**RESOLUTION NO. 7194**

**A RESOLUTION OF THE CITY COUNCIL APPROVING AND ADOPTING THE CITY OF SAN FERNANDO NATURAL HAZARDS MITIGATION PLAN**

**WHEREAS,** The Disaster Mitigation Act (DMA) of 2000 was adopted by the Federal Government and among other things, requires local authorities to prepare a Hazard Mitigation Plan (HMP) which will be utilized to protect citizens, critical facilities, infrastructure, private property and the environment from natural hazards through varying means, including increasing public awareness and identifying resources available for risk reduction and loss prevention; and

**WHEREAS,** the HMP was prepared through a process which included the Disaster Council, Local Business Owners and the General Public; and

**WHEREAS,** the HMP is a five year plan subject to evaluation on an annual basis with a revision to be prepared every five years based on the continuing evaluation of the HMP.

**NOW, THEREFORE BE IT RESOLVED** by the Mayor and Councilmembers of the City of San Fernando that the City of San Fernando Natural Hazards Mitigation Plan (Exhibit "A") is hereby approved and adopted and is to be implemented as outlined in the plan.

APPROVED AND ADOPTED this 21st day of May, 2007.

JULIE RUELAS, MAYOR

ATTEST:

ELENA G. CHÁVEZ, CITY CLERK

STATE OF CALIFORNIA )
COUNTY OF LOS ANGELES )SS
CITY OF SAN FERNANDO )

I, Elena G. Chávez, City Clerk of the City of San Fernando, do hereby certify that the foregoing Resolution was duly adopted at a regular meeting of the Council of the City of San Fernando held on the 21st day of May, 2007; and was carried by the following vote:

AYES: Ruelas, De La Torre, Veres, Hernández – 4

NOES: None

ABSENT: Martinez – 1

Elena G Chávez

ELENA G. CHÁVEZ, CITY CLERK

EXHIBIT "A'

# City of San Fernando

# Natural Hazard Mitigation Plan

May 21, 2007

Prepared by:

Roger Mason
LECMgt

# San Fernando Certification

## Table of Contents

**Table of Maps**

# PART I: Background And Methodology

## Section 1: Introduction

### Overview

The City of San Fernando is one of the oldest cities in the Los Angeles basin. The City, situated in the northeast corner of the San Fernando Valley at the foot of the Verdugo Mountains, has a history of natural disasters. This location exposes the City to the numerous earthquake faults that cross this area. In 1971 and 1994, San Fernando was badly damaged by major area earthquakes. The City has also suffered from two floods in 1934 and 1938. The primary natural hazard is the potential for earthquakes with a secondary hazard of flooding.

### Why Develop A Plan?

The City of San Fernando is currently planning for a major redevelopment of specific corridors within the City. The investment in this redevelopment combined with the increasing costs of disaster mitigation has encouraged community leaders to consider the importance of identifying effective ways to reduce the vulnerability from natural hazards. This plan will assist the City by reducing hazard risks through resource identification, increased public awareness, and improved mitigation planning.

The information and foundational resources within the Mitigation Plan:

1) Establish a basis for collaboration and coordination between City government and the public;
2) Identify and prioritize future mitigation planning and projects; and
3) Help to meet Federal requirements.

### Whom Does the Plan Affect?

The plan will impact the entire City of San Fernando. The Mitigation Plan will become a strategic framework in future City planning. The stakeholders within the San Fernando Community will benefit from the decisions based on this plan.

### Natural Hazard Land Use Policy in California

Planning for natural hazards must be a foundational step in any comprehensive urban planning. California cities are required to develop general plans that comply with statewide standards. One of the biggest problems is to continually update natural hazard mitigation planning so it corresponds to changes in local development. The City of San Fernando is especially concerned about matching the need for stimulating development and economic vitality while developing a comprehensive Natural Hazards Mitigation Plan.

## Support for Natural Hazard Mitigation

The primary responsibility for developing risk-reduction strategies, hazard mitigation plans, and implementation protocols rests at the local level. The City of San Fernando has identified some key partners in developing these strategies, plans, and protocols. In California there are three state agencies and one private university that provide invaluable assistance in this area:

The Governor's Office of Emergency Services (OES)
OES serves as the focal point of all statewide disaster preparation, mitigation, and recovery efforts. They also oversee the distribution and use of Federal disaster funds.

The California Division of Mines and Geology (DMG)
The DMG is responsible for all geologic hazards in the state. They provide research data, planning resources, and public education.

The California Division of Water Resources (DWR)
This agency is responsible for the State Water Project. They plan, design, and regulate dams. DWR provides flood protection and assists in emergencies from natural water hazards.

The University of Southern California Southern California Earthquake Center (SCEC)
The SCEC is a private and publicly funded center for information and research related to earthquake hazards in Southern California. The SCEC uses this to inform the public and assist local governments in planning related to the threat of earthquakes.

## Planning Methodology

The information in this Mitigation Plan was collected from a variety of data sources. Staff from the City of San Fernando and consultants from LECMgt LLC worked with citizen groups and mitigation-analysis experts to develop this plan. The collaboration involved public meetings with citizen groups like the San Fernando Disaster Council and other community stakeholder groups. Scientific and expert information was collected from agencies and groups such as the departments listed in the previous section. The State of California and the Federal Emergency Management Agency (FEMA) have proposed the following guidelines for completing a hazard mitigation plan:

State and Federal Guidelines for Mitigation Planning

Open public involvement with public meetings that introduce the process and project requirements.

The public must be afforded opportunities for involvement in identifying and assessing risk, drafting a plan, and involvement in the plan's approval.

Community cooperation, including opportunities for other local government agencies, local stakeholders like businesses, educational communities, and nonprofit groups.

Integration of local documents, including the City development plan, zoning ordinances, local building codes, and other related documents.

The following components must be part of the planning process:

Complete documentation of the planning process

A detailed risk assessment of the hazard exposures in the community.

A comprehensive mitigation strategy which describes the mitigation goals and objectives. This must include specific strategies, programs, and plans designed to minimize or avoid long-term natural hazard vulnerabilities.

A maintenance protocol that includes the method and schedule for monitoring and reviewing the plan, evaluating and updating the plan, and integrating the recommendations into future City planning.

Formal adoption by both State OES and FEMA.

The City of San Fernando reviewed existing mitigation plans from cities in Los Angeles County, the FEMA hazard mitigation planning standards, and the State of California Natural Hazards Mitigation Plan Guidance Handbook.

Data Collection and Documentation Strategies and Procedures

The San Fernando Natural-Hazard Mitigation Plan was developed using three data collection strategies: documentary research, community involvement, and integration of local documents and studies.

Documentary Research

The first step was documentary research. This involved reviewing documents within the City and from neighboring jurisdictions. The specific documents related to earthquakes and earthquake standards in the City of San Fernando were examined. Ten approved

natural-hazard mitigation plans from small to medium sized cities in Los Angeles County were reviewed. The City of San Fernando is geographically surrounded by the City of Los Angeles. The Los Angeles City hazard-mitigation plan was reviewed. External documents such as the Community Vulnerability Assessment Tool developed by New Hanover County, North Carolina were reviewed.

### Public Outreach

The second strategy was including community stakeholders in the process. The stakeholder groups are divided into three categories: citizens, business owners/operators, and associated organizations such as nonprofit organizations that operate within the City. Citizen feedback was collected during two public events. The first was an emergency preparedness expo hosted by the San Fernando Police Department on 4/22/06. A survey was prepared asking citizens attending the expo to answer a series of questions relating to natural hazards and soliciting comments regarding mitigation planning. The second public forum was a public meeting held in conjunction with the San Fernando Disaster Council on 6/20/06.

### Business Owners

The second group from which feedback was collected was the business owner/operators who are located in the City. The City Department of Finance provided a list of the top 25 revenue-producing businesses. The managers from some of these businesses were contacted and interviewed regarding preparation of the natural-hazard mitigation plans. These persons were asked to offer suggestions and comments for the plan. Business owners were also surveyed at the emergency preparedness expo.

### City Employees

One of the most important groups contributing to this plan were City employees. During the development of this report many employees were interviewed. There are 20–30 employees remaining from the 1994 earthquake. They provided information about the conditions after the earthquake and the impact on City operations. Several of the employees had personal photograph collections and scrapbooks of newspaper articles from the incident.

### Associated Stakeholders

The City Disaster Council includes a group of stakeholder organizations that voluntarily support the disaster-response efforts of the City. This group is comprised of nonprofit, quasi-governmental organizations such as the local chapter of the American Red Cross. The representatives of these groups were briefed and offered feedback regarding the City hazard-mitigation plan.

## Hazard Specific Research

The City of San Fernando and LECMgt collected data on the primary natural hazard, earthquakes. The data sources included but were not limited to FEMA, OES, Los Angeles County Agencies, and SCEC. Historical data was collected from archival sources and by

interviewing long-time residents and City employees. The archival sources included California State University Northridge, and San Fernando Valley Digital Photo Library.

## Documentation

The initial collection of data was done in the form of field notes prepared by an LECMgt representative. These notes were typed into electronic media and stored on the consultant's laptop computer. Periodic updates on the progress of the plan were provided by email to City administrators and elected officials. Upon the completion and approval of the report a copy will be posted on the City of San Fernando website.

## Summary

The City of San Fernando and the San Fernando Community support the program of identifying and mitigating the effects of natural hazards. This report is based on a wide selection of data that provides the most accurate understanding of the potential for losses due to natural hazards and offers solutions for mitigating their effects. The data-collection and documentation strategies and procedures are based on the established guidelines of the State OES and FEMA. The next section will provide a clear picture of the San Fernando Community.

## Section 2: Community Profile

### Introduction

Natural hazards can impact every part of the City of San Fernando. This includes the environment, population, property, and the economy. The City has historically been vulnerable to earthquakes. This vulnerability of the population will only increase with the extensive redevelopment project that is expected to bring greater commerce and population to the City in the coming decade.

The inevitability of natural hazards combined with a comprehensive redevelopment plan creates an urgent need for the City to identify mitigation strategies, collect and prepare response resources, and increase public awareness to reduce risk and minimize loss. The goal of the City of San Fernando is to create a natural-hazard mitigation plan that includes the population, business community, and City leaders in crafting a comprehensive solution to this problem.

### Geography and Environment

#### *Regional Context*

The City of San Fernando is located in the northeast corner of the San Fernando Valley. The Santa Susanna Mountains are directly north with the San Gabriel Mountain range to the east. The City is 2.4 square miles and is surrounded by the City of Los Angeles. The adjacent communities are Sylmar, Mission Hills, and Pacoima. The nearest independent city is Burbank which is 11 miles southeast on I–5.

#### *Climate*

The City of San Fernando is in the warm and dry climate of the San Fernando Valley of Southern California. The average temperatures for this area are a high of 77 degrees and a low of 51 degrees. The City can experience numerous days with temperatures exceeding 100 degrees in the Summer and early Fall. San Fernando is generally sunny and warm.

#### *Geographic Features*

The most important geographic features of the City of San Fernando lie beneath the surface of the City. The extensive earthquake fault systems located in the northeast corner of the San Fernando Valley place the City in one of the most active earthquake zones in the United States. This will be discussed in the section on earthquakes.

### Community Profile

#### *History*

The City of San Fernando began as a township in 1874. The City served as a regional center for the agricultural industry that covered the San Fernando Valley. The first step in

connecting the City to the rest of the country came with the Southern Pacific Railroad which linked San Fernando to San Francisco and Los Angeles and the rest of the United States. In 1911 the City incorporated. It was gradually surrounded by the City of Los Angeles as surrounding communities were annexed.

The agricultural industry gradually declined, replaced by urban growth and need for heavy industry. During World War II the City rapidly grew in population. In 1971 and 1994 the City was badly damaged by major regional earthquakes. In 2002 the City began a program to redevelop the major commercial corridors.

*Population and Demographics*

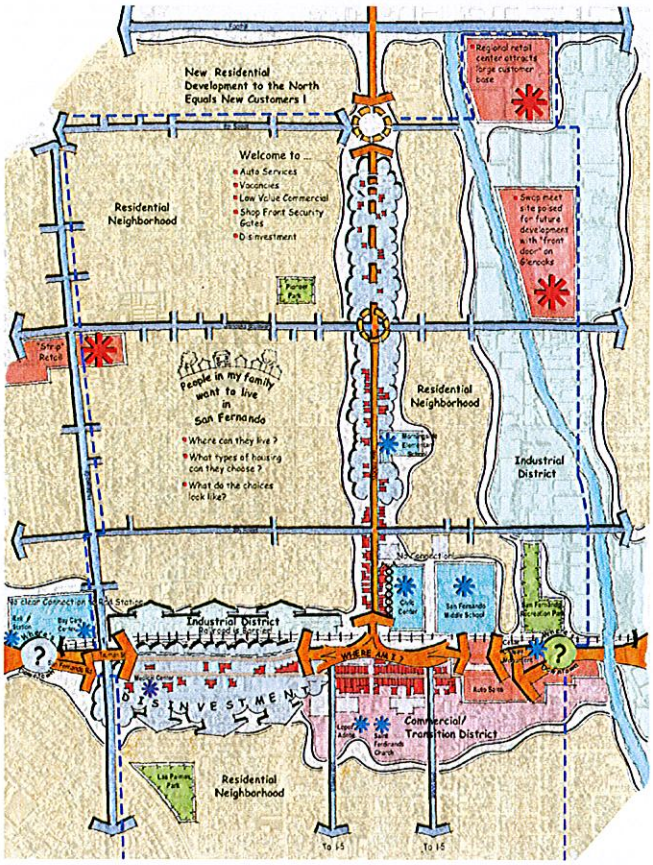
The City of San Fernando has close to 24,000 residents. The City is in the heart of the largely Latino area of the San Fernando Valley. This area has over 200,000 native Spanish speakers who live in the City and the surrounding communities. The City of San Fernando has a population that is approximately 90% Latino. The median age of residents is 27 with nearly 80% under the age of 44. This population includes long-term residents and recent immigrants. The average family is 4.33 people in size. In the past decade new generations of young professionals have returned to the City. This gradual change has helped to spark interest in revitalizing the City.

*Housing*

The housing in San Fernando is primarily single-family homes, a few condominiums with some apartment buildings. Single family homes account for 77.9% of the total housing in the City. These homes are currently priced at about $400,000 to $500,000. Housing sales are strong. The City has numerous older "Craftsman" style homes that have been purchased and restored by the new owners. The current redevelopment plan has three proposed senior housing developments.

*Community Development*

In the past 3 years the City has been developing a comprehensive redevelopment program. This plan is called *The San Fernando Corridors Specific Plan.* It targets three specific corridor sections of the City: Truman Street, San Fernando Road, and Maclay Avenue. These thoroughfares are the main streets in the City and connect San Fernando to the surrounding communities.




**San Fernando Specific Corridor Redevelopment Plan**

The objective of this plan is to revitalize the City by redeveloping properties along these corridors. This development will include a combination of new retail properties with a mix of housing developments. Each of these corridors will be based on a district concept with each district having a unique "personality." This concept will be reinforced by the unique collection of architecture, businesses, and types of residences found there. The ultimate goal is to encourage economic vitality and offer new housing options while retaining and promoting the small-town community feel of the City.

Besides the corridor redevelopment, the only remaining open space in the City will also be developed as a new retail center. This is the 20-acre partial known as the San Fernando Valley swap meet. A new high school is also planned within this space.

*Employment and Industry*

The median household income reported in the 2000 Census was $39,900. This is slightly below the average in Los Angeles County. The City labor force was estimated at 11,290 in 2002. This number includes a gradual rise in the number of jobs available in the City. The unemployment rate in San Fernando is estimated at 8.6% which is above the Los Angeles County average of 6.5%.

*Transportation*

San Fernando is located adjacent to several important freeway corridors. Interstate 5 is approximately one mile west of the City. This freeway is the major north/south highway on the west coast of the United States. Interstate 210 is east of the City and connects the San Fernando Valley to Pasadena and the San Gabriel Valley. Interstate 118 is south of the City and connects the San Fernando Valley to Ventura County.

San Fernando is also served by the Antelope Valley line of the Metrolink regional rail system. This line originates in the Antelope Valley and passes through San Fernando on its way to the Union Station terminal in downtown LA. The Metrolink station for the area is just north of the City limits in Sylmar.

The City is serviced by the regional Metro bus system with 12 cited routes and stops. The City is also served by the commercial Greyhound bus company which has a terminal just south of the City limits. The nearest commercial airport is Bob Hope Airport which is located 10 miles south in the City of Burbank.

## Section 3: Societal, Economic, and Infrastructure Analysis

### Introduction

An important part of the hazard-mitigation process is understanding the societal and economic state of the City combined with an evaluation of the City's critical infrastructure. This section draws upon information collected during the 2000 U.S. Census and a series of reports related to the 2003 San Fernando Specific Corridor Plan.

### Societal Analysis

The societal analysis of the City of San Fernando provides details about the residents within the San Fernando Community. It is important to identify members of the community with limited personal resources during a major natural disaster. The City of San Fernando is a community in transition. The San Fernando 2003 economic study describes how, in the past decade, children of long-time residents have returned to start families in San Fernando. This reverse migration of former residents has resulted in a significant impact on the average San Fernando resident.

#### *Population Profile*

The total population in the last census was just over 23,500. There are various estimates that the additional nonrecorded population of recent immigrants from Mexico, Central, and South America may increase the total population by 10–20%. It is impossible to quantify this exact number because the members of the population group are mobile. The City has some understanding of the potential numbers by the large numbers of unlicensed garage conversions providing improvised housing units.

The 2000 Census states the age group of 25–44 is the largest group in the residence pool with 89% claiming some type of Hispanic or Latino heritage. The community is nearly evenly divided between the number of renters (48%) and home owners (52%). There were no statistics available reflecting the percentage of the population who speak English but the City is well equipped to provide public information in Spanish.

There appear to be three primary at-risk groups with a low potential for sustained self-mitigation efforts during a disaster: senior citizens, single mothers, and female widows. These groups comprise approximately 25% of the population. The City has made an effort to develop new senior housing. The City has approximately 7% of the total population listing their ages as above 65. The population of single mothers is estimated at 11%. The population of female widows is 8%.

These groups are particularly vulnerable to a disaster. The elderly residents may have mobility and cognition challenges caused by age-related health problems. Beside physical limitations, the senior population has the lowest median income which is at or below the 2006 poverty line as established by the U.S. Department of Health and Human Services.

The single mothers are caring for children of various ages and other family members like senior-age relatives. The level of effort in caring for children and the elderly would certainly be limiting to a single woman during a disaster. Children are similar to the elderly in that they may be limited developmentally or physically. Supporting a family on a single income may also be an indication of vulnerability but these statistics were not available.

The third group comprised of widows has similar problems to the elderly and single mothers. In summary these three groups are particularly at risk during a disaster and will require assistance from public services.

### *Education*

The reverse migration of children returning to the City has resulted in a gradual rise in the overall education level of the San Fernando Community. The population has 19% high school graduates, 16.7% with some college, 3.6% with a college degree, and 1.9% with an advanced or professional degree. During the last Census 1,069 residents reported they are attending college. This level of education offers the City many options in providing emergency information with a variety of sources and mediums familiar to the population. This may include the use of cellular communications and Web-based information applications.

### *Personal Mobility and Transportation*

The residents of San Fernando are similar to most of the population of the Los Angeles basin. Residents' primary mode of transportation is personal automobiles. Residents reported to the census they had nearly two vehicles per household. Rental occupants reported slightly lower numbers at 1.36%. This offers hazard-mitigation planners some opportunities and challenges. Most household have their own transportation with limited access to a secondary public-transportation system. The limitations of the transportation grid in San Fernando have resulted in studies on the feasibility of mass evacuations in the San Fernando Valley. These issues are unresolved and should be part of the long-term approach to emergency planning for San Fernando.

## Economic Analysis

The City of San Fernando has a stable economy for a small geographic area. The latest economic figures available are from the last quarter of 2005. These figures indicate San Fernando is part of the growing Los Angeles County economy. The figures for 2005 reveal the City had a modest growth rate of 2.2%. This seems to signal the local economy may be slowing.

The City economic profile is divided into seven areas: consumer goods, building, auto sales, industry, restaurants, food/drug and all others. The point-of-sale revenues for these

businesses in fiscal year 2004–2005 was approximately $3.5 million dollars. The current growth is related to increases in the sales of building materials and the increase in fuel costs. Auto sales slowed with the increase in fuel costs as a probable causative factor.

The future of the City economy appears to be very promising. The City of San Fernando is about to begin a major revitalization and redevelopment program in several specific corridors of the City. This program will involve the first major infusion of new housing, commercial, and light industrial investment into the City in several decades. The redevelopment planners believe this addition of new housing combined with district-based commercial hubs will significantly boost the overall area economy by direct and secondary economic benefits. The goal is to make San Fernando a destination instead of just a thoroughfare to other locations.

## Summary

The City of San Fernando is a community on the move. The Community has begun a new period of revitalization as educated professionals return to the City to raise their families. There are several groups such as seniors and single-parent families that represent a challenge for hazard-mitigation or emergency-preparedness planners. The City economy has exhibited steady growth with unlimited potential based on the ambitious redevelopment program. The future appears promising for the San Fernando Community.

## Section 4: Risk Assessment

### What is Risk Assessment?

Conducting a risk assessment can provide the following information: the location of hazards in a city, the value of the land and property in these hazard areas, a risk analysis to life and property within these areas, and the potential environment that may result from natural hazards. The five parts of a risk assessment are as follows:

### *Hazard identification*

This is the description of the geographic extent, potential intensity, and probability of the occurrence of a natural hazard or event. The City of San Fernando has identified two major hazards that affect the City: earthquakes and floods. These hazards were identified by the City of San Fernando Disaster Council, citizen input, and the assistance of LECMgt Consultants. The geographic area of the specific hazards was determined using a combination of city-mapping resources.

### *Profiling Hazard Events*

Profiling hazard events includes four topical areas: the causes and characteristics of each hazard, the history of these types of events in the City of San Fernando, and the historic impact on the population, infrastructure, and environment relative to each hazard. ( For a full description of the natural hazards see Section Seven: Earthquakes and Section Eight: Floods.)

The nineteen natural hazards listed in the FEMA Natural Hazard Mitigation Analysis Manual were evaluated for their potential threat to the City. Most of the hazards can be eliminated because the geographic location of the City of San Fernando severely restricts their possibly of occurrence. The hazards that were not selected will not be the subject of future profiling unless the geographic boundaries of the City are changed. This seems improbable because the City of San Fernando is surrounded by the City of Los Angeles.

Avalanche: The City is in a desert area that is not prone to snowfall.
Coastal Erosion: The City is approximately 35 miles from the coast.
Coastal Storm: The Santa Monica Mountains provide a barrier from any coastal storms.
Dam Failure: This is included in the sections on earthquakes and flooding.
Drought: The City has its own water supplies and well system.
Earthquake: Found in Section Seven.
Expansive Soils: The threat from soil expansion is described in the description of the soil structure in the earthquake section.
Extreme Heat: The average temperature of the City rages from 55 to 77 degrees.
Flood: Covered in Section Eight

Hailstorm: The Average rainfall is 16 inches and the average daily temperature is 77 degrees.
Hurricane: Southern California does not experience hurricanes.
Land Subsidence: This is covered in the description of liquefaction related to earthquakes.
Landslide: The City is flat with the nearest mountains two miles to the northeast.
Severe Winter Storms: The average daily temperature is 77 degrees.
Tornado: Southern California does not experience tornados.
Tsunami: The City is protected from the coast by the Santa Monica Mountains.
Volcano: There are no active volcanoes in this area.
Wildfire: The City is not in an area of natural vegetation. The 210 Freeway is a natural firebreak between the City and the nearby mountains.
Windstorm: The City is not subject to strong winds.

### *Vulnerability Assessment/Inventorying Assets*

This type of inventory and assessment involves comparing an inventory of existing or planned property and populations against a specific type of hazard. Of particular concern are the critical locations, assets, and resources that are necessary to preserve the general welfare and the quality of life in the City. These entities fulfill important public safety, emergency response, and disaster mitigation functions. (A list of all critical infrastructure and response assets are included in Section Seven, pages 37–40.) This appendix also includes a list of public and private properties of concern including potential hazardous materials locations.

### *Risk Analysis*

In estimating potential losses due to natural hazards, the City of San Fernando has assessed the damage, injuries, and financial costs likely to be sustained in a specific geographic area by a specific hazard during a given period of time. The quantifiable measures of risk analysis are the magnitude of the potential harm and the likelihood of the event occurring. Evaluating vulnerability in the terms of dollar losses provides the City of San Fernando and the State of California a common understanding to measure the impact of hazards on assets.

### *Assessing Vulnerability/ Analyzing Development Trends*

This step involves a general description of local land uses and potential or planned development trends. Mitigation options can be considered in development and land-use planning, and future land-use decisions. Section Two describes the character and composition of the City of San Fernando. This section includes the geography, demographics, land use, development plans, employment and industry profile, and the City transportation plans. By analyzing these factors, potential problem areas can be

identified providing useful planning guidelines that allow for the integration of the final mitigation plan in future city planning.

### *Hazard Assessments*

This mitigation report was developed by gathering data related to the specific hazards identified during the development of this report. This data was complied from a variety of local, state, and federal data sources. There is no meaningful mapping possible of earthquake effects on the City of San Fernando. Any earthquake event would be the result of seismic displacements that extend far beyond and below the City limits. In a major earthquake, the entire City would be subject to the impact of the disaster.

The concern with flooding is different. According to the Los Angeles County Public Works inundation map for the Pacoima Dam and Wash, a narrow band of the northeast corner of the City might be impacted by flooding if the dam was full and suffered a sudden catastrophic failure. The potential area of flooding is approximately one block on either side of the Pacoima wash. The wash courses through the City limits for about one mile before it makes a sharp turn to the southeast and out of the City limits into the City of Los Angeles. The only structures in this area are commercial buildings and a large open-area market that is used two days a week. (For additional information, see Section Eight: Floods.)

### *Profiling Hazard Events*

Each hazard section includes documentation about the history, causes, and characteristics of the hazard in the City (Section Seven: Earthquakes, Section Eight: Floods.)

## Federal Requirements for Risk Assessment

Federal guidelines described in 44 CFR Part 201, Section 322 identify three primary criteria for assessing natural hazard risks: identifying hazards, profiling hazard events, and assessing vulnerability. Vulnerability assessments are further divided into three areas: identifying assets, estimating potential losses, and analyzing development trends. The City of San Fernando's Natural-Hazard Mitigation Plan addresses these requirements:

### *Identifying Hazards*

Each specific hazard description includes an inventory of the data sources used to determine specific hazards. Beyond identification of the data sources the specific hazards are described. Map resources are included to provide a visual reference for orientation and analysis.

### *Profiling Hazard Events*

Each hazard section includes documentation regarding the history, causes, and characteristics of the hazard in the City.

### *Assessing Vulnerability*

*Identifying Assets*

The vulnerability assessment of each hazard includes an inventory of public property within the hazardous area. Each hazard section identifies possible mitigation strategies.

*Estimating Potential Losses*

This section includes critical infrastructures and facilities within the City. The potential losses of other areas were estimated based on their current and potential growth, value, and possible planned development.

*Analyzing Development Trends*

The city profile section provides a description of the development trends including the environment, population and demographics, employment and industry, transportation and commuting, and land use and development.

*Critical Facilities and Infrastructure*

The facilities that are vital to governmental response and disaster mitigation efforts include: the Police Services building and 911 center, City Hall, the City emergency-shelter facilities, the public-works yard, and the public utilities. This assessment also includes critical facilities that, if damaged, would present a serious secondary threat.

## Summary

Natural-hazard mitigation strategies can reduce the impact of the damage or loss of critical facilities or infrastructure. By identifying a secondary hazardous materials location, it is possible to begin integrating the specific risks related to this location within the overall mitigation strategy. This can lead to a collaboration of public and private sectors to develop strategies that can reduce the impacts of natural hazards.

## Section 5: Multihazard Goals and Action Items

### Introduction

This section provides information on the process the City of San Fernando used to develop goals and specific action items pertaining to the two natural hazards identified in the Mitigation Plan. This introductory section will address the three foundational parts of the plan: mission, goals, and action items. The rest of this section will be divided into three parts: establishing guidelines for mitigation action items, developing the process of integrating public participation and input into the process, and highlighting some short- and long-term action items related to the natural hazards that were identified as multihazards.

### Local Mitigation Ordinances

The City of San Fernando does not have separate ordinances related to earthquake mitigation. The City codes regarding earthquakes are based on California State Codes. In 2006 the City adopted Ordinance 1572 to regulate the construction of buildings in areas prone to flooding. The ordinance empowers the City Community Development Director to oversee mitigation efforts to lower the risk from flood damage in areas prone to flooding. These efforts include use of flood-resistant building materials, employment of construction techniques designed to minimize damage from flooding, and drainage systems that are adequate to ensure removal of standing water.

### *Mission*

The mission of the City of San Fernando Natural-Hazards Mitigation Plan is to develop comprehensive public policies that are designed to protect the City and the environment from natural hazards. This plan specifically provides information related to protecting citizens, property, and critical infrastructures. The mission of the plan promotes increasing public awareness, carefully identifying resources to support this effort and identifying activities toward protecting the City from natural hazards.

### *Goals*

The goals identified in the Mitigation Plan explain the direction the City, related stakeholders, and residents can take to minimize the impact of potential natural hazards. The goals serve as a bridge between the broad directions included in the mission statement and the specific action items.

### *Action Items*

The action items are a list of specific steps the City and its inhabitants can take to reduce the risks that were identified. The action items are divided between short- and long-term recommendations. The short-term items are activities that may be implemented using existing resources within 1 to 2 years. Long-term items may require the collection of additional resources, changes in ordinances, and may require from 1 to 5 years to complete.

## Guidelines for Mitigation-Action Items

The goals listed in this section serve as a checklist for the mitigation planning in this study.

### *Protect Life and Property*

Design and implement activities that that will assist in protecting lives by making homes, businesses, infrastructure, critical facilities, and other properties more resistant to natural hazards.

Improve insurance coverage by concentrating on loss reduction and preventing chronic hazard vulnerabilities.

Improve hazard-assessment information to assist City development planning.

### *Public Awareness*

Develop and present education and outreach programs to increase public awareness of natural-hazard threats.

Provide public information regarding resources, partnerships, and funding resources that are available to assist with implementation activities.

### *Support Natural Systems*

Balance development and land-use plans with watershed and natural-resource planning.

Rehabilitate, enhance, and preserve natural systems to support mitigation activities.

### *Encourage Stakeholder Partnerships*

Encourage community stakeholders to support mitigation planning and implementation by emphasizing ownership.

Support community leadership in partnering in implementation activities.

### *Improve Emergency Services*

Develop policies that ensure mitigation projects critical services, facilities, and infrastructure. citizen feedback was collected during two public events.

Encourage collaboration between emergency services and community stakeholders to improve emergency-response capabilities.

Integrate natural-hazard mitigation activities with emergency plans and procedures.

## Public Participation

Public input was collected throughout the development of the Mitigation Plan. Input from the community and related stakeholders were collected using three formats: public committees, discussions with related community stakeholders, and community meetings. The public committee that oversaw the process was the San Fernando Disaster Council. This organization is made up of City employees, civic leaders, community members, and other related private and public organizations that are direct stakeholders. Descriptions of the specific strategies and procedures for public participation are contained in the first section titled Planning Methodology.

## Natural-Hazard Mitigation Plan Action Items

This plan identifies both short- and long-term action items. These action items were developed based on the information collected during the data-collection phase. The introductory section explains some of the involved persons and activities that will be part of final action items. The introductory section includes six topics that should be included in the specific action items: coordinating organization, timeline, implementation ideas, goal compliance, constraints, and project evaluation documentation. (Note: Not every topic is relevant to each action item.)

### *Coordinating Organization*

The Coordinating Organization has been identified to oversee the implementation of an individual-action item. This does not preclude additional tasking for other items or a corporate effort by several groups to accomplish a specific project or task. This organization will be responsible for supporting participants, collecting resources, ensuring collaboration between disparate groups, and seeking conventional or alternative funding sources.

### *Timeline*

This plan includes short- and long-term mitigation activities. Each action item includes an estimate of the time required to complete it. Short-term items can typically be completed in 1 to 2 years using locally available resources. Long-term items may take up to 5 years and often require the collection of additional resources and the use of alternative funding sources.

### *Implementation Plan*

Each action item includes a brief description of how the specific task will be accomplished including the identification of external funding sources such as grants.

### *Goal Compliance*

This portion of each action item explains how the item is related to the guideline planning list.

*Constraints*

Constraints may apply to some of the action items. Constraints may include legal issues or problems such as a lack of funding.

*Project Evaluation/Documentation*

Each step of the process will be evaluated and the results documented. This includes discussions regarding the final selection of what projects or mitigation activities will be selected.

## Prioritizing Action Items

The priorities for the short-term mitigation activities reflect the dynamic nature of San Fernando's future. The short-term priorities are divided between developing a role for the Natural-Hazard Mitigation Advisory Committee (NHMAC) and locating alternate funding sources for mitigation activities. The immediate future of City development mandates that hazard mitigation must become part of the planning and decision-making processes of the City. Identifying alternate funding sources is very important to support this process during the period of development when future financial resources have not been realized.

The priorities for long-term action items are divided into three areas: improving emergency response systems by integrating them into mitigation planning, developing public education related to hazard mitigation, and linking environmental data to link natural resource management to hazard mitigation planning.

The next section contains the activities related to multihazards.
Both of the natural hazards identified in this study fall into this category: earthquakes and flooding. There are six short- and three long-term activities that have been identified:

### Short-Term Activity—Multihazard #1

*Integrate the goals and action items in the City of San Fernando Natural-Hazard Mitigation Plan into existing local programs, planning, and ordinances.*

Coordinating Organization: Natural-Hazard Mitigation Advisory Committee

Time Line: Continuous

Implementation Plan:

A) The findings and recommendations of the Natural-Hazard Mitigation Plan will be used in modifying or developing future ordinances or guidelines related to new construction and development projects.

B) The findings will be included in current capital-improvement plans.

C) The Council will facilitate and coordinate planning between all stakeholders involved in developing or enforcing building and safety codes.

Goal Compliance: Encouraging partnerships and protecting life and property.

Constraints: Ensuring any new ordinances are legal and comply with existing statutes.

Project Evaluation/Documentation: A review of these activities will be included in the biannual meetings of the NHMAC. These activities will be provided to the City Administrator in the form of an annual report.

Short-Term Activity—Multihazard #2

*Identify and pursue external funding opportunities to support local mitigation activities*

Coordinating Organization: City Planning Department

Time Line: Continuous

Implementation Plan: Identify programs that encourage local stakeholders to support mitigation activities and planning. This should include identifying programs that:

A) Participate in local and regional planning and hazard-mitigation activities to ensure awareness of potential funding opportunities.

B) Identify funding programs available to community and private stakeholders and encourage local participation.

Goal Compliance: Encouraging stakeholder partnerships and improving public awareness.

Constraints: Available funding opportunities.

Project Evaluation/Documentation: A review of these activities will be included in the biannual meetings of the NHMAC. These activities will be provided to the City Administrator in the form of an annual report.

Short-Term Activity—Multihazard #3

*Establish a role for the City of San Fernando Natural-Hazard Mitigation Committee to establish a sustainable process for planning, developing, implementing, evaluating, and monitoring citywide mitigation activities.*

Coordinating Organization: City Council and the City Disaster Council

Time Line: Continuous

Implementation Plan: This activity is designed to integrate the Natural-Hazard Mitigation Advisory Committee into mainstream and ongoing City activities:

A) Establish clear organizational responsibilities and roles for committee members.

B) Oversee implementation of the Mitigation Plan.

B) Conduct an annual review of the Mitigation Plan with a comprehensive review in the third year of implementation. This will include a written report to the City Administrator and the Disaster Council.

Goal Compliance: Encourage stakeholder participation.

Constraints: Availability of personnel.

Project Evaluation/Documentation: The meetings of the committee will be documented and the minutes provided for the Disaster Council.

Short-Term Activity—Multihazard #4

*Identify, develop, and sustain collaborative programs designed to reduce natural hazards impacting local businesses, real estate, and related insurance risks.*

Coordinating Organization: City Planning Department, San Fernando Chamber of Commerce.

Time Line: Continuous

Implementation Plan: This activity will be directed at specific stakeholder groups such as local business owners and citizen homeowners:

A) Identify specific hazards that may require specific mitigation activities to help lessen insurance-loss exposure.

B) Develop public information programs to educate this stakeholder segment regarding insurance requirements.

C) Pinpoint areas of increased exposure and encourage the transfer of the cost of the risk from public coverage to comprehensive private insurance.

Goal Compliance: Protecting life and property and encouraging stakeholder partnerships.

Constraints: Available funding and personnel.

Project Evaluation/Documentation: This activity will be documented during biannual committee meetings.

Short-Term Activity—Multihazard #5

*Encourage and facilitate public and private collaboration in developing the mitigation strategy.*

Coordinating Organization: Natural-Hazard Mitigation Committee, San Fernando Chamber of Commerce.

Time Line: Continuous

Implementation Plan:

A) Identifying members of the San Fernando stakeholder community that have interests, operations, or programs impacted by the Natural-Hazard Mitigation Plan.

B) Make planning activities available to stakeholder groups to encourage participation.

C) Serve as an information conduit between City government and related stakeholders.

Goal Compliance: Encourage stakeholder partnerships and promote public awareness.

Constraints: Available personnel and funding sources.

Project Evaluation/Documentation: This goal will be reviewed during the biannual meeting of the hazard-mitigation committee.

Short-Term Activity—Multihazard #6

*Prioritize mitigation activities including the identification of properties that may be at greater risk for potential exposure to natural hazards.*

Coordinating Organization: City Planning, Public Works, and Code Enforcement.

Time Line: Continuous

Implementation Plan

A) Review historic or at-risk areas as identified in the Specific Corridor redevelopment report.

B) Review the condition of critical infrastructure locations in the City.

Goal Compliance: Protect life and property and improve emergency services.

Constraints: Availability of personnel and funding sources.

Project Evaluation/Documentation: This will be collected in a report reviewed each year by the Natural Hazard-Mitigation Committee.

Long-Term Activity—Multihazard #1

*Improving emergency response capability by linking it to the natural hazard mitigation program.*

Coordinating Organization: Police Department, Los Angeles City Fire Department, Disaster Council, and the San Fernando Chamber of Commerce.

Time Line: Continuous

Implementation Plan:

A) Identify any natural hazards that can impact the delivery or continuity of public safety services and the City emergency-response capability.

B) Compare changes in emergency-response requirements and capabilities against natural-hazard levels identified in the Natural-Hazard Mitigation Plan.

C) Encourage stakeholder participation in individual preparedness efforts.

D) Support the organization and training of Community Emergency-Response Teams throughout the City.

E) Identify private community stakeholders who may have special skills or equipment that can be used during an emergency.

Goal Compliance: Improve emergency services.

Constraints: Available personnel

Project Evaluation/Documentation: This activity will be documented and provided to the Natural-Hazard Mitigation Committee for their biannual meetings.

Long-Term Activity—Multihazard #2

*Plan, develop, and implement a public education program regarding natural-hazard mitigation for the San Fernando Community.*

Coordinating Organization: City Disaster Council

Time Line: Continuous

Implementation Plan:

A) Make the Natural-Hazard Mitigation Plan available electronically by publishing it on the City website.

B) Conduct public workshops to share the information developed by the plan.

C) Use local public-access media outlets to share information and encourage public participation.

D) Advertise the activities of the Disaster Council and the Natural-Hazard Mitigation Advisory Committee to encourage public participation.

Goal Compliance: Public Awareness

Constraints: Availability of funding and personnel.

Project Evaluation/Documentation: Document the public awareness activities for inclusion in the annual report of the Natural-Hazard Mitigation Advisory Committee.

Long-Term Activity—Multihazard #3

*Incorporate technical data of the environment to link natural-resource management and land-use planning to mitigation activities.*

Coordinating Organization: Public Works and City Planning Departments

Time Line: Continuous

Implementation Plan:

A) Review ordinances that protect natural systems and resources and integrate them with the Natural-Hazard Mitigation Plan.

B) Pursue landscaping practices that enhance and restore the natural functions of the watershed.

C) Develop outreach programs that focus on protecting the local environment as a mitigation activity.

Goal Compliance: Supporting the natural system.

Constraints: Funding, environmental-protection standards, and available personnel.

Project Evaluation/Documentation: Document and review progress at the biannual meetings of the Natural-Hazard Mitigation Advisory Committee.

Long-Term Activity—Multihazard #4

*Develop strategies to include local businesses in the City natural-hazard mitigation and emergency-preparedness planning.*

Coordinating Organization: San Fernando Disaster Council

Timeline: Continuous

Implementation Plan:

A) Develop contacts within the business community to educate them about San Fernando's natural hazard mitigation planning and City emergency preparedness plan.

B) Develop a plan to include the San Fernando business community in emergency-preparedness planning.

C) Provide training for members of the San Fernando business community in short- and long-term mitigation and emergency-preparedness practices.

Goal Compliance: Increase public awareness and stakeholder participation.

Constraints: Public interest.

Program Evaluation/Documentation: Collected in an annual report by the Hazard Mitigation Committee.

Long-Term Activity—Multihazard #5

Develop an economic forecast based on possible losses due to a natural disaster.

Coordinating Organization: City of San Fernando Redevelopment, City Finance, and The San Fernando Chamber of Commerce.

Timeline: Continuous

Implementation Plan:

A) Prepare a forecast of the potential impact of natural disasters on the San Fernando economy.

B) Develop an economic response plan in case of a major disaster.

Goal Compliance: Protecting life, property, and encouraging stakeholder partnerships.

Constraints: Availability of funding and personnel.

Project Evaluation/Documentation: A report of this forecast should be provided to the City Administrator a report.

## Summary

The San Fernando natural-hazard mitigation development process took careful notice of the standards set by state and federal guidelines. These guidelines emphasize protecting the community while encouraging stakeholder participation. One of the most important long-term activities will be including the business community in the natural-hazard and emergency-preparedness planning process. The items adopted clearly identify how the action items will be organized. Implemented, and supported. The next section will explain how the plan will be maintained.

## Section 6: Plan Maintenance

### Introduction

This section describes the process that will ensure the City of San Fernando's Natural-Hazard Mitigation Plan remains an active and relevant document. The Maintenance Plan includes: a biannual meeting schedule, public-involvement strategies, participant documentation, annual reevaluation of goal compliance, and a comprehensive review of the plan in the third year.

### Monitoring and Implementing the Plan

#### *Plan Adoption*

The San Fernando City Council will be responsible for adopting the Natural-Hazard Mitigation Plan. The City of San Fernando Emergency-Preparedness Coordinator will submit the plan to the State Hazard-Mitigation Office in the Governor's Office of Emergency Services (OES). The Office of Emergency Services will submit the plan to the Federal Emergency Management Agency for review regarding compliance with FEMA Interim Final Rule 44 CFR Part 201. Acceptance by FEMA will allow the City of San Fernando to become eligible for Hazard-Mitigation Grant-Program funds.

#### *Coordinating Body*

The City of San Fernando Hazard-Mitigation Plan will be developed and implemented by the Natural-Hazard Mitigation Advisory Committee. This committee will be attached to the City Disaster Council. The committee membership will include:

Three members of the Disaster Council
A representative of the Police Department
A representative of the Public Works Department
A representative of the City Planning Department
The City Emergency-Preparedness Coordinator

The committee will be responsible for overseeing implementation. The committee shall meet biannually with the schedule of the meetings published to encourage public access in the process. The meetings will be used to: assign mitigation activities, review and document progress, and evaluate goal compliance.

#### *Convenor*

The City Administrator, the Emergency-Preparedness Coordinator or designee, will serve as the convenor to chair and facilitate the meetings.

### Implementation Through Existing Programs

It is the intent of the Natural-Hazard Mitigation Plan that the recommendations related to mitigation activities be incorporated into existing City codes and ordinances. This

includes the City Building and Safety Code. The practices and recommendations developed in the Natural-Hazard Mitigation Plan will also be incorporated into the City Specific Corridor Redevelopment Plan and related projects. The inclusion of hazard-mitigation principles and activities will continue in future City redevelopment projects.

## Economic Analysis of Mitigation Projects

It is vital that decision makers determine the economic impact of natural hazards. This information allows stakeholders to understand the potential benefits as well as the cost of the activity. FEMA uses two approaches to evaluate the costs and benefits of natural-hazard mitigation programs.

Mitigation strategies, activities, and projects are evaluated by benefit/cost and cost-effectiveness analysis. Benefit/cost analysis can help determine if a project is worth undertaking based on the potential for future losses from disaster-related damages. Cost-effectiveness analysis evaluates the best strategy in spending funds to meet certain mitigation goals.

## Evaluating and Updating the Plan

### *Review Process*

The City of San Fernando Natural-Hazard Mitigation Plan will be evaluated on an annual basis to determine goal compliance, program effectiveness, and evaluate changes in the community which might impact the validity of the current plan. The convenor or designee will be responsible for contacting the members of the committee to schedule a meeting. If the evaluation identifies new hazards or changes that impact the plan, committee members will be assigned to investigate and make recommendations.

Once the annual evaluation including new recommendations is complete, the findings will be communicated to the City Administrator. Every 5 years the updated plan will be submitted to the State Hazard-Mitigation Officer and FEMA for review.

### *Continued Public Involvement*

The intent of this program is to encourage public involvement during the initial planning and continuing through the annual evaluation of the plan. The plan will be available at City Hall in the Public Works Department and on the City website. The public will be invited to participate during a public comment session at each meeting of the committee.

## Part II: Specific Natural Hazards

### Section 7: Earthquakes

Introduction:
Why Are Earthquakes a Threat to the City of San Fernando?

The City of San Fernando is situated in one of the most active geological areas of the United States. California has a long history of seismic activity. The U.S. Geological Survey records hundreds of minor earthquakes every week in California. Since 1769 there have been 33 major earthquakes of a magnitude of 5.0 or greater.

The most well-known geologic feature related to local seismic activity is the San Andreas Fault. This fault is approximately 400 hundred miles long. The fault begins in Mexico, travels north to San Francisco, and gradually curves out into the Pacific Ocean. Scientists estimate that in the past 1,500 years major earthquakes have occurred at about a 130-year interval. The last major earthquake related to this fault occurred near Fort Tejon in northern Los Angeles County. This earthquake occurred in 1857 and is estimated to have been a magnitude of 8. This is the largest recorded earthquake in the history of California.

Understanding Earthquakes

Earthquakes are caused by the movement of the earth's crust along fracture lines called faults. A fault is the separation point between blocks of the earth's crust where either side can move relative to the other along a parallel plane to the fracture line. Faults are divided into two main types: strike-slip and dip-slip.

*Strike-slip Faults*

Strike-slip faults appear where the fracture in the earth's crust is vertical or nearly vertical. The blocks or plates of the earth's crust will primarily move horizontally. The fault can be further categorized as right or left lateral faults depending on the direction that the fault is slipping.

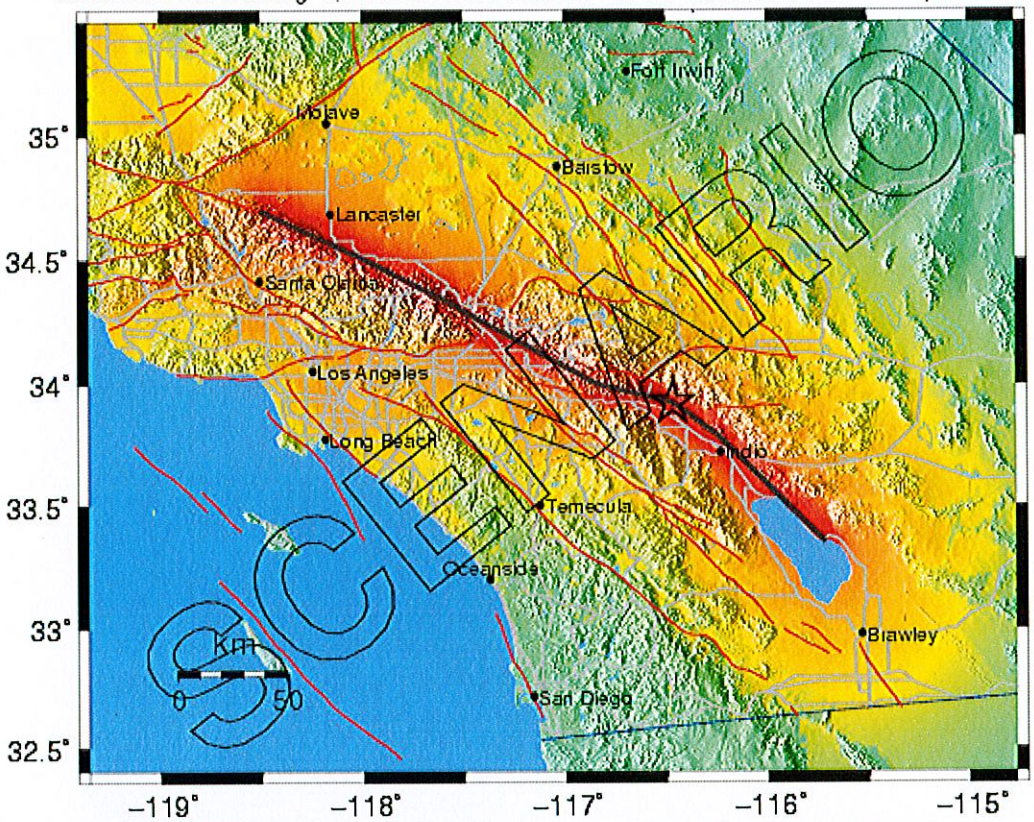
*Dip-slip Faults*

Dip-slip faults differ from strike-slip faults in that the fracture is slanted but the blocks of earth move vertically. If the earth above this fault drops during movement the fault is called a 'normal' fault. If the earth moves upwards the fault is a 'reverse' fault. Reverse faults with an angle of 45 degrees or less are called thrust faults.

-- Earthquake Planning Scenario --

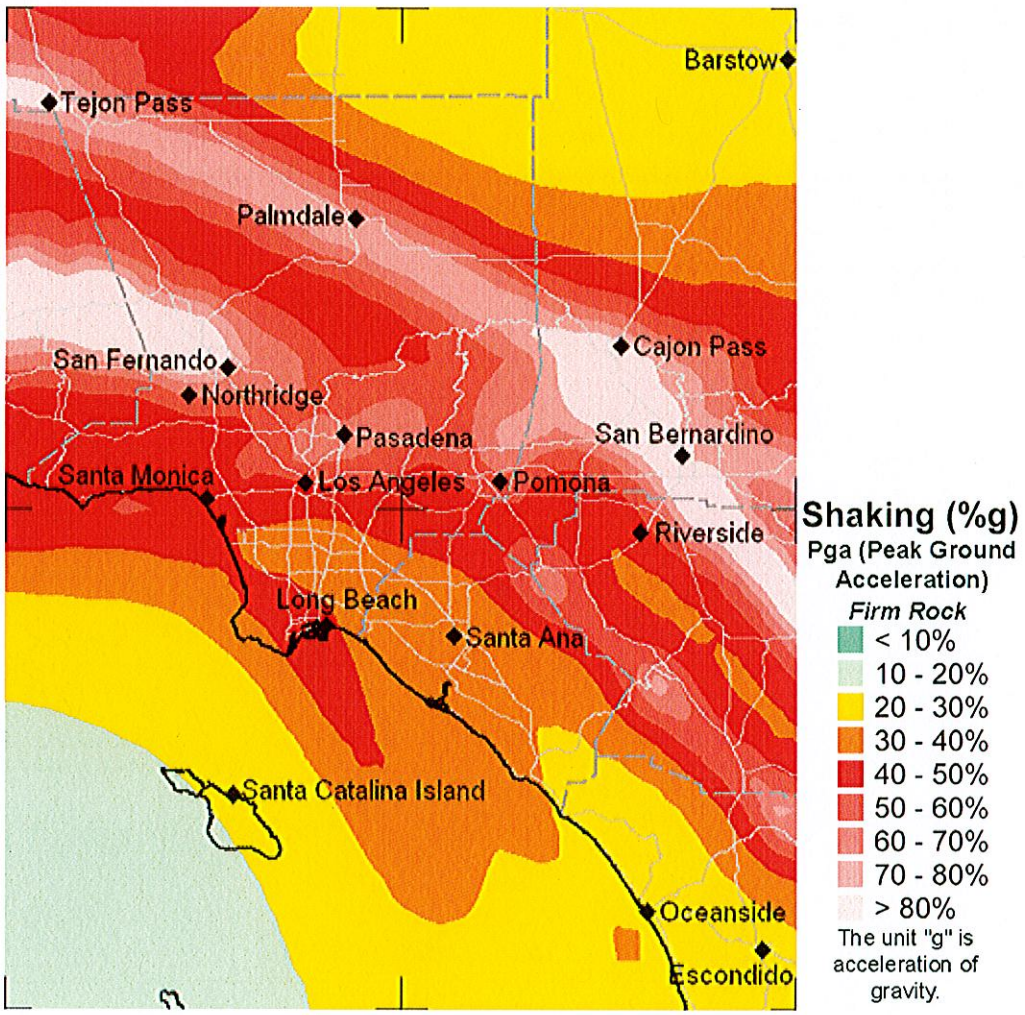
ShakeMap for Saf South7.8 Scenario

Scenario Date: Thu Aug 3, 2006 05:00:00 AM PDT M 7.8 N33.92 W116.47 Depth: 10.0km




PLANNING SCENARIO ONLY -- Map Version 4 Processed Fri Oct 6, 2006 02:40:11 PM PDT

| PERCEIVED SHAKING | Not felt | Weak | Light | Moderate | Strong | Very strong | Severe | Violent | Extreme |
|---|---|---|---|---|---|---|---|---|---|
| POTENTIAL DAMAGE | none | none | none | Very light | Light | Moderate | Moderate/Heavy | Heavy | Very Heavy |
| PEAK ACC.(%g) | <.17 | .17-1.4 | 1.4-3.9 | 3.9-9.2 | 9.2-18 | 18-34 | 34-65 | 65-124 | >124 |
| PEAK VEL.(cm/s) | <0.1 | 0.1-1.1 | 1.1-3.4 | 3.4-8.1 | 8.1-16 | 16-31 | 31-60 | 60-116 | >116 |
| INSTRUMENTAL INTENSITY | I | II-III | IV | V | VI | VII | VIII | IX | X+ |




**Interactive Ground Motion Map - Centered on 118° W (Longitude); 34° N (Latitude)**

***Peak Ground Acceleration—10% chance of being exceeded in 50 years***

Predicting Earthquakes

Seismologists have concentrated on the problem of predicting earthquakes for the past 100 years. The cost of human life and property from earthquake and earthquake-related incidents makes this natural hazard one of the greatest threats on the earth. The Indian Ocean earthquake/tsunami of 2005 was one of the greatest natural calamities in recorded history. The problem with earthquake prediction is the multitude of unknown variables that may influence geologic movement. Various scientists have suggested that several factors or a combination of these factors may cause earthquakes. These factors include hydrological conditions or changes, magma flows, temperature variations, and

underground deformation due to slippage within the earth's crust. The problem is the lack of accurate information about conditions under the surface of the earth.

Predicting earthquakes offers an opportunity to mitigate the effects of such a natural disaster but prediction also presents policy makers and public-safety decision makers with a significant challenge. Currently in Los Angeles County there are no established protocols for mass evacuation, care, and shelter of the public. If earthquakes could be predicted, providing the information to the public would present significant related problems for public officials. The possibility of public disorder or panic related to possible spontaneous evacuation is a real and important concern.

Ongoing prediction research may make accurate predictions possible in the next 5 to 10 years. Public safety planners must anticipate the benefits and challenges of improved predictive methods. Southern California is one of the internal centers for this type of research. Several methods of possibly predicting earthquakes are currently being studied. Several are based on the assumption that changes under the earth may cause surface deformations. By correlating the surface deformation changes it may be possible to predict slippage of faults under the earth.

### *Interferometric Synthetic Aperture Radar (InSAR)*

InSAR is a program developed by seismologists from the California Institute of Technology and the NASA Jet Propulsion Laboratory. The InSAR program is part of a United States government program called EarthScope which was established to understand solid-earth process and provide research data for public agencies such as FEMA. InSAR involves focusing satellite-based radar that can measure changes on the surface of the earth.

The InSAR researchers are evaluating four important questions: what mechanisms control the occurrence of seismic fault movement, what stress-transfer processes trigger seismic activity, do magma movement and earthquakes affect each other, and are there precursor surface-deformation phenomena that can be used to predict seismic activity? At this time the results have been inconclusive but a secondary benefit of this research is InSAR can provide data that can improve or define information collected by other research methods.

### *Global Positioning Satellite Research*

Global-positioning satellite (GPS) research is proving a useful tool to measure the movement of geographic features and structures on the surface of the earth. This is a similar but less expensive approach to tracking surface movement then interferometric radar-based research. GPS prediction techniques are based on the same theoretical basis as InSar: Surface deformation indicates a buildup of underground stress that precedes fault slippage. The value of GPS-based research is it uses available GPS technology and does not require the deployment of expensive technology such as launching a satellite. This simplifies the time and effort from deployment to gathering useful data. GPS-based

research can track surface movement and some types of deformation. In the past 8 years scientists from the California Institute of Technology and the United States Geological Survey (USGS) have used this method to track geological movement and evaluate possible stresses on earthquake-sensitive structures.

One of the most notable research projects has been the GPS-based monitoring of the Pacoima Dam directly east of the City of San Fernando. USGS researchers have placed GPS sensors on the dam and the surrounding topography to analyze stress levels to the structure, identify possible points of structural and topographical failure, and predict various effects on the structure based on possible earthquake scenarios.

### *Hydrological, Geochemical, and Electromagnetic Research*

The third research approach to earthquake prediction is based on examining changes in the electromagnetic, geochemical, and hydrological systems in the crust of the earth. Several research studies indicate that changes occur in these natural systems prior to an earthquake. This research has been conducted in several international universities such as the University of Athens and the University of Tokyo. The hydrological approach is based on data indicating that changes in ground-water tables may occur prior to an earthquake. This is based on data from the 1976 Tangshen earthquake in China. In this incident underground water had been steadily subsiding when a new infusion of water suddenly caused the water table to rise. This change directly preceded this earthquake.

The geochemical prediction model is based on the theory that changes in underground chemical processes may indicate an imminent earthquake event. These changes include sudden increases in radon gas levels and the salinity of ground water. The third predictive method is to monitor changes in the electromagnetic fields under the surface of the earth. Some seismologists believe that fluctuations in this field may precede an earthquake.

## Earthquake Related Hazards

There are four specific hazards associated with earthquakes: ground shaking, landslides, liquefaction, and amplification. The severity of an earthquake is further influenced by a combination of five factors found at the point of the fault and the surrounding areas. The five geographic/environmental factors are: soil composition, topography, proximity to the fault, magnitude of the earthquake, and the type of earthquake.

### *Ground Shaking*

Earthquakes generate seismic waves which are felt at the surface of the earth as ground shaking. This shaking results in the majority of the damage to structures at the earth's surface. The four factors that influence the strength of the shaking are the magnitude of the event, the distance to the epicenter, the type of fault, and the composition of the soil. Structures placed on loosely consolidated soil will typically receive greater damage than those built over bedrock or tightly compacted soil. (Note: A specific hazard related to the impact of seismic waves and the threat of flooding will be covered in the next section subtitled *Pacoima Dam).*

### *Landslides*

Landslides are a secondary earthquake-related hazard. A landslide can occur when the movement of a fault causes a hillside to become unstable and move.

### *Liquefaction*

Liquefaction occurs when the ground shaking causes soft, wet, granular soil to change from a solid state to a liquid sate. This often occurs in regions that were former river beds or have the water table near the surface. Liquefaction can cause the soil to lose its ability to support structures and result in their collapse.

### *Amplification*

The strength of seismic waves can be amplified at the surface by the presence of soft sedimentary rock formations. This commonly occurs in deep sediment-filled basins. The physical properties and depth of the rock formations along a fault area can influence the amount of amplification that occurs. Amplification is similar to liquefaction because both commonly occur in areas of soft or unconsolidated soil and result in significant surface damage to structures.

## Local Fault Zones

This section will describe some of the faults near the City of San Fernando. It should be noted that geologists believe that the area has many uncharted faults which are capable of causing a major earthquake. Besides the San Andreas Fault there are a number of active faults in the eastern San Fernando and northern San Gabriel valleys. The presence of so many active faults makes the City of San Fernando highly vulnerable to a major earthquake. These faults include Northridge, Verdugo, and Sierra Madre.

### *San Andreas*

The San Andreas fault is considered a "Master Fault" because it is the boundary of the Pacific and North American geologic plates. This fault has generated major and frequent earthquakes. This fault is approximately 1,000 miles in length. It originates in northern California and terminates in the Salton Sea region of Southern California. The fault is divided into five segments reflecting the variety and local conditions along its length. Each of these segments demonstrate independent rates of movement and are capable of causing an earthquake.

The segment closest to the City of San Fernando is the Mojave segment. This segment is approximately 83 miles long. Evaluations of the fault and its history indicate the possibility of a major earthquake incident occurring between 1994 and 2026.

*Northridge/Oak Ridge Fault*

This fault was responsible for the 1994 Northridge earthquake. It may be an extension of the easternmost section of the Oak Ridge fault system. This fault is a blind thrust fault which was unknown prior to the 1994 event. It caused major damage in the central and northern San Fernando Valley and in isolated pockets in Santa Monica and as far away as Anaheim in Orange County.

*Verdugo*

The Verdugo fault is approximately 13 miles from San Fernando. Experts have gathered conflicting data regarding the nature and composition of this fault. The most recent research indicates that this fault changes composition and direction along its length. The fault seems to vary from a reverse fault at the northern end to a left-lateral strike slip fault further south. The recurrence rate of this fault can not be estimated without field trenching studies. It is believed to be an active fault and capable of generating an earthquake in magnitude from 6.0 to 6.8.

*Sierra Madre*

The Sierra Madre fault is part of a north dipping, reverse fault zone approximately 47 miles in length. The fault runs under the San Gabriel Mountains from San Fernando to San Antonio Canyon where it forks and continues southward as the Cucamonga fault. Geologists believe the fault is divided into five segments with each segment exhibiting varying rates of slippage. The first segment is the San Fernando segment. This portion of the fault is the most active and was responsible for the 6.7 magnitude Sylmar earthquake in 1971.

Studies of this fault were conducted in 1987 and 1995. The 1987 study concluded that most of the fault line east of San Fernando was not active. A 1998 study involved field research conducted by trenching a section of the fault near Altadena. This study determined that major earthquakes, greater than 7 in magnitude, have occurred twice in the past 15 years with a ground shift of between 10 to 30 feet at the surface. Geologists have concluded some of the segments of the Sierra Madre fault may be nearing the end of their stability cycle and can be expected to cause a major earthquake in the Los Angeles basin in the near future. The occurrence of the Sylmar quake in 1971 does not seem to preclude a larger quake along any portion of the fault including the San Fernando segment.

## Historical Record of Earthquakes in San Fernando

In 1971 and 1994 the City suffered two major earthquakes. The first was the Sylmar earthquake. This event was measured at a magnitude of 6.6. It was centered in Sylmar which is a community directly north of San Fernando. The second was the 1994 Northridge earthquake which had a magnitude of 6.7.

*1971 Sylmar Earthquake*

The 1971 Sylmar earthquake struck on February 9th at 6:01 AM. The epicenter was 6 miles northeast of Sylmar. The earthquake caused 65 deaths and millions of dollars in property loss. There were numerous bridge and freeway collapses. Several large hospital complexes in Sylmar were destroyed. Un-reinforced masonry buildings were especially susceptible to the extreme shaking and many of these buildings collapsed. Many buildings were badly damaged in San Fernando.

The San Gabriel Mountains directly east of San Fernando rose several feet. Surface breaks caused by faulting during the earthquake appeared across the northeastern corner of the San Fernando Valley. This type of break appeared in a San Fernando residential area.

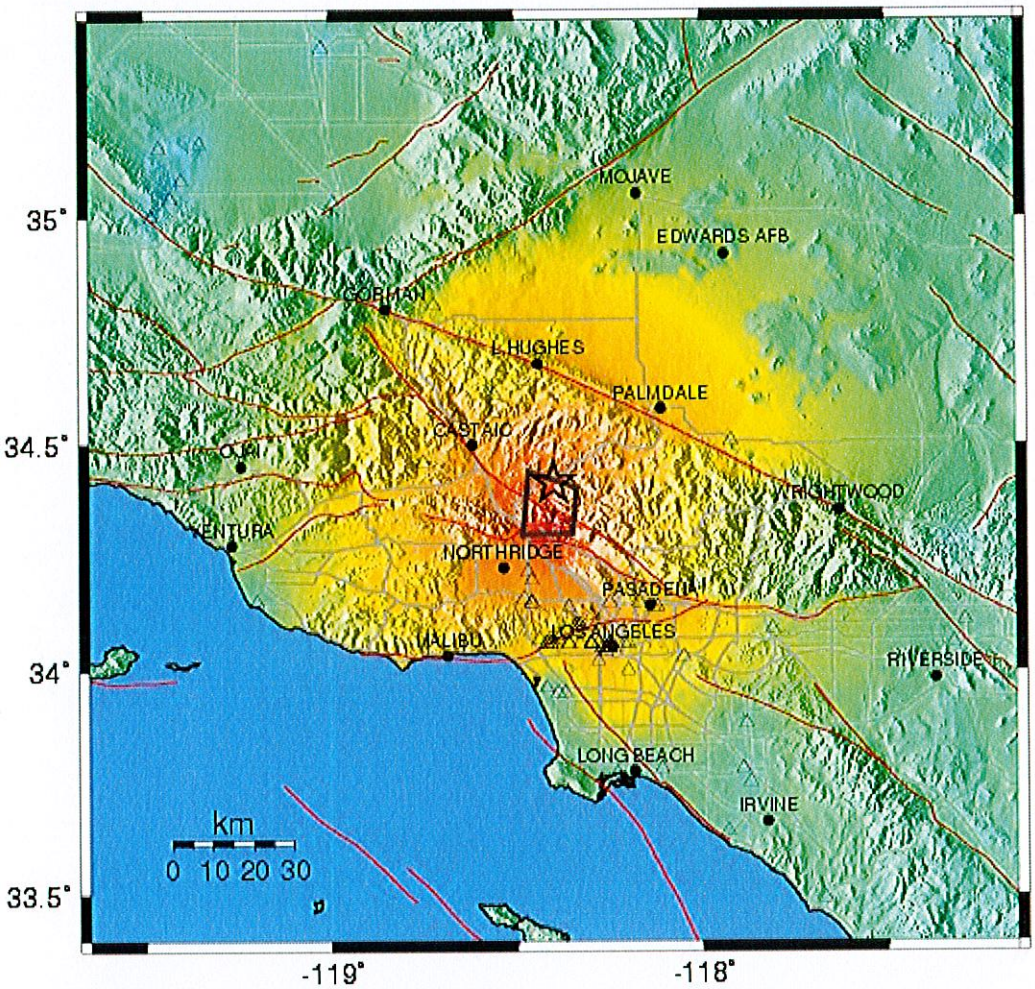
*1994 Northridge Earthquake*

The second major earthquake was the 1994 Northridge earthquake which occurred on January 17, at 0430 AM. This event was measured at a magnitude of 6.7. The City of San Fernando suffered extensive damage to structures and utilities. The earthquake originated in a hidden fault approximately 8 miles below the surface of the San Fernando Valley about 20 miles west of the City of San Fernando. The earthquake caused a rupture along the fault line that traveled upwards in a northwestern direction. The fault, now called the Oak Ridge or Northridge fault system, intersected with a branch of the Sierra Madre fault, which was responsible for the 1971 Sylmar earthquake. The earthquake lasted approximately 15 seconds.

The surface of the central San Fernando Valley was deformed upwards into an asymmetric dome. The Santa Susanna Mountains north of the San Fernando Valley were also pushed up several inches. The result was one of the greatest disasters in the history of the United States. Large portions of the northern section of the Los Angeles basin were devastated by structural collapses and a corresponding loss of life and injury. A total of 25,000 homes were totally or partially destroyed. Nine area hospitals were closed due to damage. There were 51 fatalities, and 9,000 injuries.

CISN Rapid Instrumental Intensity Map for San Fernando Earthquake

Tue Feb 9, 1971 06:00:41 AM PST M 6.7 N34.42 W118.40 Depth: 8.0km ID:San_Fernando

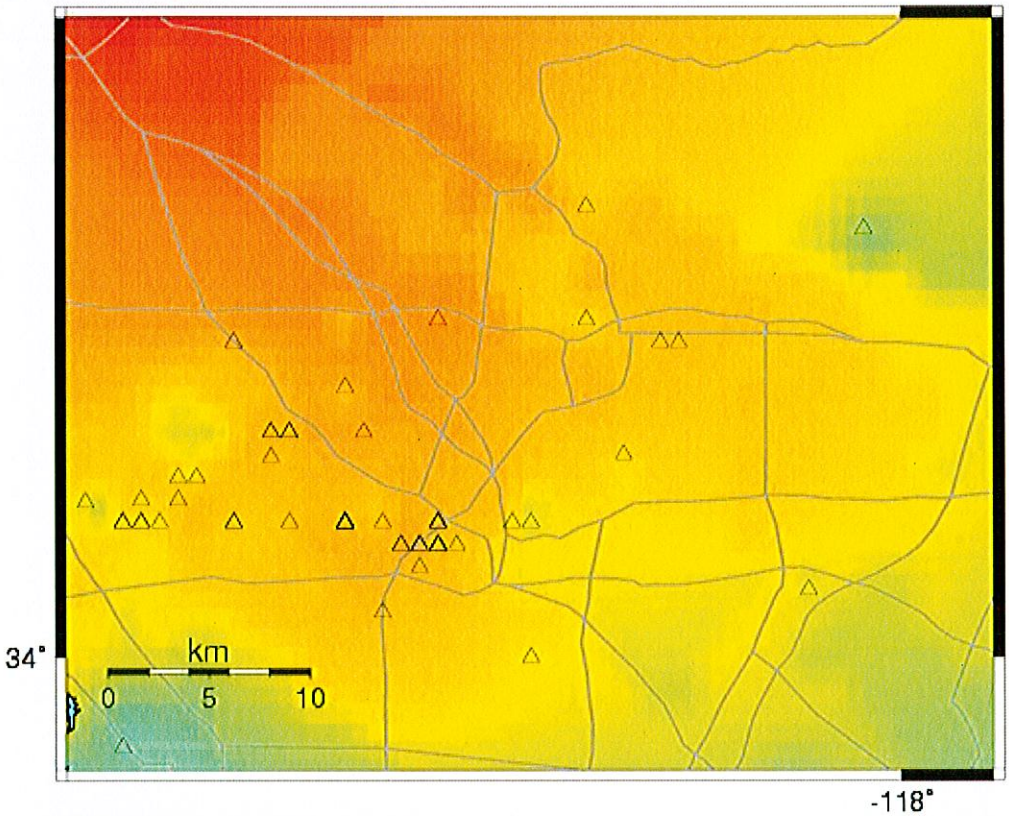



Processed: Thu Feb 19, 2004 03:44:42 PM PST.

| PERCEIVED SHAKING | Not felt | Weak | Light | Moderate | Strong | Very strong | Severe | Violent | Extreme |
|---|---|---|---|---|---|---|---|---|---|
| POTENTIAL DAMAGE | none | none | none | Very light | Light | Moderate | Moderate/Heavy | Heavy | Very Heavy |
| PEAK ACC.(%g) | *<.17* | *.17-1.4* | *1.4-3.9* | *3.9-9.2* | *9.2-18* | 18-34 | 34-65 | 65-124 | *>124* |
| PEAK VEL.(cm/s) | <0.1 | 0.1-1.1 | 1.1-3.4 | 3.4-8.1 | 8.1-16 | *16-31* | *31-60* | *60-116* | *>116* |
| INSTRUMENTAL INTENSITY | I | II-III | IV | V | VI | VII | VIII | IX | X+ |

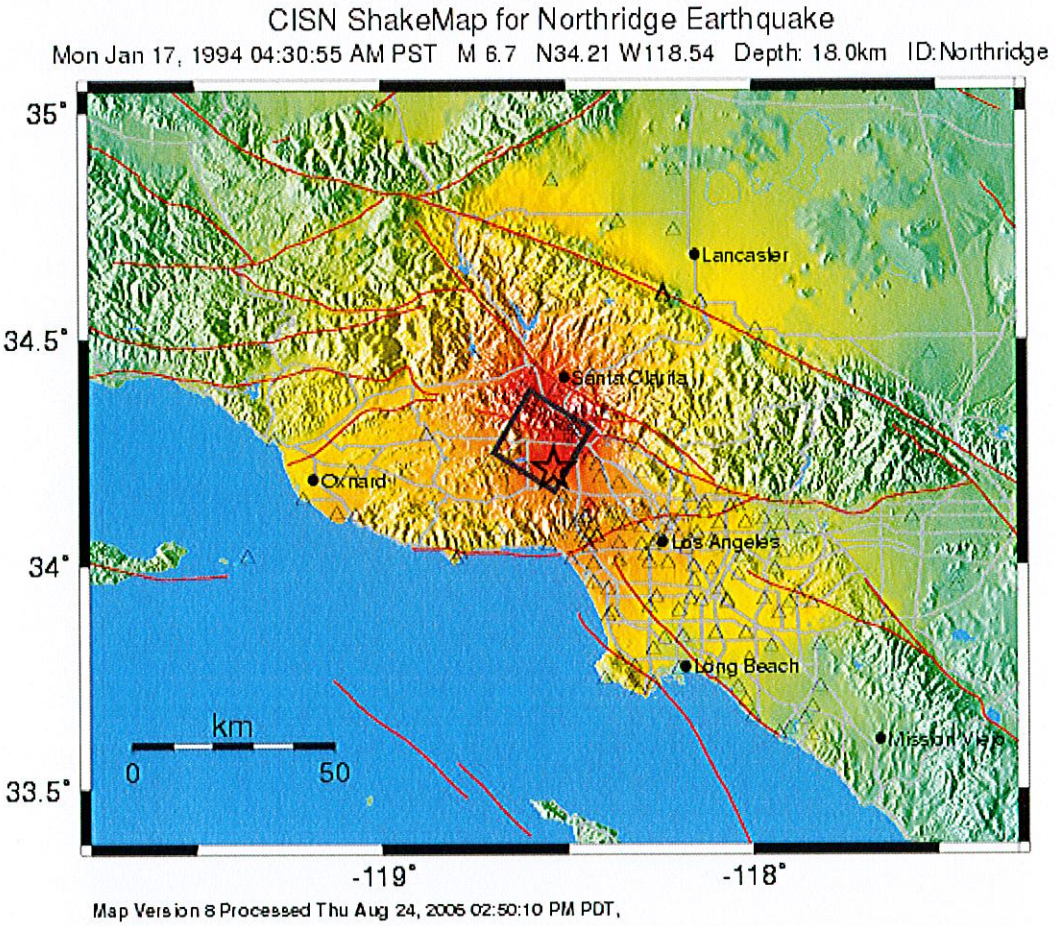
CISN Rapid Instrumental Intensity Map for San Fernando zoom Earthquake

Tue Feb 9, 1971 06:00:41 AM PST M 6.7 N34.42 W118.40 Depth: 8.0km ID:San_Fernando_zoom




PROCESSED: Fri Mar 28, 2003 01:50:10 PM PST.

| PERCEIVED SHAKING | Not felt | Weak | Light | Moderate | Strong | Very strong | Severe | Violent | Extreme |
|---|---|---|---|---|---|---|---|---|---|
| POTENTIAL DAMAGE | none | none | none | Very light | Light | Moderate | Moderate/Heavy | Heavy | Very Heavy |
| PEAK ACC.(%g) | *<.17* | *.17-1.4* | *1.4-3.9* | *3.9-9.2* | *9.2-18* | 18-34 | 34-65 | 65-124 | >124 |
| PEAK VEL.(cm/s) | <0.1 | 0.1-1.1 | 1.1-3.4 | 3.4-8.1 | 8.1-16 | *16-31* | *31-60* | *60-116* | *>116* |
| INSTRUMENTAL INTENSITY | I | II-III | IV | V | VI | VII | VIII | IX | X+ |

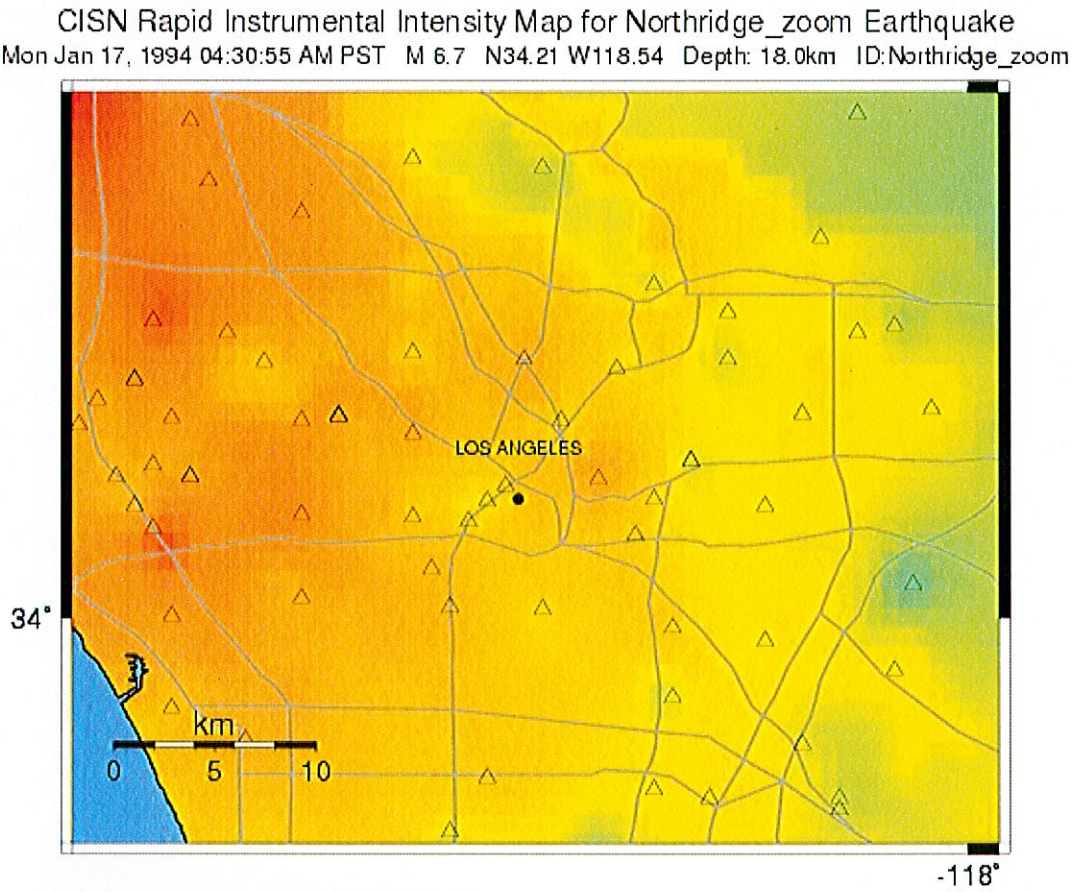



| PERCEIVED SHAKING | Not felt | Weak | Light | Moderate | Strong | Very strong | Severe | Violent | Extreme |
|---|---|---|---|---|---|---|---|---|---|
| POTENTIAL DAMAGE | none | none | none | Very light | Light | Moderate | Moderate/Heavy | Heavy | Very Heavy |
| PEAK ACC.(%g) | *<.17* | *.17-1.4* | *1.4-3.9* | *3.9-9.2* | *9.2-18* | 18-34 | 34-65 | 65-124 | >124 |
| PEAK VEL.(cm/s) | <0.1 | 0.1-1.1 | 1.1-3.4 | 3.4-8.1 | 8.1-16 | *16-31* | *31-60* | *60-116* | *>116* |
| INSTRUMENTAL INTENSITY | I | II-III | IV | V | VI | VII | VIII | IX | X+ |

After the initial event, aftershocks of varying magnitude occurred at the rate of 1000 a day for several weeks. The estimated economic loss was approximately $40 billion with $800 million in insurance claims. The City of San Fernando was badly damaged. Many homes were partially or totally destroyed. Parts of the City lost power and water. An underground petroleum pipeline on the southern edge of the City exploded causing a serious fire. Many San Fernando residents abandoned their homes during the explosion of aftershocks and moved to the open spaces of the City parks.

There were several major issues related to long-term mitigation of the earthquake's effects: severe damage to the utility infrastructure, debris removal, and clearing the parks of temporary residents. The City water system was badly damaged. This required many months of repairs to water mains and pumping stations. Debris removal required

assistance from outside agencies and lasted over 1 year. Traumatized residents remained in the parks for weeks after the earthquake. The continual impact of significant aftershocks and unrepaired damage prevented them from being willing to move back into their homes.




| PERCEIVED SHAKING | Not felt | Weak | Light | Moderate | Strong | Very strong | Severe | Violent | Extreme |
|---|---|---|---|---|---|---|---|---|---|
| POTENTIAL DAMAGE | none | none | none | Very light | Light | Moderate | Moderate/Heavy | Heavy | Very Heavy |
| PEAK ACC.(%g) | *<.17* | *.17-1.4* | *1.4-3.9* | *3.9-9.2* | *9.2-18* | 18-34 | 34-65 | 65-124 | >124 |
| PEAK VEL.(cm/s) | <0.1 | 0.1-1.1 | 1.1-3.4 | 3.4-8.1 | 8.1-16 | *16-31* | *31-60* | *60-116* | *>116* |
| INSTRUMENTAL INTENSITY | I | II-III | IV | V | VI | VII | VIII | IX | X+ |

## Community Earthquake Issues

### *What is Susceptible to Earthquakes?*

The City of San Fernando faces significant challenges related to the threat posed by earthquakes. As previously described the City sits over a geological zone that is crisscrossed by numerous active faults. The ability of structures and infrastructure to withstand earthquake effects combined with the individual preparedness of community members will determine how susceptible the San Fernando community is to earthquakes.

*Dams*

The City of San Fernando is especially vulnerable to the threat of a dam failure related to a major earthquake event. The City lies directly in line of the flood plain that originates below the Pacoima Dam in Pacoima Canyon. The canyon is in the foothills of the San Gabriel Mountains. The Pacoima Dam was built in 1926 and was the tallest concrete, arch dam in the world at the time of its dedication. The dam is 341 feet tall and over 600 feet wide. The dam varies in thickness, tapering from the base to the top. The dam is supported by a concrete thrust block at its south abutment. The dam has 11 major vertical contraction joints. There is a spillway tunnel through solid rock just south of the south abutment thrust block.

Just after the dam was opened engineers discovered the structure had a tendency to expand or contract up to six inches in an eastward direction. The cause of the displacement was determined to be variations in the ambient temperature. The greatest displacement typically occurs during the summer months of most extreme temperatures.

The dam was significantly damaged in the 1971 Sylmar earthquake. The 6.7 magnitude earthquake sent seismic waves up the mountain canyons to the dam. The topography of the canyon helped to amplify the effects of the waves. The result was a wave motion with the greatest displacement at the crest of the dam. The effect was similar to cracking a whip. The dam was approximately 75% full when the earthquake struck. The support thrust block cracked and the surrounding rock pulled away. The contraction joint nearest the block opened up and the rock just below the thrust block sagged several inches. In 1976 an attempt was made to stabilize the dam by closing the joint, patching the crack, and installing 35 steel tendons to reinforce the dam's connection to the canyon walls.

During the 1994 Northridge earthquake the dam suffered even greater damage. The rock mass below the concrete thrust block slipped. The rock connected to the thrust block moved but the connecting tendons prevented a complete failure. During the earthquake the constriction joints completely opened and closed within their range of motion. The constriction joint nearest the thrust block opened past its limit at the top and constricted closed at the bottom. A diagonal crack appeared from this joint across the thrust block into the rock abutment. Cracks also appeared in the dam wall adjacent to the thrust block. The dam's horizontal lift joints were moved and settled offset with the upper portion of the dam face pushing outwards downstream.

After the 1994 earthquake the U.S. Geological Survey (USGS) installed sensors and GPS receivers to facilitate careful measurements of the dam's movements. In 2001 a 4.3 magnitude earthquake struck the area. The new GPS system recorded the movement of the structure. The measurements disclosed that the topography and condition of the dam structure has significantly changed since the dam was built. Measurements had been made periodically since the 1920s by artificially introducing vibrations into the dam structure. A review of the earlier data compared with the available earthquake data indicated that the vibration patterns in the dam had changed significantly.

The most disturbing fact was that the variables of the canyon topography changed with each earthquake and had combined with the accumulating damage with each successive tremor. The results were studied by Dr. Steven Alves of the California Institute of Technology in his 2004 dissertation titled *Nonlinear analysis of Pacoima Dam with spatially non-uniform ground movement.*

The Pacoima Dam was designed with a specific set of vibration and oscillation parameters based on the topography and the dam design. These parameters are very important because they allow engineers to understand the dam's physical behavior and anticipate any potential structural failures. Dr. Alves concluded the structural damage and changes in topography meant it was impossible to determine exactly what structural behavior might develop or what the effects would be at any point in the structure during another major earthquake event.

Mr. Keith Lilli of the Los Angeles Flood Control District is the engineer responsible for the Pacoima Dam and the Pacoima Wash. Mr. Lilli said the Pacoima Dam was retrofitted with a large spillway system in 2004. This allows the water to be emptied more quickly than the original design allowed. Mr Lilli reported the water level is normally maintained at 23% to 30 % capacity. This level is used because of the potential for seismic activity that might damage the dam. This procedure also prevents mud and debris from blocking the spillways and valves.

The only time the level goes above this is during years of heavy rainfall. This is very infrequent because the average rainfall level is 16 inches. If higher levels were to occur, the water levels would be rapidly lowered by releasing water through the spillways into the wash system. Mr. Lilli said the GPS monitoring system provides real-time information about the condition of the dam. If there was any indication of a possible failure, the information would be transmitted to the City of San Fernando to commence an evacuation of the business along the wash .

*Buildings*

The City of San Fernando has many buildings that are susceptible to earthquake damage. Some of the buildings predate the 1994 earthquake, when building codes were not as strict. The City of San Fernando Specific Corridor Redevelopment Plan involves the replacement of several commercial corridors with new buildings and commercial development. The newer buildings will be more earthquake resistant.

A secondary threat to the buildings in San Fernando is the threat from fire. Fires often accompany major earthquakes. Damage to streets and local public safety facilities may limit an effective response to fires. Numerous underground pipelines ruptured during the 1994 earthquake which resulted in fires throughout the San Fernando Valley. The City of San Fernando had a pipeline fire on its southern border during the 1994 earthquake.

Damaged or destroyed buildings can deposit debris which are physically dangerous or possibly toxic. Debris can block streets and remain a hazard for many months after an earthquake. The City of San Fernando had a full-time crew picking up debris for nearly 1 year after the 1994 earthquake.

*Transportation Systems*
The members of the San Fernando Community commute to work using automobiles and the Metrolink rail system. The City is within easy commuting distance to three freeways. In a major earthquake these transportation systems can be damaged or destroyed. During the 1994 earthquake sections of the San Fernando and Santa Clarita Valleys were isolated due to damage to the local transportation systems.

*Infrastructure*
Infrastructure can be damaged or destroyed during a major earthquake. Schools, public buildings, bridges, and other physical support systems can be damaged or destroyed preventing public access and limiting the ability of local governments to provide basic services to their community. This threat can include the loss of public-safety facilities and other local government offices used as points of contact during times of normal operations.

The City has seven buildings including: the police department, the former police department building, city hall, the city yards/public works complex, the San Fernando Museum, and the old firehouse. The current city yards/public works complex is being relocated to the vacant police building. This move of the public works complex is the only realignment of any major public buildings planned for the immediate future. The firehouse is not currently used. The City has no plans to build any new structures.

The City has several parks. Two of the parks, Chavez and Las Palmas, have gymnasiums, kitchens, restrooms, and multipurpose rooms. These parks are the designated shelter/evacuation points for the City. Chavez Park is the designated location for the relocation of city hall and police department operations. The police department and city-hall buildings have emergency generators. The widespread damage of a major earthquake means that all buildings throughout the City will be damaged.

*Public Utilities*

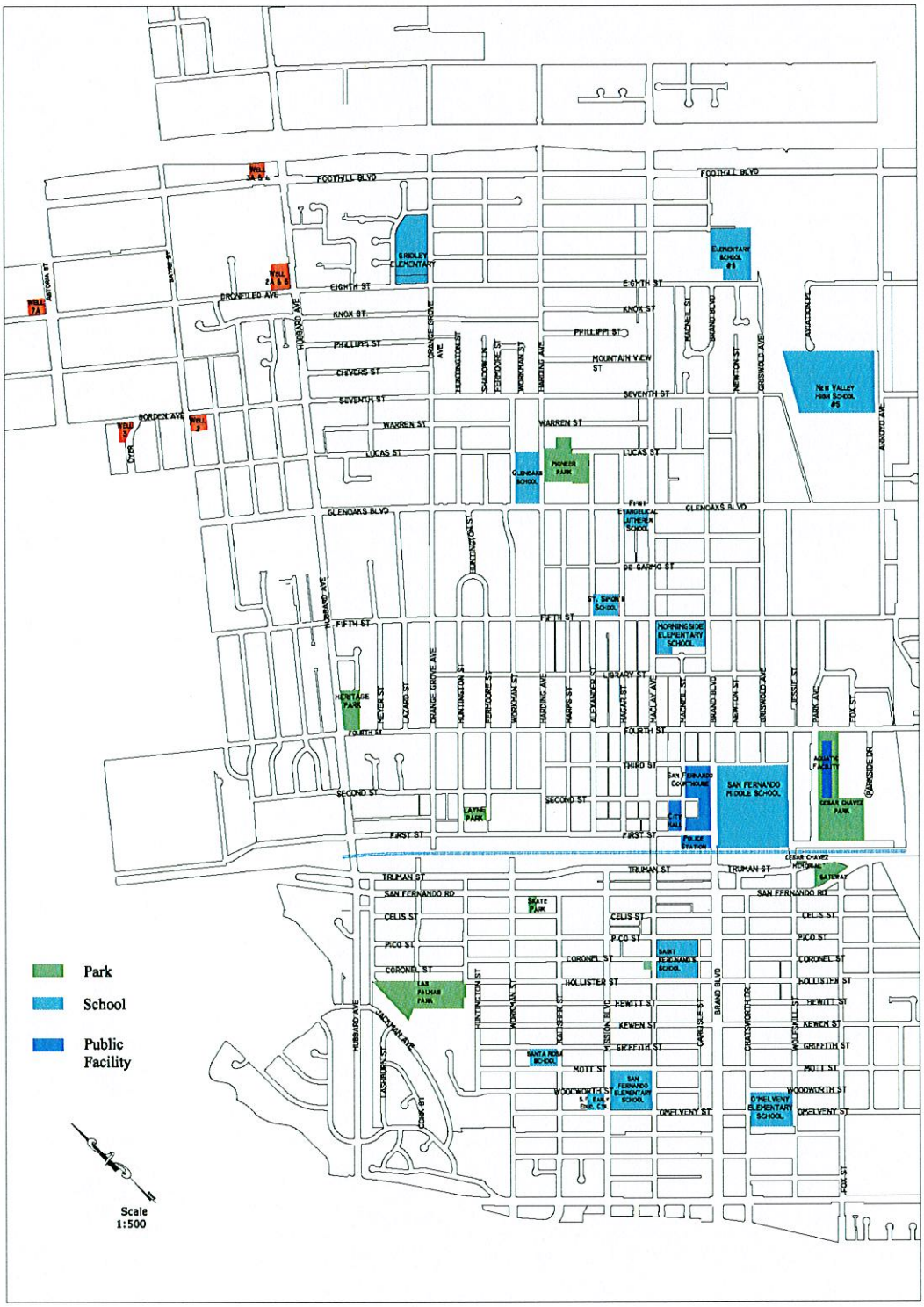
Public utilities often fail during earthquakes. Utility systems are fragile when exposed to the damage of a major earthquake. Residents of San Fernando were deprived of water and electricity during the initial phase of the 1994 earthquake. Earthquake effects such as ground shaking or liquefaction sever underground lines, topple power poles, and damage communications.

## Economic Impact of An Earthquake

It is difficult to estimate the economic impact of an earthquake. The first issue to consider is that earthquake areas are less susceptible to favorable or unfavorable geographic locations that can emphasize or mitigate the effects of a natural disaster. In many of the hazard mitigation examples there are various estimates of the damage a flood could cause to the area. One of the most important causal or mitigating variables is the geographic height of a particular location. The higher you are the safer you are. This is not the case with an earthquake. There are some causal variables related to the geologic strata under the surface of the earth but generally a major earthquake damages everything on the surface in a given area.

Despite this limitation there are ways to determine the potential impact of an earthquake on a specific area. During the 1971 and 1994 earthquakes the City of San Fernando was badly damaged. This includes the personal property and businesses in the City. A review of the documentary data available reveals that no separate audit or study was completed of the economic losses in the City. The loss figures that are available include the City of San Fernando losses in the City of Los Angeles losses.

# City of San Fernando



There are studies available that discuss specific impacts on groups like business in the affected areas. One study estimated the business loss from the Northridge earthquake at $5.945 billion and the structural damage costs at $20 billion. Total losses have been estimated as high as $44 billion dollars.

*Economic losses due to an earthquake are particularly serious. This will impact the entire City due to the widespread nature of earthquake damage.*
The businesses surveyed after the earthquake reported they had losses averaging approximately $85,000. The largest categories of losses reported include utility cutoffs, transportation/shipping disruption, inventory loss, and repair/cleanup. These types of losses can be anticipated after any major earthquake. This also resulted in nearly 121,000 Small Business Administration (SBA) loans for $3.3 billion. Besides business losses 25,000 homes were red tagged as inhabitable.

*The City of San Fernando has a total assessed property value of $1,377,904,015. Residential property represents 58%, commercial 16 %, and industrial 14%. The annual City tax revenues average between $15,000,000 and $16,000,000. These revenues include business license fees and sales taxes. The current estimate places these figures at $4,900,000 for business taxes and $1,200,000 for license fees.*

*The loss of half of the commercial business tax revenues combined with the losing half of the industrial base would result in a major impact on the City net taxable value. The City has not prepared any estimates on the potential economic impact of a major disaster. (This has been included in the section on long-term multihazard mitigation activities as Long-Term Activity—Multihazard # 5: Developing an economic forecast resulting from disasters.)*

The City of San Fernando has the FEMA HAZUS software available for future analysis of potential losses related to an earthquake.

*San Fernando Economy and Potential Earthquake Impact*
The City of San Fernando has approximately 25 businesses that provide the majority of the tax revenue for the City. Some of these businesses are major retail stores with large inventories. One of the largest has approximately $11 million dollars in inventory at their San Fernando location. A partial or total loss of just one store would severely impact the quarterly tax revenues of the City. (Note: During the data-collection portion of this report the manager of this store was interviewed. They asked that this information be kept anonymous. They did not release any information about quarterly sales receipts, citing potential economic espionage damage by competitors.)

These businesses are vital to maintaining the economic balance of the City of San Fernando. A large earthquake could disrupt these businesses directly and indirectly. A major earthquake could cause structural failures that could result in a loss of stock and prevent normal business operations. Any major earthquake would disrupt the ability of

suppliers to ship product into San Fernando, possibly prevent the workforce from coming to work, and definitely inhibit normal commerce.

The City of San Fernando's aggressive redevelopment plan will also be impacted by a major earthquake. The strategy of encouraging investment in mixed-use corridors is intended to produce significant and sustained future economic growth. A major earthquake in San Fernando will impact this plan no matter at what stage of development the disaster occurs. A major earthquake in the immediate future will certainly having a chilling affect on potential investors or potential customers of the new residential corridors.

## Existing Mitigation Activities

### *City of San Fernando Codes*

The City of San Fernando enforces zoning and building codes based on the State of California laws that regulate construction standards relating to earthquake hazards.

### *State of California Codes*

There are four California government codes that regulate earthquake safety in the State of California: the Government Code, Public Resources Code, Health and Safety Code, and Education Code. In the past 125 years the State Legislature has enacted over 200 laws regulating earthquake standards. The State of California has required significant improvement in earthquake building standards since the 1994 Northridge earthquake. A new study conducted by the California Institute of Technology indicates these standards may be insufficient in a major earthquake.

### *Earthquake Education and Research*

Southern California is one of the most seismically active regions in the United States. This geologic reality has resulted in significant research and education centers related to earthquakes located in Los Angeles County. Most of the local public and private universities in southern California have research or education centers related to the topic of earthquakes. The most significant is the Southern California Earthquake Center connected with the University of Southern California. This center is cosponsored by the National Science Foundation and the United States Geological Survey.

There is another major earthquake research center at the California Institute of Technology in Pasadena. The California Institute of Technology's Civil Engineering and Applied Mechanics Department has conducted a series of research projects designed to investigate the effects of earthquakes on different types of structures. This research indicates that even the upgraded California earthquake building standards will be grossly insufficient during an earthquake exceeding 7.1 in magnitude.

All of these centers provided many forms of earthquake information to the public. Besides these sources the County of Los Angeles sponsors an Earthquake Survival Program which is designed as an education program for County residents to assist them in preparing for an earthquake disaster.

## Earthquake Mitigation Action Items

The earthquake mitigation action items are designed to provide guidance to agencies, organizations, and residents regarding specific activities designed to help mitigate this threat. Each action item is followed by implementation suggestions.

*Prioritization of mitigation action items*

The action items were prioritized based on information collected during the documentary and field-interview process. The first four items represent some of the most immediate needs related to general emergency preparedness as well as the earthquake hazard. They are to develop a shelter plan, an evacuation plan ensuring the most current mitigation suggestions are incorporated in current redevelopment process, and reaching out to the earthquake research and education institutions in our area. The last item will provide City decision makers with the most current background information on earthquake research, which is important in developing public policy

The long term items were divided into three priorities: assisting private property owners in the City, developing new funding sources for mitigation activities, and crafting response models based on improvements in earthquake predicting. Assistance to property owners is divided into developing public education programs, locating alternative funding sources for private mitigation activities, and the increased acquisition of earthquake insurance.

### *Short-Term—Earthquake #1*

*Develop a shelter and care plan for major earthquake events impacting the City of San Fernando.*

Coordination: The Emergency-Preparedness Coordinator, City Parks Department and the Disaster Council.

Timeline: 2 years

Implementation: A) Develop a shelter plan for City residents using existing park facilities .

B) Develop a care plan for City residents using existing City properties.

Goal Compliance: Protect life and property.

Constraints: Funding to support the development of the plans.

Project Evaluation/Documentation: Report biannually to the Disaster Council.

*Short-Term—Earthquake #2*

*Develop an evacuation plan for major earthquake events impacting the City of San Fernando.*

Coordination: Emergency Preparedness Coordinator and the Police Department.

Timeline: 2 Years

Implementation: Develop an evacuation plan that addresses the needs of the San Fernando Community while integrating operational details with evacuation plans developed by the City and County of Los Angeles.

Goal Compliance: Protection of life and property, improve emergency services.

Constraints: Funding to support plan development.

Project Evaluation/Documentation: Report biannually to the Disaster Council.

*Short-Term—Earthquake #3*

*Review earthquake standards for the City of San Fernando and incorporate necessary changes into the Specific Corridor Redevelopment Plan.*

Coordination: Public Works, Community Development, City Engineering

Timeline: 2 years.

Implementation: A) Evaluate current City standards against current county/state regulations.

B) Develop recommendations for changes in current standards.

C) Incorporate the changes into the Specific Corridor Plan.

Goal Compliance: Protect life and property.

Constraints: Funding and availability of staff support.

Project Evaluation/Documentation: Biannual report for the Disaster Council/City Department Heads.

*Short–Term—Earthquake #4*

*Develop a permanent relationship with local private and public earthquake research and education institutions.*

Coordination: Emergency Preparedness Coordinator

Timeline: 2 years

Implementation: A) Contact local private and public education and research institutions.

B) Optimize City involvement to provide additional resources to Community Stakeholders and City decision makers.

Goal Compliance: Public awareness, encourage stakeholder participation.

Constraints: Funding/scheduling limitations.

Project Evaluation/Documentation: Annual report to the Disaster Council.

*Long–Term—Earthquake #1*

*Encourage seismic strength evaluations of privately owned structures within the City.*

Coordination: Disaster Council, City Engineer

Timeline: 3 to 5 years

Implementation: A) Develop an education program for the Community.

B) Design an evaluation program to provide seismic Evaluations.

Goal Compliance: Public Awareness, encourage stakeholder partnerships.

Constraints: Program funding.

Project Evaluation/Documentation: Annual report to the Disaster Council.

*Long-Term—Earthquake #2*

*Identify funding sources for structural retrofitting of structures within the San Fernando Community.*

Coordination: City Redevelopment, Emergency-Preparedness Coordinator.

Timeline: 3 to 5 years

Implementation: Collect information on external funding sources.

Goal Compliance: Protect life and property.

Constraints: Funding for staff support.

Project Evaluation/Documentation: Annual report to the Disaster Council.

*Long–Term—Earthquake #3*

*Develop public information programs to encourage earthquake preparedness.*

Coordination: Disaster Council, Emergency Preparedness Coordinator.

Timeline: 3 to 5 years

Implementation: A) Collect information gathered in short term goal # 4.

B) Integrate the information into existing education materials.

C) Develop new education programs on earthquake preparedness.

Goal Compliance: Public awareness.

Constraints: Funding limitations.

Project Evaluation/Documentation: Annual report to the City Council.

*Long-Term—Earthquake #4*

*Encourage the purchase of private earthquake insurance within the San Fernando Community.*

Coordination: Disaster Council

Timeline: 3 to 5 years.

Implementation: Develop public awareness programs about the benefits of purchasing earthquake insurance.

Goal Compliance: Protect life and property.

Constraints: Availability of affordable insurance to community stakeholders.

Project Evaluation/Documentation: Annual report to the City Council.

*Long–Term—Earthquake #5*
*Develop a response model based on the possibility of accurate earthquake prediction techniques*

Coordination: Disaster Council, Emergency Preparedness Coordinator, Police Department

Timeline: 3 to 5 years.

Implementation: Improvements in the next 5 years may make reliable earthquake predictions possible. Studies should be conducted to determine how the City would provide emergency services and protect the community should this become a reality.

Goal Compliance: Protect life and property, improve emergency services.

Constraints: Progress of earthquake research.

Project Evaluation/Documentation: Year three report to the Disaster Council.

## Impact of Mitigation Activities on the Economic Welfare of San Fernando

Mitigating the effects of a major earthquake has many obvious benefits on many levels. In any city the recovery of the local business community is vital to the general recovery of the area. In the case of San Fernando the recovery of the top 25 businesses is vital to

maintaining the business tax revenues that allow the City to operate. The mitigation activities proposed in this report include an emphasis on community education, alternative funding sources for recovery and mitigation, and involvement of the business community.

This report has explored the unique conditions surrounding an earthquake-based disaster. The result of a major earthquake is widespread devastation covering a large geographic area. In analyzing the primary economic sectors of San Fernando it is clear they are dispersed across the City. This risks will only increase as the City begins its district-based redevelopment program. Unlike other natural hazards it is not possible to identify intersections of economic centers and high risk areas. During the 1994 Northridge earthquake cities that were 60 to 70 miles away suffered major damage.

There is no possibility of employing traditional mitigation strategies like relocating an economic center to higher ground to avoid a flood-plane area. The economic centers of San Fernando cannot be moved to avoid an earthquake. The State of California made an estimation of future earthquake losses in California.

The State of California Geologic Survey estimates a 6.9 magnitude earthquake on the Verdugo fault would result in $30 billion of damage. This estimate is based on direct economic losses which consist of capital stock loss and income loss. The costs of rebuilding/construction are considered indirect costs due to the unpredictable prices of construction materials and production costs available at the time. The State Geologic Survey report states the actual cost may be several times greater than the estimated direct costs.

## Earthquake Resource Directory

*Local and Regional Resources*

**Los Angeles County Department of Public Works**
Level: County
Hazard: Multihazard
Address: 900 S. Fremont St. Pasadena, CA. 91803
Phone #: 626-458-5100
URL: http://www.ladpw.org

The Los Angeles County Department of Public Works protects life and property through a variety of programs related to education, awareness, infrastructure maintenance, public works projects, and standards and regulatory enforcement.

**Southern California Earthquake Center**
Level: Regional
Hazard: Earthquakes

Address: 3651 Trousdale Parkway Los Angeles, CA. 90089
URL: www.scec.org

The Southern California Earthquake Center is a research and education collection and clearing house. It gathers data about earthquake conditions in Southern California and integrates them into research-based data and public information programs.

**Western States Seismic Policy Council**
Level: Regional
Hazard: Earthquakes
Address: 125 California Ave, Suite D201 #1, Palo Alto, CA. 94306
Phone #: 650-330-1101
URL: www.wspc.org/home.html

This is a FEMA sponsored consortium to assist local and state governments in developing policies that help to protect communities from earthquake damage.

*State Resources*

**California Division of Mines and Geology**
Level: State
Hazard: Multihazard
Address: 801 K St. Sacramento, CA. 95814
Phone #: 916-445-1825
URL: www.consrv.ca/cgs/index.htm

The Division of Mines and Geology collects and develops technical information related to geologic-related hazards. They provide public education and advice to local governments regarding state geology matters.

**Office of Emergency Services (OES)**
Level: State
Hazard: Multihazard
Address: PO Box 41907 Rancho Cordova, CA. 95741
Phone #: 916-845-8911
URL: www.oes.ca.gov

The Governor's Office of Emergency Services coordinates state and local responses to natural and human-caused disasters in California. The office is responsible for assuring readiness for response and mitigation activities to any type of disaster.

*National and Federal Resources*

**Building Seismic Safety Council**
Level: National
Hazard: Earthquakes
Address: 1090 Vermont Ave NW, Suite 700 Washington, D.C. 20472
Phone #: 202-289-7800
URL: www.bsconline.org

The Building Seismic Safety Council develops and promotes structural standards that encourage earthquake damage mitigation efforts.

**Federal Emergency Management Agency, Region IX**
Level: Federal
Hazard: Multihazard
Address: 111 Broadway, Suite 1200, Oakland, CA. 94607
Phone #: 510-627-7100 Robert McCord
URL: www.fema.gov

This is the FEMA regional office for the western United States.

**Federal Emergency Management Agency, Mitigation Division**
Level: Federal
Hazard: Multihazard
Address: 500 C. St. SW, Washington, D.C. 20472
Phone #: 202-566-1600
URL: www.fema.gov/fima/planhowto.shtm

This division of FEMA manages all hazard-mitigation programs through research, public awareness, and local government assistance.

## Summary

An earthquake is the preeminent natural hazard facing the San Fernando Community. The City of San Fernando is in the center of one of the most seismically active regions in North America. The historical record of earthquakes in San Fernando clearly exhibits the severity of the threat facing the City. The efforts at predicting earthquakes are still in the early stages of practical development and application. The City has a unique and extensive support system from the numerous earthquake education and research organizations in Los Angeles County. Mitigation items were selected based on general needs of any earthquake-sensitive community and on specific needs of the San Fernando Community.

## Section 8: Floods

### Introduction

### Are Floods a Threat to San Fernando?

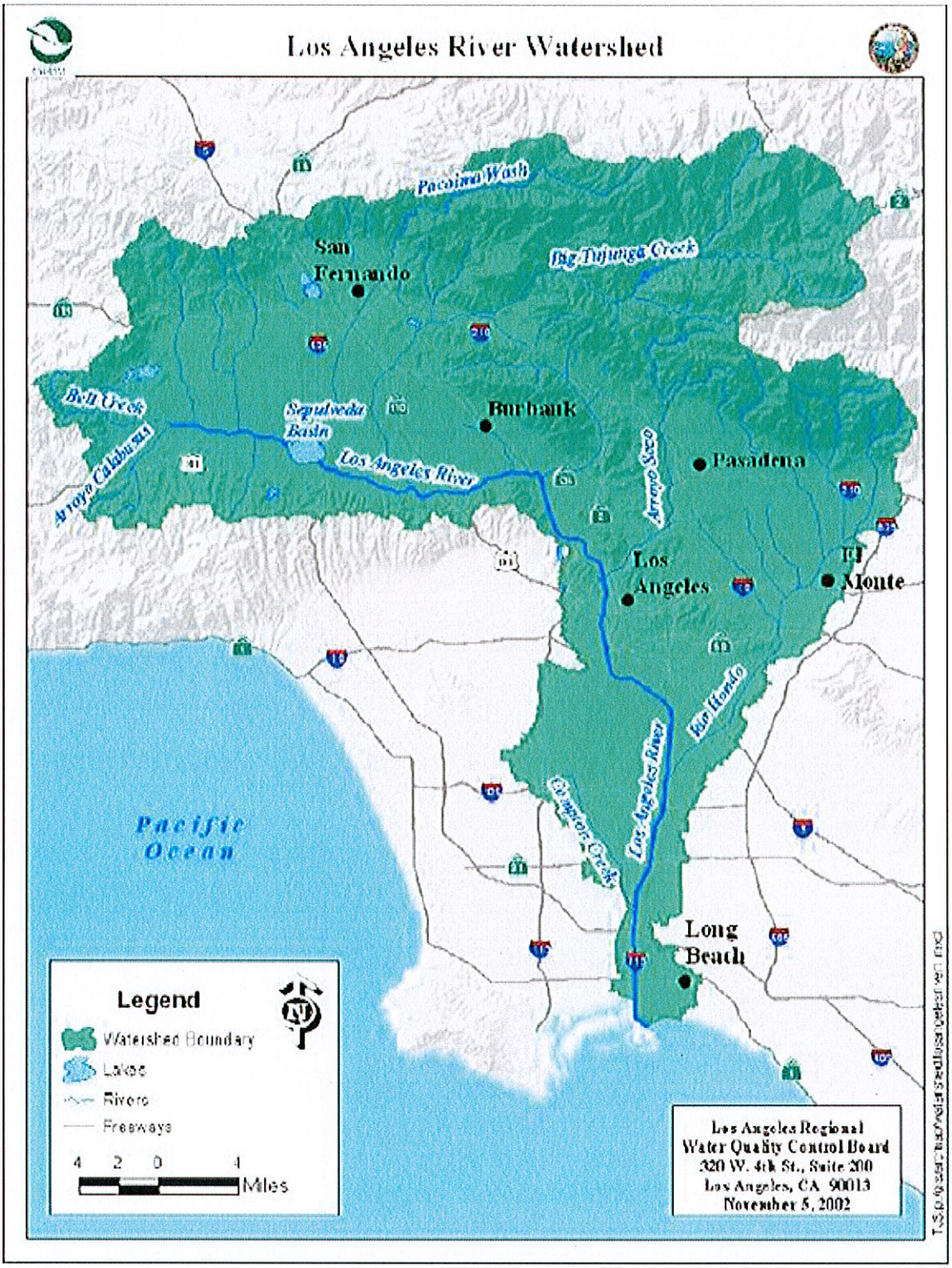
Rainfall in Los Angeles County is often unpredictable. The County is located in a dry Mediterranean-style region with an average rainfall well under 20" per year. The County has had several severe flooding events in the past 100 years. Many of these events were caused by temporary climatic changes that occur cyclically in California. The most common cyclical change is the "El Nino" condition where changes in Pacific weather patterns every 5 to 10 years can cause a dramatic increase in rainfall levels in Southern California.

These disasters were also caused by the area's topography. Many communities are at the base of foothills with rivers and floodplains which terminate in populated areas. Population growth in the area has caused a decrease in the open areas capable of absorbing rain runoff. In the past 150 years the City of San Fernando and the San Fernando Valley have had several major floods in 1934 and 1938. The flood damage resulted in the development of the Los Angeles River flood control project and mitigation projects like the Pacoima Dam.

The City of San Fernando lies directly west of Pacoima Canyon and the Pacoima Dam. There are several dry streams and washes that empty out of the foothills northeast of the City. This water is channeled through the Pacoima Wash which runs for a short distance across the northeast corner of the City. The Pacoima Wash is designed to channel away any water entering the City from the area of the Pacoima Dam.

### Flood-Zone Risk

The analysis of the National Flood Insurance Program is that San Fernando is not in a 100-year flood plain and therefore has a moderate to low risk for flooding. These zones have 1% chance of flooding each year with an average water depth of one foot.


Los Angeles River Watershed
Pacoima Wash
San Fernando
Big Tujunga Creek
Bell Creek
Arroyo Calabasas
Sepulveda Basin
Burbank
Los Angeles River
Arroyo Seco
Pasadena
Los Angeles
El Monte
Rio Hondo
Los Angeles River
Compton Creek
Pacific Ocean
Long Beach
Legend
Watershed Boundary
Lakes
Rivers
Freeways
4 2 0 4
Miles
Los Angeles Regional
Water Quality Control Board
320 W. 4th St., Suite 200
Los Angeles, CA 90013
November 5, 2002

## What Factors Create Flood Risk?

### *Flooding*

Flooding occurs when climate, topography, geology, and hydrology combine to create conditions where water flows out of natural or human-made courses.

### *Winter Rainfall*

The City of San Fernando receives most of its annual rainfall during the winter months. Average rainfall in Los Angeles County is approximately 16" a year. There are often significant swings in the amount of rainfall. The 2001–2002 winter had just under 5" and was followed up 2 years later by a winter season of 36". The 2004–2005 Los Angeles County rainfall total was the second greatest rainfall total in history.

### *Geology and Geography*

The Los Angeles County basin geology has a thick sedimentary surface composed of rock, gravel, and silt erosion that has flowed out of the surrounding foothills for thousands of years. This soil composition is capable of absorbing moisture. (This is also the basis for the liquefaction condition mentioned in the prior earthquake-threat section.) In dry rainfall periods the soil is capable of absorbing large amounts of water. If the soil is already saturated, any rainfall becomes runoff and can lead to flooding.

Human-made changes in the geography have also contributed to the problem. Los Angeles County is nearly "built out" with little open space remaining. One of the associated problems with this development is the use of asphalt to cover large areas of the surface. Nearly all roadways in Los Angeles County are asphalt. The County flood-control systems are designed to collect runoff from properties into the gutter system along streets and direct the water into the underground flood control system. Common infrastructure maintenance procedures such as paving over old asphalt can contribute to the flood risk. Procedures like repaving streets can raise the street level several inches while diminishing the water removal capabilities of a street system.

## Flood Terminology

### *Floodplain*

A floodplain is a land area that is near a river or body of water that is subject to flooding. A floodplain area can store excess flood water. A floodplain has two sections: the floodway and the flood fringe. The City of San Fernando is not in a floodplain area.

### *100-year flood*

A 100-year flood is a flood event that has a 1% chance of being equaled or exceeded in magnitude in a year. The area covered by water in a 100-year flood is called a 100-year flood plain.

### *Floodway*

Unlike floodplains, floodways are not geographic locations. The term has been adopted for regulatory purposes. Floodways are defined by the National Flood Insurance Plan (NFIP) as the channel of a river or stream and the adjacent land that must be reserved to discharge base flooding without increasing water elevation more than a foot.

### *Flood Fringe*

The term flood fringe refers to the outer portion of a waterway and is defined by the NFIP as land area outside the stream way but subject to periodic inundation by flooding. This is a particularly hazardous area because most local governments allow development in these areas.

### *Base-Flood Elevation*

Base-flood elevation is generally defined as elevation that a base flood is expected to reach. This is usually measured in feet from sea level. Communities usually determine their base-flood elevation based on data from historical flood events which indicate the water levels in past floods. The NFIP recommends that in the absence of such data an elevation can be determined based on the potential level of a 100-year flood.

## Flooding Characteristics

Any low-lying urban area is prone to flooding. There is a remote possibility of flooding San Fernando's geographic location at the foot of the mountains and in the path of the Pacoima River. Flooding in urban areas is likely when water generated by runoff exceeds the storm drain system's capacity to remove it.

*Riverine Flooding*

Riverine flooding is caused by the overbank flooding of a river or stream. This is usually the result of a sudden storm system producing heavy rainfall that overwhelms the drainage system. FEMA defines shallow flood hazards as an area normally inundated by a 100-year flood with a depth of one to three feet.

*Urban Flooding*

Urban flooding occurs when an urban area with a high concentration of impermeable surfaces is subjected to a sudden deluge of rainwater. The flow of water can pick up and deposit debris, which can block drainage points and cause water to back up. The result is the rapid build up of water which can cause flooding in intersections and block streets.

*Dam Flooding*

The greatest threat for catastrophic destruction from flooding comes from the possibility of a dam failure. There have been six major dam failures in the past 85 years in Southern California. The two worst failures were the St. Francis dam failure in 1928 and the Baldwin Hills failure in 1963. The St. Francis dam was a concrete dam that failed when surrounding topography slipped, causing the structure to fail in the middle of the night. The resulting flood killed over 500 residents as the water flowed out to the ocean. The Baldwin Hills Dam was an earthen reservoir designed to store drinking water. It failed after a crack appeared that rapidly spread into a 75' gash that emptied the entire reservoir. The cost of this failure was five deaths and 65 homes destroyed.

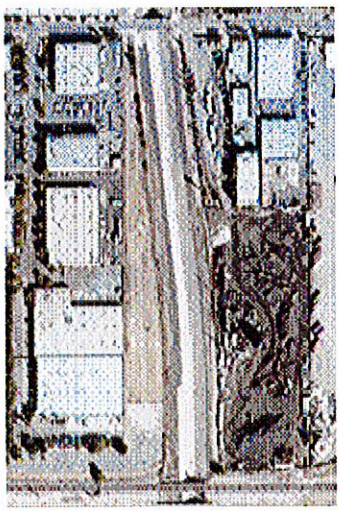
*Pacoima Dam*

Some Los Angeles County communities are directly in line with the possible flood path below a dam or reservoir and are therefore at risk. The City of San Fernando is one of these communities. San Fernando is directly west of Pacoima Canyon which is blocked by the Pacoima Dam. The capacity at the spillway is 6,060 acre feet of water. Due to seismic activity in the last 30 years the Pacoima Dan is kept at 25%–30% capacity.

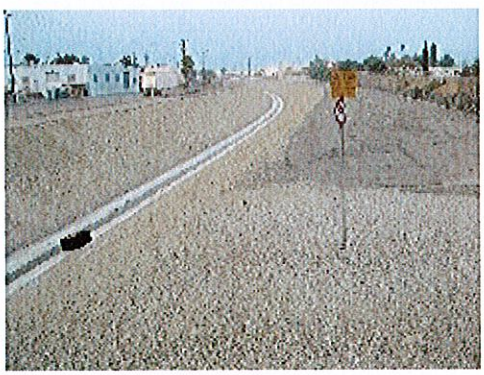
The California Division of Dam Safety placed a reservoir storage restriction on the dam after the 1994 Northridge Earthquake. The Pacoima Dam was strengthened and the spillway capacity was increased. The reservoir storage restriction was lifted but the County of Los Angeles is maintaining the restriction levels. Any changes to the structure of the dam are monitored by a global positioning satellite system which can measure deformity or increased stress loads. The monitoring system provides early warning to residents downstream from the dam.

*Pacoima Wash*

Any water released from the dam is carried away by the Pacoima Wash. The Pacoima Wash travels for a distance of a mile across the northeast corner of the City. The wash is a concrete bottomed, stone lined channel approximately 35 feet wide at the top and between 12 and 14 deep. The walls of the wash are supported by an earthen berm which is several feet taller than the wash structure. The wash is capable of rapidly channeling any water through and out of the City.



Pacoima Wash



The Pacoima Wash between Fourth and Fifth Street.

## Hazard Assessment

### *Hazard Identification*

The first step in determining a flood-hazard assessment is identifying the hazards. This step is accomplished by estimating 1) the area within the floodplain that is at risk of a flood, 2) the potential intensity of the flood, and 3) the probability of a flood event. This process is used to produce floodplain maps.

The City of San Fernando is not situated within a floodplain. The last flooding was in the 1930s and occurred prior to the completion of the Los Angeles River flood-control system. The estimates from the Los Angeles County Department of Public Works indicate that the only part of the City susceptible to possible flooding is the commercial/industrial strip that is adjacent to the Pacoima Wash. This strip is approximately one block wide on either side of the wash. The Los Angles County Flood-Control engineers believe that temporary flooding up to six feet could occur in this area if the Pacoima Dam was filled to capacity and suffered a complete failure. Because the dam is no longer allowed to fill to capacity and the average rainfall is so low, the probability of this type of flood event is very slight.

### *Vulnerability Assessment*

The second step in a flood-hazard assessment is developing a vulnerability assessment. This assessment is the combination of the hazard identification and the value of the property contained within the floodplain. This results in a working estimate because the volume of unknown factors related to the value of the property in the floodplain prevents a definitive answer.

The industrial properties in the City are primarily located in the strip adjacent to the wash. These properties are assessed at approximately 14% of assessed property value for a total value of $198,477,251. The loss of this property to flooding would have a significant impact on the general economic welfare of the City. This does not include the contents of the buildings. It was not possible to gather specific details on the contents of the buildings. The owners stated they consider this type of information to have a high level of proprietary interest and they were not willing to share it for publication in a public document. There are no residences in this area.

The impact of flooding in this area would be the loss of inventory and the possible damage or destruction of industrial manufacturing equipment in these buildings. A flood depth of six feet would temporarily isolate the northeast corner of the City. Any emergency responders would be delayed by having to cross the Pacoima Wash further downstream at unaffected crossing points. The impact on the storm-drain system would be felt outside the City limits because the water drains away from the City and the potential flood directly borders the City of Los Angeles.

There are no buildings related to critical infrastructure within this strip. There is a proposal to build a high school complex on the south side of the wash in the area currently used by the weekend open-air market. The proposed high school complex includes 190,000 square feet of buildings and related athletic facilities and fields. The environmental-impact report notes the area is not in a 500-year flood plain. The report does not analyze the possibility of a dam failure. Dam failure can be considered of minimal impact because of the restrictions on water storage levels, the monitoring system that provides real-time data on the dam's condition, and the location of the wash.

### *Risk Analysis*

The third and most advanced phase of a hazard assessment is developing a risk analysis. A risk analysis is developed by combining the hazard identification with the vulnerability assessment. Using this combination it is possible to generally predict the severity of damage based on a range of events.

The risk analysis of the City of San Fernando indicates the probability of damage by flooding is low. As mentioned, the City is located in an area of low annual rainfall; the dam outside the City limits is normally maintained at ¼ capacity; the dam has a sophisticated monitoring system that provides early warning of a structural failure; and a wash system that can rapidly direct water out of the City limits is well maintained. The qualitative term "low" indicates the environmental factors (low rainfall) combined with the current flood mitigation (the dam/wash system combined with operational restrictions on water storage) combine to make the possibility of flooding remote or slight.

The City of San Fernando does not have any financial forecasting to determine the impact of flooding along the Pacoima Wash corridor. This has been included in the recommendations as a long-term mitigation project.

## Los Angeles County Flood Control District

### *History*

After heavy flooding in 1914 the public began demanding a flood control system be established for Los Angeles County. This was the beginning of the Los Angeles Flood Control District. In 1915 the Los Angeles County Flood Control Act established the agency to control damaging flooding and optimize the use and preservation of water resources. The District worked with the US Army Corps of Engineers to develop a systems of dams and permanent channels to control flooding. This system has had limited damage due to flood-related disasters in Los Angeles County in the past 90 years.

## Community Flood Issues

### *What is Susceptible to Flood Damage?*

The greatest impact on the San Fernando Community from flooding is the potential loss of human life and personal property. These losses can be extensive, depending on conditions that may combine to maximize losses.

#### *Property Loss Resulting from Flood Events*

The extent of any property damage caused by flooding depends on the depth and velocity of the flood and persistence of the water after the flood. Water that is moving quickly will pick up debris that can cause secondary damage as it is pressed forward by the rushing water. One of the greatest causes of damage is the saturation of property by standing water left over after the flood. This damage can render buildings uninhabitable as happened in the aftermath of the Katrina flooding in 2005. The design of the Pacoima Wash greatly decreases the possibility of flooding in residential areas. The water entering the City is channeled through the wash, which is outside residential neighborhoods and is directed out of the City limits.

#### *Private Residences*

Private residences are typically very vulnerable to flooding. The style of home building in San Fernando does not usually include basements in most homes. Most Southern California residences are built close to ground level with many homes built directly on concrete slabs. This makes private homes particularly vulnerable to any standing water because of the lack of separation between the threshold of the home and the surface level of the yard. The distance of San Fernando residential areas from the wash is important. The separation of the residential areas from the wash makes the possibility of residential flooding remote.

#### *Buildings*

The City of San Fernando has a narrow corridor of industrial buildings that may be flooded by an unusual rainfall event. These buildings are located in property along the one-mile wash strip. The location of the Pacoima Dam, combined with low rainfall and the wash, decrease the probability of a flood.

#### *Transportation Systems*

The members of the San Fernando Community commute to work using automobiles and the Metrolink rail system. The City is within easy connecting distance of three freeways. Flooding due to unusual rainfall often causes the streets to flood. This can prevent access to public transportation systems. The level of flooding associated with typical Southern California storm systems means that standing water will recede quickly through the storm-drain system. This temporary flooding is caused by the lack of open ground to absorb sudden rainfall.

*Infrastructure*

Infrastructure can be damaged or destroyed during a major flood. Schools, public buildings, bridges, and other physical support systems can be damaged or destroyed preventing public access and limiting the ability of local governments to provide basic services to their community. This threat can include the loss of public-safety facilities and other local government offices used as points of contact during times of normal operations.

The City has seven buildings including: the police department, the former police department building, city hall, the city yards/public works complex, the San Fernando Museum, and the old firehouse. The City has several parks. Two of the parks, Chavez and Las Palmas, have gymnasiums, kitchens, restrooms, and multipurpose rooms. These parks are the designated shelter/evacuation points for the City. Chavez Park is the designated location for the relocation of city-hall and police-department operations. The police department and city-hall buildings have emergency generators.

The only possible infrastructure in the path of a flood from the Pacioma Wash is the proposed high school on the south side of the wash. The probability for flooding is low due to the lack of rainfall, the storage restictions on the Pacoima Dam, and the monitoring system that would warn Los Angeles County enginners of any potential failure of the dam.

*Public Utilities*

Public utilities often fail during floods. Utility systems are fragile when exposed to the damage of a major flood. Flooding can prevent access to utility systems that become damaged during a major storm. This can prevent the timely repair and restoration of services such as electricity.

*Los Angeles River*

The Los Angeles River Watershed covers an area of over 800 square miles and lies between the Santa Monica Mountains in the west and San Gabriel Mountains in the east. The river is 51 miles in length. The river flows from its headwaters in the mountains directly east and southeast of San Fernando south to Griffith Park. The river continues south across the coastal plan and empties into San Pedro Bay near Long Beach. The river has seven tributaries which include the Pacoima Wash east of San Fernando.

*Pacoima Dam*

The Pacoima Dam is part of the Los Angeles County Flood Control reservoir system. The dam has a spillway height of 1950 feet and a capacity of 6060 acre feet. The dam blocks Pacoima Canyon. The current annual inflow is 3400 acre feet. Since 1929 a majority of the inflow peak months have been during the January/February winter season.

## Current Flood-Mitigation Activities

### *Los Angeles County Flood-Control District*

The Los Angeles County Flood-Control District (LACFCD) was established after a major flood damaged Los Angeles County in 1915. The LACFCD embarked on a major project to control the Los Angeles River and its seven main tributaries. The project began with an ambitious dam-construction program between 1920 and 1939, which resulted in the construction of 15 dams. These dams and the concrete channel project of the Los Angeles River have resulted in significant improvements in flood-prevention and mitigation efforts.

The LACFCD monitors daily rainfall, the capacity level of the Pacoima Dam, and the amount of water traveling through the Pacoima Wash. During heavy rains they release water from the reservoir to prevent a sudden buildup of water and control runoff downstream. The seismic monitoring system detects any changes in the dam due to the movement of the earth.

### *City of San Fernando*

In 2006 the City adopted Ordinance 1572 to regulate the construction of buildings in areas prone to flooding. The ordinance empowers the City Community Development Director to oversee mitigation efforts to lower the risk from flood damage in areas prone to flooding. These efforts include use of flood resistant building materials, employment of construction techniques designed to minimize damage from flooding, and drainage systems that are adequate to remove standing water.

## Flood-Mitigation Action Items

The flood-mitigation action items are designed to provide guidance to agencies, organizations, and residents regarding specific activities designed to help mitigate this threat. Each action item is followed by implementation suggestions.

### *Short Term—Flood #1*

*Encourage local residents and businesses to take steps to prepare for the winter rainy season*

Coordination: Disaster Council.

Timeline: 2 years

Implementation: Design and present a community-awareness program regarding

heavy rain and flood-related hazards with preparation tips for community members.

Goal Compliance: Protect life and property.

Constraints: Funding to support the development of the plans.

Project Evaluation/Documentation: Report bi-annually to the Disaster Council.

*Short Term—Flood #2*

*Conduct an annual review with the LA County Flood Control District to update the City on any changes in the management of the Pacoima Dam or flood-control channels*

Coordination: Public Works

Timeline: Continuous

Implementation: Conduct annual update meetings with LACFCD regarding the dam and flood-control channels.

Goal Compliance: Protect life and property, improve public awareness.

Constraints: Staffing to conduct meetings.

Project Evaluation/Documentation: Report annually to the Disaster Council.

*Short Term—Flood #3*

*Develop a City Disaster Warning System*

Coordination: Emergency Preparedness Coordinator, Police Department, Public Works, Cal Tech.

Timeline: Continuous

Implementation: Design a warning system using a variety of electronic communication systems to warn residents of flooding danger.

Goal Compliance: Protect life and property, improve public awareness.

Constraints: Funding for warning system.

Project Evaluation/Documentation: Report annually to the Disaster Council, City Administrator, City Council.

*Note: This action item will be used to provide warning and emergency information for all natural and human-made hazards and disasters.*

*Long Term—Flood #1*

*Review and coordinate flood-mitigation efforts with new Specific Corridor Development.*

Coordination: Community Development, Public Works

Timeline: 1 to 5 years

Implementation: Review all flood-mitigation efforts and integrate them into The Specific Corridor Development Project.

Goal Compliance: Protect life and property.

Constraints: Staffing availability.

Project Evaluation/Documentation: Report annually to the Disaster Council, City Administrator, City Council.

*Long Term—Flood #2*

*Develop an evacuation plan for the businesses along the Pacoima Wash. This should include any future high school development by the Los Angeles Unified School District.*

Coordination: Police Department, Community Development, Public Works, Los Angeles Unified School District (LAUSD).

Timeline: 1 to 2 years.

Implementation: Include in the City Emergency-Preparedness Plans.

Goal Compliance: Protect life and property.

Constraints: Staffing availability.

Project Evaluation/Documentation: Report annually to the Disaster Council.

# Flood Resource Directory

## *County Resources*

Los Angeles County Department of Public Works

Level: County
Hazard: Multi-hazard
Address: 900 S. Fremont St., Pasadena, CA. 91803
Phone #: 626–458–5100
URL: http://www.ladpw.org

The Los Angeles County Department of Public Works protects life and property through a variety of programs related to education, awareness, infrastructure maintenance, public-works projects, and standards and regulatory enforcement.

## *State Resources*

Office of Emergency Services (OES)
Level: State
Hazard: Multi-hazard
Address: PO Box 41907, Rancho Cordova, CA. 95741
Phone #: 916–845–8911
URL: www.oes.ca.gov

The Governor's Office of Emergency Services coordinates state and local responses to natural and human-caused disasters in California. The office is responsible for assuring readiness for response and mitigation activities to any type of disaster.

## *Federal Resources*

Federal Emergency Management Agency, Region IX
Level: Federal
Hazard: Multi-hazard
Address: 111 Broadway, Suite 1200, Oakland, CA. 94607
Phone #: 510–627–7100
URL: www.fema.gov

This is the FEMA regional office for the western United States.

Federal Emergency Management Agency, Mitigation Division
Level: Federal

Hazard: Multi-hazard
Address: 500 C. St. SW, Washington, D.C. 20472
Phone #: 202–566–1600
URL: www.fema.gov/fima/planhowto.shtm

This division of FEMA manages all hazard-mitigation programs through research, public awareness, and local government assistance.

United States Geological Survey Water Resources
Level: Federal
Hazard: Flooding
Address: 6000 J Street, Placer Hall, Sacramento, Ca. 95819–6129
Phone: 916–278–3000
URL: www.usgs.gov

This agency provides education, information and research data related to water resources in the United States.

Office of Hydrology, National Weather Service
Level: Federal
Hazard: Flooding
Address: 1325 East West Highway, SSMC2, Silver Spring, MD 20910
Phone: 301–713–1658

This agency provides historical information on floods including an archive of past flood summaries.

Army Corps of Engineers
Level: Federal
Hazard: Flooding
Address: PO Box 532711, Los Angeles, Ca. 90053–2325

The Corps is responsible for the protection and development of the nation's water resources including flood control and water storage.