

3.2 LAND RESOURCES

This section describes the topography, soils, geology, seismicity, and mineral resources at the Madera and North Fork sites and in the Madera County region.

3.2.1 GENERAL ISSUES

GEOLOGICAL SETTING

Madera County's geological profile includes portions of two geological provinces, the "Great Valley Province" and the "Sierra Nevada Province." The Great Valley Province consists of the San Joaquin and Sacramento Valleys, and is approximately 435 miles in length along its north-south axis, and approximately 93 miles wide along its east-west axis. Its north-south axis is bounded by the Klamath Mountains to the north and the Transverse Ranges to the south. The province's east-west axis is bounded by the Sierra Nevada Province, consisting of the Sierra Nevada Mountains to the east, and the Coast Ranges to the west.

The Sierra Nevada portion of Madera County is shown in **Figure 3.2-1** to be composed primarily of granitic rock structures of Mesozoic age. The intermediate area, shaded in green, is identified as Mesozoic age sedimentary and volcanic rock structures, in some places strongly metamorphosed. Rock formations in western Madera County, in the Great Valley Province, are shown as sedimentary rock and alluvial deposits of Cenozoic age (approximately 65 million years ago to the present). Further discussion on geology appears under the *Paleontological Resources* heading in **Section 3.6**. Site-specific discussion on geology appears below.

MADERA COUNTY TOPOGRAPHY

A color shaded relief map of the region including and around Madera County appears in **Figure 3.2-2**. The topographical profile of Madera County is characterized as elevated in the Sierra Nevada Province to the east, and lower in its western portion, which lies within the San Joaquin Valley. The highest point in Madera County is found at Mt. Ritter (13,157 feet) among the Sierra Nevada Mountains and in the northeast, near Madera County's border with Mono County. In this portion of the County, the elevation varies greatly, owing to the peak-and-saddle topography of the Sierra Nevada Mountains. The lowest elevations in Madera County are found in the western portion, with elevations of 115 feet found along the border with Merced County, at the town of Dos Palos. Site-specific discussion on topography appears below.

MADERA COUNTY SOILS

The ground surface of the Great Valley province was formed by long-term deposition of sediments, from the late Mesozoic era (approximately 150 million years ago) and the Cenozoic era, originating in many locales from the Sierra Nevada Province to the east. The result is a

Figure 3.2-1 Central California

Figure 3.2-2 Madera County Topography

variety of soil types and provenances. Older alluvial deposits are sometimes exposed on the eastern edge of the Great Valley province. In this area, older river channels marked by fluvial debris had become covered with other sediments or igneous and pyroclastic materials, derived from volcanic processes. Soils in the Sierra Nevada Province and the foothills are generally shallower, with common outcroppings of granitic rocks. Because of the iron content of the mafic parent rocks, soils in the Sierra Nevada Province are reddish in color in many areas. Site-specific discussion on soils appears below.

SEISMICITY

Seismic Intensity: The Modified Mercalli Intensity Scale

The Modified Mercalli Intensity (MMI) scale (**Table 3.2-1**) is a common measure of earthquake effects due to ground shaking intensity. The MMI values for intensity range from I (earthquake not felt) to XII (damage nearly total), and intensities ranging from IV to X could cause moderate to significant structural damage. The damage level represents the estimated overall level of damage that will occur for various MMI intensity levels. The damage, however, will not be uniform. Some buildings will experience substantially more damage than this overall level, and others will experience substantially less damage. Not all buildings perform identically in an earthquake. The age, material, type, method of construction, size, and shape of a building all affect its performance. Maximum peak ground acceleration intensities at the site are expected to cause MMI (VII) ground shaking. Ground shaking effects of this intensity include moderate structural damage to ordinary buildings, but negligible damage to buildings of good design and construction.

Magnitude

On a Richter Scale, the magnitude of an earthquake is determined from the logarithm of the amplitude of waves recorded by seismographs. Adjustments are included for the variation in the distance between the various seismographs and the epicenter of the earthquakes. Magnitude is expressed in whole numbers and decimal fractions. For example, a magnitude 5.3 might be computed for a moderate earthquake, and a strong earthquake might be rated as magnitude 6.3. Because of the logarithmic basis of the scale, each whole number increase in magnitude represents a tenfold increase in measured amplitude; as an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value.

Earthquakes with magnitude of about 2.0 or less are usually called microearthquakes; they are not commonly felt by people and are generally recorded only on local seismographs. Events with magnitudes of about 4.5 or greater are strong enough to be recorded by sensitive seismographs all over the world. Great earthquakes, such as the 1964 Good Friday earthquake in Alaska, have magnitudes of 8.0 or higher. The Richter scale is not used to express damage.

TABLE 3.2-1
MODIFIED MERCALLI INTENSITY SCALE

Intensity Value	Intensity Description	Average Peak Acceleration
I.	Not felt except by a very few persons under especially favorable circumstances.	< 0.0015 g ^a
II.	Felt only by a few persons at rest, especially on upper floors on buildings. Delicately suspended objects may swing.	< 0.0015 g
III.	Felt quite noticeably indoors, especially on upper floors of buildings, but many persons do not recognize it as an earthquake. Standing motorcars may rock slightly. Vibration similar to a passing of a truck. Duration estimated.	< 0.0015 g
IV.	During the day felt indoors by many, outdoors by few. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motorcars rocked noticeably.	0.015 g-0.02 g
V.	Felt by nearly everyone, many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbances of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop.	0.03 g-0.04 g
VI.	Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight.	0.06 g-0.07 g
VII.	Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motorcars.	0.10 g-0.15 g
VIII.	Damage slight in specially designed structures; considerable in ordinary substantial buildings, with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving motorcars disturbed.	0.25 g-0.30 g
IX.	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.	0.50 g-0.55 g
X.	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from riverbanks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks.	> 0.60 g
XI.	Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.	> 0.60 g
XII.	Damage total. Practically all works of construction are damaged greatly or destroyed. Waves seen on ground surface. Lines of sight and level are distorted. Objects are thrown upward into the air.	> 0.60 g

NOTE: ^a g is gravity = 980 centimeters per second squared.

SOURCE: Bolt, Bruce A., *Earthquakes*, W. H. Freeman and Company, New York, 1988.

Liquefaction

Soil liquefaction can occur in seismic conditions. Liquefaction is the temporary transformation of saturated, non-cohesive material from a relatively stable, solid condition to a liquefied state as a result of increased soil pore water pressure. Soil pore water pressure is the water pressure between soil particles. Liquefaction can occur if three factors are present: seismic activity, loose sand or silt, and shallow ground water. Liquefaction potential has been found to be greatest where the ground water is within a depth of 50 feet or less, and submerged loose, fine sands occur within that depth. Liquefaction potential decreases with increasing grain size and clay and gravel content, but increases with increasing ground acceleration and duration of shaking.

3.2.2 MADERA SITE

TOPOGRAPHY

The Madera site is situated within the Great Valley Province; its mean elevation is 252 feet above sea level, with localized elevations ranging between 242 and 261 across the surface of the entire site. There are minor slopes resulting from the differences in elevation, however most of the ground surface is flat. An artificial drainage ditch, known as the Airport Ditch, lines the western boundary of the Madera site. A creek bed enters the Madera site from the southeast quadrant, and is channeled through the middle of the southern half of the Madera site. The channel proceeds directly west until it runs off site. There are no other remarkable topographical features on the Madera site.

SOILS

Madera County Soil Survey

The Natural Resource Conservation Service (NRCS) soil survey for Madera County (1990) identifies and plots soil units, and provides a summary of major physical characteristics for each unit for management considerations. In the land capability classification system used by the NRCS, soils are grouped by Soils Capability Class. A Soils Capability Class indicates limitations for practical use for food, fiber, or forage production. Classes are designated by Roman numerals I through VIII, with additional coding by subclass indicated by lower case letters. Class I is the least restricted with Class VIII being severely limited and nearly precluded from use for commercial crop production. Prime soils are those located on land which has a combination of physical and chemical characteristics best suited to produce forage, feed, food, and other crops. Soils Capability Class I and II soils form prime crop and pasture land, which, under provisions of the Farmland Protection Policy Act of 1980 (FPPA), must be evaluated in implementation of the National Environmental Policy Act (NEPA) for potential environmental effects if they are to be used for non-agricultural development. Further discussion related to the FPPA appears in **Section 3.8.3**.

The Land Capability Classification System is broken down into capability classes, subclasses and units, as applicable to the site. The Land Capability Classification System reflects a degree of limitation on soils for the suitability of most kinds of field crops. The soils in one capability unit are similar enough to require like constraints and management planning.

Madera Site Soils

The Madera site consists of the soils shown on **Table 3.2-2**. The spatial distribution of these soils is shown on **Figure 3.2-3**. San Joaquin sandy loam (SaA) soils constitute the majority of soils on the Madera site. Areas of Atwater loamy sand, Hanford sandy loam, and Tujunga sandy loam are also present on the site. The San Joaquin, Atwater, and Hanford soils are all underlain by hardpans, while the Tujunga soil is associated with former and current drainages and swales. All of the soils listed are identified as alluvial deposits.

Alamo series soils are generally poorly drained clays that overlie an iron-silica hardpan. The parent materials are mainly derived from granitic materials. Soils bearing the AsA symbol are typically associated with San Joaquin and Madera soils, usually in small areas. These soils are variable in depth, with poor drainage and very slow internal drainage. The erosion hazard of these soils is severe, with a moderate available water capacity. Runoff usually becomes ponded.

Soils of the Atwater series are well drained, and typically very deep, and are derived from parent materials comprising older granitic alluvium. Soil under the AwA symbol is moderately deep to deep over hardpan and well drained, with rapid internal drainage. Erosion hazard is severe, with a moderate available water capacity and very slow runoff.

Hanford series soils are generally textured, young alluvium derived from granitic materials with a high micaceous content; that is, containing high aluminum-silica compounds. Soils under the HfA symbol are moderately deep and well drained, with rapid internal drainage. The available water capacity of these soils is low. Erosion hazard is low, with moderately rapid runoff characteristics. Soils under the HgA symbol are shallow and well drained, with rapid internal drainage. Erosion hazard is slight, with a low available water capacity. Runoff characteristics are moderately rapid.

Soils of the Pachappa series are characteristic of alluvial fans mainly comprising older granitic alluvium. PaA soils are very deep, with good drainage and medium internal drainage. Erosion hazard is slight, with a moderate available water capacity. Runoff is very slow.

San Joaquin series soils are basically shallow hardpan consisting of micaceous materials derived from granitic rocks. SaA soils are shallow, with good external drainage and slow internal drainage. Erosion hazard is slight, with a low available water capacity. Runoff is slow, and in

some places very slow. Soils in the San Joaquin-Alamo complex (SbA) differ in that they are variable in depth, with poor drainage and very slow internal drainage. While there is no erosion hazard, the available water capacity is moderate, and runoff is often ponded.

TABLE 3.2-2
SOIL LIMITATIONS

Soils	Depth	Drainage	Internal Drainage	Erosion	Available Water Capacity	Runoff	Storie Index Rating	Capability Subclass
Alamo clay (AsA) 0 to 1% slopes	Variable	Poor	Very slow	None	Moderate	Ponded	13	IIIW-5
Atwater loamy sand (AwA) 0 to 3% slopes	Variable	Well drained	Moderately rapid	Severe	Moderate	Very slow	76	IIIe-4
Hanford sandy loam (HfA) 0 to 3% slopes	Moderately deep	Well drained	Rapid	Slight	Low	Moderately rapid	95	I-1
Hanford sandy loam (HgA) 0 to 3% slopes	Shallow	Well drained	Rapid	Slight	Low	Moderately rapid	67	IIIs-3
Pachappa fine sandy loam (PaA) 0 to 1% slopes	Very deep	Good	Medium	Slight	Moderate	Very slow	95	I-1
San Joaquin sandy loam (SaA) 0 to 3% slopes	Shallow	Good	Slow	Slight	Low	Slow to very slow	27	IVs-3
San Joaquin-Alamo complex (SbA) 0 to 3% slopes	Variable	Poor	Very slow	None	Moderate	Ponded	17	IVs-3
Tujunga loamy sand (TWA) 0 to 3% slopes	Moderate	Somewhat excessive	Very rapid	Severe	Low	Very slow	56	IIIe-4

NOTE: Capability Class: Class I soils are considered to be very good for crops, with few limitations; Class III soils have severe limitations that reduce the choice of plants, that require special conservation practices, or both; Class IV soils have very severe limitations that can restrict the choice of plants or require very careful management.

SOURCE: NRCS 1990 Madera County Soil Survey; AES 2005.

Figure 3.2-3 Madera Site Soils

Tujunga series soils are derived from granitic alluvium. Soils under the TwA symbol are moderately deep, with somewhat excessive drainage. Internal drainage is very rapid, and there is a severe erosion hazard. The available water capacity of these soils is low. Runoff is very slow.

Madera Site Seismicity

The nearest seismic hazard is the San Andreas Fault, which is approximately 40 miles southwest of the Madera site, affecting the overall seismic risk factor for Madera County. **Figure 3.2-4** shows the seismic hazards associated with the region in and around Madera County. The Madera site is shown by the United States Geological Survey (USGS) to lie within an area considered subject to 0.2g to 0.3g maximum peak acceleration, with a 2 percent chance of exceedance in 50 years. On **Table 3.2-1** above, the Modified Mercalli Intensity Scale value assigned to such an event would be VIII. The description provided lists the following conditions: damage slight in specially designed structures; considerable in ordinary substantial buildings, with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments and walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes occur in well water. Persons driving motorcars disturbed.

MINERAL RESOURCES

No mineral resources are known to exist on the Madera site. No mineral extraction or other mining activities take place on or in the vicinity of the Madera site.

3.2.3 NORTH FORK SITE

TOPOGRAPHY

The North Fork Rancheria is located in the Sierra Nevada Geomorphic Province. Its maximum elevation is 3,340 ft in the northeast corner, while its minimum elevation is 2,860 ft in the southwest corner, resulting in a slope of approximately 17% from the northeast to southwest corners.

SOILS

The soils of the North Fork site are unmapped by the NRCS. The nearest regional soils to the North Fork Rancheria have been identified as belonging to the Holland-Tollhouse association. Holland series soils are developed from coarse-grained granitic rocks, and are grayish-brown and reddish-brown in color. These soils are found at altitudes comparable to the North Fork site. Tollhouse soils are typically shallow, and are also derived from weathered granitic rocks. Topography generally ranges from hilly to very steep for soils in this association. Rock outcroppings are common in Tollhouse soil areas, though no such outcroppings were observed on the North Fork site. The Holland soils are deep, whereas the Tollhouse soils are generally shallow, and found on sharper inclines.

Figure 3.2-4

PROJECT AREA SEISMICITY

Figure 3.2-4 shows the seismic hazards associated with the region in and around Madera County. The North Fork Rancheria is approximately 80 miles northeast of the San Andreas Fault, with the continued uplift of intrusive igneous matter creating another fault system approximately six miles to the northeast. The North Fork site is shown by the USGS to lie within an area considered subject to 0.3g to 0.4g maximum peak acceleration, with a 2 percent chance of exceedance in 50 years. On **Table 3.2-1** above, the Modified Mercalli Intensity Scale value assigned to such an event would be between VIII and IX. The description provided lists the following conditions in a seismic event with an intensity value of IX: damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.

MINERAL RESOURCES

Historical records indicate extensive gold mining in the eastern Madera County town of Coarsegold. While some mining operations continue for the extraction of other mineral resources in the area, there is no known mineral resources contained on the North Fork site and no mining activity has taken place on the site.