PYRAMID GEOENGINEERING, INC.

No. 21-436
May 7, 2021

Plantation Ranch Holding Company, LLC
c/o Suzanne L. Brown, Manager
34285 Kruse Ranch Road
Cazadero, CA 95421

Subject: **GEOTECHNICAL EVALUATION and FOUNDATION PLAN REVIEW**
Proposed Water Storage Tank
34285 Kruse Ranch Road
Cazadero, CA 95421
APN: 109-030-003-000

Reference: SESOL, Inc., Structural Engineering Solutions, Structural Plans and Details, Pioneer Water Storage Tank, XLE 50-03, Plantation Ranch, 34285 Kruse Ranch Rd, Cazadero, CA, Sheets S-1 to S-7A, dated 12/23/2020.

Dear Suzanne L. Brown:

As requested, Pyramid GeoEngineering, Inc. (PGI) performed a geotechnical evaluation and plan review for a proposed new metal water storage tank on the referenced parcel. The purpose of the study was to evaluate and report geotechnical site conditions relative to the proposed structure and review of the proposed plans. Based on our evaluation and on-site subsurface exploration and observations, we submit the following comments.

INTRODUCTION

Site Description and Proposed Project

The subject building site is approximately located as shown on Figure 1, Site Vicinity within a parcel approximately 30 acres in size. The proposed tank site is in a wooded area in the northeast-central portion of the property in a nearly level clearing on a generally moderate, southwest-facing hillside. We understand the final tank site may be moved a few feet in any direction, depending on the locations of the trees. The proposed location of the tank site was marked by paint on the ground by the owner's representative. No site plan was available. The coordinates of the site were determined to be Latitude. 38.5903 and Longitude -123.308055.

The proposed steel tank will be approximately 39.5 feet in diameter and 10.5 feet in height to hold a maximum of approximately 10 feet of water. The tank is planned to be supported on a reinforced concrete ring foundation, 18 inches in width and 16 inches in depth, including 12 inches in depth below adjacent grade. The interior of the structure is planned to be on 4 inches of sand over pad grade (see referenced plans, Sheet S-1).

Scope

The scope of work for the proposed steel water tank included the following:

- Researching soil and geotechnical data,

- Exploring subsurface soil conditions,
- Analyzing the soil data compiled during the exploration,
- Reviewing geotechnical aspects of construction plans for the structure,
- Reporting our findings, and
- Providing recommendations for the foundation and site drainage.

This study excluded assessments for soil corrosivity, toxic substances, including mold, and soil or groundwater contamination and flood zone considerations.

GEOTECHNICAL EVALUATION

Geologic Setting

According to Special Report 120, Geology for Planning in Sonoma County (1980) and other published mapping, the general geology of the site area consists of Franciscan Assemblage, including sandstone and shale, with surficial residual soils and colluvial deposits in the area. The reviewed mapping does not indicate the presence of landslides in the vicinity. We did not observe indications of possible landslides at the site, although some localized shallow creep of surficial soils were present on nearby slopes as indicated by tree growth.

Seismic and Earthquake Hazards Considerations

Since this region is subject to moderate to high seismic activity, the probability of a major earthquake occurring within the economic life of the proposed improvements is high and structural damage may result. The hazard of seismic shaking is common to the subject geographic area.

The seismic risk to a structure depends on the distance from the epicenter; the characteristics of the earthquake; the geologic, groundwater, and soil conditions underlying the structure and its vicinity; and the nature of the construction. Ground rupture tends to occur along lines of previous fault rupture or tectonic creep.

The site is located within an Alquist-Priolo Earthquake Fault Zone. The nearest significant fault designated as active is the San Andreas Fault, with the nearest of 3 mapped fault traces located about 160 feet southwest of the site. There are several other historically active and potentially active faults in the region that could also cause ground shaking and ground failure at the site during a major earthquake. Under current regulatory requirements, it is our opinion that no additional geologic investigation is warranted for the proposed water tank.

Geotechnical Earthquake Design Parameters

Field data, and our experience in the site vicinity, as well as reviewed geologic mapping, indicate that the site and proximity can be assigned a Site Class D based on average soil/rock properties in the top 100 feet. Although the bedrock may be relatively shallow, we have assumed the site seismic parameters to be influenced by the surficial soils. The project designers should determine the appropriate Occupancy Category and Seismic Design Category per the 2019 CBC.

Based on our evaluation, we submit the following seismic parameters for the subject site. The seismic design criteria are based on the guidelines in ASCE 7-16 Standard using the site coordinates (longitude and latitude), Site Class D for site-specific subsurface conditions, and an assumed Risk Category=II for the proposed structure. If another Standard or other parameters are preferred, please advise. The resulting seismic design factors are summarized below.

SUMMARY OF SEISMIC DESIGN FACTORS

Site Location: Lat. 38.590278, Long. -123.308056; Site Class: D

Factor	Value
S_S	2.465
S_1	1.034
S_{DS}	1.644
PGA	1.054

Conformance to current seismic design criteria does not constitute any kind of guarantee or provide any specific assurance that significant structural damage or ground failure will not occur during a significant seismic event. The primary goal of seismic design is to protect life, and not to avoid all damage, since such design may be economically prohibitive. Following a major earthquake, a structure may be damaged beyond repair, yet not collapse.

Site Exploration

The subsurface conditions were investigated on April 21, 2021, by performing two exploratory test pits using a backhoe provided by the owner at the north and south edges of the designated tank location as shown on Figure 2 (a detailed site plan was not available at this time). The materials encountered in the exploration are described in the attached logs on Figure 3 and summarized below. The observed soils were identified in general accordance with the attached Soil Classification System Summary, Figure 4.

The Exploratory Test Pit T-1 generally encountered about 0.8 foot of clayey sand to sandy clay, with gravel and roots (topsoil) over sandy clay soils to the termination depth of 4 feet. Test Pit T-2 encountered about 1.0 foot of clayey sand to sandy clay (topsoil) over layers of sandy clay and silty clay to the termination depth of about 4 feet. No bedrock was encountered in either test pit.

Groundwater

Free ground water was not observed in the test pits at the time of exploration. Water levels must be expected to vary due to seasonal changes and physical changes to the site. Seasonal ground water may occur at very shallow depths at or near the surface.

Expansion Potential

Available soil mapping (See References) indicates the presence of soils with low to high expansion potential, depending on variable clay content. Laboratory tests on one sample from each test pit indicated a high expansion potential in the site soils, with Expansion

Indexes of 110 and 113. The recommendations presented below incorporate our observations of the expansion potential for the soils encountered.

Liquefaction Potential

Liquefaction potential is considered very low due to the subsurface conditions at the site and the absence of saturated, granular deposits that would react to cyclic seismic loading.

Geotechnical Evaluation Conclusion

Based on our observations, we judge that the proposed improvement, construction of the proposed steel water tank, is geotechnically feasible. Our exploratory test pits confirm that the site soils have a bearing capacity of a minimum of 1500 psf and are therefore suitable for the support of the water tank, provided that the recommendations provided below for the foundation and site drainage are followed.

GEOTECHNICAL FOUNDATION PLAN REVIEW

The review was strictly limited to the geotechnical aspects of the plans and details in the referenced documents. The purpose was to confirm that the geotechnical aspects of the design of the proposed water tank foundation were in general conformance with the intent of the geotechnical engineer's geotechnical evaluation.

Based on our review, it is our opinion that the geotechnical aspects of the referenced plans and related details are in general conformance with the intent of the geotechnical engineer's evaluation, subject to the following comments and recommendations:

1. **Foundation:** We concur with the proposed foundation design. However, we recommend that the site be graded to remove the layer of topsoil from the tank footprint plus 3 feet laterally outside the footprint. The topsoil encountered was 0.8 to 1.0 foot in depth, but may be more or less in depth at the site. It is possible that depths of the excavation may vary, depending on conditions observed during excavation. The topsoil should be replaced with approved engineered fill and more fill should be added to increase the pad level by an additional 1.0 foot. The regrading should extend to at least 3 feet outside the tank perimeter. The intent of having a building pad area of 2.0 feet of engineered fill is to help mitigate the potential effects of the underlying highly expansive clay soils. Site grading recommendations are attached as Figure 5.

   We recommend that the building pad excavations be observed by the geotechnical engineer or the engineer's representative to confirm that the subsurface conditions are as expected. The engineered fill placement will require geotechnical observations and testing.

2. **Drainage:** Suitable surface drainage should be constructed around the proposed water tank perimeter. At the time of our site visit, we observed that the ground surface on the upslope side of the tank site was adversely sloped downward towards the structure site. It is important that the ground surface around the entire perimeter be re-graded as necessary to have the ground sloped downward away from the structure. The 2019 CBC requires a minimum slope gradient downward away from the structure of 6 inches in 10 feet, or into a drainage swale provided to remove

surface water from the perimeter of the structure. All swale and drainage features should be designed and constructed to prevent concentration of flows and erosion.

3. **General:** We reserve the right to modify or supplement the geotechnical recommendations at any time during site development.

LIMITATIONS

Our scope of services does not include obtaining permits for any aspect of the subject project. The project Owner or Owner's representative is responsible for obtaining necessary permits for the project.

This report has been prepared for the exclusive use of the client and the client's consultants for specific application to the proposed project. Recommendations contained in this report are valid for a period of 1 year; after 1 year they must be reviewed by this firm to determine whether or not they still apply. If changes occur in the nature, design location, or configuration of the proposed development, the conclusions and recommendations contained here shall not be considered valid unless the changes are reviewed by our firm.

Our services have been provided in accordance with generally accepted geotechnical engineering practices. No warranties are made, express or implied, as to the professional opinions or advice provided. The analysis, opinions, conclusions and recommendations submitted in this report are based in part on the referenced materials, site visit and evaluation, and limited subsurface exploration. The nature and extent of variations in subsurface conditions within the construction area may not become evident until construction. If variations appear, it will be necessary to re-evaluate or revise recommendations made in this report. We do not guarantee construction, nor do we assume the contractor's primary responsibility to produce a completed project conforming to the project plans and specifications.

If you have any questions or require additional information, please contact this office.

Very truly yours,

PYRAMID GEOENGINEERING, INC.

5/7/2021

Don R. Poindexter, C.E., G.E.
Geotechnical Engineer
GE-690, Exp. 12/31/21

Attachments:
References
Figure 1, Vicinity Map
Figure 2, Exploration Location Plan
Figure 3, Exploratory Test Pit Logs.
Figure 4, Soil Classification System Summary
Figure 5, Building Area Grading Recommendations

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Figure 1

NOT TO SCALE

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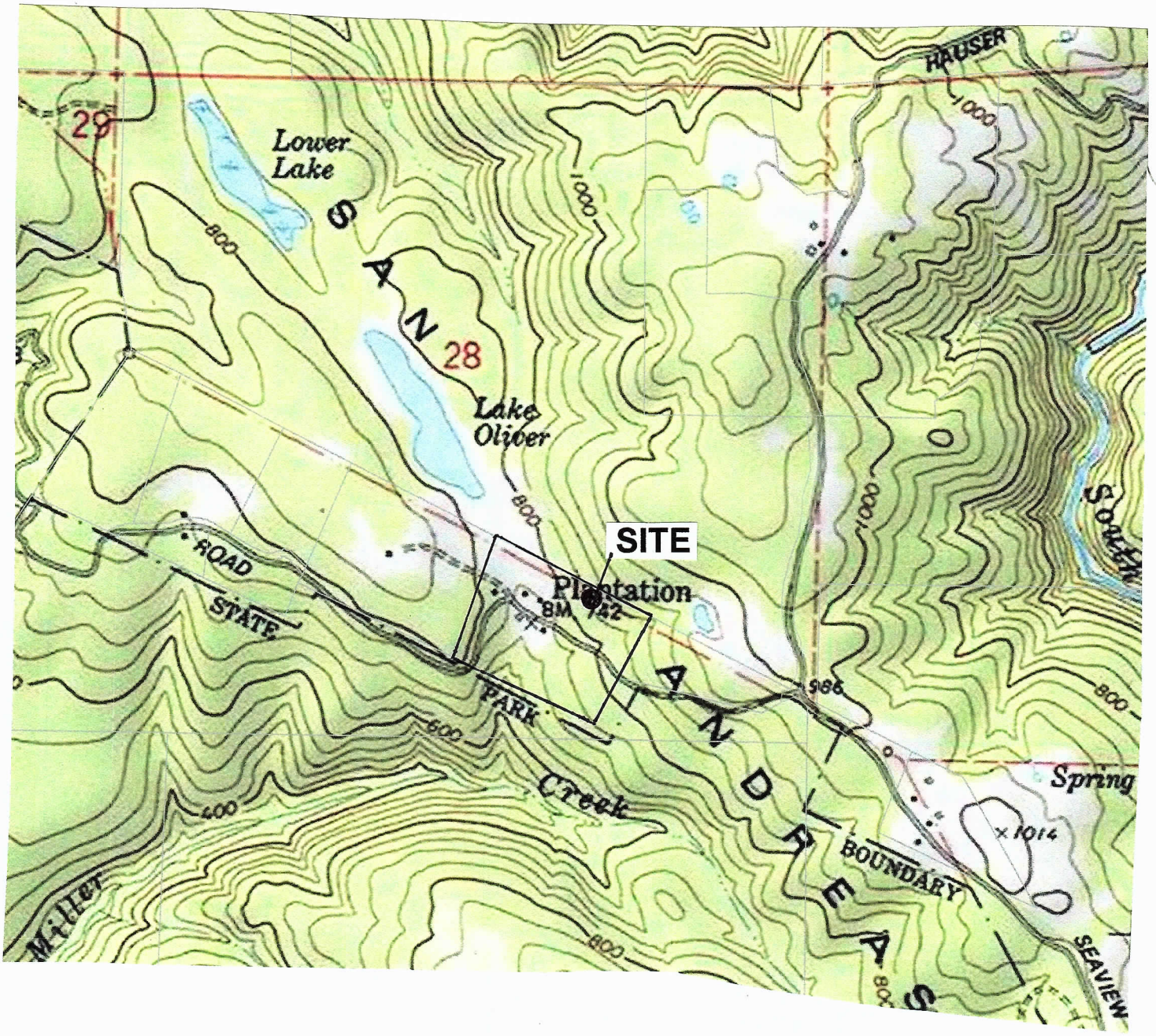

Source: USGS/Sonoma County Maps

VICINITY MAP

PYRAMID GEOENGINEERING, INC.

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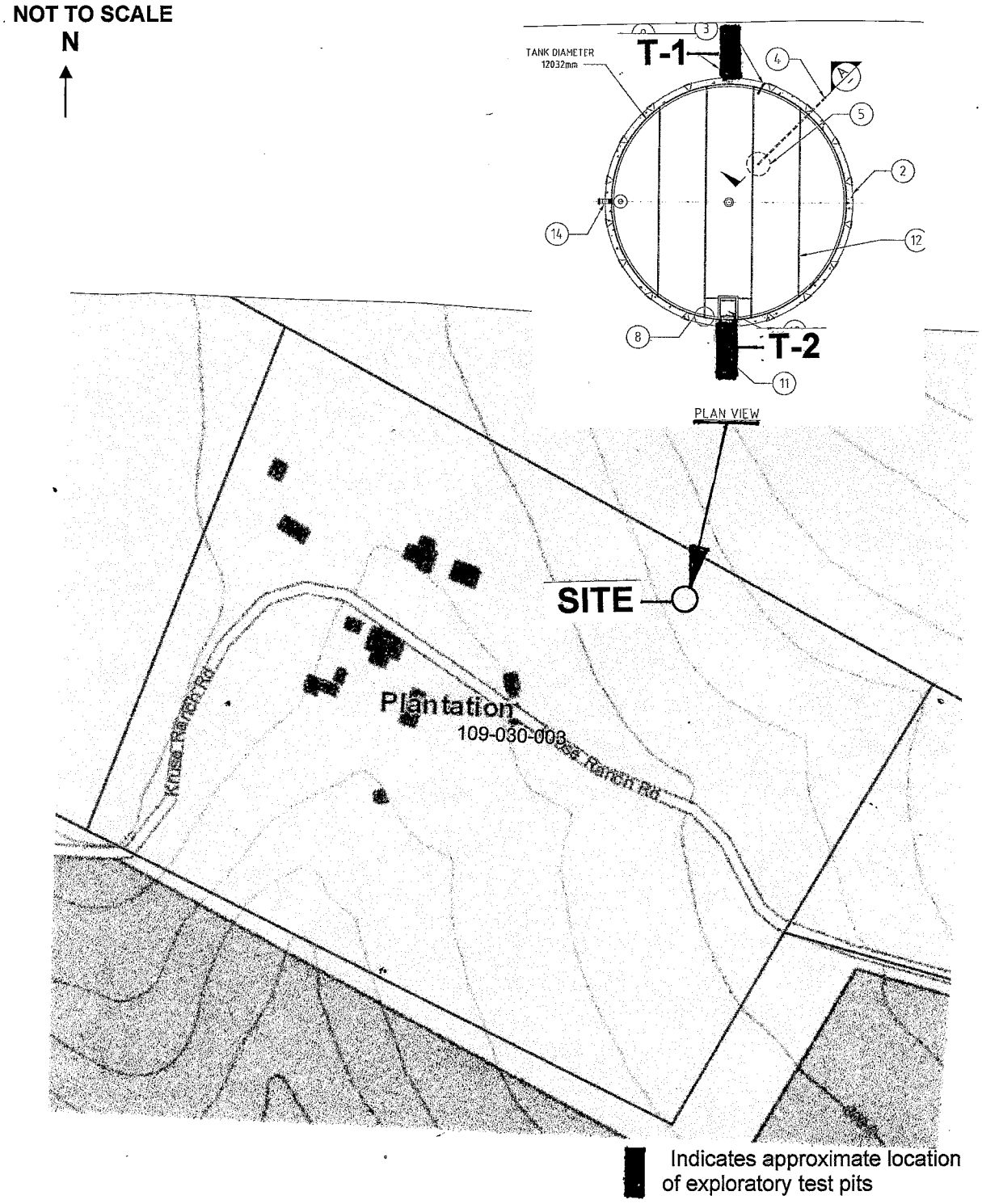
Figure 2



Source: Sonoma County Maps/SESOL Tank Plan
Note: Site Specific Plan Not Available
Tank Location: Lat. 38.590278, Long. -123.308056

EXPLORATION LOCATION PLAN

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LOGS OF TEST PITS

Date: 04/21/21 Surface gradient: Level +/-	Pit dimensions: 1.5Wx7Lx4D Pit orientation: N-S Groundwater depth: None	Logged by: DP Contractor: Client Equipment: Backhoe	Test Pit T-1

Depth (ft.)	Samples: Bulk	Samples: Tube	Pocket pen (tons/ft²)	Plasticity Index	Dry density (PCF)	Field moisture (%	Soil type USCS	Description and Remarks	Notes
1							SC/CL	**0.0-0.8 FT:** CLAYEY SAND TO SANDY CLAY, WITH ABUNDANT ROOTS AND ORGANICS, WITH GRAVEL, MEDIUM YELLOW BROWN, MOIST, LOOSE/SOFT. (TOPSOIL) **0.8-2.0 FEET:** SANDY CLAY, WITH SOME ROOTS, WITH FINE TO MEDIUM SAND SEAMS, MEDIUM YELLOW BROWN, MOIST, MEDIUM STIFF TO STIFF. **2.0-4.0 FEET:** SANDY CLAY, REDDISH BROWN, MOTTLED WITH GRAY AND YELLOW BROWN, WITH FINE TO MEDIUM SAND SEAMS, MOIST, STIFF. (COLLUVIUM)	Location: North edge of tank site. *PENETROMETER: @1.0 FT.=1.5 tsf @1.5 FT.=2.5 tsf Bulk Sample-1-2 ft. Expansion Index: EI=113
2	■		*				CL		
3							CL		
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									

Date: 04/21/21 Surface gradient: Level+/-	Pit dimensions: 1.5Wx5Lx4D Pit orientation: N-S Groundwater depth: None	Logged by: DP Contractor: Client Equipment: Backhoe	Test Pit T-2

Depth (ft.)	Samples: Bulk	Samples: Tube	Pocket pen (tons/ft²)	Plasticity Index	Dry density (PCF)	Field moisture	Soil type USCS	Description and Remarks	Notes
1							SC/CL	**0.0-1.0 FT:** CLAYEY SAND TO SANDY CLAY, WITH ABUNDANT ROOTS AND ORGANICS, DARK GRAY, MOIST, LOOSE/SOFT. (TOPSOIL) **1.0-3.0 FEET:** SANDY CLAY, YELLOW BROWN, MOTTLED WITH REDDISH BROWN AND GRAY, MOIST, MEDIUM STIFF TO STIFF. **3.0-4.0 FEET:** SILTY CLAY, WITH SAND, GRAY, MOTTLED WITH REDDISH BROWN, MOIST, STIFF. (COLLUVIUM)	Location: South edge of tank site. *PENETROMETER: @1.5 FT.=1.0 tsf @3.0 FT.=2.5 tsf Bulk Sample-2-3 ft. Expansion Index: EI=110
2			*				CL		
3	■		*						
4							CH		
5									
6									
7									
8									
9									
10									
11									
12									
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14									
15									

PYRAMID GEOENGINEERING, INC.	Client: Plantation Ranch Project: 21-436 Date: 05/07/2021	FIGURE 3

SOIL CLASSIFICATION SYSTEM SUMMARY

(Based on Unified Soil Classification System)

MAJOR DIVISIONS	SYMBOL	DESCRIPTION
GRAVEL	GW	WELL GRADED GRAVEL, GRAVEL-SAND MIX
	GP	POORLY GRADED GRAVEL, SANDY GRAVEL GRAVEL-SAND MIX
	GM	SILTY GRAVEL, POORLY GRADED GRAVEL-SAND-SILT MIX
	GC	CLAYEY GRAVEL, POORLY GRADED, GRAVEL-SAND-CLAY MIX
SAND	SW	WELL GRADED SAND, GRAVELLY SAND
	SP	POORLY GRADED SAND, GRAVELLY SAND
	SM	SILTY SAND, POORLY GRADED SAND-SILT-CLAY MIX
	SC	CLAYEY SAND, POORLY GRADED SAND-CLAY MIX
SILT AND CLAY	ML	SILT, SANDY SILT, CLAYEY SILT, NON- PLASTIC TO SLIGHTLY PLASTIC
	MH	CLAYEY SILT, MEDIUM PLASTIC TO PLASTIC FINE SAND-CLAY-SILT MIX
	CL	SANDY CLAY, SILTY CLAY, LEAN CLAY, GRAVELLY CLAY, LOW TO MEDIUM PLASTICITY
	CH	CLAY, SILTY CLAY, MEDIUM TO HIGH PLASTICITY
	OH	ORGANIC CLAY OR SILT, MEDIUM TO HIGH PLASTICITY

BUILDING AREA GRADING RECOMMENDATIONS

General

Grading is most economically performed during the summer months when soils are driest. Delays should be anticipated in site grading performed during the rainy season due to excessive soil moisture. Special and comparatively expensive construction procedures should be anticipated if grading must be completed during the winter or if the soils retain significant moisture into the dry season. Additional grading recommendations will be provided by PGI if needed during site development.

Clearing

Areas to be graded or receive improvements should be cleared of roots and organic materials. We anticipate that the required depth of stripping will generally be up to about 12 inches. Deeper stripping may be required to remove localized concentrations of organic matter, such as deeper roots or debris. The cleared organic materials should be removed; strippings may be stockpiled for reuse as topsoil in landscaping areas.

Subgrade Preparation

Soft or unsuitable soils should be removed from the building pad area. Where specified by the Geotechnical Consultant at the time of grading, exposed, suitable soils designated to support improvements or receive engineered fill should be scarified to a minimum depth of 8 inches, moisture conditioned to within approximately 2 percent of optimum moisture and compacted to at least 90 percent relative compaction in accordance with ASTM test designation D1557, or as determined by the Geotechnical Consultant.

General Engineered Fill

On-site clayey soils will not be appropriate for use as engineered fill due to high clay content. Approved imported non-expansive soils should be free of rocks or lumps greater than 4 inches in largest dimension and organic materials. Fill material should have a Plasticity Index of 15 or less or an Expansion Index of 50 or less and be approved by the Geotechnical Consultant prior to use.

General engineered fill should be placed in level lifts not exceeding 8 inches in loose thickness. Each lift should be moisture conditioned to within approximately 2 percent of optimum moisture and compacted to at least 90 percent relative compaction in accordance with ASTM test designation D1557. Fill moisture content and density should be verified by the Geotechnical Consultant.