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DESIGN •GEOLOGY

GEOTECHNICAL ENGINEERING STUDY

The Meadows at Terakee Farms

About 950 South 4300 West
West Weber, Utah

CMT PROJECT NO. 15973

FOR:
Big Buck LLC
5419 South 3275 West
Roy, Utah 84061

March 11, 2021

CMT ENGINEERING LABORATORIES

March 11, 2021

Mr. Allan Karras
Big Buck LLC
5419 South 3275 West
Roy, Utah 84061

Subject: Geotechnical Engineering Study
The Meadows at Terakee Farms
530 West 1120 North
American Fork, Utah
CMT Project No. 12106

Mr. Karras:

Submitted herewith is the report of our geotechnical engineering study for the subject site. This report contains the results of our findings and an engineering interpretation of the results with respect to the available project characteristics. It also contains recommendations to aid in the design and construction of the earth related phases of this project.

On February 2, 2021, a CMT Engineering Laboratories (CMT) staff professional was on-site and supervised the excavation of 4 test pits extending to depths of about 7.0 to 10.5 feet below the existing ground surface. Soil samples were obtained during the field operations and subsequently transported to our laboratory for further testing and observation.

Conventional spread and/or continuous footings may be utilized to support the proposed residences, provided the recommendations in this report are followed. A detailed discussion of design and construction criteria is presented in this report.

We appreciate the opportunity to work with you at this stage of the project. CMT offers a full range of Geotechnical Engineering, Geological, Material Testing, Special Inspection services, and Phase I and II Environmental Site Assessments. With offices throughout Utah, Idaho and Arizona, our staff is capable of efficiently serving your project needs. If we can be of further assistance or if you have any questions regarding this project, please do not hesitate to contact us at 801-590-0394.

Sincerely,
CMT Engineering Laboratories

LICENSED PROFESSIONAL ENGINEER # 374995 JEFFREY J. EGBERT 3/11/21 STATE OF UTAH

Jeffrey J. Egbert, P.E., LEED A.P., M. ASCE
Senior Geotechnical Engineer

Reviewed by:

Andrew M. Harris, P.E.
Geotechnical Division Manager

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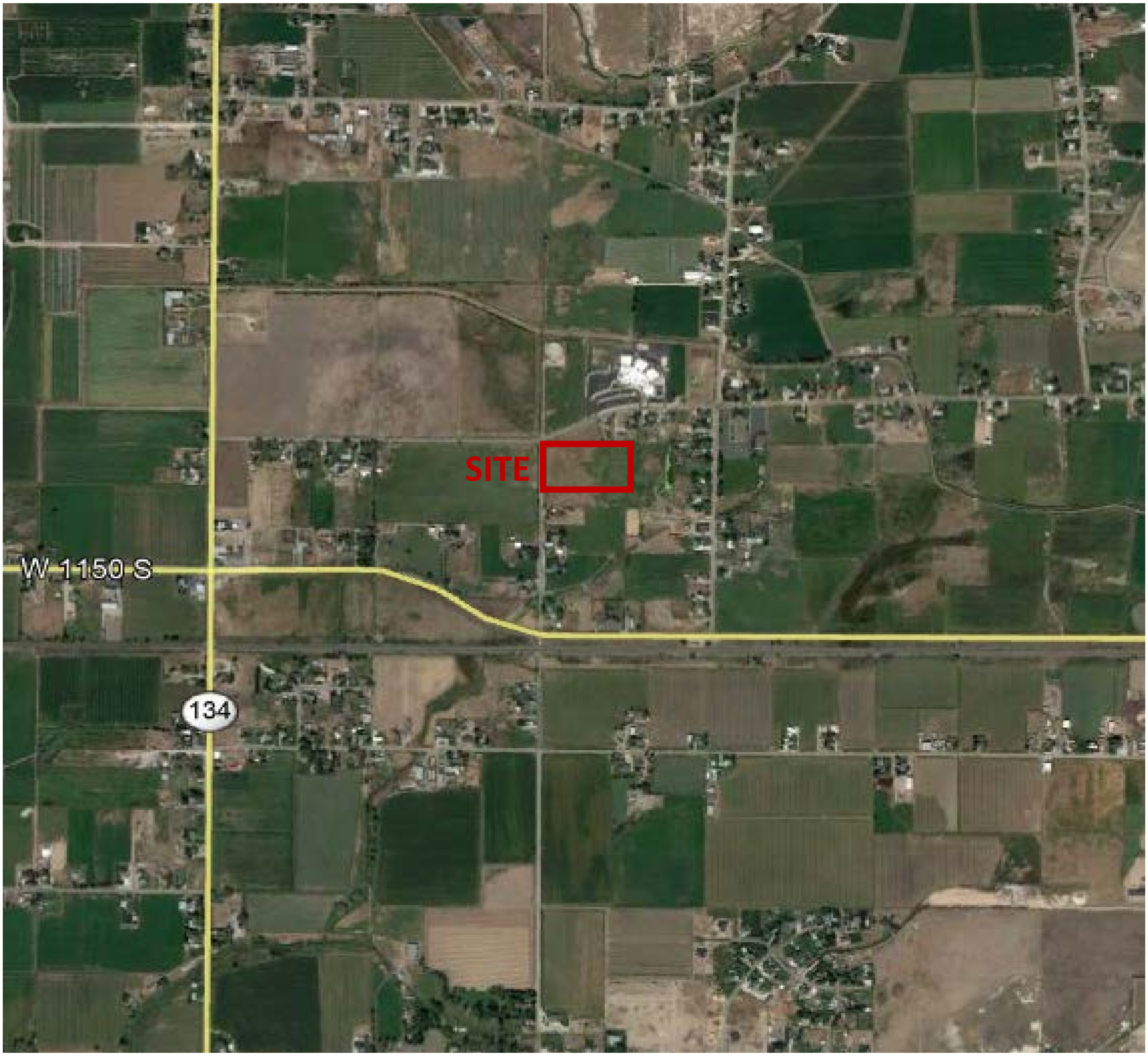
1.0 INTRODUCTION

1.1 General

CMT Engineering Laboratories (CMT) was retained to conduct a geotechnical subsurface study for the Meadows at Terakee Farms, a proposed residential development. The site is situated on the east side of 4300 West at about 950 South in West Weber, Utah, as shown in the **Vicinity Map** below.



VICINITY MAP

1.2 Objectives, Scope and Authorization

The objectives and scope of our study were planned in discussions between Mr. Kenny Palmer and Mr. Andrew Harris of CMT Engineering Laboratories (CMT). In general, the objectives of this study were to define and evaluate the subsurface soil and groundwater conditions at the site, and provide appropriate foundation, earthwork, pavement and seismic recommendations to be utilized in the design and construction of the proposed development.

In accomplishing these objectives, our scope of work has included performing field exploration, which consisted of the excavating/logging/sampling of 4 test pits, performing laboratory testing on representative samples of the subsurface soils collected in the test pits, and conducting an office program, which consisted of correlating available data, performing engineering analyses, and preparing this summary report. This scope of work was authorized by returning a signed copy of our proposal dated January 18, 2021 and executed on January 20, 2021.

1.3 Description of Proposed Construction

We understand a residential subdivision is currently planned for the site. Residences are likely to be 2 levels above grade. We anticipate the residences will be constructed using conventional wood-framing, founded on spread footings, with slab on grade floors established at or near existing site grades (no basements). Maximum continuous wall and column loads are anticipated to be 1,000 to 3,000 pounds per lineal foot and 10,000 to 50,000 pounds, respectively. If the structural loading conditions are different than we have projected, please notify us so that any appropriate modifications to our conclusions and recommendations contained herein can be made.

We anticipate that asphalt-paved a residential street will be constructed as part of the development. Traffic is projected to consist of a light volume of automobiles and pickup trucks, one or two weekly medium-weight delivery trucks, a weekly garbage truck, and an occasional fire truck.

Site development will require some earthwork in the form of minor cutting and filling. A site grading plan was not available at the time of this report, but we project that maximum cuts and fills may be on the order of 2 to 3 feet. If deeper cuts or fills are planned, CMT should be notified to provide additional recommendations, if needed.

1.4 Executive Summary

Proposed residences can be supported upon conventional spread and continuous wall foundations. The most significant geotechnical aspects regarding site development include the following:

1. Approximately 6 inches of topsoil is present on the surface which will require removal from footing, floor slab, exterior concrete flatwork, and pavement areas;
2. Subsurface natural soils predominately consist of CLAY (CL, CL-ML) layers, SILT (ML) layers, and some SAND (SC) layers, to the maximum depth explored:
3. Groundwater is shallow at this site, between about 2.5 and 3.5 feet below the surface; and

4. Foundations and floor slabs may be placed on a minimum of 18 inches of structural fill extending to suitable, undisturbed natural soils.

CMT must assess that topsoil, undocumented fills (if encountered), debris, disturbed or unsuitable soils have been removed and that suitable soils have been encountered prior to placing site grading fills, footings, slabs, and pavements.

In the following sections, detailed discussions pertaining to the site are provided, including subsurface descriptions, geologic/seismic setting, earthwork, foundations, lateral resistance, lateral pressure, floor slabs, and pavements.

2.0 FIELD EXPLORATION

In order to define and evaluate the subsurface soil and groundwater conditions, 4 test pits were excavated with a backhoe at the site to depths of approximately 7.0 to 10.5 feet below the existing ground surface. Locations of the test pits are shown on **Figure 1, Site Plan**, included in the Appendix. The field exploration was performed under the supervision of an experienced member of our geotechnical staff.

Representative soil samples were collected by obtaining disturbed "grab" samples and cutting relatively undisturbed "block" samples from within each test pit. The samples were sealed in plastic bags prior to transport to the laboratory.

The subsurface soils encountered in the test pits were classified in the field based upon visual and textural examination, logged and described in general accordance with ASTM[1] D-2488. These field classifications were supplemented by subsequent examination and testing of select samples in our laboratory. Graphical representations of the subsurface conditions encountered are presented on each individual Test Pit Log, **Figures 2 through 5**, included in the Appendix. A Key to Symbols defining the terms and symbols used on the logs, is provided as **Figure 6** in the Appendix.

Following completion of excavating operations, 1.25-inch diameter slotted PVC pipe was installed in test pits TP-1 and TP-4 to allow subsequent water level measurements.

Upon completion of logging and sampling, the test pits were backfilled with the excavated soils. When backfilling, minimal to no effort was made to compact the backfill and no compaction testing was performed. Thus, the test pit backfill is considered undocumented fill and settlement of the backfill in the test pits over time should be anticipated.

3.0 LABORATORY TESTING

Selected samples of the subsurface soils were subjected to various laboratory tests to assess pertinent engineering properties, as follows:

[1]American Society for Testing and Materials

1. Moisture Content, ASTM D-2216, Percent moisture representative of field conditions
2. Dry Density, ASTM D-2937, Dry unit weight representing field conditions
3. Atterberg Limits, ASTM D-4318, Plasticity and workability
4. Gradation Analysis, ASTM D-1140/C-117, Grain Size Analysis
5. One Dimension Consolidation, ASTM D-2435, Consolidation properties

To provide data necessary for an assessment of potential settlement from foundation loading, a consolidation test was performed on each of 2 representative samples of the natural surficial silt soils encountered across the site. Based upon the data obtained from the consolidation testing, the silt soils at this site have moderate to slightly high compressibility under additional loading. Detailed results of the consolidation tests are maintained within our files and can be transmitted to you, if so desired.

Laboratory test results are presented on the test pit logs (**Figures 2 through 5**) and in the following Lab Summary table:

LAB SUMMARY TABLE

TEST PIT	DEPTH (feet)	SOIL CLASS	SAMPLE TYPE	MOISTURE CONTENT(%)	DRY DENSITY (pcf)	GRADATION			ATTERBERG LIMITS			COLLAPSE (-)/ EXPANSION(+)
						GRAV.	SAND	FINES	LL	PL	PI	
TP-1	2	ML	Block	20	104			69		NP		
TP-1	5.5	CL	Block	95								
TP-2	4	CL-ML	Block	29	92			87	28	21	7	
TP-3	1.5	ML	Block	21	99			74		NP		

4.0 GEOLOGIC & SEISMIC CONDITIONS

4.1 Geologic Setting

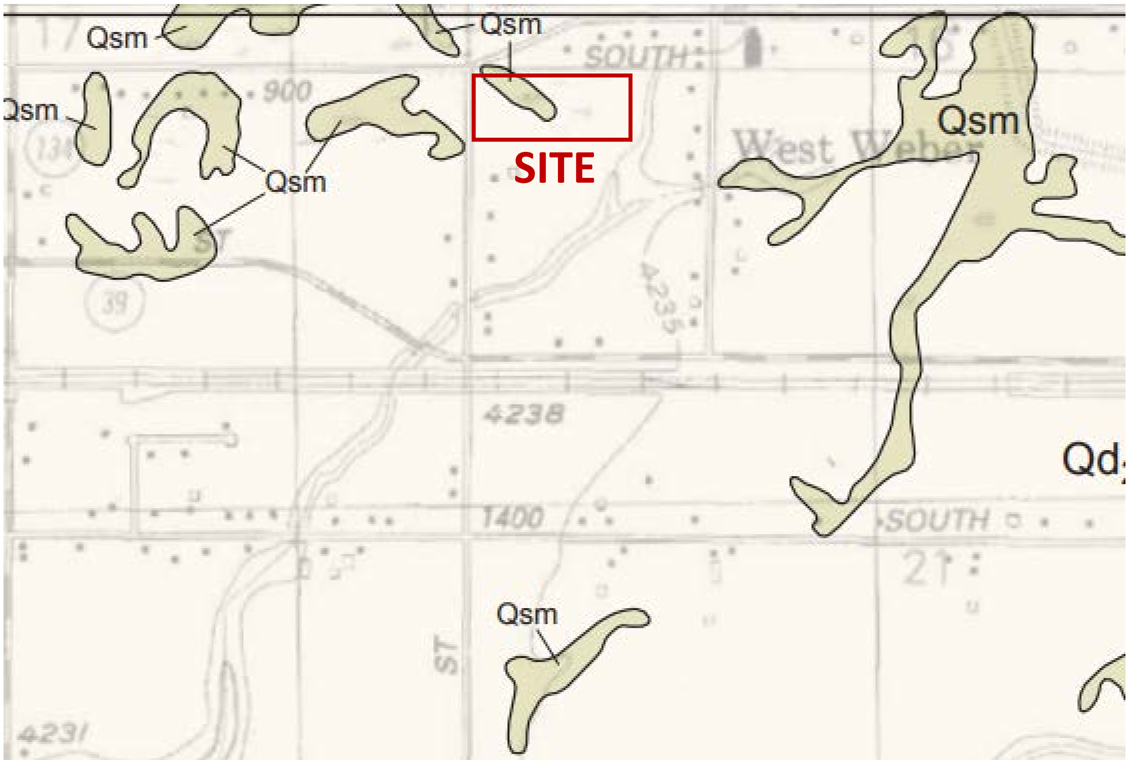
The subject site is located in the southwest portion of Davis County in north-central Utah at an elevation of approximately 4,235 feet above sea level. The site is located in a valley bound by the Wasatch Mountains on the east and Antelope Island (Great Salt Lake) and the Promontory Mountains to the west. The valley is a deep, sediment-filled basin that is part of the Basin and Range Physiographic Province. The valley was formed by extensional tectonic processes during the Tertiary and Quaternary geologic time periods. The valley is located within the Intermountain Seismic Belt, a zone of ongoing tectonism and seismic activity extending from southwestern Montana to southwestern Utah. The active (evidence of movement in the last 10,000 years) Wasatch Fault Zone is part of the Intermountain Seismic Belt and extends from southeastern Idaho to central Utah along the western base of the Wasatch Mountain Range.

Much of northwestern Utah, including the valley in which the subject site is located, was also previously covered by the Pleistocene age Lake Bonneville. The Great Salt Lake, located along the western margin of the valley and beyond, is a remnant of this ancient fresh water lake. Lake Bonneville reached a high-stand elevation of between approximately 5,160- and 5,200-feet above sea level at between 18,500 and 17,400 years ago. Approximately 17,400 years ago, the lake breached its basin in southeastern Idaho and dropped by almost 300 feet relatively fast as water drained into the Snake River. Following this catastrophic release, the lake level continued to drop slowly over time, primarily driven by drier climatic conditions, until reaching the current level of the Great Salt Lake. Shoreline terraces formed at the high-stand elevation of the lake and several subsequent lower lake levels are visible in places on the mountain slopes surrounding the valley. Much of the sediment within the Valley was deposited as lacustrine sediments during both the transgressive (rise) and regressive (fall) phases of Lake Bonneville, as well as older, pre-Bonneville lakes that previously occupied the basin.

The geology of the USGS Roy, Utah 7.5 Minute Quadrangle, that includes the location of the subject site, has been mapped by Sack[2]. The surficial geology on the majority of the subject site is mapped as "Fine-Grained Deltaic Deposits" (Map Unit Qd2) with "Marsh deposits" (Map Unit Qsm) both dated early Holocene. "The Qd2 region exhibits an approximately planar, or platform-like, topographic form and an average elevation near 4,235 feet (1,291 m), making it roughly 20 to 25 feet (6-8 m) higher than the modern delta plain and 10 feet (3 m) lower than the Gilbert shoreline of Great Salt Lake. The platform sediments are muddy to sandy, and traces of sinuous channels are visible on-air photos above 4,232 feet (1,290 m). Marsh deposits (Qsm) are mapped separately where poor drainage or seepage springs have kept the ground wet, such as in channel depressions. Thickness of this map unit probably ranges from about 10 to 20 feet (3-6 m)."

Unit Qsm is described in the mapping as "Fine-grained, saturated, dark-colored, organic-rich sediment found in wetlands associated with springs, seeps, ponds, and other areas of poor drainage and/or high-water table are mapped as Qsm deposits. On the early to middle Holocene flood plain (Qal2) and latest Pleistocene through early Holocene delta (Qd2-Qd4) surfaces, Qsm deposits occupy some of the depressions formed by channels and abandoned meanders. Even seepage from long-standing canals and ditches has locally expanded the area of marsh deposits on the quadrangle. Qsm sediments are probably less than 5 feet (1.5 m) thick". Refer to the **Geologic Map**, shown below.

[2] Sack, D., 2005, Geologic Map of the Roy 7.5' Quadrangle, Weber and Davis Counties, Utah; Utah Geological Survey Miscellaneous Publication MP-05-03, Scale 1:24,000.



GEOLOGIC MAP

4.2 Faulting

No surface fault traces are shown on the referenced geologic map crossing, adjacent to, or projecting toward the subject site. The nearest mapped active (Holocene) fault is the Weber Segment of the Wasatch Fault Zone approximately 7.5 miles to the east.

4.3 Seismicity

4.3.1 Site Class

Utah has adopted the International Building Code (IBC) 2018, which determines the seismic hazard for a site based upon 2014 mapping of bedrock accelerations prepared by the United States Geologic Survey (USGS) and the soil site class. The USGS values are presented on maps incorporated into the IBC code and are also available based on latitude and longitude coordinates (grid points). For site class definitions, IBC 2018 Section 1613.2.2 refers to Chapter 20, Site Classification Procedure for Seismic Design, of ASCE[3] 7-16, which stipulates that the average values of shear wave velocity, blow count and/or shear strength within the upper 100 feet (30 meters) be utilized to determine seismic site class.

Considering our explorations only extended to a depth of 10.5 feet, the site best fits Site Class D – Stiff Soil Profile (without data, or default), which we recommend for seismic structural design.

[3]American Society of Civil Engineers

4.3.2 Seismic Design Category

The 2014 USGS mapping utilized by the IBC provides values of peak ground, short period and long period spectral accelerations for the Site Class B/C boundary and the Risk-Targeted Maximum Considered Earthquake (MCE_R). This Site Class B/C boundary represents average bedrock values for the Western United States and must be corrected for local soil conditions. The Seismic Design Categories in the International Residential Code (IRC 2018 Table R301.2.2.1.1) are based upon the Site Class as addressed in the previous section. For Site Class D (default) at site grid coordinates of 41.2480 degrees north latitude and -112.0817 degrees west longitude, $\mathbf{S_{DS}}$ is 0.936 and the **Seismic Design Category** is D_2.

4.3.3 Liquefaction

Liquefaction is defined as the condition when saturated, loose, sandy soils lose their support capabilities because of excessive pore water pressure which develops during a seismic event. Clayey soils, even if saturated, will generally not liquefy during a major seismic event.

The site is located within an area designated by the Utah Geologic Survey[4] as having “High” liquefaction potential. This is considered a 50% probability that within a 100-year period an earthquake strong enough to cause liquefaction will occur.

A special liquefaction study was not performed for this site. Some saturated sand layers, estimated to be in a loose to medium dense state, were encountered in the test pits. These layers could be liquefiable, however, further investigation would be required to quantify the potential risk.

4.4 Other Geologic Hazards

No landslide deposits or features, including lateral spread deposits, are mapped on or adjacent to the site. The site is not located within a known or mapped potential debris flow, stream flooding[5], or rock fall hazard area.

[4]Utah Geological Survey, "Liquefaction-Potential Map for a Part of Weber County, Utah," Utah Geological Survey Public Information Series 27, August 1994. https://ugspub.nr.utah.gov/publications/public_information/pi-27.pdf
[5]https://msc.fema.gov/portal/search?AddressQuery=950%20South%204300%20West%2C%20West%20Weber%2C%20Utah#searchresultsanchor

5.0 SITE CONDITIONS

5.1 Surface Conditions

At the time the test pits were excavated the site consisted of vacant, undeveloped fields/pasture vegetated with weeds and grasses. The site grade is relatively flat. Based upon aerial photos readily available online dating back to 1993, the site has not changed significantly since that time. An open ditch on the eastern portion of the site appears to have had standing water at times. The site is bounded on the north and east by a few single-family homes, on the south by mostly fields/pasture, and on the west by 4300 West Street (see **Vicinity Map** in **Section 1.1** above).

5.2 Subsurface Soils

At the locations of the test pits we encountered approximately 6 inches of topsoil at the surface. Natural soils observed beneath the topsoil consisted of near surface layers of SILT (ML) with varying amounts of sand, generally followed by a layer of Clayey SAND (SC) of varying thickness, underlain by layers of CLAY (CL) and Silty CLAY (CL-ML), mostly with thin sand seams, extending to the bottom of the test pits.

The silt/clay soils were moist to wet, brown or gray-brown in color, and estimated to be of medium stiff consistency. They also exhibited moderate to slightly high compressibility characteristics in laboratory testing.

The natural sand soils were moist to wet, brown/gray-brown/gray in color, and estimated to be medium dense to loose.

For a more descriptive interpretation of subsurface conditions, please refer to the test pit logs, **Figures 2 through 5**, which graphically represent the subsurface conditions encountered. The lines designating the interface between soil types on the logs generally represent approximate boundaries - in situ, the transition between soil types may be gradual.

5.3 Groundwater

Groundwater was encountered in the test pits at depths of about 3.0 to 3.5 feet below existing grade at the time of our field exploration. On February 26, 2021, CMT personnel returned to the site and measured groundwater levels at depths of 2.8 to 3.1 feet, respectively, within slotted PVC pipes installed in test pits TP-1 and TP-4. These depths to groundwater could affect even shallow footing excavations.

Groundwater levels can fluctuate seasonally and in response to numerous other factors such as heavy precipitation, irrigation of neighboring land, and other unforeseen factors. Seasonal fluctuations are typically on the order of 1.5 to 2 feet. The detailed evaluation of these and other factors, which may be responsible for ground water fluctuations, and the magnitude of potential fluctuations, is beyond the scope of this study.

5.4 Site Subsurface Variations

Based on the results of the subsurface explorations and our experience, variations in the continuity and nature of subsurface conditions should be anticipated. Due to the heterogeneous characteristics of natural soils, care should be taken in interpolating or extrapolating subsurface conditions between or beyond the exploratory locations.

Also, when logging and sampling of the test pits was completed, the test pits were backfilled with the excavated soils but minimal to no effort was made to compact these soils. Thus, the test pit backfill is considered undocumented fill and settlement of the backfill in the test pits over time should be anticipated.

6.0 SITE PREPARATION AND GRADING

6.1 General

All deleterious materials should be stripped from the site prior to commencement of construction activities. This includes vegetation, topsoil, loose and disturbed soils, etc. Based upon the conditions observed in the test pits there is topsoil on the surface of the site which we estimated to be about 6 inches in thickness. When stripping and grubbing, topsoil should be distinguished by the apparent organic content and not solely by color; thus we estimate that topsoil stripping will need to include the upper 4 inches. However, if the site has been cultivated in the past, the upper 12 to 15 inches may have been disturbed during farming. Due to the shallow groundwater, we recommend that stripping and grubbing be kept to the minimum required to remove the most significant portion of the organic material.

The site should be observed by a CMT geotechnical engineer to assess that suitable natural soils have been exposed and any deleterious materials, loose and/or disturbed soils have been removed, prior to placing site grading fills, footings, slabs, and pavements.

Fill placed over large areas to raise overall site grades can induce settlements in the underlying natural soils. If more than 3 feet of site grading fill is anticipated over the natural ground surface, we should be notified to assess potential settlements and provide additional recommendations as needed. These recommendations may include placement of the site grading fill far in advance to allow potential settlements to occur prior to construction.

6.2 Temporary Excavations

Excavations deeper than 8 feet, for utility installation only, are not anticipated at the site. Shallow groundwater was encountered and later measured at this site (in the upper 3 feet). Groundwater will likely be a concern for all site grading activities and excavations. Excavation contractors should be prepared to dewater excavations.

The natural soils encountered at this site predominantly consisted of silt/clay. In clayey (cohesive) soils, temporary construction excavations not exceeding 4 feet in depth may be constructed with near-vertical side slopes. Temporary excavations up to 8 feet deep, above or below groundwater, may be constructed with side slopes no steeper than one-half horizontal to one vertical (0.5H:1V).

For sandy/gravelly (cohesionless) soils, temporary construction excavations not exceeding 4 feet in depth should be no steeper than one-half horizontal to one vertical (0.5H:1V). For excavations up to 8 feet and above groundwater, side slopes should be no steeper than one horizontal to one vertical (1H:1V). Excavations encountering saturated cohesionless soils will be very difficult to maintain, and will require very flat side slopes and/or shoring, bracing and dewatering.

To reduce disturbance of the natural soils during excavation, we recommend that smooth edge buckets/blades be utilized.

All excavations must be inspected periodically by qualified personnel. If any signs of instability or excessive sloughing are noted, immediate remedial action must be initiated. All excavations should be made following OSHA safety guidelines.

6.3 Fill Material

Following are our recommendations for the various fill types we anticipate will be used at this site:

FILL MATERIAL TYPE	DESCRIPTION | RECOMMENDED SPECIFICATION
Structural Fill	Placed below structures, flatwork and pavement. Well-graded sand/gravel mixture, with maximum particle size of 4 inches, a minimum 70% passing 3/4-inch sieve, a maximum 20% passing the No. 200 sieve, and a maximum Plasticity Index of 10.
Site Grading Fill	Placed over larger areas to raise the site grade. Sandy to gravelly soil, with a maximum particle size of 6 inches, a minimum 70% passing 3/4-inch sieve, a maximum 50% passing No. 200 sieve, and a maximum Plasticity Index of 15.
Non-Structural Fill	Placed below non-structural areas, such as landscaping. On-site soils or imported soils, with a maximum particle size of 8 inches, including silt/clay soils not containing excessive amounts of degradable/organic material (see discussion below).
Stabilization Fill	Placed to stabilize soft areas prior to placing structural fill and/or site grading fill. Coarse angular gravels and cobbles 1 inch to 8 inches in size. May also use 1.5-inch to 2.0-inch gravel placed on stabilization fabric, such as Mirafi RS280i, or equivalent (see **Section 6.6**).

On-site soils are not suitable for use as structural fill or site grading fill, but may be used as non-structural fill. Note that these soils will be inherently more difficult to work with in proper moisture conditioning (they are very sensitive to changes in moisture content), requiring very close moisture control during placement and compaction. <u>This will be very difficult, if not impossible, during wet and cold periods of the year</u>.

All fill material should be approved by a CMT geotechnical engineer prior to placement.

6.4 Fill Placement and Compaction

The various types of compaction equipment available have their limitations as to the maximum lift thickness that can be compacted. For example, hand operated equipment is limited to lifts of about 4 inches and most "trench compactors" have a maximum, consistent compaction depth of about 6 inches. Large rollers, depending on soil and moisture conditions, can achieve compaction at 8 to 12 inches. The full thickness of each lift should be compacted to at least the following percentages of the maximum dry density as determined by ASTM D-1557 (or AASHTO[6] T-180) in accordance with the following recommendations:

LOCATION	TOTAL FILL THICKNESS (FEET)	MINIMUM PERCENTAGE OF MAXIMUM DRY DENSITY
Beneath an area extending at least 4 feet beyond the perimeter of structures, and below flatwork and pavement (applies to structural fill and site grading fill) extending at least 2 feet beyond the perimeter	0 to 5	95
Site grading fill outside area defined above	0 to 5	92
Utility trenches within structural areas	--	96
Roadbase and subbase	-	96
Non-structural fill	0 to 5	90

Structural fills greater than 5 feet thick are not anticipated at the site. For best compaction results, we recommend that the moisture content for structural fill/backfill be within 2% of optimum. Field density tests should be performed on each lift as necessary to verify that proper compaction is being achieved.

6.5 Utility Trenches

For the bedding zone around the utility, we recommend utilizing sand bedding fill material that meets current APWA[7] requirements.

All utility trench backfill material below structurally loaded facilities (foundations, floor slabs, flatwork, parking lots/drive areas, etc.) should be placed at the same density requirements established for structural fill in the previous section.

Most utility companies and local governments are requiring Type A-1a or A-1b (AASHTO Designation) soils (sand/gravel soils with limited fines) be used as backfill over utilities within public rights of way, and the backfill be compacted over the full depth above the bedding zone to at least 96% of the maximum dry density as determined by AASHTO T-180 (ASTM D-1557).

[6] American Association of State Highway and Transportation Officials
[7] American Public Works Association

Where the utility does not underlie structurally loaded facilities and public rights of way, natural soils may be utilized as trench backfill above the bedding layer, provided they are properly moisture conditioned and compacted to the minimum requirements stated above in **Section 6.4**, which will be very difficult given their present very moist condition.

6.6 Stabilization

The natural silt/clay soils at this site will be susceptible to rutting and pumping. Consequently, rutting and pumping can be minimized by avoiding concentrated traffic, minimizing the load applied to the surface by using lighter equipment and/or partial loads, by working in drier times of the year, or by providing a working surface for the equipment. Rubber-tired equipment particularly, because of high pressures, promotes instability in moist/wet, soft soils. If rutting or pumping occurs, traffic should be stopped and the disturbed soils should be removed and replaced with stabilization material. Typically, a minimum of 18 inches of the disturbed soils must be removed to be effective. However, deeper removal is sometimes required.

To stabilize soft subgrade conditions a mixture of coarse, clean, angular gravels and cobbles and/or 1.5- to 2.0-inch clean gravel should be utilized, as indicated above in **Section 6.3**. Often the amount of gravelly material can be reduced with the use of a geotextile fabric such as Mirafi RS280i or equivalent. Its use will also help avoid mixing of the subgrade soils with the gravelly material. After excavating the soft/disturbed soils, the fabric should be spread across the bottom of the excavation and up the sides a minimum of 18 inches. Otherwise, it should be placed in accordance with the manufacturer's recommendation, including proper overlaps. The gravel material can then be placed over the fabric in compacted lifts as described above.

7.0 FOUNDATION RECOMMENDATIONS

The following recommendations have been developed on the basis of the previously described project characteristics, including the maximum structural loads discussed in **Section 1.3**, the subsurface conditions observed in the field and the laboratory test data, and standard geotechnical engineering practice.

7.1 Foundation Recommendations

Based on our geotechnical engineering analyses, the proposed residences may be supported upon conventional spread and/or continuous wall foundations placed on a minimum of 18 inches of structural fill extending to suitable natural soils. Stabilization fill (1.5 to 2.0 inch gravel as described in **Section 6.3**) can be used as structural fill due to the shallow groundwater. Footings may be designed using a net bearing pressure of 1,500 psf.

The term "net bearing pressure" refers to the pressure imposed by the portion of the structure located above lowest adjacent final grade, thus the weight of the footing and backfill to lowest adjacent final grade need not be considered. The allowable bearing pressure may be increased by 1/3 for temporary loads such as wind and seismic forces.

We also recommend the following:

1. Exterior footings subject to frost should be placed at least 30 inches below final grade.
2. Interior footings not subject to frost should be placed at least 16 inches below grade.
3. Continuous footing widths should be maintained at a minimum of 18 inches.
4. Spot footings should be a minimum of 24 inches wide.

7.2 Installation

Under no circumstances shall foundations be placed on undocumented fill, topsoil with organics, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water. If other unsuitable soils are encountered, they must be completely removed and replaced with properly compacted structural fill.

Deep, large roots may be encountered where trees and larger bushes are located or were previously located at the site; such large roots should be removed. The base of footing excavations should be observed by a CMT geotechnical engineer to confirm that suitable bearing soils have been exposed.

All structural fill should meet the requirements for such, and should be placed and compacted in accordance with **Section 6** above. The width of structural replacement fill below footings should be equal to the width of the footing plus 1 foot for each foot of fill thickness. For instance, if the footing width is 2 feet and the structural fill depth beneath the footing is 2 feet, the fill replacement width should be 4 feet, centered beneath the footing.

The minimum thickness of structural fill below footings should be equivalent to one-third the thickness of structural fill below any other portion of the foundations. For example, if the maximum depth of structural fill is 6 feet, all footings for the new structure should be underlain by a minimum 2 feet of structural fill.

7.3 Estimated Settlement

Foundations designed and constructed in accordance with our recommendations could experience some settlement, but we anticipate that total settlements of footings founded as recommended above will not exceed 1 inch, with differential settlements on the order of 0.5 inches over a distance of 25 feet. We expect approximately 50% of the total settlement to initially take place during construction.

7.4 Lateral Resistance

Lateral loads imposed upon foundations due to wind or seismic forces may be resisted by the development of passive earth pressures and friction between the base of the footings and the supporting soils. In determining frictional resistance, a coefficient of 0.40 for structural fill, may be utilized for design. Passive resistance provided by properly placed and compacted structural fill above the water table may be considered equivalent to a fluid with a density of 350 pcf. A combination of passive earth resistance and friction may be utilized if the friction component of the total is divided by 1.5.

8.0 LATERAL EARTH PRESSURES

We anticipate that below-grade walls no more than 2 to 3 feet high will be constructed at this site. The lateral earth pressure values given below are for a backfill material that will consist of drained sand/gravel soils (less than 10% passing No. 200 sieve) placed and compacted in accordance with the recommendations presented herein. If other soil types will be used as backfill, we should be notified so that appropriate modifications to these values can be provided, as needed.

The lateral pressures imposed upon subgrade facilities will depend upon the relative rigidity and movement of the backfilled structure. Following are the recommended lateral pressure values, which also assume that the soil surface behind the wall is horizontal and that the backfill within 3 feet of the wall will be compacted with hand-operated compacting equipment.

CONDITION	STATIC (psf/ft)*	SEISMIC (psf)**
Active Pressure (wall is allowed to yield, i.e. move away from the soil, with a minimum 0.001H movement/rotation at the top of the wall, where "H" is the total height of the wall)	35	42
At-Rest Pressure (wall is not allowed to yield)	55	113
Passive Pressure (wall moves into the soil)	425	275

*Equivalent Fluid Pressure (applied at 1/3 Height of 3-foot High Wall)
**Uniform Pressure, Seismic Only (applied at 1/2 Height of 3-foot High Wall)

9.0 FLOOR SLABS

Floor slabs may be established upon suitable, undisturbed, natural soils and/or on structural fill extending to suitable natural soils. Under no circumstances shall floor slabs be established directly on any topsoil, undocumented fills, loose or disturbed soils, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water. Floor slabs should not be placed below the existing ground surface.

In order to facilitate curing of the concrete, we recommend that floor slabs be directly underlain by at least 4 inches of "free-draining" fill, such as "pea" gravel or 3/4-inch to 1-inch minus, clean, gap-graded gravel. To help control normal shrinkage and stress cracking, the floor slabs should have the following features:

1. Adequate reinforcement for the anticipated floor loads with the reinforcement continuous through interior floor joints;
2. Frequent crack control joints; and
3. Non-rigid attachment of the slabs to foundation walls and bearing slabs.

10.0 DRAINAGE RECOMMENDATIONS

It is important to the long-term performance of foundations and floor slabs that water not be allowed to collect near the foundation walls and infiltrate into the underlying soils. We recommend the following:

1. All areas around each residence should be sloped to provide drainage away from the foundations. We recommend a minimum slope of 4 inches in the first 10 feet away from the structure. This slope should be maintained throughout the lifetime of the structure.

2. All roof drainage should be collected in rain gutters with downspouts designed to discharge at least 10 feet from the foundation walls or well beyond the backfill limits, whichever is greater.

3. Adequate compaction of the foundation backfill should be provided. We suggest a minimum of 90% of the maximum laboratory density as determined by ASTM D-1557. Water consolidation methods should not be used under any circumstances.

4. Landscape sprinklers should be aimed away from the foundation walls. The sprinkling systems should be designed with proper drainage and be well-maintained. Over watering should be avoided.

5. Other precautions that may become evident during construction.

11.0 PAVEMENTS

All pavement areas must be prepared as discussed above in **Section 6.1**. Under no circumstances shall pavements be established over topsoil, undocumented fills, loose or disturbed soils, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water.

In roadway areas, subsequent to stripping and prior to the placement of pavement materials, the exposed subgrade must be proof rolled by passing moderate-weight rubber tire-mounted construction equipment over the surface at least twice. If excessively soft or otherwise unsuitable soils are encountered, we recommend they be removed to a minimum of 18 inches below the subgrade level and replaced with structural fill.

We anticipate the natural silt/clay soils will exhibit poor pavement support characteristics when saturated or nearly saturated. Based on our laboratory testing experience with similar soils, our pavement design utilized a California Bearing Ratio (CBR) of 3 for the natural silt/clay soils.

Given the projected traffic as discussed above in **Section 1.3**, the following pavement sections are recommended for approximately 4 ESAL's (18-kip equivalent single-axle loads) per day:

MATERIAL	PAVEMENT SECTION THICKNESS (inches)	
Asphalt	**3**	**3**
Road-Base	**13**	**7**
Subbase	**0**	**8**
Total Thickness	**16**	**18**

Untreated base course (UTBC) should conform to city specifications, or to 1-inch-minus UDOT specifications for A–1-a/NP, and have a minimum CBR value of 70%. Material meeting our specification for structural fill can be used for subbase, as long as the fines content (percent passing No. 200 sieve) does not exceed 15%. Roadbase and subbase material should be compacted as recommended above in **Section 6.4**. Asphalt material generally should conform to APWA requirements, having a ½-inch maximum aggregate size, a 75-gyration Superpave mix containing no more than 15% of recycled asphalt (RAP) and a PG58-28 binder.

12.0 QUALITY CONTROL

We recommend that CMT be retained as part of a comprehensive quality control testing and observation program. With CMT on-site we can help facilitate implementation of our recommendations and address, in a timely manner, any subsurface conditions encountered which vary from those described in this report. Without such a program CMT cannot be responsible for application of our recommendations to subsurface conditions which may vary from those described herein. This program may include, but not necessarily be limited to, the following:

12.1 Field Observations

Observations should be completed during all phases of construction such as site preparation, foundation excavation, structural fill placement and concrete placement.

12.2 Fill Compaction

Compaction testing by CMT is required for all structural supporting fill materials. Maximum Dry Density (Modified Proctor, ASTM D-1557) tests should be requested by the contractor immediately after delivery of any fill materials. The maximum density information should then be used for field density tests on each lift as necessary to ensure that the required compaction is being achieved.

12.3 Excavations

All excavation procedures and processes should be observed by a geotechnical engineer from CMT or their representative. In addition, for the recommendations in this report to be valid, all backfill and structural fill placed in trenches and all pavements should be density tested by CMT. We recommend that freshly mixed concrete be tested by CMT in accordance with ASTM designations.

13.0 LIMITATIONS

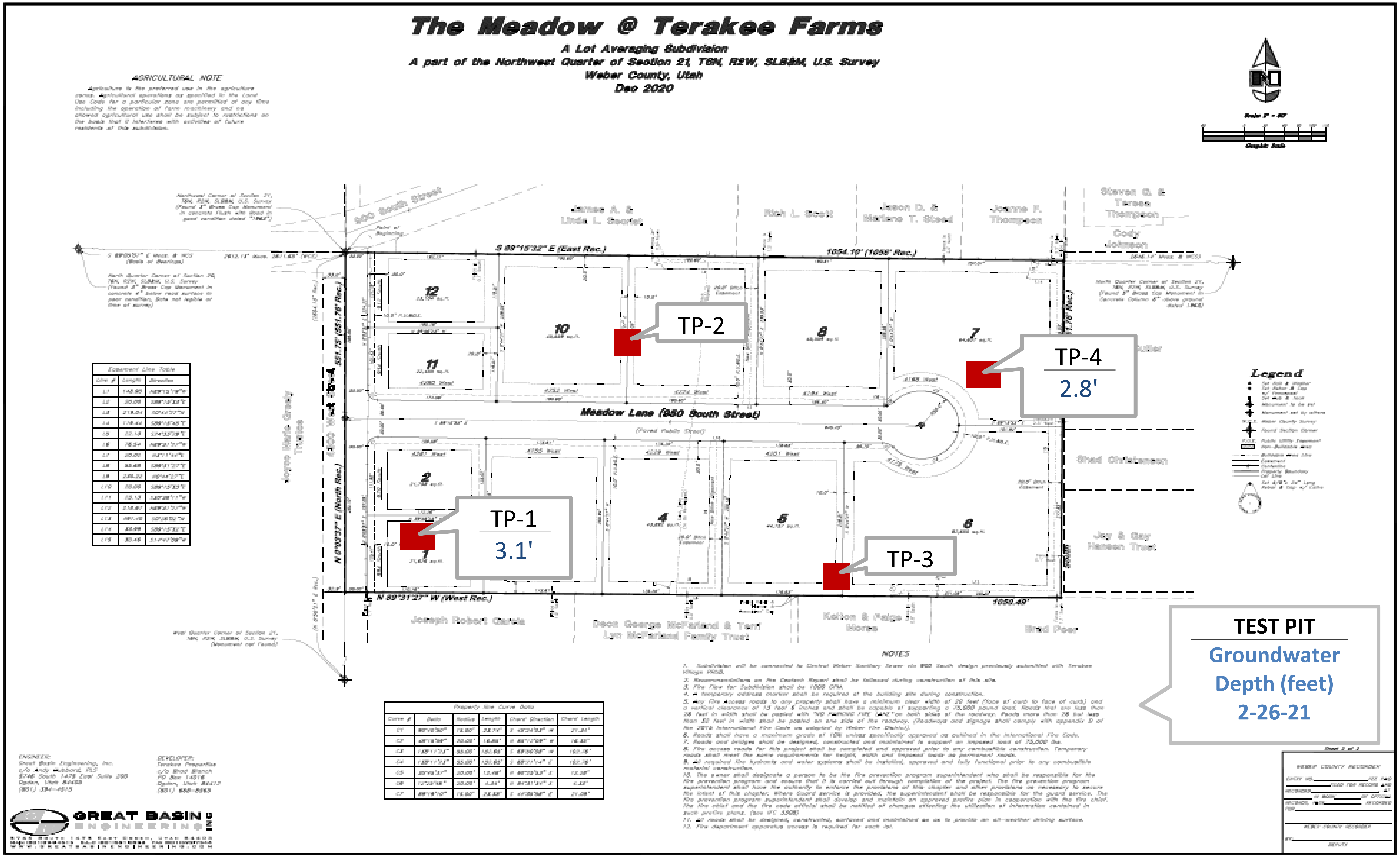
The recommendations provided herein were developed by evaluating the information obtained from the subsurface explorations and soils encountered therein. The exploration logs reflect the subsurface conditions only at the specific location at the particular time designated on the logs. Soil and ground water conditions may differ from conditions encountered at the actual exploration locations. The nature and extent of any variation in the explorations may not become evident until during the course of construction. If variations do appear, it may become necessary to re-evaluate the recommendations of this report after we have observed the variation.

Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all other warranties, either expressed or implied.

We appreciate the opportunity to be of service to you on this project. If we can be of further assistance or if you have any questions regarding this project, please do not hesitate to contact us at (801) 590-0394. To schedule materials testing, please call (801) 381-5141.

APPENDIX

SUPPORTING
DOCUMENTATION



CMT ENGINEERING LABORATORIES	The Meadows at Terakee Farms About 950 South 4300 West, West Weber, Utah	SITE PLAN	Date: 4-Feb-2021 CMT No.: 15973	Figure: 1

The Meadows at Terakee Farms

About 950 South 4300 West, West Weber, Utah

Test Pit Log — TP-1

Total Depth: 7'
Water Depth: 3.5', 3.1'
Date: 2/2/21
Job #: 15973

Depth (ft)	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gravel %	Sand %	Fines %	LL	PL	PI
0	Topsoil										
0.5	Brown SILT (ML) with sand, moist; medium stiff (estimated)										
2		■	1	20	104			69			NP
3.5	Gray Clayey SAND (SC), wet; loose (estimated); CAVING AT 4'										
4.5	Brown Sandy CLAY (CL), sand laminations, oxidation staining, wet; medium stiff (estimated)										
5.5		■	2	28	95						
7	END AT 7'										

Remarks: Groundwater encountered during excavation at depth of 3.5 feet and measured on 2/26/21 at depth of 3.1 feet.
Slotted PVC pipe installed to depth of 7.0 feet to facilitate water level measurements.

Coordinates: °, °
Surface Elev. (approx): Not Given

Equipment: Rubber Tire Backhoe
Excavated By: Rockwell
Logged By: Olivia Roberts

CMT ENGINEERING LABORATORIES

Figure: 2

The Meadows at Terakee Farms

About 950 South 4300 West, West Weber, Utah

Test Pit Log — TP-2

Total Depth: 10.5'
Water Depth: 3.5'
Date: 2/2/21
Job #: 15973

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation: Gravel %	Gradation: Sand %	Gradation: Fines %	Atterberg: LL	Atterberg: PL	Atterberg: PI
0		Topsoil										
0.5–3		Brown Clayey SAND (SC), occasional roots, very moist; medium dense (estimated)										
1			■	3								
3–10.5		Gray-Brown Silty CLAY (CL-ML) with fine sand laminations, very moist; medium stiff to soft (estimated); wet										
3.5		▽ (water level)										
4			■	4	29	92			87	28	21	7
6		grades with more frequent sand laminations										
8		grades with less sand										
10.5		END AT 10.5'										

Remarks: Groundwater encountered during excavation at depth of 3.5 feet.

Coordinates: °, °
Surface Elev. (approx): Not Given

Equipment: Rubber Tire Backhoe
Excavated By: Rockwell
Logged By: Olivia Roberts

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Figure: 3

The Meadows at Terakee Farms

About 950 South 4300 West, West Weber, Utah

Test Pit Log — TP-3

Total Depth: 8.5'
Water Depth: 3.5'

Date: 2/2/21
Job #: 15973

Depth (ft)	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gravel %	Sand %	Fines %	LL	PL	PI
0	Topsoil; sandy clay with organics										
0.5	Brown SILT (ML) with sand, very moist; medium stiff (estimated)										
1.5	grades dark brown with more sand	Block	5	21	99			74			NP
3.5	Gray-Brown Clayey SAND (SC), some layers of silty clay 1-2" thick, wet; medium dense to loose (estimated)										
5	CAVING AT 5'										
5.5	grades brown										
6		Bag	6								
7	Brown Silty CLAY (CL-ML), wet; medium stiff (estimated)										
8.5	END AT 8.5'										

Remarks: Groundwater encountered during excavation at depth of 3.5 feet.

Coordinates: °, °
Surface Elev. (approx): Not Given

Equipment: Rubber Tire Backhoe
Excavated By: Rockwell
Logged By: Olivia Roberts

CMT ENGINEERING LABORATORIES

Figure: 4

The Meadows at Terakee Farms

About 950 South 4300 West, West Weber, Utah

Test Pit Log

TP-4

Total Depth: 9'
Water Depth: 3', 2.8'

Date: 2/2/21
Job #: 15973

Depth (ft)	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gravel %	Sand %	Fines %	LL	PL	PI
0	Topsoil: Dark brown silty sandy clay										
0.5–3	Brown SILT (ML) with sand, very moist; medium stiff (estimated)										
3–5	Gray Clayey SAND (SC); wet; loose (estimated)										
5–9	Brown Silty CLAY (CL-ML) with sand laminations 1/8-1" thick, wet; medium stiff (estimated)										
9	END AT 9'										

Remarks: Groundwater encountered during excavation at depth of 3 feet and measured on 2/26/21 at depth of 2.8 feet.
Slotted PVC pipe installed to depth of 9.0 feet to facilitate water level measurements.

Coordinates: °, °

Surface Elev. (approx): Not Given

Equipment: Rubber Tire Backhoe

Excavated By: Rockwell

Logged By: Olivia Roberts

CMT ENGINEERING LABORATORIES

Figure: 5

The Meadows at Terakee Farms

Key to Symbols

About 950 South 4300 West, West Weber, Utah

Date: 2/2/21

Job #: 15973

① Depth (ft)	② GRAPHIC LOG	③ Soil Description	④ Sample Type	⑤ Sample #	⑥ Moisture (%)	⑦ Dry Density(pcf)	Gradation ⑧ Gravel %	Sand %	Fines %	Atterberg ⑨ LL	PL	PI

COLUMN DESCRIPTIONS

① **Depth (ft.):** Depth (feet) below the ground surface (including groundwater depth - see water symbol below).

② **Graphic Log:** Graphic depicting type of soil encountered (see ② below).

③ **Soil Description:** Description of soils encountered, including Unified Soil Classification Symbol (see below).

④ **Sample Type:** Type of soil sample collected at depth interval shown; sampler symbols are explained below-right.

⑤ **Sample #:** Consecutive numbering of soil samples collected during field exploration.

⑥ **Moisture (%):** Water content of soil sample measured in laboratory (percentage of dry weight of sample).

⑦ **Dry Density (pcf):** The dry density of a soil measured in laboratory (pounds per cubic foot).

⑧ **Gradation:** Percentages of Gravel, Sand and Fines (Silt/Clay), obtained from lab test results of soil passing the No. 4 and No. 200 sieves.

⑨ **Atterberg:** Individual descriptions of Atterberg Tests are as follows:

LL = Liquid Limit (%): Water content at which a soil changes from plastic to liquid behavior.

PL = Plastic Limit (%): Water content at which a soil changes from liquid to plastic behavior.

PI = Plasticity Index (%): Range of water content at which a soil exhibits plastic properties (= Liquid Limit - Plastic Limit).

STRATIFICATION	
Description	**Thickness**
Seam	Up to ½ inch
Lense	Up to 12 inches
Layer	Greater than 12 in.
Occasional	1 or less per foot
Frequent	More than 1 per foot

MODIFIERS
Trace
<5%
Some
5-12%
With
> 12%

MOISTURE CONTENT
Dry: Absence of moisture, dusty, dry to the touch.
Moist: Damp / moist to the touch, but no visible water.
Wet: Visible water, usually soil below groundwater.

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

MAJOR DIVISIONS			USCS SYMBOLS	②	TYPICAL DESCRIPTIONS
COARSE-GRAINED SOILS More than 50% of material is larger than No. 200 sieve size.	GRAVELS The coarse fraction retained on No. 4 sieve.	CLEAN GRAVELS (< 5% fines)	GW		Well-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines
			GP		Poorly-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines
		GRAVELS WITH FINES (≥ 12% fines)	GM		Silty Gravels, Gravel-Sand-Silt Mixtures
			GC		Clayey Gravels, Gravel-Sand-Clay Mixtures
	SANDS The coarse fraction passing through No. 4 sieve.	CLEAN SANDS (< 5% fines)	SW		Well-Graded Sands, Gravelly Sands, Little or No Fines
			SP		Poorly-Graded Sands, Gravelly Sands, Little or No Fines
		SANDS WITH FINES (≥ 12% fines)	SM		Silty Sands, Sand-Silt Mixtures
			SC		Clayey Sands, Sand-Clay Mixtures
FINE-GRAINED SOILS More than 50% of material is smaller than No. 200 sieve size.	SILTS AND CLAYS Liquid Limit less than 50%		ML		Inorganic Silts and Sandy Silts with No Plasticity or Clayey Silts with Slight Plasticity
			CL		Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays
			OL		Organic Silts and Organic Silty Clays of Low Plasticity
	SILTS AND CLAYS Liquid Limit greater than 50%		MH		Inorganic Silts, Micacious or Diatomacious Fine Sand or Silty Soils
			CH		Inorganic Clays of High Plasticity, Fat Clays
			OH		Organic Silts and Organic Clays of Medium to High Plasticity
HIGHLY ORGANIC SOILS			PT		Peat, Soils with High Organic Contents

Note: Dual Symbols are used to indicate borderline soil classifications (i.e. GP-GM, SC-SM, etc.).

SAMPLER SYMBOLS

- Block Sample
- Bulk/Bag Sample
- Modified California Sampler 3.5" OD, 2.42" ID D&M Sampler
- Rock Core
- Standard Penetration Split Spoon Sampler
- Thin Wall (Shelby Tube)

WATER SYMBOL

- Encountered Water Level
- Measured Water Level

(see Remarks on Logs)

1. The results of laboratory tests on the samples collected are shown on the logs at the respective sample depths.
2. The subsurface conditions represented on the logs are for the locations specified. Caution should be exercised if interpolating between or extrapolating beyond the exploration locations.
3. The information presented on each log is subject to the limitations, conclusions, and recommendations presented in this report.

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Figure:
6