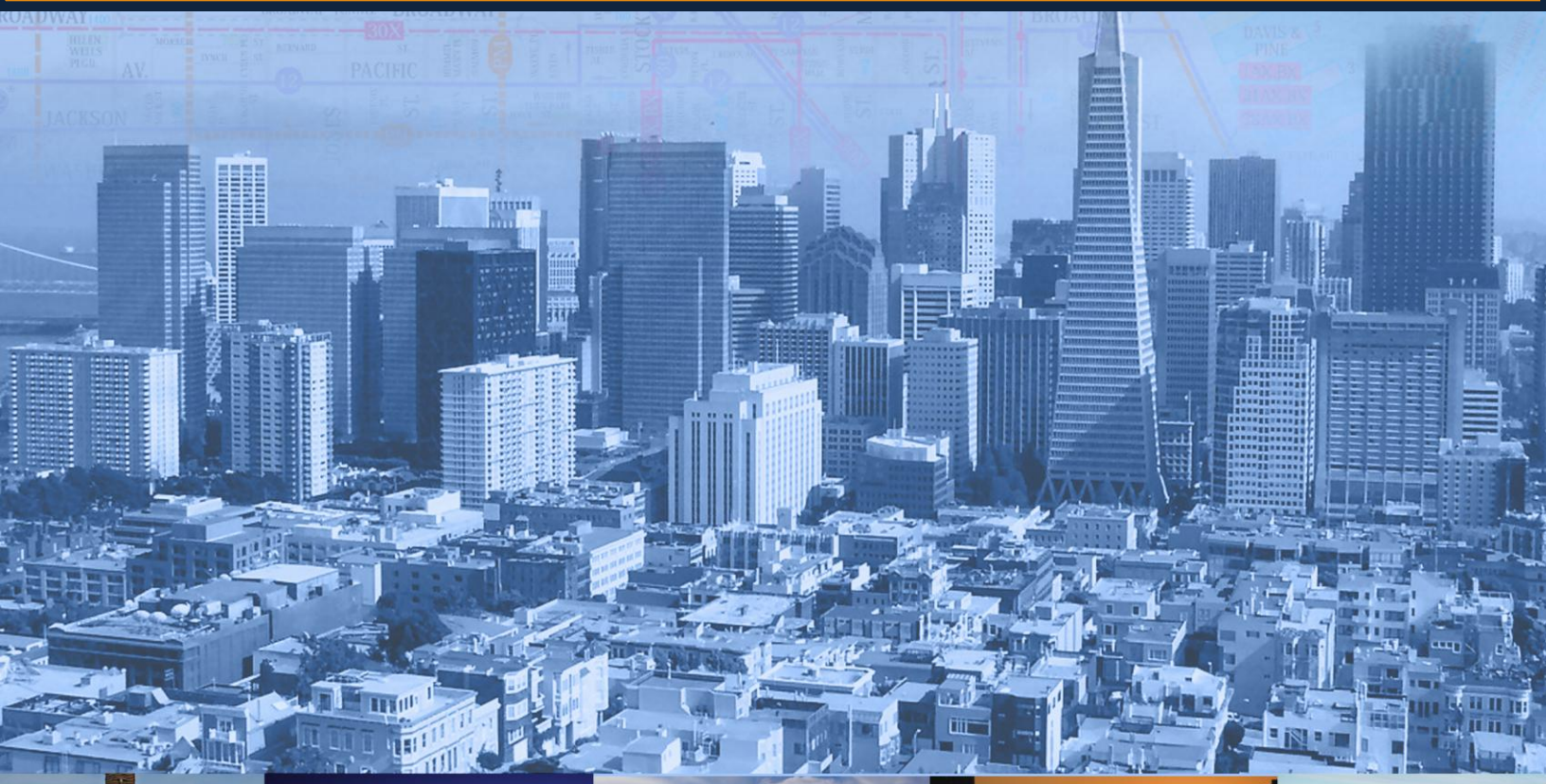


City and County of San Francisco
Emergency Response Plan

AN ELEMENT OF THE CCSF EMERGENCY MANAGEMENT PROGRAM

Earthquake Annex







Revision History

Revision Date	Version #	Section of Plan Revised	Revised by
4/08	II	Sections 1, 3, 4, 5, 6	SF DEM

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Acronyms

44 CFR	Title 44 of the Code of Federal Regulations
ABAG	Association of Bay Area Governments
ADA	Americans With Disabilities Act
ARC	American Red Cross
AWSS	Auxiliary Water Supply System
BART	Bay Area Rapid Transit
CalEMA	California Emergency Management Agency
Caltrans	California Department of Transportation
CAP	Civil Air Patrol
CAPSS	Community Action Plan for Seismic Safety
CARD	Collaborating Agencies Responding to Disasters
CCSF	City and County of San Francisco
CERS	Combined Emergency Radio System
CISN	California Integrated Seismic Network
DBI	Department of Building Inspection
DEC	Division of Emergency Communications
DEM	San Francisco Department of Emergency Management
DHS	Department of Homeland Security
DMAT	Disaster Medical Assistance Team
DMORT	Disaster Mortuary Operations Team
DOC	Department Operations Center
DPH	Department of Public Health
DPT	Department of Parking and Traffic
DPW	Department of Public Works
DSW	Disaster Service Worker
EAS	Emergency Alert System
EDIS	Emergency Digital Information System
EMMA	Emergency Managers Mutual Aid

EOC	Emergency Operations Center
ERP	Emergency Response Plan
ERT	Emergency Response Team
ESF	Emergency Support Function
FDOC	San Francisco Fire Department Operations Center
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
HSA	Human Services Agency
IAP	Incident Action Plan
ICS	Incident Command System
IHSS	In-Home Supportive Services
JFO	Joint Field Office
JIC	Joint Information Center
M	moment magnitude
METS	Mayor's Emergency Telephone System
MHOAC	Medical Health Operational Area Coordinator
MMI	Modified Mercalli Intensity
MONS	Mayor's Office of Neighborhood Services
MTC	Metropolitan Transportation Commission
MUNI	San Francisco Municipal Railway
NDMS	National Disaster Medical System
NERT	Neighborhood Emergency Response Teams
NIMS	National Incident Management System
NRF	National Response Framework
OASIS	Operational Area Satellite Information System
OCME	Office of the Chief Medical Examiner
PGA	Peak Ground Acceleration
PIO	Public Information Officer
POD	Point of Distribution
PUC	San Francisco Public Utilities Commission

RDMHC	Regional Disaster Medical Health Coordinator
REOC	Regional Emergency Operations Center
RIMS	Response Information Management System
RPD	Recreation and Parks Department
SAP	Safety Assessment Program
SAR	Search and Rescue
SBA	Small Business Administration
SEMS	Standardized Emergency Management System
SFFD	San Francisco Fire Department
SFPD	San Francisco Police Department
SFSD	San Francisco Sheriff's Department
SFUSD	San Francisco Unified School District
SOC	State Operations Center
SOP	Standard Operating Procedure
USACE	U.S. Army Corps of Engineers
USAR	Urban Search and Rescue
USGS	U.S. Geological Survey

SECTION 1 – INTRODUCTION

1.0 Purpose

The City and County of San Francisco (CCSF) and the surrounding region are subject to major earthquakes. As demonstrated by past earthquake events, such as the 1906 and 1989 earthquakes, a large earthquake will cause major damage on a regional basis, destroying or damaging thousands of buildings, disrupting transportation and utility systems, and causing thousands of injuries or fatalities. Response to a disaster of this magnitude will severely strain the resources of both the public and private sectors in the region.

The CCSF *Earthquake Annex* provides an overview of considerations for CCSF response to a major earthquake in the San Francisco Bay Area. The primary purpose of this plan is to support effective management of the initial response.

To prepare this plan, the San Francisco Department of Emergency Management (DEM) identified key response challenges after extensive research of after-action reports and lessons learned from large urban earthquakes, including the following:

- the Loma Prieta earthquake in the Bay Area (1989)
- the Northridge earthquake in the Los Angeles area (1994)
- the Hanshin-Awaji (Kobe) earthquakes in Japan (1995)

1.1 Scope and Applicability

The Earthquake Annex has been developed in accordance with the CCSF Emergency Response Plan (ERP). In keeping with the ERP's "all-hazards" approach for local emergency management, the response protocols for an earthquake, to include organization and structure, will adhere to those set forth in the ERP.

The CCSF *Earthquake Annex* supplements the ERP by providing considerations for a response to a major earthquake in the Bay Area that has a significant effect on CCSF. This plan does not change policies and direction provided in the ERP, such as policies for activating and managing the EOC. Rather, it provides additional guidance that may be used to complement the ERP.

Many variables govern the specific effects of an earthquake, from the amount of energy it releases and the location of its origin to the specific qualities of the soil and rock upon which a community is built. Given these variables, the complexity of earthquake effects, and the size and density of the Bay Area, no plan can possibly identify all considerations for a response. Consequently, this plan is not intended to describe detailed procedures for tactical execution of response tasks. However, the plan does provide considerations that can be used to prepare for, and guide the execution of, response operations.

This plan is primarily focused on response and short-term recovery operations. Elements related to preparedness, long-term recovery, and mitigation are not included.

1.2 Plan Objectives

This plan is designed to accomplish the following:

- Serve as a planning document to support further development of catastrophic incident plans by CCSF departments and agencies.
- Provide an overview of the threats that earthquakes pose to CCSF and define the potential range of impacts represented by the most likely major earthquake scenarios.
- Provide the response management team with contextual information to guide initial response planning including:
    - Response assumptions
    - Estimated impacts scaled by scenario
    - Suggested Action Plan priorities and timelines
    - Estimated resource requirements, projected shortfalls, and suggested external resource request triggers.

Appendix A, Hazard Analysis, describes the potential impact of earthquakes on CCSF. The variability associated with the occurrence of earthquakes and their effects gives rise to a wide range of predictions with regard to impacts. For the purposes of this plan, the impacts of several typically analyzed events are presented. Organization of these events in this manner promotes consistency in assumptions and allows planning to be scaled in accordance with event severity. These earthquakes are described below.

Scenario # 1:

- M 6.9 – 7.1 earthquake on the Northern segment of the Hayward Fault
- M 6.5 – 6.9 earthquake on the Peninsula segment of the San Andreas Fault

Scenario # 2:

- M 7.2 earthquake on both the Northern and Southern segments of the Hayward Fault
- M 7.1 – 7.2 earthquake on the Peninsula-Golden Gate segment of the San Andreas Fault

Scenario # 3:

- M 7.8 – 7.9 earthquake on the Northern California segments of the San Andreas Fault. This scenario approximates the 1906 earthquake.

1.3 Plan Organization

Sections 2 through 5 of this plan describe the planning assumptions, concept of operations, situational assessment approach, and suggested initial objectives.

Section 6 provides a summary of response strategies for various functions that must be performed in the wake of a major earthquake.

Appendix A describes the earthquake hazard and defines potential impacts, based on available studies of earthquake risk in the Bay Area.

1.4 Document Management and Distribution

This plan will be reviewed and revised, as necessary, on an annual basis. DEM will initiate the process and will engage the support of departments with relevant responsibilities. Each revision of the plan will be authorized by identified approval and advisory authorities. The plan may be modified as a result of post-incident analyses and/or post-exercise critiques. This plan may also be modified if responsibilities, procedures, laws, rules, or regulations pertaining to terrorism response operations change. Records of revisions to the plan will be maintained by DEM on the register at the beginning of this document. Any changes or revision to this plan will be distributed to relevant organizations.

SECTION 2 – PLANNING ASSUMPTIONS

This section outlines assumptions for this plan. These assumptions may also be used for supporting plans and other efforts.

2.0 General Planning Assumptions[1]

1. San Francisco is one of the most densely populated cities in the United States. Over 800,000 people reside in the city. The population increases significantly during the workday. The size of the population and its density significantly increase potential damage during an earthquake, as well as response requirements. Demographic information for the city is provided in Table 2-1.
2. San Francisco has a significant population for whom English may not be the primary language. Approximately 45 percent of city residents speak a language other than English at home.
3. A significant number of city residents are elderly or medically fragile. As Table 2-1 shows, approximately 25 percent of city households include residents who are over 65.
4. CCSF will implement emergency response operations in accordance with the ERP and SEMS. CCSF's response will follow the structure, processes, and procedures outlined in the ERP.
5. The Regional Emergency Coordination Plan will be implemented following any large earthquake that has a significant impact on the Bay Area.
6. CCSF will use employees as DSWs to provide support for response functions. Additionally, Neighborhood Emergency Response Teams (NERTs), nongovernmental organizations such as the American Red Cross (ARC), and spontaneous volunteers will be incorporated into response functions.
7. Within 24 hours:
   - The Mayor will declare a local emergency.
   - The Governor will declare a state of emergency and request a Presidential Declaration.
   - The President will declare a disaster, and the Federal government will implement the NRF.

2.1 Earthquake Impacts

Appendix A describes potential impacts for various earthquake scenarios. Table A-11 provides specific data regarding the impacts of these scenarios, based on numerical analyses. General impacts are described here.

[1] See Table 2-1 for sources of information cited in this section.

- Damage due to shaking will be severe.
    - Structural damage is likely to be worst in areas of soft soils or unconsolidated fill.
        - Thousands of buildings will experience total structural failure.
        - Nonstructural damage will be widespread and will cause a number of buildings to be unusable even if the structure is deemed sound.
        - Depending on the magnitude of the earthquake, hundreds of people may be trapped in collapsed structures.
- The earthquake will cause immediate, simultaneous ignitions. Dozens of structure fires will ignite throughout the city. Fires will continue to ignite as power is restored, a process that could take several weeks.
- Thousands of injuries and deaths will occur. If the earthquake occurs during midday, the number of casualties will likely be greater as the working population is affected.
- Most fatalities will occur in the first 48 hours, but recovery of those buried in debris may continue for weeks.
- Thousands of residents, as well as tourists and commuters trapped in the city due to failure of transportation systems, will require shelter because their dwellings are damaged.
- Water, power, and gas service will be interrupted.
    - Water shortages can become a significant limiting factor for hospitals, jails, and 24-hour care facilities as well as for the general public.
    - Services may gradually decline due to leaks or as generators powering pumps run out of fuel or malfunction.
    - System restoration may take days (for electrical power) or weeks (for water and gas).
- Public telephone systems, including wireless systems, will be damaged or overloaded and may take several weeks to restore.
- Major transportation facilities and systems will be damaged or disrupted. This includes:
    - Major bridges and highways
    - Mass transit systems
    - Airports
    - City streets and roads

  Structural damage to these facilities may take weeks or months to repair.
- The earthquake will generate millions of tons of debris. Initially, collapsed buildings and other structures will block roads and limit movement for evacuees and response personnel and vehicles.

- Earthquake aftershocks, some almost as large as the main shock, will occur regularly and may cause additional damage. The frequency and magnitude of aftershocks will decrease over time.
    - The cumulative impact of large aftershocks will be to cause additional structural damage and necessitate additional safety assessment inspections (for aftershocks over 5.0).
    - The occurrence of aftershocks will also have a cumulative effect on the feeling of well-being or safety for residents and responders.

2.2 Response Assumptions

- Large earthquakes will produce intense regional competition for resources. In-region Mutual Aid resources will be limited as other jurisdictions face similar circumstances.
- The State and Federal governments will immediately begin mobilization of resources. However, it may take time for resources to arrive. For example, Federal USAR teams may take 24 to 48 hours to arrive in the affected areas.
- Disrupted communications systems, overwhelmed first responders, and the overall magnitude of the situation will slow the initial situation assessment.
- Damage to CCSF facilities may require alternative arrangements for management of response services.
- Damage to water and communications systems will challenge fire-fighting operations.
- The number of people trapped in buildings may initially exceed capacity to respond.
- Damage in high-rise areas will generate the need to respond to the following:
    - Fires on upper floors.
    - Several hundred people trapped in elevators.
    - People with mobility challenges who need to evacuate but cannot use steps.
    - Injuries in high-rise areas caused by falling glass and other debris.
- Damage and disruption will necessitate deployment of law enforcement resources to maintain public order and secure dangerous sites.
- Local medical facilities may be damaged. Surviving hospital capacity may be inadequate to treat casualties and other medical emergencies, requiring that some severely injured patients be relocated to facilities outside the Bay Area. However, relocation may be limited by impacts to the transportation system.
- The demand for emergency shelter may initially exceed capacity to inspect buildings and provide the resources and staff required to open fully functional shelters.
- Capacity to shelter and care displaced residents may be exceeded, forcing relocation to other areas outside of CCSF or the Bay Area.

- Damage to transportation systems will require alternative solutions to evacuation of residents, the injured, and the medically fragile, as well as the movement of response personnel and resources into CCSF.
- It will be necessary to assess thousands of buildings, public and private, to determine whether they are safe and to assess requirements for repair.
- Resources to remove debris will initially be limited as CCSF mobilizes its own forces and available contractors in the city.
- The number of potential fatalities may exceed existing CCSF resources for handling deaths and remains.
- The demand for emergency public information will be immediate and will increase.
- Massive assistance in the form of convergent volunteers, equipment, materials, and money will continue to flow to the Bay Area, providing urgently needed resources but creating coordination and logistical support challenges.
- Planning for recovery must be immediate. A recovery structure must be developed to begin coordinating issues of community recovery, business recovery, re-establishing government services, and transition to interim and long-term housing solutions.

2.3 Potential Resource Requests

Regardless of preparation, CCSF will experience shortages of critical resources necessary to respond to the earthquake. Assumptions regarding necessary resources are described below. These resources may be available through the Mutual Aid system, the State and Federal governments, or the private sector.

- Teams to support fire-fighting operations and SAR
- Law enforcement resources for security
- Vehicles to move first responders, evacuees, and displaced residents
- Medical health professionals, DMATs, and National Disaster Medical System (NDMS) resources
- Vehicles to move the injured and medically fragile
- Air assets for reconnaissance and medical transport
- Bedding, food, water, generators, medical supplies, sanitation supplies, qualified staff, and security for shelters
- Additional shelter space outside of the city
- Mental health professionals and counselors
- Building inspectors
- Heavy equipment and operators for emergency shoring and debris removal, reduction, transport, and disposal

- Equipment, staff, and supplies for handling fatalities, such as DMORTs and portable morgue units
- Water, food, supplies, sanitation facilities, and generators to support emergency operations and to support residents
- Fuel
- Qualified emergency managers and other staff to support EOC and DOC operations
- Public Information Officers (PIOs)
- Interpreters and translators
- Structural and civil engineers
- Utility restoration teams (power, gas, water, sewer)
- Communication restoration teams (satellite, cellular, wired, voice/data/video)

Table 2-1
Demographics by Supervisorial District[2]
See Figure 2-1 for a map of Supervisorial Districts

District	1	2	3	4	5	6	7	8	9	10	11
Population	69,978	67,222	70,149	70,672	71,217	70,011	69,278	69,537	71,044	73,193	74,242
% White	49%	81%	46%	40%	60%	48%	57%	76%	44%	26%	26%
% Asian	43%	13%	47%	53%	17%	25%	32%	9%	23%	30%	46%
% Black/African American	2%	2%	2%	1%	16%	10%	4%	5%	4%	29%	9%
% Hispanic or Latino	5%	4%	4%	5%	7%	22%	8%	13%	43%	19%	26%
Home Ownership	35%	27%	13%	60%	19%	10%	61%	34%	43%	51%	70%
Households with Children under 18	21%	10%	10%	28%	12%	12%	25%	11%	32%	41%	40%
Households with Seniors over 65	26%	18%	28%	34%	19%	19%	31%	13%	24%	26%	36%
Per Capita Income	$31,594	$75,877	$37,597	$26,336	$36,248.	$24,751	$39,829	$49,392.	$21,423.	$21,789	$19,176.

Other demographic information:

- Approximately 97,648 residents of 5 years or older are listed as disabled (14.2% of population).[3]
- The number of homeless living in CCSF is approximately 5,700 (2/2005 homeless census), but the number varies.
- The average number of people per household is 2.30.
- 62% of housing units are rented and 33% are owner-occupied (approximately 5% of units vacant as of 2/2002).
- 11.3% of residents live below the poverty level (1999 figure).

[2] Legislative Analyst Report – 2000 Census Data by District

[3] 2004 American Community Survey – U.S. Census Bureau

Figure 2-1
San Francisco Supervisorial Districts

SECTION 3 – CONCEPT OF OPERATIONS

3.0 General Organization

The general organization of CCSF's emergency response system is described in the CCSF ERP. The provisions of the ERP are generally applicable in an earthquake, as with any emergency or disaster. Key concepts are repeated here.

In accordance with the principles of the Incident Command System (ICS), SEMS, and NIMS, the response to an emergency or disaster is managed at the lowest level possible. Accordingly, local government has the primary responsibility for the response to an emergency or disaster. CCSF is responsible for emergency response within its jurisdiction. Under SEMS, CCSF serves as both a local jurisdiction and an Operational Area. As such, CCSF coordinates emergency response with special districts and other entities located within the geographic boundaries of San Francisco.

When a major event, such as a major earthquake, exceeds the capabilities of CCSF to respond, CCSF may request assistance from neighboring jurisdictions through the Mutual Aid system or from the State government through CalEMA via:

- the State Warning Center in Sacramento.
- the Regional Emergency Operations Center (REOC) at the CalEMA Coastal Region in Oakland.
- the State Operations Center (SOC) in Sacramento.

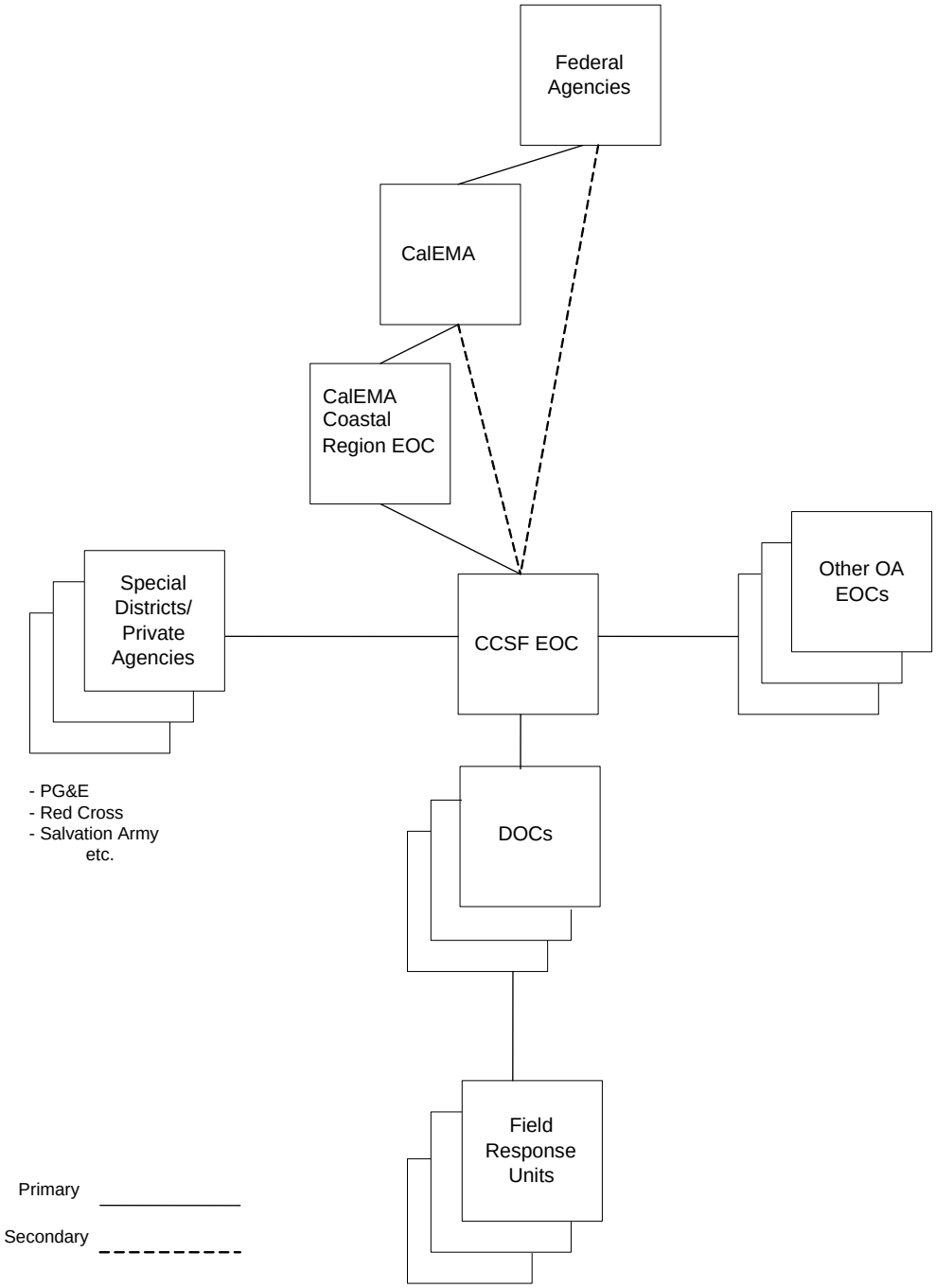
As described in the ERP, the CCSF EOC is the focal point for emergency management coordination. CCSF departments and agencies with emergency response responsibilities operate Department Operations Centers (DOCs) to manage the operations of their specific resources, including tactical operations of field units. The DOCs communicate with the EOC either via established emergency communications systems or by assigning a liaison officer to the EOC. Generally, the EOC does not communicate directly with field response units. Instead, these field units establish communications with their respective DOCs.

The relationship of these elements is shown in Figure 2-1.

3.1 EOC Operations

The focal point of coordination for citywide emergency response is the EOC, located at 1011 Turk Street. EOC operations are described more fully in the ERP. Basic operations and concepts will remain the same for an earthquake and are not repeated here.

Figure 3-1
Relationship of Emergency Response Elements



3.2 General Objectives for Response Operations

Immediately following a major earthquake, and for as long as a state of emergency exists within CCSF, response to the earthquake will be the first priority of all CCSF departments and agencies. All available CCSF Disaster Service Workers (DSWs) will be directed to achieve the following objectives:

- Save lives.
- Reduce immediate threats to life, public health and safety, and public and private property.
- Provide necessary care, shelter, and medical services to CCSF residents and other members of the general public.
- Restore the operations of facilities, whether public or privately owned, that are essential to health, safety, and welfare of the community, including critical CCSF facilities, hospitals, utilities, and transportation infrastructure.
- Assess damage to infrastructure, public facilities, and the built environment.
- Expedite the restoration of services, the economy, and the community at large; and begin the process of recovery.
- Keep the public informed.

3.3 Coordination with State and Federal Agencies

The impact of a major earthquake will necessitate coordination with State and Federal agencies to:

- Coordinate response operations.
- Request assistance to meet needs that cannot be met with CCSF resources or with Mutual Aid resources available from nearby jurisdictions.

CCSF must direct all resource requests that could be met by State or Federal agencies to CalEMA. CalEMA is responsible for:

- Mission-tasking State agencies to provide assistance.
- Requesting Federal assistance through FEMA.
- Requesting resources from other states through the Emergency Managers Mutual Aid (EMMA).

CCSF may coordinate directly with State or Federal agencies as part of specific incident response operations, particularly when necessary to save lives and protect public safety.

3.3.1 Coordination with State Agencies

Immediately following a major earthquake, the State of California will take the following actions:

- Declaration of a state of emergency by the Governor.
- Full activation of the SOC and each of the three REOCs (including the Inland Region REOC in Sacramento and the Southern Region REOC in Orange County).
- Activation of DOCs for State agencies and mobilization of State resources.
- Request for a Presidential disaster declaration by the Governor.

CalEMA is responsible for coordination of State agency response, providing State agency resources to meet needs identified by the Operational Areas, and requesting Federal resources through FEMA.

In accordance with SEMS, CCSF will coordinate with CalEMA to provide situation reports and to request resources. CCSF's initial contact with CalEMA will be to the State Warning Center in Sacramento. Once the REOC is operational, CCSF will coordinate directly with the REOC. CalEMA may provide a liaison to the CCSF EOC to facilitate coordination.

Should the Coastal Region REOC be damaged or otherwise nonoperational, CalEMA will direct CCSF to coordinate directly with the SOC or another REOC until the Coastal Region REOC is operational.

3.3.2 Coordination with Federal Agencies

If it is immediately apparent that the earthquake has caused major damage and has exceeded State and local capabilities for response, the President will declare a major disaster and the Federal government will activate the NRF, including the Catastrophic Incident Annex. Under the NRF, FEMA will begin coordinating the mobilization of Federal resources that will be necessary to support State and local response activities within the affected region. In accordance with the Stafford Act, the Federal government may provide direct Federal assistance at the request of the State, including resources necessary to save lives and protect public health and property.

FEMA will work directly with CalEMA to respond to State requests for assistance. Initially, FEMA will deploy an Emergency Response Team (ERT). The ERT includes Federal agencies that provide assistance through the Emergency Support Functions (ESFs) identified in the NRF. FEMA will also coordinate with the Defense Coordinating Officer with regard to the deployment of Department of Defense assets in support of the response. As soon as possible, FEMA will establish a Joint Field Office (JFO) with its Federal partners and CalEMA that will become the focal point of Federal response operations. The JFO may be located in Sacramento or closer to the Bay Area.

Federal support may include direct assistance from Federal agencies such as the U.S. Army Corps of Engineers (USACE) or from specialized teams, such as Urban Search and Rescue (USAR), Disaster Medical Assistance Teams (DMATs), and Disaster Mortuary Operations

Teams (DMORTs). These teams may operate within CCSF. The integration of these teams into CCSF operations will be coordinated by the appropriate EOC Operations Support Section branch. The EOC Logistics Section will coordinate logistics requirements associated with the deployment of these teams.

Depending on the magnitude of the event, FEMA may provide liaisons to work directly with CCSF to facilitate the deployment of Federal resources and assess needs. As stated above, however, CCSF must request additional Federal resources through CalEMA; CCSF cannot request resources directly from the Federal government.

3.4 Transition to Recovery

The immediate response to a major earthquake will focus on saving lives, providing resources to sustain CCSF residents, and stabilizing the situation. At some point, however, CCSF must transition to a phase in which recovery operations take precedence. Given the level of damage to housing, business, and infrastructure; the direct impact on the population; and the effect on the regional economy, full recovery from a major earthquake will take years, if not longer. Nonetheless, rapid initiation of recovery operations is critical to restoring confidence in the community.

Within the first few days of activation, the triggers for transition from EOC response to recovery operations (EOC deactivation) should be determined and shared with EOC staff. Triggers for transition from response to recovery may include the following conditions:

- Widespread fire suppression and Search and Rescue (SAR) operations have concluded.
- Evacuations have ceased.
- Mutual Aid response resources are being released.
- Care and shelter operations have stabilized and shelter population is decreasing daily.
- Aftershocks have diminished, and stabilization of the built environment has minimized the risk of aftershocks to life and property.
- Restoration of utilities and lifelines is underway.
- Local Assistance Centers are in operation.

At this point, the EOC may consider scaling back staffing to partial levels or may transition to a full recovery operation. The recovery operation can be organized with a SEMS structure and may be carried out in a facility other than the EOC or may be performed in several separate departmental locations.

SECTION 4 – SITUATION ASSESSMENT

4.0 Situation Assessment Overview

While the ability to quickly gather, verify, consolidate, and distribute confirmed situation information is vital to the response, it is equally important that initial response strategies are developed with an accurate picture of the potential scope of the disaster and that external resource requests quickly be pushed up to the State and Federal level without delay. Quickly identifying the potential scope of damage following a major earthquake is critical to mounting an effective response; however, initially this may be extremely difficult due to limited communications capability, information overload, limited staff and fragmented or conflicting damage reports.

This plan is based in part on projected impact scenarios driven by events on the earthquake faults in the Bay Area that are believed to present the greatest risk. Response strategies and resource requirement projections contained in this plan have been based in part on the three earthquake scenarios so responders can initially utilize the impact and the resource requirement projections that most closely match the actual disaster. The plan assumes that it is better to form a quick picture of the potential scope of damage using a combination of actual street-level impact reporting *and* pre-event impact modeling, rather than total reliance on waiting two to three days for confirmed impact information to be available.

Appendix A contains a hazard analysis that includes projections and mapping for the scenarios in question. The projections in Appendix A are based in part on analyses conducted using FEMA's HAZUS loss estimation tool. This information may be used as a starting point for incident-specific situation assessments. Tables and mapping to support the discussion presented in this section are included in Appendix A.

4.1 Determining the Potential Scope of the Disaster

Immediately following the earthquake, it may be possible to establish an initial assessment of the impact using available analytical tools. This assessment can be used to direct initial response activities towards those areas that are most likely to be seriously affected, given the location and magnitude of the earthquake and shaking potential within CCSF.

4.1.1 Earthquake Information

Key information about the earthquake includes:

- the source fault (e.g., San Andreas)
- location of the epicenter
- magnitude
- shaking potential
- length of shaking

If Internet access is available through existing networks or satellite backup systems, information about the earthquake can be found at:

- California Integrated Seismic Network (CISN) – http://www.cisn.org. This information is available within 10 minutes of a magnitude 3.5 or greater earthquake.
- USGS - http://earthquake.usgs.gov/. The USGS also provides information on earthquake characteristics within minutes of the event.

If the Internet is not available, information can be obtained via the following entities:

- National Warning System – 24-hour continuous private line telephone system.
- Berkeley Seismological Laboratory Earthquake Information Hotline at 510-642-2160.

4.1.2 Shake Maps

Shake maps can be used to identify areas where ground shaking is strongest and to estimate the potential for damage in those areas. As Figures A-1 through A-3 in Appendix A demonstrate, shake maps may vary significantly depending on the nature of the event. Nonetheless, they provide an immediate means for a general assessment of impact.

If the magnitude and the source fault information are known and are similar to the potential earthquake scenarios used for this plan, the appropriate shaking intensity maps in Figures A-1, A-2, and A-3 in Appendix A can be used to identify areas of potential for damage. Potential impacts for these scenarios are described in Appendix A, Table A-11.

If the magnitude, source fault, or epicenter location varies significantly from the potential earthquake scenarios, initial damage assessment assumptions may be based on the perceived shaking and damage potentials described in Table A-3 in Appendix A.

The CISN and USGS Web sites also provide shake map information based on actual events. This information is usually available via the Internet within 60 minutes of the event.

4.2 Initial EOC Actions

Initially, the EOC will take the following steps to disseminate and refine information regarding the magnitude of the disaster:

- Determine potential scope of the earthquake, including the magnitude, depth and location of the rupture, and shaking information.
- Disseminate shake map information to EOC and DOC staff so that they can incorporate information regarding potential damage into action planning.
- Analyze emerging situation information from sources such as field responders and the media to validate overall consistency of scenario projections.
- Review and clarify incomplete or conflicting information.
- Confirm or provide guidance to EOC and DOC personnel on suggested adjustments to the resource requirement projections based on updated information.

- Transmit updates to shake map and damage projection information to the REOC, DOCs, the PIO, and others as directed in accordance with situation report procedures.

4.3 Initial Situation Assessment

This section describes available means for the initial collection and dissemination of information regarding the effects of the earthquake. Table 4-1 describes critical information that must be collected during the first 24 hours following the earthquake.

4.3.1 Field Personnel Actions

Immediately following the earthquake, CCSF personnel around the city will begin reporting on the effects of the earthquake, often spontaneously. These reports will flow to dispatch centers and other points of collection. The actual number of CCSF personnel deployed at any given time varies with the time of day and the day of the week. Many of these employees, particularly those of public safety agencies, travel in radio-equipped vehicles or are carrying handheld radio equipment.

All CCSF personnel deployed in the field at the time of the event are expected to do the following:

- Assess their situation and identify any possible threats to life safety.
- Take action to protect themselves and members of the public in their immediate vicinity.
- Make note of the critical information listed above for their immediate area.
- Report time-sensitive life safety information to their dispatcher via radio.
- Report non–life safety information within 60 minutes to their DOC, either by radio or by going to the closest SFFD battalion station.
- Follow the response procedures established by their department's emergency plan.

In addition to CCSF personnel, NERT volunteers may be used to gather and transmit situation information. NERTs may include amateur radio operators and foot and vehicle couriers to report damage and needs assessments.

As stated above, critical information that must be collected during the first 24-hour period is provided in Table 4-1.

4.3.2 Aerial Reconnaissance

Daylight aerial surveillance via helicopter or fixed wing over-flight would allow response managers to quickly assess:

- General extent of damage.
- Location of large structure fires.
- Location of collapse of high-occupancy structures.
- Location of significant roadway damage, blockages, and potential alternate routes.
- Condition of potential staging areas.

In addition to assisting with aerial surveillance, helicopter and other air assets will be useful for evacuation of the injured, emergency movement of response management staff, and other critical resources.

An Air Operations Unit is not specifically designated in the ERP as part of the normal Operations Section structure; however, following a major earthquake, the Operations Section Chief may determine that an Air Operations Unit should be staffed to coordinate the wide range of air operations that will be required by the response.

Potential sources of aircraft for performing aerial surveillance include:

- California Highway Patrol
- California Department of Forestry and Fire Protection
- U.S. Coast Guard – Sector Command
- California Air National Guard
- East Bay Regional Park District
- Local TV stations (Channels 2, 4, 5, and 7)
- U.S. Air Force Auxiliary – Civil Air Patrol (CAP)
- Other branches of the U.S. military

4.4 Updates to Critical Information

Table 4-2 contains a list of critical earthquake situation information. This table contains details regarding how the information is collected and transmitted to the EOC and provides the approximate timeframes for doing so.

Table 4-1
Critical Information for the First 24 Hours

- Number and locations of deaths and injuries.
- Location and extent of secondary events, including fires, landslides, and hazardous materials events.
- Location of severely damaged or collapsed structures.
- Location and estimated number of people trapped in collapsed structures.
- Requirements for major evacuations and estimated number of people displaced.
- Status of communication systems, including:
    - Public telephone and wireless systems
    - CCSF emergency radio systems, including Combined Emergency Response System (CERS) and Department of Public Works (DPW) 800 MHz radio
    - CCSF 311 Call Center
    - 911 dispatch systems
- Damage to critical public buildings and other infrastructure, including:
    - Police and fire facilities
    - Hospitals and skilled nursing facilities
    - Schools
    - Jails
    - DOC facilities
- Critical resource shortfalls impacting public safety.
- Status (open, partial closure, or full closure) of roads, bridges, major surface streets, and public transportation systems.
- Status of and damage to major utility systems, including:
    - Water
    - Sewer
    - Power
    - Natural gas
- Results of preliminary structural assessment of designated emergency shelters.
- Location and operational status of all DOCs.

Table 4-2
Critical Situation Information

Information	Timeframe Needed	EOC Branch Responsible
Operational status of DOCs, point of contact method, table of organization, including the name of current Director	1st 12 hours	Planning Section
Status of the Mayor, President of the Board of Supervisors, and other members of the Policy Group, including any succession replacements	1st 12 hours	EOC Manager
Status and general mission capability (staff, facilities, communications, vehicles) for CCSF departments	1st 12 hours	Operations Support & Planning Sections
Status of critical CCSF systems (METS, wide area network, 911 dispatch, 800 MHz radio systems, alternate EOC facility, and 311 Call Center, etc.)	1st 12 hours	Communications Branch
Operational status of hospitals, clinics (public and private) and other care facilities, including available bed capacity and details on current or anticipated site evacuations	1st 12 hours	Human Services Branch
Locations, estimated number and extent of secondary disasters, including fires, landslides and hazardous materials incidents	1st 12 hours	Law Enforcement and Fire & Rescue Branches
Operational status for the Auxiliary Water Supply System	1st 12 hours	Fire & Rescue Branch
Location of major structure collapses, including estimated number of people trapped	1st 12 hours	Fire & Rescue Branch
Status of major transportation routes including location of roadway, highway or bridge closures	1st 12 hours	Transportation Branch
Geographic areas with concentrations of damage	1st 12 hours	Operations Support & Planning Sections
Estimate of food, housing needs for Disaster Service Workers	1st 12 hours	Logistics Section
Location of major evacuations and the estimated number of people displaced	1st 12 hours	Law Enforcement & Fire & Rescue Branches
Public health advisories	1st 12 hours	Human Services

Information	Timeframe Needed	EOC Branch Responsible
Operational status and initial damage reports from critical public facilities (e.g., Hall of Justice, San Bruno Jail, City Hall, airport, Port)	1st 24 hours	Infrastructure Branch
Estimated staffing levels and reserve capacity for police, fire, EMS, DEC and other departments	1st 24 hours	Operations Support Section
Details regarding any significant law enforcement activities, curfews or other security concerns	1st 24 hours	Law Enforcement Branch
Location of casualty collection points	1st 24 hours	Human Services
Availability of public and private ambulances	1st 24 hours	Human Services
Summary of Mutual Aid requests placed through the REOC	1st 24 hours	Logistics Section
Status of utility systems (public and private)	1st 24 hours	Infrastructure Branch
Results of preliminary structural assessment of designated emergency shelters	1st 24 hours	Infrastructure Branch
General situation summary including locations, general boundaries of damage, initial impact estimates, critical operational issues, resource shortfalls and overall situation assessment	1st 24 hours	Planning Section
Status of public transportation systems (including MUNI, CalTrain, BART, ferries, and airport)	1st 24 hours	Transportation Branch
Number of shelters open, locations, site point of contact, estimated number of residents and percentage of capacity	1st 24 hours	Human Services Branch
Breakdown of critical resource shortfalls	1st 24 hours	Operations Support & Logistics Sections
Summary Report from HAZUS loss estimation software	Within 48 hours	Advance Planning Branch (from REOC)
Estimated number of deaths and injuries, including number requiring hospitalization broken out by severity of injuries and updated information on hospital damage and current capacities	Within 48 hours	Human Services Branch

Information	Timeframe Needed	EOC Branch Responsible
Current Maritime Area Security Level and details regarding designated critical transportation routes and related access criteria and permit/identification requirements (local and regional)	Within 48 hours	Transportation Branch
Location, status, and designated use of staging areas	Within 48 hours	Logistics Section
Name and location of critical CCSF facilities currently running on generators	Within 48 hours	Infrastructure Branch
Location of emergency animal shelters	Within 48 hours	Human Services Branch
Location, extent of risk from any environmental health incidents	Within 48 hours	Human Services Branch & Hazardous Materials Unit
Status of local, State, and Federal declarations	Within 48 hours	EOC Manager
Boundaries and details regarding any "no entry" security areas established	Within 48 hours	Law Enforcement Branch
Status of fuel supplies in CCSF and key supplier inventories	Within 48 hours	Logistics Section
Details regarding shelter sites, including lead agency, name of manager, resource requirements, critical issues, status of utilities, meals served, etc.	Within 72 hours	Human Services Branch
Report of any communicable disease outbreaks in shelters or other locations	Within 72 hours	Human Services Branch
Estimated number of disaster related remains currently under jurisdiction of the Medical Examiner	Within 72 hours	Human Services Branch
Availability of currently unassigned CCSF personnel	Within 72 hours	Human Resources Branch
Identified sites with people with specific support requirements (special needs)	Within 72 hours	Human Services Branch
Initial restoration projections for designated priority routes and debris removal and management plan	Within 72 hours	Infrastructure Branch
Utility (electrical, gas, water, sewer) outages information, including estimated number of people and area affected and initial restoration projections	Within 72 hours	Infrastructure Branch
Initial restoration projections for public transportation systems	Within 72 hours	Infrastructure Branch
Summary of Mutual Aid resources received to date at CCSF staging areas	Within 72 hours	Logistics Section

Information	Timeframe Needed	EOC Branch Responsible
Preliminary damage assessment for public buildings, including information on any potential relocation requirements	Within 5 days	Infrastructure Branch
Estimated number of homes and businesses damaged by tag category and percentage of completion of the preliminary assessment	Within 7 days	Infrastructure Branch
Estimated dollar loss for public infrastructure	Within 7 days	Infrastructure Branch
Breakout of estimated costs for Public Assistance Program (FEMA) and Emergency Relief Program (FHWA) costs	Within 7 days	Operations Support & Finance and Administration Sections
Debris removal plan	Within 7 days	Infrastructure Branch
Location and hours of operation for relief supply distribution sites	Within 24 hours of establishment	Human Services Branch
Location, name of manager, lead agency, capacity and meals served per day, hours of operation for emergency kitchens and fixed feeding sites	Within 24 hours of establishment	Human Services Branch
Location of any temporary morgue facilities	Within 24 hours of establishment	Human Services Branch

SECTION 5 – OPERATIONAL PRIORITIES

5.0 Overview

This section describes action-planning objectives for the response to a major earthquake. As described throughout this plan, the unpredictability and variables associated with earthquakes will result in specific effects and corresponding needs that range widely from those presented here. However, the objectives presented here are expected to be generally relevant and can serve as a baseline for planning.

5.1 Initial Response Goals and Objectives (First 72 Hours)

The primary government response role for any emergency is the protection of life and property. The initial response objectives for CCSF following a large earthquake focus on that role and are described below. At the same time, the community, its residents, and its businesses have roles to play. They are responsible for helping each other survive the immediate effects of the earthquake and preparing to recover from the disaster. This may manifest itself in the form of assisting first-responders, participating in neighborhood mass care, coordinating their own family reunification, ensuring business continuity, and cooperating with recovery efforts.

5.1.1 First 4 Hours

Respond to the immediate known effects of the earthquake:

- Direct and assist immediate life-saving rescue operations.
- Direct fire suppression for existing structure fires and anticipate fire spread based on conditions and historic precedent.
- Deploy law enforcement resources to support response activities and maintain law and order.
- Deploy emergency medical services to major incidents.
- Establish casualty collection points for initial treatment of the injured.
- Identify potential sites for evacuation centers to accommodate displaced populations while emergency shelters are being opened.
- Identify at-risk populations, notify them, and begin to evacuate if warranted.
- Assess:
    - Situation at critical facilities, including DOCs and hospitals.
    - Situation in areas not reporting.
    - Condition of emergency communications systems.
- Implement CCSF personnel recall.
- Begin public information messaging regarding recommended personal protective actions, safe congregation points, and community assistance needed.

- Complete an initial damage assessment of the city, identifying areas affected, major incidents, and operational status of critical services.
- Create consolidated situation assessment and declare a state of emergency.

5.1.2 First 12 Hours

Assemble resources for sustained response and for providing basic services to the community:

- Assess critical resource shortfalls and begin requesting support through Mutual Aid and CalEMA. Consider a 14-day period. Assess condition of transportation system and develop alternatives for moving critical resources into the city.
- Establish perimeter control around unsafe areas.
- Establish security at critical facilities.
- Open evacuation centers.
- Assess conditions at designated emergency shelter sites and begin to supply with beds, water, food, medical support, generators, sanitation, and facility security; and begin to open emergency shelters to residents and Disaster Service Workers.
- Identify people with special support requirements and transfer to appropriate care facilities.
- Designate primary routes and implement debris clearance, route recovery, and traffic control.
- Initiate a regular status reporting and resource requesting process between area commands (if established), major incident commands (if established), and State/Federal counterparts offering coordinated assistance.
- Monitor and address identified issues regarding patient load balancing between hospitals and the related patient transport system challenges.
- Assess the need to activate the Joint Information Center.
- Determine if a curfew should be established.

5.1.3 Through 24 Hours

Consolidate system for sustaining emergency response operations:

- Concentrate CCSF emergency management efforts on supporting ongoing on-scene incident management at major incidents, reinforcing the logistical support being requested.
- Commit resources to support public safety by assisting incoming employees and gathering/distributing convergent resources from less-affected parts of the region and out-of-area State and Federal resources.
- Designate staging areas and begin planning to accommodate support personnel.

- Ensure that an adequate system is in place to fuel and maintain generators providing power to critical facilities.
- Establish temporary morgues and begin process of collecting remains.
- Conduct outreach for situation status and resource needs for affected facilities needing support from CCSF, including ancillary medical institutions, transit sites, educational centers, commercial buildings, and sites of historic/cultural significance.
- Initiate regular news briefings to inform residents on CCSF operations, steps they can take, services available to them, ongoing rumor control efforts, and ways in which the community can help.

5.1.4 Through 48 Hours

Stabilize support for affected areas and secure unaffected areas for resumption of services:

- Process ongoing logistical resource requests for emergency services and Mutual Aid needs to support incident management.
- Implement the PUC emergency drinking water plan.
- Establish a distribution network for drinking water and food for persons who are not residing in mass care facilities but are without basic services.
- Initiate damage assessment of CCSF facilities, with priority for facilities critical to response operations.
- Make arrangements for the EOC to assume responsibility for supporting incoming Mutual Aid and convergent resources, relieving field-level public safety workers to focus on providing sustained rescue, firefighting, paramedic, and law enforcement services.
- Conduct an ongoing review in EOC of current situation reporting and resource requesting processes and revise, as available systems require.
- Anticipate and support initial damage assessment visits by State and Federal officials wanting to confirm the immediate and long-term recovery needs of the city for their out-of-area resources.
- See Section 6.8.3 for logistics for responders.

5.1.5 Through 72 Hours

Begin transition from immediate emergency response efforts to sustained operations.

- Support hospital and other medical facility re-supply efforts.
- Re-evaluate mass care needs in light of any ongoing aftershocks and subsequent damage.
- Establish shelter support coordinator teams and evaluate the shelter sites to identify:
    - Site damage
    - Critical support requirements, including shelter management personnel
    - Site security

- Adequacy of feeding and medical care arrangements
- Shelter demographics (gender, children, medical needs, language barriers, disability needs)

- Establish plans for how to provide care for people with special support requirements that cannot be met in congregate care shelters.
- Establish a JIC.
- Establish the Donations Management Branch and the Human Resources Branch in the Logistics Section to facilitate the handling of volunteers and donations.
- Review and enhance security plans to maintain public order.
- Begin translating damage assessment information into initial damage estimates required by CalEMA and FEMA.
- Participate in discussions with CalEMA and FEMA on assessing services residents will require to recover from the disaster.
- Review incident status reports to prioritize incident commands that can begin suspending emergency response operations and transition to sustained response and recovery operations.

5.2 Sustained Operations

As the third 24-hour period concludes, the EOC should be supporting three primary areas of operation:

- Ongoing rescue operations and other emergency measures.
- Transitioning near-complete response efforts to sustained emergency operations, typically addressing remaining earthquake effects that do not require public safety technical skills.
- Preparing for ongoing major recovery efforts focusing on restoration of services.

Objectives for Days 3 through 7 are outlined below. Some of these objectives may occur immediately or in phases; objectives must be identified and prioritized based on overall need and resources available to respond.

- Establish plan and begin widespread safety/damage assessment of public infrastructure, such as public right-of-way (roads and sidewalks), bridges, tunnels and retaining walls.
- Establish teams to visit shelters to identify people that require special support that need to be relocated into other types of care facilities and to identify site modifications that should be made to better accommodate residents with sight, hearing, mobility or other limitations.
- Begin locating and opening relief supply and food distribution points other than the evacuation centers/shelters.
- Reinforce cost tracking guidance for CCSF responders.
- Establish responder mental health support program.

- Establish portable toilet sanitation stations around the city and related cleaning and pumping program.
- Work with ARC and other organizations to provide information to support their Disaster Welfare Inquiry Program.
- Coordinate with the business community regarding the time of their business resumption activities.
- Begin widespread safety/damage inspections of homes and businesses.
- Produce, regularly update, and distribute a disaster "Fact Sheet" to the media, people in shelters, field response personnel, and residents.
- Ensure that air quality, hazardous materials spills, and other environmental situations are monitored and risks addressed.
- Evaluate the need to designate specific routes into the city for critical relief supplies. Designating specific lanes for express bus service should also be considered.
- Survey all licensed food establishments, including the emergency shelter/evacuation centers, feeding sites, and disaster kitchens to ensure there are no unsafe food handling or other sanitation or safety concerns.
- Begin planning for the relocation of displaced CCSF staff and departments.
- Implement a process to allow limited entry (where safe) for recovery of personal items and mental health counseling for people whose homes have been red-tagged.
- Implement public information phone bank operations.

SECTION 6 – SUMMARY OF RESPONSE STRATEGIES

6.0 Overview

As described in Section 3, a major earthquake will create circumstances that will challenge the capacity of CCSF to respond.

This section outlines key response strategies for specific functions that must be undertaken following a major earthquake. The elements described here are based on lessons learned from the Loma Prieta, Northridge, and Hanshin-Awaji (Kobe) earthquakes – specifically, an evaluation of the major limitations encountered and strategies implemented during the response to those earthquakes. It is recognized that additional factors may be encountered during the response to a specific earthquake.

Functions are organized by the EOC branch or unit with coordination responsibilities for specific elements. As described in Section 2, the EOC is responsible for overall coordination of emergency response operations in CCSF. Department and agency DOCs are responsible for tactical command of field units. Although this information is presented according to the EOC organization, specific departments or agencies may have responsibilities for carrying out the functions described.

These strategies assume a Scenario 2 or 3 earthquake. See Appendix A for sources of information for assumptions related to Scenario 2 or 3 earthquakes.

6.1 Fire and Rescue Branch Functions

SFFD will manage fire suppression and SAR operations from the San Francisco Fire DOC (FDOC). These activities will be the highest priority for the SFFD and will take precedence over SFFD support for other response functions. Additionally:

- The SFFD will establish battalion command with geographical fire divisions.
- If centralized command and control is impossible, Emergency Response Districts at each of twelve Fire Battalions will manage the incident at the discretion of the Chief of the Fire Department or his/her designees until command and control is restored.

For details about SFFD operations at the EOC, DOC, and in the field, see the ESF #4: Firefighting Annex.

6.1.1 Fire Suppression

The earthquake will result in multiple conflagrations that will occur immediately. Fires will continue to break out for weeks after the earthquake as power is restored.

Key Assumption

Estimates range from 50 fires to over 130 fires for a Scenario 3 earthquake (see Appendix A).

Key Limitation

The combination of the magnitude of the event, time delays in obtaining Mutual Aid resources, and surface route obstructions will force SFFD to prioritize among multiple fire missions.

Response Strategy

1. Obtain information from SFFD companies and conduct reconnaissance (windshield surveys) to determine:
   - SFFD post-event response capability
   - Status of water supply
   - Number and severity of incidents
2. Prioritize fire suppression activities and other SFFD functions according to:
   - Protection of life and safety (highest imperative)
   - Property protection
   - Environmental protection
3. Activate emergency personnel recall procedures and modify staff scheduling and assignments.
4. Determine resource requirements and request typed resources via the CalEMA Region II Fire Mutual Aid system.
5. Coordinate with EOC Route Recovery Unit in the Transportation Branch to enable firefighters and firefighting equipment to reach conflagrations.

6.1.2 Search and Rescue

Shaking will result in partial or complete collapse of thousands of buildings, possibly trapping occupants who cannot get out without being rescued.

Key Assumption

A scenario 3 earthquake could trap 300 to 500 people requiring SAR.

Key Limitation

Not all identified resources may be immediately available. SFFD personnel may be out of the city, particularly if the earthquake occurs at night. Assistance from local and regional sources and Federal USAR teams will take time to mobilize.

Response Strategy

1. Reports of collapsed buildings with people trapped will be received from a variety of sources, including:
   - Dispatchers at the 311 Call Center, SFPD, SFFD, Division of Emergency Communications (DEC), and Municipal Transportation Agency (MTA)
   - DPW and other CCSF agencies

   All reports will be routed to the Fire and Rescue Branch, which will consolidate the information and provide to the FDOC.
2. Prioritize rescue attempts based on:
   - Number of people trapped in a particular site
   - Potential risk to SAR personnel
   - Probability of successful rescue
3. Immediately request assistance, including:
   - Resources from CalEMA Region II Fire Mutual Aid
   - Deployment of Federal USAR teams
   - Structural engineering/shoring assistance from the USACE
   - Engineering support from DPW
4. Deploy the two heavy rescue units to sites where:
   - The structure requires this capability
   - A significant number of people are believed to be trapped at the site
5. Engage NERTs to assist with SAR in their neighborhoods under the direction of a Fire Officer.

6.2 Human Services Branch Functions

The Human Services Branch in the Operations Support Sections is responsible for the following CCSF health and basic human services:

- Provision of basic necessities to persons impacted by a disaster such as food, potable water, clothing, shelter, and emotional support
- Medical, mental, and public health care
- Maintenance of animal and environmental welfare
- Mass fatality management

The Human Services Branch includes liaisons from voluntary agencies, such as the American Red Cross and the Salvation Army, to ensure close coordination and support for their mass care activities. The Human Services Branch also serves as the CCSF point of contact for the CCSF Medical Examiner and provides mutual aid assistance for dealing with human remains and the provision of additional resources, as needed.

Details about the various components within the Human Services Branch may be found in the following:

- ESF #6: Mass Care, Housing, and Human Services Annex
- ESF #8: Public Health and Medical Services Annex
- ESF #11: Animal Response Annex

6.2.1 Mass Care, Housing, and Human Services

For details about mass care, housing, and human services operations, see the ESF #6: Mass Care, Housing, and Human Services Annex.

A. Sheltering and Feeding Programs

CCSF, through the Human Services Branch, will work with its nonprofit partners to rapidly establish basic services necessary to meet immediate needs. Immediately following the earthquake, CCSF will establish evacuation centers to provide basic shelter for displaced populations. As shelter sites are inspected for damage, staffed, and opened, the sheltering operation will transition from the evacuation centers to full-service emergency shelters. This transition will occur the first few days following the earthquake.

Note: For security reasons, SFPD may also be involved at care and shelter sites.

Key Assumption

Approximately 50,000 people will seek shelter at sites run by CCSF and by private nonprofit organizations, churches, and other organizations. Each organization will manage its assigned sites but will work collaboratively to support the care and shelter system.

Key Limitation

Shortages are expected for the following:

- Bed space – actual shelter capacity will be reduced due to structural damage to some designated shelter buildings and requirements for clean-up and emergency repairs before buildings can be used as emergency shelters. Currently, 55,000 pre-identified beds are available, with only 5,000 surplus.
- Trained personnel.
- Cots and blankets, bottled water, and emergency food supplies.

Response Strategy

1. Within 24 to 48 hours, open evacuation centers adjacent to heavily damaged areas to provide a safe, controlled shelter environment, provide basic first-aid, and register people and identify those with specific support requirements.
2. Open emergency shelters within 72 hours as buildings are inspected or cleaned up, supplies are mobilized, and shelter management teams are formed. Use the CCSF shelter database to evaluate the strategic sites around the city, close to concentrations of displaced residents.
3. Augment experienced shelter management personnel with the following:
   - Human Services Agency (HSA) or other DSW personnel that are experienced supervisors and are used to working with the public.
   - NERT or other community volunteers that are experienced supervisors and are used to working with the public.

4. Initial feeding efforts will consist of distribution of pre-packaged meals. Within 7 to 10 days after the earthquake, the feeding program will shift from pre-packaged meals to limited hot meals using fixed or field kitchens.
5. Publicize the existence of shelters, but encourage residents to stay in their homes (if it is safe to do so) or seek shelter with family and friends to ease crowding at evacuation centers and emergency shelters.

B. Adapting Shelters for the Disabled

While San Francisco has identified potential shelter facilities with a capacity of approximately 55,000, not all of the facilities are compliant with requirements of the Americans With Disabilities Act (ADA). Consequently, it will be necessary to implement measures to adapt these facilities for use by disabled and elderly residents.

Key Assumption[4]

Approximately 14 percent of San Francisco residents (approximately 103,000 persons) are over 65 years of age, and 44 percent of seniors have physical disabilities. Of the total population, 7 percent (approximately 52,000 persons) have mobility impairments or other disabilities.

Key Limitation

There will be competing demands for CCSF and contractor-supplied construction personnel and materials that will be necessary to quickly repair and modify emergency shelters.

Response Strategy

1. Use the CCSF shelter database to assess potential site access issues. Sites requiring modifications will be prioritized based on:
   - The potential number of shelter residents with mobility disabilities.
   - The degree to which the site currently inhibits access.
2. Initially target the 41 partially accessible sites listed in the database for modifications.
3. Identify CCSF resources that may provide support for shelter modifications. These include:
   - DPW, through its Bureau of Building Repair section.
   - Recreation and Parks Department (RPD) Structural Maintenance Division.
   - SFUSD, through its Building and Grounds Department, which has a six-person ADA unit.
   - Contract resources obtained through any of these departments.
4. If CCSF or contractor resources are not readily available, obtain volunteer resources through craft unions and private nonprofit agencies.
5. Rapidly implement minor modifications, including:
   - Constructing or placing ramps to allow access.

[4] Community Action Plan for Seismic Safety (CAPSS) Report

- Removing the door of a toilet stall to provide access.
- Installing grab bars in toilet stalls.
- Enlarging doorways and widening aisles or other spaces.

C. Bulk Distribution of Supplies

A widespread lack of access to utilities (such as electricity, natural gas, and water) and basic supplies due to closed roads and disruption of local businesses may prevent residents from occupying their homes. Inability to provide this support to people living in their lightly damaged homes will force many to seek housing in already overcrowded public shelters.

Note: For security reasons, SFPD may also be involved at care and shelter sites.

Key Assumption

San Francisco has approximately 800,000 residents.[5] The total number of households is approximately 329,700. The average household size is 2.3 people. Approximately 15 percent of households have residents over 65 years of age.

Key Limitation

The ability to implement a robust distribution program will initially (during the first three to five days) be limited by lack of access to supplies, lack of adequate personnel, damage to transportation facilities, and lack of vehicles and other transportation resources.

Response Strategy

1. Implement the PUC Emergency Drinking Water Distribution Plan to provide access to potable water. The plan includes 67 specially designated, strategically placed, fire hydrants with water distribution manifolds connected to the potable water system; four 5,000-gallon water tanker trucks; and twelve 2,000-gallon water storage bladders.
2. Identify parameters for distribution, including:
   - Public material support needs, based on variables like the weather.
   - Concentrations of people still living in their homes.
   - Potential neighborhood distribution sites, staging areas, and warehouses.
   - Available personnel, such as DSWs and volunteers.
3. Integrate key supply and distribution resources, including:
   - Provision of ice and water by the USACE under the NRF.
   - ARC and Salvation Army mobile feeding and bulk disaster supply distribution programs.
   - Pre-existing distribution programs of local community-based organizations, such as Glide Memorial and Second Harvest Food Bank.

[5] 2008 estimate from the U.S. Census Bureau

4. Identify resources potentially available through major retailers both inside CCSF (e.g., Walgreens) and outside (Target and Wal-Mart).
5. Open 1 to 2 Points of Distribution (PODs) per district, with additional sites selected on the basis of identified needs, density of population, and damage and as resources become available.

D. Personal Care Support

The In-Home Supportive Services (IHSS) Program provides personal assistance services for low-income residents with chronic and disabling conditions who otherwise might not be able to remain and live independently at home. These services include: bathing, dressing, feeding, using the toilet, transferring, mobility assistance, cooking, and cognitive assistance and monitoring.

Key Assumption

The IHSS provides support for approximately 16,000 residents. The IHSS estimates that 400 to 500 people may be at the most significant disaster risk because of the severity of their disability, a greater need for attendant support, the lack of nearby family, and a reliance on electrical equipment.

Key Limitation

Some care providers will be injured or killed by the earthquake or prevented from reaching their normal work assignments because of transportation disruptions.

Response Strategy

1. Use the IHSS Public Authority Registry, which currently lists 300 trained personnel for "on-call" assignments, to fill caregiver gaps.
2. Train existing volunteer or other personnel (e.g., DSWs) to provide personal care assistance, utilizing the training capability of either the IHSS Public Authority or the IHSS Consortium. Potential sources of personnel include:
   - Selected and screened volunteers among the shelter residents.
   - City DSW staff that could be trained at the time of the disaster.
   - NERT or other community volunteers.
   - Hiring selected shelter residents to provide the services.
3. Once the phone system recovers, use the 311 Call Center as one method to connect in-home supportive services clients with the IHSS system.

E. Unaccompanied Minors

It is likely that, following a large earthquake, a number of minors will either become separated from their family or legal guardian or may be the only surviving member of their family. Unaccompanied minors who show up at emergency shelters and medical treatment sites will be identified by first responders

Key Assumption

Approximately 50,000 individuals are expected to require sheltering. An unknown percentage of these individuals may be minors separated from parents.

Key Limitation

Limited staff with child welfare skills will be available to run emergency shelters. There are more than 200 child social workers within the HSA's Family and Children's Services Division, but not all of these employees may be available, or they may be diverted to other more urgent needs.

Response Strategy

1. Use the HSA DOC/Human Services Branch to communicate with Child Welfare Services when unaccompanied minors are identified at any of the emergency shelters or other service sites.
2. Develop a registry of unaccompanied minors to match with inquiries from parents. Coordinate with ARC and other shelter operators.
3. Assign child social workers to work with unaccompanied minors to locate relatives in CCSF, the Bay Area region, or nationally.
4. Use the Child Welfare Services Network to provide shelter services for unaccompanied minors.
5. Given an overflow of minors within the current Child Welfare Services shelter/placement network, dedicate alternate shelter sites for unaccompanied minors that will be run by Child Welfare Workers and other HSA Family and Children Services staff. The Human Services Branch will provide supplies for the sites, including meals.

6.2.2 Public Health and Medical Services

For details about public health and medical operations, see the ESF #8: Public Health and Medical Annex.

A. Mass Casualties

CCSF has 13 city, private, and Federal hospitals (including three campuses of the California Pacific Medical Center) and 20 Community Health Network community clinics and affiliates. There are approximately 90 publicly and privately owned ambulances in CCSF.

Key Assumption

Injuries will vary greatly depending on the time of the earthquake. A Scenario 3 earthquake at 2 PM will generate over 20,000 injuries, over 5,000 of which will require hospitalization.

Key Limitation

Treatment capabilities will be limited by:

- Major structural damage to hospitals.
- A shortage of medical transport vehicles.
- A shortage of trained medical personnel.
- A shortage of medical and blood supplies.

Response Strategy

1. Assess the status of public and private health care facilities and identify resources for treatment of critically injured.
2. At the direction of the Public Health Officer, implement procedures for austere medical care.
3. Establish casualty collection points for on-scene treatment based on the location of:
   - Concentrations of injured.
   - Operational status of local hospitals.
   - Available sites and transportation routes.
4. In collaboration with CalEMA, the Regional Disaster Medical Health Coordinator (RDMHC), and the Emergency Medical Services Authority, implement a plan for regional treatment of mass casualties, to include:
   - Regionally available resources for treatment.
   - Deployment of NDMS assets and DMATs.
   - Priorities for evacuation.
   - Transportation resources.
5. Augment medical resources with:
   - CCSF DSWs who have current medical licenses.
   - Volunteers among medical professionals who reside in San Francisco.

B. Public Sanitation and Environmental Health

Widespread interruptions of the electrical and water distribution systems and damage to critical public sanitation infrastructure, such as potable water and sewage pumping stations, distribution systems, and treatment facilities will create the potential for serious public health problems.

Key Assumption

Water service will be interrupted within the first few hours of a large earthquake and could take two to three months to be fully restored. Electrical power will be interrupted immediately; interruption estimates following a major earthquake range from 7 to 15 days.

Key Limitation

Regional demand for resources, such as water trucks and portable toilets, and disruptions to transportation systems will limit capacity to respond to all situations immediately, requiring interim use of austere measures.

Response Strategy

1. Assemble a Public Sanitation Team to:
   - Assess available resources.
   - Identify needs and potential public health threats.
   - Dispatch advisors and inspectors to shelters and other locations to assist with start-up and evaluate conditions.
2. Immediately request resources through CalEMA, including water, portable toilets, hand washing stations, and shower units.
3. Establish priority locations for initial shipments of critical sanitation resources, including:
   - Hospitals, skilled nursing, and other medical care facilities.
   - Evacuation centers and emergency shelters.
   - Response sites, including staging areas, casualty collection points, and incident command posts.
   - High-occupancy government facilities, including jails.
4. Implement austere measures with available resources, including temporary sanitation facilities using plastic receptacles and pit latrines.
5. Distribute public information to provide the public with guidance to city residents on:
   - Handling procedures for sewage and garbage.
   - Food safety.
   - Water sanitation procedures, including boil water directives.
   - Vector control.
   - Expected time frames for resumption of utility services.

C. Medical/Health Care at Shelter Sites

Numerous people with varying degrees of injury will come to the initial evacuation areas or emergency shelters because they are accessible and they believe medical care will be available at the sites.

Key Assumption

Approximately 50,000 people will seek shelter at shelters run by CCSF and by private nonprofit organizations. Additional shelters will be set up spontaneously by churches and other organizations.

Key Limitation

Medical/health care resources, including trained personnel, equipment, supplies, and medications, will be in short supply. Voluntary agencies that support emergency shelter operations, such as ARC, have limited local licensed health care personnel.

Response Strategy

1. Form medical support teams, consisting of DPH health care staff and Environmental Health inspectors to provide technical guidance and support to shelter site management teams. Identify DSWs who can provide on-site support for screening and nontreatment services.
2. Initial efforts at shelters will focus on screening to:
   - Identify and triage people who have medical conditions that require acute medical care.
   - Identify persons who have chronic health problems (e.g., hypertension and diabetes) and other conditions (e.g., pregnancy or disabilities) that require referral for additional medical attention.
   - Assess those persons who need replacement of prescription medications or medical equipment but do not require hospitalization or transfer to a field care clinic.
   - Assess people for communicable diseases of public health significance.
   - Identify people with mental health/psychological problems that may require assistance.
3. Move people with conditions outlined above to available emergency care facilities or into the system for patient evacuation.
4. In general, limit on-site medical care at shelters to non-acute care, mental health support, and prescription drug replacement.
5. As resources become available (for example, through NDMS):
   - Establish care units at larger shelter sites in accordance with the DMAT clinic model.
   - Establish DPH-operated infirmaries for medically fragile shelter residents or a shelter specifically devoted to medically fragile residents.

D. Mental Health

The general population and emergency response personnel may require mental health support after a major earthquake.

Key Assumption

Approximately 50,000 people will seek shelter. An unknown percentage of sheltered individuals will have conditions requiring mental health treatment. Other sheltered individuals, first responders, DSWs, and volunteers will require mental health services related to stress.

Key Limitation

There will not be enough mental health personnel to cover all support requirements.

Response Strategy

1. Provide mental health support according to the following priorities:
   - Immediate: hospitals, casualty collection points, and mass fatality collection points.
   - Within 72 hours: emergency shelters, evacuation centers, first responder staging areas.
   - Within 7 days: EOC, DOCs, and DSW staging areas.
2. Form mobile teams that will be assigned to rotate among facilities to provide education and support to both staff and residents. Teams will be composed of DPH mental health professionals, DSWs and volunteers with mental health qualifications, and staff from voluntary organizations (such as ARC).
3. Request additional mental health resources through the MHOAC to the RDMHC.
4. Screen incoming shelter residents for pre-existing mental health conditions, current mental-health related prescription medication usage, and other factors that will require support. To the extent practicable, care for these residents in the shelter until more appropriate means (e.g., care from a family member) becomes available.
5. As resources become available, implement the following stress management services:
   - Psychological first aid program.
   - Critical Incident Stress Debriefing or Defusing sessions.
   - DSW respite and support centers.
   - Stress management educational program.
   - Referral for medical and mental health treatment.

E. Mass Fatality

A large earthquake could damage or destroy thousands of structures and cause hundreds of deaths, imposing a massive requirement for handling the deceased.

Key Assumption

A number of variables will determine the number of fatalities, including the time of day when the earthquake strikes. A Scenario 3 earthquake occurring at 2 PM would cause an estimated 1,500 fatalities.

Key Limitation

CCSF will experience critical shortages of staff to conduct investigations and oversee remains recovery operation; supplies such as body pouches; and fixed facilities in which to conduct investigations and store remains. Capacity will be further reduced if the OCME and San Francisco General Hospital facilities are heavily damaged during the event.

Response Strategy

1. Dispatch OCME staff to support Incident Commanders with retrieval of remains. In situations where structures collapse and trap large numbers of people, establish a temporary fatality collection point adjacent to the site to facilitate processing of the remains.
2. Based on the estimated size of the earthquake and number of expected fatalities, begin the process of obtaining resources through:
   - The Law Enforcement/Coroner Mutual Aid system.
   - State and Federal resources, such as DMORTs.
   - Pre-identified local private and public resources.
3. Designate the locations of:
   - A temporary morgue.
   - Temporary fatality collection points, based on projected locations where large numbers of fatalities are likely to occur.
   - Staging areas for incoming Mutual Aid resources, such as DMORTs.
4. Increase transportation resources where possible through:
   - Refrigerated rental box trucks with power lift gates that may be used to supplement existing transport capability. Simple shelving can be installed to allow stacking (limited to shoulder height).
   - Private funeral homes.
   - Emergency Medical Services units, if available.
5. Collect DNA samples, fingerprints, X-rays and dental information on all unidentified remains and process through local, regional, or national agencies for assistance in identification.

6.2.3 Animal Response

Residents who own pets will be reluctant to leave them behind following a disaster. A survey completed following Hurricane Katrina indicates that approximately 50 percent of pet owners will refuse to evacuate without their pets.[6] They will bring pets to shelters or evacuation areas if they are forced to evacuate their homes.

For details about animal response operations, see the ESF #11: Animal Response Annex.

Key Assumption

In a Scenario 2 or 3 earthquake, approximately 30,000 pets would be displaced with their owners, potentially requiring evacuation or sheltering. A significant number of pets will likely be housed with their caretakers in hotels or at unaffected family and friends. Taking these factors into consideration, CCSF will need to shelter approximately 8,300 pets.

Key Limitation

The CCSF Animal Care and Control Department does not currently have a significant reserve of emergency response equipment or materials and will immediately need outside resources to establish a large-scale animal care response.

Response Strategy

1. Once the status and safety of the primary animal shelter is established, dispatch Animal Care and Control staff to areas where high concentrations of evacuations are occurring to provide support for the pets of the evacuees and help collect strays.
2. Request for State and Federal support will be placed through CalEMA. This includes support from the California Animal Response in Emergency System program and Federal Veterinary Medical Assistance Team support.
3. Establish animal shelter sites in locations that will make them reasonably accessible for owners staying in emergency shelters. Establish at least one animal shelter site in each supervisorial district, as resources allow and if one or more emergency shelters are located there.
4. Identify three to five animal care providers per 24-hour period per shelter. If the number of personnel available through existing Animal Care Unit agencies is not adequate for the requirement, recruit and train community volunteers to provide additional staff resources.
5. For animals collected by Animal Care and Control staff:
   - Implant an identification microchip, if one is not already in place.
   - Take a digital photo of the animal and add the photo to the animal's record, which, in the case of strays, will include the area where the pet was picked up.

[6] Zogby International poll – Associated Press article of 5/23/2006

6.3 Law Enforcement Branch Functions

For details about law enforcement operations, see the ESF #13: Law Enforcement Annex.

6.3.1 Evacuation

Evacuation of members of the public who are in immediate, life-threatening situations is a high priority for CCSF. This discussion pertains to large-scale evacuations. Decisions regarding evacuation of large areas of the city (such as evacuation of multiple city blocks or neighborhoods) will be made by the Policy Group. For site-specific situations, the on-scene Incident Commander will have responsibility for evacuations necessary to save lives and protect public health and safety.

Key Assumption

Personally owned vehicles, publicly and privately operated buses and other vehicles, roads, and public transit systems will be damaged, requiring immediate assessments of available means and routes for evacuation.

Key Limitation

Damage to transportation infrastructure, including roads and bridges and blockages due to debris, may severely limit the initial ability to use buses and other large vehicles to relocate at-risk populations.

Response Strategy

1. Priorities for evacuation are as follows:
   - Movement away from immediate threats to life and safety.
   - Movement of medically fragile, elderly, and disabled persons to appropriate shelters or other facilities where the appropriate level of care can be provided.
   - Movement of residents who require shelter to an available shelter.
   - Evacuation of commuters, visitors, and other residents desiring to leave the city.
2. Identify sites for loading, unloading, and staging vehicles; and routes that are clear, or must be cleared, to provide dedicated capacity for evacuation operations.
3. Task available CCSF transit resources, including MUNI buses, with movement of evacuees according to these priorities.
4. Request support from non-CCSF transit agencies through the REOC. Working with the MTC, the REOC will coordinate:
   - Provision of transportation resources available from non-CCSF transit agencies.
   - Support from other Operational Areas, in terms of destinations for evacuees outside CCSF.
5. If evacuations impact another jurisdiction (such as San Mateo, Marin, and Alameda counties), coordinate with the Operational Area in question and the REOC.

6.3.2 Public Order and Perimeter Control

A major earthquake will generate a significant number of situations requiring the need to provide immediate assistance, maintain public order, and to control areas where hazardous or life-threatening conditions exist. Priorities for the initial deployment of law enforcement resources will be made at the SFPD DOC, after evaluation of the public safety risk presented by all of the major incidents.

Key Assumption

Occurrences requiring perimeter control will number in the hundreds, if not thousands. These sites may involve structure fires, partially or fully collapsed buildings, debris, operation of heavy equipment, marshalling of transportation resources, and hazardous materials spills. The requirement to have sworn personnel involved in perimeter control will vary by situation.

Key Limitation

Resources available will be constrained by the number of law enforcement personnel available immediately following the earthquake. Timing of the earthquake and damage to the transportation system may limit the number of personnel in, or able to reach, the city.

Response Strategy

1. General priorities are as follows:
   - Respond to those in immediate need of life-saving assistance.
   - Prevent criminal activity.
   - Assess and report damage or incidents.
   - Provide organized perimeter control for identified sites.
2. Balance these priorities with the need for security at CCSF facilities.
3. Factors for prioritizing an incident site for perimeter control include:
   - Potential need for evacuation of nearby residents, especially sites close to vulnerable populations such as hospitals, nursing homes, or schools being used as shelters.
   - Population density close to incident site.
   - Potential for rapid spread of the scope of the incident.
   - Extent of risk to public safety involved with the incident.
4. Assess the need for sworn officers at perimeter control sites. To the extent practicable, use DSWs for tasks such as traffic control, patrolling, and providing directions.
5. Following an initial assessment of needs, immediately request support from:
   - Law enforcement agencies having jurisdiction within CCSF (such as Federal Protective Services).
   - Other local jurisdictions, via the Mutual Aid system.
   - State agencies, including the California National Guard.

6.3.3 Facility Security

Damage to facilities and the need to immediately initiate response operations from key facilities will require the deployment of law enforcement personnel for security purposes. In addition to city facilities, security will be necessary at shelters, distribution points, and other locations that are critical to the response. Other public and private entities will also face security requirements.

Key Assumption

The San Francisco Sheriff's Department (SFSD), with a total of approximately 850 sworn officers, is responsible for security at key CCSF government facilities, including City Hall, Hall of Justice, county jail facilities, Civic Center Courthouse, San Francisco General and Laguna Honda hospitals, DPH clinics, and the EOC.

Key Limitation

The number of potential sites, including shelters and other relief facilities, requiring security may quickly exceed resources available to SFSD and SFPD. Approximately 2,100 security workers would be required for full security at city-operated relief sites alone.

Response Strategy

1. Provide minimum security necessary at facilities for which SFSD has responsibility, including City Hall, Civic Center Court House, and Hall of Justice; and re-direct available resources to provide security at response facilities.
2. In the initial allocation of resources for security at CCSF facilities, give first priority to facilities that are critical to the response, such as:
   - Casualty collection points and temporary morgues.
   - Hospitals.
   - Emergency shelters, first aid stations, and feeding stations.
   - Staging areas, warehouses, and PODs.
   - EOC and DOCs.
3. Other public organizations with sworn personnel (such as Bay Area Rapid Transit and Federal buildings) and private sector entities (such as hospitals) will have initial responsibility for protecting their own facilities.
4. Dispatch law enforcement personnel to non-CCSF facilities if other sources are not available and if:
   - Life-threatening circumstances are evident.
   - Response operations will be severely compromised.
5. As described in Section 5.2, request additional support from:
   - Law enforcement agencies within CCSF (such as Federal Protective Services).
   - Other local jurisdictions, via the Mutual Aid system.
   - State agencies, including the California National Guard.

6.4 Transportation Branch Functions

For details about transportation operations, see the ESF #1: Transportation Annex.

6.4.1 Route Recovery

Recovery of surface transportation routes is critical to allowing expeditious movement of response resources around CCSF and to begin the process of recovery for the city's transportation network. Given limited resources, the Transportation Branch must establish priorities for route recovery that are tied to ongoing response priorities.

Key Assumption

CCSF has designated priority routes for opening during an emergency or disaster. These routes are shown in Figure 6-1.

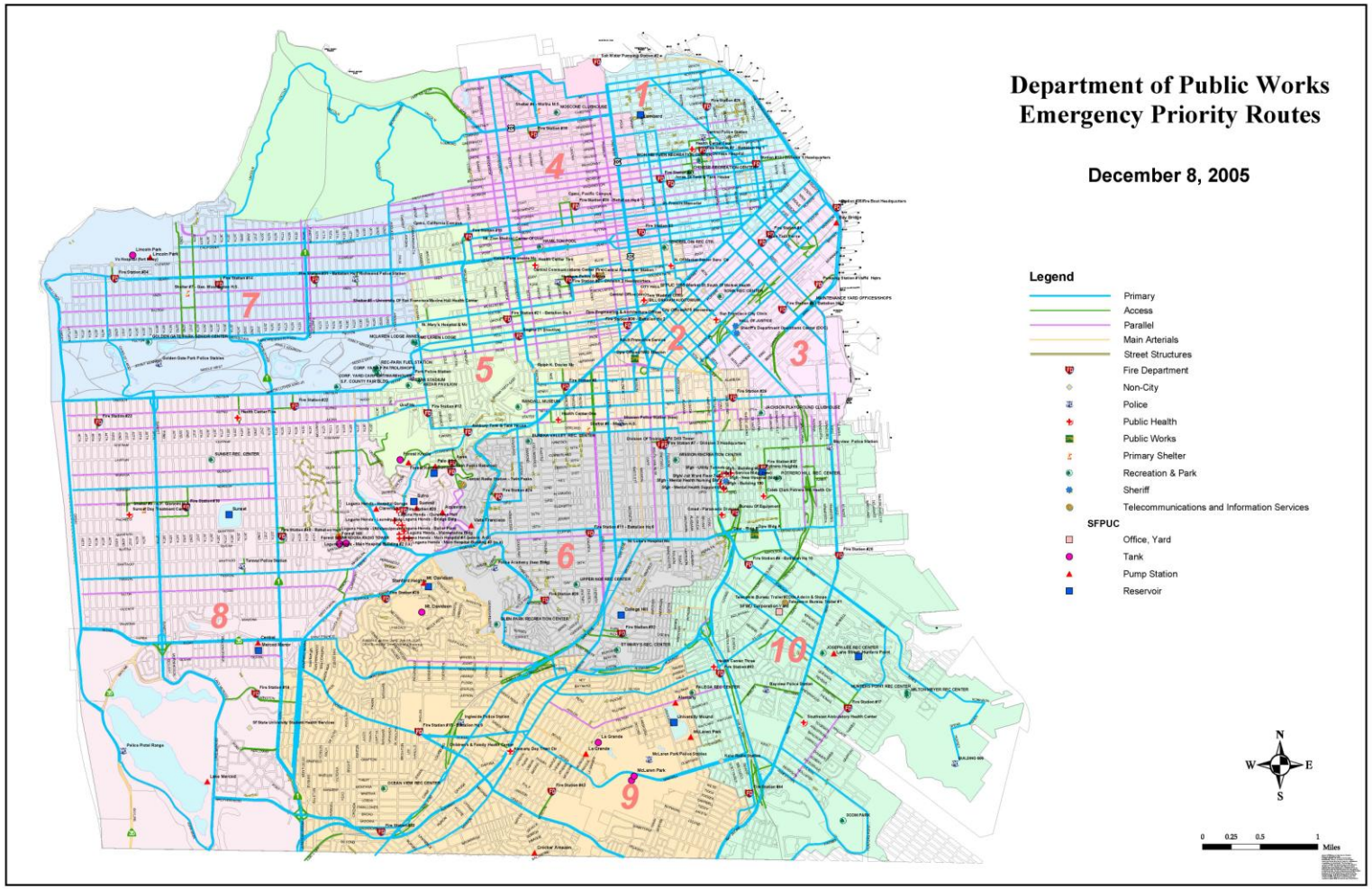
Key Limitation

CCSF will quickly exhaust its limited supply of heavy equipment and operators to perform emergency debris removal and roadway repair. CCSF will also experience shortages of supplies such as large quantities of asphalt.

Response Strategy

1. Consolidate street condition and other situational information from field personnel reports, including DPT and DPW windshield surveys, to establish an initial operational picture of the damage.
2. Develop the sequence for debris clearance and emergency repairs according to the following:
   - Evacuation routes.
   - Routes between the worst impacted areas to operating hospitals and casualty collection points.
   - Routes between the worst impacted areas and SFFD battalion stations.
   - Routes that link staging areas for Mutual Aid resources to San Mateo, Marin, and Alameda counties (including approaches to the Bay and Golden Gate bridges), including routes to San Francisco International Airport.
   - Routes necessary to allow movement of DSW personnel to their DOCs and other staging areas.
   - Routes to the DPW yard and central shops.
3. Coordinate the sequence of clearance activities with the REOC, MTC, and Caltrans to time route openings with ongoing work to open bridges and State highways.
4. Stage debris at temporary sites as routes are cleared. Reduce and remove debris to disposal locations as debris becomes available.
5. Request additional resources through the REOC, including Federal debris clearance support through the USACE.

Figure 6-1
Route Recovery Map



Source: San Francisco Department of Public Works

6.4.2 Traffic Control

As debris removal and emergency repairs have restored functionality, the primary routes may become clogged with noncritical traffic. Traffic signals may be inoperable due to power outages or damage, and spontaneous volunteers may attempt to direct traffic. The Transportation Branch will coordinate the establishment of access control measures on surface streets that are designated as primary routes.

Key Assumption

DPT has a total of approximately 250 traffic control personnel. Additionally, DPT has a list of battery-operated traffic lights that may be used to identify potential routes for traffic flow.

Key Limitation

The demand for personnel to control access to designated priority routes will compete with the demand for personnel to provide perimeter control at fire, building collapse, and other critical sites.

Response Strategy

1. Begin access control planning immediately as an integral part of the designation of primary routes.
2. Implement an access permit system that will allow prioritization of access to limited surface transportation routes. The system will accommodate the following access categories:
   - Life-safety uses (police, fire, and medical vehicles).
   - Emergency response support, including DSWs, contractors, and heavy equipment.
   - Supplies, including food, water, shelter supplies, and medical supplies.
   - Debris removal.
3. Establish a shuttle system to move first responders and DSWs in and out of the city so that they can return home or use housing resources located outside of the city.
4. Obtain additional personnel from the following sources:
   - MUNI personnel, including street inspectors are trained in traffic control.
   - NERTs.
   - Volunteers from the Police Citizens Academy.
5. Use barriers, including debris piles, MUNI buses, k-rail barriers, electronic traffic control signs, and DPT street barricades to limit access to priority routes if adequate traffic control personnel are not available.
6. Coordinate the release of public information through the PIO regarding route restrictions, projections for opening, and guidance to residents for reducing traffic impacts.

6.5 Infrastructure Branch Functions

For details about Infrastructure Branch responsibilities, see the ESF #3: Public Works and Engineering Annex and the ESF #12: Water and Utilities Annex.

6.5.1 Safety and Damage Assessments

Assessments will be necessary immediately to determine whether public and private buildings can be safely entered or used and to develop priorities for implementing repairs. The primary goals of this process are to protect the public and to expedite resumption of residence, business, services, and community activity as soon as possible.

Key Assumption

The number of buildings potentially requiring assessment is as follows:

- Currently, 172 CCSF buildings are designated as "critical facilities," and 300 buildings are designated as "important facilities."
- There are over 120,000 commercial and residential structures in San Francisco. Approximately 45,000 structures would be damaged in a Scenario 3 earthquake.

Key Limitation

The number of facilities and structures requiring immediate safety inspection is far greater than the number of trained inspectors. Supplemental resources will be required immediately.

Response Strategy

1. Conduct post-earthquake safety evaluations in three phases:
   - Initial windshield survey (non-site specific).
   - Rapid evaluation.
   - Detailed evaluation of structures with significant damage.
2. Responsibilities for assessments are as follows:
   - DPW: Public infrastructure. Critical facilities for response will be given priority.
   - Department of Building Inspection (DBI): Private buildings. DBI will post buildings with Safety Assessment Program (SAP) placards to indicate level of access permitted.
   - Department of Technology and Information Systems: Communications systems and fiber-optic network.
   - Other agencies: San Francisco International Airport, the Port of San Francisco, and MUNI will conduct assessments of their facilities. The PUC is responsible for evaluation of the water system.
3. Through the CCSF EOC Logistics Section, immediately request support from CalEMA for volunteer building Evaluators and Coordinators under the post-disaster SAP.
4. Conduct evaluations in accordance with *Procedures for Post-earthquake Safety Evaluation of Buildings* (ATC-20) developed for FEMA by the Applied Technology Council.

5. Based on the results of the windshield survey, DBI will evaluate and appropriate resources as required for rapid and detailed evaluations. DBI will not perform more detailed inspections of privately owned buildings if there is no obvious structural damage (unless requested by the owner) or if the building was obviously destroyed.

6.5.2 Emergency Shoring

Following a major earthquake, hundreds and possibly thousands of structures (including buildings, bridges, elevated roadways and other structures) may partially or fully collapse. Damaged structures may require emergency shoring to minimize the risk of further collapse, especially during the numerous aftershocks that will follow a large earthquake.

Key Assumption

Approximately 45,000 structures would be damaged in a Scenario 3 earthquake.

Key Limitation

The number of structures requiring shoring will exceed existing CCSF capacity. Other sources of materials and labor will be immediately necessary. However, regional shortages of these materials are likely to occur, given similar impacts to other communities.

Response Strategy

1. Unsafe structures requiring shoring will be identified as follows:
   - During either the windshield survey or the rapid evaluation of the safety and damage assessment process.
   - Through SAR activities.
2. Once the safety of a structure has been evaluated, determine whether an emergency demolition order should be issued or if emergency shoring will be required.
3. Criteria for prioritizing demolition and shoring operations include:
   - Potential life-safety risk. In situations where a threat to life is immediate, shoring will be implemented immediately without further evaluation. SAR teams may implement shoring as part of team operations if lives are at risk and resources are available once resources can be identified.
   - Threats to critical facilities, such as fire and police stations, schools, hospitals and clinics.
   - Potential for blockage of emergency routes and damage to critical infrastructure (such as utilities and telecommunications systems).
4. Request additional resources through the REOC, including emergency engineering and shoring support from the USACE. Note: The USACE primarily provides infrastructure (street and piping) support. CalEMA has FEMA-certified USAR Structure Specialists for building collapse expertise.
5. If a threat to life is not imminent, responsibility for performing the shoring will be determined by the ownership of the structure.

- The Department of Public Works will coordinate emergency shoring contracts for public structures through the Construction and Engineering Branch.
- The owners of privately owned structures are responsible for locating and contracting with contractors to install emergency shoring on their structures when ordered by the Department of Building Inspectors, through the Construction and Engineering Branch.

6.5.3 Debris Removal and Management

Debris from damaged buildings and other infrastructure will block streets and prevent access to buildings, impeding response functions.

Key Assumption

It is estimated that a Scenario 3 earthquake could create over 10 million tons of debris in San Francisco. Much of this debris would be generated as the demolition of damaged buildings and infrastructure proceeds.

Key Limitation

Local, State, and Federal governments and private property owners will compete for a limited number of regional debris removal contractors and equipment, as well as limited landfill and disposal capacity.

Response Strategy

1. Mobilize CCSF resources and available contractors. Immediately request direct Federal assistance through CalEMA for debris removal operations.
2. Implement debris removal in the following phases:
   - Push aside to clear a path or move to adjacent open areas to clear roadways, or demolish heavily damaged structures and secure site until debris removal is possible.
   - Remove the debris to a staging area where it will be sorted and reduced, with recyclable materials separated.
   - Move from the staging area to final disposal sites or to recycling facilities.
3. Initially prioritize CCSF debris removal resources for SAR missions and clearance of priority routes.
4. Establish:
   - Staging areas for heavy equipment.
   - Temporary staging and reduction sites for debris with access to highways and barge loading sites.
   - Locations for disposal and recycling. Work with CalEMA and regional governments to develop a regional solution to limited disposal capacity.

   Appropriate sites may be in demand for other uses, such as staging of resources for response operations. The Logistics Section will evaluate potential sites and prioritize among competing uses.

5. Establish procedures for demolition and removal of debris from public and private property. Appropriate procedures for declaration of a threat, condemnation, and hold harmless must be in place.

6.6 Communications Branch Functions

For details about Communications Branch responsibilities, see the ESF #2: Communications Annex.

6.6.1 Emergency Communications

The Communications Branch, led by DEM, is responsible for coordinating the repair of damaged CCSF communications, the allocation of CERS talk groups and frequencies, and the expansion of communications capability to fill emerging needs.

Key Assumption

Refer to the ESF#2: Communications Annex for a description of communications system failure fallback modes for use when normal communications systems are overloaded or fail.

Key Limitation

The earthquake will damage or compromise CCSF emergency communications systems. At the same time, the demand for radio communications will increase significantly as CCSF departments respond to the event.

Response Strategy

1. Immediately undertake the following measures to minimize radio system overload and maintain communications with incoming Mutual Aid resources:
   - Request that CalEMA allow CCSF to use at least two of the designated Mutual Aid frequencies.
   - Spread the frequency load by rapidly assigning currently available open talk groups, including OES-1, OES-2, Event-1, and Events-2 and -3; and communicate designations to the EOC and DOC.
   - Activate communications support for response activities, such as those of the Human Services Branch, where the lead agency does not normally utilize the CERS or DPW 800 MHz radio systems.
   - Coordinate the activation of patches between talk groups on the CERS or DPW 800 MHz system so multiple departments can share critical information and coordinate their activities.
2. Manually activate the repeater on Twin Peaks through the DEC Communications Center.
3. Assess damage to the CERS and DPW systems and engage vendors for immediate repair activities, and coordinate with telephone companies to assess system damage and determine the status of recovery efforts.
4. Confirm or modify the Incident Management Plan for Mutual Aid Agencies at the time of the disaster.

5. Regional Mutual Aid Coordinators will disseminate the appropriate radio frequency to all agencies providing resources to CCSF. DEC is the primary Mutual Aid radio control point.

6.6.2 Alert and Notification

CCSF must provide alerts and notifications to the city's population regarding additional hazards, evacuation orders, and information necessary to protect life and public health and safety.

Key Assumption

The CCSF Emergency Outdoor Warning System is one tool that can be used for warnings via siren and public address broadcast. The system is solar-powered and radio-controlled. If the siren sites are intact and the radio system operational, the system can be used if power and phone systems are disabled. Other tools are described below.

Key Limitation

Lack of electrical power will limit capabilities for distributing information to the population (e.g., certain broadcast capabilities will not be immediately available) and will limit the population's ability to receive it (e.g., televisions will not be available).

Response Strategy

1. Life-safety alert and warning information has first priority for release.
2. Situations that threaten life may become apparent at:
   - Field level. In such cases, the Incident Commander relays the information to the DOC, which coordinates with the Warning and Notification Branch at the EOC.
   - DOC or EOC level. The applicable units will coordinate with the Warning and Notification Branch to ensure that field units are informed.
3. Notify the public using the following options:
   - CCSF Outdoor Warning System, as described above.
   - Emergency Alert System (EAS). The primary local EAS broadcast station for the Bay Area is KCBS (740 AM). EAS messages may be sent via the Internet-based HazCollect system (maintained by the National Oceanic and Atmospheric Administration).
   - Public service announcements through radio and television, including radio broadcasts using the SFUSD radio station, KALW.
   - On-scene loudspeaker announcements.
4. Provide CCSF response personnel assigned close to a risk area with adequate warning and recommended personal protective actions, using the following:
   - Use of the common CERS hailing frequency (Events-1).
   - Announcements in the EOC to all sections/branches/units to warn field staff.
5. The PIO will develop the content for EAS messages and other releases in collaboration with the appropriate subject matter experts (e.g., with the Human Services Branch for health-related messages). Release of announcements will be coordinated through the JIC.

6.7 Emergency Public Information

For details about emergency public information, see the ESF #15: Joint Information System Annex.

6.7.1 Communicating with the Public

There will be a significant need to communicate a broad range of information to the public following a major earthquake, including information that is critical to their personal safety, ability to cope with the disaster, and steps toward recovery.

Key Assumption

The PIO at the EOC will initially coordinate emergency public information. Once established, the JIC will assume this function. Details about the public information function within the EOC are found in the ESF #15: Joint Information System Annex.

Key Limitation

Disruptions to, or lack of access to, television, radio, newspapers, and the Internet will limit means for communicating with the public.

Response Strategy

1. Develop standardized messages for key public safety topics. The attachment to this section, Suggested Post-Earthquake Public Disaster Information Releases, contains a list of recommended public safety messages for release.
2. Initial priorities will include providing the public with information about protecting themselves and their homes; how to access medical assistance and other critical services; and finding missing family members. Within the first week, the focus will expand to include information on where to find recovery services and how to recover possessions from damaged buildings.
3. Establish coordination with radio and TV stations. Radio stations will be the most effective method for communicating within the impacted area until power is restored. The SFUSD radio station, KALW, provides coverage for all of CCSF and can be used support the emergency broadcast needs.
4. The AlertSF system will be operational from the EOC and will provide the ability to send broadcast digital messaging to any number of groups such as vulnerable populations, large business owners, and community-based organizations.
5. As power is restored, TV, newspapers, and the Internet will again become effective information channels. Printed newsletters and flyers will also be used to communicate to people in shelters and other areas of congregation.

Attachment to Section 6.7

Suggested Post-Earthquake Public Disaster Information Releases

For Use during the First 72 Hours

- "CCSF has activated the emergency response plan and is fully deploying all available resources. Please continue to monitor emergency broadcast radio information releases, remain calm and work together with your neighbors to support each other through these next difficult days. If you have neighbors with disabilities or other impairments, please check on their welfare and support them in any way possible."
- "We need your cooperation to ensure we can respond effectively to life-safety situations. Please do not try to use your phone, unless you have a life-threatening situation. Please refrain from driving so we can keep available open streets clear for moving emergency equipment and personnel."
- "Your phone may not have a dial tone when you first pick up the receiver, due to system damage and overload. If you have a life threatening situation such as a critically injured person or large fire to report, wait for several minutes to see if a dial tone becomes available, do not just hang up immediately and try again."
- "Survey your home immediately to identify hazardous conditions, including fires, gas leaks, electrical shorts, and broken water lines, spilled flammable or hazardous materials. Be cautious of broken glass."
- "If you smell or hear escaping gas in or near your home or if your home shows signs of partial or imminent collapse, or is threatened by a large fire, evacuate immediately. Turn off the gas supply to the home at the valve where the gas line comes into the structure. If you do not smell or hear gas, in your home and there are no signs of fire, do not shut off the gas unless instructed to by emergency officials."
- "Stay away from any fallen electrical wires; do not touch or attempt to move them. Always assume they are live; avoid coming into contact with any surface touching a fallen electrical wire, especially standing water."
- "Do not use candles for lighting; they are a common source of fires, especially following earthquakes when they can be knocked over during aftershocks or cause explosions when exposed to gas. If **small** fires occur and you have access to a fire extinguisher(s) and are trained to use them, put out the fire immediately."
- "We expect numerous earthquake aftershocks in the following days and weeks; some may be substantial and cause additional damage. They will gradually subside in frequency and intensity. Stay aware of your surroundings and do not enter severely damaged buildings or sleep in hazardous locations where large, heavy items may fall on you."

- "Emergency shelters will be overcrowded and lack many basic services for several days and should be reserved for people displaced from unsafe structures. If your home is lightly damaged and still habitable after clean up of overturned furniture, broken glass or other nonstructural damage, remain in your home if possible and turn your radio to one of the emergency broadcast stations, such as 740 AM, and monitor public safety announcements. Alternatively, seek shelter with family or friends if possible."
- "Food stored in your refrigerator can normally be safely used, if consumed within four hours of a power failure. Food stored in the freezer section can be used for up to two days, if you minimize the number of times you open the door."
- "If you are forced to evacuate your home and seek emergency shelter, if possible bring the following items:
  - 'Go-kit' with basic supplies, including nonperishable food, snacks, water, first-aid supplies, and prescription medications.
  - For each person: a change of clothing, jacket, sturdy shoes, personal hygiene supplies, wash cloth and towel, pillow, blankets or sleeping bag.
  - Personal identification, credit cards, house keys, cell phone and charger, list of important phone numbers, copies of important papers (insurance policies –health and home, birth certificates, etc.).
  - A few books, toys, and games for children.
  - Special food or support materials for an infant or elder requiring these items.
- "If you evacuate with your pet, bring a separate supply of food, water, feeding dishes, leash, pet carrier, vaccination records and a supply of any prescription medications they may be taking. You will be required to muzzle your dog when using publicly available means for evacuation. Additionally, separate shelters will be set up for pets; ensure your pet is wearing identification tags."
- "Due to the potential for carbon monoxide poisoning, do not use a charcoal grill or run a generator indoors (including in your garage)."
- "We recommend that you rely on canned juices, your stored emergency drinking water, or water available from your hot water tank for your immediate drinking needs. Continue to monitor public safety announcements for the potential issuance of 'boil water' orders. If one is issued, follow the recommended guidelines for purifying your drinking water."
- "If there is a substantial amount of smoke or dust in your immediate area, wear a dust mask or otherwise avoid prolonged exposure."
- "Once telephone service begins to be restored, call your designated out-of-area emergency family contact to update them on your welfare and location, have them contact the rest of your family and friends to update them on your situation. Continue to limit your phone calls to emergency situations until otherwise notified by emergency officials."

6.7.2 National/International Communications

San Francisco has a high number of residents, workers, and visitors who are from other parts of the United States or other nations.

Key Assumption

CCSF can expect high levels of interest nationally and internationally from family and friends of CCSF residents or visitors; consulates of foreign governments with significant numbers of citizens living in or visiting San Francisco; national and international media; and national and international corporations with branch offices or staff in San Francisco.

Key Limitation

The PIO and counterparts representing other CCSF departments will be challenged by the number of inquiries and the rapidly evolving situation.

Response Strategy

1. Obtain additional PIO support through requests to neighboring jurisdictions and CalEMA.
2. The Mayor's Office will designate a response liaison, such as the Office of Protocol, to foreign consulates to ensure they are provided with all available information on their citizens and to act as a point of contact for the State Department.
3. Establish a foreign media liaison in the PIO section to coordinate media visits and inquiries.
4. Add links to the CCSF Web site to agencies such as the Red Cross that support family welfare inquiries. The Internet will ultimately be the best method for providing general information to overseas audiences. Add Web pages to the SFGOV Web site that provide access to translated situation information, damage photos, and links to other resources, such as local foreign-language media.
5. Establish designated phone numbers with pre-recorded messages in a variety of languages that provide a basic situation update and referral to the CCSF Web site for additional details. Provide the information line phone numbers to directory assistance, for use when overseas callers try to contact local government offices.

6.7.3 Translation Support

Responding CCSF departments and agencies will need translation capability to support both verbal and written communications with a wide variety of audiences some of which are pre-translated and others, which are incident specific requiring translation into specific languages at the time of the event. Examples of situations where translation services will be critical to providing services include:

- Translating printed outreach material that provides the public with information regarding how to access services and take personal protective measures.
- Emergency shelter signs and written information
- Evacuation notifications

- CCSF phone banks (e.g. 311 Call Center, which offers significant translation in 140 languages)
- Recovery service centers

Translation services will also consider the needs of sight and hearing impaired individuals.

Key Assumption

The 2000 Census estimated that approximately 45 percent of the households in CCSF speak a language other than English at home. The top five languages requiring translation services for the 911 system in 2005 were Spanish, Cantonese, Mandarin, Russian, and Vietnamese.

Key Limitation

Most commercial translation vendors serve regional markets, so there will be intensive competition for their services following a large earthquake that impacts the entire Bay Area Region.

Response Strategy

1. Review pre-scripted messages (see Section 6.9, above) that have been translated into key languages to ensure applicability.
2. Identify critical needs for translation services. These may include shelters or other service sites in areas with a concentration of non-English speakers.
3. Establish:
   - A language distribution standard for various disaster-related public communications.
   - A translation coordinator in the Human Services Branch who will monitor translation service requirements in the shelter system and coordinate Human Service Agency resources to meet identified requirements.
   - Means for translating new templates for post-disaster messaging into key languages.
4. Identify potential sources of additional translation services:
   - Existing city vendors for translation services, including International Effectiveness Centers. Additionally, the prime 911 vendor (NetworkOmni) offers a wide variety of translation services that CCSF can contract for separately.
   - CCSF translation staff. HSA maintains a list nearly 400 certified translators that they track in an internal database.
   - Staff from SFUSD's internal Translation Department.
   - DSWs with language capabilities who can serve as translators.
   - The "Language411" (http://www.language411.org) program based in Oakland offers both phone and in-person translation services and have staff that live in CCSF.
   - Community resources available through San Francisco Community Agencies Responding to Disasters (CARD) and other community-based and private nonprofit organizations.

- Volunteers. For example, the Volunteer Center serving San Francisco and San Mateo Counties has a database of volunteers that may be accessed to determine if any volunteers with language skills are available.
- Citizen Corps resources. For example, the Medical Reserve Corps in San Francisco supports Self-Help for the Elderly, a community-based organization that provides language skills specifically to serve the Chinese community. Other member-agencies, such as the City College ALERT program, may also be able to provide translation services post-disaster.
- The United Way HELPLINK 211 system uses a commercial vendor, Avid; and they have a database of 33 San Francisco non-profit agencies that have translation services.

5. In addition to previously translated, pre-scripted messages, prepare translated versions of event-specific disaster assistance information for distribution/posting at shelters and other service sites. As concentrations of non-English speaking disaster victims are identified at a specific location, such as a shelter or recovery center, the Supportive Services Unit will evaluate the feasibility of establishing on-going translation support at those sites.

   Once phone communications are restored, use the 211 system where an on-call translator can facilitate a conversation to address translation needs in shelters or at other service sites.

6.8 Logistics

For details about the EOC Logistics Section, see the ESF #7: Logistics Annex.

6.8.1 Resource Acquisition

When internal resources have been expended, CCSF will require external emergency response supplies, equipment, and specialized teams to effectuate emergency response activities. The CCSF EOC Logistics Section is responsible for obtaining these resources.

Key Assumption

Locally available response resources will be expended or utilized within the first 72 hours of a major earthquake, requiring the use of regional, State, and Federal resources. SEMS, the Master Mutual Aid Agreement, Emergency Managers Mutual Aid (EMMA), and the NRF will form the framework for obtaining additional resources.

Key Limitation

Movement of response resources into CCSF will be delayed due to infrastructure damage and debris.

Response Strategy

1. CCSF response agencies will utilize existing CCSF equipment and supplies and purchase additional supplies and equipment when possible.
2. DOCs will request additional resources through their EOC representative. Logistics will fill these requests by:
   - Locating inventories from known sources.

- Acquisition through purchasing.
- Acquisition from alternate vendors.
- Non-discipline-specific mutual aid requests.

3. The CCSF EOC Logistics Section will submit requests that cannot be filled locally to the REOC via RIMS.
   - Initial requests will be made for key resources that will be needed within the first 48 hours.
   - Requests will include requirements for transport of resources to CCSF.
   - Providers of mutual aid and other forms of assistance may include non-impacted Operational Areas, State agencies, other states, and the Federal government.

6.8.2 Staging and Distributing Resources

Emergency supplies and equipment that are delivered to support CCSF emergency response will be staged and distributed to individuals and emergency response agencies.

Key Assumption

Agencies providing resources will assist in delivering these resources to staging areas, but CCSF will be responsible for distributing the supplies to CCSF residents and individuals.

Key Limitation

Space required for resource staging will compete with space needs for other emergency response functions, including debris staging and emergency shelter for displaced residents.

Response Strategy

1. Establish staging areas for incoming Mutual Aid and other resources at large open spaces within CCSF.
2. Manage staging areas.
3. Establish points of distribution for commodities in each supervisory district.
4. Mobilize CCSF's fleet of vehicles and utilize existing contracts to rent or lease additional vehicles to move response resources and commodities from staging areas to DOCs, incident command post, and points of distribution.
5. Establish a schedule for response agencies and individuals to retrieve equipment and supplies from staging areas and points of distribution. Schedule will be communicated to DOCs and to the public through emergency public information channels.

6.8.3 Logistics for First Responders and DSWs

First responders and DSWs who are working in the city will have difficulty getting in and out of the city and will therefore require housing, meals, and other support. Additionally, first responders and other workers who are deployed by Mutual Aid providers, State and Federal

agencies, NGOs, and other organizations may initially be self-sufficient and but may eventually require logistical support.

Key Assumption

CCSF has over 20,000 personnel that may be assigned to various DSW roles. Additionally, many CCSF staff reside outside of San Francisco.

Key Limitation

Housing resources will also be in demand from city residents and visitors who cannot leave the city. CCSF will not dislocate residents or evacuees from their lodging to house DSWs.

Response Strategy

1. Use the Human Resources Branch in the Logistics Section to coordinate the acquisition of housing and allocate it to the Human Resources Branch staff at the DOCs, which will manage the actual assignment of workers to housing. These assignments must be made in coordination with other organizations that are sending workers to assist with response and recovery operations to evaluate whether these teams are self-sufficient or will require logistical support.
2. Establish shelters for first responders and DSWs using structures designated for that purpose. The requirement to house these workers must be balanced with the requirements to shelter displaced residents.
3. Evaluate existing facilities for housing options. These include:
   - Hotel rooms, once visitors have been evacuated and structures inspected.
   - University dorm rooms, once students have been evacuated.
4. Request support for alternative options from the State and Federal governments, such as:
   - Cruise ships – Assuming that piers and dockside support systems are working.
   - Military ships – Could dock in San Francisco to provide not only emergency worker housing but also a source of purified water, electricity, prepared food, medical care, and other support services.
   - Base Camps – Base camps may be established and supported by either the California Department of Forestry or the U.S. Forest Service.
   - Privately owned facilities.

6.9 Recovery

Immediately following an earthquake, all available resources must be devoted to saving lives and property. Nonetheless, recovery efforts must begin as soon as possible.

General objectives for recovery are described below in Table 6-1.

Table 6-1
Recovery Objectives by Timeframe

Phase	Objectives
Phase 1 – Initial Response 1-7 Days *Restore critical services*	▪ Debris removal and clean-up ▪ Emergency, short-term repair of lifeline utilities ▪ Emergency, short-term repair of transportation systems and provision of interim transit services ▪ Building safety inspections ▪ Coordination of State/Federal damage assessments ▪ Re-occupancy of buildings
Phase 2 – Mid-Term Planning 7- 30 Days *Meet ongoing social needs*	▪ Provision of interim housing ▪ Restoration of lifeline utilities (power, water, sewers) ▪ Restoration of social and health services ▪ Restoration of normal City services ▪ Establishment of new ordinances governing location and nature of rebuilding ▪ Examination of building standards ▪ Economic recovery measures, including interim sites for business restoration
Phase 3 – Long-Term Reconstruction Several Years *Plan for and implement re-building*	▪ Rebuilding ▪ Restoration of transportation systems ▪ Hazard mitigation ▪ Reconstruction of permanent housing ▪ Reconstruction of commercial facilities ▪ Development and implementation of long-term economic recovery targeting impacted and critical industries

Phases 1 and 2 will likely occur while the EOC is in operation and will be managed through the emergency command organization. Phase 3 will be implemented through different mechanisms, described in Section 6.9.2 below.

6.9.1 Short-Term Recovery Strategies

This section describes key issues for initiating short-term recovery operations – that is, issues that must be addressed during Phases 1 and 2 identified above. The issues described below are among those that must be addressed most urgently. These issues are also addressed in the Recovery component of the Regional Emergency Coordination Plan. The Regional Recovery Plan will provide a strategy for addressing critical issues, such as those identified below, during the first 90 days following a major earthquake. The magnitude of, and resources required to address these issues will require regional approaches with assistance from the State and Federal governments. CCSF's short-term recovery efforts will be greatly enhanced by collaboration under the Regional Recovery Plan.

A. Debris Removal Strategy

Debris must be removed from the city to allow resumption of services and business and make way for rebuilding.

1. Transition to the effort to remove material from damaged buildings and demolish unsafe structures.
2. Establish procedures to expedite removal of unsafe structures, in accordance with city requirements and FEMA requirements for reimbursement.
3. Develop a plan for transporting debris to staging sites; separating, reducing, and recycling debris; and trucking to a disposal site.
4. Secure contracting or Federal resources, such as the USACE, to support long-term debris removal operations.
5. Collaborate regionally to address movement and disposal of debris an area with limited landfill space.

B. Interim Housing Strategy

Emergency shelters are a short-term solution to the problem of displaced residents. They must transition to interim and long-term housing arrangements.

1. Establish a plan to determine interim and long-term housing needs, based on the needs of the shelter population.
2. Utilize CCSF resources, such as building inspectors, to work with shelter residents to determine whether they can move back into their homes.
3. Streamline CCSF processes for home repairs to expedite movement back to permanent residences.
4. Establish a housing recovery team to act as the lead for regional housing planning efforts and immediately begin a working dialogue with FEMA and other Federal agencies engaged in the housing issue.
5. Collaborate regionally to reach consensus regarding what type of housing is needed and where it should be placed.

C. Utility Restoration Strategy

Public and private utility providers, to include SFPUC, Pacific Gas & Electric, and telecommunications providers such as AT&T, will coordinate with the EOC Infrastructure Branch Water and Utilities Group, Municipal Unit and Non-Municipal Unit, to assess damage and restore utility services within CCSF. Restoration of services will be affected by the following:

- Key emergency response facilities will have backup power to continue operations on a temporary basis while utility service is being restored.
- Water service will be disrupted within the first several hours and could take two to three months to be fully restored.
- Electrical power will be interrupted immediately and may take 7 to 15 days or longer to restore.
- Repair sites may be inaccessible temporarily due to debris, aftershocks, and damage to transportation infrastructure.

The strategy for restoring utilities includes the following:

1. Service providers will begin damage assessments immediately. Additionally, damage information will be provided to the Water and Utilities Group from DOCs, first responders, NERTs, and other sources, which will then provide information to service providers.
2. Emergency restoration of lifeline utility services will be the top priority for the first 1-7 days after the event.
   - Service providers may implement interim repairs and establish temporary delivery systems.
   - Utility providers will restore services in accordance with their pre-established restoration priorities. The Water and Utilities Group will convey incident-specific restoration priorities to utilities services providers, which will fold these priorities into their restoration plans.
   - The Water and Utilities Group will identify priorities for restoring services to facilities and services necessary for emergency response operations (including the Auxiliary Water Supply System), hospitals and healthcare facilities, and continuity of government; as well as restoration of service to the greatest number of people.
3. The Water and Utilities Group will coordinate with SFPD, DPW, and the Municipal Transportation Agency to provide utility workers with access to repair sites.
4. Utility service providers will assist each other through pre-established mutual assistance agreements (for example, the Water Agency Response Network). The Logistics Section will facilitate the provision of resources from within CCSF and through emergency services mutual aid when requested.
5. Permanent restoration of utility infrastructure will occur after critical services are restored on an interim basis, and will continue for months after the earthquake.

D. Strategy for Disaster Assistance Programs

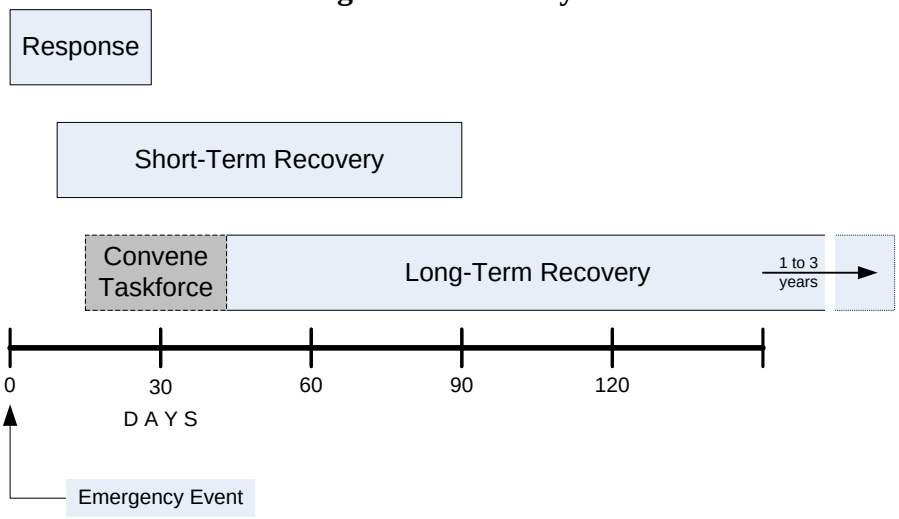
Disaster assistance is available through a wide array of State and Federal programs that can be leveraged to promote recovery.

1. Working with CalEMA, determine the appropriate number and location of Local Assistance Centers that can be established to provide residents with information regarding recovery actions and assistance that is available.
2. Establish a lead agency and procedures for ensuring that city residents are fully engaged in State and Federal Individual Assistance programs, including:
   - Emergency Food Stamps.
   - Disaster Unemployment Benefits.
   - Assistance to Individuals and Families, including Temporary Housing and grants for other uninsured disaster-related necessary expenses and serious needs.
   - State Supplemental Grant Program, which provides assistance to families and individuals that still have unmet needs after receiving assistance from the Federal government.
   - Crisis Counseling.
   - Social Security Assistance.
   - Small Business Administration (SBA) Disaster Loan Program, under which SBA provides low-interest loans for real estate repairs and costs for businesses.
3. Integrate private nonprofit assistance programs into recovery activities. These include:
   - The American Red Cross, which offers emergency shelter, food, clothing, physical and mental health support, limited grants for household items, work-related and medical equipment, and minor home repairs following natural disasters. They also provide referrals to other local and national agencies that provide home clean-up, repair, and rebuilding assistance.
   - Habitat for Humanity, which assists with repairing and replacing housing for low-income disaster victims.
   - The Salvation Army, which provides emergency shelter, food, clothing and household items.
   - The Southern Baptist Convention Disaster Relief Program, which provides assistance with food, home clean-up, and repairs.
4. Establish a lead agency for coordination with CalEMA and FEMA for application of the Public Assistance Program. Under this program, FEMA provides funding to State and local governments for extraordinary costs associated with debris removal, emergency protective measures, permanent repair or replacement of disaster-damaged facilities. Extensive coordination with CCSF departments will be necessary to track costs, facilitate inspections of damaged sites, and secure reimbursement.
5. Establish a lead agency (most likely DPW) for obtaining Emergency Relief funds from the Federal Highway Administration (FHWA). Under this program, FHWA provides funding through Caltrans for costs to open and repair Federal-aid routes.

6.9.2 Long-Term Recovery Strategy

CCSF departments and agencies have specific responsibility for implementing recovery of their respective operations and proceeding with restoration of their facilities. However, general recovery of San Francisco's services, economy, infrastructure, housing, and communities will require a coordinated effort beyond the specific responsibilities of CCSF agencies. Therefore, CCSF will convene a Recovery Management Task Force. The Task Force will provide a mechanism to coordinate the recovery activities of CCSF agencies, identify critical needs and roadblocks to recovery, leverage available resources, and coordinate CCSF efforts with those of the State and Federal governments. The Task Force will convene as short-term recovery efforts proceed and the scope and magnitude of the long-term recovery effort becomes evident, as shown in Figure 6-2.

Figure 6-2
Long-Term Recovery



The Recovery Management Task Force may consist of, but will not be limited to, the following:

- DEM
- Mayor's Office
- Board of Supervisors
- City Administrator's Office
- Controller's Office
- Planning Department
- DPW
- Hotel and tourism interests
- Bay Area Council and similar groups
- Labor Council and trade associations
- Hospital Council
- Housing owner and tenant organizations
- Port of San Francisco
- Department of Building Inspection
- DPH
- PUC
- Redevelopment Agency
- ARC and other NGOs
- Community-based organizations
- Chamber of Commerce
- Pacific Gas & Electric
- Telecommunications providers
- Building Owners and Managers Association
- Council of District Merchants

This list is illustrative only; the actual composition of the task force may depend on the specific circumstances of the earthquake's impact.

The Recovery Management Task Force will have a specialized membership derived in part from the overall group listed above plus non-profit, research and other service organizations pertinent to restoration of damaged economic and social systems. The emphasis will shift away from operations towards policy, strategy, resources, and project development.

Appendix A
Hazard Analysis

1.0 Introduction

Thousands of small, indiscernible earthquakes occur in and around the San Francisco Bay Area each year. While most of these earthquakes go unnoticed, San Francisco is highly susceptible to an earthquake of damaging magnitude on any number of local area faults. The U.S. Geological Survey (USGS) estimates that there is a 62 percent chance that a moment magnitude (M) 6.7 or larger earthquake will occur in the region before 2032.

This appendix describes the potential impact of earthquakes on the City and County of San Francisco (CCSF). The uncertainty associated with the occurrence of earthquakes and their effects gives rise to a wide range of predictions with regard to impacts. For purposes of this document, the impacts of several typically analyzed events are presented. These events include:

Scenario 1:

- M 6.9 to 7.1 earthquake on the northern segment of the Hayward Fault.

Scenario 2:

- M 7.1 to 7.2 earthquake on the Peninsula-Golden Gate segment of the San Andreas Fault.

Scenario 3:

- M 7.8 to 7.9 earthquake on the Northern California segment of the San Andreas Fault, such an event would be a repeat of the 1906 earthquake.

Impacts to housing, population, and the built environment are presented. Sources for this information include studies performed by:

- San Francisco's Community Action Plan for Seismic Safety (CAPSS) Draft Report.
- The Association of Bay Area Governments (ABAG).
- Charles Kircher and Associates.
- USGS.

2.0 Earthquake Hazard Profile

This section describes the means for characterizing earthquakes and the risk associated with earthquakes in the Bay Area.

2.1 Nature

An earthquake is due to movement, generally sudden, along a geologic fault, which results in a release of strain accumulated within or along the edge of the earth's tectonic plates. The effects of an earthquake can be felt far beyond the site of its occurrence. Earthquakes usually occur without warning and, after just a few seconds, can cause massive damage and extensive casualties. The most common effect of earthquakes is ground motion – that is, the vibration or shaking of the ground during an earthquake. Ground shaking is caused by waves in the earth's interior, also known as seismic waves, and along the earth's surface, known as surface waves.

The severity of an earthquake can be expressed in terms of intensity. Intensity is based on the damage and observed effects on people and the natural and built environment. It varies from place to place depending on the size and rupture characteristics of the earthquake, the distance from the event, the properties of the earth in which the seismic waves travel and the local geographic conditions. Intensity generally increases with the amount of energy released and decreases with distance from the causative fault of the earthquake. The scale most often used in the United States to measure intensity is the Modified Mercalli Intensity (MMI) scale. The MMI scale consists of 12 increasing levels of intensity that range from imperceptible to catastrophic destruction. Peak ground acceleration (PGA) is used as a measure of earthquake ground shaking. PGA is often expressed in terms of the acceleration due to gravity, or *g*.

Magnitude is a measure of an earthquake's strength. It is related to the amount of seismic energy released by the earthquake's causative fault. Magnitude is based on the amplitude of the earthquake waves recorded on instruments.

2.2 History

The San Andreas Fault system has a record of moderate to great earthquakes in recent, recorded history. In the period from 1800 to the present, 21 earthquakes of M 6.0 or greater have been documented in the region.

One of the region's earliest known great earthquake events occurred in June 1838 along the Peninsula segment of the San Andreas Fault. It is believed that this event was a M 7.0 to 7.4. The region's next largest earthquake occurred on October 21, 1868. This M 7.0 earthquake occurred along the southern segment of the Hayward Fault.

The region's most well-known earthquake, produced by the San Andreas Fault, occurred on April 18, 1906. Known as the "Great San Francisco Earthquake," this event lasted 45 to 60 seconds and was an estimated M 7.7 to 7.9. It is believed that the epicenter may have been just west of Daly City and that the length of the fault rupture was approximately 300 miles. MMI of VIII (moderate damage) to IX (heavy damage) extended as much as 60 miles inland. The greatest amount of damage occurred in the region's existing urban areas. In San Francisco, it is estimated that the earthquake and post-earthquake fires killed approximately 700 to 800 people (although recent research suggests this number is more likely around 3,000 people) and destroyed nearly 28,000 buildings.

On October 17, 1989, the Loma Prieta earthquake occurred near Mount Loma Prieta in Santa Cruz County. The earthquake lasted only 10 to 15 seconds but was a M 6.9 to 7.1. MMI of X (extreme damage) to IX (heavy damage) was limited to an area adjacent to the San Andreas Fault in the southern Santa Cruz Mountains. However, some of the heaviest damage occurred some 60 miles north in San Francisco's Marina District and in the East Bay. In these areas, poor soil conditions due to 19th century non-engineered fill amplified ground motions and produced liquefaction. A total of 62 deaths and 400 severe injuries were reported. In addition, over 12,000 homes and 2,600 businesses were damaged or destroyed. Additionally, major transportation facilities, including the eastern span of the Bay Bridge, the Cypress Freeway in Oakland, and the Embarcadero Freeway in San Francisco were severely damaged.

2.3 Location, Extent, and Probability of Future Events

The Bay Area is exposed to seismic hazards from numerous known faults and potentially tons of unmapped or undiscovered faults. Most of the major faults in the Bay Area are strike-slip faults, where the rupture plane is oriented vertically and the ground on one side of the fault slips horizontally past the ground on the other side of the fault. There are, however, several thrust or reverse faults in the Bay Area, where ground on one side of the fault moves upward and over the opposing side of the fault. As noted earlier, the most active strike-slip fault in the region is the San Andreas Fault, which has 10 major known fault segments. Although the San Andreas Fault does not run directly through the City of San Francisco, the fault trends through the area, 20 miles south of San Francisco. That is, the fault is located to the west of San Francisco in the Pacific Ocean until it heads inland just south of the city limits. Table A-1 lists the major known faults located within the Bay Area region.

Table A-1
Major Known Faults in the San Francisco Bay Area Region

Name	Location	Length	Most Recent Significant M > 6.5 Earthquakes
San Andreas Fault	Gulf of California to Mendocino	1,000 km	1906
Concord Fault	Contra Costa, Solano Counties	18 km	Holocene
Calaveras Fault	Alameda, Contra Costa Counties	45 km	1160 - 1425
Hayward Fault	Alameda, Contra Costa, Marin Counties	42 km	1868
San Gregorio Fault	Main, Monterey, San Mateo, Santa Cruz Counties	130 km	1270 - 1776
Rodgers Creek Fault	Sonoma County	56 km	1640 - 1776
Greenville Fault	Contra Costa, Alameda, San Jose Counties	147 km	Holocene
Mt. Diablo Thrust Fault	Contra Costa County	8 km	Late Quaternary

Source: USGS 2005

In 2002, the USGS determined with a 62 percent probability that a M 6.7 or greater earthquake will strike the region by 2031. Table A-2 shows the 10 most likely damaging earthquake scenarios in the region over a 30-year period.

Table A-2
Ten Most Likely Damaging Earthquake Scenarios

Fault	30-Year Probability (Percent)	Mean Magnitude (M)
Rodgers Creek Fault	15.2	7.0
Northern Calaveras Fault	12.4	6.8
Southern Hayward Fault	11.3	6.7
Northern and Southern Hayward Fault	8.5	6.9
Mt. Diablo Thrust	7.5	6.7
Green Valley – Concord Fault	6.0	6.7
San Andreas Fault, North Coast segment	4.7	7.9
San Andreas Fault, Peninsula segment	4.4	7.2
San Gregorio Fault, Northern segment	3.9	7.2
San Andreas Fault, Peninsula and Santa Cruz segment	3.5	7.4

Source: USGS 2003

3.0 Effects

3.1 Natural Effects

This section describes the effects of an earthquake, in terms of natural phenomena.

3.1.1 Shaking

The primary factors that control what one feels during an earthquake are:

- Magnitude: As noted earlier, magnitude is the measure of the earthquake strength. Therefore, the bigger the earthquake, the more energy is released and the more intense shaking is felt.
- Distance: Earthquake waves diminish in intensity as they travel through the ground, so earthquake shaking is generally less intense farther from the fault.
- Location: Soil conditions can also affect shaking. Shaking can become amplified in areas of areas of soft soils and fill.

A significant tool available to estimate the potential range of impacts of an earthquake is "ShakeMap," developed by the USGS. ShakeMap uses the sensor information from the Advanced National Seismic System to map actual ground shaking intensity in near real-time after an event. The program is capable of producing a color-coded map of the shaking intensity

produced over a region and posting the map to the Internet within 60 minutes of an earthquake. The color-coding of the map is based on the MMI Scale. Table A-3 shows the color-coding used to identify shaking intensity on shake maps.

Table A-3
Modified Mercalli Shaking Intensity Scale

Shake Map Color	Intensity (MMI) Value	Perceived Shaking	Potential Damage	Full Impact Description
White	I	Not Felt	None	None.
Light Blue/Aqua	II	Weak	None	Felt by people at rest on upper floors.
Aqua/Light Green	III	Weak	None	Felt indoors, hanging objects sway, vibration like passing truck.
Light Blue/Green	IV	Light	None	Hanging objects sway, vibration like a heavy truck passing.
Green/Yellow	V	Moderate	Very Light	Felt outdoors, sleepers wakened, liquids spill, small, unstable objects displaced or upset.
Yellow/ Light Orange	VI	Strong	Light	Felt by all, many frightened, run outdoors. Windows break, dishes & books fall off shelves, pictures fall
Light Orange/Dark Orange	VII	Very Strong	Moderate	Difficult to stand, drivers' notice, furniture moved, cracks in masonry, weak chimneys break.
Dark Orange/ Light Red	VIII	Severe	Moderately Heavy	Difficulty steering cars, damage to masonry, partial collapse of stucco and some masonry walls. Chimneys fall. Frame structures move relative to foundation.
Light Red/ Medium Red	IX	Violent	Heavy	General panic, older masonry buildings destroyed or heavily damaged. Frame structures shift off foundation if not bolted. Underground pipes broken.
Medium Red/Deep Red	X	Extreme	Very Heavy	Most masonry and frame structures destroyed with their foundations. Some well-built wood frame structures destroyed. Serious damage to dams, dikes. Large landslides.
Deep Red	XI	Extreme	Very Heavy	Rails bent greatly, underground pipelines completely out of service.
Deep Red	XII	Extreme	Very Heavy	Damage nearly total.

Source: USGS, 2006

Shake maps have been developed for the three earthquake scenarios described in this section. These maps are shown in Figures A-1, A-2, and A-3 toward the end of this appendix and correspond respectively to Scenarios 1, 2, and 3 described in Section 1.2. As these maps demonstrate, the Hayward Fault scenario would result in less severe shaking than the San

Andreas Fault scenarios. During the San Andreas Fault scenarios, strong shaking can be expected in the oceanside neighborhoods that lie closer to the fault. Regardless of the scenario, areas that are built on unconsolidated fill are subject to the most intense shaking. Districts such as the Marina, the Financial District, South-of-Market, Mission Bay, and Bayview/Hunters Point have been constructed through the placement of fill in areas that were formerly creeks, tidal flats, and open water and are likely to suffer the most severe shaking. These areas are also subject to liquefaction (see Section 3.1.2).

Conversely, areas constructed on stiffer soils or rock, such as the Twin Peaks neighborhood, are exposed to less severe shaking, regardless of scenario.

3.1.2 Liquefaction

Liquefaction occurs when seismic waves pass through saturated granular soil, distorting its granular structure, and causing some of the empty spaces between granules to collapse. Pore-water pressure may also increase sufficiently to cause the soil to behave like a fluid for a brief period and causing deformations. Liquefaction causes lateral spreads (horizontal movement commonly 10 to 15 feet, but up to 100 feet), flow failures (massive flows of soil, typically hundreds of feet, but up to several miles), and loss of bearing strength (soil deformations causing structures to settle or tip). There are many potential adverse consequences of liquefaction, including small building settlements, larger settlements associated with reduction of foundation bearing strength, and large lateral ground displacements that would tend to shear a building apart.

Figure A-4 shows a map of areas in San Francisco where the liquefaction is likely to occur. Areas susceptible to liquefaction are generally those locations where unconsolidated fill has been placed in areas that were formerly creeks, tidal zones, or open water. As shown in Table A-4, districts built on large areas of fill, such South-of-Market, the Marina, and Mission Bay, may experience significant losses due to liquefaction during a Scenario 3 earthquake.

Table A-4
Liquefaction-Related Damage as a Percent of Total Loss
Scenario 3

Neighborhood	Total Loss (Percent)
Bayview	13
Downtown, South of Market, Civic Center	13
Excelsior/Ingleside/Lake Merced	1
Marina	17
Mission, Castro, Glen Park, Noe Valley	7
Mission Bay, South Beach, Potrero Hill	17
North Beach	8
Pacific Heights	4
Richmond, Sunset	5
Twin Peaks	0
Western Addition	4
San Francisco Total	8

Source: CAPSS Draft Report 2003

3.1.3 Surface Faulting

Surface faulting occurs when the fault rupture in an earthquake is expressed at the earth's surface. Surface fault displacements typically range from a few inches to a foot or two for a M 6.0 earthquake to 10 feet or more for a M 7.5 earthquake. Because surface faulting tends to occur along a relatively narrow area around the fault zone, large displacements may have catastrophic effects on structures built in close proximity to the fault. While no major fault runs through San Francisco, surface faulting could affect San Francisco water and transportation systems, which both cross major faults. The city's water supply reservoirs in San Mateo County are located within the San Andreas Fault zone.

3.1.4 Landslides and Debris Flows

Earthquake-induced landslides occur as a result of horizontal forces induced in the slopes by ground shaking. The most common earthquake-induced landslides include shallow, disrupted landslides such as rock falls, rockslides, and soil slides. Initial studies by the USGS suggest that in the San Francisco Bay region, intermediate slopes with previous landslide deposits are most susceptible to future earthquake-induced landsliding. However, landsliding due to tectonic deformation can also occur near the fault rupture. Either type of earthquake-induced landslide can damage structures and impede traffic flow. Figure A-5 shows potential landslide hazard areas in San Francisco.

Debris flows are created when surface soil on steep slopes becomes totally saturated with water. Once the soil liquefies, it loses the ability to hold together and can flow downhill at very high speeds, taking vegetation and/or structures with it. In San Francisco, debris flows would generally be a risk during an earthquake during a wet winter.

3.1.5 Aftershocks

Large earthquakes will normally be followed by a larger number (possibly hundreds) of aftershocks. Aftershocks are created by ongoing movement on the fault(s) and can continue for months. The potential range in magnitude for aftershocks is generally proportional to the size of the main shock and becomes less frequent and small over time. Some aftershocks can be quite large and cause already weakened structures to collapse or suffer further damage. Most large aftershocks occur in the first 30 to 60 days after the main shock.

3.1.6 Tsunamis

Factors that affect tsunami generation from an earthquake event include:

- Magnitude (generally, M 7.5 and above).
- Depth of event (a shallow marine event that displaces seafloor).
- Type of earthquake (thrust earthquakes are more likely to cause tsunamis than earthquakes along strike-slip faults).

Earthquake-induced tsunamis are likely to advance on shore at great speeds, resulting in drowning deaths and severe damage or destruction of inundated structures.

Because the majority of the region's faults are strike-slip faults, the primary tsunami threat along the central California coast is from distant tsunamis generated by earthquakes along subduction

zones. A tsunami of 10 centimeters was recorded at the Presidio tidal gage shortly after the 1906 earthquake but otherwise had no noticeable effect. The event was caused primarily by the downdropping of the sea floor north of Lake Merced between overlapping segments on the San Andreas Fault.

In San Francisco, tsunami hazard zones are located along the shoreline in the oceanside Richmond and Sunset neighborhoods (see Figure A-6). Tsunami evacuation maps that have been prepared for the oceanside of San Francisco are based on modeling potential earthquake scenarios and extreme undersea, near-shore landslide occurrences of 42 feet vertical inundation.

3.2 Secondary Hazards in the Built Environment

This section describes additional hazards that may result from an earthquake as a result of the earthquake's impact on the built environment.

3.2.1 Fires

Post-earthquake fires often result from damage to gas lines, electrical systems, and fuel storage facilities. While large post-earthquake conflagrations are rare, they can be of disastrous proportions. In the 1906 earthquake, approximately 28,000 structures were lost due to the fires, which spread rapidly among the city's wood frame structures. Today, post-earthquake fires remain a major threat in many San Francisco neighborhoods that consist of closely built wood buildings. Post-earthquake fire risks are likely to occur where high-density wood frame housing is built over soft soils prone to high-intensity shaking. Areas such as North Beach, the Mission, and South-of-Market are prone to post-earthquake fires. Additionally, a significant number of ignitions can be expected in densely developed areas such as the Downtown and Civic Center areas. Figure A-7 depicts areas where fires are likely to break out in the greatest density during a Scenario 3 earthquake. Simultaneous ignitions, damaged communications and transportation routes, and lack of water can also impede professional response to these fires.

3.2.2 Collapsed Buildings

Widespread structural failures are likely to occur following any of the three earthquake scenarios. Structural damage is most likely to occur in areas of the most intense shaking. As with other earthquake effects, structures built on soft soils or fill are at the greatest risk. Figure A-8 shows areas in which building collapse is likely to occur in the greatest density during a Scenario 3 earthquake. Building collapses are described in additional detail in Section 4, below.

3.2.3 Dam/Reservoir Failure

Earthquakes can rupture and collapse dams and reservoirs, rapidly releasing large quantities of water and flooding property located downstream or downslope. In San Francisco, the Public Utilities Commission (PUC) manages ten covered and two uncovered reservoirs. Nine of the reservoirs are likely to experience strong shaking (PGA 28 to 32 percent) during a M 7.9 San Andreas event. The remaining three reservoirs – the Balboa Reservoir, Laguna Honda Reservoir, and Merced Manor Reservoir – are likely to experience severe shaking (PGA 36 to 40 percent) during this event.

3.2.4 Hazardous Materials Spills

Severe shaking and liquefaction caused by a large earthquake has the potential to cause significant damage to pipes, storage tanks, fuel lines and other structures at gas stations, manufacturing plants, ports, airport fueling facilities, and other facilities that handle hazardous materials. Earthquake-induced damage to rail lines and bridges can also cause derailments of cars carrying hazardous materials.

San Francisco has a limited number of manufacturing facilities, no oil refineries and relatively few sites storing a significant amount of highly toxic, explosive, or flammable chemicals or gases. However, this does not eliminate post-earthquake hazardous materials exposure. The western portions of Alameda and Contra Costa counties are home to a number of facilities, including oil refineries, rail lines carrying toxic materials, chemical processing plants and the Port of Oakland that could be a source of hazardous material exposure for San Francisco if the wind conditions are unfavorable.

4.0 Potential Impacts

Since the 1906 earthquake, San Francisco's population has doubled; its building exposure has increased by a factor of 100; and its building value has increased by a factor of 500. While building codes, modern construction techniques, and retrofits have reduced vulnerability, the increase in population and appreciated building values represent a significant increase in risk. The following describes the potential impacts of large earthquakes on San Francisco's population, residential and nonresidential buildings, and critical facilities and infrastructure.

4.1 Population

4.1.1 Displacement

Loss estimations prepared for a Scenario 2 earthquake show that over 50,000 people (7 percent of San Francisco's population) will likely need short-term shelter. Table A-5 shows neighborhoods in which shelter populations are likely to be the greatest, including those with elderly and disabled populations likely to need shelter. It is important to note that it is likely that the number of people who are displaced may be significantly higher than those needing temporary shelter. It is has been determined that, for a Scenario 2 earthquake, nearly 92,000 households[7] (or about 28 percent of the total households) will be likely to temporarily relocate with local friends and families or to alternative housing in other parts of the country.

4.1.2 Casualties

As shown in Table A-6, the number and severity of casualties will likely vary significantly depending on specific circumstances including time of day and day of the week. The greatest numbers of casualties are likely to occur during the daytime, when the commuting population nearly doubles the total population. Figure A-10 shows the distributions of daytime deaths by census tract for a Scenario 3 earthquake. As Table A-6 implies, the number of deaths during the daytime is highest in areas where the working population is greatest.

[7] CAPSS Draft Report.

4.2 Damage to Residential Buildings

Approximately 70 percent of San Francisco's 121,917 private buildings are residential. As shown in Table A-7, nearly 90 percent of these buildings are wood and are highly susceptible to post-earthquake fire conflagration. Concrete frame with unreinforced masonry infill panels are also a concern, as they are prone to collapse during earthquakes. However, approximately two-thirds of the San Francisco's existing unreinforced masonry buildings have been retrofitted to meet current building codes. Other seismically vulnerable buildings include those that have "soft stories." Soft stories have extensive exterior wall openings and insufficient exterior and interior shear walls, thereby deflecting more than other stories in the building resulting in potential collapse. Soft stories are common in residential buildings with garages on the first floor as well as corner commercial buildings with large windows opening onto both street sides. In accordance with the CAPSS study, CCSF Department of Building Inspection has determined that approximately 60 percent of San Francisco's wood frame buildings are soft-story buildings.

Table A-8 shows the number of private buildings sustaining complete economic loss. Depending on the earthquake scenario, 6 to 37 percent of the 122,000 buildings in San Francisco will likely sustain complete economic loss from the three earthquake scenarios (including post-earthquake fires). As noted earlier, specific conditions, such as areas of liquefaction and soft-story buildings, will likely make buildings more prone to damage.

Table A-5
Short-Term Shelter Population, Scenario 2

Neighborhoods	Population			Short-Term Shelter Population		
	Total	Elderly	Disabled	Total	Elderly	Disabled
Bayview	34,256	3,453	3,070	2,015	203	156
Downtown, South of Market, Civic Center	76,340	12,422	9,682	6,674	1,086	1,368
Excelsior	87,620	12,820	6,021	5,743	840	413
Ingleside	26,495	3,574	1,997	2,117	286	173
Marina	12,157	1,604	646	1,129	149	172
Merced	16,860	2,782	1,034	1,652	273	174
Mission, Castro, Glen Park, Noe Valley	122,879	10,592	8,037	8,325	718	868
Mission Bay, South Beach, Potrero Hill	16,689	1,409	897	729	46	79
North Beach	49,234	9,964	3,568	2,615	529	363
Pacific Heights	33,343	4,294	1,552	1,605	207	200
Richmond	67,814	10,568	4,481	6,356	990	723
Sunset	101,465	16,174	6,413	8,765	1,397	888
Twin Peaks	37,646	6,661	2,833	1,963	347	281
Western Addition	89,245	10,111	6,431	7,156	811	917
Total	772,043	106,428	56,662	56,844	7882	6,775

Source: CAPSS Draft Report 2003
Total population using 1990 Census information, excluding the Presidio, Golden Gate, and Treasure Island.

Table A-6
Population Casualties

Earthquake Scenario	Casualties (Earthquake at 2 AM)				Casualties (Earthquake at 2 PM)				Casualties (Earthquake at 5 PM)			
Severity of Injury	1	2	3	4	1	2	3	4	1	2	3	4
Hayward Fault, Magnitude 6.9 (Scenario 1)	1,683	316	23	41	2,509	568	71	140	1,525	335	39	76
San Andreas Fault, Magnitude 7.2 (Scenario 2)	6,954	1,718	158	287	6,519	1,694	221	430	4,227	1,072	126	240
San Andreas Fault, Magnitude 7.9 (Scenario 3)	12,261	3,284	352	658	16,614	4,983	758	1,489	9,805	2,858	406	790
Severity 1	Injuries requiring basic medical aid, including sprains, minor burns, cuts requiring stitches.											
Severity 2	Injuries requiring a greater degree of medical care (third-degree burns) and use of medical technology, including X-rays.											
Severity 3	Injuries that pose an immediate life threatening condition if not treated adequately and expeditiously, including uncontrolled bleeding, punctured organ, and other internal injuries.											
Severity 4	Instantaneously killed or mortally injured.											

Source: CAPSS Draft Report 2003

Table A-7
Private Building Count by Structure Type

Neighborhood	Wood Frame <5,000 sq. ft.	Wood Frame >5,000 sq. ft	Steel-Moment Frame	Concrete Frame Unreinforced Masonry Infill Walls	Unreinforced Masonry	Other	Total
Bayview	4,610	120	3	64	16	116	4,929
Downtown, South of Market, Civic Center	98	1,460	374	765	294	1,693	4,684
Excelsior	24,161	259	-	19	6	21	24,466
Ingleside	5,736	42	-	3	-	1	5,782
Marina	971	400	-	34	-	4	1,409
Merced	2,452	36	-	13	4	17	2,522
Mission, Castro, Glen Park, Noe Valley	11,115	1,943	5	183	30	107	13,383
Mission Bay, South Beach, Potrero Hill	1,117	352	65	140	55	298	2,027
North Beach	755	1,334	19	214	25	121	2,468
Pacific Heights	4,925	957	2	95	6	21	2,468
Richmond	9,613	1,287	-	96	4	8	11,008
Sunset	24,429	730	-	29	-	-	25,188
Twin Peaks	11,042	202	-	10	1	2	11,257
Western Addition	4,463	2,085	9	185	10	36	6,788
Total	105,487	11,207	477	1,850	451	2,445	121,917

Source: CAPSS Draft Report 2003

Table A-8
Private Building Sustaining Complete Economic Loss from Shaking Effects and Fires

Neighborhood	Total	Hayward Magnitude 6.9 (Scenario 1)	San Andreas Magnitude 7.2 (Scenario 2)	San Andreas Magnitude 7.9 (Scenario 3)
Bayview	4,929	196	807	1,710
Downtown, South of Market, Civic Center	4,684	782	952	1,693
Excelsior	24,466	969	4,648	7,282
Ingleside	5,782	126	1,766	2,677
Marina	1,409	313	419	520
Merced	2,522	29	828	1,187
Mission, Castro, Glen Park, Noe Valley	13,383	769	2,691	4,766
Mission Bay, South Beach, Potrero Hill	2,027	127	281	591
North Beach	2,468	278	336	646
Pacific Heights	2,468	565	1,297	2,068
Richmond	11,008	723	3,300	4,433
Sunset	25,188	1,497	8,363	11,001
Twin Peaks	11,257	337	2,780	4,830
Western Addition	6,788	513	1,394	2,273
Total	121,917	7,222	29,862	45,678

Source: CAPSS Draft Report 2003

4.3 Commercial and Industrial Buildings

Total loss estimates prepared for commercial and industrial establishments show that approximately 9 to 31 percent of these buildings will likely sustain complete economic loss for the three earthquake scenarios. However, as shown below in Table A-9, the amount of loss for these buildings increases to 18 to 40 percent when post-earthquake fires are taken into consideration.

Table A-9
Commercial and Industrial Economic Impact Estimates
Shaking Effects and Fires

Establishment	Total	Hayward Magnitude 6.9 (Scenario 1)	San Andreas Magnitude 7.2 (Scenario 2)	San Andreas Magnitude 7.9 (Scenario 3)
Commercial - Retail	14,830	2,549	3,494	7,260
Commercial - Other	26,602	4,819	6,026	9,005
Industrial	6,436	1,558	1,561	2,477
Other	3,841	368	636	1,567
Total	51,709	9,294	11,716	20,309

Source: CAPSS Draft Report 2003

4.4 Emergency Response Facilities

This section describes general impacts on CCSF emergency response facilities. The shake maps shown in Figures A-1 through A-3 show the relationship of some of these facilities to shaking intensities.

4.4.1 Emergency Services

In 2000, CCSF opened a newly constructed Emergency Communications Center, which consolidated 911 operations for emergency medical services, fire and law enforcement agencies; public safety dispatch; and the city's Emergency Operations Center (EOC). The Emergency Communications Center, which uses state-of-the-art radio systems that allow agencies to communicate directly with one another, has been built to current standards to withstand a major earthquake. However, shake maps show that the Center will likely experience very strong shaking (PGA 32 percent) in a Scenario 3 earthquake.

4.4.2 Fire Department

The San Francisco Fire Department (SFFD) has 48 fire stations throughout San Francisco, at the San Francisco International Airport, and on Treasure Island. SFFD facilities have been undergoing seismic upgrades since the 1950s and sustained relatively little damage during the Loma Prieta earthquake. As of April 2006, some stations still need to undergo further seismic retrofits. Approximately 80 percent of the stations are located in areas that will likely experience very strong shaking (PGA 20 to 34 percent) during a Scenario 3 earthquake.

The SFFD uses the city's water supply system as well as the emergency water supply system, known as the Auxiliary Water Supply System (AWSS), for its firefighting efforts. Both systems are subject to damage during earthquakes. During the Loma Prieta earthquake, the lower AWSS zone, which supplies water by gravity to hydrants from sea level to 150 feet in elevation, suffered five breaks in the South-of-Market neighborhood while the upper zone functioned normally. In addition, breaks in the domestic water supply system severely hampered fire suppression operations in the Marina, and one 75,000-gallon cistern developed leaks and lost 20

percent of its water. The two pump stations and fireboats that can pump saltwater functioned normally during this event.

4.4.3 Police

Ten police stations are located in San Francisco. Ground shaking analysis for a Scenario 3 earthquake shows that only two stations – located in Taraval and Ingleside – will likely experience severe shaking (PGA 34 to 40 percent), and the other stations will likely experience very strong shaking (PGA 28 to 34 percent).

4.4.4 Hospitals

San Francisco has 13 hospitals. San Francisco General Hospital is the only Level 1 Trauma Center for the region. Hospitals are expected to sustain significant damage during a major earthquake. For example, according to a recent analysis,[8] there is a 30 percent chance that San Francisco General Hospital, which is located in an area that is subject to intense shaking, would sustain extensive damage during a Scenario 3 earthquake. For all hospitals, a Scenario 3 earthquake would result in damage sufficient to reduce capacity (in terms of number of beds) by 90 percent for the first three days after the event; capacity would return to approximately 60 percent 30 days after the earthquake.

4.4.5 City/County Administration

Shortly following the Loma Prieta earthquake, 191 CCSF buildings were identified for retrofit. By 2002, renovations had been completed for almost half of these buildings, including the San Francisco City Hall. However, several major facilities, including the Hall of Justice, have never been retrofitted. The seven-story Hall of Justice building, constructed in 1958, contains the Police Department's Southern Station and its administrative, patrol and investigative headquarters; offices for courts, prosecutors, probation; the medical examiner; and two jails with a total of 800 inmates on the top floors. The building does not meet the current earthquake building code and has been deemed "seismically deficient" by the CCSF Department of Public Works. During a Scenario 3 earthquake, this area will likely experience very strong shaking (PGA 28 percent).

4.5 Utilities

4.5.1 Electrical Power and Natural Gas

Over the past several years, Pacific Gas and Electric has been replacing over 500 miles of earthquake-vulnerable cast iron gas pipelines with flexible plastic lines and reinforced electrical substations and switching and transmission facilities. The project, which is more than 90 percent complete, includes construction of redundancies so that if a substation, gas line, or electric line is disrupted, power and gas can be rerouted and service can be restored more efficiently. Nonetheless, service interruptions are likely to be severe. Interruption estimates following a major earthquake range from 7 to 15 days. The Hanshin-Awaji (Kobe) earthquake provides a recent example: following this earthquake, it took 7 days to restore electrical service to about 80

[8] Charles Kircher Associates, 2006.

percent of the affected region and 85 days to restore natural gas service to about 80 percent of the affected region.

4.5.2 Communication

Switching centers, primary distribution fiber-optic cables, and other major system components will suffer some damage; however, telecommunications are one of the most robust of all utility systems. Disruptions after an earthquake are often a result of system overload and loss of power, rather than extensive system damage.

The Public Dial Telephone Network (landline and wireless) is expected to overload and become unreliable within the first hour of a major earthquake. Local phone providers will implement load-shedding systems to restrict call volumes. This will cause delayed ring tone access and frequent "all circuits are busy" messages. Restoration of normal service levels will partly depend on the ability to educate the public to limit non-emergency calls.

4.5.3 Potable Water

Water service to households in the affected area will be impacted almost immediately, with a reduction in pressure and continued gradual decline in water pressure over the first few hours after a large earthquake. Within 12 to 24 hours, it is probable that the vast majority of homes will lose water pressure entirely.

While significant damage is possible to pumping stations, distribution lines and other system components, the worst damage to the water system will probably be to the local distribution lines at the neighborhood level. Full system restoration may take up to 90 days.

Significantly, the water supply for CCSF is delivered via the Hetch Hetchy System, which consists of 280 miles of pipelines, 60 miles of tunnels, 11 reservoirs, five pump stations, and two water treatment plants. The system crosses the San Andreas, Hayward, and Calaveras faults and is therefore at risk. Currently, if a major pipeline breaks, it is estimated that repairs might take 60 days. The San Francisco Public Utilities Commission has undertaken a 10-year effort to upgrade the aging system to make it more resistant to earthquakes. The goal of the redesign, which will be completed by 2015, is to get at least some water to residents within 24 hours and be able to restore water to full supply in 30 days.

4.6 Transportation Facilities

4.6.1 Bridges

During the Loma Prieta earthquake, a section of the upper deck of the San Francisco–Oakland Bay Bridge collapsed. Studies following the earthquake revealed that both the Bay Bridge and Golden Gate Bridge and their approaches were vulnerable to a nearby M 7.0 or greater earthquake. As a result, the California Department of Transportation (Caltrans) is conducting major seismic safety upgrades on the San Francisco side of the San Francisco–Oakland Bay Bridge, and the entire eastern span of the bridge is due to be replaced by 2012. The Golden Gate Bridge, along with the Marin Approach Viaduct and towers, is currently being retrofitted to withstand an earthquake M 8.3 on the nearby San Andreas Fault.

In addition to major bridges, elevated structures are also at risk of damage due to shaking, particularly in areas of fill and soft soils. As stated above, Bay Area freeways suffered significant

damage during the Loma Prieta earthquake; the Cypress Freeway in Oakland collapsed, and the Embarcadero and Central freeways in San Francisco were so badly damaged that they were demolished. Caltrans has implemented retrofits on major elevated freeway segments throughout the Bay Area.

4.6.2 Roads

Streets, roads, bridges (vehicle and pedestrian), tunnels, and related retaining walls are all vulnerable to earthquake-induced damage. Roadways and structures such as bridges built over areas at high risk for liquefaction are especially vulnerable to damage.

Following a major earthquake, roads will be closed due to:

- Direct surface or subgrade damage due to fault rupture, roadbed settlement, and liquefaction.
- Broken underground water, sewer, or utility lines.
- Collapsed buildings and other debris.
- Earthquake-triggered landslides.
- Reservoir or water tank failures.
- Hazardous materials problems on adjacent sites.

Table A-10 shows the results of the ABAG transportation studies regarding the impacts to roads in CCSF.

Table A-10
Road Closures in San Francisco

Scenario	1	2	3
Closed Roads	335[9]	321	429

Source: ABAG 2003

4.6.3 Mass Transit

Studies by the Bay Area Rapid Transit (BART) District suggest a major earthquake along the Hayward fault will likely affect BART services in the underground stations and the TransBay Tube in San Francisco. Underground stations may undergo racking deformation, causing moderate damage to columns and walls. In addition, vertical earthquake motions may cause overstress to roof members in these stations, also resulting in moderate damage. Backfill and poor soil surrounding the TransBay Tube may be prone to liquefaction that may cause excessive movement of the seismic joints and ventilation system. As such, BART expects 25 percent of pre-earthquake ridership capacity three days after the event, 50 percent of pre-earthquake ridership capacity within 15 months of the event, and almost 100 percent of pre-earthquake

[9] The estimated number of damaged roads depends on the segment of the fault that ruptures; this estimate is for the Peninsula segment.

ridership within two years of the event. BART is currently engaged in a $1.5 billion Seismic Retrofit Program due for completion in 2009.[10]

The San Francisco Municipal Railway (MUNI) has a fleet of 1,000 vehicles, consisting of the electric subway-surface light-rail vehicles, electric trolley buses, diesel buses, and cable cars. A major earthquake will likely result in the loss of electrical power and disrupt electrical bus service for an extended time. MUNI does have a significant number of conventional buses that are not dependant on electrical power and will be able to resume some service once streets are cleared.

Most of the infrastructure for CalTrain, which runs trains between Gilroy and San Francisco, is aboveground and has fewer bridges and tunnels subject to possible failure. However, the San Francisco station is located in an area likely to experience strong to very strong shaking during a Scenario 3 event.

4.6.4 Port of San Francisco

Many Port facilities have been seismically upgraded to meet current seismic safety standards since the Loma Prieta earthquake. Upgraded facilities include: AT&T Park, the Ferry Building and Ferry Plaza, the Port Headquarters building at Pier 1, Piers 1.5, 3, 5, 27/29, 45 and 48; and the Aquarium by the Bay. However, unreinforced masonry buildings such as Buildings 104 and 113 in Pier 70 are extremely vulnerable to ground movement and therefore have been either closed or have had their uses restricted to appropriate activities.

4.6.5 San Francisco International Airport

San Francisco International Airport did not sustain significant damage from the Loma Prieta earthquake. However, the airport is located on liquefiable Bay mud and it is possible that a future earthquake may cause significant damage, include large cracks and sand boils, to the runways. The International Terminal, completed in 2003, was designed to resist a M 8.0 earthquake on the San Andreas Fault with little to no structural damage.

The San Francisco International Airport emergency plan assumes that the airport will suffer substantial damage to on-site infrastructure, as well as to the external access roads and adjacent sections of U.S. Highway 101. The airport is designed to be self-sufficient for 72 hours, including the ability to perform search and rescue; assess damages; and provide food, water and medical care to the potential 30,000 to 35,000 people that could be stranded in the airport by the earthquake.

The San Jose Airport may retain a greater degree of its original functionality due to recent retrofit work that has been completed on the runways and other facilities. Travis Air Force Base in Fairfield is expected to remain functional and is one of the designated staging areas for Federal resources following any large disaster in Northern California.

[10] BART Seismic Vulnerability Study, 2002

4.7 Schools

There are 139 schools in the San Francisco Unified School District (SFUSD), including childhood development centers, elementary schools, middle schools, high schools, and charter schools. Approximately 39 of the 139 schools are likely to experience severe shaking (PGA 36 to 40 percent) during a Scenario 3 earthquake. These schools are located in the Sunset and Ingleside neighborhoods. The remaining 100 schools will likely experience very strong shaking (PGA 20 to 32 percent).

4.8 Economy

The economic base of San Francisco is a diverse mix of retail, tourism, finance, investment, communications, and government sector employment. While the economic base is diverse, a major earthquake could have a devastating impact on our economy, especially in sectors such as tourism.

The cost of housing in the Bay Area has created significant shortages of affordable housing. Over 60 percent of the San Francisco's housing units are occupied by renters, and only 5 percent of dwellings are vacant. Affordable housing units are in limited supply and are historically among the most vulnerable to a major earthquake. As was the case following the Loma Prieta earthquake, the impact on low-income housing will be disproportional and could result in a significant increase in our homeless population.

Numerous economic studies after earthquakes and other major disasters have shown that the damage and loss in economic activity can dramatically change the nature of the business done in both the short- and long-term in a city. For example, if many of the historic and architecturally interesting structures in San Francisco are damaged to a point where it is not economically feasible to restore them, the city will lose much of its inherent charm and attractiveness as a tourist destination. Tourism is one of the city's key industries and supports much of the commercial and entertainment businesses that make San Francisco so vital. The city's residents and employees alone cannot support the city's existing retail and lodging establishments without a substantial influx of visitors each year.

Economic damage from an earthquake will result both from direct damage to structures, equipment, and inventory; and indirectly from business interruption caused by dislocation of the workforce and damage to transportation and utility systems, ports and other critical infrastructure. The 2003 CAPSS Draft Report estimated that about 8,000 (16 percent) of all business establishments would likely be affected by shaking-related damage by a Scenario 2 earthquake, and post-earthquake fires could increase this figure significantly. Likewise, about 94,000 (15 percent) of CCSF jobs could be impacted. For a Scenario 3 earthquake, it is projected that 20,000 business establishments (39 percent) and 237,000 jobs could be lost. While the construction industry will gain jobs after an earthquake, a high percentage of retail, office, and other service jobs will be lost and may not be regained.

5.0 Impact Summary

Table A-11, below, provides a summary of impacts for the three scenarios. For reference, relevant information from the Loma Prieta and Kobe earthquakes is also presented.

Table A-11
Impact Projections

Impact	Scenario # 1	Source	Scenario # 2	Source	Scenario # 3	Source	Loma Prieta	Kobe
Buildings destroyed	7,200-18,200	B	29,800	B	45,700	B	130[11]	171,481
Total $ building loss [12]	$ 8.2 – $10 Billion	A	$ 14 Billion	A	$ 19 Billion	A	N/A	N/A
% Building value loss	15 – 19 %	A	26%	A	36%	A	N/A	N/A
Number of EQ related fires (major)	87 (47)	M	112 (71)	M	117	M	27-34	285
% Housing lost[13]	6%	F	28%	E	25%		.63%[14]	12%
Displaced households[15]	19,250	D	92,400	E	82,350	H (K)	8,598	520,000[5]
People requiring shelter	11,078	D	56,800	E	52,450	I	6,000	316,000
# Shelters[16]	12-15	J	68-75	J	64-69	J	N/A	1153[17]
Building collapses (partial)	N/A		N/A		3,500-7,000	L	30	250,000[18]
Building collapses (full)	N/A		N/A		500-1,000	L	N/A	N/A
# People trapped requiring SAR – 2AM (2PM)	N/A		N/A		301	K	N/A	6790[19]
Total injured 2AM	2,000 – 4,450	C	8,830	C	15,900	C	N/A	43,800
Total injured 2PM	3,500 – 4,075	C	8,430	C	22,355	C	N/A	N/A

[11] CCSF General Plan, Community Safety Element, page I.4.4 – April, 1997

[12] Fire and shaking related loss combined

[13] Based on an estimated 329,700 households – CAPSS Draft Report Page, 14

[14] ABAG, Preventing the Nightmare – Post Earthquake Housing Issue Papers, - J. Perkins -5/2000

[15] Number of uninhabitable homes and displaced households are assumed to be roughly the same

[16] Assumes some shelters might hold 500 -750 people each, where 1 or 2 sites may hold several thousand

[17] Regional total, Ito, Shigeru, et al. – Committee to Analyze and Learn from the Great Hanshin-Awaji (Kobe) Earthquake

[18] Estimate that includes both partial and total collapse – Ito, Shigeru, et al. – Committee to Analyze and Learn from the Great Hanshin-Awaji (Kobe) Earthquake

[19] People recovered (live and dead) by government agencies – thousands more were rescued by private citizens

Impact Projections

Impact	Scenario # 1	Source	Scenario # 2	Source	Scenario # 3	Source	Loma Prieta	Kobe
Total injured 5PM	1,900 – 2,750	C	5,425	C	13,069	C	N/A	N/A
Requiring hospitalization 2 AM	350 – 850	C	1,875	C	3,636	C (K)	N/A	8,800
Requiring hospitalization 2 PM	640 – 850	C	1,915	C	5,740	C (K)	N/A	N/A
Requiring hospitalization 5 PM	375 – 560	C	1,200	C	3,265	C	50[20]	N/A
[21]Deaths – 2AM	40-100	C	290	C	658	C (K)	N/A	6,432[22]
Deaths – 2PM	140 – 170	C	430	C	1,490	C (K)	N/A	N/A
Deaths – 5PM	75 – 100	C	240	C	790	C	N/A	N/A
# Closed Roads	214-315[23]	G	321	G	429	G	N/A	9,403[24]

Source Notes

A. CAPSS Draft Report, Table B, page xii

B. CAPSS Draft Report, Table C, page xiii

C. CAPSS Draft Report, Table 18, page 37

D. CAPSS Draft Report

E. CAPSS Draft Report, Table 19, page 40

F. ABAG Post-EQ Housing Issue Paper, Table C2, page C-3

G. ABAG Transportation Damage section – 2003 update

H. ABAG Post-EQ Housing – The Problem, Table 1, page 2

I. Personal conversation with Jeanne Perkins, ABAG

J. CCSF DEM Staff estimate

K. EERI "When the Big One Strikes Again" – 2006, Table 20

L. Personal communication w/Charlie Kircher (Kircher & Associates)

M. Personal communication w/Charlie Schawthorne

[20] State Operations Center Summary - 10/27/1989

[21] HAZUS Severity 4, instantaneously killed or mortally injured – does not reflect total estimated casualties over time

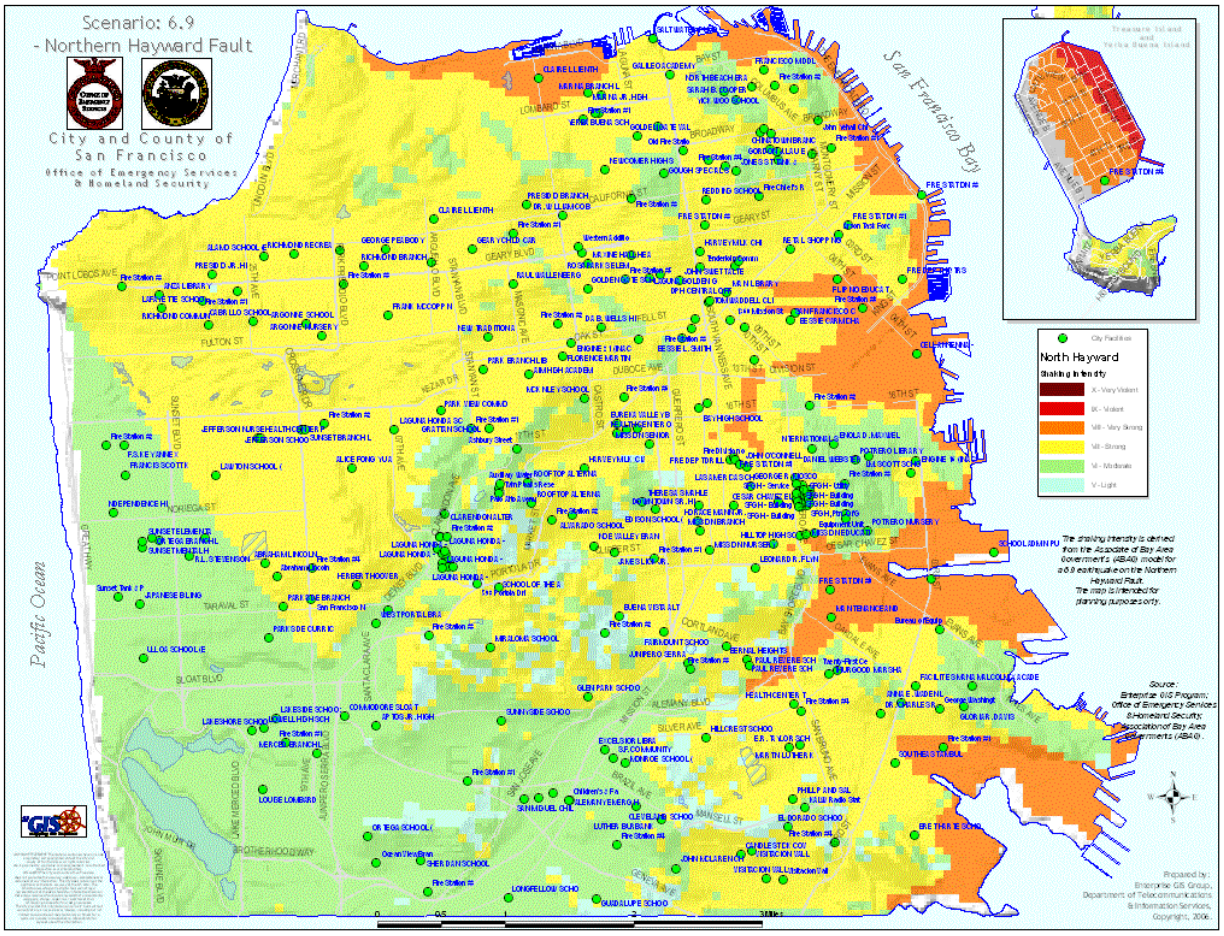
[22] Includes deaths from earthquake related causes, such as disease and suicides

[23] 214 for the Northern Golden Gate (Marin) segment vs. 335 for the Peninsula segment

[24] Regionwide number of road blockage locations (many roads closed at multiple locations)

Figure A-1
Shaking Intensity Map
Magnitude 6.9 Earthquake – Hayward Fault
(Scenario 1)

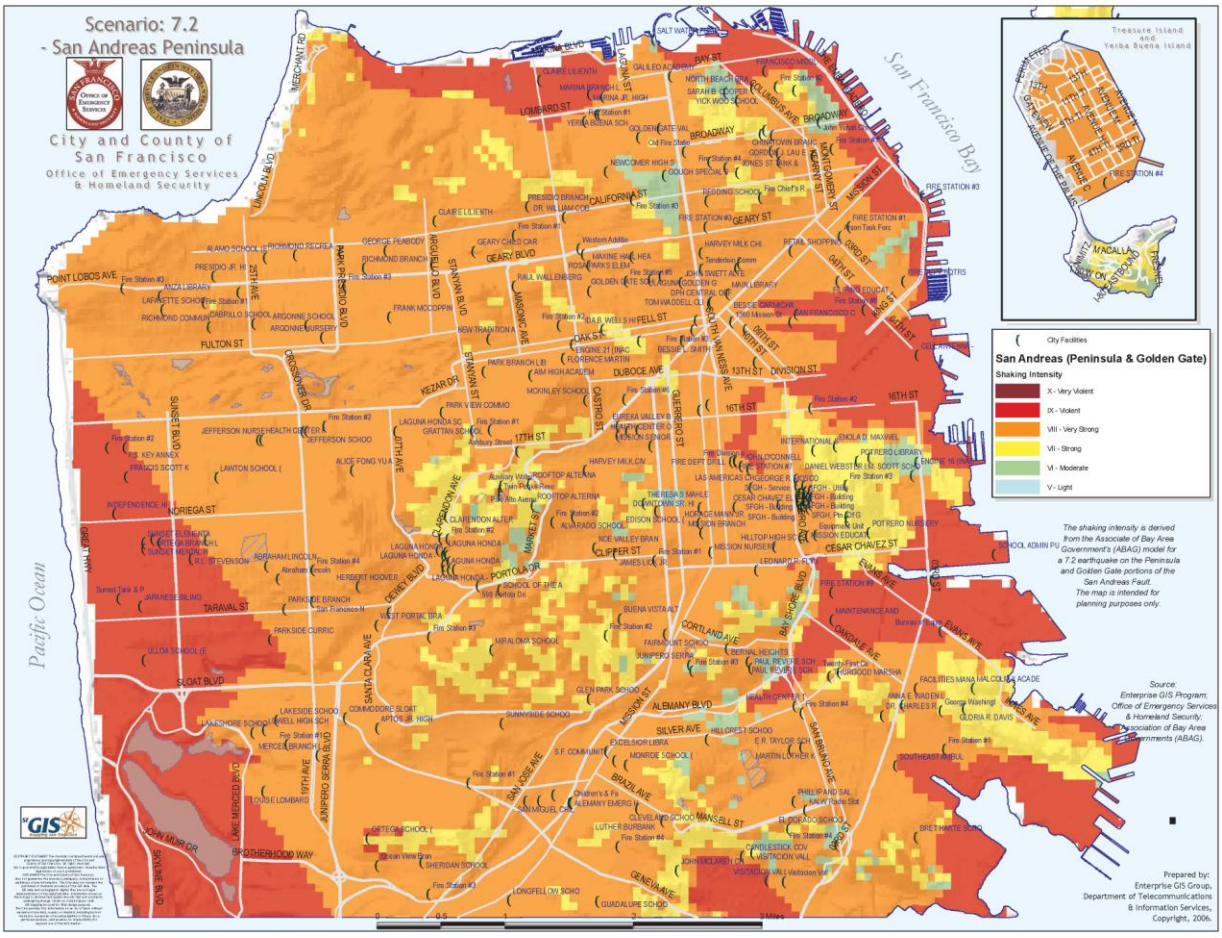
(Scalable version of map on "V" Drive at the EOC)



Source: CCSF DEM, 2006

Figure A-2
Shaking Intensity Map
Magnitude 7.2 Earthquake – San Andreas Fault
(Scenario 2)

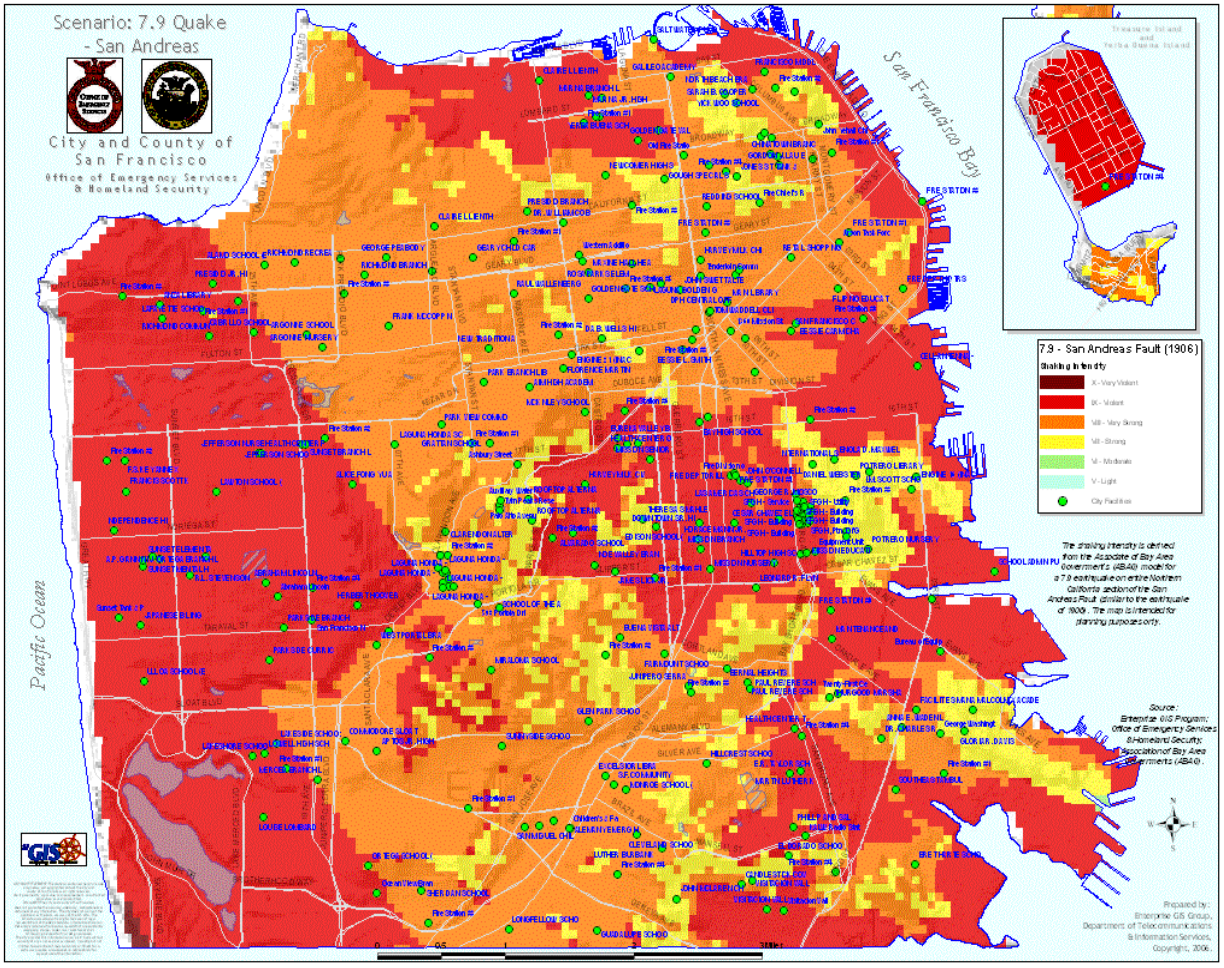
(Scalable version of map on "V" Drive at the EOC)



Source: CCSF DEM, 2006

Figure A-3
Shaking Intensity Map
Magnitude 7.9 Earthquake – San Andreas Fault
(Scenario 3)

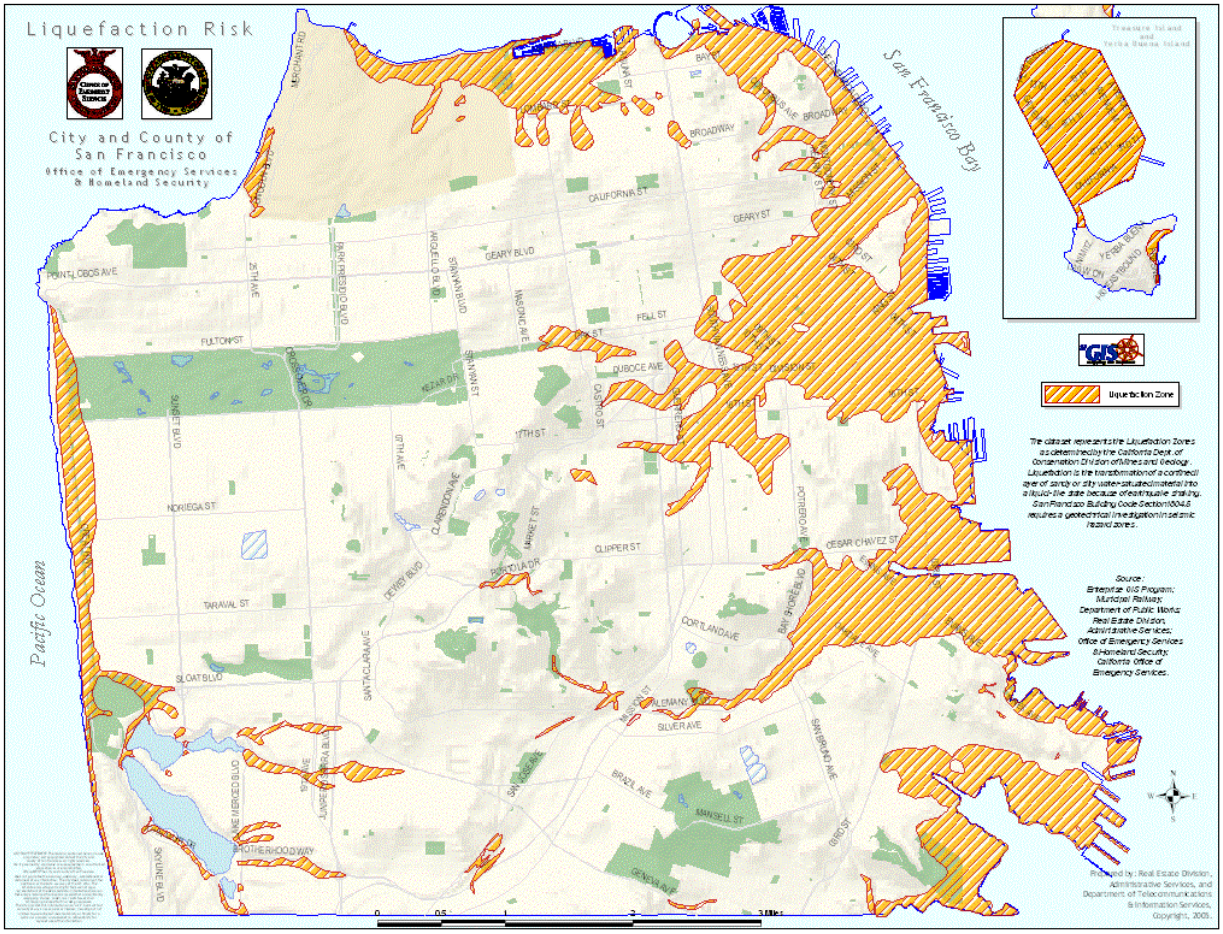
(Scalable version of map on "V" Drive at the EOC)



Source: CCSF DEM, 2006

Figure A-4
Liquefaction Zones

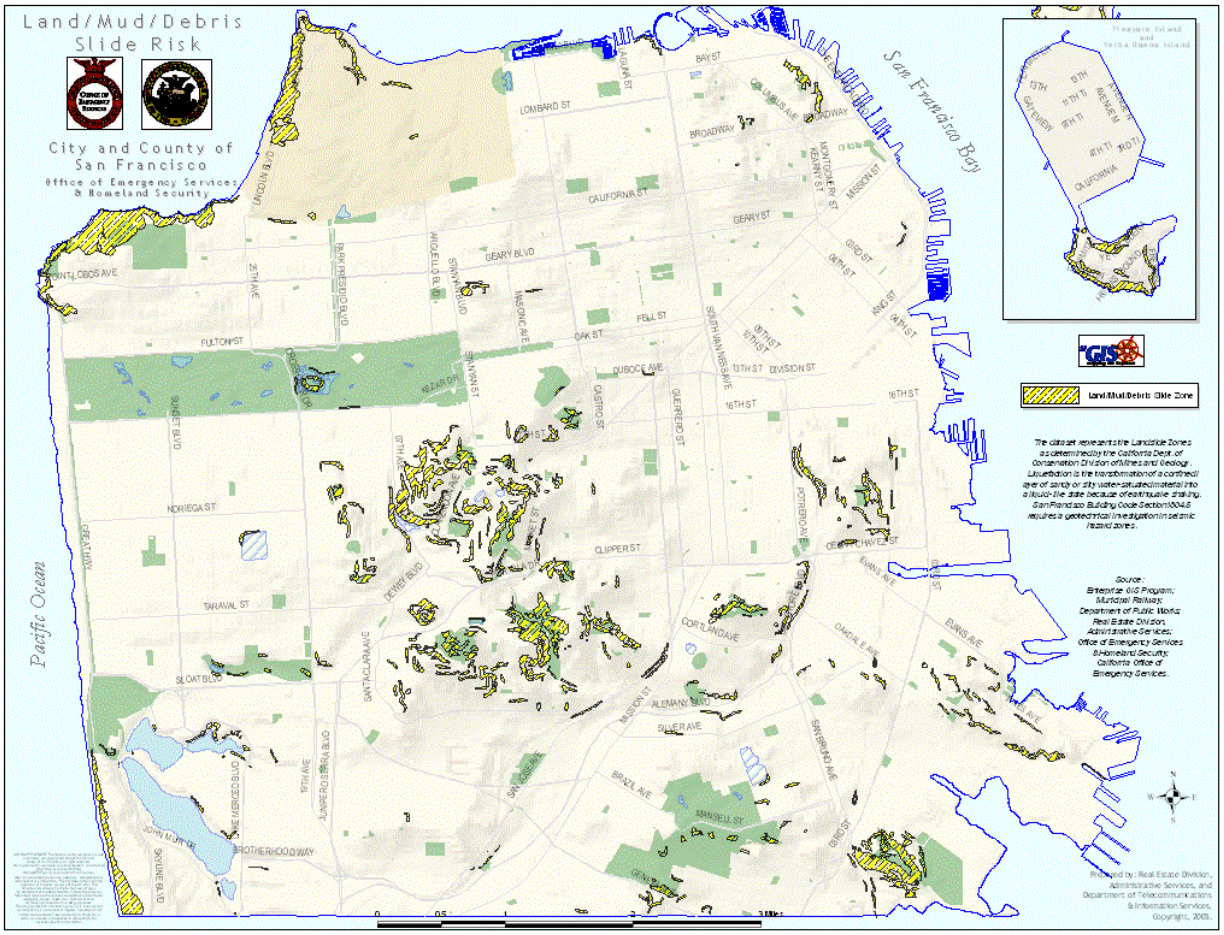
(Scalable version of map on "V" Drive at the EOC)



Source: CCSF DEM, 2006

Figure A-5
Landslide Susceptibility in San Francisco

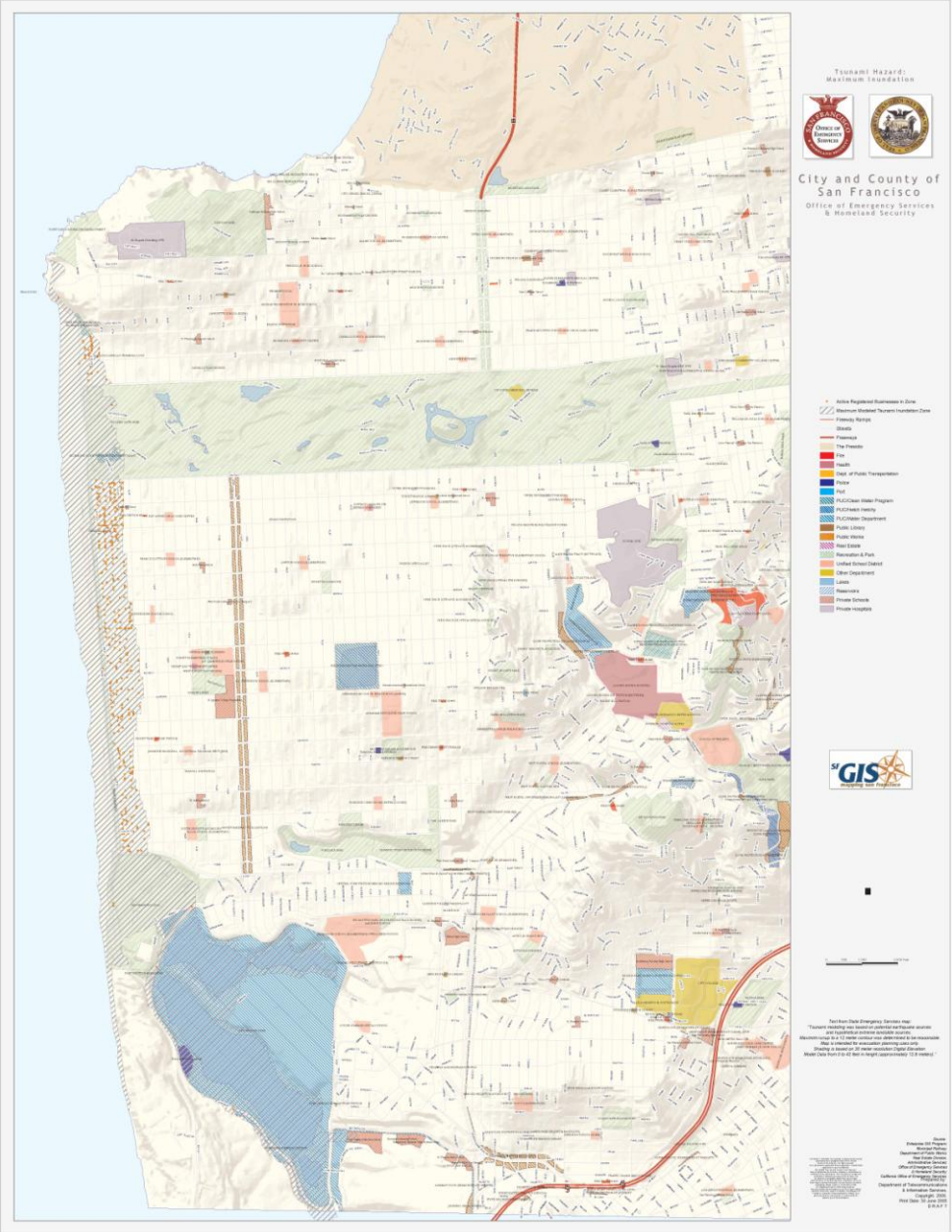
(Scalable version of map on "V" Drive at the EOC)



Source: CCSF DEM, 2006

Figure A-6
Tsunami Hazard Zones

(Scalable version of map on "V" Drive at the EOC)



Source: CCSF 2006

Figure A-7
Fire Ignition Density

Magnitude 7.9 Earthquake – San Andreas Fault

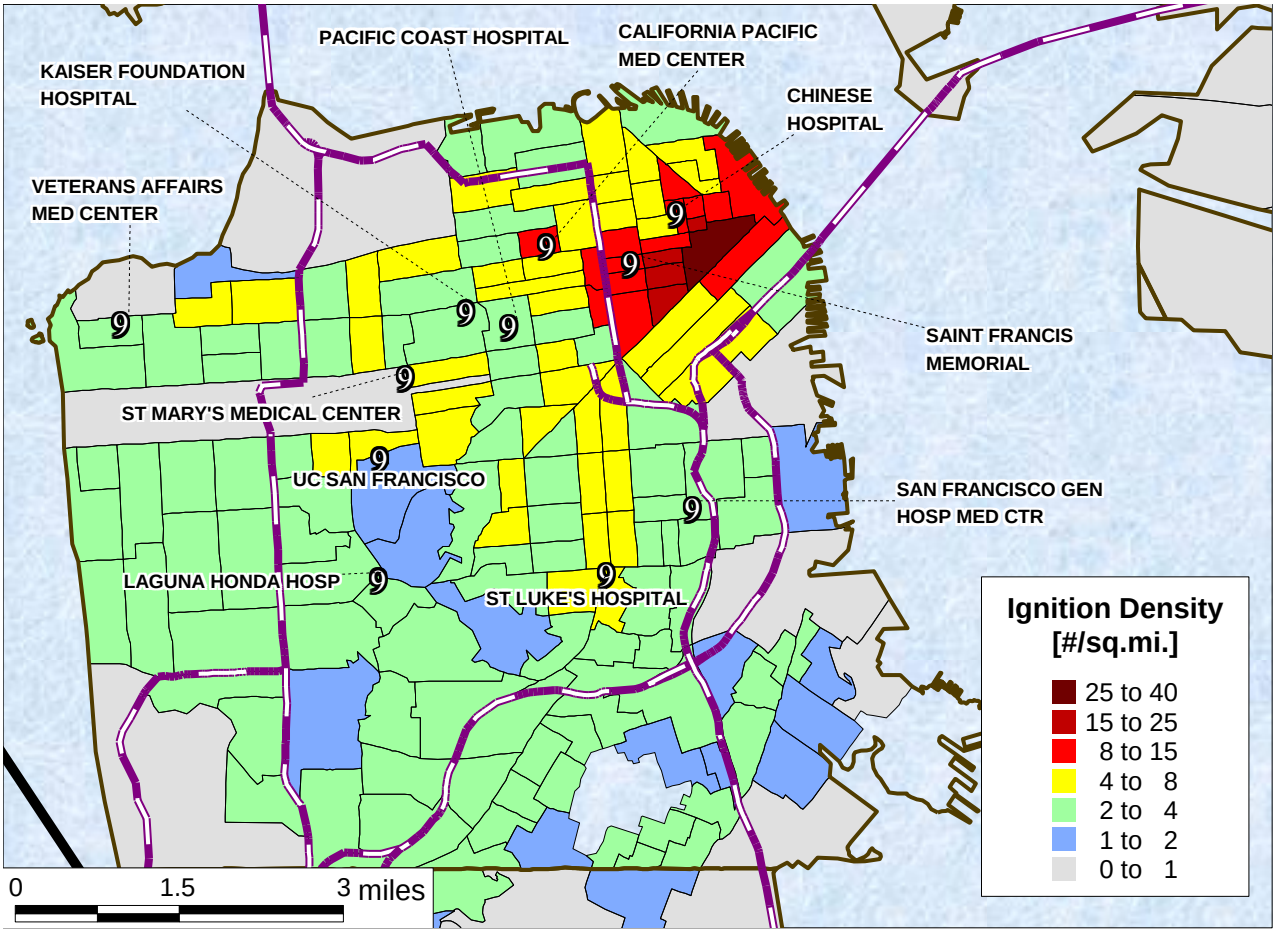
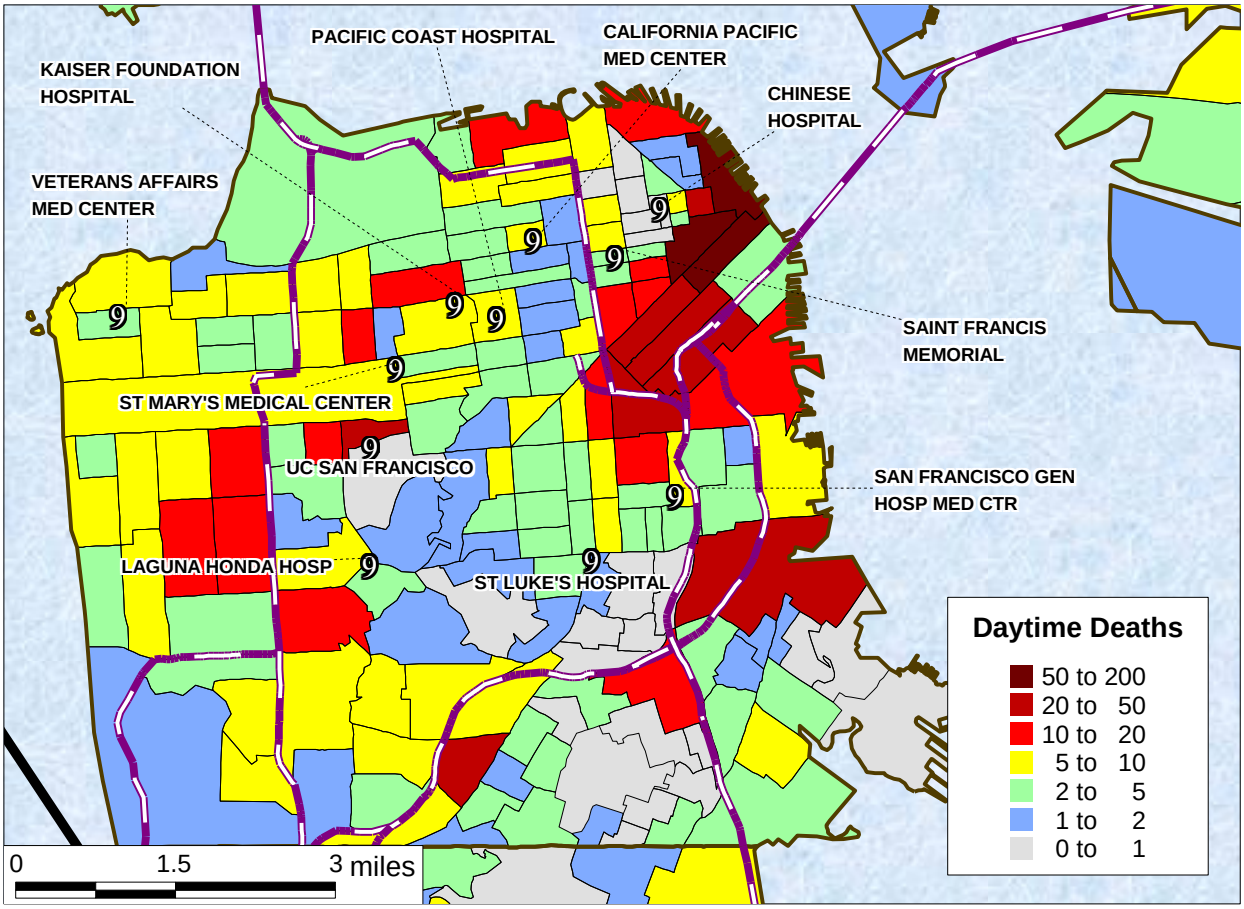


Figure A-8
Collapsed Building Risk Map

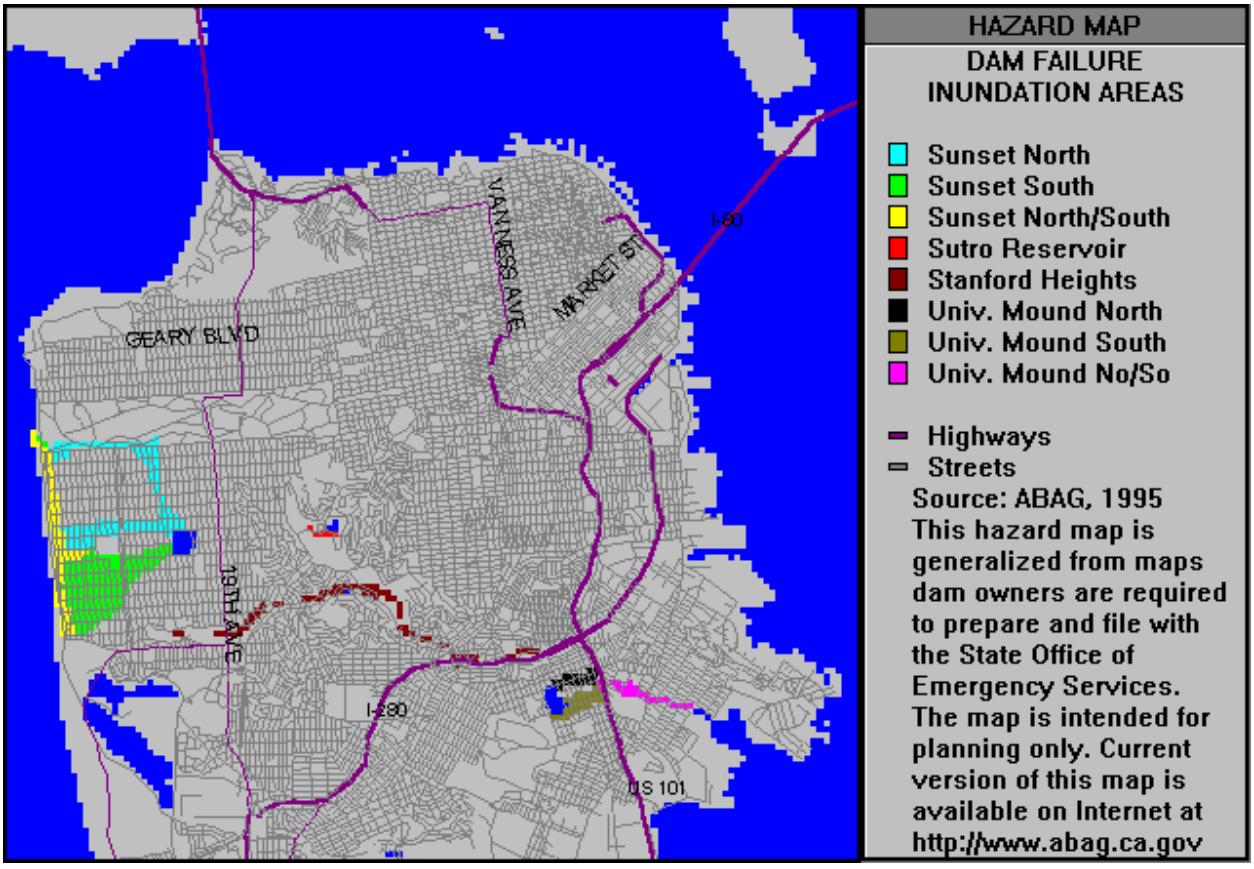
(Scalable version of map on "V" Drive at the EOC)



Source: CCSF 2006

Figure A-9
Dam Failure Inundation Zones

(Scalable version of map on "V" Drive at the EOC)



Source: ABAG 2006

Figure A-10
Daytime Deaths

Magnitude 7.9 Earthquake – San Andreas Fault

(Scalable version of map on "V" Drive at the EOC)