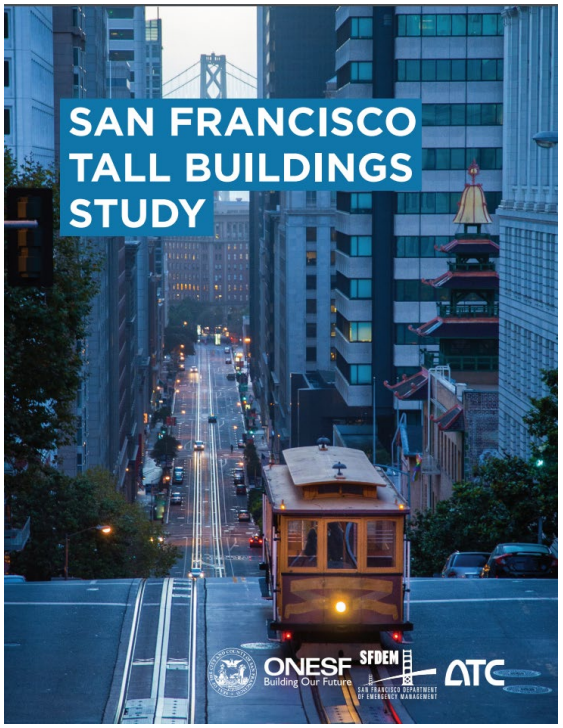
TALL BUILDINGS SAFETY STRATEGY

Project Objective and Scope

Examine the earthquake performance of San Francisco's tall buildings and develop recommendations to address building code requirements, policies and practices for the design of new buildings, assessment and retrofit of existing buildings, and post-earthquake inspection and response to promote the earthquake resilience of San Francisco

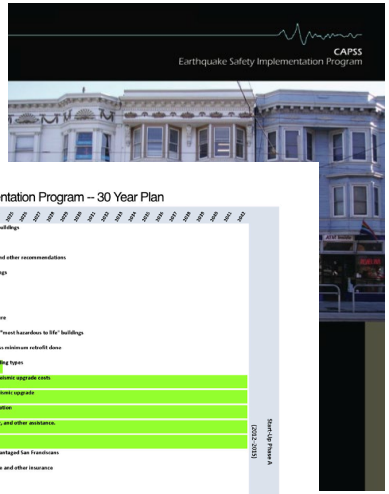
- Project initiated August 2017
- Summary Recommendations released

  October 4, 2018
- Final Report released January 2019
  http://onesanfrancisco.org/resilient-sf
- Compiled by experts pulled from the Applied Technology Council
- Under the direction of City Administrator, DEM, DBI, SFPUC, and Chief Resilience Officer

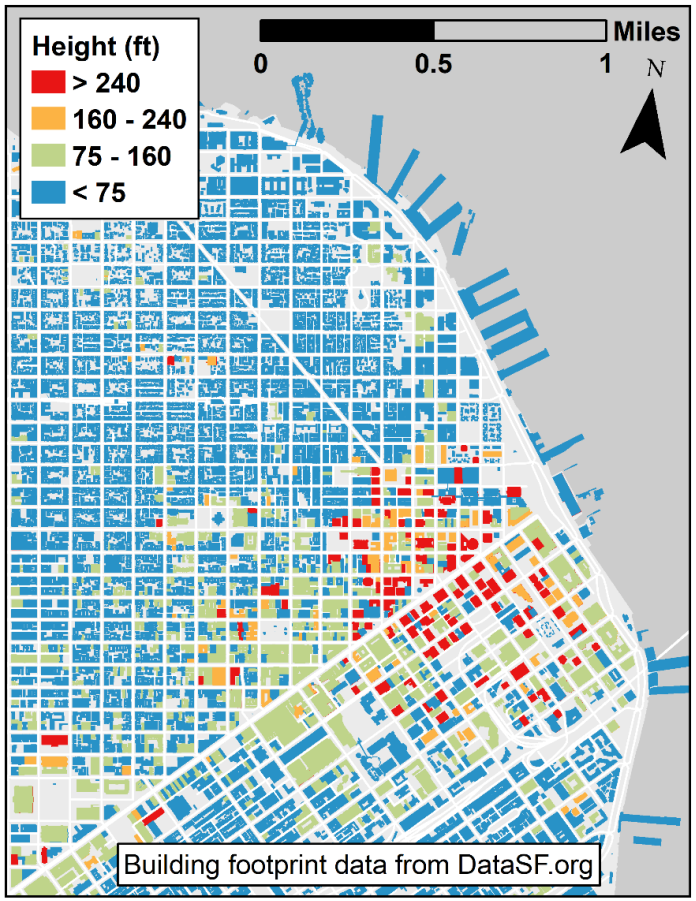


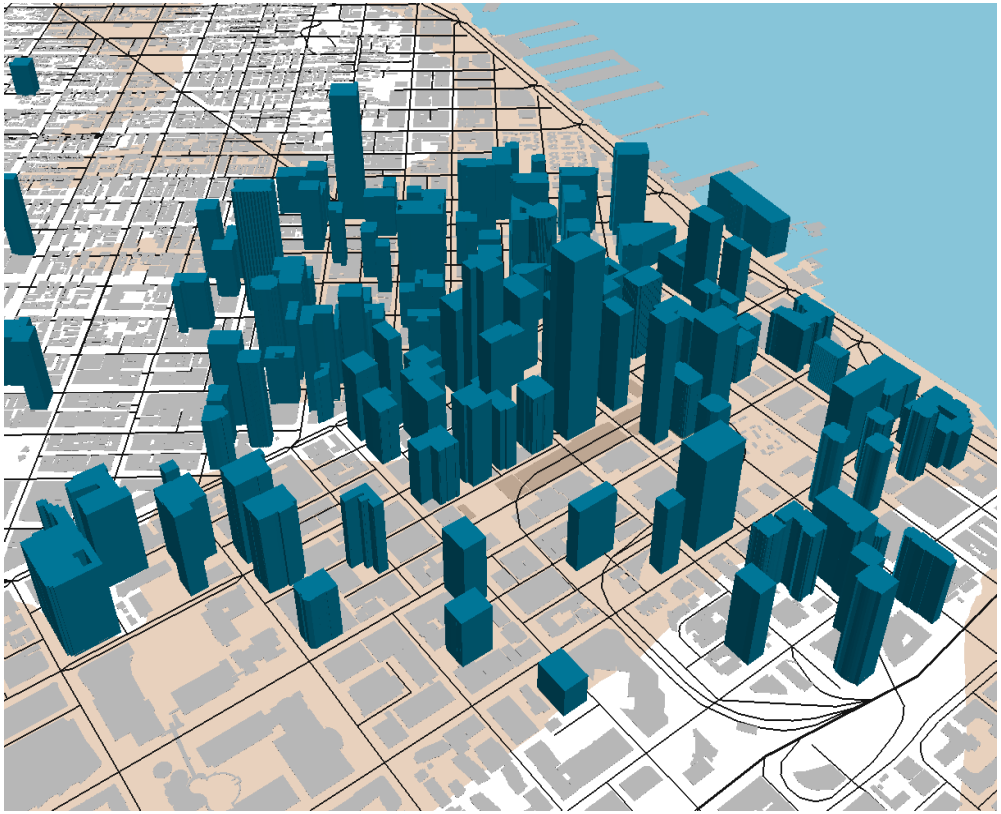
Motivation

- Growth in residential uses in the area
- Unique challenges associated with high-rises
- Economic impact
- 2011- 2040 CAPSS Work-plan
  - Plans and programs for all buildings
  - Mandatory evaluation, retrofit
  - Enhance building performance standards
- ResilientSF
- Feasibility varies for some building subsets
  - Tall buildings
  - Similarly complex or recovery-critical buildings



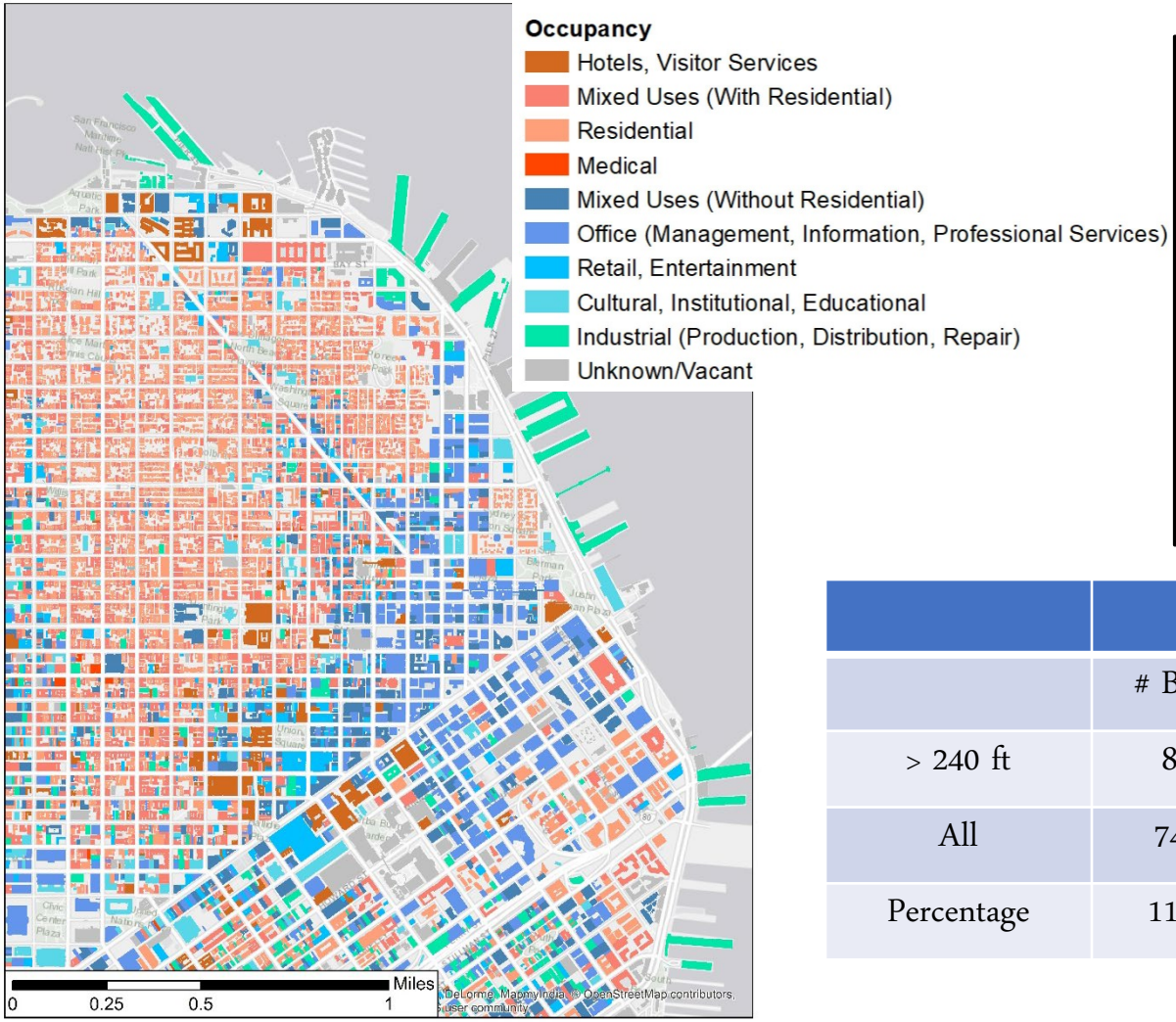
Database of Tall Buildings





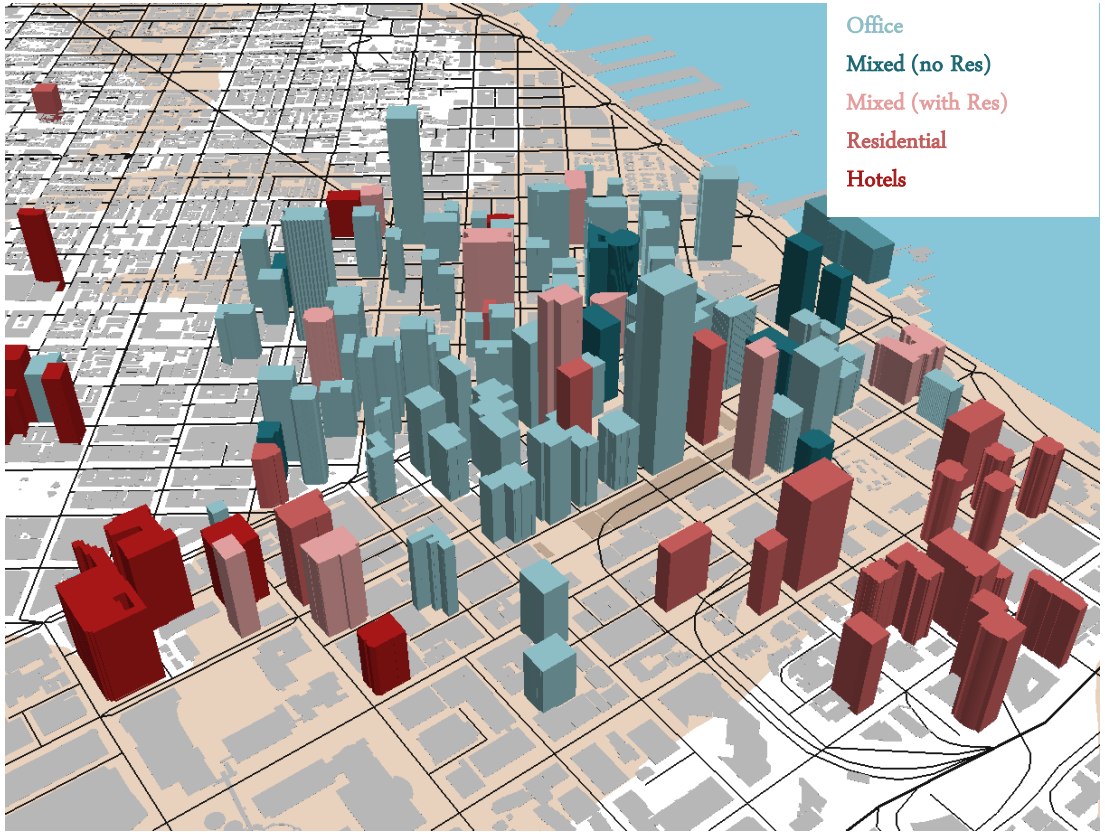
156 Tall Buildings (Over 240 ft)

Building Stock: Districts 3 & 6



	Office		Residential	
	# Bldg	Sq.Ft	# Bldg	Sq.Ft
> 240 ft	86	40M	29	20M
All	749	70M	3,949	50M
Percentage	11%	64%	1%	33%

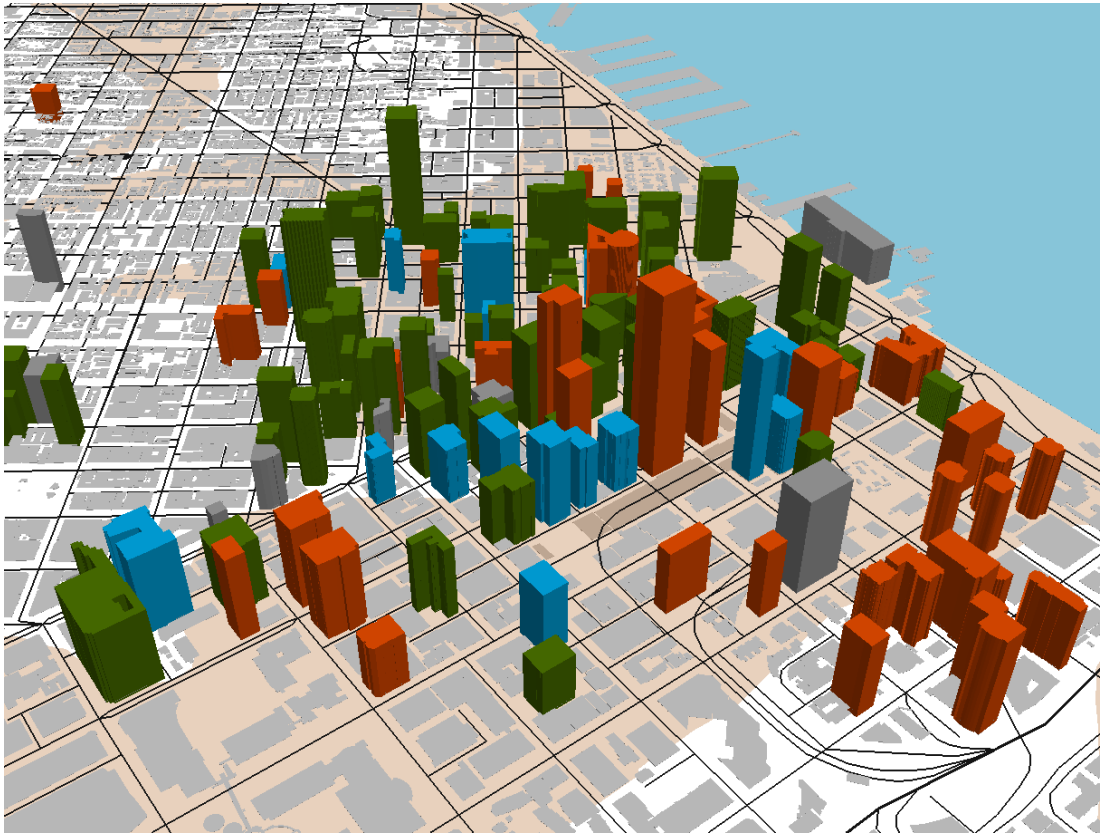
Occupancies



	CIE	Hotel	MixRes	Mixed	Office	Res
<1960	1	3	0	0	15	1
1960s	0	3	2	0	16	9
1970s	0	4	0	3	17	1
1980s	0	5	4	4	20	0
1990s	0	2	1	1	4	1
2000s	0	1	1	0	5	8
>2010	0	0	3	0	7	14

- 55% office; 22% residential; 24% mixed/hotel
- Older buildings are mostly offices (Steel moment frames)
- Newer buildings (south of Market) tend to be residential (Concrete shear wall systems)

Building Structural Systems



Structural System

- [Steel] Moment Frame - Perimeter
- [Steel] Moment Frame - Space
- [RC] Shear Wall
- [Dual] Shear Wall + RC Moment Frame
- [Dual] Shear Wall + Steel Moment Frame
- [Dual] Shear Wall + BRB
- [Dual] Braced Frame - Eccentric
- [Dual] Braced Frame - Concentric and Eccentric
- [Dual] Braced Frame - Concentric
- Unknown

- The newer buildings (south of Market) tend to be concrete shear wall systems
- Older buildings are predominantly steel moment frame systems

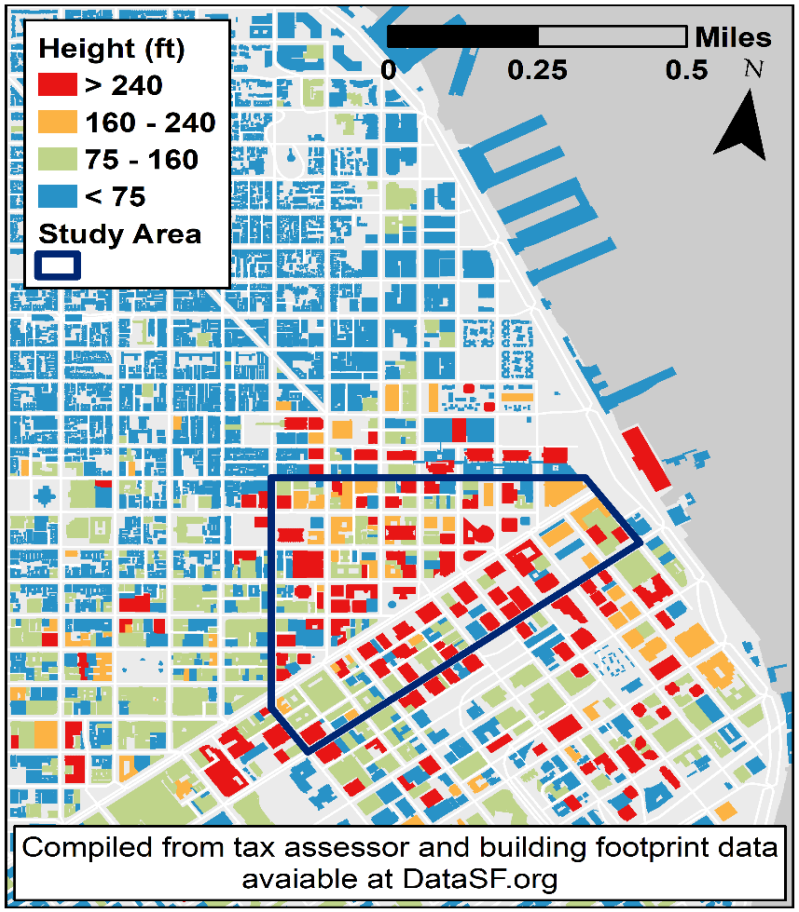
Building Foundations

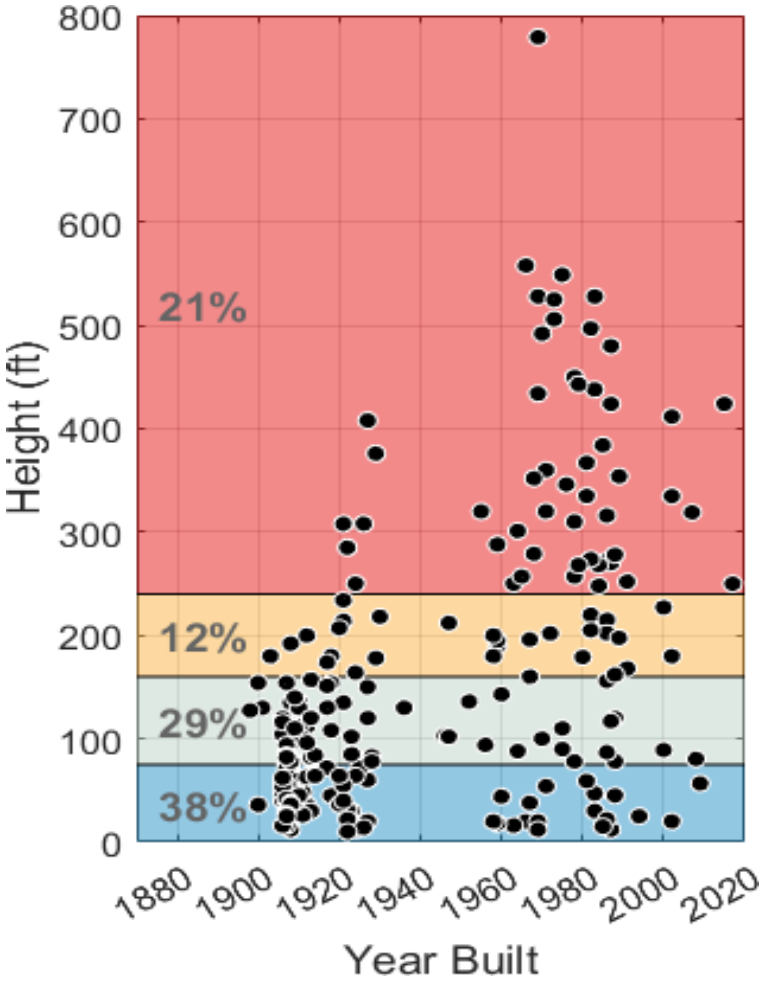
Factors of Influence

1. Depth to rock
2. Soil Type/Stiffness
   - *Marine Deposits*
   - *Colma Sands*
   - *Old Bay Clay*
3. Building Height/Weight
4. Number of Basement Levels
5. Slope/Proximity to Shoreline
6. Adjacent/Underlying Structures
7. Ground Water Level

Plus, construction technologies, logistics and economics

Downtown Recovery Plan





Summary Recommendations & Next Steps

Recommended Action	SHORT-TERM	MID-TERM	LONG-TERM
1. Actions for Reducing Seismic Risk Prior to Earthquakes – New Buildings			
1A. Develop Regulations to Address Foundation and Geotechnical Issues			
• Training and checklist	X		
• Develop Geotechnical Regulations		X	
1B. Establish Performance-Based Seismic Design Standards			X
2. Actions for Reducing Seismic Risk Prior to Earthquakes – Existing Buildings			
2A. Enforce the Repair Provisions of the San Francisco Existing Building Code with Respect to Loma Prieta Damage		X	
2B. Amend the San Francisco Existing Building Code			
• Alteration triggers	X		
• Acquisition triggers		X	
2C. Require Minimum Levels of Earthquake Insurance to Ensure Recovery			X
2D. Increase Local Water Supply for Automatic Fire Suppression Systems in Tall Buildings		X	

Mayor's Executive Directive

- Conduct community outreach to inform City stakeholders about the Tall Buildings Safety Strategy.
- Develop additional regulations to address **geotechnical issues**
- Explore adopting **higher seismic design standards**

Summary Recommendations & Next Steps

Recommended Action	SHORT-TERM	MID-TERM	LONG-TERM
3. Actions for Reducing Seismic Risk Following Earthquakes			
3A. Develop New Policies and Procedures for Implementing the State's Safety Assessment Program	X		
3B. Extend and Improve the Building Occupancy Resumption Program			
• Conduct simulation-based training	X		
• Update procedures	X		
• Extend program		X	
3C. Clarify and Update Roles and Responsibilities Associated with Post-Earthquake Emergency Response and Safety Inspection	X		
3D. Update and Amend the San Francisco Existing Building Code		X	
3E. Update Administrative Bulletin 099 and Clarify its Application to Tall Concrete Structural Systems			X
3F. Develop a New Administrative Bulletin for Post-earthquake Inspection and Evaluation of Welded Steel Moment Frames			X
3G. Create Protocols and Procedures for Establishing Cordons Around Damaged Buildings	X		
3H. Require Existing Buildings to File Recovery Plans			X
4. Actions to Improve the City's Understanding of its Tall Building Seismic Risk			
4A. Maintain and Expand the Database of Tall Buildings	X		
4B. Develop a Comprehensive Recovery Plan for the Financial District and Adjacent Neighborhoods			X

Mayor's Executive Directive

- Update the policies and procedures for implementing the **State's Safety Assessment Program** and clarify department roles and responsibilities for post-earthquake emergency response and safety inspection.
- Establish a **Disaster Recovery Taskforce** that will develop a recovery framework and a comprehensive **recovery plan for the Financial District** and adjacent neighborhoods.
- Provide information and knowledge sharing with other cities facing similar seismic challenges that are home to tall buildings

Thank You!

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