

**CHAPTER 12**

# NEIGHBORHOOD CONSEQUENCES

In this chapter, all assets and infrastructure were evaluated together in each individual neighborhood to tell the story of SLR consequences – when does SLR inundation or coastal flooding due to extreme tides first occur, when do the impacts begin to affect the local residents within the neighborhood, and when do the impacts rise up and start to affect the entire city or larger San Francisco Bay region. This report uses the Planning Department’s official neighborhood map to describe neighborhood consequences (Figure 12.1). The 37 neighborhoods provide an appropriate scale to analyze multi-sector consequences overlain with the residents and businesses that may be the most affected.

This Assessment focuses on the neighborhoods that are directly impacted by SLR and coastal

flooding – those neighborhoods that directly border the San Francisco Bay and Pacific Ocean shorelines. Although inland neighborhoods may not experience direct flooding and inundation, SLR will indirectly affect them. Many of the City’s critical services – including major transportation roadways, regional transit connections, water supply systems, wastewater services, power systems, emergency fire protection services, disaster response staging areas, and more – are located within the City’s SLR Vulnerability Zone. Many of the City’s desirable shoreline parks and trails will be more frequently flooded over time. Although all of these potential impacts will affect the entire city, those residents that live and work within the SLR Vulnerability Zone, and in particular the City’s most vulnerable neighborhoods located near the shoreline, will be most directly affected.

This Assessment focuses primarily on City-owned assets, provides detailed information to better define and understand the City's vulnerabilities to SLR and the consequences of those vulnerabilities across the City, and highlights the timing of when adaptation intervention may be required within each neighborhood. This will help the City identify, plan, and prioritize future adaptation needs.

Numerous historic, cultural, and socially-important assets are at risk within each neighborhood. The vulnerability and consequences associated with these neighborhood assets have not yet been evaluated. As a next step, the City will work with communities to understand the assets they care about at the neighborhood level (Figure 12.1), the vulnerability of those assets to SLR and coastal flooding, and the consequences of flooding to the community. This in turn will help the City define and develop SLR adaptation strategies consistent with community values, goals, and priorities.

## 12.1 THE SHORELINE

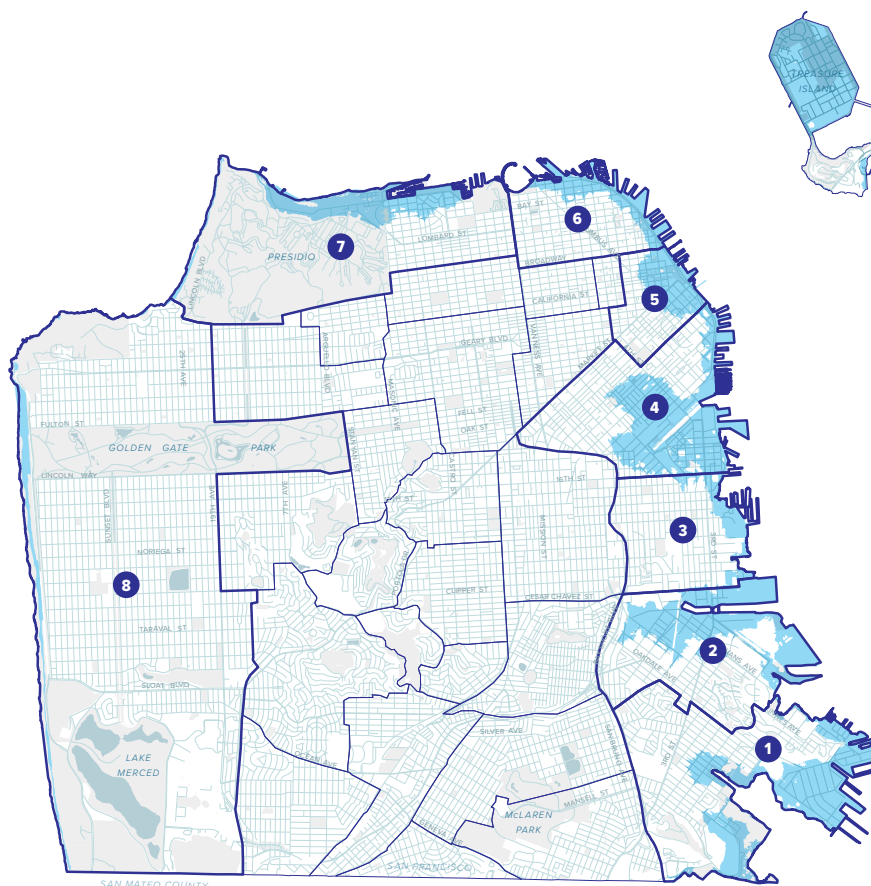
San Francisco is bounded by water on three sides with nearly 40 miles of shoreline. Along the Bay, much of the shoreline is engineered piers, seawalls, and wharves that are owned and managed by the Port of San Francisco. However, pockets of natural wetlands can be found that offer a diversity of wildlife benefits and outdoor recreation, including Heron's Head Park and India Basin Shoreline Park. Along the westside of the city, the shoreline includes both high coastal bluffs and sandy beaches, including the 3.5-mile-long Ocean Beach that attracts more than 300,000 visitors each year.

Shoreline vulnerability is a product of shoreline type (e.g., engineered shoreline structure, beach, wetland, or coastal bluff), the elevation of the shoreline relative to the Bay tides, and wave exposure. Engineered structures such as seawalls and levees<sup>1</sup> are less

<sup>1</sup> Engineered levees are not found within the San Francisco city limits; however, SFO is protected by a complex series of levees, seawalls, and floodwalls. SFO is leading a multi-year Shoreline Protection Program to address the airport's risk of flooding, both storm-related and from longer-term SLR (see Chapter 4).

**Figure 12.1**  
San Francisco's Neighborhoods

- 1 Bayview South / Hunters Point
- 2 Bayview North / Islais Creek
- 3 Potrero Hill / Central Waterfront
- 4 South of Market / Mission Bay
- 5 Financial District
- 6 North Beach / Fisherman's Wharf
- 7 Marina and Presidio
- 8 Westside / Ocean Beach





vulnerable to SLR and coastal storms until coastal water levels rise high enough to overtop the structures. However, the structural integrity of engineered structures can deteriorate over time, thereby increasing the vulnerability of these structures to extreme events.

San Francisco's Embarcadero seawall was constructed between 1879 and 1916. This structure allowed San Francisco to grow and thrive, but it has outlived its original engineering life. The City and the Port recognize the increasing vulnerability of the seawall, and have embarked on a multi-year Embarcadero Seawall Program to improve the seismic performance of the structure and provide flood protection. The Port and U.S. Army Corps of Engineers Flood Study have partnered to study flood risk and develop flood protection strategies along 7.5 miles of the San Francisco's bayside shoreline from Aquatic Park to Heron's Head Park. (See Chapter 4. *Supporting Assessments*.)

Natural shorelines such as beaches and wetlands are more vulnerable to SLR and coastal storms and are highly vulnerable to wave hazards that can erode the shoreline. Ocean Beach has experienced significant coastal erosion in the past, particularly during El Niño winters when large waves pound the shoreline and carry away large amounts of beach sand sediments. The erosion has damaged the Great Highway and parking areas and is threatening components of the City's combined wastewater system.

As sea levels rise, the potential for wave hazards and coastal erosion will increase (i.e., deeper ocean waters allow for the generation of larger waves). Coastal erosion of oceanfront beaches and bluffs will continue to change the westside shoreline over the coming century. The City was part of an extensive interagency and public process to develop the Ocean Beach Master Plan, a comprehensive long-term vision to address SLR, protect infrastructure, restore coastal ecosystems, and improve public access. The early phases of the master plan are currently in the implementation phase. (See Chapter 13. *A Changing Shoreline*.)

Although the Embarcadero Seawall Program, Flood Study, the Ocean Beach Master Plan are addressing critical near-term vulnerabilities along the shoreline, these projects do not address the entirety of the city's shoreline. In this Assessment, the entire shoreline was evaluated to understand when and where the shoreline is most likely to overtop as sea level rises.

Figure 12.2 highlights the shoreline areas where overtopping can occur based on the existing elevation of the shoreline and shoreline structures for four SLR scenarios. The inland area that could be inundated is also shown. Under Scenario 3, few shoreline reaches are overtopped, and the inland inundation is minimal. Under Scenarios 5 and 6, larger stretches of the shoreline are overtopped, and the extent of inland inundation increases. By Scenario 7, the majority of the shoreline is likely to be overtopped. The extent of shoreline overtopping and inland inundation for each of the 10 SLR Scenarios can also be viewed using the Adapting to Rising Tides Flood Explorer.<sup>2</sup>

Each neighborhood profile (see Section 12.4) includes a summary of the shoreline's characteristics, wave exposure, and where along the shoreline coastal waters could overtop the shoreline and result in inland flooding. The SLR scenario when overtopping is first likely to occur is also identified.

<sup>2</sup> The ART Bay Shoreline Flood Explorer allows for interactive exploration and download of the Bay Area SLR and shoreline analysis maps. These maps depict areas at risk of temporary or permanent flooding due to SLR and extreme tides as well as shoreline overtopping. Available at <https://explorer.adaptingtorisingtides.org/explorer>.

## 12.2 EXTREME TIDE AND SLR FLOODING

Identifying where along the shoreline floodwaters from extreme tide and SLR may overtop is important. However, identifying what and how many assets will be inundated when that overtopping occurs is also necessary for understanding the consequence story within each neighborhood. As sea levels rise, the extent of inundation will impact more and more assets across all sectors, causing a series of consequences that could range from the local scale (i.e., impacting only the inundated areas within a neighborhood, such as flooding of local streets), to the city-wide scale (i.e., impacting residents and businesses across the city, such as flooding of Recology's waste management and recycling services), to the regional scale (i.e., impacting residents and businesses across the region, such as flooding of the Embarcadero Muni/BART station).

In this Assessment, a “tipping point” has been identified for each neighborhood that highlights when inundation is impacting either multiple assets within a sector, or multiple assets across sectors, that increases the level of consequences to the city or the region. This tipping point is usually associated with a large jump in the number of residents and businesses that are impacted as well.

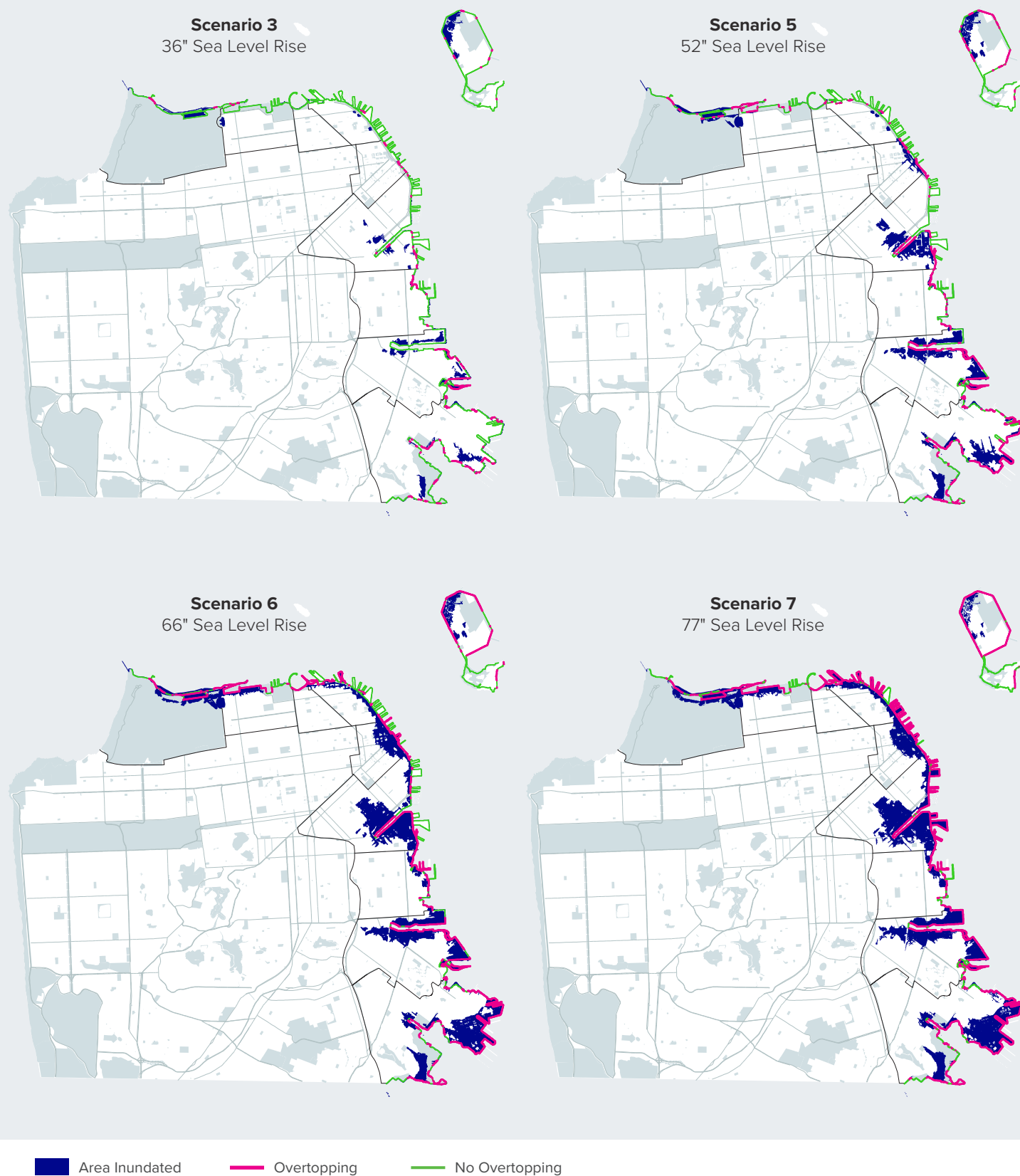
Each neighborhood profile (see Section 12.4) includes the progression of potential extreme tide and SLR flooding and a brief discussion of the City-owned assets that will be impacted. Additional details on the exposure, vulnerability, and consequences of extreme tide and SLR flooding on the city-owned assets can be found within the respective sector-based chapters.



High tides along Pier 14 / The Embarcadero. Dave Rauenbuehler (CC BY-NC 2.0)



Figure 12.2 Shoreline Overtopping for Select SLR Scenarios



## 12.3 RESIDENTS AND BUSINESSES EXPOSED TO FLOODING

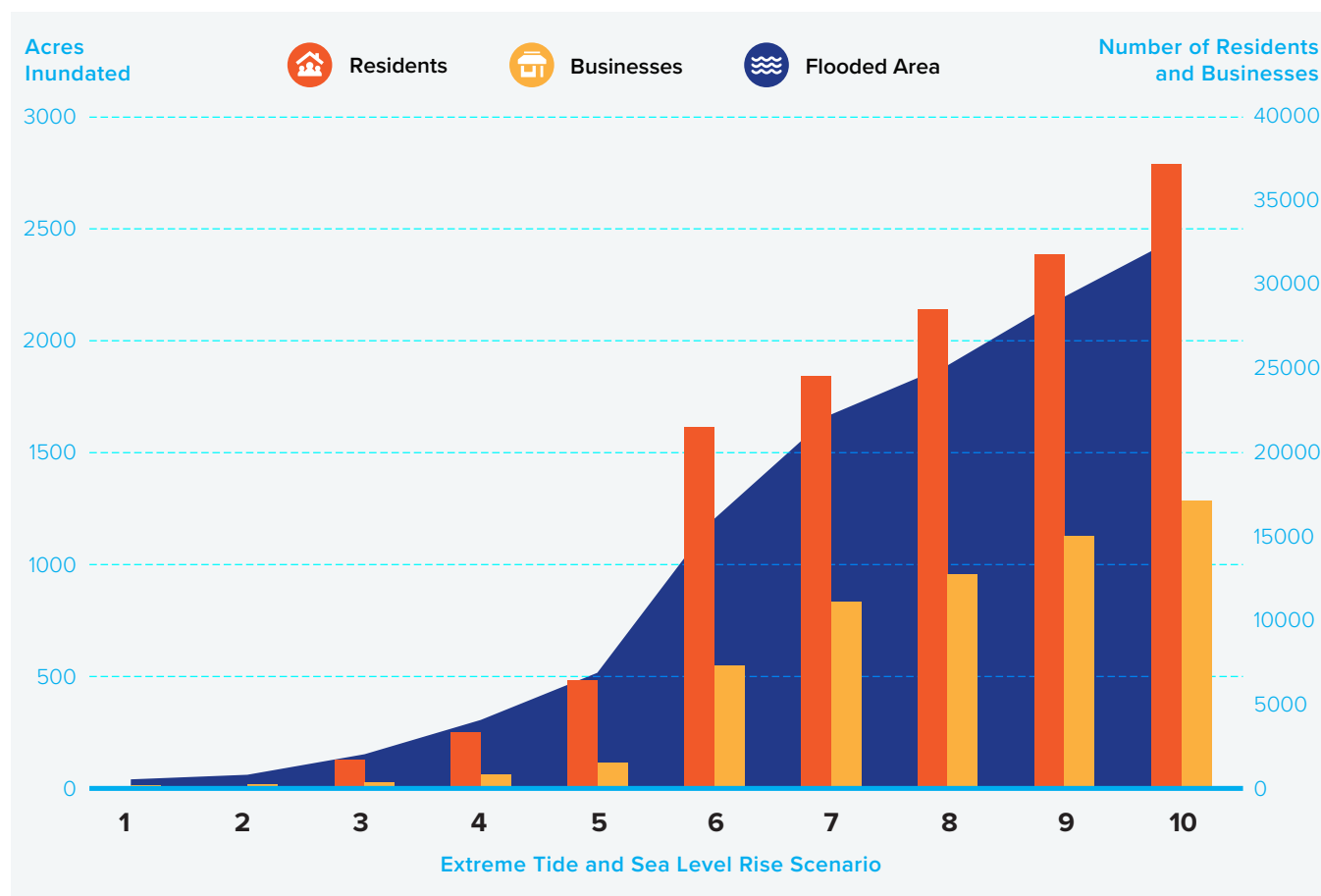
As extreme tides and SLR cause coastal waters to overtop the shoreline and inundate the City's critical infrastructure, residents and businesses will be directly affected by floodwaters. Figure 12.3 presents the number of residents and businesses that could be inundated under each SLR scenario, along with the total area of the city that could be inundated. The neighborhood profiles (see Section 12.4) include this information relative to each specific neighborhood.

## 12.4 NEIGHBORHOOD PROFILES

Neighborhood profiles were developed for each neighborhood that borders the shoreline, as shown in Figure 12.1 – including Bayview South/Hunters Point, Bayview North Islais Creek, Potrero Hill/

Central Waterfront, South of Market/Mission Bay, Financial District, North Beach and Fisherman's Wharf, Marina and Presidio, and Westside/Ocean Beach. Due to the distinct geographical differences along the shoreline, the Bayview neighborhood was divided into two profiles, with Bayview/Hunters Point including a higher concentration of residents and Bayview North Islais Creek including more industrial land use. The North Beach, Fisherman Wharf, and Russian Hill neighborhoods were combined into one profile, as Russian Hill has limited assets within the SLR Vulnerability Zone due to its steeper topography. The Marina and Presidio neighborhoods were also combined into one profile; this report does not include a detailed assessment of the Presidio shoreline. All of the westside shoreline neighborhoods were combined into one profile as few assets are located within the SLR Vulnerability Zone and the character of the shoreline is similar for purposes of description of vulnerability.

**Figure 12.3** Residents and Businesses Exposed to Flooding







## NEIGHBORHOOD PROFILE

# BAYVIEW SOUTH HUNTERS POINT

Aerial view of Bayview Hunters Point. Photo by Sergio Ruiz

The Bayview/Hunters Point neighborhood, located on the southeastern edge of San Francisco, contains the southern portion of the Bayview residential neighborhood (south of Palou Avenue), the southern Bayview industrial zone, and the Hunters Point Shipyard and Candlestick Point redevelopment area. The 3rd Street corridor is the primary neighborhood commercial district serving adjacent communities with a variety of neighborhood-serving businesses. The neighborhood's industrial area is the second most important labor market for Bayview residents, next to downtown San Francisco.<sup>1</sup> The neighborhood includes major open spaces, including Bayview Park, India Basin Park, and Candlestick Point State Recreation Area, as well as several neighborhood parks, such as Gilman Playground.

Bayview/Hunters Point is ethnically diverse with large Black, Asian, and Latino populations,<sup>2</sup> and a strong African American cultural legacy. The neighborhood has been subjected to significant historical and environmental injustices, and has high social vulnerability, with high poverty, crime,

unemployment, and hospitalization rates relative to San Francisco.<sup>3</sup> Most of the area is included within MTC's Communities of Concern.<sup>4</sup> The neighborhood has a strong cultural and economic life, including high rates of women- and minority-owned businesses,<sup>5</sup> a burgeoning local food and beverage industry, and a multitude of worship centers and community benefit organizations.

Hunters Point, has serious environmental challenges, with the former Naval shipyard's surrounding census tracts identified by CalEnviroScreen as being in the top 10 percent in California for pollution burden from cleanups, groundwater threat, hazardous waste, solid waste, and impaired water.<sup>6</sup> The Hunters Point Naval Shipyard has been identified as a federal superfund site. See Chapter 9.5 *Public Safety – Contaminated Lands*.

1 United States Census Bureau. Longitudinal Employer-Household Dynamics (LEHD). 2010. On the Map. Zip Code 94124. Available at <https://onthemap.ces.census.gov/>.

2 American Community Services (ACS). 2016. Social Explorer. Available at <https://www.socialexplorer.com/a9676d974c/explore>.

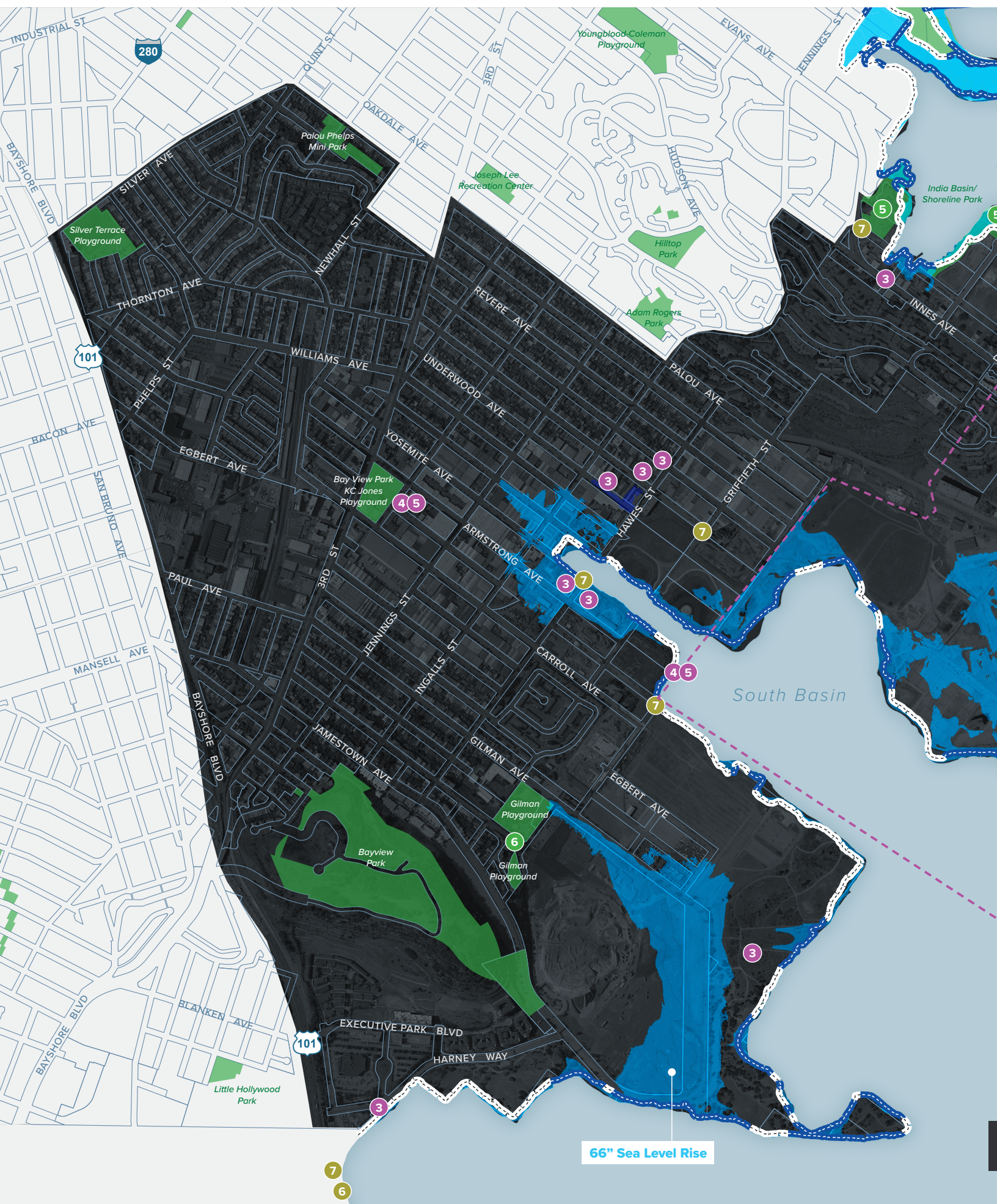
3 American Community Services (ACS). 2016. Social Explorer. Available at <https://www.socialexplorer.com/a9676d974c/explore>.

4 <http://opendata.mtc.ca.gov/datasets/mtc-communities-of-concern-in-2018-ac-2012-2016?geometry=-122.496%2C37.696%2C-122.322%2C37.744>

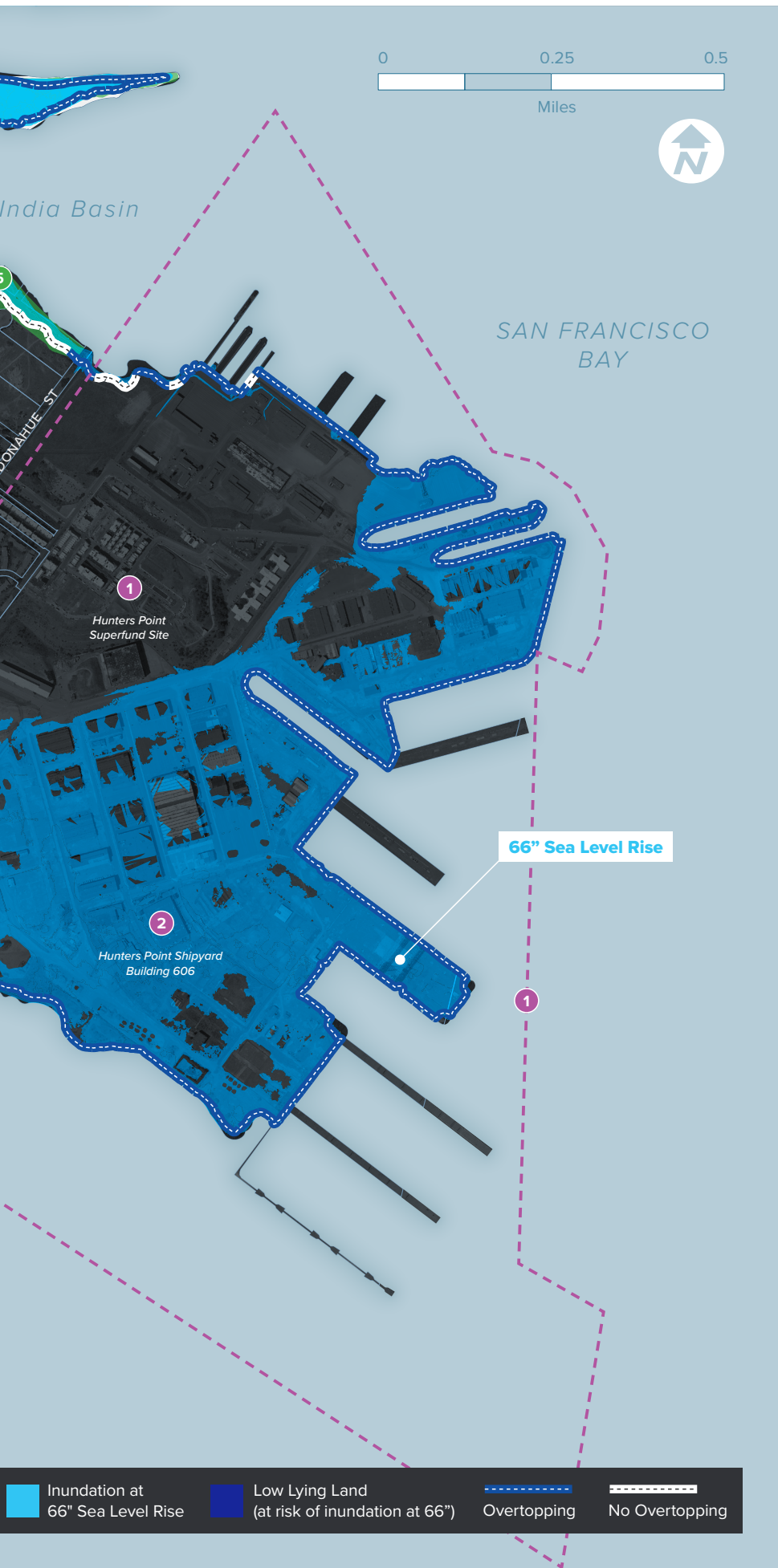
5 The San Francisco Indicator Project. Bayview/Hunter's Point Neighborhood Indicator Profiles. Available at <http://www.sfindicatorproject.org/neighborhoods/view/1>.

6 California Environmental Protection Agency (CalEPA) and Office of Environmental Health Hazard Assessment (OEHA). 2017. CalEnviroScreen 3.0. Available at <https://oehha.ca.gov/media/downloads/calenviroscreen/report/ces3report.pdf>.

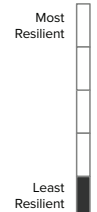
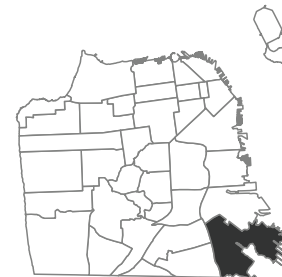








## Bayview South Hunters Point



**NEIGHBORHOOD RESILIENCY SCORE: 1**

Hazard Score: 1  
Environmental Score: 1  
Transportation Score: 1  
Community Score: 2  
Public Realm Score: 1  
Housing Score: 2  
Economy Score: 1  
Health Score: 1  
Demographics Score: 1

Source: San Francisco Climate & Health Program Neighborhood Summary  
<https://climateandhealth.org/neighborhood/>



### PUBLIC SAFETY

- 1 Hunters Point Superfund Site
- 2 Hunters Point Shipyard Building
- 3 Contaminated Land
- 4 Fireboat Pump Station
- 5 Fire Suction Connection



### WASTE WATER

- 6 Sunnysdale Pump Station
- 7 Combined Sewer Discharge (CSD)



### OPEN SPACE

- 8 India Basin Shoreline Park
- 9 Gilman Playground



Bayview Farmer's Market. Dale Cruse (CC BY 2.0)

Bayview/Hunters Point includes the Hunters Point Shipyard/Candlestick Point redevelopment area, which would nearly double the population of the entire Bayview/Hunters Point area by 2030.<sup>7</sup> The Hunters Point Shipyard, a former naval base, is a master-planned community located along the south-eastern waterfront of San Francisco.

Phase I of the Shipyard Project, which includes the Hillside and Hilltop areas, is completing the infrastructure and will ultimately include up to 1,428 homes and 20,000 square feet of commercial space. Hunters Point Shipyard and Candlestick Point Phase II covers approximately 702 acres in San Francisco's Bayview Hunters Point and Hunters Point Shipyard neighborhoods. The amended plan for the area calls for mixed-use development consisting of up to 10,672 residential units that includes a mix of affordable and market rate units, 1,146,000 square feet of neighborhood and regional retail, 4.4 million square feet of research and development/office, and 328 acres of open space.

The Shipyard Project includes SLR adaptation strategies. See Chapter 13, *A Changing Shoreline* for more detail.

## The Shoreline

The Bayview South Hunters Point neighborhood has 9.5 miles of Bay shoreline. Approximately 7.2 miles is hardened and engineered shoreline, including

<sup>7</sup> Data SF. SF Development Pipeline 2018 Q1. Available at <https://data.sfgov.org/Housing-and-Buildings/SF-Development-Pipeline-2018-Q1/dg6z-zdpi>.



Hunters Point Naval Shipyard. Flickr user Sanfranman59

piers, seawalls, and wharves. As sea level rises, wave hazards can exceed 3 feet in height<sup>8</sup> along the shoreline fronting the Hunter's Point Naval Shipyard and Hunters Point Shipyard Artists community. Wave hazards can increase the potential for coastal erosion of natural shorelines and wave damage to engineered shorelines. As sea level rises, the potential for wave hazards increases, because deeper Bay waters allow for the generation of large waves.

The remaining 2.3 miles of shoreline is natural, including India Basin Shoreline Park and the 170-acre Candlestick Point State Recreation Area. The parks are popular for fishing and bird watching. Bird watching is best in the winter when migrant waterfowl and shorebirds are numerous in the Bay, but pelicans, egrets, and hawks can also be seen throughout the year. Candlestick Point is also a popular entry point for windsurfing on the Bay.

Under Scenario 3 (36 inches) two small stretches of shoreline are overtopped, leading to minor inundation of the Hunters Point Naval Shipyard and Candlestick Point; however, no structures are impacted. At Scenario 4 (48 inches), overtopping increases and several structures are inundated. By Scenario 6 (66 inches), the inundation extends inland, and the impacts could become widespread.<sup>9</sup>












<sup>8</sup> Federal Emergency Management Agency, Preliminary Flood Insurance Rate Maps.




<sup>9</sup> The ART Bay Shoreline Flood Explorer allows for interactive exploration and download of the Bay Area SLR and shoreline analysis maps. These maps depict areas at risk of temporary or permanent flooding due to SLR and extreme tides as well as shoreline overtopping. Available at <https://explorer.adaptingtorisingtides.org/explorer>.



## Extreme Tide and SLR Flooding Vulnerabilities and Consequences

The scenarios below describe the progression of potential extreme tide and SLR flooding, along with a brief discussion of the City-owned assets that will be impacted, within the Bayview South Hunters Point neighborhood. Additional details on the exposure, vulnerability, and consequences of extreme tide and SLR flooding on City-owned assets can be found within the respective sector-based chapters. The relevant chapters are referenced below, as appropriate.

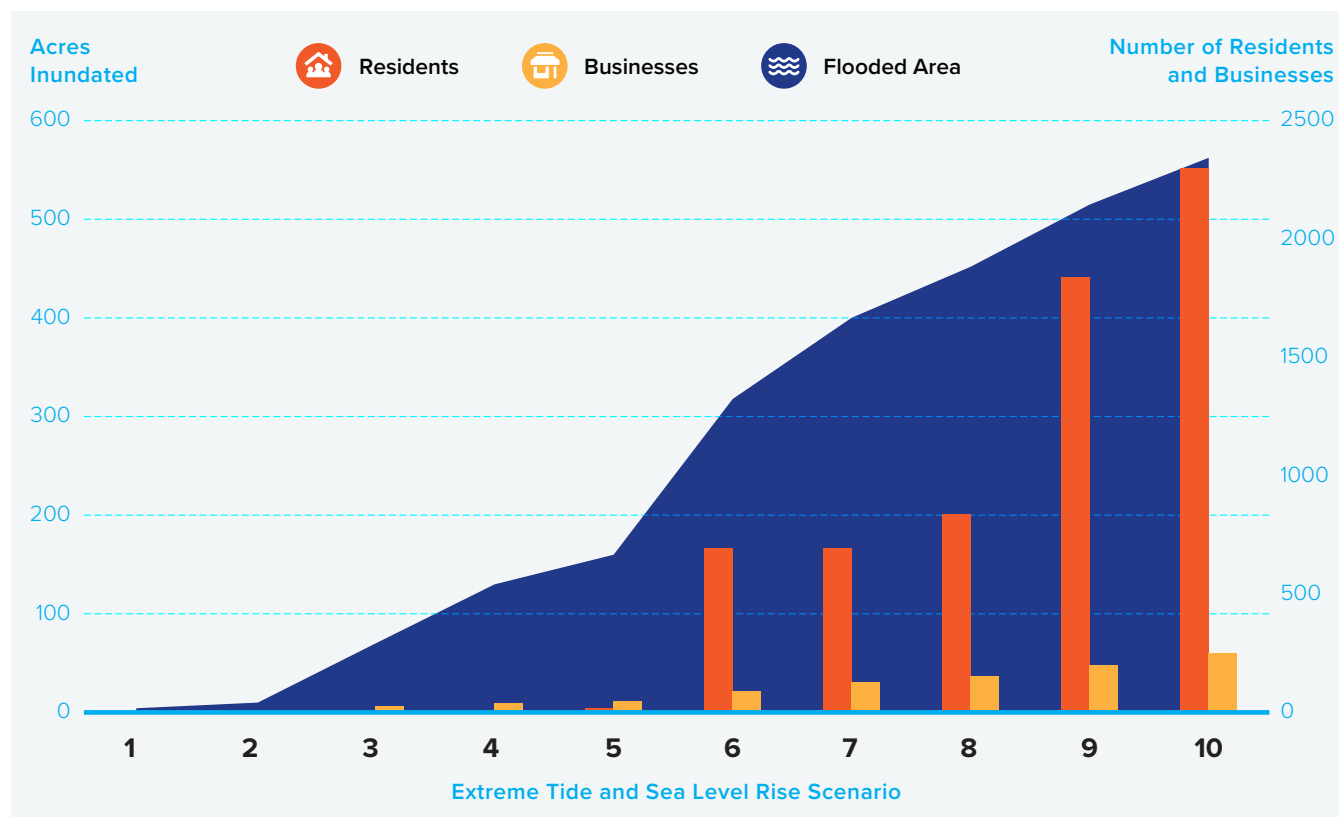
Scenario	Sector	Vulnerabilities and Consequences
<b>Scenario 1</b> (12 inches of SLR or a high tide with a 1-year recurrence interval)		<b>Open Space:</b> The fringing wetland areas along the Bay shoreline, including India Basin Shoreline Park, already experience regular inundation during high tides today. As sea levels rise, the wetlands may keep pace with SLR and continue to provide marsh habitat, or they may be submerged. The wetlands are expected to keep pace with SLR until mid-century; however, as SLR accelerates after mid-century, the wetlands may be lost if sediment doesn't accumulate fast enough to support wetland growth (due to deeper Bay levels).
<b>Scenario 2</b> (24 inches of SLR or 12 inches of SLR and a high tide with a 1-year recurrence interval)		<b>Wastewater:</b> Under Scenario 2, the higher Bay water levels may reduce the gravity-driven flow of excess combined wastewater and stormwater from the transport / storage boxes to the Bay through the combined sewer discharge outfalls (Chapter 7). This impact is only of concern during intense and prolonged rainfall events that exceed the capacity of the large underground transport / storage boxes that ring the city. This could result in an increase in localized flooding in low-lying areas.  Sunnydale pump station located on Harney Way between US 101 and the Bay is also impacted at Scenario 2. This belowgrade pump station serves the Sunnydale drainage basin during wet weather with a pumping capacity of 50 mgd. The pump station currently experiences intermittent coastal flooding; however, to date, the impacts have been negligible. Repairs and flood proofing measures are planned.
		<b>Public Safety:</b> One fire suction connection (part of the emergency firefighting water system) that allows fire engines to draw water from the Bay for fire suppression is inundated. Suction connections become unusable if they are inundated.
<b>Scenario 3</b> (36 inches of SLR or 12 inches of SLR and a high tide with a 5-year recurrence interval)	 	<b>Public Safety / Open Space:</b> Two small stretches of shoreline are overtopped under Scenario 3, resulting in inundation within the Candlestick Point State Recreation Area and the southern edge of Hunters Point Naval Shipyard.
		<b>Power:</b> In Scenario 3, flooding would create impacts to streetlights. If the streetlights are flooded temporarily for a short period, limited damage is likely to occur, and the streetlight will remain functioning. However, if streetlights are flooded for a prolonged period, the electrical infrastructure is likely to fail, rendering the streetlight inoperable and the roadway or sidewalk dark during the night.
<b>Scenario 4</b> (48 inches of SLR or 6 inches of SLR and a 100-year extreme tide)	 	<b>Public Safety / Open Space:</b> With Scenario 4, the Hunters Point Shipyard Building is inundated.
<b>Scenario 5</b> (54 inches SLR or 12 inches SLR and a 100-year extreme tide)		<b>Open Space:</b> Under Scenario 5, floodwaters overtop the Bay shoreline and impact public access areas within India Basin Shoreline Park.
<b>Scenario 7</b> (36 inches of SLR and a 100-year extreme tide)		<b>Open Space:</b> Approximately 12 percent of the Gilman Playground is inundated under Scenario 7. Flooding is limited to the playfields.
<b>Scenario 8</b> (36 inches SLR and a 100-year extreme tide)		<b>Power:</b> At Scenario 8, the Hunters Point substation is first exposed. Electric substations are extremely vulnerable to SLR and coastal flooding, and flooding of any type could interrupt power service for hours to weeks depending on the extent of damage.

Scenario	Sector	Vulnerabilities and Consequences
<h3>Scenario 9</h3> <p>(52 inches of SLR and a 100-year extreme tide)</p>		<b>Power:</b> Under Scenario 9, overhead lines and utility poles are exposed and vulnerable to flooding.
<h3>Scenario 10</h3> <p>(66 inches of SLR and a 100-year extreme tide)</p>	 	<b>Open Space:</b> Approximately 50 percent of the Gilman playground is inundated under Scenario 10. The clubhouse and playstructure remain outside of the inundation zone. <b>Mobility:</b> Two SFMTA facilities, the Paint and Meter Shops located at 1538 Yosemite Street and the Sign and Meter Shops located at 1508 Bancroft Street, could be impacted under Scenario 10. These facilities operate together, and impacts to both facilities could result in delays and disruptions to field operations and access to appropriate signage that could result in safety issues and concerns in flooded areas throughout the city.

## Residents and Businesses Exposed to Extreme Tide and SLR Flooding

As extreme tides and SLR overtop the Bay shoreline and flood the city's critical infrastructure, residents and businesses in the path of the floodwaters will be affected. Few residents and businesses are affected until Scenario 6 when approximately 90 business and 700 residents could be impacted, primarily in the vicinity of Yosemite Slough and the Candlestick RV Park.

For more information about particular properties and buildings are affected under different scenarios, use the *Adapting to Rising Tides Bay Shoreline Flood Explorer*.<sup>10</sup>



<sup>10</sup> <https://explorer.adaptingtorisingtides.org/home>





## NEIGHBORHOOD PROFILE

# BAYVIEW NORTH ISLAIS CREEK

Islais Creek at night. Photo by Patrick Boury

The Bayview North Islais Creek neighborhood located on the southeastern edge of San Francisco, and includes the industrial zone surrounding Islais Creek and the northern section of the Bayview residential area (north of Palou Avenue). The area contains several key infrastructure assets that serve the entire City, including the Southeast Wastewater Treatment Plant, Port cargo facilities, Recology Recycle Center, and multiple transportation storage, maintenance, and operation facilities. The neighborhood contains the northern portion of the 3rd Street neighborhood commercial district. Third Street, including the T-Third Light Rail line, is a critical north-south transportation route for Bayview residents. Third Street and the T-Third cross Islais Creek along the 3rd Street Bridge; the Illinois Street bridge is the only other roadway crossing over Islais Creek. The neighborhood contains several shoreline open spaces and wetland habitat, such as Heron's Head Park.

Bayview Islais Creek is ethnically diverse with large Black, Asian, and Latino populations,<sup>9</sup> and has a strong African American cultural legacy. The neighborhood has been subjected to significant historical and environmental injustices, and has high social vulnerability, with high poverty, crime,

unemployment, and hospitalization rates relative to San Francisco.<sup>1</sup> Most of the area is included within MTC's Communities of Concern.<sup>2</sup> The neighborhood has a strong economic and cultural life, with high rates of women- and minority-owned businesses, numerous community benefit organizations, worship centers, and arts and culture organizations, such as the Bayview Opera House.

The Islais Creek watershed has environmental challenges due to the long-standing presence of industrial uses and freight transportation. The neighborhood contains areas identified by CalEnviroScreen as being in the top 10 percent in California for pollution burden from hazardous waste, solid waste, and impaired water.<sup>3</sup> See Chapter 9.5 *Public Safety – Contaminated Lands* and 9.6 *Public Safety – Hazardous Materials Sites*.

1 American Community Services (ACS). 2016. Social Explorer. Available at <https://www.socialexplorer.com/a9676d974c/explore>.

2 <http://opendata.mtc.ca.gov/datasets/mtc-communities-of-concern-in-2018-ac-2012-2016?geometry=-122.496%2C37.696%2C-122.322%2C37.744>

3 California Environmental Protection Agency (CalEPA) and Office of Environmental Health Hazard Assessment (OEHHA). 2017. CalEnviroScreen 3.0. Available at <https://oehha.ca.gov/media/downloads/calenviroscreen/report/ces3report.pdf>.

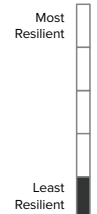








## Bayview North Islais Creek



**NEIGHBORHOOD RESILIENCY SCORE: 1**

Hazard Score: 1  
Environmental Score: 1  
Transportation Score: 1  
Community Score: 2  
Public Realm Score: 1  
Housing Score: 2  
Economy Score: 1  
Health Score: 1  
Demographics Score: 1

Source: San Francisco Climate & Health Program Neighborhood Summary  
<https://climateandhealth.org/neighborhood/>



### PUBLIC SAFETY

- 1 Fire Station #25
- 2 Forensic Service Police Department
- 3 Emergency Firefighting Water System (EFWS) Yard
- 4 Fire Station #9
- 5 Fireboat Pump Station
- 6 Fire Suction Connection
- 7 Fireboat Manifold



### TRANSPORTATION

- 8 3rd Street Bridge
- 9 Illinois Street Bridge
- 10 Marin Yard
- 11 Islais Creek Division
- 12 Burke Warehouse



### WASTEWATER

- 13 Rankin Pump Station
- 14 Davidson Pump Station
- 15 Booster Pump Station
- 16 Bruce Flynn Pump Station
- 17 Southeast Pump Station
- 18 Southeast Treatment Plant
- 19 Combined Sewage Discharge (CSD)



### OPEN SPACE

- 20 Herons Head
- 21 Pier 92 Wetlands
- 22 Islais Plaza/Islais Creek Park
- 23 Tulare Park
- 24 Fireman's Plaza Park
- 25 Gateway Park



### PORT

- 26 India Basin Marina
- 27 Pier 92: industrial, cargo ship loading
- 28 Intermodal Container Transfer
- 29 Pier 80: working pier and railroad connection
- 30 3rd Street/Cargo Way Triangle
- 31 Pier 80 Administration Building
- 32 Pier 80 Quonset Building



The City received funding from CalTrans to study flood protection and develop strategies to address SLR adjacent to Islais Creek through the Islais Creek Adaptation Strategy. The Strategy will develop a long-range vision for the Islais Creek shoreline that protects transportation infrastructure, enhances shoreline access and habitat, and nurtures community resiliency in adjoining neighborhoods. Islais Creek is also contained with the Port and U.S. Army Corps of Engineers Flood Study, which will study flood risk along San Francisco's bayside shoreline.

## The Shoreline

The Bayview North Islais Creek shoreline is 5.3 miles long, with 3.1 miles of Bay shoreline and 2.2 miles of shoreline along the Islais Creek inlet. Along the Bay, the shoreline is primarily engineered bulkheads, piers, and wharf structures that are owned and managed by the Port. The shoreline also boasts some of San Francisco's only wetlands, including the 22-acre Heron's Head Park – a thriving wildlife habitat that attracts more than 100 bird species a year. Within the Islais Creek inlet, the shoreline is primarily engineered. However, small strips of natural shoreline are located between the inlet and the inland developed areas. Some of these areas are designated as parks with public shoreline access.

Along the Bay shoreline, the wave hazards can exceed 3 feet in height,<sup>4</sup> creating the potential for coastal erosion of natural shorelines and wave damage to engineered shorelines. As sea level rises, the potential for wave hazards will increase, because deeper Bay waters allow for the generation of larger waves. The shoreline is first overtopped in Scenario 3 (36 inches); however, the inundation impacts are localized to a relatively small area along Islais Creek. The tipping point for Bayview North Islais Creek occurs in Scenario 5 (52 inches of SLR, or 12 inches of SLR coupled with a 100-year extreme tide) when larger stretches of the shoreline are overtopped and significant impacts to transportation occur.<sup>5</sup>



Southeast Wastewater Treatment Plant. Marcin Wichary



The T-Third muni train at 3rd and Marin street. Patrick Boury












Trail at Heron's Head Park. Bob Gunderson



<sup>4</sup> Federal Emergency Management Agency, Preliminary Flood Insurance Rate Maps.

<sup>5</sup> The ART Bay Shoreline Flood Explorer allows for interactive exploration and download of the Bay Area SLR and shoreline analysis maps. These maps depict areas at risk of temporary or permanent flooding due to SLR and extreme tides as well as shoreline overtopping. Available at <https://explorer.adaptingtorisingtides.org/explorer>.

## Extreme Tide and SLR Flooding Vulnerabilities and Consequences

The scenarios below describe the progression of potential extreme tide and SLR flooding, along with a brief discussion of the City-owned assets that will be impacted, within the Bayview North Islais Creek neighborhood. Additional details on the exposure, vulnerability, and consequences of extreme tide and SLR flooding on City-owned assets can be found within the respective sector-based chapters. The relevant chapters are referenced below, as appropriate.

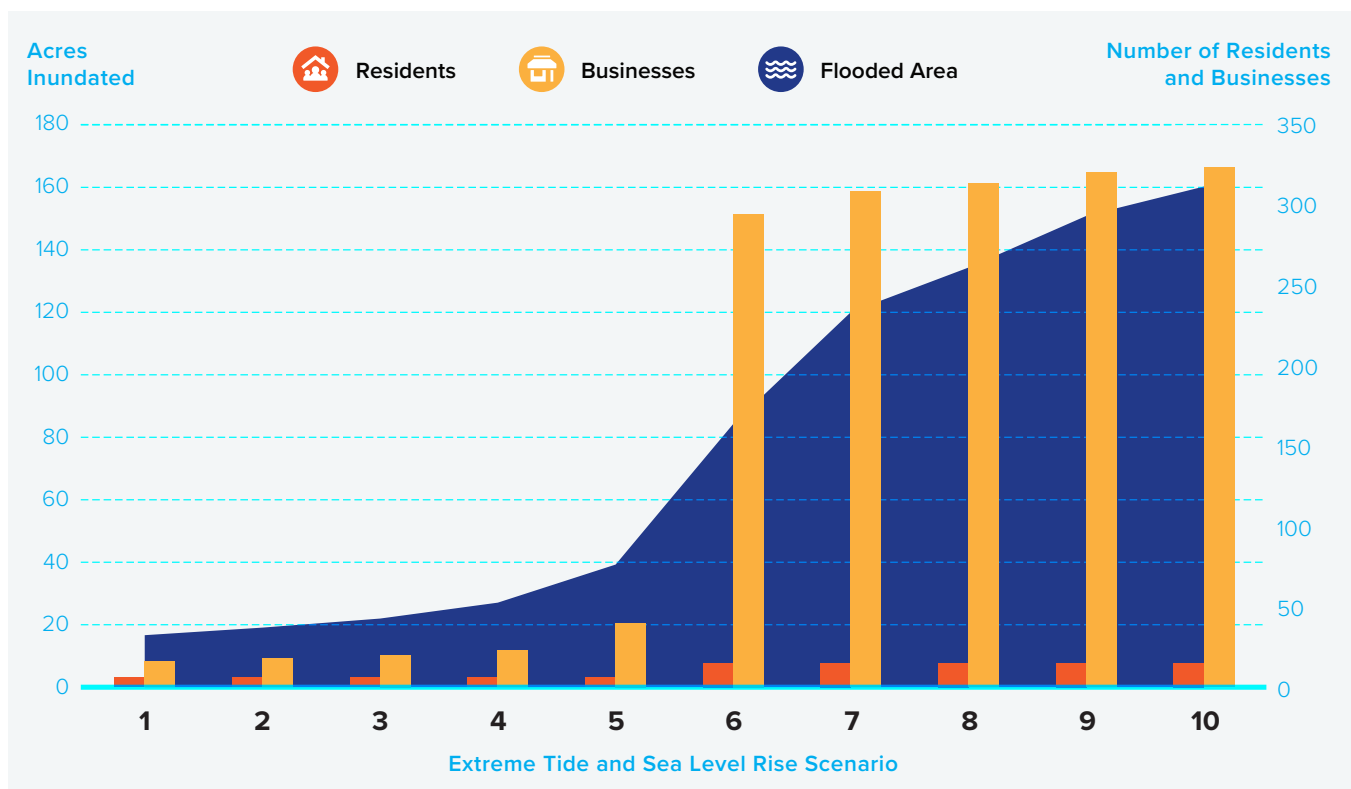
Scenario	Sector	Vulnerabilities and Consequences
<b>Scenario 1</b> (12 inches SLR or an annual extreme high tide with a 1-year recurrence interval)		<b>Open Space:</b> The wetland areas along the Bay shoreline and within Islais Creek, including Heron's Head Park and the India Basin Shoreline, already experience regular inundation during high tides today. As sea levels rise, the wetlands will either keep pace with SLR and continue to provide valuable habitat, or they will be submerged. The wetlands are expected to keep pace with SLR until mid-century; however, as SLR accelerates after mid-century, the wetlands may be lost if sediment doesn't accumulate fast enough to support wetland growth (due to deeper Bay levels).
<b>Scenario 2</b> (24 inches SLR or 12 inches SLR and an annual extreme high tide with a 1-year recurrence interval)		<b>Wastewater:</b> Under Scenario 2, the higher Bay water levels may reduce the gravity-driven flow of excess combined wastewater and stormwater from the transport / storage boxes to the Bay (Chapter 7). This impact is only of concern during intense and prolonged rainfall events that exceed the capacity of the large underground transport / storage boxes that ring the city. This could result in an increase in localized flooding in low-lying areas.
		<b>Public Safety:</b> Four fire suction connections (part of the emergency firefighting water system, discussed in Chapter 6) that allow fire engines to draw water from the Bay for fire suppression are inundated. Suction connections become unusable if they are inundated.
<b>Scenario 3</b> (36 inches SLR or 12 inches SLR and an annual extreme high tide with a 5-year recurrence interval)		<b>Public Safety:</b> A small stretch of shoreline (< 0.1 miles) is first overtopped under Scenario 3. The flooding is localized to Pier 96, impacting the Recology Recycle Central. Disruption of Recology's waste management and recycling services could have a citywide impact on waste collection and recycling efforts, resulting in additional public safety and health hazards from the local buildup of household and commercial waste.
<b>Scenario 4</b> (48 inches SLR or 6 inches SLR and a 100-year extreme tide)		<b>Port:</b> With Scenario 4, the shoreline is overtopped along the south side of Islais Creek onto Pier 92. The flooding impacts the Port's Pier 92 industrial and cargo ship loading facilities, as well as the Intermodal Container Transfer station (Chapter 10).
		<b>Public Safety:</b> One fire boat manifold (part of the emergency firefighting water system) will be inundated at this scenario. Fire boats may still be able to make a secure connection to the manifold even if it is inundated. If the fire boats cannot make a connection, and the emergency firefighting water system loses pressure, the system may become unusable.
<b>Scenario 5</b> (54 inches SLR or 12 inches SLR and a 100-year extreme tide)		<b>Port:</b> Under Scenario 5, Port operations will be impacted at Pier 80, which has two working cranes for loading and offloading, and connections to the rail line for goods movement. Pier 80 is also included in FEMA's emergency response plan as a location for staging and moving debris following a disaster, and the pier serves as an oil spill response equipment storage location. Pier 90, the Port's maritime maintenance facility, and the 3rd Street/Cargo Way Triangle are also impacted under Scenario 5.
		<b>Wastewater:</b> Two small wastewater pump stations (Rankin and Davidson) are also inundated under Scenario 5. Davidson is a belowgrade 1-mgd all-weather pump station that serves a small industrial and commercial area adjacent to I-280. Rankin is a belowgrade 3-mgd wet-weather pump station at the intersection of Rankin Street and Davidson Avenue. During wet weather, this pump station serves a local area of the Islais Creek drainage basin. Impacts at these pump stations could result in localized flooding; however, the larger Bayview North Islais Creek neighborhood would not be impacted.
		<b>Power:</b> In Scenario 5, flooding would create impacts to streetlights and overhead transmission lines. If the streetlights are flooded for a short period, limited damage would occur, and would remain functioning. However, if streetlights are flooded for a prolonged period, the electrical infrastructure is likely to fail, causing the streetlight to be inoperable. The overhead lines and utility poles would also be impacted and vulnerable under Scenario 5.

Scenario	Sector	Vulnerabilities and Consequences
	 <b>Transportation:</b>	Under Scenario 5, the impacts to transportation quickly become citywide in scale. The approaches to both bridges across Islais Creek (the 3rd Street Bridge and the Illinois Street Bridge) will be inundated, with cascading consequences to goods movement to and from Pier 90-96 via both the rail line and heavy truck traffic across the Illinois Street Bridge, public transportation across the 3rd Street Bridge via the Muni T-Third line, and pedestrian, bicycle, and vehicle traffic in and out of Bayview.
	 <b>Open Space:</b>	Scenario 5 would also create impacts to open space and shoreline access, including Islais Creek Park and Gateway Park.
<b>Scenario 6</b> (66 inches SLR or 24 inches SLR and a 100-year extreme tide)	 <b>Wastewater:</b>	At Scenario 6, three wastewater pump stations could be inundated (Southeast, Bruce Flynn, and Booster), significantly impacting the conveyance of stormwater and wastewater to and from the Southeast Treatment Plant. The 70-mgd Southeast lift station serves the Islais Creek, Yosemite, Sunnysdale, and Mariposa watersheds during both dry and wet weather. The 110-mgd Bruce Flynn wet-weather pump station also serves these watersheds to meet greater stormwater demands during rainfall events. Localized flooding could occur if either of these pump stations are impacted by floodwaters, particularly in lower-lying areas.
		<p>The 110-mgd Booster pump station conveys treated effluent from the Southeast Treatment Plant to the Bay through the Southeast Bay Outfall. The treated effluent could increase the amount of localized flooding if this pump station is impacted by Bay floodwaters.</p> <p>Several facilities at the Southeast Treatment Plant could be exposed to coastal floodwaters with 66 inches of SLR, or 24 inches of SLR coupled with a 100-year extreme tide (Scenario 6). Flooding is limited to the northern corner of the plant, which includes the Southeast Lift Station, Headworks Facilities, and Primary Sedimentation Facilities. New facilities under construction as part of the Sewer System Improvement Program are being constructed to be resilient to potential SLR and coastal flood hazards.</p>
<b>Scenario 7</b> (36 inches SLR and a 100-year extreme tide)	 <b>Port:</b>	At Scenario 7, the entire Pier 80 shoreline is overtopped, inundating the Pier 80 Administration Building and Quonset Building.
	 <b>Public Safety:</b>	The pipe yard for the Emergency Firefighting Water System is inundated under Scenario 7.
<b>Scenario 8</b> (36 inches SLR and a 100-year extreme tide)	 <b>Public Safety:</b>	Fire Station 9 is inundated at Scenario 8. This fire station is also part of Battalion 10, further impacting emergency response times in this neighborhood.
	 <b>Power:</b>	Hunters Point PG&E substation is inundated at Scenario 8. Electric substations are extremely vulnerable and flooding could interrupt power service for hours to weeks.

## Residents and Businesses Exposed to Extreme Tide and SLR Flooding

As extreme tides and SLR overtop the Bay shoreline and flood the city's critical infrastructure, residents and businesses in the path of the floodwaters will be affected. Few residents and businesses are affected until Scenario 5. At Scenario 5, floodwaters will overtop the shoreline and impact over 200 businesses, primarily in the areas adjacent to the Islais Creek Channel and on Piers 80 to 92. The areas with the most affected businesses include the areas between the Islais Creek Channel and Cesar Chavez Street to the north, I-280 to the west, and Evans Avenue (at 3rd Street), as well as part of Cargo Way to the south. Under Scenario 6, the commercially-used area south of Napoleon Street (west of I-280) is also inundated.

For more information about particular properties and buildings are affected under different scenarios, use the *Adapting to Rising Tides Bay Shoreline Flood Explorer*.<sup>6</sup>



<sup>6</sup> <https://explorer.adaptingtorisingtides.org/home>





## NEIGHBORHOOD PROFILE

# POTRERO HILL / CENTRAL WATERFRONT

Pier 70 and Central Waterfront. Photo by Flickr user IFlatworld (CC BY-NC-ND 2.0)

Potrero Hill/Central Waterfront is located on the eastern edge of San Francisco between the South of Market and Bayview neighborhoods. I-280 splits this neighborhood between the residential hillside and the low-lying area along the shoreline (known as Dogpatch), which was once a heavily industrial area but has added residential uses in recent decades. The existing industrial bands that run through the neighborhood include a number of critical city infrastructure maintenance and operation sites, such as Muni Metro East where Muni's light rail vehicles are stored. The UCSF Medical Center at Mission Bay is a major medical research facility located in the northern portion of the neighborhood.

Third Street, including the T-Third Light Rail line, is the major surface north-south connection between the Central Waterfront and the rest of the City. 22nd Street adjacent to 3rd Street forms a small-scale neighborhood commercial corridor. Several large shoreline developments, including Pier 70 and Potrero Power Station are proposed or approved for this area. These developments would bring significant numbers of new housing and jobs to the area, and contain SLR adaptation as part of their plans. See Chapter 13. *A Changing Shoreline*.

The area contains several shoreline open spaces, including Warm Water Cove, Crane Cove Park (under construction), Agua Vista Park, Bayfront Park, and several new open spaces proposed as part of new shoreline development projects

As a result of its industrial nature and its location along a major transit and highway corridor, this neighborhood sees very high rates of traffic and hazardous and solid waste, including at Pier 70.<sup>1</sup> The soil within the Pier 70 area is subject to a "Risk Management Plan" that functions as the remedial action plan for the site and ensures that contaminants in the existing soil do not pose a risk to human health or the environment. Pier 70 is in the process of being redeveloped and required environmental cleanup and decontamination are part of the agreements the Port has created with developers and in conjunction with the building of nearby Crane Cove Park. See Chapter 9.5. *Public Safety – Contaminated Lands* for more detail.

<sup>1</sup> California Environmental Protection Agency (CalEPA) and Office of Environmental Health Hazard Assessment (OEHHA). 2017. CalEnviroscreen 3.0. Available at <https://oehha.ca.gov/media/downloads/calenviroscreen/report/ces3report.pdf>.



## The Shoreline

The 2-mile-long Potrero Hill/Central Waterfront shoreline is comprised entirely of engineered structures, such as piers and seawalls. The wave hazards along this shoreline can exceed 5 feet in height, which leads to a higher potential for wave damage.<sup>2</sup> As sea level rises, the potential for wave hazards increases as deeper Bay waters allow for the generation of larger waves. The wave hazard vulnerability is important to the shoreline located near Potrero Point (between 19th and 22nd and Illinois streets). This shoreline is currently crumbling into the Bay, and dilapidated buildings are the de facto shoreline. There are occasional revetments to break up wave energy and reduce shoreline erosion, which protect the transbay cable, which enters San Francisco via the existing Potrero switchyard. The transbay cable is a 53-mile, 400-megawatt submarine high-voltage direct current transmission line located beneath San Francisco Bay delivering approximately 40 percent of the city's electricity demand.<sup>3</sup> Significant shoreline erosion could compromise the transbay cable.

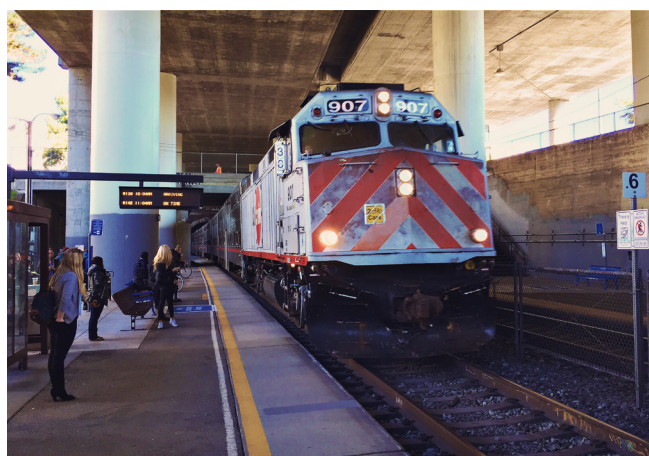
Significant overtopping of the Potrero Hill shoreline happens during Scenario 6 when over 50 percent (1.1 miles) is overtopped, leading to extensive inland flooding.<sup>4</sup>



View of Potrero Hill from SoMa. Bill Couch (CC BY-NC-ND 2.0)



Dogpatch neighborhood. Wayne Hsieh (CC BY-NC 2.0)



Caltrain 22nd Street Station. Flickr user throgers (CC BY-NC-ND 2.0)

<sup>2</sup> Federal Emergency Management Agency, Preliminary Flood Insurance Rate Maps.

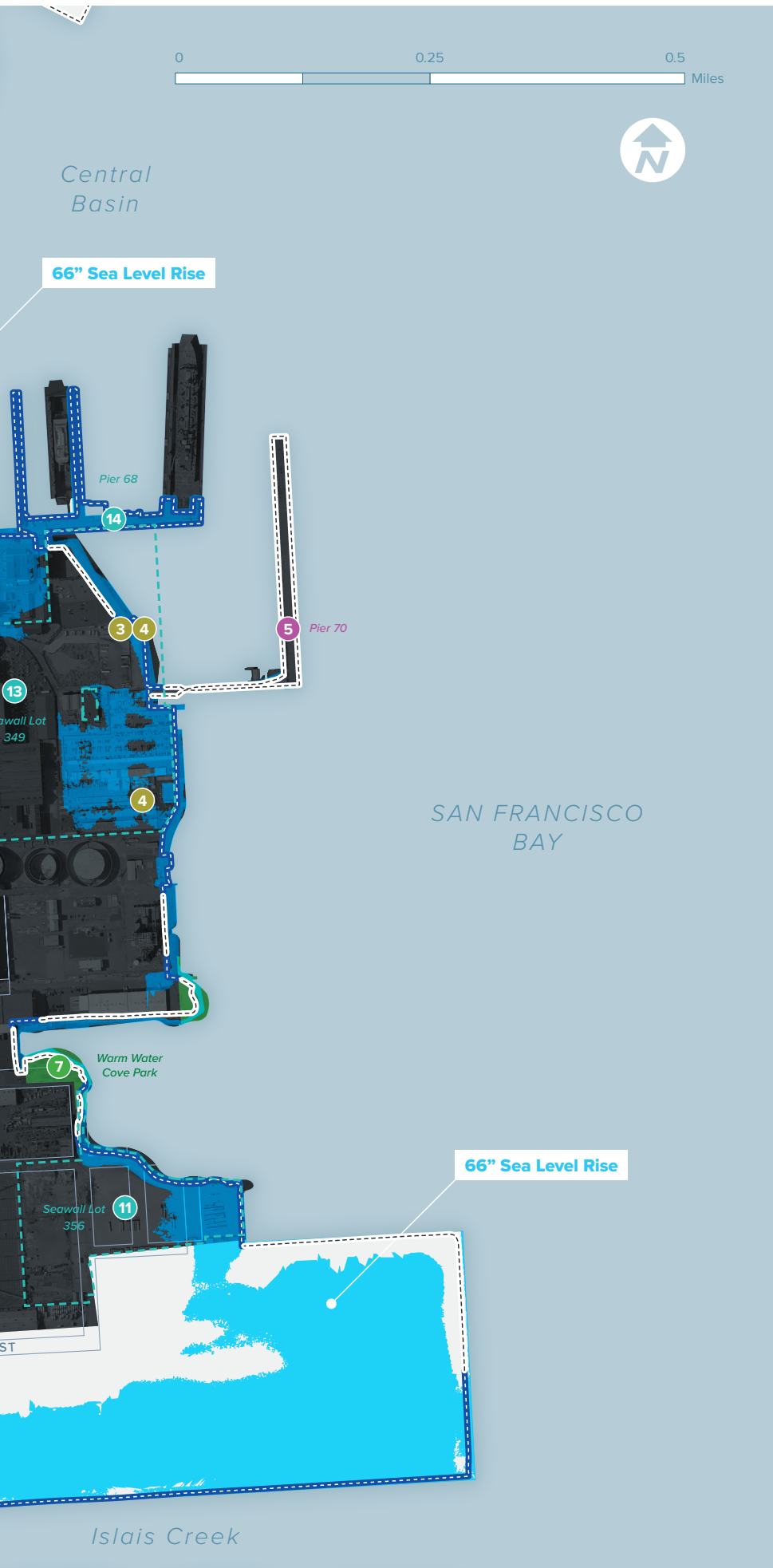
<sup>3</sup> <http://www.transbaycable.com/>.

<sup>4</sup> The ART Bay Shoreline Flood Explorer allows for interactive exploration and download of the Bay Area SLR and shoreline analysis maps. These maps depict areas at risk of temporary or permanent flooding due to SLR and extreme tides as well as shoreline overtopping. Available at <https://explorer.adaptingtorisingtides.org/explorer>.

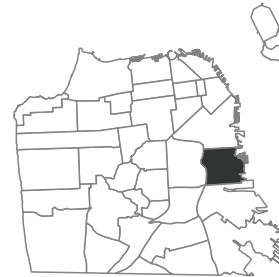








# Potrero Hill / Central Waterfront



## TRANSPORTATION

- 1 Muni Metro East Facility



## WASTE WATER

- 2 Mariposa Pump Station
- 3 Twentieth Street Pump Station
- 4 Combined Sewer Discharge (CSD)



## PUBLIC SAFETY

- 5 Pier 70



## OPEN SPACE

- 6 Aqua Vista Park (Port)
- 7 Warm Water Cove Park (Port)
- 8 Bayfront Park (Port)















## PORT

- 9 Seawall Lot 345
- 10 Seawall Lot 337 South
- 11 Seawall Lot 356
- 12 Seawall Lot 343
- 13 Seawall Lot 349
- 14 Pier 68

## Extreme Tide and SLR Flooding Vulnerabilities and Consequences

The scenarios below describe the progression of potential extreme tide and SLR flooding, along with a brief discussion of the City-owned assets that will be impacted, within the Potrero Hill/Central Waterfront neighborhood. Additional details on the exposure, vulnerability, and consequences of extreme tide and SLR flooding on City-owned assets can be found within the respective sector-based chapters. The relevant chapters are referenced below, as appropriate.

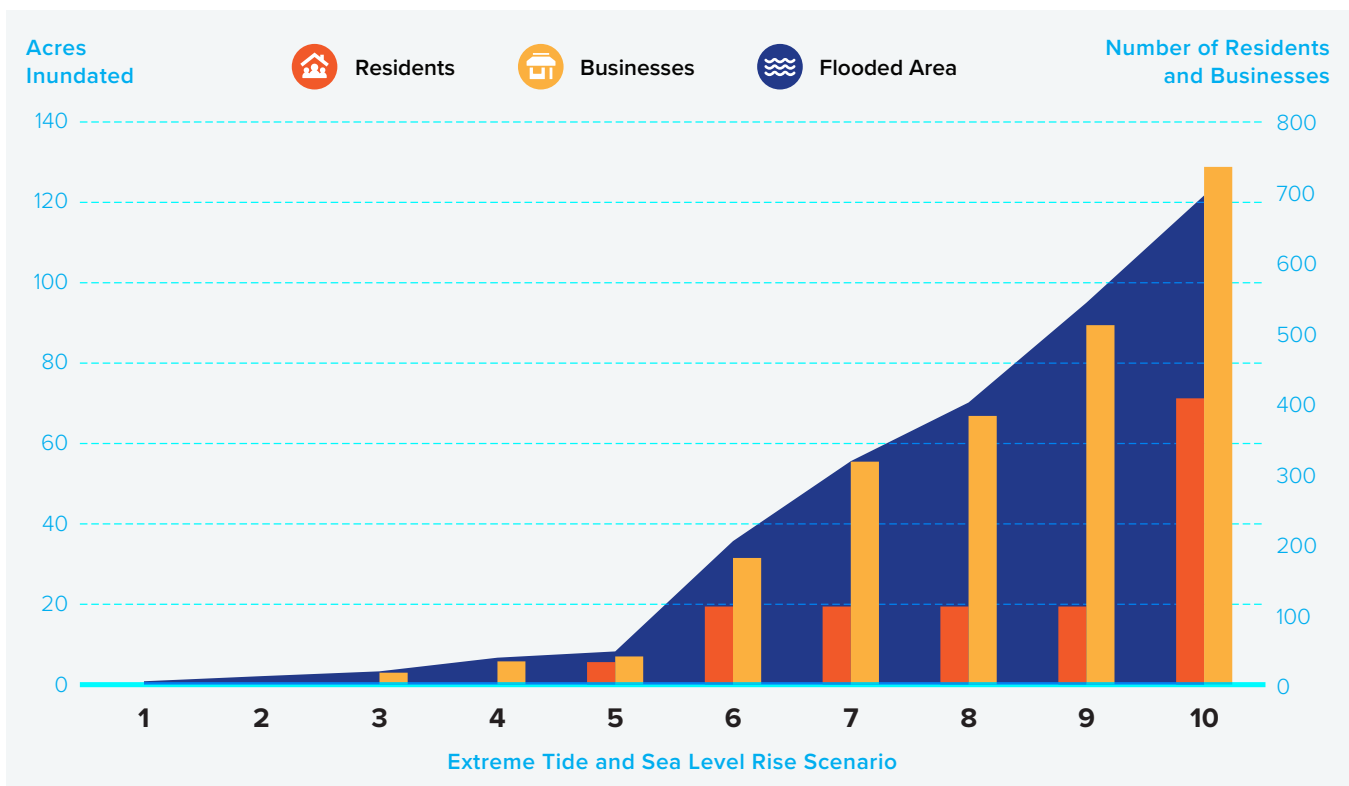
Scenario	Sector	Vulnerabilities and Consequences
<b>Scenario 2</b>  (24 inches of SLR or 12 inches of SLR and a high tide with a 1-year recurrence interval)		<b>Port:</b> Port operations could become impacted at Scenario 2 when Seawall Lot 345 is inundated (Chapter 10). This seawall lot houses a restaurant, a small private boatyard, self-storage units, and a sailing charter company.
		<b>Wastewater:</b> Under Scenario 2, the higher Bay water levels may reduce the gravity-driven flow of excess combined wastewater and stormwater from the transport / storage boxes to the Bay via combined sewer discharge outfalls (Chapter 7). This impact is only of concern during intense and prolonged rainfall events that exceed the capacity of the large underground transport / storage boxes that ring the city. This could result in an increase in localized flooding in low-lying areas.
<b>Scenario 3</b>  (36 inches of SLR or 12 inches of SLR and a high tide with a 5-year recurrence interval)		<b>Open Space:</b> Open space and aquatic areas (owned and managed by the Port) along the shoreline of the Potrero Hill neighborhood experience the first SLR impacts at Scenario 3. Both Agua Vista Park and Warm Water Cove Park have overtoped shorelines and inundation of public viewing and access areas.
<b>Scenario 4</b>  (48 inches of SLR or 6 inches of SLR and a 100-year extreme tide)		<b>Port:</b> With Scenario 4, Seawall Lot 337 becomes inundated. This seawall lot is part of the Mission Rock Mixed-Use Development Project, which includes SLR adaptation (see Chapter 13).
		<b>Power:</b> At Scenario 4, the Trans Bay Cable would be impacted at its connection with the Potrero substation. The Trans Bay Cable is a 53-mile direct current electrical transmission cable with fiber optic communication cables bundled together and buried in San Francisco Bay. The submarine nature of the cable reduces its vulnerability to SLR and coastal flooding.
<b>Scenario 5</b>  (54 inches SLR or 12 inches SLR and a 100-year extreme tide)		<b>Port:</b> At Scenario 5, Seawall Lot 356 (currently a self-storage company) becomes inundated. Future plans for this site include expanding Warm Water Cover Park and the Pier 80 Cargo Terminal.
<b>Scenario 6</b>  (66 inches of SLR or 24 inches of SLR and a 100-year extreme tide)		<b>Open Space:</b> Scenario 6 is a tipping point for flooding within the Potrero Hill neighborhood. Shoreline access at Bayfront Park becomes inaccessible and Port and SFPUC operations could be impacted.
		<b>Port:</b> Pier 68 and Seawall Lots 343 and 349 could be inundated under Scenario 6. Pier 68 is within the Union Iron Works National Register Historic District. The pier has historically provided maritime and industrial services and is still used today for ship repair. Seawall Lot 343 provides open space and houses an SFMTA substation that is extremely sensitive to inundation. Both Pier 68 and Seawall Lot 349 are part of the greater Pier 70 redevelopment project.
		<b>Wastewater:</b> Two wastewater pump stations are inundated at Scenario 6, including Mariposa pump station and the 20th Street pump station. Mariposa pump station has a 15-mgd pumping capacity, conveying both dry weather and wet weather flows for the entire Mariposa drainage basin. SFPUC is currently rehabilitating Mariposa pump station under the Sewer System Improvement Program and is incorporating flood resilience strategies into its design. The 20th Street pump station is a small pump station with a 3-mgd pumping capacity serving the eastern end of 29th Street and the old Todd Shipyard. Impacts at this pump station would be localized.
		<b>Power:</b> Under Scenario 6, the overhead lines and utility poles would be impacted and vulnerable.

Scenario	Sector	Vulnerabilities and Consequences
<b>Scenario 7</b> (36 inches SLR and a 100-year extreme tide)		<b>Power:</b> Streetlights are inundated at Scenario 7. If temporarily flooded, the streetlights would have limited damage and would remain functioning. If streetlights are flooded for a prolonged period, the electrical infrastructure is likely to fail, rendering the streetlight inoperable and the roadway or sidewalk dark during the night.
<b>Scenario 8</b> (48 inches of SLR and a 100-year extreme tide)		<b>Public Safety:</b> At Scenario 8, Pier 70's existing structures could experience flooding. This pier is listed on the National Register as the Union Iron Works Historic District due to its role in ship construction and repair over the last 150 years. The Pier 70 mixed-use development project includes SLR adaptation strategies.
<b>Scenario 10</b> (66 inches of SLR and a 100-year extreme tide)		<b>Transportation:</b> At Scenario 10, the Muni Metro East facility would be inundated. This facility spans 13 acres, including storage, maintenance, and operations facilities, and is currently the main facility where light rail vehicles and historic streetcars are repaired and maintained. There are plans to expand this facility eastward into additional areas that may be subject to flooding as sea levels rise. System-wide impacts to the Muni transit lines would occur if this facility is out of service for an extended period.

## Residents and Businesses Exposed to Extreme Tide and SLR Flooding

As extreme tides and SLR overtop the Bay shoreline and flood the city's critical infrastructure, residents and businesses in the path of the floodwaters will be affected. Few residents and businesses within the Potrero Hill neighborhood are affected until Scenario 6 when 180 businesses are impacted and more than 110 residents are impacted.

For more information about particular properties and buildings are affected under different scenarios, use the *Adapting to Rising Tides Bay Shoreline Flood Explorer*.<sup>5</sup>



<sup>5</sup> <https://explorer.adaptingtorisingtides.org/home>





## NEIGHBORHOOD PROFILE

# SOUTH OF MARKET MISSION BAY

View of Mission Creek North and SoMa. Photo by Sergio Ruiz

The SoMa and Mission Bay neighborhoods, located on the eastern edge of San Francisco, are comprised of developing mixed-use neighborhoods on both sides of Mission Creek. The neighborhood includes extensive housing and commercial buildings as well as regional destinations including UCSF Mission Bay, Oracle Park, and Chase Center. The shoreline includes historic piers and the Mission Creek tidal inlet. SoMa/Mission Bay also includes significant city and regional infrastructure, including Caltrain 4th and King Station and railyards, future California High Speed Rail, the Bay Bridge touchdown, the SFPUC's Channel Force Main, the T-Third Muni Line, and a planned new 16th Street Ferry Terminal.

SoMa/Mission Bay includes residents across a wide range of income levels and racial and ethnic groups. New development includes extensive market rate housing as well as thousands of below market rate units both north and south of Mission Creek.<sup>1</sup> Portions of SoMa that would be affected by SLR are included in MTC's Communities of Concern.

Historically, SoMa has housed many low-income residents in SROs<sup>2</sup> and has high numbers of residents

with disabilities, preventable hospitalizations, and in overcrowded and poor-quality housing<sup>3</sup>. SoMa is home to many community-based organizations. SoMa Pilipinas, San Francisco's Filipino Cultural Heritage District, provides arts, employment, and cultural events and services for Filipino-American residents.<sup>4</sup> The Central SoMa Plan, adopted in 2018, plans for nearly 16 million square feet for new housing and jobs, bringing over \$2 billion in public benefits, including 33 percent affordable housing, \$500 million for transit, substantial improvements to open space, streets, and environmental sustainability, and funding for cultural preservation and community services to the neighborhood. The Plan includes policies and funding to address SLR.

The Mission Bay redevelopment area includes 303 acres of land between the San Francisco Bay and Interstate-280. The Board of Supervisors established the Mission Bay North and South Redevelopment Project Areas in November 1998. The area will support up to 6,404 housing units, with 1,806 (~30%) affordable to moderate, low, and very low-income

1 Office of Community Investment and Infrastructure (OCII). Mission Bay. Available at <https://sfocii.org/mission-bay>.

2 Single Room Occupancy hotels.

3 San Francisco Department of Public Health. 2016. Climate and Health: Understanding the Risk: An Assessment of San Francisco's Vulnerability to Flooding and Extreme Storms.

4 SOMA Pilipinas. Welcome to Our Neighborhood. Available at <https://www.somapilipinas.org/>.





4th and King Caltrain station. Rahul Nair (CC BY-NC 2.0)



Giants ballpark. Tehani Schroeder (CC BY 2.0)

households, 4.4 million square feet of commercial use, the UCSF Mission Bay campus, and 41 acres of new public open space. The Mission Bay development requirements from the 1990s required properties to raise their foundations by one to two feet to address SLR in response to best known science at the time.

A portion of the shoreline for the SoMa neighborhood is included within the Port's Embarcadero Seawall Program, a separate but coordinated effort to create a more sustainable and resilient waterfront. Port assets within the Embarcadero Seawall Program area were not included within this assessment, although they have been identified within this profile for informational purposes. This area is also contained within the Port and U.S. Army Corps of Engineers Flood Study, which will study flood risk along San Francisco's bayside shoreline.

## The Shoreline

The SoMa/Mission Bay neighborhood has 5.3 miles of Bay shoreline, including 2 miles of direct shoreline and 3.4 miles of shoreline created by the large piers that dominate the Bayfront.

Without the protection of the piers, most of the SoMa/Mission Bay shoreline would be in a wave hazard zone. Winter storms with large waves have damaged the piers and shoreline, and under existing conditions the wave hazards are greatest between the Bay Bridge and the Pier 40 breakwater.<sup>5 6</sup>

5 Federal Emergency Management Agency, Preliminary Flood Insurance Rate Maps.

6 South Beach Harbor has a 0.4-mile breakwater protecting the Bay facing

Most of the Bay facing shoreline is not overtopped until Scenario 7; however, if the piers are damaged due to storm or wave hazards, overtopping and inland inundation could occur earlier.

The Mission Bay area has an additional 1.7 miles of shoreline created by the Mission Creek inlet (west of the Third Street bridge) and in McCovey cove (east of the Third Street Bridge). McCovey Cove includes a ferry dock, a houseboat community along the south side, and a public access walkway along the north side. Wave hazards are minimal within McCovey Cove and Mission Creek.

Most of the overtopping and subsequent flooding in the SoMa/Mission Bay neighborhood occurs along the low-lying inlet shorelines. Under Scenario 4, a third of the Mission Creek/McCovey Cove shoreline is overtopped. This includes the shoreline that contains the houseboat community and the southern side of the 4th Street Bridge, which has a large Muni light rail vehicle track interchange. Under Scenario 5, the northern shoreline of Mission Creek is also overtopped, including a public access sidewalk that is less than 30 feet in front of apartment buildings. By Scenario 6, most of the Mission Creek/McCovey shoreline is overtopped, causing widespread flooding.<sup>7</sup>

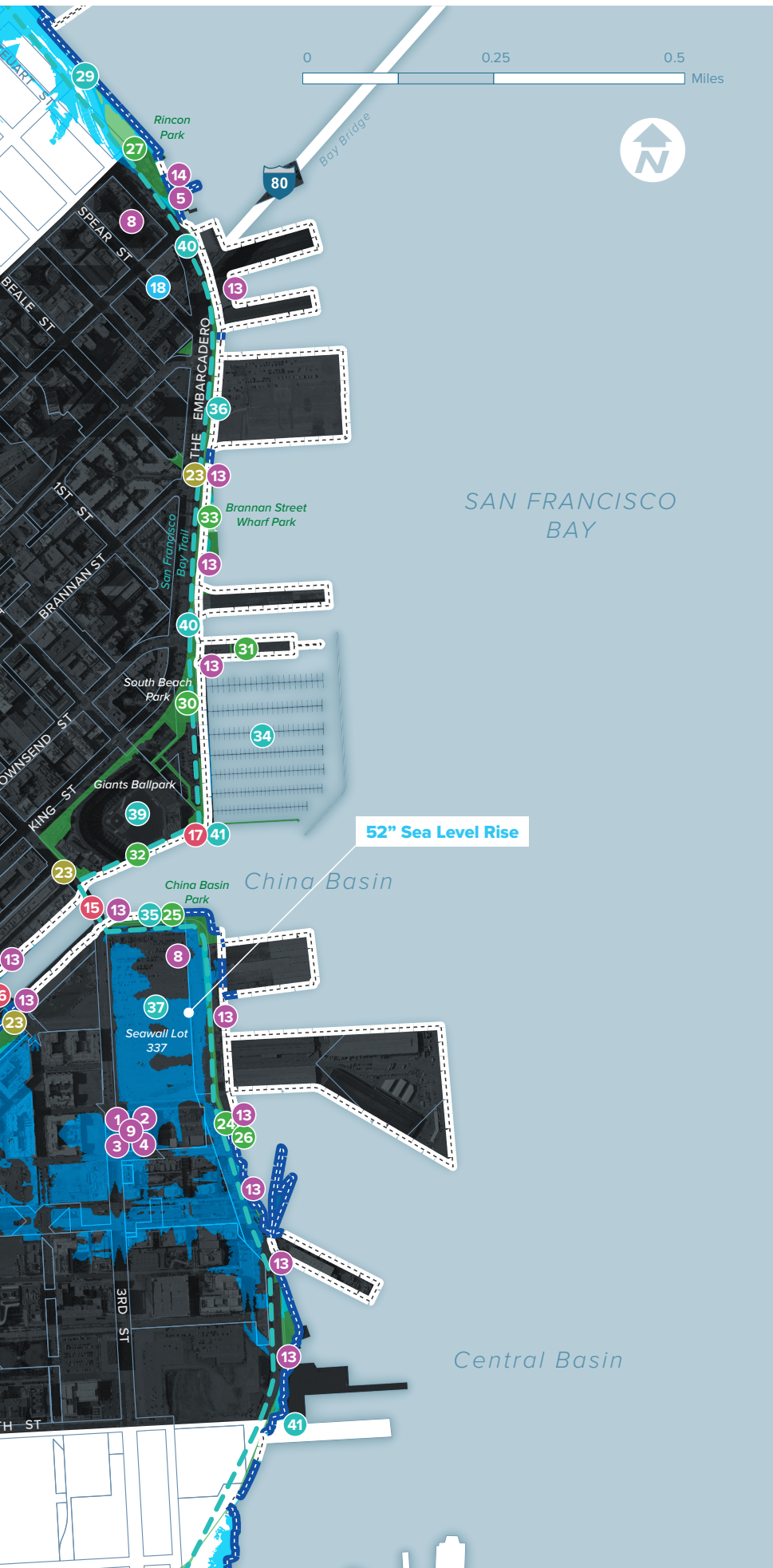
harbor, the McCovey cove side to the south, and a large Pier 40 building structure to the north. The breakwater and the structures protect the shoreline from wave hazards.

7 The ART Bay Shoreline Flood Explorer allows for interactive exploration and download of the Bay Area SLR and shoreline analysis maps. These maps depict areas at risk of temporary or permanent flooding due to SLR and extreme tides as well as shoreline overtopping. Available at <https://explorer.adaptingtorisingtides.org/explorer>.

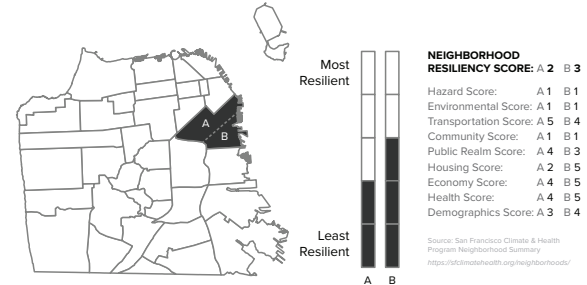








## South of Market Mission Bay



### PUBLIC SAFETY

- 1 Bureau of Fire Investigation
- 2 Southern District Fire Station
- 3 Fire Station #4
- 4 Public Safety Building
- 5 Fire Station #35 - Fireboat Headquarters
- 6 Fifth Street Homeless Center
- 7 Fire Station #8
- 8 Contaminated Land
- 9 Police Headquarters
- 10 Public Defenders Office
- 11 Hall of Justice
- 12 County Jail #4
- 13 Fireboat Pump Station / Fire Suction Connection
- 14 Fireboat Manifold



### TRANSPORTATION

- 15 Lefty O'Doul Bridge
- 16 Fourth Street Bridge
- 17 Giants Stadium Ferry Terminal



### WATER

- 18 Bay Bridge Pump Station



### WASTE WATER

- 19 Merlin Morris Pump Station
- 20 Berry Street Pump Station
- 21 Harriet-Lucerne Pump Station
- 22 Channel Pump Station
- 23 Combined Sewer Discharge (CSD)



### OPEN SPACE

- 24 Pier 52
- 25 China Basin Park
- 26 Boat Launch
- 27 Rincon Park
- 28 Shoreline Park
- 29 Mission Creek Garden
- 30 South Beach Park
- 31 South Beach Harbor
- 32 Giant's Promenade
- 33 Brannan Street Wharf















### PORT

- 34 South Beach Marina
- 35 Pier 62/McCovey Cove and China Basin
- 36 The Promenade
- 37 Seawall Lot 337
- 38 Mission Creek Marina
- 39 Giants Ballpark
- 40 Embarcadero Promenade (Bay Trail)
- 41 WETA, Golden Gate Ferries








## Extreme Tide and SLR Flooding Vulnerabilities and Consequences

The scenarios below describe the progression of potential extreme tide and SLR flooding, along with a brief discussion of the City-owned assets that will be impacted, within the SoMa/Mission Bay neighborhoods. Additional details on the exposure, vulnerability, and consequences of extreme tide and SLR flooding on City-owned assets can be found within the respective sector-based chapters. The relevant chapters are referenced below, as appropriate.

Scenario	Sector	Vulnerabilities and Consequences
<b>Scenario 1</b> (12 inches of SLR or a high tide with a 1-year recurrence interval)		<b>Public Safety:</b> Three fire suction connections (part of the emergency firefighting water system, Chapter 9) at the shoreline will experience inundation. The suction connections become unusable when inundated, largely due to limitations in fire engine access.
<b>Scenario 2</b> (24 inches of SLR or 12 inches of SLR and a high tide with a 1-year recurrence interval)	 	<b>Public Safety:</b> Twelve additional fire suction connections at the shoreline will experience inundation. <b>Wastewater:</b> Under Scenario 2, the higher Bay water levels may reduce the gravity-driven flow of excess combined wastewater and stormwater from the transport / storage boxes to the Bay via combined sewer discharge outfalls. This impact is only of concern during intense and prolonged rainfall events that exceed the capacity of the large underground transport / storage boxes that ring the city. This could result in an increase in localized flooding in low-lying areas.
<b>Scenario 3</b> (36 inches of SLR or 12 inches of SLR and a high tide with a 5-year recurrence interval)	  	<b>Port:</b> The SoMa/Mission Bay neighborhood will first experience inundation when the Mission Creek shoreline is overtopped on the south side under Scenario 3, although overall impacts are limited. The Pier 52 Boat Launch and a portion of China Basin Park will experience inundation. The Pier 52 boat launch is the only public launch point in San Francisco's Bayside waterfront. Under Scenario 3, the boat launch may still be useable, but damage to the boat launch would limit public access to the Bay. <b>Public Safety:</b> One additional fire suction connections at the shoreline will experience inundation. <b>Power:</b> Streetlights will experience inundation at Scenario 3.
<b>Scenario 4</b> (48 inches of SLR or 6 inches of SLR and a 100-year extreme tide)	 	<b>Public Safety:</b> With Scenario 4, over 60 acres of inland area will be inundated, including important community facilities, including the Bureau of Fire Investigation, Southern District Police Station, Fire Station #4, and the Public Safety Building. Fire Station #4 and the Public Safety Building (built in 2015) would be inundated. The public safety campus also contains the San Francisco Police Department headquarters, the Arson Task Force, and a Community Room serving the Mission Bay neighborhood. This could impact emergency response in the neighborhood and beyond, resulting in delays in response time and dangers to public health and safety. One of the city's fireboat manifold connections will be inundated under Scenario 4; however, it can remain in service as long as a fireboat can safely establish a connection. <b>Port:</b> Under Scenario 4, Rincon Park, which is owned and managed by the Port, could be inundated. Mission Creek Shoreline Park South, running parallel to the southern shore of Mission Creek, would be inundated. The park features walking paths, picnic areas, and community gardens and provides viewing and access to Mission Creek. Although the channel between the two parks has been significantly altered, it is the last remnant of the original Mission Bay formed by Mission Creek, and it still supports wildlife. Bayfront Park is currently a large open lot with parking and a bike path that could be inundated under Scenario 4. The park will be improved and expanded as part of the Mission Bay Redevelopment Plan.

Scenario	Sector	Vulnerabilities and Consequences
<b>Scenario 5</b>  (52 inches SLR or 12 inches SLR and a 100-year extreme tide)		<b>Transportation:</b> Under Scenario 5, flooding would extend to the north side of Mission Creek, flooding 111 acres in Mission Bay North and SoMa, nearly doubling the area impacted under Scenario 4. This has far reaching effects for local residents and businesses and includes impacts to 4.1 miles of Caltrain train tracks.
		<b>Public Safety:</b> Fire Station #35, the fireboat headquarters located on Pier 22 1/2 at Harrison Street, will be inundated under Scenario 5. This fire station is located on Port land and is located within the Embarcadero Seawall Program area discussed in Chapter 4. The three fireboats anchored here, the <i>Phoenix</i> , <i>Guardian</i> , and <i>Saint Francis</i> , can connect directly to the emergency firefighting water distribution system via five manifold connections along the shoreline, and pump saltwater from the Bay into the distribution system for fire suppression. The fireboats provide emergency backup protection in the event of a failure of the reservoirs and/or pump stations. Even though the fireboats are not affected, the headquarters and access to the boats could be impacted. This could result in impacts to this unique emergency response system with consequences for public health and safety.
		<b>Port:</b> Mission Creek Harbor, including its community of approximately 20 houseboats moored on docks, would be affected in Scenario 5. Although less than a quarter acre is shown as flooded, support facilities and utilities are sensitive to disruption. The utilities have been designed to accommodate SLR and flooding. However, permanent inundation would eliminate the ability to use the site, and due to its water dependent nature, the harbor would not be easy to relocate. This houseboat community would also be impacted by any loss in the ability to operate the drawbridges (see Chapter 5).
		<b>Wastewater:</b> The Berry Street pump station could be exposed to floodwaters under Scenario 5. It is a wet-weather pump station located below grade at the corner of Berry Street and 5th Street adjacent to Mission Creek, approximately 200 feet from the San Francisco Bay shoreline. It serves the Channel drainage basin with a pumping capacity of 9.2 mgd. During wet weather, this pump station conveys combined flows from the Berry Street drainage area to a sewer on 5th Street. Electrical equipment and controls are located at and below grade and can be affected by floodwaters entering through openings at grade. The at-grade electrical controls are also at risk from shallow flooding. Impacts at this pump station could result in localized flooding during wet weather; however, the larger Channel/Mission Creek neighborhood would not be impacted.
<b>Scenario 6</b>  (66 inches of SLR or 24 inches of SLR and a 100-year extreme tide)		<b>Transportation:</b> By Scenario 6, over 14,000 residents and nearly 2,000 businesses could be inundated by SLR and extreme coastal flooding. Both bridges across Mission Creek (Lefty O'Doul and 4th Street Bridges) will be impacted, resulting in cascading consequences to local and through traffic and operation of the T-Third line. Impacts to the T-Third would create cascading consequences throughout the Muni system. Impacts to the draw bridge operations would also impact the local houseboat community.
		<b>Public Safety:</b> The Public Defender's Office at 555 7th Street is inundated in Scenario 6. It serves 25,000 people a year and employs over 100 attorneys and 60 staff. The 5th Street Homeless Center will be impacted under Scenario 6, as well as an additional Fire Station (Fire Station #8 at 530 Bluxome Street between 4th and 5th Streets).
		<b>Wastewater:</b> Channel pump station will be impacted under Scenario 6, which could have widespread consequences for the neighborhood and the city. Channel pump station is located near Mission Bay in a mixed residential and industrial area directly adjacent to the Mission Bay shoreline. This pump station serves both the Channel and Northshore drainage basins with a pumping capacity of 103 mgd and operates continuously in both dry and wet weather. In dry weather, Channel pump station receives, and transports wastewater pumped from the North Shore pump station and flows from the Channel drainage area. The pump station conveys wastewater through the Channel force main to the Southeast Treatment Plant. In wet weather, combined flows are conveyed from the local drainage area to the Southeast Treatment Plant.
		<p>Two additional smaller wastewater pump stations (Harriet Lucerne and Merlin Morris) will also be impacted under Scenario 6, resulting in localized flooding.</p> <p>Harriet-Lucerne pump station is a belowgrade pump station located on Harriet Street with a pumping capacity of 7.3 mgd, and Merlin Morris pump station is a belowgrade pump station located on Merlin Street (near Harrison Street) with a pumping capacity of 9.2 mgd. Impacts at these pump stations could result in localized flooding; however, the larger Channel/Mission Creek neighborhood would not be impacted.</p>



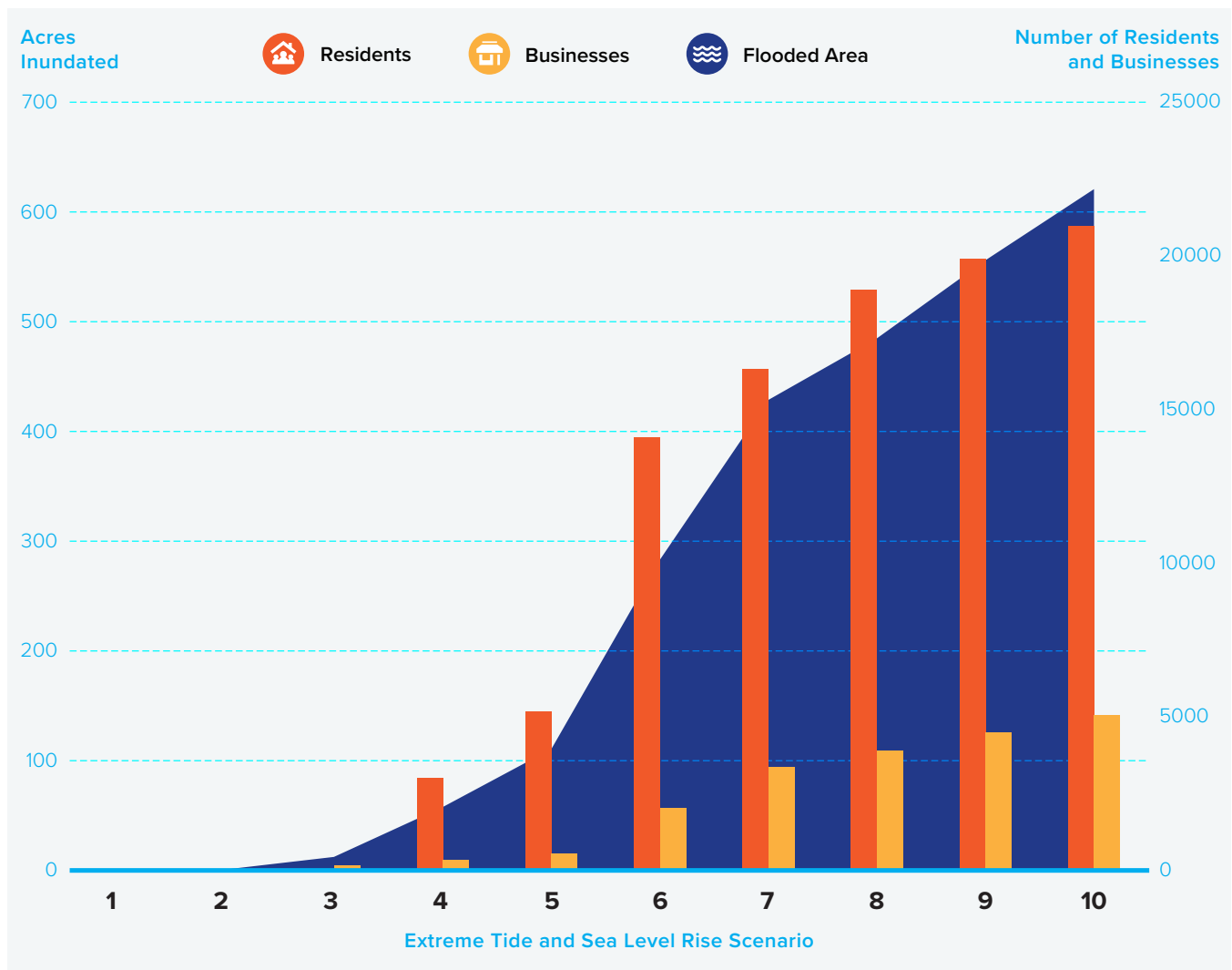
Scenario	Sector	Vulnerabilities and Consequences
		<b>Power:</b> Under Scenario 6, underground transmission lines, overhead lines, and utility poles are exposed and vulnerable to flooding.
		<b>Port:</b> Mission Creek Garden is located onshore in the southwestern corner of Mission Creek near the Houseboat Marina and could be inundated under Scenario 6.
<b>Scenario 7</b> (36 inches of SLR and a 100-year extreme tide)		<b>Transportation:</b> At Scenario 7, the Ferry Terminal serving Oracle Park for games could be inundated, as well as the Giant's Promenade. The majority of Oracle Park itself will also be inundated under this scenario.
<b>Scenario 8</b> (48 inches of SLR and a 100-year extreme tide)		<b>Water:</b> At Scenario 8, Bay Bridge pump station could be impacted, preventing the delivery of potable water to Treasure Island.
		<b>Public Safety:</b> The San Francisco County Jail #4 and the Hall of Justice at 850 Bryant St. will be partially inundated. Although the jail facility is located on the 7th floor, the building could be rendered inaccessible.
<b>Scenario 10</b> (66 inches of SLR and a 100-year extreme tide)		<b>Public Safety:</b> Fire Station #1, located at 935 Folsom at 5th Street, would be inundated and inaccessible at Scenario 10.
		<b>Open Space:</b> Gene Friend Recreation Center would not be directly inundated until Scenario 10. However, this facility is located in the historic Hayes Creek bed and it has drainage issues that could worsen as sea levels and the groundwater table rise. The building includes mechanical and electrical equipment that is at grade and sensitive to saltwater flooding. This is the only public recreation center in the SoMa neighborhood, and the center serves a large elderly population and provides services for at-risk youth. There are no nearby City-owned assets that could provide the same services and accessibility for the users of this facility.
		The 2-acre Victoria Manalo Draves Park, located at Sherman and Folsom Streets, would be affected by coastal flooding and SLR at Scenario 10. It is also located within the historic Hayes Creek bed and hydrology and drainage issues could occur as sea levels and the groundwater table rise. Most of the park areas could recover after inundation subsides. However, the community garden, and lower-lying grassy areas and park vegetation, may be impacted from rising groundwater and eventual saltwater inundation. Other San Francisco parks could provide similar services and amenities if this park is temporarily impacted; however, there are few alternative recreational spaces in the South of Market area.

## Residents and Businesses Exposed to Extreme Tide and SLR Flooding

As extreme tides and SLR overtop the Bay shoreline and flood the city's critical infrastructure, residents and businesses in the path of the floodwaters will be affected. The areas with the most affected residents and businesses initially include the Mission Bay area southwest of the Mission Creek Channel. Starting with Scenario 5, areas north of the channel north to Brannan Street, covering the entire area around the Caltrain King Street station and associated tracks, would be affected.

Residents would lose access to the shoreline, park and open spaces, transportation and eventually their homes and places of work if these areas are damaged or disrupted. These impacts would disproportionately impact vulnerable members of the community for whom the loss could be considerable, as they may not have the ability to easily retrofit or relocate to locations not impacted.

For more information about particular properties and buildings are affected under different scenarios, use the *Adapting to Rising Tides Bay Shoreline Flood Explorer*.<sup>1</sup>



<sup>1</sup> <https://explorer.adaptingtorisingtides.org/home>





## NEIGHBORHOOD PROFILE

# FINANCIAL DISTRICT

San Francisco downtown skyline. Photo by Sergio Ruiz

The Financial District, located on the eastern edge of San Francisco, is comprised of mixed-use, high-density neighborhoods near The Embarcadero and the foot of Market Street. The Financial District includes the Bay Area's largest and densest job center, significant amounts of housing and commercial space, and iconic regional destinations including the Ferry Building, Embarcadero Promenade, and the Central Embarcadero Piers Historic District.

The shoreline of this neighborhood is constructed on a series of aging seawalls referred to as the Embarcadero Seawall. (See Chapter 4.8. *San Francisco Seawall Earthquake Safety and Disaster Prevention Program* for more detailed information on seismic risks and current hazard mitigation planning efforts.) The Financial District also includes significant city and regional transportation infrastructure, including BART, Muni Metro, Muni bus lines, historic streetcars, cable cars, and ferry terminals.

The Financial District is one of the region's densest areas in terms of residents and daytime workers. The Financial District is critical to the San Francisco and regional economy. The Ferry Building and scenic

Embarcadero Promenade attract high levels of tourists. Loss of historic piers and buildings, such as the Ferry Building, would impact the historic district and affect tourism and potentially lead to the loss of tax credits. Significant disruption to this area could lead to loss of jobs, tourism, and tax revenues, causing significant economic disruption to the entire Bay Area. Service workers and those who cannot work remotely would be impacted the most.

The Financial District shoreline also plays a critical role in emergency response and disaster recovery. Fire Station #13, Embarcadero Promenade, various recreational plazas, and the ferry terminals serve critical disaster response functions, such as staging areas and evacuation points. In addition to evacuating people from San Francisco to other parts of the Bay Area, the ferry terminals can also transport supplies and personnel to assist with disaster response and recovery within San Francisco. The loss of access to the fire station, ferry terminals, or the inundation of staging areas would delay evacuation and increase emergency response times following a disaster, such as a large earthquake.

The Financial District shoreline is included within the Port's Embarcadero Seawall Program, a separate but coordinated effort to create a more sustainable and resilient waterfront. More information related to the Embarcadero Seawall Program is included in Section 4.8. Port assets within the Embarcadero Seawall Program area were not included within this assessment, although they have been identified within this profile for informational purposes. This area is also contained within the Port and U.S. Army Corps of Engineers Flood Study, which will study flood risk along San Francisco's bayside shoreline.

## The Shoreline

The shoreline of the Financial District is one mile long and entirely engineered, including seawalls and piers. Located at the southern end of the Financial District shoreline and extending over 600 feet into the Bay, Pier 14 serves as a breakwater to protect the Downtown Ferry Terminal from wave and tidal forces. Pier 14 includes several informational markers that denote projected elevations of sea levels over time.

Currently, the Downtown San Francisco Ferry Terminal Expansion Project is being constructed next to Pier 14. The new ferry gates will be built to accommodate approximately 3 to 4 feet of anticipated SLR above a 100-year extreme tide event. Pier 1 ½, located north of the Ferry Building, is a public access dock. Pier 7 is a popular public fishing pier located at the northernmost end of the Financial District's shoreline. Pier 7 is a long, thin pier, lined with benches, with panoramic views of both the Bay and the city. Pier 7 is a popular location for crab fishing, mainly at night, and for shark and perch fishing. The Bay Trail, a 500-mile long pedestrian and bicycle path around the Bay, runs along the Financial District shoreline along the Embarcadero.<sup>1</sup>

Along approximately half of the shoreline, the wave hazard can reach 3 feet in height, creating the potential for wave damage to the Ferry Building and Ferry landing area.<sup>2</sup> Water levels already overtop the shoreline under existing conditions during extreme



Giants ballpark. Photo by Tehani Schroeder (CC BY 2.0)



Financial District and downtown skyline. Photo by Flickr user gags9999 (CC BY 2.0)

high tides. The shoreline overtopping reaches a tipping point at Scenario 4 (48 inches of SLR or 6 inches of SLR and a 100-year extreme tide) when over 60 percent of the Financial District shoreline is overtopped, and widespread flooding of the Embarcadero Roadway is expected.<sup>3</sup> Inundation of this scale would significantly impact mobility, including ground traffic, public transportation, and the regional transportation network.

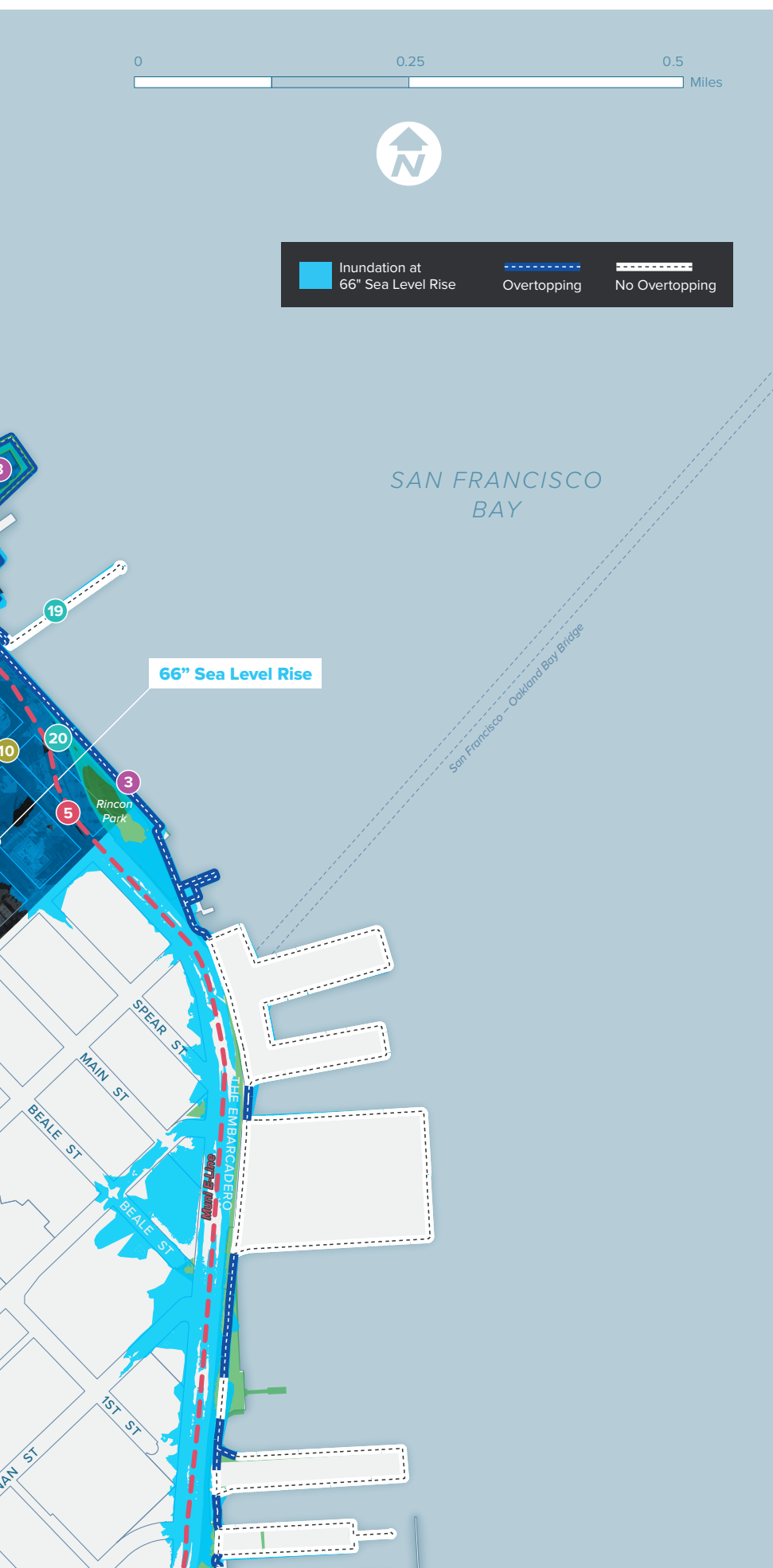
1 The San Francisco Bay Trail. Available at <http://baytrail.org/>.

2 Federal Emergency Management Agency, Preliminary Flood Insurance Rate Maps.

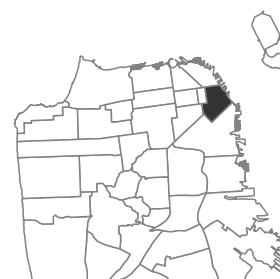
3 The ART Bay Shoreline Flood Explorer allows for interactive exploration and download of the Bay Area SLR and shoreline analysis maps. These maps depict areas at risk of temporary or permanent flooding due to SLR and extreme tides as well as shoreline overtopping. Available at <https://explorer.adaptingtorisingtides.org/explorer>.







# Financial District



**NEIGHBORHOOD RESILIENCY SCORE: 1**

Hazard Score: 1  
Environmental Score: 1  
Transportation Score: 5  
Community Score: 1  
Public Realm Score: 5  
Housing Score: 1  
Economy Score: 2  
Health Score: 2  
Demographics Score: 1

Source: San Francisco Climate & Health Program Neighborhood Summary  
<https://sfclimateandhealth.org/neighborhood/>



## PUBLIC SAFETY

- 1 Fire Station #13
- 2 Contaminated Lands
- 3 Fireboat Pump Station / Fire Suction Connection



## TRANSPORTATION

- 4 The Embarcadero
- 5 Streetcar (E-Line)
- 6 Embarcadero BART
- 7 Ferry Terminal
- 8 Cable Car
- 9 Regional bus routes (Temporary Transbay Terminal)



## WASTEWATER

- 10 Combined Sewage Discharge (CSD)



## OPEN SPACE

- 11 Embarcadero Plaza
- 12 Ferry Park/Plaza
- 13 Harry Bridge's Plaza
- 14 Maritime Plaza













## PORT










- 15 Pier 7: Public pier and fishing
- 16 Pier 3: Restaurants, offices, water taxi, Hornblower, parking (H)
- 17 Pier 1: Office (H)
- 18 Ferry Building: Offices, public serving, restaurants, retail, iconic (H)
- 19 Pier 14: Public pier and fishing
- 20 Embarcadero Promenade (Bay Trail)
- 21 WETA, Golden Gate Ferries



## Extreme Tide and SLR Flooding Vulnerabilities and Consequences

The scenarios below highlight the progression of potential extreme tide and SLR flooding, along with a brief discussion of the City-owned assets that will be impacted within the Financial District neighborhood. Additional details on the exposure, vulnerability, and consequences of extreme tide and SLR flooding on City-owned assets can be found within the respective sector-based chapters. The relevant chapters are referenced below, as appropriate.

Scenario	Sector	Vulnerabilities and Consequences
<b>Scenario 1</b> (12 inches of SLR or a high tide with a 1-year recurrence interval)	 <b>Transportation:</b>	Flooding of The Embarcadero is currently observed when Bay water levels are high. This causes minor disruption to the pedestrian and bike path on Embarcadero Promenade between the Ferry Building and Pier 14.
	 <b>Public Safety:</b>	One fire suction connection (part of the emergency firefighting water system) that allows fire engines to draw water from the Bay for fire suppression is inundated. Suction connections become unusable if they are inundated, primarily due to limitations related to fire truck access.
<b>Scenario 2</b> (24 inches of SLR or 12 inches of SLR and a high tide with a 1-year recurrence interval)	 <b>Wastewater:</b>	Under Scenario 2, the higher Bay water levels may reduce the gravity-driven flow of excess combined wastewater and stormwater from the transport / storage boxes to the Bay via combined sewer discharge outfalls (Chapter 7). This impact is only of concern during intense and prolonged rainfall events that exceed the capacity of the large underground transport / storage boxes that ring the city. This could result in an increase in localized flooding in low-lying areas.
	 <b>Public Safety:</b>	One additional fire suction connection would be inundated under Scenario 2.
<b>Scenario 3</b> (36 inches of SLR or 12 inches of SLR and a high tide with a 5-year recurrence interval)	 <b>Port / Transportation:</b>	At Scenario 3, flooding of the shoreline between the Ferry Building and Pier 14 would cause limited inundation of the Embarcadero Promenade and roadway.
		
	 <b>Power:</b>	Streetlights would experience inundation at Scenario 3.
<b>Scenario 4</b> (48 inches of SLR or 6 inches of SLR and a 100-year extreme tide)	 <b>Transportation:</b>	At Scenario 4, the westbound lanes of The Embarcadero will be inundated, causing cascading impacts to local and through traffic, bike routes, truck traffic, bus routes, pedestrian access to the shoreline, tourism, and the historic streetcar E-Line service. Although the first pedestrian entrances to the underground Embarcadero Muni/BART Station will not be directly inundated until Scenario 5, floodwaters could enter the underground station through other potential flood pathways, such as manholes, vents, and access hatches, under an earlier scenario.
	 <b>Public Safety:</b>	One additional fire suction connection would be inundated under Scenario 4.
<b>Scenario 5</b> (52 inches SLR or 12 inches SLR and a 100-year extreme tide)	 <b>Transportation:</b>	Impacts to the Embarcadero Station would cause significant citywide and regional impacts to transportation. The Embarcadero station is the last San Francisco BART stop before connecting to Oakland via the Transbay Tube. Impacts to the Embarcadero BART station would cause systemwide impacts for the BART and Muni Metro systems, significant delays, and impact the ability for travelers to make trips between San Francisco and the East Bay, impacting hundreds of thousands of riders each day. Disruption of the Embarcadero Station would lead to congestion of other modes of transportation such as buses, personal vehicles, and ferries. Flooding of the station would cause more traffic congestion throughout the city, and would impact people's ability to get to work, school, or other destinations.

Scenario	Sector	Vulnerabilities and Consequences
	 	<p><b>Port / Open Space:</b> Although the Ferry Terminal would be operational under Scenario 5, pedestrian access for boarding and offloading would be affected. Open space would also be impacted as three City recreational plazas could flood along The Embarcadero shoreline, including Embarcadero Plaza, Sue Bierman Park, and Harry Bridge's Plaza. Approximately 2 miles of the San Francisco Bay Trail will be inaccessible. The length of shoreline overtopped under Scenarios 3, 4, and 5 will be minimal (less than 0.1 mile). However, while the length of the shoreline overtopped is minimal, many assets would still be at risk of inundation due to the low-lying of the topography of the area and the ability of floodwaters to spread quickly. Alternatively, a small shoreline improvement project to prevent overtopping could provide widespread benefits.</p>
<b>Scenario 6</b>  (66 inches of SLR or 24 inches of SLR and a 100-year extreme tide)	  	<p><b>Transportation:</b> Under Scenario 6, the potential inundation could become widespread. More than 3,100 residents and 3,000 business will be impacted and there will be significant impacts to city streets and public transportation. Three entrances to the Embarcadero Muni/BART station, 10 miles of bus routes, the Historic streetcar E-Line, and the terminus of the California Street cable car line will all be impacted. The Ferry Building, a historical landmark and part of the Central Embarcadero Piers Historic District, would become inundated and the Ferry Terminal would become non-operational. Regional transit bus routes will be flooded, including SamTrans, Golden Gate Transit, and Amtrak. The Port of San Francisco's headquarters located at Pier 1 could also be flooded under Scenario 6. Pier 7 would be overtopped and public access for fishing would be limited.</p> <p><b>Open Space:</b> Maritime Plaza, located just inland of Sue Bierman Park, could also be inundated under Scenario 6. However, Maritime Plaza is elevated from street level and only access to the park is anticipated to be impacted.</p> <p><b>Public Safety:</b> One additional fire suction connection would be inundated under Scenario 6.</p>
<b>Scenario 7</b>  (36 inches of SLR and a 100-year extreme tide)		<p><b>Power:</b> There are 3.7 megawatts of PG&amp;E solar energy panels on a building that is inundated at Scenario 7. The electrical infrastructure connecting the solar panels to the power grid could be vulnerable to flooding.</p>
<b>Scenario 9</b>  (52 inches of SLR and a 100-year extreme tide)	 	<p><b>Public Safety:</b> At Scenario 9, Fire Station #13 is impacted. Impacts from SLR and coastal flooding could compromise emergency and fire response times throughout the Financial District.</p> <p><b>Wastewater:</b> Although SFPUC has underground water and combined sewer infrastructure in the Financial District, the infrastructure is not expected to be vulnerable to flooding. However, the large transport / storage box under The Embarcadero may not function as intended when Bay water levels are high. The box may not be able to discharge excess stormwater directly to the Bay during a heavy rainfall event when the city's three treatments plants exceed their capacity. This could lead to localized flooding resulting in environmental and public health hazards.</p>
<b>Scenario 10</b>  (66 inches of SLR and a 100-year extreme tide)		<p><b>Port:</b> Widespread flooding extending into the center of the Financial District would occur under Scenario 10. While inaccessible beginning around Scenario 4, Pier 14 – which provides pedestrian access for scenic vistas and fishing – becomes inundated at Scenario 10.</p>

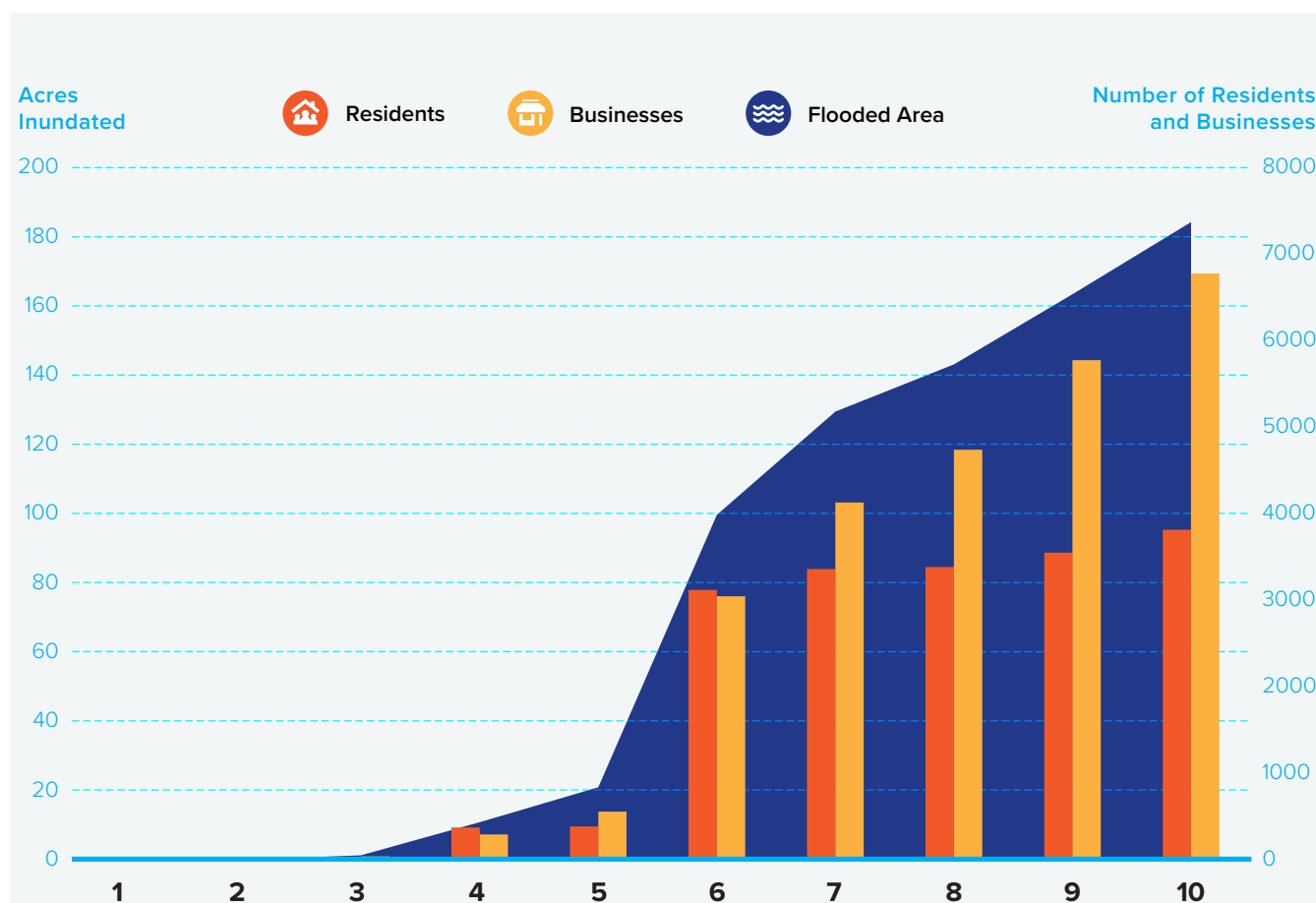


## Residents and Businesses Exposed to Extreme Tide and SLR Flooding

As extreme tides and SLR overtop the Bay shoreline and flood the city's critical infrastructure, residents and businesses in the path of the floodwaters will be affected. Few residents and businesses are affected until Scenario 4, when approximately 11 acres of the Financial District become inundated and approximately 300 businesses and nearly 400 residents are impacted. The level of impact reaches a tipping point at Scenario 6, when the shoreline is overtopped and flooding extends inland to Front Street. At this scenario, the number of residents and businesses impacted both exceed 3,000. Due to the highly dense commercial nature of the Financial District, thousands of additional businesses would be impacted under future SLR scenarios, with the total number exceeding 7,000 businesses under Scenario 10.

The Financial District is a heavily populated area and the populations at risk include residents, tourists, commuters, and vendors. Although over 3,100 residents are impacted under Scenario 6, most of the population impacted is not classified as vulnerable populations by the Department of Public Health. However, many of the people affected by inundation under later scenarios are classified as vulnerable.

For more information about particular properties and buildings are affected under different scenarios, use the *Adapting to Rising Tides Bay Shoreline Flood Explorer*.<sup>4</sup>



<sup>4</sup> <https://explorer.adaptingtorisingtides.org/home>



## NEIGHBORHOOD PROFILE

# NORTH BEACH & FISHERMAN'S WHARF

Fisherman's Wharf and Russian Hill. Photo by Daniel Pouliot (CC BY-NC-ND 2.0)

The North Beach and Fisherman's Wharf neighborhoods are located on the northeastern edge of San Francisco and include primarily commercial land use along the waterfront with some residential buildings. The neighborhood includes significant tourist attractions like the Exploratorium, Pier 39, Fisherman's Wharf, historic piers and buildings, and many hotels and restaurants. The shoreline is largely human-made and includes historic piers. Ongoing commercial fishing at Fisherman's Wharf provides an important link to San Francisco's maritime history.

North Beach is one of the City's densest daytime neighborhoods.<sup>1</sup> Fisherman's Wharf is San Francisco's most visited tourist attraction; more than 10 million

people visit this neighborhood each year.<sup>2</sup> West of Fisherman's Wharf along the shoreline is Aquatic Park. Adjacent to the San Francisco Maritime Museum and Ghirardelli Square, Aquatic Cove is a sheltered cove that is popular place for open-water swimming.

The shoreline for the North Beach neighborhood is included within the Port's Embarcadero Seawall Program, a separate but coordinated effort to create a more sustainable and resilient waterfront. More information related to the Embarcadero Seawall Program is included in Section 4.8. This area is also contained within the Port and U.S. Army Corps of Engineers Flood Study, which will study flood risk along San Francisco's bayside shoreline.

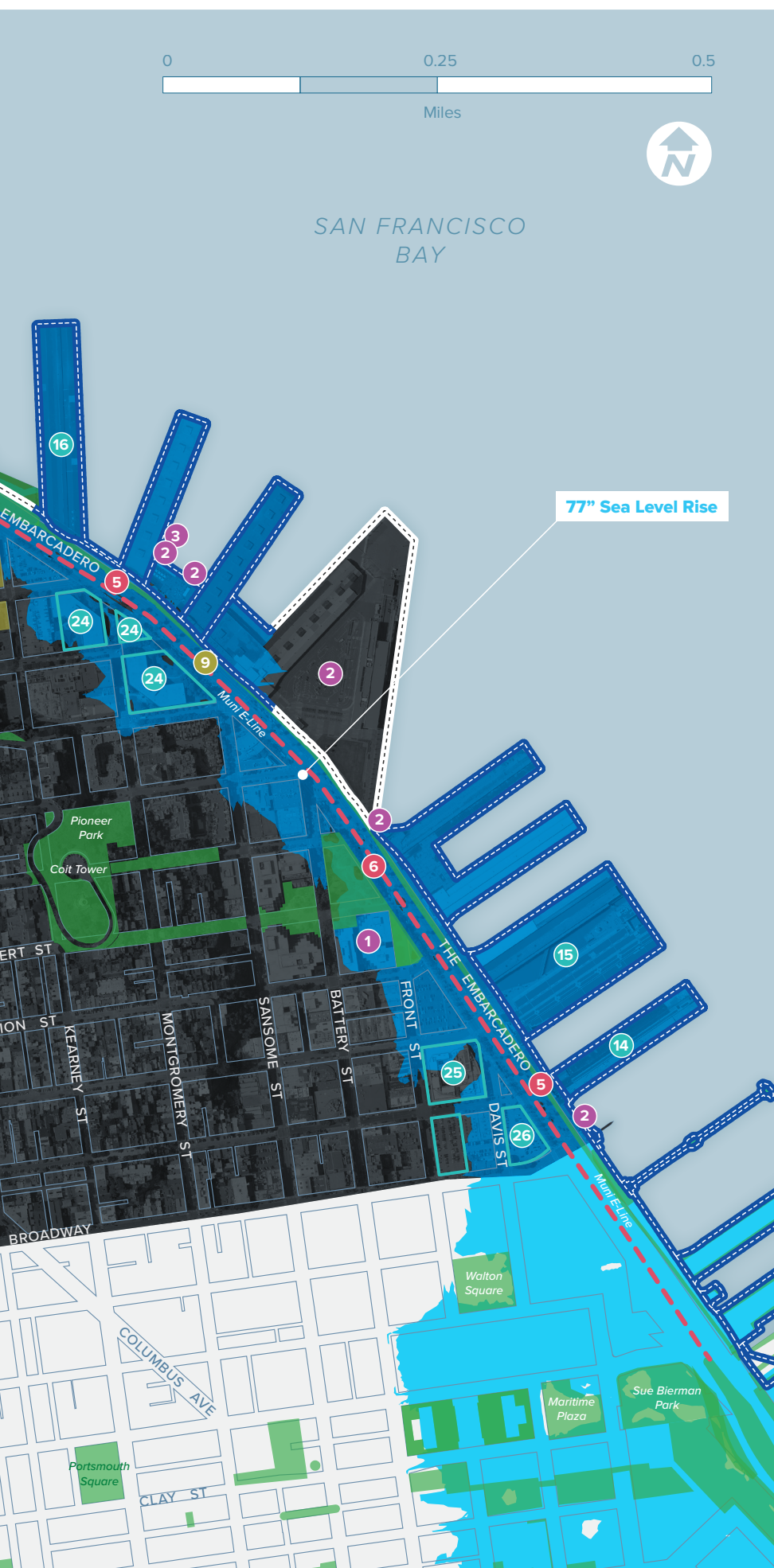
<sup>1</sup> San Francisco Department of Public Health. 2014. San Francisco Climate and Health Profile. Available at [https://sfclimatehealth.org/wp-content/uploads/2018/12/SFDPH\\_ClimateHealthProfile\\_FinalDraft.pdf](https://sfclimatehealth.org/wp-content/uploads/2018/12/SFDPH_ClimateHealthProfile_FinalDraft.pdf).

<sup>2</sup> Fisherman's Wharf Community Benefit District. Annual Report 2014-2015. Available at [http://static1.squarespace.com/static/565080e0ee4b03de1ac9f6805f/5651da4ce4b037d305df7db4/1448206308220/FWCBD+14-15+Annual\\_Report.pdf](http://static1.squarespace.com/static/565080e0ee4b03de1ac9f6805f/5651da4ce4b037d305df7db4/1448206308220/FWCBD+14-15+Annual_Report.pdf).

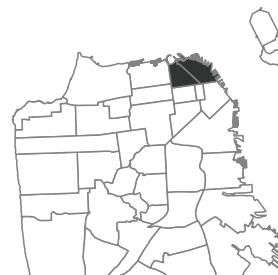








# North Beach Fisherman's Wharf



## NEIGHBORHOOD RESILIENCY SCORE: 2

Hazard Score: 1  
Environmental Score: 3  
Transportation Score: 5  
Community Score: 2  
Public Realm Score: 4  
Housing Score: 1  
Economy Score: 3  
Health Score: 3  
Demographics Score: 2

Source: San Francisco Climate & Health Program Neighborhood Summary  
<https://sfclimateandhealth.org/neighborhood/>



## PUBLIC SAFETY

- 1 Contaminated Land
- 2 Fireboat Pump Station / Fire Suction Connection
- 3 Fireboat Manifold



## TRANSPORTATION

- 4 Kirkland Division
- 5 The Embarcadero
- 6 Streetcar (E-Line)



## WASTE WATER

- 7 North Point Wet-Weather Treatment Plant
- 8 Northshore Pump Station
- 9 Combined Sewage Discharge (CSD)



## OPEN SPACE

- 10 Aquatic Park
- 11 Dolphin Club
- 12 South End Rowing Club



## PORT

- 13 Fisherman's Wharf
- 14 Pier 9 Offices, bar pilots, WETA offices
- 15 Piers 15-17 Exploratorium, public spaces, offices, iconic
- 16 Pier 35 Cruise Ship Terminal and public serving
- 17 Pier 39 Marina
- 18 Pier 39 Public serving, restaurants, retail, aquarium, iconic
- 19 Pier 41 Ferries, offices
- 20 Pier 43 Ferries
- 21 Pier 45 Public spaces, entertainment, fish processing
- 22 Pier 47 Restaurants, Fisherman's Wharf, retail, public serving
- 23 Hyde Street Harbor Commercial fishing, fish processing, historic vessels, recreational boating, fuel dock
- 24 Seawall 315-317: Waterfront Plaza (offices and restaurants)
- 25 Seawall 322: 88 Broadway (future affordable housing)
- 26 Seawall 324 Hotel Teatro Zinzani and open space





Ships along Marina Blvd. John Menard (CC BY-SA 2.0)

## The Shoreline

The North Beach and Fisherman's Wharf shoreline is 2.6 miles long and is an entirely hardened and engineered shoreline, including piers, seawalls, and wharves. Originally, the city's northeast shoreline extended to what is today Taylor and Francisco streets. North Beach was an actual beach and was filled in to allow for additional development around the late 19th century.

The Exploratorium, a popular participatory science museum for all ages, relocated from the Palace of Fine Arts to Piers 15 and 17 in April 2013. In 2014, the James R. Herman Cruise Terminal opened at Pier 27. The terminal can handle ships with up to 4,000 passengers, and the associated plaza provides 2.5 acres of dedicated public open space.

Further north along the shoreline is Hyde Street Pier. This pier houses a fuel dock, as well as the historic vessels, including the USS *Pampanito*, a decommissioned World War II era submarine, and the *Balclutha*, a 19th-century cargo ship. West of Fisherman's Wharf is the Aquatic Park Historic District, a National Historic Landmark and building complex located within the San Francisco Maritime National Historical Park. The sheltered Aquatic Cove includes a small sandy beach with a stepped concrete seawall. To the west is the horseshoe-shaped Municipal Pier, popular for fishing.



Pier 39. Wally Gobetz (CC BY-NC-ND 2.0)

Along the Bay shoreline, the wave hazards can exceed 4 feet in height,<sup>3</sup> creating the potential for coastal erosion of natural shorelines and wave damage to engineered shorelines. With SLR, the potential for wave hazards will increase because deeper Bay waters allow for the generation of larger waves. The breakwater wall surrounding Aquatic Park and Fisherman's Wharf provide significant shelter from wave hazards.







The shoreline is first overtopped in Scenario 3 (36 inches); however, the inundation impacts are localized to a relatively small area along Aquatic Park. The tipping point for North Beach and Russian Hill occurs in Scenario 6 (66 inches of SLR, or 24 inches of SLR coupled with a 100-year extreme tide) when large stretches of the shoreline are overtopped and significant impacts to the neighborhood, especially its business districts, could occur.<sup>4</sup>

<sup>3</sup> Federal Emergency Management Agency, Preliminary Flood Insurance Rate Maps.







<sup>4</sup> The ART Bay Shoreline Flood Explorer allows for interactive exploration and download of the Bay Area SLR and shoreline analysis maps. These maps depict areas at risk of temporary or permanent flooding due to SLR and extreme tides as well as shoreline overtopping. Available at <https://explorer.adaptingtorisingtides.org/explorer>.

## Extreme Tide and SLR Flooding Vulnerabilities and Consequences

The scenarios below describe the progression of potential extreme tide and SLR flooding, along with a brief discussion of the City-owned assets that will be impacted, within the North Beach and Russian Hill neighborhoods. Additional details on the exposure, vulnerability, and consequences of extreme tide and SLR flooding on City-owned assets can be found within the respective sector-based chapters. The relevant chapters are referenced below, as appropriate.

Scenario	Sector	Vulnerabilities and Consequences
<b>Scenario 1</b> (12 inches of SLR or a high tide with a 1-year recurrence interval)		<b>Public Safety:</b> Under Scenario 1, five fire suction connections (part of the emergency firefighting water system) that allow fire engines to draw water from the Bay for fire suppression are inundated. Suction connections become unusable if they are inundated.
<b>Scenario 2</b> (24 inches of SLR or 12 inches of SLR and a high tide with a 1-year recurrence interval)		<b>Wastewater:</b> Under Scenario 2, the higher Bay water levels may reduce the gravity-driven flow of excess combined wastewater and stormwater from the transport / storage boxes to the Bay. This impact is only of concern during intense and prolonged rainfall events that exceed the capacity of the large underground transport / storage boxes that ring the city. This could result in an increase in localized flooding in low-lying areas.
		<b>Public Safety:</b> Under Scenario 2, four additional fire suction connections are inundated, further reducing emergency firefighting response potential.
<b>Scenario 3</b> (36 inches of SLR or 12 inches of SLR and a high tide with a 5-year recurrence interval)		<b>Open Space:</b> Although the sandy beach in Aquatic Park will experience increasing inundation under Scenarios 1 and 2, significant loss of beach access occurs under Scenario 3. The beach and aquatic facilities (the access point for the beach and storage sheds for the boats and recreational gear used in the park) for the South End and Dolphin rowing clubs are all impacted to some degree under this scenario.
<b>Scenario 4</b> (48 inches of SLR or 6 inches of SLR and a 100-year extreme tide)		<b>Public Safety:</b> Two fire boat manifolds (part of the emergency firefighting water system) will be inundated at this scenario. Fire boats may still be able to make a secure connection to the manifold even if it is inundated. If the fire boats cannot make a connection, and the emergency firefighting water system loses pressure, the system may become unusable.
		<b>Power:</b> At Scenario 4, streetlights are inundated in North Beach.
<b>Scenario 6</b> (66 inches of SLR or 24 inches of SLR and a 100-year extreme tide)		<b>Wastewater:</b> At Scenario 6, North Point wet weather treatment plant is exposed to flooding along its northern edge. However, because the potential for flooding is limited, the treatment plant is likely to retain most of its operational capacity during a flood event that occurs when this facility is in operation.
		<b>Power:</b> At Scenario 6, streetlights are inundated in Russian Hill.
		<b>Port:</b> At Scenario 6, Hyde Street Pier and the harbor that houses San Francisco's commercial fishing fleet and fuel dock could be inundated. This pier is also located behind a breakwater wall that if overtopped could expose the city shoreline to high wave activity.  Pier 39, Fisherman's Wharf, and the surrounding open space areas could also be inundated causing significant impacts to the regional economy through lost tourism and visitors.  The new site of the Hotel Teatro ZinZanni within the Port's Historic District, across the Embarcadero from the Exploratorium and between Broadway and Green Streets, could also be inundated under Scenario 6. Under existing conditions, the site serves as a parking lot.

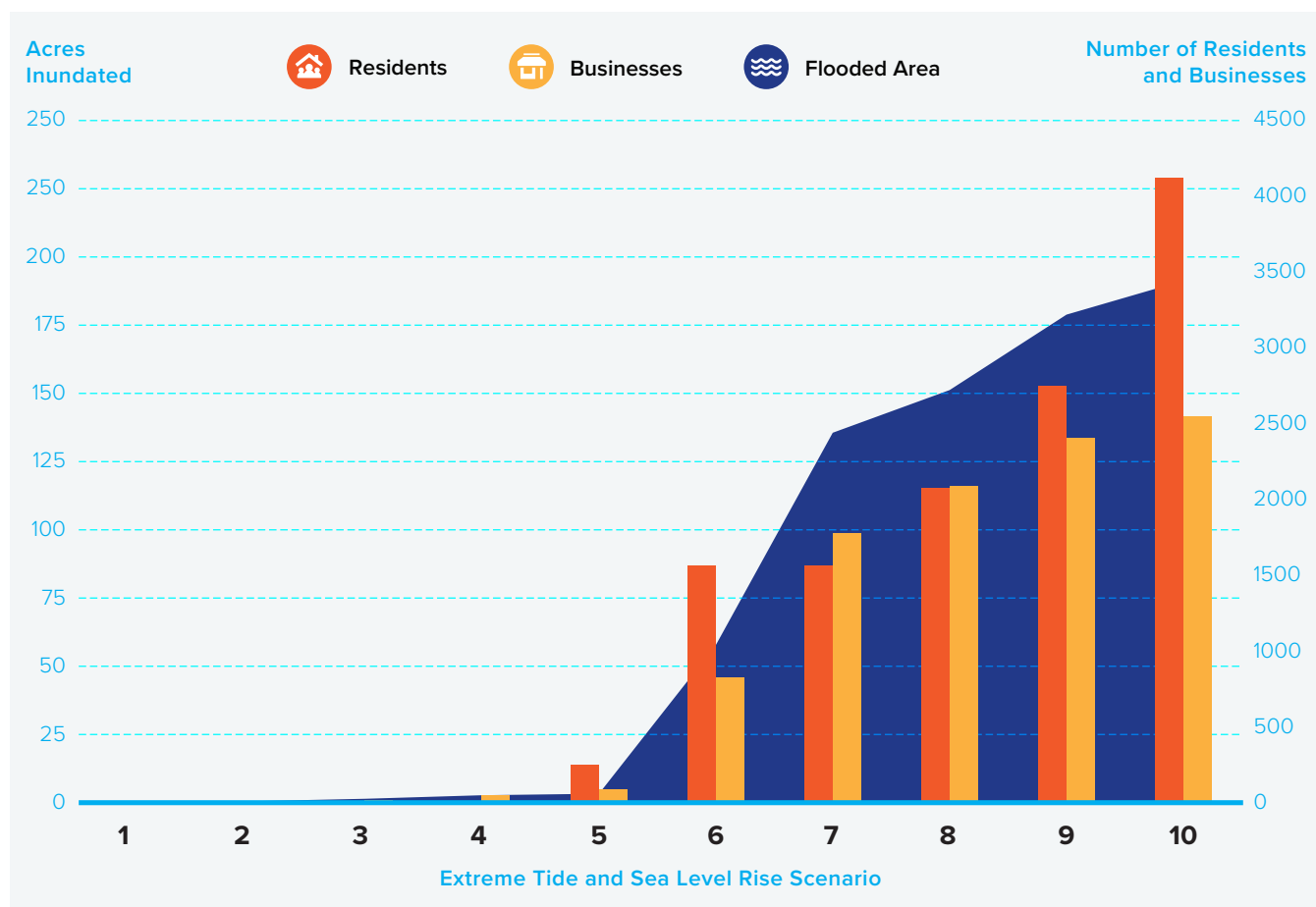


Scenario	Sector	Vulnerabilities and Consequences
		<b>Transportation:</b> Kirkland Division is a SFMTA facility is located on a 2.6-acre site between North Point, Beach, Stockton, and Powell streets. This facility provides bus storage, operations, and limited maintenance for 135 40-foot hybrid buses. The site includes mostly flat, paved surfaces with small operations and maintenance structures and underground storage tanks. If this facility is flooded, water can enter the underground storage tank through openings such as fill pipes, vent pipes, gaskets, loose fittings, covers, and sumps.
		<b>Public Safety:</b> Fire Department Pump Station No. 2 is located at the foot of Van Ness Avenue near Fort Mason. This pump station contains four diesel-driven pumps, each with a pumping capacity of 2,700 gpm at 300 psi. An approximately 160-foot concrete intake tunnel located underneath the pump station floor conveys seawater from the Bay to the pumps. This Bay connection will impact the pump station by Scenario 6. The pump station includes sensitive electrical equipment that is at and below grade and sensitive to any inundation.
<b>Scenario 7</b> (36 inches of SLR and a 100-year extreme tide)		<b>Wastewater:</b> The Northshore pump station is inundated under Scenario 7. Northshore is an abovegrade 30-mgd dry-weather pump station that serves the Northshore drainage basin, conveying wastewater to Channel pump station. Northshore pump station is located at 2001 Kearney Street, at the intersection of Kearney Street and Bay Street. During wet weather, the North Point Wet Weather Facility can treat up to 150 mgd of combined flows. Impacts at this pump station could result in localized flooding; however, the larger North Beach/Russian Hill neighborhood would not be impacted.
		<b>Port:</b> Under Scenario 7, Pier 9 (part of the Historic District and home to the Water Emergency Transportation Authority and the Bar Pilot Association) could be inundated, creating cascading impacts to ferry traffic and water-based response to regional emergencies, and container ship traffic to the Ports of Oakland and Stockton.  Pier 15/17 (part of the Historic District and home to the Exploratorium) could also be inundated, impacting tourism and a local destination for science-based educational entertainment and learning opportunities for children.
<b>Scenario 8</b> (48 inches of SLR and a 100-year extreme tide)		<b>Port:</b> The James R. Herman Cruise Terminal Cruise ship terminal is inundated at Scenario 8. This will reduce the capacity of the city to serve cruise ships and impact the tourism industry. If cruise ships are temporarily located at an alternate terminal, they may not be able to plug into shore power, which can lead to local air and water quality impacts associated with running the ship's engine to maintain onboard power.
<b>Scenario 9</b> (52 inches of SLR and a 100-year extreme tide)		<b>Public Safety:</b> Fire Department Pump Station No. 2 (Chapter 6) will be inundated by floodwaters by Scenario 9.

## Residents and Businesses Exposed to Extreme Tide and SLR Flooding

As extreme tides and SLR overtop the Bay shoreline and flood the city's critical infrastructure, residents and businesses in the path of the floodwaters will be affected. Few residents and businesses are affected until Scenario 6 when over 800 businesses and 1,500 residents are impacted. The areas with the most affected businesses are around Fisherman's Wharf and Pier 39. The impacted residents are located near the Embarcadero in North Beach.

For more information about particular properties and buildings are affected under different scenarios, use the *Adapting to Rising Tides Bay Shoreline Flood Explorer*.<sup>5</sup>



<sup>5</sup> <https://explorer.adaptingtorisingtides.org/home>





## NEIGHBORHOOD PROFILE

# MARINA & PRESIDIO

Aerial of the San Francisco Marina. Photo by Jiff Clardy (CC BY-NC-SA 2.0)

The Marina neighborhood is located on the northern edge of San Francisco between the Presidio and Aquatic Cove. The Presidio, one of the county's most famous former U.S. Army forts, is now a 1,500-acre national park in the Golden Gate National Recreation Area. The Golden Gate Bridge, the only direct ground transportation link between San Francisco and Marin County to the north, touches down in the Presidio.

The Marina District is largely residential, with over 16,000 housing units.<sup>1</sup> The neighborhood also features several neighborhood commercial corridors along Chestnut, Fillmore, and Union streets, and recreational features, such as the Moscone Softball

Fields, the Fort Mason Center for Arts and Culture, and Marina Greens. The waterfront includes two marinas for small watercraft. The Palace of Fine Arts, a dramatic neoclassical monument that remains from the 1915 Panama-Pacific Exhibition, is a major landmark and tourist attraction. Residents in this neighborhood tend to be highly educated and experience low rates of poverty relative to other neighborhoods.

The Presidio, including Baker Beach and Crissy Field, is owned and managed by the National Park Service. A detailed vulnerability assessment of National Park Service assets was not completed for this report.

<sup>1</sup> American Community Survey (ACS). 2016. Social Explorer. Available at <https://www.socialexplorer.com/a9676d974c/explore>.





Fort Mason. Adam Fagen (CC BY-NC-SA 2.0)



Marina Green. Daniel Hoherd (CC BY-NC 2.0)



Palace of Fine Arts. Elizabeth K. Joseph (CC BY 2.0)

## The Shoreline

The Marina and Presidio neighborhoods Bay shoreline is 6.6 miles long. Over half of the shoreline includes engineered shoreline structures and the remainder of the shoreline is natural (i.e., cliffs and beaches). The natural shoreline areas are primarily located in the Presidio. The neighborhoods' shoreline stretches from Aquatic Park in the east to the Golden Gate Bridge along the city's northern shore and along the west coast south to the southern part of Baker Beach.

The natural low-lying beach shorelines are the most vulnerable to SLR, wave hazards, and coastal erosion, including Chrissy Field on the Bay side and Marshall and Baker Beaches on the ocean side, both important recreational areas. The Presidio also includes high cliffs fronted by small pockets of beach. Due to its proximity and direct frontage to dynamic ocean wave hazards, these neighborhoods can experience higher wave hazards than the more sheltered Bayside neighborhoods. Wave hazards can be 6 feet or greater in some areas.<sup>2</sup> Breakwaters currently reduce the wave hazards for the from Gas House Cove to north of the Saint Francis yacht club. As sea levels rise, the breakwaters will become less effective at reducing wave hazards.

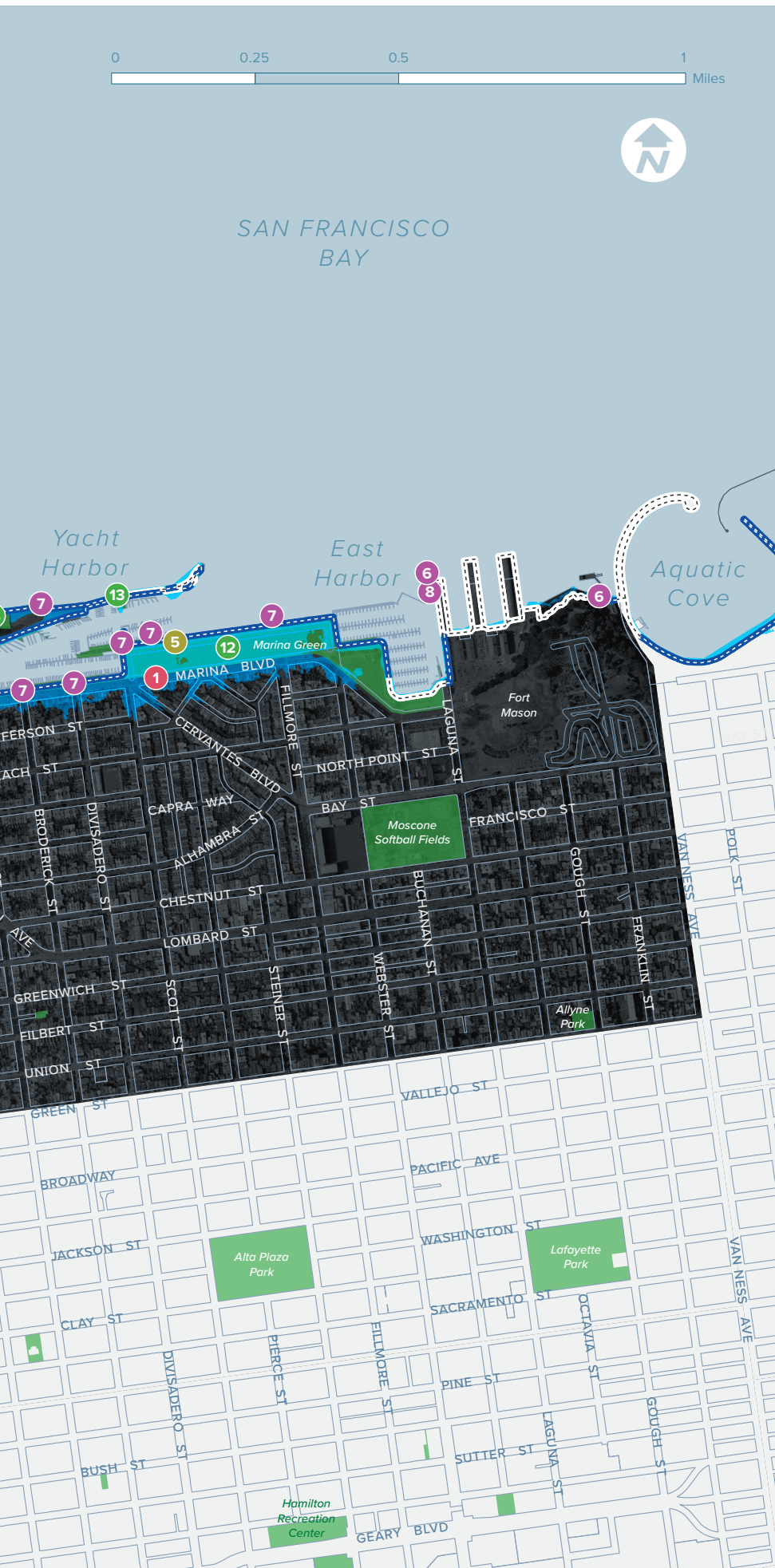
The tipping point in these neighborhoods occurs in Scenario 6, when the roads and assets (such as the Palace of Fine Arts) could be inundated. In Scenario 5, the breakwater area near the Golden Gate and Saint Francis yacht clubs is overtopped, and by Scenario 6, the Marina Green area could also be flooded.<sup>3</sup>

2 Federal Emergency Management Agency, Preliminary Flood Insurance Rate Maps.

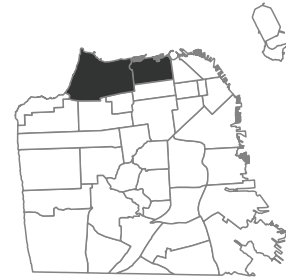
3 The ART Bay Shoreline Flood Explorer allows for interactive exploration and download of the Bay Area SLR and shoreline analysis maps. These maps depict areas at risk of temporary or permanent flooding due to SLR and extreme tides as well as shoreline overtopping. Available at <https://explorer.adaptingtorisingtides.org/explorer>.







## Marina and Presidio



### TRANSPORTATION

- 1 Marina Boulevard Arterial
- 2 Mason Street
- 3 Highway 101 / Richardson Ave



### WASTEWATER

- 4 Palace of Fine Arts Pump Station
- 5 Combined Sewer Discharge (CSD)



### PUBLIC SAFETY

- 6 Fireboat Pump Station
- 7 Fireboat Pump Station / Fire Suction Connection
- 8 Fireboat Manifold











### OPEN SPACE





- 9 Crissy Field
- 10 Yacht Harbor and Marina Green
- 11 Palace of Fine Arts
- 12 Marina Green Three Lawns
- 13 Golden Gate Yacht Club
- 14 Saint Francis Yacht Club



## Extreme Tide and SLR Flooding Vulnerabilities and Consequences

The scenarios below describe the progression of potential extreme tide and SLR flooding, along with a brief discussion of the City-owned assets that will be impacted, within the Bayview North Islais Creek neighborhood. Additional details on the exposure, vulnerability, and consequences of extreme tide and SLR flooding on City-owned assets can be found within the respective sector-based chapters. The relevant chapters are referenced below, as appropriate.

Scenario	Sector	Vulnerabilities and Consequences
<b>Scenario 1</b> (12 inches of SLR or a high tide with a 1-year recurrence interval)		<b>Open Space:</b> The Crissy Field wetlands already experience regular inundation during high tides today. As sea levels rise, the wetlands may keep pace with SLR and continue to provide valuable habitat, or they may be submerged. The wetlands are expected to keep pace with SLR until mid-century; however, as SLR accelerates after mid-century, the wetlands may be lost if sediment doesn't accumulate fast enough to support wetland growth (due to deeper Bay levels).
		<b>Public Safety:</b> One fire suction connection (part of the emergency firefighting water system) that allows fire engines to draw water from the Bay for fire suppression is inundated. The suction connections become unusable when inundated, largely due to limitations in fire engine access.
<b>Scenario 2</b> (24 inches of SLR or 12 inches of SLR and a high tide with a 1-year recurrence interval)		<b>Open Space:</b> The Marina neighborhood with its variety of high-quality aquatic recreation and shoreline access, is expected to be adversely impacted before Scenario 2, mostly due to impacts to the Marina Green seawall. The historic internal marina seawalls in the west are in poor condition and continue to fail. The northern marina shoreline adjacent is also subject to erosion, primarily due to waves generated by passing ship traffic.  Approximately 75 percent of the site is subject to tidal, wind, and wave hazards. The West Harbor has more substantial wave protection than the East Harbor. The Marina Shop's lower level floods during very high tides, and the floodwaters can impact mechanical equipment, including pumps, motors, and valves. At-grade utilities, including water and power, are connected to the docks.  The Golden Gate Yacht Club will also be impacted at this scenario. Located at 1 Yacht Road in the protected harbor, the structure is built on pilings over water and could be inundated by temporary floodwaters as early as Scenario 2. Wave action is already causing erosion issues for the access road/jetty to the Golden Gate Yacht Club. Impacts to some of the historic seawall and shoreline fortifications will become worse, eventually cutting off access to the yacht clubs and marina facilities.
		<b>Public Safety:</b> Six additional fire suction connections are inundated under Scenario 2. The suction connections become unusable when inundated, largely due to limitations in fire engine access.
		<b>Wastewater:</b> Under Scenario 2, the higher Bay water levels may reduce the gravity-driven flow of excess combined wastewater and stormwater from the transport / storage boxes to the Bay through combined sewer discharge outfalls (Chapter 7). This impact is only of concern during intense and prolonged rainfall events that exceed the capacity of the large underground transport / storage boxes that ring the city. This could result in an increase in localized flooding in low-lying areas.
<b>Scenario 4</b> (48 inches of SLR or 6 inches of SLR and a 100-year extreme tide)		<b>Transportation:</b> A major roadway, Marina Boulevard, could be impacted at Scenario 4, near Divisadero, affecting access and thru-traffic for residents and commuters.
		<b>Public Safety:</b> One fire boat manifold (part of the emergency firefighting water system) will be inundated at this scenario. Fire boats may still be able to make a secure connection to the manifold even if it is inundated. If the fireboats cannot make a connection, and the emergency firefighting water system loses pressure, the system may become unusable.
		<b>Power:</b> Under Scenario 4, streetlights are impacted by flooding.

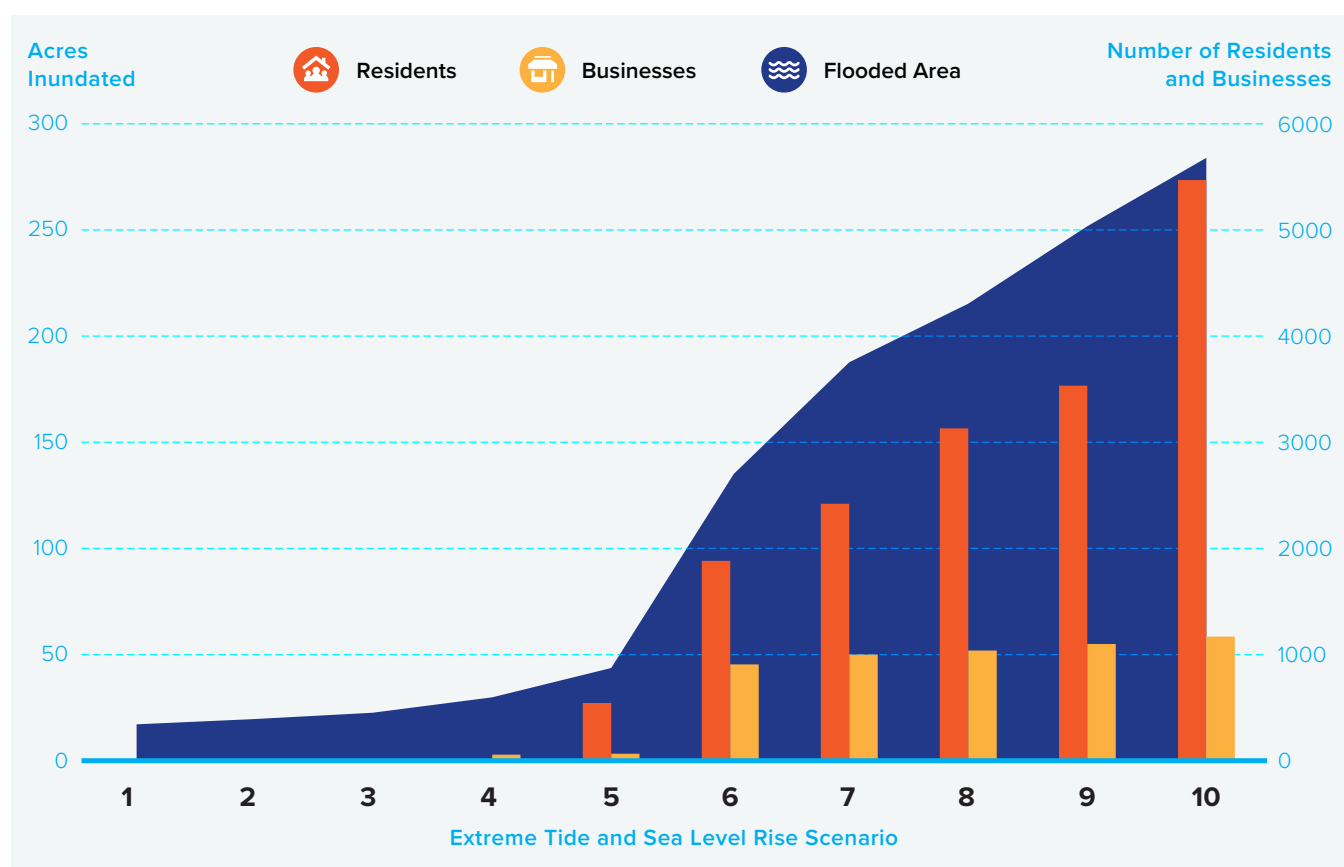
Scenario	Sector	Vulnerabilities and Consequences
<b>Scenario 5</b> (54 inches SLR or 12 inches SLR and a 100-year extreme tide)		<b>Transportation:</b> Marina Boulevard will be increasingly inundated under Scenario 5 between Broderick and Scott streets, affecting access and thru-traffic for residents and commuters. Mason Street, which serves as an alternate route to and from the Golden Gate Bridge and US 101 during commute hours, would also be inundated under Scenario 5.
<b>Scenario 6</b> (66 inches of SLR or 24 inches of SLR and a 100-year extreme tide)		<b>Wastewater:</b> The Palace of Fine Arts Pump Station, consisting of two facilities that serve a two-acre drainage area, could be inundated under Scenario 6. The pump station serves a small area in the North Shore drainage basin during dry and wet weather with a pumping capacity of 0.43 mgd. The pump station receives wastewater from the Palace of Fine Arts building, and stormwater runoff and drainage from the adjacent lagoon. Dry- and wet-weather flow is transported to the Marina transport / storage box.
		<b>Transportation:</b> The primary impacts to transportation occur under Scenario 6 when US 101/ Richardson Avenue is flooded, impacting local traffic and through traffic to the Golden Gate Bridge. This roadway is also a designated truck route. The inundation will impact public transportation, in particular the Golden Gate Transit bus connections to Marin County. Under Scenario 6, Marina Boulevard, and its adjacent residences and the Marina Green, will be inaccessible between Webster and Baker streets and the US 101 on-ramp. Large portions of Mason Street and many of the adjacent businesses will also be inaccessible.
		<b>Open Space:</b> Under Scenario 6, floodwaters could inundate the shoreline park and public access areas, including the entire Marina Green area, the yacht harbor, and the Saint Francis and Golden Gate yacht clubs.  The Palace of Fine Arts is first inundated under Scenario 6, with 75 percent of the grounds and structures impacted by temporary flooding. However, high groundwater levels and drainage issues are present today, and SLR is likely to exacerbate these issues before overland coastal flooding occurs.  The Marina Green and yacht harbors, as well as Crissy Field, provide key access and unique views of the San Francisco Bay to residents and visitors and are important for San Francisco's tourism and sailors. The marinas (the physical structures, supporting buildings, and electricity supply) could be damaged and/or become inaccessible due to flooding and secondary hazards, such as wave impacts, creating potentially long-lasting and costly impacts.



## Residents and Businesses Exposed to Extreme Tide and SLR Flooding

As extreme tides and SLR overtop the Bay shoreline and flood the city's critical infrastructure, residents and businesses in the path of the floodwaters will be affected. Under Scenario 6, the flooded area increases tenfold from about 5 to 50 acres, impacting thousands of residents and approximately 1,000 businesses. In the Marina, thousands of residents and several hundred business are impacted, while in the Presidio, less than 50 residents and less than 350 businesses are affected. The area with the most affected residents and businesses is concentrated along the waterfront, Marina Green, Marina Boulevard, and Mason Street.

For more information about particular properties and buildings are affected under different scenarios, use the *Adapting to Rising Tides Bay Shoreline Flood Explorer*.<sup>4</sup>



<sup>4</sup> <https://explorer.adaptingtorisingtides.org/home>



## NEIGHBORHOOD PROFILE

# WESTSIDE OCEAN BEACH

The Great Highway along Ocean Beach. Photo by Daniel Austin Hoherd (CC BY-NC 2.0)

The Westside neighborhoods border Ocean Beach and the Pacific Ocean between the San Mateo County border and the Golden Gate Bridge, including the Seacliff, Outer Richmond, Outer Sunset, Parkside, and Lakeshore neighborhoods. These neighborhoods are primarily residential, with Outer Richmond and Outer Sunset as two of the most heavily populated neighborhoods in the city. The Westside also features many important recreational areas, including Land's End, Sutro Baths, Golden Gate Park, Ocean Beach, the San Francisco Zoo, Fort Funston, and Lake Merced. These neighborhoods are generally set back from the ocean, with the Great Highway between them running parallel to the Pacific Ocean. The Great Highway includes a separated bicycle and pedestrian pathway. San Francisco State University and the Oceanside Treatment Plant are both located in the Lakeshore neighborhood.

The Westside neighborhoods include residents across a wide range of income and racial and ethnic groups. Richmond, Sunset, and Lakeshore have

large Asian communities, with linguistic isolation for about 15 percent of households. In Lakeshore, census tracts around San Francisco State University have high rates of poverty and housing burden. Portions of the Lakeshore neighborhood are included in MTC's Communities of Concern <sup>1</sup>

## The Shoreline

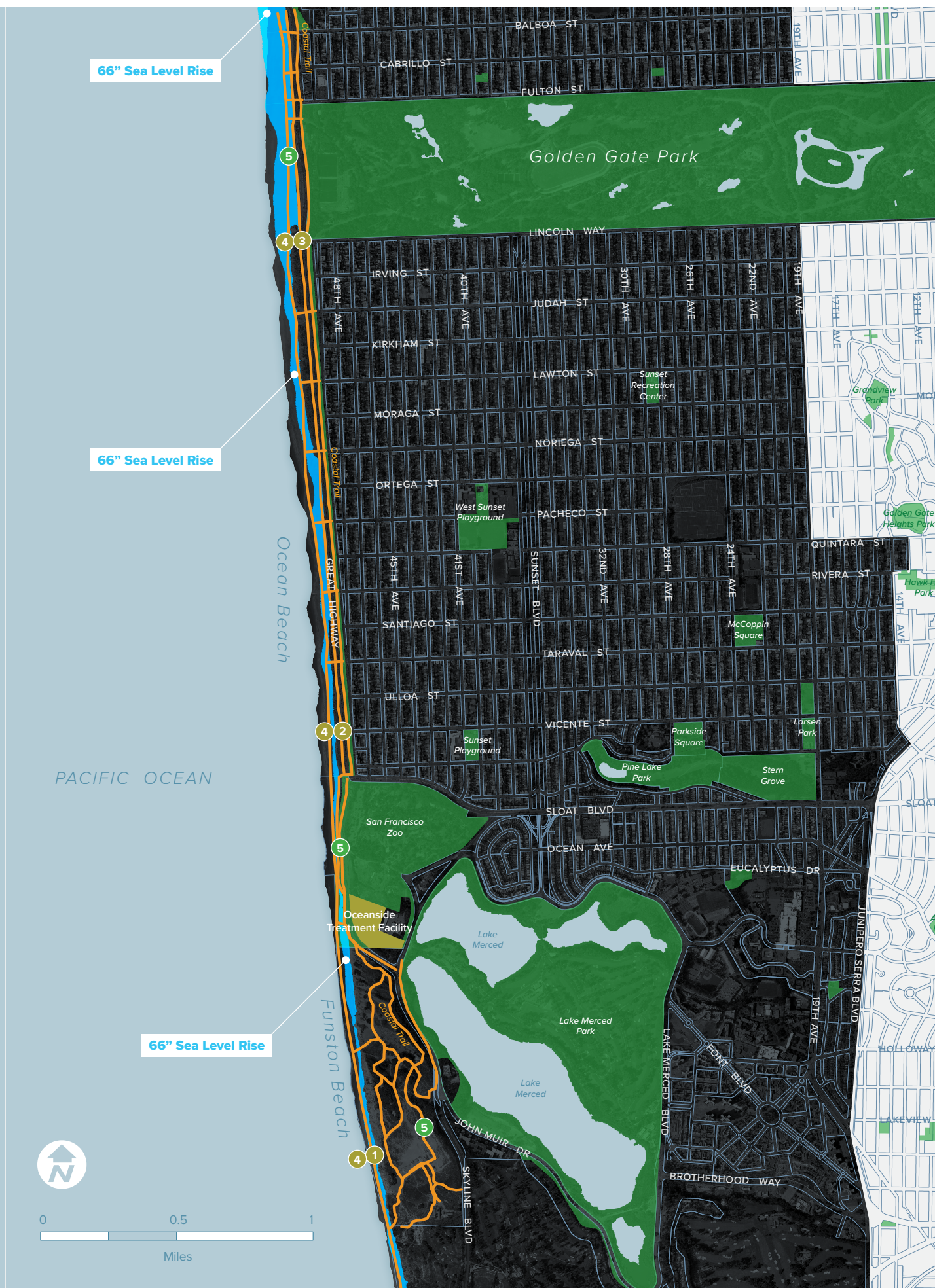
The Westside shoreline is over 5 miles long and includes both coastal bluffs and sandy beaches, including Ocean and Baker beaches. Baker Beach is a 1-mile-long beach that includes recreational picnic areas and views of Golden Gate Bridge and the Marin Headlands.<sup>2</sup> Ocean Beach, a 3.5-mile stretch of sand, draws a diverse population of more than 300,000 visitors each year and part of the Golden Gate National Recreation Area.

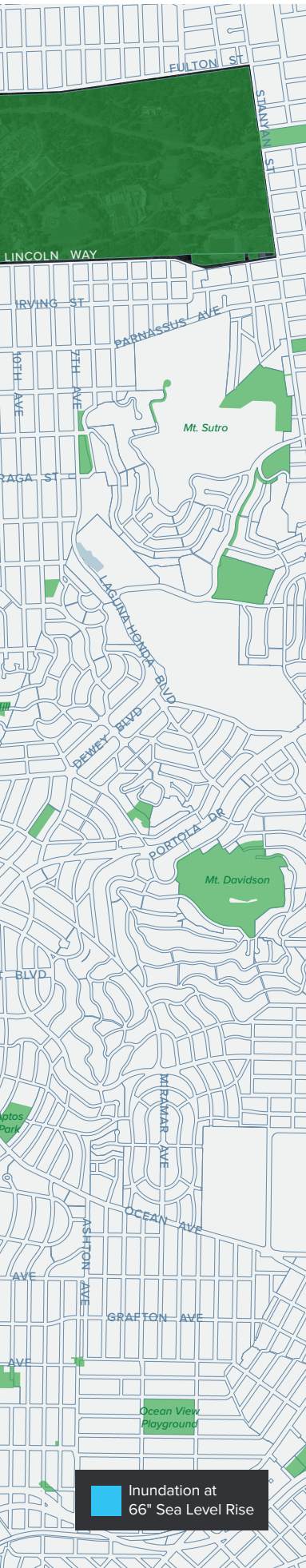
Ocean Beach has a long history of modifications, beginning with dune stabilization efforts in the 1860s, followed by construction of the Great Highway,

1 <http://opendata.mtc.ca.gov/datasets/mtc-communities-of-concern-in-2018-acs-2012-2016?fullScreen=true&geometry=-122.686%2C37.629%2C-122.338%2C37.766>

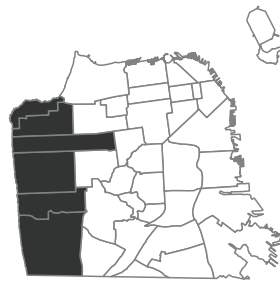
2 National Park Service. Presidio of San Francisco Baker Beach. Available at <https://www.nps.gov/prsf/planyourvisit/baker-beach.htm>.







## Westside / Ocean Beach



### WASTE WATER

- 1 Lake Merced Transport/Storage Box
- 2 Vicente Transport/Storage Box
- 3 Lincoln Transport/Storage Box
- 4 Combined Sewer Discharge (CSD)



### OPEN SPACE

- 5 Coastal Trail ———





Sea Cliff. Wayne Hsieh (CC BY-NC 2.0)

Esplanade, and O'Shaughnessy seawall in 1929, the Taraval seawall in 1941, and the Noriega seawall in the 1980s. Ocean Beach has experienced significant erosion south of Sloat Boulevard over the past two decades. Temporary measures such as rip rap have not mitigated the problem. The erosion has damaged the Great Highway, parking areas, and is threatening the most seaward component of the city's combined wastewater system — the Lake Merced Tunnel, a 14-foot-diameter pipe under the Great Highway. Since 2010, there has been an extensive interagency and public process to develop the Ocean Beach Master Plan, a comprehensive long-term vision to address SLR, protect infrastructure, restore coastal ecosystems, and improve public access.

The Westside shoreline, including Ocean Beach, is also covered by a Local Coastal Program that guides development, conservation, and the protection of coastal resources in partnership with the Coastal Commission.<sup>3</sup> Originally certified in 1986, San Francisco's Local Coastal Program was amended in May 2018 to include recommendations from the Ocean Beach Master Plan.<sup>4</sup>

City and federal agencies are working together to implement short- and long-term adaptation measures at South Ocean Beach, following the recommendations of the Ocean Beach Master Plan. Current implementation efforts include annual sand replenishment,



Dragon boats on Lake Merced. Michael Ocampo (CC BY 2.0)

roadway narrowing, and wastewater pump station improvements. Long-term improvements include road narrowing and realignment, an improved recreation trail, and the Ocean Beach Long-Term Improvements Project. See Chapter 12. *A Changing Shoreline* for more information.

The wave hazards along the Pacific Ocean shoreline are much larger than within the sheltered Bay, with wave heights exceeding 20 feet along some stretches of shoreline. As sea levels rise, the potential for wave hazards and coastal erosion will increase, because deeper ocean waters allow for the generation of larger waves. Coastal erosion of the ocean-front beaches and bluffs will continue to change the Westside shoreline over the coming century.

## Extreme Tide and SLR Flooding Vulnerabilities and Consequences

The scenarios below describe the progression of potential extreme tide and SLR flooding, along with a brief discussion of the City-owned assets that will be impacted, within the Westside neighborhoods.




For the Westside, vulnerability was evaluated relative to the 100-year dynamic water level, which includes both the 100-year extreme tide level and the increase in the mean water level due to the presence of waves often referred to as wave setup. The wave dynamics

3 California Coastal Commission. 2019. Public Resources Code Division 20: California Coastal Act. <https://www.coastal.ca.gov/coastact.pdf>.

4 City and County of San Francisco Planning Department. 2016. Local Coastal Program Amendment – Sea Level Rise Existing Data and Analyses Technical Memorandum. [http://default.sfplanning.org/plans-and-programs/local\\_coastal\\_prgrm/20160506.SFLCP\\_SLR\\_Tech\\_Memo.FINAL.pdf](http://default.sfplanning.org/plans-and-programs/local_coastal_prgrm/20160506.SFLCP_SLR_Tech_Memo.FINAL.pdf).

along the Westside shoreline are very different from those observed within the more sheltered San Francisco Bay; therefore, it is important to consider the impact of the waves along the Westside shoreline. For each of comparison with the Bayside assets, the Westside SLR and 100-year dynamic water levels are presented relative to the 10 SLR scenarios. However, the Westside shoreline analysis only evaluated the 100-year dynamic water level plus 12, 24, 36, 48, and 66 inches of SLR (Scenarios 5, 6, 7, 8, and 10, respectively).

Additional details on the exposure, vulnerability, and consequences of extreme tide and SLR flooding on City-owned assets can be found within the respective sector-based chapters. The relevant chapters are referenced below, as appropriate.

Scenario	Sector	Vulnerabilities and Consequences
<b>Scenario 5</b> (54 inches SLR or 12 inches SLR and a 100-year extreme tide)		<b>Wastewater:</b> Under Scenario 5, the higher Pacific Ocean water levels may reduce the gravity-driven flow of excess combined wastewater and stormwater from the Lake Merced and Vicente Street transport / storage boxes via the combined sewer discharge outfalls. This impact is only of concern during intense and prolonged rainfall events that exceed the capacity of the large underground transport / storage boxes that ring the city. This could result in an increase in localized flooding in low-lying areas.
		<b>Open Space:</b> Several of the trails that comprise the Coastal Trail could experience inundation under Scenario 5. Almost 100 percent of the Ocean Beach / Fort Funston Shoreline trail is inundated at this scenario, and the Baker Beach trail is approximately 90 percent inundated. Both trails run adjacent to the Pacific Ocean and can be subjected to erosion during large coastal storms with high winds and large waves.
<b>Scenario 6</b> (66 inches of SLR or 24 inches of SLR and a 100-year extreme tide)		<b>Wastewater:</b> Under Scenario 6, the higher Pacific Ocean water levels may reduce the gravity-driven flow of excess combined wastewater and stormwater from the Lincoln transport / storage boxes via the combined sewer discharge outfalls. This impact is only of concern during intense and prolonged rainfall events that exceed the capacity of the large underground transport / storage boxes that ring the city. This could result in an increase in localized flooding in low-lying areas.

## Residents and Businesses Exposed to Extreme Tide and SLR Flooding

Along the Westside shoreline, residential developments and businesses are generally located outside of the SLR Vulnerability Zone. However, the SLR Vulnerability Zone does not consider how the Westside shoreline could change if the ongoing coastal erosion hazards were allowed proceed without intervention. Currently, the implementation of the Ocean Beach Master Plan should address the most pressing erosion problems, providing protection for the city's critical infrastructure and its residents. As sea levels rise and the climate continues to change, the wave hazards may also change, placing additional areas at risk of erosion and flooding. The City is committed to monitoring long-term change along the Westside shoreline, particularly after large coastal storm events.





Ocean Beach and the Great Highway  
Photo by Martin Eckert (CC BY-NC-ND 2.0)