

4.6 GEOLOGY, SOILS, MINERAL RESOURCES, AND PALEONTOLOGICAL RESOURCES

This section describes the existing geology, soils, mineral resources, and paleontological resources in Amador County, and analyzes impacts associated with implementation of the Draft General Plan.

4.6.1 REGULATORY SETTING

FEDERAL PLANS, POLICIES, REGULATIONS, AND LAWS

The U. S. Department of Agriculture Natural Resources Conservation Service (NRCS) produces soil surveys that assist planners in determining which land uses are suitable for specific soil types and locations.

Earthquake Hazards Reduction Act

In October 1977, the U.S. Congress passed the Earthquake Hazards Reduction Act to reduce the risks to life and property from future earthquakes in the United States through the establishment and maintenance of an effective earthquake hazards reduction program. To accomplish this goal, the act established the National Earthquake Hazards Reduction Program (NEHRP). This program was substantially amended in November 1990 by the National Earthquake Hazards Reduction Program Act (NEHRPA), which refined the description of agency responsibilities, program goals, and objectives.

The mission of NEHRP includes improved understanding, characterization, and prediction of hazards and vulnerabilities; improved building codes and land use practices; risk reduction through post-earthquake investigations and education; development and improvement of design and construction techniques; improved mitigation capacity; and accelerated application of research results. The NEHRPA designates the Federal Emergency Management Agency as the lead agency of the program and assigns several planning, coordinating, and reporting responsibilities. Other NEHRPA agencies include the National Institute of Standards and Technology, National Science Foundation, and U.S. Geological Survey (USGS).

STATE PLANS, POLICIES, REGULATIONS, AND LAWS

California Geological Survey

The California Geological Survey (CGS) provides regulatory information pertaining to soils, geology, mineral resources, and geologic hazards.

CGS maintains and provides information about California's nonfuel mineral resources. California ranks second in the United States in nonfuel mineral production. In 2007, more than 30 nonfuel commodities were produced from 660 California mines (CGS 2008a). CGS also offers information about handling hazardous minerals and Surface Mining and Reclamation Act (SMARA) mineral land classifications. Information about CGS's role in the handling of hazardous minerals is provided in Chapter 4.8, "Hazards and Hazardous Materials." Information about SMARA mineral land classifications is provided directly below.

Surface Mining and Reclamation Act of 1975

The Surface Mining and Reclamation Act (SMARA, California Public Resources Code [PRC] Section 2710 et seq.) was enacted by the California Legislature in 1975 to regulate activities related to mineral resource extraction. The act requires the prevention of adverse environmental effects caused by mining, the reclamation of mined lands for alternative land uses, and the elimination of hazards to public health and safety from the effects of mining activities. At the same time, SMARA encourages both the conservation and the production of extractive mineral resources, requiring the State Geologist to identify and attach levels of significance to the state's varied

extractive resource deposits. Under SMARA, the mining industry in California must plan adequately for the reclamation of mined sites for beneficial uses and provide financial assurances to guarantee that the approved reclamation will occur. Lead agencies with permitting responsibility for proposed mining projects implement SMARA requirements.

SMARA also directs the State Geologist to classify lands in California into Mineral Resource Zones (MRZs), designated MRZ-1 through MRZ-4. The most important zone with respect to the presence of resources is MRZ-2, which is defined as “areas where adequate information indicates that significant mineral (aggregate) deposits are present or where it is judged that there is a high likelihood for their presence.” This zone is applied to known mineral deposits or where well-developed lines of reasoning, based on economic geologic principles and adequate data, demonstrate that the likelihood for occurrence of significant mineral deposits is high. MRZ-3 zones suggest the potential for deposits. This zone is less definitive than MRZ-2 and is defined as “areas containing mineral deposits the significance of which cannot be evaluated from available data.”

Alquist-Priolo Earthquake Fault Zoning Act of 1972

The Alquist-Priolo Earthquake Fault Zoning Act was passed in 1972 to mitigate the hazard of surface faulting to structures for human occupancy. The Alquist-Priolo Earthquake Fault Zoning Act only pertains to geologic hazards associated with surface fault rupture. This law does not pertain to any other geologic hazards. There are no Alquist-Priolo Earthquake Fault Zones in Amador County.

California Seismic Hazards Mapping Act of 1990

The Seismic Hazards Mapping Act of 1990 directs CGS to identify and map areas prone to earthquake hazards of liquefaction, earthquake-induced landslides, and amplified ground shaking. The purpose of the act is to reduce threats to public safety and to minimize loss of life and property by identifying and mitigating these seismic hazards. The Seismic Hazards Mapping Act was passed by the California Legislature after the 1989 Loma Prieta earthquake. There are no Zones of Required Investigation in Amador County (CGS 2009).

California Building Standards Code

The State of California provides minimum standards for building design through the California Building Standards Code (CBC, California Code of Regulations [CCR] Title 24). Information on current code requirements can be found on the California Building Standard Commission’s website (<http://www.bsc.ca.gov/>). The CBC applies to all occupancies throughout the state unless local amendments have been adopted, and includes regulations for seismic safety, excavation of foundations and retaining walls, and grading activities (including drainage and erosion control and construction on unstable soils).

The 2013 CBC became effective on January 1, 2014, and updated all the subsequent codes under CCR Title 24. The 2013 CBC uses Seismic Design Categories A through F (where F requires the most earthquake-resistant design) for structures designed for a project site. These Seismic Design Categories provide protection through “collapse prevention,” meaning that structures are designed to prevent collapse from the maximum level of ground shaking that could occur. Chapter 16 of the CBC specifies exactly how each seismic design category is to be determined on a site-specific basis depending on soil characteristics and proximity to potential seismic hazards.

Chapter 18 of the CBC regulates the excavation of foundations and retaining walls. This chapter describes the circumstances which require the preparation of a preliminary soil report, engineering geologic report, geotechnical report, and supplemental ground-response report. Chapter 18 also describes analysis of expansive soils and the determination of the depth to groundwater table. For Seismic Design Category C, Chapter 18 requires analysis of slope instability, liquefaction, and surface rupture attributable to faulting or lateral spreading. For Seismic Design Categories D, E, and F, Chapter 18 requires these same analyses, plus an evaluation of lateral pressures on basement and retaining walls, liquefaction and soil strength loss, and lateral movement or reduction in foundation soil-bearing capacity. It also addresses mitigation measures to be considered in structural design,

which may include ground stabilization, selecting appropriate foundation type and depths, selecting appropriate structural systems to accommodate anticipated displacements, or any combination of these measures. The potential for liquefaction and soil strength loss must be evaluated for site-specific peak ground acceleration magnitudes and source characteristics.

The Department of Housing and Community Development has adopted regulations implementing the State Housing Law in CCR, Title 25, for residential structures subject to the State Housing Law (installation of factory-built housing in mobile home parks). These regulations, the CBC, and the requirements of the State Housing Law, are applicable in all parts of the state.

Building standards in the CBC are adopted by the State Fire Marshal to provide protection from fire and other public safety objectives. These provisions are adopted as state law administered in part by local fire protection districts.

REGIONAL AND LOCAL PLANS, POLICIES, REGULATIONS, AND ORDINANCES

Amador County Code

Title 14, including Chapter 14.12 of the County Code, provides regulations concerning the installation and use of on-site sewage systems, including septic systems. This Chapter requires that all on-site sewage systems be installed in accordance with a permit approved by the County health department. When operation of an existing system could be a health hazard or nuisance, the County health officer has the authority to require changes to an existing on-site sewage system.

Title 15, including Chapter 15.04 of the County Code provides regulations for building, including adoption of the CBC (select provisions of which are described above). Chapter 15.40 includes regulations governing grading and erosion control, including engineering requirements, grading plans, and best management practices (BMPs) related to erosion.

Amador County Multi-Hazard Mitigation Plan

In 2014, the Amador County Office of Emergency Service (OES) updated the Hazard Mitigation Plan (HMP) which identifies potential long-term risks to people and property from natural hazards and their effects. The Plan lays out a strategy that will enable Amador County to become less vulnerable to future disaster losses. The HMP was prepared to meet the requirements of the Disaster Mitigation Act of 2000 to maintain Amador County's eligibility for FEMA Pre-Disaster Mitigation (PDM) and Hazard Mitigation Grant Programs (HMGP). The HMP covers unincorporated Amador County; the incorporated communities of Amador City, Ione, Jackson, Plymouth, and Sutter Creek; the Amador Water Agency; and the Jackson Valley Irrigation District. The HMP includes an examination of the recorded history of losses resulting from natural hazards, an analysis of future risks posed to Amador County by these hazards (e.g., wildfires, floods, and drought), and several mitigation goals and an objective based on the results of the risk assessment and includes specific recommendations for actions that can mitigate potential future disaster losses.

4.6.2 ENVIRONMENTAL SETTING

TOPOGRAPHY AND REGIONAL GEOLOGY

Amador County is located in the foothills of the Sierra Nevada, on the eastern fringe of the Sacramento Valley. The County's elevation ranges from less than 300 feet above sea level at the western end of the County to a high of more than 9,000 feet in the easternmost portion of the County. The Sierra Nevada trends north-northwest from Bakersfield to Lassen Peak, and includes the Sierra Nevada mountain range and a broad belt of western foothills. The Sierra Nevada block is composed of northwest-trending belts of metamorphic, volcanic, and igneous rocks

that have undergone intense deformation, faulting, and intrusion. Active faults that mark the eastern edge of the Sierra Nevada have resulted in upthrusting and tilting of the entire Sierra Nevada block in the last 5 million years—steeply on the eastern edge (adjacent to the Mono Basin), and gently along the western edge. The gently rolling Sierra Nevada foothills are comprised of metamorphosed sedimentary rocks that have been intruded by igneous rocks. The rock formations that make up the western edge of the Sierra Nevada block likely originally formed as a volcanic arc that was later accreted (added) to the western margin of the continent during the Jurassic period (Day 1992).

Geologic units in Amador County generally include:

- ▶ Quaternary-aged sedimentary and metasedimentary rocks, including the Riverbank and Modesto Formations, the North Merced Gravel, and various other alluvial, mine, and dredge deposits;
- ▶ Tertiary-aged sedimentary and metasedimentary rocks, including the Mehrten, Valley Springs, and Ione Formations;
- ▶ Mesozoic-aged sedimentary and metasedimentary rocks, including the Salt Springs Slate and the Mariposa and Sailor Canyon Formations;
- ▶ Mesozoic-aged volcanic rocks, including the Copper Hill, Gopher Ridge, and Logtown Ridge volcanic;
- ▶ Paleozoic-aged metasedimentary and volcanic rocks, including the Calaveras Complex;
- ▶ Plutonic rocks, including Mesozoic granitic and dioritic rocks.

SEISMICITY

Seismic activity may result in geologic and seismic hazards: seismically induced fault displacement and rupture, ground shaking, liquefaction, lateral spreading, landslides and avalanches, and structural hazards.

Earthquakes are measured based on either energy released (Richter Magnitude scale) or the intensity of ground shaking at a particular location (Modified Mercalli scale). The Richter Magnitude scale measures the magnitude of an earthquake based on the logarithm of the amplitude of waves recorded by seismographs, with adjustments made for the variation in the distance between the various seismographs and the epicenter of the earthquake. The Richter scale starts with 1.0 and has no maximum limit. Because the scale is logarithmic, an earthquake with a magnitude of 2.0 is 10 times the magnitude (30 times the energy) of an earthquake with a magnitude of 1.0.

The Modified Mercalli scale is an arbitrary measure of earthquake intensity; it does not have a mathematical basis. This scale is composed of 12 increasing levels of intensity that range from imperceptible shaking (Scale I) to catastrophic destruction (Scale XII). Table 4.6-1 provides a description of the Modified Mercalli Intensity scale.

Faults

Amador County is located within an area with relatively low seismic activity. Seismic activity may result in geologic and seismic hazards, including seismically induced fault displacement and rupture, ground shaking, liquefaction, lateral spreading, landslides and avalanches, and structural hazards. No Alquist-Priolo Earthquake Fault Zones are located in the Planning Area (CGS 2007a). Several inactive faults are known to be present in Amador County. These faults, which are not known to have been active within the past 10,000 years, include faults associated with the Bear Mountains Fault Zone and the Melones Fault Zone of the Foothills Fault System, and with the Calaveras Shoo Fly Thrust.

Nearby Alpine County is affected by Alquist-Priolo Earthquake fault zones and includes the closest active fault zones (the Genoa Fault).

**Table 4.6-1
Modified Mercalli Index**

Intensity	Effect
I	Not felt. Marginal and long period effects of large earthquakes.
II	Felt by persons at rest, on upper floors, or favorably placed.
III	Felt indoors. Hanging objects swing. Vibration like passing of light trucks. Duration estimated. May not be recognized as an earthquake.
IV	Hanging objects swing. Vibration like passing of heavy trucks; or sensation of a jolt like a heavy ball striking the walls. Standing motor cars rock. Windows, dishes, doors rattle. Glasses clink. Crockery clashes. In the upper range of IV, wooden walls and frame creak.
V	Felt outdoors; direction estimated. Sleepers wakened. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters, pictures move. Pendulum clocks stop, start, change rate.
VI	Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knickknacks, books, etc., off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry D cracked. Small bells ring (church, school). Trees, bushes shaken (visibly, or heard to rustle).
VII	Difficult to stand. Noticed by drivers of motor cars. Hanging objects quiver. Furniture broken. Damage to masonry D, including cracks. Weak chimneys broken at roof line. Fall of plaster, loose bricks, stones, tiles, cornices (also unbraced parapets and architectural ornaments). Some cracks in masonry C. Waves on ponds; water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged.
VIII	Steering of motor cars affected. Damage to masonry C; partial collapse. Some damage to masonry B; none to masonry A. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes.
IX	General panic. Masonry D destroyed; masonry C heavily damaged, sometimes with complete collapse; masonry B seriously damaged. (General damage to foundations.) Frame structures, if not bolted, shifted off foundations. Frames racked. Serious damage to reservoirs. Underground pipes broken. Conspicuous cracks in ground. In alluvial areas sand and mud ejected, earthquake fountains, sand craters.
X	Most masonry and frame structures destroyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land. Rails bent slightly.
XI	Rails bent greatly. Underground pipelines completely out of service.
XII	Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into the air.

Notes:

Masonry A: Good workmanship, mortar, and design; reinforced, especially laterally, and bound together by using steel, concrete, etc.; designed to resist lateral forces.

Masonry B: Good workmanship and mortar; reinforced, but not designed in detail to resist lateral forces.

Masonry C: Ordinary workmanship and mortar; no extreme weaknesses like failing to tie in at corners, but neither reinforced nor designed against horizontal forces.

Masonry D: Weak materials, such as adobe; poor mortar; low standards of workmanship; weak horizontally.

Source: ABAG 2003

Ground Shaking

The likelihood for future earthquakes occurring in Amador County is relatively low. This conclusion is based on historical data and the location of Amador County in relation to potentially active faults. No major earthquakes have been recorded within Amador County, although ground shaking has been felt in Amador County from earthquakes with epicenters located elsewhere. Amador County is located within a larger region with faults capable of producing maximum credible earthquakes of up to 6.5 magnitude and peak ground acceleration at the site between 0.1g to 0.2g (OES 2006).

The western portions of Amador County may experience ground shaking from distant earthquakes on faults to the west and east. Both the San Andreas fault (source of the 8.0 estimated Richter magnitude San Francisco earthquake that caused damage in Sacramento in 1906) and the closer Hayward fault have the potential for earthquake events with a greater than 6.7 magnitude. The U.S. Geological Survey recently estimated that there is a 62 percent probability of at least one 6.7 or greater magnitude earthquake occurring that could cause widespread damage in the greater San Francisco Bay area before 2032 (OES 2006).

Another potential source for earthquakes in Amador County is faults associated with the western edge of the Central Valley, recently defined as the Coast Range Central Valley (CRCV) boundary thrust fault system. Various documents define portions of this little known system as the Midland Fault Zone or the Dunnigan Hills fault where the 1892 Vacaville-Winters earthquake occurred. A southern part of the CRCV system may have been the source of the very damaging 1983 Coalinga earthquake (OES 2006).

According to maps recently developed by the Department of Conservation's California Geological Survey, the Reno-Tahoe and surrounding areas, including Amador County, have the potential for ground shaking from earthquakes. Because of the location of Reno-Tahoe and Amador County areas, the seismic hazard in these areas is related to faults on both sides of the California-Nevada border, including the Genoa Fault. Based on this data, the eastern portion of the County is at greatest risk from earthquakes (OES 2006). The most recent moderately strong earthquake affecting South Lake Tahoe occurred on September 12, 1994 and measured 6.1 on the Richter scale. (Cosmo 2006)

Liquefaction

Liquefaction, which may occur under strong ground shaking during earthquakes, is the transformation of granular sediment or fill material from a solid state to a temporarily liquid state. Liquefaction is a serious hazard because buildings on ground which undergoes liquefaction may sink or suffer major structural damage. Evidence of liquefaction may be observed in "sand boils," which are expulsions of sand and water from below the surface due to increased pore-water pressure below the surface. Liquefaction during an earthquake requires strong shaking continuing for a long time period and loose, clean granular materials (particularly sands) that may settle and compact because of the shaking.

Soil layers with high potential for liquefaction include unconsolidated sands and fine-grained material. Foothill and mountain areas have a low potential for liquefaction, except in areas of unconsolidated sediments (generally adjacent to stream channels).

Seiches

A seiche is a stationary wave produced in reservoirs, lakes, and other closed or restricted bodies of water by ground shaking. The phenomenon is similar to the oscillations which result when a bowl of water is shaken. When they occur in large reservoirs, such waves can cause overtopping of dams, posing a serious threat to adjacent areas. As described in the Amador County Multi-Hazard Mitigation Plan, University of Nevada and Japanese researchers have determined that run-up from seiche waves could occur along water bodies within the planning area (OES 2006).

Landslides

Landslides refer to a wide variety of processes that result in the perceptible downward and outward movement of soil, rock, and vegetation under gravitational influence. Common names for landslide types include slump, rockslide, debris slide, lateral spreading, debris avalanche, earth flow, and soil creep. Although landslides are primarily associated with steep slopes (i.e., greater than 15 percent), landslides can also occur in areas of generally low relief and occur as cut-and-fill failures, river bluff failures, lateral spreading landslides, collapse of wine-waste piles, failures associated with quarries, and open-pit mines. Landslides may be triggered by both natural- and human-induced changes in the environment resulting in slope instability (OES 2006).

Another type of landslide, debris flows, also occurs in some areas of Amador County. Debris flows generally occur in the immediate vicinity of existing drainage swales or steep ravines. Debris flows occur when surface soil in or near steeply sloping drainage swales becomes saturated during unusually heavy precipitation and begins to flow down a slope at a rapid rate (OES 2006).

Precipitation, topography, and geology affect landslides and debris flows. Human activities such as mining, construction, and changes to surface drainage areas also affect landslide potential. Landslides often accompany other natural hazard events (i.e., floods, wildfires, earthquakes). Landslides can occur slowly or very suddenly; can damage and destroy structures, roads, utilities, and forested areas; and can cause injuries and death (OES 2006).

The HMP indicates that no disaster declarations have occurred between 1950 and 1997 associated with landslides in Amador County. However, some areas in Amador County are susceptible to slope failure resulting in localized landslides, mudslides, and debris flows. The following are areas identified by the County with historic problems (OES 2006, p. 29):

Landslides/Mudslides

- ▶ Latrobe Road
- ▶ Michigan Bar Road
- ▶ Camanche Parkway North
- ▶ Shake Ridge Road
- ▶ Charleston Road
- ▶ Rams Horn Grade
- ▶ Sutter Creek Road
- ▶ Climax Road
- ▶ Middle Bar Road
- ▶ Electra Road

Debris Flows

- ▶ Camanche Road Bridge
- ▶ Sutter Creek Road
- ▶ Pine Grove/Volcano Road

In addition, the County has experienced numerous land/mudslides events in the past, and at times these events are associated with flooding. The majority of landslide/mudslide events in Amador County appear to have occurred at locations that inhibited travel along roadways or railways in the western-half of the County (see Exhibit 4.6-1).

Impacts from landslides primarily involve damage to infrastructure, utility systems, and roads. Road closures can further impact emergency response efforts and interrupt business and school activities. Historically, landslides resulting in significant losses have been limited in Amador County. Based on historical data, isolated landslides will likely continue to occur in areas throughout the County, but the overall vulnerability to landslides in the County remains low (OES 2006).

Avalanche Hazards

Avalanches occur when loading of new snow increases stress at a rate faster than strength of the snowpack develops causing the slope to fail. Critical stresses develop more quickly on steeper slopes and where deposition of wind-transported snow is common. The majority of avalanches occur during and shortly after storms.

Avalanches generally affect a small number of people such as snowboarders, skiers, and hikers who venture into backcountry areas during or after winter storms. Roads and highway closures, damaged structures, and destruction of forests are also a direct result of avalanches. The combination of steep slopes, abundant snow, weather, snowpack, and an impetus to cause movement create an avalanching episode. Avalanche hazards exist in eastern Amador County, where combinations of the above criteria readily occur (OES 2006).

Historically, avalanches occur within the County mostly between January and March, following snowstorms. The following areas within the County are prone to avalanche hazards:

- ▶ Highway 88, Devils Gate Area
- ▶ Kirkwood Resort and Ski Area

Land Subsidence

Land subsidence is defined as the sinking of the land over man-made or natural underground voids. The type of subsidence of greatest concern in Amador County is the settling of the ground over abandoned mines. Past mining activities created surface subsidence in some areas and created the potential for subsidence in other areas.

Subsidence can cause serious structural damage to buildings, roads, irrigation ditches, underground utilities, and pipelines. Increased surface weight from developments (e.g., roads, reservoirs, buildings) and human-caused vibrations (e.g., blasting, heavy trucks, train traffic) can accelerate the natural processes of subsidence. The consequences of improper utilization of land subject to ground subsidence generally consist of excessive economic losses, including high repair and maintenance costs for buildings, irrigation works, highways, utilities, and other structures. The HMP identified three areas with past subsidence issues, but all of these areas are within the Sutter Creek city limits. Historically, land subsidence issues in Amador County have been minimal and occurrences have been infrequent.

SOILS

The National Resources Conservation Service (NRCS) provides soils surveys and reports for Amador County.

Soil Properties

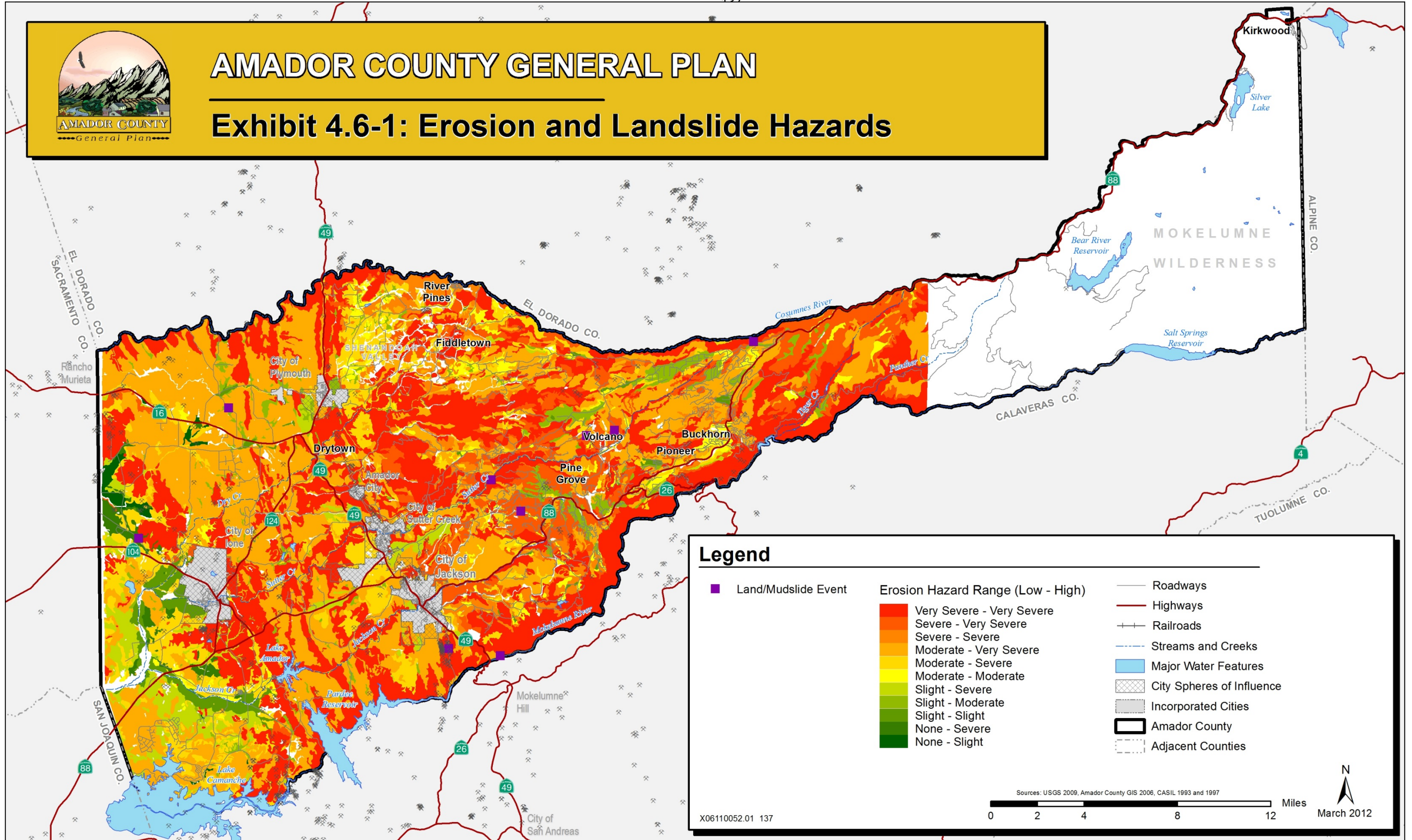
Soil properties influence the development of building sites, including the site selection, structure design, construction, performance after construction, suitability for septic systems, and site and structure maintenance. Soil limitations are based on the soil properties that affect the capacity of the soil to support a load without movement and on the properties that affect excavation and construction costs.

Soils located in areas of steep topography are prone to erosion when they are disturbed. A direct correlation exists between slope and erosion hazard. Areas with less topographic differences are not as prone to erosion hazards. Exhibit 4.6-1 illustrates erosion hazards.



AMADOR COUNTY GENERAL PLAN

Exhibit 4.6-1: Erosion and Landslide Hazards



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Shrink-swell potential is the relative change in volume to be expected with changes in moisture content, that is, the extent to which the soil shrinks as it dries out or swells when it gets wet. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils causes damage to building foundations, roads, and other structures. A high shrink-swell potential indicates a hazard to maintenance of structures built in, on, or with material having this rating. Soils in Amador County with the greatest hazards related to shrink-swell potential include Peters soils, and some Argonaut and Cohasset soils. Soil limitations are illustrated on Exhibit 4.6-2

Soils may be more or less suitable for use of septic systems depending on factors such as slope, soil depth, permeability, depth to the water table, and whether or not the soil is subject to ponding. Soils with septic limitations are illustrated on Exhibit 4.6-2.

NATURALLY OCCURRING ASBESTOS

Asbestos is a term applied to several types of naturally occurring fibrous materials found in rock formations throughout California. Exposure and disturbance of rock and soil that contains asbestos can result in the release of fibers to the air and consequent exposure to the public. All types of asbestos are now considered hazardous and pose public health risks. Asbestos is commonly found in ultramafic rock, including serpentine. Two forms of asbestos are associated with serpentine: chrysotile asbestos and tremolite/actinolite asbestos.

Areas with ultramafic (um) rocks are most likely to contain asbestos (Higgins and Clinkenbeard 2006). Amador County contains several areas of ultramafic rock, including a north-south trending belt between Ione and Highway 49, and smaller areas north of Pioneer and south of River Pines.

Areas which are moderately likely to contain NOA include metamorphosed mafic volcanic rocks (mv); metamorphosed intrusive rocks (mi); and gabbroic (mafic intrusive) rocks (gb) (Higgins and Clinkenbeard 2006). Rocks of these types in Amador County include the Copper Hill Volcanics (Jch), the Gopher Ridge Volcanics (Jgo), and the Logtown Ridge (Jlr) geologic formations. Exhibit 4.6-3 is a geologic map of Amador County, illustrating the locations of these formations.

MINERAL RESOURCES

A variety of mineral resources are present in Amador County, many of them being actively mined. SMARA classifications (indicating lands needed for their mineral content) have been applied to several areas of the County.

The classification system is intended to ensure consideration of statewide or regionally significant mineral deposits in planning and development administration. These mineral designations are intended to prevent incompatible land use development on areas determined to have significant mineral resource deposits. Permitted uses within a mineral resource zone include mining, uses that support mining such as smelting and storage of materials, or uses that will not hinder future mining such as grazing, agriculture, large-lot rural development, recreation, and open space.

The most important zone with respect to the presence of resources is MRZ-2, which is defined as “areas where adequate information indicates that significant mineral (aggregate) deposits are present (2a) or where it is judged that there is a high likelihood for their presence (2b).” This zone is applied to known mineral deposits or where well-developed lines of reasoning, based on economic geologic principles and adequate data, demonstrate that the likelihood for occurrence of significant mineral deposits is high.

As shown in Exhibit 4.6-4, a large gold deposit runs along SR 49. To the west of the gold deposit, approximately centered on the city of Ione, a large area contains a variety of minerals including sand, clay, lignite, copper, zinc,

and gold. Smaller areas of substantial mineral deposits containing limestone, lode gold, talc, and gold are scattered around the remainder of the western portion of Amador County.

PALEONTOLOGICAL RESOURCES

Paleontological Resource Inventory Methods

Stratigraphic Inventory

Geologic maps and reports covering the geology of the project site and surrounding area, including the Geologic Map of the Sacramento Quadrangle (Wagner et al. 1987), were reviewed to determine the exposed rock units and to delineate their respective aerial distributions in the project area.

Paleontological Resource Inventory

Published and unpublished geological and paleontological literature were reviewed to document the number and locations and previously recorded fossil sites from rock units exposed in and near the project site and vicinity, as well as the types of fossil remains each rock unit has produced. The literature review was supplemented by an archival search conducted at the UCMP in Berkeley, California, on August 27, 2009.

Paleontological Resource Assessment Criteria

The potential paleontological importance of the project site can be assessed by identifying the paleontological importance of exposed rock units within the project site. Because the areal distribution of a rock unit can be easily delineated on a topographic map, this method is conducive to delineating parts of the project site that are of higher and lower sensitivity for paleontological resources and to delineating parts of the project site that may require monitoring during construction.

The following tasks were completed to establish the paleontological importance of each rock unit exposed at or near the project site:

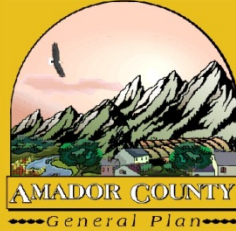
- ▶ The potential paleontological productivity of each rock unit was assessed, based on the density of fossil remains previously documented within the rock unit.
- ▶ The potential for a rock unit exposed at the project site to contain a unique paleontological resource was considered.

Paleontological Resource Assessment Results

Paleontological remains may be found in numerous types of rock formations. However, vertebrate fossils are most commonly recovered from sedimentary formations, as well as a few volcanic rock formations where sedimentary deposits are interbedded (such as the Mehrten Formation). The geology of Amador County is complex, with documented formations ranging from the Paleozoic era (dating to as early as 350 million years Before Present [B.P.]), to stream and gravel deposits still being deposited in recent times (i.e., Holocene age, 11,700 years B.P. and younger).

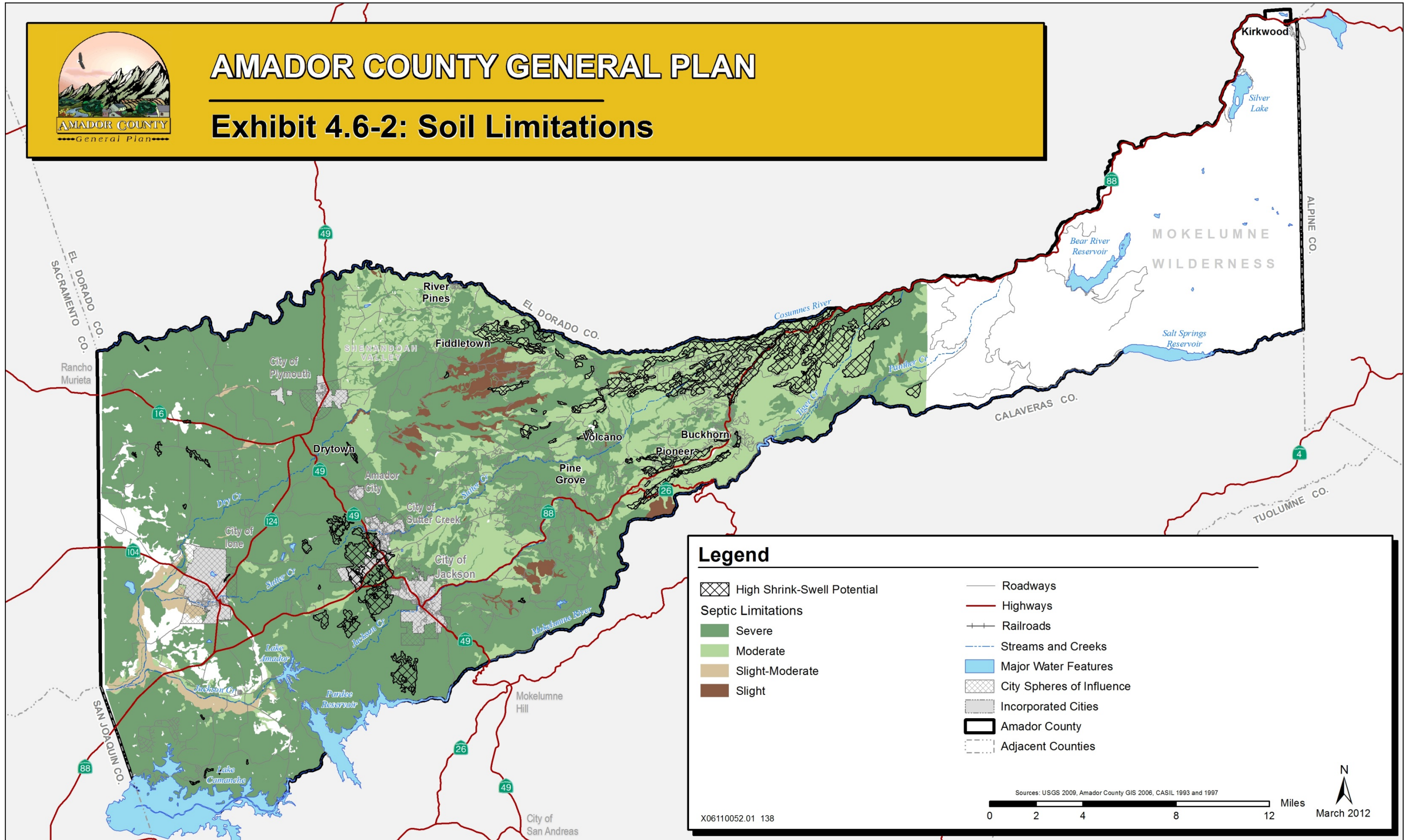
The Holocene deposits in Amador County contain only the remains of extant, modern taxa (if any resources are present); in order to be considered a unique paleontological resource, a fossil must be more than 11,700 years old. Therefore, Holocene-age formations are not considered to be paleontologically sensitive.

There are several sedimentary formations in Amador County ranging in age from Pleistocene to Eocene (Tertiary Period). The Modesto, Riverbank, Mehrten, and Ione Formations are known to have produced vertebrate fossils and therefore are considered to be of high paleontological sensitivity, as discussed in further detail below.



AMADOR COUNTY GENERAL PLAN

Exhibit 4.6-2: Soil Limitations

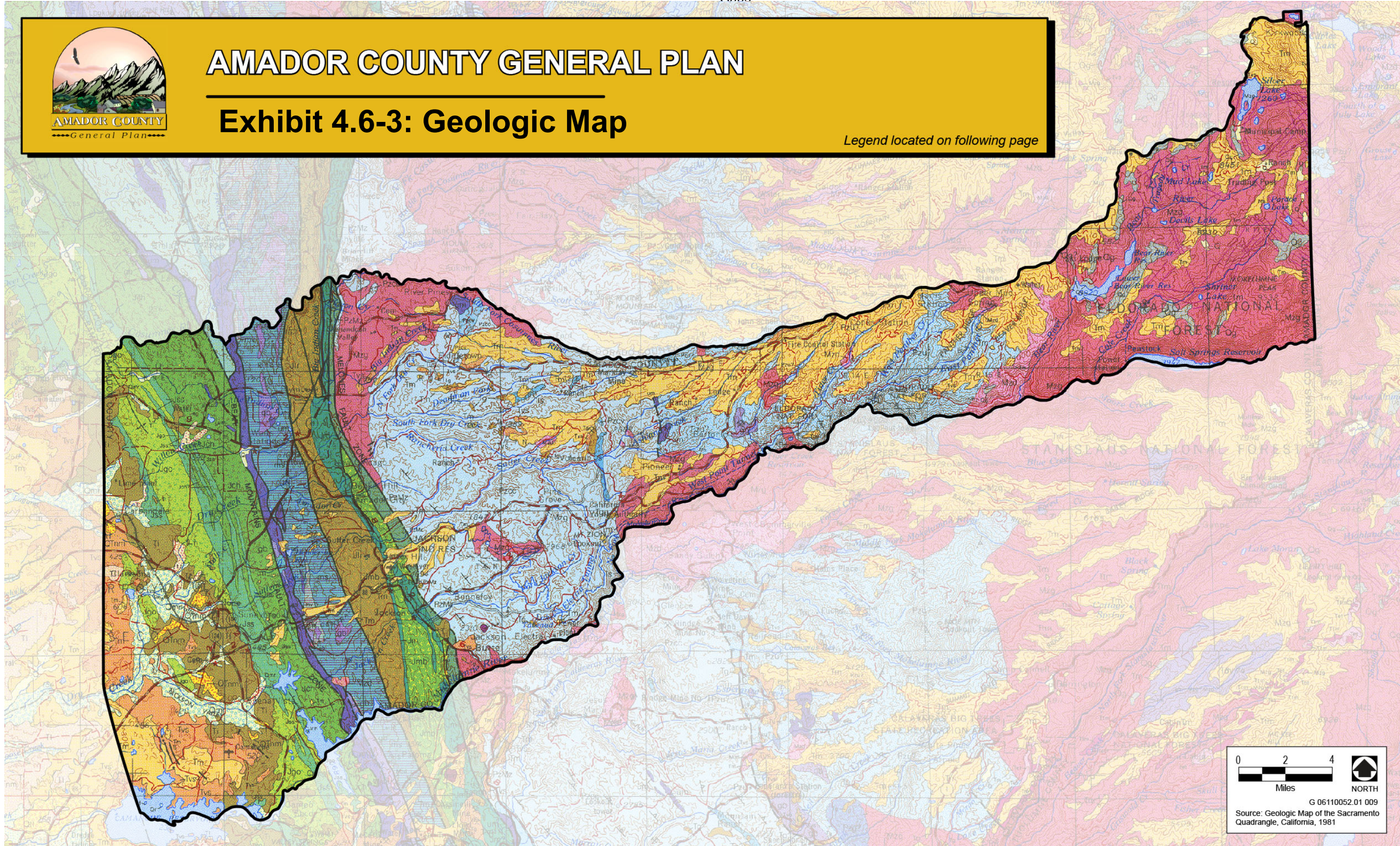





AMADOR COUNTY GENERAL PLAN

Exhibit 4.6-3: Geologic Map

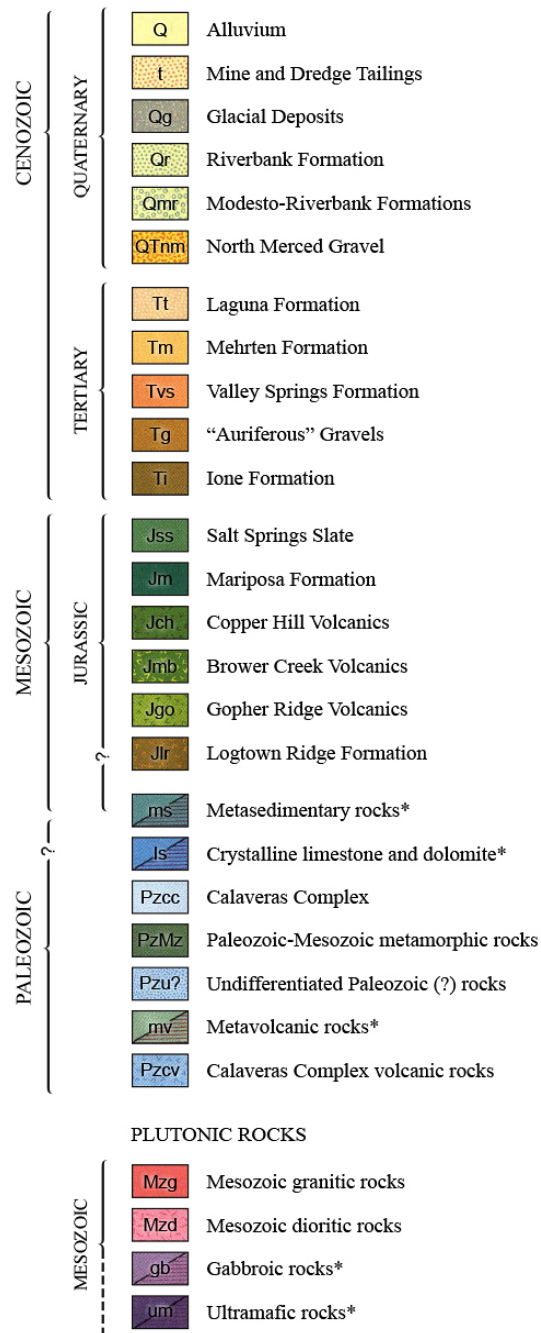
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Source: Geologic Map of the Sacramento
Quadrangle, California, 1981



* Horizontal line pattern denotes melange terrane

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Exhibit 4.6-3b Geological Legend

**Table 4.6-2
Rock Formations and Paleontological Sensitivity**

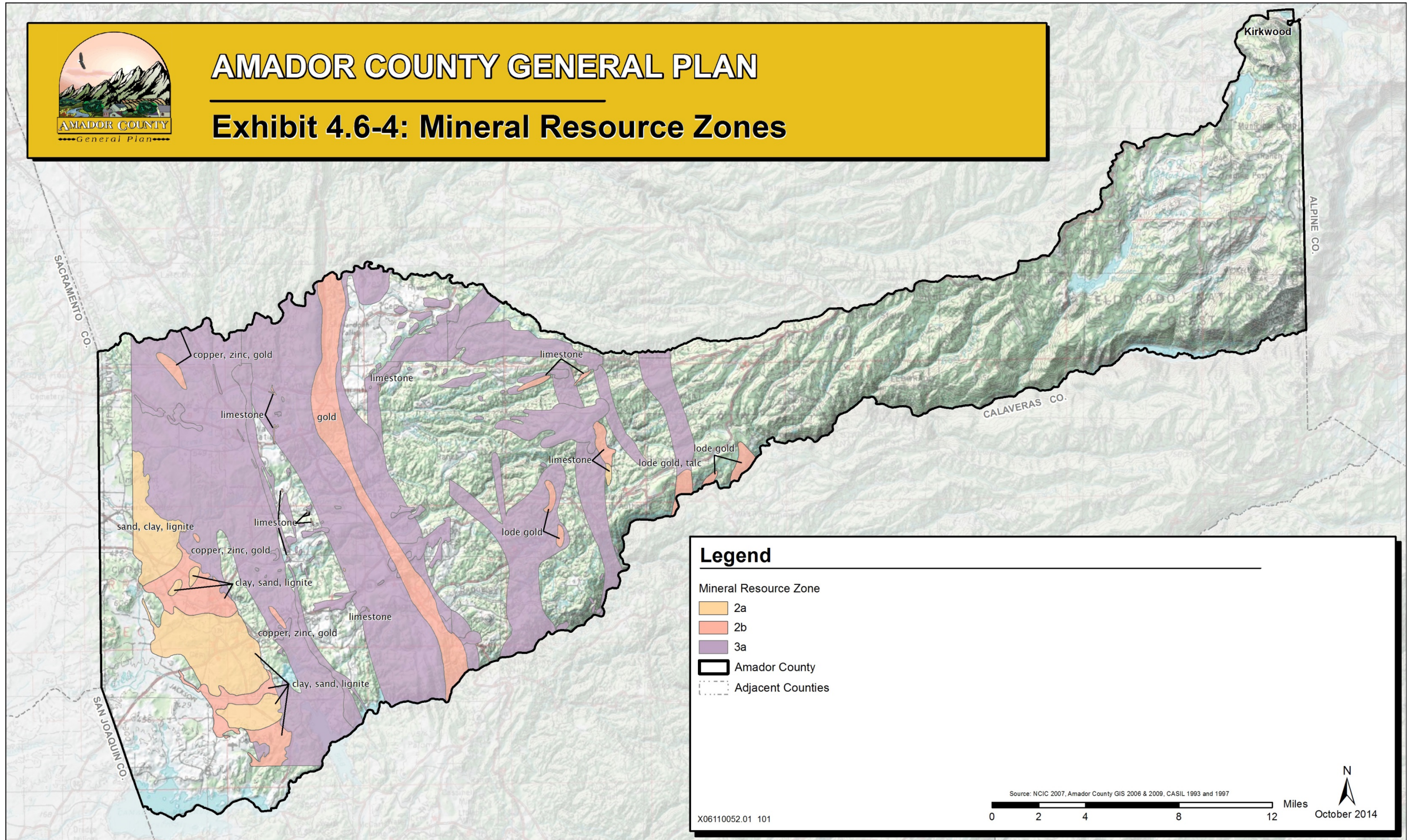
Age	Description of Rock Formation	Paleontological Sensitivity
<u>Holocene</u>	<u>Alluvium – poorly sorted stream and basin deposits, clay to boulder sized</u>	<u>Low</u>
<u>Holocene</u>	<u>Dredge and mine tailings</u>	<u>Low</u>
<u>Holocene-Pleistocene</u>	<u>Glacial deposits – unsorted cobble to bouldery till with large granitic boulders in moraines</u>	<u>Low</u>
<u>Pleistocene</u>	<u>Riverbank Formation – alluvium</u>	<u>High</u>
<u>Pleistocene</u>	<u>Modesto-Riverbank Formations – mixed alluvium from both the Riverbank and Modesto Formations</u>	<u>High</u>
<u>Pleistocene</u>	<u>North Merced Gravel – thin pediment veneer of gravel and cobble over an erosional surface, less than 6 feet thick</u>	<u>Low</u>
<u>Pliocene</u>	<u>Laguna Formation – alluvial gravel, sand, and silt</u>	<u>Low</u>
<u>Pliocene</u>	<u>Mehrten Formation – volcanic conglomerate, tuffaceous sandstone and siltstone, mudflow breccia, interbedded in some locations with sedimentary deposits</u>	<u>High</u>
<u>Pliocene to Miocene</u>	<u>Valley Springs Formation – rhyolitic tuff, sandstone, siltstone, claystone, and conglomerate</u>	<u>Low</u>
<u>Eocene</u>	<u>Ione Formation – quartzose sandstone interbedded with kaolinitic clay</u>	<u>High</u>
<u>Eocene</u>	<u>Auriferous gravel – river channel and bench gravel; pebbles, cobbles, and boulders of basement (pre-Tertiary) rocks</u>	<u>Low</u>
<u>Jurassic to Cretaceous</u>	<u>Mesozoic (plutonic) granitic rocks – granite to granodiorite</u>	<u>Low</u>
<u>Jurassic to Cretaceous</u>	<u>Mesozoic (plutonic) dioritic rocks – quartz diorite and diorite</u>	<u>Low</u>
<u>Jurassic to Cretaceous</u>	<u>Mesozoic (plutonic) gabbroic rocks - dark, coarse-grained rocks of crystalline texture, consisting mainly of pyroxene, plagioclase feldspar, and often olivine</u>	<u>Low</u>
<u>Jurassic to Cretaceous</u>	<u>Mesozoic (plutonic) ultramafic rocks – peridotite, pyroxenite, hornblendite, grades into gabbroic rock, locally serpentized</u>	<u>Low</u>
<u>Jurassic</u>	<u>Copper Hill Volcanics – metamorphosed mafic pyroclastic rocks, pillow lava</u>	<u>Low</u>
<u>Jurassic</u>	<u>Salt Springs Slate</u>	<u>Low</u>
<u>Jurassic</u>	<u>Brower Creek Volcanic Member, Mariposa Formation – mafic flows, pyroclastics</u>	<u>Low</u>
<u>Jurassic</u>	<u>Gopher Ridge Volcanics – metamorphosed mafic pyroclastic rocks, massive flows with some pillow lava</u>	<u>Low</u>
<u>Jurassic</u>	<u>Metavolcanic rocks – mafic pyroclastic and flow rocks</u>	<u>Low</u>
<u>Jurassic to Paleozoic</u>	<u>Gabbroic and hypabyssal intrusive rocks</u>	<u>Low</u>
<u>Jurassic to Paleozoic</u>	<u>Metasedimentary rocks – slate, graywacke, conglomerate, pebbly mudstone, pyroclastics, quartzite, chert</u>	<u>Low</u>
<u>Jurassic</u>	<u>Logtown Ridge Formation – metamorphosed mafic breccias, flows, pyroclastics, and volcaniclastics</u>	<u>Low</u>
<u>Paleozoic</u>	<u>Metamorphic rocks – mainly greenschist</u>	<u>Low</u>
<u>Paleozoic</u>	<u>Calaveras Complex – chert, argillite, slate</u>	<u>Low</u>

Source: Wagner et al. 1987 and AECOM 2015



AMADOR COUNTY GENERAL PLAN

Exhibit 4.6-4: Mineral Resource Zones



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A search of the University of California Museum of Paleontology (UCMP) database indicates that none of the other Tertiary Period deposits in Amador County are known to contain vertebrate fossils (UCMP 2015).

The remaining geologic formations in Amador County are of Mesozoic and Paleozoic age and have either been highly folded, faulted, and metamorphosed from high temperature and pressure; formed at depth beneath the earth's surface; or formed from eruption of lava on the earth's surface. These types of formations do not contain vertebrate fossils, and therefore are not considered to be paleontologically sensitive.

Modesto Formation

Fossil specimens from the Modesto Formation have been reported by Marchand and Allwardt (1981) near the type locality in the City of Modesto. Fossil specimens from sediments referable to the Modesto Formation have been reported at numerous other locations throughout the San Joaquin Valley (UCMP 2008), including Lathrop, Modesto, Stockton, Tracy (along the Delta-Mendota Canal), Manteca, and Merced. The Tranquility site in Fresno County (UCMP V-4401) has yielded more than 130 Rancholabrean-age (younger Pleistocene and Holocene) fossils of fish, turtles, snakes, birds, moles, gophers, mice, wood rats, voles, jack rabbits, coyote, red fox, grey fox, badger, horse, camel, pronghorn antelope, elk, deer, and bison from sediments referable to the Modesto Formation.

Riverbank Formation

Several locations in Sacramento (V-6846, V-68141, V-74086, V-69129, V-6747, V-69129, and V-75126) have yielded specimens of bison, camel, coyote, horse, Harlan's ground sloth, mammoth, packrat or woodrat, Sacramento blackfish, mole, garter snake, and gopher from sediments of the Riverbank Formation. In addition, fossil specimens recovered from excavation activities at ARCO Arena north of Sacramento in the Riverbank Formation included specimens of Harlan's ground sloth, bison, coyote, horse, camel, squirrel, antelope or deer, mammoth, and several types of plants (Hilton, Dailey, and McDonald 2000).

Mehrten Formation

Vertebrate mammal and plant fossils have been reported from the Mehrten Formation throughout the Sierra Nevada foothills and the eastern margin of the Central Valley. Within Amador County, the primary outcrop of the Mehrten Formation is near Camanche Reservoir, where several vertebrate fossil specimens have been discovered. Other vertebrate fossils have been recovered from the Mehrten Formation from over 40 locations in Calaveras, San Joaquin, Stanislaus, Tuolumne, and Merced Counties (UCMP 2009). In addition, several specimens of plant fossils have been recovered from the Mehrten Formation in Amador County near Camanche Reservoir (UCMP 2009), and in Granite Bay, Roseville, and Rocklin (Sierra College Natural History Museum 2009). Because of the large number of fossils that have been recovered from the Mehrten Formation, it is considered a paleontologically sensitive rock unit under the Society of Vertebrate Paleontology guidelines (1995).

Ione Formation

Vertebrate mammal, plant, and invertebrate fossils have been reported from the Ione Formation throughout the Central Valley and Sierra Nevada foothills. Numerous plant fossils have been recovered from the Ione Formation, including Ione, Plymouth, and Camanche Reservoir. Vertebrate mammal, plant, and invertebrate fossils have been recovered from the Ione Formation from over 300 locations in Amador, Nevada, Contra Costa, Placer, Butte, Alameda, Merced, Tuolumne, Sutter, Sierra, Plumas, Calaveras, Kern, and Stanislaus counties (UCMP 2009). Because of the large number of fossils that have been recovered from the Ione Formation, it is considered a paleontologically sensitive rock unit under the Society of Vertebrate Paleontology guidelines (1995).

4.6.3 IMPACTS AND MITIGATION MEASURES

ANALYSIS METHODOLOGY

The analysis of potential impacts to geology and soils resulting from the adoption and implementation of the Draft General Plan is based on evaluation of conditions in the County, that is based on available information from state and federal sources. For mineral resources, impact analysis is based on the potential to affect known mineral resources within the County. For paleontological resources, impact analysis is based on the likelihood that implementation of the Draft General Plan would affect areas or formations with known vertebrate paleontological resources.

THRESHOLDS OF SIGNIFICANCE

Based on Appendix G of the State CEQA Guidelines, impacts to geology, soils and mineral resources are considered significant if implementation of the Draft General Plan would do any of the following:

- ▶ expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
 - rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault (this impact is not further evaluated because there are no known earthquake faults in Amador County);
 - strong seismic ground shaking;
 - seismic-related ground failure, including liquefaction; or
 - landslides;
- ▶ result in substantial soil erosion or the loss of topsoil;
- ▶ be located on a geologic unit or soil that is unstable or that would become unstable as a result of the project and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse;
- ▶ be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property;
- ▶ have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater;
- ▶ result in the loss of availability of a known mineral resource that would be of value to the region and residents of the state; or
- ▶ result in the loss of availability of a locally important mineral resource recovery site delineated in the Amador County General Plan or the Amador County Zoning Ordinance.

For the purpose of the analysis of impacts to paleontological resources (Impact 4.6-9), the threshold of significance is based on the State CEQA Guidelines, which states that an impact to paleontological resources is considered significant if implementation of the Draft General Plan could lead to the destruction of a unique paleontological resource or site.

A paleontologically important rock unit is one that has a high potential paleontological productivity rating and is known to have produced unique, scientifically important fossils. The potential paleontological productivity rating of a rock unit exposed at the project site refers to the abundance/densities of fossil specimens and/or previously recorded fossil sites in exposures of the unit in and near the project site. Exposures of a specific rock unit at the project site are most likely to yield fossil remains representing particular species in quantities or densities similar to those previously recorded from the unit in and near the project site.

An individual vertebrate fossil specimen may be considered unique if it is identifiable and well preserved, and it meets one of the following criteria:

- ▶ a type specimen (i.e., the individual from which a species or subspecies has been described);
- ▶ a member of a rare species;
- ▶ a species that is part of a diverse assemblage (i.e., a site where more than one fossil has been discovered) wherein other species are also identifiable, and important information regarding life history of individuals can be drawn;
- ▶ a skeletal element different from, or a specimen more complete than, those now available for its species; or
- ▶ a complete specimen (i.e., all or substantially all of the entire skeleton is present).

For example, identifiable vertebrate marine and terrestrial fossils are generally considered scientifically important because they are relatively rare. The value or importance of different fossil groups varies, depending on the age and depositional environment of the rock unit that contains the fossils, their rarity, the extent to which they have already been identified and documented, and the ability to recover similar materials under more controlled conditions, such as part of a research project. Marine invertebrate fossil specimens are generally common, well developed, and well documented. They would generally not be considered a unique paleontological resource.

IMPACT ANALYSIS

IMPACT 4.6-1 **Potential for Exposure to Seismic Ground Shaking.** *Implementation of the Draft General Plan would not result in construction of improvements or buildings in areas prone to strong seismic ground shaking. This impact would be **less than significant**.*

Different types of structures are subject to different levels of ground shaking damage from seismic activity. Conventional one- and two-story wood-frame residential structures generally have performed very well during strong seismic ground shaking. Collapse or total destruction of wood-frame homes is rare, even during strong earthquakes, except in cases where these structures are affected by ground rupturing or landsliding, or are affected by extremely high ground acceleration. Unreinforced masonry buildings and other buildings constructed before 1930 that have not been seismically retrofitted would be most likely to suffer structural failure or collapse as a result of seismic ground shaking.

Amador County is located in an area of low seismic activity that has not experienced an earthquake with intensity of MMI VII or greater (the intensity at which damage to buildings would be expected) between 1800 and 1996 (Petersen et al, 1996).

Implementation of the Draft General Plan would result in new development in the planning area, including buildings, structures, paved areas, roadways, utilities, and other improvements. However, compliance with existing County regulations (Title 15 of the County Code) and the CBC regulations described in the regulatory setting of this chapter would require the site's seismic-design response spectrum to be established and incorporated into the design of all new residences and buildings. Structures would be designed to withstand

seismic forces based on CBC requirements for the appropriate site-specific Seismic Design Category. Therefore, exposure of people or structures to potential substantial adverse effects from seismic activity and related geologic hazards would be a **less-than-significant** impact.

Mitigation Measure: No mitigation measures are required.

IMPACT 4.6-2 **Potential for Seismic Ground Failure.** *Implementation of the Draft General Plan would result in construction of improvements or buildings in areas with the potential for seismic-related ground failure, including liquefaction, but existing County Regulations and the CBC would reduce effects. This impact would be **less than significant**.*

Seismic ground failure refers to conditions such as soil liquefaction, associated lateral spreading, landslides, and collapse resulting from loss of strength during earthquake shaking. The liquefaction of soils can cause them to move laterally outward from under buildings, roads, pipelines, transmission towers, railroad tracks, and other structures such as bridges. Damage is usually greatest to large or heavy structures on shallow foundations and takes the form of cracking, tilting, and differential settlement. Where gentle slopes exist, such as on stream or slough banks, liquefaction may cause lateral-spreading landslides. Whole buildings can be moved downslope by this type of ground failure. Where the condition is known to exist, structural and foundation design can usually minimize or eliminate liquefaction hazard to new construction.

Amador County is located in an area of low seismic activity that did not experience an earthquake with intensity of MMI VII or greater (the intensity at which damage to buildings would be expected) between 1800 and 1996 (Petersen et al, 1996). The risk of seismic ground failure would be correspondingly low.

Implementation of the Draft General Plan would result in new development in the planning area, including buildings, structures, paved areas, roadways, utilities, and other improvements. However, compliance with existing County regulations (Title 15 of the County Code) and the CBC regulations described in the regulatory setting of this chapter would require the site's seismic-design response spectrum to be established and incorporated into the design of all new residences and buildings. Structures would be designed to withstand seismic forces based on CBC requirements for the appropriate site-specific Seismic Design Category. Therefore, exposure of people or structures to potential substantial adverse effects structures from seismic activity and related geologic hazards would be a **less than significant** impact.

Mitigation Measure: No mitigation measures are required.

IMPACT 4.6-3 **Potential for Exposure to Landslides or Avalanche.** *Implementation of the Draft General Plan would result in construction of improvements and buildings in areas prone to landsliding, although implementation of County regulations and grading restrictions, including those concerning steepening of slopes, would reduce the risk of damage. Very limited development of structures, roadways, or utilities could occur in areas subject to avalanche, but existing County Regulations and the CBC would reduce effects. This impact would be **less than significant**.*

Implementation of the Draft General Plan would result in new development in the planning area, including buildings, structures, paved areas, roadways, utilities, and other improvements. New residential dwellings, non-residential buildings, roadways, and utilities could be constructed in areas susceptible to landslide hazards. Landslide hazard areas in the County can be inferred based on past occurrences and site topography and other climate characteristics. Factors affecting landslide potential include, but are not limited to, geologic conditions, drainage characteristics, slope gradient and configuration, vegetation, and removal of underlying support. Cuts and fills associated with road building activity are a major cause of slope instability. Historical landslide areas are identified on Exhibit 4.6-1, and future landslides would be likely to affect the same hazard areas.

Factors affecting avalanche potential include the same factors identified above for landslides, in addition to snowfall levels and slope aspect. Avalanche areas have not been formally mapped for Amador County (with the exception of mapping of the Kirkwood Specific Plan Area), but based on slope and climactic factors, these events are more likely to occur in the eastern portions of the County, in areas where very limited development of structures, roadways, or utilities would occur under the Draft General Plan.

Existing County regulations in Title 15 of the County Code (including Chapter 15.40, which governs grading), and the Draft General Plan require compliance with the CBC regulations described in the regulatory setting of this chapter. Compliance with these regulations would require that site-specific geotechnical investigations be conducted, and would preclude occupied structures being placed in areas at risk for landslide or avalanche. Other improvements which could be constructed under the Draft General Plan, including roads and utilities, could be subject to damage from landslides or avalanche, although implementation of County regulations and grading restrictions, including those concerning steepening of slopes, would reduce the risk of damage. Therefore, exposure of people or structures to potential substantial adverse effects from landslide and avalanche hazards would be a **less than significant** impact.

Mitigation Measure: No mitigation measures are required.

IMPACT 4.6-4 **Soil Erosion or Loss of Topsoil.** *Implementation of the Draft General Plan would result in new development in the planning area, including buildings, structures, paved areas, roadways, utilities, and other improvements that could lead to soil erosion or the loss of topsoil. This impact would be **significant**.*

Some soils in the planning area are considered to have high potential for erosion. Highly erosive soils can damage roads, bridges, buildings, and other structures and result in damage to sensitive biological habitats such as riparian areas and water bodies. Soil loss can be caused by sheet or rill erosion in areas where 50–75 percent of the surface has been exposed by logging, grazing, mining, or other kinds of disturbance.

Erosion caused by human activity and disturbance of surface soil, wind, and water cannot be eliminated altogether, although existing regulations such as Title 15 of the Amador County Code and the CBC (which includes erosion control measures and best management practices) can reduce the potential impacts of erosion. In Amador County, erosion is most likely in more mountainous areas with steep topography and adjacent to rivers and streams.

Further, the compaction of soils by heavy equipment may reduce the infiltration capacity of soils and increase the potential for runoff and erosion. Non-stormwater discharges could also result from activities such as construction dewatering procedures, and discharge or accidental spills of hazardous substances, such as fuels, oils, concrete, paints, solvents, cleaners, or other construction materials.

Implementation of the Draft General Plan would result in new development in the planning area, including buildings, structures, paved areas, roadways, utilities, and other improvements. In particular, construction and grading activities during development consistent with the Draft General Plan could result in soil erosion. Localized erosion hazards are prone to occur where construction sites are sloped. Even in areas where construction sites are generally flat, intense rainfall and associated stormwater runoff could result in short periods of sheet erosion within areas of exposed or stockpiled soils. If uncontrolled, exposed soil materials could cause sedimentation and blockage of drainage channels.

Existing County regulations in Title 15 of the County Code, including Chapter 15.40 “Erosion Control Ordinance”, which governs grading and excavation, and the Draft General Plan require compliance with the CBC regulations described in the regulatory setting of this chapter. Compliance with these regulations would require implementation of standard erosion control measures and BMPs. In addition, policies of the Draft General Plan (C-2.6, C-4.1, C-4.3, C-5.1, and C-5.2) would result in the incorporation of Low Impact Development (LID) standards and other BMPs into the County’s development ordinances that lessen the potential for erosion and

sedimentation; however implementation requirements are not specified and cannot be relied upon to reduce impacts below the level of significance. Therefore, this impact would be **significant**.

Mitigation Measure: Implement Mitigation Measures 4.9-1a, 4.9-1c, 4.9-1d, 4.9-2, and 4.9-3

Significance after Mitigation

Mitigation Measures 4.9-1a, 4.9-1c, 4.9-1d, 4.9-2, and 4.9-3 would assure that implementation of the Draft General Plan would not result in substantial soil erosion or the loss of topsoil, and therefore this impact would be **less than significant**. See “Significance after Mitigation” sections for Impacts 4.9-1, 4.9-2, and 4.9-3 for further details.

IMPACT 4.6-5 **Potential for Unstable Soils.** *Implementation of the Draft General Plan would result in construction of occupied structures in areas located on a geologic unit or soil that is unstable or that would become unstable, potentially resulting in on- or off-site lateral spreading, subsidence, liquefaction, or collapse, but existing County Regulations and the CBC would reduce effects. This impact would be **less than significant**.*

The liquefaction of soils can cause them to move laterally outward from under buildings, roads, pipelines, transmission towers, railroad tracks, and other structures such as bridges. Damage is usually greatest to large or heavy structures on shallow foundations and takes the form of cracking, tilting, and differential settlement. Where gentle slopes exist, such as on stream or slough banks, liquefaction may cause lateral-spreading landslides. Whole buildings can be moved downslope by this type of ground failure. Where the condition is known to exist, structural and foundation design can usually minimize or eliminate liquefaction hazard to new construction.

The type of subsidence of greatest concern in the planning area is the settling of the ground over abandoned mines. Past mining activities created surface subsidence in some areas and created the potential for subsidence or collapse in other areas. Mining activities have historically occurred throughout the County, and subsidence or settling could occur at a variety of locations across the planning area.

Compliance with existing County regulations (Title 15 of the County Code) and the CBC regulations described in the regulatory setting of this chapter would require engineering and geotechnical investigations to inform the design of new residences and buildings. Roadways, utilities, and structures would be designed based on site-specific soils information. Therefore, potential damage to structures from unstable soils would be **less than significant**.

Mitigation Measure: No mitigation measures are required.

IMPACT 4.6-6 **Construction in Areas with Expansive Soils.** *Implementation of the Draft General Plan would result in construction of occupied structures in areas with expansive soils, but existing County regulations and the CBC would reduce effects. This impact would be **less than significant**.*

Expansive or shrink-swell soils contain significant amounts of clay minerals that swell when wet and shrink when dry. These clays tend to swell despite the heavy loads imposed by large structures. Damage (such as cracking of foundations) results from differential movement and from the repetition of the shrink-swell cycle. Soils having high shrink-swell potential in at least the top 12 inches are found throughout the planning area.

Exhibit 4.6-2 illustrates soils in Amador County. Soils in Amador County with the greatest limitations related to shrink-swell potential include Peters soils, and some Argonaut and Cohasset soils. Awareness of the presence of expansive soils before construction often means that the problem can be eliminated through foundation design.

Implementation of the Draft General Plan would result in new development in the planning area, including buildings, structures, paved areas, roadways, utilities, and other improvements. However, existing County

regulations (Title 15 of the County Code) and the Draft General Plan require compliance with the CBC regulations described in the regulatory setting of this chapter. Compliance with these regulations would require engineering and geotechnical investigations to inform the design of new residences and buildings. Roadways, utilities, and structures would be designed based on site-specific soils information, including potential expansive soil limitations. Therefore, potential damage to structures from expansive soils would be **less than significant**.

Mitigation Measure: No mitigation measures are required.

IMPACT 4.6-7 Construction in Areas with Soils with Poor Septic Suitability. Residential dwellings and non-residential uses implementing the Draft General Plan could result in construction of occupied structures in areas with soils poorly suited to septic systems. Should septic systems be used in these areas, implementation of existing regulations would require use of best practices for septic systems. This impact would be **less than significant**.

Soil limitations with respect to septic systems are described as either low, moderate, or severe. These ratings are based on slope, soil depth, permeability, depth to the water table, and whether or not the soil is subject to ponding. Adverse effects associated with septic suitability of soils can be avoided through proper soil percolation testing and septic system design, construction monitoring, and post-construction monitoring and maintenance.

Implementation of the Draft General Plan would result in new development in the planning area, including buildings, structures, paved areas, roadways, utilities, and other improvements. New residential dwellings or non-residential buildings in rural areas of the County that are not served by wastewater utilities may use on-site sewage systems, including septic systems. Implementation of existing regulations (Title 14 of the County Code, including Chapter 14.12) would require that these systems be designed to meet site-specific drainage and soil conditions and specify that the systems are subject to review and conditions determined by the County Environmental Health Department.

Implementation of existing County regulations (Chapter 14.12) regulating on-site sewage disposal would reduce the impacts of soils with poor septic suitability on construction of new residential dwellings and non-residential buildings consistent with the Draft General Plan through application of engineering controls. With implementation of existing regulations, this impact is considered **less than significant**.

Mitigation Measure: No mitigation measures are required.

IMPACT 4.6-8 Loss of Availability of Known Mineral Resources. Buildout of the Draft General Plan could result in construction of new residential dwellings or non-residential uses in areas near existing or potential future mineral resource development, potentially affecting the availability of mineral resources. This impact would be **significant**.

Currently, mining in the County includes refractory sand, clay, gold, lignite, and aggregate materials, but the County's mineral products include (among others), clay, sand, gravel, aggregate, quartz sand, copper, silver, gold, soapstone, marble, slate, greenstone, river rip rap, road base, limestone, sandstone, zinc, chromite, talc, lignite, and diamonds. In addition to other mineral resources present in the planning area, the Ione Formation, located in western Amador County, is the only large source of super duty refractory clay in the western United States. This resource is used in the production of heat-resistant brick for high-temperature furnaces.

Amador County's MRZ-2 areas, described in more detail in Section 4.6.2, "Environmental Setting," include areas with known or inferred deposits of gold, lode gold, copper, zinc, talc, limestone, sand, silica sand, clay, and lignite. These MRZ-2 designations are intended to prevent incompatible land use development on areas determined to have significant mineral resource deposits.

In addition to state-designated MRZ areas, the County has applied the Mineral Resource Zone land use designation and zoning classification to lands throughout the western portion of the County. These designations support mining and related uses, and are intended to facilitate the extraction and use of mineral deposits. The County also has a zone district “MR-Mineral Resource.”

Although the Draft General Plan identifies the importance of mineral extraction to the County’s economy, and the County has designated many areas with mineral resources into the Mineral Resource Zone land use and/or MR zone district, residential dwellings and non-residential land uses which would occur under the Draft General Plan could potentially prevent or restrict the availability of either state- or locally-designated mineral resources. This could include development of new residential dwellings affecting the feasibility of extracting minerals on the same or adjacent properties, or construction of permitted uses on Mineral Resource Zone-designated or MR-zoned properties which restrict the future availability of minerals. This impact would be **significant**.

Mitigation Measure 4.6-8a: Implement P Program P-9, Mineral Resource Management

In order to ensure extraction and processing of mineral resources and aggregate deposits may continue, the County will regulate land uses in Mineral Resource Zone 2 areas to ensure compatibility between mineral extraction, and surrounding existing and planned uses.

Responsible Agencies/Departments: Planning Department

Time Frame: Ongoing

Mitigation Measure 4.6-8b: Implement Program D-1a(13), Development Project Evaluation

The County will review proposed projects for consistency with goals, policies, and implementation programs of this general plan.

- Evaluation criteria for discretionary development proposals include:

13. The County will evaluate development proposals for compatibility with nearby mineral extraction activities and mapped resources to reduce or avoid the loss of mineral resource availability.

Responsible Agencies/Departments: Planning, Transportation and Public Works, and Environmental Health Departments

Time Frame: Ongoing

Significance after Mitigation

Because implementation of Mitigation Measures 4.6-8a and 4.6-8b would require the County to regulate land uses in MRZ-2 areas to ensure continued compatibility with mineral extraction and would also evaluate development proposals to reduce or avoid the loss of mineral extraction potential, including locally important minerals. Therefore, this impact would be **less than significant**.

IMPACT 4.6-9 Possible Damage to Unknown, Potentially Unique Paleontological Resources during Earthmoving Activities. *Implementation of the Draft General Plan would result in construction and other earthmoving activities that could disturb previously unknown paleontological resources in the unincorporated area of Amador County. This impact would be significant.*

Implementation of the Draft General Plan would result in new development in the planning area, including buildings, structures, paved areas, roadways, utilities, and other improvements. The planning area includes areas underlain by the Modesto, Riverbank, Mehrten, and Ione Formations, which are considered to be

paleontologically sensitive rock units under SVP guidelines (1995). The potential that unique paleontological resources could be discovered varies on a project-by-project basis and increases with larger projects that disturb larger areas. As discussed in detail above in the section titled “Paleontological Resource Inventory and Assessment by Rock Unit,” numerous vertebrate fossil specimens have been recorded from the Modesto, Riverbank, Mehrten, and Ione Formations. The fact that vertebrate fossils have been recovered near Amador County and other recorded vertebrate fossil localities have been recorded in sediments referable to these formations, suggests that there is a potential for uncovering additional similar fossil remains during construction-related earthmoving activities, including trenching for utilities, within the planning area. This impact would be **significant**.

Mitigation Measure: Implement Mitigation Measure 4.5-2, Impose Standard Conditions on Development (related to paleontological resources).

Mitigation Measure 4.6-9: Paleontological Resource Assessment

When reviewing discretionary development proposals where a CEQA document is required, the County will require project applicants to conduct a paleontological resources impact assessment for projects proposed within the Modesto, Riverbank, Mehrten, and Ione Formations, ~~where a CEQA document is required and where substantial excavation is anticipated~~. These formations are sensitive for paleontological resources and underlie ~~many certain~~ areas of the County (~~please refer to as shown in Exhibit 4.6-3 for a geologic map of Amador County~~). Impacts to paleontological resources will be evaluated on a site-specific basis, pursuant to the State CEQA Guidelines. Where such impacts are found to be potentially significant, the County will require project applicants to implement feasible mitigation measures to reduce impacts, such as construction worker personnel education, consultation with a qualified paleontologist should resources be encountered, avoidance of resources if feasible, and recovery and curation of specimens, as appropriate. ~~Projects on already disturbed sites and projects that do not involve substantial excavation would be exempt from this requirement.~~

Actions that do not meet the CEQA definition of a “project” and therefore do not require an environmental analysis under the CEQA process shall not be required to perform a paleontological resources analysis.

Responsible Agencies/Departments: Planning

Time Frame: Ongoing

Significance after Mitigation

Because Mitigation Measure 4.6-9 would require site-specific investigation prior to discretionary projects involving ground disturbance in sensitive formations in Amador County, and offers a menu of potentially feasible measures to either avoid resources, or to recover and curate specimens, impacts on unique paleontological resources or sites would be avoided or substantially reduced. This impact would therefore be **less than significant**.

IMPACT 4.6-10 **Potential Damage from a Seiche.** Land adjacent to the County’s reservoirs is generally held in recreational use and open space, with few occupied structures. For those bodies of water in Amador County large enough to be subject to seiche, the Draft General Plan would not change existing land uses or increase risks or exposure to hazards adjacent to these water bodies. The Draft General Plan does not generally place land use designations intended for occupied structures in close proximity to large water bodies. Enclosed water bodies within the County are potential locations for a seiche to occur as a result of an earthquake, and lake users and lake shorelines could be at risk of potential damage from a seiche. This impact would be less than significant.

Most of the water bodies in the planning area are not of a sufficient size that a large damaging seiche could occur as a result of an earthquake; however, the potential does exist. For those bodies of water large enough to be subject to seiche (lakes and reservoirs including Camanche Reservoir, Pardee Reservoir, Lake Amador, Lake Tabeaud, Tiger Creek Reservoir, Salt Springs Reservoir, Silver Lake, Lower Bear River, and Bear River Reservoirs), the land adjacent the County's reservoirs is generally held in recreational use and open space, with few occupied structures. Implementation of the Draft General Plan would not change existing land uses or increase risks or exposure to hazards adjacent to these water bodies. This impact would be **less than significant**.

While highly unlikely, a seiche in one of the County's reservoirs could lead to overtopping of dams. Hazards associated with potential dam failure are discussed in Impact 4.9-6 in Chapter 4.9, "Hydrology and Water Quality."

Mitigation Measure: No mitigation measures are required.