

## 3.7 GEOLOGIC HAZARDS

This section describes the existing geologic conditions in the Draft IVMP project area, assesses the potential geologic hazards that could affect future development, and recommends mitigation measures to reduce potential project impacts. The majority of the information contained in this section is based on previous reports.

### 3.7.1 ENVIRONMENTAL SETTING

#### Location and Topography

The project area is located on the southern flank of the Santa Ynez Mountains, in the western portion of the Transverse Ranges Geomorphic and Structural Province. The area lies to the south of the Goleta Valley, which is a shallow, east-west trending valley between the Santa Ynez mountains and a low coastal plateau. The project area is on a gently sloping marine terrace that has been uplifted by the More Mesa fault system. The marine terrace that forms the plateau is approximately 40-80 feet above sea level. The coastal plain is composed of uplifted and dissected marine terraces, hills, and valleys, some of which form estuaries and lagoons (Dibblee, 1966). 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 (past 1.8 million years) period due to glacial and interglacial events superimposed upon a rising coastline have resulted in the formation of a series of uplifted marine terraces in Santa Barbara County and elsewhere in coastal California. The project area is bounded on the south by eroding sea cliffs located along the coast at Isla Vista Beach.

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 known as the Devereux Slough to the west of the project area.

There are few defined natural drainage courses in the project area. Almost all runoff in the project area is conveyed to the Pacific Ocean through urban infrastructure such as street gutters and storm drains. 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 locations 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 actions. Clearing of land for grazing and agriculture in the 1800s through the early 20th century resulted in erosion and gullying 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 in many areas occurred. Grading for roadways, beach access, and oil development activities all resulted in a highly altered environment.

### **Geologic Structure**

Isla Vista is located on an elevated marine terrace comprised of a block of Tertiary and Quaternary sediments uplifted along the active More Ranch Fault. The trend of this fault and others identified in the vicinity of the project area are illustrated on Figure 3.7-1. The “Isla Vista block” has been undergoing uplift for tens of thousands of years as a result of repeated earthquake activity on this fault. This uplifted block is composed of relatively soft sedimentary rock.

### **Stratigraphy**

A thin veneer of Quaternary Terrace (Qt) deposits underlies virtually all of the planning area. This geologically young unit, also referred to Older Alluvium is approximately 15 to 20 feet thick and composed of silt, sand and gravel deposited by stream or wind action (Dibblee, 1987). The uppermost ten feet of this unit is commonly composed almost entirely of wind-deposited sand. A layer of mollusk shells is commonly present at the base of the terrace deposits. The geologic units exposed on the sea cliff are illustrated in Figure 3.7-2.

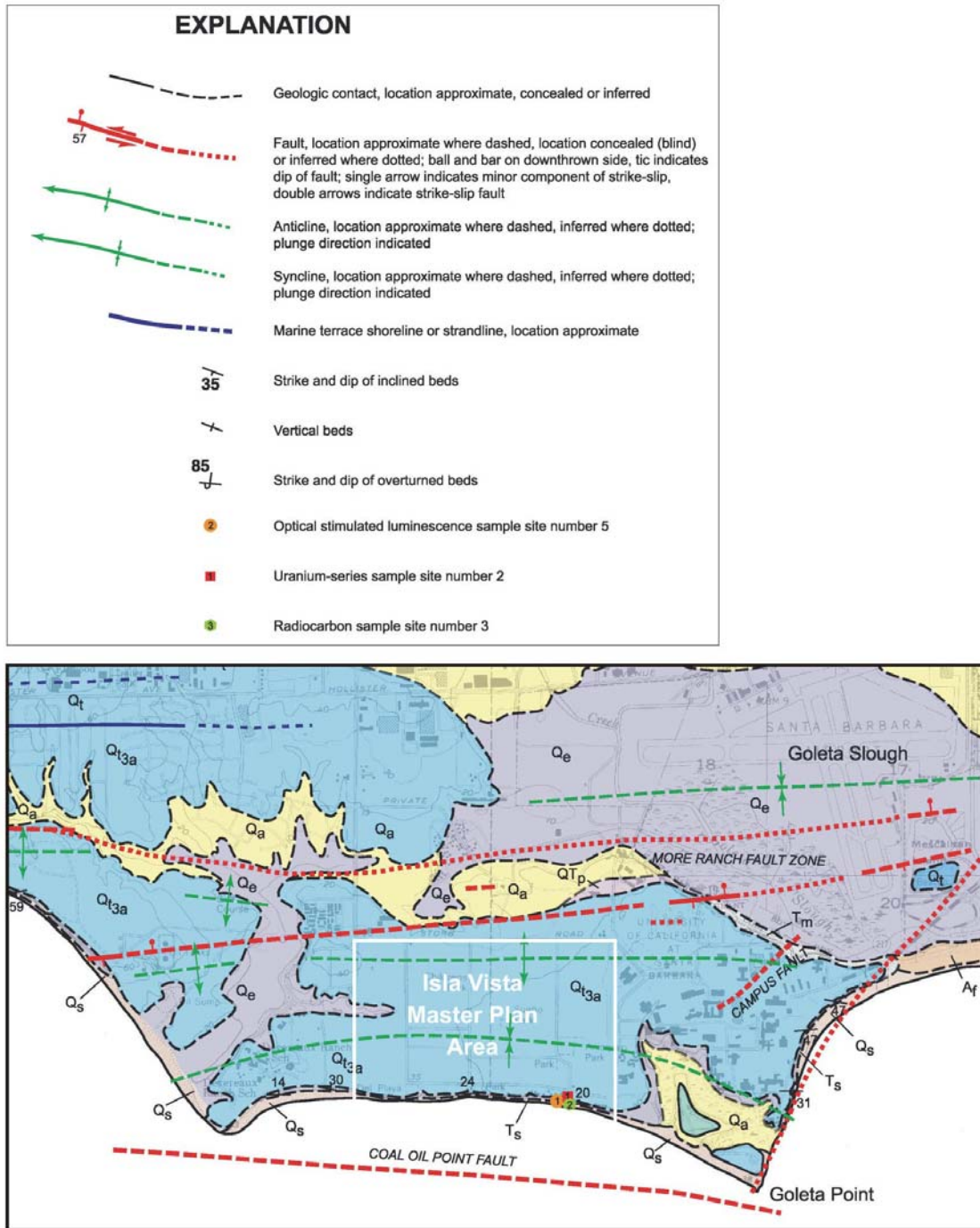
The terrace deposits are non-uniform and overlie the folded bedrock of the Miocene Monterey Formation (Tm) and the Pliocene Sisquoc Formation (Ts). The Sisquoc Formation is comprised of dark gray-green, generally massive, soft diatomaceous mudstone. This unit is more than 1,000 feet thick and is exposed on the lower half of the sea cliff south of Del Playa Drive along Isla Vista Beach.

### **Soils**

According to the Soil Survey of Santa Barbara County (Soils Conservation Service, 1981), the soils in the entire planning area are designated Conception Fine Sandy Loam (CgA). This soil occurs on nearly level ground and is described as moderately well-drained sandy loam with some clay layers. In terms of urban development, this soil is considered of low strength and moderately expansive.

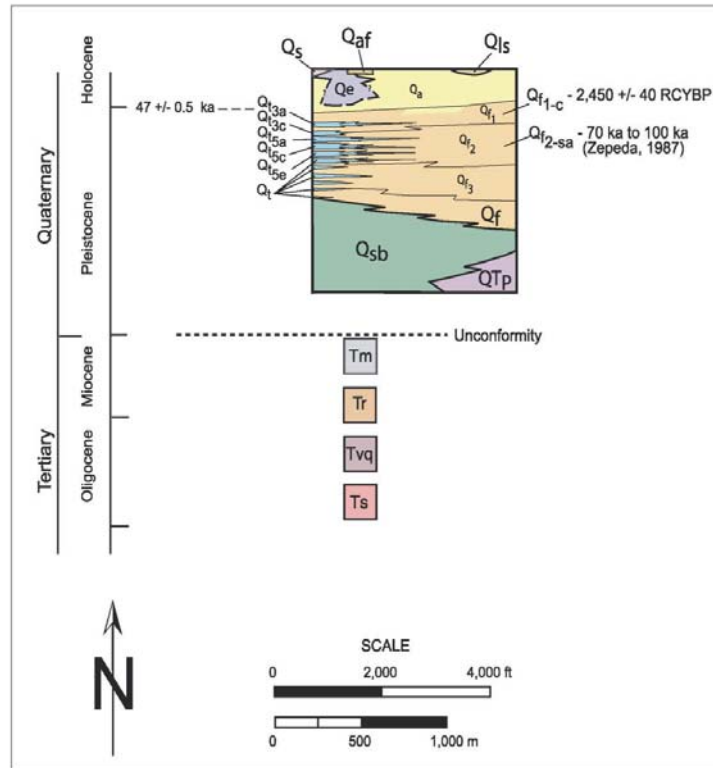
Erosion potential in most of the project area is minimal due to limited topographical variation and drainage courses. The 35 to 40-foot high coastal sea cliff located south of Del Playa Drive exists due to a combination of geologic factors. Rapid uplift of the “Isla Vista block” along the More Ranch Fault, and the presence of soft sedimentary rocks within this block have resulted in the formation of a near-vertical sea cliff that is rapidly eroding and retreating

Figure 3.7-1: Geologic Map of the Isla Vista Area



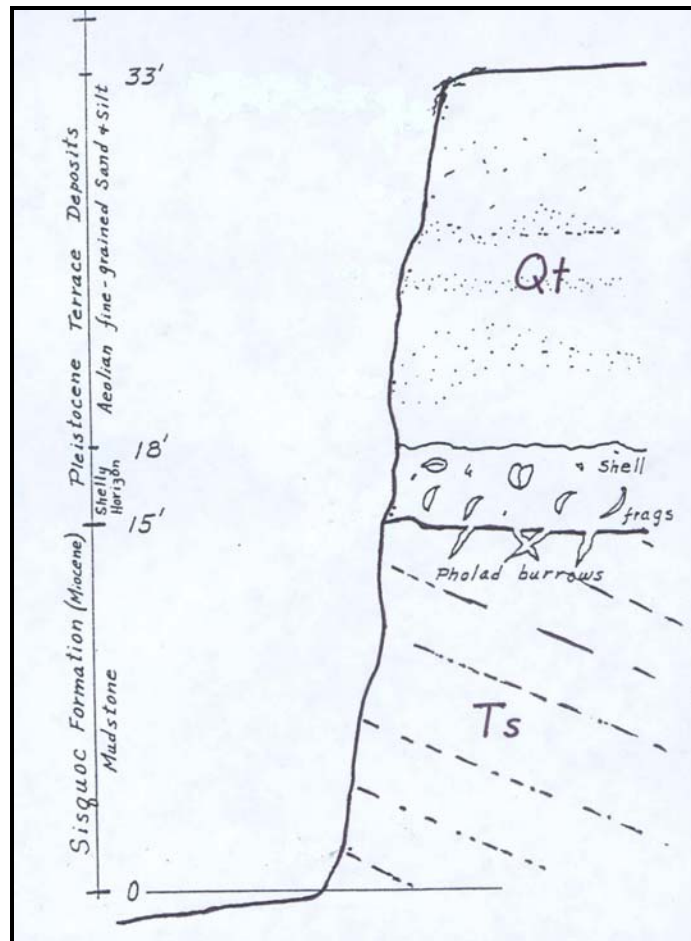
Source: Gurrola, 2003

**Figure 3.7-1(a): Geologic Map of the Isla Vista Area**



- Q<sub>af</sub>:** Artificial fill
- Q<sub>s</sub>:** Beach Sand - Unconsolidated marine and aeolian beach sand.
- Q<sub>st</sub>:** Stream Terrace Deposits - Commonly gravels, sands, and silts with minor clay interbeds.
- Q<sub>a</sub>:** Alluvium - Undifferentiated alluvial, stream channel, and floodplain deposits composed of silty sands to sandy gravels.
- Q<sub>e</sub>:** Estuarine Deposits - Commonly estuarine silts and clays with sand interbeds and lenses.
- Q<sub>ls</sub>:** Landslide Deposits - Landslide deposits includes reworked bedrock and soil units.
- Q<sub>l3a</sub>:** Marine Terrace Deposits - Second marine terrace associated with oxygen isotope substage 5a with Q<sub>l5a1</sub>, indicating youngest terrace associated with stage 5a; Q<sub>t</sub> denotes marine terrace deposit of unknown age; medial to nearshore marine sands with aeolian silts.
- Q<sub>f2</sub>:** Alluvial fan and fan terrace deposits - Third alluvial fan terrace indicating relative age with 1 indicating youngest terrace deposit based on stratigraphic position, relative amount of incision, and established chronology. Commonly dissected fan surfaces composed of grave to cobble to boulder conglomerates in a clayey silty sand matrix to sandy silts and silty clays.  
  
Quaternary alluvial fan terrace deposits that are not age-dated are correlated to regional aggradation events identified by Bull (1991):
- Q<sub>p</sub>:** Paleofluvial deposits - Undifferentiated paleostream channel and terrace deposits consisting of boulder to gravel conglomerates within a silty sand matrix.
- Q<sub>sb</sub>:** Santa Barbara Formation - Nearshore to distal marine sands with gravel to cobble conglomerates, fossiliferous limestone and silt interbeds; minor clay interbeds.
- QT<sub>p</sub>:** Pico Formation - Marine conglomerates, sandstones, and siltstone with minor fossils
- T<sub>m</sub>:** Monterey Formation - Undifferentiated diatomaceous, calcareous, and silicious shale with minor sandstone and volcanic ash deposits.
- T<sub>r</sub>:** Rincon Formation - Diatomaceous shale with thin beds of volcanic ash deposits with minor sandstone deposits.
- T<sub>vq</sub>:** Vaqueros Formation - Sandstone with siltstone and shale interbeds.
- T<sub>s</sub>:** Sespe Formation - Undifferentiated gravel conglomerate, sandstone, and shale depo

Figure 3.7-2: Typical Cross Section of Isla Vista Sea Cliff

**Legend**

Qt= Quaternary Terrace  
 Ts= Tertiary Sisquoc  
 Formation

Source: Santa Barbara County  
 Environmental Impact Report,  
 81-EIR-09

landward. Rates of sea cliff retreat were measured during preparation of the County environmental impact report 94-EIR-5 for 39 residential structures utilizing building records from County archives. In April 1994, the existing distance from each building to the cliff edge was compared with the distance to the cliff edge when the structure was built. The available records span a period of approximately 26 years. The rates of sea cliff retreat calculated for the various sites range from about 0.2 feet per year to as much as 1.2 feet per year. Table 3.7-1 lists the measured retreat rates for the developed bluff top properties studied in 94-EIR-5 along Del Playa Drive. Erosion potential along the bluff top and sea cliff areas is further discussed in Section 3.7.4, under Slope Stability/Sea Cliff retreat.

#### Slope Stability/Sea Cliff retreat

Due to the eroding coastal bluff in Isla Vista, some residential units along the south-side of Del Playa Drive have been relocated or removed since the mid-1990's.

**Table 3.7-1  
Sea Cliff Retreat Rates Along Del Playa Drive**

APN	Del Playa Drive address	Base Period analyzed (years)	Retreat Rate (feet/year)
075-192-002	6779	28.4	1.02
075-192-003	6777	25.1	0.98
<i>Escondido Pass</i>			
075-193-041	6767	27.8	0.27
075-193-040	6765	27.8	0.22
075-193-022a	6763	27	0.44
075-193-022b	6761	27	0.70
075-193-032	6757	26.2	1.15
075-193-020a	6747	27.1	0.66
075-193-020b	6745	27.1	0.76
075-193-042	6743	26.9	0.82
075-193-043	6741	26.9	0.86
075-193-030	6709	27	1.05
075-193-029	6707	27	1.13
075-193-038	6705	27	1.20
075-193-039	6703	27	0.81
<i>Camino Del Sur</i>			
075-202-001	6697	19.8	0.66
075-202-040	6693	26.2	0.55
075-202-005	6685	26.2	0.25
075-202-045	6681	26.8	0.19
075-202-008	6679	26.2	0.29
075-202-010	6665	29	0.86
075-202-035	6663	23.9	0.71
075-202-036a	6651w	25	0.83
075-202-036b	6651e	25	0.78
075-202-014	6649	26.6	0.60
075-202-015	6647	25.1	0.30
075-202-047a	6645w	24.8	0.40
075-202-047b	6645e	24.8	0.69
075-202-046	6625	25.7	0.27
075-202-048	6619	24.7	0.59
075-202-049	6613	24.7	0.18
075-202-052	6607	5.4	1.67
<i>Camino Pescadero</i>			
075-213-004	6587	26.9	0.13
075-213-009	6565	29.2	0.38
075-213-017	6561	26.1	0.44
<i>El Embarcadero</i>			
075-223-008	6531	25.8	0.35
075-223-021	6529	25.9	0.47
075-223-020	6525	26.8	0.28
075-223-022	6521	25.4	0.26

In August of 2004 the County noticed nine properties on Del Playa Drive to abate or vacate due to dangerous conditions (portions of buildings and foundations unsupported by soil and hanging over the coastal bluffs). As of late 2005 three of the buildings have been cut back to a safe distance and re-occupied, one building is in the process of being cut back to a safe distance, two buildings remain secured and un-occupied and three buildings remain occupied and are under order of the County to be continually monitored by the property owners engineering consultants as to their safety.

### 3.7.2 REGULATORY FRAMEWORK

#### **Federal Authorities and Administering Agencies**

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

#### **California State Authorities and Administering Agencies**

**California Coastal Act.** The California Coastal Act Planning and Management Policies include provisions requiring minimization of risks to life and property in areas of high geologic hazard, bluff stability and shoreline protection, minimization of geologic instability and erosion along bluffs and cliffs, and safe construction of fill.

**California Building Code.** The State of California provides a minimum standard for building design through the 2001 California Building Code (CBC). The 2001 CBC is based entirely on the 1997 Uniform Building Code (UBC), but has been modified for California conditions. The CBC regulates site demolition, excavation, grading activities, including drainage and erosion control, and construction methods to protect people and property from geologic hazards. It is generally adopted on a jurisdiction-by-jurisdiction basis, subject to further modification based on local conditions. Commercial and residential buildings are plan-checked by local building officials of California's 476 cities and 58 counties (not by state agencies).

**Alquist-Priolo Earthquake Fault Zoning Act.** The Alquist-Priolo Earthquake Fault Zoning Act of 1972 prohibits the construction of buildings used for human occupancy on active surface faults, which are faults which have ruptured the ground surface in the past 11,000 years (Holocene Time). It specifies, in part, that new habitable building structures maintain a minimum 50-foot setback from all known active faults. California Geological Survey (CGS) Special Publication 42 (updated 1999) describes Alquist-Priolo Earthquake Fault hazard zones in California. No portions of the project area are included within an Alquist-Priolo Earthquake Fault Zone designated by the State of California.

**Seismic Hazards Mapping Act.** Under CGS'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. CGS'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.

### **Local Ordinances and Administering Agencies**

**Santa Barbara County Local Coastal Plan (LCP).** The LCP contains the principal land use policies for development within the County's Coastal Zone. This program, pursuant to requirements of the California Coastal Act (Section 30108.5), contains the relevant portion of a local government's general plan, or local coastal element, which indicates the kinds, location, and intensity of land uses, the applicable resource protection and development policies and a listing of implementing actions. The County has incorporated numerous goals and policies into the Local Coastal Plan in order to ensure conformance with California Coastal Act policies. These policies are implemented through the Coastal Zoning Ordinance that require several design features to be considered, including:

- **35-148.c:** additional safety measures for utility lines in fault zones
- **35-67.1a:** 75-year bluff setback
- **35-75.3:** vegetation in bluff top development
- **35-75.4:** protection of coastal bluffs from drainage erosion
- **35-75.5:** prohibition of most development on the bluff face

**County of Santa Barbara.** Conformance with the County's Grading and Building Codes are considered generally satisfactory by the County to address geologic hazards. The County Seismic Safety and Safety Element recommends an adequate site-specific investigation be performed where the possibility of soil or geologic problems exist. The County Seismic Safety Element considers the North Branch of the More Ranch fault to be an active fault which has moved in the last 11,000 years. The 50-foot building setback is a policy, consistent with the Alquist-Priolo Earthquake Fault Zoning Act, for all active and potentially active faults in Santa Barbara County.

The County's Grading Ordinance No. 4477 (2002) 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.

The County's Building Code, Ordinance No. 4495; Chapter 10 – Building Regulations for Geologic Hazards (Sec. 10-11.2) has specific building regulations regarding structures, improvements and fencing on the Isla Vista Bluffs.



### 3.7.3 THRESHOLDS OF SIGNIFICANCE

The County Environmental Thresholds and Guidelines Manual includes Geologic Constraints Guidelines approved in August 1993 by the County. The purpose of these guidelines is to provide preliminary criteria for determining whether a particular activity could have a potentially significant impact on the environment as described in Section 15064 of the State CEQA Guidelines. Because geologic conditions are highly variable within the County, these guidelines are not fixed thresholds upon which a determination of significant impact would be made. They serve to point out when further study of site-specific conditions is required in order to assess geologic impacts. The significance level of project geologic impacts is made by P&D staff (in consultation with licensed geologists and engineers as necessary) upon review of project plans, proposed mitigation measures and site-specific geologic information.

Impacts are considered potentially significant if the proposed development activity, including all proposed mitigation measures, could result in substantially increased erosion, landslides, soil creep, mudslides and unstable slopes. In addition, impacts are considered significant when people or structures would be exposed to major geologic hazards upon implementation of the project.

Impacts related to geology have the potential to be significant if the proposed project involves any of the following characteristics:

1. The project site or any part of the project is located on land having substantial geologic constraints, as determined by P&D or Public Works. Areas constrained by geology include parcels located near active or potentially active faults and property underlain by rock types associated with compressible/collapsible soils or susceptible to landslides or severe erosion. "Special Problems" areas designated by the County Board of Supervisors have been established based on geologic constraints, flood hazards and other physical limitations to development.
2. The project results in potentially hazardous geologic conditions such as the construction of cut slopes exceeding a grade of 1.5 horizontal to 1 vertical.
3. The project proposes construction of a cut slope over 15 feet in height as measured from the lowest finished grade.
4. The project is located on slopes exceeding 20% grade.

Mitigation measures may reduce impacts to a less than significant level. These measures would include minor project redesign and engineering steps recommended by licensed geologists and engineers subsequent to detailed investigation of the site. Mitigation measures are "feasible" if they identify engineering methods or design changes that are known at the time of decision-making to be capable of implementation by commonly utilized practices and are not prohibited by ordinance or other regulation. Future technical studies may be included in a mitigation measure, but only to refine the design of engineering or design actions. Such future studies cannot be used to identify mitigation measures or to assess the feasibility of measures already proposed.

### 3.7.4 IMPACTS AND MITIGATION MEASURES

#### **Impact GEO-1: IVMP project build-out would potentially increase the risk from seismic hazards.**

No active or potentially active faults have been identified in the project area (Dibblee, 1987). The More Ranch fault, with associated branches, is located north of the project area. The Santa Barbara County Safety Element (1979) 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 the available geologic information, the future placement of new buildings across or adjacent to an active fault is not anticipated to occur as part of plan build-out. Thus, the fault rupture hazard in the planning area is *potentially considered very low and deemed less than significant*.

As with all of southern Santa Barbara County, strong shaking during earthquakes can be expected to occasionally affect the planning area. This seismically-active area has experienced numerous strong earthquakes over the past two centuries. These include events in 1812 (fault unknown; magnitude  $M_w > 7.1$ ), 1857 (San Andreas,  $M_w = 8.4$ ), 1925 (More Ranch or Mesa Fault,  $M_w = 6.3$ ), 1927 (Hosgri Fault,  $M_w = 7.3$ ) and 1978 (North Channel Fault,  $M_w = 5.9$ ). (The above information is based on studies by Topozada et al, 1981; Dolan and Rockwell, 2001; Sylvester, 2003; and Sylvester and Darrow, 1979).

Although severe shaking in the planning area could occur as a result of an earthquake on a fault located a substantial distance from the area, the maximum amount of shaking would likely occur on the nearest major active fault. The More Ranch Fault, identified as a major fault, is considered to be part of the Mission Ridge and Arroyo Parida faults identified to the east (Gurrola, 2001). Given a potential rupture length of 44 miles, the More Ranch fault system is capable of generating a maximum credible earthquake with a magnitude of 7.2. The maximum amount of ground shaking, measured as a ratio of ground acceleration to the acceleration due to gravity (g), is estimated to range from 0.60g (Mualchin, 1996) to 0.80g (Hoover, 1984).

**Mitigation Measure:** All development in the Master Plan area will continue to be subject to Seismic Zone 4 construction standards in the adopted Uniform Building Code for Santa Barbara County is sufficient toward addressing this impact.

**Residual Impact:** Seismic shaking hazards are considered potentially significant but are adequately mitigated by the Seismic Zone 4 construction standards incorporated into the adopted Uniform Building Code for Santa Barbara County. No other mitigation is required to address this hazard. Impacts are *considered less than significant (Class III)*.

#### **Impact GEO-2: IVMP project build-out would potentially increase the risk of liquefaction.**

Liquefaction is a geologic condition that occurs as a result of severe ground shaking during an earthquake. Water-saturated sandy soils may suffer a loss of soil strength during shaking that can cause severe damage to buildings and other man-made structures. Poorly consolidated

sand and a water table within 20 feet of the ground surface are generally required for liquefaction to occur.

Although the planning area is underlain by unconsolidated sandy sediments, liquefaction is not anticipated to be a substantial hazard in the areas subject to future development. This conclusion is based on the lack of a shallow water table and the limited thickness of the sandy sediments. The sandy terrace deposits are only about 15 to 20 feet thick and overlie dense claystone of the Pliocene Sisquoc Formation. Groundwater is only present as perched water that flows along the top of the claystone. Impacts related to liquefaction are *considered less than significant (Class III)*.

**Impact GEO-3: IVMP project build-out along Del Playa Drive would potentially increase the risk of slope instability and increase sea cliff retreat for existing bluff properties.**

The hazard to new development posed by the eroding sea cliff south of Del Playa Drive is addressed by County Coastal Land Use Plan (CLUP) policies which require new residential structures to be set back from the cliff edge a distance sufficient to allow the building to be safe from erosion for a period of 75 years. For existing and future bluff top development, recent additions to the County-adopted Uniform Building Code require safety fencing to be placed along the cliff edge. P&D also has a regular inspection program to identify hazardous conditions resulting from the ongoing sea cliff retreat that affects existing buildings. Hazardous conditions are abated through engineering measures, including demolition, as required by the County Building Official. The ongoing implementation of CLUP policies, building code standards and inspection procedures adequately address the hazards posed by the existence and ongoing retreat of the coastal sea cliff at Isla Vista. Impacts are *considered less than significant (Class III)*.

**Impact GEO-4: Additional development in the plan area could increase the risk from soils hazards.**

The generally sandy soils present within the planning area contain some proportion of expansive clays that could adversely affect new buildings. Sandy soils are also subject to collapse (rapid subsidence) when initially placed under load by the construction of a building. These potential hazards would be addressed as a routine part of the Building Permit process. For each proposed development, a soils investigation report prepared by a licensed geotechnical engineer is routinely required in order to identify the foundation design necessary to avoid such hazards. Impacts are considered *less than significant (Class III)*.

**Cumulative Impacts**

The pending and approved projects identified in Chapter 3, will result in cumulative impacts to geology and geologic resources. Together, these cumulative projects will ultimately generate 3,351,485 sf of commercial and industrial development and 3,313 new residential units throughout the Goleta Valley, UCSB and Isla Vista area. This will result in a cumulatively significant amount of development which has the potential to affect geologic hazards.

As indicated in the above discussion, the planning area is a nearly level area generally not subject to substantial geologic hazards. The continued implementation of existing policies and procedures are adequate to mitigate the limited potentially significant hazards that could affect future development in the project area. Impacts are considered *adverse, but less than significant (Class III)*

The Draft IVMP will contribute a significant amount of this cumulative growth to the area (1,447 housing units and 51,485 sf of commercial development). As a result, the cumulative geologic impacts are significant and unavoidable (Class I).