Architecture
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ROCKY MOUNTAIN GROUP
EMPLOYEE OWNED

GEOLOGY AND SOILS REPORT

Riverbend Crossing, Filings No 1 and 2
Fountain, Colorado

PREPARED FOR:

Avatar Fountain, LP
P.O. Box 927215
San Diego, CA 92192

JOB NO. 161921

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Respectfully Submitted,

RMG – Rocky Mountain Group

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Reviewed by,

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1.0 GENERAL SITE AND PROJECT DESCRIPTION

1.1 Project Location

The project lies in the northeast portion of Section 14, Township 15 South, Range 66 West of the 6th Principal Meridian in El Paso County, Colorado. The approximate location of the site is shown on the Site Vicinity Map, Figure 1.

1.2 Existing Land Use

The north and east portion of the site contains an existing commercial shopping center. The commercial portion of the site is developed land located west of the intersection of US Highway 85/87 and Main Street. The existing shopping center currently contains a Conoco fuel station and bowling alley along the northern portion of the site and the "strip mall" parallels the eastern property line.

The southern and western portion of the site is a proposed residential site. The site is currently undeveloped land situated between US Highway 85/87 and Fountain Creek. The residential site is located west of the existing commercial shopping center and appears to have no developed roadway access. The site is vacant and currently vegetated with native shrubs, grass, and weeds. The southern extent of the site slopes down to the floodplain of Fountain Creek.

1.3 Project Description

The Riverbend Crossing development consists of two distinct portions, a new residential development of approximately 209 single family homes, proposed to be developed in two filings based on the Final Plat for Riverbend Residential, Filing No. 1 and No. 2, provided by Barron Land, Project No. 17-054 last dated April 20, 2021. Filing 1 is to include 127 residential lots, and Filing 2 is to include 82 residential lots. It is our understanding the commercial shopping center, Riverbend Crossing Commons Development is to be rehabilitated and reconfigured to provide dedicated access to the residential development. The commercial shopping center is to be development within the City of Fountain and the residential subdivision is to be development within El Paso County. This report is to satisfy the development requirements for both the City of Fountain and El Paso County.

2.0 QUALIFICATIONS OF PREPARERS

This Geology and Soils report 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 Geoff G. Webster, P.E. Ms. Zigler is a Professional Geologist as defined by State Statute (C.R.S 34-1-201) with over 16 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 in Colorado.

Geoff Webster, P.E. is a licensed Professional Engineer with over 33 years of experience in the structural and geotechnical engineering fields. Mr. Webster is a professional engineer and holds a Master's degree from the University of Central Florida. Mr. Webster has supervised and performed numerous geological and geotechnical field investigation programs in Colorado and list other states.

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 01/06/2015 applicable sections include 8.4.9. and the Engineering Criteria Manual (ECM), specifically Appendix C last updated July 29, 2015.

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

This report presents the findings of our Geology and Soils Investigation for the River Bend development located in southern El Paso County, Colorado.

The purpose of our report is to adhere to the guidelines outlined in Appendix C of the ECM and Chapter 8.4.9 of the LDC. The occurrences of potential geologic hazards were evaluated and our opinions of the observed conditions on the proposed development with the respect to the intended usage are outlined in this report.

This report presents the findings of the study performed by RMG-Rocky Mountain Group (RMG) relating to the geology and soil conditions of the above-referenced site.

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 reports
- Available aerial photographs
- Exploratory 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

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

1. *Preliminary Subsurface Soil Investigation, Riverbend Crossing, Lots 1-136, Filing No. 1 and Lots 1-89, Filing No. 2, El Paso County, Colorado,* RMG – Rocky Mountain Group, Job No. 175644, dated May 5, 2020.
2. *Geotechnical Report, Avatar River Bend Crossing, Commercial and Residential Development, Fountain, Colorado,* prepared by RMG – Rocky Mountain Group, Job No. 161921, dated April 2, 2018.

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

4.0 SITE CONDITIONS

4.1 Proposed Land Use and Zoning

The site is generally located south and west of the intersection of U.S. Hwy 85/87 and Main Street in Fountain, Colorado, El Paso County. The site includes seven parcels and has a combined total acreage of approximately 63.6 acres, on which there are multiple existing structures associated with the shopping center. The commercial development is comprised of 5 parcels (1 through 5 denoted below) and is approximately 10.6 acres bordering Fountain Creek which includes a portion of the Fountain Creek floodplain. The residential development is comprised of two parcels (6 and 7 denoted below) which are approximately 53.04 acres of relatively flat land. Figure 2 present the general boundaries of our investigation.

The parcels included are:

1. Schedule No. 6514100026, addressed as 5510 Highway 85-87, 9,675 square feet,
2. Schedule No. 6514100001, addressed as 5510 Highway 85-87, 15,625 square feet,
3. Schedule No. 6514100025, addressed as 5530 Highway 85-87, 1.84 acres,
4. Schedule No. 6514100024, addressed as 5520 Highway 85-87, 3.08 acres,
5. Schedule No. 6514100004, addressed as 5628 Highway 85-87, 5.1 acres,
6. Schedule No. 6514100032, vacant land, 34.04 acres, and;
7. Schedule No. 6514100033, vacant land, 19 acres.

Based upon our review of the Public Record Real Estate Property Search provided by El Paso County Assessors web-site, the vacant parcels of land (listed as 6 and 7 above) are zoned "PUD – Planned Unit Development". The remainder of the parcels, (1 to 5) does not have the zoning listed on the El Paso County Assessors web-site. The properties to the north and west are County zoned as "A-5 – Agricultural". The property to the south also does not have the zoning listed.

4.2 Topography

In general, the site is relatively flat and slopes gently down to the south with approximately 8 to 15 feet of elevation difference from the northwest corner to the southeast corner of the property.

4.3 Vegetation

The majority of the site consists of native shrubs, grasses, and weeds which appear to be denser near and along Fountain Creek and the designated floodplain area. Deciduous trees are scarcely located throughout the property.

5.0 FIELD INVESTIGATION

The subsurface conditions within the property were explored by drilling 11 exploratory borings on March 2 and March 12, 2018 extending to depths of approximately 20 feet below the existing ground surface. The test borings were performed to explore the subsurface soils underlying the proposed site. The number of borings is in excess of the minimum one test boring per 10 acres of development up to 100 acres and one additional boring for every 25 acres of development above 100 acres as required by the ECM, Section C.3.3.

The test borings were drilled with a power-driven, continuous-flight auger drill rig. Samples were obtained during drilling of the test borings in general accordance with ASTM D-1586 and D-3550, utilizing a 2-inch O.D. Split Barrel Sampler and a 2½-inch O.D. California sampler, respectively. Results of the penetration tests are shown on the drilling logs. The Preliminary Concept Plan with Test Boring Locations is presented in Figure 4. An Explanation of Test Boring Logs, Test Boring Logs are presented in Appendix A.

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

6.0 GEOLOGIC AND SUBSURFACE CONDITIONS

6.1 Geologic Conditions

Based upon review of the *Geologic Map of the Elsmere Quadrangle, El Paso County, Colorado* and *Geologic Map of the Pueblo Quadrangle, Pueblo County, Colorado* the site reconnaissance, the site is underlain by the Pierre Shale.

The geology at the site and surrounding area generally consists of a silty to clayey sand with various amounts of silt overlying the Pierre Shale. A Geology/Engineering Map is presented in Figure 7.

6.2 General Geology

Our field investigation included a site reconnaissance with consideration given to geologic features and significant surficial deposits.

In general, the geology at the site consists of stream deposits and alluvium soils. The Elsmere Quadrangle and Pueblo Quadrangle are presented in Figure 6. Four geologic units were mapped at the site as:

- Qam –Middle alluvium (early Holocene and late Pleistocene) – poorly sorted silty to clayey sand with estimated thicknesses up to 30 feet.
- Qay – Young alluvium (late Holocene) – poorly sorted sand, silty sand that underlies flood plains; exposed thickness is approximately 1 to 7 feet. The young alluvium is difficult to visually differentiate from the middle alluvium Qam. The entire site is underlain by alluvium of varying thickness. The alluvium was encountered in the test borings at depths ranging from the ground surface to 20 feet.
- Kp – Pierre Shale Formation – (Upper Cretaceous) – gray to dark-gray shale that weathers to brown and olive-green clay; medium-to coarse-grained sandstone. Thickness is about 5,000 feet in the area. Claystone bedrock was encountered beneath the alluvium in the test borings at depths ranging between 4.5 to 16 feet below the ground surface.
- ss – isolated steep slopes across the site, areas that are to be "leveled out" during development.

6.3 U.S. Soil Conservation Service

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

- 28 – Ellicott loamy coarse sand, 1 to 5% slopes. Properties of the loamy coarse 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 very low, frequency of flooding and/or ponding is frequent, and landforms include flood plains and stream terraces.

- 47 – Limon clay, 0 to 3% slopes. Properties of the clay include, well-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 occasional and/or ponding is none, and landforms include alluvial fans and flood plains.

- 59 – Nunn clay loam, 0 to 3 percent slopes. Properties of the clay loam include, well-drained soils, depth of the water table is anticipated to be greater than 6.5 feet, runoff is anticipated to be low, frequency of flooding and/or ponding is none, and landforms include terraces and fans.

- 82 – Schamber-Razor complex, 8 to 50 percent slopes. Properties of the complex include, well-drained soils, depth of the water table is anticipated to be greater than 6.5 feet, run-off is anticipated to be medium, frequency of flooding and/or ponding is none, and landforms include breaks.

The USDA Soil Survey Map is presented in Figure 5.

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 silty to clayey sand with various amounts of silt (SW-SM, SP-SM, SW, GP), silty clay (CL, CH) overlying claystone and shale bedrock.

Additional descriptions and the interpreted distribution (approximate depths) of the subsurface materials are presented on the Test Boring Logs presented in Appendix A. 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 ten of the test borings at depths ranging between 4.5 to 9 feet for this investigation. The bedrock beneath the site is considered to be part of the Pierre Shale Formation and consisted of silty claystone and shale.

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 along Fountain Creek or elsewhere 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 and west towards Fountain Creek. Groundwater was encountered in eight of the test borings at depths ranging from approximately 6 to 19.5 feet at the time of drilling and when checked three days subsequent to drilling. The shallow groundwater was generally encountered along the western portion of the site that is to be the single family residences.

Fountain Creek is currently a defined drainage way. Review of the historical photos provided by Google Earth depict that Fountain Creek has remained in its present state since 1999. Evidence of recent meandering along Fountain Creek is evident between 2011 and 2015, since 2015 the Creek has remained consistent.

Based on our review of the Federal Emergency Management Agency (FEMA) Community Panel No. 08041C0951F and the online ArcGIS El Paso County Risk Map, the southern portion of the site does lie within the 500-year floodplain of Fountain Creek.

Fountain Creek 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. Additionally, the lots currently lie in the area designated as Zone AE. This area is shown hatched on the Geology/Engineering Map, Figure 7.

6.9 Features of Special Significance

Features of special significance such as accelerated erosion, (advancing gully head, badlands or cliff reentrants) were not observed on the property. Features indicating settlement or subsidence such as fissures, scarplets and offset reference features were 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 two environmental engineering units the site as:

- 1A – Stable alluvium, colluvium and bedrock on flat to gentle slopes (0 to 5%).
- 7A – Physiographic floodplain where erosion and deposition presently occur and is generally subject to recurrent flooding. Includes 100-year floodplain along major streams where floodplain studies have been conducted. The floodplain does not lie within the proposed lots and remains within the confines of Fountain Creek.

The Engineering Geology is presented in the Geology/Engineering Map in Figure 7.

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 3* indicate the southern portion of the site is identified as Floodplain Deposits which consists of sand and gravel with minor amounts of silt and clay deposited by water along present stream courses. The test borings indicated the alluvial terrace deposits were encountered. Extraction of the sand and clay 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 soils encountered in the test borings, at the time of drilling were silty to clayey sand, sandy clay, silty claystone and shale. The permeability of the sands is anticipated to be moderate to high. The permeability of the sandy clay, claystone and shale is anticipated to be low.

7.0 IDENTIFICATION AND MITIGATION OF POTENTIAL GEOLOGIC CONDITIONS

The El Paso County Engineering Criteria Manual recognizes and delineates the difference between hazards and constraints. A geologic hazard is one of several types of adverse geologic conditions capable of causing significant damage or loss of property and life. Geologic hazards are defined in Section C.2.2 Sub-section E.1 of the ECM. A geologic constraint is one of several types of adverse geologic conditions capable of limiting or restricting construction on a particular site. Geologic constraints are defined in Section C.2.2 Sub-section E.2 of the ECM. The following sections discuss potential geologic conditions that commonly exist within El Paso County, Colorado.

- Avalanches
- Debris Flow-Fans/Mudslides
- Floodplains
- Ground Subsidence
- Landslides
- Rockfall
- Ponding water
- Steeply Dipping Bedrock
- Corrosive Minerals

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

7.1 Expansive Soils and Bedrock

Based on the test borings performed by RMG for this investigation and the Preliminary Subsurface Soil Investigation (PSSI) that came after the original issuance of this report and referenced above, the silty to clayey sand generally possesses low swell potential and the sandy clay generally possess low to moderate swell potential. Bedrock was encountered in the test borings performed for this study, and is anticipated to be encountered at depths that will impact the proposed development. Should expansive soils be encountered beneath foundations, mitigation will be required.

Mitigation

Shallow foundations are anticipated for structures within this development. Foundation design and construction typically can be adjusted for expansive soils. Mitigation of expansive soils and bedrock are typically accomplished by overexcavation and replacement with structural fill, subexcavation and replacement with on-site moisture-conditioned soils, and/or the installation of deep foundation systems, all of which are considered common construction practices for this area.

Based on the PSSI, if expansive soils or bedrock are encountered during construction, they will require removal (overexcavation) and replacement with compacted structural fill. The final determination of mitigation alternatives and foundation design criteria are to be determined in site-specific subsurface soil

investigations for each lot. However, typical overexcavation depths for the expansive materials generally range from 3 to 4 feet.

A figure presenting the Anticipated Overexcavation Recommendations is included in Appendix B. The figure shows the approximate areas where expansive soils are anticipated. Provided that appropriate mitigations and/or foundation design adjustments are implemented, the presence of expansive soils and/or bedrock is not considered to pose a risk to the proposed structures.

7.2 Compressible Soils

Based on the test borings performed by RMG for this investigation, and the PSSI that came after the original issuance of this report the silty to clayey sand generally possesses low to moderate compressibility potential and the sandy clay generally possesses low compressibility potential. Should compressible soils be encountered beneath foundations, mitigation will be required.

Mitigation

Shallow foundations are anticipated for structures within this development. Foundation design and construction typically can be adjusted for compressible soils. If loose or compressible sands are encountered, mitigation can be accomplished by overexcavation and replacement with structural fill, subexcavation and replacement with on-site moisture-conditioned soils, the installation of deep foundation systems, and/or the use of a geogrid reinforced fill, all of which are considered common construction practices for this area.

Based on the PSSI, if loose/very loose soils are encountered during the Open Excavation Observation, they will require additional compaction to achieve the allowable bearing pressure that is to be indicated in the site-specific subsurface soil investigations for each lot. In some cases, removal and recompaction of up to 2 to 3 feet of soil (or more) may be required. The used 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 final determination of mitigation alternatives and foundation design criteria are to be determined in site-specific subsurface soil investigations for each lot.

A figure presenting the Anticipated Overexcavation Recommendations is included in Appendix B. The figure shows the approximate areas where loose soils are anticipated. Provided that appropriate mitigations and/or foundation design adjustments are implemented, the presence of compressible soils (loose) is not considered to pose a risk to the proposed structures.

7.3 Unstable or Potentially Unstable Slopes

Slope stability is the potential of soil covered slopes to withstand and undergo movement. The stability of a slope is determined by the balance of shear stress and shear strength. Previously stable slopes may initially be affected by preparatory factors, making the slope conditionally unstable. Factors that may trigger a slope failure may be climatic events that can make a slope actively unstable, leading to mass movements. Mass movements can be caused by an increase in shear stress, such as loading, lateral pressure, and transient forces. Alternatively, shear strength may be decreased by weathering, changes in pore water pressure, and organic material.

According to the LDC, Chapter 8.4.2 Section B.3 Unsuitable Building Areas, areas that are identified as having certain characteristics "… *shall be deemed unsuitable for building and shall be identified as no build areas on the plat."* One such characteristic is *"Areas where slopes are greater than 30%."* These areas have typically been designated as "No Build" areas in the recent past. Unstable slopes greater than 30 percent or apparent signs of ongoing slope movement were not observed around or on the property.

Mitigation

The proposed structures adjacent to Fountain Creek and along the western property boundary are outside of a 3:1 (horizontal to vertical) "influence zone" from the toe of the slope. Based on our experience with similar materials in the El Paso County area, the slope is anticipated to be stable to a slope of 3:1. Locating the proposed residence outside of this "influence zone" is a generally accepted mitigation method for similar slopes and soil conditions in this region.

For areas on the site where significant topographic changes occur, the *Riverbend Crossing, Pre-Development Grading & Erosion Control Plans*, prepared by Catamount Engineering, Job No. 17-114, dated October 19, 2020, states that overlot cut and fills are to "level out" the site and create slopes less than 3:1. These will not be areas of concern if the following is implemented during development:

- prior to placement of overlot fill or removal and recompaction of existing soils, topsoil, low-density native soil, fill and organic debris are moved prior to placing new fill.
- The subgrade should be scarified, moisture conditioned to within 2% of the optimum moisture contents, 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.

Long term fill slopes should be limited to areas supported by foundation walls or other engineered components, unless adequately benched into existing ground. Long term cut slopes in the upper soil should be limited to no steeper than 3:1 (horizontal:vertical).

We believe the surficial soils will classify as Type C materials as defined by OSHA in 29CFR Part 1926, date January 2, 1990. OSHA requires temporary slopes made in Type C materials be laid back at ratios no steeper than 1.5:1 (horizontal to vertical) unless the excavation is shored or braced. Flatter slopes will likely be necessary should groundwater conditions occur.

7.4 Creek Bank Erosion

Additional erosion to the banks of Fountain Creek due to an excessive flow of water down the creek may have the potential to undercut or erode the banks of the creek, resulting in the development of local slumps and creeping along the banks of the creek at some point in the future.

Mitigation

It is our understanding that additional grading is to occur along the banks of Fountain Creek prior to development. It is our opinion that long-term cut and fill slopes along the banks of the channel should not be steeper than a 2:1 slope (horizontal to vertical), and 3:1 slopes should be utilized where feasible. Additionally, care should be taken to limit surface runoff and to provide and maintain vegetative cover on the slopes to reduce the potential for erosion of the banks of Fountain Creek. Vegetative cover to be placed along the bank of Sand Creek may require recommendations from a qualified landscape architect and/or

drainage engineer who may be familiar with special erosion control features that should be implemented in conjunction with newly placed vegetation.

Further, as stated in the *Preliminary/Final Drainage Report for Riverbend Crossing, Filing No. 1* and 2, dated September 2018, page 11, Channel Bank Stabilization, "the resultant velocities, flow depths, the UDFCD design methodology for channel design, bank lining was deemed necessary." The following erosion protection was provided:

> protection in the form of 12" soil riprap (24' thick) will be provided along the proposed 2.5:1 side slopes. Assuming the channel is entirely composed of non-cohesive soils, the riprap toe protection will be constructed with a five foot bury depth. The height of the soil riprap on the slope will be based on the FIS flow depths and not the model results, which is a conservative approach since the model revealed lower depths. A freeboard value of 1.5' will be used per criteria recommendations. Refer to appendix for additional hydraulic analysis and design information.

RMG would also offer the following if necessary, improvements should be installed to divert surface water around the proposed construction areas or to an approved collection basin or drainage feature. Significant deposits of sediment deposition should be removed, and the area should be observed by a representative of RMG prior to placing any overlot fill. If conditions are encountered at the time of the construction that result in either water flow into the area or destabilization of the soils, stabilization techniques should be implemented. If required, stabilization methods should be determined based on the conditions encountered at the time of construction. However, methods that may potentially reduce the amount of overexcavation (versus other methods) and provide increased performance under moderately to severely unstable conditions are: the use of rip-rap (a.k.a. shot rock) and/or layered geogrid and structural fill system. Provided that appropriate mitigations are implemented, potential scour of erosive flows along Fountain Creek is not considered to pose a risk to the proposed structures.

7.5 Groundwater

Groundwater was encountered in the test borings performed for this study and in the PSSI performed after this study, during the field exploration or when checked five days subsequent to drilling. Based on review of the test borings from the previous reports referenced above, the depth of groundwater below the proposed development is anticipated to range between 6 and 19 feet below the ground surface.

Mitigation

A figure of Anticipated Areas of Potential Groundwater is included in Appendix C. The figure presents the approximate areas where basements should be avoided. The lots included are: Lots 9-16, Filing No. 1 and Lots 1-10, 78-82, Filing No. 2. It is our understanding the builder may opt for all crawlspace foundations for the entire subdivision.

In general, if groundwater was encountered within 4 to 6 feet of the proposed basement slab elevation, an underslab drain should be anticipated in conjunction with the perimeter drain. Perimeter drains are anticipated for each individual lot to prevent the infiltration of water and to help control wetting of potentially expansive and hydrocompactive soils in the immediate vicinity of foundation elements. It must be understood that the drain is designed to intercept some types of subsurface moisture and not others.

Therefore, the drain could operate properly and not mitigate all moisture problems relating to foundation performance or moisture intrusion into the basement area.
Fluctuations in groundwater and subsurface moisture conditions may occur due to variations in rainfall and other factors not readily apparent at this time. Development of the property and adjacent properties may also affect groundwater levels.

7.6 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 Ute Pass Fault lies approximately 10 miles to the 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 (Reference 11). 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.

The Pikes Peak Regional Building Code 2011, indicates maximum considered earthquake spectral response accelerations of 0.175g for a short period (S_s) and 0.060g 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 D, with an average a shear wave velocity ranging from 1,00 to 2,000 feet per second for the materials in the upper 100 feet.

7.7 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.*

Fountain, CO and the 80817 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. Fountain is located in a high risk area of the country. *The EPA recommends you take corrective measures to reduce your exposure to radon gas.*

Most of Colorado is generally considered to have the potential of high levels of radon gas, based on the information provided at: http://county-radon.info/CO/El_Paso.html. There is not believed to be unusually hazardous levels of radon from naturally occurring sources at this site.

Mitigation
Radon hazards are best mitigated at the building design and construction phases. Providing increased ventilation of basements, 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.

7.8 Fill Soils

RMG completed a *Preliminary Subsurface Soil Investigation for Riverbend Crossing, Lots 1-136, Filing No. 1 and Lots 1-89, Filing No. 2*, Job No. 175644, dated May 5, 2020. This investigation included 19 additional test borings to supplement the information obtained in this report. The test borings were drilled to 20-feet below the existing surface. Fill soils were not encountered in our investigations.

Mitigation
If limited fill soils are present they will be considered unsuitable. It is anticipated any fill soils encountered on site will be removed and recompacted during the development process. The Preliminary Subsurface Soil Investigation is included in Appendix D of the revised report.

7.9 Erosion and Corrosion

The upper sands encountered at the site are susceptible to erosion by wind and flowing water. The claystone at this site typically has low resistivity values (less than 2,000 ohm-cm) and is likely to be potentially corrosive to buried, ferrous metal piping and other structures. The sandy clay is also likely to contain elevated amounts of water soluble sulfates which are potentially corrosive to Portland cement concrete.

Mitigation
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.

7.10 Proposed Grading, Cuts and Masses of Fill

Preliminary grading plans were not provided and 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 and claystone near the surface overlying sandstone and shale. The on-site sand soils can be used as site grading fill.

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

8.0 BEARING OF GEOLOGIC CONDITIONS UPON PROPOSED DEVELOPMENT

Geologic hazards (as described in Section 8.0 of this report) were not found to be present at this site. Geologic constraints (also as described in section 8.0 of this report) such as: expansive and compressible soils, areas of shallow groundwater, faults, seismicity, radon, erosion and corrosion were found on the site. It is our opinion that the existing geologic and engineering conditions can be satisfactorily mitigated through proper engineering and design contraction practices and avoidance when deemed necessary.

The proposed development is to consist of the construction of a commercial and residential development and associated site improvements. Shallow foundations are anticipated for the structures on site. It is our opinion that the existing geologic and engineering conditions will have some constraints on the proposed development.

9.0 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 has been completed for all proposed structures.

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.

10.0 CONCLUSIONS

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

The foundation systems for the single family structures should be designed and constructed based upon recommendations developed in the site-specific Subsurface Soil Investigation.

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

We believe the surficial sand soils will classify as Type C materials and the clay soils will classify as Type B as defined by OSHA in 29CFR Part 1926, date January 2, 1990. OSHA requires temporary slopes made in Type C materials be laid back at ratios no steeper than 1.5:1 (horizontal to vertical) and slopes made in Type B materials be laid back at ratios no steeper than 1:1 (horizontal to vertical) unless the excavation is shored or braced. Flatter slopes will likely be necessary should groundwater conditions occur.

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

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

11.0 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 **Avatar Fountain, LP** in accordance with generally accepted geotechnical engineering and engineering geology practices. The conclusions and recommendations in this report are based in part upon data obtained from review of available topographic and geologic maps, review of available reports of previous studies conducted in the site vicinity, a site reconnaissance, and research of available published information, soil test borings, soil laboratory testing, and engineering analyses. The nature and extent of variations may not become evident until construction activities begin. If variations then become evident, RMG should be retained to re-evaluate the recommendations of this report, if necessary.

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

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

12.0 REFERENCES

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2. Riverbend Crossing, Pre-Development Grading & Erosion Control Plan, El Paso County, Colorado, prepared by Catamount Engineering, Job No. 17-114, dated 10/19.20.
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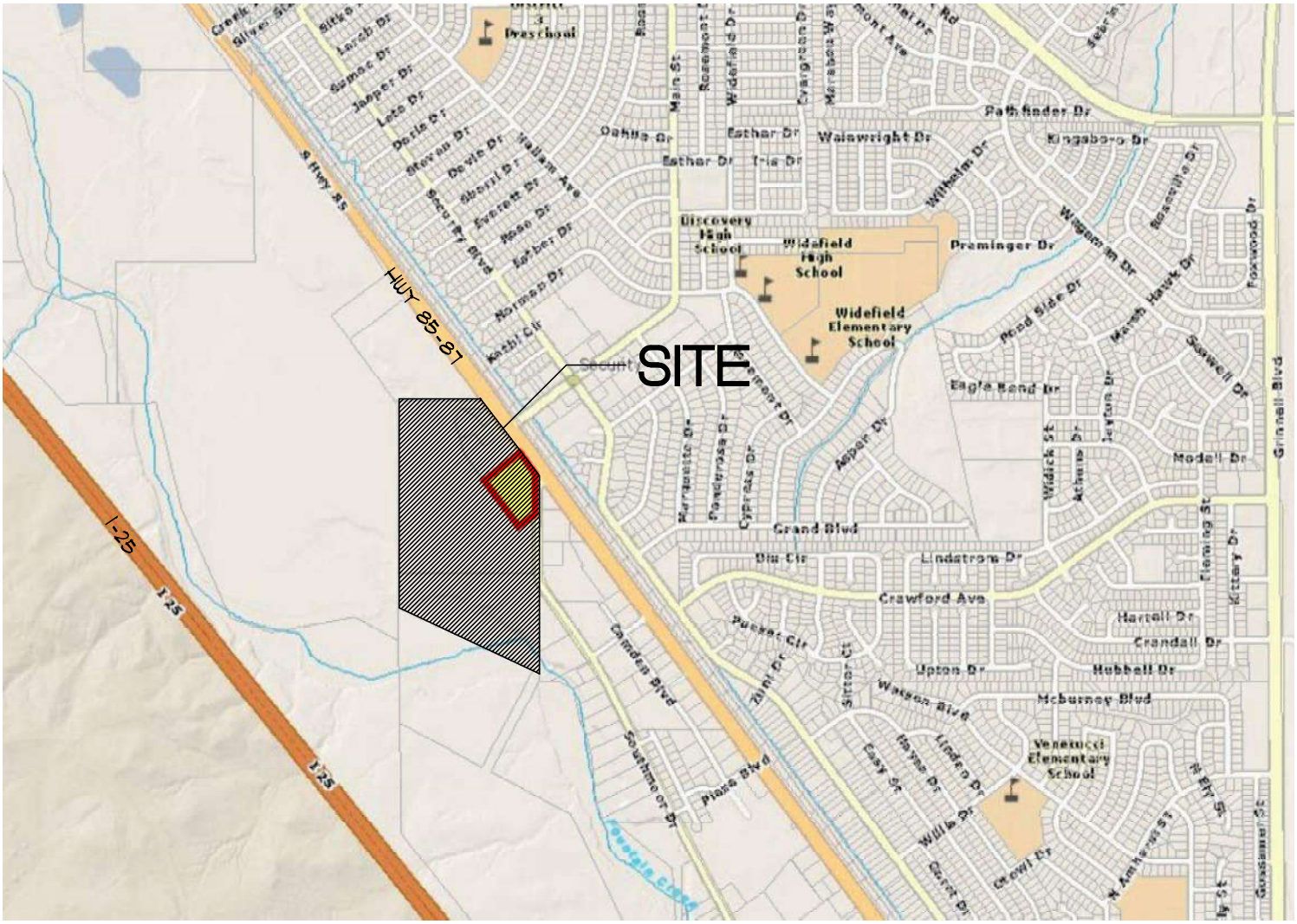
FIGURES



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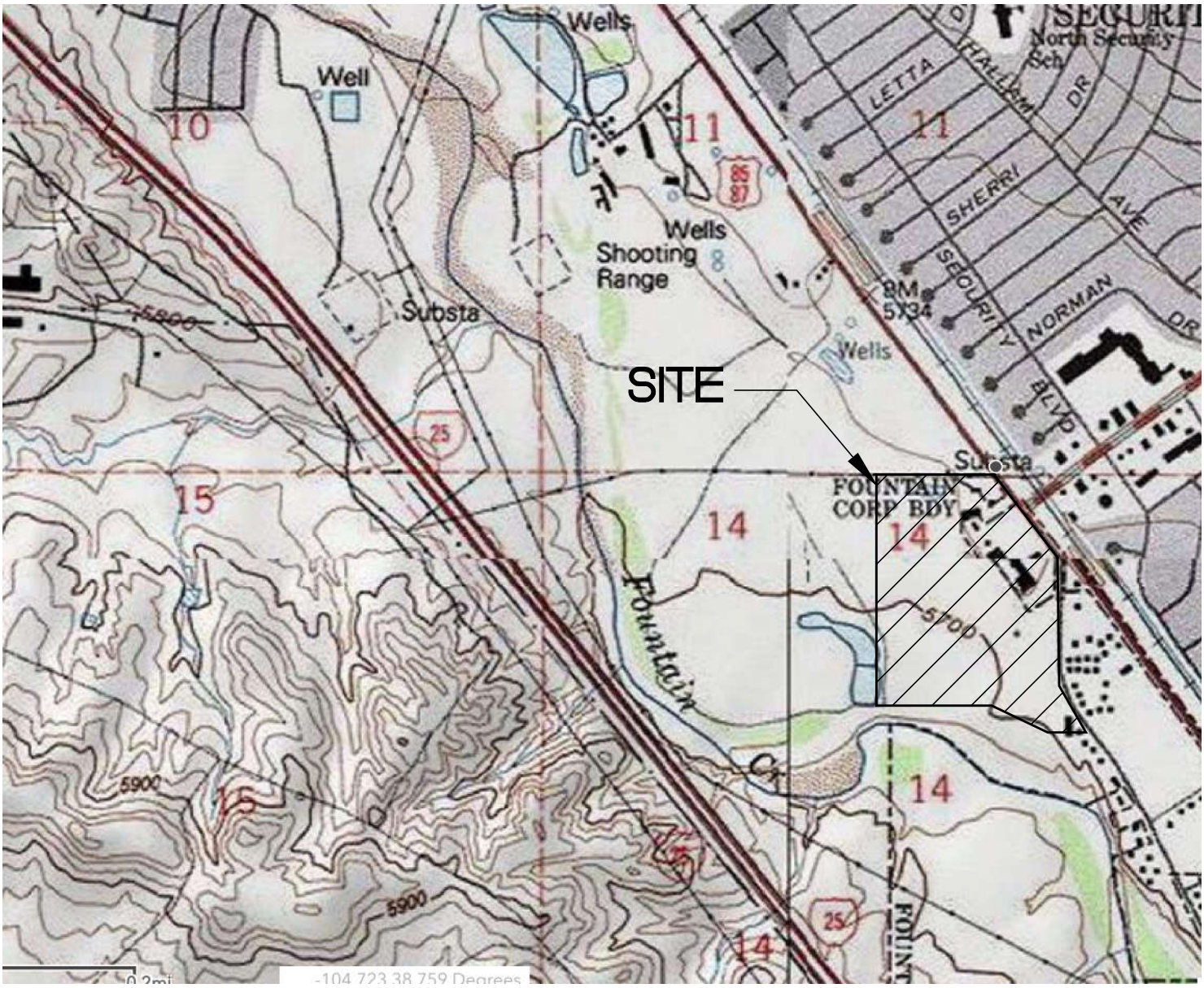
SITE VICINITY MAP

RIVER BEND CROSSING
FILING NOS. 1 AND 2
FOUNTAIN, CO
AVATAR FOUNTAIN, LP

JOB No. 161921

FIG No. 1

DATE 4-20-2018
REV 12-30-2020



REFERENCE
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BASE MAP PROVIDED BY: USGS

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USGS
TOPOGRAPHIC MAP

RIVER BEND CROSSING
FILING NOS. 1 AND 2
FOUNTAIN, CO
AVATAR FOUNTAIN, LP

JOB No. 161921

FIG No. 2

DATE 4-20-2018
REV 12-30-2020

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JOB No. 161921

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

RIVERBEND CROSSING
FILING NO. 1 & 2
FOUNTAIN, COLORADO
AVATAR FOUNTAIN, LP

ENGINEER:	GGW
DRAWN BY:	KMZ
CHECKED BY:	GGW
ISSUED:	12-29-2020
REVISION:	9-9-2021
REVISION:	

CONCEPT PLAN

SHEET No.
FIG-3

NOT TO SCALE

● DENOTES APPROXIMATE LOCATION OF TEST BORINGS PERFORMED FOR "GEOTECHNICAL REPORT" BY RMG - ROCKY MOUNTAIN GROUP, WO#: 161921, APRIL 2, 2018

● DENOTES APPROXIMATE LOCATION OF TEST BORINGS PERFORMED FOR THIS REPORT

JOB No. 161921

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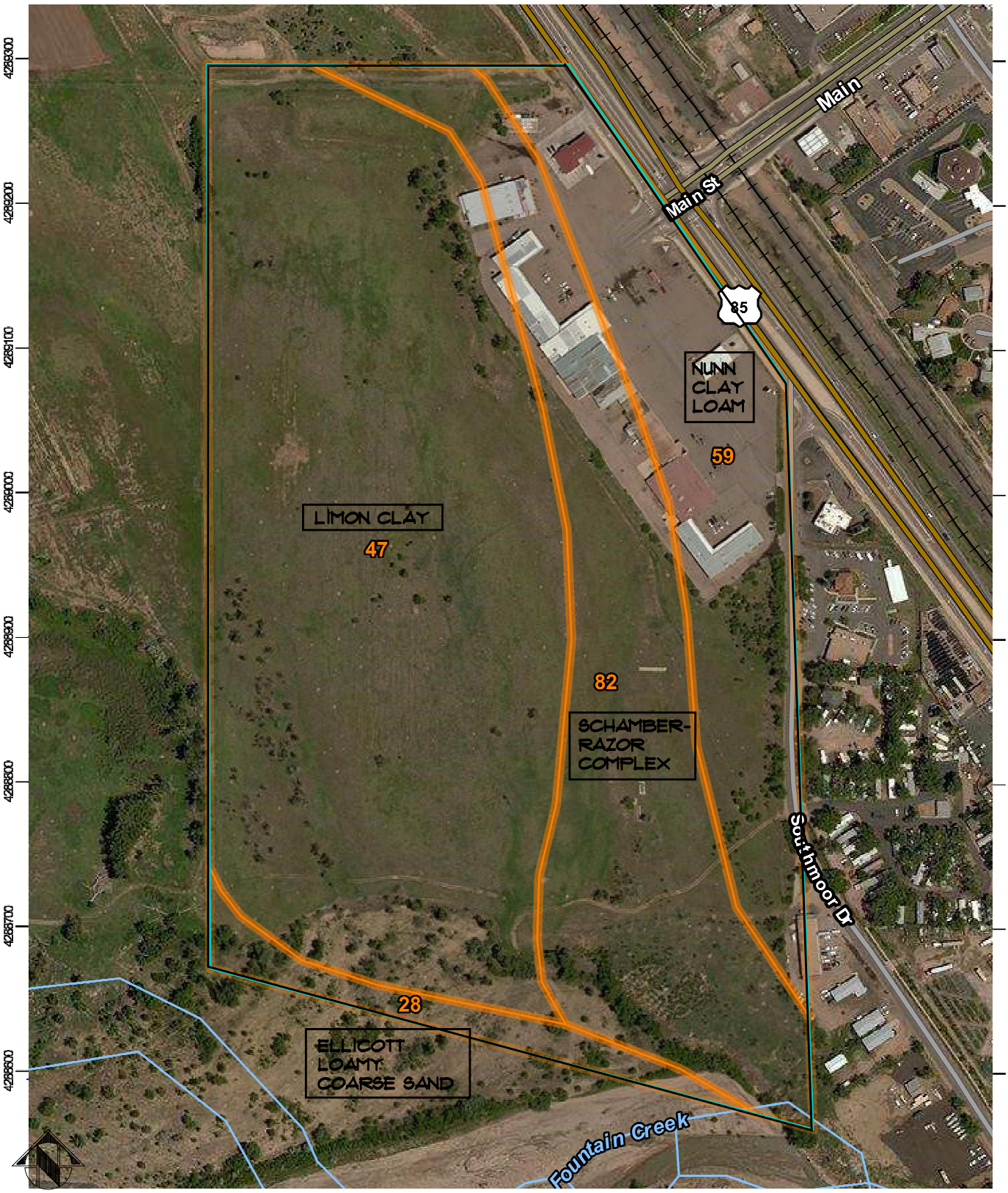
RIVERBEND CROSSING
FILING NO. 1 & 2
FOUNTAIN, COLORADO
AVATAR FOUNTAIN, LP

ENGINEER:	GGW
DRAWN BY:	KMZ
CHECKED BY:	GGW
ISSUED:	12-29-2020
REVISION:	9-9-2021
REVISION:	

TEST BORING LOCATIONS

SHEET No.
FIG-4



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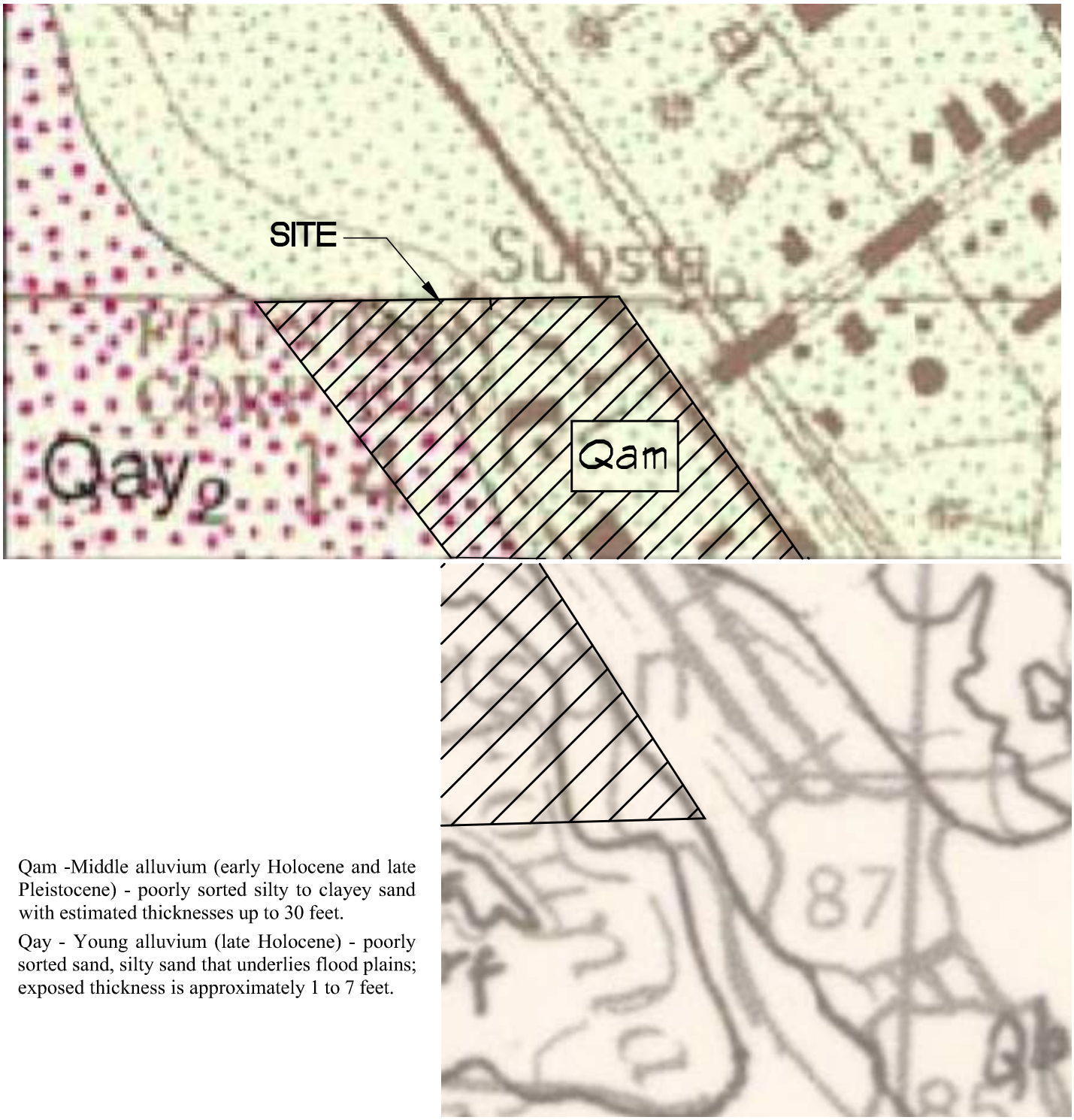
USDA SOILS SURVEY MAP

RIVER BEND CROSSING
FILING NOS. 1 AND 2
FOUNTAIN, CO
AVATAR FOUNTAIN, LP

JOB No. 161921

FIG No. 5

DATE 4-20-2018
REV 12-30-2020



Qam -Middle alluvium (early Holocene and late Pleistocene) - poorly sorted silty to clayey sand with estimated thicknesses up to 30 feet.

Qay - Young alluvium (late Holocene) - poorly sorted sand, silty sand that underlies flood plains; exposed thickness is approximately 1 to 7 feet.

REFERENCE
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ELSMERE/PUEBLO QUADRANGLE

RIVER BEND CROSSING
FILING NOS. 1 AND 2
EL PASO COUNTY, CO
AVATAR FOUNTAIN, LP

JOB No. 161921

FIG No. 6

DATE 4-20-2018
REV 12-30-2020

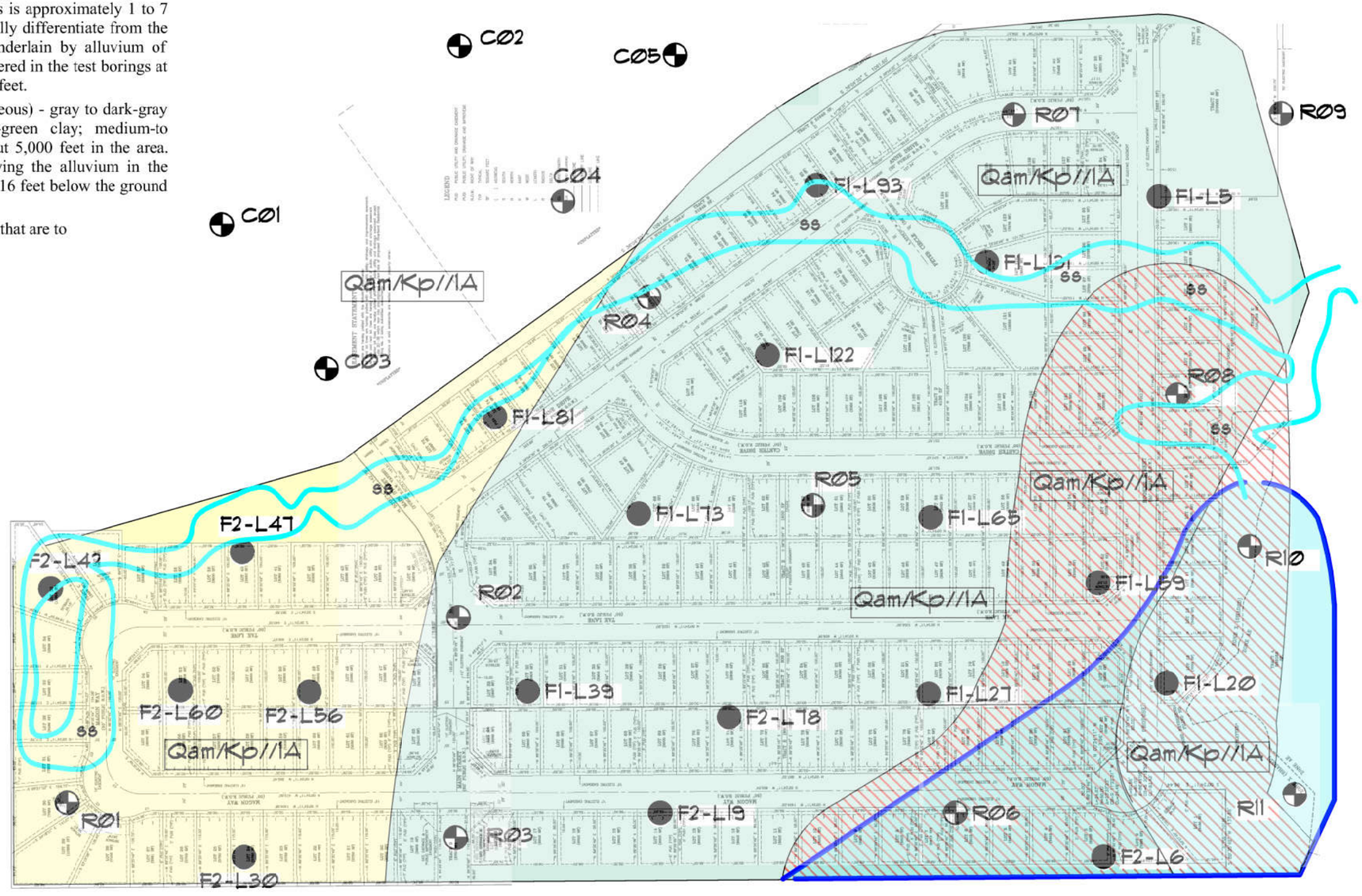
GEOLOGIC

- Qam -Middle alluvium (early Holocene and late Pleistocene) - poorly sorted silty to clayey sand with estimated thicknesses up to 30 feet.
- Qay - Young alluvium (late Holocene) - poorly sorted sand, silty sand that underlies flood plains; exposed thickness is approximately 1 to 7 feet. The young alluvium is difficult to visually differentiate from the middle alluvium Qam. The entire site is underlain by alluvium of varying thickness. The alluvium was encountered in the test borings at depths ranging from the ground surface to 20 feet.
- Kp - Pierre Shale Formation - (Upper Cretaceous) - gray to dark-gray shale that weathers to brown and olive-green clay; medium-to coarse-grained sandstone. Thickness is about 5,000 feet in the area. Claystone bedrock was encountered underlying the alluvium in the test borings at depths ranging between 4.5 to 16 feet below the ground surface.
- ss - isolated steep slopes across the site, areas that are to be "leveled out" during development

ENGINEERING

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

NOT TO SCALE



APPROXIMATE PORTION OF THE SITE WHERE EXPANSIVE OR LOOSE SOILS ARE NOT ANTICIPATED

APPROXIMATE PORTION OF THE SITE WHERE LOOSE SOILS ARE ANTICIPATED

APPROXIMATE PORTIONS OF THE SITE WHERE EXPANSIVE SOILS ARE ANTICIPATED

APPROXIMATE PORTIONS OF THE SITE WHERE BASEMENT CONSTRUCTION SHOULD BE AVOIDED

JOB No. 161921

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RIVERBEND CROSSING
FILING NO.1 & 2
FOUNTAIN, COLORADO
AVATAR FOUNTAIN, LP

ENGINEER:	GGW
DRAWN BY:	KMZ
CHECKED BY:	GGW
ISSUED:	12-29-2020
REVISION:	9-9-2021
REVISION:	

ENGINEERING GEOLOGY MAP

SHEET No.
FIG-7

REFERENCE
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FLOODPLAIN MAP

RIVER BEND CROSSING
FILING NOS. 1 AND 2
FOUNTAIN, CO
AVATAR FOUNTAIN, LP

JOB No. 161921

FIG No. 8

DATE 4-20-2018
REV 12-30-2020

APPENDIX A

RMG Geotechnical Report, Job No. 161921
dated April 2018

Architecture
Structural
Geotechnical

ROCKY MOUNTAIN GROUP

Materials Testing
Forensic
Civil/Planning

GEOTECHNICAL REPORT

Avatar River Bend Crossing
Commercial and Residential Development
Fountain, Colorado

PREPARED FOR:

Avatar Fountain, LP
P.O. Box 927215
San Diego, CA 92192

JOB NO. 161921

April 2, 2018

Respectfully Submitted,

RMG – Rocky Mountain Group

Kelli Zigler
Project Geologist

Reviewed by,

RMG – Rocky Mountain Group

Geoff Webster, P.E.
Sr. Geotechnical Project Manager

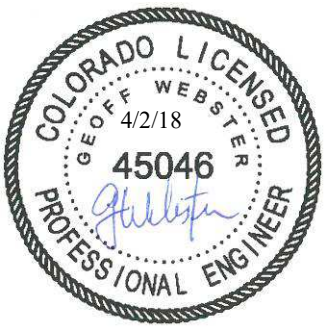


TABLE OF CONTENTS

GENERAL SITE AND PROJECT DESCRIPTION

Project Description and Scope of Work

RMG has completed a geotechnical investigation for the Avatar Riverbend development in Fountain, Colorado. The purpose of the investigation was to evaluate the subsurface soil conditions and provide geotechnical design and construction criteria for the project. These services were provided in accordance with our Proposal and Project Contract No. 161921 dated February 3, 2018.

The Riverbend development consists of two distinct portions, a new residential development of single family homes, and redevelopment of an adjacent commercial strip mall. We understand the commercial strip mall will be rehabilitated and reconfigured to provide dedicated access to the residential development. This report provides roadway and pavement recommendations for the commercial redevelopment, and foundation and earthwork recommendations for the residential development.

The commercial site is located at approximately 5680 S US Hwy 85/87 in El Paso County near the city limits of Fountain, Colorado. The site consists of several retail businesses in a strip mall configuration. We understand existing buildings may be demolished and the site reconfigured to accommodate access to the residential development. The parking area pavement may be rehabilitated or rebuilt.

The residential development is comprised of two parcels. Parcel A is 34 acres of relatively flat land, and Parcel B is 19 acres bordering Fountain Creek and includes a portion of the Fountain Creek floodplain. The site is proposed to be developed in two filings. Filing 1 will include 136 residential lots, and Filing 2 will include 89 residential lots. A full spectrum stormwater detention will most likely be required for this development, as will a sanitary lift station. The location of the site is shown on the Site Vicinity Map, Figure 1.

Existing Site Conditions

The residential site is currently undeveloped land situated between US highway 85/87 and Fountain Creek. It sits behind the commercial strip mall development and appears to have no developed roadway access. The site is vacant and currently vegetated with native shrubs, grass, and weeds. The southern extent of the site drops down to the floodplain of Fountain Creek.

FIELD INVESTIGATION AND LABORATORY TESTING

Drilling

The subsurface conditions on the site were investigated by drilling eleven (11) exploratory test borings to 20 feet depth within the residential property, and five (5) exploratory test borings to 20 feet depth within the boundary of the commercial parcel. In this report commercial borings carry a C-xx designation, while the residential borings carry an R-xx designation. The approximate locations of the test borings are presented in the Test Boring Location Plan, Figure 2.

The test borings were advanced with a power-driven, continuous-flight auger drill rig. Soil samples were obtained in general accordance with ASTM D-1586 utilizing a 2-inch OD split-barrel sampler or in general accordance with ASTM D-3550 utilizing a 2½-inch OD modified California sampler. Samples

were returned to RMG's materials testing laboratory for testing and analysis. An Explanation of Test Boring Logs is presented in Figure 3. The Test Boring Logs are presented in Figures 4 through 11.

Laboratory Testing

The moisture content for the recovered samples was obtained in the laboratory. Grain-size analysis, 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 12. Soil Classification Data are presented in Figures 13 through 16. Swell/Consolidation Test Results are presented in Figure 17.

SECTION 1 – RESIDENTIAL DEVELOPMENT

Subsurface Materials

Commercial Soil Test Borings (C-01 through C-05) were performed through the existing pavement of the commercial area and will be discussed in **Section 3 - Commercial Development** of this report. Residential Soil Test Borings (R-01 through R-11) were performed in the undeveloped parcels and are discussed below. The subsurface materials were classified by laboratory testing in accordance with the Unified Soils Classification System (USCS).

Referring to Figure 2, Test Boring Location Plan, clay, claystone and shale bedrock were encountered in Test Borings R-05, R-06, R-08, R-10 and R-11 in the southwest portion of the site. Silty sand was encountered in the other residential borings throughout the 20-foot depth tested across the north and eastern portions of the site.

Soil Test Borings: R-01, R-02, R-03, R-04, R-07, R-09

0 to 20-feet: Tan to brown, loose to medium dense, moist (wet below the water table), Silty Sand. This soil classifies primarily throughout its depth as SW-SM, well-graded silty sand with gravel.

Soil Test Borings: R-05, R-06, R-08, R-10, R-11

0 to 5-14-feet: Tan to brown, loose to medium dense, moist (wet below the water table), Silty Sand. This soil classifies primarily throughout its depth as SW-SM, well-graded silty sand with gravel.

5-14 to 20-feet: Gray, hard to very hard, moist claystone and shale bedrock. These soils classify primarily as CL, lean clay, and CH, fat sandy clay.

Additional descriptions and the interpreted distribution (approximate depths) of the subsurface materials are presented on the Test Boring Logs. The descriptions 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.

Groundwater

Groundwater was encountered intermittently across the site. The well-graded sand appears to be well-draining with groundwater encountered at 13 to19-feet depth. In those borings where claystone and shale bedrock were encountered, groundwater was perched as high as 6-feet below ground surface elevation. Depending upon final site grading and finished floor elevations, groundwater may influence the feasibility of certain structures, particularly basement construction. Fluctuations in groundwater and subsurface moisture conditions may occur due to seasonal variations in rainfall and other factors not readily apparent at this time.

CONCLUSIONS AND RECOMMENDATIONS

The following discussion is based on the subsurface conditions encountered in the test borings and on the project characteristics previously described. If conditions are different from those described in this report or the project characteristics change, RMG should be retained to review our recommendations and adjust them, if necessary.

Geotechnical Considerations

Overall, the subsurface soil conditions are favorable for residential development on shallow foundation systems. The well-graded silty sand can be prepared to provide adequate bearing capacity. Claystone and shale are not considered suitable for direct foundation bearing. In those locations where claystone and shale are present overexcavation and replacement with compacted structural fill will be necessary to provide for a minimum of 4-feet of separation between unsuitable soil and foundation elements. The area of the site that may require overexcavation and replacement can be described as the southwest portion of the site roughly defined by Soil Test Borings R-05, R-06, R-08, R-10, and R-11.

The preliminary site plan provided to RMG shows the far southern end of the site reserved for a full spectrum stormwater detention area. Soil Test Borings R-09 and R-10 were performed in this region. Detention area considerations are discussed in **Section 2 – Full Spectrum Detention Area**. The site plan also shows proposed lift station at the extreme southwestern part of the site. Soil Test Boring R-11 was performed in this location.

Site Preparation

Final grading plans were not available for review. In general, the following site preparation procedures are recommended.

Standard Penetration Test blow counts vary across the site and with depth. Due to this variability we recommend improving the soil under foundations by overexcavating the foundation areas and backfilling with compacted structural fill. The on-site silty sand soil is suitable as structural backfill. The clay and claystone is not recommended as structural backfill. Site preparation should include clearing and grubbing the site of all vegetation, topsoil, and any other deleterious material within the construction area and disposing this material appropriately. Following clearing and grubbing, the area within the foundation footprint, under basements, and a 2-foot perimeter beyond should be overexcavated two (2) feet below the bottom of footing elevation. Excavated sand soil may be stockpiled for reuse as structural backfill. An Open Excavation Observation should be made at this point to verify soil conditions are as reported in the soil boring logs herein.

Upon verification, the upper 6 inches of the exposed subsurface soils should then 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 Modified Proctor test (ASTM D-1557) prior to placing structural fill.

After compaction of the subgrade, the native material previously removed may be used as structural backfill to bring the site to bottom of footing grade. The material should not be excessively wet, should be free of organic matter and construction debris, and contain no rock fragments greater than 3-inches in any dimension. Fill material should be placed in ten-inch loose lifts with moisture content within 2 percent of optimum as determined by ASTM D-1557. Each loose lift should be compacted to a minimum of 95 percent of Modified Proctor maximum dry density as determined by ASTM D-1557. Backfill soil should be density tested to verify compaction meets these requirements.

Foundation Recommendations

Structures may be supported on shallow foundations bearing on the onsite soils when prepared in accordance with the recommendations above. When so prepared, a maximum allowable bearing pressure of 2,500 psf with no minimum dead load requirement may be used for design. The foundation design should be prepared by a qualified Colorado Registered Professional Engineer using the recommendations presented in this report. This foundation system should be designed to span a minimum of 10 feet under the design loads. The bottoms of exterior foundations should be at least 30 inches below finished grade for frost protection. When prepared and properly compacted, total settlement of 1-inch or less with differential settlement on the order of ½ inch or less is estimated. Settlement in granular material will occur relatively rapidly with construction loads. Long term consolidation settlement should not be an issue in the site material if prepared as recommended above.

All foundation and site preparation recommendations contained herein apply equally to the proposed sanitary lift station.

Open Excavation Observations

As referenced above, foundation excavations should be observed by RMG prior to placing structural fill, forms, or concrete to verify the foundation bearing conditions for each structure. Based on the conditions observed in the foundation excavation, the recommendations made at the time of construction may vary from those contained herein. In particular if claystone is encountered within 4-feet of foundation elements, additional overexcavation will be recommended. In the case of differences, the Open Excavation Observation report shall be considered to be the governing document to be used to modify the site preparation recommendations as necessary.

Floor Slabs

The in-situ silty sand soil is non-plastic and should be stable at its natural moisture content. The onsite soil is suitable as backfill material. Any fill material from outside sources used to bring the site to grade should be non-expansive granular material to control slab movement.

Soil for interior floor slabs should be prepared in a manner similar to foundations above. Areas under floor slabs should be overexcavated a minimum of 1-foot and the upper 6 inches of the exposed subsurface soils should then 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 Modified Proctor test (ASTM D-1557) prior to placing structural fill. Floor slabs should bear upon a minimum of 1-foot of structural backfill compacted to a minimum of 95 percent of Modified Proctor maximum dry density as determined by ASTM D-1557. Non-structural slabs should be isolated from foundation members with expansion material. To reduce the possibility of capillary rise of groundwater into the floor slab, and to reduce the potential for concrete curling, a minimum 3-inch layer of ¾-inch crushed stone may be placed atop the compacted structural fill. A 6-mil vapor retarder may be installed above the crushed stone.

Exterior Concrete Flatwork

Reinforced concrete exterior slabs should be constructed similarly to floor slabs on compacted structural fill, with the additional caveat they be isolated from the building with expansion material, and have a downturned reinforced thickened edge.

Lateral Earth Pressures

Foundation and basement walls should be designed to resist lateral pressures. For non-expansive backfill materials, we recommend an equivalent fluid pressure of 40 pcf for design. Expansive soils or bedrock should not be used as backfill against walls. The above lateral pressure applies to level, drained backfill conditions. Equivalent Fluid Pressures for sloping/undrained conditions should be determined on an individual basis.

CONSTRUCTION CONSIDERATIONS

Surface Grading and Drainage

A contributing factor to foundation settlement and floor slab heave in Colorado Front Range soils is the introduction of excess water. Improper site grading and irrigation water are respectively the most common cause and source of excess water. The ground surface should be sloped from the building with a minimum gradient of 10 percent for the first 10 feet. This is equivalent to 12 inches of fall across this 10-foot zone. If a 10-foot zone is not possible on the upslope side of the structure, then a well-defined swale should be created a minimum 5 feet from the foundation and sloped parallel with the wall with a minimum slope of 2 percent to intercept the surface water and transport it around and away from the structure. Roof drains should extend across backfill zones and landscaped areas to a region that is graded to direct flow away from the structure. Future homeowners should be informed to maintain the surface grading and drainage recommendations herein 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 excess water will increase the likelihood of slab and foundation movements.

Perimeter Drain

The overburden site soil is well draining, but groundwater was encountered at varying depths across the site. A subsurface perimeter drain is recommended around portions of structures which will have habitable or storage space located below the finished ground surface. This includes crawlspace areas if applicable. Where main level slab-on-grade foundation systems are utilized, a subsurface perimeter drain will not be required around the foundation.

Underslab Drain

Shallow groundwater conditions were encountered in Test Borings R-06 and R-10, and may be present at other locations. Depending on the conditions observed at the time of the Open Excavation Observation, an underslab drainage layer may also be recommended 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. Careful attention should be paid to grade and discharge of the drain pipe.

Concrete

Type I/II cement is recommended for concrete in contact with the subsurface materials. Calcium chloride should be used with caution for soils with high sulfate contents. The concrete should not be placed on frozen ground. If placed during periods of cold temperatures, the concrete should be kept from freezing. This may require covering the concrete with insulated blankets and heating. Concrete work should be completed in accordance with the latest applicable guidelines and standards published by ACI.

Exterior Backfill

Backfill around foundation stemwalls and other buried structures should be placed in loose lifts of 10-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 concrete flatwork, the materials should be compacted to 95 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.

Structural Fill - General

Except as discussed above for foundations and slab support, 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 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 should be placed in loose lifts of 10-inches, 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 materials should be compacted by mechanical means.

Materials used for structural fill should be approved by the RMG prior to use. 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.

SECTION 2 - FULL SPECTRUM DETENTION AREA

Full spectrum detention ponds are typically designed and constructed with embankments and control structures to store stormwater above the natural grade of the land. Our investigation included two Soil Test Borings in this region to characterize the subsurface soils pertinent to embankment construction, and to provide recommendations regarding embankment construction. These recommendations have 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.

Detention Storage Criteria

Detention pond embankments that impound water above the natural grade of the land are considered dams under rules and regulation promulgated by the State of Colorado Department of Natural Resources. Rules and Regulations for Dam Safety and Dam Construction have been developed to provide guidance to design engineers and constructors. Dams are regulated as jurisdictional dams or non-jurisdictional dams. In accordance with El Paso County Drainage Criteria Manual, Volume 1, Section 6.6, embankments in this development will most likely qualify as **non-jurisdictional, minor dams, with a Class III hazard rating.**

The purpose of our recommendations is to provide information to comply with the referenced guidelines and provide pertinent geotechnical information upon which to base the design and construction of pond embankments. This section presents the findings of the investigation performed by RMG and our recommendations regarding detention pond construction.

General Physiographic Setting

The site is located within the western flank of the Colorado Piedmont section of the Great Plains physiographic province. The Colorado Piedmont which formed during Late Tertiary and Early Quaternary time (approximately 2,000,000 years ago) is a broad, erosional trench which separates the Southern Rocky Mountains from the High Plains. During the Late Mesozoic and Early Cenozoic

Periods (approximately 70,000,000 years ago), intense tectonic activity occurred, causing the uplifting of the Front Range and associated downwarping of the Denver Basin to the east. Relatively flat uplands and broad valleys characterize the present-day topography of the Colorado Piedmont in this region. More particularly, the site is located on alluvial deposits with bedrock intrusions above Fountain Creek.

Topography

The ground surface generally slopes gently down to the south and southwest across the entire site and drops precipitously into Fountain Creek at the south end. Fountain Creek is adjacent to and forms the western property line.

Vegetation

Vegetation across the site generally consists of native grasses, shrubs, and weeds.

General Soil Types

The general geology of the area is typically stream terrace deposits and alluvium soils overlying the Pierre Shale. Samples from each Soil Test Boring exhibited characteristics of the general geology. The subsurface conditions can be characterized by describing two geologic units that were mapped in the vicinity of the site identified (Morgan, et al., 2003) as:

- al: alluvium is loose, unconsolidated (not cemented together into a solid rock) soil or sediments, which has been eroded, reshaped by water in some form, and redeposited in a non-marine setting. Alluvium is typically made up of a variety of materials, including fine particles of silt and clay and larger particles of sand and gravel.

- Kp: Pierre Shale – (Upper Cretaceous) Underlain by the Piney Creek Alluvium. Permeability is generally low, excavation and compaction generally easy. Foundation stability is less than fair. The majority of the formation has low to high swell potential. Slope stability is generally poor and slopes steeper than 5 degrees may slide, if the toe of the slope is removed.

Subsurface Materials

The subsurface materials encountered in Test Borings R-09 and R-10 were classified using the Unified Soils Classification System (USCS) and the materials were grouped into the general categories of silty sand and shale. These soils classify as SW-SM, well-graded silty sand, and CH, sandy fat clay. It is anticipated that subgrade foundations for embankments will be in alluvial material, and that the embankments themselves will be constructed from on-site alluvial material. Embankments are not anticipated to be constructed directly upon or built up from shale bedrock.

Groundwater

Groundwater was not encountered in R-09. Groundwater was encountered in R-10 at 6-feet below the existing ground surface. Groundwater may influence detention pond embankment design and construction.

CONCLUSIONS AND RECOMMENDATIONS

Soil and Rock Design Parameters

RMG has performed numerous laboratory tests of soil similar to the soils encountered in the Soil Test Borings. Based upon field and laboratory testing, the following soil and rock parameters are typical for the soils likely to be encountered, and are recommended for use in detention pond embankment design.

Soil Description	Unit Weight (lb/ft^3)	Friction Angle (degree)	Active Earth Pressure, Ka	Passive Earth Pressure, Kp	At Rest Earth Pressure, Ko	Unconfined compressive Strength (kip/ft^2)
Alluvial Soil SW-SM	115	30	0.33	3.0	0.50	-
Shale Bedrock CH	124	-	-	-		72

6.2 Seismic Design

In accordance with the International Building Code, 2012/2015, seismic design parameters have been determined for this site. The Seismic Site Class has been interpreted from the results of the soil test borings drilled within the project site. The USGS seismic design tool has been used to determine the seismic response acceleration parameters. USGS output is presented in Appendix B. The soil on this site is not considered susceptible to liquefaction. The following recommended Seismic Design Parameters are based upon Seismic Site Class D, and a 2 percent probability of exceedance in 50 years. The Seismic Design Category is "B".

Period (sec)	Mapped MCE Spectral Response Acceleration (g)		Site Coefficients		Adjusted MCE Spectral Response Acceleration (g)		Design Spectral Response Acceleration (g)	
0.2	S_s	0.175	F_a	1.6	S_{ms}	0.280	S_{ds}	0.187
1.0	S_1	0.060	F_v	2.4	S_{m1}	0.145	S_{d1}	0.097

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

6.3 Embankment Recommendations

Development plans providing detention pond details were not available. In general, embankments should 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 suitable for embankment construction. Structural fill should be placed in 10-inch loose lifts 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 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.

SECTION 3 - COMMERCIAL DEVELOPMENT

The discussion presented below is based on the subsurface conditions encountered in the Soil Test Borings performed through the existing pavement in the commercial development area. These borings are designated C-01 through C-05. During development if the subsurface conditions are different from those described in this report or the project characteristics change, RMG should be retained to review our recommendations and modify them, if necessary. The conclusions and recommendations presented in this report should be verified by RMG during construction.

SUBSURFACE CONDITIONS

Subsurface Materials

Commercial Soil Test Borings (C-01 through C-05) were performed through the existing pavement of the commercial area. The subsurface materials were classified by laboratory testing in accordance with the Unified Soils Classification System (USCS).

Similar soil conditions were encountered in each of the five borings.

0 to 2-inches: Asphalt Pavement

2" to 20-feet: Tan to brown, loose to medium dense, moist, Silty Sand. This soil classifies primarily throughout its depth as SW-SM, well-graded silty sand with gravel.

Additional descriptions and the interpreted distribution (approximate depths) of the subsurface materials are presented on the Test Boring Logs. The descriptions 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.

Groundwater

Groundwater was not encountered in any of the borings through the depths investigated. Fluctuations in groundwater and subsurface moisture conditions may occur due to seasonal variations in rainfall and other factors not readily apparent at this time.

CONCLUSIONS AND RECOMMENDATIONS

Based upon preliminary site plans provided to RMG, we understand some of the existing structures in the commercial strip mall area may be demolished or reconfigured to construct a roadway leading to the residential development. We also understand the existing pavement may be rehabilitated or reconstructed. New buildings may also be constructed on the site. Recommendations for commercial building foundations and for pavement design are presented below.

Geotechnical Considerations

Overall, the subsurface soil conditions are favorable for commercial development on shallow foundation systems. The well-graded silty sand found throughout the site can be prepared to provide adequate bearing capacity. Claystone and shale were not encountered in any of the test borings. Development recommendations are similar to those above for residential, but will be re-stated below.

Site Preparation

Final grading plans were not available for review. In general, the following site preparation procedures are recommended.

Standard Penetration Test blow counts indicate the in situ soil is in a relatively dense condition, but this can change with demolition and other development activities. We recommend improving the soil under foundations by overexcavating the foundation areas and backfilling with compacted structural fill. The on-site material is suitable as structural backfill. Site preparation should include clearing and grubbing the site of all vegetation, topsoil, pavement, old foundation elements, and any other deleterious material within the construction area and disposing this material appropriately. Following clearing and grubbing, the area within the foundation footprint and a 2-foot perimeter beyond should be overexcavated two (2) feet below the bottom of footing elevation. The excavated material may be stockpiled for reuse as structural backfill. An Open Excavation Observation should be made at this point to verify soil conditions are as reported in the soil boring logs herein.

Upon verification, the upper 6 inches of the exposed subsurface soils should then 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 Modified Proctor test (ASTM D-1557) prior to placing structural fill.

After compaction of the subgrade, the native material previously removed may be used as structural backfill to bring the site to bottom of footing grade. The material should not be excessively wet, should be free of organic matter and construction debris, and contain no rock fragments greater than 3-inches in any dimension. Fill material should be placed in ten-inch loose lifts with moisture content within 2 percent of optimum as determined by ASTM D-1557. Each loose lift should be compacted to a

minimum of 95 percent of Modified Proctor maximum dry density as determined by ASTM D-1557. Backfill soil should be density tested to verify compaction meets these requirements.

Foundation Recommendations

Commercial structures may be supported on shallow foundations bearing on the onsite soils when prepared in accordance with the recommendations above. When so prepared, a maximum allowable bearing pressure of 2,500 psf with no minimum dead load requirement may be used for design. The foundation design should be prepared by a qualified Colorado Registered Professional Engineer using the recommendations presented in this report. This foundation system should be designed to span a minimum of 10 feet under the design loads. The bottoms of exterior foundations should be at least 30 inches below finished grade for frost protection. When prepared and properly compacted, total settlement of 1-inch or less with differential settlement on the order of ½ inch or less is estimated. Settlement in granular material will occur relatively rapidly with construction loads. Long term consolidation settlement should not be an issue in the site material if prepared as recommended above.

Open Excavation Observations

As referenced above, foundation excavations should be observed by RMG prior to placing structural fill, forms, or concrete to verify the foundation bearing conditions for each structure. Based on the conditions observed in the foundation excavation, the recommendations made at the time of construction may vary from those contained herein. In the case of differences, the Open Excavation Observation report shall be considered to be the governing document to be used to modify the site preparation recommendations as necessary.

Floor Slabs

The in-situ silty sand soil is non-plastic and should be stable at its natural moisture content. The onsite soil is suitable as backfill material. Any fill material from outside sources used to bring the site to grade should be non-expansive granular material to control slab movement.

Soil for interior floor slabs should be prepared in a manner similar to foundations above. Areas under floor slabs should be overexcavated a minimum of 1-foot and the upper 6 inches of the exposed subsurface soils should then 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 Modified Proctor test (ASTM D-1557) prior to placing structural fill. Floor slabs should bear upon a minimum of 1-foot of structural backfill compacted to a minimum of 95 percent of Modified Proctor maximum dry density as determined by ASTM D-1557. Non-structural slabs should be isolated from foundation members with expansion material. To reduce the possibility of capillary rise of groundwater into the floor slab, and to reduce the potential for concrete curling, a minimum 3-inch layer of ¾-inch crushed stone may be placed atop the compacted structural fill. A 6-mil vapor retarder may be installed above the crushed stone.

Exterior Concrete Flatwork

Reinforced concrete exterior slabs should be constructed similarly to floor slabs on compacted structural fill, with the additional caveat they be isolated from the building with expansion material, and have a downturned reinforced thickened edge.

Lateral Earth Pressures

Foundation and basement walls should be designed to resist lateral pressures. For non-expansive backfill materials, we recommend an equivalent fluid pressure of 40 pcf for design. Expansive soils or bedrock should not be used as backfill against walls. The above lateral pressure applies to level, drained backfill conditions. Equivalent Fluid Pressures for sloping/undrained conditions should be determined on an individual basis.

SECTION 4 - PAVEMENT RECOMMENDATIONS

Pavement Design

The development area appears to be just beyond the City of Fountain city limits in El Paso County. Presuming the development will be annexed into the City of Fountain, the governing specification for roadway design will be The City of Colorado Springs Engineering Criteria Manual (if the development remains in the County, the El Paso County Engineering Manual will govern; the two documents produce similar pavement designs).

The following information is provided for general consideration and applicable to residential roadways serving the subdivision, commercial roadways providing access to the subdivision, and commercial parking pavements. Final pavement designs will be required for jurisdictional acceptance, and are typically performed with soil samples obtained from roadway areas after the deepest public utilities have been installed. Typical pavement sections based upon RMG's experience with the soils encountered on this site are presented below.

The silty sand encountered in the Test Borings will form the subgrade of pavement sections, and its stability and strength are critical to pavement design. The soil consists of well-graded silty sand. This material will typically classify as A-1 or A-2 soils in accordance with the American Association of State Highway and Transportation Officials (AASHTO) classification system. These soils are considered "excellent to good" as subgrade material.

The California Bearing Ratio, CBR, is an indication of the mechanical strength of pavement subgrades and is a key factor in determining pavement section thicknesses. A-1 and A-2 soils will typically produce CBR's of 10 or higher. At these values the minimum pavement sections prescribed in the Engineering Criteria Manuals will be sufficient for expected traffic loading in the proposed developments.

Pavement Thickness

Assuming an adequate subgrade CBR, typical pavement sections for residential roadways, paved parking areas, and for heavy vehicle loading areas are presented below, where HMA is Hot Mix Asphalt, and ABC is Aggregated Base Course.

Typical Hot-Mix Asphalt Pavement Section	
Traffic Level	**HMA over ABC (inches)**
Moderate Traffic / Some Trucks	4.0 / 6.0
Heavy Vehicles with Turning Motions	6.0 / 6.0

As an alternative to the HMA section above, Rigid Concrete Pavements are often employed in areas where heavy vehicle loading is expected. These areas include drop-off/pick-up areas, loading docks, trash pick-up areas, and other locations where heavy trucks will be making frequent turning and braking movements. Rigid pavements may be constructed directly on proof-rolled non-expansive granular subgrade, the top one foot of which has been compacted to a minimum of 95% of maximum dry density as determined by ASTM D1557.

Typical Rigid Concrete Pavement Section	
Traffic Level	**Portland Cement Concrete (in.)**
Heavy Vehicles with Turning Motions	5.0 in.

This pavement information is for preliminary planning purposes only. CBR values will be based on the materials encountered at the time of development and will be dependent upon the soil material used for site fill and subgrade construction. We suggest evaluating the soil conditions after site grading and pavement layout to perform a proper design.

CLOSING

This report has been prepared for the exclusive purpose of providing geotechnical engineering information and recommendations for development described in this report. RMG should be retained to review the final construction documents prior to construction to verify our findings, conclusions and recommendations have been appropriately implemented.

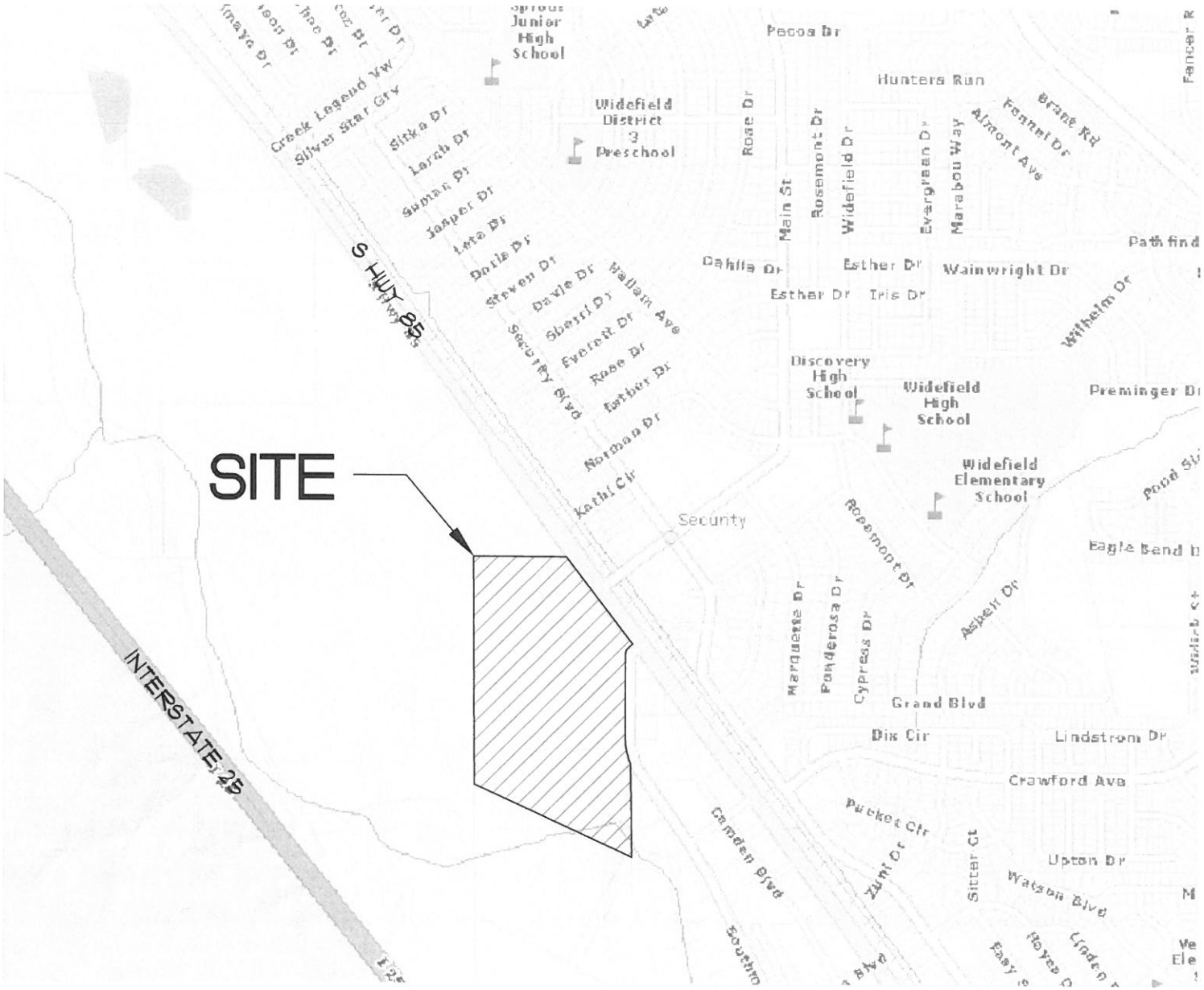
This report has been prepared for the exclusive use by **Avatar Fountain, LP** for application as an aid in the design and construction of the proposed development in accordance with generally accepted geotechnical engineering practices. The analyses and recommendations in this report are based in part upon data obtained from test borings, site observations and the information presented in referenced reports. The nature and extent of variations may not become evident until construction. If variations then become evident, RMG should be retained to review the recommendations presented in this report considering the varied condition, and either verify or modify them in writing.

Our professional services were performed using that degree of care and skill ordinarily exercised, under similar circumstances, by geotechnical engineers 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.

The scope of services for this project does not include, either specifically or by implication, 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 Client desires investigation into the potential for such contamination or conditions, other studies should be undertaken.

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

FIGURES



REFERENCE
NOT TO SCALE

ARCHITECTS RMG ENGINEERS
ROCKY MOUNTAIN GROUP

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

SITE VICINITY MAP

RESIDENTIAL / RETAIL
RIVER BEND CROSSING
FOUNTAIN, CO
AVATAR FOUNTAIN, LP

JOB No. 161921

FIG No. 1

DATE 3-21-2018

REFERENCE
NOT TO SCALE

R: RESIDENTIAL
C: COMMERCIAL

DENOTES APPROXIMATE LOCATION OF TEST BORINGS

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ROCKY MOUNTAIN GROUP

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

TEST BORING LOCATION PLAN

RESIDENTIAL / RETAIL
RIVER BEND CROSSING
FOUNTAIN, CO
AVATAR FOUNTAIN, LP

JOB No. 161921

FIG No. 2

DATE 3-21-2018

SOILS DESCRIPTION


ASPHALT


CLAYSTONE


SHALE


SILTY 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

ARCHITECTS RMG ENGINEERS

Geotechnical
Materials Testing
Civil, Planning

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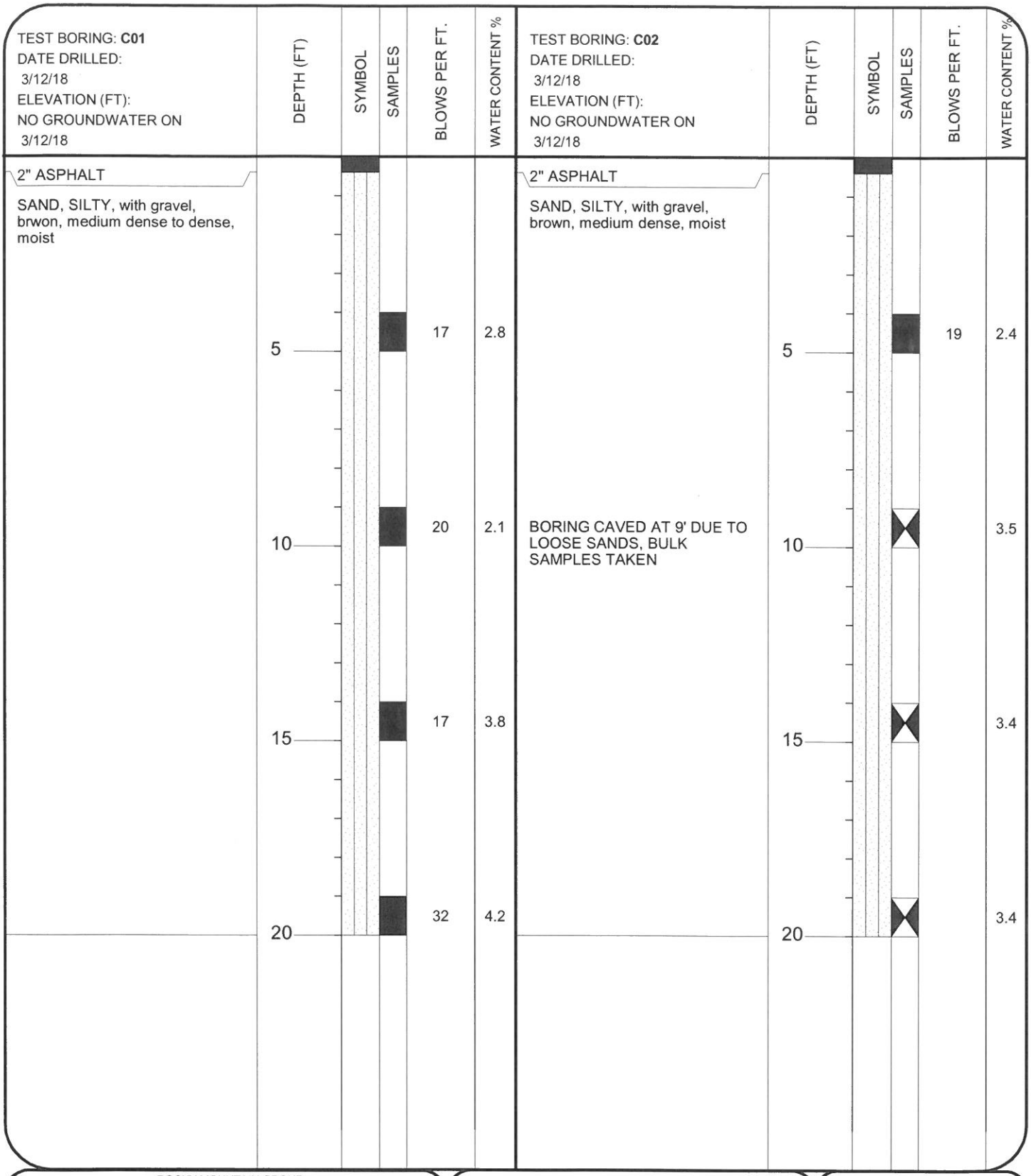
Colorado Spings, CO 80918
(719) 548-0600
SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

EXPLANATION OF TEST BORING LOGS

JOB No. 161921

FIGURE No. 3

DATE 4/2/18



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Structural
Forensics

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SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

TEST BORING LOGS

JOB No. 161921

FIGURE No. 4

DATE 4/2/18

TEST BORING: **C03**
DATE DRILLED: 3/12/18
ELEVATION (FT):
NO GROUNDWATER ON 3/12/18

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
	2" ASPHALT			
	SAND, SILTY, with gravel, brown, medium dense, moist			
5			19	9.1
10			29	2.9
15			25	3.5
20			28	2.6

TEST BORING: **C04**
DATE DRILLED: 3/12/18
ELEVATION (FT):
NO GROUNDWATER ON 3/12/18

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
	2" ASPHALT			
	SAND, SILTY, with gravel, brown, medium dense, moist			
5			18	2.1
10			10	3.5
15			17	2.1
20				2.3

ROCKY MOUNTAIN GROUP

Architectural
Structural
Forensics

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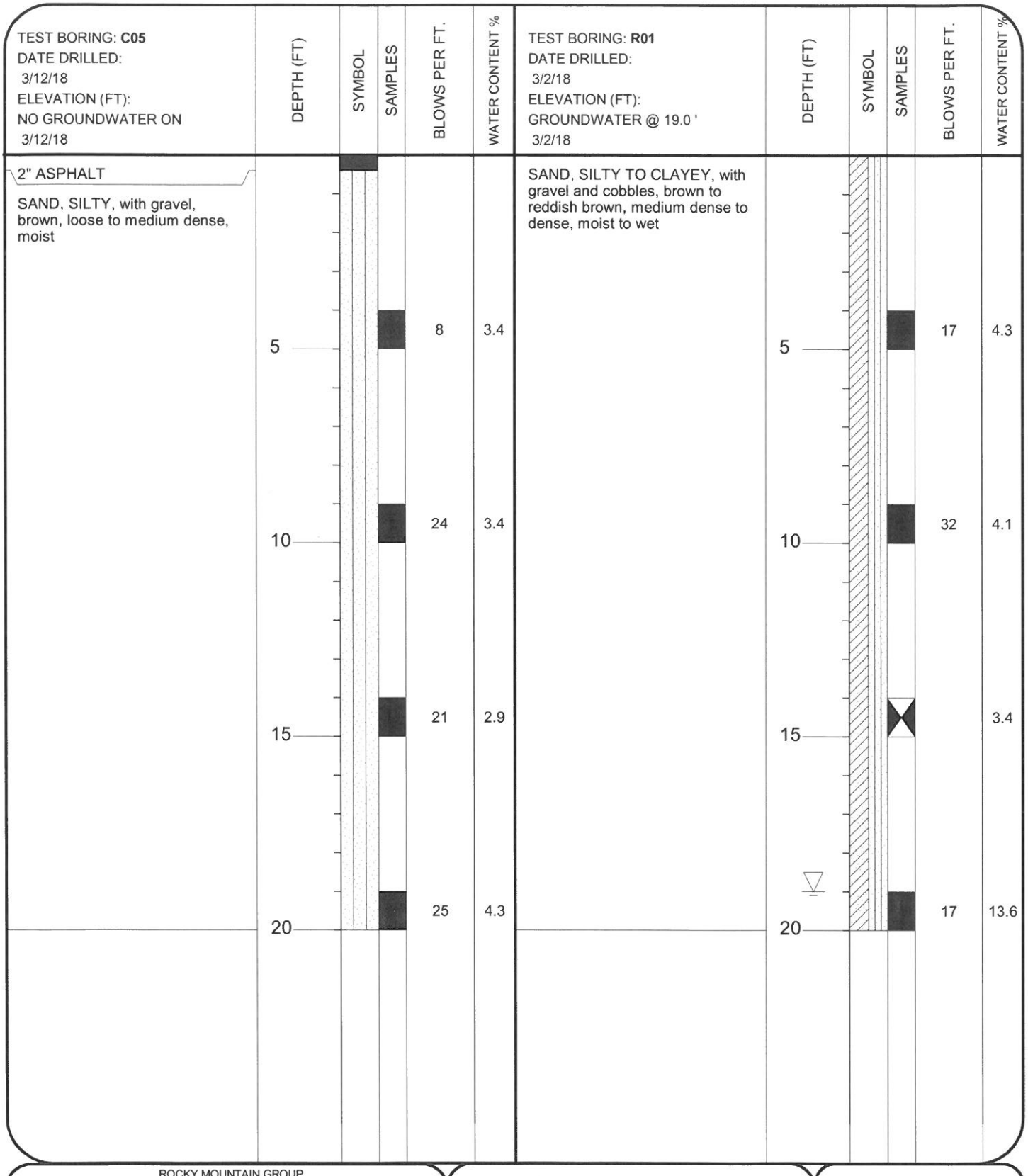
SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

TEST BORING LOGS

JOB No. 161921

FIGURE No. 5

DATE 4/2/18



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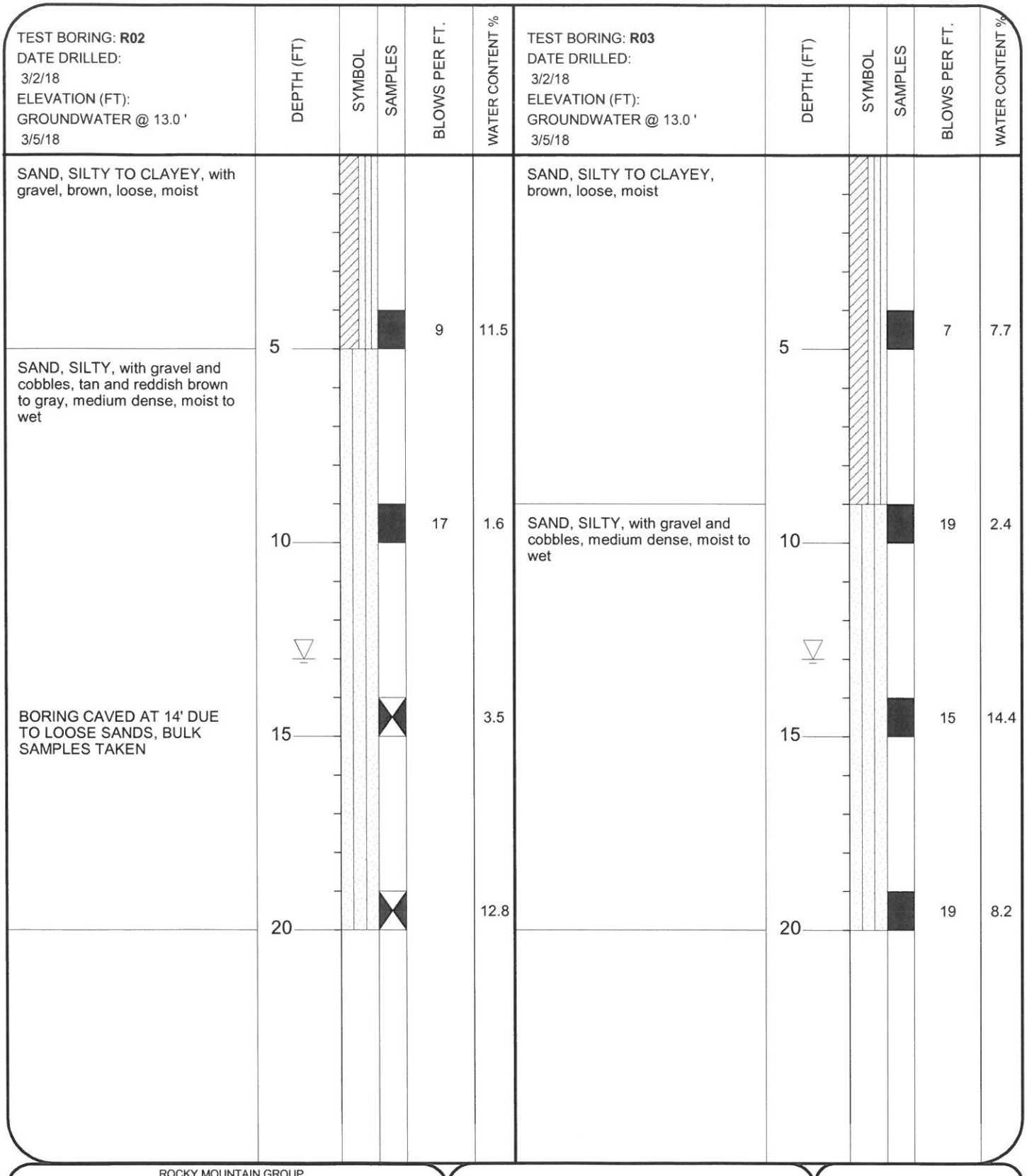
TEST BORING LOGS

JOB No. 161921

FIGURE No. 6

DATE 4/2/18



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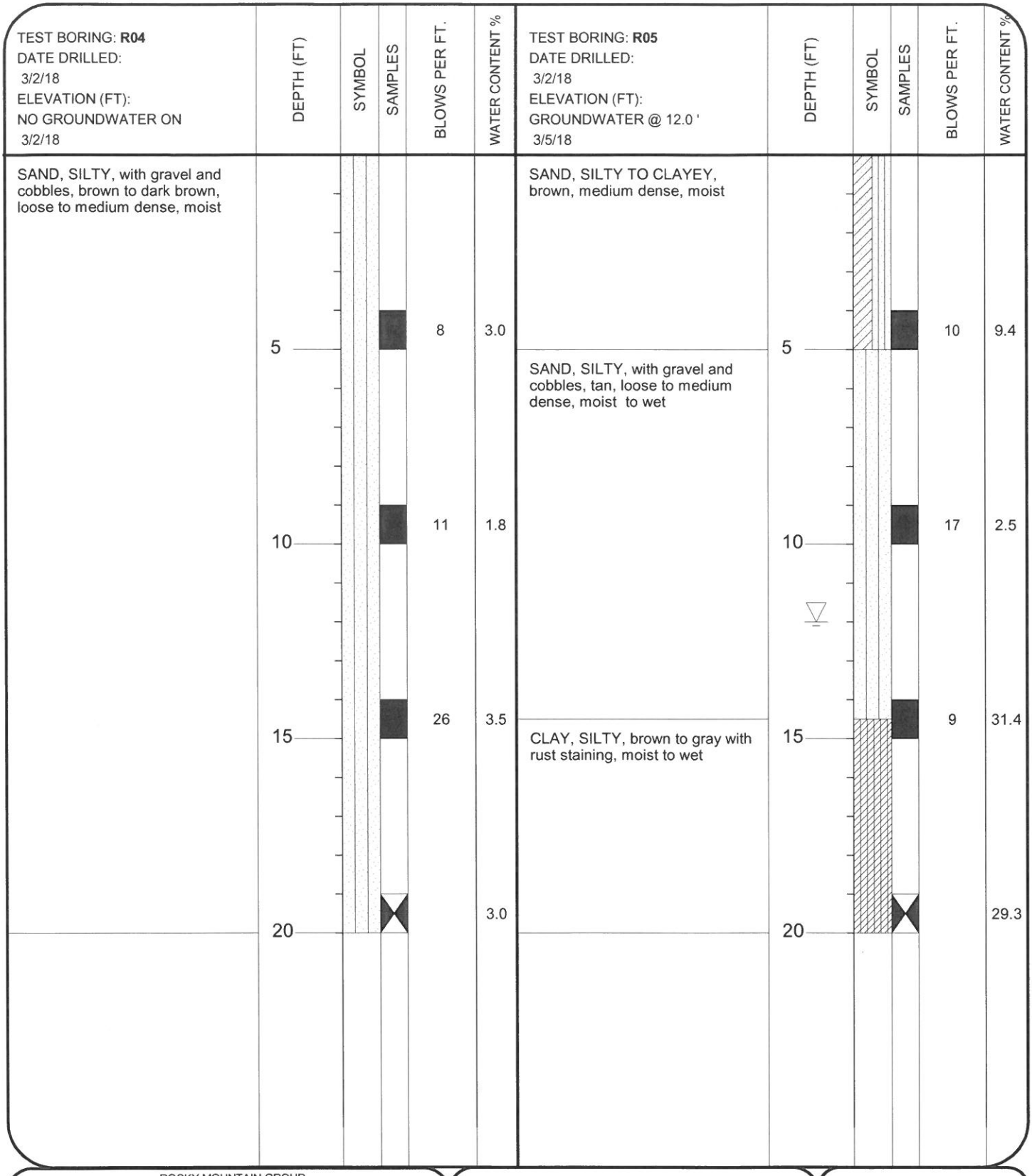
TEST BORING LOGS

JOB No. 161921

FIGURE No. 7

DATE 4/2/18



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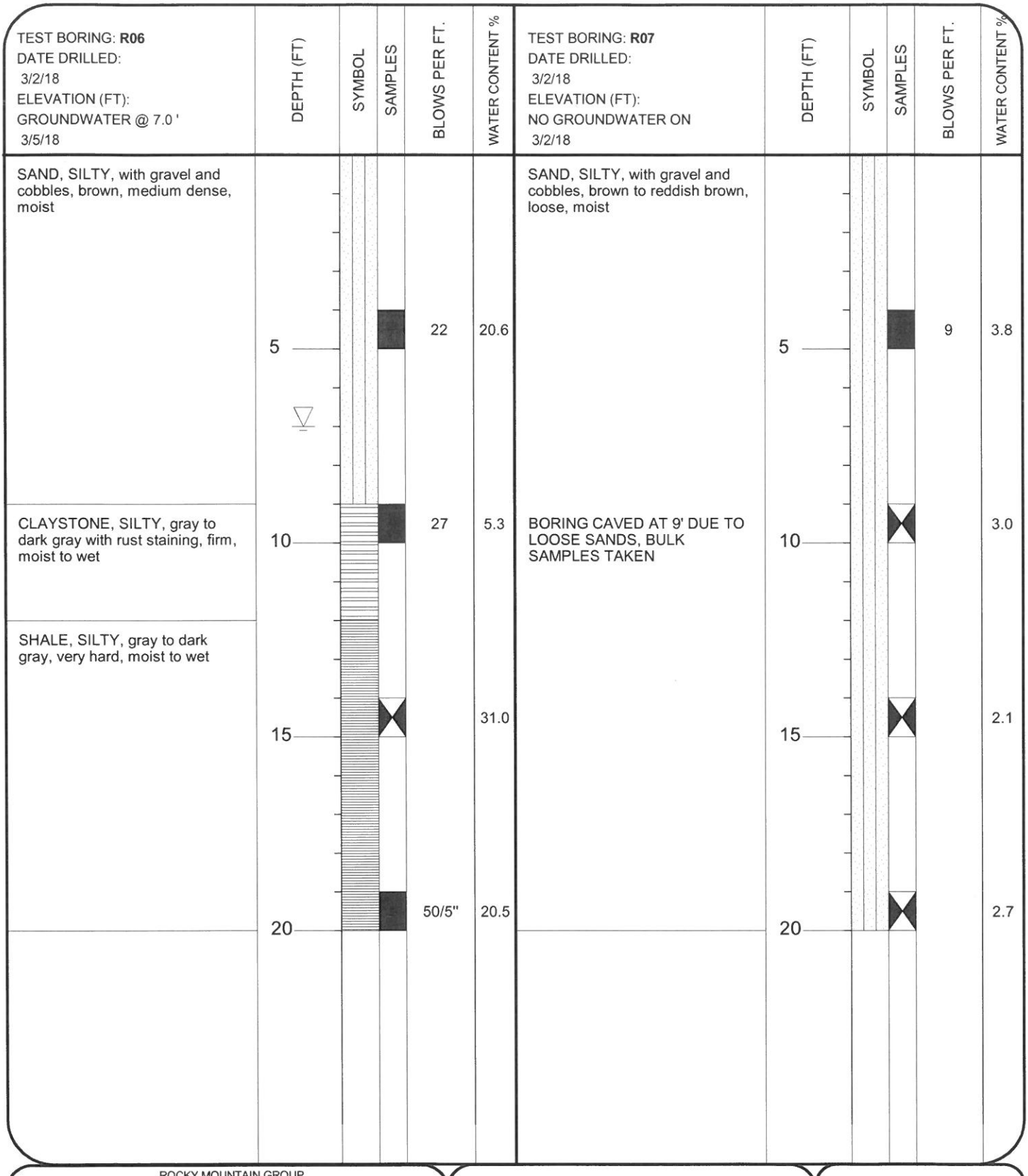
TEST BORING LOGS

JOB No. 161921

FIGURE No. 8

DATE 4/2/18



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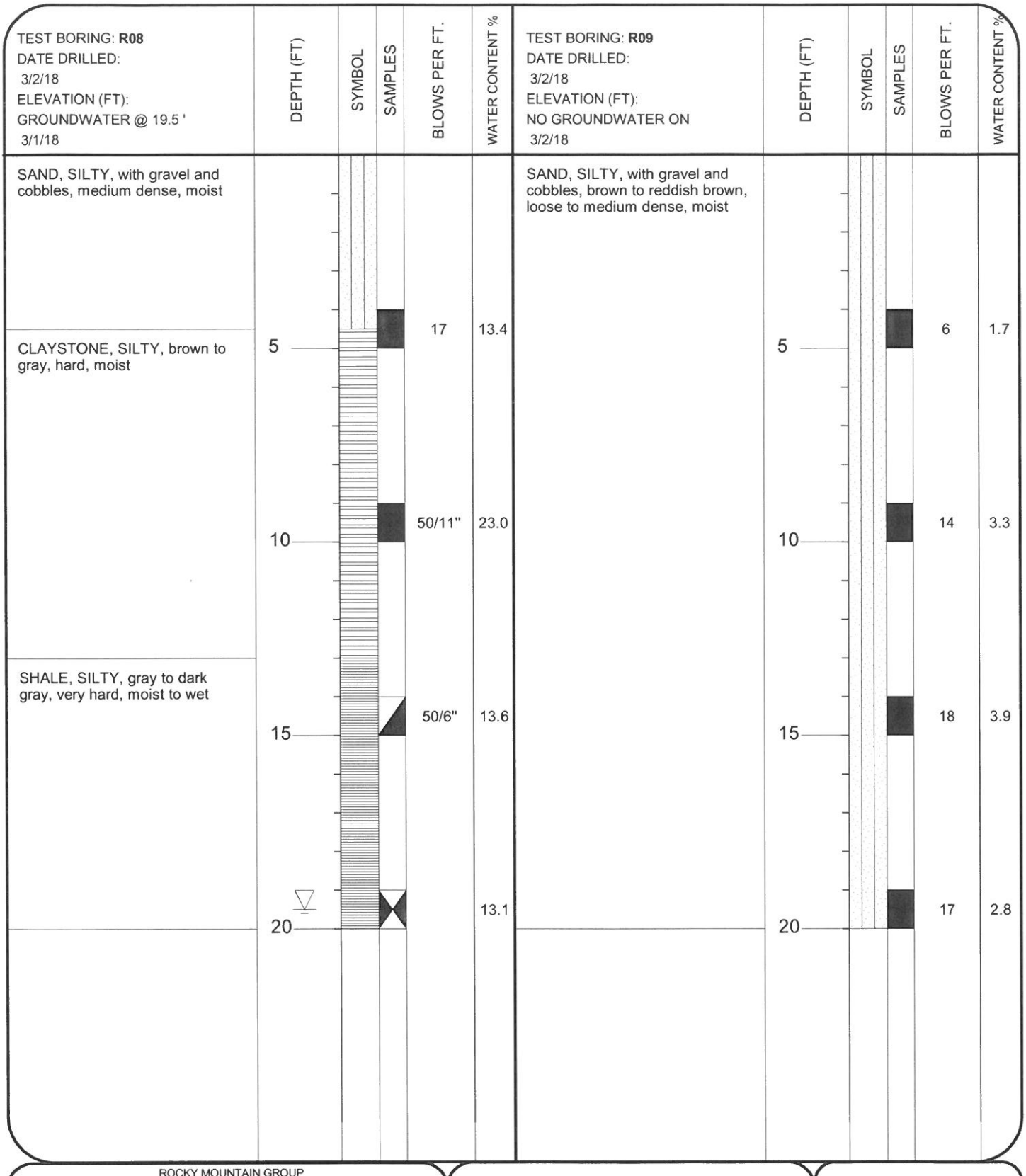
TEST BORING LOGS

JOB No. 161921

FIGURE No. 9

DATE 4/2/18



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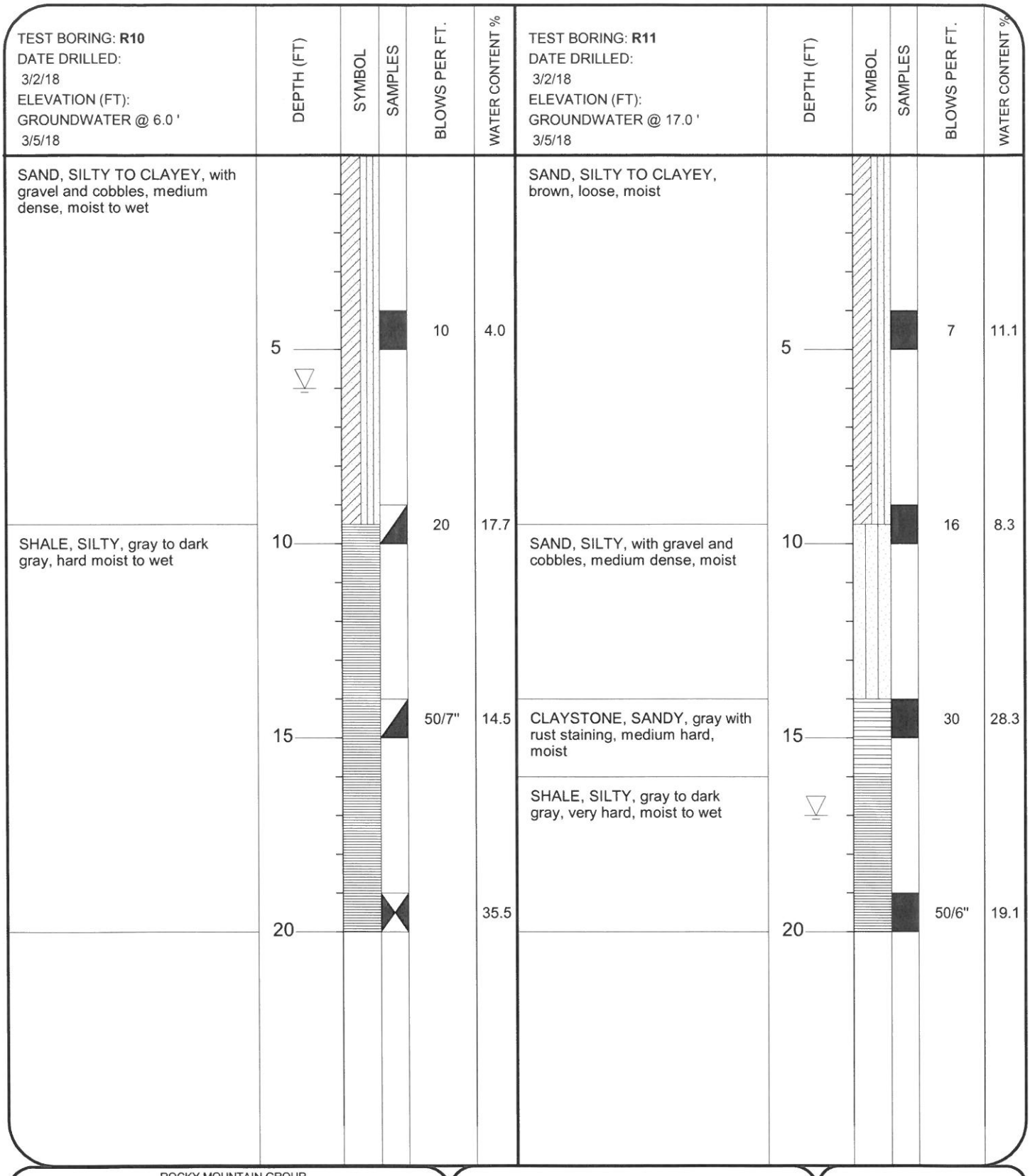
TEST BORING LOGS

JOB No. 161921

FIGURE No. 10

DATE 4/2/18



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TEST BORING LOGS

JOB No. 161921

FIGURE No. 11

DATE 4/2/18

Test Boring No.	Depth	Water Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% Retained No.4 Sieve	% Passing No. 200 Sieve	FHA Expansion Pressure (psf)	% Swell/ Collapse	USCS Classification
C01	4.0	2.8								
C01	9.0	2.1		NP	NP	44.7	3.4			SW
C01	14.0	3.8								
C01	19.0	4.2								
C02	4.0	2.4								
C02	9.0	3.5								
C02	14.0	3.4		NP	NP	21.3	7.1			SW-SM
C02	19.0	3.4								
C03	4.0	9.1		NP	NP	20.5	15.1			SM
C03	9.0	2.9								
C03	14.0	3.5								
C03	19.0	2.6								
C04	4.0	2.1								
C04	9.0	3.5		NP	NP	22.7	7.0			SW-SM
C04	14.0	2.1								
C04	19.0	2.3								
C05	4.0	3.4								
C05	9.0	3.4								
C05	14.0	2.9		NP	NP	28.3	3.3			SW
C05	19.0	4.3								
R01	4.0	4.3								
R01	9.0	4.1		NP	NP	34.8	3.1			SP
R01	14.0	3.4								
R01	19.0	13.6								
R02	4.0	11.5								
R02	9.0	1.6								
R02	14.0	3.5		NP	NP	33.4	8.7			SP-SM
R02	19.0	12.8								
R03	4.0	7.7		NP	NP		79.6			ML
R03	9.0	2.4								
R03	14.0	14.4								
R03	19.0	8.2								
R04	4.0	3.0		NP	NP	23.5	3.7			SW
R04	9.0	1.8								

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SUMMARY OF LABORATORY TEST RESULTS

JOB No. 161921
FIGURE No. 12

DATE 4/2/18

Test Boring No.	Depth	Water Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% Retained No.4 Sieve	% Passing No. 200 Sieve	FHA Expansion Pressure (psf)	% Swell/ Collapse	USCS Classification
R04	14.0	3.5								
R04	19.0	3.0								
R05	4.0	9.4								
R05	9.0	2.5								
R05	14.0	31.4		55	37		56.9			CH
R05	19.0	29.3								
R06	4.0	20.6								
R06	9.0	5.3								
R06	14.0	31.0		53	33		88.5			CH
R06	19.0	20.5								
R07	4.0	3.8								
R07	9.0	3.0		NP	NP	48.9	3.9			GP
R07	14.0	2.1								
R07	19.0	2.7								
R08	4.0	13.4								
R08	9.0	23.0	105.2	53	29		91.6		3.0	CH
R08	14.0	13.6								
R08	19.0	13.1								
R09	4.0	1.7								
R09	9.0	3.3								
R09	14.0	3.9		NP	NP	20.4	5.7			SW-SM
R09	19.0	2.8								
R10	4.0	4.0								
R10	9.0	17.7	109.6	43	30		85.6		- 0.1	CL
R10	14.0	14.5								
R10	19.0	35.5								
R11	4.0	11.1		37	23		66.2			CL
R11	9.0	8.3								
R11	14.0	28.3								
R11	19.0	19.1								

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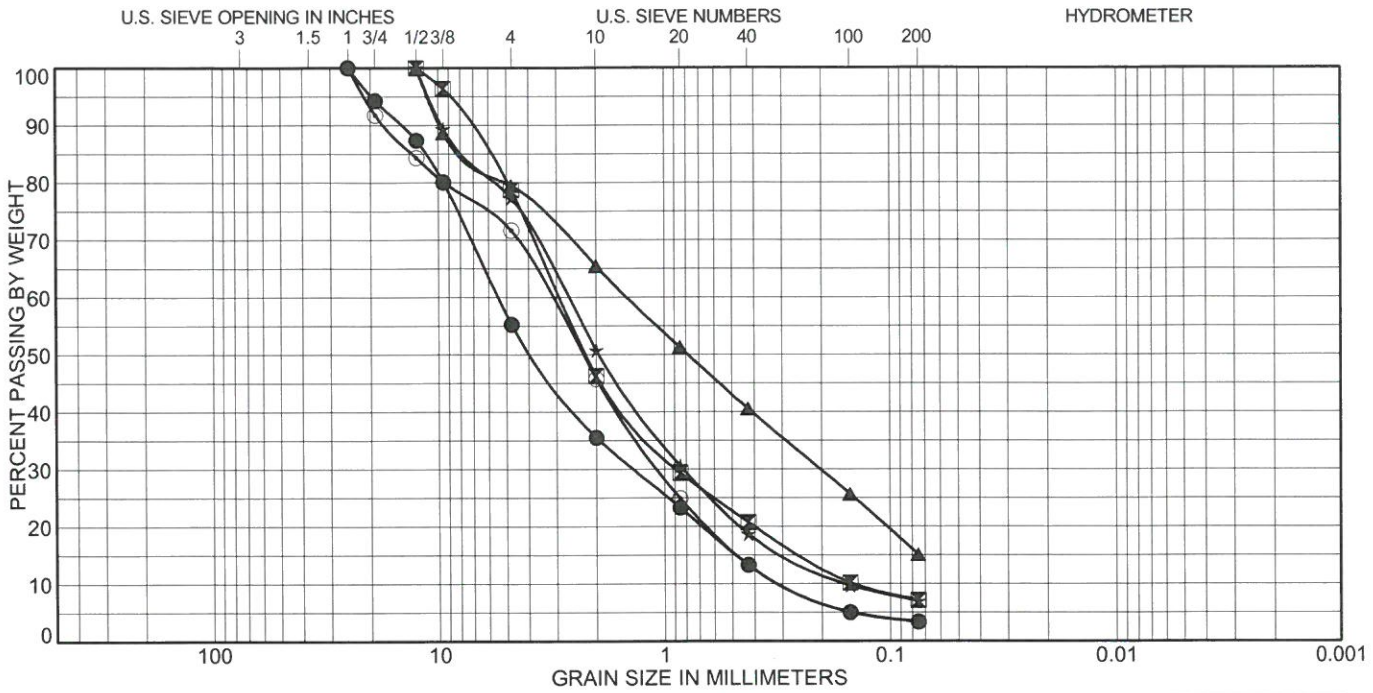
SUMMARY OF LABORATORY TEST RESULTS

JOB No. 161921
FIGURE No. 12
PAGE 2 OF 2
DATE 4/2/18



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Test Boring		Depth (ft)	Classification	LL	PL	PI
●	C01	9.0	WELL-GRADED SAND with GRAVEL(SW)	NP	NP	NP
⧓	C02	14.0	WELL-GRADED SAND with SILT and GRAVEL(SW-SM)	NP	NP	NP
▲	C03	4.0	SILTY SAND with GRAVEL(SM)	NP	NP	NP
★	C04	9.0	WELL-GRADED SAND with SILT and GRAVEL(SW-SM)	NP	NP	NP
⊙	C05	14.0	WELL-GRADED SAND with GRAVEL(SW)	NP	NP	NP

Test Boring		Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	C01	9.0	44.7	51.9	3.4	
⧓	C02	14.0	21.3	71.6	7.1	
▲	C03	4.0	20.5	64.4	15.1	
★	C04	9.0	22.7	70.3	7.0	
⊙	C05	14.0	28.3	68.4	3.3	

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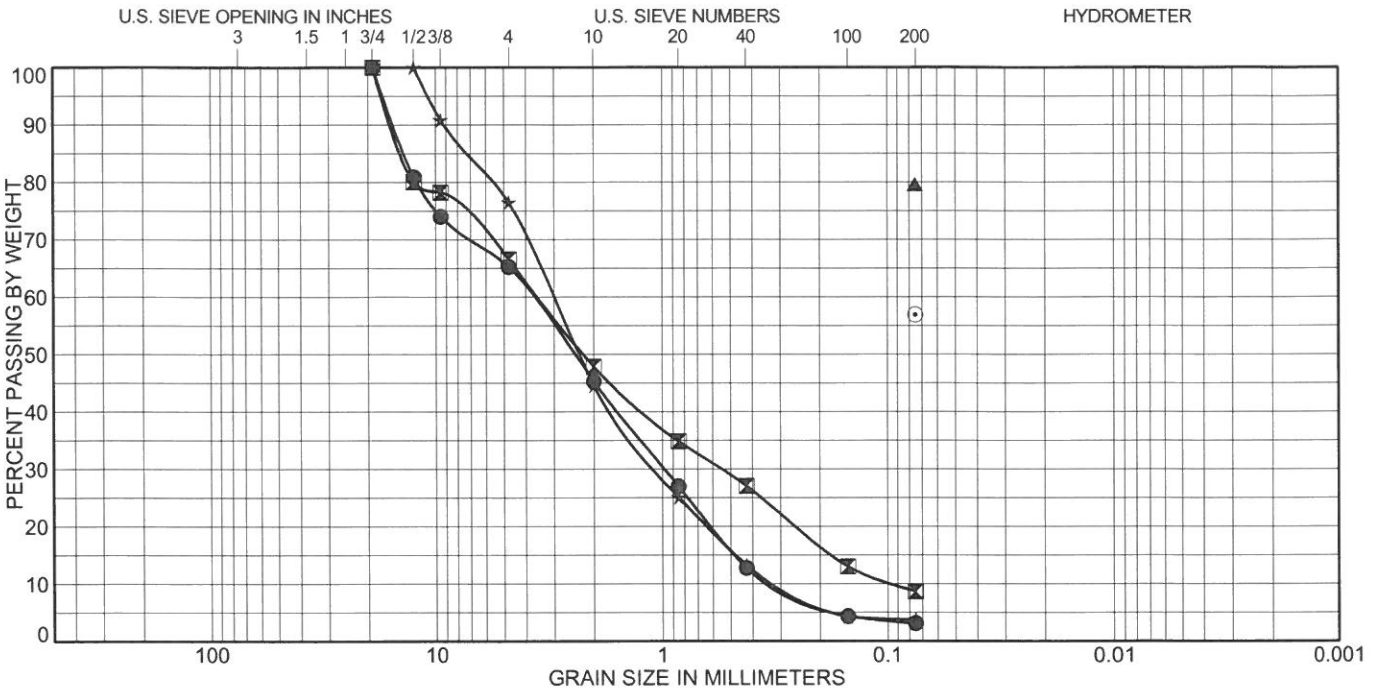
SOIL CLASSIFICATION DATA

JOB No. 161921

FIGURE No. 13

DATE 4/2/18



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Test Boring		Depth (ft)	Classification	LL	PL	PI
●	R01	9.0	POORLY GRADED SAND with GRAVEL(SP)	NP	NP	NP
⧓	R02	14.0	POORLY GRADED SAND with SILT and GRAVEL(SP-SM)	NP	NP	NP
▲	R03	4.0	SILT with SAND(ML)	NP	NP	NP
★	R04	4.0	WELL-GRADED SAND with GRAVEL(SW)	NP	NP	NP
⊙	R05	14.0	SANDY FAT CLAY(CH)	55	18	37

Test Boring		Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	R01	9.0	34.8	62.1	3.1	
⧓	R02	14.0	33.4	57.9	8.7	
▲	R03	4.0			79.6	
★	R04	4.0	23.5	72.8	3.7	
⊙	R05	14.0			56.9	

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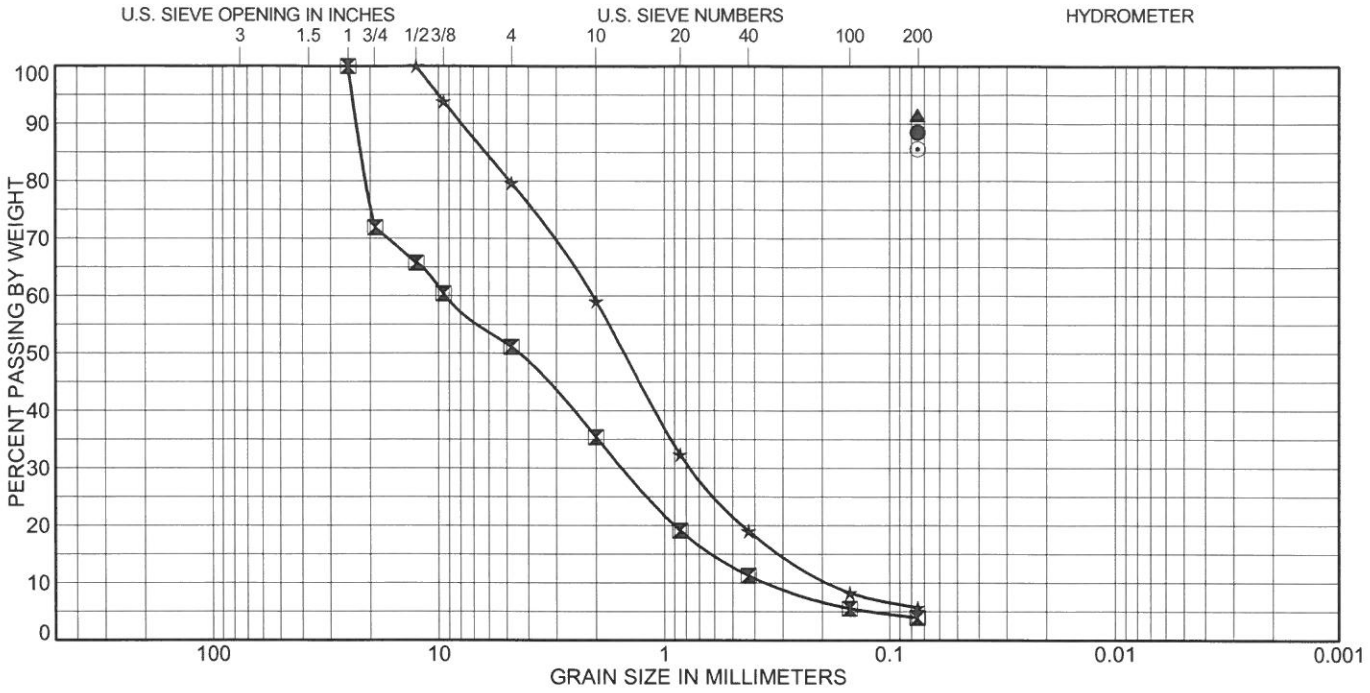
SOIL CLASSIFICATION DATA

JOB No. 161921

FIGURE No. 14

DATE 4/2/18



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Test Boring		Depth (ft)	Classification	LL	PL	PI
●	R06	14.0	FAT CLAY(CH)	53	20	33
⧓	R07	9.0	POORLY GRADED GRAVEL with SAND(GP)	NP	NP	NP
▲	R08	9.0	FAT CLAY(CH)	53	24	29
★	R09	14.0	WELL-GRADED SAND with SILT and GRAVEL(SW-SM)	NP	NP	NP
⊙	R10	9.0	LEAN CLAY(CL)	43	13	30

Test Boring		Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	R06	14.0			88.5	
⧓	R07	9.0	48.9	47.2	3.9	
▲	R08	9.0			91.6	
★	R09	14.0	20.4	73.9	5.7	
⊙	R10	9.0			85.6	

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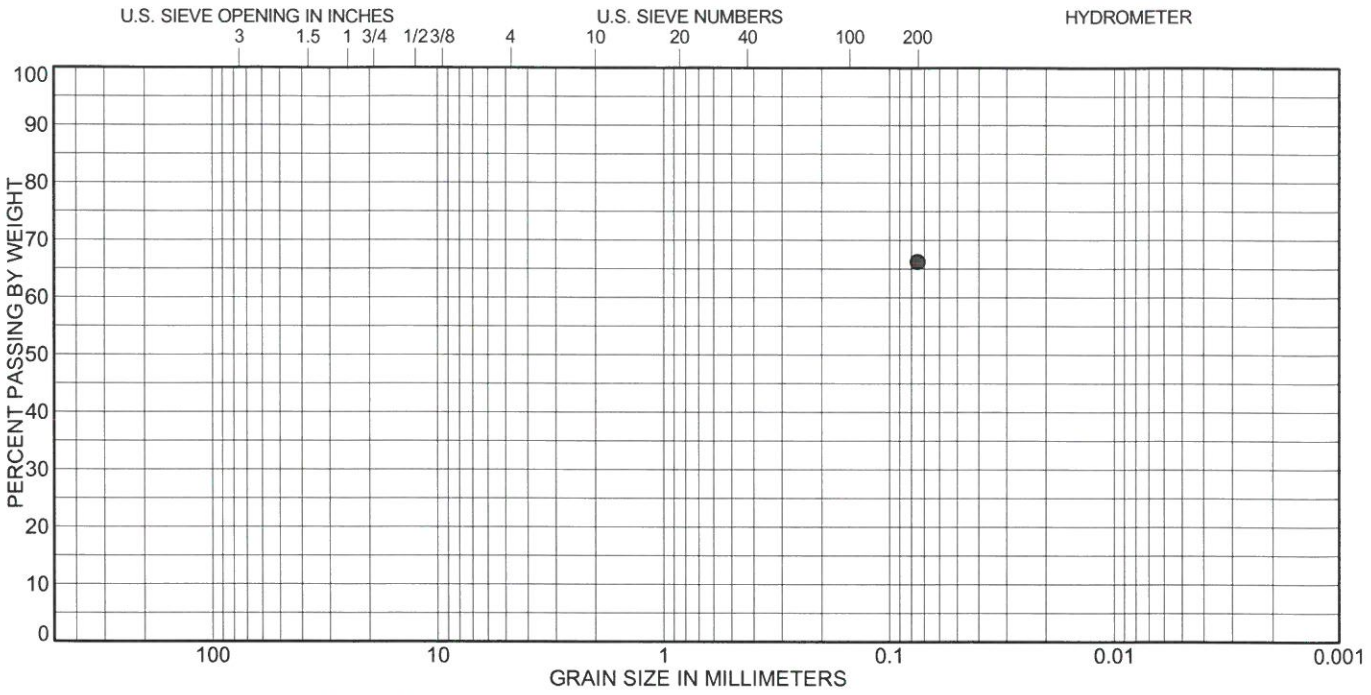
SOIL CLASSIFICATION DATA

JOB No. 161921

FIGURE No. 15

DATE 4/2/18



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Test Boring	Depth (ft)	Classification	LL	PL	PI
●	**R11**	**4.0**	**SANDY LEAN CLAY(CL)**	**37**	**14**	**23**

	Test Boring	Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	**R11**	**4.0**			**66.2**	

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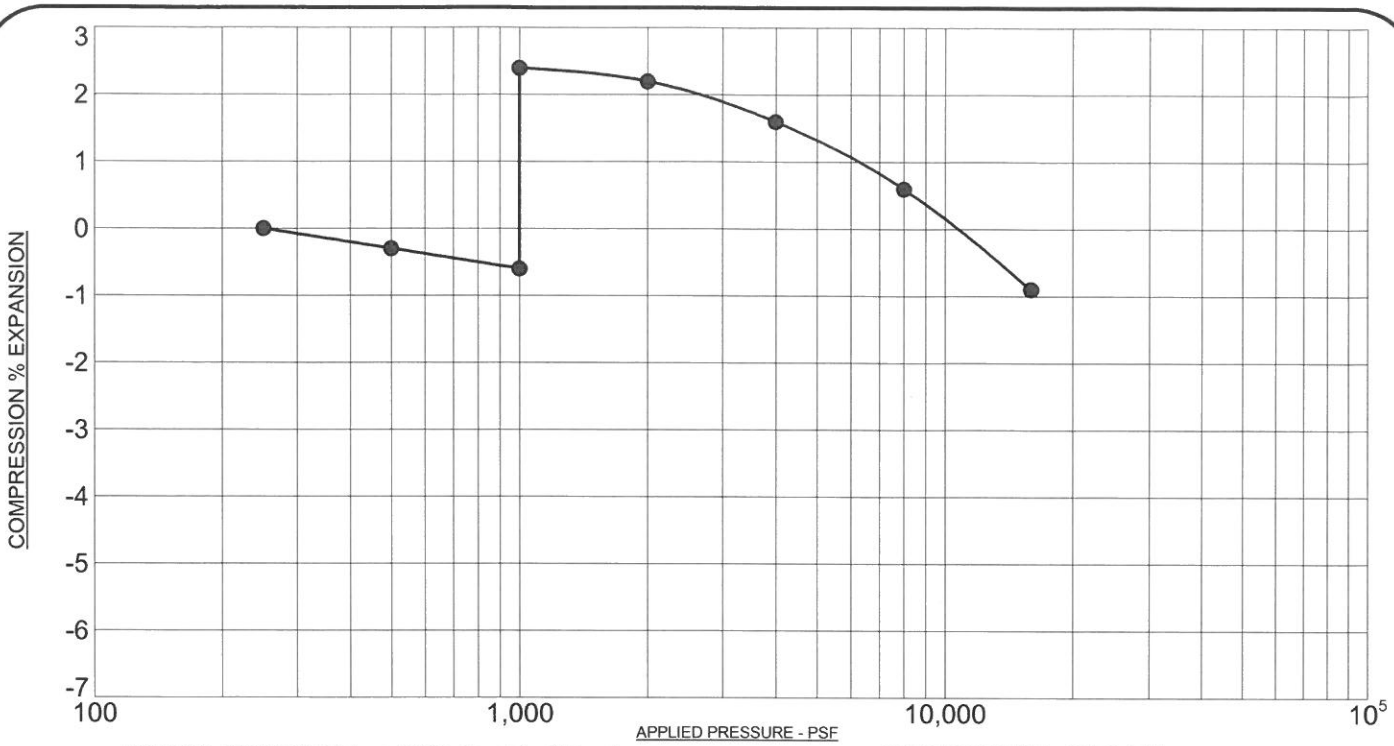
SOIL CLASSIFICATION DATA

JOB No. 161921

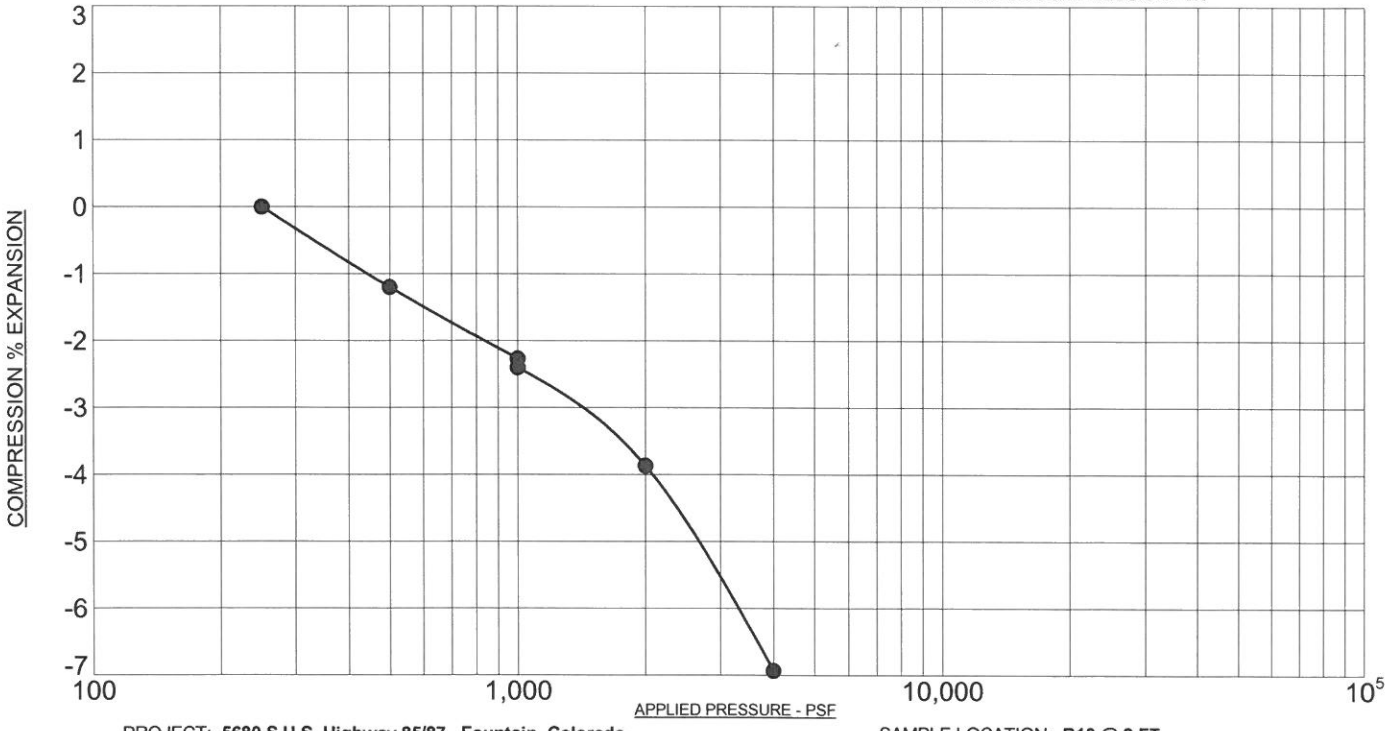
FIGURE No. 16

DATE 4/2/18



PROJECT: **5680 S U.S. Highway 85/87, Fountain, Colorado**
SAMPLE DESCRIPTION: **CLAYSTONE, SILTY**
NOTE: SAMPLE WAS INUNDATED WITH WATER AT 1,000 PSF

SAMPLE LOCATION: **R08 @ 9 FT**
NATURAL DRY UNIT WEIGHT: **105.2 PCF**
NATURAL MOISTURE CONTENT: **23.0%**
PERCENT SWELL/COMPRESSION: **3.0**



PROJECT: **5680 S U.S. Highway 85/87, Fountain, Colorado**
SAMPLE DESCRIPTION: **SAND, SILTY TO CLAYEY**
NOTE: SAMPLE WAS INUNDATED WITH WATER AT 1,000 PSF

SAMPLE LOCATION: **R10 @ 9 FT**
NATURAL DRY UNIT WEIGHT: **109.6 PCF**
NATURAL MOISTURE CONTENT: **17.7%**
PERCENT SWELL/COMPRESSION: **- 0.1**

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SWELL/CONSOLIDATION TEST RESULTS

JOB No. 161921

FIGURE No. 17

DATE 4/2/18

APPENDIX A

USGS Design Maps Summary Report

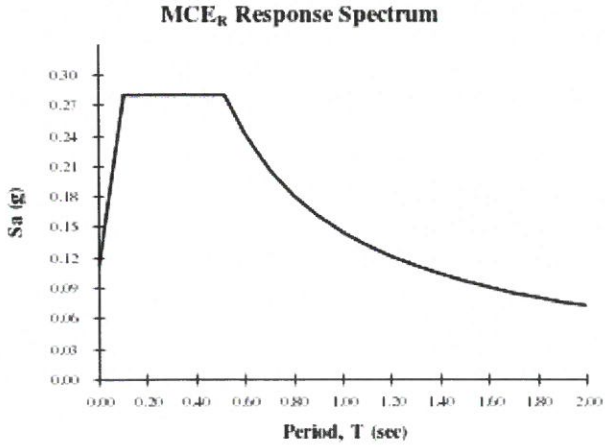
User–Specified Input

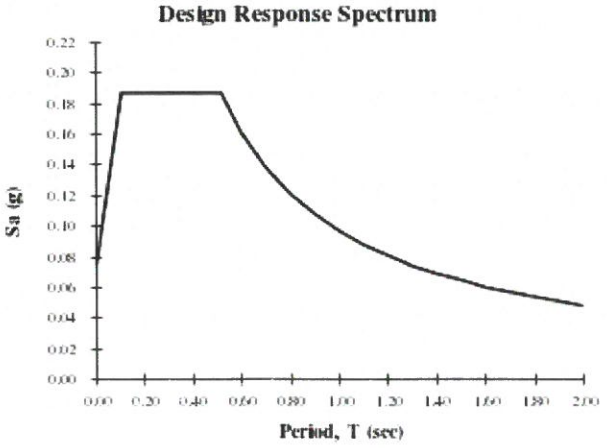
Report Title	Avatar - Riverbend Fountain Sat March 31, 2018 19:11:19 UTC
Building Code Reference Document	2012/2015 International Building Code (which utilizes USGS hazard data available in 2008)
Site Coordinates	38.74696°N, 104.74483°W
Site Soil Classification	Site Class D – "Stiff Soil"
Risk Category	I/II/III

USGS–Provided Output

S_S =	0.175 g	S_{MS} =	0.280 g	S_{DS} =	0.187 g
S_1 =	0.060 g	S_{M1} =	0.145 g	S_{D1} =	0.097 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.





APPENDIX B

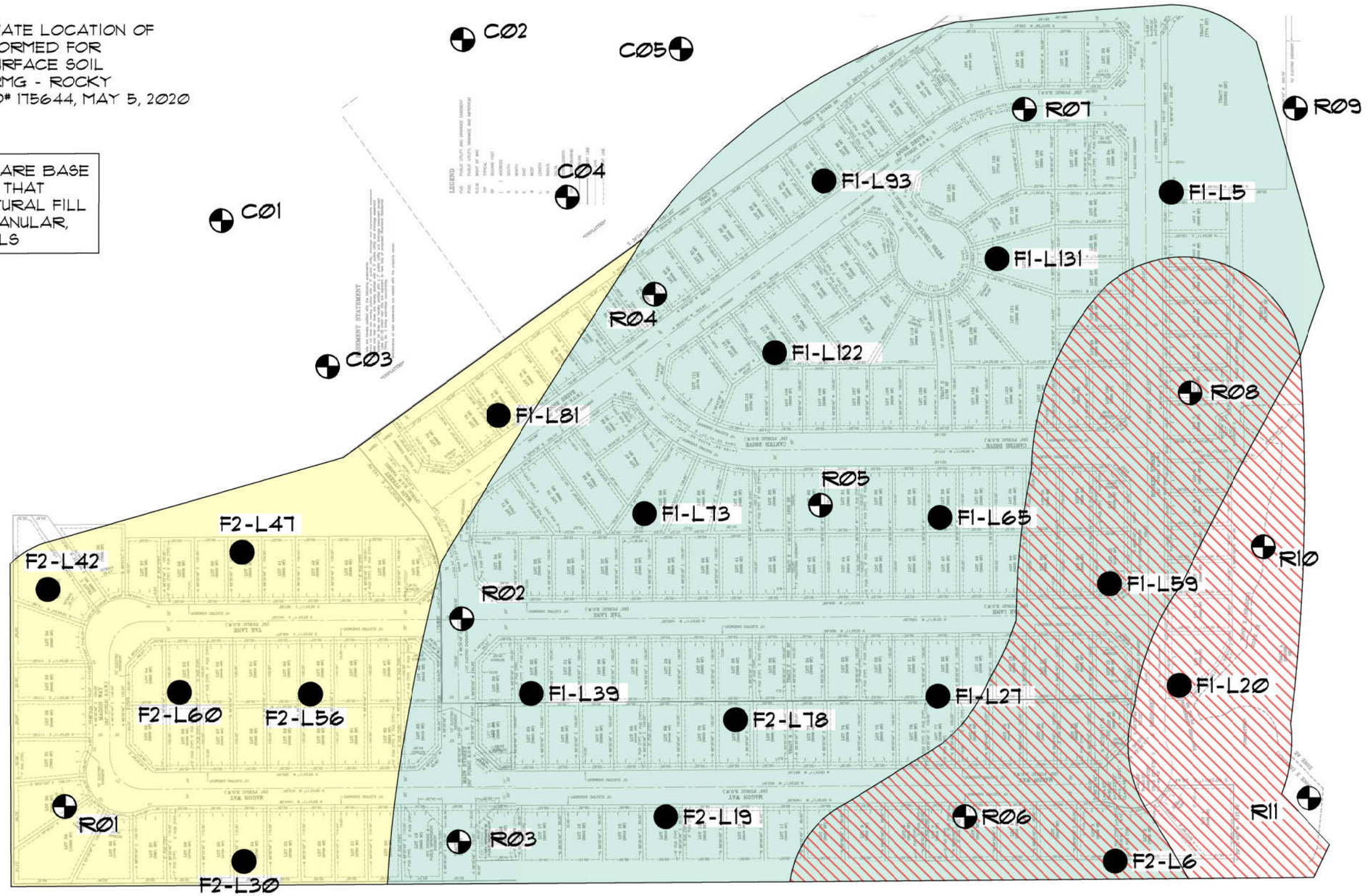
Anticipated Overexcavation Recommendations

DENOTES APPROXIMATE LOCATION OF TEST BORINGS PERFORMED FOR "GEOTECHNICAL REPORT" BY RMG - ROCKY MOUNTAIN GROUP, WO#: 161921, APRIL 2, 2018

DENOTES APPROXIMATE LOCATION OF TEST BORINGS PERFORMED FOR "PRELIMIANRY SUBSURFACE SOIL INVESTIGATION' BY RMG - ROCKY MOUNTAIN GROUP, WO# 175644, MAY 5, 2020

RECOMMENDATIONS ARE BASE ON THE ASSUMPTION THAT COMPACTED STRUCTURAL FILL WILL CONSIST OF GRANULAR, NON-EXPANSIVE SOILS

NOT TO SCALE



APPROXIMATE PORTION OF THE SITE WHERE OVEREXCAVATION IS NOT ANTICIPATED. HOWEVER, IF UNSUITABLE SOILS ARE ENCOUNTERED AT THE TIME OF THE EXCAVATION OBSERVATION, OVEREXCAVATION OR RECOMPACTION MAY BE REQUIRED

APPROXIMATE PORTION OF THE SITE WHERE 2-FOOT REMOVAL AND RE-COMPACTION OF NATIVE SAND SOILS MAY BE RECOMMENDED, AS DETERMINED AT THE TIME OF THE EXCAVATION OBSERVATIONS. NOTE, ON LOTS WHERE OVERLOT GRADING FILL EXTENDS TO AT LEAST 2 FEET BELOW BOTTOM OF PROPOSED FOUNDATION, REMOVAL / RECOMPACTION IS NOT ANTCIPATED

APPROXIMATE PORTIONS OF THE SITE WHERE IT IS ANTICIPATED THAT OVEREXCAVATION WILL BE REQUIRED FOR EXPANSIVE SOILS WITHIN 3 TO 4 FEET OF FOUNDATION COMPONENTS

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

RIVERBEND CROSSING
FILING NO. 1 & 2
FOUNTAIN, COLORADO
AVATAR FOUNTAIN, LP

ENGINEER:	GGW
DRAWN BY:	KMZ
CHECKED BY:	GGW
ISSUED:	12-29-2020
REVISION:	9-9-2021
REVISION:	

ANTICIPATED OVEREXCAVATION RECOMMENDATIONS

SHEET No.
APPENDIX B

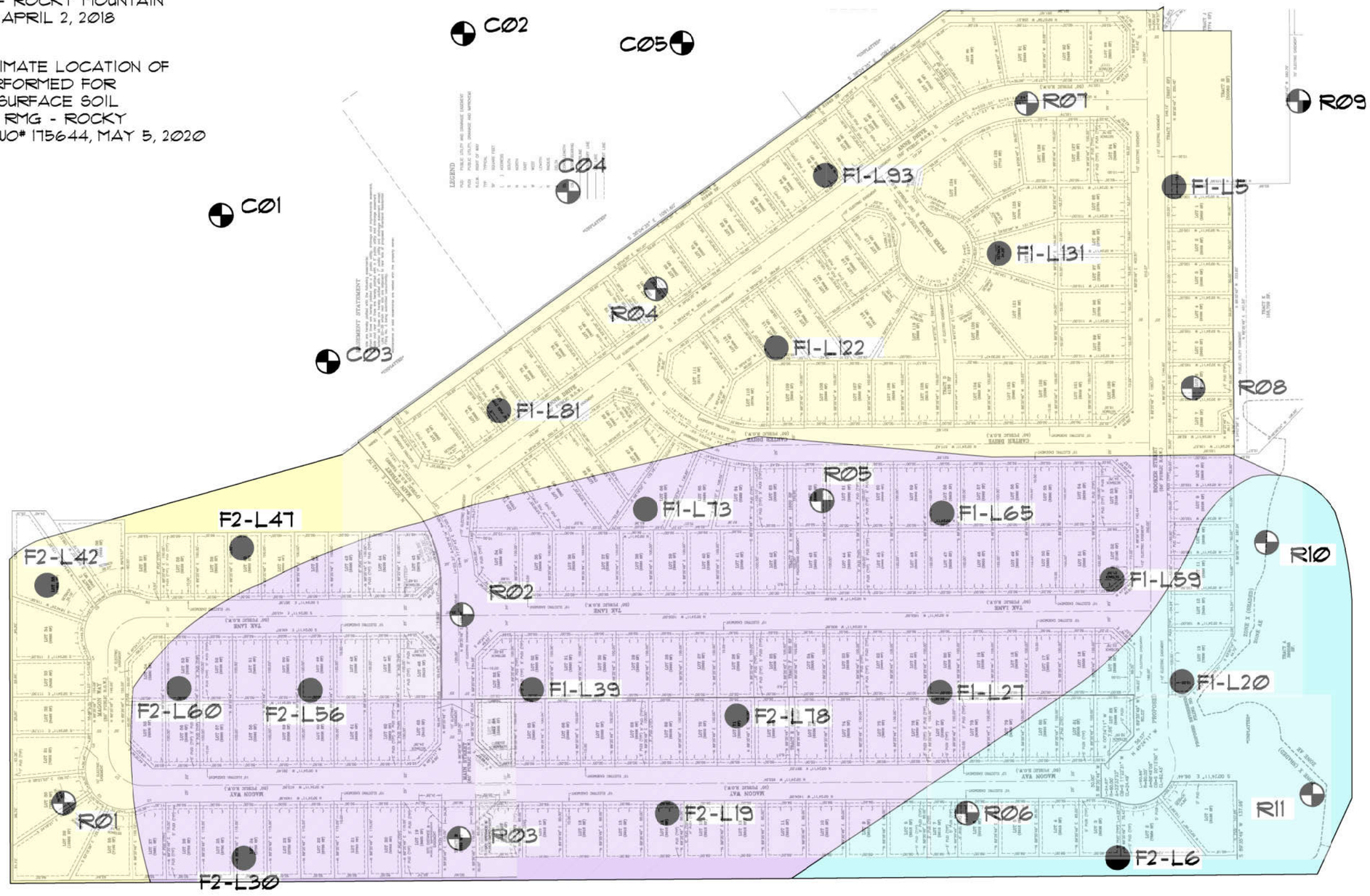
APPENDIX C

Anticipated Areas of Potential Groundwater

DENOTES APPROXIMATE LOCATION OF TEST BORINGS PERFORMED FOR "GEOTECHNICAL REPORT" BY RMG - ROCKY MOUNTAIN GROUP, WO#: 161921, APRIL 2, 2018

DENOTES APPROXIMATE LOCATION OF TEST BORINGS PERFORMED FOR "PRELIMIANRY SUBSURFACE SOIL INVESTIGATION' BY RMG - ROCKY MOUNTAIN GROUP, WO# 175644, MAY 5, 2020

NOT TO SCALE



PORTIONS OF THE SITE WHERE GROUNDWATER CONDITIONS ARE NOT ANTICIPATED TO IMPACT CONSTRUCTION

APPROXIMATE PORTIONS OF THE SITE WHERE GROUNDWATER CONDITIONS MAY BE ENCOUNTERED AT OR NEAR BASEMENT DEPTHS. MITIGATION AND/OR STABILIZATION MAY BE RECOMMENDED, AS DETERMINED AT THE TIME OF THE EXCAVATION OBSERVATION - GROUNDWATER CONDITIONS ARE NOT ANTICIPATED TO IMPACT CRAWLSPACE OR STIFFENED SLAB CONSTRUCTION

APPROXIMATE PORTIONS OF THE SITE WHERE BASEMENT CONSTRUCTION SHOULD BE AVOIDED - GROUNDWATER CONDITIONS MAY BE ENCOUNTERED AT OR NEAR CRAWLSPACE DEPTHS. MITIGATION AND/OR STABILIZATION MAY BE RECOMMENDED, AS DETERMINED AT THE TIME OF THE EXCAVATION OBSERVATION

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RIVERBEND CROSSING
FILING NO. 1 & 2
FOUNTAIN, COLORADO
AVATAR FOUNTAIN, LP

ENGINEER:	GGW
DRAWN BY:	KMZ
CHECKED BY:	GGW
ISSUED:	12-29-2020
REVISION:	9-9-2021
REVISION:	

ANTICIPATED AREAS OF POTENTIAL GROUNDWATER

SHEET No.
APPENDIX C

APPENDIX D

RMG Preliminary Subsurface Soil Investigation, Job No. 175644, dated May 5, 2020

Architecture
Structural
Geotechnical

ROCKY MOUNTAIN GROUP
EMPLOYEE OWNED

Materials Testing
Forensic
Civil/Planning

PRELIMINARY SUBSURFACE SOIL INVESTIGATION

Riverbend Crossing
Lots 1-136, Filing No. 1 and Lots 1-89, Filing No. 2
El Paso County, Colorado

PREPARED FOR:

D.R. Horton
9555 S. Kingston Ct.
Suite 200
Englewood, CO 80112

JOB NO. 175644

May 5, 2020

Respectfully Submitted,
RMG – Rocky Mountain Group

Kelli Zigler

Kelli Zigler
Project Geologist

Reviewed by,
RMG – Rocky Mountain Group

COLORADO REGISTERED
ANTHONY P. MUNGER
5/7/20
39818
PROFESSIONAL ENGINEER

Tony Munger, P.E.
Geotechnical Project Manager

TABLE OF CONTENTS

GENERAL SITE AND PROJECT DESCRIPTION

Project Description

The site is located in the western portion of Fountain, Colorado, west of the intersection of Main Street and Highway 85. More specifically, the site is located along Tak Lane, Main Street, Magon Way, Anne Way, Carter Drive, Peter Circle, and Booker Boulevard. The approximate location of the site is shown on the Site Vicinity Map, Figure 1.

The project is to consist of single-family residential construction on 225 lots at the Riverbend Crossing subdivision, Filing No. 1 and 2. The structures are anticipated to be one to two-stories in height with multi-car garages. The homes may either be constructed with or without basements. RMG – Rocky Mountain Group was retained to explore the subsurface conditions at the site and develop preliminary geotechnical engineering recommendations for design and construction.

Existing Site Conditions

The site is presently relatively undeveloped. Vegetation across the site consists of low to moderate growth of native weeds and grasses, and occasional deciduous trees. The topography across the site consists of a mild slope downwards to the south and west.

Previous Studies and Field Investigation

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

1. *Geotechnical Report, Avatar River Bend Crossing, Commercial and Residential Development, Fountain, Colorado,* prepared for Avatar Fountain, LP by RMG, Job No. 161921, last dated April 2, 2018.
2. *Geology and Soils Report, River Bend Crossing / Avatar, Fountain, Colorado,* prepared for Avatar Fountain, LP by RMG, Job No. 161921, last dated April 20, 2018.

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

FIELD INVESTIGATION AND LABORATORY TESTING

Drilling

The subsurface conditions on the site were investigated by drilling nineteen exploratory test borings to supplement the information obtained in the previous investigations referenced above. The approximate locations of the test borings are presented in the Lot Layout Plan, Figure 2.

The test borings were advanced with a power-driven, continuous-flight auger drill rig to depths of about 20 feet below the existing ground surface. Samples were obtained in general accordance with ASTM D-1586 utilizing a 2-inch OD split-barrel sampler or in general accordance with ASTM D-3550 utilizing a 2½-inch OD modified California sampler. Representative bulk samples of subsurface materials were

obtained from selected borings. An Explanation of Test Boring Logs is presented in Figure 3. The Test Boring Logs are presented in Figures 4 through 13.

Laboratory Testing

The moisture content for the recovered samples was obtained in the laboratory. Grain-size analysis, 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 14. Soil Classification Data are presented in Figures 15 through 18. Swell/Consolidation Test Results are presented in Figure 19.

SUBSURFACE CONDITIONS

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 native silty to clayey sand, sandy clay, sandy claystone, and shale.

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.

Groundwater

Groundwater was observed in the test borings on twelve of the lots at depths ranging from 9 to 19 feet below the existing ground surface at the time of field exploration. When checked three to 14 days subsequent to drilling, groundwater was measured at depths of about 6 to 13 feet below the existing ground surface. Fluctuations in groundwater and subsurface moisture conditions may occur due to variations in rainfall and other factors not readily apparent at this time. Development of the property and adjacent properties may also affect groundwater levels.

CONCLUSIONS AND RECOMMENDATIONS

The following discussion is based on the subsurface conditions encountered in the test borings and on the project characteristics previously described. If conditions are different from those described in this report or the project characteristics change, RMG should be retained to review our recommendations and adjust them, if necessary.

Geotechnical Considerations

Fill soils were not encountered during our investigation. However, some limited fill soils may be present in areas of the site. As of the issue date of this report, no documentation has been provided to RMG indicating that the fill was placed in a controlled manner, or that it was observed or tested during placement. Until such documentation is provided, the fill soils encountered on the site are considered non-engineered and are not suitable for support of foundation components. These unsuitable fill soils

may be encountered in the excavations, even on lots where none are indicated on the test boring logs. Furthermore, any fill placed atop those unsuitable fill soils will also be considered unsuitable for support of foundation components, unless the new fill soils comprise one component of a foundation bearing enhancement system. This report does not include recommendations for design or construction of such a bearing enhancement system. If such recommendations are desired, contact personnel of RMG for more information.

Additionally, loose to very loose soils were encountered in 8 of the test borings and expansive soils/bedrock were encountered in 6 of the test borings. As with fill soils, loose/very loose soils and/or expansive soils/bedrock may be encountered in the excavations, even on lots where none are indicated on the test boring logs. If encountered in the excavation, these materials will require additional compaction and/or removal (overexcavation) and replacement as indicated under the **Overexcavation and Replacement** section of this report.

Foundation design recommendations, based on the field investigation and laboratory testing, are presented below. It must be understood that these recommendations should be verified after the excavation on each individual lot is completed.

Overexcavation and Replacement

Fill soils may be considered unsuitable for a variety of reasons. These include (but are not limited to) non-engineered fills, fill soils containing trash or debris, fill soils that appear to have been improperly selected, placed and/or compacted, etc. 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).

If loose/very loose soils are encountered during the Open Excavation Observation, they may require additional compaction to achieve the allowable bearing pressure indicated in this report. Fluctuations in material density may occur. In some cases, removal and recompaction of up to 2 to 3 feet of soil (or more) may be required. 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 sandy clay, claystone, and shale have low to moderate swell potential and are not suitable for direct bearing of all shallow foundations. If expansive soils or bedrock are encountered during construction, they may require removal (overexcavation) and replacement with compacted structural fill. The need for overexcavation and replacement on each lot is dependent on the proposed foundation type and the specific soil conditions encountered on that lot. While the final overexcavation depths are to be determined by lot-specific subsurface soil investigations performed at the time of construction, typical overexcavation depths for the materials encountered generally range from 3 to 4 feet. In some cases, deeper overexcavation may be required.

All structural fill should be observed and tested during placement as indicated under the **Structural Fill** section of this report, to ensure proper compaction.

The bedrock at this site is hard to very hard and may require the use of specialized heavy-duty equipment to facilitate rock break-up and removal.

Foundation Recommendations

Reinforced or Stiffened Slab-on-Grade Foundations

A reinforced (unstiffened) slab-on-grade foundation is suitable for the proposed residential structures on some of the included lots. A stiffened slab-on-grade foundation is suitable for the proposed residential structures. Generally, stiffened slab foundations can be adjusted to the degree of stiffness required to mitigate a desired range of plasticity indices (PI). While this decision is to be made at the time of construction based on the specific builder's preferences, typical design parameters can vary from a PI of 20 up to a PI of 40. We have anticipated the deepest excavation cuts for stiffened slab construction will be approximately 2 to 3 feet below the existing ground surface.

Spread Footing Foundations

A spread footing foundation is suitable for the proposed residential structures. We have anticipated that the deepest excavation cuts for basement level construction will be approximately 6 to 8 feet below the existing ground surface.

All Foundations

For shallow foundations supported atop sand soils and/or on compacted structural fill, a maximum allowable bearing pressure in the range of 2,000 psf to 2,400 psf is common for the soil conditions encountered. The foundation design should be prepared by a qualified Colorado Registered Professional Engineer using the recommendations presented in this report. This foundation system should be designed to span a minimum of 10 feet under the design loads. The bottoms of exterior foundations should be at least 30 inches below finished grade for frost protection, unless an alternate method of frost protection is provided.

Open Excavation Observations

During construction, foundation excavations should be observed by RMG prior to placing structural fill, forms, or concrete to verify the foundation bearing conditions for each structure. Based on the conditions observed in the foundation excavation, the recommendations made at the time of construction may vary from those contained herein. In the case of differences, the Open Excavation Observation report shall be considered to be the governing document. The recommendations presented herein are intended only as preliminary guidelines to be used for interpreting the subsurface soil conditions exposed in the excavation and determining the final recommendations for foundation construction.

Floor Slabs

For interior floor slabs not comprising an integral part of a stiffened slab foundation (such as garage or basement slabs), vertical slab movements on the order of one to three inches have been estimated for the subsurface conditions encountered. If movement and associated damage to floors and finishes cannot be tolerated, a structural floor system should be used. Floor slabs should be separated from structural components to allow for vertical movement.

Exterior Slabs

Recommendations for exterior concrete slabs such as patios, driveways, and sidewalks are not included in this report.

Interior Partitions

Interior non-bearing partitions and other attached finishes do not require isolation from floor slabs that comprise a stiffened slab-on-grade foundation system.

Where basement construction with an isolated concrete slab floor is utilized, interior non-bearing partitions and attached furnishings (e.g., cabinets, shower stalls, etc.) on concrete slabs should be constructed with a void so that they do not transmit floor slab movement to the roof or overlying floor. A void of at least 1-1/2 inches is recommended beneath non-bearing partitions. The void may require reconstruction over the life of the structure to re-establish the void due to vertical slab movement.

Lateral Earth Pressures

Foundation and basement walls should be designed to resist lateral pressures. For non-expansive backfill materials, we recommend an equivalent fluid pressure of 40 pcf for design. Expansive soils or bedrock should not be used as backfill against walls.

The above lateral pressure applies to level, drained backfill conditions. Equivalent Fluid Pressures for sloping/undrained conditions should be determined on an individual basis.

Surface Grading and Drainage

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

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

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.

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.

Perimeter Drain

A subsurface perimeter drain is generally recommended 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. A typical drain detail is presented in Figure 20.

A subsurface perimeter drain is designed to intercept some types of subsurface moisture and not others. Therefore, the drain could operate properly and not mitigate all moisture problems relating to foundation performance or moisture intrusion into the basement area.

Where main level slab-on-grade foundation systems (stiffened, monolithic, or isolated) are utilized, a subsurface perimeter drain is typically not required around the foundation.

Overexcavation Drain

If an overexcavation is performed and granular, non-expansive backfill is used for the replacement soils, a subsurface drain may be recommended around the perimeter of the excavation. This drain is to be placed at the bottom of the overexcavated portion of the excavation prior to backfilling. A typical drain detail is presented in Figure 21.

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

Underslab Drain

Shallow groundwater conditions were encountered in the test borings at the time of field exploration. Depending on the conditions observed at the time of the Open Excavation Observation, an underslab drainage layer may also be recommended 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. Careful attention should be paid to grade and discharge of the drain pipe. A typical drain detail is presented in Figure 22.

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

Foundation Stabilization

If groundwater conditions encountered at the time of foundation excavation result in either water flow into the excavation 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.

Concrete

Type I/II cement is recommended for concrete in contact with the subsurface materials. Calcium chloride should be used with caution for soils with high sulfate contents. The concrete should not be placed on frozen ground. If placed during periods of cold temperatures, the concrete should be kept from freezing. This may require covering the concrete with insulated blankets and heating. Concrete work should be completed in accordance with the latest applicable guidelines and standards published by ACI.

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 concrete flatwork, the materials should be compacted to 92 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.

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 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 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). The materials should be compacted by mechanical means.

Materials used for structural fill should be approved by the RMG prior to use. 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.

CLOSING

This report has been prepared for the exclusive purpose of providing geotechnical engineering information and recommendations for development described in this report. RMG should be retained to review the final construction documents prior to construction to verify our findings, conclusions and recommendations have been appropriately implemented.

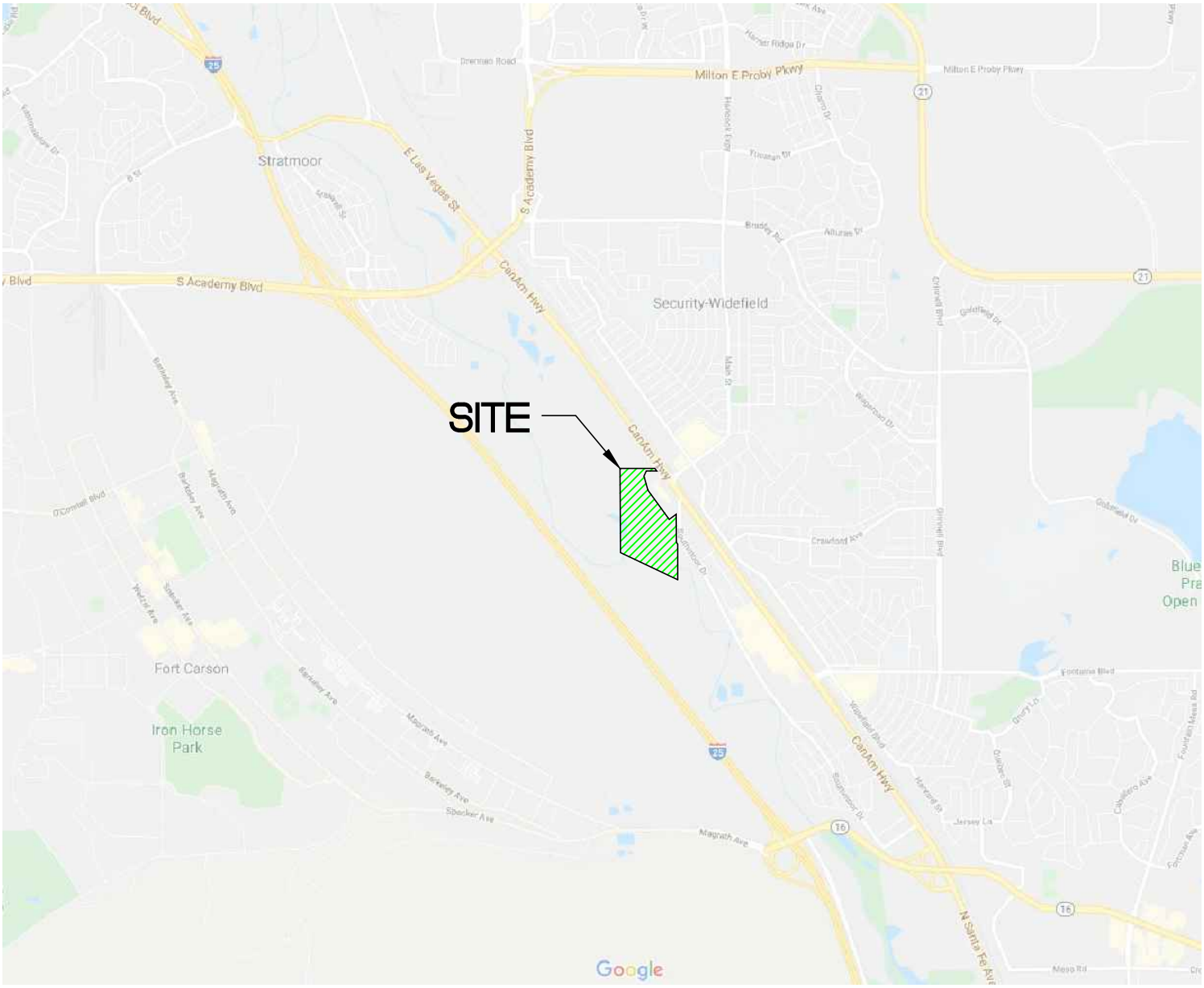
This report has been prepared for the exclusive use by **D.R. Horton** for application as an aid in the design and construction of the proposed development in accordance with generally accepted geotechnical engineering practices. The analyses and recommendations in this report are based in part upon data obtained from test borings, site observations and the information presented in referenced reports. The nature and extent of variations may not become evident until construction. If variations then become evident, RMG should be retained to review the recommendations presented in this report considering the varied condition, and either verify or modify them in writing.

Our professional services were performed using that degree of care and skill ordinarily exercised, under similar circumstances, by geotechnical engineers 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.

The scope of services for this project does not include, either specifically or by implication, 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 Client desires investigation into the potential for such contamination or conditions, other studies should be undertaken.

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

FIGURES



NOT TO SCALE

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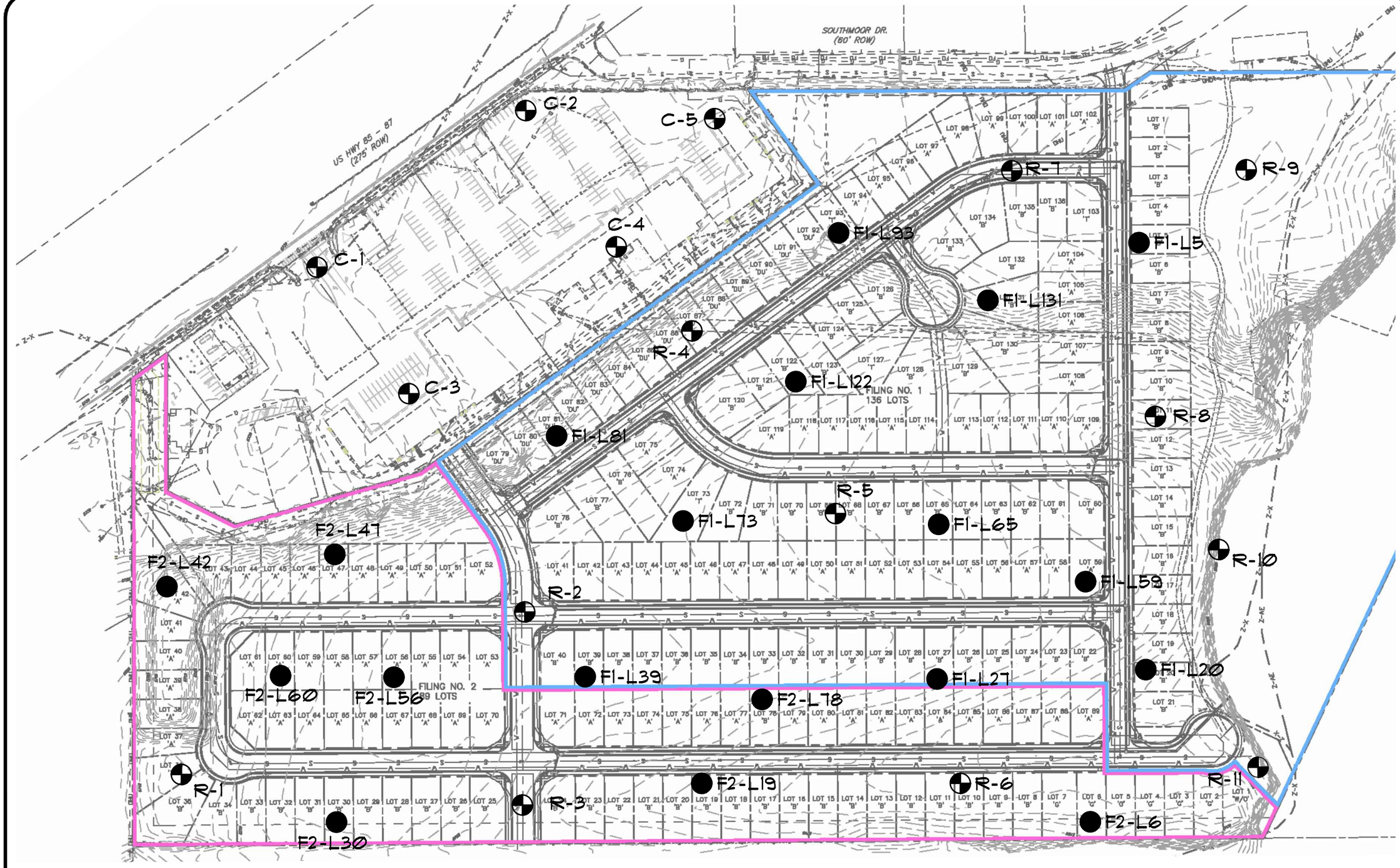
SITE VICINITY MAP

LOTS 1-136, RIVERBEND CROSSING
FILING NO. 1 &
LOTS 1-89, RIVERBEND CROSSING
FILING NO. 2
FOUNTAIN, COLORADO
D.R. HORTON

JOB No. 175644

FIG No. 1

DATE 5-5-2020



NOT TO SCALE

DENOTES APPROXIMATE LOCATION OF TEST BORINGS PERFORMED FOR "GEOTECHNICAL REPORT" BY RMG - ROCKY MOUNTAIN GROUP, WO#: 161921, APRIL 2, 2018

DENOTES APPROXIMATE LOCATION OF TEST BORINGS PERFORMED FOR THIS REPORT

JOB No. 175644

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

LOTS 1-136, RIVERBEND CROSSING FILING NO. 1 &
LOTS 1-89, RIVERBEND CROSSING FILING NO. 2
FOUNTAIN, COLORADO
D.R. HORTON

ENGINEER:	TM
DRAWN BY:	BG
CHECKED BY:	TM
ISSUED:	5-5-2020

LOT LAYOUT PLAN

SHEET No.
FIG-2

SOILS DESCRIPTION


CLAYEY SAND


CLAYSTONE


SANDY CLAY


SHALE


SILTY SAND

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

SYMBOLS AND NOTES


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


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


FREE WATER TABLE


DEPTH AT WHICH BORING CAVED


BULK — DISTURBED BULK SAMPLE


AUG — AUGER "CUTTINGS"

4.5 — WATER CONTENT (%)

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EXPLANATION OF TEST BORING LOGS

JOB No. 175644

FIGURE No. 3

DATE May/05/2020

TEST BORING: **F1_Lot 5**
ELEVATION (FT):
DATE DRILLED:
3/30/20
GROUNDWATER @ 19.0 '
4/13/20

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
SAND, CLAYEY, with gravel, dark brown, moist				
SAND, SILTY, with gravel, tan, loose to medium dense, moist to wet	5		18	1.2
	10		19	4.4
	15		22	2.6
	▽			
	20		9	23.1

TEST BORING: **F1_Lot 20**
ELEVATION (FT):
DATE DRILLED:
3/30/20
GROUNDWATER @ 6.0 '
4/13/20

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
CLAY, SANDY, with gravel, dark brown, stiff, moist				
	5		15	11.3
	▽			
CLAYSTONE, SANDY, dark gray, medium hard to very hard, moist to wet	10		50/10"	20.9
	15		50/4"	14.4
	20		50/5"	13.5

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TEST BORING LOG

JOB No. 175644

FIGURE No. 4

DATE May/05/2020

TEST BORING: **F1_Lot 27**
ELEVATION (FT):
DATE DRILLED:
3/30/20
GROUNDWATER @ 12.0 '
4/13/20

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
	SAND, CLAYEY, brown, medium dense, moist			
5			23	7.6
	SAND, SILTY, with gravel, reddish brown to tan, medium dense, moist to wet			
10			14	1.8
	CLAYSTONE, SANDY, gray, medium hard to very hard, moist to wet			
15			50/11"	17.5
20			50/5"	17.9

TEST BORING: **F1_Lot 39**
ELEVATION (FT):
DATE DRILLED:
3/30/20
GROUNDWATER @ 18.0 '
3/30/20

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
	SAND, SILTY, with gravel, brown, loose, moist to wet			
5			8	1.1
10	DUE TO LOOSE SOILS AND "CAVING" WITHIN THE HOLE, BULK SAMPLES WERE TAKEN			2.6
15				1.0
20				15.5

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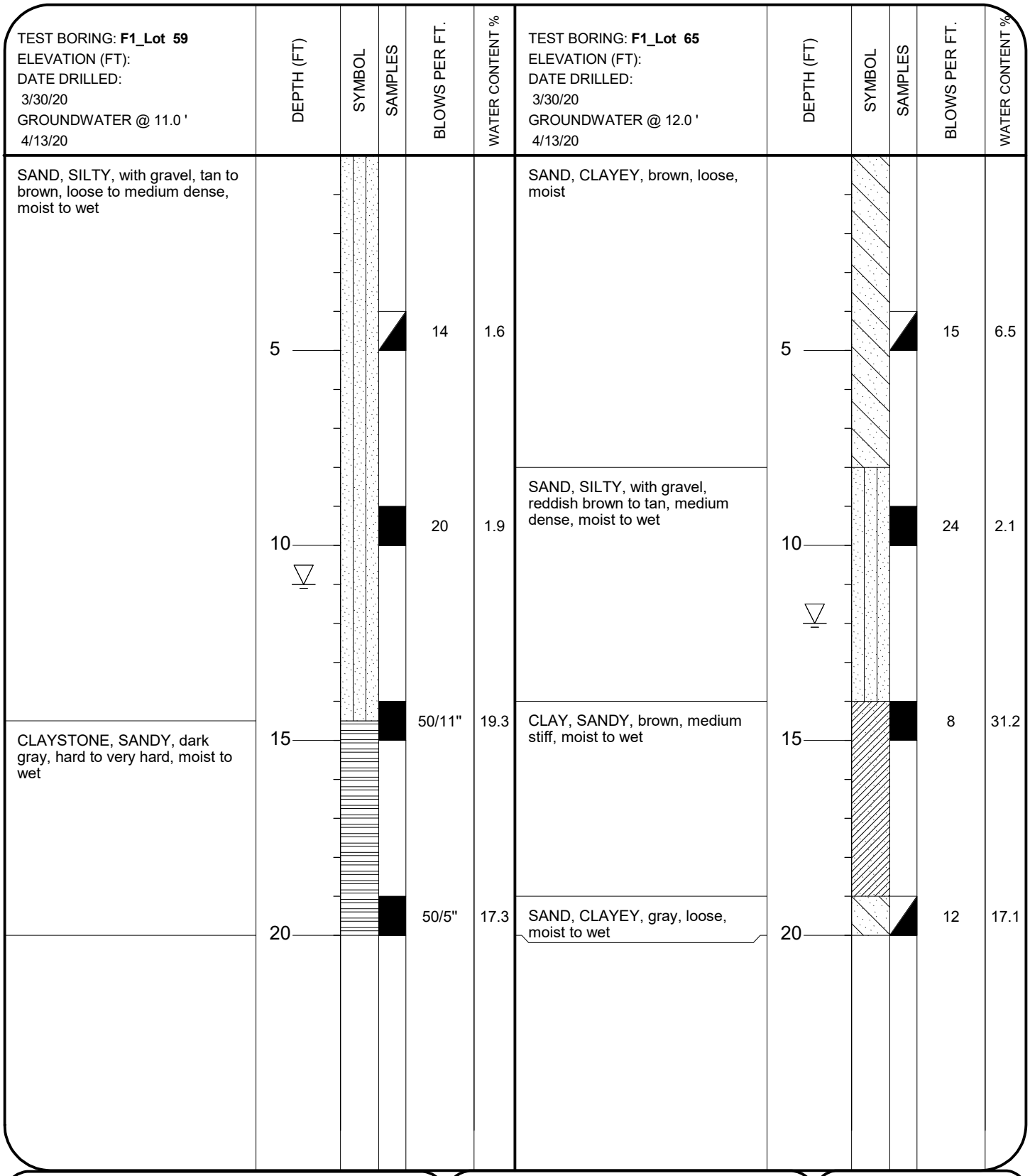
TEST BORING LOG

JOB No. 175644

FIGURE No. 5

DATE May/05/2020



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TEST BORING LOG

JOB No. 175644

FIGURE No. 6

DATE May/05/2020

TEST BORING: **F1_Lot 73**
ELEVATION (FT):
DATE DRILLED:
3/30/20
GROUNDWATER @ 15.0 '
3/30/20

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
	SAND, CLAYEY, brown, medium dense, moist			
5			13	8.8
	SAND, SILTY, with gravel, tan, loose to medium dense, moist to wet			
10			14	1.7
15 ▽			21	9.5
20			9	15.9

TEST BORING: **F1_Lot 81**
ELEVATION (FT):
DATE DRILLED:
3/30/20
NO GROUNDWATER ON
4/13/20

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
	SAND, SILTY, with gravel, tan, medium dense, moist			
5			20	2.0
10			43	2.0
15			29	5.2
20	DUE TO "CAVING," A BULK SAMPLE WAS TAKEN			3.8

ROCKY MOUNTAIN GROUP

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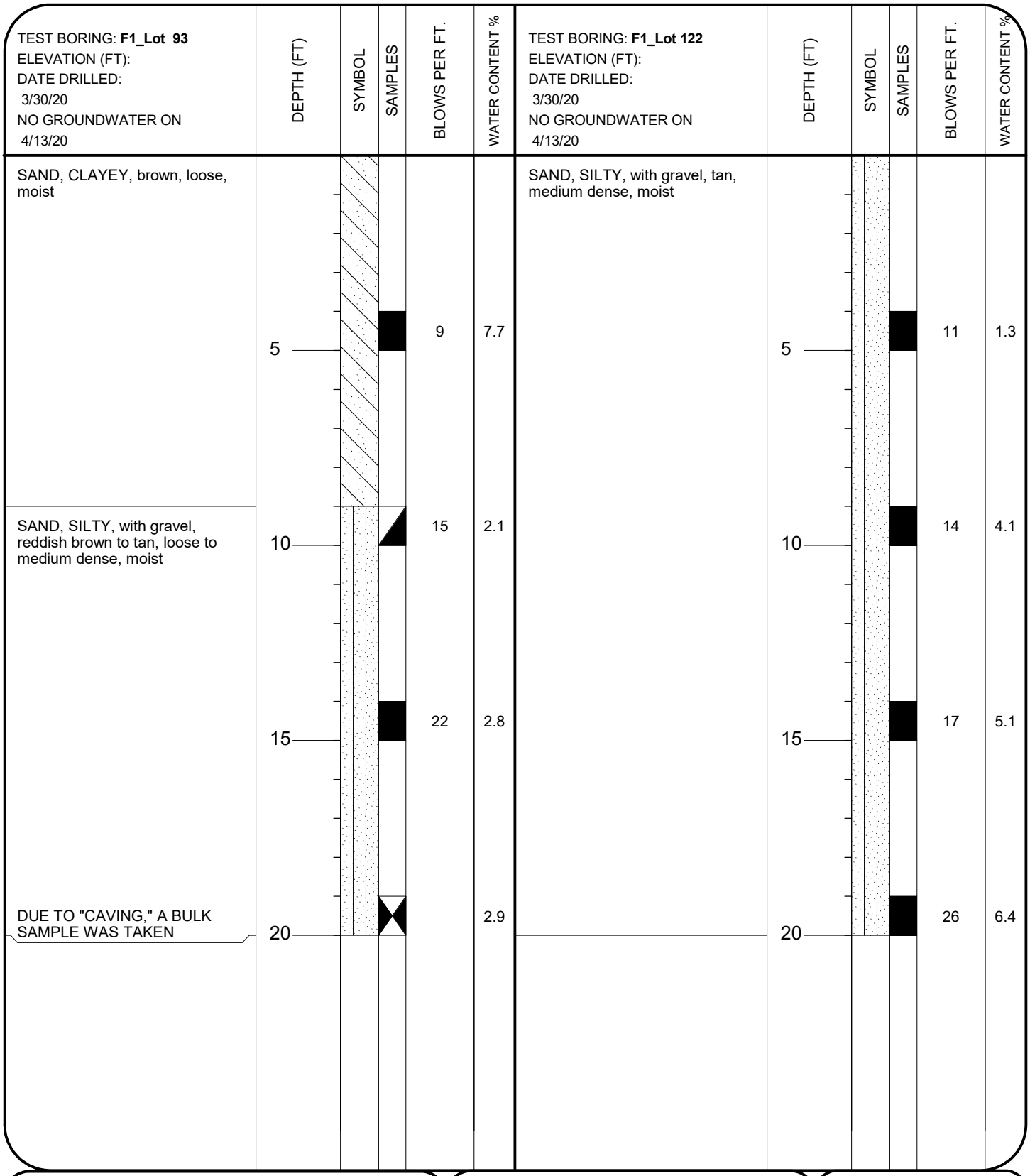
TEST BORING LOG

JOB No. 175644

FIGURE No. 7

DATE May/05/2020



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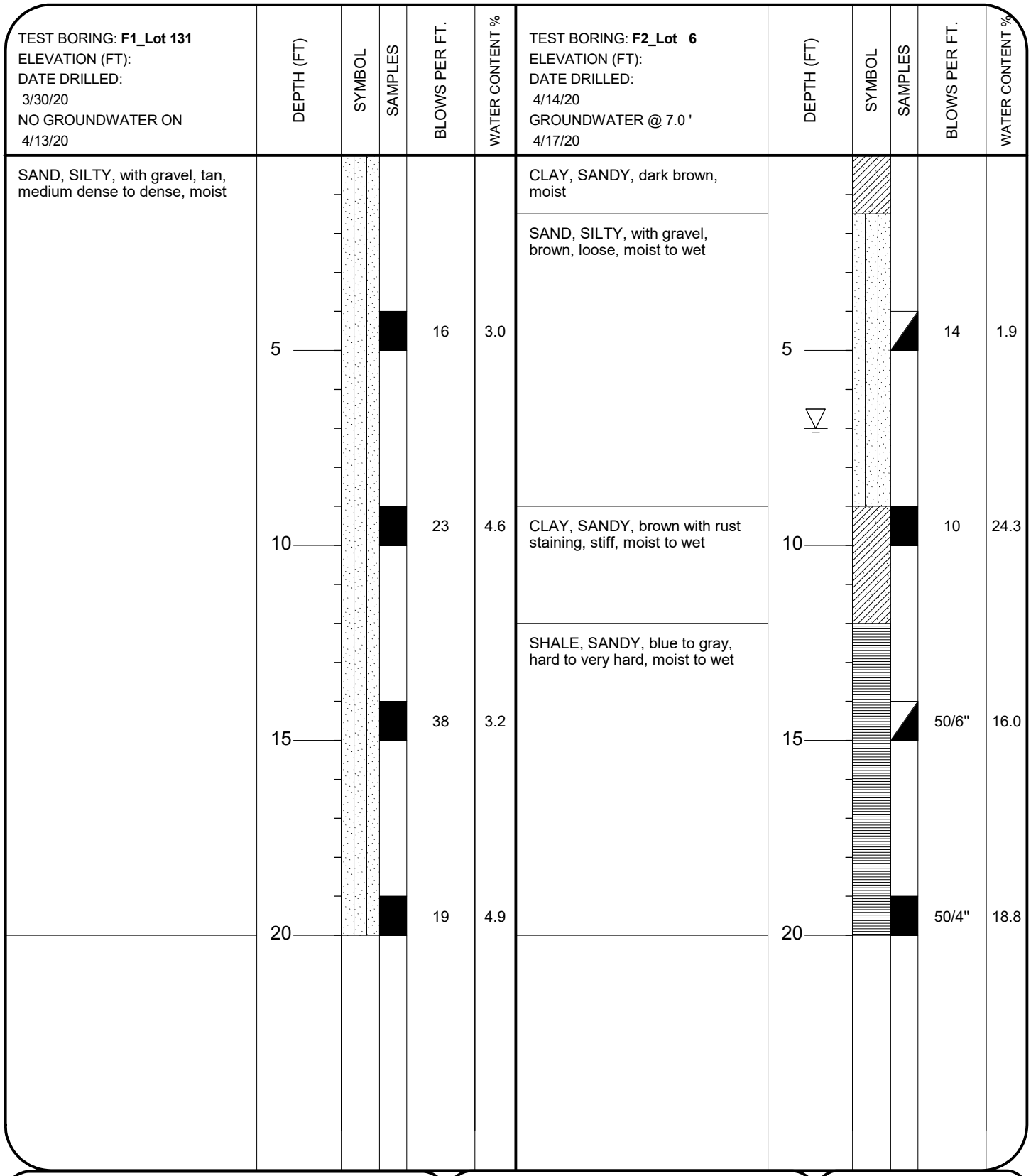
TEST BORING LOG

JOB No. 175644

FIGURE No. 8

DATE May/05/2020



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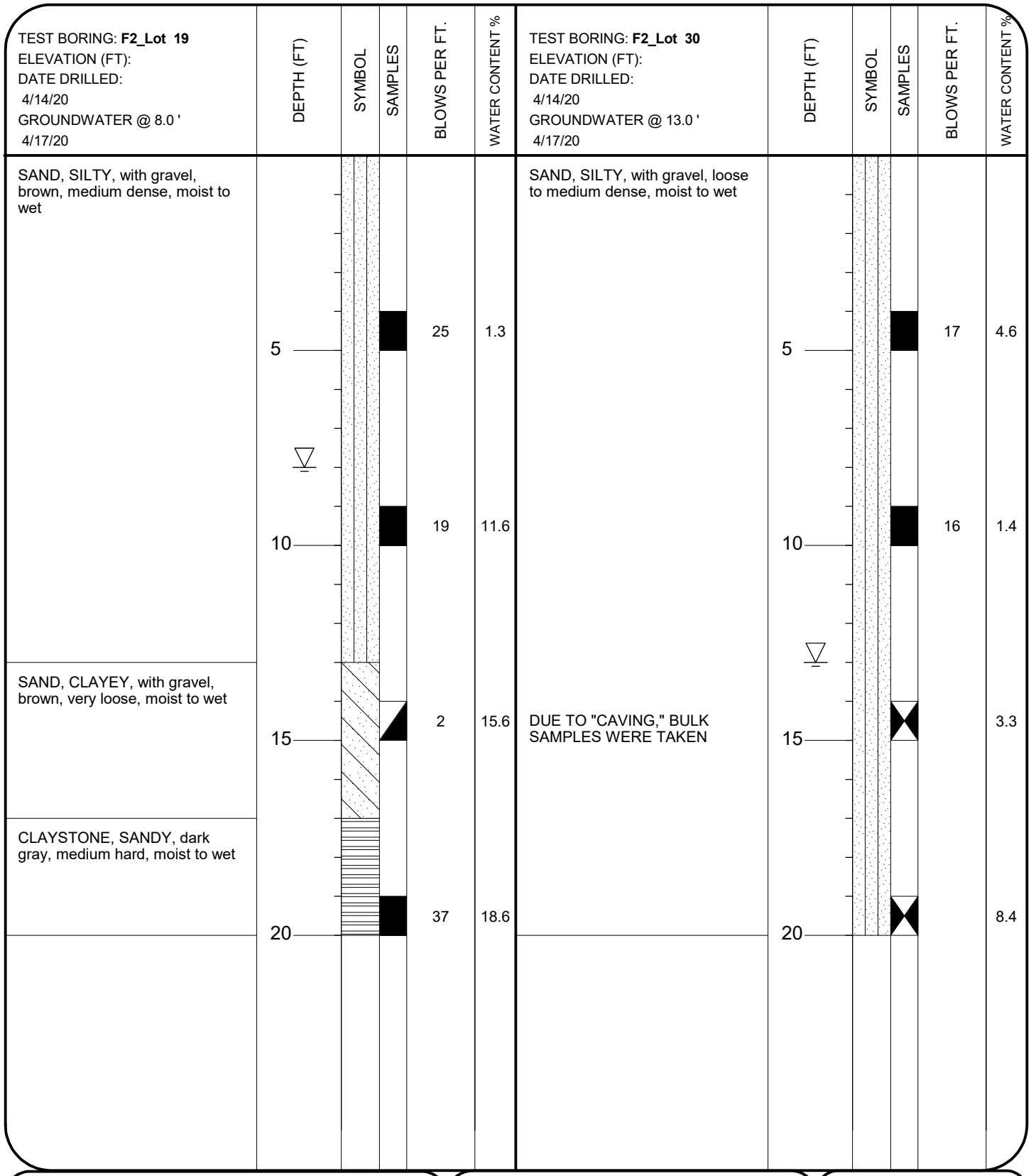
TEST BORING LOG

JOB No. 175644

FIGURE No. 9

DATE May/05/2020



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TEST BORING LOG

JOB No. 175644

FIGURE No. 10

DATE May/05/2020

TEST BORING: **F2_Lot 42**
ELEVATION (FT):
DATE DRILLED:
4/14/20
NO GROUNDWATER ON
4/17/20

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
5			14	1.1
10			13/6"	1.7
15			33	5.1
20			31	5.0

SAND, SILTY, with gravel, tan to brown, medium dense to dense, moist

COBBLES AT 6 FEET

TEST BORING: **F2_Lot 47**
ELEVATION (FT):
DATE DRILLED:
4/14/20
GROUNDWATER @ 19.0 '
4/14/20

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
5			14	3.1
10			25	1.9
15			25	4.1
20			16	13.5

SAND, SILTY, with gravel, medium dense, moist to wet

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TEST BORING LOG

JOB No. 175644

FIGURE No. 11

DATE May/05/2020

TEST BORING: **F2_Lot 56**
ELEVATION (FT):
DATE DRILLED:
4/14/20
GROUNDWATER @ 12.0 '
4/17/20

SAND, SILTY, with gravel, tan to brown, medium dense, moist to wet

COBBLES AT 11 FEET

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
5			11	7.3
10			23	1.2
15			27	11.1
20			21	8.8

TEST BORING: **F2_Lot 60**
ELEVATION (FT):
DATE DRILLED:
4/14/20
GROUNDWATER @ 11.0 '
4/17/20

SAND, SILTY, tan to light brown, medium dense, moist to wet

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
5			14	8.5
10			12	2.6
15			17	3.1
20			14	13.1

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TEST BORING LOG

JOB No. 175644

FIGURE No. 12

DATE May/05/2020

TEST BORING: **F2_Lot 78**
ELEVATION (FT):
DATE DRILLED:
4/14/20
GROUNDWATER @ 9.0 '
4/17/20

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
5			11	2.0
10			15	2.0
15				2.4
20				9.2

SAND, SILTY, with gravel, medium dense, moist to wet

DUE TO LOOSE SOILS AND GROUNDWATER, BORING "CAVED" AND BULK SAMPLES WERE TAKEN

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TEST BORING LOG

JOB No. 175644

FIGURE No. 13

DATE May/05/2020

Test Boring No.	Depth	Water Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% Retained No.4 Sieve	% Passing No. 200 Sieve	FHA Expansion Pressure (psf)	% Swell/ Collapse	USCS Classification
F1_Lot 5	4.0	1.2		NP	NP	18.6	4.9			SW
F1_Lot 5	9.0	4.4								
F1_Lot 5	14.0	2.6								
F1_Lot 5	19.0	23.1								
F1_Lot 20	4.0	11.3								
F1_Lot 20	9.0	20.9	100.4	49	30		99.2		0.7	CL
F1_Lot 20	14.0	14.4								
F1_Lot 20	19.0	13.5								
F1_Lot 27	4.0	7.6								
F1_Lot 27	9.0	1.8								
F1_Lot 27	14.0	17.5	106.5	47	24		98.4		0.0	CL
F1_Lot 27	19.0	17.9								
F1_Lot 39	4.0	1.1		NP	NP	22.9	6.0			SW-SM
F1_Lot 39	9.0	2.6								
F1_Lot 39	14.0	1.0								
F1_Lot 39	19.0	15.5								
F1_Lot 59	4.0	1.6				1.5	20.3			
F1_Lot 59	9.0	1.9								
F1_Lot 59	14.0	19.3								
F1_Lot 59	19.0	17.3								
F1_Lot 65	4.0	6.5		NP	NP	0.0	59.9			ML
F1_Lot 65	9.0	2.1								
F1_Lot 65	14.0	31.2								
F1_Lot 65	19.0	17.1								
F1_Lot 73	4.0	8.8								
F1_Lot 73	9.0	1.7		NP	NP	17.2	6.7			SP-SM
F1_Lot 73	14.0	9.5								
F1_Lot 73	19.0	15.9								
F1_Lot 81	4.0	2.0								
F1_Lot 81	9.0	2.0								
F1_Lot 81	14.0	5.2		NP	NP	12.2	5.3			SW-SM
F1_Lot 81	19.0	3.8								
F1_Lot 93	4.0	7.7		NP	NP	0.5	57.5			ML
F1_Lot 93	9.0	2.1								

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SUMMARY OF LABORATORY TEST RESULTS

JOB No. 175644
FIGURE No. 14

DATE May/05/2020

Test Boring No.	Depth	Water Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% Retained No.4 Sieve	% Passing No. 200 Sieve	FHA Expansion Pressure (psf)	% Swell/ Collapse	USCS Classification
F1_Lot 93	14.0	2.8								
F1_Lot 93	19.0	2.9								
F1_Lot 122	4.0	1.3								
F1_Lot 122	9.0	4.1		NP	NP	14.2	4.4			SW
F1_Lot 122	14.0	5.1								
F1_Lot 122	19.0	6.4								
F1_Lot 131	4.0	3.0								
F1_Lot 131	9.0	4.6								
F1_Lot 131	14.0	3.2		NP	NP	29.3	7.0			SP-SM
F1_Lot 131	19.0	4.9								
F2_Lot 6	4.0	1.9								
F2_Lot 6	9.0	24.3								
F2_Lot 6	14.0	16.0		40	21		96.1			CL
F2_Lot 6	19.0	18.8								
F2_Lot 19	4.0	1.3		NP	NP	34.2	4.8			SW
F2_Lot 19	9.0	11.6								
F2_Lot 19	14.0	15.6								
F2_Lot 19	19.0	18.6								
F2_Lot 30	4.0	4.6								
F2_Lot 30	9.0	1.4		NP	NP	19.9	5.2			SW-SM
F2_Lot 30	14.0	3.3								
F2_Lot 30	19.0	8.4								
F2_Lot 42	4.0	1.1								
F2_Lot 42	9.0	1.7								
F2_Lot 42	14.0	5.1		NP	NP	37.5	4.1			SW
F2_Lot 42	19.0	5.0								
F2_Lot 47	4.0	3.1								
F2_Lot 47	9.0	1.9		NP	NP	14.8	5.8			SW-SM
F2_Lot 47	14.0	4.1								
F2_Lot 47	19.0	13.5								
F2_Lot 56	4.0	7.3		25	5		53.5			CL-ML
F2_Lot 56	9.0	1.2								
F2_Lot 56	14.0	11.1								
F2_Lot 56	19.0	8.8								

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SUMMARY OF LABORATORY TEST RESULTS

JOB No. 175644
FIGURE No. 14

DATE May/05/2020

Test Boring No.	Depth	Water Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% Retained No.4 Sieve	% Passing No. 200 Sieve	FHA Expansion Pressure (psf)	% Swell/ Collapse	USCS Classification
F2_Lot 60	4.0	8.5								
F2_Lot 60	9.0	2.6		NP	NP	3.8	14.0			SM
F2_Lot 60	14.0	3.1								
F2_Lot 60	19.0	13.1								
F2_Lot 78	4.0	2.0		NP	NP	2.7	14.2			SM
F2_Lot 78	9.0	2.0								
F2_Lot 78	14.0	2.4								
F2_Lot 78	19.0	9.2								

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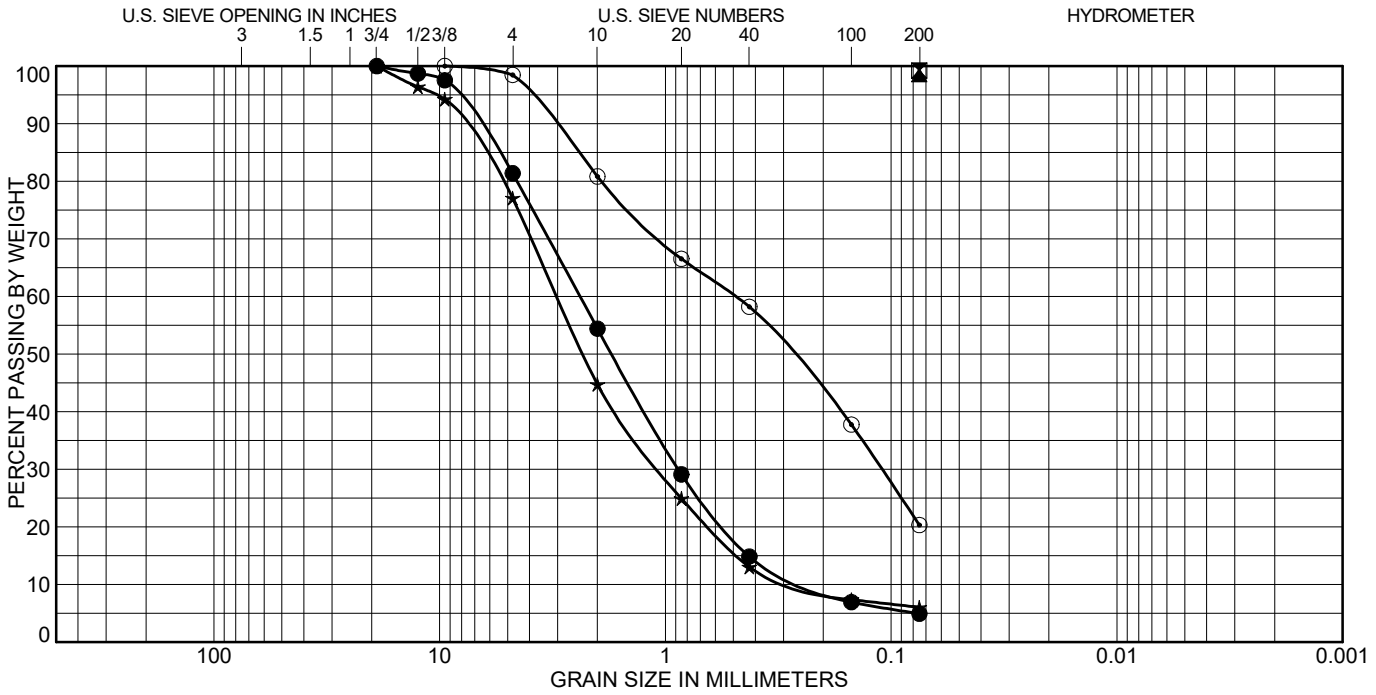
SUMMARY OF LABORATORY TEST RESULTS

JOB No. 175644
FIGURE No. 14
PAGE 3 OF 3
DATE May/05/2020



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Test Boring	Depth (ft)	Classification	LL	PL	PI
●	**F1_Lot 5**	**4.0**	**WELL-GRADED SAND with GRAVEL(SW)**	**NP**	**NP**	**NP**
⧓	**F1_Lot 20**	**9.0**	**LEAN CLAY(CL)**	**49**	**19**	**30**
▲	**F1_Lot 27**	**14.0**	**LEAN CLAY(CL)**	**47**	**23**	**24**
★	**F1_Lot 39**	**4.0**	**WELL-GRADED SAND with SILT and GRAVEL(SW-SM)**	**NP**	**NP**	**NP**
⊙	**F1_Lot 59**	**4.0**				

	Test Boring	Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	**F1_Lot 5**	**4.0**	**18.6**	**76.5**	**4.9**	
⧓	**F1_Lot 20**	**9.0**			**99.2**	
▲	**F1_Lot 27**	**14.0**			**98.4**	
★	**F1_Lot 39**	**4.0**	**22.9**	**71.1**	**6.0**	
⊙	**F1_Lot 59**	**4.0**	**1.5**	**78.1**	**20.3**	

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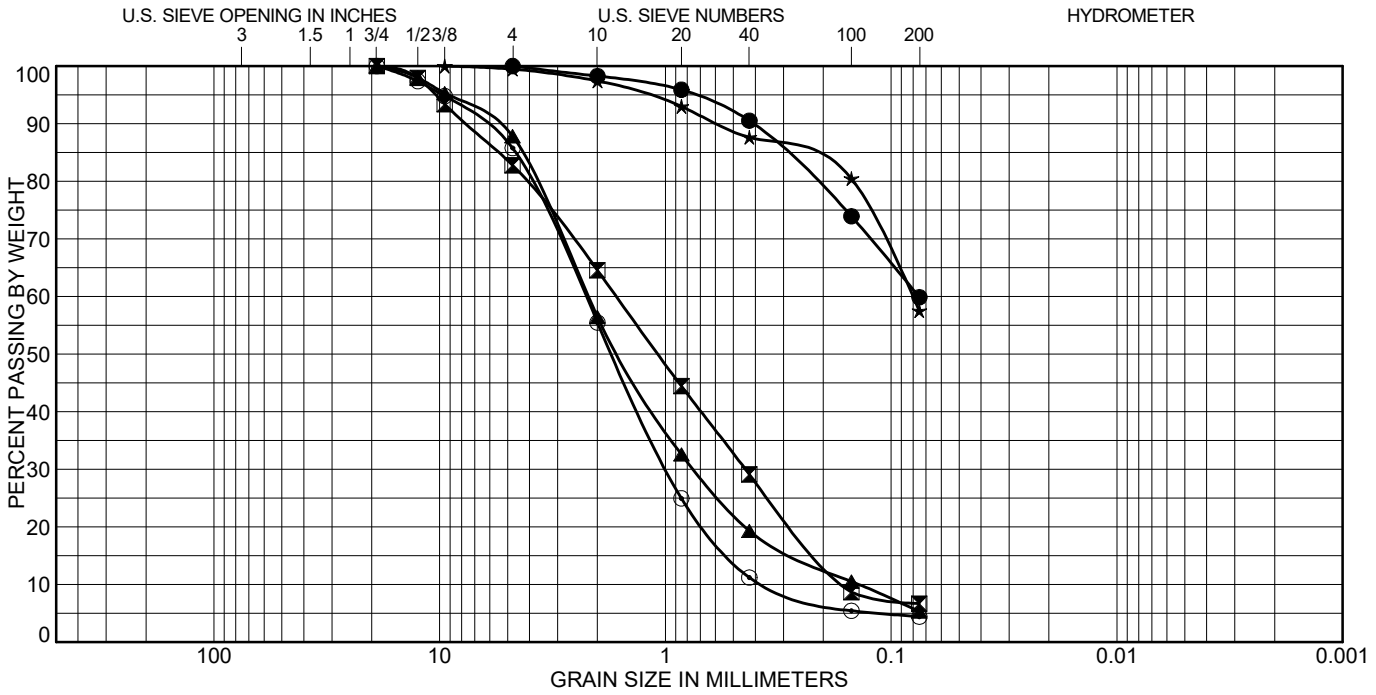
SOIL CLASSIFICATION DATA

JOB No. 175644

FIGURE No. 15

DATE May/05/2020



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Test Boring	Depth (ft)	Classification	LL	PL	PI
●	**F1_Lot 65**	**4.0**	**SANDY SILT(ML)**	**NP**	**NP**	**NP**
⧓	**F1_Lot 73**	**9.0**	**POORLY GRADED SAND with SILT and GRAVEL(SP-SM)**	**NP**	**NP**	**NP**
▲	**F1_Lot 81**	**14.0**	**WELL-GRADED SAND with SILT(SW-SM)**	**NP**	**NP**	**NP**
★	**F1_Lot 93**	**4.0**	**SANDY SILT(ML)**	**NP**	**NP**	**NP**
⊙	**F1_Lot 122**	**9.0**	**WELL-GRADED SAND(SW)**	**NP**	**NP**	**NP**

	Test Boring	Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	**F1_Lot 65**	**4.0**	**0.0**	**40.1**	**59.9**	
⧓	**F1_Lot 73**	**9.0**	**17.2**	**76.1**	**6.7**	
▲	**F1_Lot 81**	**14.0**	**12.2**	**82.6**	**5.3**	
★	**F1_Lot 93**	**4.0**	**0.5**	**41.9**	**57.5**	
⊙	**F1_Lot 122**	**9.0**	**14.2**	**81.4**	**4.4**	

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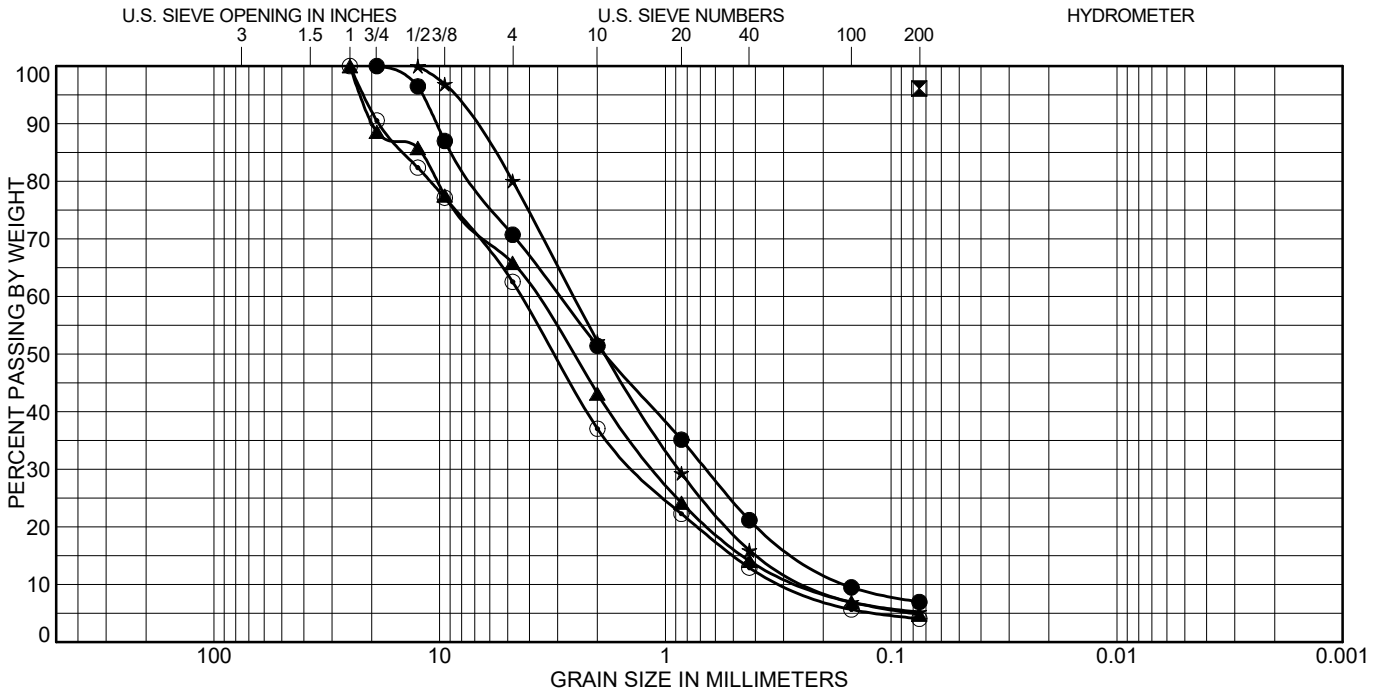
SOIL CLASSIFICATION DATA

JOB No. 175644

FIGURE No. 16

DATE May/05/2020



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Test Boring	Depth (ft)	Classification	LL	PL	PI
●	**F1_Lot 131**	**14.0**	**POORLY GRADED SAND with SILT and GRAVEL(SP-SM)**	**NP**	**NP**	**NP**
⧓	**F2_Lot 6**	**14.0**	**LEAN CLAY(CL)**	**40**	**19**	**21**
▲	**F2_Lot 19**	**4.0**	**WELL-GRADED SAND with GRAVEL(SW)**	**NP**	**NP**	**NP**
★	**F2_Lot 30**	**9.0**	**WELL-GRADED SAND with SILT and GRAVEL(SW-SM)**	**NP**	**NP**	**NP**
⊙	**F2_Lot 42**	**14.0**	**WELL-GRADED SAND with GRAVEL(SW)**	**NP**	**NP**	**NP**

	Test Boring	Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	**F1_Lot 131**	**14.0**	**29.3**	**63.8**	**7.0**	
⧓	**F2_Lot 6**	**14.0**			**96.1**	
▲	**F2_Lot 19**	**4.0**	**34.2**	**61.1**	**4.8**	
★	**F2_Lot 30**	**9.0**	**19.9**	**74.9**	**5.2**	
⊙	**F2_Lot 42**	**14.0**	**37.5**	**58.5**	**4.1**	

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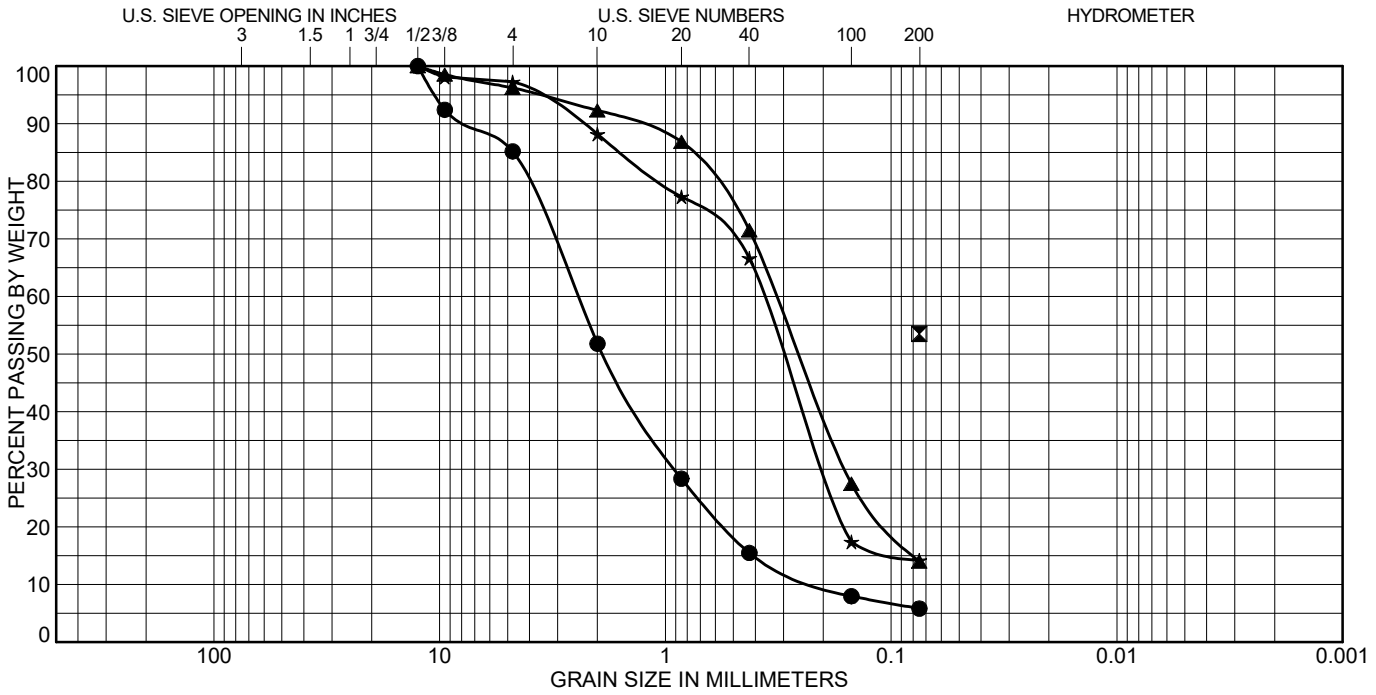
SOIL CLASSIFICATION DATA

JOB No. 175644

FIGURE No. 17

DATE May/05/2020



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Test Boring	Depth (ft)	Classification	LL	PL	PI
●	F2_Lot 47	9.0	WELL-GRADED SAND with SILT(SW-SM)	NP	NP	NP
⧓	F2_Lot 56	4.0	SANDY SILTY CLAY(CL-ML)	25	20	5
▲	F2_Lot 60	9.0	SILTY SAND(SM)	NP	NP	NP
★	F2_Lot 78	4.0	SILTY SAND(SM)	NP	NP	NP

	Test Boring	Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	F2_Lot 47	9.0	14.8	79.4	5.8	
⧓	F2_Lot 56	4.0			53.5	
▲	F2_Lot 60	9.0	3.8	82.2	14.0	
★	F2_Lot 78	4.0	2.7	83.1	14.2	

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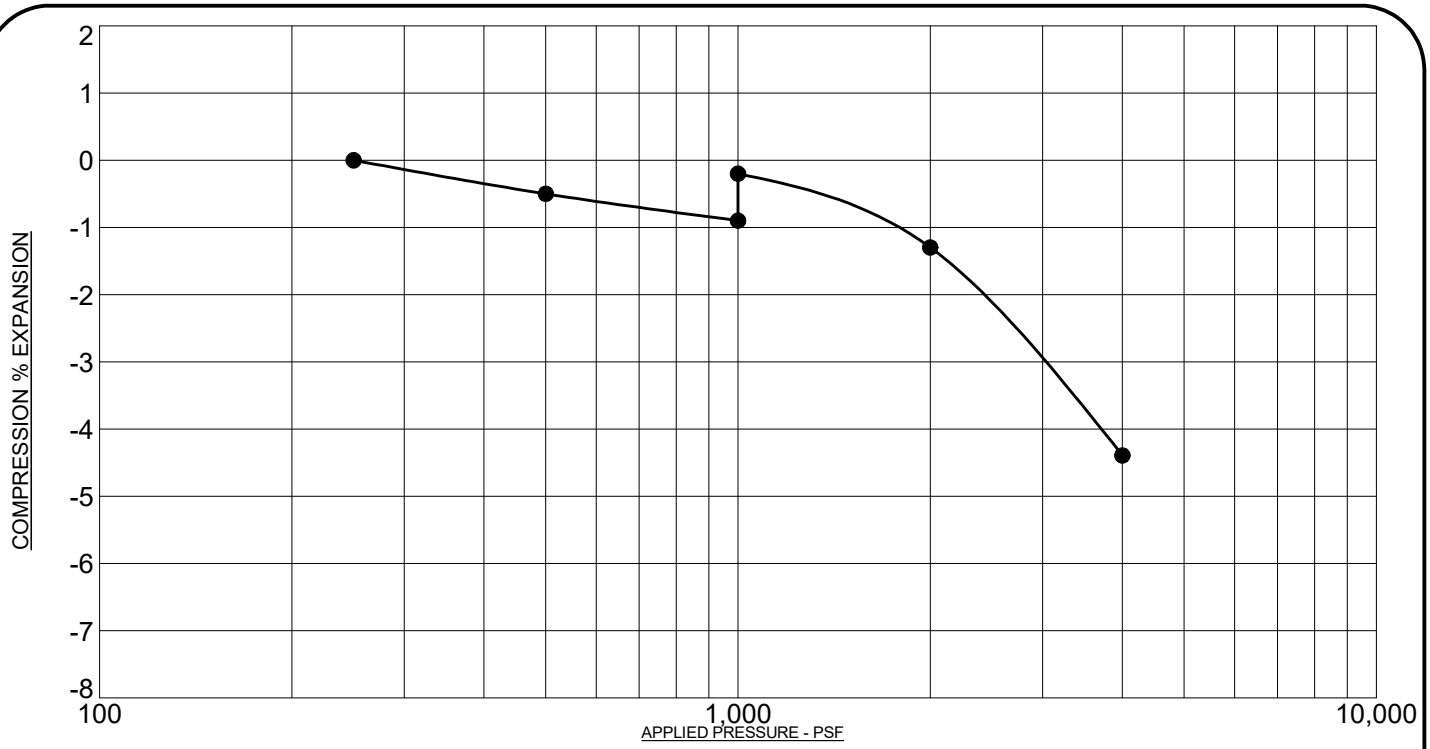
SOIL CLASSIFICATION DATA

JOB No. 175644

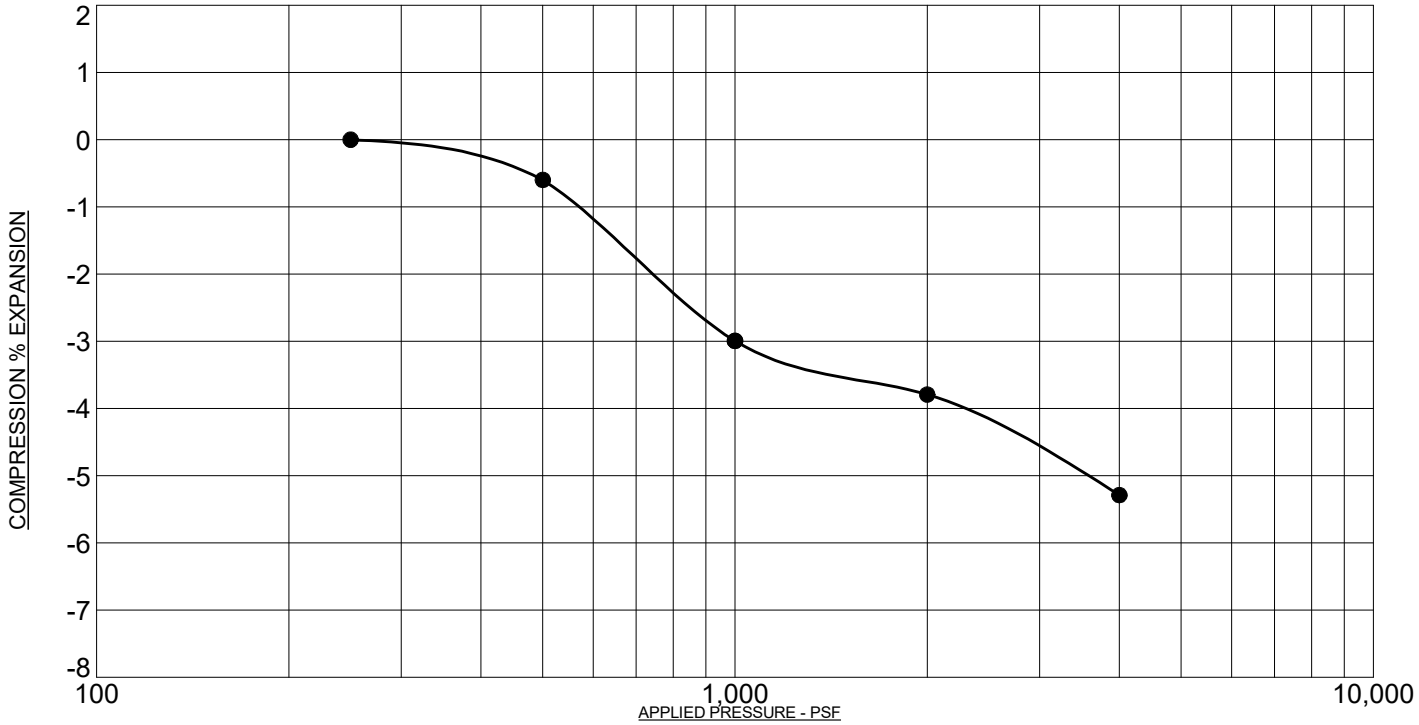
FIGURE No. 18

DATE May/05/2020



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

SAMPLE LOCATION: **F1_Lot 20 @ 9 FT**
NATURAL DRY UNIT WEIGHT: **100.4 PCF**
NATURAL MOISTURE CONTENT: **20.9%**
PERCENT SWELL/COMPRESSION: **0.7**



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

SAMPLE LOCATION: **F1_Lot 27 @ 14 FT**
NATURAL DRY UNIT WEIGHT: **106.5 PCF**
NATURAL MOISTURE CONTENT: **17.5%**
PERCENT SWELL/COMPRESSION: **0.0**

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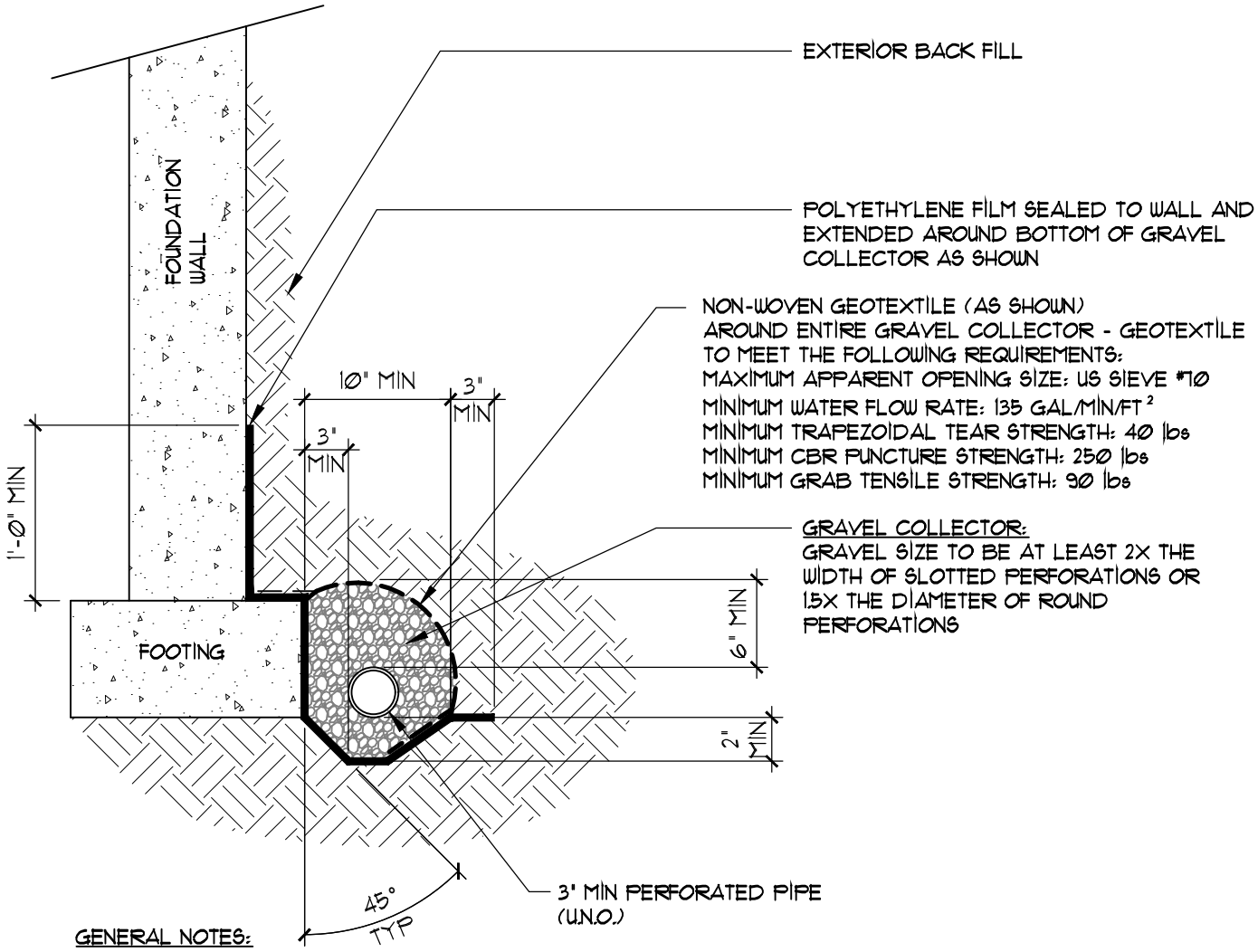
SWELL/CONSOLIDATION TEST RESULTS

JOB No. 175644

FIGURE No. 19

DATE May/05/2020



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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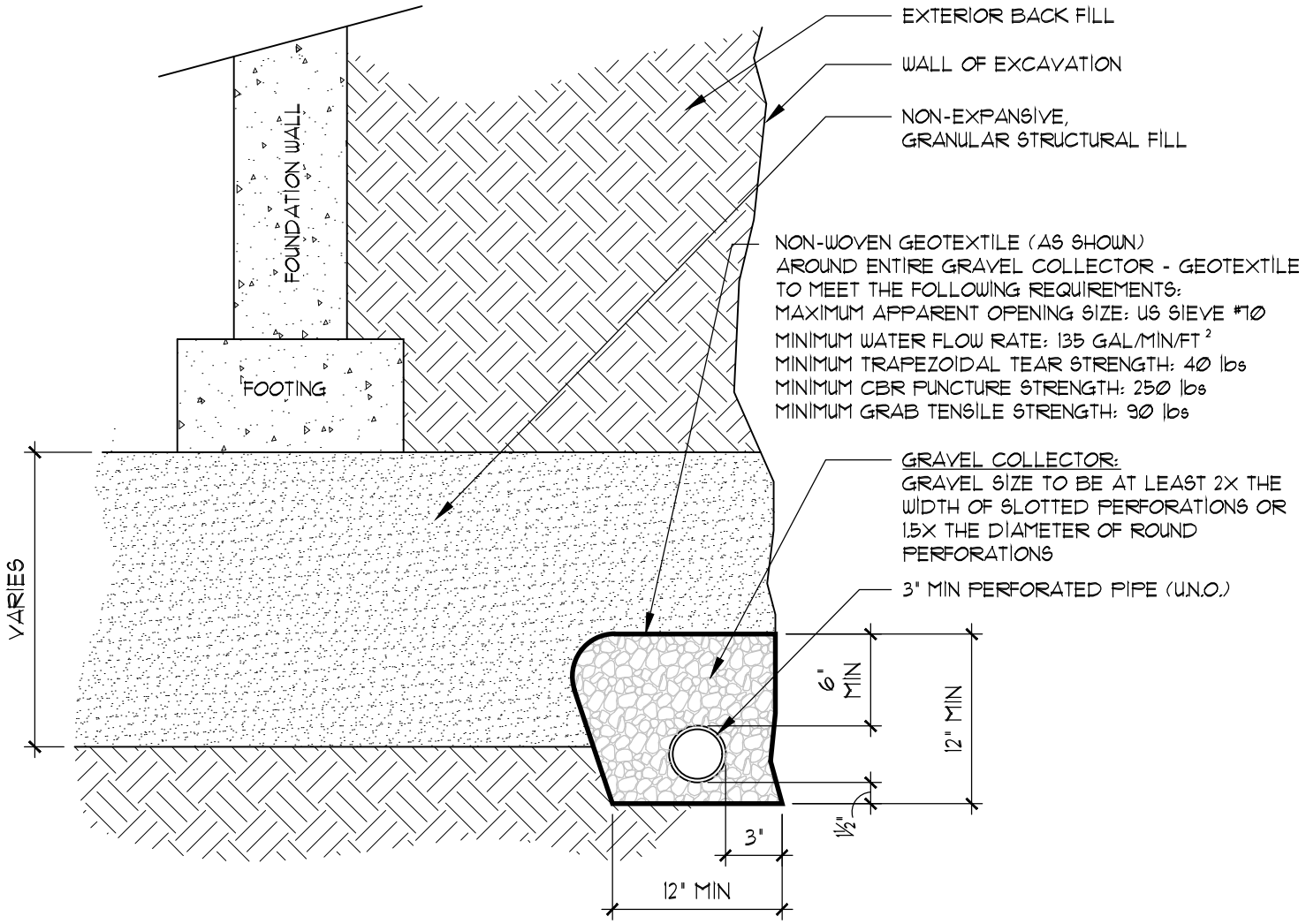
PERIMETER DRAIN

FIG No. 20



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.

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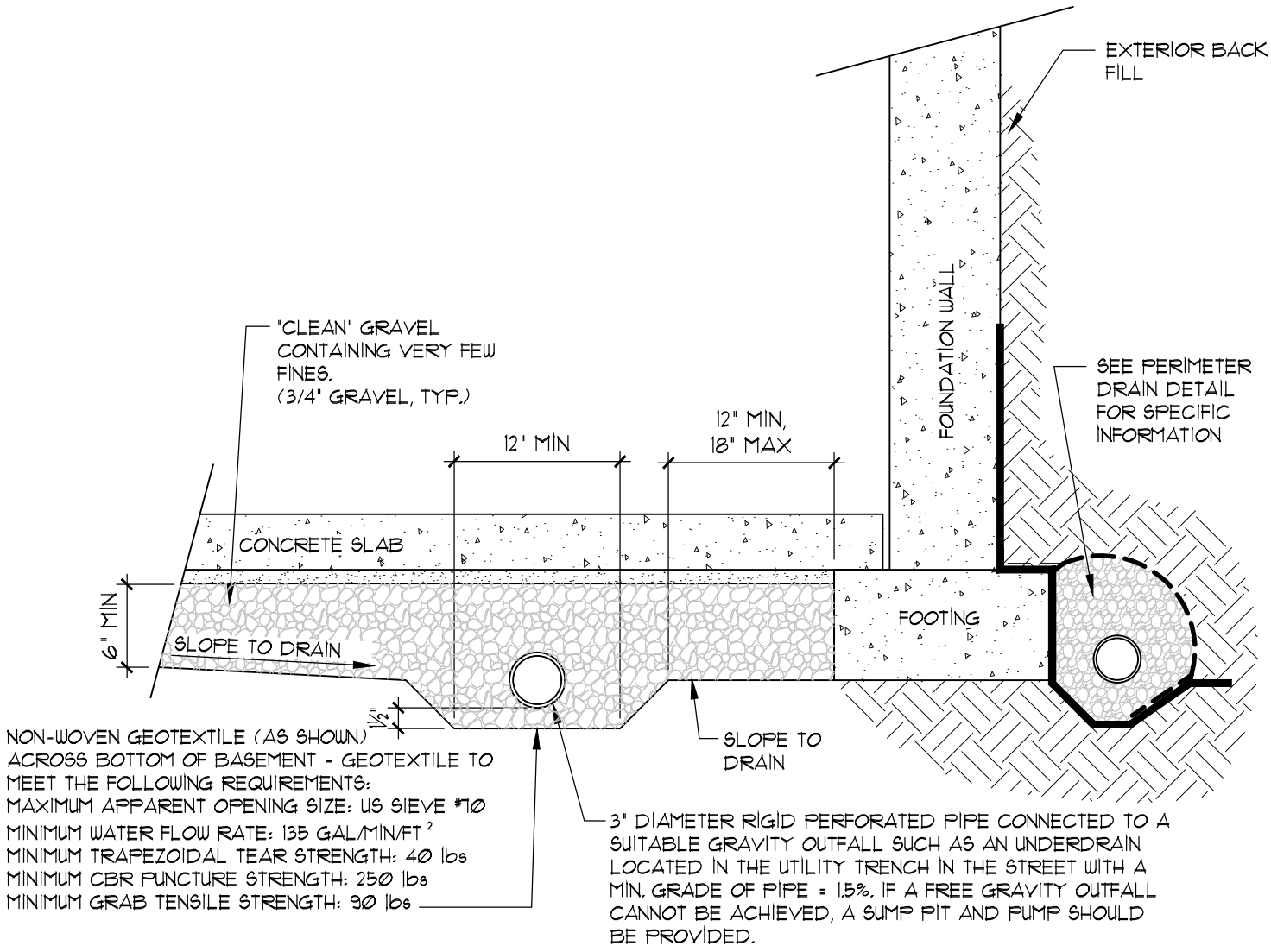
OVEREXCAVATION DRAIN

FIG No. 21



GENERAL NOTES:

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UNDERSLAB DRAIN

FIG No. 22