Architectural
Structural
Geotechnical

RMG
Engineers / Architects

Materials Testing
Forensic
Civil/Planning

SOIL AND GEOLOGY STUDY

Village at Lorson Ranch
Northeast Corner of Marksheffel Rd and Fontaine Blvd
Tract D, Carriage Meadows North, Filing No. 1
El Paso County, Colorado

PREPARED FOR:

Landhuis Company
212 N. Wahsatch Ave. Ste 301
Colorado Springs, CO

JOB NO. 195914

April 9, 2024

Respectfully Submitted,

RMG – Rocky Mountain Group

Kelli Zigler

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Reviewed by,

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1.0 GENERAL SITE AND PROJECT DESCRIPTION

1.1 Project Location

The project site lies within the SE ¼ of the SE ¼ of Section 15 and Section 15, Township 15 South, Range 65 West of the 6th Principal Meridian in El Paso County, Colorado. The approximate location of the site is shown on the Site Vicinity Map, Figure 1.

1.1 Existing Land Use

The site is to be comprised of one existing parcel. The parcel included is:

- El Paso County Parcel No. 5515413054 – is currently labeled as Fontaine Blvd, consists of 9.73 acres, is zoned PUD - *Planned Unit Development*, and is currently undeveloped.

The parcel is to maintain the current zoning of PUD.

1.2 Project Description

It is our understanding the proposed subdivision is to be named Villages at Lorson Ranch and is to consist of multiple commercial structures. Interior streets are proposed and are anticipated to be private. The development is to utilize sewer and water services provided by Widefield Water and Sanitation District. Neither individual wells nor on-site wastewater treatment systems are proposed.

1.4 Previous Investigations

Previous geotechnical/geologic investigations for this site were not provided for our review. However, one previous investigation by RMG within the area is listed below:

1. *Carriage Meadows North, Filing No. 1, Detention Pond SSI, El Paso County, Colorado*, RMG – Rocky Mountain Group, Job No. 161943, dated January 19, 2018.

The findings, conclusions and recommendations contained in this report were considered during the preparation of this report.

Additional investigations (by RMG) within the area are listed in Appendix A.

2.0 QUALIFICATIONS OF PREPARERS

This Soil and Geology Study was prepared by a professional geologist as defined by Colorado Revised Statures section 34-1-201(3) and by a qualified geotechnical engineer as defined by policy statement 15, "Engineering in Designated Natural Hazards Areas" of the Colorado State Board of Registration for Professional Engineers and Professional Land Surveyors. (Ord. 96-74; Ord. 01-42)

The principle investigators for this study are Kelli Zigler P.G., and Tony Munger, P.E. Ms. Zigler is a Professional Geologist as defined by State Statute (C.R.S 34-1-201) with over 23 years of experience in the geological and geotechnical engineering field. Ms. Kelli Zigler holds a B.S. in Geology from the

University of Tulsa. Ms. Zigler has supervised and performed numerous geological and geotechnical field investigations throughout Colorado.

Tony Munger is a licensed professional engineer with over 23 years of experience in the construction engineering (residential) field. Mr. Munger and holds a Bachelor of Science in Architectural Engineering from the University of Wyoming.

3.0 STUDY OVERVIEW

The purpose of this investigation is to characterize the general geotechnical and geologic site conditions, and present our opinions of the potential effect of these conditions on the proposed development to include commercial sites within the referenced proposed development. As such, our services exclude evaluation of the environmental and/or human, health-related work products or recommendations previously prepared, by others, for this project.

Revisions to the conclusions presented in this report have been amended since the submission of the Preliminary Sketch Plan. This study has been prepared in accordance with the requirements outlined in the El Paso County Land Development Code (LDC) specifically Chapter 8 last updated August 27, 2019 applicable sections include 8.4.8 and 8.4.9. and the Engineering Criteria Manual (ECM), specifically Appendix C last updated July 9, 2019.

This report presents the findings of the study performed by RMG relating to the geotechnical and geologic conditions of the above-referenced site. Revisions and modifications to the conclusions and recommendations presented in this report may be issued subsequently by RMG based upon additional observations made during grading and construction which may indicate conditions that require re-evaluation of some of the criteria presented in this report.

3.1 Scope and Objective

The scope of this study is to include a physical reconnaissance of the site and a review of pertinent, publically available documents including (but not limited to) previous geologic and geotechnical reports, overhead and remote sensing imagery, published geology and/or hazard maps, design documents, etc. Our services exclude the evaluation of the environmental and/or human, health-related work products or recommendations previously prepared, by others, for this project.

The objectives of our study are to:

- Identify geologic conditions that are present on this site,
- Analyze the potential negative impacts of these conditions on the proposed site development,
- Analyze the potential negative impacts to the surrounding properties and/or public services resulting from the proposed site development as it relates to existing geologic hazards,
- Provide our opinion of suitable techniques that may be utilized to mitigate the potential negative impacts identified herein.

This report presents the findings of the study performed by RMG relating to the geologic conditions of the above-referenced site. Revisions and modifications to this report may be issued subsequently by RMG, based upon:

- Additional observations made during grading and construction which may indicate conditions that require re-evaluation of some of the criteria presented in this report,
- Review of pertinent documents (development plans, plat maps, drainage reports/plans, etc.) not available at the time of this study,
- Comments received from the governing jurisdiction and/or their consultants subsequent to submission of this document.

3.2 Site Evaluation Techniques

The information included in this report has been compiled from:

- Field reconnaissance
- Geologic and topographic maps
- Review of selected publicly available, pertinent engineering/geologic reports
- Available aerial photographs
- Exploratory soil test borings by RMG
- Laboratory testing of representative site soil and rock samples by RMG
- Geologic research and analysis
- Site development plans prepared by others

Geophysical investigations were not considered necessary for characterization of the site geology. Monitoring programs, which typically include instrumentation and/or observations for changes in groundwater, surface water flows, slope stability, subsidence, and similar conditions, are not known to exist and were not considered applicable for the scope of this report.

3.3 Additional Documents

Additional documents reviewed during the performance of this study are included in Appendix A.

4.0 SITE CONDITIONS

4.1 Existing Site Conditions

The entire site is currently undeveloped land that was historically used as grazing and pasture land. Prior to 2017, the site was utilized as a landscaping tree farm. The associated structures have since been removed. No evidence of debris or permanent foundations were observed onsite at the time of drilling. A man-made pond is located near the northwestern corner of the site. The site is bound to the north by a single-family residential development, to the east by Carriage Meadows Drive, to the south by Fontaine Boulevard, and to the west by Marksheffel Road. A stone retaining wall is located just outside the southern and western boundaries, paralleling Fontaine Boulevard and Marksheffel Road, respectively.

4.2 Topography

Based on our site reconnaissance and the 2022 USGS topographic map of the Fountain quadrangle, the site topography is generally gently to moderate sloping with rolling hills. The elevation varies by approximately 10 to 12 feet across the entire site, sloping generally downwards from the northwest corner to the southeast corner of the property. Some isolated steeper slopes exist along the immediate sides of the man-man pond. No water was observed in the pond at the time of our investigation.

4.3 Vegetation

The majority of the site consists of native prairie grasses, and weeds with scattered deciduous trees near the outer edges of the property. The ground surface is generally flat but still contains tire tracks and ground surface outlines of the previous non-permanent structures that were utilized for the tree farm.

4.4 Aerial photographs and remote-sensing imagery

Personnel of RMG reviewed aerial photos available through Google Earth Pro dating back to 1999, CGS surficial geologic mapping, and historical photos by historicaerials.com dating back to 1947. Historically, the site was an agricultural farm until 1999. Prior to 1999, the original farm house south of the property (south of Fontaine Blvd) was one of the few residences in the area. After 1999, the development of Lorson Ranch began and has continued to date.

5.0 FIELD INVESTIGATION AND LABORATORY TESTING

5.1 Field Investigation

The subsurface conditions within the property were explored by drilling five (5) exploratory borings across the site on February 22, 2024, extending to depths of approximately 20 to 35 feet below the existing ground surface. The test borings were spaced to provide preliminary soil information for the proposed development. The Test Boring Location Plan is presented in Figure 2.

The number of borings is in accordance with the minimum one test boring per 10 acres of development up to 100 acres and one additional boring for every 25 acres of development above 100 acres as required by the ECM, Section C.3.3.

The test borings were drilled with a power-driven, continuous-flight auger drill rig. Samples were obtained during drilling of the test boring in general accordance with ASTM D-1586 and D-3550, utilizing a 2-inch O.D. Split Barrel Sampler and a 2½-inch O.D. California sampler, respectively. Results of the penetration tests are shown on the drilling logs. The proposed lot layout is shown on the Test Boring Location Plan, Figure 2. An Explanation of Test Boring Logs is shown in Figure 3, and the Test Boring Logs are shown in Figures 4 through 6.

5.2 Laboratory Testing

Soil laboratory testing was performed as part of this investigation. The laboratory tests included moisture content, dry density, grain-size analyses, Atterberg Limits and Swell/Consolidation tests. A Summary of Laboratory Test Results is presented in Figure 7. Soils Classification Data is presented in Figures 8 and 9. Swell/Consolidation Test Results are presented in Figures 10 through 13.

5.3 Groundwater

Groundwater was encountered in 3 of the test borings at the time of drilling at depth ranging between 26 to 27 feet. When checked 13 days subsequent to drilling, groundwater was not encountered in the borings but the borings had caved to depth ranging between 17.5 feet and 27.5 feet. It should be noted that in granular soils and bedrock (if encountered), some perched water conditions might be encountered due to the

variability of the soil profile. Isolated sand and gravel layers within the soil, even those of limited thickness and width, can carry water in the subsurface. Groundwater may also flow atop the underlying bedrock. Builders and planners should always be cognizant of the potential for the occurrence of subsurface water conditions during on-site construction (even in none was encountered at the time of the original investigation) in order to evaluate and mitigate each individual problem as necessary.

6.0 SOIL, GEOLOGY, AND ENGINEERING GEOLOGY

The site is located within the western flank of the Colorado Piedmont section of the Great Plains physiographic province. The Colorado Piedmont, formed during Late Tertiary and Early Quaternary time (approximately 2,000,000 years ago), is a broad, erosional trench which separates the Southern Rocky Mountains from the High Plains. During the Late Mesozoic and Early Cenozoic Periods (approximately 70,000,000 years ago), intense tectonic activity occurred, causing the uplifting of the Front Range and associated downwarping of the Denver Basin to the east. Relatively flat uplands and broad valleys characterize the present-day topography of the Colorado Piedmont in this region.

6.1 Subsurface Soil Conditions

The subsurface materials encountered in the test borings performed for this study were classified within the laboratory using the Unified Soil Classification System (USCS). The soils were identified and classified as clayey sand (SC), silty sand (SM), and sandy clay (CL). The upper clay soils were encountered at medium stiff to very stiff consistencies, and the sand soils were loose to medium dense. The majority of soils were at moist conditions. The clay (fill and native) is considered to possess low to high expansion potential.

Additional descriptions and the interpreted distribution (approximate depths) of the subsurface materials are presented on the Test Boring Logs. The classifications shown on the logs are based upon the engineer's classification of the samples at the depths indicated. Stratification lines shown on the logs represent the approximate boundaries between material types and the actual transitions may be gradual and vary with location.

6.2 Bedrock Conditions

In general, the bedrock (as mapped by Colorado Geologic Survey - CGS) beneath the site is considered to be part of the Pierre Shale formation. Bedrock was not encountered in the test borings performed to depths of up to 35 feet for this investigation. Bedrock is not expected to be encountered in the excavations or utility trenches for the proposed development.

6.3 U.S. Soil Conservation Service

The U.S. Soil Conservation Service along with United States Department of Agriculture (USDA) has identified the soils on the property as:

- 28 – *Ellicott loamy coarse sand, 0 to 5 percent slopes.* Properties of the loamy coarse sand include, somewhat excessively drained soils, depth of the water table is anticipated to be greater than 80 inches, runoff is anticipated to be very low, frequency of flooding is frequent, frequency of ponding is none, and landforms include flood plains and stream terraces. This loamy sand is mapped within the northeast corner of the property.

- 52 – *Manzanst clay loam, 0 to 3 percent slopes.* Properties of the clay loam include, well-drained soils, depth of the water table is anticipated to be greater than 80 inches, frequency of flooding and/or ponding is none, and landforms include terraces and drainageways. This clay loam is mapped across the majority of the site.

The USDA Soil Survey Map is presented in Figure 14 and the FEMA Map is presented in Figure 15.

6.4 General Geologic Conditions

Based on our field observations, the USDA map, and the relevant Geologic Quadrangle Maps, an interpreted geologic map of significant surficial deposits and features was mapped for the site. The identified geologic conditions affecting the development are presented in the Engineering and Geology Map, Figure 16.

The site generally consists of alluvial sand, silt and clay deposits underlain by claystone bedrock of the Pierre Shale formation. The following geologic units were mapped at the site:

- *Qa_3 – Young alluvium two (late and middle? Holocene)* – Includes several thin beds and lenses of dark-grayish-brown to very dark-grayish-brown sediment. The unit blankets large areas on broad valley floors. Upper surface of unit is 15-20 feet higher than stream channels in the southern part of the quadrangle. A very weak, 6 to 18-inch-thick soil is developed in this unit. Unit is subject to infrequent large floods and is estimated to be 10-20 feet thick.
- *Kp – Pierre Shale, Main part of formation* – Shale, minor siltstone and sandstone beds, and thin concretionary limestone beds; marine fossils in some beds; mostly dark to light gray and olive gray. Poorly exposed in general. Unit is about 1,200 feet exposed in Elsmere quadrangle. Total formation thickness is about 5,000 feet.
- *Af – Artificial Fill* – fill associated with the man-made pond
- *Fountain Ditch* – parallels the northern property boundary, is to be considered a No Build Area, and is to remain.

6.5 Structural Features

Structural features such as schistocity, folds, zones of contortion or crushing, joints, shear zones or faults were not observed on the site, in the surrounding area, or in the soil samples collected for laboratory testing.

6.6 Surficial (Unconsolidated) Deposits

Lake and pond sediments, swamp accumulations, sand dunes, marine terrace deposits, talus accumulations, creep, or slope wash were not observed on the site. Slump and slide debris were also not observed on the site.

6.7 Engineering Geology

Charles Robinson and Associates (1977) have mapped the following environmental engineering unit at the site:

- 1A – Stable alluvium, colluvium and bedrock on flat to gentle slopes (0-5%).

6.8 Features of Special Significance

Features of special significance such as accelerated erosion, (advancing gully head, badlands, or cliff reentrants) were not observed on the property. However, isolated areas of minor erosion, rill erosion has occurred. Features indicating settlement or subsidence such as fissures, scarplets, and offset reference features were not observed on the property or surrounding areas.

Features indicating creep, slump, or slide masses in bedrock and surficial deposits were not observed on the property.

6.9 Drainage of Water and Groundwater

The overall topography varies by approximately 10 to 12 feet across the entire site, sloping generally downwards from the northwest corner to the southeast corner of the property. It is anticipated the direction of groundwater is towards Jimmy Camp Creek located to the east of the site. The Fountain ditch is man-made and was constructed prior to 2006. The ditch parallels the northern property boundary, continues east across Carriage Meadows Drive, and wraps around the existing detention/retention pond and continues south to eventually daylight into Jimmy Camp Creek. The ditch is to remain.

Groundwater was encountered in 3 of the test borings at the time of drilling at depth ranging between 26 to 27 feet. When checked 13 days subsequent to drilling, groundwater was not encountered in the borings but the borings had caved to depth ranging between 17.5 feet and 27.5 feet. It should be noted that in granular soils and bedrock (if encountered), some perched water conditions might be encountered due to the variability of the soil profile. Isolated sand and gravel layers within the soil, even those of limited thickness and width, can carry water in the subsurface. Groundwater may also flow atop the underlying bedrock. Builders and planners should always be cognizant of the potential for the occurrence of subsurface water conditions during on-site construction (even in none was encountered at the time of the original investigation) in order to evaluate and mitigate each individual problem as necessary.

7.0 ECONOMIC MINERAL RESOURCES

Under the provision of House Bill 1529, it was made a policy by the State of Colorado to preserve for extraction commercial mineral resources located in a populous county. Review of the *El Paso Aggregate Resource Evaluation Map, Master Plan for Mineral Extraction*, *Map 1* indicates the site is identified as floodplain deposits consisting of sand and gravel with minor amounts of silt and clay deposited by water along present stream courses, valley fill consisting of sand and gravel with silt and clay deposited by water in one or a series of stream valleys, eolian deposits consisting of windblown sand and upland deposits consisting of sand, gravel with silt and clay; remnants of older streams desisted on topographic highs or bench like features. The extraction of the clay and claystone resources are not considered to be economical compared to materials available elsewhere within the county.

According to the *Evaluation of Mineral and Mineral Fuel Potential of El Paso County State Mineral Lands*, the site is mapped within the southern part of the Denver Basin Coal Region with a tract identifier of 41-59. However, the area of the site does not contain coal resources. The tract is underlain primarily by the Pierre Shale of Cretaceous age. No wells are drilled within the tract. Grand Union Oil Company reportedly drilled a well in the vicinity to a depth of 1,250 feet in 1901. No signs of hydrocarbons were recorded. The well was plugged and abandoned. The sedimentary rocks in this area appear to contain all of the essential elements, but existing geological control is insufficient to determine the presence of a trap or

reservoir. The tract is not prospective for metallic mineral resources. There are no mines in the Pierre Shale within ten miles of the tract, but the tract has some potential to contain useful clay and shale resources.

8.0 IDENTIFICATION AND MITIGATION OF POTENTIAL GEOLOGIC CONDITIONS

The El Paso County Engineering Criteria Manual recognizes and delineates the difference between hazards and constraints. A *geologic hazard* is one of several types of adverse geologic conditions capable of causing significant damage or loss of property and life. Geologic hazards are defined in Section C.2.2 Sub-section E.1 of the ECM. A *geologic constraint* is one of several types of adverse geologic conditions capable of limiting or restricting construction on a particular site. Geologic constraints are defined in Section C.2.2 Sub-section E.2 of the ECM (1.15 Definitions of Specific Terms and Phrases). The following geologic constraints were considered in the preparation of this report, and are not are not anticipated to pose a significant risk to the proposed development:

Hazards:

- Avalanches
- Debris Flow-Fans/Mudslides
- Ground Subsidence
- Landslides
- Rockfall

Constraints:

- Corrosive Minerals
- Erosion and Erosion-Related Slope Instability
- Floodplain/Floodway
- Steeply Dipping Bedrock
- Valley Fill
- Downhill/Down-Slope Creep
- Soil Slumps and Undercutting
- Unstable or Potentially Unstable Slopes

The following sections present geologic hazards and constraints that have been identified on the property:

8.1 Expansive Soils and Bedrock – *constraint*

Expansive soils were encountered across the entire site. Based on our laboratory testing and our experience with the soils and bedrock in the vicinity (Lorson Ranch), the sandy clay possesses low to high swell potential. The sandy clay was encountered in 3 of the 5 test borings at depths expected to influence the anticipated shallow foundations, roadways, and utility trenches.

Mitigation

One mitigation method commonly utilized in this area is "mass" removal (subexcavation) and replacement with moisture-conditioned structural fill. Our subexcavation recommendations are presented in Section **13.0 Subexcavation and Replacement** of this report.

Note, the recommended subexcavation and replacement process does not guarantee that the swell potential will be reduced to acceptable levels. It is possible that the expansive material will retain swell potential in

excess of the allowable value presented herein, even after processing and moisture-conditioning. If (at the time of the lot-specific subsurface soil investigation and/or the open excavation observation) the soil is found to possess swell potential in excess of acceptable levels for the foundation system and design parameters proposed for construction at that time, overexcavation and replacement of some or all of the previously placed fill material may be required.

One alternative to subexcavation and replacement would be a deep foundation system (consisting of drilled piers (caissons), helical piers, or micropiles) and a structural floor (wood, concrete, or steel) can be considered as an option to reduce the potential of slab and/or foundation movement related to expansive materials. Another option would be overexcavation and replacement on a lot-specific basis. If subexcavation is not performed, recommendations for these alternative mitigation/foundation systems are to be presented in the building-specific subsurface investigations performed once grading a development operations have been completed (but prior to construction).

Provided that appropriate mitigations and/or foundation design adjustments are implemented, the presence of expansive soils or bedrock is not considered to pose a risk to the proposed structures.

8.2 Compressible Soils - *constraint*

Compressible soils generally have low density, uniform grain size, and are generally deposited by wind. The surficial soils exhibit one or two of these characteristics. Shallow foundations are anticipated for the majority (if not all) of the development. Subexcavation and replacement with on-site moisture-conditioned structural fill is a commonly utilized method of mitigating compressible soils. Based on our test borings performed for this investigation, the surficial soils generally possess low to moderate compressibility potential.

Mitigation

The potential for loose and/or compressible soils exist across the entire site at varying depths. Grading and infrastructure are expected to be substantial due to the proposed subexcavation. However, subexcavation is an option to reduce the potential for loose and/or compressible soils. Our subexcavation recommendations are presented in Section **13.0 Subexcavation and Replacement** of this report.

As an alternative to subexcavation and replacement, a deep foundation system consisting of drilled piers and a structural floor (wood, concrete, or steel) can be considered as an option to reduce the potential of slab and/or foundation movement related to expansive materials.

Settlement is directly related to saturation of the soils adjacent to foundation walls and below the entire foundation areas. Good long-term drainage is imperative to reduce the potential for settlement, for the entirety of the structures life. The ground surface should be sloped from the building with a minimum gradient of 10 percent for the first 10 feet. This is equivalent to 12 inches of fall across this 10-foot zone. If a 10-foot zone is not possible on the upslope side of the structure, then a well-defined swale should be created a minimum 5 feet from the foundation and sloped parallel with the wall with a minimum slope of 2 percent to intercept the surface water and transport it around and away from the structure. Roof drains should extend across backfill zones and landscaped areas to a region that is graded to direct flow away from the structure. Homeowners should maintain the surface grading and drainage recommended in this report to help prevent water from being directed toward and/or ponding near the foundations.

Landscaping should be selected to reduce irrigation requirements. Plants used close to foundation walls should be limited to those with low moisture requirements and irrigated grass should not be located within

5 feet of the foundation. To help control weed growth, geotextiles should be used below landscaped areas adjacent to foundations. Impervious plastic membranes are not recommended.

Irrigation devices should not be placed within 5 feet of the foundation. Irrigation should be limited to the amount sufficient to maintain vegetation. Application of more water will increase the likelihood of slab and foundation movements.

Provided that appropriate mitigations and/or foundation design adjustments are implemented, the presence of compressible soils is not considered to pose a risk to the proposed structures.

8.3 Seasonal Surface and Subsurface Water - *constraint*

Jimmy Camp Creek is located east of Carriage Meadows and the Fountain Creek parallels the northern property boundary and continues east of Carriage Meadows, then is redirected to the south along the western side of Jimmy Camp Creek. Currently it is uncertain if the man-made pond is to be removed or backfilled.

Groundwater was encountered in all five of the test borings at depths of 17 to 27.5 feet. Based on the depths from the current ground surface to measured groundwater depths and the likelihood that the elevation will be raised in these areas during overlot grading, groundwater is expected to be 7 feet or deeper below the final "developed" ground surface. Even with typical seasonal variations in groundwater depths, the groundwater is not forseen to encroach within 10 feet of "typical" slab-on-grade foundation depth on the proposed lots. Currently it is our understanding the lots within this site are to be commercial properties. Generally commercial structures utilize a slab on grade foundation with minimal cuts, increasing the separation from the potentially fluctuating groundwater.

It is projected that groundwater will not affect shallow foundations for the structures or shallow buried utilities proposed on the site. Groundwater may affect areas depending upon grading cuts and within deeper excavations made for installation of utilities. It should be noted that groundwater levels, other than those observed at the time of the subsurface soil investigation, will change due to season variations, changes in land runoff characteristics and future development of nearby areas.

It should be noted that in granular soils and bedrock, some subsurface water conditions might be encountered due to the variability of the soil profile. Isolated sand and gravel layers within the soil, even those of limited thickness and width, can convey subsurface water. Subsurface water may also flow atop the interface between the upper soils and the underlying bedrock. While not indicative of a "groundwater" condition, these occurrences of subsurface water migration can (especially in times of heavy rainfall or snowmelt) result in water migration into the excavation or (once construction is complete) the building envelope. Builders and planners should be cognizant of the potential for the occurrence of subsurface water conditions within the deep utility trenches (greater than 15 feet) during on-site construction.

<u>Mitigation</u>
A minimum 3 to 5-foot separation is generally recommended between the bottom of the foundation components/floor slabs and the estimated seasonal high-water table levels. We believe the slab-on-grade foundations will have adequate separation from the underlying groundwater. Additional drainage and/or ground stabilization measures (beyond those already presented herein) are not expected.

Foundations must have a minimum 30-inch depth for frost protection. Perimeter drains are recommended around portions of the structures which will have habitable or storage space located below the finished

ground surface. This includes crawlspace areas but not the walkout trench, if applicable. Perimeter drains are recommended for portions of the structures which will have below-grade spaces to help reduce the intrusion of water into areas below grade. A typical perimeter drain detail is presented in Figure 17.

Provided that appropriate mitigations and/or foundation design adjustments are implemented, the presence of seasonally fluctuating groundwater is not considered to pose a risk to the proposed structures.

8.4 History of Landfill or Uncontrolled/Undocumented Fill Placement - *constraint*

Shallow fill soils were encountered in two of the test boring performed. Due to the previous usage of the site, fill soils may be encountered across the site at various depths. The fill soils must be considered undocumented fill, and as such are not suitable for development in its current condition for the following reasons. The degree of consolidation is unknown, material densities will vary, and pockets and seams of soft and loose material may be encountered. Uneven and differential settlement potential exists. We do not believe the site has a history of use as a landfill.

Mitigation

It is anticipated the majority of the unsuitable fill soils will be penetrated by the proposed subexcavation. However, if unsuitable fill soils remain below the proposed foundation components, they will require removal (overexcavation) and replacement with newly placed and compacted structural fill. The zone of overexcavation shall extend to the bottom of the unsuitable fill zone and shall extend at least that same distance beyond the building perimeter (or lateral extent of the fill, if encountered first).

Provided that appropriate mitigations and/or foundation design adjustments are implemented, the presence of undocumented fill placement is not considered to pose a risk to the proposed structures.

8.5 Faults and Seismicity - *hazard*

Based on review of the Earthquake and Late Cenozoic Fault and Fold Map Server provided by CGS located at http://dnrwebmapgdev.state.co.us/CGSOnline/ and the recorded information dating back to November of 1900, Colorado Springs has not experienced a recorded earthquake with a magnitude greater than 1.6 during that time period. The nearest recorded earthquakes over 1.6 occurred in December of 1995 in Manitou Springs, which experienced magnitudes ranging between 2.8 to 3.5. Additional earthquakes over 1.6 occurred between 1926 and 2001 in Woodland Park, which experienced magnitudes ranging from 2.7 to 3.3. Both of these locations are in the vicinity of the Ute Pass Fault, which is greater than 10 miles from the subject site.

Earthquakes felt at this site will most likely result from minor shifting of the granite mass within the Pikes Peak Batholith, which includes pull from minor movements along faults found in the Denver basin. It is our opinion that ground motions resulting from minor earthquakes may affect structures (and the surrounding area) at this site if minor shifting were to occur.

Mitigation

In accordance with the International Building Code, 2018, seismic design parameters have been determined for this site. The Seismic Site Class has been interpreted from the results of the soil test borings drilled within the project site. The Applied Technology Council seismic design tool has been used to determine the seismic response acceleration parameters using ASCE 7-16. The soil on this site is not considered susceptible to liquefaction. The following recommended Seismic Design Parameters are based

upon Seismic Site Class D, and a 2 percent probability of exceedance in 50 years. The Seismic Design Category is "B".

Period (sec)	Mapped MCE Spectral Response Acceleration (g)		Site Coefficients		Adjusted MCE Spectral Response Acceleration (g)		Design Spectral Response Acceleration (g)	
0.2	S_s	0.183	F_a	1.6	S_{ms}	0.293	S_{ds}	0.195
1.0	S_1	0.056	F_v	2.4	S_{m1}	0.134	S_{d1}	0.089

Notes: MCE = Maximum Considered Earthquake g = acceleration due to gravity

8.6 Radon – *constraint*

Radon is a gas that can move feely within the soil and air but can become trapped in structures constructed on the soil. Radon is a byproduct of the natural decay of uranium and radium. Trace amounts of radioactive nuclides are common in the soils and bedrock that underlie this region and site.

***"Radon Act 51** passed by Congress set the natural outdoor level of radon gas (0.4 pCi/L) as the target radon level for indoor radon levels.*

Southern El Paso County and the 80929 zip code located in Rolling Meadows / Bull Hill are has an EPA assigned Radon Zone of 1. A radon zone of 1 predicts an average indoor radon screening level greater than 4 pCi/L, which is above the recommended levels assigned by the EPA. Rolling Meadows / Bull Hill is located in a high risk area of the country. *The EPA recommends you take corrective measures to reduce your exposure to radon gas.*

Most of Colorado is generally considered to have the potential of high levels of radon gas, based on the information provided at: https://www.elpasocountyhealth.org/sites/default/files/CDPHERadonMap.pdf. There is not believed to be unusual hazardous levels of radon from naturally occurring sources at this site.

Mitigation

Radon hazards are best mitigated at the building design and construction phases. Providing increased ventilation of basements, crawlspaces, creating slightly positive pressures within structures, and sealing of joints and cracks in the foundations and below-grade walls can help mitigate radon hazards. Radon hazards are best mitigated at the building design and construction phases. Providing increased ventilation of basements, crawlspaces, creating slightly positive pressures within structures, and sealing of joints and cracks in the foundations and below-grade walls can help mitigate radon hazards. Passive radon mitigation systems are also available.

Passive and active mitigation procedures are commonly employed in this region to effectively reduce the buildup of radon gas. Measures that can be taken after the residence is enclosed during construction include installing a blower connected to the foundation drain and sealing the joints and cracks in concrete floors and foundation walls. If the occurrence of radon is a concern, it is recommended that the residence be tested after they are enclosed and commonly utilized techniques are in place to minimize the risk.

8.7 Proposed Grading, Erosion Control, Cuts and Masses of Fill and Erosion Control

Based on the test borings for this investigation, the excavations are anticipated to encounter silty to clayey sand and sandy clay. The on-site soils can generally be used as site-grading fill when properly moisture conditioned and recompacted.

Prior to placement of overlot fill or removal and re-compaction of the existing materials, topsoil, low-density native soil, fill and organic matter should be removed from the fill area. The subgrade should be scarified, moisture conditioned to within 2% of the optimum moisture content, and recompacted to the same degree as the overlying fill to be placed. The placement and compaction of fill should be periodically observed and tested by a representative of RMG during construction.

If unsuitable fill soils are encountered at the time of construction for the single-family residences, they should be removed (overexcavated) and replaced with compacted structural fill. The zone of overexcavation shall extend to the bottom of the unsuitable fill zone and shall extend at least that same distance beyond the building perimeter (or lateral extent of any fill, if encountered first). Provided that this recommendation is implemented, the presence of this fill is not considered to pose a risk to proposed structures.

We believe the sandy clay will classify as Type A material and the clayey sand, silty sand, and silty to clayey sand will classify as Type C materials as defined by OSHA in 29 CFR Part 1926. OSHA requires that temporary excavations made in Type A materials be laid back at ratios no steeper than 3/4:1 (horizontal to vertical) and temporary excavations made in Type C materials be laid back at ratios no steeper than 1 1/2:1 (horizontal to vertical), unless the excavation is shored and braced. Excavations deeper than 20 feet, or when water is present, should always be braced or the slope designed by a professional engineer. Long term cut slopes in the upper soil should be limited to no steeper than 3:1 (horizontal to vertical). Flatter slopes will likely be necessary should groundwater conditions occur. It is recommended that long term fill slopes be no steeper than 3:1 (horizontal to vertical).

Erosion Control

Erosion generally refers to lowering the ground surface over a wide area. The soils on-site are mildly to moderately susceptible to wind and water erosion. Temporary problems may arise due to minor wind erosion and dust during and immediately after construction. Watering of the cut areas or the use of chemical palliatives may be needed to control dust. However, once construction has been completed and vegetation reestablished, the potential for wind erosion and dust will be considerably reduced.

Loose soils are the most susceptible to water erosion. The windblown sands on site were encountered at loose to medium densities. Cut and fill areas may be subjected to sheetwash (surface) erosion. Unchecked erosion could eventually lead to concentrated flows of water. Generally, the most effective means to control erosion is to re-vegetate the cut and fill slopes with native vegetation.

Guideline Site Grading Specifications are included in the Appendix B.

9.0 BEARING OF GEOLOGIC CONDITIONS UPON PROPOSED DEVELOPMENT

Geologic hazards (as described in Section 8 of this report) were not found to be present at this site. Geologic constraints (also as described in section 8 of this report) such as: expansive soils and bedrock,

compressible soils, seasonally fluctuating groundwater, faults/seismicity, and radon are known to exist on the site. Where avoidance is not readily achievable, it is our opinion that the existing geologic and engineering conditions can be satisfactorily mitigated through proper engineering, design, and construction practices.

10.0 BURIED UTILITIES

Based upon the conditions encountered in the test borings, we anticipate that the soils encountered in individual utility trench excavations will consist mostly of native or moisture conditioned and recompacted clayey sand, silty to clayey sand, and sandy clay. It is anticipated the sandy clay will be encountered at medium stiff to very stiff constancies and the clayey sand soils at loose to medium dense densities. Bedrock conditions are not anticipated within the utility trenches.

We believe the sandy clay and claystone will classify as Type A material and the clayey sand, silty sand, and silty to clayey sand will classify as Type C materials as defined by OSHA in 29 CFR Part 1926. OSHA requires that temporary excavations made in Type A materials be laid back at ratios no steeper than 3/4:1 (horizontal to vertical) and temporary excavations made in Type C materials be laid back at ratios no steeper than 1 1/2:1 (horizontal to vertical), unless the excavation is shored and braced. Excavations deeper than 20 feet, or when water is present, should always be braced or the slope designed by a professional engineer.

11.0 PRELIMINARY PAVEMENTS

The proposed roadways within this development will require a new pavement design prepared in accordance with the El Paso County regulations. The interior roadways, as indicated by the *Conceptual Layout* map prepared by Matrix Design Group are to be classified as Residential Collector with 60' R.O.W, and Non-Residential Collector with an 80' R.O.W.

The actual pavement section design for individual streets will be completed following overlot grading and rough cutting of the street subgrade.

The ECM notes that mitigation measures may be required for expansive soils, shallow ground water, subgrade instability, etc. Based on the AASHTO classification of the soils in the subdivision and laboratory swell testing, the subgrade soils are expected to encounter low to high expansive potential. Therefore, special mitigation measures will likely be necessary for subgrade preparation in some areas, as determined at the time of the pavement design.

Pavement materials should be selected, prepared, and placed in accordance with the El Paso County specification and the Pikes Peak Region Asphalt Paving Specifications. Tests should be performed in accordance with the applicable procedures presented in the final design.

12.0 ANTICIPATED FOUNDATION SYSTEMS

Based on the information presented previously, conventional shallow spread-footing foundation systems, post tension (PT) slabs, and/or slab on grade foundations are anticipated to be suitable for the proposed commercial structures. It is our understanding a combination of slab and crawlspace excavations are proposed for the lots. Typical foundation cuts are anticipated to be approximately 3 to 4 feet below the

final ground surface for crawlspace and slab-on-grade foundations, not including subexcavation where performed.

Expansive soils are anticipated to be encountered in a majority of the excavations at foundation and floor slab bearing levels. Removal and replacement with structural fill is anticipated. This can be accomplished through "mass" subexcavation and replacement with moisture-conditioned expansive soils/bedrock during land development operations, lot-specific overexcavation and replacement with structural fill during construction, or use of deep foundation systems. However, it should be noted that the use of subexcavated and moisture-conditioned expansive soils as fill below foundations may result in a condition that is not suitable for all types of shallow foundations.

If a mass subexcavation is not performed, loose sands are likely to be encountered and will require additional compaction to achieve the allowable bearing pressure as indicated in a site specific subsurface soil investigation. In some cases, removal and recompaction may be required for loose soils.

It must be understood that the subexcavation and replacement process does not guarantee that the swell potential will be reduced to acceptable levels. It is possible that the expansive material will retain swell potential in excess of the allowable value presented herein, even after processing and moisture-conditioning. In such a case, the material will need to be removed, reconditioned, and replaced until the swell potential is reduced to the stated value.

If (at the time of the lot-specific subsurface soil investigation and/or the open excavation observation) the soil is found to possess swell potential in excess of acceptable levels for the foundation system and design parameters proposed for construction at that time, overexcavation and replacement of some or all of the previously placed fill material may be required.

It is also possible that material that was properly conditioned, placed, and compacted during the subexcavation process will require removal (overexcavation) and replacement at the time of construction. The swell potential of the moisture-conditioned structural fill is dependent on many factors, including (but not limited to) density/degree of compaction, moisture content (particularly changes that occur in the moisture content from the time of placement to the time of actual foundation construction), etc. Additionally, various construction processes which can adversely affect the performance of moisture-conditioned structural fill are completed at times before and after our observations, as well as between the time of land development and when the lot-specific foundation is constructed.

While the subexcavation and replacement process is generally considered suitable for use with shallow foundation types, it may result in design parameters that are not consistent with the future builder(s)' pre-existing foundation designs. In such a case, the builder would either need to obtain a foundation designed for parameters consistent with the subsurface soil conditions present at that time, or perform additional mitigation (in most cases, this consists of overexcavation and replacement with material suitable to provide the design parameters utilized in that pre-existing foundation design).

One alternative to subexcavation and replacement would be a deep foundation system (consisting of drilled piers (caissons), helical piers, or micropiles) and a structural floor (wood, concrete, or steel) can be considered as an option to reduce the potential of slab and/or foundation movement related to expansive materials. Another option would be overexcavation and replacement on a lot-specific basis. If subexcavation is not performed, recommendations for these alternative mitigation/foundation systems are to be presented in the building-specific subsurface investigations performed once grading a development operations have been completed (but prior to construction).

The final foundation design parameters are to be determined based on lot-specific subsurface soil investigation, to be performed for each structure, prior to construction. In general, for a structure supported atop moisture-conditioned structural fill, the maximum allowable bearing pressures are anticipated to be in the range of 1,500 to 2,400 psf with minimum dead loads in the range of 800 to 1,500 psf. For a structure supported atop granular, non-expansive structural fill, the maximum allowable bearing pressures are anticipated to range from 2,000 to 2,400 psf with no minimum dead load requirement. Drilled piers are currently not recommended due to the lack of bedrock within the 35-foot test borings. If drilled piers are desired it is recommended deeper borings be performed to verify the depth of bedrock in order to determine the total length of pier.

The foundation designs should be prepared by a qualified Colorado Registered Professional Engineer using the recommendations presented in this report. This foundation system should be designed to span a minimum of 10 feet under the design loads. The bottoms of exterior foundations should be at least 30 inches below finished grade for frost protection.

The Builder/Developer understands that the requirements contained herein and in the building-specific subsurface soil investigation reports are material to the reasonably anticipated performance of the foundation system the Builder/Developer elects to install at this Project. The Builder/Developer fully accepts the risk of potential movement of the foundation system and/or floor slabs as outlined in this report and the building-specific subsurface soil investigation reports, as each foundation alternative comes with varying risks of future movement and performance, in comparison to the related costs of construction. The decision regarding which foundation system alternative to install at the residence is entirely the decision of the Builder/Developer, and not RMG.

The Builder/Developer further understands that its (or its subcontractors') failure to strictly adhere to the requirements contained in this report, the building-specific subsurface soil investigation reports, and the foundation design if provided by RMG, constitute material deviations from RMG's requirements and design, for which RMG is not responsible.

12.1 Foundation Drains

A subsurface perimeter drain is recommended around portions of the structures which will have habitable or storage space located below the finished ground surface. This includes crawlspace areas. Shallow groundwater conditions (less than 15 feet) were not encountered in the test borings performed for this study. Underslab drains are not anticipated to be required for slab-on-grade construction.

13.0 SUBEXCAVATION AND REPLACEMENT

The proposed lots within Villages at Lorson Ranch contain expansive soils and bedrock at depths that are anticipated to effect the performance of foundations, floor slabs, and roadways. It is our understanding that subexcavation and replacement with moisture-conditioned and recompacted on-site material is the preferred alternative to reduce heave risk and enhance the performance of the foundations, roadways and flatwork. This type of subexcavation and replacement is commonly utilized throughout this region and is generally considered an acceptable alternative to the typical lot-by-lot overexcavation or support atop deep foundation systems.

13.1 Subexcavation

Where subexcavation is to be performed, vegetation, organic and deleterious material shall be cleared and disposed of in accordance with applicable requirements prior to performing excavation and/or filling operations.

Subexcavation for Expansive Clay Soils:
Where clay soils are present, the subexcavation should extend to minimum depths of **5 feet** (if **granular, non-expansive** structural fill is used) or **6 feet** (if **moisture-conditioned expansive** structural fill is used) below the bottom of all proposed foundations components, and at least those same distances (laterally) beyond the proposed "buildable" area for each building.

Subexcavation for Compressible Sand Soils:
Where sand soils are present, the subexcavation should extend to a minimum depth of **2 feet** below the bottom of all proposed foundations components, and at least that same distance (laterally) beyond the proposed "buildable" area for each building.

Before the placement of structural fill, the underlying subgrade shall be scarified, moisture conditioned to within 2% of the optimum moisture content and compacted to the degree specified for the overlying fill material.

13.2 Moisture-Conditioned Structural Fill

"Mass" subexcavation or lot-specific overexcavation and replacement with moisture-conditioned (on-site) structural fill is commonly utilized throughout the region, in combination with the use of an intermittent (voided) spread-footing foundation system.

Areas to receive moisture-conditioned expansive soils used as structural fill should have topsoil, organic material, or debris removed. After subexcavation to the recommended depth below the bottom of all foundation components, the upper 6 inches of exposed soil should be scarified and moisture-conditioned to facilitate compaction (usually within 2 percent of the optimum moisture content) and compacted to a minimum of 95 percent of the maximum dry density as determined by the Standard Proctor test (ASTM D-698) or to a minimum of 92 percent of the maximum dry density as determined by the Modified Proctor test (ASTM D-1557) prior to placing structural fill.

Moisture-conditioned structural fill placed on slopes should be benched into the slope. Maximum bench heights should not exceed 4 feet, and bench widths should be wide enough to accommodate compaction equipment.

Replacement structural fill shall consist of a moisture-conditioned, on-site cohesive fill material. The fill material shall be moisture conditioned and replaced as follows:

- Fill shall be free of deleterious material and shall not contain rocks or cobbles greater than 6 inches in diameter.

- Clay fill shall be thoroughly "pulverized" and shall not contain chunks greater than 1 1/2 inches in diameter if being processed and/or placed by a loader, or not greater than 3 inches in diameter if being processed/placed as part of "mass" fill (scrapers and disking) operations.

- The moisture-conditioned materials should be placed in maximum 6" compacted lifts. These materials should be compacted to a minimum of 95 percent of the maximum dry density as determined by the Standard Proctor test (ASTM D-698).

Material not meeting the above requirements shall be reprocessed.

Materials used for moisture-conditioned structural fill should be approved by RMG prior to use. Moisture-conditioned structural fill should not be placed on frozen subgrade or allowed to freeze during moisture-conditioning and placement.

To verify the condition of the compacted soils, density tests should be performed during placement. The first density tests should be conducted when 24 inches of fill have been placed.

The existing soils will require the addition of water to achieve the required moisture content. The fill soils should be thoroughly mixed or disked to provide uniform moisture content through the fill. It should be noted that clay materials compacted at the above moisture contents are likely to result in wet, slick conditions. We recommend that the excavation contractor retained to perform this work have significant experience processing subexcavated and moisture-conditioned soils.

RMG should be contacted a minimum of 3 days prior to initiation of subexcavation and moisture conditioning processes in order to schedule appropriate field services. Fill shall not be placed on frozen subgrade or allowed to freeze during processing. The time of the year when night temperatures are above freezing are the most optimal period for a subexcavation operation.

Subexcavation and moisture-treatment of expansive soils does not "permanently" alter the fundamental characteristics of the soil. If the moisture-treated soils are allowed to remain undeveloped for an extended length of time, there will be an increased risk that the treated soils will dry out, thus remobilizing their swell potential. The subexcavation process assumes that the vast majority of the site will be either landscaped and irrigated or covered in "hardscape" within 1 year of the subexcavation. In areas where construction is not completed within this time, there is an increased likelihood that additional mitigations (up to and including overexcavation and replacement to the originally specified depth). Following completion of the subexcavation and moisture conditioning process, it is imperative that the "as-compacted" moisture content be maintained prior to construction and establishment of landscape irrigation. This may require reprocessing of materials and addition of supplemental water to prevent remobilization of swell potential within the fill.

13.3 Granular Structural Fill

Areas to receive granular (non-expansive) structural fill should have topsoil, organic material, or debris removed. The upper 6 inches of the exposed surface soils should be scarified and moisture conditioned to facilitate compaction (usually within 2 percent of the optimum moisture content) and compacted to a minimum of 95 percent of the maximum dry density as determined by the Standard Proctor test (ASTM D-698) or to a minimum of 92 percent of the maximum dry density as determined by the Modified Proctor test (ASTM D-1557) prior to placing structural fill.

Structural fill placed on slopes should be benched into the slope. Maximum bench heights should not exceed 4 feet, and bench widths should be wide enough to accommodate compaction equipment.

Structural fill shall consist of granular, non-expansive material. It should be placed in loose lifts not exceeding 8 to 12 inches, moisture conditioned to facilitate compaction (usually within 2 percent of the optimum moisture content) and compacted to a minimum of 92 percent of the maximum dry density as determined by the Modified Proctor test, ASTM D-1557. The materials should be compacted by mechanical means.

Materials used for structural fill should be approved by RMG prior to use. Structural fill should not be placed on frozen subgrade or allowed to freeze during moisture conditioning and placement.

14.0 DETENTION STORAGE CRITERIA

This section has been prepared in accordance with the requirements outlined in the El Paso County Land Development Code (LDC), the Engineering Criteria Manual (ECM) Section 2.2.6 and Appendix C.3.2.B, and the El Paso County (EPC) Drainage Criteria Manual, Volume 1 Section 11.3.3.

14.1 Soil and Rock Design Parameters

It is unknown at this time if detention ponds, retention ponds or a combination of both are proposed for the development. A site grading plan with retention/retention pond specifications has not been provided to RMG by Landhuis Company.

RMG has performed laboratory tests of soil from across the proposed development. Based upon field and laboratory testing, the following soil and rock parameters are typical for the soils likely to be encountered, and are recommended for use in detention/retention pond embankment design.

Soil Description	Unit Weight (lb/ft^3)	Friction Angle (degree)	Active Earth Pressure, Ka	Passive Earth Pressure, Kp	At Rest Earth Pressure, Ko
Clay to Sandy Clay	115	17	0.548	1.826	0.708
Silty to Clayey Sand	120	28	0.361	2.770	0.531

14.2 Detention Pond Considerations

It is uncertain if above-ground embankment construction is anticipated. All pond side slopes are to be constructed with a maximum 3:1 (horizontal:vertical) slope. Side slopes should be constructed in accordance with applicable sections of the El Paso County Engineering Criteria Manual, the El Paso County Drainage Criteria Manual, and the El Paso County Land Development Code.

15.0 ADDITIONAL STUDIES

The findings, conclusions and recommendations presented in this report were provided to evaluate the suitability of the site for future development. Unless indicated otherwise, the test borings, laboratory test results, conclusions and recommendations presented in this report are not intended for use for design and construction. **We recommend that a building-specific subsurface soil investigation be performed for each proposed structure.** The extent of any fill soils encountered during the building-specific investigation(s) should be evaluated for suitability to support the proposed structures prior to construction.

The building-specific subsurface soil investigations should consider the proposed structure type, anticipated foundation loading conditions, location within the property, and local construction methods. Recommendations resulting from the investigations should be used for design and confirmed by on-site observation and testing during development and construction.

16.0 CONCLUSIONS

Based upon our evaluation of the geologic conditions, it is our opinion that the proposed development is feasible. The geologic conditions identified (expansive soils and bedrock, compressible soils, potentially unstable slopes, seasonally fluctuating groundwater, faults/seismicity, floodplain/floodways, and radon) are not considered unusual for the Front Range region of Colorado. Mitigation of geologic conditions is most effectively accomplished by avoidance. However, where avoidance is not a practical or acceptable alternative, geologic conditions should be mitigated by implementing appropriate planning, engineering, and local construction practices.

In addition to the previously identified mitigation alternatives, surface and subsurface drainage systems should be implemented. Exterior, perimeter foundation drains should be installed around below-grade habitable or storage spaces. Surface water should be efficiently removed from the building area to prevent ponding and infiltration into the subsurface soil.

The foundation systems for all proposed structures should be designed and constructed based upon recommendations developed in a site-specific subsurface soil investigation.

Foundation selection and design should consider the potential for subsurface expansive soil-related movements. Mitigation techniques commonly used in the El Paso County area include overexcavation and replacement with structural fill, subexcavation and replacement with on-site moisture-conditioned soils, and/or the installation of deep foundation systems all of which are considered common construction practices for this area.

The foundation and floor slabs of each structure should be designed using the recommendations provided in the lot-specific subsurface soil investigation performed for each lot. In addition, appropriate surface drainage should be established during construction and maintained by each property owner.

Irrigation devices should not be placed within 5 feet of the foundation. Irrigation should be limited to the amount sufficient to maintain vegetation. Application of more water will increase the likelihood of slab and foundation movements.

Additionally, the ground surface should be sloped from the building with a minimum gradient of 10 percent for the first 10 feet. This is equivalent to 12 inches of fall across this 10-foot zone. If a 10-foot zone is not possible on the upslope side of the structure, then a well-defined swale should be created a minimum 5 feet from the foundation and sloped parallel with the wall with a minimum slope of 2 percent to intercept the surface water and transport it around and away from the structure. Roof drains should extend across backfill zones and landscaped areas to a region that is graded to direct flow away from the structure. Owners should maintain the surface grading and drainage recommended in this report to help prevent water from being directed toward and/or ponding near the foundations.

Landscaping should be selected to reduce irrigation requirements. Plants used close to foundation walls should be limited to those with low moisture requirements and irrigated grass should not be located within 5 feet of the foundation. To help control weed growth, geotextiles should be used below landscaped areas adjacent to foundations. Impervious plastic membranes are not recommended.

The recommendations listed in this report are intended to address normal surface drainage conditions, assuming the presence of groundcover (established vegetation, paved surfaces, and/or structures) throughout the regions upslope from this structure. However, groundcover may not be present due to a variety of factors (ongoing construction/development, wildfires, etc.). During periods when groundcover is not present in the "upslope" regions, higher than normal surface drainage conditions may occur, resulting in perched water tables, excess runoff, flash floods, etc. In these cases, the surface drainage recommendations presented herein (even if properly maintained) may not mitigate all groundwater problems or moisture intrusion into the structure. We recommend that the site plan be prepared with consideration of increased runoff during periods when groundcover is not present on the upslope areas.

We believe the sandy clay and claystone will classify as Type A material and the clayey sand, silty sand, silty to clayey sand, and sandstone will classify as Type C materials as defined by OSHA in 29 CFR Part 1926. OSHA requires that temporary excavations made in Type A materials be laid back at ratios no steeper than 3/4:1 (horizontal to vertical) and temporary excavations made in Type C materials be laid back at ratios no steeper than 1 1/2:1 (horizontal to vertical), unless the excavation is shored and braced. Flatter slopes will likely be necessary should groundwater conditions occur.

Long term cut slopes in the upper soil should be limited to no steeper than 3:1 (horizontal to vertical). Flatter slopes will likely be necessary should groundwater conditions occur. It is recommended that long term fill slopes be no steeper than 3:1 (horizontal to vertical).

Revisions and modifications to the conclusions and recommendations presented in this report may be issued subsequently by RMG based upon additional observations made during grading and construction which may indicate conditions that require re-evaluation of some of the criteria presented in this report.

It is important for the Owner(s) of these properties read and understand this report, as well as the previous reports referenced above, and too carefully familiarize themselves with the geologic constraints associated with construction in this area. This report only addresses the geologic constraints contained within the boundaries of the site referenced above.

17.0 CLOSING

This report is for the exclusive purpose of providing geologic hazards information and preliminary geotechnical engineering recommendations. The scope of services did not include, either specifically or by implication, evaluation of wild fire hazards, environmental assessment of the site, or identification of contaminated or hazardous materials or conditions. Development of recommendations for the mitigation of environmentally related conditions, including but not limited to, biological or toxicological issues, are beyond the scope of this report. If the owner is concerned about the potential for such contamination or conditions, other studies should be undertaken.

This report has been prepared for **Landhuis Company** in accordance with generally accepted geotechnical engineering and engineering geology practices. The conclusions and recommendations in this report are based in part upon data obtained from review of available topographic and geologic maps,

review of available reports of previous studies conducted in the site vicinity, a site reconnaissance, and research of available published information, soil test borings, soil laboratory testing, and engineering analyses. The nature and extent of variations may not become evident until construction activities begin. If variations then become evident, RMG should be retained to re-evaluate the recommendations of this report, if necessary.

Our professional services were performed using that degree of care and skill ordinarily exercised, under similar circumstances, by geotechnical engineers and engineering geologists practicing in this or similar localities. RMG does not warrant the work of regulatory agencies or other third parties supplying information which may have been used during the preparation of this report. No warranty, express or implied, is made by the preparation of this report. Third parties reviewing this report should draw their own conclusions regarding site conditions and specific construction techniques to be used on this project.

If we can be of further assistance in discussing the contents of this report or analysis of the proposed development, from a geotechnical engineering point-of-view, please feel free to contact us.

FIGURES

NOT TO SCALE

ARCHITECTS RMG ENGINEERS
ROCKY MOUNTAIN GROUP

Southern Office
Colorado Springs,CO 80919
(719) 548-0600
Central Office:
Englewood, CO 80112
(303) 688-9475
Northern Office:
Windsor, CO 80620
(970) 330-1071

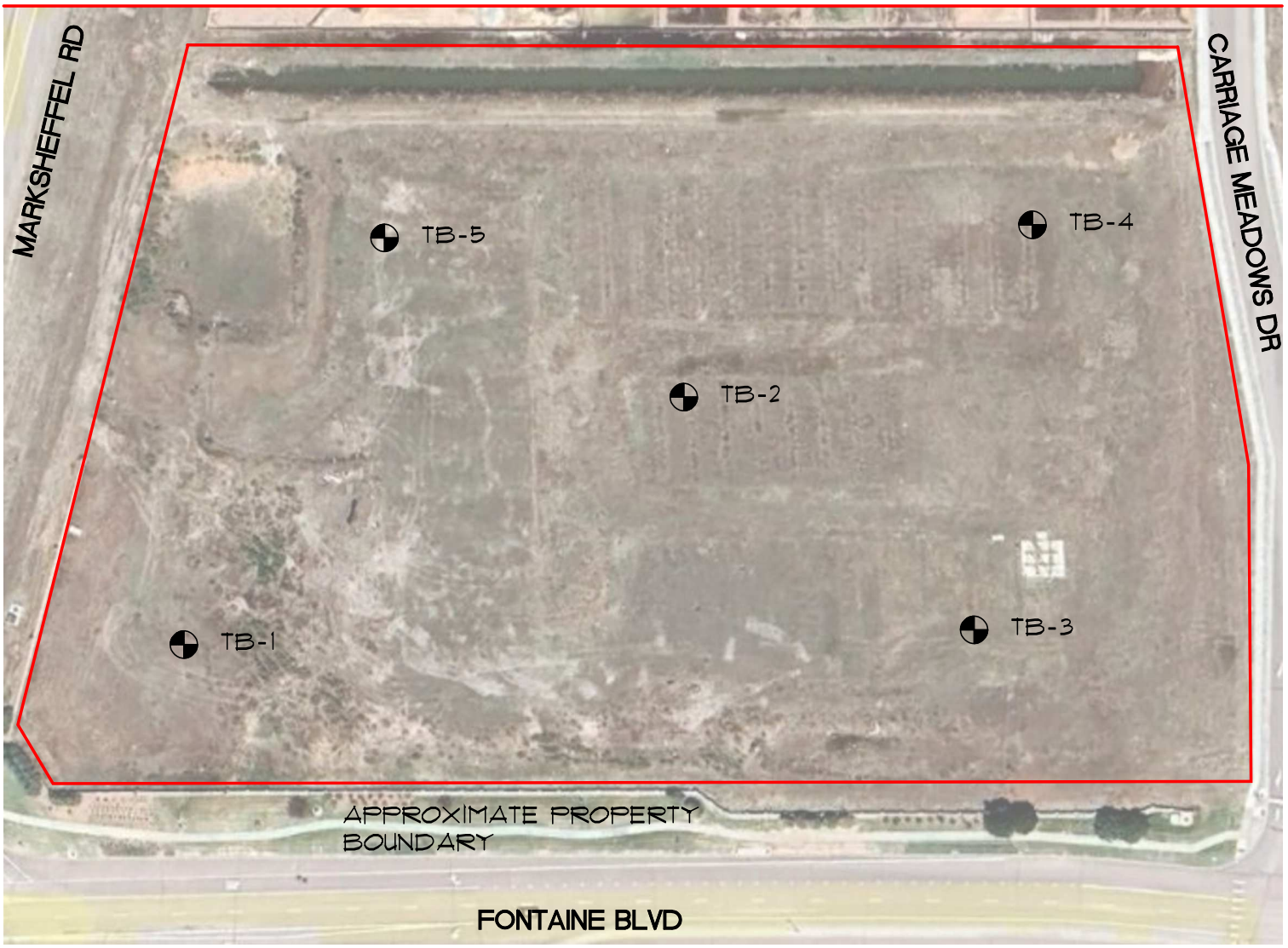
SITE VICINITY MAP

VILLAGES AT LORSON RANCH
NW CORNER OF MARKSHEFFEL RD AND FONTAINE BLVD
TRACT D, CARRAIGE MEADOWS NORTH FILING NO. 1, EL PASO COUNTY, CO
LANDHUIS COMPANY

JOB No. 195914

FIG No. 1

DATE 4-5-2024



NOT TO SCALE

DENOTES APPROXIMATE LOCATION OF TEST BORINGS

ARCHITECTS RMG ENGINEERS
ROCKY MOUNTAIN GROUP

Southern Office
Colorado Springs,CO 80919
(719) 548-0600
Central Office:
Englewood, CO 80112
(303) 688-9475
Northern Office:
Windsor, CO 80620
(970) 330-1071

TEST BORING LOCATION PLAN

VILLAGES AT LORSON RANCH
NW CORNER OF MARKSHEFFEL RD AND FONTAINE BLVD
TRACT D, CARRAIGE MEADOWS NORTH FILING NO. 1, EL PASO COUNTY, CO
LANDHUIS COMPANY

JOB No. 195914

FIG No. 2

DATE 4-5-2024

SOILS DESCRIPTION


CLAYEY SAND


FILL: SAND, SILTY TO CLAYEY


SANDY CLAY


SILTY SAND


SILTY TO CLAYEY SAND

UNLESS NOTED OTHERWISE, ALL LABORATORY
TESTS PRESENTED HEREIN WERE PERFORMED BY:
RMG - ROCKY MOUNTAIN GROUP
2910 AUSTIN BLUFFS PARKWAY
COLORADO SPRINGS, COLORADO

SYMBOLS AND NOTES


XX — STANDARD PENETRATION TEST - MADE BY DRIVING A SPLIT-BARREL SAMPLER INTO THE SOIL BY DROPPING A 140 LB. HAMMER 30", IN GENERAL ACCORDANCE WITH ASTM D-1586. NUMBER INDICATES NUMBER OF HAMMER BLOWS PER FOOT (UNLESS OTHERWISE INDICATED).


XX — UNDISTURBED CALIFORNIA SAMPLE - MADE BY DRIVING A RING-LINED SAMPLER INTO THE SOIL BY DROPPING A 140 LB. HAMMER 30", IN GENERAL ACCORDANCE WITH ASTM D-3550. NUMBER INDICATES NUMBER OF HAMMER BLOWS PER FOOT (UNLESS OTHERWISE INDICATED).


FREE WATER TABLE


DEPTH AT WHICH BORING CAVED


BULK — DISTURBED BULK SAMPLE


AUG — AUGER "CUTTINGS"

4.5 — WATER CONTENT (%)

ROCKY MOUNTAIN GROUP

Architectural
Structural
Forensics

Engineers / Architects

Geotechnical
Materials Testing
Civil, Planning

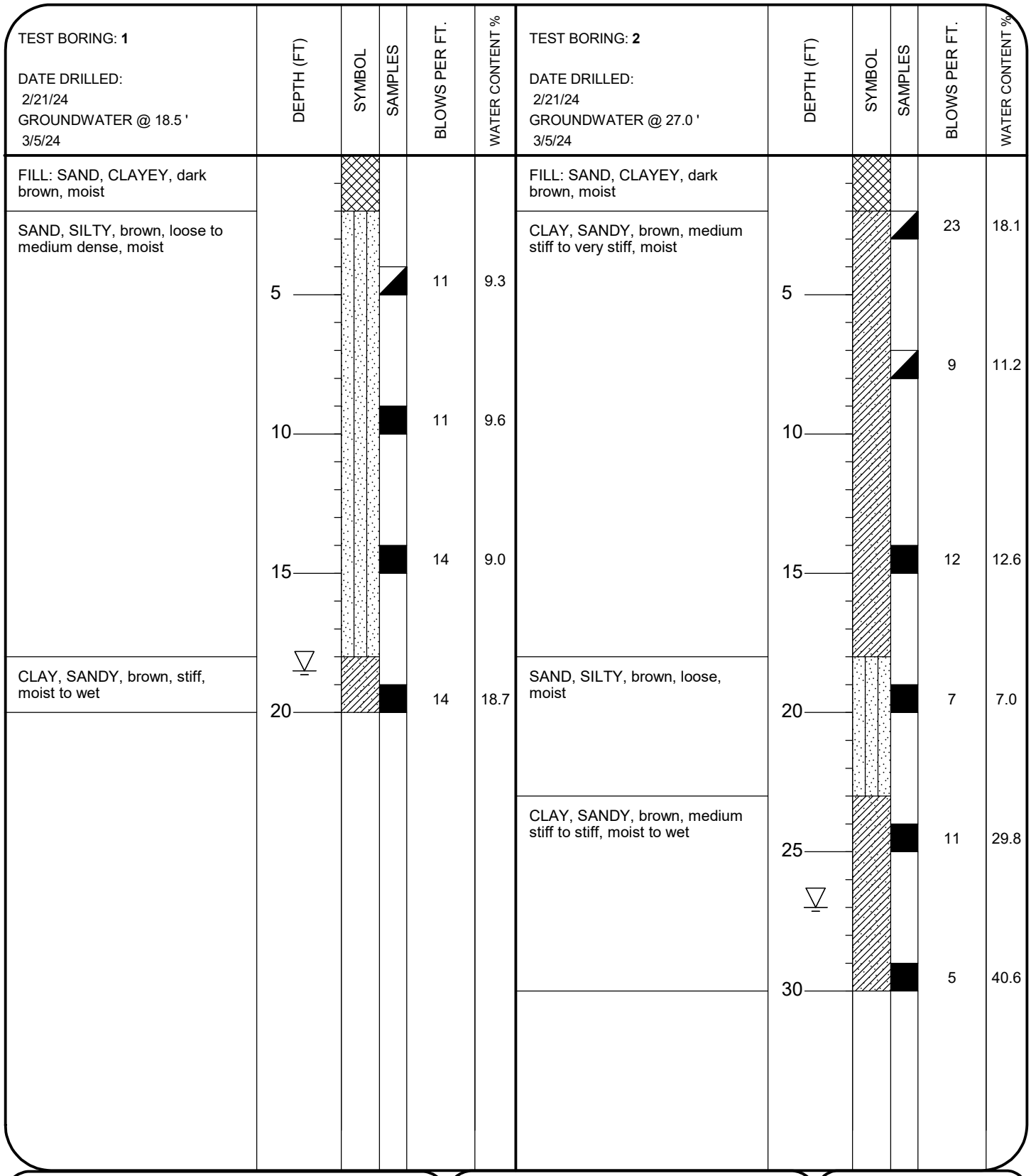
Colorado Springs: (Corporate Office)
2910 Austin Bluffs Parkway
Colorado Spings, CO 80918
(719) 548-0600
SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

EXPLANATION OF TEST BORING LOGS

JOB No. 195914

FIGURE No. 3

DATE Apr/05/2024



ROCKY MOUNTAIN GROUP

Architectural
Structural
Forensics

RMG
Engineers / Architects

Geotechnical
Materials Testing
Civil, Planning

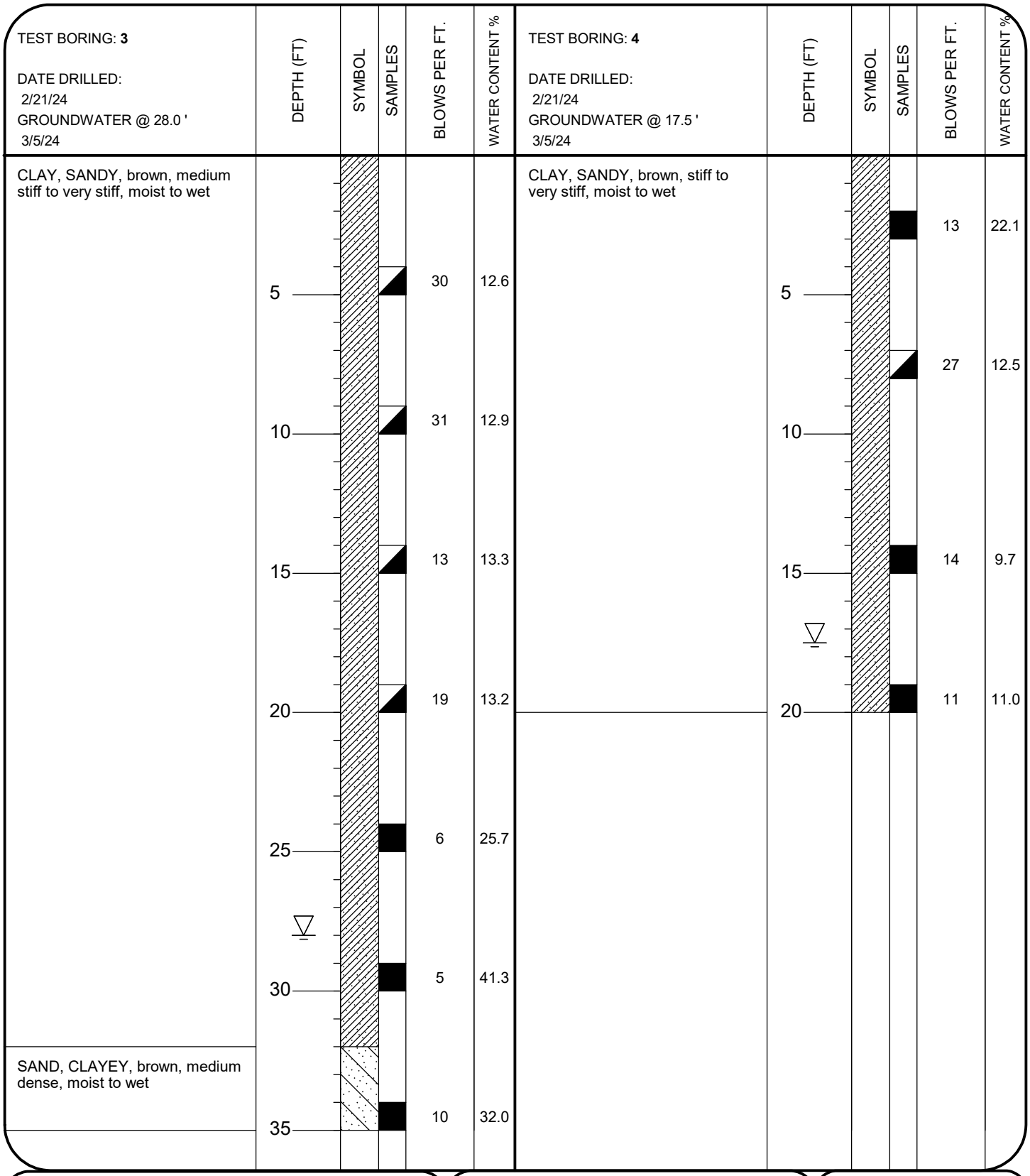
SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

TEST BORING LOG

JOB No. 195914

FIGURE No. 4

DATE Apr/05/2024



ROCKY MOUNTAIN GROUP

Architectural
Structural
Forensics

RMG
Engineers / Architects

Geotechnical
Materials Testing
Civil, Planning

SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

TEST BORING LOG

JOB No. 195914

FIGURE No. 5

DATE Apr/05/2024

TEST BORING: **5**

DATE DRILLED:
2/21/24
GROUNDWATER @ 27.5 '
3/5/24

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
SAND, SILTY TO CLAYEY, with gravel, brown, loose to medium dense, moist to wet				
5			8	5.2
10			12	11.6
15			11	8.8
20			14	20.1
25			26	4.5
▽				
30			15	16.4
35			16	14.8

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TEST BORING LOG

JOB No. 195914

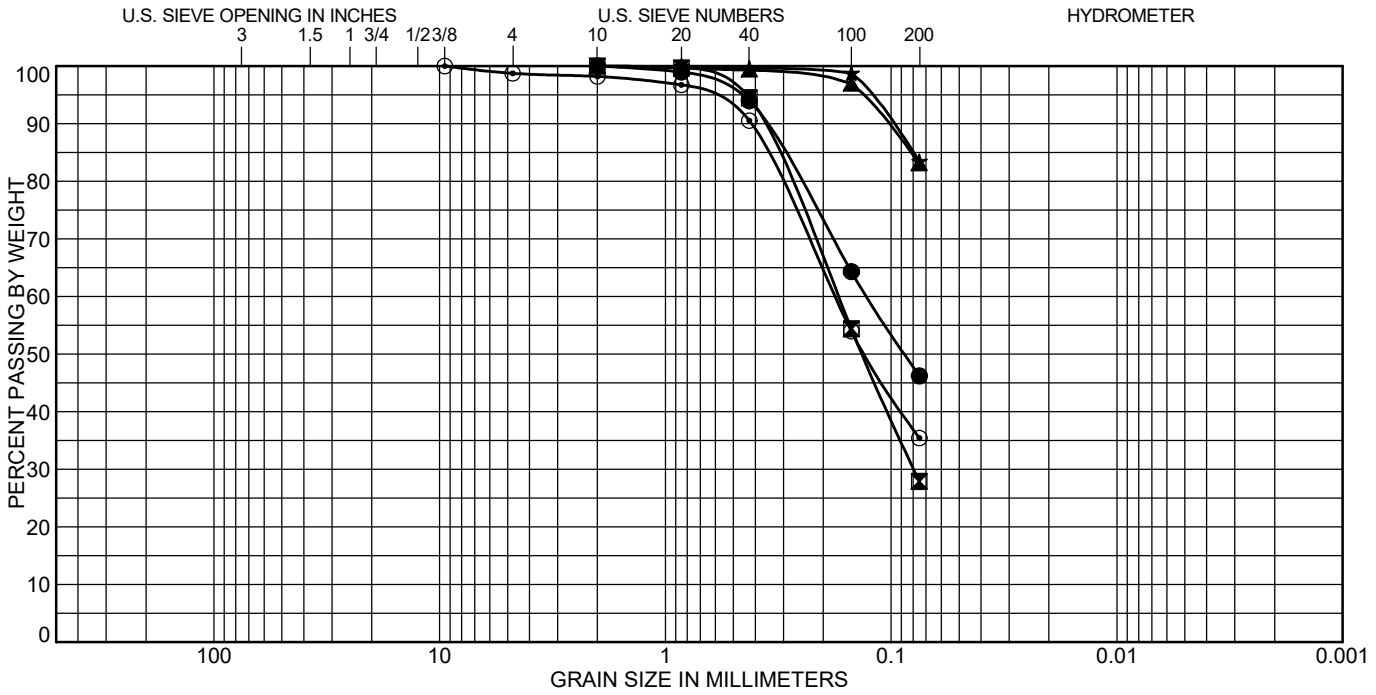
FIGURE No. 6

DATE Apr/05/2024

Test Boring No.	Depth	Water Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% Retained No.4 Sieve	% Passing No. 200 Sieve	Load at Saturation (psf)	% Swell/ Collapse	USCS Classification
1	4.0	9.3	93.6	NP	NP	0.0	46.2	1,000	- 0.9	SM
1	9.0	9.6								
1	14.0	9.0								
1	19.0	18.7								
2	2.0	18.1	101.6	62	38			1,000	3.6	
2	7.0	11.2	88.3					1,000	- 4.2	
2	14.0	12.6								
2	19.0	7.0		NP	NP	0.0	27.9			SM
2	24.0	29.8								
2	29.0	40.6		49	20	0.0	83.0			ML
3	4.0	12.6								
3	9.0	12.9	115.2					1,000	3.7	
3	14.0	13.3	109.6	38	24	0.0	83.5	1,000	1.4	CL
3	19.0	13.2	109.3					1,000	1.1	
3	24.0	25.7								
3	29.0	41.3								
3	34.0	32.0				1.3	35.4			
4	2.0	22.1								
4	7.0	12.5	117.8	45	28		76.0	1,000	5.0	CL
4	14.0	9.7								
4	19.0	11.0		37	22		81.9			CL
5	4.0	5.2		NP	NP	0.0	18.9			SM
5	9.0	11.6								
5	14.0	8.8								
5	19.0	20.1								
5	24.0	4.5		NP	NP					
5	29.0	16.4		NP	NP	7.6	7.1			SW-SM
5	34.0	14.8		NP	NP					

SUMMARY OF LABORATORY TEST RESULTS

JOB No. 195914
FIGURE No. 7
PAGE 1 OF 1
DATE Apr/05/2024



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Test Boring	Depth (ft)	Classification	LL	PL	PI
●	1	4.0	**SILTY SAND(SM)**	**NP**	**NP**	**NP**
⊠	2	19.0	**SILTY SAND(SM)**	**NP**	**NP**	**NP**
▲	2	29.0	**SILT with SAND(ML)**	**49**	**29**	**20**
★	3	14.0	**LEAN CLAY with SAND(CL)**	**38**	**14**	**24**
⊙	3	34.0				

	Test Boring	Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	1	4.0	**0.0**	**53.8**	**46.2**	
⊠	2	19.0	**0.0**	**72.1**	**27.9**	
▲	2	29.0	**0.0**	**17.0**	**83.0**	
★	3	14.0	**0.0**	**16.5**	**83.5**	
⊙	3	34.0	**1.3**	**63.3**	**35.4**	

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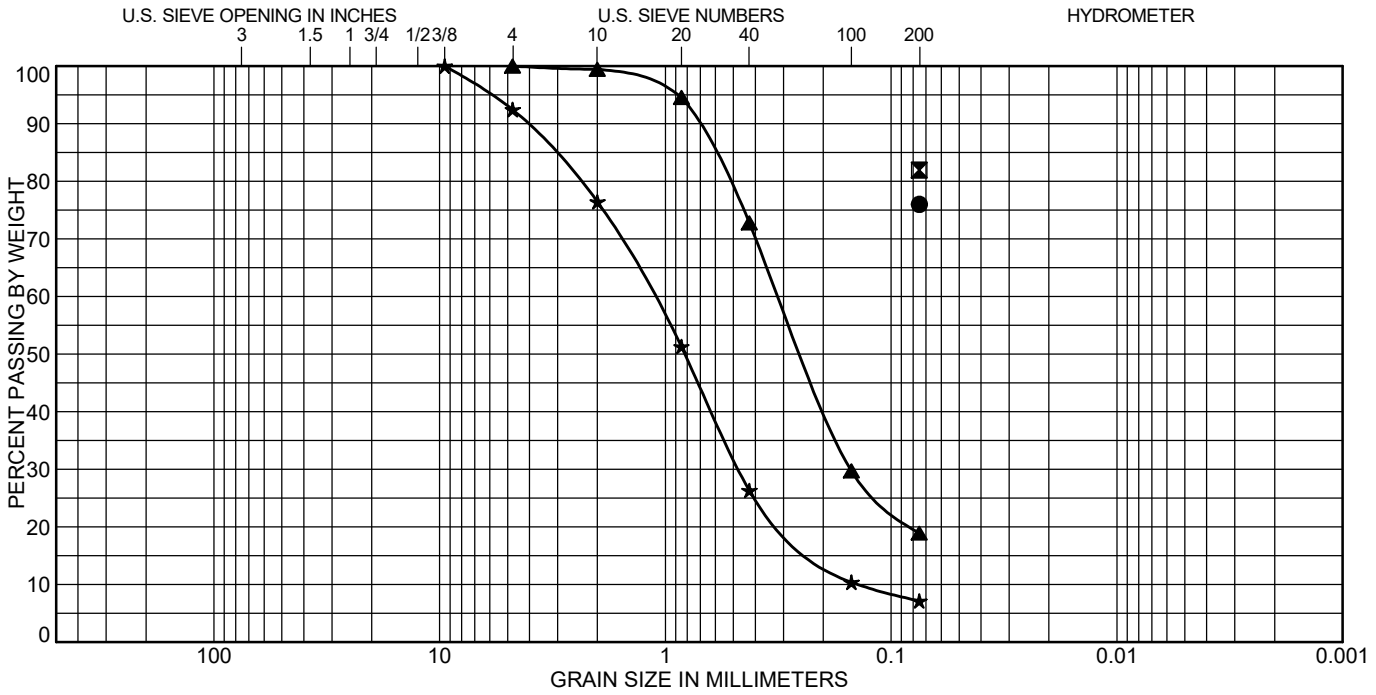
SOIL CLASSIFICATION DATA

JOB No. 195914

FIGURE No. 8

DATE Apr/05/2024



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Test Boring	Depth (ft)	Classification	LL	PL	PI
●	4	7.0	LEAN CLAY with SAND(CL)	45	17	28
⧓	4	19.0	LEAN CLAY with SAND(CL)	37	15	22
▲	5	4.0	SILTY SAND(SM)	NP	NP	NP
★	5	29.0	WELL-GRADED SAND with SILT(SW-SM)	NP	NP	NP

	Test Boring	Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	4	7.0			76.0	
⧓	4	19.0			81.9	
▲	5	4.0	0.0	81.1	18.9	
★	5	29.0	7.6	85.3	7.1	

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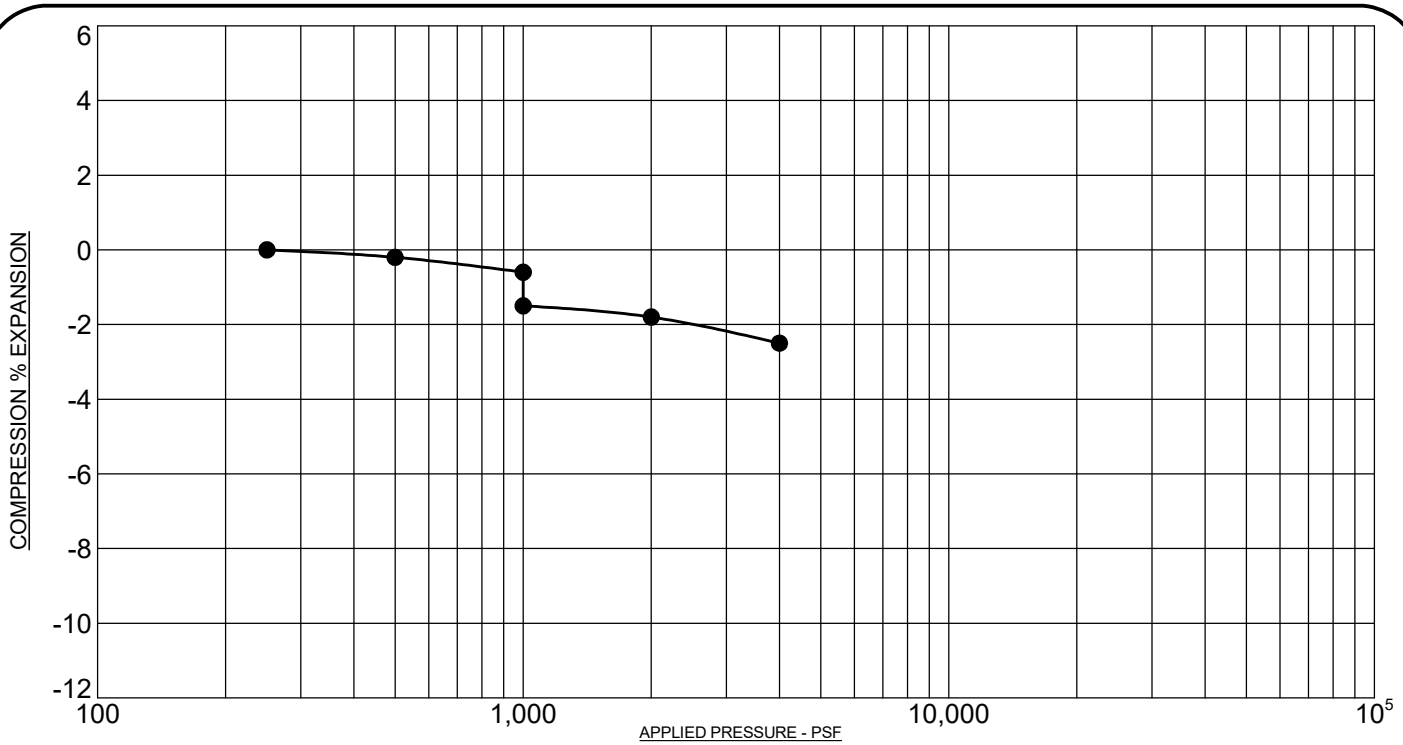
SOIL CLASSIFICATION DATA

JOB No. 195914

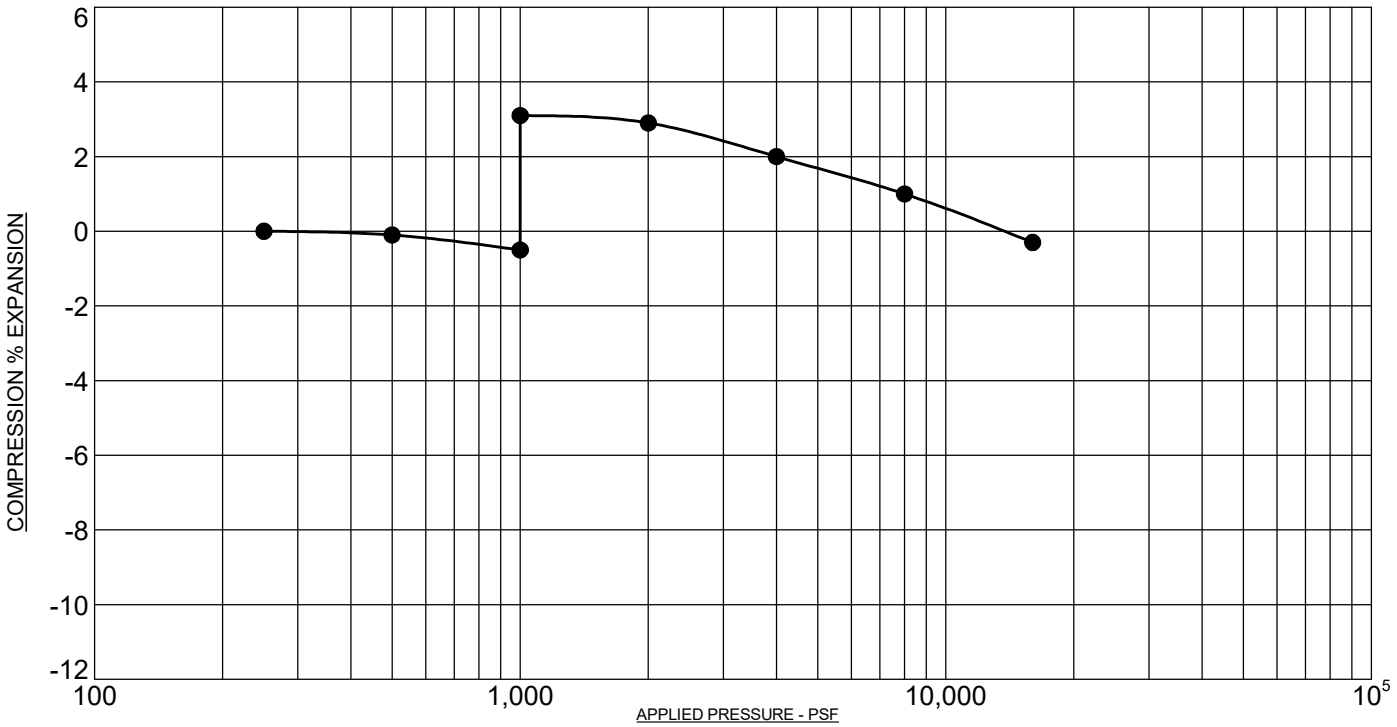
FIGURE No. 9

DATE Apr/05/2024



PROJECT: **Carriage Meadows North, Filing No. 1, El Paso County, Colorado**
SAMPLE DESCRIPTION: **SAND, SILTY**
NOTE: SAMPLE WAS INUNDATED WITH WATER AT 1,000 PSF

SAMPLE LOCATION: **1 @ 4 FT**
NATURAL DRY UNIT WEIGHT: **93.6 PCF**
NATURAL MOISTURE CONTENT: **9.3%**
PERCENT SWELL/COMPRESSION: **- 0.9**



PROJECT: **Carriage Meadows North, Filing No. 1, El Paso County, Colorado**
SAMPLE DESCRIPTION: **CLAY, SANDY**
NOTE: SAMPLE WAS INUNDATED WITH WATER AT 1,000 PSF

SAMPLE LOCATION: **2 @ 2 FT**
NATURAL DRY UNIT WEIGHT: **101.6 PCF**
NATURAL MOISTURE CONTENT: **18.1%**
PERCENT SWELL/COMPRESSION: **3.6**

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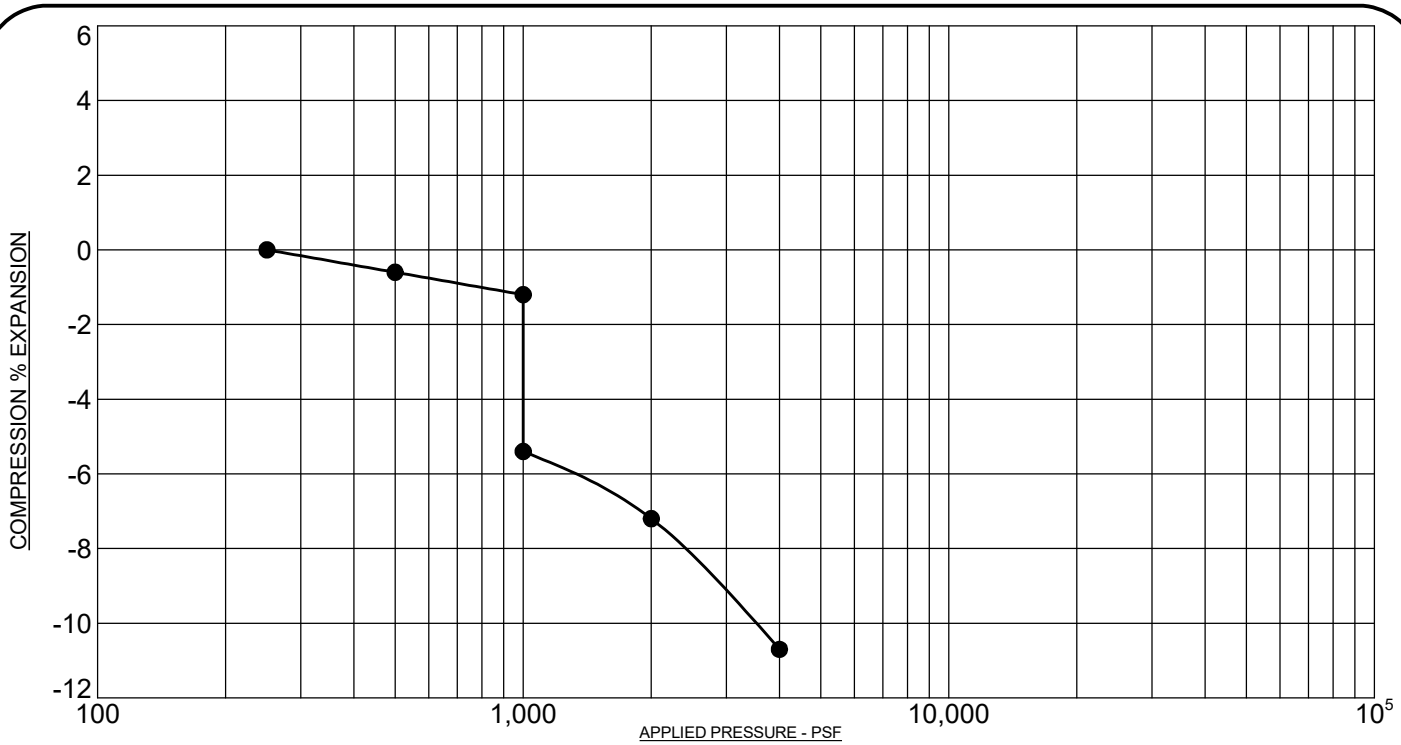
SWELL/CONSOLIDATION TEST RESULTS

JOB No. 195914

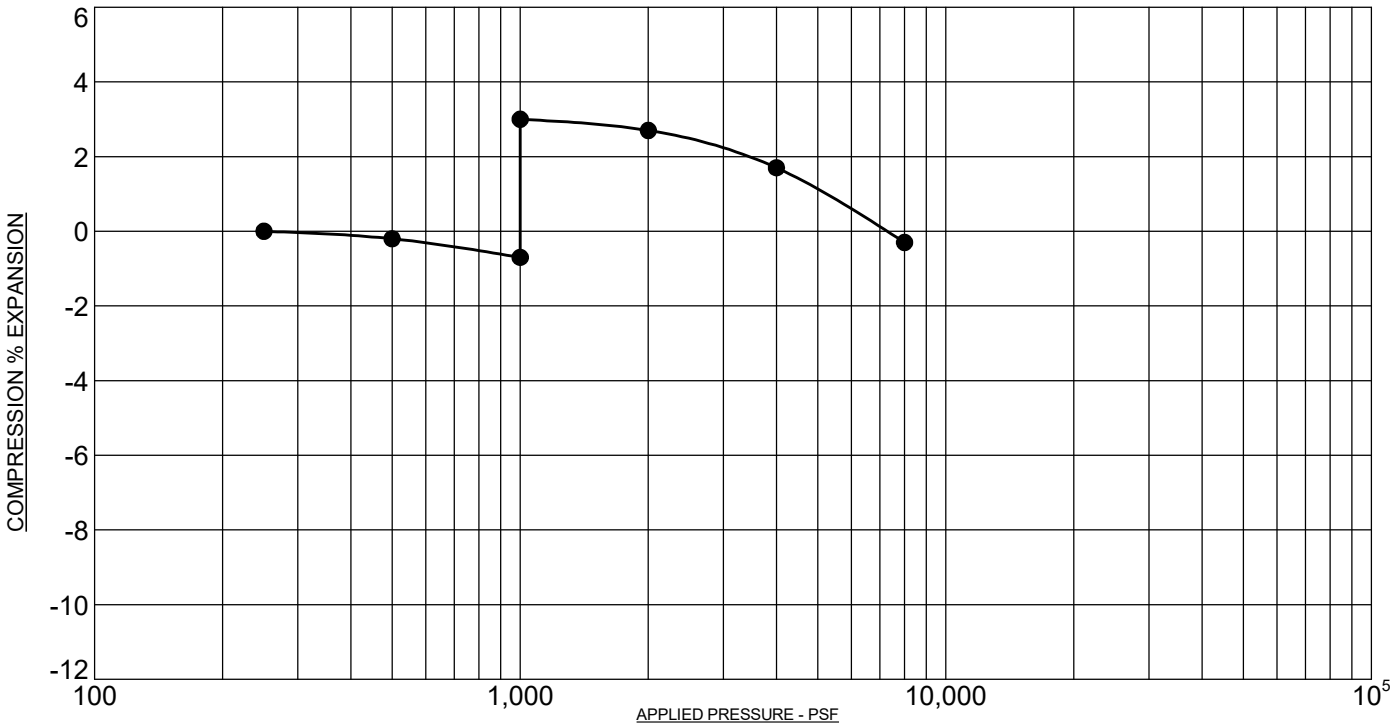
FIGURE No. 10

DATE Apr/05/2024



PROJECT: **Carriage Meadows North, Filing No. 1, El Paso County, Colorado**
SAMPLE DESCRIPTION: **CLAY, SANDY**
NOTE: SAMPLE WAS INUNDATED WITH WATER AT 1,000 PSF

SAMPLE LOCATION: **2 @ 7 FT**
NATURAL DRY UNIT WEIGHT: **88.3 PCF**
NATURAL MOISTURE CONTENT: **11.2%**
PERCENT SWELL/COMPRESSION: **- 4.2**



PROJECT: **Carriage Meadows North, Filing No. 1, El Paso County, Colorado**
SAMPLE DESCRIPTION: **CLAY, SANDY**
NOTE: SAMPLE WAS INUNDATED WITH WATER AT 1,000 PSF

SAMPLE LOCATION: **3 @ 9 FT**
NATURAL DRY UNIT WEIGHT: **115.2 PCF**
NATURAL MOISTURE CONTENT: **12.9%**
PERCENT SWELL/COMPRESSION: **3.7**

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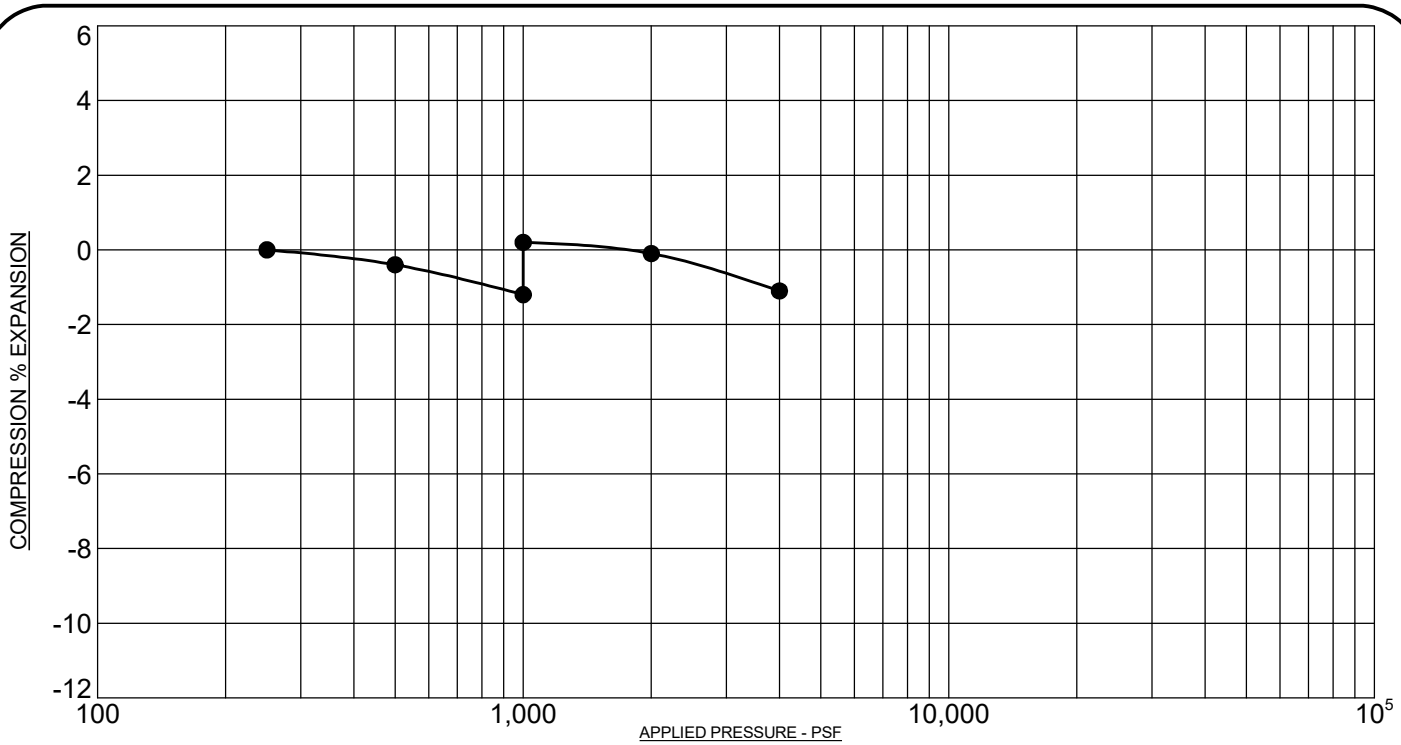
SWELL/CONSOLIDATION TEST RESULTS

JOB No. 195914

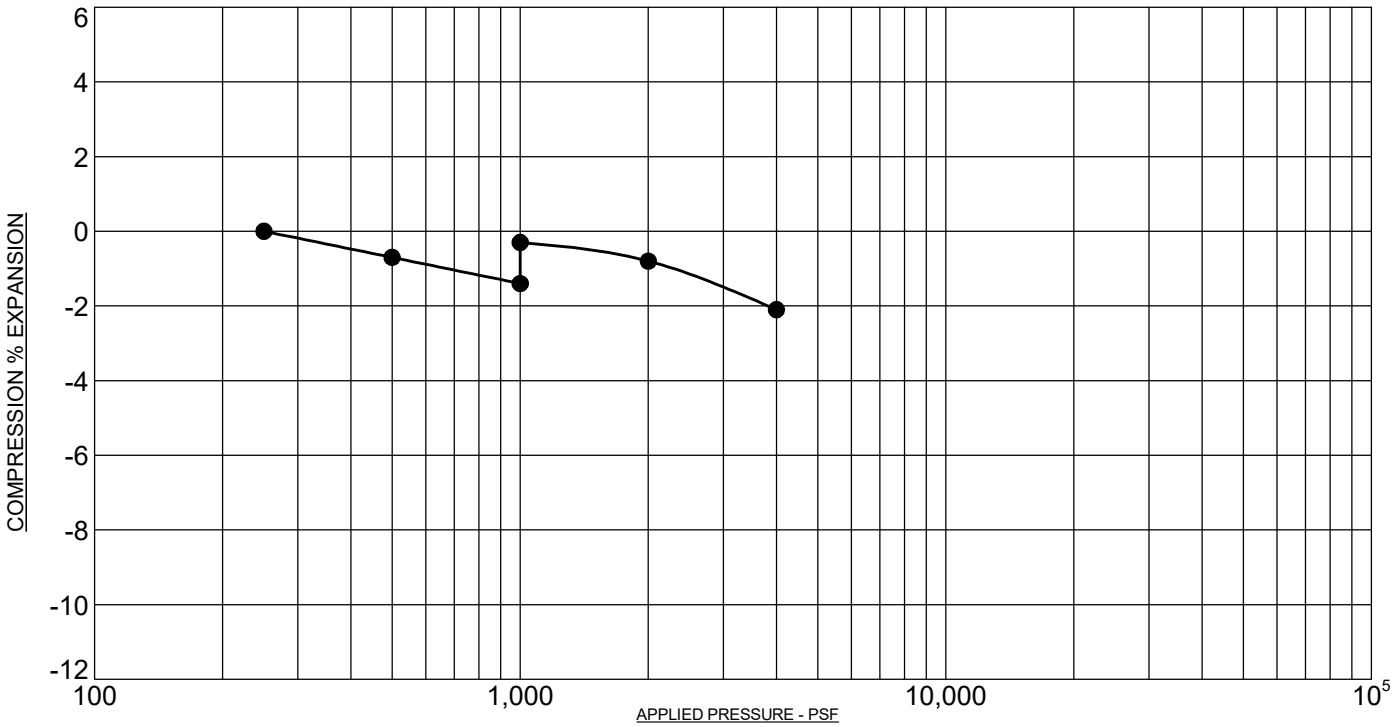
FIGURE No. 11

DATE Apr/05/2024



PROJECT: **Carriage Meadows North, Filing No. 1, El Paso County, Colorado**
SAMPLE DESCRIPTION: **CLAY, SANDY**
NOTE: SAMPLE WAS INUNDATED WITH WATER AT 1,000 PSF

SAMPLE LOCATION: **3 @ 14 FT**
NATURAL DRY UNIT WEIGHT: **109.6 PCF**
NATURAL MOISTURE CONTENT: **13.3%**
PERCENT SWELL/COMPRESSION: **1.4**



PROJECT: **Carriage Meadows North, Filing No. 1, El Paso County, Colorado**
SAMPLE DESCRIPTION: **CLAY, SANDY**
NOTE: SAMPLE WAS INUNDATED WITH WATER AT 1,000 PSF

SAMPLE LOCATION: **3 @ 19 FT**
NATURAL DRY UNIT WEIGHT: **109.3 PCF**
NATURAL MOISTURE CONTENT: **13.3%**
PERCENT SWELL/COMPRESSION: **1.1**

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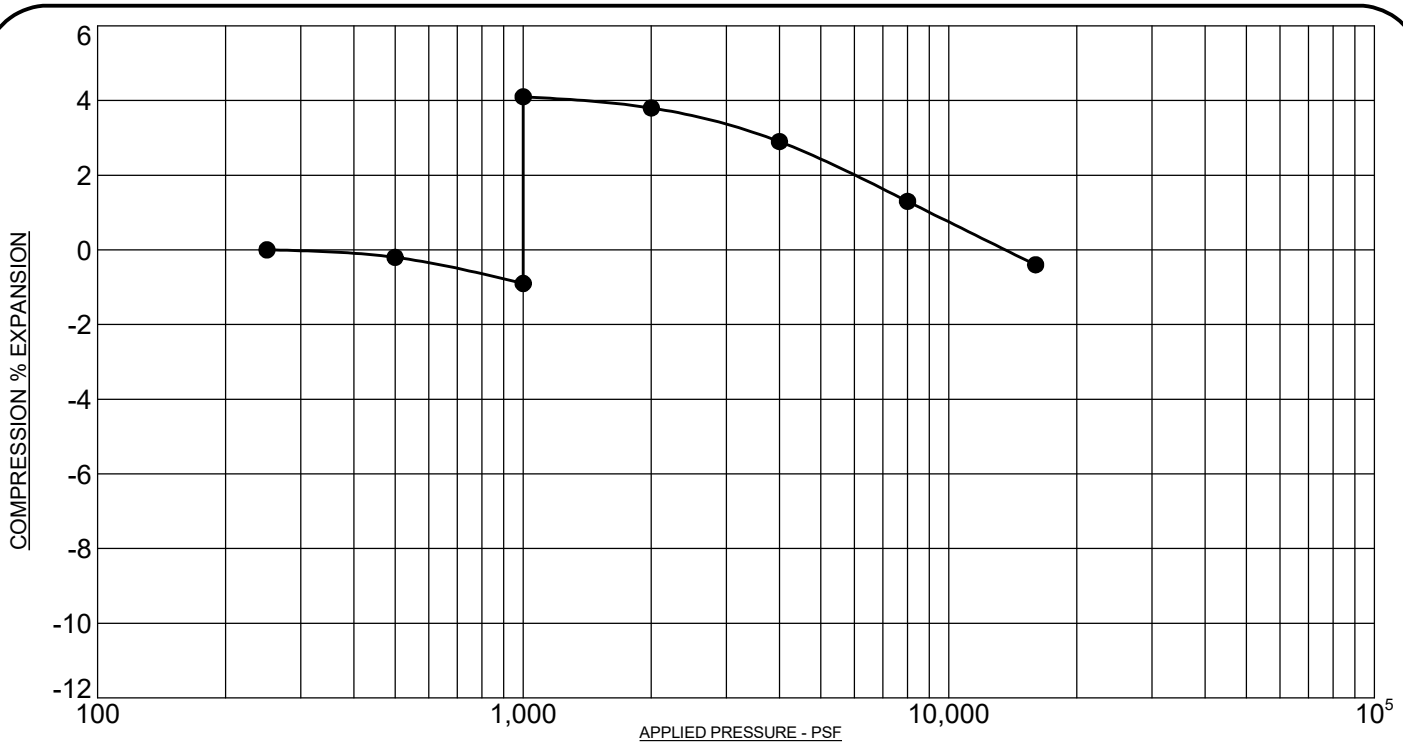
SWELL/CONSOLIDATION TEST RESULTS

JOB No. 195914

FIGURE No. 12

DATE Apr/05/2024



PROJECT: **Carriage Meadows North, Filing No. 1, El Paso County, Colorado**
SAMPLE DESCRIPTION: **CLAY, SANDY**
NOTE: SAMPLE WAS INUNDATED WITH WATER AT 1,000 PSF

SAMPLE LOCATION: **4 @ 7 FT**
NATURAL DRY UNIT WEIGHT: **117.8 PCF**
NATURAL MOISTURE CONTENT: **12.5%**
PERCENT SWELL/COMPRESSION: **5.0**

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SWELL/CONSOLIDATION TEST RESULTS

JOB No. 195914

FIGURE No. 13

DATE Apr/05/2024

12 - Bresser sandy loam, cool, 3 to 5% slopes

82 - Schamber - Razor complex, 8 to 50 percent slopes

NOT TO SCALE

BASE MAP PROVIDED BY: USDA

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Northern Office:
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(970) 330-1071

USDA SOIL SURVEY MAP

VILLAGES AT LORSON RANCH
NW CORNER OF MARKSHEFFEL RD AND FONTAINE BLVD
TRACT D, CARRAIGE MEADOWS NORTH FILING NO. 1, EL PASO COUNTY, CO
LANDHUIS COMPANY

JOB No. 195914

FIG No. 14

DATE 4-5-2024

NOT TO SCALE

BASE MAP PROVIDED BY: FEMA

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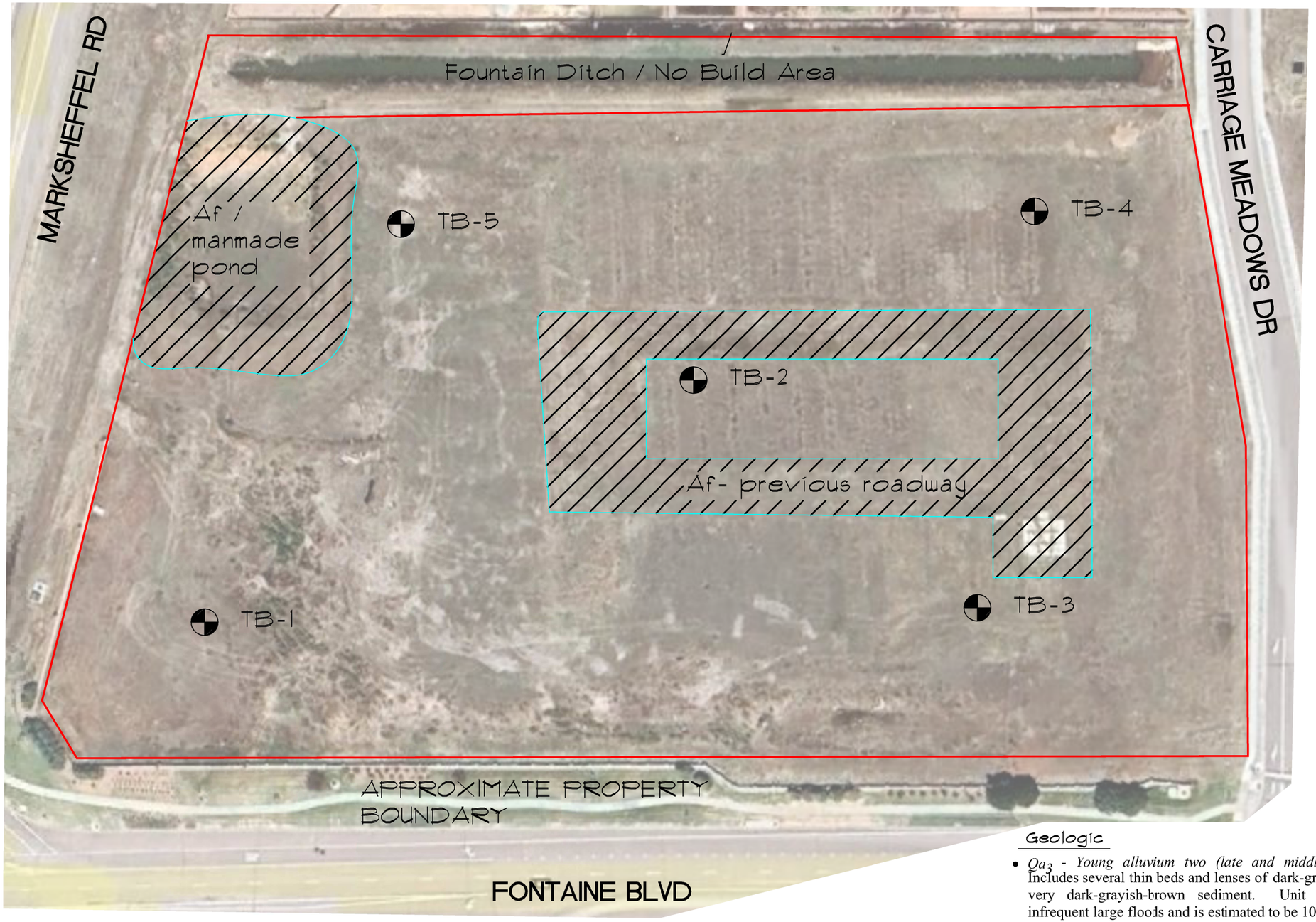
FEMA MAP

VILLAGES AT LORSON RANCH
NW CORNER OF MARKSHEFFEL RD AND FONTAINE BLVD
TRACT D, CARRAIGE MEADOWS NORTH FILING NO. 1, EL PASO COUNTY, CO
LANDHUIS COMPANY

JOB No. 195914

FIG No. 15

DATE 4-5-2024



NOT TO SCALE

DENOTES APPROXIMATE LOCATION OF TEST BORING PERFORMED FOR THIS INVESTIGATION

Areas included in this investigation

Areas where man-placed fill may be encountered from previous roadway, temporary structures, man-made pond

Engineering

- 1A - Stable alluvium, colluvium and bedrock on flat to gentle slopes (0-5%).

.

Geologic

- Qa_3 - *Young alluvium two (late and middle? Holocene)* Includes several thin beds and lenses of dark-grayish-brown to very dark-grayish-brown sediment. Unit is subject to infrequent large floods and is estimated to be 10-20 feet thick.
- *Kp - Pierre Shale, Main part of formation* - Shale, minor siltstone and sandstone beds, and thin concretionary limestone beds; marine fossils in some beds; mostly dark to light gray and olive gray. Poorly exposed in general. Unit is about 1,200 feet exposed in Elsmere quadrangle. Total formation thickness is about 5,000 feet.
- Af - Artificial Fill
- Fountain Ditch = No Build Area

JOB No. 195372

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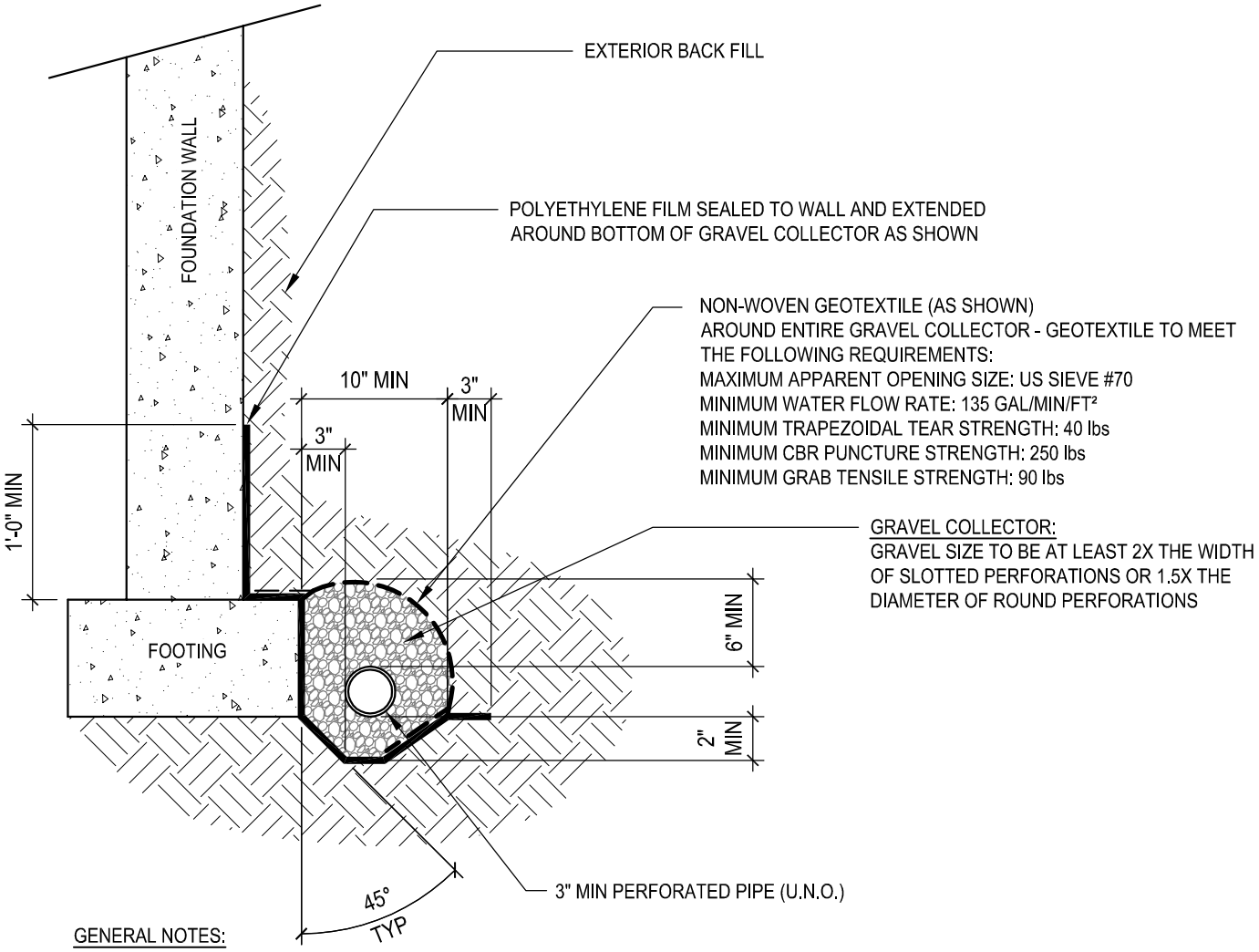
(970) 330-1071
Woodland Park Office:
(719) 687-6077
Monument Office:
(719) 488-2145
Pueblo / Canon City:
(719) 544-7750

VILLAGES AT LORSON RANCH
NW CORNER OF MARKSHEFFEL RD AND FONTAINE BLVD
TRACT D, CARRAIGE MEADOWS NORTH
FILING NO. 1, EL PASO COUNTY, CO
LANDHUIS COMPANY

ENGINEER: TM
DRAWN BY: KZ
CHECKED BY: TM
ISSUED: 4-5-2024

ENGINEERING AND GEOLOGY MAP

SHEET No.
FIG-16



GENERAL NOTES:

1. BOTTOM OF DRAIN PIPE SHALL BE AT OR BELOW BOTTOM OF FOOTING AT ALL LOCATIONS
2. ALL DRAIN PIPE SHALL BE PERFORATED PLASTIC, WITH THE EXCEPTION OF THE DISCHARGE PORTION WHICH SHALL BE SOLID, NON-PERFORATED PIPE.
3. DRAIN PIPE SHALL HAVE POSITIVE FALL THROUGHOUT.
4. DRAIN PIPE SHALL BE PROVIDED WITH A FREE GRAVITY OUTFALL, IF POSSIBLE. IF A GRAVITY OUTFALL CANNOT BE ACHIEVED, THEN A SUMP PIT AND PUMP SHALL BE USED. THE OUTFALL SHOULD EXTEND PAST BACKFILL ZONES AND DISCHARGE TO A LOCATION THAT IS GRADED TO DIRECT WATER OFF-SITE.
5. ALL DRAIN COMPONENTS SHALL BE RATED/APPROVED BY THE MANUFACTURER FOR THE INSTALLED DEPTH AND APPLICATION
6. DRAIN SYSTEM, INCLUDING THE OUTFALL OF THE DRAIN, SHALL BE OBSERVED BY QUALIFIED PERSONNEL PRIOR TO BACKFILLING TO VERIFY INSTALLATION.
7. A VERTICAL SEGMENT OF PERFORATED DRAIN PIPE, CAPPED AT THE TOP, SHALL EXTEND TO FINISH GRADE WITHIN ALL WINDOW WELLS.

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PERIMETER DRAIN

FIG No. 17

APPENDIX A
Additional Reference Documents

1. *Subsurface Soil Investigation, Lots 1-49, Carriage Meadows South at Lorson Ranch, Filing No. 2, El Paso County, Colorado*, prepared by RMG – Rocky Mountain Group, Job No. 177446, dated August 24, 2020.
2. *Subsurface Soil Investigation, Lots 1-20, 51-67, and 128-150, Carriage Meadows South at Lorson Ranch, Filing No. 2, El Paso County, Colorado*, prepared by RMG – Rocky Mountain Group, Job No. 162055, dated October 1, 2018.
3. *Subsurface Soil Investigation, Lots 21-50, 68-127, and 151-234, Carriage Meadows South at Lorson Ranch, Filing No. 2, El Paso County, Colorado*, prepared by RMG – Rocky Mountain Group, Job No. 161618, dated April 26, 2018.
4. *Subsurface Soil Investigation, Lots 1-27, 53-67, 69-92, 113-120, and 153-155, Carriage Meadows South at Lorson Ranch, Filing No. 1, El Paso County, Colorado*, prepared by RMG – Rocky Mountain Group, Job No. 167750, dated February 5, 2019.
5. *Flood Insurance Rate Map, El Paso County, Colorado and Unincorporated Areas, Community Panel No. 08041C0957G,* Federal Emergency Management Agency (FEMA), effective December 7, 2018. https://msc.fema.gov/portal/home.
6. *Geologic Map of the Fountain Quadrangle, El Paso County, Colorado, b*y White, J.L. Lindsey, K.O. Morgan, M.L., and Mahan, S.S., 2002.
7. *Environmental and Engineering Geologic Map for Land Use*, compiled by Dale M. Cochran, Charles S. Robinson & Associates, Inc., Golden, Colorado, 1977.
8. *Map of Potential Geologic Hazards and Surficial Deposits*, compiled by Dale M. Cochran, Charles S. Robinson & Associates, Inc., Golden, Colorado, 1977.
9. *Reconnaissance Geologic Map of Colorado Springs and Vicinity, Colorado,* Department of the Interior United State Geologic Survey, prepared by Glenn R. Scott and Reinhord A. Wobus, Miscellaneous Field Studies, Map MF-482, Sheets 1 and 2, 1973.
10. *El Paso County, Master Plan for Mineral Extraction,* dated February 8, 1996.
11. *Evaluation of Mineral and Mineral Fuel Potential of El Paso County State Mineral Lands Administered by the Colorado State Land Board,* prepared by Colorado Geological Survey, dated February 19, 2003, Open-file Report OF-03-07.
12. *USDA – Natural Resources Conservation Service, Web Soil Survey* https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx
13. *Colorado Springs Landslide Susceptibility, Colorado Geological Survey:* https://cologeosurvey.maps.arcgis.com/apps/webappviewer/index.html?id=5e7484a637c4432e84f4f16d0af306d3
14. *Colorado Landslide Inventory, Colorado Geological Survey:* https://cologeosurvey.maps.arcgis.com/apps/webappviewer/index.html?id=9dd73db7fbc34139abe51599396e2648.
15. *Pikes Peak Regional Building Department:* https://www.pprbd.org/.
16. *City of Colorado Springs, Subdivision Document Viewer:* http://www.springsgov.com/SubDivView/default.asp?cmdGoBack=New+Search....
17. *El Paso County Assessor, El Paso County, Colorado:*
https://property.spatialest.com/co/elpaso/#/property/5515413054
18. *Colorado Geological Survey, USGS Geologic Map Viewer*: http://coloradogeologicalsurvey.org/geologic-mapping/6347-2/.

19. *Historical Aerials:* https://www.historicaerials.com/viewer, Images dated 1947, 1955, 1960, 1969, 1983, 1999, 2005, 2009, 2011, 2013, 2015, 2017, 2019, and 2021.
20. *USGS Historical Topographic Map Explorer:* http://historicalmaps.arcgis.com/usgs/ Images dated 1950, 1951, 1956, 1657, 1963, 1966, 1970, 1974, 1977, 1994, 2001, 2013 and 2013.
21. *Google Earth Pro*, Imagery dated 1999, 2003, 2004, 2005, 2006, 2011, 2015, 2017, 2019, 2020, 2021, 2022, and 2023.