ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO 80907
PHONE (719) 531-5599
FAX (719) 531-5238

SOIL, GEOLOGY, AND GEOLOGIC HAZARD
THE COTTAGES AT MESA RIDGE
PARCEL NO. 5529100006
EL PASO COUNTY, COLORADO

Prepared for:

Goodwin Knight
8605 Explorer Drive, Suite 250
Colorado Springs, Colorado 80920

Attn: Dave Morrison

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Respectfully Submitted,

ENTECH ENGINEERING, INC.

Logan L. Langford, P.G.
Geologist

COLORADO REGISTERED
JOSEPH COLLIN GOODE JR.
23725
8-30-2022
PROFESSIONAL ENGINEER

Reviewed by:

Joseph C. Goode, Jr., P.E.
President

LLL/am

Encl.

Entech Job No. 211100
AAprojects/2021/211100 county soil/geo

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1.0 SUMMARY

Project Location

The project lies in portions of the SE¼ of Section 20, SW¼ of Section 21, NW¼ of Section 28, and the NE¼ of Section 29, Township 15 South, Range 65 West of the 6th Principal Meridian in El Paso County, Colorado. The site is located just northeast of Fountain, Colorado, city limits.

Project Description

Total acreage involved in the project is approximately 10 acres. The proposed site development consists of a residential development of sixty-one (61) cottages, a clubhouse, several detached garages, and associated site improvements. The development will utilize municipal sewer and water.

Scope of Report

This report presents the results of our geologic evaluation and treatment of engineering geologic hazard study.

Land Use and Engineering Geology

This site was found to be suitable for the proposed development. Areas were encountered where the geologic conditions will impose constraints on development and land use. These include areas of artificial fill, collapsible soils, expansive soils, potential seasonal shallow groundwater, shallow bedrock, and flowing water. Based on the proposed sketch plan, it appears that these areas will have minor constraints on the development. These conditions will be discussed in greater detail in the report.

In general, it is our opinion that the development can be achieved if the observed geologic conditions on site can be properly mitigated with site grading and engineering design. All recommendations are subject to the limitations discussed in the report.

2.0 GENERAL SITE CONDITIONS AND PROJECT DESCRIPTION

The site is in portions of the SE¼ of Section 20, SW¼ of Section 21, NW¼ of Section 28, and the NE¼ of Section 29, Township 15 South, Range 65 West of the 6th Principal Meridian in El Paso County, Colorado. The site is located just northeast of Fountain, Colorado, city limits, to the west of the intersection of South Powers Boulevard and Mesa Ridge Parkway. The location of the site is as shown on the Vicinity Map, Figure 1.

The topography of the site is generally gradually to moderately sloping to the southwest. An irrigation ditch is located along the southwestern, southern, and southeastern sides of the site, and an existing temporary detention pond is located in the southeastern portion of the site. The irrigation ditch flows in an easterly direction. Water was observed in the irrigation ditch at the time of this investigation. The site boundaries are indicated on the USGS Map, Figure 2. Previous land uses have included grazing and pasture land. The site contains primarily field grasses, and weeds. Site photographs, taken August 4, 2021, are included in Appendix A.

Total acreage involved in the proposed development is approximately 10 acres. The proposed site development consists of a residential development of sixty-one (61) cottages, a clubhouse, several detached garages, and associated site improvements. Twenty (20) Test Borings were performed on the site as part of the Subsurface Soils Investigation to determine general soil and bedrock characteristics (Reference 1). The locations of the test borings are indicated on the Site Plan/Test Boring Location Map, Figure 3. Proposed grading is shown indicated on the Site Plan with proposed cuts up to 11.5 feet and fills of approximately 3 feet. Several retaining walls are proposed across the site and should be designed by qualified professionals. Retaining walls can be constructed with mechanically stabilized earth (MSE) walls utilizing either smaller keystone type blocks or larger Redi-Rock wall systems. Retaining Wall design parameters are included in Section 10.0.

3.0 SCOPE OF THE REPORT

The scope of the report will include the following:

- A general geologic analysis utilizing published geologic data. Detailed site-specific mapping will be conducted to obtain general information in respect to major geographic and geologic features, geologic descriptions and their effects on the development of the property.

4.0 FIELD INVESTIGATION

Our field investigation consisted of the preparation of a geologic map of any bedrock features and significant surficial deposits. The Natural Resource Conservation Service (NRCS), previously the Soil Conservation Service (SCS) survey was also reviewed to evaluate the site. The position of mappable units within the subject property are shown on the Geologic Map. Our mapping procedures involved both field reconnaissance and measurements and air photo reconnaissance and interpretation. The same mapping procedures have also been utilized to produce the Engineering Geology Map which identified pertinent geologic conditions affecting development. The field mapping was performed by personnel of Entech Engineering, Inc. on August 4, 2021.

A Subsurface Soil Investigation was previously performed by Entech Engineering, Inc. for the proposed development, August 18, 2021 (Reference 1). Twenty (20) Test Borings were performed on the site to determine general soil and bedrock characteristics. The locations of the test borings are indicated on the Site Map/Test Boring Location Map, Figure 3. The Test Boring Logs are presented in Appendix B. Results of this testing will be discussed later in this report.

Laboratory testing was also performed on some of the soils to classify and determine the soils engineering characteristics. Laboratory tests included grain-size analysis, ASTM D-422, and Atterberg Limits, ASTM D-4318. Swell/Consolidation and FHA Swell Testing to evaluate expansion potential. Sulfate testing was performed on selected samples to evaluate potential for below grade concrete degradation due to sulfate attack. A Summary of Laboratory Test Results is included in Appendix B.

5.0 SOIL, GEOLOGY AND ENGINEERING GEOLOGY

5.1 General Geology

Physiographically, the site lies in the western portion of the Great Plains Physiographic Province. Approximately 8 miles to the west is a major structural feature known as the Ute Pass Fault. This fault marks the boundary between the Great Plains Physiographic Province and the Southern Rocky Mountain Province. The site exists within the southeastern edge of a large structural feature known as the Denver Basin. Bedrock in the area tends to be very gently dipping in a northeasterly direction (Reference 2). The rocks in the area of the site are sedimentary in nature and typically Upper Cretaceous in age. The bedrock underlying the site consists of the Pierre Shale Formation. Overlying this formation are unconsolidated deposits of artificial fill and residual soils of Quaternary Age. The site's stratigraphy will be discussed in more detail in Section 5.3.

5.2 Soil Conservation Survey

The Natural Resource Conservation Service (Reference 3), previously the Soil Conservation Service (Reference 4) has mapped one soil types on the site Figure 4. In general, the soils classify as sandy loams. The soils are described as follows:

Type	Description
56	Nelson-Tassel Fine Sandy Loams, 3 to 18% slopes

Complete descriptions of each soil type are presented in Appendix C. The soils have generally been described to have rapid to moderate permeabilities. Possible hazards with soil erosion are present on the site. The erosion potential can be controlled with vegetation. The majority of the soils have been described to have moderate erosion hazards.

5.3 Site Stratigraphy

The Fountain Quadrangle Geology Map showing the site is presented in Figure 6 (Reference 5). The Geology Map prepared for the site is presented in Figure 6. Two mappable units were identified on this site which are described as follows:

Qaf **Artificial Fill of Quaternary Age:** These materials man-made fill deposits associated with the irrigation ditch, berms, and soil stockpiles located across the site.

Qc/Kp **Colluvial and Residual Soils of Quaternary Age Pierre Shale of Cretaceous Age:** There is a variable layer of colluvial and residually weathered soils above the Pierre Shale. This formation consists of olive brown to gray claystone and shale. These materials were deposited in a marine environment associated with the Cretaceous Seaway. The soils and bedrock associated with this formation are typically expansive.

The soils listed above were mapped from site-specific mapping, the *Geologic Map of the Fountain Quadrangle* distributed by the Colorado Geological Survey in 2002 (Reference 5), the *Geologic Map of the Colorado Springs-Castle Rock Area*, distributed by the US Geological Survey in 1979 (Reference 6), and the *Geologic Map of the Pueblo* 1^0 *x* 2^0 *Quadrangle*, distributed by the US Geological Survey in 1978 (Reference 7). The Test Borings were also used in evaluating the site and are included in Appendix B. The Geology Map prepared for the site is presented in Figure 6.

5.4 Soil Conditions

Two soil types and three bedrock types were encountered in the test borings drilled for the subsurface investigation: Type 1: very clayey sand (SC), Type 2: very sandy to sandy clay (CL), Type 3: very clayey sandstone (SC), Type 4: sandy to very sandy claystone (CL), and Type 5: shale (CL). The soil and bedrock were classified in accordance with the Unified Soil Classification System (USCS) using the laboratory testing results and the observations made during drilling.

<u>Soil Type 1</u> classified as very clayey sand (SC). The clayey sand was encountered in three borings at the existing ground surface to depths ranging between 3 to 9 feet. Standard Penetration Testing resulted in SPT N-values of 15 to 48 blows-per-foot (bpf), indicating medium to very dense states. Water content and grain size testing resulted in approximately 6 to 17 percent water content and approximately 38 to 46 percent of the soil size particles passing the No. 200 sieve. FHA Swell Testing resulted in swell pressures between 180 and 360 psf, indicating a low expansion potential. Sulfate Testing on the clay and clay-silt resulted in less

than 0.01 sulfate by weight, indicating the very clayey sand negligible potential for below grade concrete degradation due to sulfate attack.

Soil Type 2 classified as sandy to very sandy clay and sandy clay fill (CL). The very sandy clay and sandy clay fill was encountered all but one of the test borings underlying Soil Type1 or from the surface and a depth of 20 feet in Test Boring Nos. 1, 17 and 19. Standard Penetration Testing resulted in SPT N-values of 8 to 50 bpf, indicating firm to hard consistencies. Water content and grain size testing resulted in approximately 7 to 21 percent water content and approximately 59 to 76 percent of the soil size particles passing the No. 200 sieve. Atterberg Limits Testing indicated the clay had Liquid Limits between 34 and 41 and Plastic Indexes between 15 and 25. Swell/Consolidation Testing resulted in volume changes between 0.5 and 1.5 percent, swell and 0.3 and 2.1 percent consolidation, indicating low to high swell/consolidation potentials. Sulfate Testing on the clay resulted in less than 0.01 percent sulfate by weight, indicating the sandy clay has negligible potential for concrete degradation due to sulfate attack.

Soil Type 3 classified as clayey sandstone (SC). The sandstone bedrock was encountered in Test Boring Nos. 3 at a depth of 3 feet and extending to 16 feet bgs. Standard Penetration Testing conducted on the sandstone resulted in SPT N-values of greater than 50 blows per foot (bpf), indicating very dense consistencies. Moisture content and grain size testing resulted in approximately 12 percent water content and approximately 47 percent of the soil size particles passing the No. 200 sieve. An Atterberg Limit Test resulted in a Liquid Limit of 37 and a Plastic Index of 19. Swell/Consolidation Testing resulted in volume changes of 0.01 percent, indicating low swell potentials. Sulfate testing on the sandstone resulted in 0.01 percent sulfate by weight, indicating the sandstone has negligible potential for below grade concrete degradation due to sulfate attack.

Soil Type 4 classified as sandy to very sandy claystone bedrock (CL). The claystone was encountered in 17 of the test borings ranging from 1 to 18 feet bgs and extending from 1 foot to the termination of the boring. Standard Penetration Testing resulted in SPT N-values of greater than 50 blows per foot (bpf) indicating hard consistencies. Moisture content and grain size analysis resulted in 6 to 17 percent water content and approximately 56 to 78 percent of the soils size particles passing the No. 200 sieve. Atterberg Limit Test resulted in a Liquid Limit of

35 and a Plastic Index of 1790. Swell/Consolidation Testing resulted in volume changes of 0.6 to 3.3 percent indicating low to very high swell properties. FHA Swell Testing resulted in swell pressures between 20 and 1110 psf, indicating a moderate swell expansion potential. Sulfate testing on the claystone resulted in 0.02 percent sulfate by weight, indicating the claystone has negligible potential for below grade concrete degradation due to sulfate attack.

Soil Type 5 classified as shale bedrock (SC/CL). The shale was encountered 13 of the 20 test borings underlying the claystone, Soil Type 4. Standard Penetration Testing conducted on the shale resulted in SPT N-values of greater than 50 blows per foot (bpf) indicating hard consistencies. Moisture content and grain size analysis resulted in 9.1 percent water content and 44 to 66 percent of the soil particles passing the No. 200 sieve. The shale typically has moderate to high swelling properties. Atterberg Limits and Sulfate testing was not conducted on the shale. A Summary of Laboratory Test Results is presented on Table 1, and the Test Boring Logs are presented in Appendix B.

5.5 Groundwater

Groundwater was encountered in Test Boring Nos. 2, 4, 9, 11, 12, 13, 14, 16 and 17 at depths ranging between 12 to 18 ½ feet. It is anticipated that groundwater will not affect shallow foundations for the slab-on-grade structures or shallow buried utilities proposed on this site. Groundwater may affect areas depending upon grading cuts and within deeper excavations made for installation of utilities. It should be noted that groundwater levels, other than those observed at the time of the subsurface investigation, could change due to season variations, changes in land runoff characteristics and future development of nearby areas.

It should be noted that in granular lenses, some groundwater conditions might be encountered due to the variability in the soil profile. Isolated sand and gravel layers within the soils, sometimes only a few feet in thickness and width, can carry water in the subsurface. Groundwater may also flow on top of the underlying bedrock. Builders and planners should be cognizant of the potential for the occurrence of such subsurface water features during construction on-site and deal with each individual problem as necessary at the time of construction.

6.0 ENGINEERING GEOLOGY – IDENTIFICATION AND MITIGATION OF GEOLOGIC HAZARDS

Detailed mapping has been performed on this site to produce a Geology Map/Engineering Geology Map Figure 6. This map shows the location of various geologic conditions of which the developers should be cognizant during the planning, design and construction stages of the project. Constraints/Hazards include artificial fill, collapsible soils, expansive soils, potential seasonal shallow groundwater, shallow bedrock, and flowing water. These hazards and the recommended mitigation techniques are as follows:

Artificial Fill - Constraint

Fill was encountered in some of the test borings, and fill piles were observed across portions of site, and review of historical images indicate that dumping of fill has occurred on the site. Fill associated with the irrigation ditch has also been indicated on the site Geology Map/Engineering Geology Map, Figure 6. Additionally, other areas of artificial fill may be encountered in areas other than those mapped. These piles are considered uncontrolled for construction purposes. It is anticipated the uncontrolled fill will be mitigated during site grading and development. Cut areas of up to 10.5 feet and fill areas of up to 3 feet are proposed.

Mitigation: It is anticipated the fill would be removed/mitigated during site grading. All uncontrolled fill should be completely removed prior to new fill placement. Any uncontrolled fill encountered beneath foundations will require removal and recompaction at a minimum of 95% of its maximum Modified Proctor Dry Density, ASTM D-1557. Any organic material or debris should be removed.

Collapsible Soils – Constraint

Some of the soils encountered in the test borings exhibited collapsible characteristics. In areas identified for this hazard classification, however, we anticipate a potential for settlement movements upon saturation of these surficial soils. The low density, uniform grain sized, windblown sand deposits are particularly susceptible to this type of phenomenon. Additionally, loose or collapsible soils may be encountered on this site.

Mitigation: The potential for settlement movement is directly related to saturation of the soils below the foundation areas. Therefore, good surface and subsurface drainage is extremely

critical in these areas in order to minimize the potential for saturation of these soils. The ground surface around all permanent structures should be positively sloped away from the structure to all points, and water must not be allowed to stand or pond anywhere on the site. We recommend that the ground surface within 10 feet of the structures be sloped away with a minimum gradient of five percent. If this is not possible on the upslope side of the structures, then a well-defined swale should be created to intercept the surface water and carry it quickly and safely around and away from the structures. Roof drains should be made to discharge well away from the structures and into areas of positive drainage. Where several structures are involved, the overall drainage design should be such that water directed away from one structure is not directed against an adjacent building. Planting and watering in the immediate vicinity of the structures, as well as general lawn irrigation, should be minimized.

Mitigation: Should loose or collapsible soils be encountered beneath foundations, recompaction and moisture conditioning of the upper 2 to 3 feet of soil at 95 percent of its maximum Modified Proctor Dry Density ASTM D-1557 will be required. Exterior flatwork and parking areas may also experience movement. Proofrolling and recompaction of soft areas should be performed during site work.

Expansive Soils – Constraint

Expansive soils are common in the area, and were encountered in the test borings drilled on site. Swells ranged from low to moderately high in the soils tested. The clay and claystone, if encountered beneath foundations, can cause differential movement in the structure foundation. These occurrences should be identified and dealt with on an individual basis or possibly mitigated during site grading.

Mitigation Expansive soils encountered beneath foundations will require mitigation. Mitigation of expansive soils may require special foundation design. Overexcavation and replacement with non-expansive soils at a minimum of 95 percent of its maximum Modified Proctor Dry Density, ASTM D-1557 is a suitable mitigation, which is common in the area. Floor slabs on expansive soils should be expected to experience movement. Overexcavation and replacement has been successful in minimizing slab movements. Overexcavation depths of 4 to 5 feet are anticipated for the site. Mitigation may also include moisture conditioning and recompaction of the clay soils.

Groundwater and Floodplain Areas – Constraint

An irrigation ditch is located along the southwestern, southern, and southeastern sides of the site, and an existing temporary detention pond is located in the southeastern portion of the site. Areas within the low area on-site have been identified as areas of potential seasonally shallow groundwater areas. Water was flowing in the irrigation ditch at the time of this investigation. The site is not mapped within floodplain zones according to the FEMA Map No. 08041CO956G, (Figure 7, Reference 8). These areas are discussed as follows:

Potentially Seasonal Shallow Groundwater - Constraint

The areas mapped with this hazard are located a low area in the southeastern portion of the site adjacent to a fill berm along the irrigation ditch. In these areas, we would anticipate the potential for periodically high subsurface moisture conditions and possible frost heave potential, depending on the soil conditions.

Mitigation In these locations, foundations in areas subject to severe frost heave potential should penetrate sufficient depth so as to discourage the formation of ice lenses beneath foundations. At this location and elevation, a foundation depth for frost protection of 2.5 feet is recommended. In areas where high subsurface moisture conditions are anticipated periodically, a subsurface perimeter drain will be necessary to help prevent the intrusion of water into areas located below grade. A typical perimeter drain detail is presented in Figure 9. Additionally, swales should be created to intercept surface runoff and carry it safely around and away from structures. It is anticipated that the site grading will likely mitigate potentially seasonal shallow groundwater area on the site. Prior to placing any fill all organic soils should be removed.

6.1 Relevance of Geologic Conditions to Land Use Planning

The proposed development will consist of residential development. It is our opinion that the existing geologic and engineering geologic conditions will impose some constraints on the proposed development and construction. The most significant problems affecting development will be those associated with the artificial fill, collapsible soils, expansive soils, potentially seasonal shallow groundwater areas, and shallow bedrock on-site that can be mitigated with special designs. The hazards on site may be satisfactorily mitigated through proper engineering design and construction practices.

The upper materials are typically at medium dense to dense states and firm to very stiff consistencies. Expansive soils requiring mitigation were encountered in a majority of the test borings. Loose soils if encountered at foundation depth will require recompaction. Foundations anticipated for the site are standard spread footings in conjunction with overexcavation/moisture conditioning. Excavation of the sand and clay soils is anticipated to be moderate with rubber-tired equipment. Excavation of claystone and shale may be difficult and require track-mounted equipment. Expansive soils will require special foundation design and/or overexcavation. These soils will not prohibit development.

Areas of potential seasonally shallow groundwater were observed in the low areas in southeastern portion of the site. These areas will likely be mitigated with the proposed site grading. The irrigation ditch will be filled and piped as part of the site improvements.

In summary, development of the site can be achieved, if the items mentioned above are mitigated. These items can be mitigated through proper design and construction or through avoidance. Additional subsurface soil investigation is recommended prior to construction.

7.0 ECONOMIC MINERAL RESOURCES

According to the *El Paso County Aggregate Resource Evaluation Map* (Reference 8), the area is not mapped with any aggregate deposits. According to the *Atlas of Sand, Gravel and Quarry Aggregate Resources, Colorado Front Range Counties* distributed by the Colorado Geological Survey (Reference 9), areas of the site are not mapped with any resources. According to the *Evaluation of Mineral and Mineral Fuel Potential* (Reference 10), the area of the site has been mapped as “Fair” for industrial minerals. However, considering the clayey silty nature of the soils, they would be considered to have little significance as an economic resource.

According to *the Evaluation of Mineral and Mineral Fuel Potential of El Paso County State Mineral Lands* (Reference 10), the site is mapped within the Denver Basin Coal Region. However, the area of the site has been mapped as “Poor” for coal resources. No active or inactive mines have been mapped in the area of the site. No metallic mineral resources have been mapped on-site (Reference 10).

The site has been mapped as “Fair” for oil and gas resources (Reference 10). No oil or gas fields have been discovered in the area of the site. The sedimentary rocks in the area may lack the geologic structure for trapping oil or gas; therefore, it may not be considered a significant resource. Hydraulic fracturing is a new method that is being used to extract oil and gas from rocks. It utilizes pressurized fluid to extract oil and gas from rocks that would not normally be productive. The area of the site has not been explored to determine if the rocks underlying the site would be commercially viable utilizing hydraulic fracturing. The practice of hydraulic fracturing has come under review due to concerns about environmental impacts, health and safety.

8.0 EROSION CONTROL

The soil types observed on the site are mildly to highly susceptible to wind erosion, and moderately to highly susceptible to water erosion. A minor wind erosion and dust problem may be created for a short time during and immediately after construction. Should the problem be considered severe enough during this time, watering of the cut areas or the use of chemical palliative may be required to control dust. However, once construction has been completed and vegetation re-established, the potential for wind erosion should be considerably reduced.

With regard to water erosion, loosely compacted soils will be the most susceptible to water erosion, residually weathered soils become increasingly less susceptible to water erosion. For the typical soils observed on-site, allowable velocities or unvegetated and unlined earth channels would be on the order of 3 to 4 feet/second, depending upon the sediment load carried by the water. Permissible velocities may be increased through the use of vegetation to something on the order of 4 to 7 feet/second, depending upon the type of vegetation established. Should the anticipated velocities exceed these values, some form of channel lining material may be required to reduce erosion potential. These might consist of some of the synthetic channel lining materials on the market or conventional riprap. In cases where ditch-lining materials are still insufficient to control erosion, small check dams or sediment traps may be required. The check dams will serve to reduce flow velocities, as well as provide small traps for containing sediment. The determination of the amount, location and placement of ditch linings, check dams and of the special erosion control features should be performed by or in conjunction with the drainage engineer who is more familiar with the flow quantities and velocities.

Cut and fill slope areas will be subjected primarily to sheetwash and rill erosion. Unchecked rill erosion can eventually lead to concentrated flows of water and gully erosion. The best means to combat this type of erosion is, where possible, the adequate re-vegetation of cut and fill slopes. Cut and fill slopes having gradients more than three (3) horizontal to one (1) vertical become increasingly more difficult to revegetate successfully. Therefore, recommendations pertaining to the vegetation of the cut and fill slopes may require input from a qualified landscape architect and/or the Soil Conservation Service.

9.0 ROADWAY AND EMBANKMENT CONSTRUCTION RECOMMENDATIONS

In general, the site soils are suitable for the proposed roadways and embankments. Groundwater may be encountered in deeper cuts and along drainages and low areas. If excavations encroach on the groundwater level unstable soil conditions may be encountered. Excavation of saturated soils may be difficult with rubber-tired equipment. Stabilization using shot rock or geogrids may be necessary.

Swell/Consolidation testing was conducted on the site subgrade soils which showed consolidations ranging between 0.3 to 2.1, and swells ranging between 0.1 and 3.3 percent. Many samples were above the level in which mitigation is required (2.0 percent) with a some of the soils exceeding the swell threshold. These results indicate that soil mitigation due to collapsible and expansive soils will likely be required for the roadways. Overexcavation and cement-stabilization or removal, moisture conditioning, and recompaction are suitable mitigation methods for the expansive soils in the roadways. Additional investigation for the proposed roadways will be required once site grading has been completed and utilities have been installed.

Any areas to receive fill should have all topsoil, organic material, or debris removed. Prior to fill placement, Entech should observe the subgrade. Fill must be properly benched and compacted to minimize potentially unstable conditions in slope areas. Fill slopes should be 3:1. The subgrade should be scarified and moisture conditioned to within 2 percent of optimum moisture content and compacted to a minimum of 95 percent of its maximum Standard Proctor Dry Density, ASTM D-698, prior to placing new fill. Areas receiving fill may require stabilization with rock or fabric, if shallow groundwater conditions are encountered. **Any areas receiving greater**

than 10 feet of fill will require 100% of its maximum Standard Proctor Dry Density, ASTM D-698.

New fill should be placed in thin lifts not to exceed 6 inches after compaction while maintaining at least 95 percent of its maximum Modified Proctor Dry Density, ASTM D-1557 for sandy soils, and clay soils should be compacted to a minimum of 95 percent of its maximum Standard Proctor Dry Density, ASTM D-698 at 0 to 4 percent of optimum moisture content. These materials should be placed at a moisture content conducive to compaction, usually 0 to ±2 percent of Proctor optimum moisture content. The placement and compaction of fill should be observed and tested by Entech during construction. Entech should approve any import materials prior to placing or hauling them to the site. Additional investigation will be required for pavement designs once roadway grading is completed and utilities are installed.

10.0 RETAINING WALL DESIGN VALUES

MSE walls are proposed for the site. The following preliminary values are recommended for use in designing retaining walls that may be associated with the project.

Recommended Design Values – Lateral Loading

Equivalent fluid density for lateral earth pressure granular soils(active), pcf	42
Equivalent fluid density for lateral earth pressure clay(active), pcf	50
Equivalent fluid density for lateral earth pressure granular soils(passive), pcf	300
Equivalent fluid density for lateral earth pressure granular soils(at rest), pcf	60
Soil density (compacted sand), pcf	125
Soil density (compacted clay), pcf	110
Angle of Internal Friction (loose sand), degrees	28
Angle of Internal Friction (compacted sand), degrees	32
Angle of Internal Friction (compacted clay), degrees	24
Coefficient of sliding between concrete and sand	0.35
Coefficient of sliding between concrete and clayey sand	0.25-0.30

The above lateral loading design values are for level backslope angles and no surcharge loads. If wall backfill is submerged, water pressures must be taken into account as additional wall loading. If backfill slope angles are greater than zero degrees, if the backfill is surcharged, the

design values must be adjusted to account for additional lateral loading. Expansive clay soils are not recommended for use as backfill against walls over 6 feet. All retaining walls over 4 feet will require design by a registered P.E.

11.0 CLOSURE

It is our opinion that the existing geologic engineering and geologic conditions will impose some constraints on development and construction of the site. The majority of these conditions can be mitigated through proper engineering design and construction practices. The proposed development and use are consistent with anticipated geologic and engineering geologic conditions.

It should be pointed out that because of the nature of data obtained by random sampling of such variable and non-homogeneous materials as soil and rock, it is important that we be informed of any differences observed between surface and subsurface conditions encountered in construction and those assumed in the body of this report. Individual investigations for building sites will be required prior to construction. Construction and design personnel should be made familiar with the contents of this report. Reporting such discrepancies to Entech Engineering, Inc. soon after they are discovered would be greatly appreciated and could possibly help avoid construction and development problems.

This report has been prepared for Goodwin Knight for application to the proposed project in accordance with generally accepted geologic soil and engineering practices. No other warranty expressed or implied is made.

We trust that this report has provided you with all the information that you required. Should you require additional information, please do not hesitate to contact Entech Engineering, Inc.

12.0 BIBLIOGRAPHY

1. Entech Engineering, Inc. August 18, 2021. *Subsurface Soil Investigation, Parkway Property, Parcel No. 5529100006, El Paso County, Colorado.* Entech Job No. 211100.

2. Scott, Glenn R.; Taylor, Richard B.; Epis, Rudy C. and Wobus, Reinhard A. 1978. *Geologic Structure Map of the Pueblo 1° x 2° Quadrangle, South-Central Colorado*. Sheet 2. U.S. Geologic Survey. Map I-1022.

3. Natural Resource Conservation *Service,* September 23, 2016*. Web Soil Survey.* United States Department Agriculture, http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm.

4. United States Department of Agriculture Soil Conservation Service. June 1981. *Soil Survey of El Paso County Area, Colorado.*

5. White, Jonathan L., Lindsey, Kassandra O., Morgan, Matthew L. and Mahan, Shannon A., 2017. *Geologic Map of the Fountain Quadrangle, El Paso County, Colorado*. Colorado Geological Survey. Open-File Report 17-05.

6. Trimble, Donald E. and Machette, Michael N. 1979. *Geologic Map of the Colorado Springs-Castle Rock Area, Front Range Urban Corridor, Colorado*. USGS, Map I-857-F.

7. Scott, Glenn R.; Taylor, Richard B.; Epis, Rudy C. and Wobus, Reinhard A. 1978. *Geologic Map of the Pueblo 1° x 2° Quadrangle, South-Central Colorado*. U.S. Geologic Survey. Map 1-1022.

8. Federal Emergency Management Agency. December 7, 2018. *Flood Insurance Rate Maps for El Paso County, Colorado and Incorporated Areas.* Map Number 08041CO956G

9. El Paso County Planning Development. December 1995. *El Paso County Aggregate Resource Evaluation Maps.*

10. Schwochow, S.D.; Shroba, R.R. and Wicklein, P.C. 1974*. Atlas of Sand, Gravel, and Quarry Aggregate Resources, Colorado Front Range Counties*. Colorado Geological Survey. Special Publication 5-B.

11. Keller, John W.; TerBest, Harry and Garrison, Rachel E. 2003. *Evaluation of Mineral and Mineral Fuel Potential of El Paso County State Mineral Lands Administered by the Colorado State Land Board*. Colorado Geological Survey. Open-File Report 03-07.

TABLES

TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

CLIENT GOODWIN KNIGHT
PROJECT MESA RIDGE
JOB NO. 211100

SOIL TYPE	TEST BORING NO.	DEPTH (FT)	WATER (%)	DRY DENSITY (PCF)	PASSING NO. 200 SIEVE (%)	LIQUID LIMIT (%)	PLASTIC INDEX (%)	SULFATE (WT %)	FHA SWELL (PSF)	SWELL/ CONSOL (%)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION
1	4	5			46.1			<0.01	180		SC	SAND, VERY CLAYEY
1	20	5			38.1				360		SC	SAND, VERY CLAYEY
2A	17	2-3	9.0	99.1	67.8	37	20			-2.1	CL	FILL, CLAY, SANDY
2	10	2-3	10.1	110.0	59.1					1.5	CL	CLAY, VERY SANDY
2	16	2-3	8.3	104.7	66.5					-0.3	CL	CLAY, SANDY
2	19	10	20.5	104.6	64.9	34	15			0.5	CL	CLAY, SANDY
2	1	2-3	13.4	119.6	75.6	41	25	<0.01		1.1	CL	CLAY, SANDY
3	3	10	12.4	113.9	47.0	37	19	0.01		0.1	SC	SANDSTONE, VERY CLAYEY
4	2	15	13.3	116.9	70.3	35	17	0.02		1.2	CL	CLAYSTONE, SANDY
4	5	10			78.0				1110		CL	CLAYSTONE, SANDY
4	6	5			55.7				720		CL	CLAYSTONE, VERY SANDY
4	7	5	12.4	113.9	61.0					1.3	CL	CLAYSTONE, VERY SANDY
4	9	10			63.1						CL	CLAYSTONE, SANDY
4	11	5	8.5	127.1	68.4					3.3	CL	CLAYSTONE, SANDY
4	12	20	15.1	116.9	72.6					0.6	CL	CLAYSTONE, SANDY
4	13	10			63.7						CL	CLAYSTONE, SANDY
4	14	5	10.6	97.5	53.3						CL	CLAYSTONE, VERY SANDY
4	18	15	11.4	117.7	53.1	30	16				CL	CLAYSTONE, VERY SANDY
5	8	20	9.1	97.7	66.1						CL	SHALE

Table 2: Summary of Depth of Fill, Bedrock, and Groundwater

Test Boring No.	Depth of Fill (ft.)	Depth to Bedrock (ft.)	Depth to Groundwater (ft.)
1	2	4	>20
2	N/A	7	12.5
3	N/A	3	>20
4	N/A	14	13
5	N/A	1	>20
6	N/A	1	18.5
7	N/A	1	>20
8	N/A	1	>20
9	N/A	1	17
10	N/A	3	>20
11	N/A	3	13
12	N/A	18	15
13	N/A	4*	16
14	N/A	4	15
15	N/A	1	>20
16	N/A	8	16
17	9	>20	12
18	N/A	12	>20
19	9	>20	>20
20	N/A	9	>20

* Weathered bedrock

FIGURES

N

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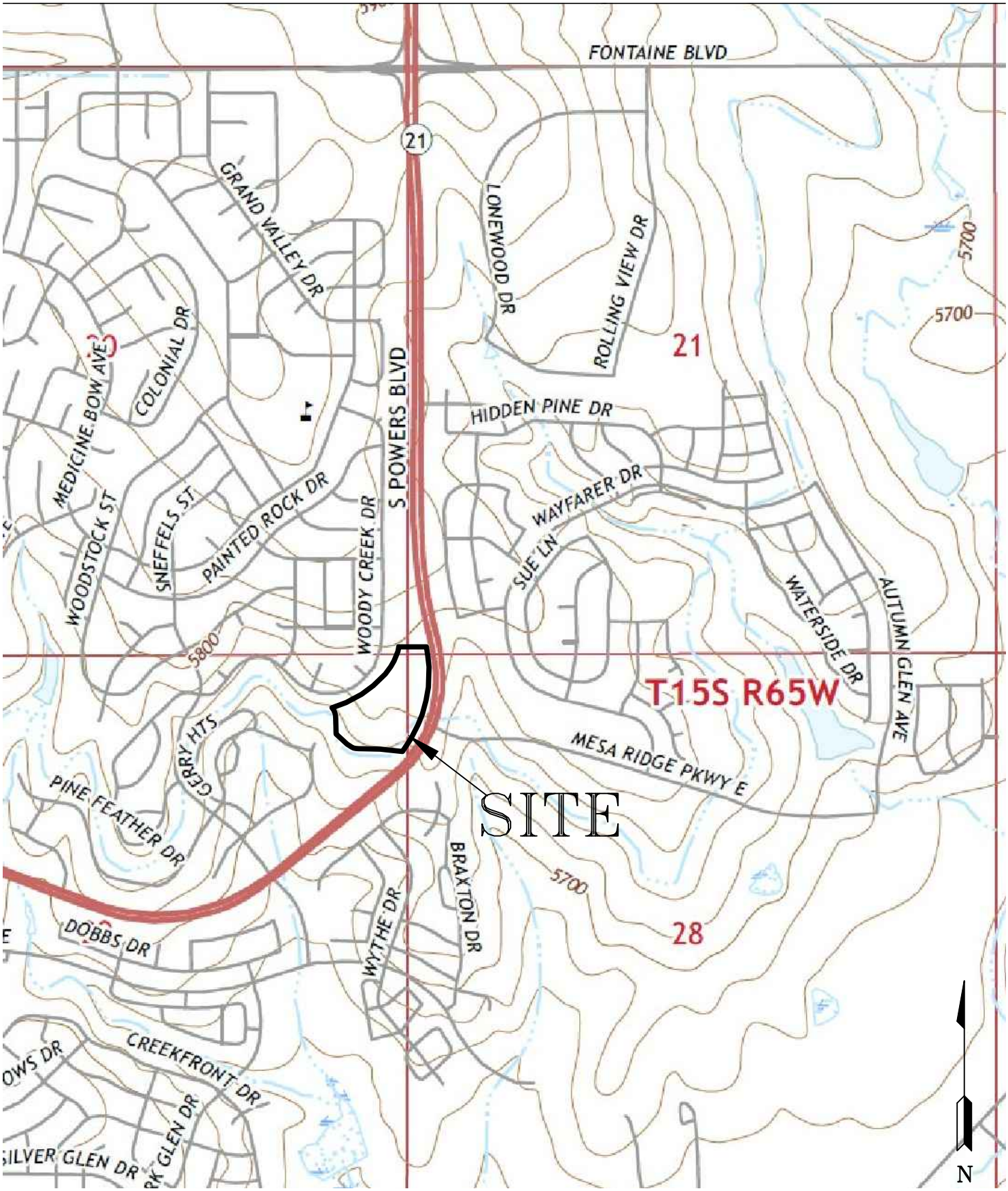
VICINITY MAP
THE COTTAGES AT MESA RIDGE
PARCEL NO. 55291-00-060
EL PASO COUNTY, CO.
FOR: GOODWIN KNIGHT

DRAWN:	DATE:	CHECKED:	DATE:
LLL	12/22/21		

JOB NO.: 211100

FIG NO.: 1



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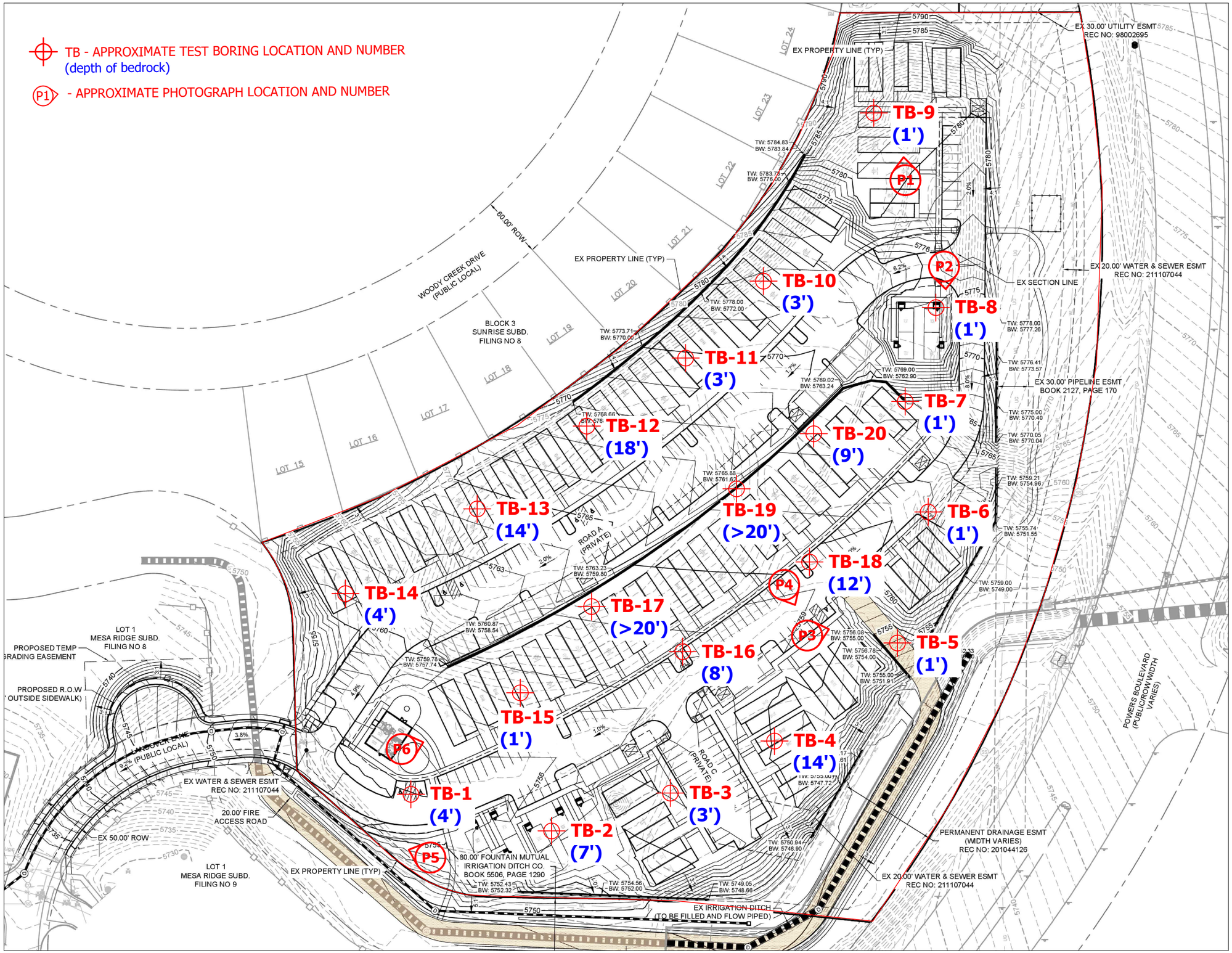
USGS MAP
THE COTTAGES AT MESA RIDGE
PARCEL NO. 55291-00-060
EL PASO COUNTY, CO.
FOR: GOODWIN KNIGHT

DRAWN:	DATE:	CHECKED:	DATE:
LLL	12/22/21		

JOB NO.: 211100

FIG NO.: 2



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SITE PLAN/TEST BORING LOCATION MAP
THE COTTAGES AT MESA RIDGE
PARCEL NO. 55291-00-060
EL PASO COUNTY, CO.
FOR: GOODWIN KNIGHT

DRAWN	LLL
CHECKED	
DATE	12/22/21
SCALE	AS SHOWN
JOB NO.	211100
FIGURE No.	3

N

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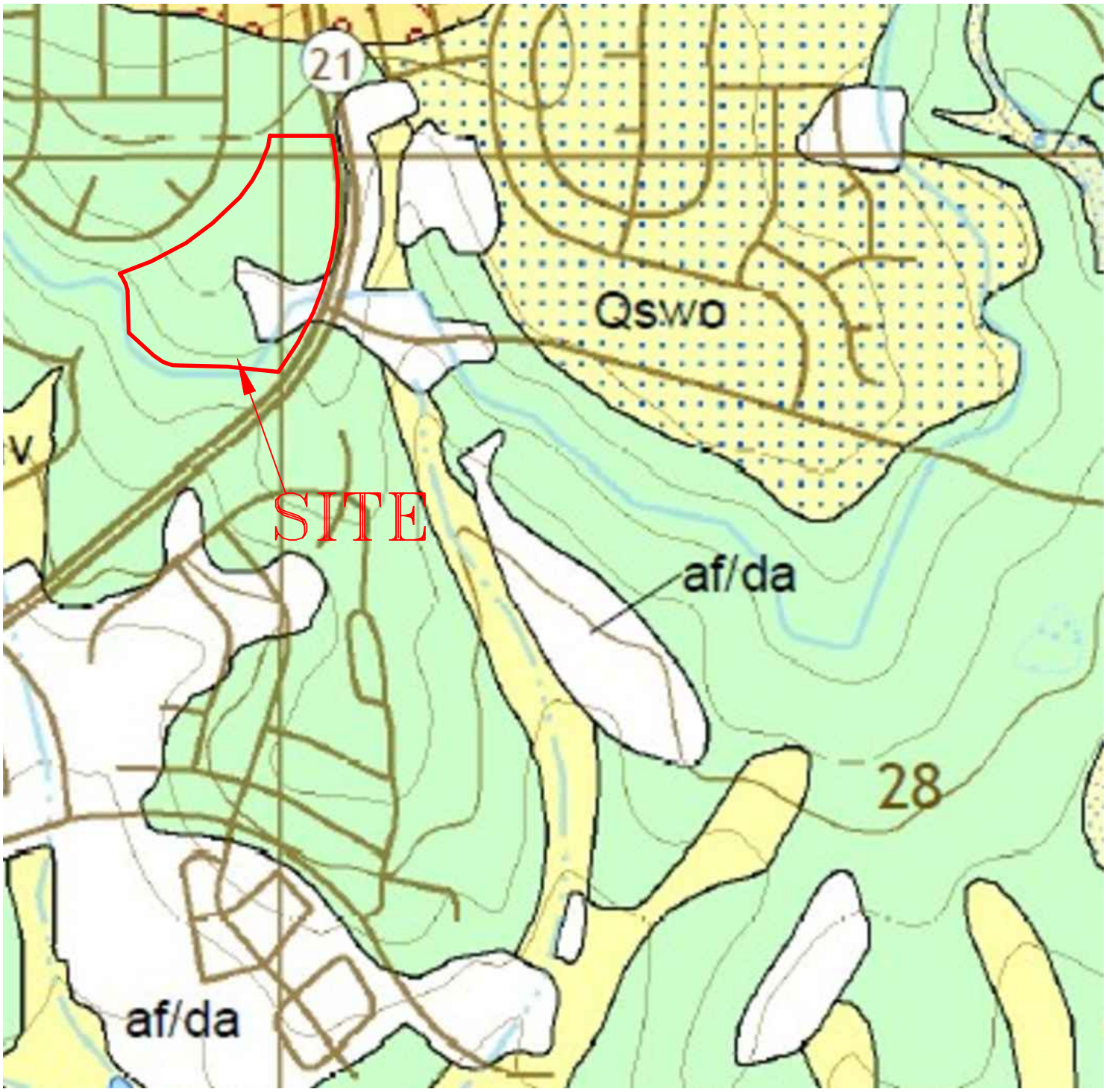
SOIL SURVERY MAP
THE COTTAGES AT MESA RIDGE
PARCEL NO. 55291-00-060
EL PASO COUNTY, CO.
FOR: GOODWIN KNIGHT

DRAWN:	DATE:	CHECKED:	DATE:
LLL	12/22/21		

JOB NO.: 211100

FIG NO.: 4



N

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FOUNTAIN QUADRANGLE GEOLOGY MAP
THE COTTAGES AT MESA RIDGE
PARCEL NO. 55291-00-060
EL PASO COUNTY, CO.
FOR: GOODWIN KNIGHT

DRAWN:	DATE:	CHECKED:	DATE:
LLL	12/22/21		

JOB NO.: 211100

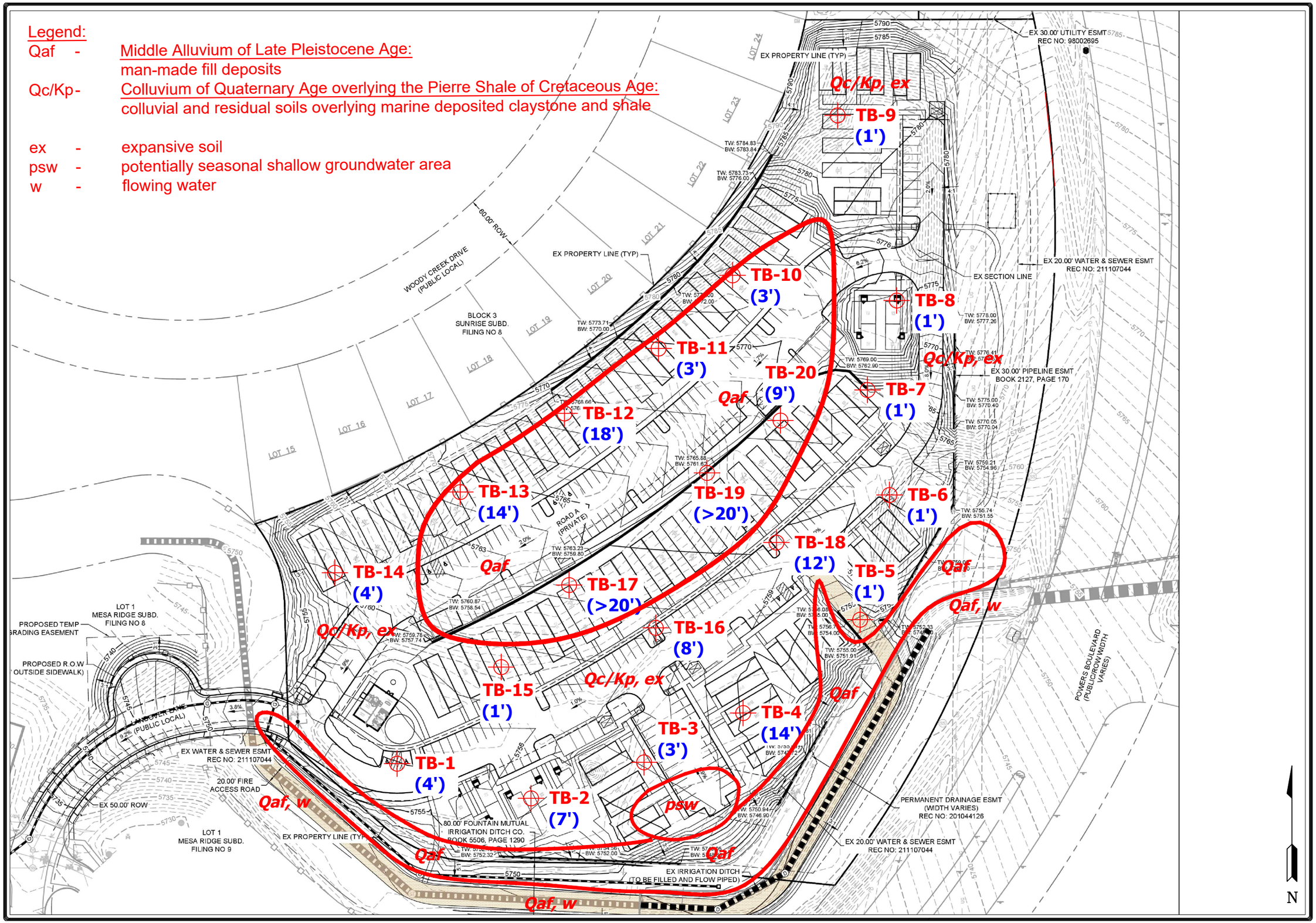
FIG NO.: 5

Legend:

Qaf - Middle Alluvium of Late Pleistocene Age:
man-made fill deposits

Qc/Kp - Colluvium of Quaternary Age overlying the Pierre Shale of Cretaceous Age:
colluvial and residual soils overlying marine deposited claystone and shale

ex - expansive soil
psw - potentially seasonal shallow groundwater area
w - flowing water



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GEOLOGY/ENGINEERING GEOLOGY MAP
THE COTTAGES AT MESA RIDGE
PARCEL NO. 55291-00-060
EL PASO COUNTY, CO.
FOR: GOODWIN KNIGHT

DRAWN: LLL
CHECKED:
DATE: 12/22/21
SCALE: AS SHOWN
JOB NO.: 211100
FIGURE No.: 6

N

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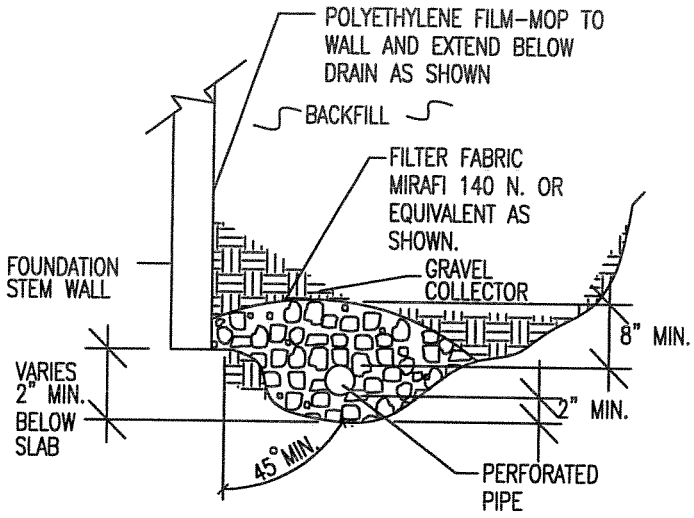
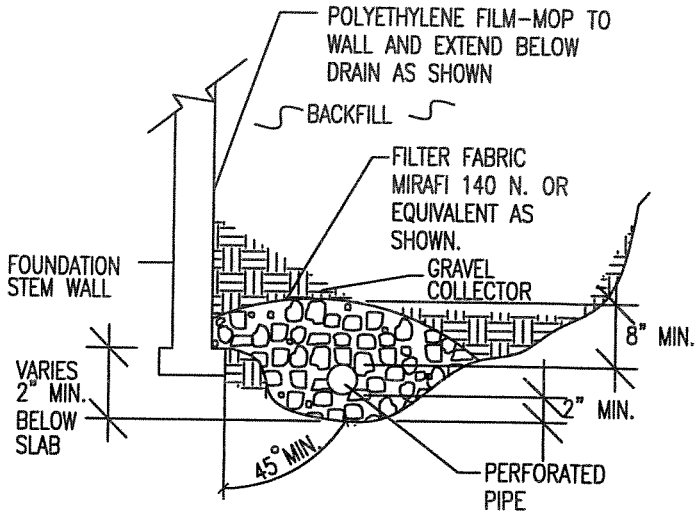
FLOODPLAIN MAP
THE COTTAGES AT MESA RIDGE
PARCEL NO. 55291-00-060
EL PASO COUNTY, CO.
FOR: GOODWIN KNIGHT

DRAWN:	DATE:	CHECKED:	DATE:
LLL	12/22/21		

JOB NO.: 211100

FIG NO.: 7





NOTES:

-GRAVEL SIZE IS RELATED TO DIAMETER OF PIPE PERFORATIONS-85% GRAVEL GREATER THAN 2x PERFORATION DIAMETER.

-PIPE DIAMETER DEPENDS UPON EXPECTED SEEPAGE. 4-INCH DIAMETER IS MOST OFTEN USED.

-ALL PIPE SHALL BE PERFORATED PLASTIC. THE DISCHARGE PORTION OF THE PIPE SHOULD BE NON-PERFORATED PIPE.

-FLEXIBLE PIPE MAY BE USED UP TO 8 FEET IN DEPTH, IF SUCH PIPE IS DESIGNED TO WITHSTAND THE PRESSURES. RIGID PLASTIC PIPE WOULD OTHERWISE BE REQUIRED.

-MINIMUM GRADE FOR DRAIN PIPE TO BE 1% OR 3 INCHES OF FALL IN 25 FEET.

-DRAIN TO BE PROVIDED WITH A FREE GRAVITY OUTFALL, IF POSSIBLE. A SUMP AND PUMP MAY BE USED IF GRAVITY OUT FALL IS NOT AVAILABLE.

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PERIMETER DRAIN DETAIL

DRAWN:	DATE:	DESIGNED:	CHECKED:

JOB NO.: 211100

FIG NO.: 8

APPENDIX A: Site Photographs

1

Looking north from the northern portion of the site.

August 4, 2021

2

Looking south from the northern portion of the site.

August 4, 2021

Job No. 211100

3

Looking northeast from the central portion of the site.

August 4, 2021

4

Looking east from the central portion of the site.

August 4, 2021

Job No. 211100

5

Looking west along irrigation ditch southwestern portion of the site.

August 4, 2021

6

Looking northeast from the southwestern portion of the site.

August 4, 2021

Job No. 211100

APPENDIX B: Subsurface Soil Investigation Test Boring Logs, Entech Job No. 211100

TEST BORING NO. 1
DATE DRILLED 6/11/2021
Job # 211100

REMARKS

DRY TO 18.5', 7/1/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
					1A
			21	11.7	2
5			50 / 9"	11.1	4
10			50 / 5"	6.5	4
15			50 / 5"	10.7	5
20			50 / 3"	10.3	5

FILL 0-2', SAND, CLAYEY, RED BROWN

CLAY, SANDY, BROWN, STIFF, MOIST

CLAYSTONE, SANDY, BROWN, HARD, MOIST

SHALE, GRAY BROWN, HARD, MOIST

TEST BORING NO. 2
DATE DRILLED 6/11/2021
CLIENT GOODWIN KNIGHT
LOCATION MESA RIDGE

REMARKS

WATER @ 12.5', 7/1/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			17	9.2	2
5			31	10.9	2
10			50 / 5"	6.6	4
15			50 / 5"	12.3	4
20			50 / 3"	10.5	5

CLAY, SANDY, BROWN, STIFF TO VERY STIFF, MOIST

CLAYSTONE, SANDY, BROWN, HARD, MOIST

SHALE, GRAY, HARD, MOIST

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ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
			7/19/21

JOB NO.: 211100
FIG NO.: B-1

TEST BORING NO. 3
DATE DRILLED 6/11/2021
Job # 211100

REMARKS

DRY TO 20', 6/11/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			14	5.6	1
5			50 / 7"	10.4	3
10			50 / 6"	12.5	3
15			50 / 4"	6.3	3
20			50 / 3"	9.9	5

SAND, VERY CLAYEY, FINE GRAINED, TAN, MEDIUM DENSE, MOIST

SANDSTONE, VERY CLAYEY, FINE GRAINED, BROWN, VERY DENSE, MOIST

SHALE, GRAY, HARD, MOIST

TEST BORING NO. 4
DATE DRILLED 6/11/2021
CLIENT GOODWIN KNIGHT
LOCATION MESA RIDGE

REMARKS

WATER @ 13', 6/11/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			18	12.9	1
5			15	16.6	1
10			9	23.1	2
15			50 / 7"	13.9	4
20			50 / 2"	8.7	5

SAND, VERY CLAYEY, FINE GRAINED, BROWN, MEDIUM DENSE, MOIST

CLAY, SANDY, SILTY, BROWN, FIRM, MOIST

CLAYSTONE, SANDY, GRAY BROWN, HARD, MOIST

SHALE, GRAY BROWN, HARD, MOIST

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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

TEST BORING LOG

DRAWN:	DATE:	CHECKED: A	DATE: 7/19/21

JOB NO.: 211100
FIG NO.: B-2

TEST BORING NO. 5
DATE DRILLED 6/11/2021
Job # 211100

REMARKS

DRY TO 20', 6/11/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
					2
			50 / 11"	11.1	4
5			50 / 8"	11.5	4
10			50 / 8"	12.2	4
15			50 / 7"	12.9	4
20			50 / 5"	11.5	4

CLAY, SANDY, BROWN
CLAYSTONE, SANDY, BROWN, HARD, MOIST

TEST BORING NO. 6
DATE DRILLED 6/11/2021
CLIENT GOODWIN KNIGHT
LOCATION MESA RIDGE

REMARKS

WATER @ 18.5', 7/1/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
					2
			50 / 8"	8.1	4
5			50 / 7"	9.9	4
10			50 / 7"	10.9	4
15			50 / 5"	10.9	4
20			50 / 3"	9.9	5

CLAY, SANDY, BROWN
CLAYSTONE, SANDY TO VERY SANDY, BROWN, HARD, MOIST

SHALE, GRAY BROWN, HARD, MOIST

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TEST BORING LOG

DRAWN:	DATE:	CHECKED: h	DATE: 7-19-21

JOB NO.: 211100
FIG NO.: B-3

TEST BORING NO. 7
DATE DRILLED 6/11/2021
Job # 211100

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 20', 6/11/21						
CLAY, SANDY, BROWN						2
CLAYSTONE, SANDY, BROWN, HARD, MOIST				50 / 11"	8.9	4
	5			50 / 8"	8.8	4
	10			50 / 8"	11.1	4
	15			50 / 7"	9.9	4
SHALE, GRAY, HARD, MOIST	20			50 / 5"	8.3	5

TEST BORING NO. 8
DATE DRILLED 6/22/2021
CLIENT GOODWIN KNIGHT
LOCATION MESA RIDGE

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 20', 6/22/21						
CLAY, SANDY, BROWN						2
CLAYSTONE, SANDY, GRAY BROWN, HARD, MOIST				50 / 8"	11.5	4
	5			50 / 7"	10.8	4
	10			50 / 6"	11.9	4
SHALE, GRAY, HARD, MOIST	15			50 / 2"	7.5	5
	20			50 / 3"	8.6	5

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COLORADO SPRINGS, COLORADO 80907

TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
			7/19/21

JOB NO.: 211100
FIG NO.: B-4

TEST BORING NO. 9
DATE DRILLED 6/22/2021
Job # 211100

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
WATER @ 17', 7/1/21						
CLAY, SANDY, BROWN						2
CLAYSTONE, SANDY, BROWN, HARD, MOIST				50 / 10"	7.4	4
	5			50 / 9"	10.9	4
	10			50 / 6"	12.2	4
SHALE, GRAY, HARD, MOIST						
	15			50 / 5"	9.8	5
	20			50 / 3"	8.7	5

TEST BORING NO. 10
DATE DRILLED 6/22/2021
CLIENT GOODWIN KNIGHT
LOCATION MESA RIDGE

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 18', 7/1/21						
CLAY, VERY SANDY, BROWN, STIFF, MOIST				22	8.3	2
CLAYSTONE, SANDY, BROWN, HARD, MOIST	5			50 / 8"	9.1	4
	10			50 / 6"	9.6	4
	15			50 / 5"	11.2	4
SHALE, GRAY, HARD, MOIST						
	20			50 / 6"	11.0	5

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COLORADO SPRINGS, COLORADO 80907

TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE: 7/19/21

JOB NO.: 211100
FIG NO.: B-5

TEST BORING NO. 11
DATE DRILLED 6/22/2021
Job # 211100

REMARKS

WATER @ 13', 7/1/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			14	6.8	2
5			50	9.0	4
10			50 / 10"	13.0	4
15			50 / 9"	14.7	4
20			50 / 7"	11.2	4

CLAY, SANDY, TAN, FIRM, MOIST

CLAYSTONE, SANDY, BROWN, HARD, MOIST

TEST BORING NO. 12
DATE DRILLED 6/22/2021
CLIENT GOODWIN KNIGHT
LOCATION MESA RIDGE

REMARKS

WATER @ 15', 7/1/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			17	10.2	2
5			30	6.8	2
10			12	12.9	2
15			8	21.1	2
20			50 / 11"	16.8	4

CLAY, SANDY, BROWN, VERY STIFF TO FIRM, MOIST TO VERY MOIST

CLAYSTONE, SANDY, BROWN, HARD, MOIST

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TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
		h	7/19/21

JOB NO.: 211100
FIG NO.: B-6

TEST BORING NO. 13
DATE DRILLED 6/22/2021
Job # 211100

REMARKS

WATER @ 16', 7/1/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	CLAY, SANDY, TAN, VERY STIFF, MOIST				
			34	8.5	2
5	CLAYSTONE, SANDY TO VERY SANDY, BROWN, HARD, MOIST		50	9.4	4
10			50/6"	11.8	4
15			50/7"	11.9	4
	SHALE, GRAY, HARD, MOIST				
20			50/4"	9.8	5

TEST BORING NO. 14
DATE DRILLED 6/22/2021
CLIENT GOODWIN KNIGHT
LOCATION MESA RIDGE

REMARKS

WATER @ 15', 7/1/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	CLAY, SANDY, TAN, VERY STIFF, MOIST				
			40	9.4	2
5	CLAYSTONE, VERY SANDY, BROWN, HARD, MOIST		50/10"	9.8	4
10			50/7"	12.3	4
15	SHALE, GRAY, HARD, MOIST		50/3"	11.4	4
20			50/3"	9.2	5

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COLORADO SPRINGS, COLORADO 80907

TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE: 7/19/21

JOB NO.: 211100
FIG NO.: B-7

TEST BORING NO. 15
DATE DRILLED 6/22/2021
Job # 211100

REMARKS

DRY TO 20', 6/22/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
					2
			50 / 11"	13.5	4
5			50 / 8"	12.7	4
10			50 / 8"	12.6	4
15			50 / 7"	11.1	5
20			50 / 5"	9.9	5

CLAY, SANDY, BROWN
CLAYSTONE, SANDY, BROWN, HARD, MOIST
SHALE, VERY SANDY, GRAY, HARD, MOIST

TEST BORING NO. 16
DATE DRILLED 6/22/2021
CLIENT GOODWIN KNIGHT
LOCATION MESA RIDGE

REMARKS

WATER @ 16', 7/1/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			26	8.9	2
5			31	11.6	2
10			50 / 10"	11.5	4
15			50 / 6"	11.7	4
20			50 / 2"	7.9	5

CLAY, SANDY, TAN, STIFF TO VERY STIFF, MOIST
CLAYSTONE, SANDY, BROWN, HARD, MOIST
SHALE, GRAY, HARD, MOIST

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COLORADO SPRINGS, COLORADO 80907

TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE: 7/19/21

JOB NO.: 211100
FIG NO.: B-8

TEST BORING NO. 17
DATE DRILLED 6/25/2021
Job # 211100

REMARKS

WATER @ 12', 7/1/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	FILL 0-9', CLAY, SANDY, BROWN, FIRM, MOIST				
			10	7.6	2A
5			11	11.1	2A
	CLAY, SANDY, BROWN, FIRM TO VERY STIFF, MOIST				
10			11	16.5	2
15			18	9.0	2
20			33	16.8	2

TEST BORING NO. 18
DATE DRILLED 6/25/2021
CLIENT GOODWIN KNIGHT
LOCATION MESA RIDGE

REMARKS

DRY TO 19', 7/1/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	CLAY, SANDY, BROWN, STIFF TO FIRM, MOIST				
			15	10.3	2
5			22	9.5	2
10			14	17.5	2
	CLAYSTONE, VERY SANDY TO SANDY, BROWN, HARD, MOIST				
15			50/8"	13.6	4
20			50/6"	12.2	4

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COLORADO SPRINGS, COLORADO 80907

TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
			7/19/21

JOB NO.: 211100
FIG NO.: B-9

TEST BORING NO. 19
DATE DRILLED 6/25/2021
Job # 211100

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 20', 6/25/21						
FILL 0-9', CLAY, SANDY, BROWN, FIRM, MOIST				12	7.6	2A
	5			10	10.8	2A
CLAY, SANDY, BROWN, STIFF, MOIST	10			15	16.3	2
	15			17	12.9	2
	20			15	19.2	2

TEST BORING NO. 20
DATE DRILLED 6/25/2021
CLIENT GOODWIN KNIGHT
LOCATION MESA RIDGE

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 19.5', 7/1/21						
CLAY, SANDY, TAN, HARD, MOIST				50	7.3	2
SAND, VERY CLAYEY, FINE GRAINED, BROWN, DENSE, MOIST	5			48	6.7	1
CLAYSTONE, SANDY, BROWN, HARD, MOIST	10			50/8"	11.6	4
	15			50/7"	12.3	4
	20			50/6"	11.1	4

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TEST BORING LOG

DRAWN:	DATE:	CHECKED: h	DATE: 7/19/21

JOB NO.: 211100
FIG NO.: B-10

APPENDIX C: Soil Survey Descriptions

El Paso County Area, Colorado

56—Nelson-Tassel fine sandy loams, 3 to 18 percent slopes

Map Unit Setting

National map unit symbol: 3690
Elevation: 5,600 to 6,400 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Nelson and similar soils: 55 percent
Tassel and similar soils: 40 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nelson

Setting

Landform: Hills
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous residuum weathered from interbedded sedimentary rock

Typical profile

A - 0 to 5 inches: fine sandy loam
Ck - 5 to 23 inches: fine sandy loam
Cr - 23 to 27 inches: weathered bedrock

Properties and qualities

Slope: 3 to 12 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: B
Ecological site: R067BY045CO - Shaly Plains
Other vegetative classification: SHALY PLAINS (069AY046CO)
Hydric soil rating: No

Description of Tassel

Setting

Landform: Hills
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous slope alluvium over residuum weathered from sandstone

Typical profile

A - 0 to 4 inches: fine sandy loam
C - 4 to 10 inches: fine sandy loam
Cr - 10 to 14 inches: weathered bedrock

Properties and qualities

Slope: 3 to 18 percent
Depth to restrictive feature: 6 to 20 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Available water supply, 0 to 60 inches: Very low (about 1.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: R067BY045CO - Shaly Plains
Other vegetative classification: SHALY PLAINS (069AY046CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 4 percent
Hydric soil rating: No

Pleasant

Percent of map unit: 1 percent
Landform: Depressions

Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 19, Aug 31, 2021