4.4 GEOLOGY AND SOILS

This chapter identifies and evaluates the changes in conditions related to geology and soils, as well as seismic conditions, associated with implementation of the proposed project. The analysis addresses potentially significant geology and soils effects, and recommends mitigation measures to reduce significant or potentially significant environmental impacts.

This project DEIR has been prepared to meet the requirements of a project-level EIR. The City's intention in preparing this project EIR is that no further environmental review under CEQA would be required for subsequent projects which are consistent with the Specific Plan to provide for the streamlined approval of projects proposed within the Plan area that are consistent with land use designations, adhere to design guidelines (specifically prototype development), or fall within the scope of the Specific Plan and EIR.

4.4.1 EXISTING CONDITIONS

GEOLOGY

Regional Geology

The City of Roseville is located in an area with underlying material composed of alluvial deposits from the Sierra Nevada Mountain Range. Geology consists of transitional formations between the alluvial deposits of the valley and volcanic material characteristic of the Sierra Nevada. The City is underlain by relatively recent Plio-Pleistocene non-marine sedimentary deposits formed during the Cenezoic period (City of Roseville 2004a).

Project Site Geology

The project site is located within the U.S. Geological Survey (USGS) Roseville and Citrus Heights 7.5-Minute Quadrangles. Topography in the Plan area is primarily flat except for Dry Creek, which sits approximately 50 feet lower in elevation than the surrounding Downtown Roseville area. Elevations range from approximately 170 feet above sea level at the northernmost extent of the Plan area, to approximately 115 feet in Dry Creek.

Review of the soils data provided through the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) *Web Soil Survey* indicates that near-surface soils in the Plan area include the following:

- Cometa-Ramona sandy loams, 1 to 5% slopes;
- Xerofluvents, occasionally flooded;
- Xerofluvents, frequently flooded; and
- Xerorthents, cut and fill areas.

Each of these soil types is discussed in greater detail below.

Cometa-Ramona

The Cometa-Ramona sandy loams soil type dominates the Plan area and is identified as an undulating soil located on low terraces. This soil type contains approximately 50% Cometa soil and 30% Ramona soil. San Joaquin sandy loam, Fiddyment loam, and Alamo clay make-up the remainder. Cometa soil is found on short side slopes and bottoms and is a deep, well-drained claypan soil that forms in alluvium primarily from granite sources. Ramona soil is found on fingerlike ridges and younger land surfaces and is a very deep and well-drained soil that forms in alluvium from predominantly granite sources.

Cometa subsoil exhibits a very slow permeability, the potential for shrink-swell, and a limited ability to support a load which creates a major limitation to urban uses. Ramona subsoil exhibits a moderately slow permeability which creates a limitation to urban uses.

Dwelling and road construction can be designed to offset the shrink-swell potential and the low bearing strength of the Cometa soil.

Xerofluvents (Occasionally Flooded)

The xerofluvents, occasionally flooded, soil type is found adjacent to stream channels (e.g., Dry Creek) and consist of small areas of moderately well-drained loamy alluvium. Areas containing this soil type are occasionally flooded by stream overflow and, therefore, are not considered suited for urban uses because of their flood hazard.

Xerofluvents (Frequently Flooded)

The xerofluvents, frequently flooded, soil type is found adjacent to stream channels (e.g., Dry Creek) and consist of narrow stringers of somewhat poorly drained recent alluvium. Areas containing this soil type are subject to frequent flooding and channelization and, therefore, are not considered suited for urban uses because of their flood hazard.

Xerorthents (Cut and Fill Areas)

The xerorthents, cut and fill areas, soil type is primarily found in the UPRR rail yard but have potential to extend into the Plan area. Xerorthents consist of mechanically removed and mixed soil material in cut and fill areas used primarily for highways and urban development. Cut and fill areas are typically well drained with a very rapid surface runoff.

REGIONAL SEISMICITY AND FAULT ZONES

Potential seismic hazards resulting from a nearby moderate to major earthquake can generally be classified as primary and secondary. The primary effect is fault ground rupture, also called surface rupture. Common secondary seismic hazards include ground shaking, liquefaction, and subsidence. Each of these potential hazards is discussed below.

Surface Rupture

Surface rupture is an actual cracking or breaking of the ground along a fault during an earthquake. Structures built over an active fault can be torn apart if the ground ruptures. Surface rupture along faults is generally limited to a linear zone a few meters wide. The Alquist-Priolo Act (see Section 4.4.3, “Regulatory Setting,” below) was created to prohibit the location of structures designed for human occupancy across the traces of active faults, thereby reducing the loss of life and property from an earthquake.

While numerous faults have been identified within 100 kilometers of the Sacramento area, there are no known active faults located within Placer County. Three inactive faults lie within the immediate Roseville vicinity: 1) the Volcano Hill Fault, extending northwesterly for approximately one mile starting just east of the City limits; 2) the Linda Creek Fault (the existence of which is disputed due to lack of recorded activity) extends along a portion of Linda Creek through Roseville and a portion of Sacramento County; and, 3) an unnamed fault alignment extending east to west between Folsom Lake and the City of Rocklin, portions of which are concealed, but possibly connected to the Bear Mountain Fault near Folsom Lake. In 1908, an earthquake estimated to have exceeded 4.0 on the Richter Scale occurred on an unnamed fault in the southwestern portion of Placer County, probably centered between Folsom and Auburn, and Placerville and Roseville (City of Citrus Heights 2000). No significant seismic event has been recorded in the Roseville vicinity since that time.

Seismic Ground Shaking

Ground shaking, motion that occurs as a result of energy released during faulting, could potentially result in the damage or collapse of buildings and other structures, depending on the magnitude of the earthquake, the location of the epicenter, and the character and duration of the ground motion. Other important factors to be considered are the characteristics of the underlying soil and rock, the building materials used, and the workmanship of the structure.

"Active" Faults in the Project Vicinity

Table 4.4-1 identifies faults that have been designated by the California Division of Mines and Geology as "active," and therefore may pose a potential geologic hazard to the project site. These faults show evidence of displacement during Holocene time (11,000 years ago to present). In addition, Table 4.4-1 identifies the approximate distance from the project site, maximum moment magnitude (M), and fault type.

Table 4.4-1
"Active" Faults in the Project Vicinity

Fault	Approximate Distance (miles) from the Plan Area	Historic Activity	Maximum Credible Earthquake[1]
Hayward Fault	60	6.8	6.5–7.0
Calaveras Fault	50	6.1	6.5–7.0
San Andreas Fault	80	7.1	8.3
Midland Fault	32	-	7.0
Dunnigan Hills Fault	35	-	6.5
Foothills Fault System	15	5.7	6.5

Note:
[1] The Maximum Credible Earthquake is defined as the strongest earthquake that is likely to be generated along an active fault zone, and is based on the geologic character of the fault and the earthquake history.
Source: *City of Citrus Heights General Plan, Summary of Background Information, November 2000*

For purposes of this EIR, the California Geological Survey's Probabilistic Seismic Hazards Mapping Ground Motion Page (California Geological Survey 2008) was consulted to estimate site-specific probabilistic ground acceleration for the Plan area. Peak horizontal ground acceleration (the level of ground shaking) with 10% probability of being exceeded in 50 years was calculated for firm rock, soft rock, and alluvium in percentage of gravity (g) (or percentage of the earth's normal gravitational strength). These calculations found that there is a 1-in-10 probability that an earthquake will occur within 50 years that would result in a peak horizontal ground acceleration (pga) exceeding 0.157 pga (California Geological Survey 2008). Peak horizontal ground acceleration is a measure of earthquake acceleration. Unlike the Richter magnitude scale, pga is not a measure of the total size of the earthquake but rather how hard the earth shakes in a given geographic area. However, pga generally correlates with the Mercalli scale.

Ground Failure/Liquefaction

Soil liquefaction occurs when ground shaking from an earthquake causes a sediment layer saturated with groundwater to lose strength and take on the characteristics of a fluid, thus becoming similar to quicksand. Factors determining the liquefaction potential are soil type, the level and duration of seismic ground motions, the type and consistency of soils, and the depth to groundwater. Loose sands and peat deposits are susceptible to liquefaction,

while clayey silts, silty clays, and clays deposited in freshwater environments are generally stable under the influence of seismic ground shaking.

Liquefaction poses a hazard to engineered structures. The loss of soil strength can result in bearing capacity insufficient to support foundation loads, increased lateral pressure on retaining or basement walls, and slope instability. Although no specific liquefaction hazard areas have been identified in the City of Roseville, this potential is recognized throughout the Central Valley where unconsolidated sediments and a high water table coincide.

No determination has been made that liquefaction exists in the Roseville area. Based on project-specific analysis and past experience, liquefaction has not been a significant problem within the City (City of Roseville 2004b).

SUBSIDENCE

Ground subsidence is the sinking of land over man-made or natural underground voids. Land subsidence can be induced by both natural and human phenomena. Natural phenomena include: subsidence resulting from tectonic deformations and seismically induced settlements; soil subsidence from consolidation, hydrocompaction, or rapid sedimentation; subsidence from oxidation or dewatering of organic-rich soils; and subsidence related to subsurface cavities. Subsidence related to human activity includes subsurface fluid or sediment withdrawal. Pumping of water for residential, commercial, and agricultural uses from subsurface water tables causes more than 80% of the identified subsidence in the United States (Galloway et al. 1999). Lateral spreading is the horizontal movement or spreading of soil toward an open face, such as a streambank, the open side of fill embankments, or the sides of levees. The potential for failure from subsidence and lateral spreading is highest in areas where there is a high groundwater table, where there are relatively soft and recent alluvial deposits, and where creek banks are relatively high.

The City's geographic location, soil conditions, and surface terrain combine to minimize risk of major damage from landslides, subsidence (gradual shrinking of the earth's surface due to underground resource extraction), or other geologic hazards resulting from seismic activity and related natural forces (City of Roseville 2004b).

SLOPE STABILITY

A landslide is the downhill movement of masses of earth material under the force of gravity. The factors contributing to landslide potential are steep slopes, unstable terrain and proximity to earthquake faults. This process typically involves the surface soil and an upper portion of the underlying bedrock. Expansive soil on slopes tends to shrink and swell in response to moisture content changes. During this shrinking and swelling process, gravity tends to work the soil downslope. Movement may be very rapid, or so slow that a change of position can be noted only over a period of weeks or years (soil "creep"). The size of a landslide can range from several square feet to several square miles.

While Roseville is located on relatively level terrain, the land gradually increases in slope to the east and north. The most significant slope areas are located along creeks and ravine areas. The soils in the Plan area have slight to moderate erosion potential, particularly adjacent to Dry Creek (NRCS 2008).

EXPANSIVE SOILS

Expansive soils have the ability to shrink and swell with wetting and drying. Soils with high clay content tend to be the most affected. The shrink-swell potential of expansive soils can result in differential movements beneath foundations. The potential for soil to undergo shrink and swell is enhanced by the presence of a fluctuating, shallow groundwater table. Volume changes of expansive soils can result in the consolidation of soft clays following the lowering of the water table or the placement of fill. The soils in the Plan area have a moderate

shrink-swell potential (NRCS 2008). Shrink-swell refers to the soils ability to expand when wet and to contract when dry.

4.4.2 REGULATORY SETTING

FEDERAL

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 and reduction program. To accomplish this, the act established the National Earthquake Hazards Reduction Program (NEHRP). This program was significantly amended in November 1990 by the National Earthquake Hazards Reduction Program Act (NEHRPA) by refining 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 (FEMA) 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 USGS.

STATE

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Act (PRC Sections 2621–2630) was passed in 1972 to mitigate the hazard of surface faulting to structures designed for human occupancy. The main purpose of the law is to prevent the construction of buildings used for human occupancy on the surface trace of active faults. The law addresses only the hazard of surface fault rupture and is not directed toward other earthquake hazards. The Alquist-Priolo Act requires the State Geologist to establish regulatory zones known as "Earthquake Fault Zones" around the surface traces of active faults and to issue appropriate maps. The maps are distributed to all affected cities, counties, and state agencies for their use in planning efforts. Before a project can be permitted in a designated Alquist-Priolo Earthquake Fault Zone, cities and counties must require a geologic investigation to demonstrate that proposed buildings would not be constructed across active faults.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act of 1990 (PRC Sections 2690–2699.6), addresses earthquake hazards from nonsurface fault rupture, including liquefaction and seismically induced landslides. The act established a mapping program for areas that have the potential for liquefaction, landslide, strong ground shaking, or other earthquake and geologic hazards. The act also specifies that the lead agency for a project may withhold development permits until geologic or soils investigations are conducted for specific sites and mitigation measures are incorporated into plans to reduce hazards associated with seismicity and unstable soils.

National Pollutant Discharge Elimination System Permit

In California, the State Water Resources Control Board (SWRCB) administers regulations promulgated by the U.S. EPA (55 Code of Federal Regulations [CFR] 47990) requiring the permitting of stormwater-generated pollution under the National Pollutant Discharge Elimination System (NPDES). In turn, the SWRCB's

jurisdiction is administered through nine regional water quality control boards. Under these federal regulations, landowners must obtain a Construction General Permit through the NPDES Stormwater Program for all construction activities with ground disturbance of 1 acre or more. The General Permit requires the implementation of best management practices (BMPs) to reduce sedimentation into surface waters and control erosion. One element of compliance with the NPDES permit is preparation of a Stormwater Pollution Prevention Plan (SWPPP) that addresses control of water pollution, including sediment, in runoff during construction (see Section 4.12, "Hydrology and Water Quality," for more information about the NPDES and SWPPPs).

California Building Standards Code

The State of California provides minimum standard for building design through the California Building Standards Code (California Code of Regulations, Title 24). Where no other building codes apply, Chapter 29 regulates excavation, foundations, and retaining walls. The California Building Standards Code (CBC) applies to building design and construction in the state and is based on the federal Uniform Building Code (UBC) used widely throughout the country (generally adopted on a state-by-state or district-by-district basis). The CBC has been modified for California conditions with numerous more detailed and/or more stringent regulations.

The state earthquake protection law (California Health and Safety Code Section 19100 et seq.) requires that structures be designed to resist stresses produced by lateral forces caused by wind and earthquakes. Specific minimum seismic safety and structural design requirements are set forth in Chapter 16 of the CBC. The CBC identifies seismic factors that must be considered in structural design.

Chapter 18 of the CBC regulates the excavation of foundations and retaining walls, and Appendix Chapter A33 regulates grading activities, including drainage and erosion control, and construction on unstable soils, such as expansive soils and areas subject to liquefaction.

LOCAL

City of Roseville General Plan

The following goals and policies from the *City of Roseville General Plan 2020* are applicable to the proposed project:

Seismic and Geologic Hazards Goal 1: Minimize injury and property damage due to seismic activity and geologic hazards.

- **Seismic and Geologic Hazards Policy 3:** Minimize soil erosion and sedimentation by maintaining compatible land uses, suitable building designs, and appropriate construction techniques.

- **Seismic and Geologic Hazards Policy 6:** Require contour grading, where feasible, and revegetation to mitigate the appearance of engineered slopes and to control erosion.

City of Roseville Building Codes and Regulations

The City of Roseville Building and Construction Ordinance (16.04) incorporates the following Uniform Codes into its building requirements to ensure that buildings are designed and sited properly to protect against seismic and unstable soils conditions: Uniform Building Code, Uniform Housing Code, Uniform Building Code for Abatement of Dangerous Buildings, Uniform Mechanical Code, Uniform Plumbing Code, and National Electric Code.

4.4.3 ENVIRONMENTAL IMPACTS

METHOD OF ANALYSIS

Evaluation of potential geologic and soil impacts was based on a review of documents pertaining to the Plan area, including the City of Roseville General Plan, the U.S. Department of Agriculture NRCS *Soil Surveys* (NRCS 2008); California Geological Survey geologic maps; and published and unpublished geologic literature. The information obtained from these sources was reviewed and summarized to establish existing conditions and to identify potential environmental effects, based on the standards of significance presented in this section. In determining the level of significance, the analysis assumes that the proposed project would comply with relevant federal, state, and local ordinances and regulations, as well as the City of Roseville General Plan policies and building code requirements presented in this section. Water quality effects during construction are addressed in Section 4.12, "Hydrology and Water Quality."

The proposed project would not remove septic systems and does not include and would not use septic tanks or alternative wastewater disposal systems. This issue will not be analyzed further in this DEIR.

THRESHOLDS OF SIGNIFICANCE

An impact is considered significant, as defined by the State CEQA Guidelines (Appendix G), if the proposed project or alternatives would:

- expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
  - the 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;
  - 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 landsliding, lateral spreading, subsidence, liquefaction, or collapse; or
- be located on expansive soil, as defined in Table 18-1-B of the UBC, creating substantial risks to life or property.

IMPACT 4.4-1 **Geology and Soils – Risks to People and Structures Caused by Seismic Hazards, Including Surface Fault Rupture and Strong Ground Shaking.** *The Plan area is not located within an earthquake fault zone as designated by the Alquist-Priolo Earthquake Fault Zone Act. In addition, the Plan area is not located in an area considered by the California Geological Survey to be a relatively high ground shaking zone. Therefore, project development in the Plan area does not have the potential to expose people and structures to substantial adverse effects from seismic hazards including fault ground rupture and strong seismic ground shaking. This impact is considered* ***less than significant****.*

The project site is not located within an earthquake fault zone as designated by the Alquist-Priolo Earthquake Fault Zone Act (California Geological Survey 2008). The nearest fault that has been zoned as "active" is the Foothills fault system located approximately 15 miles east of the Plan area; this fault is estimated to have a maximum moment magnitude of 6.5 (Table 4.4-1).

The California Geological Survey's Probabilistic Seismic Hazards Mapping Ground Motion Page (California Geological Survey 2008) was consulted to estimate site-specific probabilistic ground acceleration for the Plan area. The calculations found that there is a 1-in-10 probability that soils in the Plan area will have a peak horizontal ground acceleration (level of ground shaking) exceeding 0.157 pga within 50 years (California Geological Survey 2008).

Strong ground shaking may also occur in the Plan area as a result of large, distant earthquakes. However, faults most notable for having the capability of resulting in a large earthquake (i.e., Hayward, Calaveras, San Andreas) are located over 50 miles from the Plan area and would not present any danger to structures in the Plan area. In addition, future development projects in the Plan area would be required to meet standards and regulations of the California Building Standards Code and of the City of Roseville.

Because development in the Plan area with homes and other urban structures does not have the potential to expose people to substantial adverse effects from fault ground rupture and strong seismic ground shaking, this impact is considered less than significant.

IMPACT 4.4-2 Geology and Soils – Seismically Induced Risks to People and Structures Caused by Liquefaction. *The Plan area is not located in an area considered to be exposed to relatively high ground shaking and ground shaking, as a result of seismic activity from nearby or distant earthquake faults, would not cause seismic-related ground failure, including liquefaction. The potential for seismically induced liquefaction in the Plan area is low because soil types are not identified to be subject to the effects of liquefaction and liquefaction has posed a historical problem in Roseville. This impact would be* ***less than significant****.*

Based on the soil types found in the Plan area and the relative distance of faults that could result in exposing the soils in the Plan area to ground shaking, the risk of liquefaction is considered low. Although no specific liquefaction hazard areas have been identified in the City of Roseville, this potential is recognized throughout the Central Valley where unconsolidated sediments and a high water table coincide. However, to date no determination has been made that liquefaction exists in the Roseville area and based on project-specific analysis and past experience by City engineers, liquefaction has not posed a significant problem in the City. Given this low risk of exposure and the nature of the soil types found at the project site that would be subject to liquefaction, the risk to people and structures appears to be low and this impact is considered less than significant.

IMPACT 4.4-3 Geology and Soils – Seismically-Induced Risks to People and Structures Caused by Landsides. *The project is not located in an area considered to be exposed to relatively high ground shaking. Ground shaking, as a result of seismic activity from nearby or distant earthquake faults, could cause seismic-related ground failure, including landslides in areas where slopes are present. Specifically, Dry Creek has steep slopes on both sides of the creek corridor that could be subject to landslides during a seismic event. Because the Specific Plan identifies improvements within the Dry Creek corridor, this impact is considered* ***potentially significant****.*

While landslides caused by seismic activity could occur along the steeper slopes along Dry Creek in the Plan area, there is no indication of major slope instability along Dry Creek, and no evidence of recent landslides in the Plan area or in the vicinity. While the potential for a major landslide along Dry Creek is low, site soils could be subject to localized soil creep, slumping, and small landslides on oversteepened slopes, along incised drainages, and in water-saturated granular soils found along Dry Creek.

The Downtown Roseville Specific Plan identifies improvements that would occur along Dry Creek to protect and further develop the natural habitat for Dry Creek (Policy 8.4.2). Improvements could include planting additional trees in the floodplain and modifications to the streambed to improve habitat for aquatic wildlife species. Specific improvements related to improving habitat include bank recontouring and stabilization to reduce the amount of erosion that is prevalent in some reaches of the Dry Creek stream corridor and installation of riffles. Another improvement would involve installing future storm drain treatment mechanisms identified as part of the storm water component of the Plan to improve the overall water quality in Dry Creek. In addition, the Specific Plan identifies excavation would occur for an amphitheater adjacent to the Dry Creek.

Although the improvements to Dry Creek are intended to improve existing biological habitat conditions and drainage capabilities, details related to these improvements have not yet been identified. In addition, excavation activities associated with the amphitheater could directly affect slopes along Dry Creek. As a result, the potential for these improvements to effect the stability of banks along Dry Creek are not known. Therefore, this is considered a potentially significant impact.

IMPACT 4.4-4 Geology and Soils – Construction-Related Erosion Hazards. *Based on soil types that have a moderate to high erosion potential and steep slopes in the Dry Creek corridor, excavation and grading of soil could result in erosion during construction activities. Erosion and sediment control plans would be required to be prepared as part of individual development projects in the Plan area under the City's Grading Ordinance which would require reducing erosion and retaining sediment on-site. This impact is considered to be* ***less than significant****.*

Construction activities associated with future development projects in the Plan area would involve excavation and grading of soil which would expose on-site soils to wind and water erosion. In general, the potential for erosion to occur at a specific project site is low on slopes with gradients less than 10% (found in the majority of the Plan area). Where slope gradients are between 10% and 30%, the potential for erosion is moderate. The erosion potential for soil on slopes greater than 30% is considered high, as found in the Dry Creek corridor.

Although the majority of development activities envisioned as part of the Specific Plan would occur on relatively flat slopes, excavation activities are expected to occur for an amphitheater located adjacent to the Dry Creek corridor (Policy 8.4.2). Excavation activities associated with the amphitheater could occur in areas with slopes greater than 10%.

In accordance with the City's Grading Ordinance, the applicant for a specific development project occurring in the Plan area, including the proposed amphitheater, would be required to submit an erosion and sediment control plan to reduce the amount of erosion and retain sediment on the project site. In addition, the City's Grading Ordinance includes specific standards for project construction and erosion control including the requirement for prompt re-vegetation of disturbed areas, avoidance of grading activities during wet weather, avoidance of disturbance within drainages, as well as other erosion and sedimentation control measures.

Because the soils in the plan area have only a slight potential for erosion and because erosion control measures would be implemented, construction activities associated with development projects in the Plan area would result in a less-than-significant impact on soil erosion.

IMPACT 4.4-5 Geology and Soils – Potential for Subsidence or Compression of Unstable Soils. *The Plan area is not located in a known subsidence area as identified by the City of Roseville General Plan and is not located on soils that exhibit the potential to subside. This impact is considered* ***less than significant****.*

Subsidence, the sinking of land, is caused by compaction of unconsolidated soil units during a seismic event, compaction by heavy structures, erosion of peat soils, or groundwater depletion. Subsidence usually occurs over a broad area and is therefore not detectable at the ground surface.

The Plan area is not located in a known subsidence area as identified by the City of Roseville General Plan. In addition, the City's geographic location, soil conditions, and surface terrain combine to minimize risk of major damage from subsidence (gradual shrinking of the earth's surface due to underground resource extraction) or other geologic hazards resulting from seismic activity and related natural forces (City of Roseville 2004b). Therefore, this impact is considered less than significant.

IMPACT 4.4-6 Geology and Soils – Potential for Damage Associated with Expansive Soils. *Soil types found in the Plan area are moderately to highly susceptible to expansive soil behavior. Expansive soils may cause differential and cyclical foundation movements that can cause damage and/or distress to overlying structures. However, preparation of geotechnical evaluations would be required to be prepared as part of the building permit process which would identify any needed special construction and/or design methods for alleviating soil constraints. This impact would be considered* ***less than significant****.*

Expansive soils comprise mainly clays that increase in volume when water is absorbed and shrink when dry. All of the soil types occurring in the Plan area contain various levels of clay in their compositions. Although expansive soils generally have the ability to shrink and swell with wetting and drying, their shrink-swell potential can result in differential movements beneath foundations. Soils with high clay content tend to be the most affected by expansion. Most important to future urban development envisioned in the Plan area, if the expansive soils are not considered during design and construction, structural damage, warping, and cracking of roads and sidewalks, and rupture of utility lines may occur. According to the NRCS, the soil types found in the Plan area have a moderate shrink-swell potential (NRCS 2008). However, this constraint can be overcome through application of standard engineering practices and compliance with the UBC and City of Roseville Improvement Standards. In addition, site-specific geotechnical evaluations would be required to be prepared by developers in the Plan area as required as part of the building permit process. The geotechnical evaluations would identify locations where special construction and design methods would be needed and would include recommendations for alleviating constraints due to expansive soils or other soil constraints. Developers would be required to comply with recommendations set forth in the geotechnical evaluation as required by the City's building permit process. Therefore, this impact is considered less than significant.

4.4.4 MITIGATION MEASURES

No mitigation measures are necessary for the following less-than-significant impact:

4.4-1: Geology and Soils – Risks to People and Structures Caused by Seismic Hazards, Including Surface Fault Rupture and Strong Ground Shaking

4.4-2: Geology and Soils – Seismically Induced Risks to People and Structures Caused by Liquefaction

4.4-4: Geology and Soils – Construction-Related Erosion Hazards

4.4-5: Geology and Soils – Potential for Subsidence or Compression of Unstable Soils

4.4-6: Geology and Soils – Potential for Damage Associated with Expansive Soils

The following mitigation measures are provided for significant impacts.

Mitigation Measure 4.4-3: Geology and Soils – Seismically-Induced Risks to People and Structures Caused by Landslides

To minimize potential damage from unstable soil (landslides) along Dry Creek, the project applicant shall hire a qualified, licensed geotechnical engineer to map the Dry Creek corridor for clay-rich, weak soils, and high groundwater conditions prior to any construction or grading activities occurring in Dry Creek. Any unstable or

hazardous slopes identified during the geotechnical investigation shall be identified by the geotechnical engineer and the geotechnical engineer shall provide recommendations for preventing landslides during project design and/or construction. These measures shall be included in grading permits prior to approval by the City.

4.4.5 RESIDUAL SIGNIFICANT IMPACTS

Implementation of the above mitigation measures would reduce all significant impacts to a less-than-significant level.