7.5 LESS SIGNIFICANT HAZARD PROFILES

7.5.1 SEVERE WINTER WEATHER

7.5.1.1 Nature

Severe winter weather includes extreme cold, heavy snowfall, ice storms, winter storms, and/or strong winds. In addition, winter storms may result in other hazards such as flooding, severe thunderstorms, tornadoes or extreme winds.

The Hazard Mitigation Team identified snowstorms and strong winds as the most likely severe winter weather hazards based on history in the City of Redding.

Snow

The National Weather Service (NWS) defines *snow* as a steady fall of snow for several hours or more. *Heavy snow* is defined as either snowfall accumulating to 4 inches in depth in 12 hours or less, or snowfall accumulating to 6 inches or more in depth in 24 hours or less.

Heavy snow can result in collapse of structures from the weight of the snow, downed trees or large branches, power outages, flooding and auto accidents. In addition, it can hamper emergency services and recovery efforts.

Wind

Wind is commonly reported using terms such as *fastest-mile* wind speed and/or *peak gust* wind speed. The *fastest-mile* wind speed is defined at the highest wind speed measured at an altitude of 30 feet, in open terrain, over a period of time that it takes for one mile of wind to pass by the anemometer, the instrument used to measure wind speed.

The *peak gust* wind speed is the highest wind speed measured over a period of 2 to 5 seconds. It is approximately 20% larger than the *fastest-mile* wind speed. Therefore, a *fastest-mile* wind speed of 75 miles per hour (mph) would correspond to a peak gust wind speed of approximately 90 mph. The shorter the duration of measurement, the higher the wind speed due to the gust factor (i.e. the rapid variation of wind speed in time).

High winds are defined as winds of 40 mph or greater lasting for one hour or longer, or wind gusts of 58 mph or greater. Hurricane force winds are often referred to when sustained winds exceed 74 mph. High winds can result in damage to roofing materials, downed trees or large branches, power outages, auto accidents, and the collapse of awnings, patio covers and carports. The presence of downed trees and branches can also hamper emergency services and recovery efforts.

7.5.1.2 History

The City of Redding typically experiences severe winter weather during the months of December and January. Storms with strong southerly winds with or with out heavy rain are relatively common during these months and typically occur several times per year. Wind speeds of 40 to 50 mph and peak gusts up to 60 mph occur with some regularity. On the other hand, snowstorms are not as common an occurrence for the City. It's not unusual for the City to experience no measurable amounts of snow for several years in a row.

Snow

According to newspaper reports, the largest one-day (unofficial) record for snowfall in Redding occurred on New Years Day in 1899 with more than 23 inches of snow.

The National Weather Service (NWS) official records, which begin in 1893, indicate that the largest one-day snowfall total at 16 inches, two-day snowfall total at 20 inches, and maximum 3-day snowfall total at 23 inches. The exact dates of the NWS records are not known, but are likely to be from the City of Redding's most damaging snowstorm on record which began on December 22, 1968. In this event, several storms produced wet snow that caused a number of roofs to collapse, most notably a drug store, bowling alley, billiards parlor, roller rink, grocery store, wholesale food warehouse, and the top of the main airplane hanger at Benton Airpark.

Other damage reported included the toppling or breaking of overloaded trees and large limbs, and metal awnings collapsing onto cars. Total damage was estimated at $3.2 million.

In December of 1988, three different storm systems dumped a total of 17 inches of snow in Redding. On New Years Eve in 1992 an unexpected snowstorm caught Redding residents off guard when 4 to 10 inches of snow fell. These events appear to have been mostly an inconvenience to City residents and resulted in little damage. In late December 2003, the City of Redding experienced its the most damaging snowfall since 1968. Snow began falling in the evening of December 28th and continued to do so steadily through the next morning. While snow accumulations did vary significantly through out the City, the north and west areas of the City experienced the largest snowfall amounts of nearly 12 inches. There were a few industrial buildings that experienced partial roof collapses and several collapsed metal roof carports at an apartment complex. While the structural damage was much less than what had occurred in the 1968 snowstorm, there was a significant number of downed trees and tree branches, power lines and some auto accidents from this storm. The tree damage occurred most commonly on large canopy live oak trees that collected the heavy snow on their leaf laden branches. Unlike other oak trees common in the Redding area, live oaks do not lose their leaves in the fall. Some of the fallen trees and/or limbs caused damage to residences while many others fell into and blocked streets.
The City of Redding Electric Utility classified the December 2003 snowstorm as the one in twenty-five year event (i.e. occurs once every twenty five years). Their storm event was logged between December 28, 2003 and January 2, 2004 and included the snowstorm and a windstorm that followed with wind speeds in excess of 60 miles per hour. The storm events affected 13,229 customers. The total direct cost to the Electric Utility was reported as $328,500.

Wind

According to the National Weather Service (NWS), the highest recorded wind speeds in the City of Redding occurred in early December of 1995 when 60 mph (fastest-mile) and 85 mph peak gusts were measured. The Record Searchlight reported that these hurricane force winds knocked down fences, toppled trees and power poles, tore roofing off houses, tipped a big rig in a parking lot while causing damage at the Redding Municipal Airport to 4 planes and 18 hangars. The storm also resulted in the death of a woman who was smothered when a large oak tree fell through her mobile home and landed on the bed where she was sleeping. This storm appears to have produced the strongest winds since 1877 when peak gusts were estimated to be nearly 80 mph.

Many long time Redding residents make comparisons between the December 1995 storm and what is referred to as the Columbus Day Storm. On October 12, 1962 this storm blew into to California as a result of tropical typhoon Frieda apparently with wind gusts slightly less that the December 1995 storm. It too caused damage to fences, roofs, trees, power poles, etc.

7.5.1.3 Future Events

Based on the historical data, it is expected that City of Redding will continue to experience severe winter weather, including high winds and heavy snow. High winds with gusts up to 60 mph are anticipated to occur on a fairly regular basis. While snowstorms that produce small amounts of snowfall accumulation may occur slightly less often as storms that produce high winds, snowstorms that produce damaging amounts of snowfall are expected to occur much less often (i.e. approximately once every 20 years).

7.4.1.4 Present and Future Mitigation Efforts

The City of Redding enforces the California Building Code (CBC) and the applicable sections of the code that relate to snow load and wind load design. The current design criterion for the City of Redding is 30 pounds per square foot (psf) non-reducible snow load and wind loading based on 75 miles per hour (mph) fastest-mile wind speed with the appropriate exposure category for the site (i.e. exposure B or exposure C for open and flat site conditions).

In the summer of 1969, as a direct result of the damage from the December 1968 snowstorm, the City adopted a minimum design (roof) snow load of 30 pounds per square foot (psf) for all new structures. This design snow load was based on the recommendations from a committee of local engineers, architects, and building inspectors who investigated and studied the roof failures. Prior to the 1968 storm, there was no snow load design requirement.

The City does have a number of structures that were constructed prior to the 30 psf snow load. The current policy is that structures built prior to 1970 must under go a snow load analysis by a qualified design professional (i.e. licensed engineer of architect) when that structures under goes a change in use or occupancy that results in structure being placed in higher hazard occupancy group, as required by CBC Chapter 34. Structures that are found to structurally deficient are required to upgraded to support a 30 psf snow load.

7.5.1.5 Mitigations

Goal 9: Reduce deaths, injuries, structural damage and losses from severe winter weather.

Objective 9.A: Ensure that structures in the City are adequate to resist snow and wind loads.

Action 9.A.1: Continue to enforce the snow and wind provisions of the latest edition of the California Building Code for new construction, alterations and additions.

Action 9.A.2: Continue to require a snow load analysis of existing structures (built prior to 1970) that undergo a change in use or occupancy that results in a higher hazard occupancy group.

Objective 9.B: Ensure City preparedness for emergency response actions due to severe winter weather.

Action 9.B.1: Continue active participation and training of City personnel in the State OES Safety Assessment Program (SAP).

Action 9.B.2: Provide yearly review of the procedures of safety assessment inspections including proper use of the City's official placards (unsafe, restricted use & inspected) and how to complete the rapid and detailed safety assessment evaluation forms.

Action 9.B.3: Conduct annual emergency operation's center drills to ensure efficiency of City staff and coordination of resources and information.

7.5.2 EARTHQUAKES

7.5.2.1 Nature

A fault is a thin layer of crushed rock between two blocks of the earth's crust that have moved relative to one another. A fault can range in length from a few centimeters to thousands of miles.

An earthquake is the shaking and vibration at the surface of the earth resulting from underground movement along a fault plane, and less frequently from volcanic activity. Earthquakes occur when forces underground cause the fault to rupture and suddenly slip. This occurs when the stress build up at the fault exceeds the strength of rock resisting the movement.

Two of the most common methods to describe an earthquake are by intensity and magnitude. Intensity and magnitude measure different characteristics of earthquakes.

Intensity

Intensity is a measure of the strength of shaking experienced in an earthquake at a particular location. The intensity scale used in the United States is the Modified Mercalli (MM) intensity scale, which represents the local effect or damage caused by an earthquake (see Table 7-4). This scale, composed of 12 increasing levels of intensity that range from imperceptible shaking to catastrophic destruction, is designated by Roman numerals (I through XII). The lower numbers of the intensity scale generally deal with the manner in which the earthquake is felt by people. The higher numbers of the scale are based on observed structural damage. The maximum observed intensity generally occurs near the earthquake epicenter, and the intensity generally decreases away from the epicenter.

Sometimes earthquakes are referred to by the maximum intensity they produce. The Modified Mercalli intensity value assigned to a specific site after an earthquake has a more meaningful measure of severity to the general public than the earthquake magnitude because intensity refers to the observed effects and damage actually experienced at that location. For example, an earthquake of intensity *MM II* would barely be felt by people favorably situated, while intensity *MM X* would produce heavy damage, especially to unreinforced masonry structures.

Local geologic conditions strongly influence the intensity of an earthquake. Commonly, sites on soft ground or alluvium may have intensities 2 to 3 units higher than sites on bedrock.

Magnitude

Magnitude is a measure of the size of the earthquake and energy released at the source of the earthquake, where the fault slip has occurred. Magnitude is determined from measurements on seismographs which record the ground motion from the earthquake.

Magnitude scales, like the Richter (local) magnitude and moment magnitude, measure the size of the earthquake at its source. Thus, they do not depend on where the measurement of the earthquake is made. Earthquakes below magnitude M2.5 are generally not felt by people. Table 7-5 represents the approximate Modified Mercalli intensity near the epicenter of the earthquake versus the earthquake magnitude.

TABLE 7-4
MODIFIED MERCALLI INTENSITY SCALE

MM Intensity	Observed effects and damage
I	Not felt except by a very few under especially favorable conditions.
II	Felt only by a few persons at rest, especially on upper floors of buildings.
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do
IV	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes,
V	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects
VI	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster.
VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial
IX	Damage considerable in specially designed structures; well-designed frame structures thrown
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed
XI	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
XII	Damage total. Lines of sight and level are distorted. Objects thrown into the air.

TABLE 7-5
MODIFIED MERCALLI INTENSITY AND MAGNITUDE

MM Intensity	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Magnitude	1 – 2	2 – 3	3 – 4	4	4 – 5	5 – 6	6	6 – 7	7	7 – 8	8	> 8

Seismic Hazards

The primary seismic hazard is ground shaking caused by the earthquake and resulting seismic waves. Ground shaking is most often reported as peak ground acceleration (PGA) which represents the largest ground acceleration recorded by a particular station during an earthquake. PGA may be given in various acceleration units but is most commonly reported as a percentage (or fraction) of the acceleration of gravity (i.e. “g”). Table 7-6 represents the approximate relationship between the Modified Mercalli intensity and PGA, as a percentage of “g”.

TABLE 7-6
MODIFIED MERCALLI INTENSITY AND PGA

MM Intensity	I	II-III	IV	V	VI	VII	VIII	IX	X+
Perceived Shaking	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
Potential Damage	None	None	None	Very light	Light	Moderate	Moderate/ Heavy	Heavy	Very heavy
PGA (%g)	< .17	.17 - 1.4	1.4 - 3.9	3.9 - 9.2	9.2 - 18	18 - 34	34 - 65	65 - 124	> 124

Secondary hazards include surface faulting, liquefaction, landslides and tsunamis. Surface faulting is displacement that reaches the earth's surface during slip along a fault. Liquefaction is the process by which water-saturated sediment temporarily loses strength and acts as a fluid.

7.5.2.2 History

Shasta County has a low level of historic seismic activity. In the past 120 years there has been no significant property damage or loss of life due to earthquakes occurring within or near the County. Maximum recorded intensities have reached *MM VII*, with possibly one instance of *MM VIII*. Most of the stronger intensity seismic activity in Shasta County has occurred in the eastern half of the County near Lassen Peak.

The City of Redding is located in the less seismically active western half of Shasta County, referred to as an area of “moderate seismicity”. Earthquake activity has not been a serious hazard in the City of Redding’s history, nor is it probable that it will become a serious hazard in the future.

Research of historical earthquakes indicates that Redding has experienced several moderate sized earthquakes, magnitude 4.0 to 4.5 (estimated) in 1904, 1915, 1919, 1920 and 1930.

On November 26 (Thanksgiving Day), 1998, the City of Redding experienced a local magnitude M_L 5.2 earthquake that was centered three miles north-northwest of Redding near Keswick Dam. This was the largest recorded earthquake since the U.S. Geological Survey began monitoring Shasta County in 1981 and believed to be the largest earthquake in the Redding area since 1878. No structural damage was reported in the City of Redding. Nonstructural damage that was reported consisted of broken merchandise at a liquor store, a grocery store and a drug store, loss of power at a grocery store due to a damaged electrical panel, a fire sprinkler break causing damage in a mechanical room and two operating rooms at Mercy Medical Center, and non-structural cracks at expansion joints in a highway overpass. Outside of the City limits; a 4 million gallon water tank in Bella Vista lifted about an inch off its foundation, resulting in bent anchor bolt washers; and a PG & E transformer caught fire in Corning resulting in temporary power outage for 7500 customers.

The only reported earthquake injury occurred in the City of Shasta Lake when a woman slipped and fell in a grocery store. She was later admitted to Mercy Medical Center for X-rays.

7.5.2.3 Future Events

Ground Shaking

Redding is located within Seismic Zone 3 per the 2001 California Building Code. The exposure to strong seismic shaking is considered to be relatively low. The maximum earthquake intensity is expected to be between *MM VI* & *MM VII* (see Table 7-4).

According to the California Department of Conservation – Division of Mines and Geology (DMG), seismic hazard mapping indicates approximate probabilistic peak ground accelerations (PGA) of 16%g, 18%g and 22%g on firm rock, soft rock, and alluvium site soil categories respectively. These ground accelerations correspond to the earthquake that has a 10% probability of being exceeding in 50 years, or the earthquake that has a return interval of 475 years.

Surface Faulting

There are no fault-rupture hazard zones within the City of Redding, as defined by the Alquist-Priolo Earthquake Fault Zoning Act. Therefore, surface fault rupture is not considered to be a significant hazard.

Ground Failure

Based on the low to moderate expected PGA, and the geology and the topography within the City of Redding, seismically induced land sliding and/or liquefaction are not considered significant hazards.

7.5.2.4 Present and Future Mitigation Efforts

Damage in Redding resulting from earthquakes would most likely be from ground shaking, and less likely from related ground failure. The effects of ground shaking are best mitigated by adequate design for the maximum probable earthquake for the City of Redding. The effects of ground failure are best mitigated by adequate geotechnical investigations of specific sites.

The City of Redding enforces the California Building Code, which establishes building requirements for all new structures based on predicted earthquake intensities. The risk of loss of life and property damage due to seismic activity is assumed to be minimized if the California Building Code is enforced. The Seismic Hazards Assessment for the City of Redding states *"... the UBC (Uniform Building Code) generally provides conservative ground motion criteria for the design of new buildings and structures ... the probability is small that the UBC [design standard] will be exceeded."* However, the Assessment also states that some structures on alluvial deposits and soft rock could experience peak horizontal accelerations greater than those anticipated in the UBC and, therefore, recommends that site specific seismic hazard evaluations be performed for critical facilities. The Seismic Hazards Assessment for the City of Redding also includes maps of the potential liquefaction areas within the City's sphere of influence. The Assessment recommends that where areas of liquefaction potential are anticipated, site specific investigations regarding liquefaction potential should be made.

Plan review of building permit applications are provided through the Building Division of the Development Services Department. The Building Division currently consists of eighteen staff members; a chief building official/assistant director, a supervising building inspector, four building inspectors, three plan checkers, two plan check engineers, three code enforcement officers and three clerical staff. All of the building inspectors and plan checkers are certified by the International Code Council (ICC). In addition to the ICC certifications, the chief building official and both plan check engineers hold licenses as California structural engineers. As compared to other jurisdictions north of Sacramento, the City of Redding has long had a reputation of having one of the most thorough building plan check processes intended to safeguard life limb and property as stated in the California Building Code.

7.5.2.5 Vulnerability

The City of Redding recently ran an earthquake scenario based on an expected peak ground acceleration (PGA) of 18%g over the entire City (See Figure 11). Building Damage Ratios were estimated at 6% for older structures located in the immediate downtown area of the City, and 3% for all other areas within the City. The Building Damage Ratio represents an estimate of the ratio, as a percentage, of the repair cost divided by the replacement cost. The higher damage ratio in the downtown area was chosen since these structures are typically older and less likely to have been constructed with any seismic code design provisions (i.e. pre seismic code buildings). The total damage is estimated at $198 million for the City as a whole (see Table 7-7), which is less than 1% of the damage estimates from the 1994 Northridge earthquake.

TABLE 7-7
EARTHQUAKE DAMAGE ESTIMATES

Type of Structure	Number of Structures			Value of Structures			Estimated Damage
	# in City	# with DR = 6%	# with DR = 3%	Value in City	Value with DR = 6%	Value with DR = 3%	
Residential	24,780	2,426	22,354	$4,604 M	$180 M	$4,424 M	$144 M
Commercial	776	219	557	$430 M	$66 M	$364 M	$15 M
Industrial	328	39	289	$106 M	$5 M	$101 M	$3 M
Agricultural	15	3	12	$7 M	$1 M	$6 M	$0 M
Religious / Non-Profit	33	9	24	$29 M	$3 M	$26 M	$1 M
Government	164	76	88	$625 M	$124 M	$501 M	$22 M
Education	54	17	37	$290 M	$116 M	$175 M	$12 M
Utilities	25	10	15	$32 M	$1 M	$31 M	$1 M
TOTAL	**26,175**	**2,799**	**23,376**	**$6,123 M**	**$496 M**	**$5,628 M**	**$198 M**

DR = Estimated Damage Ratio = repair cost / replacement cost
M = millions of dollars

7.5.2.6 Mitigations

Goal 10: Reduce deaths, injuries, structural damage and losses from earthquakes.

Objective 10.A: Ensure that structures in the City are adequately earthquake resistant.

Action 10.A.1: Continue to enforce the seismic provisions of the latest edition of the California Building Code for new construction, alterations and additions.

Action 10.A.2: Continue to require a seismic analysis of existing structures (built under earlier building codes) that undergo a change in use or occupancy that results in a higher hazard occupancy group.

Objective 10.B: Ensure City preparedness for emergency response actions due to earthquakes.

Action 10.B.1: Continue active participation and training of City personnel in the State OES Safety Assessment Program (SAP).

Action 10.B.2: Provide yearly review of the procedures of safety assessment inspections including proper use of the City's official placards (unsafe, restricted use & inspected) and how to complete the rapid and detailed safety assessment evaluation forms.

Action 10.B.3: Conduct annual emergency operation's center drills to ensure efficiency of City staff and coordination of resources and information.

7.5.3 ELECTRICAL / EXTREME HEAT

7.5.3.1 Nature

Redding Electric Utility (REU) owns, operates and maintains the City of Redding's Transmission and Distribution Electric System. During an average year, we deliver over 800 Gigawatts of energy to our customers. The major hazards facing the Utility are natural disasters and energy supply shortage.

7.5.3.2 History

Historically, wind and snow storms have had the greatest impact on the delivery of power to our customers. On December 31, 2003, the Redding area experienced an abnormally heavy snow storm, leaving many customers without power for a period of up to four days.

Energy supply shortages in California also threaten the availability for our customers. In 1996, Redding was impacted by a West Coast power outage that caused the automatic load shedding of about 30% of our customers for over 30 minutes.

7.5.3.3 Present and Future Mitigation Efforts

To mitigate the impact of natural disasters, REU participates in a local Emergency Response group, belongs to the California Utility Emergency Association (CUEA) and has entered into individual "mutual aid" agreements with many other California utilities. REU also adheres to an aggressive system maintenance and tree trimming program.

In regards to energy supply mitigation, REU belongs to the Western Electricity Coordinating Council (WECC). WECC is one of the coordination councils under the jurisdiction of the North American Reliability Council (NARC). WECC sets the reliability standards for all electrical utilities connected to the Western Grid. These WECC standards govern the majority of REU's emergency procedures and protocols relating to system stability and reliability. In addition to meeting WECC standards, REU has taken additional measures to mitigate energy supply shortages such as installing local power generation and installing emergency "off-system" generators. Additionally, REU maintains the following emergency plans:

REU Plans

- Emergency Operating Procedures
  - Section 22: Power Control Center Rules & Procedures
- Electric Emergency Plan - Public Notification and Appeal
- Power Plan Emergency Hazardous Materials Business Plan
- Spill Prevention Control and Countermeasure Plans (SPCC)
- Hazardous Materials Business Plans for REU Facilities

7.5.3.4 Mitigations

Goal 11: Reduce deaths, injuries, structural damage and losses from electrical / extreme heat.

Objective 11.A: *Manage the Power System to ensure safe and reliable operation of the City's electric system through twenty-four-hour dispatching of the distribution system and real-time scheduling of the City's power plants.*

Action 11.A.1: Provide safe, reliable switching control and coordination of field crews throughout the year.

Action 11.A.2: Real-time operators and preschedulers continue to constantly monitor the energy market for opportunities to reduce power supply costs.

Objective 11.B: *Ensure the Redding Power Plant is available to meet the City's needs whenever required.*

Action 11.B.1: Continue to maintain the existing Redding Power Plant units' availability at 95.1%.

Objective 11.C: *Continue construction of new or upgrading of existing 115kV transmission, substation, and distribution facilities to meet expanding system needs and maintain a reliable and safe system.*

Action 11.C.1: Complete the Moore Road Substation expansion by June 2005.

Action 11.C.2: Install 11 miles of new 12kV distribution line.

Objective 11.D: *Continue to mitigate potential hazards of trees in the proximity of overhead power lines.*

Action 11.D.1: Continue to implement a program that allows for trimming of trees on a three-year or less trim cycle that meets new California State Public Utility Commission (CPUC) tree-trimming clearance standards that were established in January of 1997.

Action 11.D.2: Continue to implement a program to apply tree growth regulators to slow the growth of faster growing trees located adjacent to or under overhead power lines.

Objective 11.E: *Continue to serve all customers in the event of a single contingency equipment failure or main feeder line failure.*

Action 11.E.1: Review and update existing 115kV and 115/12kV substation and 12kV distribution expansion plans.

7.5.4 AVIATION DISASTER

7.5.4.1 Nature

Redding Municipal Airport experiences thousands of landings and take-offs each year. Various user groups utilize the Public Airport, such as private, commercial and governmental agencies, including U. S. Forest Service and California Department of Forestry and Fire Protection (CDF). During the summer months, the use of the airport becomes somewhat busier due to the fire suppression flights offered to the northwest region by the U. S. Forest Service and CDF.

7.5.4.2 History

The airport has very few crashes, and maintains airport approaches as per the FAA Regulations.

7.5.4.3 Mitigation Efforts and Vulnerability

The airport's most probable scenario for an incident would likely occur during the hot summer months, when strong gusty winds and increase in air traffic occur. Using this scenario, we created the most likely incident: a Boeing 727 comes in short of Runway 34, and impacts south of Marvel Lane, near Airport Road. In this impact area, there is one residential and two commercial occupancies. The values of the properties total approximately $620,000, and life loss would be estimated at three persons on the ground and unknown number of persons on board the aircraft. We have outlined the following plans which have been created and maintained by the Airport Managers, which are used to mitigate and respond to any disaster:

List of the Plans:

Airport Emergency Plan - 2003 (2005 Update - Pending FAA approval)

7.5.4.4 Mitigations

Goal 12: Reduce deaths, injuries, structural damages and losses from aviation disasters.

Objective 12.A: *Implement the adopted Airport Emergency Plan which is utilized to mitigate and respond to an aviation disaster.*

Action 12.A.1: Continue to update the Airport Emergency Plan.

Action 12.A.2: Ensure the Airport Emergency Plan complies with FAA regulations.

Action 12.A.3: Conduct aviation disaster drills once every three years.

7.5.5 BIOTERRIOSM

7.5.5.1 Nature

The definition of terrorism according to the Federal Bureau of Investigation is the unlawful use of force against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives. Terrorist acts include the use of arson, hostile takeovers, shootings, bombings, hostage taking, and the deployment of chemical agents or biological agents. Weapons of mass destruction associated with terrorism are defined as chemical, biological, radiological, nuclear, and explosive (CBRNE). Bioterrorism includes the use of biological agents (bacteria, viruses, parasites, or toxins) to intentionally produce a disease in a group of people to meet terrorist goals.

Attractive targets for bioterrorism include sporting events, political conventions, and other special events, because they are highly visible, generate a large volume of attendance, and attract celebrities and/or political leaders. Targets of opportunity include large public works facilities, water distribution systems, postal delivery, or large venues where large groups of people congregate.

7.5.5.2 History

To date, the city of Redding has yet to experience an act of bioterrorism. However, as with most mid-size cities in California, Redding has its vulnerabilities. In consideration of its mild climate, special events, and attractiveness to tourists, Redding stands out for those who would commit such atrocities.

Although, as mentioned, no significant acts of bioterrorism have occurred, Redding has in fact experienced incidents of naturally occurring or accidental exposure to biological agents (bacteria, viruses, parasites, and toxins).

7.5.5.3 *Future Events*

Without a history of significant acts of terrorism or threats thereof having taken place in the city of Redding, there is virtually no data available in which to predict a specific act that may occur. However, when considering the increase of terrorist attacks that have occurred worldwide and throughout the nation, it is only prudent to plan and prepare for when such an event occurs in Redding, and where the city's vulnerabilities lie.

7.4.5.4 Present and Future Mitigation Efforts

The Shasta Cascade Hazardous Materials Response Team (SCHMRT) is a cooperative team covering six Northern California counties. All personnel are trained to meet mandated requirements for the Hazardous Materials Operational Level. A small group of personnel have been trained to the higher levels of Hazardous Materials Technician and Specialist. Due to lengthy railway lines and State highways traversing the City, there is an ongoing potential for a hazardous materials transportation incident. Personnel have limited abilities to respond to incidents of biological agent exposure.

In an effort to combat the potential threat of bioterrorism, the Redding main postal facility of the US Postal Service is being equipped with the Bio Defense/Bio Shield Program. The program aims to keep the public safe by detecting the presence of biological agents.

Personnel of the Redding Fire and Police Departments are members of the Shasta County Public Health Joint Advisory Council (JAC). The Shasta County Public Health Department has access to the California Health Alert Network (CAHAN). This network is designed to alert local health departments throughout California in the event of a public health emergency (bioterrorism). CAHAN provides a central point of access to local health departments and their partners for sending and receiving alerts as well as locating, creating, and sharing critical information from a web-based interface.

The Shasta County Public Health Department recently upgraded their laboratory facility to process and test a variety of materials which may include suspected biological agents. The department added additional microbiologists who received specialized training in select-agent testing.

7.5.5.5 Mitigations

Goal 13: Reduce deaths, injuries, structural damage and losses from bio-terrorism.

Objective 13.A: Provide training to personnel in the latest tactics and personal protection in the event of bio-terrorism.

Action 13.A.1: Continue to provide training to all personnel to meet mandated requirements for the Hazardous Materials Operational Level.

Action 13.A.2: Continue to provide training to a small group of personnel to the higher levels of Hazardous Materials Technician and Specialists.

Action 13.A.3: Continue to apply for grants to assist with the expenses associated with ongoing traing and updated equipment purchases.

Objective 13.B: Enhance communication between agencies to mitigate deaths, injuries, structural damage and losses from bio-terrorism.

Action 13.B.1: Continue membership with the Shasta County Public Health Joint Advisory Council (JAC).

Action 13.B.2: Continue to provide access to the California Health Alert Network (CAHAN).

7.5.6 TERRORISM

7.5.6.1 Nature

Unlike accidents or natural disasters, an act of terrorism is a manmade event designed to extort governments or communities for the purpose of bringing about political, social, and/or economic change. The damage and disruption that may occur from such an event could be immeasurable, crippling a city, region, state, or nation's economy with long-lasting effects. The psychological factor alone would no doubt affect the well being and sense of security people have come to know and enjoy.

The goals and objectives of a terrorist attack are to disrupt society and to affect as many lives as possible. This can be accomplished by many means including the deployment of weapons of mass destruction or by disrupting or damaging community and/or government infrastructure. It may also be accomplished through cyber attacks on business and/or government computer systems.

Weapons of mass destruction (WMD) used by terrorists to accomplish their goals may include but are not limited to the following:

- Chemical, i.e., nerve gas or blistering agent.
- Biological, i.e., anthrax, botulism, or smallpox
- Nuclear explosion (thermonuclear).
- Radiological dispersal device (dirty bomb).
- Conventional or improvised explosive device.

Of all these weapons, the easiest to obtain and use has been the conventional or improvised explosive device. The catastrophic attacks on the World Trade Center buildings in New York City, the Pentagon, and the Alfred P. Murrah Federal building in Oklahoma City proved to the nation that there are no safe havens when considering acts of terrorism. Redding, California, is no exception.

The freedom of movement and virtually unrestricted access to government officials, buildings, and critical infrastructure that are afforded to citizens and visitors, presents terrorists the opportunity to deliver an attack of devastation with only the crudest devices of weapons of mass destruction.

7.5.6.2 History

To date, the city of Redding has yet to experience an act of terrorism of any significance. However, as with most mid-size cities in California, Redding has its vulnerabilities. In consideration of its mild climate, special events, and attractiveness to tourists, Redding stands out for those who would commit such atrocities.

Although, as mentioned, no significant acts of terrorism have occurred, Redding has in fact experienced acts of terrorism on a much smaller scale that would include arson, bomb threats, and hostage incidents.

7.5.6.3 Future Events

Without a history of significant acts of terrorism or threats thereof having taken place in the city of Redding, there is virtually no data available in which to predict a specific act that may occur. However, when considering the increase of terrorist attacks that have occurred worldwide and throughout the nation, it is only prudent to plan and prepare for when such an event occurs in Redding, and where the city's vulnerabilities lie.

More than ever before, plans to mitigate possible terrorist attacks are taken into consideration during the planning phases of special events that take place throughout the city each year. By monitoring intelligence bulletins from agencies that include the FBI and Department of Homeland Security, as well as from local allied agencies, city officials are now in a position to greatly decrease the chances of a terrorist attack and/or mitigate the effects of an attack if one were to occur. Additional measures can be found under section Present and Future Mitigation Efforts.

7.5.6.4 __Present and Future Mitigation Efforts__

Over the past few years, the Redding Police Department, in concert with other city departments and allied agencies, have taken steps in which to combat the threat of a terrorist attack. These steps include, but are not limited to, the following:

The service weapon of a Redding Police Officer has been changed from a 7-round magazine capacity Sig-Sauer weapon to a 15-round Glock weapon. In addition, to augment the Department's arsenal capability in the event of a terrorist attack, most officers have been trained in and are now equipped with .223 caliber semi-automatic rifles. They have also been outfitted with ballistic helmets and gas masks and have been trained in the area of crowd management and control. They have also been trained in response tactics and identification of potential terrorist targets.

Police patrol vehicles have been equipped with MDCs (Mobile Data Computers) that contain software specific to our local schools to include site survey information. Planning sessions have also been conducted with school officials to coordinate emergency services response to critical incidents at school facilities.

Redding Police personnel have kept current with suspected terrorist activities through information bulletins provided by the FBI, the Department of Homeland Security, and CATIC (California Anti-Terrorist Information Center). Police management review these bulletins daily. Police Investigators have also worked with and have shared suspected terrorist information with state and federal law enforcement agencies. A police officer is attending WMD training at the Federal Law Enforcement Training Center. A police lieutenant is attending anti-terrorism training at the FBI National Academy.

The Redding Police Department has and continues to work in unison with the Shasta County Sheriff's Department with annual county-wide disaster drills. Both agencies have worked together to identify potential terrorist targets in our region.

Redding Police representatives meet quarterly with state and local OES (Office of Emergency Services) representatives on the Mutual Aid Region Advisory Committee to discuss recent disasters and ways in which to mitigate future events.

Redding Police representatives meet occasionally with Shasta County Public Health Joint Advisory Committee (JAC) representatives to discuss natural disasters, disease outbreaks, and terrorist incidents affecting public health.

City officials and department heads meet semiannually to conduct EOC (Emergency Operations Center) drills and or exercises. The drills simulate large-scale natural disasters and terrorism incidents in and around the city of Redding. All city departments practice their skills to manage critical incidents utilizing the Standardized Emergency Management System (SEMS) and the National Incident Management System (NIMS).

Site surveys have been conducted of critical city infrastructure to include the Civic Center, water treatment facilities, power generation facilities, and airports. Police officers tour these facilities with management to determine vulnerabilities in security and operational procedures. Recommendations are made for improvements.

A police department policy to address the Homeland Security Advisory System "threat conditions" was adopted. This policy addresses both national and regional threats. The policy guides police officers in securing critical facilities within the city.

Several City of Redding departments, in cooperation with the Shasta County Office of Emergency Services, have procured anti-terrorism and disaster management equipment through annual U.S. Department of Homeland Security funding. Some items include: armored vehicle, additional haz-mat response equipment, and personal protective equipment. Plans to improve radio communications with allied agencies are currently in effect.

7.5.6.5 Vulnerability

Vulnerabilities (or targets) of a terrorist attack can vary, depending upon a terrorist(s) agenda. However, when considering the disruption of lives, continuity of government, and businesses to be a common objective, it's reasonable to believe that certain structures, facilities, and institutions standout more than others. These may include, but are not limited to, the following:

- City infrastructure
- Aviation facilities
- Power generation plants
- Water treatment facilities
- Water waste facilities
- Government buildings
- Police and fire facilities
- Medical facilities
- Communications infrastructure
- Politically and/or symbolic structures

Each of these structures and/or facilities are present in Redding and must be protected from would be terrorists. Depending upon the facility, some measures of protection have already been put in place. These measures include, but are not limited to, private security, video surveillance, increased police protection, and, in some instances, metal and bomb detection.

Although a degree of vulnerability to terrorist attacks will be ever present, it is the City's goal through training, awareness, and education that this be kept to an absolute minimum. This is best accomplished through partnership with allied agencies, private businesses, and assistance from the general public. Accomplishing this goal will help to maintain the quality of life Redding citizens have come to know and expect.

7.5.6.6 Mitigations

Goal 14: Reduce the potential of terrorist activity in the City of Redding.

Objective 14.A: Increase the expertise and awareness of various City of Redding personnel regarding terrorism issues.

Action 14.A.1: Selected police officers and fire fighters will attend training regarding weapons of mass destruction (WMD).

Action 14.A.2: Obtain access to FBI secure database for terrorism related, law enforcement sensitive information.

Objective 14.B: Increase networking communication between City of Redding personnel and the community regarding terrorist related activity.

Action 14.B.1: Increase community awareness through Neighborhood Watch crime prevention program.

Action 14.B.2: Disseminate press releases and activate the Emergency Alert System (EAS) during times of severe terrorism threat conditions.

Objective 14.C: Augment City of Redding personnel with additional personal protective equipment (PPE).

Action 14.C.1 Procure additional weaponry for police personnel such as small caliber patrol rifles.

7.5.7 DAM OVERFLOW OR FAILURE

7.5.7.1 Nature

Shasta Dam, on the Sacramento River just above Redding, serves to control floodwaters and store winter runoff for irrigation in the Sacramento and San Joaquin Valleys, maintain navigable flows, provide flows for the conservation fisheries in the Sacramento River and it's downstream tributaries, provide water for municipal and water district use, protect the Sacramento-San Joaquin Delta from saltwater intrusion, and generate hydroelectric power. In addition, Shasta Lake, behind Shasta Dam, provides boating and recreation opportunities that bring millions of dollars to the Redding area annually.

Shasta Dam is the second largest dam in mass in the United States (behind Grand Coulee Dam on the Columbia River in Washington state). The dam is 602 feet high, with a crest length of 3,460 feet. It is 883 feet thick at the bottom and 30 feet thick at the top. Shasta Dam is a curved concrete gravity-type dam with 6.5 million cubic yards of concrete weighing 15 million tons. Construction of the dam started in 1938 and was completed in 1945. The spillway is 487 feet long—the largest man-made waterfall in the world. The spillway is 375 feet wide with three drum-gates, each 110 feet wide and 28 feet tall, and weighing 500 tons each. There are 18 outlets on the face of the dam, each 8.5 feet in diameter with a maximum overall capacity of 186,000 cubic feet per second.

Prior to the construction of Shasta Dam, floods frequently ravaged the Sacramento Valley, including the State Capital. It is estimated that Shasta Dam has prevented over 5 billion dollars in flood damages. The US Bureau of Reclamation uses flood control procedures and regulations prescribed by the Corps of Engineers for operations per agreements between the two entities.

The City of Redding is the first incorporated city downstream of Shasta Dam through which the Sacramento River flows. As such, it would be directly affected by a dam overflow or failure. Although these are two different types of events, the results are the same – uncontrolled releases from Shasta Dam.

Dam Overflow

A dam overflow is more likely than a dam failure. A dam overflow would be characterized by an "overtopping" of the dam. In reality, it is unlikely that a true overtopping of the dam would take place. The design of the structure includes three gigantic spillway gates to minimize the possibility of a true overtopping of the dam. During an intense and prolonged storm period that might bring water levels near the top of the dam, these spillway gates would be lowered allowing water to be discharged down the spillway. Controlling, or funneling, the discharge down the spillway prevents structural erosion along the base and sides of the dam, protects the turbine power generation plant at the base of the dam, and allows a minimal amount of control of the release in cubic feet per second.

Dam Failure

A dam failure is less likely than a dam overflow. A dam failure would be characterized by a structural breach of the dam. Flooding and overtopping, earthquakes, release blockages, landslides, lack of maintenance, improper operation, poor construction, or vandalism or terrorism typify dam failures. California has had about 45 failures of non-federal dams. These failures occurred for a variety of reasons, the most common being overtopping of earthen dams. Some of the other reasons include specific shortcomings in the dams themselves or inadequate assessment of the surrounding geomorphologic characteristics. Shasta Dam is a federal dam and the design of the dam is that of one of the largest concrete dams in the world, secured firmly on bedrock.

7.5.7.2 Effects of Dam Overflow or Failure

Uncontrolled releases from the dam, although very unlikely, would devastate the entire northern Central Valley. The Sacramento River and its tributaries would overtop banks and levees. Massive flooding in the lowlands along the river would occur and Interstate 5, the main west coast transportation artery, would be affected by closure and possibly other structural damage.

Other effects of large-scale flooding downstream include: loss of life; limited potable water supplies; potential for spread of disease from the release of untreated sewage; structural damage to buildings; probable loss of electricity and landline communications; crop damage and loss of agricultural lands; loss of livestock; emergency response efforts hampered by flooded transportation corridors; and the inevitable clean-up of silt, mud flows, erosion, and debris.

In the event of a dam failure, large-scale flooding could occur repeatedly until the replacement of the dam is complete. As stated before, prior to the completion of Shasta Dam, devastating floods were a regular occurrence in the Sacramento River valley.

7.5.7.3 History

Dam Overflow

Shasta Dam has never overflowed in its 60-year history. In 1977 and again in 1998, prolonged warm spring rainfalls in the watershed above Shasta Dam raised the lake levels as much as 10-feet per day for more than a week. This early snowmelt was followed by intense storms over several days that dropped record precipitation bringing lake levels to within 10 feet of the top. In 1998, the flows were increased to 80,000 cfs out of the dam, but inflow to the lake was steady at more than 225,000 cfs. The storms subsided as the lake neared 4 feet from the top and the Bureau of Reclamation assured everyone that the dam was never in danger of overtopping. The next day officials at the dam announced that for only the second time in the dams' history, the massive drum gates would all be lowered and water would come over the entire spillway in an effort to draw the lake back down to comfortable levels. The spillway gates remained open for several days, as shown in the picture, releasing 78,000 cfs.

Dam Failure

Although there is a history of 45 dam failures within the State of California, most of the failures were earthen dams. Of the concrete dams that failed, all were of the "thin-arch" design. Shasta Dam is a federally controlled and inspected dam, and is considered a thick arch. Seismic activity is monitored and tunnels throughout the dam itself allow inspectors to monitor for cracks and seepage. The dam is built on bedrock and is geomorphologically sound. The probability of a dam failure is extremely low.

Shasta Dam releasing 78,000 cfs

7.5.7.4 Future Events

There is an extremely low likelihood of either a dam overflow or a dam failure. Record rainfall events drew lake levels near the top twice in the last two decades, but both events were sidestepped using modern weather forecasting and safe release levels from the dam. Following the terrorist events of 9/11/01, Shasta Dam was closed to traffic across the dam for security reasons, thus minimizing a terrorist threat. The dam has since re-opened to through traffic by permit but maintains a policy of “no parking or stopping” on the dam.

7.5.7.5 Present and Future Mitigation Efforts

The City of Redding has developed Inundation Maps showing the flood prone areas should a catastrophic failure or a dam overflow occur. This map shows projected floodplain for flows of 100,000 cfs and 310,000 cfs, as delineated from water surface profiles generated by the Army Corps of Engineers, 1942. A recent **EOC** drill simulated uncontrolled releases of 100,000 cfs as part of the exercise. A map of the 100-year floodplain for the Sacramento River showing these inundation areas is included as Figure 6.

7.5.7.6 Vulnerability

Although it is highly unlikely, the most probable scenario would be a dam overflow, not a dam failure. In the event that prolonged periods of high-intensity rain, typically in mid to late spring, in the watersheds above Shasta Dam, the inflows to the lake could exceed 225,000 cfs for extended periods of time. If the lake levels were near capacity and discharges from the dam at 80,000 cfs were unable to draw the lake down enough to prevent an overtopping, the Bureau of Reclamation would likely be forced to open the spillway gates and allow higher flows. There is no precedence for this, but it is likely that the Bureau would give 12 or more hours notice of the impending rise in river flows. The City of Redding has run an EOC drill simulating an uncontrolled release at 100,000 cfs with 12 hours notice for evacuation of people and livestock from the inundation area. The affected area covers 3,000 ac and would displace some 1,987 people. Damages estimates are $131.2 million. See Figure 6 for Inundation Map.

7.5.7.7 Mitigations

Goal 15: Reduce the possibility of property damage and loss of life due to flooding from a dam overflow or failure.

Objective 15.A: Maintain best possible coordination of information and emergency response.

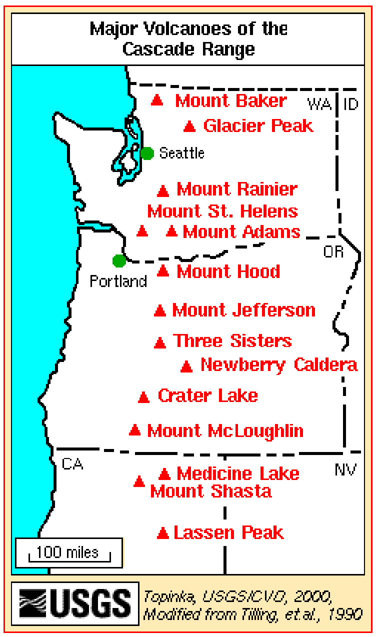
Action 15.A.1: Continue communication and coordination with the Bureau of Reclamation and maintain up-to-date Inundation maps.

Action 15.A.2: Maintain Emergency Operations Center (EOC) for coordination of information and emergency response, with annual exercises simulating disaster response. Funding is available.

7.5.8 Volcanic

7.5.8.1 Nature

Volcano activity in this region is a rare occurrence; however the City of Redding is flanked on two sides by large mountains that are considered volcanic in nature. The two mountains, Mount Shasta located approximately 56 miles to the north and Lassen Peak located approximately 46 miles to the east of Redding are considered two of the potentially active volcanoes in the Cascade Range. The Cascade Range, a chain of volcanic cones, extends through Washington and Oregon into California. The Cascade Range is transected by deep canyons of the Pit River. The river flows through the range between Mount Shasta and Lassen Peak, after winding across interior Modoc Plateau on its way to the Sacramento River.



The largest and highest volcano in the southern Cascades, Mount Shasta is a compound stratovolcano, composed of overlapping cones centered around at least four main vents. -- *Miller, 1980; 1989*

Lassen Peak marks the southern end of the Cascade Range and is the most recently active volcano in northern California. Lassen Peak is a dacite plug which formed about 11,000 year ago after the collapse of nearby Brokeoff Mountain, once a volcano the size of Mount Shasta about 450,000 years ago. -- *Kilbourne and Anderson, 1981*


Mt. Lassen

7.5.8.2 History

Shastina, west of the cluster of other central vents, was formed mainly between 9,700 and 9,400 years; the Hotlum cone, which forms the summit and the north and northwest slopes of Mount Shasta, may overlap Shastina in age, but most of the Hotlum cone is probably younger. Mount Shasta has continued to erupt at least once every 600-800 years for the past 10,000 years. Its most recent eruption probably was in 1786. Evidence for this eruption, recorded from sea by the explorer La Perouse, is somewhat ambiguous, but his description could only have referred to Mount Shasta. (This description has been the subject of debate lately.) A small craterlike depression in the summit dome, containing several small groups of fumaroles and an acidic hot spring, might have formed during that eruption; lithic ash preserved


Mt. Shasta

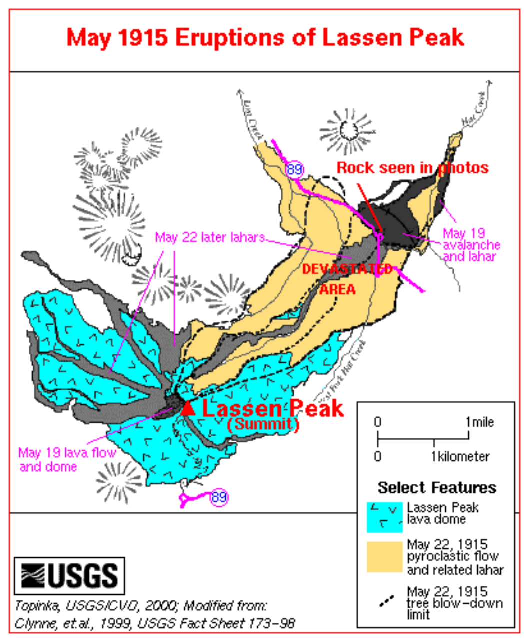
on the slopes of the volcano and widely to the east yields charcoal dates of about 200 years. -- *Christiansen, 1990, IN: Wood and Kienle*

Three episodes of volcanism have occurred at the Lassen volcanic center in the past 1,100 years. These are the complex eruption at Chaos Crags, the eruptions at Cinder Cone, and the summit eruptions of Lassen Peak in 1914-1917. -- *Clynne, 1990, IN: Wood and Kienle*

The most recent eruptive activity occurred at Lassen Peak in 1914-1917 A.D.. This eruptive episode began on May 30, 1914, when a small phreatic eruption occurred at a new vent near the summit of the peak. More than 150 explosions of various sizes occurred during the following year. By mid-May 1915, the eruption changed in character; lava appeared in the summit crater and subsequently flowed about 100 meters over the west and probably over the east crater walls. Disruption of the sticky lava on the upper east side of Lassen Peak on May 19 resulted in an avalanche of hot rock onto a snowfield. A lahar was generated that reached more than 18 kilometers down Lost Creek. On May 22, an explosive eruption produced a pyroclastic flow that devastated an area as far as 6 kilometers northeast of the summit. The eruption also generated lahars that traveled more than 20 kilometers down Lost Creek and floods that went down Hat Creek. A vertical eruption column resulting from the pyroclastic eruption rose to an altitude of more than 9 kilometers above the vent and deposited a lobe of pumiceous tephra that can be traced as far as 30 kilometers to the east-northeast The fall of fine ash was reported as far away as Elko Nevada, more than 500 kilometers east of Lassen Peak. Intermittent eruptions of variable intensity continued until about the middle of 1917. -- *Hoblitt, et.al., 1987*

7.5.8.3 __Future Events__

According to the 1995 Woodward-Clyde study commissioned by the City of Redding, the potential for impact from either Mount Shasta or Lassen Peak eruptions are minimal. Due to the upper wind currents and geographical locations ash from either of these two mountains will not likely impact Redding. It is noted in this study that debris flows from a Mount Shasta eruption would follow river valleys such as those occupied by the Sacramento River, Squaw Valley River, and the McCloud River to the south and the Shasta River to the north. This debris flow hazard zone terminates where the tributaries enter Lake Shasta and would be unlikely to overflow Shasta Dam. Redding lies outside the flowage hazard zones associated with Mount Shasta and the City is not likely to be threatened by future eruptions, according to the 1995 study.



7.5.8.4 __Present and Future Mitigation Efforts__

Due to the low probability of a catastrophic eruption from either of these two mountains impacting the City of Redding, it is our recommendation to monitor the situations and develop a plan when and if such events would occur.

7.5.8.5 __Vulnerability__

The City of Redding faces a low probability of impact from eruptions occurring at either Mount Shasta or Lassen Peak.

7.5.8.6 __Mitigation__

Goal 16: Reduce deaths, injuries, structural damage and losses from volcanic activity.

Objective 16.A: Minimize future deaths, injuries, structural damage and losses due to volcanic activity.

Action 16.A.1: Monitor the situations and develop a plan when and if the probability of volcanic activity increases to a level of significance.

7.6 INVENTORY ASSETS

An inventory of assets is a step in the risk assessment process. This is the identification of assets that may be affected by hazard events. The inventory of assets is divided into population, buildings, and critical facilities and infrastructure. The detailed information on these identified assets have been provided in Section 6: Community Description. The information was from various sources, including the US Census Bureau and the Red Cross.