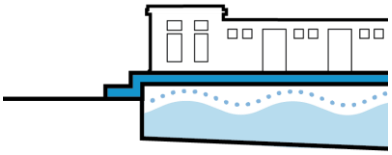
Measure Profile

Elevated Wharf

Flood Adaptation Measure

PHYSICAL INFRASTRUCTURE



SHORELINE LOCATION:

Shoreline

Brannan Street Wharf ©Eric Arneson

DESIGN LIFE	ADAPTABILITY	IMPACT ON THE WATERFRONT	CONSTRUCTION COST
50+ years	Medium	Major Intervention	TBD

COASTAL FLOOD HAZARDS MITIGATED:

Sea Level Rise | Storm Surge | Groundwater | Waves | Erosion

MEASURES COMPATIBILITY:

Flood	Seismic
Raised Pathways, Elevated Piers, Floodwalls	Super Bulkhead Wharf

ECOSYSTEM SERVICES: Measure may affect these shoreline values

Aquatic Habitat	Terrestrial Habitat	Water Quality	Carbon Storage
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DESCRIPTION:

The existing bulkhead wharves provide flood protection for the Promenade and Embarcadero roadway by preventing wave run-up and overtopping, while also adding approximately 1 foot of vertical elevation through an upward slope toward the water. By elevating these wharves (either in-place or Bayward), the same flood protection system is able to be maintained, with the new elevation set based on sea level rise projection.

CONSIDERATIONS:

- High seismic co-benefit.
- Provides ability to protect historic structures.

ADVANTAGES:

- Limited impact on Bay fill, leading to potentially easier path to environmental clearance.
- Conventional construction operation for wharf structure.
- High seismic co-benefit.

DISADVANTAGES:

- Potential challenge associated with disassembling/reassembling or moving historic building.

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	• Good longevity and durability, relative to spot measures or deployable solutions.	

CONSTRUCTION IMPACTS TO THE PUBLIC:

- The most challenging aspect in constructing this measure will be the management (disassemble/reassemble or move) the historic bulkhead building and identifying/implementing a light weight fill below the existing wharf.
- The measure can be readily implemented from marine equipment, and potential challenges installing piles through the rock dike associated with rebuilding wharf in place are avoided by moving piles bayward of this difficult driving/vibrating region.

SEA LEVEL RISE ADAPTATION OPPORTUNITIES:

- Elevated wharves could be adapted through the inclusion of floodwalls and raised features.
- Additional Bayside elevation could be included, though that adaptation would result in additional Bay fill.

CASE STUDIES:

- Brannan Street Wharf
- WETA Downtown Ferry Terminal

DESIGN OPPORTUNITIES:

Ecological Enhancements

- Raised wharves could incorporate ecological enhancements such as ecological concrete and increased light below decks.

Urban Design

- Reconstruction of wharves provides some opportunity for urban design improvement with a larger footprint, especially if the bulkhead buildings are permanently moved bayward.

Form

- TBD

DESIGN CONSIDERATIONS:

- Being in a relatively high seismic hazard alignment along the waterfront, any new wharf would need to accommodate potential ground movement during a seismic event, consistent with USACE seismic standards (ER 1110-2-1806 and -1150).
- Fill below the existing wharf would need to be evaluated for seismic safety and for consolidation settlement potential which could impact landside utilities.
- Seismic jointing between wharves and piers will be a challenge at the existing wharf and pier elevation, if these joints (i.e. deck elevations) are able to stay dry this will not be an issue.

SITE-SPECIFIC CONSIDERATIONS:

- Seawall instability will vary along the northern waterfront, which will change the design of the wharf.

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URBAN DESIGN CONSIDERATIONS:

- Reconstruction of wharves provides some opportunity for urban design improvement with a larger footprint, especially if the bulkhead buildings are permanently moved bayward.

INSTALLATION AND CONSTRUCTABILITY CONSIDERATIONS:

- The most challenging aspect in constructing this measure will be the management (disassemble/reassemble or move) the historic bulkhead building and identifying/implementing a lightweight fill below the existing wharf.
- Can be readily implemented from marine equipment, and potential challenges installing piles through the rock dike associated with rebuilding wharf in place are avoided by moving piles bayward of this difficult driving/vibrating region.

ARCHITECTURAL CONSIDERATIONS:

- ADA transitions and access to the elevated wharf would require thoughtful urban design and accessibility layout, but the bayside alignment of the wharf allows for these transitions to occur over a larger horizontal footprint within the existing promenade and wharf areas.

HISTORICAL RESOURCE CONSIDERATIONS:

- Performing this work at or near bulkhead buildings will require significant consultation with historic resource agencies Bulkhead buildings could be left in place while new wharf is constructed then moved onto the new marine structure foundation during construction of existing wharf fill as temporary staging or permanently.

OPERATION AND MAINTENANCE CONSIDERATIONS:

- Constructing wharves as flood protection is a passive solution but inherently involves more maintenance than the seawall options due to the increase quantity and area of structure exposed to the marine environment (whole underdeck and pile connection area versus vertical wall only).
- No operational costs to deploy.