5.5 GEOLOGY AND SOILS

This section of the Draft Environmental Impact Report (DEIR) evaluates the potential for implementation of the Crummer Site Subdivision project to impact geological and soil resources in the City of Malibu. The analysis in this section is based in part on the following technical report(s):

- *Feasibility-Level Grading Plan Review, Proposed Malibu Bluffs Development: 5-Lot Subdivision, "The Crummer Site," APN 4458-018-019, 24200 Pacific Coast Highway, City of Malibu, California*, Leighton and Associates, Inc., December 5, 2007.
- *Revised Addendum No. 1, Feasibility-Level Grading Plan Review Proposed Malibu Bluffs Development: 5-Lot Subdivision, "The Crummer Site," APN 4458-018-019, 24200 Pacific Coast Highway, City of Malibu, California*, Leighton and Associates, Inc., October 29, 2008.
- *Responses to the City of Malibu Geotechnical Review Sheet Dated March 20, 2008, Proposed Residential Development, "Crummer Site," 24200 Pacific Coast Highway, APN 4458-018-019, City of Malibu, California*, Leighton and Associates, Inc., September 21, 2009a.
- *Geotechnical Evaluation of Proposed Onsite Wastewater Treatment System, Proposed Residential Development "Crummer Site," 24200 Pacific Coast Highway, APN 4458-018-019, City of Malibu, California*, Leighton and Associates, Inc., September 21, 2009b.
- *Phase I Environmental Site Assessment, 24200 Pacific Coast Highway, Malibu, Los Angeles County, California,* Leighton and Associates, October 28, 2011.
- *Response to City of Malibu Comments on Earth Consultants International Report Entitled "Hydrogeological/Treated Water Mounding Report for the Proposed Malibu Bluffs Residential Development at 24120 (aka 24200) Pacific Coast Highway (aka Crummer Site), APN 4458-018-019, TTM 07-003, Malibu, California," dated September 21, 2009*, Earth Consultants International, Inc., March 7, 2012.
- *Responses to City of Malibu Geotechnical Review Dated January 12, 2010: Proposed Residential Development "Crummer Site" 24200 Pacific Coast Highway (Aka 24210) APN 4458-018-019 City of Malibu, California.* Leighton Associates, March 7, 2012.
- *Response to City of Malibu Environmental Health Review Sheet Dated December 21, 2009,* Earth Consultants International, Inc., March 7, 2012
- *Responses To City Of Malibu Geotechnical Review Dated May 7, 2012 Proposed Residential Development "Crummer Site" 24200 Pacific Coast Highway (Aka 24210) APN 4458-018-019 City Of Malibu, California*, Leighton and Associates Inc., May 16, 2012
- *Geotechnical Reports for Individual Lots,* Leighton and Associates May 16, 2012
- *Response to City of Malibu Environmental Health Review Sheet Dated April 16, 2012,* Earth Consultants International, Inc., May 22, 2012.
- *City of Malibu Geology Review Sheets,* City of Malibu 2008- 2012

Complete copies of these studies are included Appendix J of this Draft EIR.

5.5.1 Environmental Setting

Regional Geology

California is divided into geomorphic provinces, which are distinctive, generally easy-to-recognize natural regions in which the geologic setting types of landforms, patterns of landscape features such as drainage, and climate are similar. The proposed project site is in the Transverse Ranges province, which extends from Santa Barbara County to the Mojave Desert. This province is characterized by an east–west–trending geologic grain, meaning that the faults, folds, mountains, and valleys of the region are generally aligned in an east–west direction. The east–west grain of the province is in marked contrast to the north–south alignment of neighboring provinces, giving rise to the name "transverse." The Transverse Ranges are a tectonically active region, with high rates of uplift, folding, and sedimentation. This deformation is driven by north–south compression from the convergence of the North American Plate and the Pacific Plate. The convergence has caused folding and faulting in the rock units and overlying sediments in the region.

The Santa Monica Mountains are in the southernmost portion of the Transverse Ranges. The Santa Monica Mountains are roughly 45 miles long. They form an east–west range of low mountains along the southern California coast from the Oxnard Plain to the City of Los Angeles, and they are characterized by long, south-draining canyons on their south flank and short, north-draining canyons on their north flank. The main ridgeline of the range and the long ridges that extend southward from its crest generally reach altitudes of 1,500 to 2,100 feet above mean sea level.

The City of Malibu, which is in the southwest part of the Transverse Range Geomorphic Province, includes approximately 27 miles of coastline bounded by the Pacific Ocean. Coastal area within the City of Malibu is underlain by a wide variety of earth materials, including bedrock, terrace deposits, artificial fill, beach sand deposits, wind-blown dune sand, and rip-rap.

Regional Faulting and Seismicity

Earthquakes are common to southern California. Faults are typically classified as active, potentially active, or inactive based on geologic evidence used to determine the likelihood of future ruptures along a fault. Those faults that have evidence of surface displacement within (the last 11,000 years) have the highest potential of generating earthquakes and are described as active. Distinct landforms that could suggest movement within the last 11,000 years include sag ponds, offset drainages, linear valleys, and springs.

Earthquakes

Peak ground acceleration (PGA) is generally used to measure the amplitude of a particular ground motion. The PGA corresponding to the design basis earthquake (DBE) for the site with a 10 percent probability of exceedance in a 50-year time period was obtained from the California Geological Survey (CGS). The California Building Code (CBC) similarly defines the DBE as ground motion that has a 10 percent probability of exceedance in a 50-year time period; that is, ground motion with an average 475-year return period.

Acceleration is measured in units of g, where g is equal to the rate of acceleration caused by the earth's gravity at sea level. The DBE PGA for the site based on alluvium conditions is reported as 0.51g. The magnitude-weighed liquefaction opportunity PGA is reported as 0.39g. The predominant earthquake for the site is reported to have a magnitude of 7.3 on the Richter Scale.

Regional Faults

The Malibu Coastal Fault Zone (MCFZ) is located approximately 200 feet north of the site. The fault exhibits reverse and left-lateral slip. Displacement of up to 7,500 feet vertically, north side up, and up to nine miles of left slip have been documented. This fault was thought to be potentially active. However, investigations by Leighton and Associates, Inc., in the Malibu Civic Center area and north of Winter Mesa, across the Pacific Coast Highway (PCH), concluded that the fault was not active. Investigations by Earth Consultants International onsite concluded that potential onsite splays of the Malibu Coast Fault are also not active. As a result of these studies, the faults mapped on the subject site were determined to be not active, and the Alquist-Priolo Earthquake Fault Zone on the site was, therefore, removed by the State of California in August 2007.

The Puerco Canyon Fault is mapped close to the southern boundary of the site. It has been modeled as a splay of the Malibu Coast fault and would therefore display similar displacement characteristics. No evidence of Quaternary or Holocene displacement has been documented. In the site area, the Puerco Canyon fault has been mapped as the tectonic contact between the Monterey Formation (north of the fault) and the underlying Trancas Formation. Both formations are middle Miocene age.

Local Topography

The site is on an ancient coastal wave-cut terrace known as Winter Mesa immediately west of Winter Canyon and north of the Pacific Ocean. Site elevations vary from approximately 80 to 206 feet above mean sea level (msl) within the property boundaries. The majority of the site is gently sloping with steeper slopes that descend from the site to the north, east, and south. The northern slope is a cut slope associated with construction of PCH, roughly 2:1 (horizontal:vertical), and up to approximately 60 feet tall. The eastern slope generally has a gradient of 1:1 or shallower and is up to approximately 120 feet tall; however, portions of the slope are steeper due to historical grading activities. The southern slope is a maximum of approximately 120 feet tall and as steep as 0.7:1. The slope descends to a terraced area bordering the Pacific Ocean that is currently occupied by Malibu Road and numerous residential structures. The terraced area is a result of the Amarillo Beach landslide complex.

Two minor drainages to the southeast toward Malibu Road have formed minor canyons into the terrace east and west of the proposed structure at Lot 5. Drainage for the project is generally via sheetflow southward toward the minor canyons. Portions of the site drain toward the north and west. The site is partially covered with coastal flora. The recent fires have burned almost all of the vegetation that existed along the east slope and varying amounts of the vegetation on the south and north slopes.

Earth Materials

The following is a list of geologic units and their general descriptions as observed or anticipated:

Topsoil. Topsoil was encountered throughout the site and generally ranges from 0.5 to 2 feet in thickness. These soils consist of sand, sandy silt, and sandy clay mixtures with variable amounts of gravel. The soils are brown to dark brown, dry to moist, and loose to medium dense, and are often disturbed by animal burrows or seasonal disking, and have a moderate organic content.

Fill. Minor accumulations of undocumented or uncertified fill associated with construction of dirt roads, and historical agricultural activities, including seasonal disking and fault trenching, are widespread throughout the site. It appears that fill has been placed in the minor canyon at the south terminus of Winter Mesa Road. The limits of uncertified fill are delineated where significant amounts were obvious based on previous subsurface investigations, aerial photo review, and field mapping. Fills generally consist of medium orange brown mixtures of sand, silt, and clay, with few to some

gravel. The material encountered is generally moist, loose, or soft, and somewhat rich in organic materials in some zones. **Colluvium.** Colluvium accumulates along steep slopes, in swales, and on dip slopes. Colluvium is a collection of loose and generally heterogeneous soil materials and rock fragments forming as a result of weathering and down-slope creep. Colluvium was encountered to a depth of approximately 16 feet in an offsite boring by Leighton.

Landslide Debris. Deep-seated landslides have not been mapped or observed within the limits of the project site, but immediately to the south of the site along the alignment of Malibu Road, a landslide complex (known as the Amarillo Beach landslide) has been documented. The landslide material consists of highly weathered, deformed, incompetent siltstones, mudstones, shales, and sandstones of the Monterey Formation.

Alluvium. Alluvium is deposited along the axis of Winter Canyon to the east. Minor accumulations exist within the minor canyons. Deposits range from 0.5 feet to approximately 4 feet thick. The material generally consists of brown interbedded silty sands, sandy silt, and clayey sand with varying amounts of gravel.

Terrace Deposits. Nonmarine and marine terrace deposits generally range from a few feet to over 25 feet in thickness and cap the underlying wave-cut marine terrace. The deposits generally consist of subhorizontally deposited light brown and orange to reddish-brown clayey sands, sandy clays, silty sands, and sands with lenses of gravel and cobbles. The deposits are generally dense to very dense, dry to very moist. Depositional contacts are crude, erosional, and discontinuous and indicate episodic debris deposition.

Monterey Formation. The Monterey Formation is exposed along the east and southern slopes. Locally the Monterey Formation consists of diatomaceous to locally siliceous platy siltstone mudstone, and shale of mid-Miocene age. Where exposed at the surface or immediately beneath the bedrock/terrace deposit contact, the bedrock is weathered, light gray to chalky white, and soft, with the exception of interbedded hard siliceous layers. With depth the bedrock becomes olive gray or olive brown. Bedding is very well defined. Regionally the bedding strikes slightly northeast to slightly northwest and dips moderately to steeply northward (35 to 80 degrees from horizontal). Locally, the bedrock exhibits tight isoclinal folds, small faults, and shear zones associated with regional deformation.

Structure and Distribution of Earth Units

The site is on an emergent wave-cut platform that is overlain by younger marine and nonmarine Terrace Deposits. The wave-cut platform emerged as a result of prehistoric changes in sea level during glacial and interglacial epochs combined with regional tectonic uplift of the land during Pleiostocene time. The Terrace Deposits generally dip subhorizontally to southward at shallow angles. The Terrace Deposits unconformably overlie the Monterey Formation.

Undocumented fill and minor amounts of alluvium mantle the terrace deposits and Monterey Formation. On the lower portions of the slopes both on- and offsite are accumulations of colluvium, slopewash, undocumented fill, and landslide deposits.

Bedding within the Monterey Formation is generally very well defined. Onsite bedding strikes roughly east–west and dips moderately to steeply northward (35 to 80 degrees from horizontal). Locally the bedrock exhibits curviplanar bedding planes with open to tight folds, with few small faults and shear zones associated with folding and deformation. There are also zones with calcareous and siliceous nodules. Subsurface explorations revealed a moderate amount of jointing and fracturing of the bedrock onsite with only few joints observed to be planar or continuous around the walls of the bucket auger borings. The joints/fractures generally extend only a few feet in any direction and have random orientations. Localized joints or fractures may cause the occurrence of localized surficial instability or rock topple within very weathered near-surface slope areas, but do not provide for continuous surfaces that could combine with bedding planes to cause block failures in slope areas.

Landslides and Debris Flow Hazards

During field investigations and reconnaissance, no signs of deep-seated landslide features were observed onsite. Only isolated erosion, rilling, and gullies were noted along the lower slopes. Signs of small or minor slumps or surficial scarring as a result of heavy rains from past winters were observed. These features were not of significant enough size to be mappable. The slopes were heavily vegetated in most areas prior to the fires. Minor accumulations of topsoil, colluvium, and uncertified fill were observed in localized areas. Minor signs of headward erosion of slopes were observed in localized areas. However, in the northeast corner of the site, a substantial gully has formed along the Caltrans slope adjacent to Lot 1.

Immediately to the south of the site along Malibu Road is the historical Amarillo Beach landslide. This landslide is documented as a complex of rotational landslides affecting the south-facing coastal cliffs and the area underlying the Malibu Road and the adjacent beachfront properties. Movement within the Malibu Coast Fault Zone, weathering, erosion, undercutting by wave action, and the presence of groundwater have been described as contributing factors for slope instability for the area.

Significant movement of the Amarillo Beach landslide complex would most likely adversely affect the offsite residential structures along Malibu Road. Significant movement of the feature could cause headward movement of the headscarp region of the Amarillo Beach landslide complex.

The western and southern portions of the project site contain steep downward slopes. The height and steepness of the slopes are such that they may be susceptible to seismically induced slope failure or landsliding. The California Department of Conservation Division of Mines and Geology mapped the project site on Malibu Beach Quadrangle map of their Seismic Hazard Zones mapping program. The Seismic Hazards Zones map identifies the slopes on the eastern and southern boundaries of the project site as an earthquake-induced landslide hazard zone, where "previous occurrence of landslide movement, or local topographic, geological, geotechnical, and subsurface water condition indicate a potential for permanent ground displacements."

Bluff Retreat

The project site includes steep bluffs to the south and east. In their October 29, 2008, Addendum to the Feasibility-Level Grading Plan Review, Leighton determined that the average historic rate of bluff retreat is 0.12 feet per year. To account for future extreme conditions, such as future El Niño storm events, Leighton has assumed a long-term bluff retreat rate of 0.2 feet per year.

Groundwater

The property is located in the Malibu Valley Groundwater Basin of the South Coast Hydrologic Region. Site-specific data from borings and from subsequent groundwater level measurements (Leighton 2009b) indicate that groundwater exists within the underlying bedrock. Only temporary perched water conditions are expected to occur in localized areas within the Terrace Deposits and at the Monterey Formation / Terrace Deposits interface following heavy rainfall (Leighton 2009b). Groundwater is inferred to flow to the south toward the Pacific Ocean. Based on a review of onsite groundwater data, groundwater levels in the onsite monitoring wells have ranged from a high elevation of 140.24 feet above msl (65.4 feet below existing ground surface) in Monitoring Well LMW-6 on 10/2/2008 in the northwest corner of the subject site near the proposed gatehouse location, to 11.95 feet above msl (143 feet below existing ground surface) in Monitoring Well LMW-3 on 4/23/2008 at the southeastern margin of proposed Lot 2 on the subject site (Leighton 2009b).

Liquefaction and Seismically Induced Settlement

The California Seismic Hazard Zones map identifies no liquefaction zones on the project site. Leighton and Associates' Feasibility-Level Grading Plan Review concluded that, based on historic high groundwater levels and observed groundwater levels, soil conditions, and the design basis earthquake, the potential for liquefaction or seismically induced settlement is very low.

Tsunamis and Seiches

Seiches are large resonant waves generated by ground shaking in enclosed or partially enclosed water bodies or bays, such as Santa Monica Bay. Tsunamis are waves generated in large bodies of water by fault displacement, submarine slides, or major ground movement. Tsunamis can travel across the entire Pacific Ocean basin or they can be local. The most frequent causes of tsunamis are shallow underwater earthquakes and submarine landslides.

The project site is approximately 300 feet from the Pacific Ocean and Santa Monica Bay. However, due to the project site's elevation, it is unlikely that it would be affected by tsunamis. An inundation map contained in the City of Malibu Emergency Response Plan for Tsunami Operations (ERPTO) indicates a potential tsunami inundation zone for central Malibu. The inundation zone does not include the project site. The response plan states that any area 90 feet above sea level or higher is considered an area safe from tsunami upsurge. Some portions of the onsite slopes descend to 80 feet above sea level. However, the vast majority of the site, including the relatively flat areas proposed for development, are 90 feet above sea level or higher. Due to its elevation, it is vey unlikely that the project site would be impacted by a tsunami.

Regulatory Setting

Federal

The National Pollutant Discharge Elimination System

The State Water Resources Control Board administers the National Pollutant Discharge Elimination System (NPDES) program, with assistance from local jurisdictions. All construction projects of one acre or more are required to submit for approval of a Notice of Intent to be covered under the Storm Water Permit, in compliance with the NPDES program. In addition, projects are required to develop and implement a Storm Water Pollution Prevention Plan (SWPPP), incorporating best management practices that minimize erosion and subsequent pollution of nearby waterways during construction and operation of a project.

State

California Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act was signed into law in 1972, and its primary purpose was to mitigate the hazard of fault rupture by prohibiting the building of structures for human occupancy across the trace of an active fault. The act also requires the State Geologist to delineate earthquake fault zones along faults that are "sufficiently active" and "well defined." Pursuant to this act, the construction of structures for human occupancy is not allowed within 50 feet of the trace of an active fault.

Seismic Hazard Mapping Act

The Seismic Hazard Mapping Act was adopted by the state in 1990 for the purpose of protecting the public from the effects of nonsurface fault rupture earthquake hazards. The CGS prepares and provides local governments with seismic hazard zone maps that identify areas susceptible to amplified shaking, liquefaction, earthquake-induced landslides, and other ground failures. The seismic hazard zones delineated by the CGS are referred to as "zones of required

investigation" because site-specific geological investigations are required for construction projects in these areas. Before a project can be permitted, cities and counties must require a geologic investigation to demonstrate that the proposed buildings *will not be constructed in areas subject to the effects of liquefaction and earthquake-induced landslides without mitigation.* .

California Building Code

State law requires every locality to adopt the provisions of the CBC. These codes provide minimum standards to protect property and the public welfare by regulating the design and construction of excavations, foundations, building frames, retaining walls, and other building elements to mitigate the effects of earthquakes and adverse soil conditions. The procedures and limitations for the design of structures are based on site characteristics, occupancy type, configuration, structural system height, and seismic zoning for Seismic Zone 4.

California Coastal Act

Section 30253 of the Coastal Act states that new development shall minimize risks to life and property in areas of high geologic, flood, and fire hazards. It also states that new development shall assure stability and structural integrity, and neither create nor contribute significantly to erosion, geologic instability, or destruction of the site or surrounding area or in any way require the construction of protective devices that would substantially alter natural landforms along bluffs and cliffs.

Local

City of Malibu Municipal Code

Building codes are put forth in Chapter 15.04, Building Code, of the City of Malibu Municipal Code. The codes contained in that chapter are intended to ensure that buildings in the City of Malibu are structurally safe and equipped to remain intact during seismic events.

City of Malibu Geotechnical Guidelines

Guidelines for the preparation of engineering geologic and geotechnical engineering reports for projects in the City of Malibu were prepared by City Building and Safety Department staff and Bing Yen & Associates, Inc. and issued in February 2002.

City of Malibu Plumbing Code

The City of Malibu has adopted Los Angeles County Code Title 28, Plumbing Code. Appendix K of the plumbing code includes regulations governing private sewage disposal systems such as the onsite wastewater treatment system (OWTS) Package Plant proposed. This would require that the seepage pits be placed where they could not impact residences or groundwater.

City of Malibu Local Coastal Program Land Use Plan

LCP Land Use Plan (LUP) Chapter 4 includes policies intended to minimize hazards associated with shoreline and bluff development. The LCP identifies the following geologic hazards, which require development controls to minimize risk.

- Low Slope Stability and Landslide/Rockfall Potential: hillside areas that have the potential to slide, fail, or collapse.
- Fault Rupture: the Malibu Coast-Santa Monica Fault Zone.

- Seismic Ground Shaking: shaking induced by seismic waves traveling through an area as a result of an earthquake on a regional geologic fault.
- Floodprone Areas: areas most likely to flood during major storms.
- Liquefaction: areas where water-saturated materials (including soil, sediment, and certain types of volcanic deposits) can potentially lose strength and fail during strong ground shaking.
- Liquefaction/Floodprone Areas: areas where saturated sediments lie in flood plains.

City of Malibu LCP Local Implementation Plan

Chapter 9 of the Local Implementation Plan is intended to minimize the same areas of hazards as the LCP above. It includes specific requirements for developments that are intended to reduce risks related to the above geologic hazards.

5.5.2 Thresholds of Significance

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

G-1 Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:

i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault. (Refer to Division of Mines and Geology Special Publication 42.)

ii) Strong seismic ground shaking.

iii) Seismic-related ground failure, including liquefaction.

iv) Landslides.

G-2 Result in substantial soil erosion or the loss of topsoil.

G-3 Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse.

G-4 Be located on expansive soil, as defined in Table 18-1B of the Uniform Building Code (1994), creating substantial risks to life or property.

G-5 Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water.

The 2012 Initial Study, included as Appendix C, substantiates that impacts associated with the following thresholds would be less than significant:

- Thresholds G-1(i), G-1(ii), and G-1(iii)

These impacts will not be addressed in the following analysis.

5.5.3 Environmental Impacts

The following impact analysis addresses thresholds of significance for which the 2012 Initial Study disclosed potentially significant impacts. The applicable thresholds are identified in brackets after the impact statement.

Impact 5.5-1:	Slopes along the southern and eastern boundaries of the project site do not meet the City's requirement for the minimum factor of safety. [Thresholds G-1(IV) and G-3]

Impact Analysis: The project site is on a bluff, with steep slopes on the southern and eastern boundaries of the project site. These slopes are identified in California's Seismic Hazards Zones map as having a potential for "permanent ground displacement." In their grading plan review and addendum, Leighton concluded that the slopes do not meet the City's requirements for minimum 1.5 factor of safety, based on laboratory testing, shear strength data, and the historic retreat of the project site bluffs. The measured groundwater depths and anticipated build-up of perched water following heavy rainfall and due to groundwater mounding below "geoflow" fields were considered in the slope stability analyses. Leighton assumed that a temporary perched water zone of up to five feet sits in the terrace deposits above the bedrock contact.

Leighton concluded that structural setback zones are necessary to ensure that no people or structures are at risk of hazards due to slope instability. The grading plan has been modified and the setback zone incorporated as a project design feature based on the Revised Geotechnical Map (Leighton May 2012) included in Appendix J of this Draft EIR. The eastern margin of the proposed swimming pool on Lot 1 also located within the setback zone

A portion of the garage and single-family structure on Lot 2 would be located within the safety setback zone the factor of safety of these portions of the garage and residence is less than 1.5. The eastern margin of the proposed swimming pool on Lot 1 also located within the setback zone. The City Geologist made a note of this in his approval, requiring specific stabilization recommendations for portions of the garage, residence, and pool to ensure long-term stability of the sites.

Based on the findings summarized in all referenced Leighton reports, the proposed development would be safe from hazards posed by landslides, settlement, or slippage provided that the recommendations in the reports are implemented. Moreover, Leighton determined that the proposed development would not adversely impact the geotechnical stability of property outside of the project site.

The building plans and geotechnical report for all five dwellings were reviewed by the City from a geotechnical perspective. The City determined that the project applicant has demonstrated geotechnical feasibility City geotechnical staff will review complete sets of building (for all structures) and grading plans for each residential lot during the Building Plan Check stage once the projects are submitted to the Building and Safety Department. City geotechnical staff, through the Building Plan Check process would ensure that the proposed project meets the requirements of the Building Code and that the stabilization recommendations for portions of any pools, buildings, or habitable structures within safety setback zone are implemented.

Impact 5.5-2:	Project development could result in substantial soil erosion or the loss of topsoil. [Threshold G-2]

Impact Analysis: Soil erosion is a normal and inevitable geologic process whereby earthen materials are loosened, worn away, decomposed, or dissolved, and removed from one place and transported to another. Precipitation, running water, waves, and wind are all agents of erosion. Ordinarily, erosion proceeds so slowly as to be imperceptible, but when the natural equilibrium of the environment is disturbed, the rate of erosion can be greatly accelerated. This can create aesthetic and engineering problems. Accelerated erosion within an urban area can cause damage by undermining structures, blocking storm sewers, and depositing silt, sand, or mud in roads and tunnels. Many eroded materials are eventually discharged to our coastal waters, where the entrained silt and other fine-grained sediment remain suspended in the water for some time, constituting a pollutant and altering the normal balance of plant and animal life.

Substantial soil erosion is not expected to occur during the operational phase of the proposed project. However, construction of the proposed project would involve grading, excavation, and hauling of materials (dirt, demolition debris, etc.) off the site. These activities could result in the loss of topsoil or substantial erosion-related impacts to offsite areas, such as the Winter Canyon drainage and storm drains along Malibu Road. The soils exposed on the slopes of the proposed project site are typical of hillside development near the coast and are vulnerable to erosion. Slope maintenance would be required and is a part of the planned community's covenants, conditions, and restrictions, which would include protocols for proper maintenance of the slopes and prompt restoration following heavy precipitation events and/or fires. Other specific measures to help stabilize the slope include hydroseeding of the slope with native flora to maintain its stability, prohibition of excavating/cutting into the slopes or removal of slope failure debris without prior approval from a geotechnical engineer, controlled irrigation to avoid destabilizing the slope by overwatering, and regular maintenance of the slope and drainage infrastructure at the site.

Development of the project site is subject to local and state codes and requirements for erosion control and grading during construction. The proposed project would comply with standard conditions, including South Coast Air Quality Management District Rules 402 and 403, which would reduce construction erosion impacts. Rule 403 requires that fugitive dust be controlled with best available control measures so that the presence of such dust does not remain visible in the atmosphere beyond the property line of the emissions source. Rule 402 requires dust suppression techniques be implemented to prevent dust and soil erosion from creating a nuisance offsite. The proposed project would also be subject to NPDES permitting regulations, including the development and implementation of a SWPPP, which is further discussed in Section 5.6, *Hydrology and Water Quality*, of this Draft EIR.

Impact 5.5-3:	The proposed project would place structures on potentially unstable soils. [Thresholds G-3 and G-4]

Impact Analysis: The project site is not within a State of California zone for potential liquefaction hazard. The historic high groundwater in low-lying areas west of the site is approximately five feet below ground surface (bgs). However, based on borings performed by Leighton, Leighton concluded that groundwater elevations onsite are much deeper and occur within the underlying bedrock. Only temporary perched water conditions are expected to occur in localized areas within the terrace deposits. Based on the specific soil conditions, the DBE, and the current and historic high groundwater levels at the site, Leighton concluded that the potential for liquefaction occurring beneath the site is very low.

Site soils are likely corrosive to ferrous metals with negligible sulfate and chloride attack potential. Because irrigation water in Southern California is considered to have moderate sulfate attack potential, concrete exposed to irrigation

water should be designed to resist moderate sulfate exposure. The upper soils consist of undocumented fill and disturbed natural soils. The upper soils of the site are therefore not considered suitable for support of structures. In accordance with the recommendations of Leighton's report, the proposed project would overexcavate and replace the upper soils as compacted fill. This would ensure that no structures would be placed on soils that could be subject to lateral spreading, subsidence, liquefaction, collapse, or expansion.

Impact 5.5-4: Site conditions are adequate to support the onsite wastewater treatment system. [Threshold G-5]

Impact Analysis: Potential geotechnical constraints associated with the installation of the OWTS Package Plant and wastewater dispersal system include percolation rates, slope instability, and depth to groundwater. Field investigations indicated that shallow groundwater was not present at this site. Groundwater generally was encountered at depths from 72 to 143 feet bgs, according to the Geotechnical Evaluation of Proposed OWTS prepared by Leighton and Associates. The proposed plan is to install the OWTS in the northwest corner of the site near the intersection of Winter Mesa Drive and PCH and to discharge the treated effluent from the OWTS into seepage pits located in the southernmost portion of Lot 7 along Winter Mesa Drive.

Percolation testing was conducted at the site by Lawrence Young (2008). Based on the percolation results from 12 borings advanced at the site, the best location for the dispersal field was determined to be the southern portion of Lot 7. The treated effluent would be dispersed into a series of 10 seepage pits that would be 6 feet in diameter and 61 to 67 feet deep (Ensitu Engineering 2009). The water would percolate into the unoxidized zone of the Monterey Formation bedrock. Percolation test results indicate that the use of seepage pits at this location would meet the requirements of the LIP and the City of Malibu's Plumbing Code.

In addition, a hydrogeologic/wastewater mounding study was conducted by Earth Consultants International (ECI) to determine if there would be sufficient separation between the bottoms of the seepage pits and groundwater (ECI 2009). The groundwater mounding study concluded that even under extreme rainfall conditions and maximum discharge rates from adjacent facilities, the predicted groundwater mound in the vicinity of the seepage pits would be less than one foot and would not breach the required 10-foot separation distance between the bottom of the pits and the groundwater table. ECI collected more than two years of additional groundwater level data (ECI 2012). The new data covered a wetter than "normal" water year (2010–2011), which included a strong rainfall event on March 20, 2011. Based on a comparison of the four years of rainfall and groundwater level data, ECI found that precipitation generally has had little impact on the Crummer Site water table. However, wells north of the fault zones showed slightly elevated water levels (compared to the previous water year) after the larger storms in 2010–2011. Consequently, ECI choose to base the new groundwater mounding analysis on actual groundwater levels collected on May 12, 2011, rather than the hypothetical "extreme rainfall event" presented in the September 2009 report. The May 2011 date corresponds to the highest water levels in the northern wells after the March 20th storm.

The cumulative impact of future wastewater disposal occurring at the project site and the adjacent towing site (aka Tow Yard) simultaneously, at their peak design flows, was used as the basis for the groundwater modeling. The results of the modeling indicate the proposed onsite wastewater treatment system would have no adverse impacts on the project site or adjacent down-gradient properties. Maximum groundwater elevation changes (i.e., predicted mounding) due to the combined discharges range from 0.14 feet (about 1.7 inches) on the Towing site to about 0.38 feet (about 4.5 inches) at the project site. Groundwater would not adversely affect the performance of existing offsite sewage disposal systems.

The potential impact of the OWTS Package Plant on slope stability also was evaluated. The potential for treated effluent to daylight at the south-facing bluff is not likely due to the presence of east–west–trending buried faults

between the seepage pit area and the bluff face (ECI, 2009). Also, the potential for effluent to daylight along the eastern perimeter slope is unlikely because of the long travel distance from the seepage pit area and groundwater flow gradients, which are mostly to the south and southeast. The likelihood of slope seepage is also reduced by the significant depth to groundwater at the site and the minimal increases in groundwater elevations due to mounding. Therefore, the City determined that mounding under the anticipated loading rates is in conformance with LCP/LIP Section 18.7.

A nitrate balance mass loading analysis considered certain revisions to up-gradient sources of nitrate. The nitrate loading (expressed as nitrate-nitrogen) from the treated wastewater disposal at the project site would be on the order of 2 milligrams per litre (mg/l). Based on the analysis, the nitrogen loading from the discharge at the project site would not cause groundwater beneath the site and in immediate down-gradient locations to exceed 10 mg/l. The City of Malibu has determined that groundwater quality related to nitrogen loading would not be impaired and has approved the OWTS from a hydrogeologic perspective.

There would be no significant impact on groundwater levels or slope stability, both onsite and offsite, as a result of the operation of the OWTS Package Plant and associated seepage pit system. The mitigation measures below would ensure that no significant impacts related to the OWTS would occur.

5.5.4 Cumulative Impacts

Impacts relating to soils and geologic influences are site specific and generally cannot be considered in cumulative terms. Mitigation of geologic, seismic, and soil impacts of development projects would be specific to each site. Modern building standards serve to reduce seismic-related risks to less than significant levels. In addition, the proposed project, as well as foreseeable projects, would be required to comply with the applicable state and local requirements. Therefore, the project-specific impacts, as well as the impacts associated with other projects, would be reduced to a less than significant level. Seismic impacts are a regional issue and are also addressed through compliance with applicable codes and design standards. Therefore, no adverse cumulative impacts related to soils and geology are anticipated as a result of the proposed project.

The recalibrated groundwater mounding analysis indicates there are no adverse hydrogeologic effects on the project site or on adjacent down-gradient properties due to a rise in groundwater levels or migration of groundwater resulting from the dispersal of treated wastewater, even if both the proposed project's and towing site treatment systems are operating simultaneously at peak design flows.

5.5.5 Existing Regulations and Standard Conditions

The proposed project would comply with:

- California Building Code. California Code of Regulations, Title 24, Part 2
- Uniform Building Code. Published by the International Conference of Building Officials
- The City of Malibu Local Coastal Program, Land Use Plan and Local Implementation Plan
- The City of Malibu General Plan Safety Element
- Statewide General Construction NPDES Permit (Order 92-08-DWQ)
- South Coast Air Quality Management District Rules 402 and 403

5.5.6 Level of Significance Before Mitigation

Upon implementation of regulatory requirements and standard conditions of approval, the following impacts would be less than significant:

- Cumulative Impacts There would not be cumulatively considerable impacts related to geology or soils associated with the project.

Without mitigation, the following impacts would be **potentially significant**:

- Impact 5.5-1 The proposed project would create residences near steep slopes, which could be susceptible to landslides.
- Impact 5.5-2 Construction activities could result in soil erosion and related impacts.
- Impact 5.5-3 The existing soils onsite may not be capable supporting the proposed structures.
- Impact 5.5-4 The proposed OWTS system has the potential to contaminate groundwater or contribute to slope instability.

5.5.7 Mitigation Measures

Impact 5.5-1, Impact 5.5-2, and Impact 5.5-3

5-1 The proposed project shall be constructed in accordance with the geotechnical engineering recommendations as presented in the Leighton and Associates, Inc., "Feasibility-Level Grading Plan Review, Proposed Malibu Bluffs Development: 5-Lot Subdivision, 'The Crummer Site,' APN 4458-018-019, 24200 Pacific Coast Highway, City of Malibu, California," as well as any subsequent documents, including responses to City comments. These recommendations address site preparation, excavation, fill placement and compaction, foundation design, and site drainage, among other topics.

Impact 5.5-1

5-2 The planned community's covenants, conditions, and restrictions shall include protocols for proper maintenance of the slopes and prompt restoration following heavy precipitation events and/or fires.

5-3 Excavating and cutting into the slopes or removal of slope failure debris by the tenants or one or more future property owners without prior approval from a geotechnical engineer shall be prohibited by the covenants, conditions, and restrictions for the proposed development. This information shall also be recorded against the title of each residential property. The services of such a geotechnical engineer shall become necessary should a slope excavation be a desired, planned activity proposed by one or more property owners, or in response to unforeseen slope failure, such as sloughing in the aftermath of heavy rain.

Impact 5.5-4

5-4 The proposed onsite wastewater treatment system shall be installed in accordance with the geotechnical engineering recommendations as presented in "Geotechnical Evaluation of Proposed Onsite Wastewater

Treatment System, Proposed Residential Development 'Crummer Site,' 24200 Pacific Coast Highway, APN 4458-018-019, City of Malibu, California, as well as any subsequent documents, including responses to City comments. These recommendations address site preparation, excavation, fill placement and compaction, foundation design, and site drainage, among other topics.

5-5 The Applicant shall obtain final construction plan approval for the proposed onsite wastewater treatment systems from the City Environmental Health Administrator. The final design must be engineered to meet the effluent limits specified in waste discharge requirements and requirements of the Regional Water Quality Control Board and the United States Environmental Protection Agency.

5-6 The proposed onsite wastewater treatment system shall not be installed within the structural setback zone as presented in the Leighton and Associates, Inc., "Feasibility-Level Grading Plan Review, Proposed Malibu Bluffs Development: 5-Lot Subdivision, 'The Crummer Site,' APN 4458-018-019, 24200 Pacific Coast Highway, City of Malibu, California."

5.5.8 Level of Significance After Mitigation

The Feasibility-Level Grading Plan Review and related documents concluded that the proposed project is feasible from a geotechnical standpoint, provided that the geotechnical recommendations of the report are followed and incorporated in the design and construction of the project. The mitigation measures identified above would reduce potential impacts associated with geology and soils to a level that is less than significant. Therefore, no significant unavoidable adverse impacts relating to geology and soils have been identified.