

CHAPTER 11

PORT OF SAN FRANCISCO

The Port's jurisdiction provides a variety of uses along the waterfront, including maritime activities and services such as fishing, ferry transportation, water-based recreation, harbor services, and cargo shipping, as well as public access, parks, and open spaces, protection of natural and cultural resources, and space for much of San Francisco's last remaining critical industrial uses. The Port is also home to several well-loved institutions, including the Exploratorium, Oracle Park, the Ferry Building, Heron's Head Park and EcoCenter, and Fisherman's Wharf. The Port provides shoreline protection for 7.5 miles of the City and County of San Francisco's waterfront, including regional and citywide assets such as BART, Muni, utilities, homes, jobs, and critical emergency response facilities and services.

From its establishment in 1863 until 1968, the State of California oversaw management of the Port. In 1968, the Burton Act mandated the transfer of Port lands from state management to the City and County of San Francisco. Subsequently, the Port Commission was established as an enterprise department of the City to develop, lease, administer, manage, and maintain Port lands.

In addition to an enterprise department of the City, the Port is also a trustee for the Public Trust for the State of California. The Public Trust Doctrine recognizes the public's right to natural resources such as air, water, and access to the sea. In California, the Public Trust generally refers to lands that are submerged, tidal, or filled and retained in public ownership.¹

¹ Port of San Francisco (Port). 2009. "Chapter 3: General Land Use Policies." Waterfront Land Use Plan. https://sfport.com/ftp/uploadedfiles/about_us/divisions/planning_development/ch3.pdf. Revised October.

The State Lands Commission administers public trust lands that were not granted to a local agency and oversees the activities of local grantees such as the Port. As a trustee, the Port ensures that land uses within its jurisdiction are consistent with the Public Trust, reserving these lands for uses that promote navigation, fisheries, and waterborne commerce; enhance natural resources; and attract people to use and enjoy the Bay.¹ The Port works closely with state agencies, including the State Lands Commission and BCDC. As a port and waterfront land manager, the Port also works closely with federal agencies, including the U.S. Army Corps of Engineers.

The Port's primary shoreline ownership runs from Fisherman's Wharf in the north to India Basin in the south. This assessment focuses on Port assets located in the southern waterfront outside of the three miles of Embarcadero Seawall. The Embarcadero Seawall extends from Fisherman's Wharf to Mission Creek and faces both flooding and seismic risks and is undergoing a separate vulnerability and risk assessment as part of the Embarcadero Seawall Program. The Embarcadero Seawall Program is a separate but coordinated effort to create a more sustainable and resilient waterfront and is described further in Section 4.8.

This Assessment focuses on Port lands in the southern waterfront from Mission Creek to India Basin (Figure 11.1). The following sections describe various Port assets and provide information about how key assets and asset categories may be vulnerable to SLR and coastal flooding.

For the purposes of this assessment, the Port's assets are organized by the following asset categories:

- **Port Structures** – Piers, bulkhead buildings, wharves, seawall lots, and harbors
- **Recreation and Public Open Space** – public realm and open space areas
- **Transportation** – Ferries, streets, bridges, shipping berths, cargo facilities, and railroads

- **Utilities** – over land (buried) and over water (under pier) stormwater utilities
- **Adaptation Projects** – planned or completed SLR adaptation projects

Each asset is categorized further by Port use and service type. Port use was included as another metric to help assess the vulnerability and consequences of coastal flooding. The following uses are included below and defined in Table 11.1:

- Natural Resources and Public Open Spaces
- Historic Districts and Potential Historic Features
- Maritime
- Industrial
- Environmental Hazards
- Commercial
- Residential
- Emergency Response
- Utilities
- Transportation

Table 11.1 Port Use and Service Category Classifications

Port Use Category	Description
Natural Resources and Public Open Spaces	Uses that protect or enhance natural resources and provide public access to open spaces.
Historic District	The area of the Port discussed in this report contains two historic districts – the Union Iron Works Historic District designated on April 17, 2014, and a portion of the Embarcadero Historic District designated on May 12, 2006.
Potential Historic Feature	Structures and objects that may be historic or may contain historic features but have not yet been evaluated or identified as a historic resource or part of a historic district.
Maritime*	Uses that depend on a waterfront location to operate or uses that support maritime activities. Examples include cargo shipping, ship repair, the fishing industry, harbor services, excursions, water recreation, ferries and water taxis, passenger cruise ships, historic ships, and maritime support services and offices.
Industrial	Industrial operations that support maritime and general industrial activities. This includes industrial buildings on piers and seawall lots as well as open land operations and berthing activities.
Commercial*	Commercial uses on piers and seawall lots. Those on piers include artist studios and galleries, entertainment, recreational/fitness services, museums, parking for acceptable uses, retail, visitor services, warehousing and storage, wholesale trader, and general offices. Those on seawall lots include the same as commercial piers as well as hotels, general offices, parking, and warehousing/storage.
Residential	Sites that include residential housing.
Emergency Response	Assets identified by the Port's Embarcadero Seawall Program, in close coordination with the Department of Emergency Management and the Water Emergency Transportation Authority, as being part of the City, Port, and region's emergency response system.
Utilities	Assets that include utilities on them. This includes utilities owned by the Port and utilities owned by other agencies or companies.
Transportation	Assets that include a component related to transportation (parking, roadway, bridges, ferries, freight and commuter rail, etc.).

*Port of San Francisco (Port). 2009. "Chapter 3: General Land Use Policies." Waterfront Land Use Plan. https://sfport.com/ftp/uploadedfiles/about_us/divisions/planning_development/ch3.pdf. Revised October.

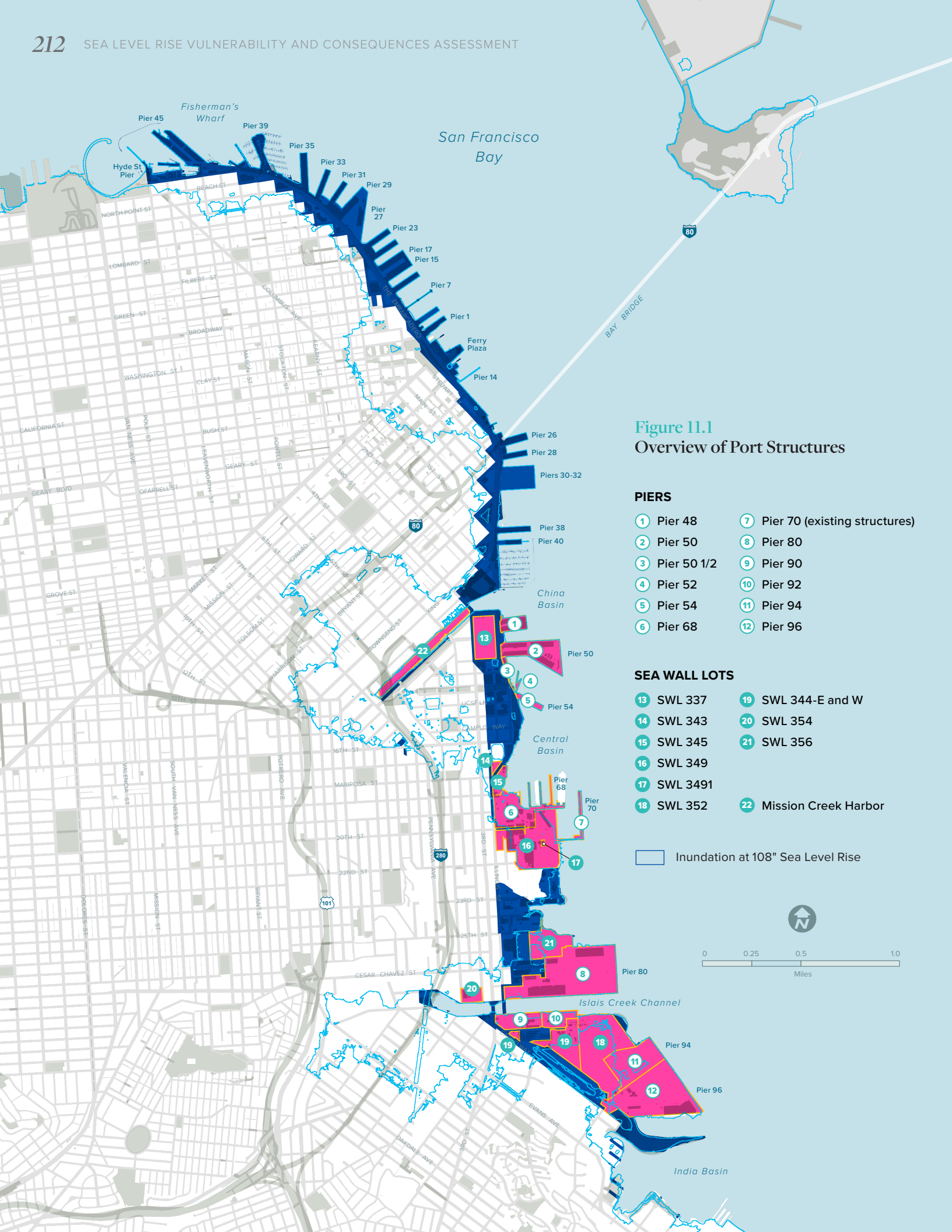
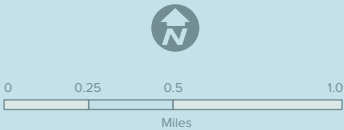


Figure 11.1
Overview of Port Structures

- PIERS**
- 1 Pier 48
 - 2 Pier 50
 - 3 Pier 50 1/2
 - 4 Pier 52
 - 5 Pier 54
 - 6 Pier 68
 - 7 Pier 70 (existing structures)
 - 8 Pier 80
 - 9 Pier 90
 - 10 Pier 92
 - 11 Pier 94
 - 12 Pier 96
- SEA WALL LOTS**
- 13 SWL 337
 - 14 SWL 343
 - 15 SWL 345
 - 16 SWL 349
 - 17 SWL 3491
 - 18 SWL 352
 - 19 SWL 344-E and W
 - 20 SWL 354
 - 21 SWL 356
 - 22 Mission Creek Harbor

Inundation at 108" Sea Level Rise





11.1 PORT STRUCTURES

Port structures include piers, bulkhead buildings, wharves, seawall lots, and harbors. This section describes the Port structures located in the southern waterfront, describes their vulnerabilities, and highlights the consequences that could occur if the structures are flooded. Figure 11.1 shows the Port structures and the SLR Vulnerability Zone.² Table 11.2 summarizes the Port use type categories for each Port structure.

² The SLR Vulnerability Zone was adopted by the City in 2014. It is the area that could be flooded by a 100-year coastal flood event coupled with 66 inches of SLR, a probable worst-case scenario by the end of the century. Chapter 2, *Climate Science*, provides additional information on the SLR Vulnerability Zone, climate science, and SLR scenarios.

11.1.1 Potentially Vulnerable Port Structure Assets

Because the Port's jurisdiction is along the city's bayside shoreline, all Port structures were considered potentially vulnerable and were included in the vulnerability assessment. A description of the various Port structures, uses, and their vulnerabilities is included below.

Table 11.2 Port Structure Assets by Use Category

Asset	Port Use Category									
	Natural Resources and Open Spaces	Historic District	Potential Historic Feature	Maritime	Industrial	Commercial	Residential	Emergency Response	Utilities	Transportation
Pier 48	•	•		•		•		•	•	
Pier 50	•		•	•	•	•		•	•	
Pier 50 1/2			•	•		•			•	
Pier 52	•			•		•			•	•
Pier 54				•	•	•		•	•	
Pier 68	•	•		•	•			•	•	•
Pier 70 (existing structures)		•		•		•			•	
Pier 80	•			•	•			•	•	•
Pier 90					•	•		•	•	
Pier 92	•			•	•			•	•	•
Pier 94	•				•			•	•	
Pier 96	•			•				•	•	
SWL 337	•				•	•	•	•	•	•
SWL 343				•		•			•	
SWL 345	•			•		•			•	•
SWL 349						•			•	•
SWL 3491						•			•	•
SWL 356						•			•	
SWL 344 - E and W					•			•	•	
SWL 352					•			•	•	
SWL 354									•	•
Mission Creek Harbor				•			•		•	

11.1.1.1 PIERS

The piers primarily consist of finger piers built over water (see Photo 11.1), except Piers 80-96, which are primarily “filled” piers created with a soldier pile wall. There is a mix of open piers that have no buildings on them as well as piers with warehouse sheds and bulkheads with office space on the marginal wharf. The Port leases the piers to various entities for a mix of industrial, commercial, and maritime activities.³ Pier uses and conditions vary greatly between individual piers and may change over time due to rehabilitation, maintenance, or aging.

Because the piers are primarily located over water, they are vulnerable to wind, tidal, and wave forces in addition to flooding by SLR. The piers’ infrastructure includes structural support piles located in water and associated utilities that are continuously exposed to the same wind, tidal, and wave forces and are vulnerable to corrosion and deterioration over time.

³ Specific tenants mentioned include those present at the time this Assessment was conducted. Individual leases may vary over time.

Pier 48 is a historic pier within the Embarcadero Historic District located south of Oracle Park adjacent to the mouth of Mission Creek (Photo 11.2). It is leased by several companies and serves a variety of maritime, commercial, environmental, and emergency response uses. Part of the pier, including Shed A, Shed C, and the outdoor space between them, is leased by Giants Enterprises and rented as an event, entertainment, and conference space. Westar Marine Services provides tugboat services, warehousing and storage, and hazardous waste storage and transportation at this location. In the event of an emergency or disaster, Pier 48 could provide a staging area for people waiting to evacuate from the City.

The pier is generally in good condition, except the apron that needs rehabilitation.

Pier 50 is a large pier that provides maritime, industrial, commercial, and emergency response services. The Maritime Administration Ready Reserve (MARAD) provides a critical fleet of roll-on/roll-off ships. These large vessels are designated to carry wheeled cargo



Photo 11.1 Piers along the Embarcadero. Flickr user bobglennan (CC BY-NC-ND 2.0)



Photo 11.2 Pier 48 at night. Dave Rauenbuehler (CC BY-NC 2.0)

such as cars, trucks, semi-trailer trucks, trailers, and railroad cars. They have ramps that enable vehicles to drive directly onto the ship and can be mobilized and at sea within 96 hours to respond to emergencies. These ships can also provide auxiliary power to the City and serve as emergency medical facilities in the event of a disaster. In addition to Pier 50, the MARAD fleet includes two vessels at Pier 80 and one vessel at Pier 96.

Westar Marine Services is headquartered at Pier 50 and provides a variety of marine services, including marine construction support, ship assist, barge and tanker escort, storage and delivery to vessels anchored in San Francisco Bay, ship staff water taxi service, offshore towing, and specialty barge services.

Additional commercial tenants at Pier 50 include private transportation companies. The southern edge of the pier provides transient and long-term lay berths (berths used for idle vessels). Pier 50 also houses the Port's primary maintenance facilities and personnel, including the more than 100 skilled craftspeople that are responsible for the preservation and improvement of the Port's fishing harbors, ferry landings, public parks, cargo terminals, piers, and baseball stadium.

The maritime and emergency response services provided at Pier 50 are important resources for the Port and City. Access to vessels from the pier would be moderately impacted by temporary flooding and highly impacted by permanent flooding, potentially

eliminating the ability for the vessels to operate from Pier 50. Relocating the maritime assets may prove difficult as they require a waterfront location to operate. Additionally, the pier houses a significant number of Port maintenance shops and employees, which would be difficult, but not impossible, to relocate.

Pier 50 ½ is located south of Pier 50. It consists of small public access yacht clubs that include private guest docks for overnight mooring. The current tenants include Mariposa Hunters Point Boat Club and Bayview Boat Club. Marinas and guest docks are generally able to respond to a range of water levels and may be able to be adapted to address higher water levels. However, land-based auxiliary facilities and access to the yacht clubs could be limited by temporary and permanent flooding.

Pier 52 is a wooden pier in poor condition. It serves as a wave attenuator to the adjacent public boat launch, which is the City's only trailered boat launch (discussed in section 10.2).

Pier 54. The eastern side of Pier 54 is an open paved area where floats are built for various events, including Burning Man, Carnival, and Bay-to-Breakers. The pier also includes a shed that houses the American Red Cross, the Chinese Chamber of Commerce, and a variety of construction consultants. The pier also has a long-term lay berth. The current uses at the site could be relocated relatively easily.

Pier 68 is within the Union Iron Works Historic District and has historically provided maritime and industrial services. It consists of large ship dry docks, cranes, and industrial buildings, and has most recently been used for ship repair. The use of the pier could continue under temporary flooding scenarios as activities could resume after flood waters recede. However, permanent inundation would eliminate the ability to use the pier for ship repair. Pier 68 is part of the greater Pier 70 project described below and in Chapter 13, *A Changing Shoreline*.

Pier 70 (existing structures). Pier 70 is within the Union Iron Works Historic District due to its role in ship construction and repair over the last 150 years (Photo 11.3). Existing structures at the site have

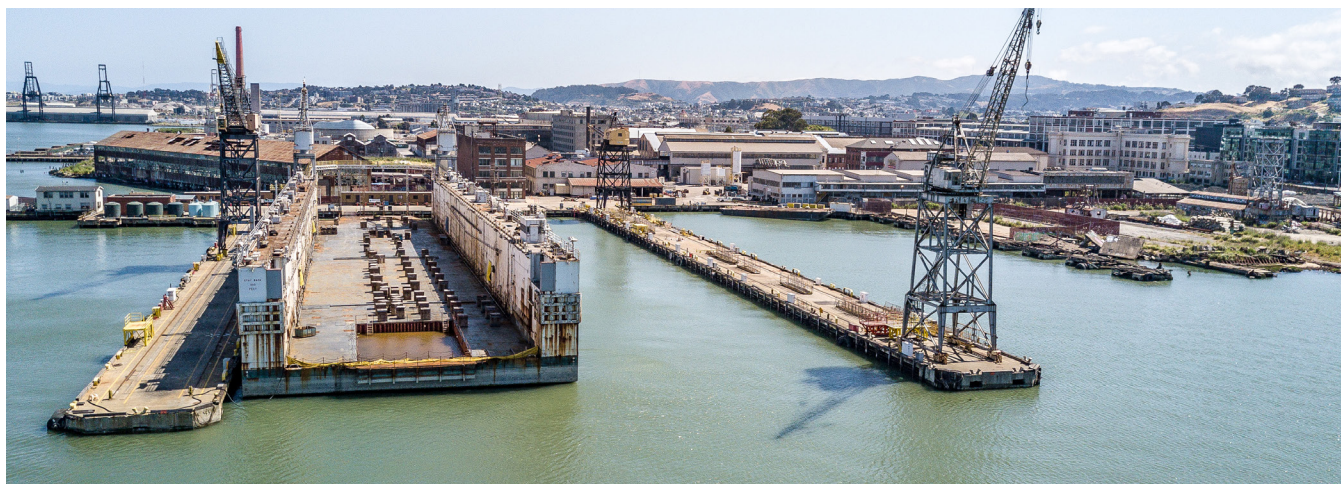


Photo 11.3 Existing structures on Pier 70. Jim Maurer (CC BY-NC-ND 2.0)

deteriorated over time and the pier itself is largely unused. However, a Port-led process to create a new, mixed-use development in the area is underway and is referred to as Pier 70. The Pier 70 project will revitalize the area east of Illinois Street extending from Mariposa to 22nd Street by rehabilitating historic resources, supporting ongoing ship repair, providing new waterfront parks and shoreline access, and creating space for new residential, office, retail, and production, design, and repair uses.⁴ The Pier 70 project area encompasses Piers 68 and 70, and SWLs 349 and 3491. The project includes SLR adaptation components and is further described in Chapter 13, *A Changing Shoreline*. Additionally, information regarding potential hazards related to contaminated lands at Pier 70 is discussed in Chapter 9, *Public Safety*.

Pier 80 is a 60-acre working cargo pier with two warehouses, four deepwater berths, and two cranes used to offload materials from ships (Photo 11.4). The pier is primarily located on Bay fill and is not pile-supported except for the pier edges. It is connected to the San Francisco Bay Railroad, which connects to the regional Joint Powers Board Caltrain line that provides access to Union Pacific Railroad. The railroad serves as a conduit to move goods and materials from vessels to the regional railroad system and is critical to the City's emergency response and recovery plan. San Francisco Bay Railroad is described further in Section 11.3.

Pier 80 is included in FEMA's emergency response plan as a location for staging and moving debris following a disaster. It also serves as an oil spill response equipment storage location. The pier has been generally well maintained and its fendering and pilings are in good condition. However, issues related to fill settlement and stormwater drainage have led to ponding issues. This ponding may be exacerbated by SLR, resulting in additional flooding.

Pier 80 provides important maritime, industrial and disaster response services. It is the only pier that can unload materials from ships directly to railroad cars. Due to the importance of the pier and lack of redundancy of services elsewhere, Pier 80 is highly sensitive to both temporary and permanent flooding.

Pier 90 is located at the southern entrance of the Islais Creek Third Street and Illinois Street Bridges. The Pier 90 area consists of both pile-supported and "filled" pier areas using fill behind a seawall. It is used by the Port for maritime maintenance and is also home to San Francisco Fire Department Station 25. The vulnerability of fire stations to SLR is discussed in Chapter 9, *Public Safety*. In addition to the fire station, an Emergency Firefighting Water System manifold is located at Pier 90. Further information regarding the Emergency Firefighting Water System is described in Chapter 9, *Public Safety*. Additional industrial and commercial tenants are located at Pier 90 as well.

⁴ Port of San Francisco. 2010. Pier 70 Preferred Master Plan. Available at https://sfport.com/ftp/uploadedfiles/about_us/divisions/planning_development/southern_waterfront/pier70masterplan_intro-overview.pdf.



Photo 11.4 Pier 80 Cranes used to offload materials from ships. Dave Rauenbuehler (CC BY-NC 2.0)

Pier 92 is leased by Hansen Aggregates, Cemex, and Central Concrete. Like Pier 90, Pier 92 is both pile-supported and filled land behind a seawall. The pier provides maritime services through cargo ship loading and includes two concrete batch plants that are the City's sole providers of concrete. These concrete plants are essential for both new commercial development and critical City infrastructure construction and maintenance. Both Cemex and Central Concrete bring their aggregate products over the Pier 92 docks for batching into concrete. Pier 92 could provide emergency response services with its large vessel berth. The Pier has not been evaluated for contaminants, but likely contains creosote-treated piles, similar to other piers.

This site provides essential industrial services. Most of its operations could continue under minor flooding of 12 inches or less. However, flooding could hinder some of the sustainability practices at the site, such as rain water harvesting and concrete recycling. Additionally, the distribution of concrete to project sites could be hindered if access roads are flooded.

Pier 94 is also leased by Hansen Aggregates and other similar industrial operations. The facility includes storage space for sand and aggregate materials delivered to Pier 94 or mined from the Bay and is connected to the San Francisco Bay Railroad



Photo 11.5 Aerial view of sand storage site (front) and Recology recycling center (back) at Piers 94 and 96. Dave Rauenbuehler (CC BY-NC 2.0)

(Photo 11.5). The location is identified by FEMA as a staging area for goods as well as a debris removal site in the event of a disaster. The industrial and emergency response services would be difficult to relocate or replace.

Pier 96. A Recology recycling center is located at Pier 96 (Photo 11.5). The pier also has a large open paved area currently under negotiations to be used as a roll-on/roll-off marine cargo terminal. The pier is connected to the San Francisco Bay Railroad. The site also includes a long term lay berth used by MARAD, Westar, and Silverado. Pier 96 is identified by FEMA as a staging area for goods as well as a debris removal site in the event of a disaster. The seawall on the south face of the pier is deteriorated and in need of repair. It is currently subject to flooding during extreme high tides and this flooding will become more severe as sea levels rise.

Pier 96 provides important community services, including recycling and emergency response, that could be impacted by both temporary and permanent flooding. The regional importance of the recycling center is discussed further in Chapter 9, Public Safety. As discussed in Section 11.3, rail is highly vulnerable to flooding and cannot operate if the tracks are not visible. The maritime, industrial, and emergency response services at Pier 96 would be difficult to relocate or replace.

11.1.1.2 SEAWALL LOTS

The Port's seawall lots (see Photo 10.3) originally served as backlands for cargo shipping, warehousing, cruise ships, and ferry operations or as railyard facilities.⁵ Now, the Port leases out these spaces for a variety of uses, including storage space, artist work studios, restaurants, and maintenance facilities. The seawall lots' vulnerabilities to SLR vary based on their location and proximity to the Bay.

SWL 337. Seawall Lot 337 is the site of the 28-acre Mission Rock Mixed Use Development Project (Photo 11.6). The Mission Rock project includes approximately 2,000 residential units, one million square feet of commercial space, and 10 acres of new open space. The project plan includes SLR adaptation strategies that protect the mixed-use development to six feet of SLR. It also includes a buffer area that begins as a park space designed to accommodate temporary inundation and has a funding mechanism that will contribute to onsite and offsite SLR adaptation. The phasing of the development allows the site to continue to serve as surface parking to support

Oracle Park and Chase Event Center games and events. Further detail on the Mission Rock project is included in Chapter 13, *A Changing Shoreline*. SWL 337 could serve as a staging area for people waiting to evacuate after an emergency or disaster.

SWL 343. Seawall Lot 343 (also known as Mission Bay Parcel P23/24) includes a small park and an SFMTA substation and provides stormwater benefits to the area. The park includes green space and a basketball court. The substation has sewer, fuel, electrical, and communication utility lines running through it and provides power to the T and Central Subway Muni lines. In addition to providing open space and housing the substation, Seawall Lot 343 provides stormwater treatment for the Mission Bay southern watershed, including the University of California, San Francisco (UCSF) Medical Center at Mission Bay. Stormwater flows through a gravity system to the northern portion of site (referred to as P23) and is then pumped to the southern portion of the site (referred to as P24) for treatment in landscape swales before being released into the Bay.

⁵ Port of San Francisco. 2017. Waterfront Plan Land Use Subcommittee Slideshow, "Port Seawall Lots" June 7. Available at https://sfport.com/sites/default/files/2017-06-07%20Presentation%20on%20Seawall%20Lots-%206-7-17%20NOTES_0.pdf.



Photo 11.6 Rendering of Mission Rock development on SWL 337. Perkins&Will

Flooding of this area could have major implications for mobility and stormwater management in Mission Bay. If the electrical equipment in the substation were to flood, the substation may no longer function. While waterproofing and moving water-sensitive components, such as electrical equipment, out of the flood zone could reduce the risk of temporary flooding, a larger-scale strategy may be needed to reduce disruption and damage to the substation. Inundation of the area could also limit the function of the stormwater treatment system and lead to stormwater management issues for the Mission Bay southern watershed, resulting in degradation of the water quality entering the Bay after a storm.

The park's bioswale and bioretention areas were designed to integrate with a nearby pump station, which collects runoff from a drainage basin area. The remainder of the park is used for active and passive recreation. The park was not designed to accommodate temporary flooding associated with SLR or coastal flooding; therefore, the landscaping and other surfaces could be disrupted and possibly damaged by temporary coastal flooding. Such temporary flooding would also increase maintenance and operations needs for the park.

SWL 345. Seawall Lot 345 houses a restaurant, a small private boatyard leased by San Francisco Boatworks, self-storage units, and the Ruby Sailing Charter Company. The restaurant has a dock that guests can sail directly up to. Ruby Sailing is also operated out of the dock. The lot includes parking for the restaurant and boatyard as well.

The boatyard and restaurant may be able to continue operations with localized flooding by using deployable flood measures during high water events and flood proofing the facilities to reduce damage during temporary flood events. However, as flooding becomes more frequent and widespread, access to the area becomes unreliable, maintenance and operations costs would increase, and the costs of disruption and damage would increase. Once the flooding become a daily tidal event, the uses would need to be adapted or lost. Additionally, flooding of the boatyard could mobilize hazardous materials that are used by the boatyard, degrading water quality.

SWL 349 and 3491. As mentioned above, Seawall Lots 349 and 3491 are part of the greater Pier 70 project (described in Chapter 13, *A Changing Shoreline*). The Pier 70 project includes remediation of environmental contamination as well as SLR adaptation measures. Chapter 9, *Public Safety*, includes additional information regarding potential hazards related to contaminated lands.

SWL 356. Seawall Lot 356 is currently rented by a self-storage company. Using deployable flood measures during high water events could reduce the damage and disruption to the facility from localized flooding. Nonetheless, it may prove challenging to fully flood proof the facility, and inundation of stored items could occur. As flooding becomes more frequent and widespread, access to the area would become unreliable, maintenance and operations costs would increase, and the costs of disruption and damage would also increase. Because self-storage does not require a waterfront location, this use could be relocated. Future plans for this site include allocating two acres to the expansion of Warm Water Cove Park and using the remaining six acres to expand the Pier 80 Cargo Terminal.

SWL 344 E and 344 W. Seawall Lots 344 East and West, also referred to as the Pier 90-96 Backlands, were recently improved by elevating the sites approximately 12 feet on the northern and eastern boundaries, except for the location of Darling Delaware, an industrial facility that repurposes meat byproducts and processes them to reclaim bio-nutrients, fats, oils, proteins, meals, and other by-products. Currently, the site has four primary uses that include:

1. Building resources at the northwest corner, which is under lease to the San Francisco Department of Environment for building material recycling;
2. A lease to Darling Delaware for industrial use;
3. Concrete crushing and recycling; and
4. A self-storage facility.

Future tenants for the recently improved areas include construction laydown space. In the long-term, this site will likely become warehouse space to



Photo 11.7 Mission Creek houseboats. Travis Wise (CC BY 2.0)

support cargo operations and help meet the City's demand for production, distribution, and repair uses.

SWL 352. Seawall Lot 352 hosts Hanson Aggregates, which provides sand import and processing. It also has a tidal wetland and buffer area (referred to as the Pier 94 wetlands) that provides open space and habitat. Future development plans include the development of an asphalt batch plant or expanded Hanson Bulk cargo import operations.

SWL 354. The Islais Creek Division SFMTA facility, completed in June 2018, is located at SWL 354. The eastern portion is Port-owned and leased to SFMTA. The facility houses a bus yard, fuel wash facility, and operations center. The development also included the construction of Islais Creek North-West Park, a shoreline park with art installations.

11.1.1.3 Mission Creek Harbor

Mission Creek Harbor includes a community of approximately 20 houseboats moored on docks (Photo 11.7). The community has been present since

the 1960s when it was relocated from Islais Creek. The harbor is also home to a wide variety of wildlife, including shorebirds, manta rays, and sea lions.

Harbors and marinas are usually able to accommodate higher water levels, but the support facilities would be 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. Higher water levels would make it difficult for this use to remain without a larger-scale intervention.

11.1.2 Port Structures Exposure

The exposure of piers, wharves, bulkhead buildings, seawall lots, and harbors was evaluated relative to the 10 SLR scenarios defined in Chapter 2, *Climate Science*. The percentage and area of each asset that would be inundated under each scenario were calculated and are presented in Tables 11.3 and 11.4, respectively.

**Table 11.3** Pier and Harbor Exposure with Sea Level Rise (% Inundated and Area Inundated)

Port Structure	Pier and Harbor Exposure under Each Scenario (% Inundated)									
	1	2	3	4	5	6	7	8	9	10
Pier 48	0%	0%	0%	0%	5%	12%	100%	100%	100%	100%
Pier 50	0%	0%	0%	0%	0%	4%	100%	100%	100%	100%
Pier 50 1/2	3%	7%	15%	32%	39%	72%	86%	87%	87%	87%
Pier 52	0%	0%	0%	0%	100%	100%	100%	100%	100%	100%
Pier 54	0%	0%	0%	0%	1%	1%	99%	99%	99%	99%
Pier 62	3%	8%	13%	24%	28%	56%	72%	83%	97%	97%
Pier 68	1%	2%	3%	7%	8%	56%	76%	82%	89%	91%
Pier 70	0%	0%	0%	0%	0%	0%	0%	85%	85%	85%
Pier 80	0%	0%	0%	1%	52%	77%	93%	95%	98%	99%
Pier 90	0%	0%	0%	1%	66%	85%	86%	86%	86%	86%
Pier 92	0%	0%	0%	18%	31%	90%	97%	97%	97%	97%
Pier 94	0%	0%	1%	17%	21%	42%	54%	59%	71%	79%
Pier 96	3%	16%	28%	55%	61%	75%	84%	88%	93%	96%
Mission Creek Harbor	1%	1%	1%	1%	1%	2%	2%	2%	2%	2%

Port Structure	Pier and Harbor Exposure under Each Scenario (Acres Inundated)									
	1	2	3	4	5	6	7	8	9	10
Pier 48	0.00	0.00	0.01	0.02	0.28	0.70	5.96	5.96	5.96	5.96
Pier 50	0.00	0.00	0.00	0.00	0.00	0.85	20.09	20.09	20.09	20.09
Pier 50 1/2	0.04	0.09	0.20	0.41	0.50	0.93	1.12	1.13	1.14	1.14
Pier 52	0.00	0.00	0.00	0.00	0.57	0.57	0.57	0.57	0.57	0.57
Pier 54	0.00	0.00	0.00	0.00	0.01	0.02	2.66	2.66	2.66	2.66
Pier 62	0.05	0.11	0.18	0.33	0.38	0.75	0.98	1.13	1.32	1.32
Pier 68	0.13	0.36	0.76	1.53	1.79	12.78	17.31	18.67	20.23	20.66
Pier 70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.59	2.59	2.59
Pier 80	0.02	0.05	0.09	0.50	34.28	50.75	61.11	62.99	64.38	65.51
Pier 90	0.00	0.00	0.00	0.14	7.20	9.36	9.43	9.44	9.46	9.47
Pier 92	0.01	0.01	0.02	1.29	2.21	6.31	6.82	6.83	6.83	6.83
Pier 94	0.01	0.02	0.35	4.30	5.49	10.84	14.01	15.40	18.47	20.54
Pier 96	1.39	8.54	14.57	28.51	31.71	38.99	44.00	46.10	48.29	49.94
Mission Creek Harbor	0.09	0.13	0.17	0.20	0.21	0.25	0.26	0.26	0.26	0.26

Table 11.4 Seawall Lot Exposure with Sea Level Rise (% Inundated and Area Inundated)

Seawall Lot Number	Seawall Lot Exposure under Each Scenario (% Inundated)									
	1	2	3	4	5	6	7	8	9	10
Seawall Lot 337	0%	0%	0%	54%	65%	98%	100%	100%	100%	100%
Seawall Lot 343	0%	0%	0%	0%	0%	29%	98%	100%	100%	100%
Seawall Lot 345	6%	20%	27%	49%	59%	87%	91%	94%	97%	97%
Seawall Lot 349	0%	1%	1%	2%	2%	22%	41%	53%	78%	84%
Seawall Lot 3491	0%	0%	0%	0%	0%	5%	100%	100%	100%	100%
Seawall Lot 349	0%	0%	0%	0%	0%	1%	28%	52%	64%	70%
Seawall Lot 356	0%	0%	0%	0%	0%	0%	12%	37%	78%	98%
Seawall Lot 356	0%	1%	1%	9%	13%	27%	37%	44%	67%	76%
Seawall Lot 344-East	0%	0%	0%	15%	24%	43%	51%	58%	60%	61%
Seawall Lot 344-West	0%	0%	0%	0%	29%	98%	100%	100%	100%	100%
Seawall Lot 352	8%	9%	10%	13%	14%	17%	20%	22%	27%	32%
Seawall Lot 354	0%	0%	0%	0%	77%	85%	90%	93%	100%	100%

Seawall Lot Number	Seawall Lot Exposure under Each Scenario (Acres Inundated)									
	1	2	3	4	5	6	7	8	9	10
Seawall Lot 337	0.00	0.00	0.00	7.97	9.54	14.51	14.76	14.76	14.76	14.76
Seawall Lot 343	0.00	0.00	0.00	0.00	0.00	0.32	1.07	1.09	1.09	1.09
Seawall Lot 345	0.25	0.86	1.17	2.09	2.53	3.72	3.91	4.02	4.15	4.16
Seawall Lot 349	0.14	0.28	0.42	0.63	0.72	7.82	14.97	19.16	28.30	30.41
Seawall Lot 3491	0.00	0.00	0.00	0.00	0.00	0.01	0.27	0.27	0.27	0.27
Seawall Lot 349	0.00	0.00	0.00	0.00	0.00	0.02	0.49	0.92	1.14	1.24
Seawall Lot 356	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.90	1.91	2.39
Seawall Lot 356	0.05	0.12	0.20	1.27	1.83	3.67	5.16	6.05	9.25	10.49
Seawall Lot 344-East	0.00	0.00	0.00	2.58	4.27	7.59	9.06	10.37	10.59	10.75
Seawall Lot 344-West	0.00	0.00	0.00	0.00	0.27	0.93	0.95	0.95	0.95	0.95
Seawall Lot 352	3.51	3.99	4.73	6.02	6.42	7.71	9.23	10.28	12.17	14.50
Seawall Lot 354	0.00	0.00	0.00	0.00	1.22	1.36	1.43	1.49	1.59	1.59

11.1.3 Port Structures Vulnerability Summary

The vulnerability of Port structures to SLR varies for temporary and permanent inundation and is highly depending on the assets' characteristics.

Piers 80, 92 and 94 provide important industrial services that require access to marine terminals. These piers experience significant flooding beginning at SLR Scenario 4 (48 inches of SLR or six inches of SLR and a 100-year extreme tide) and Scenario 5 (52 inches of SLR, or 12 inches of SLR and a 100-year extreme tide). With 52 inches of SLR, 52 percent of Pier 80, 31 percent of Pier 92, and 21 percent of Pier 94 would become inundated.

While many of the activities at these piers could likely resume after floodwaters recede, temporary and localized flood events will result in damage and disruption to the structures and their uses. This damage and disruption will increase as flooding becomes more frequent, resulting in higher maintenance and operations costs, and direct costs associated with the disruption, loss of function, and water quality impacts. Permanent flooding associated with flooding that occurs daily would require adaptation measures or the loss of function. These areas are some of the last remaining industrial and heavy maritime functions in San Francisco and if they are lost, these functions and the associated jobs and opportunities associated with them may also be lost.

Over 55 percent of Pier 96 will be inundated at approximately 48 inches of additional water, or Scenario 4. Pier 96 is the location of Recology, the City's recycling facility. This is a large, critical facility that may be hard to relocate and would be vulnerable to temporary inundation with damage and disruption to both the facility and the function.

The harbor and boatyards have limited redundancy and would be difficult to relocate. While the Mission Creek harbor houseboats are located on the water and will not themselves be flooded, the surrounding areas begin to flood significantly at Scenario 4 (48 inches of SLR or six inches of SLR and a 100-year extreme tide). This would limit access to houseboats and use of auxiliary equipment.

The connection with the San Francisco Bay Railroad and regional transportation network on Piers 80, 92, 94, and 96 and Seawall Lots 354 E and W, and 355, provides a unique service that lacks redundancy and requires proximity to the shoreline. As previously mentioned, Pier 80 experiences significant flooding beginning at Scenario 5 (52 inches of SLR). The pier's function would be reduced and its ability to transport goods on the San Francisco Bay Railroad would be eliminated as the tracks would become flooded with up to four feet of water. This vulnerability is further discussed in Section 10.3, Port Transportation.

Vulnerability is dependent on the location of the asset. Piers and boatyards located over water experience a higher level of impact from SLR from flooding. Additionally, they are more vulnerable to tidal, wind, and wave hazards that could damage pilings and reduce the use of the facility.

Even if the asset itself could withstand temporary or permanent flooding, if access to the asset is limited, the function of the asset would be lost.

11.1.4 Port Structures Consequence Summary

Key consequences and consequences that could occur to society and equity, the economy, environment, and governance (see Chapter 3, Assessment Approach) were evaluated assuming no action is taken to address the impacts associated with SLR or extreme tide flooding. These consequences are listed below. However, several actions are currently planned or in progress to address some of the noted impacts. For a description of the current or planned projects, see Chapter 13, *A Changing Shoreline*.



KEY ISSUE 1: LOSS OF PORT USES AND SERVICES

Inundation of Port structures or surrounding areas would impact the function and character of the City's waterfront and the Port's Public Trust responsibilities for the State of California. The Port's maritime, water-dependent, public access, open spaces, and historic resources are all part of its Public Trust mission and the loss of these facilities and services would be a significant impact to the State and the City.

The degree of impact varies depending on each structure's elevation, condition, and use, and the type of flooding. Temporary and localized flooding, flooding that increases in frequency, duration, and economic scale, and permanent flooding (or flooding that occurs once a day) will result in different consequences. All types of flooding will reduce access, increase disruption, result in damage to facilities and functions, and increase maintenance and operations costs.

Many of the uses in the southern waterfront are dependent on automobile, truck, and rail access and would become inaccessible if adjacent roads are flooded. Increased frequency and duration of flooding would disrupt business continuity, resulting in losses for those businesses, and directly impact employees as well as other businesses and patrons that rely on those businesses.

Permanent inundation would eliminate these facilities, and the community and economic benefits they provide. Permanent inundation would be especially harmful to industrial operations, which are primarily confined to the southern waterfront, maritime operations, which require a waterfront location to operate,

and critical emergency response services. Disruption and damage to industrial and maritime facilities and functions would result in a loss of jobs in these sectors, as well as impacts to small businesses that provide services to these facilities. Damage to critical emergency response facilities and services would impact both community and citywide response and recovery.



Society and Equity: Many Port structures provide emergency response services in the event of a disaster such as an earthquake.

These structures are identified by FEMA and the City as staging areas for people and supplies, medical response centers, water-based evacuation locations, and debris removal sites. If these facilities are flooded, or are inaccessible due to flooding, their use for emergency response would become limited resulting in delays in response times and dangers to public safety. An additional discussion of emergency response services is provided in Chapter 9, *Public Safety*.

Piers 48, 50, 50 ½, 68, and 70 are part of historic districts or have potential historic features that pay homage to the rich maritime and industrial history of the area. Historic preservation is a fundamental function of the Port as a steward of the Public Trust. These structures contribute to the nature and character of the waterfront and are an important resource to the City and nation. Flooding of these structures could damage the historic attributes and result in a loss of designation for the City's Historic District or damage to these districts.

All the City's recycling is processed by Recology's waste management facility at Pier 96. Disruption to this facility could have a citywide impact on waste collection and recycling, impacting public health and citywide environmental stewardship goals. The reduction in recycle processing would require alternate means to manage the recycling of waste generated across San Francisco. This is a critical City facility that may be hard to relocate. Temporary inundation would result in disruption to this critical function. More frequent and widespread flooding would result in disruption, damage, and environmental consequences.



Economy: The southern waterfront is home to much of the City's remaining industrial sites. Pier 92 hosts two concrete batching plants that supply a significant amount of concrete to the City. Disruption of concrete batching due to flooding could cascade across the building industry. Additionally, structures in the southern waterfront have several commercial tenants. Disruption to these structures would harm the local economy.

The loss or inability of Port structures to provide industrial, maritime, and commercial uses would also impact local and regional jobs. A significant number of local jobs and businesses rely on these facilities and functions. The loss of these facilities would have significant impacts from neighborhood to regional scale.



Environment: Parking lots and other surfaces on piers and SWLs accumulate oil and other hazardous materials from vehicular use.

Flooding could mobilize these contaminants by washing them into parks, open spaces, wetlands, and the Bay.

SLR could limit some of the function of the stormwater management systems installed on seawall lots. This could lead to greater flooding issues at a watershed scale and result in lower-quality water entering the Bay after a storm.

The loss of the wetlands and natural areas in the southern waterfront would eliminate the remaining natural resources along this segment of the Bay shoreline.

Many areas in the southern waterfront are home to past contaminants. Current uses also store industrial and maritime material that if mobilized by a flood event could have water and soil quality impacts.



Governance: Addressing the consequences of flooding and planning for future SLR adaptation will require coordination between multiple agencies at various levels of government.

This includes coordination and cooperation with the adjacent neighborhoods, City agencies, BCDC, State Lands Commission, U.S. Army Corps of Engineers,

and other agencies. Due to multi-agency involvement, and various permit and other approval requirements, action to address SLR could take a significant period.

Additionally, the Port leases land to tenants including private companies, City agencies, and the U.S. military, and coordination with these tenants will be important. While the Port is the owner of these lands, many are operated by the tenants. Management decisions related to addressing the consequences of flooding and planning for future SLR adaptation could complicate lease terms and will require additional coordination with tenants.



11.2 PORT PUBLIC OPEN SPACE

San Francisco's Bay shoreline is home to a variety of public open spaces including parks, plazas, the waterfront promenade, the Blue Greenway and the San Francisco Bay Trail, open water basins, wetlands, and the Bay Area Water Trail (which connects with the Bay Trail). The Port owns and operates most parks and open spaces located along the eastern waterfront. The Port-owned assets located within the SLR Vulnerability Zone include boat launches, plazas, parks, and wetlands. These are shown on Figure 11.2 and discussed in Section 11.2.1. Table 11.5 summarizes the Port use type categories for each asset.

In addition to Port-owned parks, there are several other parks along the Bayside waterfront, including India Basin Shoreline Park, Aquatic Park, and the San Francisco Maritime National Historic Park. India Basin Shoreline Park (see Photo 10.2) is owned by both the Port and the San Francisco Recreation and Park Department (RPD) and is further discussed in Chapter 10, Open Space. The public open spaces assessed in this section include those in the SLR Vulnerability Zone located south of the Embarcadero Seawall Program area.

11.2.1 Potentially Vulnerable Public Open Space Assets

A description of the various public open space assets and their vulnerabilities is included below.

China Basin Park

China Basin Park is a public park located at the mouth of Mission Creek, across the channel from AT&T Park. It includes picnic areas and a small baseball diamond.

Mission Creek Shoreline Park South

Mission Creek Shoreline Park South runs parallel to the southern shore of Mission Creek. It features walking paths, picnic areas, and community gardens (Photo 11.8).

This park, along with Mission Creek Shoreline Park North (outside of the assessment area), 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. The Mission Creek Harbor Association, located on a portion of its south bank, harbors recreational boats and houseboats (Section 11.1.3), and developed and maintains a landscaped public access area along the adjoining channel shoreline.

Table 11.5 Port Structure Assets by Use Category

Asset	Port Use Category								
	Natural Resources and Open Spaces	Historic District	Maritime	Industrial	Commercial	Residential	Emergency Response	Utilities	Transportation
China Basin Park	●							●	
Mission Creek Shoreline Park South	●		●		●			●	●
Pier 52 Boat Launch	●		●				●	●	●
Bayfront Park	●			●					●
Agua Vista Park	●		●						●
Warm Water Cove Park	●								
Islais Creek Parks	●								
Bayview Gateway Park	●								
Pier 94 Wetlands	●								
Pier 98 - Herons Head Park	●								



Photo 11.8 Mission Creek Shoreline Park South. Sergio Ruiz

Pier 52 Boat Launch

The Pier 52 boat launch is a public facility that also includes a parking lot. Docks and launches are designed to accommodate higher water levels temporarily. Permanent inundation would eliminate the use at this location. Docks and launches are highly adaptable to higher water levels. At permanent inundation levels, the landside services and support will be harder to adapt and protect.

The boat launch is an important asset as there are a limited number of public boat launches in San Francisco. Furthermore, this is the only public motorized boat launch in the City. In addition to providing important public access to the Bay, the boat launch is used by the Port maintenance crews as launch access for pier maintenance activities and emergency response. The boat launch would be sensitive to flooding and would need to be raised to adapt to SLR.

Bayfront Park

Bayfront Park is currently a large open lot with parking and a bike path. The park will be improved and expanded as part of the Mission Bay Redevelopment Plan, as described below.

Agua Vista Park

Agua Vista Park is a small landscaped park and fishing pier located in Mission Bay (Photo 11.9). It

includes picnic benches and public art. The park will be redesigned and upgraded in 2020 to incorporate stormwater treatment and shoreline protection measures. Upgrades do not change the current uses and facilities at the park but include elevating the site for added shoreline protection.

Warm Water Cove Park

Warm Water Cove Park consists of open space and walking paths adjacent to the shoreline. The Port and City plan to expand and rehabilitate the park in the future to the Southwest.

Islais Creek Parks

Several Port open space assets are located adjacent to Islais Creek (Photo 11.10). The northern shoreline includes Islais Creek North-West and Tulare Park. Islais Creek North-West provides public access to Islais Creek and connects the northern shoreline of Islais Creek between I-280 and Cesar Chavez to Tennessee Street. This provides nearly continuous shoreline access around Islais Creek. It includes the SFPUC promenade, located on Port property, and the SFMTA promenade, located primarily outside of Port property. Tulare Park is a small park located east of Third Street that provides additional shoreline access.

The southern shoreline includes Islais Creek South, also referred to as Islais Landing. Islais Landing is a small park that includes a picnic area, a



Photo 11.9 Agua Vista Park. Flickr user sfworldsfair



Photo 11.10 Islais Creek Parks. Port of San Francisco



Photo 11.11 Pier 94 Wetlands. Port of San Francisco



Photo 11.12 Heron's Head Park. Port of San Francisco

human-powered boat landing, and storage for small watercrafts. Currently, the park and boat landing are maintained by a cooperative paddling club which stewards the park in exchange for space in the boat storage area.

Bayview Gateway

Bayview Gateway is a small public open space behind San Francisco Fire Department Station 25. The park contains several picnic tables and views of Islais Creek. This park was constructed in 2015 and the design includes an elevated wharf edge to protect the area to an elevation of two feet.

Pier 94 Wetlands

The wetlands at Pier 94 developed when a small salt marsh formed along the northeast shore of Pier 94 after a portion of the pier's fill material subsided and became subject to tidal inundation (see Photo 11.11).

The Port completed the Pier 94 wetland enhancement project in 2006 to improve the physical, hydrologic, and aesthetic features of the wetland in order to increase its functional ecosystem value. Now, these small wetlands provide rare and valuable salt marsh habitat for a variety of plant and animal species, including migratory birds. Along with the Port, the Golden Gate Audubon Society works to continue to restore and protect the wetlands. The Golden Gate Audubon Society adopted the wetlands and hosts regular volunteer events and wildlife viewing events.

Heron's Head Park

Heron's Head Park is a 24-acre park that includes salt marsh habitat, ecosystem restoration activities, walking paths, bird watching, and environmental activities (Photo 11.12). The EcoCenter at Heron's Head Park is a community facility located at the park.

Table 11.6 Open Space Exposure with Sea Level Rise (% inundated and area inundated)

Open Space Asset	Open Space Exposure under Each Scenario (% Inundated)									
	1	2	3	4	5	6	7	8	9	10
China Basin Park	4%	8%	12%	19%	22%	58%	77%	86%	97%	97%
Mission Creek Shoreline South	2%	4%	10%	40%	52%	79%	88%	91%	95%	97%
Mission Creek Shoreline Garden	0%	0%	1%	4%	8%	68%	99%	100%	100%	100%
Pier 52 Boat Launch	4%	10%	21%	39%	46%	67%	78%	80%	81%	81%
Bayfront Park	4%	7%	12%	23%	38%	86%	88%	88%	88%	88%
Agua Vista Park	3%	7%	10%	16%	20%	52%	72%	81%	85%	85%
Agua Vista Park Pier	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Warm Water Cove Park	2%	5%	7%	10%	11%	15%	18%	21%	28%	42%
Islais Creek North (PUC Promenade)	0%	0%	0%	0%	30%	36%	57%	69%	99%	100%
Islais Creek North (MTA Promenade)	0%	0%	0%	0%	99%	100%	100%	100%	100%	100%
Tulare Park	0%	0%	0%	0%	53%	64%	80%	92%	97%	99%
Islais Creek South (Islais Landing)	0%	0%	0%	0%	67%	92%	95%	96%	96%	96%
Bayview Gateway	0%	0%	0%	0%	70%	94%	96%	96%	98%	99%
Pier 94 Wetlands	49%	54%	58%	62%	64%	70%	77%	81%	86%	90%
Heron's Head Park	44%	51%	56%	60%	61%	64%	67%	69%	72%	74%
Heron's Head Extension	0%	0%	0%	0%	0%	0%	2%	9%	22%	44%

Open Space Asset	Open Space Exposure under Each Scenario (Acres Inundated)									
	1	2	3	4	5	6	7	8	9	10
China Basin Park	0.08	0.17	0.25	0.40	0.46	1.19	1.58	1.77	2.00	2.00
Mission Creek Shoreline South	0.07	0.16	0.40	1.66	2.15	3.29	3.65	3.75	3.92	4.02
Mission Creek Shoreline Garden	0.00	0.00	0.00	0.01	0.03	0.25	0.36	0.37	0.37	0.37
Pier 52 Boat Launch	0.03	0.07	0.16	0.30	0.36	0.52	0.61	0.62	0.63	0.63
Bayfront Park	0.08	0.16	0.26	0.53	0.86	1.95	1.99	1.99	1.99	1.99
Agua Vista Park	0.02	0.04	0.06	0.08	0.11	0.28	0.39	0.44	0.46	0.46
Agua Vista Park Pier	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Warm Water Cove Park	0.04	0.08	0.11	0.16	0.17	0.23	0.29	0.33	0.44	0.67
Islais Creek North (PUC Promenade)	0.00	0.00	0.00	0.00	0.26	0.32	0.51	0.61	0.88	0.89
Islais Creek North (MTA Promenade)	0.00	0.00	0.00	0.00	0.30	0.30	0.30	0.30	0.30	0.30
Tulare Park	0.00	0.00	0.00	0.00	0.15	0.18	0.23	0.26	0.27	0.28
Islais Creek South (Islais Landing)	0.00	0.00	0.00	0.00	0.67	0.92	0.95	0.96	0.96	0.96
Bayview Gateway	0.00	0.00	0.00	0.00	1.02	1.36	1.39	1.40	1.42	1.44
Pier 94 Wetlands	5.32	5.81	6.28	6.67	6.85	7.57	8.28	8.71	9.23	9.74
Heron's Head Park	8.86	10.17	11.24	12.04	12.18	12.87	13.36	13.75	14.31	14.78
Heron's Head Extension	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.12	0.32	0.64

The EcoCenter is owned and maintained by the Port and is operated by The Bay Institute Aquarium Foundation. It provides educational services and activities related to renewable energy, pollution and greenhouse gas reduction, wastewater treatment, rainwater harvesting, sustainability, and the green economy.

The Port is currently working on a plan to protect the park with a living shoreline (vertical levy) to reduce current erosion and address SLR projections to approximately 2050. If successful, the Port will have the project completed in 2021, which will protect portions of the park for two feet of SLR.

11.2.2 Public Open Space Exposure

The exposure of public open space areas was evaluated relative to the 10 SLR scenarios defined in Chapter 2, *Climate Science*. The percentage and area for each asset that could be inundated under each scenario were calculated and are presented in Table 11.6.

11.2.3 Public Open Space Vulnerability Summary

The Port's public open spaces provide recreation, shoreline access and bay access to San Francisco residents and visitors from the Bay Area and beyond. These public open spaces also provide environmental benefits including wildlife habitat and stormwater treatment.

Because most of the Port's open spaces are located adjacent to the shoreline, they are exposed early to SLR. In fact, many of these areas already experience increased inundation and erosion. Several open spaces, specifically the Pier 94 wetlands and Heron's Head Park, experience significant flooding beginning at SLR Scenario 1 (12 inches of SLR or an annual extreme high tide with a 1-year recurrence interval). At SLR Scenario 5 (52 inches of SLR, or 12 inches of SLR and a 100-year extreme tide) and Scenario 6 (66 inches of SLR or 24 inches of SLR and a 100-year extreme tide), the majority of Port open space areas become significantly flooded.

Some of the parks and open space assets and services are highly sensitive to both temporary and permanent flooding. In many cases, this is because the vegetation, habitat, and landscaping present are salt-sensitive or sensitive to periods of inundation. Localized, temporary inundation might be accommodated by some of these spaces. This would require additional Port maintenance and operations staff and resource time to address. As water levels rise and park closures and flood damage increase, the services provided by the Port's public open spaces and habitat assets would be lost even before permanent flooding eliminates the use of shoreline open spaces.

Park space and other open space assets are limited and highly valued in San Francisco both generally and along the waterfront. There is no redundancy for these areas and these parks and natural areas would be difficult to move elsewhere in the City, particularly due to their water dependence.

11.2.4 Public Open Space Consequence Summary

Key consequences were evaluated assuming no action is taken to address the impacts associated with SLR or extreme tide flooding. These consequences are listed below. However, several actions are currently planned or in progress to address some of the noted impacts. For a description of the current or planned projects, see Chapter 13, *A Changing Shoreline*.



Key Issue: Port public open spaces provide important parks and shoreline access for visitors and communities located in the southern waterfront. Heron's Head Park and the EcoCenter are valuable resources to the Bayview community due to proximity and lack of other resources in the area. The Pier 52 boat launch is the only public launch point in San Francisco's Bayside waterfront. Damage to the boat launch would impact public access to the Bay. Shoreline areas and the Pier 94 wetlands include tidal salt marsh and upland habitat that provide food and shelter for a variety of shorebirds and foraging habitat for raptors. These public open space areas are sensitive to flooding and the loss of their functionality would impact the environment as well as access for local communities.

11.3 PORT TRANSPORTATION

The Port plays an important role in local and regional transportation. Port facilities host ferry terminals, maritime berths, streets, parking lots, boat ramps, and bicycle and pedestrian paths. It also provides a connection to the regional rail network through the San Francisco Bay Railroad.

There are critical connections between the southern and northern parts of the City located in this geography. Several of these are bridges that are located within Port jurisdiction. These bridges include the Third and Fourth Street bridges that cross the Mission Creek Channel and the Illinois Street and Islais Creek/Third Street bridges that cross Islais Creek. Most streets located along the waterfront are on Port-owned land. While some streets are maintained by the Port, the majority are maintained and managed by Public Works, SFPUC, and SFMTA.

This section focuses on the Port's railroad assets and maritime berths. The other transportation assets located on Port property are managed and operated by Public Works and other agencies, and are assessed in Chapter 5, *Transportation*. Figure 11.3 shows the San Francisco Bay Railroad and the SLR Vulnerability Zone and the maritime berthing inventory for the southern waterfront.

11.3.1 Potentially Vulnerable Transportation Assets

11.3.1.1 San Francisco Bay Railroad

San Francisco Bay Railroad is an independently owned and operated short line railroad that has operations in San Francisco and Richmond, California. For over a decade, the Port has contracted with the railroad to provide railroad services and rail terminal operations. San Francisco Bay Railroad operates on Port land at Piers 92, 94, 96, and 80 and at the Port's railyard, the Intermodal Container Transfer Facility, adjacent to Seawall Lots 344 East and 352. It hauls soils and other cargos to and from the railyard for interchange with Union Pacific Railroad via the Caltrain line where it can then be transferred to other regions of the United States. The railroad's primary business is transporting contaminated soils and debris from various large construction projects in San Francisco to a landfill in Utah.

San Francisco Bay Railroad is an important asset that lacks redundancy (see Photo 11.13). In addition to providing an important industrial service, it keeps hundreds of trucks off City roads and regional freeways. It could also provide emergency response service by hauling away debris or providing support for reconstruction following an earthquake or other disaster.



Photo 11.13 San Francisco Bay Railroad at Pier 80. Dave Rauenbuehler (CC BY-NC 2.0)

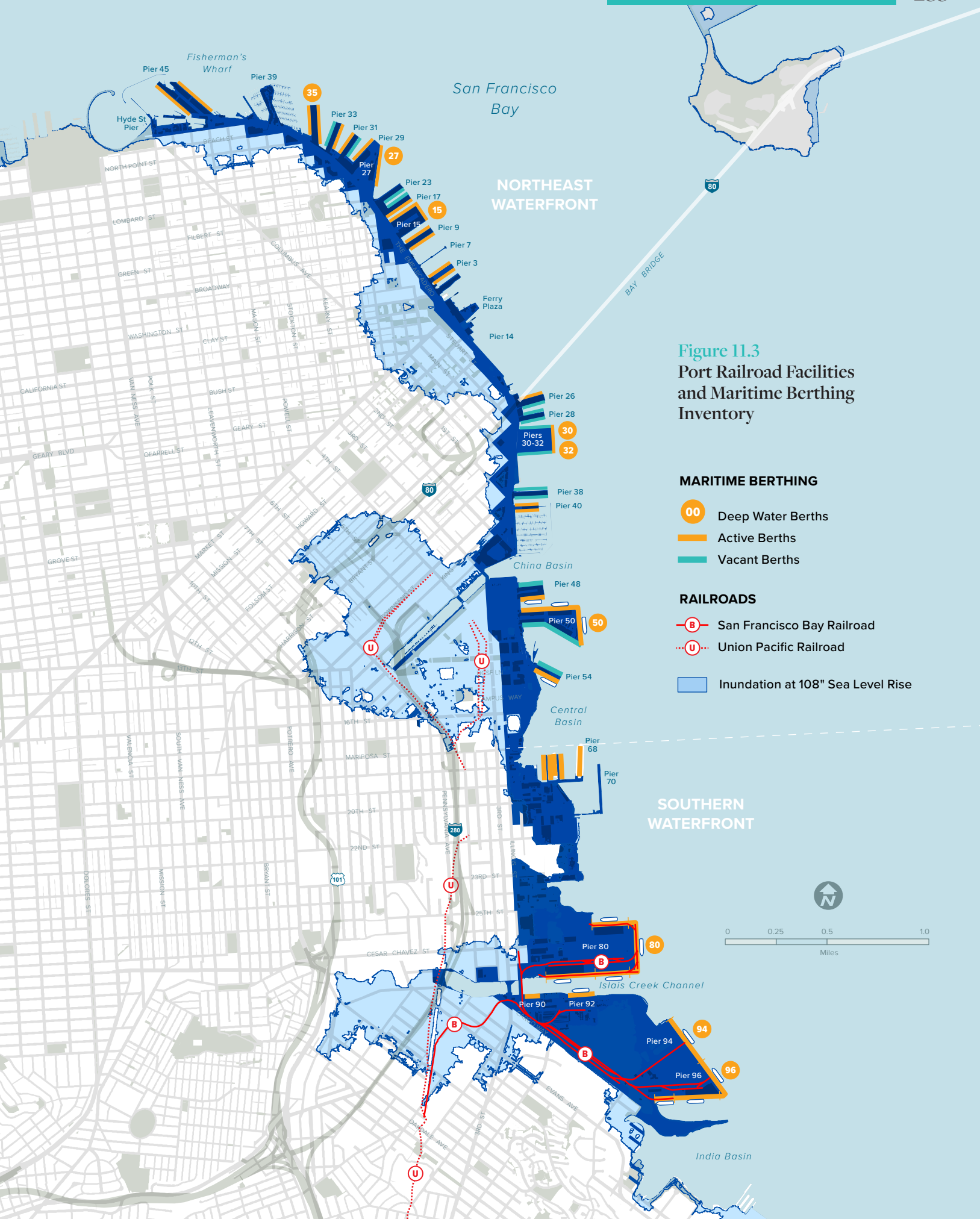




Photo 11.14 Ship docked at Pier 80. Dave Rauenbuchler (CC BY-NC 2.0)

In the future, additional passenger rail service is anticipated due to Caltrain electrification efforts and anticipated high-speed rail improvements. This increased traffic will reduce the operating windows for Port cargo rail operations.

Rail is particularly sensitive to flooding because it cannot operate with even minimal flooding and flooding on one section of the rail results in disruption to the whole network. The train is inoperable if the railroad tracks are not visible and, thus, it is sensitive to both temporary and permanent flooding. Regular operations should be able to resume after temporary flooding provided there is no corrosion or debris on the tracks.

11.3.1.2 Maritime Berths

The Port's maritime berths host a number of services, including cruise ships, ferries and excursions, historic ships, fireboats, fishing fleets, and cargo operations (Photo 11.14). The vessels present in the southern waterfront primarily include industrial cargo ships and small watercrafts used for recreational boating (Figure 11.3). While the vessel berths themselves may not be impacted by SLR, the access to the piers they dock at, or the piers themselves, could become flooded under future SLR scenarios. Section 11.1 provides a discussion of the various piers' vulnerability to SLR.

11.3.2 Transportation Exposure

The exposure of San Francisco Bay Railroad was evaluated relative to the 10 SLR scenarios defined in Chapter 2, *Climate Science*. The percentage and distance for each asset that could be inundated under each scenario were calculated and are presented in Table 11.7.

11.3.3 Transportation Vulnerability Summary

Railroad operations are impacted beginning at SLR Scenario 2 (24 inches of SLR or 12 inches of SLR and an annual extreme high tide with a 1-year recurrence interval) when the tracks at Pier 96 are inundated. Temporary inundation of the Port's cargo terminals would not hinder current operations as they could

Table 11.7 Transportation Exposure with Sea Level Rise (% inundated and area inundated)

Port Transportation	Railroad Exposure under Each Scenario (% Inundated)									
	1	2	3	4	5	6	7	8	9	10
San Francisco Bay Railroad	0%	6%	8%	14%	40%	56%	67%	69%	73%	83%
Intermodal Container Transfer Facility	0%	0%	0%	10%	18%	25%	25%	28%	30%	47%

Port Transportation	Railroad Exposure under Each Scenario (Miles Inundated for Railroad and Acres Inundated for Intermodal Container Transfer Facility)									
	1	2	3	4	5	6	7	8	9	10
San Francisco Bay Railroad	0.02	0.39	0.55	0.91	2.63	3.62	4.34	4.46	4.72	5.37
Intermodal Container Transfer Facility	0	0	0	2.4	4.3	5.7	5.8	6.4	7.1	10.9

resume after flood waters recede. The Intermodal Container Transfer Facility experiences minimal flooding at Scenario 4 (48 inches of SLR or six inches of SLR and a 100-year extreme tide) in the northern portion of the facility. Scenario 4 (48 inches of SLR or six inches of SLR and a 100-year extreme tide) results in additional flooding of tracks. At Scenario 5 (52 inches of SLR, or 12 inches of SLR and a 100-year extreme tide), the connection to Union Pacific Railroad would be inundated, rendering the railroad inoperable.

The vulnerability of the marine vessel berths is dependent upon the conditions of the piers they are located at. While the berths could still be functional under future SLR scenarios, access to the piers or the piers themselves could become flooded. Additionally, storm damage to utilities or fenderings could occur and be exacerbated by SLR.

11.3.4 Transportation Consequence Summary

Key consequences and consequences that could occur to society and equity, the economy, environment, and governance (see Chapter 3, *Assessment Approach*) were evaluated assuming no action is taken to address the impacts associated with SLR or extreme tide flooding. These consequences are listed below. However, several actions are currently planned or in progress to address some of the noted impacts. For a description of the current or planned projects, see Chapter 13, *A Changing Shoreline*.



KEY ISSUE: The Port's maritime berths and connection to the regional railroad enable important industrial and maritime uses in the southern waterfront. The loss of these modes of transportation would result in additional road congestion and reduce or eliminate much of the remaining industrial and industrial maritime uses in San Francisco.



Society and Equity: Disruption of rail service could result in increased traffic on local roads and interstates. In addition to road congestion, this could result in increased air and noise pollution in nearby neighborhoods. Furthermore, loss of rail in the area would impact local employment given that San Francisco Bay Railroad hires almost exclusively from the local community. This would disproportionately impact workers from the Bayview neighborhood and people living in the southern waterfront.

The railroad and maritime berths serve industrial transportation needs and could also be used during emergencies to transport supplies and remove debris. If these become inaccessible due to flooding, their use for emergency response could become limited resulting in delays in response times and dangers to public safety.



Economy: Disruption of rail service would impact the industrial operations at Piers 80, 92, 94, and 96 and could result in economic losses to the local community and beyond. It could lead to increased truck traffic, or the relocation of these services to a different Port within the Bay Area.



Environment: San Francisco Bay Railroad's primary business is transporting contaminated soils from construction projects in San Francisco to a landfill out of state. Using rail rather than long-haul trucks to transport materials saves approximately one million gallons of diesel fuel annually, producing approximately 90 percent fewer carbon dioxide emissions.⁶ If rail became unavailable due to flooding, the use of long-haul trucks would have a large environmental impact.

6 Port of San Francisco, 2017. Request approval of an Amended and Restated Lease No. L-14397 ("Lease") between the Port of San Francisco and San Francisco Bay Railroad, Inc. <https://sfport.com/sites/default/files/Commission/Documents/Commission%20Meeting%20Staff%20Reports/Item%2012A%20SF%20Bay%20Railroad.pdf>

11.4 PORT UTILITIES

Many utilities are located within or beneath Port property, including water, wastewater, stormwater, communications, electrical, fuel, and maintenance structures (Photos 11.15 and 11.16). Service disruptions to these utilities would have citywide consequences and would impact the ability of the Port and the Port tenants, employees, and small businesses to operate and provide services.

This section focuses on the Port's storm sewer system. The vulnerabilities of other utilities are further described in their respective sections. Chapter 6, *Water*, includes a description of the regional water supply, local potable water supply system, low-pressure fire system and AWSS/high-pressure fire system. Chapter 7, *Wastewater*, details the City's wastewater collection and treatment system. Chapter 8, *Power*, describes SFPUC and PG&E power assets such as sub-stations, switch gear, and transformer boxes.

The majority of the City of San Francisco is served by a combined sewer system where stormwater and residential and commercial sewage is conveyed together to treatment plants prior to discharge into the San Francisco Bay or Pacific Ocean. In addition to this combined system, there are several separate storm sewers operated by the Port or SFPUC. These systems convey stormwater runoff directly to surface waters such as lakes or San Francisco Bay and are subject to the National Pollutant Discharge Elimination System (NPDES) Phase II Municipal General Permit for municipal stormwater discharges. The SFPUC system, discussed in Chapter 7, *Wastewater*, consists of small stormwater systems located in parks throughout the City. The Port's storm sewer serves areas along the City's waterfront and drains into San Francisco Bay.

The Port developed a Stormwater Management Plan and administers a Stormwater Management Program to reduce runoff pollution and protect the water quality of the San Francisco Bay. The program includes public



Photo 11.15 Sea Wall Lot 349 AWSS piping improvements. Dave Rauenbuehler (CC BY-NC 2.0)

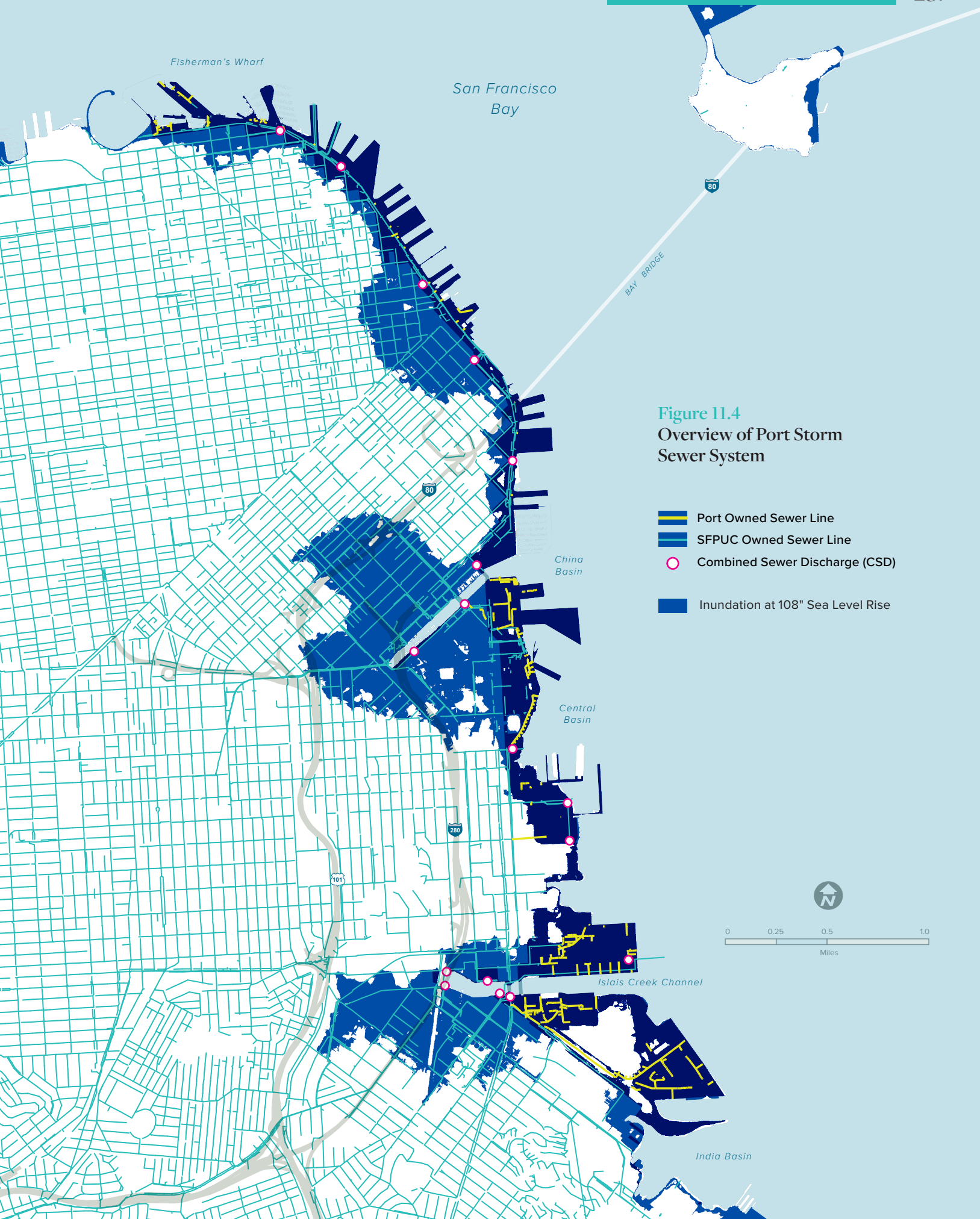




Photo 11.16 Pier 70 Utility Improvements at SWL349. Dave Rauenbuehler (CC BY-NC 2.0)



outreach and education, industrial facility inspections, illicit discharge investigation and enforcement, construction site management, and maintenance of the drainage system. The program focuses on waterfront areas and provides design guidelines that will apply to new development or redevelopment along the waterfront to limit pollution or improve stormwater quality before it reaches the Bay.

While the majority of the Port's jurisdiction is served by the separate storm sewer system, there are a few areas where stormwater is conveyed to the City's combined sewer system.⁷ These include:

- Upland areas of Fisherman's Wharf between Pier 39 and Hyde Street Harbor (excluding Pier 45);
- The southwest edge of South Beach Harbor parking lot at Pier 40, abutting the Embarcadero;
- The majority of Pier 70 extending from the foot of 20th street to the Port's property line on Illinois Street;
- Parcels adjacent to 21st, 22nd, 23rd, and 24th Streets, east to the Port's property line on Illinois Street;
- Pier 80 west of the entrance to the container terminal at the foot of Cesar Chavez Street;

- The Darling Delaware facility at Pier 92, except two drains near the northeast corner of the leasehold; and
- Cargo Way, except the Amador Street entrance at Pier 90.

The Port's stormwater efforts focus on maritime operations and commercial development along the waterfront (see Figure 11.4). The Stormwater Management Plan has a targeted emphasis on the area north of Pier 41 due to the high level of commercial and industrial activities located there, and the southern waterfront extending south of Mariposa Street to India Basin due to the significant level of planned redevelopment. The potential vulnerability of the stormwater drainage system is described below and differs for the utilities located on land or under piers. Additional public and private utilities run through the Port's jurisdiction and their connection with the Port is discussed in Section 11.4.1.

⁷ Port of San Francisco. 2003. Storm Water Management Plan 2003 – 2004. Available at https://www.waterboards.ca.gov/water_issues/programs/storm-water/swmp/sfport_swmp.pdf.

11.4.1 Summary of Potentially Vulnerable Utility Assets

The vulnerability of the Port's stormwater sewer system varies based on the asset's location – either on land or under pier. Generally, the assets located under piers are more vulnerable to SLR. These utilities run underneath the pier decks where they are constantly exposed to harsh conditions from corrosive Bay waters and impacts from debris mobilized by waves and tidal forces. These utilities have high corrosion rates and will eventually become inaccessible for maintenance and replacement as sea levels rise. Sump pumps are also located below the pier decks and are subject to saltwater intrusion and corrosion.

There is an ongoing plan to move under pier utilities above the piers. This work is programmed to extend 30 years and is not yet fully funded. It does not fully eliminate the risk to utilities as the sump pumps will still be located below deck vulnerable to corrosion and salt water intrusion. The Port is still developing a plan to address this issue.

On land, utilities will experience fewer disruptions and will likely be able to handle temporary flooding. However, if salt water enters the storm sewer system through sump pumps or storm drains, it could corrode the pipes increasing their sensitivity to SLR.

11.4.2 Utilities Consequence Summary

Key consequences were evaluated assuming no action is taken to address the impacts associated with SLR or extreme tide flooding. These consequences are listed below. However, several actions are currently planned or in progress to address some of the noted impacts. For a description of the current or planned projects, see Chapter 13, *A Changing Shoreline*.



KEY ISSUE: Many of the Port's piers have stormwater utilities that run underneath the pier deck where they are exposed to the harsh conditions of corrosive Bay waters and impacts from tidal debris. SLR may increase this exposure and damage to the under-pier utilities can reduce their ability to function and negatively affect water quality.

11.5 Port Sea Level Rise Adaptation Projects

The Port has a number of resilience efforts and SLR adaptation projects planned, including park projects, mixed-use development projects, and infrastructure projects to address seismic safety, SLR, and coastal flooding. These are described in Chapter 13, *A Changing Shoreline*.



House boats on Mission Creek.
Photo by Sergio Ruiz.