4.5 GEOLOGY, SOILS, AND SEISMICITY

This chapter provides an overview of the regulatory framework and existing geologic conditions for the study area. The chapter also evaluates the potential environmental impacts of the proposed project as they relate to geology, soils, and seismicity.

4.5.1 ENVIRONMENTAL SETTING

4.5.1.1 REGULATORY FRAMEWORK

This section summarizes key State and local regulations pertaining to geology, soils, and seismicity that are applicable to the proposed project. There are no Federal regulations relating to geology, soils, and seismicity that are directly applicable to the proposed project.

State Regulations

The most relevant State laws that regulate geology, soils, and seismicity in the study area are the Alquist-Priolo Earthquake Fault Zoning Act, the Seismic Hazards Mapping Act, and the California Building Code, each of which is described below.

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act was passed in 1972 to mitigate the hazard of surface fault rupture to structures used for human occupancy.[1] The main purpose of this Act is to prevent the construction of buildings used for human occupancy on top of active faults. This Act only addresses the hazard of surface fault rupture and is not directed toward other earthquake hazards, such as earthquake-induced liquefaction or landslides.[2]

The law requires the State Geologist to establish regulatory zones (known as Earthquake Fault Zones or Alquist-Priolo Zones) around the surface traces of active faults, and to issue appropriate maps.[3] The maps, which are developed using existing US Geological Survey (USGS) 7.5-minute quadrangle map bases, are then distributed to all affected cities, counties, and State agencies for their use in planning and controlling new or renewed construction. Generally, construction within 50 feet of an active fault zone is prohibited.

[1] California Geological Survey, Alquist-Priolo Earthquake Fault Zoning Act, http://www.consrv.ca.gov/cgs/rghm/ap/Pages/main.aspx, accessed on November 4, 2015.

[2] California Geological Survey, Alquist-Priolo Earthquake Fault Zoning Act, http://www.consrv.ca.gov/cgs/rghm/ap/Pages/main.aspx, accessed on November 4, 2015.

[3] California Geological Survey, Alquist-Priolo Earthquake Fault Zoning Act, http://www.consrv.ca.gov/cgs/rghm/ap/Pages/main.aspx, accessed on November 4, 2015.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act, which was passed in 1990, addresses seismic hazards such as liquefaction and seismically-induced landslides.[4] Under this Act, seismic hazard zones are mapped by the State Geologist to assist local governments in land use planning. Section 2691(c) of this Act states that "it is necessary to identify and map seismic hazard zones in order for cities and counties to adequately prepare the safety element of their general plans and to encourage land use management policies and regulations to reduce and mitigate those hazards to protect public health and safety." Section 2697(a) of the Act states that "cities and counties shall require, prior to the approval of a project located in a seismic hazard zone, a geotechnical report defining and delineating any seismic hazard."

California Building Code

The State of California provides a minimum standard for building design through Title 24 of the California Code of Regulations (CCR), commonly referred to as the "California Building Code" (CBC). The CBC is located in Part 2 of Title 24. The CBC is updated every three years, and the current 2013 CBC went into effect in January 2014. It is generally adopted on a jurisdiction-by-jurisdiction basis, subject to further modification based on local conditions. The 2013 CBC has been adopted for use by the City of Menlo Park, according to Section 12.04.010 of the Menlo Park Municipal Code.

Through the CBC, the State provides a minimum standard for building design and construction. The CBC contains specific requirements for seismic safety, excavation, foundations, retaining walls, and site demolition. It also regulates grading activities, including drainage and erosion control.

Local Regulations

Emergency Operation Plan

The City of Menlo Park adopted an Emergency Operation Plan (EOP) in January 2011.[5] The City developed the EOP to better prepare for responses to "extraordinary" emergency situations that could result from natural disasters and technological incidents. To prepare for these emergencies, the City assessed the potential risks associated with earthquakes, flooding, wildland fire, and other disasters. Based on this evaluation, various response strategies were developed. These strategies are addressed in Volume 2 of the EOP as follows: Chapter 1 introduces the City's Emergency Management System and four emergency management phases, as well as required activities and responsible parties for each phase; Chapter 2 describes regulatory frameworks and relevant legal authorities; Chapter 3 provides a threat assessment including estimated potential risks associated with various natural and man-made disasters; and Chapter 4 provides a recovery plan, including damage assessments and disaster assistance programs.

[4] California Geological Survey, Alquist-Priolo Earthquake Fault Zoning Act, http://www.consrv.ca.gov/cgs/rghm/ap/Pages/main.aspx, accessed on November 4, 2015.

[5] City of Menlo Park, 2011. *Emergency Operation Plan, Basic Plan*, Volume 2, http://www.menlopark.org/documentcenter/view/815, accessed on February 26, 2015.

Menlo Park General Plan

The City of Menlo Park General Plan includes goals, policies, and programs relevant to the environmental factors potentially affected by the proposed project. Applicable goals, policies, and programs are identified and assessed for their effectiveness later in this chapter under Section 4.5.3, Impact Discussion.

Menlo Park Municipal Code

The City of Menlo Park Municipal Code, organized by title, chapter, and section, contains all ordinances for Menlo Park. Title 12, Buildings and Construction, includes regulations relevant to geology and seismic events in Menlo Park as discussed below.

Chapter 12.04, Adoption of Codes

Under Chapter 12.04, Adoption of Codes, the City has adopted all parts of the most recent triennial publication of the California Code of Regulations, Title 24 except Part 9, California Fire Code. Together, they are referred to as the building code of the city. In addition, Chapters 12.06 through 12.18 of the City of Menlo Park Municipal Code implement certain amendments to the City's building code.

Land Development Guidelines[6]

The City of Menlo Park Department of Public Works, Engineering Division has a variety of development-related guidelines that govern new residential and commercial construction, additions to existing buildings, and redevelopment projects. Some of the guidelines prescribe construction-related stormwater control and treatment measures (including Best Management Practices [BMPs] such as underground detention systems, vegetated swales, inlet/filter basins, and the like) that are intended to reduce stormwater runoff and prevent sediment and pollutants from entering the City's storm drain system and creeks, as well as San Francisco Bay.[7]

The guidelines also set forth submittal requirements for landscaping plans and grading and drainage (G&D) plans. Pursuant to the Engineering Division's grading guidelines, G&D plans are required for construction projects where more than 500 square feet of a given lot will be changed from pervious areas to impervious cover (i.e., buildings, paved areas). The guidelines also require the inclusion of site plans and storm drain control plans in a G&D plan, so that proposed storm drain and utility systems, frontage improvements, and irrigation plans are clearly identified. The City also requires G&D plans to address erosion and sedimentation control details and to include an Impervious Area Worksheet that evaluates potential changes to impervious areas.

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[6] City of Menlo Park, Department of Public Works, Engineering Division, Guidelines & Information, http://menlopark.org/147/Engineering-Division, accessed on November 5, 2015.

[7] City of Menlo Park, Department of Public Works, Engineering Division, *Construction Erosion and Sediment Control Plan Requirements*, http://menlopark.org/DocumentCenter/View/5672, accessed on November 6, 2015.

4.5.1.2 EXISTING CONDITIONS

Regional Seismicity

The Earth's crust includes tectonic plates that locally collide with or slide past one another along plate boundaries. California is particularly susceptible to such plate movements, notably the largely horizontal or "strike-slip" movement of the Pacific Plate, as it impinges on the North American Plate. In general, earthquakes occur when the accumulated stress along a plate boundary or fault is suddenly released, resulting in seismic slippage. This slippage can vary widely in magnitude, ranging in scale from a few millimeters or centimeters, to tens of feet.

The performance of man-made structures during a major seismic event varies widely due to a number of factors, including location with respect to active fault traces or areas prone to liquefaction or seismically-induced landslides; the type of building construction (i.e., wood frame, unreinforced masonry, non-ductile concrete frame); the proximity, magnitude, and intensity of the seismic event itself; and many other factors. In general, evidence from past earthquakes shows that wood frame structures tend to perform well especially when their foundations are properly designed and anchored. Conversely, older, unreinforced masonry structures and non-ductile reinforced concrete buildings (especially those built in the 1960s and early 1970s), do not perform as well, especially if they have not undergone appropriate seismic retrofitting. Applicable building code requirements, such as those found in the CBC, include seismic requirements that are designed to ensure the satisfactory performance of building materials under prescribed seismic conditions.

Faults

The study area, like much of the San Francisco Bay area, is vulnerable to seismic activity due to the presence of active faults in the region. The closest and most prominent active fault near the study area is the San Andreas Fault System, which is located about 2.5 miles west of the southwest boundary of the city limits.[8] Other active earthquake faults in the region include the Monte Vista Fault, which lies roughly 3 miles to the south, the Hayward Fault which lies roughly 13 miles to the north, the Calaveras Fault which is approximately 19 miles to the east, and the San Gregorio Fault, whose trace passes as close as 13 miles southwest of the study area.[9] No mapped earthquake faults run within the study area. Thus, surface fault rupture is not considered a significant hazard within the study area.[10]

Although it has not been classified as an "active" fault (i.e., having ruptured in the past 11,000 years) by the California Geological Survey (CGS), the Pulgas Fault is interpreted to cross the south-central part of

[8] United States Geological Survey (USGS), Montara Mountain (1980), Palo Alto (1973), San Mateo (1980), and Woodside (1973), Quadrangles, California, 7.5 Minute Series (Topographic), scale 1:24,000.

[9] Hart, E.W., and Bryant, W.A., *Fault-Rupture Hazard Zones in California, Alquist-Priolo Earthquake Fault Zoning Act with Index to Earthquake Fault Zones Maps*, California Geological Survey, Special Publication 42, revised 1997, Supplements 1 and 2, 1999, Supplement 3, 2003. 19 International Conference of Building Officials, Uniform Building Code, Volumes 1, 2 & 3; Chapter 16, Structural Forces (earthquake provisions).

[10] Annex to 2010 Association of Bay Area Governments (ABAG), *Local Hazard Mitigation Plan Taming Natural Disasters, City of Menlo Park*, http://resilience.abag.ca.gov/wp-content/documents/2010LHMP/MenloPark-Annex-2011.pdf, accessed on February 26, 2015.

Menlo Park. According to geologic maps published by the USGS, the main trace of this thrust fault trends northwest-southeast along the base of the foothills that occupy the southwest part of the study area.[11]

Ground Shaking

The severity of ground shaking depends on several variables such as earthquake magnitude, hypocenter proximity, local geology including the properties of unconsolidated sediments, groundwater conditions, and topographic setting. In general, ground shaking hazards are most pronounced in areas that are underlain by loosely consolidated soil/sediment.[12]

When earthquake faults within the Bay Area's nine-county area were considered, the USGS estimated that the probability of a magnitude (M) 6.7 or greater earthquake prior to year 2032 is 62 percent, or roughly a two-thirds probability over this timeframe. Individually, the forecasted probability for each individual fault to produce an M 6.7 or greater seismic event by the year 2032 is as follows: 27 percent for the Hayward Fault, 21 percent for the San Andreas Fault, 11 percent for the Calaveras Fault, and ten percent for the San Gregorio Fault.[13] Earthquakes of this magnitude can create ground accelerations severe enough to cause major damage to structures and foundations not designed to resist the forces generated by earthquakes. Underground utility lines are also susceptible where they lack sufficient flexibility to accommodate the seismic ground motion.[14] In the event of a M 7.9 earthquake on the San Andreas Fault, the seismic forecasts presented on the Association of Bay Area Governments' interactive GIS website (developed by a cooperative working group that included the USGS and the CGS) suggest that most parts of the study area are expected to experience "very strong" shaking, whereas certain foothill areas and areas near the Dumbarton Bridge are expected to experience "violent" shaking.[15]

The April 1906 earthquake on the San Andreas Fault, estimated between M 7.7 and 8.3, was the largest seismic event in recent history that affected the study area. More recently, the M 6.9 Loma Prieta earthquake of October 1989 on the San Andreas Fault caused significant damage throughout the Bay Area, although no deaths were reported in San Mateo County.

Liquefaction

Liquefaction typically occurs in areas where moist, fine-grained, cohesionless sediment or fill materials are subjected to strong, seismically-induced ground shaking. Under certain circumstances, the ground shaking can temporarily transform an otherwise solid material to a fluid state. Liquefaction is a serious hazard because buildings in areas that experience liquefaction may subside and suffer major structural damage.

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[11] USGS, 1993, Geologic Map of the Palo Alto and Part of the Redwood Point 7 ½ Minute Quadrangles, San Mateo and Santa Clara Counties, Miscellaneous Investigations Series Map I-2371, by Earl H. Pampayan.

[12] Southern California Earthquake Center (SCEC), 2011. *Putting Down Roots in Earthquake Country*, Lucile M. Jones, United States Geological Survey (USGS), and Mark Benthien, SCEC.

[13] United States Geological Survey (USGS), San Francisco Region Earthquake Probability, http://earthquake.usgs.gov/regional/nca/wg02/images/percmap-lrg.html, accessed on February 26, 2015.

[14] Association of Bay Area Governments (ABAG), 1995. *The San Francisco Bay Area On Shaky Ground*, Publication Number P95001EQK, 13 maps, scale 1:1,000,000.

[15] Association of Bay Area Governments (ABAG), 2013, Interactive Hazards Map, Earthquake Shaking Scenarios., http://gis.abag.ca.gov/website/Hazards/?hlyr=northSanAndreas, source: USGS 2013, accessed on November 6, 2015.

Liquefaction is most often triggered by seismic shaking, but it can also be caused by improper grading, landslides, or other factors. In dry soils, seismic shaking may cause soil to consolidate rather than flow, a process known as densification.

Liquefaction potential in the study area ranges from very low in the southern hill areas to very high in the Baylands. Close to San Francisco Bay, in the northeastern most part of the study area, the prevailing soil type is known as "Bay Mud," which consists of silty clay, sand, gravel, peat, and shell fragments. These low-lying areas that front the bay are particularly susceptible to liquefaction. According to hazard maps published by the CGS, the northeast part of the study area (generally, within 1¾ miles of the west end of the Dumbarton Bridge) and areas flanking San Francisquito Creek to the northwest, have been designated as liquefaction hazard zones.[16] In the southern parts of the study area, the prevailing soil type often consists of alluvium that lies atop the sandstone, chert, shale, and limestone of the Late Jurassic to Early Cretaceous Franciscan Formation.[17] These areas are judged to have a low susceptibility to liquefaction.

Landslides, Erosion, and Subsidence

Landslides are gravity-driven movements of earth materials that may include rock, soil, unconsolidated sediment, or combinations of such materials. The rate of landslide movement can vary considerably. Some move rapidly as in a soil or rock avalanche, while other landslides creep or move slowly for extended periods of time. The susceptibility of a given area to landslides depends on many variables, although the general characteristics that influence landslide hazards are well understood. The factors that influence the probability of a landslide and its relative level of risk include the following:

- Slope Material: Loose, unconsolidated soils and soft, weak rocks are more hazardous than are firm, consolidated soils or hard bedrock.
- Slope Steepness: Most landslides occur on moderate to steep slopes.
- Structure and Physical Properties of Materials: This includes the orientation of layering and zones of weakness relative to slope direction.
- Water Content: Increased water content increases landslide hazard by decreasing friction and adding weight to the materials on a slope.
- Vegetation Coverage: Abundant vegetation with deep roots promote slope stability.
- Proximity to Areas of Erosion or Man-made Cuts: Undercutting slopes can greatly increase landslide potential.
- Earthquake Ground Motions: Strong seismic ground motions can trigger landslides in marginally stable slopes or loosen slope materials, and also increase the risk of future landslides.

[16] California Geological Survey (CGS), 2006. Seismic Hazards Zone, Palo Alto Quadrangle, Official Map, released October 18, 2006. Scale 1:24,000.

[17] City of Menlo Park, 1994. Final Environmental Impact Report for Amendments to the City of Menlo Park General Plan Land Use and Circulation Elements and Zoning Ordinance, pages IV.H-1 to IV.H-5.

Landslides have the potential to occur within the study area, most notably on some of the hilly slopes that lie southwest of the street Alameda de las Pulgas. In these areas, landslides are commonly associated with bedrock outcrops of the Franciscan Formation, which frequently form steeper slopes. Shale is the most unstable of the many rock types within the Franciscan Formation, whereas sandstone and conglomerate units tend to be more stable with a lower landslide risk. Much of the upland areas in the study area are typified by shallow soil that overlies Franciscan bedrock. Landslides are not an issue in parts of the study area where the topography is flat. Due to the differences in the physical characteristics of slope materials, which markedly influence landslide potential, some superficially similar areas may differ widely in terms of landslide hazards. For this reason, site-specific geotechnical investigations are essential to the accurate assessment of potential landslide hazards at any given project site.

Land Subsidence

Subsidence hazards are known to be present in the study area. In the Baylands and adjacent fill areas that occupy the northeastern-most part of the study area, historical subsidence has been attributed to the highly compressible nature of the underlying fill and sediments. Historical groundwater overdraft in the Menlo Park-Palo Alto area, notably from the 1920s through the mid-1960s, has been the cause of settlement in much of the study area.[18] From the late 1960s on, imported water from the Hetch Hetchy Aqueduct to the east has all but replaced groundwater as a source of drinking water. Groundwater levels have risen in response, and the subsidence hazards associated with overdraft and hydro-compaction were effectively halted as of 1969.[19]

Expansive Soil

Expansive soils can change dramatically in volume depending on moisture content. When wet, these soils can expand; conversely, when dry, they can contract or shrink. Sources of moisture that can trigger this shrink-swell phenomenon can include seasonal rainfall, landscape irrigation, utility leakage, and/or perched groundwater. Expansive soil can exhibit wide cracks in the dry season, and changes in soil volume have the potential to damage concrete slabs, foundations, and pavement. Special building/structure design or soil treatment are often needed in areas with expansive soils.

Expansive soils are typically very fine-grained with a high to very high percentage of clay, typically montmorillonite, smectite, or bentonite clay. Linear extensibility soil tests are often used to identify expansive soils, wherein soil sample volume/length changes in response to reduced moisture content.[20] A linear extensibility of 3 percent or greater connotes moderate to high shrink-swell potential. This soil behavior has the potential to cause damage to buildings, roads, and other structures.

[18] Todd Engineers, 2005. *Feasibility of Supplemental Groundwater Resources Development Menlo Park and East Palo Alto, California*.

[19] USGS, 1999, *Land Subsidence in the United States* , edited by Devin Galloway, David R. Jones, and S.E. Ingebritsen , Circular 1182.

[20] Army Corps of Engineers Field Manual TM 5-818-7, 1985. http://armypubs.army.mil/eng/DR_pubs/dr_a/pdf/tm5_818_7.pdf, accessed on February 26, 2015.

A 1991 U.S. Department of Agriculture (USDA) soil survey of San Mateo County provides an overview of the soil types present in the study area soils as well as their physical and engineering properties.[21] The study, whose extent embraced the southernmost part of the County including the City of Menlo Park, broadly identified three major soil associations in the study area: 1) the Accelerator-Fagan association soils, typically comprised of deep, well-drained loams or clay loams that are most prevalent in the southern foothills; 2) the Botella complex soils that are generally composed of deep or very deep, well drained clay loams, and predominantly found in the central part of the study area; and 3) and Urban land-Orthents, very deep, poorly drained, texturally heterogeneous soils that have been used for fill in a (proportionally) smaller area along the Baylands edge.

The USDA county-wide soil survey notwithstanding, the shrink-swell potential at a given project within the study area may often be highly site-specific, requiring careful geotechnical investigation prior to project design and construction. For example, soils on the northeastern Baylands edge, as in the vicinity of the Facebook East and West Campus project, are known to be clay-rich and poorly drained, and are likely to possess high shrink-swell potential.[22] Elsewhere in the study area, soil test data in the USDA's Web Soil Survey (a nationwide data repository) shows soil plasticity index values of 10 to 12 percent, suggesting low to moderate shrink-swell potential at those locations.[23]

4.5.2 STANDARDS OF SIGNIFICANCE

The proposed project would result in a significant impact if it would:

1. Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
   - Strong seismic ground shaking.
   - Seismic-related ground failure, including liquefaction.
   - Landslides.
2. Result in substantial soil erosion or the loss of topsoil
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.
4. Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property.
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.

[21] U.S. Department of Agriculture (USDA), 1991. Soil Conservation Service, Soil Survey of San Mateo County, Eastern Part, and San Francisco County, California, issued May 1991.

[22] City of Menlo Park, 2011. Facebook Campus Project Draft EIR, dated December 2011, prepared by Atkins, Inc.

[23] U.S. Department of Agriculture (USDA), Natural Resources Conservation Center, Web Soil Survey, 2013. http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm last accessed on February 15, 2013.

4.5.3 IMPACT DISCUSSION

GEO-1 Implementation of the proposed project would not expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving strong seismic ground shaking; seismic-related ground failure, including liquefaction; or landsliding.

No Alquist-Priolo Earthquake Fault Zones have been mapped within the study area. The Pulgas Fault, a northwest-trending thrust fault, has been mapped near the base of the foothills that define the southwest part of the study area. This fault shows no evidence of activity in the past 11,000 years and is not considered "active" by the CGS.[24] Based on published seismic research and forecast, in the event of a large, M 7.9 earthquake on the nearby San Andreas Fault, much of the study area is projected to experience "very strong" or even "violent" ground shaking, with the most intense shaking forecast for the northeastern and southwestern parts of the study area.[25]

Based on mapping by the CGS, certain northeastern parts of the study area, particularly those areas underlain by Bay Mud, are judged to have a high potential for seismically-induced liquefaction. Lastly, landsliding hazards are typically low in the study area, due in part to the prevailing flat topography. Exceptions are found in the foothill areas in the southeast part of the study area, where certain steeper hillsides have been mapped as seismically-induced landslide hazard zones.

State-level protections concerning the seismic hazards discussed above include the Alquist-Priolo Earthquake Fault Zoning Act of 1972, the Seismic Hazards Mapping Act of 1990, and the California Building Code (i.e., CCR Title 24).

The proposed Land Use (LU) Element, which would be adopted as part of the proposed project, and existing Section IV, Safety (S) of the Open Space/Conservation, Noise and Safety Elements, contain general goals, policies and programs that would require local planning and development decisions to consider impacts related to strong seismic ground shaking; seismic-related ground failure, including liquefaction; or land sliding. The following General Plan goals, policies and programs would serve to minimize potential adverse risks specifically associated with strong seismic ground shaking, seismic-related ground failure, including liquefaction or landslides:

- Goal LU-4: Promote the development and retention of business uses that provide goods or services needed by the community that generate benefits to the City, and avoid or minimize potential environmental and traffic impacts.

[24] United States Geological Survey (USGS), 2000. *Geologic Map and Map Database of the Palo Alto 30' X 60' Quadrangle, California*, E.E. Brabb, R.W. Graymer, and D.L. Jones.

[25] California Seismic Safety Commission (CSSC), California Geological Survey (CGS), California Emergency Management Agency (CalEMA), and United States Geological Survey (USGS), *Earthquake Shaking Potential for the San Francisco Bay Region*, 2003, http://resilience.abag.ca.gov/earthquakes/, accessed on February 26, 2015.

  - Policy LU-4.5: Business Uses and Environmental Impacts. Allow modifications to business operations and structures that promote revenue generating uses for which potential environmental impacts can be mitigated.
- Goal S-1: Assure a Safe Community. Minimize risk to life and damage to the environment and property from natural and human-caused hazards, and assure community emergency preparedness and a high level of public safety services and facilities.
  - Policy S-1.1: Location of Future Development. Permit development only in those areas where potential danger to the health, safety and welfare of the residents of the community can be adequately mitigated.
  - Policy S-1.3: Hazard Data and Standards. Integrate hazard data (geotechnical, flood, fire, etc.) and risk evaluations into the development review process and maintain, develop and adopt up-to-date standards to reduce the level of risk from natural and human-caused hazards for all land use.
  - Policy S-1.5: New Habitable Structures. Require that all new habitable structures to incorporate adequate hazard mitigation measures to reduce identified risks from natural and human-caused hazards.
  - Policy S-1.7: California Building Standards Code. Encourage the reduction of seismically vulnerable buildings and buildings susceptible to other hazards through enforcement of the California Building Standards Code and other programs.
  - Policy S-1.13: Geotechnical Studies. Require site-specific geologic and geotechnical studies for land development or construction in areas of potential land instability as shown on the State and/or local geologic hazard maps or identified through other means.
  - Policy S-1.14: Potential Land Instability. Prohibit development in areas of potential land instability identified on State and/or local geologic hazard maps, or identified through other means, unless a geologic investigation demonstrates hazards can be mitigated to an acceptable level as defined by the State of California.
    - Program S-1.A: Link the City's Housing and Safety Elements. Continue to review and revise the Safety Element, as necessary, concurrently with updates to the General Plan Housing Element whenever substantial new data or evidence related to prevention of natural and human hazards become available.
    - Program S-1.B: Maintain Up-to-Date Hazard Maps and Databases. Maintain up-to-date databases and maps of geologic and other hazards to identify areas prone to hazards for planning purposes on an on-going basis concurrently with the Housing Element Updates.
    - Program S-1.D: Require Early Investigation of Potential Hazard Conditions. Require that potential geologic, seismic, soils, and/or hydrologic problems confronting public or private development be thoroughly investigated at the earliest stages of the design process, and that these topics be comprehensively evaluated in the environmental review process by persons of competent technical expertise.
    - Program S-1.E: Modify the Zoning and Subdivision Ordinances as Needed to Address Hazard Mitigation. Modify the Zoning Ordinance as needed when new information on natural hazards

becomes available and to provide for hazard reduction measures as a part of the design criteria for development review. Review the Subdivision Ordinance and modify as needed to include hazard reduction in the process of dividing land for development.

- Program S-1.G: Share Hazard Data with Other Agencies. Participate in a cooperative County-wide program to pool natural hazard data developed through special studies or via the project review process and continue to update and implement the Local Hazard Mitigation Plan.
- Program S-1.H: Enforce Seismic Risk Analysis and Adequate Construction Standards. Enforce seismic risk analysis and adequate construction standards through the building permit and inspection process.

Thus, because future development under the proposed project, as part of the City's project approval process, would be required to comply with existing regulations, including General Plan policies that have been prepared to minimize impacts related to strong seismic ground shaking; seismic-related ground failure, including liquefaction; or landsliding, and because the City, throughout the 2040 buildout horizon, would implement the General Plan programs that require ongoing review, identification and maintenance of maps and regulations related to geologic and seismic hazards, impacts would be *less than significant*.

Significance Without Mitigation: Less than significant.

GEO-2 Implementation of the proposed project would not result in substantial soil erosion or the loss of topsoil.

Substantial soil erosion or loss of topsoil during construction could undermine structures and minor slopes, and this could be a concern of nearly all construction resulting from implementation of the proposed project. Compliance with existing regulatory requirements, such as implementation of erosion control measures as specified in the City of Menlo Park Engineering Division's Grading and Drainage Control Guidelines, would reduce impacts from erosion and the loss of topsoil to the extent practicable. Examples of these erosion control measures include hydroseeding or short-term biodegradable erosion control blankets; vegetated swales, silt fences, or other inlet protection at storm drain inlets; post-construction inspection of drainage structures for accumulated sediment; and post-construction clearing of debris and sediment from these structures.

Furthermore, the anticipated residential and commercial construction under the proposed project would be concentrated on sites that are already developed and/or underutilized. For this reason, development would likely result in limited soil erosion or loss of topsoil. Adherence to existing regulatory requirements, that include, but are not limited to, the City of Menlo Park's grading and drainage requirements for new developments, would ensure that impacts associated with substantial erosion and loss of topsoil during the development under the proposed project would be *less than significant*.

Significance Without Mitigation: Less than significant.

GEO-3 Implementation of the proposed project would not result in a significant impact related to development on unstable geologic units and soils or result in lateral spreading, subsidence, liquefaction, or collapse.

Unstable geologic units are known to be present within the study area. The impacts of such unstable materials include, but may not be limited to, subsidence in the Baylands where the underlying sediments have been described as highly compressible, and nearby areas of artificial fill near the edge of San Francisco Bay. Elsewhere in the study area, historical groundwater over-extraction from the 1920s through the mid-1960s resulted in a sharp lowering of groundwater levels and local subsidence. A shift to imported sources of drinking water (i.e., the Hetch Hetchy Reservoir) in the late 1960s effectively halted that subsidence.

In addition to protections afforded by State laws, such as the Seismic Hazards Mapping Act of 1990, General Plan policies and programs listed under GEO-1 would require local planning and development decisions to consider impacts related to development on unstable soils. These General Plan goals, policies and programs would serve to minimize potential adverse risks specifically associated with unstable soils. For example, compliance with General Plan Policy S-1.13, which requires site-specific geologic and geotechnical studies for land development or construction in areas of potential land instability, provide additional safeguards. Similarly, General Plan Policy S-1.14 generally bars development in areas of potential land instability already identified on State and/or local geologic hazard maps.

Under the General Plan, the City is required to implement the General Plan programs related to geologic and seismic hazards over the duration of the General Plan buildout. Program S-1.A requires the City to continue to review and revise the Safety Element, as necessary, concurrently with updates to the General Plan Housing Element whenever substantial new data or evidence related to prevention of natural and human hazards become available. Program S-1.B requires the City to maintain up-to-date databases and maps of geologic and other hazards to identify areas prone to hazards for planning purposes on an on-going basis concurrently with the Housing Element Updates. Program S-1.D requires the City to require that potential geologic, seismic, soils, and/or hydrologic problems confronting public or private development be thoroughly investigated at the earliest stages of the design process, and that these topics be comprehensively evaluated in the environmental review process by persons of competent technical expertise. Program S-1.E requires the City to modify the Zoning Ordinance as needed when new information on natural hazards becomes available and to provide for hazard reduction measures as a part of the design criteria for development review. Review the Subdivision Ordinance and modify as needed to include hazard reduction in the process of dividing land for development. Program S-1.G requires the City to participate in a cooperative County-wide program to pool natural hazard data developed through special studies or via the project review process and continue to update and implement the Local Hazard Mitigation Plan. Program S-1.H: requires the City to inforce seismic risk analysis and adequate construction standards through the building permit and inspection process.

Thus, because future development under the proposed project, as part of the City's project approval process, would be required to comply with existing regulations, including General Plan policies that have been prepared to minimized impacts related to development on unstable geologic units and soils where lateral spreading, subsidence, liquefaction, or collapse could occur in the study area, and because the City, throughout the 2040 buildout horizon, would implement the General Plan programs that require ongoing review, identification and maintenance of maps and regulations related to geologic and seismic hazards, impacts would be *less than significant*.

Significance Without Mitigation: Less than significant.

GEO-4 Implementation of the proposed project would not create substantial risks to property as a result of its location on expansive soil, as defined by Section 1803.5.3 of the California Building Code.

As previously discussed, the pattern of expansive soils within the study area is such that expansive soils (denoted by soils with high linear extensibility and plasticity index) are most prevalent in the northeastern-most part of the study area, in the neighborhoods that lie closest to San Francisco Bay. Development in this part of the study area would be subject to requirements of the CBC, as adopted in Chapter 12.04 of the City's Municipal Code and enforced by the City during plan review prior to building permit issuance. The CBC contains specific requirements for seismic safety, excavation, foundations, retaining walls, and site demolition, and it also regulates grading activities, including drainage and erosion control. Furthermore, requirements for geotechnical investigations at development site locations where potential land instability has already been identified are bolstered by various goals, policies, and programs of the General Plan as previously cited under GEO-1. Thus, because future development under the proposed project, as part of the City's project approval process, would be required to comply with existing regulations, including General Plan policies that have been prepared to minimized impacts related to development on expansive soil in the study area, and because the City, throughout the 2040 buildout horizon, would implement the General Plan programs that require ongoing review, identification and maintenance of maps and regulations related to geologic and seismic hazards, impacts would be *less than significant*.

Significance Without Mitigation: Less than significant.

GEO-5 Implementation of the proposed project would 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.

Development within the study area is not expected to require the use of septic tanks or alternative waste water disposal systems. Wastewater will be discharged into the existing public sanitary sewer system in the study area, which is serviced by the West Bay Sanitary District and the South Bayside Systems Authority (now known as Silicon Valley Clean Water or SVCW). The West Bay Sanitary District provides and maintains the sanitary sewer system in the City, whereby wastewater is conveyed to an advanced, two-stage biological treatment facility operated by the SVCW prior to discharge to San Francisco Bay.

As such, impacts of future project development where soils may be incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sanitary sewers are not available would be *less than significant*.

Significance Without Mitigation: Less than significant.

4.5.4 CUMULATIVE IMPACT DISCUSSION

GEO-6	**Implementation of the proposed project, in combination with past, present, and reasonably foreseeable projects, would result in less-than-significant cumulative impacts with respect to geology, soils, and seismicity.**

This section analyzes potential cumulative geological impacts that could arise from future development under the proposed project combined with projected regional growth in its immediate vicinity and the reasonably foreseeable projects described in Chapter 4, Environmental Evaluation, of the Draft EIR.

Anticipated new development in the study area would be subject to CBC and Municipal Code requirements, as well as the General Plan polices. Compliance with these requirements would, to the maximum extent practicable, reduce cumulative, development-related impacts that pertain to seismic shaking, seismically induced landslides and liquefaction, and expansive soils.

Similarly, compliance with relevant Municipal Code requirements, as well as the requirements of the CBC, would minimize the cumulative impacts associated with substantial erosion or loss of topsoil.

Project implementation would not result in a significant impact with respect to geology, soils, and/or seismicity and would not significantly contribute to cumulative impacts in this regard. Therefore, the cumulative impacts associated with project implementation, together with anticipated growth in its immediate vicinity, would result in a *less-than-significant* cumulative impact with respect to geology, soils, and seismicity.

Significance Without Mitigation: Less than significant.