Disaster Preparedness and Safety Element

Introduction

The purpose of the Disaster Preparedness and Safety Element is to reduce the risk of death, injuries, property damage, and economic and social dislocation from natural and man-made hazards and disasters. Earthquakes, fires, landslides, floods, and hazardous materials releases are the primary hazards confronting the Berkeley community and are therefore the focus of this Element.[1] However, implementation of policies and actions included in this Element will make Berkeley more resistant to all kinds of hazards and disasters that may occur in Berkeley. The Disaster Preparedness and Safety Element provides the policy framework to support the City's mitigation, emergency preparedness, disaster response, and future recovery efforts.

To maximize its effectiveness, the Disaster Preparedness and Safety Element is intended to complement and support the other General Plan Elements and City documents such as the Multi-Hazard Functional Plan for Emergency Operations. Integrating safety as a consideration into all City decisions will ensure a safer and more sustainability community. For example, the Disaster Preparedness and Safety Element supports Land Use Element goals for neighborhood protection, Urban Design and Preservation Element goals for the protection of architecturally and historically significant buildings, and Housing Element goals for preserving and maintaining housing stock and increasing residential disaster preparedness.

Policy Background

Berkeley, like other Bay Area cities, faces a wide range of hazards ranging from natural hazards, such as earthquakes and fires, to man-made hazards such as the handling and transport of hazardous materials. The City must strive to understand the risks that these hazards pose and devise strategies that attain a

[1] Hazardous materials are addressed in the Environmental Management Element.

reasonable degree of safety for the community. Although threats cannot be eliminated, their level of damage can be minimized through individual and community preparedness, individual and community action to reduce or eliminate long-term risks (mitigation efforts), and sound development practices.

Given that the community is largely urbanized and densely populated, the challenge for Berkeley is to improve the safety of the existing built environment through a variety of systematic, ongoing, and incremental actions. These actions to reduce risk should be based on sound analysis of hazardous conditions and should include economically realistic interventions and incentives.

Berkeley's fire, police, and health departments are first responders in the event of any natural and/or man-made disasters. In order to prepare for a disastrous event, coordination with other agencies is critical. The ability of the University of California, the Berkeley Unified School District, and the City of Berkeley to prepare for, and respond to, a major disaster in a coordinated manner is essential to the health and safety of the Berkeley community. Coordination with neighboring jurisdictions is also critical. Wildfires can ignite in neighboring jurisdictions and spread quickly into Berkeley. Hazardous material spills or explosions in adjacent cities can affect Berkeley residents. Other municipalities, public and private utilities and transportation systems, hospitals, and special districts provide vital resident-serving services that are highly vulnerable to earthquakes and other hazards. This regional interdependence of medical, transportation, communications, emergency response, and other systems necessitates active coordination and a consistent level of mitigation and preparedness.

Lastly, but most importantly, the community must be prepared if the City is to reduce the risks associated with a major disaster. Neighborhood and business groups need to be trained on how to prepare for and respond to a major disaster. If the citizens of Berkeley are prepared, the risk to life and property from a major disaster will be significantly reduced. A major focus of the City's mitigation efforts must be the preparation and training of the community to help itself.

In recent years, the Berkeley community has made major accomplishments toward risk reduction in Berkeley. In 1992, the Berkeley community approved Measures G and A, which provided funds for the seismic retrofitting of all City fire stations and public schools, the creation of an emergency operations center, and improvements to the water system. Measure S was approved in 1996 and provided funds for seismic retrofit of the Central Library and the Civic Center Building (City Hall). The seismically reinforced Ronald Tsukamoto Public Safety Building, housing Police and Fire administrative staff, opened in 2000. Other public buildings remain to be seismically retrofitted, however.

Also in 1992 the Berkeley City Council established the Residential Seismic Retrofitting Incentive Program that provides two types of financial incentives to homeowners to retrofit their homes. The City will waive up to one-third of the transfer tax on a home sale, if the funds are used for seismic upgrades of the property. Between fiscal year 1992/93 and fiscal year 1997/98, approximately $3,589,400 in property transfer tax for approximately 7,641 properties was waived under the Residential Seismic Retrofitting Incentive Program. The City will waive permit fees for seismic retrofitting of non-strengthened homes and unreinforced masonry structures. Between 1992 and 1999, approximately $1,079,000 in permit fees was waived for 4,100 permits under the Residential Seismic Retrofitting Incentive Program. These incentives are credited with giving Berkeley one of the highest residential retrofit rates in the state.
The Seismic Technical Advisory Group (STAG) was approved by City Council on March 14, 1995 to advise on seismic safety matters and assist in the development of a comprehensive seismic hazard mitigation strategy for the City of Berkeley. The panel was originally made up of three professors from the University of California at Berkeley; two earthquake-engineering experts, Professor Vitelmo Bertero and Professor James Kelly; and a seismic safety public policy expert, Professor Mary Comerio. L. Thomas Tobin, former Executive Director of the California Seismic Safety Commission, replaced Professor Comerio upon her departure. Professor Kelly recently resigned in April of 2002.

Overall, the Seismic Technical Advisory Group has provided review for the seismic improvements to many City buildings, including the MLK Civic Center Building and the Public Safety Building. Currently, the Group is reviewing the seismic upgrades of other public buildings and providing guidance for the Soft Story Assessment Project. The Seismic Technical Advisory Group's varied expertise makes them a unique asset to Berkeley in the development of a comprehensive approach to addressing the significant risk the community faces from earthquake hazards.

In September 1996, the Berkeley City Council adopted the *Multi-Hazard Functional Plan for Emergency Operations*. Coordinated and prepared by the City's Office of Emergency Services, this comprehensive citywide Plan outlines the critical functions and responsibilities of City departments and agencies in responding to an emergency. The *Multi-Hazard Functional Plan* identifies the potential extent of damage that would be inflicted by a disaster to emergency services buildings (e.g., hospitals), utilities, and transportation systems. An Emergency Management Organization defined in the Plan consists of a formal structure detailing the functions and responsibilities of each department in an emergency situation. The Fire Department's fire and rescue operations would continue to carry out the same functions (including firefighting, rescue operations, hazardous materials management, and emergency medical treatment and triage) as in non-emergency periods. However, additional functions necessary in emergency periods are also spelled out. For example, the Fire Department would be responsible for all fire suppression and rescue operations, but would coordinate with the Office of Emergency Services (OES), Police Department, and Department of Public Works in alerting and warning the general public of dangers and in providing mass casualty treatment and transportation.

In 1998, the City of Berkeley won the Western States Seismic Safety Council's award for Overall Excellence in Hazard Mitigation, the Association of Bay Area Government's (ABAG) Award for Retrofit Incentive Programs, and recognition as the Federal Emergency Management Agency's (FEMA) 1998 Project Impact Model Community of the Year.

In 1999, FEMA designated the City of Berkeley as a Project Impact community. This initiative commits the City to creating, in partnership with the private sector, a risk-based, cost-effective, multi-hazard, community-supported long-term strategy to provide a heightened level of protection from natural hazards. The cornerstone of this commitment involves an aggressive public education effort aimed at strengthening and inspiring community mitigation actions.

In 2004, the City adopted its first Hazard Mitigation Plan. It is part of the Disaster Preparedness and Safety Element of the General Plan. The City updated the Disaster Mitigation Plan in 2014 and renamed it the Local Hazard Mitigation Plan (LHMP). On 12/16/14, the City Council adopted the LHMP (by reference) into the General Plan. Reso. 66,897-NS (Exh. A), 2014) The LHMP has since been updated again in 2019 and has replaced the 2014 plan. The LHMP will continue to be updated periodically, as required by State and Federal regulations. (Reso. 69,237-NS (Exh. A), 2019)

In recent years, the City has been working to improve its website as a source of disaster preparedness and planning information for citizens. The site includes extensive information and checklists designed for citizen use. From the website, citizens can access other websites with important information. Some of the most useful information, as of the date of this publication, is available to the public at the following World Wide Web addresses:

1. City of Berkeley website: www.ci.berkeley.ca.us
2. City of Berkeley website disaster preparedness checklist for use by Berkeley citizens: www.ci.Berkeley.ca.us/Fire/earthquake.htm
3. Community Preparedness website: www.preparenow.org/

4. Association of Bay Area Governments website providing detailed information and maps: www.abag.ca.gov/bayarea/eqmaps/eqmaps.html
5. Seismology Laboratory at the University of California: www.seismo.berkeley.edu/seismo/Homepage.html
6. U.S. Geological Survey: www.usgs.gov

In addition to the website, the City is able to provide up to the minute emergency information and evacuation information on radio KCBS (740AM), KGO (810AM), and Berkeley's WNZV (1610AM).

Hazards and Vulnerabilities

The Berkeley community is faced with several major potential hazards and associated vulnerabilities. The following sections of this Element identify the major hazards confronting the community, and those aspects or areas of the community that are most vulnerable to those hazards.

Seismic and Geological Hazards

Berkeley and the Bay Area are situated in a seismically active area. A system of parallel faults, including the Hayward, Rodgers Creek, Calaveras, San Andreas, and numerous other faults, exists in the area and poses a potential threat to the community. On October 14, 1999, the United States Geological Survey's Working Group on Earthquake Probabilities issued the following information assessing the likelihood of large earthquakes in the San Francisco Bay Area.

> *In 1990, the Working Group focused on the San Andreas, the Hayward, and the Rodgers Creek faults. Using information on the slip rates of each fault, the date of previous large events, and assumptions about fault geometry, the report concluded that the chance of one or more large earthquakes in the San Francisco Bay Area in 30 years was approximately 67%.*

30-year Probabilities of One or More Magnitude 6.7 Earthquakes on San Francisco Bay Area Faults	
Earthquake Fault	***Percent Chance of Occurrence***
Hayward/Rodgers Creek	*32%*
San Andreas	*21%*
Calaveras	*18%*
San Gregorio	*10%*
Concord/Green Valley	*6%*
Greenville	*6%*
Mt. Diablo	*4%*
Hayward Fault Probabilities	
Southern Hayward	*17%*
Northern Hayward	*16%*
Rodgers Creek	*20%*

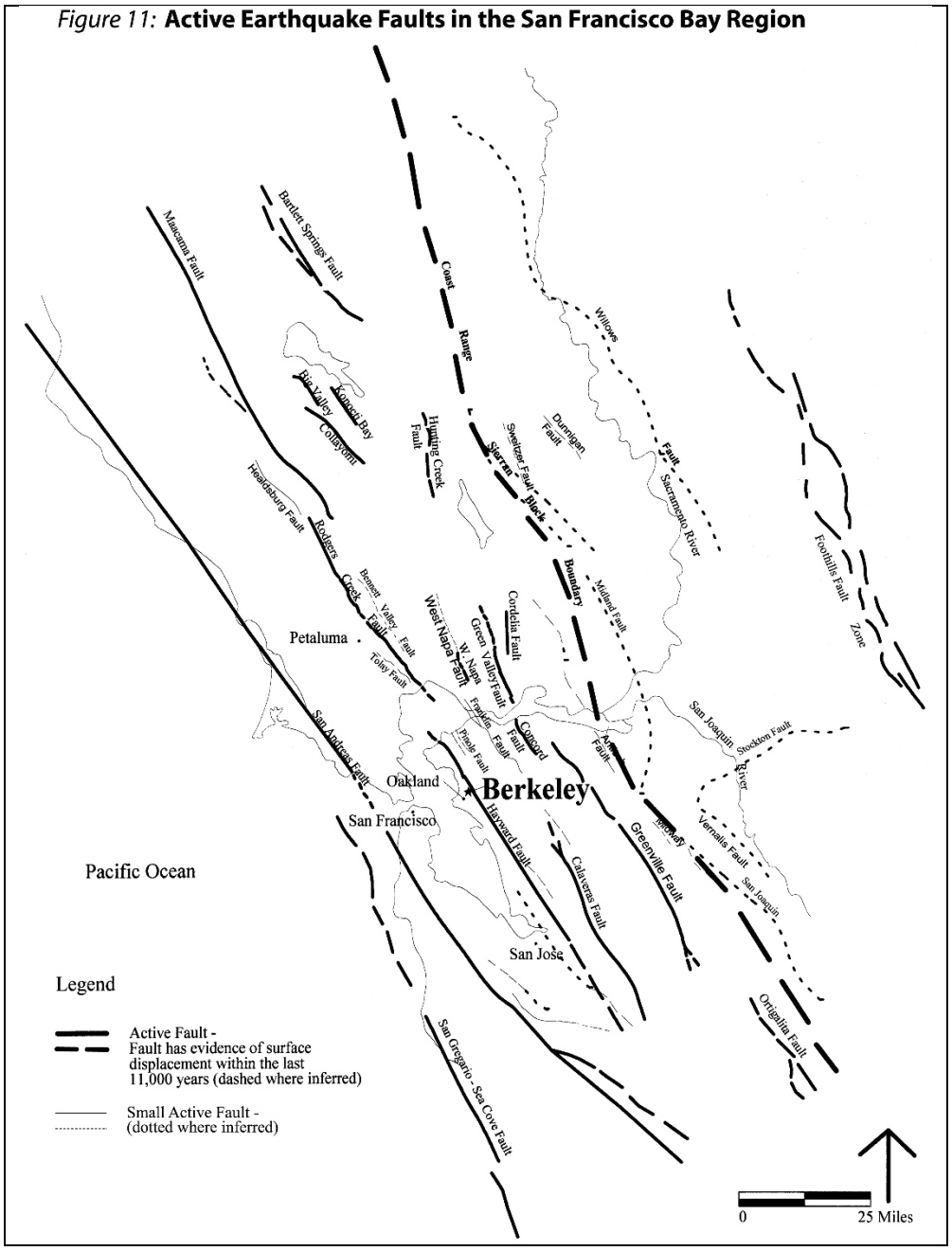
> *The new report assesses the odds of a magnitude 6.7 or higher over the next 30 years as 70% in the San Francisco Bay Area, with an uncertainty of 10%. Although these results are very similar to the 1990 study, the Working Group believes that the new numbers are more robust and reliable. This high probability of a damaging earthquake is extremely sobering.*

The risk of a damaging earthquake encompasses the entire San Francisco Bay Area. While the previous studies concentrated on the San Andreas and Hayward fault systems, this report makes it clear that the hazard extends beyond the Peninsula and the East Bay. This is particularly relevant for the rapidly growing regions of Contra Costa, Alameda, Solano, Santa Clara, San Benito, and Napa counties. In addition to computing a regional probability, the Working Group has computed fault-specific and segment- specific probabilities.[2]

Figure 11 shows the approximate location of the faults in the region.

[2] For the most recent available information on seismic hazards available to the public, readers are encouraged to review information provided by the Seismology Laboratory at the University of California and the U.S. Geological Survey. (See website information above.)

Figure 11: **Active Earthquake Faults in the San Francisco Bay Region**



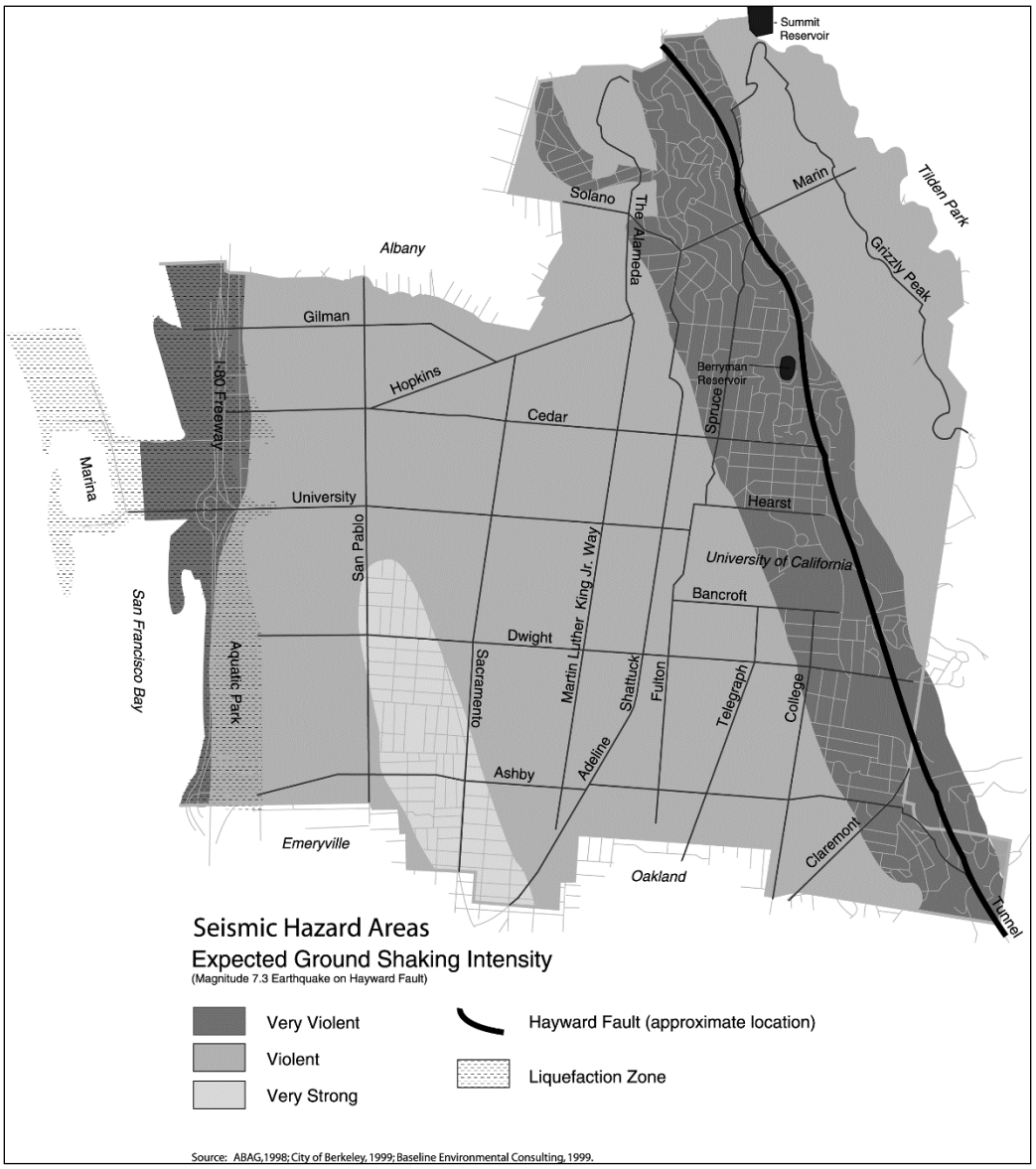


Figure 12: Ground Shaking Intensity

These numbers are similar to the 1990 numbers, which yielded 23% for the Southern Hayward, 28% for the Northern Hayward, and 22% for the Rodgers Creek fault. However, many people will be surprised that these are lower estimates. Several changes in the 1999 methodology explain the difference. First, the new report accounted for more variations in fault rupture. For example, the 1990 report estimated probabilities for the rupture of the Rodgers Creek fault, the Northern Hayward and the southern Hayward as individual segments. The 1999 report accounts for the possibility that these individual segments may rupture together and cause larger earthquakes. By allowing for the occurrence of larger earthquakes, the computed probabilities decrease since the larger events are less frequent. Second, the new report includes the effects of the "stress shadow" of the 1906 earthquake. That is, it accounts for interactions between the faults. In the case of the 1906 earthquake, the movement of the San Andreas acted to reduce the stress on the Hayward fault. Third, the new models account for the fact that the Hayward fault "creeps". Through this seismic movement, some of the strain accumulation is released. Finally, new studies have shown that the 1868 earthquake was larger than previously thought, both in terms of the length of the rupture and the amount of slip. A larger rupture results in a larger strain release and contributes to lowering the probability.

The most significant physical characteristics of a major earthquake in Berkeley will be earthquake-induced ground shaking, which can lead to surface fault rupture, ground failure, and fire. Ground shaking is the vibration that radiates from the earthquake fault. Because it can damage or collapse buildings and other structures, it is the most serious and direct hazard produced by an earthquake. The impact of ground shaking on a building or structure is a function of the nature of the underlying soil; the structural characteristics of the building and the quality of workmanship and materials; the location and magnitude of the event; and the duration and character of the ground motion. Figure 12 shows the approximate location and intensity of ground shaking that might be expected in a magnitude 7.3 earthquake on the Hayward fault.

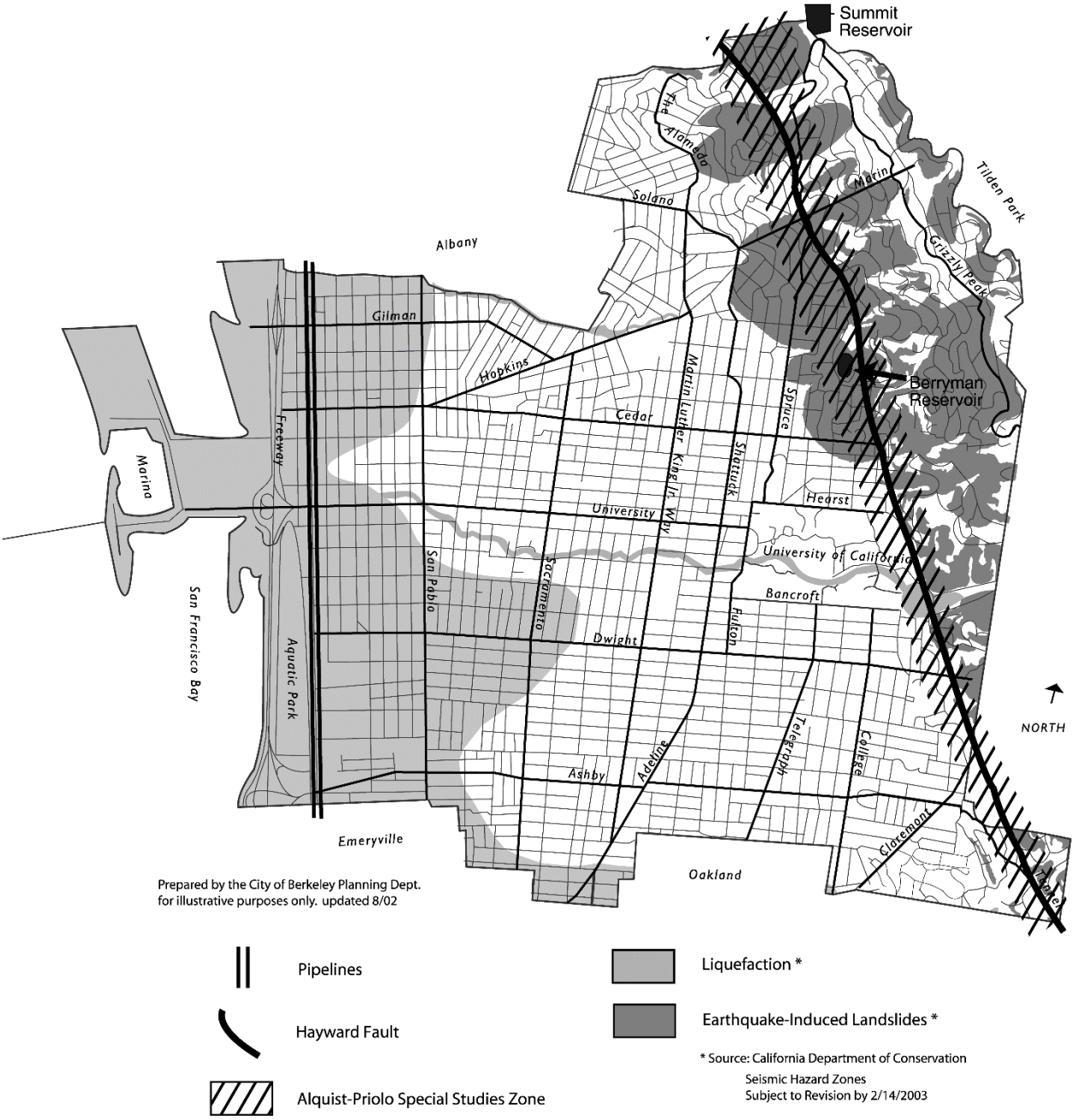
Earthquake-induced ground failure includes liquefaction, settlement, fault rupture, lateral spreading, and landslides. Liquefaction is the loss of soil strength due to shaking on water-saturated granular soils. The potential for liquefaction in Berkeley exists primarily to the west of the railroad tracks in low-lying areas adjacent to San Francisco Bay. Settlement is the vertical consolidation of loose soils and alluvium caused by ground shaking or liquefaction. The ground surface can range from a drop of a few inches to several feet, and may occur many miles from the epicenter. Along the Berkeley waterfront the potential for settlement exists due to underlying weak bay mud fill typical of the area. Lateral spreading is the horizontal movement or spreading of soil toward an open face such as a stream bank or the open sides of fill embankments. In Berkeley, locations most likely to be affected are areas with improperly engineered fill; steep, unstable banks; and areas near the waterfront underlain by soft bay mud soil deposits. In a major earthquake, Berkeley can expect lurch cracking to result in extensive rippling and fracturing of pavement and curbs, and damage to sewer, gas, and water lines. Seismic activity can also trigger landslides, primarily in the hill areas, which can result in significant property damage, injury, and loss of life.

Fire often accompanies earthquake damage. Fire following an earthquake is a particular concern because of the likelihood of numerous simultaneous ignitions, broken mains, and demands on fire personnel. Ruptured or disrupted gas service lines and mains, power lines, water heaters, wood, gas or electric stoves, and other gas or electrical appliances and equipment cause most earthquake-induced fires. As demonstrated in the San Francisco Marina District in 1989 and in the 1995 Kobe earthquake, modern cities are vulnerable to devastation from multiple fires, which, coupled with road blockages and damage to the water delivery system, can greatly exacerbate the initial damage from the seismic forces.

Figure 13 shows the approximate location of areas vulnerable to a combination of hazards caused by a major earthquake.

The combination of earthquake-induced ground shaking, potential lateral spreading, fault rupture and fire is of particular concern in the residential hill areas of Berkeley east of the Hayward Fault line. In these areas, many homes are on steep slopes, and access to many of these areas is difficult for emergency vehicles due to narrow, winding roads, some of which are cul-de-sacs. The eastern edge of the city is heavily wooded, which provides fuel for earthquake-induced fire. These areas are entirely residential and do not have easy access to any City emergency services. If the northern Hayward Fault were to rupture, many of the roads leading from the City's emergency service facilities (police and fire stations) to these residential areas could be made impassible and the areas would then be isolated. There is currently only one fire station east of the Hayward Fault and it is not capable of servicing this whole area without assistance in the event of a major disaster. Other hazards initiated by ground shaking include hazardous material releases and inundation due to reservoir failure. Problems can be exacerbated further and emergency response hindered due to the loss of critical facilities, and disruption of transportation and communication links.

Figure 13: **Multiple Earthquake-Related Hazards**



Seismic and Geological Vulnerabilities

In the event of an earthquake, people may be killed by the failure of buildings, transportation structures, or utilities, or by associated hazards such as fire, hazardous material releases, and possible inundation due to dam failure or flooding.

Hazardous Buildings - Buildings constructed before building codes were in effect, and buildings built to earlier building codes, are the most likely to suffer serious damage. As illustrated by the 1994 Northridge

earthquake, even newer buildings are vulnerable where poor construction, workmanship, and/or maintenance are present. The Association of Bay Area Governments estimates that 13,372 units in Berkeley will be uninhabitable after a major earthquake, resulting in a total shelter population of 8,530. Commercial buildings, utilities, and public roads will be destroyed or disabled. Local businesses will be disrupted and potentially permanently altered. Many businesses may not be able to recover financially from the physical damage and the loss of sales revenue during the recovery period.

In a disaster, the most vulnerable buildings include: unreinforced masonry (URM), concrete frames, tilt-up buildings built before the mid-1970s, and buildings with soft stories. Additionally, buildings with termite damage, dry rot, poor construction quality or other structural conditions can further exacerbate seismic vulnerability, even if the structure was properly designed.

In 1986, Senate Bill 547 required cities to create an inventory of URMs and to develop a mitigation program. In 1989 the city compiled an inventory of URM buildings. Then in 1991, the City adopted an ordinance mandating that URM buildings built before 1956 (except for residential buildings with fewer than five units) be posted immediately with a warning and seismically retrofitted to certain "performance standards" by deadlines based on the risk category assigned each building. The six risk categories are based upon use and occupancy load. Buildings with the highest occupancy such as theaters, or structures housing essential services, are assigned to the highest risk categories and had the shortest deadlines for retrofit. Smaller buildings and buildings with lesser hazards, such as brick parapets, are assigned to the lower categories. A total of 727 properties containing potentially hazardous URM buildings were originally placed on the list. Of those, 230 properties remain on the URM list with deadlines for all except category VI having now passed. Starting in FY 2001, the City has targeted bringing the remaining buildings into compliance, with the higher-use buildings as a priority.

Buildings with "soft" stories (open or irregular structural designs that lack lateral strength), structures made from non-ductile concrete, and buildings improperly anchored to their foundations are highly susceptible to damage. Residential uses are threatened particularly by soft story conditions because of parking below multi-unit buildings and by homes built on cripple walls and those not anchored to their foundations. Non-ductile concrete buildings are common in Berkeley's commercial and industrial areas.

Utilities - Water, gas, storm, and wastewater mains and pipes, electrical systems, and telecommunications are vulnerable to damage. Especially at risk are systems that have non-ductile pipes, or systems located in areas subject to ground failure. Overhead power lines may fall as a result of severe ground shaking, blocking streets for emergency access and evacuation, creating safety hazards, causing fires, and further complicating communication and emergency response.

Transportation - Public roads on vulnerable soils such as Interstate 880, which is constructed on landfill; streets in the hills built on historic landslide areas; as well as overpasses, bridges, and railway and port facilities are highly vulnerable to earthquake-induced ground shaking.

Fire Hazards and Vulnerabilities

The City of Berkeley faces an ongoing threat from urban and wildland fire. Susceptibility to fire is heightened due to Berkeley's dense development pattern, characterized by older structures including high rise buildings, multi-storied residential units, and a variety of warehouse, manufacturing, and commercial properties. Berkeley also faces a significant wildland fire danger along its hillsides where the wildland and residential areas interface. Wildland fires can result from both human activity and natural causes. Once ignited, these fires can be difficult to contain. The risk of fire is most common during the dry months of May through October, and can become extreme when the warm, dry Diablo winds blow out of the northeast. When the winds blow strongly, fires occurring in the densely vegetated hill areas are extremely difficult to control. A wildfire can move with breathtaking speed, down from the ridge in 30 minutes, expanding to one square mile in one hour, and then consuming hundreds of residences in a day.

In the Berkeley and Oakland Hills there have been 14 wildland fires since 1923, which collectively have burned 9,000 acres and destroyed more than 3,500 structures.

On September 17th, 1923, a fire started in Wildcat Canyon, just over the ridge from Berkeley. It was a warm day, with a strong northeast wind, which blew the flames up over the ridge into northeast Berkeley. Firefighters were able to do little to slow the fire as flying embers spread it rapidly from block to block. By the time the winds finally changed in the late afternoon, the fire had burned all the way to the northern edge of the University campus and as far west as Shattuck Avenue. Several thousand people were homeless, and 584 homes were destroyed. Had the winds not shifted, the fire could have burned to the Bay.

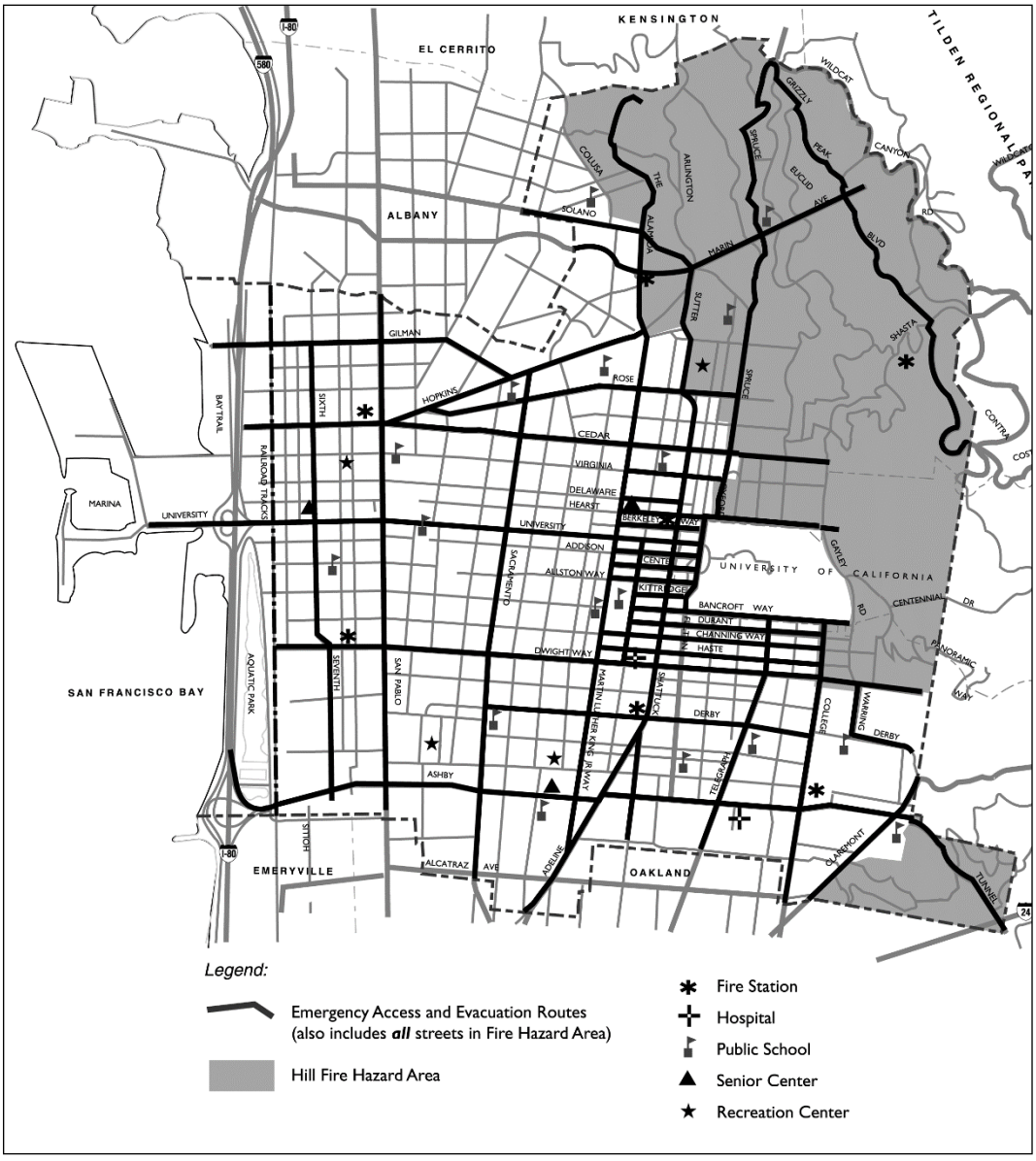


Figure 14. Hazardous Hill Area, Fire Station Locations and Evacuation Routes

Because of increased development and vegetation growth in the hills, the fire threat continually increases. Abundant dead brush and vegetation, and non-fire-resistant building materials, fueled the 1991 firestorm, which ignited in the Oakland Hills. The combination of fuel, drought, hot and dry weather, wind

conditions, poor accessibility, and insufficient water pressure in some areas proved devastating. The fire destroyed 62 homes in Berkeley and more than 3,000 homes in Oakland, consuming one house every 11 seconds in the first three hours. Twenty-five people lost their lives in the fire.

In the aftermath of the 1991 Fire, the City established the Hill Hazardous Fire Area District. The purpose of the District was to expand inspection programs, reduce excess vegetation, and educate residents about the special needs for vegetation management and fire prevention for people living in the urban/wildland interface. Hazardous fire area inspections are conducted annually by fire companies, between May and September. Vegetation removal programs, including the chipper and debris box programs, continue with funding provided by a surcharge on the refuse bills for residents in the hill area. In 1997, the City Council-approved assessment district in the Berkeley hills area ended; however, the danger from a wildfire has not. The continued commitment of the residents to a fire-safe area is critical.

Figure 14 shows the location of the Hill Hazardous Fire Area and the Emergency Access and Evacuation Routes established in the General Plan Transportation Element. *(Also see Transportation Policy T-28.)* All streets in the Fire Hazard Area are considered to be evacuation routes, as are the public paths that make up Berkeley's pathway network system (*see Figure 6, Transportation Element*).

Efforts are currently underway to construct a new fire station for the hill areas east of the Hayward fault. The objective of the current efforts is to develop a facility that will be able to respond to major disasters in these neighborhoods.

The location of the residential hill areas adjacent to regional parklands poses two additional fire prevention challenges. First and foremost, these parklands are heavily wooded providing ample fuel for a major wildland fire that can easily move into the Berkeley neighborhoods. Second, these areas are managed by the East Bay Regional Park District and serviced by the California Department of Forestry (CDF). Therefore coordination between the City of Berkeley and the adjacent jurisdiction is essential. Major issues that must be addressed are: 1) the benefits and implications of establishing and maintaining a firebreak between the wildland areas and the residential areas of Berkeley, and 2) joint response plans to fires in the area.

To fight fires effectively, adequate water pressure, supply, and delivery must be available. While water pressure is generally adequate throughout the city, fire-fighting capability can be hampered by supply and pressure limitations in particular water pressure zones. Moreover, an earthquake can easily sever water lines in the area. Several areas in the East Bay Hills can produce flame fronts that cannot be controlled with water from hydrants, fire truck hoses, or helicopter buckets, or with retardant drops from air tankers, until the winds die down in the late afternoon. Compounding this threat is the fact that evacuation can be difficult, slow, and dangerous due to winding and narrow roadways in the hills.

A secondary hazard is the potential for massive land sliding on fire-burned hillsides when heavy rains follow firestorms. Extreme heat from firestorms can create an impermeable soil layer beneath the surface. When heavy rains fall on denuded slopes, soil saturation occurs rapidly and the danger of landslides in susceptible areas is great, posing a risk to life, structures, and infrastructure.

In conclusion, areas of the city that are most vulnerable to fire hazards are:

Hillside Residential Areas Near and Adjacent to Wildland Areas - There are approximately 750 residences in vulnerable hillside areas in Berkeley.

Structures Built with Combustible Materials - The presence of wood siding, shake roofs, and other combustible materials heightens the vulnerability of residences and structures in the hills area.

Areas of Heavy or Unmanaged Vegetation - Dense vegetation increases the danger to people and structures from fire. The fuel load is particularly high in the Berkeley hills.
Circulation and Utilities - As demonstrated in the 1991 firestorm, narrow winding roads can become inaccessible and unusable for evacuation or for emergency equipment and personnel. Aboveground utility poles can exacerbate problems.

The Water Delivery System - In an emergency the age of the existing water supply system may cause the system to be unreliable.

Landslide Hazards and Vulnerabilities

In Berkeley, the potential for landslide from seismic activity or heavy rain is high in the hill areas and along remnant stream banks in some parks and neighborhoods. Landslide-prone areas include several large residential areas below Grizzly Peak Boulevard, south of Marin Avenue and east of The Alameda.

Geologists estimate that 45 to 65 percent of the landslide-susceptible areas will experience large, coherent movement in a major earthquake. The range of movement depends upon whether slopes are wet or dry when ground shaking occurs. Movement could range from a few inches to 20 feet. Efforts to minimize landslide potential occur as part of the development review process and can involve grading, soil strengthening, structural engineering components, and landscape methods (all of which are subject to City inspection services). Most of the Berkeley hillside development, however, predates current best practices and codes and therefore remains vulnerable to the threat of landslides.

Landslides due to slope failure are most frequent in high rainfall periods. The probability is greater in steeply sloped areas, although landslides may occur on slopes of 15 percent or less. Slope steepness and nature of underlying soils are the most important factors affecting the landslide hazard**.** However, factors such as the surface and subsurface drainage patterns, improper grading, alteration of drainage patterns, and removal of vegetation can also increase landslide hazards**.**

Areas of the community that are vulnerable to landslide hazards include hundreds of homes, roads, sidewalks, underground utilities (water, wastewater, etc), and aboveground utilities (electricity, telecommunications) that are situated on historic landslide areas. Several collector streets that are critical for emergency access and evacuation are located in areas historically susceptible to landslides - including sections of Arlington, Marin, Spruce, Euclid, Shasta, La Loma, and Keith.

Flood Hazards and Vulnerabilities

The flood potential in Berkeley is a relatively mild threat in comparison to seismic, landslide, and fire risks. Flooding events may occur as flash floods, local storm drain blockages, or tidally influenced events. Seismically induced reservoir failure and inundation is unlikely, but such an event should be considered. There exists some potential for wave damage along the Berkeley waterfront, but tsunami waves (triggered by earthquakes, underwater landslides, or volcanic eruptions) have historically resulted in little damage around San Francisco Bay. Figure 15 shows the approximate location of flood hazards in Berkeley.

Areas of the city vulnerable to flood hazards include:

Strawberry Creek - Flowing from the hills through the University campus, Strawberry Creek poses a flood hazard for the area immediately west of Oxford Street, as well as to parts of the campus. The North Fork of Strawberry Creek in particular, which captures a significant amount of urban runoff, is subject to flash flood conditions in periods of intense rainfall. A number of creeks in Berkeley have significantly flooded in recent years.

Figure 15: **Flood and Tsunami Prone Areas**

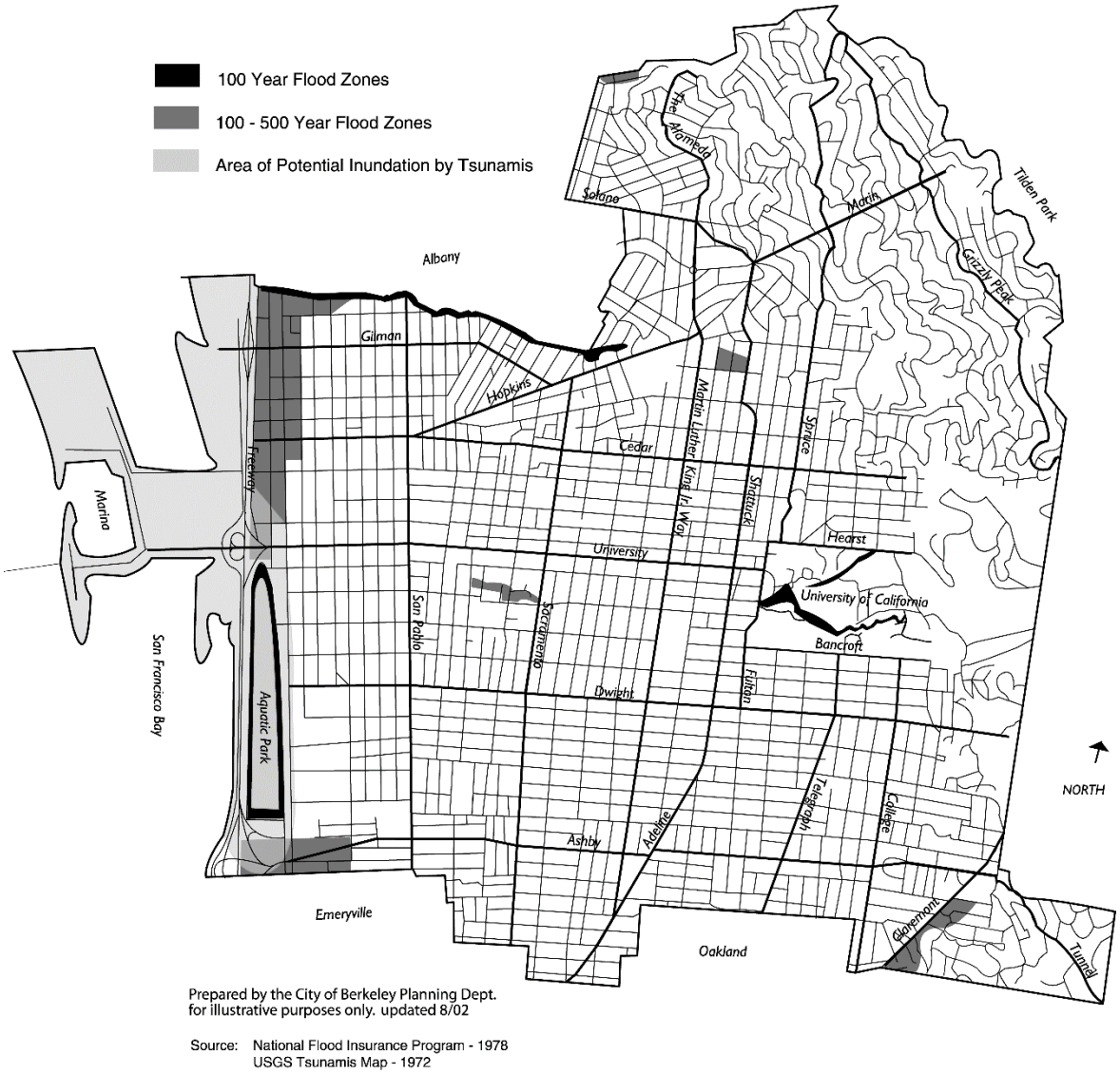


Figure 15. Flood Hazards

Tidal Basin Areas - The Tidal Basin Areas west of Third Street between Codornices Creek and Gilman Street, and Aquatic Park between University Avenue and Ashby Avenue, are potentially vulnerable to flooding and tsunami.

Summit and Berryman Reservoirs - Properties below major water reservoirs in the hills may be subject to flooding in the event of an earthquake-induced rupture of the reservoir. Reservoir inundation is caused by structural failure, possibly from an earthquake or rain overflow. Inundation could affect those areas downhill, or west, of the Berryman and Summit Reservoirs. The Summit Reservoir, located on the Berkeley/Kensington border, would affect areas along Berkeley's border between Grizzly Peak Boulevard and The Alameda. The Berryman Reservoir, adjacent to Codornices Park, could potentially inundate a large portion of the city, including neighborhoods near Hopkins and Cedar Streets and in West Berkeley, particularly at Aquatic Park and other areas east of the I-80 freeway.

Figure 16 shows the approximate areas of the city that could be vulnerable to inundation from a reservoir failure.

The 37-million-gallon Summit Reservoir may be vulnerable to inundation if a seismic event exceeded magnitude 7.5 on the Hayward Fault, or 8.5 on the San Andreas Fault. The Summit Reservoir was evaluated for seismic stability in 1985 and reviewed again in 1992.[3] The evaluation found that the embankments would remain stable in a 7.5 event on the Hayward fault or a magnitude 8.5 earthquake on the San Andreas Fault. Therefore flooding due to catastrophic failure is considered unlikely. Nonetheless, the inundation area is mapped for notice and evacuation purposes. The possibility of inundation from the Berryman Reservoir is short-term as EBMUD has an approved project underway for replacement of the reservoir with one 4.6-million-gallon steel tank or two smaller tanks depending on the geotechnical conditions encountered once the reservoir is drained. EBMUD plans to drain the Berryman reservoir in June 2002.

Figure 16: **Reservoir Inundation Hazard**

Figure 16. Reservoir Inundation Hazards.

Element Objectives

[3]Analysis was reviewed and approved by the California Division of Safety of Dams, which has jurisdiction over the facility.

The policies and actions of the Disaster Preparation and Safety Element are intended to achieve the following six objectives:

1. Establish and maintain an effective emergency response program that anticipates the potential for disasters, maintains continuity of life-support functions during an emergency, and institutes community-based disaster response planning, involving businesses, non-governmental organizations, and neighborhoods.

2. Improve and develop City mitigation programs to reduce risks to people and property from natural and man-made hazards to socially and economically acceptable levels.

3. Plan for and regulate the uses of land to minimize exposure to hazards from either natural or human-related causes and to contribute to a "disaster-resistant" community.

4. Reduce the potential for loss of life, injury, and economic damage resulting from earthquakes and associated hazards.

5. Reduce the potential for loss of life, injury, and economic damage resulting from urban and wildland fire.

6. Reduce the potential for loss of life and property damage in areas subject to flooding.

Policies and Actions

Emergency Preparedness and Response

Policy S-1 Response Planning
Ensure that the City's emergency response plans are current and incorporate the latest information on hazards, vulnerability, and resources. *(Also see Transportation Policy T-28.)*

Actions:

A. Test, maintain, and revise the City's disaster response plan(s) consistent with the California Standardized Emergency Management System (SEMS) and establish clear coordination of roles and expectations with the County Office of Emergency Services, the University of California, the Berkeley Unified School District, neighboring jurisdictions, and other agencies.

B. Designate and publicize evacuation routes, shelter locations, and emergency service locations (hospitals, fire stations, etc.) within the city and sub region. Include existing city pathways and other pedestrian right-of-ways in the published designated evacuation route map. Prioritize undergrounding of utilities for designated routes to make them more reliable.

C. Designate and publicize emergency access routes with the city and sub region. Prioritize undergrounding of utilities to enhance reliability of emergency access routes and minimize conflagration hazards from fallen power lines.

D. City departments shall conduct an appropriate level of staff training addressing emergency readiness, evacuation routes, first aid, staging areas and procedures, continuity of services, and response and recovery operations and including CERT training for all City employees.

E. Establish facilities and provide equipment that may be used by citizens during the first days immediately after a major disaster until such time as City services become available.

F. Prepare an annual report in consultation with the Fire Safety Commission and other relevant Commissions and Boards on the state of preparedness in Berkeley.

G. Conduct coordinated planning and training between local and regional police, fire, and public health agencies in preparation for natural and man-made disasters, and ensure that the City's disaster response communication technologies are compatible with regional agency communication technologies.

Policy S-2 Neighborhood Preparation and Education
Continue to provide education, emergency preparedness training, and supplies to the community at the neighborhood level to support neighborhood- and community-based disaster response planning.

Actions:

A. Enhance the Community Emergency Response Training (CERT) program to provide disaster preparedness training to the community at the neighborhood level. Work with the Berkeley Unified School District to develop and implement a CERT curriculum.

B. Work with neighborhood associations and other community groups to organize disaster preparedness and other training activities on a block-by-block basis.

C. Map existing neighborhood disaster preparedness groups and seek to fill gaps with new or extended groups. Establish central locations within each neighborhood for aid and information exchanges.

D. Continue to enforce restrictions on illegal window bars.

E. Explore implementation of a siren system, combined with reverse calling and other methods as a way to warn neighborhoods about problems.

Policy S-3 Public Information
Publicize disaster preparedness efforts (such as CERT) and expand public awareness of specific hazards and risks by making available all relevant information including mapping and reports on various hazards, information on vulnerability and risk reduction techniques, evacuation routes, and emergency services, and information on financial and technical assistance resources.

Actions:

A. Continue to provide emergency preparedness and planning information to citizens through libraries, the City website, radio, and other locations.

B. Explore possible programs that would enable, encourage, or require landlords, property managers, and realtors to provide information to new tenants and new homeowners about emergency preparedness, evacuation routes, and home safety.

Policy S-4 Special Needs Communities
Continue to work with the social service community to ensure the safety of special needs populations.

Actions:

A. Encourage partnerships between public safety, public health, and community services providers to develop and implement community safety and community service programs.

B. Work closely with area hospitals to encourage hospital preparation and coordinate disaster recovery plans.

Policy S-5 The City's Role in Leadership and Coordination
Ensure that the City provides leadership and coordination of the private sector, public institutions, and other public bodies in emergency preparedness.

Actions:

A. Promote information sharing and seek to coordinate and implement collaborative mitigation and response planning and information gathering efforts with neighboring cities, Alameda and Contra Costa Counties, the East Bay Regional Park District, other agencies, non-profit organizations, businesses and industries, educational institutions, and residents.

B. Promote information sharing and seek to coordinate and implement collaborative mitigation and response planning and information gathering efforts.

Policy S-6 Damage Assessment
Establish and maintain a rapid damage assessment capability.

Action:

A. Formulate and adopt damage assessment protocols, and train appropriate inspection and other personnel to implement these protocols.

Policy S-7 Emergency Water Supply
Protect life and property in the event of an earthquake by evaluating alternate drinking water and fire-fighting water supply in the event of failure of the East Bay Municipal Utility District (EBMUD) water supply.

Policy S-8 Continuity of Operations
Provide for the continuation of City government and services following a major disaster.

Action:

A. Establish plans including such aspects as emergency supplies sufficient to carry out assigned disaster responsibilities.

Policy S-9 Pre-Event Planning
Establish pre-event planning for post-disaster recovery as an integral element of the emergency preparedness programs of the City Council and each of the City departments.

Actions:

A. Establish a framework and process for recovery planning that specifies roles, priorities, and responsibilities of various departments within the City organization, and that outlines a structure and process for policy-making involving elected officials and appointed advisory committee(s).

B. Prepare a basic Recovery Plan that outlines the major issues and tasks that are likely to be the key elements of community recovery. Examine issues such as debris removal, provision of shelter, interim housing, restoration of services, interim business resumption facilities, protection of historic resources, standards for replacement of non-conforming structures and uses, and restoring neighborhood and community character.

C. Integrate recovery planning as an element of the Community-Based Disaster Response Plan. Identify possible roles for community organizations, business representatives, and neighborhoods in the recovery process.

MITIGATION

Policy S-10 Sustaining Mitigation Initiatives
Improve public awareness and establish new public/private partnerships to implement mitigation initiatives in the community and region through programs such as Project Impact.

Actions:

A. Analyze and evaluate the benefits of formulating City plans and programs for short-term and long-term mitigation.

B. Perform appropriate seismic analysis based on current and future use for all city-owned facilities and structures.

C. Request and encourage neighboring cities, other agencies, non-profit organizations, neighborhood and citizen groups, business organizations, and the University of California also to formulate and implement complementary mitigation action plans.

Policy S-11 Historic Structures
Encourage and support the long-term protection of historic or architecturally significant structures to preserve neighborhood and community character. *(Also see Urban Design and Preservation Policy UD-7.)*

Actions:

A. Create incentives for owners of historic or architecturally significant structures to undertake mitigation to levels that will minimize the likelihood of demolition and maximize the ability to repair or avoid damage in the event of a natural disaster.

B. Consistent with public safety and acceptable risk determinations, seek all feasible means to avoid demolition of historic or architecturally significant structures following a disaster by pursuing repair, rehabilitation, and preservation of structures, facades, or other features.

Policy S-12 Utility and Transportation Systems
Improve the disaster-resistance of utility and transportation systems to increase public safety and to minimize damage and service disruption following a disaster.

Actions:

A. Support and encourage efforts undertaken by Caltrans, the East Bay Municipal Utility District, Pacific Gas & Electric, telephone and telecommunications companies, Amtrak, the Union Pacific Railroad, AC Transit, and the Bay Area Rapid Transit System to plan for and finance seismic retrofit and other disaster-resistance measures.

B. Work closely with the utility companies to facilitate undergrounding of utilities.

C. Urge the Public Utilities Commission, utilities, and oil companies to strengthen, relocate, or otherwise safeguard natural gas and other pipelines where they extend through areas of high liquefaction potential, cross potentially active faults, or traverse potential landslide areas, or areas that may settle differentially during an earthquake.

Disaster-Resistant Land Use Planning

Policy S-13 Hazards Identification
Identify, avoid and minimize natural and human-caused hazards in the development of property and the regulation of land use.

Actions:

A. Maintain and make publicly available up-to-date hazard maps identifying areas subject to heightened risk from potential seismic hazards (including fault rupture, ground failure, ground shaking, and liquefaction), and fire, flood, landslide, and other hazards, such as toxic contamination and radioactive release.

B. Improve the understanding of identified hazards and mitigation needs via area-specific studies such as microzonation studies.

Policy S-14 Land Use Regulation
Require appropriate mitigation in new development, in redevelopment/reuse, or in other applications. *(Also see Land Use Policies LU-4, LU-6, and LU-7.)*

Actions:

A. When appropriate utilize the environmental review process to ensure avoidance of hazards and/or adequate mitigation of hazard-induced risk.

B. Require soil investigation and/or geotechnical reports in conjunction with development/redevelopment on sites within designated hazard zones such as areas with high potential for soil erosion, landslide, fault rupture, liquefaction and other soil-related constraints.

C. Place structural design conditions on new development to ensure that recommendations of the geotechnical/soils investigations are implemented.

D. Encourage owners to evaluate their buildings' vulnerability to earthquake hazards, fire, landslides, and floods and to take appropriate action to minimize the risk.

E. Develop criteria for disaster-resistant land use regulations to ensure that new construction reduces rather than increases risk of all kinds.

Policy S-15 Construction Standards
Maintain construction standards that minimize risks to human lives and property from environmental and human-caused hazards for both new and existing buildings.

Actions:

A. Periodically update and adopt the California Building Standards Code with local amendments to incorporate the latest knowledge and design standards to protect people and property against known fire, flood, landslide, and seismic risks in both structural and non-structural building and site components.

B. Ensure proper design and construction of hazard-resistant structures through careful plan review/approval and thorough and consistent construction inspection.

Policy S-16 Residential Density in the Hills
Consider changes to the existing residential zoning in high-risk, residential areas, such as the Hill Hazardous Fire Area, to reduce the vulnerability of these areas to future disasters. *(See the Hill Hazardous Fire Area map on page S-10.)*

Actions:

A. Consider zoning amendments to prevent future development, including the prohibition of new second units, in these areas or sites in these areas that are particularly vulnerable to natural disaster. *(Also see Housing Policy H-17.)*

B. Consider fire safety, evacuation, and emergency vehicle access when reviewing secondary unit or other proposals to add residential units in these areas.

Seismic Hazards

Policy S-17 Residential Seismic Retrofitting Incentive Program
Maintain existing programs such as the Residential Seismic Retrofitting Incentive Program to facilitate retrofit of potentially hazardous structures.

Action:

A. Expand public awareness of the program and take other actions to publicize and improve the effectiveness of the program.

Policy S-18 Public Information
Establish public information programs to inform the public about seismic hazards and the potential hazards from vulnerable buildings**.**

Policy S-19 Risk Analysis
Understand and track changes in seismic risk utilizing the best available information and tools.

Actions:

A. Make maximum use of new available information to update maps that depict seismic hazards.

B. Encourage building owners (including public sector agencies and local jurisdictions) to install instruments to record earthquake shaking in conjunction with the State's Strong Motion Instrumentation Program.

Policy S-20 Mitigation of Potentially Hazardous Buildings
Pursue all feasible methods, programs, and financing to mitigate potentially hazardous buildings.

Actions:

A. Implement an effective Un-Reinforced Masonry (URM) Program to retrofit all remaining non-complying buildings. Work with owners of potentially hazardous buildings to obtain structural analyses of their buildings and to undertake corrective mitigation measures to improve seismic resistance or to remove the buildings and replace them with safer buildings.

B. Create a program similar to the URM Program to reduce risks to people and property for all potentially hazardous buildings in Berkeley, with a priority on multi-family soft-story buildings.

C. Consider requiring disclosure of potential hazards to occupants and residents of potentially hazardous buildings, along with mitigation and safety information and technical assistance.

D. Investigate and adopt financial, procedural, and land use incentives and provide technical assistance for owners of potentially hazardous structures, such as soft-story buildings, to facilitate retrofit.

E. Investigate and adopt retrofit guidelines and building codes that address structural and nonstructural mitigation to facilitate the retrofit of all types of existing buildings.

F. Consider the formulation and adoption of a retrofit standard for single-family homes.

G. Evaluate the ability of essential public facilities to maintain structural integrity and remain operational in the event of a strong earthquake. Those facilities unable to remain operational should be modified to bring them into conformance. Emergency guidelines shall be developed for buildings for which structural (and/or non-structural) modification and provision of back-up utility services are not feasible.

H. Establish a prioritized program for seismic retrofit of the remaining unreinforced public structures.

Fire Hazards

Policy S-21 Fire Preventive Design Standards
Develop and enforce construction and design standards that ensure new structures incorporate appropriate fire prevention features and meet current fire safety standards.

Actions:

A. Strengthen performance review and code enforcement programs.

B. Promote the installation of built-in fire extinguishing systems and early warning fire alarm systems.

C. Maintain City standards for minimum width and vertical clearance, and ensure that new driveways and roadways meet minimum standards of the Uniform Fire Code or subsequent standards adopted by the City.

D. Provide adequate water for fire suppression for new development in accordance with City standards for minimum volume and duration of flow.

E. Establish criteria for the installation of gas shutoff valves in new and existing construction, to reduce the risk of post-earthquake fires.

Policy S-22 Fire Fighting Infrastructure
Reduce fire hazard risks in existing developed areas.

Actions:

A. Develop proposals to make developed areas more accessible to emergency vehicles and reliable for evacuation. Consider restricting on-street parking, increasing parking fines in hazardous areas, and/or undergrounding overhead utilities. Require that all private access roads be maintained by a responsible party to ensure safe and expedient passage by the Fire Department at any time, and require approval of all locking devices by the Fire Department. Ensure that all public pathways are maintained to provide safe and accessible pedestrian evacuation routes from the hill areas. *(Also see Transportation Policies T-28 and T-52.)*

B. Evaluate existing access to water supplies for fire suppression. Identify, prioritize, and implement capital improvements and acquire equipment to improve the supply and reliability of water for fire suppression. Continue to improve the water supply for fire fighting to assure peak load water supply capabilities. Continue to work with EBMUD to coordinate water supply improvements. Develop aboveground (transportable) water delivery systems.

C. Provide properly staffed and equipped fire stations and engine companies. Monitor response time from initial call to arrival and pursue a response time goal of four minutes from the nearest station to all parts of the city. Construct a new hill area fire station that has wildland fire fighting equipment and ability.

Policy S-23 Property Maintenance
Reduce fire hazard risks in existing developed areas by ensuring that private property is maintained to minimize vulnerability to fire hazards.

Actions:

A. Continue and expand existing vegetation management programs.

B. Property owners shall be responsible for maintaining their structures at a reasonable degree of fire and life safety to standards identified in adopted codes and ordinances.

C. Promote smoke detector installation in existing structures. Require the installation of smoke detectors as a condition of granting a permit for any work on existing residential and commercial buildings and as a condition for the transfer of property.

D. Promote fire extinguisher installation in existing structures, particularly in kitchens, garages, and workshops.

E. Require bracing of water heaters and gas appliances and the anchoring of houses to foundations to reduce fire ignitions following earthquakes.

Policy S-24 Mutual Aid
Continue to fulfill legal obligations and support mutual aid efforts to coordinate fire suppression within Alameda and Contra Costa Counties, Oakland, the East Bay Regional Park District, and the State of California to prevent and suppress major wildland and urban fire destruction.

Actions:

A. Work with inter-agency partners and residents in vulnerable areas to investigate and implement actions to improve fire safety, using organized outreach activities and councils such as the Hills Emergency Forum and the Diablo Fire Safe Council.

B. Establish close coordination with the California Department of Forestry to minimize the risk of wildland fire in the hill areas.

Policy S-25 Fire Safety Education
Use Fire Department personnel to plan and conduct effective fire safety and prevention programs.

Actions:

A. Provide fire safety presentations and programs to local schools, community groups, and neighborhoods.

B. Provide fire safety classes for high-occupancy institutional land uses, and commercial and industrial occupancies.

C. Develop and implement a program to improve public awareness and disseminate appropriate warnings during times of high fire danger.

Flood Hazards

Policy S-26 Flood Hazards Mitigation
Reduce existing flood hazards in Berkeley.

Actions:

A. Conduct periodic evaluation of reservoir safety and undertake actions necessary to mitigate the potential for dam failure.

B. Continue to rehabilitate the City's storm drain system to reduce local flooding caused by inadequate storm drainage.

C. Continue and significantly strengthen programs promoting storm drain maintenance by public and private sectors.

D. Continue to work with the East Bay Municipal Utility District to complete the planned seismic improvements to the Berryman Reservoir.

Policy S-27 New Development
Use development review to ensure that new development does not contribute to an increase in flood potential.

Actions:

A. Regulate development in the Waterfront flood-prone areas consistent with the Berkeley Waterfront Specific Plan.

B. Ensure that new development conforms to requirements and guidelines of the National Flood Insurance Program (NFIP).

C. Require new development to provide for appropriate levels of on-site detention and/or retention of storm water.

D. Regulate development within 30 feet of an exposed streambed as required by the Preservation and Restoration of Natural Watercourses (Creeks) Ordinance. *(Also see Environmental Management Policy EM-27.)*

Policy S-28 Flood Insurance
Reduce the cost of flood insurance to property owners in the city.

Actions:

A. Identify, prioritize, and implement activities necessary to qualify for a high Community Rating System (CRS) evaluation under the National Flood Insurance Program (NFIP).

B. Update and revise flood maps for the city.

C. Incorporate FEMA guidelines and suggested activities into City plans and procedures for managing flood hazards.