Geotechnical Engineering
Construction Inspection
Materials Testing

GEOTECHNICAL ENGINEERING EVALUATION

Oro Valley Assisted Living

12380 and 12400 W. Vistoso Park Road
Oro Valley, AZ

PATTISON ENGINEERING, LLC
Project Number 22-045

Prepared for: Round Lake, LLC
April 18, 2022

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Pattison Engineering LLC

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Oro Valley Assisted Living
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Oro Valley, Arizona

We have completed the geotechnical evaluation for the proposed Round Lake LLC development in accordance with our Proposal Number 22-P110, dated March 14, 2022. Our project study results are attached.

In our opinion, the site's subsurface soil and other conditions can be made suitable for support of the proposed development provided the designers, contractors, and owners follow the report recommendations. Our evaluation showed silty, clayey sands, clayey sands, and silty sands with gravel. We expect the subsurface and underlying soils to provide suitable support for structures provided that these soils do not experience dramatic moisture increases. The general soil conditions and specific recommendations are presented in the report.

We thank you for selecting PATTISON ENGINEERING, L.L.C. and look forward to being a member of your team on the remainder of this project. If you have any questions about this report, or require additional consultation, please call us.

Sincerely,
PATTISON ENGINEERING, L.L.C.
Geotechnical, Construction Inspection, and Materials Testing Services

Registered Professional Engineer (Civil) CERTIFICATE NO. 47658 FRANCISCO J. JACINTO Date Signed: 4-18-22 ARIZONA, U.S.A.

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INTRODUCTION

This report presents the results of our geotechnical engineering services for the proposed Oro Valley Assisted Living development to be located at 12380 and 12400 W. Vistoso Park Road, in Pima County, Arizona. The site is located in Section 32, Township 11 South, Range 14 East, of the Gila and Salt River Base and Meridian in Oro Valley, Arizona. The Site Plan in the Appendix shows the location of the site.

We obtained information on site soil conditions, performed field and laboratory testing, and geotechnical engineering analyses. This report presents our conclusions and recommendations regarding the engineering properties of the soils encountered and their relationship to the proposed development. Specifically, the report addresses the following information:

- General site and subsurface conditions encountered during our evaluation.
- Recommendations and design criteria for foundation systems, including allowable bearing capacity, lateral earth pressures and estimated settlements.
- Recommendations for support of interior concrete slabs-on-grade.
- Recommendations for flexible pavement section.
- Recommendations for grading requirements, including site and building area preparation, fill placement, and suitability of existing soils for fill.

The Appendix contains the results of the field explorations and tests and provides a site plan showing the exploration locations.

Project Information

We understand that a 120,000 square-foot, 3-story assisted living building with 8-12 single-story, one-bedroom casitas is planned for this development. We assume that the structures will use wood-frame construction and have concrete slab-on-grade floors. We have not been given structural details but we assume that maximum wall and column loads will be less than 4 klf and 60 kips, respectively. Furthermore, we have not been provided with a grading plan but we assume that finished grades are expected to be at to within a few feet of existing grades. In addition, flexible asphalt paved drives and parking lots are expected.

Evaluation and Testing

To obtain information on the conditions at this site and to determine applicable soil properties, we completed an on-site evaluation. The extent of our evaluation and testing programs is described in the following section.

Field Evaluation

We reviewed the site to obtain information on the general surface conditions. On March 21 and 22, 2021, we also observed the excavation of 11 borings to depths ranging between approximately 5 and 26.5 feet below existing site grade. The site plan shows the approximate exploration locations. The Appendix contains logs of the subsurface conditions encountered at the explorations.

During the field exploration, the subsurface conditions were described, and the encountered soils were sampled, visually classified and logged. We used the Unified Soil Classification System to classify soils. The soil classification symbols appear on the exploration logs and are briefly described in the Appendix.

Laboratory Evaluation

We performed laboratory analyses on soil samples to aid in material classification and estimate pertinent engineering properties of the on-site soils. We performed the tests in general accordance with applicable ASTM standards. The Appendix contains our laboratory test results.

FINDINGS

Site Conditions

At the time of our exploration, the site was undeveloped property. The on-site vegetation consisted of creosote, brush, mesquite, and palo verde trees. The site was relatively flat with good surface drainage to the southeast.

Subsurface Conditions

The soils encountered were very loose to dense silty, clayey sand, sands with silt, and silty sands with gravel. The soils exhibited non-plastic to low plasticity. Soil moisture contents were dry to slightly damp at the time of our field evaluation and no free groundwater was encountered in any of the explorations. These observations represent groundwater conditions at the time of the filed exploration and may not be indicative of other times, or at other locations. Groundwater conditions can change with varying seasonal and weather conditions and other factors.

The subsurface conditions described are based on the soils encountered at the specific boring locations. Variations in the soils between borings can occur. The logs in the Appendix show details of the subsurface conditions encountered during the field evaluation.

Conclusions

In our opinion, the site's natural subsurface soil conditions can be made suitable for support of the proposed development provided the designers, contractors, and owners follow the report recommendations. Our conclusions regarding the soils and planned development are given in the following discussion.

Compressive Properties

At their existing water contents subsoils near shallow foundation level are expected to have low to medium compressive potentials under the loads expected for the construction. Medium to moderately high additional compression is expected when the water content is increased. We expect that total settlement of the proposed structures, supported as recommended, will be less than 1 inch. Differential settlement should be approximately half of the total settlement provided there is positive drainage and typical local climatic conditions prevail.

Most settlement is expected to occur soon after construction, although additional foundation movements could occur if water from any source infiltrates the underlying soils. Severe overwatering, ponding water, and significant or prolonged leaks that wet soils below the structure can result in adverse differential settlement.

The potential differential movement is a function of the depth and lateral extent of wetting of the supporting soils. It is extremely important, therefore, that precautions be taken in design, construction preparations, and maintenance to minimize the potential for moisture increases (from any source) beneath the structures. We suggest that all underground piping within or near the structures be designed with flexible couplings so minor deviations in alignment do not cause damage. Any utility knockouts should be oversized to accommodate differential movements.

Expansive Properties

The existing soils have a relatively low expansive potential. Special preparations or construction details related to swelling pressure or heave are considered unnecessary. Clay or clayey soils with higher swell potential, however, may exist on site. The earthwork must be carefully monitored by experienced personnel supervised by a Geotechnical Engineer. The contractor should notify the Geotechnical Engineer if the soil conditions vary significantly from those shown in this report or if there are any questions regarding the type of soil or its condition.

RECOMMENDATIONS

General

All structural elements will experience at least some differential movement and the various components must accommodate this potential. We recommend that you have the Architect, the Structural Engineer, Civil Engineer, Landscape Architect, and all other design team members and contractors read this report and consider our comments. The basis for our comments on foundation and slab design details is primarily our experiences with recurring problems associated with many of these items.

In the following section, we provide recommendations for the supporting systems that we believe are appropriate for the construction conditions. We do not intend to provide recommendations that prevent all undesirable effects resulting from structural movements. We intend to provide reasonable solutions to help control effects the soil may have on the structures.

Shallow Conventional Foundations

We expect that the proposed structures can be supported by conventional spread foundations bearing on engineered fill. The engineered fill shall be constructed according to the recommendations given in the ***Earthwork*** section of this report. The supporting system may consist of continuous wall footings and independent spread footings and slabs-on-grade. Monolithic foundations and slabs may be used provided they are properly designed and constructed.

The following table presents alternative foundation depths and allowable bearing pressures:

Footing Depth Below Finished Grade, ft.[1]	Allowable Bearing Pressure, psf[2]
1.5	1600
2.0	2000
2.5	2400

[1] Finished grade is the lowest adjacent grade for perimeter footings and floor level for interior footings.

[2] Allowable bearing pressures depend on compliance with the Earthwork recommendations of this report.

Recommended minimum widths of column, wood-frame and masonry wall footings are 24, 12, and 16 inches, respectively. Governing building codes may require greater widths. A one-third increase in the bearing pressures is allowable for transient wind or seismic loads. The bearing values given are net bearing values so the weight of the concrete in the footings may be ignored.

All footings, stemwalls, and masonry walls should be reinforced to reduce the effects of potential differential movements. Reinforcement should be consistent with structural requirements to minimize the possibility of longitudinal cracking along the wall. We suggest continuous reinforcement through these areas because we frequently see cracks in the slab portions of monolithic construction parallel to the thickened edges. This cracking occurs because of differential movement between the slab and thickened edge and insufficient reinforcing to resist the shear and flexural stresses. In our opinion, such differential movement should be expected because of the different loading conditions and potential variations in soil properties.

The Geotechnical Engineer or his representative must observe the site preparations and foundation excavations. The purpose of this review would be to determine if the soils and conditions are similar to those expected for support of the footings. Any soft, loose or unacceptable soils should be properly compacted and may require additional undercutting.

Floor Slabs

Floor slabs may be supported on properly placed and compacted fill. The contractor should prepare the slab subgrade, subbase fill, and base course as outlined in the ***Earthwork*** section of this report. For lightly loaded slabs, a minimum 4-inch layer of base course should be provided beneath all slabs to provide more uniform support and help prevent capillary rise and a damp slab. We have sometimes seen upward vapor transmission through floor slabs that has caused distortion of vinyl tiling and various other moisture-related annoyances. Most of these problems appear to us to be more common when the underlying soils are clayey or there are subbase fills of several feet or more. You may want to *consider* providing a vapor retarder beneath slabs to help reduce the transmission potential.

The slab thickness, concrete strength, and reinforcing should be designed by a Structural Engineer. We recommend that slabs supporting typical light loads be at least 4 inches thick. We believe using reinforcing steel in slabs is beneficial for minimizing cracks and strengthening the cross-section in the event tensile or flexural stresses develop. If a *nonreinforced* slab is chosen, we still suggest using steel reinforcing at least in interior or re-entrant corners.

Reinforcing should be placed diagonally across the interior projection of corners. Reinforcement should be positioned as near the mid-height of the slab as possible while maintaining codes. Alternatively, control joints may be used for this situation. Slabs should be jointed around columns and along footing supported walls, so the slab and footings are able to settle independently. If steel reinforcing is not used, we recommend using a fibermesh additive to the concrete to aid in controlling cracks from drying shrinkage and thermal changes.

To provide stress relief and help eliminate random cracking, we suggest providing control joints at spacings less than 12 feet. Wider joint spacings are possible depending on the slab thickness, absence or presence of reinforcing, concrete mix design, and the curing environment. The joint locations should be determined by the Structural Engineer. Joint locations should be developed considering such items as shrinkage potential, slab thickness, curing, fixed element restrictions, slab penetrations, type of floor covering, and specialized equipment placement.

The proper curing of concrete, especially for flatwork (slabs), is extremely important in minimizing plastic shrinkage cracks and slab curling. We believe that many slab cracking problems can be mitigated or even eliminated by proper curing. We strongly suggest moist-curing slabs for at least three days after placement and preferably a week, unless moisture-sensitive coverings are planned. Curing promotes more complete hydration of the cement and reduces plastic drying shrinkage, especially near the exposed upper portion of the slab. Alternatively, applying a liquid membrane curing compound could also be beneficial, but the type of floor covering and manufacturer specifications should be considered because the compound could adversely affect their warranties. For vinyl or wood flooring, it is generally preferable to cure concrete with water-proof paper or plastic sheets for 3 to 7 days because these methods do not add moisture. Also important are the mix design and quality control during construction.

All concrete placement and curing operations should follow recommendations of the American Concrete Institute manual. Improper curing and excessive slump (water-cement ratio) could cause excessive shrinkage, cracking, or curling of the concrete. Concrete slabs should be allowed to cure adequately before placing vinyl or other moisture-sensitive floor covering. To prevent incomplete bonding, distortion, and water vapor entrapment, flooring should not be placed until the moisture content of the slab is at or below the manufacturer's requirements. We can provide third-party relative humidity (RH) probe testing during construction if desired. This method is generally regarded as a more optimal way of testing for water vapor transmission because it measures emissions within the slab and not just the surface.

Lateral Earth Pressures

For cantilevered or restrained (at-rest case) walls above any free water surface with level backfill and no surcharge loads, the recommended equivalent fluid pressures and coefficients of base friction are presented in the following table.

EARTH PRESSURE STATE		EQUIVALENT FLUID PRESSURE, psf/ft
Active		
	Undisturbed Native Soil	**35**
	Granular Backfill	**30**
Passive		
	Undisturbed Native Soil	**350**
	Granular Backfill	**475**
At-rest (restrained)		
	Undisturbed Native Soil	**55**
	Granular Backfill	**50**
Coefficient of Base Friction = 0.45*		

* For short retaining walls with minimal cover on the outside face, the coefficient of base friction should be reduced to 0.35 when used in conjunction with passive pressure.

We do not expect submerged soil conditions; the lateral earth pressures shown therefore do not include this condition. We should be consulted for additional recommendations if submerged conditions are to be included in the design. Any surcharge from adjacent loading will also increase the lateral pressure and must be added to the above earth pressures.

The contractor should use granular, relatively free-draining soil for retaining wall backfill to reduce the potential for hydrostatic pressure buildup. Retaining walls should be designed with a backdrain that either drains to lower ground or to a sump with a float-activated pump. The level of this drain should be lower than the lowest retained earth behind the wall; the perforations in the drain pipe should be at least 8 inches lower than the top of any interior slabs in front of the wall.

Moderate to high plasticity clay soils should not be used as backfill against retaining structures. Properly place and compact all backfill as recommended in this report. Cobbles, if present, should be removed from the soils placed adjacent to walls so high-intensity point loads do not occur. Avoid nesting of larger particles because voids could form and cause subsidence of the backfill.

Waterproof the exterior face of below-grade walls that are exposed to interior spaces to retard moisture penetration. It is important that all backfill be properly placed and compacted. Mechanically compact all backfill in layers. Water settling or flooding is not acceptable. Care should be taken to avoid damaging the walls when placing the backfill. Backfill should be inspected and tested during placement and compaction, especially if there will be overlying elements supported by the backfill such as foundations, stairs, walls, and planters.

Seismicity

For structural designs based upon the International Building Code 2018, the soil site class is D. S_s, the spectral response acceleration at short period is 0.271 S_1, the spectral response acceleration at 1-second period is 0.077g. Site coefficients Fa and Fv in accordance with tables 1613.3.3 (1) and 1613.3.3 (2) are 1.583 and 2.4, respectively.

Flexible Pavement Section

On the basis of the existing subgrade conditions and the anticipated traffic, we recommend the following pavement sections for the private drives.

AREA	ASPHALT CONCRETE, in.	BASE COURSE, in.
Automobile Parking for Passenger Vehicles and Light Trucks	2.5	4
Major Access Drives with Truck Traffic	3	4

We should be consulted for possible supplemental recommendations if additional information showing the amounts and types of traffic becomes available, especially for truck traffic. Consideration should also be given to using portland cement concrete paving in truck loading and unloading areas. Bituminous surfacing should be dense-graded, central-plant-mix, asphalt concrete. Base course and asphalt concrete should conform to Oro Valley/Pima County specifications.

We recommend using portland cement concrete (rigid) pavement for heavily used areas such as for trash receptacles. Portland cement concrete approach slabs should also be provided for heavy loading of service trucks. If used, rigid pavement section should be at least 5 inches thick over 4 inches of aggregate base course. We recommend that the concrete have a 28-day compressive strength of at least 4000 psi. To control cracking caused by volume-change, warping, and load stresses within the concrete slab, joints should be provided in both longitudinal and transverse directions and at isolated locations of restraint such as manholes or other penetrations through the pavement. Joints may consist of transverse expansion joints, longitudinal or transverse weakened-plane joints, or isolation joints.

To control cracking caused by volume-change, warping, and load stresses within the concrete slab, joints should be provided in both longitudinal and transverse directions and at isolated locations of restraint such as manholes or other penetrations through the pavement. Joints may consist of transverse expansion joints, longitudinal or transverse weakened-plane joints, or isolation joints.

The Earthwork section of this report presents subgrade, subbase fill, and compaction requirements. Paved surfaces should be sloped to provide drainage away from the pavement. Water should not pond in areas directly adjoining paved sections. The native soils can lose stability if subjected to conditions which increase the water content.

Additional Comments Regarding Pavement

Thinner pavement sections may be used, but might result in reduced pavement life and increased maintenance costs. The usual functions of a pavement surface are to provide a stable surface for pedestrians and vehicles under the expected weather and traffic conditions, provide adequate friction to minimize vehicular sliding, and to inhibit dust and erosion. In these regards, we expect that thinner pavement sections, such as a minimum 2 inches of asphalt concrete overlying 4 inches of base course, might provide many of these elements for a significant period if the subgrade soil doesn’t increase in moisture. Thinner sections than recommended are likely, however, to require rehabilitation and maintenance at earlier stages.

A major factor in the selection of a pavement section, especially for private pavements, is the fiscal consequences. Clearly, a thinner section will have lower initial costs and higher maintenance and replacement costs. Early deterioration or practical failure of the proposed thinner section is unlikely to directly endanger the public, provided the pavement is promptly and routinely maintained. If the owner fails to routinely inspect the pavement and neglects to make prompt repairs, pavement distress could propagate, causing more serious problems.

These problems could expose the owner to liability from accidental injuries caused by displaced or damaged pavement surfaces. In summary, the choice of pavement section should be made by the owner after considering both the performance and fiscal factors. We do, however, encourage you to consider using the pavement section recommended in our report for main drives and other high traffic areas.

Asphalt concrete pavement deteriorates or fails not only from traffic-induced stresses and strains, but also from the effects of sun and rain, and freeze and thaw cycles. These factors are usually independent of traffic and would be similar for any pavement section. However, cracking or deterioration of the asphalt concrete surface from environmental conditions would result in failure or serious distress significantly sooner in thinner sections. This fact, therefore, should also be considered in your evaluation of pavement alternates.

Exterior Features

Exterior slabs-on-grade, exterior architectural features, and utilities may experience some movement due to the volume change of the underlying soils. The potential for movement and resulting distress could be reduced by the following measures:

- Minimizing moisture increases in the soil
- Moisture-density control during placement of soil
- Use of designs which allow vertical movement between the exterior features and adjoining structural elements
- Placement of effective control joints on relatively close centers
- Allowance for vertical movements in utility connections

Temporary Construction Excavations

Temporary unsurcharged construction excavations should be sloped or shored. Slopes should not be steeper than 1 to 1 (horizontal to vertical) in the natural soil. Slopes may need to be flattened depending on conditions exposed during construction. If there is not enough space for sloped excavations, shoring should be used.

Various shoring systems are possible; their selection and design, however, is beyond the scope of our current evaluation. The design of a retaining system is dependent on the construction method, the sequence of operations, and adjacent construction. The contractor's and designer's responsibilities for design and construction should be clearly defined. Exposed slopes should be kept moist (but not saturated) during construction. Traffic and surcharge loads should be at least 10 feet from the top of the excavation. All excavations should be completed in accordance with the most recent OSHA requirements.

Slopes and Soil Erodibility

To provide slope stability against mass failure, we recommend that cut and fill slopes less than 7 feet in height have maximum gradients of 1 to 1 (horizontal to vertical). Fill embankments must be properly compacted and, when occurring on natural slopes with inclinations equal to or greater than 5 to 1, constructed on reasonably level cut benches. We recommend that fill slopes be compacted and then cut back or shaped so that proper compaction is obtained. It may not be necessary to overbuild and cut back slopes if the contractor demonstrates that the techniques used result in a properly compacted and prepared slope face. These allowable slope gradients assume proper protection against erosion.

Exposed slopes should be covered as quickly as possible with vegetative or other ground covers such as mulch, jute netting, crushed rock, or rip-rap to avoid unnecessary soil losses. Slopes should be scraped or raked across the slopes (perpendicular to flow), unless they are trackwalked, to aid in providing greater infiltration rates of surface water. If the slopes are shaped by trackwalking, with tracked vehicles, they should be worked up and down as the tread imprints will create grooves parallel to the slope which will aid infiltration rates and trap seeds.

During construction, graded, unprotected areas should retain as much natural vegetation as possible. Vegetation along the perimeters of graded areas should be left intact to control erosion and serve as a sediment trap. Exposed soil areas should be sprinkled with water during construction to reduce transportation of soil by wind. If rains are anticipated during construction, flows over the disturbed areas can be minimized by diverting upslope surface water through use of berms or ditches. Outfall areas associated with detention areas, diversion features, or collection facilities should be provided with energy dissipators such as riprap aprons to reduce surface water velocity.

The following table shows the recommended slope protection for various slope gradients with vertical slope heights of less than 7 feet.

Slope Gradient (horizontal to vertical)	Slope Protection
3:1 or flatter	Revegetate with native species or provide other ground covers such as netting or crushed rock
steeper than 3:1 to 2:1	Rip-rap with filter cloth or cover with mulch, jute, or excelsior netting and then revegetate with native species or provide other ground covers
steeper than 2:1 to 1:1	Grouted or wire-tied rip-rap, asphalt emulsion, or concrete revetments
steeper than 1:1	Stability analysis or retaining wall designed by a structural engineer

Often, unprotected cut and fill slopes are desired for portions of the project. Given the same slope gradients and slope lengths, unprotected slopes can result in about 10 times more soil loss than protected slopes. However, slope gradients and slope lengths are the most critical aspects controlling soil loss since they directly influence the velocity of runoff. If unprotected slopes are used, we suggest they be 5 to 1 (horizontal to vertical) or flatter and at least protected from concentrated upslope drainage. Continuous slope lengths should also be kept relatively short, preferably less than 15 feet. Slope lengths can be reduced by providing frequent intercepting benches or terraces. Areas beneath unprotected slopes may require sediment retention structures to trap eroded soil before it is deposited on undesirable areas. Unprotected slopes should eventually become vegetated and an erosion pavement, resulting from the erosion process, is likely to form across the surface.

Erosional activity, if allowed to form and propagate, will increase soil loss and could cause loss of support to structures, streets and other facilities. Periodic maintenance and prompt repair of erosional features is important to prevent unnecessary soil losses. The effectiveness of erosion control measures should be evaluated subsequent to heavy or prolonged rains. We also recommend an erosional maintenance program be established and implemented.

Surface Drainage

A major cause of soil-related damage to structures in this region is moisture increases in the supporting soil. It is therefore extremely important to provide positive drainage away from the structures, both during construction and throughout its lifes. Infiltration of water into utility or foundation excavations must be prevented.

Waterlines and sewerlines should be carefully tested and inspected for leaks prior to backfilling. Planters and other surface features that could retain water in areas adjacent to the structures or pavement should be eliminated or constructed so that accumulated water is discharged onto a positive gradient at least 5 feet from the structures. Roof rainwater, water from cooling unit condensation, and water heater drains should also be discharged onto a positive gradient at least 5 feet from the structures. Trees should not be planted closer to structures than their expected canopy radius at maturity.

In areas where sidewalks or paving do not immediately adjoin the structures, protective slopes should be provided with an outfall of at least 3 percent for at least 5 feet from perimeter walls. Backfill against footings, exterior stemwalls, and in utility and sprinkler line trenches should be well compacted and free of all construction debris to minimize the possibility of moisture infiltration.

We are aware of many pavement settlement problems within developments. These settlements appear to mostly have been related to inadequate utility backfill compaction, both in primary trenches and subsequent connection service trenches and the introduction of water. Oftentimes, dry utility trenches are located along roadways and outside of curb lines (hence not protected by pavement) where surface and irrigation water can infiltrate. Furthermore, building connection services from the utilities are often loosely backfilled and frequently occur within drainage swales, conditions that increase the potential for water to infiltrate beneath the pavement and curbs. Inadequately compacted trenches, or even trenches backfilled with soils more permeable than the adjacent soils, can act as conduits for moisture migration. It is very important, therefore, to provide adequate testing and monitoring of all backfill. If possible, it is preferable to locate connection services beyond drainage swales.

Some drainage facilities, such as rock-lined drainage swales, often degrade over time and become inefficient or ineffective. Additionally, they are often just dumped into place and not shaped so as to properly receive and channelize water. We highly recommend that such porous swales not be constructed within 10 feet of the structures unless they have significant positive gradients and are constructed to efficiently receive and direct water. A more effective and desirable method would be to conduct water through closed conduits directly to a properly prepared discharge area. The owners should be made aware that extensive water infiltrating the supporting soils beneath the structures could cause differential movements of the supporting system and thus the framing.

Underground Utility Systems

All underground piping within or near the structures should be designed with flexible couplings so minor deviations in alignment do not cause damage. Any utility knockouts should be oversized to accommodate differential movements. All trench backfill throughout the development should be well-compacted to help avoid serving as a subsurface conduit beneath structures.

Construction Review

The Geotechnical Engineer or his representative must observe the site preparations and foundation bearing conditions. The purpose of this review would be to determine if the soils and conditions are similar to those expected for support of the footings. Subgrade preparation and engineered fill construction supporting structural elements is considered Special Inspection and must be completed under the continuous supervision of the Geotechnical Engineer. Any soft, loose or unacceptable soils should be properly compacted and may require supplemental recommendations.

We recommend surveying the finished floor elevation of all slabs-on-grade and maintaining this record. In the event of future movement, this information could be extremely helpful in assessing the conditions and providing remedial measures.

EARTHWORK

General

The Geotechnical Engineer or his representative must observe the site preparations and foundation bearing conditions. The purpose of this review would be to determine if the soils and conditions are similar to those expected for support of the footings. Subgrade preparation and engineered fill construction supporting structural elements is considered Special Inspection and must be completed under the continuous supervision of the Geotechnical Engineer. Any soft, loose or unacceptable soils should be properly compacted and may require supplemental recommendations.

We recommend surveying the finished floor elevation of all slabs-on-grade as soon as possible at the time of completion and maintaining this record. In the event of future movement, this information could be extremely helpful in assessing the conditions and providing remedial measures.

Site Clearing

Strip and remove any debris, vegetation, loose or wet soil and other deleterious materials from the building areas and at least 5 feet beyond. All exposed surfaces should be free of mounds and depressions that could prevent uniform compaction.

In areas that will receive fill, slopes steeper than 5 to 1 (horizontal to vertical) should be benched to reduce potential slippage between slopes and fills. Benches should be reasonably level and wide enough to allow appropriate use of compaction and earth-moving equipment on a level plane.

Excavation

Shallow excavations in the soils we encountered during our evaluation should be possible with conventional equipment. The speed and ease of excavating will depend on the type of grading equipment, the skill of the operators and the structure of the deposit. If more information regarding excavation is desired, we suggest a study using equipment similar to that expected for the actual construction. The information contained in this report is intended for design and preliminary estimating purposes. Contractors reviewing the report must draw their own conclusions regarding the types of excavation equipment.

Foundation Preparation

Foundations and slabs-on-grade shall bear exclusively on engineered fill. The contractor shall overexcavate the natural soils, as required, to provide the thickness of engineered fill shown in the following schedule.

BUILDING ELEMENT	REQUIRED ENGINEERED FILL
Continuous wall foundations	Equal to the width of the foundation; but not less than 5 feet
Column foundations	Equal to one-half the foundation length; but not less than 5 feet
Interior slabs	At least 5 feet

The amount of engineered fill shown in the above table is the minimum amount that shall be constructed beneath the base of foundations or slabs. The engineered fill should extend laterally beyond the footing edges at least 5 feet. Where exterior walks or slabs are present along the building, the engineered fill shall extend at least 2 feet beyond their edges. It may be more economical and convenient to construct the engineered fill to a uniform base elevation across the *entire* building pad area. If this is done, the required engineered fill should be referenced below the deepest foundation bottom.

After overexcavation has been accomplished, the contractor should scarify, moisten or dry as required, and compact the exposed soils to a minimum depth of 8 inches. This 8-inch depth may be included in the required depth of compaction below foundations and slabs. The contractor should prepare the subgrade and construct engineered fill in a manner resulting in *uniform* water contents and densities after compaction. The contractor shall place and compact at least four inches of base course beneath interior slabs to provide more uniform support and help prevent a damp slab. If a vapor retarder is used, the base course should be finished fairly smooth to help avoid puncturing of the membrane during placement of reinforcing and concrete.

The Geotechnical Engineer or his representative *must* observe the site preparations and foundation excavations. Subgrade preparation and engineered fill construction supporting structural elements is considered Special Inspection and must be completed under the *continuous* supervision of the Geotechnical Engineer. Any soft, loose or unacceptable soils should be properly compacted and may require additional undercutting.

Because the natural soils at this site can compress under changes in moisture content, water harvesting or retention/detention may affect structures and ground-supported elements, especially sidewalks, slabs, and pavements close to the basins.

Vapor Retarder Considerations

If moisture-sensitive floor coverings are used, an impermeable vapor retarder should be considered beneath the floor sections. If used, the design and installation should be in accordance with ASTM E1745, ASTM E1643, and ACI 302. The vapor retarder should be at least 10-mil. The vapor retarder is not a geotechnical requirement and should be provided by the architect or structural designer.

Materials

Imported soils and existing granular soils with low expansive potentials and all particles passing the 6-inch sieve may be used as fill material for the following areas:

- Foundation areas
- Interior slab areas
- Backfill
- Pavement areas

Imported soils should conform to the following requirements:

IMPORT SOIL PROPERTIES	
SIEVE SIZE	**PERCENT PASSING, by dry weight**
6"	**100**
No. 4	**50-100**
No. 200	**40 max.**
Maximum Expansive Potential = 1.5%*	
Maximum Soluble Sulfates = 0.10%	

* Measured on a sample compacted to approximately 95 percent of the ASTM D698 maximum dry density at about three percent below optimum water content. The sample is confined under a 100 psf surcharge and submerged.

Aggregate base course below concrete floor slabs should conform to the following requirements:

AGGREGATE BASE COURSE	
SIEVE SIZE	**PERCENT PASSING, by dry weight**
1"	**100**
3/4"	**90 to 100**
1/4"	**45 to 75**
No. 200	**0 to 10**
Plasticity Index = 5 max.	

Placement and Compaction

The contractor should place and compact fill in horizontal lifts, 8 to 10 inches in loose thickness, using equipment and procedures that will produce the recommended moisture contents and densities throughout the lift. When lighter hand-held compaction equipment is used, the loose lift thickness should be 4 to 6 inches.

Materials should be compacted to the following standards. Depending on the actual soils and compaction equipment, compaction moisture contents may need to be changed to avoid or limit soil yielding or pumping.

Imported soils (if required to raise grades) and on-site soils with low expansion potential should be compacted within a water content range of 3 percent below to 3 percent above optimum.

Soil Type and Area	Minimum Percent Compaction, ASTM D-698
On-site subgrade soils, on-site soils as subbase fill, and imported soils*	
Below foundations	**95**
Below slabs-on-grade	**95**
Below pavements	**95**
Base Course below slabs	**95**
ase Course below pavements	**100**
Nonstructural backfill, ***not providing lateral or vertical support of structural elements***	**90**

* Fill 5 feet or more below finished grade should be compacted to at least 100 percent of ASTM D-698.

CLOSURE

Additional Services

Field observation and testing during construction, and reviewing the plans and specifications are integral factors in developing and implementing our conclusions and recommendations. Our involvement during construction is important to observe compliance with the design concepts, specifications, or recommendations, and to allow efficient design changes if the subsurface conditions differ from those anticipated. PATTISON ENGINEERING, L.L.C. offers these services and is the most qualified to determine consistency of field conditions with the data used in our analyses. It is the client's responsibility to make this report available, in its entirety, to all design team members, contractors, and owners.

Limitations

The services we performed for this project include professional opinions and judgments based on the data collected. We performed our professional services using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical engineers practicing in southern Arizona. We do not intend to provide recommendations that prevent all undesirable effects resulting from structural movements. We intend to provide reasonable solutions to help control effects the soil may have on the structures. We make no other warranty, expressed or implied.

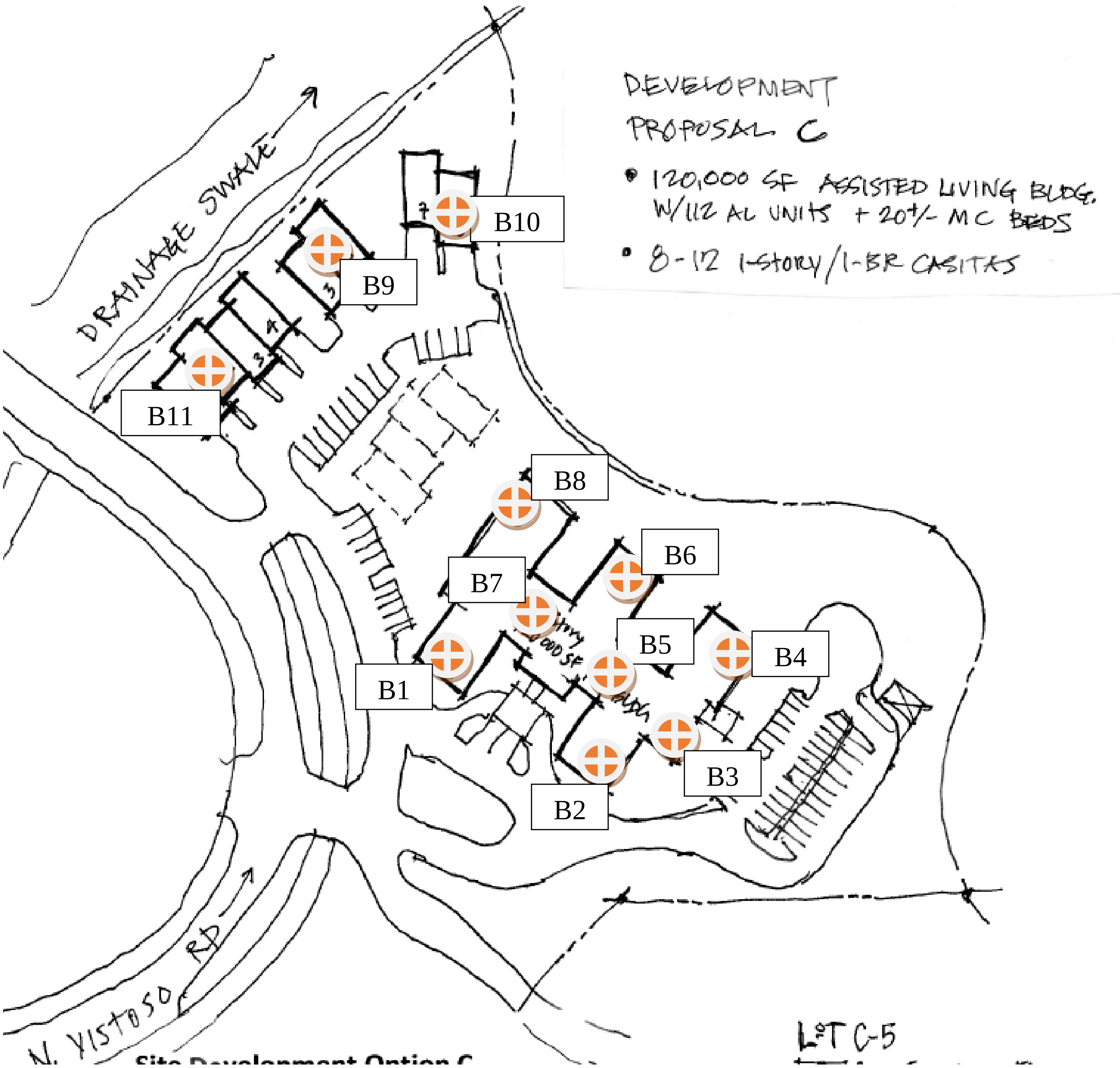
We prepared the report as an aid for the design of the project. This report is not a bidding document and any contractors reviewing it must draw their own conclusions regarding site conditions and specific construction techniques to be used on this project.

Our services did not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in the soil, groundwater, or air, on or below or around, this site. All conditions documented or observed are strictly for the information of our client. If environmental information is required, we recommend that an environmental assessment be completed which addresses these concerns.

We based our recommendations on the assumption the soil and groundwater conditions across the site are similar to those encountered at the exploration locations. The extent and nature of subsurface soil and groundwater variations may not be evident until construction. If conditions encountered during construction appear to differ from those described in this report, we should be consulted to assess the impact and provide supplemental recommendations. Our evaluation and report does not include the effects, if any, of underlying geologic hazards or regional groundwater withdrawal and we express no opinion regarding their effects on surface movement.

APPENDIX

Site and Exploration Location Plan



KEY:

B# BORING LOCATION

Method of Soil Classification

Major Divisions	Subdivisions	USCS Symbol		Typical Names
Coarse-grained soils (More than 50% retained on No. 200 sieve)	Gravels (More than 50% of coarse fraction retained on No. 4 sieve)	GW	Less than 5% fines*	Well-graded gravels or gravel-sand mixtures, little or no fines
		GP	Less than 5% fines*	Poorly graded gravels or gravelly sands, little or no fines
		GM	More than 12% fines*	Silty gravels, gravel-sand-silt mixtures
		GC	More than 12% fines*	Clayey gravels, gravel-sand-clay mixtures
	Sands (50% or more of coarse fraction passes No. 4 sieve)	SW	Less than 5% fines*	Well-graded sands or gravelly sands, little or no fines
		SP	Less than 5% fines*	Poorly graded sands or gravelly sands, little or no fines
		SM	More than 12% fines*	Silty sands, sand-silt mixtures
		SC	More than 12% fines*	Clayey sands, sand-clay mixtures
Fine-grained soils (50% or more passes the No. 200 sieve)	Silts and Clays (Liquid limit less than 50)	ML	Inorganic soil	Inorganic silts, rock flour, silts of low plasticity
		CL	Inorganic soil	Inorganic clays of low plasticity, gravelly clays, sandy clays, etc.
		OL	Organic soil	Organic silts and organic clays of low plasticity
	Silts and Clays (Liquid limit 50 or more)	MH	Inorganic soil	Inorganic silts, micaceous silts, silts of high plasticity
		CH	Inorganic soil	Inorganic highly plastic clays, fat clays, silty clays, etc.
		OH	Organic soil	Organic silts and organic clays of high plasticity
Peat	Highly Organic	PT		Peat and other highly organic soils

- *Fines* are those soil particles that pass the No. 200 sieve. For gravels and sands with between 5 and 12% fines, use of dual symbols is required (i.e., GW-GM, GW-GC, GP-GM, or GP-GC).

CLASSIFICATION	U.S. Standard Sieve Size
BOULDERS	Above 12”
COBBLES	12” to 3”
GRAVEL	3” to No. 4
Coarse	3” to 3/4”
Fine	3/4” to No. 4
SAND	No. 4 to No. 200
Coarse	No. 4 to No. 10
Medium	No. 10 to No. 40
Fine	No. 40 – No. 200
SILT & CLAY	Below No. 200

Coarse Grained Scale
(50% retained on #200 sieve)

ADJECTIVE	%
trace	0-10
some	10-20
with	20-30
“-y” or “-ey”	30-50

P = poorly graded
W = well graded

P.I.	ADJECTIVE
< 1	non-plastic
1-7	low plasticity
8-25	medium plasticity
> 25	high plasticity

Boring Log Notes

The number shown in **Boring No.** refers to the approximate location of the same number shown on the **Site Plan** as positioned in the field by pacing from property lines and/or existing features.

The number shown in **Blows/12"** refers to the number of blows of a 140-pound weight dropped 30 inches, required to advance the sampler. **H** in **Sample Type** is a hand sample from the auger cuttings. **RS** in **Sample Type** is a 2.42-inch-inside-diameter ring sampler. Refusal to penetration for the ring sampler is considered more than 50 blows per foot. **SS** in **Sample Type** is a 2.0-inch-outside-diameter split-spoon sampler. This sampler is used to perform the Standard Penetration Test (SPT) ASTM D1586. Refusal to penetration is considered to be one of the following items: 1. A total of 50 blows has been applied during any one of the three 6-inch increments; 2. A total of 100 blows has been applied; 3. There is no observed advance of the sampler during application of 10 successive blows of the hammer.

USCS Code refers to the soil type as defined by the **Unified Soil Classification System.** The soils were visually classified in the field and, where appropriate, classifications were modified by visual examination of samples in the laboratory and by appropriate test.

These notes and boring logs are intended for use in conjunction with the purposes of our services defined in the text. Boring log data should not be construed as part of the construction plans or as defining construction conditions.

Boring logs depict our interpretations of subsurface conditions at the locations and on the date(s) shown. Variations in subsurface conditions and soil characteristics may occur between borings. Groundwater levels may fluctuate due to seasonal variations and other factors.

In general, terms and symbols on the boring logs conform with **"Standard Definitions of Terms and Symbols Relating to Soil and Rock Mechanics"** (ASTM D653).

Laboratory Test Results

BORING NO.	DEPTH (FT)	PLASTICITY		% PASSING #200 SIEVE	SOIL CLASSIFICATION	IN-SITU DRY DENSITY (PCF)	IN-SITU MOISTURE CONTENT (%)
		LL	PI				
B-1	0-5	--	NP	15.2	SM	--	--
B-1	2-3	--	--	--	SM	112	3.3
B-2	0-5	18	7	18.8	SC-SM	--	--
B-3	2-3	--	--	--	SC-SM	117	3.0
B-5	0-5	--	NP	15.2	SM	--	--
B-5	2-3	--	--	--	SM	89	3.0
B-7	2-3	--	--	--	SM	114	1.9
B-8	0-5	--	NP	16.0	SM	--	--
B-9	0-5	--	--	11.1	SP-SM	--	--
B-9	2-3	--	--	NP	SP-SM	113	3.7

EXPANSION PROPERTIES						
BORING NO.	DEPTH (FT)	SOIL CLASS	COMPACTED DRY DENSITY (PCF)	MOISTURE CONTENT (%)	SURCHARGE (KSF)	EXPANSION (%)
B-2	0-5	SC	123.3	5.4	0.1	0.3

*Sample remolded to 95 percent of Maximum Dry Density at 3% below optimum moisture content and inundated with water.

COMPRESSION TESTING						
BORING NO.	DEPTH (FT)	IN-SITU DRY DENSITY (PCF)	IN-SITU MOISTURE CONTENT (%)	SURCHARGE (KSF)	TOTAL COMPRESSION (%)	
					UNSATURATED	SATURATED
B-1	2-3	112	3.3	1.5	3.9	--
				2.0	4.3	10.4
B-3	2-3	117	3.0	1.5	3.8	--
				2.0	4.0	8.6
B-5	2-3	89	3.0	1.5	2.5	--
				2.0	2.7	5.9
B-7	2-3	114	1.9	1.5	4.1	--
				2.0	4.4	9.4
B-9	2-3	113	3.7	1.0	1.6	4.6

Boring Logs

Geotechnical Engineering
Construction Inspection
Materials Testing

BORING NUMBER
B-1
SHEET 1 OF 1

Client: Round Lake LLC

Project: Oro Valley Assisted Living
Location: 12380 and 124000 W. Vistoso Park Road

Location of Boring: SEE SITE PLAN

Elevation: Datum:
Logged By: IM Date: 3/21/22
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
H				0	SM	SILTY SAND with gravel, brown, non-plastic		
RS	4	12/9				very loose, slightly damp	112	3.3
RS	7	12/12		5		loose		
SS	2 3 4	18/15		10				
SS	6 9 8	18/15		15		medium dense		
SS	6 7 12	18/16		20	SC-SM	SILTY, CLAYEY SAND with gravel, brown, medium dense		
SS	4 10 9	18/16		25	SM	SILTY SAND with gravel, brown, medium dense		
				30		BOTTOM OF HOLE AT 26.5 FEET *No Free Water Encountered*		

Sample Type Key:
SS = Split Spoon
RS = Ring Sample
H = Hand Sample

Drilling Equipment:
CME-75

Geotechnical Engineering
Construction Inspection
Materials Testing

BORING NUMBER **B-2**
SHEET 1 OF 1

Client: Round Lake LLC

Project: Oro Valley Assisted Living
Location: 12380 and 124000 W. Vistoso Park Road

Location of Boring: SEE SITE PLAN

Elevation: Datum:
Logged By: IM Date: 3/21/22
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
H				0	SC-SM	SILTY, CLAYEY SAND with gravel, brown, low plasticity		
RS	50/ 10	10/10				dense		
RS	15	12/11		5		loose		
					SM	SILTY SAND with gravel, brown		
SS	2 3 4	18/15		10		loose		
SS	5 4 6	18/14		15		medium dense		
SS	3 3 3	18/18		20		loose		
					SC-SM	SILTY, CLAYEY SAND with gravel, brown		
SS	15 21 19	18/0		25		dense		
						BOTTOM OF HOLE AT 26.5 FEET *No Free Water Encountered*		
				30				

Sample Type Key:
SS = Split Spoon
RS = Ring Sample
H = Hand Sample

Drilling Equipment:
CME-75

Geotechnical Engineering
Construction Inspection
Materials Testing

BORING NUMBER
B-3

Client: Round Lake LLC

Project: Oro Valley Assisted Living
Location: 12380 and 124000 W. Vistoso Park Road

Location of Boring: SEE SITE PLAN

Elevation: | Datum:
Logged By: IM | Date: 3/21/22
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
H				0	SM	SILTY SAND with gravel, brown, non-plastic		
RS	17	12/9				medium dense, slightly damp	117	3.0
RS	23	12/9		5				
					SC-SM	SILTY, CLAYEY SAND with gravel, brown		
SS	1 3 2	18/18		10		loose		
SS	5 4 5	18/18		15		loose		
SS	17 13 7	18/18		20		medium dense		
SS	5 6 5	18/18		25	SM	SILTY SAND with gravel, brown, medium dense		
						BOTTOM OF HOLE AT 26.5 FEET *No Free Water Encountered*		
				30				

Sample Type Key:
SS = Split Spoon
RS = Ring Sample
H = Hand Sample

Drilling Equipment:
CME-75

Geotechnical Engineering
Construction Inspection
Materials Testing

BORING NUMBER
B-4
SHEET 1 OF 1

Client: Round Lake LLC

Project: Oro Valley Assisted Living
Location: 12380 and 124000 W. Vistoso Park Road

Location of Boring: SEE SITE PLAN

Elevation: Datum:
Logged By: IM Date: 3/21/22
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
H				0	SM	SILTY SAND with gravel, brown, non-plastic		
RS	27	12/10				medium dense		
RS	16	12/11		5				
SS	6 4 2	18/17		10	SC-SM	SILTY, CLAYEY SAND with gravel, brown, loose		
SS	6 14 13	18/18		15		medium dense		
SS	14 12 10	18/18		20				
SS	2 3 5	18/14		25		loose		
						BOTTOM OF HOLE AT 26.5 FEET *No Free Water Encountered*		
				30				

Sample Type Key:
SS = Split Spoon
RS = Ring Sample
H = Hand Sample

Drilling Equipment:
CME-75

Project Number 22-045

Geotechnical Engineering
Construction Inspection
Materials Testing

BORING NUMBER
B-5
SHEET 1 OF 1

Client: Round Lake LLC

Project: Oro Valley Assisted Living
Location: 12380 and 124000 W. Vistoso Park Road

Location of Boring: SEE SITE PLAN

Elevation: Datum:
Logged By: IM Date: 3/21/22
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
H				0	SM	SILTY SAND with gravel, brown, non-plastic		
RS	5	12/9				very loose, slightly damp	89	3.0
RS	4	12/11		5				
					SC-SM	SILTY, CLAYEY SAND with gravel, brown, low plasticity		
SS	3 10 7	18/18		10		medium dense		
SS	8 10 13	18/18		15		slightly damp		
SS	8 12 13	18/18		20				
					SM	SILTY SAND with gravel, brown, non-plastic		
SS	3 4 3	18/18		25		loose		
						BOTTOM OF HOLE AT 26.5 FEET *No Free Water Encountered*		
				30				

Sample Type Key:
SS = Split Spoon
RS = Ring Sample
H = Hand Sample

Drilling Equipment:
CME-75

Geotechnical Engineering
Construction Inspection
Materials Testing

BORING NUMBER
B-6
SHEET 1 OF 1

Client: Round Lake LLC

Project: Oro Valley Assisted Living
Location: 12380 and 124000 W. Vistoso Park Road

Location of Boring: SEE SITE PLAN

Elevation: | Datum:
Logged By: IM | Date: 3/21/22
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
H				0	SC-SM	SILTY, CLAYEY SAND with gravel, brown, low plasticity		
RS	15	12/12				loose		
RS	17	12/12		5		medium dense		
SS	11 13 10	18/18		10				
SS	9 10 10	18/13		15	SM	SILTY SAND with gravel, brown, non-plastic		
SS	5 7 6	18/18		20				
SS	6 7 5	18/14		25				
						BOTTOM OF HOLE AT 26.5 FEET *No Free Water Encountered*		
				30				

Sample Type Key:
SS = Split Spoon
RS = Ring Sample
H = Hand Sample

Drilling Equipment:
CME 75

Geotechnical Engineering
Construction Inspection
Materials Testing

BORING NUMBER
B-7
SHEET 1 OF 1

Client: Round Lake LLC

Project: Oro Valley Assisted Living
Location: 12380 and 124000 W. Vistoso Park Road

Location of Boring: SEE SITE PLAN

Elevation: | Datum:
Logged By: IM | Date: 3/22/22
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
H				0	SM	SILTY SAND with gravel, brown, non-plastic		
RS	7	12/12				loose, dry	114	1.9
RS	6	12/10		5		very dense		
SS	2 3 4	18/15		10		loose		
					SC-SM	SILTY, CLAYEY SAND with gravel, brown, low plastcity		
SS	6 8 10	18/17		15		medium dense		
SS	8 14 10	18/14		20				
SS	6 7 5	18/15		25				
				30		BOTTOM OF HOLE AT 26.5 FEET *No Free Water Encountered*		

Sample Type Key:
SS = Split Spoon
RS = Ring Sample
H = Hand Sample

Drilling Equipment:
CME-55

Geotechnical Engineering
Construction Inspection
Materials Testing

BORING NUMBER
B-8
SHEET 1 OF 1

Client: Round Lake LLC

Project: Oro Valley Assisted Living
Location: 12380 and 124000 W. Vistoso Park Road

Location of Boring: SEE SITE PLAN

Elevation: Datum:
Logged By: IM Date: 3/22/22
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
H				0	SM	SILTY SAND with gravel, brown, non-plastic		
RS	17	12/12				medium dense		
RS	18	12/12		5				
SS	10 11 12	18/17		10	SC-SM	SILTY, CLAYEY SAND with gravel, brown, medium dense, low plastcity		
SS	6 9 10	18/13		15	SM	SILTY SAND with gravel, brown, non-plastic		
SS	10 14 17	18/14		20				
SS	2 6 10	18/1		25				
				30		BOTTOM OF HOLE AT 26.5 FEET *No Free Water Encountered*		

Sample Type Key:
SS = Split Spoon
RS = Ring Sample
H = Hand Sample

Drilling Equipment:
CME-55

Geotechnical Engineering
Construction Inspection
Materials Testing

BORING NUMBER
B-9
SHEET 1 OF 1

Client: Round Lake LLC

Project: Oro Valley Assisted Living
Location: 12380 and 124000 W. Vistoso Park Road

Location of Boring: SEE SITE PLAN

Elevation: Datum:
Logged By: IM Date: 3/22/22
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
H				0	SP-SM	SAND with silt and gravel, brown, slightly damp, non-plastic		
RS	8	12/10				loose, slightly damp	113	3.7
RS	7	12/12		5				
SS	9 13 17	18/12		10	SC-SM	SILTY, CLAYEY SAND with gravel, brown, low plasticity		
						BOTTOM OF HOLE AT 11.5 FEET *No Free Water Encountered*		
				15				
				20				
				25				
				30				

Sample Type Key:
SS = Split Spoon
RS = Ring Sample
H = Hand Sample

Drilling Equipment:
CME-55

Geotechnical Engineering
Construction Inspection
Materials Testing

BORING NUMBER
B-10
SHEET 1 OF 1

Client: Round Lake LLC

Project: Oro Valley Assisted Living
Location: 12380 and 124000 W. Vistoso Park Road

Location of Boring: SEE SITE PLAN

Elevation: | Datum:
Logged By: IM | Date: 3/2/22
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
H				0	SC-SM	SILTY, CLAYEY SAND with gravel, brown, low plasticity		
RS	27	12/12				medium dense		
RS	50/ 10	10/10		5		dense		
SS	2 7 5	18/10		10		medium dense		
						BOTTOM OF HOLE AT 11.5 FEET *No Free Water Encountered*		
				15				
				20				
				25				
				30				

Sample Type Key:
SS = Split Spoon
RS = Ring Sample
H = Hand Sample

Drilling Equipment:
CME-55

Geotechnical Engineering
Construction Inspection
Materials Testing

BORING NUMBER
B-11
SHEET 1 OF 1

Client: Round Lake LLC

Project: Oro Valley Assisted Living
Location: 12380 and 124000 W. Vistoso Park Road

Location of Boring: SEE SITE PLAN

Elevation: Datum:
Logged By: IM Date: 3/22/22
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
H				0	SC-SM	SILTY, CLAYEY SAND with gravel, brown, low plasticity		
				5		BOTTOM OF HOLE AT 5 FEET *No Free Water Encountered*		
				10				
				15				
				20				
				25				
				30				

Sample Type Key:
SS = Split Spoon
RS = Ring Sample
H = Hand Sample

Drilling Equipment:
CME-55