



City and County of San Francisco

Hazard Mitigation Plan

AN ELEMENT OF THE CCSF EMERGENCY MANAGEMENT PROGRAM



June 2014







HAZARD MITIGATION PLAN

CITY AND COUNTY OF SAN FRANCISCO

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Contents

Acronyms and Abbreviations ..... **iv**

Section 1: Introduction **1**

1.1 Hazard Mitigation Planning 1
1.2 Local Mitigation Planning Requirements 1
1.3 Grant Programs With Mitigation Plan Requirements 2
1.3.1 Stafford Act Grant Programs 2
1.3.2 National Flood Insurance Act Grant Programs 3
1.4 Hazard Mitigation Plan Description 4

Section 2: Local Plan Adoption **7**

Section 3: Planning Area Description **8**

3.1 Scope of Planning Area 8
3.2 Location, Geography, and History 8
3.3 Government 9
3.4 Economy 10
3.5 Demographics 10

Section 4: Planning Process **12**

4.1 Initial Planning Process, 2005 Plan 12
4.2 2008 Plan Update Process 13
4.3 2014 Plan Update Process 13
4.4 Public and Stakeholder Outreach 17
4.4.1 Public Outreach 18
4.4.2 Stakeholder Outreach 19
4.5 Incorporation of Existing Plans and Other Relevant Information 20

Section 5: Hazard Analysis **22**

5.1 Overview 22
5.2 Hazard Identification and Screening 22
5.3 Hazard Profile 26
5.3.1 Seismic Hazards 26
5.3.2 Weather-Related Hazards 35
5.3.3 Other Hazards 50

Section 6: Vulnerability Analysis **67**

6.1 Asset Inventory 67

6.1.1 Population and Building Stock 67
6.1.2 Essential Facilities and Infrastructure within San Francisco County 68
6.1.3 Essential Facilities and Infrastructure Outside San Francisco County 69
6.2 Methodology 70
6.3 Data Limitations 70
6.4 Exposure Analysis 71
6.5 Summary of Impacts 75
6.5.2 Weather-Related Hazards 76
6.5.3 Other Hazards 77
6.6 Land Use and Development Trends 78
6.7 NFIP-Insured Structures with Repetitive Damage 82

Section 7: Capability Assessment 83

Section 8: Mitigation Strategy 108

8.1 Update of Local Hazard Mitigation Goals 108
8.2 Review of 2008 HMP Mitigation Implementation Strategy 109
8.3 Identification of New and Updated Potential Mitigation Actions 113
8.4 Prioritization of 2014 HMP Mitigation Actions 121
8.5 2014 HMP Mitigation Action Plan 122

Section 9: Plan Maintenance 126

9.1 Monitoring, Evaluating, and Updating the Plan 126
9.2 Integration into Other Planning Mechanisms 128
9.3 Continued Public Participation in Plan Maintenance 129

Section 10: References 130

Tables

4-1 2014 Hazard Mitigation Plan Planning Team 13
4-2 Initial Summary of 2014 HMP Update Needs 15
5-1 Hazard Identification and Screening 23
5-2 Abbreviated Modified Mercalli Intensity (MMI) Scale 27
5-3 Magnitude and Intensity Comparisons 28
5-4 Major Known Faults in the San Francisco Bay Area 29
5-5 Probabilities of One or More Major Earthquakes in the San Francisco Bay Region 2007-2036 30
5-6 San Francisco High-Wind Events 1950-2012 45

5-7 State-Regulated Dams within the San Francisco County Limits 53
5-8 San Francisco Working Fires and Greater Alarms 2008-2012 57
6-1 CCSF Population and Building Inventory by Area 68
6-2 Essential Facilities and Infrastructure within San Francisco County 68
6-3 Exposure Analysis Overview – Population and Building Stock Summary 72
6-4 Exposure Analysis Overview – Essential Facilities and Infrastructure within San Francisco County 74
6-5 Potential Hazard Exposure Analysis Overview – Estimated Population and Building Inventory 78
6-6 Exposure Analysis Overview – Plan Areas Major Development Projects 81
7-1 Local Human and Technical Resources for Hazard Mitigation 84
7-2 Local and Federal Financial Resources for Hazard Mitigation 88
7-3 Local Legal and Regulatory Resources Available for Hazard Mitigation 93
7-4 Local Current, Ongoing, and Completed Hazard Mitigation Projects and Programs 102
8-1 Mitigation Goals 108
8-2 Review of 2008 HMP Mitigation Implementation Strategy 110
8-3 New and Updated Potential Mitigation Actions 114
8-4 2014 HMP Mitigation Action Plan 123

Appendices

A FEMA *Local Mitigation Plan Review Tool*
B Local Plan Adoption Resolution
C Figures
D Planning Team Meetings
E Public and Stakeholder Outreach
F Essential Facilities and Infrastructure Within San Francisco
G Essential Facilities and Infrastructure Outside San Francisco
H Plan Maintenance Documents
I Electronic Document

Acronyms and Abbreviations

2005 HMP	2005 Multi-Jurisdictional Local Government Hazard Mitigation Plan: City and County of San Francisco Annex
2008 HMP	2008 City and County of San Francisco Hazard Mitigation Plan
2014 HMP	2014 City and County of San Francisco Hazard Mitigation Plan
ABAG	Association of Bay Area Governments
ALERT	Auxiliary Law Enforcement Response Team
ARCBA	American Red Cross Bay Area Chapter
BART	Bay Area Rapid Transit
CAL FIRE	California Department of Forestry and Fire Protection
Cal OES	California Governor's Office of Emergency Services
Caltrans	California Department of Transportation
CAP	Citywide Action Plan
CAPSS	Community Action Plan for Seismic Safety (CAPSS)
CBRNE	chemical, biological, radiological, and nuclear, explosive
CCSF	City and County of San Francisco
CFR	Code of Federal Regulations
CGS	California Geological Survey
CIP	Capital Improvement Program
CPP	Capital Planning Program
CRS	Community Rating System
DART	Disaster Animal Response Team
DBI	Department of Building Inspection
DEM	Department of Emergency Management
DMA 2000	Disaster Mitigation Act of 2000
DOE	Department of Environment
DPC	Disaster Preparedness Coordinators
DPH	Department of Public Health
DPW	Department of Public Works
DSOD	California Division of Safety of Dams
DT	Department of Technology

DWR	California Department of Water Resources
EPA	United States Environmental Protection Agency
ERP	Emergency Response Plan
ESER	Earthquake Safety and Emergency Response Bond
ESIC	Earthquake Safety Implementation Committee
ESIP	Earthquake Safety Implementation Program
FEMA	Federal Emergency Management Agency
FHSZ	Fire Hazard Severity Zone
FIRM	Flood Insurance Rate Map
FMA	Flood Mitigation Assistance (grant program)
FY	fiscal year
GIS	Geographic Information System
GP	General Plan
GSA	General Services Agency
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
LEED	Leadership in Energy and Environmental Design
M	Magnitude
ML	Local Magnitude
Mw	Moment Magnitude
MMI Scale	Modified Mercalli Intensity scale
mph	miles per hour
MUNI	Municipal Railway
NCDC	National Climatic Data Center
NCRIC	Northern California Regional Intelligence Center
NERT	Neighborhood Emergency Response Team
NFIP	National Flood Insurance Program
NRC	National Response Center
PDM	Pre-Disaster Mitigation
PGA	Peak ground acceleration
POC	Point of Contact

RFC	Repetitive flood claims
RL	Repetitive Loss
RPD	Recreation and Parks Department
SF CARD	San Francisco Community Agencies Responding to Disaster
SFFD	San Francisco Fire Department
SFGIS	San Francisco Enterprise GIS
SFHA	Special Flood Hazard Area
SFMTA	San Francisco Municipal Transportation Agency
SFO	San Francisco International Airport
SFPD	San Francisco Police Department
SFPUC	San Francisco Public Utilities Commission
SFUSD	San Francisco Unified School District
SoMa	South of Market
SRL	Severe Repetitive Loss
SSIP	Sewer System Improvement Program
Stafford Act	Robert T. Stafford Disaster Relief and Emergency Assistance Act
TIDA	Treasure Island Development Agency
UCERF	Uniform California Earthquake Rupture Forecast
UMB	unreinforced masonry building
URS	URS Corporation
USC	United States Code
USGBC	United States Green Building Council
USGS	United States Geological Survey
WHO	World Health Organization
WMD	Weapon of Mass Destruction
WGCEP	Working Group on California Earthquake Probabilities
WSIP	Water System Improvement Program

Section 1: Introduction

The City and County of San Francisco (CCSF) has developed this Hazard Mitigation Plan (the 2014 HMP) to assess risks to CCSF by natural and human-caused hazards, and to develop mitigation strategies for reducing the impact of those risks. The 2014 HMP represents CCSF's commitment to San Francisco to take action to help reduce risk and create a safer, more resilient community. The plan also serves as a guide for CCSF decision-makers as they commit resources to reduce the effects of hazards on our people and property.

CCSF has prepared the 2014 HMP in accordance with the requirements of the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988 (the Stafford Act), 42 United States Code (USC) §§ 5121 et seq., as amended by the Disaster Mitigation Act of 2000 (DMA 2000), Public Law 106-390, and its implementing Code of Federal Regulations (CFR) provisions, 44 CFR Part 201. The San Francisco Department of Emergency Management (DEM), Division of Emergency Services, has coordinated preparation of the 2014 HMP in cooperation with other CCSF agencies and departments. The 2014 HMP updates and replaces the HMP prepared by the City in 2008.

This section provides a brief introduction to hazard mitigation planning, local mitigation plan requirements, and Federal Emergency Management Agency (FEMA) mitigation grants. The section also provides a description of the 2014 HMP.

1.1 Hazard Mitigation Planning

Hazard mitigation is "any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards." (44 CFR § 201.2.) In general, hazard mitigation is work done to minimize the impact of a hazard event before it occurs. The goal of such mitigation efforts is to reduce losses from future disasters. The purpose of mitigation planning is for local governments to identify the hazards that impact them, to identify a plan of actions and activities to reduce losses from those hazards, and to establish a coordinated process to implement that plan, taking advantage of a wide range of resources. (See 44 CFR § 201.1(b).)

At the local level, hazard mitigation is a process in which a local jurisdiction identifies and profiles hazards that affect the local area, analyzes the people and facilities at risk from those hazards, and develops mitigation actions to lessen or reduce the impact of profiled hazards. The jurisdiction's implementation of mitigation actions, which include long-term strategies that may involve planning, policy changes, programs, projects, and other activities, is the primary objective of this process.

1.2 Local Mitigation Planning Requirements

Local hazard mitigation planning is governed by the Stafford Act, as amended by DMA 2000, and by federal regulations implementing the Stafford Act. As revised by DMA 2000, the Stafford Act requires state, local, and tribal governments to develop and submit for approval a mitigation plan that outlines processes for identifying the natural hazards, risks, and vulnerabilities of the jurisdiction. FEMA approval of such plans is a prerequisite to receiving federal hazard mitigation grant funds. (See 42 USC § 5165(a).)

To implement the mitigation planning requirements of the Stafford Act, FEMA promulgated 44 CFR Part 201, the federal regulations governing the planning process, plan content, and the process for obtaining approval of the plan from FEMA. The planning requirements set forth in the CFR, including plan update requirements, are identified in their appropriate sections throughout this plan.

The State of California's local mitigation plan requirements are the same as those imposed by federal law. Thus, local hazard mitigation plans in California are only required to cover natural hazards. However, San Francisco's 2008 HMP contained coverage of human-caused hazards. The Planning Team determined that omitting coverage of human-caused hazards from the 2014 HMP would represent a step backwards in planning for and developing strategies to mitigate hazards and threats in the Planning Area. Accordingly the 2014 HMP contains coverage of both natural and human-caused hazards.

The FEMA *Local Mitigation Plan Review Tool*, which documents San Francisco's compliance with Code of Federal Regulations requirements for local mitigation planning, is provided in Appendix A.

1.3 Grant Programs With Mitigation Plan Requirements

Currently, five FEMA grant programs provide funding to local entities that have a FEMA-approved local mitigation plan meeting federal hazard mitigation plan requirements. Two of the grant programs are authorized under the Stafford Act. The remaining three programs are authorized under the National Flood Insurance Act and the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act.

1.3.1 Stafford Act Grant Programs

1.3.1.1 Hazard Mitigation Grant Program

The Hazard Mitigation Grant Program (HMGP) provides grants to state, local, and tribal entities to implement long-term hazard mitigation measures after declaration of a major disaster. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters, and to enable mitigation measures to be implemented during the immediate recovery from a disaster. To qualify for HMGP funding, projects must provide a long-term solution to a problem, such as elevating a home to reduce the risk of flood damage rather than buying sandbags and pumps to fight the flood. In addition, the project's potential savings must exceed the cost of implementing the project.

HMGP Funds may be used to protect either public or private property, or to purchase property that has been subjected to, or is in danger of, repetitive damage. The amount of funding available for the HMGP under a particular disaster declaration is limited. Under the program, the federal government may provide a state or tribe with up to 20 percent of the total disaster grants awarded by FEMA, and may provide up to 75 percent of the cost of projects approved under the program.

1.3.1.2 Pre-Disaster Mitigation Program

The Pre-Disaster Mitigation (PDM) Program provides funds to state, local, and tribal entities for hazard mitigation planning and the implementation of mitigation projects before a disaster event. PDM grants are awarded on a nationally competitive basis. Like HMGP funding, the potential savings of a PDM project must be more than the cost of implementing the project. Funds may be used to protect either public or private property or to purchase property that has been subjected to, or is in danger of, repetitive damage. The total amount of PDM funding available is appropriated by Congress on an annual basis. In fiscal year (FY) 2012, Congress appropriated $36 million for PDM grants. The Federal government provides up to 75 percent of the cost of projects approved under the program.

1.3.2 National Flood Insurance Act Grant Programs

1.3.2.1 Flood Mitigation Assistance Grant Program

As noted above, the goal of the Flood Mitigation Assistance (FMA) Grant Program is to reduce or eliminate flood insurance claims under the NFIP. This program places particular emphasis on mitigating repetitive loss (RL) properties. The primary source of funding for the FMA program is the National Flood Insurance Fund. Grant funding is available for three types of grants: Planning, Project, and Technical Assistance. Project grants, which use the majority of the program's total funding, are awarded to local entities to apply mitigation measures to reduce flood losses to properties insured under the NFIP. In FY 2008, FMA funding totaled $30 million. The cost-share for this grant is 75 percent federal/25 percent nonfederal. However, a cost-share of 90 percent federal/10 percent nonfederal is available in certain situations to mitigate severe repetitive loss (SRL) properties.

1.3.2.2 Repetitive Flood Claims Program

The Repetitive Flood Claims (RFC) Program provides funding to reduce or eliminate the long-term risk of flood damage to residential and non-residential structures insured under the NFIP. Structures considered for mitigation must have had one or more claim payments for flood damages. In FY 2008, Congress appropriated $10 million for the implementation of this program. All RFC grants are eligible for up to 100 percent federal assistance.

1.3.2.3 Severe Repetitive Loss Program

The Severe Repetitive Loss (SRL) Program provides funding to reduce or eliminate the long-term risk of flood damage to residential structures insured under the NFIP. Structures considered for mitigation must have had at least four NFIP claim payments over $5,000 each, when at least two such claims have occurred within any 10-year period, and the cumulative amount of such claim payments exceeds $20,000; or for which at least two separate claims payments have been made with the cumulative amount of the building portion of such claims exceeding the value of the property, when two such claims have occurred within any 10-year period. Congress has authorized up to $40 million per year from FY 2005–FY 2009. The cost-share for this grant is 75 percent federal, 25 percent nonfederal. However, a cost-share of 90 percent federal, 10

percent nonfederal is available to mitigate SRL properties when the state or tribal plan addresses ways to mitigate SRL properties.

1.4 Hazard Mitigation Plan Description

The remainder of the 2014 HMP consists of the sections and appendices described below:

Section 2: Adoption By Local Government

Section 2 addresses the requirement of local plan adoption.

Section 3: Planning Area Description

Section 3 describes and provides a general history and background of the CCSF Planning Area, including historical trends for population, and the demographic and economic conditions that have shaped the area. A location map of San Francisco and the Bay Area is provided in Appendix C, Figures.

Section 4: Planning Process

Section 4 describes the plan update process for adoption of the 2014 HMP, including a brief history of adoption of the 2005 Multi-Jurisdictional Local Government Hazard Mitigation Plan for the San Francisco Bay Area: City and County of San Francisco Annex (the 2005 HMP), and the 2008 City and County of San Francisco Hazard Mitigation Plan (the 2008 HMP). Section 4 identifies members of the 2014 HMP Planning Team (the Planning Team), and describes the 2014 HMP planning process; documentation of Planning Team meetings is included in Appendix D, Planning Team Meetings. This section also describes stakeholder and public outreach activities engaged in by CCSF as part of the planning process; documentation of public-stakeholder outreach is included in Appendix E, Public and Stakeholder Outreach. In addition, the section documents the Planning Area's review and incorporation of relevant plans, reports, and other appropriate information.

Section 5: Hazard Analysis

Section 5 describes the process used by the Planning Team to review and revise the hazards to be profiled in the 2014 HMP. The section also includes hazard profiles for each hazard selected for profiling, including a description of the nature, history, location, extent, and probability of future events for each hazard. It is important to note that the hazard profiles in this section only address hazards impacting San Francisco County. Extra detail is provided in the flood hazard profile to meet FMA planning requirements. In addition, hazard and location maps for assets within CCSF are provided in Appendix C, Figures. Location maps for CCSF-owned assets located outside county boundaries are provided in Appendix G, Essential Facilities and Infrastructure Outside San Francisco County.

Section 6: Vulnerability Analysis

Section 6 identifies potentially vulnerable assets — including people, residential, nonresidential, and essential facilities and infrastructure — within the CCSF Planning Area. The information presented in this section was compiled by assessing the potential impacts from each hazard using geographic information system (GIS) data. The resulting discussion identifies the full

range of hazards the CCSF Planning Area could face, and the potential social impacts, damages, and economic losses.

Section 7: Capability Assessment

Section 7 identifies and evaluates the human, technical, financial, and legal and regulatory resources available for hazard mitigation within San Francisco. In addition, this section describes current, ongoing, and completed mitigation projects and programs within CCSF. The section also describes CCSF's participation in the National Flood Insurance Program (NFIP).

Section 8: Mitigation Strategy

Section 8 provides the mitigation strategy selected by the Planning Team for reducing the potential losses identified in the vulnerability analysis. The Planning Team reviewed and revised the 2008 HMP's mitigation goals and implementation strategy to create an updated list of hazard mitigation projects to be undertaken by CCSF during the life of the 2014 HMP. Through an evaluation and prioritization process described in this section, the Planning Team selected high-priority projects to be included in the 2014 HMP implementation strategy. In addition, Section 8 provides an update on CCSF's progress in implementing the mitigation actions selected for the 2008 HMP.

Section 9: Plan Maintenance

Section 9 describes the formal plan maintenance process selected by the Planning Team to ensure that the 2014 HMP remains a viable, living document. The plan maintenance process includes procedures for monitoring, evaluating, and updating the 2014 HMP; for implementing the 2014 HMP through existing planning mechanisms, and for continued public involvement in the HMP planning process. Plan maintenance documentation is included in Appendix H.

Section 10: References

Section 10 lists reference materials used to prepare the 2014 HMP.

Appendix A

Appendix A contains the FEMA *Local Mitigation Plan Review Tool*, which documents CCSF's compliance with the local hazard mitigation plan requirements of 44 CFR Part 201, and the requirements of 44 CFR Part 78 for flood risk mitigation plans.

Appendix B

Appendix B contains the Resolution of the San Francisco Board of Supervisors adopting the 2014 HMP, as approved by San Francisco Mayor Edwin M. Lee.

Appendix C

Appendix C includes maps identifying known hazard areas, population density, land use and development, and other relevant maps for the Planning Area.

Appendix D

Appendix D contains documentation of meetings held by the Planning Team.

Appendix E

Appendix E documents the stakeholder and public outreach efforts engaged in during the 2014 HMP planning process, including public information regarding the 2014 HMP and the planning process that was posted on DEM's website, and the presentation to 2014 HMP stakeholders.

Appendix F

Appendix F is provided on a DVD disk in an electronic format only, because of its size. This appendix contains the list of essential facilities and infrastructure located within CCSF boundaries that are included in the asset inventory list for the 2014 HMP. In addition, this appendix includes the exposure analysis for these assets.

Appendix G

Appendix G contains a list of CCSF-owned essential facilities and infrastructure located outside CCSF boundaries, which CCSF intends to fully integrate into the jurisdiction's hazard assessment in future plan updates. It also includes some hazard maps for relevant out-of-county areas.

Appendix H

Appendix H provides the 2014 HMP plan maintenance documents.

Appendix I

Appendix I contains an electronic version of the 2014 HMP on disk.

Section 2: Local Plan Adoption

The requirements for adoption of this plan by the local governing body, as set forth in the Stafford Act, as amended by DMA 2000, and its implementing regulations, are described below.

FEMA REGULATION CHECKLIST: PLAN ADOPTION

Adoption by the Local Governing Body

44 CFR § 201.6(c)(5): The local hazard mitigation plan shall include "[d]ocumentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, County Commissioner, Tribal Council)."

Element

E1. Does the Plan include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval?

Source: FEMA, *Local Mitigation Plan Review Tool*, March 2013.

The Board of Supervisors of the City and County of San Francisco adopted the 2014 HMP by resolution on [date to be added]. Mayor Edwin Lee approved the resolution on [date to be added]. A scanned copy of the resolution is included in Appendix B, Local Plan Adoption. Accordingly, the City and County of San Francisco meets the requirements of the Stafford Act, as amended, and 44 CFR § 201.6(c)(5).

Section 3: Planning Area Description

This section describes the Planning Area covered by the 2014 HMP, as well as its location within the State of California, and its geography, history, government, economy, and demographics.

3.1 Scope of Planning Area

The Planning Area covered by the 2014 HMP includes the City and County of San Francisco, as shown on Figure C-1 (Appendix C, Figures). San Francisco is the only consolidated city-county in California; the City of San Francisco is the sole municipality located within the county. San Francisco County encompasses approximately 232 square miles, though land makes up only 47 of those square miles. Included within county boundaries are Treasure Island and the Farallon Islands. Unlike Treasure Island, the Farallon Islands are uninhabited with the exception of the Southeast Farallon Islands, where research residents stay.

In addition, the Planning Team determined that it is important to the safety and resiliency of San Francisco to address essential CCSF-owned assets located outside county boundaries in its mitigation planning. The 2014 HMP begins this integration process by identifying essential out-of-county assets, which are included in Appendix G, Essential Facilities and Infrastructure Outside San Francisco County. For a location map showing major CCSF-owned, out-of-county assets, see Figure G-1 (Appendix G, Essential Facilities and Infrastructure Outside San Francisco County). Future plan updates will incorporate out-of-county assets into the vulnerability analysis and other sections of the plan as well.

3.2 Location, Geography, and History

The City and County of San Francisco is located on the coast of Northern California. It forms the northern tip of a peninsula lying between San Francisco Bay and the Pacific Ocean and is bordered by the Pacific Ocean to the west, by San Francisco Bay to the north and east, and by San Mateo County to the south. San Francisco is approximately 350 miles northwest of Los Angeles and approximately 300 miles south of the California-Oregon border. CCSF occupies approximately 47 square miles. Elevations in San Francisco range from sea level at the Pacific Ocean to 928 feet at the top of Mount Davidson, near the geographical center of the City.

San Francisco's climate is temperate and Mediterranean, characterized by moist, mild winters and dry summers. The varied topography and marine surroundings have led to the development of a number of microclimates within CCSF. Fog is common in San Francisco, particularly in the neighborhoods bordering the Pacific Ocean. Temperatures in CCSF usually range between 50 and 70 degrees Fahrenheit in the summer, and between 40 and 60 degrees Fahrenheit in the winter.

The Golden Gate Weather Services estimates that 80 percent of San Francisco's seasonal rain falls between November and March, with average total rainfall of approximately 21.5 inches per year. Rainfall from May through September is rare; less than one inch, or approximately five percent of the City's yearly total rainfall falls during these months. Snowfall is also rare in San Francisco: There are 10 documented instances of measurable snow at the official observation site over the past 143 seasons.

The region around San Francisco Bay was first inhabited between 10,000 and 20,000 years ago by indigenous people now known as the Costanoan or Ohlone. "Costanoan" is a linguistic term for a family of at least eight different languages. Prior to the arrival of the Spanish in the Bay Area in the 18th Century, the Costanoan-speaking people lived in approximately 50 distinct, politically autonomous nations or "tribelets." The group that lived in the San Francisco area is today known as the Ramaytush. Ethnographers further classify the Ramaytush into several local tribes, including the Yelamu group, which had several villages within present-day San Francisco.

In 1769, Spanish explorers led by Gaspar de Portolà discovered the mouth of San Francisco Bay, which is now known as the Golden Gate. Portolà claimed the Bay Area for Spain; seven years later, Father Junipero Serra established Mission San Francisco de Asís, also known as Mission Dolores. In 1776, a Spanish expedition led by Juan Bautista de Anza sited the area now known as the Presidio, and later that year, the Spanish built a fort there. In 1821, after the Mexican War of Independence, the Presidio passed to Mexico, which at the time included San Francisco and much of the southwestern United States.

Following the United States victory in the Mexican-American War in 1846, the US took control of the portion of California that included San Francisco. San Francisco officially became part of the United States on the signing of the Treaty of Guadalupe Hidalgo in 1848. At the time, San Francisco was known as Yerba Buena, but was named San Francisco by the city's chief magistrate in 1846.

The discovery of gold in California in 1848 precipitated a mass migration of Americans westward. Between January 1848 and December 1849, San Francisco's population exploded from 1,000 to 25,000 inhabitants. By 1870, San Francisco was the largest American city west of the Mississippi River, a distinction it maintained until 1920. After California became a state in 1850, the State Legislature established San Francisco as one of the state's original 18 counties. San Francisco County government was established on April 1, 1850; the City of San Francisco was incorporated on April 15, 1850. The Consolidation Act of 1856 mandated combining the City and County into a single geographic and political unit.

3.3 Government

The City and County of San Francisco is a home rule city and county under the California Constitution. As a home rule city and county, San Francisco has enacted a City Charter that provides that the city and county have supreme authority over its municipal affairs. (See San Francisco City Charter, art. I, § 1.101; Cal. Const. art. XI, §§ 5(a), 6(a).) This means that San Francisco voters have the power to determine how their city government is organized, and may adopt legislation regarding municipal affairs that is different than that enacted by the state. In other words, as a charter city, San Francisco's ordinances concerning municipal affairs take precedence over a state law governing the same issues.

Under its 1996 Charter, San Francisco government is composed of a legislative, judicial, and executive branch. (See San Francisco City Charter, art. II, III, VII.) The legislative branch consists of an 11-member Board of Supervisors. (San Francisco City Charter, art. II, § 2.100.) Each member of the Board of Supervisors is elected by a majority vote of the residents of the district he or she represents. (See San Francisco City Charter, art. XIII, §§ 13.100, 13.100.5.) Because

San Francisco is both a city and county, the Board of Supervisors also serves as a city council. The Board of Supervisors is led by a President selected by members of the Board; the Board President presides over Board meetings and appoints members of Board committees. (See San Francisco City Charter, art. II, § 2.116.)

The Mayor of San Francisco serves as the chief executive officer and official representative of the City and County. The Mayor has responsibility for general administration and oversight of all departments and governmental units in San Francisco. The Mayor also has authority to appoint members of City boards and commissions, though the Board of Supervisors may reject such appointments by a two-thirds vote. (See San Francisco City Charter, art. III, § 3.100.)

3.4 Economy

San Francisco is a worldwide tourist destination and a global financial center. Over 30 international financial institutions, and some of the largest banks in the United States, are based in San Francisco. According to the San Francisco Travel Association, in 2012 San Francisco hosted 16.5 million visitors who spent over $8.9 billion in local businesses, the highest spending levels experienced by the city to date. On an average day in 2012, visitors spent over $24 million. US Department of Commerce statistics indicate that in 2012, San Francisco was the fifth most visited American city by overseas tourists.

The nine-county San Francisco Bay Area (the Bay Area) thrives on international trading and shipping. According to the US Department of Commerce, in 2011 the Bay Area exported goods totaling over $52 billion, or 30 percent of California's total exports; the Bay Area is the fourth largest exporting region in the US. The San Francisco International Airport (SFO), the largest airport in the Bay Area, contributes significantly to trade, shipping, and tourism in the region. Federal Aviation Administration (FAA) statistics indicate that in 2012, SFO ranked seventh among US airports in enplanements, with over 21 million passengers.

CCSF is home to over 6,000 information technology firms, including industry leaders such as Twitter, Instagram, and Yelp. The Bay Area also hosts the largest number of research universities and federal research institutions in the United States. Bay Area colleges and universities produce more Ph.D. scientists and engineers than any other metropolitan area in the country. The University of California, San Francisco (UCSF) is the site of a major biomedical research campus. San Francisco's Mission Bay area has become a center for high-technology medical sciences. The headquarters of the California Institute for Regenerative Medicine, an agency funding stem cell research, is located in Mission Bay. Nearly one-third of total worldwide biotechnology workers are employed in San Francisco and the Bay Area.

3.5 Demographics

According to the United States Census Bureau, San Francisco's population in 2010 was 805,235, placing the city 13th on the list of most populous American cities. San Francisco is the most densely-settled large city (defined as a city with population greater than 200,000) in the state of California, and the second most densely-populated major city in the United States after New York. According to the 2010 Census, 4.4 percent of San Franciscans were under five years of

age; 86.4 percent were over 18 years of age; and 13.6 percent were 65 years old or older. The median age in San Francisco in 2010 was 38.5 years.

The 2010 Census also indicates that San Francisco's racial composition is as follows: 48.5 percent White, 33.3 percent Asian, 15.1 percent Hispanic or Latino, 6.1 percent Black or African American, 0.5 percent American Indian and Alaska Native, 0.4 percent Native Hawaiian and other Pacific Islander, and 4.7 percent two or more races.

In addition, the 2010 Census estimated that 484,137 San Franciscans were part of the labor force. Of that number, an estimated 447,467 were employed and 36,368 were unemployed, for an approximate unemployment rate of 7.5 percent. The median income in San Francisco in 2010 was $72,947; the 2010 per capita income was estimated at $46,777. The percentage of families and people whose income was below the poverty level for the preceding year was 7.6 percent; 12.3 percent of individuals were reported to be living below the poverty level in 2010.

Section 4: Planning Process

The requirements for documentation of the HMP planning process, as provided in the Stafford Act as amended, and in its implementing regulations, are described below.

FEMA REGULATION CHECKLIST: PLANNING PROCESS

Documentation of the Planning Process

44 CFR § 201.6(c)(1): The plan shall include "[d]ocumentation of the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved."

Elements

A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? 44 CFR § 201.6(c)(1).

Source: FEMA, *Local Mitigation Plan Review Tool,* March 2013.

Note: **For coverage of Elements A5-A6, see Section 9, Plan Maintenance.**

This section summarizes the Planning Area's hazard mitigation planning efforts in 2005 and 2008, and describes in more detail the 2014 HMP update process. In addition, the section describes public and stakeholder outreach efforts as part of the 2014 HMP update process. The section also summarizes the review and incorporation of existing plans, studies, and reports used to develop the 2014 HMP. Documentation of the 2014 HMP planning process is provided in Appendix D, Planning Team Meetings. Documentation of the 2014 HMP public and stakeholder outreach efforts is included in Appendix E, Public and Stakeholder Outreach Information.

4.1 Initial Planning Process, 2005 Plan

As noted in Section 1.4 above, the initial basis for this plan was the 2005 Multi-Jurisdictional Local Government Hazard Mitigation Plan (2005 HMP) prepared by the Association of Bay Area Governments (ABAG). Plan development for the 2005 HMP occurred over a nine-month period, from June 2004 to April 2005. To begin the planning process, ABAG held a series of forums across the Bay Area. At the San Francisco forum held on June 1, 2004, CCSF policy, planning, building, public works, and emergency management personnel were invited to learn about DMA 2000, the multi-jurisdictional plan and annexes, a GIS-based hazard identification and risk assessment, and possible mitigation projects to be included in a community annex.

Over the next four months, ABAG staff reviewed existing technical reports and studies as a basis for the hazard assessment, exposure, and vulnerability portions of the 2005 HMP. ABAG staff also prepared online GIS hazard maps; drafted goals, policies, and a list of proposed mitigation projects based on existing HMGP projects; and presented this information to its Regional Planning Committee in September 2004. In addition, ABAG drafted an outline of mitigation strategies and circulated the strategies to all participating local government agencies for comment.

ABAG distributed a draft version of the 2005 HMP base plan at the ABAG General Assembly conference on October 6, 2004. Between October and November 2004, ABAG presented the draft base plan at several existing Bay Area workshops and forums. Comments received from the general public, participating jurisdictions, the California Governor's Office of Emergency Services (Cal OES), and FEMA were incorporated into the draft plan by late January 2005. ABAG's Executive Board adopted the base plan portion of the 2005 HMP on March 17, 2005. The San Francisco Board of Supervisors adopted the 2005 HMP on April 12, 2005, and Mayor Gavin Newsom approved the adoption resolution on April 15, 2005.

4.2 2008 Plan Update Process

In mid-2007, the San Francisco Department of Emergency Management (DEM) decided to update the 2005 HMP after determining that additional hazards and mitigation projects needed to be addressed in the plan. DEM retained URS Corporation as a consultant to assist in development of the plan update, and initiated the planning process in April 2008 by inviting several CCSF departments and agencies, as well as San Francisco Community Agencies Responding to Disaster (SF CARD), to participate as Planning Team members.

A series of three Planning Team meetings were held over the next seven months to review the existing 2005 HMP, to develop a preliminary list of hazards to be profiled, and to review and finalize the list of CCSF assets to be included in the 2008 HMP. In addition, the 2008 Planning Team reviewed and revised a list of potential mitigation projects submitted by various departments and agencies and by the consultants, developed evaluation criteria, and selected the 2008 implementation strategy.

In August, the Planning Team reviewed and commented on the draft 2008 HMP. After incorporating Planning Team comments, DEM made a revised draft available on the DEM website for public comment. The revised draft 2008 HMP was sent to Cal OES and FEMA for review in October 2008. After receiving preliminary approval of the plan in mid-October, the San Francisco Board of Supervisors adopted the 2008 HMP by resolution on December 8, 2008; Mayor Newsom approved the adoption resolution on December 16, 2008. FEMA formally approved the 2008 HMP on January 9, 2009.

4.3 2014 Plan Update Process

In July 2013, DEM convened a Planning Team for purposes of assessing and updating the 2008 HMP. A series of four Planning Team meetings were held from July through September 2013. Members of the 2014 HMP Planning Team are listed in Table 4-1, below.

Table 4-1: 2014 Hazard Mitigation Plan Planning Team

Department or Agency	Member Name	Key Role
DEM	Amy Ramirez	Lead Emergency Planner, Primary DEM Point of Contact
	Edie Schaffer	Emergency Planner, Secondary DEM Point of Contact
	Amiee Alden	Outreach to city leaders

Table 4-1: 2014 Hazard Mitigation Plan Planning Team

Department or Agency	Member Name	Key Role
DEM (cont.)	Alicia Johnson	Public and stakeholder outreach planning and implementation
	Robert Stengel	New hazard profiles, plan review
	Francis Zamora	Public information and outreach, HMP web site design and maintenance
Capital Planning Program	Brian Strong	CCSF assets and planning projects, HAZUS study of critical CCSF facilities
Department of Building Inspection (DBI)	Neil Friedman	CCSF building inventory, DBI mitigation projects, UMBs
Department of Environment (DOE)	Cal Broomhead	Hazard assessment, DOE capabilities and mitigation projects
	Calla Ostrander	Hazard assessment, DOE capabilities and mitigation projects
Department of Public Health (DPH)	Naveena Bobba	Hazard assessment, DPH capabilities and mitigation projects
	Teri Dowling	Hazard assessment, DPH capabilities and mitigation projects
Department of Public Works (DPW)	Cynthia Chono	Hazard assessment, DPW capabilities and mitigation projects
Earthquake Safety Implementation Program (ESIP)	Micah Hilt	ESIP capabilities and mitigation projects
	Patrick Otellini	ESIP capabilities
Mayor's Office of Disability	Carla Johnson	Input and guidance on people with disabilities and access and functional needs
Northern California Regional Intelligence Center (NCRIC)	Dave Sullivan	Hazard assessment, NCRIC capabilities and mitigation projects
Office of City Administrator, General Services Agency (GSA)	Nick Majeski	GSA capabilities
Office of the City Administrator, Risk Management Program	Matt Hansen	Asset lists, CCSF Floodplain Administrator delegatee, flood-related mitigation projects
Office of Community Investment and Infrastructure	Leo Levenson	Land use and development
Planning Department	Scott Edmondson	Land use and development, climate change
	Lily Langlois	Planning capabilities and mitigation projects
	Teresa Ojeda	GIS, land use and development
Port of San Francisco	Sidonie Sansom	Port assets, capabilities, and mitigation projects
Real Estate Division	John Updike	CCSF assets
Recreation and Parks Department (RPD)	Karen Mauney-Brodek	RPD capabilities and mitigation projects
	Angelica Quicksey	Hazard assessment, RPD capabilities and mitigation projects
San Francisco International Airport (SFO)	Jeff Airth	SFO capabilities and mitigation projects
	Toshia Marshall	SFO assets, capabilities, and mitigation projects

Table 4-1: 2014 Hazard Mitigation Plan Planning Team

Department or Agency	Member Name	Key Role
San Francisco Fire Department (SFFD)	Assistant Deputy Chief Kyle Merkins	SFFD capabilities and mitigation projects, fire-related hazards
San Francisco Municipal Transportation Agency (SFMTA)	Scarlett Lam	Hazard assessment, SFMTA assets and capabilities
San Francisco Public Utilities Commission (SFPUC)	Mary Ellen Carroll	SFPUC assets and mitigation projects
	Joshua Keene	SFPUC assets
	Brad Wilson	SFPUC assets, capabilities, and mitigation projects
Treasure Island Development Agency (TIDA)	Bob Beck	TIDA assets, capabilities, and mitigation projects
	Peter Summerville	TIDA assets, capabilities, and mitigation projects

UMB = unreinforced masonry building

On July 31, 2013, DEM held the first Planning Team meeting to begin the plan update process. As shown in Appendix D, Planning Team Meetings, DEM planners familiarized the Planning Team with local mitigation plan requirements under the Stafford Act and its implementing regulations, described the plan update process, reviewed FEMA's feedback on the 2008 HMP, and provided a schedule for updating the plan. DEM planners also provided the Planning Team with a summary of recommended changes to be made to the 2014 HMP. A summary of the recommended changes and plan update needs is shown in Table 4-2. The Planning Team reviewed the hazards addressed in the 2008 HMP and other CCSF plans, including the 2009 Emergency Response Plan (ERP) and the 2012 Community Safety Element to San Francisco's General Plan. Planning Team members made suggestions on additional hazards to consider for inclusion in the updated plan.

Table 4-2: Initial Summary of 2014 HMP Update Needs

2008 HMP	Actions Needed to be Taken
Prerequisites section	• Rename as "Local Plan Adoption" section. • Obtain adoption of the 2014 HMP by the Board of Supervisors, with approval from the Mayor.
Introduction	• Update hazard mitigation planning and grant information.
Community Description	• Rename as "Planning Area Description" section. • Update demographic, historical, government, and economic information.
Planning Process	• Create a 2014 HMP Planning Team and begin the meeting process. • Review 2008 HMP and update as needed to reflect changes in hazards affecting the Planning Area, changes in CCSF priorities, and progress in mitigating hazards since 2008. • Review and update essential assets to be analyzed. • Develop and implement a public and stakeholder outreach strategy. • Incorporate other existing plans and reports into 2014 HMP. • Document the entire 2014 HMP update process.

Table 4-2: Initial Summary of 2014 HMP Update Needs

2008 HMP	Actions Needed to be Taken
Hazard Analysis and Vulnerability Analysis	• Update hazards to be profiled to reflect any changes since 2008. • Update assets to be analyzed to include assets added since 2008, and to identify essential CCSF-owned assets outside county boundaries. • Remap hazard areas and asset locations in GIS. • Update the vulnerability analysis using updated asset and hazard information, interpret analysis, and discuss new findings. • Share vulnerability analysis with the Planning Team to discuss findings.
Capability Analysis	• Review, update, and document all local legal and regulatory, administrative and technical, and financial resources available for hazard mitigation. • Update local current, ongoing, and completed mitigation projects and programs to reflect progress since 2008. • Add information regarding ability to expand on and improve existing policies and programs. • Address CCSF's participation in the NFIP and continued compliance with NFIP requirements.
Mitigation Strategy	• Meet with the Planning Team to determine if the 2008 HMP mitigation goals and criteria are still relevant. • Update the status of 2008 HMP mitigation strategies to be implemented. • Develop a comprehensive list of new and updated mitigation actions from CCSF agencies and departments. • Revise the mitigation action evaluation and prioritization process as needed. • Determine the implementation strategy for selected mitigation actions.
Plan Maintenance	• Review the plan maintenance strategy, determine if monitoring, evaluation, and updating procedures were followed, and if not, update as necessary. • Review the strategy for continued public participation in the plan maintenance process and update as necessary.

At the second Planning Team meeting on August 28, 2013, DEM planners provided the Planning Team with the preliminary list of hazards to be profiled in the 2014 HMP. The 2005 HMP addressed eight natural hazards; the 2008 HMP addressed an additional six natural hazards (reservoir failure, coastal flooding, stormwater ponding, heat, landslides, and wind) and four human-caused hazards (hazardous material, Weapon of Mass Destruction (WMD), energy supply, and terrorism). The 2014 HMP Planning Team determined that hazard profiles for pandemic and climate change should be added to the 2014 HMP, and that human-caused hazards should be maintained even though not required by the Stafford Act.

In addition, the Planning Team began reviewing the list of CCSF assets to be included in the 2014 HMP, and decided that it should begin integration of essential CCSF-owned assets located outside San Francisco County in the 2014 HMP. DEM planners also presented a proposed plan for public and stakeholder outreach to the Planning Team for their review and comment. After the meeting, the Planning Team was asked to review and provide DEM with an update on the 2008 HMP capability assessment. Planning Team members also were asked to provide a status update on mitigation projects adopted as part of the 2008 HMP, and to submit mitigation project ideas to DEM planners on behalf of their department or agency.

A third Planning Team meeting was held on September 19, 2013. At this meeting, the Planning Team reviewed the 2008 HMP mitigation goals and prioritization criteria, and a draft version of the status update on the mitigation strategies selected for implementation for the 2008 HMP. The Planning Team also reviewed and commented on the public-stakeholder outreach plan and efforts. DEM planners also presented the Planning Team with draft hazard assessment materials, and an updated asset list for review and comment.

During the fourth Planning Team meeting held on September 25, 2013, the Planning Team reviewed and revised the list of potential mitigation projects submitted by various departments; and reviewed different evaluation criteria, such as cost-benefit, local champion, feasibility within the lifespan of the 2014 HMP, and funding availability. Thereafter, the Planning Team slightly revised the mitigation goals and evaluation criteria, then determined the high-priority projects to be included in the 2014 mitigation action plan. Departments with high-priority projects submitted to DEM detailed project information, including a project timeline, and details of project funding and administration for inclusion in the implementation strategy.

From mid-September through November, Planning Team members received portions of the draft 2014 HMP by email, and reviewed and provided comments on these materials to DEM planners. DEM incorporated Planning Team feedback, and provided team members with a revised draft 2014 HMP for review at the end of November. A public comment draft version of the 2014 HMP was made available on the DEM website for a 15-day public comment period on December 3, 2013. On December 19, 2013, DEM sent the revised draft of the 2014 HMP to Cal OES for preliminary review. Cal OES forwarded the 2014 HMP to FEMA Region IX on March 6, 2014. On July 1, 2014, FEMA issued its letter approving the Plan pending local adoption.

4.4 Public and Stakeholder Outreach

The requirements for public and stakeholder outreach, as provided in the federal regulations implementing the Stafford Act as amended, are described below.

FEMA REGULATION CHECKLIST: PLANNING PROCESS

Public and Stakeholder Outreach

44 CFR § 201.6(b): "[T]he planning process shall include . . . [a]n opportunity for the public to comment on the plan during the drafting stage and prior to plan approval" and "[a]n opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process . . . ."

Elements

A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? 44 CFR § 201.6(b)(2).

A3. Does the Plan document how the public was involved in the planning process during the drafting stage? 44 CFR § 201.6(b)(1).

Source: FEMA, *Local Mitigation Plan Review Tool,* March 2013.

Note: **For coverage of Elements A5-A6, see Section 9, Plan Maintenance.**

Shortly after the 2014 HMP planning process began, DEM members of the Planning Team developed a proposed 2014 HMP public and stakeholder outreach plan, which they shared with the Planning Team at its second meeting on August 28, 2013 (See Appendix D, Planning Team Meetings). The proposed outreach plan recommended a two-pronged strategy for reaching out to the public focused on efforts during the drafting phase and prior to plan adoption. The proposed outreach strategy also recommended a series of meetings with CCSF stakeholders to publicize CCSF's HMP update efforts, and to obtain feedback on the 2014 HMP. The Planning Team provided comments on the outreach plan at its August 28 meeting. A copy of CCSF's 2014 HMP public and stakeholder outreach plan is included in Appendix E, Public and Stakeholder Outreach.

4.4.1 Public Outreach

The following activities were undertaken as part of outreach to members of the public regarding the 2014 HMP:

- Issuance on August 29, 2013, of a press release regarding the 2014 HMP update process, with a request for public comment.
- Posting of notices on social media about the 2014 HMP update, with a request for public comment.
- Creation of a DEM HMP web page on the DEM web site.
- Inclusion of notices on the 2014 HMP update in San Francisco Supervisor constituent newsletters.
- Presentation of information on the HMP update process at neighborhood meetings in Diamond Heights on August 28, and in Chinatown on September 12, 2013.
- Posting of new hazard profiles and revised portions of the 2014 HMP on the DEM HMP web page from October 15, through November 15, 2013.
- Posting of the complete updated draft version of the 2014 HMP on the DEM web page on December 4, 2013, with a request for public comment.
- Publicizing the posting of the complete updated draft version of the 2014 HMP on the DEM web page through social media.

For documentation of the above public outreach efforts, see Appendix E, Public and Stakeholder Outreach.

As an initial step in its public outreach strategy, DEM issued a press release on the 2014 HMP update process, and posted notices regarding the 2014 HMP update on DEM's Internet blog and on social media outlets such as Twitter and Facebook. Each of these notices stated that CCSF sought public input on the 2014 HMP update, and on the hazard mitigation process as a whole. At the time, DEM's blog had over 1800 subscribers; DEM also had nearly 60,000 Twitter followers, and almost 2,200 Facebook "friends."

To facilitate two-way communication on the 2014 HMP, DEM first created a separate HMP web page on its web site located at www.sfdem.org/hmp. DEM planners developed a two-page summary describing the HMP update process, which was shared on the web page and with city

leaders, including the San Francisco Board of Supervisors. As a result of this effort, Supervisors Katy Tang and Norman Yee shared information about the HMP update process with their constituents via their monthly newsletters. Next, DEM posted updated sections of the 2014 HMP as they were prepared. Then, on December 4, 2013, DEM uploaded a complete draft of the 2014 HMP for public comment. In addition, DEM Planning Team members gave presentations on the 2014 HMP update process at public meetings in San Francisco's Diamond Heights neighborhood on August 28, 2013, and in Chinatown on September 12, 2013.

During this process, DEM did not receive substantive public comment on the 2014 HMP. However, we did receive comments on how members of the public like to receive information about hazards in CCSF, and on how they would use that information to better prepare for disasters. Favored methods of communication included email, Facebook, and Skype. Some participants asked specific questions about neighborhood issues that might be exacerbated after a disaster, such as water pipe failure and sinkholes.

For documentation of the above 2014 HMP public outreach efforts, see Appendix E, Public and Stakeholder Outreach.

4.4.2 Stakeholder Outreach

To facilitate stakeholder involvement for the 2014 HMP update, DEM planners provided an overview of the 2014 HMP update and answered questions regarding the plan update process to the following stakeholder groups:

- **Business Owners and Managers Association of San Francisco** Meeting, August 13, 2013, which included 25 representatives from San Francisco businesses such as ABM Security Services, Academy of Art University, American Academy of Ophthalmology, ForeScout Technologies, Kilroy Realty Corporation, Paramount Group, PM Realty Group, and Universal Protection Service.
- **San Francisco Capital Planning Committee** meeting, September 9, 2013, which included representatives from the San Francisco Controller's Office, the Department of Public Works, the San Francisco International Airport, the Municipal Transportation Agency, the Planning Department, the Port of San Francisco, the San Francisco Public Utilities Commission, and the Recreation and Parks Department.
- **San Francisco Lifelines Council** Meeting, September 19, 2013, which included representatives from CCSF departments and agencies; major business partners such as Pacific Gas & Electric, AT&T, Comcast, and Verizon; and regional transportation organizations such as Golden Gate Bridge Transportation District, Caltrain, the California Department of Transportation (Caltrans), the San Francisco Bay Area Water Transit Authority, Bay Area Rapid Transit (BART), Amtrak, and Union Pacific Railroad.
- **San Francisco Disaster Preparedness Coordinators** (DPC) Meeting on October 3, 2013, which included senior CCSF department and agency staff responsible for coordinating emergency preparedness activities within their respective departments.

DEM planners also held a special 2014 HMP stakeholders meeting at the CCSF Emergency Operations Center on September 20, 2013. Emergency management staff from neighboring Marin, Alameda, and San Mateo counties were invited to attend the meeting and comment on

CCSF's 2014 HMP update process. Staff from partner organizations such as the American Red Cross Bay Area (ARCBA), the Association of Bay Area Governments, BART, Bayshare, the Business Owners and Managers Association, the National Park Service, the Neighborhood Empowerment Network, the San Francisco Arts Commission, San Francisco Collaborating Agencies Responding to Disaster, the San Francisco Interfaith Council, the San Francisco Neighborhood Emergency Response Team (NERT), the San Francisco Office of Small Business, and the San Francisco Planning and Urban Research were also invited to attend the stakeholders meeting. Representatives from ARCBA, Bayshare, and Alameda County attended the meeting, and provided feedback on how they prefer to receive information about the hazard mitigation planning process.

For documentation of the above 2014 HMP stakeholder outreach, see Appendix E, Public and Stakeholder Outreach.

4.5 Incorporation of Existing Plans and Other Relevant Information

The requirements for review and incorporation of existing plans, studies, reports, and other relevant information, as provided in the federal regulations implementing the Stafford Act, are described below.

FEMA REGULATION CHECKLIST: PLANNING PROCESS

Review and Incorporation of Existing Plans Studies, and Other Information

44 CFR § 201.6(b): "[T]o develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include . . . [r]eview and incorporation, if appropriate, of existing plans, studies, reports, and technical information."

Element

A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? 44 CFR §201.6(b)(3).

Source: FEMA, *Local Mitigation Plan Review Tool,* March 2013.

Note: **For coverage of Elements A5-A6, see Section 9, Plan Maintenance.**

During the plan update process, members of the Planning Team reviewed and incorporated information into the 2014 HMP information from several existing plans, studies, and reports. State and CCSF plans studies, and reports integrated into the 2014 HMP are listed below. A complete list of the sources consulted in the update of this plan is provided in Section 10, below.

- *San Francisco Emergency Response Plan* (ERP) (2009), and associated Annexes: The Hazards identified in the ERP, and more fully discussed in Annexes to the ERP, provided a basis for the hazards selected for the 2014 HMP.
- *San Francisco General Plan, Community Safety Element* (2012): The hazards identified in the 2012 Community Safety Element provided natural hazard profile information for seismic hazards (ground shaking and ground failure) and inundation hazards (tsunami and flooding).

- *San Francisco General Plan, Area Plans* (1989-2012): The land use and development trends identified in the Area Plans provided guidance for development trends identified in the 2014 HMP vulnerability analysis.
- *San Francisco General Plan, Land Use Index* (2011): Land use and development trends identified in the *Land Use Index* provided guidance for development trends identified in the 2014 HMP vulnerability analysis.
- *Here Today—Here Tomorrow: The Road to Earthquake Resilience in San Francisco, Community Action Plan for Seismic Safety* (CAPSS) (2010): The CAPSS provided information on the extent and impact of seismic-related hazards on San Francisco.
- *CAPSS Earthquake Safety Implementation Program, City and County of San Francisco Workplan 2012-2042* (2011): As a 30-year program of mitigation strategies and projects to be undertaken by CCSF to improve San Francisco's seismic safety and resiliency, the Workplan informed the Planning Team in selecting 2014 HMP mitigation strategies.
- *Hazus Analysis for the City and County of San Francisco's High Priority City-Owned Buildings* (2012): This report, prepared for the CCSF Capital Planning Program, provided guidance on seismic-related vulnerabilities of CCSF.
- *SFPUC Stormwater Management Plan* (2004): The Stormwater Management Plan provided hazard information for the 2014 HMP stormwater ponding hazard profile.
- *San Francisco Building Codes*: These codes regulate new construction and major remodels and additions; they were used to develop and update the Section 7, Capability Assessment.
- *California Climate Adaptation Planning Guide* (APG) (2012): The APG provides extensive information on the effects of climate change on California, and provides guidance on adaptation planning that was used to develop the climate change hazard profile contained in Section 5.
- *2013 State of California Multi-Hazard Mitigation Plan* (2013): This plan, prepared by Cal OES, was consulted to ensure that the hazard profiles and mitigation strategy in the 2014 HMP are consistent with the state's current hazard profiles and mitigation strategy.
- *2010 State of California Multi-Hazard Mitigation Plan* (2010): This plan, prepared by Cal OES, was consulted to ensure that the hazard profiles and mitigation strategy in the 2014 HMP are consistent with the state's most recent, proposed hazard profiles and mitigation strategy.
- *California Department of Conservation, Division of Mines and Geology, Seismic Hazard Zone Report for the City and County of San Francisco, California* (2000): This report provided information about the seismic hazard zone maps and the potential for ground shaking, liquefaction, and landslides in San Francisco.

Section 5: Hazard Analysis

5.1 Overview

As part of the hazard mitigation planning process, the Planning Area must conduct a risk assessment to determine the potential impact of hazards on the people, economy, and built and natural environments in the community. The risk assessment begins with an analysis of the types of hazards affecting the planning area. A hazard analysis involves identification and screening of each hazard, followed by the profiling of those hazards recognized to have the greatest impact on the Planning Area.

Hazard identification is the process of recognizing the natural and human-caused events that threaten an area. Hazard profiling is accomplished by describing hazards in terms of their nature or type, history, location, extent, and probability. A natural hazard is a source of harm or difficulty created by a meteorological, environmental, or geological event. A human-caused hazard results from human activity and includes technological hazards and terrorism.

Technological hazards are generally accidental or result from events with unintended consequences, such as an accidental hazardous materials release. Terrorism is an activity that involves an act dangerous to human life or that is potentially destructive of critical infrastructure or key resources, which violates state or federal criminal laws and is intended to intimidate or coerce civilians, to influence government policy, or to affect government conduct. (See Homeland Security Act of 2002, 6 USC § 101(16).)

Hazards have been identified through the collection of historical and anecdotal information, through a review of existing plans and studies, and through the preparation of hazard maps of the planning area. Hazard maps are used to determine the geographic extent of the hazards and to define the approximate boundaries of areas at risk. Though a particular hazard may not have occurred in recent history in the planning area, the 2014 HMP considers all hazards that may potentially affect the planning area. However, the Planning Team has eliminated from consideration hazards that are unlikely to occur or for which the risk of damage is accepted as being very low.

5.2 Hazard Identification and Screening

The Planning Team reviewed the hazards identified in the 2008 HMP, the San Francisco General Plan, and the 2009 CCSF Emergency Response Plan (ERP). In addition, the Planning Team reviewed CCSF disaster and history from 2008 through 2013, and other literature related to potential future hazards. Table 5-1, below, reflects this review, as well as a review of the Presidential- and state-declared emergencies and disasters that have occurred in the Planning Area from 1953 through September 2013.

Table 5-1: Hazard Identification and Screening

Hazard Type	Subhazard	State Proclamation	Presidential Declaration	Hazard Identified in 2009 ERP; Community Safety Element; 2005 HMP; 2008 HMP	Hazard Profiled in 2014 HMP Section 5.3
Avalanche					No
Civil Unrest		Unknown (1966)			No
Climate Change				General Plan	Yes
Dam Failure				2008 HMP	Yes, as Reservoir Failure
Drought		Unknown (2008) Unknown (2006)*		2005 HMP, 2008 HMP	Yes
Energy Emergency/ Power Disruption		GP-2001 (2001)		2008 HMP	Yes
Erosion					No
Expansive Soil					No
Flood		GP-96-01 (1996) Unknown (1958)	DR-1203 (1998) DR-1046 (March 1995) (1958)	General Plan, ERP, 2005 HMP, 2008 HMP	Yes
Hailstorm					No
Hazardous Material Event				General Plan, ERP, 2008 HMP	Yes, as Human-Caused Hazard
Heat, Extreme				2008 HMP	Yes
Hurricane					No
Land Subsidence					No
Landslide				General Plan, 2005 HMP, 2008 HMP	Yes
Oil Spill		Unknown (2007)		ERP, 2008 HMP	Yes, as Hazardous Material Event

Table 5-1: Hazard Identification and Screening

Hazard Type	Subhazard	State Proclamation	Presidential Declaration	Hazard Identified in 2009 ERP; Community Safety Element; 2005 HMP; 2008 HMP	Hazard Profiled in 2014 HMP Section 5.3
Seismic	Ground Shaking		DR-845 (1989)	General Plan, ERP, 2005 HMP, 2008 HMP	Yes
	Liquefaction		DR-845 (1989)	General Plan, ERP, 2005 HMP, 2008 HMP	Yes
	Lateral Spread		DR-845 (1989)	2008 HMP	Yes, as part of Earthquake-Induced Landslide
	Earthquake-Induced Landslide			General Plan, ERP, 2005 HMP, 2008 HMP	Yes
Pandemic		Unknown (Swine Flu 2009)			Yes
Reservoir Failure				General Plan, ERP, 2008 HMP	Yes, as an Other Hazard
Snow					No
Transportation Disruption		Unknown (2007)			Yes
Terrorism/ WMDs				ERP	Yes, as an Other Hazard, Human-Caused
Tornado					No
Urban Conflagration				General Plan, ERP, 2008 HMP	Yes, as an Other Hazard
Volcano					No
Tsunami				General Plan, ERP, 2005 HMP, 2008 HMP	Yes, as a Seismic Hazard
Wildfire		Rim Fire – Unknown (2013)	DR-4158 (2013)	2005 HMP, 2008 HMP	Yes
Winds, Extreme		Unknown (2008) GP-96-01 (1996)	DR-1203 (1998)	General Plan, 2008 HMP	Yes

Since 1988, Presidential declared disasters have been assigned a unique disaster number.

* June 6, 2006, Water Management and Fish Shortage: Chinook salmon population was extremely low because of poor ocean conditions, drought, water management and quality, and other causes.

The Planning Team decided to maintain the following hazards profiled in the 2008 HMP:

- Seismic hazards
  - Ground shaking
  - Ground failure (landslide and liquefaction)
  - Tsunami
- Weather-related hazards
  - Drought
  - Flood (coastal and stormwater ponding)
  - Heat
  - Landslide
  - Wind
- Other hazards
  - Reservoir failure
  - Wildfire
  - Urban conflagration
  - Human-caused (hazardous material, WMD, energy supply, and terrorism)

In addition, the Planning Team determined that hazard profiles should be added to the 2014 HMP for pandemic and climate change. The addition of pandemic is based on CCSF's experience with the swine flu in 2009. The addition of climate change is based on growing scientific evidence of the impact of climate change on coastal cities such as San Francisco, as well as CCSF-led planning efforts since 2008 to begin addressing the challenges posed by climate change.

Section 5.3 provides a detailed profile or description of the hazards identified above in terms of their effect on the planning area.

5.3 Hazard Profile

The requirements for hazard profiles, as provided in the Code of Federal Regulations, are described below.

FEMA REGULATION CHECKLIST: RISK ASSESSMENT

Hazard Identification

44 CFR § 201.6(c)(2)(i): "[The risk assessment shall include a] description of the type of all natural hazards that can affect" the jurisdiction.

Elements

B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect the jurisdiction? See 44 CFR § 201.6(c)(2)(i).

B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for the jurisdiction? See 44 CFR § 201.6(c)(2)(i).

Source: FEMA*, Local Mitigation Plan Review Guide*, *March 2013.*

Note: **For coverage of Elements B3 and B4, see Sections 6.5 and 6.7, below.**

The specific hazards selected by the Planning Team for profiling have been examined in a methodical manner based on the following factors:

- Nature or type.
- History.
- Location.
- Extent and probability of future events.

It is important to note that the hazard profiles in Section 5.3 address hazards impacting San Francisco County only. Profiled hazards are presented below in the following order: seismic hazards, weather-related hazards, and other hazards. The order of presentation does not signify the level of importance or risk.

5.3.1 Seismic Hazards

The 2014 HMP provides seismic hazard profiles for ground shaking, ground failure (including landslide and liquefaction), and tsunami.

5.3.1.1 Ground Shaking

Nature

Earthquakes represent one of the most destructive sources of risk and vulnerability for San Francisco in terms of recent history and the probability of future destruction. "Earthquake" is a term used to describe the sudden slip on a fault, and the resulting ground shaking and radiated seismic energy caused by the slip, by volcanic or magmatic activity, or by other sudden stress changes in the earth. Faults are planes of weakness in the earth's crust where one side has moved relative to the other.

The effects of large earthquakes can be felt far beyond the site of their occurrence. Earthquakes occur without warning, and can cause significant damage and extensive casualties after just a few seconds. The most common effect of earthquakes is ground motion, the movement or shaking of the earth's surface during an earthquake. Ground shaking is caused by seismic waves that are generated by the sudden slip on a fault, and travel through the earth or along its surface.

The severity of an earthquake can be expressed in terms of intensity. Intensity measures the strength of shaking produced by an earthquake at a certain location, as indicated by its effects on people, structures, and the natural environment. Intensity generally increases with the amount of energy released, which is proportional to the size of the earthquake, and decreases with distance from the quake epicenter.

A scale often used to measure intensity is the Modified Mercalli Intensity (MMI) Scale. As shown in Table 5-2, the MMI Scale consists of 12 increasing levels ranging from imperceptible to total destruction. With the advent of modern instrumentation, ground shaking intensity can be quantitatively measured in terms of acceleration, velocity, or displacement. Peak ground acceleration (PGA) is a common ground motion parameter used by engineers. It measures earthquake intensity by quantifying how hard the earth shakes in a given location. PGA is expressed as a percentage of the acceleration of gravity (g): One g is an acceleration of 980 centimeters/second.

Another common means of measuring earthquake severity is Magnitude (M). Magnitude measures the energy released at the source of the earthquake; it is determined from the amplitude of the earthquake waves recorded on seismographs. The first magnitude scale was the Richter Scale, also known as local magnitude (ML). The Richter Scale has limited range and applicability, and does not satisfactorily measure the size of the largest earthquakes. The magnitude scale currently used by seismologists is the moment magnitude (Mw) scale. The Mw scale, based on the concept of seismic moment, is uniformly applicable to all sizes of earthquakes. Table 5-3 shows an approximate correlation between the Mw and MMI Scale.

Table 5-2: Abbreviated Modified Mercalli Intensity (MMI) Scale

Intensity	Effects
I	Not felt except by a very few under especially favorable conditions.
II	Felt only by a few persons at rest, especially on upper floors of buildings.
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster.

Table 5-2: Abbreviated Modified Mercalli Intensity (MMI) Scale

Intensity	Effects
	Damage slight.
VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly-built or badly-designed structures; some chimneys broken.
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly-built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
XII	Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Source: US Geological Survey (USGS). http://earthquake.usgs.gov/learning/topics/mag_vs_int.php.

Table 5-3: Magnitude and Intensity Comparison

Magnitude (Mw)	MMI Scale
1.0-3.0	I
3.0 - 3.9	II – III
4.0 - 4.9	IV – V
5.0 - 5.9	VI – VII
6.0 - 6.9	VII – VIII
7.0 and higher	VIII or higher

Source: USGS. http://earthquake.usgs.gov/learning/topics/mag_vs_int.php.

History

Historically, the San Andreas fault system is the most active fault system in Northern California. This fault system is capable of generating very strong earthquakes of M 7.0 or greater. The last major earthquake on the northern portion of the fault occurred in 1906. Known as the Great San Francisco earthquake, this event lasted 45 to 60 seconds and is estimated at moment magnitude 7.7, or an estimated Richter magnitude of 8.3. It is believed to have caused intensities as high as XI on the MMI Scale. As shown on Figure C-4 (Appendix C, Figures), the San Andreas and other regional faults, including the Hayward fault, have generated 69 recorded M 5.0 or greater earthquakes since 1800. Of these recorded earthquakes, three (1838, 1906, and 1989) registered at a ML of 6.8 or greater.

Location

Though no known active faults are present within San Francisco County boundaries, San Francisco is exposed to seismic hazards from numerous known faults, and from potentially unmapped or undiscovered faults. Most of the major faults in the Bay Area are strike-slip faults, which are vertical or nearly vertical fractures where the ground generally moves horizontally. The Bay Area also has several thrust or reverse faults, where ground moves upward and over adjacent ground. The most active strike-slip faults in the region are the San Andreas Fault, which has 10 different fault segments; and the Hayward fault, which has three fault segments, including the Rodgers Creek fault. Table 5-4 lists major Bay Area faults, their locations, and lengths within the Bay Area.

Table 5-4: Major Known Faults in the San Francisco Bay Area

Fault Source	Location	Length (miles)
Northern San Andreas	Northern California coast	294
Hayward/Rodgers Creek	Alameda, Contra Costa, Marin, and Sonoma counties	22/39
Calaveras	Alameda, Contra Costa counties	27
Concord/Green Valley	Alameda, Contra Costa, Solano, Santa Clara counties	12/ 22
Greenville Fault	Alameda, Contra Costa, Santa Clara counties	45
San Gregorio	Marin, Monterey, San Mateo, Santa Cruz counties	108
Mt. Diablo Thrust	Contra Costa County	15

Sources: 2002 WGCEP, 2003, Uniform California Earthquake Rupture Forecast, Version 1 (UCERF 1): Earthquake Probabilities in the San Francisco Bay Region: 2002-2031, USGS Open-File Report 2003-214 [http://pubs.usgs.gov/of/2003/of03-214/]; 2007 WGCEP, 2008, Uniform California Earthquake Rupture Forecast, Version 2 (UCERF 2): USGS Open-File Report 2007-1437 and California Geological Survey Special Report 203, 28 [http://pubs.usgs.gov/of/2007/1091/].

Extent and Probability of Future Events

As noted earlier, the severity or extent of an earthquake can be expressed in terms of the MMI Scale. Figures C-5 and C-6 (Appendix C, Figures) show the shaking intensity areas for a Mw 7.9 earthquake on the northern segment of the San Andreas Fault, an event similar to the 1906 earthquake; and a Mw 6.9 earthquake on the northern segment of the Hayward Fault. Figure C-5 shows that all of San Francisco is susceptible to very strong to extreme shaking. Figure C-6 shows areas subject to very strong shaking include the Lake Merced area, Treasure Island, the Marina District, North Waterfront, Financial District North, Financial District South, South of Market (SoMa), Mission Bay, South Beach, Potrero Hill, Bayview District, and Hunters Point neighborhoods.

There is a strong likelihood that San Francisco will experience a significant earthquake from one of the known major faults in the next 30 years. In 2008, the Working Group on California Earthquake Probabilities (WGCEP) issued its 2008 Uniform California Earthquake Rupture Forecast (UCERF). The 2008 UCERF indicated that there is a 63 percent chance that a major earthquake of moment magnitude 6.7 or greater will strike the nine-county Bay Area region over a 30-year period (2007–2036) along one of the seven fault systems identified in the forecast. The results of the 2008 UCERF are shown in Table 5-5, below. The WGCEP is expected to issue an updated earthquake rupture forecast in early 2014.

Table 5-5: Probabilities of One or More Major Earthquakes in the San Francisco Bay Region 2007-2036

Source Fault	Probability
Bay Area Region	0.63
San Andreas	0.21
Hayward/Rodgers Creek	0.31
Calaveras	0.11
Concord/Green Valley	0.03
San Gregorio	0.06
Greenville	0.03
Mt. Diablo Thrust	0.01

Note: Major earthquakes are equal to or greater than Mw 6.7.

Source: USGS, Fact Sheet 2008-3027, 4 p. [http://pubs.usgs.gov/fs/2008/3027/].

5.3.1.2 Ground Failure

Liquefaction

Nature

Liquefaction occurs when vibrations from an earthquake cause soil particles to lose contact with each other. The soil begins to behave like a liquid, and may lose the ability to support weight. The effects on buildings and other infrastructure can be extremely damaging, resulting in structural damage, including cracking of foundations, damage to support structures, and even collapse, potentially causing injuries and leaving structures unusable.

Liquefaction is usually temporary and is most often caused by an earthquake vibrating water-saturated fill or unconsolidated soil. It typically occurs when loose, granular sediment or fill becomes saturated by ground water during strong shaking. The collapse of the granular structure increases pore space water pressure, and decreases the soil's shear strength, causing ground rupture, sand boils, ground subsidence, and lateral displacement of the ground.

History

The United States Geological Survey (USGS) has mapped liquefaction occurrences in San Francisco for earthquakes occurring in 1838, 1852, 1865, 1868, 1906, 1954, and 1989. Detailed liquefaction maps for the 1906 earthquake show very high liquefaction-susceptible areas along the ocean front and bay front, in SoMa, the Mission District, Downtown, and Financial District South neighborhoods, and on Treasure Island. Detailed liquefaction maps for the 1989 Loma Prieta earthquake show susceptibility to liquefaction in the same areas affected by the 1906 earthquake, and in addition include the Marina District.

After the 1989 Loma Prieta earthquake, liquefaction in the Marina District caused vertical settlement, lateral displacement of buildings, buckling of sidewalks, cracking of asphalt pavement, and breaking of water pipes and gas lines. Over 70 sand boils were reported in garages and backyards; some sand boils were nearly four feet in depth. Liquefaction during the Loma Prieta quake also impacted the Auxiliary Water Supply System (AWSS), which provides the City with water for firefighting purposes.

Location

As shown on Figure C-7 (Appendix C, Figures), the California Geological Survey (CGS) has mapped areas of liquefaction potential, as required by the Seismic Hazard Mapping Act of 1990. Liquefiable soils in San Francisco are generally found in areas of fill along the bay front, former bay inlets, and sandy low-lying areas along the ocean front. Areas subject to liquefaction include the Lake Merced area, the Richmond and Sunset Districts along Ocean Beach, Treasure Island, and the Marina District, North Waterfront, Financial District North, Financial District South, SOMA, Mission Bay, South Beach, Potrero Hill, Bayview District, and Hunters Point neighborhoods, and the area surrounding the San Francisco International Airport (SFO).

Extent and Probability of Future Events

The extent of liquefaction from an earthquake is unknown. However, as previously mentioned, liquefaction can cause ground rupture, sand boils, ground subsidence, and lateral and vertical displacement of the ground. Because San Francisco includes areas where ground conditions are prone to liquefaction, CCSF will likely experience liquefaction during the next major earthquake. SFO is located is another area that is likely to experience liquefaction in a major earthquake. As noted earlier, scientists have determined that a 63 percent chance exists that a major earthquake will strike along one of the seven Bay Area fault systems over a 30-year period (2007-2036).

Earthquake-Induced Landslide

Nature

A landslide is the downhill movement of ground typically caused by the action of gravity on weakened soil or rock. Slopes may be weakened by weathering, erosion, saturation, and the addition of weight from artificial fill, structures, or rock. Earthquake-induced landslides typically originate from steep and weakened slopes, and occur as a result of ground shaking. The most common earthquake-induced landslides include shallow rock falls, disrupted rock slides, and

disrupted slides of earth and debris. The term landslide is used for varying phenomena, including mudflows, mudslides, debris flows, rock falls, rockslides, debris avalanches, debris slides, lateral spreads, and slump-earth flows.

History

USGS records show that localized damage in the San Francisco Bay Area due to earthquake-induced landslides has been recorded since 1838 for at least 20 earthquakes. The 1906 earthquake generated more than 10,000 landslides throughout the region, killing 11 people and causing substantial damage to buildings and infrastructure. The most significant landslides caused by the 1989 Loma Prieta earthquake were located in the Santa Cruz Mountains. However, landslides from the Loma Prieta earthquake were reported in San Francisco, in the Lake Merced area, in the weakly-cemented sand, silt, and clay of the Merced Formation. These same materials also are believed to have produced several landslides in the 1906 earthquake, and in the 1957 Daly City earthquake.

Location

According to the CGS, steep slopes on hills and cliffs and intermediate slopes with previous landslide deposits are highly susceptible to landslides. In addition, weak saturated soils that are bordered by steep or unsupported embankments or slopes are prone to lateral spreading, which is a type of landslide. The Seismic Hazard Zone Map in Figure C-8 (Appendix C, Figures) shows areas susceptible to earthquake-induced landslide in San Francisco. These areas include hills and cliffs in the Outer Richmond, Sea Cliff, Presidio, Lake Shore, Bayview Heights, Midtown Terrace, Twin Peaks, Clarendon Heights, Golden Gate Heights, Forest Hills, Diamond Heights, Eureka Valley/Castro, Dolores Heights, and Noe Valley neighborhoods.

Extent and Probability of Future Events

The extent of an earthquake-induced landslide is unknown, as it depends on the landslide characteristics and materials and on the settings in which the landslide occurs. As noted above, shallow rock falls, disrupted rock slides, and disrupted slides of earth and debris are the most common types of earthquake-induced landslides. Earth flows, debris flows, and avalanches of rock, earth, or debris typically transport material the farthest.

USGS studies show that earthquakes as small as Mw 4.0 may trigger landslides on susceptible slopes. Larger earthquakes may generate thousands of landslides within the near epicentral zone. Given the 63 percent chance of an earthquake occurring along one of the Bay Area faults over a 30-year period (2007–2036), San Francisco is likely to experience one or more earthquake-induced landslides from a major earthquake event.

5.3.1.3 Tsunami

Nature

A tsunami is a series of waves generated in a body of water by a disturbance that vertically displaces the water. Generally, subduction zone earthquakes of Mw 7.5 or greater at plate boundaries may cause tsunamis. Tsunamis also may be generated by submarine and subaerial

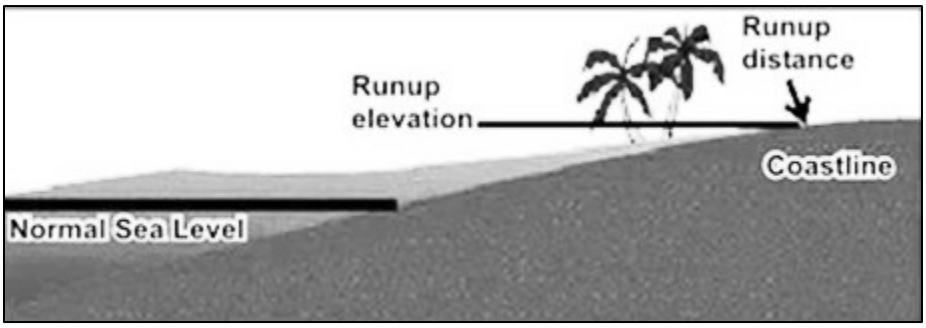
landslides (which may also be caused by earthquakes), submarine volcanic eruptions, and the collapse of volcanic edifices. The Bay Area may be affected by tsunamis from both distant sources, such as large earthquakes elsewhere in the Pacific Rim; and from relatively local sources off the coast of Northern California, such as local earthquakes and landslides.

A single tsunami may involve a series of waves, known as a train, of varying heights. It is important to note that the first wave is often not the largest. In open water, tsunamis exhibit long wave periods of up to several hours, and wavelengths that can extend up to several hundred miles. These characteristics distinguish tsunamis from typical wind-generated swells on the ocean, which might have a period of about 10 seconds and a wavelength of 300 feet.

Tsunamis may travel across the ocean at speeds of about 500 miles per hour. The height or amplitude of a tsunami wave in deep water is generally one to three feet or less, and thus may not be noticeable to people on ships. However, as tsunami waves approach land, and as the ocean shallows, the waves slow to around 30 to 60 miles per hour, but grow significantly in height.

Tsunami run-up occurs when a peak in the tsunami wave travels from the near-shore region onto shore. Run-up is a measurement of the height of the water onshore observed above a reference sea level. It refers to both the distance inland, and the elevation above normal high tide, that a tsunami can reach after moving past the normal shoreline during dry-land inundation from a given point on the coast. Run-up is generally expressed as elevation above normal high tide. Run-up elevation numbers from the same tsunami will vary along a coastline due to the influence of offshore bathymetry and onshore topography.

Figure 5-1: Tsunami Run-up Cross-Section



Source: SMS-Tsunami-Warning.com, http://www.sms-tsunami-warning.com/pages/runup-inundation#

Tsunamis not only affect beaches open to the ocean, but also may cause damage to ports, harbors, bays, tidal flats, and the shores of large coastal rivers. Due to their long wavelengths, tsunami waves can also diffract around land masses. Thus, the notion that offshore islands, peninsulas, and even man-made breakwaters may provide protection is false.

History

Since 1850, 53 tsunamis have been recorded or observed in San Francisco Bay. Nine of these tsunamis originated in Alaska and were caused by an earthquake, by an earthquake and landslide, or by a volcano and earthquake. Only one tsunami has been recorded as originating

along the central California Coast: A 4-inch wave run-up was recorded at the Presidio gauge station shortly after the 1906 earthquake. The 1906 earthquake is believed to have caused downdropping of the seafloor north of Lake Merced, between overlapping segments of the San Andreas Fault, generating a small tsunami.

Little damage occurred in San Francisco as a result of the tsunami generated by the Japan Tohoku earthquake of March 11, 2011. The Tohoku tsunami produced a maximum measured amplitude of .62 meters (approximately two feet) at the San Francisco Marina, and estimated maximum currents of seven knots, or approximately eight miles per hour. Currents in excess of three knots are known to cause damage to fixed piers and structures, as well as present hazards to water navigation. Two piles were broken, and boats keeled over in the San Francisco Marina. However, damage was minimized because the largest surges occurred during low tide.

Location

In 2009, CGS, the California Governor's Office of Emergency Services (Cal OES), and the Tsunami Research Center at the University of Southern California produced statewide tsunami inundation maps for California. The maps were prepared to assist coastal communities in identifying their tsunami hazards, and were intended as a basis for creating tsunami evacuation and emergency response plans. The inundation lines shown on the maps represent the maximum considered tsunami run-up based on several extreme, but realistic, tsunami sources. Figure C-9 (Appendix C, Figures) shows the tsunami inundation map prepared for CCSF. The map illustrates coastal land areas that could become submerged in a tsunami.

The area of land subject to inundation is a direct result of wave height locally, at the shoreline during the tsunami event. How much water arrives is controlled by how much water has been displaced, or moved, due to surface rupture at the earthquake source. Tide level (high tide vs. low tide) and offshore and onshore topography are crucial factors in determining how much land is inundated for a given section of coastline; hence the importance of local tsunami inundation maps.

Areas within CCSF shown to be subject to tsunami inundation include coastal areas of Lake Merced, the Sunset and Richmond Districts; and bayside areas of Sea Cliff, the Presidio, the Marina District, North Waterfront, Fisherman's Wharf, China Basin, Mission Bay, Potrero Hill, Bayview, and Hunter's Point Districts. In addition, tsunami inundation may affect Treasure Island, and portions of Yerba Buena Island and SFO that are adjacent to San Francisco Bay. See Figure C-9 (Appendix C, Figures).

Extent and Probability of Future Events

The inundation modeling used to create the 2009 inundation maps estimates that maximum tsunami wave run-up elevation at the Golden Gate would be 13 feet at the shoreline, with run-up to 19 feet along northern portions of CCSF near Crissy Field (National Geodetic Vertical Datum). This wave run-up would dissipate as it moved east, north, and south, out of the gate, and into San Francisco Bay. By the time it reached the eastern shoreline of the Bay at Alameda, run-up would be 13 feet. Maximum wave heights at SFO from the scenarios used to create the inundation maps are below three feet.

Probability-based tsunami inundation maps and products that can be used for site evaluation, land-use planning, and building design and construction are currently being developed by the State of California, NOAA, and FEMA. Release of these products is anticipated over the next several years, depending on funding.

Because the majority of the region's faults are strike-slip faults, a tsunami is not expected to be a major threat as a result of a near-source, regional earthquake. There is a potential threat from earthquake-induced landslide sources from a strike-slip fault event. Additionally, the nearby Point Reyes Thrust Fault may displace water, causing a tsunami. However, the primary tsunami threat to the San Francisco Bay Area is from distant-source earthquakes originating in subduction zones elsewhere in the Pacific basin, particularly from the Alaska and Aleutian Subduction Zone. Data from the California Seismic Safety Commission indicates that since 1872, Alaska earthquakes have produced tsunami run-ups in the Bay Area nine times, for a recurrence interval of 15.67 years. Historically, the run-ups from these events have been only a few inches.

5.3.2 Weather-Related Hazards

For this 2014 HMP update, weather related hazard profiles have been developed for drought, flood, heat, non-earthquake induced landslide, and wind.

5.3.2.1 Drought

Nature

The broad definition of drought is insufficient water over a prolonged time period. A drought occurs when there is a prolonged period of dryness in which precipitation is less than expected or needed in a given geographic location or climate over an extended period of time. In California, droughts typically occur in the winter, because winter is California's primary precipitation or wet season. During drought winters, the high pressure belt that sits off the west coast of North America, and typically shifts southward during the season, remains stationary. As a result, Pacific storms that would normally approach the Northern California Coast are diverted elsewhere, depriving the Sierra Nevada Mountain range of its normal winter storm activity and precipitation.

The San Francisco Bay Area and much of the state depend on spring runoff from the Sierra Nevada snowpack to replenish the water supply. Dry winters mean reduced snowpack. When dry winters occur over consecutive years, or when water demand increases beyond supply, drought is the result. Drought is a gradual phenomenon that may span multiple seasons and years. Understanding drought as a recurring feature of climate is a first step toward creating management practices that effectively mitigate its effects.

Drought is often measured in terms of its effect on crops, or in terms of its environmental impact, such as livestock deaths, wildfire, impaired productivity of forest land, damage to fish habitat, loss of wetlands, and air quality effects. Drought may also be measured by its social effects, including economic and physical hardship and increased stress on residents of a drought-stricken area. In San Francisco, the primary impact of drought is reduced availability of water for residential and commercial use.

History

As a cyclic part of California's climate, drought occurs in both summer and winter, with an average recurrence interval between four and 10 years. Short-term annual events are more frequent. Less frequent long-term events have ranged from two to four years in length. Droughts exceeding three years are relatively rare in Northern California.

To date, San Francisco County has not been declared a Presidential disaster area as a result of drought. However, statewide droughts have been declared in 1976-1977, 1987-1992, and 2008. In the summer of 2013, as a result of the two previous dry winters, the United States Department of Agriculture declared the state a drought disaster area to provide relief for farmers and for the agriculture industry.

Location

When drought exists in the region, it affects all of San Francisco.

Extent and Probability of Future Events

Drought is difficult to measure due to its diverse geographical and temporal nature and its operation on many scales. Despite that difficulty, various indices for measuring and characterizing drought can be useful. The most commonly used are the Palmer Drought Indices (Palmer Z Index, Palmer Drought Severity Index, and Palmer Hydrological Drought Index) and the Standardized Precipitation Index. Overall, the indices show that as of October 2013, San Francisco's climate division, the central coastal zone that extends south to San Luis Obispo, is currently experiencing severe drought conditions.

Like much of the rest of California, San Francisco has had two relatively dry winters in a row. As a result, the long term drought severity index for San Francisco's climate division has risen to severe values (-3.0 to -3.9 moisture state). It is not known how long current severe drought conditions will persist. According to the 2010 California State Hazard Mitigation Plan, droughts in excess of three years are rare in Northern California. However, state water officials recently informed local water districts to prepare for the possibility that 2014 could be the third dry year in a row. A new water year for measuring rainfall began on October 1, 2013, so any new rainfall amounts over the next water year should act to reduce current drought severity values. In general, Northern California, including San Francisco, can expect to experience a drought every four to 10 years.

Without effective mitigation strategies, recent climate change studies point to an increase in the frequency and severity of future drought occurrences over the next century. Long-term climate forecast models suggest that a warming planet will lead to changes in precipitation distribution, including a reduced Sierra snowpack and earlier melting of the snowpack. Assuming this forecast is correct and that CCSF's population continues to increase, a greater number of water users will lead to greater water demand and a reduction in water storage supplies, increasing the challenge of managing drought in California. For further discussion of climate change as a hazard, see Section 5.3.2.6.

5.3.2.2 Flood

Nature

Flooding is the accumulation of water where such accumulations do not normally occur, or the overflow of excess water from a stream, river, lake, reservoir, or coastal body of water onto adjacent floodplains. Floodplains are lowlands adjacent to water bodies that are subject to recurring floods. In most cases, floods are naturally occurring events that are considered hazards when people and property are affected. The description of this hazard includes flooding that has the potential to occur within San Francisco county limits, and flooding that may affect CCSF-owned assets located outside county limits.

Nationwide, floods result in more deaths than any other natural hazard. Physical damage from floods includes the following:

- Inundation of facilities, causing water damage to structures and contents.
- Impact damage to buildings, roads, bridges, culverts, and other facilities from high-velocity flow and waves, and from debris carried by floodwaters. Debris may also accumulate on bridge piers and in culverts, increasing loads on these features or causing overtopping or backwater effects.
- Erosion of stream banks and shorelines, undermining or damaging nearby facilities.
- Release of sewage and hazardous or toxic materials as wastewater treatment plants and other facilities are inundated, storage tanks are damaged, and pipelines are severed.

Floods also disrupt the normal function of a community by causing economic losses through the closure of businesses and government facilities; and disruption of communications and utilities, such as water and sewer service. In addition, floods may result in excessive expenditures for emergency response.

The following types of flooding may occur in San Francisco:

- **Coastal flooding** in San Francisco is generally caused by high tides, storm surge, and wave action associated with Pacific Ocean storms. These storms typically occur from November through February, and affect the open Pacific Ocean coast and the shoreline of San Francisco Bay. Most of the Pacific Ocean coastline consists of bluffs, beaches, and sand dunes. However, the Great Highway is frequently closed during storm events and was severely damaged during a storm in 2010. Along the bay shoreline, inundation may close roadways and cause damage to nearby structures; wave action can damage waterfront facilities.
- **Stormwater ponding**, also referred to as localized flooding, occurs in San Francisco when runoff during heavy rains is too great to be captured and carried by the stormwater system. Operation of the stormwater system may also be disrupted when vegetation or other debris blocks inlets or pipes. In these situations, runoff may “pond” in low-lying areas, such as street intersections, or may enter nearby structures. In addition to causing flood damage, stormwater ponding can create a pollution problem

when floodwaters carry debris, chemicals, trash, and other pollutants that have collected on streets.

- **Riverine flooding** occurs when runoff from rainfall and snowmelt exceeds the carrying capacity of streams and rivers. San Francisco does not contain significant riverine flooding sources, because few natural watercourses remain. However, CCSF-owned assets outside county limits are located in areas that are subject to riverine flooding.

History

A query of historical flood data available from the National Climatic Data Center (NCDC) indicates that CCSF has experienced 12 flood events from 1996 through July 2013. With the exception of a flood event affecting the Oceanview District of San Francisco in October 2009, all other reported flood events occurred during the months of December, January, and February.

Location

Within CCSF, coastal flood hazards affect the Pacific Ocean coast and the shoreline of San Francisco Bay. Flooding from the bay also affects Treasure Island. Coastal flood hazards affecting the county are shown on the 2008 Interim Floodplain Map prepared by the City Administrator's Office, as shown in Figure C-11 (Appendix C, Figures).

Stormwater ponding is widespread within the county. Areas of severe stormwater ponding have been identified by the Department of Public Works and are shown in Figure C-12 (Appendix C, Figures). Areas of stormwater ponding include the ocean-front areas of the Lakeshore, Outer Parkside, and Outer Sunset neighborhoods, and portions of the Lake District, Mission Bay, North Waterfront, Inner Mission, Bayview District, Bernal Heights, and Mission Terrace neighborhoods. In addition, during winter storms, coastal flooding often occurs in the South Beach and Rincon Hill neighborhoods along The Embarcadero near Pier 14 and Rincon Park and at the foot of Mission Street. With sea level rise, the number and intensity of these inundations are likely to increase. For further discussion of climate change, including sea level rise, see Section 5.3.2.6.

Extent and Probability of Future Events

Floods are described in terms of their extent, including the horizontal area affected and the vertical depth of floodwaters, and the related probability of occurrence. Flood studies often use historical records, such as stream-flow and tidal gauges, to determine the probability of occurrence of floods of different magnitudes. The probability of occurrence is expressed as a percentage of the chance of a flood of a specific extent occurring in a given year. Based on previous flood occurrences, CCSF can expect to experience at least one flood event every 15 months. The magnitude of flood used as the standard for floodplain management in the United States is a flood having a probability of occurrence of one percent in any given year. This is known as the 100-year flood or base flood.

Flood Insurance Rate Maps

The most readily available source of information regarding the one-percent-annual-chance flood is the system of Flood Insurance Rate Maps (FIRMs) prepared by FEMA. These maps are

used to support the National Flood Insurance Program (NFIP). Under the NFIP, the federal government makes affordable flood insurance available in communities that participate in the program. In exchange, participating communities agree to adopt and enforce floodplain management requirements meeting the minimum NFIP criteria. San Francisco has participated in the NFIP since 2010.

FIRMs are prepared on a countywide-basis and may include the following information:

- Special Flood Hazard Area (SFHA): A SFHA is an area that is subject to flooding during the one-percent-annual-chance flood. The SFHA is the basis for the insurance and floodplain management requirements of the NFIP. A SFHA may be associated with a riverine or other inland flooding source, such as a stream, river, or lake; or with a coastal flooding source, such as San Francisco Bay.
- Base Flood Elevation (BFE): The BFE is the estimated flood elevation for the one-percent-annual-chance flood. The BFE is used for insurance ratings and for floodplain management.
- SFHA zone designations: An SFHA is identified using a zone designation that is determined based on the level of detail used to establish the SFHA and the physical characteristics of the SFHA. The zone designation conveys the level of risk associated with the flood hazard; it is used for insurance rating and to determine the appropriate floodplain management requirements for structures located in that zone. “Zone A” is used for inland flooding sources and for coastal flooding sources where waves are less than three feet in height. SFHAs in coastal areas where waves are three feet or greater in height are identified as “Zone V” on the FIRM.
- Other flood hazard data: The FIRM may also show other flood hazard data, such as floodplains associated with a flood having a 0.2 percent chance of occurrence in a given year (the 500-year flood), and levees that meet certain flood protection standards. The FIRM may also show areas of minimal flood hazard, designated “Zone X.”

Flood Hazard Mapping Within CCSF

Unlike most communities that participate in the NFIP, San Francisco does not have a final, published FIRM. In 2007, FEMA provided CCSF with a “preliminary” or draft FIRM showing SFHAs along the waterfront from the Presidio to Hunters Point, and on Treasure Island. Though FEMA never finalized that FIRM, the City Administrator’s Office used it to create the 2008 Interim Floodplain Map. The Interim Floodplain Map provides flood hazard data for use in implementing the City’s Floodplain Management Ordinance within the county. FIRMs for other counties are used to implement the Floodplain Management Ordinance for city-owned assets outside the county.

FEMA is in the process of preparing a FIRM for San Francisco. Through a contractor, FEMA has conducted two studies to develop flood hazard data for the City:

- Bay Study: This study involves analysis of flood hazards on San Francisco Bay. It is being used to generate flood hazard data for San Francisco's waterfront east of the Golden Gate Bridge, for Treasure Island, and for SFO. This study is complete.
- Open Coast Study: This study involves analysis of flood hazards for the Pacific Ocean. It is being used to generate flood hazard data for the Pacific coastline of San Francisco west of the Golden Gate Bridge. This study is underway and will be completed in late 2013 or 2014.

After completion of the Bay Study, FEMA moved forward with production of a FIRM using the results of this study. In May 2013, FEMA provided CCSF with a draft work map for review. This map shows:

- Coastal SFHAs with wave heights exceeding three feet (Zone V areas) along the entire waterfront east of the Golden Gate Bridge, along the shoreline of Treasure Island, and along the shoreline of SFO. BFEs, which reflect the maximum wave run-up elevation at the shoreline, range from 10 feet[1] along the northeast waterfront to 16 feet just inside the Golden Gate.
- SFHAs representing inundation from coastal flood hazards with wave heights less than three feet (Zone A areas). SFHAs are shown inland of the shoreline at Crissy Field, in the vicinity of the Ferry Building, at Mission Bay, in the vicinity of Islais Creek, at Hunters Point, at Candlestick Point, for Treasure Island, and for most of SFO. BFEs in these areas range from 10 to 12 feet.
- No SFHAs associated with inland flooding sources. As described above, there are no natural flooding sources within the county limits. FEMA did not perform a study of storm water flooding. Therefore, the FIRM will not show flood hazard data for this type of flooding.

FEMA expects to issue a preliminary FIRM showing these SFHAs in early 2014, and to finalize and publish the FIRM in 2015. Because this map is still in production, specific data elements for the SFHAs described above could change. However, the general location and extent of the SFHAs depicted on the FIRM is likely to remain consistent. Depending on the timing for completion of the Open Coast Study, FEMA will incorporate flood hazard data from this study into the FIRM. Though data from the Open Coast Study is not yet available, it is expected to show flood hazard data consistent with what is shown on CCSF's Interim Floodplain Map.

Stormwater Ponding Within CCSF

Stormwater ponding is generally only a few inches in depth, but ponding to depths of up to four feet can occur. Historical occurrences indicate that San Francisco can expect to experience heavy precipitation events routinely every winter. Therefore, occurrences of stormwater ponding are likely to occur annually.

[1] BFEs are given in feet relative to the North American Vertical Datum (NAVD) of 1988.

5.3.2.3 Heat

Nature

Located at the north end of a peninsula and surrounded on three sides by San Francisco Bay and the Pacific Ocean, San Francisco is almost perfectly positioned for moderate temperatures year round. Cool marine air and coastal fog keep the average summertime temperatures between 60 and 70 degrees Fahrenheit. The warmest time of year is typically the late summer and early fall when the fog is less pronounced. However, occasional heat events (defined below) do occur for San Francisco. Given that San Francisco has such a relatively mild climate, a sudden spike in temperatures has a much greater impact on local residents compared with noncoastal communities. Though air conditioning is the leading protective factor against heat-related illness and death, most residential units in San Francisco lack air conditioning.

According to the National Weather Service, extreme heat occurs when the temperature reaches extremely high levels or when the combination of heat and humidity causes the air to become oppressive and stifling. Generally, extreme heat is considered to be 10 degrees above the normal temperature over an extended period of time. However, extreme heat can manifest itself in several ways, including:

- A spell of sweltering humidity, which reaches levels commonly associated with moist tropical regions. Stress on the body can be exacerbated when atmospheric conditions cause pollutants to be trapped near the ground.
- An excessively dry condition, in which strong winds and blowing dust can worsen the situation.
- A rise in the heat index, the body's perception of the "apparent" temperature based on both the air's real temperature and the amount of moisture present in the air. Humidity and mugginess makes the temperature seem higher than it is. In high humidity, an 85 degree day may be perceived as 95 degrees.

During heat or extreme heat events, local National Weather Service offices may issue heat-related messages as conditions warrant. Such messages include:

- **Excessive Heat Outlook**: Issued when the potential exists for an excessive heat event in the next three to seven days. An outlook carries a minimum 30 percent confidence level that the event will occur.
- **Excessive Heat Watch**: Issued when conditions are favorable for an excessive heat event in the next 12 to 48 hours. A watch is given when the level of confidence that the event will occur reaches 50 percent or greater.
- **Excessive Heat Advisory**: Issued when an excessive heat event is expected in the next 36 hours. An advisory is used for a less severe event that is not assumed to be life-threatening, when caution is advised to mitigate the event's impact.

- **Excessive Heat Warning**: The most serious alert, issued when an excessive heat event is expected in the next 36 hours, or such an event is occurring, is imminent, or has a very high probability of occurring. A warning assumes the potential for health consequences due to extreme heat.

History

Using data from the National Weather Service (NWS), since 1875, San Francisco's daily temperature has exceeded 100 degrees only 12 times, for a recurrence interval of approximately once every 11 years. Since 1875, the NWS observation site in downtown San Francisco has averaged 1.8 days per year with high temperatures at or above 90 degrees. However, 1984 was an exception to this average: There were 10 days during that year when temperatures were at or above 90 degrees.

On the rare days when the temperature reaches 100 degrees, the health impact is extreme. On June 14, 2000, CCSF experienced a 103-degree heat wave, the highest temperature ever recorded for San Francisco. This heat event resulted in reports of 102 heat-related illnesses and nine deaths in San Francisco. A California Energy Commission study indicates that over the past 15 years, heat waves have claimed more lives in California than all other declared disaster events combined.

Location

Though an excessive heat event in CCSF would impact all areas of San Francisco, it would not affect all CCSF inhabitants equally. The elderly, the very young, and those with chronic health problems are most at risk when extreme heat occurs. Using socioeconomic and census tract data for the entire city, the San Francisco Department of Public Health has developed a Heat Vulnerability Index to determine CCSF neighborhoods with the highest concentration of residents at risk in excessive heat events. A map showing areas of vulnerability is shown in Figure C-18 (see Appendix C, Figures). Neighborhoods with the greatest risk include Chinatown, Downtown-Civic Center, Bayview, and the Mission District.

Extent and Probability of Future Events

In San Francisco, heat or extreme heat is generated when a massive high-pressure ridge inhibits the normal onshore breezes, resulting in temperatures in the high 80s, 90s, and possibly the 100s. Based on previous occurrences, San Francisco can expect to experience temperatures in excess of 90 degrees only a couple of times every year, generally between May and October. According to the California Climate Adaptation Strategy, California is getting warmer, leading to increasing frequency, intensity, and duration of heat waves. For further information on climate change impacts, see Section 5.3.2.6.

5.3.2.4 Non-Earthquake Induced Landslide

Nature

As noted in Section 5.3.1.2, the earthquake-induced landslide section above, a landslide is the downhill movement of slope-forming materials such as rock, soil, fill, or some combination of these, typically caused by the action of gravity on weakened soil or rock. The term actually encompasses five types of slope movement: falls, topples, slides, spreads, and flows. These may be further classified by the type of geologic material: bedrock, debris, or earth. Common landslide types include debris flows, which are often referred to as mudflows or mudslides, and rock falls.

The susceptibility of hillsides and mountainous areas to landslides depends on variations in geology, topography, vegetation, and weather. Slopes may be weakened by weathering, erosion, saturation, and the addition of weight from artificial fill, structures, or rock. Landslides also may occur due to indiscriminate development of sloping ground, or the creation of cut-and-fill slopes in areas of unstable or inadequately stable geologic conditions. Non-earthquake-induced landslides, the focus of this subsection, often occur as a result of intense or prolonged precipitation, which can saturate slopes and cause failures.

History

Non-earthquake-induced landslides in San Francisco generally occur during or after prolonged winter rainstorms. On January 3-5, 1982, a catastrophic rainstorm in the Central California coast triggered landslides in San Francisco, which resulted in approximately $399,000 in damages (approximately $967,000 in 2013 dollars) to public and private property in CCSF, predominantly to private residences. Most landslide damage was located in the Twin Peaks, Mount Davidson, and Glen Park areas.

Landslides also occurred in February 1998, as a result of El Niño storms. El Niño is a disruption of the ocean-atmosphere system in the Tropical Pacific, which has important consequences for weather and climate around the globe. Between February 2, and February 26, 1998, landslides and minor debris flows were reported on steep slopes near Mount Sutro, Mount Davidson in the Miraloma Park neighborhood, and in the Twin Peaks, Diamond Heights, Potrero Hill, and Seacliff neighborhoods. These landslides caused an estimated $4.1 million in damages (approximately $5.7 million in 2013 dollars) to residential properties, and to the Olympic Club golf course.

Nine years later, on February 28, 2007, after three days of rainfall, a 75-foot-wide mass of Telegraph Hill slid down a granite and sandstone slope above Broadway Street. Approximately 120 people from a 45-unit condominium were evacuated until the property owner stabilized the hillside. Similarly, in January 2012, extensive rainfall resulted in a rockslide on Telegraph Hill, which crushed a car and required the partial evacuation of a condominium complex.

Location

As noted in Section 5.3.1.2, the areas most susceptible to landsliding in San Francisco are steep slopes on hills and cliffs. CGS has not prepared maps for San Francisco that identify hazards

associated with non-earthquake induced landslides. However, areas that are subject to landslides during earthquakes are also subject to landslides under other conditions. Thus, the earthquake-induced landslide map (Figure C-8, Appendix C, Figures) is instructive as to the location of steep-sloped areas where landslides may occur due to heavy rainfall or other non-seismic conditions. These landslide-prone areas include the Outer Richmond, Sea Cliff, Lake Shore, Bayview Heights, Midtown Terrace, Twin Peaks, Clarendon Heights, Golden Gate Heights, Forest Hills, Diamond Heights, Eureka Valley/Castro, Dolores Heights, and Noe Valley neighborhoods, the Presidio, and Yerba Buena Island.

Extent and Probability of Future Events

The USGS reports that landslides in San Francisco are typically narrower than 1,500 feet. Landslides are likely to occur during winter storm events that produce heavy or prolonged rainfall. Based on previous occurrences, San Francisco can expect to experience a landslide every seven to 10 years, particularly during winters in which a strong El Niño increases the frequency and intensity of Pacific storms. Areas burned as a result of wildfires are particularly susceptible to landslides depending on slope conditions and soil characteristics.

5.3.2.5 Wind

Nature

Winds are horizontal flows of air that blow from areas of high pressure to areas of low pressure. Wind strength depends on the difference in pressure between the high- and low-pressure systems and the distance between them. A steep pressure gradient results from a large pressure difference or short distance between these systems, causing high winds.

The National Weather Service (NWS) defines “high winds” as sustained wind speeds of 40 miles per hour (mph) or greater lasting for one hour or longer, or winds of 58 mph or greater for any duration. The NWS issues a wind advisory when there are sustained winds of 25 to 39 mph, or gusts to 57 mph. A wind storm is an incident exceeding those values as measured by weather observation equipment, or as indicated by damage consistent with such wind speeds.

During the summer months in San Francisco, temperature and pressure differences between the Pacific Ocean and the interior valleys of California create strong afternoon and evening sea breezes. These westerly winds flow across the Golden Gate and through breaks in the high terrain of the Coast Range, often reaching afternoon speeds of between 20 and 30 mph. Normally, CCSF’s hilly terrain breaks up strong winds, but occasionally strong storms with significant wind gusts halt normal activity in the city, and cause widespread power line damage and electrical outages due to toppled trees and broken limbs.

In addition, the typical summer weather pattern of cooler, more humid air flowing in an easterly direction from the ocean to inland areas reverses. These hot, dry offshore winds from the northeast, which typically occur in the Bay Area during the spring and fall, are known as “Diablo winds.” Diablo winds can be quite strong, with gusts up to 40 mph. Diablo winds are most common in the fall when the jet stream dips farther south, and alternating areas of high and low pressure affect California. Fall is also the time of year when wildlands and the urban-

wildland interface are particularly dry. Dry land cover, when combined with hot dry Diablo winds, may result in high fire danger. This was the meteorological scenario leading to the Oakland Hills firestorm in October 1991.

History

In San Francisco, high winds associated with cyclonic systems and their cold fronts occur in the winter, generally between the months of November through March. Data from the Golden Gate Weather Service on some of the larger, more recent, high wind storm events in San Francisco is presented in Table 5-6 below. NOAA's National Climatic Data Center has recorded nine significant winter wind storm events in San Francisco from 1950 through 2012.

Table 5-6: San Francisco High-Wind Events 1950-2012

	Dec. 22, 1955	Oct. 12, 1962	Mar. 31, 1982	Dec. 22, 1982	Dec. 12, 1995	Dec. 16, 2002	Jan. 4, 2008	Oct. 13, 2009
CCSF 24-Hour Rain Total (in inches)	2.57"	3.11"	2.57"	2.00"	3.27"	2.07"	2.01"	2.48"
SFO Maximum Sustained Wind	42 mph	43 mph	47 mph	47 mph	54 mph	43 mph	53 mph	41 mph
Peak Bay Area Wind	90 mph	86 mph	81 mph	100 mph	103 mph	91 mph	87 mph	77 mph

Source: Golden Gate Weather Services, Bay Area Storm Index [http://ggweather.com/basi_archive.htm].

Location

San Francisco as a whole is subject to strong southeasterly winds associated with powerful winter cold fronts. However, strong sea winds from the Pacific Ocean generally have a greater impact on the west side of San Francisco. Each year, at least one winter storm typically results in closure of the Great Highway, when wind gusts deposit large amounts of sand on the roadway. The Great Highway runs along the Pacific Ocean on the western boundary of San Francisco through the Outer Sunset and Outer Richmond Districts.

Extent and Probability of Future Events

Storms combining strong winds with heavy rain have the largest impact on San Francisco during the winter months. Wind gusts of 40 mph have the potential to bring down trees and branches and to trigger power outages leaving thousands of people without electricity. Based on previous wind events, San Francisco can continue to expect to experience at least one winter wind storm annually.

Sustained winds of more than 50 mph have been recorded in San Francisco during various Pacific Storms. During isolated storm incidents, gusts may peak at more than 100 mph along the coast and at higher elevations. In such conditions, Bay Area bridges become hazardous, especially for big rig trucks that may overturn on bridges during high wind events.

5.3.2.6 Climate Change

Climate change involves a long-term shift in global weather patterns, especially increases in temperature and storm activity. Though climate change is a global problem, its impacts will be local. For the CCSF Planning Area, potential climate change impacts include hotter weather, flooding from intensive rains, sea level rise, reduced snow pack, increase in disease vectors, rapid price increases, power outages, and shortages in food and other resources. This section profiles temperature increases, precipitation shifts, and sea level rise due to climate change.

Temperature Rise

Nature

Based on statistics gathered by the National Weather Service, extreme heat events were the number one cause of weather-related fatalities in the United States in 2012. Because of CCSF's temperate climate, most people do not view the city as an area of concern for extreme heat events. However, climate change models project a gradual warming during this century, with heat waves increasing in frequency and severity. San Francisco is particularly vulnerable because of our lack of physiologic and technologic adaptations. Indeed, San Francisco housing stock typically lacks central air conditioning due to its age and to the cooler climate. Studies by the California Department of Public Health in 2008 indicate that in past heat events affecting the state, the highest risk of heat-related illness occurred in cooler regions in coastal counties, not in the Central Valley where the highest actual temperatures were experienced. In addition, heat events can create intensive demands on the electric transmission system, leading to power outages and their accompanying impacts on people. For additional discussion of extreme heat as a hazard, see Section 5.3.2.3, above.

History

Climate change is a gradual process that has been occurring for approximately a century. Since 1920, average annual temperatures have been increasing across California and the San Francisco Bay Area. The July 2006 California heat wave, which was felt in San Francisco, was the largest heat wave on record since 1948. During the hottest day of that four-day event, San Francisco experienced temperatures over 100 degrees Fahrenheit. On that day, the daily emergency medical system call volume for San Francisco more than doubled due to heat-related health impacts throughout the city. In addition, since 2003, California has experienced electricity shortages resulting in 48 Flex Alerts and 25 transmission emergencies, typically during heat events, as air conditioning loads climb in the afternoon and remain high until late at night.

Location

An extreme heat event will affect the entire city. However, the San Francisco Department of Public Health (DPH) recently completed an extensive study to identify local neighborhoods and population groups at greatest risk for heat waves and poor air quality in San Francisco. The study accounted for up to 20 different social, geographic, and environmental variables. Though the different index-creation techniques generated somewhat different patterns of vulnerability, a few neighborhoods were identified as highly vulnerable by all methods. These neighborhoods

include Chinatown, Downtown Civic Center, Bayview, and Mission. For the San Francisco Heat Vulnerability Index Map showing areas of vulnerability to heat, see Figure C-18 (Appendix C, Figures).

Extent and Probability of Future Events

California's climate is expected to become considerably warmer during this century. How much warmer, and how extensively the local climate will change as a result, are still to be determined. Much depends on the rate at which fossil fuels continue to be burned. The San Francisco Department of the Environment (DOE) has convened a climate adaptation working group, SFAdapt, which is tasked with making some of these determinations using available climate science. Some modeling suggests that future climate change scenarios could include more severe weather episodes, such as warmer and longer heat waves. Such episodes would impact the Bay Area's ability to maintain healthy air quality, particularly in terms of increased ozone levels, as ozone is highly temperature-sensitive.

The 2012 California Adaptation Planning Guide, prepared by Cal OES and by the California Natural Resources Agency, lays out the following temperature change projections for the Bay Area Region from 1990 to 2100, using a higher carbon emission scenario:

- January: 4°F to 5°F increase in average temperatures.
- July: 5°F to 6°F increase in average temperatures.

Climate models cited in this study make the following additional projections for the Bay Area during this century:

- After 2050, the rate of warming will become considerably greater.
- There will be greater warming in summer months than in winter months.
- Summer heat waves will become more common and more intense.
- Increased warming will have widespread effects on ecosystem health, agricultural production, water use and availability, and energy demand.

Precipitation Changes

Nature

In addition to changes in temperature, both California and the San Francisco Bay Area will continue to see a shift in precipitation patterns, though studies remain uncertain about the nature and extent of precipitation change. Shifts in precipitation would have an impact on the state's agricultural production and food supply. Without adequate preparation, more intense and frequent rainstorms in San Francisco could severely stress the city's combined sewer and stormwater system.

Increased warming has also resulted in a decrease in the overall volume of the snowpack in the Sierra Nevada Mountain range. As temperatures continue to rise, and as mountain areas receive more rain instead of snow, the snowpack will be further threatened. A reduction to the ensuing spring snowpack runoff may directly impact the state's water supply, as changes in runoff timing may increase the risk of summer or fall water shortages throughout the region. Moreover, reduced runoff from the Sierra Nevada Mountains into San Francisco Bay will affect

the salinity of the bay, which threatens local ecosystems and infrastructure, as well as the livelihoods that depend on them. Reduced total precipitation – whether rain or snow – may lead to a reduction in overall water supply. Conversely, a wetter, warmer climate may lead to an increase in vectors, insects or other organisms that spread disease, which could increase the demand on the public health system.

History

Historically, precipitation patterns in the Bay Area Region are characterized by considerable variability between years and decades. According to the Western Regional Climate Center, San Francisco ranges from very wet winters that greatly exceed its 100-year average of 21.14 inches of rain per year, to dry winters with nearly half the average annual rainfall. Though, historically, San Francisco has not experienced major flooding from winter storms, the El Nino winter storms of 1997-1998 and 2003-2004 did create isolated flooding events, resulting in displaced San Francisco residents.

The driest year of the last 100 reported years was 1924, when the state average rainfall was only 10.50 inches. The region with the most stations reporting the driest year in 1924 was the San Francisco Bay Region. The second driest year was 1977, when the average rainfall was 11.57 inches. California has experienced a series of multi-year droughts of large scale. Of note was the 1976-1977 drought, when statewide snowpack runoff hit an all-time low; 47 of the state's 58 counties declared local, drought-related emergencies at that time. The 1987-1992 drought was notable for its six-year duration; 23 counties declared local drought emergencies during that period. For further discussion of drought as a hazard, see Section 5.3.2.1, above.

Location

Warming temperatures and reduced snow pack may affect water supplies for San Francisco and for the state. The Hetch Hetchy Regional Water System, which is owned and operated by San Francisco, provides water to 2.4 million people in CCSF and in the greater Bay Area. Eighty-five percent of the water comes from Sierra Nevada snowmelt stored in the Hetch Hetchy reservoir situated on the Tuolumne River in Yosemite National Park. Hetch Hetchy water travels 160 miles from Yosemite to the San Francisco Bay Area.

Given more severe winter storms, certain areas of San Francisco are more prone to flooding due to topography and the network of San Francisco's combined sewer system. These areas are found on the east side of the City at locations that were historic drainage basins, particularly Mission Creek and Islais Creek. Significant subsidence is also occurring in the South of Market area that will contribute to local flooding. For maps showing areas within CCSF that are prone to stormwater ponding generally, see Figure C-12 (Appendix C, Figures). For further discussion of flooding as a hazard, see Section 5.3.2.2, above.

Extent and Probability of Future Events

The 2012 California Adaptation Planning Guide cites selected models using the high carbon emission scenario to project a moderate decline in annual rainfall of one to three inches by 2050, and four to five inches by 2090 throughout the Bay Area Region. Great caution is attached to this projection, as precipitation rates vary widely in the region. Moreover, current

models have limited ability to project precipitation impacts of increased carbon dioxide emissions in the Central California. However, the future may be drier compared to the period for which we have historical annual precipitation averages. Climate change models reviewed by the California Climate Change Center in 2012 indicate that the greatest decline in annual precipitation in the Bay Area may occur in March and April, while precipitation levels during core winter months remains relatively unchanged.

As mentioned earlier, the Sierra Nevada Mountain Region will see more precipitation fall as rain instead of snow, while the snow that does fall will melt earlier, significantly reducing the spring snowpack. By the end of the century, if temperatures rise to the medium warming range and precipitation decreases, late spring mountain stream flow could decline by up to 30 percent. Decreasing snowmelt and spring stream flows, coupled with increasing demand for water resulting from a growing population and from a hotter climate, could lead to increasing water shortages. California's water resources are already overstretched by the demands of a growing economy and population.

Sea Level Rise

Nature

Surrounded on three sides by water, San Francisco is particularly vulnerable to rising sea levels. Sea level rise has been increasing globally for the past century. As global temperatures increase, the rate of sea level rise will increase accordingly. Using conservative modeling with emission scenarios that are actually less than current emission rates, the California Climate Change Center estimated in 2009 that the number of San Franciscans at risk to a 100-year flood will increase from 190 to 3,800 individuals, assuming a 1.4 meter (55 inch) rise in sea level by 2100.

History

Present estimates by the California Climate Change Center assume that sea-level rise along the California coast, particularly at the mouth of the San Francisco Bay, will be approximately the same as global estimates by the year 2100. In addition, according to a National Research Council 2012 report, subsidence in areas south of Cape Mendocino may add an additional one to 11 inches of net sea level rise to global figures. Tidal gauge measurements along the California coast from San Francisco to La Jolla indicate a rise in sea level of about eight inches, which is consistent with global sea level rise.

Location

Sea level rise will affect many coastal areas of CCSF, including Ocean Beach, the Marina, the Embarcadero, and the entire bayside edge, as well as parts of Treasure Island. Flooding from sea level rise will likely damage buildings and roads in these areas. In addition, salt water intrusion will likely cause damage to underground infrastructure, such as pipes and foundations. Coastal flooding also presents a risk to major transportation infrastructure in the region, especially to the Port of San Francisco and to San Francisco International Airport (SFO). For further discussion of flooding as a hazard, see Section 5.3.2.2. CCSF is currently assessing the many different maps and projections showing the impact of sea level rise on the City with

the goal of selecting planning information, including mapping, that most accurately reflect the extent of this hazard within San Francisco.

Extent and Probability of Future Events

As global temperatures continue to rise, sea levels will also continue to rise in response. Predictions of the rate of sea level rise vary, due primarily to uncertainty regarding the amount of meltwater from land-based ice in Greenland and Antarctica. In 2009, the California Climate Change Center predicted that by 2100, sea levels may rise up to 1.4 meters or 55 inches, posing a considerable threat to coastal and low-lying areas adjacent to San Francisco Bay. One high-end scenario predicts a 150-centimeter sea level rise (four feet, 11 inches) by 2100. More recently, the National Research Council surveyed all sea level rise science related to the West Coast of the United States, and estimated a net sea level rise (including vertical land movement) between 17 and 66 inches by 2100.

Using the 2009 California Climate Change Center prediction of a 55-inch sea level rise by 2100, the number of acres vulnerable to flooding is expected to increase 20 to 30 percent in most parts of the Bay Area, with some areas projected to experience increases of over 40 percent. The California Adaptation Planning Guide further estimates that coastal areas will experience an increase of approximately 15 percent in the acreage vulnerable to flooding. Increases of this magnitude would inundate coastal areas with salt water, accelerate coastal erosion, threaten inland water systems, and disrupt wetlands and natural habitats.

5.3.3 Other Hazards

Other hazards described in the 2014 HMP include pandemic, reservoir failure, wildfire, urban conflagration, and human-caused hazards.

5.3.3.1 Pandemic

Nature

A pandemic is an epidemic of an infectious disease occurring worldwide, or over a very wide area, which crosses international boundaries and affects a large number of people. Pandemic influenza is one of the most pressing public health planning needs today. Even with a "moderate" pandemic, the cumulative effect on health and health care would be dire. For example, the 1918 "Spanish Flu," which had a 30 percent attack rate and a 2 percent case fatality rate, was defined by the Center for Disease Control (CDC) as a moderate event.

Pandemics are hazards that have a long duration. Though daily impacts may be low, cumulative impacts are likely to be overwhelming for both the health system and the community. During a moderate pandemic, San Francisco could see a sustained increase in intensive care unit admissions, in emergency department (ED) admissions, in patients needing to be placed in respiratory isolation, and in deaths. Capacity to provide medical care, including basic emergency medical system (EMS), hospital ED services, and isolation rooms, will be reduced. At the same time, a higher than usual absenteeism rate for all employees is expected. It is estimated that there would be an 18 percent decrease in workers secondary to being ill with

the flu, with effects compounded over time. This would have dramatic consequences both for the health care system and for the community in general.

Compared to the 1918 pandemic event, an influenza pandemic today could have far-reaching, negative consequences for the health and well-being of San Francisco's residents and for the economic and social stability of the Bay Area. Our population includes more elderly and immune-compromised people (such as people with HIV/AIDS and chemotherapy patients) than it did in the past. Our ability to respond effectively to a pandemic is also compromised. Our health care system today has little surge capacity. "Just-in-time" ordering of needed supplies has replaced the warehousing of critical items onsite for most businesses and governmental organizations. In addition, unlike citizens in 1918, we are not accustomed to following government restrictions, including the rationing of goods and services.

History

There have been five pandemics since 1900; the 2009 H1N1 Pandemic is the most recent. Worldwide, the H1N1 Pandemic of 2009 resulted in 482,000 laboratory confirmed cases and 6,071 deaths. In San Francisco, 208 hospitalizations and 60 intensive care unit (ICU) or fatal cases were reported during the 2009 H1N1 Pandemic.

Because pandemics are recurring events, it is not a question of whether there will be another pandemic; the question is when the next pandemic will occur and how severe it will be. Previous pandemics occurred in 1918-1920, 1957-1958, 1968-1969, 1977-1978, and 2009-2010. The 1918-1920 Pandemic, often referred to as the Spanish Flu, was unusually severe and had a high mortality rate. It is estimated that the 1918 Pandemic killed up to one percent of the world's population, or 40,000,000 people worldwide, including more than 500,000 in the United States.

Location

By definition, a pandemic is a global event; San Francisco would expect to be uniformly affected by a pandemic flu. The World Health Organization (WHO) classifies pandemics according to phases. Phase 1 starts with the virus circulation among domesticated or wild animals prior to human infection. Additional phases coincide with community level outbreaks in multiple countries in multiple WHO regions, culminating with Phase 6. A Phase 6 Pandemic involves a virus that is widespread, with human-to-human transmissibility.

Since travelers and residents are free to travel throughout the city, it is anticipated that from a hazard mitigation perspective, San Francisco will be uniformly affected geographically. However, based on the actual pandemic virus, certain populations within San Francisco may have different morbidity and mortality than the general population. In general, the following groups tend to be at higher risk for influenza complications: individuals with specific chronic medical conditions; children younger than five years old, with children younger than two at special risk; adults 65 years of age and older; pregnant women; American Indians; and Alaskan Natives.

Extent and Probability of Future Events

Based on the Bay Area Regional Risk Assessment conducted in 2011, the probability of a naturally occurring, mild to moderate pandemic affecting San Francisco is considered high: The city received a score of three out of a possible four. In many respects, CCSF is more vulnerable to a pandemic today than it was in 1918, because people in the Bay Area travel more internationally and come into contact with far more people on a daily basis than did people in 1918.

The extent of a pandemic depends on the actual virus involved. The 2009 H1N1 Pandemic was generally considered mild, with a very low case fatality rate; 18,000 deaths were reported worldwide. In contrast, the 1918 Pandemic had a higher case fatality rate, with a reported 20 to 100 million deaths worldwide. As stated earlier, based on the CDC's scale, the 1918 Pandemic is considered a moderate pandemic influenza.

The speed of onset of a Pandemic also varies depending on the particular influenza virus, how rapidly it spreads, the availability of vaccines and antivirals, and the effectiveness of medical and non-medical containment measures. Some influenza strains remain at early phases, with no human-to-human transmission for many years, while others move through the stages to become a pandemic relatively quickly. Global travel and movement of populations speeds up the spread of disease.

Pandemics are likely to last between six and 12 weeks, and typically come in two to three waves over a three- to 18-month period. The second wave may occur several months after the first wave. The level of illness during the second wave is often more severe than that in the first wave.

5.3.3.2 Reservoir Failure

Nature

A reservoir failure is the structural collapse of a dam or other structural element, such as the wall of a tank, resulting in a release of water stored in the reservoir. A reservoir failure may occur due to the age of the structure, to inadequate spillway capacity, or to structural damage caused by an earthquake or flood. The sudden release of water has the potential to cause dangerous flooding conditions, resulting in human casualties, economic loss, and environmental damage.

This type of disaster is dangerous because it can occur rapidly, providing little warning and thus curtailing evacuation time for people living downstream from or below a reservoir. If reservoirs are located on streams, the flows resulting from reservoir failure generally are much larger than the capacity of downstream channels and can therefore lead to extensive flooding. Flood damage occurs as a result of the momentum of the flood caused by sediment-laden water, flooding over the channel banks, and the impact of the debris carried by the flow.

History

To date, there is no history of a dam or reservoir failure occurring within CCSF boundaries.

Location

There are 15 reservoirs located within San Francisco County limits. Five CCSF reservoirs are considered to be dams regulated by the California Department of Water Resources, Division of Safety of Dams (DSOD). Under California law, state-regulated dams are artificial barriers that do or may impound or divert water, and are 25 feet or more in height, or that hold back 50 acre-feet or more of water. (See California Water Code § 6002.) The state also regulates artificial barriers that are more than six feet in height, regardless of storage capacity; or that hold more than 15 acre-feet of water, regardless of height. (See California Water Code § 6003.)

State-regulated dams within San Francisco County limits are listed in Table 5-7, below, and are shown in Figure C-14 (Appendix C, Figures). Table 5-7 includes the names of the reservoirs and dams, the year of construction, the type of construction of the main dam, the reservoir capacity in acre-feet, and the reservoir area. CCSF and the SFPUC also own a number of state-regulated dams located outside county boundaries.

Table 5-7: State-Regulated Dams Within San Francisco County Limits

Reservoir Name	Dam Name	Year Constructed	Construction Type	Reservoir Capacity (acre-feet)	Reservoir Area (acres)
Sutro Reservoir	Sutro Reservoir	1952	Earth	96	6
Sunset Reservoir	Sunset North Basin	1938	Earth	275	12
	Sunset South Basin	1960	Earth	268	12
Twin Peaks Reservoir	Stanford Heights	1928	Earth	37	2
University Mound	University Mound North	1885	Earth	182	10
	University Mound South	1937	Earth	250	11

Source: California Department of Water Resources, Division of Safety of Dams, 2012.

In addition, CCSF is home to a number of reservoirs that do not fall under the California Water Code requirements for state regulation. Along with the state-regulated reservoirs shown in Table 5-7, these additional reservoirs are part of the SFPUC's San Francisco retail water system. This system includes 10 reservoirs and eight water tanks located within CCSF, which store water delivered by the Hetch Hetchy Water System and the local Bay Area water system.

Extent and Probability of Future Events

The probability of a failure involving dams or reservoirs located in or owned by CCSF is unknown. Most of the dams and reservoirs that are part of the SFPUC-owned and operated Hetch Hetchy Regional Water System are more than 75 years old. Damage to dams and reservoirs may be caused by a major earthquake, by a severe storm with attendant runoff, by a slope failure, or through terrorism. Given the strong likelihood of a major earthquake occurring

in the San Francisco Bay Area within the next 30 years, dam or reservoir failure and resultant inundation must be considered as a possible risk.

As required by California law, inundation maps showing areas of potential flooding in the event of sudden or total failure of state-regulated dams or reservoirs located in CCSF have been prepared by the dam owner and submitted to the Cal OES and the DSOD. Such maps are required by state law when the partial or total failure of such structures would result in death or personal injury. Inundation areas for three of the five reservoirs within CCSF have been reproduced in Figure C-14 (Appendix C, Figures). In addition to being incomplete, the inundation areas shown on Figure C-14 are likely outdated, as they are based on maps prepared in the 1970s, which do not necessarily take into account subsequent construction and other neighborhood changes that might affect water flow patterns. Accordingly, the exact extent of potential flood inundation due to reservoir failure in San Francisco is unknown.

5.3.3.3 Wildfire

Nature

A wildfire is an unplanned, uncontrolled fire in an area of combustive vegetation or fuel. Wildfires can be caused by human activities, such as arson or campfires, or by natural events such as lightning. Wildfires often occur in forests or other areas with ample vegetation. In areas where structures and other human development meet or intermingle with wildland or vegetative fuels, wildfires can cause significant property damage and may present an extreme threat to public health and safety; such areas are referred to as the "wildland urban interface."

The following three factors contribute significantly to wildfire behavior and can be used to identify wildfire hazard areas:

- **Topography:** The steeper the slope, the faster fire will travel uphill. South-facing slopes are also subject to more solar radiation, making them drier and thus intensifying wildfire behavior. However, ridge tops may mark the end of wildfire spread, as fire spreads more slowly or may even be unable to spread downhill.
- **Fuel:** The type and condition of vegetation plays a significant role in the occurrence and spread of wildfires. Certain types of plants are more susceptible to burning, or burn with greater intensity. Nonnative plants may be more susceptible to burning than native species. Dense or overgrown vegetation increases the amount of combustible material available to fuel the fire; this is referred to as the "fuel load." The ratio of living to dead plant matter is also important. The risk of fire increases significantly during periods of prolonged drought, as the moisture content of both living and dead plant matter decreases, or when a disease or infestation has caused widespread damage. Fuel continuity, meaning its horizontal and vertical spacing, is also an important factor.
- **Weather:** The most variable factor affecting the behavior of wildfires is weather. Temperature, humidity, wind, and lightning can affect chances for ignition and spread of fire. Extreme weather, such as high temperatures and low humidity, can lead to extreme

wildfire activity. In contrast, cooling and higher humidity often signal reduced wildfire occurrence and easier containment.

Even small fires can threaten lives and resources and destroy improved properties. If not promptly controlled, wildfires may grow into an emergency or disaster.

The indirect effects of wildfires can be catastrophic. Besides stripping the land of vegetation and destroying forest resources, large, intense fires can harm the soil, waterways, and the land itself. Soil exposed to intense heat may lose its ability to absorb moisture and support life. Exposed soils erode quickly and enhance siltation of rivers and streams, which in turn enhances flood potential, harms aquatic life, and degrades water quality. Land stripped of vegetation is also subject to increased landslide hazards.

History

The California Department of Forestry and Fire Protection (CAL FIRE) has no record of any wildfires occurring within CCSF, which is a highly-urbanized area. Though the 2014 HMP does not address hazards for assets outside CCSF limits, it is important to note that CCSF declared a local emergency during the development of this plan. The Rim Fire, which began on August 17, 2013, in Tuolomne County, burned over 257,000 acres, and threatened the Hetch Hetchy Regional Water System, which provides approximately 85 percent of San Francisco's total water needs. The Rim Fire reached the edges of the Hetch Hetchy Reservoir watershed, but did not impact water quality or water delivery operations. However, the fire did cause damage to CCSF-owned property and infrastructure in the area.

CCSF declared a local emergency due to the Rim Fire on August 22, 2013. The Governor of California issued a state emergency proclamation for the fire on the same day, and on August 23, 2013, submitted a request for a federal fire management assistance declaration. A Fire Management Assistance declaration, FEMA-5049-FM, was issued on August 23, 2013, making FEMA funding available to reimburse up to 75 percent of the eligible firefighting costs for managing, mitigating, and controlling the fire. On December 13, 2013, Major Disaster Declaration DR-4158 was issued by President Obama for the Rim Fire. The declaration makes it possible to obtain federal assistance for repairs or replacement of damaged public facilities, and for hazard mitigation projects undertaken to prevent or reduce long-term risk to life and property from the Rim Fire.

Location

In 2007, pursuant to state law, CAL FIRE adopted Fire Hazard Severity Zone (FHSZ) maps for State Responsibility Areas (SRAs), the areas in California where the state is financially responsible for the prevention and suppression of wildfires. The maps use a fuel ranking assessment methodology that assigns a rank -- moderate, high, or very high -- based on expected fire behavior for unique combinations of topography and vegetative fuels under a given severe weather condition, including wind speed, humidity, and temperature. CAL FIRE has also developed FHSZ maps for Local Responsibility Areas (LRAs) within California. LRAs include incorporated cities such as San Francisco, where fire protection is typically provided by a city fire department. The LRA fire hazard zone maps developed by CAL FIRE use an extension of the

SRA FHSZ model, which reflects flame and ember intrusion from adjacent wildlands and from flammable vegetation in urban areas.

The current CAL FIRE fire hazard map for CCSF indicates that San Francisco has no Very High Fire Hazard Severity Zones in its LRA. However, as shown in Figure C-13 (Appendix C, Figures), CAL FIRE has designated a small portion of the Crocker Amazon neighborhood as a high fire hazard area. Moderate fire hazard areas include wooded areas near Fort Funston and Lake Merced in the Stonestown District; Stern Grove in the Central Sunset District; Mount Davidson and Glen Canyon Park in the Miraloma and Diamond Heights neighborhoods; the Forrest Knolls and Midtown Terrace neighborhoods; wooded areas of Sutro Heights, Lincoln Park, the Presidio, and Fort Mason; and in Bayview Park and Candlestick Recreation Area in the Bayview-Hunter's Point Districts of San Francisco. Yerba Buena Island has also been designated by CAL FIRE as a moderate fire hazard area.

Extent and Probability of Future Events

The CAL FIRE LRA Fire Hazard Severity map shown in Figure C-13 (Appendix C, Figures) displays the extent of wildfire hazards in San Francisco. In general, the susceptibility for wildfires dramatically increases in the late summer and early autumn as vegetation dries out, decreasing plant moisture content and increasing the ratio of dead fuel to living fuel. Common causes of wildfires include arson and negligence. However, as noted above, there is no historical record of a wildfire occurring in CCSF. Therefore, the probability of a future wildfire event within CCSF appears to be low to moderate.

5.3.3.4 Urban Conflagration

Nature

An urban conflagration is a large fire occurring in a built environment that spreads beyond one city block to destroy whole sections of a city. If not contained, an urban conflagration may expand uncontrollably beyond its original source area to engulf adjoining regions. Conflagrations can have many causes, including:

- Criminal acts, such as arson, illegal explosive devices, acts of terrorism, or civil unrest;
- Residential accidents, including improper use of electrical and heating appliances, improper storage or handling of flammables, faulty connections, grease fires, misuse of matches and lighters, or improper disposal of charcoal and wood ashes;
- Industrial accidents, such as hazardous material incidents, explosions, and transportation accidents;
- Acts of nature, including lightning strike, and ignitions following a large earthquake.

Wind, extremely dry weather conditions, explosions, and a dense environment of structures built with combustible materials can also contribute to an urban conflagration.

History

Records from the San Francisco Fire Department Museum dating back to the mid-1800s show that San Francisco was devastated by six major fires during the California Gold Rush era, from 1848 to 1855. These fires destroyed 25 to 50 percent of the city, and thus are considered "great fires." The largest fire to affect CCSF to date occurred as a result of the Great San Francisco Earthquake of 1906. On the morning of April 18, 1906, a Mw 7.8 earthquake shook the region; within two hours of the quake, 52 fires had ignited within San Francisco. The fires quickly spread throughout the northeastern portion of the City, burning an area covering approximately 4.7 square miles, and destroying 80 percent of the 28,000 buildings lost after the quake. The 1906 temblor severely damaged the City's water system, limiting firefighters' ability to suppress the fires. The City's Auxiliary Water Supply System (AWSS) was constructed in 1913 with the goal of avoiding such devastation in the aftermath of another earthquake.

San Francisco's most recent large urban fire occurred as a result of the Loma Prieta earthquake on October 17, 1989. A total of 41 fires were reported in San Francisco after the Loma Prieta quake; gas pipe and main ruptures ignited 27 fires within the City, including a major blaze in the Marina District that destroyed four buildings and claimed the lives of five people. Though Loma Prieta damaged domestic water pipes in the Marina District, the fire boat Phoenix and the City's Portable Water Supply System (PWSS) were used to prevent the Marina fire from becoming a conflagration. The AWSS was largely functional after the Loma Prieta earthquake, but communication systems and valving capability issues hampered its immediate implementation. These issues have since been addressed; in addition, a major effort is currently underway to upgrade the AWSS.

Table 5-8 below shows the number of working fires and greater alarms responded to by the San Francisco Fire Department from 2008 through 2012. During this five-year period, there were two five-alarm fires, and 15 four-alarm fires.

Table 5-8: San Francisco Working Fires and Greater Alarms 2008-2012

Year	Alarm Level 1	Alarm Level 2	Alarm Level 3	Alarm Level 4	Alarm Level 5	Total
2008	247	27	4	1		279
2009	194	12	9	3		218
2010	195	12	2	1		210
2011	204	22	7	3	2	238
2012	166	26	4	7		203

Source: San Francisco Fire Department 2013.

Location

Figure C-15 (Appendix C, Figures) shows urban conflagration hazard areas for all parts of the City for which Assessor parcel data is available. This model takes into account building construction material, land use, and structural age. For construction material, wood frame structures were assumed to be more vulnerable to conflagration than other structure types.

Similarly, commercial and industrial land uses were calculated as a higher urban conflagration risk. Finally, older structures were assumed to have a high conflagration risk, as they pre-date modern fire codes. Areas within CCSF believed to be at greatest risk for urban conflagration include the North Waterfront, South Beach, Mission Bay, Potrero Hill, Hunters Point, Van Ness/Civic Center, Downtown, Tenderloin, and Hayes Valley neighborhoods.

Extent and Probability of Future Events

The urban conflagration map shown in Figure C-15 (Appendix C, Figures) displays the extent of urban conflagration hazards within CCSF, ranging from very low, to extreme. Most of the City is considered at moderate risk for urban conflagration.

Based on the working fire and greater alarm statistics set forth in Table 5-8 above, during the five-year period from 2008 through 2012, the San Francisco Fire Department responded to an average of 230 fires per year. During this same time period, there were approximately four single-alarm fires every week. Larger fires – two-alarms or greater – occurred an average of 35 times annually.

The most likely scenario leading to urban conflagration in CCSF is a severe earthquake in the Bay Area, particularly on the North San Andreas Fault zone. Because San Francisco's building stock is composed predominantly of wood, the fires resulting from such earthquakes may cause far more damage. Given the strong likelihood of a major earthquake in the San Francisco Bay Area within the next 30 years, urban conflagration must be considered as a possible risk.

5.3.3.5 Human-Caused Hazards

Though the Stafford Act, as amended by DMA 2000, does not require local hazard mitigation plans to cover human-caused hazards, the CCSF Planning Team has determined that such coverage is important to raise awareness and to act as a catalyst for efforts to improve the safety and resilience of our community. Human-caused hazards are distinct from natural hazards in that they are caused primarily by human activity. For purposes of the 2014 HMP, human-caused hazard profiles have been developed for hazardous materials, energy shortages, terrorism, and cyber attack.

Hazardous Materials

Nature

Hazardous materials have properties that make them potentially dangerous and harmful both to human health and to the environment. An accidental hazardous material release can occur wherever hazardous materials are manufactured, stored, transported, or used. Depending on the substance involved, the release may affect nearby populations and may contaminate critical or sensitive environmental areas. The universe of hazardous materials is large and diverse. Hazardous substances can be in liquid, solid, or gas form, and can include toxic chemicals, radioactive materials, infectious substances, and wastes.

Over the past 25 years there has been heightened awareness and attention paid to the health hazards posed by toxic materials. During this period, many federal, state, and local regulations

governing hazardous materials have been put into place. These regulations are continually updated and augmented. The Hazardous Materials and Waste Program at the San Francisco Department of Public Health (DPH) implements six state environmental mandates and two local mandates regulating hazardous materials activities. DPH environmental health staff inspect regulated businesses at least once every three years.

A release of hazardous materials can occur from any of the following:

- Fixed facilities such as refineries, storage facilities, manufacturing facilities, warehouses, wastewater treatment plants, swimming pools, dry cleaners, automotive sales and repair, and gas stations.
- Highway and rail transportation, such as tanker trucks and railcars transporting hazardous materials.
- Commercial maritime transportation, including transportation of petroleum products by barges and ocean-going tankers and spills associated with petroleum terminals.
- Air transportation involving cargo packages.
- Pipeline transportation of substances such as petroleum products, natural gas, and other chemicals.

Though large petroleum storage or manufacturing facilities are typically located outside of residential areas, pipelines are ubiquitous in our communities. Virtually all natural gas, which accounts for about 28 percent of energy consumed annually in the United States, is transported by transmission pipelines.

History

Hazardous materials incidents impacting the San Francisco Bay Area have occurred as a result of spills from commercial and recreational vessels in the San Francisco Bay; from transportation accidents that resulted in petroleum spills; from sewer breaks and overflows; and from various accidents or incidents related to the manufacture, use, and storage of hazardous materials by industrial and commercial facilities. One of the most publicized incidents occurred on November 7, 2007, when the container ship Cosco Busan struck the Delta Tower of the San Francisco - Oakland Bay Bridge during a thick fog. Over 53,569 gallons of heavy fuel oil, often referred to as "bunker fuel," spilled into San Francisco Bay, soiling San Francisco's western, northern, and northeastern coastline, as well as other shorelines throughout the Bay Area. The spill impacted birds, marine mammals, fish, and humans, and required clean-up and response efforts from local, state, and federal authorities.

More recently, October 30, 2009, another tanker vessel, the Dubai Star, spilled over 400 gallons of intermediate fuel oil during a refueling incident just south of the Bay Bridge. The spill affected more than 10 miles of shoreline, from just north of the east approach to the Bay Bridge to San Leandro Bay along the Alameda County coastline. The impact included bird mortalities, as well as beach and fisheries closures.

The National Response Center (NRC), which serves as the sole national point of contact for reporting all oil, chemical, radiological, biological, and etiological discharges into the

environment in the United States, shows that from 2002 through 2012, a total of 806 hazardous material incidents were reported in the CCSF jurisdictional area. Of this number, 586 were water-related incidents including bilge oil, gasoline, hydraulic oil, jet fuel, and diesel oil spills. Common causes of these incidents included operator error and equipment failure. During this same 10-year period, NRC data also indicates that there were 45 rail-related incidents, and 49 land-based, non-rail spill incidents.

The San Francisco DPH Environmental Health Section reports that in 2012 alone, there were 44 hazardous material incidents in San Francisco in which the department provided on-scene response. Thirteen incidents involved on-scene responses in coordination with the San Francisco Fire Department. Seventeen incidents involved abandoned hazardous waste on city streets; these calls were initiated by the Department of Public Work's dispatch center. One incident involved blood and hypodermic needles, and was initiated by the Recreation and Parks Department. Five incidents involved sewer and diesel spill response calls from the Public Utilities Commission and Port of San Francisco.

Location

An accidental hazardous material release can occur wherever hazardous materials are manufactured, stored, transported, or used. In San Francisco, a hazardous material event is most likely to occur within the City's industrial area, which is concentrated in the southeast part of the city. The primary PG&E gas transmission pipeline also runs through the southeast part of the city.

In addition, a variety of transportation corridors traverse the city. Though federal regulations impose restrictions on the use of certain routes to transport hazardous materials within CCSF, vehicles using CCSF transportation corridors commonly carry a variety of hazardous and highly flammable materials, such as gasoline, petroleum products, and other chemicals known to cause human health problems. Similarly, container ships, car carriers, tankers, and other types of vessels constantly move through the shipping channels of San Francisco Bay, presenting a risk to the local marine environment in the event of a spill. Hazardous materials also are transported to and from, are used, and are stored at the San Francisco International Airport (SFO) and at adjacent airport facilities just south of San Francisco.

Extent and Probability of Future Events

The geographic and economic characteristics of San Francisco make it likely that hazardous materials releases will continue to occur. Based on statistics maintained by DPH, from 2002 through 2012, there were 384 hazardous materials incidents requiring a response in San Francisco. CCSF's commercial sector and transportation routes share space with several bodies of water, wetlands, environmentally sensitive areas, and a densely-populated urban environment, creating areas of great potential risk for a hazardous materials release. Moreover, SFO, a large international airport, is just a few miles from downtown San Francisco. Thus, the threat to San Francisco of a hazardous material incident impacting land, sea, or air remains high.

Energy Shortage

Nature

An energy shortage or disruption is a bottleneck in the supply of energy resources to an economy. Energy resources include electrical power, natural gas, and petroleum products used for transportation, manufacturing, residential, and commercial purposes. Such resources may encompass extraction, transmission, generation, distribution, and storage of fuels.

Like all jurisdictions, San Francisco is dependent on an adequate energy supply for the functioning of four critical sectors: industrial, transportation, residential, and commercial. Because San Francisco operates on a just-in-time basis with the delivery of energy resources, any disruption to the energy supply chain may create a shortage that is felt immediately. Energy supplies may be disrupted in two ways:

- Intentional: Includes outages that are planned or scheduled, such as for maintenance; unscheduled disruptions, which are generally done on the spot; demand-side management disruptions done as part of an agreement during periods of peak system loads; and load-shedding disruptions done when the system is under extreme stress due to heavy demand or the failure of energy facilities.
- Unintentional: Outages that are unplanned. These outages may be caused by a utility company accident, an equipment malfunction or failure, vandalism or terrorism, weather, excessive operation, or overload of the system.

Energy shortages in San Francisco generally take the form of short-term interruptions in basic electrical service which, though inconvenient to users, do not pose a threat to public health and safety. Most service outages are relatively small, isolated events caused by accidents or failures due to aging electrical infrastructure. More widespread power outages are infrequent and are generally caused by weather-related events such as winter storms or heat waves that elevate electrical usage beyond system capacity. A prolonged, widespread service interruption, which is an assumed risk following a large local earthquake event, will pose a much greater threat to San Francisco's overall health and safety. There will be a cascading impact on other essential infrastructure, such as fuel and water systems that require electricity for fuel pumps to operate.

Pacific Gas and Electric Company (PG&E) is the gas and electricity utility provider for most local residents and business. However, San Francisco operates its own municipal power network: The Hetch Hetchy Power System, owned and operated by the San Francisco Public Utilities Commission (SFPUC), supplies energy to all San Francisco’s municipal facilities, services, and customers. SFPUC customers include SFO, San Francisco General Hospital (SFGH), the San Francisco Municipal Railway (MUNI), Police, Fire, and city residences and businesses in the Hunters Point Shipyard and on Treasure Island.

History

San Francisco experienced a series of electric power supply shortages in 2001. On January 17, 2001, the California Independent System Operator (CAISO), the entity that coordinates the statewide flow of electrical supply, declared a Stage 3 Emergency, the most extreme level,

intended to avert a total electrical power failure. CAISO issues Stage 3 Emergencies when operating electricity reserves are forecast to be less than three percent; Stage 3 Emergencies necessitate rolling blackouts that rotate among customers to reduce load demand. This scenario was repeated the following day, on January 18, 2001. On March 19, 2001, the CAISO again declared a Stage 3 Emergency.

Rotating outages and blackouts such as those experienced in 2001 can also occur during periods of extreme temperatures that lead to heavy electric power consumption. For example, a July 2006 extreme heat event affected the entire state, producing record energy demand levels in California. The state was able to avoid rotating outages due to a combination of favorable factors.

Other than the Great 1906 San Francisco Earthquake and Fire, the only time San Francisco experienced a widespread blackout was during the 1989 Loma Prieta earthquake. Electricity was lost to most of San Francisco. Severe shaking associated with the 1989 quake caused PG&E power plants located in Potrero Hill and Hunters Point to trip off almost immediately. Local electric distribution lines were also hard hit. Lines broke or slapped together, arcing or shorting out transformers. Power was fully restored three days later.

Location

Geographically, all of San Francisco is susceptible to an energy supply disruption. However, as with extreme heat events, the human impact from such events may vary. Persons who are older, who have few economic resources, or who rely on electric power for life-saving medical equipment, such as respirators, will be extremely vulnerable in power outages of this magnitude.

Extent and Probability of Future Events

San Francisco remains susceptible to energy supply disruptions that can occur as rolling blackouts where customers temporarily lose power, as well as brownouts where the voltage level falls below the normal minimum level specified for the system. However, the threat of such disruptions has lessened since the State of California implemented emergency technology and energy conservation programs, and adopted measures to mitigate energy market manipulation and reduce distribution bottlenecks.

It is more likely that San Francisco will experience an energy supply disruption due to a severe weather or high wind event. CCSF generally experiences one or two winter storms each year that generate enough wind to cause local, neighborhood-based outages around the city. Severe earthquakes may also result in energy disruptions, as in the 1989 Loma Prieta earthquake. In addition to local natural disasters, an energy emergency may also be caused by geopolitical events such as terrorism, civil disturbance, or embargo, which may directly affect energy prices and supply.

Terrorism

Nature

The Federal Bureau of Investigation (FBI) defines terrorism as the unlawful use of force or violence against persons or property to intimidate or coerce a government, the civilian population, or any segment of it, in furtherance of political or social objectives. The FBI further categorizes terrorism in the United States (US) as either domestic or international. Domestic terrorism occurs primarily within the territorial jurisdiction of the US. In contrast, international terrorism occurs primarily outside the territorial jurisdiction of the US, or transcends national boundaries in terms of the means by which they are accomplished, the persons they appear intended to intimidate or coerce, or the locale in which their perpetrators operate. For example, the 1995 bombing of the Murrah Federal Building in Oklahoma City was an act of domestic terrorism; the September 11, 2001, terrorist attacks in New York City, Washington, D.C., and Pennsylvania were international in nature.

The objective of terrorism is not solely to cause death or destruction. Terrorists typically engage in terrorism with the goal of instilling fear and helplessness in others for political purposes. Terrorists seek to destroy, incapacitate, or exploit critical infrastructure and key resources, threaten national security, inflict mass casualties, weaken economies, and damage public morale and confidence.

Terrorist attacks may take numerous forms. Incidents with the greatest impact are those involving weapons of mass destruction (WMD). Under federal law, a WMD is defined as an explosive, incendiary, or poison gas bomb, grenade, rocket, or other destructive device or weapon designed or intended to cause death or serious bodily injury through the release, dissemination, or impact of toxic or poisonous chemicals. WMDs also include weapons involving a biological agent, toxin, or vector; and weapons designed to release radiation or radioactivity at a level dangerous to human life. WMDs are often categorized as chemical, biological, radiological, nuclear, or explosive (CBRNE weapons). For discussion of cyber terrorism, see the discussion of cyber attacks, below.

The United States had largely avoided the impact of international terrorism until 2001. The terrorist attacks of September 11, 2001, marked a dramatic increase in international terrorism. These incidents, coupled with a series of anthrax-related incidents in late 2001, are indicative of the increasing threat of terrorists using various forms of WMD in the United States.

Each year, the San Francisco Police Department (SFPD) receives hundreds of calls regarding bomb threats to schools, government buildings, religious sites, and commercial facilities. The SFPD also receives reports of suspicious devices and unknown substances and powders. Though, to date, CCSF has not suffered significant harm from these threats, they still require local government to mobilize resources and activate emergency procedures on a regular basis. In some instances, large-scale evacuation of target locations was necessary, including a temporary shutdown of SFO.

History

San Francisco has experienced incidents that could be classified as domestic terrorism, including at least one involving an explosive device. On July 22, 1916, the City was the site of the Preparedness Day Bombing, in which 10 persons were killed and 40 wounded after a suitcase bomb detonated during a parade held in anticipation of the United States' imminent entry into World War I. On July 1, 1993, a gunman carrying hundreds of rounds of ammunition terrorized a high-rise office building located at 101 California Street, in the City's financial district, killing eight people and wounding six.

Since September 11, 2001, the number of threats involving the use of chemical, nuclear, or biological agents by individuals and terrorist groups wishing to instill fear and disrupt communities within the United States has escalated. However, to date, San Francisco has not experienced a high profile attack by groups or individuals associated with international terrorist organizations. Nor has San Francisco experienced an incident involving a biological, chemical, radiological, or nuclear weapon. Nevertheless, domestic terrorist incidents such as the April 15, 2013, Boston Marathon Bombing have led to heightened security efforts in San Francisco, as in other, similar urban areas.

Location

San Francisco meets all the criteria for being a high-value target. It is a heavily-visited, highly-visible city with iconic, globally-recognized cultural landmarks, including dual bridges, building towers and office buildings, sports stadiums, distinctive neighborhoods, a heavily-used public transportation system, and many public areas where large groups of people congregate. Any of these facilities or infrastructure could be identified as a high-value terrorist target that would produce substantial publicity in the event of a successful attack.

Extent and Probability of Future Events

San Francisco has a higher risk for a terrorist incident than other smaller urban areas due to its high-profile national image, and the large number of tourists who visit our city each year. The Threat Hazard Identification and Risk Assessment (THIRA) is a comprehensive assessment of the threats and hazards in a jurisdiction. Based on the 2013 THIRA for the greater San Francisco Bay Area, the types of terror threats and their likelihood were ranked as follows:

1. Vehicle-borne improvised explosive device (IED).
2. Aircraft as a weapon.
3. IED.
4. Biological (contagious).
5. Cyber attack.
6. Chemical agent.
7. Arson or incendiary attack.
8. Conventional attack.

Cyberterror

Nature

The FBI has defined cyberterrorism as a premeditated, politically-motivated attack against information, computer systems, computer programs, and data that results in violence against noncombatant targets by subnational groups or clandestine agents. The U.S. National Infrastructure Protection Center defines cyberterrorism as a criminal act perpetrated through the use of computers and telecommunications capabilities, which results in violence, destruction, or disruption of services, to create fear by causing confusion and uncertainty within a given population, with the goal of influencing a government or population to conform to a particular political, social, or ideological agenda. As used in this HMP, cyberterror impacts the community, the state, or the nation as a whole, rather than individual or business interests alone.

Cyber-based attacks gain access to or intrude on critical infrastructure systems, such as financial services, communications, energy, or transportation systems, with the potential to alter their reliable functioning. Disruption to such systems could pose a critical threat to national and economic security. Examples of cyberterrorism include a recent security breach by unauthorized intruders into the parent company of the NASDAQ, which is the second largest stock exchange platform in the world; or an ongoing attack on a police emergency radio system in 2003.

Over the past five years, the threat from cyberterror has grown exponentially, in part due to the rapid growth in the use of the Internet, and the expansion of technology in general. The widespread use of computers in practically every industry contributes to the complexity of protecting against and mitigating cyberterrorism. Nationally, the number of attacks reported to the Department of Homeland Security (DHS) National Cyber Investigative Joint Task Force (NCIJTF) grew by 52 percent in 2012, with 198 attacks reported in 2012, though only a few of these attacks resulted in actual security breaches. The energy sector was the most-targeted industry in 2012, with 82 attacks reported. The water industry was next with 29 reported attacks; chemical plants faced seven cyber attacks; the nuclear industry reported six attacks.

History

To date, San Francisco has not experienced a full-scale cyber attack. However, in 2008, in a well-publicized incident, a CCSF network engineer denied department supervisors access to the City's IT network. The San Francisco Department of Technology (DT) reports that it blocks up to 1,200 hits per day from outside hackers. During the Occupy San Francisco protests in 2011, the number of attacks on CCSF websites and IT systems jumped significantly. During that same time period, a group known as Anonymous breached the Bay Area Rapid Transit (BART) system's website and released customers' personal information. The Anonymous attack was done in response to BART blocking passenger cell service to thwart an earlier protest.

Location

Cyberterror as a hazard can touch all aspects of our community, including government, business, and private individuals.

Extent and Probability of Future Events

Given the fact that San Francisco is home to a large Internet and computer technology industry, the city is an inviting target for cyber terrorist groups, both domestic and foreign. However, it is difficult to predict the extent of harm that might result in CCSF from a successful cyberterror attack on local infrastructure. Nevertheless, cyberterror is expected to continue and to intensify in the near future. The March 2013 Worldwide Threat Assessment of the US Intelligence Community described an increasing risk to US critical infrastructure from cyberterror attacks, along with an eroding ability on the part of economic and national security interests to combat cyberterror.

Section 6: Vulnerability Analysis

A vulnerability analysis predicts the extent of exposure that may result from a hazard event of a particular intensity in a given area. The analysis provides quantitative data that may be used to identify and prioritize potential mitigation strategies by allowing communities to focus attention on areas with the greatest risk of damage. This section provides a vulnerability analysis including an asset inventory, a description of the methodology used to perform the vulnerability analysis, a summary of the data limitations, an exposure analysis, a summary of impacts as required by the Code of Federal Regulations, and a summary of land use and development trends. The section also addresses National Flood Insurance Program (NFIP) repetitive damage structures, as required by the federal regulations.

6.1 Asset Inventory

The federal regulations implementing the Stafford Act include the following recommendations on the manner in which local jurisdictions should describe vulnerability:

FEMA RECOMMENDATIONS: RISK ASSESSMENT

Assessing Vulnerability

The plan should describe vulnerability in terms of (see 44 CFR § 201.6(c)(2)(ii)(A)-(B)):

(A) The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

(B) An estimate of the potential dollar losses to vulnerable structures identified above and a description of the methodology used to prepare the estimate.

Source: FEMA, *Local Mitigation Plan Review Tool*, Plan Strengths and Opportunities for Improvement, March 2013.

Assets within CCSF that may be affected by hazard events include the City's population, general building stock, and essential facilities and infrastructure. A list of essential facilities and infrastructure located within San Francisco County, including department, facility type, and facility name, is located in Table F-1 (Appendix F, Essential Facilities and Infrastructure within San Francisco County). A list of CCSF-owned essential facilities and infrastructure located outside San Francisco County limits, including department, facility type, facility name, and county, is provided in Table G-1 (Appendix G, Essential Facilities and Infrastructure Outside San Francisco County).

6.1.1 Population and Building Stock

Population data for San Francisco was obtained from the United States Census Bureau, which was collected at the level of the census block. San Francisco's total population in 2010 was 805,235 (see Table 6-1). The United States Census Bureau estimated CCSF's population for 2012 to be 825,863, an increase of approximately 2.6 percent. Population density throughout CCSF is shown on the map in Figure C-16 (Appendix C, Figures).

Table 6-1: CCSF Population and Building Inventory By Area

Population	Building Inventory by Area (Square Miles)		
2010 Census	Residential Buildings	Mixed Residential/ Commercial Buildings	Commercial Buildings
805,235	16.54	0.83	2.57

Sources: US Census Bureau San Francisco County Quick Facts; San Francisco Planning Department, 2013.

The square miles of the San Francisco building inventory as shown in Table 6-1 were based on estimates from CCSF land use information (see Appendix C, Figure C-17) provided by the San Francisco Planning Department. A total of 16.54 square miles of residential buildings were considered in this analysis, including single-family and multifamily dwellings. A total of 2.57 square miles of commercial buildings were also analyzed, including industry, retail trade, wholesale trade, personal and repair services, professional and technical services, banks, medical offices, religious centers, entertainment and recreational facilities, theaters, and parking facilities. In addition, 0.83 square miles of property zoned as mixed residential and commercial buildings were included in this analysis.

6.1.2 Essential Facilities and Infrastructure within San Francisco County

In general, an essential building or infrastructure is defined as a public or private facility that provides essential products and services to the general public, including important public safety, emergency response, and disaster recovery functions. For purposes of the 2014 HMP, essential facilities and infrastructure are defined to include only those facilities and infrastructure owned by the City, with the exception of some educational facilities that are owned and operated by the San Francisco Unified School District or the State of California. The essential facilities and infrastructure included in this plan were obtained by combining data from CCSF's Real Estate Division, Risk Management's list of scheduled assets, and the list of assets from the 2008 HMP. They are identified by department in Table 6-2, and in the tables set forth in Appendix F, List of Essential Facilities and Infrastructure within San Francisco County.

Table 6-2: Essential Facilities and Infrastructure within San Francisco County

Department		Number of Facilities and Infrastructure
Acronym	Name	
AAM	Asian Art Museum	1
ACC	Animal Care and Control	1
CAS	California Academy of Sciences	1
CDF	Convention Facilities Department	3
DEM	Department of Emergency Management	1
DPH	Department of Public Health	18
DPW	Department of Public Works	317

Table 6-2: Essential Facilities and Infrastructure within San Francisco County

Department		Number of Facilities and Infrastructure
Acronym	**Name**	
DOT	Department of Transportation	1
FAMSF	Fine Arts Museums of San Francisco	3
GSA	General Services Agency	2
HAS	Human Services Agency	12
JUV	Juvenile Probation Department	1
MTA	Municipal Transportation Agency	79
PORT	Port of San Francisco	164
REAL ESTATE	Real Estate Division	9
RPD	Recreation and Parks Department	107
SFAC	San Francisco Arts Commission	5
SFFD	Fire Department	44
SFPD	Police Department	13
SFPL	Public Library, San Francisco	20
SFPUC	Public Utilities Commission	67
SFFD	Sherriff Department	4
SFUSD	Unified School District, San Francisco	130
TIDA	Treasure Island Development Authority	25
WMPAC	War Memorial and Performing Arts Center	2
	Total	**1,049**

Source: CCSF Real Estate Division, Risk Management, SF Enterprise GIS, 2013.

6.1.3 Essential Facilities and Infrastructure Outside San Francisco County

CCSF owns and operates a number of facilities and infrastructure located outside county limits. For the 2014 HMP, the Planning Team decided to begin integration of essential CCSF-owned facilities and infrastructure located outside county limits. As shown in Figure G-1 (Appendix G, Essential Facilities and Infrastructure Outside San Francisco County), these facilities and infrastructure include the San Francisco International Airport; County Jail #5–San Bruno Complex; recreational facilities, such as Camp Mather, owned by the Recreation and Parks Department; Redwood Center, a mental health facility owned by Department of Public Health; wastewater treatment plants; and the tunnels, pipelines, power stations, and dams comprising the Hetch Hetchy Water System.

A complete vulnerability analysis for the out-of-county areas where these facilities and infrastructure are located was beyond the time and resources of the 2014 Planning Team. The Planning Team is committed to completing the integration of vulnerability-related information for CCSF-owned, out-of-county essential facilities and infrastructure in future plan updates.

6.2 Methodology

To assess the risks associated with the hazards profiled in the 2014 HMP, a conservative exposure-level analysis was conducted. This analysis is a simplified assessment of the potential effects of the hazards on values at risk, without considering the probability or level of damage.

Using Census block-level information, a spatial proportion was employed to determine the percentage of the population located in areas where hazards are likely to occur. Using CCSF's land use maps, a spatial proportion was used to determine the square miles of each type of combined use district (residential, non-residential, and mixed residential/commercial) that are located in areas where hazards are likely to occur.

Using data from CCSF departments and from the San Francisco Enterprise GIS Program (SFGIS), geocoded locations of essential facilities and infrastructure were compared to locations where hazards are likely to occur. If any portion of the assets fell within a hazard area, the asset was counted as impacted.

For each physical asset located within a hazard area, exposure was calculated by assuming the worst-case scenario: that is, the asset would be completely destroyed and would have to be replaced. The aggregate exposure, in terms of replacement value or insurance coverage, for each category of structure or facility was calculated. A similar analysis was used to evaluate the proportion of the population at risk. However, the analysis simply represents the number of people at risk; no estimate of the number of potential injuries or deaths was prepared.

6.3 Data Limitations

The vulnerability estimates provided in the 2014 HMP use the best data currently available to produce an approximation of risk. These estimates may be used to understand relative risk from hazards and potential losses. However, uncertainties are inherent in any loss estimation methodology. In part, these uncertainties arise from incomplete scientific knowledge concerning hazards and their effects on the built environment, and from the use of approximations and simplifications that are necessary for a comprehensive analysis.

In addition, this vulnerability analysis does not include estimated values or insured values for identified assets. To date, several of the CCSF-owned facilities are self-insured and do not have a replacement value or insurance coverage value.

It is also important to note that the quantitative vulnerability assessment results are limited to the exposure of people, building stock, and essential facilities and infrastructure to the identified hazards. It is beyond the scope of the 2014 HMP to develop a more detailed or comprehensive assessment of risk (including annualized losses, people injured or killed, shelter requirements, loss of facility or system function, and economic losses). Such impacts may be addressed with future updates of the HMP.

Due to a combination of a lack of adequate information, the lack of a standard methodology for a quantitative exposure analysis, and limited GIS capabilities, vulnerability results have not been prepared for the following hazards: drought, heat, wind, climate change, pandemic, and

human-caused. Thus, a quantitative vulnerability analysis has been prepared for the following hazards:

- Ground shaking.
- Ground failure.
- Tsunami.
- Flood.
- Reservoir failure.
- Wildfire.
- Urban Conflagration.

6.4 Exposure Analysis

The results of the exposure analysis for population and building stock as well as essential facilities and infrastructure within San Francisco County limits are summarized in Tables 6-3 and 6-4. In addition, the exposure analysis by hazard for each essential facility and infrastructure within San Francisco County is located in Table F-2 (Appendix F, Essential Facilities and Infrastructure within San Francisco County).

Table 6-3: Exposure Analysis Overview – Population and Building Stock Summary

Hazard				Population Affected	Building Area by Zoning Designation (Square Miles)		
Hazard Group	**Hazard Category**	**Hazard Subcategory**	**Hazard Area**	**2010 Census**	**Residential Buildings**	**Mixed Residential/ Commercial Buildings**	**Commercial Buildings**
Seismic	Ground Shaking	San Andreas	Very Violent	779,154	16.14	0.82	2.52
			Violent	22,617	0.39	0.01	0.04
		Hayward	Very Violent	9	N/A	N/A	0.0004
			Violent	113,736	1.24	0.38	0.90
			Strong	688,038	15.29	0.45	1.66
	Ground Failure	Liquefaction	Earthquake-Induced Liquefaction Zone	114,703	0.82	0.32	0.82
		Landslide	Earthquake-Induced Landslide Zone	13,103	0.49	0.00	0.05
	Tsunami	-----	Inundation Area	21,875	0.18	0.01	0.13
Weather-Related Hazards	Flood	Coastal	100-Year Flood Zone	9,685	0.03	0.00	0.01
		Stormwater	Ponding Area	5,614	0.05	0.01	0.04
Other Hazards	Reservoir Failure	-----	Inundation Area	23,886	0.74	0.00	0.03
	Wildland Fire	-----	High	855	0.03	0.00	0.00
			Moderate	15,929	0.35	0.01	0.01

Table 6-3: Exposure Analysis Overview – Population and Building Stock Summary

Hazard				Population Affected	Building Area by Zoning Designation (Square Miles)		
Hazard Group	**Hazard Category**	**Hazard Subcategory**	**Hazard Area**	**2010 Census**	**Residential Buildings**	**Mixed Residential/ Commercial Buildings**	**Commercial Buildings**
	Urban Conflagration	-----	Extreme	55,760	1.16	1.01	0.00
			Very High	114,561	3.64	0.21	0.07
			High	197,304	2.74	3.32	0.45

Table 6-4: Exposure Analysis Overview – Essential Facilities and Infrastructure within San Francisco County

Hazard				Number of Essential Facilities and Infrastructure
Hazard Group	**Hazard Category**	**Hazard Subcategory**	**Hazard Area**	
Seismic	Ground Shaking	San Andreas	Very Violent	1015
			Violent	35
		Hayward	Very Violent	0
			Violent	363
			Strong	687
	Ground Failure	Liquefaction	Earthquake-Induced Liquefaction Zone	233
		Landslide	Earthquake-Induced Landslide Zone	44
	Tsunami	-----	Inundation Area	156
Weather-Related Hazards	Flood	Coastal	100-Year Flood Zone	47
		Stormwater	Ponding Area	13
Other Hazards	Reservoir Failure	-----	Inundation Area	16
	Wildland Fire	-----	High	0
		-----	Moderate	22
	Urban Conflagration	-----	Extreme	1
			Very High	88
			High	58

6.5 Summary of Impacts

The requirements for a description of the local jurisdiction's vulnerability to the hazards profiled in its hazard mitigation plan, as set forth in the federal regulations implementing the Stafford Act, are provided below.

FEMA REGULATION CHECKLIST: RISK ASSESSMENT

Vulnerability Description

44 CFR § 201.6(c)(2)(ii): "The plan shall include" a "description of the jurisdiction's vulnerability to the hazards described in" the plan. "This description shall include an overall summary of each hazard and its impact on the community."

Element

B3. Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability? See 44 CFR § 201.6(c)(2)(ii).

Source: FEMA*, Local Mitigation Plan Review Guide*, *March 2013.*

As part of the risk assessment required by the federal regulations, the 2014 HMP includes the following description of CCSF's overall vulnerability to each of the hazards addressed in the quantitative exposure analysis in Section 6.4:

- Ground shaking.
- Ground failure.
- Tsunami.
- Flood.
- Reservoir failure.
- Wildfire.
- Urban Conflagration.

6.5.1.1 Ground Shaking

Approximately 100 percent of CCSF's population, building stock, and essential facilities and infrastructure are located within the very violent and violent shaking intensity hazard areas for a Mw 7.9 earthquake along the northern segment of the San Andreas fault. Within the very violent shaking intensity area (44.90 square miles) are an estimated 779,154 people (96.76 percent), 16.14 square miles of residential buildings (97.58 percent), 0.82 mixed residential/commercial buildings (98.80 percent), and 2.52 miles of commercial buildings (98.05 percent). In addition, this hazard area includes 1015 essential facilities and infrastructure (96.76 percent). The remaining population, building stock, and essential facilities and infrastructure are located within the violent intensity hazard areas for this hazard.

Nearly 100 percent of the City's population (801,774) is located in the violent and strong shaking intensity hazard areas (46.39 square miles) for a Mw 6.9 earthquake on the northern segment of the Hayward Fault. This hazard area also includes 16.53 square miles of residential

buildings (99.94 percent), 0.83 square miles of mixed residential/commercial buildings (100 percent), and 2.56 square miles of commercial buildings (99.61 percent). Within these two shaking intensity hazard areas are 100 percent of CCSF's essential facilities and infrastructure.

6.5.1.2 Ground Failure

An estimated 114,703 people in San Francisco (14.24 percent) are located within the earthquake-induced liquefaction hazard area of the Seismic Hazard Zone Map. This area includes 0.82 square miles of residential building stock (4.96 percent), 0.32 square miles of mixed residential/commercial buildings (38.55 percent), and 0.82 square miles of commercial buildings (31.91 percent). Also located within the liquefaction hazard area are 233 essential facilities and infrastructure (22.19 percent). The liquefaction hazard area encompasses a total of 9.27 square miles (19.73 percent) within San Francisco County.

An estimated 13,103 people (1.63 percent) are located within an earthquake-induced landslide zone. Also included in this zone are 44 essential facilities and infrastructure (4.19 percent), 0.49 square miles of residential buildings (2.96 percent), nearly 0.004 square miles of mixed residential/commercial buildings (0.46 percent), and 0.05 square miles of commercial buildings (1.95 percent).

6.5.1.3 Tsunami

An estimated 21,875 people in CCSF (2.72 percent) are located within the tsunami inundation area. Also at risk are 156 essential facilities and infrastructure (14.86 percent), 0.18 square miles of residential buildings (1.09 percent), 0.01 square miles of mixed residential/commercial buildings (1.20 percent), and 0.13 square miles of commercial buildings (5.06 percent). The tsunami inundation hazard area encompasses a total of 3.13 square miles (6.66 percent) of San Francisco County.

6.5.2 Weather-Related Hazards

6.5.2.2 Flood

An estimated 9,685 people (1.20 percent) are located within the 100-year flood hazard area indicated by the 2008 Interim Floodplain Map. Within the 1.76 square miles of this hazard area are 0.03 residential buildings (0.18 percent) and 0.01 commercial buildings (0.39 percent), which makes up approximately 1.76 square miles within CCSF. There are 47 essential facilities and infrastructure located within the 100-year flood hazard area.

In addition, an estimated 5,614 people (0.70 percent) are located in a stormwater ponding hazard area, as defined by the SFPUC. This area includes 0.05 square miles of residential buildings (0.30 percent), 0.01 square miles of mixed residential/commercial buildings (1.20 percent), and 0.04 square miles of commercial buildings (1.56 percent), approximately 0.51 square miles within San Francisco. There are also 13 essential facilities and infrastructure (1.24 percent) located within the stormwater ponding hazard area.

6.5.3 Other Hazards

6.5.3.2 Reservoir Failure

Inundation maps prepared for the state-regulated Sutro, Sunset North and South, and University Mound North and South dams show that an estimated 23,886 people (2.97 percent) are at risk for inundation due to reservoir failure. This includes 0.74 square miles of residential buildings (4.47 percent) and 0.03 square miles of commercial buildings (1.17 percent). There are 16 essential facilities and infrastructure (1.24 percent) within this hazard area, which makes up 1.41 square miles (3.01 percent) within San Francisco County.

6.5.3.3 Wildfire

The CAL FIRE Fire Hazard Severity Zone (FHSZ) maps show that there are 0.05 square miles of land located within the high FHSZ, and an additional 4.10 square miles are located within the moderate FHSZ. Within the high FHSV are 855 people (0.11 percent) and 0.03 square miles of residential buildings (0.18 percent). No essential facilities and infrastructure are located within this hazard area.

Within the moderate FHSZ are 15,929 people (1.98 percent). The 4.10 square miles encompassed by the moderate FHSZ includes 0.35 square miles of residential buildings (2.12 percent), 0.01 square miles of mixed residential/commercial buildings (1.20 percent), and 0.01 square miles of commercial buildings (0.39 percent). There are 22 essential facilities and infrastructure (2.10 percent) located within the moderate FHSZ.

6.5.3.4 Urban Conflagration

There are 4,928 people (0.61 percent) located within the extreme urban conflagration hazard area, which encompasses 0.37 square miles (0.80 percent) of CCSF. This includes 0.04 square miles of residential buildings (0.27 percent), and 0.30 square miles of mixed residential/commercial buildings (36.08 percent). One essential facility or infrastructure is located within the extreme urban conflagration hazard area.

Over 29,000 people (3.65 percent) are located within the very high urban conflagration hazard area, which encompasses 1.78 square miles (3.79 percent). This includes 0.88 square miles of residential buildings (5.33 percent), 0.13 square miles of mixed residential/commercial buildings (16.18 percent), and 0.12 square miles of commercial buildings (4.74 percent). There are also 88 essential facilities and infrastructure (8.39 percent) located within the very high urban conflagration hazard area.

Within the 2.01 square miles comprising the high urban conflagration hazard area, there are an estimated 51,566 people at risk (6.40 percent). This area includes 1.08 square miles of residential buildings (6.51 percent), 0.19 square miles of mixed residential/commercial buildings (23.37 percent), and 0.13 square miles of commercial buildings (4.89 percent). There are 59 essential facilities and infrastructure (5.62 percent) located in this hazard area.

6.6 Land Use and Development Trends

The requirements for updating local mitigation plans to reflect changes in development, as set forth in the federal regulations implementing the Stafford Act, are provided below.

FEMA REGULATION CHECKLIST: PLAN UPDATE

Plan Update to Reflect Development Changes

44 CFR § 201.6(d)(3): A local jurisdiction must review and revise its plan to reflect changes in development.

Element

D1. Was the plan revised to reflect changes in development? 44 CFR § 201.6(d)(3).

Source: FEMA, *Local Mitigation Plan Review Tool*, March 2013.

In addition, the Code of Federal Regulations recommends that local jurisdictions describe vulnerability in terms of describing land use and development trends within the community, as set forth below.

FEMA RECOMMENDATION: RISK ASSESSMENT

Description of Vulnerability: Land Use and Development Trends

44 CFR § 201.6(c)(2)(ii)(C): The plan should describe vulnerability in terms of "[p]roviding a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions."

Source: FEMA, *Local Mitigation Plan Review Tool*, Plan Strengths and Opportunities for Improvement, March 2013.

Though San Francisco is largely built-up, rezoning and planning efforts initiated by the San Francisco Planning Department over the last ten years have established policies and guidelines allowing for additional growth in locations where transit availability is high, and where additional housing or commercial uses are appropriate and can be accommodated. Redevelopment areas and projects within CCSF that were adopted prior to the State of California's 2012 dissolution of redevelopment agencies have been taken up by the San Francisco Office of Community Investment and Infrastructure (OCII), the successor agency to the former San Francisco Redevelopment Agency. Under state law, OCII is authorized to continue to implement several major redevelopment projects that were previously administered by the former San Francisco Redevelopment Agency.

Table 6-5, below, lists the various planning and redevelopment areas where future growth is expected to occur. These areas also are shown on Figure C-20 (Appendix C, Maps).

Table 6-5: Plan Areas and Major Development Projects

Planning/Redevelopment Areas	Square Miles	Growth Potential	
		Residential Units	Non-Residential Square Footage
Balboa Park	0.32	1,800	123,600

Table 6-5: Plan Areas and Major Development Projects

Planning/Redevelopment Areas	Square Miles	Growth Potential	
		Residential Units	Non-Residential Square Footage
Bayview	3.69	1,200	1,465,000
Candlestick Point	0.44	7,500	3,385,000
Central Corridor	0.58	11,700	9,391,000
Central Waterfront	0.66	1,600	250,700
East SoMa	0.47	6,500	821,900
Executive Park	0.08	1,600	321,000
Glen Park	0.06	150	23,500
Hunters Point	0.80	12,100	3,000,000
Japantown	0.23	2,700	470,000
Market / Octavia	0.62	4,000	21,000
Mid-Market	0.13	3,000	547,800
Mission	1.33	1,700	111,200
Mission Bay	0.49	6,000	8,000,000
Park Merced	0.29	7,200	400,000
Pier 70	0.26	1,000	2,000,000
Rincon Hill	0.09	7,750	500,000
Schlage Lock	0.07	1,250	90,000
Sea Wall Lot 337	0.03	1,500	2,750,000
Showcase Square / Potrero Hill	1.06	4,500	487,700
Transbay Terminal	0.09	2,600	3,100,000
Transit Center District	0.23	1,350	6,600,000
Treasure Island	0.89	8,000	550,000
Western SoMa	0.47	2,800	1,225,500

Source: San Francisco Planning Department, 2013.

Most of the planning efforts shown in Table 6-5 above are now being implemented. At this time, there are approximately 53,600 housing units and 21,532,000 square feet of commercial space in the development pipeline. Over 6,000 units in the pipeline are under construction and are expected to be completed by 2015; 1,858,000 square feet of commercial development are also under construction and are expected to be built during the same time period.

Large projects currently under construction are located in Market/Octavia (Hayes Valley), MidMarket/Central Market (Tenderloin and Downtown), in Rincon Hill, and in Mission Bay. Other large projects expected to begin construction soon are located in the Potrero Hill and Hunters Point neighborhoods. Over half of the projects in the housing pipeline are planned developments on Treasure Island and in the Park Merced and Candlestick Point (Bayview) neighborhoods. These major development projects were granted land use entitlements between 2010 and 2011, and could be completed by 2025.

The exposure analysis overview of the neighborhoods where future growth is planned is shown in Table 6-6, below.

Table 6-6: Exposure Analysis Overview – Plan Areas Major Development Projects

				Balboa Park	Bayview	Candle-stick Point	Central Corridor	Central Waterfront	East SoMa	Executive Park	Glen Park	Hunters Point	Japan-town	Market/ Octavia	Mid-Market	Mission	Mission Bay	Park-merced	Pier 70	Rincon Hill	Schlage Lock	Sea Wall Lot 337	Showplace Square/ Potrero Hill	Transbay	Transit Center District	Treasure Island	Western SoMa
Hazard Group	**Hazard Category**	**Hazard Subcategory**	**Hazard Area**	Area (Sq. Mi.)	Area (Sq. Mi.)	Area (Sq. Mi.)	Area (Sq. Mi.)	Area (Sq. Mi.)	Area (Sq. Mi.)	Area (Sq. Mi.)	Area (Sq. Mi.)	Area (Sq. Mi.)	Area (Sq. Mi.)	Area (Sq. Mi.)	Area (Sq. Mi.)	Area (Sq. Mi.)	Area (Sq. Mi.)	Area (Sq. Mi.)	Area (Sq. Mi.)	Area (Sq. Mi.)	Area (Sq. Mi.)	Area (Sq. Mi.)	Area (Sq. Mi.)	Area (Sq. Mi.)	Area (Sq. Mi.)	Area (Sq. Mi.)	Area (Sq. Mi.)
Seismic Hazards	Ground Shaking	San Andreas	Very Violent	0.3239	3.4685	0.4044	0.5808	0.5586	0.4683	0.0801	0.0619	0.7355	0.2320	0.6222	0.1267	1.3270	0.4909	0.2886	0.1439	0.0860	0.0706	0.0310	1.0043	0.0914	0.2289	0.5229	0.4675
			Violent	0.0000	0.1726	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0587	0.0000	0.0000	0.3204	0.0000
		Hayward	Violent	0.0000	3.2684	0.4016	0.5808	0.5586	0.4683	0.0245	0.0000	0.4579	0.0000	0.0000	0.0652	0.0283	0.4909	0.0000	0.1439	0.0860	0.0000	0.0310	0.5691	0.0914	0.2289	0.6410	0.3704
			Strong	0.3239	0.3727	0.0028	0.0000	0.0000	0.0000	0.0556	0.0619	0.2776	0.2320	0.6222	0.0615	1.2987	0.0000	0.2886	0.0000	0.0000	0.0706	0.0000	0.4939	0.0000	0.0000	0.2043	0.0971
			Moderate	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	Ground Failure	Liquefaction	Liquefiable Soil	0.0000	1.5718	0.3457	0.4758	0.4424	0.3341	0.0139	0.0185	0.5360	0.0000	0.1711	0.0000	0.1042	0.4671	0.4685	0.0219	0.0850	0.0307	0.0310	0.2559	0.0857	0.2182	0.6544	0.4293
		Earthquake-Induced Landslide	Landslide Zone	0.0000	0.1575	0.0108	0.0000	0.0025	0.0012	0.0135	0.0013	0.0130	0.0000	0.0014	0.0000	0.0000	0.0000	0.0000	0.0000	0.0012	0.0000	0.0000	0.0493	0.0000	0.0000	0.0499	0.0000
	Tsunami	-----	Inundation Area	0.0000	0.1447	0.0452	0.0000	0.3250	0.0115	0.0000	0.0000	0.1525	0.0000	0.0000	0.0000	0.0000	0.0859	0.0000	0.1433	0.0018	0.0000	0.0275	0.0000	0.0000	0.0014	0.6551	0.0000
Weather-Related Hazards*	Flood	Coastal	100-Year Flood Zone	0.0000	0.2194	0.0909	0.0110	0.0810	0.0000	0.0000	0.0000	0.2083	0.0000	0.0000	0.0000	0.0000	0.0450	0.0000	0.0423	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1800	0.0150
		Stormwater	Ponding Area	0.0000	0.0709	0.0332	0.0771	0.0115	0.0125	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0517	0.0335	0.0000	0.0000	0.0000	0.0016	0.0000	0.0149	0.0000	0.0009	0.0000	0.0853
Other Hazards*	Reservoir Failure	-----	Inundation Area	0.0000	0.0815	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	Wildfire	-----	Very High	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
			High	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
			Moderate	0.0000	0.1705	0.1029	0.0000	0.0000	0.0000	0.0000	0.0000	0.0391	0.0000	0.0000	0.0000	0.0000	0.0000	0.0235	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2291	0.0000
	Urban Conflagra-tion	-----	Extreme	0.0000	0.1660	0.0029	0.0053	0.0353	0.0119	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0323	0.0064	0.0000	0.0000	0.0060	0.0116	0.0000	0.0571	0.0000	0.0000	0.0000	0.0007
			Very High	0.0000	0.3255	0.0007	0.0000	0.4224	0.0348	0.0000	0.0000	0.0000	0.0358	0.0679	0.0001	0.0443	0.0073	0.0000	0.1800	0.0003	0.0007	0.0019	0.1338	0.0000	0.0000	0.0000	0.0004
			High	0.0009	0.4249	0.0426	0.0164	0.0183	0.0341	0.0022	0.0000	0.0000	0.0024	0.0304	0.0002	0.1706	0.0000	0.0656	0.0000	0.0327	0.0252	0.0000	0.0821	0.0013	0.0000	0.0000	0.0094
			Total Sq. Mi.	0.3239	3.6907	0.4383	0.5808	0.6562	0.4689	0.0801	0.0619	0.7970	0.2320	0.6222	0.1267	1.3270	0.4909	0.2886	0.2571	0.0860	0.0706	0.0310	1.0630	0.0914	0.2289	0.8884	0.4675

* Drought, heat, wind, climate change, non-earthquake-induced landslide, pandemic, and human-caused hazards are not included in this analysis. In general, drought, heat, and wind affect San Francisco equally. The best data available for analysis of non-earthquake-induced landslide is the data for earthquake-induced landslides. The potential exposure from climate change, pandemic, and human-caused hazards is unknown at this time, and therefore is not included in this analysis.

6.7 NFIP-Insured Structures with Repetitive Damage

The Code of Federal Regulations requirements for addressing NFIP-insured structures that are repetitively damaged by floods are set forth below.

FEMA REGULATION CHECKLIST: RISK ASSESSMENT

Vulnerability Description: NFIP Insured Structures

44 CFR § 201.6(c)(2)(ii): The plan must "address NFIP insured structures that have been repetitively damaged by floods."

Elements

B4. Does the Plan address NFIP insured structures within the jurisdiction that have been repetitively damaged by floods? See 44 CFR § 201.6(c)(2)(ii).

Source: FEMA*, Local Mitigation Plan Review Guide*, March 2013.

The 2014 HMP does not address Repetitive Loss (RL) properties, which are properties that have experienced more than one flood insurance claim under the National Flood Insurance Program (NFIP). Since San Francisco became a member of the NFIP in 2010, there have been no storm events severe enough to cause widespread flooding. Accordingly, San Francisco does not have any RL properties.

Since 2010, a total of 49 NFIP policies have been issued in CCSF. To date, NFIP-insured property owners in CCSF have paid total premiums of $51,814. Total coverage to date is $13,435,000. CCSF has had only one loss claim, and has not paid any claims. There have been no claims for substantial damage.

Section 7: Capability Assessment

The federal regulations implementing the Stafford Act, as amended by DMA 2000, require local mitigation plans to select mitigation strategies based on the jurisdiction's mitigation-related capabilities. (See 44 CFR § 201.6(c)(3).) A capability assessment summarizes the authorities, policies, programs, staff, funding, and other resources available to the Planning Area to accomplish mitigation and reduce vulnerability to hazards. The assessment also provides information on CCSF's ability to expand on and improve its existing policies and programs. In addition, the capability assessment describes current, ongoing, and recently completed mitigation projects and programs undertaken by the Planning Area, and provides information regarding CCSF's implementation of and continued participation in the National Flood Insurance Program (NFIP).

FEMA REGULATION CHECKLIST: CAPABILITY ASSESSMENT

Capability Assessment

44 CFR § 201.6(c)(3): – The plan must include mitigation strategies based on the jurisdiction's "existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools."

Elements

C1. Does the plan document the jurisdiction's existing authorities, policies, programs and resources, and its ability to expand on and improve these existing policies and programs? 44 CFR § 201.6(c)(3).

C2. Does the Plan address the jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? 44 CFR § 201.6(c)(3)(ii).

Source: FEMA, *Local Mitigation Plan Review Tool*, March 2013.

Note: **For coverage of Elements C3 – C5, see Section 8, Mitigation Strategies. For coverage of Element C6, see Section 9, Plan Maintenance.**

7.1 Human and Technical Resources

Table 7-1 describes the human and technical resources available to CCSF to accomplish hazard mitigation in the Planning Area, including overseeing mitigation projects and the implementation of this plan. The table describes the staff or personnel resources, responsible departments or agencies, and principal activities related to hazard mitigation for relevant departments or agencies.

Table 7-1: Local Human and Technical Resources for Hazard Mitigation

Staff/Personnel Resources	Department or Agency	Principal Activities Related to Hazard Mitigation
Planners or engineers with knowledge of land development, land management practices, and human-caused and natural hazards	Planning Department (Planning)	Develops and maintains the General Plan, including the Community Safety Element. Develops area plans based on the General Plan, to provide more specific guidance for the development of the various neighborhood areas. Reviews of private development projects and proposed capital improvements projects and other physical projects involving property for consistency and conformity with the General Plan. Anticipates and acts on the need for new plans, policies, and Planning Code changes. Applies approved General Plan Elements, Area plans, policies, Planning Code, and other regulations to proposed land use decisions.
	Department specific	Other CCSF departments with planning personnel include the Port of San Francisco (Port), the Recreation and Parks Department (RPD), and the San Francisco Public Utilities Commission (SFPUC).
Engineers or professionals trained in construction practices related to buildings or infrastructure	Department of Building Inspection (DBI)	DBI oversees the effective, efficient, fair, and safe enforcement of the San Francisco Building, Housing, Plumbing, Electrical, Mechanical, and Disability Access Codes.
	Department of Public Works (DPW)	DPW maintains city roads and street structures, such as bridges, tunnels, retaining walls; promotes the undergrounding of overhead utilities; and provides architectural, civil, structural, electrical, hydraulic, and mechanical engineering services, including project and construction management. DPW also is the regulator of the Subdivision Code.
	General Services Agency (GSA)	GSA oversees the maintenance, operations, and management of City-owned buildings and infrastructure, technology and telephony services, and design and construction of department's capital improvements.
	SFPUC	SFPUC, under the Infrastructure Division, has engineers (Civil, Mechanical, Electrical, Structural, and Corrosion disciplines) in the Engineering Management Bureau (EMB) and construction inspectors in the Construction Management Bureau (CMB).

Table 7-1: Local Human and Technical Resources for Hazard Mitigation

Staff/Personnel Resources	Department or Agency	Principal Activities Related to Hazard Mitigation
Engineers or professionals trained in construction practices (cont.)	San Francisco International Airport (SFO)	SFO oversees maintenance, operations, and management of city-owned airport buildings and infrastructure, technology, and telephony services, design and construction of the SFO's capital improvements, and airport risk management. SFO's Building Inspection and Code Enforcement (BICE) oversees enforcement of SFO's Tenant Improvement Guide, and enforcement of the California Building Standards, Plumbing, Electrical, Mechanical, and Disability Access Codes.
	Department specific	Other departments with engineering personnel include the Department of Environment (DOE) and the Port.
Floodplain Manager	Office of the City Administrator	San Francisco is a member of the National Flood Insurance Program (NFIP). The City is in the process of working with FEMA to analyze their pre-preliminary floodplain mapping. The Floodplain Manager is the City Administrator, or his or her designee. The Floodplain Manager is responsible for working with stakeholders to ensure the Floodplain Damage Prevention Ordinance is followed within CCSF.
Emergency managers and analysts	Department of Emergency Management (DEM), Division of Emergency Services	Maintains the Emergency Response Plan and other emergency-related plans for San Francisco. Provides support to local response and relief activities within the Emergency Operation Center, and works closely with regional, state, and federal partners to provide information and coordinate assistance. Helps coordinate regional emergency response planning in partnership with the nine Bay Area counties and the cities of Oakland and San Jose. Highlights the importance of disaster preparedness through public education efforts, including its preparedness website, www.sf72.org, which helps San Franciscans plan for emergencies such as earthquakes, fires, severe storms, and power outages. Facilitates meetings of the San Francisco Disaster Council.
	Department specific	Other departments with emergency management staff include DPW, General Services Agency (GSA), the Port, San Francisco International Airport (SFO), the San Francisco Municipal Transportation Agency (SFMTA), and SFPUC.

Table 7-1: Local Human and Technical Resources for Hazard Mitigation

Staff/Personnel Resources	Department or Agency	Principal Activities Related to Hazard Mitigation
Finance	Department-specific Mayor's Office of Public Finance	Manages grants. Utilizes three principal types of municipal debt obligations to finance long-term capital projects and the acquisition of select equipment. Other departments with financial or grant personnel include DEM, the Port, SFMTA, and SFPUC.
Public Information Officers (PIO)	Department-specific	Provide public and media information regarding CCSF disaster response, mitigation, and recovery efforts. CCSF departments with PIOs include DEM, San Francisco Fire Department, San Francisco Police Department (SFPD), the Port, SFO, and SFPUC.
Public Preparedness Education	San Francisco Fire Department (SFFD) Neighborhood Emergency Response Team (NERT) San Francisco Animal Care and Control (ACC) Disaster Animal Response Team (DART) SFPD Auxiliary Law Enforcement Response Team (ALERT)	NERT offers free disaster preparedness training to thousands of San Francisco residents and to those who work in CCSF. Provides an organizing framework and support to neighborhood NERT teams, which self-deploy in the event of a serious earthquake or other major disaster. DART offers free training in caring for and sheltering animals in a disaster. Volunteers assist ACC in staffing animal shelters in disasters. Participants must complete basic NERT training in order to volunteer. ALERT offers free training to those who live, work, or attend school in CCSF in how to assist law enforcement during disasters, including performing traffic control, reporting criminal activity, assisting at an SFPD incident Command Post, providing well-being checks, securing resource locations, and delivering logistical supplies. Participants must complete basic NERT training in order to volunteer.
Risk Management	GSA, Risk Management SFO	GSA maintains the Risk Management Program for CCSF, which provides services to City departments by assisting them in managing their risk of injury to people and property, involving employees, City property, and the public at large. This program purchases insurance for City departments and acts in an advisory capacity with respect to workers' compensation, public liability, City property, and City contracts. Risk Management is also active in bond and insurance matters to facilitate small-business contracting with CCSF. SFO risk management staff evaluates risk at the Airport and ensures proper mitigation for the impact of SFO-related hazards.

Table 7-1: Local Human and Technical Resources for Hazard Mitigation

Staff/Personnel Resources	Department or Agency	Principal Activities Related to Hazard Mitigation
Technical Resources		
Asset management and repair assessment Disaster recovery and vulnerability assessment of information technology (IT)	DPW	Asset management tool for roads and street structures that helps prioritize repair work and establish fiscal year projects. Projects are submitted through the capital plan process for funding. This process could be adapted to include hazard vulnerability in DPW annual inspection process. Currently conducting a disaster recovery and vulnerability assessment of IT infrastructure. Results of the assessment will help identify hazard mitigation projects.
Geographic Information System (GIS)- or HAZUS-MH-skilled personnel	Department of Technology, San Francisco Enterprise Geographic Information System (SFGIS) Department specific.	Provides high-quality spatial data to CCSF departments and to the public and offers essential mapping services to citizens through SFgov.org. Other CCSF departments with trained, skilled GIS personnel include DPW, the Department of Emergency Management (DEM), Planning, the Port, RPD, and SFPUC.

7.2 Financial Resources

Table 7-2 describes the local and federal resources that may be available to CCSF to promote hazard mitigation, including mitigation projects identified in the 2014 HMP implementation strategy. The table discusses the type and subtype of the financial resource, administrator, purpose, and availability and the amount for each financial resource.

Table 7-2: Local and Federal Financial Resources for Hazard Mitigation

Type	Subtype	Administrator	Purpose	Amount/Availability
Local	General Fund	Department-specific	Program operations and specific projects.	Variable.
	General Obligation (GO) Bonds	Mayor's Office of Public Finance	GO Bonds are appropriately used for the construction or acquisition of improvements to real property broadly available to San Francisco residents and visitors. Such improvements include, but are not limited to, libraries, hospitals, parks, public safety facilities, and cultural and educational facilities.	The Board of Supervisors must hold a minimum of two public hearings before placing a GO bond measure on the ballot. Before issuance of any new money or refunding GO bonds, the Board of Supervisors must approve a resolution authorizing such issuance by majority vote. All new-money GO bonds issued by the City must be approved by two-thirds of the voters voting in the election. Outstanding GO bonded indebtedness cannot exceed three percent of the Assessed Valuation of taxable property within the County's jurisdictional area.
	Lease Revenue Bonds	Mayor's Office of Public Finance	Lease revenue bonds are appropriately used to finance capital projects that (1) have an identified budgetary stream for repayment (e.g., specified fees, tax receipts, etc.); (2) generate project revenue but rely on a broader pledge of general fund revenues to reduce borrowing costs; or (3) finance the acquisition and installation of equipment for the City's general governmental purposes.	The Board of Supervisors must hold a minimum of one public hearing to place the lease revenue bond measure on the ballot. Subsequent to successful passage and prior to any issuance of new money or refunding lease revenue bonds, the Board of Supervisors will approve, by majority vote, a resolution authorizing such issuance. All new money lease revenue bonds will be approved by 50 percent plus one of the voters voting in the election. No statutory restriction exists on the amount of Lease Revenue Bonds that can be outstanding at any given time.

Table 7-2: Local and Federal Financial Resources for Hazard Mitigation

Type	Subtype	Administrator	Purpose	Amount/Availability
Local (cont.)	Certificates of Participation (COPs)	Mayor's Office of Public Finance	Used for acquisition of existing facilities or construction of new facilities that result, on a present value basis, in immediate or future savings in payments currently made or to be made by the City's general fund. For example, COPs may be used to provide funds to execute a lease purchase option for a facility through which future savings accrue, on a net present value basis, to the general fund during the period for which the COPs and the obviated lease would be outstanding.	COPs may consist of lease financing agreements between the City and a for-profit lessor. Issuances of COPs must be authorized by resolution of the Board of Supervisors by majority vote and must be validated by the Superior Court of San Francisco. COPs are not subject to voter approval, but are subject to validation.
	Public-Private Partnerships	Various Departments, City Administrator	Includes the use of professionals and professional associations for research and development of plans, guidance, recommendations, etc.	Project specific
	General Obligation Bond measures	RPD	RPD's plan for capital improvements is addressed through periodic General Obligation Bond measures that provide funding for major capital renovations to park properties. Voters have approved park bond measures in 2000, 2008, and 2012. Planning for capital improvements at sites included in these bond measures has addressed potential hazards, particularly seismic hazards, and has identified ways to mitigate them.	Project specific
	General Airport Revenue Bonds	SFO	Used for construction of SFO Capital Plan Projects, including improvements to facilities and infrastructure, health, safety and security enhancements, environmental mitigation, and seismic retrofits.	SFO specific

Table 7-2: Local and Federal Financial Resources for Hazard Mitigation

Type	Subtype	Administrator	Purpose	Amount/Availability
Federal	Hazard Mitigation Grant Program (HMGP)	Federal Emergency Management Agency (FEMA)	Support post-disaster mitigation plans and projects.	Available to California communities after a Presidentially-declared disaster has occurred in California. Grant award based on specific projects as they are identified.
	Pre-Disaster Mitigation (PDM) grant program	FEMA	Support pre-disaster mitigation plans and projects.	Available on an annual basis, nationally competitive grant. Grant award based on specific projects as they are identified. Mitigation projects have a $3M federal share cap. Planning projects have a $1M federal share cap.
	Flood Mitigation Assistance (FMA) grant program	FEMA	Mitigate repetitively flooded structures and infrastructure.	Available on an annual basis, distributed to California communities by the California Governor's Office of Emergency Services (Cal OES). Grant award based on specific projects as they are identified.
	Assistance to Firefighters Grant (AFG) Program	FEMA/USFA (U.S. Fire Administration)	Provide equipment, protective gear, emergency vehicles, training, and other resources needed to protect the public and emergency personnel from fire and related hazards.	Available to fire departments and nonaffiliated emergency medical services. Grant award based on specific projects as they are identified.
	Community Block Grant Program Entitlement Communities Grants	US HUD (U.S. Department of Housing and Urban Development)	Acquisition of real property, relocation and demolition, rehabilitation of residential and non-residential structures, construction of public facilities and improvements, such as water and sewer facilities, streets, neighborhood centers, and the conversion of school buildings for eligible purposes.	Available to entitled cities, including San Francisco. Grant award based on specific projects as they are identified.
	Community Action for a Renewed Environment (CARE)	U.S. Environmental Protection Agency (EPA)	Through financial and technical assistance, offers a way for a community to organize and act to reduce toxic pollution locally. Through CARE, a community creates a partnership that implements solutions to reduce releases of toxic pollutants and minimize human exposure.	Competitive grant program. Grant award based on specific projects as they are identified.

Table 7-2: Local and Federal Financial Resources for Hazard Mitigation

Type	Subtype	Administrator	Purpose	Amount/Availability
Federal (cont.)	Buffer Zone Protection Plan (BZPP)	FEMA	Infrastructure protection grant program to help local law enforcement and first responders identify and mitigate vulnerabilities at highest-risk critical infrastructure sites.	$5.2M was allocated to California in FY2010 to improve critical infrastructure security in selected jurisdictions.
	Clean Water State Revolving Fund (CWSRF)	EPA	A loan program that provides low-cost financing to eligible entities within state land for water quality projects, including all types of non-point source, watershed protection or restoration, estuary management projects, and more traditional municipal wastewater treatment projects.	Through CWSRF, the EPA has provided more than $5B annually to fund water quality protection projects for wastewater treatment, nonpoint source pollution control, and watershed and estuary management.
	Public Health Emergency Preparedness Cooperative Agreement	Department of Health and Human Services (HHS) Centers for Disease Control and Prevention (CDC)	Funds are intended to upgrade state and local public health jurisdictions' preparedness and response to bioterrorism, outbreaks of infectious diseases, and other public health threats and emergencies.	Competitive grant program. Grant award based on specific projects as they are identified.

Table 7-2: Local and Federal Financial Resources for Hazard Mitigation

Type	Subtype	Administrator	Purpose	Amount/Availability
	Homeland Security Preparedness Technical Assistance Program	FEMA/DHS	Build and sustain preparedness technical assistance activities in support of the four homeland security mission areas (prevention, protection, response, recovery) and homeland security program management.	Technical assistance services developed and delivered to state and local homeland security personnel. Grant award based on specific projects as they are identified.
	Airport Improvement Program (AIP)	Federal Aviation Agency (FAA)/Department of Transportation (DOT)	The AIP provides grants to public agencies, private owners and entities for the planning and development of public-use airports that are included in the National Plan of Integrated Airport Systems (NPIAS).	Airport-specific. FAA bases distribution of these funds on present national priorities and objectives. Typically, AIP funds are first apportioned into major entitlement categories such as primary, cargo, and general aviation. Remaining funds are distributed to a discretionary fund.
	Passenger Facility Charge (PFC)	FAA/DOT	The PFC Program allows collection of PFC fees for every boarded passenger at commercial airports controlled by public agencies. Airports use the fees to fund FAA-approved projects to enhance safety, security, or capacity; reduce noise; or increase air carrier competition.	Airport-specific. To be PFC eligible, projects must support the movement of passengers, cargo, and baggage.
Other	Grants	Private Foundations	In coordination with the Mayor's Office, convene CCSF departments to plan for adaptation to climate change, including sea level rise, heat, and water shortage.	To Be Determined

7.3 Legal and Regulatory Resources

Table 7-3 describes the legal and regulatory capabilities that affect or promote hazard mitigation, preparedness, response, and recovery in the Planning Area. Legal and regulatory capabilities include CCSF's plans, policies, and ordinances. The table provides the name, description, hazards identified, area of emergency management addressed, and effect on development in hazardous areas for each legal or regulatory capability.

Table 7-3: Local Legal and Regulatory Resources Available for Hazard Mitigation

Regulatory Tool	Name	Description (Effect on Hazard Mitigation)	Hazards Addressed	Mitigation, Preparedness, Response, or Recovery	Affects Development in Hazard Areas?
Plans	City and County of San Francisco, General Plan: Community Safety Element, 2012	Includes a comprehensive description of plans and programs aimed at addressing earthquake risk. Provides an overview of civic organizations and resources addressing mitigation, preparation, response, and recovery, including: Mitigation and preparedness: Medical emergencies and pandemics; preparedness strategies for builders, developers, and private homeowners; and the importance of retrofitting privately-owned and public buildings. Response: Communications and increased access to information; resumption of social services; access to capital; and the protection of vulnerable historic resources. Recovery and reconstruction: Recommendations for a Recovery and Reconstruction Plan to guide long-term recovery before an emergency, and necessary ordinances or code changes to facilitate repair and reconstruction after the disaster. Can be expanded to include additional hazards identified in the 2014 HMP.	Ground Shaking, Ground Failure, Liquefaction and Landslides, and Impacts of Future Earthquakes Inundation Hazards: Tsunami, Flooding. Reservoir Failure, Sea Level Rise	Mitigation & Preparedness Response Recovery & Reconstruction	Yes

Table 7-3: Local Legal and Regulatory Resources Available for Hazard Mitigation

Regulatory Tool	Name	Description (Effect on Hazard Mitigation)	Hazards Addressed	Mitigation, Preparedness, Response, or Recovery	Affects Development in Hazard Areas?
	City and County of San Francisco, Emergency Response Plan (ERP) (2009)	Provides a high level overview of how CCSF will respond to an emergency. The ERP also describes the role of the Emergency Operation Center (EOC), and the coordination that occurs between the EOC and City's departments and other response agencies. Additionally, the ERP describes how the EOC serves as the focal point among local, state, and federal governments in times of disaster. Annexes to this plan describe in more detail the actions required of CCSF departments, agencies, and personnel in addressing particular hazards or carrying out specific emergency functions. Can be expanded to address new hazards identified in the 2014 HMP.	Mentions the following as examples of hazards to which CCSF is particularly vulnerable to: Earthquake Tsunami Flood Winter Storm Terrorism / CBRNE	Response	No
	SFPUC Stormwater Management Plan (SWMP) (2004)	Describes measures the City will take to minimize stormwater pollution. The SWMP is required by the National Pollutant Discharge Elimination System Phase II regulations, which became effective in March 2003.	Stormwater	Mitigation & Preparedness	Yes
	Port of San Francisco Stormwater Management Plan (2003)	Describes measures the Port will take on Port property to minimize stormwater ponding and pollution.	Stormwater	Mitigation & Preparedness	Yes
	City and County of San Francisco Climate Action Plan (2004)	Describes measures the City can take to mitigate local greenhouse gas emissions and reduce impacts and vulnerabilities of San Francisco to sea level rise, resource price spikes and shortages, heat death, invasive vectors, and other impacts of global climate change.	Climate Change	Mitigation, Preparedness	Yes

Table 7-3: Local Legal and Regulatory Resources Available for Hazard Mitigation

Regulatory Tool	Name	Description (Effect on Hazard Mitigation)	Hazards Addressed	Mitigation, Preparedness, Response, or Recovery	Affects Development in Hazard Areas?
	Community Action Plan for Seismic Safety (CAPSS)	Provides DBI and other CCSF departments and policymakers with a plan of action for reducing earthquake risks in existing, privately-owned buildings regulated by DBI, and develops repair and rebuilding guidelines to expedite recovery after an earthquake. CAPSS is now being implemented through Earthquake Safety Implementation Program (ESIP), with initiatives including mandatory soft story retrofit, post-earthquake repair and retrofit standards, and development of a façade maintenance program.	Seismic	Mitigation	Yes
	SFO Tenant Improvement Guide (TIG)	TIG works to exceed minimum California Building Code standards by increasing building, facility, and fire protection safeguards at SFO for all new construction projects. Additionally TIG minimizes stormwater pollution through compliance with the SWMP and High Rise Sprinkler Ordinance.	Stormwater, Seismic, Fire	Mitigation and Preparedness,	Yes
Policies	City and County of San Francisco, Executive Order 10-02, Earthquake Safety Implementation Committee (ESIC)	Executive Order 10-02 directed the establishment of the ESIC under the aegis of the City Administrator to oversee the process of implementing the Community Action Plan for Seismic Safety (CAPSS) recommendations by creating the ESIC.	Seismic	Mitigation	Yes
	SFO Strategic Five Year Plan, Reaching for Number One Program	Describes measures SFO will take toward resource conservation and energy efficiency through standards set within the US Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED) program.	Energy disruption	Mitigation	Yes

Table 7-3: Local Legal and Regulatory Resources Available for Hazard Mitigation

Regulatory Tool	Name	Description (Effect on Hazard Mitigation)	Hazards Addressed	Mitigation, Preparedness, Response, or Recovery	Affects Development in Hazard Areas?
Ordinances	City and County of San Francisco, Building Code (2010), including California Residential Code (2010) and California Green Building Standards Code (2010)	Establishes minimum requirements to safeguard the public health, safety, and general welfare through structural strength, means of egress facilities, stability, access to persons with disabilities, sanitation, adequate lighting and ventilation, energy conservation, and safety to life and property from fire and other hazards attributed to the built environment; to regulate and control demolition of all buildings and structures, and the quarrying, grading, excavation, and filling of land; and to provide safety to fire fighters and emergency responders during emergency operations (Section 101.A.2). Specific chapters of the code that address hazards include: Chapter 7 – Fire and Smoke Protection Features Chapter 9 – Fire-Protection Systems Chapter 13 – Resource Conservation (Energy Efficiency) Chapters 16 – Structural Design Chapter 16B – Earthquake Hazard Reduction in Unreinforced Masonry Bearing (UMB) Wall Buildings: Required all owners of UMBs to retain a licensed civil structural engineer or architect to file a form with DBI to identify the “hazard class” of the building; required all owners of UMBs to seismically upgrade buildings by February 15, 2006. Chapter 16C – Seismic Strengthening Provisions for Unreinforced Masonry Bearing Wall Buildings	Seismic, Fire, Energy	Mitigation, Preparedness, and Response	Yes

Table 7-3: Local Legal and Regulatory Resources Available for Hazard Mitigation

Regulatory Tool	Name	Description (Effect on Hazard Mitigation)	Hazards Addressed	Mitigation, Preparedness, Response, or Recovery	Affects Development in Hazard Areas?
Ordinances (cont.)	Building Code (cont.)	Chapter 16D – Parapets and Appendages Chapter 34B – Mandatory Earthquake Retrofit of Wood-Frame Buildings: Establishes seismic retrofit requirements for existing wood-frame buildings with three or more stories, or two stories over a basement or underfloor area with any portion extending above grade, which contain five or more dwelling units and for which a permit for construction of a new building was applied for before January 1, 1978, or which is determined by DBI to have been originally constructed before January 1, 1978.			
	City and County of San Francisco, Administrative Code, Floodplain Management Program	Article XX, Section 2A.280 - 2A.285 – The Floodplain Management Ordinance adopted by CCSF, requires that new structures, substantial improvements to existing structures, and substantial damage repairs in designated flood prone areas be protected against flood damage at the time of initial construction; and prohibits certain land uses that would increase flood hazards.	Flooding	Mitigation	Yes
	City and County of San Francisco, Housing Code (2007; a new code will be issued as of January 1, 2014)	Provides for the maintenance of minimum requirements for the protection of life, limb, health, property, safety, and welfare of the general public and the owners and occupants of residential buildings in San Francisco (Section 102). Specific chapters that address hazards include: Chapter 6 – Structural Requirements Chapter 9 – Fire Protection Chapter 12 – Residential Energy Conservation	Seismic, Fire, Energy, Drought	Mitigation, Preparedness, and Response	Yes

Table 7-3: Local Legal and Regulatory Resources Available for Hazard Mitigation

Regulatory Tool	Name	Description (Effect on Hazard Mitigation)	Hazards Addressed	Mitigation, Preparedness, Response, or Recovery	Affects Development in Hazard Areas?
Ordinances (cont.)		Chapter 12A – Residential Water Conservation Chapter 13 – Maintenance, Sanitation and Repair			
	City and County of San Francisco, Fire Code (2010; a new code will be issued as of January 1, 2014)	Regulates and governs the safeguarding of life and property from fire and explosion hazards arising from the storage, handling, and use of hazardous substances, materials, and devices, and from conditions hazardous to life or property in the occupancy of buildings and premises; provides for the issuance of permits, inspections, and other Fire Department services, and the assessment and collection of fees for those permits, inspections, and services (Preface). Specific chapters of the code that address hazards include: Chapter 4 – Emergency Planning and Preparedness Chapter 9 – Fire Protection Systems Chapter 46 – Construction Requirements for Existing Buildings (including automatic sprinkler systems)	Fire	Preparedness, Mitigation	No
	City and County of San Francisco, Administrative Code	Chapter 66 – Seismic Safety Retrofit Program Chapter 66A – Seismic Safety Loan Program: Implements a program to lend taxable general obligation bond proceeds to building owners to finance the seismic retrofit of unreinforced masonry buildings.	Seismic	Mitigation	Yes
	City and County of San Francisco, Environmental Code	Chapter 9 – Greenhouse Gas Emissions Targets and Departmental Action Plans: Sets a Greenhouse gas emissions reduction schedule and mandates annual reporting; directs all departments to take all	Climate Change	Mitigation	No

Table 7-3: Local Legal and Regulatory Resources Available for Hazard Mitigation

Regulatory Tool	Name	Description (Effect on Hazard Mitigation)	Hazards Addressed	Mitigation, Preparedness, Response, or Recovery	Affects Development in Hazard Areas?
Ordinances (cont.)		reasonable measures; directs the Department of Environment to create a CCSF greenhouse gas emissions plan and track progress of City departments; directs the Planning Department to review the General Plan and make appropriate changes.			
	City and County of San Francisco, Health Code	Specific chapters that address hazards include: Article 2 – Communicable Diseases Article 21 – Hazardous Materials: Provides information on the location, type, and health risks of hazardous materials used, stored, or disposed of in the City to firefighters, health officials, planners, elected officials, and residents. Article 21A – Risk Management: Implements a program for prevention of accidental releases. Article 22 – Hazardous Waste Management: Regulates local facilities that generate or treat hazardous waste.	Pandemic Hazardous Materials	Preparedness & Response	No
	City and County of San Francisco, Public Works Code	Specific articles that address hazards include: Article 4 – Sewers: Article 4.2, Sewer System Management, protects and enhances sewer system water quality and stormwater collection by minimizing increases in pollution from stormwater runoff; by controlling discharges to the sewer and drainage systems from spills, dumping, or disposal of pollutants; and by reducing stormwater run-off rates, volume, and nonpoint source pollution through stormwater management controls.	Stormwater ponding; hazardous materials; climate change; landslides	Mitigation	Yes

Table 7-3: Local Legal and Regulatory Resources Available for Hazard Mitigation

Regulatory Tool	Name	Description (Effect on Hazard Mitigation)	Hazards Addressed	Mitigation, Preparedness, Response, or Recovery	Affects Development in Hazard Areas?
Ordinances (cont.)		Article 16 – Urban Forestry Ordinance: Promotes the planting and maintenance of trees and green spaces in public places to favorably modify microclimates, abate air and noise pollution, and reduce soil erosion and runoff.			
	City and County of San Francisco, Subdivision Code	Establishes procedures and requirements for control and approval of subdivision development within CCSF in accordance with California Subdivision Map Act (SMA); ensures the development of subdivisions consistent with the objectives of the San Francisco Master Plan.	Fire Traffic safety	Mitigation	Yes
	City and County of San Francisco, Police Code	Section 1.1 – Clipper Cove Special Use Area: Designates Clipper Cove as a Special Use Area, establishes Rules and Regulations for vessels and vessel operators within Clipper Cove, allows for enforcement by SFPD and TIDA, and for vessel removal by TIDA for violations, including but not limited to submerged vessels, vessels spilling or dumping materials into Clipper Cove, and vessels involved in illegal activities as defined by the San Francisco Police Code and the California Harbor and Navigation Code.	Hazardous materials	Mitigation and Response	No
	City and County of San Francisco, Port Building Code (2010) (new code to be issued as of January	Specific chapters that address hazards include: Chapter 7 – Fire Resistance Rated Construction Chapter 7A – Materials and Construction Methods For Exterior Wildfire Exposure Chapter 9 – Fire Protection Systems	Fire, Terrorism, Energy Disruption, Climate Change, Seismic, Hazardous	Preparedness & Mitigation	Yes Yes Yes

Table 7-3: Local Legal and Regulatory Resources Available for Hazard Mitigation

Regulatory Tool	Name	Description (Effect on Hazard Mitigation)	Hazards Addressed	Mitigation, Preparedness, Response, or Recovery	Affects Development in Hazard Areas?
Ordinances (cont.)	1, 2014)	Chapter 10A – Security Systems Chapter 13 – Resource Conservation Chapter 13A – Commercial Water Conservation Chapter 16 – Structural Design Chapter 31F – Marine Oil Terminals	Materials		Yes Yes No Yes No

7.4 Mitigation Projects and Programs

Table 7-4 describes current, ongoing, and completed large-scale mitigation projects and programs implemented by CCSF. For this capability assessment, current projects are those that are being implemented now and in the near term. Ongoing projects are those that have been implemented and continue to be implemented over an extended period of time, defined as 10 years or more. Because CCSF has implemented numerous mitigation projects and programs, only mitigation projects and programs for essential facilities and infrastructure, and residential buildings are included in this table. The table includes the type of facility or infrastructure mitigated, a brief description of the project, and a timeframe for each project or program identified.

Table 7-4: Local Current, Ongoing, and Completed Hazard Mitigation Projects and Programs

Status	Essential Facilities and Infrastructure, Private Buildings	Description	Year(s)
Current	Essential Facilities and Infrastructure	San Francisco General Hospital (SFGH) Seismic Rebuild In 2008, San Francisco voters approved a bond measure to rebuild SFGH to comply with seismic safety standards required by Senate Bill 1953, an amendment to the Alfred E. Alquist Hospital Seismic Safety Act of 1983 (Alquist Act). Construction work began in 2009 on a 453,000 square-foot, base-isolated building that will be able to glide 30 inches in any direction. The new building houses 284 beds, a 32-bed increase. Emergency Department beds will increase from 27 to 60; operating rooms will increase from 10 to 14.	To be completed by 2015
		See Ongoing Projects and Programs, SFPUC Water System Improvement Plan and Sewer System Improvement Plan	
		San Francisco International Airport (SFO) Air Traffic Control Tower Replacement Project SFO has begun construction of a new seismically-advanced air traffic control tower to ensure airport operation after a major earthquake. The seismic design for the new tower allows the structure to withstand a magnitude 8 earthquake. The top of the tower has also been designed not to sway with wind loads, to ensure better comfort for air traffic controllers.	To be completed in 2015 To be completed

Table 7-4: Local Current, Ongoing, and Completed Hazard Mitigation Projects and Programs

Status	Essential Facilities and Infrastructure, Private Buildings	Description	Year(s)
Current (cont.)	Essential Facilities and Infrastructure (cont.)	SFO Shoreline Protection Feasibility Study Based on preliminary Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) done as part of the National Flood Insurance Program (NFIP), nearly the entire Airport is designated as Special Flood Hazard Area (SFHA) Zone A, subject to inundation by the one percent annual chance flood, or base flood. The Shoreline Protection Feasibility Study provides an assessment of existing shoreline protection measures and makes recommendations for new shoreline protection measures to protect SFO property from the one percent annual chance floods and from interim sea level rise. SFO Terminal 3 Improvement Projects This project will result in seismic upgrades to SFO Terminal 3 to prevent structure performance failure in a major earthquake. Improvements to the east side of the terminal will bring it into compliance with the latest life safety and building code requirements, will improve the terminal's energy efficiency, and will extend its useful life another 40 years. SFO Runway Safety Area (RSA) Enhancement Under the RSA enhancement project, required under Public Law 109-115, SFO is reconfiguring all four runways, constructing new taxiways leading to the new runway thresholds, relocating Federal Aviation Administration (FAA) navigational landing instrument systems, and constructing four engineered material arresting systems to protect passengers and aircraft in the event of an aircraft overshooting or overrunning a runway.	in 2015 To be completed in 2014 To be completed in 2015
	Private Buildings	Unreinforced Masonry Building (UMB) Retrofit Program Provides $350M in bonds to retrofit privately owned UMBs. The program is administered by the Department of Building Inspection and is designed to minimize the displacement of residents and commercial tenants after a disaster.	1992 – present

Table 7-4: Local Current, Ongoing, and Completed Hazard Mitigation Projects and Programs

Status	Essential Facilities and Infrastructure, Private Buildings	Description	Year(s)
Ongoing	Essential Facilities and Infrastructure, Private Buildings	San Francisco Unified School District (SFUSD) Capital Improvements Safety and modernization upgrades and improvements to 47 school sites, including the design and construction of a new middle school in the Bayview District.	2010 - 2019
		Port Capital Plan Identifies a total of approximately $2.2 billion for maintenance and seismic upgrade work required on Port facilities, including rehabilitation and redevelopment of the Pier 70 area; security upgrades to the Pier 27 cruise terminal; substructure repair and seismic improvements to the Pier 35 cruise terminal; replacement of the Wharf J-9 seawall; and repairs and seismic upgrades to Piers 9, 19, 23, 33, and 50. San Francisco Stormwater Design Guidelines The SFPUC and the Port partnered to develop the Guidelines, which implement the San Francisco Stormwater Management Ordinance. The Guidelines require new development and redevelopment disturbing 5,000 square feet or more of ground surface to manage stormwater on-site using low impact design (LID) strategies such as vegetated roofs, swales, rainwater harvesting, and rain gardens. The Guidelines protect CCSF by reducing the wet weather burden on its combined sewer, and by reducing pollution in stormwater runoff in areas of new development and redevelopment.	2012-2031 Ongoing since 2010
		Earthquake Safety Implementation Program (ESIP) ESIP is a 30-year plan to implement the recommendations of the CAPSS study, completed in 2010. Because of the likelihood of an earthquake in the near future, ESIP began with implementation of the Mandatory Soft Story Retrofit Ordinance, a major effort to address the likely failure of many of San Francisco's larger soft-story apartment buildings. Other plan elements that are underway or already completed include a study of the earthquake safety of CCSF's private schools, enacting standards for repair and retrofit of structures after an earthquake, and assisting in adoption of an update to the Community Safety Element of the City's General Plan.	2012 - 2042

Table 7-4: Local Current, Ongoing, and Completed Hazard Mitigation Projects and Programs

Status	Essential Facilities and Infrastructure, Private Buildings	Description	Year(s)
Ongoing (cont.)	Essential Facilities and Infrastructure, Private Buildings (cont.)	Earthquake Safety and Emergency Response (ESER) Bond Program The ESER Bond Program is a program to seismically repair and enhance CCSF's aging emergency response infrastructure and enhance our emergency response. The ESER Program has three components: the Public Safety Building (PSB), Neighborhood Fire Stations and Support Facilities (NFS), and the Auxiliary Water Supply System (AWSS). The PSB project will provide a replacement facility for the SFPD Headquarters and the Southern District Police Station. The NFS Project will seismically retrofit and make other necessary health and safety improvements to ensure selected fire stations are fully functional after a major earthquake. The AWSS project will improve and seismically upgrade the AWSS, the high-pressure water system used by firefighters to fight fires.	PSB completion: 2014 NFS completion: 2017 AWSS completion: 2018
		CCSF Participation in National Flood Insurance Program (NFIP) In 2008, CCSF applied to join the NFIP, and adopted a floodplain management ordinance governing new construction and requiring substantial improvements to existing buildings in flood-prone areas. The ordinance designates the City Administrator's Office as the City's Floodplain Administrator. FEMA approved San Francisco's application for participation in the NFIP in April 2010. The City is working with FEMA to develop Flood Insurance Rate Maps (FIRMs) for CCSF. For further discussion of CCSF participation in NFIP, see Section 5.3.2.2.	Ongoing since 2010
		Water System Improvement Program (WSIP) (formerly known as the Capital Improvement Program (CIP)) WSIP is a $4.6 billion, 81-project program undertaken by the SFPUC to reduce the vulnerability of the CCSF water system to damage from earthquakes, to increase system reliability to deliver water by providing the redundancy needed to accommodate outages, to make improvements related to water supply-drought protection, and to enhance sustainability by optimizing protection of the natural and human environment. Over two-thirds of WSIP projects have been completed. Projects include the Calaveras Dam Replacement Project, and replacing the Bay Division Pipeline System (BDPL), a five-mile-long tunnel under San Francisco Bay.	2010 - 2017

Table 7-4: Local Current, Ongoing, and Completed Hazard Mitigation Projects and Programs

Status	Essential Facilities and Infrastructure, Private Buildings	Description	Year(s)
Ongoing (cont.)	Essential Facilities and Infrastructure, Private Buildings (cont.)	SFPUC Sewer System Improvement Program (SSIP) SSIP is a 20-year, multi-billion dollar investment by SFPUC to upgrade aging sewer infrastructure in San Francisco to ensure a reliable, seismically safe sewer system. The SSIP upgrades CCSF's grey infrastructure for reliability and regulatory compliance and implements green infrastructure projects to protect the health of our community and environment. The program is to be implemented in three phases over the next 20 years.	2012 - 2032
		National Weather Service (NWS) TsunamiReady and StormReady Status To achieve TsunamiReady and StormReady status, San Francisco County incorporated severe weather threats into the CCSF 2008 HMP and the 2009 CCSF Emergency Response Plan; maintains a 24-hour warning point and an emergency operations center; established multiple ways to receive severe weather warnings and forecasts and to alert the public; created a system to monitor weather conditions locally; and promoted public readiness through community seminars, severe weather spotter training, and by conducting emergency exercises. In addition, San Francisco International Airport became a NWS StormReady Commercial Site in 2009, and a TsunamiReady Commercial Site in 2013.	2008, 2011, and ongoing 2009, 2013, and ongoing
Complete	Essential Facilities and Infrastructure	San Francisco Unified School District (SFUSD) Capital Improvements Substantial capital improvements to 59 school sites, including addressing safety and modernization needs. Critical Infrastructure Buffer Zone Implemented Buffer Zone Protection measures for three critical facilities.	2003 - 2010 2010 - 2013
		SFO Upper Viaduct Seismic Retrofit As a part of the Caltrans Seismic Retrofit program, the SFO Terminal upper level viaduct was retrofitted to “no collapse, minimal damage.” See Ongoing Projects and Programs, Port of San Francisco Capital Plan See Ongoing Projects and Programs, SFPUC Water System Improvement Plan and Sewer System Improvement Plan	Completed in 2011

Table 7-4: Local Current, Ongoing, and Completed Hazard Mitigation Projects and Programs

Status	Essential Facilities and Infrastructure, Private Buildings	Description	Year(s)
Complete (cont.)	Essential Facilities and Infrastructure, Private Buildings	Community Action Plan for Seismic Safety (CAPSS) Project A nine-year, $1 million study undertaken by the Department of Building Inspection (DBI) to understand, describe, and suggest strategies for mitigation of the risk to San Francisco from earthquakes. The CAPSS report provided an extensive analysis of potential seismic impacts and community-supported recommendations for mitigating those impacts. The CAPSS Project has culminated in the formation of the Earthquake Safety Implementation Committee (ESIC) under the City Administrator's Office, which in 2011 created the Earthquake Safety Implementation Program (ESIP) to implement the CAPSS (see Ongoing Programs, above).	Completed in 2010

Section 8: Mitigation Strategy

The mitigation strategy is the heart of a local hazard mitigation plan: It represents the blueprint chosen by the jurisdiction to reduce or prevent losses stemming from the hazards identified in the risk assessment. As required by the federal regulations implementing the Stafford Act, the mitigation strategy consists of the following steps:

- Updating local hazard mitigation goals.
- Reviewing and updating the 2008 HMP mitigation implementation strategy.
- Identifying new and updated mitigation actions.
- Prioritizing 2014 HMP mitigation actions.
- Implementing the 2014 HMP mitigation action plan.

8.1 Update of Local Hazard Mitigation Goals

The requirements for developing local hazard mitigation goals, as provided in the federal regulations implementing the Stafford Act as amended, are described below.

FEMA REGULATION CHECKLIST: MITIGATION STRATEGY

Local Hazard Mitigation Goals

44 CFR § 201.6(c)(3)(i): The plan shall include a "description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards."

Element

C3. Does the Plan include goals to reduce or avoid long-term vulnerabilities to identified hazards? 44 CFR § 201.6(c)(3)(i).

Source: FEMA, *Local Mitigation Plan Review Tool*, March 2013.

Mitigation goals are defined as general guidelines that explain what a community wants to achieve in terms of hazard and loss mitigation. Goals provide a framework for identifying, prioritizing, and implementing actions to reduce a community's risk to hazards. Typically, goal statements are broad, policy-oriented statements representing a long-term, community-wide vision. Table 8-1 below, sets forth the updated mitigation goals adopted by the Planning Team to reduce CCSF's vulnerability to hazards profiled in this plan. During the 2014 plan update process, the mitigation goals were modified slightly for clarity and to incorporate additional hazards covered in the 2014 HMP.

Table 8-1: Mitigation Goals

Goal Number	Goal Description
1	Implement disaster-resistant measures in San Francisco's existing and future built environment.
2	Build and support local capacity to enable the City government and the greater San Francisco community to prepare for, respond to, and recover from disasters.
3	Reduce the possibility of damages and losses due to seismic hazards, including ground shaking,

Table 8-1: Mitigation Goals

Goal Number	Goal Description
	ground failure, and tsunami.
4	Reduce the possibility of damages and losses due to weather-related hazards, including drought, flood, heat, landslide, wind, and climate change.
5	Reduce the possibility of damages and losses due to other hazards, including pandemic, reservoir failure, wildfire, urban conflagration, and human-caused hazards.

8.2 Review of 2008 HMP Mitigation Implementation Strategy

The requirements for reflecting progress in local mitigation efforts, as provided in the federal regulations implementing the Stafford Act, are described below.

FEMA REGULATION CHECKLIST: PLAN REVIEW AND REVISION

Progress in Local Mitigation Efforts

44 CFR § 201.6(c)(d)(3): "A local jurisdiction must review and revise its plan to reflect . . . progress in local mitigation efforts . . . ."

Element

D2. Was the Plan revised to reflect progress in local mitigation efforts? 44 CFR § 201.6(d)(3).

Source: FEMA, *Local Mitigation Plan Review Tool*, March 2013.

During the 2014 HMP update process, the Planning Team reviewed the 2008 HMP mitigation implementation strategy and provided updates on the status of each project selected for implementation. Table 8-2, below, contains the results of this review, which shows the progress made by CCSF over the last five years in implementing the strategies selected in 2008. The table indicates for each project whether it was completed, deleted, delayed, or is ongoing. The table also specifies a completion date for projects that were delayed or are ongoing.

Table 8-2: Review of 2008 HMP Mitigation Implementation Strategy			
Action Number	**Description**	**Administering Department**	**Status**
1.A	Create a coordinated geographic information system (GIS)-based pre-application review for new construction and major remodels in hazard areas, such as liquefaction, lateral spread, landslide, or Special Flood Hazard Area (SFHA) zones.	Planning Department, Department of Building Inspection (DBI)	Project delayed due to late selection of software vendor. Anticipated completion date: 8/2014. With "rollout" of new DBI-Planning "joint" computer systems, GIS hazard information will be tied to Assessor's Parcel Numbers (APNs), so it will appear when one looks up an APN.
2.B	Inventory and develop replacement values for all City-owned assets to help the City better understand the values of assets at risk.	Capital Planning Program (CPP) and Risk Management Division	Project delayed due to lack of resources. Anticipated completion date: 2018.
2.C	Replace and/or seismically retrofit the Auxiliary Water Supply System (AWSS) infrastructure to ensure that emergency water is available during a disaster (multi-part project).	San Francisco Public Utilities Commission (SFPUC), Department of Public Works (DPW)	Project on schedule. Anticipated completion date: 2016 through 2018.
2.D	Conduct structural assessment for and develop and implement plans to seismically retrofit or replace City-owned bridges and other critical street structures that are categorized as structurally deficient by Caltrans and are necessary for first responders to use during an emergency.	DPW	Project on schedule. Islais Creek anticipated completion date: 6/2016. 3rd Street Bridge anticipated completion date: 6/2016. 20% Assessment Complete (100% 2017) 15% Plan Complete (100% 2018)
3.A	Develop a Soft Story Seismic Retrofit program that provides financing programs to seismically retrofit soft-story buildings in San Francisco.	DBI, Earthquake Safety Implementation Program (ESIP)	Project on schedule: Soft Story Legislation adopted on 4/18/2013, operative as of 6/17/2013. Anticipated completion date: 2042.
3.B	Implement industry guidelines and building codes developed by the Pacific Earthquake Engineering Research (PEER) Center Tall Building Initiative.	University of California, Berkeley (DBI was involved in preliminary discussions, only)	Project completed: PEER Report issued in 11/2010. DBI uses PEER Report in initial structural assessment of tall buildings before designs are submitted for permitting.

Table 8-2: Review of 2008 HMP Mitigation Implementation Strategy			
Action Number	**Description**	**Administering Department**	**Status**
3.H	Seismically upgrade Treasure Island Causeway, which is a critical lifeline access to the island, and protect the utility corridor that runs under the causeway.	Treasure Island Development Authority (TIDA)	Project delayed to coordinate with schedule of infrastructure improvements planned under Disposition and Development Agreement (DDA) between TIDA and Treasure Island Community Development (TICD). Anticipated completion date: 2017.
3.I	Seismically retrofit or upgrade major Recreation and Parks Department (RPD) facilities and those identified as potential shelters.	RPD	Project delayed due to lack of resources. Anticipated completion date: 2018.
4.A	Upon joining the National Flood Insurance Program (NFIP), implement the floodplain management ordinance for existing and new development in the SFHA (identify structures or parcels located in the SFHA, incorporate elevation requirements into the development of a permitting process for new or substantially improved properties, and prepare Elevation Certificates when necessary).	Planning, City Administrator	Implementation of project completed.
4.D	Stabilize cliffs susceptible to sliding and failure through bolts, soft netting, and vegetation stabilization methods.	RPD, DPW	Project completed.
4.E	Develop and implement beach-nourishment projects for San Francisco beaches affected by beach erosion caused by strong El Niños.	DPW, SFPUC, San Francisco Public Urban Research Association (SPUR)	Project completed, though monitoring is ongoing.
4.F	Develop and implement a stormwater systems upgrade to better accommodate stormwater and reduce stormwater ponding and localized flooding.	SFPUC	Project delayed: In initial planning and scoping phase. Anticipated completion date: 2020.

Table 8-2: Review of 2008 HMP Mitigation Implementation Strategy			
Action Number	**Description**	**Administering Department**	**Status**
4.I	Build ring levees or berm improvements around drainage pump houses (localized flood control projects) to specifically protect pumps, which are critical elements in the island's flood control system. This element of construction is separate from the larger flood control project on the island.	TIDA	Project delayed to coordinate with schedule of infrastructure improvements planned under DDA between TIDA and TICD. Anticipated completion date: 2025.
5.A	Develop a public outreach and awareness program about heat and human health. Ideas include media announcements, buddy system, heat line, increased emergency medical staff, home visits to the elderly, cooling stations, outreach visits to the homeless, etc.	Department of Public Health (DPH), Human Services Agency	Project on schedule.
5.C	Provide an annual training class and exercise for the Pacific Coast Federation of Fishermen's Association San Francisco fishing fleet to be trained/retrained in boom deployment and oil cleanup.	San Francisco Department of Emergency Management (DEM)	Training for commercial fisherman is a responsibility of the California Office of Spill Prevention and Response (OSPR) under California Government Code § 8670.8(a).
5.D	Implement recommended Buffer Zone Protection measures for pre-designated critical facilities and infrastructure.	DEM	Project completed.

8.3 Identification of New and Updated Potential Mitigation Actions

The requirements for identifying and analyzing a comprehensive range of specific mitigation actions and projects, as provided in the regulations implementing the Stafford Act, are described below.

FEMA REGULATION CHECKLIST: MITIGATION STRATEGY

Identification and Analysis of Mitigation Actions

44 CFR § 201.6(c)(3)(ii): The mitigation strategy shall include "a section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.

Elements

C4. Does the Plan identify and analyze a comprehensive range of specific mitigation actions and projects for the jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? See 44 CFR § 201.6(c)(3)(ii).

Source: FEMA, *Local Mitigation Plan Review Tool*, March 2013.

Mitigation actions are specific activities, projects, measures, or processes that a community can take to reduce or eliminate risk to people and property from hazards. Mitigation actions are usually grouped into four broad categories: local plans and regulations, structure and infrastructure projects, natural systems protection, and education and awareness programs.

As part of the plan review process, the Planning Team developed new mitigation strategies based on the list of potential mitigation strategies from the 2008 HMP, the 2014 HMP vulnerability analysis, the revised and updated capability assessment, and the status of implementation strategies selected in 2008.

As listed in Table 8-3, the Planning Team developed 44 potential mitigation actions. For each mitigation action, the following information is listed: type of mitigation project; hazard(s) addressed; type of development affected by action; and the source of the mitigation project idea.

Table 8-3: New and Updated Potential Mitigation Actions

Goal	Action #	Action Description	Mitigation Type	Hazard(s) Addressed	Existing or New Development	Project Idea Source
Goal #1: Implement disaster-resistant measures in San Francisco's existing and future built environment.	1.A	Create a joint Planning Department (Planning)-Department of Building Inspection (DBI), geographic information system (GIS)-based pre-computer system tying hazard areas such as liquefaction, lateral spread, landslide, or Special Flood Hazard Area (SFHA) to Assessor's Parcel Numbers (APNs) for new construction and major remodels in those areas.	Property Protection	Seismic, Flood, Landslide	New and Existing	HMP Planning Team
	1.B	Improve and maintain critical infrastructure identified under the Earthquake Safety and Emergency Response (ESER) Bond Program, the Justice Facility Improvement Program, and the Public Health Facilities Improvement Program.	Prevention, Property Protection	All	New and Existing	Capital Planning Program (CPP)
	1.C	Implement Auxiliary Water Supply System (AWSS) Planning Study recommendations to rehabilitate the system, seismically brace weak pipes and cisterns, construct new cisterns, and make other improvements to ensure its continued operation after a disaster.	Structural Project	Seismic	Existing	CPP
	1.D	Seismically retrofit or replace CCSF-owned bridges, tunnels and other critical street structures that are necessary for first responders to use during an emergency.	Structural Project	Seismic	Existing	CPP
	1.E	Continue to implement the 50 tasks identified in the 30-year Earthquake Safety Implementation Program (ESIP).	Prevention, Property Protection	Seismic	New and Existing	Community Action Plan for Seismic Safety (CAPSS)

Table 8-3: New and Updated Potential Mitigation Actions

Goal	Action #	Action Description	Mitigation Type	Hazard(s) Addressed	Existing or New Development	Project Idea Source
Goal #1 (cont.)	1.F	Evaluate risks and implement geotechnical/structural stabilization plans and measures to protect network of structures and utilities (including seawall, Embarcadero Roadway, and Promenade) along the San Francisco Waterfront from seismic or liquefaction hazards.	Structural/ Geotechnical	Seismic	New and Existing	Port of San Francisco (Port)
	1.G	Implement lifelines interdependency recommendations to identify critical dependencies, single point of failures and ensure continuity of operations in post-disaster response and recovery.	Prevention, Property Protection	Seismic	New and Existing	CPP
Goal #2: Build and support local capacity to enable the City government and the greater San Francisco community to prepare for, respond to, and recover from disasters.	2.A	Refine inventory and/or develop replacement values for all CCSF-owned facilities and their content to help CCSF better understand the values of assets at risk.	Property Protection	All	Existing	Risk Management (RM)
	2.B	Ensure the structural and non-structural safety and security of the San Francisco Data Centers, fiber optics, and related communications and data infrastructure to ensure that the City's data processing and communication functions are operable during and after a disaster.	Structural Project	All	Existing	Department of Technology (DT)
	2.C	Draft and implement a citywide energy assurance plan for critical assets to ensure post-disaster operability.	Emergency Services	Energy Emergency	Existing	CPP
	2.D	Implement the use of solar and energy storage to power electrical backup systems such as communications systems, city government fuel stations, water filtration systems, and water supply stations.	Emergency Services	Energy Emergency, Climate Change	New	Department of Environment (DOE)

Table 8-3: New and Updated Potential Mitigation Actions

Goal	Action #	Action Description	Mitigation Type	Hazard(s) Addressed	Existing or New Development	Project Idea Source
Goal #2 (cont.)	2.E	Create Neighborhood Support Centers that serve as designated, pre-event, neighborhood-level communication and recovery activity hubs.	Emergency Services	All	New	CAPSS
	2.F	Develop criteria for high-priority neighborhoods where microgrids can provide a strategic and critical difference for community energy emergency resilience. Identify up to 10 neighborhoods and specific areas for development of microgrids. Develop an implementation plan and funding plan for each microgrid.	Emergency Services	Energy Emergency, Climate Change	New	DOE
Goal #3: Reduce the possibility of damages and losses due to seismic hazards, including ground shaking, ground failure, and tsunami.*	3.A	Continue to hold workshops and advance implementation of the Mandatory Soft Story Retrofit Ordinance.	Property Protection, Public Education	Seismic	Existing	General Services Agency (GSA)
	3.B	Relocate the Office of Chief Medical Examiner to a seismically safe facility of about 45,000 square feet.	Property Protection, Structural	Seismic	Existing and New	CPP
	3.C	Retrofit General Hospital Building 5 to ensure functionality of critical clinics.	Property Protection, Structural	Seismic	Existing	CPP
	3.D	Relocate the San Francisco Police Department (SFPD) Forensic Services and Traffic Company to a seismically safe, 105,000 square foot building.	Property Protection, Structural	Seismic	Existing and New	CPP
	3.E	Provide Animal Care and Control with a seismically safe, improved operational facility.	Property Protection, Structural	Seismic	Existing and New	GSA
	3.F	Seismically upgrade Kezar Pavilion to ensure the safety of staff and patrons.	Property Protection, Structural	Seismic	Existing	Recreation and Parks Department (RPD)

Table 8-3: New and Updated Potential Mitigation Actions

Goal	Action #	Action Description	Mitigation Type	Hazard(s) Addressed	Existing or New Development	Project Idea Source
Goal #3 (cont.)	3.G	Implement geotechnical stabilization measures to protect Treasure Island from seismic hazards.	Property Protection, Structural	Seismic	Existing and New	Treasure Island Development Agency (TIDA)
	3.H	Seismically upgrade Treasure Island Causeway to preserve critical lifeline access to the island and to protect the utility corridor that runs under the causeway.	Structural Project	Seismic	Existing	TIDA
	3.I	Continue to develop the Business Occupancy Resumption Program (BORP) program for critical CCSF facilities and privately-owned buildings, and expand BORP to more buildings in CCSF, as appropriate.	Property Protection	Seismic	New	CPP
	3.J	Continue to use FEMA-developed HAZUS and similar models and tools to guide emergency and capital planning decisions.	Structural	Seismic	New	CPP
	3.K	Update or assign an additional 50 Seismic Hazard Ratings to city-owned buildings using CCSF's rating system.	Structural	Seismic	New	CPP
	3.L	Continue to Implement geotechnical stabilization measures to protect runways and taxiways from seismic hazards.	Structural/ geotechnical	Seismic	New and Existing	Association of Bay Area Governments (ABAG)
	3.M	Seismically upgrade Terminal B at San Francisco International Airport (SFO) to current seismic building codes.	Structural Project	Seismic	Existing	Capital Plan
	3.N	Seismically retrofit or upgrade seismically deficient RPD facilities and shelters.	Structural Project	Seismic	Existing	RPD

Table 8-3: New and Updated Potential Mitigation Actions

Goal	Action #	Action Description	Mitigation Type	Hazard(s) Addressed	Existing or New Development	Project Idea Source
Goal #4: Reduce the possibility of damages and losses due to weather-related hazards, including drought, flood, heat, landslide, wind, and climate change.	4.A	Work closely with FEMA to implement the preliminary Flood Insurance Rate Map (FIRM) (estimated completion in 2014) and the final FIRM (estimated completion in 2015). Continue to adhere to all NFIP requirements.	Prevention, Property Protection	Flood	Existing and New	Port/City Administrator
	4.B	Implement Phase I of the Sewer System Improvement Program (SSIP), including Low Impact Development (LID) projects, and conduct public outreach and Urban Watershed Seminars in the eight urban watershed areas of CCSF. Publish watershed design tools and website resources devoted to green infrastructure.	Public Education, Natural Resources Protection	Flood	Existing	San Francisco Public Utilities Commission (SFPUC)
	4.C	Reinforce existing Port sea walls and/or build new levees and sea walls as needed to address rising sea levels.	Property Protection	Flood, Climate Change	Existing	Port
	4.D	Develop and implement a stormwater systems upgrade to better accommodate stormwater and reduce stormwater ponding and localized flooding over the next 20 years.	Prevention	Flood	Existing	SFPUC
	4.E	Continue the Great Highway Long-Term Stabilization program to respond to continuing beach erosion impacts along the Great Highway at Ocean Beach south of Sloat Boulevard.	Prevention	Coastal Erosion, Climate Change	Existing	CPP
	4.F	Carry out hydrology/hydraulic studies to determine the feasibility of the proposed perimeter flood protection.	Property Protection	Flood	Existing and New	HMP Planning Team
	4.G	Build ring levees around the drainage pump houses (localized flood control projects) to specifically protect the pumps, which are	Property Protection	Flood	New	TIDA

Table 8-3: New and Updated Potential Mitigation Actions

Goal	Action #	Action Description	Mitigation Type	Hazard(s) Addressed	Existing or New Development	Project Idea Source
Goal #4 (cont.)		critical elements in the island's flood control system.				
	4.H	Develop a public outreach and awareness program about heat and human health. Ideas include media announcements; public information about heat effects and cooling centers; outreach visits to the elderly, homeless, and other vulnerable populations; community resilience efforts; etc.	Public Education	Heat	N/A	DEM
	4.I	Upgrade segments of the SFO shoreline protection system that do not meet regulatory freeboard requirements when compared to the one-percent-annual-chance stillwater elevation. Address gaps in the system that could allow the entry of floodwater; and address openings for stormwater drainage that do not have closure devices, which could allow the entry of floodwaters. Upgrade seawalls to address sea level rise.	Property Protection	Flood	Existing	SFO/FEMA/San Francisco Bay Conservation and Development Commission (BCDC)
	4.J	Implement a wildland-urban interface conflagration fuel reduction program, such as collecting and disposing of dead fuel, within parks and open spaces.	Prevention, Natural Resources Protection	Wildfire, Urban Conflagration	Existing and New	HMP Planning Team
	4.K	Implement staged wetland retreat to maintain wetlands as a natural habitat and as a buffer against extreme weather events and sea level rise in order to protect inland property.	Natural Resources Protection, Property Protection	Flood, Climate Change, Tsunami	Existing and New	DOE
	4.L	Perform annual maintenance of the Crystal Springs, Calaveras, and San Antonio	Prevention	Wildfire	Existing	SFPUC

Table 8-3: New and Updated Potential Mitigation Actions

Goal	Action #	Action Description	Mitigation Type	Hazard(s) Addressed	Existing or New Development	Project Idea Source
Goal #4 (cont.)		watersheds to construct fire breaks, mow areas of grass, and clear around assets to prevent wildfire damage and mitigate wildfire hazards.				
	4.M	Upgrade storm drainage outfall pump stations 1A, 1B, and 1C to protect SFO's airfield from 100-year floods and sea level rise.	Property Protection	Flood	Existing	Capital Plan
Goal #5: Reduce the possibility of damages and losses due to other hazards, including pandemic, dam and reservoir failure, urban conflagration, and human-caused hazards.	5.A	Complete the Calaveras Dam retrofit, as part of the Water System Improvement Program (WSIP).	Structural Project	Seismic, Dam and Reservoir Failure	Existing	SFPUC
	5.B	Implement recommended Buffer Zone Protection measures for predesignated critical facilities and infrastructure.	Prevention	WMD/ Terrorism	Existing	Northeast States Emergency Consortium
	5.C	Develop and implement a public outreach campaign to educate property owners, and to enable removal of household hazardous waste from homes and businesses to prevent toxic spills, fires, environmental exposure and health hazards in case of disaster.	Prevention	Hazardous Material Event	Existing	DOE
	5.D	Implement physical security upgrades at all new WSIP facilities.	Prevention	WMD/ Terrorism	New	HMP Planning Team

* "Seismic" as listed in the "Hazard(s) Addressed" category of this table refers to both ground shaking and ground failure (earthquake-induced landslide, liquefaction, and lateral spread), unless otherwise noted.

8.4 Prioritization of 2014 HMP Mitigation Actions

The requirements for prioritization of mitigation actions, as provided in the federal regulations implementing the Stafford Act as amended by DMA 2000, are described below.

FEMA REGULATION CHECKLIST: MITIGATION STRATEGY; PLAN REVIEW AND REVISION

Implementation of Mitigation Actions

44 CFR § 201.6(c)(3)(iii): The mitigation strategy section shall include "an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs."

Element

C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost-benefit review), implemented, and administered by the jurisdiction? 44 CFR § 201.6(c)(3)(iii).

Plan Review and Revision

44 CFR § 201.6(d)(3): "A local jurisdiction must review and revise its plan to reflect . . . changes in priorities . . . ."

Element

D3. Was the plan revised to reflect changes in priorities? 44 CFR § 201.6(d)(3).

Source: FEMA, *Local Mitigation Plan Review Tool*, March 2013.

Note: **For coverage of Element C6, integration of the action plan, see Section 9.2, below.**

After developing the list of potential mitigation actions set forth in Table 8-3 above, the 2014 Planning Team reviewed and revised the evaluation criteria utilized in 2008 to reflect changes in CCSF priorities. In revising the 2008 evaluation criteria, Planning Team considerations included the level of public or political support for potential strategies, their technical feasibility, cost versus benefit, life safety, and community resiliency. The Planning Team chose the following evaluation criteria:

1. Ability to reduce expected future damages and losses (cost-benefit).
1. Ability to be implemented during the five-year lifespan of the 2014 HMP.
2. Current or potential support from the public, the Mayor, or the San Francisco Board of Supervisors.
3. Local department or agency champion.
4. Increased resiliency of the City and its residents.

The Planning Team then used the revised evaluation criteria to prioritize the potential mitigation actions in Table 8-3 to determine the strategies to be included in the 2014 HMP mitigation action plan. The strategies chosen as a result of the prioritization process appear in Table 8-4 below.

8.5 2014 HMP Mitigation Action Plan

The mitigation action plan developed by the Planning Team appears in Table 8-4 below. This table includes all high-priority mitigation actions that CCSF intends to implement during the five-year lifespan of the 2014 HMP, assuming funding availability. Table 8-4 lists the mitigation action number, a description of the mitigation action and the facility or infrastructure to be mitigated (if known or applicable), the department or agency charged with administering and implementing the mitigation action, the estimated timeframe for completion of the action, potential funding sources, and the estimated action cost.

Table 8-4: 2014 HMP Mitigation Action Plan

Action #	Action Description	Administering Department or Agency	Estimated Project Timeframe	Potential Funding Source	Estimated Cost
1.A	Create a joint Planning Department (Planning)-Department of Building Inspection (DBI), GIS-based pre-computer system tying hazard areas such as liquefaction, lateral spread, landslide, or Special Flood Hazard Area (SFHA) to Assessor's Parcel Numbers (APNs) for new construction and major remodels in those areas.	Earthquake Safety Improvement Program (ESIP)	1-2 years	TBD	$1,000,000 (as part of software update)
1.C	Implement Auxiliary Water Supply System (AWSS) Planning Study recommendations to rehabilitate the system, seismically brace weak pipes and cisterns, construct new cisterns, and make other improvements to ensure its continued operation after a disaster.	San Francisco Public Utility Commission (SFPUC)	1-2 years	Earthquake Safety and Emergency Response (ESER) Bond	$102,400,000
2.A	Refine inventory and/or develop replacement values for all CCSF-owned facilities and their contents to help CCSF better understand the values of assets at risk.	Risk Management (RM)/Capital Planning Program (CPP)/Real Estate (RE)	2-5 years	TBD	$200,000
2.F	Develop criteria for high priority neighborhoods where microgrids can provide a strategic and critical difference for community energy emergency resilience. Identify up to 10 neighborhoods and specific areas for development of microgrids. Develop an implementation plan and funding plan for each microgrid.	Department of Environment (DOE)	2 years	Grants	$200,000
3.A	Continue to hold workshops and advance implementation of the Mandatory Soft Story Retrofit Ordinance.	ESIP	Ongoing	TBD	TBD
3.B	Relocate the Office of Chief Medical Examiner to a seismically safe facility of about 45,000 square feet.	General Services Agency (GSA)/Department of Public Works (DPW)	2-5 years	General Obligation Bonds	$65,000,000
3.D	Relocate the San Francisco Police Department (SFPD) Forensic Services and Traffic Company to a seismically safe, 105,000 square foot building.	DPW	5 years	General Obligation Bonds	$165,000,000

Table 8-4: 2014 HMP Mitigation Action Plan

Action #	Action Description	Administering Department or Agency	Estimated Project Timeframe	Potential Funding Source	Estimated Cost
3.H	Seismically upgrade Treasure Island Causeway to preserve critical lifeline access to the island and to protect the utility corridor that runs under the causeway.	GSA/Treasure Island Development Agency (TIDA)	4 years	HMPG or PDM	$5,000,000
3.I	Continue to develop the Business Occupancy Resumption Program (BORP) program for critical CCSF facilities and privately-owned buildings, and expand BORP to more buildings in CCSF, as appropriate.	DBI	4 years	General Fund and various sources	$50,000-450,000
3.J	Continue to use FEMA-developed HAZUS and similar models and tools to guide emergency and capital planning decisions.	GSA/DPW	1-2 years	General Fund and department budgets	$100,000
3.K	Update or assign an additional 50 Seismic Hazard Ratings to city-owned buildings using the City's rating system.	GSA/DPW	4 years	General Fund, General Obligation bonds	$1,500,000
3.N	Seismically retrofit or upgrade seismically deficient Recreation and Parks Department (RPD) facilities and shelters.	RPD	3-5 years	General Obligation Bonds	$34,000,000
4.B	Implement Phase I of the Sewer System Improvement Program (SSIP), including Low Impact Development (LID) projects, and conduct public outreach and Urban Watershed Seminars in the eight urban watershed areas of CCSF. Publish watershed design tools and website resources devoted to green infrastructure.	SFPUC	1 year	SSIP bond funding	TBD
4.E	Continue the Great Highway Long-Term Stabilization program to respond to continuing beach erosion impacts along the Great Highway at Ocean Beach south of Sloat Boulevard.	DPW	4-5 years	SFMTA and Federal Highway Administration (FHWA)	$3,000,000-$5,000,000
4.H	Develop a public outreach and awareness program about heat and human health. Ideas include media announcements; public information about heat effects and cooling centers; outreach visits to the elderly, homeless, and other vulnerable populations; community resilience efforts; etc.	Department of Public Health (DPH)	1-2 years	Public Health Emergency Preparedness (PHEP)	$1,500,000

Table 8-4: 2014 HMP Mitigation Action Plan

Action #	Action Description	Administering Department or Agency	Estimated Project Timeframe	Potential Funding Source	Estimated Cost
4.I	Upgrade segments of the San Francisco International Airport (SFO) shoreline protection system that do not meet regulatory freeboard requirements when compared to the one-percent-annual-chance stillwater elevation. Address gaps in the system that could allow the entry of floodwater; and address openings for stormwater drainage that do not have closure devices, which could allow the entry of floodwaters. Upgrade seawalls to address sea level rise.	SFO	5 years	Capital Planning/Federal	$60,000,000
4.L	Perform annual maintenance of the Crystal Springs, Calaveras, and San Antonio watersheds to construct fire breaks, mow areas of grass, and clear around assets to prevent wildfire damage and mitigate wildfire hazards.	SFPUC	Annual	SFPUC Budget	Not available
4.M	Upgrade storm drainage outfall pump stations 1A, 1B, and 1C to protect the SFO airfield from 100-year floods and sea level rise.	SFO	1-2 years	TBD	$3,500,000
5.A	Complete the Calaveras Dam retrofit, as part of the Water System Improvement Program (WSIP).	SFPUC	3 years	WSIP bond funding	$500,000,000
5.B	Implement recommended Buffer Zone Protection measures for predesignated critical facilities and infrastructure.	SFPD/San Francisco Municipal Transportation Agency (SFMTA)/SFPUC	3 years	Various non-grant sources; WSIP funding	$15,000,000
5.C	Develop and implement a public outreach campaign to educate property owners, and to enable removal of household hazardous waste from homes and businesses to prevent toxic spills, fires, environmental exposure, and health hazards in case of disaster.	DOE	1 – 2 years	TBD	TBD
5.D	Implement physical security upgrades at all new WSIP facilities.	SFPUC	3 years	WSIP Bond Funds	$4,700,000,000

Section 9: Plan Maintenance

This section describes the formal plan maintenance process identified by the Planning Team to ensure that the 2014 HMP remains an active, viable document, and that the mitigation strategies set forth in the HMP are implemented. The section includes an explanation of the procedures the San Francisco Department of Emergency Management (DEM) intends to utilize to:

- Monitor, evaluate, and update the HMP.
- Incorporate the requirements of the HMP into existing planning mechanisms.
- Continue public participation in the plan maintenance process.

9.1 Monitoring, Evaluating, and Updating the Plan

The requirements for monitoring, evaluating, and updating the 2014 HMP provided by the Stafford Act, as amended by DMA 2000, and by its implementing regulations, are described below.

FEMA REGULATION CHECKLIST: PLAN MAINTENANCE PROCESS

Monitoring, Evaluating, and Updating the Plan
44 CFR § 201.6(c)(4)(i): The plan shall include a plan maintenance process that includes a "section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle."
Element

A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating, and updating the mitigation plan within a five-year cycle)?

Source: FEMA, *Local Mitigation Plan Review Tool*, March 2013.

The 2014 HMP was prepared through a collaborative effort by the HMP Planning Team, with coordination from DEM. To maintain the momentum created by the Planning Team during the planning process, and to build on previous hazard mitigation planning efforts and successes, DEM will continue to hold and coordinate Planning Team meetings as a primary method of monitoring, evaluating, and updating the 2014 HMP. The 2014 Planning Team has designated members who will serve on an Interim Planning Team, which will meet at least once each year during the first four years following adoption of the 2014 HMP. DEM will continue to coordinate the Interim Planning Team, as well as the monitoring, evaluation, and updating of the 2014 HMP.

At least once each year after adoption of the 2014 HMP, the DEM Point of Contact (POC) will email the members of the Interim Planning Team an Annual Review Questionnaire, as shown in Appendix H, Plan Maintenance Documents. The questionnaire allows members of the Interim Planning Team to evaluate and provide feedback on CCSF's planning process, hazard analysis, vulnerability analysis, capability assessment, and mitigation strategies. The DEM POC will collect completed questionnaires, and will compile and summarize the results. DEM will then facilitate at least one Interim Planning Team meeting each year to share questionnaire results and to get additional feedback from the team on next steps.

The Interim Planning Team will use the results of the annual review questionnaire to determine whether the 2014 HMP needs to be updated earlier in the five-year planning cycle set forth in the Stafford Act. Earlier updating may be necessary, for example, to address new or more threatening hazards, to address needs following a disaster, or to address new technical reports or findings. If the DEM POC believes that the 2014 HMP needs to be updated earlier in the planning cycle, or when it is time to begin the normal five-year plan revision, the DEM POC will inform and convene the Interim Planning Team and begin the update process.

As part of the annual review process, each department or agency administering a mitigation project as part of the 2014 mitigation action plan also will be asked to complete a Mitigation Action Progress Report (see Appendix H, Plan Maintenance Documents). The progress report provides the Interim Planning Team with an update on the status of implementation of the projects included in the action plan, including any changes made to the project scope. The progress report also asks administering departments or agencies to identify impediments to implementation and to describe appropriate strategies for overcoming these issues. The DEM POC will compile, summarize, and share the results of the reports with the Interim Planning Team at the annual meeting. Based on these results, the DEM POC may request administering departments or agencies to meet to discuss the project.

In addition to holding at least one annual meeting, the Interim Planning Team will meet to update the 2014 HMP every five years. To ensure that this update occurs in a timely fashion, after completion of the third year following plan adoption, the Interim Planning Team will undertake the following activities:

- Thoroughly analyze and update the risk of natural and human-caused hazards in the Planning Area.
- Complete a new Annual Review Questionnaire and review previous questionnaires.
- Provide a detailed review and revision of the mitigation strategy.
- Prepare a new mitigation action plan.
- Prepare an updated draft HMP and submit it to Cal OES and FEMA for preliminary review.
- Submit the updated draft HMP to the Board of Supervisors and Mayor for adoption.
- Submit the updated HMP to FEMA for final approval.

The Planning Team is also committed to working on and resolving the following issues in future plan updates:

- Fully integrating CCSF-owned, out-of-county assets into the HMP for purposes of risk assessment.
- Developing and utilizing a more comprehensive method for assessing CCSF's vulnerability to hazards, such as incorporation of HAZUS-MH to model the City's vulnerability to earthquakes and floods.

9.2 Integration into Other Planning Mechanisms

The requirements for integrating the 2014 HMP into other planning mechanisms in the jurisdiction, as provided in the Stafford Act and its implementing regulations, are described below.

FEMA REGULATION CHECKLIST: PLAN MAINTENANCE

Incorporation Into Other Planning Mechanisms

44 CFR § 201.6(c)(4)(ii): The plan shall include a plan maintenance process that includes a "process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate."

Element

C6. Does the plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate?

Source: FEMA, *Local Mitigation Plan Review Tool*, March 2013.

Before discussing integration of the 2014 HMP into existing planning mechanisms, it is important to note how the 2008 HMP was incorporated into CCSF planning mechanisms. The Community Safety Element of the General Plan of the City and County of San Francisco (CCSF) was specifically revised in 2012 to incorporate the 2008 HMP. The 2012 Safety Element includes hazard discussion from the 2008 HMP, and notes the important role played by the 2008 HMP as an implementation program of the Safety Element. In addition, the 2008 HMP was incorporated into the CCSF Community Action Plan for Seismic Safety (CAPSS) Earthquake Safety Implementation Program Workplan 2012-2042. Information from the 2008 HMP also was incorporated into San Francisco's 2008 Emergency Response Plan, 2011 Tsunami Response Annex, and 2011 Disaster Debris Management Plan.

After adoption of the 2014 HMP, the Planning Team will ensure that elements of the 2014 HMP are similarly incorporated into other existing planning mechanisms. The processes for incorporating the 2014 HMP into various planning documents will occur as other plans are updated, and when new plans are developed. Therefore, members of the Planning Team will undertake the following activities:

- The Planning Team's DEM POC will ensure that as other emergency management plans are being developed or updated, the hazards and risks addressed in those plans are consistent with those identified and profiled in the 2014 HMP.
- Planning Team members from the Planning Department will ensure that hazards addressed in the Community Safety Element update of the General Plan are consistent with those profiled in the 2014 HMP. In addition, during the Safety Element update process, Planning Department members of the Planning Team will ensure that the goals identified in the mitigation strategy are addressed as "objectives," and that the mitigation actions developed in the implementation strategy are addressed as "policies" in the Community Safety Element.
- Planning Team members from the San Francisco Public Utilities Commission (SFPUC), the Port of San Francisco (the Port), and the Treasure Island Development Agency (TIDA)

will ensure that updates of the Stormwater Management Plan for CCSF, for the Port, and for Treasure Island incorporate the stormwater hazards profile and exposure analysis from the 2014 HMP.

- Planning Team members from the SFPUC will ensure integration of SFPUC-related mitigation actions from the 2014 HMP implementation strategy into the agency's Water System Improvement Program, Sewer System Improvement Program, and other such programs as these programs are developed or updated.
- All Planning Team members will work to ensure integration of the 2014 HMP into their department or agency plans and programs, as appropriate.

9.3 Continued Public Participation in Plan Maintenance

The requirements for continued public participation in the plan maintenance process, as provided in the Stafford Act and its implementing regulations, are described below.

FEMA REGULATION CHECKLIST: PLAN MAINTENANCE

Continued Public Participation

44 CFR § 201.6(c)(4)(iii): The plan must include a plan maintenance process that includes "[d]iscussion on how the community will continue public participation in the plan maintenance process."

Element

A5. Is there discussion of how the community will continue public participation in the plan maintenance process?

Source: FEMA, *Local Mitigation Plan Review Tool*, March 2013

In addition to the above plan maintenance activities, keeping the 2014 HMP current requires continuing efforts to provide members of the public with opportunities to be involved in the plan maintenance process. DEM and the Planning Team remain dedicated to involving the public in ongoing reshaping and updating the of CCSF's HMP.

After adoption of the 2014 HMP, a downloadable copy of the plan will be made available on DEM's website for public review. Any proposed changes or updates to the 2014 HMP will be posted on DEM's website. The DEM website will include an e-mail address and phone number to which people can direct their comments or concerns. DEM will also create a system for members of the public to continue to provide feedback on the plan through the DEM website. DEM will publicize these actions through issuance of a media release, and through its social media accounts, including Twitter and Facebook.

The Planning Team is also committed to identifying additional opportunities to raise community awareness about the 2014 HMP and the hazards that affect the Planning Area. The Planning Team will continue to raise awareness of the hazards affecting the Planning Area through the DEM website, printed materials, and community outreach at events such as neighborhood and preparedness fairs. Members of the Planning Team and other CCSF departments and agencies that typically engage in public outreach related to preparedness, response, recovery, or mitigation will be asked to assist in sharing information about the HMP and the planning process with those who live or work in CCSF.

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