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SOILS AND GEOLOGY STUDY
18735 Brown Road
Lots 1-3, Boyd Minor Subdivision
El Paso County, Colorado

PREPARED FOR:

Chris Boyd
6238 Gilmer Way
Westerville, OH 43081

JOB NO. 186500

January 26, 2022
Revised: February 8, 2021

Respectfully Submitted,
RMG – Rocky Mountain Group

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Project Geologist

Reviewed by,
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Geotechnical Project Manager

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1.0 GENERAL SITE AND PROJECT DESCRIPTION

1.1 Project Location

The project lies in lot 2 of Section 7, Township 11 South, Range 65 West of the 6th Principal Meridian in El Paso County, Colorado, and is generally located northeast of the intersection of Walker Road and Brown Road. The approximate location of the site is shown on the Site Vicinity Map, Figure 1.

1.2 Existing Land Use

The site currently consists of one parcel (per the El Paso County Assessor's website) of approximately 35 acres:

- Schedule No. 5100000433, current land use is classified as agricultural grazing land

The current zoning is *"RR-5" – Residential Rural.* The parcel is currently undeveloped, vacant land.

1.3 Project Description

It is our understanding the existing 35 acres is to be subdivided into a total of three lots consisting of one 15-acre lot and two 10-acre lots. The Proposed Lot Layout is presented in Figure 2.

Each new lot is to be serviced by an on-site wastewater treatment system (OWTS) and an individual water supply well. The site is to be accessed from Brown Road.

2.0 QUALIFICATIONS OF PREPARERS

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

The principle investigators for this study are Kelli Zigler P.G., and Tony Munger, P.E. Ms. Zigler is a Professional Geologist as defined by State Statute (C.R.S 34-1-201) with over 21 years of experience in the geological and geotechnical engineering field. Ms. Kelli Zigler holds a B.S. in Geology from the University of Tulsa. Ms. Zigler has supervised and performed numerous geological and geotechnical field investigations throughout Colorado.

Tony Munger, P.E. is a licensed professional engineer with over 21 years of experience in the construction engineering (residential) field. Mr. Munger holds a B.S. in Architectural Engineering from the University of Wyoming.

3.0 STUDY OVERVIEW

The purpose of this investigation is to characterize the general geotechnical, geologic site conditions, and on-site wastewater treatment system (OWTS) feasibility and present our opinions of the potential effect of these conditions on the proposed development within El Paso County, Colorado. As such, our services

exclude evaluation of the environmental and/or human, health related work products or recommendations previously prepared, by others, for this project.

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

3.1 Scope and Objective

The scope of this study is to include a physical reconnaissance of the site and a review of pertinent, publically available documents including, but not limited to, previous geologic and geotechnical reports, overhead and remote sensing imagery, published geology and/or hazard maps, design documents, etc.

The objectives of our study are to:

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

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

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

3.2 Site Evaluation Techniques

The information included in this report has been compiled from several sources, including:

- Field reconnaissance
- Geologic and topographic maps
- Review of selected publicly available, pertinent engineering reports
- Available aerial photographs
- Subsurface exploration
- Visual and tactile characterization of representative site soil and rock samples
- Geologic research and analysis
- Lot Layout prepared by Chris Boyd

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

3.3 Additional Documents

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

4.0 SITE CONDITIONS

4.1 Existing Site Conditions

The site is undeveloped, vacant land. The site is generally located northeast of the intersection of Walker Road and Brown Road in El Paso County, Colorado and comprises approximately 35 acres. The site is zoned RR-5, rural residential. Adjacent properties to the north, west, and east are zoned RR-5, rural residential. The property to the south is zoned RR-5 and A-35, agricultural.

4.2 Topography

Based on our site reconnaissance on December 1, 2021 and USGS 2019 topographic map of the Black Forest Quadrangle, a drainage channel with a retention pond traverses the site from the southwest moving down-gradient to the north and east, as can be seen in Figure 6, Engineering and Geology Map. The water levels in the retention pond and drainage areas are anticipated to vary dependent upon local precipitation events. The site generally slopes downward from the northwest and southeast corners to the drainage channel, with a total elevation difference of approximately 85 feet.

4.3 Vegetation

The site vegetation primarily consists of native grasses and other prairie-type vegetation.

4.4 Aerial photographs and remote-sensing imagery

Personnel of RMG reviewed aerial photos available through Google Earth Pro dating back to 1999, CGS surficial geologic mapping, and historical photos by historicaerials.com dating back to 1952. Historically, the site has remained undeveloped, vacant land. The retention ponds located within and outside of the property appear to have been constructed between 1960 and 1969.

5.0 FIELD INVESTIGATION AND LABORATORY TESTING

It is our understanding the existing 35 acres is to be subdivided into a total of three lots, one 15-acre lot and two 10-acre lots. Each of the new lots are to contain a single-family residence with well and septic.

5.1 Test Pit Excavations

Three test pits were performed by RMG to explore the subsurface soils underlying the proposed on-site wastewater treatment systems. The number of test pits is in accordance with the Regulations of the El

Paso County Board of Health, Chapter 8, On-site Wastewater Treatment Systems (OWTS) as required by 8.5.D.3.a.

The test pits were excavated to 8 feet below the existing ground surface. Additional information is provided in Section 9.0, On-site Disposal of Wastewater.

5.2 OWTS Visual and Tactile Evaluation

A visual and tactile evaluation was performed by RMG for this investigation. The soils were evaluated to determine the soils types and structure. Bedrock was not encountered in the test pits. The soil descriptions of the test pit evaluation are presented in Figure 4, Test Pit Logs, and the approximate locations of the test pits are presented in Figure 8, Test Pit Location Map.

5.3 Groundwater

Groundwater was not encountered in the test pits performed by RMG on December 3, 2021. No indications of redoximorhpic conditions were observed.

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

6.0 SOIL, GEOLOGY, AND ENGINEERING GEOLOGY

The site is located within the central portion of the Great Plains Physiographic Province. A major structural feature known as the Rampart Range Fault is located approximately 12.5 miles west of the site. The Rampart Range Fault marks the boundary between the Great Plains Physiographic Province and the Southern Rocky Mountain Province. The site exists within the southern portion of a large structural feature known as the Denver Basin. In general, the geology at the site consists of alluvium of Palmer Divide overlying the bedrock of the Upper part of the Dawson Formation. The alluvium generally consist of silty clay, silty clay loam, sandy clay loam, and clay. The upper part of the Dawson Formation is generally comprised of the arkosic sandstone, claystone, mudstone, and conglomerate and localized coal beds.

6.1 Subsurface Soil Conditions

The subsurface soils encountered in the RMG test pit excavations were classified using the United States Department of Agriculture (USDA) soil descriptions. The on-site soils classified as silty clay, silty clay loam, sandy clay loam, and clay.

The classifications shown on the logs are based upon the engineer's classification of the samples at the depths indicated. Stratification lines shown on the logs represent the approximate boundaries between material types and the actual transitions may be gradual and vary with location.

6.2 Bedrock Conditions

Bedrock (as defined by USDA Soil Structure and Grade) was not encountered in the test pit excavations performed for this investigation. In general, the bedrock (as defined by Colorado Geologic Survey) beneath the site is considered to be part of the Upper Dawson Formation – facies unit five which consists

of very thick-bedded to massive, cross-bedded, light-colored arkose, pebbly arkose, and arkosic pebble conglomerate. Facies unit five also contains common beds of white to light-tan, fine- to medium-grained feldspathic, cross-bedded friable sandstone. The Dawson formation is thick-bedded to massive, generally light colored arkose, and pebbly. The sandstones are poorly sorted with high clay contents. The sandstone is generally permeable, well drained, and has good foundation characteristics. The Dawson sandstone is generally not considered a restrictive layer for OWTS.

6.3 U.S. Soil Conservation Service

The U.S. Soil Conservation Service along with United States Department of Agriculture (USDA) identifies the site soils as:

- 15 – Brussett loam, 3 to 5 percent slopes. Properties of the loam include well drained soils, depth of the water table is anticipated to be greater than 80 inches, runoff is anticipated to be low, frequency of flooding and ponding is none, and landforms include hills.
- 67 – Peyton sandy loam, 5 to 9 percent slopes. Properties of the sandy loam include well drained soils, depth of the water table is anticipated to be greater than 80 inches, runoff is anticipated to be medium, frequency of flooding and ponding is none, and landforms include hills.
- 69 – Peyton-Pring complex, 8 to 15 percent slopes. Properties of the complex include well drained soils, depth of the water table is anticipated to be greater than 80 inches, runoff is anticipated to be medium, frequency of flooding and ponding is none, and landforms include hills.

The USDA Soil Survey Map is presented in Figure 5.

6.4 General Geologic Conditions

Based on our field observations and review of relevant geologic maps, a geologic map was prepared which identifies the geologic conditions affecting the development. The geologic conditions affecting the development are presented in the Engineering and Geology Map, Figure 6.

The site generally consists of alluvium deposits overlying sandstone bedrock. Five geologic units were mapped at the site as:

- *TKda5 – Dawson formation, facies unit five (early to middle(?) Eocene)* – The unit is dominated by very thick-bedded to massive, cross-bedded, light-colored arkose, pebbly arkose, and arkosic pebble conglomerate. Facies unit five contains common beds of white to light-tan, fine- to medium-grained feldspathic, cross-bedded friable sandstone. The unit is estimated to be about 500 feet thick in the quadrangle; the top of the unit has been removed by erosion.
- *QTa – Alluvium of Palmer Divide (early? Pleistocene or Pliocene?)* – The deposits included in this oldest alluvial category include predominately sand deposits in the northwestern part of the quadrangle. The alluvium of Palmer Divide is up to 30 feet thick in the Black Forest quadrangle. The sandy deposits are composed generally of very pale-brown and pinkish-brown, fine to coarse sand interbedded with pinkish-gray to light brownish-gray pebble gravel. The sand is poorly sorted, medium to thin bedded, thinly laminated, and composed largely of quartz grains. The sandy pebble and cobble gravel is composed largely of subangular to subrounded fragments of white or light-gray quartz, light-pink to light-red and reddish-brown feldspar, a few fragments of pink to light-red to reddish-brown granite, and rare fragments of brownish-gray Wall Mountain Tuff.
- *sw* –Seasonally Wet Area.

- *psw* – Potentially Seasonally Wet Area
- *af* – Artificial fill Area – Artificial fill placed between 1960 and 1969 for the creation of a retention pond dam near the southwest corner of the property.

6.5 Engineering Geology

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

- *1A* – Stable alluvium, colluvium and bedrock on flat to gentle slopes (0-5%).
- *3B* – Expansive and potentially expansive soil and bedrock on flat to moderate slopes (0-12%).
- *7A* – Physiographic floodplain, as mapped by Charles Robinson and Associates (1977), where erosion and deposition presently occur.

6.6 Structural Features

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

6.7 Surficial (Unconsolidated) Deposits

Lake sediments, swamp accumulations, sand dunes, marine terrace deposits, talus accumulations, creep, or slope wash were not observed on the site. Slump and slide debris were also not observed on the site. However, pond sediment is anticipated to be present within the retention pond observed on the site.

6.8 Features of Special Significance

Features of special significance such as accelerated erosion, (advancing gully head, badlands, or cliff reentrants) were not observed on the property. Features indicating settlement or subsidence such as fissures, scarplets, and offset reference features were not observed on the study site or surrounding areas. Features indicating creep, slump, or slide masses in bedrock and surficial deposits were not observed on the property.

6.9 Drainage of Water and Groundwater

A drainage channel traverses the site from the southwest moving down-gradient to the north and east. Both sides of the site generally slope down toward this drainage channel. It is anticipated that surface water will generally flow across the site to this drainage, then down-gradient to the north and east. Groundwater was not encountered in the test pits performed for this current study and is not anticipated to affect shallow foundations.

6.10 Flooding and Surface Drainage

Based on our review of the Federal Emergency Management Agency (FEMA) Community Panel No. 08041C0305G and the online ArcGIS El Paso County Risk Map, the entire site lies outside of identified 100 or 500-year floodplains. The site lies in Zone X. Zone X is defined by FEMA as an area of minimal flood hazard that is determined to be outside the Special Flood Hazard Area and higher than the elevation of the 0.2-percent-annual-chance (or 500-year) flood. The FEMA Map is presented in Figure 7.

7.0 ECONOMIC MINERAL RESOURCES

Under the provision of House Bill 1529, it was made a policy by the State of Colorado to preserve for extraction commercial mineral resources located in a populous county. Review of the *El Paso Aggregate Resource Evaluation Map, Master Plan for Mineral Extraction*, *Map 1* indicates the site is identified as Stream Terrace Deposits and Floodplain Deposits. The older stream deposits contain sand, gravel, silt and clay preserved on benches or broad flat to sloping areas adjacent to streams. The Floodplain Deposits consist of sand and gravel with minor amounts of silt and clay deposited by water along present stream courses. Extraction of the sand, gravel, silt or clay more than likely would not be considered to be economical compared to materials available elsewhere within the county.

According to the *Evaluation of Mineral and Mineral Fuel Potential of El Paso County State Mineral Lands*, the site is mapped within the southern part of the Denver Basin Coal Region. However, the area of the site has been mapped "Poor" for coal resources. The tract contains strata that may contain coal but no coal occurrences are within five miles. No metallic mineral resources have been mapped on the site. No oil and gas wells are drilled on this tract. The nearest historic coal mine sites are located around nine miles southwest of the tract in the Colorado Springs coal field. In this part of the Denver coal region, coal resources are locally present within the lower part of the Laramie Formation of Upper Cretaceous age. The tract is unlikely to host industrial minerals or construction materials.

8.0 IDENTIFICATION AND MITIGATION OF POTENTIAL GEOLOGIC CONDITIONS

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

- Avalanches
- Debris Flow-Fans/Mudslides
- Floodplains
- Ground Subsidence
- Landslides
- Rockfall
- Steeply Dipping Bedrock
- Unstable or Potentially Unstable Slopes
- Corrosive Minerals

The following section presents the geologic conditions that have been identified on the property:

8.1 Expansive Soils

Based on the test pits performed by RMG for this investigation and our experience with similar materials in this area, the silty to sandy clay and silty to sandy clay loam generally possess low to moderate swell potential. The Dawson formation is known to have moderate to high swell potential in some locations. It is anticipated that expansive soil/bedrock may be encountered at depths anticipated to affect residential foundations. If these materials are encountered in the excavations for the proposed residences, they can readily be mitigated with typical construction practices common to this region of El Paso County, Colorado.

Mitigation

Foundation design and construction are typically adjusted for expansive soils. Mitigation of expansive soils may include overexcavation and replacement with non-expansive structural fill. Drilled piers are not anticipated. Floor slabs bearing directly on expansive soils are expected to experience movement. Overexcavation and replacement with compacted non-expansive soils can be successful in reducing slab movement.

If expansive soils or bedrock are encountered during construction, mitigation of these expansive materials should follow the recommendations presented in a lot-specific subsurface soil investigation performed for each proposed structure.

8.2 Compressible Soils

Based on the test pits performed by RMG for this investigation and our experience with similar materials in this area, the silty to sandy clay and silty to sandy clay loam generally possess low compressibility potential. If compressible materials are encountered in the excavations for the proposed residences, they can readily be mitigated with typical construction practices common to this region of El Paso County, Colorado.

It is unknown at this time whether the proposed single-family residences will have crawlspaces, basements or a combination of both. Foundation design and construction are typically adjusted for compressible soils.

Mitigation

Mitigation of compressible 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. If soft or loose soils are encountered, mitigation of compressible soils can be accomplished by overexcavation and replacement with structural fill, subexcavation and replacement with on-site moisture-conditioned soils, and/or the use of a geogrid reinforced fill.

If expansive soils or bedrock are encountered during construction, mitigation of these expansive materials should follow the recommendations presented in a lot-specific subsurface soil investigation performed for each proposed structure.

8.3 Artificial Fill

A dam is located within the parcel near the southwest boundary corner. The Geologic Map of the Black Forest Quadrangle has identified the dam area as artificial fill. Based on historical aerial imagery, the dam was constructed sometime between 1960 and 1969. The location of the dam and artificial fill placement are presented in the Engineering and Geology Map, Figure 6.

Mitigation

It is not anticipated that the home location will encroach within the drainage channel or the immediate vicinity of the dam. As such, mitigation of artificial fill is not anticipated to be required. However, if future structures are to be constructed within these areas, the recommendations presented in a lot-specific subsurface soil investigation performed for each proposed structure should consider mitigation of artificial fill soils.

8.4 Ponding Water

Based on the site observations, review of USGS topographic maps, and Google Earth images dating back to 1999, ponding water is present in the retention pond on the site. In this area, we would anticipate the potential for periodically high subsurface moisture conditions and frost heave potential. The pond area lies within a low-lying area of the site.

Mitigation

Foundations must have a minimum 30-inch depth for frost protection. Perimeter drains are recommended around portions of the structures which will have habitable or storage space located below the finished ground surface. This includes crawlspace areas but not the walkout trench, if applicable. Perimeter drains help prevent the intrusion of water into areas below grade. A typical perimeter drain is presented in Figure 10.

It is not anticipated that the home location will encroach within the drainage channel or retention pond areas. As such, mitigation of the pond sediment is not anticipated to be required. However, if future structures are to be constructed within these low-lying areas, the recommendations presented in a lot-specific subsurface soil investigation performed for each proposed structure should consider mitigation of unconsolidated sediments.

8.5 Scour and Erosion

Scour generally refers to a localized loss of soil, often around foundation elements. Erosion generally refers to lowering the ground surface over a wide area.

Visible evidence of ongoing erosion/scour was observed within and adjacent to the drainageway along the slopes to the north and south. The drainageway runs from the southwest to northeast. It is unknown at this time the approximate locations of the proposed single-family residences for this site, but it is anticipated that construction will not encroach within the drainageway.

Mitigation

Significant care should be taken (both during construction and in the final grading of the lot) to divert surface drainage and downspout discharge water around the structure to a location that will not significantly alter the overall drainage of the development or result in the need for additional drainage mitigation measures at the time of construction on nearby lots.

Any landscaping in the immediate vicinity of the proposed structure should utilize xeriscape techniques in order to minimize needed irrigation to maintain landscaping. Further, stormwater and snowmelt runoff from parking (driveway) areas should be directed towards drainage channels and away from slopes, both during construction activities and upon completion of site development.

It is not anticipated that the home location will encroach within the drainage channel. As such, mitigation for scour and erosion is not anticipated to be required. However, if future structures are to be constructed within these low-lying areas, the recommendations presented in a lot-specific subsurface soil investigation performed for each proposed structure should consider mitigation of scour and erosion.

8.6 Faults and Seismicity

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

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

Mitigation

The Pikes Peak Regional Building Code, 2017 Edition, indicates maximum considered earthquake spectral response accelerations of 0.201g for a short period (S_s) and 0.057g 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 average shear wave velocities ranging from 2,500 to 5,000 feet per second for the materials in the upper 100 feet.

8.7 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".*

Northern El Paso County and the 80908 zip code in which the site is located, has an EPA assigned Radon Zone of *1*. A radon Zone of *1* predicts an average indoor radon screening level greater than 0.4 pCi/L (picocuries per liter), which is above the recommended levels assigned by the EPA. *The EPA recommends corrective measures to reduce exposure to radon gas.*

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

Mitigation

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

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

9.0 ON-SITE WASTEWATER TREATMENT SYSTEMS

It is our understanding that On-site Wastewater Treatment Systems (OWTS) are proposed for the subdivided lots. The site was evaluated in general accordance with the El Paso Land Development Code, specifically sections 8.4.8. Three 8-foot deep test pits were performed across the site to obtain a general understanding of the soil and bedrock conditions. The Test Pits Logs are presented in Figure 4.

The United States Department of Agriculture (USDA) as discussed in section 6.3 consisted of silty clay, silty clay loam, sandy clay loam, and clay. One limiting layer was encountered in Test Pit 2 from 0 to 3 ft. because of the coarseness of the material. The long term acceptance rates (LTAR) associated with the soils observed in the test pits range from 0.20 to 0.80 (soil types R-1 to 4) gallons per day per square foot. Signs of seasonal groundwater were not observed in the test pits.

Contamination of surface and subsurface water resources should not occur provided the OWTS sites are evaluated and installed according to the El Paso County Board of Health Guidelines and property maintained.

Treatment areas at a minimum, must achieve the following:

- Treatment areas must be 4 feet above groundwater or bedrock as defined by the Definitions 8.3.4 of the Regulations of the El Paso County Board of Health, Chapter 8 OWTS Regulations, most recently amended May 23, 2018;
- Each lot (after purchase but prior to construction of an OWTS) will require an OWTS Site Evaluation report prepared per *the Regulations of the El Paso County Board of Health, Chapter 8 OWTS Regulations*. During the site reconnaissance, a minimum of two 8-foot deep test pits will need to be excavated in the vicinity of the proposed treatment area;
- Comply with any physical setback requirements of Table 7-1 of the El Paso County Department of Health and Environment (EPCHDE);
- Treatment areas are to be located a minimum 100 feet from any well (existing or proposed), including those located on adjacent properties per Table 7-2 per the EPCHDE;

It is our opinion that if the EPCHDE physical setback requirements are met for each lot, there are no restrictions on the placement of the individual On-site Wastewater Systems.

Soil and groundwater conditions at the site are suitable for individual treatment systems. It should be noted that the LTAR values stated above are for the test pit locations performed for this report only. The LTAR

values may change throughout the site. If an LTAR value of less than 0.35 (or soil types 3 to 5) are encountered at the time of the site specific OWTS evaluation, an "engineered system" will be required.

10.0 BEARING OF GEOLOGIC CONDITIONS UPON PROPOSED DEVELOPMENT

Geologic hazards (as described in Section 8.0 of this report) found to be present at this site include faults/seismicity and radon. Geologic constraints (as described in section 8.0 of this report) found to be present at this site include expansive soils, compressible soils, and artificial fill. It is our opinion that the existing geologic and engineering conditions can be satisfactorily mitigated through proper engineering, design, and construction practices.

11.0 ADDITIONAL STUDIES

The findings, conclusions and recommendations presented in this report were provided to evaluate the suitability of the site for future development. Unless indicated otherwise, the test pits, laboratory test results, conclusions and recommendations presented in this report are not intended for use for design and construction.

A lot-specific subsurface soil investigation will be required for all proposed structures including (but not limited to) residences, retaining walls (if proposed), etc.

12.0 CONCLUSIONS

Based upon our evaluation of the geologic conditions, it is our opinion that the proposed development is feasible. The geologic conditions identified are considered typical for the Front Range region of Colorado. Mitigation of geologic conditions is most effectively accomplished by avoidance. However, where avoidance is not a practical or acceptable alternative, geologic conditions should be mitigated by implementing appropriate planning, engineering, and suitable construction practices.

In addition to the previously identified mitigation alternatives, surface and subsurface drainage systems should be considered. Exterior, perimeter foundation drains should be installed around below-grade habitable or storage spaces. A typical perimeter drain detail is presented in Figure 10. Surface water should be efficiently removed from the building area to prevent ponding and infiltration into the subsurface soil.

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

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

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

It is important for the Owner(s) of the property to read and understand this report, and to carefully familiarize themselves with the geologic hazards associated with construction in this area. This report only addresses the geologic constraints contained within the boundaries of the site referenced above.

The foundation systems for the proposed single-family residential structures and any retention/detention facilities should be designed and constructed based upon recommendations developed in a site-specific subsurface soil investigation.

13.0 CLOSING

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

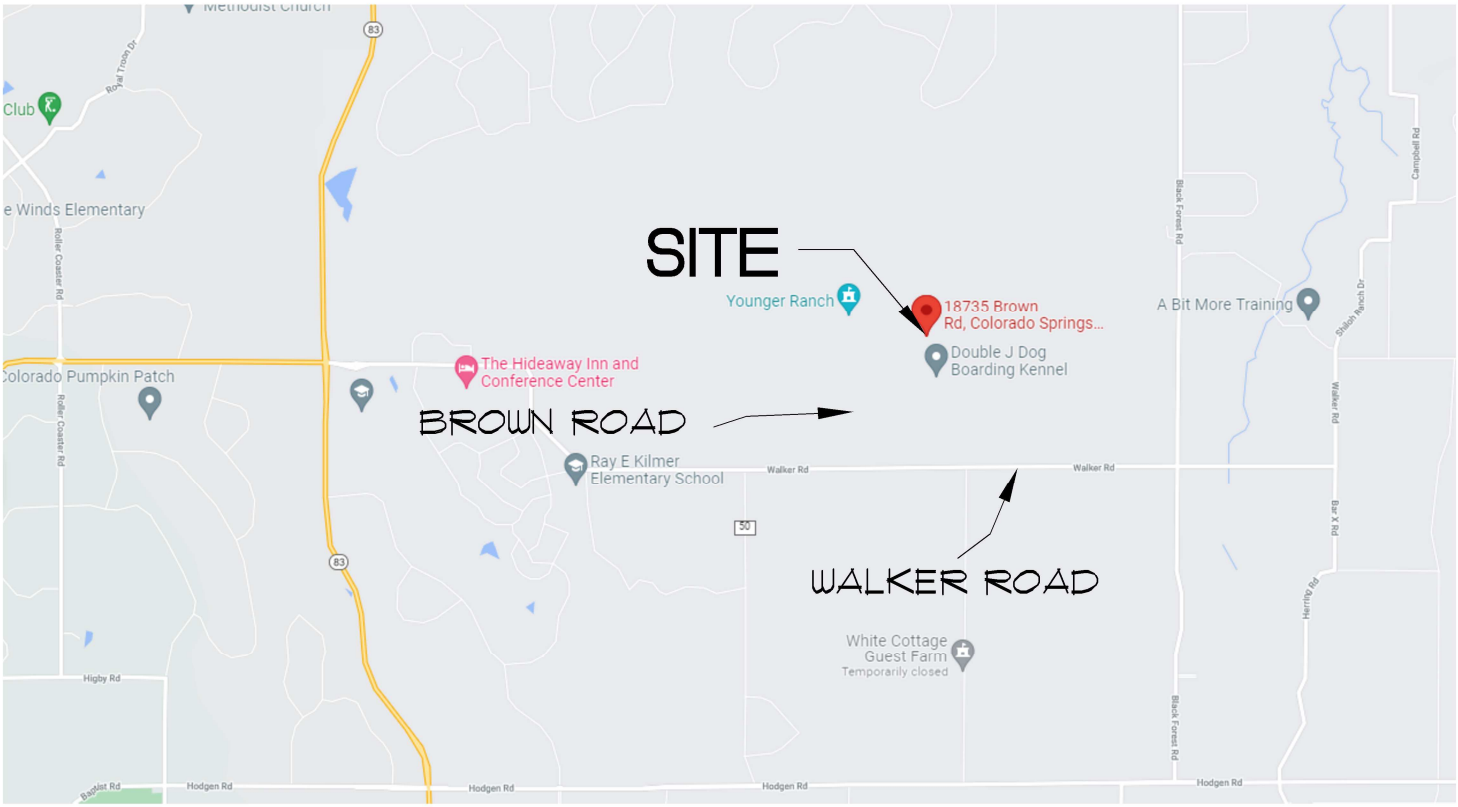
This report has been prepared for **Chris Boyd** in accordance with generally accepted geotechnical engineering and engineering geology practices. The conclusions and recommendations in this report are based in part upon data obtained from review of available topographic and geologic maps, review of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

APPENDIX A
Additional Reference Documents

1. *Land Survey Plat Map, 18735 Brown Road, El Paso County, Colorado*, prepared by SMH Consultants, Job No. 2010CS4032, last dated October 30, 2020.
2. *Flood Insurance Rate Map, El Paso County, Colorado and Unincorporated Areas, Community Panel No. 08041C0305G,* Federal Emergency Management Agency (FEMA), effective December 7, 2018.
3. *Geologic Map of the Black Forest Quadrangle, El Paso County, Colorado*, Madole, R.F., 2003, Colorado Geological Survey Open-File Report OF03-06.
4. *Cherry Valley and Black Forest Quadrangle, Environmental and Engineering Geologic Map for Land Use*, compiled by Dale M. Cochran, Charles S. Robinson & Associates, Inc., Golden, Colorado, 1977.
5. *Black Forest Quadrangle, Map of Potential Geologic Hazards and Surficial Deposits*, compiled by Dale M. Cochran, Charles S. Robinson & Associates, Inc., Golden, Colorado, 1977.
6. *Pikes Peak Regional Building Department:* https://www.pprbd.org/.
7. El Paso County Assessor Website https://property.spatialest.com/co/elpaso/#/property/5100000433 Schedule No. 5100000433
8. *Colorado Geological Survey, USGS Geologic Map Viewer*: http://coloradogeologicalsurvey.org/geologic-mapping/6347-2/.
9. *Historical Aerials:* https://www.historicaerials.com/viewer, Images dated 1952, 1955, 1960, 1969, 1983, 1999, 2005, 2009, 2011, 2013, 2015, and 2017.
10. *USGS Historical Topographic Map Explorer:* http://historicalmaps.arcgis.com/usgs/ Colorado Springs, Black Forest Quadrangle dated 1898, 1909, 1948, 1969, 1981 and 1989.
11. *Google Earth Pro*, Imagery dated 1999, 2004, 2005, 2006, 2011, 2013, 2015, 2017, 2019 and 2020.
12. *USDA Web Soil Survey* https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx
13. *Colorado Springs and Vicinity Natural Hazard Explorer* https://www.arcgis.com/apps/MapSeries/index.html?appid=dce03f88b282442d8ec751fd439e357e
14. *El Paso County Aggregate Resource Evaluation, Map 1,* prepared by El Paso County Planning Department, October 1995
15. *Evaluation of Mineral and Mineral Fuel Potential of El Paso County State Mineral Lands administered by the Colorado State Land Board,* Open File Report OF-03-07, Colorado Geological Survey
16. *Applied Technology Council (ATC) Hazards by Location Map Viewer for Seismicity* https://hazards.atcouncil.org/#/seismic?lat=39.1019501&lng=-104.7174657&address=18735%20Brown%20Rd%2C%20Colorado%20Springs%2C%20CO%2080908%2C%20USA

FIGURES



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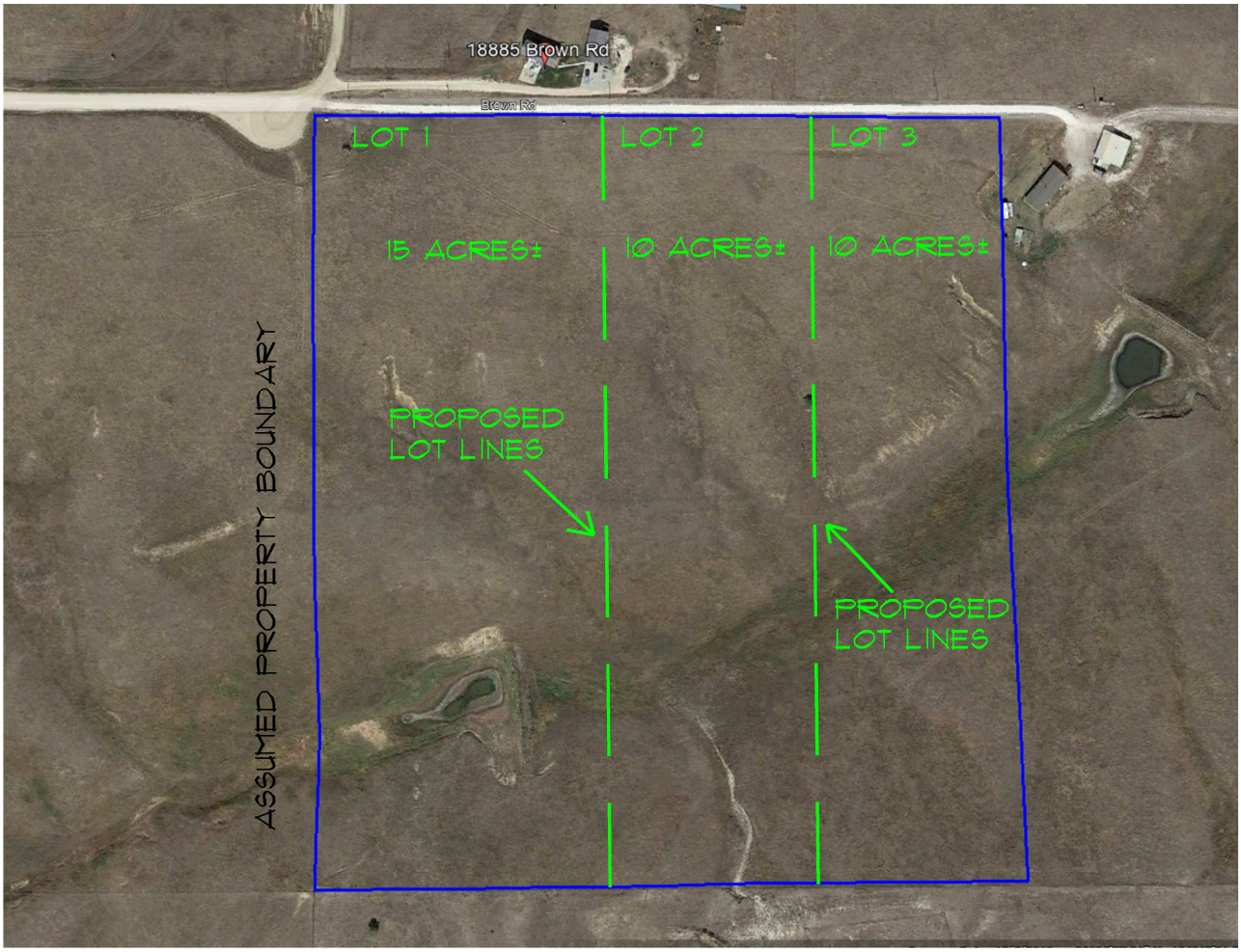
SITE VICINITY MAP

18735 BROWN ROAD
LOTS 1-3, BOYD MINOR SUBDIVISION
EL PASO COUNTY, COLORADO
CHRIS BOYD

JOB No. 186500

FIG No. 1

DATE 2-8-2022



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PROPOSED LOT LAYOUT

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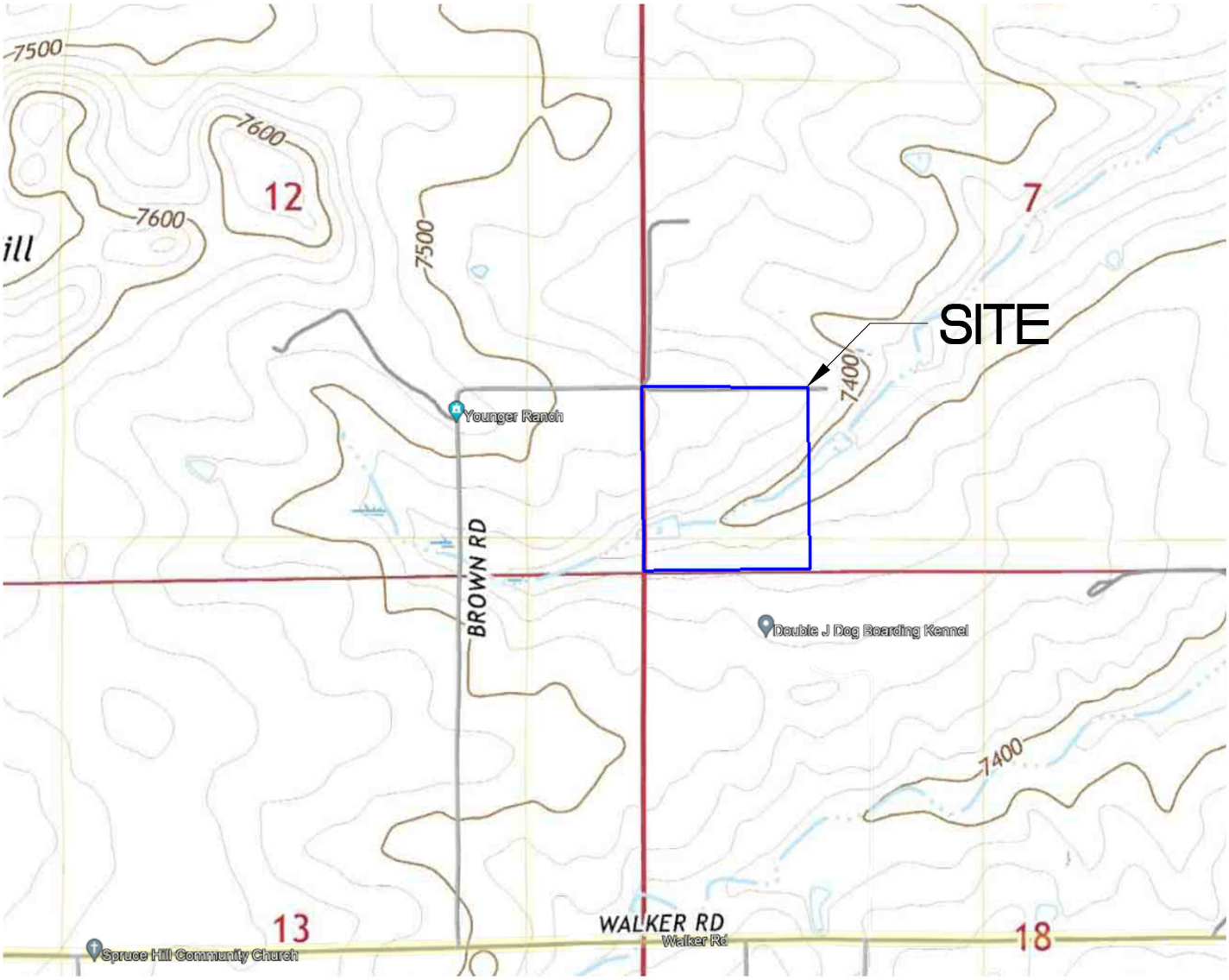
FIG No. 2

DATE 2-8-2022



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USGS TOPO MAP

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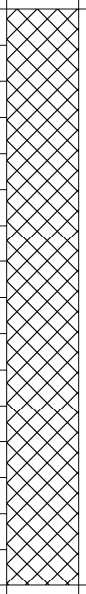
FIG No. 3

DATE 2-8-2022

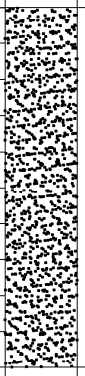
TEST PIT TP-1

DATE OBSERVED: 12/3/21

SOIL DESCRIPTION	DEPTH (FT)	SYMBOL	SOIL TYPE
0 - 8.0 FT SILTY CLAY (STRONG, BLOCKY)	2ft 4ft 6ft 8ft		4

TEST PIT TP-2

DATE OBSERVED: 12/3/21

SOIL DESCRIPTION	DEPTH (FT)	SYMBOL	SOIL TYPE
0 - 3.0 FT SILTY CLAY LOAM (STRONG, BLOCKY)	2ft		R-1
3.0 - 8.0 FT SANDY CLAY LOAM (MODERATE)	4ft 6ft 8ft		3

SOIL DESCRIPTIONS

SILTY CLAY LOAM

SILTY CLAY

SANDY CLAY LOAM

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TEST PIT LOGS

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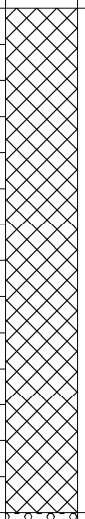
FIGURE No. 4

PAGE 1 OF 2

DATE 2-8-2022

TEST PIT TP-3

DATE OBSERVED: 12/3/21

SOIL DESCRIPTION	DEPTH (FT)	SYMBOL	SOIL TYPE
0 - 7.0 FT SILTY CLAY (STRONG, BLOCKY) (MODERATE)	2ft 4ft 6ft		4
7.0 FT - 8.0 FT CLAY (MODERATE)	8ft		4

SOIL DESCRIPTIONS

 SILTY CLAY

 CLAY

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TEST PIT LOGS

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FIGURE No. 4

PAGE 2 OF 2

DATE 2-8-2022

15 - Brussett loam, 3 to 5 percent slopes
67 - Peyton sandy loam, 5 to 9 percent slopes
69 - Peyton-Pring complex, 8 to 15 percent slopes

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USDA SOIL SURVEY MAP

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FIG No. 5

DATE 2-8-2022

REFERENCE
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Geologic Conditions

TKda5 - Dawson Formation, Facies Unit Five (early to middle Eocene)

QTa - Alluvium of Palmer Divide (early Pleistocene or Pliocene)

sw - Seasonally Wet Area

psw - Potentially Seasonally Wet Area

af - Artificial Fill Area

Engineering Conditions

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

3B - Expansive and potenially expansive soil and bedrock on flat to moderate slopes (0-12%)

7A - Physiographic Floodplain where erosion and deposition presently occur (as mapped by Charles Robinson and Associates, 1977)

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Pueblo / Canon City:
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LOTS 1-3
BOYD MINOR SUBDIVISION

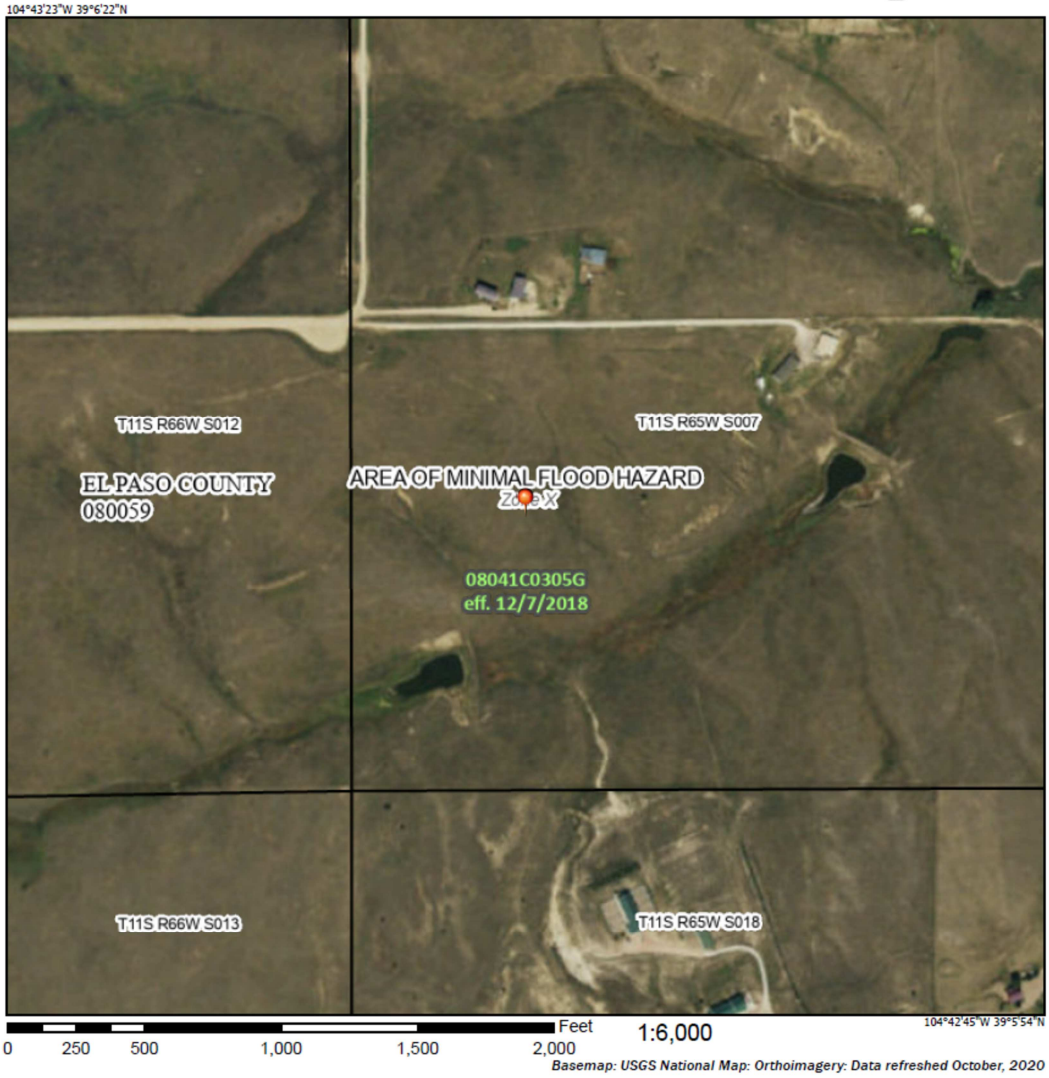
EL PASO COUNTY, COLORADO
CHRIS BOYD

ENGINEER:	TPM
DRAWN BY:	KCR
CHECKED BY:	TPM
ISSUED:	2-8-2022

ENGINEERING AND GEOLOGY MAP

SHEET No.
FIG-6

National Flood Hazard Layer FIRMette



Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) Zone A, V, A99
- With BFE or Depth Zone AE, AO, AH, VE, AR
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
- Future Conditions 1% Annual Chance Flood Hazard Zone X
- Area with Reduced Flood Risk due to Levee. See Notes. Zone X
- Area with Flood Risk due to Levee Zone D

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard Zone X
- Effective LOMRs
- Area of Undetermined Flood Hazard Zone D

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 12/14/2021 at 5:28 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

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FEMA MAP

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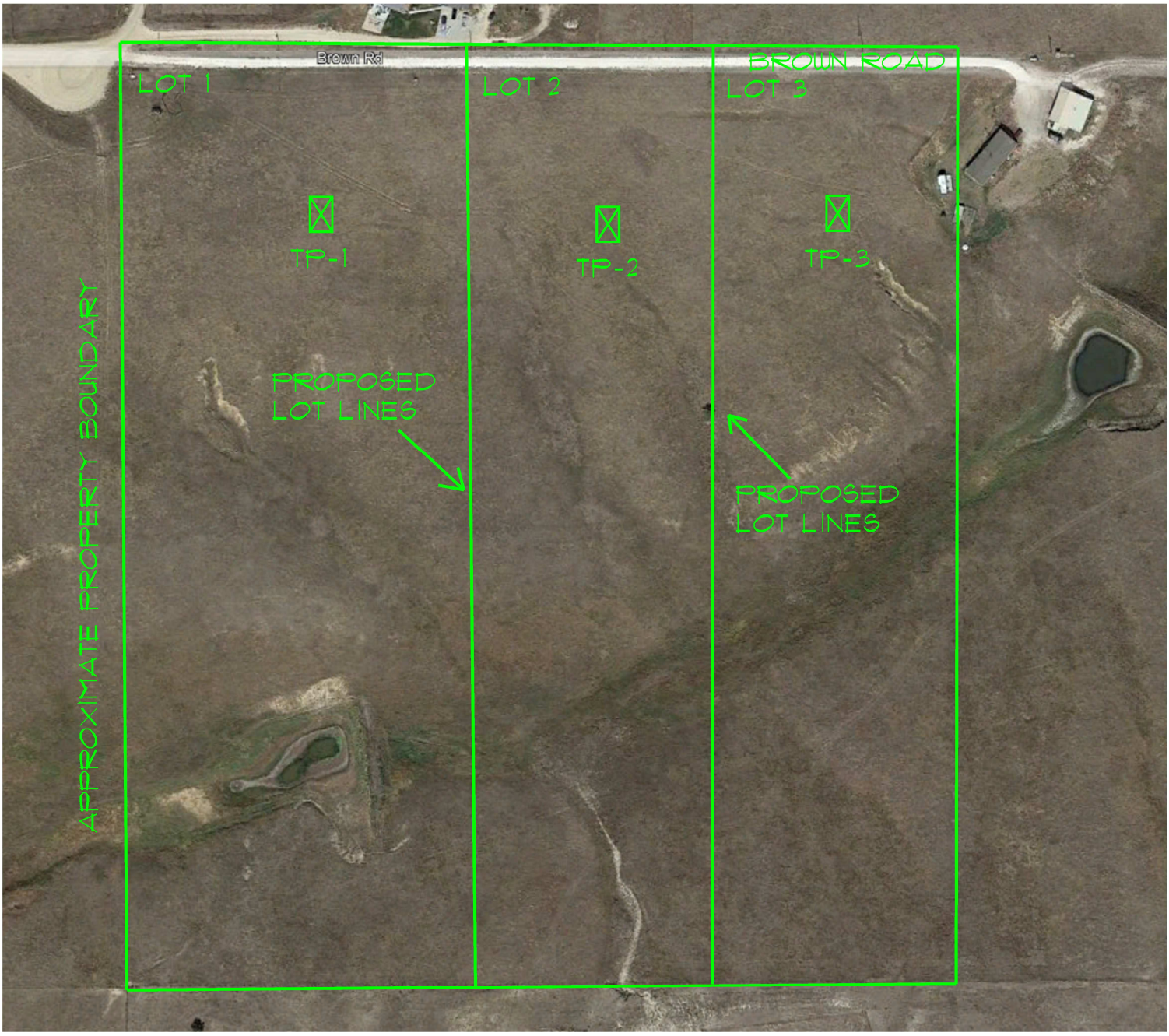
FIG No. 7

DATE 2-8-2022



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DENOTES APPROXIMATE LOCATION OF TEST PITS

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TEST PIT LOCATION MAP

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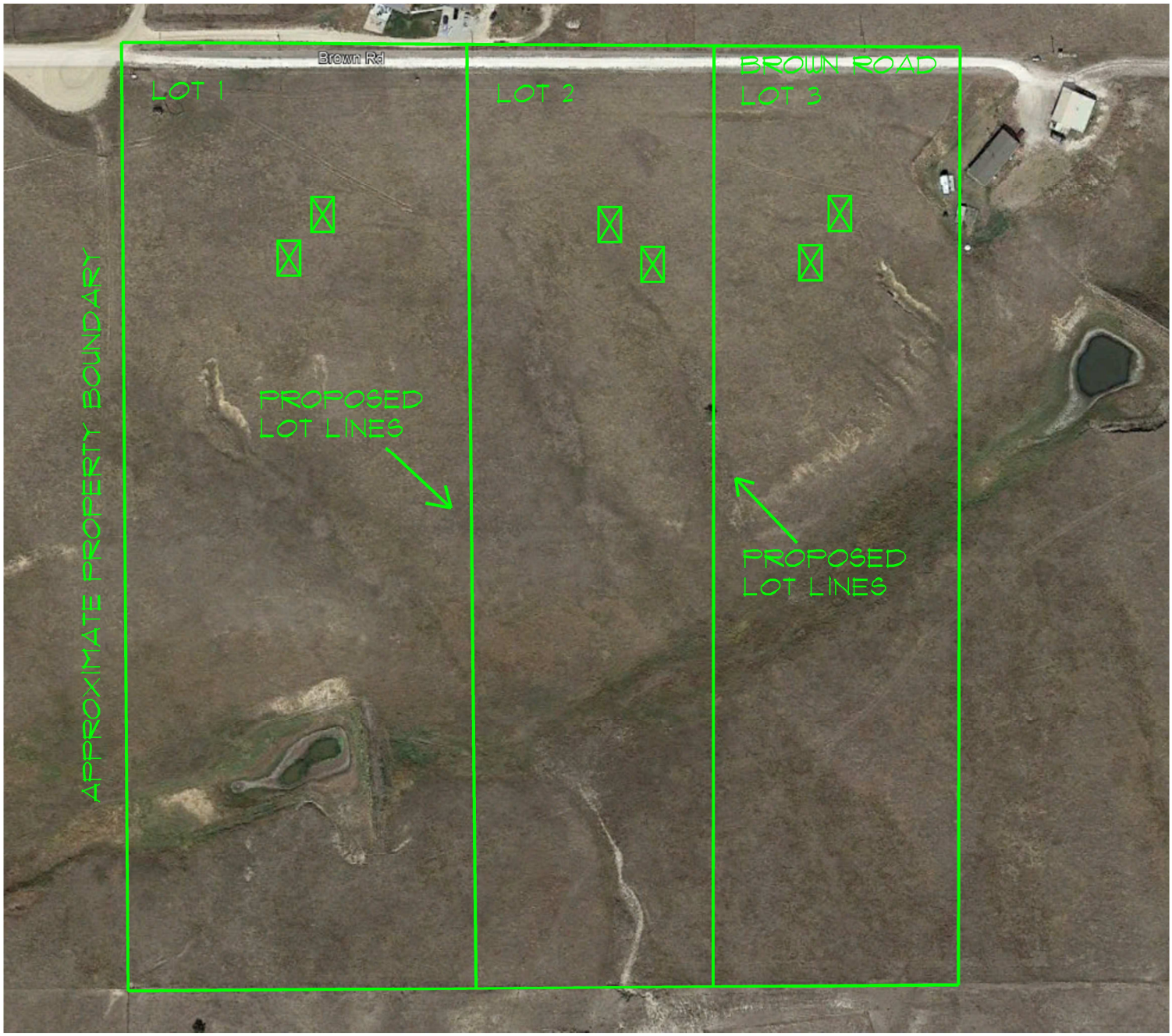
FIG No. 8

DATE 2-8-2022



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DENOTES PRIMARY AND ALTERNATE SEPTIC LOCATIONS

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SEPTIC SUITABILITY MAP

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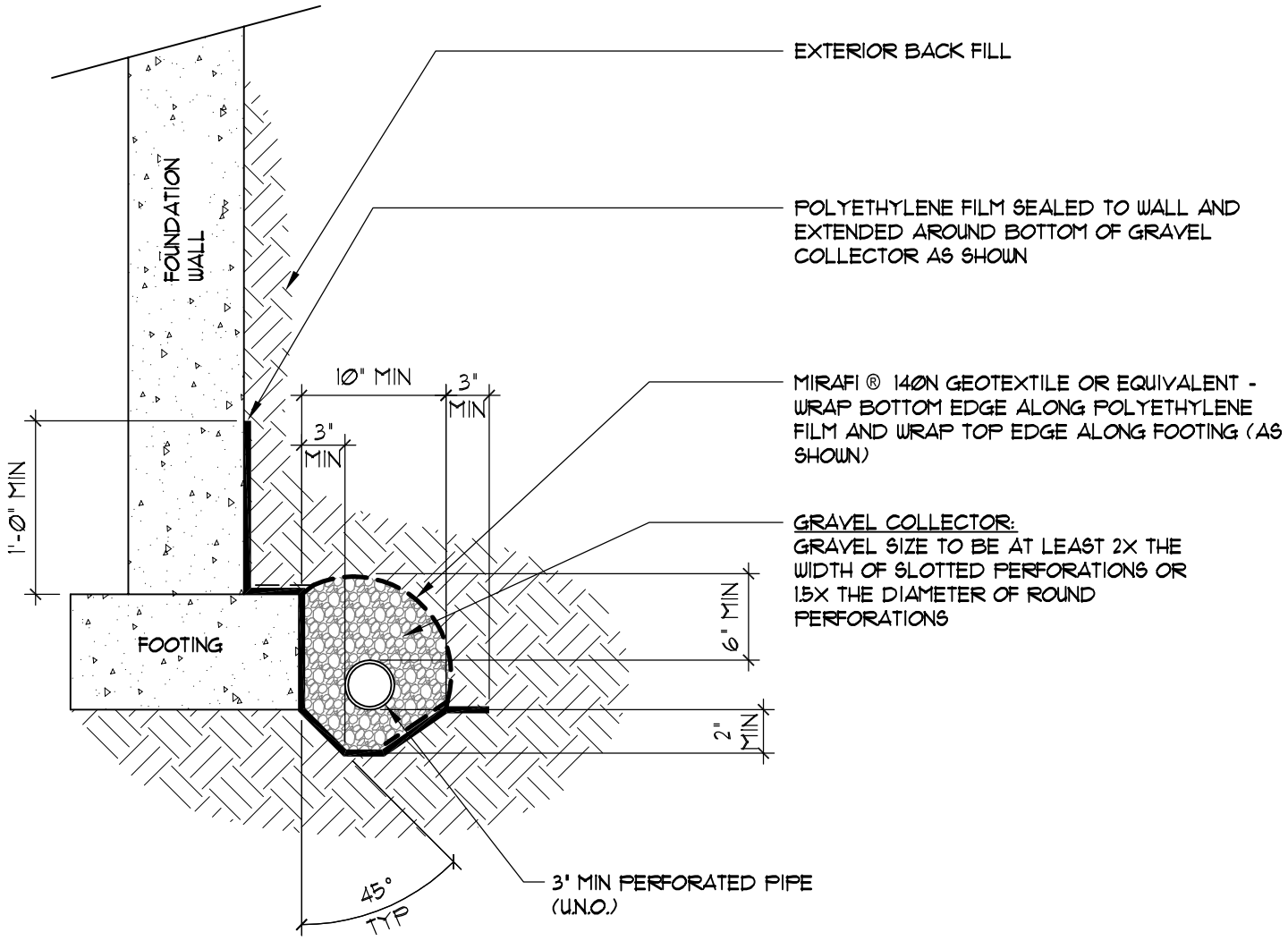
FIG No. 9

DATE 2-8-2022



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.
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.

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PERIMETER DRAIN

FIG No. 10