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Materials Testing
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GEOLOGY AND SOILS STUDY

Creekside South at Lorson Ranch
El Paso County, Colorado

PREPARED FOR:

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

JOB NO. 173922

February 27, 2020

Respectfully Submitted,
RMG – Rocky Mountain Group

Kelli Zigler

Kelli Zigler
Project Geologist

Reviewed by,
RMG – Rocky Mountain Group

COLORADO REGISTERED
ANTHONY P. MUNGER
2/27/20
39818
PROFESSIONAL ENGINEER

Tony Munger, P.E.
Geotechnical Project Manager

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1.0 GENERAL SITE AND PROJECT DESCRIPTION

1.1 Project Location

The project lies in the north half of Section 23, 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.

1.2 Existing Land Use

The site currently consists of one parcel. The total area of the proposed site is to be 64.26 acres as denoted on P1 of the PUD Development & Preliminary Plan for Creekside South at Lorson Ranch. The parcel included is:

- Schedule No. 5500000424 which consists of 50.98 acres and is currently not developed.

The current and proposed zoning is "RM PUD" (Residential Medium Planned Unit Development).

The Jimmy Camp Creek East Tributary (JCCET) is adjacent to this development, but none of the currently proposed lots are located within the designated FEMA floodplain.

1.3 Project Description

The proposed site development is to consist of single-family residential construction on a total of 200 lots. Lots 1-76, 80-100 and 103-200 are to be a minimum 3,825 square feet. Lots 77-79, and 101-102 are to be approximately 2.5 acres each. Entrance into the subdivision is to be provided from Trappe Drive, located along the eastern boundary of the site. Additional proposed land usage includes, landscaped easements, parks, open space, trail corridors, utility easements, drainage and detention facilities. The Proposed Lot Layout is presented in Figure 2.

An abandoned FMIC ditch currently extends through the middle of the site. It is our understanding that this ditch is to be filled in and re-graded during the overlot grading process.

All streets within the subdivision are to be public Residential Urban Local with a 50’ R.O.W and constructed to El Paso County standards. RMG has not yet been provided with the final names of the interior streets, as of the issuance of this report. The streets are to be maintained by El Paso County Department of Transportation.

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.

It is our understanding the Jimmy Camp Creek East Tributary is to be dedicated to, owned by, and maintained by the Lorson Ranch Metropolitan District No. 1. Improvements are to be completed by the developer/owner as required.

2.0 QUALIFICATIONS OF PREPARERS

This Geology and Soils 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 19 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 19 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 of single-family residences within the referenced site. 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 may be issued based upon submission of the Development 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 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 Previous Studies and Field Investigation

Reports of previous geotechnical engineering/geologic investigations for nearby sites were available for our review and are listed below:

1. *Subsurface Soil Investigation, Lorson Ranch SDS Crossings, Lorson Ranch East, El Paso County, Colorado*, prepared by RMG – Rocky Mountain Group, Job No. 159665, last dated November 17, 2017.
2. *Geology and Soils Report, Creekside at Lorson Ranch, Filing No. 1, El Paso County, Colorado,* prepared by RMG – Rocky Mountain Group, Job No. 164808, last amended December 4, 2018.

3.4 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 site is currently vacant. Jimmy Camp Creek East Tributary forms the northern boundary of the site. The creek is currently in its native state throughout the majority of the property. However, a section of the JCCET has reportedly undergone reconstructed near the northeast corner of the property. An abandoned FMIC ditch is located south of JCCET and extends across the middle portion of the site.

4.2 Topography

Based on our site reconnaissance and the *Early Overlot Grading / Erosion Control Plans* referenced herein, the site topography is generally rolling hills and does not contain slopes other than the banks of the JCCET embankment and the abandoned FMIC ditch. The approximate elevation varies from 7 to 18 feet across the site.

4.3 Vegetation

The majority of the site consists of low lying native grasses and weeds. The few deciduous trees located on the property, generally near the abandoned FMIC ditch or the bank of the JCCET.

The soils exposed along the banks of the JCCET appear to be stable, and consist primarily of moderately cemented silty sand and trace gravel. It does not appear that these slopes have experienced significant sloughing, nor do they appear to have been deeply undercut or weakened the rills. JCCET was dry.

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. The site has remained generally undisturbed since 1947. The FMIC ditch was in place prior to 1947. We didn't observe obvious signs of significant improvements to JCCET, other than the reconstruction of the JCCET near the northeastern corner of the property.

5.0 FIELD INVESTIGATION AND LABORATORY TESTING

The subsurface conditions within the property were explored by drilling a total of twelve (12) exploratory borings between December 30, 2019 and January 3, 2020, extending to depths of approximately 20 to 45 feet below the existing ground surface. Test borings TB-1 and TB-2 were performed to obtain soil information for the sanitary sewer crossings that are proposed to cross JCCET near the southwestern portion of the property. The sanitary sewer crossings are to be located within the current FMIC easement. The recommendations for the sanitary sewer crossings will be presented in a separate geotechnical investigation report (by RMG) that is currently in process. The test boring logs and laboratory test results from TB-1 and TB-2 were also considered in the preparation of this report. The Proposed Lot Layout with Test Boring Locations is presented in Figure 2.

The number of borings is in excess of 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. An Explanation of Test Boring Logs and the Test Boring Logs are presented in Figures 3 through 9.

5.1 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 10. Soils Classification Data is presented in Figures 11 through 13. Swell/Consolidation Test Results are presented in Figures 14 through 17.

5.2 Groundwater

Groundwater was encountered in three of the test borings performed for this study at depths ranging from 14 to 22 feet below the existing surface during the field exploration and in six of the test borings at depths ranging from 12 to 26 feet when checked five to six days subsequent to drilling.

Based on our knowledge of the area and engineering design and construction techniques commonly employed in the El Paso County area at this time, it is our opinion that there is insufficient reason to preclude full-depth basements on any of the lots in this subdivision at this time. If shallow groundwater conditions are found to exist at the time of the site-specific Subsurface Soil Investigations, the feasibility of basement construction and/or any recommended mitigation measures are to be addressed at that time.

Fluctuations in groundwater and subsurface moisture conditions may occur due to variations in rainfall and other factors not readily apparent at this time. Development of the property and adjacent properties may also affect groundwater levels.

6.0 SOIL, GEOLOGY, AND ENGINEERING GEOLOGY

6.1 Geologic Conditions

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.

6.2 Subsurface Soil Conditions

The subsurface materials encountered in the test boring performed for this study were classified within the laboratory using the Unified Soil Classification System (USCS). The materials were identified and classified as native silty to clayey sand (SM, SC), sandy clay (low to high plasticity CL-CH), sandy claystone and Pierre Shale bedrock (CL-CH).

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.

6.3 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 encountered in the test boring performed for this investigation. Claystone bedrock was encountered at depths ranging from the surface to approximately thirty-four feet below the existing surface. The bedrock is anticipated to be encountered in the foundation excavations and utility trenches for the proposed development.

6.4 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:

- 3 – Ascalon sandy loam, 3 to 9 percent slopes. The Ascalon sandy loam was mapped by the USDA to encompass a small portion near the southwest portion of the property along the south side of JCCET. Properties of the sandy loam include, well-drained soils, depth of the water table is anticipated to be greater than 6.5 feet, runoff is anticipated to be low, frequency of flooding and/or ponding is none, and landforms include interfluves.
- 10 – Blendon sandy loam, 0 to 3 percent slopes. The Blendon sandy loam was mapped by the USDA to encompass a sliver near the northern portion of the property along the south side of JCCET. Properties of the sandy loam include, well-drained soils, depth of the water table is anticipated to be greater than 6.5 feet, runoff is anticipated to be low, frequency of flooding and/or ponding is none, and landforms include terraces, alluvial fans.
- 52 – Manzanst clay loam, 0 to 3 percent slopes. The Manzanst clay loam was mapped by the USDA to encompass the northern portion of the property along the south side of JCCET. Properties of the clay loam include, well-drained soils, depth of the water table is anticipated to be greater than 6.5 feet, runoff is anticipated to be low, frequency of flooding and/or ponding is none, and landforms include terraces and drainage-ways.
- 54 – Midway clay loam, 3 to 25 percent slopes. The Midway clay loam was mapped by the USDA to encompass a small portion of the property near the southeast corner. Properties of the clay loam include, well-drained soils, depth of the water table is anticipated to be greater than 6.5 feet, runoff is anticipated to be medium, frequency of flooding and/or ponding is none, and landforms include hills.
- 56 – Nelson-Tassel fine sandy loams, 3 to 18 percent slopes. The Nelson-Tassel fine sandy loams were mapped by the USDA to encompass the majority of the southern of the property. Properties of the fine sandy loams include, well-drained soils, depth of the water table is anticipated to be greater than 6.5 feet, runoff is anticipated to be medium, frequency of flooding and/or ponding is none, and landforms include hills.
- 104 – Vona sandy loam, 0 to 3 percent slopes. The Vona sandy loam was mapped by the USDA to encompass the southwest corner of the property. Properties of the sandy loam include, well-drained soils, depth of the water table is anticipated to be greater than 6.5 feet, runoff is anticipated to be medium, frequency of flooding and/or ponding is none, and landforms include sand sheets.

- 108 – Wiley silt loam, 3 to 9 percent slopes. The Wiley silt loam was mapped by the USDA to encompass a small portion of the property near the northeastern portion of the property. Properties of the sandy loam include, well-drained soils, depth of the water table is anticipated to be greater than 6.5 feet, runoff is anticipated to be medium, frequency of flooding and/or ponding is none, and landforms include hills.

The USDA Soil Survey Map is presented in Figure 19.

6.5 General Geologic Conditions

Based on our field observations, the USDA map, and the Geologic Map of the Fountain Quadrangle, 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 18.

The site generally consists of sand with various amounts of silt and sandy clay (alluvium). Three geologic units were mapped at the site as:

- *Qa_3 – Alluvium three (lower to middle? Holocene)* – well sorted sand and clayey to silty sand that is occasionally mottled and stratified. Unit may contain gravel lenses. The unit forms broad terraces along Jimmy Camp creek. The unit is up to 50 ft thick with increased gravel content in the lower 15 feet. The soils may be prone to settlement or swelling. The alluvium was encountered in the test borings performed by RMG to a depth of 34 feet.

- *Qav – Valley-fill alluvium (Holocene)* – unsorted to poorly sorted, weakly stratified, sandy to silty clay deposited as valley fill in broad drainage swales on low hillsides, underlain by Pierre Shale. The unit typically contains dispersed small gravel clasts composed of fine to medium crystalline pebble-gravel, Pierre Shale concretion fragments are common. The Valley-fill alluvium and Alluvium three are visually unrecognizably different in the test borings performed by RMG.

- *Kpc - Pierre Shale, cone-in-cone zone of Lavington (1993) Formation (upper Cretaceous)* - typically consists of dark-gray to tan-gray to olive gray subblocky to finely fissile non-calcareous shale, silty shale, thin bentonite beds with very fine-grained sandstone. Thickness of this zone is approximately 2,290 feet.

6.6 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.

6.7 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. The alluvial deposits are non-marine terrace deposits that have been reworked from either conglomerates in the Dawson Formation up-valley along Jimmy Camp Creek or reworked from gravel-capped mesas from the Pleistocene.

6.8 Engineering Geology

Charles Robinson and Associates (1977) have mapped two environmental engineering units at the site as:

- 2A – Stable alluvium, colluvium and bedrock on flat to gentle to moderate slopes (5 to 12%).
- 7A – Physiographic floodplain where erosion and deposition presently occur and is generally subject to recurrent flooding. Includes 100-year floodplain along major streams where floodplain studies have been conducted.

The Engineering Geology is presented in the Engineering and Geology Map, Figure 18.

6.9 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. 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.

6.10 Drainage of Water and Groundwater

The overall topography of the site slopes down from the south to the northwest, towards JCCET. JCCET is a currently a defined drainageway extending along the northern and western property boundaries. It is anticipated the direction of groundwater is towards Jimmy Camp Creek. The creek is not anticipated to adversely impact the placement of the residences in the subdivision. Construction during land development and of the residential structures are not to encroach with in the creek.

Groundwater was encountered in three of the test borings performed for this study at depths ranging from 14 to 22 feet below the existing surface during the field exploration and in six of the test borings at depths ranging from 12 to 26 feet when checked five to six days subsequent to drilling.

The three borings where groundwater was encountered within 15 feet of the existing ground surface were located within the area of the proposed sanitary sewer crossing and the area of the proposed detention pond. Based on the results of our investigation, our knowledge of the area, and engineering design and construction techniques employed in the El Paso County area at this time, it is our opinion that there is insufficient reason to preclude full-depth basements on any of the proposed lots in the subdivision at this time. If shallow groundwater conditions are found to exist at the time of the site-specific subsurface soil investigations, the feasibility of basement construction and/or any recommended mitigation measures are to be addressed at that time.

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 2* indicates the site is identified as valley fill comprised of sand and gravel with silt and clay deposited by water in one or a series of stream valley. Extraction of the sand and gravel 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 Denver Basin Coal Region. However, the area of the site has been mapped "Poor" for coal resources, no active or inactive mines have been mapped in the area of the site. No metallic mineral resources have been mapped on the site.

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:

- Avalanches
- Debris Flow-Fans/Mudslides
- Floodplains
- Ground Subsidence
- Landslides
- Rockfall
- Ponding water
- Steeply Dipping Bedrock
- Unstable or Potentially Unstable Slopes
- Scour, Erosion, accelerated erosion along creek banks and drainageways
- Springs and High Groundwater
- Corrosive Minerals

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

8.1 Expansive Soils and Bedrock

Based on the test borings performed by RMG for this investigation and the previous geotechnical engineering/geologic investigation referenced above, the silty to clayey sand generally possesses low swell potential and the sandy clay, claystone, and shale generally possess low to high swell potential. It is anticipated that expansive soils/bedrock will be encountered at depths anticipated to affect residential foundations. These materials are readily mitigated with typical construction practices common to this region of El Paso County, Colorado.

Mitigation

Shallow foundations are anticipated for structures within this development. Foundation design and construction typically can be adjusted for expansive soils. Mitigation of expansive soils and bedrock are typically accomplished by 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 final determination of mitigation alternatives and foundation design criteria are to be determined in site-specific subsurface soil investigations for each lot.

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 Hydrocompactive Soils (Moisture Sensitive Soils)

Based on the test borings performed by RMG for this investigation and the previous geotechnical engineering/geologic investigations referenced above, the silty to clayey sand generally possesses low to moderate hydrocompactive potential and the sandy clay generally possesses low hydrocompactive potential. The claystone/shale encountered generally possess nil to low hyrdocompactive potential. It is anticipated that hydrocompactive soils will be encountered at depths anticipated to affect residential foundations. These materials are readily mitigated with typical construction practices common to this region of El Paso County, Colorado.

Mitigation

Shallow foundations are anticipated for structures within this development. Foundation design and construction typically can be adjusted for hydrocompactive soils. If loose or hydrocompactive sands are encountered, mitigation can be accomplished by overexcavation and replacement with structural fill, subexcavation and replacement with on-site moisture-conditioned soils, the installation of deep foundation systems, and/or the use of a geogrid reinforced fill, all of which are considered common construction practices for this area. The final determination of mitigation alternatives and foundation design criteria are to be determined in site-specific subsurface soil investigations for each lot.

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

8.3 Drainageways – Jimmy Camp Creek East Tributary

The JCCET is located along the northern property boundary for the site. Based on the FEMA Map Panel number 08041C0975G, effective December 7, 2018, the proposed lots lie outside the designated floodplain. It is our understanding that the floodplain alignment is in the process of being revised under a LOMR that was recently completed by Kiowa Engineering and approved by FEMA. The LOMR is not yet effective, as it has yet gone through the 120-day comment period. It is also our understanding the floodplain is to be contained within the JCCET. The current FEMA Map is presented in Figure 21.

The 100-year floodplain reflected on the PUD & Preliminary Plan provided by Kimley Horn shows that the current floodplain does not encroach into the proposed lots for the Creekside South subdivision. However, the current floodplain does encroach into Tract B, where the proposed detention pond is to be located.

Mitigation

Provided that the final floodplain extents, as amended by the recently submitted LOMR described above, do not encroach within the boundaries of the proposed lots, it is our opinion that additional mitigation is not required at this time. As noted herein, final determination of basement feasibility and foundation drainage measures are to be determined by the site-specific subsurface soil investigations performed at the time of construction.

8.4 Drainageways – FMIC Ditch Infill

At the time of the site reconnaissance, the FMIC ditch was dry. Based on overhead imagery, the FMIC ditch appears to have contained very little to no water since 1947. The FMIC dich is to be filled in during the development process, to allow for the proposed residential lots.

Mitigation

If necessary, the FMIC ditch should be dewatered prior to placing any overlot fill. In order to avoid ponding water in the area, improvements should be installed to divert surface water around the proposed construction areas directly to JCCET, or to another approved collection basin or drainage feature. Significant deposits of sediment deposition should be removed, and the area should be observed by a representative of RMG prior to placing any overlot fill. If conditions are encountered at the time of the construction that result in either water flow into the area or destabilization of the soils, stabilization techniques should be implemented. If required, stabilization methods should be determined based on the conditions encountered at the time of construction. However, methods that afford potentially a reduced amount of overexcavation (versus other methods) and provide increased performance under moderately to severely unstable conditions are the use of rip-rap (a.k.a. shot rock) and/or layered geogrid and structural fill system.

8.5 Faults and Seismicity

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

The Pikes Peak Regional Building Code, 2017 Edition, indicates maximum considered earthquake spectral response accelerations of 0.185g for a short period (S_s) and 0.059g for a 1-second period (S_1). Based on the results of our experience with similar subsurface conditions, we recommend the site be classified as Site Class B, with average shear wave velocities ranging from 2,500 to 5,000 feet per second for the materials in the upper 100 feet.

8.6 Radon

***"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 80925 zip code located in Lorson Ranch, 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. Black Forest 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: http://county-radon.info/CO/El_Paso.html. There is not believed to be unusually 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 and crawlspaces, creating slightly positive pressures within structures, and sealing of joints and cracks in the foundations, slabs, and below-grade walls can help mitigate radon hazards.

8.7 Erosion

Due to the fine-grained nature of the soils on the site, the upper sands encountered at the site are susceptible to erosion by wind and flowing water. However, based on the relatively limited flows that have historically been conveyed through the JCCET, significant erosion and/or scouring of the tributary is not anticipated.

Mitigation:
Minor wind erosion and dust problems may arise during and immediately after construction. If the problem becomes severe during this time, watering of the cut areas may be implemented to reduce the occurrence of dust. Installation of erosion protection or vegetation after completion of the structures is anticipated to mitigate the majority of the erosion and dust problems.

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

Fill Soils

Fill soils were not encountered at the time of drilling. If fill soils are encountered, they may be considered unsuitable for a variety of reasons. These include (but are not limited to) non-engineered fills, fill soils containing trash or debris, fill soils that appear to have been improperly placed and/or compacted, etc. If unsuitable soils are encountered during the site-specific Subsurface Soil Investigation and/or the open excavation observation, they may require removal (overexcavation) and replacement with compacted structural fill.

Mitigation
Based on the test borings for this investigation, the excavations are anticipated encounter silty to clayey sand, sandy clay and claystone. The on-site soils can generally be used as site-grading fill, though use

of claystone within the fill should be avoided where the fill will be located below the proposed foundations.

The *Early Overlot Grading and Erosion Control Plan for Creekside South*, referenced herein, was reviewed and considered in the preparation of this report. The majority of the deeper fills, up to 14- to 22-feet deep, are proposed along the northern portion of the lots, directly south of JCCET. These fills are located outside the anticipated footprint of the proposed single-family residences. Proposed cuts and fills located within the proposed building envelopes are anticipated to vary between 0 and 6 feet.

Prior to placement of overlot fill or removal and recompaction 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 during overlot grading, they should be removed (overexcavated) and replaced with compacted structural fill. Structural fill may consist of the onsite material as it is reworked, moisture conditioned and recompacted.

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 anticipate that the deepest excavation cuts for crawlspace or garage level construction will be approximately 3 to 4 feet below the existing ground surface, and for basement level construction will be approximately 6 to 8 feet below the existing ground surface. We believe the surficial soils will classify as Type C materials as defined by OSHA in 29CFR Part 1926, dated January 2, 1990. OSHA requires temporary slopes made in Type C materials be laid back at ratios no steeper than 1.5:1 (horizontal to vertical) unless the excavation is shored or braced. 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).

9.0 BEARING OF GEOLOGIC CONDITIONS UPON PROPOSED DEVELOPMENT

Geologic hazards (as described in Section 8.0 of this report) were not found to be present at this site. Geologic constraints (also as described in section 8.0 of this report) such as expansive and hydrocompactive soils, faults, seismicity, erosion and radon, were found on the site. Where avoidance is not feasible, it is our opinion that the existing geologic and engineering conditions can be satisfactorily mitigated through proper engineering, design, and contraction 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 of native silty to clayey sand, sandy clay and claystone. It is anticipated the sands will be encountered at loose to medium dense conditions, the sandy clay at stiff to very stiff conditions, and the claystone at medium hard to hard conditions. Bedrock is anticipated to be encountered within some or all of the utility trenches.

We believe the sand will classify as Type C materials and the clay as Type B materials, as defined by OSHA in 29 CFR Part 1926. OSHA requires that temporary excavations made in Type B and C materials be laid back at ratios no steeper than 1:1 (horizontal to vertical) and 1½:1 (horizontal to vertical), respectively, unless the excavation is shored and braced. Excavations deeper than 20 feet, or when water is present, should always be braced or have the slope designed by a professional engineer.

11.0 PAVEMENTS

The proposed roadways with in this development will require a new pavement design prepared in accordance with the El Paso County regulations.

The site plan provided by Kimley Horn has the interior roadways classified as Typical Urban Local. Exterior roadways, such as Lorson Boulevard north of the proposed new development, are to be classified as Residential Urban Collectors. ***The actual pavement section design for individual streets is to be performed following completion of utility installation within the roadways.***

The Lorson Ranch area has generally preferred to construct the roadways with a composite roadway section consisting of Hot Mix Asphalt over Cement-Treated Subgrade (CTS). For purposes of this report, we anticipate the subgrade soils will primarily have American Association of State Highway and Transportation Officials (AASHTO) Soil Classifications of A-6(3), A-3(0) and A-1-b with an estimated design subgrade "R-values" on the order of approximately 5 to 15.

The above values are for preliminary planning purposes only, and may vary upon final design depending on the soil materials used for subgrade construction within the proposed roadways. 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 foundation systems consisting of standard spread footings/stemwalls are anticipated to be suitable for the proposed residential structures. It is our understanding that crawlspace and/or basement excavations are proposed. The anticipated excavation cuts are approximately 3 to 4 feet below the final ground surface for crawlspaces and 6 to 8 feet for basements, not including overexcavation, if needed.

Expansive sandy clay and claystone were encountered in the test borings performed for this study. Expansive soils are anticipated to be encountered near foundation and/or floor slab bearing levels. Overexcavation and replacement or subexcavation with nonexpansive structural fill will be required.

Overexcavation depths of 3 to 6 feet are typical for the soil conditions encountered. However, the final overexcavation depths may be up to 10 feet or more. Overexcavation depths for each lot are to be determined in site-specific subsurface soil investigations, and confirmed at the time of the open excavation observations for each lot.

If loose sands are encountered, they may require additional compaction to achieve the allowable bearing pressure as indicated in a site specific subsurface soil investigation report. In some cases, removal and recompaction may be required for loose soils. Similarly, if shallow groundwater conditions are encountered and result in unstable soils unsuitable for bearing of residential foundations, these soils may require stabilization prior to construction of foundation components.

If undocumented fill is encountered during construction of the structures, it will be assumed that this fill was not moisture conditioned and compacted in a manner consistent with the **Structural Fill** recommendations contained within this report, unless appropriate documentation can be provided. If such fill is encountered, it is not considered suitable for support of shallow foundations. This unsuitable fill will require removal (overexcavation) and replacement with non-expansive, granular structural fill below foundation components and floor slabs. The structural fill should be observed and tested during placement as indicated under the **Structural Fill** section of this report, to ensure proper compaction.

Following completion of the overexcavation and moisture conditioning process, it is imperative that the "as-compacted" moisture content be maintained prior to construction.

The foundation system for each single family residence should be designed and constructed based upon recommendations developed in a site-specific subsurface soil investigation. The recommendations presented in the *Subsurface Soil Investigation* report for each lot should be verified following the excavations of each structure and evaluation of the building loads.

12.1 Foundation Stabilization

Groundwater was encountered in six of the test borings performed for this study. Based on a review of previous geotechnical engineering/geologic investigations in the area, it is anticipated the groundwater will have adequate separation from the bottom of the proposed basement foundation components and floor slabs. However, if moisture conditions encountered at the time of the foundation excavation result in water flow into the excavation and/or destabilization of the foundation bearing soils, stabilization techniques should be implemented. Various stabilization methods can be employed, and can be discussed at the time of construction. However, a method that affords potentially a reduced amount of overexcavation (versus other methods) and provides increased performance under moderately to severely unstable conditions is the use of a layered geogrid and structural fill system.

Additionally, if groundwater were to flow into the excavation, a geosynthetic vertical drain and an overexcavation perimeter drain may be required around the lower portions of the excavation to allow for installation of the layered geogrid and structural fill system.

12.2 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 but not the walkout trench, if applicable.

Shallow groundwater conditions were not encountered in the test boring performed for this study or the previously reviewed geotechnical engineering/geologic investigations. Depending on the conditions encountered during the site-specific subsurface soil investigations and the conditions observed at the time of construction, additional subsurface drainage systems may be recommended.

One such system is an underslab drainage layer to help intercept groundwater before it enters the slab area should the groundwater levels rise. In general, if groundwater was encountered within 4 to 6 feet of the proposed basement slab elevation, an underslab drain should be anticipated. Another such system would consist of a subsurface drain and/or vertical drain board placed around the perimeter of the overexcavation to help intercept groundwater and allow for proper placement and compaction of the replacement structural fill. Careful attention should be paid to grade and discharge of the drain pipes of these systems.

It must be understood that the drain systems are designed to intercept some types of subsurface moisture and not others. Therefore, the drains could operate properly and not mitigate all moisture problems relating to foundation performance or moisture intrusion into the basement area.

13.0 EARTHWORK

13.1 Moisture-Conditioned Structural Fill

Areas to receive moisture-conditioned expansive soils used as 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 98 percent of the maximum dry density as determined by the Standard Proctor test (ASTM D-698) or to a minimum of 95 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.

Moisture conditioned 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.

- Claystone fill shall be thoroughly "pulverized" and shall not contain claystone chunks greater than 1 1/2 inches in diameter.

- When claystone is to be incorporated, the fill materials shall be processed in a stockpile **(processing these materials in the excavations will not be permitted)**. These stockpiled fill materials shall be moisture-conditioned to a minimum of 1 percent to 4 percent above optimum moisture content (as determined by the Standard Proctor test, ASTM D-698), with an average of not less than 1 1/2 percent above optimum moisture content. These materials, once moisture conditioned and thoroughly mixed, should rest in the stockpile a minimum of 24 hours to ensure proper distribution of the moisture through the material. After resting, the materials

should be re-wet and re-mixed to replace the surficial moisture lost to evaporation during the resting period. Fill materials not containing claystone do not require processing in a stockpile.

- Fill materials shall be moisture-conditioned to a minimum of 1 percent to 4 percent above optimum moisture content (as determined by the Standard Proctor test, ASTM D-698), with an average of not less than 1 1/2 percent above optimum moisture content.

- The moisture-conditioned materials should be placed in maximum 6" compacted lifts. These materials should be compacted to a minimum of 98 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.

It is anticipated that 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 the clay soils 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 subexcavation and moisture-conditioned soils.

Frequent moisture content and density tests shall be performed in the field to verify conformance with the above specifications. Furthermore, representative samples of the moisture-conditioned fill shall be obtained by personnel of RMG on a daily basis for follow-up swell testing to demonstrate that the swell potential has been reduced to not more than 1 percent swell when saturated under a 1,000 psf surcharge pressure. Areas where the follow-up swell tests indicate swells higher than that value shall have the fill material removed, reprocessed, recompacted, and retested.

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 sub-excavation operation.

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.

13.2 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

TB-10 was located in the general vicinity of the proposed detention pond in Tract B. 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 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
Lean Clay with Sand (CL)	105	28	0.361	2.77	0.531

14.2 Detention Pond Considerations

Based on a review of the *Early Overlot Grading / Erosion Control Plans*, the proposed detention pond in Tract B is to be excavated approximately 14-feet below the surrounding ground surface. As such, above-ground embankment construction is not anticipated, nor is it anticipated that impounded stormwater runoff will be stored above the natural ground surface. Detention pond side slopes are to be constructed with a maximum 3:1 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 *lot-specific* **Subsurface Soil Investigation** be performed for the proposed structures. The extent of any fill soils encountered during the lot-specific investigation(s) should be evaluated for suitability to support the proposed structures prior to construction. Additionally, the groundwater conditions encountered in the lot-specific investigation should be evaluated to determine the feasibility of basement construction on that lot.

The lot-specific subsurface soil investigation 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 and hydrocompactive soils, seismicity, radon, and erosion) 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 system for each single family residence should be designed and constructed based upon recommendations developed in a site-specific subsurface soil investigation.

The foundation and floor slabs of the 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 the homeowner.

We believe the surficial sand soils will classify as Type C materials and the clay soils will classify as Type B as defined by OSHA in 29CFR Part 1926, date January 2, 1990. OSHA requires temporary slopes made in Type C materials be laid back at ratios no steeper than 1.5:1 (horizontal to vertical) and slopes made in Type B materials be laid back at ratios no steeper than 1:1 (horizontal to vertical) unless the excavation is shored or 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 to carefully to familiarize themselves with the geologic hazards 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

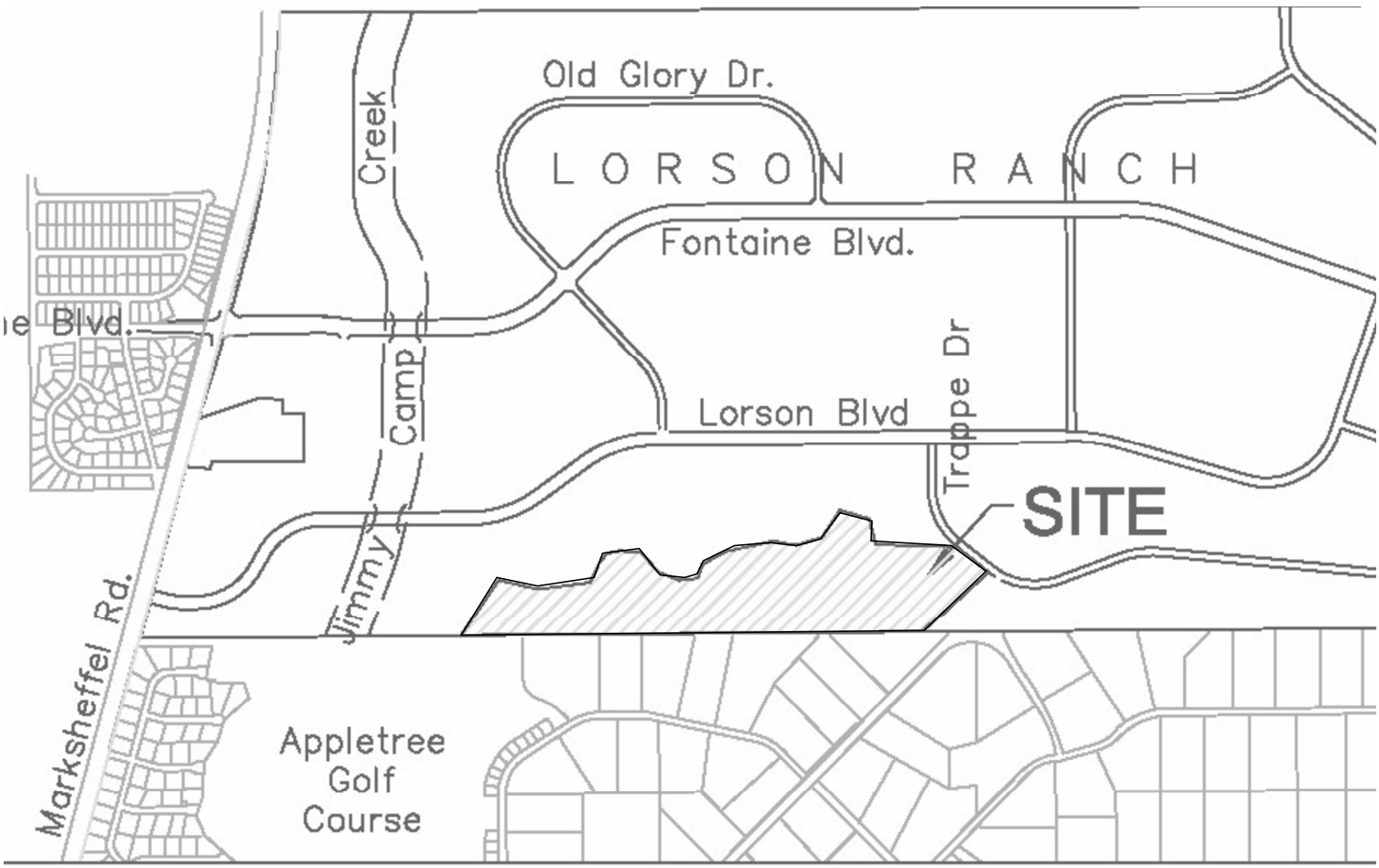
This report is for the exclusive purpose of providing geologic hazards information and preliminary geotechnical engineering recommendations. The scope of services did not include, either specifically or by implication, evaluation of wild fire hazards, environmental assessment of the site, or identification 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
80918
(719) 548-0600
Central Office:
Englewood, CO 80112
(303) 688-9475
Northern Office:
Greeley / Evans, CO 80620
(970) 330-1071

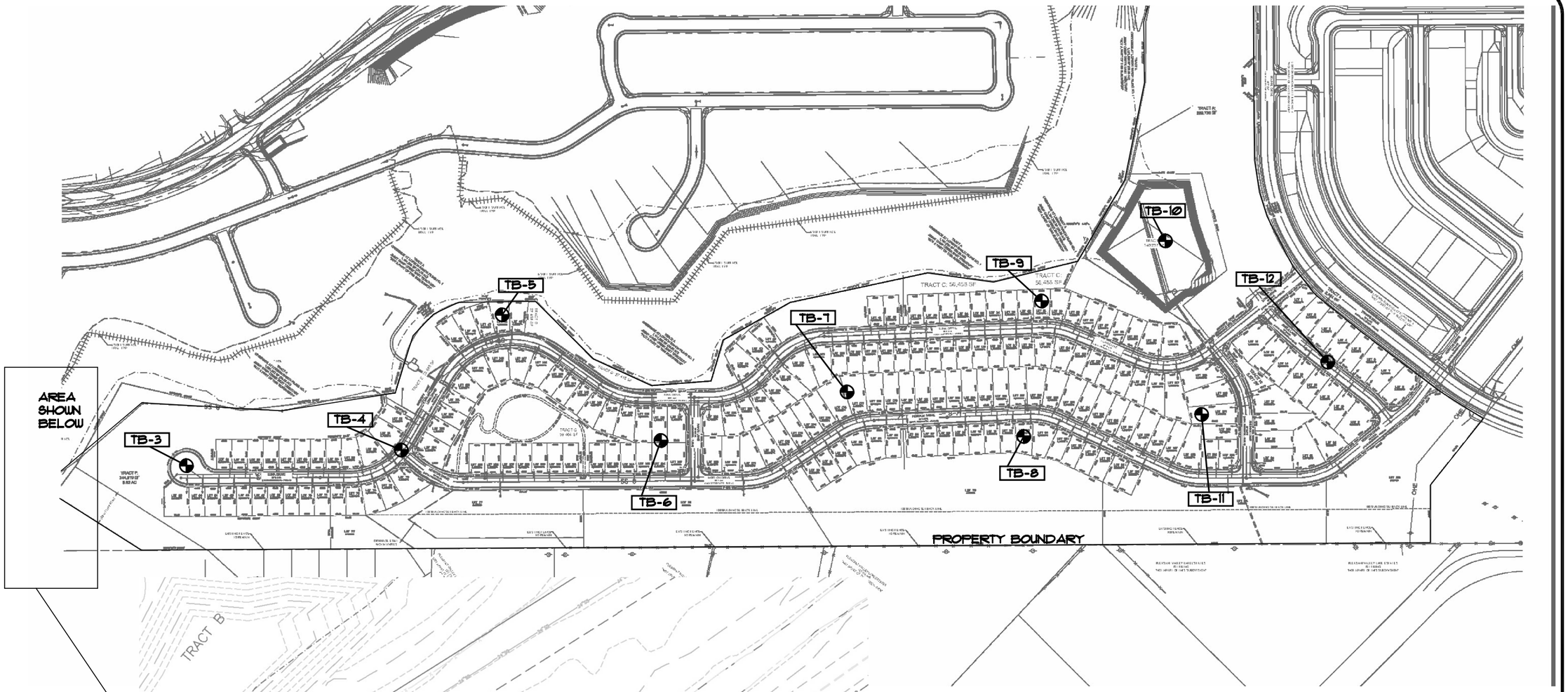
SITE VICINITY MAP

CREEKSIDE SOUTH
AT LORSON RANCH
EL PASO COUNTY, COLORADO
LANDHUIS COMPANY

JOB No. 173922

FIG No. 1

DATE 2-27-2020



● DENOTES APPROXIMATE LOCATION OF TEST BORINGS PERFORMED FOR THIS INVESTIGATION

NOT TO SCALE

BASE MAP PROVIDED BY: KIMLEY HORN

JOB No. 173922

ARCHITECTS RMG ENGINEERS
ROCKY MOUNTAIN GROUP

Southern Office
Colorado Springs, CO 80918
(719) 548-0600
Central Office:
Englewood, CO 80112
(303) 688-9475
Northern Office:
Greeley / Evans, CO 80620
(970) 330-1071
Woodland Park Office:
(719) 687-6077
Monument Office:
(719) 488-2145
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(719) 544-7750

CREEKSIDE SOUTH
AT LORSON RANCH
EL PASO COUNTY, CO
LANDHUIS, CO

ENGINEER:
DRAWN BY: KMZ
CHECKED BY: TPM
ISSUED: 2262020

PROPOSED
LOT LAYOUT WITH TEST
BORING LOCATIONS

SHEET No.
FIG-2

SOILS DESCRIPTION


CLAYEY SAND


CLAYSTONE


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 (%)

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Geotechnical
Materials Testing
Civil, Planning

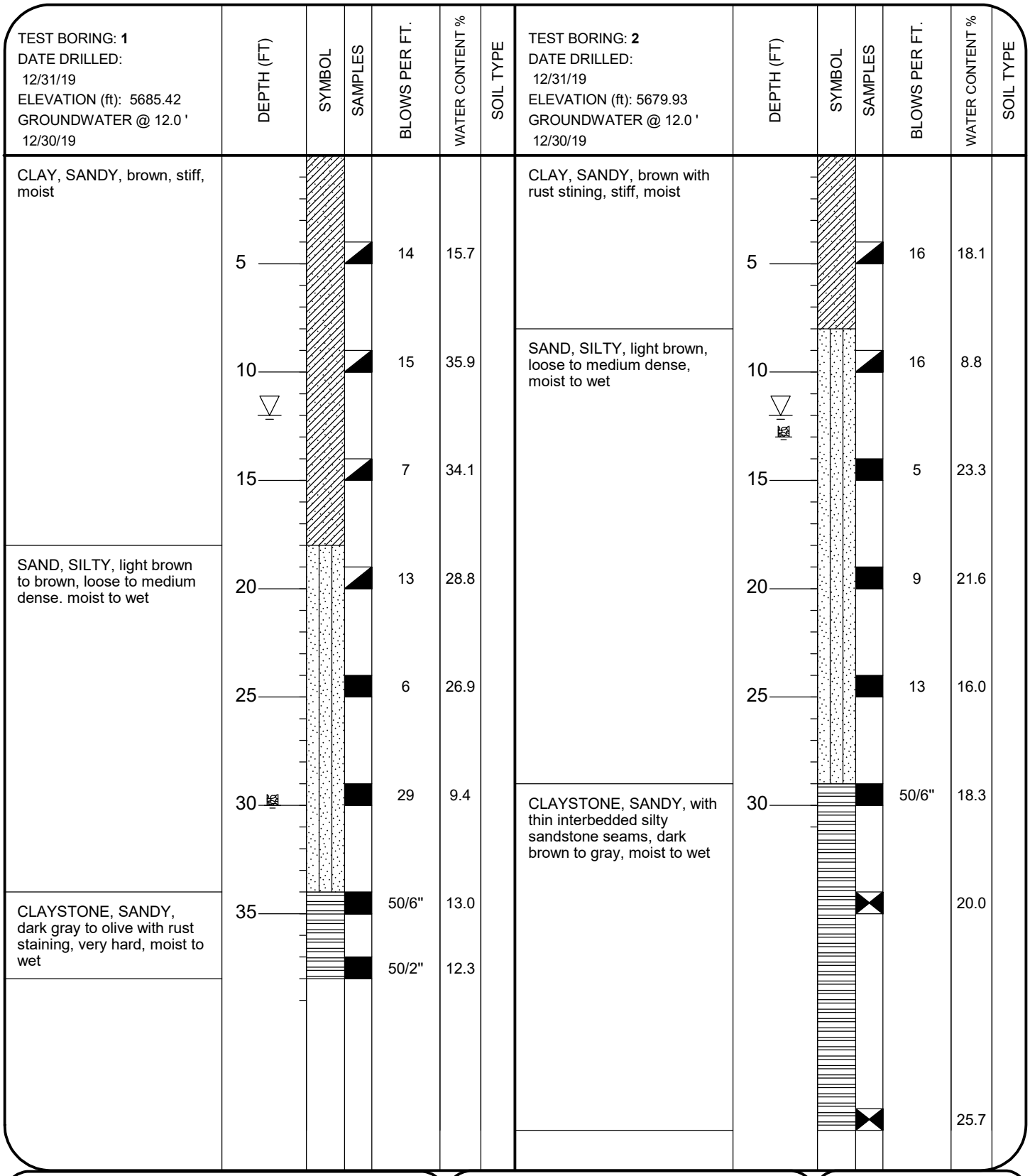
Colorado Springs: (Corporate Office)
2910 Austin Bluffs Parkway
Colorado Spings, CO 80918
(719) 548-0600
SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

EXPLANATION OF TEST BORING LOGS

JOB No. 173922

FIGURE No. 3

DATE 2/27/20



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ARCHITECTS RMG ENGINEERS

Architectural
Structural
Forensics

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

TEST BORING LOGS

JOB No. 173922

FIGURE No. 4

DATE 2/27/20

TEST BORING: **3**
DATE DRILLED: 12/24/19
ELEVATION (ft): 5707.65
GROUNDWATER @ 26.0 '
12/30/19

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %	SOIL TYPE
SAND, SILTY TO CLAYEY, light brown to brown, medium dense, moist					
5			16	7.8	
10			11	7.3	
CLAY, SANDY, brown, stiff, moist					
15			10	11.5	
SAND, CLAYEY, brown, medium dense, moist					
20			20	11.0	
CLAYSTONE, SANDY, brown with rust staining, firm to hard, moist					
25			46	17.4	
30			50/8"	14.3	

TEST BORING: **4**
DATE DRILLED: 12/24/19
ELEVATION (ft): 5701.91
GROUNDWATER @ 21.0 '
12/30/19

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %	SOIL TYPE
SAND, SILTY, brown, loose to medium dense, moist to wet					
5			12	4.8	
10			13	3.9	
15			9	5.1	
20			9	10.0	
SAND, CLAYEY, brown with rust staining, medium dense, moist to wet					
25			11	23.4	

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Geotechnical
Materials Testing
Civil, Planning

Colorado Springs: (Corporate Office)
2910 Austin Bluffs Parkway
Colorado Spings, CO 80918
(719) 548-0600
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TEST BORING LOGS

JOB No. 173922

FIGURE No. 5

DATE 2/27/20

TEST BORING: **5**
DATE DRILLED: 1/3/20
ELEVATION (ft): 5698.95
GROUNDWATER @ 19.0 '
12/30/20

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %	SOIL TYPE
					SAND, SILTY, light brown, medium dense, moist
5			13	5.8	
					CLAYSTONE, SANDY, brown, medium hard to hard, moist to wet
10			35	11.9	
15			50/10"	10.3	
20			50/8"	16.2	
25			50/10"	14.7	

TEST BORING: **6**DATE
DRILLED: 1/3/20
ELEVATION (ft): 5710.52
NO GROUNDWATER ON
1/7/20

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %	SOIL TYPE
					CLAY, SANDY, brown, very stiff, moist
5			26	4.8	
					CLAYSTONE, SANDY, brown with rust staining, medium hard, to hard, moist
10			50/10"	10.1	
15			50/7"	10.4	
20			50/8"	11.8	

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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

TEST BORING LOGS

JOB No. 173922

FIGURE No. 6

DATE 2/27/20

TEST BORING: **7**
DATE DRILLED: 1/3/20
ELEVATION (ft):5720.43
NO GROUNDWATER ON 1/7/20

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %	SOIL TYPE
5			22	11.3	SAND, CLAYEY, light brown, medium dense, moist
10			50/11"	12.7	CLAYSTONE, SANDY, brown, hard, moist
15			50/6"	14.8	
20			50/8"	14.5	

TEST BORING: **8**
DATE DRILLED: 1/3/20
ELEVATION (ft): 5725.06
NO GROUNDWATER ON 1/7/20

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %	SOIL TYPE
5			15	7.3	CLAY, SANDY, light brown, stiff, moist
10			50/11"	11.5	CLAYSTONE, SANDY, brown, hard, moist
15			50/7"	11.9	
20				9.9	

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ARCHITECTS RMG ENGINEERS

Geotechnical
Materials Testing
Civil, Planning

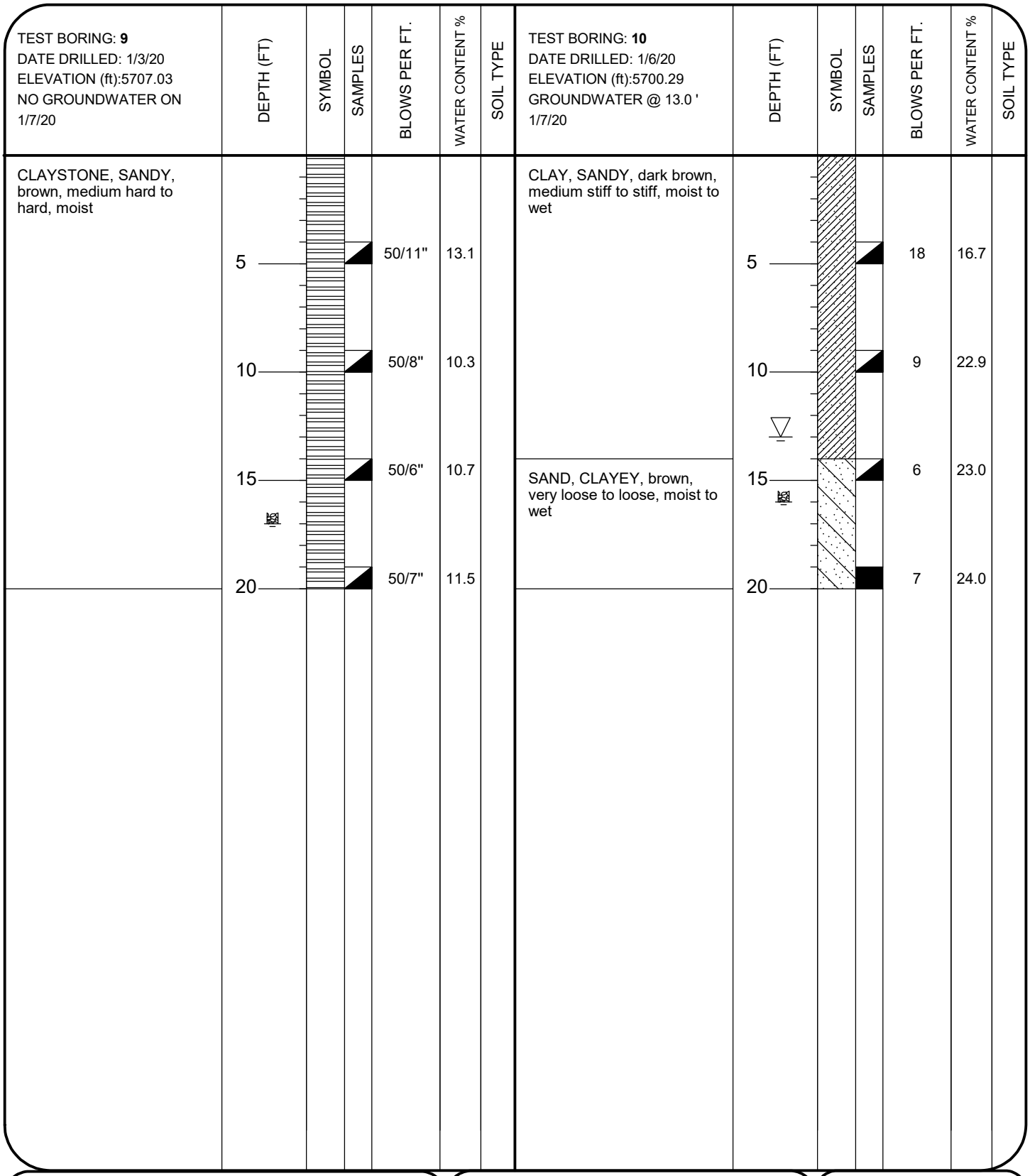
Colorado Springs: (Corporate Office)
2910 Austin Bluffs Parkway
Colorado Spings, CO 80918
(719) 548-0600
SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

TEST BORING LOGS

JOB No. 173922

FIGURE No. 7

DATE 2/27/20



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TEST BORING LOGS

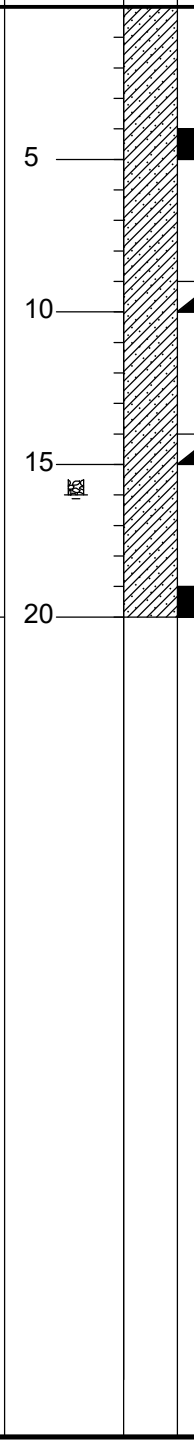
JOB No. 173922

FIGURE No. 8

DATE 2/27/20

TEST BORING: **11**
DATE DRILLED: 1/6/20
ELEVATION (ft):5714.44
NO GROUNDWATER ON 1/7/20

CLAY, SANDY, light brown to brown, stiff to very stiff, moist

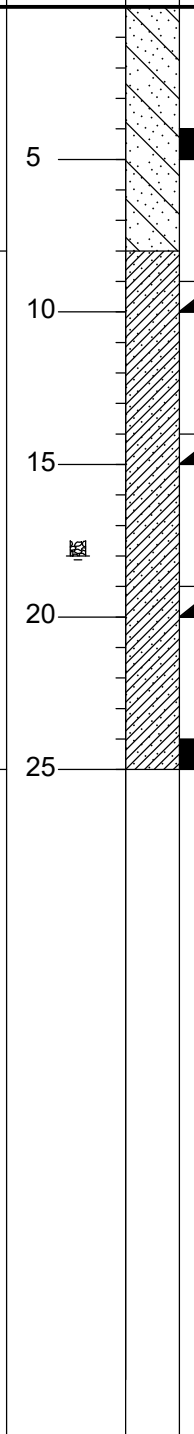


DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %	SOIL TYPE
5			18	8.8	
10			18	9.0	
15			18	11.7	
20			17	12.0	

TEST BORING: **12**
DATE DRILLED: 1/6/20
ELEVATION (ft):5715.44
NO GROUNDWATER ON 1/7/20

SAND, CLAYEY, light brown, medium dense, moist

CLAY, SANDY, dark brown to brown, stiff to very stiff, moist



DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %	SOIL TYPE
5			19	8.7	
10			33	13.6	
15			17	17.9	
20			16	15.1	
25			15	17.0	

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TEST BORING LOGS

JOB No. 173922

FIGURE No. 9

DATE 2/27/20

Test Boring No.	Depth	Water Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% Retained No.4 Sieve	% Passing No. 200 Sieve	% Swell/ Collapse	Load (psf)
1	4.0	15.7							
1	9.0	35.9		78	51	0.0	98.1		
1	10.0	35.9	86.0					1.3	
1	14.0	34.1							
1	19.0	28.8							
1	24.0	26.9							
1	29.0	9.4							
1	34.0	13.0							
1	37.0	12.3							
2	4.0	18.1		45	31	0.0	72.0		
2	9.0	8.8		NP	NP	0.0	10.4		
2	14.0	23.3							
2	19.0	21.6							
2	24.0	16.0							
2	29.0	18.3							
2	30.0	14.2							
2	34.0	20.0		NP	NP	2.7	47.0		
2	44.0	25.7							
3	4.0	7.8							
3	9.0	7.3							
3	14.0	11.5							
3	19.0	11.0							
3	24.0	17.4	117.5	42	28	0.0	74.5	2.4	
3	29.0	14.3							
4	4.0	4.8							
4	9.0	3.9		NP	NP	0.0	24.5		
4	14.0	5.1							
4	19.0	10.0							
4	24.0	23.4							
5	4.0	5.8							
5	9.0	11.9							
5	14.0	10.3	117.2	44	29		79.0	3.2	
5	19.0	16.2							
5	24.0	14.7							

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SUMMARY OF LABORATORY TEST RESULTS

JOB No. 173922
FIGURE No. 10

DATE 2/27/20

Test Boring No.	Depth	Water Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% Retained No.4 Sieve	% Passing No. 200 Sieve	% Swell/ Collapse	Load (psf)
6	4.0	4.8							
6	9.0	10.1	122.5	37	23		67.5	1.3	
6	14.0	10.4							
6	19.0	11.8							
7	4.0	11.3							
7	9.0	12.7							
7	14.0	14.8	111.7	40	8		77.5	- 0.7	
7	19.0	14.5							
8	4.0	7.3		34	22	0.2	79.5		
8	9.0	11.5							
8	14.0	11.9							
8	19.0	9.9							
9	4.0	13.1							
9	9.0	10.3	123.8	36	23	0.0	72.1	0.8	
9	14.0	10.7							
9	19.0	11.5							
10	4.0	16.7	104.7	37	23	0.0	82.0	- 3.5	
10	9.0	22.9							
10	14.0	23.0							
10	19.0	24.0							
11	4.0	8.8							
11	9.0	9.0		31	17	0.0	68.3		
11	14.0	11.7							
11	19.0	12.0							
12	4.0	8.7							
12	9.0	13.6	117.4	43	27		92.2	3.1	
12	14.0	17.9							
12	19.0	15.1							
12	24.0	17.0							

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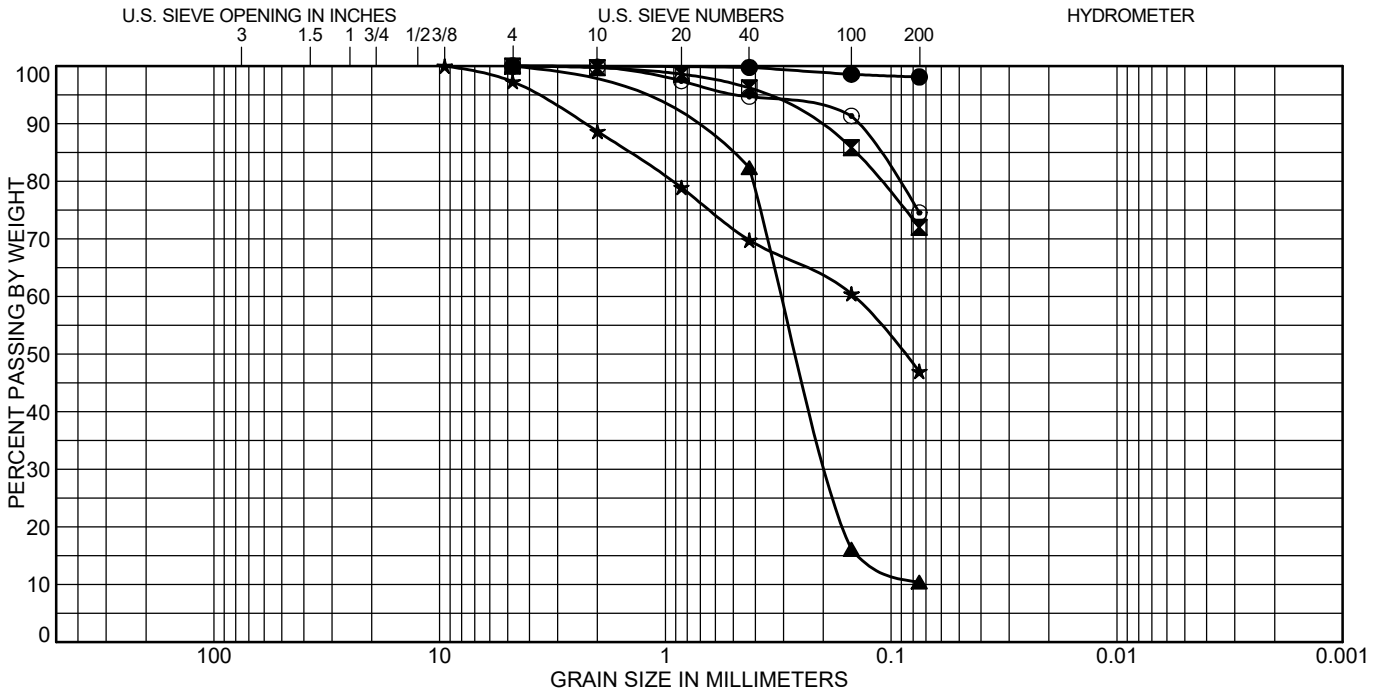
SUMMARY OF LABORATORY TEST RESULTS

JOB No. 173922
FIGURE No. 10

DATE 2/27/20



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Test Boring		Depth (ft)	Classification	LL	PL	PI
●	1	9.0	FAT CLAY(CH)	78	27	51
⊠	2	4.0	LEAN CLAY with SAND(CL)	45	14	31
▲	2	9.0	POORLY GRADED SAND with SILT(SP-SM)	NP	NP	NP
★	2	34.0	SILTY SAND(SM)	NP	NP	NP
⊙	3	24.0	LEAN CLAY with SAND(CL)	42	14	28

Test Boring		Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	1	9.0	0.0	1.9	98.1	
⊠	2	4.0	0.0	28.0	72.0	
▲	2	9.0	0.0	89.6	10.4	
★	2	34.0	2.7	50.3	47.0	
⊙	3	24.0	0.0	25.5	74.5	

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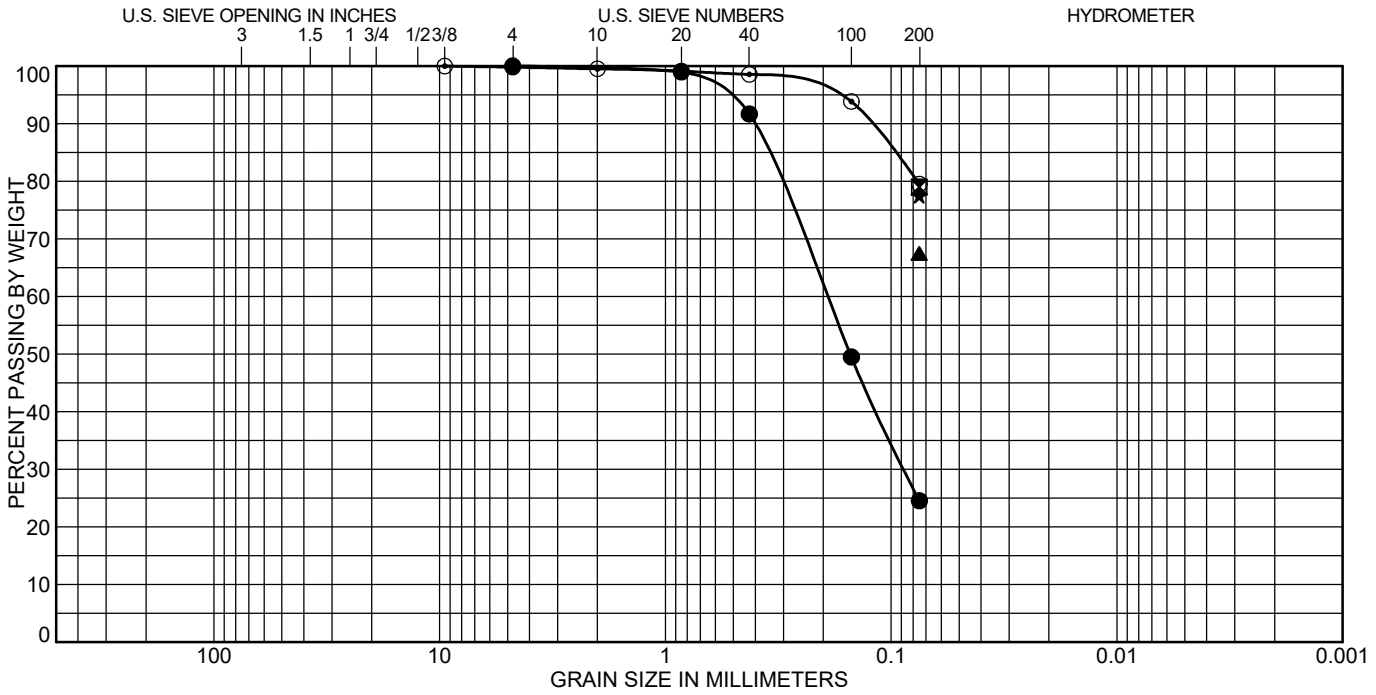
SOIL CLASSIFICATION DATA

JOB No. 173922

FIGURE No. 11

DATE 2/27/20



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Test Boring		Depth (ft)	Classification	LL	PL	PI
●	4	9.0	**SILTY SAND(SM)**	**NP**	**NP**	**NP**
⊠	5	14.0	**LEAN CLAY with SAND(CL)**	**44**	**15**	**29**
▲	6	9.0	**SANDY LEAN CLAY(CL)**	**37**	**14**	**23**
★	7	14.0	**SILT with SAND(ML)**	**40**	**32**	**8**
⊙	8	4.0	**LEAN CLAY with SAND(CL)**	**34**	**12**	**22**

Test Boring		Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	4	9.0	**0.0**	**75.5**	**24.5**	
⊠	5	14.0			**79.0**	
▲	6	9.0			**67.5**	
★	7	14.0			**77.5**	
⊙	8	4.0	**0.2**	**20.3**	**79.5**	

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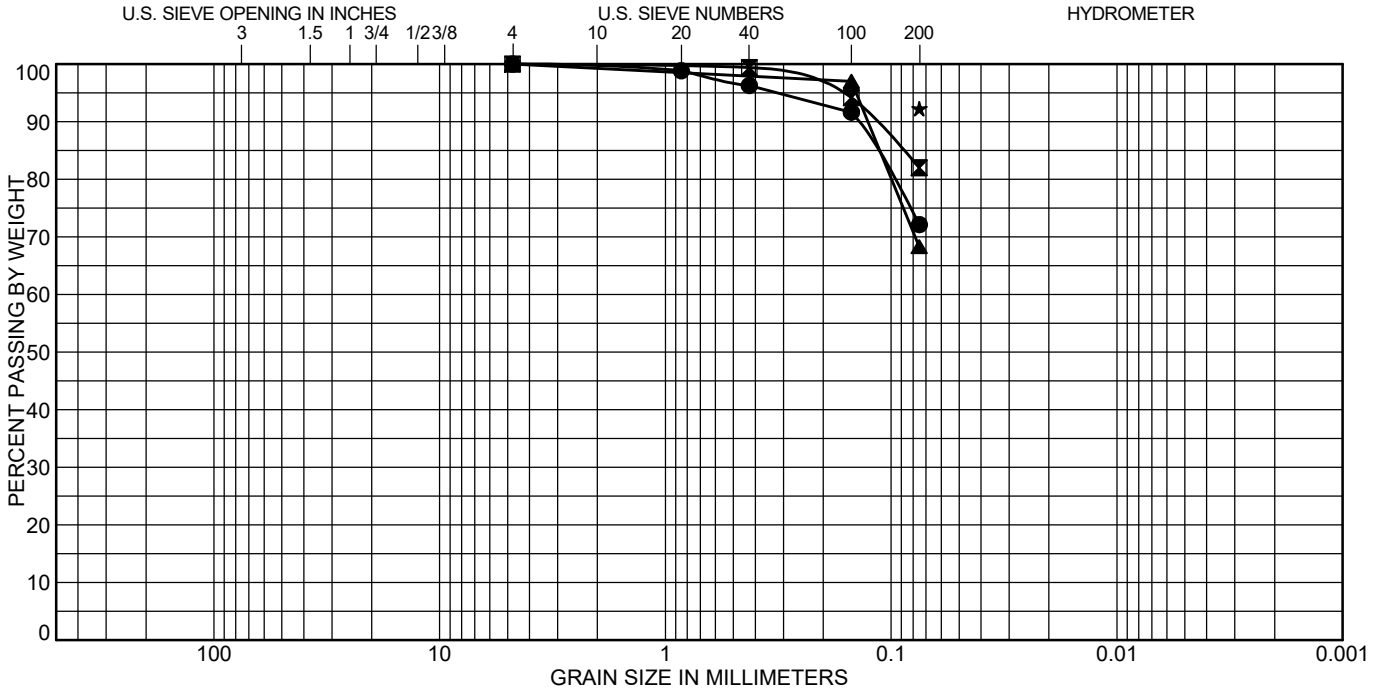
SOIL CLASSIFICATION DATA

JOB No. 173922

FIGURE No. 12

DATE 2/27/20



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Test Boring		Depth (ft)	Classification	LL	PL	PI
●	9	9.0	**LEAN CLAY with SAND(CL)**	36	13	23
⧓	10	4.0	**LEAN CLAY with SAND(CL)**	37	14	23
▲	11	9.0	**SANDY LEAN CLAY(CL)**	31	14	17
★	12	9.0	**LEAN CLAY(CL)**	43	16	27

Test Boring		Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	9	9.0	0.0	27.9	72.1	
⧓	10	4.0	0.0	18.0	82.0	
▲	11	9.0	0.0	31.7	68.3	
★	12	9.0			92.2	

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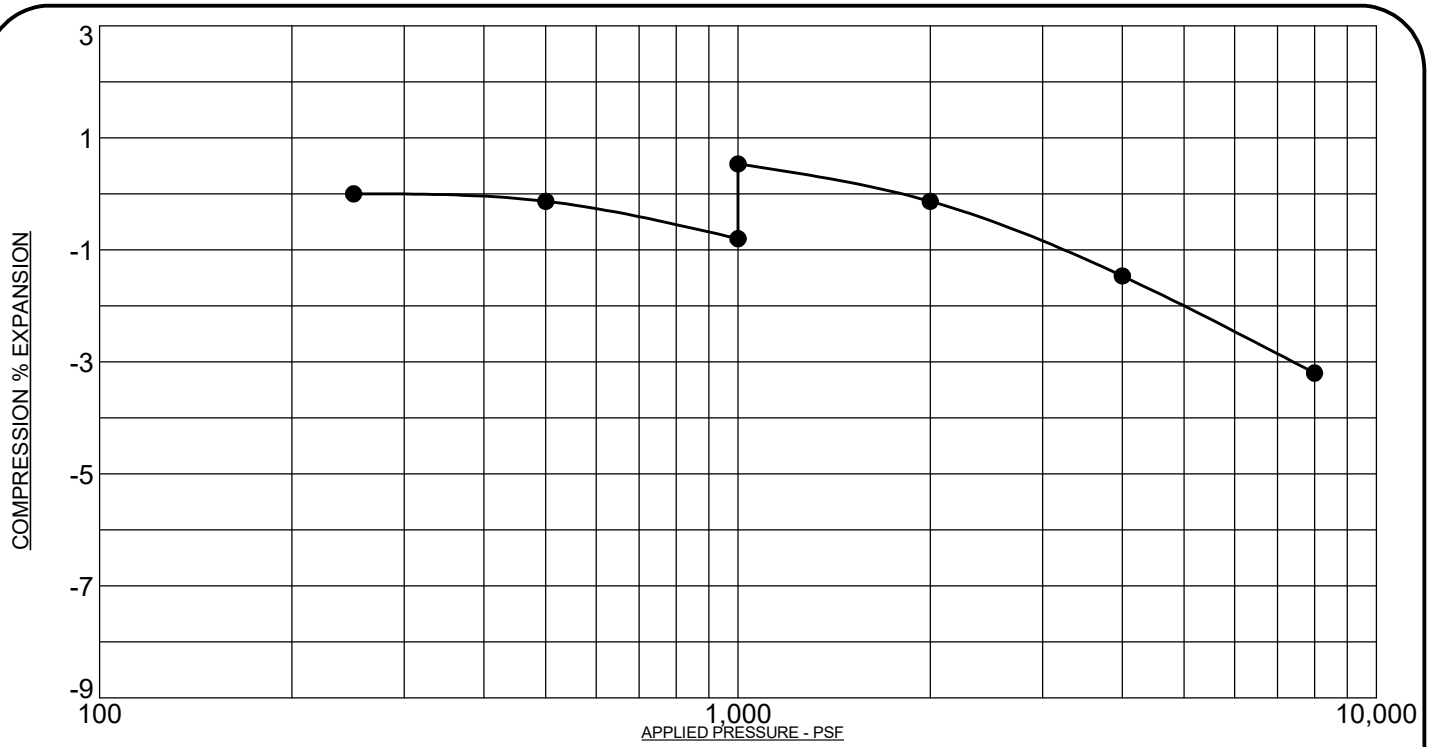
SOIL CLASSIFICATION DATA

JOB No. 173922

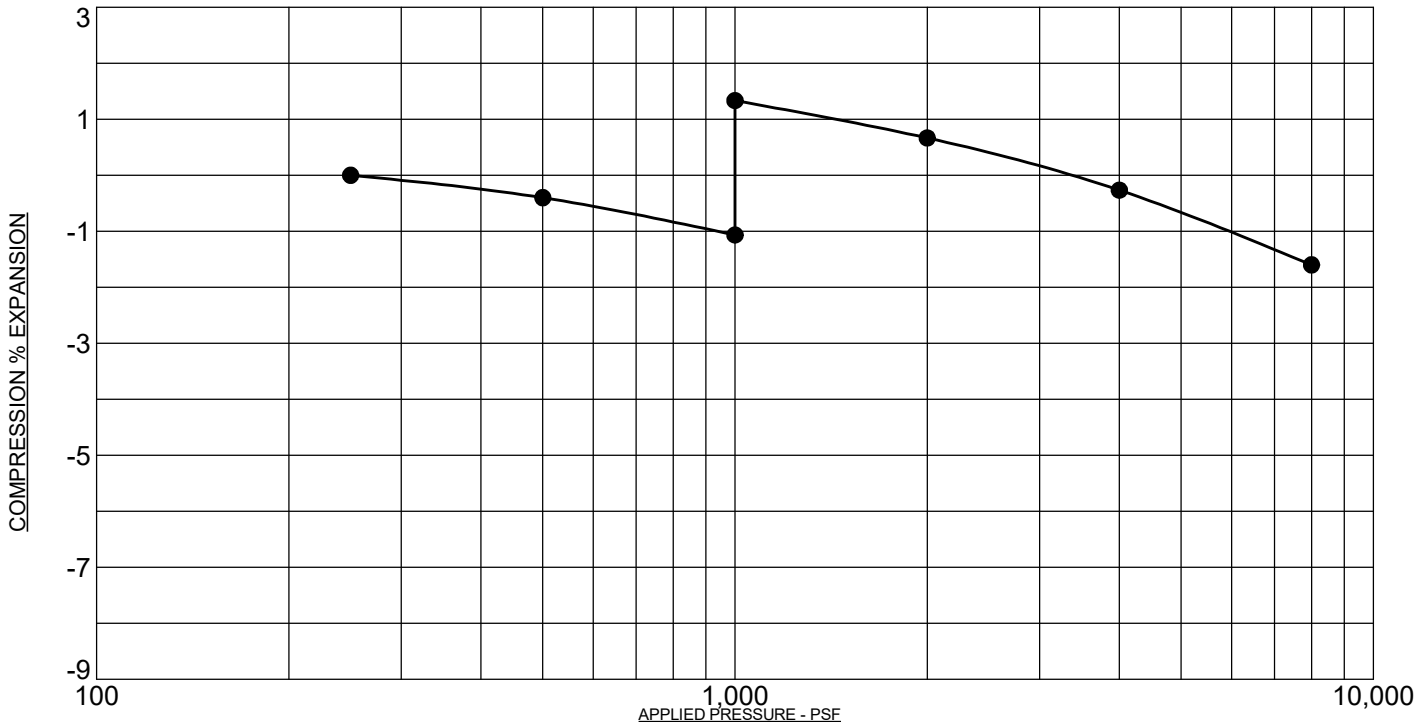
FIGURE No. 13

DATE 2/27/20



PROJECT: **Creekside South, El Paso County, Colorado**
SAMPLE DESCRIPTION: **CLAY, SANDY**
NOTE: SAMPLE WAS INUNDATED WITH WATER AT 1,000 PSF

SAMPLE LOCATION: **1 @ FT**
NATURAL DRY UNIT WEIGHT: **86.0 PCF**
NATURAL MOISTURE CONTENT: **35.9%**
PERCENT SWELL/COMPRESSION: **1.3**



PROJECT: **Creekside South, El Paso County, Colorado**
SAMPLE DESCRIPTION: **CLAYSTONE, SANDY**
NOTE: SAMPLE WAS INUNDATED WITH WATER AT 1,000 PSF

SAMPLE LOCATION: **3 @ 24 FT**
NATURAL DRY UNIT WEIGHT: **117.5 PCF**
NATURAL MOISTURE CONTENT: **17.4%**
PERCENT SWELL/COMPRESSION: **2.4**

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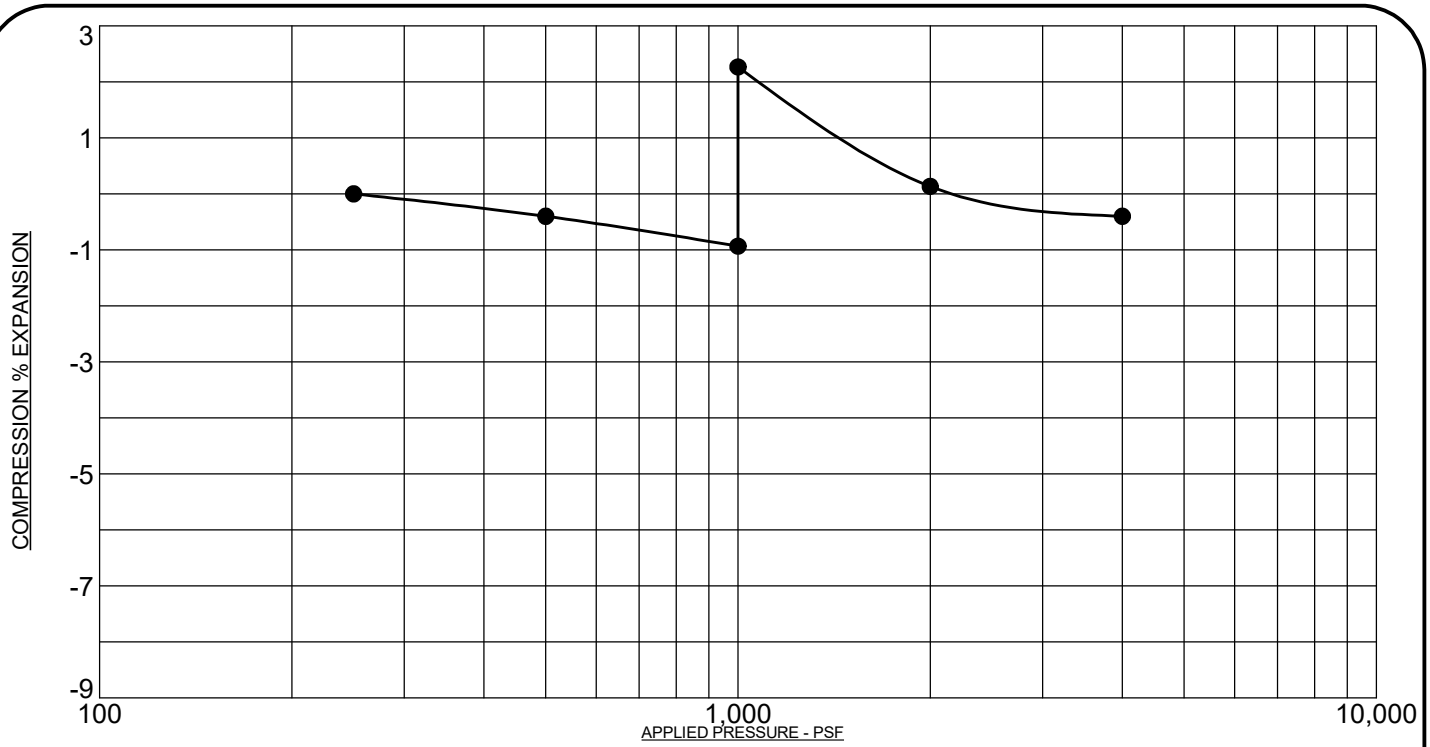
SWELL/CONSOLIDATION TEST RESULTS

JOB No. 173922

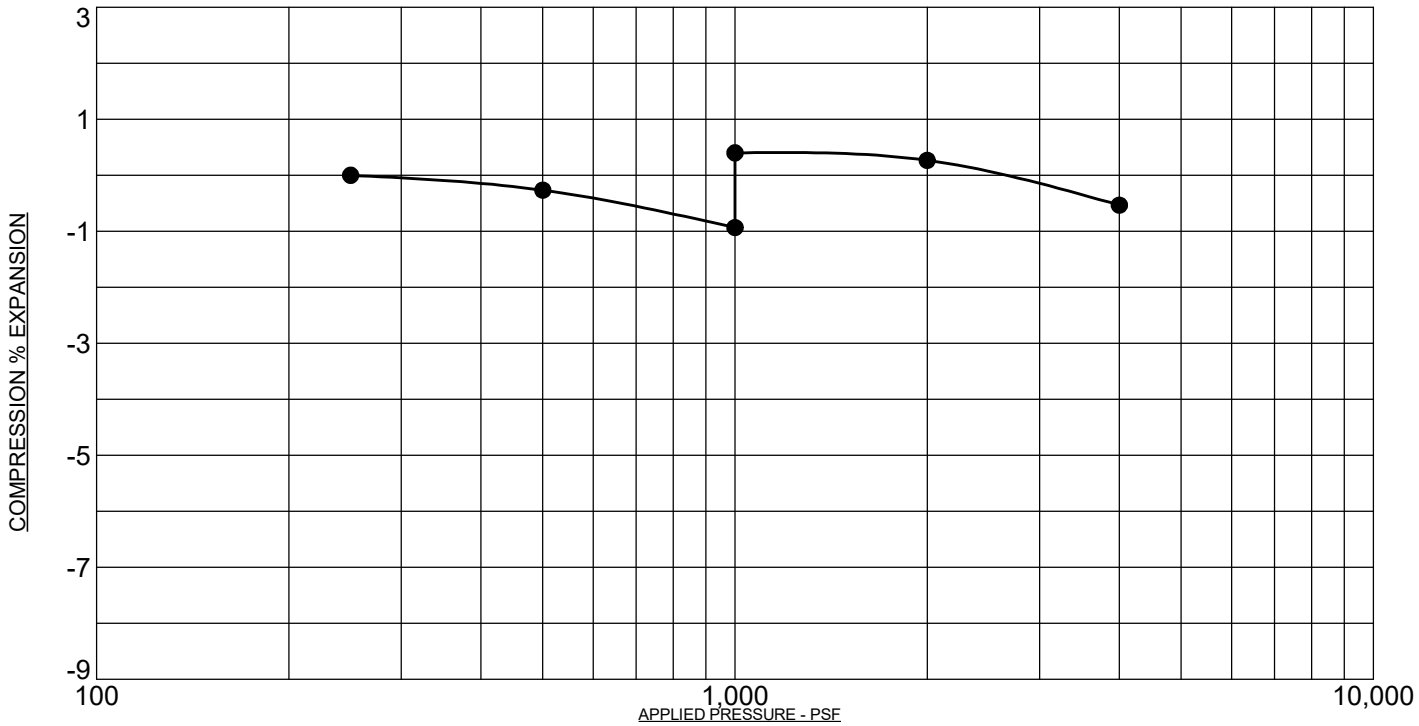
FIGURE No. 14

DATE 2/27/20



PROJECT: **Creekside South, El Paso County, Colorado**
SAMPLE DESCRIPTION: **CLAYSTONE, SANDY**
NOTE: SAMPLE WAS INUNDATED WITH WATER AT 1,000 PSF

SAMPLE LOCATION: **5 @ 14 FT**
NATURAL DRY UNIT WEIGHT: **117.2 PCF**
NATURAL MOISTURE CONTENT: **10.3%**
PERCENT SWELL/COMPRESSION: **3.2**



PROJECT: **Creekside South, El Paso County, Colorado**
SAMPLE DESCRIPTION: **CLAYSTONE, SANDY**
NOTE: SAMPLE WAS INUNDATED WITH WATER AT 1,000 PSF

SAMPLE LOCATION: **6 @ 9 FT**
NATURAL DRY UNIT WEIGHT: **122.5 PCF**
NATURAL MOISTURE CONTENT: **10.1%**
PERCENT SWELL/COMPRESSION: **1.3**

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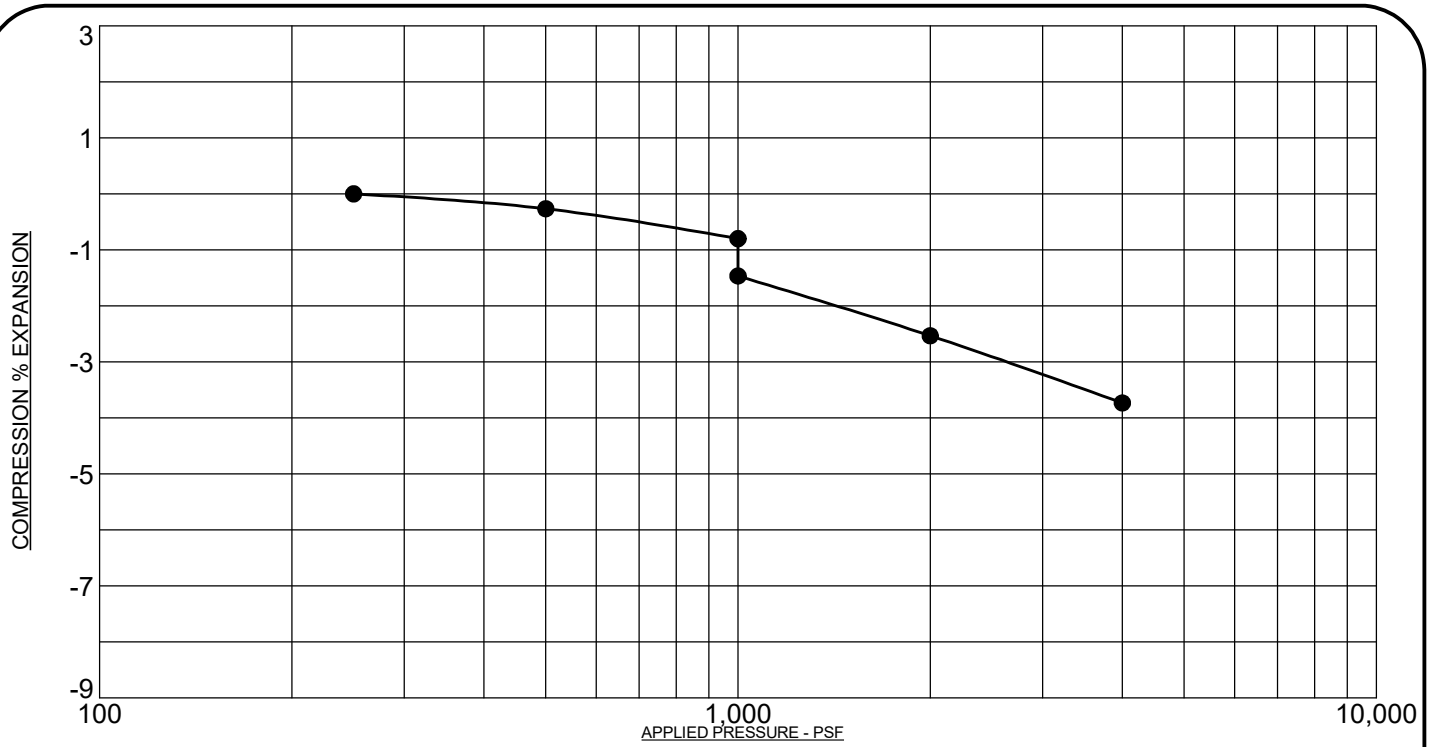
SWELL/CONSOLIDATION TEST RESULTS

JOB No. 173922

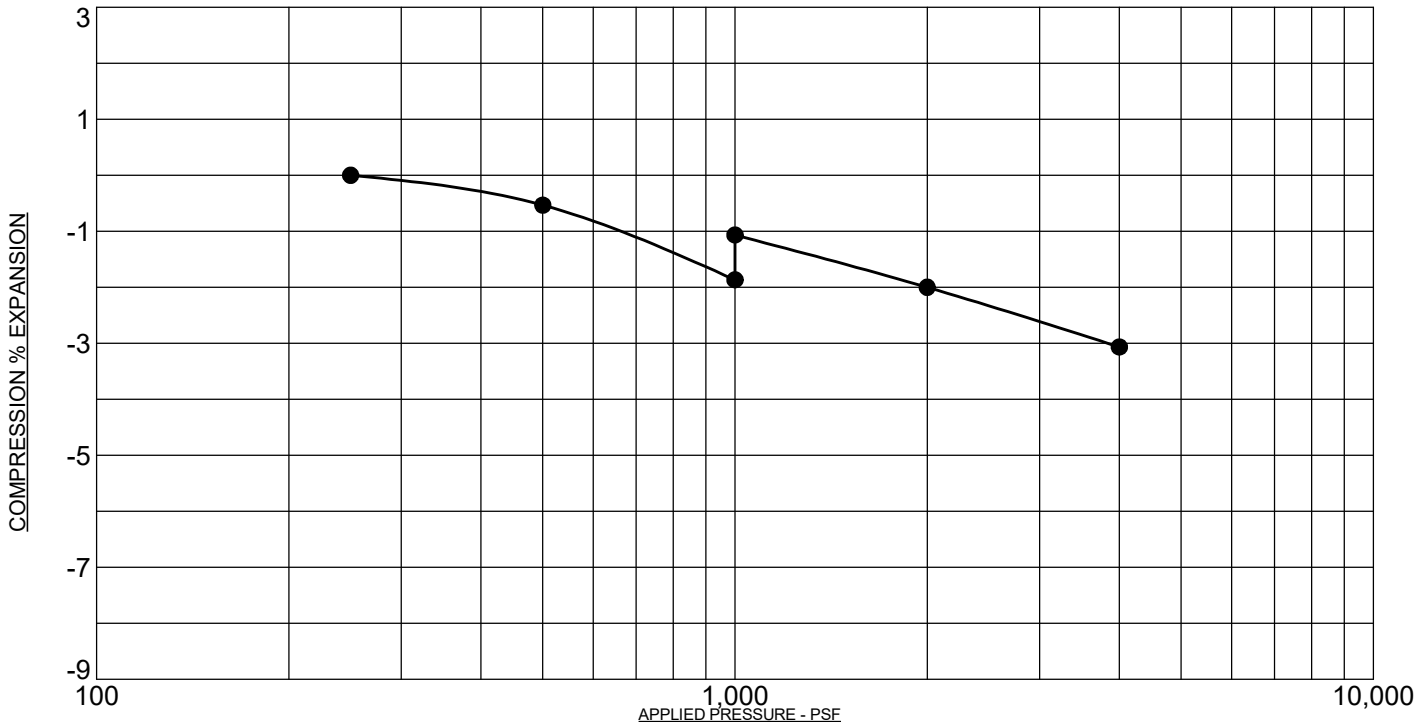
FIGURE No. 15

DATE 2/27/20



PROJECT: **Creekside South, El Paso County, Colorado**
SAMPLE DESCRIPTION: **CLAYSTONE, SANDY**
NOTE: SAMPLE WAS INUNDATED WITH WATER AT 1,000 PSF

SAMPLE LOCATION: **7 @ 14 FT**
NATURAL DRY UNIT WEIGHT: **111.7 PCF**
NATURAL MOISTURE CONTENT: **14.8%**
PERCENT SWELL/COMPRESSION: **- 0.7**



PROJECT: **Creekside South, El Paso County, Colorado**
SAMPLE DESCRIPTION: **CLAYSTONE, SANDY**
NOTE: SAMPLE WAS INUNDATED WITH WATER AT 1,000 PSF

SAMPLE LOCATION: **9 @ 9 FT**
NATURAL DRY UNIT WEIGHT: **123.8 PCF**
NATURAL MOISTURE CONTENT: **10.3%**
PERCENT SWELL/COMPRESSION: **0.8**

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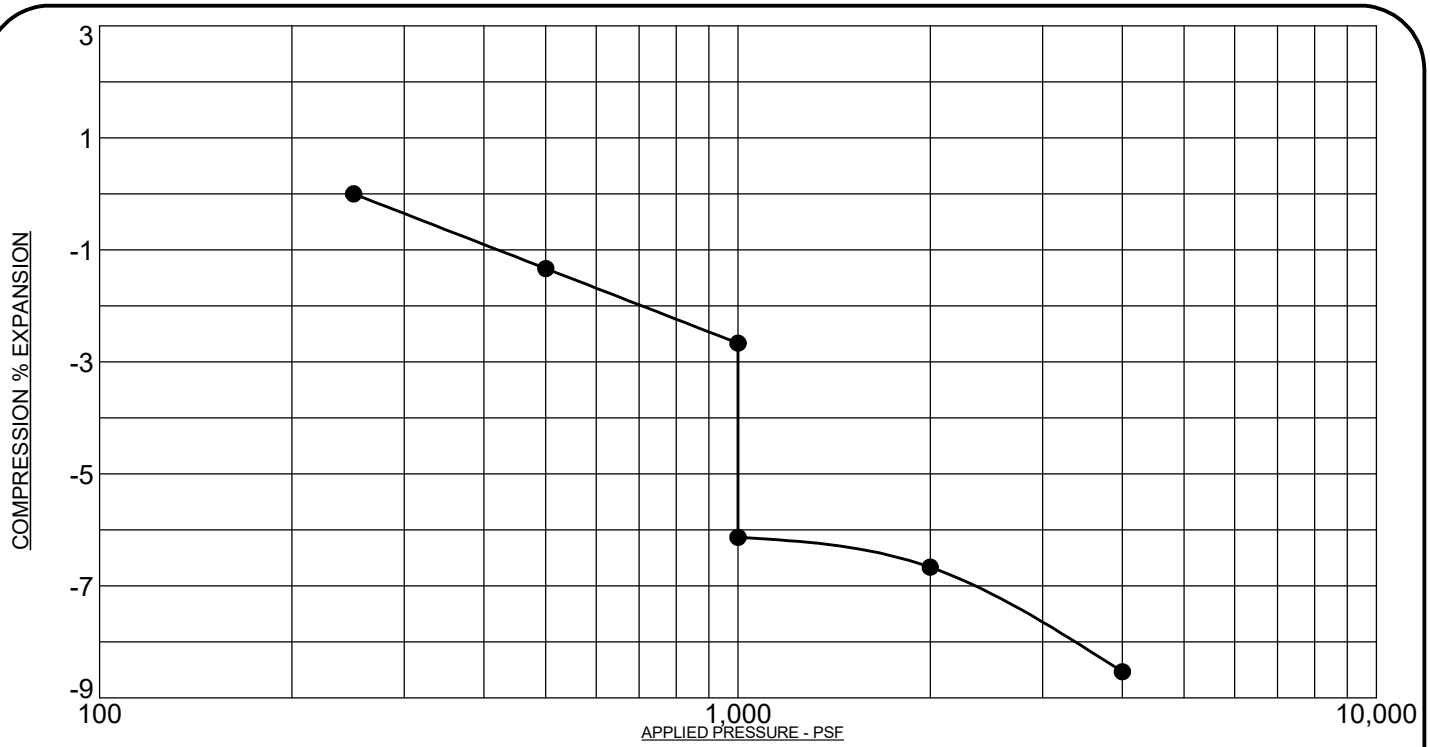
SWELL/CONSOLIDATION TEST RESULTS

JOB No. 173922

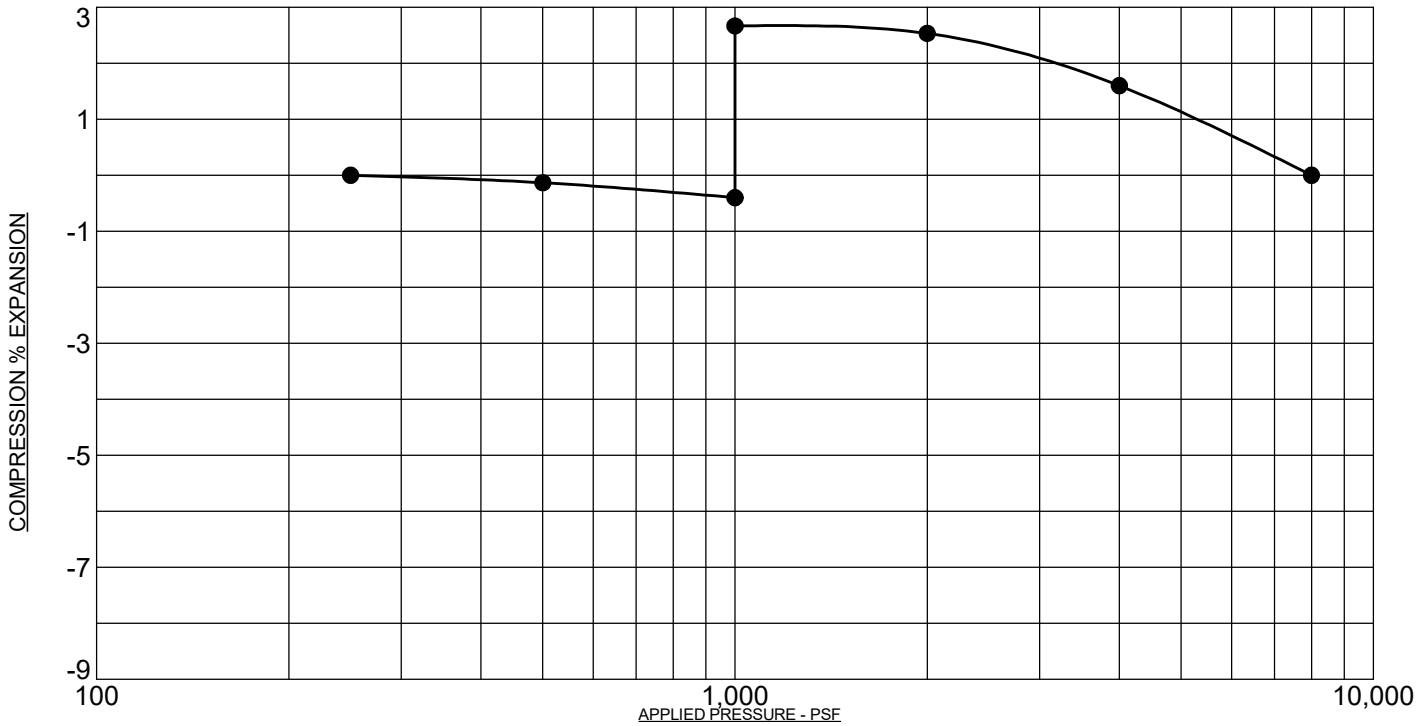
FIGURE No. 16

DATE 2/27/20



PROJECT: **Creekside South, El Paso County, Colorado**
SAMPLE DESCRIPTION: **CLAY, SANDY**
NOTE: SAMPLE WAS INUNDATED WITH WATER AT 1,000 PSF

SAMPLE LOCATION: **10 @ 4 FT**
NATURAL DRY UNIT WEIGHT: **104.7 PCF**
NATURAL MOISTURE CONTENT: **16.7%**
PERCENT SWELL/COMPRESSION: **- 3.5**



PROJECT: **Creekside South, El Paso County, Colorado**
SAMPLE DESCRIPTION: **CLAY, SANDY**
NOTE: SAMPLE WAS INUNDATED WITH WATER AT 1,000 PSF

SAMPLE LOCATION: **12 @ 9 FT**
NATURAL DRY UNIT WEIGHT: **117.4 PCF**
NATURAL MOISTURE CONTENT: **13.5%**
PERCENT SWELL/COMPRESSION: **3.1**

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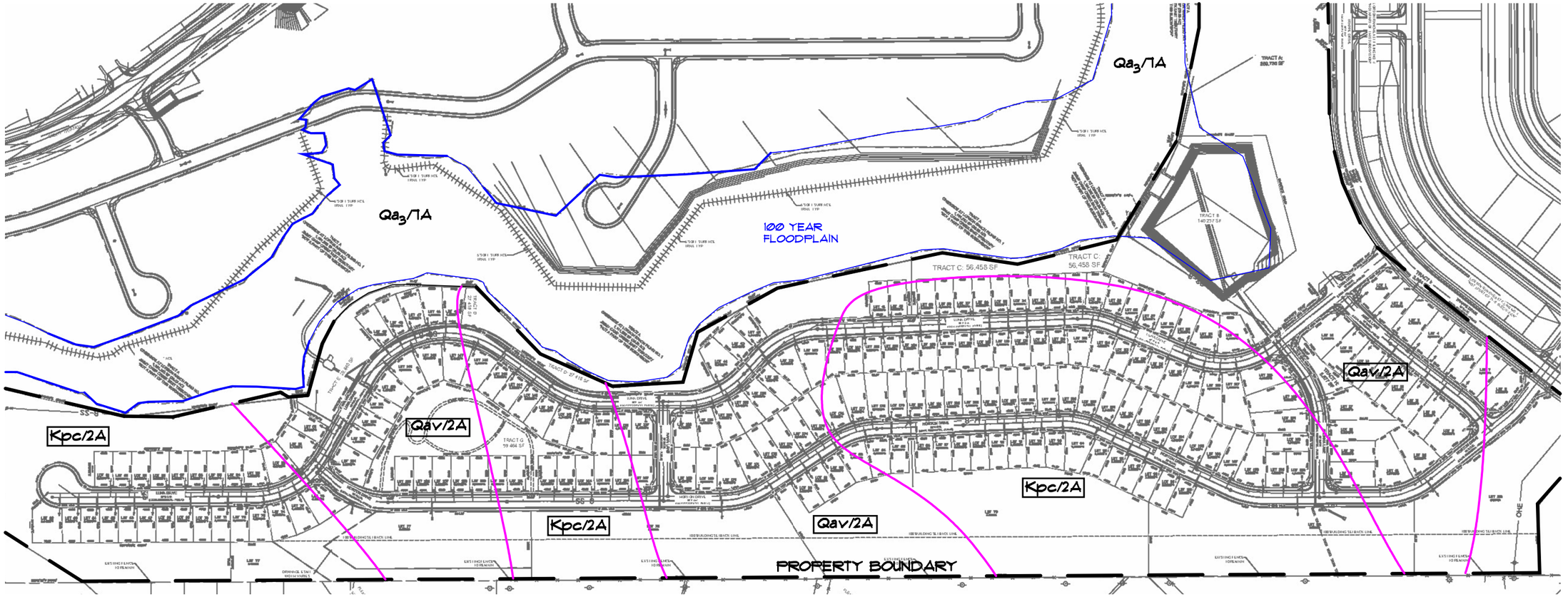
SWELL/CONSOLIDATION TEST RESULTS

JOB No. 173922

FIGURE No. 17

DATE 2/27/20



Geologic

Qa_3- Alluvium three (lower to middle? Holocene) - well-sorted sand and clayey to silty sand, may contain gravel lenses. Forms board terraces along Jimmy Camp Creek. Unit is up to 50 feet thick and was encountered up to 34 feet in the borings. Unit may be prone to settlement and/or swelling.

Qav - Valley-fill alluvium (Holocene) - unsorted to poorly sorted, weakly stratified, sandy to clay deposited as valley fill in broad drainage swales on low hillsides, underlain by the Pierre Shale. Unit thickenss ranges from 5 to 20 feet depending on width of drainageway. Contains, expansive clay and may be prone to swelling. The unit is unrecognizable difficult to determine from alluvium three in test borings.

Kpc - Pierre Shale, cone-in-cone zone of Lavington (1993) Formation (upper Cretaceous) - typically consists of dark-gray to tan-gray and olive brown subblocky to finely fissile non=calcareous shale, thin bentonite beds with very fine-grained sandstone. Thickness of zone is approximately 2,290 feet.

Engineering

2A - Stable alluvium, colluvium and bedrock on gentle to moderate slopes (5 to 12%).

7A - Physiographic floodplain where erosion and deposition presently occur and is generally subject to recurrent flooding. Includes 100-year floodplain along majoy streams where floodplain studies have been conducted.

NOT TO SCALE

BASE MAP PROVIDED BY: KIMLEY HORN

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Monument Office:
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Pueblo / Canon City:
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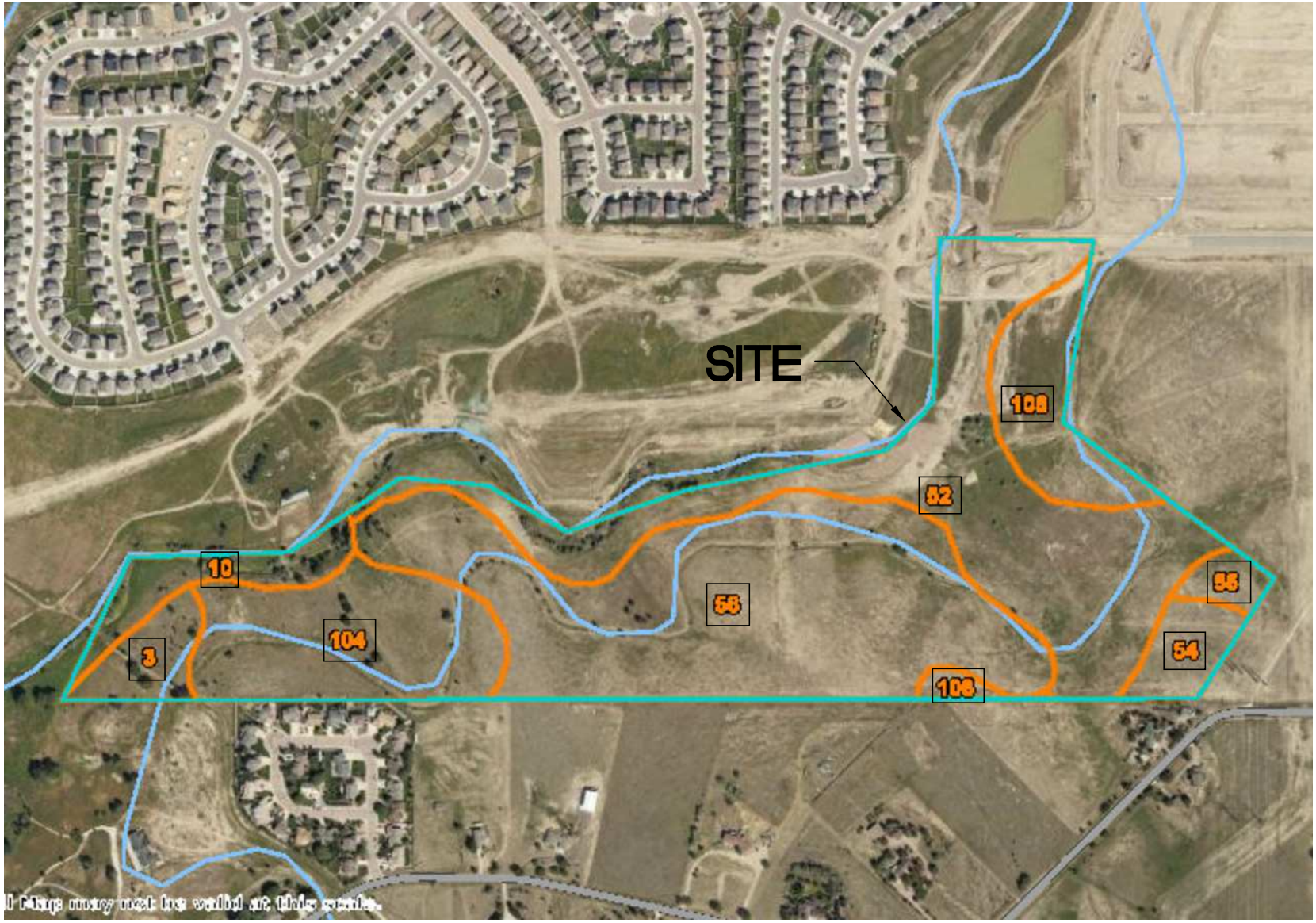
CREEKSIDE SOUTH
AT LORSON RANCH
EL PASO COUNTY, CO
LANDHUIS, CO

ENGINEER:	
DRAWN BY:	KMZ
CHECKED BY:	TPM
ISSUED:	2-27-2020

ENGINEERING AND GEOLOGY MAP

SHEET No.
FIG-18



DESCRIPTIONS OF EACH USDA SOIL TYPE CAN BE FOUND IN SECTION 6.4 (U.S. SOILS CONSERVATION SERVICE) OF THE REPORT

NOT TO SCALE
BASE MAP PROVIDED BY:USDA

JOB No. 173922
FIG No. 19
DATE 2-27-2020

USDA SOILS SURVEY MAP

CREEKSIDE SOUTH
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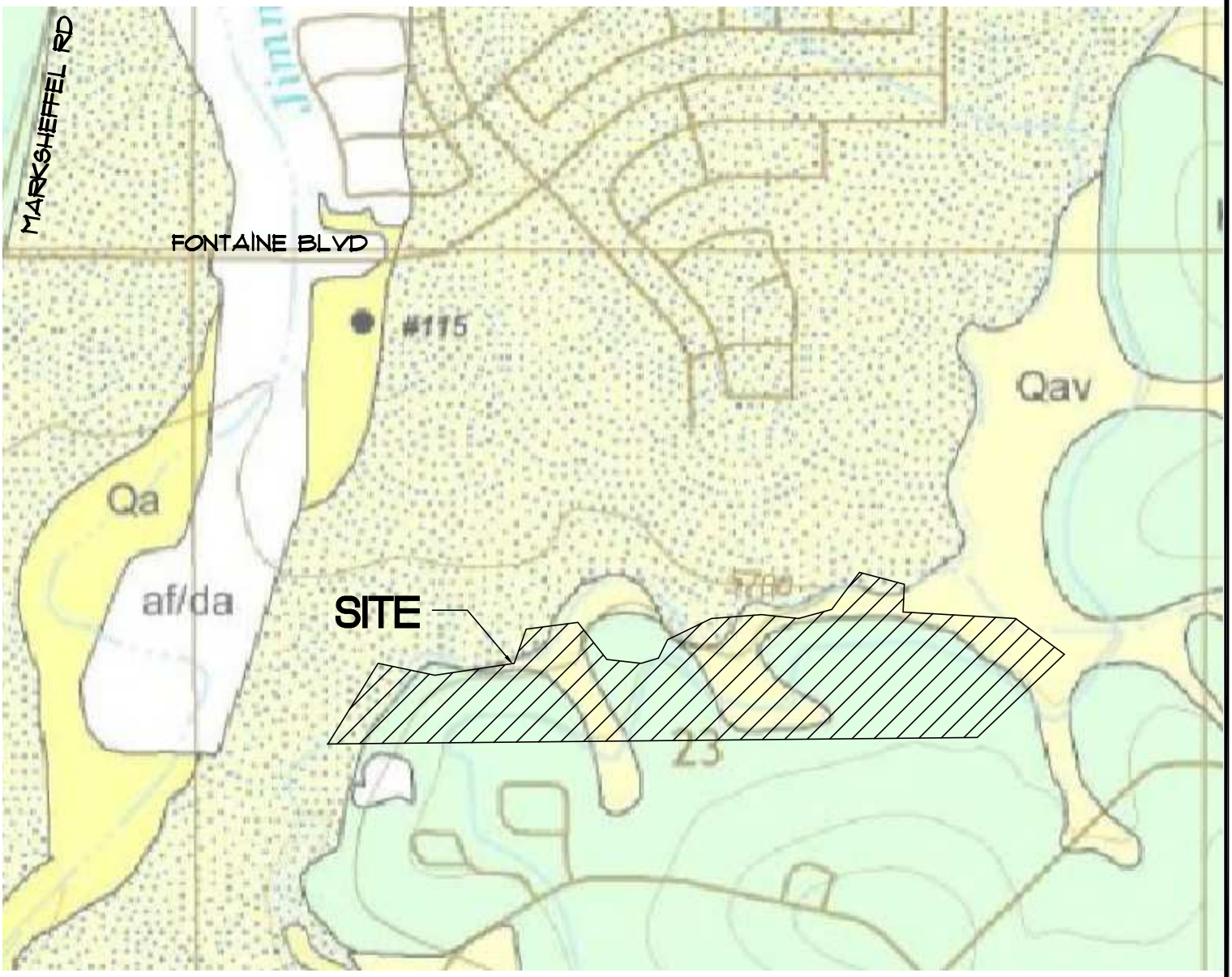

Qa_3 - Alluvium three (lower to middle? Holocene)

Qav - Valley-fill alluvium (Holocene)

Kpc - Pierre Shale, cone-in-cone zone of Lavington (1993) Formation (Upper Cretaceous)

NOT TO SCALE

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Colorado Springs,CO 80918
(719) 548-0600
Central Office:
Englewood, CO 80112
(303) 688-9475
Northern Office:
Greeley / Evans, CO 80620
(970) 330-1071

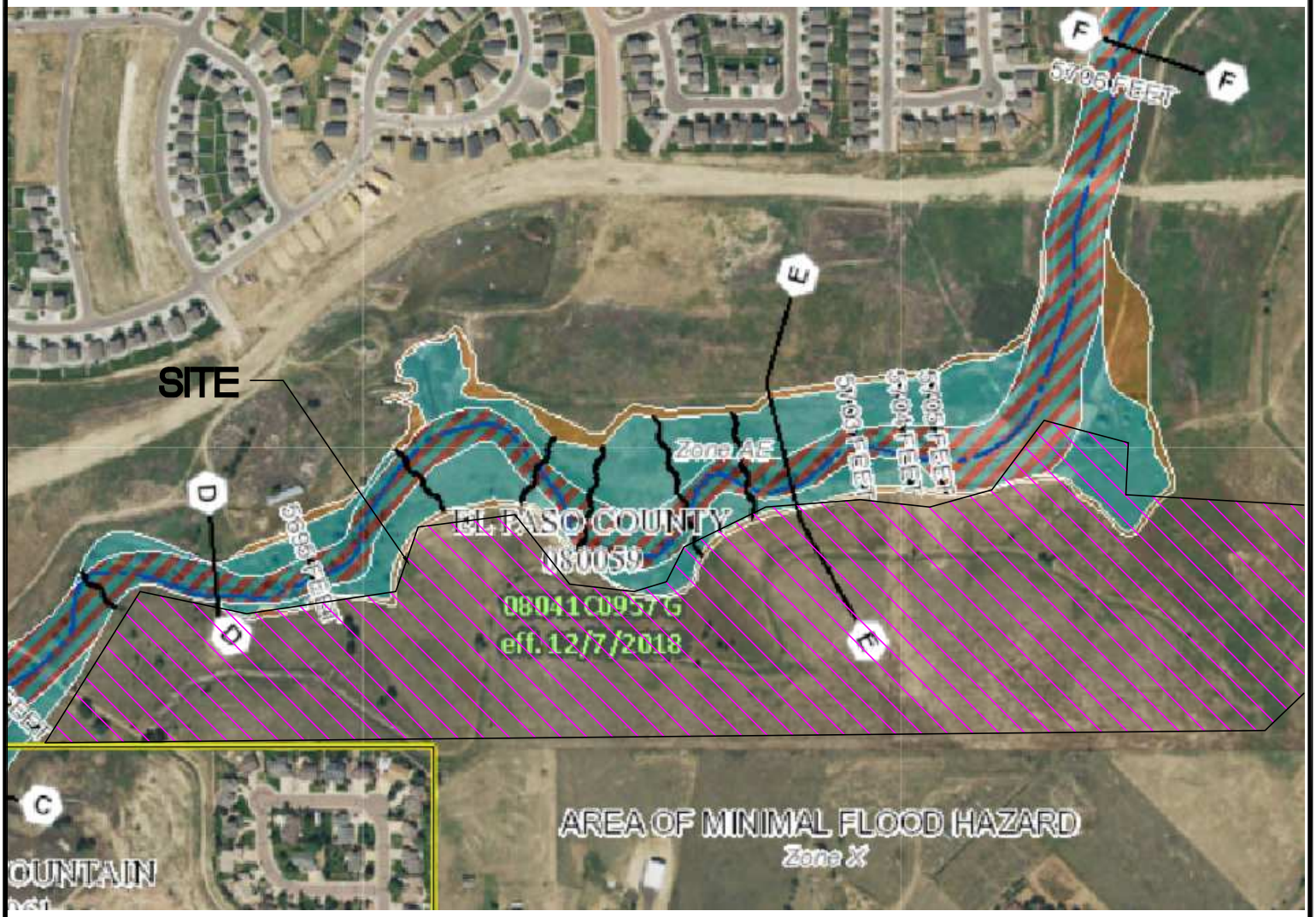
FOUNTAIN QUADRANGLE

CREEKSIDE SOUTH
AT LORSON RANCH
EL PASO COUNTY, COLORADO
LANDHUIS COMPANY

JOB No. 173922

FIG No. 20

DATE 2-27-2020



NOT TO SCALE

ARCHITECTS RMG ENGINEERS
ROCKY MOUNTAIN GROUP

Southern Office
Colorado Springs,CO
80918
(719) 548-0600
Central Office:
Englewood, CO 80112
(303) 688-9475
Northern Office:
Greeley / Evans, CO 80620
(970) 330-1071

FEMA MAP

CREEKSIDE SOUTH
AT LORSON RANCH
EL PASO COUNTY, COLORADO
LANDHUIS COMPANY

JOB No. 173922

FIG No. 21

DATE 2-27-2020

APPENDIX A
Additional Reference Documents

1. *PUD & Preliminary Plan, Creekside South at Lorson Ranch, El Paso County, Colorado*, prepared by Kimley Horn., Project No. 2816.20, last dated February 10. 2020.
2. *Carriage Meadows South at Lorson Ranch, Early Overlot Grading and Erosion Control Plan, El Paso County Colorado,* prepared by Core Engineering Group, Project No. 100.051, last dated January 15, 2020.
3. *Preliminary Drainage Plan, Creekside at Lorson Ranch, PUD SP-20-X*, prepared by Core Engineering Group, Project No. 100.051, last dated January 15, 2019.
4. *Flood Insurance Rate Map, El Paso County, Colorado and Unincorporated Areas, Community Panel No. 081041C0975G,* Federal Emergency Management Agency (FEMA), effective December 7, 2018.
5. *Geologic Map of the Fountain quadrangle, El Paso County, Colorado*, Jonathan L. White, Kassandra O. Lindsey, Matthew L. Morgan, and Shannon A. Mahan. Colorado Geological Survey Open-File Report OF-17-05.
6. *Fountain, Quadrangle, Environmental and Engineering Geologic Map for Land Use*, compiled by Dale M. Cochran, Charles S. Robinson & Associates, Inc., Golden, Colorado, 1977.
7. *Fountain, Quadrangle, Map of Potential Geologic Hazards and Surficial Deposits*, compiled by Dale M. Cochran, Charles S. Robinson & Associates, Inc., Golden, Colorado, 1977.
8. *Pikes Peak Regional Building Department:* https://www.pprbd.org/.
9. https://property.spatialest.com/co/elpaso/#/property/5522105006 Schedule No.: 5522105006.
10. *Colorado Geological Survey, USGS Geologic Map Viewer*: http://coloradogeologicalsurvey.org/geologic-mapping/6347-2/.
11. *Historical Aerials:* https://www.historicaerials.com/viewer, Images dated 1947, 1960, 1969, 1999, 2005, 2009, 2011, 2013, and 2015.
12. *USGS Historical Topographic Map Explorer:* http://historicalmaps.arcgis.com/usgs/ Colorado Springs Quadrangles dated 1950, 1951, 1958, 1963, 1969, 1970, 1975, 1978, 1981, 1994, 2013 and 2016.
13. *Google Earth Pro*, Imagery dated 1999, 2003, 2004, 2005, 2006, 2011, 2015, and 2017.