STRONGER HOUSING, SAFER COMMUNITIES

STRATEGIES FOR SEISMIC & FLOOD RISKS

A MANUAL FOR LOCAL GOVERNMENTS

March 2015

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A special thanks to all participants in our workshop series who assisted with the development of the strategies

This project was generously funded by:

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ABAG Publication # P15002EQK

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ACRONYMS AND ABBREVIATIONS

ABAG	Association of Bay Area Governments
AIA	American Institute of Architects
APA	American Planning Association
ASCE	American Society of Civil Engineers
ATC	Applied Technology Council
BayREN	Bay Area Regional Energy Network
BART	Bay Area Rapid Transit
BCDC	Bay Conservation and Development Commission
BFE	Base Flood Elevation
CALBO	California Building Officials
CalTrans	California Department of Transportation
CBC	California Building Code
CEA	California Earthquake Authority
CGS	California Geological Survey
CoC	Communities of Concern
CRC	California Residential Code
CRS	Community Rating System
CSLB	Contractors State License Board
CSSC	California Seismic Safety Commission
DWR	California Department of Water Resources
EIR	Environmental Impact Report
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Association
FIRM	Flood Insurance Rate Map
GHZ	Geologic Hazard Zone
HCD	California Department of Housing and Community Development
HUD	Housing and Urban Development
IEBC	International Existing Building Code
JPC	Joint Policy Committee
LHMP	Local Hazard Mitigation Plan
LID	Low Impact Development
LOS	Level of Service

MHHW	Mean Higher High Water
MMI	Modified Mercalli Intensity
MTC	Metropolitan Transportation Commission
NABCEP	North American Board of Certified Energy Professionals
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
PACE	Property Assessed Clean Energy
PDA	Priority Development Area
PUD	Planned Unit Development
SEAOC	Structural Engineers Association of California
SEAONC	Structural Engineers Association of Northern California
SB 375	Senate Bill 375
SFHA	Special Flood Hazard Area
SGC	Strategic Growth Council
SPUR	San Francisco Planning and Urban Research
TDR	Transfer of Development Rights
TOD	Transit Oriented Development
UASI	Urban Area Security Initiative
ULI	Urban Land Institute
URM	Unreinforced Masonry
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

CHAPTER 1

HOW THIS MANUAL CAN BENEFIT YOUR COMMUNITY

The reason for this manual

This manual was written to make the strategies developed for ABAG and BCDC's Housing and Community Multiple Hazard Risk Assessment Project accessible and usable for local jurisdictions throughout the Bay Area. It is a resource to support action at multiple levels to address seismic and flooding vulnerabilities in the Bay Area. While we continue to learn about risks in the Bay Area, we know actions that can happen now to help the region become more resilient in the face of earthquakes and flooding.

Who should use this manual

This manual is primarily geared to be easily understood by local jurisdiction staff, elected officials, policy makers, and other local decision-makers who are in the position to implement the strategies laid out within. Community groups, local leaders, and residents may also advocate for these strategies to their leaders.

What you can learn from this manual

This manual is designed for the user to quickly and easily:

- Gain an understanding of the vulnerabilities considered and the strategies aimed at reducing them
- Decide which strategies are most applicable to your jurisdiction
- Learn how to gain a high level understanding of each strategy's aims for quick and easy policy-level decision making
- Gain information on how to implement each strategy in a meaningful, in-depth way

CHAPTER 2

AN INTRODUCTION TO HOUSING AND COMMUNITY VULNERABILITY

Housing and Community Vulnerability

The strategies presented in this manual are designed to respond to specific vulnerabilities identified and analyzed for the Bay Area through the Housing and Community Multiple Hazard Risk Assessment Project. The project conducted a region-wide vulnerability analysis for three types of natural hazards, nine fragile housing types, and ten community vulnerability indicators.

Table 2-1: Description of Hazards used in the Vulnerability Analysis

Hazard	Description
Ground Shaking	MMI VIII or above, from expected ground shaking from a M7.8 (San Andreas fault) M6.9 (Hayward fault)
Liquefaction	Moderate Hazard
	High Hazard
Flooding	Current 100-year flood zone
	Future, sea level rise = 24”
	Future, sea level rise = 36”
	Future, sea level rise = 48”

Hazards

The vulnerability analysis considered three hazards: ground shaking, liquefaction, and flooding. The specific hazard scenarios used in the analysis are summarized in Table 2-1 at left.

Different earthquakes cause different levels of ground shaking throughout the region. We selected shaking scenario maps from two previously modelled earthquake scenarios – a Magnitude 7.9 scenario on the San Andreas Fault and a Magnitude 7.0 scenario on the

Hayward fault – and determined areas likely to experience ground shaking hazard levels of MMI VIII or above in these scenarios. The ground shaking hazard analysis only includes homes that are likely to be exposed to MMI VIII and greater ground shaking, as they are the most likely to be significantly damaged, thus displacing residents.

Liquefaction hazard levels were determined based on liquefaction susceptibility combined with shaking intensity (MMI). For the purpose of this project, moderate or high liquefaction hazard areas were examined using MMI from the future earthquake shaking scenario maps for the two scenarios outlined above (a San Andreas or Hayward event), as they are the most likely to cause major building damage that displaces residents from their homes.

Any amount of flooding has the potential to displace residents from their homes, as even short duration flooding can undermine building structures or create unsafe living conditions due to mold growth and contamination. Current flooding scenarios are based on published National Flood Insurance Program (NFIP) rate maps.

Future flooding scenarios are based on three regional inundation maps developed by NOAA Coastal Services Center. These three inundation maps are used to represent future flooding from different combinations of sea level rise and tide levels.

Key Considerations

Hazards can have significant impacts on communities that live in high hazard areas

Much of the Bay Area is exposed to natural hazards that have the potential to cause significant impacts on the region and its residents. Seismic events may cause ground shaking or liquefaction, and many shoreline areas are vulnerable to existing flooding and may experience increased flooding in the future due to sea level rise.

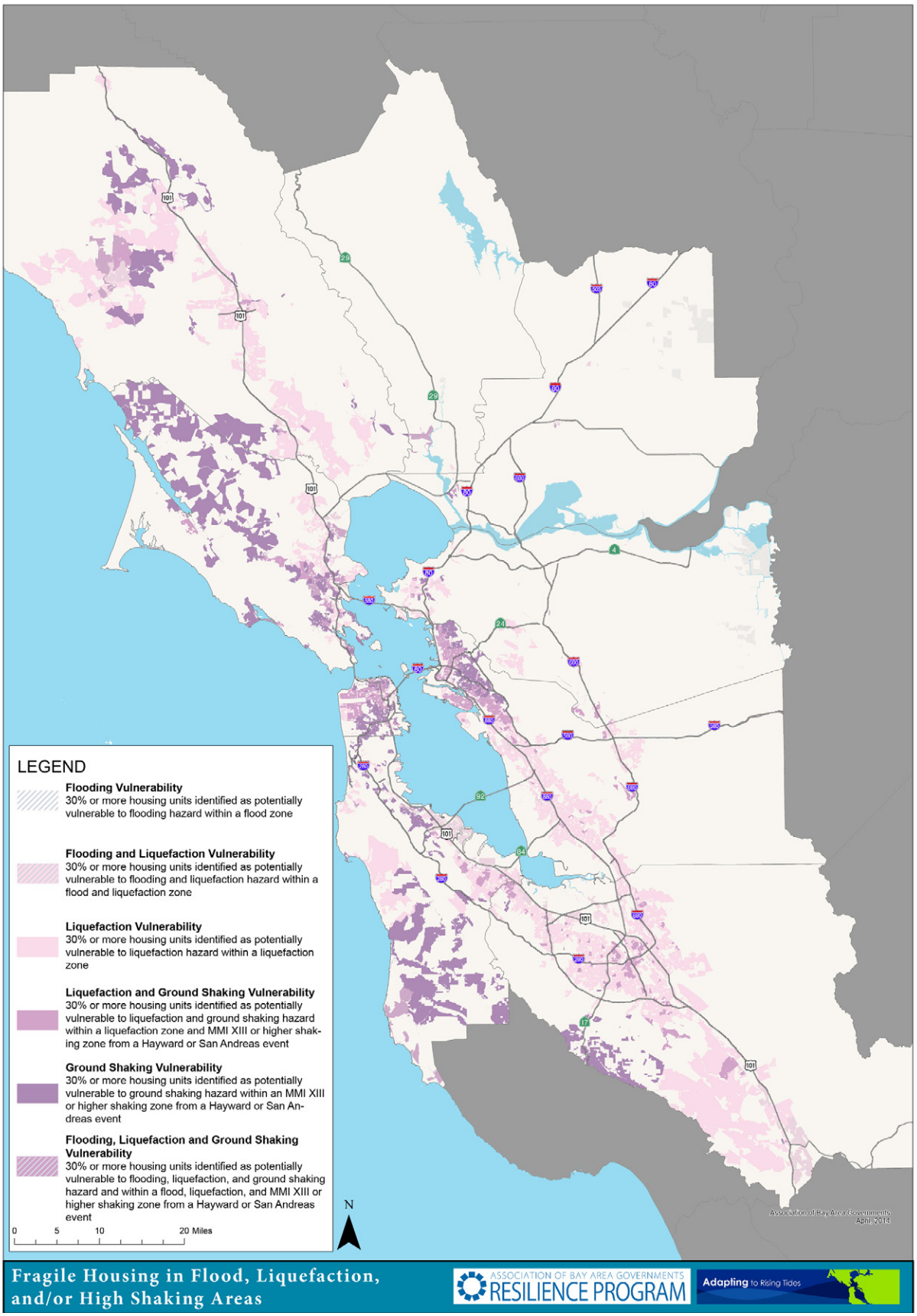
Housing Vulnerability

Regional housing vulnerability was determined based on the eight potentially fragile building types commonly found in the Bay Area. The presence of vulnerable housing is indicated if 30% or more of housing units in a block group are a fragile housing type located in an area of ground shaking, liquefaction, or flooding hazard.

Table 2-2: Indicators of Fragile Housing

Hazard Type	Fragile Housing Type
Ground Shaking MMI XIII or above	Hillside
	Single family cripple wall
	Single family house over garage
	Unreinforced masonry
	Multi-family cripple wall
	Multi-family weak story or open front
	Multi-family non-ductile concrete
Moderate Liquefaction Hazard	Insufficient foundation to withstand liquefaction, e.g., less than 10 floors
High Liquefaction Hazard	
Current flood zone	All housing types
Future flooding with sea level rise	

BAY AREA HOUSING AND COMMUNITY MULTIPLE HAZARD RISK ASSESSMENT



Fragile Housing in Flood, Liquefaction, and/or High Shaking Areas

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Adapting to Rising Tides

Housing is generally built to life safety standards rather than shelter-in-place standards

The fragile housing typology is designed to identify subsets of the Bay Area housing stock that are likely to possess characteristics that increase their vulnerability. This method identifies only what are deemed as the most fragile common housing structure types found within the Bay Area due to likely poor structural performance in an earthquake (i.e., those conditions most likely to cause housing to be red-tagged, requiring either demolition or extensive and lengthy repairs). This method considers critical combinations of material, system, etc. that indicate high fragility. As key data such as structure type (wood frame, concrete, etc.) is not widely available, proxies such as size, age, number of stories, and location that are associated with the most common fragile housing types are used. As different hazards interact with building types differently, hazards including liquefaction, ground shaking, and flooding are examined separately.

Each fragile housing type was mapped at the block group level to identify block groups with the characteristic combinations associated with each fragile housing type. Only block groups exposed to the identified hazard level for ground shaking, liquefaction, and flooding are flagged; vulnerability is a combination of exposure and fragility.

Key Considerations

Ground shaking can damage cripple wall and house-over-garage single-family homes

Many established residential neighborhoods have single-family homes that could be significantly damaged during an earthquake. These include homes with short unreinforced walls that raise the first floor 1-5 feet above ground level (i.e., cripple walls) and those that are two or more stories with garages or other large openings on the first floor. Renters and owners of single-family homes that are not retrofitted may be displaced from their existing neighborhood and could have a difficult time rebuilding or finding a replacement home.

Ground shaking can damage weak story, concrete and cripple wall multi-family housing

There are a number of multi-family housing types that can be significantly damaged if not properly retrofitted. This includes those with parking or retail on the ground floor (i.e., weak story or open front), those built from concrete that is not properly reinforced (i.e., non-ductile), or those that have short unreinforced walls that raise the first floor 1-5 feet above ground level (i.e., cripple walls). Depending on the number of units, damage to multi-family housing can displace a large number of residents, many of who are likely renters. In addition, multi-family housing does not always receive an equitable share of state or federal financial and technical assistance during recovery efforts and therefore may not always be rebuilt in a timely manner.

Housing is generally built to life safety standards rather than shelter-in-place standards

The current building code is designed to a life safety standard to protect occupant lives during an earthquake event. Newly constructed housing built to life safety standards can still be significantly damaged during an earthquake, displacing residents while the structure is repaired or replaced. The result is that some residents will not be able to shelter-in-place or remain in their homes, and that extensive repairs or rebuilding may be required.

Most foundations cannot withstand liquefaction

Homes located where soils are susceptible to liquefaction, (e.g., along the Bay shoreline or on fill) may experience significant enough damage during an earthquake to become uninhabitable. Most single- and multi-family homes under 10 stories are unlikely to have foundations stable enough to withstand liquefaction even if they can withstand ground shaking.

Most houses cannot withstand any amount of flooding

If exposed to flooding, most housing built in the Bay Area will be damaged as current construction materials, siting and design standards do not consider potential exposure to either water or salt. As sea level rises, existing and future housing of all types within FEMA identified Special Flood Hazard Areas (SFHAs) will be at greater risk of flooding, and housing in low-lying areas not currently at risk may begin to experience flooding.

Houses with habitable space or critical equipment below-grade are at risk from flooding

Homes with habitable living space or critical building equipment below-grade are likely to be significantly damaged by flooding. Neighborhoods close to the bay shore, with existing drainage issues, such as street or basement flooding during current rainfall events or when groundwater levels are high, will be at even greater risk as the Bay rises due to sea level rise.

Table 2-3: Indicators of Community Vulnerability

Indicator	Measure
Housing cost burden	% household monthly housing >50% of gross monthly income
Transportation cost burden	% household monthly transportation costs >5% of gross monthly income
Home ownership	% not owner occupied housing
Household income	% households with income <50% AMI
Education	% persons >18 years without a high school diploma
Racial/Cultural Composition	% non-white
Transit dependence	% households without a vehicle
Non-English speakers	% households where no one ≥ 15 speaks English well
Age - Young children	% young children < 5 years
Age – Elderly	% elderly, > 75 years

BAY AREA HOUSING AND COMMUNITY
MULTIPLE HAZARD RISK ASSESSMENT
LEGEND
Community Vulnerability Score
3 - 4 Indicators
5 - 6 Indicators
7 - 10 Indicators
0 5 10 20 Miles
N
Association of Bay Area Governments
May, 2014
Communities at Risk in High Hazard Areas
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RESILIENCE PROGRAM
Adapting to Rising Tides

Community Vulnerability

Community vulnerability was determined using ten indicators that represent characteristics of individuals and households that affect their ability to prepare for, respond to, and recover from a disaster. These indicators collectively present a picture of a community's vulnerability. A concentration of these indicators is assumed to influence the recovery of a community. Key themes that emerged included age-related vulnerabilities, language and ethnicity vulnerabilities, cost-burdened residents, housing tenure issues, and access to resources.

Indicators were measured and scored using the method developed by the Metropolitan Transportation Commission (MTC) to identify Communities of Concern (CoC). This is meant to identify block groups with higher than average concentrations of the particular indicator and therefore may have higher concentrations of vulnerability.

Key Considerations

Many community members have limited access to resources

Many Bay Area residents that live in areas at risk from natural disasters are resource-constrained. This includes households that are low- and very low-income, households of all income levels that are housing and transportation cost-burdened, and transit-dependent households that do not own a car. Resource-limited households are less able to prepare for natural disasters, and if displaced from damaged homes, will likely struggle to find housing that is affordable and near to the jobs, schools, medical facilities, and other services they rely on.

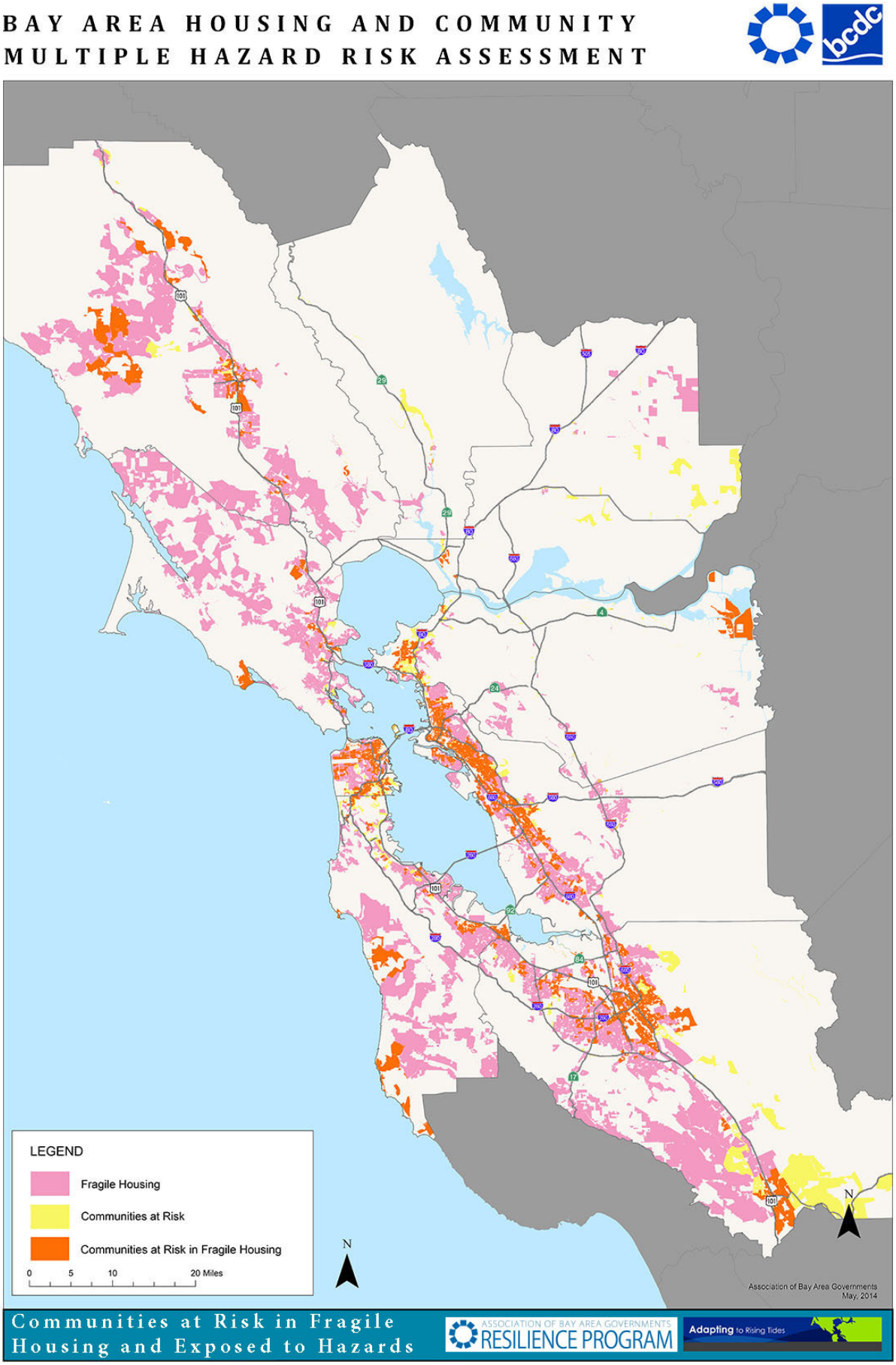
Housing affordability is an existing challenge that will be compounded after a natural disaster.

Housing affordability is an existing challenge that could hinder recovery

Housing affordability for both renters and owners is an existing challenge in the Bay Area that will compound the number of community members displaced by a natural disaster. Much of the region is housing cost-burdened already, spending 50% or more of income on housing. After a disaster, if many housing units are lost, a constrained market may drive up the cost of housing even further. Loss or damage of housing that results in increased costs to either renters or home-owners will likely increase the number of permanently displaced Bay Area residents. Finding replacement housing that is affordable and near jobs, schools, medical facilities, and other services will be a significant challenge.

Renters have limited ability to improve their housing resilience

Many Bay Area residents that live in areas at risk from natural disasters are renters. Renters have a limited ability to improve the housing in which they live and often do not have hazard insurance to protect themselves and their belongings in case of a disaster. Communities with a large number of renters,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Association of Bay Area Governments
May, 2014
Communities at Risk in Fragile Housing and Exposed to Hazards
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RESILIENCE PROGRAM
Adapting to Rising Tides

and in particular resource-limited renters, will need to assist these residents both during a disaster (e.g., with shelter-in-place facilities), as well as post-disaster to help them find interim, affordable housing that avoids permanent displacement of renters from these communities.

Many community members have limited or inadequate information about hazards

Access to timely, correct, and meaningful information both before and after a natural disaster can be challenging in all communities and can be a particular challenge in communities that are ethnically and culturally diverse, and where there is a large number of households in which English is not the primary language spoken. Additionally, in the Bay Area many of these same community members are resource-constrained renters who are often living in overcrowded housing. Damage to housing during a natural disaster can lead to a significant amount of displacement and a struggle to find housing that is affordable and near enough to jobs, schools, medical facilities, and other services.

Information on elderly and very young community members is limited

Up-to-date and easily accessible information about the number of elderly and very young living in a community can be challenging to find, particularly during a disaster when it is most needed. This information is critical as it can be difficult to evacuate these community members, especially if they need specialized equipment or supervision, and shelter-in-place facilities need to be prepared to both house them safely and maintain communication with concerned family members.

Housing and Community Risk Map

The final mapping and analysis consists of three maps. The final maps represent block groups within the Bay Area that are likely to be exposed to hazards and also have housing and community characteristics that indicate higher vulnerability, or are more likely to be affected to the degree that residents will have trouble preparing for, responding to, and recovering from a major disaster. Local jurisdictions can use this analysis to zoom in on areas that require more nuanced vulnerability assessment, including more accurate fragile housing inventories and a more detailed understanding of community vulnerability that incorporates a qualitative understanding of community capacity.

CHAPTER 3

HOW TO USE THE STRATEGIES

Choosing which strategies to use

Strategies are designed to be responsive to the vulnerability types identified and analyzed, choosing which strategies to use is most easily approached through the following steps, using table 3-1:

- Identify which vulnerability you want to address - natural hazards, housing vulnerability, or community vulnerability.
- Identify the key finding that most closely matches your risk
- Choose which specific indicator you'd like to address
- Identify your "short list" of strategies that meet your specific vulnerability concerns

Note: Many strategies address multiple vulnerabilities and will appear more than once in the strategy selection table.

Once an initial strategy list is identified, users can view the overview and summary table for each strategy in Chapter 4.

To most efficiently reduce vulnerability:

Strategies to address hazard risks should be considered first

Understanding hazards and avoiding high hazard areas is fundamental to resilience.

Strategies to address housing vulnerability should be considered next

Keeping housing intact immediate reduces the vulnerability of its residents, even if other community vulnerability indicators are present.

Strategies to address community vulnerability should be considered last

The following tables reflect this order of priority.

Users may also look at the strategy list at the beginning of Chapter 4 to identify applicable strategies. The summary table is organized by scale and grouped into similar strategy types to provide a snapshot of how the strategies fit together in relationship to one another.

Table 3-1: Strategy selection table

HAZARDS

What key finding do you want to address?	What indicator do you want to address?	Strategies to consider
Hazards will have significant impacts on communities that live in high hazard areas	Ground shaking (MMI XIII or above)	Strategy 1: Complete seismic hazard mapping of urban and urbanizing areas Strategy 2: Evaluate current guidelines and the "state of practice" for mapping, evaluating and mitigating seismic hazards, particularly multi-hazard areas Strategy 11: Develop locally-specific seismic hazard maps *Also see strategies for "Any hazard" below*
	Moderate to high liquefaction	Strategy 1: Complete seismic hazard mapping of urban and urbanizing areas Strategy 2: Evaluate current guidelines and the "state of practice" for mapping, evaluating and mitigating seismic hazards, particularly multi-hazard areas Strategy 11: Develop locally-specific seismic hazard maps *Also see strategies for "Any hazard" below*
	Current and future flooding	Strategy 5: Establish a cooperative shoreline management program Strategy 31: Incorporate sea level rise guidance within the capital planning process *Also see strategies for "Any hazard" below*
	Any hazard	Strategy 6: Develop guidelines for the siting and design of transit-oriented development to reduce seismic and flood risks Strategy 10: Host a regional "Smart and Safe" growth design competition Strategy 12: Increase protection of critical facilities and lifelines in high hazard areas Strategy 13: Reduce or prohibit development in the most hazardous areas while ensuring equity and beneficial use of these areas Strategy 14: Establish overlay zoning districts to help facilitate safe and smart new development Strategy 15: Establish a Transfer of Development Rights program to redirect development from high hazard areas to preferred, low hazard areas Strategy 34: Create a pre-disaster rebuild and recovery plan Strategy 35: Revise local plans and development codes to allow temporary land uses to facilitate and expedite post-disaster recovery

HOUSING VULNERABILITY

What key finding do you want to address?	What indicator do you want to address?	Strategies to consider
Ground shaking can damage vulnerable single and multi-family homes	Single or multi-family cripple wall homes	Strategy 4: Improve the quality assurance of non-engineered retrofits by developing a statewide retrofitting license for contractors, with contractor training and technical materials Strategy 18: Develop cripple wall retrofit program *Also see strategies for "Any fragile housing type" below*
	Single family house over garage	Strategy 17: Develop soft story retrofit program *Also see strategies for "Any fragile housing type" below*
	Multi-family weak story or open front homes	Strategy 17: Develop soft story retrofit program *Also see strategies for "Any fragile housing type" below*
	All fragile housing types vulnerable to ground shaking	Strategy 7: Encourage innovative insurance solutions at the state and federal levels, and in partnership with the private sector Strategy 16: Create a fragile housing inventory Strategy 20: Ensure that major upgrades and repairs to existing buildings address seismic and flood-related hazards. Strategy 24: Enhance minimum requirements for non-structural anchorage and bracing of interior partition walls in residential buildings Strategy 32: Create geologic hazard abatement districts (GHADS) to fund hazard mitigation Strategy 33: Create Mello-Roos Community Facilities Districts to provide financing to property owners for resiliency improvements
Most foundations cannot withstand liquefaction	Insufficient foundation, e.g., less than 10 floors	Strategy 7: Encourage innovative insurance solutions at the state and federal levels, and in partnership with the private sector Strategy 8: Advocate for changes to federal and state programs to improve multi-family rebuilding efforts Strategy 22: Enhance minimum design requirements for new small scale residential building foundations in liquefaction zones
Housing is generally built to life safety standards	All fragile housing types	Strategy 21: Assign higher seismic importance factor to new large scale residential buildings. Strategy 22: Enhance minimum design requirements for new small scale residential building foundations in liquefaction zones Strategy 25: Develop and adopt guidelines for building utility connections to incorporate earthquake safety features Strategy 36: Develop and implement a shelter-in-place program
Most houses cannot withstand any amount of flooding, especially those with habitable living space or critical equipment below-grade	All housing types vulnerable to flooding	Strategy 20: Ensure that major upgrades and repairs to existing buildings address seismic and flood-related hazards. Strategy 26: Participate in FEMA's Community Rating System Strategy 27: Reduce flood risk through integrated watershed management Strategy 28: Increase standards in local floodplain management ordinances beyond the minimum requirements of FEMA's NFIP program Strategy 29: Require flood-proof construction methods and techniques within and adjacent to special flood hazard zones Strategy 30: Revise minimum building elevation standards and maximum building height-limits for new development

COMMUNITY VULNERABILITY

What key finding do you want to address?	What indicator do you want to address?	Strategies to consider
Information about the needs and location of elderly and very young community members is limited	Dependent ages - young children or Elderly	Strategy 39: Create a community capacity inventory
Many community members have limited or inadequate information about hazards	Language and ethnicity -community of color and non-English speakers	Strategy 3: Develop education program(s) to encourage homeowners and renters to purchase of hazard insurance Strategy 40: Disseminate best available hazard and climate risk information through community-based organizations and non-traditional partners
Housing affordability is an existing challenge that will make recovery more difficult	Housing cost burdened	Strategy 3: Develop education program(s) to encourage homeowners and renters to purchase of hazard insurance Strategy 7: Encourage innovative insurance solutions at the state and federal levels, and in partnership with the private sector Strategy 38: Protect affordable housing during recovery
Renters have a limited ability to improve the resilience of the housing they live in	Renters, low-income renters	Strategy 3: Develop education program(s) to encourage homeowners and renters to purchase of hazard insurance Strategy 8: Advocate for changes to federal and state programs to improve multi-family rebuilding efforts Strategy 19: Require hazard disclosure for renters Strategy 37: Improve the resilience of rental units and ensure they are re-built after loss or damage due to a natural disaster
Many community members are resource constrained and less able to prepare for or recover after a disaster	Access to resources: housing and transportation cost burdened, transit dependent (no vehicle), very low income or low graduation rate	Strategy 7: Encourage innovative insurance solutions at the state and federal levels, and in partnership with the private sector Strategy 9: Decrease reliance on grid-supplied power

How to read each strategy

This section is designed to familiarize the reader with structure and terminology found in the 40 detailed strategies included in the next section.

Each strategy begins with a title and a snapshot summary, which captures the intent and action of the strategy in a short paragraph.

Each strategy also features a summary table that provides defining indicators for the strategy. Any of the indicators that apply to the strategy will be in in bold (see "region" below as an example), whereas the indicators that do not apply will remain in grey. A sample table is shown in Table 3-2, followed by explanations of the terminology found in the table.

Lead: Each strategy has been identified by the level which is most practical to lead the initiative – state, regional, or local. While the emphases of these strategies are actions that occur largely at the local level, there are some initiatives that require systemic change at a higher level such as the state. Strategies designated to be led by the state require legislation, are actions housed within a state agency, or require coordinated effort between the regions. In cases where the State is the most logical lead, regional and local governments can provide support. In some cases state-level work may be a prerequisite for regional or local work, such as state-led mapping efforts.

Many actions will need to be developed and initiated through a regional effort, led by a regional body such as ABAG, MTC, or the JPC. Regional leadership makes sense for efforts that should be consistent across the region, e.g., adopting retrofit standards; or for planning or actions that require coordination between multiple jurisdictions and special districts, e.g., for shoreline protection. For certain actions, this regional work will then spur community-specific actions at the local level with policy, assistance, or information-sharing.

Target Development Type: This section indicates whether the strategy is geared towards protecting existing development or towards building safer, smarter new development. Most jurisdictions will likely have a mix of existing and new development in vulnerable areas and this section can help jurisdictions decide where to use which strategy.

Hazard Addressed: Some of the strategies are designed to respond to one of the three specific hazards addressed in this project – ground shaking, liquefaction, or existing or future flooding. Jurisdictions can select only the strategies that apply to the specific hazards in their area. Other strategies are designed to be able to respond to and address multiple hazards; jurisdictions need to consider how to tailor the strategy to fit their specific hazards profile.

Community Vulnerability Addressed: Each of the strategies was designed to address the vulnerabilities identified through the regional housing and community vulnerability assessment. The community vulnerability indicators are grouped into five categories. Some strategies address a particular type of community vulnerability (or vulnerabilities)

Table 3-2: Sample strategy template

Lead			**Scale of Benefit**		
State	**Region**	Local jurisdiction	Region	Community	Resident
Target Development Type		**Hazard Addressed**			
Existing	New	Ground Shaking	Liquefaction	Flooding	
Community Vulnerability Addressed				**Vulnerable Housing Type Addressed**	
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	Access to Resources	Single or Two Family	Multi-family	Cripple Wall	Soft story or House over garage
Action Categories					
Evaluation	Program/ Operation	Plans and Policies	Codes, Regulations, and Ordinances	Coordination	Education/ Outreach
Prerequisite Strategies			**Other Related Strategies**		
None			None		

Description

Governance/Implementation Issues

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	Development and Construction Loans	Individual Home Improvement or Commercial Renovation Loans	Revolving Loan Fund Programs	**Grant Programs**	Other

Implementation Partner(s)

State	Region	Local

Example(s)

as identified here. For strategies that have a general communitywide benefit, specific community vulnerabilities are not identified.. This section is completed only for strategies that have a direct benefit for a particular community vulnerability.

Vulnerable Housing Type Addressed: Some strategies are designed to directly address one of the fragile housing types identified in the assessment phase as likely to be found in the Bay Area and also to experience significant damage. If the strategy is specifically tailored to one of these fragile housing types, it will be indicated here. Jurisdictions looking to address a specific fragile housing vulnerability should look to this section to select strategies that specifically address that fragile housing type. This section will only be filled out on strategies that have a direct benefit to that particular housing type, such as a mitigation program.

Action Categories: This section identifies the type(s) of action that will occur to develop and implement the strategy.

Evaluation: Evaluation actions help to better understand current levels of resilience and set a baseline against which to track future work. They may also provide insight into the status or effectiveness of existing programs, policies, or resources, or provide data that helps guide the direction or phasing of a program.

Program/Operation: These actions require a program with stakeholder support, resources, public involvement, and a defined outcome. Many of these types of actions will require local level programs, with possible assistance and coordination from the regional level.

Plans and Policies: These actions seek to develop policies or plans which support resilience capacity-building and can be adopted at the local level. They may trigger the following category on Codes, Regulations, and Ordinances.

Codes, Regulations, and Ordinances: These actions are the technical application of Plans and Policies (see previous action type). These are specific changes that alter the requirements for practice within a jurisdiction, such as building codes or zoning.

Coordination: Coordination actions involve bringing together multiple stakeholders to make common decisions that are mutually beneficial. These types of actions are most common in multi-jurisdictional issues such as flooding, and may be facilitated at the regional level.

Education/Outreach: Education actions actively seek to gather and communicate new information to assist stakeholders and encourage voluntary actions to increase housing resilience.

Prerequisite Strategies: Many strategies work best when other strategies are also implemented, as they assist with information gathering or represent actions that may be more cost effective when coordinated. Suggested prerequisites represent strategies that greatly assist in the implementation of the strategy in question if they are implemented first.

Other Related Strategies: Other related strategies are those that may have a similar structure for implementation or cover related issues or produce co-benefits that should be considered in tandem.

Description: This section lays out the intent of the strategy; the reason why the strategy is needed, including the problem or vulnerability that needs addressing, and why or how it is not currently properly addressed; what action the strategy proposes; and how the action responds to the problem. This section also may have some commentary on the direct benefits from strategy (such as economic, social, and environmental benefits). This section may also include, as necessary, background information or context, definitions of key terms, explanations of standards, and alternatives for implementation. This is typically the longest section and constitutes the main body of the strategy.

Governance/Implementation Issues: This section calls out specific considerations local governments will need to account for if they plan on implementing the strategy. This includes passing ordinances, altering language in building codes, or lobbying to state government. This section may also explain any governance actions that may have to take place at the state or regional level. This section may also highlight unintended consequences of implementing the strategy on other areas of government, e.g., if a strategy has the potential to unintentionally raise rents, exacerbating housing affordability issues. This section should assist jurisdictions in understanding the complexity of implementing this action from a political perspective in order to decide which strategies are most appropriate for their jurisdiction.

Potential Financing Mechanisms: This section identifies the financing mechanism(s) that can be used to finance the strategy. Each of these financing mechanisms is explained in greater detail in Table 3-3 to help jurisdictions decide which mechanisms may be most appropriate in a given situation. Many strategies may not require a specific financing program but may require resources at a local level for staff time. This section should assist jurisdictions in understanding the amount of resources needed to develop and implement the strategy, and who will bear the greatest financial burden. See "Choosing the right financing mechanisms" in the next section for more detail.

Implementation Partner(s): This section contains a table that describes how state, regional, or local agencies can assist with implementing the strategy.

Example(s): This section will include cases where similar strategies have been used successfully, more thorough explanations of standards referenced in the strategy description, and links to sample ordinances or policies that a jurisdiction would need to implement the strategy. In all cases, links will be provided as available for further research. When possible, examples will be local and applicable to the Bay Area. In some cases, state, national, or global best practices will be referenced, particularly for strategies that are innovative or reflect new ways of thinking.

Choosing the right financing mechanisms

Consideration was given the most appropriate financing mechanisms that might be used to implement the strategies. There are two categories of financing:

- The first category comprises strategies related to planning, programs, and operations.
- The second category includes strategies related to capital expenditures.

Some strategies can be implemented through existing departments and programs, sometimes at no additional cost, or through new or expanded programs for which a budget must be found. General fund resources, fee-based special purpose funds, or state, federal, or private grants are among the main sources of funds for these types of strategies.

Other strategies involve capital projects, which, by and large, require a level of funding that is a few orders of magnitude greater than planning-level, programmatic, or operational strategies. Depending on the strategy, funding may come from the private sector (individuals, a development company, or professional or philanthropic organizations), the public sector, or a cooperative effort among public and private actors.

Financing property-specific improvements and neighborhood-level or larger investments in infrastructure can be challenging in California. State legislation and

Crises arising from natural disasters and other events have driven innovation in financing

ballot measures have put strict limitations on the ability of the State and local governments to raise the capital needed to implement projects (and to mandate repayment schemes for the borrowing that typically is necessary). These limitations—and crises arising from natural disasters and other events—have driven a lot of innovation in financing mechanisms. Although traditional mechanisms are still available, the aforementioned limitations make it difficult to use those mechanisms (specifically, selling bonds to raise capital that are paid back through an increase in property or sales taxes). Drawing from "existing" sales tax or property tax revenues from city and county general funds is generally considered untenable because of the existing fiscal constraints plaguing most California cities. Therefore, this overview discusses methods for locating new funding mechanisms.

The applicability of different financing mechanisms depends on a variety of factors that include the following:

- The geographic extent of stakeholders affected by the challenge that the investment is intended to address, such as:
    - An individual property
    - A neighborhood
    - A collection of neighborhoods
    - A city
    - A county

- A utility's or transportation district's service territory

- The type of threat the investment is intended to address, such as:
  - Seismic-related
  - Flood-related
- The type of property or infrastructure asset the investment is intended to address
- The type of investment (e.g., investment in publicly shared infrastructure such as a roadway with multiple uses, or investment a levee primarily for flood control)
- The ability of beneficiaries of the investment to bear the costs of repaying whatever debt is taken on to make the investment
- The political and financial appetite of civic leaders, community leaders, individual business and residential property owners, tenants, and users of services to permit and ultimately pay for the investments.

Table 3-3 lists examples of financing mechanisms, the agency normally responsible for administering the mechanism, the source of repayment used for the mechanism, and the scale at which the mechanism is typically applied. In addition, the table identifies whether or not the mechanism requires voter approval for implementation, thereby indicating the political viability of the mechanism. The last column identifies by strategy number, the adaptation strategies recommended in this report, which could be financed by the mechanisms listed in this table.

Table 3-3: Financing mechanisms table

Name	Administrator	Source of Repayment	Area of Application	Voter Approval Considerations	Applicable Strategies
City/County/ State Bond Program	City, County, Regional Agency, or State	General fund, sales tax, or hotel tax Service fees, property tax, tax increments	Citywide, Countywide, or Statewide	General obligation bonds require two-thirds voter approval. Revenue bonds require majority voter approval.	12, 20, 26
Parcel or Sales Tax	City, County, Regional, or State	Parcel tax or sales tax	Citywide, Countywide, Region-wide, or Statewide	Parcel or sales taxes require two-thirds voter approval	5, 12, 26, 38
Tax-based Special Districts	Special District	Ad-valorem property tax	Districtwide	Tax-based special districts need two-thirds voter approval to be able to levy special taxes.	5, 9, 12, 14, 17, 26, 32, 33, 38
Fee-based Special Districts	Special District	Service fees	Districtwide	Fee-based special districts do not need voter approval to issue bonds for capital generation. Similarly, fees charged by special districts do not require voter approval as long as the fees are for a specific benefit, service, or product provided directly to the fee payer.	5, 6, 12, 26
Infrastructure Financing Districts	City or County	Property tax increments within the district	Districtwide	Property tax increments proposed by infrastructure financing districts require both local and countywide approval, where both jurisdictions forego general fund revenue to pay back infrastructure investments.	6, 14, 36
Joint Powers Authorities (also known as Public Financing Authorities)	Joint Powers Authority appointed by City or County	Income from public project projects (e.g. income generated by a Port Authority by leasing space to businesses)	Multi-city, Countywide, Region-wide, District	This mechanism requires multi-jurisdictional buy-in before it can be implemented.	None

Name	Administrator	Source of Repayment	Area of Application	Voter Approval Considerations	Applicable Strategies
Municipal Enterprise Funds	City, County, or utility	Users of Infrastructure Services (e.g., water, energy, etc.)	Citywide, Countywide, District	Fees charged by municipal enterprises do not require voter approval as long as the fees are for a specific benefit, service, or product provided directly to the fee payer.	12
Development and Construction Loans	Local or regional banks	Income from investment	Neighborhood wide	None	6, 14, 15, 20, 21, 22, 23, 24, 25, 26, 28, 29, 30
Individual Home Improvement Loans or Commercial Renovation Loans	Local or regional banks, local, regional, state, and federal agencies	Individual or business income	Individual property owner or individual business	None	12, 17, 18, 20, 22, 23, 24, 25, 26, 28, 29, 37, 38
Revolving Loan Fund (RLF) Programs	Local, regional, state, and federal agencies	Income from investment, individual and business income	Citywide, neighborhood wide, individual households and businesses	None	12, 23, 24, 25, 26, 28, 29
Grant Programs	Local, regional state, or federal agencies, philanthropic organizations	None required	Citywide, neighborhood-wide	None	1, 2, 4, 5, 6, 10, 11, 12, 20, 22, 23, 24, 25, 26, 27, 28, 29, 35, 37, 38, 39, 40

CHAPTER 4

VULNERABILITY REDUCTION STRATEGIES

STRATEGY SNAPSHOT

State-Led Strategies Page

1. Complete seismic hazard mapping of urban and urbanizing areas.....42

   Encourage the California Geological Survey (CGS) to complete mapping of seismic hazard zones for the portions of the Bay Area that are not currently mapped or in the process of being mapped with priority given to urban and urbanizing areas.

2. Evaluate current guidelines and the "state of practice" for mapping, evaluating and mitigating seismic hazards, particularly multi-hazard areas 45

   Through its authority under the State Seismic Hazard Mapping Act, encourage the California Geological Survey (CGS) to work with regional and local agencies and the geology/ geotechnical community in the Bay Area to evaluate current guidelines, as well as the current state of practice, for mapping, evaluating and mitigating seismic hazards, particularly in areas of expected growth that are also vulnerable to tsunami, flooding and permanent inundation.

3. Develop education program(s) to encourage homeowners and renters to purchase hazard insurance 50

   This strategy recommends creating targeted education programs that encourage homeowners and renters to better understand their risk and make more informed decisions about the purchase of earthquake insurance. This includes education about retrofitting versus insurance, understanding the site-specific hazards of their building, helping them understand what the costs versus benefits are of purchasing insurance, and what is and is not covered by hazard insurance policies.

4. Improve the quality assurance of non-engineered retrofits by developing a statewide retrofitting license for contractors, with contractor training and technical materials.....53

   Increase the number of skilled contractors, contractor knowledge, consistency in retrofit quality, and owner assurance and trust in non-engineered retrofits by developing a regional or statewide program to train and license or certify contractors in non-engineered seismic retrofits.

Region-Led Strategies

5. Establish a cooperative shoreline management program 57

Coordinate with government agencies, organizations, and land owners to establish and maintain a cooperative shoreline management program. This cooperative program could identify strategies for shared decision-making and funding to reduce current and future flood risks in a manner that benefits and balances issues of equity, economy, and environment.

6. Develop guidelines for the siting and design of transit-oriented development to reduce seismic and flood risks 61

Encourage the Metropolitan Transportation Commission to include an annex to its Station Area Planning Manual that contains guidelines for on-site planning and design techniques that could reduce risk to areas vulnerable to flooding, shaking, and liquefaction hazards. The annex would be consistent with the overarching purpose of MTC Resolution 3434 Transit-Oriented Development (TOD) policy for regional transit expansion projects, taking into account techniques to mitigate for the risk of introducing 42,000 new housing units along the region's major transit corridors.

7. Encourage innovative insurance solutions at the state and federal levels, and in partnership with the private sector 66

Lobby and advocate for the expansion of state- and federally-mandated catastrophe insurance programs, such as the California Earthquake Authority. Better insurance solutions could enhance mitigation efforts by offering incentives such as building permit rebates, lower premiums or deductibles for retrofitted homes, state-level tax incentives, and state and federal grants to fortify homes and business.

8. Advocate for changes to post-disaster federal and state multifamily housing rebuilding programs 69

Lobby at the state and federal levels to ensure multi-family housing receive a fair and equitable share of financial and technical assistance during rebuilding and recovery efforts.

9. Decrease reliance on grid-supplied energy 72

Promote buildings that will maintain livable conditions in the event of extended loss of power or heating fuel. This can be done through incentives for residential energy efficiency retrofits, weatherization projects, building design standards that promote energy load reductions and on-site generated electricity or bi-direction energy sources, that make homes habitable when there are utility outages caused by disasters.

10. Host a regional "Smart and Safe" growth design competition 76

Develop a region-wide design competition to promote innovative approaches to resilient design and new solutions to building high-density, mixed-use community development or redevelopment in a safe and smart manner in areas that are susceptible to multiple hazards

Locally-led Strategies

11. Develop locally-specific seismic hazard maps 80

Encourage local governments to develop locally specific seismic hazard maps to improve upon mapping resolution and, support more informed and nuanced decision-making about development and hazard mitigation, particularly in urban and urbanizing seismically hazardous areas.

Strategies that reduce development in the highest hazard areas 85

12. Increase protection of critical facilities and lifelines in high hazard areas 85

Encourage local governments to require critical infrastructure and public-service facilities to be located or relocated outside high hazard areas, or that seismic- and flood-related mitigation and other protective measures be undertaken to enhance the structural integrity, overall performance, and functionality of facilities that must be located within high hazard areas. Emphasis should be given to ensuring the continuity of operations of critical facilities and lifelines essential to helping residents remain in their homes following a disaster and facilitating and expediting community and regional post-disaster recovery.

13. Reduce or prohibit development in the most hazardous areas while ensuring equity and beneficial use of these areas 90

Reduce or prohibit development in high hazard areas, incentivize relocation out of these areas, and reduce or prohibit rebuilding after a disaster. This strategy also works to create beneficial uses, such as open space, flood mitigation and recreation, for non-developable high hazard lands.

14. Establish overlay zoning districts to help facilitate safe and smart new development 95

Establish overlay zoning districts, such as a Planned Unit Development (PUD) overlay district, to cluster new development into lower hazard areas on a particular site while also establishing special conditions for development in high hazard areas.

15. Establish a Transfer of Development Rights program to redirect development from high hazard areas to preferred, low hazard areas 101

Amend local development codes to establish a Transfer of Development Rights (TDR) program, which could place permanent conservation or hazard mitigation easements on properties in high hazard areas, to prevent or minimize the vulnerability of new development to seismic and flood hazards.

Strategies to retrofit fragile housing in seismic hazard areas.....106

16. Create a fragile housing inventory.....106

Create and maintain a database that includes the type and location of fragile housing by building type and housing tenure (owner vs. renter), and the property's retrofit status. This would include developing and sustaining standardized, transferrable procedures for collecting and managing data. The inventory should contain, at a minimum, unreinforced masonry buildings, soft-story buildings, and non-ductile concrete buildings.

17. Develop and implement a soft story retrofit program.....110

Develop voluntary or mandatory retrofit program(s) to address soft story housing in areas where it makes up a large percentage of a jurisdiction's housing stock (as a whole or for a specific vulnerable community). Pair programs with financing tools and incentives. Consider different incentives and financing tools for more vulnerable communities, such as low-income residents or renters. The program should consider how to handle compliance and enforcement standards, mechanisms for enacting the program, and which retrofit standards to use.

18. Develop and implement a cripple wall retrofit program 115

Develop a retrofit program to address cripple wall housing in areas where it makes up a large percentage of a jurisdiction's housing stock (as a whole or for a specific vulnerable community). Pair programs with financing tools and incentives. Consider different incentives and financing tools for low-income homeowners or renters. The program should consider how to handle compliance and enforcement standards, mechanisms for enacting the program, and which retrofit standards to use.

19. Require hazard disclosure for renters.....120

This strategy recommends the development of policies that require residential property managers and landlords to disclose hazard risk information to renters in a manner similar to that required when residential properties are sold, including if the property is listed on a fragile housing inventory.

20. Ensure that major upgrades and repairs to existing buildings address seismic and flood-related hazards 124

Encourage local governments to develop and adopt special repair and upgrade standards for existing buildings that are not typically part of hazardous building abatement programs and are also potential candidates for conversion to mixed-use or higher-density residential use in areas of expected growth. This strategy focuses on reducing the risks posed by existing hazardous buildings by addressing both seismic and flood-related hazards at the time of upgrade (such as a mixed-use or residential conversion) or major repairs following a disaster.

Strategies to increase building standards for new construction in seismic hazard zones 128

21. Assign higher seismic importance factor to new large-scale residential buildings 128

Amend the local building code to enhance structural and nonstructural design requirements for new large-scale residential buildings by adoption of increased seismic importance factor to improve their seismic performance level.

22. Enhance minimum design requirements for new small-scale residential building foundations in liquefaction zones 131

Amend the local building code to require enhanced foundation design requirements for new small-scale residential development (e.g. single or two-family dwellings) and for significant modifications to existing small-scale residential development to limit foundation damage due to liquefaction.

23. Restrict use of significant structural irregularities in residential buildings .. 135

Amend the local building code to restrict the use of structural irregularities in the design of new residential construction as well as existing residential construction subject to significant modification in areas with high or moderate shaking and liquefaction potential.

24. Enhance minimum requirements for non-structural anchorage and bracing of interior partition walls in residential buildings 138

Amend the local building code to include enhanced non-structural anchorage and bracing requirements for interior partition walls in existing residential buildings in areas with shaking potential.

25. Develop and adopt guidelines for building utility connections to incorporate earthquake safety features 141

Amend the local building code to require that utility connections to buildings incorporate safety features to prevent adverse impacts from earthquakes. Develop guidelines on safety measures such as adequate displacement allowance for building utility connections, if there are no existing guidelines.

Strategies to address flooding hazards 145

26. Participate in FEMA's Community Rating System 145

Encourage local governments to participate in FEMA's Community Rating System (CRS), a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum National Flood Insurance Program (NFIP) requirements by reducing local flood insurance rates.

27. Reduce flood risk through integrated watershed management.....149

Develop a program to work with public and private landowners to decrease the risk of flooding by advancing watershed management projects that reduce and/or store runoff during rainfall events, including the installation of green infrastructure and Low Impact Development (LID) practices, and improve the condition in the floodplain, for example through floodplain restoration or improvement.

28. Increase standards in local floodplain management ordinances beyond the minimum requirements of FEMA's NFIP program 153

Adopt a floodplain management ordinance that exceeds the minimum requirements of the NFIP to reduce potential risk from flood events that exceed the 100-year (1% annual chance) event. A strong floodplain management ordinance will ensure that land-use decisions account for current flood risks based on available information and assessments and consider more extreme events and/or future flood risk associated with sea level rise.

29. Require flood-proof construction methods and techniques within and adjacent to special flood hazard zones 158

Amend the applicable local codes to require flood-proof construction techniques in structures in special flood hazard zones, high hazard zones, and adjacent areas. Requiring flood-proofing techniques in these special flood hazard and high hazard zones could reduce the potential of damage to a structure and its contents in the event of a flood. Requiring the same level of flood-proofing in areas adjacent to these zones could reduce the potential for damage in areas that may be flooded in the future with sea level rise, or by flood events that exceed the FEMA 1% annual chance (100-year) flood conditions.

30. Revise minimum building elevation standards and maximum building height-limits for new development.....163

Revise building standards to require that habitable building space and sensitive building components be elevated above current and future flood levels. In tandem, maximum building height limits may be increased to reduce conflicts where these codes are applied together.

31. Incorporate sea level rise guidance within the capital planning process 167

City and County departments submit projects for incorporation within the respective local government's capital plan. The goal of the capital plan to provide clear direction on how the local government's assets will be maintained and improved over time, and to identify and prioritize projects for funding within the multiyear capital plan timeframe. The capital planning process can require that all projects located within a specific sea level rise inundation zone boundary adhere to sea level rise vulnerability and risk assessment guidance and identify appropriate adaptation strategies.

Policy tools that support financing mechanisms.....170

32. Create geologic hazard abatement districts to fund hazard mitigation 170

Establish Geologic Hazard Abatement Districts (GHADs) as a mechanism for raising funds and defining responsibility for the prevention, mitigation, abatement or control of geologic hazards, including landslides, land subsidence, soil erosion, earthquake, fault movement or any other natural or unnatural movement of land or earth. GHAD related projects can include the mitigation or abatement of structural hazards that are partly or wholly caused by geologic hazards and they can include flood control structures.

33. Create Mello-Roos Community Facilities Districts to provide financing to property owners for resiliency improvements.....174

Facilitate collaboration among local governments and property owners to form a district in which property owners opt in to participate, wherein the district would use capital raised by issuing bonds to make resiliency improvements, which is paid back through a property tax assessment.

Strategies to prepare for post-disaster recovery.....177

34. Create a pre-disaster rebuild and recovery plan 177

Make decisions about long-term disaster recovery, and implement as policy, such as when, where, and how rebuilding will occur after a natural disaster, which areas will be rebuilt according to existing plans and codes and which will be re-planned, whether rebuilt homes will be encouraged or required to be more likely to withstand the effects of future hazard events, and who will be in charge of coordinating and overseeing the recovery process through the development of a pre-disaster recovery plan.

35. Revise local plans and development codes to allow temporary land uses to facilitate and expedite post-disaster recovery 182

Revise local plans and development codes to permit interim or temporary land uses to support critical public facilities to facilitate and expedite recovery after a disaster event.

36. Develop and implement a shelter-in-place program 186

Develop a comprehensive shelter-in-place program to allow residents to remain in their homes after a disaster. Establish engineering criteria to determine shelter-in-place capacity, develop acceptable habitability standards for sheltering-in-place, and prepare and adopt regulations that allow for the use of these standards in a declared housing emergency period. Also develop plans for implementing the program, such as public training materials, coordinating with post-disaster evaluation procedures, and setting up neighborhood support centers.

37. Improve the resilience of rental units and ensure they are re-built after loss or damage due to a natural disaster 190

Adopt new policies, and strengthen existing policies, to improve the resilience of available rental units, and develop policies to ensure that rental units damaged during a natural disaster are replaced in kind (with a similar number/type) during rebuilding and recovery rather than being converted to owner-occupied properties.

38. Protect housing affordability during recovery 194

Develop a community planning process to support rebuilding of affordable housing after a disaster, adopt policies to support the replacement of affordable housing units that have been damaged or demolished, and prioritize the deployment of interim housing in vulnerable communities.

Strategies for coordination with non-profit organizations and community organizations 198

39. Create a community capacity inventory.....198

This strategy recommends developing or enhancing an existing community capacity inventory by first defining the elements that should be included (such as critical facilities and community services), engaging NGOs and city agencies to utilize current work, and then developing and sustaining standardized, transferrable procedures for collecting and managing data. Partnerships with NGOs such as Code for America could yield an open-source, collaborative format for collecting and sharing this information.

40. Disseminate best available hazard and climate risk information through community-based organizations and non-traditional partners.....202

This strategy recommends seeking opportunities to expand existing, successful community-based programs (e.g. programs on crime, blight, neighborhood beautification, education or other important community issues) in order to better communicate hazard and climate risk information to community members. An example of such an expansion would be the promotion of voluntary retrofits to building owners in coordination with the public health sector Healthy Homes educational campaigns.

State *Region* *Local*

1. Complete seismic hazard mapping of urban and urbanizing areas

Encourage the California Geological Survey (CGS) to complete mapping of seismic hazard zones for the portions of the Bay Area that are not currently mapped or in the process of being mapped with priority given to urban and urbanizing areas.

Lead			**Scale of Benefit**		
State	Region	Local jurisdiction	**Region**	Community	Resident
Target Development Type			**Hazard Addressed**		
Existing	**New**		**Ground Shaking**	**Liquefaction**	Flooding

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	Access to Resources	**Single or Two Family**	**Multi-family**	**Cripple Wall**	**Soft story or House over garage**

Action Categories					
Evaluation	Program/ Operation	**Plans and Policies**	Codes, Regulations, and Ordinances	Coordination	Education/ Outreach

Prerequisite Strategies	**Other Related Strategies**
None	Strategy 2: Evaluate current guidelines and the "state of practice" for mapping, evaluating and mitigating seismic hazards, particularly multi-hazard areas

Description

The 1990 Seismic Hazard Mapping Act requires the State Geologist and CGS to prepare maps of seismic hazard zones, identifying the areas that are susceptible to strong ground shaking, earthquake-induced landslides, liquefaction, or other ground failures. The Act also requires that the areas susceptible to tsunami and seiches be included in these maps when appropriate hazard information and funding are available to complete this work. In addition, the 1972 Alquist-Priolo Earthquake Fault Zoning Act requires CGS to establish earthquake fault zones around the surface traces of active faults and issue appropriate maps of these fault zones.

Proposed development or major renovations of existing development in mapped hazard zones are required to perform site specific geotechnical investigations prior to receiving construction permits or approval of subdivisions. When hazards are identified in these reports, the proposed design must take measures to mitigate their effects. Cities and counties are also required to take into account seismic hazards zones when preparing the safety element (and other elements which must be consistent with the safety element according to state law) of their general plans, and when adopting and revising land-use planning and permitting ordinances.

In the Bay Area, CGS has prepared State seismic hazard zone maps for liquefaction and earthquake-induced landslide hazards in San Francisco and parts of Alameda, Santa Clara, and San Mateo counties. Mapping for surface fault rupture has also been completed in all Bay Area counties. However, hazard zone maps for tsunami and seiches have not yet been fully developed. Consequently, current tsunami maps should only be used for evacuation planning, but future iterations may be sufficiently detailed to use in land-use planning.

CGS is in the process of collecting geotechnical reports and landslide inventories in San Mateo and Contra Costa counties and plans to release updated liquefaction and earthquake-induced landslide hazard maps for these counties in mid-2015. Even when this mapping is completed, gaps will remain in portions of eastern and northern Alameda county and eastern and southern Santa Clara county as well as all of Marin, Sonoma, Napa, and Solano counties. Because mapped hazard zones are the primary tool used by local governments to mitigate development within seismically hazardous areas, it is crucial that State mapping for all urban and urbanizing areas of the Bay Area be completed. Priority might be given to areas of planned future growth and areas that have been identified by USGS maps as having high liquefaction hazard (see: http://gis.abag.ca.gov/website/Hazards/?hlyr=liqSusceptibility).

Updated seismic hazard maps will provide local governments with the State-backed regulatory tools to mitigate seismic hazards for all future development as well as substantial renovations of existing development in hazardous areas. Moreover, updated State maps will help local governments identify areas where more locally specific seismic hazard maps would be useful to inform local development decisions (see Strategy 2: Evaluate current guidelines and the "state of practice" for mapping, evaluating and mitigating seismic hazards, particularly multi-hazard areas). In the absence of State designated hazard areas or locally-specific maps, local governments may wish to look to USGS liquefaction maps for direction on potentially hazardous areas which should require site-specific investigation.

Governance/Implementation Issues

Given its authority under the State Seismic Hazard Mapping Act, CGS is the appropriate agency to implement this strategy. CGS might want to work with regional agencies such as ABAG and city and county planning departments to identify key areas of future development and prioritize map preparation in the Bay Area. The USGS could also help identify areas of high liquefaction hazard which have not yet been covered by State seismic hazard zones. This strategy could be linked to the State of California's Hazard Mitigation Plan (see: http://hazardmitigation.calema.gov/plan/state_multi-hazard_mitigation_plan_shmp), the ABAG Regional Hazard Mitigation Plan (see http://quake.abag.ca.gov/mitigation/), and local hazard mitigation plans especially in communities where there are gaps in map coverage as an impetus for heightening awareness and raising the priority for completing this work.

The strategy may increase the upfront cost of approved development in designated hazard zones, as new development may be subject to more stringent hazard evaluation, mitigation and design requirements. However, this strategy could help reduce the economic and social costs of hazards, as new development would either be redirected to other locations, or be required to incorporate mitigation measures if it is approved in pre-identified hazard zones.

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	Development and Construction Loans	Individual Home Improvement or Commercial Renovation Loans	Revolving Loan Fund Programs	**Grant Programs**	Other

CGS receives funding from the Strong Motion Instrumentation and Seismic Hazards Mapping Fund that was specifically created to finance mapping and mapping guideline updates. Its funding comes from building permit applications fees collected by cities and counties. As a result, levels of funding allocated for mapping can fluctuate with the boom and bust cycle of California's building industry. The State Legislature appropriates the funds in the Hazards Mapping Fund and could allocate additional funds in the state budget to provide the funding needed to expand the mapping program.

Implementation Partner(s)

State	Region	Local
CGS will lead this mapping effort.	Regional agencies such as ABAG could help prioritize regional mapping needs.	City and county planning and building departments could help prioritize local mapping needs.

Examples

State guidelines referenced in this strategy include the following:

- California Seismic Hazards Mapping Act (Public Resources Code, Chapter 7.8, Sections 2690–2699.6) (see http://www.consrv.ca.gov/cgs/shzp/Pages/prc_shmact.aspx)

- Alquist-Priolo Earthquake Fault Zoning Act (see http://www.conservation.ca.gov/cgs/rghm/ap/Pages/main.aspx)

State regulatory maps can be found at http://www.quake.ca.gov/gmaps/WH/regulatorymaps.htm

Seismic hazard mapping information for the Bay Area can also be found at ABAG (see http://resilience.abag.ca.gov/earthquakes/)

2. Evaluate current guidelines and the "state of practice" for mapping, evaluating and mitigating seismic hazards, particularly multi-hazard areas

Through its authority under the State Seismic Hazard Mapping Act, encourage the California Geological Survey (CGS) to work with regional and local agencies and the geology/geotechnical community in the Bay Area to evaluate current guidelines, as well as the current state of practice, for mapping, evaluating and mitigating seismic hazards, particularly in areas of expected growth that are also vulnerable to tsunami, flooding and permanent inundation.

Lead			**Scale of Benefit**		
State	Region	Local jurisdiction	**Region**	Community	Resident
Target Development Type		**Hazard Addressed**			
Existing	**New**	**Ground Shaking**	**Liquefaction**	Flooding	
Community Vulnerability Addressed				**Vulnerable Housing Type Addressed**	
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	Access to Resources	**Single or Two Family**	**Multi-family**	**Cripple Wall**	**Soft story or House over garage**
Action Categories					
Evaluation	Program/ Operation	Plans and Policies	Codes, Regulations, and Ordinances	Coordination	Education/ Outreach
Prerequisite Strategies			**Other Related Strategies**		
None			Strategy 1: Complete seismic hazard mapping of urban and urbanizing areas		

Description

The 1990 Seismic Hazard Mapping Act requires CGS to develop guidelines and criteria for seismic hazard zone delineation, which are published in CGS Special Publication 118 (Recommended Criteria for Delineating Seismic Zones in California). The Seismic Hazard Mapping Act also recommends that these criteria be updated as, and when, the understanding of seismic phenomena and the methods used to assess their likelihood and potential impacts on the built environment improve. The last update of this publication was conducted in 2004.

CGS has also developed guidelines for evaluating and mitigating seismic hazards, which are published in Special Publication 117A: Guidelines for Evaluating and Mitigating Seismic Hazards in California. This publication provides guidance for the site-specific investigations and analysis of hazards, the mitigation of hazards, and the review of site-specific investigation reports for State seismic hazard zones. It is a valuable reference document for cities and counties and

other lead permitting agencies in developing their own seismic hazard review procedures and ensuring compliance with state and local planning and development regulations. Historically, this publication has been updated to reflect significant changes in practice as a result of continuing research in geotechnical earthquake engineering and soil mechanics, and from investigations of several earthquakes. It was last updated in 2008.

Through its authority under the State Seismic Hazard Mapping Act, this strategy encourages CGS to work with regional and local agencies and the geology/geotechnical community in the Bay Area to evaluate current guidelines, as well as the current state of practice, for mapping, evaluating and mitigating seismic hazards, particularly in areas of expected growth that are also vulnerable to tsunami, flooding and permanent inundation. This evaluation might be initiated with a workshop that considers: relevant lessons learned from recent earthquake and tsunami disasters since 2004 in New Zealand, Japan, Chile and elsewhere, as well the latest hazard science and data (including tsunami inundation and the effects of flooding and permanent inundation on earthquake hazards). Topics for consideration as part of the evaluation include:

- potential updates to State guidelines for mapping seismic hazards (CGS Special Publication 118) and the evaluation and mitigation of seismic hazards (CGS Special Publication 117A);
- promoting use of CGS' publically available geotechnical database of site-specific geotechnical investigations; and
- potential need for a regional technical assistance service to help local planning and permitting agencies as well as practicing geologists and geotechnical engineers to improve standards of practice for seismic hazard review.

For potential updates to the CGS guidelines, the evaluation might look at the guidelines and approaches taken by other state or local agencies in the United States and in other seismic-prone regions of the world, including Japan and New Zealand, and also consider whether guidance should be expanded to consider how flood/inundation risks in seismic hazard areas can affect earthquake mitigation practices as well as incorporating lessons learned from earthquakes that have occurred since the guidelines were last updated.

In promoting use of CGS' geotechnical database, the evaluation might look at online geotechnical databases that have been implemented in New Zealand, Japan, and elsewhere, to help permitting agencies and project proponents in designing mitigation solutions for seismic hazards.

In considering the potential need for a regional technical assistance service, the evaluation might canvass local jurisdictions in the Bay Area to understand whether jurisdictions have sufficient resources in-house, or through their consulting geologists/geotechnical engineers to manage the local seismic hazard review process. It might also look at current standards

Evaluate current guidelines and "state of the practice" for mapping, evaluating, and mitigating seismic hazards, particularly in multi-hazard areas	**State**	*Region*	*Local*

of practice for seismic hazard review, including whether considerations of flood/inundation hazards are part of the review, and assess whether a regional technical assistance service might be needed to help jurisdictions carry out seismic hazard reviews and raise the standard of practice. Such a service would not be a replacement for current staff, or consulting geologists and geotechnical specialists, but rather as a means of ensuring a consistent, high-quality of practice, as well as filling in gaps in staff or consultants where they exist. This may be particularly valuable for local governments in high growth areas on high hazard lands, and also for those that do not have adequate expertise on staff or have limited funding for staff review or third-party peer reviews of geotechnical reports.

Governance/Implementation Issues

Given its authority under the State Seismic Hazard Mapping Act, CGS is the appropriate agency to implement this strategy. CGS may want to involve the U.S. Geological Survey, other state agencies, such as the Flood Management Division of the California Department of Water Resources (DWR), regional and local agencies, and geology and geotechnical engineering professionals in the state in developing and conducting the evaluation.

Updates in the State's guidelines and other aspects of implementing this strategy could lead to an increase in the upfront cost of approved development in designated hazard zones, as new development may be subject to more stringent hazard evaluation, mitigation, and design requirements. However, this strategy could help reduce the economic and social costs of hazards, as new development will either be redirected to other locations, or be required to incorporate resiliency measures if it is approved in pre-identified hazard zones. The strategy may also have some indirect environmental and social benefits if it results in the creation or protection of habitat, open space, and recreational areas in hazard zones.

This strategy could be linked to the State of California's Hazard Mitigation Plan and the ABAG Regional Hazard Mitigation Plan (see: http://resilience.abag.ca.gov/mitigation/). It might also be aligned with support and implementation of the Plan Bay Area (see: http://onebayarea.org/plan-bay-area.html). Aligning this strategy with these planning efforts could help promote awareness of the need and raise the priority for conducting an evaluation of current guidelines and best practices. The provision of a regional technical assistance service could also target communities in urban and urbanizing areas and which have priority development areas identified in the Plan Bay Area.

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities

State *Region* *Local* *Evaluate current guidelines and "state of the practice" for mapping, evaluating, and mitigating seismic hazards, particularly in multi-hazard areas*

Municipal Enterprise Funds	Development and Construction Loans	Individual Home Improvement or Commercial Renovation Loans	Revolving Loan Fund Programs	**Grant Programs**	**Other**

CGS receives funding from the Strong Motion Instrumentation and Seismic Hazards Mapping Fund that was specifically created to finance these efforts. Its funding comes from building permit applications fees collected by cities and counties. As a result, levels of funding allocated for mapping can fluctuate with the boom and bust cycle of California's building industry. The State Legislature appropriates the funds in the Hazards Mapping Fund and can allocate additional funds in the state budget to provide additional funding to improve the program.

The U.S. Geological Survey's external grants program or the FEMA Hazard Mitigation Grant Program funds may be sources of funding for the evaluation. The California Earthquake Authority or other state agencies also may see value in contributing partial funding to the effort.

Implementation Partner(s)

State	Region	Local
Flood Management division of the California Department of Water Resources (DWR), the California Association of Building Officials (CALBO), and the Association of Engineering Geologists (practicing geologists and geotechnical engineers) would be useful partners for CGS to provide technical input on the evaluation and help assess the current state of practice. They could also assist in providing outreach and training on any new guidelines that might be developed. For example, CALBO provides training to local building officials on reviewing and approving site specific investigations and hazard mitigation plans and this might be expanded to include more training related to seismic hazards review and use of the CGS geotechnical database.	ABAG and BCDC would be useful partners for CGS to provide input on the evaluation of current guidelines and also to help assess the current state of practice for seismic hazards review in the region. They might also be partners is helping to organize and promote the use of CGS' geotechnical database and any regional technical assistance service that might be developed.	City and county planning, building and engineering departments would be useful partners for CGS to elicit input on the evaluation of current guidelines as well as the current state of practice. Their input would also be needed to determine the needs for a regional technical assistance service.

Evaluate current guidelines and "state of the practice" for mapping, evaluating, and mitigating seismic hazards, particularly in multi-hazard areas	**State**	*Region*	*Local*

Examples

State guidelines referenced in this strategy include the following:

- California Seismic Hazards Mapping Act (Public Resources Code, Chapter 7.8, Sections 2690–2699.6) (see http://www.consrv.ca.gov/cgs/shzp/Pages/prc_shmact.aspx)
- Alquist-Priolo Earthquake Fault Zoning Act (see http://www.conservation.ca.gov/cgs/rghm/ap/Pages/main.aspx)
- California Geological Survey Special Publication 117a: Guidelines for Evaluating and Mitigating Seismic Hazards in California (see http://www.conservation.ca.gov/cgs/shzp/webdocs/Documents/sp117.pdf)
- California Geological Survey Special Publication 118 (Recommended Criteria for Delineating Seismic Zones in California (see http://www.conservation.ca.gov/cgs/shzp/webdocs/sp118_revised.pdf)

Examples of technical assistance databases:

Technical assistance databases have been launched in New Zealand, Japan, and elsewhere, to help permitting agencies and project proponents in designing mitigation solutions for seismic hazards, such as liquefaction.

The Canterbury Geotechnical Database, called Project Orbit, was launched by the New Zealand Earthquake Commission in the Christchurch area following the 2010–2011 earthquakes. Subsurface drilling data is loaded into the database and is available to all geotechnical and structural engineers, council officers, and other specialists, working to design of foundations for repairs and rebuilding of homes (see: https://canterburygeotechnicaldatabase.projectorbit.com/Registration/Login.aspx?ReturnUrl=%2f)

Examples of technical assistance services:

Technical assistance models can be found under FEMA's post-disaster community recovery planning assistance programs (see: http://www.fema.gov/community-planning-and-capacity-building).

Other technical assistance models can be found under Urban Area Security Initiative (UASI)-funded pre-disaster recovery planning services. These models include a pre-selected cadre of firms that are eligible to assist communities with disaster recovery planning (see: http://www.calema.ca.gov/ems-hs-hazmat/Pages/Urban-Areas-Security-Initiative-%28UASI%29.aspx).

State *Region* *Local*

3. Develop education program(s) to encourage homeowners and renters to purchase hazard insurance

This strategy recommends creating targeted education programs that encourage homeowners and renters to better understand their risk and make more informed decisions about the purchase of earthquake insurance. This includes education about retrofitting versus insurance, understanding the site-specific hazards of their building, helping them understand what the costs versus benefits are of purchasing insurance, and what is and is not covered by hazard insurance policies.

Lead			**Scale of Benefit**		
State	Region	Local jurisdiction	Region	Community	**Resident**

Target Development Type		**Hazard Addressed**		
Existing	**New**	**Ground Shaking**	**Liquefaction**	Flooding

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	**Cost Burdened**	**Housing Tenure**	**Access to Resources**	**Single or Two Family**	**Multi-family**	**Cripple Wall**	**Soft story or House over garage**

Action Categories					
Evaluation	**Program/ Operation**	Plans and Policies	Codes, Regulations, and Ordinances	Coordination	**Education/ Outreach**

Prerequisite Strategies	**Other Related Strategies**
None	Strategy 11: Develop locally-specific seismic hazard maps

Description

In the wake of a natural disaster, homeowners and renters of all income levels can be severely affected by the destruction of their homes, particularly if they are not covered by a natural hazards insurance policy. According to the California Earthquake Authority, only 10 percent of the California's homeowners and renters have purchased an earthquake insurance policy. Reasons for low levels of participation by residents may be lack of awareness or understanding of insurance, and issues with the perceived cost-benefit of maintaining an earthquake insurance policy due to high premiums and high deductibles. For example, the statewide average annual cost of earthquake premiums is about $800 and typically comes with a 15% or a 10% deductible, which means that a homeowner insured for $650,000 (the average cost of a home in the Bay Area) with a 15% deductible would be responsible for $97,500 of repairs before coverage kicks in. Most homeowners aren't prepared for that sort of cash outlay, particularly in a post-disaster situation. Another reason homeowners and renters avoid purchasing earthquake insurance is because they believe federal programs will provide financial assistance after a natural disaster. However, assistance from federal and state disaster relief programs alone is unlikely sufficient to repair a majorly damaged home to pre-disaster conditions, which poses dire consequences for uninsured very low, low and medium income households, cost burdened households and people living in fragile housing types.

Develop education program(s) to encourage homeowners and renters to purchase hazard insurance **State** *Region* *Local*

Renters are especially susceptible to catastrophic loss because they usually do not have control over the structure they live in, and since they will not be faced with repair costs after a disaster, typically do not receive much, if any, assistance. However, their homes may not be habitable after a disaster and they will likely be faced with a changed rental market. Many low-income renters will be forced to leave their neighborhoods to find affordable temporary housing. In addition, many renters do not have renters insurance or are not aware of the availability of earthquake policies, despite their low cost and significant coverage benefits not just for possessions, but for displacement and alternate housing costs after an earthquake.

Retrofitting homes is always the first step in protecting existing housing stock, particularly given the current financial constraints of earthquake insurance for homeowners. However, in many cases the purchase of earthquake insurance is the most financially logical option, such as for single family homes in liquefaction areas where retrofit is prohibitively expensive or impractical, or for renters who are unable to influence the retrofit of their buildings. Furthermore, even a home that is habitable following a disaster may have extensive costs related to repairing non-structural damage and replacing contents.

Homeowners and renters alike need to make informed decisions about the purchase of earthquake insurance. This includes understanding site specific risk (see Strategy 11: Develop locally-specific seismic hazard maps), understanding all retrofit options, and thoroughly understanding what insurance does and does not cover for the price. Individuals should have the knowledge to weigh benefits and compromises and make informed decisions about purchasing earthquake insurance, for example understanding that for small amounts of damage, such as was incurred in the South Napa Earthquake, deductibles are sufficiently high that insurance is not the best option, but mitigation actions such as securing chimneys and strengthening cripple walls is the better way to improve the resilience of the housing.

The California Earthquake Authority (CEA) provides earthquake insurance for the state of California. While the CEA already has an advertising campaign in place throughout the state and provides information on policies on its website, this could be expanded by the state and the CEA could partner with regional and local governments to develop tailored, targeted messaging in regions or jurisdictions with specific characteristics, such as high liquefaction susceptibility areas, high percentage of renters, or low income residents who are unlikely to have savings. Jurisdictions or regional agencies could support messaging with local analysis of costs, likelihood of disasters, and provide localized information about retrofit standards and incentives.

Governance/Implementation Issues

Insurance can be important for recovery in many situations, but it's not always the best option. From a jurisdiction's perspective, retrofit is the preferred way to build in resilience, since it keeps housing intact and keeps residents in their homes. Any program promoting insurance would have to balance the needs and desires of the region and the jurisdiction with the safety and security of residents.

State *Region* *Local* *Develop education program(s) to encourage homeowners and renters to purchase hazard insurance*

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	Development and Construction Loans	Individual Home Improvement or Commercial Renovation Loans	Revolving Loan Fund Programs	Grant Programs	**Other**

Jurisdictions will need to provide resources for staff time, printed materials, and possibly outreach events.

Implementation Partner(s)

State	Region	Local
CEA should serve as the primary lead on this effort and form partnerships with regional and local governments.	ABAG or other regional agencies or nonprofits can help promote insurance messaging at a regional level, and assist with coordinating jurisdictions' efforts.	Local jurisdictions may partner with local nonprofits or community groups to reach particular targeted audiences, such as renters or low income residents.

Examples

The following is an example of an NGO partner that could help jurisdictions to promote targeted insurance education on a local level.

The United Policyholders Roadmap to Preparedness (R2P) program

The United Policyholders Roadmap to Preparedness (R2P) program promotes disaster preparedness and insurance literacy through outreach and education in partnership with civic, faith based, business and other non-profit associations. It offers workshops, presentations and tools and tips that help people and businesses make savvy insurance decisions and be properly insured, resilient and able to recover after an adverse event.

See: http://www.uphelp.org/roadmap-preparedness

4. Improve the quality assurance of non-engineered retrofits by developing a statewide retrofitting license for contractors, with contractor training and technical materials

Increase the number of skilled contractors, contractor knowledge, consistency in retrofit quality, and owner assurance and trust in non-engineered retrofits by developing a regional or statewide program to train and license or certify contractors in non-engineered seismic retrofits.

Lead			**Scale of Benefit**		
State	**Region**	Local jurisdiction	**Region**	Community	**Resident**

Target Development Type		**Hazard Addressed**		
Existing	New	**Ground Shaking**	Liquefaction	Flooding

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	Access to Resources	Single or Two Family	Multi-family	**Cripple Wall**	Soft story or House over garage

Action Categories					
Evaluation	**Program/ Operation**	Plans and Policies	Codes, Regulations, and Ordinances	Coordination	Education/ Outreach

Prerequisite Strategies	**Other Related Strategies**
None	Strategy 18: Develop and implement a cripple wall retrofit program

Description

Single-family home types at highest risk for damage in earthquakes include un-retrofitted homes built before 1978, especially homes on hillsides, homes with cripple walls, and homes with living spaces above a garage. While most of these retrofits should be designed by an engineer, many cripple wall retrofits may not need to be engineered.

Cripple walls are the short wood stud walls that enclose a crawl space under the first floor of a building. Most Bay Area detached homes built before 1940 have cripple walls, often indicated by a series of steps leading up to the front door. Cripple walls are at risk of severe damage or collapse during an earthquake, and may require that a home be demolished and rebuilt, even if the rest of the home is intact. Additionally, a non-engineered cripple wall retrofit is generally very affordable (between $2,000 and $10,000, depending on the size and condition of the home) and relatively easy to accomplish. Retrofitting these older homes is important so that fewer people will be displaced from their homes after an earthquake, and necessary repair costs will be reduced (see Strategy 18: Develop and implement a cripple wall retrofit program).

State *Region* *Local* *Improve the quality assurance of non-engineered retrofits by developing a statewide retrofitting license for contractors, with contractor training and technical materials*

Often single-family home retrofits are designed and performed by licensed contractors who have no special training in seismic construction. ABAG estimates that one-third to two-thirds of cripple wall retrofits in the Bay Area are not adequate to resist damage in strong earthquake shaking. The key difference between standard construction and construction designed to resist seismic forces is that the structure must be able to resist side-to-side (shaking) forces in addition to vertical (gravity) forces.

While California has adopted standards for retrofitting single-family homes, the standards are voluntary and only apply to simple homes on flat land. Homeowners who have paid significant amounts of money for inadequate retrofits are living with a false sense of security that won't be uncovered until after an earthquake. Proper training and licensing of contractors who perform retrofits will help ensure that retrofits are done properly and that homeowners' performance expectations are met.

The best way to address this issue would be for for the California Legislature to direct the Contractors State License Board to create a new contractor license classification for seismic retrofit, similar to classifications already in place for electrical and plumbing work. The licensing should include training, examination, and renewal every three years consistent with updates to the building code. City inspectors and buildings officials should also be trained so they can provide adequate inspection and plan review of retrofit designs. A list of licensed retrofit contractors should be available online for use by homeowners seeking trained contractors.

An alternative way to train contractors is through an informal training and certification program, such as those offered by the North American Board of Certified Energy Practitioners (NABCEP) for renewable energy contractors. NABCEP certification is not a professional license issued by a government agency, and does not authorize a certificant to practice; however, it provides a means for quality renewable energy contractors to set themselves apart in the marketplace and offers assurances to those who hire these professionals that they have received the appropriate training. ABAG's Training Center or another interested agency can offer a certification course for seismic retrofit contractors that would provide the education needed by contractors and the assurances needed by homeowners. The necessary training material has already been compiled by ABAG, but the logistics of offering the training has yet to be worked out.

Governance/Implementation Issues

Adoption of a new contractor licensing classification through the Contractors State License Board will require an act of the State Legislature, which will be a challenging task. Creating an informal seismic retrofitting certification would require action by ABAG or another interested agency. Cities and counties or other agencies that provide incentives for seismic retrofitting of single family homes should require that trained contractors perform the retrofit in order to be eligible for financial incentives.

Improve the quality assurance of non-engineered retrofits by developing a statewide retrofitting license for contractors, with contractor training and technical materials

State *Region* *Local*

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	Development and Construction Loans	Individual Home Improvement or Commercial Renovation Loans	Revolving Loan Fund Programs	**Grant Programs**	**Other**

Contractors would pay for the training themselves, making the program self-sustaining. Seed funding may be needed for the training agency or organization to support start-up costs and development of the training program.

Implementation Partner(s)

State	Region	Local
California State Legislature and Contractors State License Board for adoption of a new contractor licensing category. California Earthquake Authority (CEA) has plans to implement a retrofit incentive program and would be an important partner to insure that contractors performing these retrofits are properly trained.	In the absence of state licensing, ABAG can develop and conduct a contractor certification program through its Training Center.	Local governments who review single-family home retrofit plans can require that contractors follow IEBC A3 or Plan Set A when applicable, or hire an licensed engineer for the retrofit design and that the retrofits be performed by specially licensed or certified contractors.

Examples

The following is an example of a training and certification program intended to improve the quality assurance of contractor work

North American Board of Certified Energy Practitioners (NABCEP)

When the California State License Board (CSLB) lumped photovoltaics installation with the solar hot water license (plumbing skills), the solar industry established a separate voluntary certification program called the North American Board of Certified Energy Practitioners (NABCEP). NABCEP offers entry-level knowledge assessment, professional certification, and company accreditation programs to renewable energy professionals throughout North America.

State *Region* *Local* *Improve the quality assurance of non-engineered retrofits by developing a statewide retrofitting license for contractors, with contractor training and technical materials*

A NABCEP certification is not a professional license issued by a government agency, and does not authorize a certificant to practice, but it does raise industry standards and promote consumer confidence. NABCEP is known as the "gold standard" for PV and Solar Heating Installation and PV Technical Sales Certifications.

In order to receive certification, the contractor must have education and experience in solar installation. For contractors who lack hands-on experiences, training courses are available as partial fulfillment of the eligibility requirements. All participants must pass a written certification examination. Certified contractors can use the NABCEP certification logo on promotional materials and have their name on the online list of certified solar installers. Contractors must be re-certified every three years, with documented experience installing three qualifying PV systems during the previous three year period and obtain at least 18 contact hours of continuing education.

The NABCEP certification program is overseen by a volunteer board comprised of renewable energy stakeholder representatives including the solar industry, NABCEP certificants, renewable energy organizations, state policy makers, educational institutions, and trades.

See: http://www.nabcep.org/

5. Establish a cooperative shoreline management program

Coordinate with government agencies, organizations, and land owners to establish and maintain a cooperative shoreline management program. This cooperative program could identify strategies for shared decision-making and funding to reduce current and future flood risks in a manner that benefits and balances issues of equity, economy, and environment.

Lead			**Scale of Benefit**		
State	**Region**	Local jurisdiction	**Region**	Community	Resident

Target Development Type		**Hazard Addressed**		
Existing	**New**	Ground Shaking	Liquefaction	**Flooding**

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	Access to Resources	**Single or Two Family**	**Multi-family**	Cripple Wall	Soft story or House over garage

Action Categories					
Evaluation	**Program/ Operation**	**Plans and Policies**	Codes, Regulations, and Ordinances	**Coordination**	Education/ Outreach

Prerequisite Strategies	**Other Related Strategies**
None	None

Description

Shoreline management is difficult to coordinate, especially when there are multiple landowners, landowners that are protected by shorelines they do not own, and agencies and organizations that own shoreline areas but have other mandates and priorities. Additionally, the Bay Area has multiple regulatory agencies with jurisdictional authority over the shoreline. Shoreline projects are usually conducted as maintenance and improvement projects that address immediate needs. The projects do not consider future climate and the longer term challenges of sea level rise or storm surge, nor do they fully reduce or mitigate flood risks. In addition, these projects often address the single issue of flood protection and do not assess flooding in a natural and sustainable manner (e.g., placing riprap slope protection on a single shoreline segment to address areas of ongoing erosion).

This strategy proposes a cooperative shoreline management program that would establish and maintain coordinated decision-making and financing among public agencies and private entities. The program should articulate the organizational roles and responsibilities of each participant, the flood risk maps and analysis that will be used, and how planning and funding

decision will be made. There is no simple mechanism for this type of coordination. The goal of this strategy is long-term, effective, and integrated management of the shoreline including ongoing maintenance and new capital investments that mitigate the impacts of temporary storm event flooding and permanent inundation from sea level rise.

Models for this type of coordination could come from existing joint powers authority structures, through memorandum of understanding, or other tools designed to organize diverse interests and allow for shared decision-making and financing. An identified mechanism for cost sharing would be necessary to encourage and support larger scale shoreline or landscape projects that involve multiple agencies, organizations, and property owners. Funding could be tiered, based on the type of project being implemented or on the number of those participating or the length of shoreline being addressed. For example, multi-objective projects such as living or horizontal levees that provide flood risk reduction as well as ecosystem, water quality, and public access benefits could be eligible for more funding support in the form of federal, state, and regional grant programs than a traditional levee approach. Similarly, a strategy that is cooperatively implemented by a number of agencies, organizations, and property owners and reduces flood risk for an entire neighborhood could receive more funding than a strategy that is cooperatively implemented by fewer partners and reduces flood risks for only several homes or land uses.

It can be challenging to initiate coordination among agencies, organizations, and property owners on issues beyond their regular planning and programmatic efforts. A regional, state, or federal agency could serve as an early convener and provide staff and technical assistance. Possible convener agencies include Association of Bay Area Governments (ABAG), Bay Conservation and Development Commission (BCDC), United States Army Corps of Engineers (USACE), Environmental Protection Agency (EPA), National Oceanic and Atmospheric Administration (NOAA), or United States Fish and Wildlife Services (USFWS).

A coordinated shoreline management program that results in projects that meet the needs of a variety of stakeholders is likely to have broader economic, social, and environmental co-benefits, including habitat restoration, habitat and home protection, and job security.

Governance/Implementation Issues

This strategy will require coordination among agencies, organizations, and land owners that typically have not cooperated in the past on decision-making and financing of shared projects. New coordination efforts could cause significant challenges, particularly in initiating and maintaining the program with full participation of all stakeholders.

Potential Financing Mechanisms

City/County/ State Bond Program	**Parcel or Sales Tax**	**Tax-based Special Districts**	**Fee-based Special Districts**	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	Development and Construction Loans	Individual Home Improvement or Commercial Renovation Loans	Revolving Loan Fund Programs	**Grant Programs**	Other

This strategy will require the convening agency to dedicate resources to initiate and run a working group of participating stakeholders. Resources will also be required from participating stakeholders. The costs associated with coordination would likely be shared by each of the participating entities. Furthermore, coordinated management efforts may lead to cost savings among cooperating agencies by reducing duplication of efforts or inconsistencies. The financing mechanism for future coordinated management that results from collaboration would depend on the project scale and objectives , and could include several options such as state grant programs, tax-based special districts, fee-based special districts, a parcel tax funded program, etc.

Implementation Partner(s)

State	Region	Local
State agency partners with a role in coastal planning such as State Coastal Conservancy and Office of Policy and Research	A regional agency such as ABAG or BCDC could serve as an early convener. All agencies with jurisdiction over shoreline protection infrastructure and adjacent assets, and other regional stakeholders such as adjacent landowners.	All agencies with jurisdiction over shoreline protection infrastructure and adjacent assets, and other regional stakeholders such as adjacent landowners.

Examples

The following is an example of an existing program where the state coordinates and assists local shoreline management that can be leveraged to implement this strategy:

State of Washington Cooperative Shoreline Master Program (SMP)

The Shoreline Management Act (SMA, RCW 90.58.020) establishes a cooperative program between local and state governments for management of Washington's fresh and saltwater shorelines. Local governments develop and administer a Shoreline Master Program for their local area, and the Washington Department of Ecology provides support and oversight. See:

http://www.ecy.wa.gov/programs/sea/SMA/guidelines/index.html

As a part of this program, two-year Shoreline Master Program grants are available to local governments (cities, towns, and counties) as assistance for implementing and updating approved SMPs. Grant limits are dependent on shoreline length, complexity, population, and development pressure. See:

http://www.ecy.wa.gov/programs/sea/grants/smp/moreinfo.html

6. Develop guidelines for the siting and design of transit-oriented development to reduce seismic and flood risks

Encourage the Metropolitan Transportation Commission to include an annex to its Station Area Planning Manual that contains guidelines for on-site planning and design techniques that could reduce risk to areas vulnerable to hazards such flooding, shaking, and liquefaction. The annex would be consistent with the overarching purpose of MTC Resolution 3434 Transit-Oriented Development (TOD) policy for regional transit expansion projects, taking into account techniques to mitigate for the risk of introducing 42,000 new housing units along the region's major new transit corridors.

Lead			**Scale of Benefit**		
State	**Region**	Local jurisdiction	Region	Community	**Resident**

Target Development Type		**Hazard Addressed**		
Existing	**New**	**Ground Shaking**	**Liquefaction**	**Flooding**

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	**Cost Burdened**	Housing Tenure	**Access to Resources**	**Single or Two Family**	**Multi-family**	**Cripple Wall**	**Soft story or House over garage**

Action Categories					
Evaluation	Program/ Operation	**Plans and Policies**	Codes, Regulations, and Ordinances	Coordination	Education/ Outreach

Prerequisite Strategies	**Other Related Strategies**
None	Strategy 22: Enhance minimum design requirements for new small-scale residential building foundations in liquefaction zones

Description

Among other things, the Station Area Planning Manual provides guidance for meeting transit corridor housing thresholds, appropriate mix of commercial and employment uses with housing, future land-use changes, station access needs, circulation improvements, and pedestrian-friendly design. The density and intensity of the land-use mix is based on the station area place type. The manual does not, however, provide guidance on how to achieve the objectives of the Priority Development Area (PDA) program in accommodating the majority of new jobs and housing in a manner that reduces risk.

This strategy proposes that MTC prepare as an annex to the Station Area Planning Manual that includes guidelines for on-site planning and design techniques that could reduce risk to areas vulnerable to hazards such as flooding, shaking, and liquefaction.

The annex would be consistent with the overarching purpose of MTC Resolution 3434 Transit-Oriented Development (TOD) policy for regional transit expansion projects, which is to:

1. Accommodate the majority of future growth (new jobs and housing) in close proximity to public transit stations and transit corridors while ensuring that the regional transit network can accommodate the anticipate increase in transit use;
2. Support a growing market demand for more vibrant, walkable and transit convenient lifestyles;
3. Improving the cost effectiveness of regional investments in new transit expansions;
4. Easing the Bay Area's chronic housing shortage while creating vibrant new communities, and helping preserve regional open space; and
5. Collaboration among transportation agencies, local jurisdictions, members of the public and the private sector to create development patterns that are more supportive of transit.

The annex would not modify MTC Resolution 3434, but support its implementation, taking into account techniques to mitigate for the risk of introducing 42,000 new housing units along the region's major new transit corridors. In addition, the annex should support planning strategies that reduce risk from earthquakes and flooding of placing 78% of new housing units and 62% of new jobs within Priority Development Areas per the ABAG/MTC Focus program.

General planning and design guidance would be included in the annex and address the following topics:

1. PDA and project-scale planning and design techniques that reduce risks from on-site flooding and storm surge from extreme weather events through techniques such as low-impact development (e.g., naturalized stormwater management) and naturalized and engineered storm surge protection facilities;
2. Working with existing, or restoring, site contours or natural drainage ways, or designing naturalized vegetated stormwater drainages to reduce flood hazards.
3. Siting of new housing and commercial development, and retrofitting of existing development, to avoid, where possible, soils with the highest liquefaction potential or, alternatively, encouraging construction techniques minimize liquefaction hazards per Strategy 22: Enhance minimum design requirements for new small-scale residential building foundations in liquefaction zones.

Governance/Implementation Issues

Given that MTC has exclusive jurisdiction over the development of the manual, this strategy does not require collaboration with other agencies. However, other agencies such as transit service providers and congestion management agencies could play an advisory role in the development of the annex. BCDC and ABAG could potentially provide resources on identifying current and projected inundation zones and seismic zones respectively.

Develop guidelines for the siting and design of transit-oriented development to reduce seismic and flood risks *State* **Region** *Local*

Once developed and adopted, the guidelines, prepared as an annex to the manual, may be used by local governments. Implementation of the guidelines might require revisions to local government plans, potentially including local general plans, specific plans, district, and other plans; development codes; design guidelines, and subdivision improvement standards.

Local governments have exclusive jurisdiction over their local plans and codes, and therefore, compliance with requirements under this strategy will not require collaboration among local governments and regional agencies, but can certainly benefit from collaboration. For example, ABAG could potentially facilitate the development of model code language for this strategy, such that it is accessible to all communities. This strategy is in alignment with the ABAG Regional Hazard Mitigation Plan and local hazard mitigation plans.

Implementation of the guidelines in this strategy can also occur through a combination of technical and staffing assistance through the PDA program and knowledge sharing networks established through ABAG, universities in the Bay Area, and nonprofit organizations such as SPUR, Urban Land Institute, American Planning Association (APA), and American Institute of Architects (AIA).

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	**Fee-based Special Districts**	**Infrastructure Financing Districts**	Joint Powers Authorities
Municipal Enterprise Funds	**Development and Construction Loans**	Individual Home Improvement or Commercial Renovation Loans	Revolving Loan Fund Programs	**Grant Programs**	**Other**

Given that this strategy is aimed at ensuring the safety of new development through site planning and design requirements, it is expected that for new development, any additional costs resulting from hazard mitigation site planning and design techniques would be borne by developers. For developers, the financing mechanism would be the same as for other types of private development. Developers of affordable housing can access subsidies, such as the Low Income Housing Tax Credits, HOME funds from HUD, and below market rate loans from community development finance institutions, to help finance the costs.

The cost to local governments of adopting PDA plans that significant reduce the risk of providing the majority of new housing and jobs within PDAs can be offset through the various regional, state, and federal grant programs such as the ABAG/MTC PDA program (which provides planning grants), the Strategic Growth Council Planning Grant program, the Caltrans Sustainable Transportation Planning grant program, and other regional, state, and federal grant programs.

Financing for non-transit infrastructure and facilities in PDAs needed to mitigate for natural hazards could also be provided through a number of district financing mechanisms, such as infrastructure financing districts (see Table 3-4 on page 23). Financing could also come from state or federal programs that provide grants for hazard mitigation planning.

Implementation Partner(s)

State	Region	Local
No state partners are required for this strategy.	ABAG, MTC, transit service providers, congestion management agencies, BCDC (See section on governance and implementation issues for more detail on the role of these agencies)	Local jurisdictions (see section on governance and implementation issues for more detail on the role of local governments)

Examples

NOAA/EPA, Achieving Hazard-Resilient and Coastal Waterfront Smart Growth

This report focuses on how coastal and waterfront communities can create environmentally and economically sustainable neighborhoods while minimizing risks from coastal flooding. The report provides ideas for further research, tools, services, and approaches that federal and state agencies, academics, organizations, and practitioners could consider to improve integration of smart growth and hazard mitigation approaches along the coast. Together, smart growth strategies and hazard mitigation measures can offer communities tools they can use to meet their safety, economic, environmental, quality of life, and transportation goals. Communities that better integrate smart growth approaches and hazard mitigation can use funds and staff time more effectively, make development rules clearer and more predictable for developers, and keep people and property safer.

This report examines the intersection between hazards mitigation and smart growth strategies related to green infrastructure, protection of hazard-prone area along the water, protection of hazardous areas and environmentally sensitive areas (such as wetlands and floodplains), planning in advance for emergency public transportation, elevating buildings to protect them from flooding, and relocating development out of hazard-prone areas.

The report also recommends siting and site design strategies that integrate risk as a siting principle into land-use planning, including:

- Identifying areas exposed to different levels of risk and adjust, as needed, overtime as the level of risk changes;

- Identifying redevelopment opportunities that are within or adjacent to already developed areas but out of hazard-prone areas;
- Preserving green infrastructure and critical environmental areas in strategic locations to reduce risk; and
- Considering how infrastructure siting decisions influence the location of other development.

http://coastalsmartgrowth.noaa.gov/resilience.html

New York City Urban Waterfront Adaptive Strategies

New York City's coastal zone encompasses the extensive wetlands of Jamaica Bay and Long Island Sound, dense commercial centers and industrial areas, beachfront residential communities, and myriad other neighborhoods. This study explores the range of coastal management and protection options that are suited to urban areas with large existing populations in flood zones, limited space, and shorelines that have been altered and often hardened in a variety of ways. Given the diversity of geography and uses within urban areas, each stretch of the waterfront faces specific types and levels of risk and presents different opportunities and constraints.

Strategies in this document include interventions upland, at the shoreline, or in the water, which frequently involve many individual sites and landowners, and are often built and maintained by public agencies. The objectives of various reach strategies include stabilizing land against erosion and daily tide levels, reducing wave forces, blocking the flooding of upland neighborhoods, and removing development from vulnerable areas. Some strategies can reduce risks from multiple hazards, while others may not. Strategies that involve land use, siting, and project design considerations include elevation of land and streets, development of waterfront parks, creation or restoration of "living shorelines," and strategic retreat.

Each strategy carries with it costs and benefits, which should be broadly defined. Potential costs include financial costs, both to construct and maintain new pieces of infrastructure, as well as indirect costs, such as environmental degradation, impacts on neighborhood vitality, economic activity and tax revenues, or the quality of public space and urban design. The benefit of a strategy can be measured in terms of risk reduction, as well as the potential co-benefits associated with it, such as environmental improvements, economic development, and the improvement of the city's public realm.

http://www.nyc.gov/html/dcp/pdf/sustainable_communities/urban_waterfront_print.pdf

7. Encourage innovative insurance solutions at the state and federal levels, and in partnership with the private sector

Lobby and advocate for the expansion of state- and federally-mandated catastrophe insurance programs, such as the California Earthquake Authority. Better insurance solutions could enhance mitigation efforts by offering incentives such building permit rebates, lower premiums or deductibles for retrofitted homes, state-level tax incentives, and state and federal grants to fortify homes and business.

Lead			**Scale of Benefit**		
State	**Region**	Local jurisdiction	**Region**	Community	Resident

Target Development Type		**Hazard Addressed**		
Existing	**New**	**Ground Shaking**	**Liquefaction**	**Flooding**

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	**Cost Burdened**	**Housing Tenure**	**Access to Resources**	**Single or Two Family**	**Multi-family**	Cripple Wall	Soft story or House over garage

Action Categories					
Evaluation	Program/ Operation	Plans and Policies	Codes, Regulations, and Ordinances	**Coordination**	**Education/ Outreach**

Prerequisite Strategies	**Other Related Strategies**
None	Strategy 3: Develop education program(s) to encourage homeowners and renters to purchase hazard insurance Strategy 17: Develop and implement a soft-story retrofit program Strategy 18: Develop and implement a cripple wall retrofit program

Description

In the wake of a natural disaster, homeowners and renters of all income levels can be severely affected by the destruction of their homes, particularly if they are not covered by a natural hazards insurance policy. According to the California Earthquake Authority (CEA), only 10 percent of the California's homeowners and renters have purchased an earthquake insurance policy. Reasons for low levels of participation by residents may be lack of awareness or understanding of insurance, and issues with the perceived cost-benefit of maintaining an earthquake insurance policy due to high premiums and high deductibles. For example, the statewide average annual cost of earthquake premiums is about $800 and typically comes with a 15% or a 10% deductible , which means that a homeowner insured for $650,000 (the

average cost of a home in the Bay Area) with a 15% deductible would be responsible for $97,500 of repairs before coverage kicks in. Most homeowners aren't prepared for that sort of cash outlay, particularly in a post-disaster situation. Another reason homeowners and renters avoid purchasing earthquake insurance is because they believe federal programs will provide financial assistance after a natural disaster. However, assistance from federal and state disaster relief programs alone is unlikely sufficient to repair a majorly damaged home to pre-disaster conditions, which poses dire consequences for uninsured very low, low and medium income households, cost burdened households and people living in fragile housing types.

To help make earthquake insurance more manageable for a wider audience of homeowners, and thus reduce uninsured losses in an earthquake, this strategy recommends that jurisdictions seek opportunities to participate in lobbying at the state and federal levels to create and expand all-hazards insurance pools, expand state and federal grant programs to retrofit homes and businesses and tie state-level incentives such as reduced premiums for retrofitted homes (see Strategy 17: Develop and implement a soft story retrofit program, Strategy 18: Develop and implement a cripple wall retrofit program). Jurisdictions can also partner with existing insurance providers, such as CEA, to implement innovative risk reduction programs, such as CEA's Brace and Bolt program, which provides grants and discounts on insurance premiums for participating in a retrofit program. Partnerships with CEA can also help tailor improved insurance programs to the specific needs of the jurisdiction and region.

This strategy also recommends working with private insurers to offer insurance products that would help rebuild disaster-damaged homes and businesses to higher standards.

In conjunction with these efforts, a jurisdiction should conduct a public outreach campaign to encourage homeowners and renters to purchase hazard insurance, which could further improve rates of participation (see Strategy 3: Develop education program(s) to encourage homeowners and renters to purchase hazard insurance).

Governance/Implementation Issues

Jurisdictions are unlikely to have the resources to influence federal, state, or private insurance practices. However, many partners are available that can leverage local efforts. Jurisdictions may coordinate with a regional partner such as the Association of Bay Area Governments to lobby at the state and federal levels for the expansion of insurance pools and leverage partnerships with private insurers.

Partnerships with private insurance companies and organizations that have traditionally been supporters of natural disaster mitigation efforts such as Nationwide Insurance, the National Association of Mutual Insurance Companies (NAMIC), and the Insurance Institute for Business & Home Safety (IBHS) could help lobbying efforts at the state and federal level to improve incentives.

Partnerships with advocacy groups like BuildStrong – a group of national business and consumer organizations, firefighters, emergency managers, building professionals and insurance groups could help lobby for the adoption of statewide model building codes.

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	Development and Construction Loans	Individual Home Improvement or Commercial Renovation Loans	Revolving Loan Fund Programs	Grant Programs	**Other**

Jurisdictions will need to provide staff resources. The California Earthquake Authority has funding for research. This might be tapped to analyze the alternative forms of hazard insurance that could better serve the needs of homeowners and renters.

Implementation Partner(s)

State	Region	Local
California Earthquake Authority, private insurance companies and organizations such as Nationwide Insurance, the National Association of Mutual Insurance Companies (NAMIC), and Insurance Institute for Business & Home Safety (IBHS).	ABAG can help coordinate and leverage local efforts to lobby at state and federal levels.	*No local partners are required for this strategy.*

Examples

The following is an example of a retrofit program, initiated by an insurance provider (CEA), designed to increase retrofits and reduce earthquake insurance premiums.

Earthquake Brace+Bolt Program

This program, still in pilot phase, is a partnership between CEA and CalOES. The program provides a $3,000 incentive to homeowners who bolt their homes to their foundations and implement cripple wall strengthening using Standard Plan Set A. In addition to the $3,000 incentive, policyholders may be eligible for a five percent Hazard Reduction Premium Discount if homes are retrofitted using the Brace+Bolt standards.

https://www.earthquakebracebolt.com/

8. Advocate for changes to post-disaster federal and state multifamily housing rebuilding programs

Lobby at the state and federal levels to ensure multifamily housing receive a fair and equitable share of financial and technical assistance during rebuilding and recovery efforts.

Lead			**Scale of Benefit**		
State	**Region**	Local jurisdiction	Region	**Community**	Resident

Target Development Type		**Hazard Addressed**		
Existing	**New**	**Ground Shaking**	**Liquefaction**	Flooding

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	**Language & Ethnicity**	**Cost Burdened**	**Housing Tenure**	**Access to Resources**	Single or Two Family	**Multi-family**	Cripple Wall	Soft story or House over garage

Action Categories					
Evaluation	Program/ Operation	Plans and Policies	Codes, Regulations, and Ordinances	**Coordination**	Education/ Outreach

Prerequisite Strategies	**Other Related Strategies**
None	Strategy 37: Improve the resilience of rental units and ensure they are re-built after loss or damage due to a natural disaster Strategy 38: Protect affordable housing during recovery

Description

Rebuilding of multifamily housing is often difficult and lags behind rebuilding of single family homes, for multiple reasons. Multifamily housing is often occupied by renters, not the building owner, so there is less of an incentive for the building owner to rebuild quickly and in-kind, since the owners are more likely motivated by financial investments rather than rebuilding a home.

In past disasters, HUD and FEMA have provided funding to residents for repairs and rebuilding through the Community Development Block Grant Program; however the majority of the funding typically goes to single family homeowners. For example, in Hurricane Katrina, $8.9 billion was made available to homeowners versus $1.2 billion for multifamily and renters.

Post-disaster rebuilding of multifamily buildings is often reliant on housing and finance markets. From a developer's perspective, post-disaster multifamily reconstruction projects can be difficult in that financial institutions often offer programs to incentivize large scale rebuilding projects

but do not incentivize smaller rental property rebuilding projects under the premise that large-scale projects happen more quickly and efficiently. This may permanently change the look and feel, as well as residential demographics, of many Bay Area neighborhoods unless small-scale multifamily rebuilding is also incentivized or supported through policy.

Vulnerable populations who are residents of affordable or multifamily housing are also usually underrepresented in the planning process, which leaves them the hardest and longest hit in the wake of a natural disaster.

In order to ensure that multifamily housing gets rebuilt quickly and in-kind and promote equitable rebuilding for multifamily housing, this strategy recommends that jurisdictions seek opportunities to participate in lobbying at state and federal levels for equitable rebuilding programs for multifamily homes. Jurisdictions should partner with neighborhood organizations, city government, regional and state agencies and key civic organizations to brainstorm and build effective arguments and advocate for equitable funds distribution after a disaster. With appropriate advocacy, HUD funds may be more equitably distributed in future disasters. Post-disaster funding for rebuilding may also help incentivize investment rebuilding in small-scale multifamily that may make less sense from a traditional market perspective.

This strategy should be paired with local policies to protect rental and affordable housing. See Strategy 37: Improve the resilience of rental units and ensure they are re-built after loss or damage due to a natural disaster, and Strategy 38: Protect affordable housing during recovery.

Governance/Implementation Issues

Advocacy and lobbying at the state level is best coordinated by the region to ensure that jurisdictions have the strongest voice.

Partnerships with state funded organizations such as California Housing Partnership Corporation could provide technical assistance and data for affordable housing developers, government officials and housing advocates seeking to preserve existing affordable housing. Additionally, jurisdictions could partner with labor groups to ensure fair hiring practices and equal representation from trades members.

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities

Advocate for changes to post-disaster federal and state multifamily housing rebuilding programs *State* **Region** *Local*

Municipal Enterprise Funds	Development and Construction Loans	Individual Home Improvement or Commercial Renovation Loans	Revolving Loan Fund Programs	Grant Programs	**Other**

General funding is needed for staff time to participate in lobbying actions.

Implementation Partner(s)

State	Region	Local
California Housing Partnership Corporation (CHPC), California Department of Housing and Community Development (HCD) could be potential partners for advocacy.	Other jurisdictions, regional housing associations, private developers, labor organizations, and regional agencies such as ABAG could be potential partners and provide support for advocacy.	Neighborhood organizations and civic organizations may provide support for advocacy.

Examples

No examples available.

9. Decrease reliance on grid-supplied energy

Promote buildings that will maintain livable conditions in the event of extended loss of power or heating fuel. This can be done through incentives for residential energy efficiency retrofits, weatherization projects, building design standards that promote energy load reductions and on-site generated electricity or bi-direction energy sources, that make homes habitable when there are utility outages caused by disasters.

Lead			**Scale of Benefit**		
State	**Region**	**Local jurisdiction**	Region	**Community**	Resident

Target Development Type		**Hazard Addressed**		
Existing	**New**	**Ground Shaking**	**Liquefaction**	Flooding

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	**Cost Burdened**	Housing Tenure	**Access to Resources**	Single or Two Family	Multi-family	Cripple Wall	Soft story or House over garage

Action Categories					
Evaluation	Program/ Operation	Plans and Policies	Codes, Regulations, and Ordinances	Coordination	**Education/ Outreach**

Prerequisite Strategies	**Other Related Strategies**
None	Strategy 36: Develop and implement a shelter-in-place program

Description

After a disaster, utilities may be unavailable for long periods of time, and residents may need to be self-sufficient. Households with elderly, very young, and/or disabled individuals as well as those that are cost burdened are especially vulnerable to post-disaster living circumstances in which there is an extended loss of power, fuel or water to maintain the habitability of their homes because of complications relating to limited mobility, low physical tolerance to extremes in temperature, or limited access to resources. Increasing the energy efficiency, weatherization, and on-site renewable energy can maintain livable thermal conditions in the event of extended loss of power or heating fuel through the use of elements such as energy-efficient building envelopes, natural ventilation, and passive solar heating.

Benefits of energy efficiency, renewable energy, and weatherization upgrades are usually marketed as a way to lower utility bills, increase thermal comfort, potentially increase home value, help the environment, and support local economy, but messaging should also include that an energy efficient home will be more habitable should a long period of utility interruption

occur after a natural disaster. This strategy recommends that jurisdictions build on existing renewable energy, weatherization and energy efficiency upgrade and incentive programs, highlighting the co-benefits of passive heating/cooling in an outage scenario, and by altering on-site generation projects to be functional in outage scenarios. This strategy could also include outreach to targeted communities such as low income, the elderly, or disabled individuals who are particularly vulnerable to the loss of habitability after a disaster.

Governance/Implementation Issues

This strategy should be led by parties (local jurisdictions, energy retrofit non-profits, private energy retrofit organizations) already administering/implementing building energy upgrades, or on-site generation projects. For energy efficiency upgrades an education program to highlight the added benefit of greater comfort in outage scenarios can be made. For on-site energy generation new standards may need to be developed by a local jurisdiction.

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	**Tax-based Special Districts**	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	Development and Construction Loans	Individual Home Improvement or Commercial Renovation Loans	Revolving Loan Fund Programs	Grant Programs	**Other**

Jurisdictions will need to provide staff time to work with locally active energy upgrade organizations.

Financing for residential energy upgrades could come from the California Alternative Energy and Advanced Transportation Financing Authority's Property Assessed Clean Energy (PACE) reserve fund. Although the future of residential PACE financing is still uncertain in California, the establishment of a reserve fund may indicate that it could be revitalized at some point.

Implementation Partner(s)

State	Region	Local
California Public Utilities Commission (CPUC) and California Energy Commission (CEC) could provide incentive or financing programs. These could be packaged and advertised at the regional or local level.	Association of Bay Area Governments (ABAG)'s Bay Area Regional Energy Network (BayREN) program provides single family and multifamily energy upgrade programs to the region and can serve as messaging partners to jurisdictions.	Nonprofit or for-profit energy retrofit organizations or renewable energy providers can partner with jurisdictions to incorporate resilience messaging and target particularly vulnerable audiences.

Examples

ICLEI's 2014 report "Solar Energy & Resilience Planning - A practical guide for local governments" outlines examples of projects that have used solar energy for both sustainability and resilience purposes. The document also has a chapter on financing.

http://www.icleiusa.org/solar-and-resilience-guidebook/view

The following are examples of standards, programs and incentives for energy efficiency retrofits, weatherization projects and onsite power generation.

Standards

The 2013 Building Energy Efficiency Standards, comprising Title 24, Parts 1 and 6, of the California Code of Regulations.

http://www.energy.ca.gov/2012publications/CEC-400-2012-004/CEC-400-2012-004-CMF-REV2.pdf

Programs/Incentives

CHF Residential Retrofit Program

Eligible homeowners of single family, 1-4 unit residential properties can apply for a 6.5% fixed interest rate loan, up to $50,000, to make energy efficiency home improvements through the CHF Residential Retrofit Program, which is administered by the CRHFMA Homebuyers Fund (CHF), in partnership with Energy Upgrade California. Rental properties are also eligible for the program, which is offered in 44 California counties, including all of the nine Bay Area counties. Examples of eligible energy efficiency work under the program include: window and duct

sealing, insulating walls and attics, installing new hearing and air conditioning systems, and installing new water heaters, windows. Renewable energy measures (i.e. solar measures) are also eligible for financing under the program, subject to requirements.

http://www.chfloan.org/Programs/Energy/energy_program.html

CA Weatherization Assistance Program (WAP)

The Association for Energy Affordability The Department of Energy's Weatherization Assistance Program (WAP) in California is a whole-building program to improve energy efficiency in low-income properties, administered by the Department of Community Services and Development (CSD). Since the implementation of the multifamily WAP protocol in California in 2011, AEA has been providing WAP energy audits and technical assistance to income-qualified properties. AEA is capable of not only providing the energy audit and associated TREAT energy model, but also detailed specifications, construction administration, and quality assurance and verification of installed energy savings measures.

http://www.benefits.gov/benefits/benefit-details/1844

Bay Area Regional Energy Network

BayREN is a collaboration of the nine counties that make up the San Francisco Bay Area. Led by the Association of Bay Area Governments (ABAG), BayREN implements effective energy saving programs on a regional level and draws on the expertise, experience, and proven track record of Bay Area local governments to develop and administer successful climate, resource, and sustainability programs. BayREN is funded by California utility ratepayers under the auspices of the California Public Utilities Commission. BayREN offers programs for single family homeowners, with rebates up to $4,500, and a program for multifamily property owners providing rebates up to $750 per unit.

https://www.bayren.org/

Marin County Showcase Home Event Incentive

Marin County provides a Showcase Home Event Incentive, which is a $1,000 incentive for homeowners to invite friends, family and colleagues over upon completion of a home energy upgrade project in order to showcase the work they did. Homeowners receive an Event Tool Kit.

http://www.marincounty.org/depts/cd/divisions/planning/sustainability/energy-programs/energy-upgrade-california

10. Host a regional "Smart and Safe" growth design competition.

Develop a region-wide design competition to promote innovative approaches to resilient design and new solutions to building high-density, mixed-use community development or redevelopment in a safe and smart manner in areas that are susceptible to multiple hazards

Lead			**Scale of Benefit**		
State	**Region**	Local jurisdiction	**Region**	**Community**	Resident

Target Development Type		**Hazard Addressed**		
Existing	**New**	**Ground Shaking**	**Liquefaction**	**Flooding**

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	Access to Resources	Single or Two Family	Multi-family	Cripple Wall	Soft story or House over garage

Action Categories					
Evaluation	**Program/ Operation**	Plans and Policies	Codes, Regulations, and Ordinances	Coordination	**Education/ Outreach**

Prerequisite Strategies	**Other Related Strategies**
None	None

Description

Current design practices to avoid or mitigate existing hazards in new developments or redevelopments may be limited or cumbersome and often do not consider long-term changes in hazard risk that may occur as the climate changes. For example, existing liquefaction mitigation approaches for new construction (e.g.; deep-pile foundations or implementing ground improvements to create a better building platform) can be costly, particularly for low-rise and wood-frame structures, and are not often voluntarily implemented. Additionally, current building codes are designed to protect life safety, and additional protection against ground shaking may be too costly or cumbersome. Similarly, traditional approaches for mitigating current and future flood risks, including the construction of levees or elevating the first floor of all buildings can also be costly and possibly detract from future capital investment in flood-prone or low-lying shoreline areas. There is little incentive to incorporate expanded thinking about resilient building practices in the current state of practice.

All of these challenges present opportunities for innovation in community and building design and development practices as well as promote an increased awareness about hazard avoidance and mitigation in light of the region's future growth challenges, through a design competition. A design competition creates opportunities to draw on the expertise of students, academicians, and practitioners in developing new ideas, in collaboration with community stakeholders.

A design competition could take many forms, but typically centers around a unique and specific design challenge, such as planning for sea level rise in a specific geographical area, or developing innovative solutions to address liquefaction. The competition should be widely advertised to schools, designers, and the technical and engineering communities to bring together multiple bodies of expertise and solutions thinking. Winners may be eligible to receive a prize such as cash, or the opportunity to further develop their idea in partnership with a jurisdiction or organization.

Governance/Implementation Issues

An organization or association with a regional presence, as well as a consortium of professional and civic interest groups, could be appropriate conveners of a design competition to spur innovation in multi-hazard development and design practices. Multi-sector partners are highly desirable to assist with planning and implementation. Examples include the Urban Land Institute (ULI), and SPUR. The competition could be tailored to the Bay Area by developing design criteria that are consistent with provisions in regional plans, such as Plan Bay Area (see: http://onebayarea.org/plan-bay-area.html), and the ABAG Regional Hazard Mitigation Plan (see http://quake.abag.ca.gov/mitigation/) to both promote the use and awareness of policies and strategies in these plans and to also ensure consistency with the region's planning goals.

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	Development and Construction Loans	Individual Home Improvement or Commercial Renovation Loans	Revolving Loan Fund Programs	**Grant Programs**	Other

Potential funding for a design competition could be obtained through grants from philanthropic organizations, such as the Kresge Foundation, as well as government grant programs, such as the US Department of Housing and Urban Development's Community Development Block Grant (HUD CDBG) Program (as it has done with "Rebuild by Design"), FEMA's Hazard Mitigation Grant

Program, or the California Earthquake Authority (CEA) Mitigation Program.

Implementation Partner(s)

State	Region	Local
State agencies such as CalOES, CEA, or HCD might be partners in fundraising, development of the competition scope, schedule, guidelines, and eligibility requirements, and in recruiting participants. Depending on the solutions proposed, other institutions such as the California Building Standards Commission, State Seismic Safety Commission, and the California Department of General Services' Division of the State Architect might be involved as part of the judging panel.	Regional agencies might be partners in fundraising, development of the competition scope, schedule, guidelines, and eligibility requirements, and in recruiting participants.	Local governments, local, regional, state or national professional and civic interest groups, community organizations, and local universities, might be partners in the fundraising, development of the competition scope, schedule, guidelines, and eligibility requirements, and in recruiting participants. It may be beneficial to align the implementation of this strategy with the academic calendar of local universities. Representatives from partner organizations might also serve as advisors for competition participants.

Examples

The following are examples of design competitions launched with the goal of generating innovative ideas for responding to hazards:

Rising Tides Design Competition, San Francisco Bay Area, CA

In 2009, the San Francisco Bay Conservation and Development Commission (BCDC) held an open international design competition to generate ideas for responding to sea level rise in San Francisco Bay and beyond. See:

http://www.risingtidescompetition.com/risingtides/Home.html

Rebuild by Design Competition, New York/New Jersey area

Founded as a response to Hurricane Sandy's devastation in the region, Rebuild by Design is dedicated to creating innovative community- and policy-based solutions to protect cities vulnerable to increasingly intense weather events and future uncertainties. It was initiated by

HUD and the Presidential Hurricane Sandy Rebuilding Task Force in 2013 and the winners of the competition were announced in June 2014. See:

http://www.rebuildbydesign.org/.

"Designing with Water" Resilience Design Competition, Boston MA

In August 2014, the City of Boston, in partnership with the Boston Redevelopment Authority, Boston Harbor Association and Boston Society of Architects, announced the upcoming launch of an international design competition to obtain implementable planning and design solutions that will prepare three at-risk waterfront sites in Boston for current coastal flood risks and future sea-level-rise. The competition follows on recent sea level studies for the region. Funding for the contest has come from the Massachusetts Office of Coastal Zone Management and the Barr Foundation. See:

http://www.bostonredevelopmentauthority.org/news-calendar/news-updates/2014/08/01/designing-with-water%E2%80%9D-in-boston-and-around-the-wor

11. Develop locally-specific seismic hazard maps

Encourage local governments to develop locally specific seismic hazard maps to improve upon mapping resolution and, support more informed and nuanced decision-making about development and hazard mitigation, particularly in urban and urbanizing seismically hazardous areas.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	Region	**Community**	Resident
Target Development Type		**Hazard Addressed**			
Existing	**New**	**Ground Shaking**	**Liquefaction**	Flooding	
Community Vulnerability Addressed				**Vulnerable Housing Type Addressed**	
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	Access to Resources	Single or Two Family	Multi-family	Cripple Wall	Soft story or House over garage
Action Categories					
Evaluation	**Program/ Operation**	**Plans and Policies**	Codes, Regulations, and Ordinances	Coordination	Education/ Outreach
Prerequisite Strategies			**Other Related Strategies**		
Strategy 1: Complete seismic hazard mapping of urban and urbanizing areas Strategy 2: Evaluate current guidelines and the "state of the practice" for mapping, evaluating, and mitigating seismic hazards, particularly multi-hazard areas			None		

Description

The California Geological Survey (CGS) provides maps at a resolution of 1:24,000 identifying areas that are susceptible to strong ground shaking, earthquake-induced landslides, liquefaction, and faulting. In State-mapped hazard zones, proposed development or major upgrades to existing development are required to perform site specific geotechnical investigations prior to receiving construction permits or approval of subdivisions. When hazards are identified in these reports, the proposed project must take measures to mitigate their effects. As discussed in Strategy 1, the State seismic hazard mapping has not been completed in some urban and urbanizing areas of the Bay Area (see http://www.quake.ca.gov/gmaps/WH/regulatorymaps.htm for gaps in coverage).

In addition to coverage gaps, State seismic hazard maps used to regulate development have some important limitations which local governments may wish to improve upon for the

purposes of planning future growth and siting development in the least hazardous portions of a State-mapped zone. The maps are prepared at a fairly coarse resolution of 1:24,000 and mapping methodologies do not depict different degrees of hazard but rather provide regional estimates of the areas susceptible to earthquake-related hazards and where more site-specific studies are needed. CGS states that, "the Seismic Hazard Zone Maps may not show all areas that have the potential for liquefaction, landslide, strong ground shaking or other earthquake and geologic hazard. Also, a single earthquake capable of causing liquefaction or triggering landslide failure will not uniformly affect the entire area zoned." (See CGS disclaimer http://www.conservation.ca.gov/cgs/shzp/Pages/SHMPDisclaimer.aspx). Lack of detailed information on severity of the hazard and the areas it affects could lead to unwise development decisions at the local level.

Local governments and other lead permitting agencies are encouraged to develop their own locally-specific seismic hazard maps to inform local decision-making on appropriate land uses, development densities, and subdivision design and building standards. These maps could be prepared at higher-resolution scales (such as 1:2,400 to 1:7,200) with priority given to mapping urban and urbanizing seismically hazardous areas so that this more detailed information can be available when new development or redevelopment is proposed. Mapping priority should also be given to areas where seismic hazards correlate with other hazard related risks such as wildfire, flooding and permanent inundation.

In addition to the State seismic hazard maps, additional resources are available to local governments for use in developing more detailed seismic hazard maps. USGS has developed a liquefaction susceptibility map (last updated in 2006) which identifies areas across the entire Bay Area susceptible to liquefaction based on an analysis of the underlying geologic materials (see: http://gis.abag.ca.gov/website/Hazards/?hlyr=liqSusceptibility). This map can point to areas that are more highly susceptible to liquefaction hazard. However, this map is developed based on broad, regional scale data whereas geology and liquefaction susceptibility can change over very short distances. Additional local mapping can further refine these liquefaction zones.

CGS requires that local governments forward site specific geotechnical reports to CGS for use in improving hazard mapping. CGS is currently in the process of making these reports available to the public through a geotechnical database and they also could be used in developing locally-specific seismic hazard maps. For example, data from these reports may provide more detail on the degree and location of liquefaction hazards and earthquake-induced landslides within the hazard zone.

Governance/Implementation Issues

Local governments and other development permitting agencies would lead in implementing this strategy. Such a mapping effort might be undertaken as part of the next round of local general plan land use or safety element updates or as part of a local hazard mitigation planning

update. Local government and agency leadership would be required to develop the necessary political support and funding to implement the strategy. Most communities retain consultants to prepare the maps. The CGS Special Publications 117A and 118 provide seismic mapping criteria and review guidelines that local governments and lead permitting agencies can use as resources for locally-specific mapping and guideline development. Other communities in the Bay Area and California that have prepared more locally-specific maps and guidelines that can be resources for implementation as well as an experienced cadre of local practicing geologists and geotechnical engineers that can provide assistance.

This strategy could be added as a strategy in the next round of updates to the State of California's Hazard Mitigation Plan, the ABAG Regional Hazard Mitigation Plan (see http://quake.abag.ca.gov/mitigation/), and local hazard mitigation plans an impetus for heightening awareness about the need and raising the priority for completing this work.

The strategy may increase the upfront cost of approved development in designated hazard zones, as new development may be subject to more stringent hazard review, mitigation and design requirements. However, this strategy could help reduce the economic and social costs of hazards, as new development would either be redirected to other locations, or be required to incorporate mitigation measures to address the mapped hazards.

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	Development and Construction Loans	Individual Home Improvement or Commercial Renovation Loans	Revolving Loan Fund Programs	**Grant Programs**	**Other**

Local governments and permitting agencies could receive some funding through development applications. Under State regulations (Public Resources Code Section 2705.C.1 and C.2) cities and counties may retain up to 5 percent of the total amount collected in building permit fees for the Strong Motion Implementation Program for data utilization, seismic education, and improving the preparation for damage assessment after strong seismic motion events. Seismic hazard mapping might qualify for this use. However, neither development applications nor a percentage of the SMIP fees is likely to be sufficient for the implementation of this strategy.

Local governments and other permitting agencies can also apply for funds from the U.S. Geological Survey's external grants program and FEMA's Hazard Mitigation Grant Program funds may be a source for locally-specific mapping and guideline development. In addition, MTC's Priority Development Area (PDA) Planning Program and Smart Growth Technical Assistance Program may also serve as a potential source of financial and technical assistance in Priority Development Areas.

Implementation Partner(s)

State	Region	Local
CGS could be a partner in education and training for local governments on mapping methodologies and best practices.	The Association of Bay Area Governments (ABAG) and the Association of Engineering Geologists (practicing geologists and geotechnical engineers) could be useful partners in advocacy, education and training for local governments on mapping methodologies and best practices	The building and land development community could partners in advocating for the preparation of such maps and funding their creation.

Examples

State guidelines referenced in this strategy include the following:

- California Seismic Hazards Mapping Act (Public Resources Code, Chapter 7.8, Sections 2690–2699.6) (see http://www.consrv.ca.gov/cgs/shzp/Pages/prc_shmact.aspx)
- Alquist-Priolo Earthquake Fault Zoning Act (see http://www.conservation.ca.gov/cgs/rghm/ap/Pages/main.aspx)
- California Geological Survey Special Publication 118 (Recommended Criteria for Delineating Seismic Zones in California (see http://www.conservation.ca.gov/cgs/shzp/webdocs/sp118_revised.pdf)
- Strong Motion Implementation Program, Public Resources Code Section 2705.C.1 and C.2 (see http://www.leginfo.ca.gov/cgi-bin/displaycode?section=prc&group=02001-03000&file=2700-2709.1)

Many counties and cities in the San Francisco Bay Area have developed their own more locally-specific hazard maps and seismic hazard review policies as part of their planning and development regulations. They include the town of Portola Valley, cities of Morgan Hill and Belmont and Napa, Sonoma, and Santa Clara counties.

Town of Portola Valley, CA

Straddling the San Andreas fault and with landslide-prone terrain, the Town of Portola Valley has had detailed geologic maps (1:6,000) and a corresponding interpretive map entitled "Movement Potential of Undisturbed Ground" since the 1970s (see http://www.portolavalley.net/index.aspx?page=377). Stanford University geology professors and students assisted with the original mapping project which relied upon aerial photographs, field investigations, and other available geologic studies. By using professors and students, the Town was able to afford the cost (approximately $12,000 at the time.) The maps have been periodically updated by the Town's Geologist as new information emerges. The maps are then integrated into the land use and development policies and procedures outlined in the Town's general plan, zoning ordinance, subdivision regulations, site development (grading) regulations and building code. When a development application is submitted, it is first reviewed against the maps to determine where building sites are restricted or prohibited, and procedures that must be followed to mitigate the identified hazards. The Town's Geologist is charged with ensuring that all new development conforms to the Town's geologic hazard requirements and oversees the geologic review process.

Santa Clara County, CA

Santa Clara County has mapped Geologic Hazard Zones (GHZ) for possible faults, landslides, compressible soils, dike failure flooding, and liquefaction (see: http://www.sccgov.org/sites/PLANNING/GIS/GEOHAZARDZONES/Pages/SCCGeoHazardZoneMaps.aspx). The zones were produced by combining information from a variety of published and unpublished sources. The Santa Clara Board of Supervisors officially adopted the County Geologic Hazards Zones (GHZ) and a companion geologic review ordinance in 2002. The County GHZs identify areas where available information suggests specific geologic hazards may be present. In those areas, the ordinance requires that the owner/applicant submit a geologic report (prepared and signed by a Certified Engineering Geologist [CEG]) for review by the County Geologist prior to approval of certain applications for construction. When the Board adopted the County GHZs in 2002, the State Geologist had already released four official State Seismic Hazard Zones Maps, the landslide and liquefaction zones on those maps were incorporated into the County GHZs. At that time, the Board of Supervisors also adopted a provision that the County GHZs would be revised to include California's Seismic Hazard Zones (SHZ) whenever the State Geologist released additional SHZ maps.

12. Increase protection of critical facilities and lifelines in high hazard areas

Encourage local governments to require critical infrastructure and public-service facilities to be located or relocated outside high hazard areas, or that seismic- and flood-related mitigation and other protective measures be undertaken to enhance the structural integrity, overall performance, and functionality of facilities that must be located within high hazard areas. Emphasis should be given to ensuring the continuity of operations of critical facilities and lifelines essential to helping residents remain in their homes following a disaster and facilitating and expediting community and regional post-disaster recovery.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	**Region**	**Community**	Resident

Target Development Type		**Hazard Addressed**		
Existing	**New**	**Ground Shaking**	**Liquefaction**	**Flooding**

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	Access to Resources	Single or Two Family	Multi-family	Cripple Wall	Soft story or House over garage

Action Categories					
Evaluation	Program/ Operation	**Plans and Policies**	Codes, Regulations, and Ordinances	**Coordination**	Education/ Outreach

Prerequisite Strategies	**Other Related Strategies**
Strategy 1: Complete seismic hazard mapping of urban and urbanizing areas Strategy 2: Evaluate current guidelines and the "state of the practice" for mapping, evaluating, and mitigating seismic hazards, particularly multi-hazard areas Strategy 11: Develop locally-specific seismic hazard maps	None

Description

The continuity of operations of lifelines and critical facilities such as electricity and natural gas services, water and wastewater facilities and systems, lifeline transportation routes, and hospitals and medical facilities is critical after a disaster. It can both help to keep residents in their homes and to facilitate and expedite community and regional disaster recovery. However, many local plans, codes, and regulations currently do not have specific provisions for ensuring continued operations of existing or proposed critical infrastructure and facilities in high hazard areas, and thus vulnerable infrastructure and facilities in high hazards areas can put the entire community at risk.

This strategy encourages local governments to update general and specific plans, zoning codes, development guidelines, and building codes to better protect key public infrastructure and facilities in the highest hazard areas. To determine the highest hazard areas, jurisdictions can apply a "microzonation" approach to identify those portions of hazard areas (such as those identified on the State seismic hazard maps or in FEMA flood zones) that have the highest hazards and vulnerabilities. More detailed geologic and flood risk investigations may be needed to identify highest hazard micro-zones within hazard zones and identify zones where infrastructure damage could be catastrophic, or areas where mitigation proves to be too difficult or costly. This strategy should be tied to local hazard mapping efforts (See Strategy 11: Develop locally-specific seismic hazard maps). At a minimum, jurisdictions should examine areas with potential for landslide, liquefaction, fault rupture, and temporary or permanent flooding.

Decisions would need to be made as to which types of critical infrastructure and public service facilities need to be addressed, and how hazards could be minimized. Hazards could be minimized by either restricting construction of new critical infrastructure and facilities in these areas, relocating existing critical infrastructure and facilities outside these areas, or recommending that mitigation and other protective measures be adopted by infrastructure and facilities to upgrade or enhance their structural integrity and overall performance and functionality following a disaster.

There are many factors that determine strategies for reducing vulnerability, including the age and replacement schedule of infrastructure, costs for relocating, costs for protection, and costs for strengthening. For example, critical elements of electricity, natural gas, water, and wastewater systems and facilities may need to remain in their present location, either until the end of their useful life or because of extensive existing development, but could have berms and other flood protection devices installed around them.

Policies to implement this strategy may involve modifications to local general plan safety elements and land-use elements and specific/area plans for designated areas, and adding provisions for relocations or upgrades to existing facilities and systems into hazard mitigation and capital improvement plans. When large-scale developments are proposed, it may be possible to require relocations or upgrades of existing critical infrastructure and public-serving facilities as part of the project plans.

Governance/Implementation Issues

Local governments have leadership for implementing the planning and policy development for this strategy. Local governments are likely to have a lot more leverage in implementing this strategy for locally-owned facilities and lifelines than for regional utility districts or privately-owned facilities and lifelines. In these instances, collaboration and partnering will be essential. Local governments can be useful partners in advocating the need for such actions to facility and

lifeline owners, boards of directors, and regulators. This strategy could be added as a strategy in the next round of updates to the State of California's Hazard Mitigation Plan, the ABAG Regional Hazard Mitigation Plan (see http://quake.abag.ca.gov/mitigation/), and local hazard mitigation plans an impetus for heightening awareness about the need and raising the priority for completing this work.

Potential Financing Mechanisms

City/County/ State Bond Program	**Parcel or Sales Tax**	**Tax-based Special Districts**	**Fee-based Special Districts**	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	Development and Construction Loans	**Individual Home Improvement or Commercial Renovation Loans**	**Revolving Loan Fund Programs**	**Grant Programs**	Other

Improvements to critical infrastructure that is publically owned, such as water, wastewater, and transportation, could be financed through a bond program, tax-based special districts, fee-based public districts, municipal enterprise funds, a parcel or sales tax, and grants. Improvements to privately owned critical infrastructure, such as electricity and natural gas, could be financed through customer rates and fees. Improvements to other privately owned critical assets, such as hospitals and medical facilities, could be financed through commercial renovation loans or a revolving loan fund program.

Implementation Partner(s)

State	Region	Local
No state partners are required for this strategy.	Regional agencies such as ABAG could provide technical guidance and case studies on areas where this strategy has been implemented.	Developers, municipal utilities, non-municipally owned utilities and transportation agencies; school districts; hospital and medical districts; and other infrastructure providers are all partners in implementation.

Examples

The following is an example of a jurisdiction making planning policy and zoning changes to limit, replace or upgrade critical facilities in high hazard areas:

Southeast Florida Regional Climate Action Plan, 2012

The Southeast Florida Regional Climate Change Compact (Compact) was formed in 2010 and involves Palm Beach, Broward, Miami-Dade, Monroe Counties, their municipalities and partners, who worked collaboratively to develop a regional climate action plan in 2012 which has a 5 year implementation horizon (see https://www.broward.org/Legislative/Documents/ChangingClimate.pdf). Several policies in the plan address the conduct of inventories and development of policies for addressing the vulnerabilities of critical infrastructure and facilities to current and permanent flooding. They include the following:

"Develop local and, where appropriate, regional inventories of existing potable water supply delivery and collection systems, vulnerable wellfields, wastewater collection and/or treatment infrastructure, septic tanks/drainfields, and stormwater drainage and treatment facilities; assess the potential impact from climate change of each component; and develop different climate change scenarios and adaptation strategies for high-risk utilities and/or infrastructure which may require replacement, reinforcement, or relocation to ensure the long-term viability of the system (e.g., modified site, depth, elevation, materials, or connection requirements)"

"Utilize existing and refined inundation maps and stormwater management models to identify areas and infrastructure at increased risk of flooding and tidal inundation with increases in sea level, to be used as a basis for identifying and prioritizing adaptation needs and strategies."

The following is an example of a city ordinance requiring enhanced flood protection measures for critical facilities:

City of Boulder, CO

In 2013, the City of Boulder adopted an ordinance requiring enhanced flood protection measures for critical facilities located in 100-year and 500-year floodplains. Critical facilities to which this ordinance applies include facilities that serve at risk populations, such as schools, day cares and senior care facilities. They also include essential service facilities such as fire and police stations, and water and wastewater treatment facilities, and high-risk facilities such as hazardous materials storage sits. If these facilities are located in 500-year floodplains, they are required to flood-proof, or elevate structures. Hazardous waste storage sites are required to use enhanced methods to contain waste. Furthermore, all critical facilities located in either the

100-year or 500-year floodplain are required to have in place, an evacuation plan or a shelter-in-place plan that has been approved by an appropriate professional to ensure the plan meets safety requirements.

See: https://bouldercolorado.gov/pages/critical-facilities-lodging-facilities-ordinance

The following is an example of a project involving the relocation of a critical facility following a flood event.

Iowa City, IA

A major flood event in 2008 rendered one of the wastewater treatment plants located in a floodplain in the City of Iowa inoperable. Following this event, the City of Iowa made a decision to shut down this treatment plant, and relocate wastewater treatment operations to its other treatment plant, located outside the floodplain. The site of the closed treatment plant is to become a part of a recreational park with wetlands and other amenities. The introduction of wetlands to this site will contribute to flood mitigation upstream and downstream of the site.

See: http://homelandsecurity.iowa.gov/documents/misc/FLOOD_Presentation_IowaCity.pdf

State *Region* **Local**

13. Reduce or prohibit development in the most hazardous areas while ensuring equity and beneficial use of these areas

Reduce or prohibit development in high hazard areas, incentivize relocation out of these areas, and reduce or prohibit rebuilding after a disaster. This strategy also works to create beneficial uses, such as open space, flood mitigation and recreation, for non-developable high hazard lands.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	Region	**Community**	Resident
Target Development Type		**Hazard Addressed**			
Existing	**New**	**Ground Shaking**	**Liquefaction**	**Flooding**	
Community Vulnerability Addressed			**Vulnerable Housing Type Addressed**		
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	Access to Resources	Single or Two Family	Multi-family	Cripple Wall	Soft story or House over garage
Action Categories					
Evaluation	**Program/ Operation**	**Plans and Policies**	**Codes, Regulations, and Ordinances**	Coordination	Education/ Outreach
Prerequisite Strategies			**Other Related Strategies**		
Strategy 1: Complete seismic hazard mapping of urban and urbanizing areas Strategy 2: Evaluate current guidelines and the "state of practice" for mapping, evaluating, and mitigating seismic hazards, particularly multi-hazard areas Strategy 11: Develop locally-specific seismic hazard maps			Strategy 14: Establish overlay zoning districts to help facilitate safe and smart new development Strategy 15: Establish a Transfer of Development Rights program to redirect development from high hazard areas to preferred, low hazard areas		

Description

Existing zoning regulations and designations in a community may not always facilitate safe new development or protect existing development from hazards. This may result in new development or redevelopment in locations that are vulnerable to damaging seismic hazards, or temporary flooding and permanent inundation from storm surge and sea level rise.

Local governments are encouraged to review and update general and specific plans, zoning codes, development guidelines, and building codes considering ways to limit or prohibit development, provide incentives for relocating existing development, and limit or prohibit redevelopment after a disaster in the highest hazard areas. The new codes, plans and

guidelines should also encourage the development of beneficial uses such as open space and recreation in areas deemed unsafe for development.

To determine the highest hazard areas, jurisdictions should apply a "microzonation" approach to identify those portions of hazard areas that have the highest hazards and vulnerabilities. High hazard areas may be identified on state seismic hazard maps (see http://www.conservation.ca.gov/cgs/shzp/Pages/Index.aspx), seismic maps that illustrate potential ground shaking or liquefaction areas (http://resilience.abag.ca.gov/earthquakes/ and http://earthquake.usgs.gov/regional/nca/qmap/), or FEMA flood maps (http://msc.fema.gov/portal) However, it is highly recommended that jurisdictions conduct more detailed geologic and flood risk investigations at a more detailed scale to identify the highest hazard micro-zones within hazard areas and identify specific areas where damage to housing could be catastrophic, or areas where mitigation proves to be too difficult or costly. Strategy 12: Develop locally-specific seismic hazard maps outlines a process for establishing local hazard mapping and is a highly suggested prerequisite to this strategy. At a minimum, jurisdictions should examine areas with potential for landslide, liquefaction, fault rupture, and temporary or permanent existing and future flooding.

Various mandates and incentives could be considered as options for implementing this strategy and will be discussed in greater detail in the following strategies. They include:

- Adding policy statements and criteria to general plan open space elements and specific/area plans for designated areas; amending zoning ordinances to create a zoning overlay district;
- Officially designating these areas for open space, flood mitigation or recreational uses. These areas could be redesigned with green infrastructure for flood mitigation and have multiple uses and benefits if well-designed;
- Amending building codes to prevent the restoration of hazardous buildings to pre-disaster event conditions (see Strategy 20: Ensure that major upgrades and repairs to existing buildings address seismic and flood related hazards);
- Adopting a transfer of development rights (TDR) program (see Strategy 15: Establish a Transfer of Development Rights program to redirect development from high hazard areas to preferred, low hazard areas);
- Instituting a post-disaster voluntary buyout program to acquire substantially damaged and hazardous properties; or increasing existing standards, such as for FEMA's NFIP program (see Strategy 28: Increase standards in local floodplain management ordinances beyond the minimum requirements of FEMA's NFIP program).

Governance/Implementation Issues

Local governments are the lead agencies for implementing this strategy. However, successful implementation will require collaboration and partnerships between local governments, open

space trusts and park agencies, and potential funding agencies, as well as with developers and property owners. Guidance documents, case studies, and draft ordinances may need to be developed to help promote adoption of this strategy.

The strategy could adversely impact property tax revenues from high hazard zones, as it redirects new and existing development to other locations. However, this strategy could help reduce the economic and social costs of hazards. The strategy could also have some indirect environmental and social benefits if it results in the creation or protection of habitat, open space, recreational areas in hazard zones.

This strategy could be added as a strategy in the next round of updates to the State of California's Hazard Mitigation Plan, the ABAG Regional Hazard Mitigation Plan (see http://quake.abag.ca.gov/mitigation/), and local hazard mitigation plans an impetus for heightening awareness about the need and raising the priority for completing this work.

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	Development and Construction Loans	Individual Home Improvement or Commercial Renovation Loans	Revolving Loan Fund Programs	**Grant Programs**	**Other**

Funding may be needed to conduct any detailed land assessment necessary in order to identify hazard zones that pose the highest risk to new and existing development. However, this may have already been accomplished, such as through conducting detailed local hazard mapping (see Strategy 11: Develop locally-specific seismic hazard maps); through the development of a Local Hazard Mitigation Plan; or through the implementation of other similar strategies. Local, state, and federal grants are a likely source for any additional land assessments or mapping. These assessments could also be required as part of site-specific mapping and investigations triggered by the development application.

Additional financing will be required to implement the mandates or incentives aimed at reducing or prohibiting new development in the most hazardous areas. The type of financing will depend on the nature of the mandate or incentive. Financing for buyout programs typically comes from FEMA. Private land conservation organizations or government bodies may purchase conservation easements to keep land as open space. A transfer of development rights incentive program would be self-financing.

Implementation Partner(s)

State	Region	Local
CGS could be a partner in education and training for local governments on mapping methodologies and best practices.	BCDC could be a partner in working with local jurisdictions around the Bay to help identify areas where this strategy applies and helping to provide education and training. ABAG and the Association of Engineering Geologists (practicing geologists and geotechnical engineers) could be useful partners in advocacy, education and training for local governments on methodologies and best practices.	Local regional open space districts and non-profit organizations involved in open space acquisition and management could be potential partners in helping to fund the acquisition of high hazard areas and the creation and maintenance of open space.

Examples

The following are examples of programs put in place to transfer high-hazard lands into parks, permanent open space or other beneficial uses:

Buyout Program, City of Grand Forks, North Dakota

The City of Grand Forks, North Dakota has built a river greenway development, following the 1997 Red River flood. After the 1997 flood, Grand Forks used FEMA Hazard Mitigation Grant Program funds and US Department of Housing and Urban Development (HUD) Community Development Block Grant–disaster recovery grant funds to buy out almost 800 homes. In compliance with National Flood Insurance Program (NFIP) guidelines, the City established a voluntary buyout program to acquire all the properties that had structural damage exceeding 50% of the pre-flood market value and that were located in the 100-year floodplain. Over time, the City expanded the buyout program to include other heavily damaged properties, both inside and outside the 100-year floodplain, as well as properties that were likely to be in the path of the proposed alignment of a new levee flood protection system. Properties that were purchased with FEMA-HMGP funding ultimately were converted to park land or other

permissible uses under the FEMA guidelines. In all, over 2,200 acres of land along both sides of the Red River were converted into a permanent greenway of open space that is designed to provide numerous recreational opportunities and room for the river to expand in future floods without endangering lives or property. The greenway features several parks, a campground, two golf courses, over 20 miles of multi-purpose trails, and fishing sites.

See: http://www.grandforksgov.com/greenway/index.html

Open Space Districts, San Francisco Bay Area, California

Some Bay Area communities have limited development potential in more flood-prone and geologically hazardous lands. These lands were then later acquired by open space trusts and park districts and turned into permanent open space and recreational areas. One of the landmark examples is the Windy Hill Open Space Preserve in the Town of Portola Valley, CA (see http://openspace.org/preserves/pr_windy_hill.asp). The 1,132 acre preserve that exists today originated from a 1979 donation of 535 acres of land to the Peninsula Open Space Trust (POST) that included landslide prone areas along the San Andreas Fault and for which development potential was limited in the Town of Portola Valley's General Plan and its land movement potential and slope-density regulations. The land was subsequently transferred to Mid-peninsula Regional Open Space District (MROSD) which manages it along with 25 other preserves, spanning 62,000 acres in San Mateo and Santa Clara Counties.

Federal guidelines applicable to this strategy include the following:

FEMA 2006, National Flood Insurance Program (NFIP) Community Rating System (CRS): A Local Official's Guide to Saving Lives, Preventing Property Damage, Reducing the Cost of Flood Insurance.

See: http://www.fema.gov/media-library/assets/documents/16104?id=3655)

14. Establish overlay zoning districts to help facilitate safe and smart new development

Establish overlay zoning districts, such as a Planned Unit Development (PUD) overlay district, to cluster new development into lower hazard areas on a particular site while also establishing special conditions for development in high hazard areas.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	Region	**Community**	Resident

Target Development Type		**Hazard Addressed**		
Existing	**New**	**Ground Shaking**	**Liquefaction**	**Flooding**

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	Access to Resources	Single or Two Family	Multi-family	Cripple Wall	Soft story or House over garage

Action Categories					
Evaluation	Program/ Operation	**Plans and Policies**	**Codes, Regulations, and Ordinances**	**Coordination**	Education/ Outreach

Prerequisite Strategies	**Other Related Strategies**
Strategy 1: Complete seismic hazard mapping of urban and urbanizing areas Strategy 2: Evaluate current guidelines and the "state of practice" for mapping, evaluating, and mitigating seismic hazards, particularly multi-hazard areas Strategy 11: Develop locally-specific seismic hazard maps	Strategy 13: Reduce or prohibit development in the most hazardous areas while ensuring equity and beneficial use of these areas Strategy 15: Establish a Transfer of Development Rights program to redirect development from high hazard areas to preferred, low hazard areas

Description

Existing zoning regulations and designations in a community may inadvertently allow or even incentivize new development in hazardous areas. This may be due to restrictions on high-density development in low hazard locations, or from a lack of restrictions on new development (or significant modifications to existing development) in high hazard locations. This lack of flexibility in existing zoning regulations may result in development being sited in locations that are vulnerable to high levels of ground-shaking and/or liquefaction from earthquakes, or temporary flooding/permanent inundation from storm surge and sea level rise. It may also result in missed opportunities to site more suitable land uses, development styles, and construction types for a particular hazard.

State *Region* **Local** *Establish overlay zoning districts to help facilitate safe and smart new development*

This strategy encourages local governments to implement overlay zoning districts to allow more flexible zoning provisions, such that they can enable safe and smart new development. Overlay zoning is a regulatory tool that establishes a special zoning district over an existing zoning designation and contains special development provisions within the district that may be different from the provisions of the underlying zoning designation. Overlay zoning can be used to encourage specific locations, styles, and types of development and can be used to address any hazard, including liquefaction, existing flooding, and future flooding.

One of the most commonly used overlay zoning methods is the overlay district. A PUD overlay can be used to encourage higher-density development in portions of a proposed development site that have a lower exposure to hazards (without necessarily increasing overall allowable density of the site). A PUD overlay permits a developer to meet overall community density and land-use goals without being bound by existing zoning requirements. A PUD overlay district can include provisions to encourage clustering of buildings, designation of common open space, and incorporation of a variety of building types and mixed land uses. A PUD overlay district is planned and built as a unit, thereby establishing the type and location of uses and buildings over the entire overlay area.

An overlay district can be used to create more stringent design requirements for development in areas with moderate or high exposures to hazards, beyond the requirements of the underlying zoning designation. These requirements would depend on the type of hazard to which the area is exposed, and would focus primarily on site planning and design aspects, which may include the following:

- Delineation of different areas within a district with varying levels of use restrictions and siting/site design guidance, based on the hazards' extent;
- Dimensional regulations for disturbed and impervious surfaces;
- Use of green infrastructure (storm water management techniques) for flood mitigation purposes;
- Use of site planning and grading techniques that address liquefaction hazards;
- Use of setbacks/shoreline buffers to address flooding and inundation.

An overlay district can be an effective tool to reduce the vulnerability of new development proposed on a particular parcel. It can be applied to any and all of the key hazards of concern: ground shaking and liquefaction from earthquakes, as well as current and future flooding hazards from storm surge and sea level rise. By encouraging smaller lot sizes or building footprints, new development can be located safely outside the highest hazard areas.

Overlay zoning can also be used to provide a variety of communitywide, economic, and environmental benefits, such as more efficient site design, preservation of amenities such as open space, lower costs for street construction and utility extension for the developer, and lower maintenance costs for the municipality. Depending upon the specific site, open space preservation might also provide an added economic or environmental benefit, such as wetland preservation.

Governance/Implementation Issues

Local governments are the lead agency for implementing this strategy. Adding an overlay district requires minor to moderate revisions to local zoning ordinances and it may also require additions to other local plans and planning and development regulations, such as subdivision and site design review ordinances. In bay shoreline and coastal areas, collaboration with BCDC and the California Coastal Commission may be necessary if they have jurisdiction. Implementing this strategy will require outreach to gain political support from the public, as well as some training and education for developers as it proposes deviations from existing zoning regulations. Although the concept behind this strategy is replicable for other cities and counties, the zoning revisions recommended by this strategy are inherently site-specific and should be tailored to address the hazards and other unique elements of a specific area. Implementation could be linked to the next round of local general plan land use or safety element updates or added as a strategy in the next round of updates to local hazard mitigation plans an impetus for heightening awareness about the need and raising the priority for completing this work.

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	**Tax-based Special Districts**	Fee-based Special Districts	**Infrastructure Financing Districts**	Joint Powers Authorities
Municipal Enterprise Funds	**Development and Construction Loans**	Individual Home Improvement or Commercial Renovation Loans	Revolving Loan Fund Programs	Grant Programs	**Other**

If the overlay district results in more stringent construction requirements for developers, the additional costs of development would typically be borne by the developer, and financed through development and construction loans. Developers of affordable housing can access subsidies, such as the Low Income Housing Tax Credits, HOME funds from HUD, and below market rate loans from community development finance institutions, to help finance the costs of development or renovation. The costs to local governments to review the development applications are also borne by the developer.

If the overlay district results in the designation of open space or infrastructure that benefits a specific area (i.e. neighborhood, district, city, county), then the creation/maintenance of those facilities and services could be financed through a tax-based special district, fee-based special district, or infrastructure financing district.

Implementation Partner(s)

State	Region	Local
In bayshore and coastal areas, collaboration with the California Coastal Commission may be necessary.	In bayshore and coastal areas, collaboration with BCDC may be necessary.	Developers are essential partners in implementing this strategy, and open space and park districts may also need to be involved in specific development efforts.

Examples

The following are examples of overlay districts functioning in specific cities:

Planned Unit Developments in the Town of Portola Valley, CA

The Planned Unit Development provisions of the Town of Portola Valley, CA's Zoning Ordinance "allow diversification in use and in the relationships of various buildings, structures, and open spaces in building groups and variations in the allowable heights of buildings and structures… to achieve a higher quality of development through better adjustment to terrain and greater preservation of natural features than could otherwise be achieved, while still maintaining privacy for individual home sites" (Section 18.44.010, see http://www.portolavalley.net/index.aspx?page=149). Over the years, several development projects have been approved using the Town's PUD provisions as a mechanism to cluster development onto the safest portions of a site. The 200-home community of Portola Valley Ranch was developed on a 438-acre site that includes unstable, landslide-susceptible hillsides and the San Andreas Fault crossing through its center. The Town of Portola Valley required the developer to conduct geotechnical investigations and to design the subdivision to avoid the fault and unstable hillsides. Under the PUD provisions, the developer was able to create lots smaller than normally permitted under the Town's zoning ordinance. The lots were clustered in the least vulnerable areas, keeping the most unstable hillsides and the fault zone in permanent open space. (See Portola Valley Ranch, http://www.pvranch.org; and Tyler, Look Before You Build, p. 16, http://pubs.usgs.gov/circ/1995/c1130/).

Resource Conservation District in Chapel Hill, NC

The Resource Conservation District (RCD) has been applied to areas within and along

watercourses in the Town of Chapel Hill's planning jurisdiction, and placed additional development restrictions on properties in these areas. The goal of the RCD is to preserve the quality of the town's actual or potential water supply sources, to minimize danger to lives and properties from flooding in and near the watercourses, to preserve the water carrying capacity of the watercourses, to protect them from erosion and sedimentation, to retain open spaces and greenways and protect their environmentally-sensitive character, to preserve urban wildlife and plant life habitats from the intrusions of urbanization, to provide air and noise buffers to ameliorate the effects of development, and to preserve and maintain the aesthetic qualities and appearance of the Town.

See: http://www.townofchapelhill.org/Modules/ShowDocument.aspx?documentid=2423

Town of South Hampton, NY

Southampton's Tidal Floodplain Overlay District aims to minimize damage from coastal storms by requiring setbacks for ocean beach water frontages in accordance with the town's Coastal Erosion Hazards Ordinance. Structures on other types of water frontages must be set back at least 75 feet from the upper edge of the tidal wetland.

http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CCAQFjAA&url=http%3A%2F%2Fwww.nyserda.ny.gov%2F-%2Fmedia%2FFiles%2FAbout%2FStatewide-Initiatives%2FCGC-Plans%2FLong-Island-CGC-Plan-Report.pdf&ei=QypYVM7QNceeyASNx4CADw&usg=AFQjCNEAwFLSW3Q2xxk8Mdo3oILV1pyLOg&bvm=bv.78677474,d.aWw&cad=rja

The following are examples of guidance on how an overlay district can be established.

California Geological Survey, Special Publication 117A: Guidelines for Evaluating and Mitigating Seismic Hazards.

The Guidelines are intended to assist owners/developers who are seeking approval of specific development projects within zones of required investigation, reviewers (e.g., geologists and/or civil engineers) who must investigate a site and recommend mitigation of identified hazards, and public agencies in the planning and development approval process. Included in the Guidelines are recommendations for site planning and grading techniques that can reduce risk from liquefaction hazards.

See: http://www.conservation.ca.gov/cgs/shzp/webdocs/Documents/sp117.pdf

State *Region* **Local** *Establish overlay zoning districts to help facilitate safe and smart new development*

Guidance on Planned Unit Development

Town of Portola Valley, CA, Code of Ordinances, Title 18 Zoning

- Chapter 18.44 Planned Unit Development
- Chapter 18.28 P-C (Planned Community) District Regulations
- Chapter 18.50 Parcel Area, Section 18.50.050 Planned unit developments.
- Chapter 18.50 Parcel Area, Section 18.50.050 Planned unit developments – Areas of land movement potential.

See: https://library.municode.com/index.aspx?clientId=13781&stateId=5&stateName=California

City of Oakland, CA, Planning Code, Title 17

- Chapter 17.140 – Planned unit development procedure
- Chapter 17.142 – Planned unit development regulations

See: www2.oaklandnet.com/oakca1/groups/ceda/documents/policy/oak042613.pdf

15. Establish a Transfer of Development Rights program to redirect development from high hazard areas to preferred, low hazard areas

Amend *local development codes to establish a Transfer of Development Rights (TDR) program, which could place permanent conservation or hazard mitigation easements on properties in high hazard areas, to prevent or minimize the vulnerability of new development to seismic and flood hazards.*

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	Region	**Community**	Resident

Target Development Type		**Hazard Addressed**		
Existing	**New**	**Ground Shaking**	**Liquefaction**	**Flooding**

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	Access to Resources	Single or Two Family	Multi-family	Cripple Wall	Soft story or House over garage

Action Categories					
Evaluation	Program/ Operation	**Plans and Policies**	**Codes, Regulations, and Ordinances**	**Coordination**	Education/ Outreach

Prerequisite Strategies	**Other Related Strategies**
Strategy 1: Complete seismic hazard mapping of urban and urbanizing areas Strategy 2: Evaluate current guidelines and the "state of practice" for mapping, evaluating, and mitigating seismic hazards, particularly multi-hazard areas Strategy 11: Develop locally-specific seismic hazard maps	Strategy 13: Reduce or prohibit development in the most hazardous areas while ensuring equity and beneficial use of these areas Strategy 14: Establish overlay zoning districts to help facilitate safe and smart new development

Description

Existing zoning regulations and designations in a community may inadvertently allow or even incentivize new development in hazardous areas. This may be due to restrictions on high-density development in low hazard locations, or lack of restrictions on new development (or significant modifications to existing development) in high hazard locations. This lack of flexibility in existing zoning regulations may result in development being sited in locations that are vulnerable to ground-shaking and/or liquefaction from earthquakes, or temporary flooding/ permanent inundation from storm surge and sea level rise.

State *Region* **Local** *Establish a Transfer of Development Rights program to redirect development from high hazard areas to preferred, low hazard areas*

Nearly all of the Bay Area is subject to ground shaking from seismic activity. However, the extent to which such shaking represents a significant hazard within any particular PDA depends on its location with respect to active faults, soil and geologic conditions, whether existing buildings have been constructed or retrofitted for high levels of seismic safety, and other factors. Most at risk would be buildings and other structures within fault zones (areas surrounding active faults), where future ground movement is likely to occur, and where surface displacement along a fault would cause serious structural damage to any overlying building, structure, transportation facility, utilities, and other infrastructure.

Secondary effects of earthquake ground shaking also present significant hazards. For example, PDAs with soils subject to liquefaction (even if distant from a fault zone) are at higher risk through ground failure and damage to overlying structures. "Lurching," the horizontal movement of ground next to slope faces, particularly in areas underlain by loosely consolidated soils (such as creek banks), can also present a significant hazard. Finally, PDAs near upland areas could be susceptible to landslides, land slips, mudflows, and/or debris flows triggered by an earthquake, and magnified by heavy rainfall or changes in ground conditions caused by development activity. This strategy proposes that jurisdictions adopt development code revisions to establish a TDR program which would provide regulatory and financial incentives to developers and homeowners to direct more intense development away from highest risk areas and into lower-risk areas, or areas where such risks can be better managed. TDR is a voluntary, market-based land-use tool that essentially "swaps" development rights in high hazard areas for rights to develop in other, more preferred areas. Landowners in high hazard areas receive a certificate representing the land's development potential, which they can then sell to a developer who wishes to increase the development potential in the preferred area. In selling the certificate, they waive their development rights on that property. This incentivizes development in preferred areas and limits development in hazardous areas. A TDR program could be applied to new as well as existing development, could be administered by local as well as county agencies or special districts, and can be used to incentivize eventual removal of development in high-risk areas.

The ability of a TDR program to succeed will depend on existing market conditions, development and regulatory standards, and the ability to generate financially feasible new development through redirection of development away from more vulnerable to less vulnerable areas. Typical TDR programs have the following steps:

- Identification of properties at greater risk where land and/or building mitigation strategies are cost prohibitive and development should not occur. This can be done using federal or state hazard maps and supplemented with local investigations and mapping (see Strategies 1, 2 and 11) as well as areas of preferred development.
- Determine the development value of hazardous areas to establish appropriate TDR ratios[1]

1 A TDR ratio is a measure of the number of development "credits" in relation to the amount of development otherwise permitted that a property owner in a hazardous area may receive as an inducement not to develop such land. A TDR ratio of 2:1 in a residential zone means that a property

for different categories of vulnerable land, providing greater priority for higher risk areas, and ensuring that TDR ratios provide sufficient financial incentives for willing property owners to sell development rights, and for others to purchase those rights for development in preferred areas.

- Linkage of the TDR program to other programs or strategies that seek to direct future development to specific areas (such as areas of high growth) or to achieve various community and sustainability benefits (e.g., transportation-based greenhouse gas reduction, open space preservation, community revitalization).

Governance/Implementation Issues

This strategy will require a relatively minor revision to local development codes or regional agency plans. Therefore, it will not require collaboration with other cities or agencies, because local governments and regional agencies have exclusive jurisdiction over their development regulations and plans. This strategy can be replicated in other local governments and agencies, as long as any site-specific conditions are addressed.

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	**Development and Construction Loans**	Individual Home Improvement or Commercial Renovation Loans	Revolving Loan Fund Programs	Grant Programs	**Other**

A TDR program acts as a self-financing program, under which property owners in high-risk areas have an incentive to sell their development rights to developers or individual buyers looking to develop property in low-risk areas identified as suitable for high density development by the implementing local government. Developers/individual buyers would rely on loans/equity to purchase development rights from sellers. The TDR program can be managed by a brokerage firm or could be paid directly to the local regulatory body (e.g. city). Developers may be eligible to receive higher construction/development loans if the TDR program results in high-density development in low-risk areas.

Implementation Partner(s)

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owner in a hazardous area can sell the rights to develop two housing units in a non-hazardous area for every one housing unit otherwise permitted the hazardous area. For example, if a property owner's land is in a residential zoning district that allows 5 dwelling units per acre, that property owner could receive 10 housing unit "credits" that could be used in another, non-hazardous, location.

State	Region	Local
No state partners are required for this strategy.	*No regional partners are required for this strategy.*	No public agency partners are required for setting up a TDR program. However, developers and homeowners are crucial. Participants in the program and would ultimately affect the success of such a program. Also, a local agency may wish to partner with a real estate broker, particularly one knowledgeable in TDR programs.

Examples

The following examples include programs designed to reduce development in areas subject to natural hazards, while other programs are focused on land conservation. Both types of programs could be transferrable to areas of high growth.

Portland, OR Willing Seller Program

In 1997, the City of Portland created its Willing Seller Land Acquisition Program, initially to provide a mechanism to reduce exposure to flooding hazards along Johnson Creek and implement the Johnson Creek Restoration Plan. The program helps move people and property out of areas that frequently flood. Restoration projects on land acquired through the program increase flood storage, improve fish and wildlife habitat, restore wetlands, and create passive recreational activities for city residents. Environmental Services offers willing sellers fair market value for their property. Owners are under no obligation to sell to the city. The city places deed restrictions on purchased properties designating them as open space in perpetuity and ensuring no future expenditure of federal disaster assistance funds for the property.

Environmental Services land-banks acquired properties while designing floodplain management projects and securing funding. The city uses many of the properties to create constructed wetlands, floodplain terraces and open space for flood management, habitat and passive recreation.

https://www.portlandoregon.gov/bes/article/10623

Malibu, CA TDR Program

Under the Malibu program, sending sites are referred to as “donor lots” and are pre-designated by area and characteristics of location and natural resources. For example, one category is “existing lots within the following small lot subdivisions within Los Angeles County where the lots contain environmentally sensitive habitat area and are contiguous to each other or to other retired lots,” followed by a list of neighborhoods.

The number of credits sent from a donor site depends on the resources of the site. For certain small-lot subdivisions, the calculation can be based on the following formula: Credit Area = (A/5) * (50-S)/35, where A is the area of the small lot in square feet, S is the average slope of the small lot in percent, and slope calculations are based on the natural (not graded) conditions. Thus, a lot with a steep slope will generate a smaller credit area. A different allocation rate applies to other parcels that consist predominately of environmentally sensitive habitat, are located within certain "significant watersheds" in the Santa Monica Mountains area, are adjacent to existing parkland where development cannot be sited to avoid encroachment of fire abatement requirements, or are in designated wildlife corridors in the Santa Monica Mountains coastal zone.

The development credits from these donor lots can be sent to any area within the city of Malibu where new lots can be created through subdivision within the residential zoning categories or multifamily projects in the "multifamily residential" and "multifamily beachfront residential" zones. The number of credits required depends on the type of development. For new subdivisions, the applicant must have one development credit for each newly subdivided lot. Large multifamily projects must have one credit for each new unit authorized, minus the number of existing parcels within the project site. The Malibu planning director grants the right to use transferred development credits in a development once the applicant has purchased the credits from a donor site, recorded a permanent, irrevocable open space easement on that site dedicated to the city, and merged the retired lot with adjacent, unrestricted lots.

http://www.rff.org/rff/Documents/Walls_McConnell_Sep_07_TDR_Report.pdf

Claremont, CA Hillside Development Ordinance (Chapter 16.010 of the Municipal Code)

The Claremont Zoning Code includes a Hillside Development District. With a transfer of development rights provision, that is intended to provide for limited uses of hillside areas which are consistent with the General Plan... The hillside areas must be kept in a natural state to the greatest extent feasible." This goal is accomplished by tying the intensity of any development in the hillside areas to the steepness of the terrain and accessibility; i.e., the steeper the slope and/or the further away from existing roads and infrastructure, the less development is allowed. The amount of development allowed on any hillside parcel is expressed in terms of "development credits." The Hillside Ordinance allows for the transfer of some or all of the development credits from a hillside parcel to one of six flatter and more accessible "residential cluster sites." Once a hillside parcel has all of its development credits transferred away, its owner must enter into a legally-binding agreement keeping the land as open space in perpetuity. Including such a requirement is more effective at preserving open space than adopting an ordinance that only zones the hillside land as open space or low density. That's because such zoning could always be changed by future city councils if they so desired.

http://qcode.us/codes/claremont/

16. Create a fragile housing inventory

Create and maintain a database that includes the type and location of fragile housing by building type and housing tenure (owner vs. renter), and the property's retrofit status. This would include developing and sustaining standardized, transferrable procedures for collecting and managing data. The inventory should contain, at a minimum, unreinforced masonry buildings, soft-story buildings, and non-ductile concrete buildings.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	Region	**Community**	Resident

Target Development Type		**Hazard Addressed**		
Existing	New	**Ground Shaking**	Liquefaction	Flooding

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	Access to Resources	**Single or Two Family**	**Multi-family**	**Cripple Wall**	**Soft story or House over garage**

Action Categories					
Evaluation	**Program/ Operation**	Plans and Policies	Codes, Regulations, and Ordinances	**Coordination**	Education/ Outreach

Prerequisite Strategies	**Other Related Strategies**
None	Strategy 17: Develop and implement a soft story retrofit program Strategy 18: Develop and implement a cripple wall retrofit program Strategy 19: Require hazard disclosure for renters

Description

Many jurisdictions don't have a good sense of the vulnerability of their own housing stock. While jurisdictions have records of basic building information at the time of construction or major remodel, none of these records are developed with seismic issues in mind.

The first step to understanding how to reduce vulnerability in existing housing stock is to identify and inventory fragile housing types. This data can guide future policy by identifying the most vulnerable neighborhoods, better understanding the breadth and depth that would be required by a retrofit program, and identifying priorities for mitigation. A fragile housing inventory can also identify areas where damage might be concentrated after a disaster if mitigation doesn't occur.

At a minimum, inventories should identify the types of buildings that pose the greatest risk for loss, including unreinforced masonry buildings (required by state law to be inventoried as of 1986), non-ductile concrete buildings, and soft story buildings. Other fragile building types to

be inventoried could include single family and multi-family cripple wall, hillside homes subject to earthquake-induced landslide, or homes in areas highly susceptible to liquefaction. This program could also be expanded to include homes vulnerable to other hazards such as flooding or fire.

An inventory program has multiple levels and forms it can take:

1. Initial screening

The first step is identifying potentially fragile buildings. Many jurisdictions do a windshield survey, utilizing city staff and volunteers from engineering professional groups, to either walk or drive through residential neighborhoods and visually identify buildings that possibly fall into a fragile housing category. Once this survey is complete, jurisdictions notify building owners that their buildings have been identified as potentially fragile.

2. Mandatory evaluation

Once an initial list has been compiled, jurisdictions should require that building owners provide more information or conduct a more thorough investigation of their buildings to get a more nuanced understanding of their fragility. This phase of the program would be where building owners have the opportunity to exempt themselves, for example if they have already completed a retrofit, or if an engineer has documented the stability of the building. Most building owners will need to hire a contractor or engineer to evaluate their building to determine fragility and report this information back to the city.

3. Next steps

After a jurisdiction has compiled accurate information about the fragility of its housing stock, there are several potential next steps. Compiling an inventory is the necessary first step for a retrofit program and should be incorporated into the inventory in the mandatory evaluation phase. Other jurisdictions who are not ready to implement a retrofit program may require other measures such as placarding to notify anyone who enters the building that it could be unsafe in an earthquake, or notification of tenants that the building is not retrofitted and has been identified as a fragile building (see Strategy L-20, Require hazard disclosure for renters).

4. Alternative path

Some jurisdictions may not have the resources to complete an inventory using staff time. Another option for implementation of this inventory is to require evaluations at the time of sale. Transfer of property would trigger the evaluation of any building, not just identified fragile building types. Jurisdictions would have to provide guidelines for evaluation to ensure that each building is evaluated using the same criteria. The evaluation results would be required to be disclosed to the purchaser and also reported to the jurisdiction. This strategy can also be used to gather site-specific hazard information (see Strategy 11, Develop locally-specific seismic hazard maps). The advantage of this path is that it requires less investment and time from the jurisdiction; however since the evaluation is not triggered until a home is sold, it could take much longer to establish a complete inventory of all buildings.

No matter the path of compliance, jurisdictions need to develop some standardized procedures for data collection and management, as well as standards for evaluation. For example, FEMA P-807, Seismic Evaluation and Retrofit of Multi-Unit Wood-Frame Buildings With Weak First Stories, provides a standard for evaluating potential soft story buildings. Staff should be assigned to manage the data and procedures set up to maintain up to date information, for example if a fragile building is retrofitted to acceptable standards its status should be updated within the inventory.

Governance/Implementation Issues

Identifying buildings as potentially hazardous can have impacts on the real estate market and on perceived liability for earthquake damages. Buildings that have been identified and labeled may suffer from lower rents or less desirability due to their status until they have been retrofitted. Building owners may perceive that the government is limiting their ability to make an income. However, pressure from the market may push building owners to retrofit. Like any building improvement, this may cause rents to rise, creating a larger gap between rents in retrofitted and unretrofitted buildings.

Building owners may also be concerned about increased liability if knowledge of unsafe conditions is transferred to the building owner or made available to residents. If building owners are aware that their buildings are likely to not perform well in a major earthquake and do not retrofit, they could be liable for damage. However, without mandated disclosure, building owners could argue that they were unaware and thus not liable.

This strategy may require significant staff time from the jurisdiction. Jurisdictions should also consider implementing programs or incentives for retrofitting at the same time as inventories are developed, as this can save staff time and resources for the jurisdiction as well as for building owners and reduce liability fears. See Strategies 17: Develop a soft story retrofit program, and 18: Develop a cripple wall retrofit program, for information on how to develop a retrofit program. Jurisdictions should also consider implementing Strategy 19: Require hazard disclosure for renters, at the same time as developing an inventory.

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	Development and Construction Loans	Individual Home Improvement or Commercial Renovation Loans	Revolving Loan Fund Programs	Grant Programs	**Other**

Jurisdictions need resources for staff time, but unless retrofit programs are also implemented at the same time as the inventory, no financing mechanisms are needed for building owners as they are expected to pay for building evaluations from their own funds. For more financing ideas, see Strategies 17: Develop a soft story retrofit program, and 18: Develop a cripple wall retrofit program.

Implementation Partner(s)

State	Region	Local
No state partners are required for this strategy.	ABAG could help coordinate regional standards for retrofit, ensuring that the expected performance of soft story buildings throughout the region is consistent. ABAG could also provide model language for ordinances adopted by local jurisdictions as well as guidance and best practices.	Jurisdictions should include local partners such as property managers and renters associations, as well as affordable housing advocates to ensure a transparent and equitable process in developing and adopting this policy.

Examples

State of California Unreinforced Masonry Program

In 1986, California enacted a law that required local governments in seismically hazardous areas to inventory unreinforced masonry buildings (URMs) and to establish a loss reduction program for URM buildings within their jurisdiction. Retrofit was not made mandatory, though many buildings have been voluntarily retrofitted through this program.

For more information:

http://mitigation.eeri.org/wp-content/uploads/femap774.pdf

http://www.seismic.ca.gov/pub/CSSC%202006%20URM%20Report%20Final.pdf

New Zealand Earthquake Prone Building Identification

New Zealand requires local governments to identify earthquake prone buildings (defined as failing to meet 34% of the current New Building Standard). The program has four stages: identification, initial evaluation, communication to building owners, and a section 124 notice, which is required to be affixed to the building. An overview of the program can be found here:

http://www.nzi.co.nz/Documents/NZI%20Earthquake-prone%20building%20booklet_Dec2012-compressed.pdf

17. Develop and implement a soft story retrofit program

Develop voluntary of mandatory retrofit program(s) to address soft story housing in areas where it makes up a large percentage of a jurisdiction's housing stock (as a whole or for a specific vulnerable community). Pair programs with financing tools and incentives. Consider different incentives and financing tools for more vulnerable communities, such as low-income residents or renters. The program should consider how to handle compliance and enforcement standards, mechanisms for enacting the program, and which retrofit standards to use.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	Region	**Community**	Resident

Target Development Type		**Hazard Addressed**		
Existing	New	**Ground Shaking**	Liquefaction	Flooding

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	Access to Resources	Single or Two Family	Multi-family	Cripple Wall	**Soft story or House over garage**

Action Categories					
Evaluation	**Program/ Operation**	**Plans and Policies**	**Codes, Regulations, and Ordinances**	Coordination	Education/ Outreach

Prerequisite Strategies	**Other Related Strategies**
Strategy 16: Create a fragile housing inventory	Strategy 17: Develop and implement a cripple wall retrofit program Strategy 19: Require hazard disclosure for renters Strategy 20: Ensure that major upgrades and repairs to existing buildings address seismic and flood-related hazards

Description

Soft story residential buildings are those that have large openings on the first flood, typically parking or commercial space, with residential units on the upper floors. Most were built prior to 1990. Ground shaking causes such structures to sway and may cause the ground story to collapse, damaging the floors above it as well. A soft-story collapse can have particularly disastrous consequences considering that they can crush cars and kill people occupying the open areas. ABAG modeling has shown that, in both a large earthquake on the Hayward or San Andreas faults, two-thirds of the uninhabitable housing units will likely be in soft-story residential buildings.

Considering the threat to public safety that soft story buildings pose, jurisdictions with high numbers of units in soft story buildings should consider developing a mandatory soft story

retrofit program. This type of program generally includes several steps: 1) Developing an inventory of soft story buildings (see strategy 16, Create a fragile housing inventory); 2) Require building owners to have their buildings evaluated by an engineer to confirm their soft story condition; 3) Determine standards for retrofit to give guidance on how to strengthen a weak first story; 4) Develop and adopt a program that includes requirements for timing of the retrofit, which buildings are subject to requirements and at what time, protections for renters, and consequences for lack of compliance; and 5) Provide financing tools for owners to retrofit.

1. Develop an inventory of soft story buildings

Jurisdictions who have already completed Strategy 16: Create a fragile housing inventory, can decide if soft story buildings pose a significant threat to housing in their jurisdictions. Soft story housing was typically built prior to 1970 and is usually multifamily. Not all jurisdictions may have large numbers of soft story buildings. However, if a jurisdiction decides, based on their inventory, that a significant portion of their residents reside in this fragile housing type, a mandatory retrofit program will have significant impact. Furthermore, if a jurisdiction is already aware of a large inventory of soft story housing and has not yet completed the fragile housing inventory, it could conduct a more limited inventory focusing on the fragile housing types known to be present.

2. Require building owners to have their buildings evaluated

Initial fragile housing inventories typically rely on visual inspections of the outside of buildings by trained professionals to screen for certain characteristics that could indicate a fragile housing type. However, only an engineer can determine whether a structure is actually capable of withstanding the lateral accelerations we expect in a major earthquake. Building owners who have been flagged in an initial screening as possibly having soft story characteristics should be notified and required to submit engineering calculations to the jurisdiction within a particular time period that either prove that they do not have dangerous soft story conditions and are therefore exempt from the mandatory retrofit, or that they do have soft story conditions and are therefore subject to retrofit.

3. Determine standards for retrofit

Jurisdictions need to decide what level of retrofit is sufficient to fulfill the requirements of the retrofit program. Standards for retrofit increase the likelihood that all buildings will perform to a certain life safety level. Jurisdictions should choose from existing standards or develop their own and develop guidance for engineers to promote even application of the standards. There are several existing standards that address soft story retrofits, including the 2012 International Existing Building Code (IEBC) Appendix Chapter A4; ASCE 41-06; ASCE 41-13; and FEMA P-807 (see more information on each of these standards below in Examples).

4. Develop and adopt a program

Mandatory retrofit programs should be adopted by the jurisdiction as an ordinance that amends the local building code. Retrofit programs will reflect decisions on several criteria, including: which buildings will be addressed and when (for example, targeting high occupancy

or critical occupancy buildings first, then smaller buildings at a later date); criteria for exemption from the program; timeline for compliance steps (first submitting engineering reports and plans, then completing the retrofit); consequences for noncompliance; and modifications or protections that need to be addressed for renters in buildings undergoing retrofit, including displacement and pass-through of retrofit costs.

5. Provide financing tools for building owners

Soft story retrofits typically cost anywhere from $2,000 to $10,000 per unit. In large, multi-unit buildings, retrofitting may be a significant cost. Jurisdictions need to decide if they will provide financing tools to building owners to assist with costs. Specific financing mechanisms are discussed below.

Governance/Implementation Issues

This strategy will require the adoption of a soft story retrofit ordinance. Once adopted, building officials will have to be educated on the changes, and at least 0.5 FTE of city staff should be devoted to managing and implementing the program. Building owners who retrofit will need to obtain a permit from a building inspector confirming the retrofit was done in accordance with the adopted standard.

Some jurisdictions may have difficulty getting political buy-in to pass this program because of the costs imposed upon building owners. Tenants' rights groups may have concerns about burdens for low-income renters. Jurisdictions should provide several opportunities for the public, tenants' rights groups, building owners, and other stakeholders to provide feedback and ask questions.

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	**Tax-based Special Districts**	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	Development and Construction Loans	**Individual Home Improvement or Commercial Renovation Loans**	Revolving Loan Fund Programs	**Grant Programs**	Other

Retrofits can be paid through many mechanisms. In the case of soft story retrofits, most building owners will take out home improvement loans. Some jurisdictions may choose to provide financial incentives, such as grants, rebates, or low-cost loans. One popular form of financing is similar to PACE, or Property assessed clean energy bonds, typically used for energy retrofit programs. These bonds provide funding to building owners which is paid back over a period of time through an annual assessment on their property tax bill. One advantage of

this system is that the financing is tied to the property, not an individual. A more complete description of this process can be found in the examples below from the City of San Francisco.

Implementation Partner(s)

State	Region	Local
No state partners are required for this strategy.	ABAG could help coordinate regional standards for retrofit, ensuring that the expected performance of soft story buildings throughout the region is consistent. ABAG could also provide model language for ordinances adopted by local jurisdictions as well as guidance and best practices.	Jurisdictions should include local partners such as property managers and renters associations, as well as affordable housing advocates to ensure a transparent and equitable process in developing and adopting this policy.

Examples

City of San Francisco

In 2013 San Francisco passed legislation that requires the evaluation and retrofit of "multi-unit soft-story buildings," defined as: Wood-frame structures, containing five or more residential units, having two or more stories over a "soft" or "weak" story, and permitted for construction prior to January 1, 1978.

San Francisco uses compliance tiers to determine the timeline for completing seismic retrofit work. Any building containing educational, assembly, or residential care facilities must be retrofitted first, followed by any building containing 15 or more dwelling units, any building not falling within another tier, and finally any building containing ground floor commercial uses or any building in a mapped liquefaction zone.

San Francisco is offering a PACE-modelled program through GreenFinanceSF for the retrofit of any soft story building.

Earthquake Safety Implementation Program information page: http://sfdbi.org/mandatory-soft-story-program

Department of Building Inspection information page: http://www.sfgsa.org/index.aspx?page=6048

Public financing option information: http://sfgsa.org/index.aspx?page=6570

City of Oakland

The City of Oakland is taking steps to identify soft-story multi-unit buildings vulnerable to collapse in earthquakes. Past earthquakes have demonstrated that these buildings pose a safety risk to tenants and occupants, a financial risk to owners and risk the recovery of the City and region. In 2008, Oakland surveyed its multi-family buildings with five or more units and in 2009, Oakland passed an ordinance that required the owners of these buildings to complete a simple evaluation of the ground floor. The 2013 report documents the data collected thus far as a result of that ordinance and recommends next steps the City and residents can take to reduce damage to multi-unit wood-frame soft-story buildings in an earthquake.

Soft Story Screening information page: http://www2.oaklandnet.com/Government/o/PBN/OurOrganization/BuildingServices/o/Permits/DOWD008964

ABAG Oakland Soft Story information page: http://resilience.abag.ca.gov/projects/oakland-soft-story/

City of Berkeley

The City of Berkeley has a mandatory soft story retrofit program, effective January 2014 that applies to wood frame buildings constructed prior to 1987. The program began with a mandatory Engineering Evaluation Report for all potential soft story buildings in 2005. Owners have until December 31, 2016 to apply for a building permit and must complete the retrofit work within two years of submitting their permit application. Currently there are no financial incentives associated with the program, though the program does allow for a “hardship exception” that allows for extra time to retrofit if building owners are unable to finance a retrofit.

Soft story information page: http://www.cityofberkeley.info/Planning_and_Development/Building_and_Safety/Soft_Story_Program.aspx

18. Develop and implement a cripple wall retrofit program

Develop a retrofit program to address cripple wall housing in areas where it makes up a large percentage of a jurisdiction's housing stock (as a whole or for a specific vulnerable community). Pair programs with financing tools and incentives. Consider different incentives and financing tools for low-income homeowners or renters. The program should consider how to handle compliance and enforcement standards, mechanisms for enacting the program, and which retrofit standards to use.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	Region	**Community**	Resident

Target Development Type		**Hazard Addressed**		
Existing	New	**Ground Shaking**	Liquefaction	Flooding

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	Access to Resources	Single or Two Family	Multi-family	**Cripple Wall**	Soft story or House over garage

Action Categories					
Evaluation	**Program/ Operation**	**Plans and Policies**	**Codes, Regulations, and Ordinances**	Coordination	Education/ Outreach

Prerequisite Strategies	**Other Related Strategies**
Strategy 4: Improve the quality assurance of non-engineered retrofits by developing a statewide retrofitting license for contractors Strategy 16: Create a fragile housing inventory	Strategy 7: Encourage innovative insurance solutions at the state and federal level in partnership with the private sector Strategy 17: Develop and implement a soft story retrofit program Strategy 19: Require hazard disclosure for renters Strategy 20: Ensure that major upgrades and repairs to existing buildings address seismic and flood-related hazards

Description

Cripple walls are the short wood stud walls that enclose a crawl space under the first floor of a building. Most Bay Area detached homes built before 1940 have cripple walls, often indicated by a series of steps leading up to the front door. Cripple walls are at risk of severe damage or collapse during an earthquake, and may require that a home be demolished and rebuilt, even if the rest of the home is intact. ABAG estimates only 20-40% of older homes in the Bay Area have been strengthened, leaving an estimated 200,000 unbraced cripple walls. Retrofit solutions

are often relatively affordable and can be completed by the homeowner in many cases. By retrofitting these vulnerable structures fewer people will be displaced from their homes after an earthquake, and necessary repair costs will be reduced.

Two points should be addressed by a jurisdiction taking action: (1) A standard must be adopted by the local jurisdiction to give guidance on how to strengthen the walls, and (2) develop an education and/or incentive program for implementation.

1. Adopt a Policy

A cripple wall retrofit standard is necessary to ensure the investments being made are significantly improving the building performance. Without a standard, building departments will generally provide a permit for any cripple wall improvement as it will nominally improve the performance. Using a standard ensures upgrades use proper bolt sizing/spacing and plywood coverage, significantly improving the performance of the structure. The California Department of Housing and Community Development (HCD) adopted Appendix Chapter A3 of the California Existing Building Code as the recommended standard for cripple wall retrofit. In the Bay Area, many jurisdictions have adopted a standard plan set for simple, short cripple wall retrofits, called Plan Set A (http://www.abag.ca.gov/bayarea/eqmaps/fixit/plansets.html). ABAG has developed a model resolution that jurisdictions can use to adopt Plan Set A in their own community (available at http://quake.abag.ca.gov/residents/planset/). More complex retrofits (irregular building footprints, cripple walls over 4 feet in height) must be reviewed by an engineer and cannot use Plan Set A; however Appendix Chapter A3 provides guidance for more complex retrofits.

2. Get building owners to retrofit!

Both education and incentives can be successful methods to achieve adoption. Relative to many other fragile building types cripple wall retrofits are more affordable and non-invasive. The typical cripple wall home retrofit, completed by a licensed contractor, costs between $2,000 - $10,000 depending on the condition and size of the home. The cost of repair after a damaging earthquake can be more than ten times greater. In areas where this investment can be financed by the building owner an education program may be successful by itself. Similarly, with some existing experience and additional training homeowners can complete a retrofit on their own using resources like the standard Plan Set A (see above), and some jurisdictions have even provided free training and tool lending services to assist homeowners who want to do the work themselves. Financial incentives can make owners more willing to retrofit, who otherwise are unable to afford the improvement. Another option for incentives is expedited permitting or waiver of permit fees, particularly if the homeowner uses Plan Set A, which is standardized and does not require special plan review.

Alternately, this retrofit program could be made mandatory. This would require a fragile building inventory (see strategy: Create a fragile housing inventory), noticing, and consequences for lack of compliance. A mandatory program could also be supplemented with education and financing incentives.

Governance/Implementation Issues

This strategy will require the adoption of cripple wall retrofit standards. Once adopted, building officials will need to be educated about the changes. Building owners who retrofit will need to obtain a permit from a building inspector who confirmed the retrofit was done in accordance with the adopted standard. If there is an education or incentive program to implement, standard resources will be needed to operate such programs.

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	Development and Construction Loans	**Individual Home Improvement or Commercial Renovation Loans**	Revolving Loan Fund Programs	**Grant Programs**	Other

Retrofits can be paid through many mechanisms. In many cases homeowners will pay for retrofits out of their own savings or take out loans. This is particularly true with cripple wall retrofits, as they tend to be fairly low-cost. Some jurisdictions may choose to provide financial incentives, such as grants or rebates as discussed in the examples below.

Implementation Partner(s)

State	Region	Local
CEA has been working on programs to incentivize cripple wall retrofit programs through rebates from the state. Jurisdictions could benefit from lessons learned by CEA and utilize pre-developed standards and guidelines. CEA may also offer incentives through lowered insurance premiums.	ABAG could, through partnership with the CEA and local jurisdictions, help develop and establish model ordinance language and common retrofit standards and procedures for use throughout the language as well as provide case studies from other jurisdictions	*There are no local partners needed for this strategy.*

Examples

The following examples offer retrofit standards to consider for use as part of a cripple wall retrofit program as well as examples of successful incentives and tools that jurisdictions have used for cripple wall retrofits.

Policies

2010 California Existing Building Code, Title 24, Part 2, Appendix A - Prescriptive Provisions for Seismic Strengthening of Cripple Walls and Sill Plate Anchorage of Light, Wood-Frame Residential Buildings

CEBC Chapter A3 provides detailed descriptions of building elements that need to exist and the prescriptive plans on completing a retrofit. See:

http://publicecodes.cyberregs.com/st/ca/st/b200v10/st_ca_st_b200v10_appaa3_sec001.htm

http://www.documents.dgs.ca.gov/bsc/prpsd_chngs/documents/erm_files/HCD-EF-02-10-ET.pdf

City of Los Angeles Prescriptive Standard.

See: http://www.abag.ca.gov/bayarea/eqmaps/fixit/manual/PT14-App-A.PDF

Standard Plan Set A and model resolution for jurisdictions to adopt Plan Set A.

See: http://quake.abag.ca.gov/residents/planset/

Incentives

Financial

The City of Berkeley uses tax rebates and fee waivers to incentivize retrofits. See:

http://www.cityofberkeley.info/Planning_and_Development/Building_and_Safety/Transfer_Tax_Reductions_For_Qualifying_Seismic_Work.aspx

The California Earthquake Authority through their Brace + Bolt program offered $3,000 to homeowners to retrofit their homes. The first pilot period has closed, but future programs are likely. See:

https://www.earthquakebracebolt.com/

Training

The city of San Leandro has an especially robust program for cripple wall retrofit. They have run training programs to educate owners and contractors on current retrofitting standards. The city also has a retrofit handbook and a tool lending library. See:

http://www.sanleandro.org/depts/cd/bldg/retrofit/default.asp0

Materials

The City of Berkeley and the City of Oakland have tool lending libraries for residents who want to perform seismic work themselves. See:

http://www.berkeleypubliclibrary.org/locations/tool-lending-library

http://oaklandlibrary.org/locations/tool-lending-library

19. Require hazard disclosure for renters

This strategy recommends the development of policies that require residential property managers and landlords to disclose hazard risk information to renters in a manner similar to that required when residential properties are sold, including if the property is listed on a fragile housing inventory.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	Region	Community	**Resident**

Target Development Type		**Hazard Addressed**		
Existing	New	**Ground Shaking**	**Liquefaction**	**Flooding**

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	Cost Burdened	**Housing Tenure**	Access to Resources	**Single or Two Family**	**Multi-family**	**Cripple Wall**	**Soft story or House over garage**

Action Categories					
Evaluation	Program/ Operation	Plans and Policies	**Codes, Regulations, and Ordinances**	Coordination	Education/ Outreach

Prerequisite Strategies	**Other Related Strategies**
Strategy 16: Create a fragile housing inventory	None

Description

Renters have few protections from hazards in their rental units because they rarely have the ability to directly influence the retrofit of the building. Many renters are unaware also of the particular hazards a building is exposed to, or the condition and retrofit status of the building. Currently few jurisdictions require hazard disclosures to renters, though law requires such disclosures when a building is purchased and sold. Empowering renters to make decisions about the safety of where they live through mandatory hazards disclosure gives renters more control over the safety of their housing and sends a signal to landlords that safety from hazards is a critical component of good business and may increase retrofits for multifamily buildings.

This strategy recommends developing policies that would require residential property managers and landlords to provide lessees with a disclosure statement for natural hazard risk, in a manner similar to the Natural Hazard Disclosure Statement required by California Civil Code 1002.6c for sellers of real property. The lessor would provide disclosure to the lessee when entering into a rental agreement or lease for a residence that lies within a statutorily defined hazard area and/or is classified in a fragile housing inventory (see Strategy 16: Create a fragile housing inventory).

The California Civil Code requires certain landlord disclosures (e.g., lead, asbestos, carcinogenic material contamination) but does not require disclosure for natural hazard risk. Currently, natural hazard risk disclosure is only mandated for sale or transfer of property under the Natural Hazards Disclosure Act, as set forth in Civil Code Section 1002.6c, which requires that sellers of real property and their agents provide prospective buyers with a Natural Hazard Disclosure Statement, including a checklist, when the property being sold lies within one or more of six state-mapped hazard areas:

- A special flood hazard area designated by the Federal Emergency Management Agency
- An area of potential flooding in the event of a dam failure, designated by the state Office of Emergency Services
- A very high fire hazard severity zone designated by the California Department of Forestry and Fire Protection
- A wildland fire area that may contain substantial forest fire risks and hazards, designated by the State Board of Forestry
- An earthquake fault zone designated by the State Geologist
- A seismic hazard zone designated by the State Geologist

Additionally, several jurisdictions require supplemental advisory disclosures in addition to the Transfer Disclosure Statement required by Civil Code Section 1102.6 including requirements that sellers to disclose the existence of certain known fragile housing conditions (e.g., cripple walls with no shear paneling, soft story conditions) to buyers at the time of sale. This disclosure should also be made available to renters, including the retrofit status of the building.

By aligning required landlord disclosures with required disclosures for sellers of property in natural hazard areas and/or with fragile housing conditions, a jurisdiction can provide social and economic benefits to renter households by making them aware that they live in a hazard zone; disclosure may prompt these community members to not rent a property if they deem the hazard too high, or to take precautionary measures that would increase their resilience to a natural disaster, such as purchase hazard insurance or obtain necessary resources to prepare their households for emergencies.

Jurisdictions should consider including a provision that landlords provide tenants with informational materials on risk and how to increase their safety to seismic events, such as the purchase of earthquake insurance policies or securing nonstructural elements. Jurisdictions may develop this material themselves, use existing materials from USGS, CGS, and ABAG, or coordinate with other jurisdictions to develop regional materials.

Governance/Implementation Issues

Implementing new mandatory disclosures for landlords may be met with resistance from property management and landlord associations, as they may feel that it could hurt their

business or force them to lower rents on unsafe buildings. This strategy may, in actuality, have little effect in many markets, including very tight housing markets or among very low-income renters, where renters have less freedom of choice.

However, disclosures could also incentivize landlords to retrofit as a way of making their units more desirable. This strategy has the potential to influence the rental market to naturally value safer buildings over unsafe buildings. While this can be beneficial for landlords, who are able to charge a premium for retrofitted buildings, it also has the potential to devalue buildings that are not retrofitted and force low-income residents into unsafe housing.

Standardizing disclosures across the region can help ensure equity across the region, preventing the concentration of low-income housing in non-regulated jurisdictions and enclaves of privilege in regulated jurisdictions.

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	Development and Construction Loans	Individual Home Improvement or Commercial Renovation Loans	Revolving Loan Fund Programs	Grant Programs	**Other**

This strategy would require jurisdictions to allocate staff time for policy development and implementation.

Implementation Partner(s)

State	Region	Local
Jurisdictions can obtain the most updated hazard maps and guidelines from the California Geological Survey's Department of Conservation.	ABAG could help coordinate regional standards for disclosure, ensuring that jurisdictions with disclosure policies in place do not lose substantial housing and residents to unregulated jurisdictions.	Housing advocacy organizations such as Tenants' Rights NGOs and Property Owner associations could provide local political support and expertise for the development of a hazard disclosure ordinance for renters.

Examples

The following are examples of natural hazard or hazardous housing conditions disclosures regulations currently in effect.

California Civil Code Section 1103: ARTICLE 1.7. Disclosure of Natural and Environmental Hazards, Right-to-Farm, and Other Disclosures Upon Transfer of Residential Property

http://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=CIV&sectionNum=1103

Natural Hazards Disclosure Act, as described by California Geologic Survey

http://www.conservation.ca.gov/cgs/shzp/Pages/shmprealdis.aspx

City of Berkeley Soft Story Ordinance

The City of Berkeley passed a mandatory Soft Story Retrofit Ordinance in January 2014. However, the City began inventorying soft story buildings in the late 1990's, and in 2005, passed an ordinance requiring a) engineering evaluations of all buildings on the inventory list; b) placing signs around the building entrances of all buildings on the inventory list; and c) disclosure to renters that the building is on the inventory list. Policy language is below:

19.39.060 Owner and tenant obligations.

A. Obligation of Owners to Notify Tenants and Post Notice regarding the status of the building. Once the Building Official's determination is final, owners of buildings on this inventory shall do the following:

1. Within 30 days, notify each tenant in writing, using the Notice to Tenants form provided by the Building and Safety Division, and notify each prospective tenant prior to a change of tenancy, that the building is included on the inventory. Thereafter, the Rent Stabilization Board may provide such notice on an annual basis.

The complete ordinance can be found on City of Berkeley website:

https://www.cityofberkeley.info/uploadedFiles/Planning_and_Development/Level_3_-_Building_and_Safety/2013-12-03%20Item%2003%20Ordinance%207318(1).pdf

20. Ensure that major upgrades and repairs to existing buildings address seismic and flood-related hazards

Encourage local governments to develop and adopt special repair and upgrade standards for existing buildings that are not typically part of hazardous building abatement programs and are also potential candidates for conversion to mixed-use or higher-density residential use in areas of expected growth. This strategy focuses on reducing the risks posed by existing hazardous buildings by addressing both seismic and flood-related hazards at the time of upgrade (such as a mixed-use or residential conversion) or major repairs following a disaster.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	Region	**Community**	Resident

Target Development Type		**Hazard Addressed**		
Existing	New	**Ground Shaking**	**Liquefaction**	**Flooding**

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	Access to Resources	**Single or Two Family**	**Multi-family**	**Cripple Wall**	**Soft story or House over garage**

Action Categories					
Evaluation	Program/ Operation	Plans and Policies	**Codes, Regulations, and Ordinances**	Coordination	Education/ Outreach

Prerequisite Strategies	**Other Related Strategies**
Strategy 11: Develop locally-specific seismic hazard maps	None

Description

Many local governments have policies and standards in place that set conditions on existing buildings susceptible to hazards such as earthquakes. For example, in the Bay Area, many local governments have adopted standards requiring structural upgrades of significantly hazardous buildings at the time of major remodeling or upgrading (e.g., when the upgrade value is at more than 50% of the building value), and some have adopted earthquake-related restrictions on the expansion or conversion of vulnerable buildings if the planned modifications do not include hazard mitigation and reinforcement actions. Additionally, local governments have also enacted restrictions on the post-disaster repairs of substantially damaged hazardous building types, such as unreinforced masonry buildings (URMs), to their pre-disaster event state, unless substantial mitigation and reinforcement is done.

In some cases, these local policies and standards are driven by federal agencies. For example, the National Flood Insurance Program (NFIP) requires that participating communities adopt

floodplain management regulations so that substantially flooded buildings will be rebuilt to current flood-related building codes and other land-use regulations.

This strategy encourages local governments to take inventory of their existing policies on upgrade and repair requirements for vulnerable building types and evaluate whether they cover all applicable hazards, and include special provisions for buildings vulnerable to multiple hazards. Particular consideration should be given to vulnerable building types that are not typically part of hazardous building abatement programs, such as older concrete buildings, and are also potential candidates for conversion to mixed-use or higher-density residential use in areas of expected growth.

For example, in the case of NFIP participant communities in the Bay Area, the flood damage-related restrictions on existing buildings could be expanded to include buildings located in areas outside the NFIP zones but within sea level rise hazard areas. Similarly, the flood-related restrictions could be expanded to address buildings located in liquefaction hazard zones.

This strategy also encourages local governments to conduct an inventory of all plans, policies, codes, and other regulations ahead of disasters, to understand which types of buildings are targeted for post-disaster mitigation and reinforcement, what regulations say about nonconforming uses, and to clarify policies so that no conflicting standards exist that will confuse the rebuilding process. Ensure that codes for rebuilding after a disaster include appropriate upgrades to improve the resilience of the building to future disasters, and also consider the financial burden on building owners. For example certain rebuild requirements, such as parking requirements, could be relaxed in exchange for resiliency upgrades, such as bringing older buildings up to current seismic codes). Issues of preserving buildings of historical and cultural significance also need to be considered.

Governance/Implementation Issues

Local governments have leadership for implementing this strategy. Guidance documents or draft ordinances may need to be developed to promote adoption of this strategy. More guidance from the geotechnical and engineering community may be needed to identify hazardous buildings in communities, and define the appropriate repair and rebuild standards to address liquefaction and other earthquake-related hazards and sea level rise/flood hazards. This strategy could be linked to the State of California's Hazard Mitigation Plan, the ABAG Regional Hazard Mitigation Plan (see http://quake.abag.ca.gov/mitigation/), and local hazard mitigation plans.

State *Region* **Local** *Ensure that major upgrades and repairs to existing buildings address seismic and flood-related hazards*

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	**Development and Construction Loans**	**Individual Home Improvement or Commercial Renovation Loans**	Revolving Loan Fund Programs	**Grant Programs**	Other

Local general funds are a likely source for inventory and policy development efforts, unless a regional assessment and funding program is developed. Financing mechanisms for retrofitting hazardous buildings could include a bond program for public buildings, construction loans, individual home improvement loans, and grants specific to resilience. Affordable housing owners may be able to access Low Income Housing Tax Credit financing, HOME funds from HUD, and below market rate loans from community development finance institutions to help finance the costs of retrofits.

Grants or subsidized loans may be needed to make compliance feasible for existing housing that serves low and moderate income households. The Community Development Block Grant program can be used to fund housing rehabilitation programs that serve low and moderate income persons. Communities can also apply FEMA's Hazard Mitigation Grant Program or Pre-Disaster Mitigation Grant Program funding to housing rehabilitation needs. There could be an opportunity to finance resiliency investment using a Community Benefits District framework akin to the PACE program, where investments would be paid through the property taxes. The application of CBD financing for resiliency is unprecedented and would require additional legal analysis before its implementation

Post-disaster financing of building improvements for affected property owners often is available through provisions addressing the increased cost of compliance in private market earthquake and flood insurance, and from the NFIP. For example, insurance under the NFIP helps policyholders pay up to $30,000 to bring a "substantially damaged" or "repetitively damaged" building into compliance with state or community floodplain management laws or ordinances. Also, in a presidential-declared disaster, affected communities may be able to access post-disaster Hazard Mitigation Grant Program (HMGP) funds and use these to provide grants to building owners for this purpose. Small Business Administration (SBA) disaster loans also are available to qualifying individuals and businesses following a presidential disaster declaration.

Ensure that major upgrades and repairs to existing buildings address seismic and flood-related hazards *State* *Region* **Local**

Implementation Partner(s)

State	Region	Local
No state partners are required for this strategy.	ABAG and professional interest groups in the region, such as the Earthquake Engineering Research Institute (EERI) and Structural Engineers Association of Northern California (SEAONC) could be partners to assist in preparing guidance documents or draft ordinances and promoting their adoption.	*No local partners are required for this strategy.*

Examples

State and federal guidelines applicable to this strategy include the following:

FEMA 2006, National Flood Insurance Program (NFIP) Community Rating System (CRS): A Local Official's Guide to Saving Lives, Preventing Property Damage, Reducing the Cost of Flood Insurance (see http://www.fema.gov/media-library/assets/documents/16104?id=3655

FEMA Increased Cost of Compliance Coverage (see http://www.fema.gov/national-flood-insurance-program-2/increased-cost-compliance-coverage)

California Building Standards Code (Title 24, California Code of Regulations) (see http://www.bsc.ca.gov/codes.aspx)

California State Historical Building Code (SHBC) (see http://ohp.parks.ca.gov/?page_id=21410)

The following are examples of cities in which mandates have been enacted for upgrades to building susceptible to earthquakes:

Standards for Retrofitting Hazardous Buildings, City of Los Angeles, CA

After the 1994 Northridge earthquake, building officials in Los Angeles proposed a program to inspect older concrete buildings and required the retrofit of all those buildings that were found to be vulnerable. Rather than making the retrofits mandatory, the City Council adopted a voluntary standard and only required retrofits if the building changed its use or undertook a major remodel or upgrade. LA's downtown revival in the late 1990s unexpectedly brought those standards into play—dozens of older warehouses and commercial buildings were converted to residential use, and investors found spending even $1 million for retrofitting to be an acceptable cost. (Los Angeles Municipal Code, Chapter IX. Building Regulations, and LA Times. See: http://articles.latimes.com/2013/oct/15/local/la-me-downtown-concrete-20131016)

21. Assign higher seismic importance factor to new large-scale residential buildings

Amend the local building code to enhance structural and nonstructural design requirements for new large-scale residential buildings by adoption of increased seismic Importance Factor to improve their seismic performance level.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	Region	**Community**	Resident

Target Development Type		**Hazard Addressed**		
Existing	**New**	**Ground Shaking**	Liquefaction	Flooding

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	Access to Resources	Single or Two Family	**Multi-family**	Cripple Wall	Soft story or House over garage

Action Categories					
Evaluation	Program/ Operation	Plans and Policies	**Codes, Regulations, and Ordinances**	Coordination	Education/ Outreach

Prerequisite Strategies	**Other Related Strategies**
Strategy 11: Develop locally-specific seismic hazard maps	None

Description

The California Building Code (CBC) and American Society of Civil Engineers (ASCE) Standard 7-05 has set specific seismic design criteria for structures that fall under specific risk categories, such as risk category III (e.g. high occupancy buildings that pose a substantial hazard to human life in the event of failure)and risk category IV (e.g. essential buildings).

Structures under these risk categories are assigned a higher "seismic importance factor," which is a metric used to indicate the required seismic design criteria for the given structure. A higher importance factor value indicates the need for more stringent design criteria, such as enhanced resistance to lateral forces, or enhanced nonstructural anchorage and bracing requirements). The CBC prescribes minimum seismic importance factors for specific type of buildings, which can potentially be made more stringent based on use and/or occupancy by local governments, given that they have jurisdiction over their building codes.

Definitions for risk categories and corresponding seismic importance factors are presented in Tables 1.5-1 and Tables 1.5-2 of the American Society of Civil Engineers' building design standards (ASCE 7-10. See: https://engineering.purdue.edu/CE/Academics/Groups/Structural/Details/PersonalWebPage/mdbowman/CE470_files/Fall2011/Articles/ASCE_MinimumDesign.pdf).

Further clarification on risk categories for buildings with different types and levels of occupancy is provided in the California Building Code (CBC Part 2, Volume 2, Table 1604.5. See: https://law.resource.org/pub/us/code/bsc.ca.gov/gov.ca.bsc.2010.02.2.html).

The current occupancy thresholds that trigger the above mentioned requirements for high occupancy buildings in areas with seismic hazards might be too high. This means that new large-scale residential buildings with occupancies lower than the current occupancy threshold have lower seismic design requirements.

This strategy proposes that local governments adopt code revisions to lower the occupancy threshold that triggers seismic design requirements for buildings falling under Risk Category III. Thus, under this strategy, the seismic design requirements for new large-scale residential buildings would be stepped up to a higher performance level than is typically applied for the occupancy load of such buildings. The proposed new trigger threshold for buildings in Risk Category III could be in the range of 200-300.

This lower threshold would be applied in order to achieve more robust performance of both structural and non-structural elements during a design level seismic event. This would provide the population in an area of high growth with a higher functional level, and post-earthquake building occupancy is more likely to be achieved.

Governance/Implementation Issues

This strategy proposes revisions to local building codes where applicable, along with appropriate training for local building officials, so that they understand the new requirements. The revisions should be included in plan check-lists to ensure proper enforcement.

Additionally, local governments may also consider developing external reference documents for developers and contractors to ensure more uniform application across the region. Given that local governments have exclusive jurisdiction over their building codes, this strategy does not require collaboration among local governments and regional agencies, but can certainly benefit from collaboration. For example, ABAG could potentially facilitate the development of model code language for this strategy, such that it is accessible to all communities.

Initial implementation is likely to occur within large, individual jurisdictions that have the resources to fund implementation. The implementation approach developed by early adopters may be used as a template for other locations, or may be passed up to the state level for wider access.

State	*Region*	**Local**	*Assign higher seismic importance factor to new large-scale residential buildings*

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	**Development and Construction Loans**	Individual Home Improvement or Commercial Renovation Loans	Revolving Loan Fund Programs	Grant Programs	Other

Given that this strategy is aimed at ensuring safe execution of new large-scale residential buildings by improving their seismic performance, it is expected that any additional costs resulting from more stringent requirements would be borne by developers. The implementation of this strategy would be financed by development or construction loans. Developers of affordable housing can access subsidies, such as the Low Income Housing Tax Credits, HOME funds from HUD, and below market rate loans from community development finance institutions, to help finance the costs.

Implementation Partner(s)

State	Region	Local
The CSSC and state organizations such as SEAOC could assist with the development of statewide standards.	SEAONC could assist with developing technical guidelines and external reference documents for developers and contractors. ABAG could facilitate the development of model code language to adopt the updated building codes.	*No local partners are required for this strategy.*

Examples

None available

22. Enhance minimum design requirements for new small-scale residential building foundations in liquefaction zones

Amend the local building code to require enhanced foundation design requirements for new small-scale residential development (e.g. single or two-family dwellings) and for significant modifications to existing small-scale residential development to limit foundation damage due to liquefaction.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	**Region**	Community	Resident

Target Development Type		**Hazard Addressed**		
Existing	**New**	Ground Shaking	**Liquefaction**	Flooding

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	Access to Resources	**Single or Two Family**	**Multi-family**	Cripple Wall	Soft story or House over garage

Action Categories					
Evaluation	Program/ Operation	Plans and Policies	**Codes, Regulations, and Ordinances**	Coordination	Education/ Outreach

Prerequisite Strategies	**Other Related Strategies**
None	Strategy 1: Complete seismic hazard mapping of urban and urbanizing areas Strategy 11: Develop locally-specific seismic hazard maps

Description

Small-scale residential development is typically designed and constructed in accordance with the California Residential Code (Title 24, Part 2.5). Foundation design according to this code doesn't always provide sufficient performance in earthquake-induced liquefaction unless the local building official requires a project-specific evaluation of these issues (typically triggered by being located in a California Geological Survey Zone of Required Investigation) that is more in line with the California Building Code's (CBC) Title 24, Part 2.5, section R401.4, which provides higher performance levels for foundations in liquefaction-prone areas. Insufficient foundations may crack or fail if subject to liquefaction, often rendering the home uninhabitable and unrepairable.

This strategy proposes adopting municipal revisions that enhance the requirements for the design of residential foundations of new small-scale residential development in areas deemed susceptible

to liquefaction (through State mapping, see Strategy 1: Complete seismic hazard mapping of urban and urbanizing areas, or through local mapping efforts, see Strategy 11: Develop locally-specific seismic hazard maps). The enhanced foundation design requirements may also apply to existing small-scale residential development for which significant alterations are proposed and which trigger mandatory seismic upgrades in accordance with the California Residential Code (Title 24, Part 2, Chapter 34) or local building code modifications. Enhanced foundation design can be implemented through voluntary or mandatory policies or programs. Enhanced foundation requirements may be based on generalized liquefaction hazard zones or site-specific investigation, depending on the amount of available local data and the certainty of jurisdictions about liquefaction susceptibility areas.

A standard approach should be developed that provides a range of enhanced foundation options that respond to both the size of the building and the severity of the expected liquefaction. Enhanced foundation types could consist of a grillage of tied grade beams, a mat foundation or piles. Soil grouting may also be a possible solution where the liquefaction layer is shallow and of appropriate composition. Other possible solutions could be proposed at a local level or developed in collaboration with local structural engineering professional organizations. These enhanced foundation types would minimize the risk of severe, unrepairable damage to residential structures subjected to liquefaction.

Governance/Implementation Issues

This strategy will require revisions to local government building codes where applicable, along with appropriate training for local building officials, so that they understand the new requirements and limits of application. The revisions should be included in plan check-lists to ensure proper enforcement.

Implementing this strategy requires an assessment of liquefaction risk at a local scale. Cities may use CGS liquefaction maps (available for the South Bay, Peninsula, and East Bay) or USGS liquefaction susceptibility studies. Jurisdictions may require additional site-specific soil investigations to determine actual liquefaction susceptibility to trigger enhanced foundation requirements.

Local governments may also consider developing external reference documents for developers and contractors to ensure more uniform application across the region. Given that local governments have exclusive jurisdiction over their building codes, this strategy does not require collaboration among local governments and regional agencies, but can certainly benefit from collaboration to implement even standards across the region and to assist smaller jurisdictions which may not have the resources to develop the ordinance locally. For example, ABAG could potentially facilitate the development of model code language for this strategy, such that it is accessible to all communities.

Enhance minimum design requirements for new small-scale residential building foundations in liquefaction zones *State* *Region* **Local**

Initial implementation is likely to occur within large, individual jurisdictions that have the resources to fund implementation. The implementation approach developed by early adopters may be used as a template for other locations, or may be passed up to the state level for wider access. This strategy may also be phased, beginning with voluntary compliance and moving towards mandatory compliance as buy-in is developed.

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	**Development and Construction Loans**	**Individual Home Improvement or Commercial Renovation Loans**	Revolving Loan Fund Programs	**Grant Programs**	Other

Given that this strategy is aimed at ensuring safe execution of small-scale residential development through enhanced construction requirements, it is expected that for new development, as well as retrofits to existing development, any additional costs resulting from more stringent requirements would be borne by the individual property owners, and in some cases, developers. For individual property owners, the primary financing mechanism would be individual loans, and for developers, the financing mechanism will likely be development/ construction loans. Grants or subsidized loans may be needed to make compliance feasible for existing housing that serves low and moderate income households. The Community Development Block Grant program can be used to fund housing rehabilitation programs that serve low and moderate income persons. Communities can also apply FEMA's Hazard Mitigation Grant Program or Pre-Disaster Mitigation Grant Program funding to housing rehabilitation needs.

Implementation Partner(s)

State	Region	Local
State and federal agencies such as the California Geological Survey and U.S. Geologic Survey are crucial partners to identify high liquefaction susceptibility zones. The CSSC and state organizations such as SEAOC could assist with the development of statewide standards.	For standardized requirements and implementation across a region (e.g., the Bay Area), local bodies with experience coordinating this type of effort, such as ABAG, could be engaged. Structural engineering associations such as SEAONC may also be partners in developing consistent standards.	*No local partners are required for this strategy.*

Examples

Code Amendments on Foundation Design requirements, Los Angeles County, CA

Los Angeles County has amended its building code to make foundation design requirements more stringent than normal under the California Residential Code. Los Angeles County has adopted a standardized approach to foundation design requirements, based on building size. For example, Table 1809.7 in Section 1809 of the Los Angeles County, California, Code of Ordinances, Title 26 – BUILDING CODE, CHAPTER 18 – SOILS AND FOUNDATIONS indicates increasing width and depth requirements for perimeter foundations depending on the number of stories. The developer can override these prescriptive requirements with a site-specific geotechnical investigation. See: https://library.municode.com/HTML/16274/level2/TIT26BUCO_CH18SOFO.html

Enhanced Foundation Design Specifications, City of Christchurch, New Zealand

After the earthquakes of 2010 and 2011, that caused widespread liquefaction damage to the residential sector in Christchurch, the government did a comprehensive assessment of future liquefaction risk in residential areas. They developed three technical categories based on liquefaction risk, and developed requirements for enhanced foundation design based for each technical category. See: http://canterburyresidentialrebuild.govt.nz/tc3/foundation-guidelines.

23. Restrict use of significant structural irregularities in residential buildings

Amend the local building code to restrict the use of structural irregularities in the design of new residential construction as well as existing residential construction subject to significant modification in areas with high or moderate shaking and liquefaction potential.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	Region	**Community**	Resident

Target Development Type		**Hazard Addressed**		
Existing	**New**	**Ground Shaking**	**Liquefaction**	Flooding

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	Access to Resources	**Single or Two Family**	**Multi-family**	**Cripple Wall**	**Soft story or House over garage**

Action Categories					
Evaluation	Program/ Operation	Plans and Policies	**Codes, Regulations, and Ordinances**	Coordination	Education/ Outreach

Prerequisite Strategies	**Other Related Strategies**
Strategy 11: Develop locally-specific seismic hazard maps	None

Description

New buildings are to be designed per the California Building Code (CBC) for life safety performance. In general, these buildings should exhibit acceptable seismic performance, but they may experience some level of structural damage in addition to non-structural damage. Chapter 16 under Title 24 Part 2, Volume 2 of the CBC recognizes a number of structural conditions that deviate from regular building geometry. When such irregularities are incorporated into the structure, the code requires additional prescriptive measures that will help to mitigate any negative consequences of including these features in the design. However, there are some structural irregularities described in the building code, for which the prescriptive mitigation measures may not be sufficient, if those buildings are in areas prone to liquefaction and shaking, and such structural irregularities are likely to have more impact on building performance.

This strategy proposes that local governments adopt code revisions which would require the elimination of those structural irregularities that may adversely impact the performance of buildings in areas with high liquefaction and shaking potential. For buildings in areas with moderate liquefaction and shaking potential, those structural irregularities could be allowed, but with limitations, as required by individual jurisdictions, to improve the overall performance of the residential building stock.

This strategy is applicable to new development, and can also be adapted to for application to existing buildings that are subject to significant (trigger-level) alterations or building additions.

Governance/Implementation Issues

This strategy will require revisions to local government building codes where applicable, along with appropriate training for local building officials, so that they understand the new requirements and limits of application. The revisions should be included in plan check-lists to ensure proper enforcement. Additionally, local governments may also consider developing external reference documents for developers and contractors to ensure more uniform application across the region.

Given that local governments have exclusive jurisdiction over their building codes, this strategy does not require collaboration among local governments and regional agencies for implementation at the local level, but can certainly benefit from collaboration. For example, Association of Bay Area Governments (ABAG) could potentially facilitate the development of model code language for this strategy, such that it is accessible to all communities, and can be implemented by a consortium of cities across the region. Initial implementation is likely to occur within large, individual jurisdictions that have the resources to fund implementation. The implementation approach developed by early adopters may be used as a template for other locations, or may be passed up to the state level for wider access.

Some challenges and intermediate actions will need to be addressed prior to initiating/implementing this strategy. Detailed statewide maps of liquefaction zones are not available yet for all areas, including areas of high growth (see Strategy 11: Develop locally specific hazard maps), and therefore, local governments may need to produce their own maps to identify zones with high liquefaction potential. Furthermore, this strategy will require a study to identify the small number of building irregularities (individually or in combination) that are expected to have the most impact on building performance during a seismic event. This type of work can be tasked to organizations that are experienced in performing this type of work, such as the Applied Technology Council.

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	**Development and Construction Loans**	**Individual Home Improvement or Commercial Renovation Loans**	**Revolving Loan Fund Programs**	**Grant Programs**	Other

Given that this strategy is aimed at ensuring safe execution of large-scale residential buildings through the elimination or reduction of structural irregularities, it is expected that for new development, as well as retrofits to existing development, any additional costs resulting from more stringent requirements would be borne by developers or individual property owners. For new construction, the cost of compliance would likely be financed by development/construction loans. Developers of affordable housing can access subsidies, such as the Low Income Housing Tax Credits, HOME funds from HUD, and below market rate loans from community development finance institutions, to help finance the costs of new construction or renovation.

For owners of existing buildings that need to comply with new codes due to a substantial improvement, costs would likely be financed by individual home improvement loans. Grants or subsidized loans may be needed to make compliance feasible for existing housing that serves low and moderate income households. The Community Development Block Grant program can be used to fund housing rehabilitation programs that serve low and moderate income persons. Communities can also apply FEMA's Hazard Mitigation Grant Program or Pre-Disaster Mitigation Grant Program funding to housing rehabilitation needs.

Implementation Partner(s)

State	Region	Local
No state partners are required for this strategy.	ABAG, Applied Technology Council (see section on Governance/Implementation Issues for more details on the potential role of these partners)	*No local partners are required for this strategy.*

Examples

The following is an example of a code amendment that does not allow structural irregularities under special circumstances:

Code Amendments on Structural Irregularities, California Division of the State Architect/ California Office of Statewide Health Planning and Development

An example of structural irregularities that are not allowed under special circumstances is contained in Section 1616A.1.10 of the CBC, which modifies the code provisions for California Division of the State Architect/California Office of Statewide Health Planning and Development design in seismic design category D. The structural irregularities that are the subject of this clause are described in the American Society of Civil Engineers' (ASCE) standards on Minimum Design Load for Buildings and Other Structures (ASCE 7-10, Table 12.3-1, Type 1b (Extreme Torsional Irregularity) and Table 12.3-2, Type 1b (Extreme Soft Story Irregularity) and Type 5a (Weak Story Irregularity)). Per this clause of the CBC, building configurations that would otherwise be permitted, containing these structural irregularities, are not allowed. Although these same structural irregularities may not be the main concern under liquefaction conditions, a study of the sensitivity of the two tables of irregularities in ASCE 7-10 will provide more accurate information, on which a final determination can be based.

24. Enhance minimum requirements for non-structural anchorage and bracing of interior partition walls in residential buildings

Amend the local building code to include enhanced non-structural anchorage and bracing requirements for interior partition walls in existing residential buildings in areas with shaking potential.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	Region	**Community**	Resident

Target Development Type		**Hazard Addressed**		
Existing	New	**Ground Shaking**	Liquefaction	Flooding

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	Access to Resources	**Single or Two Family**	**Multi-family**	**Cripple Wall**	**Soft story or House over garage**

Action Categories					
Evaluation	Program/ Operation	Plans and Policies	**Codes, Regulations, and Ordinances**	Coordination	Education/ Outreach

Prerequisite Strategies	**Other Related Strategies**
None	None

Description

The publication FEMA E-74: Reducing the Risks of Nonstructural Earthquake Damage notes that the majority of earthquake damage to existing construction in recent US earthquakes has come from non-structural failures. In existing residential construction, the interior walls are frequently attached to the ceiling, relying on the ceiling "diaphragm" for support. During strong shaking, the ceiling can prove to be inadequate, and compression may result in local failure, which in turn, may lead to collapse of the wall and-or the adjacent portion of ceiling. This type of failure is more likely when heavy objects, such as large TV monitors or bookcases are attached to the wall. Although the long term impact of non-structural damage is less significant than structural damage to overall integrity of the building, the residence may still be rendered uninhabitable for a significant period and, depending on the level of finishes, may be a high cost item to repair.

This strategy proposes that local governments adopt code revisions which enhance requirements for non-structural anchorage and bracing of interior partition walls in existing residential buildings. This strategy would be applicable to existing buildings for which

significant alterations are proposed and may be linked to mandatory seismic upgrade triggers. Enhanced non-structural anchorage and bracing methods include adding collector strut/tie elements through the ceiling framing and/or bracing the walls up to the next level of floor framing or roof framing. Some guidance can be found in FEMA E-74 Chapter 6 and local jurisdictions may seek help from local structural engineering professional bodies in development of template solutions.

This strategy specifically targets retrofits to partition walls as opposed to retrofits to other non-structural elements in residential buildings, because retrofits to partition walls may be the low-hanging fruit in the range of options for non-structural elements like HVAC systems or stairs. While anchorage and bracing requirements do exist for partition walls above 6 feet in existing residential buildings undergoing modification, the requirements for older construction can be ambiguous, which is why this strategy has been proposed.

Governance/Implementation Issues

This strategy would require revisions to local government building codes where applicable, along with appropriate training for local building officials, so that they understand the new requirements. The revisions should be included in plan check-lists containing non-structural anchorage and bracing options for different types and vintages of development to ensure proper enforcement.

Additionally, local governments may also consider developing similar external reference documents for homeowners, developers and contractors to ensure more uniform application across the region. Given that local governments have exclusive jurisdiction over their building codes, this strategy does not require collaboration among local governments and regional agencies, but can certainly benefit from collaboration. For example, ABAG could potentially facilitate the development of model code language for this strategy, such that it is accessible to all communities.

Initial implementation is likely to occur within large, individual jurisdictions that have the resources to fund implementation. The implementation approach developed by early adopters may be used as a template for other locations, or may be passed up to the state level for wider access.

State *Region* **Local** *Enhance minimum requirements for non-structural anchorage and bracing of interior partition walls in residential buildings*

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	**Development and Construction Loans**	**Individual Home Improvement or Commercial Renovation Loans**	**Revolving Loan Fund Programs**	**Grant Programs**	Other

Given that this strategy is aimed at enhancing the habitability of residential units through non-structural bracing and anchorage methods, any additional costs resulting from more stringent requirements would be borne by the individual property owners, and in limited cases, developers. For individual property owners, the primary financing mechanism would be individual loans (or potentially grants), and for developers, the financing mechanism will likely be development/ construction loans. Grants or subsidized loans may be needed to make compliance feasible for existing housing that serves low and moderate income households. The Community Development Block Grant program can be used to fund housing rehabilitation programs that serve low and moderate income persons. Communities can also apply FEMA's Hazard Mitigation Grant Program or Pre-Disaster Mitigation Grant Program funding to housing rehabilitation needs.

Implementation Partner(s)

State	Region	Local
No state partners are required for this strategy.	ABAG could potentially facilitate development of model code language	*No local partners are required for this strategy.*

Examples

None available

25. Develop and adopt guidelines for building utility connections to incorporate earthquake safety features

Amend the local building code to require that utility connections to buildings incorporate safety features to prevent adverse impacts from earthquakes. Develop guidelines on safety measures such as adequate displacement allowance for building utility connections, if there are no existing guidelines.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	Region	Community	**Resident**

Target Development Type		**Hazard Addressed**		
Existing	**New**	**Ground Shaking**	**Liquefaction**	Flooding

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	**Access to Resources**	**Single or Two Family**	**Multi-family**	**Cripple Wall**	**Soft story or House over garage**

Action Categories					
Evaluation	Program/ Operation	Plans and Policies	**Codes, Regulations, and Ordinances**	Coordination	Education/ Outreach

Prerequisite Strategies	**Other Related Strategies**
None	None

Description

Water, wastewater, electricity, and natural gas connections at building interfaces are susceptible to damage or rupture during strong shaking, especially if building settlements also occur relative to the surrounding land (or vice versa for pile-supported structures) as a result of liquefaction. While guidelines do exist on earthquake safety features for natural gas connections to buildings, similar guidelines may not be available for other types of utility connections such as water, wastewater and electricity.

This strategy proposes that local governments adopt code revisions requiring the use of safety features for natural gas connections to buildings based on existing best practices. Safety measures could include the use of shut-off valves for natural gas connections.

Furthermore, this strategy proposes that guidelines be developed for use by local governments, which require that utility connections be installed with adequate allowance for significant relative displacement at the building perimeter, to capture the most extreme displacements that may occur as a result of shaking, especially in areas where buildings are also subject to liquefaction-induced settlement.

This strategy can be implemented as part of the building permitting requirements for new construction and also could be required when a building expansion or other trigger event occurs. Current practice for new construction already requires a compressible filler material at foundation wall openings, where utility lines pass through. Where a liquefaction hazard exists, the potential for movement will be increased and may require other special measures, if very large displacements are to be accommodated. More research will likely be required on what kinds of measures are suitable to accommodate very large displacement. This research could potentially be taken on by professional association committees that have an interest in exploring this issue.

This strategy is important, not just because it can prevent physical damage to utility connections (and in turn prevent utility service disruption at the building scale), but also because it can prevent cascading impacts at a neighborhood or community scale, such as fires from natural gas leakage, thereby improving community resilience. This strategy can achieve its objectives most effectively when it is adopted at the neighborhood scale or community scale. Piecemeal adoption may not result in prevention of cascading impacts at a larger scale (e.g., if a neighborhood contains a mix of buildings with natural gas shut-off valves and without shut-off valves, fires can spread from damaged natural gas connections without shut-off valves to buildings with shut-off valves).

Governance/Implementation Issues

This strategy will require revisions to local government building codes where applicable, along with appropriate training for local building officials, so that they understand the new requirements. The revisions should be included in plan check-lists to ensure proper enforcement.

Additionally, local governments may also consider developing external reference documents for water, gas and electric utilities to ensure more uniform application across the region. Given that local governments have exclusive jurisdiction over their building codes, this strategy does not require collaboration among local governments and regional agencies, but can certainly benefit from collaboration. For example, ABAG could potentially facilitate the development of model code language for this strategy, such that it is accessible to all communities.

In most cases, local governments may not have ownership and/or operational control over utilities, and therefore, local governments would need to collaborate with utilities in enforcing the requirements proposed by this strategy.

Initial implementation is likely to occur within large, individual jurisdictions that have the resources to fund implementation. The implementation approach developed by early adopters may be used as a template for other locations, or may be passed up to the state level for wider access.

Develop and adopt guidelines for building utility connections to incorporate earthquake safety features	*State*	*Region*	**Local**

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	**Development and Construction Loans**	**Individual Home Improvement or Commercial Renovation Loans**	**Revolving Loan Fund Programs**	**Grant Programs**	Other

Given that this strategy is aimed at minimizing disruption to utility connections, it is expected that any additional costs resulting from more stringent requirements, which would not be significant compared with the total development cost, would be borne by developers (via development/construction loans) or individual property owners (via individual loans). Developers of affordable housing can access subsidies, such as the Low Income Housing Tax Credits, HOME funds from HUD, and below market rate loans from community development finance institutions, to help finance the costs of new construction or renovation. This strategy could also be financed with municipal enterprise funds in the case of municipal utilities. In the case of privately owned utilities, this strategy could be financed through user fees or rates.

Grants or subsidized loans may be needed to make compliance feasible for existing housing that serves low and moderate income households. The Community Development Block Grant program can be used to fund housing rehabilitation programs that serve low and moderate income persons. Communities can also apply FEMA's Hazard Mitigation Grant Program or Pre-Disaster Mitigation Grant Program funding to housing rehabilitation needs.

Implementation Partner(s)

State	Region	Local
No state partners are required for this strategy.	ABAG could provide model code language and ordinances	*No local partners are required for this strategy.*

Examples

The following are examples of local governments which have adopted natural gas shut-off valve ordinances.

Contra Costa County, CA

See: http://www.earthquakestore.com/valve-regulations-cc.html

Alameda County, CA

See: http://www.earthquakestore.com/valve-regulations-alameda1.html

City of Berkeley, CA

See: http://www.ci.berkeley.ca.us/uploadedFiles/Clerk/Level_3_-_City_Council/2010/09Sep/2010-09-21_Item_02_Ordinance_7151.pdf

The following are examples of guidelines on the design, choice of material, and installation techniques for utility connections, which were developed following major earthquake events in two cities in New Zealand.

Guidelines on safety feature for utility connections

New Zealand is subject to intense and frequent seismic events. Damage to electricity and other infrastructure assets in the 1987 earthquake in the Town of Edgecumbe added impetus to infrastructure vulnerability considerations, including the vulnerability of utility connections. During the 1990s, the Christchurch Engineering Lifelines Group produced a report called Risks and Realities, which draws attention to the importance of adopting best practices in design, choice of material and installation of infrastructure, including the installation of flexible connections where assets (especially buried assets such as pipes and cables) enter buildings, especially in liquefaction zones.

See: https://caenz.squarespace.com/s/Risk_Realities.pdf

Following the major Christchurch earthquakes of 2010 and 2011, a report called The Value of Lifeline Seismic Risk Mitigation in Christchurch (June 2012), commissioned by the New Zealand Earthquake Commission, documents the substantial range of risk reduction and readiness steps taken by lifeline utilities in Christchurch over recent years to reduce the impact of earthquakes.

See: http://www.eqc.govt.nz/sites/public_files/1393-lifeline-seismic-risk-mitigation-christchurch.pdf

26. Participate in FEMA's Community Rating System

Encourage local governments to participate in FEMA's Community Rating System (CRS), a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum National Flood Insurance Program (NFIP) requirements by reducing local flood insurance rates.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	Region	**Community**	Resident

Target Development Type		**Hazard Addressed**		
Existing	**New**	Ground Shaking	Liquefaction	**Flooding**

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	Access to Resources	**Single or Two Family**	**Multi-family**	Cripple Wall	Soft story or House over garage

Action Categories					
Evaluation	**Program/ Operation**	Plans and Policies	Codes, Regulations, and Ordinances	Coordination	Education/ Outreach

Prerequisite Strategies	**Other Related Strategies**
None	Strategy 28: Increase standards in local floodplain management ordinances beyond the minimum requirements of FEMA's NFIP program Strategy 29: Require flood-proof construction methods and techniques within and adjacent to special flood hazard areas Strategy 30: Revise minimum building elevation standards and maximum building height limits for new development

Description

Currently, most communities at risk from existing coastal or riverine flooding hazards have only put in place strategies that meet the bare minimum FEMA requirements. FEMA requirements are based on existing coastal and riverine flood hazards (and often based on studies that are decades out of date), and therefore do not take into account future impacts of sea level rise, storm surge, and precipitation. In fact, in some cases, adopting the minimum standard often may not even account for existing flood hazards. There are ongoing efforts among Bay Area cities to conducted updated coastal flood hazard analyses, but these analyses do not include riverine flooding, or the combined impacts of riverine and coastal flooding. Lastly, there is a lack of awareness among community members, of the coastal and riverine flood hazards to which their community is, or might be exposed in the future.

In recognition of the limitations of FEMA guidelines, and of the lack of awareness of community members about flood hazards, FEMA offers a number of voluntary programs to local governments, through which they can exceed minimum FEMA requirements and increase community awareness. This strategy proposes that local governments participate in one such voluntary program, called the Community Rating System (CRS).

FEMA's CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities which exceed the minimum NFIP requirements. Communities are rated from 1 to 9, based on the number of CRS activities that are effectively implemented to reduce flood risk. Each class increase results in a 5% decrease in the flood insurance premium (from a 5% discount for a Class 9 to a 45% discount for a Class 1). The class ratings reflect the reduced flood risk that results from the community actions meeting the three goals of the CRS, as follows:

- Reduce flood damage to insurable property;
- Strengthen and support the insurance aspects of the NFIP, and
- Encourage a comprehensive approach to floodplain management.

This strategy has social benefits because it addresses community vulnerabilities to flood hazards. This strategy also has economic benefits through reduced flood insurance premiums. New and re-modeled structures that comply with this strategy may receive reduced flood insurance premiums by adopting flood-proofing techniques. If the community participates in the CRS program, all structures within the community, regardless of flood-proofing, may receive reduced flood insurance premiums after the community adopts flood-proofing requirements within and adjacent to the SFHAs that exceed the NFIP requirements.

See: http://www.fema.gov/national-flood-insurance-program-community-rating-system

Governance/Implementation Issues

Under this strategy, the first step would be to identify the city or county staff person who will take the lead on developing the CRS plan. FEMA recommends that this person be designated officially and be authorized to develop the plan. In other communities, this lead individual typically comes from Planning, Engineering, or Permit Departments, the Department of Inspection Services, or the Emergency Preparedness Department. Key staff from all affected departments would be given time to participate in the plan development and implementation process.

Potential Financing Mechanisms

City/County/ State Bond Program	**Parcel or Sales Tax**	**Tax-based Special Districts**	**Fee-based Special Districts**	**Infrastructure Financing Districts**	Joint Powers Authorities
Municipal Enterprise Funds	**Development and Construction Loans**	**Individual Home Improvement or Commercial Renovation Loans**	**Revolving Loan Fund Programs**	**Grant Programs**	**Other**

The funding to develop and implement this strategy could come from the city, group of cities, or county participating in the plan development. Staff time and resources will be required to develop the plan. Technical assistance grants may available from the Metropolitan Transportation Commission (MTC), particularly for communities with designated Priority Development Areas (PDAs). Funding mechanisms for implementing the actions in the plan would depend on the nature of the actions, which include from outreach projects (e.g. sending information on flood hazards to residents), regulations (e.g. open space preservation), and physical improvements (e.g. drainage system modifications, levee maintenance, etc.). Given the broad range of actions that could be carried out under the CRS, any of the financing mechanisms listed in Table 3-4 could be applicable for this strategy.

Implementation Partner(s)

State	Region	Local
FEMA can assist communities in developing their CRS plans	*No regional partners are needed for this strategy*	Communities and their county can work together to develop consistent plans and assist each other in meeting the plan requirements.

Examples

Codes/Standards/Programs referenced in this strategy include the following:

- FEMA Community Rating System

FEMA provides sample CRS plans that can be used as a reference when developing community or county-based plans (see: http://www.fema.gov/media-library-data/20130726-1755-25045-1178/example_plans.pdf).

FEMA has produced a CRS fact sheet that references the following four communities which have the highest CRS ratings in the country, and therefore the largest flood insurance premium reductions for their residents (see: http://www.fema.gov/media-library-data/1395661546460-d6859e8d080fba06b34a6f1a4d0abdba/NFIP_CRS_March+2014+508.pdf):

- Roseville, California was the first to reach the highest CRS rating (Class 1). Damaging floods in 1995 spurred Roseville to strengthen and broaden its floodplain management program. Today the City earns points for almost all CRS creditable activities. The average premium discount for policies in the Special Flood Hazard Area (SFHA) is $832.
- Comprehensive planning for floodplain management has been a key contributor to Tulsa, Oklahoma's progress in reducing flood damage from the dozens of creeks within its jurisdiction. The City (Class 2) has cleared more than 900 buildings from its floodplains. The average premium discount for policies in the SFHA is $583.
- King County, Washington (Class 2) has preserved more than 100,000 acres of floodplain open space and receives additional CRS credit for maintaining it in a natural state. The average premium discount for policies in the SFHA is $650.
- Pierce County, Washington (Class 2) maintains over 80 miles of river levees. County officials mail informational brochures annually to all floodplain residents. The average premium discount for policies in the SFHA is $666.

27. Reduce flood risk through integrated watershed management

Develop a program to work with public and private landowners to decrease the risk of flooding by advancing watershed management projects that reduce and/or store runoff during rainfall events, including the installation of green infrastructure and Low Impact Development (LID) practices, and improve the condition in the floodplain, for example through floodplain restoration or improvement.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	Region	**Community**	Resident

Target Development Type		**Hazard Addressed**		
Existing	**New**	Ground Shaking	Liquefaction	**Flooding**

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	Access to Resources	**Single or Two Family**	**Multi-family**	Cripple Wall	Soft story or House over garage

Action Categories					
Evaluation	**Program/ Operation**	**Plans and Policies**	Codes, Regulations, and Ordinances	Coordination	Education/ Outreach

Prerequisite Strategies	**Other Related Strategies**
None	None

Description

This strategy recommends developing an integrated watershed management program to reduce the risk of coastal and riverine flooding. The program would encourage watershed-wide solutions, including engineered and nature-based watershed management approaches such as the installation of green infrastructure, use of Low Impact Development (LID) practices, and improving the condition of the floodplain through restoration or maintenance. This strategy will help protect both existing and future housing located in coastal and riverine floodplains as well as adjacent low-lying areas that will be susceptible to flooding during storm events as sea level rises.

This strategy recommends building on the existing California Regional Water Quality Control Board's Municipal Regional Stormwater Permit to requiring all new development and redevelopment projects over a certain size conform to a set of LID requirements. Low Impact Development (LID) is a land development and redevelopment approach that focuses on site layout and natural landscaping to increase infiltration and retention and minimize rainfall runoff. LID includes the use of both green infrastructure as well as carefully developed site

layout to balance green space with housing density goals. Green infrastructure includes rain gardens, planter boxes and vegetated swales to infiltrate rainfall; cisterns to retain rainfall; and green roofs, permeable pavements and pavers to decrease impervious surfaces and increase infiltration. Many of these practices are appropriate for both existing housing retrofits and new housing developments, depending on the neighborhood and housing types.

The strategy also recommends developing watershed management action plans that identify the current flood risks and the actions that will be taken to reduce them. The actions can include green infrastructure retrofits and LID practices to reduce the amount of rainfall runoff as well as floodplain improvements to increase flood management capacity. New developments that use LID can save money by reducing or eliminating the need for, or reducing the size of, traditional stormwater infrastructure.

Governance/Implementation Issues

There are a variety of implementation options and strategies that could be pursued to advance this strategy including a local ordinance that would require all sites over an acre (or some other threshold- #of units or density of units) to comply, or that would provide a density bonus option, which is zoning tool that allows a developer to exceed allowable density requirements in exchange for providing a public benefit.

This strategy could also be implemented through regulations or incentives by regional or state agencies, including the San Francisco Bay Regional Water Quality Control Board, or by ABAG and MTC including these requirements in SCS guidance on developing high density residential and mixed use area, or by prioritizing funding to jurisdictions that incorporate these strategies, or possibly through a CEQA incentive or reduced requirement.

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	Development and Construction Loans	Individual Home Improvement or Commercial Renovation Loans	Revolving Loan Fund Programs	**Grant Programs**	**Other**

Jurisdictions will need to provide staff time for the development and management of the program. Funding for project implementation may come from:

- EPA SF Bay Area Water Quality Improvement grant funds
- CA Department of Water Resources Integrated Regional Water Management (IRWM) Program grant funds

Implementation Partner(s)

State	Region	Local
There are no state partners needed for this strategy.	While this strategy can be implemented locally, the strategy is greatly improved if jurisdictions coordinate with regional agencies and adjacent jurisdictions to manage watersheds holistically. Such agencies may include the San Francisco Bay Regional Water Quality Control Board, Bay Area Storm Water Management Agencies Association, BCDC, MTC, and adjacent jurisdictions	*There are no local partners needed for this strategy.*

Examples

The following are examples of local watershed management policies currently in effect.

San Jose City Council Policy 6-29: Post-Construction Urban Runoff Management

In San Jose, all new development or redevelopment projects that create 10,000 SF or more of impervious surface are required to comply with a set of LID requirements, supplemented by more quantitative numeric sizing criteria. The City has also developed an Urban Runoff Management Policy that requires developers to demonstrate compliance with performance standards early in the planning process. Before development or redevelopment projects are accepted, all new development or redevelopment projects that meet the impervious surface thresholds defined in the Municipal Regional Stormwater Permit must submit a Stormwater Control Plan. Stormwater Control Plans must illustrate how the project will integrate site design, source control measures, and treatment control measures to comply with appropriate performance standards. The SJ Department of Planning reviews development applications before granting permits and inspects approved projects during construction to verify compliance. See:

http://www.sanjoseca.gov/clerk/cp_manual/CPM_6_29.pdf

San Francisco Public Utilities Stormwater Design Guidelines

The San Francisco Public Utilities Commission (SFPUC) and the Port of San Francisco (Port) partnered to develop the San Francisco Stormwater Design Guidelines. The Guidelines require new development and redevelopment disturbing 5,000 square feet or more of the ground surface to manage stormwater on-site. The Guidelines show project applicants how to achieve on-site stormwater management using low impact design (LID) strategies, also known as green infrastructure. These strategies include vegetated roofs, swales, rainwater harvesting, and rain gardens. The Guidelines protect San Francisco's environment by reducing pollution in stormwater runoff in areas of new development and redevelopment and by reducing the wet weather burden on San Francisco's combined sewer. See:

http://www.sfwater.org/modules/showdocument.aspx?documentid=2779

California Regional Water Quality Control Board's Municipal Regional Stormwater Permit

Municipal Regional Stormwater NPDES Permit (MRP) Final Order :

http://www.swrcb.ca.gov/sanfranciscobay/board_decisions/adopted_orders/2009/R2-2009-0074.pdf

28. Increase standards in local floodplain management ordinances beyond the minimum requirements of FEMA's NFIP program

Adopt a floodplain management ordinance that exceeds the minimum requirements of the NFIP to reduce potential risk from flood events that exceed the 100-year (1% annual chance) event. A strong floodplain management ordinance will ensure that land-use decisions account for current flood risks based on available information and assessments and consider more extreme events and/or future flood risk associated with sea level rise.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	Region	**Community**	Resident

Target Development Type		**Hazard Addressed**		
Existing	**New**	Ground Shaking	Liquefaction	**Flooding**

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	Access to Resources	**Single or Two Family**	**Multi-family**	Cripple Wall	Soft story or House over garage

Action Categories					
Evaluation	Program/ Operation	Plans and Policies	**Codes, Regulations, and Ordinances**	Coordination	Education/ Outreach

Prerequisite Strategies	**Other Related Strategies**
None	Strategy 26: Particpiate in FEMA's Community Rating System

Description

Currently, most communities at risk from existing coastal or riverine flooding have regulations in place that meet minimum federal and state requirements. Local jurisdictions can adopt floodplain management ordinances that are more stringent than minimum federal and state requirements to reduce risks both from current extreme flood events that could have wide-ranging and costly consequences (e.g., the 500-year event), as well as from increased risk of coastal and riverine flooding that will accrue as sea level rises.

Federal requirements set by FEMA are based on existing coastal and riverine flood hazards studies, many of which are decades out of date and therefore do not take into account recent changes in sea level or precipitation patterns. Currently, FEMA is in the process of conducting detailed coastal engineering analyses and mapping of the San Francisco Bay shoreline, which will result in revised and updated Flood Insurance Rate Maps (FIRMs) for each of the nine counties. However, studies of many riverine floodplains are out of date and are not included in the current FEMA study. In addition, while FEMA is in the process of studying future impacts to coastal floodplains from sea level rise, this effort is in the pilot stage and is not currently available.

Recognizing the limitations of FEMA guidelines, FEMA requires all local governments that participate in the NFIP to adopt floodplain management ordinances that either meet or exceed the minimum NFIP requirements. Currently, all Bay Area counties participate in the NFIP program. This strategy proposes that local governments participating in the NFIP adopt floodplain ordinances that exceed NFIP requirements.

Local floodplain management ordinances govern construction practices within the floodplain, including special flood hazard zones and high hazard zones. For example, the floodplain management ordinances requires first floor elevations of structures to be at or above the FEMA base flood elevation (BFE), which is calculated based on the 1% annual chance (100-year) flood elevation as shown on a Flood Insurance Rate Map (FIRM).

Minimum NFIP requirements allow the first floor elevation to be at the BFE, however FEMA recommends elevating the first floor elevation by 1 foot above the BFE. Local governments could increase the requirement to 2 feet above the BFE which would reduce flood insurance premiums, provide greater protection to those living in the structure, and would likely reduce the impacts from mid-century projected sea level rise. If this particular requirement is implemented, current building height restrictions in place may need to be revised to accommodate an increase in the first floor elevation (see Strategy 30: Revise minimum building elevation standards and maximum building height-limits for new development).

Under this strategy, all new development and substantially improved structures would be required to meet the more stringent floodplain management ordinances. "Substantially improved" generally means any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50% of the market value of the structure before the start of construction associated with the improvements. If a building is substantially improved, it would need to be brought into compliance with the floodplain management ordinances, including elevating the first floor of the structure above the BFE by the adopted amount. Federally funded programs such as the Hazard Mitigation Grant Program (HMGP) provide financial assistance to states and local governments to implement long-term hazard mitigation strategies that reduce or eliminate losses from future disasters. Such programs could be an important resource for providing financial assistance to those unable to afford the costs associated with increasing structure elevations, as such costs can quickly escalate beyond affordability.

When updating floodplain management ordinances, jurisdictions need to consider the tradeoffs between potential cost burden on low-income property owners and the affordability of rental units with the increase in public safety and reduction in insurance premiums. This strategy has community benefits because it will improve the ability of those living in the structures to shelter in place (see Strategy 35: Revise local plans and development codes to allow temporary land uses to facilitate and expedite post-disaster recover) and also has economic benefits through reduced flood insurance premiums. If the jurisdiction participates in the Community Rating System (CRS) program (see Strategy 26: Participate in FEMA's community rating system), all structures within the community, regardless of their first floor elevation, may receive reduced flood insurance premiums once the community adopts requirements that exceed the NFIP requirements.

Increase standards in local floodplain management ordinances beyond the minimum requirements of FEMA's NFIP program	*State*	*Region*	**Local**

Governance/Implementation Issues

FEMA requires all communities to participate in the NFIP and adopt floodplain management ordinances that meet or exceed the minimum NFIP requirements. Adopting ordinances that exceed the minimum NFIP requirements may result in concern from developers as the costs associated with construction may increase although this may be balanced against lower flood insurance premiums. Jurisdictions may be more successful in adopting more stringent floodplain ordinances if they work with FEMA and neighboring jurisdictions to develop consistent ordinances that balance competing needs and encourage a reduction in potential flood damage. Adopting ordinances that exceed minimum NFIP requirements links directly with FEMA's Community Rating System (CRS), which could result in additional insurance premium reductions for participating communities.

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	**Development and Construction Loans**	**Individual Home Improvement or Commercial Renovation Loans**	**Revolving Loan Fund Programs**	**Grant Programs**	Other

Minimal funding is required to develop and implement this strategy, although the city or county will need to have a plan or program in place to review compliance, which may be incorporated within existing permit compliance programs. The cost burden for compliance with the floodplain management ordinances will be placed on developers and property owners. For new development, the cost of compliance would likely be financed by development/construction loans or individual loans. Developers of affordable housing can access subsidies, such as the Low Income Housing Tax Credit, HOME funds from HUD, and below market rate loans from community development finance institutions to help finance the costs.

For owners of existing buildings that need to comply with new ordinances due to a substantial improvement, costs would likely be financed by individual home improvement loans or commercial renovation loans. Grants or subsidized loans may be needed to make compliance feasible for existing housing that serves low and moderate income households. The Community Development Block Grant program can be used to fund housing rehabilitation programs that serve low and moderate income persons. Communities can also apply FEMA's Hazard Mitigation Grant Program or Pre-Disaster Mitigation Grant Program funding to housing rehabilitation needs. Finally, there could be an opportunity to finance resiliency investment using a Community Benefits District framework akin to the PACE program, where investments would be paid through the property taxes. The application of CBD financing for resiliency is unprecedented and would require additional legal analysis before its implementation.

Implementation Partner(s)

State	Region	Local
FEMA region IX can assist communities in developing and updating floodplain management ordinances. Jurisdictions across the region can work together to develop consistent ordinances, which can improve both the effectiveness of ordinances and create more predictability for developers that plan and design projects in different jurisdictions	*No regional partners are required for this strategy.*	*There are no local partners needed for this strategy.*

Examples

Codes/Standards Referenced in this strategy include the following:

- FEMA floodplain management ordinances. See:

https://www.fema.gov/national-flood-insurance-program-2/floodplain-management-ordinances

- FEMA Community Rating System. See:

http://www.fema.gov/national-flood-insurance-program-community-rating-system

The following are examples of communities that have adopted a floodplain management ordinance targeting new development in flood hazard zones, with requirements that are slightly above NFIP requirements.

California's City of Chula Vista Climate Action Planning

Requires all new development to be designed to accommodate 50 years of sea level rise within coastal and tidally-influenced areas. The City Engineer is also required to revise the Subdivision Manual every five years to define new sea level rise estimates and set minimum requirements for adaptation and mitigation.

http://www.chulavistaca.gov/clean/PDF/ClimateActionPlanUpdate_Nov13ProgressReport_FINAL.pdf

Increase standards in local floodplain management ordinances beyond the minimum requirements of FEMA's NFIP program	*State*	*Region*	**Local**

The City of Boulder, Colorado, Boulder Revised Code – Chapter 9.3 – Overlay Districts

For new residential construction and substantial improvement of residences located in the City of Boulder, the lowest floor and associated structures must be constructed a minimum of two feet above the 100-year flood elevation. http://www.colocode.com/boulder2/chapter9-3.htm#section9_3_2 and http://www.colocode.com/boulder2/chapter9-16.htm

California's Central Valley Flood Protection Plan, State Plan of Flood Control Descriptive Document

Adopted a goal of using at least the 200-year flood event as the flood protection elevation for urban areas by the year 2016. Communities unable to make the 2016 goal must be able to certify that they are making adequate progress on an annual basis and will meet the 200-year event protection level by 2025.

http://www.water.ca.gov/cvfmp/docs/SPFCDescriptiveDocumentNov2010.pdf

North Carolina's Charlotte-Mecklenburg Storm Water Storm Water Services Flood Mitigation Program

In addition to the floodplain based on existing 100-year event, Community (Future) Floodplains were developed to project continued growth within the County and increased runoff during large events. Implementation of a more conservative Floodway that is 45% wider than the FEMA minimum further restricts development in a floodplain, further reducing loss of life and property to large storm events. A Floodplain Buyout Program was established to allow homeowners to voluntarily sell homes and businesses located in the regulated floodplain. After purchase, these buildings are removed and the property is restored to its natural state to be used as wildlife habitat, parks, or community green space.

http://charmeck.org/stormwater/regulations/Documents/Floodplain%20Documents/Floodplain%20Technical%20Guidance%20Document%2003_08.pdf

Richmond Code of Ordinances, Article XII – Public Works, Chapter 12.56 – Flood Damage Prevention.

https://library.municode.com/HTML/16579/level2/ARTXIIPUWO_CH12.56FLDAPR.html

The following is an example of resources provided by FEMA on the benefits of adopting a freeboard requirement for first floor elevations above the BFE (which could be one possible element of an enhanced floodplain management ordinance).

http://www.fema.gov/media-library-data/20130726-1537-20490-8154/fema499_1_4.pdf

State *Region* **Local**

29. Require flood-proof construction methods and techniques within and adjacent to special flood hazard zones

Amend the applicable local codes to require flood-proof construction techniques in structures in special flood hazard zones, high hazard zones, and adjacent areas. Requiring flood-proofing techniques in these special flood hazard and high hazard zones could reduce the potential of damage to a structure and its contents in the event of a flood. Requiring the same level of flood-proofing in areas adjacent to these zones could reduce the potential for damage in areas that may be flooded in the future with sea level rise, or by flood events that exceed the FEMA 1% annual chance (100-year) flood conditions.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	Region	**Community**	Resident

Target Development Type		**Hazard Addressed**		
Existing	**New**	Ground Shaking	Liquefaction	**Flooding**

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	Access to Resources	**Single or Two Family**	**Multi-family**	Cripple Wall	Soft story or House over garage

Action Categories					
Evaluation	Program/ Operation	Plans and Policies	**Codes, Regulations, and Ordinances**	Coordination	Education/ Outreach

Prerequisite Strategies	**Other Related Strategies**
None	Strategy 26: Participate in FEMA's Community Rating System

Description

Flood insurance rate maps (FIRMS) identify zones that are vulnerable to coastal and riverine flood hazards. However, depending on when the study was conducted to either develop or update the FIRMS these maps may not identify all areas that are currently at risk and are not likely to identify areas that could be at future risk due to climatic changes such as sea level rise, storm surge elevations, or increased precipitation. As a result, the current level of flood-proofing may not be adequate to withstand current, let alone, future flooding. Moreover, existing development in flood hazard zones may not have been required to use flood-proof construction techniques, and both areas of existing and new housing may be at risk of flooding but have not yet been identified as being at risk.

This strategy proposes that local governments adopt code revisions requiring flood-proof construction techniques for all development in special flood hazard and high hazard zones based on the most up to date FIRM available. Furthermore, this strategy proposes extending

flood-proofing requirements to adjacent areas that are currently identified as being at lower risk (e.g., within the 500-year floodplain) and that are likely to be at greater risk from both riverine and coastal flooding as sea level rises.

Requiring or encouraging all new construction or substantially improved structures to incorporate flood proofing methods may reduce the risk of damage from current flood events, make an allowance for future sea level rise, as well as for short-term flood events that exceed the 1% annual chance (100-year) flood conditions shown on the FIRMs. "Substantially improved" generally means any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50% of the market value of the structure before the start of construction associated with the improvements.

While updating food-proof construction requirements, jurisdictions need to consider the trade-offs between potential cost burden on low-income property owners and the affordability of rental units with the increase in public safety and reduction in insurance premiums. This strategy has community benefits because it will improve the ability of those living in the structures to shelter in place (See Strategy 35: Revise local plans and development codes to allow temporary land uses to facilitate and expedite post-disaster recover) and also has economic benefits through reduced flood insurance premiums.

Governance/Implementation Issues

FEMA requires all communities to participate in the NFIP and adopt floodplain management ordinances that meet or exceed the minimum NFIP requirements. Adopting ordinances that exceed the minimum NFIP requirements may result in concern from developers as the costs associated with construction may increase although this may be balanced against lower flood insurance premiums. Jurisdictions may be more successful in adopting more stringent floodplain ordinances if they work with FEMA and neighboring jurisdictions to develop consistent ordinances that balance competing needs and encourage a reduction in potential flood damage. Adopting ordinances that exceed minimum NFIP requirements links directly with FEMA's Community Rating System (CRS), which could result in additional insurance premium reductions for participating communities.

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	**Development and Construction Loans**	**Individual Home Improvement or Commercial Renovation Loans**	**Revolving Loan Fund Programs**	**Grant Programs**	Other

Minimal funding is required to develop and implement this strategy, although the city or county will need to have a plan or program in place to review compliance, if compliance with this strategy is considered mandatory and not merely a recommendation. Compliance review may be incorporated within existing permit compliance programs. Community Development Block Grant (CDBG) funds can be used for code inspections and code enforcement, but with specific guidelines and limitations to help ensure it benefits low and moderate income persons.

The cost burden for compliance will be placed on developers and property owners. For new construction, the cost of compliance would likely be financed by development/construction loans or individual loans. Developers of affordable housing can access subsidies, such as the Low Income Housing Tax Credit, HOME funds from HUD, and below market rate loans from community development finance institutions to help finance the costs.

For owners of existing buildings that need to comply with new codes due to a substantial improvement, costs would likely be financed by individual home improvement loans or commercial renovation loans. Grants or subsidized loans may be needed to make compliance feasible for existing housing that serves low and moderate income households. The Community Development Block Grant program can be used to fund housing rehabilitation programs that serve low and moderate income persons. Communities can also apply FEMA's Hazard Mitigation Grant Program or Pre-Disaster Mitigation Grant Program funding to housing rehabilitation needs. Finally, there could be an opportunity to finance resiliency investment using a Community Benefits District framework akin to the PACE program, where investments would be paid through the property taxes. The application of CBD financing for resiliency is unprecedented and would require additional legal analysis before its implementation.

Implementation Partner(s)

State	Region	Local
FEMA can assist local governments in more stringent flood-proofing construction guidelines and techniques recommended under this strategy (which could include more stringent requirements for flood-proof construction methods and techniques).	Jurisdictions across the region, along with ABAG, can work together to develop consistent ordinances, which can improve both the effectiveness of guidelines and create more predictability for developers that plan and design projects in different jurisdictions.	*There are no local partners needed for this strategy.*

Examples

The following are examples of cities that have adopted specific flood-proofing construction methods and techniques in special flood hazard zones.

City of New York, NY

On January 31, 2013, the New York City Building Code was updated to match New York State standards for flood protection, requiring buildings to protect to a level one or two feet higher

than the FEMA-designated flood elevation, depending on building type. Single- and two-family homes are now required to provide two feet of extra protection (commonly called "freeboard") above flood elevation, and most other buildings are required to provide a foot of freeboard.

Owners of severely damaged or destroyed buildings are required to comply with the flood resistant construction standards of Building Code when they rebuild. In addition, any property owner within the newly enlarged FEMA flood zones may consider making their building comply with new FEMA standards, which call for them to be raised or flood-proofed to a higher elevation. This will reduce their vulnerability to future floods, as well as help to avoid higher flood insurance premiums.

Flood-resistant construction standards are minimum requirements for construction in the flood zone established by the Federal Emergency Management Agency (FEMA), the New York State Building Code and the City's Building Code. These standards require that flood-resistant materials be used for parts of buildings that are susceptible to water damage, that certain buildings and uses be elevated above anticipated flood levels and that buildings are designed to withstand the pressure of waves, when necessary. Flood-resistant construction standards are defined in Appendix G of the NYC Building Code and the American Society of Civil Engineers' Flood Resistant Design and Construction manual, referred to as ASCE 24.

State of Florida

The Florida Building Code (FBC) was amended in 2010 to include flood-proofing requirements for development in flood hazard areas. Florida law was amended in 2010 to allow communities to adopt local administrative amendments to implement the flood provisions of the FBC (see s. 553.73 (5), F.S.). The statute also allows local technical amendments to adopt flood provisions that are more stringent than the FBC (also called "higher standards"). Once an owner or developer makes a decision to construct, add to or substantially improve a building in a flood hazard area, certain state-wide requirements intended to minimize future flood damage must be satisfied. Prior to the 2010 Florida Building Code (FBC), those requirements were found only in local floodplain management regulations. Flood provisions are now in the state codes, making it easier for design professionals and builders to address the requirements along with other applicable load and design requirements. Many Florida communities and property owners can attest that designing and constructing buildings to account for flood loads and conditions significantly reduce damage.

City of Richmond, CA

The City of Richmond's code of ordinances has flood-proofing requirements for structures which have the first floor elevation (or the basement elevation) lower than the 100-year flood elevation. This code could be revised such that flood-proofing requirements are expanded to additional areas and to additional structures.

- Richmond General Plan, Public Safety and Noise Chapter, Action SN.1D

- Richmond Code of Ordinances, Article XII – Public Works, Chapter 12.56 – Flood Damage Prevention. See: https://library.municode.com/HTML/16579/level2/ARTXIIPUWO_CH12.56FLDAPR.htmlhttps://library.municode.com/HTML/16579/level2/ARTXIIPUWO_CH12.56FLDAPR.html

https://library.municode.com/HTML/16579/level2/ARTXIIPUWO_CH12.56FLDAPR.html

This strategy also can draw on the following FEMA and USACE resources on flood-proofing:

- FEMA Flood Proofing Programs

See: http://www.fema.gov/national-flood-insurance-program-2/floodproofing

- USACE Flood Proofing Techniques, Programs, and References

See: http://www.usace.army.mil/Portals/2/docs/civilworks/Project%20Planning/nfpc/Flood%20Proofing%20Techniques%20Programs%20and%20References%202000.pdf

- USACE Local Flood Proofing Programs

See: http://crsresources.org/files/300/360_local_flood_proofing_programs_2005.pdf

30. Revise minimum building elevation standards and maximum building height-limits for new development

Revise building standards to require that habitable building space and sensitive building components be elevated above current and future flood levels. In tandem, maximum building height limits may be increased to reduce conflicts where these codes are applied together.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	Region	**Community**	Resident

Target Development Type		**Hazard Addressed**		
Existing	**New**	Ground Shaking	Liquefaction	**Flooding**

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	Access to Resources	**Single or Two Family**	**Multi-family**	Cripple Wall	Soft story or House over garage

Action Categories					
Evaluation	Program/ Operation	Plans and Policies	**Codes, Regulations, and Ordinances**	Coordination	Education/ Outreach

Prerequisite Strategies	**Other Related Strategies**
None	Strategy 26: Participate in FEMA's Community Rating System Strategy 28: Increase standards in local floodplain management ordinances beyond the minimum requirements of FEMA's NFIP Orogram Strategy 29: Require flood-proof construction methods and techniques within and adjacent to special flood hazard zones

Description

Codes addressing new development include specifications for building elevation and maximum building height standards. Current codes may require new buildings to have habitable first floors and sensitive building components elevated within Special Flood Hazard Zones, as reflected on Flood Insurance Rate Maps (FIRMs), However, codes are unlikely to require similar standards in areas at risk of future flooding due to sea level rise and changing storm surge levels.

Local development codes also include specifications limiting the height of buildings, measured in feet and/or building stories. These codes may not always discount the first floor building elevation from the overall height limit. Therefore, if building elevation standards are updated

to reflect changes to the Special Flood Hazard Areas (SFHA) or to account for future flood risks, these updates may be in conflict with development codes that set maximum building height limits.

This strategy therefore suggests revising development codes to increase the minimum elevation requirements for habitable building space and sensitive building components. The increased elevation requirements would be above expected flood levels plus an amount of freeboard in areas within the current 100-year and 500-year flood event, high hazard zones, areas adjacent to these zones, and areas expected to flood as sea level rises. Furthermore, this strategy suggests revising development codes to discount the elevated portion of the building, including additional elevation above the expected flood level (i.e., freeboard), from the measured building height. Specifically, the portion of a building (measured from ground level) that elevates the structure above the projected flood levels plus an amount of freeboard would not be counted towards the building's height allowance.

The feasibility of modifying the building height allowance would depend on the other benefits that could accrue, including requirements or incentives for street activation, consistent with flood safety, to maintain a vibrant urban setting. Activation may include adding outdoor seating and other activity areas, elevated stoops, terraces, balconies, parklets, murals and other building art that encourages street-level activity.

This strategy is in alignment with Strategies 28: Increase standards in local floodplain management ordinances beyond the minimum requirements of FEMA's NFIP program, and 29: Require flood-proofing construction methods and techniques within and adjacent to special flood hazard zones.

Governance/Implementation Issues

This strategy would require revisions to local development codes where applicable, along with appropriate training for local building officials, so that they understand the new requirements and limits of application. The revisions should be included in plan checklists to ensure proper enforcement.

Additionally, local governments may also consider developing external reference documents for developers and contractors to ensure more uniform application across the region. Given that local governments have exclusive jurisdiction over their development codes, this strategy does not require collaboration among local governments and regional agencies, but can certainly benefit from collaboration. For example, ABAG could potentially facilitate the development of model code language for this strategy, such that it is accessible to all communities. This strategy is in alignment with the State of California's Hazard Mitigation Plan, the ABAG Regional Hazard Mitigation Plan (see http://quake.abag.ca.gov/mitigation/), and local hazard mitigation plans.

Initial implementation is likely to occur within large, individual jurisdictions that have the resources to fund implementation. The implementation approach developed by early adopters may be used as a template for other locations, or may be passed up to the state level for wider access.

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	**Development and Construction Loans**	Individual Home Improvement or Commercial Renovation Loans	Revolving Loan Fund Programs	Grant Programs	Other

Given that this strategy is aimed at ensuring safe execution of large-scale residential buildings through enhanced construction requirements, it is expected that for new development, any additional costs resulting from more stringent requirements would be borne by developers. For developers, the financing mechanism will likely be development/construction loans. Developers of affordable housing can access subsidies, such as the Low Income Housing Tax Credits, HOME funds from HUD, and below market rate loans from community development finance institutions, to help finance the costs.

Implementation Partner(s)

State	Region	Local
CalOES, which provides technical and/or grant assistance for pre-disaster preparedness, hazard mitigation, and post-disaster recovery planning.	ABAG could facilitate development of model code language.	*There are no local partners needed for this strategy.*

Examples

Zoning Code Amendment on Elevation, New York City, New York

Updates to building elevation standards and building height-limit standards have been implemented in New York City, in the form of a zoning code amendment. This amendment was one part of a wide range of efforts by New York to recover from Hurricane Sandy, to promote rebuilding and increase the city's resilience to climate-related events, including coastal flooding

and storm surge. The changes were intended to remove regulatory barriers that would hinder or prevent the reconstruction of storm-damaged properties. They also were needed to enable new and existing buildings to comply with new, higher flood elevations that were issued by the Federal Emergency Management Agency (FEMA), and to meet new requirements in the New York City Building Code. Constructing to these new standards will reduce vulnerability to future flood events, as well as help property owners avoid higher flood insurance premiums. The zoning code changes will allow interior stairs and ramps to be discounted from floor area calculations at a ratio proportional to the height of the first floor above grade. In higher density commercial districts, where the entire street wall has to be located on the street line, this requirement will be reduced to 70 percent to allow flexibility to provide stairs and ramps outside the building. The zoning changes also will allow creative landscaping solutions in front yard or setback areas, such as gently sloped or terraced landscaping toward the main building entrance, fronting the street.

Amendment to New York City Zoning Text on Flood Resilience (N 130331[A] ZRY), October 2013. See: http://www.nyc.gov/html/dcp/pdf/flood_resiliency/final_text.pdf

31. Incorporate sea level rise guidance within the capital planning process

City and County departments submit projects for incorporation within the respective local government's capital plan. The goal of the capital plan to provide clear direction on how the local government's assets will be maintained and improved over time, and to identify and prioritize projects for funding within the multiyear capital plan timeframe. The capital planning process can require that all projects located within a specific sea level rise inundation zone boundary adhere to sea level rise vulnerability and risk assessment guidance and identify appropriate adaptation strategies.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	**Region**	Community	Resident
Target Development Type		**Hazard Addressed**			
Existing	**New**	Ground Shaking	Liquefaction	**Flooding**	
Community Vulnerability Addressed			**Vulnerable Housing Type Addressed**		
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	Access to Resources	Single or Two Family	Multi-family	Cripple Wall	Soft story or House over garage
Action Categories					
Evaluation	Program/ Operation	**Plans and Policies**	Codes, Regulations, and Ordinances	Coordination	Education/ Outreach
Prerequisite Strategies			**Other Related Strategies**		
None			None		

Description

Local governments often use multiyear capital plans to identify and prioritize publically-funded projects that will maintain or improve its assets over time. The capital planning process is also used to select those projects for funding that best meet the needs, guidance and policies of the local government. The capital planning committee (or other government body responsible for approving the capital plan submissions) can adopt guidelines that outline a unified sea level rise vulnerability and risk framework that must be applied for any project (capital improvements and/or new projects) located within a specified sea level rise and coastal storm surge inundation zone. Adopting a unified framework will allow for ease of comparison across projects, and will ensure that all projects located within the identified vulnerable area consider sea level rise risks appropriately within the project planning process.

While this strategy focuses on publicly financed projects, it could result in ancillary protection for housing if housing is located in an area where the local government will be implementing a capital project. Through this strategy, local governments can lead by example and incorporate resiliency against sea level rise in publicly financed capital projects, and ultimately, this strategy could be extended to the private sector, which will address the vulnerability of housing and development to sea level rise.

Governance/Implementation Issues

This strategy will require the adoption of sea level rise guidance within the capital planning process. One adopted, a process for evaluating compliance must also be implemented. All capital plan submissions would need to include a form or checklist that certifies that the submission is in compliance with the guidance.

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	Development and Construction Loans	Individual Home Improvement or Commercial Renovation Loans	Revolving Loan Fund Programs	Grant Programs	**Other**

The financing mechanism through which this strategy can be implemented is the local government's capital budget as specified in the capital plan. The capital plan is a long-term finance plan with an allocated capital budget, which can prioritize projects based on whether they have met certain criteria. If sea level rise considerations are one of the funding criteria by which projects are evaluated for funding approval, projects that have conducted a sea level rise vulnerability assessment and identified adaptation strategies will be more likely to receive funding from the capital budget. The capital budget is an amalgamation of different sources of financing, including project area development fees, state funds, federal funds, and local revenue such as property taxes or sales taxes.

Implementation Partner(s)

State	Region	Local
No state partners are required for this strategy	No regional partners are required for this strategy, although ABAG could help facilitate a common set of sea level rise projections or guidelines for incorporation into capital plans.	No local partners are required for this strategy, although it is recommended that a city interested in implementing this strategy should encourage neighboring jurisdictions to do.

Examples

San Francisco, CA

The City and County of San Francisco recently adopted Guidance for Incorporating Sea Level Rise into Capital Planning in San Francisco: Assessing Vulnerability and Risk to Support Adaptation on September 22, 2014. The guidance document and the accompanying checklist are available at the links below. These documents are still in the process of being finalized.

Guidance for incorporating sea level rise into Capital Planning in San Francisco: http://onesanfrancisco.org/wp-content/uploads/Agenda-Item-4-SLR-Guidance-DRAFT.pdf

32. Create geologic hazard abatement districts to fund hazard mitigation

Establish Geologic Hazard Abatement Districts (GHADs) as a mechanism for raising funds and defining responsibility for the prevention, mitigation, abatement or control of geologic hazards, including landslides, land subsidence, soil erosion, earthquake, fault movement or any other natural or unnatural movement of land or earth. GHAD related projects can include the mitigation or abatement of structural hazards that are partly or wholly caused by geologic hazards and they can include flood control structures.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	Region	**Community**	Resident
Target Development Type		**Hazard Addressed**			
Existing	**New**	**Ground Shaking**	**Liquefaction**	Flooding	
Community Vulnerability Addressed			**Vulnerable Housing Type Addressed**		
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	Access to Resources	**Single or Two Family**	**Multi-family**	Cripple Wall	Soft story or House over garage
Action Categories					
Evaluation	**Program/ Operation**	Plans and Policies	Codes, Regulations, and Ordinances	Coordination	Education/ Outreach
Prerequisite Strategies			**Other Related Strategies**		
None			None		

Description

At the local scale, there are many projects competing for local funds, of which projects focusing on resiliency improvements are just one kind. This strategy proposes that local governments create a GHAD, an assessment district, which can generate capital to be ear-marked for resiliency-related capital improvements and ongoing maintenance of those improvements within a specifically defined area. While GHADs have been primarily used for capital improvements, in some cases, they may be used in some cases to fund emergency response programs (see example on Pajaro Dunes below).

Geological Hazard Abatement Districts (GHADs) are unique to California. They are enabled by the 1979 Beverly Act, provides a mechanism to deal with prevention, mitigation, abatement and control of geological hazards. The Beverly Act defines a geological hazard as an actual or threatened landslide, land subsidence, soil erosion, earthquake, or any other natural or unnatural movement of land or earth.

Once established, GHADs are independent political subdivisions of the State and have similar authorities as local governments. The GHAD may purchase and dispose of property, acquire property by eminent domain, levy and collect assessments, sue and be sued, and construct and maintain improvements. By utilizing a GHAD, property owners are able to cooperate in solving a common problem by having one Plan of Control across property boundaries, joint financing and arms-length protection against liability pursuing the remediation and/or prevention of geologic hazards.

The use of a GHAD could be evaluated against other long-term funding alternatives, such as Community Facilities Districts (CFDs). Although the termination of CFDs often is tied to repayment of infrastructure bonds, GHADs usually are created with perpetual funding streams and corresponding long-term operations, maintenance, and prevention responsibilities. Compared to CFDs, GHADs can:

- Own and acquire land (which can be used to fund a Conservation Easement. See: http://ghad.hpsdev.com/ifile/GHAD%20General%20and%20CE%20Funding_7-2011.pdf)
- Focus on hazard prevention
- Quickly respond to new land stability circumstances
- Have less complicated formation and management requirements
- Have unlimited duration

Governance/Implementation Issues

A GHAD can be formed by a petition signed by property owners or by a resolution of a local legislative body. The project proponent or local legislative body must take the leadership to prepare a Plan of Control and manage the GHAD formation process. The Plan of Control must describe the geological hazard and the plan to abate it. A majority vote based on assessed value of all property owners within the proposed GHAD boundary is required to establish a GHAD (meaning each property owner's vote is weighted according to each property's assessed value). There are additional requirements about public noticing and petitioning of property owners as defined in the legislation. After the GHAD is formed, a board of directors is appointed to manage the district and there may also be permitting and environmental compliance requirements associated with the design and implementation of resiliency improvements.

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	**Tax-based Special Districts**	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	Development and Construction Loans	Individual Home Improvement or Commercial Renovation Loans	Revolving Loan Fund Programs	Grant Programs	Other

This is largely a self-financing strategy. Funds will be required to conduct the initial investigations, develop a Plan of Control, and receive approval for district formation from the legislative body. These costs typically are borne by property developers/owners or local governments. After formation, property owners within the GHAD are assessed annually for the life of the GHAD. If a substantial amount of funding is needed at the outset of the GHADs life (i.e., before funds have had time to accumulate), a bond can be floated, secured by future property tax assessments on the parcels of participating property owners.

Implementation Partner(s)

State	Region	Local
No state partners are required for this strategy	Regional permitting agencies may also be involved in the review and approval of proposed resilience improvements.	Local legislative body, existing property owners, or the developer (if it is within a new development) would be involved in formation of the GHAD. Local permitting agencies may be involved in the review and approval of proposed resilience improvements.

Examples

The following are examples of GHADs created to address seismic and flooding hazards:

Pajaro Dunes GHAD, Santa Cruz County, CA

In 1998, Santa Cruz County and the coastal residential community of Pajaro Dunes formed a GHAD which has financed the construction and maintenance of a wall along the Pajaro River and a coastal protection structure that helps minimize damage to the Pajaro Dunes community from coastal flooding and other natural hazards. A critical component of the GHAD's operation is planning and funding for engineering construction crews to immediately address any damage to the river wall and the coastal protection structure cause by an earthquake or coastal storms.

See: http://www.pajarodunesassociation.com/

Santa Cruz County, CA GHAD

Santa Cruz County formed a GHAD for ten separate properties in Aptos, Boulder Creek, and Watsonville. The properties were severely damaged by landslides and uninhabitable or remain at risk of further landslide activity. The County of Santa Cruz acquired the properties through FEMA's Hazard Grant Mitigation Program. The property owners were compensated $1,941,000, which was 75% of the assessed value of the properties. The remaining dwellings on the properties were demolished; the land has been retained as open space.

See: http://www.co.santa-cruz.ca.us/grandjury/gj2003responses/6_-_2_ghad1.pdf

City of San Ramon, CA GHAD

The City of San Ramon, California has a GHAD formed for the purpose of preventing, mitigating, abating, and controlling geological hazards. San Ramon City Council members serve as the GHAD Board of Directors, and the District is managed by City staff. The GHAD boundaries include the West Branch area, located at Crow Canyon Road and Dougherty Road, Old Ranch Summit, and the Dougherty Valley, totaling approximately 2,767 acres of open space. Funding for the GHAD is obtained through an annual assessment on properties located within the GHAD boundaries.

See: http://www.sanramon.ca.gov/engr/ghad.html#sthash.zXF98MDO.dpuf

Guidelines and resources for this strategy include the following:

The Beverly Act of 1979 (SB 1195), California State Statue, Division Resources Code, Sections 26500-26654, see http://www.consrv.ca.gov/cgs/rghm/Pages/GHAD_law.aspx

California Association of GHADs, see http://www.ghad.org/

Olshansky, R.B., 1986, "Geological Hazard Abatement Districts": California Geology v. 39:7, p. 158-159, see http://www.consrv.ca.gov/cgs/rghm/Pages/haz_abatement.aspx

33. Create Mello-Roos Community Facilities Districts to provide financing to property owners for resiliency improvements

Facilitate collaboration among local governments and property owners to form a district in which property owners opt in to participate, wherein the district would use capital raised by issuing bonds to make resiliency improvements, which is paid back through a property tax assessment.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	Region	**Community**	Resident
Target Development Type		**Hazard Addressed**			
Existing	**New**	**Ground Shaking**	**Liquefaction**	**Flooding**	
Community Vulnerability Addressed			**Vulnerable Housing Type Addressed**		
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	Access to Resources	**Single or Two Family**	**Multi-family**	**Cripple Wall**	**Soft story or House over garage**
Action Categories					
Evaluation	**Program/ Operation**	Plans and Policies	Codes, Regulations, and Ordinances	Coordination	Education/ Outreach
Prerequisite Strategies			**Other Related Strategies**		
None			None		

Description

At the local scale, there are many projects competing for local funds, of which projects focusing on resiliency improvements are just one kind.

This strategy proposes that local governments create a Mello-Roos Community Facilities District (CFD), a tax-based district which can generate capital that could be ear-marked for resiliency improvements within the district. Mello-Roos Community Facilities Districts (CFDs) are authorized under Section 26104 of the California Public Resources Code. CFDs enable local property owners (both private and public) to invest in their properties to, among other purposes, "bring buildings or real property, including privately owned buildings or real property, into compliance with seismic safety standards or regulations," and for "flood and storm protection services, including, but not limited to, storm drainage and treatment systems and sandstorm protection systems." No limits or requirements exist pertaining to size, number of units, or contiguous boundaries of CFDs (i.e., a CFD could be a small subset of a community, and may contain property owner participants whose parcels are non-contiguous).

Create Mello-Roos Community Facilities Districts to provide financing to property owners for resiliency improvements *State* *Region* **Local**

A CFD is formed through a majority vote of property owners. In the case of existing development, the formation of a CFD requires a two-thirds majority vote of residents/property owners within the proposed boundaries of the district. For new greenfield developments, securing a majority is easy because typically just one property owner is involved – the developer – and it is that property owner who initiates the CFD formation process. Part of CFD formation includes procurement of engineering studies to develop an estimate of total project costs. The costs typically are borne by property owners. After a CFD is formed, its projects are financed through the sale of a bond which is secured by supplemental tax assessments on participating property owners. Repayment terms are typically are set over 20 years. Funds collected by the CFD remain within the CFD and are not subject to transfer to another agency. CFDs are a valuable mechanism for raising the upfront capital needed to fund investments in seismic retrofits and flood protection.

Governance/Implementation Issues

A CFD requires a majority vote for formation. The local government partner can facilitate the issuance of the bond as well as the bond's repayment through property tax assessments. The local government can also play the role of soliciting bids from the vendors who implement the resiliency improvement projects. The local government could manage the mechanics of property tax collections and disbursements.

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	**Tax-based Special Districts**	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	Development and Construction Loans	Individual Home Improvement or Commercial Renovation Loans	Revolving Loan Fund Programs	Grant Programs	Other

This is a self-financing strategy. In a CFD, initial capital is generated via bond sales, which are secured by property tax assessments on the parcels of participating property owners in the district.

Implementation Partner(s)

State	Region	Local
No state partners are required for this strategy	*No regional partners are required for this strategy.*	Developers and property owners are key partners for implementing this strategy. Jurisdcitions must develop buy-in.

Examples

The following is an example of a city that has created a citywide CFD to facilitate seismic retrofits.

City of San Francisco, CA

The City of San Francisco has created a citywide CFD that property owners can join. The primary purpose of the CFD is to facilitate property owner compliance with the City's soft-story ordinance. The ordinance requires seismic retrofits of residential buildings of five units or more (i.e., multi-family buildings). Private schools also are eligible. Approximately 3,000 properties are subject to the ordinance's requirements. To date, about 250 to 300 property owners have expressed a strong interest in participating in the CFD (through submission of an initial screening form), with an estimated $26 million in total project costs. Interest rates on the bonds have not been determined yet (and thus the annual assessment amounts for each property have not been determined either). The City is in the process of releasing a Request for Qualifications, for project implementation contractors and investors.

34. Create a pre-disaster rebuild and recovery plan

Make decisions about long-term disaster recovery, and implement as policy, such as when, where, and how rebuilding will occur after a natural disaster, which areas will be rebuilt according to existing plans and codes and which will be re-planned, whether rebuilt homes will be encouraged or required to be more likely to withstand the effects of future hazard events, and who will be in charge of coordinating and overseeing the recovery process through the development of a pre-disaster recovery plan.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	Region	**Community**	Resident

Target Development Type		**Hazard Addressed**		
Existing	**New**	**Ground Shaking**	**Liquefaction**	**Flooding**

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	**Language & Ethnicity**	**Cost Burdened**	**Housing Tenure**	**Access to Resources**	Single or Two Family	Multi-family	Cripple Wall	Soft story or House over garage

Action Categories					
Evaluation	Program/ Operation	**Plans and Policies**	Codes, Regulations, and Ordinances	Coordination	Education/ Outreach

Prerequisite Strategies	**Other Related Strategies**
Strategy 16: Create a fragile housing inventory Strategy 17: Develop and implement a soft story retrofit program Strategy 18: Develop and implement a cripple wall retrofit program	Strategy 13: Reduce or prohibit development of housing in the most hazardous areas while ensuring equity and beneficial use of these areas Strategy 14: Establish overlay zoning districts to help facilitate safe and smart new development Strategy 15: Establish a Transfer of Development Rights program to redirect development from high hazard areas to preferred, low hazard areas Strategy 35: Revise local plans and development codes to allow temporary land uses to facilitate and expedite post-disaster recovery Strategy 36: Develop and implement a shelter-in-place program

Description

After a disaster, many people in positions of authority face immense pressure to quickly make decisions and ensure that recovery action is taking place. The public expects quick restoration

of the life they had previously known, and this pressure can often lead to decisions that are uncoordinated, not fully considered, stopgap in nature, or do not align with a community's agreed-upon long-term goals. Communication among various levels of authority and different systems may be lacking. Outside interests or financial constraints may place additional pressure on decision-makers. Decisions may be made without public input or public consideration. Outdated rules and regulations may present unforeseen problems, with no public policy tools available for change. Many ad-hoc groups may arise and make decisions of their own without awareness of or regard for other groups. Outside experts with little or no knowledge of local issues may come in to contribute their opinion, without sufficient knowledge of the local social context and with little regard to follow-through and consequences. Many issues may arise in the recovery phase that can have repercussions in the community for decades.

While specific recovery actions cannot be known or implemented until after a disaster, when the full consequences are assessed and the immediate response needs of the community are met, there are many actions that can be taken before a disaster that assist and expedite recovery, such as adopting a pre-disaster rebuild and recovery plan.

Planning ahead can result in an expedited recovery due to coordinated communication, pre-approved recovery plans, and established planning systems and frameworks. Recovery planning in advance of a disaster may also result in a recovery phase that requires far less repair or restoration investment, because inter-jurisdictional efforts are not duplicated, money is spent in a coordinated manner, and pre-disaster mitigation has lessened damage. Anticipating where people will live and creating a post-disaster housing plan means fewer displaced residents, which can contribute to a more stable economy post-disaster. Planning with businesses on how to retain their services after a disaster can also stabilize the local economy, and minimize disruption to people's everyday lives. Planning for recovery can also identify and prioritize actions for vulnerable populations and anticipate their unique needs. Lastly, the process of planning for disaster recovery before a disaster happens can result in a shared vision for the future, as stakeholders and residents begin to understand how they want their region to grow and what it could look like if a disaster expedites change and renewal. This can also result in a more empowered and informed public.

A pre-event recovery and reconstruction ordinance is a comprehensive document that should :

- Be adopted by local governing body action before a disaster happens
- Authorize establishment and maintenance of a local recovery management organization
- Direct the preparation of a pre-event short- and long-term recovery plan
- Establish emergency powers by which the local government staff can take extraordinary action
- Identify methods for local government to take cooperative action
- Specify the means for consulting with and assisting citizens, businesses, and community stakeholder organizations

The ordinance should make decisions about several key decisions that will emerge following a disaster. These include:

- **Governance structure.** Many decisions will have to be made quickly following a disaster that can impact long-term recovery. While response systems are typically robust and well-practiced, it's not always clear who is in charge of the transition to long term recovery or who will lead the recovery process. It is recommended that jurisdictions appoint a local disaster recovery manager and activate a recovery task force to oversee recovery decisions and work with existing governmental structures.
- **Debris removal.** In many disasters, debris is more abundant than jurisdictions had anticipated, particularly when residents bring debris from the interior and exterior of their homes. While many jurisdictions have debris management agreements in place, they should be reviewed to ensure that there is adequate capacity to deal with debris quickly and that hazardous waste is dealt with quickly and safely.
- **Building permits.** Many building owners will want to begin repairs and rebuilding quickly after the disaster. Traditional permitting can be time consuming, more so if staff is limited and many people are wanting permits at the same time. Jurisdictions should decide how to handle high demand for building permits, and if they will waive or reduce plan check fees or offer simplified review and plan check to expedite permits for disaster repair and rebuild projects. Jurisdictions may also want to consider establishing a one-stop permit center with extra staff devoted to disaster-related permits where all city and utility departments are located together.
- **Zoning and planning.** A disaster with significant damage can be an opportunity for jurisdictions to rebuild in ways that resolve long-term building issues or expedite long-term planning goals. Jurisdictions should consider how a disaster can be an opportunity to reduce risks from future earthquakes, eliminate non-conforming uses, modify existing land uses, correct planning or zoning inconsistencies, realign, extend, or improve roads, improve housing conditions or affordability, enhance the local economy, upgrade inadequate commercial, industrial, or public facilities, improve urban design, provide open space, or preserve historic buildings or other cultural resources. Jurisdictions need to decide if existing planning documents will be sufficient to guide recovery or whether new documents are necessary to establish new goals and intentions.

Governance/Implementation Issues

How and when rebuilding occurs is a highly sensitive topic both for residents and politicians. Residents often want reassurance that life will go back to normal and want the familiarity of the life they knew before the disaster. Politicians will need to act quickly and be transparent about the decision-making process to secure the trust of their constituents and to limit speculation. Many difficult and potentially unpopular decisions will have to me made about where rebuilding occurs in high hazard areas or which areas are prioritized to receive resources, and these decisions will need to be made quickly. Creating buy-in for post disaster plans before the disaster occurs is crucial to being able to rebuild with minimal objection after a disaster.

Having residents participating in re-visioning allows everyone to understand that rebuilding is an opportunity to meet the community's long-term goals rather than just rebuild as-is, while also providing a forum for identifying key community characteristics that the residents hope to preserve. The success of pre-disaster planning hinges upon an effective and inclusive planning process and assurance that the vision will be implemented smoothly and quickly after the disaster hits.

In addition to local planning, jurisdictions could benefit from understanding how their neighbors are planning for recovery and how the region is planning.

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	Development and Construction Loans	Individual Home Improvement or Commercial Renovation Loans	Revolving Loan Fund Programs	**Grant Programs**	**Other**

Jurisdictions will need resources for staff time to develop the plan. Grants from the California Earthquake Authority, Strategic Growth Council, CalOES, or FEMA could help to support this effort. No other financing mechanisms will be needed pre-disaster. Post-disaster, many diverse sources will provide financing for rebuilding.

Implementation Partner(s)

State	Region	Local
No state partners are required for this strategy	ABAG could provide model language for ordinances adopted by local jurisdictions as well as guidance and best practices. ABAG could also provide coordination and facilitation between jurisdictions to help coordinate recovery visions and standardize practices.	*There are no local partners needed for this strategy.*

Examples

American Planning Association's Planning for Post-Disaster Recovery

In 1998, APA published Planning for Post-Disaster Recovery and Reconstruction (No. 483/484) that provides important modes of thinking about long-term disaster recovery. In 2013, they developed a model pre-event recovery ordinance that can be used as a model for jurisdictions wishing to prepare their own ordinance.

https://www.planning.org/research/postdisaster/pdf/modelrecoveryordinance.pdf

ABAG's Recovery Toolkit for Local Governments

In 2012, ABAG's Earthquake and Hazards Program developed a recovery toolkit for their General Assembly. The toolkit includes checklists and plans, recovery ordinances and tools, articles on funding and economic issues, papers on recovery concepts and frameworks, and a number of case studies and additional thinking.

http://quake.abag.ca.gov/resilience/toolkit/

City of Oakland Long-Term Disaster Recovery Plan

In 2010, ABAG assisted the City of Oakland with developing a Disaster Recovery Plan, intended to serve as a model for other Bay Area governments.

http://quake.abag.ca.gov/wp-content/documents/resilience/toolkit/Oakland%20Long%20Term%20Disaster%20Recovery%20Plan.pdf

Post-Disaster Redevelopment Planning: A Guide for Florida Communities

Guidance from the Florida Department of Community Affairs and the Florida Division of Emergency Management for preparing post-disaster redevelopment plans.

http://resilience.abag.ca.gov/wp-content/documents/resilience/toolkit/Post%20Disaster%20Redevelopment%20Planning.pdf

35. Revise local plans and development codes to allow temporary land uses to facilitate and expedite post-disaster recovery

Revise local plans and development codes to permit interim or temporary land uses to support critical public facilities to facilitate and expedite recovery after a disaster event.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	Region	**Community**	Resident

Target Development Type		**Hazard Addressed**		
Existing	**New**	**Ground Shaking**	**Liquefaction**	**Flooding**

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	Cost Burdened	Housing Tenure	Access to Resources	Single or Two Family	Multi-family	Cripple Wall	Soft story or House over garage

Action Categories					
Evaluation	Program/ Operation	**Plans and Policies**	**Codes, Regulations, and Ordinances**	Coordination	Education/ Outreach

Prerequisite Strategies	**Other Related Strategies**
Strategy 34: Create a pre-disaster rebuild and recovery plan	Strategy 36: Develop and implement a shelter-in-place program

Description

Following a disaster, everyday services such as social assistance, medical care, or other basic infrastructure may not be available, and may take several weeks, months, or years to reach the same level of service as before the disaster. Much of the standard "infrastructure" that delivers government services, medical care, shelter, food, and other essential services may be damaged or destroyed. Electricity, gas, water and telephone service are likely to be disrupted, and business may be inoperable. Currently, local jurisdictions may not have appropriate planning or zoning designations and/or development standards that allow for the construction of temporary buildings, infrastructure, and public spaces that can help meet basic needs in the interim while rebuilding is occurring.

This strategy proposes that local jurisdictions incorporate allowance in their local plans and development regulations for temporary buildings, structures, and support infrastructure in order to provide continued services to residents. Temporary land uses can accommodate critical facilities or any other temporary land uses that support recovery.

Critical public facilities can include a wide range of infrastructure, buildings, and public spaces that support police, fire, emergency medical or emergency communications facilities that aid in the delivery of post-event support. Other temporary facilities may include information

dissemination or rebuilding assistance, showers, toilet, or laundry facilities, neighborhood support centers (see Strategy 36: Develop and implement a shelter-in-place program), or offices and storefronts. In addition to providing basic services, these places and facilities also can allow businesses to re-open temporarily and serve the community as quickly as possible after a serious event until more permanent rebuilding can occur.

Jurisdictions need to make several decisions about temporary land-use regulations, including who shall have the authority to issue permits, what temporary uses will be allowed, which zones will allow temporary land uses, how long temporary land uses will be allowed, and other guidelines relating to the benefit and appropriateness of temporary uses.

Governance/Implementation Issues

This strategy will require a relatively minor revision to local plans and development codes, but will have to consider the schedule and frequency of amendments allowed by the local jurisdiction for applicable plans and codes. Collaboration with other cities or regional planning agencies is advisable so that the best local and accessible distribution of locations for building and facilities for post-disaster response can be determined, and standardized policy language can be developed. However, local jurisdictions have exclusive authority over their development regulations and plans and this strategy can be implemented independently. This strategy can be replicated by other local jurisdictions and agencies, as long as any site-specific conditions are addressed.

This strategy can be integrated into a Pre-Disaster Recovery and Rebuild Plan or ordinance (see Strategy 34: Create a pre-disaster rebuild and recovery plan), and should coordinate with shelter in place policies (see Strategy 36: Develop and implement a shelter- in-place program).

This strategy aligns with the State of California Emergency Management Plan, in which the concept of operations and coordination with other agencies and private relief organizations during disaster response and early phases of recovery identifies the need to use building, facilities, and publicly accessible places for staging areas, temporary shelters, animal shelters, transitional housing, distribution centers, mass care facilities, and other uses that may not otherwise be permitted by local codes.

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	Development and Construction Loans	Individual Home Improvement or Commercial Renovation Loans	Revolving Loan Fund Programs	**Grant Programs**	Other

This strategy suggests code revisions that will allow the siting of critical and other facilities. If temporary facilities are needed after a disaster, they would likely be financed by state or federal recovery grant programs (e.g. the State of California's Disaster Recovery Initiative grants, or the US Department of Housing and Urban Development's Community Development Block Grants).

Implementation Partner(s)

State	Region	Local
No state partners are required for this strategy	ABAG can provide tools and technical assistance to local governments to identify critical infrastructure and facilities needed for disaster response and recovery and incorporation of strategies to remove policy and regulatory barriers as part of pre-disaster recovery and preparedness planning. SPUR has develop research and policy papers that could help communities in the Bay Area identify critical infrastructure that may be needed for successful disaster response and recovery and barriers from local policies and codes. Adjacent municipalities often face similar hazards and could have similar disaster relief and recovery needs. Through collaboration, adjacent municipalities can help each other develop common strategies for addressing potential planning policy and code constraints. Red Cross, Voluntary Organizations Active in Disaster (VOADs) – Nonprofit organizations that are partners with governmental organizations in disaster response and recovery can provide input into the types of critical infrastructure and facilities needed to aide disaster relief and recovery and the potential barriers that local planning policies and codes could create for the location of such facilities where they may be needed for disaster response or recovery.	Local affiliates of national organizations, such as the American Red Cross, Catholic Charities, and Habitat for Humanity, may be able to advise on the types of temporary buildings and facilities that may be needed, and/or the types of permanent buildings and facilities that could be used temporarily, for uses related to disaster response and early phases of recovery, so that local governments can better understand how to revise their local plans and codes to allow for temporary or permanent buildings or facilities to be used for purposes that would not otherwise be permitted. This need could last several months or more to aid in disaster response and early recovery.

Revise local plans and development codes to allow temporary land uses to facilitate and expedite post-disaster recovery	*State*	*Region*	**Local**

Examples

APA Model Pre-Event Recovery Ordinance, Section 9.6 - Temporary Use Permits

This model ordinance allows local governments to establish a recovery organization, authorizes preparation of a recovery plan, and grants emergency powers for staff actions which can ensure post-disaster recovery for local governments.

See: https://www.planning.org/research/postdisaster/pdf/modelrecoveryordinance.pdf

City of Los Angeles, CA

The City's municipal code includes the following regulations which allow land-use approval for properties damaged in a local emergency:

Zoning Code, Article 6, Temporary Regulations Relating to Land-Use Approvals for Properties Damaged in a Local Emergency.

See: https://law.resource.org/pub/us/code/city/ca/LosAngeles/Municipal/chapter01.html

36. Develop and implement a shelter-in-place program

Develop a comprehensive shelter-in-place program to allow residents to remain in their homes after a disaster. Establish engineering criteria to determine shelter-in-place capacity, develop acceptable habitability standards for sheltering-in-place, and prepare and adopt regulations that allow for the use of these standards in a declared housing emergency period. Also develop plans for implementing the program, such as public training materials, coordinating with post-disaster evaluation procedures, and setting up neighborhood support centers.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	Region	Community	**Resident**

Target Development Type		**Hazard Addressed**		
Existing	**New**	**Ground Shaking**	**Liquefaction**	Flooding

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	**Cost Burdened**	**Housing Tenure**	**Access to Resources**	**Single or Two Family**	**Multi-family**	Cripple Wall	Soft story or House over garage

Action Categories					
Evaluation	**Program/ Operation**	**Plans and Policies**	Codes, Regulations, and Ordinances	Coordination	**Education/ Outreach**

Prerequisite Strategies	**Other Related Strategies**
Strategy 16: Develop a fragile housing inventory	Strategy 17: Develop and implement a soft story retrofit program Strategy 18: Develop and implement a cripple wall retrofit program

Description

After a major disaster, many residents whose homes are damaged may not be able to live in their homes, overwhelming temporary shelters and city services and relying on temporary housing or rental housing. Many vulnerable residents may be forced to leave even though this poses many challenges. For example, seniors may have limited mobility or limited resources, and may be heavily dependent on the services in their neighborhood or city. Low income residents may be unable to afford temporary rentals, particularly if a low pre-disaster rental vacancy rate creates a tight rental market. These and other factors could permanently alter the demographics of a jurisdiction and the region. Availability of housing is a significant factor in keeping residents within their community after a disaster. Other factors that contribute to this decision include availability of infrastructure and services, jobs, schools, and the ability to meet daily needs within the community.

This strategy recommends developing and adopting a shelter-in-place program that increases the ability of residents to remain in their homes after a major disaster. A shelter-in-place program has several components which are outlined below.

1. Develop shelter-in-place targets

Each jurisdiction should have an understanding of their specific housing vulnerabilities through the development of a fragile housing inventory (see Strategy 16: Develop a fragile housing inventory). Based on this, and estimates of uninhabitable housing after a disaster, the jurisdiction should set a target for how many households will be able to shelter in place after a disaster. In the SPUR report, Safe Enough to Stay, a 95% shelter-in-place target is recommended for the City of San Francisco. This is based on capacity for short-term shelter (shelter beds) and medium-term or interim housing (hotel rooms, trailers) and analysis on how housing damage affected community resilience in recent relevant disasters. Goals may vary based on each jurisdiction's unique capacity and vulnerability profile. This step should be developed with consideration of interim housing goals and strategies.

2. Determine which engineering criteria to use to determine shelter-in-place capacity

This step involves performing seismic evaluations to determine the capacity of existing buildings to provide shelter in place capacity. This step should also determine when and why a shelter-in-place evaluation should be done; for example they could be triggered by major building upgrades or any other time a seismic safety evaluation would be triggered. The criteria for seismic evaluation would simply be expanded to shelter in place capacity, not just life safety. Evaluation could also be voluntary or mandatory. If a building does not meet shelter in place standards, which many will not be expected to, the jurisdiction will need to move to the next step to improve the quality of existing buildings to shelter in place standards.

3. Develop targeted retrofit programs to limit catastrophic structural damage in the most fragile housing types (see Strategies 17 and 18)

Residents will not be able to shelter in place if their homes have significant structural damage, so a successful shelter in place strategy relies heavily on retrofitting existing housing to limit structural damage. These programs should select retrofit guidelines that are geared towards sheltering in place, not just life safety. Many engineering guidelines, as well as building codes for new construction, focus on the ability of people to survive a disaster and get out of the building safely, but are not necessarily high enough to ensure that the structure is habitable after a disaster. When developing retrofit programs, standards should go above and beyond life safety.

4. Develop habitability requirements for after the disaster

In order to determine the extent of damage that actually occurred, and if a home is safe for occupancy, standards must be developed to determine if a unit is safe and habitable for sheltering in place. Criteria should include major structural damage, means of egress, weather protection, and basic services such as power and water. The standards should temporarily

supersede regular building codes in the post-disaster phase. These standards should become increasingly stringent over time and eventually be lifted as homes are repaired. Detailed criteria should be developed for the immediate post-disaster phase, one week after the disaster, one month after, three months after, and then after the declared housing emergency is over, and training should be provided for inspectors on shelter-in-place criteria.

5. Implement policies that support the program, and begin implementation.

A shelter in place program needs to have a few supporting pieces of policy enacted at the jurisdictional level. This includes the aforementioned fragile building inventory and seismic retrofit programs; changing seismic evaluation criteria to include a shelter in place standard and adopting shelter in place habitability standards for the post-disaster period. An implementation program needs to be developed as well, with city staff dedicated to the program. The implementation program should include public education on how to shelter in place, training of city staff on new evaluation criteria, and ensuring the availability of resources in communities to meet daily needs, particularly when services such as water and power are not available. SPUR recommends the creation of neighborhood support centers within communities to provide news, communication services, assistance in conducting shelter in place evaluations, access to services and agencies, distribution of goods, and temporary services such as access to power, port-a-potties, portable showers, or washers and dryers.

Governance/Implementation Issues

This strategy will require new policies and revisions to local government building codes, along with appropriate training for local building officials so that they understand the new requirements. This strategy also requires coordinating and aligning standards for multiple policy processes, including building inventories, seismic retrofit programs, and seismic review processes. This strategy should be implemented at each jurisdiction, but may benefit from coordination at a regional level. For example, the region could agree on regional standards for shelter in place engineering criteria and post-disaster habitability standards. However, implementation of the program would occur at a local level.

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	Development and Construction Loans	Individual Home Improvement or Commercial Renovation Loans	Revolving Loan Fund Programs	Grant Programs	**Other**

This strategy requires financing for multiple types of actions. Much of the cost associated with this strategy will be city staff costs to develop and enact the policies. Additionally, financing will be required for the retrofit programs identified. Financing mechanisms for retrofit programs should be addressed when developing that program (See Strategy 17: Develop and implement a soft story retrofit program, and Strategy 18: Develop and implement a cripple wall retrofit program for more detail on financing building retrofit programs).

Implementation Partner(s)

State	Region	Local
No state partners are required for this strategy	Regional partners such as ABAG could help jurisdictions coordinate and develop model ordinances and consistent standards within the region.	Jurisdictions should partner with neighborhood groups to build neighborhood support centers. Jurisdictions may also want to partner with neighboring jurisdictions to provide consistent opportunities for sheltering in place across borders.

Examples

SPUR's Safe Enough to Stay report is the major inspiration behind this strategy and recommends many well-researched examples and standards to use in a shelter in place program.

http://www.spur.org/publications/spur-report/2012-02-01/safe-enough-stay

ASCE 31 is a national standard for the seismic evaluation of existing buildings. SPUR recommends the use of ASCE 31 in assessing buildings for shelter in place capacity before a disaster.

http://ascelibrary.org/doi/book/10.1061/9780784406700

37. Improve the resilience of rental units and ensure they are re-built after loss or damage due to a natural disaster

Adopt new policies, and strengthen existing policies, to improve the resilience of available rental units, and develop policies to ensure that rental units damaged during a natural disaster are replaced in kind (with a similar number/type) during rebuilding and recovery rather than being converted to owner-occupied properties.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	Region	Community	**Resident**

Target Development Type		**Hazard Addressed**		
Existing	**New**	**Ground Shaking**	**Liquefaction**	**Flooding**

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	Cost Burdened	**Housing Tenure**	Access to Resources	**Single or Two Family**	**Multi-family**	Cripple Wall	Soft story or House over garage

Action Categories					
Evaluation	**Program/ Operation**	Plans and Policies	**Codes, Regulations, and Ordinances**	Coordination	Education/ Outreach

Prerequisite Strategies	**Other Related Strategies**
None	Strategy 16: Create a fragile housing inventory Strategy 17: Develop and implement a soft story retrofit program Strategy 18: Develop and implement a cripple wall retrofit program

Description

This strategy recommends jurisdictions adopt policies to improve the resilience of available rental units and require that rental housing that has been damaged or destroyed by a natural disaster is replaced in kind. During post-disaster rebuilding efforts, rental housing that is significantly damaged is often demolished and rebuilt as for-sale or owner-occupied properties (e.g., condominiums), reducing the number of rental units available. This is largely because building owners find owner-occupied properties more profitable than rentals, and allows them to make a profit without continued upkeep or investment in the building. However, not only does this displace renters from their existing communities, but also drives up rents in the remaining rental units, making it more difficult for medium, low, or very low income renters to return to their communities (see Strategy 38, Protect housing affordability during recovery). Wholesale loss of rental units can significantly alter the cultural, racial, income, and age diversity

of a community. This strategy takes a two-pronged approach: avoid the loss of rental units by mitigating the potential damage of rental units through retrofitting, and requiring that rental housing that is damaged and demolished due to a natural disaster is replaced in kind. Local jurisdictions can use these paired strategies to provide broad social and economic benefits to renters as well as property owners, in addition to benefiting those with limited income or access to resources.

The primary tool to improve the resilience of rental properties should be retrofitting multifamily buildings to mitigate structural damage from a disaster in order to support continuous housing and reduce displacement. Retrofits provide a win-win situation for landlords and renters: capital improvements in the form of retrofits increase property values for landlords as well as provide renters with increased protections from natural hazards (see Strategies 17 and 18, Develop and implement a soft story retrofit program, and Develop and implement a cripple wall retrofit program, for more information on mandatory retrofit programs). However, voluntary or mandatory retrofits can jeopardize the affordability of rental housing, and especially for low and very low income renters. This is of particular concern if a Capital Improvement Passthrough (CIP) is triggered allowing a landlord to raise rents to offset the costs of retrofitting his/her building. Jurisdictions can incentivize landlords not to raise rents by partnering with private lenders to create financing programs for property owners who wish to retrofit their rental properties. Jurisdictions can support low income renters by developing means-tested exemptions for CIPs, whereby a household is relieved from payment of a CIP if it can demonstrate that the payment would cause financial hardship. Jurisdictions can also regulate amortization periods for CIPs so that costs are spread over a long time period, e.g. 10 years.

There are existing protections in place for rental housing from normal market processes; however these protections rarely include protections from involuntary loss from natural hazards. For example, Through the Costa Hawkins Act, landlords can raise rent stabilized units to market rates for a sublessee if the Master Tenant vacates the unit. The Ellis Act allows landlords to evict tenants as a way to go out of business, and is often used to remove a property from municipal rent controls or convert it to for-sale units. Many jurisdictions have protections in place to address the loopholes in these laws that can negatively impact renters, as well as rules regarding the conversion of rental housing to for-sale condominiums to protect housing affordability. However, there is often no language to address the involuntary loss of housing due to a disaster. This strategy recommends the adoption of policies, provisions, or ordinances, or the amendment of existing policies, that limit condo conversion and require private property owners and local agencies to produce an in-kind replacement of rental units destroyed by natural disasters such as earthquake, flooding or fire, or by the damages that follow such events. The implementation of this strategy will vary by jurisdiction based on existing policies but will most likely require a multifaceted approach that combines policy mechanisms such as Tenant Protection, Affordable Housing, Rent Stabilization and Just Cause Eviction, and Condominium Conversion ordinances.

Governance/Implementation Issues

This effort can be led by the jurisdiction's Planning and Housing Departments. All jurisdictions benefit from adopting policies that require in-kind replacement of rental housing following involuntary removal due to a natural disaster by amending existing ordinances or adoption of a new ordinance. However, jurisdictions with tight rental markets will especially benefit from adopting policies that preserve the overall number of existing rental units post-disaster. Additionally, a jurisdiction could establish a voluntary or mandatory retrofit program pending the feasibility of partnering with private lenders to create a financing program for property owners and the development of policy mechanisms to support low income or housing cost burdened populations that would be adversely affected by a mandatory retrofit program.

Mandatory retrofit programs may result in political opposition from property owners, especially in jurisdictions that implement rent control ordinances. In these communities rental property owners may be facing financial obstacles if costs exceed potential income and there are legal barriers to increasing rents. Jurisdictions should work with property owner associations and housing advocates alike to ensure a transparent and equitable process in developing mandatory retrofit policies.

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	Development and Construction Loans	**Individual Home Improvement or Commercial Renovation Loans**	Revolving Loan Fund Programs	**Grant Programs**	Other

In order to finance retrofit programs, a jurisdiction could partner with private lenders or apply for state or federal hazard mitigation assistance funds. See Strategies 18 and 19, Develop a soft story retrofit program and Develop a cripple wall retrofit program, for more information on retrofit program financing.

Development or amendment of policies, provisions or ordinances will require staff time from each jurisdiction.

Improve the resilience of rental units and ensure they are re-built after loss or damage due to a natural disaster *State* *Region* **Local**

Implementation Partner(s)

State	Region	Local
No state partners are required for this strategy	*No regional partners are needed for this strategy.*	Housing advocates, property owners, HOAs, developers, private banks, tenant advocacy groups and CBOs who represent low-income and affordable housing interests.

Examples

The following is an example of a policy that strengthens the seismic resilience, while maintaining affordability, of rental units.

San Francisco Rent Board Tenant Petition 524 - Tenant Capital Improvement Passthrough Hardship Application

On October 10, 2013, Mayor Ed Lee signed into law provisions that clarify the existing process for residential tenant financial hardship, allowing tenants who cannot afford the capital improvement passthrough of the costs of a mandatory seismic retrofit a clearer and simplified path to being granted a hardship exemption. The household must supply documentation demonstrating that all adults are recipients of means-tested public assistance (e.g., Social Security Supplemental Income, General Assistance, Personal Assisted Employment Services, etc.) or otherwise qualified based on household gross income and assets.

http://www.sfrb.org/modules/showdocument.aspx?documentid=2670

38. Protect housing affordability during recovery

Develop a more fair community planning process for rebuilding affordable housing after a disaster, adopt policies to support the replacement of affordable housing units that have been damaged or demolished, and prioritize the deployment of interim housing in vulnerable communities.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	Region	Community	**Resident**

Target Development Type		**Hazard Addressed**		
Existing	**New**	**Ground Shaking**	**Liquefaction**	**Flooding**

Community Vulnerability Addressed					**Vulnerable Housing Type Addressed**			
Age	Language & Ethnicity	**Cost Burdened**	**Housing Tenure**	**Access to Resources**	**Single or Two Family**	**Multi-family**	Cripple Wall	Soft story or House over garage

Action Categories					
Evaluation	**Program/ Operation**	**Plans and Policies**	**Codes, Regulations, and Ordinances**	**Coordination**	Education/ Outreach

Prerequisite Strategies	**Other Related Strategies**
None	Strategy 37: Improve the resilience of rental units and ensure that they are rebuilt after loss or damage due to a natural disaster

Description

Natural disasters can cause serious housing shortages, resulting in displaced renter and owner households across all income levels in urgent need of affordable housing. A decrease in the overall housing supply, coupled with the fact that middle- and upper-income households are better able to obtain alternate or temporary housing than lower income households in a constricted housing market, can drive up home prices and rental rates and exacerbate housing affordability problems. This can relegate low-income households to poorer quality housing or force them to leave the area altogether, either temporarily or permanently, if they are unable to find an affordable living situation. Wholesale loss of affordable housing can significantly alter the cultural, racial, income, and age diversity of a community. Moreover, in the urgency of reconstruction, allocations of state and federal assistance funds may be distributed disproportionately less to poorer communities due to their lack of influence or access to resources, which can greatly diminish their ability to recover from a natural disaster (see also Strategy 37: Improve the resilience of rental units and ensure they are re-built after loss or damage due to a natural disaster). The urgency to rebuild can also lead to lack of a well thought out plan to provide or replace permanent housing for low-income populations.

Jurisdictions should develop a plan to incentivize or require the replacement of affordable housing that has been destroyed in a natural disaster, as well as supporting programs that provide interim housing assistance after a disaster to help low-income and housing cost-burdened community members remain in the area during recovery.

Jurisdictions can best prepare themselves to implement this strategy during post-disaster recovery by creating an inventory of where their most vulnerable community members (e.g., low income, cost burdened, transit dependent, disabled) live in relation to the location of designated affordable housing stock and high hazard areas. In a recovery period, jurisdictions can use this inventory to understand where affordable housing rebuilding needs to occur as well as targeted housing assistance programs that respond to community needs.

There are three components to implementing this strategy:

1. **Convene neighborhood-scale councils in addition to sector-based and interagency councils to ensure a fair and equitable planning for rebuilding permanent, affordable housing.**

In order to ensure a fair and equitable planning process for rebuilding affordable permanent housing during a recovery period, a jurisdiction could facilitate equal representation from displaced homeowners and renters of all incomes by convening neighborhood-scale councils in addition to sector-based and interagency councils. A jurisdiction could use the Citizens of Oakland Respond to Emergencies (CORE) program model to identify community leaders who could establish a neighborhood-scale council prior to a disaster. Communities could be divided into geographic neighborhoods or communities, then groups and residents in that area volunteer to serve on the council. They would meet prior to a disaster to discuss their role, goals, logistics, etc. Then, if a disaster occurred, they could meet as soon as it was practicable to do so.

2. **Support the replacement of affordable housing units damaged in a disaster.**

A jurisdiction could encourage the rebuilding of new affordable housing by adopting ordinances that would require and/or incentivize, if certain findings are met, a development or redevelopment project to include units of affordable housing via zoning bonuses, tax incentives, etc. If the site was previously developed with affordable housing, the jurisdiction could mandate that rebuilding of affordable housing on-site, or the requirement of building new affordable housing on a new site if the risk of another natural hazard is deemed too high. While this provision may already be in place if affordable housing is lost through natural development processes, specific language should be included on loss by natural hazards.

3. **Prioritize interim housing in the post-disaster period for the most vulnerable community members and seek support from temporary housing assistance programs to help vulnerable community members remain in, or return to, the area and rebuild.**

Using the inventory described above, jurisdictions should help agencies and organizations responsible for temporary housing assistance prioritize the installation of mobile homes or

other types of temporary shelters to areas to areas with high concentrations of elderly, very young, transit dependent, or cost burdened households with the goal of keeping these people as close to their homes as possible, if it is safe to do so.

Temporary housing assistance programs can help displaced renters and owners obtain permanent housing, repair their homes during recovery or navigate the insurance claims process. Jurisdiction can work with state and federal partners to ensure that local disaster recovery loan or voucher programs give displaced homeowners and renters assistance with rental payments or home repairs. Jurisdictions could also partner with NGOs to follow-up with low-income households who have left the area and help them return by supplying them with information about these assistance programs. The goal of these assistance programs is to provide enough resources for people to remain in an area during the intermediate phase of recovery, while rebuilding their homes, returning to work or otherwise trying to resume normal life.

Governance/Implementation Issues

This strategy may be led by the jurisdiction's Planning, Housing, and Emergency Management/ Response Departments.

The jurisdiction would provide staff support for neighborhood council development and pre-disaster interim housing planning efforts.

Voluntary implementation of replacing affordable housing units in-kind could be achieved through offering zoning bonuses, expedited permits, reduced fees, cash subsidies or other incentives for developers.

Identify funding from federal and state natural disaster mitigation programs and develop processes to distribute local disaster recover loan or voucher programs.

Potential Financing Mechanisms

City/County/ State Bond Program	**Parcel or Sales Tax**	**Tax-based Special Districts**	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	Development and Construction Loans	**Individual Home Improvement or Commercial Renovation Loans**	Revolving Loan Fund Programs	**Grant Programs**	**Other**

Jurisdictions could implement a construction excise tax to provide long-term funding streams at the local level for new affordable housing construction.

Post-disaster, the U.S. Small Business Administration (SBA) would be the primary federal source of low-interest disaster-recovery loans to help community members with issues of housing affordability during recovery. If homeowners cannot afford a low-interest loan on top of their mortgage payment, SBA is sometimes able to assist with refinancing existing mortgages and folding in payments for repairs. If a household's income is too low to qualify for a loan and they are not covered by insurance or other assistance, SBA will refer them to the FEMA Individual and Family Grant Program (IFGP).

Implementation Partner(s)

State	Region	Local
NGOs such as the National Low Income Housing Coalition at the state partner level and the Nonprofit Housing Association of Northern California could help to advocate for the highest federal budget appropriations for HUD reconstruction programs.	*No regional partners are needed for this strategy.*	Partnerships with local chapters of NGOs such as Habitat for Humanity and Americorps could assist with low cost reconstruction programs during a post-disaster recovery period.

Examples

The following is an example of a post-disaster housing assistance program.

HUD and FEMA's Disaster Housing Assistance Program – Sandy (DHAP-Sandy)

In the wake of Superstorm Sandy, the HUD and FEMA Interagency Agreement created a temporary housing assistance program called the Disaster Housing Assistance Program – Sandy (DHAP-Sandy). The DHAP-Sandy provides monthly rent subsidies, security deposit assistance, and utility deposit assistance to assist eligible New York State residents displaced by Hurricane Sandy. Pursuant to FEMA's grant authority, a grant will be provided to the New York State's Office of Homes and Community Renewal (HCR) to administer DHAP-Sandy to eligible residents of the State of New York. The HCR will make rental assistance payments, on behalf of eligible families, to participating landlords for a period of up to 12 months commencing from the effective date of the initial Disaster Rent Subsidy Contract (DRSC). To be eligible for DHAP-Sandy, the family must have been displaced by Hurricane Sandy and referred to HUD by FEMA. FEMA is solely responsible for determining if the family is initially eligible to receive assistance under DHAP-Sandy. Under DHAP-Sandy, HCR will assume responsibility not only to provide a monthly rent subsidy on behalf of the family but also to assist the family in locating an eligible unit. DHAP-Sandy is a temporary housing assistance program that terminates on December 31, 2014.

39. Create a community capacity inventory

This strategy recommends developing or enhancing an existing community capacity inventory by first defining the elements that should be included (such as critical facilities and community services), engaging NGOs and city agencies to utilize current work, and then developing and sustaining standardized, transferrable procedures for collecting and managing data. Partnerships with NGOs such as Code for America could yield an open-source, collaborative format for collecting and sharing this information.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	Region	**Community**	Resident
Target Development Type		**Hazard Addressed**			
Existing	**New**	**Ground Shaking**	**Liquefaction**	**Flooding**	
Community Vulnerability Addressed			**Vulnerable Housing Type Addressed**		
Age	**Language & Ethnicity**	**Cost Burdened**	**Housing Tenure**	**Access to Resources**	
Single or Two Family	Multi-family	Cripple Wall	Soft story or House over garage		
Action Categories					
Evaluation	**Program/ Operation**	Plans and Policies	Codes, Regulations, and Ordinances	**Coordination**	Education/ Outreach
Prerequisite Strategies			**Other Related Strategies**		
None			None		

Description

This strategy recommends developing or enhancing an existing community capacity inventory to support local capacity to prepare for, respond to, and recover from a natural disaster. Resilience can be enhanced in a community that may not have traditional, measurable indicators of resilience through community capacity building, meaning services and resources that directly help residents reduce their vulnerability. Maintaining a community capacity inventory in an open, publicly shareable format can help community members access services and resources both before and after a natural hazards disaster or other type of emergency. Developing or consolidating existing inventories into one database can also help jurisdictions, organizations and agencies prepare for and respond to natural hazards and other disruptions, allowing for better communication with communities prior to, during and after an event and more effective use of all community assets during the response phase.

The first step is to determine what defines local community capacity, and then determine the elements to be included in the inventory. Based on the agreed upon definition a jurisdiction may need to establish criteria for the types of organizations, services and facilities to be included, and

to reduce duplication of efforts, input should be sought from community service agencies to determine if they relevant data, and if they have or are planning on developing similar inventories.

Determining what is included in the inventory should include consideration of the particular characteristics of communities in the jurisdiction that affect resilience to, and opportunities to recover from, natural hazards. The type of elements that could be in the inventory include the name, type, location and services provided by community-based organizations, emergency response NGOs, faith-based groups and any other non-traditional actors that have critical facilities, offer emergency resources or services, or have existing relationships with community leaders that could enhance the coordination of response and recovery efforts. Organizations involved in coordination, such as United Way, 211, Voluntary Organizations Active in Disaster, may provide additional guidance on the agency types to include. Agencies providing critical human services such as feeding, sheltering, childcare, elder care, and physical and mental health support should be considered.

In addition to these organizations, the type, location and services provided by critical facilities will be a major component of the inventory. Critical facilities are those that are vital to emergency response activities or critical to the health and safety of the public before, during, and after an event, such as hospitals, emergency operations centers, police stations, fire stations, nursing homes, schools, vehicle and equipment storage facilities, shelters, etc.). In addition, there are certain facilities that if damaged would make response and recovery to a natural disaster more challenging. These include transportation facilities, facilities that store hazardous materials, facilities that generate or distribute power, water utilities, and wastewater treatment plants.

Jurisdictions could leverage partnerships with regional organizations such as ABAG, MTC and BCDC to garner support for the creation of a community capacity inventory. A common community capacity inventory or common standards across the region would enable a more coordinated level of response.

Governance/Implementation Issues

Initiating the strategy would require the jurisdiction to define the elements it will include in the inventory and consideration of how to develop and sustain standardized procedures for collecting and keeping data up to date. A lead agency to serve as the point of contact for the inventory strategy should be selected by the jurisdiction and it should be experienced in data collection and management. Seeking community feedback about selecting a lead agency could prove helpful. Implementing the strategy would require coordinating with participating organizations, outreach and compiling existing inventories, and may also include contracting a partner to develop the necessary software.

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	Development and Construction Loans	Individual Home Improvement or Commercial Renovation Loans	Revolving Loan Fund Programs	**Grant Programs**	Other

The strategy could be financed through state and federal hazard mitigation assistance grant programs

Implementation Partner(s)

State	Region	Local
There are no state partners needed for this strategy.	*Jurisdictions could leverage partnerships with regional organizations such as ABAG, MTC, BCDC, Northern California Voluntary Organizations Active in Disaster (NorCal VOAD), and/or 211 Bay Area to garner support for the creation of a community capacity inventory.*	*Local partners such as community agencies like Community Agencies Responding to Disasters (SF CARD and CARD Alameda), American Red Cross, and local VOADs can help to coordinate existing community capacity efforts and provide guidance on defining the elements that should be included in the community capacity inventory.*

Examples

The following are examples of community capacity inventories currently in development by jurisdictions.

Town of Littleton, New Hampshire's Model Community Project

The Town of Littleton received a model community grant under New Hampshire's Real Choice Systems Change Initiative to develop and maintain an infrastructure to remove barriers preventing persons who are aging and others with disabilities from fully participating in community life. Key to this project is identifying and inventorying community assets and capacity including individual talents, knowledge, and skills of local residents including elders and persons with disabilities. The idea is to build on existing relationships to enhance, coordinate,

facilitate, and develop support for assistive technology, transportation, employment, greater public access, personal assistance, information and referral, and integration of services between individuals, associations, local government, public institutions, and the private sector. One of the primary goals is to promote the value of every resident through a capacity inventory and an educational and outreach campaign focused on inclusive principles so that all residents are able to maintain, increase, and maximize personal choice and independence to lead full and productive lives.

See: http://www.golittleton.com/littleton_model_comm.php

PlaNYC's A Stronger, More Resilient New York - Community Preparedness and Response Initiative #2: Launch a Pilot Program to Identify and Address Gaps in Community Capacity

The City of New York learned from Superstorm Sandy that neighborhoods with higher community capacity tended to prove more resilient. Subject to available funding, the City of New York will conduct a pilot community needs assessment in one to-be-identified Sandy impacted community. Upon selection of the applicable community, OEM and the City's Center for Economic Opportunity (CEO) will work with local residents to identify community strengths and needs and develop a set of recommendations for improving local preparedness and response capacity to extreme weather events. Following this "gap identification process," the City and the community subsequently will develop and implement a plan—as well as seek philanthropic and other potential funding sources—to address identified needs.

See: http://s-media.nyc.gov/agencies/sirr/SIRR_singles_Lo_res.pdf

40. Disseminate best available hazard and climate risk information through community-based organizations and non-traditional partners

This strategy recommends seeking opportunities to expand existing, successful community-based programs (e.g. programs on crime, blight, neighborhood beautification, education or other important community issues) in order to better communicate hazard and climate risk information to community members. An example of such an expansion would be the promotion of voluntary retrofits to building owners in coordination with the public health sector Healthy Homes educational campaigns.

Lead			**Scale of Benefit**		
State	Region	**Local jurisdiction**	Region	**Community**	Resident
Target Development Type		**Hazard Addressed**			
Existing	**New**	**Ground Shaking**	**Liquefaction**	**Flooding**	
Community Vulnerability Addressed				**Vulnerable Housing Type Addressed**	
Age	**Language & Ethnicity**	Cost Burdened	Housing Tenure	**Access to Resources**	
Single or Two Family	Multi-family	Cripple Wall	Soft story or House over garage		
Action Categories					
Evaluation	**Program/ Operation**	Plans and Policies	Codes, Regulations, and Ordinances	**Coordination**	**Education/ Outreach**
Prerequisite Strategies			**Other Related Strategies**		
None			Strategy 16: Create a fragile housing inventory Strategy 39: Create a community capacity inventory		

Description

Current best available climate and hazard risk information may not be sufficiently translated or communicated in a manner that equally targets all members of the community. In addition, this information may be in formats that are not easily shared with community members.

This strategy recommends providing targeted outreach and educational materials and programs to help communities better prepare for disasters so that community members will be better able to remain in their homes post-disaster. This offers broad social and economic benefits for the greater community, such as supporting local businesses, neighborhoods, and neighborhood services by reducing the potential devastating impacts to the local economy that could result from the departure of local residents.

Disseminate best available hazard and climate risk information through community-based organizations and non-traditional partners *State* *Region* **Local**

In order to develop targeted education programs for all-hazards disaster preparedness, this strategy recommends that jurisdictions conduct an assessment to determine the specific needs and characteristics of the community within their jurisdictions and to better understand the specific hazards they may experience and the type of housing in which they live. This may be best achieved by partnering with community-based organizations that have existing knowledge of, and relationships with specific neighborhoods throughout the jurisdiction.

Once partners and programs have been identified, the jurisdiction can develop targeted outreach and educational materials and programs to address these specific vulnerabilities. The jurisdiction can also coordinate with organizations to build capacity in existing programs, as well as initiate new programs by working with community partners to secure funding from federal, state, or private foundation grants.

Examples of targeted education programs include explaining the benefits of hazard insurance to renter households, shelter-in-place training for elderly and special needs households, and translating these and other programs into the languages predominantly spoken within the jurisdiction.

Governance/Implementation Issues

To implement this strategy, jurisdictions should seek opportunities to expand relationships with existing community-based programs that have a history of success that can partner in conducting targeted community outreach and education. Jurisdictions may also seek efficiencies by partnering with County Public Health Departments to develop educational materials and initiate outreach strategies. Implementing this strategy in an effective manner will require local jurisdictions to either conduct an assessment of the specific community, housing and hazard characteristics or leverage existing information. The assessment could be taken up in a stepwise manner by prioritizing the neighborhoods most at risk first using a high level screening approach or locally available information such as a fragile housing inventory (see Strategy 16: Create a fragile housing inventory) or existing neighborhood/community program information (see Strategy 39: Create a community capacity inventory).

Potential Financing Mechanisms

City/County/ State Bond Program	Parcel or Sales Tax	Tax-based Special Districts	Fee-based Special Districts	Infrastructure Financing Districts	Joint Powers Authorities
Municipal Enterprise Funds	Development and Construction Loans	Individual Home Improvement or Commercial Renovation Loans	Revolving Loan Fund Programs	**Grant Programs**	**Other**

The jurisdiction should engage private partners such as foundations, corporations and individuals to provide necessary program funding through tax-based incentives, or apply for existing local, state or federal grant programs (e.g., HUD's Healthy Homes campaign).

Implementation Partner(s)

State	Region	Local
Partners in providing best available hazard and climate risk information include state agencies (as well as federal agencies such as NOAA and FEMA).	Partners in providing best available hazard and climate risk information include regional organizations such as ABAG.	Partners in developing program components and disseminating materials could include County Health Departments, community-based organizations, faith-based organizations, research institutions and other non-traditional partners who already have successful programs within neighborhoods and communities of the jurisdiction.

Examples

The first two are examples of education and outreach campaigns that leverage community partnerships to disseminate best available hazard and climate risk information, while the third example demonstrates how community relevant hazard information can be broadly disseminated.

National Oceanic and Atmospheric Administration (NOAA) Storm Surge Marketing Outreach

To better provide actionable information to keep the public safe, Eastern Research Group, Inc., through a contract from NOAA, conducted social science research to inform the creation of a Potential Storm Surge Flooding map from the National Hurricane Center. A marketing plan also was developed to guide outreach and education so that broadcast meteorologists and National Weather Service (NWS) staff members can better communicate the impacts of storm surge. Outreach materials such as the tip sheets have proven useful, helping broadcasters and emergency managers better understand the map and ensuring a consistent message among NWS partners to help save lives during the next storm.

California Earthquake Authority's (CEA) Putting Down Roots in Earthquake Country Handbook

In January 2007, the USGS, with the assistance of New American Media and the Asian Pacific Fund and using funding provided by the CEA, launched the latest iterations of the handbook, Protecting Your Family From Earthquakes - The Seven Steps to Earthquake Safety. The updated versions of the popular PDR handbook were tailored to the Bay Area's Latino, Korean, Vietnamese, and Chinese communities, in whose families there may be both English-speaking and non-English-speaking members. The handbooks deliver important messages of earthquake preparedness and recovery, including information on risk mitigation, retrofitting, financial preparedness, and recovery. Community members assisted in providing handbook content and advising on approaches to incorporate communities' cultural needs.

The CEA supported the mass-media launch of Protecting Your Family From Earthquakes with media-buys from Bay-Area ethnic publications, as recommended by community members, the Asian Pacific Fund, New American Media, the Red Cross, and PG&E's Consumer Outreach Department, all of whom have extensive knowledge of outreach campaigns to non-English-speaking audiences.

FEMA's National Preparedness Community Portal and America's PrepareAthon Campaign

America's PrepareAthon! is a national campaign to help individuals, organizations, and communities to prepare for specific hazards through drills, group discussions, and exercises. The goal of this campaign is to increase the number of individuals who understand which disasters could happen in their community, know what to do to be safe and mitigate damage, and take action to increase their preparedness and participate in community resilience planning. In addition to the America's PrepareAthon campaign, FEMA's online community preparedness resource includes hazard-specific guides and Protective Guidance documents. The Be Smart-Know Your Alerts and Warnings factsheet provides a brief summary of the various alerts and warnings available from federal, state, local governments and private sector that households can sign up for to stay informed and ready to take action in the event of a natural disaster. The Be Smart – Protect Critical Documents and Valuables is a checklist that can help individuals take an inventory of important household documents (e.g., financial and medical records), contacts, and valuables.

ASSOCIATION OF BAY AREA GOVERNMENTS
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