

WATERFRONT RESILIENCE PROGRAM UPDATE

Port Commission Agenda Item #11

October 11, 2022



Waterfront Resilience Program



TODAY'S AGENDA

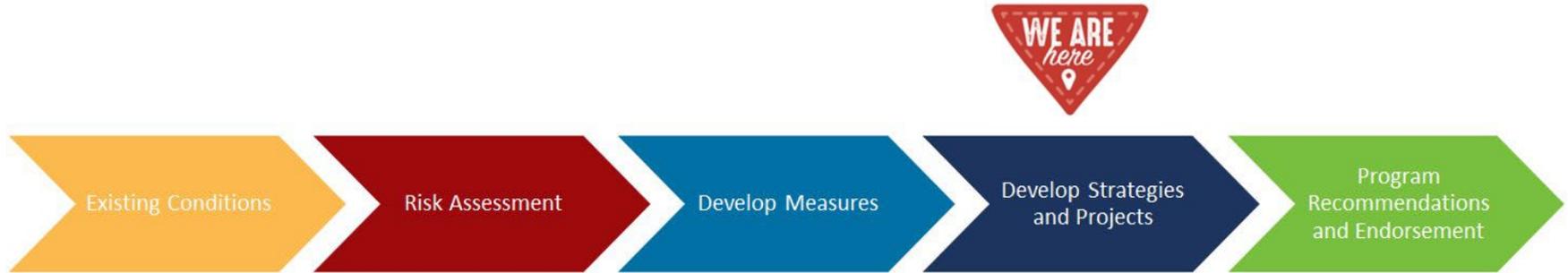
Presentation Overview



- Understanding the Risks
 - *What we're facing*
- Waterfront Resilience Program
 - *What we're doing*
- Community Priorities
 - *What we've heard*
- Range of Possibilities
 - *What we're considering*
- Draft Waterfront Adaptation Strategies
- Next Steps

DRAFT WATERFRONT ADAPTATION STRATEGIES

Presentation Overview



The Port of San Francisco has developed seven high-level Draft Waterfront Adaptation Strategies through a collaborative interagency process and over five years of public engagement.

The draft Strategies are ready for public feedback, with a goal of reaching a Draft Waterfront Adaptation Plan by Summer 2023.

DRAFT WATERFRONT ADAPTATION STRATEGIES

Port-led, City of San Francisco Agencies, and USACE Partnered in Development Process



SAN FRANCISCO WATERFRONT COASTAL FLOOD STUDY



**US Army Corps
of Engineers®**

The Port and U.S. Army Corps of Engineers (USACE) are conducting a **waterfront coastal flood study** for San Francisco, which could result in **significant federal funding for flood risk reduction**.

This funding could also **improve shoreline stability** where USACE would fund coastal flood defenses and **provide other community benefits** that are part of a cost-effective plan. The Port and City have goals to further improve seismic resilience and provide other community benefits that will not be eligible for USACE funding.

Understanding the Risks *What We're Facing*



Waterfront Resilience Program

CLIMATE CHANGE HAS GLOBAL IMPACTS

Including Here In San Francisco



San Francisco Chronicle

S.F.'s Embarcadero needs to be raised as much as 7 feet to prepare for sea level rise, city says

John King
Nov. 3, 2021 | Updated: Nov. 1, 2022 6:20 p.m.



— A car drives through floodwaters caused by large waves crashing into Pier 14 along the Embarcadero in San Francisco in 2018. The Port of San Francisco has obtained a court restraining order suggesting parts of the area need to be raised seven feet to avoid future flooding.

RISING TO THE CHALLENGE

San Francisco Faces Urgent Seismic, Coastal, and Inland Flood Risks Today

SEISMIC RISKS



San Francisco, 1906



Marina, 1989

COASTAL FLOODING

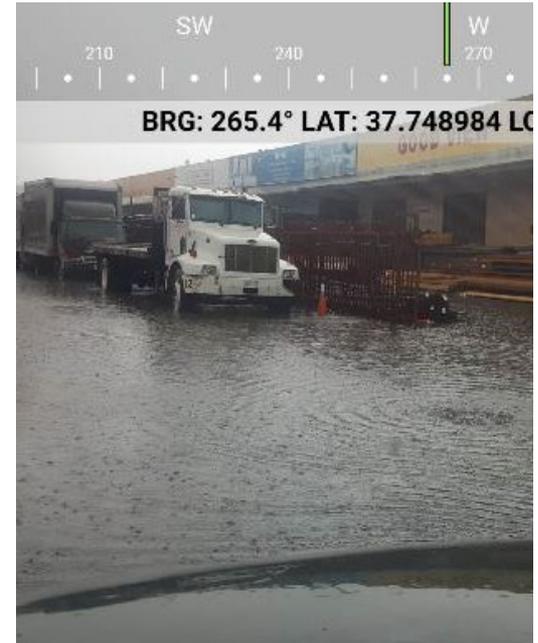


Recology



The Embarcadero

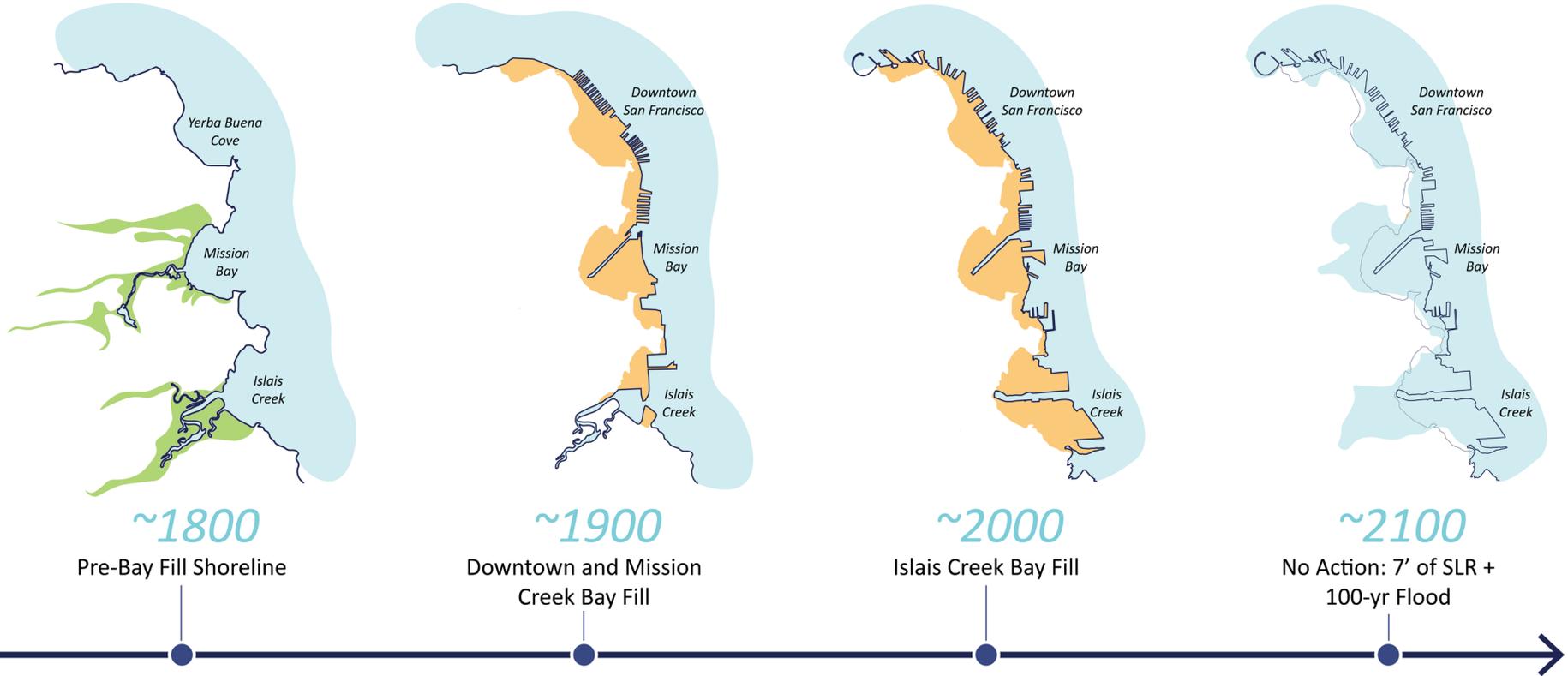
INLAND FLOODING



Islais Creek outfall and Marin St.

HISTORIC SHORELINE + BAY FILL

From the 1800s

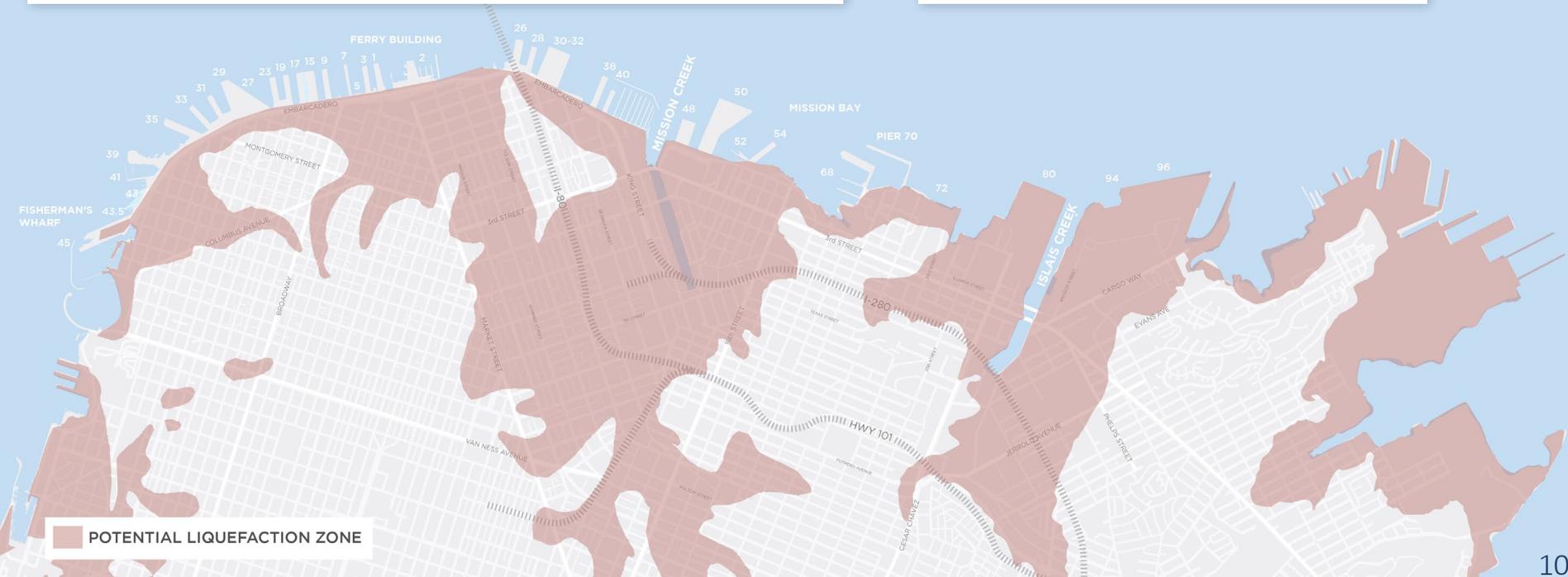


WATERFRONT WIDE EARTHQUAKE HAZARDS

Very High Earthquake “Liquefaction” Risk

Liquefaction occurs when water-saturated sediment (like sand) temporarily loses strength and acts as a fluid

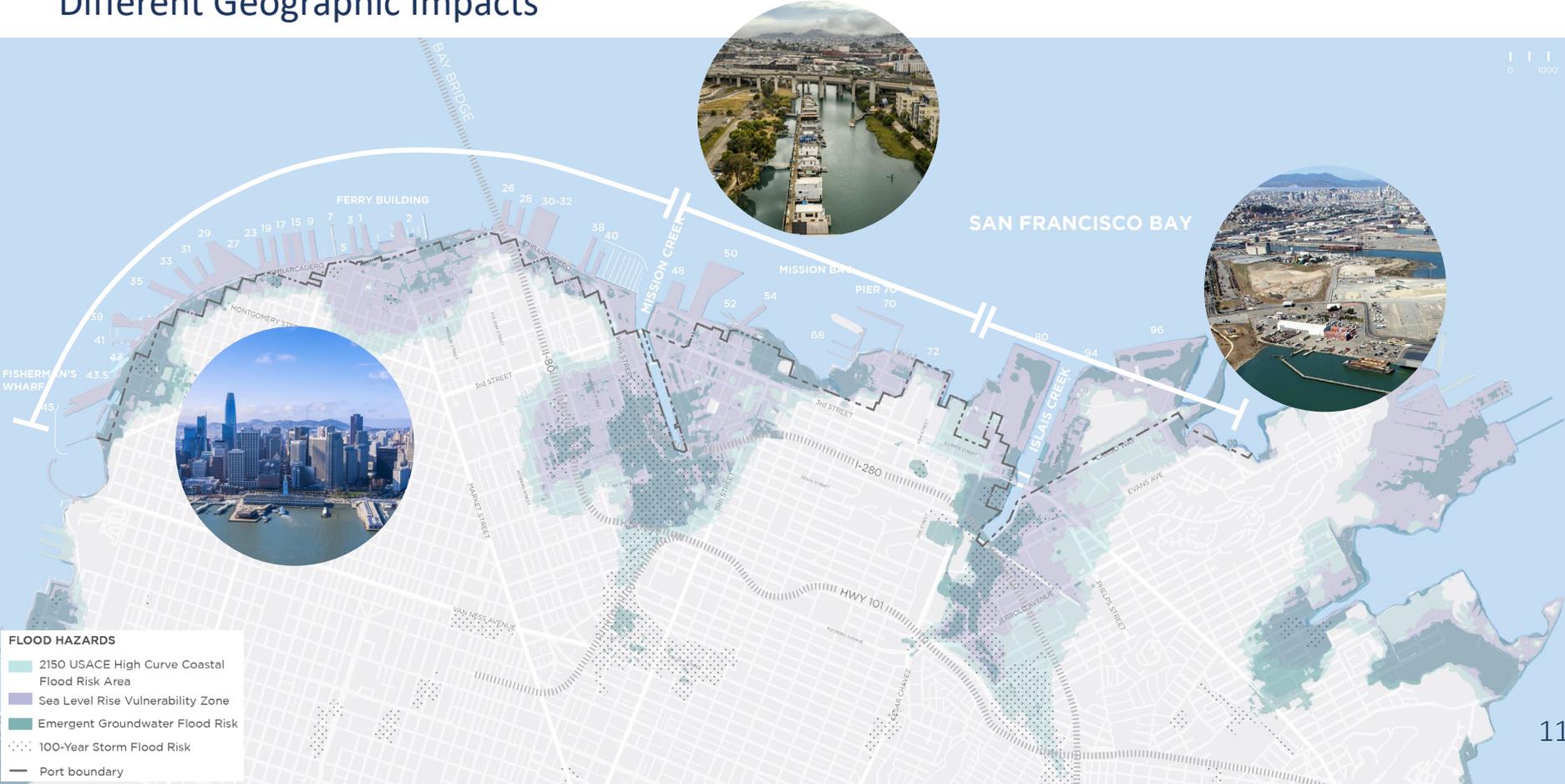
Various levels of lateral spreading risk along the shoreline



POTENTIAL LIQUEFACTION ZONE

COASTAL AND INLAND FLOOD RISK

Different Geographic Impacts



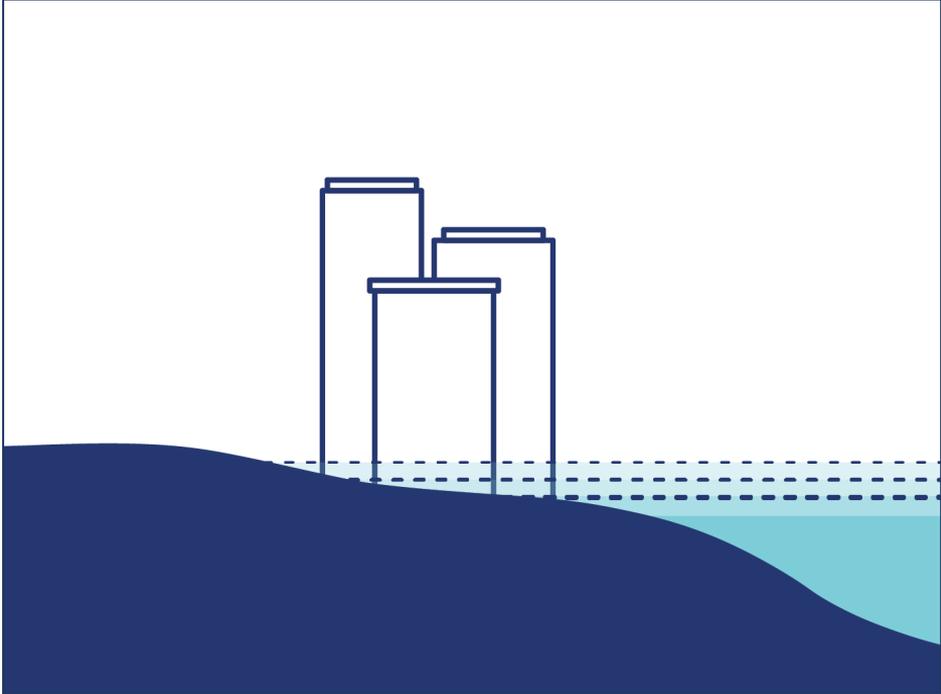
- FLOOD HAZARDS**
- 2150 USACE High Curve Coastal Flood Risk Area
 - Sea Level Rise Vulnerability Zone
 - Emergent Groundwater Flood Risk
 - 100-Year Storm Flood Risk
 - Port boundary

COASTAL AND INLAND FLOODING



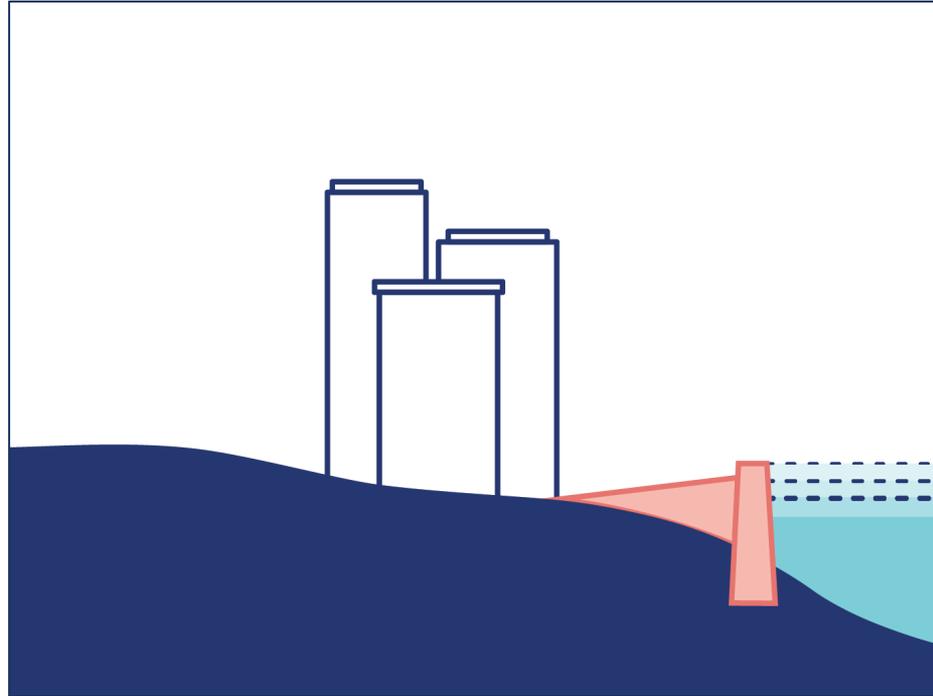
Existing conditions

COASTAL AND INLAND FLOOD RISK



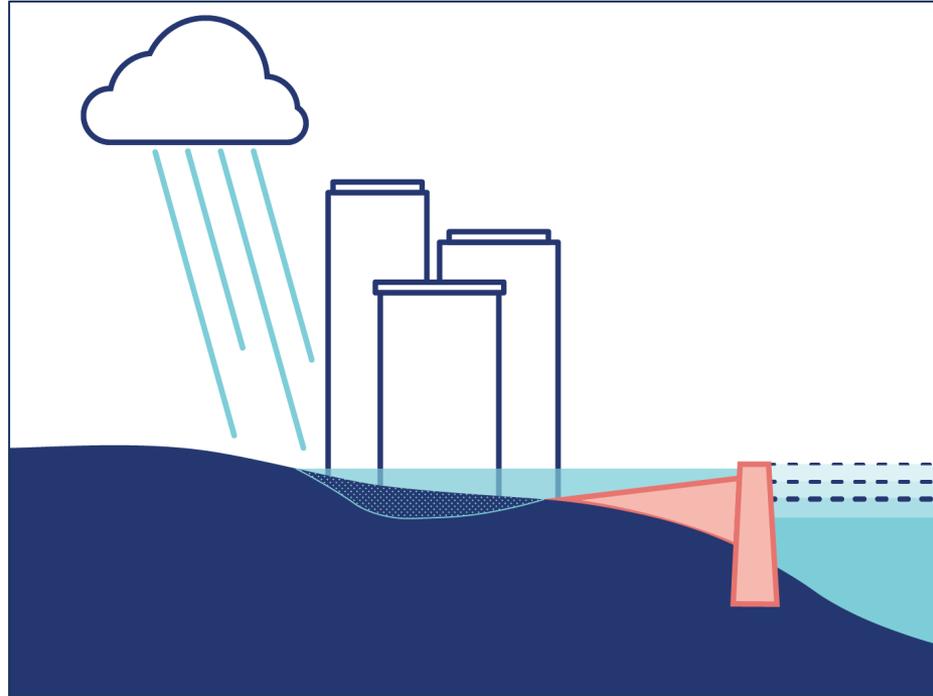
Sea levels rise

COASTAL AND INLAND FLOOD RISK



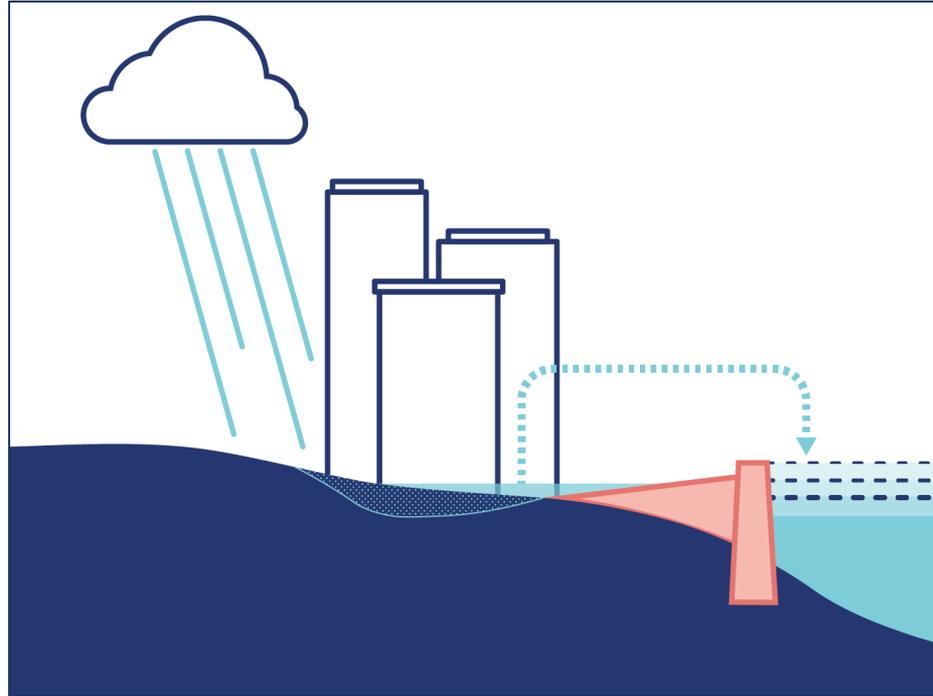
**Raise shoreline to defend
against sea level rise**

COASTAL AND INLAND FLOOD RISK



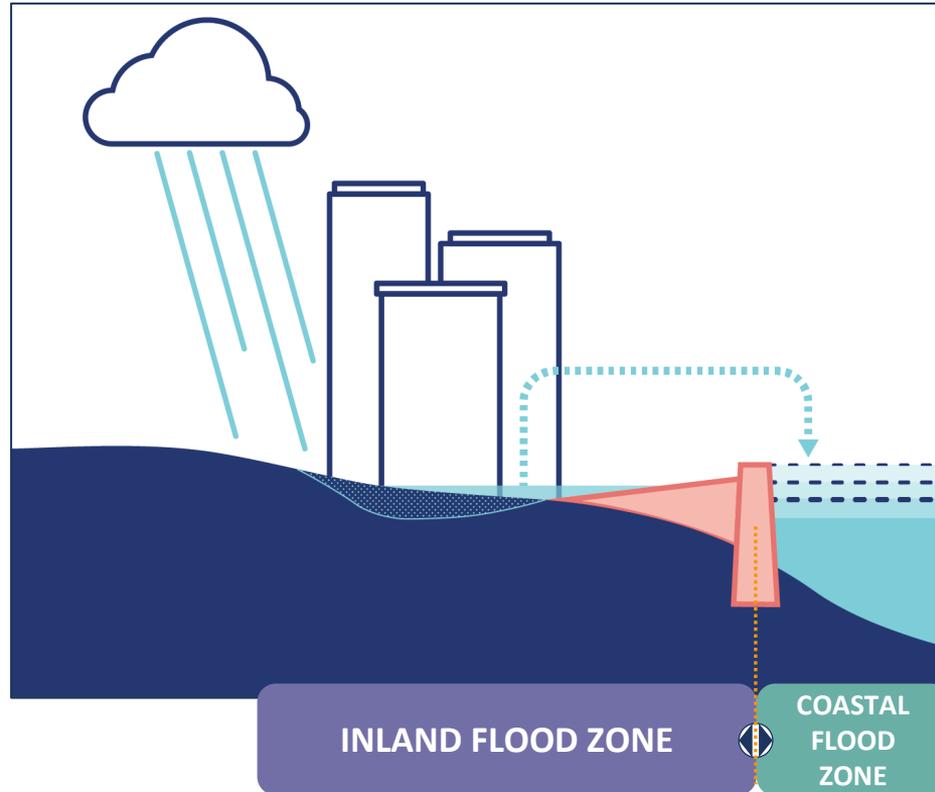
**Groundwater
and stormwater
flooding behind raised
shoreline**

COASTAL AND INLAND FLOOD RISK



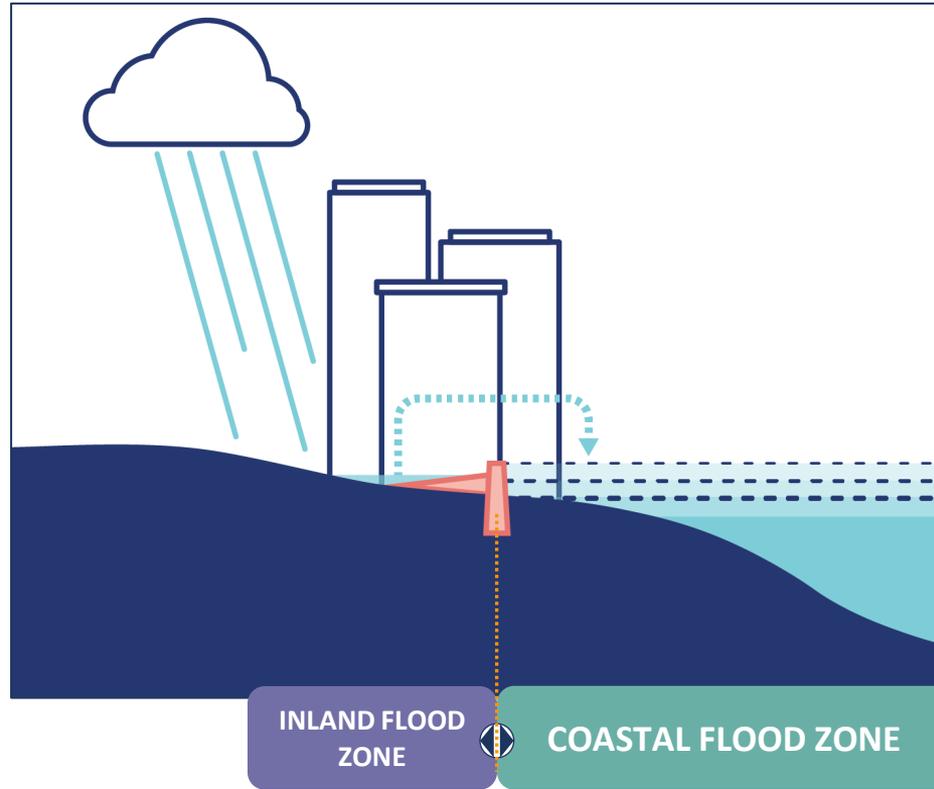
**Pumping reduces flooding
behind raised shoreline**

COASTAL AND INLAND FLOOD RISK



Two related forms of flooding

COASTAL AND INLAND FLOOD RISK



Shift based on the location of flood protection

Any solution endorsed by the City of San Francisco will aim to address **all three risks**:
seismic risks, **coastal flooding** and **inland flooding**.



Waterfront Resilience Program

What We're Doing

LADY FISH
SAN FRANCISCO, CA

BESHA II
SAN FRANCISCO



WATERFRONT RESILIENCE PROGRAM VISION STATEMENT

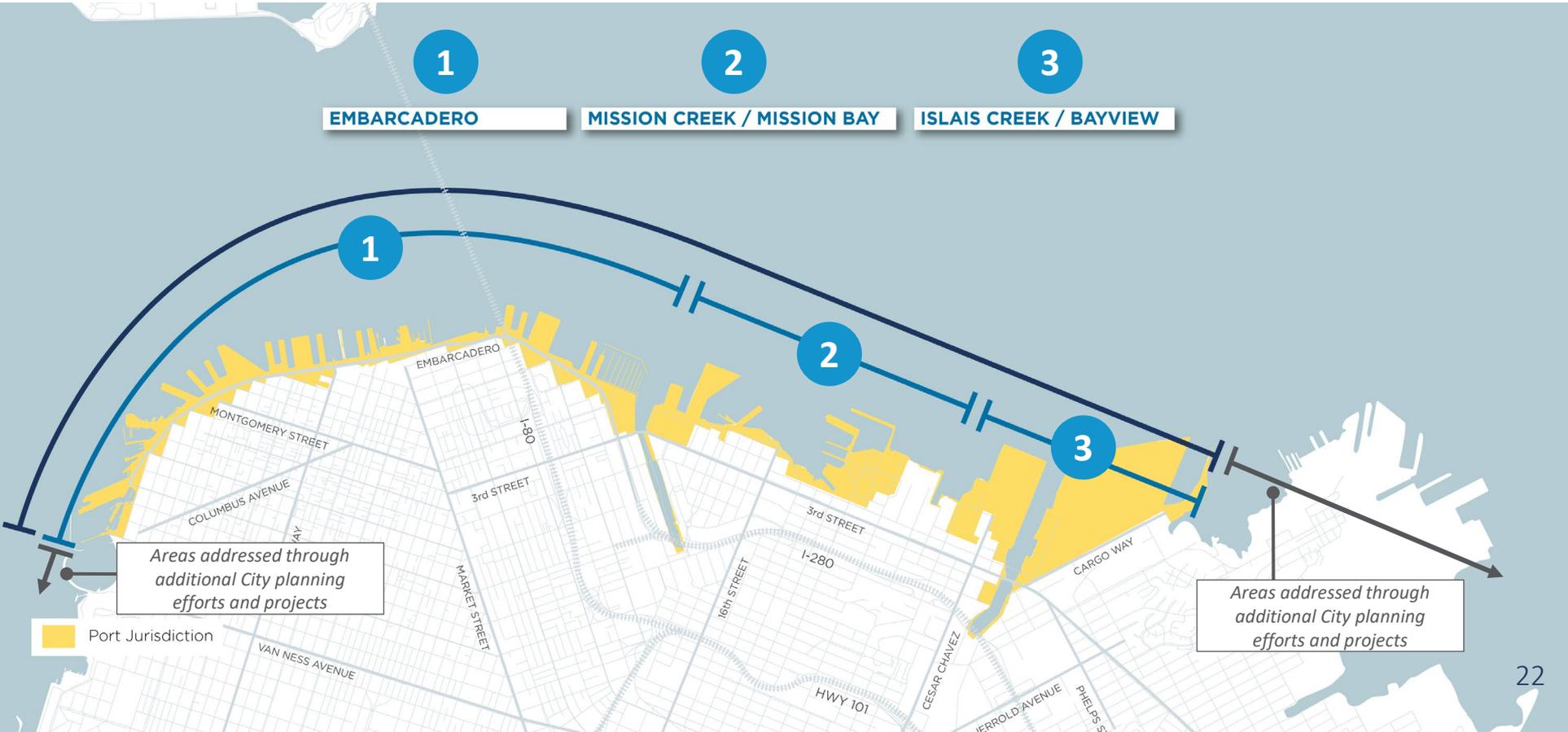
Affirmed through Robust Community Engagement

The Port's Waterfront Resilience Program will take actions to **reduce seismic and climate change risks** that support a safe, equitable, sustainable, and vibrant waterfront.



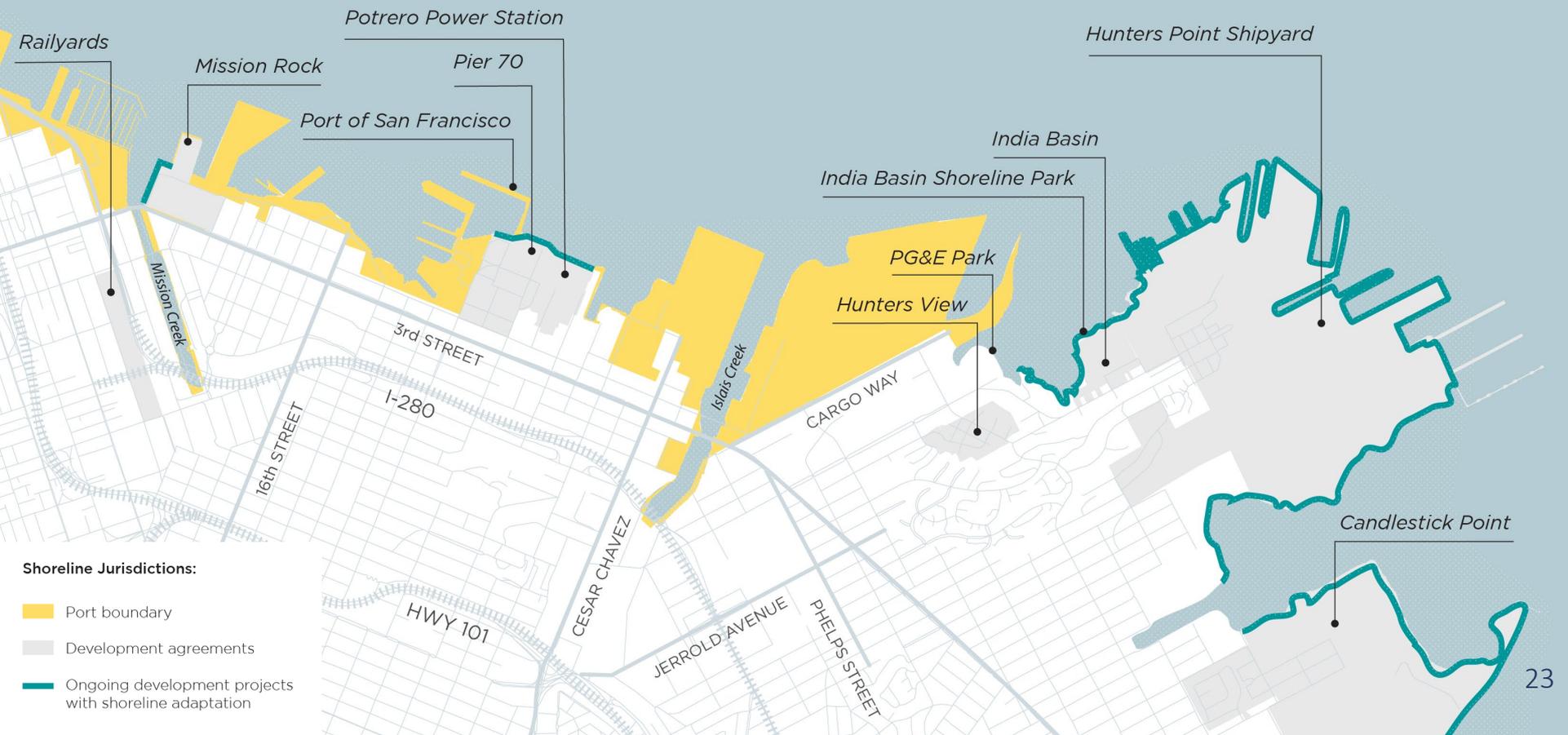
PROGRAM AREA

Focus is Conceptual-Level Strategies Within the Port's Jurisdiction



OTHER CITY ADAPTATION PROJECTS

Outside Port jurisdiction





Community Priorities

What We've Heard



DRAFT WATERFRONT ADAPTATION STRATEGIES

Community Input Helped Define the WRP

1

Focus on life safety & emergency response

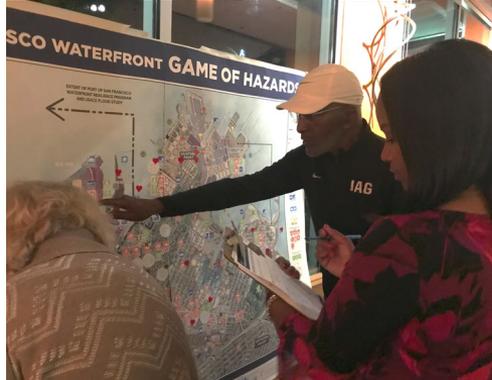
2

Prioritize assets most loved by the community and most important to the city

3

Put people first

Assets and services most prioritized: housing, disaster recovery facilities, utilities, transportation and businesses



NATURE BASED SOLUTIONS

Prioritize Nature and Healing the Bay



Seattle



CMG Landscape Architecture



CMG Landscape Architecture



CMG Landscape Architecture



Port of SF



SITELAB Urban Studio

PUBLIC SPACES

Expand Open Spaces and the City's Connection to the Waterfront



EQUITY

Center Racial and Social Equity and Environmental Justice



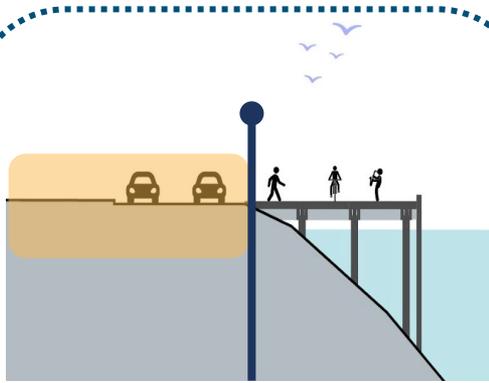


Range of Possible Solutions

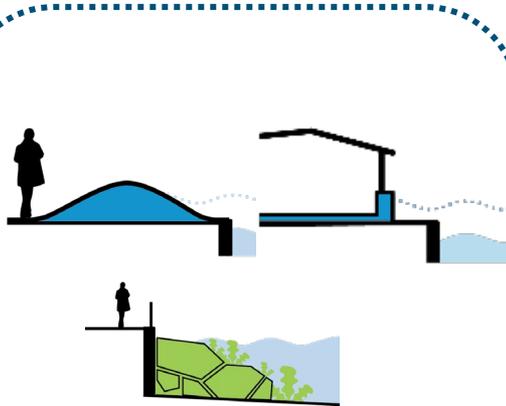
What We're Considering

DRAFT WATERFRONT ADAPTATION STRATEGIES

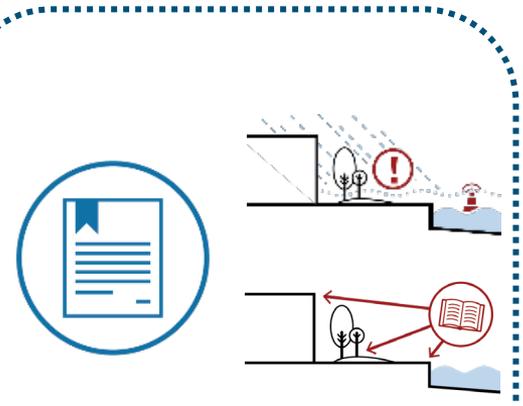
Key Components



**Coastal Flood Defense
Location + Height**
*And area of elevation
change*



Physical Changes
*Such as earthquake-
resilient berms,
floodproofing, and
nature-based features*



Policy Changes
*Such as resilient codes,
warning systems, and land
use changes*

USACE SAN FRANCISCO WATERFRONT COASTAL FLOOD STUDY

Driving Questions

What if...
we **did not adapt**
to mitigate the
risks?

What if...
we adapted by
floodproofing
and **moving**
buildings and assets,
without coastal flood
structures?

What if...
we address flooding
at a **lower rate** of
sea level rise?

What if...
we address flooding
at a **higher rate** of
sea level rise,
as recommended by
CA and SF guidance?

USACE SAN FRANCISCO WATERFRONT COASTAL FLOOD STUDY

Draft Waterfront Adaptation Strategies

What if...
we **did not adapt**
to mitigate the
risks?

STRATEGY A

What if...
we adapted by
floodproofing
and **moving**
buildings and assets,
without coastal flood
structures?

STRATEGY B

What if...
we address flooding
at a **lower rate** of
sea level rise?

STRATEGY C

STRATEGY D

What if...
we address flooding
at a **higher rate** of
sea level rise,
as recommended by
CA and SF guidance?

STRATEGY E

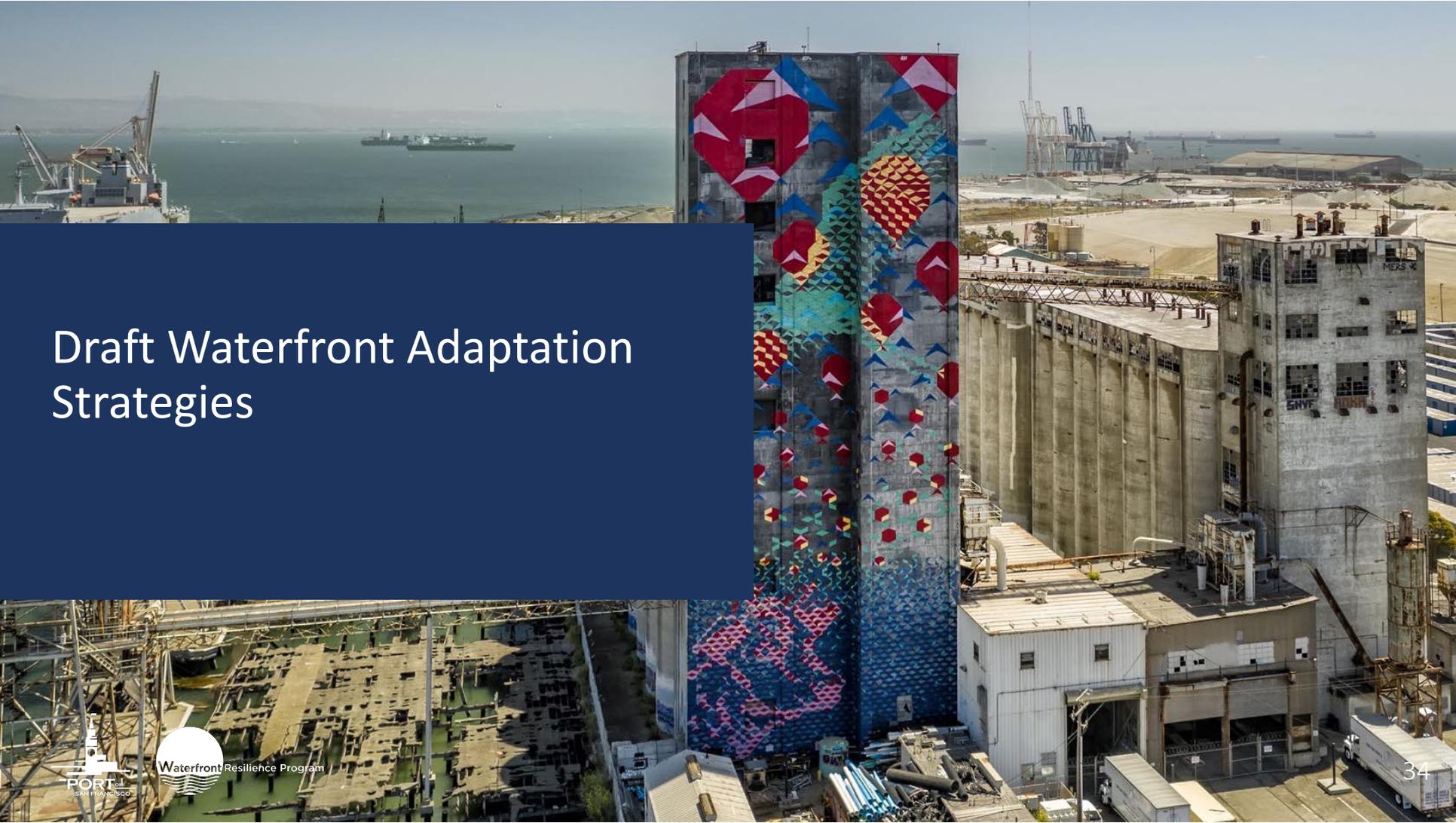
STRATEGY F

STRATEGY G

THE ROLE OF COMMUNITY FEEDBACK

Pathway to the Draft Waterfront Adaptation Plan



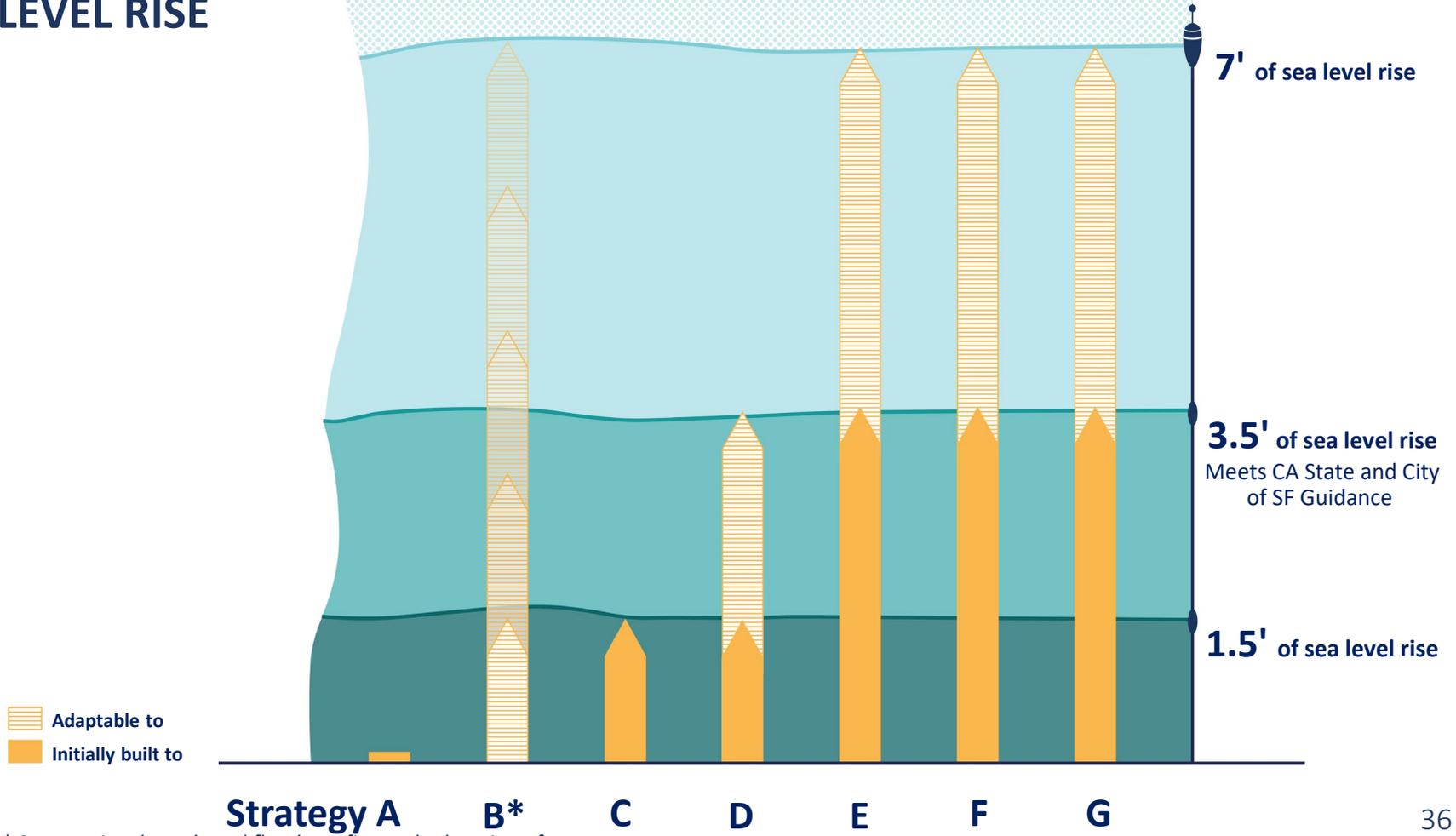
An aerial photograph of an industrial waterfront area. A prominent feature is a tall, narrow concrete building covered in a vibrant, multi-colored mural of geometric patterns and shapes. To the left, a large body of water is visible with several ships and cranes. To the right, there are various industrial structures, including a large white building with a corrugated metal roof and a taller, more complex structure. The sky is clear and blue.

Draft Waterfront Adaptation Strategies

TIME HORIZONS



SEA LEVEL RISE



* Strategy involves phased floodproofing and relocation of assets

USACE SAN FRANCISCO WATERFRONT COASTAL FLOOD STUDY

Focused on Strategies A-D

What if...
we **did not adapt**
to mitigate the
risks?

STRATEGY A

What if...
we adapted by
floodproofing
and **moving**
buildings and assets,
without coastal flood
structures?

STRATEGY B

What if...
we address flooding
at a **lower rate** of
sea level rise?

STRATEGY C

STRATEGY D

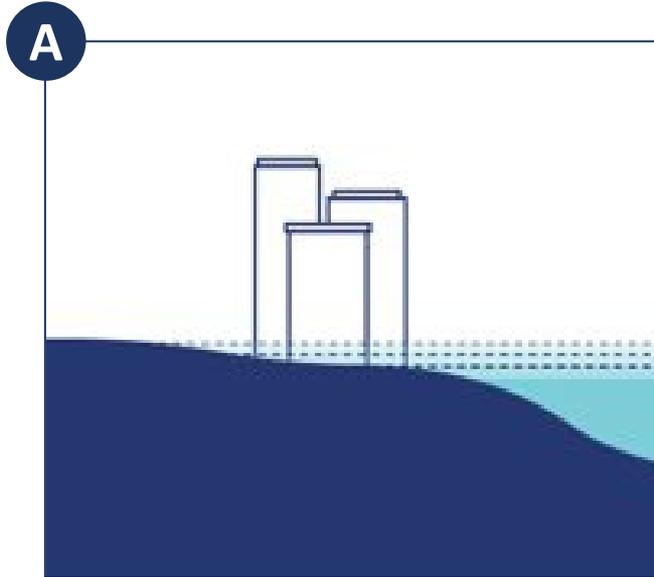
What if...
we address flooding
at a **higher rate** of
sea level rise,
as recommended by
CA and SF guidance?

STRATEGY E

STRATEGY F

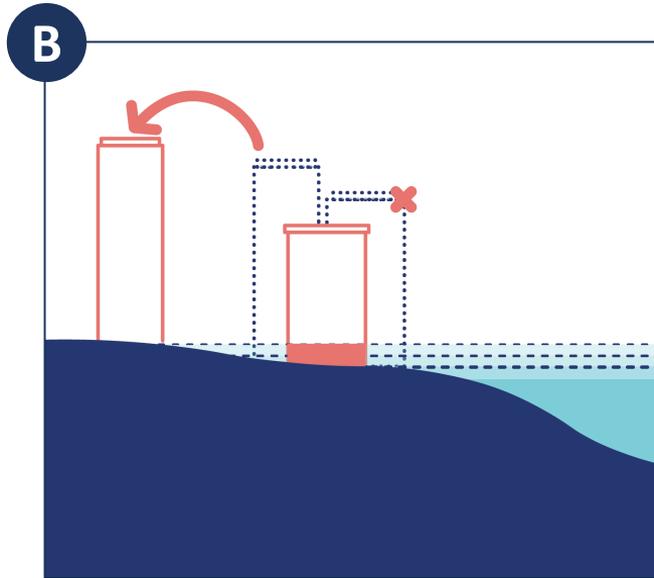
STRATEGY G

STRATEGY A – NO ACTION



This strategy takes no actions to reduce flood risks beyond projects that are already approved

STRATEGY B – NONSTRUCTURAL OPTION



Moves people and assets away from the risk, uses nonstructural measures (such as floodproofing) to reduce risks, and allows water to go where it wants rather than constructing traditional structural solutions

STRATEGY B – NONSTRUCTURAL OPTION

Examples



Warning systems



Floodproofing

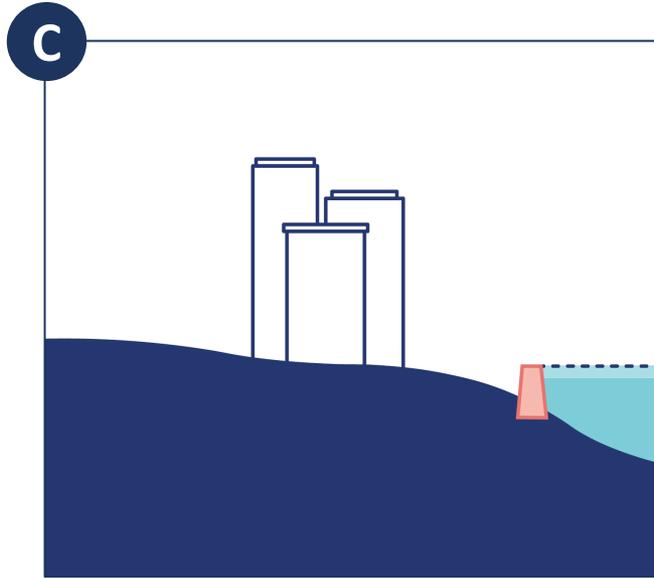


Raise structure in place



Buyouts

STRATEGY C – LOWER SEA LEVEL RISE



Adapts the shoreline to withstand 1.5' of sea level rise by 2040 using a combination of structural and nonstructural measures

STRATEGY C – LOWER SEA LEVEL RISE

2040

- Coastal Flood Defense
- Coastal Adaptation Zone
- Inland Adaptation Zone
- Planned / Proposed Developments

Address flooding in lowest lying areas along the waterfront (1.5' sea level rise)

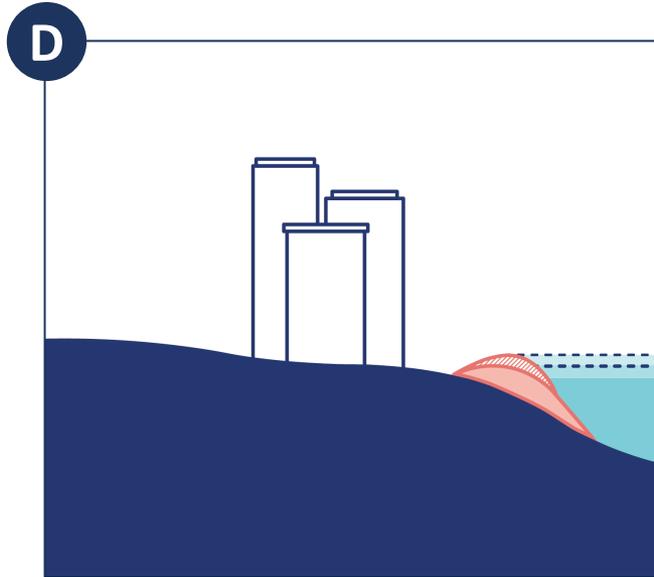
Tie into Planned / Proposed Developments

Build infrastructure to pump away stormwater/groundwater flooding



SAN FRANCISCO BAY

STRATEGY D – LOWER SEA LEVEL RISE – ADAPTABLE



Adapts the shoreline to withstand 1.5' of sea level rise by 2040, with the possibility of building higher by 2090

STRATEGY D – LOWER SEA LEVEL RISE – ADAPTABLE

2040

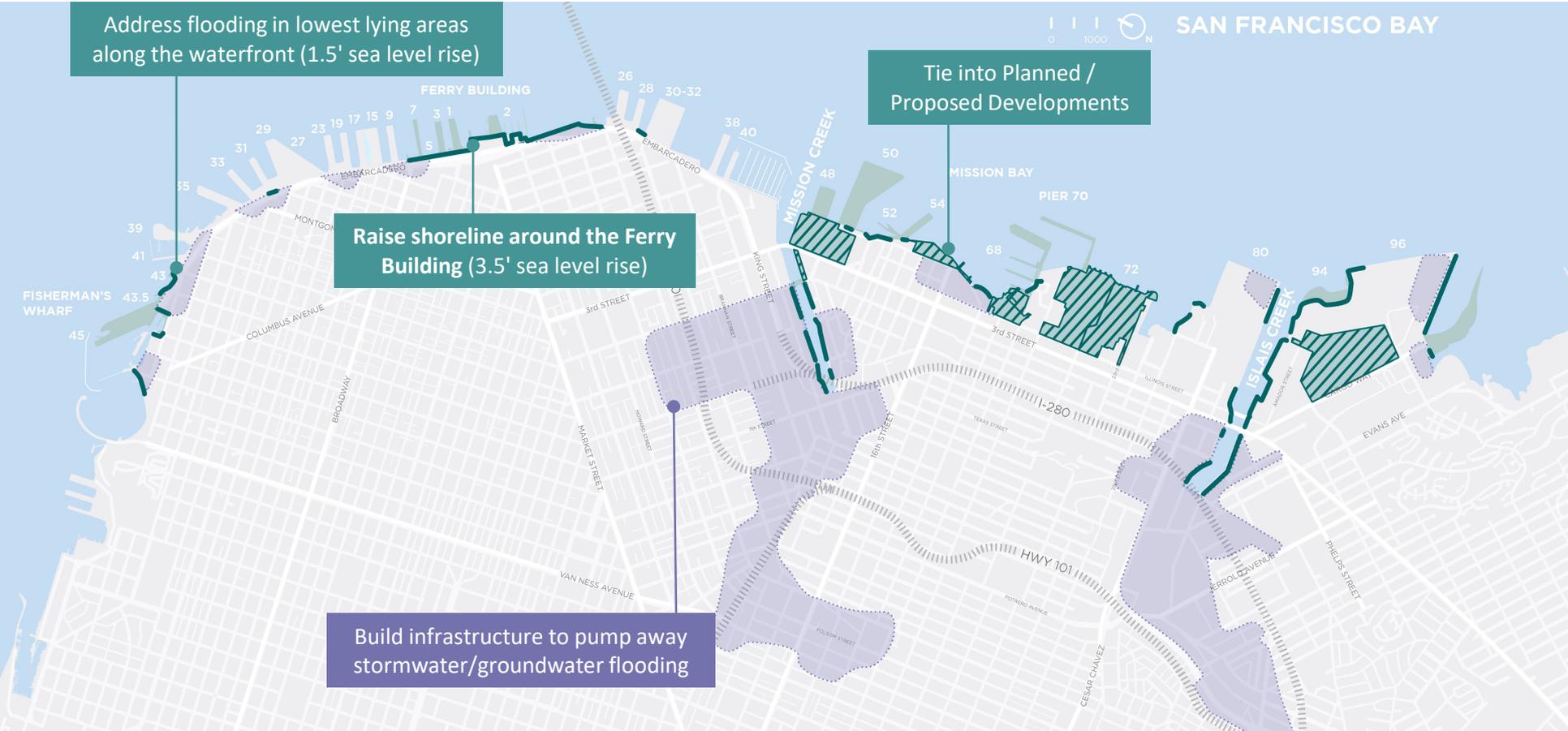
- Coastal Flood Defense
- Coastal Adaptation Zone
- Inland Adaptation Zone
- Planned / Proposed Developments

Address flooding in lowest lying areas along the waterfront (1.5' sea level rise)

Raise shoreline around the Ferry Building (3.5' sea level rise)

Tie into Planned / Proposed Developments

Build infrastructure to pump away stormwater/groundwater flooding



STRATEGY D – LOWER SEA LEVEL RISE – ADAPTABLE

2090

- Coastal Flood Defense
- Coastal Adaptation Zone
- Inland Adaptation Zone
- Planned / Proposed Developments

Raise remaining shoreline
(3.5' sea level rise)

0 1000' N SAN FRANCISCO BAY



Invest in additional infrastructure
to pump away stormwater/
groundwater flooding

Raise bridges and connected
roads/transit (3.5' sea level rise)

USACE SAN FRANCISCO WATERFRONT COASTAL FLOOD STUDY

Focused on Strategies E, F, and G

What if...
we **did not adapt**
to mitigate the
risks?

STRATEGY A

What if...
we adapted by
floodproofing
and **moving**
buildings and assets,
without coastal flood
structures?

STRATEGY B

What if...
we address flooding
at a **lower rate** of
sea level rise?

STRATEGY C

STRATEGY D

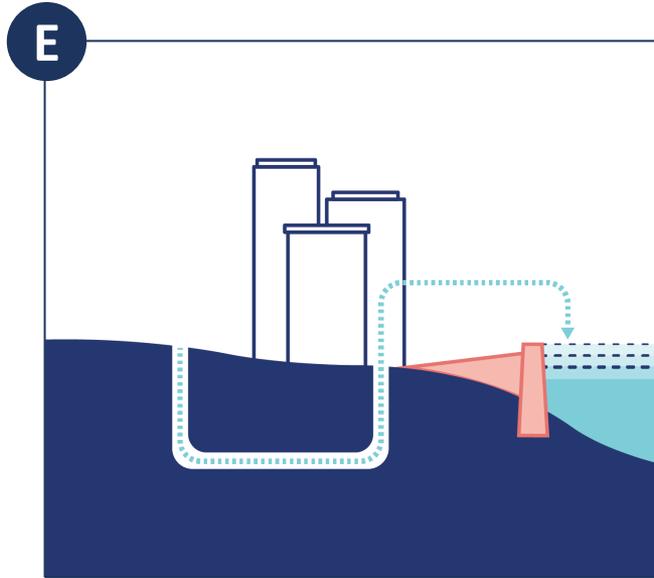
What if...
we address flooding
at a **higher rate** of
sea level rise,
as recommended
by **CA and SF**
guidance?

STRATEGY E

STRATEGY F

STRATEGY G

STRATEGY E – HIGHER SEA LEVEL RISE – HOLD THE LINE



Preserves a waterfront that looks and functions much as it does today by adapting the shoreline

STRATEGY E – HIGHER SEA LEVEL RISE – HOLD THE LINE

2040

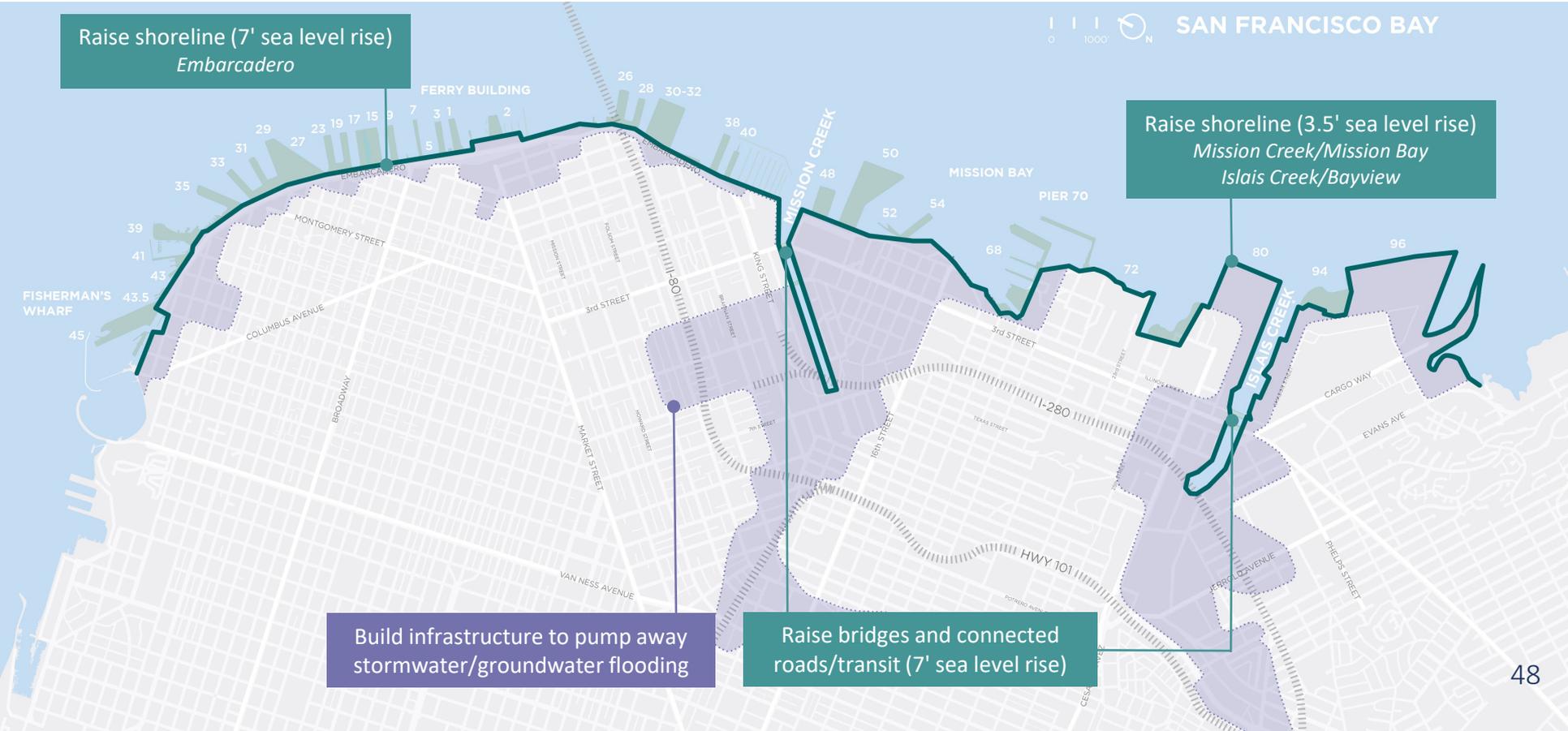
- Coastal Flood Defense
- Coastal Adaptation Zone
- Inland Adaptation Zone

Raise shoreline (7' sea level rise)
Embarcadero

Raise shoreline (3.5' sea level rise)
*Mission Creek/Mission Bay
Islais Creek/Bayview*

Build infrastructure to pump away
stormwater/groundwater flooding

Raise bridges and connected
roads/transit (7' sea level rise)



STRATEGY E – HIGHER SEA LEVEL RISE – HOLD THE LINE

Islais Creek / Bayview in 2090



STRATEGY E – HIGHER SEA LEVEL RISE – HOLD THE LINE

Mission Creek / Mission Bay in 2090



Redesign for a narrower Terry Francois Blvd

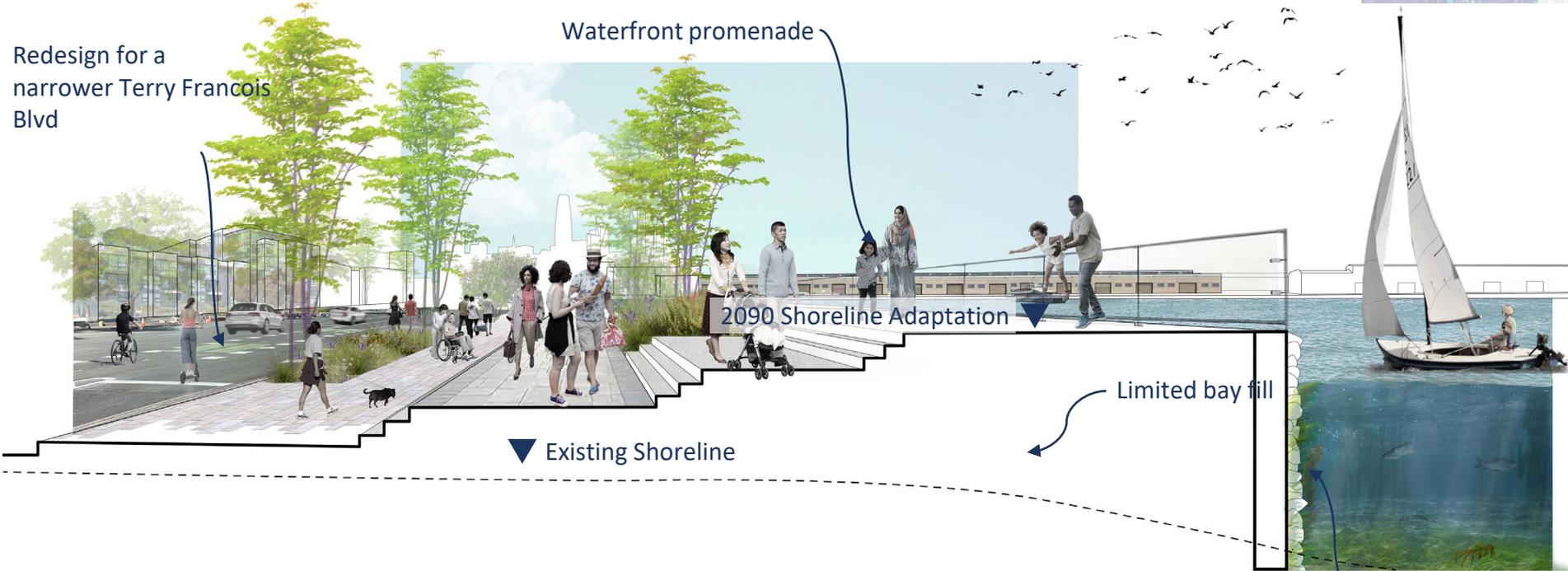
Waterfront promenade

2090 Shoreline Adaptation

Limited bay fill

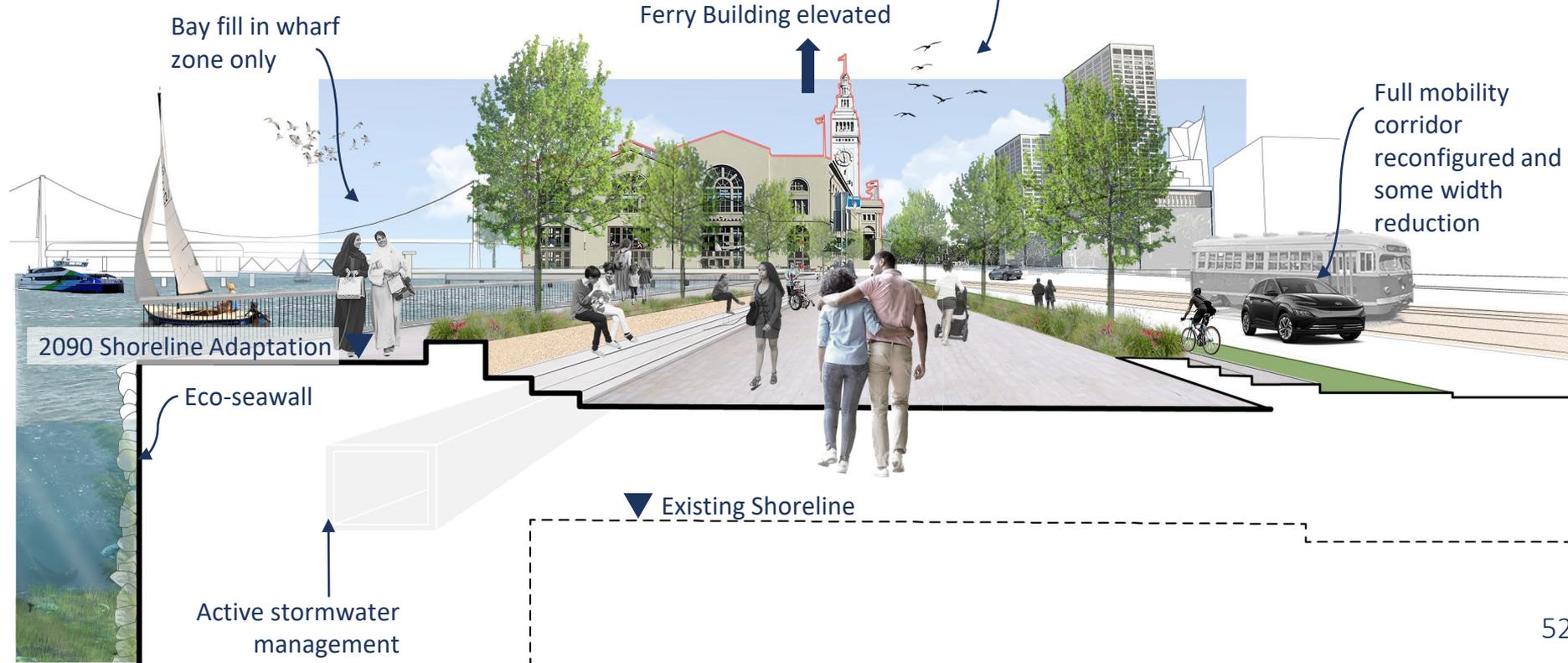
Existing Shoreline

Eco seawall

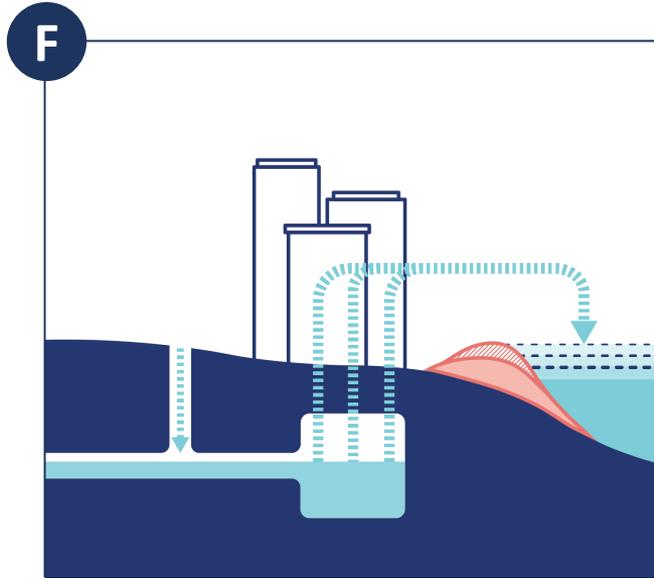


STRATEGY E – HIGHER SEA LEVEL RISE – HOLD THE LINE

Embarcadero in 2090



STRATEGY F – HIGHER SEA LEVEL RISE – MANAGE THE WATER



Creates an active system for managing flooding by heavily relying on machinery

STRATEGY F – HIGHER SEA LEVEL RISE – MANAGE THE WATER

2040

- Coastal Flood Defense
- Coastal Adaptation Zone
- Inland Adaptation Zone

Raise shoreline (7' sea level rise)
Embarcadero

0 1000' N SAN FRANCISCO BAY

Raise shoreline (3.5' sea level rise)
*Mission Creek/Mission Bay
Islais Creek/Bayview*

Build infrastructure to pump away
stormwater/groundwater flooding

Construct tide gates (7' sea level rise)
keeping roads, bridges in place

Adapt Port working
lands to flooding
(3.5' sea level rise)



STRATEGY F – HIGHER SEA LEVEL RISE – MANAGE THE WATER

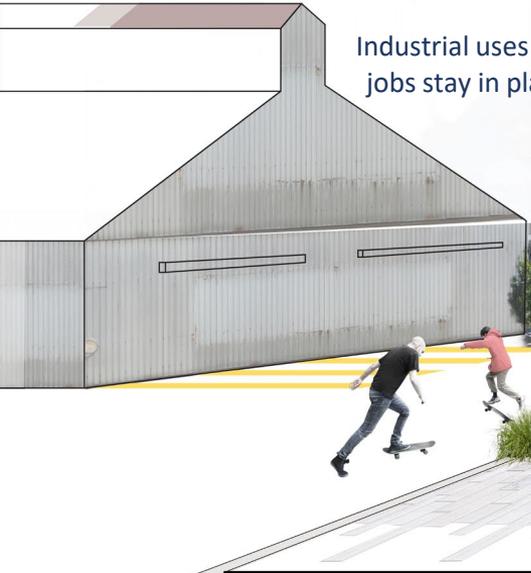
2090

- Coastal Flood Defense
- Coastal Adaptation Zone
- Inland Adaptation Zone



STRATEGY F – HIGHER SEA LEVEL RISE – MANAGE THE WATER

Islais Creek / Bayview in 2090



Industrial uses and jobs stay in place



Water access and recreational activities

Improved public access

2040 and 2090 Coastal Defense at Existing Shoreline

Eco seawall



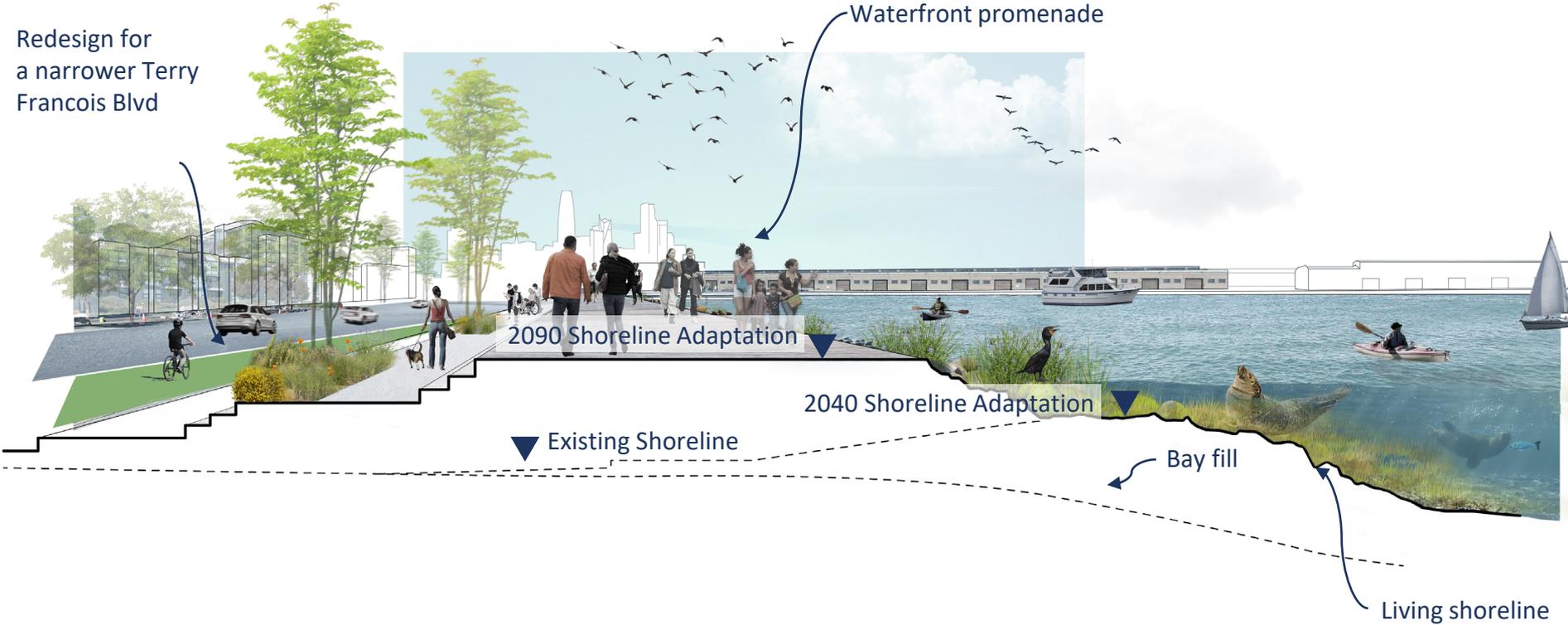
STRATEGY F – HIGHER SEA LEVEL RISE – MANAGE THE WATER

Mission Creek / Mission Bay in 2090



Redesign for
a narrower Terry
Francois Blvd

Waterfront promenade



2090 Shoreline Adaptation

2040 Shoreline Adaptation

Existing Shoreline

Bay fill

Living shoreline

STRATEGY F – HIGHER SEA LEVEL RISE – MANAGE THE WATER

Embarcadero in 2090



Elevated bayward promenade with public realm improvements

Ferry Building stays in place

Limited impacts to mobility corridor

Most bay fill

2090 Shoreline Adaptation

2040 Shoreline Adaptation

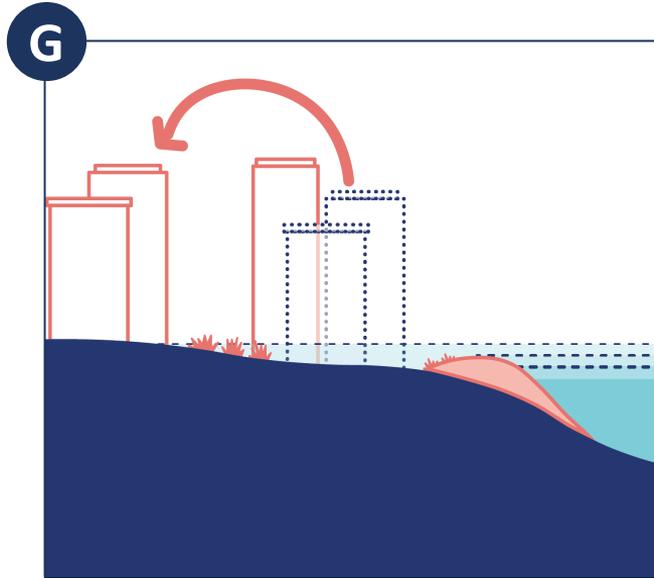
Habitat terraces

Active stormwater management

Existing Shoreline



STRATEGY G – HIGHER SEA LEVEL RISE – ALIGN WITH WATERSHEDS



Advances shoreline adaptation while working with natural inland flooding patterns to floodproof some buildings and infrastructure and move others away from the highest risk areas

STRATEGY G – HIGHER SEA LEVEL RISE – ALIGN WITH WATERSHEDS

2040

- Coastal Flood Defense
- Coastal Adaptation Zone
- Inland Adaptation Zone

Raise shoreline (7' sea level rise)
Embarcadero

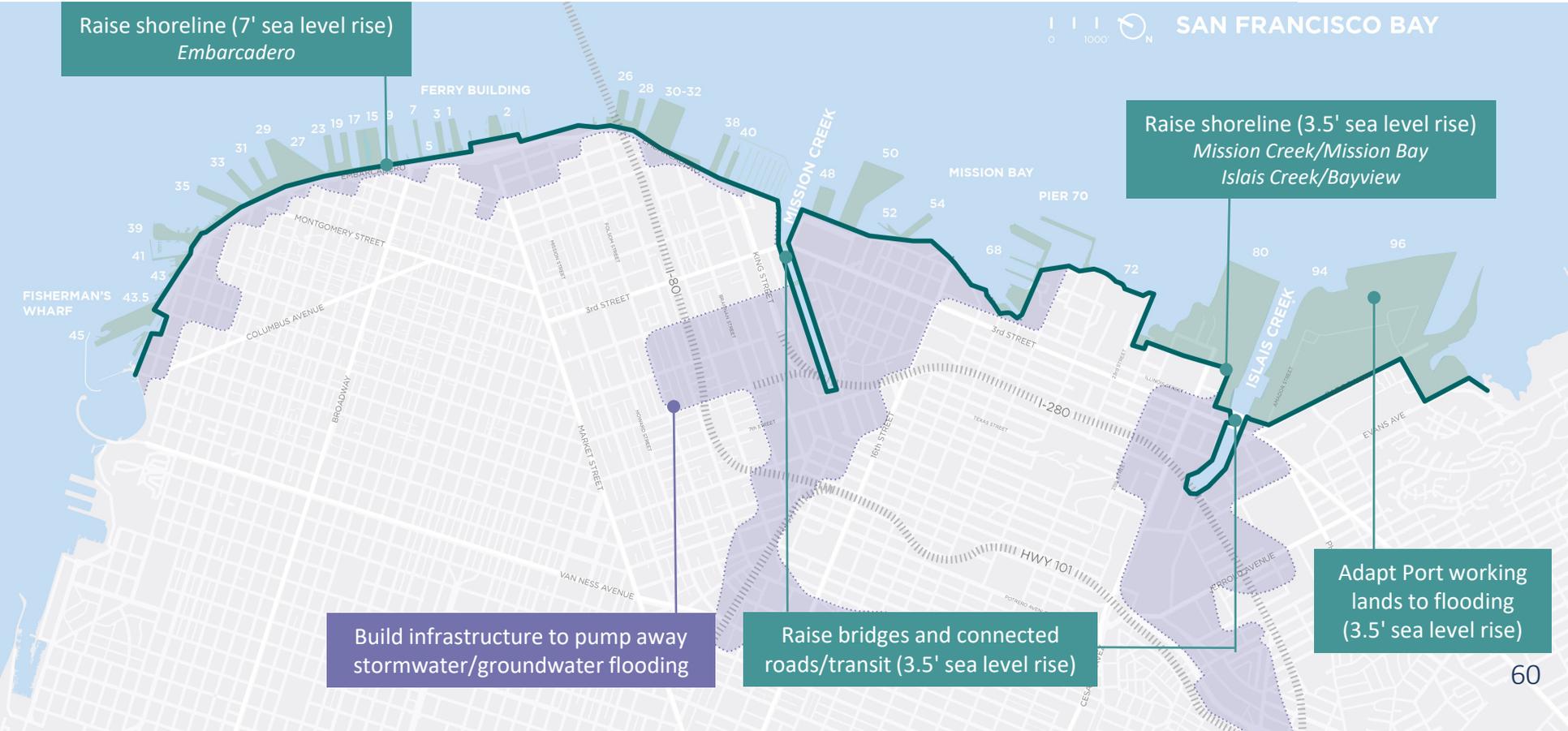
0 1000' N SAN FRANCISCO BAY

Raise shoreline (3.5' sea level rise)
*Mission Creek/Mission Bay
Islais Creek/Bayview*

Build infrastructure to pump away
stormwater/groundwater flooding

Raise bridges and connected
roads/transit (3.5' sea level rise)

Adapt Port working
lands to flooding
(3.5' sea level rise)



STRATEGY G – HIGHER SEA LEVEL RISE – ALIGN WITH WATERSHEDS

2090

- Coastal Flood Defense
- Coastal Adaptation Zone
- Inland Adaptation Zone

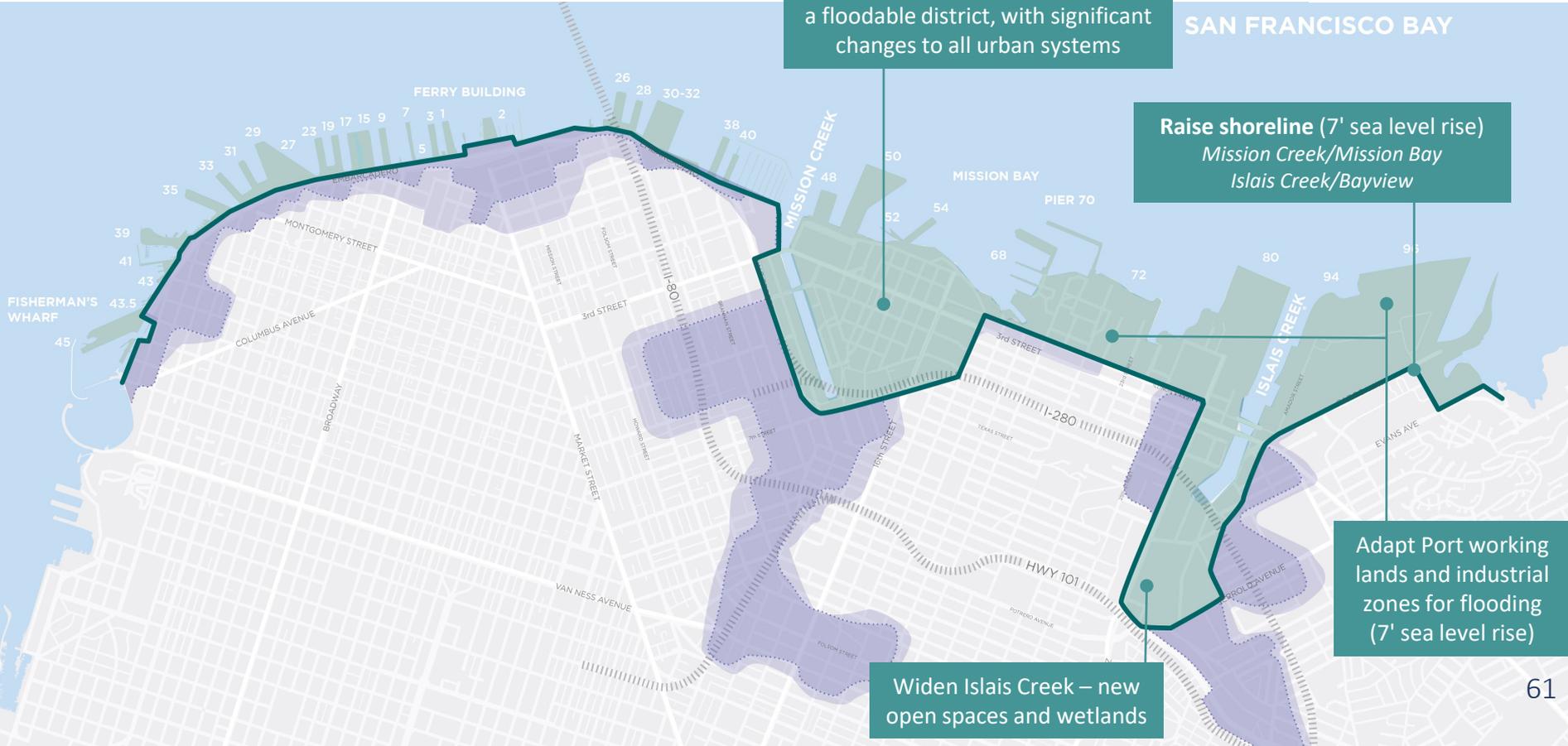
SAN FRANCISCO BAY

Mission Bay transformed to a floodable district, with significant changes to all urban systems

Raise shoreline (7' sea level rise)
Mission Creek/Mission Bay
Islais Creek/Bayview

Adapt Port working lands and industrial zones for flooding (7' sea level rise)

Widen Islais Creek – new open spaces and wetlands



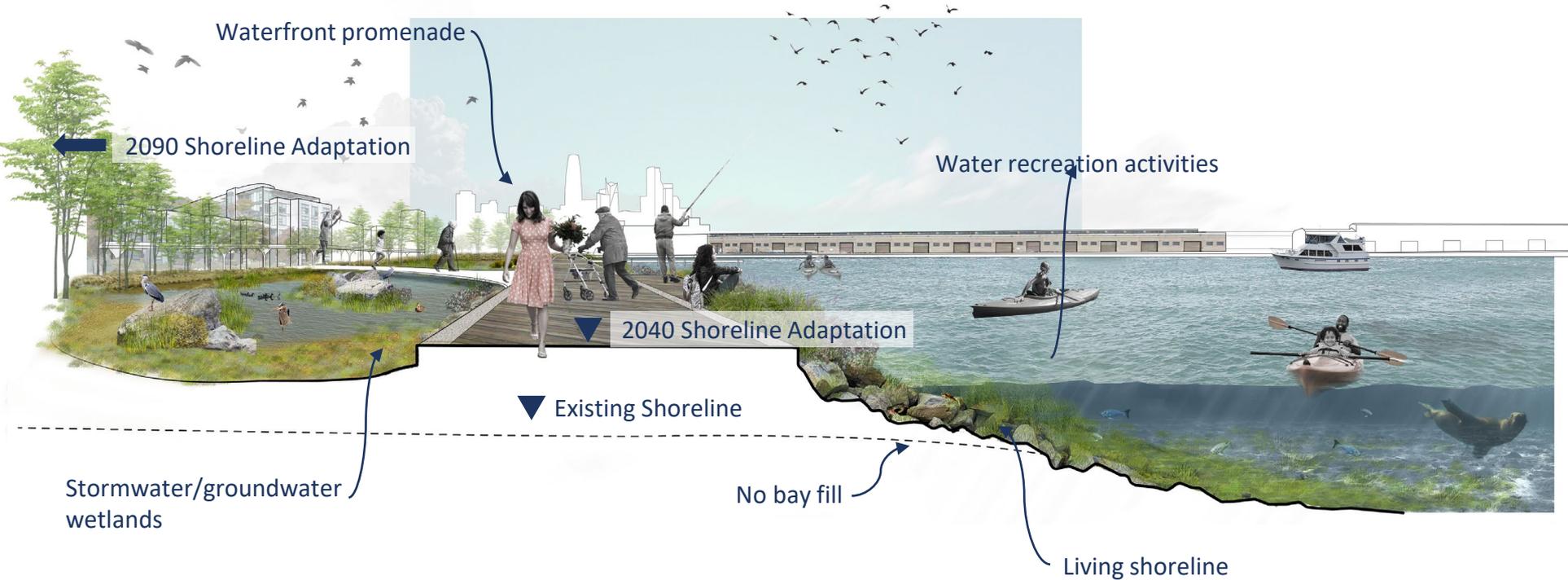
STRATEGY G – HIGHER SEA LEVEL RISE – ALIGN WITH WATERSHEDS

Islais Creek / Bayview in 2090



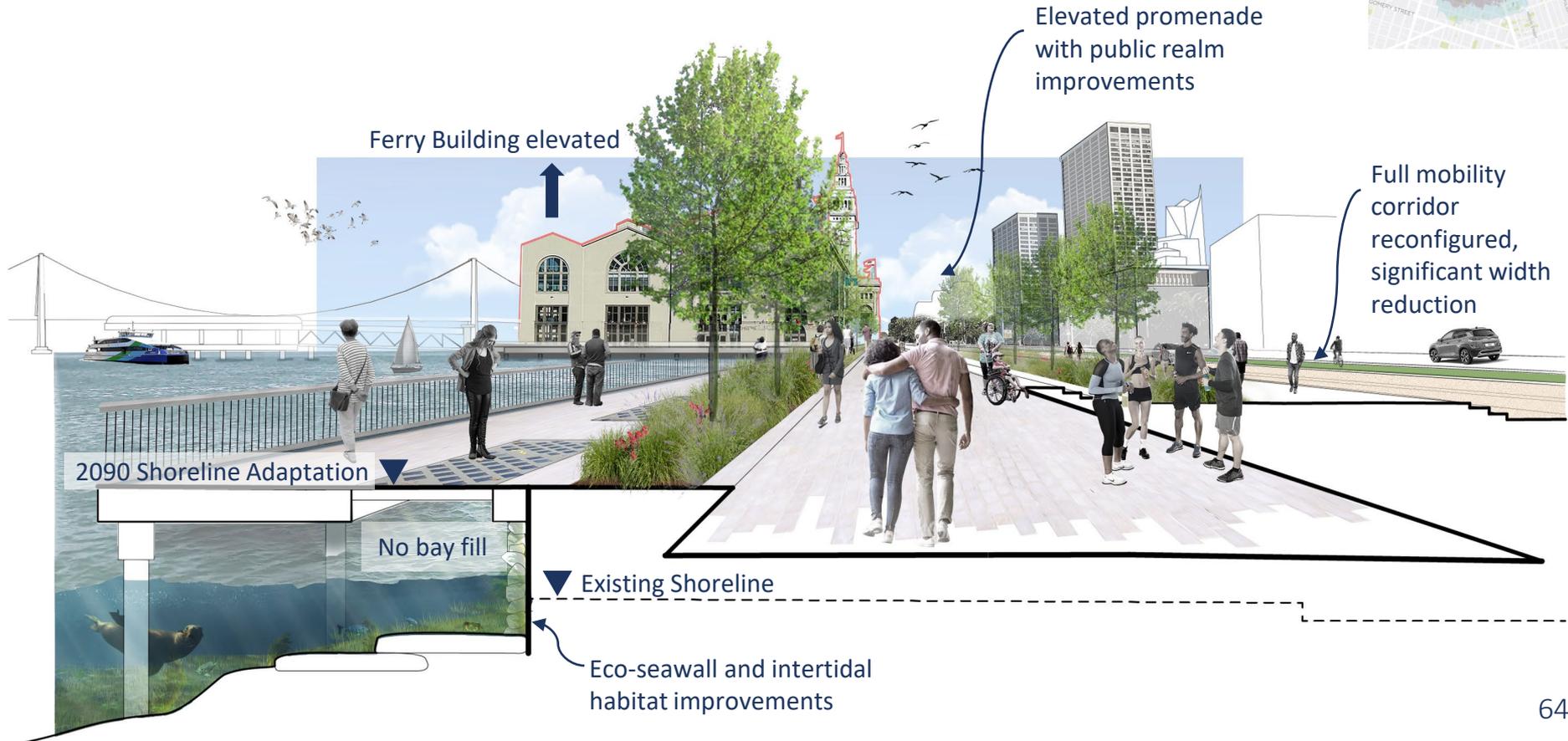
STRATEGY G – HIGHER SEA LEVEL RISE – ALIGN WITH WATERSHEDS

Mission Creek / Mission Bay in 2090



STRATEGY G – HIGHER SEA LEVEL RISE – ALIGN WITH WATERSHEDS

Embarcadero in 2090



Next Steps



DRAFT WATERFRONT ADAPTATION STRATEGIES DEVELOPMENT SCHEDULE



COMMUNITY ENGAGEMENT PLAN

OCT

NOV

DEC

JAN

Materials Live on sfport.com/wrp

Other Commission Meetings

Community Workshops /
Meetings

In Person Outreach via Walking Tours
and Waterfront Community Mixer

Digital Engagement via StoryMaps

Presentations to CACs, southern waterfront CBOs, etc.

Focus Groups by Geography



JOIN THE CONVERSATION

Different Options for Engaging



- Join us at an upcoming meeting – online or digital
- Forward the digital engagement tool to your friends and colleagues
- Join us at the upcoming Waterfront Community Mixer
- More information here: sfport.com/wrp

A photograph of two children riding bicycles on a dirt path. The child in the foreground is wearing a red and white shirt, white shorts, and a yellow helmet. The child in the background is wearing a dark jersey with the number 30 and a dark helmet. In the distance, a coastal town with buildings and a large ship is visible under a clear blue sky. The path is surrounded by dry, brushy vegetation.

Thank You

Adam Varat | adam.varat@sfport.com

