

**FACULTY AND FAMILY STUDENT HOUSING,
OPEN SPACE PLAN, AND LRDP AMENDMENT EIR**

4.2 GEOLOGY AND GEOLOGIC HAZARDS

Section 4.2

4.2.1 Introduction

*Geology &
Geologic Hazards*

This section of the EIR describes the existing geology and soils conditions in the project area and analyzes the potential for the proposed project to expose people or structures to risk of loss, injury, or death resulting from seismic activity, to result in substantial soil erosion or the loss of topsoil, or result in development on unstable soils.

Information in this section is based on previous reports such as the University Natural Areas Plan (Ferren and Thomas, 1995), geotechnical evaluations (Fugro West, 1996, 2003), and the EIR for the North and West Campus Housing LRDP Amendment (Wallace, Roberts and Todd, 1997). This information has been updated with more recent publications and sources, as listed in the References section, as well as air photo interpretation, GIS work, and confirmatory field work during July and August 2003.

Comments regarding geology and geologic hazards received in response to the Notice of Preparation for the project included requests for discussion of the fault systems underlying the project site, and the potential effects of the geologic and seismic characteristics of the project site upon the project. The Notice of Preparation, written responses to the Notice of Preparation, and a summary of issues raised at the Public Scoping meeting are included in Appendices A and B of this EIR.

4.2.2 Existing Conditions

4.2.2.1 Topographic Setting—Regional Overview

The Ellwood-Devereux Joint Proposal Area is located on the southern flank of the Santa Ynez Mountains, in the western portion of the Transverse Ranges Geomorphic and Structural Province. This Province is characterized by east-west trending faults, folds, mountain ranges, and valleys. The Santa Barbara area portion of the province is bounded on the north by the Santa Ynez Mountains and on the south by the northern Channel Islands. The Santa Barbara Channel separates the offshore islands from the mainland. Between the Santa Ynez Mountains and the Santa Barbara Channel is a transitional zone consisting of a coastal plain and shoreline. The coastal plain is composed of uplifted and dissected marine terraces, hills, and valleys (Dibblee, 1966), some of which form estuaries and lagoons.

The Joint Proposal Area lies to the south of the Goleta Valley, a shallow, east-west trending valley between the Santa Ynez mountains and a low coastal plateau, or mesa. Much of the Joint Proposal Area is on a gently sloping marine terrace that has been uplifted by the More Mesa fault system. The marine terrace that forms the mesa is about 40–80 feet above sea level. It was formed at sea level as a wave-cut abrasion platform that eroded and beveled off a bedrock surface. Subsequent tectonic uplift of the terrace surface resulted in a mesa. Sea level changes during the Quaternary period (past 1.8 million years) due to glacial and interglacial events

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superimposed upon a rising coastline has resulted in the formation of a series of uplifted marine terraces in Santa Barbara County, and elsewhere in California.

Marine fossils preserved in pebble to cobble conglomerates or in rocky intertidal fossiliferous units can be observed along the sea cliffs immediately above the beveled bedrock surface that formerly formed the shoreline abrasion platform terrace surface. These fossils have been dated by radiocarbon and uranium-series dating, suggesting that the terrace formed about 45,000 years ago.

Devereux Creek cuts through this marine terrace, forming a large, broad estuary (Devereux Slough) that separates the terrace surface upon which Isla Vista is located from the rest of the Joint Proposal Area to the west. Stream erosion has dissected the marine terrace to produce the present isolated mesas and intervening drainages that form most of the upland portions of the Joint Proposal Area. Geomorphic and subsurface information suggest that Devereux Slough connected with Goleta Slough in the recent past. Thus, Isla Vista was once an island, separated from the 'mainland' by a large estuarine/lagoonal complex.

The topography of the uplifted terrace surface is gently sloping but undulatory, and has been incised by and is controlled by Devereux Creek and to a lesser extent smaller drainages. The Creek trends east-west and forms a central valley between gently sloping hills. The location of the Creek itself is likely fault controlled, as its course closely follows and parallels the trace of the North Branch of the More Ranch fault. The More Ranch fault has uplifted and tilted the 45,000 year-old marine terrace to the south of the fault, creating a barrier. What was once a gently seaward-sloping marine terrace now tilts north, towards the mountains in many places. The uplift and warping of the terrace has also created vernal pools in several on the Ellwood and Isla Vista mesas to the south of the fault. Several steep ravines cut through the hills leading to Devereux creek, and three ravines lead down to the shoreline. Thus, the uplifted mesa (marine terrace) areas have been dissected by stream, as well as shoreline erosion.

Many modifications to the natural topography have also been made as the result of human activity. Clearing of land for grazing and agriculture in the 1800s through the early 20th century has resulted in erosion and gulying of several areas. Paving of roads and parking lots has contributed to runoff and erosion. Removal of topsoil and infilling of wetlands at Devereux Slough for a golf course and for land development has occurred in many areas. Grading for roadways, beach access, and oil development activities all have resulted in a highly altered environment.

Elevations at the University's project sites range from sea level at the southern property boundary to about 70 feet in the COPR Expansion Area. Slope gradients range from 1 to 15 percent along the hills, to 30 percent along the Devereux Creek and to over 200 percent along the sea cliffs and in steep ravines. The uplifted marine terrace slopes toward Devereux Creek in the north, towards the Ocean in the south, and towards Devereux Slough in the COPR area.

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4.2.2.1.1 Topographic Setting—North Campus. The University’s North Campus sub-area includes two proposed development sites on one legal parcel: the North Parcel site located south of Phelps Road and Marymount Way; and the Storke-Whittier Parcel located south of Whittier Drive and west of Storke Road. Under the University’s proposed project, the North Campus – South Parcel site is part of the Open Space Plan. Section 6.0 (Alternatives) of this EIR addresses an alternative to the proposed project that would involve residential development on the South Parcel. Local topography (refer to Figure 4.2-1) for each of these sites is described below.

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The North Parcel site ranges in elevation from 15 to 35 feet above sea level, with grades of 5 percent to greater than 30 percent. The highest elevation is in the western portion of the site, and the topography generally slopes towards the south and east.

The topography of the South Parcel site ranges in elevation from 10 feet above sea level in the east to 70 above sea level feet in the west. The topography of the South Parcel has been dramatically altered by human activities, as the topsoil of this area was removed in the 1960s to be used as artificial fill for the adjacent golf course. Five large, linear, NW-SE trending berms were graded in an attempt to control sediment erosion and runoff onto the golf course. The berms and the intervening areas are in places highly eroded. The sediments from this area have eroded into and have created a sediment delta infilling the northwest portion of Devereux Slough. The original Devereux Slough extended to the north and west beneath what is now the golf course and possibly also part of the South Parcel. Average grades range from 5 to 30 percent, with locally steeper slopes on the sides of the berms.

The Storke-Whittier Parcel ranges in elevation from 9 to 25 feet above sea level, with grades of 3 percent to greater than 10 percent. The highest elevation is in the southeastern portion of the site adjacent to Storke Road and the Venoco access road. An unnamed tributary of Devereux Creek bisects the site from west to east. For the portions of the site adjacent to Storke Road, topography slopes toward the creek from both the northeast and southeast portions of the site. The site located along Whittier Drive and west of the existing Ocean Meadows Golf Course parking area is a flat area except where the site is bisected by a small drainage that flows southwesterly through the property to an isolated depression on the northern margin of Ocean Meadows Golf Course. Topography on this site slopes very gently toward the drainage feature.

4.2.2.1.2 Topographic Setting—West Campus. The topography of the West Campus Mesa parcel is variable, and is characterized by gently sloping upland mesa in the north and a shallow swale, commonly referred to as the “North Slough Finger” of Devereux Slough in the south. Elevations range from 3-15 feet above sea level in the North Slough Finger to 40 feet above sea level on the mesa itself. The South Slough Finger, formerly connected to and an integral part of Devereux Slough, has been partially infilled with alluvium and artificial fill such that it is at a slightly higher elevation than the tidal flats of the Slough itself. The grade of the mesa is less than 5 percent. The grade of the slopes leading down to North Slough Finger and to Devereux Slough range from 30 to 50 percent.

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The topography of the West Campus Bluffs (refer to Figure 4.2-1) consists of a low gradient elevated marine terrace at an elevation of about 30 feet above sea level bounded to the south by steep sea cliffs. The sea cliffs have grades ranging from 50 percent to 200 percent. The sea cliffs are subvertical in some areas, and have been incised by erosional gullies and undeveloped trails. The sea cliffs in Isla Vista to the east of the West Campus Bluffs are retreating at a long-term rate of about 12 to 18 inches per year due to shoreline erosion (Norris, 1968).

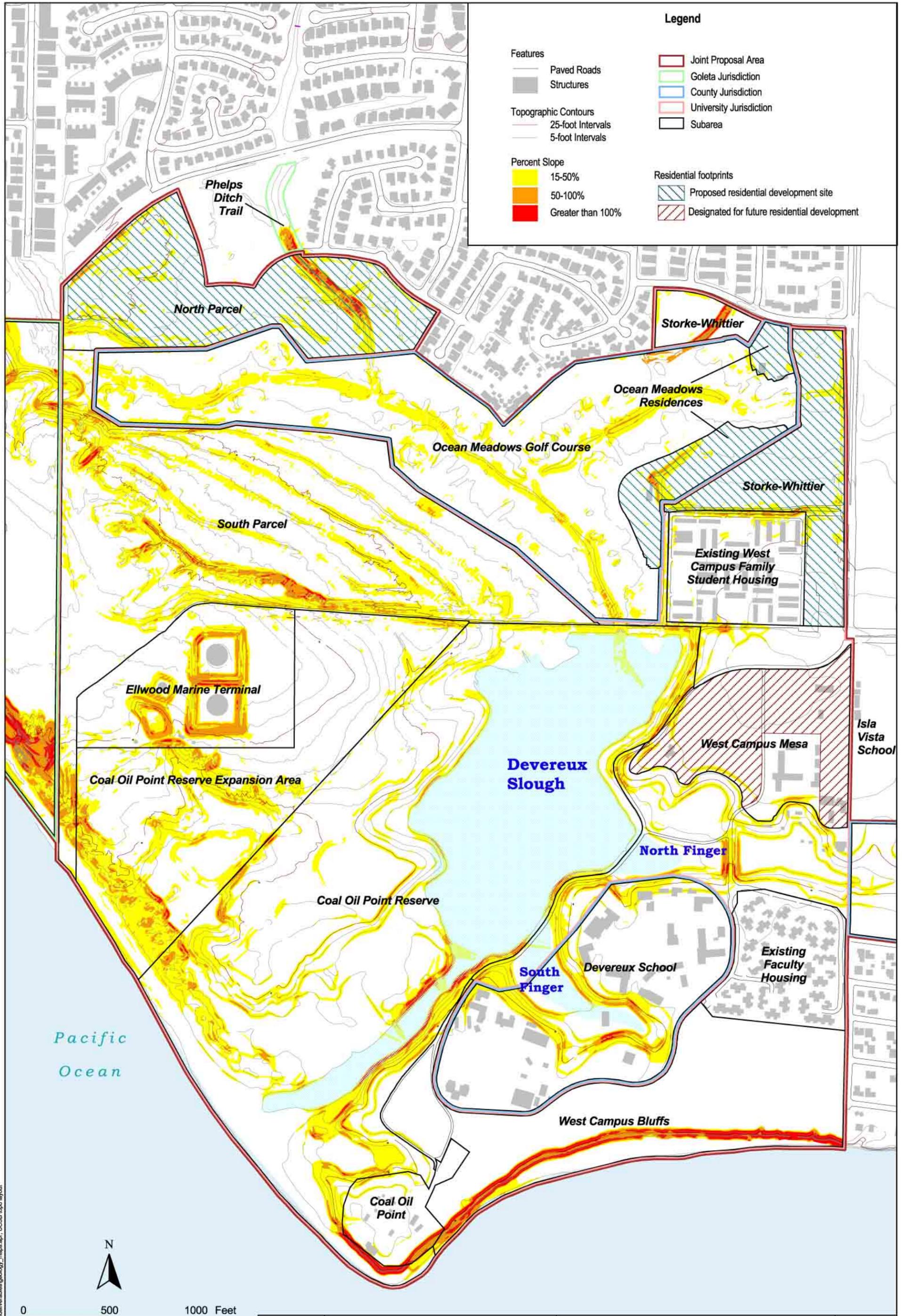
Coal Oil Point itself is a significant geographic feature. It extends far south into the Santa Barbara Channel, and as such is exposed to large winter waves. Topographically, Coal Oil Point is a small flat mesa about 35 feet above sea level. It is bound to the south and east by sloping sea cliffs with grades of 30 percent to 100 percent. A shallow swale descends to the northwest through sand dunes to Devereux Slough and Sands Beach.

The Coal Oil Point Reserve is a large area that encompasses Devereux Slough and upland areas to the west. Most of the Slough is a tidal flat, with the exception of the previously mentioned sediment delta that is propagating onto the Slough from the South Parcel site of the North Campus property. Several headlands extend out into the Devereux Slough. A secondary large wetland area in the Coal Oil Point Reserve is a large pond, located in the COPR expansion area to the west of Devereux Slough. The Pond is not tidally influenced, and is separated from Devereux Slough and the Pacific Ocean by hummocky coastal sand dunes.

Elevations in the Coal Oil Point Reserve range from sea level to 65 feet above sea level. The highest area is the northwest portion adjacent to the Ellwood Marine Terminal. Gently sloping topography having slope grades of 5–10 percent characterize much of the area, although steeper grades are locally present in dune areas, on promontories around the Slough, and slopes to the north and east of the Dune Pond. Numerous small enclosed depressions exist in the dune areas between the Slough and the Dune Pond; standing water was observed to occur in several of these depressions during the winter months, forming a string of small ponds connecting south to Devereux Slough.

4.2.2.2 Geology and Geohazards—Regional Overview

4.2.2.2.1 Tectonic Setting. California straddles the transform margin of Western North America. Santa Barbara County is situated to the southwest of the San Andreas Fault, which is generally considered the primary structural boundary between the Pacific and North American tectonic plates. As the Pacific Plate moves towards the northwest at a rate of about 45 mm/year as the result of seafloor spreading, it collides with and slides past the North American Plate. Transpressional forces are created in the ‘Big Bend’ of the plate boundary zone where the San Andreas fault deviates to the west from its predominant northwest trend, creating the Transverse Ranges. The Santa Ynez Mountains and northern Channel Islands form the westernmost compartment of the Transverse Ranges, and are actively rising as a result of the oblique plate collision process.



T:\Elwood_Devereux\deliverables\geology_maps.apr UCSB topo layout

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 1 inch = 500 feet
 Projection: State Plane CA Zone 5, NAD83, Feet



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Figure 4.2-1. Local Topography

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The Santa Ynez Mountains and adjacent coastal areas are cut by a series of active, subparallel faults and folds, referred to as the Santa Barbara Fold Belt (SBFB) (Gurrola, 2003). Most of the faults in the SBFB are reverse (thrust) faults, many of which are normal faults that have been inverted. The SBFB has formed on the south flank of the Santa Ynez Mountains Anticlinorium, likely as the result of shortening along a blind basal detachment, the San Cayetano thrust fault (Namson and Davis, 1990). The San Cayetano and associated active shallow crustal faults such as the Red Mountain, North Channel, More Ranch/Mission Ridge/Arroyo Parida, and Santa Ynez faults are the largest seismic sources in the vicinity of the Joint Proposal Area.

Uplift of the Santa Ynez Mountains and the coastal terraces on the SBFB and the effects of erosion have largely controlled topographic landform and drainage development. Sedimentary rocks of Cretaceous to Miocene age have been uplifted and eroded, creating the scenic, steeply dipping strike ridges on the south flank of the range. On the Goleta Coastal plain, these bedrock units are overlain by relatively flat-lying sediments and soils of Pleistocene through Holocene (Recent) age. These Late-Quaternary sediments and soils have been folded and offset by faults, clearly demonstrating recent fault activity.

The combined effects of repeated, large sea level changes in the Quaternary (past 1.8 million years) and tectonic uplift of the coastal plain on the More Ranch fault system (Figure 4.2-2) have resulted in uplifted marine terraces, including the mesas upon which the University, Isla Vista, Ellwood, and Devereux areas are located. This marine terrace has been dated at approximately 45,000 years before present (B.P.).

4.2.2.2.2 Stratigraphy. Regional stratigraphy consists of Tertiary marine and nonmarine sedimentary rocks. The general geology of the coastal mesa consists of thin veneer of Quaternary marine and nonmarine terrace deposits unconformably overlying Tertiary sedimentary rocks. The Miocene and Pliocene Bedrock formations of the Open Space Plan area are mostly overlain by Holocene and Older Alluvial (Pleistocene) terrace deposits (Dibblee, 1966).

The bedrock lithology of most of the project area is composed of the Monterey shale (Tm). This Miocene-age shale is well exposed along the sea cliffs to the west of Devereux Slough, and exhibits whitish gray, finely laminated bedding planes that are steeply dipping to the south in most places. The Miocene-Pliocene age Sisquoc Formation (Ts) bedrock, which overlies the Monterey Formation, is present to the south and east of Devereux Slough. Both the Sisquoc and Monterey Formations are folded and faulted, so the bedding orientation and dip changes along the coast.

Recent geotechnical investigations by Fugro West, Inc. (2003) suggest that Pliocene-age Pico Formation marine siltstone strata are locally present beneath estuarine deposits at the University's San Clemente Housing development and at the adjacent Ocean Meadows Golf Course site.

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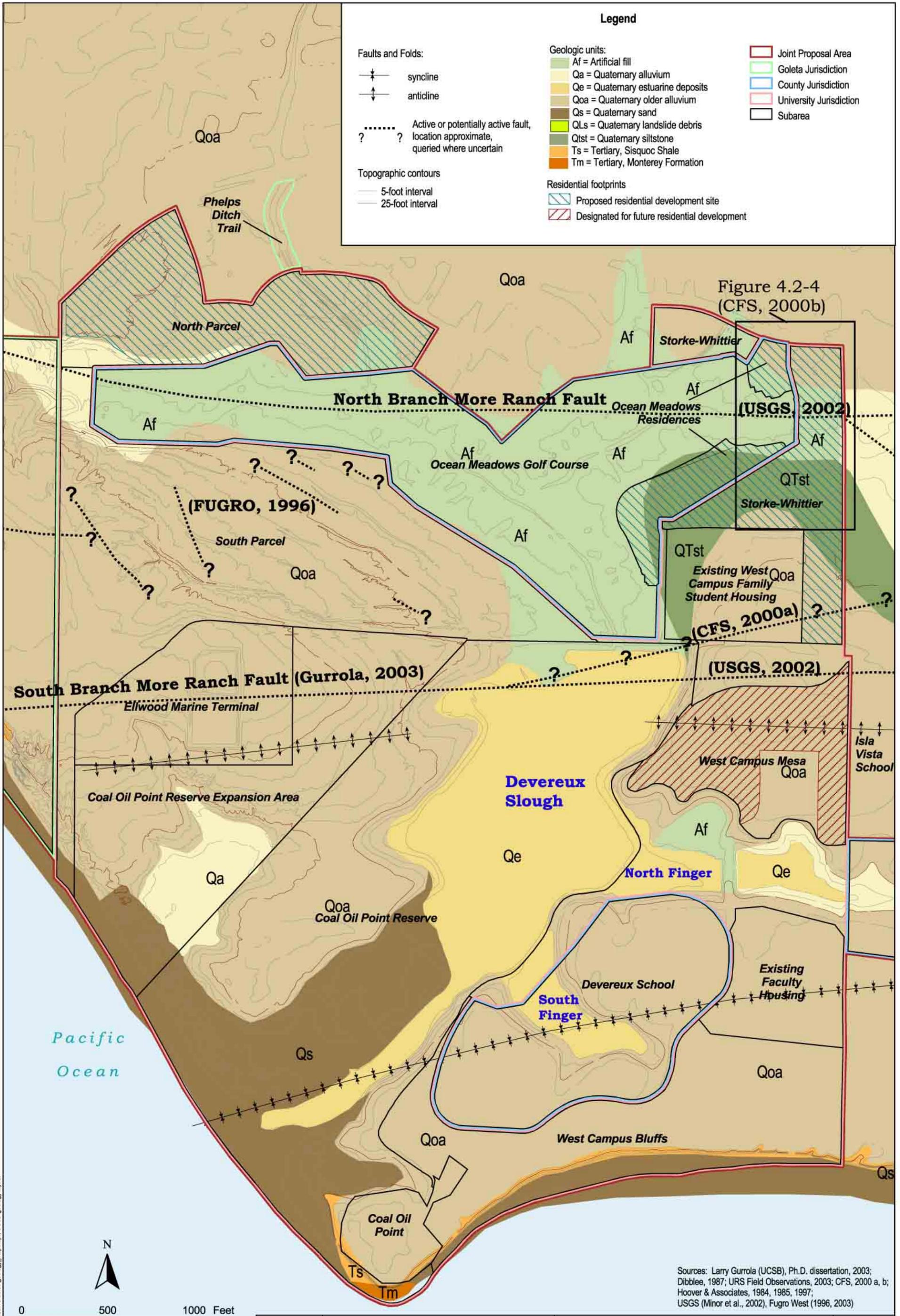
Older Alluvium (Qoa) forms the surficial strata over most of the upland terrace mesas. It consists of marine and non-marine terrace deposits (Dibblee, 1966, 1987a,b). Recent Landslide deposits (Qls) are locally found along the sea cliff. Younger Alluvium (Qa) is common along Devereux Creek and its tributaries, as well as other low-lying areas. Estuarine silts and clays (Qe) are exposed on the tidal flats of Devereux Slough and Goleta Slough. Beach and dune sands (Qs) are found on beaches and near the mouth of Devereux Slough. Finally, artificial fill (Af) is found on golf courses and in many areas that have been developed on former wetlands and other low-lying areas.

4.2.2.2.3 Local Faulting. At least three major fault zones cross the project area. These faults include the South, Central, and Northern branches of the More Ranch fault. These faults are south-dipping reverse faults, which elevate the marine terrace on the mesa from the Goleta Valley to the north. They are visible on the sea cliffs, and in the case of the North Branch More Ranch fault, have clear geomorphic expression. The North Branch More Ranch fault is mapped by Dibblee (1987 a,b), Olson (1972), Minor et al. (2002), and Gurrola (2003) as trending through the central portion of the Ocean Meadows Golf Course. To the west, the hanging wall anticline of this fault forms the Ellwood Oil Field reservoir, which produced approximately 100,000,000 barrels of oil from 1928 to 1971.

The South Branch More Ranch fault passes through the general vicinity of the above ground oil tanks in the Ellwood Marine Terminal, as mapped by Gurrola (2003). The Middle Branch More Ranch fault parallels the north and south branches, and lies about halfway between them (Hoover and Associates, 1984). The South Branch More Ranch fault reportedly cuts the 45,000-year marine terrace at the University, and is thus considered potentially active. The state of activity of the Middle Branch of the More Ranch fault is unknown, but the basal terrace deposits are offset by the fault on Ellwood Mesa, suggesting that it is also potentially active.

Dibblee (1966) indicates displacement of both recent and older alluvial deposits along the North More Ranch fault. Holocene movement of this fault is suggested by north-facing fault scarps that are present on the east and west ends of this 9-mile-long fault. The uplifted coastal mesas (Ellwood, Devereux, Isla Vista, University, and More Mesa) occur to the south of this fault as a result of fault movement. To the east, it connects with the Mission Ridge-Arroyo Parrida fault system.

The Santa Barbara County General Plan Safety Element considers the More Ranch fault(s) to be active. However, the More Ranch fault has not yet been zoned as an active fault by the State of California (Jennings, 1994). Based on sea cliff exposures, geomorphic expression and oil well data, the North Branch of the More Ranch fault is likely the most active structure in the More Ranch fault system. It locally warps, folds and faults the 45,000-year marine terrace platform and overlying alluvial sediments from Ellwood to More Mesa (Gurrola, 2003). Gurrola et al. (2003) consider the More Ranch fault to be potentially active. Fugro West (2003) suggests the North and South Branches converge to the east of the University near the former Mescalitan Island. Fugro West does not recognize the Middle Branch of the fault.



Legend

Faults and Folds:

- syncline
- anticline
- Active or potentially active fault, location approximate, queried where uncertain

Topographic contours

- 5-foot interval
- 25-foot interval

Geologic units:

- Af = Artificial fill
- Qa = Quaternary alluvium
- Qe = Quaternary estuarine deposits
- Qoa = Quaternary older alluvium
- Qs = Quaternary sand
- QLs = Quaternary landslide debris
- Qtst = Quaternary siltstone
- Ts = Tertiary, Sisquoc Shale
- Tm = Tertiary, Monterey Formation

Residential footprints

- Proposed residential development site
- Designated for future residential development

Other:

- Joint Proposal Area
- Goleta Jurisdiction
- County Jurisdiction
- University Jurisdiction
- Subarea

Figure 4.2-4 (CFS, 2000b)

(USGS, 2002)

(FUGRO, 1996)

(Gurrola, 2003)

(CFS, 2000a)

(USGS, 2002)

Sources: Larry Gurrola (UCSB), Ph.D. dissertation, 2003; Dibblee, 1987; URS Field Observations, 2003; CFS, 2000 a, b; Hoover & Associates, 1984, 1985, 1997; USGS (Minor et al., 2002), Fugro West (1996, 2003)

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1 inch = 500 feet

Projection: State Plane CA Zone 5, NAD83, Feet

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A 50-foot setback from potentially active faults for human-occupied structures was proposed by Hoover and Associates (1984, 1985), including the More Ranch faults described herein. This is the same setback as the State of California's setback distance for active faults. It is also consistent with the Fault Setback Policy (Policy 30253.1) contained in the University's Long Range Development Plan, which states that buildings shall be constructed no closer than 50 feet from active or potentially active faults. Finally, a 50-foot offset requirement is consistent with the Santa Barbara County General Plan Seismic Safety Element, which suggests the appropriate setback distance from the trace of a fault would be variable, depending on conditions, but normally would be at least a minimum of 50 feet on each side of the sheared zone. Refer to Figure 4.2-4 (Approximate Surface Trace of North Branch More Ranch Fault), and Figure 4.2-5 (Geologic Cross Section of North Branch More Ranch Fault).

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Some geologists have suggested that other faults, such as the North Ellwood fault, the Coal Oil Point fault, and other unnamed secondary faults, cross the Joint Proposal Area (Hoover and Associates, 1985; UCSB, 1990; Fugro West, 1996, 2003). URS considers the North Elwood fault to be part of the North More Ranch fault zone, rather than a separate structure. The Coal Oil Point and other unnamed secondary faults have not been confirmed and have not been recognized by Jennings (1994), Dibblee (1987 a,b), Gurrola (2003), or Santa Barbara County (Moore and Taber et al., 1979). URS does not consider these faults to be active, seismogenic structures. However, the short secondary faults in the South Parcel of North Campus are recognized by the University on the basis of Fugro West (1996).

4.2.2.2.4 Seismicity. Santa Barbara is located in a seismically-active area (McLauren and Savage, 2001). The western Transverse Ranges have experienced numerous seismic events over the last two centuries, including a few historic large-scale (magnitude >6.0) events such as the 1812 earthquake. The 1812 event had a probable magnitude of $M_w > 7.1$ (Toppozada et al., 1981), and may have occurred offshore or on the San Cayetano fault to the east (Dolan and Rockwell, 2001) or the Santa Ynez River fault to the northwest (Sylvester, 2003; Sylvester and Darrow, 1979). Other destructive earthquakes struck the Santa Barbara and Goleta area in 1857 (San Andreas Fault, $M_w = 8.4$), 1925 (Santa Barbara vicinity, $M_w = 6.3$, possibly More Ranch or Mesa fault), 1927 ($M_w = 7.3$, Hosgri fault, offshore Pt. Arguello) and 1978 ($M_w = 5.9$, offshore North Channel fault).

Regional onshore faults that can be expected to cause seismic shaking in the Open Space Plan area during an earthquake include the San Andreas Fault (52 miles from site), and the Santa Ynez Fault and Santa Ynez River Fault (10 miles from site). Both of these faults are considered active (Dibblee, 1966). The San Cayetano blind thrust fault poses another significant seismic hazard. It is a blind fault, likely buried approximately 10-12 km beneath the site (Namson and Davis, 1988, 1990). The offshore Pitas Point/North Channel and Red Mountain faults (5 and 16 miles from the site, respectively) also are considered active and would cause seismic shaking at the site during an earthquake (Foxall et al., 1995). Finally, the Oak Ridge Fault and the Channel Islands thrust pose significant offshore seismic sources (Shaw and Suppe, 1990; Sorlein et al., 2000).

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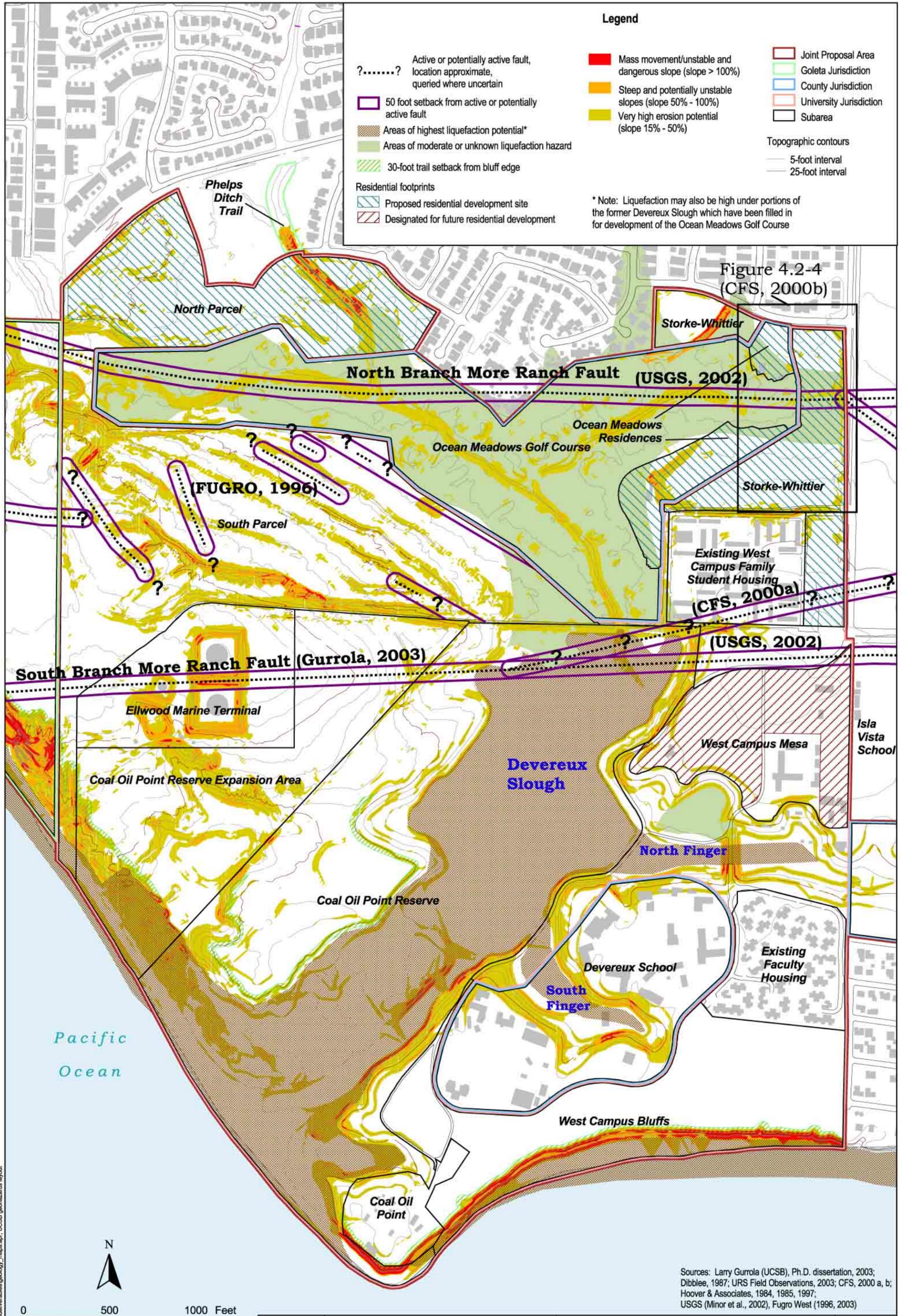
The maximum probable magnitude of an earthquake along an active, or potentially active, fault may be calculated as a function of the fault's total length or as a function of the fault surface area (Wells and Coppersmith, 1994). The maximum probable earthquake for building design determinations that could theoretically be produced by the More Ranch fault alone is a maximum credible earthquake magnitude of 6.8 (Hoover and Associates, 1985). However, Gurrola et al. (2001) consider the More Ranch fault as part of an extended fault system that includes the Mission Ridge and Arroyo Parida faults to the east. This entire fault system has a length of about 70 km. Given a rupture length of 70 km, the More Ranch-Mission Ridge-Arroyo Parida fault system is capable of generating a maximum credible earthquake magnitude of about 7.2.

Damage from an earthquake on the More Ranch fault would occur from ground shaking created by seismic waves traveling through rock and soil. The amount of shaking is measured as ground acceleration. The acceleration on site is a function of earthquake magnitude, site distance from the earthquake source, and rock and soil types present on the site. Some workers have suggested that the More Ranch fault could generate a peak bedrock acceleration of 0.80 g (County of Santa Barbara, 1997). A larger magnitude earthquake on an off-site fault would generate ground accelerations of about 0.75 g as a function of distance from the site (Hoover and Associates, 1985). Damage to existing wood-frame structures and underground utilities can be expected to be considerable with these ground accelerations.

URS considers it more reasonable to use estimated ground accelerations from Caltrans (Mualchin, 1996). The Caltrans seismic hazard map suggests that the peak ground acceleration on bedrock beneath the project area is approximately 0.6 g, although higher peak accelerations can be generated locally.

4.2.2.2.5 Liquefaction. Liquefaction is a rapid loss of strength in water-saturated sandy soils produced by ground shaking during an earthquake. Seismic waves can increase intergranular pore pressure and cause a rapid loss of bearing strength. Poorly consolidated coarse soils and a water table within 20 feet of the ground surface are prerequisites for this phenomenon to occur. Low coastal areas and alluvial valleys are most susceptible to liquefaction.

The County of Santa Barbara identifies the Ellwood area as having a low to moderate liquefaction hazard (Moore and Taber et al., 1979). However, areas of beach sand, the broader area of the Devereux Creek bottom on the Doty parcel (immediately west of North Campus), and areas underlain by estuarine deposits in the present and former Devereux Slough could have a high liquefaction potential if unconsolidated sand layers exist below the water table at shallow depths.



Legend

- ?.....? Active or potentially active fault, location approximate, queried where uncertain
- 50 foot setback from active or potentially active fault
- Areas of highest liquefaction potential*
- Areas of moderate or unknown liquefaction hazard
- 30-foot trail setback from bluff edge
- Residential footprints
- Proposed residential development site
- Designated for future residential development
- Mass movement/unstable and dangerous slope (slope > 100%)
- Steep and potentially unstable slopes (slope 50% - 100%)
- Very high erosion potential (slope 15% - 50%)
- Joint Proposal Area
- Goleta Jurisdiction
- County Jurisdiction
- University Jurisdiction
- Subarea
- Topographic contours
- 5-foot interval
- 25-foot interval

* Note: Liquefaction may also be high under portions of the former Devereux Slough which have been filled in for development of the Ocean Meadows Golf Course

Figure 4.2-4 (CFS, 2000b)

Existing West Campus Family Student Housing (CFS, 2000a)

(USGS, 2002)

South Branch More Ranch Fault (Gurrola, 2003)

North Branch More Ranch Fault (USGS, 2002)

(FUGRO, 1996)

Sources: Larry Gurrola (UCSB), Ph.D. dissertation, 2003; Dibblee, 1987; URS Field Observations, 2003; CFS, 2000 a, b; Hoover & Associates, 1984, 1985, 1997; USGS (Minor et al., 2002), Fugro West (1996, 2003)

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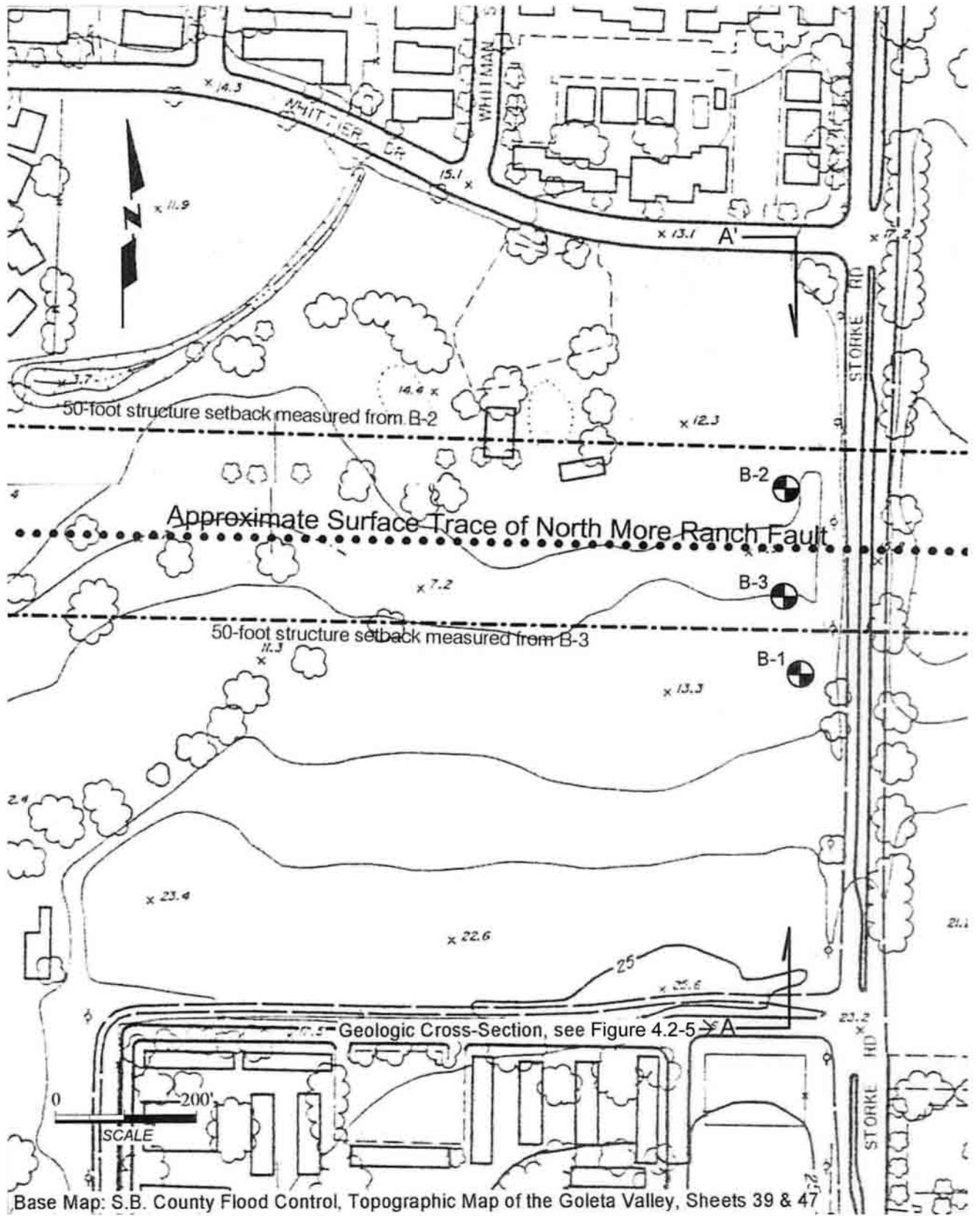
1 inch = 500 feet
Projection: State Plane CA Zone 5, NAD83, Feet



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Figure 4.2-3. Geohazards Map

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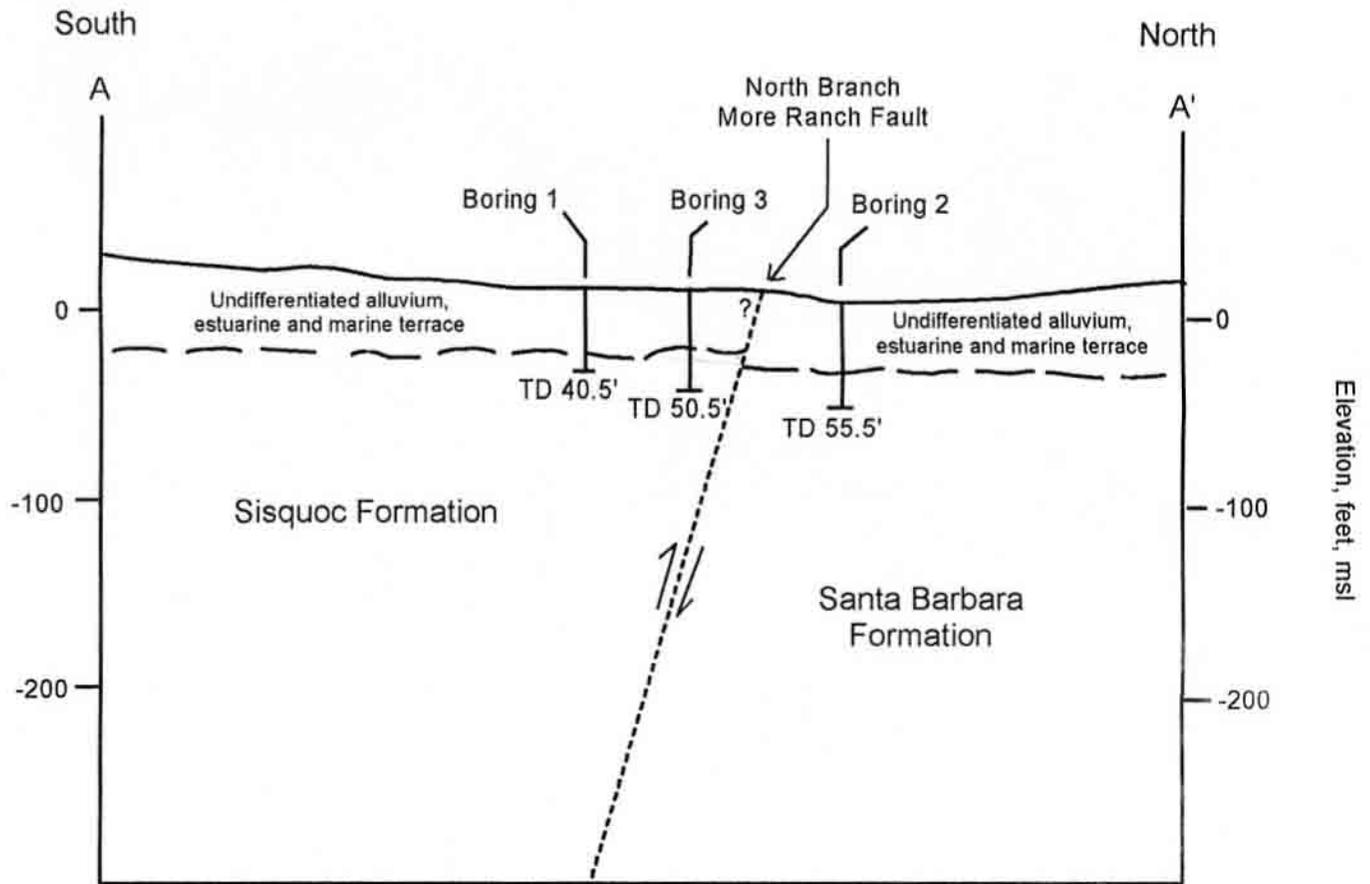


Base Map: S.B. County Flood Control, Topographic Map of the Goleta Valley, Sheets 39 & 47

Source: CFS Geotechnical Consultants, 2000b

Boring Location and Number

	<p>Faculty and Family Student Housing, Open Space Plan & LRDP Amendment EIR</p> <p>University of California, Santa Barbara</p>	<p>Figure 4.2-4. Approximate Surface Trace of North Branch More Ranch Fault</p>	<p>April 2004</p>
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Scale:
Horizontal: 1 inch = 200 feet
Vertical: 1 inch = 100 feet

Source: CFS Geotechnical Consultants, 2000



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Figure 4.2-5. Geologic Cross-Section
of North Branch More Ranch Fault

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4.2.2.2.6 Slope Stability. Various types and degrees of slope instability are part of the natural weathering and erosional cycles of an area. Factors contributing to slope instability include topography, bedrock and soil types, bedrock orientation, precipitation, vegetation, seismic shaking, and human-induced topographic alteration. Slope stability covers a series of mass-movement phenomena such as large landslides, rockfalls, mudflows, and shallow soil failure. These mass movements may be triggered by seismic activity, rainfall, undercutting of sea cliffs by wave erosion, and other factors.

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A slope stability analysis of the marine terrace deposits performed by Hoover and Associates (1985) indicates that gross overall stability of an 18-foot-high, 1.5:1 slope generally meets Santa Barbara County requirements for static conditions. State Guidelines for development setbacks from coastal bluffs are outlined by Johnsson (2003).

4.2.2.2.7 Expansive Soils. Expansive soils within the project area are limited the West Campus Bluffs. The expansive soils consist of Diablo Clay (soil mapping units DaC and DaD), and have a high shrink-swell potential. Diablo Clay soils are mapped in the central and east portion of the West Campus Bluffs (see Figure 4.2-6).

4.2.2.2.8 Differential Settlement and Land Subsidence. Subsidence is displacement of the ground surface vertically over a broad region or at localized areas. Differential settlement often occurs on cut-and-fill slopes, where fill areas often settle through time. Land subsidence is likely in areas occupied by the former Goleta and Devereux Sloughs. Emplacement of fill soils on underlying estuarine deposits could result in compaction and settlement of several inches due to the emplaced loads.

Numerous tsunamis have occurred historically in the Santa Barbara/Goleta area. Tsunamis may be generated by distal sources in other parts of the Pacific Rim, or by coseismic displacements on local faults, such as the Channel Islands Thrust fault system. Local earthquake events may trigger large-scale slope failures in the Santa Barbara channel, resulting in moderate to large local tsunami events such as occurred in 1812. Recent work suggests that purely tectonically generated tsunamis could result in run-up of about 7 feet, whereas combinations of tectonic sources and submarine mass movements could generate local tsunami run-up as high as about 50 feet (Borrero et al., 2001). The California Office of Emergency Services has been provided with a recommended tsunami evacuation zone by Synolakis (2003) of 33 feet above sea level for coastal portions of Southern Santa Barbara County.

4.2.2.3 Geology and Geohazards—North Campus

The North Campus consists of three parcels: the “North Parcel,” located to the North of the Golf Course, the “South Parcel,” which is located to the south of the Golf Course, and the “Storke-Whittier” parcel, located along Whittier and Storke Roads.

Geohazards present in the North Parcel (refer to Figure 4.2-3) include mass movement, flooding, liquefaction, ground settlement, and seismicity. As previously discussed, the North

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Campus Faculty Housing parcels range in elevation from about 10 to 35 feet above sea level, with grades of 5 percent to greater than 30 percent. Erosion and mass movement may occur on the moderate slopes on the southwest side of the property. Flooding is a hazard in the low-lying areas on either side of Phelps ditch at the eastern end of the property (see Section 4.2.1). Liquefaction and ground settlement also pose hazards in the low-lying portions of the sub-area, which are located on fill material overlying the former northern portion of Devereux Slough. Severe seismic shaking from an earthquake generated by the More Ranch fault or other nearby active fault system poses a hazard throughout the region.

Geohazards present in the South Parcel include mass movement, flooding, surface fault rupture, and seismicity. Other potential hazards include ground settlement and liquefaction. The topography of the South Parcel ranges in elevation from 10 feet above sea level in the east to 70 feet above sea level in the west. The topography of the South Parcel has been dramatically altered by man's activities, as the topsoil of this area was removed in the 1960s to be used as artificial fill for the adjacent golf course. The eastern portion of the South Parcel may be on artificial fill overlying estuarine sediments. Average grades range from 5 to 30 percent, with locally steeper slopes on the sides of sediment berms and diversion ditches.

Erosion and small scale mass movement is taking place on moderate to steep slopes on the berms, which bisect the South Parcel. Flooding is a hazard in the low-lying areas at the eastern end of the South Parcel adjacent to the Slough and Golf Course. Liquefaction and ground settlement could also pose hazards in the eastern, low-lying portions of the South Parcel, which may be located on fill material overlying the former northern portion of Devereux Slough. Severe seismic shaking from an earthquake generated by the More Ranch fault or other nearby active fault system poses a hazard throughout the South Parcel. Several potentially active faults cross the South Parcel (Figure 4.2-3), including the Middle Branch of the More Ranch fault (Hoover and Associates, 1985) and numerous short cross faults mapped by Fugro West (1996).

Geohazards present in the Storke-Whittier Parcel (refer to Figure 4.2-3) include flooding, surface fault rupture, seismicity, ground settlement, and liquefaction. Much of the area lies within the 100-year floodplain, and is located on what was formerly the northern part of Devereux Slough. Given the potential for a 1.6- to 6.6-foot rise in sea level over the next century, the flood hazard will only increase in the future. The North Branch of the More Ranch fault crosses the parcel, presenting a ground rupture hazard. The potential for ground settlement and liquefaction exists because the site overlies soft and saturated estuarine silts, clays, and sands (Fugro West, 2003). Groundwater is at a shallow depth throughout the area. Severe seismic shaking from an earthquake generated by the More Ranch fault or other nearby active fault system poses a significant hazard.



Residential footprints
 Proposed residential development site
 Designated for future residential development
 Joint Proposal Area
 Goleta Jurisdiction
 County Jurisdiction
 University Jurisdiction
 Subarea
 Soil Boundary

Data Source: County of Santa Barbara; USDA-NRCS SSURGO, Soil Survey of Santa Barbara County, California, South Coastal Part, 1999.
 Image Source: AirPhotoUSA, September 2002, 2' Resolution

Legend	
Soil Classifications	
AC	Aquents, Fill Areas
BE	Beaches
Ca	Camarillo Fine Sandy Loam
Cb	Camarillo, Variant, Fine Sandy Loam
CgA	Concepcion Fine Sandy Loam, 0 to 2 Percent Slopes
CgC2	Concepcion Fine Sandy Loam, 2 to 9 Percent Slopes, Eroded
CgD2	Concepcion Fine Sandy Loam, 9 to 15 Percent Slopes, Eroded
CgE2	Concepcion Fine Sandy Loam, 15 to 30 Percent Slopes, Eroded
DU	Dune Land
DaC	Diablo Clay, 2 to 9 Percent Slopes
DaD	Diablo Clay, 9 to 15 Percent Slopes
MeC	Milpitas-Positas Fine Sandy Loams, 2 to 9 Percent Slopes
MeD2	Milpitas-Positas Fine Sandy Loams, 9 to 15 Percent Slopes, Eroded
W	Water
XA	Xerorthents, Cut and Fill Areas

0 500 1000 Feet
 1 inch = 500 feet
 Projection: State Plane CA Zone 5, NAD83, Feet

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4.2.2.4 Geology and Geohazards—West Campus

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Geohazards present in the West Campus Mesa sub-area (refer to Figure 4.2-3) include slope stability and seismicity. The grade of the slopes leading down to North Finger and to Devereux Slough range from 30 to 50 percent, and are thus susceptible to erosion, creep and other forms of mass movement. Potential peak ground acceleration of 0.6 g or greater is possible on the site due to severe ground shaking from an earthquake generated by the More Ranch fault or other nearby active fault system.

Geohazards present in the West Campus Bluffs (refer to Figure 4.2-3) sub-area include slope stability, expansive soils, tsunami, flooding, and seismicity. The hazard posed by slope stability is moderate to high. Slope creep may be taking place on the steep slopes on the south side of the West Campus Bluffs. Small slumps, slides, and rockfalls are other forms of mass movement contributing to erosion and retreat of the sea cliffs in this area. As previously discussed, the sea cliffs on the Main Campus, Isla Vista, and the West Campus Bluffs are retreating as a result of erosion. The rate of sea cliff retreat is variable, however, and appears to be slower along the West Campus Bluffs than in Isla Vista. This may be due to less exposure to wave erosion as a result of protection afforded by Coal Oil Point. Gullying and erosion of the top of the bluffs appears to be taking place as a result of uncontrolled runoff and numerous trails descending the cliffs. The bluffs are relatively flat and poorly drained, so shallow flooding and sheetflow occurs during storm events.

Highly expansive soils consisting of Diablo Clay (DaC) underlie a large portion of the West Campus Bluffs (see Figure 4.2-6), posing a hazard to building foundations.

Potential peak ground acceleration of 0.6 g or greater is possible on the site due to ground shaking from an earthquake generated by the More Ranch fault or other nearby active fault systems. The tsunami hazard is moderate to high due to the direct southern exposure to the Santa Barbara Channel.

Geohazards present in the Coal Oil Point sub-area (refer to Figure 4.2-3) include mass movement, tsunami, and seismicity. Coal Oil Point extends far south, and is highly exposed to large winter waves and tsunamis. Coal Oil Point is about 35 feet above sea level, and is bound to the south and east by sloping sea cliffs with grades of 30 to 100 percent. Mass movement by a variety of processes is occurring on the Point, and the sea cliffs are retreating. Severe seismic shaking from an earthquake generated by the More Ranch fault or active offshore fault poses a significant hazard.

Geohazards present in the Coal Oil Point Reserve sub-area (refer to Figure 4.2-3) include mass movement, flooding, tsunami, surface fault rupture, seismicity, ground settlement, and liquefaction. The Coal Oil Point Reserve is a large area that encompasses Devereux Slough, beach areas, and upland areas to the west. Elevations in the Coal Oil Point Reserve range from sea level to 65 feet above sea level. Gently sloping topography having slope grades of 5 to 10

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percent characterize much of the area, although steeper grades are locally present in dune areas, on promontories around the Slough, and slopes to the north and east of the Dune Pond.

Mass movement is a common and natural phenomenon in sand dunes, which are migratory features. Minor slumps and slides may also occur on steeper slopes north of the Dune Pond and on promontories around Devereux Slough. Flooding of low-lying areas is likely to occur in the back-dune area, the Slough and on the beach. Future sea level rise will likely increase the flood hazard.

Tsunami hazard is moderate to high due to the exposure to the Santa Barbara Channel. Surface fault rupture is possible on the South Branch of the More Ranch fault, which is potentially active. The state of activity of the Coal Oil Point fault is unknown. Ground settlement poses a hazard in Devereux Slough, and the liquefaction hazard is high in the Slough, on the beach, and in dune areas under saturated conditions. Severe seismic shaking from an earthquake generated on the More Ranch fault system or an offshore fault poses a significant hazard.

4.2.2.5 Soils—Regional Overview

The majority of the information presented in this section was obtained from the USDA's Soil Survey of Santa Barbara County, California – South Coastal Part (1981). Soils of the Joint Proposal Area, including those portions under the University's jurisdiction, can be grouped into associations that have formed on foothill and coastal terraces, in canyons and coastal plains, and in wetlands such as estuaries. The Milpitas-Positas-Concepcion association, for example, is composed of nearly level to steep, moderately well drained fine sandy loams on terraces. The Ayar-Diablo-Zaca association is composed of gently sloping to very steep, well-drained clays on uplands. The Camarillo-Aquepts association is composed of nearly level, poorly drained and very poorly drained fine sandy loams on low flood plains and tidal flats. The USDA Natural Resources Conservation Service (formerly the Soil Conservation Service) has mapped the soils located within the region. Approximately 14 mapped soil units have been identified. These soils are shown on Figure 4.2-6 and are listed in Table 4.2-1.

Aquepts are found in fill areas (AC) which are reclaimed areas of soils resulting from filling low, poorly drained areas near the ocean. The soil material used for fill as well as the depth of the fill is variable. Permeability is variable, but typically is rapid, runoff is slow, and the hazard of erosion is low. Areas of beach sand (BE) have a severe wind and water erosion hazard.

The Camarillo series consist of poorly drained soils on flood plains. These soils formed in stratified alluvium derived from calcareous sedimentary rock. Slopes are 0 to 2 percent and permeability is moderate. Within this series, the Camarillo fine sandy loam (Ca) is nearly level soil located a few feet above sea level. Some of these areas are ponded during prolonged rain. Runoff is very slow, the shrink-swell potential is low, and the hazard of overflow is moderate. Unless protected, most areas are subject to infrequent flooding and damaging deposition.

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Table 4.2-1. Project Area Soil Characteristics

Soil Designation /a/	Name/Texture	Slope (percent)	SCS Capability Class	Erosion Hazard	Runoff	Shrink Swell Potential	Flood Hazard	Water Table Depth (feet)
AC	Aquents, fill areas	-	-	Slight	Slow	-	-	2-6
BE	Beach sand	0-2	VIII	Severe	Very slow	Low	Common	Variable
Ca	Camarillo fine sandy loam	0-2	III	Slight	Very slow	Low	Common	1-6
Cb	Camarillo fine sandy loam	0-2	III	Slight	Very slow	Low	Common	1-6
CgA	Concepcion fine sandy loam	0-2	III	Slight	Slow	Low	None	>6
CgC2	Concepcion fine sandy loam	2-9	IV	Mod. (gullying)	Rapid	Low	None	>6
CgD2	Concepcion fine sandy loam	9-15	VI	High	Rapid	Low	None	>6
CgE2	Concepcion fine sandy loam	15-30	VI	Very high (gullying)	Rapid	Low	None	>6
DaC	Diablo clay	2-9	II	Slight	Med.	High	None	>6
DaD	Diablo clay	9-15	III	Mod.	Med.	High	None	>6
DU	Dune land	-	VIII	Severe	Very slow	Low	None	Variable
MeC	Milpitas-Positas fine sandy loam	2-9	III	Mod.	Med.	Low	None	>6
MeD2	Milpitas-Positas fine sandy loam	9-15	IV	High	Rapid	Low	None	>6
W	Water	- ¹	- ¹	- ¹	- ¹	- ¹	- ¹	- ¹
XA	Xerorthents	- ¹	- ¹	Variable	Variable	- ¹	- ¹	- ¹

¹Dash (-) indicates no interpretation provided by USDA.

Source: USDA Soil Survey, 1981.

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Section 4.2 The Camarillo variant consists of poorly drained soils on low flood plains formed in deposits of loamy stratified alluvium derived from calcareous rock. Slopes are 0 to 2 percent and permeability is slow. Within this variant, the Camarillo Variant, fine sandy loam (Cb) is nearly level soil located on low alluvial plains. Internal drainage is slow, and during winter rainwater may stand on the surface. Runoff is very slow, the shrink-swell potential is low, and the hazard of overflow is moderate. Most areas are subject to overflow and damaging if unprotected.

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The Concepcion series consists of moderately well drained soils on low terraces that parallel the coastline. The soils formed in mixed alluvium. Slopes range from 0 to 50 percent and permeability is very slow. Within this series, the Concepcion fine sandy loam (CgA) is a nearly level soil located on low terraces in a narrow band paralleling and adjacent to the ocean (0 to 2 percent slopes). In areas along the coastal cliffs, deep gullies have formed and extend into this soil. Runoff is slow, the shrink-swell potential is low, and the hazard of erosion is slight. The Concepcion fine sandy loam (CgC2) is a gently sloping to moderately sloping eroded soil located on low terraces in narrow bands paralleling the ocean (2 to 9 percent slopes). Most areas have been cultivated and contain numerous gullies and rills. Gullies, as much as 50 feet deep, commonly extend a few feet to several hundred feet into these terraces. Runoff is medium, the shrink-swell potential is low, and the hazard of erosion is moderate. The Concepcion fine sandy loam (CgD2) is a strongly sloping eroded soil along drainageways that have dissected old terraces. Most areas contain deep gullies in the drainageways and gullies and rills on side slopes above the drainageways. Runoff is rapid, the shrink-swell potential is low, and the hazard of erosion is high. The Concepcion fine sandy loam (CgE2) is a moderately steep soil located on terrace breaks along drainageways. Deep-fluted gullies are common in the bottom of the drainageways and on side slopes. Runoff is rapid, the shrink-swell potential is low, and the hazard of erosion is very high.

The Diablo series consists of well-drained soils on low hills within 3 miles of the coast. The soils formed in soft shale and mudstone. Slopes range from 2 to 50 percent and permeability is slow. High shrink-swell potential is a severe limitation for urban development. Within this series, the Diablo clay (DaC) is a gently sloping to moderately sloping soil on low terrace-like hills (2 to 9 percent slopes). Runoff is moderate, and the hazard of erosion is slight. The Diablo clay (DaD) is a rolling soil on low hills and broad ridgetops. Both runoff and the hazard of erosion are moderate.

Dune Land (DU) consists of hummocks, mounds, and hills of loose wind-deposited marine sand in scattered areas along the coast. Most areas are active and shifting. The soil material has no profile development and consists of loose sand.

The Milpitas series consists of moderately well drained soils on terraces. The soils formed in mixed alluvial deposits. Slopes range from 2 to 50 percent and permeability is very slow. Within this series, the Milpitas-Positas fine sandy loam (MeC) consists of gently sloping and moderately sloping soils located on terraces in unpredictable patterns (2 to 9 percent slopes). The complex consists of 40 percent Milpitas fine sandy loam and 40 percent Positas fine sandy loam. Runoff is moderate, the shrink-swell potential is low, and the hazard of erosion is moderate. The

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Milpitas-Positas fine sandy loam (MeD2) consists of strongly sloping eroded soils located on terraces. The complex consists of 45 percent Milpitas fine sandy loam and 40 percent Positas fine sandy loam. Runoff is rapid, the shrink-swell potential is low, and the hazard of erosion is high.

The Xerorthents, cut and fill areas (XA) consist of mechanically manipulated soils where the original profile is no longer discernible. Some areas have been mechanically cut, either to supply fill material or to remove uneven high spots. Other areas have been covered by fill that contains varying amounts of rock, concrete, asphalt, and other debris. This soil is typically well drained. Permeability, runoff, and hazard of erosion are variable and require on-site investigation.

Agriculturally, the Diablo clay has an SCS capability Class II designation as prime agricultural land. The State Department of Conservation Important Farmlands mapping program, however, designates the Ellwood Mesa/Santa Barbara Shores sub-areas as land that does not meet the criteria for prime farmland (Environmental Science Associates, 1992). The Diablo clay soils within the West Campus Bluffs sub-area likewise would not meet the same criteria for prime farmland because they have not been cultivated or used as farmland for the past 5 years.

4.2.2.5.1 Soils—North Campus. Soil units located within the North Campus project area include AC, Cb, CgA, CgC2, CgE2, MeC, MeD2, and XA. This area has been highly altered from its natural state. Disturbed areas where cutting and filling has occurred predominate in the area north of Venoco Road. In the upland parts of the North Campus sub-area where the native soils were removed by cut-and-fill operations for the golf course, the native soils were probably soils with a fine sandy loam topsoil with a clay subsoil. These soils were probably Concepcion, Milpitas, or Positas series soils. The lowlands along Devereux Creek probably had Camarillo variant soils, which also have a sandy loam topsoil and a subsurface clay layer. Additional information regarding soil conditions is provided below for each of the specific building sites.

North of the golf course, the North Parcel area contains primarily cut and graded soils on the west side and less disturbed areas to the east. The strip of land along the western boundary, the steeper slopes to the north of Devereux Creek, and the areas on both sides of Phelps Ditch are less disturbed and have more intact native soils. The more disturbed soils in the areas excavated during construction of the golf course have low water-holding capacity and poor vegetative cover. The less disturbed areas have a higher water-holding capacity and vegetative cover, and more clay and a higher shrink-swell potential. Some erosion is occurring where the slope breaks and falls more steeply to Devereux Creek (Wallace, Roberts and Todd, 1997).

On the South Parcel, in the area immediately north of the oil storage facility, the cut operation removed most of the topsoil and subsoil down to a sandy substrate. This cut area now has a relatively undeveloped fine sandy loam soil. This soil has a poor water-holding capacity and generally sparse vegetative cover, is well drained and is highly erodible when disturbed. It has low shrink-swell potential. At the upper margins of this cut area, ongoing erosion appears to be concentrated where the cut meets intact clay subsoil. At that point, the intact subsoil is eroding (Wallace, Roberts and Todd, 1997).

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Section 4.2 On the lower slopes between the oil storage facility and the golf course, the cut was probably less deep and not all of the clay loam subsoil was removed. In areas where some subsoil or topsoil remains, the soil has better water-holding capacity and a generally better cover of grasses. **Geology and Geologic Hazards** It is well drained to moderately well drained and has high shrink-swell potential. At the base of the slope from the oil storage facility north to the golf course, part of the area may have surface soil material that is fill. The soil here is variable, and includes sandy loam to clay loam or clay textures. Drainage and shrink-swell potential are variable (Wallace, Roberts and Todd, 1997).

The Storke-Whittier area around the east end of the golf course and west of Storke Road has cut (XA) and fill (AC) soils, and also retains some of the native soils (MeC). The native soils will generally have high shrink-swell potential in the subsoil. The fill area under the driving range of the golf course is moderately well to somewhat poorly drained (Wallace, Roberts and Todd, 1997).

4.2.2.5.2 Soils—West Campus. Soil units located within the West Campus Mesa project area include CgA and CgD2. On the westernmost portion of the area where the slopes are steeper, the soil is highly erodible. Soil units located within the West Campus Bluffs sub-area include CgA and DaC. Diablo clay (DaC) has a high shrink-swell potential, which poses a severe limitation for urban development. Soil units located within the Coal Oil Point sub-area include BE, CgA, CgE2, and DU (refer to Figure 4.2-6 for the locations and Table 4.2-1 for interpretations).

Soil units located within the COPR and Expansion sub-areas include BE, CgA, CgC2, CgE2, DaC, and DU (refer to Figure 4.2-6 for the locations and Table 4.2-1 for interpretations). Specifically, wetland soils at Coal Oil Point Reserve include: 1) unmapped examples of Aquents-flooded types in and around Devereux Slough; 2) Concepcion and related soils in the eroded drainages of the Northern and Southern Slough Fingers; and 3) beach sand in portions of the marine zone. The upland terraces and slopes are characterized by Concepcion and Diablo soils or dune sand. West of Devereux Slough, Concepcion soils characterize the terraces and slopes. A large area of Diablo clay occurs along the southern portion of the area, is more poorly drained, and historically supported vernal pools. Concepcion soils of the region contain clay-pan subsoil layers that also contribute to the potential occurrence of vernal pools (Ferren and Thomas, 1995).

4.2.2.6 Inland and Coastal Erosion—Regional Overview

The topography of the Joint Proposal Area is discussed in Section 4.2.1.1. Local topography is shown on Figure 4.2-1 and areas of steep slopes are shown on Figure 4.2-3. In general, the steeper the slopes the higher the erosion potential. Slope of less than 5 percent are generally considered to have a low erosion potential. Slopes of 5 to 10 percent are considered to have a moderate erosion potential. Slopes of 10 to 15 percent are considered to have a high erosion potential, and slopes of >15 percent are considered to have a very high erosion potential. However, there are many exceptions to this general erosion potential classification, as erosion

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potential is affected by many factors including vegetation, exposure to erosive forces of streams and waves, topsoil development, bedrock type and inclination, runoff, wastewater, and land use.

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Sea cliff erosion and retreat is an ongoing, natural process that cannot be halted. The rate of sea cliff erosion is nonuniform because the composition of orientation of cliff materials is variable, and because wave energy and surface runoff varies along the coast. Sea cliff retreat is an episodic, rather than gradual or steady process, and as such failures occur in catastrophic events often years apart. Such slope failures often occur during El Nino winters, when precipitation, surface runoff, and wave energy are greatest. Slumps or slides occur in bedrock, often removing several feet of cliff face bedrock material in seconds. The hazards associated with cliff retreat may be minimized or mitigated by establishing trail setback zones from bluffs, controlling surface water runoff, and providing clearly marked and well-maintained public beach access trails. Slope stabilization measures can also be implemented locally at beach access sites with approval from the California Coastal Commission.

Inland Erosion is taking place in many portions of the Joint Proposal Area for a variety of reasons, many of which are directly related to man's activities. Some areas, such as the South Parcel of the North Campus, have been stripped of all topsoil for use as artificial fill in the golf course. Other areas are eroding due to lack of vegetation, having been cleared of native vegetation for farming and grazing. Off-road vehicles have created gullies, which are conduits for runoff and result in erosion. Finally, some inland erosion is likely the result of natural geologic and hydrologic processes in areas of tectonic uplift and oversteepening, such as along the North Branch of the More Ranch fault system.

4.2.2.6.1 Inland and Coastal Erosion—North Campus. The North Campus North Parcel site has grades of 5 percent to greater than 30 percent. The highest elevation is in the western portion of the parcel, and the topography generally slopes towards the south and east. Localized gullying and erosion was noted in this area of high-intensity off-road vehicle use.

The North Campus South Parcel site has been dramatically altered by man's activities, as the topsoil of this area was removed in the 1960s to be used as artificial fill for the adjacent golf course. Several large, linear, NW-SE trending berms and diversion ditches were graded in an attempt to control sediment erosion and runoff. The berms, diversion ditches and the intervening areas are in places highly eroded due to the lack of topsoil and unrestricted off-road vehicle use. The sediments from this area have eroded into and have created a sediment delta infilling the northwest portion of Devereux Slough.

The University's (North Campus Housing Open Space and Habitat Management Plan identified seven areas of significant erosion on the South Parcel. These include the following:

- Devereux Creek Embankment Erosion
- Upper Plateau Bare Soils
- Typical Erosion at Cross-Cutting Recreational Trails

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- Severe Erosion at Main Diversion Ditch
 - Lower area of Severe Erosion
 - Filled Sediment Basin with Willows
 - Alluvial Fan from Sediment Basin Culvert

The Storke-Whittier Parcel does not exhibit significant erosion; however, the area of the existing golf course driving range is characterized by a relatively flat area with bare soil or sparse vegetation, and is susceptible to erosion and sediment runoff into the drainage channel that bisects the site.

4.2.2.6.2 Inland and Coastal Erosion—West Campus. The West Campus Mesa is fairly level in most areas, with grades of less than 5 percent. The grade of the slopes leading down to North Finger and to Devereux Slough range from 30 to 50 percent, however, and some localized erosion of surficial soils appears to be taking place on these slopes. Localized erosional features were noted on slopes in the vicinity of the communal stables, adjacent to the North Finger.

The West Campus Bluffs are bounded to the south by steep sea cliffs (refer to Figure 4.2-1). The sea cliffs have grades ranging from 50 to 200 percent, consist of erodible terrace deposits and Sisquoc Siltstone, and are eroding as the result of uncontrolled surface water runoff and wave erosion. The sea cliffs have been incised by erosional gullies and numerous undeveloped tracks and trails. Burrowing rodents also contribute to erosion of the cliff face.

The sea cliffs in Isla Vista to the east of the West Campus Bluffs are retreating at a long-term rate of about 12 to 18 inches per year due to shoreline erosion (Norris, 1968). This is one of the highest rates recorded on the coast of California. The coastal trail from Isla Vista to Sands Beach passes within 5 to 20 feet of the edge of the bluff in many areas, and uncontrolled runoff from the seaward-sloping mesa and the trail itself are contributing to downcutting and headward erosion of gullies and erosion of the sea cliffs.

Coal Oil Point is exposed to large winter storm waves and is actively eroding. Surface water runoff from the mesa, rodent burrowing, and human tracks and trails are also contributing to gullying and erosion of the sea cliffs. Long term average sea cliff retreat rates of Coal Oil Point are likely similar to those in Isla Vista, which range from 12 to 18 inches per year (Norris, 1968). Sea cliff retreat is a natural process that cannot be stopped. However, in many cases, the rate of cliff erosion and retreat can be reduced by controlling runoff, shoreline protection, and slope stabilization measures.

Gently sloping topography having slope grades of 5 to 10 percent characterize much of the Coal Oil Point Reserve, although steeper grades are locally present in dune areas, on promontories around Devereux Slough, and slopes to the north and east of the Dune Pond. Erosion does not appear to be a significant problem in most areas to the west of Devereux Slough, although some erosion is taking place on the moderate slopes to the north of the Dune Pond and along the

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Slough. Localized gullying and erosion is also taking place at the far western boundary of the COPR, where a rough trail descends down a gully to the beach. Downcutting and erosion is also apparent on the NE-SW trending trail just to the east of the Dune Pond.

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Wind erosion and migration of sand dunes is a natural phenomenon that is taking place along the coastal zone. The beach provides sand, which replenishes the supply of sand to the dunes, so this does not appear problematic.

Historical land use and ongoing erosion of upland areas to the north of Devereux Slough, including the South Parcel of North Campus, has resulted in significant infilling of the Slough. Restoration of tidal flow to the lagoon may require dredging operations, as discussed in Section 4.4.

4.2.3 Regulatory Framework

4.2.3.1 Federal

The Uniform Building Code (UBC) defines different regions of the United States and ranks them according to their seismic hazard potential. There are four types of these regions, including Seismic Zones 1 through 4, with Zone 1 having the least seismic potential and Zone 4 having the highest seismic potential. The UCSB campus is within in Seismic Zone 4; accordingly, any future development would be required to comply with all design standards applicable to Seismic Zone 4.

4.2.3.2 State

California Building Code. The State of California provides a minimum standard for building design through the California Building Code (CBC). The CBC is based on the UBC, which has been modified for California conditions, and is generally adopted on a jurisdiction-by-jurisdiction basis, subject to further modification based on local conditions. The project area is located in Seismic Zone IV (County of Santa Barbara, 1979).

Chapter 23 of the CBC contains specific requirements for seismic safety. Chapter 29 of the CBC regulates excavation, foundations, and retaining walls. Chapter 33 of the CBC contains specific requirements pertaining to site demolition, excavation, and construction to protect people and property from hazards associated with excavation cave-ins and falling debris or construction materials. Chapter 70 of the CBC regulates grading activities, including drainage and erosion control. Construction activities are subject to occupational safety standards for excavation, shoring, and trenching as specified in Cal-OSHA regulations (Title 8 of the CCR) and in Section A33 of the CBC.

Alquist-Priolo (AP) Earthquake Fault Zoning Act. The Alquist-Priolo Earthquake Fault Zoning Act of 1972 prohibits the construction of buildings used for human occupancy on active or potentially active surface faults. The Act defines “active” and “potentially active” faults utilizing the same age criteria noted above for the CDMG. However, only those potentially

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Section 4.2 active faults that have a relatively high potential for ground rupture are identified as fault zones. Therefore, not all faults termed “potentially active” by the CDMG are zoned under the Alquist-Priolo Act. No portions of the project area are included within an Alquist-Priolo Earthquake Fault Zone designated by the State of California.

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Seismic Hazards Mapping Act. CDMG also provides guidance with regard to seismic hazards. Under CDMG’s Seismic Hazards Mapping Act, seismic hazard zones are to be identified and mapped to assist local governments in planning and developing purposes. The intent of this publication is to protect the public from the effects of strong ground shaking, liquefaction, landslides, or other ground failure, and other hazards caused by earthquakes. In addition, CDMG’s Special Publications 117, Guidelines for Evaluating and Mitigating Seismic Hazards in California, provides guidance for evaluation and mitigation of earthquake-related hazards for projects within designated zones of required investigations.

4.2.3.3 Local

County of Santa Barbara

Conformance with the County of Santa Barbara’s Grading and Building Codes are considered generally satisfactory (by the County) with respect to geologic hazards, but some amendments are recommended by the County (County of Santa Barbara, 1979). The County General Plan Seismic Safety and Safety Element recommends an adequate site-specific investigation be performed where the possibility of soil or geologic problems exist. The County’s Grading Ordinance No. 3937 (County of Santa Barbara, 1991) pertains to new grading, excavations, fills, cuts, borrow pits, stockpiling, and compaction of fill, “... where the transported amount of materials... exceeds 50 cubic yards or the cut or fill exceeds 3 feet in vertical distance to the natural contour of the land.”

University of California

On January 17, 1995, The Regents adopted an updated Policy on Seismic Safety. This establishes that University policy is “to the maximum extent feasible by present earthquake engineering practice to acquire, build, maintain, and rehabilitate buildings and other facilities which provide an acceptable level of earthquake safety.” The level of safety is defined in the University policy. The policy articulates five primary points:

- *Program for Abatement of Seismic Hazards.* Develop a program for the identification and temporary and permanent abatement of seismic hazards in existing buildings and other facilities.
- *Consulting Structural Engineer.* Engage structural engineers to examine existing buildings and other facilities and submit reports on the adequacy of resistance to seismic forces of University facilities, based on Title 24 of the California Code of Regulations and upon the engineers’ professional evaluations with respect to Appendix A to the policy.

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- *Standards for Seismic Rehabilitation Projects.* Correctional programs for structures that do not provide adequate safety shall provide, at a minimum, an acceptable level of earthquake safety equivalent to the current seismic provisions of Title 24 of the California Code of Regulations, or local seismic requirements, whichever is more stringent, with respect to life safety and prevention of personal injury. Preliminary plans for all seismic rehabilitation shall be reviewed by the consulting structural engineer, and recommendations of the structural engineer shall be incorporated into the project plans by the design engineer.
- *Repair of Buildings and Other Facilities Damaged by Earthquakes.* This section sets standards for University buildings and facilities that are damaged by earthquakes, based on the reduction in lateral load of the structure in question.
- *New Buildings and Other Facilities:* The design of new buildings shall, at a minimum, comply with the current provisions of Title 24 of the California Code of Regulations, or local seismic requirements, whichever is more stringent. Provisions shall also be made for adequate anchoring of nonstructural building elements. No new University structures may be constructed on the trace of a known, active fault. All plans shall be reviewed by a consulting structural engineer, who must, prior to release of funds, certify that the structure complies with the University Policy on Seismic Safety.

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4.2.4 Project Impacts and Mitigation

4.2.4.1 Methodology

For those areas in which new residential development or open space improvements may occur, existing geologic and soil conditions were reviewed, based on information included in the environmental setting, to determine whether geologic or soils hazards could occur, or whether development could result in substantial soil erosion.

4.2.4.2 LRDP Policies

The Coastal Act Element of the LRDP included a range of policies and standards (herein termed LRDP policies) to demonstrate consistency of the LRDP, and projects implemented under the LRDP, with the statutory requirements of Chapter 3 of the Coastal Act (commencing with Section 30200). The following LRDP policies are relevant to Geology and Geologic Hazards.

30253.1. Buildings shall not be placed astride any faults. The actual setback from the fault trace shall be determined based upon site-specific geotechnical studies, but no closer than 50 feet from active or potentially active faults.

30253.2. Sub-surface geotechnical and soil studies shall be conducted to determine proper building foundation and infrastructure design to address potential seismic and liquefaction hazards, if any

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Section 4.2 **30253.3.** No development shall be permitted on the bluff face, except for staircases or access ways to provide public beach access and pipelines for instructional or research-oriented use.

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30253.6. New development located less than 50 feet from the bluff top shall be constructed to insure that all surface and subsurface drainage shall not significantly contribute to bluff erosion or instability.

30253.7. New development shall be constructed at a sufficient distance to maintain the proposed structure for a minimum of 100 years without the construction of shoreline protective devices.

30253.8. The campus shall determine the required setbacks for new buildings through the use of a report by a registered engineering geologist.

30253.11. Pedestrian use of unimproved paths up and down the bluff shall be discouraged. To this end, a fence shall be constructed on the coastal bluff top edge, wherever it does not now exist.

30251.8. Existing topography, vegetation, and scenic features of the West Campus are to be retained and incorporated into the proposed development whenever possible.

30251.11. Contours of finished surfaces on West Campus are to be blended to achieve a consistent grade and natural appearance. Borders of cut slopes and fills are to be rounded off to minimum radius of five feet so as to blend with the natural terrain.

30253.12. Surface and sub-surface drainage pipes shall be designed to minimize erosion and instability of the bluff face and only where no other less damaging drainage system is feasible. Drainage devices extending over the bluff face shall not be permitted if the site can feasibly be drained landward of the bluff face.

30253.13. Within 50 feet of the bluff top, vegetation shall be maintained or replanted with drought resistant species should grading be required to establish proper drainage landward of the bluff.

30240(a).10. South-facing ocean bluffs on the Main and West Campuses shall be left in their present state.

30231.1. In order to protect identified campus wetlands, environmentally sensitive habitat areas, and coastal waters from sediment transfer or contamination from urban runoff during construction, the following grading and erosion control practices shall be followed:

- a) North and West Campuses construction periods shall be scheduled during the dry months of the year (May through October) whenever possible;

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- b) If grading occurs during the rainy season (November through April), sediment traps, barriers, covers, or other methods shall be used to reduce erosion and sedimentation.
- c) A site-specific erosion control and landscape plan shall be prepared for all new construction.
- d) Whenever practical, land on the North and West Campuses is to be developed in increments of workable size, which can be completed during a single construction season: erosion and sediment control measures are to be coordinated with the sequence of grading.
- e) Excavated materials shall not be deposited or stored where the material can be washed away by high water or storm runoff.
- f) Grading operations on campus shall be conducted so to prevent damaging effects of sediment production and dust on the site and on adjoining properties.
- g) When vegetation must be removed on campus, the method shall be one that will minimize the erosive effects from the removal.
- h) Exposure of soil to erosion by removing vegetation shall be limited to the area required for construction operations. The construction area should be fenced to define Project boundaries.
- i) Removal of existing vegetation on campus is to be minimized whenever possible.
- j) Temporary mulching, seeding or other suitable stabilization measures shall be used to protect exposed areas during construction or other land disturbance activities on campus.
- k) Topsoil removed from the surface in preparation for grading and construction on-campus is to be stored on or near the site and protected from erosion while grading operations are underway, provided that such storage may not be located where it would cause suffocation of root systems of trees intended to be preserved. After completion of such grading, topsoil is to be restored to exposed cut and fill embankments of building pads so as to provide suitable base for seeding and planting.
- l) Slopes, both cut and fill on campus, shall not be steeper than 2:1 unless a geological and engineering analysis indicates that steeper slopes are safe and erosion control measures are specified.
- m) Slopes on campus shall not be constructed so as to endanger or disturb adjoining property.
- n) Sediment basins, sediment traps, or similar sediment control measures shall be installed before extensive clearing and grading operations begin for campus development.
- o) Neither wet concrete, nor slurries thereof, shall be permitted to enter any campus wetlands.

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30231.2. Projects shall be designed to minimize soil erosion and, where possible, to direct surface runoff away from coastal waters, environmentally sensitive habitat areas, and wetlands, according to the following policies:

- a) West and Storke Campus site development is to be accomplished, whenever feasible, in a manner that will maximize percolation and infiltration of precipitation into the ground.

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- Section 4.2* b) During campus development, sediment shall be retained on the site.
- Geology and Geologic Hazards* c) The University shall work with property owners adjacent to the West Campus and Santa Barbara County to ensure that development of such properties does not introduce sedimentation into the West Campus marsh, to the maximum extent feasible.
- d) Projects shall be designed to conduct storm water drainage away from Devereux Slough and Storke Campus Wetlands, whenever feasible.
- e) If storm water can only be feasibly discharged into campus wetlands, it shall comply in all respects to all applicable standards of the Regional Water Quality Control Board (RWQCB).
- f) At Coal Oil Point, if percolation is determined through tests to be inadequate, to prevent bluff top erosion, storm waters will be collected and drained directly to the ocean by means of pipes discharging at the base of the bluffs.
- g) Runoff from new development and the planned parking lot at Coal Oil Point shall be directed to the east-facing bluff on the Point, and the drainage structures integrated with the planned stairway to the beach, if feasible. Traps and filters for roadway contaminants shall be provided as part of the drainage structures.
- Policies (h)–(k) are not applicable, as they apply to the main campus and campus lagoon.
- l) New development adjacent to the required 100-foot building setback surrounding the upland limit of the wetland shall not result in significant adverse impacts due to additional sediments, nutrients, pollutants and other disturbance.
- m) All sewage from campus development shall be disposed of in sanitary sewer lines or approved septic tank system subject to design and performance requirements of the RWQCB.

30231.3. Drainage and runoff shall not adversely affect campus wetlands.

- a) The near slopes along the edge of the wetlands shall remain an undisturbed buffer area.
- b) Pollutants shall not be allowed to enter the area through drainage systems (1980 LRDP Development Standard).
- c) Runoff into the wetlands will not increase sediment from campus property.

30233(a).1. Fills shall not encroach on Devereux Slough, Storke Campus Wetlands, campus lagoon, or any other natural watercourses or constructed channels on campus.

30233(a).2. Fills shall have suitable protection against erosion.

4.2.4.3 Thresholds of Significance

The following thresholds of significance are based on Appendix G of the CEQA Guidelines. For purposes of this EIR, implementation of the proposed project may have a significant adverse impact related to geology and geologic hazards if it would result in any of the following:

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- Expose people or structures to potential substantial adverse effects involving risk of loss, injury, 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
 - Landslides
- Result in substantial soil erosion or the loss of topsoil
- Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse
- 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
- 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

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4.2.4.4 Effects Not Found to be Significant

The Goleta West Sanitary District provides sanitary sewer service to the UCSB campus. Existing wastewater infrastructure is located generally along existing streets and structured pathways, and any new development would connect to or extend existing wastewater lines. Because no septic tanks or alternative wastewater systems are proposed, the Initial Study (included in Appendix A of this EIR) determined that no effects associated with soils incapable of adequately supporting these systems would occur, and no additional analysis is required in this EIR.

4.2.4.5 Impacts and Mitigation Measures

Impact 4.2-1. Development of the proposed project could expose people and/or structures to potentially substantial adverse effects resulting from seismic surface rupture, ground shaking, ground failure, or landslides. With implementation of identified Mitigation Measures, this impact would be reduced to a *less-than-significant* level.

Amendment of the LRDP to permit residential development on the North Campus, coastal access improvements, and open space management activities, including habitat restoration, could expose people and/or structures to potentially substantial adverse effects resulting from seismic surface rupture, ground shaking, ground failure, or landslides.

As described above in section 4.2.1.6.3, Local Faulting, three major fault zones cross the project area, one of which -- the North Branch More Ranch fault -- is considered active by the Santa

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Section 4.2 Barbara County General Plan Safety Element. The estimate for the maximum probable earthquake produced by the More Ranch Fault alone is a magnitude 6.8 event; however, the **Geology and** More Ranch fault can be considered part of an extended fault system to the east that is **Geologic** considered capable of generating a maximum credible earthquake of magnitude 7.2. **Hazards**

As shown in Figure 4.2-2, a portion of the North Branch More Ranch Fault skirts the southern portion of the North Parcel project site and bisects the north-south orientation of the Storke-Whittier Parcel. As shown in Figure 4.2-3, the majority of the North Parcel is not considered subject to liquefaction. There are small areas along the bank of Phelps Ditch considered to have liquefaction and mass movement potential; however, no structures are sited on or near those areas for the proposed project. As shown in Figure 4.2-2, the North Branch More Ranch Fault crosses the middle of the Storke-Whittier Parcel. The Storke-Whittier Parcel contains an area considered to have liquefaction potential, underlying the edge of the proposed project development. The site also has an area of mass movement potential, however no structures are proposed on that portion of the site.

Construction on or near a fault could result in significant damage to structures from fault displacement, ground shaking, or ground failure in the event of seismic activity. Such damage could include foundation impairment that could make the structures uninhabitable. In cases of significant damage, people could be exposed to injury or death. Both the North Campus Faculty Housing project and the Sierra Madre Family Student Housing would be sited in accordance with the UC Policy on Seismic Safety and consistent with LRDP policy 30253.1, through inclusion of a setback at least 50 feet from the North Branch More Ranch fault. In addition, as part of the proposed project and consistent with LRDP policy 30253.2, geotechnical and soil studies would be performed to determine proper building foundation design to address any potential seismic hazards. To further reduce potential geological risks to people or structures no development other than Open Space Plan–related access improvements and trail formalizations would occur on the bluff face, consistent with LRDP policy 30253.3; and any development or trail formalizations that do occur within this area be would consistent with LRDP policy 30253.6 such that all surface and subsurface drainage would be designed in such as way as to not significantly contribute to bluff erosion or instability.

The improvement of coastal access and the restoration of management of open space areas within the South Parcel, the West Campus Mesa and Bluffs, and Coal Oil Point could increase use of those areas. As shown in Figure 4.2-2, portions of the Middle and South Branch More Ranch Faults cross the Open Space area. As shown in Figure 4.2-3, portions of the Open Space area are also subject to liquefaction and mass movement potential. The proposed improvements might expose on-site structures and people to substantial seismic hazards if an earthquake occurs along the More Ranch Fault; however, to date there are no recorded instances of seismic hazards endangering existing recreational uses of the project area. The proposed parking areas and the replacement of the restroom at the Coal Oil Point would be designed and sited in accordance with the planning principles listed above, including siting at least 50 feet away from a known fault, and performing geotechnical and soil studies to guide design and address any potential seismic hazards.

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While project development as proposed could potentially expose on-site structures and people to seismic hazard risks, the proposed project is not located within an Alquist-Priolo earthquake zone. Damage to building foundation, structure, and hazards to persons could result if a major seismic event was to occur, and these impacts would be potentially significant. In order to ensure compliance with current practices ensuring seismic building safety, the following Mitigation Measures (MM) would be required:

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MM 4.2-1(a). Per LRDP policy 30253.7, new development shall be constructed at a sufficient distance to maintain the proposed structure for a minimum of 100 years without the construction of shoreline protective devices.

MM 4.2-1(b). During project-specific design, a site-specific geotechnical study shall be conducted under the direct supervision of a California Registered Engineering Geologist or licensed geotechnical engineer to assess seismic, geological, soil, and groundwater conditions at each construction site and develop recommendations to prevent or abate any identified hazards. The University shall incorporate or adhere to the recommendations of each site-specific report that are designed to reduce potential exposure to seismic hazards. These recommendations would include, but not be limited to, specific foundation design features, building and/or structural design features, and grading and excavating recommendations.

MM 4.2-1(c). Per LRDP policy 30253.8, the campus shall determine the required setbacks for new buildings through the use of a report by a registered engineering geologist.

As discussed above, the proposed project is consistent with LRDP Policies designed to reduce potentially substantial adverse effects resulting from seismic surface rupture, ground shaking, ground failure, or landslides. To further address seismic safety MM 4.2-1(a) will reduce potential geologic safety issues in the bluff area. In addition, MMs 4.2-2(b), and 4.2-2(c) would ensure incorporation of recommendations from the geotechnical investigation into project plans and appropriate setbacks from geologic hazards including fault traces. Impacts of the project on exposure to seismic hazards would be reduced to a *less-than-significant* level.

Impact 4.2-2. Grading and/or excavation of soils in association with construction of residential development or open space improvements could result in substantial soil erosion and the loss of topsoil. With implementation of identified mitigation measures, this impact would be reduced to a *less-than-significant* level.

Amendment of the LRDP to permit residential development on the North Campus, coastal access improvements, and open space management activities, including habitat restoration, could expose soils to disturbance and result in substantial soil erosion or the loss of topsoil.

Development of faculty housing would result in grading of approximately 23 acres of land on the North Parcel. Development of the Sierra Madre Family Student Housing complex would result in grading of approximately 13.5 acres of land (10 acres on the Storke-Whittier Parcel and 3 acres of existing lawn area adjacent to the West Campus Family Student Housing complex).

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Section 4.2 Improvement of approximately 8.175 miles of existing trails would result in some grading along trails, to provide a level surface or to expand the width of the trail. Based on the proposed trail types and widths identified in the Open Space Plan, approximately 6.2 acres of ground surface could be graded to improve trails. Development of public parking at up to four locations would result in grading of approximately 0.6 acre of land (total for all four locations, including restroom replacement at Coal Oil Point). Thus, residential development and coastal access improvements could result in grading of up to 43.3 acres of land.

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Restoration of habitat and management of open space resources could also result in ground disturbance in some locations, however, it is anticipated that such disturbance would generally be limited to small discontinuous areas, would only involve use of hand tools, and would be conducted in accordance with the goals and objectives of the Open Space Plan. Because of the degraded state of the South Parcel, including large areas of exposed soils that are subject to erosion, restoration of those areas could require erosion control measures that could include grading to reduce topographic variation, which could require the use of heavy construction equipment in some areas. Consistent with the Open Space Plan, a restoration plan for the area would be prepared and would include erosion control measures to address the period of construction and revegetation of restored areas.

Currently, the North Campus is undeveloped, but heavily disturbed by historic activities, including expansive cut and fill areas created during the construction of the Ocean Meadows Golf Course, and ongoing recreational use of the area. The cut and fill soils have variable erosion potential. The less disturbed soils on the site have a higher water-holding capacity and more clay, while more disturbed soils on the site have low water-holding capacity and poor vegetative cover. The proposed project would be constructed mainly on the more disturbed soils, and along with the planting of vegetation, may act to stabilize these more disturbed soils.

The Storke-Whittier Parcel has both cut and fill soils, with variable erosion potential, and some native soils, which have low erosion hazard potential. The proposed project would be constructed mainly upon the native soil Milpitas-Positas fine sandy loam (MeC), which has a moderate erosion potential.

Residential development on the North Parcel and the Storke-Whittier Parcel would require the removal and recompaction of soils on site and grading, followed by construction of buildings and landscaping of associated open spaces, with bioswales and other features to reduce erosion and runoff. Trenching, grading, and compacting associated with construction of structures, modification/relocation of underground utility lines, and landscape/hardscape installation could expose areas of soil to erosion by wind or water during these construction processes, which would occur over an 18-month period for each site.

The extent of ground disturbance related to coastal access improvements would vary depending on the specific improvement. Construction of surface parking lots and major trails (e.g., those identified as Type H) would likely involve use of construction equipment to level ground surfaces. Pedestrian only trails, particularly those within or adjacent to the Coal Oil Point

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Reserve, would be improved with hand tools only (e.g., shovels) and thus would result in less disturbance. Similarly, ground disturbance associated with boardwalks and coastal access stairways would be accomplished with hand tools.

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Restoration of habitat and other open space management actions are anticipated to only involve use of hand tools and thus would result in only limited ground disturbance.

Since the overall project site does not contain steep slopes, the potential for erosion by water through surface drainage during construction would be reduced. Earth-disturbing activities associated with construction would be temporary and would not result in a permanent or significant alteration of significant natural topographic features that could increase or exacerbate erosion. Specific erosion impacts would depend largely on the areas affected and the length of time soils are subject to conditions that would be affected by erosion processes. To reduce potential soil erosion impacts from construction and project-related activities, the proposed project has, whenever possible, retained and incorporated, to the extent possible, the existing topography, vegetation, and scenic features of the West Campus (consistent with Per LRDP policy 30251.8). This would reduce erosion by limiting disturbance of existing soil formations and retaining current vegetation that aids in soil retention. Also, consistent with LRDP policy 30240(a).10, south-facing ocean bluffs on the West Campus will remain in their present state to reduce potential erosion of these areas, with the exception of coastal access stairways specifically intended to reduce coastal erosion from informal access trails.

Because the University's proposed project would disturb an area greater than five acres in size, the University would be required to file a Notice of Intent to comply with the Phase I National Pollutant Discharge Elimination System (NPDES) general construction activities stormwater discharge permit from the State Water Resources Control Board (SWRCB.) This permit requires the developer to prepare and implement a Stormwater Pollution Prevention Plan (SWPPP). As required by the SWRCB, the SWPPP would be required to reduce non-point source pollution by identifying including plans and measures for construction and post-construction stormwater management programs that are aimed at erosion and sediment controls, runoff water quality monitoring, waste disposal measures, post-construction sediment and erosion control measures and maintenance responsibilities, non-stormwater management controls, reducing non-point source pollution, including sediments.

Although the potential for erosion would be limited, exposure of soil to wind and water during construction would still occur. Impacts associated with erosion and loss of topsoil would be potentially significant, and the following Mitigation Measure would be required to reduce impacts from erosion during construction:

- MM 4.2-2(a).** (i) Per LRDP policy 30251.11, contours of finished surfaces on the North and West Campuses are to be blended to achieve a consistent grade and natural appearance. Borders of cut slopes and fills are to be rounded off to minimum radius of five feet so as to blend with the natural terrain.

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(ii) This shall be applicable to development and structures on the North and West Campuses.

MM 4.2-2(b). Per LRDP policy 30253.12, surface and sub-surface drainage pipes shall be designed to minimize erosion and instability of the bluff face and only where no other less damaging drainage system is feasible. Drainage devices extending over the bluff face shall not be permitted if the site can feasibly be drained landward of the bluff face.

MM 4.2-2(c). Per LRDP policy 30253.13, vegetation within 50 feet of the bluff top shall be maintained or replanted with drought resistant species should grading be required to establish proper drainage landward of the bluff.

MM 4.2-2(d). Per LRDP policy 30231.1, to protect identified campus wetlands, environmentally sensitive habitat areas, and coastal waters from sediment transfer or contamination from urban runoff during construction, the following grading and erosion control practices shall be followed:

- a) North and West Campuses construction periods shall be scheduled during the dry months of the year (May through October) whenever possible;
- b) If grading occurs during the rainy season (November through April), sediment traps, barriers, covers, or other methods shall be used to reduce erosion and sedimentation.
- c) A site-specific erosion control and landscape plan shall be prepared for all new construction.
- d) ~~Whenever practical, land~~ on the North and West Campuses is to be developed in increments of workable size ~~which that~~ can be completed during a single construction season: erosion and sediment control measures are to be coordinated with the sequence of grading.
- e) Excavated materials shall not be deposited or stored where the material can be washed away by high water or storm runoff.
- f) Grading operations on campus shall be conducted so to prevent damaging effects of sediment production and dust on the site and on adjoining properties.
- g) When vegetation must be removed on campus, the method shall be one that will minimize the erosive effects from the removal.
- h) Exposure of soil to erosion by removing vegetation shall be limited to the area required for construction operations. The construction and staging area should be fenced to define Project boundaries.
- i) Removal of existing vegetation on campus is to be minimized whenever possible.
- j) Temporary mulching or other suitable stabilization measures shall be used to protect exposed areas during construction or other land disturbance activities on campus.
- k) Topsoil removed from the surface in preparation for grading and construction on-campus is to be stored on or near the site and protected from erosion while grading operations are

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underway, provided that such storage may not be located where it would cause suffocation of root systems of trees intended to be preserved. After completion of such grading, topsoil is to be restored to exposed cut and fill embankments of building pads so as to provide a suitable base for seeding and planting.

- l) Slopes, both cut and fill on campus, shall not be steeper than 2:1 unless a geological and engineering analysis indicates that steeper slopes are safe and erosion control measures are specified.
- m) Slopes on campus shall not be constructed so as to endanger or disturb adjoining property.
- n) Sediment basins, sediment traps, or similar sediment control measures shall be installed before clearing and grading operations begin.
- o) Neither wet concrete, nor slurries thereof, shall be permitted to enter any campus wetlands.

MM 4.2-2(e). Prior to the start of construction for any site restoration activities, a restoration plan shall be prepared that identifies construction and post-construction erosion control measures to minimize exposure of soils to wind and water erosion and deposition of sediment in adjacent areas and drainage courses.

During construction, erosion potential would be minimized by implementing mitigation measures related to minimization of erosion, as well as incorporating all recommendations regarding erosion potential outlined in geotechnical and soil analyses prepared for residential developments under MM 4.2-1(b). Erosional effects would further be reduced through preparation and adherence to a SWPPP as described above. In addition, implementation of MMs 4.2-2(a) through 4.2-2(e) during development of the proposed project would reduce effects from erosion, and this impact would be reduced to a *less-than-significant* level.

Impact 4.2-3. Construction in areas underlain by soils of varying stability could subject people and structures to hazards associated with landsliding, lateral spreading, subsidence, liquefaction, collapse, or differential settlement. With implementation of the identified Mitigation Measure, this impact would be reduced to a *less-than-significant* level.

Amendment of the LRDP to permit residential development on the North Campus, coastal access improvements, and open space management activities, including habitat restoration, could subject people and structures to hazards associated with landsliding, lateral spreading, subsidence, liquefaction, collapse, or differential settlement.

Development of faculty housing would occur on approximately 27 acres of land on the North Parcel. Development of the Sierra Madre Family Student Housing complex would result in grading of approximately 13 acres of land (10 acres on the Storke-Whittier Parcel and 3 acres of existing lawn area adjacent to the West Campus Family Student Housing complex). Coastal access improvements would include improvement of approximately 8.175 miles of existing trails, improvement of coastal access (e.g., boardwalks or stairways) at three locations, provision of a new coastal access stairway, development of public parking at up to four locations, and

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Section 4.2 replacement of the portable restroom at Coal Oil Point. Construction of residential development and coastal access improvements would occur in areas of variable soil characteristics.

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The soils underlying the North Parcel and the Storke-Whittier Parcel are primarily artificial fills (see Figure 4.2-6, Soils Map), and soil characteristics could affect the structural integrity of proposed development. Although native soils on the North Parcel do not have liquefaction potential, the unconsolidated artificial fill could be considered prone to settlement and liquefaction. In addition, soils on the Storke-Whittier Parcel are of a soft, saturated nature (estuarine deposits), and present the potential for settlement and liquefaction. Erosion and mass movement (landslide) may occur on the moderate slopes on the southwest side of the North Parcel property, but this would not be a concern on the Storke-Whittier Parcel.

The proposed project calls for open space improvements as part of the overall project plan, and these improvements—including trail improvements, parking lots, and restrooms—could be built on cut and fill soils, as well as a variety of native soils, which present varying potential for settlement and liquefaction, with particular concern for these hazards in the eastern, low-lying portions of the South Parcel. Erosion and mass movement are occurring on the moderate to steep slopes on berms bisecting the South Parcel. Improvements under the Open Space Plan would not result in substantial construction. Risk of landslide or other hazards of geological instability could be minimized by implementation of mitigation measures detailed above in Impact 4.2-1 and 4.2-2. However, improvements that are implemented would be exposed to site-specific soil constraints.

Most of the proposed improvements involve pedestrian, bicycle, and equestrian trails and viewpoint seating; a restroom and a parking area are also proposed. By utilizing the Open Space Plan management actions, including setbacks for trails on bluffs, risk of hazards of geological instability due to trail construction would be minimized, and construction of the proposed restroom and parking area would be accomplished in a manner that minimizes these hazards.

The proposed project will, whenever possible, retain and incorporate, to the extent possible, the existing topography, vegetation, and scenic features of the West Campus (consistent with Per LRDP policy 30251.8). This would reduce potential hazards associated with landsliding, lateral spreading, subsidence, liquefaction, collapse, or differential settlement by reducing project-related erosion potential. Also, consistent with LRDP policy 30240(a).10, south-facing ocean bluffs on the Main and West Campuses will remain in their present state to reduce potential soil instability hazards of these areas.

The project would be required to implement MM 4.2-1(a) through 4.2-1(d), as discussed under impact 4.2-1. These mitigation measures would require the project to comply with University Policy on Seismic Safety and prepare a site-specific geotechnical study, which would address hazards of geological instability due to proposed development. With the consideration that engineering controls and corrective grading would be performed for the proposed project, the potential for effects of soil instability within the project site is considered low. Structural foundation engineering for the project would follow the recommendations of the geotechnical

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and soils analyses to be completed per MM 4.2-1(b). While project development as proposed could potentially result in exposure of structures or people to hazards of geological instability, implementation of the above-identified Mitigation Measures, as well as compliance with applicable building codes, during development of the proposed project would reduce this impact to a *less-than-significant* level.

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Impact 4.2-4. Implementation of the proposed project could result in construction of facilities on expansive soils, creating substantial risk to people and structures. With implementation of the identified Mitigation Measure, this impact would be reduced to a *less-than-significant* level.

Amendment of the LRDP to permit residential development on the North Campus and coastal access improvements could occur in areas with expansive soils, creating substantial risk to people and structures.

A soil's potential to shrink and swell depends on the amount and types of clay in the soil. The higher the clay content, the more the soil will swell when wet and shrink when dry. Expansive soils can cause structural damage to foundations and roads without proper structural engineering and are generally less suitable or desirable for development than nonexpansive soils because of the necessity for detailed geologic investigations and costlier grading applications. As discussed previously in Section 4.2.1.11, the soils underlying the project sites are not considered expansion prone (low shrink-swell potential). Appropriate engineering design to address the issue of expansive soils would be addressed through MM 4.2-1(b), discussed above. Therefore, risk of hazards associated with expansive soils is considered slight for the residential aspects of the proposed project.

The proposed project calls for open space improvements as part of the overall project plan, and these improvements would be constructed on cut and fill soils, as well as a variety of native soils, some of which have high shrink-swell potential, in particular Diablo clay soils. However, to date there are no recorded instances of hazards associated with expansive soils endangering existing recreational uses of the project area.

Most of the proposed improvements involve pedestrian, bicycle, and equestrian trails and viewpoint seating; a restroom and a parking area are also proposed. By utilizing the Open Space Plan design principles, including flexibly bound decomposed granite for trail development, risk of hazards associated with expansive soils in the Open Space Plan area would be minimized, and in accordance with the Open Space Plan management actions, siting and construction of the proposed restroom and parking area could be accomplished in a manner which minimizes these hazards.

While project development as proposed could potentially result in exposure of structures or people to risks associated with expansive soils, with implementation of and MM 4.2-1(b), this impacts due to expansive soils would be reduced to a less-than-significant level.

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Section 4.2 4.2.5 Cumulative Impacts

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The geographic context for the analysis of cumulative geology and soils impacts is the County of Santa Barbara, including all cumulative growth therein, as represented by full implementation of the County of Santa Barbara General Plan, the City of Santa Barbara General Plan, the City of Goleta General Plan, the UCSB Long Range Development Plan, and all approved or potential projects identified in Table 4.1-1. Worth noting, geologic impacts are generally site-specific. Cumulative development does not combine such that geologic impacts are greater or different. Each development site has unique geologic considerations that must be considered on a site-specific basis such that appropriate site development and construction standards are imposed.

The proposed project would increase the number of people and structures that could be exposed to potential effects related to seismic hazards such as surface rupture, groundshaking, ground failure, or landslides. Development of the proposed project also would increase the number of structures that could be subject to the effects of seismic hazards or other soil constraints that could affect structural integrity, roadways, or underground utilities. Potentially adverse environmental effects associated with seismic hazards, as well as those associated with topographic alteration and erosion, are usually site-specific and would generally not combine with similar effects that could occur with other projects throughout the Santa Barbara region. Compliance with the University Policy on Seismic Safety and adherence to the recommendations of site-specific geotechnical studies would ensure that the site-specific impacts, and the resulting cumulative impacts, are reduced to less-than-significant levels. In addition, all projects must comply with federal, state, and local regulations, such as the CBC, Alquist-Priolo Earthquake Fault Zoning Act, Seismic Hazards Mapping Act, and the County of Santa Barbara's Grading and Building Codes, that have been promulgated to avoid or reduce impacts to people or property resulting from seismic hazards. The contribution of the proposed project to impacts associated with exposing people and property to groundshaking effects would not be considered cumulatively considerable and a less-than-significant impact would result.

Cumulative development in the Santa Barbara area, including the proposed project site, would involve grading activities that would remove surface vegetation, alter topography, and potentially expose soils to greater erosion potential. The South Coast Hydrologic Unit, which generally includes that area west of the Santa Ynez Mountains, from Carpinteria to Arguello, and includes the Devereux Creek Watershed, forms the geographic context of cumulative erosion and topsoil impacts.

The magnitude of this impact would be greatest during construction, particularly if large-scale development occurs simultaneously within hydrologic unit, which ultimately drains to the Pacific Ocean, and/or within each watershed. Development throughout Santa Barbara is subject to state and local runoff and erosion prevention requirements, including the applicable provisions of the State General Construction Activity Permit BMPs as outlined in a Stormwater Pollution Prevention Plan, and Phases I and II of NPDES, as well as implementation of fugitive dust control measures of SCAQMD Rule 403. These measures are implemented as conditions of approval of project development (or mitigation measures) and are subject to monitoring and

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enforcement by the agencies and/or special districts with discretionary approval authority for each project. As a result, it is anticipated that cumulative impacts on the South Coast Hydrologic Unit due to runoff and erosion from cumulative development activities would be less than significant. The project's contribution would not be cumulatively considerable, as it would similarly comply with all of the applicable requirements, and a less-than-significant impact would result. Moreover, as undeveloped land is converted to urban uses, exposed soil would be covered with impervious surfaces, which would reduce the erosion potential over the long-term.

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Cumulative development in the Santa Barbara area, particularly in areas where Prime Farmland, Unique Farmland, or Farmland of Statewide Importance would be converted to urban uses, would result in the loss of topsoil, which would be considered a significant cumulative impact due to the extent of the conversion of agricultural lands to urban uses. However, because there are no such designated farmlands within the proposed project site, the contribution to the cumulative loss of topsoil would not be cumulatively considerable, and a less-than-significant impact would result.

As with seismic hazard impacts, the analysis of impacts on development from unstable soils, such as areas subject to landslides, lateral spreading, subsidence, liquefaction, collapse, or expansiveness, is generally site specific. All development in the County and City of Santa Barbara is required to undergo an analysis of geological and soil conditions applicable to the development site in question, and restrictions would be placed on development in the event that geological or soil conditions pose a risk to safety. Further, as discussed in the cumulative analysis for seismic hazards, compliance with the University Policy on Seismic Safety and adherence to the recommendations of site-specific geotechnical studies would ensure that site-specific impacts, and the resulting cumulative impacts, are reduced to less-than-significant levels. In addition, all projects must comply with federal, state, and local regulations, such as the CBC, Alquist-Priolo Earthquake Fault Zoning Act, Seismic Hazards Mapping Act, and the County of Santa Barbara's Grading and Building Codes, that have been promulgated to avoid or reduce impacts to people or property resulting from geologic or seismic hazards. The contribution of the proposed project to impacts associated with exposing people and property to unstable soils would not be considered cumulatively considerable and a less-than-significant impact would result.

4.2.6 References

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