APPENDIX D

Geology and Soils

GMU GEOTECHNICAL, INC.

23241 Arroyo Vista
Rancho Santa Margarita
CA 92688

voice: 949.888.6513
fax: 949.888.1380
web: www.gmugeo.com

PROJECT MEMORANDUM

To: Mr. Steve Chiu
APA Engineering, Inc.
9880 Irvine Center Drive
Irvine, California 92618

Date: October 24, 2013

Project No. 13-172-00

From: Bob Mutchnick, PG, CEG
Ali Bastani, PhD, PE, GE

Subject: **Aliso Viejo Ranch Project,** Preliminary Geologic, Corrective Grading, Infiltration, Seismic and Foundation Information

---

Geologic Data

The site is located north of Cedarbrook and west of Park within the City of Aliso Viejo and is underlain by artificial fill and alluvial soils over bedrock of the Monterey Formation. The fill is typically comprised of silty sand with some clay. The alluvium generally consists of silty sands to clayey silts. The surficial soils are considered to be moderately to highly expansive, based on the results of our laboratory testing. The bedrock of the Monterey Formation generally consists of clayey siltstone. No active or inactive faults are known to cross the site. No landslides have been mapped within the site. According to the State of California Seismic Hazard Zone map for the San Juan Capistrano 7.5-minute quadrangle, the site is susceptible to earthquake-induced liquefaction.

Subsurface Soil

Based on our site exploration, the subsurface soils consisted of undocumented fill and alluvium soils ranging from about 7.5 feet to greater than 25 feet over Monterey Formation bedrock. The maximum thickness of undocumented fill (i.e., about 5 feet) was located within and adjacent to the graded pad area in the central portion of the site (i.e., future basketball facility and southerly portions of community center) and northeasterly area (i.e., future open field activity area). Fill materials encountered within the remaining portions of the site were less than 2 feet thick. The deepest alluvial soils encountered (i.e., >25 feet) were present in the central and southerly portion of the site. The encountered fill consisted of damp to moist, medium dense, silty sands with some clay. The alluvial deposits generally consisted of dry to wet, medium dense to dense, silty sands and moist to wet, firm to stiff clayey silts. The Monterey Formation bedrock, where encountered, consisted of moist to wet, firm to very stiff, clayey silts.

Groundwater Table

Groundwater table was encountered at 15 to 25 feet below ground surface (bgs) across the site. According to the State of California Seismic Hazards Zone Report for the San Juan Capistrano 7.5 minute Quadrangle, the highest historic groundwater table was 5 feet bgs. Since the historic groundwater table of 5 feet bsg is unlikely and will partially flood Aliso Viejo Middle School, we utilized a groundwater depth of 10 feet bsg in our liquefaction analysis.

Corrective Grading

Removal of Existing Fill: All existing fill materials underlying and/or providing lateral support for the proposed improvements at the site shall be removed. Based on our exploration, up to about 5 feet of fill is present within and adjacent to the graded pad area at the central portion of the site (i.e., future basketball facility and southerly portion of community center building) and at the northeasterly portion of the site (i.e., future open field activity field). The fill materials encountered throughout the remainder of the site were less than 2 feet thick.

Building Pad Areas: Corrective grading shall extend a minimum of 5 feet below the existing ground surface or below the depth of existing fill (i.e., removals within existing graded pad area described above are expected to on the order of 10 feet). The corrective grading also needs to provide a minimum of 3 feet of engineered fill beneath the bottom of proposed foundations; therefore additional corrective may be required. Removals should extend across the entire building pad, and extend a minimum of 5 feet laterally beyond the edges of foundations or equidistant to the depth of fill below the foundation, whichever is greater.

Miscellaneous Foundations: Corrective grading for miscellaneous foundations (i.e., for screen walls, planter walls, pilasters, trellis structures, etc.) shall extend a minimum of 3 feet below the existing ground surface or below bottom of the fill. The removals should extend a minimum of 2 feet laterally beyond edge of foundations or equidistant to the depth of fill below the foundation, whichever is greater.

Pavement and Hardscape Areas: Corrective grading shall extend at least 3 feet below the existing grade or below fill. Additional corrective grading, may be required to provide for a minimum of 1 foot of engineered fill beneath the bottom of the structural sections. Corrective grading should extend 3 feet laterally beyond the improvement footprint.

Infiltration

The results of the infiltration testing indicated infiltration rates ranging from 0.2 to 0.5 inch per hour with an average rate of 0.35 inch per hour.

Seismic Design

Site-specific seismic design parameters were determined using the USGS computer program titled “Seismic Hazard Curves and Uniform Hazard Response Spectra, Version 5.1.0.” The site coordinates used in the analysis were 33.5805° North Latitude and 117.7145° West

Longitude. On-site structures should be designed in accordance with the following 2010 CBC criteria:

Parameter	Factor	Value
Mapped Spectral Response Acceleration (0.2 sec Period)	S_S	1.466g
Mapped Spectral Response Acceleration (1.0 sec Period)	S_1	0.518
Site Class	Site Class	D
Site Coefficient	F_a	1.0
Site Coefficient	F_v	1.5
Maximum Considered Earthquake Spectral Response Acceleration (0.2 sec Period)	S_{MS}	1.466g
Maximum Considered Earthquake Spectral Response Acceleration (1.0 sec Period)	S_{M1}	0.777g
Design Spectral Response Acceleration (0.2 sec Period)	S_{DS}	0.978g
Design Spectral Response Acceleration (1.0 sec Period)	S_{D1}	0.518g

Liquefaction Potential: Low ___, Med. __**X**_, High _____
Earthquake-Induced Settlement: Low ____, Med. __**X**_, High _____
Expansive Soils: No ____, Yes __**X**__
Corrosive Soils: No ____, Yes __**X**__

Building Foundations - Post Tensioned or Shallow Foundation with Conventional Slab

Post Tensioned Slab

Foundation Type: Post-tensioned ribbed or mat slab

Cut-Off Barrier: Install a vapor barrier, Stego 15 Mil Class A or equivalent, to about 5 feet below grade around the entire perimeter of the building to act as cut-off against water intrusion below the slab.

Bearing Material:	Minimum 3 feet of engineered fill
Allowable Bearing Capacity:	2000 psf Minimum depth (see edge beam thickness)
Ultimate Coefficient of Friction:	0.35
Ultimate Passive Resistance:	250 psf/ft (disregard upper 6 inches of embedment)
Modulus of Subgrade Reaction:	50 pci
Slab Subgrade Moisture Conditioning:	Minimum 3% over optimum - depth of 18 inches
Slab Thickness:	Slab – Per Structural Engineer Ribbed Slab – Minimum 5-inch-thick slab Stiffness of ribbed slab equivalent to mat slab
Edge Beam Thickness:	Ribbed slab - minimum 24-inch embedment from lowest adjacent soil grade Mat slab – minimum 12-inch embedment from lowest adjacent soil grade
Reinforcement:	Minimum two #5 bars @ top and bottom of edge beam or rib

PTI Foundation Design Parameters and Recommendations

General:	Slabs designed for both potential expansion and settlement
Expansive Soils:	Utilize PTI Manual, Latest Edition If PT ribbed slab design selected, stiffness to be equivalent to stiffness PT mat slab Center Lift: E_m = 9.0 ft Y_m = 0.44 inch Edge Lift: E_m = 5.7 ft Y_m = 1.95 inch
Settlement:	Shall be reviewed when column and wall loads become available
Deflection Criteria:	As a minimum, stiffness coefficients contained in Table 6.2 of the PTI Manual, 3rd Edition corresponding to “Stucco or Plaster” should be utilized

Concrete:	0.45 w/c ratio, f'c $\geq$4500 psi (sulfate resistance)
Cement Type:	V
PT End Caps:	Full encapsulation required
Steel Reinforcement:	Minimum concrete cover of 3 inches
Vapor Retarder:	Stego 15 or equivalent 4" sand required beneath vapor retarder Sand above retarder per structural engineer and/or PT designer

Shallow Foundation with Conventional Slab

Foundation Type:	Continuous and spread footings
Cut-Off Barrier:	Install a vapor barrier, Stego 15 Mil Class A or equivalent, to about 5 feet below grade around the entire perimeter of the building to act as cut-off against water intrusion below the slab.
Bearing Material:	Minimum 3 feet of engineered fill
Design Settlement Values:	Shall be reviewed when column and wall loads become available

Foundation Design Parameters:

• Minimum Footing Depth:	Interior footing: 24 inches below top of slab Exterior perimeter footing: 24 inches below lowest adjacent grade
• Minimum Footing Width:	24 inches
• Allowable Bearing Value:	2,000 psf, 1/3 increase for transient loads
• Modulus Subgrade Reaction:	50 pci
• Ultimate Passive Resistance:	250 psf (disregard upper 6 inches of embedment; when combining with friction, passive should be reduced by one-half)
• Ultimate Coefficient of Friction:	0.35
Slab Design:	In accordance with the WRI/CRSI publication "Design of Slab-on-Ground Foundations" utilizing an Effective Plasticity Index of 45

Minimum Slab Thickness:	Minimum 8-inches thick - designed by structural engineer
Minimum Slab Reinforcement**:**	Minimum double layer of No. 5 bars placed at 12 inches on center, to be designed by structural engineer. Reinforcement spacing may be revised by structural engineer based on confirmation of design with geotechnical engineer.
Slab Subgrade Moisture Conditioning:	Minimum 3% over optimum - depth of 18 inches
Concrete:	0.45 w/c ratio, f'c $\geq$4500 psi (sulfate resistance)
Cement Type:	V
Steel Reinforcement:	Minimum concrete cover of 3 inches.
Vapor Retarder:	Stego 15 mil or equivalent. 4" sand required beneath vapor retarder. Sand above retarder per structural engineer.

Additional Field Investigation Required: Yes: _____ No: ___**X**___