CAMPBELL GEO, INC.
ENGINEERING AND ENVIRONMENTAL GEOSCIENCE

Preliminary Review of Geologic Hazards
Santa Barbara Metropolitan Transit District Parcels
4678 Calle Real/149 N. San Antonio Road
Santa Barbara, California

January 17, 2018

Submitted to

Suzanne Elledge Planning and Permitting Services, Inc.
1625 State Street, Ste 1
Santa Barbara, CA 93101

Attn: Mr. Steve Fort

Prepared by

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C A M P B E L L G E O, I N C.
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Santa Barbara, CA 93101

Attn: Mr. Steve Fort

Subject: Preliminary Review of Geologic Hazards
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Dear Mr. Fort:

INTRODUCTION

Campbell·Geo, Inc. is pleased to present this preliminary geologic hazards evaluation of the Santa Barbara MTD parcels located at 4678 Calle Real/149 N. San Antonio Road in Santa Barbara, California. The analysis provides a preliminary assessment of geologic hazards that could inhibit development of potential building sites. The site consists of four parcels totaling approximately 19 acres, with the following Assessor Parcel Numbers (APNs): APN 59-140-004 (8.85 acres), APN 59-140-005 (4.00 acres), APN 59-140-006 (4.66 acres), and APN 67-230-026 (1.42 acres).

Please see Plate 1, attached to this letter, illustrating the project location and a preliminary geologic map of the site and nearby area. The site was visited by the undersigned in December 2017. The purpose of our work is to provide a review of geologic hazards associated with the site and to assess if the site is worthy of further geologic/geotechnical investigation to support possible development and to provide design level information for possible future work by structural/civil engineers and architects.

PREVIOUS WORK

Interface Planning and Counseling Corporation - 1993

The Santa Barbara Metropolitan Transit District published an Environmental Impact Report (EIR) to help identify potentially significant adverse environmental impacts

generated by land use changes and to identify measures to minimize or mitigate related environmental impacts. The EIR identified Geology and Soils, among other topics, to have the potential to be significant issues.

The EIR notes that a Preliminary Geologic Investigation dated April 15, 1993 was prepared by Rick Hoffman and Associates. We did not review or obtain a copy of that report.

A sub-surface investigation to evaluate the presence of onsite faults concluded that none existed within the boundaries of the property, (Hoffman, 1993). The potential for liquefaction at the proposed site was considered to be low based on the Hoffman investigation. Other geologic hazards (slope stability, compressible/collapsible soils and tsunamis) were determined to be insignificant or not present at all by Hoffman. The EIR (Hoffman) noted evidence of minor flooding along the south perimeter within the drainage swale.

The EIR concluded that the potential for ground surface rupture at the site location was low due to the absence of known active faults on the property. However, the proximity of the site to active regional faults was considered to result in a generally high seismic risk, similar to most areas on the south coast of Santa Barbara County. The EIR concluded that assuming all site improvements would be properly engineered and constructed, the potential for structural damage would be reduced. With mitigation and implementation of design features, all impacts related to geology and soils would be reduced to insignificant levels, based on the analysis in the 1993 EIR.

Eastern Goleta Valley Community Plan – 2015

This planning document prepared by the County of Santa Barbara, included discussion of development policies related to geology, topography, and soils. No site specific geologic information relative to the MTD property was included. None of the

policies/prohibitions described related to geology would appear to directly affect overall development of this site.

Regional Investigations

Regional investigations (the County of Santa Barbara's 2009 Seismic Safety Element), and regional Geologic Maps (Dibblee, 1987, and California Geologic Survey, 2010) were reviewed during the course of this investigation. To examine the location of inferred faults in the vicinity of the project, we also reviewed other geologic maps (Olson, 1982; Gurrola, 2006, and; Minor *et al*., 2009). One inferred unnamed fault has been mapped to trend onto the property, as indicated on the 2009 map, shown on Plate 1. This inferred (unconfirmed) fault is not mapped on the basis on onsite or nearby trenching and is inconsistent with the absence of onsite faulting determined by Hoffman's 1993 subsurface investigation.

SITE CONDITIONS

Existing Land Use/Vegetation

A single family residence and maintenance shed once occupied the project location and have since been demolished. The site is currently undeveloped, with a paved driveway bisecting the south-western portion of the property. The majority of the site is covered in annual grass and weeds. Native trees and shrubs are sparsely populated around the property with denser areas on the northern property line as well as in a swale/drainage. Calle Real parallels the southern property line, the east side is bordered by San Antonio Road and the rest of the site is bordered by commercial and residential development. Some debris and trash dumping was noted near the north property line.

Topography/Drainage

The property is located in the Hospital Creek Watershed (Figure 21, Eastern Goleta Valley Community Plan, 2015). The topography at the site is mostly flat to gently sloping

with some moderately steep slopes in limited areas. Slopes vary between nearly flat (southwest area) to 100% (south area), based on the 2017 topographic map (Waters Cardenas Land Surveying, December 22, 2017). Other notable slopes include 58% in the northwest, 45% in the northeast and east area, and 65% in the southeast. None of the existing slopes are higher than 20 feet. The north property boundary near the northeast corner is approximately marked by a retaining wall that varies in height from roughly 4 to 10 feet. A topographic knoll exists in the southeastern area of the site. Runoff of surface water drains towards the south of the property into a swale before entering a reported concrete culvert under Calle Real.

Groundwater

The site is located in the North-Central Goleta Groundwater Basin. It overlies Holocene and Pleistocene aged alluvium and the Santa Barbara Formation of Pleistocene-age. Hoffman (as quoted in the 1993 EIR) estimated a depth to groundwater at approximately 135 to 168 feet below ground surface. A more detailed geologic investigation (ie exploratory borings) would be needed to accurately determine the actual depth to groundwater. In general, groundwater levels are expected to be variable, dependent upon season, climatic conditions, irrigation, surface runoff, and other factors. Potential shallow subsurface water and moisture issues can and should be addressed through properly designed control of surface water, subsurface water drainage systems, and structure subgrade water proofing.

GEOLOGY

Regional Setting

The south coast of Santa Barbara County is located on the southern flank of the Santa Ynez Mountains, which make up a portion of the Transverse Range Province of California. The regional geologic structure consists of mostly south dipping sedimentary rocks uplifted from the north by tectonic movement along several generally east to west trending fault and

fold structures, and by ongoing regional tectonic compression of the Santa Barbara Channel area. The uplifted Tertiary- and early Quaternary-age rocks underlying the project area are moderately deformed by folding and faulting.

Tectonic activity is ongoing, as evidenced by earthquakes in the geologically recent past (1812, 1925, 1941, and 1978) that resulted in moderate to severe damage in the Santa Barbara area. A regional geologic map showing fault locations relative to the project site has been prepared from a portion of the 2009 map by Minor *et al*. and is presented as Plate 1. The one inferred fault feature shown trending onto the site was reportedly not found to be present in exploratory trenching conducted in 1993 (Hoffman).

The site overlies Holocene and Pleistocene-age alluvium and older alluvium deposits. The depth to bedrock of the Pleistocene-age Santa Barbara Formation could be less than 100 feet. A more detailed geologic investigation would be needed to accurately determine the actual depth to bedrock. The consolidated rocks in the vicinity of the site structurally trend east-west and the stratigraphic beds dip to the south, south-west under the subject property.

Site Geology: Lithology

The geologic formations exposed on the site described by Dibblee (1987) and Minor (2009) are Holocene-age channel alluvium (Qa) and older alluvial deposits (Qoa) of the Pleistocene-age. The geologic units are shown on the project Geologic Map - Plate 1, and are described, oldest to youngest, below:

Alluvium (Qac)

A thin deposit (up to 5m) of unconsolidated sediments, the alluvium consists of sand, pebbles, cobbles and boulders transported by the stream eroded from bedrock north of the site. The alluvium itself is generally an acceptable material for building foundations, but issues related to high groundwater and creek setbacks should be further evaluated.

Older Alluvial deposits (Qoa)

Qoa is made up of moderately consolidated, poorly sorted, crudely stratified, sand, gravel, and cobbles (and occasionally boulder size fragments). Rarer interbeds of clay, silt and mudstone are found in proximal and distal facies of alluvial fans shed from the Santa Ynez Mountains.

Santa Barbara Formation (Qsb)

The Santa Barbara Formation is a fossiliferous Quaternary period, Pleistocene-age marine unit of alternating pale-gray, buff, and tan friable sandstone. This unit does not crop out at the site, but based on nearby exposures may be the bedrock underlying the alluvial deposits.

Site Geologic Structure

The alluvium is weakly consolidated material that exhibits no bedding planes at the project site. The older underlying sedimentary Santa Barbara Formation units dip moderately steep to the southwest. Bedding dip angles were all less than 30° (1:1 angle), as measured by Minor *et al.,* (2009) in surface outcrops nearby and do not present an unsupported, or "daylighted" bedding condition.

POTENTIAL GEOLOGIC HAZARDS

Faults

A geologic fault is a fracture(s) in the crust of the earth along which rocks on one side have moved relative to rocks on the other side. In an earthquake, fault ruptures almost always follow sections of pre-existing fault planes, although rupture may not occur along the entire length of the fault. Fault rupture may occur at significant depths in the earth and are

sometimes not accompanied by rupture at ground surface. Inactive geologic faults are structures with no evidence of movement within the last 1.6 million years. "Potentially Active" is a term that has been used to describe geologic faults that have exhibited movement during the last 1.6 million years. The State of California (Alquist-Priolo Earthquake Fault Zoning Act, 1972) defines Active faults as those where rupture within the last 11,000 years (the Holocene epoch) can be demonstrated.

In the property area, no active faults, defined by the Alquist-Priolo Act, have been mapped by the State of California. The closest fault in that category is the onshore portion of the Red Mountain Fault, shown on the Pitas Point Quadrangle, which is more than 15 miles east of the site (AP Zoning Map, November 1991). The offshore portion of the fault is inferred and trends to the west towards the Santa Barbara area.

The Pitas Point and North Channel Slope Faults are "interweaved or stacked" (Kamerling and Sorlien, 1999) and are considered to be the same potential seismic source. Hubbard *et al,* (2014), concludes that the Red Mountain Fault links to the deeper fault structure that study refers to as the Ventura-Pitas Point Fault, and that large, multi- segment earthquakes are possible on the Ventura-Pitas Point Fault and other faults located along strike.

The primary mapped fault of interest in the project area is the Mission Ridge, Arroyo Parida, More Ranch Fault System (MR/AP-MR), located approximately 0.7 miles south of the project site. Although the MR/AP-MR fault has not been "zoned" as an active fault under the Alquist-Priolo Act, it is considered probably to be active by several geologists, including LaForge and Anderson (2001), Gurrola (2006), and the County of Santa Barbara Comprehensive Plan Seismic Safety Element (Moore and Taber, 2009). The fault system extends approximately 30 miles to the east into Ventura County. An earthquake magnitude of 7.2 is possible on this MR/AP-MR fault system, according to the California Geologic Survey and Cao *et al.,* 2003. The CGS reports the fault slip rate to be approximately 0.4 mm/year. A southeast extension of an unnamed fault that may be related to the San Pedro Fault is mapped by one geologist (Minor, 2009) to extend onto the site (see Plate 1).

Reported previous trenching by Hoffman in 1993 found no evidence for that fault on the site. The County Seismic Safety Element (2009) considers the San Pedro Fault to be inactive. A trenching investigation conducted approximately 1,500 feet to the east by Campbell Geo in 2010 (Santa Barbara County Sherriff's site) also found no evidence for fault surface rupture on the unnamed extension/branch of the San Pedro Fault.

Some investigators (Namson and Davis, 1990 and Hubbard *et al*, 2014) have stated the opinion that the region is underlain by a large "blind thrust" fault (detachment) and fold structure. Although this blind thrust fault does not break the ground surface, it may have larger seismic shaking potential than the faults considered to exist by the California Geologic Survey, according to studies by these investigators.

Ground Shaking

Severe ground shaking during earthquakes is a hazard endemic to most of California. Several earthquakes of Richter magnitude 6 (or larger) have been recorded in the area in recent historic times. Earthquakes that produced strong, significant ground shaking affecting this site in recent history include the earthquake of 1812, the Santa Barbara Earthquake of 1925, the 1941 earthquake near Carpinteria, and the magnitude 5.8 event in 1978, which is also known as the "Santa Barbara Earthquake" (Miller and Felzeghy, 1978).

A more comprehensive analysis of seismic shaking at this site can be done in a more detailed report using computer models in accordance with the requirements of the California Building Code (CBC). The models utilize the California Geological Survey's catalog of earthquakes and faults in relation to the horizontal coordinates of the site to determine the various ground motion parameters from faults within a 100-km search radius that will produce the highest amount of seismic shaking at the project site. The ground motion analysis can be used by the design engineer for structure design in accordance with the CBC.

Artificial Fill

Artificial fill that resulted from previous site grading appears to be present in some areas on site, based on the current topography, including the shoulder area adjacent to San Antonio Road. Fill, concrete debris and some other trash was visible on the surface and partially buried in the area close the north property boundary, between 300 and 650 feet, roughly, east of the northwest property corner. The presence of one 55 gallon drum was also noted. Environmental releases at trash disposal sites can be an issue in some instances. Properly engineered and constructed fill should perform satisfactorily, and undocumented/unengineered fill is usually removed or recompacted. A detailed geotechnical investigation can evaluate what is present and provide recommendations for site preparation.

Erosion

Soil, colluvium and other surface deposits will be subject to shallow erosion. Shallow surficial instability or erosion should be anticipated on slopes with poor drainage devices and/or inadequate vegetation or other ground cover. Surficial instability may also be exhibited on slopes steeper than 2:1, horizontal to vertical, but that issue can be addressed at least partially by properly designed drainage and erosion control features. No areas of significant active erosion were noted during our site visit. Various methods for erosion control during construction and after project completion can be employed to address this potential issue.

Slope Stability

Regional mapping indicates the absence of existing landslides at the site. The site is located in an area of “low landslide potential,” as identified by the Santa Barbara County Safety Element (2009). We also reviewed the USGS landslide hazard map (Bezore and Wills, 1999). No landslides are mapped in this area and there is a low landslide hazard (Subarea 2).

Radon Gas

Radon is an odorless and colorless radioactive gas produced by the natural decay of minerals found in many types of earth materials. Unhealthful concentrations of radon gas that have the potential to collect in indoor air breathing spaces are found at some locations on the south coast, due to the mineralogy of the underlying geologic unit(s). Radon is not typically associated with the underlying Quaternary unconsolidated deposits or the Santa Barbara Formation at this site. The California State Geological Survey's Radon Zone Map for Santa Barbara County (Churchill, 1995) indicates that the project is in an area with low radon levels. An onsite measurement of radon has not been made. Addressing radon hazards is not technically complicated and can typically be accomplished by proper venting of subslab or subfloor spaces.

Tsunamic and Volcanic Hazards

These hazards do not affect the site.

Liquefaction, Soil Creep, and Expansive Soils

Liquefaction is the loss of strength of saturated sandy soil accompanying ground shaking during an earthquake. The earthquake's seismic energy can densify loose, saturated, granular soil causing a reduction in the pore space between the sand grains. This transfers the intergranular load to the pore water and results in a temporary loss of strength. This hazard is typical of areas with shallow groundwater and loose, unconsolidated sedimentary deposits, such as are present in portions of downtown Santa Barbara. The previous geologic hazards analysis (Hoffman, 1993) concluded that materials at this site are not subject to liquefaction. That conclusion can be evaluated with a detailed geotechnical filed investigation (borings and soil sample analysis).

Soil creep is the slow downslope movement of surficial soils. It involves clayey soils and is due, at least in large part, to the volume changes from cyclic wetting and drying. During periods of heavy and prolonged rains, the soils may become saturated and slump, a

small shallow form of landslide involving only the upper few feet of surficial material, such as the slope failure/creep area above the driveway north of the switch-back. Although some soil creep is expected to occur during periods of wet weather, it is not considered a significant hazard at this site if installed drainage features operate adequately and are properly maintained.

Expansive soils are those that contain clay minerals which swell when the moisture content increases and shrink when the moisture decreases. Such soils form ground cracks when they are allowed to dry out. The volume changes resulting from variable moisture conditions can cause movement and cracking of structures built on expansive soils. The County of Santa Barbara Seismic Safety and Safety Element (Moore and Taber, 2009) has identified the liquefaction and soil creep hazards to be low or non-existent in the site vicinity. That study considered expansive soil to be a low to moderate hazard in this area. A detailed geotechnical soil investigation can and should be conducted to evaluate this hazard.

CONCLUSIONS AND RECOMMENDATIONS

A geologic hazards review has been conducted at the approximately 19-acre parcel located at 4678 Calle Real. Based on the literature we have reviewed, our experience and knowledge of the area, and our reconnaissance level site visit, no serious geologic hazards exist. Specifically, there appears to be a low or non-existent threat from the following geologic hazards:

- Tsunami
- Volcanism
- Slope Stability
- Liquefaction
- Soil Creep
- Onsite fault rupture

Other geologic hazards may affect the site, but are considered low to moderate hazard. These include:

- Erosion
- High Groundwater
- Seismic Shaking
- Expansive Soils
- Undocumented Fill

We recommend a detailed geotechnical study conducted with a subsurface investigation (soil borings and test pits) to confirm the depth to groundwater and evaluate the liquefaction, soil creep and expansive soil hazards if present at all. The area of trash, debris and undocumented fill can be explored with test pits to determine what may be buried and approximate areas of removal. If extensive trash deposits are found (more than just a few/several pieces) or if leaking containers are found, Santa Barbara County Environmental Health Services should be contacted. The geotechnical study should take into consideration conceptual site development and site grading plans. The geotechnical study can be used by the design engineer to develop site grading and building foundation plans.

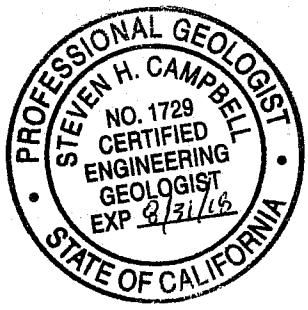
That study can also perform the seismic motion analysis in conformance with the current building code requirements. Seismic shaking will occur at this site, but is not, in general, expected to be greater than at any other location on the south coast of Santa Barbara County. Wood frame structures built to UBC standards generally respond well to ground shaking as severe as experienced in recent history at this site without catastrophic structural damage or loss of life. The building code is intended to protect against complete or catastrophic building failure.

LIMITATIONS

The analyses, conclusions, and recommendations contained in this report are based on site conditions as they existed at the time of our investigation. No subsurface evaluation

was conducted and no geotechnical analyses were conducted. Our analysis was limited to a review of geologic hazards.

If you have any questions concerning this report, please do not hesitate to contact us.



Sincerely,
Campbell·Geo, Inc.

Steven H. Campbell
Professional Geologist
State of California, #5576
Certified Engineering Geologist
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Clients\SEPPS\ R1.doc

Attachments: Plate (1)

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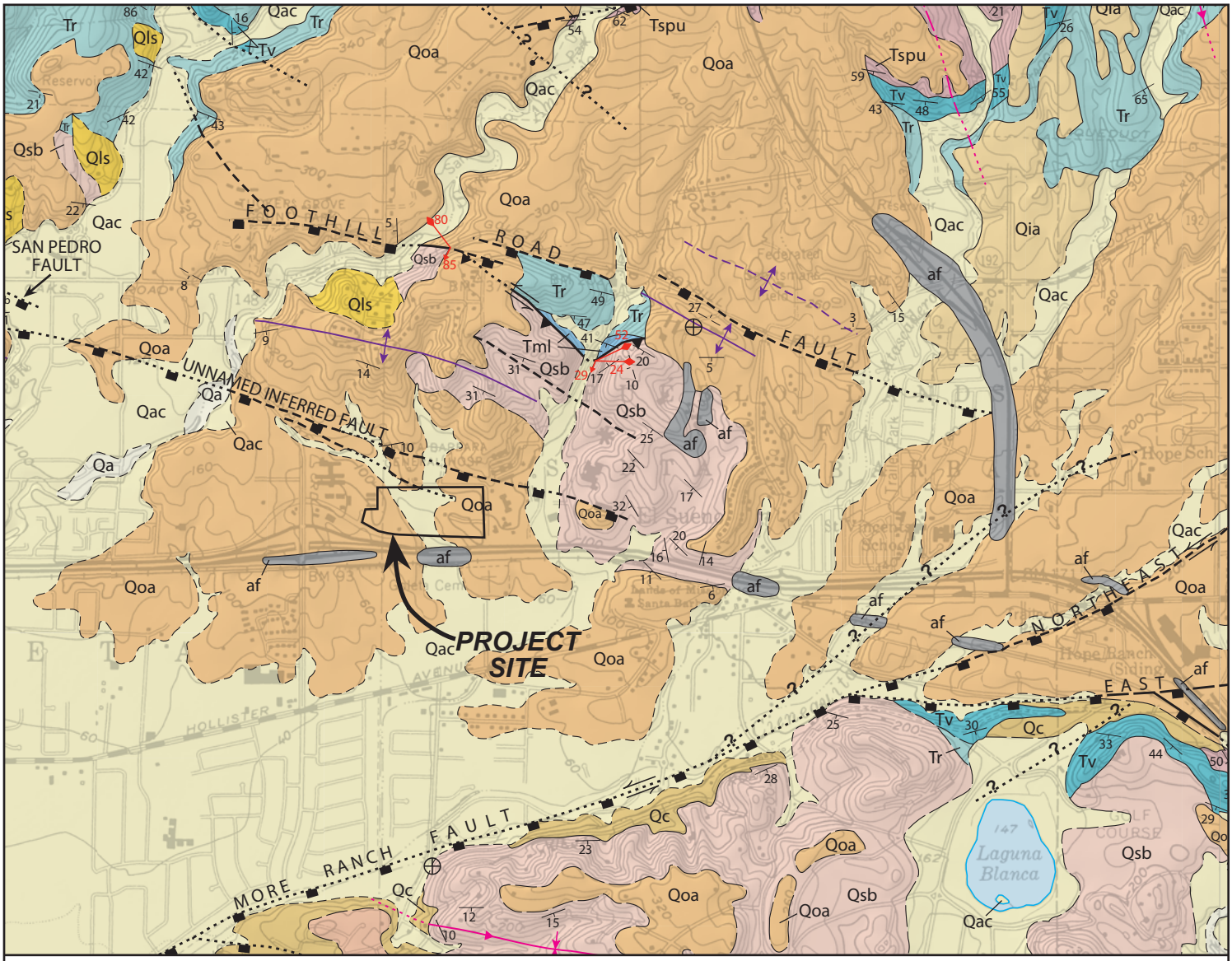

Geology from "Geologic Map of the Santa Barbara Coastal Plain Area, Santa Barbara County, California", by Minor, S., et.al, 2009.

PROJECT LOCATION AND GEOLOGIC MAP OF THE MTD PROPERTY AND VICINITY

4678 Calle Real / 149 N. San Antonio Road
Santa Barbara, California

EXPLANATION

AGE			
Quaternary	Holocene	af	Artificial fill
		Qa	Active channel alluvium
		Qb	Beach deposits
	?	Qac	Alluvium and colluvium
	Pleistocene	Qls	Landslide deposits
		Qia	Intermediate alluvial deposits
		Qoa	Older alluvial deposits
		Qsb	Santa Barbara formation
Tertiary	Miocene	Tml	Monterey formation (lower calcaeous unit)
		Tr	Rincon shale
	Oligocene	Tv	Vaqueros formation
		Tspu	Sespe formation (upper sandstone and mudstone unit)

SCALE IN FEET

0 2,000 4,000

SYMBOLS

- Formation contact; dashed where inferred
- Fault; ball/bar on apparent downthrownside; dashed where approximate; dotted where concealed
- Reverse fault with rectangles on upthrown side; short-dashed where inferred
- Thrust fault with teeth on hanging wall
- Anticline
- Syncline
- 20 Strike and Dip
- Horizontal Bedding

CAMPBELL·GEO, INC.
ENGINEERING AND ENVIRONMENTAL GEOSCIENCE

DAS Date 8-30-10

Plate 1