

5. Environmental Analysis

5.4 GEOLOGY AND SOILS

This section of the Draft Environmental Impact Report (DEIR) evaluates the potential for implementation of the CollegeTown Specific Plan to impact geological and soil resources in the City of Fullerton.

5.4.1 Environmental Setting

5.4.1.1 REGULATORY BACKGROUND

Geologic Setting

The project site is in the Peninsular Ranges Geomorphic Province, a series of mountain ranges separated by northwest-trending valleys, which characterizes the southwest portion of California. The project site is located in the northeast part of the Los Angeles Basin, southeast of the Coyote Hills, which is an east-to-west-trending range of hills. Geological mapping of the area indicates that the near-surface native soils at the subject site consist of Holocene to Pleistocene-age nonmarine alluvium composed of varying proportions of sand, gravel, silt, and clay deposited by fluvial systems (Morton 2004; Leighton and Associates 2006). Based on geotechnical boring logs collected on the University House development adjacent to the site, the near-surface soils consist mainly of sand and silt, with varying proportions of silt, clay, and gravel (Leighton and Associates 2006). Clay lenses with thickness ranging from 5 to 10 feet were also encountered in some of the borings and were generally deeper than 20 feet below the ground surface (Leighton and Associates 2006).

Faulting and Seismicity

Numerous faults have been mapped in southern California, several of which are within approximately 62 miles (100 kilometers) of the project site. The California Geological Survey (CGS) requires that faults within 100 kilometers that could affect the site or the revised project be identified. The major active and potentially active fault systems that could produce significant ground shaking at the site include the Elysian Park Blind Thrust, Whittier, and San Jose faults.

Geologic Hazards

Subsidence

In California, subsidence related to human activities has been attributed to withdrawal of subsurface fluids such as oil and groundwater, oxidation of subsurface organic material such as peat and coal, and hydroconsolidation (from excessive irrigation) of loose, dry soils in a semiarid climate.

Withdrawal of groundwater has occurred in the project area for agricultural purposes; however, this practice has been greatly reduced in recent years, due to the change in predominant land use in the 1960s from growing crops to residential, retail, and academic uses. As a result, groundwater elevations in the vicinity of the site have risen. With respect to oxidation of organic soils, numerous borings drilled on the University House development adjacent to the site have not encountered highly organic soils such as peat. Further, borings indicate that the soils are moist almost up to the ground surface. Consequently, the future occurrence of subsidence resulting from human activities is judged to be remote.

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Landslides and Slope Stability

A landslide is the perceptible downslope movement of earth mass. Landsliding can range from a downward creep of soil and rock material to sudden failure of entire hillsides. Landslides include rockfalls, slumps, block slides, mudslides, debris flows, and mud flows. Landsliding or slope instability may be caused by natural factors such as fractured or weak bedrock, heavy rainfall, erosion, earthquake activity, and fire, as well as by human alteration of topography and water content.

Soil Characteristics

Compressible Soils

Soils will become compressed to varying degrees when a load is placed on the soil, due to a decrease in the total volume of pore spaces between grains of soil. The alluvial soils onsite are considered to be slightly to moderately compressible.

Expansive Soils

Expansive soils swell when they become wet and shrink when they dry out, resulting in the potential for cracked building foundations and in some cases, structural distress of the buildings themselves. Based on boring logs from the adjacent University House development, potentially expansive clay layers were encountered deeper than 20 feet below the ground surface.

Hydrocollapse

Hydrocollapse is the potential settlement of a soil under stress, such as the weight of a structure, when the soil is wetted. Hydrocollapse conditions are usually encountered in relatively dry, desert environments not usually subjected to any prolonged precipitation. This condition would not be expected at the subject site.

Corrosive Soils

Water-soluble sulfates in soil can damage concrete. However, concrete in contact with soil containing sulfate concentrations of less than 0.10 percent by weight is considered to have negligible sulfate exposure. Representative near-surface soil samples were tested for soluble sulfate content on the adjacent University House development; the concentrations found were less than 0.02 percent by weight, indicating negligible sulfate exposure.

Soil corrosivity to ferrous metals, that is, metals containing iron, can be estimated by electrical resistivity, chloride content, and pH. The resistivity of a material is its resistance to the flow of electric current; soil having resistivity of 2,000 ohm-centimeters or less is generally considered to be corrosive. Samples of soils on the adjacent University House development showed minimum resistivity of between 1,405 and 1,542 ohm-centimeter, indicating that they are corrosive to ferrous metals.

Erosion

Erosion is the movement of soil and rock from place to place. Erosion is a natural process and is occurring within the existing project site. Common forces that cause erosion include wind and flowing water. Within the

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project site, gravity also causes erosion in the form of landslides. The project site is gently sloping to nearly flat. Ground-disturbing activities such as grading can greatly increase the rate of erosion if effective erosion-control measures are not employed.

Seismic Hazards

Earthquake Faults, Including Information on Historical Earthquakes

Numerous faults have been mapped in southern California, several of which are within about 62 miles (100 kilometers) of the project site (see Table 5.4-1). CGS requires that faults within 100 kilometers that could affect the site or the revised project be identified. The major active and potentially active fault systems that could produce significant ground shaking at the site include the Elysian Park Blind Thrust, Whittier, and San Jose faults. Characteristics of a few of these individual fault systems are discussed on the next page.

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Table 5.4-1 Earthquake Faults

Fault Name	Distance from Project Site (miles)
Elysian Park Blind Thrust	2.7
Whittier	4.2
San Jose	11.4
Chino-Central Ave. (Elsinore)	12.9
Elsinore-Glen Ivy	14.3
Newport-Inglewood (L.A. Basin)	14.5
Compton Thrust	16.2
Sierra Madre	18.2
Cucamonga	19.5
Newport-Inglewood (Offshore)	19.7
Raymond	21.1
Clamshell-Sawpit	21.9
Palos Verdes	23.2
Verdugo	23.5
Hollywood	26.0
Santa Monica	33.2
San Jacinto-San Bernardino	33.3
Elsinore-Temecula	34.7
San Andreas – Mojave	36.1
San Andreas – 1857 Rupture	36.1
San Andreas – Southern	36.2
San Andreas – San Bernardino	36.2
Sierra Madre (San Fernando)	36.4
San Gabriel	38.1
San Jacinto-San Jacinto Valley	38.5
Cleghorn	38.6
Malibu Coast	38.7
Northridge (E. Oak Ridge)	40.9
Coronado Bank	41.9
North Frontal Fault Zone (West)	45.7
Santa Susana	46.8
Anacapa-Dume	47.0
Holser	53.4
San Jacinto-Anza	56.3
Rose Canyon	57.8
Simi-Santa Rosa	59.7
Oak Ridge (Onshore)	60.1
Elsinore-Julian	60.7

Source: Blake 2000; Leighton and Associates 2006.

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Historical earthquakes in the project area include the 1857 Fort Tejon earthquake (magnitude 7.9) on the San Andreas Fault, the 1933 Long Beach earthquake (magnitude 6.3) along the Newport-Inglewood Fault Zone, the 1987 Whittier Narrows earthquake (magnitude 5.9) on the Elysian Thrust Fault, the 1992 Landers earthquake (magnitude 7.4), the 1994 Northridge earthquake (magnitude 6.6), the 2008 Chino Hills earthquake (magnitude 5.5).

Surface (Fault) Rupture

To protect structures from the hazard of surface ground rupture along a fault line, the CGS, under the state-mandated Alquist-Priolo Act of 1972, has delineated “Earthquake Fault Zones” along active or potentially active faults. A fault is considered active if there is evidence of movement along one or more of its segments in the last 11,000 years, which is either directly observable or inferred. A well-defined fault is one in which its trace can be clearly detected by a trained geologist as a physical feature at or just below the ground surface. A well-defined fault may be identified by either direct or indirect methods. If a site is in an Earthquake Fault Zone, a detailed fault investigation is required prior to construction. The project site is not in an Earthquake Fault Zone and there are no faults known to exist or mapped crossing the site.

Strong Seismic Ground Shaking

The probability that the site will be subject to strong seismic shaking from a moderate to large earthquake on a major active fault in the Los Angeles region is high. The intensity of ground shaking at a given location depends primarily upon the earthquake magnitude, faulting mechanism, distance from the source (epicenter) and the site response characteristics. The intensity of shaking is generally amplified in areas underlain by deep deposits of loose, unconsolidated soils. Ground shaking is also known to be enhanced by topographic highs. The most common effects of strong seismic shaking include liquefaction and its related ground deformations, dynamic settlement, and landsliding.

Seismically Induced Slope Failure

Landslides triggered by earthquakes have been documented to cause significant damage. In California, large earthquakes triggered landslides that were responsible for destroying or damaging numerous structures. Areas that are most susceptible to seismically induced slope failure are steep slopes in poorly cemented or highly fractured rocks; areas underlain by loose, weak soils; and areas on or adjacent to existing landslide deposits.

Liquefaction and Related Ground Failure

Liquefaction is a process whereby strong earthquake shaking causes sediment layers that are saturated with groundwater to lose strength and behave as a fluid. This subsurface process can lead to near-surface or surface ground failure that can result in property damage and structural failure. If surface ground failure does occur, it is usually expressed as lateral spreading, flow failures, ground oscillation, and/or general loss of bearing strength. Sand boils (injections of fluidized sediment) commonly accompany these different types of failure.

In order to determine a region’s susceptibility to liquefaction, three major factors must be analyzed:

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- The intensity and duration of ground shaking.
- The age and textural characteristic of the alluvial sediments. Generally, the younger, less-well-compacted sediments tend to have a higher susceptibility to liquefaction. Textural characteristics also play a dominant role in determining liquefaction susceptibility. Sand and silty sands deposited in river channels and floodplains tend to be more susceptible to liquefaction, and floodplains tend to be more susceptible to liquefaction than coarser or finer grained alluvial materials.
- The depth to groundwater. Groundwater saturation of sediments is required in order for earthquake induced liquefaction to occur. In general, groundwater depths shallower than 10 feet to the surface cause the highest liquefaction susceptibility.

Research and historical data indicate that loose, granular materials at depths of less than 50 feet with silt and clay contents of less than 30 percent, saturated by a relatively shallow groundwater table are most susceptible to liquefaction. These geological conditions are typical in parts of southern California, including the City of Fullerton, and in valley regions and alluviated floodplains.

Hazardous Buildings

The principal threat in an earthquake is not limited to ground shaking, fault rupture, or liquefaction, but the damage that the earthquake causes to buildings that house people or an essential function. Continuing advances in engineering design and building code standards over the past decade have greatly reduced the potential for collapse in an earthquake of most of our new buildings. However, many buildings were built in past decades, before some of the earthquake design standards were incorporated into the building code. Several specific building types are a particular concern in this regard.

- **Unreinforced Masonry Buildings:** In the late 1800s and early 1900s, unreinforced masonry was the most common type of construction for larger downtown commercial structures and for multistory apartment and hotel buildings. These were recognized as a collapse hazard following the San Francisco earthquake of 1906, the Santa Barbara earthquake of 1925, and the Long Beach earthquake of 1933. These buildings are still recognized as the most hazardous buildings in an earthquake.

Per Senate Bill 547, local jurisdictions are required to enact structural hazard reduction programs by (a) inventorying pre-1943 unreinforced masonry buildings, and (b) developing mitigation programs to correct the structural hazards.

- **Precast Concrete Tilt-up Buildings:** This building type was introduced following World War II and gained popularity in light industrial buildings during the late 1950s and 1960s. Extensive damage to concrete tilt-up buildings in the 1971 San Fernando earthquake revealed the need for better anchoring of walls to the roof, floor, and foundation elements of the building and for stronger roof diaphragms.¹ In

¹ A roof diaphragm is a structural roof deck that is capable of resisting shear that is produced by lateral forces, such as wind or seismic loads.

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the typical damage to these buildings, the concrete wall panels would fall outward and the adjacent roof would collapse, creating a direct hazard.

- **Soft-Story Buildings:** Soft-story buildings are those in which at least one story, commonly the ground floor, has significantly less rigidity and/or strength than the rest of the structure. This can form a weak link in the structure unless special design features are incorporated to give the building adequate structural integrity. Typical examples of soft-story construction are buildings with glass curtain walls on the first floor only, or buildings placed on stilts or columns, leaving the first story open for landscaping, street-friendly building entry, parking, or other purposes. In the early 1950s to early 1970s, soft story buildings were a popular construction style for low- and mid-rise concrete frame structures.
- **Nonductile Concrete Frame Buildings:** The brittle behavior of nonductile concrete frame buildings can create major damage and even collapse under strong ground shaking. This type of construction, which generally lacks masonry shear walls, was common in the very early days of reinforced concrete buildings, and they continued to be built until the codes were changed to require ductility in the moment-resisting frame in 1973.

There were large numbers of these buildings built for commercial and light industrial use in California's older, densely populated cities. Although many of these buildings have four to eight stories, there are many in the lower height range. This category also includes one-story parking garages with heavy concrete roof systems supported by nonductile concrete columns.

5.4.1.2 EXISTING CONDITIONS

Topography

The site is on an alluvial fan in the northeast part of the Los Angeles Basin, southeast of the Coyote Hills. The site ranges in elevation between approximately 210 to 240 feet above mean sea level. The topography of the site has a gentle gradient to the southwest (slopes less than 0.9 percent). Surrounding areas away from the site also have gentle terrain.

Surficial Units

The near-surface geology of the site has been mapped as mostly Holocene and late Pleistocene alluvial fan deposits mainly composed of silt and sand, with the remaining area on the southern portion of the site mapped as middle to early Pleistocene alluvial fan deposits mainly composed of silt and sand. This description is similar to the soils documented on the adjacent University House development. Units of potentially expansive clay were not encountered in the upper 20 feet of the adjacent site.

Faulting and Seismicity

The site is in a seismically active region bounded by active faults and affected by historic large earthquakes. Therefore, it is reasonable to assume that the site will be subjected to future seismic shaking that may occur along one or more local or regional faults. No known faults have been identified on the site. A listing of nearby faults is presented in Table 5.4-1 above.

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Other Hazards (e.g., landslides/liquefaction)

As shown on the State of California Seismic Hazard Zone Maps for the La Habra and Anaheim Quadrangles, the project area is not within a Zone of Required Investigation for Earthquake-Induced Landslides or a Zone of Required Investigation for Liquefaction. Additionally, the geotechnical report for the adjoining University House project did not expect any impacts from landslides or liquefaction for the adjacent site. Landslides and liquefaction are not likely to impact the project site.

5.4.2 Thresholds of Significance

According to Appendix G of the CEQA Guidelines, a project would normally have a significant effect on the environment if the project would:

- G-1 Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
 - i) 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. (Refer to Division of Mines and Geology Special Publication 42.)
 - ii) Strong seismic ground shaking.
 - iii) Seismic-related ground failure, including liquefaction.
 - iv) Landslides.
- G-2 Result in substantial soil erosion or the loss of topsoil.
- G-3 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.
- G-4 Be located on expansive soil, as defined in Table 18-1B of the Uniform Building Code (1994), creating substantial risks to life or property.
- G-5 Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water.

The Initial Study, included as Appendix A, substantiates that impacts associated with the following thresholds would be less than significant:

- Threshold G-1.i
- Threshold G-1.iv
- Threshold G-5

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These impacts will not be addressed in the following analysis.

5.4.3 Environmental Impacts

The following impact analysis addresses thresholds of significance for which the Initial Study disclosed potentially significant impacts. The applicable thresholds are identified in brackets after the impact statement.

Impact 5.4-1: Project residences, occupants, visitors, etc., would be subject to potential seismic-related hazards. [Thresholds G-1.ii and iii]

Impact Analysis: Although liquefaction is not considered a potential hazard for the project site, there is a very high probability that strong seismic shaking could potentially impact the project site. The Los Angeles Basin and vicinity contains a number of known earthquake faults, which are listed in Table 5.4-1. Of the faults listed, the southern section of the San Andreas Fault is estimated to be capable of generating the greatest magnitude earthquake, M_w 7.1. The most intense potential ground shaking at the project site is estimated to be from the Elysian Park Blind Thrust Fault, which passes north of the project site.

However, seismic shaking is a risk throughout southern California, and the project site is not at greater risk of seismic activity or impacts than other areas. Additionally, the state regulates development in California through a variety of tools that reduce hazards from earthquakes and other geologic hazards. The 2013 California Building Code (CBC; California Code of Regulations, Title 24, Part 2) contains provisions to safeguard against major structural failures or loss of life caused by earthquakes or other geologic hazards. The City of Fullerton's Building Regulations are included in the City's Municipal Code as Chapter 14.03 (Building Code). The City has adopted by reference the most recent version of the CBC. Projects considered for approval under the Specific Plan would be required to adhere to the provisions of the CBC, which are imposed on project developments by the City during the building plan check and development review process. Compliance with the requirements of the CBC for structural safety during a seismic event would reduce hazards from strong seismic ground shaking to less than significant levels.

Impact 5.4-2: Unstable geologic unit or soils conditions, including soil erosion, could result due to development of the project. [Thresholds G-2 and G-3]

Impact Analysis: The young alluvial sediment underlying the project is generally poorly consolidated and susceptible to erosion. Grading temporarily increases the potential for erosion by removing protective vegetation, changing natural drainage patterns, and constructing slopes. Common means of soil erosion from construction sites include water, wind, and being tracked offsite by vehicles.

However, compliance with the CBC and review of grading plans for individual projects by the Building Division would ensure that no significant impacts would occur. In addition, construction activities on project sites larger than one acre would be subject to the National Pollution Discharge Elimination System (NPDES) requirements. Under the NPDES, a Storm Water Pollution Prevention Plan (SWPPP) would be required along with best management practices (BMPs) designed to prevent erosion and siltation during a project's construction phase. Individual project applicants would also be required to adhere to the applicable provisions outlined in Chapter 12.18 (Water Quality Ordinance) of the City's Municipal Code. For example,

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Section 12.18.030 (Control of urban runoff) contains stormwater requirements for new development and significant redevelopment to preserve water quality and prevent erosion in the City (see also Section 5.7, *Hydrology and Water Quality*).

Adherence to NPDES requirements, the SWPPP and related BMPs, and the City's stormwater and urban runoff pollution regulations would ensure that no significant impacts would occur.

Impact 5.4-3: Soil conditions could result in risks to life or property. [Threshold G-3]

Impact Analysis: The thick alluvial deposits composing the Los Angeles Basin may be susceptible to compaction, with resulting subsidence at the surface, in the event of rapid groundwater withdrawal. Additionally, the young sediments underlying the City are generally dry and loose in the upper few feet, and much of the City has historically been intensively farmed, and is therefore susceptible to compression. Furthermore, expansive soils are possible in the City where there is clay.

Development projects considered for approval under the Specific Plan could expose structures or persons to potentially significant hazards from ground subsidence or compressed or expansive soils. However, individual development projects would be required to adhere to existing building and grading codes. These codes contain provisions for soil preparation to minimize hazards from unstable and expansive soils. For example, Chapter 14.03 (Building Code) of the City's Municipal Code establishes rules and regulations to control excavation, grading, and earthwork construction (including fills). Additionally, as standard procedure by the City of Fullerton, grading and soil compaction requires the preparation of site-specific grading plans, soils and geotechnical reports (which must address liquefaction, subsidence, and other potential soil stability hazards), and hydrology studies, which are required to be submitted to and reviewed and approved by the City and county prior to the commencement of any grading activities. Submittal of these technical plans and studies would ensure that hazards arising from unstable and expansive soils would not occur, as they would be prepared in accordance with grading and engineering standards outlined in the most current CBC. After compliance with existing regulations, risks arising from unstable and expansive soils would be less than significant.

5.4.4 Cumulative Impacts

The area for which cumulative geology and soils impacts are considered is the project vicinity. Other projects would be required to adhere to the provisions of the CBC, which are imposed on project developments by the City during the building plan check and development review process. Compliance with the requirements of the CBC for structural safety during a seismic event and from unstable and expansive soils would reduce hazards from seismic events to less than significant levels. Likewise, adherence to NPDES requirements, the SWPPP and related BMPs, and the City's stormwater and urban runoff pollution regulations would ensure that no significant impacts would occur. Cumulative impacts are less than significant.

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5.4.5 Existing Regulations and Standard Conditions

State

- 2013 California Building Code (Title 24, California Code of Regulations, Part 2)

City of Fullerton Municipal Code

- Chapter 12.18 (Water Quality Ordinance)
- Chapter 14.03 (Building Code)
- Chapter 15.47 (Site Plan Review), Chapter 15.56 (General Provisions, Conditions and Exceptions)
- Section 16.05.065 (Soils Report)

5.4.6 Level of Significance Before Mitigation

Upon implementation of regulatory requirements and standard conditions of approval, the following impacts would be less than significant without mitigation: 5.4-1, 5.4-2, and 5.4-3.

5.4.7 Mitigation Measures

Project-level and cumulative impacts to geology and soils are less than significant. No mitigation measures are required.

5.4.8 Level of Significance After Mitigation

No mitigation is required because the existing regulations and standard conditions identified above would reduce potential project-level and cumulative impacts associated with geology and soils to a level that is less than significant. Therefore, no significant unavoidable adverse impacts relating to geology and soils have been identified.

5.4.9 References

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United States Geological Survey (USGS). 2012. 7.5' Topographic Series, Anaheim, California Quadrangle Map.