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Materials Testing
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SOILS AND GEOLOGY STUDY

Phases 1-4, Falcon Highlands
El Paso County, Coloradao

PREPARED FOR:

Challenger Colorado, LLC
8605 Explorer Drive, Suite 250
Colorado Springs, CO 80920

JOB NO. 184041

October 8, 2021
Amended September 7, 2022

Respectfully Submitted,
RMG – Rocky Mountain Group

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Reviewed by,
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Please provide an updated soils & geology report that is specific to this individual filing and provides the level of detail needed to make a finding of compliance with LDC Sec. 8.4.9

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1.0 GENERAL SITE AND PROJECT DESCRIPTION

1.1 Project Location

The project lies in a portion of Section 12, Township 13 South, Range 65 West of the 6th Principal Meridian in El Paso County, Colorado. The site is located directly east of the intersection of Highway 24 and Meridian Road. 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 four full parcels and a portion of Sch. No. 5300000566. The combined total area of the proposed site is to be between 124.41 acres (as referenced per the El Paso County Assessors website) and 125.56 acres (per the Concept Plan provided by Matrix). The concept Plan is presented in Figure 2, Phasing Exhibit. Per the El Paso County Assessors website, the five parcels included are:

- Schedule No. 5300000586 consists of approximately 109.05 acres and encompasses the majority of the site. The parcel is currently partially developed.
- Schedule No. 5300000587 which consists of approximately 4.76 acres and is located in the northern portion of the site. The parcel is currently not developed.
- Schedule No. 53000000588 which consists of approximately 7.41 acres and is located on the northern portion of the site. The parcel is currently not developed.
- A portion of Schedule No. 5300000566 which consists of approximately 2 acres, which is a narrow piece parcel located along the eastern portion of the site. The parcel is currently not developed.
- Schedule No. 5312400012 consists of approximately 1.19 acres and consists a small triangular shaped parcel located along the eastern portion of the site. The parcel is currently not developed.

The above parcels were originally included in the *Falcon Highlands P.U.D Development Plan, last modified May 3, 2002* previously recorded under reception no. 202131586 per a document search of EDARP – Electronic Development Application Review Program for El Paso County, CO Planning and Community Development website. It is our understanding, due to the elapsed time since the prior approval, that an updated Geology Study is required for approval of the currently proposed development.

1.3 Project Description

The site is to be developed as a single-family residential subdivision and is proposed to contain a total of 380 single-family lots. The development is to utilize sewer and water services. Individual wells and on-site wastewater treatment systems are not proposed. Two detention ponds are proposed along the southern boundary within the designated open spaces. The proposed detention ponds are to be built-up, with the same bottom elevation of 6,809.50 feet for both ponds and a top elevation for pond 1 (western-most) of 6,818 feet and 6,818.50 feet for pond 2.

The main access to the subdivision is to be from the north by extending three existing roadways. Antelope Meadows Circle and Bridal Vail Way are to be extended from the north to the south and Birch Hollow Way is to extend to the east and connect with Antelope Meadows Circle. Antelope Meadows Circle is to be constructed with a 60-foot public ROW that will meet the requirements of an El Paso County Urban Residential Collector roadway. The interior roads are to be constructed with 50-foot ROWs and be classified as Public which will also need to meet the requirements of El Paso County Urban Local and

Urban Local (Low Volume) roadways. The Site Plan with Test Boring Locations is presented in Figure 3.

RMG – Rocky Mountain Group was retained to explore the subsurface conditions at the site and develop geotechnical engineering recommendations for the proposed land development operations.

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 20 years of experience in the geological and geotechnical engineering field. Ms. Kelli Zigler holds a Bachelor of Science 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 20 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
- Laboratory testing of representative site soil and rock samples
- 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

One Report of previous geotechnical engineering/geologic investigation for the site and nearby sites were available for our review and are listed below:

1. *Engineering Geology Study, Falcon Highlands Subdivision, El Paso County, Colorado,* prepared by John Himmelriech & Associates, Project No. 00-139, dated June 28, 2000.

2. *Soil and Geology Study, Falcon Highlands, Woodmen Road and Tamlin Road, El Paso County, Colorado,* prepared by Entech Engineering, Inc., Entech Job No. 39431, last dated January 24, 2002.

3.4 Additional Documents

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

4.0 SITE CONDITIONS

4.1 Proposed Land Use and Zoning

It is our understanding that the project is to consist of single-family residential construction on 380 lots at the Falcon Highlands subdivision. The residential structures are anticipated to be one to two-stories in height with multi-car garages. The homes may be constructed with or without basements.

Figure 2 presents the general boundaries of our investigation.

4.2 Topography and Vegetation

Based on our site observations, the overall ground surface generally slopes gently down to the south across the entire site. The elevation difference across the site from north to south is approximately 30 to 35 feet.

The majority of the site consists of native grasses and weeds. Deciduous trees are present near the natural low lying drainages. Vegetation is denser along the natural low lying drainages, particularly near the eastern portion of the site which lies within a special flood hazard area/FEMA floodplain.

4.3 Site Reconnaissance and Observations

Based on our site reconnaissance and the historical aerial imagery dating back to 1947, the site was raw open grazing land prior to 1999. Between 1999 and 2005, the subdivision to the southeast of Woodmen Road and Rolling Thunder Way was under construction. Around the same time, near the southwest corner of this site, scraping of vegetation had begun and stockpiles of soil are visible. These stockpiles were observed on-site at the time of our site reconnaissance on June 10, 2021. From 2005 to 2009, the previously proposed roadways were graded in. Between 2011 and 2013, soil stockpiles are visible along the western portion of the site. At the time of our site reconnaissance, household and construction debris was observed. The roadways observed in the 2009 imagery were visible at our site visit, but overgrown with native grasses and weeds.

5.0 FIELD INVESTIGATION

5.1 Drilling

The subsurface conditions within the property were explored by drilling eleven exploratory borings on June 8, 2021. The borings extended to depths of approximately 20 feet below the existing ground surface. The test borings were performed to explore the subsurface soils underlying an area that encompasses this proposed development. The test borings for this investigation are presented in the Test Boring Location Plan, Figure 2. The number of borings is equal to 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 borings in general accordance with ASTM D-1586 utilizing a 2-inch O.D. split barrel sampler or in general accordance with ASTM D-3550 utilizing a 2½-inch OD modified California sampler. Results of the penetration tests are shown on the drilling logs. The Test Boring Logs are presented in Figures 5 through 10 of this report.

5.2 Laboratory Testing

The moisture content for the recovered samples was obtained in the laboratory. Grain-size analysis, dry density, Atterberg Limits, and Denver Swell/Consolidation tests were performed on selected samples for purposes of classification and to develop pertinent engineering properties. A Summary of Laboratory Test Results is presented in Figure 11 (2 pages). Soil Classification Data are presented in Figures 12 and 13. Swell/Consolidation Test Results are presented in Figures 14 through 16.

6.0 GEOLOGIC AND SUBSURFACE CONDITIONS

6.1 Geologic Conditions

Based upon review of the *Falcon Quadrangle Geologic Map, El Paso County, Colorado*, the site is within an area of the Colorado Piedmont, a region that is distinguished primarily by the fact that is has been stripped of the Miocene fluvial rocks that cap the adjoining High Plains Section of the Great Plains physiographic province. Sand is abundant is the Falcon area because the sandstone bedrock of the Squirrel Formation and/or Dawson Formation is at or near the surface. Sandy alluvial and pluvial deposits blanket the majority of the area and are generally 5 feet thick or more. The deposits are considered residuum, unconsolidated material derived from the weathering of the underlying bedrock, and is wide-spread. The sandstone is generally weakly-cemented, easily excavated, shows little or no lamination, and can be irregularly stratified with evidence of cross sorting.

6.2 General Geology

Our field investigation included a site reconnaissance with consideration given to geologic features and significant surficial deposits. The general geology of the area is typically a combination of alluvial and pluvial deposits overlying the Black Squirrel Formation. Five general geology units were mapped in the vicinity of the site and are identified (Morgan, et al., 2012) as:

- *Qa2: Alluvium two* (lower Holocene) – Dark gray to brown, poorly to well sorted, moderately consolidated, silt, sand, gravel, and minor clay and occasional boulders in stream terrace deposits approximately 6 to 12 feet above the modern flood plain or as non-terrace forming alluvium in valley headwaters. Clasts are subrounded to well-rounded and the dominant sediment is sandy gravel with a silty sand matrix. Clay seams are poorly to moderately stratified.

- *Qp: Playa deposits* (Holocene) – Gray to dark brown, moderately well sorted, moderately consolidated, clay, silt, sand, and scattered granules. Forms flat-surfaced seasonal pons within eolian sand. In some areas this unit may be overlain by windblown sand and sheetwash deposits. Thickness of the playa deposits are generally greater than 5 feet.

- *Tbs: Black Squirrel Formation (Paleocene)* – Gray-green to tan to brownish gray, moderately-well sorted cross-bedded sandy arkoses interbedded with micaceous sand claystones that contain abundant plant fragments and occasional, fine-to medium-grained massive arkosic beds. The exposed upped part of the Black Squirrel Formation is gradational with the overlying Dawson Arkose making the contact problematic. Thickness within the Falcon quadrangle is approximately 130 feet. The claystone within this unit may be prone to swelling when wet.

- *Af: – Artificial Fill* – man-placed fill in the form of stockpiles that were placed between prior to 2005 to 2015, as indicated by historical aerial photos. The stockpiles generally consisted of unsorted silt, sand, clay, and rock fragments. The unsorted soil was mixed with uncontrolled dumping of household debris. The average thickness of the unit is less than 15 feet, above and below the ground surface.

- *Sw: seasonally wet area* – area where near-surface moisture conditions may occasionally occur, as indicated by historical aerial photos.

The general geology is presented in the Engineering and Geology Map, Figure 17.

6.3 U.S. Soil Conservation Service

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

- 8 – Blakeland loamy sand, 1 to 9% slopes. Properties of the Blakeland loamy sand include, somewhat excessively drained soils, depth of the water table is anticipated to be greater than 6.5 feet, run-off is anticipated to be low, frequency of flooding and/or ponding is none, and landforms include hills and flats.

- 9 – Blakeland-Fluvaquentic Haplaquolls (BFH) - loamy sandy, sand, 1 to 9 percent slopes. Properties of the BFH - gravelly 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 somewhat excessively drained, frequency of flooding and/or ponding is none, and landforms include hills and flats.

  The USDA Soil Survey Map is presented in Figure 18.

6.4 Subsurface Materials

The subsurface materials encountered in the test borings were classified using the Unified Soils Classification System (USCS) and the materials were grouped into the general categories of man-placed fill consisting of silty to clayey sand, native sand with various amounts of silt and clay, native sandy clay, silty sandstone, and sandy claystone.

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.

6.5 Bedrock Conditions

Bedrock was encountered in all but one of the test borings performed for this investigation. The bedrock beneath the site is considered to be part of the Squirrel Formation and/or Dawson Formation and consists of sandy claystone, siltstone, and silty to clayey sandstone. The claystone within the Dawson Arkose is considered to be expansive. The sandstone is considered to have good foundation characteristics. Excavation may be difficult but generally can be accomplished by standard construction equipment (mini excavator, loader).

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, surrounding the site or in the soil samples collected for laboratory testing.

6.7 Surficial (Unconsolidated) Deposits

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

6.8 Drainage of Water and Groundwater

The overall topography of the site slopes down to the south. Groundwater was encountered in seven of the test borings at depths ranging from approximately 10 to 19 feet at the time of drilling. When checked approximately 120 days subsequent to drilling, groundwater was encountered in all 11 test borings at depths ranging from approximately 9 to 17.4 feet.

An "Unnamed Tributary" is currently present near the eastern and southern boundary of the site. Review of the historical photos provided by Google Earth depict that the "Unnamed Tributary" adjacent to the site has remained relatively undisturbed since at least 1947. Based on the review of the Concept Plan, it appears the "Unnamed Tributary" is to remain undisturbed within the designated open spaces near the eastern boundary, but improved by the proposed construction of two detention ponds in the open space near the southern boundary.

6.9 Features of Special Significance

Features of special significance such as accelerated erosion, (advancing gully heads, badlands or cliff reentrants) were not observed on the property. Features indicating settlement or subsidence such as fissures, scarplets and offset reference features were also not observed on the property.

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

6.10 Engineering Geology

The Engineering Geology is presented below. Charles Robinson and Associates have mapped one environmental engineering unit on the site as:

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

The engineering geology is presented in the Engineering and Geology Map, Figure 17.

6.11 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 *Master Plan for Mineral Extraction*, *Map 2* indicates the site is not identified as an aggregate resource. Extraction of the sand and sandstone resources are not considered to be economical compared to materials available elsewhere within the county.

6.12 Permeability

The permeability of a soil measures how well air and water can flow within the soil. Soil permeability varies according to the type of soil and other factors.

The infiltration rate of a soil refers to how much water a type of soil can absorb over a specific time period. Infiltration rates are determined by soil permeability and surface conditions, and usually are measured in inches per hour.

The materials encountered in the test borings at the time of drilling were silty to clayey sand, sandy clay, silty sandstone, and sandy claystone. The permeability of the sands is anticipated to be moderate to high. The permeability of the sandstone is anticipated to range from low to high. The permeability of the clay and claystone is anticipated to be low.

7.0 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 Flows, Debris Fans, Mudslides
- Floodplains
- Ground Subsidence
- Landslides
- Rockfall
- Steeply Dipping Bedrock
- Unstable or Potentially Unstable Slopes
- Scour, Erosion, Accelerated Erosion along creek banks and drainageways

The following sections discuss potential geologic conditions that are anticipated to impact the subject site:

7.1 Compressible and/or Potentially Expansive Soils

The subsurface materials at the site generally consist of silty to clayey sand and sandy clay overlying sandstone and claystone. Based on the test borings performed for this investigation, the soils and bedrock encountered at the site generally possess low to moderate swell potential and low compressibility potential. If these materials are encountered in the excavations for the proposed residences, they can readily be 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 are typically adjusted for expansive or compressible soils. Mitigation of expansive soils is typically accomplished by overexcavation and replacement with structural fill, or subexcavation and replacement with on-site moisture-conditioned soils. Mitigation of compressible soils is typically accomplished by removal and recompaction with on-site moisture-conditioned soils.

7.2 Undocumented Fill

Fill soils were encountered in five of the eleven test borings performed by RMG, as presented in Figures 5-10. The fill was located in the southern half of the lot and near the western boundary.

The fill soils must be considered undocumented fill, and as such are not suitable for development in its current condition for the following reasons: the degree of consolidation is unknown, material densities will vary, pockets and seams of soft and loose material may be encountered and uneven and differential settlement potential can exist. It is our opinion that they can be mitigated with typical construction practices common to the Colorado Springs area. If unsuitable fill soils are encountered during the Open Excavation Observation, they will require removal (overexcavation) and replacement 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 the fill, if encountered first).

7.3 Faults and Seismicity

Review of the *Geologic Map of the Colorado Springs Quadrangle* and *Map of Areas Susceptible to Differential Heave in Expansive, Steeply Dipping Bedrock, City of Colorado Springs, Colorado* indicates the Rampart Range Fault lies approximately 12.5 miles to the west of the proposed residential development, and the Ute Pass Fault lies approximately 15 miles to the south and west of the proposed residential development. According to the CGS, these faults are not considered to be recently active. However, they have been active during geologic times and could affect the site if they did rupture.

Information presented by the CGS indicates that several recent earthquakes have occurred in the vicinity of the Ute Pass Fault near Colorado Springs and Woodland Park. The earthquakes, with magnitudes in the range of 3.0 to 3.9, occurred approximately from 1962 to 2007.

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. Ground

motions resulting from small earthquakes are more likely to affect structures at this site and will likely only affect slopes stability to a minimal degree.

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.

7.4 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.*

The 80931 zip code located in El Paso County, 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.*

All 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, 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 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.

7.5 Flooding and Surface Drainage

An "Unnamed Tributary" resides along the eastern and southern portion of the proposed development. Per the Flood Insurance Study report and Flood Insurance Rate Map for FEMA Map Number 08041C0516G dated December 7, 2018, the "Unnamed Tributary" resides in Zone AE, which is defined by FEMA as areas subject to inundation by the 1-percent-annual chance-flood event determined by detailed methods. This area is shown hatched on the Engineering and Geology Map, Figure 17.

The remainder of the site lies in the Zone X. 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 FEMA map is presented in Figure 20.

Mitigation
No construction is currently proposed within the areas identified as Zone AE. Construction on nearby lots should be configured such that the lowest floor elevation is maintained at least 1 foot above the applicable Base Flood Elevation (BFE).

7.6 Ponding Water, Springs and Seasonal Groundwater

Based on the site observations, review of USGS topographic maps dating back to 1951, Google Earth images dating back to September 1999, springs do not appear to originate on the subject site. However, ponding water and areas of seasonal shallow groundwater were encountered during our investigation. In these areas, we would anticipate the potential for periodically high subsurface moisture conditions and frost heave potential. These areas lie within low-lying areas along the southern portion of the site.

A groundwater check was performed on October 6, 2021, approximately three and a half months after the time of drilling. The check revealed that all eleven test borings had water present at a depth ranging from 9 to 17.4 feet.

Fluctuations in groundwater and subsurface moisture conditions may 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 the land development phase 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, installation of an underdrain below the roadways, etc.) can significantly alter the depth and flow paths of the subsurface water. The construction of surrounding lots can also alter the amount and depth of subsurface groundwater below a given lot. The potential exists for high groundwater levels during high moisture periods and should structures encroach on these areas the following mitigations should be followed.

Groundwater may affect areas depending upon grading cuts and within deeper excavations made for installation of utilities. It should be noted that groundwater levels, other than those observed at the time of the subsurface soil investigation, could change due to season variations, changes in land runoff characteristics, and future development of nearby areas.

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

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 help prevent the intrusion of water into areas below grade. A typical perimeter drain detail is presented in Figure 21.

If groundwater is encountered at the time of the site-specific subsurface soil investigations within 4 to 6 feet of the proposed basement 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 area.

Mitigation of groundwater is most readily accomplished by avoidance. Challenger Homes is proposing the use of non-basement foundations in "Phase 2" as designated on the Concept Plan, prepared by Matrix. The remainder of the site is to have an option for basements. In areas where basements are proposed, an underdrain placed at the bottom of sanitary sewer trenches within drive lanes may help reduce the impact of groundwater on basement suitability. Underdrains placed in the sanitary sewer trenches in areas where groundwater is anticipated will likely be the "active" type, which uses a perforated drain pipe. In areas where groundwater is not anticipated, "passive" type underdrains may be used.

To date, RMG has not been provided with cut/fill plans or a site grading plan. As such, we are unable to map areas where groundwater is anticipated to be within 14 feet of the proposed ground surface. Therefore, basement construction should be restricted except where one of the following conditions apply:

- Underdrains are installed at the bottom of sanitary sewer trenches within drive lanes;
- A year-long groundwater monitoring study has been undertaken, and the results indicate that groundwater is sufficiently deep to allow basement construction;
- The proposed site grading will result in at least 14 feet of separation between the proposed ground surface and the groundwater elevation.

7.7 Erosion and Corrosion

The upper sands encountered at the site are susceptible to erosion by wind and flowing water. The sandstone and claystone at this site typically have low resistivity values (less than 2,000 ohm-cm) and are likely to be potentially corrosive to buried, ferrous metal piping and other structures.

Mitigation

Due to the nature of the soils on the site, it is anticipated that the majority of the surficial soils (silty to clayey sand and sandy clay) are subject to erosion by wind or water. The majority of the site has low lying vegetation that is reducing the potential for erosion. During development and construction, disturbance of the site most likely will occur and may require regrading and revegetation.

Sandstone bedrock underlies the entire site. Sandstone bedrock is generally considered to contain corrosive minerals. To help mitigate potential corrosion, buried ferrous metal piping, conduit, and similar construction materials should be coated, wrapped or otherwise protected to avoid or reduce contact with the on-site soils. For environments corrosive to concrete, sulfate-resistant cement and additives should be used.

7.8 Surface Grading and Drainage

The recommendations listed in this report are intended to address normal surface drainage conditions, assuming the presence of groundcover (established vegetation, paved surfaces, and/or structures) throughout the regions upslope from this structure. However, groundcover may not be present due to a variety of factors (ongoing construction/development, wildfires, etc.). During periods when groundcover is not present in the "upslope" regions, higher than normal surface drainage conditions may occur, resulting in perched water tables, excess runoff, flash floods, etc. In these cases, the surface drainage

recommendations presented herein (even if properly maintained) may not mitigate all groundwater problems or moisture intrusion into the structure. We recommend that the site plan be prepared with consideration of increased runoff during periods when groundcover is not present on the upslope areas.

Mitigation

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

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

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

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

Preliminary grading plans were not provided or reviewed at the time the report was issued. It is assumed based on the test borings for this investigation that the excavations will encounter silty to clayey sands, sandy clay, silty to clayey sandstone, and sandy claystone.

Mitigation

The on-site soils can be used as site grading fill, though the clay and claystone should be avoided in areas where the proposed foundations are not anticipated to penetrate through the grading fill.

The on-site soils are mildly susceptible to wind and water erosion. Minor wind erosion and dust may be an issue for a short time during and immediately after construction. Should the problem be considered severe during construction, watering of the cut areas may be required. Once construction is complete, vegetation should be re-established.

Prior to placement of overlot fill or removal and recompaction of the existing materials, topsoil, low-density native soil, all uncontrolled or undocumented fill, and organic matter should be removed from the proposed fill area. The subgrade should be scarified, moisture conditioned to facilitate compaction (usually 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.

Guideline Site Grading Specifications are included in the Appendix B.

8.0 BEARING OF GEOLOGIC CONDITIONS UPON PROPOSED DEVELOPMENT

Geologic hazards (as described in section 7.0 of this report) and geologic constraints (also as described in section 7.0 of this report) were found to be present at this site.

The geologic hazards anticipated to affect this site are faults/seismicity and radioactivity/radon gas. The most significant geologic constraints to development recognized at this site are expansive/compressible soils and shallow groundwater. The geologic conditions encountered at this site are relatively common to the immediate area and mitigation can be accomplished by implementing common engineering and construction practices. None of these conditions are anticipated to preclude the proposed development.

9.0 BURIED UTILITIES

Based upon the conditions encountered in the exploratory test borings, we anticipate that the soils encountered in the utility trench excavations will consist of silty to clayey sands, (SM and SC) well graded sand and sandstone with silt (SW-SM) and sandy clay/claystone (CL). It is anticipated that the sands will be encountered at loose to medium dense relative densities, the clays at medium stiff to very stiff consistencies. Bedrock consisting of sandstone and claystone may be encountered at hard to very hard consistencies. The bedrock should be easily excavatable with standard construction equipment (mini-excavator, loader). Depending on the depth of excavations, temporary shoring and hydraulic water pumps may be required to prevent the collapse of trenches and the accumulation of water at the bottom of the excavation.

We believe the sand will classify as Type C material and the clays will classify as Type A material as defined by OSHA in 29 CFR Part 1926. OSHA requires that temporary excavations made in Type A and C materials be laid back at ratios no steeper than ¾:1 (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 the slope designed by a professional engineer.

Utility mains such as water and sanitary sewer lines are typically placed beneath paved roadways. The settlement of the utility trench backfill can have a detrimental effect on pavements and roadway surfaces. We recommend that utility trench backfill be placed in thin loose lifts, moisture conditioned as required and compacted to the recommendations outlined in the **Exterior Backfill** section of this report. The placement and compaction of utility trench backfill should be observed and tested by a representative of RMG during construction.

It is a common local practice for underdrains to be placed at the bottom of sanitary sewer trenches within drive lanes. Underdrains placed in the sanitary sewer trenches in areas where groundwater is anticipated will likely be the "active" type, which uses a perforated drain pipe. In areas where groundwater is not anticipated, “passive” type underdrains may be used. The outfall for the sanitary sewer trench underdrain was not known at the time of this investigation because the development plan and grading plan were not available for our review. Typical underdrain details are presented in Figures 23 and 24.

10.0 PRELIMINARY PAVEMENT SECTIONS

Preliminary roadway plans were not provided prior to the report issue date. Roadways throughout the proposed development are classified as "Urban Residential Collector", "Urban Local", and "Urban Local (Low Volume)" and are anticipated to have 50 to 60-foot Public Right of Ways. ***The actual pavement section design for individual streets is to be completed following overlot grading and rough cutting of the street subgrade.***

For purposes of this report (preliminary planning), we anticipate the subgrade soils will primarily have an American Association of State Highway and Transportation Officials (AASHTO) Soil Classification of A-1-b, A-2-4, A-2-6, A-6, and A-7-6 with estimated California Bearing Ratio (CBR) values of approximately 5 to 15.

The above values are for preliminary planning purposes and may vary upon final design, dependent upon the soil material used for subgrade construction.

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.

11.0 ANTICIPATED FOUNDATION SYSTEMS

Based on the information presented previously, conventional shallow foundation systems consisting of standard spread footings/stemwalls or conventionally-reinforced stiffened (ribbed) slabs-on-grade are anticipated to be suitable for the proposed residential structures. It is assumed that the deepest excavation cuts will be approximately 6 to 8 feet below the final ground surface, not including overexcavation which may be required on a lot-by-lot basis.

Due to their swell potential, the sandy clay and claystone are generally not suitable for support of spread footing foundations or floor slabs. Where expansive soils are encountered near spread footing foundation or floor slab levels, they should be removed and replaced with granular, non-expansive structural fill. Foundation systems which may reduce or eliminate the need for overexcavation include (but are not limited to) post-tensioned slabs-on-grade, integral stiffened (ribbed) slab foundations, drilled pier (caisson) foundations with or without structural floors, etc.

If loose or compressible sands are encountered, they may require additional compaction. In some cases, removal and recompaction may be required for loose soils. Similarly, if shallow groundwater conditions result in unstable soils, unsuitable for bearing of residential foundations, these soils may require stabilization or overexcavation and replacement prior to construction of foundation components.

The foundation system for each lot should be designed and constructed based upon recommendations developed in a detailed Subsurface Soil Investigation completed after site development activities are complete. The recommendations presented in the Subsurface Soil Investigations should be verified by an Open Excavation Observation following the excavation on each lot.

11.1 Subexcavation and Moisture-Conditioned Fill

Based upon the field exploration and laboratory testing, subexcavation and replacement is not anticipated. However, prior to performing excavation and/or filling operations, vegetation, organic and deleterious material shall be cleared and disposed of in accordance with applicable requirements. The excavation should extend to a minimum depth below and laterally beyond the bottom of foundations as determined based on final grading plans.

11.2 Foundation Stabilization

Groundwater and loose soils were encountered at the time of drilling. 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, dependent upon the rate of groundwater 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.

11.3 Foundations Drains

A subsurface perimeter drain is required around portions of the structure which will have habitable or storage space located below the finished ground surface. This includes crawlspace areas but not the walkout trench, if applicable.

Groundwater conditions were encountered in the test borings at the time of field exploration. Depending on the conditions encountered during the lot specific Subsurface Soil Investigation and the conditions observed at the time of the Open Excavation Observation, 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. An Underslab Drain detail is presented in Figure 22. 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.

11.4 Structural Fill

Areas to receive 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.

11.5 Exterior Backfill

Backfill 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 85 percent of the maximum dry density as determined by the Modified Proctor test, ASTM D-1557 on exterior sides of walls in landscaped areas. In areas where backfill supports pavement and/or concrete flatwork, the materials should be compacted to 90 percent of the maximum dry density.

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.

The appropriate government/utility specifications should be used for fill placed in utility trenches. If material is imported for backfill, the material should be approved by the Geotechnical Engineer prior to hauling it to the site.

The backfill should not be placed on frozen subgrade or allowed to freeze during moisture conditioning and placement. Backfill should be compacted by mechanical means, and foundation walls should be braced during backfilling and compaction.

11.6 Design Parameters

The allowable bearing pressure of the subsurface soils should be determined by a detailed site specific Subsurface Soil Investigation and verified by and Open Excavation Observation, as noted above.

12.0 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.

12.1 Soil and Rock Design Parameters

Two detention ponds are proposed along the southern boundary within the designated open spaces. It is our understanding that the proposed detention ponds are to be built-up approximately 8.5 to 9 feet above grade. 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, K_a	Passive Earth Pressure, K_p	At Rest Earth Pressure, K_o
Silty to Clayey Sand (SC/SM)	115	28	0.36	2.77	0.53
Sandy Clay (CL)	110	17	0.55	1.83	0.71
Silty Sandstone	120	30	0.33	3.00	0.50
Sandy Claystone	115	20	0.49	2.04	0.66

12.2 Embankment Recommendations

Above-grade embankments are to be constructed with 4:1 slopes. Embankments 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 Manual. The following recommendations are in accordance with the El Paso county DCM Volume 2, Extended Detention Basin (EDB), Design Procedure and Criteria, paragraph 8.

The ground area to receive embankments should be cleared and grubbed to a minimum depth of two-feet to remove grass, shrubs, trees, roots, stumps, and other organic material. The exposed soil should be 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 Modified Proctor test (ASTM D-1557). The prepared surface should present a firm and stable condition.

Embankment should be constructed as structural fill on a prepared stable base. On-site native soil, when screened of all deleterious material and cobbles greater than 6-inches in any dimension, is anticipated to be suitable for embankment construction. Structural fill should be placed in 10-inch loose lifts, 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 Modified Proctor test (ASTM D-1557).

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 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.

13.0 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. ***A site-specific subsurface soil investigation will be required for all proposed structures including (but not limited to) residences, retaining walls and pumphouses, commercial buildings, etc.***

To develop recommendations for construction of the proposed roadways, a pavement design investigation should be performed. This investigation should consist of additional test borings, soil laboratory testing and specific recommendations for the design and construction of roadway pavement sections.

14.0 CONCLUSIONS

Based upon our evaluation of the geologic conditions, it is our opinion that the proposed development is feasible. The potential for expansive/compressible soils and shallow groundwater are not considered unusual for the Front Range region of Colorado. Mitigation of geologic hazards is most effectively accomplished by avoidance. However, where avoidance is not a practical or acceptable alternative, geologic hazards 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 each proposed building structure. Surface water should be efficiently removed from the building area to prevent ponding and infiltration into the subsurface soil. Due to the shallow groundwater conditions and proximity to the "Unnamed Tributary", additional subsurface drainage systems may also be required.

Stiffened slab foundations are currently proposed with in Phase 2 as designated on the Concept Plan. The remainder of the lots are to have the option for basement construction.

The foundation and floor slabs of the structure should be designed using the recommendations provided in the site specific Subsurface Soil Investigation performed for each lot. In addition, appropriate surface drainage should be established during construction and maintained by the homeowner.

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

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.

15.0 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 **Challenger Colorado, LLC** 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 and/or geologic hazards point-of-view, please feel free to contact us.

FIGURES

NOT TO SCALE

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Central Office:
Englewood, CO 80112
(303) 688-9475
Northern Office:
Greeley / Evans, CO 80620
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SITE VICINITY MAP

PHASE 1-4, FALCON HIGHLANDS
ANTELOPE MEADOWS CIRCLE
EL PASO COUNTY, COLORADO
CHALLENGER COLORADO, LLC

JOB No. 184041

FIG No. 1

DATE 10-8-2021

TRACT TABLE

TRACT	SIZE (SF)	LANDSCAPE/OPEN SPACE/ TRAIL	PARKS AND TRAILS	SIGNAGE/ PUBLIC IMPROVEMENTS	DRAINAGE/ DETENTION	PUBLIC UTILITIES	OWNED BY	MAINTAINED BY
A	266,205	X		X			FHMD	FHMD
B	6,301			X			FHMD	FHMD
C	66,263	X		X		X	FHMD	FHMD
D	6,600	X				X	FHMD	FHMD
E	11,000	X				X	FHMD	FHMD
F	1,504,044	X	X	X	X	X	FHMD	FHMD
G	152,030	X	X				FHMD	FHMD
H	7,089			X			FHMD	FHMD
I	8,141			X			FHMD	FHMD
TOTAL	2,027,673							

FHMD = FALCON HIGHLANDS METROPOLITAN DISTRICT

PHASING

PHASE	# OF UNITS	LOT NUMBERS	DEVELOPMENT TIMLINE
1	50	1-12, 48-88	FALL 2022
2	193	13-45,89-243	2023
3	111	244-354	FUTURE
4	24	355-378	FUTURE

FALCON HIGH

EL PASO COUNT
PLANNED UNIT DEVEL(
PRELIMINARY F
A PORTION OF SECTION 12, TOWNSHI
WEST OF THE SIXTH PRINCIPAL MERIDIA
STATE OF COLORA

JOB No. 184041

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Pueblo / Canon City:
(719) 544-7750

PHASE 1-4, FALCON HIGHLANDS
ANTELOPE MEADOWS CIRCLE

EL PASO COUNTY, COLORADO
CHALLENGER COLORADO, LLC

ENGINEER:	TM
DRAWN BY:	KZ
CHECKED BY:	TM
ISSUED:	10/8/2021
REVISION:	UPDATE LOT LAYOUT 9-7-2022

CONCEPT PLAN PHASING EXHIBIT

SHEET No.
FIG-2

REFERENCE
NOT TO SCALE

DENOTES APPROXIMATE
LOCATION OF TEST BORINGS

JOB No. 184041

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PHASE 1-4, FALCON HIGHLANDS
ANTELOPE MEADOWS CIRCLE

EL PASO COUNTY, COLORADO
CHALLENGER COLORADO, LLC

ENGINEER:	TM
DRAWN BY:	KZ
CHECKED BY:	TM
ISSUED:	10/8/2021
REVISION: LAYOUT	UPDATE LOT 9-7-2022

SITE PLAN WITH TEST BORING LOCATIONS

SHEET No.
FIG-3

SOILS DESCRIPTION


CLAYSTONE


FILL: SAND, SILTY TO CLAYEY


SANDSTONE


SANDY CLAY


SILTY SAND


SILTY TO CLAYEY SAND

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

SYMBOLS AND NOTES


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


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


FREE WATER TABLE


DEPTH AT WHICH BORING CAVED


BULK — DISTURBED BULK SAMPLE


AUG — AUGER "CUTTINGS"

4.5 — WATER CONTENT (%)

ROCKY MOUNTAIN GROUP

Architectural
Structural
Forensics

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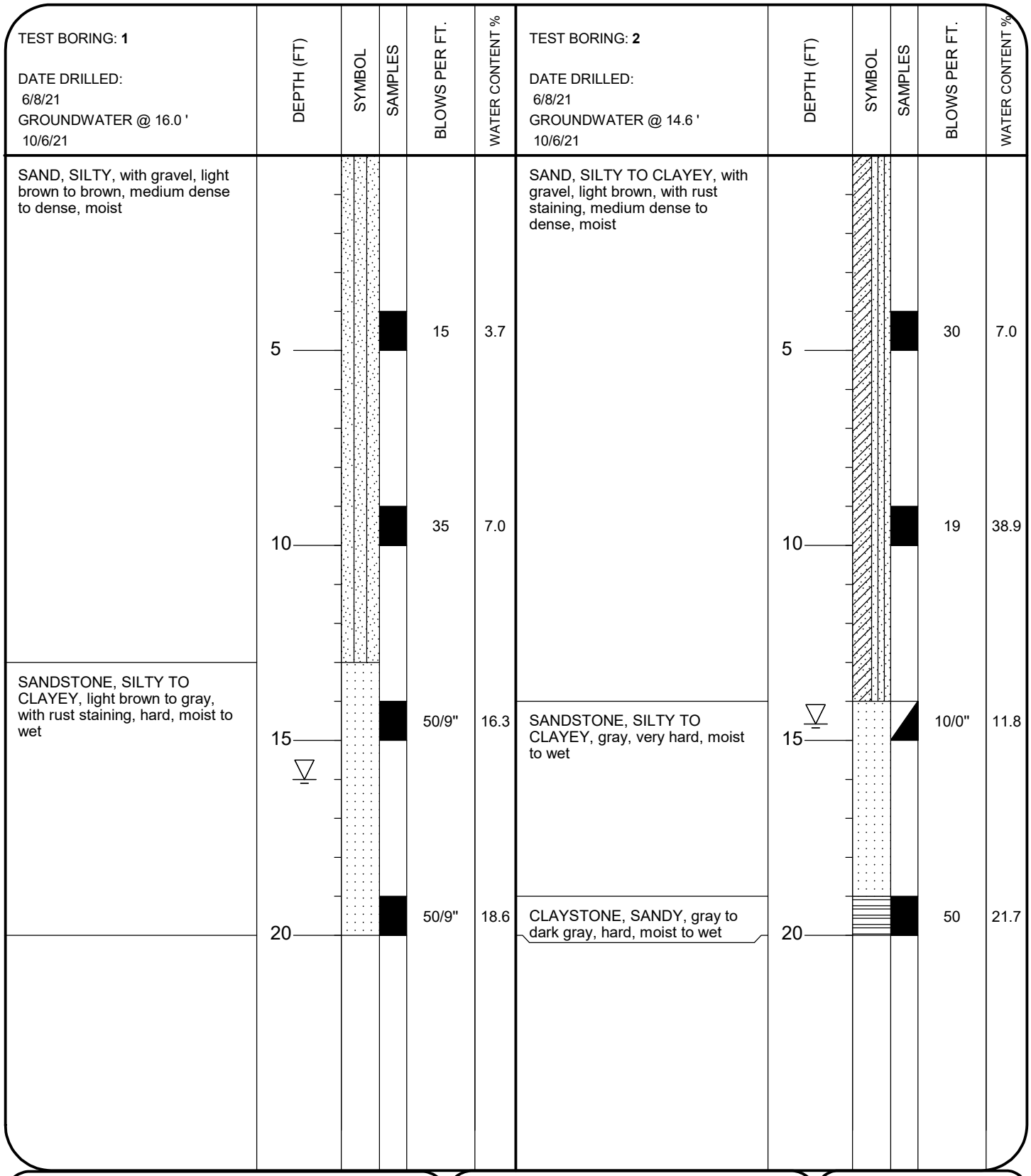
SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

EXPLANATION OF TEST BORING LOGS

JOB No. 184041

FIGURE No. 4

DATE 10/8/2021



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Structural
Forensics

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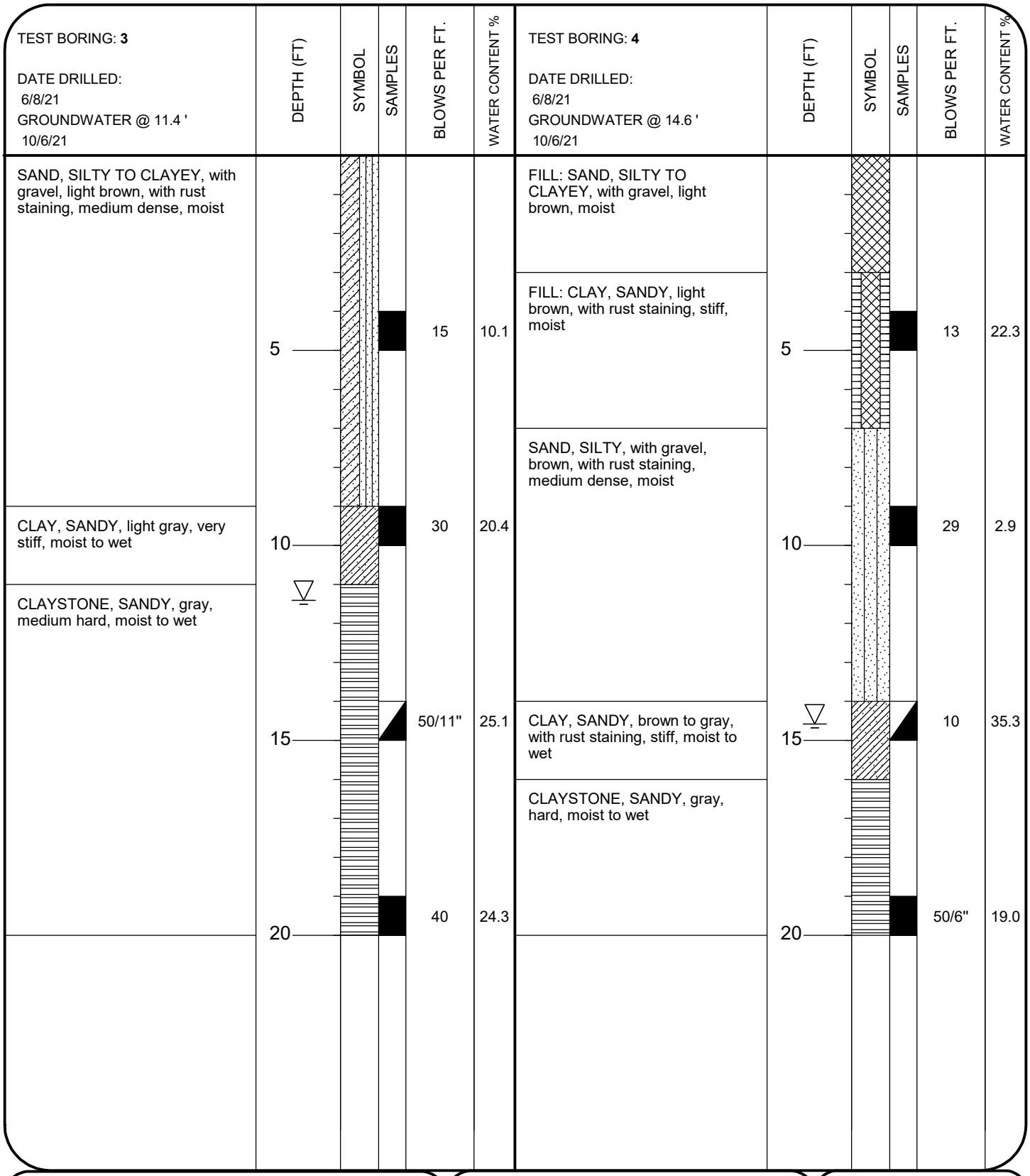
TEST BORING LOG

JOB No. 184041

FIGURE No. 5

DATE 10/8/2021



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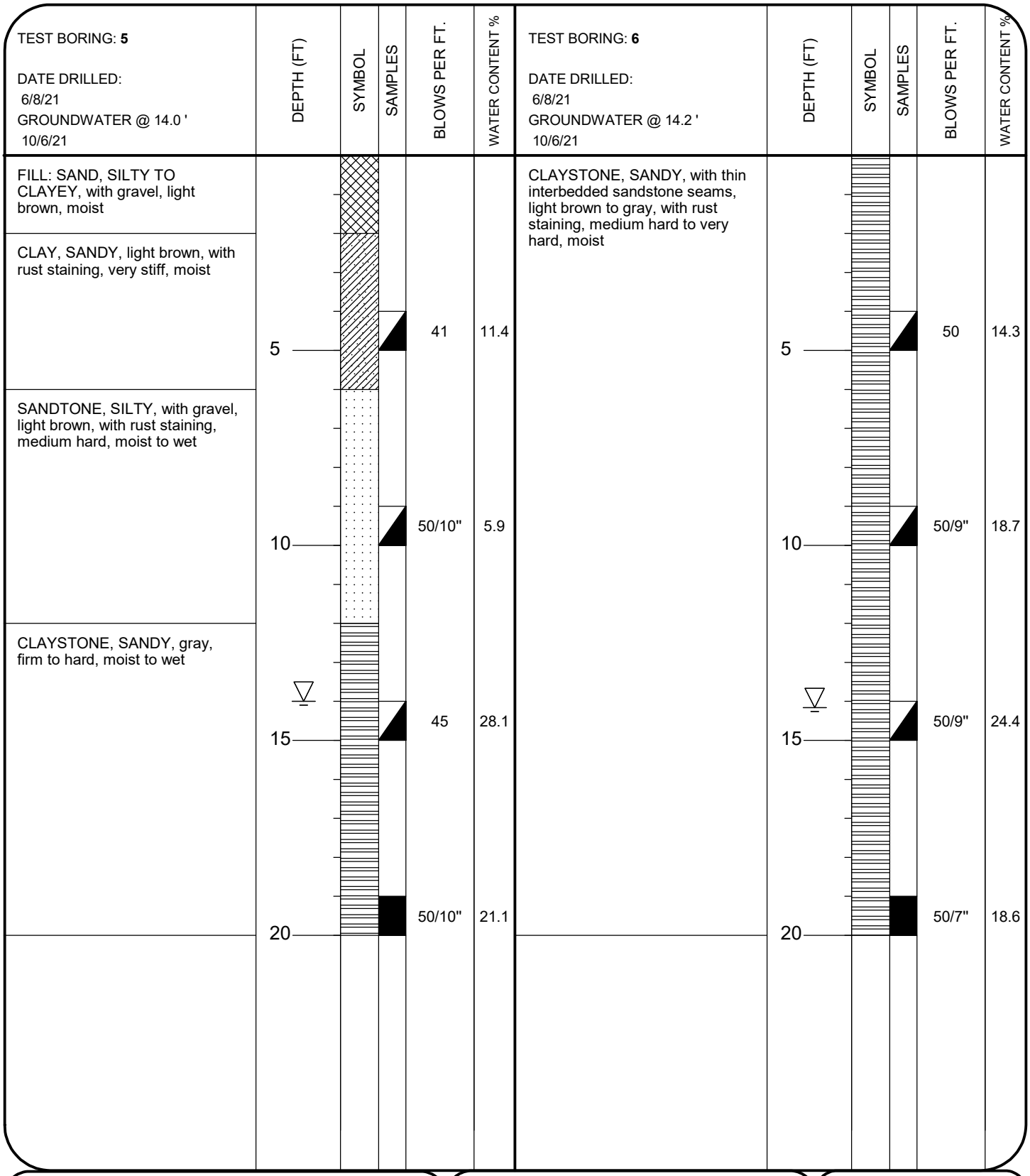
TEST BORING LOG

JOB No. 184041

FIGURE No. 6

DATE 10/8/2021



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TEST BORING LOG

JOB No. 184041

FIGURE No. 7

DATE 10/8/2021

TEST BORING: **7**

DATE DRILLED:
6/8/21
GROUNDWATER @ 9.0 '
10/6/21

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
5			47	18.6
10			50/10"	16.5
15			50/6"	14.3
20			50/6"	20.3

FILL: SAND, SILTY TO CLAYEY, with gravel, light brown, moist

CLAYSTONE, SANDY, dark brown, with rust staining, firm to hard, moist to wet

SANDSTONE, SILTY, light gray, very hard, moist

TEST BORING: **8**

DATE DRILLED:
6/8/21
GROUNDWATER @ 17.4 '
10/6/21

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
5			15	3.0
10			32	26.9
15			50/8"	14.4
20			50/11"	16.8

FILL: SAND, SILTY TO CLAYEY, with gravel, light brown, moist

SAND, SILTY TO CLAYEY, brown, medium dense, moist

CLAY, SANDY, brown, with rust stining, very stiff, moist

CLAYSTONE, SANDY, olive to gray, medium hard to hard, moist to wet

ROCKY MOUNTAIN GROUP

Architectural
Structural
Forensics

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TEST BORING LOG

JOB No. 184041

FIGURE No. 8

DATE 10/8/2021

TEST BORING: **9**

DATE DRILLED:
6/8/21
GROUNDWATER @ 14.4 '
10/6/21

FILL: CLAY, SANDY, brown, with rust staining, stiff, moist

SANDSTONE, SILTY, gray, with rust staining, firm, moist to wet

CLAYSTONE, SANDY, dark brown to gray, medium hard, moist to wet

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
5			10	9.4
10			15	12.6
15 ▽			24	16.2
20			42	21.6

TEST BORING: **10**

DATE DRILLED:
6/8/21
GROUNDWATER @ 15.0 '
10/6/21

SAND, SILTY TO CLAYEY, with gravel, light brown to brown, with rust staining, dense, moist

CLAYSTONE, SANDY, olive, firm, moist to wet

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
5			34	5.8
10			40	9.2
15 ▽			44	19.2
20			45	25.8

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TEST BORING LOG

JOB No. 184041

FIGURE No. 9

DATE 10/8/2021

TEST BORING: **11**

DATE DRILLED:
6/21/21
GROUNDWATER @ 9.3 '
10/6/21

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
SAND, SILTY TO CLAYEY, brown to gray, with rust staining, medium dense to dense, moist to wet				
5			19	10.1
10			32	13.7
SANDSTONE, SILTY, light gray, hard, moist to wet				
15			50/8"	18.9
20				23.0

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TEST BORING LOG

JOB No. 184041

FIGURE No. 10

DATE 10/8/2021

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	3.7								
1	9.0	7.0		NP	NP	0.2	11.1			SW-SM
1	14.0	16.3								
1	19.0	18.6								
2	4.0	7.0		NP	NP	4.8	18.4			SM
2	9.0	38.9								
2	14.0	11.8								
2	19.0	21.7								
3	4.0	10.1								
3	9.0	20.4		30	11	11.2	13.2			
3	14.0	25.1								
3	19.0	24.3								
4	4.0	22.3	89.1	35	29	0.0	88.5		- 0.6	CL
4	9.0	2.9								
4	14.0	35.3								
4	19.0	19.0								
5	4.0	11.4								
5	9.0	5.9								
5	14.0	28.1	97.5	28	9				1.7	
5	19.0	21.1								
6	4.0	14.3								
6	9.0	18.7	105.7	29	12		26.5		- 0.5	SC
6	14.0	24.4								
6	19.0	18.6								
7	4.0	18.6					66.0			CL
7	9.0	16.5								
7	14.0	14.3								
7	19.0	20.3								
8	4.0	3.0								
8	9.0	26.9		47	26		75.9		2.8	CL
8	14.0	14.4								
8	19.0	16.8								
9	4.0	9.4								
9	9.0	12.6	116.0	33	19		50.4		- 0.7	CL

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SUMMARY OF LABORATORY TEST RESULTS

JOB No. 184041
FIGURE No. 11
PAGE 1 OF 2
DATE 10/8/2021

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
9	14.0	16.2								
9	19.0	21.6								
10	4.0	5.8				9.5	11.7			SW-SM
10	9.0	9.2								
10	14.0	19.2								
10	19.0	25.8								
11	4.0	10.1				5.3	12.8			
11	9.0	13.7								
11	14.0	18.9								
11	19.0	23.0								

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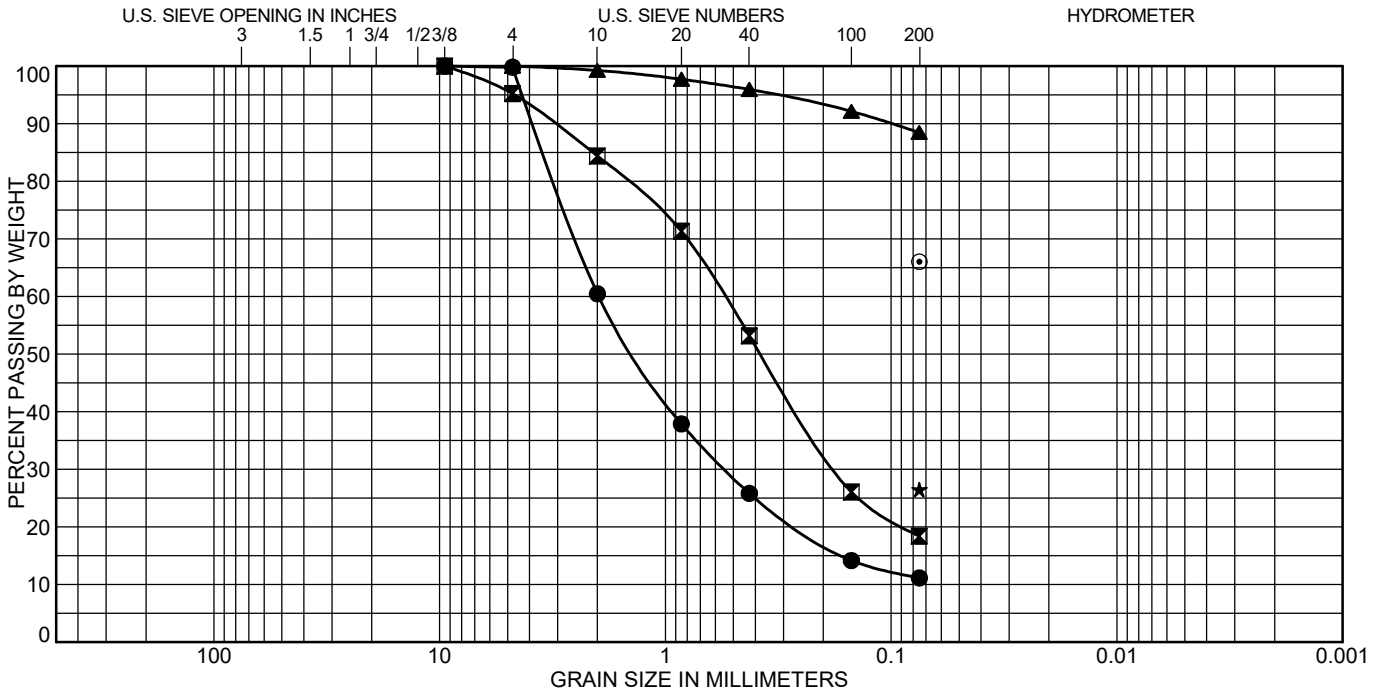
SUMMARY OF LABORATORY TEST RESULTS

JOB No. 184041
FIGURE No. 11
PAGE 2 OF 2
DATE 10/8/2021



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Test Boring	Depth (ft)	Classification	LL	PL	PI
●	1	9.0	WELL-GRADED SAND with SILT(SW-SM)	NP	NP	NP
⊠	2	4.0	SILTY SAND(SM)	NP	NP	NP
▲	4	4.0	LEAN CLAY(CL)	35	6	29
★	6	9.0	CLAYEY SAND(SC)	29	17	12
⊙	7	4.0				

	Test Boring	Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	1	9.0	0.2	88.7	11.1	
⊠	2	4.0	4.8	76.8	18.4	
▲	4	4.0	0.0	11.5	88.5	
★	6	9.0			26.5	
⊙	7	4.0			66.0	

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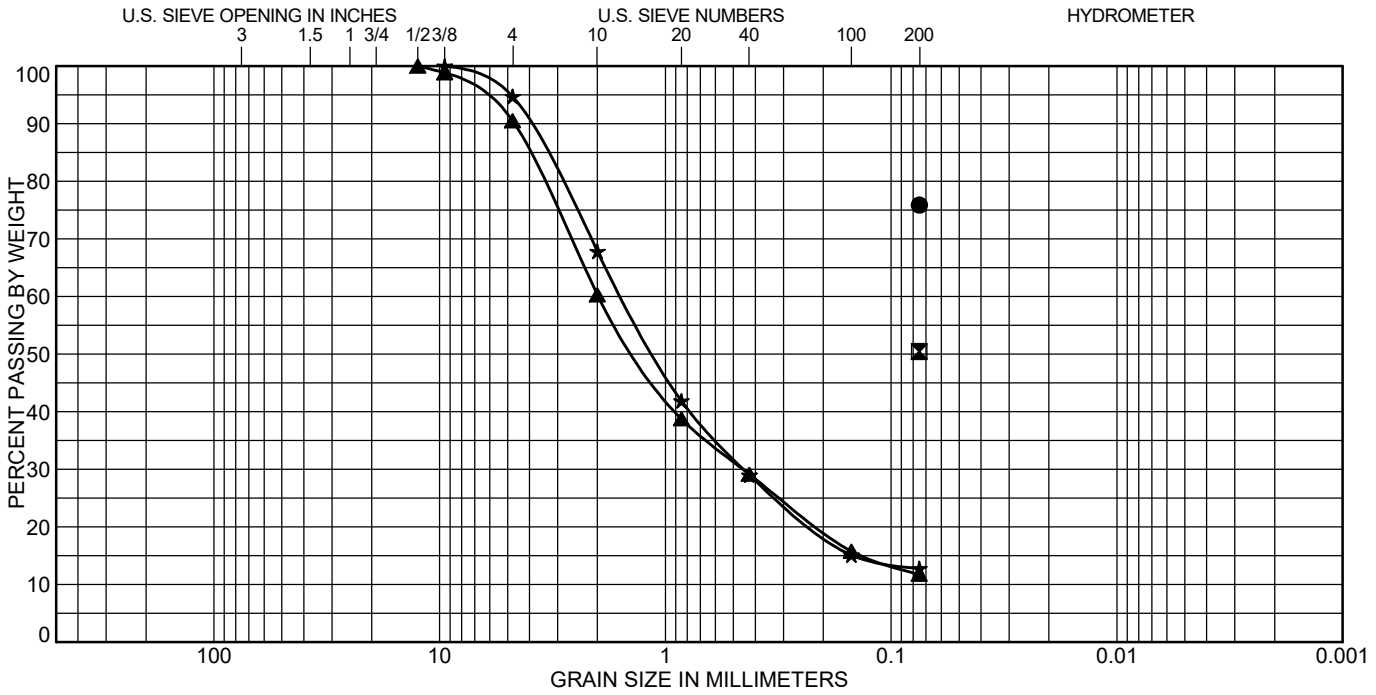
SOIL CLASSIFICATION DATA

JOB No. 184041

FIGURE No. 12

DATE 10/8/2021



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Test Boring	Depth (ft)	Classification	LL	PL	PI
●	8	9.0	LEAN CLAY with SAND(CL)	47	21	26
⧓	9	9.0	SANDY LEAN CLAY(CL)	33	14	19
▲	10	4.0	WELL-GRADED SAND with SILT(SW-SM)	NP	NP	NP
★	11	4.0				

	Test Boring	Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	8	9.0			75.9	
⧓	9	9.0			50.4	
▲	10	4.0	9.5	78.7	11.7	
★	11	4.0	5.3	81.9	12.8	

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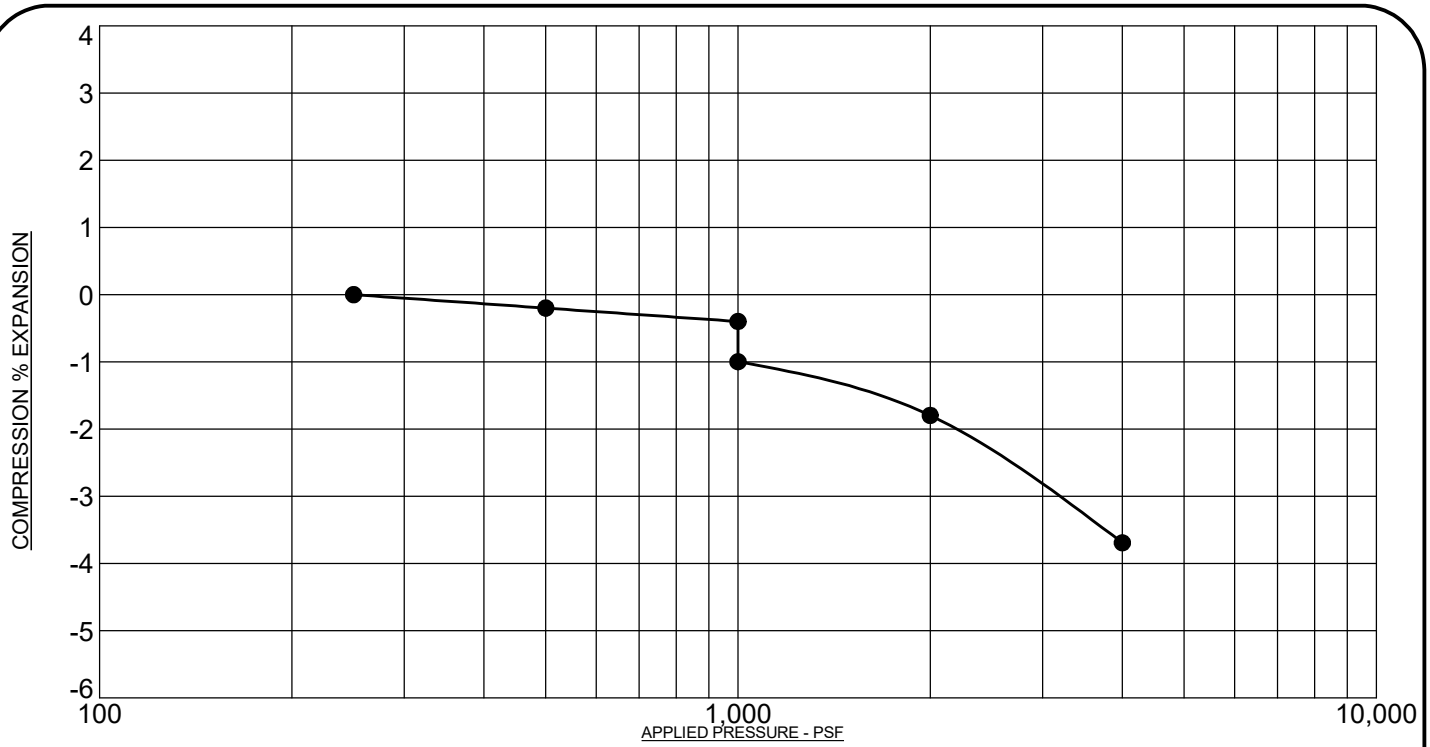
SOIL CLASSIFICATION DATA

JOB No. 184041

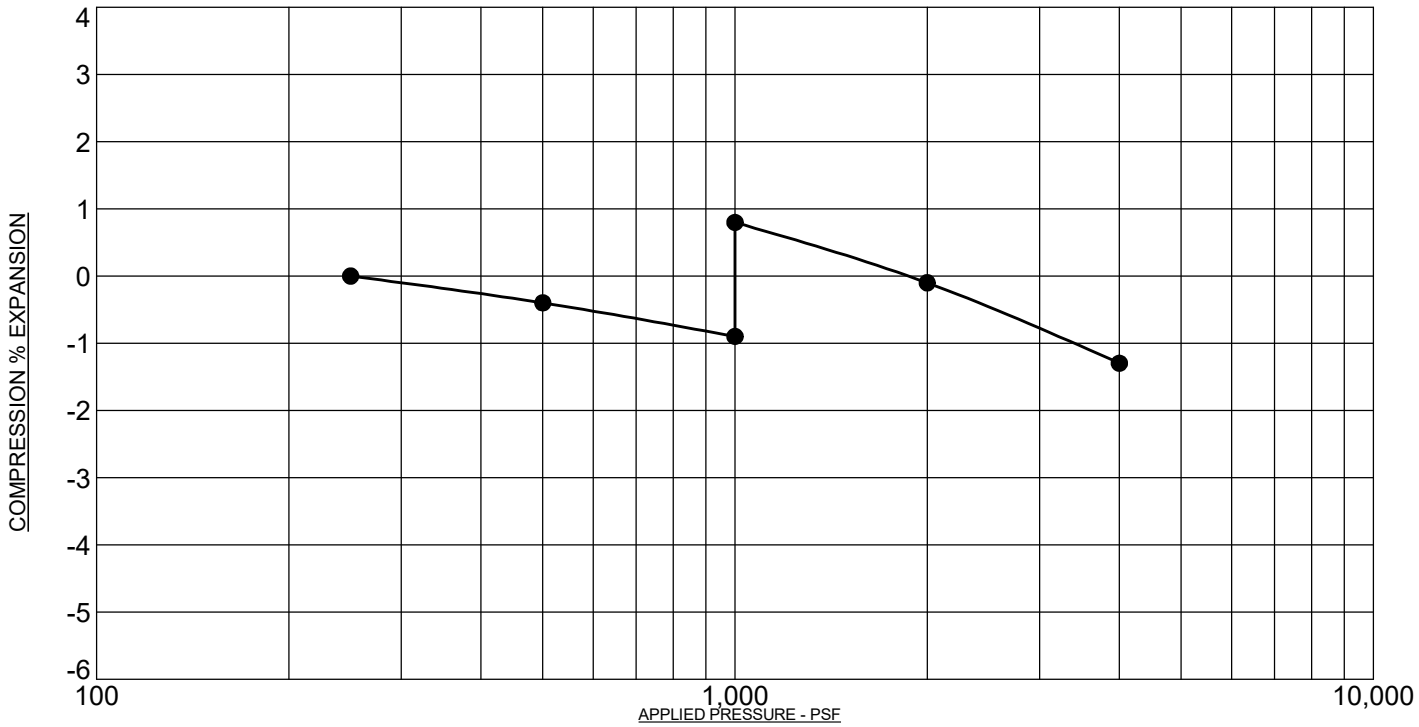
FIGURE No. 13

DATE 10/8/2021



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

SAMPLE LOCATION: **4 @ 4 FT**
NATURAL DRY UNIT WEIGHT: **89.1 PCF**
NATURAL MOISTURE CONTENT: **22.6%**
PERCENT SWELL/COMPRESSION: **- 0.6**



PROJECT: **Falcon Highlands 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: **97.5 PCF**
NATURAL MOISTURE CONTENT: **28.1%**
PERCENT SWELL/COMPRESSION: **1.7**

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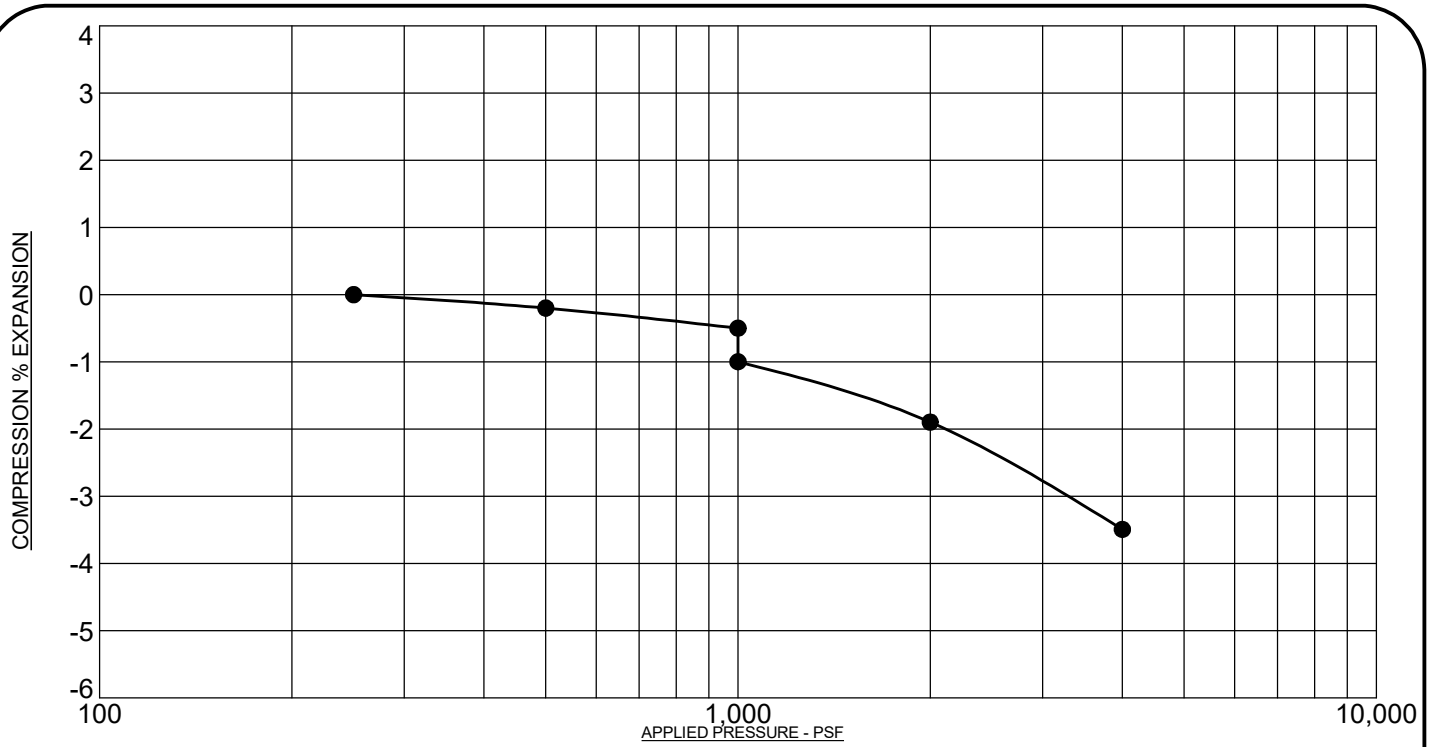
SWELL/CONSOLIDATION TEST RESULTS

JOB No. 184041

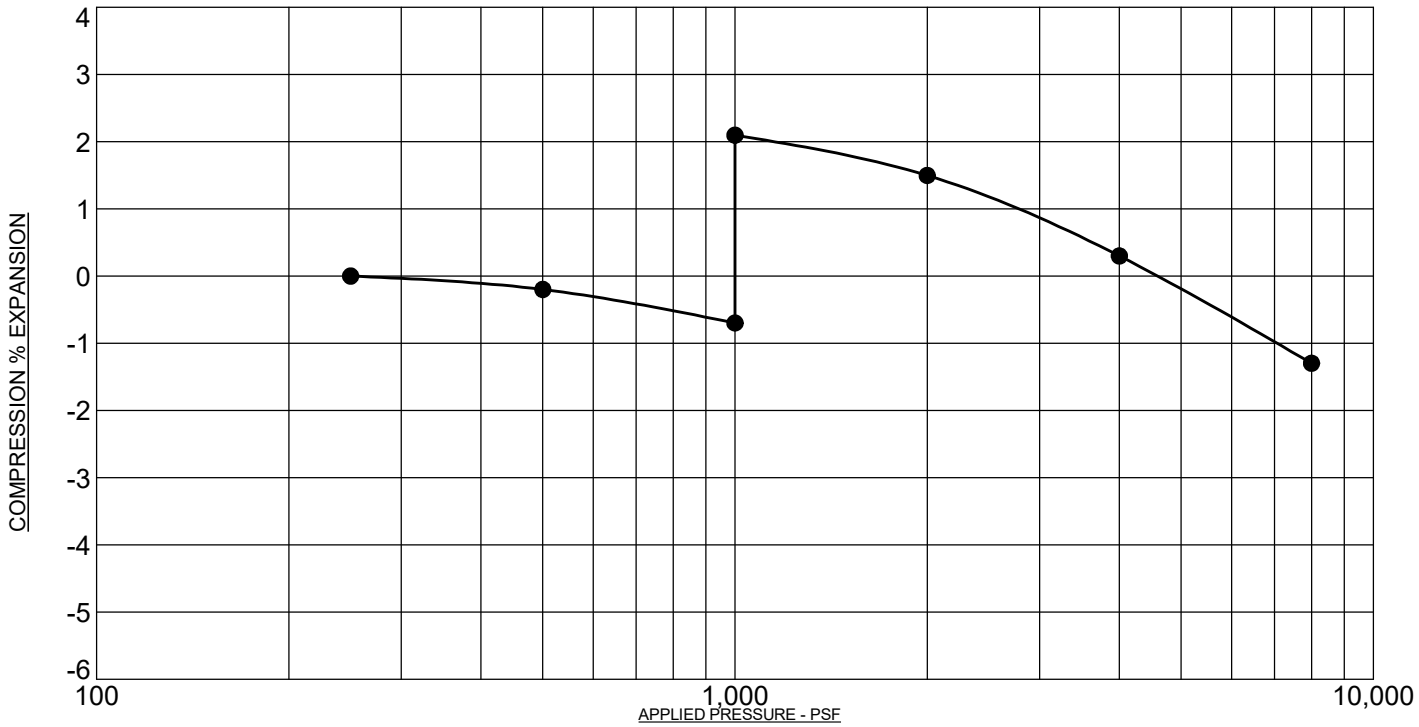
FIGURE No. 14

DATE 10/8/2021



PROJECT: **Falcon Highlands El Paso County, Colorado**
SAMPLE DESCRIPTION: **CLYSTONE, SANDY**
NOTE: SAMPLE WAS INUNDATED WITH WATER AT 2,000 PSF

SAMPLE LOCATION: **6 @ 9 FT**
NATURAL DRY UNIT WEIGHT: **105.7 PCF**
NATURAL MOISTURE CONTENT: **18.7%**
PERCENT SWELL/COMPRESSION: **- 0.5**



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

SAMPLE LOCATION: **8 @ 9 FT**
NATURAL DRY UNIT WEIGHT: **PCF**
NATURAL MOISTURE CONTENT: **26.9%**
PERCENT SWELL/COMPRESSION: **2.8**

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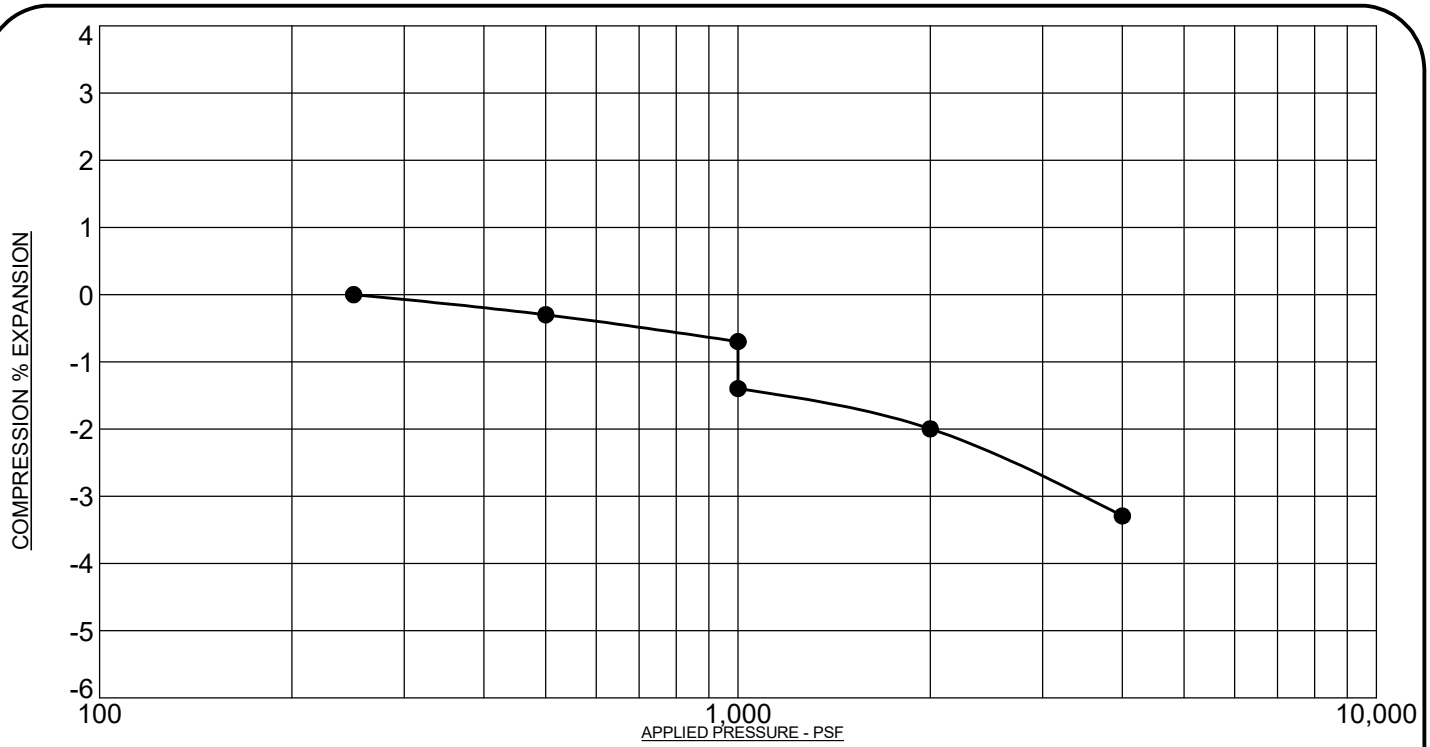
SWELL/CONSOLIDATION TEST RESULTS

JOB No. 184041

FIGURE No. 15

DATE 10/8/2021



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

SAMPLE LOCATION: **9 @ 9 FT**
NATURAL DRY UNIT WEIGHT: **116.0 PCF**
NATURAL MOISTURE CONTENT: **12.6%**
PERCENT SWELL/COMPRESSION: **- 0.7**

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SWELL/CONSOLIDATION TEST RESULTS

JOB No. 184041

FIGURE No. 16

DATE 10/8/2021

REFERENCE
NOT TO SCALE

General Geologic Conditions

- Qa2 - Alluvium two (lower Holocene) - Dark gray to brown, poorly to well sorted, moderately consolidated, silt, sand, gravel, and minor clay and occasional boulders in stream terrace deposits approximately 6-12 feet above the modern flood plain or as non-terrace forming alluvium in valley headwaters. Unit is subject to occasional flooding. Maximum exposed thickness locally exceeds 20 feet.
- Qp - Playa deposits (Holocene) - Gray to dark brown, moderately well sorted, moderately consolidated, clay silt, sand, and scattered granules. Forms flat-surfaced seasonal ponds within eolian sand (Qes). In some areas this unit may be overlain by windblown sand and sheetwash deposits.
- Tbs - Black Squirrel Formation (Paleocene) - Gray-green to tan to brownish gray, moderately-well sorted cross-bedded sandy arkoses interbedded with micaceous sandy claystones that contain abundant plant fragments and occasional, fine- to medium-grained massive arkosic beds. Exposed thickness is approximately 130 feet. The claystones within this unit may be prone to swelling when wet.
- af - Man-placed fill placed between 2005 and 2011
- sw - Seasonal wet area

Engineering Geology

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

DENOTES APPROXIMATE LOCATION OF TEST BORINGS

JOB No. 184041

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Monument Office:
(719) 488-2145
Pueblo / Canon City:
(719) 544-7750

PHASE 1-4, FALCON HIGHLANDS
ANTELOPE MEADOWS CIRCLE
EL PASO COUNTY, COLORADO
CHALLENGER COLORADO, LLC

ENGINEER:	TPM
DRAWN BY:	KCR
CHECKED BY:	TPM
ISSUED:	10-8-2021
REVISION: UPDATE LOT LAYOUT	9-7-2022

ENGINEERING AND GEOLOGY MAP

SHEET No.
FIG-17

8 - Blakeland loamy sand, 1 to 9 percent slopes

9 - Blakeland-Fluvaquentic Haplaquolls

NOT TO SCALE

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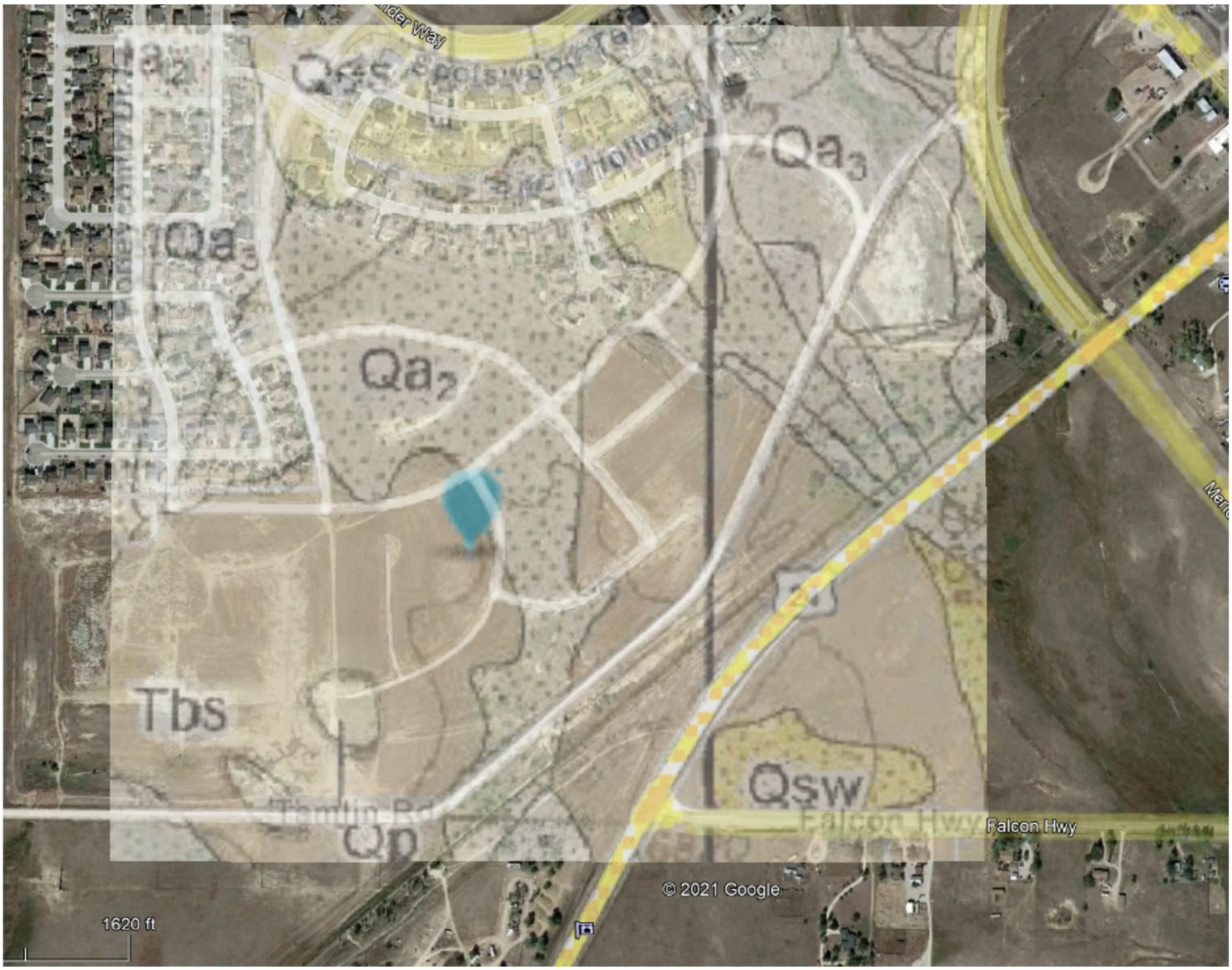
USDA SOIL SURVEY MAP

PHASE 1-4, FALCON HIGHLANDS
ANTELOPE MEADOWS CIRCLE
EL PASO COUNTY, COLORADO
CHALLENGER COLORADO, LLC

JOB No. 184041

FIG No. 18

DATE 10-8-2021



Qa2 - Alluvium Two

Tbs - Black Squirrel Formation

Qp - Playa Deposits

NOT TO SCALE

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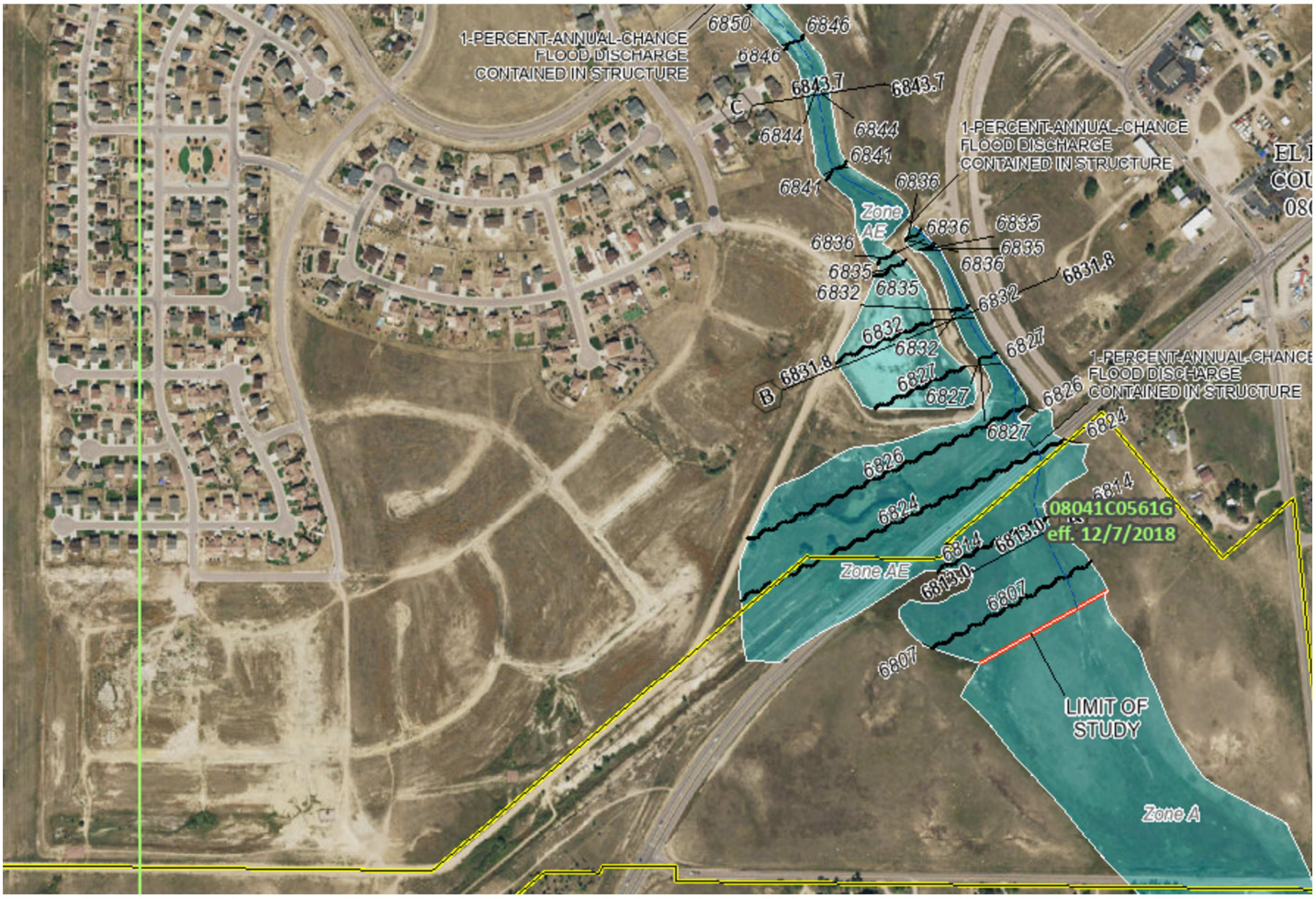
FALCON QUAD MAP

PHASE 1-4, FALCON HIGHLANDS
ANTELOPE MEADOWS CIRCLE
EL PASO COUNTY, COLORADO
CHALLENGER COLORADO, LLC

JOB No. 184041

FIG No. 19

DATE 10-8-2021



NOT TO SCALE

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FEMA MAP

PHASE 1-4, FALCON HIGHLANDS
ANTELOPE MEADOWS CIRCLE
EL PASO COUNTY, COLORADO
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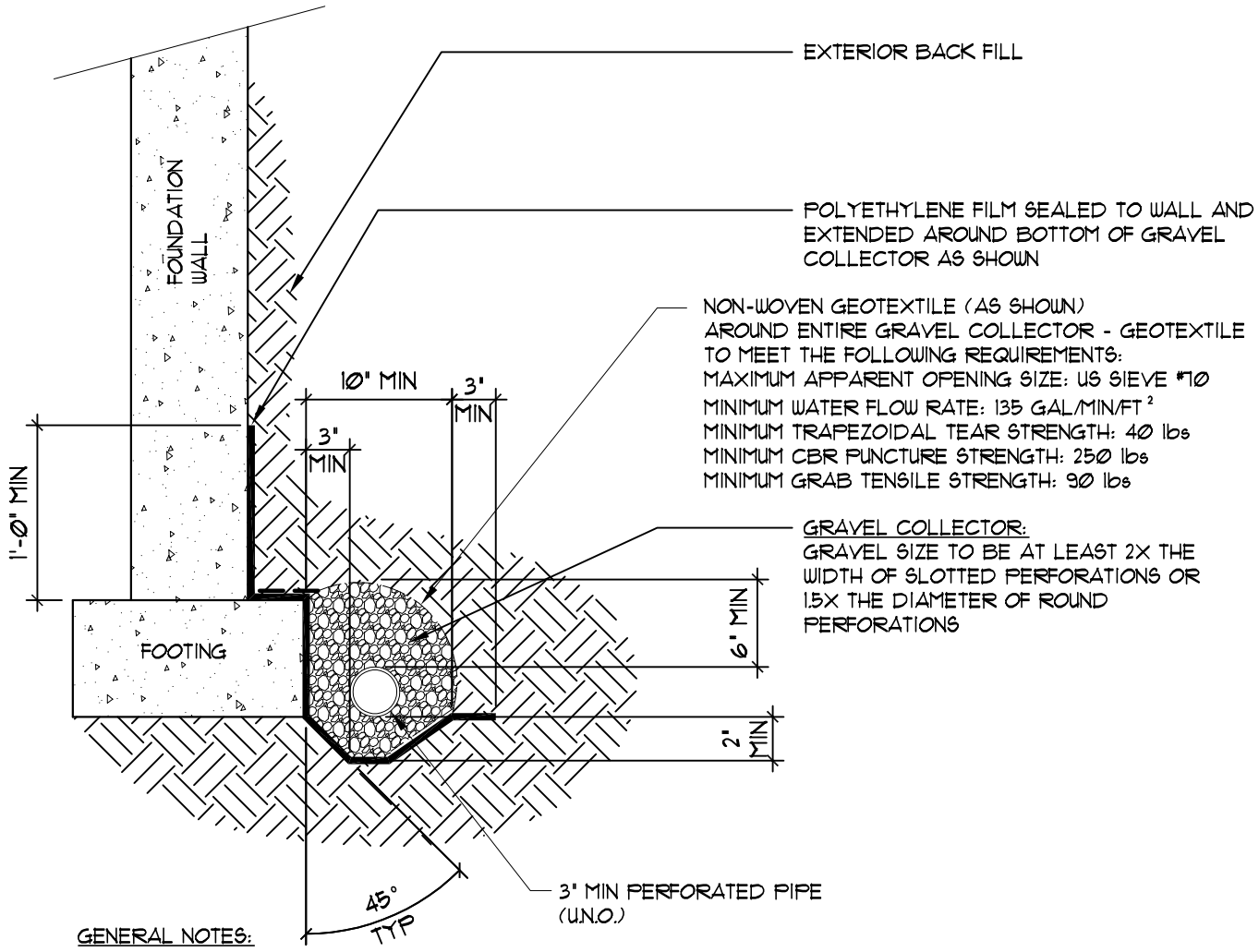
JOB No. 184041

FIG No. 20

DATE 10-8-2021



GENERAL NOTES:

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

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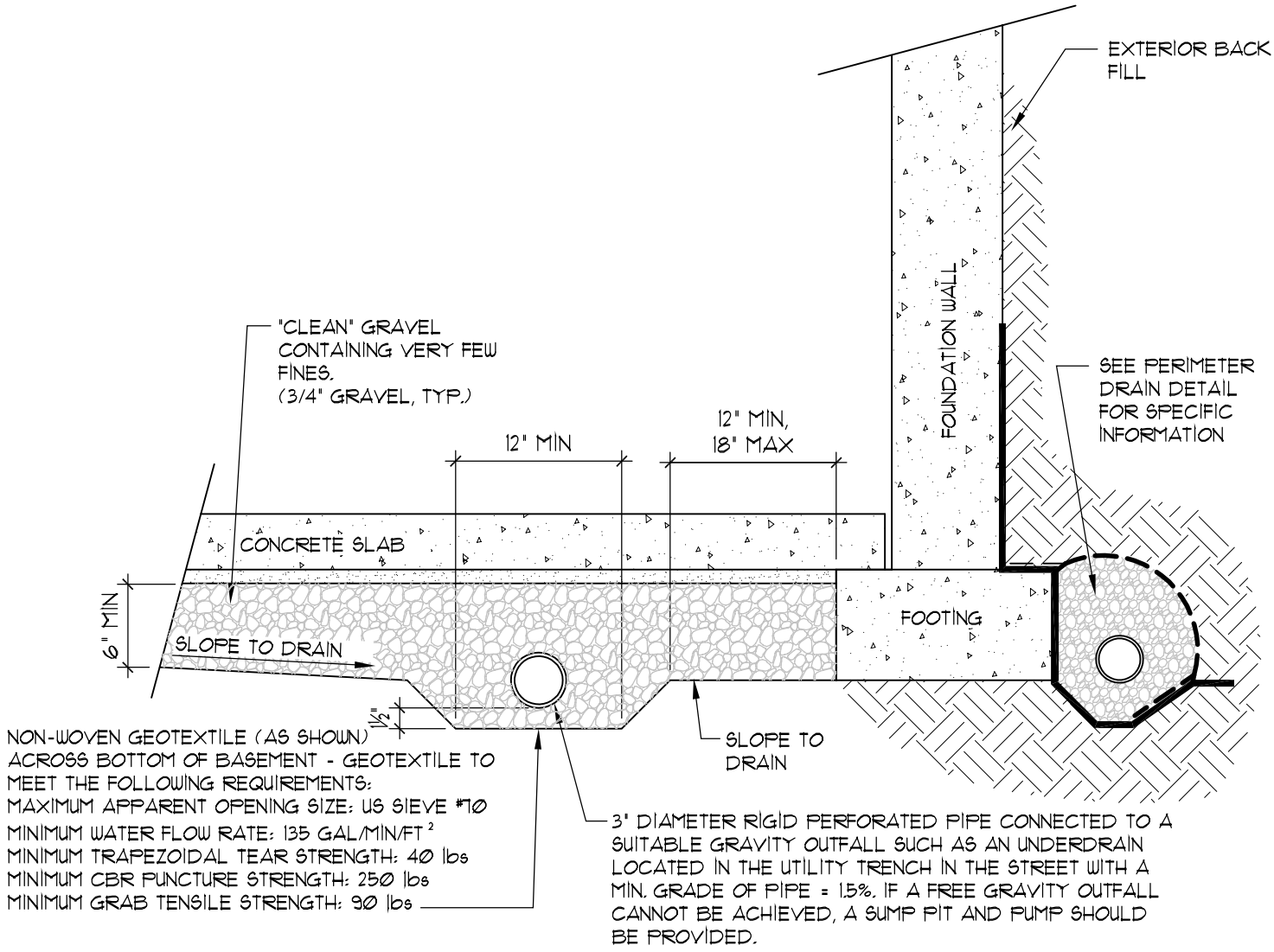
PERIMETER DRAIN

FIG No. 21



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.

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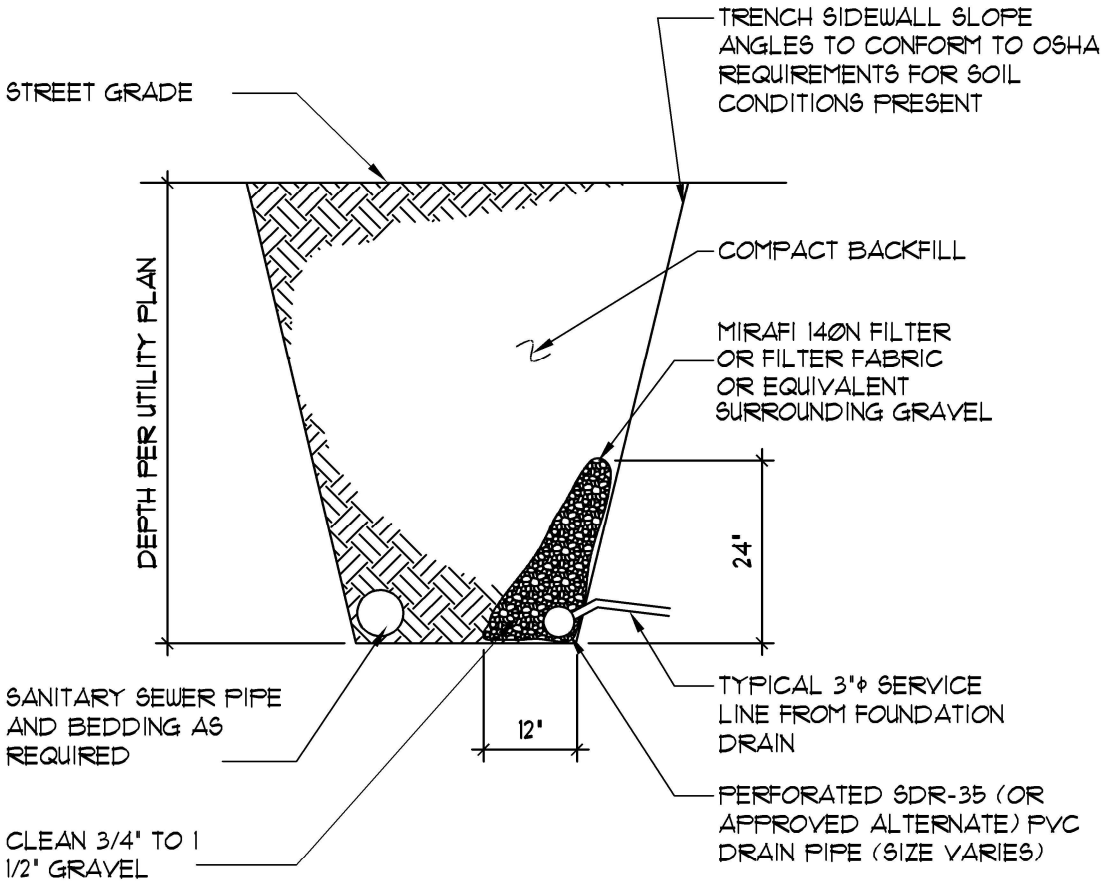
UNDERSLAB DRAIN

FIG No. 22

NOTE: TO BE USED IN CASES WHERE GROUNDWATER IS FOUND DURING TRENCHING OR WHERE SHALLOW GROUNDWATER IS KNOWN TO EXIST



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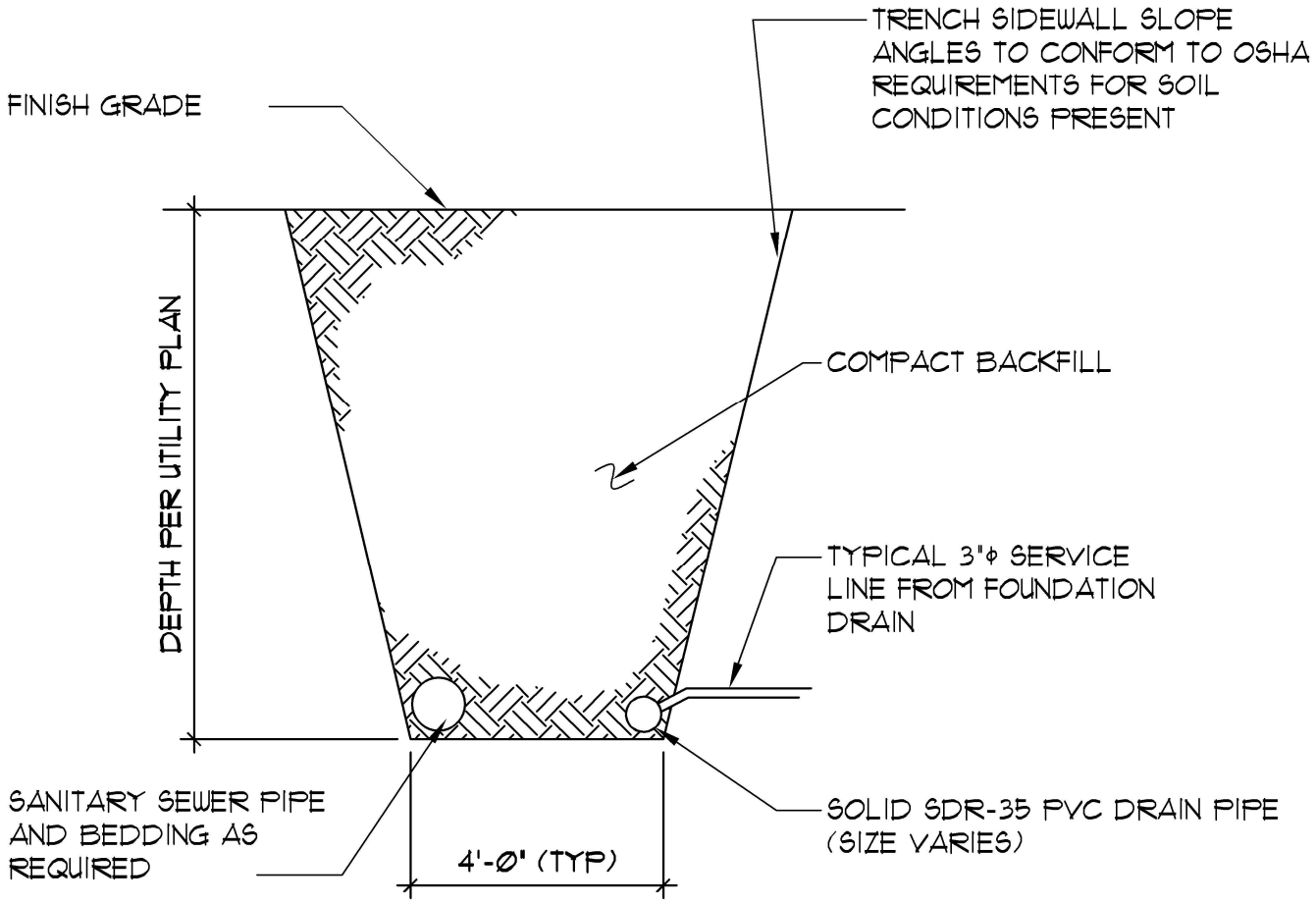
ACTIVE UNDERDRAIN IN SANITARY SEWER TRENCH

FIG No. 23

NOTE: TO BE USED WHERE NO SHALLOW GROUNDWATER IS KNOWN TO EXIST



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PASSIVE UNDERDRAIN IN SANITARY SEWER TRENCH

FIG No. 24

APPENDIX A
Additional Referenced Documents

1. Falcon Highland, Concept Plan 03, Phasing Exhibit, prepared by Matrix, dated May 18, 2021
2. El Paso County, updated thru July 9, 2019, Section 8.4.9, *El Paso County Land Development Code*.
3. El Paso County, revise July 9, 2019, *Appendix C, Soils Investigation Reports and Mitigation*, *Engineering Criteria Manual*.
4. Google Maps, Aerial Photograph, downloaded June through October, 2021.
5. El Paso County, February 8, 1996, *Master Plan for Mineral Extraction, Map 2.*
6. Kirkham, R.M. and Rogers, W.P., 1981, *Earthquake Potential in Colorado, A Preliminary Evaluation*, Colorado Geological Survey, Bulletin 43.
7. Colorado Geological Survey, 1991, *Results of the 1987-88 EPA Supported Radon Study in Colorado, with a discussion on Geology*, Open file Report 91-4.
8. Dames and Moore, 1985, *Colorado Springs Subsidence Investigation, State of Colorado Mined Land Reclamation*. (Reviewed to verify project location)
9. Federal Emergency Management Agency (FEMA), dated December 7, 2018, *Flood Insurance Rate Map, El Paso County, Colorado and Unincorporated Areas, Community Panel No.* 08041C0553G.
10. United States Department of Agriculture Soils Conservation Service, 1980, *Soil Survey of El Paso County Area, Colorado.*
    http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx
11. On-site Wastewater Treatment Systems (OWTS) Regulations, El Paso County, Colorado, Chapter 8, effective April 10, 2014 amended July 7, 2018.
12. Wait, T.C. & White, J.L., 2006. *Rockfall Hazard Susceptibility in Colorado Springs*, El Paso County, Colorado. Colorado Geological Survey, Open-File Report 06-3
13. Colorado Geologic Survey, Colorado Landslide Inventory:
14. https://cologeosurvey.maps.arcgis.com/apps/webappviewer/index.html?id=5e7484a637c4432e84f4f16d0af306d3
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APPENDIX B
Guideline Site Grading Specifications

Description: Unless specified otherwise by local or state regulatory agencies, these guideline specifications are for the excavation, placement and compaction of material from locations indicated on the plans, or staked by the Engineer, as necessary to achieve the required elevations. These specifications shall also apply to compaction of materials that may be placed outside of the project.

General: The Geotechnical Engineer shall approve fill materials, method of placement, moisture contents and percent compactions, and shall give written approval of the compacted fill.

Clearing Site: The Contractor shall remove trees, brush, rubbish, vegetation, topsoil and existing structures before excavation or fill placement is commenced. The Contractor shall dispose of the cleared material to provide the Owner with a clean job site. Cleared material shall not be placed in areas to receive fill or where the material will support structures. Clearing shall also include removal of existing fills that do not meet the requirements of this specification and existing structures.

Preparation of Slopes or Drainage Areas to Receive Fill: Natural slopes or slopes of drainage gullies where grades are 20 percent (5:1, horizontal to vertical) or steeper shall be benched prior to fill placement. Benches shall be at least 10 feet wide. Benches may require additional width to accommodate excavation or compaction equipment. At least one bench shall be provided for each 5 feet or less of vertical elevation difference. The bench surface shall be essentially horizontal perpendicular to the slope or at a slight incline into the slope.

Scarifying: Topsoil and vegetation shall be removed from the ground surface in areas to receive fill. The surface shall be plowed or scarified a minimum of 12 inches until the surface is free from ruts, hummocks or other uneven features which would prevent uniform compaction by the equipment to be used.

Compacting Area to Receive Fill: After the area to receive fill has been cleared and scarified, it shall be disked or bladed until it is free from large clods, moisture conditioned to a proper moisture content and compacted to the maximum density as specified for the overlying fill. Areas to receive fill shall be worked, stabilized, or removed and replaced, if necessary, in accordance with the Geotechnical Engineer's recommendations in preparation for fill.

Fill Materials: Fill material shall be free from organic material or other deleterious substances, and shall not contain rocks or lumps having a diameter greater than six inches. Fill materials shall be obtained from cut areas shown on the plans or staked in the field by the Engineer or imported to the site and shall be approved by the Geotechnical Engineer prior to placement. It is recommended that the fill materials have nil to low expansion potential, i.e., consist of silty to slightly clayey sand.

Moisture Content: Fill materials shall be moisture conditioned to within limits of optimum moisture content specified. Sufficient laboratory compaction tests shall be made to determine the optimum moisture content for the various soils encountered in borrow areas or imported to the site.

The contractor may be required to add moisture to the excavation materials in the borrow area if, in the opinion of the Geotechnical Engineer, it is not possible to obtain uniform moisture content by adding

water to the fill material during placement. The Contractor may be required to rake or disk the fill soils to provide uniform moisture content through the soils.

The application of water to embankment materials shall be made with watering equipment, approved by the Geotechnical Engineer, which will give the desired results. Water jets from the spreader shall not be directed at the embankment with such force that fill materials are eroded.

Should too much water be added to the fill, such that the material is too wet to permit the desired compaction to be obtained, compacting and work on that section of the fill shall be delayed until the material has been allowed to dry to the required moisture content. The Contractor will be permitted to rework the wet material in an approved manner to hasten its drying.

Compaction of Fill Areas: Selected fill material shall be placed and mixed in evenly spread layers. After each fill layer has been placed, it shall be uniformly compacted to not less than the specified percentage of maximum density. Fill materials shall be placed such that the thickness of loose material does not exceed 12 inches and the compacted lift thickness does not exceed 6 inches.

Compaction, as specified above, shall be obtained by the use of sheepsfoot rollers, multiple-wheel pneumatic-tired rollers, or other equipment approved by the Geotechnical Engineer. Granular fill shall be compacted using vibratory equipment or other equipment approved by the Geotechnical Engineer. Compaction shall be accomplished while the fill material is at the specified moisture content. Compaction of each layer shall be continuous over the entire area.

Density Criteria:

A. For on-site fills supporting utilities, roadways and landscaping, 95% of the Standard Proctor dry density.

B. For structural fill soils supporting buildings, 92% of the Modified Proctor dry density or 95% of the Standard Proctor dry density.

C. For general grading fills, 90% of the Standard Proctor dry density.

Compaction of Slopes: Fill slopes shall be compacted by means of sheepsfoot rollers or other suitable equipment. Compaction operations shall be continued until slopes are stable, but not too dense for planting, and such that there is no appreciable amount of loose soil on the slopes. Compaction of slopes may be done progressively in increments of three to five feet in height or after the fill is brought to its total height. Permanent fill slopes shall not exceed 3:1 (horizontal to vertical).

Density Testing: Field density testing shall be performed by the Geotechnical Engineer at locations and depths of his choosing. Where sheepsfoot rollers are used, the soil may be disturbed to a depth of several inches. Density tests shall be taken in compacted material below the disturbed surface. When density tests indicate the density or moisture content of any layer of fill or portion thereof is below that required, the particular layer or portion shall be reworked until the required density or moisture content has been achieved.

Observation and Testing of Fill: Observation by the Geotechnical Engineer shall be sufficient during the placement of fill and compaction operations so that he can declare the fill was placed in general conformance with Specifications. All observations necessary to test the placement of fill and observe compaction operations will be at the expense of the Owner.

Seasonal Limits: No fill material shall be placed, spread or rolled while it is frozen, thawing, or during unfavorable weather conditions. When work is interrupted by heavy precipitation, fill operations shall not be resumed until the Geotechnical Engineer indicates the moisture content and density of previously placed materials are as specified.

Reporting of Field Density Tests: Density tests made by the Geotechnical Engineer shall be submitted progressively to the Owner. Dry density, moisture content, percent compaction, and approximate location shall be reported for each test taken.