SECTION 3.5
GEOTECHNICAL/SOILS

3.5 GEOTECHNICAL/SOILS

3.5.1 INTRODUCTION

This section is based on a geotechnical impact report prepared for the proposed project by Southland Geotechnical Consultants (May 2007). The Geotechnical Report evaluated existing geotechnical conditions (*e.g.*, geologic hazards, soil engineering properties, and onsite pedologic characteristics) and identified potential geotechnical constraints to the proposed project. The technical report is presented in its entirety in **Appendix F** of this EIR.

3.5.2 METHODOLOGY

The methodology utilized to prepare the Geotechnical Report included the following:

- Review of geologic maps, literature and aerial photographs pertaining to the proposed project site and general vicinity;
- Field reconnaissance of the existing geologic and surficial soil conditions in the project areas; and
- Geotechnical analysis of the data obtained.

The Geotechnical Report is based on information presented in existing geologic/geotechnical literature, including previous geotechnical reports prepared for various projects at SDSU, and the consultant's experience on SDSU projects and properties with similar geotechnical conditions.

3.5.3 EXISTING GEOTECHNICAL CONDITIONS

3.5.3.1 General Geologic Setting

The proposed project area, the SDSU campus generally, and the City of San Diego, are located in the coastal section of the Peninsular Ranges geomorphic province. The northwesterly-trending mountain ranges of this province generally are underlain by basement rocks consisting of Jurassic metamorphic rocks intruded by Cretaceous igneous rocks of the southern California batholith. During the past 54 million years, the western, coastal flank of this mountainous area has experienced several episodes of marine inundation and subsequent regression. This ebb and flow resulted in deposition of a thick sequence of marine and nonmarine sediments (*e.g.*, claystones, siltstones, sandstones and conglomerates) on the basement rocks. Lower base levels, a result of post-Pleistocene sea-level lowering, allowed stream erosion to create the relatively steep, deeply-incised canyons present in the area. During formation of the canyons, streams deposited alluvial sediments in canyon bottoms and locally perched on slopes as stream terrace deposits.

3.5.3.2 Geologic/Soil Units

The geologic and soil units underlying the individual project component sites and nearby vicinity have been mapped and investigated by various geologists and geotechnical consultants. Detailed descriptions of the geologic/soils units encountered by these geologists and consultants are provided in various geologic/geotechnical documents for the campus area. These include site-specific geotechnical evaluations performed by GeoTek Insite, Inc., for the Alvarado Campus component of the proposed project. Relevant geotechnical information from these previous evaluations is included within this analysis.

A general overview of the area's geologic composition is contained in **Figure 3.5-1, Generalized Geologic Map**, taken from Kennedy and Peterson's "Geology of the La Mesa Quadrangle, San Diego County, California." Additionally, summary descriptions of the geologic/soil units, presented in order of increasing age, underlying the proposed project sites are set forth below.

3.5.3.2.1 Existing Fill Soils

Development of the SDSU campus has included placement of fill in various locations and has included the infilling of previously existing canyons in the campus area. Fill soils also were placed in the project area during grading of the I-8 freeway corridor and construction of the San Diego Trolley extension. Fill soils are reported to underlie the majority of the site of the proposed Alvarado Campus. The fill soils in the project component areas generally appear to be comprised primarily of locally-derived materials, ranging in composition from sandy clays to silty and clayey sands, commonly with abundant gravel/cobbles. Some fill areas may also include boulder-sized rock fragments, concrete/asphalt chunks, and debris.

3.5.3.2.2 Natural Topsoil

Natural topsoil is developed on and typically is gradational with the underlying geologic formations. Once developed, topsoil covers natural ground surfaces. Topsoil has been encountered underlying fill soils at various locations on the SDSU campus.

DOTTED LINES REPRESENT 10-FOOT CONTOURS
DATUM IS MEAN SEA LEVEL

1975

EXPLANATION

QUATERNARY — Holocene

Qsw / Qal + Qsw

Alluvium and Slopewash

Qsw, Slopewash; Qal & Qsw, Alluvium and Slopewash undifferentiated.

Qls

Landslide deposits

QUATERNARY — Pleistocene

Qt

Stream-terrace deposits

Ql

Lindavista Formation

TERTIARY — Pliocene

Tsd

San Diego Formation

TERTIARY — Eocene

Tp / Tmv / Tst

Poway Group

Tp, Pomerado Conglomerate; Tmv, Mission Valley Formation; Tst, Stadium Conglomerate. Conglomerate marked by circle pattern.

Tf

Friars Formation

Conglomerate marked by circle pattern.

CRETACEOUS

Kg

Granite rocks

Undifferentiated granitic rocks of the southern California batholith.

JURASSIC

Jsp

Santiago Peak Volcanics

SYMBOLS

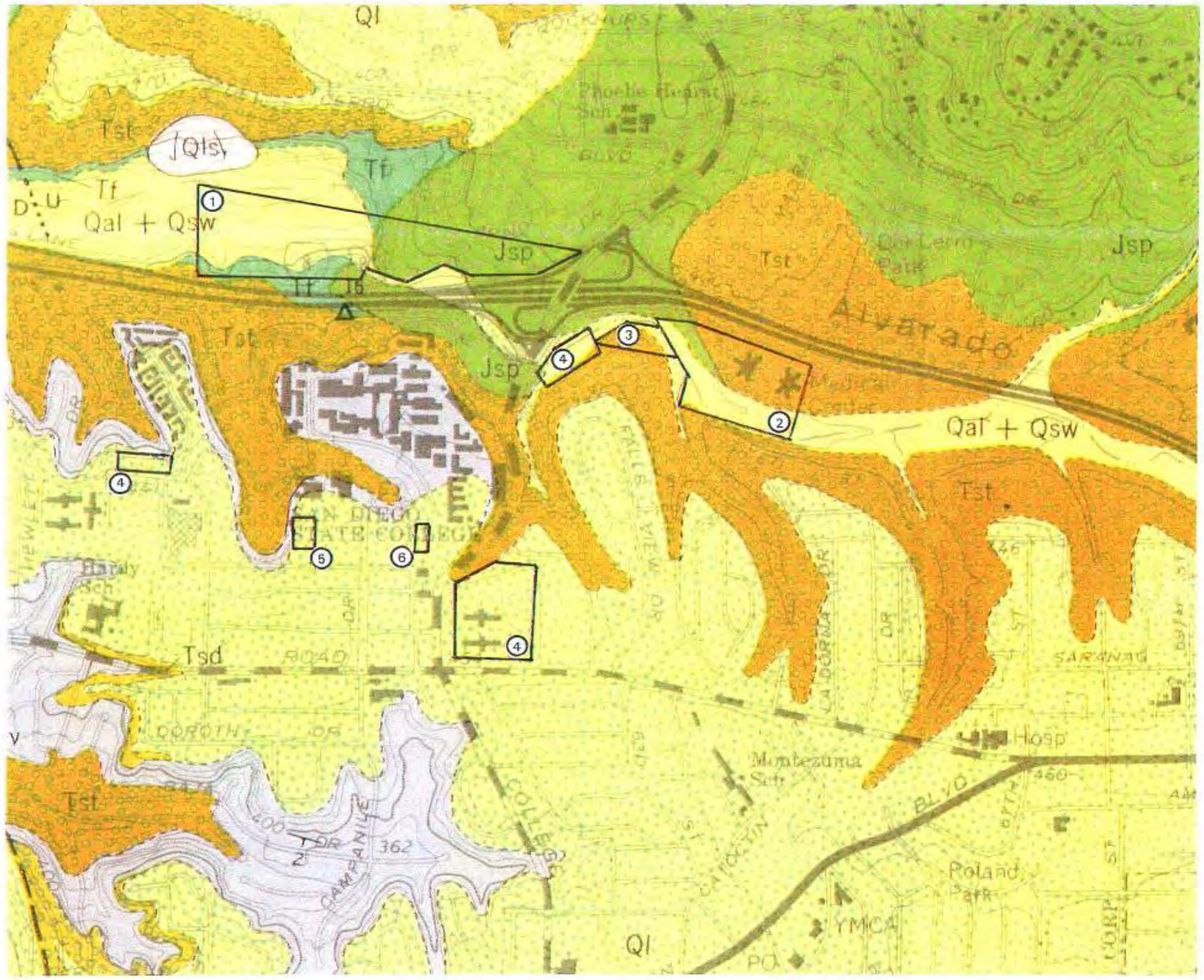
Contact

(dashed where approximately located; dotted where concealed)

Fault, showing dip

(dashed where approximately located; dotted where concealed; U, upthrown

NORTH



Approximated Locations of Project Components:

1. Adobe Falls
2. Alvarado Campus
3. Alvarado Hotel
4. Student Housing
5. Campus Conference Center
6. Aztec Center

This is excerpted from Kennedy and Peterson's map "Geology of the La Mesa Quadrangle, San Diego County, California" in CDMG Bulletin 200 (Reference 5)

1000 0 1000 2000 3000

SCALE in FEET

GENERALIZED GEOLOGIC MAP

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2007 Campus Master Plan Revision

Project No. 270C111

FIGURE 1

SGC

3.5.3.2.3 Alluvium/Slopewash

Alluvium is the accumulation of soils deposited chiefly by running water in the bottoms of canyons and their tributaries. Slopewash is a term applied to the accumulation of soil deposits from proximate geologic units on the face and along the base of a slope. Slopewash chiefly is deposited by the action of gravity and surface water flow. For the purposes of this study, alluvium and slopewash deposits are not differentiated, and have been identified within the Alvarado Creek drainage course.

3.5.3.2.4 Ancient Landslide Deposits

According to the American Geological Institute's Glossary of Geology, a "landslide" includes any "wide variety of mass-movement landforms and processes involving the downslope transport, under gravitational influence, of soil and rock material (*en masse*). Usually the displaced material moves over a relatively confined zone or surface of shear." As used locally, the term, landslide, typically implies deep-seated movement of a mass of soil/rock over a fairly discrete basal failure surface or surfaces.

An ancient landslide was identified offsite and northwest of the Adobe Falls Lower Village project area. The landslide appears to have occurred along a weak clay layer or bedding-plane shear within the Friars Formation. In addition, a slope failure is known to have occurred several years ago between Genoa Drive and Adobe Falls Road. Reconnaissance-level geologic observations of the proposed project component sites, other than Adobe Falls, do not indicate the on-site presence of ancient landslides or deep-seated slope instability.

3.5.3.2.5 Lindavista Formation

The Pleistocene-aged Lindavista Formation underlies the majority of the mesa-top portions of the SDSU campus and the general vicinity. The Lindavista Formation generally is known to consist of orange-brown gravel/cobble conglomerate with a clayey to silty sandstone matrix. Well-cemented zones locally occur within the Lindavista Formation.

3.5.3.2.6 Mission Valley Formation

In the project area west of College Avenue, the Eocene-aged Mission Valley Formation is mapped as underlying the Lindavista Formation. The Mission Valley Formation generally is known to consist of gray silty fine sandstone and conglomerate.

3.5.3.2.7 Stadium Conglomerate

The Eocene-aged Stadium Conglomerate is mapped as underlying the Mission Valley and Lindavista Formations west of College Avenue and underlies the Lindavista Formation east of College Avenue. The Stadium Conglomerate generally is known to consist of yellow-brown to orange-brown gravel/cobble conglomerate with a silty to clayey sandstone matrix. Occasional boulders and sandstone interbeds also may exist within this geologic unit. The Stadium Conglomerate locally is well cemented.

3.5.3.2.8 Friars Formation

The Eocene-aged Friars Formation is mapped in the northern portion of the existing SDSU campus and in the area north of the Interstate 8 ("I-8") freeway. The Friars Formation generally is known to consist of lagoonal and alluvial sediments that consist, more specifically, of claystone, thinly laminated siltstone/claystone, sandstone and conglomerate. Landslides have occurred along weak clay layers and bedding-plane shears within the Friars Formation.

3.5.3.2.9 Santiago Peak Volcanics

The Jurassic-aged Santiago Peak Volcanics are the hard "bedrock" unit underlying the sedimentary rocks in the northern portions of the SDSU campus and project area. The Santiago Peak Volcanics generally are known to be comprised of hard, mildly metamorphosed volcanic, volcaniclastic, and sedimentary rocks of variable composition and color.

3.5.3.3 Geologic Structure

The sedimentary formations exposed on the SDSU campus area and on adjacent areas generally are flat-lying or may very gently dip with respect to their sedimentary bedding. No major folding of the on-site geologic units has been reported previously, and major folding is not anticipated in the general SDSU vicinity.

Bedding-plane shears occur within the Friars Formation. The bedding-plane shears generally are parallel to the bedding and typically consist of thin seams of weak, soft remolded clay. As mentioned above, landslides may occur on weak clay layers or bedding-plane shears within the Friars Formation.

Generally, the sedimentary geologic units were deposited unconformably on an irregular, erosional surface developed on the underlying hard metamorphic rock of the Santiago Peak Volcanics.

3.5.3.4 Faulting

A review of geologic maps and literature pertaining to the general study area indicates that there are no known major or "active" faults on or in the immediate vicinity of the proposed project areas. An "active" fault is defined by the California Geological Survey ("CGS") as one which has "had surface displacement within Holocene time (about the last 11,000 years)." Additionally, the project area is not located within a State-delineated "Alquist-Priolo Earthquake Fault Zone."

Evidence for active faulting at the SDSU campus was not identified or reported during the previous geologic/geotechnical studies performed on and near the project areas. The nearest known active faults are: (i) the Rose Canyon fault, located approximately 6 miles west of the SDSU campus; (ii) the Coronado Bank fault, located offshore approximately 20 miles west of the campus; and (iii) the Elsinore fault, located approximately 35 miles northeast of the campus. The San Andreas fault is located approximately 80 miles east-northeast of SDSU. **Figure 3.5-2, Regional Fault Map**, depicts the regional faults in southern California and identified herein.

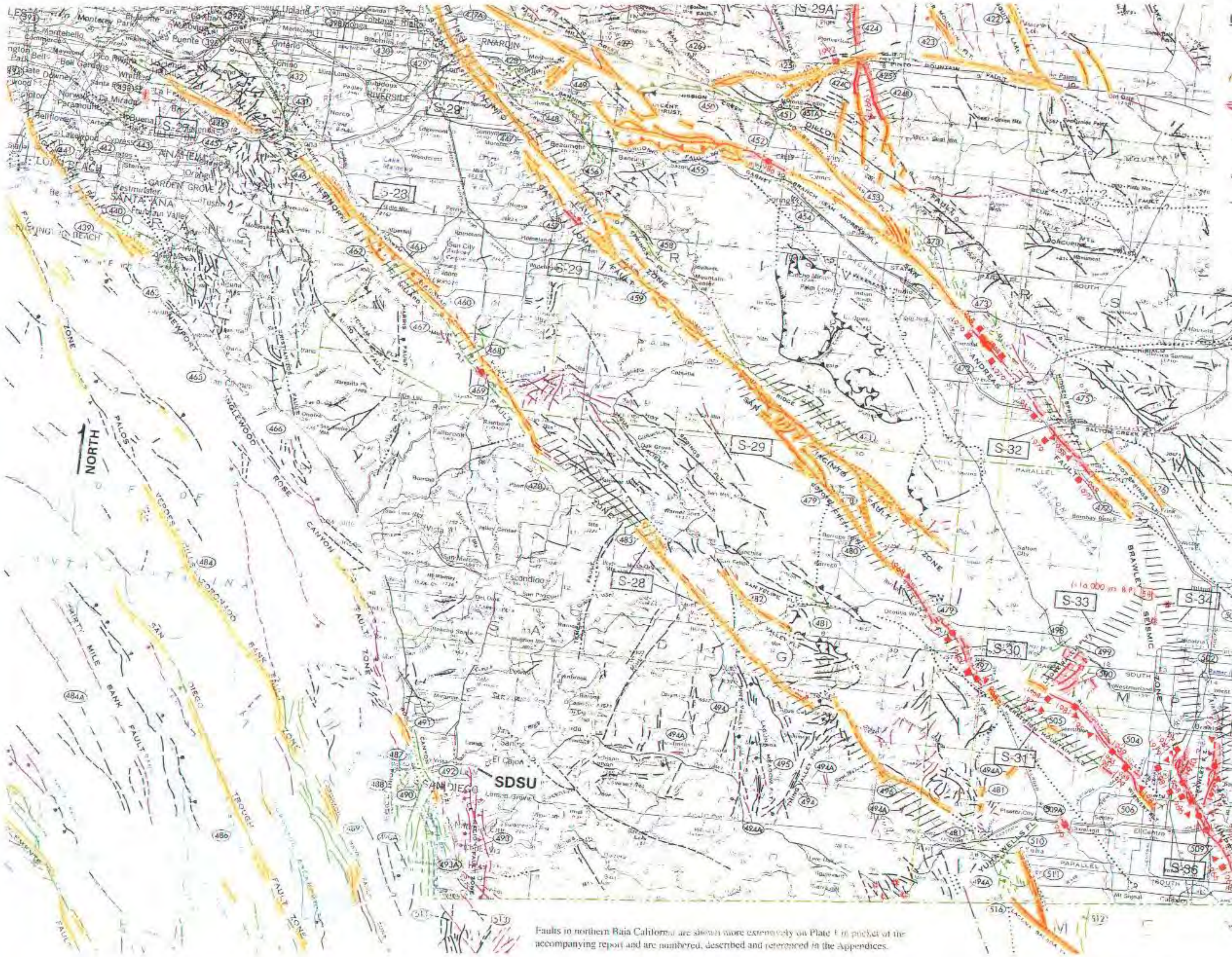
Based on a review of the City of San Diego's Seismic Safety Study, the SDSU campus is located approximately 0.3 mile east-northeasterly of a mapped trace of the La Nacion fault. The La Nacion fault generally is not known to displace Quaternary deposits; therefore, the La Nacion fault currently is interpreted by most geologists not to be an "active" fault based on CGS criteria. Surficial evidence for on-site active faulting was not observed during site visits conducted in connection with the preparation of this analysis.

3.5.3.5 Groundwater

Groundwater seepage was reported in several geotechnical reports for projects on and near this study's project sites. The groundwater encountered appears to have settled at the fill-natural ground contact or in permeable sandstone layers in the on-site geologic formations. Groundwater also occurs within alluvium deposited within on-site drainage courses, including Alvarado Creek. The likely source of groundwater is infiltration of landscape irrigation waters and precipitation.

3.5.4 THRESHOLDS OF SIGNIFICANCE

Appendix G of the CEQA Guidelines provides that geotechnical constraints may be potentially significant if the proposed project would "expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:"



LEGEND

Faults...

with historic (last 200 years) displacement

with Holocene (Recent) displacement without historic record

with Late Quaternary fault displacement (during past 700,000 years)

Quaternary fault (age undifferentiated)

Pre-Quaternary fault (older than 1.6 million years or without recognized Quaternary displacement)

Fault segment associated with significant linear trend of accurately located earthquake epicenters

10 0 10

SCALE (miles)

Modified from Fault Activity Map of California and Adjacent Areas (Reference 5)

REGIONAL FAULT MAP

San Diego State University
2007 Campus Master Plan Revision

Project No. 270C111

FIGURE 2

SGC

(a) 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);

(b) Strong seismic ground shaking;

(c) Seismic-related ground failure, including liquefaction; or

(d) Landslides.

Geotechnical constraints also could be considered potentially significant if the project would:

(a) Result in substantial soil erosion or the loss of topsoil;

(b) 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;

(c) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1997), creating substantial risks to life or property;

(d) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water;

(e) Place within a 100-year flood hazard area structures which would impede or redirect flood flows;

(f) Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam; or

(g) Result in inundation by seiche, tsunami, or mudflow.

3.5.5 POTENTIAL GEOTECHNICAL IMPACTS

The following is a summary of the potential geotechnical impacts evaluated for the proposed project component areas. A matrix table summarizing the result of the analysis, **Table 3.5-1,**

Generalized Summary Of Geologic Units, Geologic Resources And Geotechnical Constraints, is also provided. This information is also depicted in **Figure 3.5-3, Potential Geotechnical Constraints Map**.

3.5.5.1 Landslides/Slope Instability

Based on the analysis conducted, there are no known or suspected landslides in the proposed project areas. However, an ancient, but *not* active landslide (to be distinguished), does exist offsite northwest of the Adobe Falls Lower Village site.

With respect to slope instability, factors such as the presence of weak clay beds, bedding-plane shears, and adversely-oriented joints and/or bedding may contribute to such instability. Slope failures potentially could damage project improvements. Further, grading of these slope areas during project implementation also has the potential to aggravate deep-seated instability (if present).

Surficial sloughing of slope faces results when there is rapid downhill movement of saturated near-surface soils off of moderate to steep slopes. Accumulated debris may fill drainage canyons or damage improvements. Additionally, improvements at the top of a slope may become undermined by surficial sloughing.

Due to existing on-site conditions, development of the following proposed project components may result in potentially significant impacts relating to slope instability:

> *Adobe Falls Faculty/Staff Housing:* This site includes hillside terrain that is subject to instability. Also, clayey soils may exist within the geologic units at the site.
>
> *Alvarado Campus*: A northerly-facing canyon slope borders the southern edge of the site. However, geotechnical evaluations at the site did not reveal evidence of ancient landsliding or slope instability.
>
> *Alvarado Hotel*: On the north side of the site, slopes exist along the Alvarado Creek channel.

Table 3.5-1
Generalized Summary Of Geologic Units, Geologic Resources And Geotechnical Constraints

GEOLOGIC UNITS (see Figure 1)	Adobe Falls	Alvarado Campus	Student Union	Student Housing	Alvarado Hotel	Campus Conference Center
	fill soils alluvium/slopewash Stadium Conglomerate Friars Formation Santiago Peak Volcanics	fill soils alluvium/slopewash Stadium Conglomerate Santiago Peak Volcanics	fill soils, Lindavista Formation	fill soils Lindavista Formation Mission Valley Formation Stadium Conglomerate Santiago Peak Volcanics	fill soils alluvium/slopewash Stadium Conglomerate Santiago Peak Volcanics	fill soils Mission Valley Formation Stadium Conglomerate
GEOLOGIC/SOIL RESOURCES						
USDA Soil Survey	Rm, FxE, Ohe	TuB, FxE, DcF	OkC	OkC, RhC, FxE	FxE	OkC
CDMG Mineral Resource Zone	MRZ-3	MRZ-2	MRZ-2	MRZ-2/3	MRZ-2/3	MRZ-2
POTENTIAL GEOTECHNICAL CONSTRAINTS						
Landslides/ Slope Instability	X	X	---	X	X	---
Erosion	X	X	X	X	X	X
Unconsolidated Soils	X	X	X	X	X	X
Expansive Soils	X	X	X	X	X	X
Hard Rock/ Excavatability	X	X	X	X	X	X
Groundwater/ Seepage	X	X	X	X	X	X
Flood Inundation	X	X	---	X	X	---
Liquefaction	---	---	---	---	---	---
Fault Rupture	---	---	---	---	---	---
Seismic Shaking	X	X	X	X	X	X
Tsunami	---	---	---	---	---	---
Seiche	---	---	---	---	---	---

Notes: Please refer to accompanying text for further discussion of this summarized information.
X – indicates potential geotechnical constraint may exist at project component site.

LEGEND

MAPPED POTENTIAL GEOTECHNICAL CONSTRAINTS
(with potentially impacted project components listed)

- Slope instability
  (AF, AC, AH, SH)
- Unconsolidated soils (natural topsoil not included on map)
  (AF, AC, AH, SH, CCC, AzC)
- Hard metavolcanic rock
  (AF, AC, AH, SH)
  (well-cemented concretionary zones not mapped)
- Near-surface groundwater (Alvarado Creek only)
  (AF, AC, AH)
  (seepage not mapped)

OTHER POTENTIAL GEOTECHNICAL CONSTRAINTS (NOT MAPPED)
(all project components are potentially impacted)

- Erosion
- Expansive soils
- Seismic shaking

GEOTECHNICAL CONSTRAINTS EVALUATED - NO IMPACT

- Liquefaction
- Fault rupture
- Tsunami
- Seiche

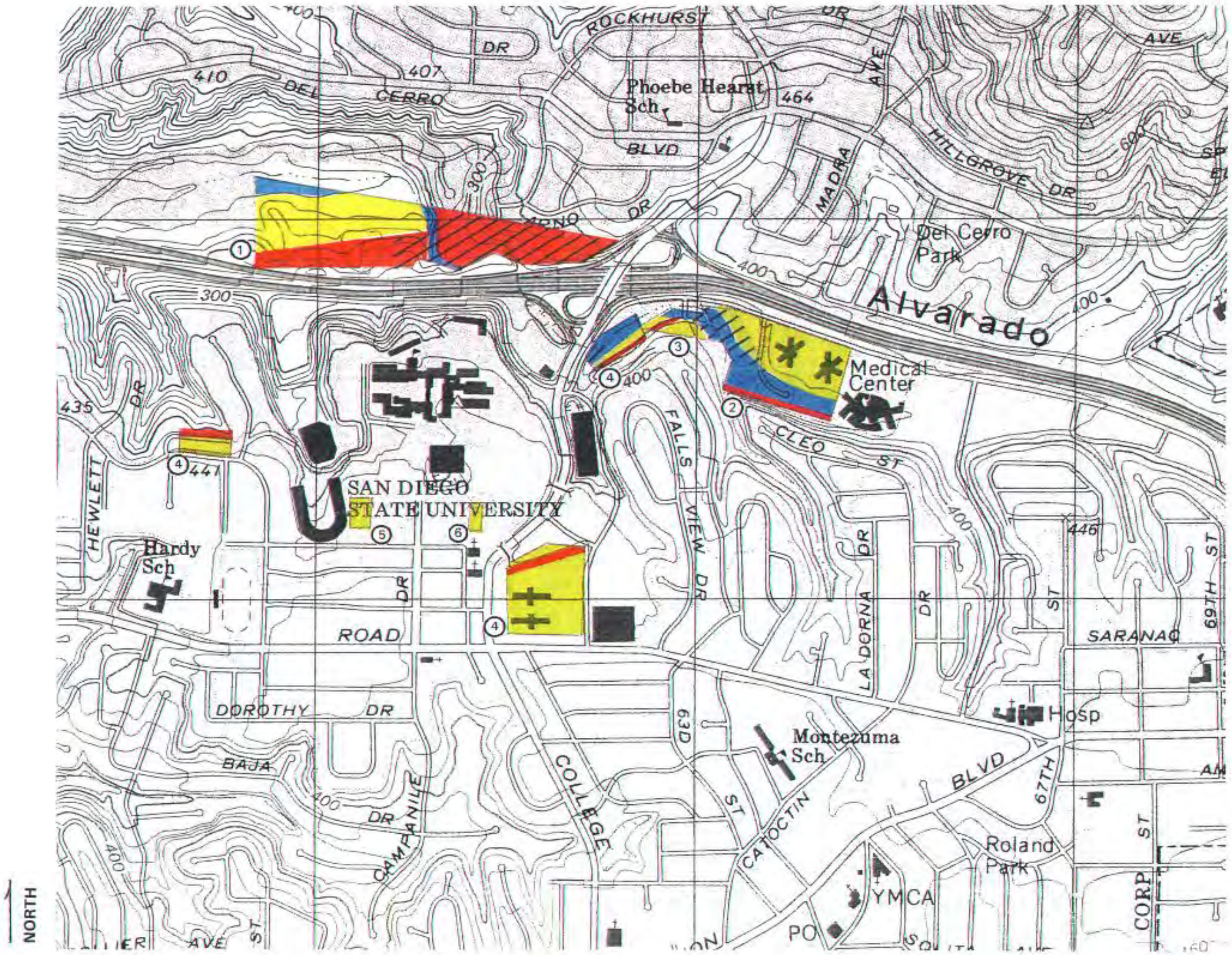
APPROXIMATED LOCATIONS OF PROJECT COMPONENTS

1. Adobe Falls (AF)
2. Alvarado Campus (AC)
3. Alvarado Hotel (AH)
4. Student Housing (SH)
5. Campus Conference Center (CCC)
6. Aztec Center (AzC)

APPROXIMATE SCALE: 1 inch = 1,000 feet

Base map is an enlargement of a portion of the USGS 7.5-minute La Mesa topographic quadrangle San Diego County, California, (1994 edition)

PLEASE NOTE THAT THIS MAP IS A GENERALIZED REPRESENTATION OF THE POTENTIAL CONSTRAINTS IMPACTING THE SDSU 2007 CAMPUS MASTER PLAN REVISION PROJECT COMPONENTS. PLEASE REFER TO THE ACCOMPANYING TEXT FOR MORE EXPLANATION OF THE POTENTIAL GEOTECHNICAL CONSTRAINTS FOR THIS PROJECT



POTENTIAL GEOTECHNICAL CONSTRAINTS MAP

San Diego State University
2007 Campus Master Plan Revision

Project No. 270C111

FIGURE 3

SGC

Student Housing: Slopes exist along the southern edge of the G Lot Residence Hall site, along the northern edge of the U Lot Residence Hall site, and at the C Lot site where the Villa Alvarado Residence Hall Expansion is proposed.

3.5.5.2 Erosion

Disturbance of the ground surface during construction of proposed facilities may increase or decrease the erosion potential of a site. The potential for erosion is a concern present at all of the proposed project components.

3.5.5.3 Unconsolidated Soils

Unconsolidated soils in the proposed project areas consist of existing fill soils, natural topsoil, and alluvium/slopewash. These soils typically are considered potentially compressible and may possess unacceptable settlement characteristics under structural and fill loads. If not mitigated, improvements built on potentially compressible, unconsolidated soils may crack as a result of soil settlement. Excavations exposing unconsolidated soils may also be subject to sloughing.

Due to the existing conditions, development of the following proposed project components may result in potentially significant impacts relating to unconsolidated soils:

Adobe Falls Faculty/Staff Housing: Unconsolidated soils including alluvium/slopewash, natural topsoil, and existing fill soils (associated with the I-8 freeway and adjacent development) exist at the site.

Alvarado Campus: Unconsolidated soils consisting of alluvium and fill soils are reported to underlie the majority of this site.

Alvarado Hotel: Unconsolidated soils consisting of alluvium/slopewash and fill soils (associated with existing development) likely exist at this site.

Campus Conference Center: This site is located along the edge of a filled canyon, and the San Diego Trolley extension crosses the area underground. Fill soils associated with the existing improvements may include unconsolidated soils.

Student Housing: Unconsolidated soils, primarily consisting of fill soils, likely exist at all four proposed sites. In addition, unconsolidated alluvial soils may exist at the Villa Alvarado Residence Hall Expansion site.

Student Union/Aztec Center Expansion and Renovation: Fill soils associated with the existing improvements may include unconsolidated soils.

3.5.5.4 Expansive Soils

Expansive soils primarily consist of clayey soils that have a potential for significant volume changes (shrinking and swelling) with moisture fluctuations. Expansive soils in the proposed project areas include clayey existing fill soils, clayey natural topsoils, and the clayey portions of the on-site geologic formations. If not mitigated, near-surface expansive soils may cause uplift and cracking of slabs, pavements and other improvements. Other expansive soil-related problems include poor drainage and poor establishment of vegetation.

Due to existing on-site conditions, development of each of the proposed project component sites may result in potentially significant impacts relating to expansive soils.

3.5.5.5 Hard Rock/Excavatability

Hard metamorphic rock of the Santiago Peak Volcanics underlies portions of the Adobe Falls Faculty/Staff Housing, Alvarado Campus, and Alvarado Hotel sites. Hard rock may present excavation difficulties during grading. In addition, the onsite sedimentary geologic formations may include locally well-cemented concretionary horizons. These well-cemented zones may present additional excavation difficulties during grading and construction activities. All of the project sites may include hard rock and/or well-cemented zones. For example, the D Lot portion of the Alvarado Campus site, which is underlain by the Stadium Conglomerate geologic unit, is reported to be "generally very difficult to excavate."

3.5.5.6 Groundwater/Seepage

Near-surface groundwater typically is encountered in low-lying areas such as the bottoms of canyons and tributary drainages. The Alvarado Creek drainage course crosses the central portion of the proposed Adobe Falls Faculty/Staff Housing, Alvarado Campus, Alvarado Hotel, and Villa Alvarado Residence Hall Expansion sites. In addition, perched groundwater was reported in some of the previous geotechnical borings on and near the project areas and also may be encountered during development of the project components. The likely source of the groundwater is infiltration of landscape irrigation waters and precipitation. Seasonal fluctuations of the on-site groundwater conditions may occur. Groundwater and/or seepage may be encountered at all of the project sites. In fact, groundwater has been encountered in several exploratory borings at the Alvarado Campus site. The depth to groundwater, where encountered, ranged from 10 to 17 feet below the existing ground surface at the time of drilling.

3.5.5.7 Flood Inundation

Surface water flow during major storm events may fill and, on occasion, overflow the existing Alvarado Creek drainage channel. In addition, Lake Murray is a dam-impounded reservoir located upstream approximately one mile from the SDSU campus. Flood inundation may occur at the Adobe Falls Lower Village, Alvarado Campus, Alvarado Hotel, and Village Alvarado Residence Hall Expansion sites.

3.5.5.8 Liquefaction

Liquefaction is caused by strong vibratory motion (typically due to earthquakes) and may occur in areas underlain by loose granular soils and a near-surface groundwater table. Soils that liquefy may settle. Further, improvements underlain by soils that liquefy also may settle and suffer damage. The potential for seismically-induced liquefaction at each of the proposed project sites is considered low due to the density and grain-size characteristics of the geologic/soil units in the project areas.

3.5.5.9 Fault Rupture

Ground rupture typically is associated with moderate to large earthquakes occurring on active faults. The hazard associated with ground rupture is potential damage to structures situated across a ruptured fault trace. Since no mapped active fault traces are known to cross the proposed project areas, the potential for surface rupture (ground breakage along fault traces) is considered very low.

3.5.5.10 Seismic Shaking

Southern California is a seismically active region. Ground shaking due to earthquakes on active regional faults should be expected at all the sites and may impact the proposed improvements. Each of the proposed project components may potentially be impacted by seismic shaking; however, these impacts are not considered significant due to the project's distance from any active fault.

3.5.5.11 Tsunami

Tsunami are sea waves generated by submarine earthquakes, landslides, or volcanic action. Due to the distance from the coastline, the possibility of inundation of the proposed project sites by a tsunami is considered very low.

3.5.5.12 Seiche

Seiche are periodic oscillations of a body of water. The possibility of the inundation of the project sites from a seiche is very low.

3.5.6 MITIGATION MEASURES

Site-specific measures for potential geotechnical constraints are developed during the geotechnical design studies phase of project development. The following is a discussion of typical site-specific measures that would address the potential geotechnical constraints (i.e., impacts) identified above:

> *Landslides/Slope Instability* – There are no known or suspected deep-seated landslides impacting the project sites. Therefore, mitigation of deep-seated landslides does not appear necessary for these sites. However, the deep-seated stability of existing and proposed slopes likely will require further evaluation, including subsurface investigation, laboratory testing and stability analyses. Geologic conditions that may be exposed in cut slopes can be assessed prior to excavation by subsurface exploration during project-specific geotechnical investigations. In addition, temporary excavations and cut slopes typically are checked by an engineering geologist during construction for indications of potentially adverse conditions, such as out-of-slope joints or loosely embedded boulders. Potential landslides or slopes with potential deep-seated instability concerns may be mitigated by generally accepted remedial grading techniques including partial or complete removal, stability with drained earthen buttresses, shear keys, or stabilization fills.
>
> In general, to reduce the potential of most slope instability concerns (both deep-seated and surficial), current grading codes (such as Section 3301 of CBC) typically require that graded slopes not exceed a gradient of 2 to 1 (horizontal to vertical). Slopes steeper than 2 to 1 generally are known to be prone to surficial instability. Typical mitigation measures to reduce the potential impacts of surficial instability may include slope flattening, slope-top setbacks, the installation and maintenance of drainage provisions,

and planting of slope-stabilizing vegetation. Typical slope setback dimensions are discussed in Section 1806 and provided on Figure 18-I-1 of the CBC.

Erosion – Proper grading techniques (with appropriate compaction efforts), use of stormwater pollution prevention devices (per City of San Diego guidelines), revegetation of disturbed areas, and construction of appropriate drainage provisions can reduce the potential for erosion of sites. The maintenance of drainage provisions, such as periodic removal of accumulated eroded soils and debris from surface drains, also is needed. A project designed and constructed in accordance with properly-engineered grading and drainage plans will not negatively impact the erosion potential of the sites and surrounding areas.

Unconsolidated Soils – The extent and depths of potentially compressible, unconsolidated soils can be assessed by subsurface exploration and laboratory testing during project-specific geotechnical investigations (per Section 1804 of CBC). Mitigation measures for structural/fill areas underlain by unconsolidated soils typically include removal of the compressible soils and replacement with properly compacted fill or deep foundation systems, such as drilled piers or piles, which extend through the compressible soils and are supported by the underlying, firm natural soils.

Expansive Soils – The expansion (shrink-swell) potentials of the on-site soils can be assessed by laboratory testing of representative soil samples obtained during site-specific geotechnical investigation studies. The expansion potential of soils is typically tested in accordance with UBC test standard 18-2 and classified based on the "expansion index" test result. Section 1803 (and Table 18-I-B) of the CBC states that structures founded on soils with expansion index greater than 20 will require special design. Typical mitigation measures include grading such that expansive soils are not placed within the upper few feet of finished grade. As an alternative, "special" deepened and/or stiffened foundation systems for proposed structures may be considered. Surface and subsurface drainage provisions also may be implemented to reduce moisture fluctuations in subgrade soils.

Hard Rock/Excavatability - Based on the proposed project's grading schemes, subsurface geotechnical investigations may be performed to evaluate excavatability characteristics of hard rock that may be encountered in the deeper cut areas of some of the project sites (specifically, the Adobe Falls Faculty/Staff Housing, Alvarado Campus, Alvarado Hotel, and Villa Alvarado Residence Hall Expansion sites). In general, excavations deeper than about 10 feet in areas underlain by the hard metamorphic rock of Santiago Peak Volcanics may be facilitated in a number of ways (*e.g.*, controlled blasting, heavy ripping, jackhammering, and/or chemical splitting techniques) during grading. Pre-construction surveys of the site conditions on nearby properties may be performed prior to controlled blasting, and instrumentation may be installed to monitor noise and vibration during controlled blasting.

The Lindavista Formation, Stadium Conglomerate and Friars Formation may have locally well-cemented concretionary horizons which may present excavation difficulties during grading operations. In general, construction blasting is not used to facilitate excavation of concretionary horizons, however, heavy ripping efforts and jackhammering may be considered.

An evaluation of the suitability of the onsite soils and rock for use as fill should also be made during the site-specific geotechnical studies. In general, the onsite soils appear suitable for processing into fills; however, oversize materials from excavations in the hard rock areas may not be suitable for use as compacted fill and may require offsite disposal or other special handling and placement techniques during grading. Section 300 of the "Greenbook" provides specifications of typical fill materials and their typical maximum allowed dimensions.

Groundwater/Seepage – Site-specific geotechnical investigation studies typically include an evaluation of the depth to the groundwater surface and the potential for seeps. Sections 1804 and 1821 of the CBC state that groundwater levels should be investigated. Subsurface and surface drains in filled areas and behind retaining walls commonly are designed and constructed to reduce potential adverse impacts associated with seepage conditions. Appropriate shoring and possibly dewatering in excavations below or near the groundwater level can reduce the potential for caving of excavations due to groundwater seeps.

Flood Inundation – Typical mitigation methods to reduce the impacts of flood inundation include drainage channel improvements, flood-resistant project design (Appendix Chapter 31 of the CBC) and construction, and floodplain management regulations. FEMA generally requires flood insurance in areas subject to 100-year flood inundation.

The stability of the Lake Murray dam is monitored by the City of San Diego and State of California Division of Safety of Dams.

Liquefaction - The potential for liquefaction at the sites is generally considered low. In fact, the potential for liquefaction at the Alvarado Campus site has specifically been evaluated to be low. Nonetheless, liquefaction should be addressed during geotechnical design studies for the project components. However, mitigation measures with regard to liquefaction are likely unnecessary.

Fault Rupture - Surface rupture due to active faulting at the project sites is considered very low and mitigation measures with regard to ground rupture along active faults are not needed at the proposed project areas.

Seismic Shaking – Evaluations of potential seismic shaking will be performed during site-specific geotechnical studies for the various components of the project. The effects of seismic shaking can be reduced by adhering to current design parameters of the applicable sections of the UBC and CBC (including but not limited to CBC Chapters 16 and 18).

Tsunami - The potential for inundation by tsunami at the sites is considered very low and mitigation measures with regard to tsunami are not needed.

Seiche - The potential for inundation by seiche at the sites is considered very low and mitigation measures with regard to seiche are not needed.

Based on the analysis conducted, the geotechnical conditions in the proposed project area will not significantly impact the development and implementation of the proposed project components if appropriate geotechnical design recommendations developed from site-specific geotechnical investigations are included in the design and construction of the proposed project. The incorporation of these site-specific recommendations into the design and construction of the project components would reduce any potentially significant impacts to a level below significant.

On that basis, the following mitigation measures are proposed to reduce the potentially significant geotechnical effects of the proposed project to a level below significant:

GEO-1 Prior to the commencement of design and construction activities relating to the proposed project components, SDSU, or its designee, shall conduct, or cause to be conducted, a geotechnical investigation in conformance with the requirements of the California Building Code ("CBC") and Uniform Building Code ("UBC"). The site-specific geotechnical investigations will include, to the extent required by the CBC and UBC, subsurface exploration, laboratory testing, and geotechnical analysis. The investigations will address the potential for landslides/slope instability, erosion, unconsolidated soils, expansive soils, groundwater seepage, flood inundation and seismic shaking. Based on the results of the site-specific investigations, geotechnical design recommendations will be developed and included within each respective project component's design and construction in conformance with any/all applicable CBC and UBC requirements.

GEO-2 During grading activities associated with development of the proposed project, SDSU, or its designee, shall require that compressible soils present on the site be removed where structural fill areas are underlain by unconsolidated soils and replaced with properly compacted or deep foundation systems, which extend through the compressible soils and are supported by the underlying firm natural soils.

GEO-3 During grading activities associated with development of the proposed project, SDSU, or its designee, shall require that expansive soils present on the site are not placed within the upper few feet of finished grade, or "special" deepened and/or stiffened foundation systems for proposed structures are utilized.

3.5.7 CUMULATIVE IMPACTS

Impacts relative to geology and soils generally are confined to the project site; the effects of two or more projects that occur at different locations are not affected by, and would not impact, the same piece of land. Furthermore, as discussed above, mitigation is proposed to reduce any of the proposed project's potential impacts relative to geology and soils to a level below significant. Therefore, the proposed project would not result in significant cumulative impacts to geology and soils.

3.5.8 LEVEL OF SIGNIFICANCE AFTER MITIGATION

With implementation of the proposed mitigation measures identified in this section, the potential impacts relative to geology and soils would be reduced to a level below significant.