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Rashelle Hobbs, Recorder, Salt Lake County, Utah
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Millcreek Planning & Zoning
1330 E Chambers Avenue
Millcreek, UT 84106
801-214-2700

GEOLOGICAL HAZARDS DISCLOSURE AND ACKNOWLEDGEMENT

Disclose and Acknowledgement Regarding Development of Property Located within a Geological Hazards Special Study Area

The undersigned (print name) Nathan Brockbank, hereby certify(ies) to be owner(s) of the real property described below, which is located within Salt Lake County, State of Utah

Millcreek File or Permit Number SD-24-012

Street Address: 4433 South Garden Drive

Parcel Number (required): 22-05-179-030-0000

Legal Description (attached):

Acknowledgements:

1. The real property described above is either partially or wholly located within a Geological Hazards Special Study Area as defined in Chapter 19.75, Geological Hazards Ordinance, in the Millcreek Code of Ordinances and consist of the following:

☐ Surface Fault Rupture	☐ Debris Flow
☐ High Liquefaction Potential	☐ Rock-Fall Path
☑ Moderate Liquefaction Potential	☐ Avalanche Path
☐ Landslide	☐ Sensitive Land

2. This Geological Hazards Disclosure and Acknowledgement is filed in accordance with the Geological Hazards Ordinance (Chapter 19.75) **requires:** ☑, or **does not require:** ☐ a site-specific natural hazards study and report. If required by ordinance, a site-specific geological hazards study and report has been prepared for the above described real property which addresses the nature of the hazards and their potential effect on the proposed development of the above described real property and the occupants thereof in terms of risk and potential damage. The report and conditions and requirements for development of the property are on file with Millcreek which is available for public inspection.

Legal Description

LOT 4, GARDEN ACRES. 4748-1043 4748-1044 6904-702 6904-0703 7271-2380 10384-8463 10563-7630 10563-7634

Millcreek Planning & Zoning
1330 E Chambers Avenue
Millcreek, UT 84106
801-214-2700

PROPERTY OWNER'S AFFIDAVIT

Nathan A Brockbank Garden Acres LLC
(Owner of the Real Property)

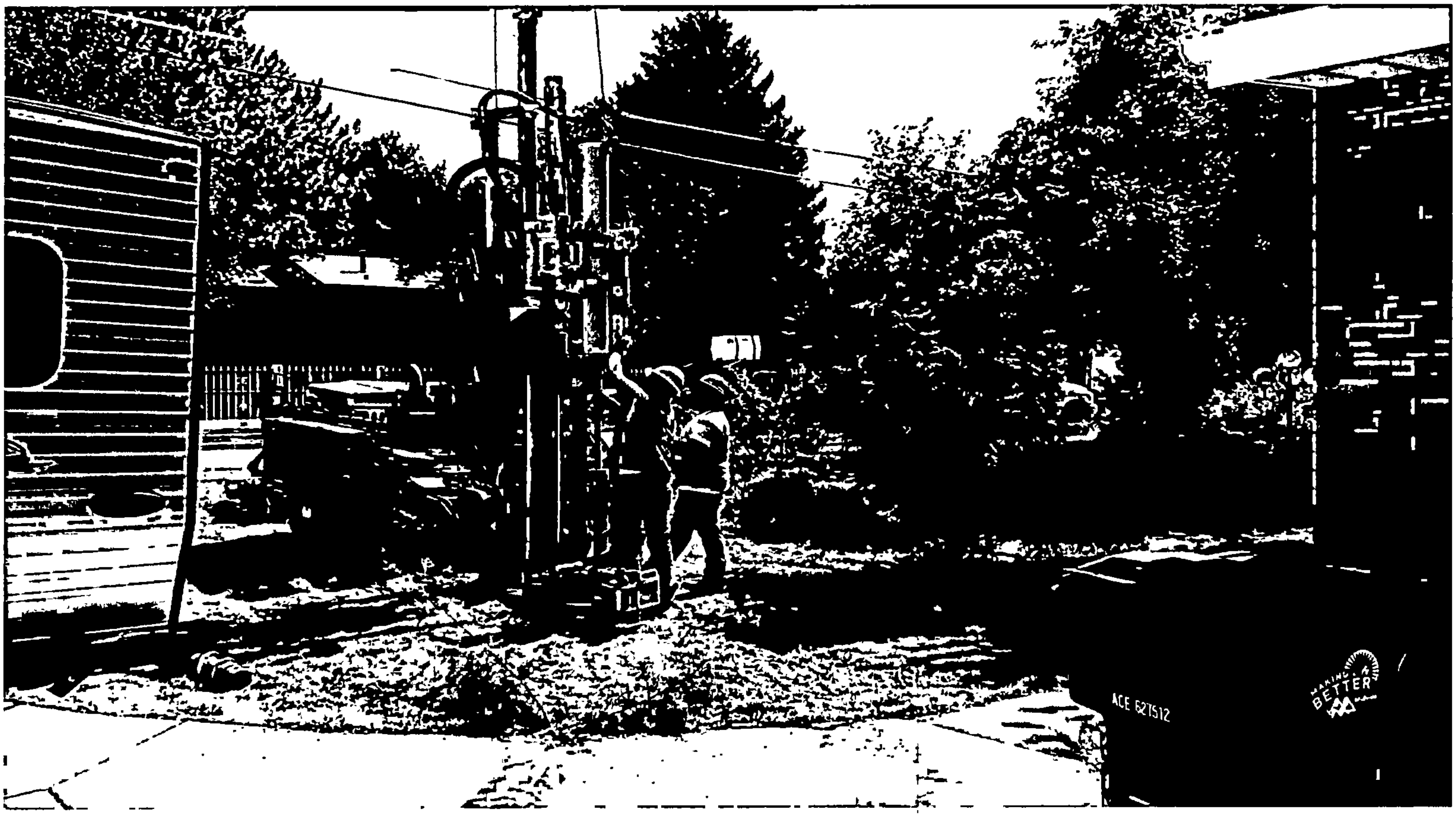
STATE OF UTAH }
} ss
COUNTY OF SALT LAKE }

The foregoing instrument was acknowledged before me this 7 day of January 20 25
by Candice A. Kidd

Notary Public - State of Utah
CANDICE A. KIDD
Comm. #717021
My Commission Expires
March 1, 2025

Notary Public
Residing in: Salt Lake County

CMT TECHNICAL SERVICES



ENGINEERING • GEOTECHNICAL • ENVIRONMENTAL (ESA I & II) •
MATERIALS TESTING • SPECIAL INSPECTIONS •
ORGANIC CHEMISTRY • PAVEMENT
DESIGN • GEOLOGY

GEOTECHNICAL ENGINEERING STUDY

Garden Drive Towns

4433 South Garden Drive
Millcreek, Utah

CMT PROJECT NO. 22526

FOR:
Western States Ventures
Nate Brockbank
2265 East Murray Holladay Road
Holladay, Utah 84117

August 23, 2024

August 23, 2024

Mr. Nate Brockbank
Western States Ventures
2265 East Murray Holladay Road
Holladay, Utah 84117

Subject: Geotechnical Engineering Study
Garden Drive Towns
7240 South 525 East
Midvale, Utah
CMT PROJECT NO. 22526

Mr. Brockbank:

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 September 19, 2022, a CMT Technical Services (CMT) staff professional was on-site and supervised the drilling of 3 bore holes extending to depths of about 16.5 to 51.5 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. An infiltration test was also performed at the site.

Conventional spread and/or continuous footings may be utilized to support the proposed structures, provided the recommendations in this report are followed. This report presents detailed discussions of design and construction criteria for this site.

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, Arizona, Colorado and Texas, 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 801-492-4132.

Sincerely,
CMT Technical Services

LICENSED PROFESSIONAL ENGINEER
10618648
NATHAN D. PACK
8/23/24
STATE OF UTAH

Nathan D. Pack, P.E.
Senior Geotechnical Engineer

Reviewed by:

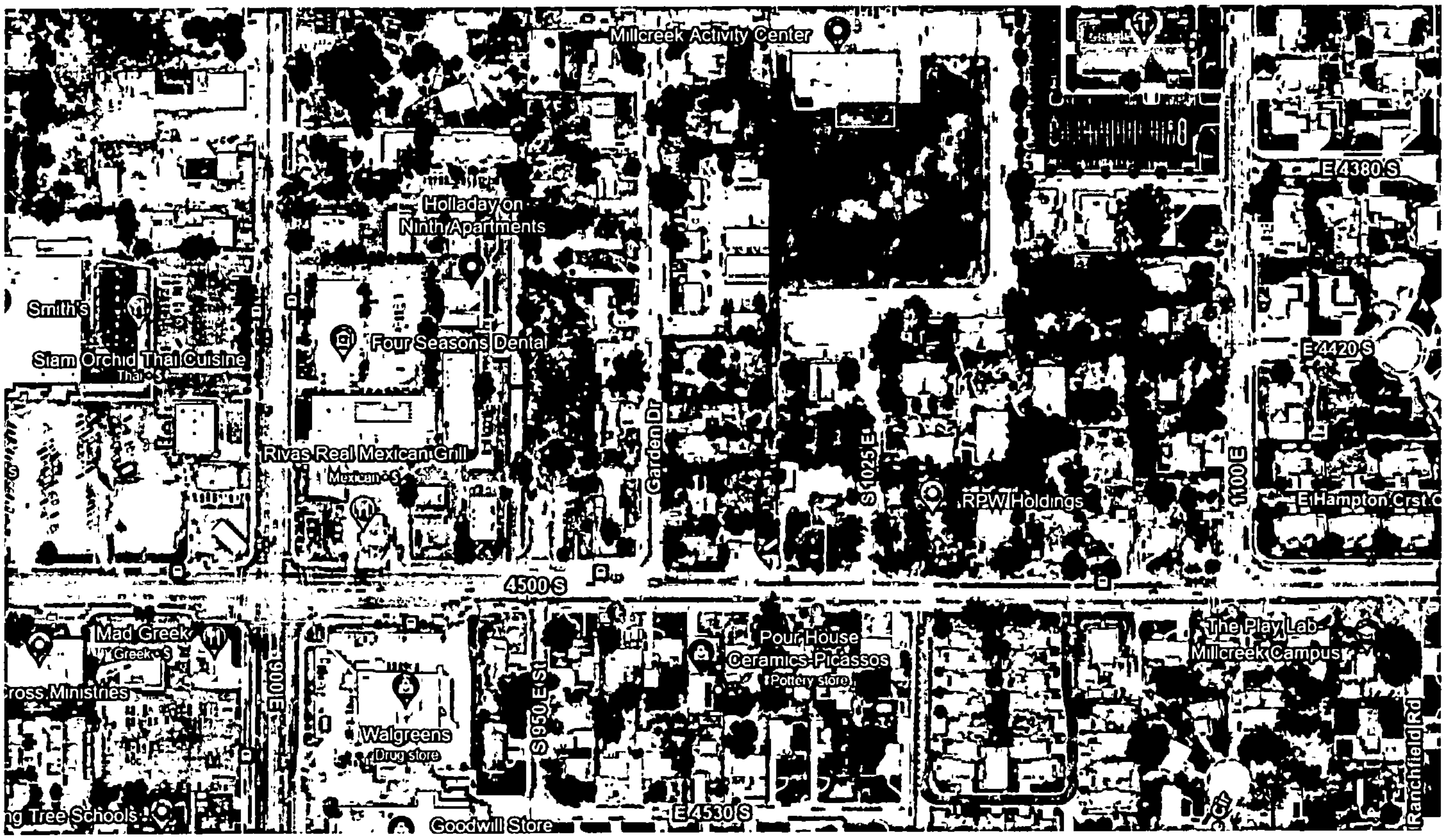
Jeffrey J. Egbert, P.E., LEED A.P., M. ASCE
Senior Geotechnical Engineer

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 General

CMT Technical Services (CMT) was retained to conduct a geotechnical subsurface study for the proposed construction of small housing units. The site is situated on the west side of Garden Drive at 4433 South in Millcreek, 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. Nate Brockbank of Western States Ventures, and Mr. Nathan Pack of 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 drilling/logging/sampling of 1 bore hole, performing laboratory testing on representative samples of the subsurface soils collected in the bore hole, 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 6/13/2024 and executed on 6/18/2024.

1.3 Description of Proposed Construction

We understand that the proposed construction consists of townhomes. We project that wall loads will not exceed 5,000 pounds per linear foot and column loads will not exceed 80,000 pounds. Floor slab loads are anticipated to be relatively light, with an average uniform loading not exceeding 100 pounds per square foot. 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 also understand that pavements at the site will include light-duty parking areas and internal drive lanes, which we anticipate will utilize both asphalt and concrete pavement. Traffic is projected to consist of mostly automobiles and light trucks, a few daily 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 5 to 8 feet. If deeper cuts or fills are planned, CMT should be notified to provide additional recommendations, if needed.

1.4 Executive Summary

The most significant geotechnical aspects regarding site development include the following:

1. Foundations and floor slabs may be constructed on suitable undisturbed natural soils or on structural/engineered fill which extends to natural soils.
2. Groundwater was encountered at a depth of 24 feet, which will likely not affect excavations and construction.

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 setting, seismicity, earthwork, foundations, lateral resistance, lateral pressure, floor slabs, and pavements.

2.0 FIELD EXPLORATION

2.1 General

To define and evaluate the subsurface soil and groundwater conditions, 1 bore hole was drilled at the site to a depth of approximately 51.5 feet below the existing ground surface. Location of the bore hole is 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.

Samples of the subsurface soils encountered in the bore hole were collected at varying depths through the hollow stem drill augers. Relatively undisturbed samples of the subsurface soils were obtained by driving a split-spoon sampler with 2.5-inch outside diameter rings/liners into the undisturbed soils below the drill augers. Disturbed samples were collected utilizing a standard split spoon sampler. This standard split spoon sampler was driven 18 inches into the soils below the drill augers using a 140-pound hammer free-falling a distance of 30 inches. The number of hammer blows needed for each 6-inch interval was recorded. The sum of the hammer blows for the final 12 inches of penetration is known as a standard penetration test and this 'blow count' was recorded on the bore hole log.

The subsurface soils encountered in the bore hole 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. A log of the bore hole, including a description of the soil strata encountered, is presented on ***Figure 2***, included in the Appendix. Sampling information and other pertinent data and observations are also included on the log. In addition, a Key to Symbols defining the terms and symbols used on the log is provided as ***Figure 3*** in the Appendix.

2.2 Infiltration Testing

An Infiltration test was also performed as part of our field exploration in the northeast corner of the site at a depth of about 3 feet below the existing ground surface. The testing consisted of creating and filling a small hole at that depth with water and measuring the rate of water drop within the small hole over a certain period (i.e. 10 minutes). We repeated this process multiple times until subsequent readings were the same. The results of this test indicate that the clay soils at this site have an infiltration rate of approximately **5.45 minutes per inch**. This rate could increase (become slower) over time due to siltation, thus we recommend an appropriate factor of safety be applied for design.

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 Dimensional Consolidation, ASTM D-2435, Consolidation properties

To provide data for an analysis of potential settlement from structural loading, a one-dimensional consolidation test was performed on each of 1 sample of the subsurface soils collected in the bore hole. Based upon data obtained from the consolidation testing, the clay soils at this site are moderately over-consolidated and moderately compressible under additional loading, and the deeper clays showed a small swell potential when water was added during the tests. Detailed results of the consolidation test are maintained within our files and can be transmitted to you, if so desired.

Laboratory test results are presented on the bore hole log (***Figure 2***) and in the following **Lab Summary Table**:

LAB SUMMARY TABLE

BORE HOLE	DEPTH (feet)	SOIL CLASS	SAMPLE TYPE	MOISTURE CONTENT(%)	DRY DENSITY (pcf)	GRADATION			ATTERBERG LIMITS			COLLAPSE (-)/ EXPANSION(+)
						GRAV.	SAND	FINES	LL	PL	PI	
B-1	2.5	CL	Rings	16	98	0	10	90	30	16	14	
	7.5	CL	SPT	17		7	38	55	22	16	6	
	15	CL	SPT	25		11	6	83	35	20	15	
	25	CL	SPT	22		6	22	72	27	18	9	
	45	CL	SPT	28		0	2	98	35	21	14	
	50	CL	SPT	19		0	5	95	28	18	10	

4.0 GEOLOGIC & SEISMIC CONDITIONS

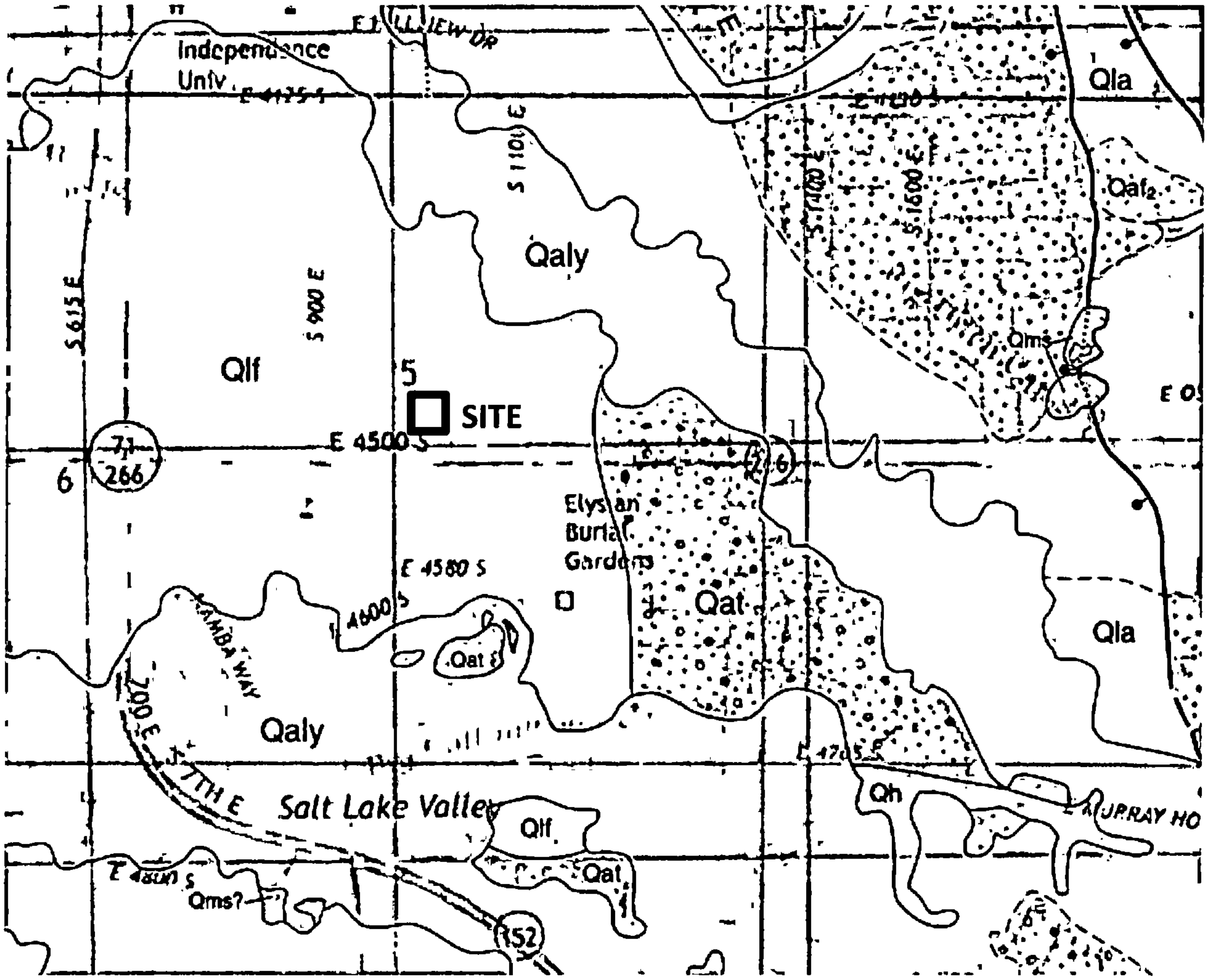
4.1 Geologic Setting

The subject site is in the northeast portion of the Salt Lake Valley in north-central Utah. The site sits at an elevation of approximately 4,323 feet above sea level. The Salt Lake Valley is a deep, sediment-filled basin that is part of the Basin and Range Physiographic Province. The valley is bounded by the Wasatch Mountain Range on the east and the Oquirrh Mountain Range on the west. The valley was formed by extensional tectonic processes during the Tertiary and Quaternary geologic time periods. The subject site and surrounding areas are 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 Salt Lake Valley, was also previously covered by the Pleistocene age Lake Bonneville. The Great Salt Lake, located to the northwest of the valley, is a remnant of this ancient freshwater 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 relatively fast, by almost 300 feet, 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 valleys of northwest Utah. Much of the sediment within the Salt Lake Valley was deposited as lacustrine sediments during both the transgressive (rise) and regressive (fall) phases of Lake Bonneville and in older, pre-Bonneville lakes that previously occupied the basin.

The geology of the USGS Sugarhouse, Utah 7.5 Minute Quadrangle, that includes the location of the subject site, has been mapped by McKean[2]. The surficial geology at the location of the subject site is mapped as "Lacustrine silt and clay" (Map Unit Qlf) dated upper Pleistocene. Unit Qlf is described in the referenced map as "Moderately sorted silt and clay with minor fine sand and locally pebble gravel; typically laminated or thin bedded; variably calcareous; ostracodes locally common; deposited in shallow to moderately deep parts of the Bonneville basin; commonly gradational upslope into lacustrine sand and silt (Qlsp); locally concealed by loess veneer; regressive Lake Bonneville shorelines typically poorly developed in contrast to shorelines on units Qlgp and Qlsp; mapped west of the East Bench fault where deposit is incised by Big and Little Cottonwood Creeks; exposed thickness less than 25 feet (7 m)." No fill or disturbed ground is mapped within the subject site. Refer to the **Geologic Map**, shown on the following page.

2McKean, A.P., 2018, Interim Geologic Map of the Sugarhouse Quadrangle, Salt Lake County, Utah; Utah Geological Survey Open File Report 687DM, Scale 1:24,000.



GEOLOGIC MAP

4.2 Faulting

No active fault rupture traces are mapped crossing, adjacent to, or projecting toward the subject site. The nearest active fault is the Salt Lake City Segment of the Wasatch Fault Zone approximately 1.0 miles to the east.

4.3 Seismicity

4.3.1 Site Class

Utah has adopted the International Building Code (IBC) 2021, 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 2021 Section 1613.2.2 refers to Chapter 20, Site Classification Procedure for Seismic Design, of ASCE[3] 7-16, which stipulates that the

[3]American Society of Civil Engineers

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. Based on average shear wave velocity data within the upper 30 meters ($V_{S,30}$) published by McDonald and Ashland[4], the subject site is located within unit description Q01S, which has a log-mean $V_{S,30}$ of 198 meters per second (650 feet per second). Thus, it is our opinion the site best fits Site Class D – Stiff Soil (with data), which we recommend for seismic structural design.

4.3.2 Ground Motions

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 2021 Table R301.2.2.1.1) are based upon the Site Class as addressed in the previous section. For Site Class D (with data) at site grid coordinates of 40.6753 degrees north latitude and -111.8629 degrees west longitude, $\mathbf{S_{DS}}$ is 0.97 and the **Seismic Design Category** is D_2.

4.3.3 Liquefaction

The site is located within an area designated by the Utah Geologic Survey[5] as having "Moderate" liquefaction potential. 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.

We evaluated the liquefaction potential of the soils encountered in the bore hole using the procedures described in Youd et al[6] and Idriss & Boulanger[7]. Our evaluation indicates isolated zones of the saturated sandy soils could liquefy under a major seismic event. Maximum anticipated settlement resulting from the liquefaction is under 1 inch. This amount of settlement is considered tolerable for structures, although some relatively minor structural damage would be possible. Lateral spreading due to liquefaction is not anticipated to occur. Liquefaction mitigation is typically not performed for residential development.

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[4] McDonald, G.N. and Ashland, F.X., 2008, "Earthquake Site-Conditions Map for the Wasatch Front Urban Corridor, Utah," Utah Geological Survey Special Study 125, 41 pp.

[5] Utah Geological Survey, "Liquefaction-Potential Map for a Part of Salt Lake County, Utah," Utah Geological Survey Public Information Series 25, August 1994. https://ugspub.nr.utah.gov/publications/public_information/pi-25.pdf

[6] Youd, T.L.; Idriss, I.M.; Andrus, R.D.; Arango, I.; Castro, G.; Christian, J.T.; Dobry, R.; Finn, W.D.L.; Harder, L.F. Jr.; Hynes, M.E.; Ishihara, K.; Koester, J.P.; Liao, S.C.; Marcuson, W.F. III; Martin, G.R.; Mitchell, J.K.; Moriwaki, Y.; Power, M.S.; Robertson, P.K.; Seed, R.B.; and Stokoe, K.H. II; October 2001, "Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils," ASCE Journal of Geotechnical and Geoenvironmental Engineering, p 817-833.

[7] Idriss, I.M. and Boulanger, R.W., December 2010, "SPT-Based Liquefaction Triggering Procedures," Department of Civil & Environmental Engineering, University of California at Davis, Report No. UCD/CGM 10/02, 259 p.

4.4 Other Geologic Hazards

No landslide features or deposits, including lateral spread deposits, are mapped on or adjacent to the subject site. The site is not located in a mapped or known debris flow, stream flooding[8], or rock fall hazard area.

5.0 SITE CONDITIONS

5.1 Surface Conditions

The site is currently occupied by a residential home. Based upon aerial photos dating back to 1993 that are readily available on the internet, the existing residence has been there since that time. Overall, the site is relatively flat, with a very slight slope downward to the west. The site is bordered on the north, south and east by residential homes, and on the west by Garden Drive (see **Vicinity Map** in **Section 1.1** above).

5.2 Subsurface Soils

At the location of the bore hole we encountered approximately 6 inches of topsoil at the surface. We observed natural soils beneath the topsoil, consisting of Lean CLAY (CL) and SILTY CLAY (CL-ML) layers, with varying amounts of sand, extending to the maximum depth penetrated of approximately 51.5 feet. The clay soils were slightly moist to wet, brown in color, and soft to stiff in consistency. They also exhibited moderate over consolidation and strength characteristics with moderate to slightly high compressibility characteristics and a small amount of collapse? when wetted.

For a more descriptive interpretation of subsurface conditions, please refer to the bore hole log, ***Figure 2***, 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 bore hole at a depth of about 24 feet below existing grade at the time of our field exploration.

Groundwater levels can fluctuate seasonally. Numerous other factors such as heavy precipitation, irrigation of neighboring land, and other unforeseen factors, may also influence ground water elevations at the site. The detailed evaluation of these and other factors which may be responsible for ground water fluctuations, is beyond the scope of this study.

[8]https://msc.fema.gov/portal/search?AddressQuery=3405%20South%202410%20East%2C%20Millcreek%2C%20Utah#searchresultsanchor

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.

6.0 SITE PREPARATION AND GRADING

6.1 General

We understand that the existing structure will be removed. Removal should include floor slabs, footings, and any underground utilities that will be abandoned. Resulting excavations should be backfilled with compacted structural fill. All deleterious materials should be stripped from the site prior to commencement of construction activities. This includes loose and disturbed soils, topsoil, vegetation, etc. Based upon the conditions observed in the boring there is topsoil on the surface of part of the site which we estimated to be about 0.5 feet 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. All undocumented fill (if encountered) shall be removed from beneath structures, but may remain beneath flatwork and pavements, provided they are properly prepared and the owner understands that additional maintenance may be required. Outside of building footprints, proper preparation of undocumented fill and disturbed soils shall consist of scarifying the surface to a minimum depth of 8 inches and re-compacting the scarified soils in place. The exposed subgrade must then be proof-rolled by passing moderate-weight rubber tire-mounted construction equipment over the surface at least twice. If excessively soft or loose soils are encountered, they must be removed (up to a maximum depth of 2 feet) and replaced with structural fill.

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 are not anticipated at the site. 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).

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 minimum 15% passing and a maximum 30% 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- to 2.0-inch gravel placed on stabilization fabric, such as Mirafi RS280i, or equivalent (see **Section 6.6**).

On-site clay soils are not suitable for use as structural fill but may be used as site grading fill and non-structural fill. Note that these clay soils are moisture-sensitive, which means they are 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. This will be very difficult, if not impossible, during wet and cold periods of the year. We also recommend that site grading fills using natural clay soils not exceed 3 feet in thickness below structures.

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[9] T-180) in accordance with the following recommendations:

[9] American Association of State Highway and Transportation Officials

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[10] 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).

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**.

6.6 Stabilization

The natural clay soils at this site will likely be susceptible to rutting and pumping. The likelihood of disturbance or rutting and/or pumping of the existing natural soils is a function of the soil moisture content, the load applied to the surface, as well as the frequency of the load. Consequently, rutting and pumping can be minimized by avoiding concentrated traffic, minimizing the load applied to the surface by using lighter equipment and/or

[10] American Public Works Association

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 (if encountered), a mixture of coarse, clean, angular gravels and cobbles and/or 1.5- to 2.0-inch clean gravel should be utilized. 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, the subsurface conditions observed in the field and the laboratory test data, as well as common geotechnical engineering practice.

7.1 Foundation Recommendations

Based on our geotechnical engineering analyses, the proposed structures may be supported upon conventional spread and/or continuous wall foundations placed on suitable, undisturbed natural soils and/or on structural fill extending to suitable natural soils. Footings may be designed using a net bearing pressure of 1,500 psf if placed on suitable, undisturbed, natural soils or 2,000 psf if placed on a minimum 18 inches of structural fill. 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.

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. If unsuitable soils are encountered, they must be completely removed and replaced with properly compacted structural fill. Excavation bottoms should be observed by a CMT geotechnical engineer to assess if 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 footings will cross over an area where an old basement was backfilled, and the maximum depth of structural fill used for the backfill 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 0.30 for natural clay soils or 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 400 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 FLOOR SLABS

Floor slabs may be established upon suitable, undisturbed, natural soils and/or on structural fill extending to suitable natural soils (same as for foundations). 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.

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 quarters 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.

9.0 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 structure should be sloped to provide drainage away from the foundations. We recommend a minimum slope of 6 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.

10.0 PAVEMENTS

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

Prior to 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 loose soils are encountered, they must be removed (up to a maximum depth of 2 feet) and replaced with structural fill.

We anticipate the natural 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 is based upon a California Bearing Ratio (CBR) of 3 for the natural clay soils. Given the projected traffic as discussed above in **Section 1.3**, the following pavement sections are recommended for the given ESAL's (18-kip equivalent single-axle loads) per day:

MATERIAL	PAVEMENT SECTION THICKNESS (inches) PARKING AREAS (1 ESAL per day)			DRIVE AREAS (3 ESAL'S per day)		
Asphalt	3	3	---	3.5	3.5	---
Concrete	---	--	5	---	---	6
Road-Base	8	4	5	10	6	5
Subbase	0	6	0	0	6	0
Total Thickness	11	13	10	13.5	15.5	11

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.

The rigid pavement sections recommended above are for non-reinforced Portland cement concrete. Concrete should be designed in accordance with the American Concrete Institute (ACI) and joint details should conform to the Portland Cement Association (PCA) guidelines. The concrete should have a minimum 28-day unconfined compressive strength of 3,000 pounds per square inch and contain 6% ±1% air-entrainment.

For dumpster pads, we recommend a pavement section consisting of 6.5 inches of Portland cement concrete and 6 inches of aggregate base over properly prepared suitable natural subgrade or site grading structural fills extending to suitable natural soils. Dumpster pads constructed overlying undocumented fills must be heavily reinforced.

11.0 QUALITY CONTROL

We recommend that CMT be retained as part of a comprehensive quality control testing and observation program. With CMT onsite 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:

11.1 Field Observations

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

11.2 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 achieved.

11.3 Excavations

All excavation procedures and processes should be observed by a geotechnical engineer from CMT or his 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.

12.0 LIMITATIONS

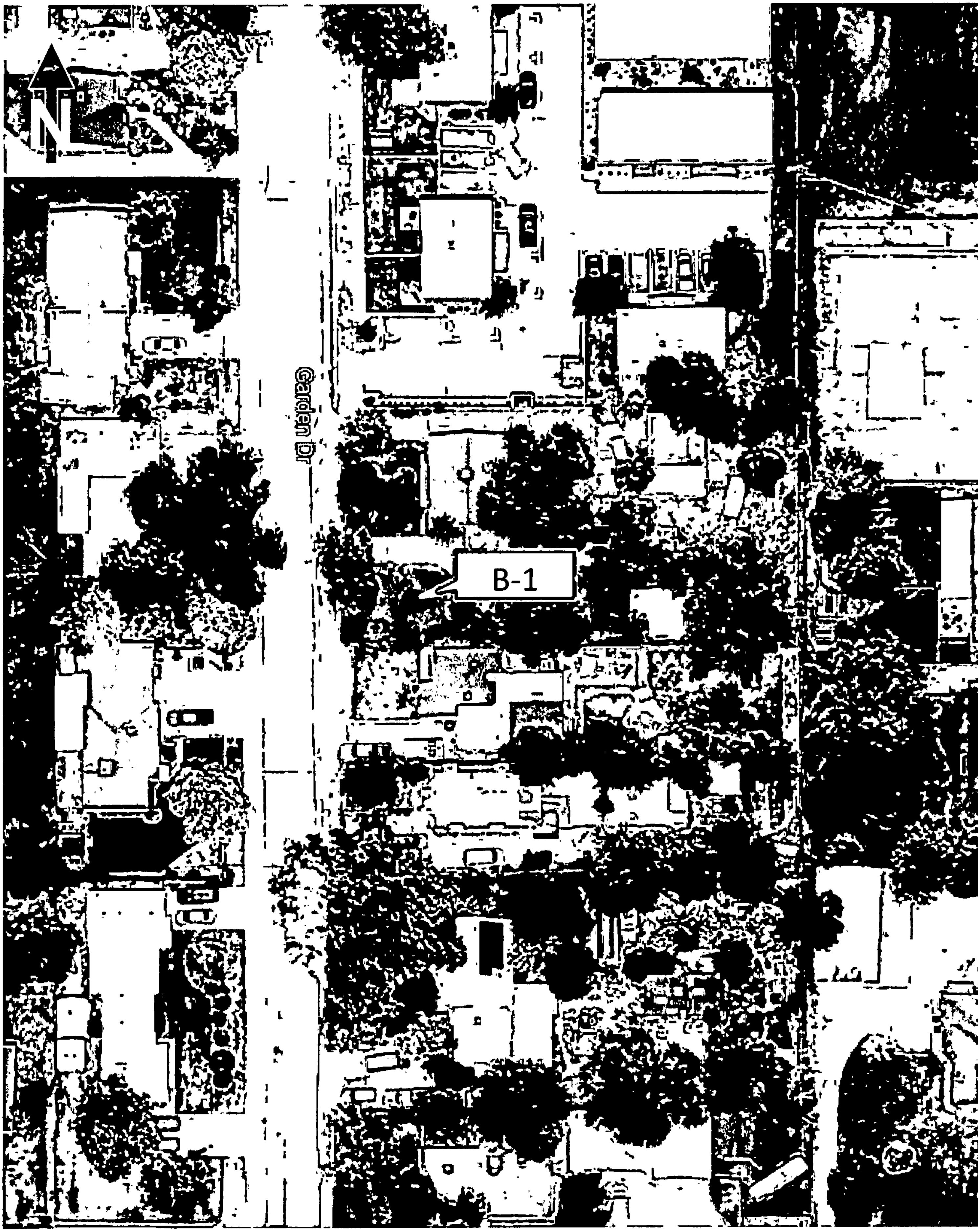
The recommendations provided herein were developed by evaluating the information obtained from the subsurface explorations and soils encountered therein. The exploration logs reflect the subsurface conditions only at the specific location at the time designated on the logs. Soil and ground water conditions 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 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) 492-4132. To schedule materials testing, please call (801) 381-5141.

APPENDIX

SUPPORTING
DOCUMENTATION



Garden Drive Liquefaction Study

4433 South Garden Drive, Millcreek, Utah

CMT TECHNICAL SERVICES

Site Map

Date:	27-Jun-24
Job #	22526

Figure: 1

Garden Drive Liquefaction Study

Bore Hole Log **B-1**

4433 South Garden Drive, Millcreek, Utah

Total Depth: 51.5'
Water Depth: 24'

Date: 3/17/17
Job #: 22526

Depth (ft)	Soil Description	Sample #	Blows (N)	Total	Moisture (%)	Dry Density(pcf)	Gravel %	Sand %	Fines %	LL	PL	PI
0	6" Topsoil											
	Brown Silty to Sandy CLAY (CL) — moist, stiff											
		1	11 10 8	18	15.6	98	0	10.7	89.3	30	16	14
4												
		2	2 2 3	5								
8		3	2 2 1	3	17.4		6.5	38.4	55.1	22	16	6
		4	1 0 2	2								
12												
16		5	3 1 1	2	25		10.9	5.6	83.5	35	20	15
20		6	3 2 3	5								
24	grades gray — wet											
		7	2 0 0	0	21.7		6.3	22	71.7	27	18	9
28												

Remarks: Groundwater encountered during drilling at depth of 24 feet.

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

Equipment: Hollow-Stem Auger
Automatic Hammer, Wt=140 lbs, Drop=30"
Excavated By: Great Basin Drilling
Logged By: Hogan Wright

Page: 1 of 2

Figure: 2

CMT TECHNICAL SERVICES

Garden Drive Liquefaction Study

Bore Hole Log B-1

4433 South Garden Drive, Millcreek, Utah

Total Depth: 51.5'
Water Depth: 24'

Date: 3/17/17
Job #: 22526

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Blows (N)	Total	Moisture (%)	Dry Density(pcf)	Gravel %	Sand %	Fines %	LL	PL	PI
28														
		Gray Sand and Clay (SP-CL) wet, medium dense/stiff		8	6 4 4	8								
32														
36				9	6 7 4	11								
40				10	3 2 2	4								
44														
				11	4 3 2	5	27.8		0	2.3	97.7	35	21	14
48														
				12	2 3 2	5	19.2		0	4 7	95.3	28	18	10
52		END AT 51.5'												
56														

Remarks: Groundwater encountered during dril!.ng at depth of 24 feet.

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

Equipment: Hollow-Stem Auger
Automatic Hammer, Wt=140 lbs, Drop=30"
Excavated By: Great Basin Drilling
Logged By: Hogan Wright

Figure: 2

CMT TECHNICAL SERVICES

Garden Drive Liquefaction Study

Key to Symbols

4433 South Garden Drive, Millcreek, Utah

Date: 3/17/17

Job #: 22526

① Depth (ft)	② GRAPHIC LOG	③ Soil Description	④ Sample Type	⑤ Sample #	Blows(N) ⑥	⑦ Total	⑧ Moisture (%)	⑨ Dry Density(pcf)	Gradation ⑩ Gravel %	Sand %	Fines %	Atterberg ⑪ LL	PL	PI

COLUMN DESCRIPTIONS

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

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

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

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

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

⑥ **Blows:** Number of blows to advance sampler in 6" increments, using a 140-lb hammer with 30" drop.

⑦ **Total Blows:** Number of blows to advance sampler the 2nd and 3rd 6" increments.

⑧ **Moisture (%):** Water content of soil sample measured in laboratory (percentage of dry weight).

⑨ **Dry Density (pcf):** The dry density of a soil measured in laboratory (pounds per cubic foot).

⑩ **Gradation:** Percentages of Gravel, Sand and Fines (Silt/Clay), from lab test results of soil passing No. 4 and No. 200 sieves.

⑪ **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.
Saturated: 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 Very Fine Sands, Silty or Clayey Fine Sands or Clayey Silts with Slight
			CL		Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean
			OL		Organic Silts and Organic Silty Clays o f Low Plasticity
	SILTS AND CLAYS Liquid Limit greater than 50%		MH		Inorganic Silts, Micacious or Diatomacious Fine Sand or Silty Soils with Plasticity (Elastic Silts)
			CH		Inorganic Clays of High Plasticity, Fat Clays
			OH		Organic Silts and Organic Clays of Medium to High Plasticity
HIGHLY ORGANIC SOILS			PT		Peat, Humus, Swamp 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.

Figure: 3

CMT TECHNICAL SERVICES