AQUA ENGINEERING

TECHNICAL MEMORANDUM

TO: Laura Oliver, Deputy Recorder

FROM: Shay Stark, Planner

DATE: May 3, 2022

SUBJECT: **Barton Subdivision – Sensitive Area Determination – Planning Commission**

PROJECT NO.:

Elk Ridge has received a final plat application for the Barton Subdivision (Project). As part of this process, they have also submitted Sensitive Area Maps that are required as part of the HR-1 Zone. Since the creation of this zone there has been very little development in the HR-1 Zone. While lots 1,2,3 & 5 are shown on the maps they are located in the R-1-15,000 zone and should be treated as such. Up until a few weeks ago the city has only had a very small 8.5 X11 Sensitive Lands Map to use for review of these projects. As there is not a lot of precedence to lean on, we are in relatively uncharted territory in making these determinations. As this application is reviewed it is important to consider the following statements found in the Municipal Land Use Development and Management Act in the Utah State Code:

Effective 5/9/2017
10-9a-306. Land use authority requirements -- Nature of land use decision.

(1) A land use authority shall apply the plain language of land use regulations.

(2) If a land use regulation does not plainly restrict a land use application, the land use authority shall interpret and apply the land use regulation to favor the land use application.

(3) A land use decision of a land use authority is an administrative act, even if the land use authority is the legislative body.

The requirements found in the Elk Ridge City Land Use Code for the determination of environmental factors a Sensitive Area in the HR-1 Zone include the following:

10-9A-10: SUBDIVISION DESIGN AND ENVIRONMENTAL CONSTRAINTS:

Designing a development that conforms to the natural constraints of the terrain and the unique geologic features of the area is a main concern for maintaining the safety of current and future residents, preserving the aesthetic appearance of the hillside terrain, and allowing wildlife to continue to reside in the area. The first stage in designing a development in the HR-1 Zone shall be to determine what areas shall be left in a natural condition and how development shall minimize impacts to the hillside terrain. (Ord. 08-4, 2-26-2008)

10-9A-10-1: SENSITIVE AREA DETERMINATION:

In designing a development an applicant must first identify the property's sensitive environmental and aesthetic areas such as steep slopes, ridgeline areas, ravines and drainages, fault lines, unstable soils, and wildlife habitat areas. Impacts of development to these areas should be minimized or be dedicated to open space. A sensitive areas plan shall be required prior to the

preliminary plat mapping all environmental constraints and illustrating the proposed layout of the subdivision demonstrating that impacts to the sensitive environmental and aesthetic areas are avoided or minimized. (Ord. 08-4, 2-26-2008)

The next sections of code point out the specific requirements to be included on the Sensitive Areas Plan:

10-9A-10-2: RAVINES AND DRAINAGES:

A ravine is considered a continual low point in topography that slopes down a hillside. A drainage is similar to a ravine but is shown on the General Plan soils map as a low point that could carry water. The area thirty feet (30') from each side of the center of these features shall be designated as open space. All slopes twenty percent (20%) or greater and any incidental lesser slopes interspersed within these steeper slopes, rising from ravines and drainages, shall also be designated as open space. No building envelope shall be within these areas. City staff or the Planning Commission can require a larger setback if the drainage is wide in nature or if greater distances are required as established by a professional geologist, geotechnical engineer, or civil engineer registered in the State of Utah. (Ord. 08-4, 2-26-2008)

10-9A-10-3: RIDGELINES:

A "ridge" is defined as an elongated crest or series of crests of a hill and a "ridgeline" is defined as the highest elevation of a ridge running parallel with the long axis of the ridge. Any ridge or ridgeline or portion of a ridge or ridgeline with slopes greater than twenty percent (20%) shall be designated as open space. The open space area associated with the ridgeline will include all slopes twenty percent (20%) or greater and any lesser slopes interspersed within these steeper slopes. Required open space shall also extend uphill fifty feet (50') from the crest of the twenty percent (20%) slopes. City staff shall designate ridgeline areas citywide and show them on the sensitive lands map on file. No building envelope shall be within these areas. (Ord. 08-12, 7-22-2008, eff. 8-12-2008)

10-9A-10-4: FAULT LINES:

No building envelope shall be located within a minimum of one hundred feet (100') of a fault line as shown on the sensitive lands map on file, unless greater distances are required as established by a professional geologist or geotechnical engineer registered in the state of Utah. (Ord. 08-4, 2-26-2008)

10-9A-10-5: WILDLIFE CORRIDORS:

Development shall preserve features, such as ridgelines, drainages, ravines, and other areas identified as a wildlife corridor. City staff shall designate wildlife corridors citywide and show them on the sensitive lands map on file. (Ord. 08-4, 2-26-2008)

10-9A-10-6: UNSTABLE SOILS:

No building envelope shall be located within one hundred feet (100') of an area identified to have unstable soils as disclosed within a geotechnical report, unless greater distances are required as

established by a professional geologist or geotechnical engineer registered in the state of Utah. (Ord. 08-4, 2-26-2008)

10-9A-10-7: SLOPES TWENTY PERCENT OR GREATER:

All land having a slope of twenty percent (20%) or greater that is not a part of an approved building envelope shall remain in its natural state and shall not be graded, fenced, or otherwise disturbed. The planting of additional vegetation and/or the addition of sprinkler irrigation systems is allowed. Roads, trails, firebreaks, utilities, retention walls, and driveways can traverse these areas if it is demonstrated that they adhere to cuts and fills requirements in section 10-9A-17-4 of this article and other requirements in this code or that by their construction other adverse conditions are mitigated. (Ord. 08-4, 2-26-2008)

10-9A-10-8: REMOVAL OF NATURAL VEGETATION FOR A DEVELOPMENT:

Natural vegetation including indigenous hardwood trees shall not be removed except for those portions of the site to be committed to the construction of roads, trails, firebreaks, utilities, and retention walls. All areas proposed for removal of vegetative materials shall be shown on the revegetation/retention plan. Revegetation of the types of trees removed may be required by the planning commission or from a professional landscaping firm for areas of cuts and fills and around retention walls. Areas requiring revegetation will be shown on the revegetation/retention plan. (Ord. 08-4, 2-26-2008)

Attached is a portion of the City Sensitive Lands Map with the location of the subject property outlined in Red. According to the code, the map may be used to help make determinations for most of the criteria noted in the above sections of code. In some case more accurate information can be gathered from a Geotechnical Report and a slope analysis done by the applicants Engineer. The drawings provided by the applicant utilize all three sources in addition to an aerial photo to help locate vegetation for the Revegetation/Retention Plan. Staff asked the Applicant to document specifically which sections of the code applied to specific comments on the drawings to help with the determination.

The Sensitive Areas Plan utilizes an actual survey of the site for the slope analysis. This slope information is more accurate than the slope data provided on the city Sensitive Land Map and has been utilized to address those items requiring consideration of slope (Sections #2 and #7). Results from a site specific Geo-technical report have been utilized to determine the quality of site soils and faulting for Sections # 4 and # 6. The report has been attached for reference.

One specific point that is noted on the Sensitive Area Plan is that the area around the existing cul-de-sac has steep slopes because of excavation for the cul-de-sac. This is manmade and not natural and thus does not need to be preserved as a no build area. The same applies to the small manmade excavation that is located at the south end of the proposed cul-de-sac.

The Sensitive Areas Plan and Revegetation/Retention Plan also point out that the property owners will provide a site plan that will show specific building locations and areas that will be left natural or restored and revegetated to match the natural vegetation within the buildable area. The Applicant desires to have flexibility within the buildable area to accommodate yet to be designed homes and landscaping improvements and thus has not specifically described what tree groupings may be removed within the buildable areas.

The Revegetation Plan utilizes an aerial photo so that the existing tree groupings can be clearly seen. The proposed boundaries of the building envelopes are also provided to show what plantings are located in the building areas and may be affected by the site plans provided as part of the building permit application. Tree groupings within the buildable areas may potentially be removed to allow development of the lot.

FRONT SETBACK EXCEPTION

The Applicant has also requested an exception to the front setback of 20 feet on Lot # 4 based upon the following section of code:

10-9A-12-7: FRONT SETBACK EXCEPTION:
The planning commission can approve an adjustment to the front setback of not less than twenty feet (20') from the front lot line abutting a street if it is demonstrated that by doing so sensitive areas such as steep slopes, ridgelines, drainage areas, or wildlife corridors would be preserved. A forty-five foot (45') clear zone at the corner of a road intersection is still required. (Ord. 08-4, 2-26-2008)

The key for Planning Commission is that this front setback exception may be granted: *if it is demonstrated that by doing so sensitive areas such as steep slopes, ridgelines, drainage areas, or wildlife corridors would be preserved.*

If the exception is approved the motion should include a summary statement or reference to a statement of how the preservation of these sensitive areas' items have been addressed specific to the area on the plan that the exception affects, which looks to be the small portion of Lot #4 that wraps around the cul-de-sac to the east of the main property.

RECOMMENDATION

Based upon a favorable discussion by Planning Commission and a finding that each of the environmental considerations found in 10-9A-10 through 10-9A-10-8 have been adequately addressed it is recommended that the Planning Commission motion that the proposed Sensitive Areas Plan and Revegetation/Retention Plan have sufficiently addressed each of the environmental factors required in Sensitive Area Determination per the requirements of the HR-1 zone. Please state any conditions or changes desired by the Planning Commission, if any, in the motion.

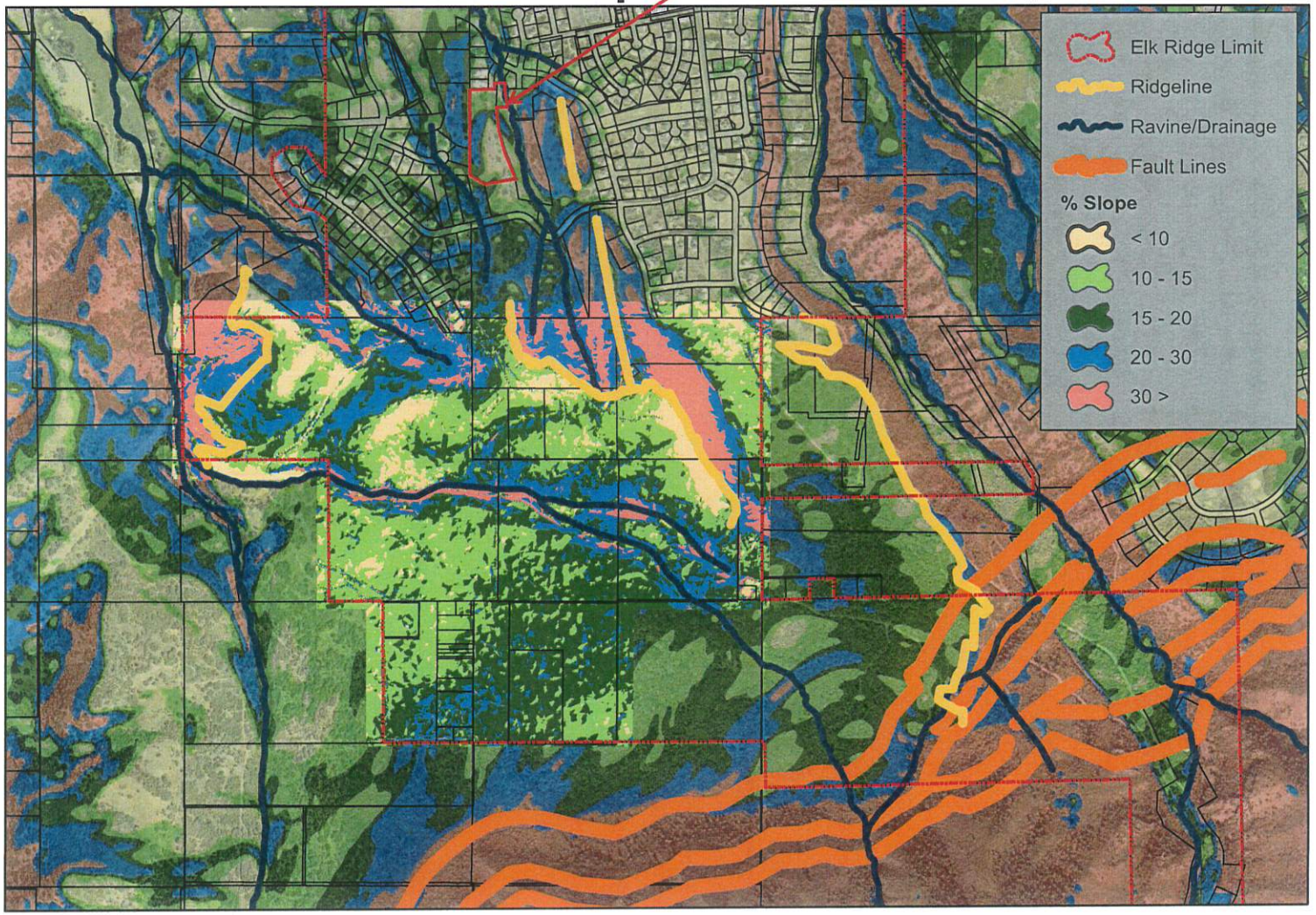
MEMO ON FRONT SETBACK EXCEPTION IS COMING.

END

Attachments

Sensitive Areas Map

City of Elk Ridge
Final Approval - 23 Sept 2008



This map is for reference only.
Development setbacks from sensitive areas shall be delineated when required detailed work is done at the development stage.
All Ravines/Drainage, Fault Lines, Ridgelines and 30% slopes shall also be considered Wildlife Corridors.

NOTES:

1. AREA DISTURBED DURING CONSTRUCTION WILL BE LANDSCAPED OR RESEEDED WITH NATIVE TOPSOILS THAT CONTAIN NATIVE SEED.
2. NATURAL VEGETATION ON STEEP SLOPES THAT ARE NOT PART OF BUILDING ENVELOPE AND OTHER ENVIRONMENTALLY SENSITIVE AREAS ON THE SITE WILL REMAIN IN OPEN SPACE.
3. UPON DEVELOPMENT, INDIVIDUAL LOTS WILL BE REQUIRED TO HAVE A SITE GRADING AND LANDSCAPING PLAN. THIS NEEDS TO SHOW THE HOME LOCATION, REQUIRED GRADING FOR THE DEVELOPED BUILDING AREA AND LANDSCAPING FOR THE LOT. UNDISTURBED AREAS ARE TO REMAIN OPEN SPACE.
4. LOTS 1, 2, 3 & 5 ARE LOCATED IN THE R-1-15,000 ZONE. LOT 4 IS LOCATED IN THE HR-1 ZONE.

THIS DRAWING HAS BEEN CREATED TO FULFILL THE REQUIREMENTS FOUND IN ELK RIDGE LAND USE CODE 10-9A-10-8.

(24"x36")
SCALE 1" = 60'
(11"x17")
SCALE 1" = 120'

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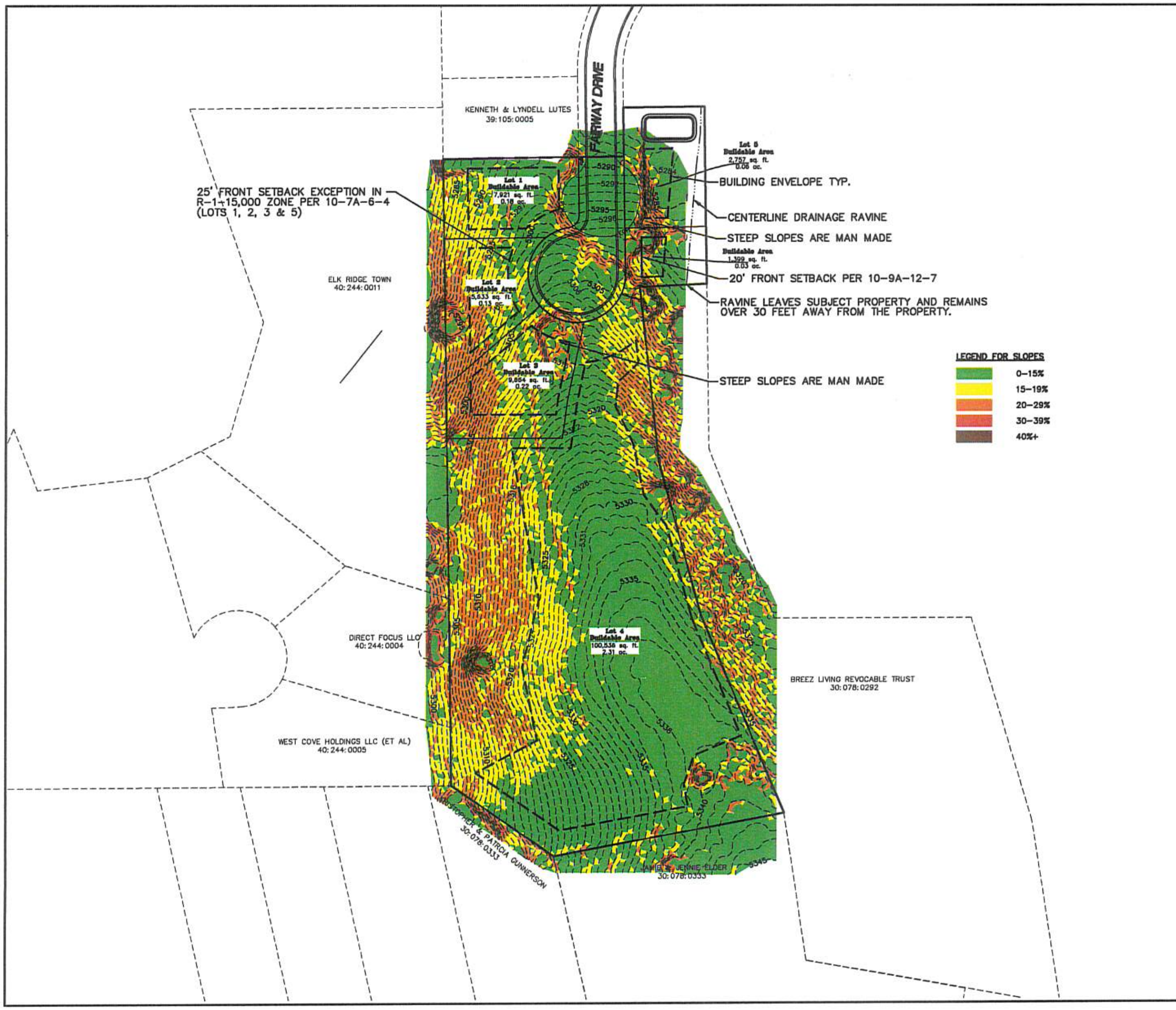
BARTON SUBDIVISION

ATLAS ENGINEERING L.L.C.
PHONE: 801-655-0566
FAX: 801-655-0109
946 EAST 800 NORTH
SUITE A
SPANISH FORK, UT 84660

REVEGETATION / RETENTION PLAN

ELK RIDGE, UTAH

SHEET NO.
1



NOTES:

1. IN ACCORDANCE WITH 10-9A-10-3, THERE ARE NO RIDGELINES OR FAULT LINES ON THE PROPERTY AS DEPICTED ON THE CITY SENSITIVE LANDS MAP.
2. PER 10-9A-10-2, THE AREA 30 FEET FROM THE RAVINE HAS BEEN EXCLUDED FROM THE BUILDING ENVELOPES AND WILL BE DESIGNATED AS "OPEN SPACE" ON THE FINAL PLAT.
3. PER 10-9A-10-4, NO FAULT LINES ARE SHOWN ON OR SURROUNDING WITH IN 100 FEET OF THIS PROPERTY ON THE SENSITIVE AREAS MAP NOR WERE ANY FOUND IN THE GEO-TECHNICAL STUDY.
4. IN ACCORDANCE WITH 10-9A-10-5 AND ACCORDING TO THE CITY SENSITIVE LANDS MAP, THE RAVINE/DRAINAGE LOCATION SHOWN IS ALSO CONSIDERED A WILDLIFE CORRIDOR. THIS CORRIDOR IS BEING MAINTAINED BY THE REQUIRED OPEN SPACE.
5. IN ACCORDANCE WITH 10-9A-10-6 AND PER THE GEOTECH REPORT BY CMT ENGINEERING PROJECT NO. 17685 DATED JANUARY 11, 2022, THERE ARE NO UNSTABLE SOILS ON THE PROJECT.
6. PER 10-9A-10-7, SLOPES GREATER THAN 20% HAVE BEEN EXCLUDED FROM THE BUILDING ENVELOPE OF LOT 4 IN THE HR-1 ZONE AND SHALL BE DESIGNATED AS OPEN SPACE.
7. DRIVEWAY NOT TO BE GREATER THAN 12% SLOPE, 15% IF HEATED.
8. CUT/FILL SLOPES TO BE LESS THAN 7FT.
9. PLAN SHOWS 25 FT FRONT SETBACK TO MINIMIZE IMPACT TO SENSITIVE AREAS AND UTILIZE THE NATURAL TERRAIN PER ELK RIDGE CITY CODE, LOT DESIGN REQUIREMENTS 10-9A-12 AND GRADING OF INDIVIDUAL BUILDING LOT 10-9A-17.
10. CUT AND FILLS SHALL BE NO STEEPER THAN 2:1 WITH EROSION CONTROL. THE MAXIMUM CUMULATIVE CUT AND FILL ALLOWED ON SITE IS 15 FT.
11. THE ALLOWABLE BUILDING ENVELOPES HAVE BEEN SHOWN FOR EACH LOT. UPON DEVELOPMENT, INDIVIDUAL LOTS WILL BE REQUIRED TO HAVE A SITE GRADING AND LANDSCAPING PLAN. THIS NEEDS TO SHOW THE HOME LOCATION, REQUIRED GRADING FOR THE DEVELOPED BUILDING AREA AND LANDSCAPING FOR THE LOT. UNDISTURBED AREAS ARE TO REMAIN OPEN SPACE.

SHEET NO. 1

SENSITIVE AREAS PLAN

ELK RIDGE, UTAH

BARTON SUBDIVISION

ATLAS ENGINEERING L.L.C.
PHONE: 801-655-0566
FAX: 801-655-0109
946 EAST 800 NORTH
SUITE A
SPANISH FORK, UT 84660

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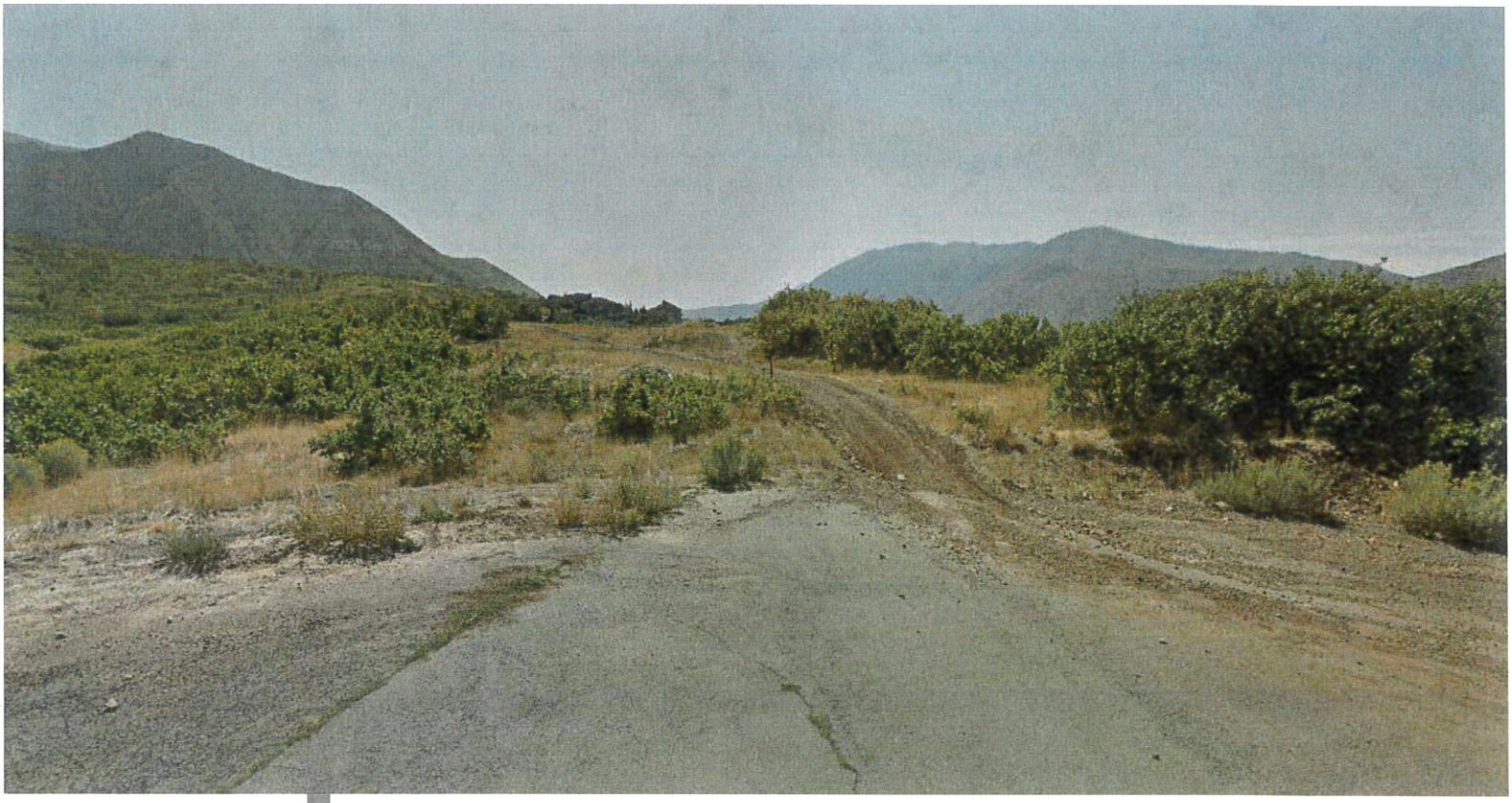
CMT ENGINEERING LABORATORIES



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

GEOTECHNICAL ENGINEERING STUDY

Barton Subdivision

Fairway Drive
Elk Ridge, Utah

CMT PROJECT NO. 17685

FOR:
Richard Barton
69 East Hudson Drive
Elk Ridge, Utah 84651

January 11, 2022

CMT ENGINEERING LABORATORIES

January 11, 2022

Mr. Richard Barton
69 East Hudson Drive
Elk Ridge, Utah 84651

Subject: Geotechnical Engineering Study
Barton Subdivision
Fairway Drive
Elk Ridge, Utah
CMT Project No. 17685

Mr. Barton:

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 December 20, 2021, a CMT Engineering Laboratories (CMT) staff professional was on-site and supervised the excavation of 4 test pits extending to depths of about 3.5 to 6.0 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 801-492-4132.

Sincerely,
CMT Engineering Laboratories

LICENSED PROFESSIONAL ENGINEER
374995
JEFFREY J.
EGBERT
1/11/22
STATE OF UTAH

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

Reviewed by:

William G. Turner, P.E., M.ASCE
Senior Geotechnical Engineer

CMT ENGINEERING LABORATORIES

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 General

CMT Engineering Laboratories (CMT) was retained to conduct a geotechnical subsurface study for the proposed development of a residential subdivision. The parcel is situated at the south end of the existing Fairway Drive in Elk Ridge, 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 communications between Mr. Richard Barton, property owner, and Mr. Jeff Egbert 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 and executed on November 16, 2021.

1.3 Description of Proposed Construction

We understand that the proposed structures will be single family residences which we project will have two levels of wood frame construction above grade and a single level of reinforced concrete below grade (basement). We project that maximum structural loads for the residences will be on the order of 4,000 pounds per lineal foot for walls and 40,000 pounds for columns. 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 pavement at the site will include extending Fairway Drive further south ending in a cul-de-sac, which we anticipate will utilize asphalt 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 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 to 12 inches of topsoil on the surface, which will require removal beneath structures, flatwork, and pavements;
2. Subsurface natural soils consist of SAND (SC) with varying amounts of gravel
3. Groundwater was not encountered in the subsurface explorations; and
4. Foundations and floor slabs may be placed on suitable, undisturbed natural soils or on properly placed and compacted 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 3.5 (where refusal occurred) to 6.0 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 from within the test pits. 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.

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. Moisture Content, ASTM D-2216, Percent moisture representative of field conditions
2. Atterberg Limits, ASTM D-4318, Plasticity and workability
3. Gradation Analysis, ASTM D-1140/C-117, Grain Size Analysis

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)	SAMPLE TYPE	SOIL CLASS	MOISTURE CONTENT(%)	GRADATION			ATTERBERG LIMITS		
					GRAV.	SAND	FINES	LL	PL	PI
TP-1	2	Bag	SC	21	7	57	36			
TP-2	5.5	Bag	SC	14	15	59	26			
TP-3	2	Bag	SC	18	19	44	37	46	24	22
TP-3	5	Bag	SC	8	10	57	33			

[1]American Society for Testing and Materials

4.0 GEOLOGIC & SEISMIC CONDITIONS

4.1 Geologic Setting

The subject site is located in the southeast portion of Utah Valley in north-central Utah at an elevation of approximately 5,200 to 5,250 feet above sea level. Utah 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, and is bordered by the Wasatch Mountain Range on the east and Lake Mountain and West Mountain on the west. Utah 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 Utah Valley, was also previously covered by the Pleistocene age Lake Bonneville. Utah Lake, which currently occupies much of the western portion of the valley, 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 levels of Utah Lake and the larger Great Salt Lake to the north. 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 Utah 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.

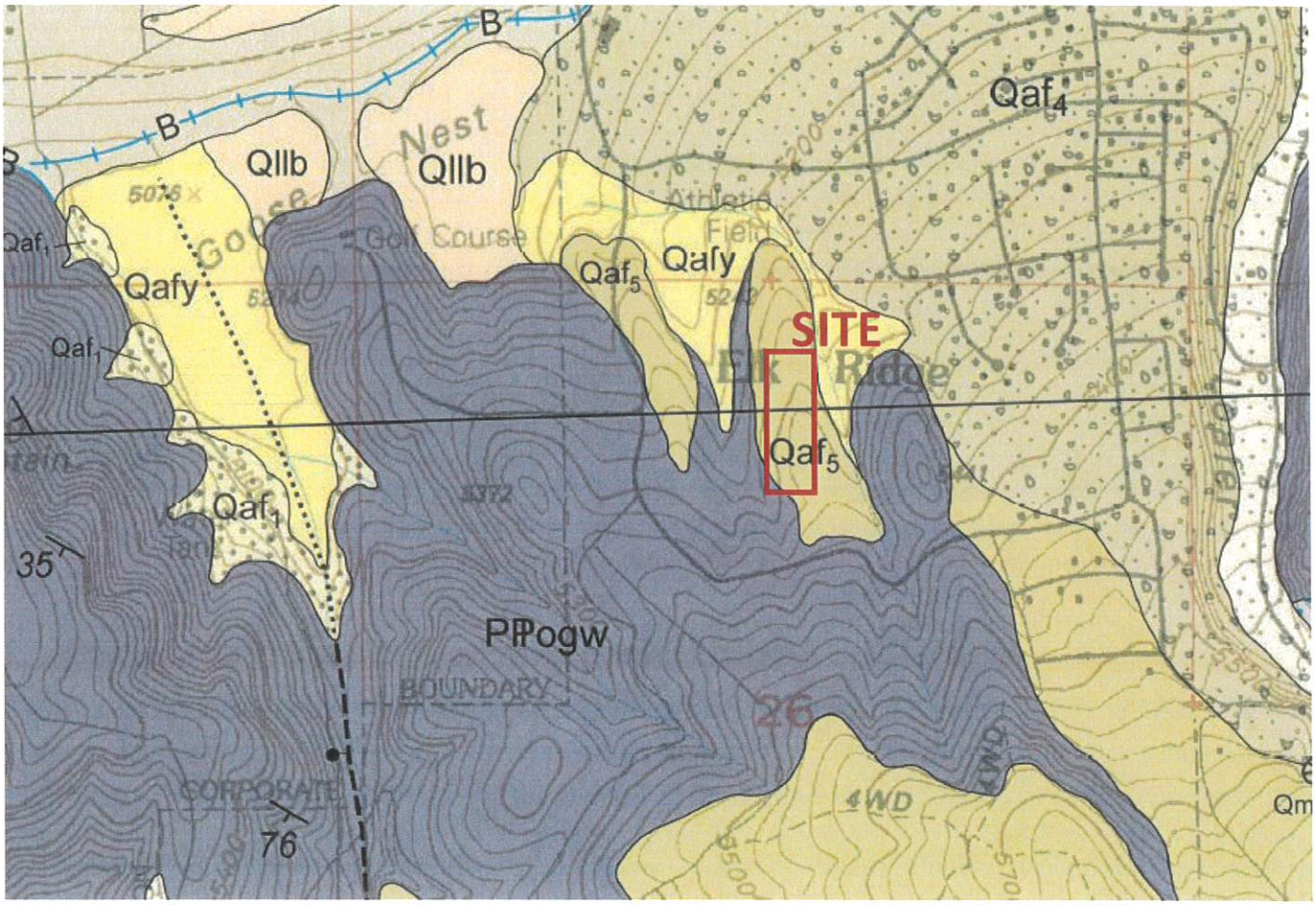
The geology of the USGS Spanish Fork, Utah 7.5 Minute Quadrangle, which includes the location of the subject site, has been mapped by Solomon, Clark, and Machette[2]. The surficial geology at the site is mapped as "Alluvial-fan deposits, pre-Little Valley lake cycle" (map unit Qal_5) dated middle Pleistocene, and "Granger Mountain and Wallsburg Ridge Members of the Oquirrh Formation" (map unit PPogw) dated lower Permian [Wolfcampian] to Upper Pennsylvanian [Virgilian-Missourian].

Map unit Qal_5 is described as "Poorly sorted, clast-supported pebble to cobble gravel, with matrix-supported interbeds in the upper part; locally bouldery, in a matrix of sand, silt, and clay; deposits are deeply dissected, lack fan morphology, and are typically preserved remnants of high surfaces on bedrock. On the piedmont between Payson and Maple Canyons; appear incised by level-4 alluvial-fan deposits (Qaf_4). ... Correlative alluvial deposits likely underlie Lake Bonneville deposits and probably grade laterally to lacustrine sediment of the Pokes Point and other lake cycles older than the Little Valley lake cycle (Scott and others, 1983; Machette and Scott, 1988), although not observed in Utah Valley (Machette, 1992). Equivalent to the older part of older alluvial-fan deposits (Qafo) but differentiated where Little Valley and pre-Little Valley deposits can be separated based on

[2] Solomon, B.J., Clark, D.L., and Machette, M.N., 2007, Geologic Map of the Spanish Fork Quadrangle, Utah County, Utah; Utah Geological Survey Map 227, Scale 1:24,000.

fan morphology, degree of dissection, and incision of younger into older deposits. Exposed thickness less than 60 feet(20 m)."

Map unit PPogw is described as "Medium-gray weathering to very-pale-orange, fine-grained, calcareous sandstone interbedded with light-gray, light-red, and very pale orange quartzite, light-gray quartz sandstone, and few medium-gray, fine-grained sandy limestone beds. Limestone intervals are less than 40 feet (12 m) thick. Strata are laminated to thick bedded. Present east of Payson Canyon forming ledges, cliffs, and slopes of Tithing Mountain, Loafer Canyon, and heavily vegetated Loafer Mountain areas, often obscured by vegetation and unmapped colluvial cover. Mapped as undivided unit due to poor exposure and lack of fossil data." No fill has been mapped at the location of the site on the geologic map. Refer to the **Geologic Map**, shown below.



GEOLOGIC MAP

4.2 Faulting

No surface fault traces are shown on the referenced geologic map crossing or projecting toward the subject site. The nearest mapped fault is the Benjamin Fault mapped just west of the subject site on the referenced geologic map. The fault is mapped as a dotted line at the location meaning that it is concealed by surficial sediments and

there is no surficial expression of the fault. The active Provo Segment of the Wasatch Fault Zone is mapped approximately 1.3 miles to the southeast.

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.

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 Qafo, which has a log-mean $V_{S,30}$ of 502 meters per second (1,647 feet per second). Thus, it is our opinion the site best fits Site Class C – Very Dense Soil & Soft Rock Profile, which we recommend for seismic structural design.

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 C at site grid coordinates of 40.0104 degrees north latitude and -111.6814 degrees west longitude, $\mathbf{S_{DS}}$ is 1.226 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[5] as having "Very Low" liquefaction potential. This is considered a less than 5% probability that within a 100-year period and earthquake strong enough to cause liquefaction will occur.

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[3]American Society of Civil Engineers

[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 Utah County, Utah," Utah Geological Survey Public Information Series 28, August 1994. https://ugspub.nr.utah.gov/publications/public_information/pi-28.pdf

A special liquefaction study was not performed for this site. We encountered unsaturated, dense to very dense sand within the depths we explored. In our opinion, the soils we encountered support the mapped very low liquefaction potential designation.

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 debris flow, stream flooding, or rock fall hazard area.

5.0 SITE CONDITIONS

5.1 Surface Conditions

At the time the test pits were excavated the site consisted of undeveloped land vegetated with grasses, weeds, and shrubs. The site grade sloped downward to the north with an overall relief of about 50 feet, and to the west with an overall relief of about 60 feet. Based upon aerial photos dating back to 1993 that are readily available on the internet, the site has been undeveloped since at least that time. The existing portion of Fairway Drive was constructed between 1997 and 2003. The site is bordered on the north by existing residences and the south end of Fairway Drive, on the south by residences, and on the east and west by undeveloped land and residences (see **Vicinity Map** in **Section 1.1** above).

5.2 Subsurface Soils

At the locations of the test pits we encountered approximately 6 to 12 inches of topsoil at the surface. The natural subsurface soils exposed in the test pits consisted of light brown to red-brown, moist, Clayey SAND (SC) with varying amounts of gravel and cobbles, extending to the maximum depth explored of approximately 6 feet. The natural sand soils were estimated to be of dense to very dense relative density. The natural sand soils are projected to exhibit moderately high bearing strength characteristics with moderately low compressibility characteristics.

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 not encountered at the time of our field explorations within the maximum depth explored of about 6 feet below the existing ground surface. Groundwater is not anticipated to be encountered during construction.

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.

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 to 12 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 to 6 inches. Where larger shrubs are located, roots likely extend deeper.

Site clearing and grubbing 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. Groundwater was not encountered within the depths explored, about 3.5 to 6.0 feet at the time of our field explorations, and is not anticipated to be encountered in excavations.

The natural soils encountered at this site predominantly consisted of sand/gravel. 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.

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 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 partide 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 sand soils have a higher fines content than is recommended for structural fill, but appear suitable for use as site grading fill and non-structural fill situations.

Note that with the higher fines contents these soils 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.

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 5 to 8	95 98
Site grading fill outside area defined above	0 to 5 5 to 8	92 95
Utility trenches within structural areas	--	96
Roadbase and subbase	-	96
Non-structural fill	0 to 5 5 to 8	90 92

Structural fills greater than 8 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). The natural sand soils at this site will not likely meet these specifications.

[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 (except topsoil) 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 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 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, 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 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 suitable, undisturbed natural soils and/or on structural fill extending to suitable natural soils. Footings may be designed using a net bearing pressure of 2,500 psf if placed on suitable, undisturbed, natural soils or 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. If other unsuitable soils are encountered, they must be completely removed and replaced with properly compacted structural fill. The base of footing excavations should be observed by a CMT geotechnical engineer to assess that suitable bearing soils have been exposed.

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.

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 natural sand/gravel soils and 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 425 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 project that basement walls up to 8 feet tall will be constructed at this site. The lateral earth pressure values given below are for a backfill material that will consist of drained natural sand/gravel soils 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	N/A
Passive Pressure (wall moves into the soil)	425	265

*Equivalent Fluid Pressure (applied at 1/3 Height of Wall)
**Equivalent Fluid Pressure (added to static and applied at 1/3 Height of 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 (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 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

10.1 Surface Drainage

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.

10.2 Foundation Subdrains

The soils encountered at this site primarily consisted of clayey sand/gravel (SC), but groundwater was not encountered in our explorations and is not anticipated within the upper 10± feet. Thus, it is our opinion that perimeter foundation subdrains are not needed for this site.

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 (if encountered), loose or disturbed soils, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water.

In the roadway area, 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 sand soils will exhibit good 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 10 for the natural sand/gravel.

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	**8**	**4**
Subbase	**0**	**6**
Total Thickness	**11**	**13**

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

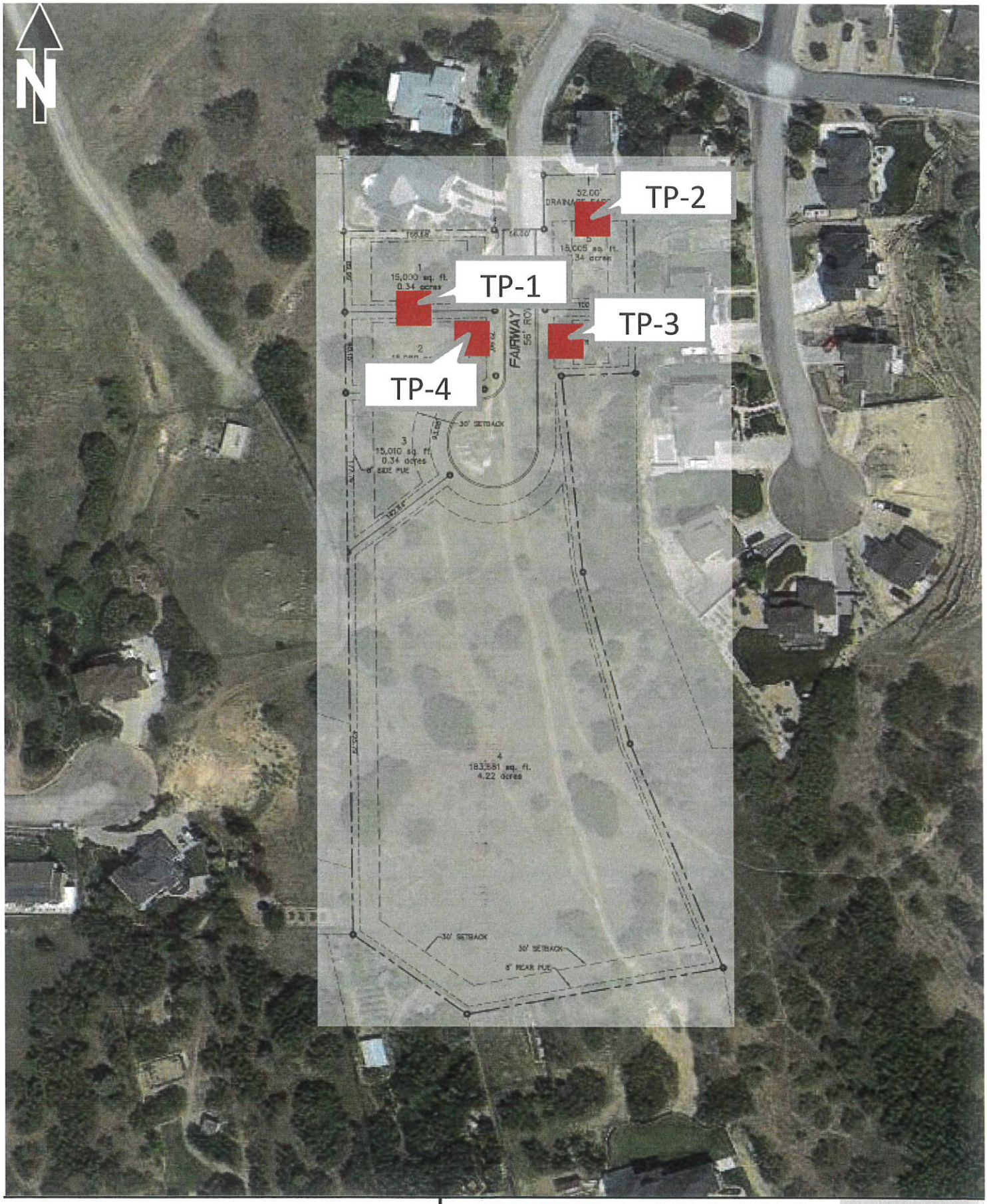
The recommendations provided herein were developed by evaluating the information obtained from the subsurface explorations and soils encountered therein. The exploration logs reflect the subsurface conditions only at the specific location at the particular time designated on the logs. Soil and ground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

APPENDIX

SUPPORTING
DOCUMENTATION



Barton Subdivision

Fairway Drive, Elk Ridge, UT

CMT ENGINEERING LABORATORIES

Site Map

Date:	20-Dec-21
Job #	17685

Figure: 1

Barton Subdivision

Fairway Dr., Elk Ridge, UT

Test Pit Log TP-1

Total Depth: 3.5'
Water Depth: (see Remarks)

Date: 12/20/21
Job #: 17685

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		TOSPOIL: Clay, gravel, roots, organics, brown										
1		Clayey SAND (SC), some gravel, cobbles, moist, light brown dense to very dense (estimated)										
2				8	21		7	57	36			
3												
4		REFUSAL AT 3.5 FEET										
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												

Remarks: Groundwater not encountered during excavation.

Coordinates: 40.011°, -111.6818°
Surface Elev. (approx): Not Given

Equipment: Rubber Tire Backhoe
Excavated By: Farrer Excavation
Logged By: A. Smoot

CMT ENGINEERING LABORATORIES

Figure: 2

Barton Subdivision

Fairway Dr., Elk Ridge, UT

Test Pit Log TP-2

Total Depth: 6'
Water Depth: (see Remarks)

Date: 12/20/21
Job #: 17685

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		TOSPOIL: Clay, sand, roots, organics, dark brown										
1		Clayey SAND (SC) with gravel, cobbles, moist, brown dense (estimated)										
2				1								
3												
4												
5												
6				2	14		15	59	26			
6		END AT 6.0 FEET										
7												
8												
9												
10												
11												
12												
13												
14												

Remarks: Groundwater not encountered during excavation.

Coordinates: 40.0113°, -111.6811°
Surface Elev. (approx): Not Given

Equipment: Rubber Tire Backhoe
Excavated By: Farrer Excavation
Logged By: A. Smoot

CMT ENGINEERING LABORATORIES

Figure: 3

Barton Subdivision

Fairway Dr., Elk Ridge, UT

Test Pit Log TP-3

Total Depth: 5.5'
Water Depth: (see Remarks)

Date: 12/20/21
Job #: 17685

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		TOSPOIL: Clay, sand, roots, organics, red brown										
1		Clayey SAND (SC) with gravel, moist, red-brown dense (estimated)										
2				3	18		19	44	37	46	24	22
3		grades more gravelly										
4				4								
5		grades less gravel, light brown very dense (estimated)		5	8		10	57	33			
6		END AT 5.5 FEET										
7												
8												
9												
10												
11												
12												
13												
14												

Remarks: Groundwater not encountered during excavation.

Coordinates: 40.0109°, -111.6813°
Surface Elev. (approx): Not Given

Equipment: Rubber Tire Backhoe
Excavated By: Farrer Excavation
Logged By: A. Smoot

CMT ENGINEERING LABORATORIES

Figure: 4

Barton Subdivision

Fairway Dr., Elk Ridge, UT

Test Pit Log TP-4

Total Depth: 5'
Water Depth: (see Remarks)

Date: 12/20/21
Job #: 17685

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		TOPSOIL: Clay, sand, roots, organics, brown										
1		Clayey SAND (SC) with gravel, cobbles, moist, brown dense (estimated)										
2				6								
3		grades light brown										
4												
5		END AT 5.0 FEET										
6												
7												
8												
9												
10												
11												
12												
13												
14												

Remarks: Groundwater not encountered during excavation.

Coordinates: 40.0109°, -111.6816°
Surface Elev. (approx): Not Given

Equipment: Rubber Tire Backhoe
Excavated By: Farrer Excavation
Logged By: A. Smoot

CMT ENGINEERING LABORATORIES

Figure: 5

Barton Subdivision

Fairway Dr., Elk Ridge, UT

Key to Symbols

Date: 12/20/21

Job #: 17685

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.

CMT ENGINEERING LABORATORIES

Figure: 6