Alpha Geotechnical and Testing Services, Inc.
Certificate of Authorization No. 00007967
Foundation Evaluations
Environmental Studies
Construction Materials Testing

June 30, 2023
File No. 23-5612

Mr. Rob Kasper
Lock and Load Storage, LLC
3196 Merchants Row Blvd., Suite 130
Tallahassee, FL 32311

Subject: Subsurface Exploration and Geotechnical Evaluation for **Lock and Load Storage Facility** – Parcel #2133206040020, Tallahassee, Florida

Dear Mr. Kasper:

As authorized by you on May 19, 2023, Alpha Geotechnical and Testing Services, Inc. has completed a subsurface soil exploration at the subject site. The purpose of this exploration was to evaluate subsurface conditions encountered in our test borings as they relate to construction of three new storage warehouse buildings, parking and drive areas, and a storm water management facility (SWMF). A total of fourteen soil test borings and two *in-situ* infiltration tests were conducted along with selective laboratory classification tests to aid in our evaluation.

As a summary of our findings and recommendations, the bores primarily encountered silty sands until depths as much as about 8 ½' at one of the SWMF borings to as little as 6" deep in the northeastern part of the site. Next, variable marbled colored clayey sands were typically penetrated, often underlain by fat clay (locally referred to as "pipe clay") as shallow as about 2' deep in the northwest corner of the site but usually around 4' to 5' deep elsewhere. The soils were generally found to be in a medium dense or very stiff condition. Groundwater was found only in one of the bores at about 12' deep at the time of drilling.

The fat clay soils are problematic in that they are moderately expansive, so special stiffening of foundations will be needed for the buildings. Additionally, since some manmade fill appears to exist near the surface in one or more locations, all building and pavement area footprints should be thoroughly compacted with a heavily loaded dump truck or roller-compactor to increase bearing capacity and to aid in identifying any "soft" areas. Thereafter, a safe allowable bearing capacity of 2,500 pounds per square foot should be available for shallow spread footings.

At the storm water pond, the infiltration test results at a depth of about 3' below the surface averaged 4.74 inches/hour in the silty sand soils. Groundwater was not encountered in either of the 20' deep borings at the SWMF, but we recommend a seasonal high groundwater atop the fat clay around 9' below the surface. In this regard, we recommend a safety factor of at least 5.0 with the average measured rate, so the design infiltration rate would be 0.95 inch/hour. This high safety factor should prevent groundwater mounding from occurring.

The recommendations submitted in this report are based upon the data obtained from the soil borings presented on Figure 1. This report does not reflect any variations that may occur between or away from the borings. Possible variations may not become evident until during the course of construction or during additional investigation. **Finally, we recommend a review of final design drawings and specifications by our office, to determine if recommendations made herein have been properly interpreted and implemented.** This exploration only deals with the near surface soil deposits. It is not intended to include analysis of deeper soil or rock strata where cavities and caverns may exist. Sinkholes do occur in Leon County; however, this report does not address the possibility of sinkhole occurrence at the site. This report documents our findings and recommendations and was prepared exclusively for use by our Client and their Consultants only for this project.

Sincerely,
Alpha Geotechnical and Testing Services, Inc.

Stephen P Shanley
Digitally signed by Stephen P Shanley
Date: 2023.06.30 17:25:54 -04'00'

Stephen P. Shanley, PE
FL #40653

This item has been digitally signed and sealed by Stephen P. Shanley, PE on the date adjacent to the seal. Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

STEPHEN P. SHANLEY
LICENSE
No. 40653
6/30/23
STATE OF FLORIDA
PROFESSIONAL ENGINEER

1.0 PROJECT DESCRIPTION

As listed by the Leon County Property Appraiser's office, parcel ID 2133206040020 at the northwest of the intersection of Appleyard Drive and Jackson Bluff Road on the west side of Tallahassee, Florida is the subject of our exploration. The site is approximately a 2.18-acre tract where a new mini storage warehouse facility is to be constructed. The property is currently undeveloped and primarily grass covered.

Your civil engineering consultant, Mr. Ryan Culton, PE, provided us a copy of the *Grading and Drainage Plan* (the *Plan* - sheet 7) for the project. The *Plan* shows the footprints of two single-story storage buildings generally situated on the northeast portion of the property and a two-story structure at the northwest. A storm water management facility (SWMF) is shown in the south end of the site. Proposed parking and drive areas traverse the property. An excerpted portion of the *Grading and Drainage Plan* is included in our Figure 1 drawing at the end of this report to display our boring locations.

Since the site is relatively flat, we anticipate site grading will require minimal cut and fill (estimate ± 1' to 2' overall) except for construction of the SWMF which we anticipate will be dug approximately 3' into the existing earth. We expect the buildings will be pre-fabricated metal structures or with masonry walls with concrete floor slabs on grade and perimeter "turned down" or shallow strip footings. Continuous wall footing loads are not expected to exceed 3 kips (a kip is 1,000 pounds) per lineal foot and column footings, if any, should be no more than 75 kips each.

The recommendations contained in this report will not necessarily apply if loading conditions are in excess of these estimates, so please advise if needed.

2.0 FIELD EXPLORATION

To evaluate subsurface conditions, fourteen soil test borings were conducted at the site and are designated B-1 through B-14 as shown on Figure 1. Eight of the borings (B-1 through B-8) were done within planned building footprints and advanced to 15' below existing land surface; four pavement area bores (B-9 through B-12) penetrated 5' each; two borings (B-13 and B-14) were completed within the SWMF to 20' each. Borings B-1 and B-4 were conducted with our Simco model 2800 drill rig using solid augers. The consistency (relative hardness) of the soils was determined by measuring blow counts (N-values) by driving a split-spoon sampler with a 140-pound sliding hammer in accord with the Standard Penetration Test (SPT) method (ASTM D 1586). The remaining borings were done with hand operated augers (ASTM D 1452) and borings B-2, -3, -5, -6, -7 and -8 were supplemented with readings from a dynamic cone penetrometer (DCP) device (ASTM Special Technical Publication #399) to determine soil consistency. "P-value" readings from the DCP are comparable to the SPT "N-value".

The locations of the borings are shown on the attached Figure 1. The locations were determined by taped measurement from existing site features. Therefore, locations should be considered accurate to the degree of the method of measurement used.

Also, we dug test pits adjacent to boring B-13 and B-14 to a depth of approximately 3' where we performed a test for *Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer* (ASTM D 3385). Metal rings with internal diameters of approximately 1 and 2 feet were driven into the ground at the depth described above. The inner ring was advanced to about 3"; the outer ring penetrated about 4". An approximate 1½" head of water was maintained within both during performance of the test and we observed the infiltration rate over a period of at least 6 hours on 6/26 (B-13) and 6/27/23 (B-14).

3.0 SUBSURFACE CONDITIONS

3.1 General

Subsurface conditions encountered during our field exploration are shown on the soil boring profiles presented on Figure 1. The stratification lines represent the approximate boundaries between the soil layers, but subtle changes in the soil matrix may make these changes more gradual than the boundary lines tend to illustrate.

The soil descriptions shown adjacent to the boring profiles on Figure 1 are based on a visual/manual classification procedure in accordance with the methodology presented in ASTM D 2488. We supplemented these with a few laboratory classification tests to confirm our classifications in accordance with the Unified Soil Classification System (ASTM D 2487).

3.2 Soil Conditions

Brown to brownish gray and sometimes black silty sand topsoil was first penetrated in most borings, extending to about 6". Variable tan to orange silty sand strata were next penetrated in the borings on the west side of the property until about 2' to 5' deep (up to 8 ½' deep at B-14) whereas most of the northeast borings found variable colored clayey sands below the topsoil. The west side borings likewise penetrated variably colored clayey sands below the silty sand layers. In general, with exception of the shallow pavement area borings, all but one of the deeper borings encountered variable red, orange and white marbled fat clay "sandwiched" between similar clayey sand strata. This fat clay appears as shallow as about 1 ½' to 2' deep in borings B-1 and B-5 and first discovered at 9' deep in B-2 (fat clay was not found in B-6). The deeper reaches of some of the borings finally advanced into silty sands before terminating at 15' to 20'.

A notable exception was the discovery of possible manmade fill extending to about 3' deep in boring B-10 at the northeast corner within the planned roadway.

Based on the penetration resistance "N-values" and "P-values", the near surface silty and clayey sand soils are in a loose to medium dense condition and the deeper fat clays are very stiff.

The reader should examine the individual boring profiles on Figure 1 for a more detailed description of the subsurface conditions at the locations drilled.

3.3 Groundwater Conditions

A groundwater table was detected only in the silty sand stratum at boring B-4 at a depth of 11.9' the day after completion. However, we anticipate that perched groundwater may occur atop the very clayey sand to fat clay strata in some areas during heavy, prolonged rain periods. Therefore, we recommend considering a "seasonal high" groundwater table atop these layers at an average depth around 9' below the surface (approximately elevation 57').

3.4 Infiltration Characteristics at SWMF

Based on the results from the double-ring infiltrometer test, an unsaturated vertical infiltration rate of 7.47 inches/hour and 2.00 inches/hour was determined when flow became stabilized after an elapsed time of 6 hours within the bottom of the 3' deep pits adjacent to boring locations B-13 and B-14, respectively.

4.0 LABORATORY TESTING PROGRAM

Laboratory testing was performed on selected samples to aid in soil classification and to further define the engineering properties of the soils. The laboratory tests included Natural Moisture Content (ASTM D 2216), Percent Finer than the U.S. No. 200 Sieve (ASTM D 1140, to assess percent silt and clay), and Atterberg Limits tests (ASTM D 4318, to evaluate plasticity characteristics). The test results are presented on Figure 1 adjacent to the soil boring profiles, at the depth from which the samples were recovered.

5.0 ENGINEERING EVALUATION AND RECOMMENDATIONS

5.1 General

Because the building and parking/drive footprints will be constructed in areas where we found some loose surface soils and based on the discovery of possible manmade fill in one boring (B-10), it will be very important to "proof-roll" the building and parking/drive areas. This will increase bearing capacity and reduce the potential for excessive settlement. This action should also aid in detecting possible "weak" areas that could require improvement. Moreover, prepared footing bottoms will likewise require densification. Details of the necessary densification and proof-compacting are included in the next section.

Further, given that fat clay (locally referred to as "pipe clay") with a moderate propensity to shrink and swell with varying moisture conditions is within the zone of influence of shallow foundations, we recommend that all footings should be specially stiffened with a top and bottom layer of reinforcing steel to mitigate potentially significant differential movement associated with volume changes in the clays. Because the clays are deeper and shallower in some bores, such differential could be accentuated – estimate up to 1" from one end of a building to the other.

With regard to anticipated infiltration of storm water through the bottom of the planned pond, we recommend a safety factor of at least 5.0 should be applied to the measured rate to accommodate possible soil variation and future maintenance concerns such as sedimentation of pond bottom as well as the somewhat restrictive clayey sand and fat clay layers found at greater depth. Therefore, we recommend that the pond may be designed with a vertical infiltration rate of no more than 0.95 inch/hour. The horizontal permeability is estimated to be 1.5 times the vertical infiltration value. Although we expect a seasonal high groundwater table about 9' below surrounding ground at the SWMF (estimate about 6' below pond bottom), groundwater mounding should not occur so long as the pond is designed with the recommended infiltration rate above.

To summarize requirements of the Leon County ordinance regarding storm water design standards:

- The average measured unsaturated infiltration rate was found to be 4.74 inches/hour. Based on available literature, the saturated infiltration rate is estimated to be approximately 25% faster – about 5.9 inches/hour.
- A clay confining layer is intermittently present across the site but appears no closer than 9 ½' deep at one of the SWMF borings and deeper at the other.
- Given the presence of relatively pervious silty sands that should form the pond bottom and thus allow both vertical and horizontal flow, we do not believe that groundwater mound should occur.
- We recommend using the average measured unsaturated infiltration rate within the test pits with a safety factor of 5.0 for the design infiltration rate of the SWMF. Therefore, a design infiltration rate of 0.95 inch/hour may

be used for the pond. This reduced rate should adequately accommodate impacts from construction and future maintenance concerns such as clogging as well as possible mounding.

5.2 Site Preparation

The following are our recommendations for site soil preparation and foundation design for a shallow foundation system. These recommendations should be **incorporated into the project specifications.**

1. The entire structure area "footprints" and planned pavement areas, plus a minimum margin of five feet laterally, should be stripped and grubbed of all surface vegetation, debris and other deleterious material, as encountered. During the clearing and grubbing operation, roots with a diameter greater than one-inch or small roots in high density should be completely removed. These materials should be disposed in areas designated by the Owner. Excavated soils may be stock-piled for later reuse. Most of the near surface silty sand soils (but not the topsoil), particularly on the west and south portion of the site, could be used for structural fill or back-fill on the site so long as they comply with the recommendations included in item 5 below.

   Any existing utility pipelines (*e.g.* storm sewer lines, drain-field piping, *etc.*) that currently lie within new building footprints should be removed and back-filled, not just abandoned in place.

2. The cleared and/or cut surface in building construction areas must be proof-rolled using a heavily loaded dump truck or roller-compactor. Adjust the moisture content of the soil, as necessary, to aid compaction. We recommend 5 passes in one direction, and 5 passes in a perpendicular direction in the building area. More passes could be needed however. The objective is to achieve a minimum 95% percent Modified Proctor maximum dry density (ASTM D 1557) to a depth of at least 12" below the compacted surface.

   We recommend performance of at least one field density test for each 5,000 square feet of prepared area (but a minimum of three tests, regardless of the size). **It is important to contact the testing laboratory at least a few days prior to proof-rolling, so that they can obtain proctor test samples, and perform the proctor tests in the laboratory, so that the maximum proctor dry density values will be available at the time of proof-rolling and density testing.**

3. If any areas <u>yield</u> during proof-rolling, they must be explored in a few small test pits to evaluate the condition of the soils. Should yielding result from excessive soil moisture, two corrective alternatives may be considered.

   a. If the existing soils are sands or clayey sands (less than 50% clay), dry the soils until the moisture content is 2 to 3 percent below the optimum moisture content as determined from the Modified Proctor test. The soils may be harrowed and air-dried to obtain the desired moisture for compaction.
   b. Replace the wet material with soils conforming to that stated in Item 5, below.

   Replace any materials, if determined to be deleterious, in areas that "yield" during the proof-rolling operation, with suitable fill material conforming to that stated in Item 5, below.

4. After satisfactory proof-rolling of the cleared and/or cut surfaces in accordance with the above, filling with suitable, well-compacted soil may proceed. Fill material should conform to that stated in Item 5 below, and should be placed in level lifts not exceeding 12 inches in uncompacted thickness. Each lift should be compacted by repeated passes with appropriate compaction equipment, to achieve at least 95 percent of the Modified Proctor maximum dry density. The filling and compaction operations should continue until the desired elevation is achieved. Again, at least one field density test for each 5,000 square feet of prepared fill area should be performed (minimum 3 tests).

5. Fill materials required to elevate the slab area should consist of select fills, which are uniformly graded clean sands to slightly silty or slightly clayey sands, free of organics and other deleterious materials, **with less than 35 percent passing the No. 200 sieve**. These soil types are less sensitive to moisture problems and are less likely to experience time related settlement than more silty or clayey soils, so the use of select fill tends to reduce earthwork delays caused by seasonal rains and minimize the potential for differential settlement of foundations. Much of the naturally occurring near surface silty sand soils encountered in our borings do comply with these recommendations, otherwise an off-site borrow source should be considered.

5.3 Shallow Foundation Design

As mentioned in section 5.1, moderately expansive clay soils were encountered in some of the building borings that could cause adverse differential settlement of ±0.5" in addition to anticipated load related settlement. Therefore, **we recommend that the perimeter and interior load bearing footings should be stiffened** with a top and bottom layer of reinforcing steel so as to resist possible differential movements caused by volume changes in the clays and for the circumstance that possible excessively loose soils are beyond the beneficial improvement of the proof-compaction. As an alternative, a post-tensioned slab could be constructed. For design purposes, an edge moisture variation distance $\mathbf{e_m}$ of 7', plastic limit of 33, and plastic index of 37 (consider soil montmorillonite) may be used for calculations for post-tensioned slabs if constructed. A modulus of sub-grade reaction of 300 pounds per cubic inch may be used. In no case should lean or fat clays exist within 24" of bottom of concrete footings. If present close to foundations, these problematic soils should be undercut and replaced with well-compacted sandy soils.

Foundation soils prepared in accordance with the above recommendations (natural soils or back-fills) should be suitable for supporting the proposed structures with a design soil contact pressure of 2,500 pounds per square foot (psf) or less. The weight of the concrete may be neglected when computing the contact pressure. Footings should be embedded at least 18" below surrounding ground. Isolated footings should be at least 18" on each side to prevent punching shear failures.

Based on the information gathered during our exploration and the loading conditions previously estimated, along with satisfactory completion of the recommended soil and foundation improvements discussed above, the recommended soil contact pressure will yield a minimum factor of safety greater than 2.0 against bearing capacity failure. The total load related settlement is estimated to be one-half inch or less.

5.4 Retaining Walls and Loading Docks

Retaining walls or loading docks should be designed to withstand the lateral forces exerted by the backfill soils and surcharge loads on the floor slab or outside finished grade. We suggest using a coefficient of lateral earth pressure of 0.36 for walls which are able to deflect slightly and 0.6 for walls unable to deflect. A passive earth pressure coefficient of 3.0, and a coefficient against sliding of 0.45 may be used in calculations. A moist soil weight of 120 pcf should be multiplied by the appropriate coefficient of lateral earth pressure to determine the equivalent fluid pressure acting on the wall. Also, the surcharge loads should be multiplied by the appropriate coefficient to determine the resulting additional uniform horizontal load. The previously recommended bearing capacity for foundations for buildings likewise applies to retaining wall footings.

Backfill placed behind loading docks or retaining walls should consist of granular soils that are free draining and relatively free of fines (less than 15% passing the No. 200 sieve). Although we do not anticipate the retaining walls will intercept groundwater, landscape irrigation and possible isolated "wet" spots could cause hydrostatic pressure buildup behind walls. Therefore, weep holes with filtration protection or sub-drains should be constructed at the base of all retaining walls. The backfill within 5 feet of the wall should be placed in thin lifts and be compacted with hand-held or light-weight compactors. Over-compaction of the backfill should be avoided since it could cause excessively large earth pressures to develop against the walls. Heavy equipment should be kept at least 5 feet away from the wall.

5.5 Pavement Section Design

In order to prepare the site to support a semi-flexible pavement section, follow the site preparation recommendations in Section 5.2 of this report, items 1 through 5.

The following additional requirements must be applied. Typically, the top 24 inches of sub-grade soil should be AASHTO classification (M-145) types A-1, A-3, or A-2-4, which are low plasticity to non-plastic soils, with no more than 35 percent passing the U.S. No. 200 sieve, liquid limit less than 40, and plasticity index less than 10. Therefore, site soils that do not meet these criteria should not be used, and/or must be over-excavated, if present within 24 inches of bottom of base elevation. However, undercutting can sometimes be limited to 18" below sub-grade surface in low traffic areas and could be addressed on a case-by-case basis. Most of the silty sands on the site are designated A-2-4 and therefore generally do comply with this recommendation. However, the clayey sands on the eastern part of the site are generally considered A-6 and would not be satisfactory as sub-grade for pavements.

Also, any soils within 12 inches elevation of the bottom of base grade must meet the following Florida Limerock Bearing Ratio (LBR) requirement.

> The top 12 inches of the pavement sub-grade must exhibit a minimum laboratory LBR value of 35. LBR testing of the proposed sub-grade soils must be performed well in advance of pavement section construction, to determine if stabilization and/or off-site soils are required. If deficient, then stabilization must be performed in accordance with the Florida Department of Transportation *Standard Specifications For Road and Bridge Construction* (FDOT Standard Specifications), latest edition, Section 160, Type B or C stabilization, whichever is more appropriate for the soil conditions.
>
> The near surface silty sand soils found in our borings will likely comply with the physical characteristics above. If testing shows they do not, stabilization with other materials (possibly clayey soils or crushed limestone mixed into the site soils) could be needed.

Following are recommendations to develop a pavement section for support of light to medium vehicular traffic.

1. Compact the top 12 inches of the pavement sub-grade to at least 98 percent of the Modified Proctor maximum dry density (AASHTO T180 or ASTM D 1557). Again, the LBR requirement is 35 minimum.

2. Install a 6-inch (minimum) thick limerock base or sand-clay base (FDOT Standard Specifications Section 911 or 914) in accordance with Section 204 or 230 of FDOT Standard Specifications. The base must be compacted to at least 98 percent of the Modified Proctor maximum dry density.

3. After placement of a prime coat or tack coat (FDOT Section 300), install 2" of "superior performance asphalt pavement" (*Superpave*) in accord with FDOT Section 334 of the *Standard Specifications for Roads and Bridges*. Specifically, the asphalt should consist of two layers: 1" thick asphalt structural course (SP 12.5) overlaid by a 1" thick asphalt friction course (SP 9.5).

Regardless of the pavement section base type selected, we recommend that the civil design features of the project be planned such that the site groundwater table cannot reach an elevation higher than 24 inches below bottom of the base elevation. Such features can include perimeter ditches, and if required, sub-drains. Please refer to Section 3.3 of this report for discussion of groundwater conditions at the site.

The latest version of the Florida Department of *Transportation Standard Specification for Road and Bridge Construction* shall govern the design and placement of the base course and asphaltic concrete wearing surface.

The above minimum requirements will satisfactorily support heavy automobile and medium truck traffic, and occasional tractor-trailer or garbage truck traffic. **We recommend that heavier truck traffic areas as well as within 30' of the approaches to the garbage dumpsters, the base thickness should be increased by 2 inches, and increase the asphaltic concrete by 1 inch.** Alternatively, a 6" thick concrete pavement with underlying 4" thick gravel cushion may be used for this area as well as all other pavement areas. Concrete for pavements should exhibit a minimum compressive strength of 4,000 psi after 28-days.