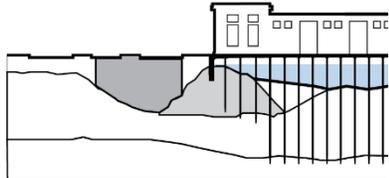


Liquefaction Mitigation

Seismic Adaptation Measure

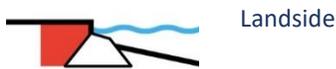


TARGETED MEASURE



TYPE: Geotechnical

SHORELINE LOCATION:



Installation at night © Fugro and SGH

DESIGN LIFE 100+ years	ADAPTABILITY Low	IMPACT ON THE WATERFRONT Minor Landside Intervention	CONSTRUCTION COST Moderate
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SEISMIC HAZARDS MITIGATED:

Lateral Spreading



Liquefaction



SEISMIC PERFORMANCE IMPROVED:

Structures



Utilities and Transportation



MEASURES COMPATIBILITY:	Flood	Seismic
	None	Shoreline Stabilization Bulkhead Wharf Retrofit Utility Retrofit

DESCRIPTION:

Strengthened in situ soils (fill only) landside of the existing shoreline. This would mitigate liquefaction-induced settlements that would otherwise damage the Embarcadero, the promenade, the light rail and utilities, but does not stop damaging lateral spreading displacements.

CONSIDERATIONS:

- Locations of soil improvement determined by exposure of utility and transportation system components to liquefaction as well as accessibility to the liquefiable fill from the ground surface.
- Soil improvement would be limited to the liquefiable fill below the water table.

ADVANTAGES:

- Measure specifically targets the soils which cause liquefaction-induced settlements.
- Requires less utility relocation work than landside shoreline stabilization measures
- Waterfront buildings can remain occupied during construction.
- No in-water work.

DISADVANTAGES:

- Does not mitigate lateral spreading due to shoreline instability.
- Reduces but does not eliminate vertical displacements due to shoreline instability.
- Requires careful monitoring of utilities during construction.

Liquefaction Mitigation

Seismic Adaptation Measure



CONSTRUCTION IMPACTS TO THE PUBLIC:

- Construction could occur mostly at night with evening closure of the Embarcadero, promenade and light rail guideway.
- Impacts to users of the promenade and the Embarcadero would likely be limited.

SEA LEVEL RISE ADAPTATION OPPORTUNITIES:

- This measure does not present any opportunities for sea level rise adaptation.

DESIGN CONSIDERATIONS:

- The heterogeneity of the fill would make it difficult to achieve a uniform density and strength using liquefaction mitigation.

SITE-SPECIFIC CONSIDERATIONS:

- Areas with a high concentration of utilities and/or large sewer structures would limit access to the fill below and may compromise the effectiveness of the improvement.
- Difficult to access fill below light rail track slabs.

URBAN DESIGN CONSIDERATIONS:

- This measure does not present any urban design opportunities or considerations.

HISTORICAL RESOURCE CONSIDERATIONS:

- This measure would not impact any historical buildings

INSTALLATION AND CONSTRUCTABILITY CONSIDERATIONS:

- This measure would require closely spaced grid of injection points while avoiding existing utilities.
- Drilling through light rail track slabs to access the fill would be required.
- Monitoring of utilities during grouting operations would be required.