Structural
Geotechnical

Materials Testing
Forensic

SOIL AND GEOLOGY STUDY

Team Chris Subdivision
Black Squirrel Creek
El Paso County, Colorado

PREPARED FOR:

Christine Tschamler
6275 Montarbor Drive
Colorado Springs, CO 80918

JOB NO. 196369

September 13, 2024

Respectfully Submitted,
RMG – Rocky Mountain Group

Kelli Zigler
Project Geologist

Reviewed by,
RMG – Rocky Mountain Group

Tony Munger, P.E.
Sr. Geotechnical Project Manager

TABLE OF CONTENTS

1.0 GENERAL SITE AND PROJECT DESCRIPTION

1.1 Project Location

The project lies in the NE¼ of Section 14, Township 11 South, Range 65 West of the 6th Principal Meridian in El Paso County, Colorado. The site is generally located on the southeast corner of the intersection of Black Squirrel Road and Black Squirrel Road. The approximate location of the site is shown on the Site Vicinity Map, Figure 1.

EPC database has the private road listed as Lil Squirrel Lane. Please update this throughout this report in both the written narrative and figures.

1.2 Existing and Proposed Land Use

The site currently consists of one parcel (per the El Paso County Assessor's website):

- Schedule No. 5114000019, currently labeled as Black Squirrel Rd, zoned RR-5, consists of approximately 20 acres of vacant land.

The site currently does not have an access road to the proposed build sites. Access to the property was made through the trees, where possible for a truck mounted drill rig and mini-excavator.

1.3 Project Description

It is our understanding the parcel is to be subdivided into three lots. According to the proposed concept plan provided by our Client, the lots are to consist of approximately 6.38 to 6.40 acres each. Each lot is to eventually contain a single-family residence, a well, and an On-site Wastewater Treatment System (OWTS). The Proposed Lot Layout is presented in Figure 2, Proposed Lot Layout.

1.4 Previous Investigations

A Wastewater Study was performed in conjunction with this study and is listed below:

1. *Wastewater Study, Black Squirrel Rd, El Paso County, Colorado*, RMG – Rocky Mountain Group, Job No. 196369, dated September 13, 2024.

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

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, P.E. is a licensed professional engineer with over 23 years of experience in the construction engineering (residential) field. Mr. Munger holds a B.S. in Architectural Engineering from the University of Wyoming.

3.0 STUDY OVERVIEW

The purpose of this investigation is to characterize the general geotechnical, geologic site conditions and present our opinions of the potential effect of these conditions on the proposed development within the town of Peyton, El Paso County, Colorado. 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 El Paso County Engineering Criteria Manual (ECM), specifically Appendix C last updated July 9, 2019.

3.1 Scope and Objective

The scope of this study is to include 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.

The objectives of our study are to:

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

This report presents the findings of the study performed by RMG-Rocky Mountain Group 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 several sources, including:

- Geologic and topographic maps
- Review of selected publicly available, pertinent engineering reports
- Exploratory test borings and test pits
- Available aerial photographs
- Geologic research and analysis

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 at this time.

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 site is vacant land, bound to the north, east and west by Black Squirrel Road, and to the south by a partially developed single-family residential parcel. The site is located primarily within the W. Kiowa Creek Drainage. W. Kiowa Creek is located south of the property and trends down from the west to the east.

4.2 Topography and Vegetation

The site surface characteristics were observed to consist of flat to mildly rolling terrain with low lying grasses, weeds, and dense forest. An intermittent drainage is traverses the lots from the northeast corner to the southwest corner. Below is an image from the Black Forest 2022 (US Topo) indicating the intermittent drainage.

Insert from USGS 2022 Topo

Northwest

4.3 Aerial Photographs and Remote-Sensing Imagery

Personnel of RMG reviewed aerial photos available through Google Earth Pro dating back to 1952, Colorado Geological Survey (CGS) surficial geologic mapping, and historical photos by historicaerials.com dating back to 1947. The intermittent drainage is clearly visible in the 1955, 1956, and 1969 photos. Since 1969, the forest has become denser obscuring the drainage. Northeast of the site, upstream within the drainage, is an earthen dam and spillway that has been in place since prior to 1952. The site has remained undeveloped land to present.

5.0 FIELD INVESTIGATION AND LABORATORY TESTING

The current subsurface conditions within the property were explored by drilling two (2) exploratory test borings to depths of 20-feet below the existing ground surface on May 10, 2024 and observing two 8-foot deep test pits on May 17, 2024. The test pits were excavated for preliminary OWTS purposes. The total number of borings generally meets the minimum criteria as stipulated in 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 Modified O.D. California sampler, respectively. Results of penetration tests are shown on the drilling logs. The test boring locations are presented in the Test Boring Location Plan, Figure 3. An Explanation of Test Boring Logs is presented in Figure 4 and the Test Boring Logs are presented in Figure 5.

5.1 Laboratory Testing

Soil laboratory testing was performed as part of this investigation. Laboratory testing included moisture content, grain-size analysis and Atterberg Limits. A Summary of Laboratory Test Results is presented in Figure 6. Soil Classification Data is presented in Figure 7. Denver/Consolidation Test Results are presented in Figure 8.

5.2 Groundwater

Groundwater was encountered in both the test borings at depths ranging between 8 and 19 feet during the field exploration for this investigation. Groundwater or indications of groundwater (or redoximorphic features) was not observed in the test pits. Our test borings and test pits were located adjacent to the drainageway to capture the "worst-case" scenario for seasonal groundwater and/or perched water. The subsurface water encountered at 8 feet in test boring TB-2 appears to be perched atop the bedrock and may not be indicative of the true groundwater table located at depth, at approximately 19 feet.

It should be noted that in granular soils and bedrock, 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, as encountered in our test borings. Builders and planners should be cognizant of the potential for the occurrence of subsurface water conditions during on-site construction, in order to evaluate and mitigate each individual problem as necessary.

Fluctuations in groundwater and subsurface moisture conditions will occur due to variations in rainfall, irrigation, changes in surface drainage patterns, and other factors not readily apparent at this time. Development of the property and adjacent properties may also affect groundwater levels. In the absence of irrigation, a minimum of 4 to 6-feet of fluctuation in groundwater levels, perched or within the fractured bedrock, should be expected.

5.3 OWTS Visual and Tactile Evaluation

The visual and tactile information obtained by RMG for the *Wastewater Study* was considered in the preparation of this investigation. Bedrock was not encountered in the 8-foot deep test pits. Neither restrictive layers nor seasonal high groundwater were encountered in the test pits. However, based on the test borings, restrictive layers, such as shallow perched water and/or bedrock may be present in some portions of the site at depths that would impact the proposed OWTS systems.

Soil and groundwater conditions at the site are suitable for individual treatment systems. The LTAR values ranged between 0.15 and 0.60 for the onsite soils observed in the test pits. It should be noted that the LTAR values are for the test pit locations performed for this report only. The LTAR values may change throughout the site. If an LTAR value of less than 0.35 (soil types 3A to 5) or greater than 0.80 (soil type 0) is encountered at the time of the site specific OWTS evaluation, an "engineered system" will be required.

Based on the soils encountered in our test pits, soil type 3A (LTAR 0.30), soil type 4 (LTAR 0.20), and soil type 4A (LTAR 0.15) and the potential for restrictive layers, "engineered systems" should be anticipated for all the lots within the subdivision.

6.0 SOIL, GEOLOGY, AND ENGINEERING GEOLOGY

The site is located within the western portion of the Great Plains Physiographic Province. A major structural feature known as the Rampart Range Fault is located approximately 17 miles west of the site. Rampart Range Fault marks the boundary between the Great Plains Physiographic Province and the Southern Rocky Mountain Province. The site exists within the southern edge of a large structural feature known as the Denver Basin. In general, the geology at the site consists of alluvium overlying the bedrock of the Upper part of the Dawson Formation. The alluvium generally consists of gravelly loamy sands to extremely gravelly loamy sands. The upper part of the Dawson Formation is generally comprised of the arkosic sandstone, claystone, mudstone, conglomerate, and localized coal beds.

6.1 Subsurface Soil Conditions

The subsurface materials encountered in the test boring were classified within the laboratory using the Unified Soil Classification System (USCS). The materials classify primarily as silty to clayey sand, sandstone bedrock (SM/SC), sandy clay and claystone (CL).

Additional descriptions and the interpreted distribution (approximate depths) of the subsurface materials are presented on the Test Boring Logs. The classifications shown on the log are based upon the engineer's description 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

Bedrock was encountered in one of the test borings performed for this study, at a depth of 8 feet. In general, the bedrock (as mapped by CGS) is considered part of the Dawson formation and consists of silty sandstone with interbedded layers of claystone. The Dawson formation is thick-bedded to massive, generally light colored arkose, pebbly, and pebble conglomerate. The sandstone is generally poorly sorted with various amounts of clay content. The sandstone is generally permeable, well drained, and has good foundation characteristics. The claystone is generally well sorted with high sand content. The claystone is less permeable than the sandstone and is generally not suitable for direct bearing of shallow foundations.

If bedrock is encountered, the Dawson sandstone and claystone can readily be excavated with standard construction equipment such as a front-end loader, skid loader, and/or (mini) excavator. Blasting of rock is not expected.

6.3 U.S. Soil Conservation Service

The United States Department of Agriculture (USDS) and the Natural Resources Conservation Services (NRCS) soil survey identified the following soil types on the property. The soil conditions as indicated by the USDS data are anticipated to consist of:

- 26 – Elbeth sandy loam, 8 to 15 percent slopes. The Elbeth sandy loam was mapped by the USDA to encompass the majority of the site. Properties of the Elbeth sandy loam include well drained soils, depth of the water table is anticipated to be greater than 80 inches, runoff is anticipated to be medium, frequency of flooding and/or ponding is none, and landforms include hills.
- 36 – Holderness loam, 8 to 15 percent slopes. The Holderness loam was mapped by the USDA to encompass the northeast and northwest corners of the site. Properties of the Holderness loam include well drained soils, depth of the water table is anticipated to be greater than 80 inches, 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 below.

Note, as stated on the original download from the USDA, the soil map may not be valid at the scale it was printed at, map scale 1:2,150 as printed on a landscape (11" x 8.5") sheet.

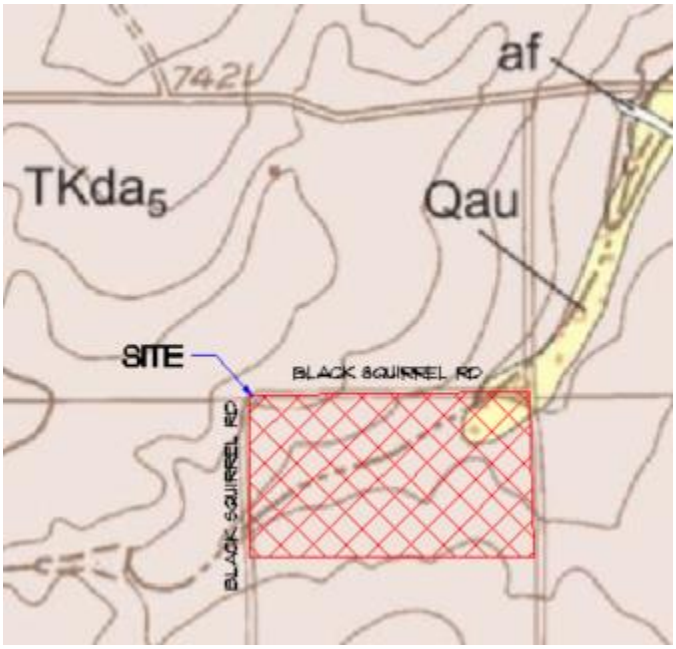
Insert from USDA, National Resources Conservation Service

6.4 General Geologic Conditions

Based on review of relevant geologic maps, we identified the geologic conditions (listed below) affecting the development, as shown on the Engineering and Geology Map, Figure 9.

The site generally consists of alluvium deposits of the Holocene and Pleistocene overlying the Dawson Formation at depth. The following general geologic units were mapped/observed at the site:

- *TKda5 – Dawson formation, facies unit five* – white to light tan, thin to medium bedded, fine to medium-grained feldspathic sandstone or pebbly conglomerate. The Dawson is known to contain occasional interbedded sandy claystone. Estimated thickness is around 500 feet. The Dawson sandstone was encountered in one the test borings, TB-2 at a depth of 7 feet and extended to the 20-foot termination depth of the boring. The sandstone bedrock is anticipated to be encountered at various depths across the site.



Insert from the Black Forest 2022 (US Topo)

- *psw – potentially seasonally wet* – areas that may collect surface water during high moisture events.

6.5 Engineering Geology

One engineering geology unit was mapped at the site and is shown on the Engineering and Geology Map, Figure 9.

- *2D* – Eolian deposits generally on flat to gentle slopes of upland areas.

6.6 Structural Features

Structural features such as schistocity, folds, zones of contortion or crushing, joints, shear zones or faults were not observed by RMG on the site or in the surrounding area.

6.7 Surficial (Unconsolidated) Deposits

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

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. Features indicating settlement or subsidence such as fissures, scarplets, and offset reference features were not observed on the study site or surrounding areas.

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

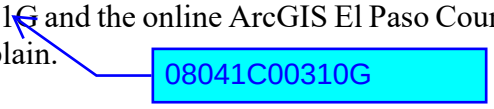
However, it should be emphasized that all construction should remain outside the natural drainageway unless regrading of the drainageway is planned on a lot by lot basis. If regrading is proposed, it is recommended prior to construction, a civil engineer should consider the potential impacts of surface runoff water (particularly within the drainageway) when selecting locations for the proposed structures and wastewater treatment areas, near the drainageway.

6.9 Groundwater and Drainage of Surface Water

The overall topography of the site slopes down from the southwest to the northeast. It is anticipated the direction of surface water and groundwater is to flow in the same direction. Groundwater was encountered in both the test borings but was not encountered in the test pits performed for this current study and the *Wastewater Study* (referenced in Appendix A).

6.10 Flooding and Surface Drainage

Based on our review of the Federal Emergency Management Agency (FEMA) Community Panel No. 08041C0031G and the online ArcGIS El Paso County Risk Map, the entire site lies outside of a 100-year floodplain.



Zone X is defined by FEMA as an area of minimal flood hazard that is determined to be outside the Special Flood Hazard Area and higher than the elevation of the 0.2-percent-annual-chance (or 500-year) flood. The entire site lies within Zone X, as indicated in the photo below.

Insert from National Flood Hazard Layer FIRMette, USGS National Map 2023

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. The valley fill deposits consist of sand and gravel with silt and clay deposited by water in one or a series of stream valleys. Extraction of the sand and gravel more than likely would not be 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. However, the area of the site has been mapped "Somewhat 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. No oil and gas wells are drilled on this tract, or within two miles of it. There are no historic coal mines in the vicinity. In this part of the Denver coal region, coal resources are locally present within the lower part of the Laramie Formation of Upper Cretaceous age.

The alluvium on this site may contain trace sand or gravel. Due to the high clay content in the sandstone of the upper Dawson Formation and the interbedded claystone, the sand and gravel are generally not considered economical mineral resources.

8.0 IDENTIFICATION AND MITIGATION OF POTENTIAL GEOLOGIC CONDITIONS

The El Paso County Engineering Criteria Manual recognizes and delineates the difference between geologic 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 hazards and constraints were considered in the preparation of this report and are not anticipated to pose a significant risk to the proposed development:

Hazards

- Avalanches
- Debris Flow-Fans/Mudslides
- Ground Subsidence and Abandoned Mining Activity
- Landslides
- Rockfall

Constraints

- Corrosive Minerals
- Downhill/Down-slope Creep
- Ponding Water
- Scour, Erosion, accelerated erosion along creek banks and drainage ways
- Steeply Dipping Bedrock
- Unstable or Potentially Unstable Slopes
- Undocumented Fill or History of Landfill

The following sections present the geologic conditions that have been identified on (or anticipated to be on) the property:

8.1 Compressible Soils - *constraint*

Based on the test borings performed for this investigation, the site has a layer of sandy clay extending to depths of 3 to 5 feet across the entire site. Some areas may encounter deeper clays. It is anticipated that the on-site sand soils will be encountered within each building excavation. In some cases, the sands encountered in the excavations may be loose.

Mitigation

If loose soils are encountered beneath the proposed foundations, mitigation will be required. Mitigations are anticipated to consist of additional compaction to achieve suitable allowable bearing pressures. Fluctuations in material density may occur. In some cases, removal and recompaction of up to 2 to 3 feet of soil may be required. The removal and recompaction shall extend a minimum of the same distance beyond the building perimeter, and at least that same distance beyond the perimeter of counterfort and "T" wall footings. The use of track-mounted excavation equipment, or other low ground pressure equipment, is recommended on loose soils to reduce the likelihood of loss of stability during excavation.

The potential for settlement is directly related to saturation of the soils below the foundation areas. Therefore, good surface and subsurface drainage is critical in these areas in order to reduce the potential for saturation of the soils. Provided appropriate mitigations and/or foundation design adjustments are implemented as recommended in lot-specific soil reports, the presence of compressible soil is not considered to pose a risk to the proposed structures.

8.2 Potentially Expansive Soils and Bedrock – *constraint*

Based on the test borings performed by RMG for this investigation (and our knowledge of the surrounding area), the sandy clay and claystone bedrock (if encountered) generally possess low to high swell potential. It is anticipated if expansive clay soils or claystone bedrock are encountered at the time of the site-specific subsurface soil investigation, they can be readily mitigated with typical construction practices common to this region of El Paso County, Colorado.

Mitigation

Sporadic areas of expansive soils and bedrock are to be expected within the Dawson Formation. If expansive soils or bedrock are encountered beneath the foundations, mitigation will be required. "Mass" subexcavation during land development is currently not proposed, nor do we recommend it at this time. Overexcavation and replacement with non-expansive soils at a minimum of 95 percent of its maximum Modified Proctor Dry Density (ASTM D-1557) is a suitable mitigation. Floor slabs bearing directly on expansive material should be expected to experience movement. Overexcavation and replacement has been successful in minimizing slab movement. Overexcavation is not anticipated for the majority of the lots. However, where clay or claystone are encountered, overexcavation may be required. Moisture conditioning and recompacting the on-site clays may also be considered for mitigation of expansive materials.

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.

8.3 Seasonally Fluctuating Surface Water and Groundwater – *constraint*

Based on the site observations, review of USGS topographic maps dating back to 1947, and review of Google Earth images dating back to 1999, springs do not appear to originate on the subject site. Our test borings and test pits were located adjacent to the drainageway. As a result, it is anticipated that groundwater conditions in the locations of the proposed residences (away from the drainageway) will be deeper below the existing ground surface at those locations than indicated by the test borings presented herein. Further, the subsurface water encountered at 8 feet in test boring TB-2 appears to be a limited source of water perched atop the bedrock, and not be indicative of a persistent groundwater condition. Isolated areas of seasonal shallow groundwater may still exist. Fluctuating surface water within the drainageway should be anticipated during heavy rain storms and precipitation events.

Drilling occurred in May of 2024, when seasonal groundwater levels are generally anticipated to be slightly higher than the winter months. Fluctuations in groundwater and subsurface moisture conditions will occur due to variations in rainfall and other factors not readily apparent at this time. Groundwater information obtained at the time of the preliminary investigations performed prior to any future land development may or may not be representative of the conditions present at the time of construction. Furthermore, the development processes (reshaping of the ground surface, installation of buried utilities, etc.) can significantly alter the depth and flow paths of the

water. The construction of surrounding lots can also alter the amount and depth of subsurface groundwater below a given lot.

Mitigation

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 10.

Additional drains may be required if water (surface, perched groundwater, or true groundwater) is encountered at the time of the site-specific subsurface soil investigations within 4 to 6 feet of the proposed slab elevation. An underslab drain would be considered in conjunction with the perimeter drain. It must be understood that subsurface drains are designed to intercept some types of subsurface moisture and not others. Therefore, the drain(s) could operate properly and not mitigate all moisture problems relating to foundation performance or moisture intrusion into the basement areas. A typical underslab drain is presented in Figure 11.

Based on the presence of groundwater at the time of drilling and the surrounding topography, shallow crawlspace foundations are anticipated to have a minimum of 3-foot separation from the underlying seasonally fluctuating groundwater. However, full depth basements may not have a minimum of 3-foot separation from the underlying seasonally fluctuating groundwater.

As noted in Section 5.2, above, in the absence of irrigation, a 4 to 6-foot fluctuation in groundwater levels (perched on or contained within the underlying bedrock) is anticipated. With the potential for elevated surface water near the drainageway and within the fractured bedrock, the feasibility of basements will need to be evaluated at the time of the site-specific subsurface soil investigation for each lot (once the final location of each home has been determined). It is understood that El Paso County and/or their elected third party reviewer CGS may recommend a year-long groundwater monitoring program prior to approving basement construction. If basements are proposed on these lots, it would be advisable to initiate groundwater monitoring sufficiently in advance of construction to allow for completion of a monitoring program and resubmittal to the County.

The drainageway will need to be taken into consideration when considering the placement of the residences and OWTS areas on all three lots.

8.4 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 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

near 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 0.218g 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.

8.5 Radon – *hazard*

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".*

Northern El Paso County, in which the site is located, has an EPA assigned Radon Zone of *1*. A radon Zone of 1 predicts an average indoor radon screening level greater than 0.4 pCi/L (picocuries per liter), which is above the recommended levels assigned by the EPA. *The EPA recommends corrective measures to reduce exposure to radon gas.*

All of the State of Colorado is considered EPA Zone 1 based on the information provided at https://county-radon.info/CO/El_Paso.html. Elevated hazardous levels of radon from naturally occurring sources are not anticipated 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. 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.

9.0 ON-SITE WASTEWATER TREATMENT SYSTEMS

It is our understanding that On-site Wastewater Treatment Systems (OWTS) are proposed for each lot. The site was evaluated in general accordance with the El Paso Land Development Code, specifically sections 8.4.8. Two 8-foot deep test pits were performed across the site to obtain a general understanding of the soil and bedrock conditions. The Test Pit Logs are presented in the *Wastewater Study,* Appendix B.

The United States Department of Agriculture (USDA) soil types encountered in our test pits consisted of sandy clay loam and sand. Limiting layers were not encountered in the test pits. The long term acceptance rates (LTAR) associated with the soils observed in the test pits of the on-site material ranged from 0.15 to 0.60. Signs of seasonal groundwater were not observed in the test pits.

Treatment areas at a minimum must achieve the following:

- The treatment areas must be 4 feet above groundwater or bedrock as defined by the Definitions 8.3.4 of the Regulations of the El Paso County Board of Health, Chapter 8, *OWTS Regulations*, effective July 7, 2018;
- Prior to construction of an OWTS, an OWTS design prepared per *the Regulations of the El Paso County Board of Health, Chapter 8, OWTS Regulations* will need to be completed. A scaled site plan and engineered design will also be required prior to obtaining a building permit;
- Comply with any physical setback requirements of Table 7-1 of the El Paso County Department of Health and Environment (EPCDHE);
- Treatment areas are to be located a minimum 100 feet from any well (existing or proposed), including those located on adjacent properties per Table 7-2 per the EPCDHE;
- Treatment areas must also be located a minimum 50 feet from any spring, lake, water course, irrigation ditch, stream or wetland, and 25 feet from dry gulches;
- Other setbacks include the treatment area to be located a minimum 10 feet from property lines, cut banks and fill areas (from the crest);
- The new lots shall be laid out to ensure that the proposed OWTS does not fall within any restricted areas, (e.g. utility easements, right of ways). Based on the proposed lot layout and the information obtained from the test pit observations, each lot has a minimum of two locations for the OWTS as currently proposed.

Soil and groundwater conditions at the site are suitable for individual treatment systems. The LTAR values ranged between 0.15 to 0.60 for the onsite soils observed in the test pits. It should be noted that the LTAR values are for the test pit locations performed for this report only. The LTAR values may change throughout the site. If an LTAR value of less than 0.35 (soil types 3A to 5) or greater than 0.80 (soil type 0) is encountered at the time of the site specific OWTS evaluation, an "engineered system" will be required.

Contamination of surface and subsurface water resources should not occur provided the OWTS sites are evaluated and installed according to the El Paso County Board of Health Guidelines and property maintained. It is our opinion that if the EPCHDE physical setback requirements are met

for each lot, there are no restrictions on the placement of the individual On-site Wastewater Systems.

10.0 BEARING OF GEOLOGIC CONDITIONS UPON PROPOSED DEVELOPMENT

Geologic hazards (as described in section 8 of this report) found to be present at this site include faults and seismicity. Geologic conditions (as described in section 8 of this report) found to be present at this site include potentially compressible, expansive soils/bedrock, and seasonally fluctuating subsurface water and/or groundwater. It is our opinion that the existing geologic and engineering conditions can be satisfactorily mitigated through proper engineering, design, and construction practices.

11.0 ADDITIONAL STUDIES

The findings, conclusions and recommendations presented in this report were provided to evaluate the suitability of the site for the proposed minor subdivision and 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. ***A site-specific subsurface soil investigation will be required for all proposed structures including (but not limited to) residences and retaining walls (if utilized), etc.***

The results of the site-specific subsurface evaluation will need to determine the depth of groundwater and the feasibility of a full-depth basement (if proposed), provide recommendations for earthwork, foundations, floor systems, surface and subsurface drainage, and pavement recommendations (if needed) for design purposes.

12.0 CONCLUSIONS

Based upon our evaluation of the geologic conditions, it is our opinion any proposed future development is feasible. The geologic conditions identified are considered typical 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 suitable construction practices.

It should be reiterated that all construction should remain outside the natural drainageway unless regrading of the drainageway is planned on a lot by lot basis or a year-long groundwater monitoring program is initiated prior to construction. If regrading is proposed, it is recommended prior to construction, a civil engineer consider the potential impacts of surface runoff water (particularly within the drainageway) when selecting locations for the proposed structures and wastewater treatment areas, near the drainageway.

In addition to the previously identified mitigation alternatives, surface and subsurface drainage systems should be considered for any future structures. 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.

We believe the silty to clayey sand will classify as Type B material as defined by OSHA. OSHA requires that temporary excavations made in Type B materials be laid back at ratios no steeper than 1:1 (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).

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 each lot read and understand this report, and to carefully 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.

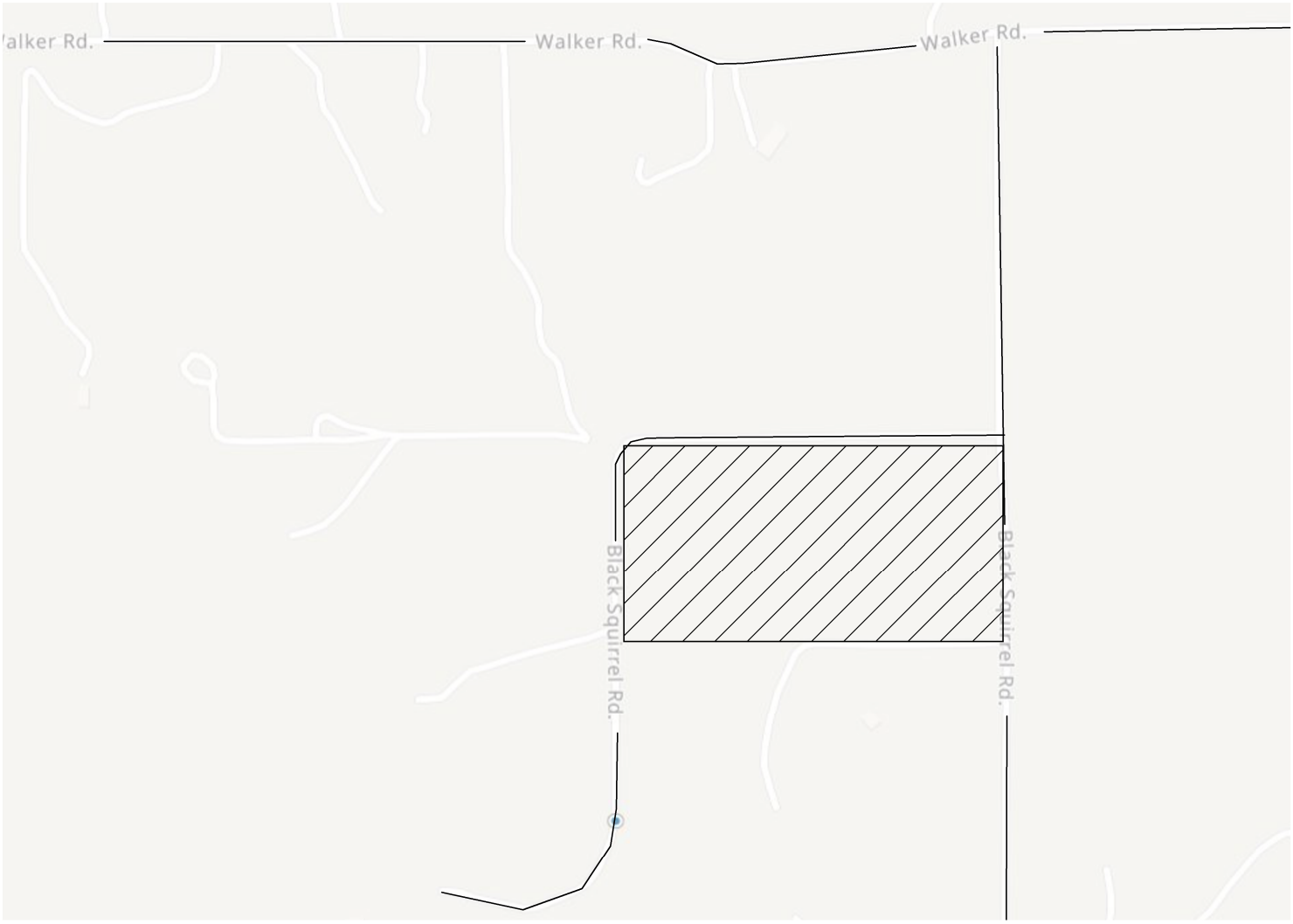
13.0 CLOSING

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 **Christine Tschamler** 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.

FIGURES



NOT TO SCALE

Architecture
Structural
Geotechnical

RMG

Materials Testing
Forensics
Civil / Planning

Engineers / Architects
SOUTHERN COLORADO OFFICE
2910 AUSTIN BLUFFS PKWY, SUITE 100,
COLORADO SPRINGS, CO 80918
(719) 548-0600 ~ WWW.RMGENGINEERS.COM
Southern Colorado, Denver Metro, Northern Colorado

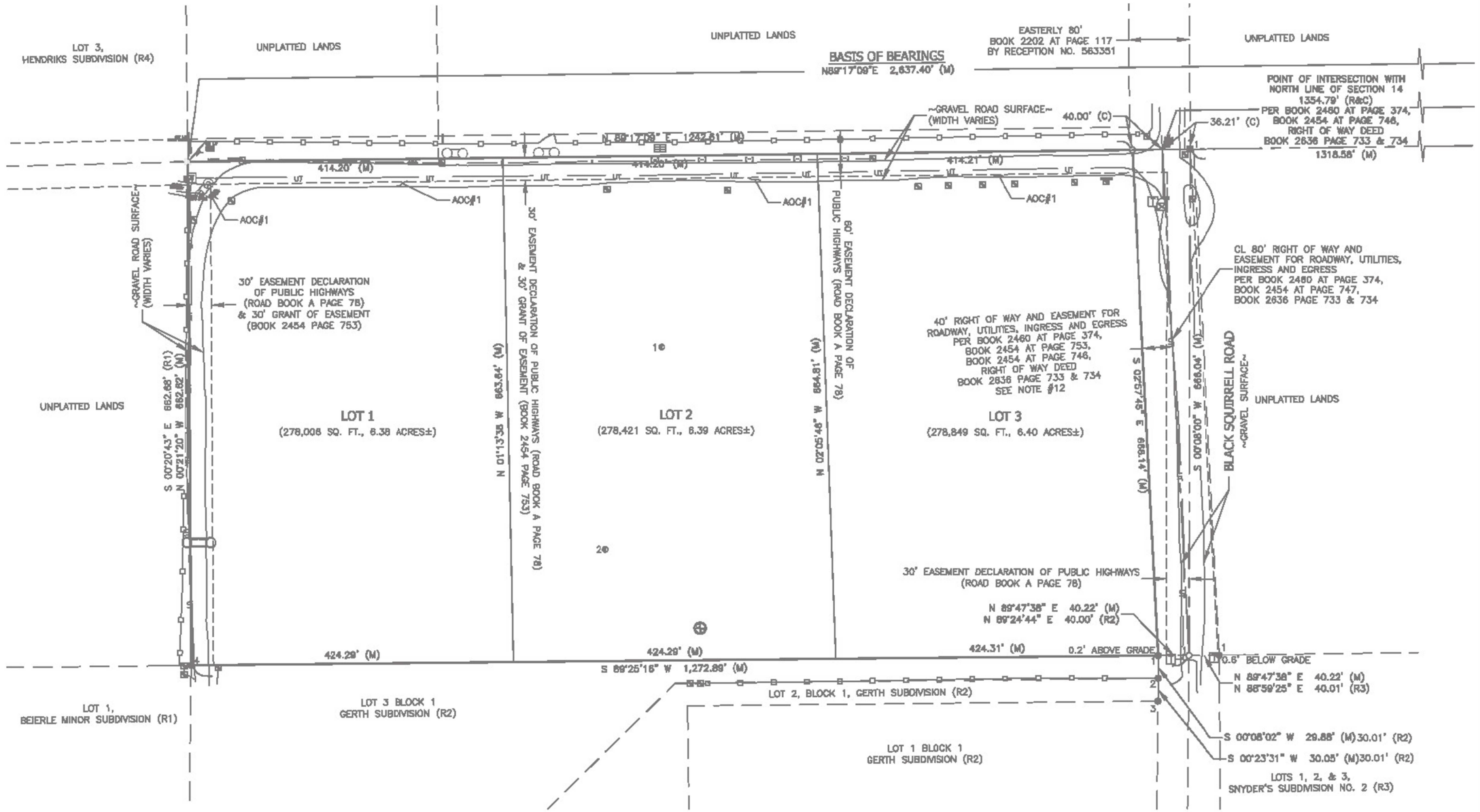
SITE VICINITY MAP

MINOR SUBDIVISION
BLACK SQUIRREL RD
EL PASO COUNTY, CO
CHRISTINE TSCHAMLER

JOB No. 196369

FIG No. 1

DATE 9-13-2024



NOT TO SCALE

BASE MAP PROVIDED BY APEX LAND SURVEYING AND MAPPING, LLC

JOB No. 196369

RMG
Materials Testing
Forensics
Civil / Planning
Architecture
Structural
Geotechnical
Engineers / Architects
SOUTHERN COLORADO OFFICE
2910 AUSTIN BLUFFS PKWY, SUITE 100,
COLORADO SPRINGS, CO 80918
(719) 548-0600 ~ WWW.RMGENGINEERS.COM
SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

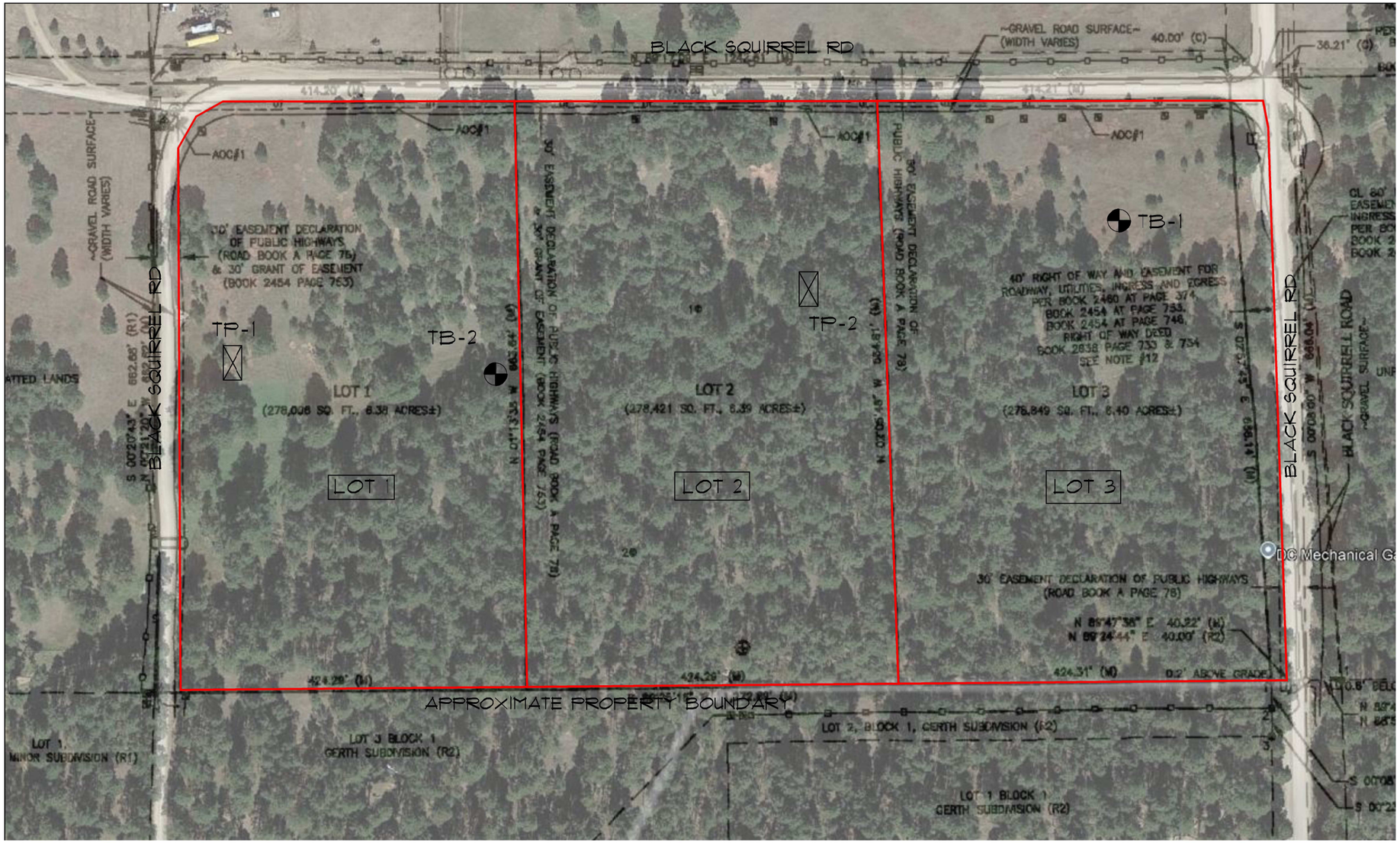
TEAM CHRIS SUBDIVISION
BLACK SQUIRREL RD

EL PASO COUNTY, COLORADO
CHRISTINE TSCHAMLER

ENGINEER:	TM
DRAWN BY:	KZ
CHECKED BY:	TM
ISSUED:	9-13-2024

PROPOSED LOT LAYOUT

SHEET No.
FIG-2



DENOTES APPROXIMATE LOCATION OF TEST BORINGS

DENOTES APPROXIMATE LOCATION OF TEST PITS

NOT TO SCALE

JOB No. 196369

RMG
Materials Testing
Forensics
Civil / Planning
Architecture
Structural
Geotechnical
Engineers / Architects
SOUTHERN COLORADO OFFICE
2910 AUSTIN BLUFFS PKWY, SUITE 100,
COLORADO SPRINGS, CO 80918
(719) 548-0600 ~ WWW.RMGENGINEERS.COM
SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

TEAM CHRIS SUBDIVISION
BLACK SQUIRREL RD

EL PASO COUNTY, COLORADO
CHRISTINE TSCHAMLER

ENGINEER:	TM
DRAWN BY:	KZ
CHECKED BY:	TM
ISSUED:	9-13-2024

TEST BORING AND TEST PIT LOCATIONS

SHEET No.
FIG-3

SOILS DESCRIPTION


CLAYEY SAND


SANDSTONE


SANDY CLAY

UNLESS NOTED OTHERWISE, ALL LABORATORY
TESTS PRESENTED HEREIN WERE PERFORMED BY:
RMG - ROCKY MOUNTAIN GROUP
5085 LIST DRIVE, SUITE 200
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

Structural Forensics

RMG

Geotechnical Materials Testing

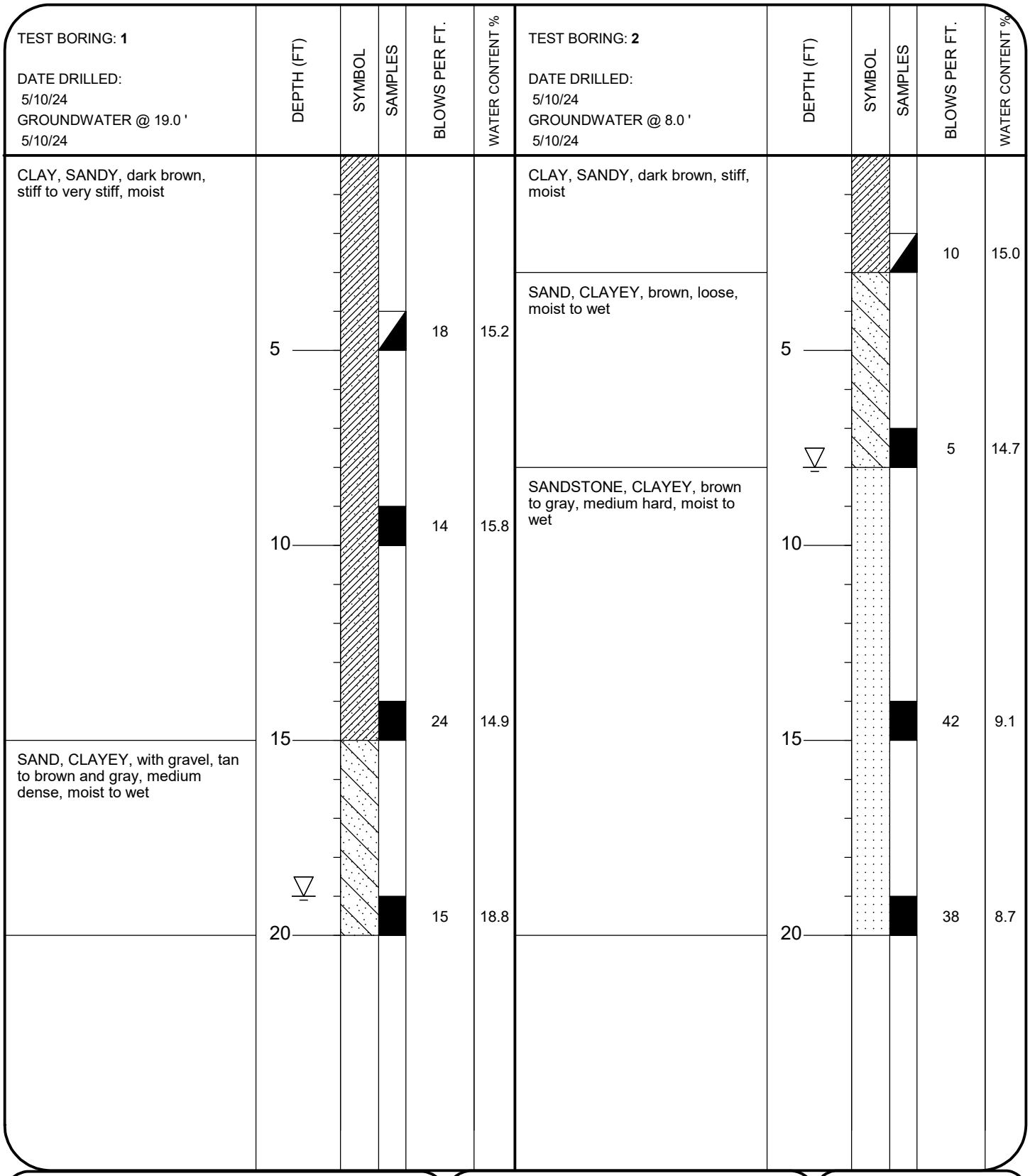
Colorado Springs: (Corporate Office)
5085 List Drive, Suite 200
Colorado Spings, CO 80918
(719) 548-0600
SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

EXPLANATION OF TEST BORING LOGS

JOB No. 196369

FIGURE No. 4

DATE Sep/13/2024



ROCKY MOUNTAIN GROUP

Structural Forensics

RMG

Geotechnical Materials Testing

Colorado Springs: (Corporate Office)
5085 List Drive, Suite 200
Colorado Spings, CO 80918
(719) 548-0600
SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

TEST BORING LOG

JOB No. 196369

FIGURE No. 5

DATE Sep/13/2024

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	15.2	94.8							
1	9.0	15.8		27	9		58.0			CL
1	14.0	14.9								
1	19.0	18.8								
2	2.0	15.0	100.8					1,000	- 0.1	
2	7.0	14.7								
2	14.0	9.1		28	12		43.0			SC
2	19.0	8.7				1.4	20.7			

ROCKY MOUNTAIN GROUP

Structural Forensics

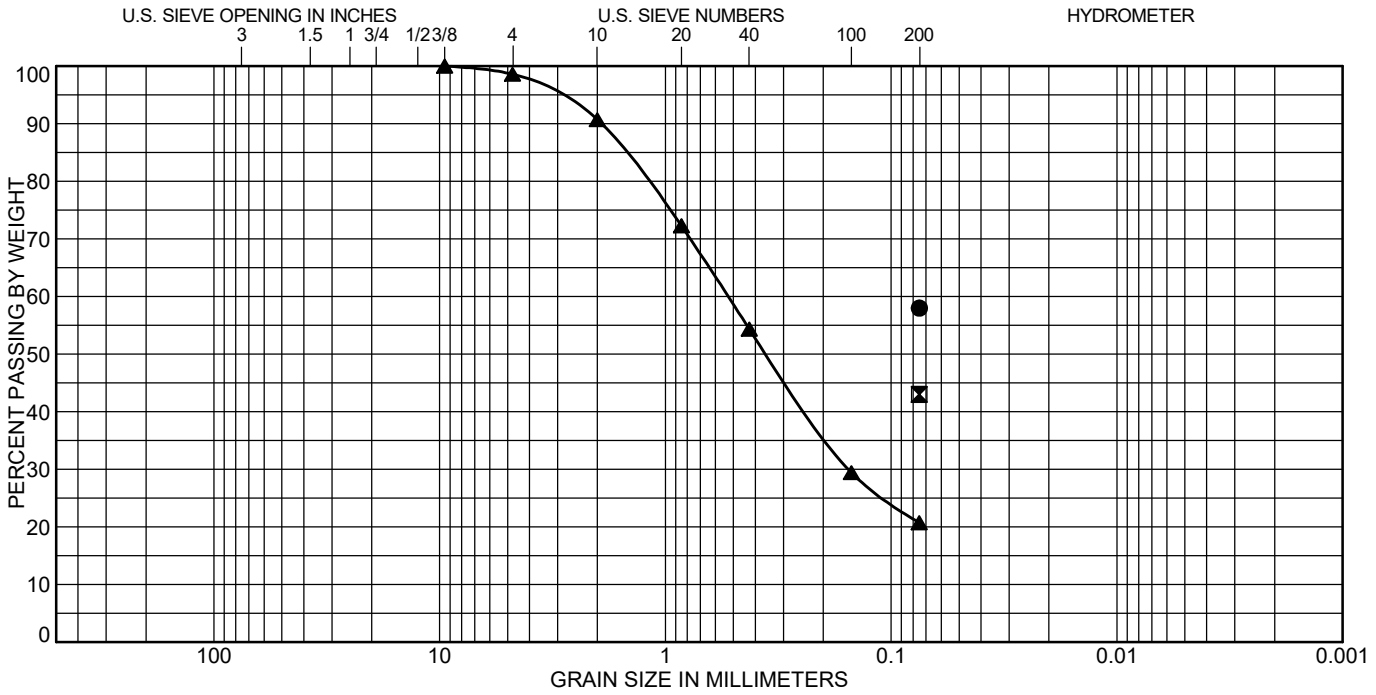
RMG

Geotechnical Materials Testing

Colorado Springs: (Corporate Office)
5085 List Drive, Suite 200
Colorado Spings, CO 80918
(719) 548-0600
SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

SUMMARY OF LABORATORY TEST RESULTS

JOB No. 196369
FIGURE No. 6
PAGE 1 OF 1
DATE Sep/13/2024



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Test Boring	Depth (ft)	Classification	LL	PL	PI
●	1	9.0	SANDY LEAN CLAY(CL)	27	18	9
⧓	2	14.0	CLAYEY SAND(SC)	28	16	12
▲	2	19.0				

	Test Boring	Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	1	9.0			58.0	
⧓	2	14.0			43.0	
▲	2	19.0	1.4	77.9	20.7	

ROCKY MOUNTAIN GROUP

Structural Forensics

RMG

Geotechnical Materials Testing

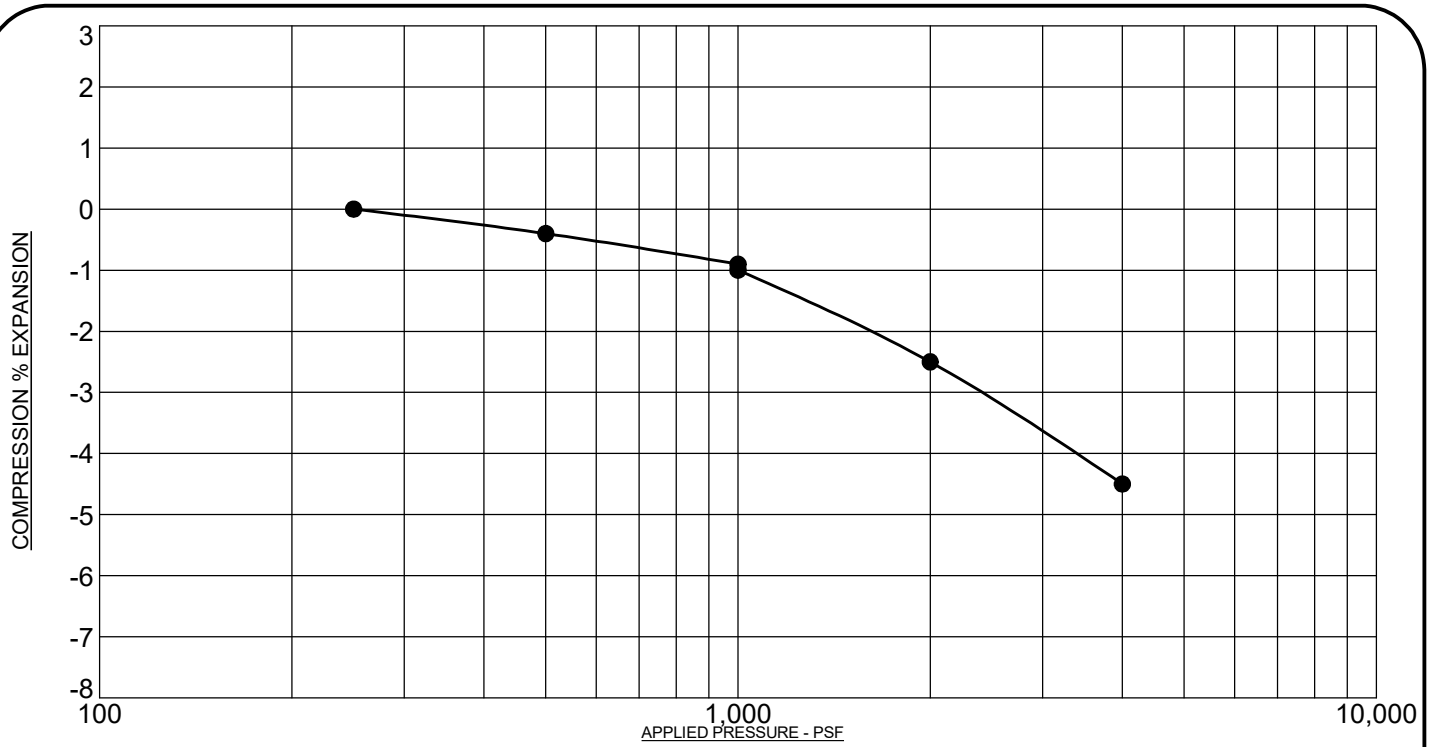
Colorado Springs: (Corporate Office)
5085 List Drive, Suite 200
Colorado Spings, CO 80918
(719) 548-0600
SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

SOIL CLASSIFICATION DATA

JOB No. 196369

FIGURE No. 7

DATE Sep/13/2024



PROJECT: **Black Squirrel Rd, 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: **100.8 PCF**
NATURAL MOISTURE CONTENT: **15.0%**
PERCENT SWELL/COMPRESSION: **- 0.1**

ROCKY MOUNTAIN GROUP

Structural Forensics

RMG

Geotechnical Materials Testing

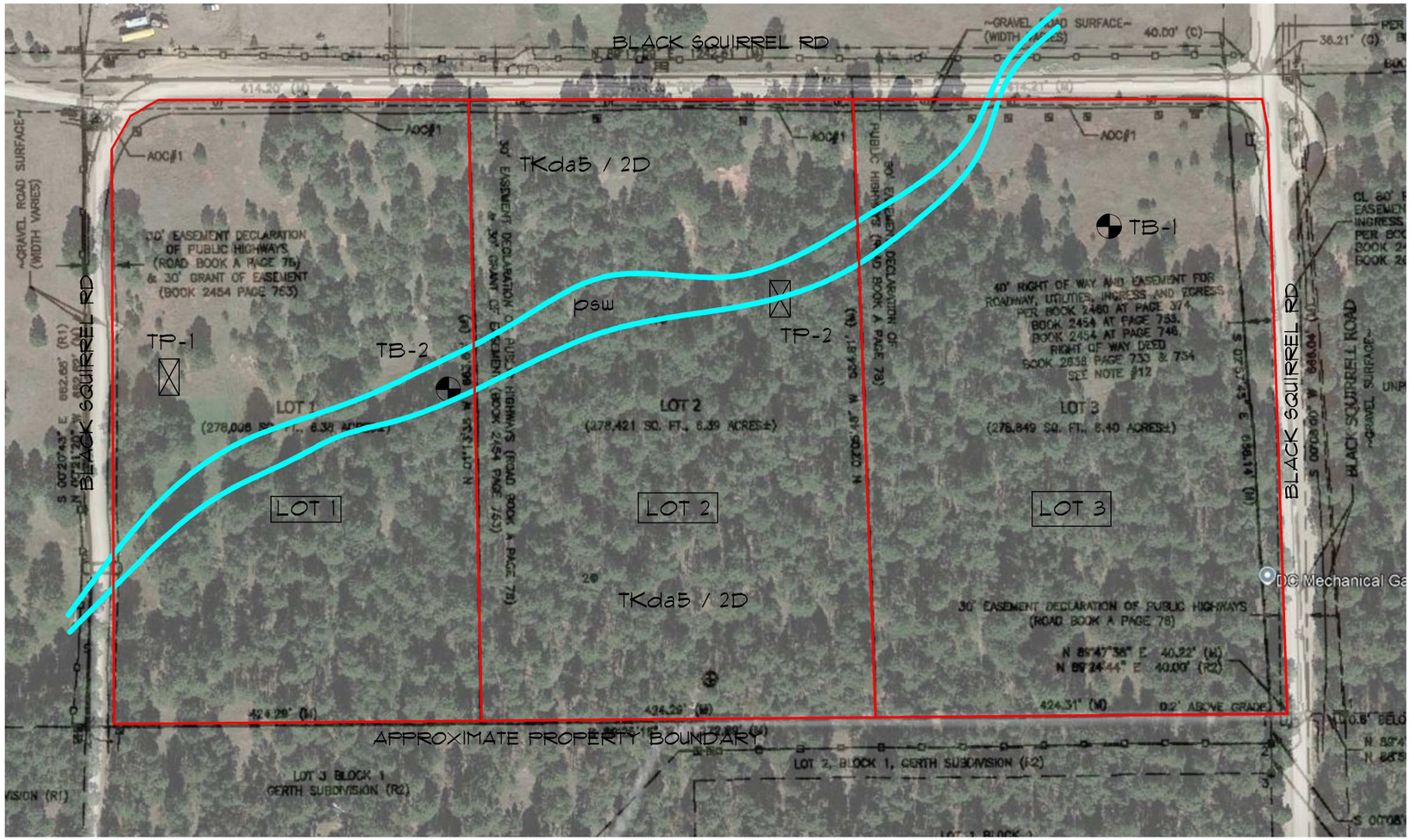
Colorado Springs: (Corporate Office)
5085 List Drive, Suite 200
Colorado Spings, CO 80918
(719) 548-0600
SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

SWELL/CONSOLIDATION TEST RESULTS

JOB No. 196369

FIGURE No. 8

DATE Sep/13/2024



Geologic Conditions

- *TKda5- Dawson formation, facies unit five* - white to light tan, thin to medium bedded, fine to medium-grained feldspathic sandstone or pebbly conglomerate. The Dawson is known to contain occasional interbedded sandy claystone. Estimated thickness is around 500 feet.
- *psw - potentially seasonally wet* - areas that may collect surface water during high moisture events.

Engineering Conditions

- *2D* - Eolian deposits generally on flat to gentle slopes of upland areas.

NOT TO SCALE

DENOTES APPROXIMATE LOCATION OF TEST BORINGS

DENOTES APPROXIMATE LOCATION OF TEST PITS

JOB No. 196369

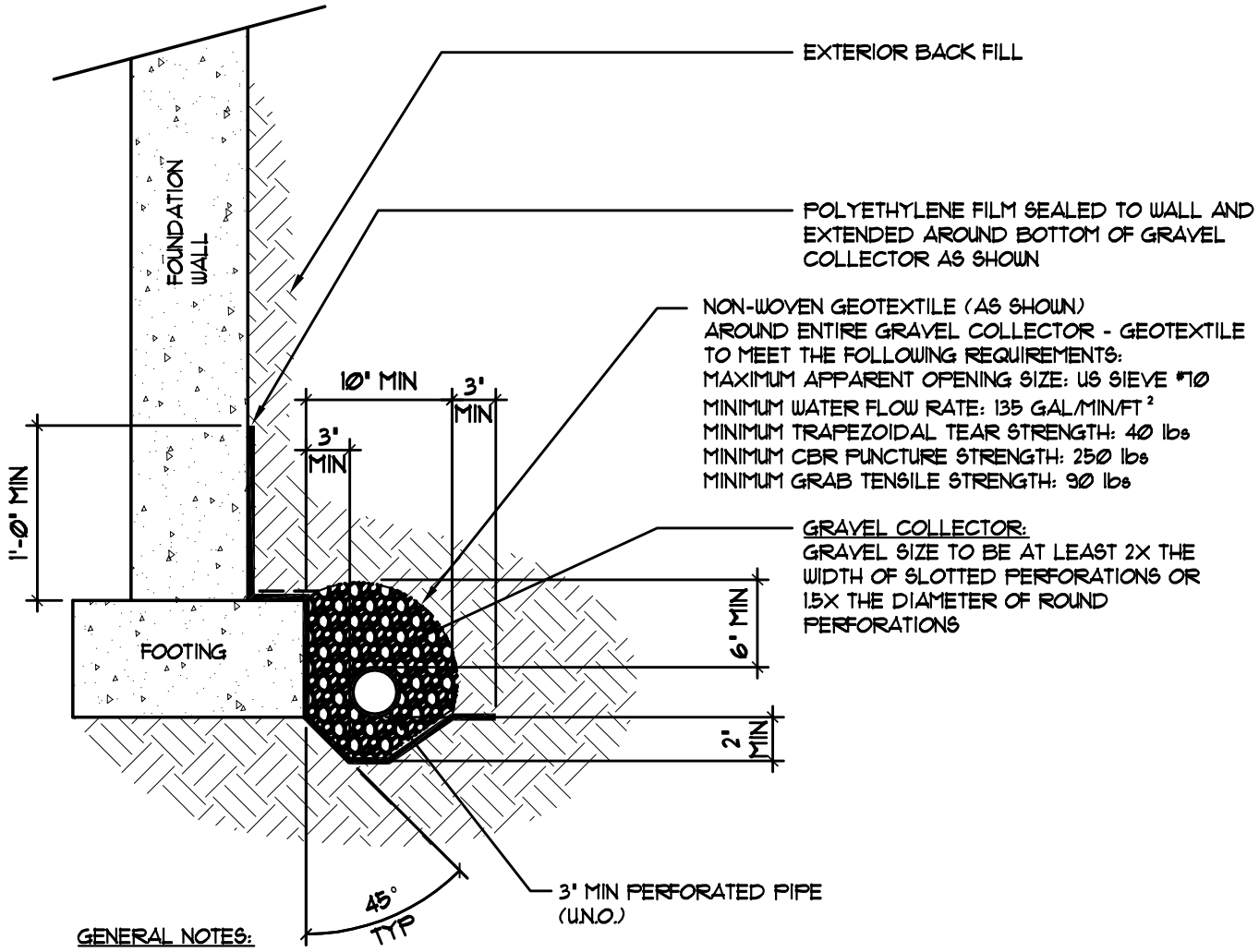
RMG
Materials Testing
Forensics
Civil / Planning
Architecture
Structural
Geotechnical
Engineers / Architects
SOUTHERN COLORADO OFFICE
2910 AUSTIN BLUFFS PKWY, SUITE 100,
COLORADO SPRINGS, CO 80918
(719) 548-0600 ~ WWW.RMGENGINEERS.COM
SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

TEAM CHRIS SUBDIVISION
BLACK SQUIRREL RD
EL PASO COUNTY, COLORADO
CHRISTINE TSCHAMLER

ENGINEER:	TM
DRAWN BY:	KZ
CHECKED BY:	TM
ISSUED:	9-13-2024

ENGINEERING AND GEOLOGY MAP

SHEET No.
FIG-9



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.

Architecture
Structural
Geotechnical

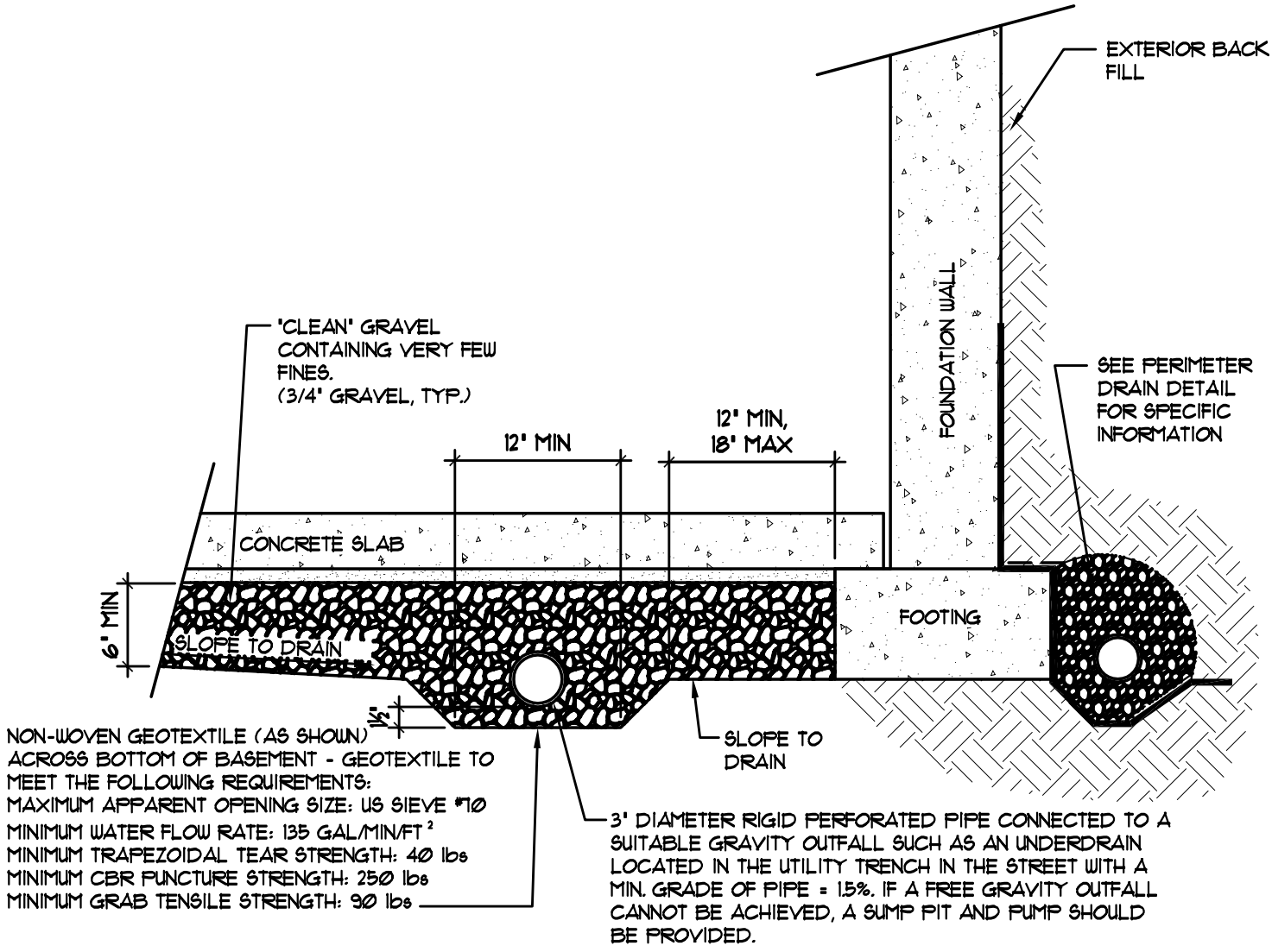
RMG

Materials Testing
Forensics
Civil / Planning

Engineers / Architects
SOUTHERN COLORADO OFFICE
5085 LIST DRIVE, SUITE 200,
COLORADO SPRINGS, CO 80919
(719) 548-0600 ~ WWW.RMGENGINEERS.COM
Southern Colorado, Denver Metro, Northern Colorado

PERIMETER DRAIN

FIG No. 10



GENERAL NOTES:

1. ALL DRAIN PIPE SHALL BE PERFORATED PLASTIC, WITH THE EXCEPTION OF THE DISCHARGE PORTION WHICH SHALL BE SOLID, NON-PERFORATED PIPE.
2. DRAIN PIPE SHALL HAVE POSITIVE FALL THROUGHOUT.
3. 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.
4. ALL DRAIN COMPONENTS SHALL BE RATED/APPROVED BY THE MANUFACTURER FOR THE INSTALLED DEPTH AND APPLICATION
5. DRAIN SYSTEM, INCLUDING THE OUTFALL OF THE DRAIN, SHALL BE OBSERVED BY QUALIFIED PERSONNEL PRIOR TO BACKFILLING TO VERIFY INSTALLATION.

Architecture
Structural
Geotechnical

RMG

Materials Testing
Forensics
Civil / Planning

Engineers / Architects
SOUTHERN COLORADO OFFICE
5085 LIST DRIVE, SUITE 200,
COLORADO SPRINGS, CO 80919
(719) 548-0600 ~ WWW.RMGENGINEERS.COM
Southern Colorado, Denver Metro, Northern Colorado

UNDERSLAB DRAIN

FIG No. 11

APPENDIX A

Additional Reference Documents

1. *Geology and Soils Report, Parcel No.'s 512300013 and 5123000014, El Paso County, Colorado* prepared by RMG – Rocky Mountain Group, Job No. 167392, dated January 16, 2019.
2. *Flood Insurance Rate Map, El Paso County, Colorado and Unincorporated Areas, Community Panel No. 08041C0310G,* Federal Emergency Management Agency (FEMA), effective December 7, 2018.
3. *Geologic Map of Colorado, Ogden, 1979, U.S. Geological Survey*
4. *Generalized Surficial Geologic Map of the Pueblo 1 degree X 2 degree Quadrangle, Colorado. U.S. Geological Survey, Map MF-2388, 2002.*
5. *Geologic Map of the Pueblo 1 Degree X 2 Degrees Quadrangle, South-Central Colorado, U.S. Geological Survey*. Compiled by Scott, Taylor, Epis and Wobus, 1976.
6. *Notes on the Denver Basin Geologic Maps: Bedrock Geology, Structure, and Isopach Maps of the Upper Cretaceous to Paleogene Strata between Greely and Colorado Springs, Colorado, Colorado Geological Survey.* Compiled by Dechesne, Raynolds, Barkmann and Johnson, 2011.
7. *Environmental and Engineering Geologic Map for Land Use*, compiled by Dale M. Cochran, Charles S. Robinson & Associates, Inc., Golden, Colorado, 1977.
8. *Pikes Peak Regional Building Department:* https://www.pprbd.org/.
9. *El Paso County Assessor Website* https://property.spatialest.com/co/elpaso/#/property/3400000295 Schedule No. 3400000295
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 1952, 1955, 1983, 1984, 1999, 2005, 2009, 2011, 2013, 2015, and 2017.
12. *USGS Historical Topographic Map Explorer:* http://historicalmaps.arcgis.com/usgs/ El Paso County, Ellicott Quadrangle, 2019.
13. *Google Earth Pro*, Imagery dated 1999, 2004, 2005, 2006, 2011, 2013, 2015, 2017, 2019, 2020. 2021, and 2022.
14. *Coal resources of the Denver and Cheyenne basins, Colorado*, Kirkham, R.M., and Ladwig, L.R., 1979, Colorado Geological Survey Resource Series 5, 70 p., 5 plates
15. *Evaluation of Mineral and Mineral Fuel Potential of El Paso County State Mineral Lands*