Seismic Evaluation of Structures at Plant Nos. 1 and 2

Project PS15-06

Kathy Millea, Director of Engineering

Operations Committee

May 6, 2020

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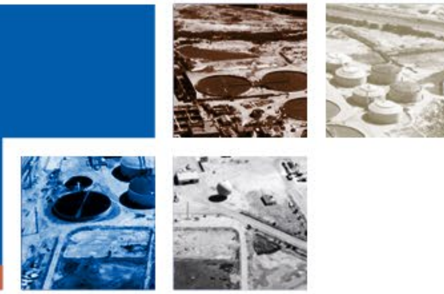
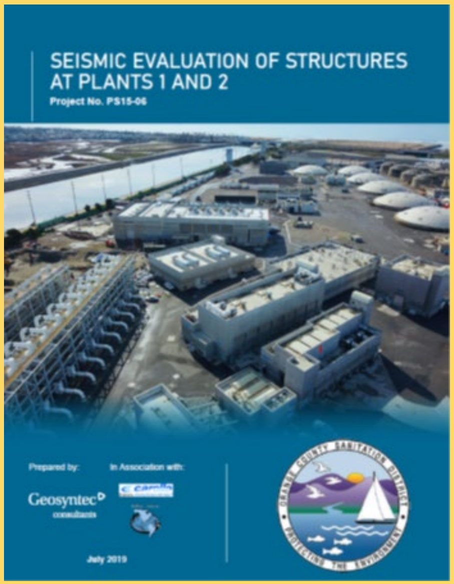
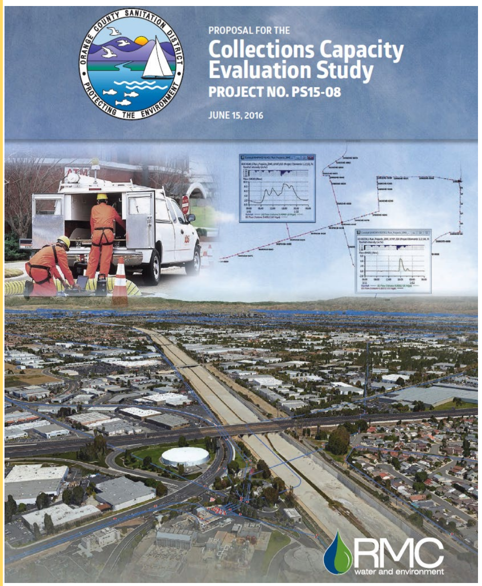
ORANGE COUNTY SANITATION DISTRICT

Fostering Resilience at OCSD

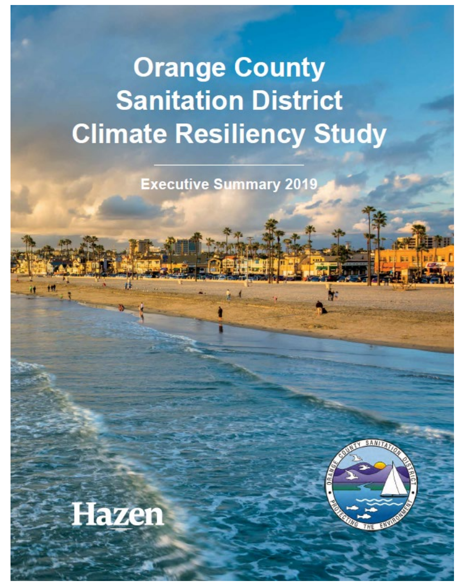




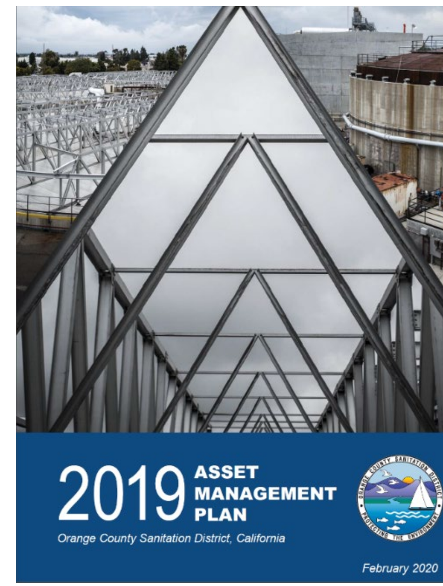
Seismic Evaluation Study



Collections Capacity Evaluation Study

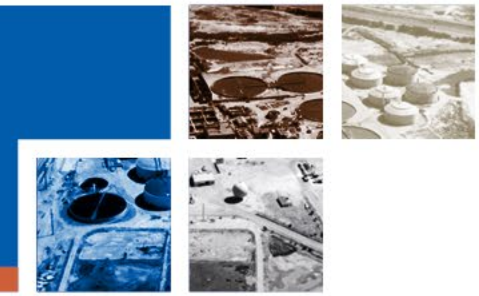


Climate Resiliency Study



Asset Management Plan

Long History of Seismic Evaluations



1991

Seismic Risk Analysis Plants 1 and 2

Evaluated process facilities at Plant Nos. 1 and 2 relative to their performance to 1991 Building Code

2014

SP-182: Plant No. 2 Digesters and Tunnels Seismic Hazard Evaluation

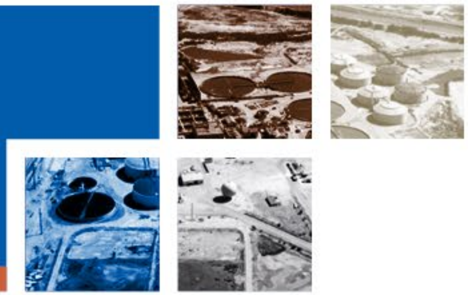
Quantify the vulnerability of Plant No. 2 digesters and associated facilities

2018

PS15-06: Seismic Evaluation of Structures at Plant Nos. 1 and 2

Evaluated process facilities at Plant Nos. 1 and 2 constructed prior to 2001 Building Code

Long History of Seismic Evaluations



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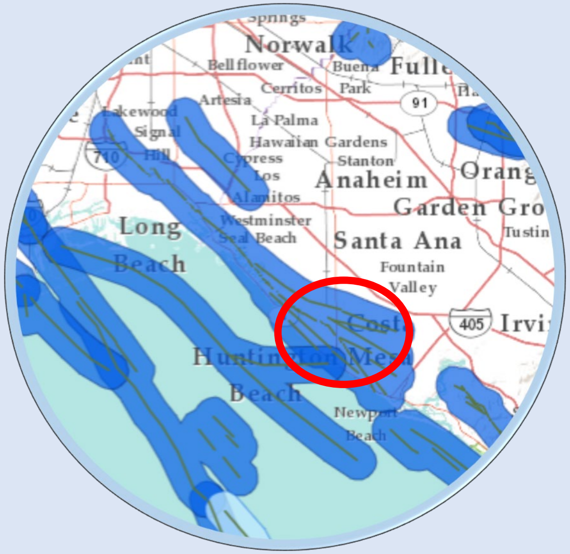
Seismic Risks

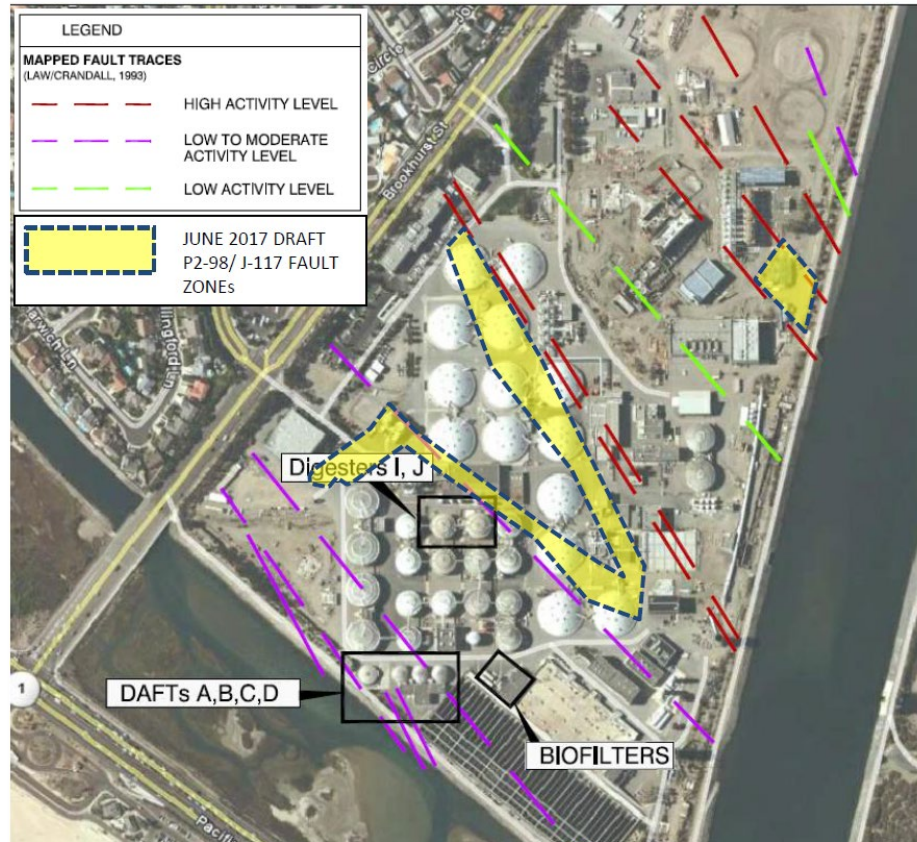
Local Faults



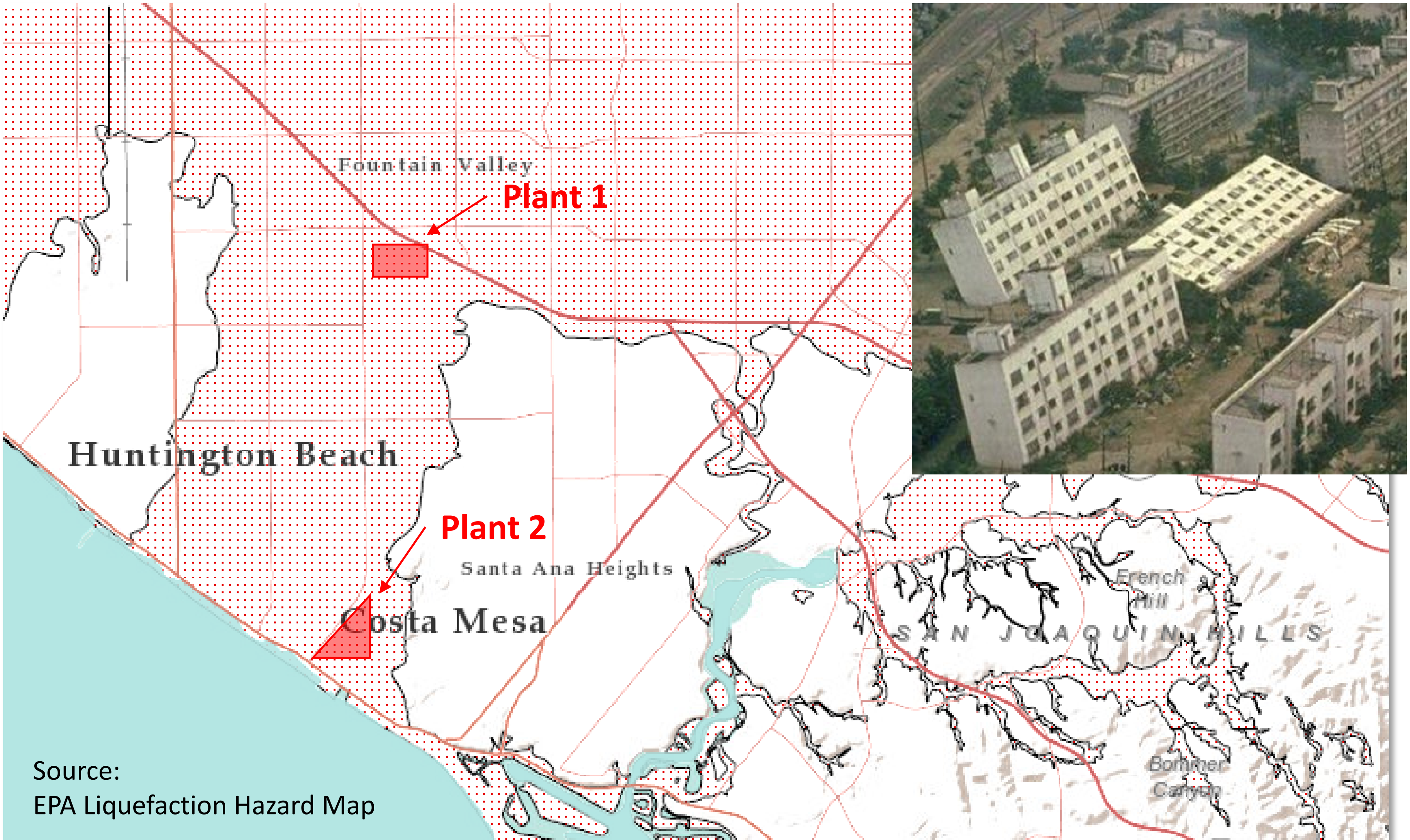
Liquefaction

Lateral Spread

Several Local Faults Impact Seismic Hazards

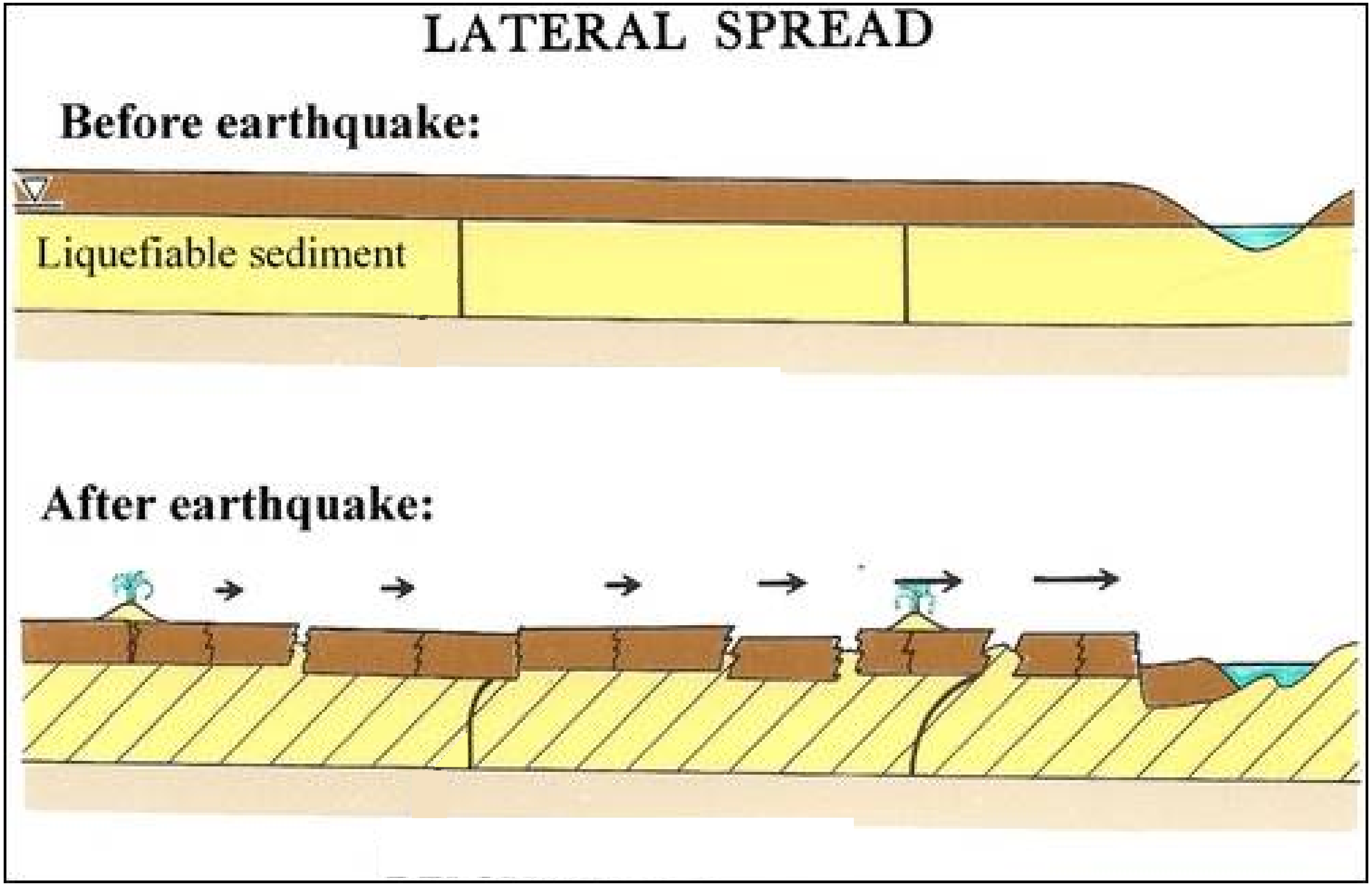


Potential Liquefaction Hazard Zone



Source:
EPA Liquefaction Hazard Map

Lateral Spread a Risk



Lateral Spread a Risk

Mitigation Measures

If this is the problem…

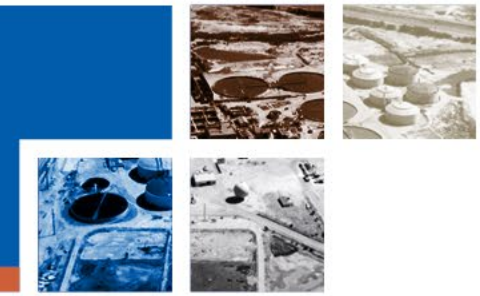
Local Faults

Liquefaction

Lateral Spread

What is the solution?

Structural Mitigation



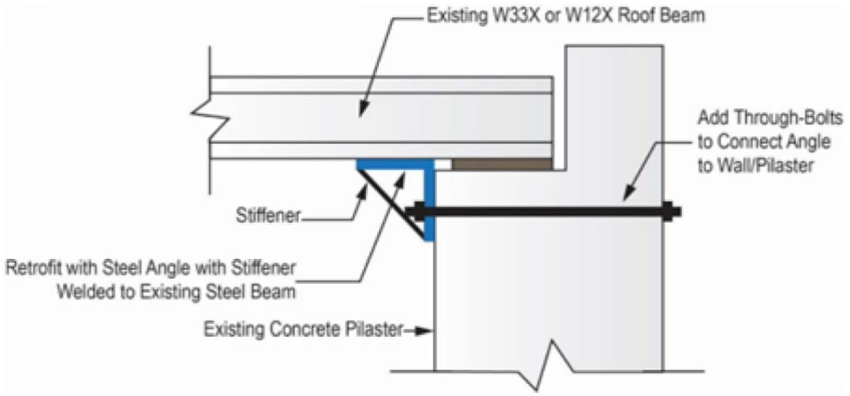
Vulnerability

Separation of the roof element from the wall caused roof to collapse

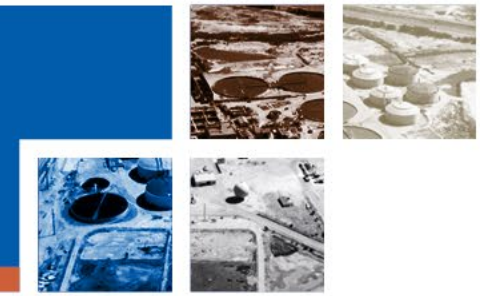
Ref: 1994 Northridge Earthquake. EERI, Earthquake Engineering Research Institute

Mitigation

Installation of wall anchorage



Geotechnical Mitigation



Vulnerability

Soils became liquified during a seismic event, reducing the ground's ability to support loads

Niigata Japan, June 16, 1964
Photo Credit: National Geophysical Data Center

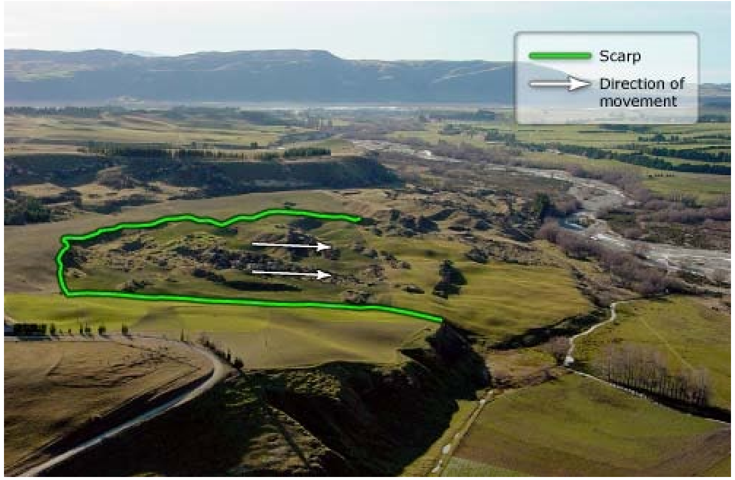
Mitigation

Deep soil mixing is one alternative to stabilize soil by "cementing" the sand particles together

Lateral Spread Mitigation

Vulnerability

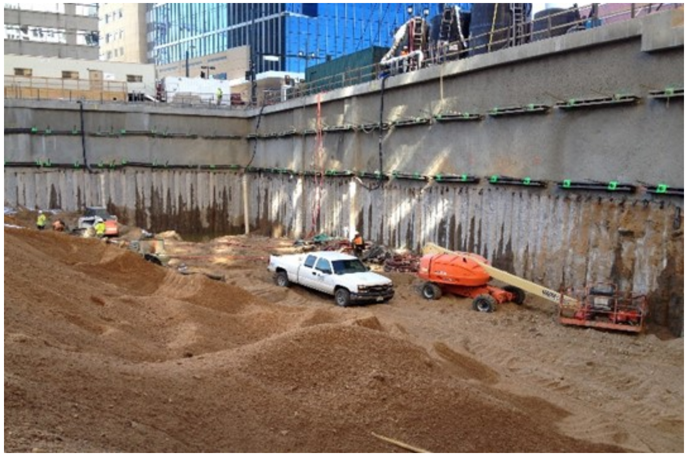
Seismic event causes soil to move laterally towards a free surface of lower elevation (river bed)



Ref: Michael J. Crozier, 'Landslides - Hill country, regolith and submarine landslides', Te Ara - the Encyclopedia of New Zealand

Mitigation

Installation of closely spaced piles effectively creates a “wall” that is designed to resist lateral soil movement



Summary of Seismic Risk Mitigation

63 Structures Evaluated

Designed to older Building Codes that do not consider current seismic performance criteria

48 Structures Identified with Structural and/or Geotechnical Deficiencies

Deficiencies from design code changes that influence loading conditions and building performance during seismic events

16 Structures Impacted by Lateral Spread

Caused by liquefiable soils and vertical separation between the plant sites and the Santa Ana River or Talbert Marsh

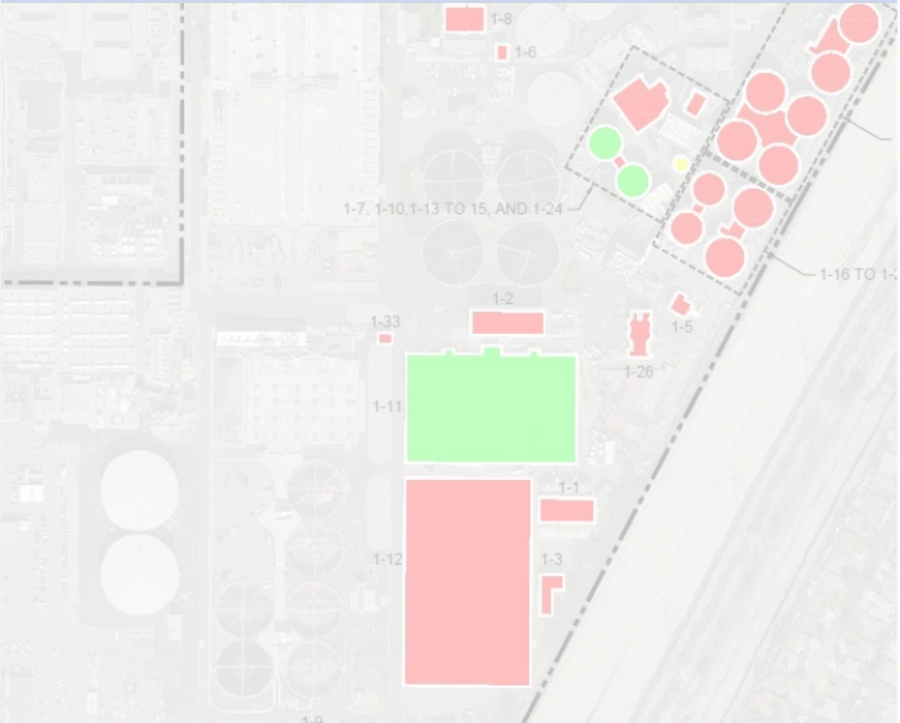
13 Structures Improved Under Planned Projects

Identified in the 2017 Facilities Master Plan; separate seismic projects will be created for other facilities

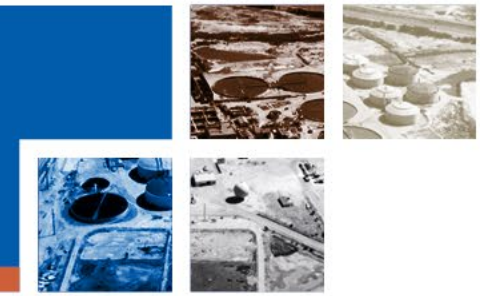
3 Structures Require Complete Replacement

The seismic upgrade costs are greater than the value of the structure

Mitigation Costs	Plant 1	Plant 2
Structural	$25 M	$16 M
Geotechnical	$11 M	$143 M
Lateral Spread	$100 M	$50 M



Recommendations



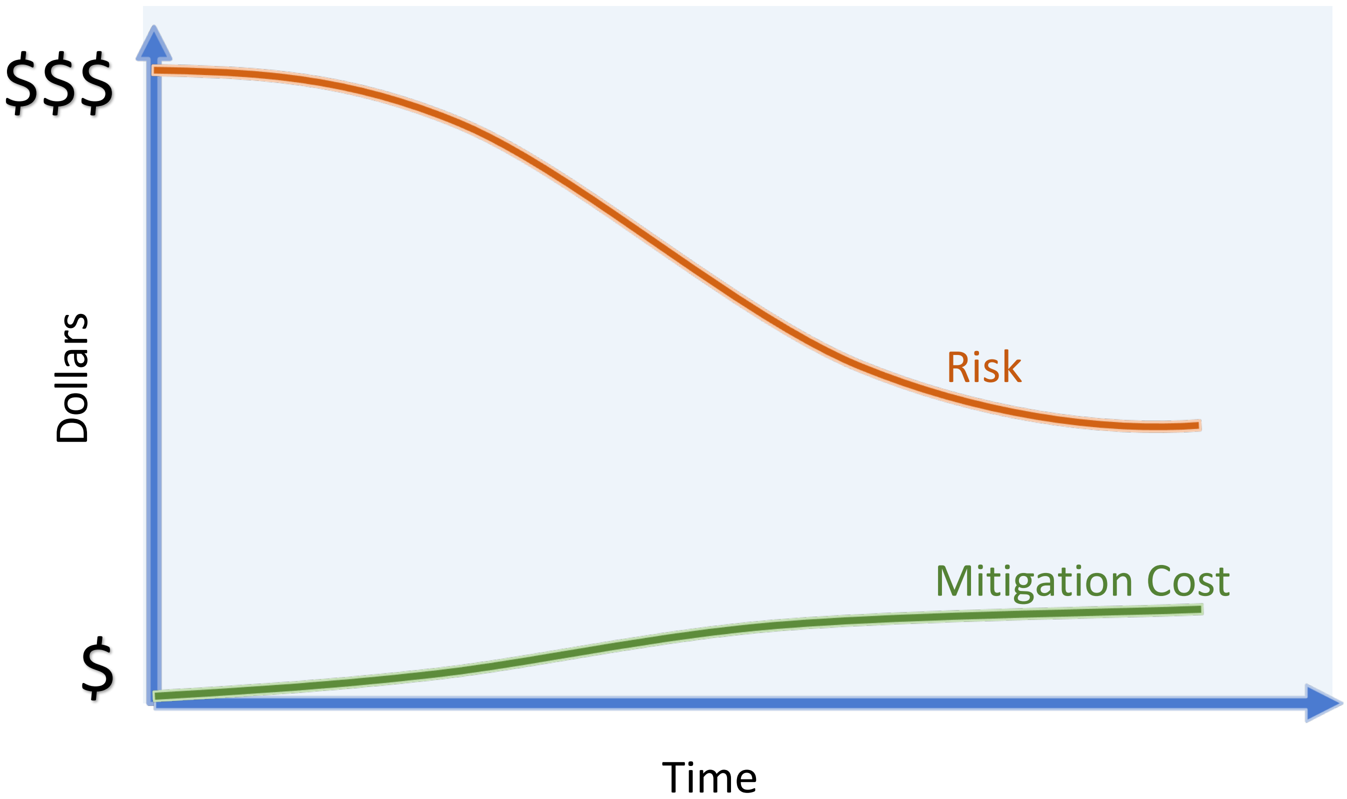
Study Summary

Mitigation Costs	Plant 1	Plant 2
Structural	$25 M	$16 M
Geotechnical	$11 M	$143 M
Lateral Spread	$100 M	$50 M

Budget Proposal

Mitigation Costs	Plant 1	Plant 2
Structural	$25 M	$16 M
Geotechnical	$9 M	$125 M
Lateral Spread	$100 M	$50 M

A Strategic Seismic Program Will Reduce Long-Term Risk



Risks

Replacement costs of critical facilities that may be compromised from a seismic event

Seismic Program

Implementation costs of performing seismic rehabilitation of facilities

Questions?

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