3.6 GEOLOGY AND SOILS

INTRODUCTION

The purpose of this section is to identify the existing geologic setting of the Project site and vicinity, analyze potential impacts with respect to geology and soils that would result from the project, and develop mitigation measures to reduce potentially significant impacts. The geotechnical considerations associated with the Proposed Project include hazards that could result from Project construction and design, and naturally occurring geologic hazards. Background information and analysis presented in this section are based in part on review of the project geotechnical feasibility study conducted by Albus-Keefe and Associates, Inc., in 2019 (AKAI 2019 included as ***Appendix 3.6-A****), the "Updated" Geologic Assessment of Surface Fault Rupture Potential conducted by Albus-Keefe & Associates, Inc. (AKAI 2020 included as* ***Appendix 3.6-C****), and the* City of Moorpark General Plan.

An "Updated" Geologic Assessment prepared by AKAI in 2020 includes (1) a review of previous geotechnical/fault reports for the site. (2) review of fault investigation reports performed within nearby properties, (3) review of existing readily available geologic data, (4) development and execution of a laboratory testing program, (4) soil stratigraphic assessment and evaluation of data. The recommendation of the geotechnical feasibility study will be incorporated into the project to the maximum degree feasible and is included as ***Appendix 3.6-A*** *of this environmental impact report (EIR).*

Additional technical information is provided by the Updated Paleontological Records Search and Assessment for the Hitch Ranch Specific Plan City of Moorpark, Ventura County, California, conducted by First Carbon Solutions in March 2020. And included as ***Appendix 3.6-E*** *(FCS 2020).*

3.6.1 EXISTING CONDITIONS

3.6.1.1 Regional Geologic Setting

The site is located within the south-central portion of the Ventura Basin in the western Transverse Ranges geomorphic province. The Ventura Basin is an east-west trending trough that experienced basin inversion (extensional to compressional forces) during late Miocene- to early Pliocene.[1] The change from an extensional to compressional environment is believed to be associated with the development of the "Big Bend" of the San Andreas Fault to the north resulting in north-south crustal shortening of the region.[2]

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1 Yeats, R., Huftile, G.J., and Stitt, L., 1994, Late Cenozoic tectonics of the east Ventura Basin, Transverse Ranges, California: AAGP Bulletin, California, v. 78, p. 1040-1074.

2 DeVecchio, D.E., Keller, E.A., Fuchs, M., Owen, L.A., 2012, Late Pleistocene structural evolution of the Camarillo fold belt: Implications for lateral fault growth and seismic hazard in Southern California: Lithosphere, v. 4, no. 2, p. 91-109.

Continued north-south compressional tectonics has produced an intricate system of east-west trending thrust faults, reverse faults, and large-scale folding throughout the basin.

In closer proximity, the site is located on the southern piedmont slopes of the Oak Ridge Mountains. The south margin of the site represents the geomorphic transitions to the valley floor (Little Simi Valley). The Oak Ridge Mountains have been tectonically uplifted in response to folding and reverse slip on the south-dipping Oak Ridge Fault. Across Little Simi Valley to the south, the north-dipping Simi-Santa Rosa fault system resulted in the uplift of the Las Posas Hills. Both faults underlie the Site at depth and result in crustal shortening of the vicinity. Deformation associated with the compression between the Oak Ridge and Simi-Santa Rosa fault systems has resulted in a complex regime of folding and secondary faulting.

The Oak Ridge Mountains and surrounding vicinity are underlain by thousands of feet of sediments that rest unconformably on igneous and metamorphic basement rock. With respect to the near-surface geologic conditions, the southern piedmont slopes of the Oak Ridge Mountains are generally underlain by bedrock assigned to the Pleistocene-age Saugus Formation.[3] Other regional maps have also identified these same deposits as Pleistocene-age older alluvium. The Saugus Formation is terrestrial in origin and is believed to have largely been deposited by the ancestral Santa Clara River. Levi and Yeats[4] utilized magneto-stratigraphy in the nearby Santa Susana Mountains to estimate the lower age of the Saugus at 2.3 million years old (Ma) and the upper age at 400 to 500 thousand years old (Ka). Locally, the discovery of a mammoth during grading for Tract 5054 has provided a biostratigraphic age of 850 Ka to 780 Ka for the upper Saugus Formation in the immediate Site vicinity.[5] The Saugus Formation is generally overlain by late Pleistocene- to Holocene-age alluvial and colluvial deposits within the canyon areas and small tributary drainages. The location of the site and relation to the regional geology is shown the **Regional Geologic Map, Figure 3.6-1**.

3.6.1.2 Geologic Units

Geologic units within the Project site are Quaternary-age older alluvium, recent alluvium, topsoil/colluvium, and artificial fill. Each of the on-site geologic units is described below.

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3 Dibblee, T.W., and Ehrenspeck, H.E., ed., 1992, Geologic map of the Moorpark quadrangle, Ventura County, California: Dibblee Geological Foundation, Dibblee Foundation Map DF-40, Scale 1:24,000.

4 Levi, Shaul, and Yeats, Robert S., 1993, Paleomagnetic constraints on the initiation of uplift on the Santa Susana Fault, Western Transverse Ranges, California, copyright 1993 by the American Geophysical Union. https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/93TC00133, accessed June 16, 2021.

5 Wagner, H.M., Lander, B., Roeder, M.A., Prothero, D.R., McDaniel, G.E., Jr., 2007, A new Irvingtonian land mammal assemblage from the Saugus Formation, Moorpark, Ventura County, California: Bulletin of the Southern California Academy of Sciences, v. 10, no. 2, p. 141.

Artificial Fill (Af)

Artificial fill materials were encountered in exploratory excavations and identified during field mapping throughout the site. These fills are generally associated with drainage berms, access roads, and various above- and below-ground modifications that were made to the property in association with the site's previous use. More recent end-dump fills were also locally encountered on the site. The fill materials encountered are generally comprised of locally-derived brown to dark brown and red brown clayey sand and sandy clay. These materials are typically damp to moist, loose to medium dense / soft to stiff, and contain scattered gravels and cobbles. The artificial fill materials encountered in exploratory trench T-4 (AKAI 2019) in a drainage area located in the northeasterly portion of the site also contained abundant construction debris and other assorted trash.

The artificial fills associated with the drainage berms and access roads that extend throughout the site are up to 5 feet thick. Fills encountered within buried drainages identified in the northwesterly portions of the site and locally in a drainage in the northeasterly portion of the site are up to as much as 13 feet thick.

Topsoil

A thin veneer of topsoil is generally present in the upper 3 to 5 feet of the surface. The topsoil is generally formed in-place by weathering of the underlying units and has been substantially disturbed from ploughing. The topsoil is generally comprised of very dark brown to very dark gray clayey sand and sandy clay that is typically damp to moist, loose / soft to medium stiff, and contains scattered gravel and roots. The topsoil was also observed to be moderately porous and have local, poorly-developed blocky ped structures where not completely disturbed.

Colluvium (Qcol)

Colluvium is generally comprised of brown to dark brown and reddish-brown sandy clay, clayey sand and silty sand. The colluvial materials are typically damp to moist, soft to medium stiff / loose to medium dense, moderately porous, and have slightly- to moderately-developed blocky ped structures with clay films and carbonate on ped surfaces. A trace to some gravel is present within colluvium materials. The colluvial deposit measured up to 14 feet in thickness within the center of the drainages.

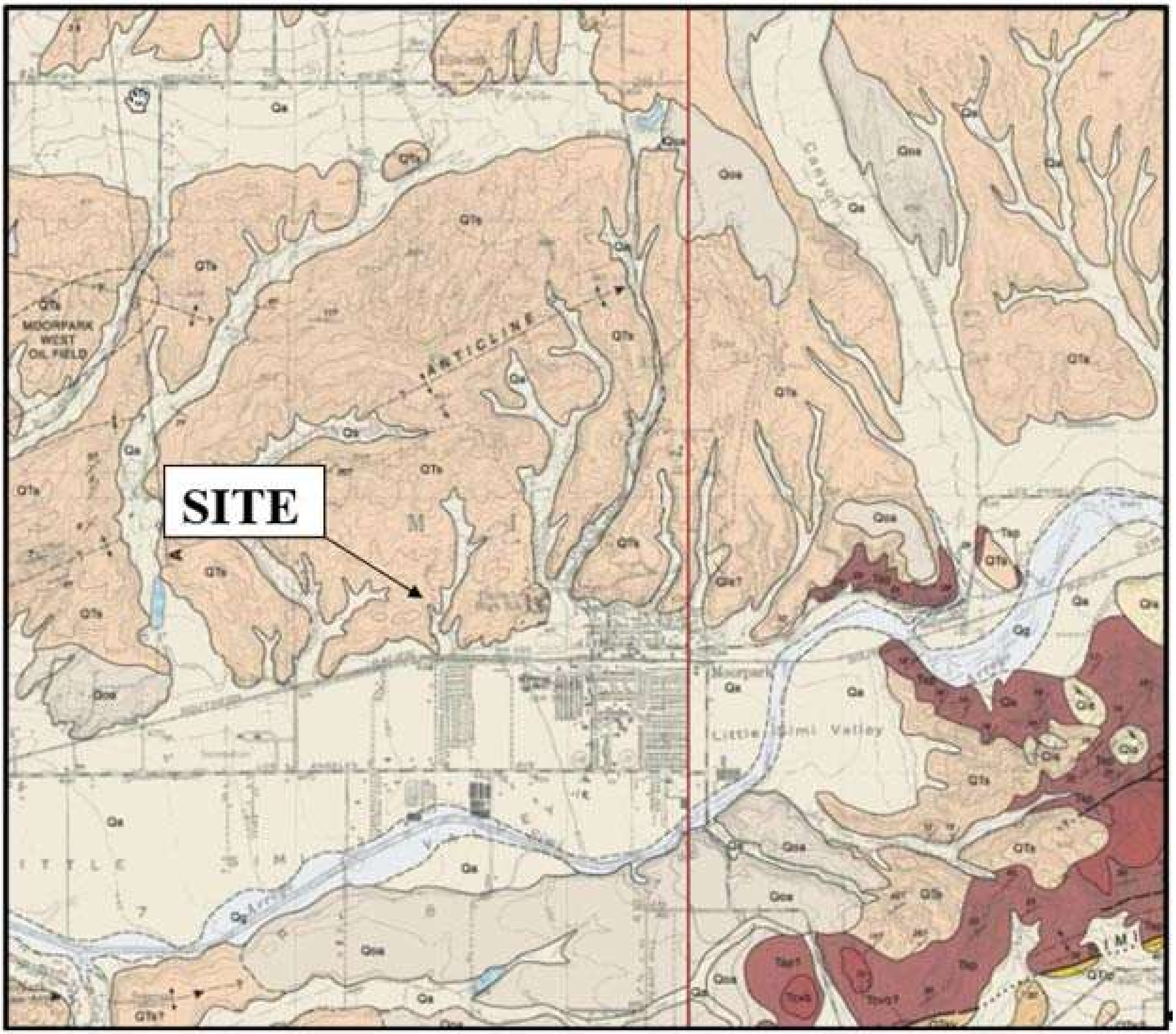


Figure 3.6-1 Regional Geologic Map

From: Dibblee, T.W., and Ehrenspeck, H.E., ed., 1992, Geologic map of the Moorpark quadrangle, Ventura County, California: Dibblee Geological Foundation, Dibblee Foundation Map DF-40, scale 1:24,000.

Alluvium (Qal)

Alluvium was encountered within both wide and narrow drainage channels across the site. The alluvium encountered within narrow drainages is generally comprised of light brown to dark brown silty sand, clayey sand, and sand within the upper 15 to 18 feet and light brown to reddish brown silty sand at depth. Alluvial material in narrow drainages is typically medium dense with an occasional layer of loose material at depth and are dry to moist. These materials generally become reddish brown in color at depth, and contain pores throughout the deposit. Alluvium in narrow drainage channels also locally contains increased deposits of sandy material and varying abundance of gravel.

Alluvial material encountered within the wide drainage channels generally consists of silty sand, clayey sand, gravelly sand and sand, with occasional interbeds of sandy clay, clay with sand, and clay. The sandy material is generally of various shades of brown, dry to moist, and loose to dense. The upper portion of the alluvial material is typically darker brown in color, lower in moisture content, and less dense. The fine-grained materials are generally dark brown to brown, moist, and medium stiff to hard. Coarse-grained gravelly material is typically found at the base of the alluvial layer.

Bedrock: Saugus Formation (Qs)

The bedrock materials encountered onsite are assigned to the Saugus Formation. This unit, which was also identified as older alluvium in some of the previous work by Gorian[6] and some geologic maps, generally consists of various shades of brown interbedded sandstone and siltstone with occasional conglomerate beds and lenses. In general, the bedrock materials are dry to moist and moderately hard to locally very hard particularly within the finer-grained well-indurated stratum. The near surface bedrock materials are generally moderately to extremely weathered with scattered krotovinas and roots and no visible structure. Depositional features observed within the Saugus Formation include cross bedding, graded bedding, channel scours and fills, and lateral facies changes typically resulting in interfingered deposits. Soil development features observed within the near surface Saugus Formation include local blocky ped structures, carbonate development, iron and manganese oxide staining, and siliceous cemented horizons. Sub-horizontal, laterally-discontinuous, closely-spaced, clay-rich laminations or lamellae (termed "Bt lams" in this report) were also observed within the sandier units. The Bt lams are easily distinguished from the parent material by their slightly darker and more oxide-stained characteristics.

Note: Information regarding whether the Project site contains radioactive bedrock materials that could be a source of

6 Gorian and Associates, Inc., 1999, Geotechnical Update Report, Specific Plan #1, Hitch Ranch (300 acre parcel), City of Moorpark.

radon gas is contained in ***Section 3.8, Hazards and Hazardous Materials****.*

3.6.1.3 Soil Characteristics

Expansive Soils. Expansive soils are generally composed of clays that swell when wet and shrink when dried. For example, wetting can occur naturally through absorption, rainfall, groundwater intrusion, or irrigation. When structures are located on expansive soils, foundations have the tendency to rise during the wet season, and sink during the dry season. Movements can vary under the structures, which in turn create new stresses on various sections of the foundation. Evidence of the uneven movement is noticeable in warped window frames and doorframes. These variations in ground movement can lead to structural damage. The expansion potential on the Project site ranges from Low to Medium with some soils in the High range.[7]

Collapsible Soils. Soils that are relatively dry and loose can undergo sudden collapse when they become wetted. Such soils tend to consist of sandy soils with minor amounts of fines (silts and clays). The fine soils create a "gluing" between particles of sand that is strong while dry but weak when wet. The specific plan is underlain by natural topsoil, colluvium, and alluvium that typically exhibits characteristics of collapsible soils. Adverse conditions caused by collapsible soils are readily mitigated by recompacting the soils into a dense condition and above optimum moisture content.

3.6.1.4 Slope Stability

In general, landsliding, as well as the lateral force exerted by landslides, can damage or destroy engineered structures. Slope stability is affected by various parameters including the strength of soil and bedrock, groundwater conditions, height of slope, and angle of slope. Calculations are made to consider these factors and determine the factor of safety against failure. The city of Moorpark requires that slopes demonstrate a calculated factor of safety exceeding 1.5 for normal (static) conditions and 1.1 for earthquake (seismic) loading conditions. Where a slope does not exhibit these minimum factors of safety, steps must be taken to enhance the factor of stability. The most common methods involve regrading of the slope to make them flatter, lower, or replaced with stronger materials.

No landslides have been identified within the site on the Landslide Inventory map by the California Division of Mines and Geology or the *Moorpark General Plan* Safety Element. Cut slopes may expose rock that has locally-adverse geologic conditions, expose sandy bedrock materials that are friable and prone to erosion, or create possible nuisance seepage issues. Very limited portions of the specific plan area are located in a State of California Earthquake-Induced Landslide Zone as identified on the California Geological Survey, Earthquake Zones of Required Investigation - Moorpark Quadrangle. Engineering

7 As defined by ASTM D4829, Standard Test Method for Expansion Index of Soils.

analyses to evaluate stability at the site indicate that some slopes have factors of safety less than required by the city of Moorpark. Due to these issues, some slopes will require mitigation for potential instability.

3.6.1.5 Seismic Characteristics

Faulting and Ground Rupture

The earth's crust is divided into various "tectonic" plates that move very slow relative to each other. Southern California lays near the boundary of two tectonic plates called the Pacific plate and North American plate. The North American plate is moving southerly while the Pacific Plate is moving northerly. Faults form in the region between the two tectonic plates as they move past each other. The primary fault in southern California is the San Andreas Fault that extends approximately 750 mile through the state and forms the boundary between the two tectonic plates. Other faults are also present in southern California as part of the overall tectonic system. Faults represent a potential hazard due to the potential for ground rupture that can cause severe damage and destruction to overlying and nearby structures. For this reason, habitable structures cannot be constructed across active faults.

Faults are categorized by the California Division of Mines and Geology (CDMG) as active, potentially active, or inactive. Active faults are those that show evidence of surface displacement during the Holocene epoch, which is within the last 11,000 years. Potentially active faults are those that show evidence of last displacement during the Quaternary epoch, which is within the last 1.6 million years. Faults showing no evidence of displacement within the last 1.6 million years may be considered inactive for most purposes, except for some critical structures.

The specific plan site is located in a seismically active region and is in close proximity to several active and potentially active faults in southern California. Under the Alquist-Priolo Special Studies Zones (APSSZ) Act of 1972, the California State Geologist delineates special study zones along known active and potentially active faults in California. Jurisdictions affected by the zones must regulate development within the zones and ensure that construction does not take place over potential rupture zones. The specific plan site does not lie within an APSSZ. Based on published geologic information and trenching conducted on the specific plan site, no active or potentially active faults are known to exist on or traverse through the site. The closest faults that can contribute intense seismic ground shaking are listed in **Table 3.5-1, Nearby Faults,** and described below. The locations of the nearest faults are depicted in **Figure 3.6-2, Earthquake Fault Zone Maps.**

Table 3.6-1
Nearby Faults

Fault Name	Approximate Distance from Specific Plan Site (miles)	Maximum Moment
Simi–Santa Rosa	2 miles	6.8
Oak Ridge (onshore portion)	5 miles	6.9
Santa Susana	6 miles	6.6
San Cayetano	8 miles	6.8
Northridge (East Oak Ridge)	12 miles	6.9
Holser	12 miles	6.5

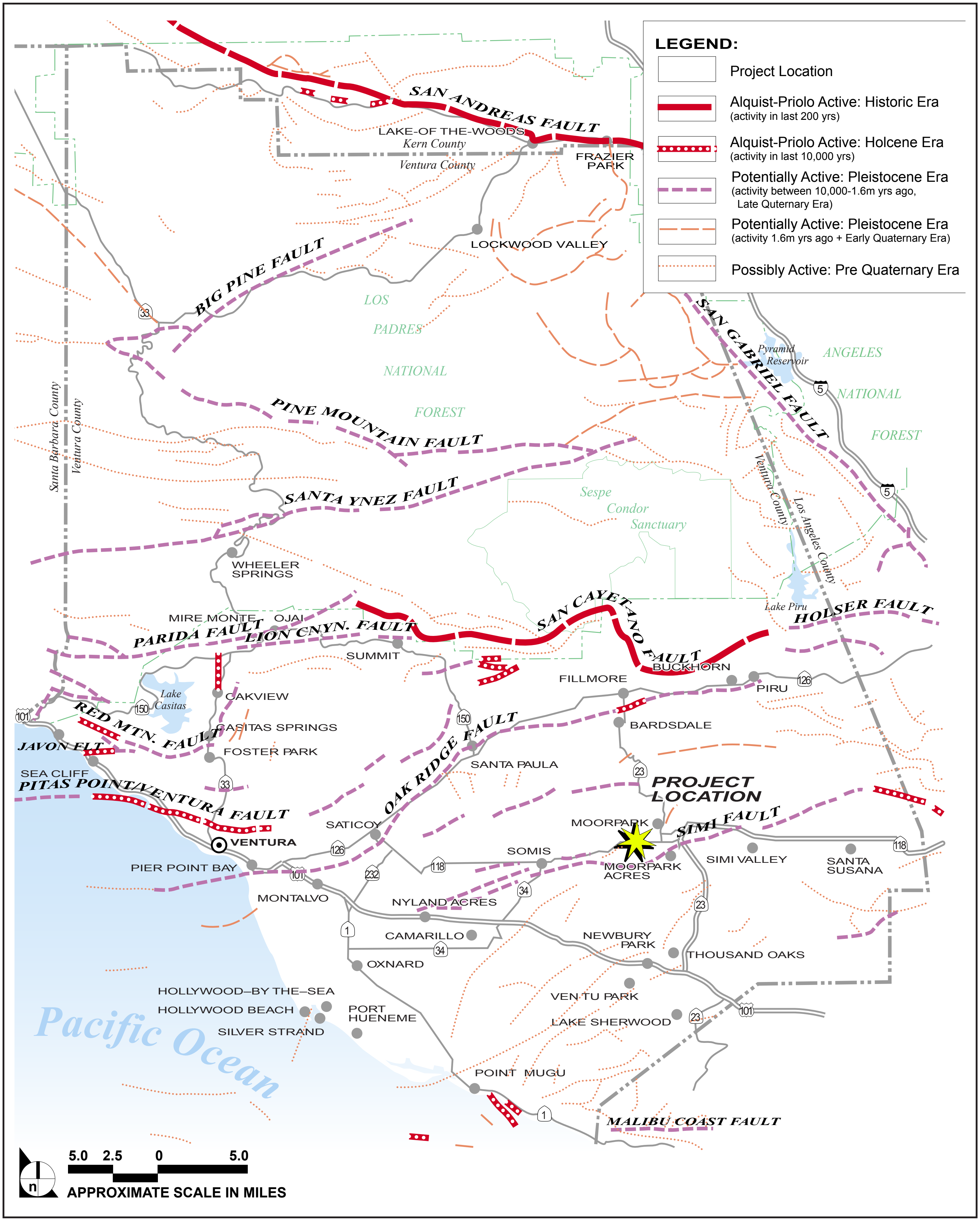
Source: Southern California Probabilistic Seismic Hazard Assessment Maps (PSHA). Available online at: https://www.conservation.ca.gov/cgs/Pages/PSHA/shaking-assessment.aspx, accessed 26 February 2020.

Ground Shaking

As movement of the crustal tectonic plates occurs, slippage along faults results in ground shaking. The energy generated by this slippage moves away from the faults as waves in all directions. The resulting ground shaking is greatest near the faults and dissipates with distance from the fault. Therefore, locations in close proximity to faults are prone to strong ground shaking. The strong ground shaking can cause severe damage or destruction of buildings and other improvements as they are thrown side to side as well as up and down. The specific plan site is located in close proximity to several active faults and as such, could be subjected to strong ground shaking.

Strong ground shaking can also result in secondary impacts such as liquefaction, seismic settlement, landsliding, lateral spreading, ground lurching, seiches, and tsunamis. These secondary impacts can also result in severe damage to urban structures.

Liquefaction. Liquefaction is a process by which soils may liquefy and lose strength during moderate to severe ground shaking. The potential for liquefaction is greatest in areas with loose, granular, low-density soils where the water table is within the upper 50 feet of ground surfaces. Buildings and other structures on the ground surface may tilt and sink, while lightweight objects that are buried may rise to the surface. Slopes and sloping ground underlain liquefiable soils can undergo large lateral movements commonly called lateral spreading. Portions of the site located along the southern boundary were found to be underlain by layers of loose sands within the upper 50 feet and are below groundwater. Engineering analyses have confirmed these layers are prone to liquefication during a strong ground shaking event.



SOURCE: California Department of Conservation, Division of Mines and Geology, Publications and Information, 1999.

FIGURE **3.6-2**

IMPACT SCIENCES

Regional Faults

1318.003•05/2020

Seismic Settlement. Soils that undergo liquefaction will tend to seek a denser condition which causes the overlying ground to settle. The ground surface is estimated to undergo subsidence on the order of a few inches. However, no residential structures are planned to be supported by these materials.

Seismic Landsliding. Earthquakes cause large horizontal forces and slopes subjected to these forces can become unstable and fail, particularly if they are high and/or steep. Engineering analyses have identified that a limited number of natural slopes along the southern boundary of the specific plan and therefore will require mitigation.

Lateral Spreading. While soils are liquefied, they can lose significant strength and make the ground prone to sliding or "lateral spreading." The presence of liquefiable soils may cause instability of slopes located along the southern boundary of the specific plan and therefore mitigation will be required.

Seiches. Seiches are the displacement of water within an enclosed body of water such as a lake caused by earthquakes. Strong ground motions from an earthquake cause the water to slosh back and forth onto land. No sizable enclosed body of water is within the site or its vicinity. As result, the potential for hazards associated with seiches is non-existent.

Tsunamis. A tsunami is a sea wave generated by large-scale displacements of the ocean floor that causes sudden surge of water on to the land. Tsunamis are most commonly caused by movement along faults and underwater landslides activated by earthquakes. The portion of the site to be developed is elevated approximately 500 feet above mean sea level and is located a substantial distance from a significant body of water. As such, the potential for hazards related to tsunami is considered very low.

3.6.1.6 Groundwater

The project area is located over the Las Posas Basin (LPB), an east-west-trending structural depression containing water-bearing sediments of Pliocene to Recent Aged. The basin is believed to be divided into separate basins (North and South) by the Moorpark Anticline, a large east-west-trending structure located north of Los Angeles Avenue. The specific plan site overlies the North LPB and is not located within a groundwater recharge area. The main source of recharge of the North LPB within the Moorpark area is through the Fox Canyon and Grimes Canyon aquifer system which outcrops north of Moorpark in the Grimes Canyon and South Mountain areas. These aquifers are considered confined and protected from surface infiltration over much of the LPB by a clay cap, except in the vicinity of the previously mentioned Grimes Canyon and South Mountain areas.[8] The Hitch Ranch site is located in the area consisting of significant amounts of clays and silts that cap the aquifer. Currently, rainfall that falls on the specific plan

8 Metropolitan Water District of Southern California, *Draft Groundwater Assessment Study Report*. March 2007.

site is either taken up by vegetation, evaporates, or moves through the soil in a downslope direction towards the Arroyo Simi. Some of this flow may percolate down to the groundwater on route to the Arroyo Simi and once in the channel may percolate through the streambed into the water table. As the Arroyo Simi continues downstream, it supplies water to the North Las Posas groundwater basin.[9,10]

Groundwater wells located and excavated on the Project site have measured the depth to groundwater at about 98 to 600 feet below ground surface (bgs). Nonetheless, perched (trapped) groundwater was observed at depths ranging from 15 to 46 feet bgs from 1999 to 2019 (AKAI 2019). The water encountered at depths of 15 feet is considered perched in lenticular-shaped semipermeable soil zones surrounded by less-permeable soils. Based on well logs it appears that useable groundwater is several hundred feet deep. The perched groundwater was only observed in the southern portion of the site (AKAI 2019).

3.6.1.7 Paleontological Resources

Geology and Paleontology

An earlier paleontological assessment was done for this project (SWCA 2006). Pursuant to comments and direction received from the City of Moorpark, it was determined that an updated paleontological records search for the project area would be required to bring the report's findings up to date, particularly in light of significant discoveries made in the area that were not available to the study's authors at the time of writing. Chief among them are two particularly important discoveries (the Moorpark Highlands Project and the "Moorpark Mammoth" site) that were recovered from the Saugus Formation in 2005 and have added significant information to the age and nature of Saugus Formation deposits in the area of the Proposed Project. The information in the following section is based on the **Updated Paleontological Records Search and Assessment for the Hitch Ranch Specific Plan City of Moorpark, Ventura County, California**, conducted by First Carbon Solutions in March 2020. And included as **Appendix 3.6-E** (FCS 2020).

Previous geologic mapping of the project area indicates the site is underlain by Pleistocene-age Saugus Formation[11] although some publications identify this same deposit as Late Quaternary Older Alluvium. However, it should be noted that geotechnical studies conducted at the Project site report the composition

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9 Calleguas Municipal Water District, *Final Program EIR for the Las Posas Basin Aquifer Storage and Recovery Project*, April 1995.

10 California Department of Water Resources (DWR), California's Groundwater Bulletin 118- Las Posas Valley Groundwater Basin. January 2015.

11 Dibblee, T.W., and Ehrenspeck, H.E., ed., 1992, Geologic map of the Moorpark quadrangle, Ventura County, California: Dibblee Geological Foundation, Dibblee Foundation Map DF-40, Scale 1:24,000.

of the surficial sediments as Saugus Formation as well as Holocene (Recent) alluvium, colluvium, and artificial fill. Grading of the site is expected to disturb Saugus Formation deposits.

Saugus Formation. The definition of the Saugus Formation has been revised since the original report (SWCA 2006). It is now defined as being a non-marine formation. Marine strata formerly assigned to the Saugus Formation are now assigned to the Pico Formation. The Sunshine Ranch and Camarillo members of the Saugus Formation have been formally adopted. Some strata producing marine organisms and formerly assigned to the Saugus Formation are now assigned to the Pico Formation. However, in the Moorpark area, the Saugus Formation is mapped as undifferentiated as to member.

The Saugus Formation is the oldest formation within the project area. The Saugus Formation is mapped in the hills of the project area. It occurs beneath older alluvium in the western portion of the Proposed Project. It is described as moderately-sorted commonly cross-bedded and channeled; interbedded with moderate-brown to reddish-brown poorly sorted sandy mudstone and local claystone seams in the type area and other portions of the eastern Ventura basin, reflecting overbank deposits and paleosols; fluvial near the basin axis, transitioning to alluvial fan environment near the basin margins; interfingers with shallow marine sands to the west. Mammalian fossils collected from the upper member of this formation belong to the Irvingtonian North American Land Mammal Age. A combination of faunistic and geomagnetic evidence indicates an age range of 850,000 to 780,000 years for the part of the Saugus Formation that produced those fossils.

Late Quaternary Older Alluvium. Geologic mapping of the project area indicates that Late Quaternary older alluvial deposits are exposed in the valleys of the Hitch Ranch project area. Other workers designate the rock units exposed in the hills of Hitch Ranch as Late Quaternary (Pleistocene) Older Alluvium. The Older Alluvium at Hitch Ranch is composed of up to 36 feet of interbedded, lenticular yellowish-brown sand, light yellowish-brown silt, and yellowish-brown clay that often contain clasts from the underlying Modelo Formation. Current data indicates that the Older Alluvium in the Moorpark area is Middle Pleistocene (400,000 to 280,000 years old).

Recent Alluvium, Colluvium, and Artificial Fill. Previous geotechnical studies (AKAI 2019) for the Hitch Ranch Specific Plan project indicate that some of the surficial sediments overlying the Saugus Formation in the project area are Holocene (Recent) alluvial stream deposits, colluvium, and artificial fill. Holocene deposits are too young to contain fossils and are thus classified as low-sensitivity sediments. The uppermost younger alluvial deposits are determined to have a low paleontological sensitivity rating; however, according to Society of Vertebrate Paleontology (SVP) guidelines, geologic units greater than 5,000 years old may contain fossilized material. Therefore, the paleontological sensitivity of the young alluvial sediments mapped within the Project site increases with age (i.e., depth). Artificial fill obviously has low potential for paleontological resources. Even if fossils were found in artificial fill, the original locality of the fossils would be unknown.

Museum Records Search. The updated paleontological records search showed no localities within the boundaries of the Proposed Project. The list of fossils and localities that the Natural History Museum of Los Angeles County (LACM) reported this year in the vicinity of the Proposed Project does not differ from the list provided in the 2006 SWCA report. There is one recorded fossil from older Quaternary alluvium. It is that of a horse. That locality is southwest of the Proposed Project. The other is of a mastodon (family *Mammutidae*), from the Saugus Formation, locality LACM (CIT) 585. That locality is somewhat farther to the southwest. Personnel involved in the recovery and reporting of the Meridian Hills Project reported that a collection of Saugus fossils from that project were curated at the Santa Barbara Museum of Natural History. The Curator of Geology at that institution made available a spreadsheet of the Meridian Hills Project fossils curated there. The Meridian Hills Project is a very short distance from the Proposed Project. Overall, the museum reported 16 horse fossils, six mammoth fossils-including two species, two llama fossils, five specimens belonging to camel family, one rabbit, an unspecified number of rodent teeth belonging to six general and one extinct species, and one specimen of an unspecified proboscidean. The museum also reported it has no other collections from the Saugus Formation or from Moorpark.

Literature Review. At the time of the original report (SWCA 2006), the Saugus Formation had not produced a significant amount of vertebrate fossils in the Simi Valley. However, since the publication of the original report, a considerable number of fossils have been collected from the Saugus Formation in Moorpark. A development known as the Meridian Hills Project produced vertebrate fossils, and that project lies a few yards northeast of the Proposed Project. The Meridian Hills Project produced a 70 percent complete skeleton of the southern mammoth (*Mammuthus meridionalis*), elements of the Columbian mammoth (*Mammuthus columbi*), the western horse (possibly Equus occidentalis), the large-headed llama (*Hemiauchenia macrocephala*), as well as smaller vertebrates. The smaller organism include a probable cottontail rabbit (possibly Sylvilagus), a species of the pocket gopher (*Thomomys*), a species of the pocket mouse (*Perognathus*), a species of the kangaroo rat (Dipodomys), a species of the harvest mouse (*Reithrodontomys*), a species of the wood rat (Neotoma), and Mead's pine mouse (*Pitymys meadensis*). The demonstration that these two species of *Mammuthus* overlapped in this time interval is important. The collection of organisms from this project was designated the Meridian Hills local fauna (Wagner et al., 2007). Those authors demonstrated that the known ranges of the southern mammoth and Mead's pine mouse plus the magnetostratigraphic data from the site narrowed the age range of this deposit to 850,000 to 780,000 years. The collection was accessioned by the Santa Barbara Museum of Natural History.

Another development known as Moorpark Highlands Project produced vertebrate fossils, and it lies farther to the northeast, across Walnut Canyon Road. The final report for the paleontological resource monitoring and mitigation effort by the Chambers Group was authored by Hugh Wagner (Chambers 2007). Mr. Wagner reported that a collection of mollusk fossils was obtained from the Pico Formation, and several vertebrate fossils, including a partial skeleton of a mastodon (Mammut sp.,) from the Saugus Formation. Fossils of horse were also recovered. The report states that, "The specimens have since been cleaned, sorted, and analyzed and were recently curated into the collections of the Museum of Natural History, Los Angeles, California." An accession form from the LACM was included as Attachment F. However, the form is undated, has no accession number, and is not signed by any staff member of the museum. Through a personal communication, Dr. Samuel McLeod of the LACM assured that no vertebrate fossils from that project were ever accessioned or curated by the LACM. Furthermore, personal communication with Jonathan Hoffman stated that no such collection had been curated at the Santa Barbara Museum of Natural History.

***Results and Analysis*. Table 3.6-2, Paleontological Sensitivities of Geologic Units within the Hitch Ranch Project Area**, summarizes the paleontological sensitivity ratings of the geologic units underlying the Hitch Ranch Specific Plan project area.

Table 3.6-2
Paleontological Sensitivities of Geologic Units within the Hitch Ranch Project Area

Geologic Formation	Age	Fossils	Paleontological Sensitivity
Alluvium, Colluvium, and Fill	Holocene	None	Low to High
Older Alluvium	Pleistocene-Holocene	Terrestrial Vertebrates	High
Saugus Formation	Plio-Pleistocene	Terrestrial Vertebrates	Very High

Source: First Carbon Solutions, March 2020

The search of the LACM collections records indicated that at least one nearby locality produced vertebrate fossils in the older alluvium, and many localities in the older alluvium in Southern California. Older alluvium is almost always rated at least at a high level of paleontological sensitivity. When the first paleontological assessment was written, the LACM collections records showed a single Simi Valley locality that had produced a vertebrate fossil. That statistic has not changed, but multiple subsequent projects near the Proposed Project have produced significant vertebrate fossil collections. The Saugus Formation in Moorpark must therefore be rated as having a very high level of paleontological sensitivity.

3.6.2 REGULATORY FRAMEWORK

3.6.2.1 International

Uniform Building Code (UBC)

The UBC is published by the International Conference of Building Officials and forms the basis for California's Building Code, as well as approximately 50 percent of the state building codes in the United States. It has been adopted by the California Legislature to address the specific building conditions and structural requirements for California, and provide guidance on foundation design and structural engineering for different soil types. The UBC defines and ranks the regions of the United States according to their seismic hazard potential. There are four types of regions defined by Seismic Zones 1 through 4, with Zone 1 having the least seismic potential and Zone 4 having the highest.

3.6.2.2 Federal

Earthquake Hazards Reduction Act

The Earthquake Hazards Reduction Act of 1977 (Public Law 95-124) established the National Earthquake Hazards Reduction Program which is coordinated through the Federal Emergency Management Agency (FEMA), the U.S. Geological Survey (USGS), the National Science Foundation, and the National Institute of Standards and Technology. The purpose of the Program is to establish measures for earthquake hazards reduction and promote the adoption of earthquake hazards reduction measures by federal, state, and local governments; national standards and model code organizations; architects and engineers; building owners; and others with a role in planning and constructing buildings, structures, and lifelines through (1) grants, contracts, cooperative agreements, and technical assistance; (2) development of standards, guidelines, and voluntary consensus codes for earthquake hazards reduction for buildings, structures, and lifelines; and (3) development and maintenance of a repository of information, including technical data, on seismic risk and hazards reduction. The Program is intended to improve the understanding of earthquakes and their effects on communities, buildings, structures, and lifelines through interdisciplinary research that involves engineering, natural sciences, and social, economic, and decisions sciences.

Disaster Mitigation Act (2000)

The federal Disaster Mitigation Act (DMA; Public Law 106-390) provides the legal basis for FEMA mitigation planning requirements for state, local, and Indian Tribal governments as a condition of mitigation grant assistance. DMA 2000 amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act by repealing the previous mitigation planning provisions and replacing them with a new set of requirements that emphasize the need for state, local, and Indian Tribal entities to closely coordinate mitigation planning and implementation efforts. The requirement for a state mitigation plan is continued as a condition of disaster assistance, adding incentives for increased coordination and integration of mitigation activities at the state level through the establishment of requirements for two different levels of state plans. DMA 2000 also established a new requirement for local mitigation plans and authorized up to 7 percent of Hazard Mitigation Grand Program funds available to a state for development of state, local, and Indian Tribal mitigation plans.

Clean Water Act

The Federal Water Pollution Control Act of 1972, often referred to as the Clean Water Act, empowers the US Environmental Protection Agency (US EPA) with regulation of wastewater and stormwater discharges into surface waters by using National Pollutant Discharge Elimination System (NPDES) permits and pretreatment standards. At the state level, these permits are issued by the Regional Water Quality Control Boards, but the US EPA may retain jurisdiction at its discretion. The Clean Water Act's primary application for geology and soils is with respect to the control of soil erosion during construction.

U.S. Geological Survey Landslide Hazard Program

The USGS Landslide Hazard Program provides information on landslide hazards including information on current landslides, landslide reporting, real time monitoring of landslide areas, mapping of landslides through the National Landslide Hazards Map, local landslide information, landslide education, and research.

3.6.2.3 State

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act (California Public Resources Code Section 25523(a); 20 CCR 1752(b) and (c); 1972 [amended 1994]) was passed in 1972 to regulate development on or near active fault traces to reduce the hazards associated with surface faulting. The Alquist-Priolo Earthquake Fault Zoning Act's main purpose is to prevent the construction of buildings used for human occupancy on the surface trace of active faults. Within Alquist-Priolo Earthquake Fault Zones, site-specific geologic investigations must be performed prior to permitting, and must demonstrate that a proposed building will not be constructed across active faults. If an active fault is found, any structures for human occupancy must be set back from the fault, generally 25 to 50 feet.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act addresses seismically induced hazards, including liquefaction and landsliding (slope instability). Seismic hazard zones showing areas where there is potential for ground shaking, liquefaction, landsliding, and other types of ground failure have been developed by the state to better regulate development in hazard-prone areas. For sites located within a seismic hazard zone, geotechnical investigations must be conducted to assess if a hazard exists, and the investigations must provide options for mitigation if any hazards are identified. Geotechnical investigations within seismic hazard zones should be conducted following guidelines specified by CGS Special Publication 117, "Guidelines for Evaluating and Mitigating Seismic Hazards." The California Public Resources Code Chapter 7.8, 1990 Seismic Hazards Mapping Act, allows the lead agency to withhold permits until geologic investigations are conducted and mitigation measures are incorporated into plans.

California Building Standards Code

The State of California's minimum standards for structural design and construction are given in the California Building Standards Code (CBSC) (CCR Title 24). The CBSC is based on the federal Uniform Building Code (International Code Council 1997), which is used widely throughout United States (generally adopted on a state-by-state or district-by-district basis) and has been modified for California conditions with numerous, more detailed or more stringent regulations. The CBSC provides standards for various aspects of construction, including but not limited to: excavation, grading, and earthwork construction; fills and embankments; expansive soils, foundation investigations, and liquefaction potential; and soil strength loss.

Southern California Catastrophic Earthquake Preparedness Plan

The Southern California Catastrophic Earthquake Preparedness Plan, based on the California Geological Survey and USGS's ShakeOut Scenario of 2008, was released in 2010 and examines the initial impacts, inventories resources, cares for those wounded and homeless, and develops a long-term recovery process. The process of Long-Term Regional Recovery (LTRR) provides a mechanism for coordinating federal support to state, tribal, regional, and local governments, nongovernmental organizations (NGOs), and the private sector to enable recovery from long-term consequences of extraordinary disasters. The LTRR process accomplishes this by identifying and facilitating the availability and use of recovery funding sources and providing technical assistance (such as impact analysis) for recovery and recovery planning support. "Long term" refers to the need to reestablish a healthy, functioning region that would sustain itself over time. Long-term recovery is not debris removal and restoration of utilities, which are considered immediate or short-term recovery actions. The LTRR's three main focus areas are housing, infrastructure (including transportation), and economic development.

3.6.2.4 Local

City of Moorpark General Plan Safety Element

The *City of Moorpark General Plan* Safety Element was adopted in 2001.

Goal 1: Minimize the potential damage to structures and loss of life that could result from earthquakes.

Policy 1.1: Continue to implement Uniform Building Code seismic safety standards for construction of new buildings, and update the City's codes as needed in response to new information and standards developed at the State level.

Policy 1.2: Require the preparation of detailed geologic studies for any development proposal within seismic hazard zones and liquefaction hazard zones.

(Goal 2 is not applicable to the project)

Goal 3: Protect public and private properties from geologic hazards associated with steep slopes, unstable hillsides, and subsidence.

Policy 3.1: Reduce the risk of impacts from geologic hazards by applying proper engineering, building construction, and retrofitting requirements to the development process.

Policy 3.2: Require that slope stability analyses be conducted for new development in hillside areas.

Policy 3.3: Require that hillside developments incorporate measures that mitigate slope failure potential and provide for long-term slope maintenance.

Moorpark Municipal Code Title 15

Title 15 details Building Code for the City of Moorpark, which includes the California Building Code, 2016 Edition, as adopted and amended by the Moorpark Municipal Code.

3.6.3 THRESHOLDS OF SIGNIFICANCE

The following standards of significance are based on Appendix G of the *2019 California Environmental Quality Act (CEQA) Statutes and Guidelines*. For the purposes of this revised draft program EIR, impacts would be significant if the project would:

- Directly or indirectly cause 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;
  - Strong seismic ground shaking;
  - Seismic-related ground failure, including liquefaction; or
  - Landslides.
- Result in substantial erosion or the loss of topsoil.
- Be located on a geologic unit or soil type that is unstable, or that could become unstable as a result of the project, and potentially result in on-site or off-site landslides, lateral spreading, subsidence, liquefaction, or collapse.
- Be located on expansive soil, creating substantial risks to life or property.
- 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.
- Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature.

3.6.4 METHODOLOGY

This section evaluates hazards to people or property from geology and soils, identifies mitigation measures for the impacts, and evaluates the residual impacts. The potential for hazards to people and property from geology and soils was evaluated in accordance with Appendix G of the 2019 State California Environmental Quality Act (CEQA) Guidelines. The methodology for determining the significance of potential risk to people and property in relation hazards posed by geology and soils compares the existing conditions to the future conditions upon project completion, as required by *CEQA Guidelines* Section 15126.2(a).

3.6.5 PROJECT IMPACTS

Impact GEO-1a **Directly or indirectly cause 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. Refer to Division of Mines and Geology Special Publication 42.**

Less than Significant

The Hitch Ranch Project proposes to construct 755 residential units, including single-family and multi-family homes, retention basins, and supporting roadways, all of which are subject to seismic events (see **Table 3.6-1**). Seismic events can damage transportation infrastructure and urban development through surface rupture, ground shaking, liquefaction, and landslides.

The 2020 AKAI *"Updated" Geologic Assessment of Surface Fault Rupture Potential* evaluated the northerly portion of the site and identified two fault zones which were determined through soil-stratigraphic assessment to be pre-Holocene-age faults, as defined by the California Geological Survey. Therefore, they are not considered active fault lines. In addition, previous studies by GIA for the site did not find any evidence of faulting or any other forms of deformation of the deposits encountered within their trenches in the central and southerly portions of the Site. AKAI also found that there is no evidence of Holocene-age faulting during investigations of neighboring projects. AKAI concludes that the potential for future ground rupture within the Site associated with "active" faulting is considered very low and no mitigation measures are required.

Based on the Division of Mines and Geology Special Publication 42 (SP-42), fault-related (tectonic) ground deformation is defined as "Surface and near-surface deformation caused by fault rupture at depth or at some horizontal distance away from the fault that is not expressed as discrete surface fault, including both brittle (fissures and tension cracks) and non-brittle (folding, warping, or tilting) deformation". The Alquist-Priolo Act does not specifically address fault-related ground deformation. However, in accordance with the guidelines in SP-42, fault-related ground deformation should also be assessed with respect to its impact on the ability of a structure for human occupancy to provide for life-safety and serviceability.

Based on AKAI's assessment, the anticlinal fold encountered in trench FT-1 evaluated in the northern portion of the Site is interpreted to be a fault-related structure associated with the Southern Area thrust fault. In addition, results of AKAI's soil-stratigraphic assessment indicates the folding occurring more than 58,000 years ago and probably much later. Considering the folding encountered during AKAI's investigation is pre-Holocene in age and that previous studies by GIA for the site did not find any evidence of faulting or any other forms of deformation within GIA's trenches in the central and southerly portions of the site, the probability of fault-related ground deformation during the life of the proposed structures within the Site is considered very low. No mitigation measures are required.

Furthermore, AKAI goes onto to find that their estimates of uplift of the anticlinal fold indicate that if a large earthquake on either the Oak Ridge fault or the Simi-Santa Rosa happens to occur near the Site causing movement of the Southern Area thrust fault beneath the site, the vertical uplift of the anticlinal structure within the site would be relatively small. AKAI has estimated the resulting vertical uplift would be about 1.3 inches or less. Due to the recurrence frequency of such events, only one event is likely to occur during the design life of the project (50 to 100 years). This uplift would also likely be very gently distributed at the ground surface over the broad area of the anticlinal structure such that differential tilting would be negligible. Therefore, construction and operation of the Proposed Project would not expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving fault rupture or ground deformation. Therefore, impacts related to surface rupture from a known earthquake fault would be less than significant.

Impact GEO-1b Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving strong seismic ground shaking.

Less than Significant

As with all properties in the seismically active Southern California region, the primary seismic hazard for the Project Site is the potential for strong ground shaking. The Project Site is susceptible to ground shaking as a result of potential movement along faults in the region.

According to the AKAI's "Updated" Geotechnical Feasibility Investigation, during the life of the proposed development, the Site could experience very high levels of ground shaking associated with the nearby Oak Ridge fault, the Simi-Santa Rosa fault, and other nearby faults (see **Table 3.6-1**). AKAI recommends that future structures be designed, as a minimum, in conformance with Chapter 16 of the latest California Building Code (CBC) to mitigate this potential hazard. All projects are required to adhere to the latest CBC and as a result, development of the proposed Project would not expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving seismic-related ground failure or liquefaction. Therefore, impacts related to ground failure would be less than significant.

Impact GEO-1c Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving seismic-related ground failure and liquefaction.

Less than Significant with Mitigation

Most of the site is underlain by conditions that are not considered to be susceptible to liquefaction. However, a limited portion of the site along the southern margin is underlain by liquefiable soils that could undergo ground failure. Depending on the estimated severity of liquefaction, which would be determined by conducting a design-level geotechnical investigation, mitigation is anticipated to consist of providing sufficient setbacks from such areas to avoid adverse effects of these conditions. Where setbacks are not feasible, various alternative methods could be implied such as (1) in-situ densification by means of deep dynamic compaction (DDC) and associated subsurface drains; (2) vibro-replacement (stone columns) and vibroflotation; (3) compaction grouting or chemical stabilization employing pressure techniques; and (4) special structural design consisting of deep foundations and self-supporting structural floor slabs to transfer loads below zone(s) of concern, or a thick mat foundation. Therefore, the impact related to liquefaction may be significant. The project will implement **Mitigation Measure GS-1** which will require the applicant to implement one of the available mitigation alternatives listed above. The potential of damage and injury to persons occupying the project would be reduced to less than significant with the implementation of mitigation.

Impact GEO-1d Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving landslides.

Less than Significant with Mitigation

Steep natural slopes are located within the southwestern area of the specific plan site. The slopes are about 70 to 80 feet in height. The slopes have gradients of 1-1/2 (horizontal [h]) to 1 (vertical [v]), and 2(h) to 1(v) or shallower. Engineering analyses have identified these slopes have factors of safety for stability that are less than required by governing construction codes. Habitable structures are proposed to be setback from these slopes to where the factors of safety for stability meet or exceed governing construction codes, and impacts would be less than significant.

Manufactured slopes within the development area are proposed to be constructed at a gradient of 2(h) to 1(v) or less. The highest or maximum cut slope in the development area would be about 75 feet in height and would be situated just north of Poindexter Avenue. The highest or maximum fill slope in the development area would be about 61 feet in height and occur along a south-facing slope near the south-central portion of the specific plan site. Lastly, a fill over cut slope of about 89 feet in height is proposed in the southeastern portion of the specific plan site. Proposed manufactured slopes on the specific plan site would result in a static safety factor of greater than 1.5, thus resulting in less than significant impacts.

Cut slopes could exposed localized conditions of locally-adverse geologic structure, expose sandy bedrock materials that are friable and prone to erosion, or possible nuisance seepage issues. However, implementation of **Mitigation Measure GS-1** through **GS-3**, would reduce potential impacts related to this issue to less than significant with mitigation.

Impact GEO-2 Would the Project result in substantial soil erosion or the loss of topsoil?

Less than Significant

Demolition, site grading, and construction phases of the Proposed Project would involve earth movement, use of heavy machinery, and use of potentially contaminating substances such as petroleum products, paints, and building materials. Grading of the Project site would involve the cut and fill approximately 2.5 million cubic yards of earth, which would be balanced on site. Maximum cut slopes would be approximately 75 feet high, and maximum fill areas would be approximately 61 feet high.

Approximately 198.7 acres (78 percent) of the Project site would be graded under the proposed specific plan. Approximately 55.2 acres (22 percent) of the Project site would remain undisturbed. Unless preventative control measures are implemented, short-term wind and water driven erosion of soils from the Project site and leaching of substances into underlying groundwater could occur during grading and construction, which would result in surface and groundwater contamination. However, under the requirements of the Clean Water Act (CWA) amendments of 1972, the project construction contractor will be required to file a notice of intent under the State's National Pollutant Discharge Elimination System (NPDES) General Construction Permit (CAS00002). The project applicant would be required to adhere to conditions under the NPDES permit set forth by Los Angeles Regional Water Quality Control Board (LARWQCB), and prepare and submit a Storm Water Pollution Prevention Plan (SWPPP) to be administered throughout all phases of grading and project construction. The SWPPP will incorporate Best Management Practices (BMPs) to ensure that potential water quality impacts during construction phases are minimized, see **Section 3.10 Hydrology**. In addition, the SWPPP will require that if any spill of materials known to be water pollutants or hazardous materials does occur, the LARWQCB and Ventura County Environmental Health Division (VCEHD) will be contacted immediately (if necessary) and appropriate cleanup of the spill will take place as soon as possible. The NPDES permit application approval conditions set forth by LARWQCB will dictate the actual measures and requirements of the project SWPPP and any other provisions deemed necessary by LARWQCB. The requirements set forth by the LARWQCB will serve to reduce potential impacts to water resources that could result during grading and construction phases to a less than significant level.

Impact GEO-3 **Would the Project 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?**

Less than Significant with Mitigation

Liquefaction. Hillside areas on the specific plan site that are underlain by older alluvium are not considered to be susceptible to liquefaction. The scattered layers of recent alluvium in the lower-lying areas, however, do have the potential for liquefaction if saturated. The potential for structural damage and risk to persons does exist without the incorporation of ground improvements/techniques to reduce movement of the structure. Depending on the estimated severity of liquefaction, which would be determined by conducting a design-level geotechnical investigation, deep ground improvement techniques may include the following alternatives: (1) in-situ densification by means of deep dynamic compaction (DDC) and associated subsurface drains; (2) vibro replacement (stone columns) and vibroflotation; (3) compaction grouting or chemical stabilization employing pressure techniques; and (4) special structural design consisting of deep foundations and self-supporting structural floor slabs to transfer loads below zone(s) of concern, or a thick mat foundation. **Mitigation Measure GS-1** would require the implementation of one of the available structural design alternatives, Therefore the potential impacts would be reduced to less than significant levels.

Seismic Settlement. Recent alluvium soils on the Project site may be subject to seismically induced settlement. These soils would provide problems in the event of an earthquake when located within the influence of structures, potentially causing risk to persons occupying the on-site structures. Furthermore, these soils are not suitable for direct support of footings, pavement, concrete slabs, or for use as structural fill. Measures contained in AKAI's geotechnical feasibility report indicate that soils will either require densification or over-excavation in areas below the structures and pavement, and that these materials must be replaced with a properly compacted fill. **Mitigation Measure GS-3** would require the implementation of the recommended measures to provide uniform and competent-bearing mat and reduce the potential for settlement and differential movement. Therefore, the potential settlement impacts would be reduced to less than significant levels.

Collapsible Soils. The site is underlain by topsoil, colluvium, and alluvium that may be prone to collapse upon wetting. Soil collapse could lead to excessive settlement of overlying structures and improvements.

However, with implementation of **Mitigation Measure GS-1**, the impact will be reduced to less than significant levels.

Landslides. As indicated in **Impact GEO-1d**, natural slopes along the southern margin of the Project site could result in a potentially significant impact in regard to landslides. However, with implementation of **Mitigation Measure GS-1** through **GS-3**, the impact will be reduced to less than significant levels.

Lateral Spread. Lateral spread refers to landslides that commonly form on gentle slopes or behind slope faces and that have rapid fluid-like movement. As indicated in **Impact GEO-1c**, limited portions along the southern margin of the site could undergo lateral spreading. However, with implementation of **Mitigation Measure GS-1** through **GS-3** the impact will be reduced to less than significant levels.

Impact GEO-4 **Would the Project be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect risks to life or property?**

Less than Significant with Mitigation

The site is located in an area that has a very low to high shrink-swell potential. When structures are located on expansive soils, foundations have the tendency to rise during the wet season and sink during the dry season. Movements can vary under the structures, which in turn create new stresses on various sections of the foundation. These variations in ground settlement can lead to structural damage or failure. However, the project will implement **Mitigation Measure GS-1** which will require the applicant to define the severity of liquefaction, settlement, and expansiveness conditions, and implement one of the available structural design alternatives listed; with the implementation of **Mitigation Measure GS-1**, the impacts would be less than significant.

Impact GEO-5 **Would the project 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?**

No impact

The Project site is located in an urban area served by a wastewater collection, conveyance, and treatment system operated by the Moorpark Wastewater Treatment Facility. No septic tanks or alternative disposal systems currently exist on the site or proposed by the project. Thus, there would be no impact. Refer to **Section 3.17, Wastewater** for an analysis of the sewer system for the Proposed Project.

Impact GEO-6 Would the project directly or indirectly destroy a paleontological resource or site or unique geologic feature?

Less than Significant with Mitigation

Development of the project would disturb approximately 198.7 acres on the site from construction related construction activities. In addition to grading, construction activities that would disturb the subsurface would include construction of residential units and access roads. A separate assessment of paleontological resources was conducted by First Carbon solutions in February 2020 and included a comprehensive literature review, museum records search, and a field survey.

Previous geologic mapping of the project area indicates the presence of Late Quaternary Older Alluvium and the underlying Plio-Pleistocene Saugus Formation within the project area. However, it should be noted that the GIA geotechnical studies conducted at the Project site instead report the composition of the surficial sediments as Late Quaternary Older Alluvium and Holocene (Recent) alluvium, colluvium, and artificial fill. Core samples taken from Hitch Ranch indicate that the Plio-Pleistocene Saugus Formation is present beneath the Older Alluvium. Furthermore, the AKAI study found that the two faults identified in the northern portions of the site are in the bedding of the Saugus Formation. Thus, the Saugus Formation may be impacted during grading of the Proposed Project area.

On March 29, 2005, an earthmover uncovered the bones of a Southern mammoth, (*Archidiscodon meridionalis*) estimated to be 1 million years old in the Meridian Hills development, an approximately 325-acre project of William Lyons Homes located north of downtown Moorpark and just west of Walnut Canyon Road, and approximately 0.5 mile north of the Project site.[12] This find was discovered in the Saugus Formation and approximately 70 percent of the bones were recovered and assembled. The mammoth was donated to the Santa Barbara County Natural History Museum. Mastodon bones have also been discovered on the Moorpark Highlands Project site approximately 1.5 miles northeast of the Project site.

Due to the high paleontological sensitivity of the Plio-Pleistocene Saugus Formation and the older Quaternary alluvium, excavations in these units within the Hitch Ranch project area are likely to have a negative impact on nonrenewable paleontological resources unless proper mitigation measures are implemented. Impacts are therefore potentially significant. **Mitigation measures GS-4** through **GS-8** will be implemented in order to reduce the impact posed to the highly paleontological areas of the Project site to less than significant levels.

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12 City of Moorpark, *Moorpark is Mammoth Country*, 2005.

3.6.6 CUMULATIVE IMPACTS

Unless otherwise noted, the cumulative impacts analysis for the specific plan project considers the buildout of land within the project study area, which is inclusive of the City of Moorpark, based on current land use designations set forth in the City's general plan, as well as all known general plan amendment requests for additional development in the study area. A cumulative impact is an impact that is created as a result of the combination of the Proposed Project together with other past, present, and probable future projects causing related impacts. Cumulative geology and soils impacts can occur where there would be an ongoing alteration to the natural topography; past, present, and foreseeable future development would occur in seismically active areas; grading activities would affect the stability of past, present, and foreseeable future development; and/or erosion would cumulatively affect water quality.

Generally, impacts related to geotechnical conditions are site-specific and, in this case, would be limited to areas within the development boundaries of the specific plan site. Soil stability and erosive conditions for development sites in the immediate vicinity of the specific plan site are expected to be similar to those found on the specific plan site. Buildings and facilities on and off the site are required to be sited, designed, and constructed in accordance with geotechnical and seismic building codes. Future off-site projects would also be expected to mitigate their respective impacts to a less than significant level with the implementation of site-specific/project-specific mitigation set forth in their respective soils and geotechnical reports. Additionally, any potential incremental contribution of the Hitch Ranch Specific Plan project to off-site soils and geological impacts is not cumulatively significant because the Proposed Project will comply with the applicable requirements of the *California Building Code*, and the mitigation program requirements will be implemented during project construction. For these reasons, the project's contribution to cumulative geotechnical and soils impacts is less than significant.

3.6.7 MITIGATION PROGRAM

3.6.7.1 Standard Conditions and Requirements

- Grading, drainage, and improvement plans and supporting reports and calculations must be prepared in accordance with the latest California Building Code as adopted by the City of Moorpark and in conformance with the latest "Land Development Manual" and "Road Standards" as promulgated by Ventura County; "Hydrology Manual" and "Design Manual" as promulgated by Ventura County Watershed Protection District; "Standard Specifications for Public Works Construction" as published by BNI (Except for signs, traffic signals, and appurtenances thereto which must conform to the provisions of Chapter 56 for signs and Chapter 86 for traffic signals, and appurtenances thereto, of the

"Standard Specifications," most recent edition, including revisions and errata thereto, as published by the State of California Department of Transportation).

- Grading, drainage, and improvement plans and supporting reports and calculations must be prepared in accordance with the most recently approved "Engineering Policies and Standards" of the City of Moorpark and "Policy of Geometric Design of Highways and Streets," most recent edition, as published by the American Association of State Highway and Transportation Officials. In the case of conflict between the standards, specifications, and design manuals listed herein and above, the criteria that provide the higher level of quality and safety prevail as determined by the City Engineer and Public Works Director. Any standard specification or design criteria that conflicts with a Standard or Special Condition of Approval of this project must be modified to conform with the Standard or Special Condition to the satisfaction of the City Engineer and Public Works Director.

- Prior to issuance of a grading permit, final approved soils and geology reports must be submitted to the City Engineer and Public Works Director. The approved final report must encompass all subsequent reports, addendums, and revisions under a single cover. Where liquefaction hazard site conditions exist, an extra copy of the final report must be provided by the applicant to the City Engineer and Public Works Director and be sent by the applicant to the California Department of Conservation, Division of Mines and Geology in accordance with Public Resources Code Section 2697 within 30 days of report approval.

- Prior to issuance of the grading permit, a grading remediation plan and report must be submitted for review and approval of the City Engineer and Public Works Director. The report must evaluate all major graded slopes and open space hillsides whose performance could affect planned improvements. The slope stability analysis must be performed for both static and dynamic conditions, using an appropriate pseudo-static horizontal ground acceleration coefficient for earthquakes on faults, capable of impacting the project in accordance with standard practice as outlines in DMG Special Publication No. 117, 1997.

- Prior to issuance of a grading permit, a qualified, currently registered Professional Civil Engineer in good standing with the State of California shall be retained to prepare Erosion and Sediment Control Plans in conformance with the currently issued Ventura County Municipal Storm Water NPDES Permit. These Plans shall address, but not be limited to, construction impacts and long-term operational effects on downstream environments and watersheds. The Plans must consider all relevant NPDES requirements and recommendations for the use of the best available technology and specific erosion control measures, including temporary measures during construction to minimize water quality effects to the maximum extent practicable. Prior to the issuance of an initial grading permit, review and approval by the Community Development Director and City Engineer and Public Works Director is required.

3.6.7.2 Mitigation Measures

The following mitigation measures, as presented in the geotechnical feasibility study, would reduce the potentially significant impacts to a less than significant level.

GS-1: The applicant shall conduct additional geotechnical work, consisting of soil borings and laboratory analysis, within the areas of the structures to better define the severity of liquefaction, settlement, and expansiveness conditions. Once the severity of these soil characteristics are determined, then appropriate measures contained within the geotechnical reports will be incorporated into the design of the project. Feasible techniques to mitigate any defined liquefaction, settlement, and expansive soils could include, but would not be limited to, (1) in-situ densification; (2) vibro replacement; (3) compaction grouting or chemical stabilization; or (4) deep foundations and self-supporting structural slabs, (5) over-excavation and replacement with properly compacted fill, and/or (6) design of foundation systems with appropriate thickness and reinforcing.

Timing/Implementation: Prior to grading permit issuance and as part of Improvement Plan approvals

Enforcement/Monitoring: City of Moorpark Public Works and Building Safety Departments

GS-2: All cut-and-fill slopes must be designed at a 2:1 [2(h) to 1(v)] gradient or less.

Timing/Implementation: Prior to grading permit issuance.

Enforcement/Monitoring: City of Moorpark Public Works Department

GS-3: Cut slopes exposing rock that exposes locally-adverse geologic conditions, expose sandy bedrock materials that are friable and prone to erosion, or where possible nuisance seepage issues could occur may require replacement with stabilization fill slopes. Stabilization fill slopes typically consists of removing the exposed slope face in a swath 10 to 15 feet wide (extending in from the slope face) and rebuilding the slope with compacted fill. All cut slopes shall be evaluated to confirm that no adverse geologic conditions are exposed at slope locations.

Timing/Implementation: During on-site grading activities

Enforcement/Monitoring: City of Moorpark Public Works Department

Paleontological Resources:

GS-4: Due to the potential that paleontological resources may be present on the Project site, the City of Moorpark shall require a note on any plans that require ground disturbing excavation that there is a potential for exposing buried paleontological resources. Construction personnel associated with earth moving equipment, drilling, grading, and excavating, shall be provided with basic training conducted by a qualified paleontologist, to be retained and compensated by the development team. Issues that shall be included in the basic training will be geared toward training the applicable construction crews in the identification of areas with the potential for containing paleontological deposits, further described below. Training will include written notification of the restrictions regarding disturbance and/or removal of any portion of paleontological deposits and the procedures to follow should a resource be identified. The construction contractor, or its designee, shall be responsible for implementation of this measure.

All project-related ground disturbances that could potentially impact the Saugus Formation and Quaternary older alluvium on site will be mapped by a qualified paleontological monitor, and provided to the construction crews during the aforementioned training. The paleontological monitor shall be available on-call as needed, when ground disturbing work is occurring in these areas, as these geologic units are determined to have a high paleontological sensitivity rating. Since younger alluvial and colluvial deposits cover the majority of the site and are considered to have a low paleontological sensitivity, monitoring of excavation activities in these units will be conducted on a part-time/on-call basis to ensure that no underlying sensitive units are being impacted.

Timing/Implementation: During ground moving activities

Enforcement/Monitoring: City of Moorpark Community Development Department, and the development team retained qualified paleontologist

GS-5: A qualified paleontologist as defined by the SVP Guidelines (2010) will be retained, and compensated by the development team, to supervise monitoring of construction excavations and to produce a mitigation plan for the Proposed Project. Paleontological monitoring will include inspection of exposed rock units during active excavations. The monitor will have authority to temporarily divert grading away from exposed fossils in order to professionally and efficiently recover the fossil specimens and collect associated data. The qualified paleontologist will prepare monthly progress reports to be filed with the applicant and the lead agency.

Timing/Implementation: During ground moving activities

Enforcement/Monitoring: City of Moorpark Community Development Department, and the development team retained qualified paleontologist

GS-6: At each fossil locality, field data forms will be used to record pertinent geologic data, stratigraphic sections will be measured, and appropriate sediment samples collected and processed for analysis.

Timing/Implementation: During ground moving activities in event resource are discovered

Enforcement/Monitoring: City of Moorpark Community Development Department, and the development team retained qualified paleontologist

GS-7: Recovered fossils will be prepared to the point of curation, identified by qualified experts, listed in a database to facilitate analysis, and reposed in a designated paleontological curation facility. Potential repositories include the Natural History Museum of Los Angeles County and the Museum of Ventura County as determined by the Moorpark City Council.

Timing/Implementation: During ground moving activities in event resource are discovered

Enforcement/Monitoring: City of Moorpark Community Development Department, and the development team retained qualified paleontologist

GS-8: The qualified paleontologist shall prepare a final monitoring and mitigation report to be filed with the applicant, the lead agency, and the repository.

Timing/Implementation: During ground moving activities in event resource are discovered

Enforcement/Monitoring: City of Moorpark Community Development Department, and the development team retained qualified paleontologist

3.6.8 LEVEL OF SIGNIFICANCE AFTER MITIGATION

Project specific and cumulative residual impacts would be less than significant.