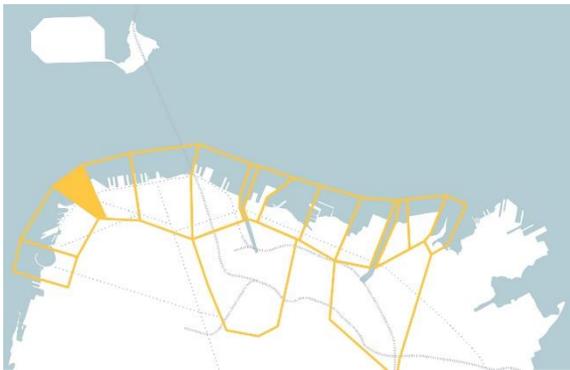




SHORELINE TYPE:	SEISMIC RISK ¹ :	FLOOD RISK ² :	
Engineered: Filled land retained by rock dike with pile supported concrete bulkhead wall and wharves. Second generation piers and wharves.	Shoreline Instability: High	Tipping Point Elevation:	65" above high tide
	Liquefaction Risk: High in Embarcadero Fill	Coastal Flood Events	Timing
	Shoreline Structure Vulnerability: Moderate to High		
Subsurface Profile: Non-engineered fill, shallow rock at Telegraph Hill, potential liquefiable sand layers	Unique Conditions: Shallower rock near Telegraph hill and second generation wharves and piers	100-yr Flood + 25" SLR	Today
		High tide + 66" SLR	2065 - 2095

SUBAREA DESCRIPTION



The Pier 31 to 35 subarea is located on the northeast corner of the Fisherman’s Wharf area. It contains Piers 31, 33, and 35, which are part of the waterfront’s active maritime industry and contribute to the Port’s Embarcadero Historic District. These piers provide berths for excursion terminals and fish processing. Telegraph Hill, including Pioneer Park, and North Beach are part of this subarea. The combination of current and historic maritime uses, industry, and jobs are critical parts of how the Port plans to support a diverse waterfront for generations to come.

The shoreline is hardened by the existing pier structures. The piers provide wave hazard reduction for the landward Embarcadero, but

the piers themselves are subject to wave impacts.

The primary flood pathway is from overtopping of the shoreline, initially at Pier 29½, resulting in inundation of a small portion of the pier and parking area. Higher bay water levels result in inundation of the Embarcadero roadway and adjacent seawall lots; however, this inundation is caused by overtopping in the adjacent Subarea 2-1. Floodwaters are conveyed by

¹ Shoreline Instability ratings within Embarcadero Seawall Program area based on advanced shoreline stability analysis and averaged over each subarea. Shoreline Structure Vulnerability based on Mean Damage Ratio calculated for the 225 year seismic event averaged across subarea.

² The timing of coastal flood events that will cause significant flooding in this subarea is provided as a range of dates based on the sea level rise projection scenarios provided by the California Ocean Protection Council (OPC) per the Likely and 1-in-200 chance of occurrence projections.

Pier 31-35

Subarea 1-3



the Embarcadero roadway into this subarea. Eventually, all piers within this subarea will be overtopped, resulting in subarea wide inundation that comingles with the adjacent subareas.

COMMUNITY IDENTIFIED PRIORITIES:	
Places <ul style="list-style-type: none">• Pier 35• Alcatraz Terminal	Since 2017, the Port has connected with tens of thousands of community members through the Waterfront Resilience Program. Public feedback collected about Piers 31 to 35 underscores the importance of preserving views of the bay, accessing water-based transportation, and creating opportunities for recreation. Community members also expressed a desire for a continuous and safe pedestrian and bicycle pathway that connects the waterfront. Further feedback highlights additional community priorities, including opportunities to improve public access to the waterfront and protecting utilities that keep neighborhoods and the city running.



FIRST FLOODING OF ASSETS

The chart below describes the vulnerability of specific assets within the Pier 31-35 subarea to flooding. These assets will be exposed to coastal flooding when the water level in the Bay reaches a certain height above the current high tide. The heights at which each asset is exposed to flooding is indicated with the shaded cells in the table. Over time and due to sea level rise these water levels can occur due to large storm events such as a 100 year flood of daily high tides. For example, the Embarcadero Roadway is exposed to flooding when the water rises 66 inches above current high tide, which could occur due to a 100 year flood with 3 ft. of sea level rise or as during daily high tide with 5.5 ft. of sea level rise.

● High Tide ○ 100 Year Flood ■ Shaded cells indicate the water levels at which assets are exposed to flood

SEA LEVEL RISE		WATER LEVEL ABOVE CURRENT HIGH TIDE										
		0"	12"	24"	36"	48"	52"	66"	77"	84"	96"	108"
Today		●				○						
1 ft. SLR			●				○					
3 ft. SLR					●				○			
5.5 ft. SLR								●				○
Historic and Cultural												
	Historic piers 31, 33, and 35								■	■	■	■
	-	-										
Disaster Response												
	Pier 35 Large Vessel Berth	N/A (Flooding not quantified for floating overwater or in-water assets)										
	Pier 35 Staging Area								■	■	■	■
	Seawall Lot 314 Staging Area							■	■	■	■	■
Open Space and Ecology												
	Bay Trail								■	■	■	■
	Chestnut and Kerry Open Space											>
	Promenade								■	■	■	■
	Telegraph Hill / Pioneer Park											>
Maritime												
	Alcatraz Landing								■	■	■	■
	Pier 31								■	■	■	■
	Pier 35								■	■	■	■



	Waterfront Plaza													
Transportation														
	Embarcadero Roadway													
	Muni Light Rail (E, F)													
Utilities														
	Embarcadero Transport / Storage Box	N/A (Buried assets are not directly impacted by flooding)												
	Jackson Transport / Storage Box													
	North Point Deepwater Outfalls													

EARTHQUAKE AND FLOODING RISK: MULTI-HAZARD RISK ASSESSMENT KEY FINDINGS FOR THIS SUBAREA

As detailed in the Seawall Earthquake Safety General Obligation Bond Report prepared when Proposition A was considered for the November 2018 ballot, the Port has spent the past two years assessing what is at risk on the Embarcadero waterfront when considering an earthquake or flood event to establish a basis for the development of Proposition A projects. This study is called the Multi-Hazard Risk Assessment, or MHRA.

We knew the Port’s aging Embarcadero Seawall was at grave risk from earthquakes. MHRA findings tell us there are areas more at risk of earthquake damage due to different soil conditions - and some less so.

Specifically, the historic bulkhead wharves and historic buildings at Piers 31, 33 and 35 within this subarea are at high risk within this subarea for seismic damage and increasing flood risk as sea level rises. This area of the Promenade and bulkhead wharves is highly active with pedestrians. The entire length of the Embarcadero roadway, including the segment within this subarea is at significant risk from an earthquake and the Embarcadero roadway is also one of the lowest elevations along the waterfront making it important to address as sea levels rise.

Here are some specific key findings that relate to this subarea:

- Up to 40,000 people could be at risk on Port property if an earthquake occurs during the day.
- Many historic buildings and bulkhead wharves are at high risk. The bulkhead wharves are the structures located where the pile supported piers over the Bay meet the land. These structures are interconnected with the Seawall and support the ornate, historic bulkhead buildings that line the Embarcadero. These structures are at high risk of earthquake damage and will flood with increasing sea levels.
- At just over 2 feet of sea-level rise, expected to occur between 2050 and 2075, the Embarcadero roadway and promenade will reach a tipping point where the 100-year flood causes widespread overtopping of the shoreline, resulting in significant disruption to multi-modal movement, cutting off landside access to all Port facilities and flooding the Financial District nearly to Beale Street. Such widespread flooding results in severe disruption and damage to the entire Embarcadero corridor and historic district, along with hundreds of other small businesses, residential and commercial uses, jobs and critical services, impacting not only the City but the greater Bay Area



region. Additionally, access to Port infrastructure via the Embarcadero is cut off which is expected to eliminate the ability for the Port to carry out its public trust responsibilities and maintain and operate critical City, State, and Port assets and services.

Disaster Response

Pier 35:

- Of the six deep draft berths along the northern waterfront, the Pier 27 and Pier 35 cruise ship terminals are the only facilities expected to be at least partially operational after a 225-year earthquake scenario, though access to both facilities may be impaired from the Embarcadero and wharf damage. At the 975-year earthquake, Pier 35 is expected to be unusable and access is further complicated at Pier 27. When functional and accessible, these two facilities can efficiently receive, store, and manage large volumes of emergency supplies during the recovery phase. Earthquake damage that reduces or eliminates deep draft berthing capacity and staging along the northern waterfront could restrict the flow of supplies required for short-term recovery efforts.
- Critical disaster response and recovery services are provided by all maritime infrastructure assets and functions, including for embarkation and debarkation; assembly and staging; berthing for deep-draft vessels; and centers for emergency response and operations.

Maritime

Pier 33:

- Regional enjoyment of the Bay is facilitated by water recreation, excursion, ferry, cruise, and ceremonial berth functions that are not replicated, or are scarce, within the region.
- Regional tourism is supported by cruise, excursion, and ferry services that are not replicated elsewhere in the region.

Utilities and Mobility:

Piers 31-35:

- Ground displacement (lateral spreading and liquefaction-induced settlement), rather than ground shaking, is expected to drive utility damage, with significant damage occurring by the 100-year earthquake level. Damage is anticipated to be widespread with likely hotspots, including Piers 31-35, primarily caused by local ground displacement differentials where pipes cross a transport storage box or other large underground structure.
- Co-location of utility and transportation systems. Utility pipelines run below the roadway, light rail, and promenade. Damaged utilities may impact the ability to use the road, and utility repairs or replacements will have major impacts on use during the work. In the event of a large earthquake, the severity of damages predicted to utility and transportation infrastructure suggests that full reconstruction of the Embarcadero may be needed.
- Evacuation and Emergency Response. Disruption to the utility and mobility systems will impact evacuations and emergency response for the 100-year earthquake level and beyond. Vehicle and pedestrian access will be slowed by the poor state of the roadway, potential flooding and ground failure caused by broken water mains, and potential overflow of wastewater onto the roadway. Potential breaks to the natural gas system and potential live electrical lines pose a threat to life safety while evacuation is underway.
- Overtopping and inland flooding will allow significant amounts of saltwater to enter the wastewater system, greatly increasing the volume of water that needs to be stored, conveyed, and treated. Under 2.2 feet of sea-level rise, a 100-year extreme tide will allow significant floodwater to enter through catch basins and manholes and mix with both sewer and stormwater. Coupled with wet weather, this could overwhelm the collection system and cause inland flooding and flooding in buildings with fixtures below the flood elevation, which will then be conveyed to the



lowest elevation via the city's roadways. In addition, the increased salinity in the wastewater system may impact treatment plant operations and increase corrosion rates of wastewater infrastructure.

Transportation

Piers 31-35:

- Transportation system earthquake damage hotspots are primarily located along the Embarcadero in the Northeast Waterfront. Due to the configuration of underground utilities, damage is likely to be most significant between North Point and Sansome streets (adjacent to Pier 31 through 35) and the Embarcadero between Broadway and Howard streets (adjacent to Pier 7 through Pier 14).
- The groundwater table will rise in unison with sea-level rise. By 2.2 feet of sea-level rise, the bedding underneath the Embarcadero roadway and SFMTA Muni light rail surface tracks will start to become continuously saturated, leading to a surge in operation and maintenance costs for the critical Embarcadero transportation corridor.

Historic Resources

- As a group, the bulkhead wharves and bulkhead buildings represent the greatest risk. Damage to or loss of the bulkheads would greatly affect the feeling of the district from the city side and could impact the district's integrity with regard to architecture, planning, engineering, and government.
- Under 3.3 feet of sea-level rise, the impact to the district is anticipated to be high, given daily flooding of key assets, assuming no preventative action is taken. Adaptation efforts as well as preservation, rehabilitation, restoration or reconstruction work after a flooding event should involve historic preservation stakeholders and be consistent with the Secretary of the Interior's Standards for the Treatment of Historic Properties.

Open Space and Public Realm

- Under 2.2 feet of sea-level rise, a 100-year flood will make the entire waterfront unusable and inaccessible due to widespread flooded areas. This same widespread inaccessibility would occur an average every 10 years under 3.3 feet of sea-level rise, and on a daily basis under 5.3 feet of sea-level rise.

Land Use

- At the higher water levels over 3.3 feet of sea-level rise, much of the North Beach/Fisherman's Wharf, Financial District, and South of Market/Mission Bay neighborhoods would begin to experience more frequent flooding.

WHAT IS AT STAKE?

Given the potential impacts of earthquakes, flooding, and future sea level rise, what is at stake in the Pier 31-35 subarea?

In Piers 31-35, earthquakes and sea level rise could impact residents' and visitors' ability to access waterfront open space, recreational opportunities, and historic resources, which could be impacted over time as the bay rises. Earthquakes could damage the piers and bulkhead buildings, resulting in debris and disruption while the area is cleared and repaired. Earthquake damage to the Embarcadero Roadway and Promenade could also result in significant and lengthy disruption to utility and mobility assets that are relied upon by local neighborhoods, the City, and the region. Jobs associated with the tourism industry would likely be impacted should a seismic and flood event create prolonged interruption of people accessing this part of the waterfront.



FUTURE POTENTIAL MEASURES UNDER CONSIDERATION IN THIS SUBAREA:

FLOOD MEASURES:

Physical Infrastructure		Ecological Infrastructure	
 Floodwalls	 Levees	 Ecological Marine Structures	 Ecological Features
 Seawalls	 Breakwaters	 Aquatic Habitat	 Ecological Shorelines
 Raised Marine Structures	 Building Adaptations		
 Tide Gates	 Deployables		

SEISMIC MEASURES:

Shoreline Stabilization

 Nearshore Buttress	 Landside Buttress	 Drilled Shafts	 Super Bulkhead Wharf
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Targeted Measures

 Bulkhead Wharf Retrofit	 Liquefaction Mitigation		
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FLOOD AND SEISMIC MEASURES:

Policy and Emergency Preparedness

 Policies and Zoning	 Emergency Preparedness		
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