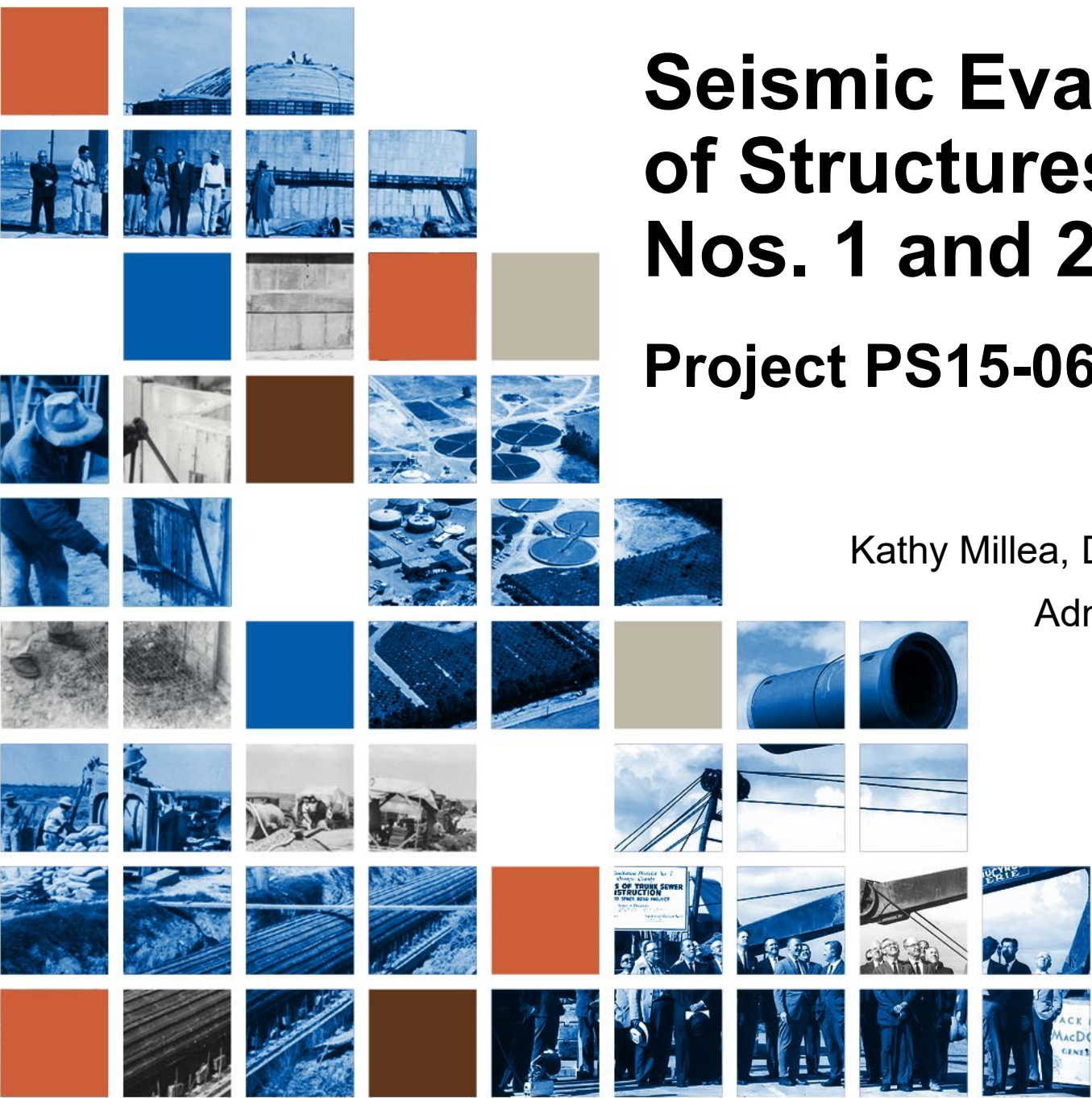


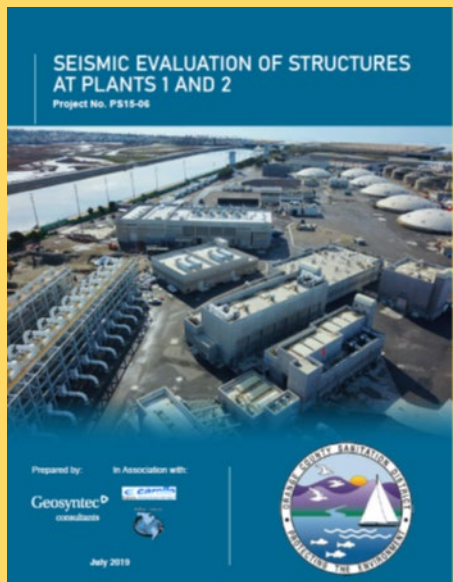
Seismic Evaluation of Structures at Plant Nos. 1 and 2

Project PS15-06

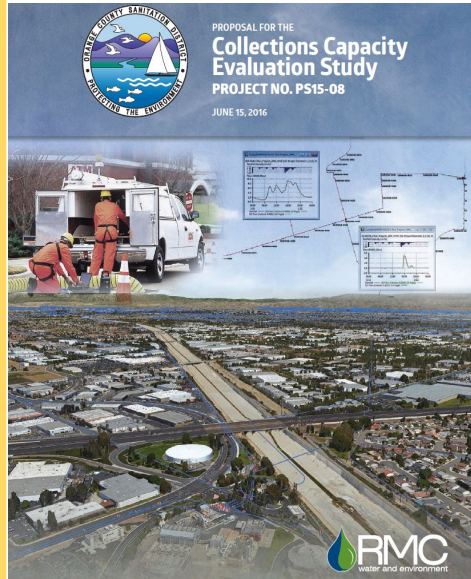
Kathy Millea, Director of Engineering
Administration Committee
May 13, 2020



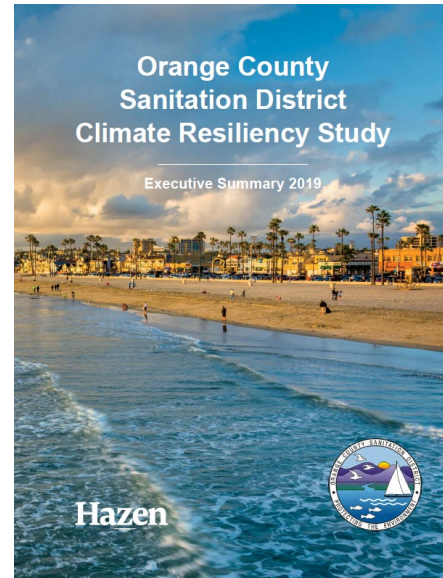
Fostering Resilience at OCSD



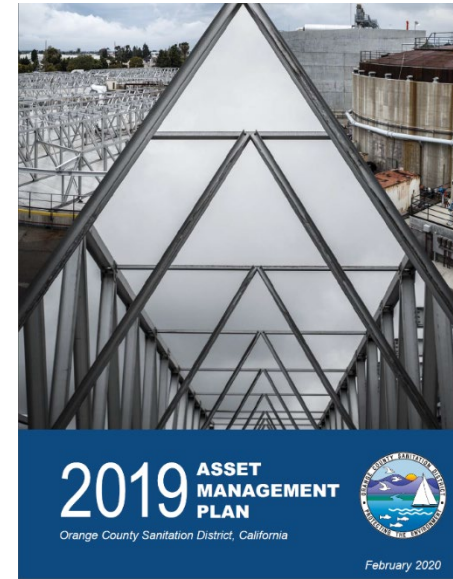
Seismic Evaluation Study



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



1991

Seismic Risk Analysis Plants 1 and 2

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Seismic Risks



Local Faults



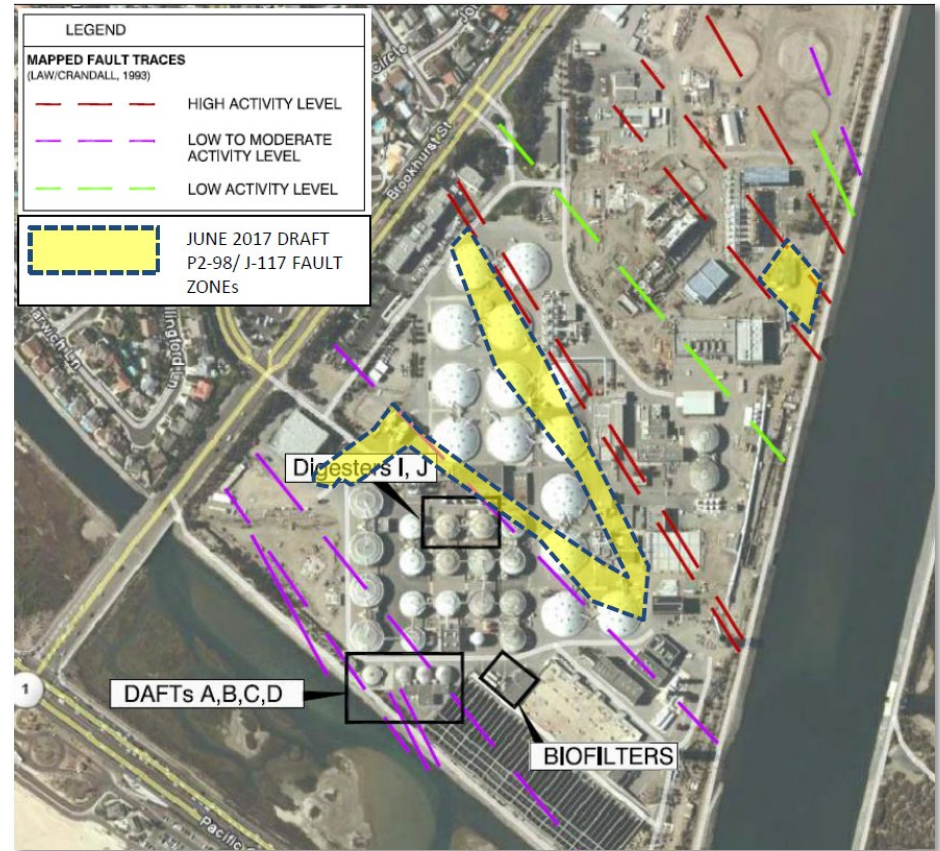
Liquefaction



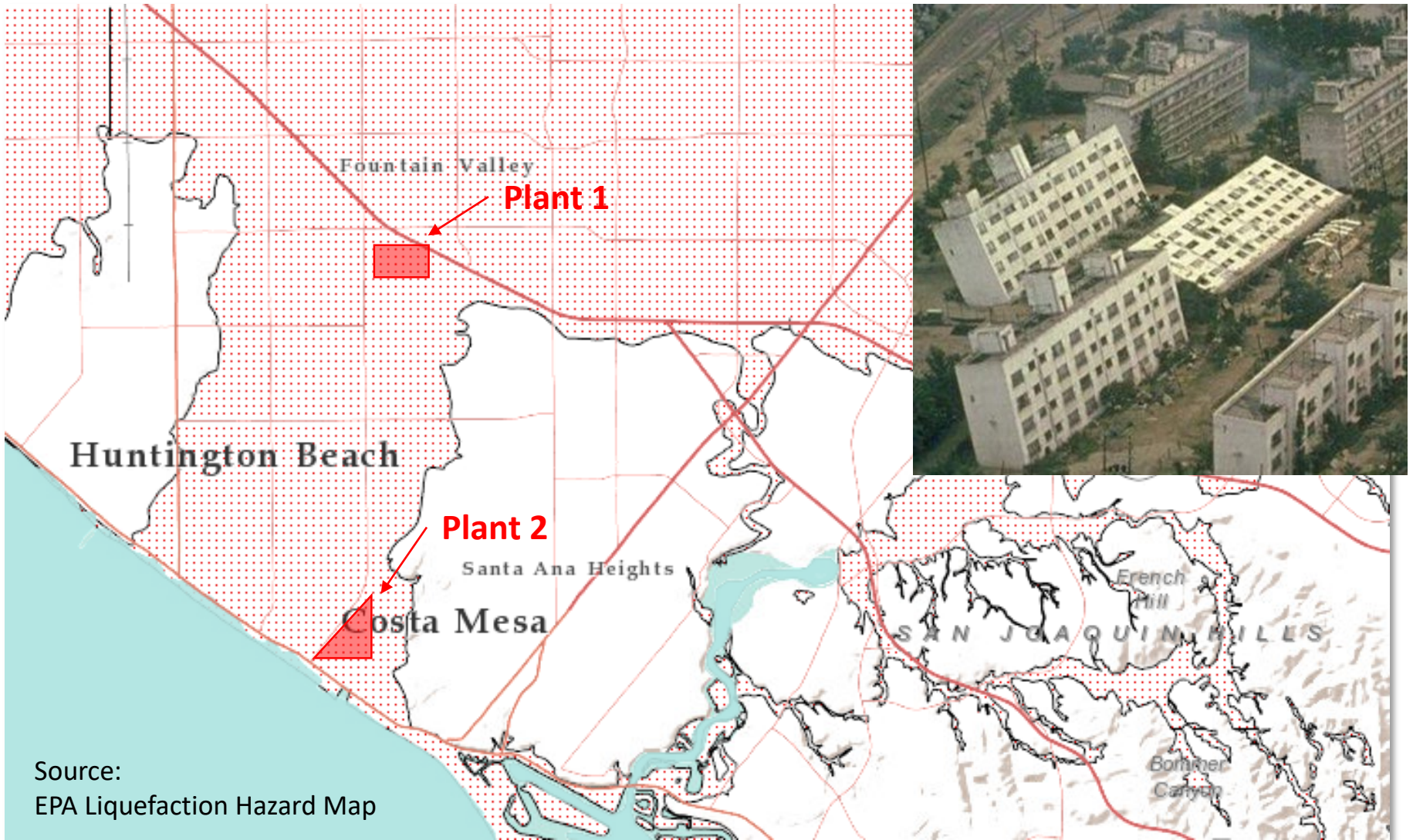
Lateral Spread



Several Local Faults Impact Seismic Hazards



Potential Liquefaction Hazard Zone



Source:
EPA Liquefaction Hazard Map

Lateral Spread a Risk

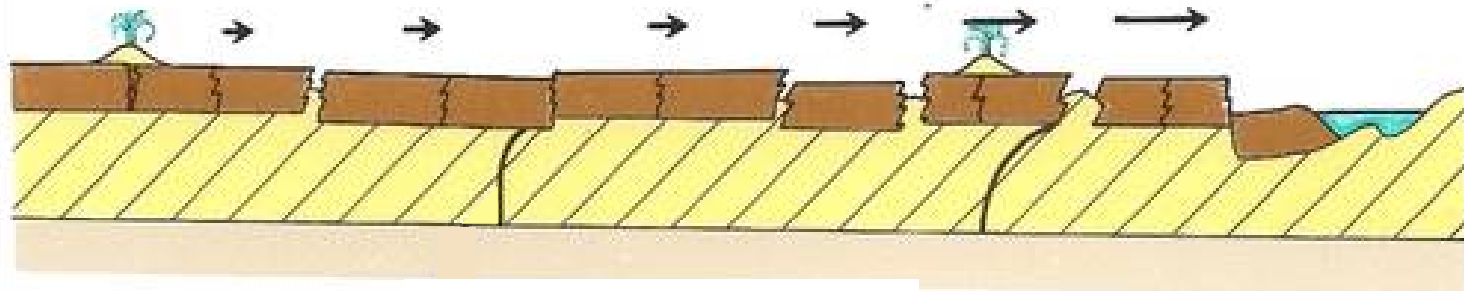


LATERAL SPREAD

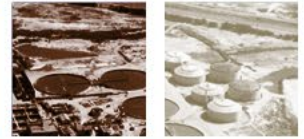
Before earthquake:



After earthquake:



Lateral Spread a Risk



LATERAL SPREAD

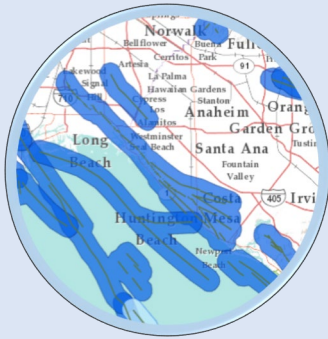


Mitigation Measures



If this is the problem...

Local Faults



Liquefaction



Lateral Spread



What is the solution?

Structural Mitigation



Vulnerability

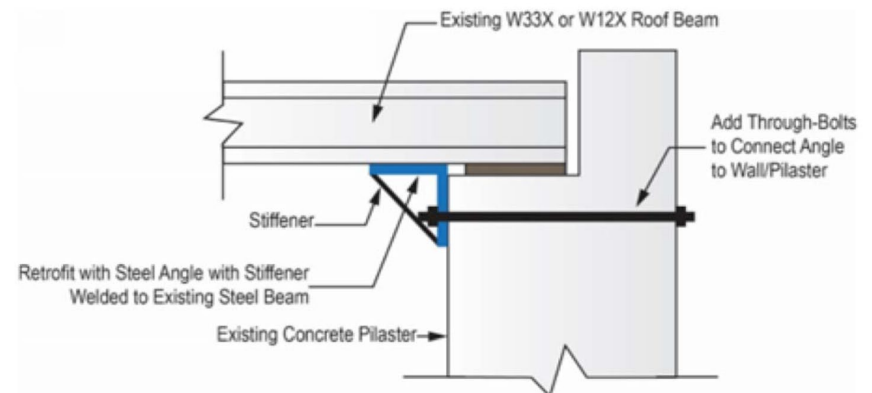
Separation of the roof element from the wall caused roof to collapse



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



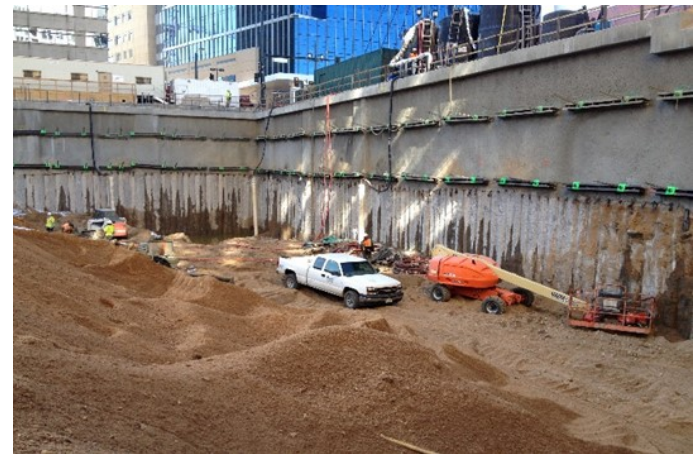
Vulnerability

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



Mitigation

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



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

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

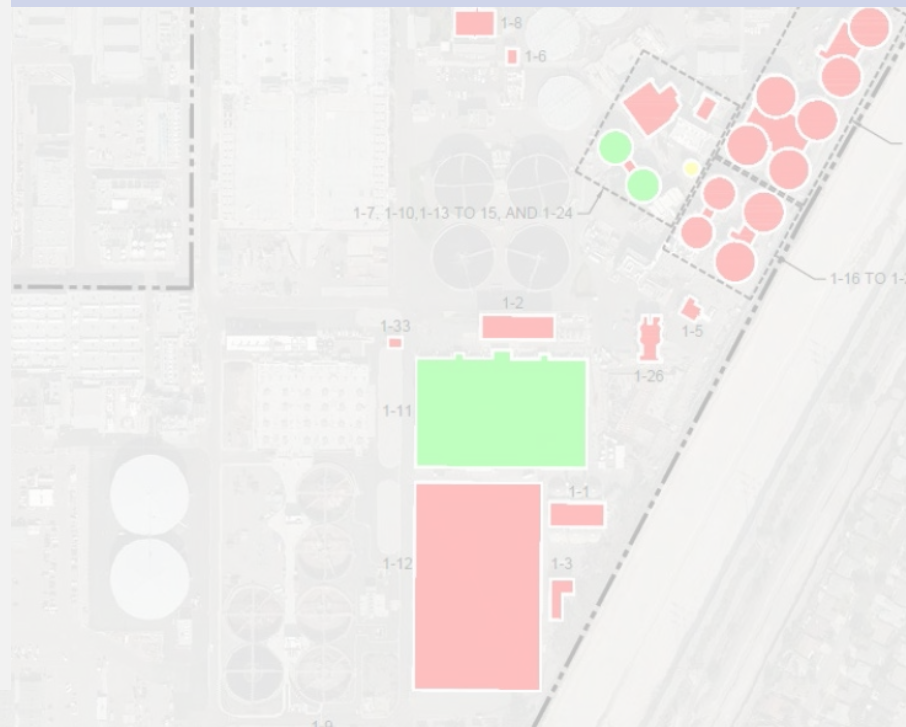
13 Structures Improved Under Planned Projects

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

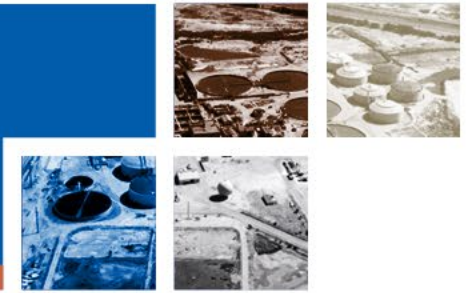
3 Structures Require Complete Replacement

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



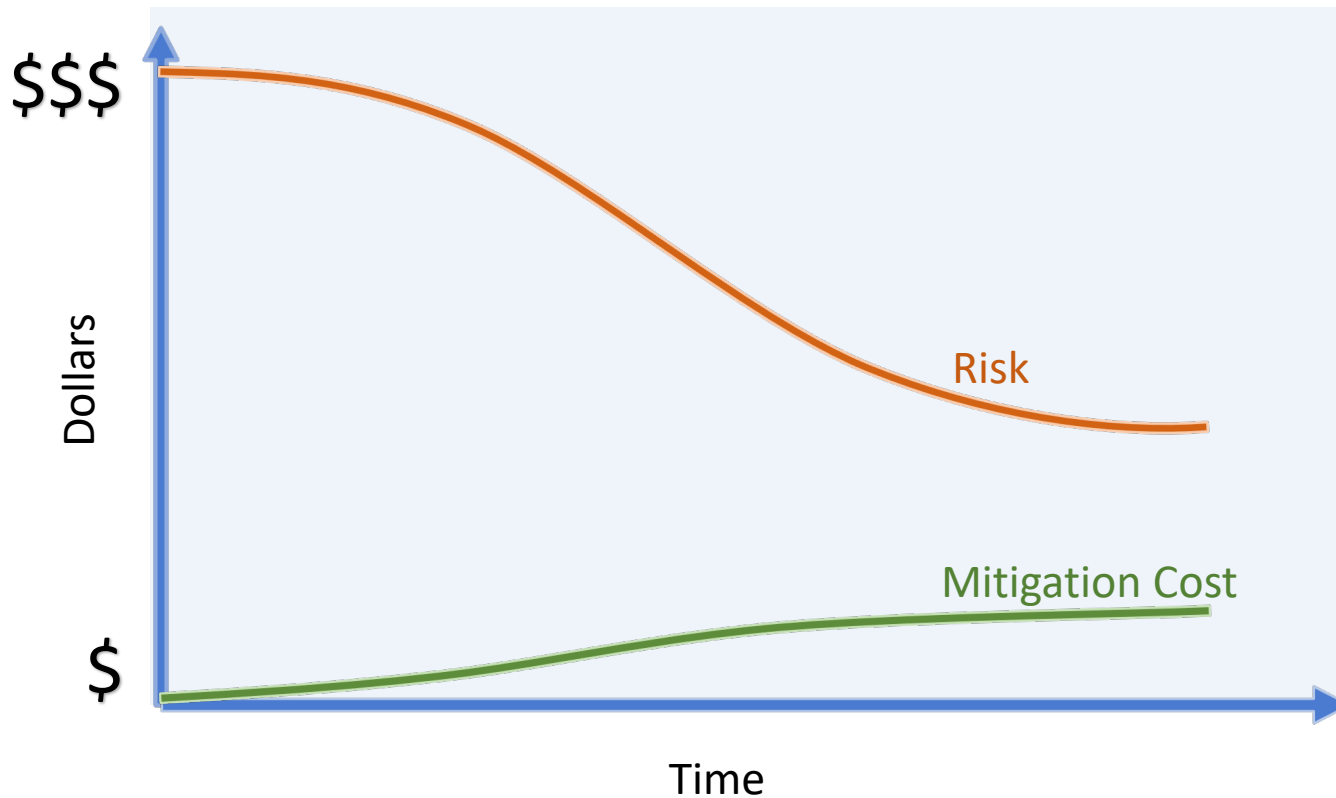
Study Summary

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?

