III. Community Vulnerability Assessment

Based on the *Hazard Identification and Analysis* conducted for El Dorado County, the hazards listed below have been chosen for inclusion in a vulnerability assessment.

- **Wildfire**
- **Floods**
- **Dam Inundation**
- **Seiche**
- **Earthquakes, Sinkholes and Landslides**
- **Winter/Seasonal Storms**
- **Erosion**
- **Avalanche**

The above hazards were chosen from the previous sections due to the higher level of risk for these hazards compared to others and the impact these hazards may have on the county's infrastructure. It is important to note that this risk assessment is based on best available data and represents a base-level assessment for the planning area. Additional work will be done on an on-going basis to enhance, expand and further improve the accuracy of the baseline established here.

Methodologies Used

To drive the risk assessment effort, information was gathered from the public, and various U.S. and local website databases, County files, current County hazard mitigation plans, the County General Plan and local newspaper archives. This information was then analyzed for the potential hazards that exist, our vulnerability, and what can be done to prevent, and or mitigate the threats that exist.

It should be noted that the determinations presented in this section with regard to vulnerability were developed using best available data, and the results are an *approximation* of risk. These estimates should be used to understand relative risk from hazards and the potential losses that may be incurred; however, uncertainties are inherent in any loss estimation methodology, arising in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment and also from approximations and simplifications that are necessary in order to provide a comprehensive analysis.

Explanation of GIS-based Risk Assessment Methodology

The general steps used in the GIS-based assessment are summarized below:

- The first step in conducting this facet of the risk assessment consisted of GIS data collection from local, state and national sources.

- Primary data layers include past disaster losses involving OES, Cal EMA and FEMA, and various geo-referenced point locations and line files. For floods and winter storms risk was assessed by using the GIS data and calculating the total structural value of all of the infrastructure, roadways and transportation related structures estimated to be at risk. The structural values were estimated for a typical mile of roadway in El Dorado County from a combination of files and current construction cost tables. The losses were determined by applying that data to the estimated number of miles lost during a flood, or other event and annualized.

- A similar process to that described above for floods was followed to address the hazard of dam failure and subsequent inundation and landslides. The area of potential inundation was determined using the inundation maps the State of California requires owners or operators of larger dams to prepare. The maps were submitted to the Office of Emergency Services (OES) and forwarded to the County Emergency Services Coordinator. Those maps were combined into one and overlaid with the transportation system structures to determine structures within the inundation zones (Figure 111-10 on page 13 of this section). The risk of inundation damages was then calculated similarly the process outlined for flood events.

- For volcano, erosion hazards, sinkholes and avalanches, meaningful historical data (meaning data which would have included roadway damages and other essential indicators) was virtually non-existent, and therefore annualized potential losses for these hazards are assumed to be negligible.

Explanation of Hybrid Approach

As described in the preceding commentary, the quantitative assessment focuses on potential loss estimates, while the qualitative assessment is comprised of a scoring system built around values assigned by the Hazard Mitigation Advisory Committee to the likelihood of occurrence, spatial extent and potential impact of each hazard presented. For likelihood of occurrence, the following four options were available to members of the Mitigation Advisory Committee: Highly Likely, Likely, Possible or Unlikely. For spatial extent, three options were offered to describe the area which might be expected to be affected: Large, Moderate or Small. For potential impact, the choices consisted of: Catastrophic, Critical, Limited or Minor. Table 111-1 provides the criteria associated with each label.

Table 111-1. Criteria for Qualitative Assessment

	Assigned Value	Definition
Likelihood of Occurrence		
Highly Likely	3	Near 100% annual probability
Likely	2	Between 10 and 100% annual probability
Possible	1	Between 1 and 10% annual probability
Unlikely	0	Less than 1% annual probability
Spatial Extent		
Large	3	More than 50% of area infrastructure affected
Moderate	2	Between 10 and 50% of area infrastructure affected

Small	1	Less than 10% of area infrastructure affected
Potential Impact		
Catastrophic	4	High number of deaths/injuries possible. More than 50% of infrastructure, roadways and transportation facilities in affected area damaged or destroyed. Complete shutdown of facilities for 30 days or more.
Critical	3	Multiple deaths/injuries possible. More than 25% of infrastructure, roadways and transportation facilities in affected area damaged or destroyed. Complete shutdown of facilities for more than one week.
Limited	2	Minor injuries only. More than 10% of infrastructure, roadways and transportation facilities in affected area damaged or destroyed. Complete shutdown of facilities for more than one day.
Minor	1	Very few injuries, if any. Only minor infrastructure, roadway and transportation facility damage and minimal disruption on quality of life. Temporary shutdown of facilities.

The values assigned for each option chosen are added together for each hazard to arrive at a total score. All conclusions are presented in "Conclusions on Hazard Risk," found at the end of this section. Findings for each hazard are detailed in the hazard-by-hazard vulnerability assessment which follows, beginning with an overview of the planning area.

Overview of El Dorado County Vulnerability

El Dorado County is a political subdivision of the State of California established in 1850. The County is one of California's original 27 counties and it continues to have its County seat in its first and only location, the City of Placerville. It is located in the bend of eastern California. It is just 30 miles east of Sacramento, California's State Capitol and 40 miles west of Carson City, Nevada's State Capitol.

El Dorado County encompasses 1,805 square miles, located on the western slope of the mountain range known as the Sierra Nevada and is bordered to the east by the State of Nevada, to the north by Placer County, to the west by Sacramento County and to the south by Amador and Alpine Counties. The western areas of the county are made up of mostly rolling foothills. Eastern areas of the County are at higher elevations. The City of Placerville, the County seat, is about 2,000 feet above sea level. Portions of Lake Tahoe (the largest alpine lake in North America at 12 miles wide, 22 miles long and having 72 miles of shoreline) and approximately one million acres of national forest land make up the easterly section of El Dorado County.

El Dorado County has one U.S. route (U.S. Highway 50) and four other State Routes (State Routes 49, 89, 153, and 193). U.S. Highway 50 is the primary transportation facility in El Dorado County, providing connections to Sacramento County and the State of Nevada. It accesses nearly all of the recreation areas and tourist attractions for visitors to the County. U.S. Highway 50 is also the major commute route to employment locations in the greater Sacramento area and the major shipping route for goods movement by truck. It connects the County to Sacramento to the west, where it connects with Interstate 5, connecting to all other areas north and south, and to Interstate 80, which connects to San Francisco. To the east, the highway connects to Carson City and Reno, Nevada and areas east. The western half of its length in El Dorado County is four-lane freeway, except for a short distance in the

City of Placerville. The eastern half winds over the Sierra Nevada and becomes a city street in South Lake Tahoe, the County's largest city.

Other highways in El Dorado County include State Highway 49, the historical Mother Lode Highway of 49'er fame, which travels north connecting Placerville to Auburn, Grass Valley, and Interstate 80 traveling east. Highway 49 also connects Placerville south to the California Gold Country, and also provides an alternate connection to Interstate 5 traveling south.

State Highway 193 in El Dorado County connects the populated foothills north of Placerville to Highway 49 between Placerville and Auburn.

State Highway 89 connects South Lake Tahoe south to U.S. Highway 395 south to Los Angeles, and north along the western shore of Lake Tahoe toward Truckee and Interstate 80.

State Route 153 is a one-half mile long road that provides access from State Route 49 to the Marshall Monument in Coloma, and does not handle regional traffic.

TOPOGRAPHY AND LAND FORMS

Landforms within the County range from gently rolling foothills in the west to steep, jagged mountainous terrain in the east and along the canyons of the Carson, American, Mokelulumne and Cosumnes Rivers, which flow through the County. These landforms were derived from the uplifting of the Sierra Nevada Range from the Pacific Ocean, which once covered El Dorado County and most of California. Over millions of years, the water receded as the Sierra Nevada Range was uplifted from below. The original smooth, rolling mountains were transformed by volcanic action, glaciers and tumbling rivers into a series of broad sloping benches separated and deeply cut by river canyons and numerous tributary drainages. El Dorado County is within the Sierra Nevada Geomorphic Province. Elevations range from 200 feet, in the western valleys between the foothills, to 10,881 feet at some mountain peaks in the Sierra Nevada Mountain Range.

The County's three major rivers, the South and Middle Forks of the American, and the Cosumnes occupy deep canyons that drain west into the Sacramento Valley. Slopes along these river canyons are extremely steep with gradients of 60% to 100% and with banks rising as much as 1,000 to 2,000 feet above the riverbeds. Slopes on the broad areas between these major river canyons are moderately steep with gradients of 30% to 60%.

Five major kinds of geologic formations make up the County. Along the western part is a series of rolling grassy hills with metamorphic rocks. Slates, phyllites, and schists dominate with small localized areas of limestone and dolomite. Underlying the central and easterly sections of the County are the typical granitic rocks of the Sierras. Overlying these granitic rocks along the major ridges are volcanic breccias and flows. The volcanic rocks once covered most of the eastern portions of the County but have been mostly removed by subsequent erosion exposing the underlying granitic rocks.

Glacial deposits occur primarily above the 6,500 foot elevation but locally extend to as low as 4,000 feet occurring as veneers along the canyon walls of the rivers. Much of the glacial material has been reworked by rainfall flowing down the canyon walls.

Recent alluvial fill material occurs in basins in the glaciated areas and a few larger basin fill areas along the rivers. Many of the large river basin areas have been flooded by manmade reservoirs, such as Loon Lake, Union Valley, Ice House, and Brush Creek. Many small terraces and benches are found along minor stream courses; however, because the rivers occupy the entire stream course area in the canyon bottoms, few stable terraces are found there. There are also remnants of older Tertiary terraces, some of which were hydraulically mined for gold. From the Sierra Crest down to the 7,000-foot elevation, the mountains have been glaciated with significant amounts of granitic and volcanic rock outcrops interspersed with areas of glacial deposits left on ridges and canyon walls. Glaciation extended down the river canyons leaving the steep-sided, barren rocky gorges that are in evidence today.

The area from the 7,000-foot elevation down to 3,500 feet is dominated by coniferous forest of varied composition. There are also many narrow barren volcanic ridges, some isolated meadows and large areas of hardwood forests and shrub vegetation types.

Most of the area below 3,500 feet is rolling to hilly with numerous small drainages, many of them steep-sided. Vegetation in this area is a mixture of shrub types with scattered coniferous forest on the north and east slopes at the higher elevations and oak woodlands predominating at the lower elevations.

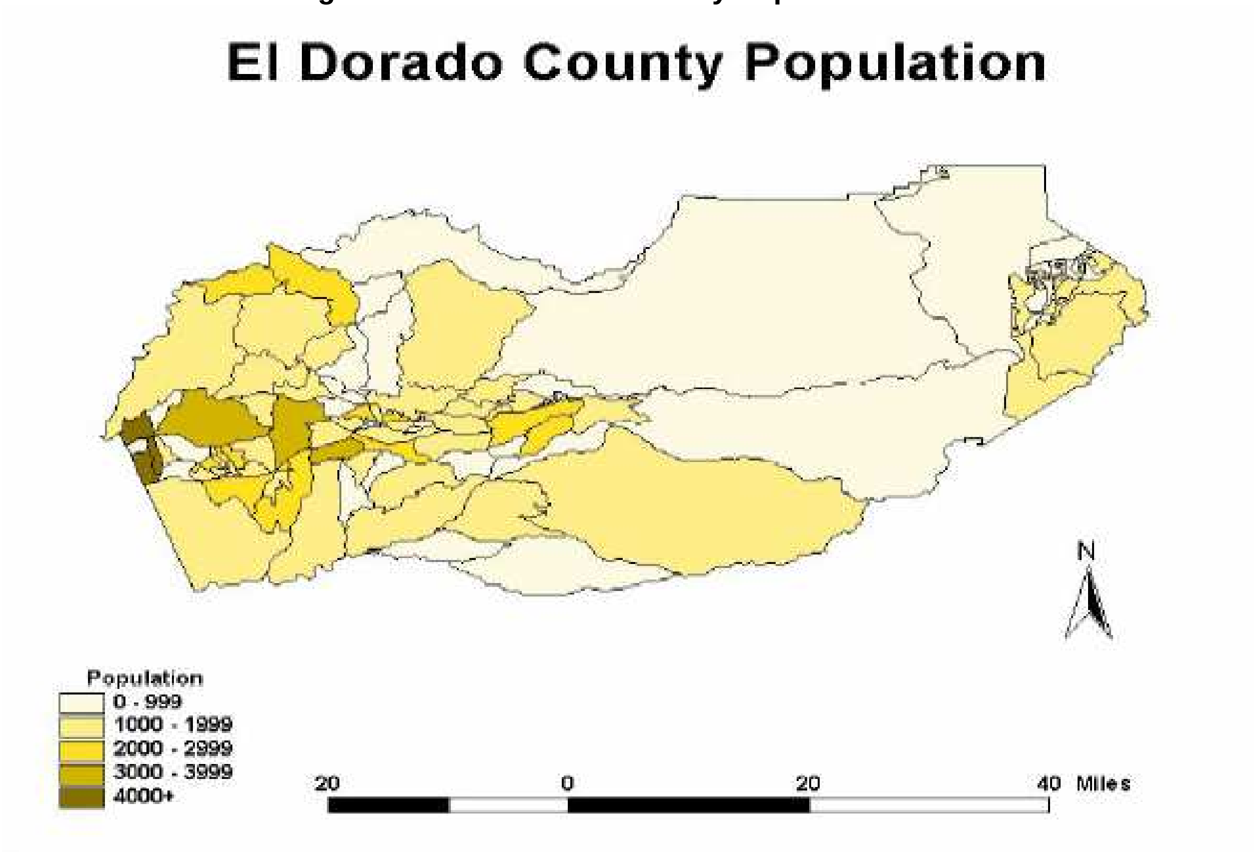
There is one fault zone on land under the County's jurisdiction, the Rescue Lineament-Bear Mountain fault zone. This fault zone cuts across the western end of the County trending north to south. However, there has been no appreciable movement in this fault and no record of damages sustained from events stemming from this fault. The next closest fault to El Dorado County is the North Tahoe Fault, which lies northeast of the County's border, beneath the surface of Lake Tahoe, trending east to west. Both of these faults' likelihood of occurrence rate is 0% placing them in the "unlikely" category in the Criteria for Qualitative Assessment.

The transportation infrastructure development capacity of El Dorado County is constrained by its geology, landform, and soils. These factors are used to determine the existence of steep slopes, fault zones, and soils unsuitable for road or transportation facility foundations.

DEMOGRAPHICS

According to the U.S. Census Bureau, the estimated population of El Dorado County on July 1, 2008 was 176.075. The population of El Dorado County has seen rapid growth within the last decade. Since 2003, the population has increased 5 percent, exhibiting a total growth rate of over 30% percent, or 42,000 people, with roughly 98 people per square mile, a 27% increase since 1991. Over 78% of the population lives in unincorporated areas outside of the city limits as shown in Figure 111-2. Keeping in mind that the more densely populated the area, the higher the demand for roadways and access to public transportation, resulting in a concentration of transportation infrastructures in these areas.

Figure 111-2 El Dorado County Population



DEVELOPMENT TRENDS

Since the early 1980's, El Dorado County has been included in the Sacramento Metropolitan Statistical area. Major residential communities (El Dorado Hills, Cameron Park, and Shingle Springs) in the western part of the county serve as suburban areas to the booming Sacramento metropolitan region. The unique environment and high quality of life in El Dorado County provide the "get away" lifestyle desired by employees and leaders of the region's new and expanding businesses.

El Dorado County's quality of life and proximity to Sacramento have resulted in rapid growth over the past 20 years. Total population nearly doubled between the 1970 and 1980 census years, then nearly doubled again by the 1990 census. Population growth of approximately 3.5% annually is projected into the 21st century.

Studies show that 78.2% of population increases since 1980 is due to the overall growth of the Sacramento Region with the majority of the growth in El Dorado County occurring in the El Dorado Hills/Cameron Park area. As transportation services and housing opportunities increase, this trend is expected to continue.

The General Plan directs future growth in areas contiguous to existing communities or development, or within logical in-fill areas. None of the future new growth areas are directly affected by the known hazards of flooding or dam inundation. The more generally distributed hazards such as storms or earthquakes cannot be avoided totally with planning growth in specific areas, due to the pervasive nature of those hazards within El Dorado County. Wildfire in particular is considered by the General Plan, which for the most part directs significant dense growth to areas of the County in lower elevations where the vegetation density and relative wildfire hazards are somewhat reduced.

LAND USE

El Dorado County features a large geographic area consisting of approximately 1,144,480 acres, stretching from 30 miles east of Sacramento in the west to the Nevada state line in the east. The County is located on the western slope of the Sierra Nevada mountain range. Of the 1,155,000 total acres, approximately 534,000 acres are National Forest or other lands under Federal jurisdiction (see Figure 111-3). An additional 27,181 acres are owned by other public agencies including 9,751 acres which are State Lands (see Figure 111-4) with the remaining acreage held by other local agencies. The remaining 583,299 acres are primarily privately held and subject to typical residential, commercial, or industrial development which would therefore require transportation infrastructure for continued development. The County's transportation system is primarily focused around the roadway network. Most in-county travel is in automobiles because low-density development patterns have limited the viability of facilities or services related to transit, bicycles, and pedestrians. For purposes of this plan, those are the properties that are considered "developable" and therefore would require development of transportation and infrastructure to match the projected growth.

Figure 111-3. Location of Public Held Lands in El Dorado County

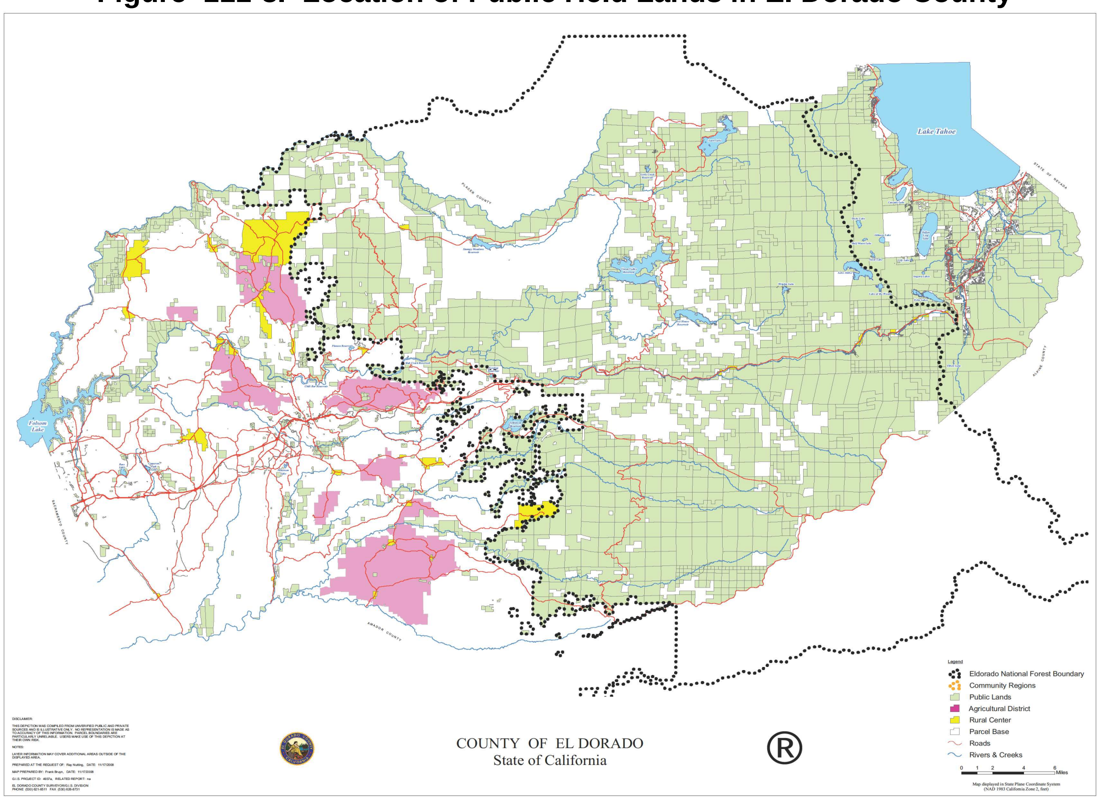
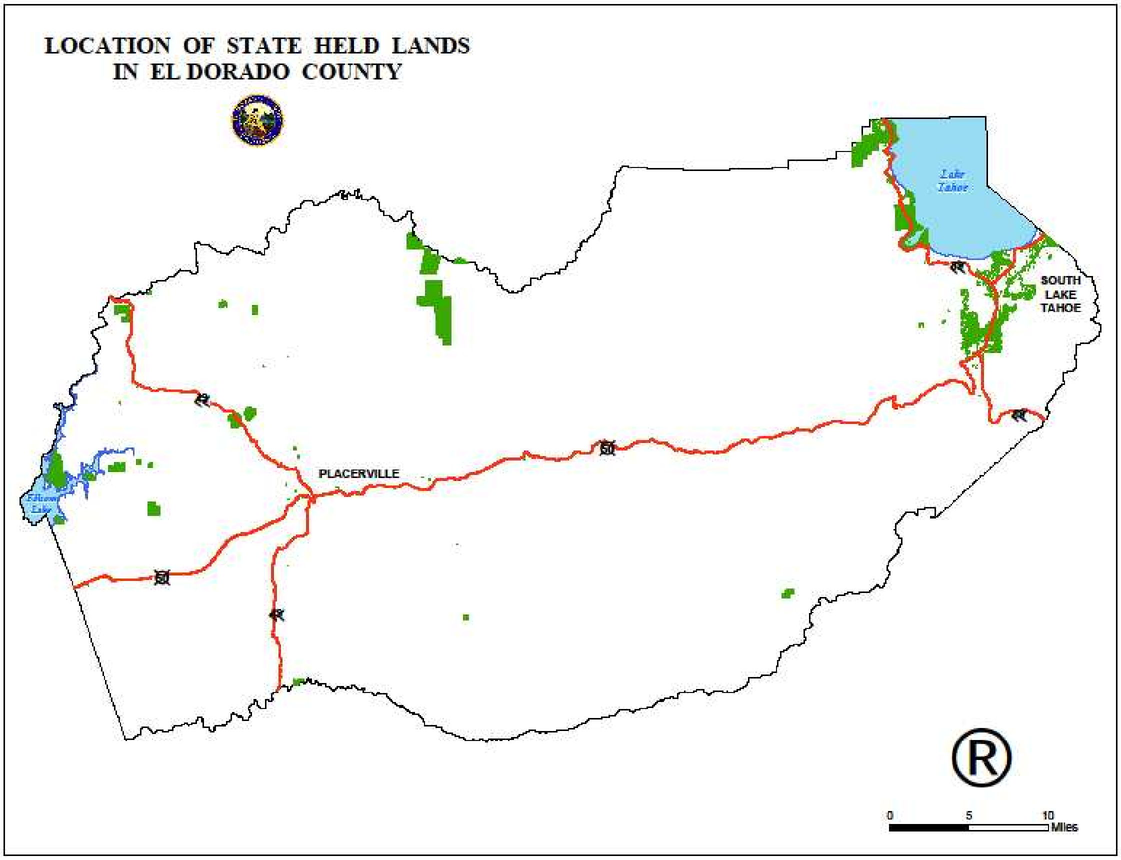


Figure 111-4. Location of State Held Lands in El Dorado County



COMMUNITY ORIENTATION

The following graphic, Figure 111-5, shows the general orientation of communities within El Dorado County. The original settlement pattern reflected the location of the sources of gold or other resources that the settlers came to exploit, and the current arrangement of communities in large part reflects that history. A more complete discussion of the historic settlement of El Dorado County is found in the following section "Historical Resources." All of the various communities are connected by and therefore reliant upon County roadways for commute purposes. According to the 2000 Census, almost 90 percent of all trips from home to work by County residents were made by automobile.

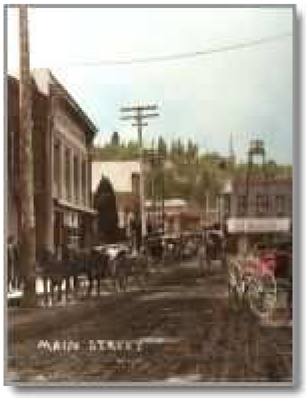
Figure 111-5. Location of Communities in El Dorado County

HISTORIC RESOURCES

According to history books, the Miwok & Maidu Indian tribes split the southwestern portion of what is now El Dorado County. The Maidu tribe had vast territories to the north, their 74 villages stretched roughly from the Nevada state line, over the mountains and down into the foothills of El Dorado County, while the Miwok went south with a small band along the Pacific coast, west of El Dorado County. The County's indigenous peoples, the Central Sierra Maidu arrived between 2000 and 600 years ago. The most visible remnants of the County's past are found in its Gold Rush Era buildings and artifacts dating from 1848, however the County's rich heritage also is well-grounded in its lumber, railroad, and transportation development past. .

With this rich heritage, the County is, like many Central Sierra counties, home to numerous resources which are both concentrated along old, historic Main Streets and scattered throughout the hills, valleys, mountains and waterways of the County's public and private lands. The following graphic list shows some of the areas in El Dorado County that contain a significant number of historic structures, most occupied and used for residences, businesses and offices. Access to all of these historic sites is dependent upon the transportation infrastructure of El Dorado County.

Partial Graphic Listing of Historic Sites in El Dorado County



Placerville, California c. 1900

Placerville, the County Seat, is a charming California "gold rush" town named after the placer gold deposits found in its riverbeds and hills in the late 1840's.

Gold Discovery Site, Coloma
Sutter's Mill

Actual site of the gold discovery in California on January 24, 1848.

Historic Strawberry Lodge

Along the banks of the cascading American River on Highway 50, this historic lodge, dating back to 1858, was once a stop for the Pony Express.

The Tallac Historic Site "Valhalla"

The Tallac Historic Site, often referred to as "Valhalla," includes 74 acres of secluded woods and over a quarter of a mile of south shoreline on Lake Tahoe between Emerald Bay and Camp Richardson. It is listed on the National Register of Historic Places. Far from the crowds and gambling, the Tallac Historic Site is home to the archeological remains of the Tallac Resort and three large summer estates built by wealthy San Franciscans in the late 1800's and early 1900's. The Tallac Resort includes three estates, all of which are open to the public.

Pearson, the Ice Merchant

John McFarland Pearson was an early Placerville businessman who emigrated from Scotland in 1852. He got his start as an ice merchant cutting ice from mountain lakes and the American River near what is known today as Riverton and Ice House Road. Pearson would haul ice into town by horse and wagon, and then sell the ice blocks to the town's people.

In 1859, Pearson built the Pearson Soda Works building at 594 Main St. where it still stands today.

The building has several interesting features; like a 135-foot abandoned mining tunnel carved into the hill behind the building that served as a cooler. It also has iron doors that help support part of the upper floor, and a water driven elevator that once transported the heavy cases of soda from the bottling room to the storage areas.

The threat from hazards to the transportation structures and systems that provide the public access to these cultural resources is relatively easy to define and quantify, however, the loss of revenue, were the public to be unable, due to transportation system failure, to visit these historic sites, would be difficult to define, and probably impossible to quantify. Since the transportation infrastructure is vital to the tourism industry. This particularly applies to historic transportation structures, such as “No Hands Bridge” (Figure 111-6), which can be damaged or destroyed by natural hazards, in particular earthquakes, landslides or floods. The historic structures were constructed long before modern codes that require seismic reinforcement. A major earthquake could cause substantial loss of these types of structures throughout the County. As the historic structures are, for practical purposes, irreplaceable then rebuilding after such a disaster would result in new structures that would not have the same character and the same value as the historic resources.

"Mountain Quarry Bridge", "Railroad Bridge”, and finally the name, "No Hands Bridge," which it is known by today, was initially built by the Pacific Portland Cement Company to accommodate trains servicing an upstream rock quarry. It was the first concrete bridge of its kind in North America.

"No Hands" Bridge (Figure 111-6)

The bridge was completed on March 23, 1912, by 600 men working on the Placer County side and 200 more on the El Dorado side for $300,000. At the time of its construction, the bridge was the longest concrete arch bridge in the world.

High Potential Loss to Transportation Infrastructures and Critical Facilities

El Dorado County has inventoried high potential loss transportation infrastructures within the County along with critical facilities such as transportation maintenance sites and public transit facilities. These facilities are considered to be of special value and/or significance, and are considered as a default to be generally at-risk from such hazards as earthquakes and winter storms. Table 111-7 lists these facilities along with a total number in the County's inventory that are assumed to be at-risk from most general hazards.

Table 111-7. High Potential Loss Transportation Infrastructure and Critical Facilities

Type	Total Number in Inventory
Regional Roadway System – Miles of Roadway	1075
Bridges	93
Box Culverts	141
Public & Commercial Bus Transportation Systems	1
Airports – County owned/maintained	2
Park-and-Ride Facilities	14
Transportation Facilities & Maintenance Yards	7

Critical Transportation Related Facilities

The El Dorado County Department of Transportation's facilities are critical for response to hazards, or for circulation and access for others to respond to disaster events, or are in some way vulnerable to the hazards being evaluated.

The seven main Transportation facilities and yards house the principal assets of the County Transportation Department for road maintenance, and are used for a variety of storage, repair, crew functions and administrative services. They include significant storage areas for equipment and supply stockpiles, as well as crew quarters, garages and other structures.

Another group of critical assets are the bridges on County-maintained roadways spanning the rivers and streams in the County. The most significant bridges and larger culverts are considered critical, all of which are susceptible to damage from hazards such as winter/seasonal storms, flooding, and earthquakes.

Still another group of critical transportation facilities are the areas airports and bus stations. Not only the facilities themselves but the roadways giving access to them would be critical for the residents of El Dorado County during any disaster event.

Wildfire

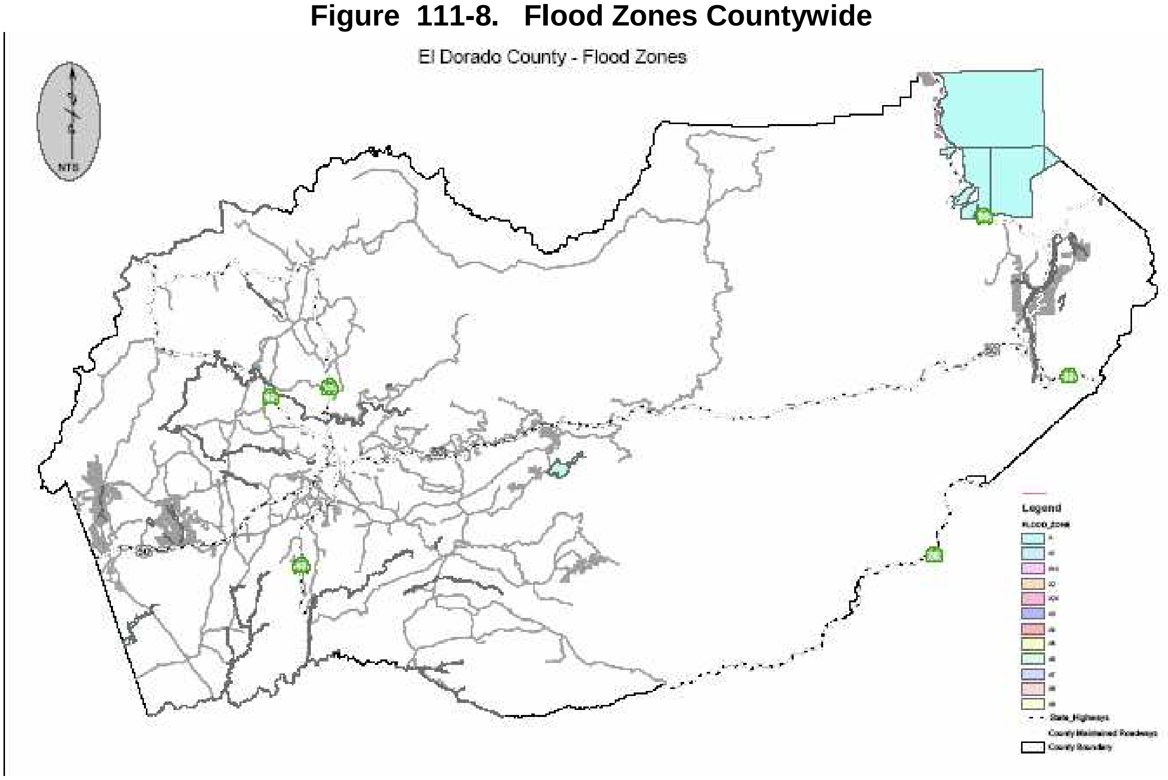
The threat of wildfires to the counties infrastructure along with the likelihood of occurrence is such a high risk that an entire section was devoted to this hazard.

See section titled "Wildland Fire Hazard Mitigation Plan" submitted by the El Dorado County Fire Safe Council and AEU CAL FIRE for a comprehensive assessment of this hazard.

Flood

The vulnerability assessment for flooding in El Dorado County is based on a detailed GIS analysis utilizing data from FEMA and data provided by the County. The FEMA data are based on the current Flood Insurance Rate Maps (FIRM). Figure 111-8 shows a graphic representation of the GIS files identifying flood zones on a countywide scale.

Figure 111-8. Flood Zones Countywide



It should be acknowledged that the FEMA provided FIRM maps and the GIS files based on that data are not fully complete. There are some portions of floodplains in the County that have never been mapped by FEMA and therefore are identified on the map sheets and data files as being outside of the 100-year flood zone. However, it is very likely that some of these areas, if analysis were done to clearly define the 100-year floodplain, would be vulnerable to flood hazards. However, lacking that, this exercise must rely on available data, meaning that the following statistics must be viewed with the limitations just described.

Flood/Dam Failure Inundation

The General Plan would have a significant impact if development would: place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or FIRM or other flood hazard delineation map; place within a 100-year flood hazard area structures that would impede or redirect floodflows; expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam; or result in inundation by Seiche or mudflow.

Impacts related to mudflows are addressed in Section IV of this Plan. Because the potential for seismic activities on the west slope of the county is low and development standards are required for buildings within the 100-year floodplain, Seiches are not expected to inundate any new development adjacent to lakes and reservoirs. As such, Seiches are not analyzed further in this subsection.

Risk of Exposure to Flood Hazards within the 100-Year Floodplain.

New development, including housing, could occur in the designated 100-year floodplain. The County's Flood Damage Prevention Ordinance contains development standards applicable to all development within the 100-year floodplain that protects development and occupants from flood hazards and prohibits redirection or obstruction of flood flow. The potential for exposure of people and property to flood hazards is low and new development in the 100-year floodway would not impede or redirect flood flows.

The land use map designates land uses within the FEMA 100-year floodplain. For purposes of this analysis, the General Plan land use designations have been categorized based on the maximum intensity of land use allowed by each of the General Plan land use maps, as shown below:

< **High intensity:** high-density residential, medium-density residential, low-density residential (i.e., lot sizes ranging from 5 to 10 acres), multifamily residential, industrial, commercial, research and development, public facilities, and the adopted plan.

< **Medium intensity:** tourist recreational, rural land, rural residential (i.e. lot sizes ranging from 10 to 40 acres), and agricultural land.

< **Low intensity:** natural resources and open space. In general, these are areas expected to continue to function largely as undeveloped open space areas.

Within the 100-year floodplain, the risk of exposure to flood conditions would be the greatest in areas designated as high-intensity land uses, because the highest amount of development and thus the greatest number of people would be exposed to flood hazards. Medium-intensity land uses would result in the exposure of less development and fewer occupants to flood hazards; thus the risk is reduced correspondingly. Very few structures and occupants would be expected in the low-intensity land uses areas; thus the risk is the least in these areas. The Table below shows the acreage in each category.

Designated Land Use Intensity Within the 100-Year Floodplain
General Plan Acreages of Various Intensity Land Uses
1996 General Plan

High	Medium	Low	Total
2,026	2,202	3,875	8,103

The acreage reflected under each of the land use intensity categories contains both developed and undeveloped lands. Development in the 100-year floodplain may be subject to property damage and occupants to injury or death caused by flood conditions during an 100-year flood event. Also, if critical emergency response facilities, such as hospitals, are constructed within the floodplain, the ability of the County to respond to emergencies during a flood event may be compromised.

Flood hazards may be averted by requiring new development to incorporate design measures that would protect structures and occupants from flood-related damage. Such hazards may also be averted by prohibiting certain types of development within the 100-year floodplain. The County's Flood Damage Prevention Ordinance has incorporated various requirements into the County Zoning Ordinance that are applicable to development within the floodplain. Building permits, which are required for both discretionary and ministerial development, are reviewed for consistency with the Flood Damage Prevention Ordinance before construction or development begins within the FEMA-designated 100-year floodplain (FEMA Flood Hazard Zones A and A1-30).

Developments within the floodplain are required to comply with development standards designed to minimize onsite flood damage. Within the floodplain, new construction and substantial improvements to existing structures require that the lowest floor be elevated above the 100-year flood elevation. New nonresidential buildings must either meet these requirements or provide an alternative method of flood-proofing that is certified by a registered architect or engineer and approved by the County Building Department. In all areas within the 100-year floodplain, compliance with specialized standards of construction are required, including anchoring of all new construction and substantial improvements, the use of materials and equipment resistant to flood damage, and the use of methods and practices that minimize flood damage (e.g. watertight doors, reinforcement of walls, anchoring of structures, and accessory items).

The Flood Damage Prevention Ordinance places even stricter standards on development within the floodway. Rivers and streams where FEMA has prepared detailed engineering studies may be designated as floodways. For most waterways, the floodway is where the water is likely to be deepest and fastest. It is the area of the floodplain that should be reserved (kept free of obstructions) to allow floodwaters to move downstream. Placing fill or buildings in a floodway may block the flow of water and increase flood heights (FEMA 2003). The ordinance requires engineering studies to demonstrate that any proposed structures or substantial improvements to existing structures would not increase the flood elevation before such structures or improvements may be permitted within the floodway

AT-RISK STRUCTURES

A GIS analysis was accomplished by comparing the FEMA FIRM mapping locations with the El Dorado County's Department of Transportation maps indicating location of roads, bridges, culverts and facilities and other related data. The datasets were compared in order to ascertain the total number of transportation structures that at least partially within the floodplain, and the number that are identified as being within the floodplain. An “annualized” estimate was created by multiplying the number of structures estimated to be within the 100-year floodplain by the typical value of a structure, and dividing that by 100. This is the typical method used to annualize potential flood risk, as used by the US Army Corps of Engineers in estimating benefits of proposed flood control projects. These benefits are then used in a cost/benefit study of a proposed flood control project, which would assumedly remove or lower the risk of flooding. In the case of this analysis, the object is to simply create an annualized risk for flood damage to transportation structures.

This same process was used to identify developed properties that may be impacted by flooding. Flood GIS data was compared with Assessor data files to identify the number of structures within a 250 ft buffer zone of the 100-year floodplain. There were a total of 1547 parcels identified within the buffer zone with a total value of $492,863,915.

The results of this analysis are presented in Table 111-9, which follows:

Table 111-9 Overview of At-Risk Transportation Structures in El Dorado County (100-Year Floodplain)

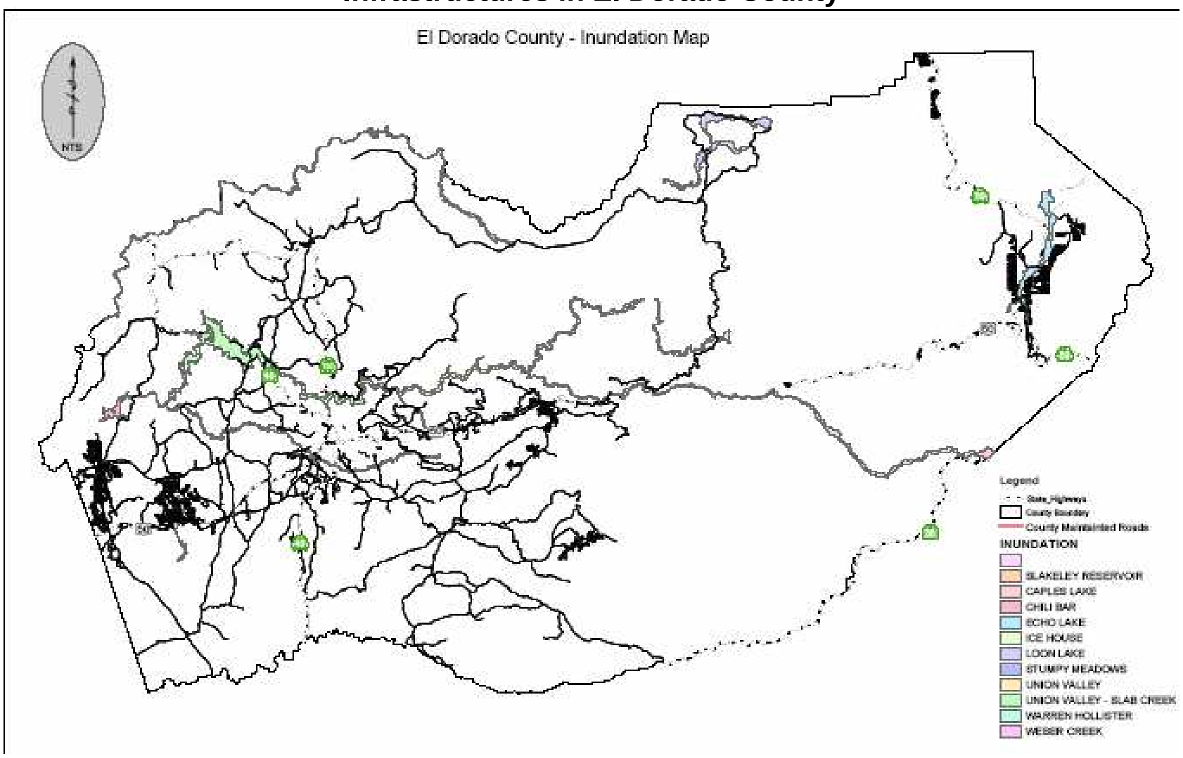
Total Number of Roadway miles with some portion within the 100 year floodplain	7.27
Total Number of Bridges within the 100 year floodplain	7
Total Number of Transportation Maintenance Facilities/Yards within the 100-year floodplain	0
Total value of potentially affected structures	$805,123.46
Annualized Loss Estimate	$8,051.23

Dam Failure/Inundation

The vulnerability assessment for dam failure in El Dorado County is based on a detailed GIS analysis utilizing data from dam operators and data provided by the County. Dam operators are required to prepare dam failure inundation maps by the State Office of Emergency Services (OES) for any dam where potential flooding in the event of partial or total failure of any dam that would result in death or personal injury. The OES has the responsibility to distribute inundation maps for these areas, and the maps are to be kept on file with the OES and the State Department of Water Resources. A notice is to be posted at the County Recorder's Office, County Assessor's Office, and County Planning Agency that identifies the location of the map and any subsequent information received by the County regarding changes to the inundation areas. The El Dorado County Community Development Department maintains copies of the inundation maps for use by realtors and property owners in determining natural hazard disclosure items for properties up for sale.

The inundation maps compared to the Transportation and Circulation maps derived from the Department of Transportation’s files, to determine which inundation areas actually affected transportation infrastructure, or which could be developed requiring new transportation infrastructure (areas owned by government agencies such as the El Dorado National Forest or one of the reservoir-owning irrigation districts were not counted). Those dams with inundation areas that affected no County maintained transportation structures were not analyzed any further. Figure 111-10 reflects the dams and their inundation zones considered to have the potential to affect El Dorado County transportation systems.

Figure 111-10. Dams and Their Inundation Areas That Affect Transportation Infrastructures in El Dorado County



The process was similar to that carried out for FEMA flood zones in the section of this document concerning flooding. All of the developable transportation areas that fell within the inundation zones were counted, along with those containing transportation structures at the present time within the actual inundation zone. An estimate of 75% was used to predict the total number of structures at risk to inundation from any of the dams based on the probability that 75% of all transportation structures would be lost. Engineering criteria for design are based on the maximum anticipated load, including a flood occurrence of a 10,000-year event, and an anticipated seismic event of 7.5 on the Richter Scale.

Assuming the anticipated seismic event has a similar interval of 10,000 years, these factors were used in determining the annualized risk, ie. it is likely that a dam failure would happen once every 10,000 years.

The following table 111-11 shows the results:

Table 111-11. Results of Potential Dam Inundation Analysis

Total Transportation Dept structures that fall within a Dam Inundation Area	75% of Structures that are Potentially Affected	Value of Structures at Risk of Dam Failure Inundation	Annualized Risk based on 1/10,000 Threat of Dam Failure
41	**30**	**$ 4,644,597.26**	**$ 464.45**

Seiche

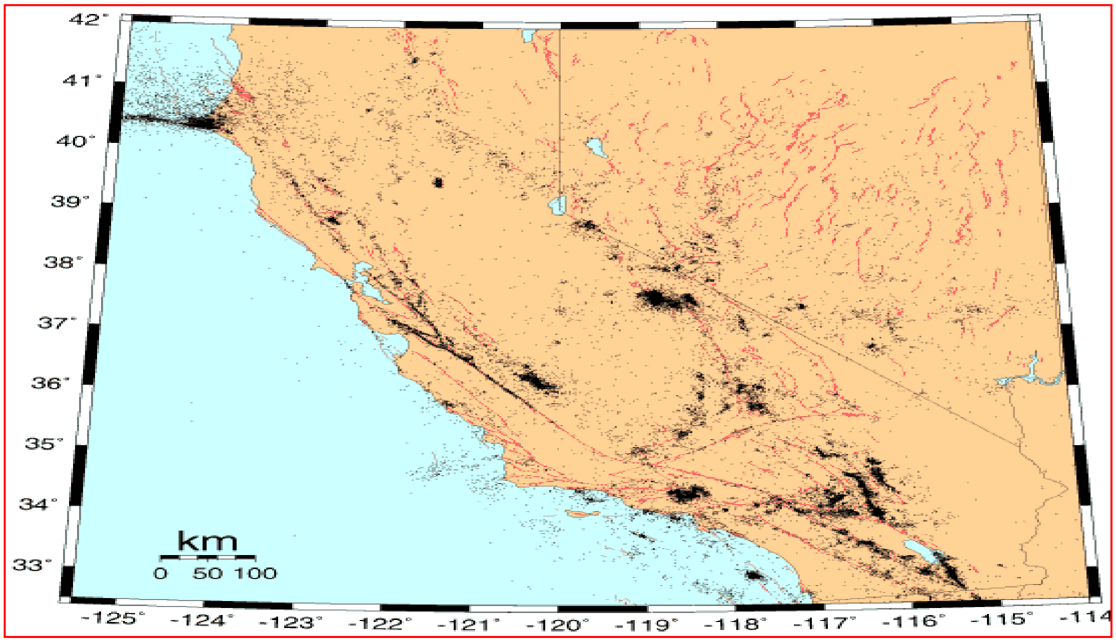
The risk for a Seiche wave for the area is considered to be unlikely, with a less than 1% per year chance of occurring. In the event of a Seiche wave the area affected, depending on the severity would be limited to infrastructure within the Tahoe Basin area.

Earthquakes, Landslides and Sinkholes

EARTHQUAKES

The risk for earthquake for the area, as well as potential losses due to earthquake impact, is considered to be low relative to much of California. As indicated by the seismic activity map, Figure 111-12, the region of the state where El Dorado County is located, just east of Lake Tahoe, seldom suffers the effects of even a 2.5 magnitude earthquake. Earthquakes of that magnitude do little to no damage to transportation structures.

Figure 111-12 Recorded seismicity in California 1969 - 2000, Magnitude 2.5 and larger.



The above attempts to quantify the annual risk vulnerability to earthquakes but does not take into account the possible impacts to historic transportation structures that are particularly vulnerable. Although rare, if the County were to endure a seismic event of the larger variety, it might very well damage or destroy historic transportation structures. Having been built prior to modern code requirements, those structures are generally lacking the reinforcement and other provisions included in the structural design of modern transportation, leaving them more vulnerable to earthquake hazards. It is not practical to attempt an estimate for those structures, as they cannot be replaced.

SINKHOLES

There are no known incidences where structural damage has occurred due to the formation of natural sinkholes in the County. Based on the available evidence, classic sinkholes as a result of solution of limestone rock are not considered to be a hazard of consequence to El Dorado County.

Subsidence as a result of previous underground mining activity could prove to be consequential in portions of El Dorado County where significant underground mining activity has occurred. Most of the underground mining happened in the areas of the County that overlie the Mother Lode gold veins, or in "pocket" mine areas of isolated gold ore that are found to the east of the Mother Lode. Fortunately, most of the mined areas have not been substantially developed, so if subsidence occurs then the losses should be minimized to a few roadways. However, portions of the City of Placerville are underlain by mine workings, and the threat could be more significant in that location.

Without an historical record of failures or damage associated with subsidence, an approach to attempt to quantify the hazard has not been identified. Therefore, the annualized losses for sinkhole hazards are considered to be negligible, and the annualized losses for subsidence are unknown.

LANDSLIDES

As discussed in the Hazard Identification and Analysis Section II, there have been rare occurrences of landsliding or general instability in El Dorado County. Most of these have been in the higher elevations, along the South Fork of the American River, on the Highway 50 corridor, in eastern El Dorado County. Comprehensive mapping of these isolated areas that may have experienced landslides or are prone to experience landslides in the future has yet to be completed.

However, on January 24, 1997, after a long period of heavy rains, tons of earth gave way down a steep Sierra Nevada canyon slope and slid onto U.S. Highway 50. The since named Mill Creek landslide closed U.S. Highway 50 and briefly dammed (5 hours) the nearby South Fork of the American River, about 25 miles east of Placerville in El Dorado County. Highway 50, although a major transportation route through El Dorado County, is a State maintained highway. Therefore, the financial burden for cleanup, debris removal and road repairs of approximately $4.5 million dollars, fell to Caltrans. The indirect costs to the area residents along with the Tahoe Basin which relied heavily on tourists is estimated at being more than 1 million dollars a day, for the month period that the road was closed.

Many other large landslides along this corridor of the South Fork of the American River have moved in the geologic past, and some may impact Highway 50 in the future. Although most slides in this canyon are dormant during dry times, they typically become active during or following extended periods of rain or snow melt due to increased ground-water pressures. These elevated pressures, in turn, reduce the overall strength of the slope and induce down slope movement. Many landslides along the corridor move slowly, traveling perhaps only a few inches over many days. Occasionally, however, a landslide will move rapidly, traveling hundreds of fee in a matter of minutes, as did the Mill Creek landslide. Another occurrence upriver in 1983 closed the highway for 75 days, again however, with Highway 50 being State maintained, other than the economic losses from the highway closure; El Dorado County suffered no substantial loss.

Prior to the installation of monitors, landslide movement patterns and associated hydrologic conditions along Highway 50 were not systematically measured. During the wet winter of 1996, U.S. Forest Service geologists observed ground cracking in the hill slope that would later become the Mill Creek landslide. These field observations, however, were not sufficient to indicate that sudden and rapid movement would occur the following year.

Soon after the Mill Creek landslide, the USGS installed a real-time monitoring system at the nearby active Cleveland Corral Landslide. A real-time monitoring system provides near-continuous measurements on the hydrologic conditions and ground movement of the landslide. Data collected at such a continuous rate and in real-time will greatly increase the understanding of dynamic landslide activity and behavior in the Highway 50 corridor. The data will enable geologists to detect changes in landslide movement, monitor the rainfall and ground water conditions, and hopefully anticipate possible catastrophic movement at the Cleveland Corral landslide site.

The El Dorado County General Plan land use diagrams do not allow for any type of dense development in these mostly rural areas, so the possible hazards of sloughing or sliding of these slopes is not considered a potential hazard of any consequence. At this time, the overall hazard and potential losses from landslides is considered negligible.

Winter/Seasonal Storms

Winter and seasonal storms can affect large geographic areas and often impact multiple counties, or they can be very localized. The classic winter storm involves a cold front accompanied by strong winds, bringing low elevation snow to the mountains and foothills and rainfall to the lowest elevations. The snow and freezing rain brings down trees, which lay across roadways, causing snarls in traffic, and isolating communities. Other seasonal storms are a result of intense rainfall in certain areas (a storm “cell”), which overwhelm drainage systems and cause flooding of roads or bridge failures.

Although these events can happen in almost any part of the County, it is difficult to assess the vulnerability of the County assets to this risk. Seasonal, localized flooding due to inadequate drainage or general development impacts occur in Cameron Park along the main drainage and street crossings, along various sections of Latrobe Road near Deer Creek, and Pleasant Valley Road east of Gold Oak School. In addition, various locations in the County are occasionally subject to shallow flooding of streets which require sand-bagging to protect those facilities. Infrastructure damage, particularly damages to roadways, culverts, bridges, and other parts of the County road network are more common and difficult to predict due to the unknown location of future storm cell events. The 1997 heavy winter storms affecting the watershed regions of the Cosumnes and American Rivers resulted in the flooding of many communities in El Dorado County. This resulted in major infrastructure damages particularly damages to roadways, culverts and bridges.

Due to the nature of bridges and culverts, it can be assumed that many of those assets on County roads and State Highways would be at risk of flooding as they were during the winter storms that triggered major floods along the South Fork of the American and the Cosumnes Rivers.

A summary of transportation infrastructure damages from the 1997 winter storm related floods is as follows:

Debris Removal from Roads, Bridges & Culverts	$ 58,684
Placing of Signs & Barricades, Closing Bridges & Roads	10,278
Road & Embankment Repairs/Replacements	416,373
Road & Culvert Repairs/Replacements	163,605
Road, Shoulder & Guard Rail Repairs/Replacements	75,452
Road Repairs/Replacements (washout/erosion)	227,803
Road & Bridge Repairs/Replacements	1,152,433
Dept of Transportation Water Retention Pond Repairs	2,890
Total Approximate Costs	$2,107,518

There have been occurrences that were compounded by chains of events, such as an intense rainfall on top of snow cover in the watershed of the American and Consumes Rivers, as happened during the 1997 winter storm floods. However, other parts of the County infrastructure network affected by winter storms, not directly in these watersheds, are more common and difficult to predict due to the unknown location of future storm cell events.

Over the 10-year period form 1992 to 2002, there were two events that caused significant damages; storms in 1995 and 1997 both caused more than $2 million in damages. Although the sample period is very short, the annualized cost is estimated at $400,000. Potential losses may be further inflated by additional factors not represented in this estimate, such as removal of snow from roadways.

A qualitative facet of vulnerability in El Dorado County is the broad manner in which severe seasonal storms, particularly snowfall, causes general disruption. Normal mobility is lost, as roadways become clogged with accidents and vehicles stuck in snow or otherwise unprepared for winter's severe weather. Particularly for tourists and new residents, the lack of preparedness causes hardship for all and magnifies the difficulty of dealing with storms. Difficult to quantify on a gross scale, these impacts are significant and result in a high ranking for this hazard based on a qualitative understanding.

Erosion

As described in the Hazard Identification and Analysis Section, erosion is a natural function that moves soil material from higher points to lower points. In a county with areas of particularly steep gradient, it is expected that erosion will continue over time to reduce the slopes to lower and lower elevations. However, this normal function is so slow and incremental as to be imperceptible. This can change if the erosion functions are accelerated by events, predominantly human activities related to development and grading.

Grading and development usually only affects relatively small areas and the increased erosion as a result has a corresponding limited effect. Although the erosion gullies and sedimentation of improper grading or land clearing practices can be substantial locally, they usually do not cause widespread or long-term problems or economic impacts.

Wildfires can also eliminate the ground cover of plants that result in increased erosion. This is usually limited to the area burned, or the watershed that includes a burned area. However, some wildfires affect tens of thousands of acres, causing significant problems in that watershed, and resulting sedimentation runoff. Normal reseeding and planting processes after wildfires can reduce the impacts however, if erosion occurs that reduces the topsoil available for reestablishment of trees and vegetation as well as sedimentation downstream. As all of the watersheds in the County eventually end up in flat-water reservoirs, the sediment is normally deposited in the pool of a reservoir. The reservoir then has a reduced capacity and eventually will shorten the effective lifespan of the reservoir.

Because El Dorado County has minimal traditional cropland-style agriculture, there are no direct impacts of erosion related to tilling and farming as can happen with traditional field agriculture.

In general, erosion impacts from grading and development are typically on a very small scale and present no quantifiable vulnerability to the community. Nor does El Dorado County agriculture present a significant or quantifiable risk. Erosion and sedimentation as a result of denuded watersheds after wildfires could be a more significant hazard, but the economic impacts are either not available or clearly defined. With the exception of erosion caused by the 1997 Winter Storm Floods detailed earlier in the Winter Storm section of this document, the overall vulnerability of erosion as a hazard to the County is either negligible or currently undefined.

Avalanche

Avalanches can occur on any slope given the right conditions, however, certain times of the year and certain locations are more prone to avalanche than others. December to April is when most avalanches occur. This is the time when the snowfall amounts are highest in the mountain areas of El Dorado County.

Climbers, backcountry skiers, and snowmobilers are by far the most likely to be involved in avalanches. One of the major reasons for increasing avalanche fatalities is the boom in mountain industries and recreation. Skiing, hiking and other winter sports draw millions of people to the mountains. To support these activities, more roads are forced into avalanche prone areas. Most of the properties where these activities take place are either in Federal, State or privately owned lands. The overall vulnerability of avalanche as a hazard to the County is either negligible or currently undefined.

Conclusions on Hazard Risk

As explained in "Methodologies Used," a hybrid approach was employed to reconcile findings from both a quantitative assessment and a qualitative assessment (based on a scoring and ranking system scored by general consensus of the Local Hazard Mitigation Planning Committee). Table 111-13 summarizes the annualized expected losses for each hazard, which are a culmination of the quantitative assessment. The top hazard identified through this process is winter storms.

Table 111-13. Summary of Potential Annualized Losses (From Quantitative Assessment)

Hazard	Estimated Annualized Losses
Wildland Fire	Significant
Floods	8,051.23
Dam Failure	464.45
Earthquakes, Sinkholes and Landslides	Negligible
Winter Storms	421,503.60
Erosion	Negligible
Avalanche	Negligible

Based upon the qualitative approach defined in detail under Methodologies Used, the risk from natural hazards in El Dorado County was weighed by the Hazard Mitigation Advisory Committee and criteria was used to assign values to the likelihood of occurrence, spatial extent affected, and potential impact of each hazard. These values combined to form a total rating for each hazard (Table 111-14). The dominant hazard identified through this process is the wildfire hazard followed by the winter or seasonal storm hazard.

Table III-14. Hazard Risk Ratings (From Qualitative Assessment)

Hazard	Likelihood	Spatial Extent	Potential Impact	HAZARD RATING
Wildland Fire	3	2	3	**8**
Floods	2	2	3	**7**
Dam Failure	0	1	4	**5**
Seiche	0	1	2	**3**
Earthquakes, Sinkholes and Landslides	1	2	1	**4**
Winter / Seasonal Storms	3	3	2	**8**
Erosion	1	2	1	**4**
Avalanche	2	1	1	**4**

The conclusions drawn from the qualitative and quantitative assessments, combined with final determinations from the Hazard Mitigation Advisory Committee, were fitted into three categories for a final summary of hazard risk based on High, Moderate or Low designations (Table 111-15). The hazards identified with the highest risk through this process are the wildland fire, winter/seasonal storm and resulting floods. The next highest is dam failure, which is categorized as high, in that while it is highly unlikely to occur, the results would be catastrophic. The remaining four moderate risk hazards identified are, earthquakes / sinkholes, landslides, erosion, Seiche, and avalanche.

Table III-15. Estimated Risk Levels for El Dorado County (Combination of Qualitative and Qualitative Assessments)

HIGH RISK HAZARDS	Wildland Fire, Winter / Seasonal Storms; & resulting Floods;
MODERATE RISK HAZARDS	Dam Failure Earthquakes, Sinkholes, and Landslides; Erosion, Avalanche
LOW RISK HAZARDS	None Identified

It should be noted that although some hazards may show Moderate or Low risk, hazard occurrence is still possible. Also, any hazard occurrence could potentially cause a sizable impact and losses could be extremely high.

In conclusion, while El Dorado County's infrastructure is susceptible to a wide range of natural hazards to varying degrees, the hazard of Wildland Fire, Winter/Seasonal Storms and the resulting floods, is of the utmost, immediate concern to the County and its communities with regard to hazard mitigation practices and policies. This is further reflected in the *Mitigation Strategy* section of this Plan.