

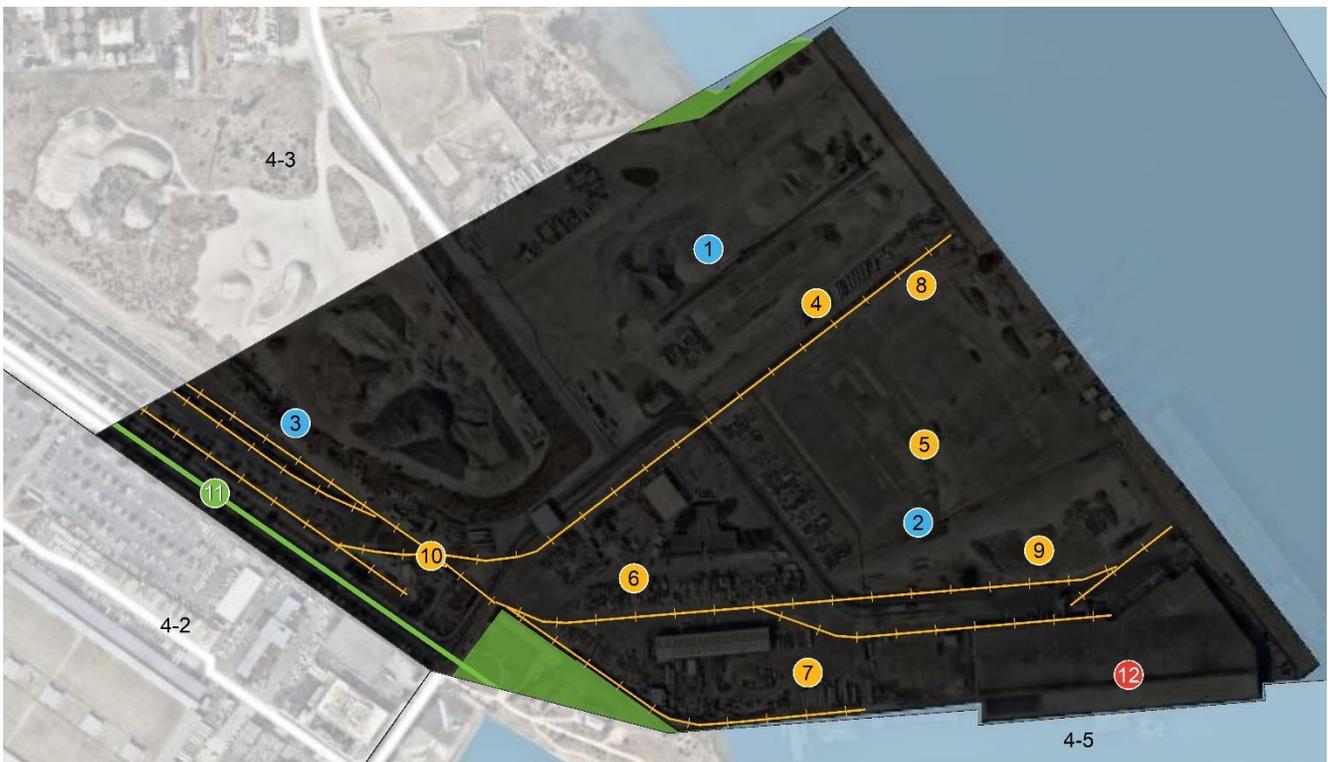


Subarea Description

Piers 94 and 96 (Subarea 4-4) includes Piers 94 and 96, a mostly industrial area located on Bay fill. In the event of a disaster, a FEMA Staging Area is located on Pier 94 and a Debris Removal Staging Area is on Pier 96. Critical infrastructure includes a dry-bulk cargo terminal, the San Francisco Bay Railroad, the Recology Recycling Center (including sustainable crushing and concrete recycling facilities) and a long term lay berth used for maritime, industrial, and emergency response services.

The shoreline within this subarea is primarily engineered (structures on piles) that transitions to an embankment at the boundary with Subarea 4-5.

The primary pathways of flooding are from overtopping of the southern edge of Pier 96 adjacent to Lash Lighter Basin, and eventually overtopping of the shoreline at Pier 94 adjacent to the Pier 94 Wetlands. Eventually inundation of this subarea connects with all adjacent subareas (Subareas 4-2, 4-3, and 4-5).



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Assets and Landmarks



Maritime

- 1. Hansen Aggregates (Pier 94)
- 2. Pier 96
- 3. Intermodal Cargo Transfer Facility



Disaster Response

- 4. FEMA Staging Area (Pier 94)
- 5. Debris Removal Staging Area (Pier 96)
- 6. Medical Examiner Temporary Morgue (Staging Area)
- 7. Mobile Hospital Trailers (Staging Area) (Pier 96)
- 8. Large Vessel Berth (Pier 96)
- 9. Department of Building Inspection Trailer (Staging Area) (Pier 96)
- 10. San Francisco Bay Railroad



Transportation

- 10. San Francisco Bay Railroad



Open Space and Ecology

Open Space

- 11. Bay Trail / Blue Greenway



Critical Facilities

- 12. Recology Recycling Center



Timing of Exposure: Assets and Landmarks

Assets / Landmarks	Flood Scenario	Equivalent Events	Timing				
			USACE Low	USACE Inter.	OPC Most Likely	USACE High	OPC 1-in-200
 Maritime							
<ul style="list-style-type: none"> Pier 96 	12" (7.5 ft. NAVD)	High tide +12" SLR	>2150	2070	2047	2038	2034
		1-YR + 0" SLR	Today	Today	Today	Today	Today
<ul style="list-style-type: none"> Hansen Aggregates (Pier 94) 	36" (9.5 ft. NAVD)	High tide +36" SLR	>2150	2144	2091	2074	2063
		50-YR + 0" SLR	Today	Today	Today	Today	Today
<ul style="list-style-type: none"> Intermodal Cargo Transfer Facility 	108" (15.5 ft. NAVD)	High tide + 108" SLR	>2150	>2150	>2150	2140	2119
		100-YR + 67" SLR	>2150	>2150	2145	2107	2087
 Disaster Response							
<ul style="list-style-type: none"> San Francisco Bay Railroad 	12" (7.5 ft. NAVD)	High tide +12" SLR	>2150	2070	2047	2038	2034
		1-YR + 0" SLR	Today	Today	Today	Today	Today
<ul style="list-style-type: none"> Mobile Hospital Trailers (Staging Area) (Pier 96) Department of Building Inspection Trailer (Staging Area) (Pier 96) 	36" (9.5 ft. NAVD)	High tide +36" SLR	>2150	2144	2091	2074	2063
		50-YR + 0" SLR	Today	Today	Today	Today	Today
<ul style="list-style-type: none"> Debris Removal Staging Area (Pier 96) 	48" (10.2 ft. NAVD)	High tide + 48" SLR	>2150	>2150	2113	2088	2073
		100-YR + 7" SLR	2088	2048	2032	2025	2023
<ul style="list-style-type: none"> FEMA Staging Area (Pier 94) 	52" (10.8 ft. NAVD)	High tide + 52" SLR	>2150	>2150	2120	2092	2076
		100-YR + 11" SLR	2138	2066	2044	2035	2032



Timing of Exposure: Assets and Landmarks

Assets / Landmarks	Flood Scenario	Equivalent Events	Timing				
			USACE Low	USACE Inter.	OPC Most Likely	USACE High	OPC 1-in-200
<ul style="list-style-type: none"> Medical Examiner Temporary Morgue (Staging Area) (Pier 96) 	66" (12.0 ft. NAVD)	High tide + 66" SLR	>2150	>2150	2143	2106	2086
		100-YR + 25" SLR	>2150	2115	2072	2060	2053
<ul style="list-style-type: none"> Large Vessel Berth (Pier 96) 	--	--	--	--	--	--	--



Transportation

<ul style="list-style-type: none"> San Francisco Bay Railroad 	12" (7.5 ft. NAVD)	High tide + 12" SLR	>2150	2070	2047	2038	2034
		1-YR + 0" SLR	Today	Today	Today	Today	Today



Open Space and Ecology

<ul style="list-style-type: none"> Bay Trail / Blue Greenway 	84" (13.5 ft. NAVD)	High tide + 84" SLR	>2150	>2150	>2150	2121	2100
		100-YR + 43" SLR	>2150	>2150	2104	2083	2069



Critical Facilities

<ul style="list-style-type: none"> Recology Recycling Center 	12" (7.5 ft. NAVD)	High tide + 12" SLR	>2150	2070	2047	2038	2034
		1-YR + 0" SLR	Today	Today	Today	Today	Today



Timing of Exposure: Subarea

Adaptation Focus	Shoreline Type	Flood Scenario	Timing					
			Return	USACE Low	USACE Inter.	OPC Most Likely	USACE High	OPC 1-in-200
Immediate	Engineered	12" (7.5 ft. NAVD)	High tide +12" SLR	>2150	2070	2047	2038	2034
			1-YR + 0" SLR	Today	Today	Today	Today	Today
Tipping Point	Engineered	36" (9.5 ft. NAVD)	High tide +36" SLR	>2150	2144	2091	2074	2063
			50-YR + 0" SLR	Today	Today	Today	Today	Today
Long Term >2050	Engineered	77" (12.9 ft. NAVD)	High tide +36" SLR	>2150	>2150	>2150	2116	2095
			100-YR + 0" SLR	>2150	2144	2091	2074	2063

Flood Progression

Immediate Flood Risk

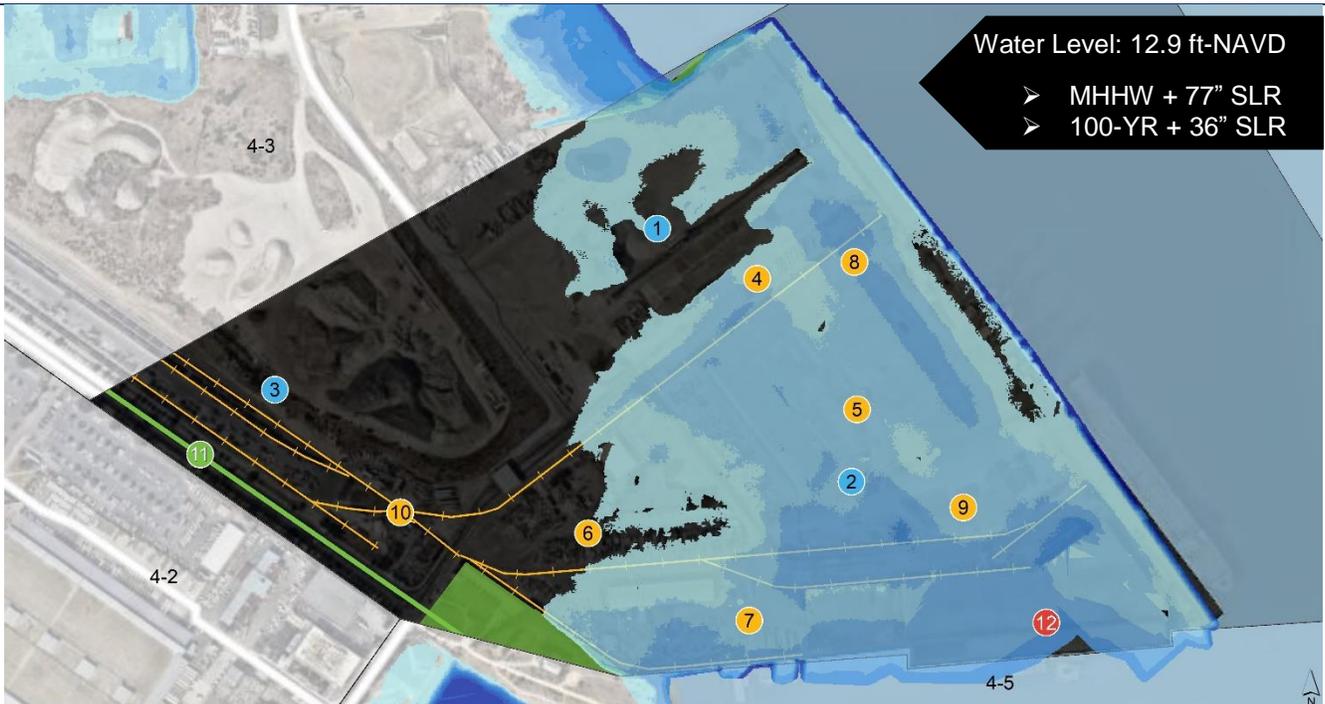




Substantial Flood Risk (Tipping Point)



Long-Term Flood Risk (>2050)





The following describes the progression of potential extreme tide and sea level rise flooding, along with a brief discussion of the assets that will be impacted within Subarea 4-4.

Flood Scenario	Assets	Consequences				
		USACE Low	USACE Int.	OPC Most Likely	USACE High	OPC 1:200
High tide + 12" SLR	1-YR + 0" SLR	Today	Today	Today	Today	Today

Water Level Elevation: 7.5 ft. NAVD88



Maritime

Pier 96 is impacted. Pier 96 is a low-lying area built on fill material and is vulnerable to near-term inundation from SLR.



Disaster Response

A portion of the San Francisco Bay Railroad will be impacted. For over a decade, the Port has contracted with the railroad to provide railroad services and rail terminal operations. 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.



Transportation

A portion of the San Francisco Bay Railroad will be impacted.



Critical Facilities

Recology's Recycle Central on Pier 96 will be impacted. This facility extracts recyclables and serves as a recycling buy-back center.

High tide + 24" SLR	5-YR + 0" SLR	USACE Low	USACE Int.	OPC Most Likely	USACE High	OPC 1:200
		Today	Today	Today	Today	Today
High tide + 24" SLR	5-YR + 0" SLR	--	--	--	--	--

Water Level Elevation: 8.5 ft. NAVD88

Pier 94-96

Subarea 4-4



Flood Scenario	Assets	Consequences				
		USACE Low	USACE Int.	OPC Most Likely	USACE High	OPC 1:200
High tide + 36" SLR	50-YR + 0" SLR	Today	Today	Today	Today	Today
Water Level Elevation: 9.5 ft. NAVD88		Maritime Pier 94 will be inundated. It is 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.				
		Disaster Response Several assets on Pier 96 are impacted. The Mobile Hospital Trailer and Department of Building Inspection Trailer are impacted by this water level; however, these assets can easily be relocated. The use of this area as a Staging Area would be limited.				
High tide + 48" SLR	100-YR + 7" SLR	2088	2048	2032	2025	2023
Water Level Elevation: 10.2 ft. NAVD88		Disaster Response The Debris Removal Staging Area at Pier 96 is inundated.				
High tide + 52" SLR	100-YR + 11" SLR	2139	2066	2044	2035	2032
Water Level Elevation: 10.8 ft. NAVD88		Disaster Response The portion of Pier 94 identified by FEMA as a Staging Area is inundated.				
High tide + 66" SLR	100-YR + 25" SLR	>2150	2115	2072	2060	2053
Water Level Elevation: 12.0 ft. NAVD88		Disaster Response The Medical Examiner Temporary Morgue will be impacted; however, these assets can easily be relocated. The use of Pier 96 as a Staging Area would be further reduced under this scenario.				

Pier 94-96

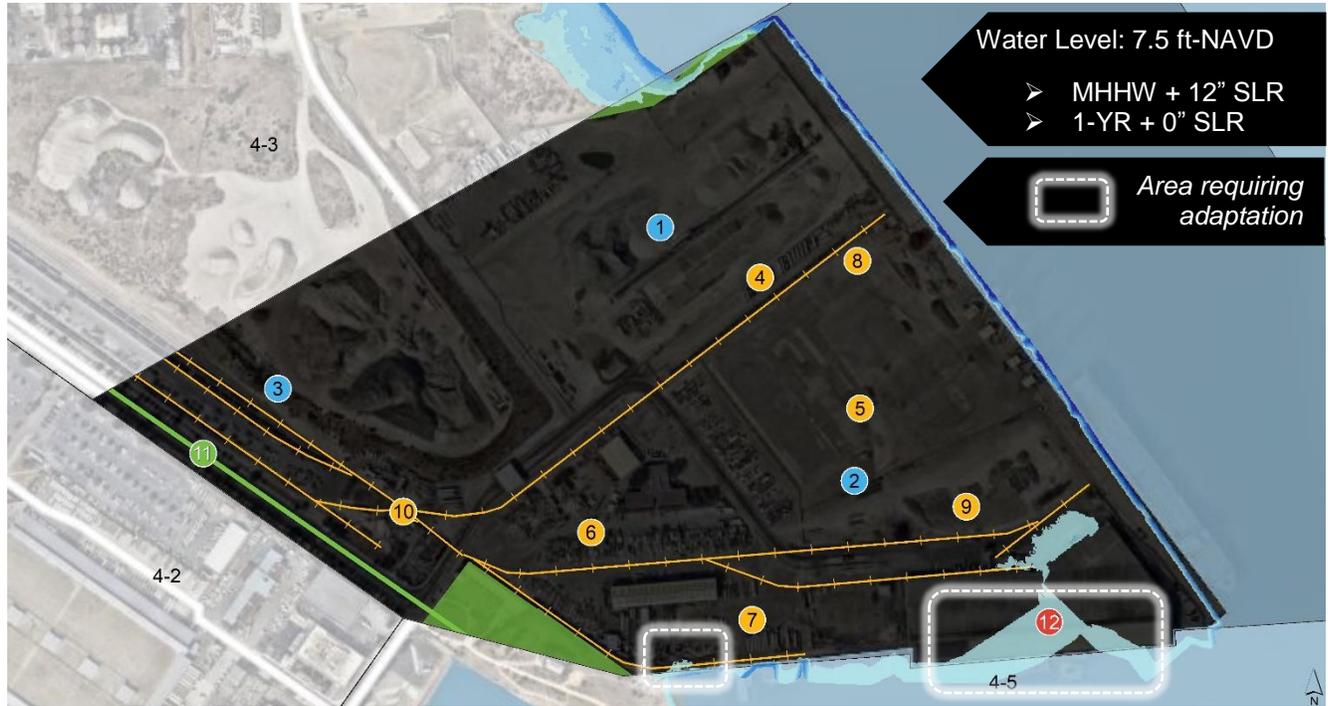
Subarea 4-4



Flood Scenario	Assets	Consequences				
		USACE Low	USACE Int.	OPC Most Likely	USACE High	OPC 1:200
High tide + 77" SLR	100-YR + 36" SLR	>2150	2144	2091	2074	2063
Water Level Elevation: 12.9 ft. NAVD88	--	--	--	--	--	--
High tide + 84" SLR	100-YR + 43" SLR	>2150	>2150	2104	2083	2069
Water Level Elevation: 13.5 ft. NAVD88		Open Space and Ecology A portion of the Bay Trail leading to Heron’s Head Park and India Basin Shoreline Park in the adjacent Subarea 4-5 is inundated.				
High tide + 96" SLR	100-YR + 55" SLR	>2150	>2150	2125	2096	2078
Water Level Elevation: 14.5 ft. NAVD88	--	--	--	--	--	--
High tide + 108" SLR	100-YR + 67" SLR	>2150	>2150	2145	2107	2087
Water Level Elevation: 15.5 ft. NAVD88		Maritime Portions of the Intermodal Cargo Transfer facility within this subarea are inundated.				



Adaptation Focus: Immediate



Shoreline Characteristics	Shoreline Overtopping					Timing of Impact (100-YR)					
	Classification	Avg. Elev.	Avg. Depth (ft)	Max Depth (ft)	Length (ft)	%	USACE Low	USACE Inter.	OPC Most Likely	USACE High	OPC 1-in-200
Engineered	7.0 ft. NAVD	0.5	1.1	599	11.5%	Today	Today	Today	Today	Today	Today

Flood Pathways

- Overtopping occurs over a short stretch of an engineered portion of the Bay shoreline along the southern edge of Pier 96. Overtopping of this shoreline allows flooding to inundate a portion of Pier 96 (Recology Recycle Center).
- Isolated overtopping also occurs over a small stretch of shoreline along the southern edge of Pier 96 adjacent to Heron’s Head Park. Overtopping of this shoreline results in minor localized inundation of the immediate landward area.

Shoreline Focus

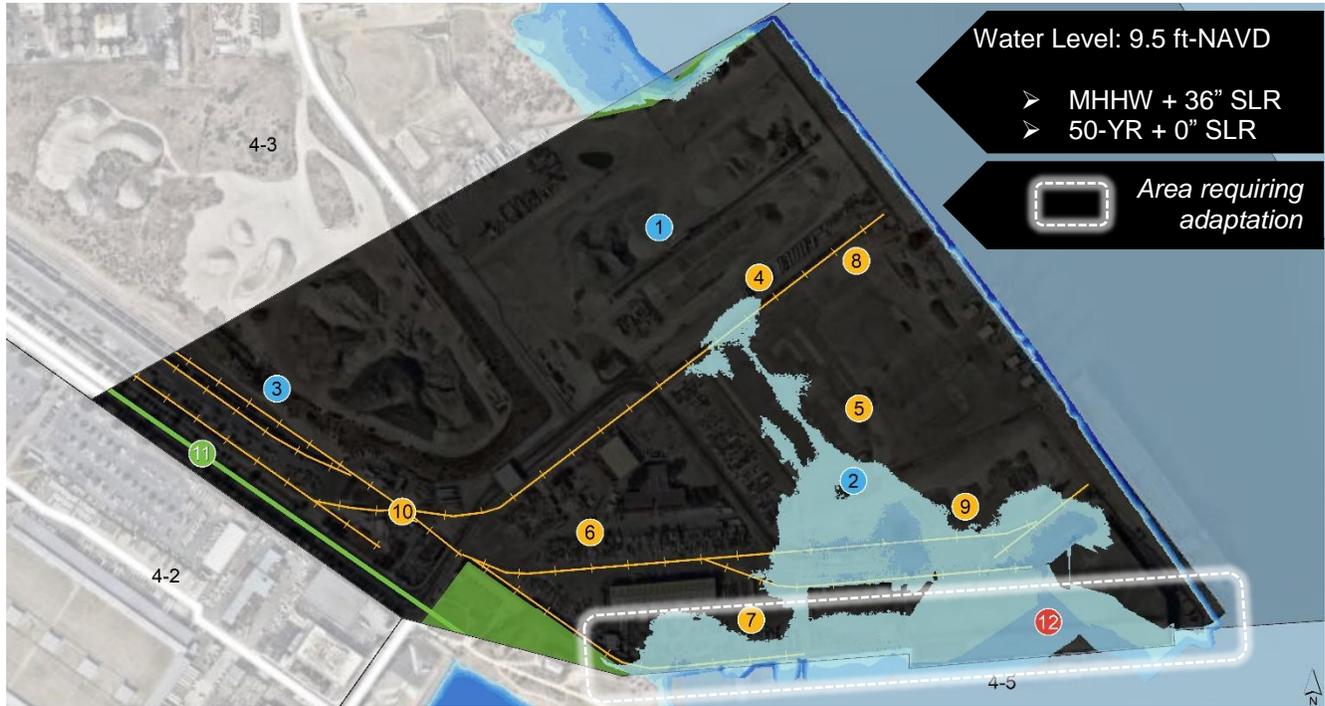
- Initial adaptation measures could focus on the shoreline edge along the southern edge of Pier 96 to reduce overtopping risk.

Adaptation Considerations

- Adaption measures for this scenario should consider adaptive measures that allow shoreline protection to be increased over time for higher scenarios.
- There is minimal space available between the existing shoreline edge and the existing structure.



Adaptation Focus: Tipping Point



Shoreline Characteristics	Shoreline Overtopping					Timing of Impact (100-YR)				
	Avg. Elev.	Avg. Depth (ft)	Max Depth (ft)	Length (ft)	%	USACE Low	USACE Inter.	OPC Most Likely	USACE High	OPC 1-in-200
Engineered	8.0 ft. NAVD	1.3	3.1	2,324	44.6%	Today	Today	Today	Today	Today

Flood Pathways

- Overtopping occurs over almost the entire south facing shoreline along Pier 96. Overtopping of this shoreline allows flooding to inundate a large portion of Pier 96 (Recology Recycle Center) and a small portion of Pier 94.
- Floodwaters are carried from the Pier 96 shoreline to Pier 94 via a broad low-lying depression crossing Pier 96.

Shoreline Focus

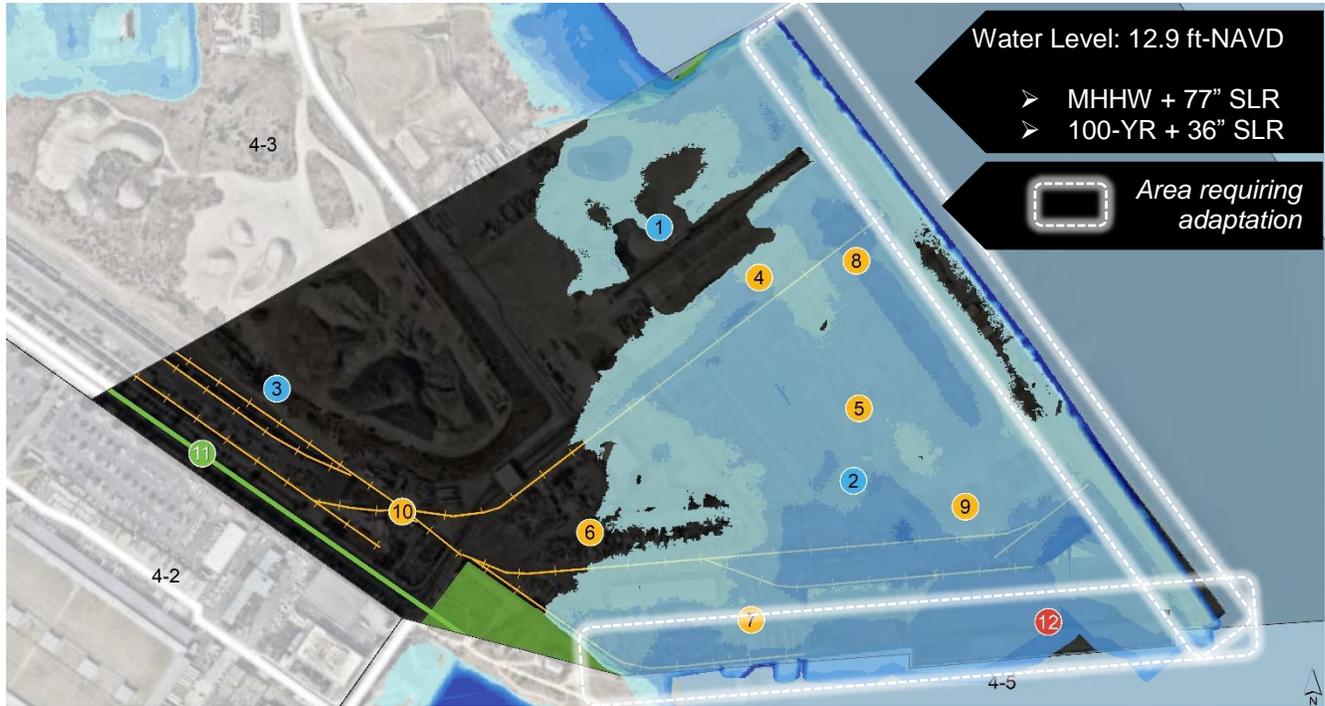
- Initial adaptation measures could focus on the shoreline edge along the southern edge of Pier 96 to reduce overtopping risk.

Adaptation Considerations

- Adaption measures should consider adaptative measures that allow shoreline protection to be increased over time for higher scenarios.
- While there is minimal space available between the shoreline edge and the existing Recology Recycle Center facility for adaptation measures, there is some open space available to the west along the shoreline.



Adaptation Focus: Long-Term >2050



Shoreline Characteristics	Shoreline Overtopping					Timing of Impact (100-YR)				
	Classification	Avg. Elev.	Avg. Depth (ft)	Max Depth (ft)	Length (ft)	%	USACE Low	USACE Inter.	OPC Most Likely	USACE High
Engineered	10.1 ft. NAVD	2.8	6.5	5,217	100.0%	>2150	2144	2091	2074	2063

Flood Pathways

- Overtopping occurs over most the shoreline, resulting in significant inundation of the inland areas. Inundation is exacerbated by multiple points of overtopping.

Shoreline Focus

- Adaptation measures to address flooding are required along most of the shoreline.

Adaptation Considerations

- At this scenario, flooding is contained within this subarea. With higher water levels, flooding will eventually connect with the flooded areas within Subarea 4-2 and 4-3.