Informational Presentation
Earthquake Vulnerability Study of the Northern Waterfront Seawall
Progress Update

Port Commission Meeting - October 13, 2015

Steven Reel, Project Manager, Engineering Division
1850s San Francisco near downtown
Great Seawall 1878 - 1915

• Planned in 1870, constructed 1878 to 1915
• Four Miles Long, Located hundreds of feet Bayward of Shoreline
• Created 700+ acres of new land.
160 Years Later

PIER 45

PIER 50
Design & Construction
Choose elevation that has worked well, approximately 8-1/2 feet above Mean Sea Level and 3 feet above the Highest Recorded Tide.
22 Historic Seawall Sections – 1924 Map
B, A, 1, 2, 3, 4, 5, 6, 7, 8a, 8b, 8, 9a, 9b, 9, 10, 11a, 11, 12, 13, 46, 48

55 Combinations of Bulkheads and Wharves
Vulnerability Study Contract Information

Prime Consultant - GHD/GTC Joint Venture
GHD – Multinational Firm, SF Office
GTC – SF LBE Geotechnical Firm
25% LBE Subconsultant Participation Goal
$425,000 Contract
Target Completion early 2016
Vulnerability Study Contract Scope

High Level Screening Approach based on Available Information

Phase 1: Comprehensive Information Review and Evaluation (COMPLETE)

Phase 2: Vulnerability Analysis (UNDERWAY)

Phase 3: Mitigation Alternatives and Recommendations (UNDERWAY)

Peer Review by Separate Contract (PENDING)
Vulnerability Study Contract Scope

• Establish Zone of Influence
• Develop detailed subsurface maps & profiles
• Generate site specific earthquake hazard ground shaking data
• Analyze rock dike for stability and upland areas for lateral spreading and settlement
• Structural analysis of select bulkhead walls and wharves
Vulnerability Study Contract Scope

• Map utilities and assess impacts
• Assess post earthquake flood hazards
• High level economic impact analysis
• Develop conceptual level mitigation measures
• Rank and prioritize areas for mitigation and/or detailed investigation
Zone of Influence – Study Boundary
Subsurface Mapping – Artificial Fill Thickness
Subsurface Mapping – Artificial Fill Thickness
Subsurface Mapping – Young Bay Mud Thickness
Subsurface Mapping – Bedrock Elevation
Subsurface Mapping – Bedrock Elevation
Representative Sections
Section B - Vicinity of Pier 43
Representative Sections
Section 1 - Vicinity of Pier 39
Representative Sections
Section 3 - Vicinity of Pier 29
Representative Sections
Section 7 - Vicinity of Pier 3
Representative Sections
Section 8b - Vicinity of Ferry Building
Representative Sections
Section 9a – Vicinity of Howard St.
Representative Sections
Section 12 – Vicinity of Pier 38
Representative Sections
Section 46 – Vicinity of AT&T Park
Structural Sections

Bulkhead Wall & Wharf – Pier 9 Area
Structural Sections

Bulkhead Wall & Wharf – Pier 17 Area
Structural Sections
Bulkhead Wall & Wharf – Pier 26 – 28 Area
Structural Sections
Bulkhead Wall & Wharf – Pier 38 Area
USGS WORKING GROUP ON CALIFORNIA EARTHQUAKE PROBABILITIES 2014 UPDATE

72% PROBABILITY OF MAJOR EARTHQUAKE BY 2044

<table>
<thead>
<tr>
<th>Magnitude (greater than or equal to)</th>
<th>Average repeat time (years)</th>
<th>30-year likelihood of one or more events</th>
<th>Readiness</th>
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<td>5</td>
<td>1.3 (0.7)</td>
<td>100% (1.0)</td>
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<td>6</td>
<td>8.9 (1.0)</td>
<td>98% (1.0)</td>
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<tr>
<td>6.7</td>
<td>29 (1.1)</td>
<td>72% (1.1)</td>
<td>1.1</td>
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<td>7</td>
<td>48 (0.9)</td>
<td>51% (1.3)</td>
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<td>7.5</td>
<td>124 (0.7)</td>
<td>20% (1.6)</td>
<td>0.9</td>
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<tr>
<td>8</td>
<td>825 (0.7)</td>
<td>4% (1.9)</td>
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1906 vs 1989 Loma Prieta Earthquake
Ground shaking recorded in Germany

Comparison of 1906 and Loma Prieta records at Gottingen, Germany

[Graph showing seismic waves for 1906 and Loma Prieta earthquakes]
Figure 3-20: Trend of Ground Surface Spectral Acceleration at 0.2-second Period with Average Return Period.
Next Steps

• Complete Initial Draft of Vulnerability Results, end of 2015
• Peer Review, end of 2015
• Final Draft of Results & Recommendations early 2016
• Inform efforts to improve resiliency, Waterfront Land Use Plan Update, and Climate Change Planning
QUESTIONS