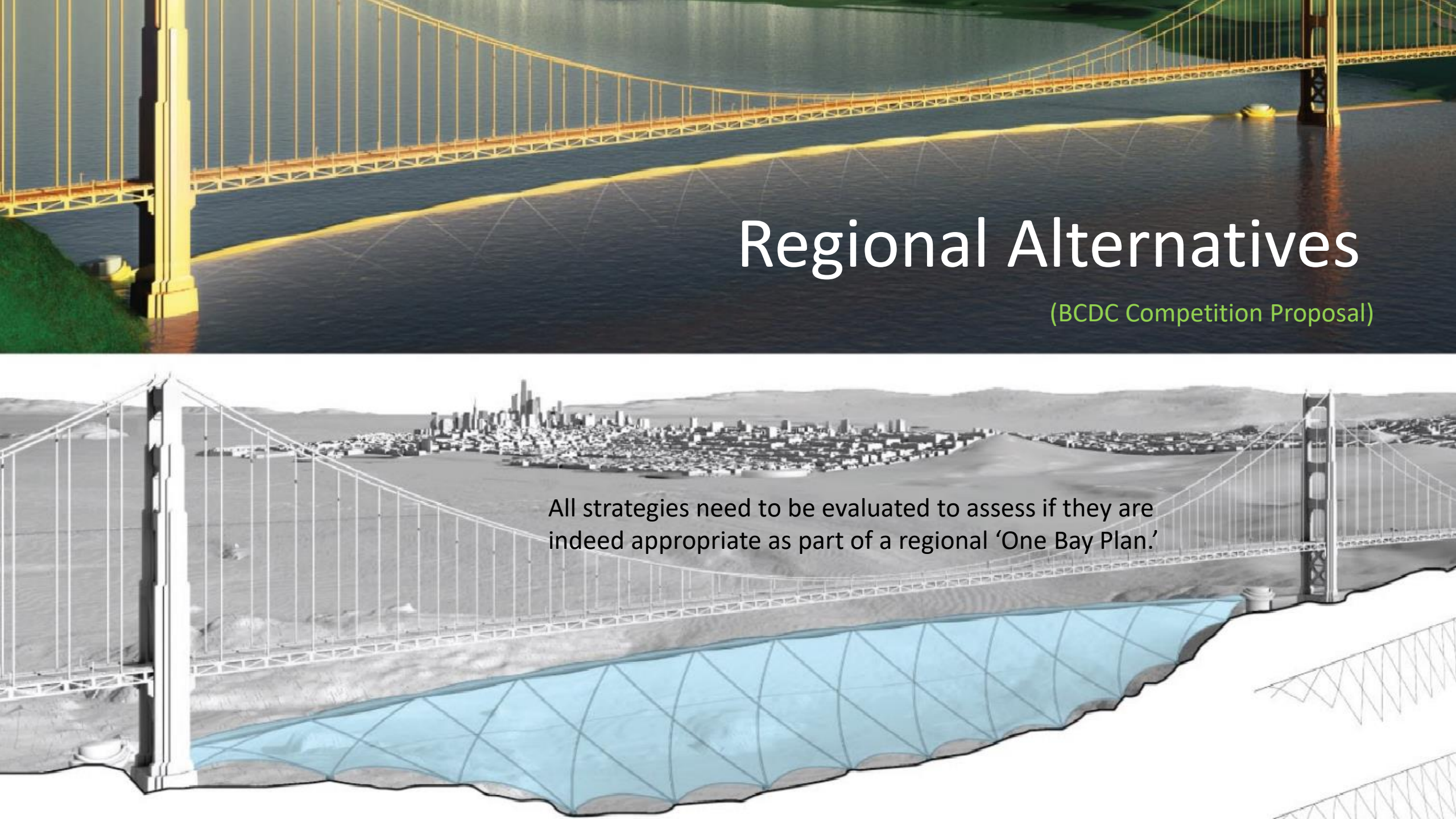
Regional Surge Protectors?

A regional surge protector in Europe:

Regional Alternatives

(BCDC Competition Proposal)



All strategies need to be evaluated to assess if they are indeed appropriate as part of a regional ‘One Bay Plan.’

Overview Messages

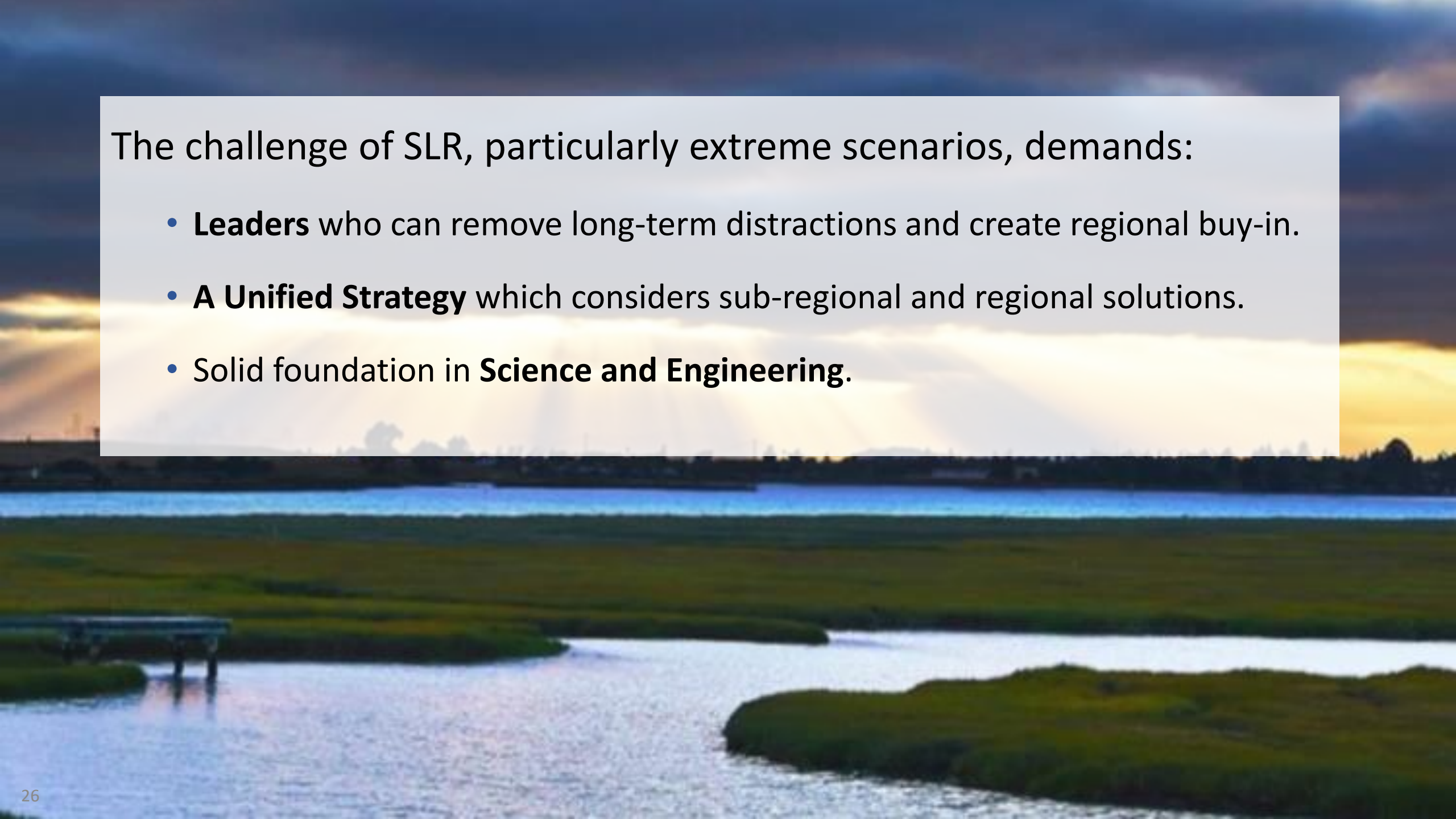
- There are many SLR adaptation strategies being contemplated at different scales but we must first evaluate their impacts and effectiveness and then decide wither to keep them or disregards them as an alternative.
- We must think beyond a 50-year CIP horizon – what we do today must be able to adapt at least for the next 80+ years.
- All adaptation strategies need to be evaluated based on feasibility, technical practicality, environmental impacts, community acceptance and more using an all inclusive decision matrix.
- We must also plan to accommodate the H++ flood level (9.3 feet).

Key Takeaways

- Evaluate ALL possible adaptation strategies for its impacts on the entire Bay.
- Make decisions only after we fully understand the regional impacts of each strategy.
- Consider projects that reach beyond our existing governance constraints into grander regional solutions.

Importance of Regional Evaluation

- Identify scalable, multi-benefit projects that benefit the region.
- Unify priorities of a “One Bay” approach to funding.
- Create inclusive governance.
- Leverage the Bay’s “best and brightest” as a technical resource.
  - Like the people in this room!



The challenge of SLR, particularly extreme scenarios, demands:

- **Leaders** who can remove long-term distractions and create regional buy-in.
- **A Unified Strategy** which considers sub-regional and regional solutions.
- Solid foundation in **Science and Engineering**.

Lead future generations to go beyond our current way of problem solving to create adaptable and enduring solutions.

Are we up to the challenge?