Appendix J
Safety Element Technical Background Report

Geologic and Seismic Hazards

INTRODUCTION

The geologic and seismic conditions in and around Santa Barbara can result in a variety of hazards that can damage public and private buildings, transportation systems and utilities, and result in disruptions of service systems, substantial monetary costs, injuries, and even loss of life. The effects of geologic and seismic hazards are in large part dependent on site-specific conditions and the type of development that has occurred at that site. It is not the purpose of the Safety Element to determine how geologic or seismic hazards may affect a particular property, but rather to assist in the planning process by providing information regarding regional and local conditions, which can be used to identify general areas that may be adversely affected by geologic and seismic hazards. For example, the presumed location and activity characteristics of a fault can be used to determine its potential to result in ground rupture or ground shaking impacts at a particular project site, and certain geological formations are more prone to be associated with certain hazards such as landslides or liquefaction.

This section of the Safety Element provides a brief overview of general geologic and seismic conditions in the City of Santa Barbara, describes how hazards may affect development in the City, and identifies programs and regulations that have been implemented to minimize the effects of geologic and seismic hazards.

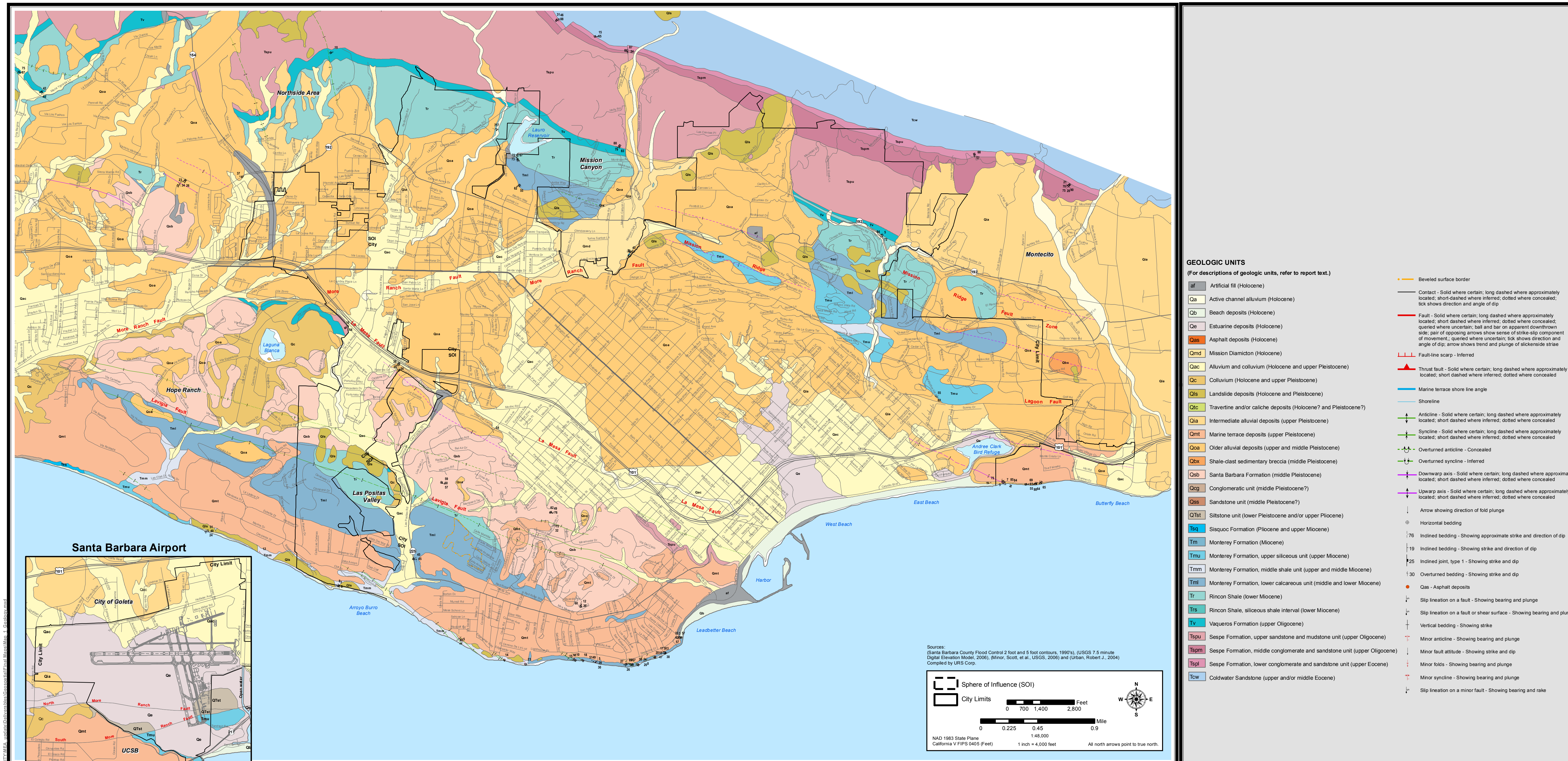
GEOLOGY AND SOILS

General Geology

Santa Barbara is located on an east-west trending coastal plain that is about three miles wide, extending between the Santa Ynez Mountains to the north and the Pacific Ocean to the south. A regional system of faults and folds collectively known as the Santa Barbara Fold Belt has modified the coastal plain and created elevated topographic features in the City such as Mission Ridge (the Riviera neighborhoods) and the Mesa. Movement along the faults and folds of the Santa Barbara Fold Belt generally occurs as a result of transferred strain originating from movement along the San Andreas Fault, which is approximately 40 miles north of Santa Barbara.

Figure 2, Santa Barbara Geology, presents a map depicting the locations of the geologic formations found in Santa Barbara and the surrounding areas. As shown by Figure 2, much of the low-lying areas in Santa Barbara are covered by unconsolidated deposits of silt, sand, gravel, cobbles and boulders (alluvial material), most of which was washed down from the Santa Ynez Mountains over the past 1.8 million years. Other consolidated sedimentary geological formations found in the City include the Santa Barbara, Monterey, Rincon and Sespe Formations. The Santa Barbara Formation is the youngest of these formations and is comprised of sands and silts that were deposited between 1.8 and five million years ago. The Santa Barbara Formation can be found throughout much of the Alta Mesa neighborhood. The Monterey Shale Formation was formed between five and 23 million years ago and is predominately exposed in the sea cliffs that form the southern border of the Mesa neighborhoods, parts of the Riviera neighborhood, and the middle portion of the Las Positas area. The Rincon Shale was formed roughly between 16 and 23 million years ago and is a clay-rich formation that is also exposed in the Las Positas area, and in the Foothill and Riviera neighborhoods.

Figure 2



City of Santa Barbara General Plan Geology

Map prepared by URS Corporation, April 2008

The Sespe Formation is the oldest geologic formation in the City and was formed from clay and sand sediments deposited about 23 to 34 million years ago. The Sespe Formation is exposed in the Cielito neighborhood. More detailed information regarding each of the geological formations depicted on Figure 2 is provided by Appendix A of the *Geology and Geohazards Technical Report*.

Soils

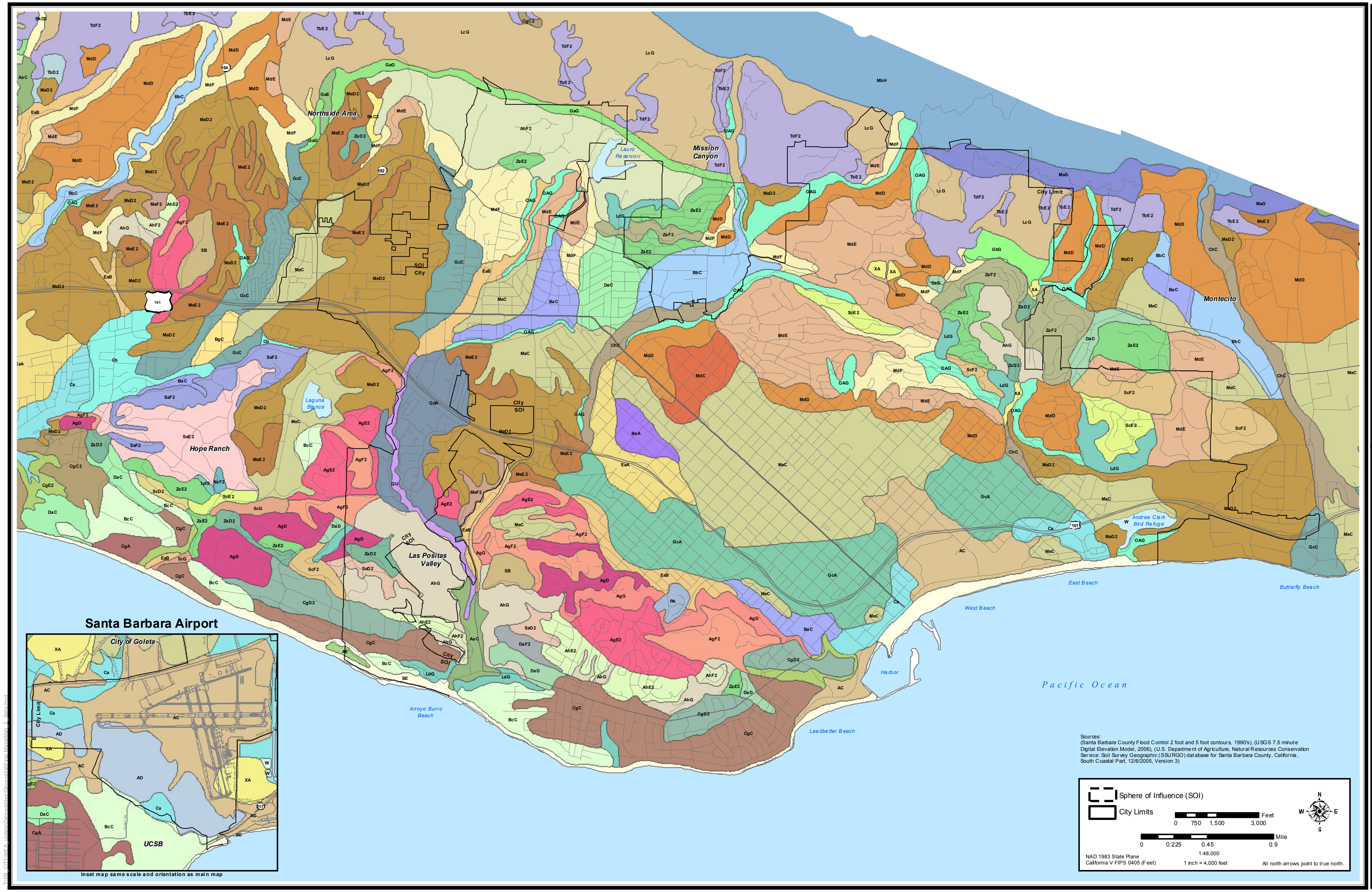
Soils in the Santa Barbara area are generally derived from parent material found in alluvial fans, floodplains and former tidal flats; elevated coastal terraces and valleys; and the foothill and mountain areas. Figure 3, Santa Barbara Soils, depicts the type and location of the various soil types found in the Santa Barbara area. As shown on Figure 3, about 90 soil types have been identified in and near the City. In addition, other areas of the City contain materials such as artificial fill, beach sand and rock outcrops.

Soils found in the City vary substantially in composition (i.e., amount of sand, clay, silt, etc.), depth, and drainage-related properties. Variations in these characteristics influence how the soils may affect urban development and behave during an earthquake. For example, soils with a high clay content may expand when wet and contract when dry, and this action can damage building foundations, walkways and other hardscapes. Unconsolidated soils can amplify the effects of ground shaking during an earthquake, and some granular soils may experience a sudden loss of strength known as liquefaction.

Additional information about the soils found in and near Santa Barbara can be obtained at the United States Department of Agriculture, Natural Resource Conservation Service website:

http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx.

Figure 3



SOIL TYPES

(For descriptions of soil units, refer to SSURGO database.)

Code	Description	Code	Description
No Data		GaG	GAVIOTA SANDY LOAM, 9 TO 30 PERCENT SLOPES
AC	AQUENTS, FILL AREAS	GbG	GAVIOTA-ROCK OUTCROP COMPLEX, 50 TO 75 PERCENT SLOPES
AD	AQUEPTS, FLOODED	GcA	GOLETA FINE SANDY LOAM, 0 TO 2 PERCENT SLOPES
AE	ARGIXEROLLS AND XERERTS, LANDSLIDES AREAS	GcC	GOLETA FINE SANDY LOAM, 2 TO 9 PERCENT SLOPES
AaA	AGUEDA SILTY CLAY LOAM, 0 TO 2 PERCENT SLOPES	GdA	GOLETA LOAM, 0 TO 2 PERCENT SLOPES
AaC	AGUEDA SILTY CLAY LOAM, 2 TO 9 PERCENT SLOPES	LaE	LINNE CLAY LOAM, 15 TO 30 PERCENT SLOPES
AaD	AGUEDA SILTY CLAY LOAM, 9 TO 15 PERCENT SLOPES	LaF2	LINNE CLAY LOAM, 30 TO 50 PERCENT SLOPES, ERODED
AbC	AGUEDA-GOLETA COMPLEX, 2 TO 9 PERCENT SLOPES	LaG	LINNE CLAY LOAM, 50 TO 75 PERCENT SLOPES
Af	ARTIFICIAL FILL	LbG	LODO-ROCK OUTCROP COMPLEX, 50 TO 75 PERCENT SLOPES
AgD	ARNOLD LOAMY SAND, 15 TO 30 PERCENT SLOPES, ERODED	LcG	LODO-SESPE COMPLEX, 50 TO 75 PERCENT SLOPES
AgE2	ARNOLD LOAMY SAND, 30 TO 50 PERCENT SLOPES, ERODED	LdG	LOPEZ-ROCK OUTCROP COMPLEX, 50 TO 75 PERCENT SLOPES
AgF2	ARNOLD LOAMY SAND, 50 TO 75 PERCENT SLOPES	LdH	LOPEZ-ROCK OUTCROP COMPLEX, 75 TO 100 PERCENT SLOPES
AgG	ARNOLD LOAMY SAND, 9 TO 15 PERCENT SLOPES	LeE2	LOPEZ-SANTA LUCIA COMPLEX, 30 TO 50 PERCENT SLOPES, ERODED
AhE2	AYAR CLAY, 15 TO 30 PERCENT SLOPES, ERODED	LeF2	LOPEZ-SANTA LUCIA COMPLEX, 9 TO 30 PERCENT SLOPES, ERODED
AhF2	AYAR CLAY, 30 TO 50 PERCENT SLOPES, ERODED	LgE2	LOS OSOS CLAY LOAM, 15 TO 30 PERCENT SLOPES, ERODED
AhG	AYAR CLAY, 50 TO 75 PERCENT SLOPES	LgF2	LOS OSOS CLAY LOAM, 30 TO 50 PERCENT SLOPES, ERODED
BE	BEACHES	LhG	LOS OSOS-MAYMEN COMPLEX, 50 TO 75 PERCENT SLOPES
BaA	BALLARD FINE SANDY LOAM, 0 TO 2 PERCENT SLOPES	MaE	MAYMEN STONY FINE SANDY LOAM, 15 TO 30 PERCENT SLOPES
BaC	BALLARD FINE SANDY LOAM, 2 TO 9 PERCENT SLOPES	MaG	MAYMEN STONY FINE SANDY LOAM, 30 TO 75 PERCENT SLOPES
BbC	BALLARD VARIANT, STONY FINE SANDY LOAM, 2 TO 9 PERCENT SLOPES	MbH	MAYMEN-ROCK OUTCROP COMPLEX, 50 TO 75 PERCENT SLOPES
BcC	BAYWOOD LOAMY SAND, 2 TO 9 PERCENT SLOPES	Mc	METZ LOAMY SAND
BgA	BOTELLA SHALY CLAY LOAM, 2 TO 9 PERCENT SLOPES	MdC	MILPITAS STONY FINE SANDY LOAM, 15 TO 30 PERCENT SLOPES
BgC	BOTELLA SILTY CLAY LOAM, 0 TO 2 PERCENT SLOPES	MdD	MILPITAS STONY FINE SANDY LOAM, 2 TO 9 PERCENT SLOPES
BhC	BOTELLA SILTY CLAY LOAM, 2 TO 9 PERCENT SLOPES	MdE	MILPITAS STONY FINE SANDY LOAM, 30 TO 50 PERCENT SLOPES
BkC2	BOTELLA VARIANT CLAY LOAM, 2 TO 9 PERCENT SLOPES, ERODED	MdF	MILPITAS STONY FINE SANDY LOAM, 9 TO 15 PERCENT SLOPES
BkD2	BOTELLA VARIANT CLAY LOAM, 9 TO 15 PERCENT SLOPES, ERODED	MeC	MILPITAS-POSITAS FINE SANDY LOAM, 9 TO 15 PERCENT SLOPES, ERODED
Ca	CAMARILLO FINE SANDY LOAM	MeD2	MILPITAS-POSITAS FINE SANDY LOAMS, 15 TO 30 PERCENT SLOPES, ERODED
Cb	CAMARILLO, VARIANT, FINE SANDY LOAM	MeE2	MILPITAS-POSITAS FINE SANDY LOAMS, 2 TO 9 PERCENT SLOPES
CcF	CAPITAN COBBLY CLAY LOAM, 30 TO 50 PERCENT SLOPES	MeF2	MILPITAS-POSITAS FINE SANDY LOAMS, 30 TO 50 PERCENT SLOPES, ERODED
CdG	CAPITAN-ROCK OUTCROP COMPLEX, 50 TO 75 PERCENT SLOPES	MgF2	MONTARA STONY CLAY, 15 TO 50 PERCENT SLOPES, ERODED
CeB	CONCEPCION FINE SANDY LOAM, 0 TO 2 PERCENT SLOPES	NaF2	NACIMIENTO SILTY CLAY LOAM, 30 TO 50 PERCENT SLOPES, ERODED
CgA	CONCEPCION FINE SANDY LOAM, 15 TO 30 PERCENT SLOPES, ERODED	NbG	NACIMIENTO-LANDSLIDE COMPLEX, 30 TO 75 PERCENT SLOPES
CgC	CONCEPCION FINE SANDY LOAM, 2 TO 9 PERCENT SLOPES	OAG	ORTHENTS, 50 TO 75 PERCENT SLOPES
CgC2	CONCEPCION FINE SANDY LOAM, 2 TO 9 PERCENT SLOPES, ERODED	PA	PITS AND DUMPS
CgD2	CONCEPCION FINE SANDY LOAM, 30 TO 50 PERCENT SLOPES, ERODED	RA	RIVERWASH
CgE2	CONCEPCION FINE SANDY LOAM, 9 TO 15 PERCENT SLOPES, ERODED	Rb	ROCK OUTCROP-MAYMEN COMPLEX, 75 TO 100 PERCENT SLOPES
CgF2	CONCEPCION LOAMY SAND, 0 TO 5 PERCENT SLOPES	SB	SANITARY LANDFILL AREAS
ChC	CORTINA STONY LOAMY SAND, 2 TO 9 PERCENT SLOPES	SaD2	SAN ANDREAS-TIERRA COMPLEX, 15 TO 30 PERCENT SLOPES, ERODED
CkD2	CROW HILL SILTY CLAY LOAM, 15 TO 30 PERCENT SLOPES, ERODED	SaE2	SAN ANDREAS-TIERRA COMPLEX, 30 TO 50 PERCENT SLOPES, ERODED
CkE2	CROW HILL SILTY CLAY LOAM, 30 TO 50 PERCENT SLOPES	SaF2	SAN ANDREAS-TIERRA COMPLEX, 9 TO 15 PERCENT SLOPES, ERODED
CkF	CROW HILL SILTY CLAY LOAM, 50 TO 75 PERCENT SLOPES	ScD2	SANTA LUCIA SHALY CLAY LOAM, 15 TO 30 PERCENT SLOPES, ERODED
CkG	CROW HILL SILTY CLAY LOAM, 9 TO 15 PERCENT SLOPES, ERODED	ScE2	SANTA LUCIA SHALY CLAY LOAM, 30 TO 50 PERCENT SLOPES, ERODED
DU	DUNE LAND	ScF2	SANTA LUCIA SHALY CLAY LOAM, 9 TO 15 PERCENT SLOPES, ERODED
DaC	DIABLO CLAY, 15 TO 30 PERCENT SLOPES, ERODED	ScG	SANTA LUCIA SHALY LOAM, 50 TO 75 PERCENT SLOPES
DaD	DIABLO CLAY, 2 TO 9 PERCENT SLOPES	TaE2	TIERRA-SAN ANDREAS COMPLEX, 15 TO 30 PERCENT SLOPES, SEVERELY ERODED
DaE2	DIABLO CLAY, 30 TO 50 PERCENT SLOPES, ERODED	TbD2	TODOS CLAY LOAM, 15 TO 30 PERCENT SLOPES, ERODED
DaF2	DIABLO CLAY, 9 TO 15 PERCENT SLOPES	TbE2	TODOS CLAY LOAM, 9 TO 15 PERCENT SLOPES, ERODED
ES	ESCARPMENT	TdF2	TODOS-LODO COMPLEX, 30 TO 50 PERCENT SLOPES, ERODED
EaA	ELDER SANDY LOAM, 0 TO 2 PERCENT SLOPES	XA	XERORTHENTS, CUT AND FILL AREAS
EaB	ELDER SANDY LOAM, 2 TO 9 PERCENT SLOPES	ZaD2	ZACA CLAY, 15 TO 30 PERCENT SLOPES, ERODED
Eb	ELDER-SOBOBA COMPLEX, 2 TO 9 PERCENT SLOPES	ZaE2	ZACA CLAY, 30 TO 50 PERCENT SLOPES, ERODED
GU	GULLIED LAND	ZaF2	ZACA CLAY, 9 TO 15 PERCENT SLOPES, ERODED
GaE	GAVIOTA SANDY LOAM, 30-75 PERCENT SLOPES		

City of Santa Barbara General Plan Soils

Map prepared by URS Corporation, April 2008

REGIONAL AND LOCAL FAULTS

A fault is a fracture in the earth's crust along which one side has moved relative to the other side. Movement along a fault can occur suddenly during an earthquake or very slowly in a process known as "creep." Faults can be very short or hundreds of miles long, and offset between the two sides of the fault can vary between less than an inch and hundreds of miles. Sometimes one side of the fault moves up while the other moves down (normal, reverse or thrust faults), or the two sides move horizontally in opposite directions (strike-slip faults). Some faults are well known and easy to locate by surface exposures, while others show no expression on the ground surface to reveal their presence (blind thrust faults). Figure 4, Fault Activity Descriptions, provides additional information regarding how faults are classified related to their activity, which refers to the last time movement occurred along the fault.

Regional Faults

The most recognized fault in California is the San Andreas fault, which is approximately 40 miles northeast of the City and is the boundary between two large tectonic plates: the Pacific Plate on the west side of the fault and the North American Plate on the east side. Studies of the fault have indicated that there has been about 186 miles of offset along the fault system over the past 12 million years. The Pacific and North American plates slide past each other with relative motions to the northwest and southeast, respectively. However, east of Santa Barbara there is a "kink" in the San Andreas Fault commonly referred to as the "Big Bend" where the two plates do not slide past each other. In the Big Bend area the plates collide, which causes compression, folding and thrust faulting. Thrust faulting is the dominant type of fault movement that occurs in the Santa Barbara Fold Belt and in the Santa Barbara area.

Other major faults in the Santa Barbara region are also capable of causing large earthquakes. Characteristics of some of the major faults in the Santa Barbara region are provided on Table 1.

Local Faults

Figure 2, Santa Barbara Geology, depicts the location of major faults or fault systems within or near the City of Santa Barbara. A brief description of each of the faults is provided below, and Table 2 provides a summary describing the characteristics of faults located in the City.

Figure 4

FAULT ACTIVITY DESCRIPTIONS

A classification system has been devised to describe how recently movement has occurred along a fault. A system for describing when movement on a fault last occurred is important because faults that have moved in the geologically recent past are considered to be the faults most likely to move in the near future. Agencies such as the California State Mining and Geology Board and the California Geological Survey use the following terms to describe a fault's activity characteristics.

Historically Active. Faults that have had movement in the past 200 years are classified as being historically active.

Active. A fault that has moved during the Holocene epoch is considered to be an active fault. The Holocene is generally considered to have begun about 11,000 years ago.

Potentially Active. Faults that displace geologic formations of Pleistocene age but show no evidence of movement in the Holocene period can be considered to be potentially active. Pleistocene time is the period between about two million and 11,000 years ago.

Inactive. Faults that show no evidence of movement during the past two million years and show no potential for movement in the future are classified as inactive.

Table 1 - Major Faults in the Santa Barbara Region

Fault Name	Location Relative to Santa Barbara	Fault Length (miles)	Fault Activity Classification	Estimated Slip Rate (mm/yr)	Estimated Maximum Magnitude	Notes
San Andreas	The Cholame segment is 40 miles to the northeast	800 For the entire fault	Historically Active	34 on the Cholame segment	7.3 on the Cholame segment	Movement on the Cholame segment caused the 1857 Fort Tejon earthquake. Other large earthquakes have occurred on the San Andreas fault in 1906 and 1989.
Oak Ridge (Mid-Channel Segment)	14 miles to the southeast in the Santa Barbara Channel	23	Active	1.0	6.6	The offshore Mid-Channel segment of this fault is part of a larger system that extends into Ventura County
Red Mountain	2 miles to the south in the Santa Barbara Channel	24	Active	2.0	7.0	The offshore segment of this fault is part of a larger system that extends into Ventura County
North Channel Slope	8 miles to the southeast in the Santa Barbara Channel	42	Active	2.0	7.4	The offshore segment of this fault is part of a larger system that extends into Ventura County
Santa Ynez	6 miles to the north	80	Active	2.0	7.1	Movement on this fault has resulted in the uplift of the Santa Ynez Mountains
Santa Cruz Island	28 miles to the south	31	Active	1.5	7.0	This fault is part of a larger system that extends to Ventura County

Many geologists consider one or more of the following local faults to be branches or "backthrusts" to some of the major fault systems listed above.

Mission Ridge Fault System. The Mission Ridge fault system has been mapped in Santa Barbara as a zone of roughly parallel faults located in the northwest portion of the City, predominately in the Eucalyptus Hill, Riviera and Cielito neighborhoods. The Mission Ridge fault is part of a larger fault system that includes the More Ranch Fault to the west, and the Arroyo Parida and Santa Ana faults to the east. The Mission Ridge segment of the fault is approximately 10.5 miles long, while the entire fault system has a length of approximately 43 miles.

Based on studies of the More Ranch segment of the Mission Ridge fault system conducted in the Ellwood Mesa of Goleta (approximately 8 miles west of Santa Barbara), there have been several earthquakes along the fault during the late Pleistocene, and it is expected that earthquakes on the Mission Ridge fault system have a return period of approximately 3,000 years. The City's 1979 Seismic Safety Element classified the Mission Ridge fault as being potentially active, but recommended that additional studies of the fault's activity be conducted. Based on recent studies, the *Geology and Geohazards Technical Report* classifies the southern branches of the Mission Ridge fault zone as being "apparently active," and the northern branch of the fault as being "potentially active." It is estimated that a 7.2 magnitude earthquake could be generated if approximately one-half of the 43-mile Mission Ridge fault system were to rupture. The 10.5-mile Mission Ridge segment of the fault system has the potential to result in an estimated 6.5 magnitude earthquake.

More Ranch Fault. The More Ranch fault is located in the northwestern part of the City and is the western segment of the Mission Ridge fault system. Branches of the More Ranch fault have been identified or are inferred to exist in the Foothill, San Roque, East San Roque, Hope and Upper State neighborhoods. The More Ranch fault is approximately 10 miles long and extends westward through the southern portion of the Santa Barbara Municipal Airport property. The City's 1979 Seismic Safety Element and the *Geology and Geohazards Technical Report* classify the More Ranch fault as an "apparently active" fault.

Mesa Fault. The Mesa fault extends between a branch of the More Ranch fault to the west and an area near Stearns Wharf to the east. The fault likely continues eastward offshore as the Rincon Creek fault. The onshore portion of the Mesa fault is approximately 4.5 miles long and is located along the base of the Mesa in the Lower West and Westside neighborhoods. Portions of the fault are also located in the West Beach, West Downtown and Hidden Valley neighborhoods. The City's 1979 Seismic Safety Element indicated that the Mesa fault was potentially active, however, the *Geology and Geohazards Technical Report* classifies the Mesa fault as being "apparently active."

Lagoon Fault. The Lagoon fault begins in Montecito about one-half mile north of the Coast Village neighborhood, and extends westward to Sycamore Creek where it bends to the northwest until it terminates near the western end of Mission Ridge. The Lagoon Fault is about 4.5 miles long and passes through the Eucalyptus Hill and Riviera neighborhoods. The City's 1979 Seismic Safety Element indicated that the Lagoon fault was potentially active, however, the *Geology and Geohazards Technical Report* classifies the Lagoon fault as being "apparently active."

Lavigia Fault. The Lavigia fault is about four miles long and extends east to west through Elings Park in the central portion of the Bel Air neighborhood, and along the southern boundary of the Hidden Valley neighborhood. The *Geology and Geohazards Technical Report* classifies the Lavigia fault as being "potentially active."

Rocky Nook Fault. The Rocky Nook fault begins in the Riviera neighborhood and extends to the northwest, where it is exposed in a small bedrock exposure in Rocky Nook Park. The fault continues to the northwest, where it likely links with a fault that contains possible fault slivers that pass beneath the Lauro Reservoir dam in the Foothill neighborhood. The *Geology and Geohazards Technical Report* classifies the Rocky Nook fault as being "apparently active."

Old San Marcos Fault. The Old San Marcos fault consists of three branches located northwest of the City. Two of the fault's branches are located within the City's Sphere of influence and cross State Route 154 about one mile north of the city limits. The *Geology and Geohazards Technical Report* classifies the Old San Marcos fault as being "potentially active."

Foothill Road Fault. The Foothill Road fault consists of multiple branches in a zone approximately one-half mile wide, located north of U.S. 101 and predominately west of the city limits. The *Geology and Geohazards Technical Report* classifies the Foothill Road fault as being "potentially active."

Table 2 – Summary of Major Local Faults

Fault Name	Location (Santa Barbara Geographic Areas)	Fault Length (miles)	Fault Activity Classification	Estimated Slip Rate (m/ky)(1)	Estimated Maximum Magnitude
Mission Ridge	Riviera and Upper State	10.5	Apparently Active	0.3-0.4	6.5
More Ranch	Riviera, Upper State and Airport	10	Apparently Active	0.3	6.4
Mesa	Waterfront, Downtown and Westside	4.5	Apparently Active	1	6.3
Lagoon	Riviera and Eastside	4.5	Apparently Active	unknown	?
Lavigia	Las Positas Valley	4	Potentially Active	0.1	6.4
Rocky Nook	Upper State	2.5	Apparently Active	unknown	?

(1) m/ky = meters per 1,000 years

HISTORICAL SEISMICITY IN SANTA BARBARA

The City of Santa Barbara is located in a geologically complex and seismically active region, and structures in the City have been damaged by earthquake-generated ground shaking on several occasions. The most notable earthquakes to have affected the City are the great earthquakes of 1812 and 1857, and the Santa Barbara earthquake of 1925. A summary of the larger earthquakes to affect Santa Barbara during historical times is provided on Table 3, and Figure 5 provides information regarding the 1925 earthquake.

EARTHQUAKE HAZARD REDUCTION REQUIREMENTS

Numerous regulatory requirements and planning programs have been implemented at the State level to minimize the effects of faulting and seismic hazards. Some of these requirements are described below.

Alquist-Priolo Earthquake Fault Zoning Act

The 1971 San Fernando Earthquake was caused by a rupture of the San Fernando fault and resulted in the loss of many structures that had been built across the fault's path due to ground surface displacement and rupture. This earthquake demonstrated the need to avoid developing buildings across active faults and led to the passage of the Alquist-Priolo Special Studies Zone Act of 1972, which was renamed to the Earthquake Fault Zoning Act in 1994. The Act prohibits the construction of buildings for human occupancy across active faults, and structures covered by the Act must be setback from the location of the fault. A common setback distance is approximately 50 feet; however, the actual setback requirement may be increased or decreased depending on the type of structure proposed and its intended use, and the results of required site-specific investigations. There are currently no Alquist-Priolo designated Earthquake Fault Zones in the City of Santa Barbara.

Seismic Hazards Mapping Act

Extensive damage caused by ground failures during the 1989 Loma Prieta earthquake focused attention on the effects of earthquake-induced landslides and liquefaction, leading to the passage of the Seismic Hazards Mapping Act. Pursuant to the Act, the California Geological Survey is to provide local jurisdictions with Seismic Hazard Zone maps that identify areas susceptible to liquefaction, earthquake-induced landslides, and other ground failures. The Act also requires local jurisdictions to consider seismic hazard zones as part of safety planning and building permit processes. California Geological Survey Special Publication 117A, "*Guidelines for Evaluation and Mitigation Seismic Hazards in California*" provides standards of practice for geotechnical hazard investigations for construction projects located in Seismic Hazard Zones.

The Act identifies topographic map quadrangles throughout the State that are considered to be "high risk quads" and that are to be evaluated for seismic risk. The Santa Barbara quadrangle map has been identified as a "high risk quad," however, an evaluation of the area's seismic risks has not yet been completed by the California Geological Survey.

Table 3
City of Santa Barbara Historical Seismicity Summary

Date	Magnitude	Location	Description
March 24, 1806	Unknown	Unknown	Damage occurred to the Santa Barbara Mission and Presidio.
December 21, 1812	7.1	West of Ventura in the Santa Barbara Channel	Buildings at the Santa Barbara Mission sustained many cracks, and buildings at the Presidio were left uninhabitable. The church at the La Purísima (Lompoc) Mission was destroyed. One earthquake-related fatality was reported, and other fatalities were probably avoided due to a strong foreshock about 15 minutes before the main earthquake. A tsunami may have occurred at Refugio Canyon.
January 9, 1857	7.9	San Andreas fault, Cholame segment	This earthquake ruptured approximately 186 miles of the San Andreas fault. Ground fissures, liquefaction-related "sand blows" and changes in the flow of springs were observed in Santa Barbara. Strong earthquake-related shaking lasted from one to three minutes throughout affected areas.
July 27, 1902	6.0 (?)	Los Alamos	Several strong earthquakes caused extensive damage to oilfield equipment in the Los Alamos area. Shaking occurred in Santa Barbara but no damage was reported.
June 29, 1925	Both 6.3 and 6.8 are reported	Santa Barbara	Property damage was estimated at eight million dollars and 13 people were killed. The Sheffield Reservoir earthen dam was destroyed, but the released water caused little damage. Most of buildings along State Street built on fill material were destroyed or had to be razed. Structures built on solid ground generally experienced little damage.
June 29, 1926	5.5 (?)	Santa Barbara	Considered to be an aftershock of the 1925 earthquake. Damage in Santa Barbara was generally light and buildings reconstructed after the 1925 earthquake experienced little damage. One child was killed by a falling chimney.
November 4, 1927	7.1	Off Point Arguello	The most severe damage occurred in northern Santa Barbara and southern San Luis Obispo Counties. A tsunami was recorded on tide gages in San Francisco and San Diego, and five–foot high waves were observed at Pismo, Port San Luis and Surf.
June 30, 1941	5.9	Offshore Carpinteria	Moderate damage in Santa Barbara and Carpinteria, consisting mostly of broken windows, cracked plaster, severed water mains, and broken bottles in stores.
July 21, 1952	7.3	Kern County	Slight damage to buildings in Santa Barbara.
Summer of 1968	5.2	Santa Barbara Channel	An earthquake swarm, or a sequence of earthquakes which are temporarily and spatially related without an earthquake of outstanding magnitude, occurred in the east part of the Santa Barbara Channel. The swarm consisted of 63 earthquakes, the largest of which was magnitude 5.2 and occurred on July 4.
August 13, 1978	5.9	Off Goleta Point	Most of the damage from this earthquake occurred at UCSB, causing about 3.4 million dollars of damage to 10 major on-campus buildings.

Figure 5

1925 SANTA BARBARA EARTHQUAKE

The Santa Barbara Mission was damaged by the 1812 earthquake and rebuilt by 1820. The 1925 earthquake caused the extensive damage shown in this photograph.

The California Hotel opened four days before the earthquake and experienced heavy damage to brick walls that were not securely tied to the building. Some occupants left the building by lowering themselves to the street using bed sheets.

Many of the unreinforced masonry buildings along State Street were damaged or destroyed.

The earthquake occurred on June 29, 1925 at 6:44 a.m. and was caused by movement on a fault located in the Santa Barbara Channel. Santa Barbara had a population of about 25,000 in 1925, and the earthquake resulted in 13 fatalities. The number of casualties was probably reduced due to the early hour that the earthquake occurred.

No foreshocks were reported before the earthquake, however a water system pressure gauge recording card showed disturbances beginning at 3:27 am, which were likely caused by foreshocks. Then City Manager Herbert Nunn reported noticing a strong smell of oil at the beach soon before the earthquake occurred.

It was reported that strong ground shaking caused by the earthquake lasted 19 seconds, and four strong aftershocks occurred within 20 minutes after the quake. Additional aftershocks occurred for a year after the main earthquake. After the major shaking subsided, many of the buildings in the City's business district were destroyed or severely damaged. Unlike the 1906 San Francisco earthquake where much of the damage to the city was caused by the subsequent fire, gas and electrical power to Santa Barbara was turned off soon after the earthquake. Since no fires occurred after the Santa Barbara earthquake, the destructive force of the groundshaking could be clearly seen.

Most of the homes in the City experienced only minor damage, such as broken brick chimneys. Historian Walker A. Tompkins noted that after the earthquake one thing became obvious, "*the quake destroyed the shoddy and left the substantial*." Newer buildings in the City that survived the earthquake included the Lobero Theater, Masonic Temple, the Daily News Building (the News Press Building), City Hall, the El Paseo and Presidio complexes, the main post office at State and Anapamu Streets (now the Art Museum), and Santa Barbara High School.

After the earthquake, the City embarked on a major reconstruction effort. As part of this program, policies were adopted to promote the construction of buildings in the Spanish Colonial Revival style. As a result, the earthquake had a substantial effect on the appearance of Santa Barbara today.

Photo Source: UCSB Institute for Crustal Studies

Real Estate Disclosure Requirements

The Natural Hazards Disclosure Act requires sellers of real property to provide prospective buyers with a "Natural Hazard Disclosure Statement" when the property is located in a Seismic Hazard Zone or an Earthquake Fault Zone. California State law also requires that when houses built before 1960 are sold, the seller must provide the buyer a completed earthquake hazards disclosure report, and a copy of the booklet entitled "*The Homeowner's Guide to Earthquake Safety*." The booklet contains a sample of a residential earthquake hazards report that buyers are required to fill in, and it provides specific information on common structural weaknesses that can fail and damage homes during earthquakes.

Building Codes

The Uniform Building Code was a model building code published approximately every three years until 1997 when it was replaced in 2000 by the International Building Code. In 2010, the California Building Standards Commission adopted the 2009 International Building Code, as amended, which became the 2010 California Building Standards Code. This Code is commonly referred to as the California Building Code (California Code of Regulations, Title 24). Development in the State must comply with the requirements of the California Building Code as amended and adopted by local jurisdictions. The California Building Code, plus local amendments, is adopted by the City of Santa Barbara by Municipal Code Section 22.04.

Unreinforced Masonry Law

The Unreinforced Masonry Law of 1986 required all cities and counties in Seismic Zone 4 (zones near historically active faults) to identify potentially hazardous unreinforced masonry buildings in their jurisdictions, establish a loss reduction program, and report their progress to the State by 1990. The Unreinforced Masonry Law program was implemented in Santa Barbara under the requirements of Municipal Code Section 22.18.

California State Multi-Hazard Mitigation Plan

The purpose of this Plan is to significantly reduce deaths, injuries and other disaster losses caused by natural and human-caused hazards, including earthquakes. California is required to have a Federal Emergency Management Agency-approved multi-hazard mitigation plan to be eligible for disaster recovery assistance and mitigation funding, and it is required that the Plan be updated every three years. The Plan is also used to coordinate the preparation of *Santa Barbara County Multi-Jurisdictional Hazard Mitigation Plan.*

GROUND RUPTURE

Description of the Hazard

Seismically induced ground rupture is a break or deformation of the ground surface resulting from movement along a fault. Primary fault rupture refers to cracking and offset of the ground surface along a rupturing fault during an earthquake. As the rupture reaches the ground surface, it may spread out into complex patterns of secondary faulting and ground deformation.

Ground rupture generally results in a small percentage of the total damage caused by an earthquake, but structures affected by primary ground rupture are usually severely damaged. Ground rupture can also result in the alteration of surface drainage patterns, changes in ground water levels, and changes to the gradient of the ground surface. Offset of the ground surface caused by fault rupture can range from several inches to tens of feet, therefore, it is typically not practical or feasible to reduce damage to structures caused by ground rupture through engineering design. The avoidance of areas that may be affected by primary ground rupture is generally the most appropriate risk reduction measure. Ground surface displacement and distortion associated with secondary faulting can be relatively minor or can be large enough to cause significant damage to structures.

Local Conditions

Faults located in the City of Santa Barbara and within the City's sphere of influence were identified by the *Geology and Geohazards Technical Report*, and are depicted on Figure 6, Fault Hazard Zones. This figure shows the location or suspected location of known faults, and also depicts a 200-foot buffer area around each fault (100 feet on each side of the fault). The purpose of the buffer area is to accommodate possible variations in the location of the fault when its location is not certain, to include possible splays of the fault that could result in secondary fault rupture impacts, and to identify areas where fault location investigations may be required for proposed development projects.

Active Faults

Faults considered to be active have the highest risk of causing ground rupture-related impacts. Faults identified by the *Geology and Geohazards Technical Report* as being active for planning purposes include the:

Mission Ridge, Lagoon and Rocky Nook faults, which are primarily located in the Riviera area of the City.

More Ranch fault, located predominately in the Upper State area and at the Airport.

Mesa fault, located predominately in the Westside area, but also in portions of the Downtown and Waterfront areas.

Potentially Active Faults

Faults considered to be potentially active have a reduced risk of ground rupture when compared to the risk presented by active faults. Faults located in the City considered to be potentially active for planning purposes include the:

Northern branch of the Mission Ridge fault in the Cielito neighborhood.

Lavigia fault in the Hidden Valley neighborhood.

Small unnamed faults observed in the coastal bluffs in the Mesa neighborhood.

Hazard Reduction

The *Geology and Geohazards Technical Report* provides recommendations regarding the evaluation of proposed development projects for possible ground rupture hazards. The *Technical Report* specifies what type of fault investigations should be conducted for various types of development projects located within the fault hazard zones identified on Figure 6. It is the objective of the *Technical Report* preparation guidelines to evaluate the potential for ground rupture hazards so that if necessary appropriate risk avoidance or reduction measures can be implemented. The hazard reduction guidelines provided by the *Technical Report* are summarized below. Please refer to the *Geology and Geohazards Technical Report* for a complete description of the recommended hazard evaluation and study requirements.

The *Geology and Geohazards Technical Report* indicates that the California Building Code (Title 24) defines "essential facilities" to include facilities such as schools, hospitals, police and fire stations. The *California General Plan Guidelines* (2003) defines "critical facilities" as "*facilities that either (1) provide emergency services or (2) house or serve many people who would be injured or killed in case of disaster damage to the facility. Examples include hospitals, fire stations, police and emergency services facilities, utility facilities, and communications facilities*." In most cases, it would be appropriate to conduct project site fault investigations for land uses referred to as "essential" and "critical" facilities.

Additional guidelines and investigation requirements for development/remodeling of schools are published by the State of California General Services Department, Division of the State Architect. Similarly, investigations of sites for hospitals and certain health care facilities are subject to requirements by the State of California Office of Statewide Health Planning and Development.

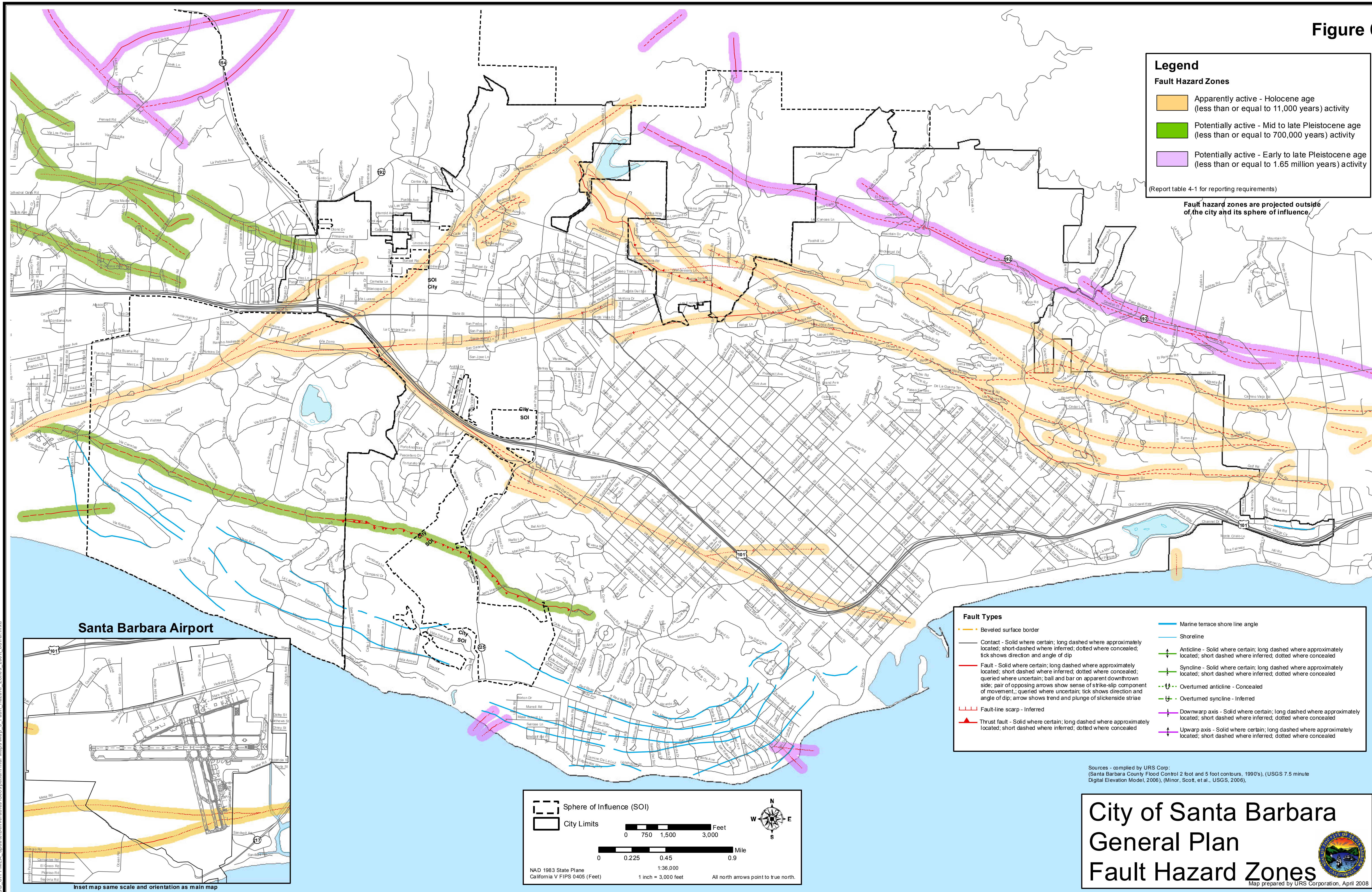


Figure 6
Legend
Fault Hazard Zones
Apparently active - Holocene age (less than or equal to 11,000 years) activity
Potentially active - Mid to late Pleistocene age (less than or equal to 700,000 years) activity
Potentially active - Early to late Pleistocene age (less than or equal to 1.65 million years) activity
(Report table 4-1 for reporting requirements)
Fault hazard zones are projected outside of the city and its sphere of influence.
Santa Barbara Airport
Inset map same scale and orientation as main map
Fault Types
Beveled surface border
Contact - Solid where certain; long dashed where approximately located; short-dashed where inferred; dotted where concealed; tick shows direction and angle of dip
Fault - Solid where certain; long dashed where approximately located; short dashed where inferred; dotted where concealed; queried where uncertain; ball and bar on apparent downthrown side; pair of opposing arrows show sense of strike-slip component of movement,; queried where uncertain; tick shows direction and angle of dip; arrow shows trend and plunge of slickenside striae
Fault-line scarp - Inferred
Thrust fault - Solid where certain; long dashed where approximately located; short dashed where inferred; dotted where concealed
Marine terrace shore line angle
Shoreline
Anticline - Solid where certain; long dashed where approximately located; short dashed where inferred; dotted where concealed
Syncline - Solid where certain; long dashed where approximately located; short dashed where inferred; dotted where concealed
Overturned anticline - Concealed
Overturned syncline - Inferred
Downwarp axis - Solid where certain; long dashed where approximately located; short dashed where inferred; dotted where concealed
Upwarp axis - Solid where certain; long dashed where approximately located; short dashed where inferred; dotted where concealed
Sources - compiled by URS Corp:
(Santa Barbara County Flood Control 2 foot and 5 foot contours, 1990's), (USGS 7.5 minute Digital Elevation Model, 2006), (Minor, Scott, et al., USGS, 2006),
Sphere of Influence (SOI)
City Limits
Feet
0 750 1,500 3,000
Mile
0 0.225 0.45 0.9
NAD 1983 State Plane California V FIPS 0405 (Feet)
1:36,000
1 inch = 3,000 feet
All north arrows point to true north.
City of Santa Barbara
General Plan
Fault Hazard Zones
Map prepared by URS Corporation, April 2008
T:\SB_CITY\MEA_update\Deliverables\Geospatial\Final Maps\Map_3_Fault_Hazard_Zones_200ft_buffer.mxd

Active Faults

Screening Level Fault Investigations[1] should be prepared for non-exempt[2] single-family residential units, residential projects with more than four units, and multi-family residential projects.

Project Site Fault Investigations[3] should be conducted for commercial, industrial and essential/critical facility projects located within designated zones for the More Ranch, Mission Ridge, Lagoon, and Rocky Nook faults.

Potentially Active Faults

Figure 2, Santa Barbara Geology, depicts two classifications of potentially active faults. Faults that demonstrate movement between 11,000 and 700,000 years ago are highlighted in green and include the Lavigia and Foothill Road faults. Faults that demonstrate movement between 11,000 and 1.65 million years ago are highlighted in purple and include the north branch of the Mission Ridge fault and the Old San Marcos fault. The *Geology and Geohazards Technical Report* recommendations for conducting fault investigations for both fault classifications are summarized below.

Screening level fault investigations should be conducted for non-exempt single-family residential, multiple (four or fewer) single-family and multi-family residential, and commercial/industrial projects located within designated fault zones for the Lavigia and Foothill Road faults.

Project site fault investigations should be prepared for essential/critical facilities located within designated fault zones for the Lavigia, Foothill Road, north branch of the Mission Ridge, and Old San Marcos faults.

For projects identified as having the potential to be adversely impacted by a primary fault rupture hazard, hazard reduction measures will generally consist of providing an appropriate setback between the fault and the proposed structure. For linear structures such as pipelines that must cross the fault, appropriate mitigation may include providing shut-off valves on both sides of the fault. For secondary fault rupture impacts, appropriate hazard reduction measures may include appropriate structural engineering to accommodate anticipated levels of ground movement or surface warping. It is anticipated that all proposed mitigation measures will be recommended based on the results of site-specific fault investigations and comply with appropriate engineering practices.

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[1] Screening level investigations will often include a review of available reports and data, air photo interpretation, and geologic reconnaissance. Based on the information obtained from these types of information sources, it may be determined that a site investigation is warranted.

[2] Exempt projects include projects with four or fewer wood- or steel-frame single family dwellings not exceeding two stories; wood- or steel-frame single family dwellings on parcels with prior acceptable geologic reports; condominium conversions; and small additions to existing structures not exceeding 50 percent of the existing structure value.

[3] Project site investigations are to follow California Geological Survey requirements specified in Special Note 49, and include field investigation, laboratory testing and geological analysis.

GROUND SHAKING

Description of the Hazard

Sudden movement along all or part of a fault releases accumulated strain and energy and the released energy radiates through the ground in all directions in the form of earthquake waves. As the waves pass through an area, they produce the shaking effects that are the predominant cause of earthquake damage. Earthquake-related groundshaking can also result in a various ground failure impacts such as liquefaction and slope instability.

The effects of earthquake-induced groundshaking at a particular site are a function of many factors. Some of the factors that influence the intensity of groundshaking are briefly described below.

Earthquake Magnitude

Earthquake magnitude is an indication of the amount of energy released by an earthquake. As an earthquake's magnitude increases, the potential for strong groundshaking will also increase. Additional information regarding how earthquake magnitudes are determined is provided on Figure 7.

There is usually a direct correlation between the length of a fault and the maximum magnitude earthquake that the fault is capable of producing - as the fault rupture length increases, the amount of energy released and the earthquake magnitude will also increase. Therefore, longer faults often have the capability of producing higher magnitude earthquakes than shorter faults.

Distance from the Epicenter

Groundshaking intensity generally diminishes as the distance from the earthquakes epicenter increases, but exceptions to this relationship occur. For example, the fault rupture that caused the 7.1 magnitude Loma Prieta earthquake occurred in an area near the City of Santa Cruz, but extensive groundshaking damage occurred in the Marina District in the City of San Francisco, more than 60 miles north of the earthquake epicenter. Variations in the epicenter distance/intensity relationship can be caused by a variety of factors, such as the manner in which the earthquake waves were generated, the depth at which the fault rupture occurred, characteristics of the earth's crust between the epicenter and the area where shaking was experienced, local soil conditions, and the directions that the seismic waves travelled.

Duration of Strong Shaking

Larger earthquakes generally have a longer duration of strong shaking than smaller earthquakes. The duration of shaking plays a major role in determining the amount of structural damage and potential for ground failure.

Local Geologic Conditions

Geologic conditions such as the presence of loose sediment or weathered rock will cause the travel speed of seismic waves to slow, causing the wave's energy to be converted from speed to amplitude, which will increase the effects of shaking at the site. The thickness, density and consistency of the soil, as well as the presence of shallow groundwater also have the potential to amplify the effects of groundshaking.

Figure 7

HOW EARTHQUAKES ARE MEASURED

Earthquakes are measured in terms of their magnitude and intensity. Magnitude refers to the size of an earthquake or the amount of energy released when movement along the fault occurred. The earthquake's intensity describes its effects in a given area. Although several methods have been developed to measure earthquake magnitude, typically only one magnitude is attributed to an earthquake. However, the same earthquake can have a wide range of intensities due to variations in local geologic conditions and structure characteristics.

The **Richter scale** was developed in 1932 by Charles Richter and earthquake magnitudes were calculated based on the maximum amplitude registered on a standard seismogram. Magnitude measurements using this system were based on one aspect of the seismogram, which limited the ability to measure the power of large earthquakes.

The **moment magnitude scale** was developed in 1978 and is the scale most commonly used today. The moment magnitude scale is related to the physical size of the fault rupture and movement across the fault, which provides a uniform measure of the strength of an earthquake. Similar to the Richter scale, the moment magnitude scale is a logarithmic scale so a magnitude 6.0 earthquake releases 32 times more energy than a magnitude 5.0 and nearly 1,000 times more energy than a 4.0. That does not mean, however, that the ground shakes a thousand times harder in a 6.0 than a 4.0 earthquake because the energy of the larger earthquake is released over a wider area.

Many scales have been developed to describe the intensity of an earthquake, but they are generally based on observed effects at a particular site. In the United States, the **Modified Mercalli** is the most commonly used earthquake intensity scale. This scale is general in nature and provides a description of earthquake effects ranging from Roman numeral "I" (felt by very few individuals) to "XII" (damage is total).

Building Construction

The construction characteristics of buildings, such as its size and height, materials and construction methods, will substantially influence how the building responds to the effects of groundshaking. Generally, small, well-constructed one- and two-story wood and steel frame buildings have performed well in earthquakes because of their light weight and flexibility. Several design characteristics for small wood frame buildings can, however, result in an increased potential for damage during earthquakes. These characteristics include structures that are not adequately tied to their foundation; and "soft-story" buildings, such as two-story residences that do not provide adequate bracing for the upper level of the building. For example, structural development above a garage may not have adequate lateral support because in essence the garage only provides three support walls instead of four. Reinforced concrete structures will also usually perform well. Buildings constructed from non-flexible materials, such as unreinforced brick, concrete or adobe are more vulnerable to damage caused by groundshaking. Unreinforced masonry buildings are prone to failure in large earthquakes due to inadequate anchoring of the walls to the roof and floor, lack of structural reinforcement in brittle or non-ductile building materials, and sometimes poor construction workmanship. In addition to a building's construction methods, every structure has its own fundamental period or natural vibration characteristics. If vibrations caused by groundshaking coincide with the natural vibration period of a structure, damage to the structure can be greatly increased.

Ground Acceleration

While magnitude is a measurement of the amount of energy released by the earthquake, ground acceleration is a measurement of how fast the ground moves at a given location. Two different methods have been developed to predict possible ground shaking hazards at a particular location based on ground acceleration characteristics. The first method is a deterministic ground shaking hazard evaluation, which will estimate the peak ground acceleration produced by an earthquake of a specified magnitude on a particular fault, such as a 7.0 magnitude earthquake on the San Andreas Fault. This type of analysis is generally based on observations of damage from past earthquakes. The second method is a probabilistic evaluation, which will describe the likelihood of peak ground acceleration exceeding a specified level due to an earthquake in a given region over a set period of time. For example, a probabilistic analysis may indicate that there is a ten percent chance of peak ground acceleration exceeding 0.5g in the next 50 years at a given site.

The United States Geological Survey indicates that a ground acceleration of 0.10g may be an approximate threshold of damage for older (pre-1965) dwellings or dwellings not made to resist earthquakes. Some post-1985 dwellings that were built to California earthquake standards have experienced severe shaking (0.6g) with only chimney damage and damage to building contents.

Local Conditions

Earthquake-generated groundshaking has the potential to result in significant life, safety and property damage impacts in Santa Barbara, and groundshaking may be caused by movement along a fault located in or near the City, or from a more distant fault. The United States Geological Survey's Probabilistic Seismic Hazard Assessment model (2009) indicates that there is a 60-80 percent probability that the Santa Barbara area will be affected by a magnitude 5.0 or greater earthquake in the next 50 years. The model also indicates that there is a 50-60 percent chance of a 6.0 magnitude earthquake and a 15-20 percent chance of 7.0 magnitude earthquake occurring in the next 50 years.

Estimates of groundshaking intensity that could occur in Santa Barbara are provided by the *Geology and Geohazards Technical Report* and were estimated using a probabilistic seismic hazard assessment model developed by the United States Geological Survey. The seismic ground motion map provided by the *Geology and Geohazards Technical Report* is provided as Figure 8, Peak Ground Acceleration, and depicts peak ground accelerations anticipated to occur with a 10 percent chance of exceedance within a 50-year period.

In general, peak ground acceleration values depicted on Figure 8 are highest in the eastern portion of the City and lowest in the western portion. The highest estimated peak ground acceleration of 0.538g would occur in the Coast Village neighborhood, and the lowest peak ground acceleration of 0.408g is predicted to occur in the Campanil neighborhood. Predicted peak ground accelerations at the Santa Barbara Municipal Airport range from 0.403g to 0.416g. Although there is some variation in anticipated peak ground acceleration values throughout the City, all of the reported values have the potential to result in substantial damage to buildings and structures. Additional information detailing how the peak ground acceleration values depicted on Figure 8 were derived is provided by the *Geology and Geohazards Technical Report*.

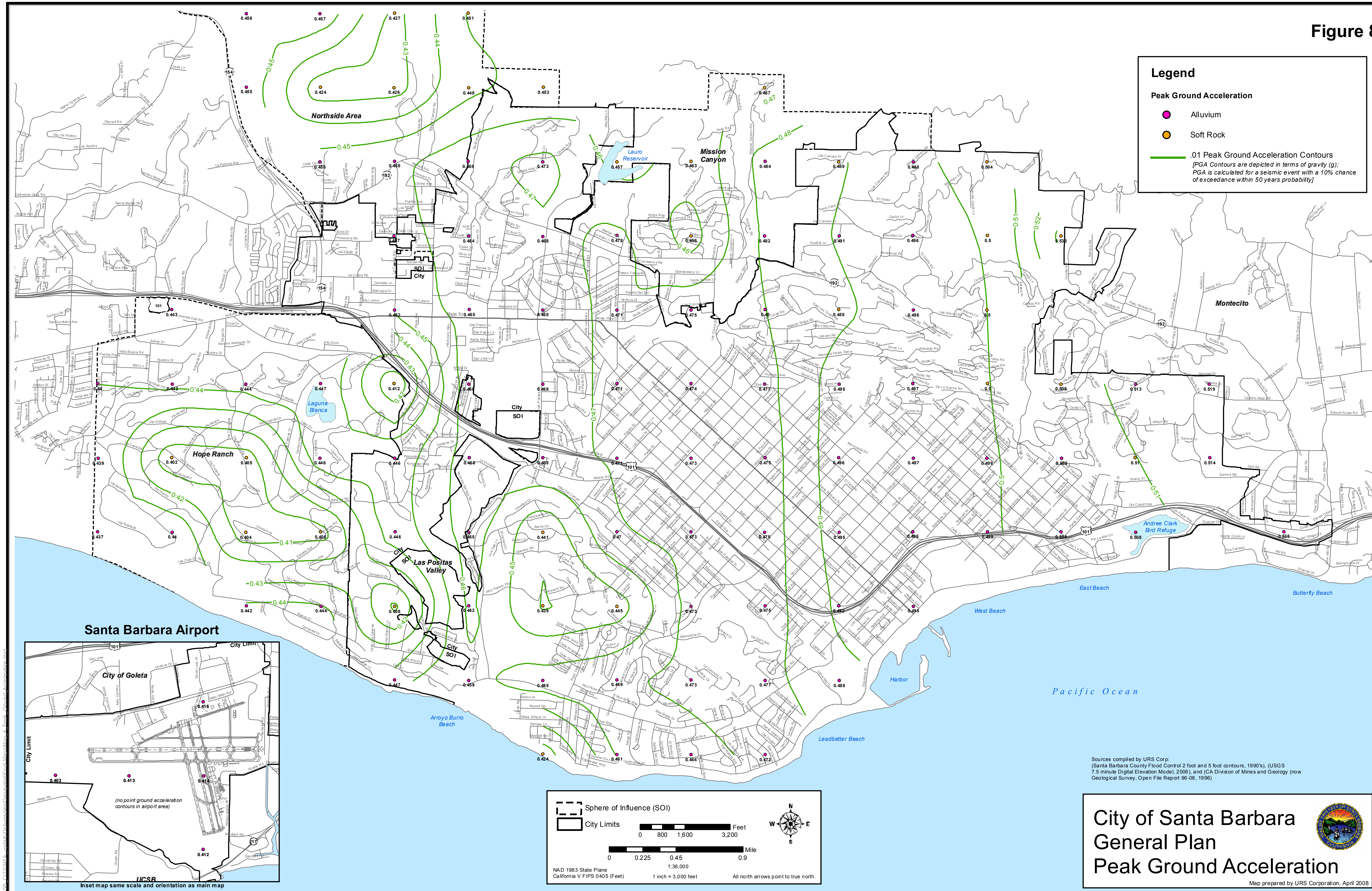

Legend
Peak Ground Acceleration
Alluvium
Soft Rock
.01 Peak Ground Acceleration Contours
[PGA Contours are depicted in terms of gravity (g); PGA is calculated for a seismic event with a 10% chance of exceedance within 50 years probability]
Northside Area
Mission Canyon
Lauro Reservoir
Montecito
Hope Ranch
Laguna Blanca
Las Positas Valley
Andree Clark Bird Refuge
East Beach
West Beach
Butterfly Beach
Leadbetter Beach
Arroyo Burro Beach
Harbor
Pacific Ocean
Santa Barbara Airport
City of Goleta
(no point ground acceleration contours in airport area)
UCSB
Inset map same scale and orientation as main map
Sphere of Influence (SOI)
City Limits
NAD 1983 State Plane California V FIPS 0405 (Feet)
1:36,000
1 inch = 3,000 feet
All north arrows point to true north.
Sources compiled by URS Corp: (Santa Barbara County Flood Control 2 foot and 5 foot contours, 1990's), (USGS 7.5 minute Digital Elevation Model, 2006), and (CA Division of Mines and Geology (now Geological Survey, Open File Report 96-08, 1996)
City of Santa Barbara
General Plan
Peak Ground Acceleration
Map prepared by URS Corporation, April 2008

Figure 8

Hazard Reduction

Substantial changes and refinements have been made to the California Building Code (CCR, Title 24) to reduce the potential for structural damage during earthquakes. The California Building Code provides seismic design requirements for general structures in the State and requires that they be able to accommodate seismic ground motions generated by a Design Basis Earthquake, defined as the earthquake with a 10 percent chance of being exceeded within a 50 year period (the ground acceleration values depicted on Figure 8). The California Building Code also requires that "essential facilities" be designed to resist structural collapse resulting from ground motions produced by an earthquake with a 10 percent chance of exceedance within a 100-year period.

The 2011 Santa Barbara Annex to the *Multi-Jurisdictional Hazard Mitigation Plan* includes recommended mitigation actions to reduce risks created by geologic hazards, including the effects of groundshaking, and to ensure that critical services and facilities survive a disaster. The mitigation actions recommended by the Santa Barbara Annex for specified facilities are reviewed and revised at least every five years to reflect updated hazard reduction information, priorities and funding constraints. The mitigation actions recommended by the 2011 Santa Barbara Annex are related to reducing groundshaking hazards to City-owned facilities, including the: police station; Laguna pump station; seismic renovations to Harbor facilities; and strengthening existing gravity/unreinforced retaining walls adjacent to roadways in high fire hazards areas in the City.

The *Geology and Geohazards Technical Report* provides recommendations for assessing the potential for groundshaking hazards on proposed development projects. The *Technical Report* indicates that the peak ground acceleration values depicted on Figure 8 should only be used in preliminary site assessment or planning efforts, and that site-specific evaluation of design earthquake ground acceleration values should be required for minor improvement, all residential, commercial/industrial, and essential/critical facility projects.

The City of Santa Barbara has implemented several programs to minimize potential structural damage impacts during earthquakes. Municipal Code Section 22.18 requires that unreinforced masonry buildings be retrofitted to reduce the danger of collapse during earthquakes. The Building and Safety Department estimates that 256 buildings, located mostly in the Downtown area, have been upgraded. From time to time, however, additional safety issues associated with unreinforced buildings are discovered and those issues are rectified upon discovery consistent with City and State requirements. The Building and Safety Department has also implemented a "prescriptive seismic strengthening" program consistent with the California Building Code. This voluntary program assists homeowners in making seismic safety improvements to their residences, which often includes improvements to tie the structure to its foundation.

LIQUEFACTION

Description of the Hazard

Liquefaction is a temporary loss of soil strength that can occur during moderate to large earthquakes. Three conditions must be present for liquefaction to occur: affected soils must be comprised of granular material such as sand or silt-sized particles; the soil must be saturated by groundwater; and the soil must be relatively loose or cohesionless.

Soil consists of individual particles, each of which is in contact with adjacent particles. The weight of the overlying soil particles produces contact forces between particles, which holds individual particles in place and gives the soil its strength. Liquefaction occurs when force (i.e., earthquake groundshaking) is applied to loose, granular, saturated soil and the individual particles attempt to move into a more-dense configuration. During an earthquake, however, there is not adequate time for the water in the pore spaces between soil particles to be squeezed out, which prevents the soil particles from moving closer together. This is accompanied by an increase in water pressure, which reduces the contact forces between individual soil particles, resulting in a weakening of the soil. The water pressure between soil particles may become so high that many of the particles lose contact with each other. When this occurs, the soil will have little strength and will behave more like a fluid rather than a solid.

Of the three conditions that must be present for liquefaction to occur, saturation of soil by groundwater is the condition that has the potential to change over time, particularly in response to seasonal fluctuations in groundwater levels. A short- or long-term increase in groundwater levels, in both shallow "perched" groundwater sources or in deeper aquifers, could have the potential to increase the occurrence and severity risk of liquefaction. Areas with shallow groundwater have a higher risk for liquefaction to occur, and in general, liquefaction risk is considered to be low when groundwater levels are more than about 60 feet below the ground surface. In areas with groundwater shallower than 60 feet, the liquefaction hazard may or may not be present, depending on the size, distribution and cohesion of soils.

Liquefaction can result in several types of ground failures. Lateral spreading results in the displacement of blocks of solid soil on the ground surface due to the liquefaction of a subsurface soil layer. A flow failure occurs in a sloping area when liquefied soil or blocks of solid material are carried by a subsurface layer of liquefied soil. This type of failure can occur in areas that have a slope gradient as little as three percent and saturated, non-cohesive materials that may be deeper than 60 feet. Ground oscillation may result when liquefaction occurs at depth in a relatively level area, causing solid blocks of soil to move back and forth in the liquefied zone. The resulting ground oscillation may result in the creation of fissures and the formation of sand "volcanoes." Ground lurching occurs when saturated soils move in a wave-like manner in response to intense ground shaking.

Liquefied soil will have a substantial loss of bearing strength, which may cause buildings in affected areas to settle or tilt. The resulting structural damage can range from minor to complete failure. Depending upon buoyancy differences between the liquefied soil and lightweight or unanchored underground structures such as pipelines, underground structures may float upward to the ground surface.

Local Conditions

The potential for liquefaction to occur in Santa Barbara was evaluated by the *Geology and Geohazards Technical Report*, and that hazard assessment was predominately based on the identification of areas with non-cohesive granular soils and a known depth to groundwater of less than 60 feet. Areas that may be affected by a potential liquefaction hazard were also identified and mapped as part of the preparation of this Safety Element. Potential liquefaction hazard areas are identified on Figure 9 as having a high, moderate and low potential for liquefaction to occur. Areas of the City identified by the Safety Element as having a high liquefaction potential include those areas with non-cohesive granular soils and where groundwater is shallowest. Areas of the City with the highest liquefaction risk generally include the following neighborhoods: East Beach, the southern portion of the Eastside, Milpas, Lower East, Lower State, the western portion of Downtown, the southern portion of Laguna, Lower West, the eastern portion of West Beach, the southern portion of the Westside, areas along Arroyo Burro Creek in the Campanil, the Waterfront and Airport.

As indicated in the Description of the Hazard section above, groundwater levels are an important component in determining the potential for liquefaction to occur, and seasonal and long-term variations in groundwater levels can substantially increase or decrease liquefaction hazard risk. To more accurately assess the potential for local groundwater conditions to contribute to liquefaction-related risks in the City, the Safety Element liquefaction hazard risk evaluation included a review of historic groundwater levels throughout the City. This evaluation was conducted by reviewing various geotechnical investigations and reviewing shallow aquifer groundwater level records for various sites in the City that have been monitored for several years or more (*e.g.*, properties with contaminated groundwater assessment/cleanup activities). Additional information regarding groundwater levels in the City is provided in the High Groundwater Hazard section provided below. The liquefaction hazard evaluation was also made using data from various site specific geotechnical studies that collected soil grain size and cohesion data from subsurface exploration to evaluate future site settlement under seismic loading conditions.

As part of the 2011 Santa Barbara Annex to the *Multi-Jurisdictional Hazard Mitigation Plan,* a vulnerability assessment was conducted to identify City-owned facilities that could be adversely affected by hazards, including earthquake-induced liquefaction. The facilities included in the assessment consisted mostly of utility, government, public safety and other infrastructure structures. The vulnerability assessment identified 38 individual structures or buildings located in areas with a "high" potential to experience liquefaction. Most of the identified facilities are located at the Harbor or beach area, the Airport, the City's desalinization facility and the wastewater treatment plant. An additional 28 facilities were identified as being located in an area with a "moderate" potential to experience liquefaction. Please refer to the Santa Barbara Annex for additional information regarding the possible effects of liquefaction on the City's infrastructure and government facilities.

Hazard Reduction

The *Geology and Geohazards Technical Report* provides recommendations regarding the evaluation of potential liquefaction hazards and indicates the types of site investigations to be conducted for various types of development projects proposed within areas identified as having a "high," "moderate," or "low" liquefaction hazard. These recommendations are also applicable to the liquefaction risk zones identified by the Safety Element evaluation of liquefaction hazards in the City. The *Technical Report* hazard reduction guidelines are summarized below. Please refer to the *Geology and Geohazards Technical Report* for a complete description of the recommended hazard evaluation and study requirements.

For areas designated as having a "low" liquefaction hazard potential, the *Geology and Geohazards Technical Report* indicates that no site-specific liquefaction hazard evaluation is required for the construction of minor improvements to existing uses or for new residential buildings. Site investigations should be conducted for commercial, industrial, large public facilities and essential facilities. In areas with a "moderate" liquefaction hazard, screening level site investigations possibly followed by subsurface investigations to assess potential liquefaction hazards should be conducted for all proposed structures. In areas with a "high" liquefaction potential, the *Technical Report* recommends conducting site investigations for minor improvements to existing uses, single family residences, multiple residence projects, commercial/industrial projects and essential facilities. Requirements for conducting site-specific liquefaction evaluations are provided by the California Building Code and California Geological Survey Special Publication 117A, *Guidelines for Evaluation and Mitigating Seismic Hazards in California.* Hazard evaluation and mitigation guidelines specified by Special Publication 117A implement the requirements of the Seismic Hazards Mapping Act, but may also be applied to projects located outside of designated hazard zones.

Potential Liquefaction Hazard Zones

Liquefaction is a mitigable hazard and its effects on structures can be minimized through a variety of project site modifications and/or building designs. Site modifications may include compacting soils that have the potential to liquefy, or installing subsurface drains to reduce the potential for groundwater saturation of the soil. Building design measures may include providing building foundations that can withstand expected amounts of liquefaction-induced ground settlement, or constructing buildings on piles that extend to firm soil.

TSUNAMI

Description of the Hazard

A tsunami (also commonly referred to as a seismic sea wave or tidal wave) is a series of waves generated by a vertical displacement of the ocean floor, most commonly as a result of earthquake-related faulting. A tsunami may also be caused by a large undersea landslide or volcanic eruption, or even a meteor impact. In the open ocean, tsunami waves have a wavelength (the distance from the crest of one wave to the crest of the next wave) that may be approximately 100 miles long, a low wave amplitude (the height from the wave crest to trough), and travel at speeds of up to 600 miles an hour. As the waves enter shallow water along the coast, they slow down and the wave height increases. The arrival of the first tsunami wave is often preceded by a trough or recession of sea level. The waves may rise to several feet in height, although in rare cases, may reach heights of tens of feet. The height of the waves will be influenced by many factors, including near-shore bathymetry, shape of the coastline and tide height. After the arrival of the first wave, subsequent waves may increase in height and arrive minutes to hours later.

The effects of a tsunami may be relatively minor, such as flooding of low-lying coastal areas similar to the effects of a rapidly rising tide. Large tsunamis, however, can come onshore as a vertical wall of turbulent water, travel 1,000's of feet inland and cause extensive damage. Damage from large tsunamis can result from inundation, wave impact on structures, debris carried by the wave, and erosion. Tsunamis can also result in the creation of strong and unusual ocean currents.

A tsunami may be generated by a local source, such as a nearby fault. When this occurs, the first waves may reach coastal areas within minutes after the groundshaking stops, which limits the ability to issue warnings to potentially affected areas. Tsunamis may also be generated by a distant source, such as large earthquakes that occur in the seismically active Pacific Rim area. Tsunami waves can travel 100's or 1,000's of miles and still maintain enough energy to be destructive when they reach shore.

The West Coast/Alaska Tsunami Warning Center is operated by the National Oceanic and Atmospheric Administration (NOAA) and provides tsunami detection, forecast and warning services for the west coast of the United States. Based on seismic analysis of large earthquakes, sea level data, forecast models, historic data and other criteria, NOAA issues various levels of tsunami warnings. A **tsunami warning** is issued when a tsunami with the potential to generate widespread inundation is imminent, expected or occurring. A **tsunami advisory** is issued there is a potential for tsunami-generated strong currents or waves that could be dangerous in areas very near the coastline. A **tsunami watch** is issued to alert emergency management officials and the public of an event that may later impact the watch area. A tsunami **information statement** is issued to inform emergency management officials and the public that an earthquake has occurred, or that a tsunami warning, watch or advisory has been issued for another region.

Local Conditions

The threat of a locally-generated tsunami affecting Santa Barbara is relatively low based on the low recurrence interval for this hazard, as large, locally-generated tsunamis in California are estimated to occur about once every 100 years. Reports of past tsunami events in the Santa Barbara area are often poorly documented, such as the accounts of a tsunami that was reported to have occurred on December 21, 1812. Unconfirmed estimates of wave height from this event indicate that a 30- to 35-foot wave occurred in Santa Barbara, but recent studies concluded that the wave was probably 15- to 20-feet at the most. Reported wave heights from other locally-generated tsunami events have generally ranged from less than one foot to about 2.5 feet.

Tsunamis with the potential to adversely affect Santa Barbara can also be generated by distant sources, and two such events have occurred recently. Tsunami waves occurred in Santa Barbara in response to an 8.8 magnitude earthquake off the coast of Chile on February 27, 2010; and the 9.0 magnitude Tohoku, Japan earthquake on March 11, 2011. Additional information about the effects of these events in Santa Barbara is provided on Figure 10.

To assist local jurisdictions with tsunami hazard evacuation planning efforts, a map depicting areas of the City that could be affected by tsunami wave inundation has been prepared by the University of Southern California Tsunami Research Center (Figure 11). Potential inundation areas were identified by evaluating local bathymetry and local and distant sources that could generate a tsunami. Potential tsunami generation sources include movement along local and distant faults, and large undersea landslides in the Santa Barbara Channel. Potential inundation areas were identified based on computer modeling of multiple sources and were adjusted for high tide conditions. Potentially affected areas are low-lying parts of the City generally located south of the U.S. 101 freeway in the East Beach, Waterfront and West Beach neighborhoods. Additional inundation areas were identified near the intersection of Cliff Drive and Las Positas Road in the western end of the West Mesa neighborhood, and at the Santa Barbara Airport.

Tsunamis are most often generated by large earthquakes. There is presently no correlation between the effects of climate change and the reoccurrence interval of tsunami events. However, an accelerated increase in sea level induced by climate change could increase the potential for tsunami-related damage because an increase in sea level could allow waves to travel further inland.

The 2011 Santa Barbara Annex to the *Multi-Jurisdictional Hazard Mitigation Plan* provides a vulnerability assessment to identify City-owned facilities that could be adversely affected by a tsunami. The vulnerability assessment identified 36 individual structures or buildings located in areas that could be affected by tsunami inundation. The identified facilities are located at the Harbor, Airport, the City's desalinization facility and wastewater treatment plant.

Figure 10

RECENT TSUNAMI EVENTS IN SANTA BARBARA

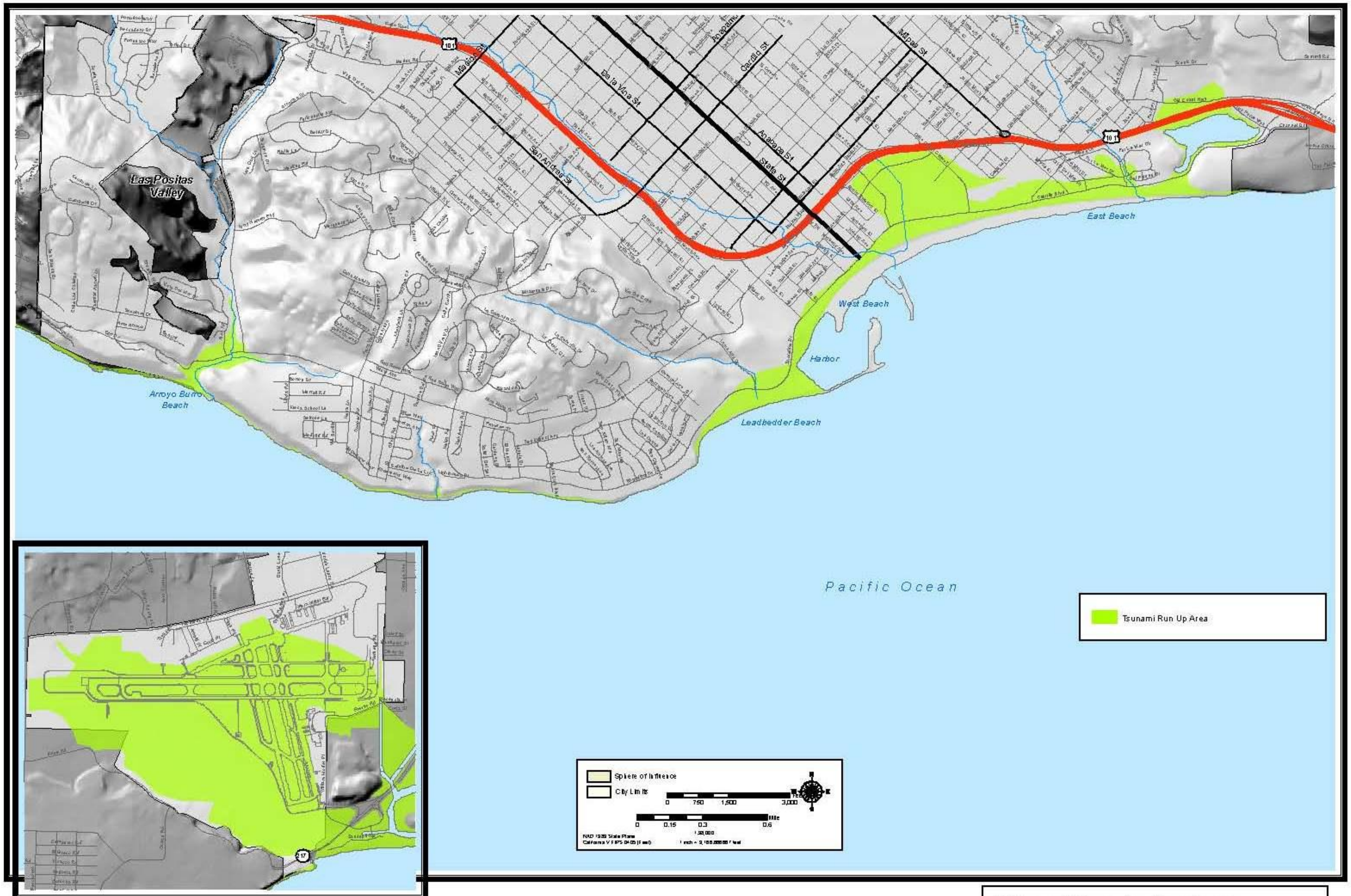
Tsunami waves are often preceded by the retreat of ocean water along the coast. This picture shows the drop in water levels at the Santa Barbara Harbor before waves generated by the 2011 Japan earthquake arrived.

This picture also shows the drop in water level within the Harbor before the arrival of tsunami waves generated by the 2011 Japan earthquake.

As a result of the March 11, 2011 magnitude 9.0 earthquake off the coast of Japan, the West Coast/Alaska Tsunami Center issued a tsunami advisory for the California coast, and tsunami waves occurred in Santa Barbara about 11 hours after the earthquake occurred. Wave run up in the Harbor was about three feet in height, and the waves damaged a crane, bait barge and several boats. Total damage caused by the tsunami waves was estimated to be about $70,000.

On February 27, 2010, a magnitude 8.8 earthquake occurred along the central coast of Chile and a tsunami advisory was issued for California. Tsunami waves of about three feet in height were reported by tide gauges in the Santa Barbra Channel. In Santa Barbara, tsunami waves resulted beach erosion and the displacement of buoys. Tsunami wave surges from this event lasted more than 20 hours.

Photo source: www.sbwatertaxi.com



City of Santa Barbara
General Plan
Tsunami Hazard Zone

Figure 11

Hazard Reduction

Numerous programs have been implemented at the federal, state and local level to identify tsunami-related hazards, reduce the risk of injury and damage caused by tsunamis, and to educate the public about tsunami-related hazards. Federal programs include those implemented under the National Tsunami Hazard Mitigation Program, the United States Geological Survey and NOAA. Hazard reduction programs have been implemented at the State level by the California Geological Survey and Emergency Management Agency. At the local level, tsunami hazards have been evaluated by the *Santa Barbara County Multi-Jurisdiction Hazard Mitigation Plan,* and the *Tsunami Response Plan (2012)* prepared by the City of Santa Barbara Fire Department Office of Emergency Services.

Santa Barbara was designated as a TsunamiReady™ community in 2012, which is a tsunami hazard planning and response program administered by NOAA through the National Weather Service. To be recognized as TsunamiReady, communities must implement specified criteria, including the establishment of a 24-hour warning system, have more than one method to receive tsunami warnings and to alert the public, promote public readiness, and develop a tsunami response plan. The TsunamReady designation is effective for three years and may help to lower the City's National Flood Insurance Program insurance premiums. As part of effort to be designated a TsunamiReady community, the City has installed signs identifying areas that could be inundated by a tsunami and signs that identify designated evacuation routes. Additional information regarding the information signs and designated evacuation routes is provided on Figure 12.

The City's *Tsunami Response Plan* provides information and guidance regarding actions to be implemented upon receiving information that a tsunami watch, advisory or warning is in effect. The Plan addresses a variety of tsunami hazard response actions, including the coordination of evacuation and rescue operations; procedures to allow re-entry into affected or potentially affected areas; and the roles and responsibilities of various City personnel before, during and after a tsunami warning has been issued.

SEICHE

Description of the Hazard

A seiche (pronounced saysh) is a wave or series of waves in an enclosed or semi-enclosed body of water such as a lake, reservoir, harbor or even a swimming pool. Seiche waves can be generated by events such as earthquake-related groundshaking, a landslide into the water body, wind or a tsunami. A wave within the enclosed water body will travel the length of the basin and can be reflected back in the opposite direction. Repeated wave reflections can produce a standing wave in the water body. If the seiche wave overtops the edge of the water body, the wave can run up onto adjacent land areas. The intensity of damage that may be caused by a seiche is proportional to the magnitude and proximity of the event causing the seiche, the amount of freeboard[4] present in the affected water body when the seiche occurs, the size of the water body, and the proximity of development to the edge of the water.

[4] Freeboard refers to the space between the water surface and the top of a structure that contains the water.

Figure 12

TsunamiReady™ DESIGNATED EVACUATION ROUTES

To help educate the public and reduce risks associated with tsunami-related hazards, the City has been designated a TsunamiReady community by the National Weather Service. As part of this effort, the City has prepared a *Tsunami Response Plan,* which outlines procedures and requirements for responding to tsunami hazard warnings issued by the West Coast/Alaska Tsunami Warning Center. As part of the TsunamiReady planning effort, the City has installed signs identifying potential tsunami inundations areas, and signs that identify tsunami hazard zone evacuation routes that have been identified by the *Tsunami Response Plan*.

The following roadways have been designated as evacuation routes and would provide one-way traffic out of potential inundation areas with one lane open for first responders:

- Castillo Street
- Garden Street
- Calle Cesar Chavez
- Milpas Street
- Cabrillo Blvd. west to La Marina
- Cabrillo Blvd. east to Hot Springs Road

Warning signs that have been posted in areas of the City that could be affected by a tsunami wave.

Local Conditions

There are several water bodies in or adjacent to the City that could be affected by a seiche, including the Andre Clark Bird Refuge, Lauro Reservoir and the Harbor. The Andre Clark Bird Refuge is a relatively small and shallow water body and does not present a serious seiche risk. The Lauro Reservoir is located north of and adjacent to the city limits. Should a seiche wave overtop the dam, areas in the City below and in the vicinity of the dam could be inundated. A seiche in the Harbor could cause damage to boats, wharfs and structures adjacent to the water.

Hazard Reduction

Property owners down-hill or adjacent to water bodies that could be affected by a seiche should be made aware of the potential hazard. The 2011 *Santa Barbara County Multi-Hazard Mitigation Plan* indicates that development located adjacent to the Harbor and Lauro Reservoir should consider the possible effects of this hazard. Providing appropriate setbacks between structures and areas that could experience seiche-related inundation would substantially reduce the risk of damage from this hazard.

LANDSLIDES

Description of the Hazard

Landslides occur on sloping ground when the weight of the material that comprises the slope and the weight of objects placed on the slope (driving forces) exceed the shear strength of the slope material (resisting forces). The stability of a slope, or the potential for slope movement to occur, is dependent on many factors, including: the height and steepness of the slope, the shear strength of rock and/or soil that comprises the slope, the orientation of bedding planes in underlying geologic formations, and the amount of water contained in the slope material. These and many other factors will influence the stability of a slope, but in general, sandy or granular soils and rock units are stronger and less likely to be associated with large-scale landsliding than are soil and rock units composed of fine-grained silt or clay.

The down-slope movement of earth material is part of a continuous process of erosion, however, the stability of a slope can be adversely affected by a wide variety of factors. Changes to the stability of a slope can be caused by erosion of the toe of a slope, placing additional weight on the slope, changes to the slope's configuration by grading, earthquake-related groundshaking, or fires that remove vegetation from the surface of the slope. Adding water to a slope can also result in adverse changes to the slope's stability because the water adds weight to the slope, can reduce the cohesion of soil particles, and can also decrease the strength of a zone of weakness (slip plane) within the slope material. The amount of water applied to a slope can be increased in a variety of ways, but intense rainfall can rapidly add extensive quantities of water to slope material. Other possible sources of additional water include irrigation, septic systems, changes in drainage patterns, or broken water/sewer lines.

The down-slope movement of earth material can occur in a variety of ways and the manner in which slope movement occurs will be controlled by the geologic characteristics of the affected area. A **rock slide** involves the movement of bedrock material and typically occurs on steep slopes. An **earth flow** usually occurs in fine-grained (silt and clay) materials and is often initiated by prolonged periods of rainfall. These types of landslides are generally slow moving and may continue to move for days or weeks after movement begins. A **debris slide** typically occurs on steep slopes with coarse-grained soil, usually in response to intense rain events. Debris slides often form steep, un-vegetated scars that are likely to remain un-vegetated for many years. Slopes burned by wildfires are especially susceptible to debris flows due the absence of vegetation and roots to bind surface soils. A **rock fall** is a landslide where a mass of rock detaches from a steep slope. Rock falls generally occur on steep slopes of hard, fractured rock.

Local Conditions

The potential for landslides to affect Santa Barbara and adjacent areas was evaluated by the *Geology and Geohazards Technical Report*, and that hazard assessment identified landslide-prone areas based on the results of previous landslide identification and mapping efforts. The Slope Failure Hazard Zones map provided on Figure 13 depicts four different landslide risk categories identified by the *Technical Report*, ranging from "Very Low" to "High." A summary describing each of the four hazard risk areas is provided below. Please refer to the *Geology and Geohazards Technical Report* for a complete description of the designated landslide risk areas.

Hazard Area 1 – Very Low Landslide Potential

Landslides are very rare to non-existent in these relatively level areas, and areas with this designation will probably remain relatively stable unless the topography is substantially altered. Parts of the City with a Hazard Area 1 designation include the eastern Downtown area, most of the Waterfront, most of the Westside, and the southern part of the Eastside area.

Hazard Area 2 – Low Landslide Potential

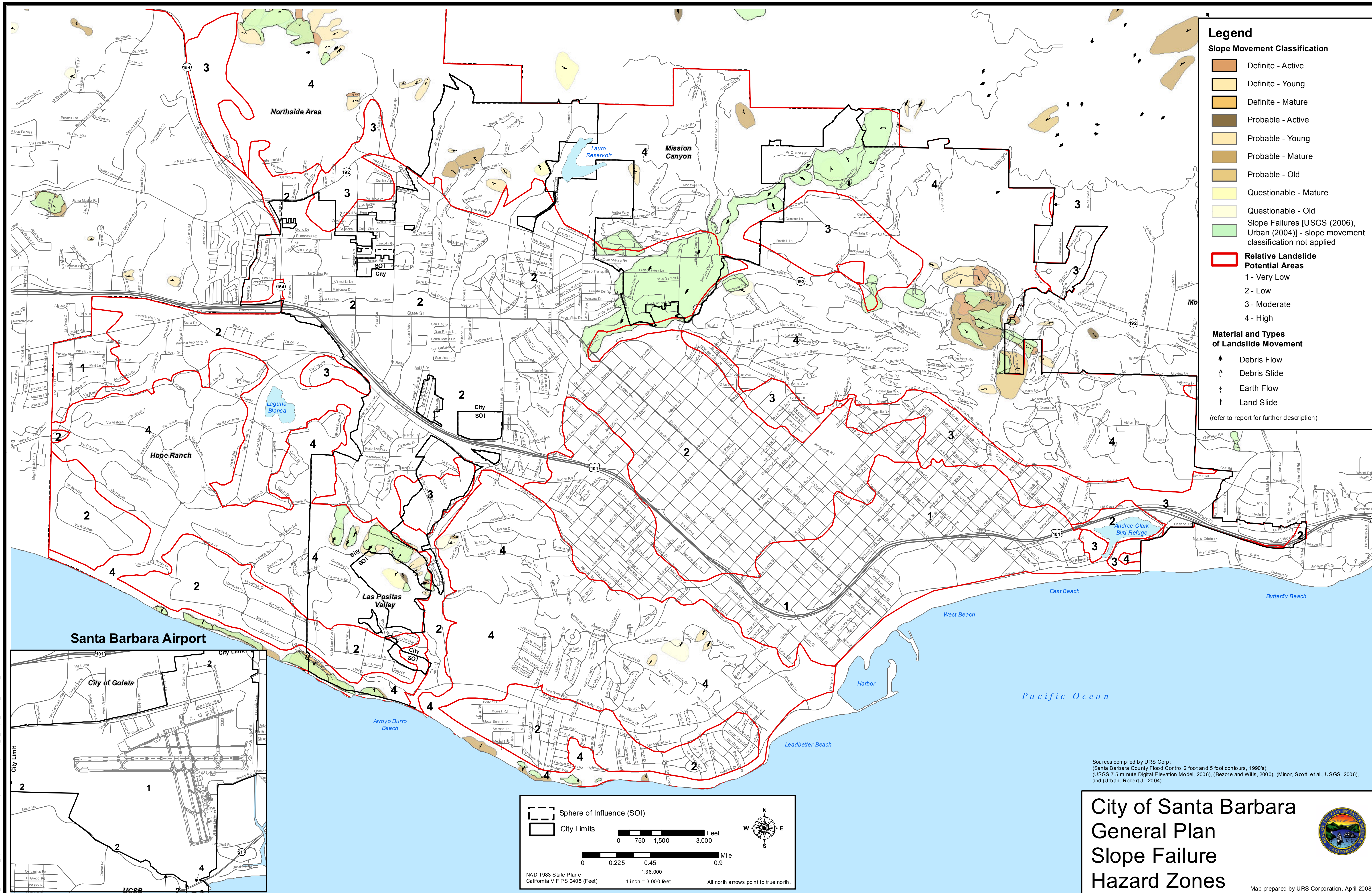
Areas with this designation have gentle to moderate slopes underlain by relatively competent earth material that is considered unlikely to become unstable under natural conditions. The stability of slopes in Hazard Area 2 could change in response to terrain modifications. Hazard Area 2 includes the western part of the Downtown area, southern portions of the Mesa, most of the Upper State area, areas generally adjacent to Las Positas Road and the southern portion of the of the Las Positas area.

Hazard Area 3 – Moderate Landslide Potential

Slopes with this designation are at or near their stability limits due to the presence of weaker geologic materials, steeper slopes, or a combination of these factors. Although most slopes within Hazard Area 3 do not currently contain landslide deposits, the materials that underlie the slopes have the potential to fail if modified. Areas designated as Hazard Area 3 include the northern portion of the Eastside area, the southernmost extent of the Riviera, localized portions of the Riviera, and the northern part of the Las Positas area.

Hazard Area 4 – High Landslide Potential

Slopes in Hazard Area 4 are considered to be naturally unstable and subject to failure even without being modified by grading- or other development-related processes. These areas are characterized by steep slopes and include most areas previously affected by landslides, as well as areas where there is substantial evidence of downward "creep" of surface materials. Soil "creep" is the slow downward movement of surface soil that typically occurs in clay-rich, expansive soils that expand when wet and contract when dry. Earthflows are the most common type of slope failure in these hazard areas, but slides of intact bedrock are also common. Hazard Area 4 includes parts of the Mesa north of SR 225, the steep slopes located along the west side of the Las Positas area, most of the Riviera, and the coastal bluffs in the southwestern part of the City. Additional information about coastal bluff erosion hazards is provided in the Sea Cliff Retreat section of the Safety Element.



Slope Failure Hazard Zones - Figure 13

Two areas of recent landsliding are located in Sycamore Canyon and are commonly referred to as the "Conejo Road Landslide" and the "Canon View Road/Sycamore Canyon Landslide." Movement of slopes in this area apparently began in response to heavy "El Niño" rain events in 1982-83. In January 2005 heavy rains resulted in additional slope movement that resulted in the closure of a two-mile segment of State Route 144 (Sycamore Canyon Road) south of State Route 192. In addition to closing the highway, eight homes were destroyed and many other homes, roadways and driveways experienced structural damage. The damaged section of SR 144 was gated and closed, and could only be opened when a high fire danger "Red Flag Alert" was in effect. In the Canon View Road area, using a 50 million dollar settlement agreement from Caltrans, affected property owners formed a corporation that was responsible for repairing, restoring and stabilizing the landslide on the east side of Sycamore Canyon. The landslide repair project was initiated in 2007 and implemented extensive engineering and construction methods to remediate the slide, including the use of retaining walls, numerous reinforced concrete piers, structures to tie the piers together and anchor them to the hillside, reinforced earthfills and buttresses, and new drainage systems. The landslide remediation project required five years to complete and SR 144 was opened to motorists and emergency vehicles on April 3, 2012.

The Conejo Road and Sycamore Canyon landslides clearly demonstrate the damage that can be caused by local landslides and the resources that may be required to repair landslide-related damage. Other recent landslide events have demonstrated that the Santa Barbara area can be adversely affected even when a landslide occurs well beyond the city limits. In January 2005 a series of strong storms triggered a large debris flow above the community of La Conchita in Ventura County, and the landslide resulted in 10 deaths and damaged or destroyed 36 residences. Debris from the landslide extended across U.S. Highway 101, which resulted in the closure of the highway and constrained access to Santa Barbara from the south while the debris was removed.

As part of the Santa Barbara Annex to the *Multi-Jurisdictional Hazard Mitigation Plan,* a vulnerability assessment was conducted to identify City-owned utility, government, public safety and infrastructure facilities that could be adversely affected by landslide-related hazards. The vulnerability assessment concluded that no "critical" City-owned facilities were located in areas designated as having a "high" or "moderate" landslide risk.

Hazard Reduction

The *Geology and Geohazards Technical Report* indicates when site-specific slope stability investigations should be prepared for various types of development projects based on the project's location and the landslide risk designation depicted on Figure 13. The *Technical Report* landslide hazard evaluation guidelines are summarized below. Please refer to the *Geology and Geohazards Technical Report* for a complete description of the recommended hazard evaluation and study requirements.

If a project site is located outside a designated hazard area or is located within Hazard Areas 1 or 2, a slope stability geotechnical evaluation will not be required for most types of projects unless the project could result in a slope stability hazard due to proposed excavations or the creation of fill slopes. A site-specific geotechnical analysis that considers the potential for landslide-related impacts is recommended for essential/critical facilities located in Hazard Areas 1 or 2. With possibly a few exceptions for very minor projects, a site-specific geotechnical report to evaluate potential slope stability hazards should be required all development projects located within or adjacent to Hazard Areas 3 or 4.

The objective of required slope stability investigations is to evaluate existing slope stability conditions and to determine if project-related modifications to a slope would have the potential to result in on- or off-site stability impacts. If necessary, the evaluation should also identify ways that the project and/or that proposed changes to a slope can be modified to minimize stability-related impacts. Numerous methods can be used to evaluate the stability of a particular slope, but in general slope stability evaluations estimate the strength of the soil or rock that comprise the slope (resisting forces), and the weight of the slope and objects placed on the slope (driving forces) above a potential slide surface or "slip plane." The value of the resisting forces divided by the value of the driving forces determines the "factor of safety." A factor of safety value below 1.0 is theoretically impossible because the slope would have already failed. A value of 1.0 indicates marginal stability/a failure is imminent. As values increase above 1.0, confidence that the slope is stable also increases. A factor of safety of 1.5 (and a factor of safety of 1.1 under seismic shaking conditions) is typically required to demonstrate that a slope would remain stable after the implementation of a proposed project. Typically, many potential sliding surfaces will be evaluated and the surface with the lowest factor of safety will be the location where slope failure is most likely to occur. Slope stability geotechnical evaluations prepared pursuant to the *Geology and Geohazards Technical Report* guidelines should be consistent with the geology report preparation guidelines adopted by the California Board for Geologists and Geophysicists. Site-specific studies should also comply with requirements required by the California Building Code and California Geological Survey Special Publication 117, *Guidelines for Analyzing and Mitigating Landslide Hazard in California*.

A variety of techniques may be used to mitigate slope stability hazards, and one or more methods may be recommended by a site-specific slope stability evaluation. Common methods for minimizing landslide-related hazards may include avoidance of hazardous areas, removal of unstable material, appropriately engineered grading prior to construction, dewatering slopes and controlling site drainage, reducing the slope gradient or the weight of objects placed on the slope, and the use of drought tolerant landscaping with strong root systems. Geotechnical engineering design measures, such as those used in the Conejo Landslide area, may also be used to reduce landslide hazards in areas that have been previously developed.

The Santa Barbara Annex to the *Multi-Jurisdictional Hazard Mitigation Plan* includes recommended mitigation actions to reduce landslide-related risks to City-owned facilities or on City-owned property. The recommended mitigation actions include the stabilization of hillsides in Honda Valley in the Alta Mesa neighborhood that are located adjacent to a high pressure gas line that serves the City; slope stability improvements along steep creek banks in Hidden Valley Park in the Hidden Valley neighborhood; improvements to address slope undercutting that could contribute to a landslide and adversely affect vehicle and emergency access to Stevens Park in the East San Roque neighborhood; conduct geotechnical studies, stabilize slope retaining walls, and provide drainage improvements in the area of Francheschi Park/Mission Ridge Road to minimize landslide- and resulting access-related impacts; and provide improvements to gravity/unreinforced retaining walls in the high fire hazard zones of the City to reduce the potential for landslide-related access impacts.

SEA CLIFF RETREAT

Description of the Hazard

Sea cliff retreat is an erosion- and landslide-related hazard that affects the ocean bluffs located along the City's coast. The coastal bluff environment is very dynamic and can present great variation in the composition, structure and strength of the rocks and soil that form the bluffs. These conditions result in hazard assessment and reduction challenges not generally associated with natural or manufactured slopes located in inland areas.

Sea cliff retreat is a continual, natural process caused by both marine and terrestrial erosion process that causes the face of the bluff to "retreat," or move landward. Wave action is the predominant erosion process in the Santa Barbara area as waves can erode the base of the cliff and remove support for overlying cliff material, which increases the potential for landslides to occur. Bluffs that are subject to wave-related erosion often have a configuration that is vertical or nearly vertical. Where beaches are wide and waves seldom reach the base of the cliff, terrestrial processes, such as erosion by stormwater runoff over the face of the bluff, can be the dominant cause of sea cliff retreat. Terrestrial erosion processes generally result in the formation of bluffs with a more gently sloping profile.

Ocean bluffs may appear to go unchanged for many years as erosion of the cliff occurs slowly, either by the gradual ("grain-by-grain") loss of bluff material, or by the loss of small blocks or shallow slumps of surficial material. This gradual loss of sea cliff material typically occurs as a result of terrestrial erosion processes. Conversely, extensive losses of bluff material may occur suddenly due to large landslides that occur when the stability of the slope is adversely changed and "driving" forces exceed the "resisting" forces of the bluff material[5]. The addition of water to the bluff during heavy rainfall events is a common trigger for landslides. Although large slope failures occur infrequently, these episodic events and the associated loss of material will substantially influence the overall average rate of bluff retreat.

Rates of sea cliff retreat can be delayed or accelerated by human actions. Seawalls and revetments can slow sea cliff retreat at a specific site, but can also result in increased beach sand erosion and accelerated bluff erosion adjacent to the protective structure. Increases in the amount of water that infiltrates into the bluff by rainfall, irrigation, septic tanks or changes in drainage patterns can increase the rate of cliff erosion by increasing water pressure within the material that comprises the bluff, and by adding weight to the bluff. The application of water to the top of the bluff can also result in water percolating into the bluff and emerging on the bluff face as a spring or seep, which can substantially weaken the cliff. Other actions that can increase the rate of bluff retreat include adding structures (weight) to the top of the bluff, which can increase the potential for landslides; the construction and use of pathways on the cliff face, which can concentrate and accelerate runoff-related erosion; and planting vegetation with shallow roots or that becomes heavy and can pull soil away from the cliff face.

Local Conditions

There are approximately four miles of coastal bluffs within the City limits, including the cliffs that form the southern portion of the West Mesa and East Mesa neighborhoods, and the cliffs adjacent to the Clark Estate and the Santa Barbara Cemetery in the East Beach neighborhood. The height of the sea cliffs in Santa Barbara gradually decrease from west to east, with cliffs of about 150 feet located in the Douglas Family Preserve area; 100 feet in the West Mesa neighborhood; and about 50 feet along Shoreline Park in the East Mesa neighborhood. The coastal bluffs are about 50 feet in height adjacent to the cemetery in the East Beach neighborhood of the City.

Most of the sea cliffs in the City are comprised of Monterey shale that is capped by unconsolidated marine terrace deposits. The shale is often comprised of thin beds that can vary in structure and composition, and that have been folded, fractured and tilted. The potential for slope failure can be substantially increased when bedding planes dip (tilt) toward the beach at an angle that is less steep than the sea cliff face, a condition referred to as "daylighted" bedding.

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[5] Please refer to the Landslide section for additional information regarding "driving" forces and "resisting" forces.

Several large landslides have affected the Santa Barbara ocean bluffs in the recent past. On February 14, 1978, the El Camino de la Luz landslide encompassed an area approximately three acres in size and resulted in the destruction of two homes. The eastern edge of the landslide was located approximately 400 feet west of Lighthouse Creek in the West Mesa neighborhood. The probable cause of this landslide was determined to be bedding planes that dipped toward the beach and surface water runoff that permeated the ground in the slide area as a result of a series of large storms. On January 25, 2008, a landslide affected the bluff in Shoreline Park. This landslide extended 70 feet along the top of the cliff and moved the bluff edge landward 38 feet. Other landslide areas along the bluffs adjacent to the East and West Mesa neighborhoods are depicted on Figure 13, Slope Failure Hazard Zones. Overall, the bluffs adjacent to the Mesa neighborhoods and the Santa Barbara Cemetery/Clark Estate have been designated by the *Geology and Geohazards Technical Report* as having a "high" landslide potential.

Sea Cliff Retreat Rates

As described above, sea cliff retreat occurs as a result of a terrestrial and marine erosion processes, can be influenced by human activities and variations in the structure of the bluffs, and can occur slowly due to "grain-by-grain" erosion or rapidly as a result of large landslides. When all of these factors are considered over an extended period of time, an average rate of bluff retreat can be estimated.

Several different studies of sea cliff retreat rates have been conducted in the Santa Barbara area. The *Geology and Geohazards Technical Report* reports that a study by Norris (1986) evaluated coastal erosion rates along the Santa Barbara coastline that occurred over a 70-year period and determined that the highest retreat rate was approximately 12 inches per year, while the average erosion rate was eight inches per year. The difference between the highest and average retreat rates emphasizes that sea cliff retreat does not occur at a steady rate and can be highly variable over time.

The *City of Santa Barbara Sea Level Rise Vulnerability Study* (Griggs, 2012) reports that based on a review of historical aerial photographs, average long-term sea cliff retreat rates in Santa Barbara ranged between six and 12 inches per year. Another study by Hapke and Reid (2007) compared cliff edge positions on aerial photographs from the 1930's with LiDAR[6] data from 1998. That study identified average sea cliff retreat rates of about four to 18 inches per year for cliffs adjacent to the West and East Mesa neighborhoods, and just under six inches per year for the cliffs adjacent to the Clark Estate/Santa Barbara Cemetery in the East Beach neighborhood.

The estimated rates of sea cliff retreat vary due to local differences in the composition and structure of the bluffs, the effects of bluff-top development, and barriers located at the base of the bluffs such as cobbles, boulders, or rip rap. Although there can be a wide variation in the rate of retreat at individual sites and bluff retreat generally occurs in an episodic manner, the average rate of retreat for the Santa Barbara bluffs when measured over an extended period of time is about six to 12 inches per year. At that average rate, the City's ocean bluffs can be expected to retreat by approximately 10-20 feet over the next 20 years, and approximately 45 to 90 feet by 2100.

[6] LiDAR is an acronym for Light Detection and Ranging. This system uses a narrow laser beam to map physical features with very high resolution.

The *Geology and Geohazards Technical Report* identifies areas adjacent to the current (2013) bluff edge that may be affected by sea cliff retreat over the next 75 years. A 75-year timeframe was used because this is the period of time used by the City as the expected design life of new structures, and if sea cliff retreat were to threaten a structure that is at least 75 old, the structure would likely be obsolete and ready for demolition for reasons other than encroaching erosion. Based on a conservative (the highest average bluff retreat rate) estimate of 12 inches of sea cliff retreat per year, for planning purposes it can be expected that the bluff edge that existed in 2012 will retreat landward by approximately 75 feet over the next 75 years (2088). Figure 14, 75-Year Coastal Bluff Retreat Line, depicts the bluff-top areas of the City that could be affected by sea cliff retreat over the next 75 years. This figure presents a theoretical bluff retreat area that is to be used for planning purposes only. Actual rates of sea cliff retreat and the area that may be affected over the next 75 years will vary considerably due to site-specific geologic and other conditions.

Resources that May be Affected by Sea Cliff Retreat

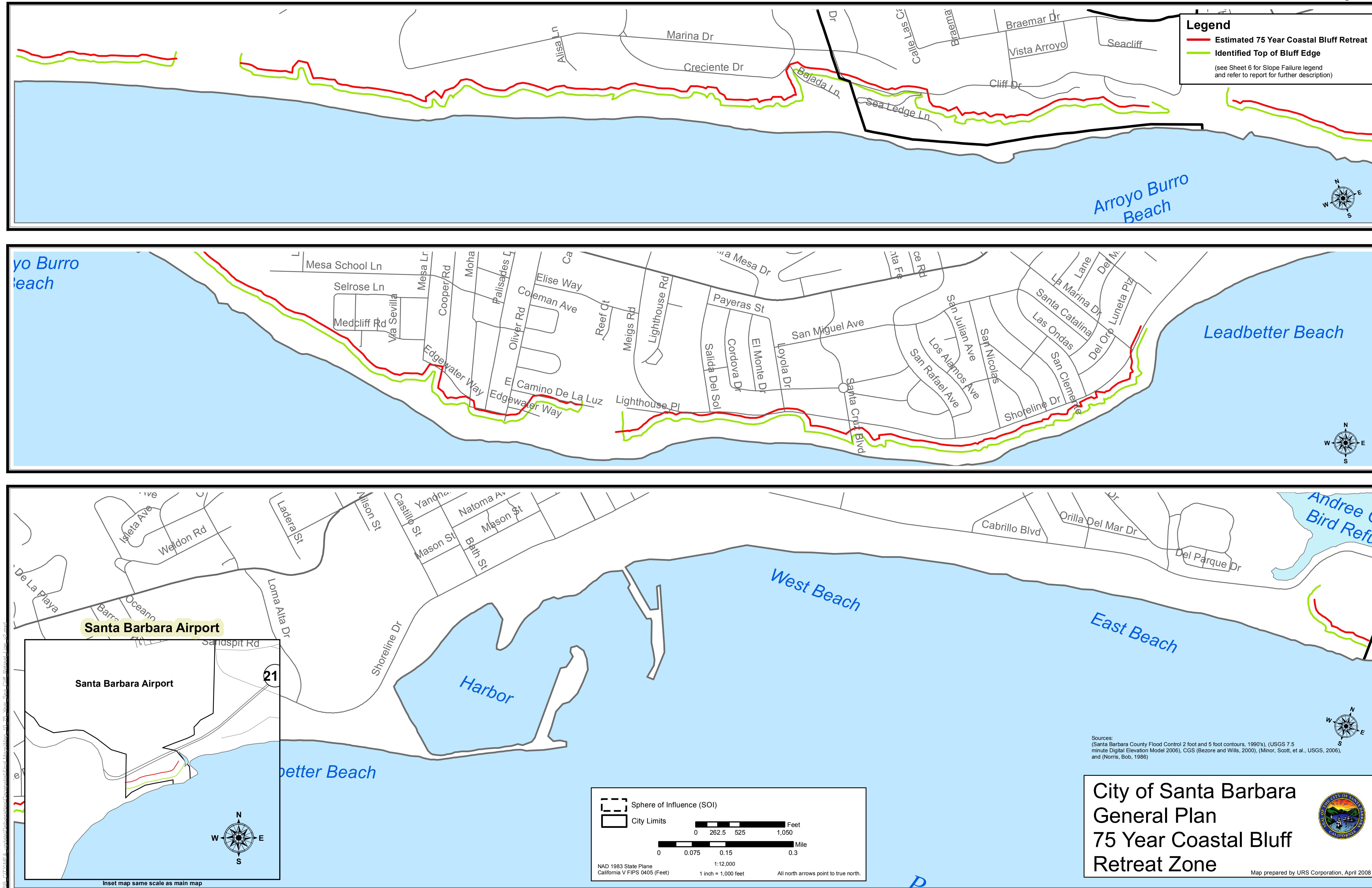
There are 98 single-family homes in the East and West Mesa neighborhoods located in the vicinity of the ocean bluff edge. Two major City parks, Shoreline Park and the Douglas Family Preserve, as well as the Santa Barbara Cemetery and the Clark Estate, are also located along the edge of an ocean bluff. The single-family residences located adjacent to the bluff edge were constructed at different times and with different setbacks from the bluff's edge, but as of 2012, are setback from the bluff edge by approximately 35 to 300 feet. There are approximately 25 residences located within 75 feet of the existing bluff edge, and facilities in Shoreline Park such as walkways and a restroom structure are within 50 feet of the present cliff edge. Although bluff retreat is episodic and actual rates of retreat over a given period cannot be predicted with certainty, residences, park facilities and associated streets, structures, parking lots, storm drains, water and sewer lines located within 75 feet of the bluff edge will be vulnerable to damage or destruction due to ongoing sea cliff retreat.

Sea Cliff Retreat Rates and the Effects of Climate Change

An expected consequence of climate change caused by increasing concentrations of greenhouse gases in the Earth's atmosphere is a rise in sea level, primarily due to the breakup and melting of ice caps and glaciers and a volumetric expansion of seawater as it warms. As sea level rises, ocean bluffs will be more vulnerable to wave-related erosion, which will likely result in an increase in existing sea cliff retreat rates.

Long-term measurements of sea level elevation along the California coast have indicated that the ocean is rising. Of the 12 tide gauges maintained along the California coast by the National Oceanic and Atmospheric Administration, 10 of the gauges have recorded average sea level rise rates that range between 0.83 and 2.22 mm/yr. Exceptions to these measurements have occurred at Humboldt Bay, where sea level has risen at a rate of 4.72 mm/yr, which indicates that land in the area is subsiding. At Crescent City, measured sea level is dropping 0.65 mm/yr, which indicates that the land surface in that area is being uplifted at a rate that is greater than global sea level rise. Satellite data collected since 1993, which is not influenced by regional effects of land subsidence or uplift, indicate that the average global rate of sea level rise is a little more than three mm/yr. A tide gauge at the Santa Barbara Harbor has indicated an average sea level rise of 1.25 mm/year, however, the gauge has been relocated twice resulting in a large possible measurement margin of error.

Figure 14



75 Year Coastal Bluff Retreat Zone- Figure 14

Estimates of future increases in the elevation of sea level vary considerably based on assumptions regarding greenhouse gas emission control effectiveness and other factors. The California Ocean Protection Council, which consists of representatives of 15 state agencies, has adopted future sea level rise projections for use in State planning and regulatory actions. These sea level rise guidelines identify a five- to eight-inch rise in sea levels over year 2000 conditions by 2030; 10-17-inches of sea level rise by 2050; and between 31 and 69 inches of sea level rise by 2100.

Other possible climate change-related effects could also increase existing average sea cliff retreat rates in the Santa Barbara area. For example, changes in climatic conditions may result in an increase in the frequency and severity of storms, and an increase in the height of waves as they approach the shore. Such changes to ocean conditions will result in increased ocean bluff erosion by storm waves.

Although there is substantial variation in predictions of future increases in sea level, particularly for conditions between 2050 and 2100, it is reasonably expected that the combination of increased sea levels and storm severity will lead to increased rates of erosion at the coastline, including a narrowing of beaches and an increase in the frequency and intensity of wave attack at the base of the coastal bluffs. There are locations in the Mesa neighborhoods where terrestrial processes are currently the predominant source of bluff erosion, which has resulted in the creation of cliffs with a rounded appearance. An increase in sea level and wave height will result in a corresponding increase in wave attack at the base of those bluffs, resulting in a steepening of the cliff face and increased retreat rates. At bluff locations along the Mesa where marine process are the predominant form of erosion and the cliffs have a steep gradient, an increase in sea level and wave height will expose the base of the cliff to increased wave attack, which could result in a substantial increase in existing retreat rates.

Similar to the uncertainty associated with predictions of future climate change-induced increases in sea level, there is extensive variation in predictions regarding future increases in the rates at which sea cliff retreat will occur. The *California Climate Adaptation Strategy* (2009) indicates that a recent study of southern California concluded that erosion rates are expected to accelerate by 20 percent for a sea-level rise of 39.4 inches (100 cm). Under such a scenario, the average rate of sea cliff retreat in Santa Barbara would increase from the current six to 12 inches per year to approximately seven to 14 inches per year.

In his assessment of the possible effects of sea level rise in Santa Barbara, Griggs bases his analysis of impacts associated with an increase in sea cliff retreat rates on the assumption that erosion rates will double to approximately 12-24 inches per year. Griggs concludes that there is a “moderate” potential for such an increase in average sea cliff rates to occur over the short- to intermediate-term (2012 to 2050), and a “high” or “very high” probability for such increases over the intermediate- to long-term (2050-2100). If sea cliff retreat rates were to double, Santa Barbara could experience up to 80 to 160 feet of erosion landward of the present cliff edge by the year 2100, which could threaten or require the removal of about 67 bluff top homes in the Mesa neighborhoods.

The *Plan Santa Barbara EIR’s* evaluation of long-term (2050 to 2100) climate change induced changes to existing sea cliff retreat rates indicates that the bluffs along Shoreline Park could retreat by 275 feet from their present location by the year 2100, and cliffs adjacent to residential areas of the Mesa could retreat 525 feet from their present location by 2100. These projections would require average erosion rates to increase by three to six times above current average rates of retreat in the Shoreline Park area, and six to 12 times above current average retreat rates in the Mesa neighborhoods. In his assessment of possible future sea cliff retreat rates, Griggs suggests using these sea cliff retreat rate projections with caution, and recommends that a program to monitor sea cliff retreat rates be established. Documentation of future changes in sea cliff retreat rates will provide the City with information needed to respond appropriately to increased sea cliff retreat hazards.

Hazard Reduction

The California Coastal Act requires that new development shall:

(1) Minimize risks to life and property in areas of high geologic, flood and fire hazard.

(2) Assure stability and structural integrity, and neither create nor contribute significantly to erosion, geologic instability, or destruction of the site or surrounding area or in any way require the construction of protective devices that would substantially alter natural landforms along bluffs and cliffs. (CCR Section 30253)

This law requires that new development be sited in such a way that it will not be subject to erosion or stability hazards during its design life, and that coastal armoring (i.e., seawalls, revetments, etc.) will not be needed to protect the development. As described above, the City assumes a 75-year design life for primary structures, including remodels or additions. Based on an assumed 75-year structure design life, an appropriate setback distance from the existing bluff edge is determined by multiplying the average annual sea cliff retreat rate appropriate for the project site by 75. Proposed accessory structure, patios, landscaping and other minor improvements may be located seaward of the 75-year sea cliff retreat line with discretionary City approval that recognizes that such development may have less than a 75-year design life or can be easily removed if threatened by sea cliff retreat.

The *Geology and Geohazards Technical Report* indicates that a site-specific sea cliff retreat evaluation should be prepared if habitable structures (i.e., single- or multi-family dwellings), commercial/industrial buildings, essential facilities, or minor improvements are proposed to be located seaward of the sea cliff retreat line depicted on Figure 14, or within 50 feet of the bluff edge, whichever is greater. No evaluation report is required for such development if it would be located landward of the sea cliff retreat line provided on Figure 14, or more than 50 feet of the bluff edge, whichever is greater.

The required sea cliff retreat evaluation study should comply with report preparation guidelines identified by the *Geology and Geohazards Technical Report*, and the methodology used by the California Coastal Commission staff that is provided as Safety Element Technical Background Report Appendix B. In summary, the Coastal Commission staff methodology includes several analysis steps to determine the appropriate setbacks on coastal bluffs including determine the location of the bluff edge; perform slope stability analysis and need for slope stability setback; identify appropriate long-term erosion rates to evaluate sea cliff retreat rates at the project site and to identify a 75-year erosion setback line.

Development setbacks are typically measured from the existing bluff edge, which is commonly defined as the intersection between the steeply sloping bluff face and the flat or more gently sloping bluff top. However, determining the actual location of the bluff edge can be subject to various interpretations, particularly if the bluff edge is irregular, rounded, there is a sloping bluff top, or previous development has occurred near the bluff edge. Additional guidance regarding the determination of where the bluff edge is located is provided in Appendix B.

After the location of the bluff edge has been determined, the bluff should be evaluated to determine if it is stable (i.e., not subject to landslide failure under various, static or earthquake conditions, or due to increases in groundwater levels due to storm conditions). If the bluff is determined to be stable, and it is also determined that it would remain stable after the completion of the proposed development, then an appropriate setback from the bluff edge to the proposed structure(s) that will accommodate at least 75 years of sea cliff retreat plus a factor of safety is identified. Sea cliff retreat rates used to determine the structure setback distance should consider site-specific historic rates of erosion, as well as future rates of erosion that may occur as a result of changing climatic conditions. If it is determined that the bluff is not stable, the distance from the unstable bluff edge to a position on the project site where the bluff is considered to be stable must be identified. From the location where the bluff is considered to be stable, a 75-year erosion setback is then established. This setback distance should also consider historic sea cliff retreat rates as well as possible future increases in retreat rates. Additional information regarding the evaluation of sea cliff stability and the identification of historic sea cliff retreat rates is provided in Appendix B and by the *Geology and Geohazards Technical Report*.

A variety of measures may be implemented to minimize the potential effects of sea cliff retreat/slope stability impacts on new development. While specific measures should be identified by a site-specific evaluation, general measures include controlling site drainage to minimize the infiltration of stormwater into subsurface materials, minimizing the application of landscape water, and avoiding the use of septic systems. Structure foundations and design elements should extend to suitable depths, and be of appropriate strength to not be compromised and to support the structure in the event of bluff failure or if retreat encroaches upon the foundation of the structure.

The Santa Barbara Annex to the *Multi-Jurisdictional Hazard Mitigation Plan* includes recommended mitigation actions to reduce the effects of sea cliff retreat on City-owned facilities. The recommended mitigation actions include continued management of sidewalks, vegetation and other facilities in Shoreline Park; rebuilding the beach access steps known as "1000 Steps" located west of Shoreline Park in the Mesa East neighborhood; and maintenance of the Mesa Lane coastal access steps in the West Mesa neighborhood.

SOIL EROSION

Description of the Hazard

Soil erosion occurs when wind, water or ground disturbances cause soil particles to move and be deposited elsewhere. Numerous conditions will influence the susceptibility of soil to the effects of erosion, although the characteristics of the soil, vegetative cover and topography are important factors. Soils with high clay content are generally less susceptible to erosion than soils with high sand or silt content. Soils with a high organic material content are often less susceptible to erosion because the organic matter helps to bind the soil particles, and also absorbs water, which reduces runoff. Soils that are compacted will promote higher water runoff rates, which can increase erosion. Soils covered with vegetation are less susceptible to erosion because the plants add organic material to the soil, shelter the soil from wind, and the plant roots bind the soil together. The removal of vegetation by construction activities or wildfire can result in a substantial increase in erosion rates. Areas with steep topography are more susceptible to erosion because sloping areas will generally have higher runoff water velocities, which increase the ability of water to dislodge and carry soil particles.

Increases in soil erosion rates caused by disturbances of the ground surface, fires or other causes can result in increased sediment loads in receiving waters such as ponds, reservoirs, streams and the ocean. Increased sediment loads can have a variety of adverse effects on water quality. In addition to impacts such as decreased water clarity, reduced light penetration and diminished photosynthesis in aquatic plants, sediment particles can carry pollutants such as nutrients, bacteria, pesticides, metals and hydrocarbons. These pollutants can impair water quality by promoting algae growth and associated decreases in dissolved oxygen levels, and may also be toxic to aquatic organisms.

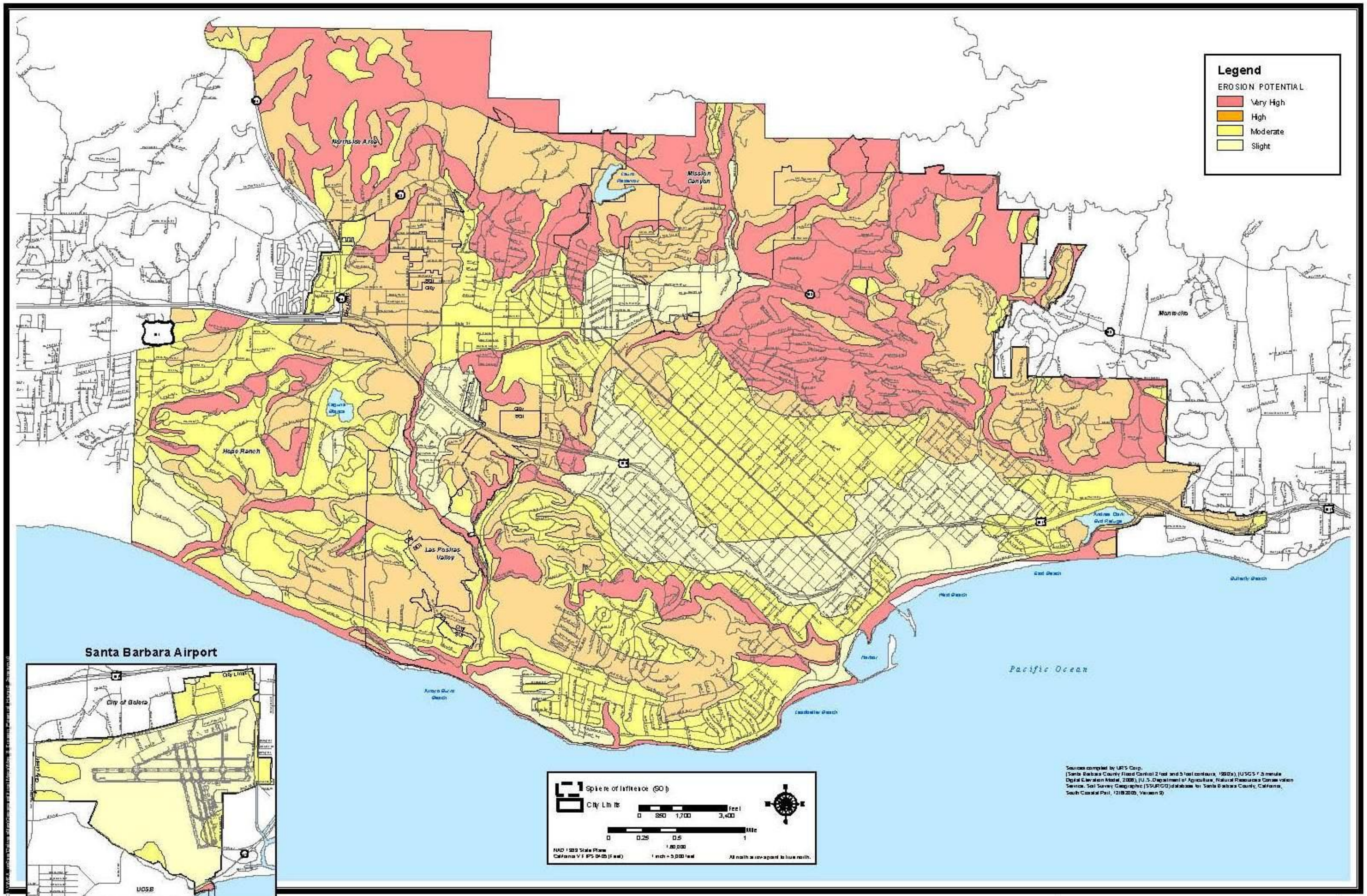
Local Conditions

Potential erosion hazards areas in the City were identified by the *Geology and Geohazards Technical Report* based on soil characteristic data obtained from the U.S. Department of Agriculture – National Resource Conservation Service. Erosion hazard levels throughout the City were classified on a scale ranging from "Very High" to "Slight," and are depicted on Figure 15, Erosion Potential Hazard Zones. In general, areas with a higher erosion hazard potential are located in the hillside or sloping areas of the City, such as the Riviera, and portions of the Upper State, Mesa and Las Positas areas. Portions of the City that are level or with only moderate slopes are generally classified as having a "Moderate" to "Slight" erosion hazard potential.

Hazard Reduction

Numerous federal, state and local regulatory programs have been enacted to reduce the potential for erosion-related hazards. At the federal level, the Clean Water Act and National Pollutant Discharge Elimination System (NPDES) permits require the implementation best management practices to reduce erosion and sedimentation from non-point sources such as construction sites. In 1990, California implemented the Porter-Cologne Water Quality Control Act, which enables the State Water Resources Control Board to implement federal NPDES requirements. Federal and State regulations are also implemented at the local level by programs such as the Santa Barbara Storm Water Management Program, which provides policies and programs for managing storm water runoff from development sites; the Storm Water Best Management Practices Guidance Manual, which provides information related to the implementation of erosion control best management and low impact development practices; and the building and grading requirements provided by Title 22, Environmental Policy and Construction, of the City's Municipal Code.

The *Geology and Geohazards Technical Report* provides recommendations regarding the evaluation of potential erosion hazards at development project sites. The *Technical Report* indicates that a site-specific erosion potential investigation is not required for projects located in areas designated as having a "Slight" erosion potential. In areas designated as having a "Moderate" erosion potential, a site investigation should be required for projects that would result in the creation of steep fill slopes. With some exceptions for very minor projects, site-specific erosion investigations should be prepared for all proposed development projects in areas with a "High" or "Very High" hazard classification. The *Geology and Geohazards Technical Report* also describes the type of information that should be included in a project-specific erosion evaluation. In general, the assessment is to be consistent with federal, state and local regulatory requirements and should identify feasible methods to control erosion during and after the completion of construction activities. Please refer to the *Geology and Geohazards Technical Report* for a complete description of the recommended erosion hazard evaluation and study requirements.



City of Santa Barbara
General Plan
Erosion Potential
Hazard Zones

Map prepared by URS Corporation, April 2008

Figure 15

EXPANSIVE SOIL

Description of the Hazard

Expansive soils, also known as "shrink/swell" soils, will expand when wet and shrink when they become dry. The expansion of the soil occurs when clay minerals contained in the soil attract and absorb water. Water that causes the soil to swell may be derived from precipitation, irrigation, or other moisture sources. Repeated cycles of shrinking and swelling can cause building foundations, walls, ceilings and floors to crack, and windows and doors to warp so that they do not function properly. Differential shrinking and swelling can also damage surface improvements such as roadways and sidewalks, often resulting in a "wavy" appearance.

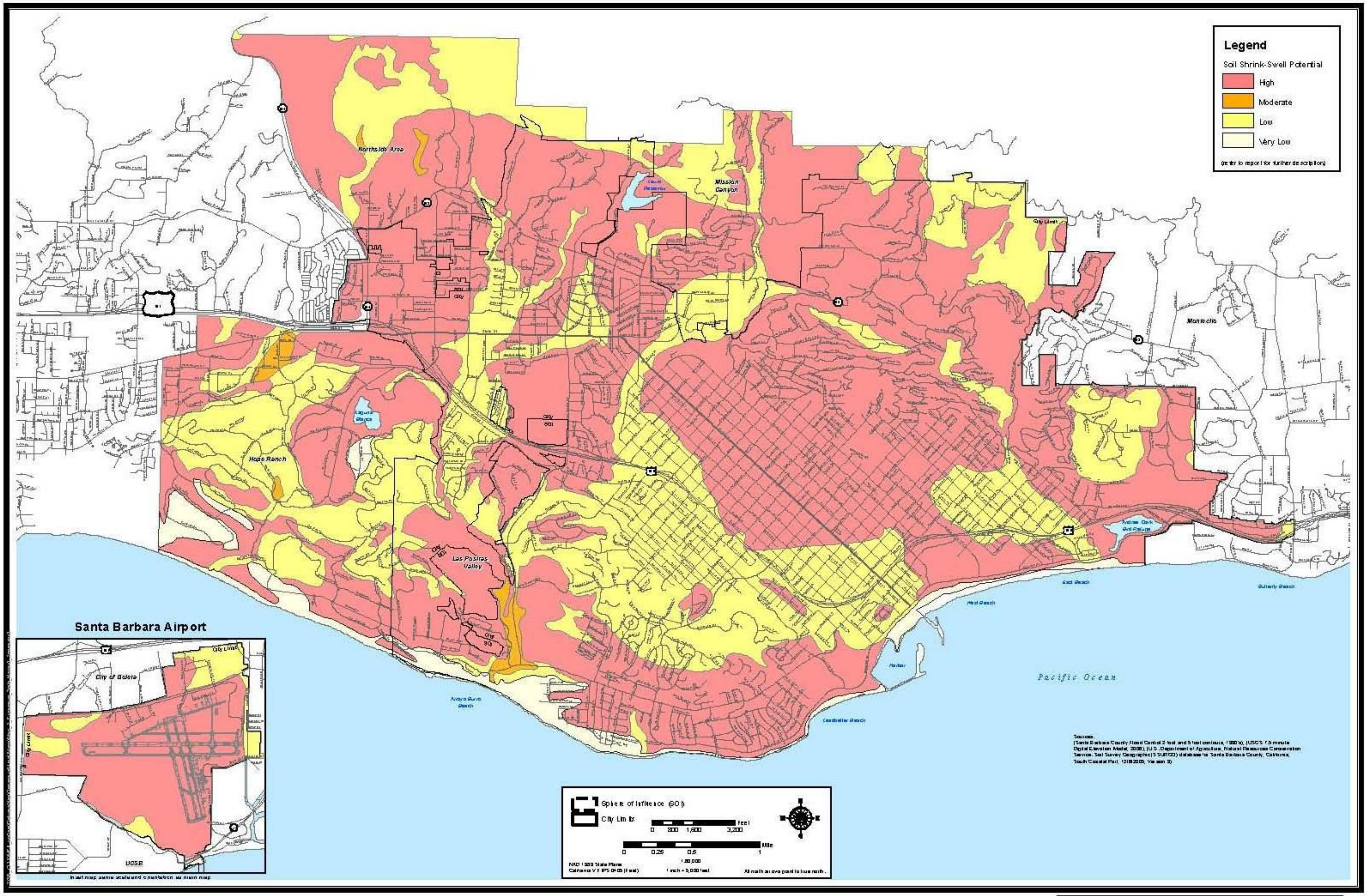
Local Conditions

Soils located in the City that present a potential shrink/swell hazard were identified by the *Geology and Geohazards Technical Report* based on soil characteristic data obtained from the U.S. Department of Agriculture – National Resource Conservation Service. The potential for soils to result in a shrink/swell hazard were classified on a scale ranging from "High" to "Very Low," and are depicted on Figure 16, Expansive Soil Hazard Zones. In general, areas that are underlain with soils that have a "High" shrink/swell potential are located throughout the City, but predominately in the Downtown, Mesa, and hillside areas in the northern and western portions of the City.

Hazard Reduction

The *Geology and Geohazards Technical Report* provides recommendations regarding the evaluation of potential expansive soil hazards at development project sites. The *Technical Report* indicates that a site-specific expansive soil investigation is not required for development projects, other than essential facilities, located in areas designated as having a "Very Low" or "Low" hazard potential. During site evaluations, local soils engineers may conduct one or more expansivity test at sites with marginal potential for expansive soils. In areas designated as having a "Moderate" or "High" expansive soil potential, a site-specific soil investigation should be prepared for all development projects. The *Technical Report* also describes the type of information that should be included in a project-specific evaluation. In general, the assessment is to be consistent with requirements of applicable building codes. Please refer to the *Geology and Geohazards Technical Report* for a complete description of the recommended hazard evaluation and study requirements.

Expansive soil hazards can be addressed if considered early in a development project's design. Specific foundation preparation and/or structure designs are generally capable of minimizing damage that may result from the presence of expansive soils.



City of Santa Barbara
General Plan
Expansive Soils
Hazard Zones

Figure 16

RADON

Description of the Hazard

Radon is an invisible and odorless radioactive gas that is created as a result of the decay of uranium and thorium that is naturally present in rocks and soils. Breathing air with elevated levels of radon gas can result in an increased risk of developing lung cancer.

The average uranium content in the earth's continental crust is about 2.5 to 2.8 parts per million, although certain rock types and soils derived from those rocks can have substantially higher concentrations. As radon gas is produced, it moves through rock fractures and soil pore spaces. Movement of radon gas away from its site of origin is typically on the order of tens of feet, but may be up to 100's of feet. The decay of uranium and thorium can produce several radon isotopes, although radon-222 is the most commonly detected isotope because it has the longest half-life of 3.8 days.

Radon gas moves from the soil and into buildings in various ways. It can enter through cracks in slabs or basement walls, pores and cracks in concrete blocks, and openings around pipes. Since radon enters buildings from the adjacent soil, concentrations of the gas are generally highest in basements and in ground floor rooms. Small amounts of radon can also enter buildings that use private wells if water drawn from the well contains dissolved radon gas.

The U.S. Environmental Protection Agency (EPA) reported in 1991 that the average radon concentration for indoor air in American homes is about 1.3 picocuries per liter (pCi/L).[7] The average radon concentration in outdoor air is about 0.4 pCi/L. While all buildings have some potential for elevated radon levels, buildings located on rocks and soil containing elevated levels of uranium or thorium will have a greater likelihood of having elevated radon concentrations. The EPA and the California Department of Public Health recommends that individuals avoid long-term exposures to radon concentrations above 4 pCi/L.

Not everyone exposed to radon will develop lung cancer. The EPA and National Cancer Institute estimate that there are between 7,000 and 30,000 annual lung cancer deaths in the U.S. attributable to radon.

Local Conditions

In 1993 the U.S. Geological Survey, along with various state agencies, evaluated each county in the U.S to identify potential radon hazard zones. In California, Santa Barbara and Ventura Counties were the only counties in the state identified as having predicted average indoor radon concentrations above 4 pCi/L. This rating is attributed to the presence of Rincon Shale and Monterey Shale Formations in various locations throughout both counties.

Areas of the City that have a moderate to high potential for elevated radon concentrations were identified by the *Geology and Geohazards Technical Report* and are depicted on Figure 17, Radon Hazard Zones. Areas designated as having a "High" or "Moderate" radon potential are generally located in areas underlain by the Rincon or Monterey Formations, or soils derived from those formations. In general, areas designated as having a "High" or "Moderate" risk potential are located in the upper elevations of the Riviera and Upper State Street area, and portions of the Mesa and Las Positas areas.

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[7] A picocurie is one trillionth of a Curie, an international measurement unit of radioactivity.

The California Department of Public Health collects building radon test data by zip code to identify areas that have the potential to have high indoor radon levels. Radon data collected by the Department of Public Health for the City of Santa Barbara is summarized below on Table 4. The data indicates that the highest numbers of tests have been conducted, and the highest percentage of tests results with radon concentrations above 4pCi/L are located in the northern areas of the City, which were also identified as having a "High" potential hazard risk on Figure 17.

Table 4
Santa Barbara Radon Test Result Data

Zip Code	General Area	No. of Reported Tests Conducted	No. of Reported Tests above 4pCi/L
93101	Downtown and Westside	70	1
93103	Lower Riviera and Eastside	84	8
93105	Upper Riviera, Upper State and portions of Las Positas. This zip code also includes unincorporated areas north of the City	352	91
93109	Mesa and parts of Las Positas	104	4

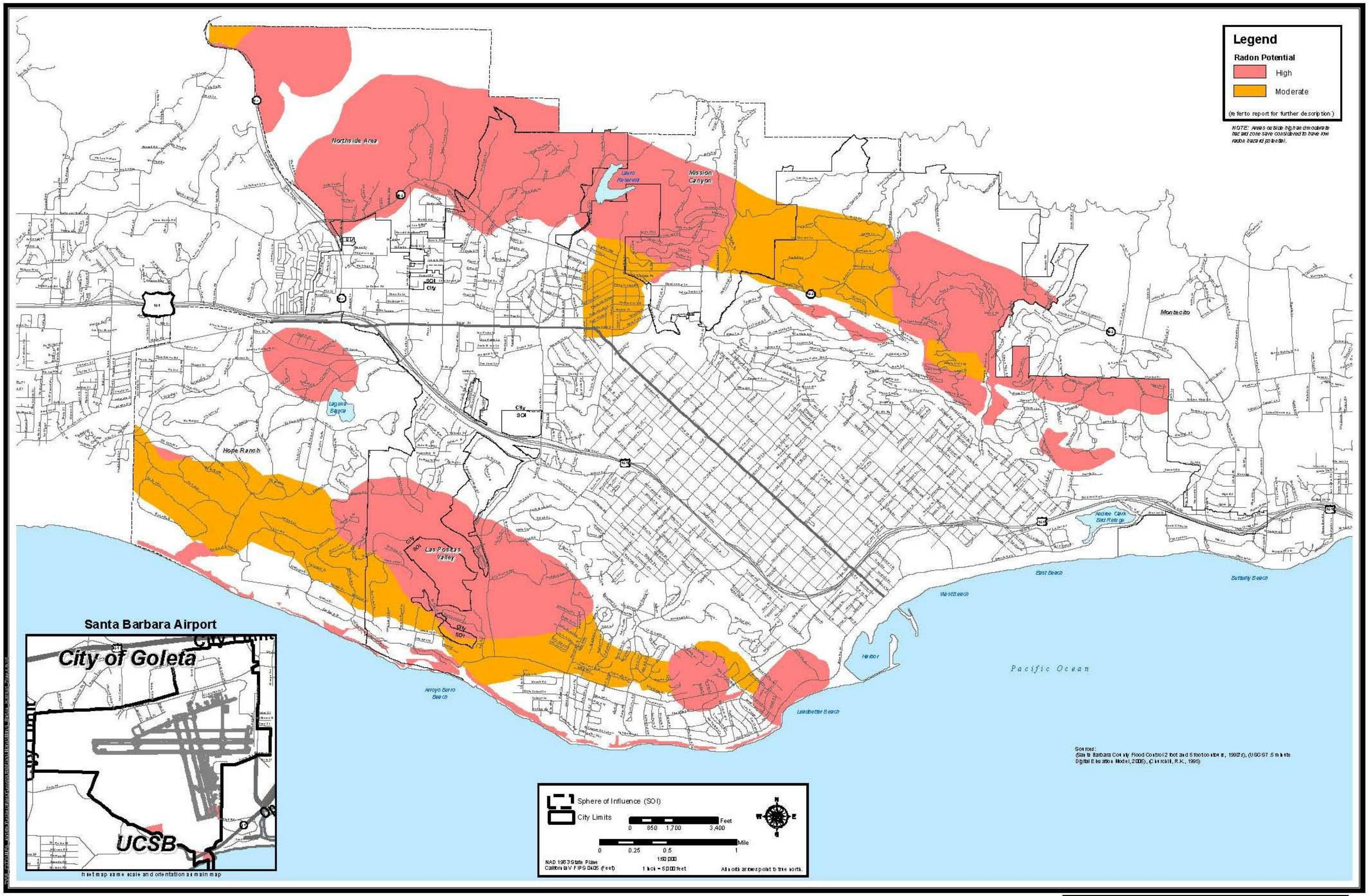
Source: California Department of Public Health, 2012. The data provides test results through May 4, 2010.

Hazard Reduction

The *Geology and Geohazards Technical Report* provides recommendations regarding the evaluation of potential radon exposure hazards at development project sites. The *Technical Report* indicates that in areas designated as having a "Moderate" or "High" hazard potential, new development, other than the construction of minor improvements, should incorporate engineered controls into the design of structures. No hazard evaluation or control measures are required for new development located in areas located beyond the potential hazard areas identified by Figure 17. Please refer to the *Geology and Geohazards Technical Report* for a complete description of the recommended radon hazard evaluation and control requirements.

A common method to minimize the potential for exposure to radon is to install a soil depressurization system that uses a fan and ventilation pipes to create a vacuum below the building slab or a crawl space below an impermeable plastic sheet. Passive ventilation systems that do not rely on the use of a fan can be installed in new construction. Sealing foundation cracks, pipe penetrations and utility channels can also be an effective measure to reduce indoor radon concentrations.

Risk levels at individual homes can vary substantially based on local variability in soil permeability, building design and condition, and building use. Inexpensive and easy to use kits to test indoor air for the presence of radon are available to assess potential hazard risks at individual buildings.



City of Santa Barbara
General Plan
Radon Hazard Zones

Figure 17

HIGH GROUNDWATER

Description of the Hazard

High groundwater or near-surface groundwater is a hazard that can have an adverse effect on building construction, roads, storage tank installation, utility installation, and other projects with structural elements that penetrate the subsurface. Once installed, buildings and other facilities in areas with high groundwater can be subjected to moisture intrusion and, in some cases, tremendous buoyancy forces that may push up on the structure, potentially causing structural offsets at the ground surface or otherwise causing extensive damage. In general, groundwater within 15 feet of ground surface can create a nuisance and can require special structure design to address buoyancy and moisture intrusion. Large, deep structures may have issues with water deeper than 15 feet. During construction, specific steps to de-water excavation areas and provide side slope stability may be necessary in areas of shallow groundwater. In areas of chemical spills, de-watering may mobilize contaminant plumes or, at a minimum, may require permitted treatment systems to remove contaminants prior to discharge of the removed groundwater. High groundwater can also increase liquefaction and the slope stability hazards.

Local Conditions

Groundwater levels can vary over time in response to climatic conditions. In general, the periods of highest groundwater can be expected during and sometimes for several months after rainy seasons with above-average rainfall totals. Recent very high rainfall seasons included 1998 (rainfall at 204% of 139-year average) and 2005 (166% of 139-year average). As expected, a review of various data from groundwater monitoring sites located throughout the City indicated that shallow groundwater levels peaked in those years.

A uniform, shallow groundwater body is not typically found in portions of the City underlain by bedrock. However, buildings located on pads cut into hillsides can sometimes be affected during periods of wet weather by shallow water in fractures or pore spaces in contact with foundations and basements.

Areas of the City that have the potential to be affected by high groundwater are depicted on Figure 18. Areas that generally have potentially shallow groundwater, moderately shallow groundwater, and deep groundwater were identified by reviewing various geotechnical investigations, other readily accessible data sources and a publically accessible database maintained by the California State Water Resources Control Board (GeoTracker). Locations with shallow groundwater data were chosen based on their special positioning and the amount of available historic data. Sites with data from the wet years of 1995, 1998, and/or 2005 were preferred in order to identify reasonable peak groundwater elevation values. Areas of the City depicted on Figure 18 as having potentially shallow groundwater are those areas where groundwater could be encountered at a depth of less than 15 feet below the ground surface, although over time and due to climatic conditions, there can be substantial variability in groundwater levels at a particular site. In general, neighborhoods in the City that have the potential for high groundwater-related hazards include East Beach, the southern portion of the Eastside, Milpas, Lower East, Lower State, the southern portion of Downtown, the southern portion of Laguna, Lower West, West Beach, the southern portion of the Westside, the Waterfront and Airport, and areas located adjacent to the major creeks in the City.

Hazard Reduction

The first step to reduce potential adverse effects of high groundwater is to review available data for the site or nearby areas. The GeoTracker database can be very useful, especially if data from the recent peak years (1995, 1998, 2005) is available. Ground surface elevations should be considered when comparing depth-to-water measurements between sites with varying elevations. Deep aquifer or production well data may not reflect actual shallow groundwater depth, as data from deeper water wells may not provide accurate information for depth to groundwater in the uppermost saturated portions of the subsurface. Site specific investigation (soil borings and/or cased wells/piezometers) will provide up-to-date depth to groundwater data. Upon determination of a "design groundwater elevation," the structure design and building methods can be evaluated and planned as necessary to mitigate the hazard.

Control of groundwater is typically a complex problem and it is difficult to predict the volume of water necessary to dewater a particular site or the effect on the engineering characteristics of the dewatered material. Hydrologic parameters and the stability and behavior of soil in an excavation made for construction that is to be dewatered should be evaluated prior to initiating dewatering work. Building design and construction methods to minimize the effects of high groundwater may include various dewatering systems, such as pumping or siphoning of an excavation made during construction, vacuum wellpoint systems, and deep pumped wells. Groundwater cut-off structures and grouting methods are among other methods used for excavation dewatering during construction and for the finished structure. Requirements for building damp-proofing and water proofing are included in the California Building Code.

Figure 18

Shallow Groundwater Hazard Zones

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Fire Hazards

INTRODUCTION

Two types of fire hazards have the potential to affect Santa Barbara: fires that occur in "wildland" areas and structure fires in urban areas. The City of Santa Barbara Fire Department is largely staffed and equipped for structure fire protection, but in recent years has placed greater emphasis on planning for wildland fire protection and prevention. This section of the Safety Element provides a description of both wildland and structure fire hazards that have the potential to affect the City, and describes measures that have been implemented to minimize the risk of fire-related hazards.

WILDLAND FIRE HAZARDS

Description of the Hazard

Wildland fires are a natural process and plants native to chaparral habitats exhibit many diverse adaptations to survive fire. However, wildland fires can result in a multitude of adverse effects on the built environment, including the potential for loss of life, damage or destruction of public and private structures, loss of personal property, damage to infrastructure systems, and damage to recreation facilities and open space areas. Wildland fires can also result in the loss of hillside vegetation over extensive areas, which can result in a variety of adverse post-fire effects. The loss of protective vegetation can result in substantial increases in stormwater runoff, erosion and sedimentation, and can substantially increase the potential for and severity of landslides, mudslides and downstream flooding. A fire-related increase in these hazards may impact areas not directly affected by the fire and may result in extensive damage to downstream homes, roads, debris basins and other drainage and utility infrastructure, the impairment of water quality, and adverse impacts to aquatic habitats.

A wildland fire that occurs in the vicinity of urban development is often referred to as a "wildland-urban interface" fire. These types of fires have been described as occurring in "*the area or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.*"[8] Wildland-urban interface fires can occur where there is a distinct boundary between the built and natural areas, or may occur in areas where development and infrastructure is intermixed with the natural area. In large wildland-urban interface fires, the fire may be fueled by structures as well as native and landscape vegetation. The 2008 Tea Fire and the 2009 Jesusita Fire are recent examples of large wildland-urban interface zone fires in the Santa Barbara that resulted in extensive damage to structures and infrastructure. In contrast, the 2007 Zaca Fire that burned over 220,000 wildland acres in northern Santa Barbara County was one of the largest fires ever to occur in California and did not burn any structures.

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[8] State of California Multi-Hazard Mitigation Plan, 2010

Wildland-urban interface zones are often designated as having a high wildfire hazard potential due to a combination of factors that increase the risk of a wildland fire. Property owners can implement a variety of construction and vegetation management practices to reduce the potential for wildfire-related damage, but must also accept the risk associated with living in a high fire hazard environment. Additional information regarding local wildfire hazard conditions and risk reduction programs is provided below.

Due to the extensive environmental, social and monetary costs associated with wildfires, federal, state and local agencies have implemented a wide variety of fire prevention and suppression programs. To alert firefighting agencies and the public of weather conditions that may contribute to the start or rapid spread of a fire, such as low humidity, high winds and/or lightning storms, the National Weather Service may issue a "Red Flag Warning." Such a warning is often used by local agencies to increase staffing and equipment resources, and to temporarily ban outdoor fires and other possible fire ignition sources. When a wildfire does occur, most communities, including Santa Barbara, rely on mutual aid resources to supplement local fire suppression capabilities. Mutual aid may be provided by neighboring agencies, fire departments location throughout the state, as well as state and federal resources. The California Department of Forestry and Fire Protection (CAL FIRE) is a state agency that assists fire departments with mutual aid efforts and suppression capabilities. In extreme emergencies, California National Guard resources may also be utilized, such as helicopters, support personnel and communications equipment. State and federal mutual aid support may also be provided by the California Emergency Management Agency and the U.S. Forest Service.

Local Conditions

Conditions that Contribute to a High Wildfire Hazard

Natural- and development-related conditions can combine to increase the potential for and the severity of wildland fires. Based on an evaluation of these conditions, the Santa Barbara Fire Department has identified areas of the City that have a high wildfire hazard. Conditions that contribute to a high wildfire hazard are briefly described below.

Vegetation. Much of the wildland area within and adjacent to Santa Barbara is covered with a plant community known as chaparral, which commonly consists of species such as chamise, manzanita and ceanothus. This plant community has evolved so that fire has become a natural part of the ecosystem and is periodically required to clear old plants and accumulated dead plant material so that new plant growth can occur. Fire exclusion and suppression practices have resulted in large accumulations of these highly flammable plant materials in certain hillside areas, and when burned under wildfire conditions, the result is intense fire behavior that increases the potential for damage to natural and developed resources.

Climate. The local Mediterranean climate is characterized by moist winters that promote plant growth, and dry summers that lower vegetation (fuel) moisture levels, making the plants susceptible to fire. Short-term weather conditions, such as Santa Ana and sundowner winds, can result in strong, hot winds that lower fuel moisture levels and cause flames to spread rapidly and erratically. Additional information about sundowner winds is provided on Figure 19.

Topography. Steep slopes can substantially limit the ability of firefighters to reach and fight fires. Steep terrain also channels air flow, which can create erratic wind patterns and influence the direction and speed at which a fire spreads.

Road and Driveway Requirements. The Fire Department has adopted access standards for new development in high fire hazard areas, and those standards address items such as road width, gradient, surface material, vertical clearance, turning radius, dead ends, bridges and address requirements. Development that occurred in high fire hazard areas prior to the adoption of current standards often does not meet the existing requirements, which can impede the ability of the Fire Department to fight fires and result in safety issues for fire fighters. Access along roadways that otherwise meet current standards can be constrained by on-street parking and vegetation that has been allowed to grow close to the roadway.

Water Supply. The Fire Department has adopted water supply and fire hydrant standards for development in high fire hazard areas. These standards were adopted after the 1977 Sycamore Canyon fire, when water supply systems were not able to provide adequate water pressure and volume. New water systems have been developed in high fire hazard areas that provide additional reservoirs, pump stations, water mains and fire hydrants. Despite these improvements, water supply may be limited in some high wildfire hazard areas during a fire emergency because of the high demand placed on the water system.

Figure 19

SUNDOWNER WINDS IN SANTA BARBARA

Sundowner winds generally occur in the late afternoon or evening, resulting in gentle offshore breezes and a rise in temperature. Stronger sundowners may occur several times a year and can result in a large temperature rise and local gale-force winds. Rarely, probably only several times a century, an "explosive" sundowner occurs, resulting in extremely strong and hot winds. In these events, super-heated air from the Santa Ynez Valley races down the mountains onto the Santa Barbara coastal plain.

A phenomenal sundowner occurred on June 17, 1859 and was recorded by a survey boat anchored off Santa Barbara. The ship record indicates that temperatures were in the 80's by mid-morning, and at approximately 1 p.m. gusty winds developed and the temperature began to rise. At 2 p.m. the survey boat recorded a temperature of 133 degrees and heavy blowing dust. A U.S. government report stated "calves, rabbits and cattle died on their feet. Fruit fell from trees to the ground scorched on the windward side; all vegetable gardens were ruined. A fisherman in a rowboat made it to the Goleta Sandspit with his face and arms blistered as if he had been exposed to a blast furnace." By 5 p.m. the temperature dropped to 122 degrees, and by 8 p.m. it had cooled to 77 degrees.

The temperature of 133 degrees was the highest recorded temperature in North America for 75 years until a temperature of 134 degrees was recorded in Death Valley.

Response Time. The Santa Barbara Fire Department's response time standard, which is the amount time between receiving a call for service and arriving at the scene, is four minutes. Most of the City can be reached by a responding fire engine within the four-minute standard, however, several high fire hazard areas require more than a four-minute response time. An extended fire response time increases the potential for a fire to escape initial control, which increases fire risk to surrounding areas. Areas of the City that are located beyond the four-minute response standard include the Eucalyptus Hill neighborhood, the northern portion of the Cielito neighborhood, the extreme northern portion of the Foothill neighborhood, and the western portion of the Campanil neighborhood.

High Fire Hazard Areas in Santa Barbara

The Fire Department has identified four high fire hazard zones in the City based on fire hazard and risk factors identified and evaluated by the Department's 2004 Wildland Fire Plan. Each of the identified fire hazard zones presents a varying level of hazard risk. The four wildland fire hazard zones identified by the Wildland Fire Plan are depicted on Figure 20 and include the:

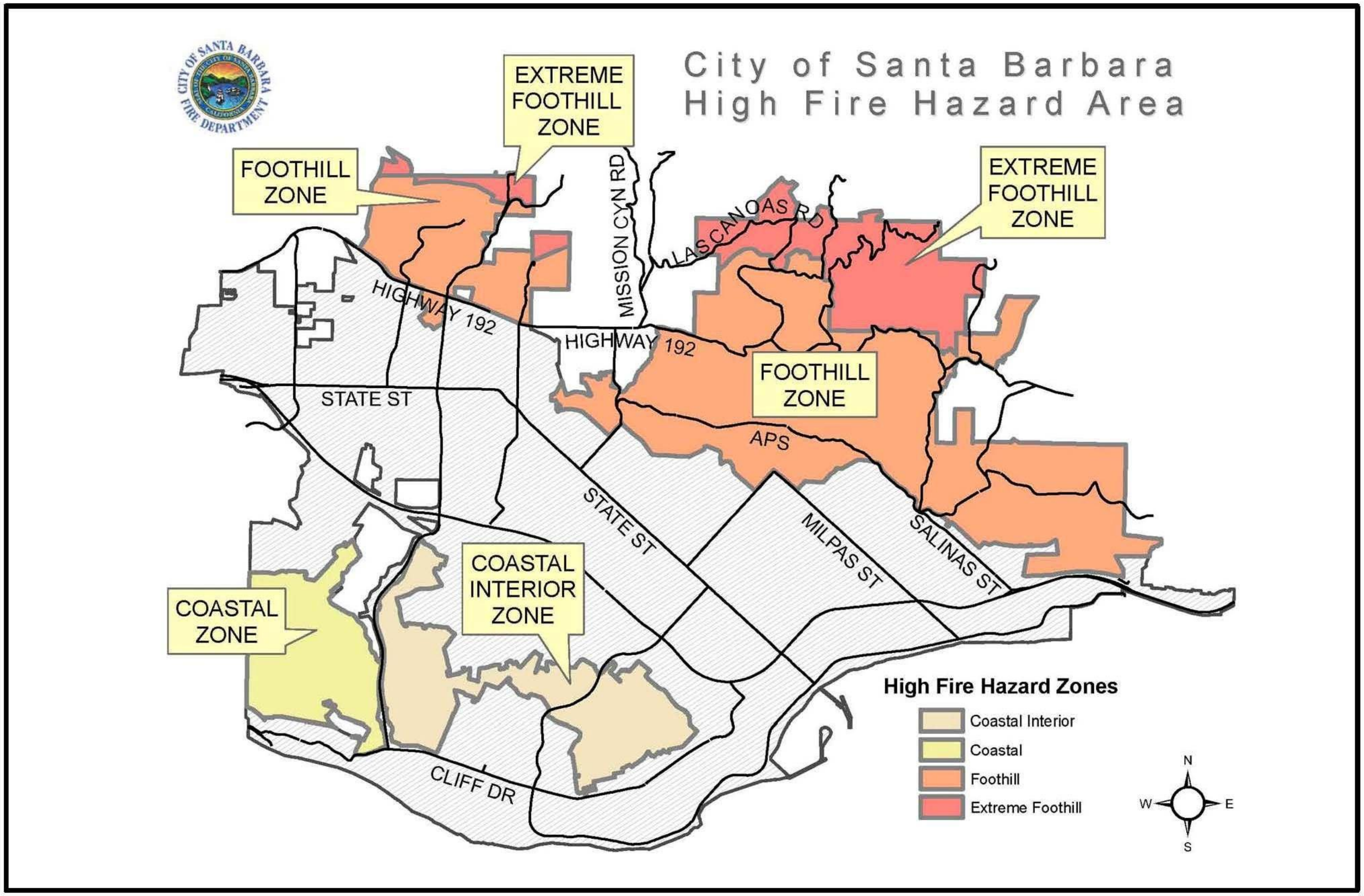
Extreme Foothill Zone, Foothill Zone, Coastal Zone and Coastal Interior Zone. Characteristics that contribute to the high wildfire hazard condition in each of the zones are summarized below.

Extreme Foothill Zone. Areas of the City in the Extreme Foothill Zone are located in what is roughly the northern half of the Cielito neighborhood and the northern-most portion of the Foothill neighborhood. This zone has a combination of heavy vegetation located within the City and in the adjacent Los Padres National Forest; slopes with a gradient greater than 30 percent and that face to the south and southwest; and drainages that are aligned to frequent hot and dry wind conditions. The majority of this zone is outside the Department's four-minute response time, and there are areas within the zone that have limited water supplies. The main roads in this zone meet Fire Department access standards; however, many smaller roads, driveways and bridges do not meet current standards. Portions of this area have been burned during recent fires, including the Coyote (1964), Sycamore Canyon (1977), Painted Cave (1990), Tea (2008) and Jesusita (2009) fires.

Foothill Zone. The Foothill Zone includes all or portions of the Cielito, Riviera and Lower Riviera, Eucalyptus Hill and Foothill neighborhoods. Vegetation in this area includes a mix of heavy brush and canopy fuels provided by oak and eucalyptus trees; heavy vegetation in creek areas; and slopes with gradients that vary between 20 and 40 percent and that are oriented to the south and southwest. The majority of this zone is within the Fire Department's four-minute response area, however, some of the main roads and many of the smaller residential roads do not meet the Department's road standards. This zone generally has adequate water supplies, which reduces potential fire hazards; however, the high density of residential structures located throughout this zone increases the wildfire hazard. This zone has been affected by several wildfires, including the Coyote (1964), Sycamore Canyon (1977), Tea (2008) and Jesusita (2009) fires.

Coastal Zone. The Coastal high fire hazard zone is located in the southwestern portion of the City and consists mostly of the Campanil neighborhood. This zone has diverse pockets of vegetation, such as chaparral, oak forests, coastal sage scrub, landscape vegetation, agricultural lands and eucalyptus groves, and much of the vegetation occurs on slopes that range in gradient from 10 to 35 percent. The ocean's influence dominates weather patterns in this zone for most of the year, however, down canyon winds that can cause the rapid spread of flames may be a factor. The western portion of this zone is located beyond the Fire Department's four-minute response time standard. The majority of the roads in this zone meet the Fire Department's standards and water supplies also meet Fire Department requirements.

Coastal Interior Zone. The Coastal Interior high fire hazard zone includes all or portions of the Bel Air, Alta Mesa, and Westside neighborhoods. This zone has areas with moderate brush and heavy canopy fuels that are interspersed among areas with high concentrations of structures. The ocean's influence dominates weather patterns most of the year, however, down canyon winds can cause the rapid spread of flames on slopes that vary in gradient between 10 and 35 percent. This zone is within the Fire Department's four-minute response time standard, and the majority of the roads meet Fire Department's standards. This zone also meets the Fire Department's water supply standards.



Source: City of Santa Barbara, 2012

Figure 20

City of Santa Barbara
General Plan
High Fire Hazard Zones

Structures that May be Affected by Wildfires

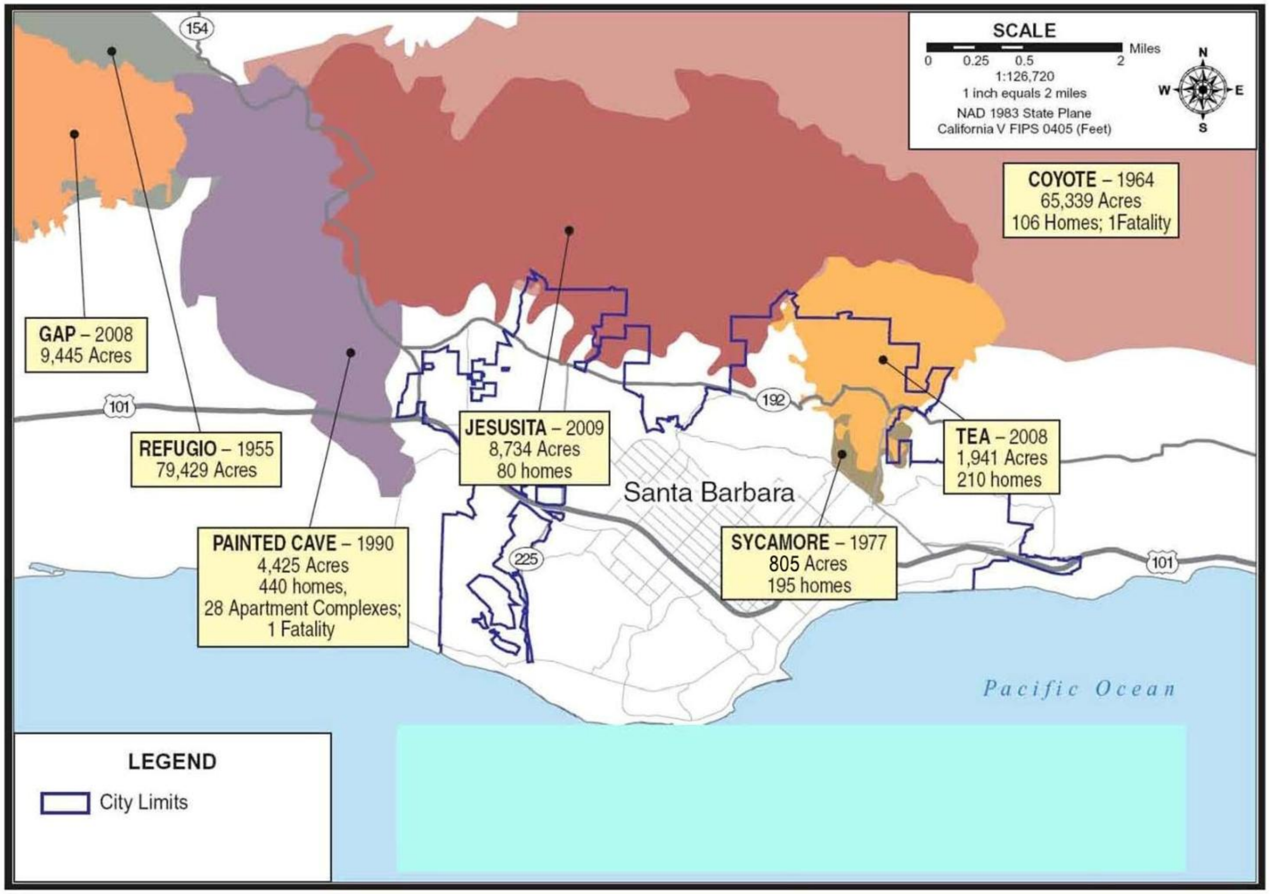
The *Wildland Fire Plan* (2004) evaluated fire hazards based on a variety of factors, including the number of structures located in areas subject to wildfire hazards. The *Wildland Fire Plan* determined that there were 138 structures in the Extreme Foothill zone, 4,308 structures in the Foothill zone, 570 structures in the Coastal zone, and 365 structures in the Coastal Interior zone. While the actual number of structures located in each high fire hazard zone will vary somewhat over time, the data provided by the *Wildland Fire Plan* is indicative of the relative hazards associated with potential structure damage and loss due to wildfire in the various hazard zones that have been identified in the City.

As part of the Santa Barbara Annex to the *Multi-Jurisdictional Hazard Mitigation Plan,* a vulnerability assessment was conducted to identify City-owned facilities that could be adversely affected by wildfire hazards. The facilities included in the assessment consisted mostly of utility, government, public safety and other infrastructure structures. The vulnerability assessment identified 20 individual structures or buildings located in what the *Hazard Mitigation Plan* identified as having a "very high" fire hazard. The areas determined to have a "very high" fire hazard generally correspond to the Extreme Foothill and Foothill high fire hazard zones depicted on Figure 20. The facilities identified by the *Hazard Mitigation Plan* as being located in a very high hazard zone include the Cater Water Treatment Plant, and the Skofield and Bothin pump stations.

Recent Wildland Fires in the Santa Barbara Area

Wildland fires have been a significant part of Santa Barbara's history. Between 1964 and 2012, seven major wildfires have occurred in the Santa Barbara "front country," which is the area along the south-facing slope of the Santa Ynez Mountains between the Gaviota Pass to the west and the Santa Barbara/Ventura County line to the east. In total, these seven fires have burned over 100,000 acres, destroyed over 1,100 structures, and resulted in six fatalities. A summary of the major wildfires that have occurred in the Santa Barbara area since 1964 is provided on Table 5, and the areas affected by recent fires are depicted on Figure 21. Additional information regarding the 2008 Tea Fire and the 2009 Jesusita Fire is provided on Figure 22.

Figure 21



Source: Santa Barbara General Plan Update Program EIR, 2010

City of Santa Barbara
General Plan
Santa Barbara Region Recent Wildfires

Table 5
Recent Wildfires in the Santa Barbara Front Country

Fire	Year	Acreage Burned	Structures Lost	Fatalities
Coyote	1964	67,000	106 homes	1
Romero	1971	14,538	4 homes	4
Sycamore Canyon	1977	805	195 homes	0
Painted Cave	1990	4,900	440 homes 28 apartments 30 other structures	1
Gap	2008	9,445	0 homes 4 structures	0
Tea	2008	1,940	210 homes	0
Jesusita	2009	8,733	80 homes 1 commercial property 79 other structures	0

Post-Fire Recovery

The City has implemented a variety of programs and procedures to assist property owners that have been affected by recent wildfires. Information and assistance can be obtained regarding a variety of fire-related reconstruction requirements, including debris removal, erosion control, development requirements for non-conforming buildings, requirements for soils reports, review and construction requirements for main and accessory structures, and the temporary use of residential trailers during construction. As part of the rebuilding effort, the City encourages homeowners to incorporate fire prevention, energy efficiency and sustainability measures into proposed residence designs.

Possible Effects of Climate Change on Wildfire Hazards

It is anticipated that future effects of climate change will include decreased precipitation, increased temperature, longer and more frequent periods of drought, and periodic high rainfall events that could result in an increase in the growth of grasses and other "flashy" fuels. Climate change-induced stresses on plant communities could also make them more susceptible to pests and disease, which could result in an increase in plant mortality and additional accumulations of dead plant material. Each of these conditions, or a combination of these conditions, would have the potential to result in an increase in the frequency and severity of wildfires in the Santa Barbara area. An increased risk for wildfires will place additional importance on the use of fire resistant construction techniques and the implementation of vegetation management programs, particularly in wildland–urban interface areas.

Figure 22

RECENT WILDFIRES IN SANTA BARBARA

The Jesusita Fire of 2009 burned the foothills north of and in the City of Santa Barbara.
(photo source: samedwardsfamily.com)

The 2008 Tea Fire started in Montecito on November 13 at 6:30 pm and was not controlled until November 17. Driven by sundowner winds gusting up to 70 miles an hour, the fire burned 1,940 acres and destroyed 210 homes. 106 of the burned homes were located in the City of Santa Barbara. A total of 2,235 firefighters and nine helicopters were used to fight the fire. Total suppression costs were estimated to be 5.7 million dollars.

Flames of the Jesusita Fire as seen from the waterfront area. Stearns Wharf is visible in the foreground.
(photo source: samedwardsfamily.com)

The 2009 Jesusita Fire started on May 5, 2009 in an area near Cathedral Peak and burned a total of 8,733 acres and 80 homes. Evacuation orders for affected areas were not lifted until May 13th. In total, 1,857 fire fighters, 111 fire engines, four helicopters and an air attack tanker were used to control the fire. Fire suppression costs were estimated to be 20 million dollars.

Flames from the 2008 Tea Fire are seen from De la Guerra Plaza adjacent to City Hall.
(photo source:a11news.com)

Strong winds blow smoke from the Jesusita Fire across the Santa Barbara Channel.
(photo source: earthobservatory.nasa.gov)

Hazard Reduction

Numerous regulatory requirements and risk reduction programs to minimize the effects of wildfires have been implemented by the City, county, state and federal agencies. In general, these requirements include standards related to fire prevention and suppression, and making structures more resistant to wildfires. Some of the wildfire hazard reduction measures that are implemented by the City of Santa Barbara Fire Department are briefly described below.

Wildland Fire Plan. The Santa Barbara Fire Department prepared the *Wildland Fire Plan* in 2004 to provide a comprehensive and coordinated approach to reducing the impacts of wildland fire. The Plan identifies and evaluates the City's high fire hazard areas, identifies policies and actions to reduce the threat of wildland fire to the community, and provides a process to prioritize and fund implementation of wildland fire risk reduction projects. The Plan identifies a wide range of risk reduction measures, including public education, inter-agency coordination, vegetation/fuel management, evacuation planning and code enforcement.

Building and Fire Code Requirements. The California Building Code (CCR, Title 24) includes wildland-urban interface fire area building standards that apply to new buildings, remodels and additions to structures located in each of the high wildfire hazard zones that have been identified by the Santa Barbara Fire Department. The intent of these regulations is to provide a reasonable level of exterior wildfire exposure protection through the use of ignition resistant materials and design. This building code provides requirements for building-related elements such as roofing material, exterior coverings, decks and accessory structures, exterior doors and windows, roof and attic vents, and building eaves. The high fire hazard area building requirements provided by the California Building Code, plus local amendments, are adopted by the City of Santa Barbara under Municipal Code Section 22.04.

Other standards for development in high fire hazard and wildland-urban interface areas are provided by Santa Barbara Municipal Code Section Title 8, Fire Protection. This section adopts the requirements, with amendments, of the International Building Code and California Fire Code.

Vegetation Management. Vegetation management programs reduce the amount of combustible vegetation that is present in a specified area. By reducing the amount of fuel available to burn during a wildfire, flame lengths and the intensity of the fire will be reduced. Vegetation management is often accomplished through the implementation of fuel modification programs that include actions such as removing dead vegetation, thinning plants to reduce the amount of combustible vegetation, removing highly combustible plant species, and providing plants that are more resistant to fire. Other objectives of fuel modification programs are to retain compatibility with adjacent natural landscapes, provide wildlife habitat and maintain ecosystem functions.

Vegetation management activities are often implemented to provide defensible space around structures to create an area that can slow the spread and intensity of a fire, and to provide an area where firefighters can more safely work to save the structure. More information regarding defensible space requirements in the City of Santa Barbara is provided below.

Wildland Fire Suppression Assessment District. The City of Santa Barbara has implemented an assessment district to support the implementation of a variety of vegetation management and fire safety programs for properties located in the Extreme Foothill and Foothill High Fire Hazard Zones (Figure 20). Examples of vegetation management programs that have been implemented in conjunction with Assessment District activities are provided below.

Community Fuels Treatment Network. This program conducts fuel modification activities in Vegetation Management Units located throughout the Assessment District to reduce fuel loads, particularly in areas adjacent to the dense chaparral vegetation that exists outside of the City limits. Fuel modification actions include the removal of selected exotic (non-native) plants; thinning, pruning and limbing vegetation to remove "ladder"[9] fuels; removing dead plant material; and thinning continuous areas of brush.

Community Hazard Reduction Project. The Fire Department has implemented this program to work with property owners and neighborhoods to conduct fuel modification activities, particularly in areas that did not burn in the 2008 Tea Fire and the 2009 Jesusita Fire.

Road Clearance. The purpose of this program is to reduce the amount of vegetation along roadways, which reduces potential evacuation hazards during a wildfire and provides improved access for fire engines and equipment during a wildfire.

Chipping Service. This service is offered to homeowners to encourage them to create and maintain defensible space around structures, and to provide a cost-effective way to dispose of the cut plant material.

Defensible Space Inspections. Upon request, the Santa Barbara Fire Department will provide a property inspection and offer recommendations to improve fire safety.

Creek Vegetation Management. The Fire Department generally conducts very little vegetation management in creek areas located in high fire hazard zones. When vegetation management activities in creek areas are deemed necessary, they generally occur outside a 15-foot buffer zone measured from the top of the creek bank. However, the removal of dead brush and exotic plants, using hand tools only, may also occur in areas up to the top of the bank.

On occasion, the Fire Department may determine that more comprehensive vegetation management is required within a creek or within the 15-foot top of bank buffer zone. Conditions that may require limited vegetation management in creek areas may include: an abundance of dead wood in the understory that has resulted in accumulations of "ladder" fuels near structures or key defensible spaces to be used for firefighting; when highly flammable vegetation such as eucalyptus trees, giant reed or pampas grass dominate the riparian corridor and have created hazardous fuel conditions; or high fuel conditions are present in a creek adjacent to a road or bridge that provides emergency evacuation egress or fire fighter access. The Fire Department will prepare a vegetation management plan each time it proposes to conduct work in a creek area, and measures to protect aquatic and riparian resources in the work area will be identified and implemented. In addition, the Department will obtain a Streambed Alteration Agreement (Fish and Game Code 1601) from the California Department of Fish and Wildlife prior to the implementation of the vegetation management work.

Defensible Space Requirements. Reducing the amount of vegetative fuel that exists around a building or structure increases the probability of surviving a wildfire. A defensible space perimeter will also provide firefighters with a safer working environment as a fire approaches, and minimizes the chance that a structure fire will escape to surrounding wildland areas.

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[9] Ladder fuels are live or dead vegetation that allow a fire to climb up from the ground into a tree canopy. Common ladder fuels include tall grasses and shrubs, and low-hanging tree branches.

Santa Barbara Fire Department's *Wildland Fire Plan* identifies four high fire hazard zones in the City (Figure 20) and recommends defensible space distance standards for each of the hazard zones. The recommended defensible space distance standards were subsequently adopted by the City with the passage of Ordinance No. 5535 (Municipal Code Chapter 8.04). The City's required defensible space distances for each hazard zone are provided on Table 6.

Table 6
High Fire Hazard Area Defensible Space Requirements

Hazard Zone	Defensible Space Required From Structures
Coastal Interior	30 to 50 feet
Coastal	50 to 70 feet
Foothill	100 feet
Extreme Foothill	150 feet

Ordinance No. 5535 requires that property owners in the high fire hazard areas maintain native, non-native and landscape vegetation in accordance with the distance requirements shown on Table 7. Ordinance No. 5535 also recommends that defensible space requirements be increased around structures located on slopes with a gradient greater than 20 percent, and provides additional defensible space and landscaping requirements related to items such as annual "weed abatement," horizontal and vertical vegetation clearance requirements from streets and driveways, tree trimming standards, separation distances between plants maintained within required defensible space area, and the use/disposal of brush trimmings.

The City of Santa Barbara takes a comprehensive approach to wildland mitigation measures in the wildland urban interface areas, particularly in the Foothill and Extreme Foothill zones, through a combination of public education, road clearance, vegetation management projects and defensible space.

State law, under Public Resources Code (PRC) section 4291, requires homeowners in high fire hazard areas to thin flammable vegetation up to 100 feet around structures in two zones to provide "defensible space." The City adopts and amends the California Fire Code by local ordinance and in that document establishes greater distance for defensible space than the PRC. The adopting ordinance is based upon local climatic, topographical and geological findings that allow for more stringent requirements than are applied at the state level. Chapter 49 of that code contains 37 local amendments, 11 of which amend the defensible space Chapter 4907.

Section 4907.2 addresses distance requirements, including 150 feet throughout the extreme Foothill Zone. Additional clearance requirements may extend the required clearance up to 300 feet, depending on slope, under Section 4907.7. This gives the Fire Code Official discretion based on individual circumstances. In addition, sections are added that address chimney clearance, overhanging trees, vines and climbing ornamentals, roof debris and fire safe landscaping. Vegetated roofs – also known as "green roofs", are not allowed in the high fire hazard areas of the City, and that section was added based on defensible space concerns. These extraordinary measures, based in part on the Santa Barbara Wildland Fire Plan, balance the fire safety aspects of the wildland urban interface with the protection of biological resources and geological concerns such as erosion control.

STRUCTURE FIRE HAZARDS

Description of the Hazard

The City of Santa Barbara Fire Department provides fire prevention, suppression and other emergency response services. In addition to responding to structure fires, the Fire Department responds to medical emergencies, accidents, hazardous material releases and rescues. The Fire Department is also responsible for aircraft emergencies at the Santa Barbara Airport. Non-emergency services provided by the Fire Department include conducting fire and life safety inspections, building inspections, fire code investigations, code compliance, development review and public education.

The risk to life and property resulting from structure fires can be influenced by many factors. Some of the conditions that must be considered when assessing potential structure fire hazards and the appropriate level of fire protection that should be provided include: the availability of adequate water supplies, the size, height and construction characteristics of the structure; the type of use occupying the structure and the type of materials that may be present in the building; and the ability to provide adequate emergency ingress and egress.

Local Conditions

The Santa Barbara Fire Department operates seven fire stations and an aircraft fire fighting station at the Airport. In 2012, the Department has 89 firefighters to serve a resident population of approximately 90,000 people. This results in a fire fighter to resident ratio of almost one fire fighter per 1,000 residents, which is a good service ratio. The Fire Department estimates that during the day when visitors and out-of-town employees are present, the City's population increases to an average of approximately 123,000 people, which decreases the fire fighter to population served ratio. The Fire Department responded to 7,790 alarms in 2011, and of those calls, 5,518 (71%) were for medical emergencies.

Hazard Reduction

The prevention of fires in the urban areas of Santa Barbara is a primary objective of the Fire Department. Regulations to minimize the risk of structure fires are provided by the International Fire Code and the California Fire Code, and these requirements, with amendments, have been adopted by the City under Santa Barbara Municipal Code Chapter 8.04. This Chapter of the Municipal Code also includes a variety of other fire prevention development standards, such as fire hydrant placement and fire flow requirements for residential and commercial structures; road and driveway dimensions; and requirements to install automatic fire sprinklers in new construction and in buildings that are being expanded or altered. Chapter 8.04 also includes requirements related to the avoidance and abatement of fire hazards, weed abatement requirements, and regulation enforcement procedures.

Flooding Hazards

INTRODUCTION

Three types of flooding hazards have the potential to affect Santa Barbara: stream flooding that occurs when stormwater runoff overtops a creek's banks; coastal area flooding caused by ocean tides, sea level conditions and/or storm-generated waves; and the inundation of areas that may occur due to the failure of a dam. This section of the Safety Element provides a description of flooding-related hazards that have the potential to affect the City; describes how climate change may affect stream and coastal area flooding hazards; and describes measures that have been implemented to minimize the risk of flooding hazards.

STREAM FLOODING

Description of the Hazard

Stream flooding occurs when stormwater runoff in a stream channel exceeds the water carrying capacity of the channel, causing water to flow over the stream's banks. Several factors will influence the severity of a flood event, including: rainfall intensity and duration; ground surface permeability; drainage infrastructure capacity and the geographic characteristics of the watershed, such as its size, shape and slope.

Stream channels located in the Santa Barbara area and their associated watersheds often experience short-duration, high-intensity rainfall events. The upper reaches of the stream watersheds are generally located in the Santa Ynez Mountains close to the City and have steep topography and shallow soils. These conditions can result in high runoff rates and creek flows that rise quickly, and then drop back to winter base flow levels soon after the intense rainfall stops. Many of the natural creek channels in the City do not have the capacity to convey the sudden increases in flood flows that can occur during a large storm, and the areas with the greatest potential to experience out of channel flows are located in the lower creek reaches where streambed gradients flatten and channel bank tops are relatively low. During high flow events, the creeks can also carry large loads of sediment and debris that can clog drainage facilities and impair flows beneath bridges, which can contribute to the inundation of floodplain areas. A "floodplain" area is the relatively flat or lowland area adjoining a stream that is subject to periodic inundation by floodwater. This area is distinguished from the "floodway," which is the channel of a stream and the adjacent area that must be preserved to discharge floodwater associated with a 100-year flood without cumulatively increasing the water surface elevation more than one foot.

The extent of damage caused by a flood depends on a variety of factors, such as topography, the depth and duration of flooding; velocity of flow, the sediment load carried and deposited by floodwaters; the extent of development located in the flooded area, and effectiveness of weather forecasting and flood warnings. While there are some benefits associated with flooding, such as the replenishment of beach sand and nutrients to agricultural land, flooding is generally considered to be a hazard to development. Flooding-related impacts can include injuries and loss of life; damage to structures, property and infrastructure; damage to vegetation, and potential health hazards from ruptured sewer lines and damaged septic tanks.

The magnitude and severity of flood events may be increased by a variety of natural- and development-related conditions. Natural factors can include the excessive growth of brush and trees within drainage channels, which may obstruct stream flows and result in an increase in floodwater heights. Fires within the watershed will result in the removal of vegetation that helps to control the amount and rate of stormwater runoff. Without the protective vegetation, soil erosion is increased and the additional sediment can accumulate in drainage channels and decrease their water carrying capacity. Urban development often results in an increase in impervious surface areas, which changes the drainage area's storm water runoff characteristics. These effects are referred to as "hydromodification" and can result in increased stormwater runoff volume, velocity, temperature, and discharge duration. Hydromodification can also result in increased erosion and sedimentation, and may also contribute to increases in pollutants in runoff water. The combined effect of more runoff reaching the stream channel sooner can substantially increase flooding-related hazards and result in more severe and frequent floods. Urban development can also result in the placement of structures and fill material in floodplain areas, which reduces the space available for holding floodwater and increases water levels and flow rates.

To protect urban development from the impacts of flooding, stream channels are often "channelized" (i.e., straightened and/or lined with concrete or other material) to move water through the channel more efficiently. However, as runoff water emerges from the channelized section of the stream, it is often delivered to an unchannelized down-stream section at velocities that the natural section of the stream is not capable of adequately carrying. This can result in increased flooding impacts downstream and erosion of the stream bed and banks.

Floods are generally described in term of their frequency of occurrence. For example, a 100-year flood is defined by evaluating the long-term average time period between floods of a certain size, and identifying the size of flood that has a one percent chance of occurring during any given year. A recurrence interval such as a 25-year or 100-year flood represents only the long-term statistical average time period between floods of a specific size. Floods of any size may occur at much shorter intervals or even within the same year.

Stream flow is generally measured in terms of peak discharge, which is the maximum volume of water passing a point along the channel during a given time interval, such as cubic feet per second. The volume and velocity of stream flow is an important factor that influences the physical characteristics of a stream channel, the stream's ecosystem, and flooding potential.

Local Conditions

Santa Barbara Area Watersheds and Creeks

Four major watersheds drain through the City of Santa Barbara to the Pacific Ocean. The creeks that drain those watersheds include Arroyo Burro Creek, Mission Creek, Sycamore Creek and the Laguna Channel. The Arroyo Burro, Mission and Sycamore Creeks originate in the Santa Ynez Mountains and drain areas within the Los Padres National Forest, as well as developed areas of the City. The Laguna Channel watershed drains an almost entirely urbanized watershed within the City. The locations of each of these watersheds are depicted on Figure 23. Additional information about each of the City's major watersheds is provided below and on Table 7.

Flows in the City's creeks are highly variable due to the seasonal pattern of rainfall that occurs in the region. Rainfall is concentrated in the winter months, ranging from about 18 inches per year on the coastal plain, to as much as 32 inches per year in the mountains north of the City. As a result, significant flows in the creeks generally occur only during winter and spring months.

Arroyo Burro Creek. Arroyo Burro Creek begins in the Santa Ynez Mountains and has two main tributaries in the upper reaches of the watershed: San Roque Creek and Barger Creek. Barger Creek joins Arroyo Burro Creek near Foothill Road (SR 192), and San Roque Creek converges with Arroyo Burro Creek south of Upper State Street. A 1,400-foot segment of Arroyo Burro north of U.S. Highway 101 was realigned and channelized to accommodate construction of the highway. Two minor tributaries also converge with Arroyo Burro Creek along its lower reaches: Las Positas Creek, which joins the main channel northwest of Elings Park; and Mesa Creek, which joins the main channel near Arroyo Burro County Park and the tidally influenced lagoon that has formed at the end of Arroyo Burro Creek.

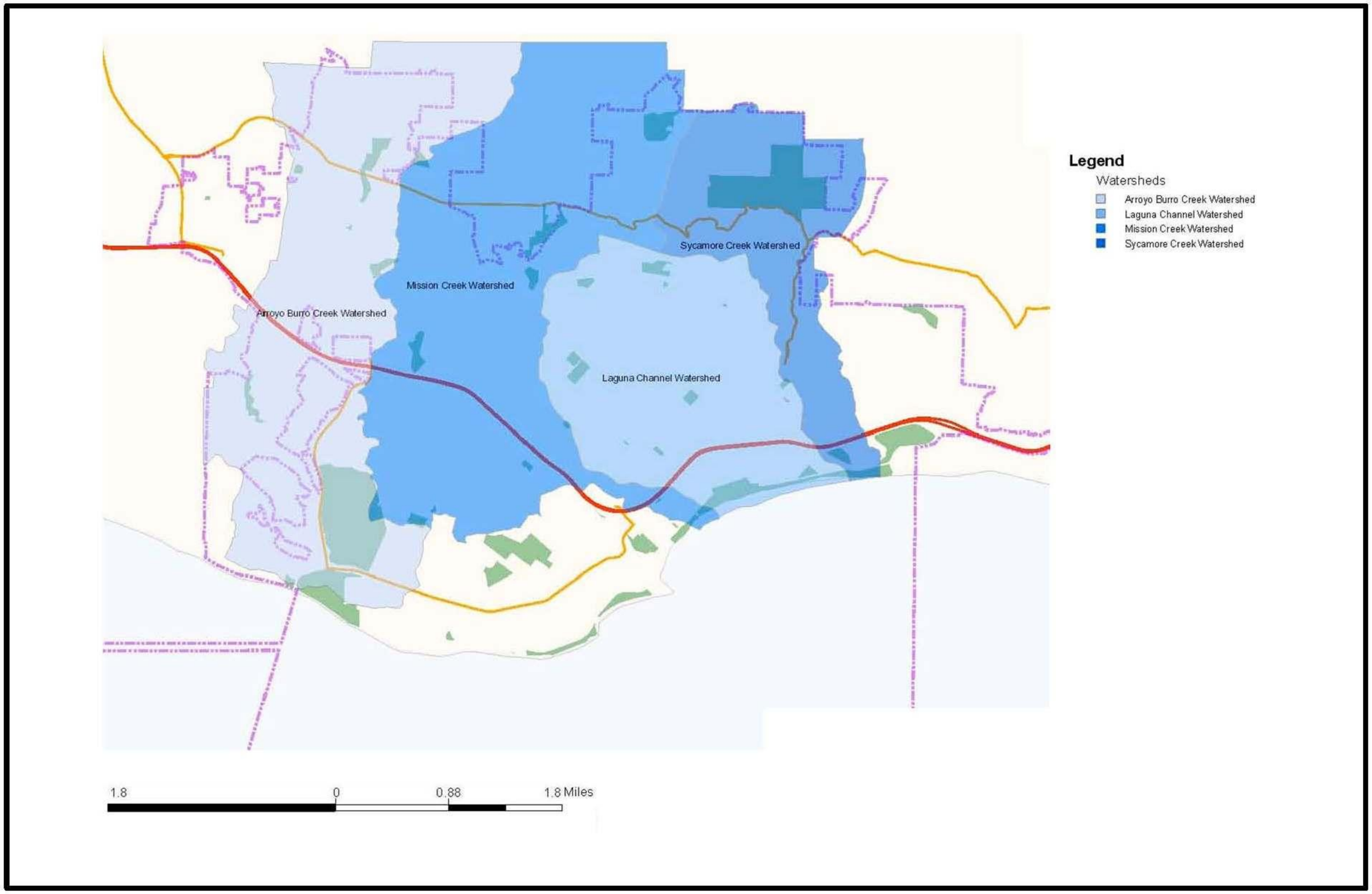
Mission Creek. Mission Creek begins in the Santa Ynez Mountains about three quarters of a mile north of the Santa Barbara Botanical Gardens and has two major tributaries: Las Canoas Creek and Rattlesnake Creek, both of which join the Mission Creek channel near Foothill Road. Mission Creek enters the City near the Museum of Natural History and Mission Santa Barbara, and then extends through urbanized areas until it reaches the ocean east of Stearns Wharf, where it forms a tidal lagoon that extends to the east of the wharf. The size of the lagoon can vary considerably depending upon flows in the creek, the beach sand berm, and tide conditions. Segments of the lower reaches of Mission Creek have been extensively modified. A segment about three quarters of a mile long, extending roughly between Arrellaga Street and Canon Perdido Street adjacent to U.S. 101, has been channelized with concrete walls. The channelization project cut off an "oxbow" or bend in the creek channel that was formerly located on what is now the west side of the highway in the vicinity of Bohnett Park. In many areas between Canon Perdido Street and the creek mouth, the creek's banks have been "armored" to protect adjacent development from bank erosion and flooding impacts. As the creek approaches the ocean, the creek gradient becomes relatively flat and the adjacent areas are subject to periodic flooding.

Table 7
City of Santa Barbara Watershed Characteristics

Watershed/ Creek Name	**Watershed Area** (acres)	**Creek Length** (miles)	**Jurisdiction** (acres/percentage of total watershed)			**Watershed Development Characteristics**
			Los Padres National Forest.	**City of Santa Barbara**	**County of Santa Barbara**	
Arroyo Burro Creek	5,633	7+	2,522/45%	2,537/45%	574/10%	77% open space 23% urban
Mission Creek	7,418	7.5	3,256/44%	3,021/41%	1,141/15%	68% open space 32% urban
Sycamore Creek	2,590	5	613/24%	1,427/55%	550/21%	66% open space 24% urban
Laguna Channel	2,022	na	0/0	1,983/98%	39/2%	21% open space 79% urban

na: most of the channel is constructed storm drain facilities

Figure 23



Source: City of Santa Barbara, 2013

City of Santa Barbara
General Plan
Santa Barbara Area Watersheds

Sycamore Creek. Sycamore Creek begins in the Los Padres National Forest and has five major tributaries: the main stem, which begins near the Sheffield Reservoir site; Parma Park tributaries; Coyote Creek; Westmont Creek and Chelham Creek. The tributaries converge near the intersection of Sycamore Canyon Road (SR 144) and Stanwood Drive (SR 192), where the creek enters the City. From there the creek continues southward through urbanized areas until it reaches the ocean at East Beach, east of the Cabrillo Pavilion Arts Center. The gradient of the lower portion of the creek is relatively level, making this area is subject to periodic flooding.

Laguna Channel. The Laguna Channel watershed includes major portions of the Downtown, Eastside and Waterfront areas of the City, and also includes the lower portions of the Riviera area. Much of the Laguna Channel watershed occupies the area of the historic Estero that was located in the eastern portion of the Santa Barbara. The Laguna Channel is not a natural drainage. North of U.S. 101, the Laguna Channel consists of a series of underground reinforced concrete boxes and pipes. An open channel begins south of the highway and ends at the ocean near Chase Palm Park, where a tide gate is provided to prevent ocean water from entering the channel. Most of the Laguna Channel has a low to very low gradient, making the adjacent areas prone to flooding.

Other Drainages. Several smaller creeks are also located within the City of Santa Barbara. ***Cieneguitas Creek*** begins in the Santa Ynez Mountains and enters the western portion of the City near Cieneguitas Road and Foothill Road (SR 192). The creek flows to the southwest and converges with Atascadero Creek, which drains to the Goleta Slough. ***Arroyo Hondo Creek*** begins east of Carrillo Street in the Alta Mesa neighborhood and extends eastward to Leadbetter Beach. ***Lighthouse Creek*** begins south of Cliff Drive in the West Mesa neighborhood and drains to the ocean near the Coast Guard lighthouse and La Mesa Park.

Airport Area. The Santa Barbara Municipal Airport is located on low-lying ground within the historic boundaries of the Goleta Slough, and is also in an area where four major creeks are located: San Pedro, Tecolotito, Carneros and Las Vegas Creeks. The combined watershed area of the four creeks is approximately 30,000 acres or 64 square miles. The creeks on the Airport land typically have perennial flow due to tidal action and high groundwater discharge. The Airport property is very flat and is subject to periodic flooding.

Flood Hazard Zones in Santa Barbara

The Federal Emergency Management Agency (FEMA) has designated flood hazard zones throughout the City based on the results of studies that identify areas subject to inundation by a “base flood,” which FEMA defines as a 100-year flood. The flood hazard areas, also known as Special Flood Hazard Areas, are depicted on Flood Insurance Rate Maps. Studies that are conducted to identify areas affected by a base flood evaluate a variety of flooding-related conditions and parameters, such as historic flooding; meteorological, hydrologic and hydraulic data; topography, open space and urban development conditions; and existing flood control structures and improvements. The flood hazard areas identified by Flood Insurance Rate Maps identify flood-prone areas based on the conditions at the time of the study, and do not consider the impacts of future development. The boundaries of designated flood hazard areas may be updated by FEMA from time to time to reflect changed conditions within the watershed or to correct a mapping error. Various map revision procedures are required by FEMA based on the reason and extent of the requested change to a Flood Insurance Rate Map.

Flooding in low-lying areas of the City located near the areas where creek or drainage channels discharge to the ocean can be increased when high tides coincide with intense rainfall events. The higher sea level conditions caused by high tides can slow the flow of water before it reaches the ocean, causing flood flows to back up into flood-prone areas located near the coast.

The designated 100-year flood zone areas in the City of Santa Barbara encompass 1,166 acres, or 9.7 percent of the City. Areas of the City that have been identified as being located within a 100-year floodplain are generally depicted on Figure 24 and are briefly described below. The Flood Insurance Rate Maps prepared by FEMA should be reviewed for more detailed information regarding the location of 100-year floodplain areas.

Arroyo Burro Creek. Floodwater from Arroyo Burro Creek during a 100-year storm may inundate an area located north of and adjacent to U.S. 101 in the southeastern portion of the Upper State neighborhood. On the south side of the highway, areas of the Hidden Valley neighborhood may also be flooded. Small areas in the San Roque and Hitchcock neighborhoods adjacent to San Roque Creek, a tributary to Arroyo Burro Creek, may also experience flooding-related impacts.

Mission Creek. Flood zones along the northern portions of Mission Creek are generally confined to the creek channel until the creek enters the Oak Park neighborhood, where 100-year flood zones have been designated along the western portion and in the southeastern area of the neighborhood. Along the lower reaches of the creek, flooding may affect areas located in the West Downtown, Lower State, West Beach and Waterfront neighborhoods. Floodwater from Mission Creek can also enter the Laguna Channel watershed, which adversely affects the ability of the Laguna Channel to convey flood flows.

Sycamore Creek. Runoff from a 100-year storm is generally contained within or adjacent to the Sycamore Creek channel until it reaches the Eastside neighborhood, where the southern portion of the neighborhood may experience flooding. Sycamore Creek can also cause flooding impacts in portions of the East Beach neighborhood, where overbank flows occur due to a reduction in the creek channel slope and the resulting reduction in channel conveyance capacity.

Laguna Channel. Flooding associated with the Laguna Channel during a 100-year storm can affect portions of the Lower State and Milpas neighborhoods, the western end of the East Beach neighborhood, and extensive areas of the Waterfront and Lower East neighborhoods.

Airport Area. Extensive areas located at and adjacent to the Airport may be inundated during a 100-year storm. The new airline terminal building is located within a 100-year floodplain, but outside of the designated boundaries of the floodway. The new terminal building was constructed in accordance with the requirements of the City's Floodplain Ordinance, which required the structure to be elevated to the 100-year flood water elevation.

City of Santa Barbara
General Plan
100-Year Floodplains

Figure 24

Structures That May be Affected by Flooding

Buildings and structures located within the flood hazard areas depicted by Flood Insurance Rate Maps and generally illustrated on Figure 24 may be affected by flooding resulting from a 100-year storm. As part of the Santa Barbara Annex to the *Multi-Jurisdictional Hazard Mitigation Plan,* a vulnerability assessment was conducted to identify City-owned facilities that could be adversely affected by flooding hazards resulting from a 100-year storm. The vulnerability assessment indicates that various Airport and Santa Barbara Harbor facilities, Stearns Wharf, the Public Works yard on Laguna Street, and Fire Station No. 2 on Cacique Street are located within designated flood hazard areas.

Storm and Flood Events in the Santa Barbara Area

Santa Barbara is frequently affected by large storms and damaging floods, and since 1862 at least 19 separate flooding events have caused damage in the City. On average, a damaging flood occurs in the City approximately once every eight years. Brief descriptions of some of the larger storm and flooding events that have affected the Santa Barbara area are provided below.

Three storms that occurred between December 1861 and January 1862 are collectively referred to the Great Floods, and caused extensive damage throughout California. Sediment and debris from the Santa Ynez Mountains that was produced by the storms filled in the Goleta Slough, which before the storms was deep enough to accommodate large ships.

Heavy rains started on January 15, 1914 and continued for two weeks, producing over 16 inches of rain. The storm resulted in the destruction of 12 homes and six bridges in the Mission Creek area.

Storms in January 1952 inundated more than fifty homes around Mission Creek. The Santa Barbara County Flood Control District was created in response to the damage caused by these storms.

Relatively light rains fell on areas burned by the Coyote fire in 1964, but due to the fire-related removal of vegetation form the watershed the rain caused severe flooding in creeks that flow through the Montecito area.

Storms during January 1969 caused flooding damage throughout California, and flooded the Santa Barbara Airport.

El Niño storms that occurred during the winter of 1982 and 1983 caused extensive damage throughout Southern California. A storm on March 2, 1983 generated waves that caused extensive damage to Stearns Wharf, the Santa Barbara Harbor, and the Leadbetter Beach parking lot.

Storms that occurred in January and March of 1995 caused extensive damage in Santa Barbara and surrounding areas. The January 10th storm damaged or flooded 510 structures on the South Coast, and temporarily closed U.S. 101, the Santa Barbara Airport and rail service through the area. The Airport was almost completely submerged and was closed for three days while mud and debris was removed from runways. The March 10th storm damaged many of the structures affected by the January storm, and once again closed the Airport. One fatality occurred in the Sycamore Creek area.

Several large rainfall events in February 1998 dropped over 21 inches of rain on the Santa Barbara area. The storms closed the Airport and resulted in other disruptions to travel through the area.

A powerful storm in January 2005 caused wide-spread damage throughout Southern California, including the La Conchita landslide that resulted in 10 fatalities and damaged or destroyed 31 homes.

Possible Effects of Climate Change on Stream Flooding

Although the effects of climate change may result in overall drier conditions and a decrease in average amounts of precipitation, it is expected that the number of intense rainfall events will increase. If large storms occur more frequently, a corresponding increase in the frequency and severity of stream flooding is likely to occur and more extensive areas could be affected by flooding.

In addition to an increase in storm intensity and frequency, flooding in coastal areas where streams meet the coast may be increased due to a rise in sea level. Estimates of future increases in the elevation of sea level vary considerably due to variations in assumptions regarding greenhouse gas emission control effectiveness and other factors. However, projections of future sea level rise provided by the Coastal and Ocean Working Group of the California Climate Action Team (2010) indicate that a five- to eight-inch rise in sea level over year 2000 conditions may occur by 2030; 10- to 17-inches of sea level rise may occur by 2050; and between 31 and 69 inches of sea level rise may occur by 2100. As ocean levels rise, backwater conditions may be created that slow the flow of floodwater as it drains to the ocean, resulting in increased upstream flooding of low-lying coastal areas.

A climate change-related increase in temperatures and a reduction in average amounts of precipitation will have the potential to result in more frequent and severe wildfires. If fires result in more widespread removal of protective vegetation from watershed areas, stormwater runoff rates and volumes can be expected to increase, resulting in an increased potential for downstream flooding. In addition, the amount of sediment and debris generated by storms would also be increased, which can reduce the water carrying capacity of stream channels and flood control facilities. Increased sediment and debris volumes can also increase the "bulk" of floodwaters, which can contribute to an increase in the extent of areas affected by flooding.

Hazard Reduction

Numerous regulatory requirements and risk reduction programs have been implemented by federal, state and local agencies to minimize the effects of stream flooding. In general, these requirements include programs that reduce the potential for damage to structures and to provide and maintain flood control facilities. Some of the measures that reduce the risk and consequences of flooding in the City are briefly described below.

National Flood Insurance Program. The National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973 require FEMA to evaluate flood hazards, and in doing so FEMA prepares Flood Insurance Rate Maps that identify Special Flood Hazard Areas. The base flood is the regulatory standard used by the National Flood Insurance Program as the basis for requiring owners of structures located in Special Flood Hazard Areas to purchase and maintain flood insurance as a condition of receiving federal or federally related financial assistance, such as mortgage loans from federally insured lending institutions. The National Flood Insurance Program is required to offer federally subsidized flood insurance to property owners in communities that adopt and enforce floodplain management ordinances that meet minimum criteria established by FEMA.

Santa Barbara County Flood Control District. The Santa Barbara County Flood Control District has a wide range of responsibilities and provides services to the City of Santa Barbara. Services provided by the District include the operation and maintenance of the stream and drainage channels under the jurisdiction of the District; the construction, operation and maintenance of debris basins that retain rock, sand, mud and organic debris that can clog channels and diminish the effectiveness of downstream flood control facilities; emergency storm response, including providing information to the public, storm monitoring and floodflow forecasting; and post-storm rehabilitation of damaged flood control facilities.

City Storm Drain System. The stormwater conveyance system within the urbanized areas of the City includes structures such as streets, curbs, gutters, culverts, ditches, manmade channels, and below ground pipes that drain runoff to the City's creeks and major drainage channels. The purpose of the storm drain system is to carry runoff as quickly and efficiently as possible from developed areas to drainage facilities and eventually to the Pacific Ocean. The City Public Works Department, Street Division, operates and maintains the majority of the City's storm drain system, which includes activities such as: inspecting and repairing damaged facilities; cleaning and hauling away storm debris; responding during storm conditions to clear clogged drainage facilities; operation and maintenance of pump stations; and cleaning catch basin filters.

StormReady Designation. Santa Barbara has been designated as a StormReady® community, which is a planning and response program administered by NOAA through the National Weather Service. To be recognized as StormReady, communities must implement specified preparation criteria, including: have an emergency operations center capable of fulfilling specified functions; have multiple ways to receive National Weather Service warnings; have the capabilities to conduct or have access to specified meteorological monitoring systems; have one or more methods to provide storm-related information to the public; implement community preparedness measures and activities; and have and maintain an approved hazardous weather action plan.

City of Santa Barbara Development Requirements and Guidelines

Flood Plain Management Ordinance. Municipal Code Section 228.24, Flood Plain Management, provides requirements to minimize impacts that may result from development within floodplain areas. The objectives of the Ordinance include: protect human life and health; minimize expenditure of public money for repairs to flood control facilities; minimize damage to infrastructure; and ensure that potential buyers are notified that property is located in a flood hazard area.

Development Along Creeks Ordinance. Municipal Code Section 28.87.250, Development Along Creeks, provides requirements to minimize development-related impacts that may result from development adjacent to Mission Creek. The ordinance requirements apply to proposed development located within 25 feet of the top of the creek bank. The purpose of the requirements are to: prevent undue damage or destruction of developments by flood waters; prevent development on one parcel from causing undue detrimental impact on adjacent or downstream properties during a flood; and to protect the public health, safety and welfare.

Storm Water Management Plan. The goal of the City's Storm Water Management Plan is to protect the quality of water within the City to the maximum extent practicable. To achieve this goal, the Plan identifies strategies and guidelines related to the implementation of six stormwater management minimum control measures. Minimum Control Measure No. 5 addresses post-construction stormwater management and minimizing the rate and volume of stormwater discharges from a project site. This control measure includes requirements that post-development peak stormwater runoff discharge rates not exceed the estimated pre-development rate when the increased peak discharge rate has the potential to result in downstream erosion. To the extent feasible, new development and redevelopment is required to retain, at a minimum, the peak run-off differential from pre-and post-conditions for a 25-year storm. Through the implementation of this requirement, a project's contribution to downstream flooding impacts will be reduced to the maximum extent practicable.

Storm Water Best Management Practices Manual. The Storm Water Best Management Practices Manual provides methods to achieve the water quality protection and stormwater runoff reduction goals of the City's Storm Water Management Plan. These goals can be achieved through the use of a combination of site design and runoff control best management practices. New and redevelopment projects are encouraged to implement Low Impact Development strategies to reduce runoff volume and discharge rate, which can minimize a projects contribution to peak runoff flows and downstream flooding-related impacts.

DAM FAILURE

Description of the Hazard

A dam is an artificial barrier that has the ability to impound water for the purpose of storage or control of the water. Dam inundation is the flooding of lands due to the release of impounded water resulting from the failure or overtopping of a dam. Dams can fail for one or a combination of reasons, including: overtopping caused by floods that exceed the capacity of the dam; failure of materials used in construction of the dam; movement and/or failure of the foundation supporting the dam; inadequate maintenance; or deliberate acts of sabotage.

The severity of downstream effects resulting from a dam failure is related to the manner in which the dam fails. A breach of the dam would likely result in a flood wave that builds gradually to a peak, then declines until the water level in the reservoir recedes to an elevation below the breach or until the reservoir is empty. If a dam were to fail rapidly, a flood wave would be formed quickly and then be followed by a gradual decline in flood water. A catastrophic dam failure could inundate areas downstream, resulting in flooding, loss of life and injury, property damage, erosion and sediment deposition.

Local Conditions

The Lauro Dam and Reservoir is located north of and adjacent to the City limits and adjacent to the Foothill neighborhood. It was constructed in 1952 by the Bureau of Reclamation as part of the Cachuma Project, and is part of the South Coast Conduit water distribution system that provides water for the City of Santa Barbara and other communities on the South Coast. The dam is owned by the Bureau and is operated by the Cachuma Operations and Maintenance Board.

Lauro Dam is an earth filled structure that impounds water from Diablo Creek, which has a 0.44 square mile watershed area. The dam is 137 feet in height and the reservoir capacity is about 590 acre-feet. When full, the reservoir has a surface of about 15.6 acres and a maximum depth of about 56 feet. The dam has a spillway pipe that discharges to San Roque Creek under emergency conditions.

During the excavation of the dam foundation a southeast-northwest trending fault zone was observed in the center of the excavation. The fault was not considered a potential hazard at that time, however, based on the results of subsequent studies, the Bureau of Reclamation concluded that movement along the fault had the potential to displace the foundation of the dam. The fault located beneath the dam is described as the Rocky Nook fault in the Regional and Local Faults subsection of the Introduction provided above. Due the identified fault hazard, the Bureau evaluated several dam strengthening alternatives with the objective of correcting seismic safety deficiencies of the dam to achieve an acceptable level of risk that protects the public and maintains the benefits of the dam and reservoir. Modifications to the dam were completed in 2007. The dam was modified to capture seepage that could result from movement of the fault and to channel the seepage in a controlled manner, allowing the reservoir to empty without the embankment failing and causing downstream flooding (Bureau of Reclamation, 2004).

The Santa Barbara Annex to the *Multi-Jurisdictional Hazard Mitigation Plan* includes a map that depicts areas downstream of the Lauro Reservoir that would have the potential to be inundated in the event of a dam failure. Water released from the reservoir could follow two routes. Released water could travel across the western portion of the East San Roque neighborhood and the eastern segment of the Upper State neighborhood before it enters the Mission Creek channel and then generally stay within the channel until it reaches the ocean. The other pathway would be across the southeastern corner of the San Roque neighborhood, across Upper State and portions of the Hitchcock and Hidden Valley neighborhoods, before the water enters the Arroyo Burro Creek channel and generally stays within the channel until it reaches the ocean.

Hazard Reduction

The Bureau of Reclamation and other federal agencies, such as FEMA, have established extensive regulatory requirements and programs that require ongoing inspection and maintenance of federally-owned dams. With the continued implementation of existing programs, the risk of a catastrophic dam failure of the Lauro Dam and resulting effects in the City are very low. No additional hazard reduction measures are required to reduce the potential for or consequences of impacts related to dam failure inundation.

COASTAL FLOODING AND INUNDATION

The effects of high tides, storm waves and a rising sea level may occur individually or in combination, resulting in an increased potential for substantial damage to development and coastal resources located on or near the coastline. This section describes existing coastal flooding conditions that have occurred in Santa Barbara, and also describes how climate change-related effects may contribute to an increase in coastal flooding and inundation hazards.

Description of the Hazard

Coastal flooding refers to a temporary covering of areas on or near the coastline caused by stream flow, high tides, ocean storm conditions or a combination of those processes. For example, when large storms cause high stream flows during high tide conditions, the elevated ocean level can create a “backwater” effect that impedes the drainage of stream flow into the ocean. This can increase floodwater heights in both coastal and inland areas near the coast. The impacts of coastal flooding may be substantially increased in the future due to climate change-related effects such as a rise in sea level, an increase in the frequency and severity of large storms, or an increase in wave heights.

Coastal inundation refers to a permanent covering of an area by ocean water. A climate change-related rise in sea level would be the source of new inundation-related impacts. Beach and adjacent low-lying areas would be the most susceptible to the effects of coastal inundation.

Local Conditions

Coastal Flooding. Coastal flooding in Santa Barbara has generally occurred as a result of storm surge (large, storm-generated ocean waves moving onshore) combined with high tide conditions. The destructive combination of waves and a high tide was demonstrated in 1983 when waves generated by a large El Niño storm eroded portions of the Leadbetter Beach parking lot, damaged the Santa Barbara Yacht Club building and the Harbormaster’s office, damaged Stearns Wharf, and carried debris across Chase Palm Park and onto Cabrillo Boulevard.

Figure 25 depicts coastal areas of the City that could be flooded as a result of storm surge during a 100-year storm under existing sea level conditions. Coastal areas that would be expected to incur flooding-related damage include most beaches and adjacent areas as far inland as Shoreline Drive and Cabrillo Boulevard. Figure 25 also depicts areas that could be affected by coastal flooding caused by a 100-year storm plus the effects of a 55-inch increase in sea level. A 55-inch increase in sea level is near the high end of ocean level projections for conditions that could occur by the year 2100. Under these possible future conditions, the areas that could be affected by coastal flooding are located substantially further inland than under existing ocean level conditions, and include much of the East Beach, Lower East and Laguna neighborhoods. Future coastal flooding conditions at the Airport would also be expected to increase in terms of frequency and severity, with additional low-lying areas near the airport experiencing the effects of coastal flooding during large storms.

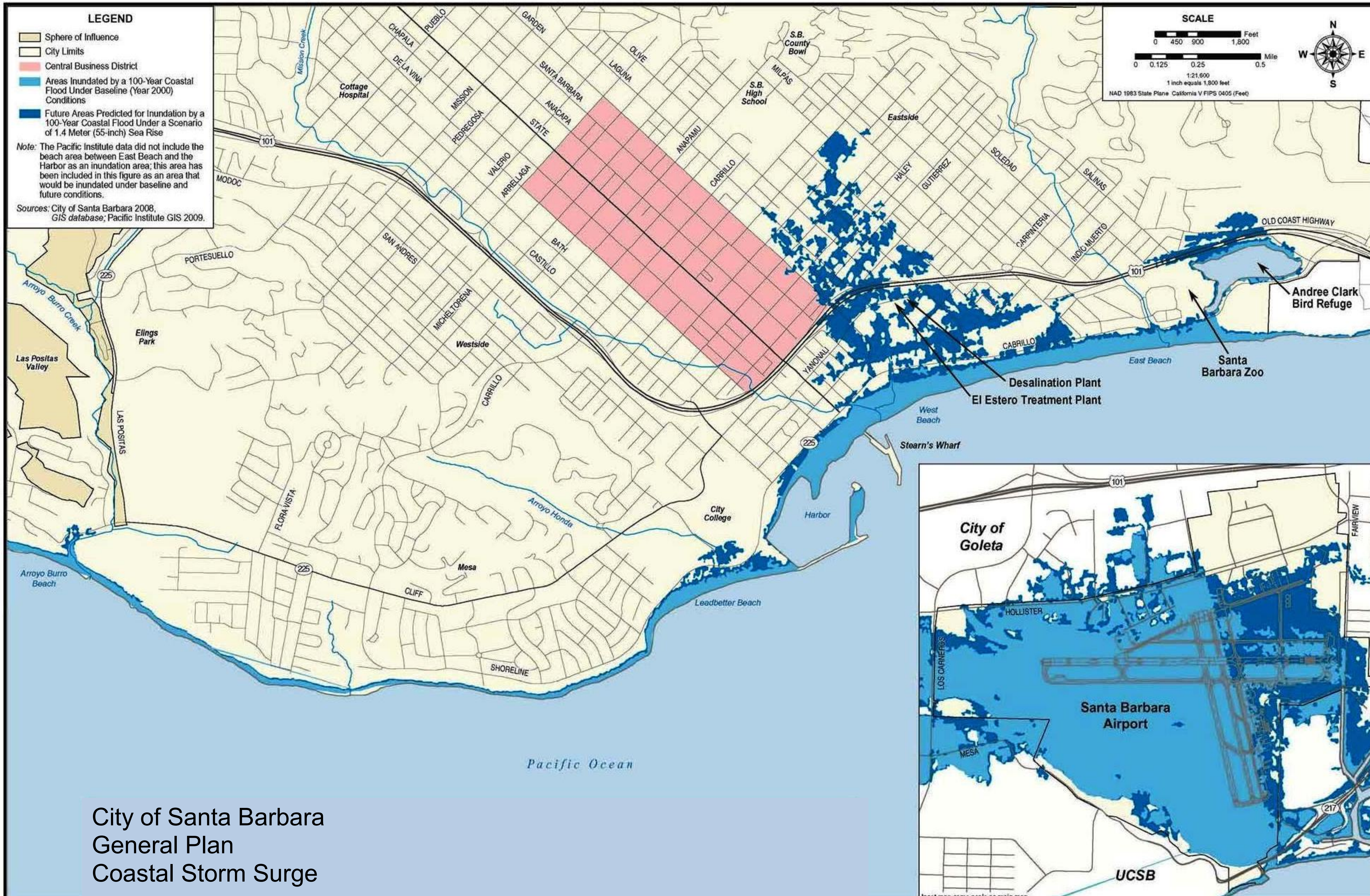
There is a level of uncertainty associated with predicting how sea level rise conditions will affect coastal and inland areas because it is not known how fast or how much sea level conditions will continue to change in the future. However, it is reasonable to expect that as sea level increases, impacts resulting from coastal flooding will also increase.

Coastal Inundation. The potential for City beaches and adjacent areas to be inundated as a result of a climate change-related increase in sea level will be controlled by factors such as the future rate and magnitude of sea level rise, and the width and elevation of the City's beaches. Projections regarding the possible magnitude of sea level rise vary substantially; however, the *City of Santa Barbara Sea Level Rise Vulnerability Study* (Griggs, 2012) concluded that over an intermediate time frame (to 2050) a projected 14-inch rise in sea level would have a low probability of resulting in a permanent loss of City beaches. If sea levels were to continue to rise, areas that would have formerly only been temporarily flooded or submerged during very high tides and/or large El Niño storms will gradually begin to be inundated permanently. Over a long-term period (to 2100), a 55-inch rise in sea level would substantially increase the probability of permanent beach and adjacent area inundation.

Hazard Reduction

Reducing possible coastal flooding and inundation impacts resulting from the effects of climate change will require the implementation of adaptation strategies. The *Santa Barbara Climate Action Plan* (2012) identifies a range of adaptation strategies for coastal flooding and inundation hazards. These strategies include: continue to implement existing emergency preparedness and response programs; conduct more detailed and periodic mapping of areas susceptible to coastal flooding and inundation so that more accurate predictions of potential future effects can be made; implement public facility programs to make infrastructure less vulnerable to flooding and inundation impacts; and implement land use policies that minimize potential exposures of structures to rising sea levels.

Figure 25



Source: Santa Barbara General Plan Update Program EIR, 2010

Hazardous Materials

INTRODUCTION

Chemical substances have many necessary and practical applications in our modern society, and are used extensively in manufacturing, commerce, agriculture, institutions such as hospitals and schools, and by households. The benefits derived from the use of chemicals are substantial, but due to their widespread use, accidental releases to the environment are likely to occur. When this happens, significant health, safety and environmental hazards can result. This section provides a brief overview of local programs that minimize the potential for adverse effects resulting from the use of hazardous materials. Potential issues associated with the transportation of hazardous materials through the Santa Barbara area are described in the Public Safety section.

Description of the Hazard

For this evaluation, a hazardous material is considered to be any substance that because of its quantity, concentration, physical or chemical characteristics poses a significant hazard to human health and safety or the environment in the event of an accidental or uncontrolled release. An extremely hazardous material is a substance that shows high acute or chronic toxicity, carcinogenity, bioaccumulative properties, is persistent in the environment, or is water reactive. A hazardous material may become a hazardous waste upon its abandonment, discard or recycling; or by actions that change the composition of previously non-hazardous material.

In addition to hazardous materials used by commercial, industrial and institutional uses, hazardous materials such as cleaners, paint, automotive and garden products, hobby supplies and swimming pool chemicals are used in substantial quantities in residential areas. The improper use or disposal of these types of hazardous materials has the potential to result in adverse health, safety and environmental consequences. An emerging health and safety issue is the improper disposal of pharmaceuticals, which when introduced into the environment can result in adverse human health and ecosystem impacts.

Soil and/or groundwater contamination are common consequences resulting from accidental releases of hazardous materials or waste. While there are many ways that hazardous substances can be released to the environment, leaking underground fuel tanks and releases from industrial land uses are common sources. Wastewater treatment plants are not intended to treat household hazardous wastes or pharmaceutical wastes, and the disposal of those substances to sewer systems can result in disruptions to the operation of the treatment plants and significant adverse impacts to the quality of treatment plant discharges.

Many federal and state regulatory programs have been enacted to protect water, air and land resources from the adverse effects of hazardous material releases. Regulatory programs also address the use, transportation and disposal of hazardous materials and waste; require that major hazardous material users/hazardous waste generators disclose those operations to the public; and ensure that releases to the environment are controlled and remediated in a manner that protects public safety.

Local Conditions

The Santa Barbara County Fire Department's Site Mitigation Unit and Leaking Underground Fuel Tank programs provide regulatory oversight of the assessment and remediation of hazardous material release sites in the City of Santa Barbara. The County Fire Department maintains a list of leaking underground fuel tank and other contamination sites located in the City. The areas with the highest concentration of contamination sites are generally located in the commercial and industrial areas of the Downtown, Eastside and Waterfront/Harbor areas, in the vicinity of Cottage Hospital; along Cliff Drive in the Mesa area; areas along Upper State Street; and at and near the Airport. The areas of the City where hazardous material release sites are most commonly located are depicted on Figure 26.

Several state agencies also provide information that is available to the public that identify sites with soil and groundwater contamination. The Hazardous Waste and Substances Sites List (Cortese List) is used by the state and local agencies to comply with CEQA requirements to provide information about the location of hazardous material release sites. This list is developed by the California Environmental Protection Agency, and information on the list is provided by the California Department of Toxic Substances Control (DTSC) and other state and local agencies. The California State Water Resources Control Board's GeoTracker program is a data management system that provides the location of and information about hazardous material release sites that have impacted groundwater.

Hazard Reduction

As indicated above, a variety of state and federal regulations have been enacted to protect public safety, minimize the risk of an accidental release, and to mitigate potential impacts when a release occurs. In general, these regulations pertain to all aspects of hazardous materials management, including material storage; handling and transportation; employee and public noticing; spill contingency planning; and emergency response measures. In California, the Unified Program consolidates, coordinates, and makes consistent the administrative requirements, permits, inspections, and enforcement activities of six environmental and emergency response programs:

Hazardous Materials Release Response Plans and Inventories (Business Plans)

California Accidental Release Prevention (CalARP) Program

Underground Storage Tank Program

Aboveground Petroleum Storage Act (APSA) Program

Hazardous Waste Generator and Onsite Hazardous Waste Treatment (tiered permitting) Programs

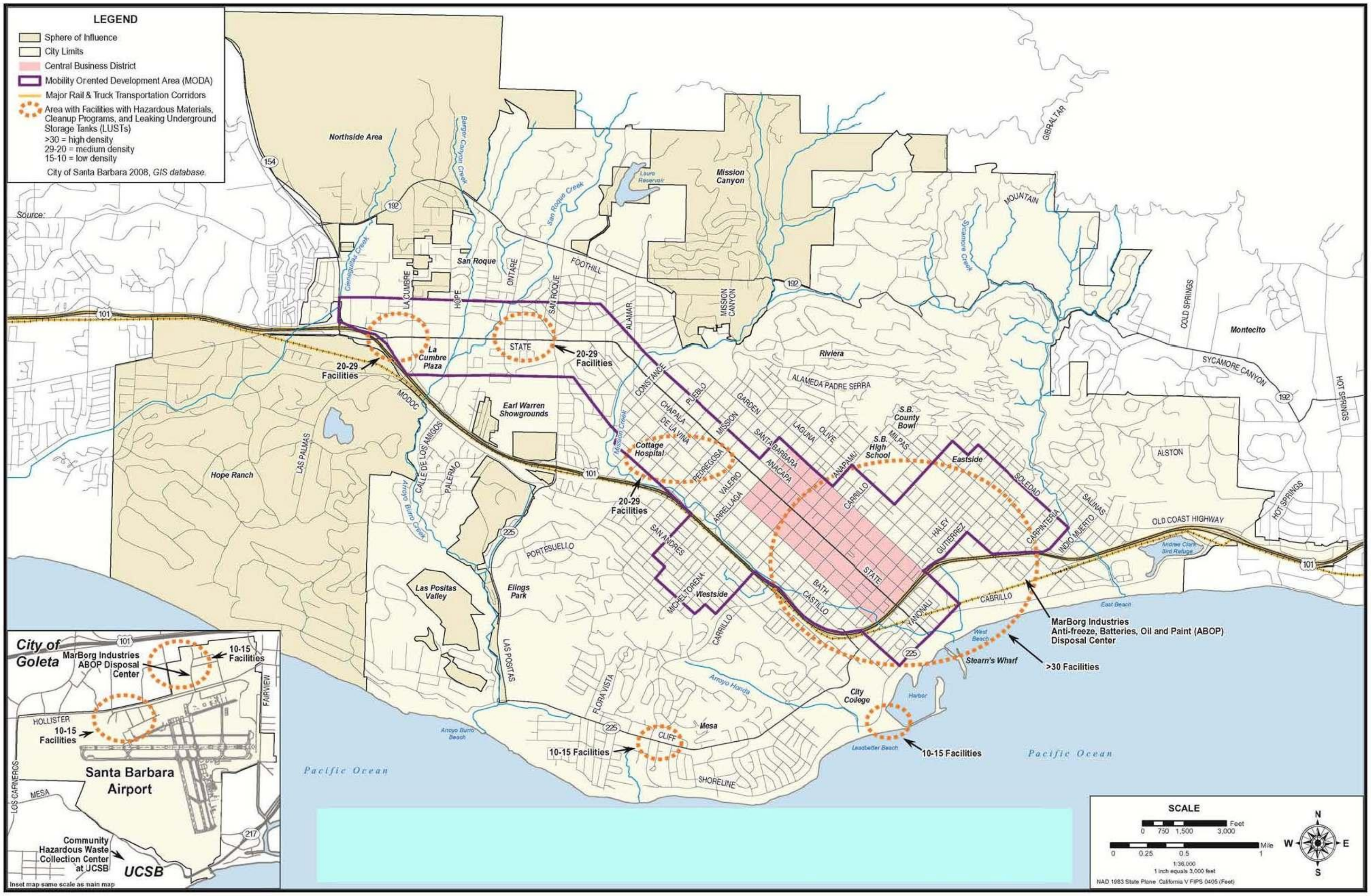
California International Fire Code: Hazardous Material Management Plans and Hazardous Material Inventory Statements

The Unified Program is implemented at the local level by Certified Unified Program Agency (CUPA). In Santa Barbara County, the Hazardous Materials Unit of the Santa Barbara County Fire Department serves as the CUPA.

Business Plans. A regulatory program to minimize potential hazardous material-related hazards that is implemented on a local level is a requirement to prepare a Hazardous Material Business Plan. Business Plans are required whenever a business or facility handles, uses or stores a hazardous material or waste in quantities greater than or equal to threshold amounts (55 gallons for liquids, 200 cubic feet for gases, and 500 pounds of solids). Business Plans provide information that may be used by first responders to prevent or mitigate impacts to the public health and safety and to the environment resulting from a release or threatened release of a hazardous material. Business Plans are also used to satisfy federal and state Community Right-To-Know laws that require disclosure of hazardous material use characteristics to the public. A Business Plan must provide detailed information regarding the hazardous material inventory at a regulated facility; emergency response plans and procedure in the event of a reportable release or threatened release; and safety training for employees. Completed Business Plans are submitted to the CUPA and the local fire agency.

The City of Santa Barbara Fire Department is preparing to implement a geographical information system that will provide first responders with immediate access to hazardous material information provided by the Business Plans that have been prepared for regulated hazardous material use/storage sites in the City. Access to this information will substantially improve emergency response capabilities and protect the safety of first responders, the public and the environment. Household hazardous wastes and unused pharmaceuticals are commonly present in residences located throughout the community and have the potential to impact water quality, soil, human health, and ecosystems if not managed and disposed of properly. To avoid these potential consequences, it is important to provide adequate opportunities for the public to properly dispose of hazardous and pharmaceutical wastes. Four household hazardous waste collection facilities are located at various locations throughout the Santa Barbara region, and Santa Barbara Sheriff's stations will accept unused pharmaceuticals. Providing additional opportunities and facilities for the safe collection of household hazardous wastes and pharmaceuticals would further reduce the potential for health, safety and environmental effects that may be associated with the improper disposal of those substances.

Integrated Pest Management. The use of pesticides, including insecticides, rodenticides, herbicides and fungicides, is another action that has the potential to result in the presence of hazardous materials in the environment. Pesticide residue, even in very low concentrations, can be toxic to aquatic organisms and result in health impacts to humans. The City of Santa Barbara adopted an Integrated Pest Management strategy in January 2004 to reduce the amount and toxicity of pesticides used on City property, and where feasible, to eliminate pesticide use in public areas. Integrated Pest Management is a set of principles developed to reduce or eliminate pesticide use while minimizing pest damage. The City's program has been implemented by all City departments, including the City Parks and Recreation Department, and has been shown to be effective at reducing pesticide use.



Source: Santa Barbara General Plan Update Program EIR, 2010

Figure 26

City of Santa Barbara
General Plan
Hazardous Material Release Areas

Public Safety

INTRODUCTION

Public safety issues addressed by this Safety Element include risk resulting from aircraft operations at the Santa Barbara Municipal Airport; the transportation of hazardous materials along local highways and rail lines through the City; the presence of natural gas transmission and distribution pipelines, and the creation of electromagnetic fields by high voltage transmission lines.

AIRCRAFT OPERATIONS

Description of the Hazard

The Santa Barbara Municipal Airport is owned and operated by the City of Santa Barbara and is located in an incorporated area of the City, about eight miles west of the Downtown area of the City. The Airport property consists of 970 acres, including a 225-acre industrial and commercial area located along Hollister Avenue. The remaining airport area includes approximately 266 acres for airfield operations, 78 acres for aviation facilities and related businesses, and 430 acres within the Goleta Slough Ecological Reserve. A major runway safety improvement project and the redevelopment of the Airport's terminal building were completed in 2011 and 2012, respectively.

Airports can have beneficial economic and other effects on the communities around them, but can also result in impacts such as noise, vibration, odors, and the risk of accidents. Surrounding land uses can also adversely affect airport operations, particularly if development is allowed to encroach into the airspace used by approaching or departing aircraft. The *California Airport Land Use Planning Handbook* (2011) indicates that airport land use compatibility is the reconciliation of how land development and airports function together, and defines airport land use compatibility as follows: "*airport compatible land uses are defined as those uses that can coexist with a nearby airport without either constraining the safe and efficient operation of the airport or exposing people living or working nearby to unacceptable levels of noise or safety hazards. Compatibility concerns include any airport impact that adversely affects the livability of surrounding communities, as well as any community characteristic that can adversely affect the viability of an airport.*"

To a large extent, land use compatibility is evaluated by determining the locations around an airport that have the greatest risk of experiencing an aircraft accident, and determining the risk of an accident occurring. Typically, accidents occur along the extended runway centerline. The implementation of safety and airspace protection measures minimizes the number of people at and away from the airport that are exposed to the risk associated with potential aircraft accidents and avoids flight hazards that interfere with aircraft navigation.

To assist in the evaluation of land use development and compatibility issues involving airports, in 1967 the California Legislature authorized the formation of Airport Land Use Commissions and the preparation of Airport Compatibility Land Use Plans. It is the objective of these planning programs to minimize the public's exposure to excessive noise and safety hazards, while providing for the orderly expansion of airports. An *Airport Land Use Plan* for the public airports in Santa Barbara County was adopted in 1993 and is administered by the Santa Barbara County Association of Governments (SBCAG). SBCAG is in the process of preparing an update to the 1993 Airport Land Use Plan, and the Santa Barbara Airport is in the process of preparing a new Master Plan for the airport property.

Local Conditions

The Santa Barbara Airport is located within the historic boundaries of the Goleta Slough and land uses adjacent to the airport are predominately airport-related or open space. Other land uses have been developed in the vicinity of the Airport, including the University of California at Santa Barbara, and urban development located in the City of Goleta and unincorporated portions of the County of Santa Barbara. Future development within those areas has the potential to result in safety-related conflicts with airport operations.

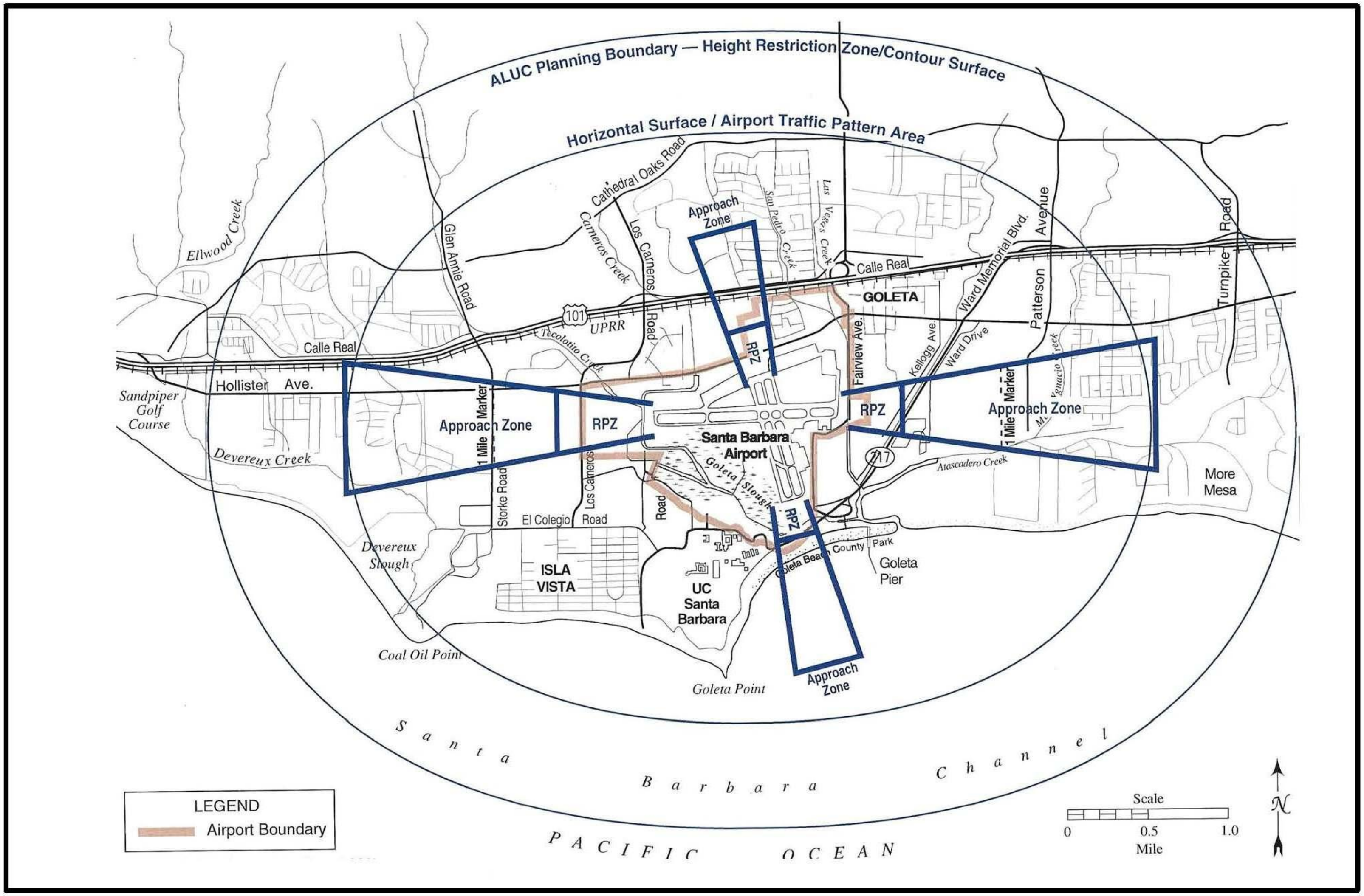
The Santa Barbara Airport includes a primary east-west runway (Runway 7-25) and two parallel north-south runways (Runways 15-33, East and West). The Federal Aviation Administration and California have established airport and runway protection zones that are intended to minimize potential aircraft-related hazards. The existing airport/runway protection zones for the Santa Barbara Airport are depicted on Figure 27, and the types of land uses that may be compatible within each of the zones are summarized below. Please refer to the most-current Airport Land Use Plan for updated airport and runway safety zone designations and more detailed land use compatibility standards for each safety zone.

The **Runway Protection Zone** (RPZ) for the Santa Barbara Airport, which is also referred to as the "Clear Zone" by the City's Zoning Ordinance and the Airport Land Use Plan, is to be kept free of obstructions or distracting effects (e.g., flashing lights, sunlight reflection, glare, smoke, bird concentrations and electrical interference) that may affect aircraft operations. The *Santa Barbara Airport Land Use Plan* indicates that incompatible land uses in the RPZ include residential, commercial and industrial development, outdoor recreation facilities, and hazardous installations such as oil or gas storage.

The **Approach Zone** is an extension of the RPZ. As indicated by the Airport Land Use Plan, land uses that may be compatible within the Approach Zone include low density single-family dwellings; transportation and communication facilities; and specified manufacturing, warehouse, commercial, and recreation uses. Proposed land uses within the Approach Zone that would attract large concentrations of people are to be reviewed by the Airport Land Use Commission. "Large concentrations" of people are defined as being "on the order of 25 people per acre."

Land uses considered to be compatible with the **General Airport Traffic Pattern Zone** include residential, commercial, industrial and recreational uses. Proposed land uses within this zone that would attract large concentrations of people are to be reviewed by the Airport Land Use Commission.

Tall structures near airports have the potential to be hazardous to aircraft operations. Within the **Height Restriction Zone**, Part 77 of the Federal Aviation Regulations (FAR) establishes standards for determining when new development would result in an obstruction to navigable airspace. The regulations require that the FAA be notified of proposed construction or alteration of objects, whether permanent, temporary or of natural growth, if those objects would be of a height that exceeds FAR Part 77 criteria. The height limits are defined in terms of imaginary surfaces in the airspace that extend upward and outward from the airport runways.



Source: Santa Barbara Airport Final EIS/R for the Aviation Facilities Plan

Figure 27

City of Santa Barbara
General Plan
Airport Protection Zones

Hazard Reduction

The type and intensity of future development that may occur on City property at and adjacent to the Airport is controlled by several land use planning programs, including the requirements of the Airport Zoning Ordinance, Title 29 of the Municipal Code, the *Airport Industrial Area Specific Plan, City of Santa Barbara Coastal Plan for the Airport and Goleta Slough,* and the *Aviation Facilities Plan.* In addition, future land uses on Airport property would be required to comply with the standards established by the most-current version of the *Airport Land Use Plan,* as well as FAA and other applicable regulations.

The potential for future development on properties located in the vicinity of the Airport to result in land use or safety conflicts would be minimized by complying with existing FAA regulations and reviewing projects to ensure that they are consistent with the land use planning objectives of the most-current *Airport Land Use Plan* and the *California Airport Land Use Planning Handbook.*

HAZARDOUS MATERIAL TRANSPORT

Description of the Hazard

An accidental release of hazardous materials or hazardous wastes at an industrial or commercial site, or the improper use and disposal of household hazardous waste in a residential area, has the potential result in adverse health, safety and/or environmental effects. Those hazards, however, are likely to be limited to the affected property and adjacent areas. The transportation of hazardous materials through Santa Barbara by vehicle or rail, has the potential to result in the creation of hazardous conditions that can affect a widespread area.

The potential for a spill or leak to occur while hazardous materials are being transported is very low, however, the consequences of such an event can be high. For example, the Association of American Railroads reports that each year, about 1.7 million carloads of hazardous materials are transported by rail in the United States, and in 2008, 99.998 percent of rail hazmat shipments reached their destination without a release caused by a train accident. However, in 1991 a train derailment near the community of Sea Cliff in Ventura County caused the release of aqueous hydrazine, which is used to make agricultural, metal plating, plastics and photo processing chemicals; and the release of naphthalene, an industrial solvent. Both chemicals can be toxic if inhaled and their release caused the evacuation of approximately 300 residents and resulted in the closure of a 10-mile section of U.S. 101. Northbound and southbound traffic on the highway was rerouted to State Routes 166 and 33 while cleanup operations were underway.

Local Conditions

U.S. 101 and the Union Pacific Railroad extend through Santa Barbara from east to west and both are used for the transportation of hazardous materials. The City has limited control over the volume and type of materials transported along these corridors and it can be expected that various types of hazardous materials, including explosives, compressed and liquefied gases, petroleum products, agricultural chemicals, industrial chemicals, military ordinance, radioactive material and hazardous wastes will pass through the City on a regular basis.

In the event of a hazardous material release, emergency response is provided by the California Highway Patrol, City Fire Department and the Santa Barbara County Fire Department, along with Caltrans and local Sheriffs and Police Departments to provide containment, enforcement and traffic routing assistance. If necessary, the California Emergency Management Agency (Cal EMA) Hazardous Materials Section will coordinate the implementation of a hazardous material emergency response, and provide state and local managers with emergency coordination and technical assistance.

Another major transportation facility in the Santa Barbara area is SR 154, however, the transportation of hazardous waste is restricted along the portion of SR 154 that extends between the southern junction with U.S. 101 and the SR 246 intersection near Solvang. In addition, the California Assembly passed House Resolution HR 31 in 2012, which urges truck drivers traveling through Santa Barbara County to continue on State Highway Route 101 rather than using SR 154. The purpose of the resolution is to increase traffic safety along the highway, which will also minimize the potential for an accidental release of hazardous substances that could affect the water supply provided by Lake Cachuma.

Hazard Reduction

Numerous federal regulations have been enacted to manage the transportation of hazardous materials and waste, including the requirements of the Hazardous Materials Transportation Act, which is administered by the Department of Transportation, and the requirements of the Resource Conservation and Recovery Act, which is administered by the Environmental Protection Agency. These and other regulations establish standards for labeling and manifesting hazardous waste; prescribe minimum safety standards and handling requirements; and require the implementation of appropriate material release response. State oversight of hazardous material transportation is also provided by numerous agencies, including California Highway Patrol requirements for carrier and driver licensing and safety; Department of Toxic Substances Control requirements pertaining to hazardous waste transportation; and Department of Motor Vehicles requirements for hazardous waste hauling vehicle registration and specialized driver certifications.

The Federal Railroad Administration is predominately responsible for rail safety in the U.S. and implements a variety of rail safety programs related to the transportation of hazardous materials, including track and rail car safety requirements. At the State level, the California Public Utilities Commission provides oversight for the transportation of hazardous materials by rail, and conducts inspections of hazardous material shippers.

NATURAL GAS PIPELINES

Description of the Hazard

Risks to the public from natural gas pipelines result from the potential for an unintentional release, which can impact surrounding populations, property, and the environment. These consequences may result from fires or explosions caused by ignition of the released gas, as well as possible toxicity and asphyxiation effects. Pipeline releases can occur due to a variety of causes, including internal and external corrosion, excavation damage, mechanical failure, operator error, and natural force damage (i.e., earthquakes).

The U.S. Department of Transportation, Pipeline & Hazardous Materials Safety Administration (PHMSA) provides data regarding the occurrence and consequences of natural gas pipeline-related incidents in the U.S. PHMSA reports that between 1992 and 2011, there have been a total of 124 “serious” incidents involving onshore natural gas pipelines, resulting in 43 fatalities and 209 injuries. “Serious” pipeline incidents are defined as an event involving a fatality or injury requiring in-patient hospitalization.

Although natural gas pipeline incidents are infrequent, they do have potentially significant consequences that may impact the general public. This was evidenced in 2010 in the City of San Bruno, when a 30-inch natural gas transmission pipeline ruptured and the ensuing explosion and fire killed eight people, destroyed 37 homes, damaged 18 homes and resulted in numerous injuries.

Local Conditions

In the Santa Barbara area, the Southern California Gas Company is the natural gas utility company and operates a system of natural gas transmission and distribution lines that are generally located in the northern portion of the City, along the waterfront and on airport property. Transmission lines operated by the Gas Company generally operate at pressures above 200 pounds per square inch and transport gas from supply points to the gas distribution system. The distribution pipelines operate at pressures above 60 pounds per square inch and deliver gas in smaller volumes to the lower pressure distribution system.

Hazard Reduction

The federal government establishes minimum pipeline safety standards under the U.S. Code of Federal Regulations, Title 49, Parts 191 through 199. The Office of Pipeline Safety, within the U.S. Department of Transportation has overall regulatory responsibility for hazardous liquid and gas pipelines. Through certification by the Office of Pipeline Safety, California regulates, inspects and enforces intrastate gas pipeline safety requirements. These actions are implemented by the Office of the State Fire Marshal. In addition, the California Public Utilities Commission also has responsibilities regarding gas pipeline safety. On April 19, 2012, the Public Utilities Commission adopted a decision broadening the scope of its Natural Gas Safety Rulemaking and directed all California natural gas system operators to file natural gas system operator safety plans for their gas transmission and distribution facilities.

The Southern California Gas Company implements a pipeline safety program that includes measures such as: odorizing gas so leaks are more easily detectable; conducts leak surveys and pipeline patrols to identify missing pipeline markers, indicators of pipeline leaks, and construction activity that could damage a pipeline; interior and exterior pipeline corrosion control measures; and inspection and maintenance of valves, underground vaults, pipeline crossings, and pressure-relief devices.

Another important pipeline safety precaution are requirements to contact Underground Service Alert prior to initiating drilling or excavation activities so that the location of below ground utilities can be identified.

ELECTROMAGNETIC FIELDS

Description of the Hazard

The most common type of electricity used in the United States is alternating current (AC), where the current does not flow steadily in one direction but moves back and forth at a rate of 60 times per second. Wherever there is an electric current, there are also electric and magnetic fields, which are created by the electric charges. Electric fields are formed by the amount of the charge and magnetic fields result from the motion of the charge.

Electric fields are measured in terms of volts per meter (V/m) or kilovolts per meter (kV/m). Almost all household appliances create an electric field when plugged in, even when not in use. Magnetic field intensity is measured in units of gauss (rhymes with mouse) or milliGauss (mG). Another measurement unit for magnetic field levels is the microtesla (μT), where one microtesla equals 10 mG.

Electric and magnetic fields are created by high voltage electricity transmission lines, distribution lines that bring electricity into structures, wiring within households, and by common household appliances that use electricity. The strength of electric and magnetic fields produced by electrical lines and appliances diminishes quickly as the distance from the source of the field increases.

Electric and magnetic fields associated with the use of electricity differ from other types of electromagnetic energy such as x-rays and microwaves. For example, x-rays have so much energy that they can "ionize" or break up molecules and damage the DNA of cells. Microwaves are absorbed by water and can heat the water contained in living tissue. Because electric and magnetic frequency fields that are usually present in the environment do not ionize molecules or heat tissue, it was previously believed that they have no effect on biological systems. In the mid-1970's, however, a variety of studies demonstrated that biological changes can be produced by these weak fields.

More recent scientific research has focused on exposure to electromagnetic fields (EMF) rather than electric fields. Although some studies raised the possibility of emotional, behavioral, and reproduction effects, the greatest public concern regarding EMF exposure generally pertains to a statistical association between magnetic fields and cancer. Although the results of studies regarding this issue vary, most have concluded that there is insufficient data to conclude that there is a cause and effect relationship between EMF and cancer. The American Cancer Society provides the following information regarding the potential link between EMF and cancer:

> *Electric currents create extremely low-frequency (ELF) electromagnetic fields, which are at the low-energy end of the electromagnetic spectrum. We are all exposed to electromagnetic fields from the earth itself and from man-made sources. Examples of man-made sources include power lines, household wiring, and electrical appliances (when they are on).*
>
> *The possible link between electromagnetic fields and cancer has been a subject of controversy for several decades. Because we are all exposed to different amounts of these fields at different times, the issue has been difficult to study.*
>
> *One of the main concerns has been whether ELF affects the risk of childhood cancers such as leukemia and brain tumors. In the studies that have looked at a possible link with childhood leukemia, the results have been mixed. If there is an increased risk it is likely to be small, but a weak link cannot be ruled out entirely. Studies of other childhood cancers have generally not found any strong links to electromagnetic fields.*
>
> *Most studies in adults have not found links between electromagnetic fields and cancer.*
>
> *It's not clear exactly how electromagnetic fields, a form of low-energy, non-ionizing radiation, could increase cancer risk. Studies of lab animals have generally not found that magnetic fields increase the risk of cancer. The absence of a link in animal studies makes it less likely that human exposure to electromagnetic fields, at home or at work, affects cancer risk.*
>
> *The National Institute of Environmental Health Sciences (NIEHS) describes the scientific evidence suggesting that electromagnetic field exposures pose a health risk as "weak". But because a possible increase in cancer risk can't be ruled out completely, the NIEHS has advised that people concerned about EMF exposure may want to consider practical ways to reduce their exposure, such as finding out where their major EMF sources are and limiting the time spent near them. There are more costly actions, such as burying power lines or moving out of a home, that might also lower EMF exposure. But because scientists aren't sure if EMF poses any health hazards, it's not clear if such actions are warranted, according to the NIEHS.*

Local Conditions

Southern California Edison (SCE) provides electrical service to the City. The transmission system in the City includes several large tower-mounted 66 kilovolt (kV) lines extending east to west along the base of the Santa Ynez Mountains, approximately two miles north of the City. The electrical distribution system operates at 2.4 kV, 4.16 kV and 16.5 kV and is distributed as needed throughout the City. Approximately 30 percent of the City's distribution system is underground.

SCE reports that according to the NIEHS, magnetic fields under main feeder distribution lines or above underground lines can create fields around 10 to 20 mG. For smaller distribution lines, field levels are often below 10 mG to under 1 mG. At a distance of 100 feet, the magnetic field levels from distribution lines often drop to values similar to levels found in most homes.

Hazard Reduction

There are no federal or California numerical thresholds for exposure to electromagnetic fields. In 2006, the California Public Utility Commission determined that it is appropriate for utilities to continue to take no-cost or low-cost measures where feasible to reduce EMF exposure from new or upgraded utilities (CPUC Decision D.06-01-042). These types of actions may include design changes to utility systems, routing lines to limit exposures to areas of concentrated population and group facilities such as schools and hospitals, installing taller distribution line support structures, widening right of way corridors, and the burial of distribution lines.

Limiting EMF exposure may be achieved by implementing a practice referred to as "prudent avoidance." Prudent avoidance is a principle of risk management indicating that reasonable efforts to minimize potential risk should be taken when the actual magnitude of the risk is unknown. For individuals, this may be achieved by increasing the distance between yourself and appliances and/or minimizing time you use appliances at home or work. For jurisdictions, this could entail the implementation of no-cost and low-cost project design measures similar to those described above.

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