CAMPBELL·GEO, INC.
ENGINEERING AND ENVIRONMENTAL GEOSCIENCE

January 22, 2015

The Boyd Family Trust
c/o Prudential California Realty
1170 Coast Village Road
Santa Barbara, CA 93108

Attn: Mr. Ken Switzer

Subject: Geologic Hazard Summary
1250 Cliff Drive
Santa Barbara, California

Dear Mr. Switzer:

INTRODUCTION

This letter summarizes our review of geologic conditions at the residential property located at 1250 Cliff Drive in Santa Barbara, California. Please see Plate 1 – Regional Geologic Map of the area, attached to this letter. The purpose of our work is to provide a review and summary of geologic hazards associated with the property, based on published regional maps, selected technical reports, and our short reconnaissance level site visit. Campbell Geo's work follows our proposal dated January 6, 2015, authorized on that same day.

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 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 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 fault location map for the project site and vicinity prepared from a portion of the 2009 map by Minor *et al*. is presented as Plate 1.

Site Geology: Lithology

The geologic formations exposed on and in close proximity to the site are, from oldest to youngest, the Monterey formation (Tm), the Santa Barbara formation (Qsb), the marine terrace (Qmt), and Artificial Fill (Qaf). The geologic units are shown on Plate 1.

Monterey formation (Tm)

The Monterey Formation is a white to tan colored mudstone, brecciated in some areas, which was deposited in a deep marine environment. It may contain microfossils. Some small Monterey fragments were found in onsite soils, but no rock outcrops were observed.

Santa Barbara Formation (Qsb)

A marine deposit, the Santa Barbara formation, is a friable massive and relatively soft sandstone. It was deposited in a near shore environment, and contains a diverse assemblage of marine fossils. Some shell fragments were noted in onsite soils.

Marine Terrace (Qmt)

Unconsolidated sand, silt, clay, and gravel deposits are identified collectively as the marine terrace. It is typically in unconformable (or angular) contact with the underlying Monterey formation. Gurrola (2006) cites an age of 70,000 years for the marine terrace in this area.

Artificial fill (Qaf)

Although it is not mapped on Plate 1, artificial fill is also present at this site. Artificial fill may be found in relatively thin sections on this site, including on the outside (downhill) edge of slopes where they descend from driveways, graded pads, or possibly at retaining walls. Recommendations for artificial fill when and if site development occurs typically include removal and recompaction under the supervision of a geotechnical engineer.

Site Geologic Structure

The site sits atop largely unconsolidated marine terrace deposits, which consist of beach sands and ancient estuary silts and clays. At relatively shallow depths beneath the marine terrace deposits is the Monterey formation, which makes up the sea cliffs south of the site at Shoreline Park.

Topography

The property slopes moderately to gently towards the south, decreasing from elevation 222 feet to 176 feet above sea level, based on the Waters Land Surveying topographic map provided to us. North of the site, the grade steepens into hills which are composed of the Santa Barbara formation.

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, rupture surfaces almost always follow pre-existing faults or fault zones. Inactive geologic faults are structures with no evidence of movement within the last 1.6 million years. Potentially active geologic faults are those 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. The

1972 Alquist Priolo Act prohibits development over faults that are active and are "well-defined," *i.e.*, that can be traced at or just below ground surface.

At the 1250 Cliff Drive site, no confirmed active faults have been mapped by the State of California (Jennings, 2010) or other previous investigations we have reviewed. There are offsite, nearby mapped active and potentially active faults, the closest being the Lavigia Fault. The southeastern extent of the Lavigia Fault is mapped 500 feet to the south of the property by Hoover & Associates (Hoover, 1978). Field observations by the undersigned are consistent with Hoover's location of the Lavigia Fault, south of the property. On the USGS Geologic Map of Santa Barbara (Minor, 2009), the Lavigia fault is shown to be located further from the site (see Plate 1).

The nearest active fault mapped in accordance with the 1972 A-P Act is the Red Mountain Fault in the Pitas Point Quadrangle in Ventura County. The fault surface expression shown on the State of California Special Studies Zone Map (1991) is located roughly 20 miles east of the project site, but the map does not show the trace of the fault offshore where the fault trends to the west towards the Santa Barbara area. The closest subsurface portion of the Red Mountain Fault is estimated to be approximately 4.5 miles (7.2 kilometers) from the Cliff Drive site. An earthquake magnitude of 7.0 (Mw) is possible on the Red Mountain Fault, according to the CGS, and is considered to be the source of a magnitude 5.9 earthquake affecting the area in 1941 (Moore and Taber, 1979). The other major local structure that may be a nearby source of ground motion is the Pitas Point-North Channel Slope Fault. It is located approximately 6 miles (9.7 kilometers) from the site and is capable of generating a magnitude 7.4 (Mw) earthquake (Cao, 2003, CGS, 2007, and USGS, 2008). Other investigators (Namson and Davis, 1990) have stated the opinion that the region is underlain by a large "blind thrust" fault 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 have produced strong, significant ground shaking ($g \geq 0.200$) affecting this site in recent geoologic history. Notable historic earthquakes were the events occurring in 1806, 1812, 1862, the "Santa Barbara Earthquake" of 1925, the 1941 earthquake, and the magnitude 5.1 event in 1978, which is also referred to as the "Santa Barbara Earthquake" (Miller and Felzeghy, 1978). Many historic Santa Barbara earthquakes have been due to known or suspected rupture of offshore faults.

Slope Stability

The project site is moderately sloping, with an overall elevation gain of 46 feet. Near Cliff Drive, the overall slope gradient is 10 percent. At the steeper portion of the site, near the north property line, the slope is approximately 25%. The site appears to have been terraced originally by cut and fill grading. A formal slope stability analysis has not been conducted, but if the terrace slopes were engineered and constructed properly during site grading for the residence, they do not likely present a geologic hazard to the project. There are no landslides mapped at or near the site on the USGS report, Landslide Inventory Map of Southeastern Santa Barbara County (Bezore and Wills, 1999).

The USGS (Bezore and Wills, 1999) and City of Santa Barbara (2013 Seismic Safety Element) has identified a site to be in an area of "High Landslide Potential." However, the mapping of different hazard areas is broad and general. Although the topography of the area just south of Cliff Drive, is similar to the 1250 site, that area is categorized as Hazard Area 2, "Low Landslide Potential" on the 1999 and 2013 maps.

New structures should be located with a setback from the toe or top of slopes in accordance with the California Building Code (CBC Chapter 18), unless a separate study supports an alternative setback/clearance under procedures described in the CBC.

Radon Gas

Radon is an odorless and colorless radioactive gas produced by the natural decay of minerals found in many types of earth materials with features common to many types of building construction that result in gas traps. Soil gas can migrate from the subsurface and accumulate in the structure, thereby potentially affecting indoor air. Concentrations of radon gas are found at some locations on the south coast, due to the mineralogy of some specific geologic unit(s), especially the Rincon and Monterey formations. The Rincon formation is not exposed at or near ground surface at this site, but the Monterey formation both underlies and crops-out in surface exposures near the property.

The USEPA's county by county nationwide map of radon risk assigned the highest of three risk levels to Santa Barbara County as a whole. The more detailed California State Geological Survey's Radon Zone Map for Santa Barbara County (CDMG, 1995) indicates a "high" potential for excessive in-door radon levels in the general vicinity of the project site. No onsite measurements of radon have been made by this office.

There are various methods that are not particularly complicated to reduce the hazards presented by radon gas, including depressurization systems, passive ventilation systems, and the sealing of foundation slab cracks. Simple kits exist to test indoor air for the presence of radon.

Liquefaction

A phenomenon wherein soil loses its strength due to moderate or large ground shaking, liquefaction occurs under the following conditions: the soils are composed of sand or silt-sized grains, the soil is saturated with liquid, and the soil is loose or cohesionless. When these conditions are present, and there is significant ground shaking, the soil particles lose contact with one another, and the water pressure increases, causing the soil to behave more like a liquid. Liquefaction can cause catastrophic damage to structures and roads.

The risk of liquefaction has been mapped as a function of soil cohesion and depth to groundwater. Because groundwater in the area of 1250 Cliff Drive is not shallow, it has been mapped as an area of low liquefaction potential by the City of Santa Barbara 2013 report.

Expansive Soils

Expansive soils will increase or decrease volume as they become saturated or dry out. Specifically, clay minerals in the soils will trap water introduced to the subsurface by precipitation, irrigation, or other sources.

Soils were mapped based on data obtained from the U.S. Department of Agriculture, and their potential to shrink/swell were ranked from "high" to "very low." 1250 Cliff Drive is located in an area of "high" shrink/swell potential, although a spot check of surface soils indicated they were not particularly clay rich. A site-specific soil investigation should be conducted for new development. That investigation should be consistent with applicable building codes. There are specific foundation designs typically effective at eliminating or minimizing the effects of expansive soil.

High Groundwater

Shallow groundwater can lead to issues of moisture intrusion into structures, buoyancy forces, and the previously described condition known as liquefaction. Groundwater in the area of 1250 Cliff Drive has been mapped as "moderately shallow" to "deep" by the city's 2013 report.

Seiches, Volcanism, Seacliff Retreat

These geologic hazards do not affect the site.

Previous Oil Field Development

Although no longer active, the Mesa Oil Field was discovered in 1929. Based on information published by the California Department of Oil Gas and Geothermal Resources

(DOGGR), the field reached its maximum yield in 1935, producing 1.1 million barrels (bbl) of oil that year, after which production probably began to decline rapidly. Total historical production from the field was reportedly 3.7 million bbl oil and 7.5 million cubic feet of gas. Based on historical aerial photographs, the majority of drilling activity lasted less than 10 years. The main area of the Mesa field is listed as abandoned in 1976 by DOGGR, although most activity had ceased many decades prior to that date.

Residential development of the general Mesa area mostly occurred after World War II, although the existing residence at 1250 Cliff Drive was probably built in the early 1900s. Based on our review of the online DOGGR data and DOGGR Map No. 301, the closest oil well or test hole to the property was the T.G. Ross test hole, located south of the property, approximately 50 feet south of Cliff Drive. The website and map indicate it was a dry hole and was "plugged" and abandoned. Another oil well, somewhat further southeast and approximately 100 feet south of Cliff Drive, is identified as the Trans-Oceanic Oil Corporation "Mdivani 1-A" well. It is also indicated to be plugged and abandoned.

CONCLUSIONS/RECOMMENDATIONS

There do not appear to be significant geologic constraints to site development. A subsurface investigation is recommended to develop design level geologic/geotechnical parameters for new development. The 1250 Cliff Drive site is not subject to volcanism, tsunamis, seiches, or seacliff retreat. No active or potentially active faults have been identified to exist through the site by regional mapping (Hoover and USGS). The site is not located in an earthquake fault zone that is currently mapped in accordance with the Alquist-Priolo Act of 1972. New structures should be designed to resist the effects of seismic ground motions in accordance with the current editions of the Uniform Building Code and the California Building Code.

The gentle to moderately sloping site has not been identified to contain landslides on the basis of regional mapping. Expansive soil may be present. A geotechnical investigation should include an analysis of that type of soil so that recommendations can be provided to the

design engineer to accommodate that condition in the site grading, building foundation, paving, and hardscapes.

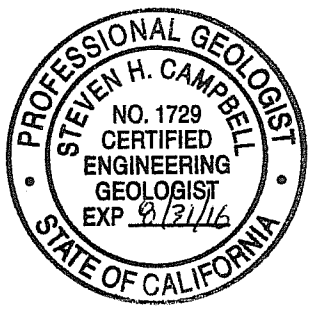
The California State Geological Survey's Radon Zone Map for Santa Barbara County (CDMG, 1995) indicates locally high radon levels may be encountered. Radon has not been specifically evaluated at this particular site. Control of radon is typically accomplished by "sub-slab or sub-floor depressurization" and venting, and it is not technically complicated.

For new development, we recommend that a detailed topographic map (1" = 40' or smaller suggested scale) be completed by a licensed land surveyor, including proposed building sites and the adjacent slopes. Aerial photographs, if they are made for the survey, should be reviewed for geologic features at and near the proposed building site, prior to a detailed geotechnical investigation.

LIMITATIONS

No subsurface investigation has been conducted by this office and, therefore, our conclusions/recommendations are preliminary. No warranty, expressed or implied, is made in connection with this report or other communications. This report is provided for the use and benefit of the Boyd Family Trust.

Please contact us if we can be of further service or if you have any questions.



Sincerely,
Campbell·Geo, Inc.

Steven H. Campbell
Certified Engineering Geologist
State of California, #1729

SHC/rig
Clients/Boyd/ Boyd R1.doc
Enclosure: Plate (1)

REFERENCES CITED

Bezore, S. and Wills, C.J., 1999, “Landslide Hazard Maps of Southeastern Santa Barbara County, California," USGS OFR 99-12.

California Geologic Survey and US Geological Survey, “The Uniform California Earthquake Rupture Forecast,” CGS Special Report 203A and USGS OFR 2007-1437A.

Cao, T., *et al*., 2003, “The Revised 2002 California Probabilistic Seismic Hazard Maps, June 2003” (modification of USGS Open-File Report 02-420, as used in Blake 2005).

City of Santa Barbara, 2013, "General Plan, Safety Element Technical Background Report - Appendix J. "

Dibblee, T.W., Jr., 1966, “Geology of the Central Santa Ynez Mountains Santa Barbara County, California,” Division of Mines, State of California Department of Natural Resources, Bulletin 186.

Dibblee, T.W., Jr., 1986, “Geologic Map of the Santa Barbara Quadrangle, Santa Barbara County, California,” Dibblee Geologic Foundation Map #DF-06, Santa Barbara, California.

Gurrola, L.D., 2002, “Geologic Map of the Western Santa Barbara Fold Belt, Santa Barbara, California,” UCSB Ph.D. Thesis.

Gurrola, L.D., 2006, “Active Tectonics and Earthquake Hazards of the Santa Barbara Fold Belt, Santa Barbara, California,” UCSB Ph.D. Thesis.

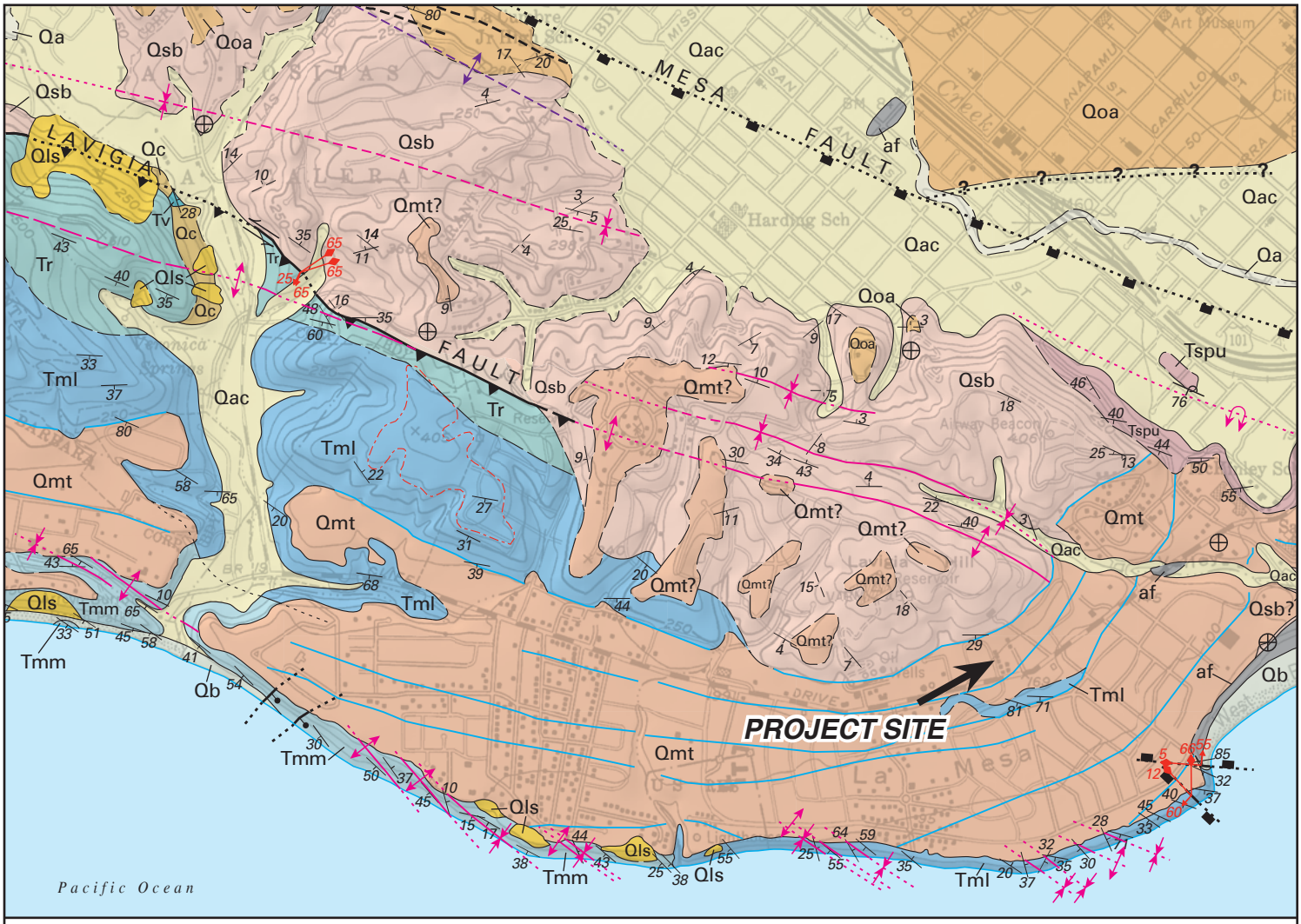
Hoover, M.F., 1978, “Geologic Hazards Evaluation of the City of Santa Barbara,” October 27, 1978.

Jennings, C.W., 2010, “Fault Activity Map of California,” California Geologic Survey, Geologic Data Map No. 6.

Minor, S.A., Kellogg, K.S., Stanley, R.G., Gurrola, L.D., Keller, E.A., and Brandt, T.R. 2009, “Geologic Map of the Santa Barbara Coastal Plain, Santa Barbara County, California,” U.S. Geological Survey Scientific Investigations Map 3001, Scale 1:24,000.

Namson, J. and David, T., 1990, “Late Cenozoic Fold and Thrust Belt of the Southern Coast Ranges and Santa Maria Basin, California,” AAPG Bulletin, vol. 7, No. 4, pp. 467-492.

State of California, Division of Mines and Geology, 1995, “Radon Zone Map for Santa Barbara County.



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

PROJECT LOCATION AND REGIONALGEOLOGIC MAP

1250 Cliff Drive
Santa Barbara, California

Date

EXPLANATION

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

N

SCALE IN FEET

0 2,000 4,000

SYMBOLS

- Formation contact; dashed where inferred
- Outline of erosionally beveled geomorphic surface
- Marine-terrace shoreline angle
- 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; small red arrow shows direction and angle of dip; red diamond arrow shows bearing and rake of slickenlines and inferred slip direction of hanging-wall block (70 / 80)
- Anticline/Overturned Anticline
- Syncline
- 20 — Strike and Dip
- Horizontal Bedding

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