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SOIL, GEOLOGY, AND GEOLOGIC HAZARD STUDY
COPPER CHASE AT STERLING RANCH
EL PASO COUNTY, COLORADO

Prepared for

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Respectfully Submitted,

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Entech Job No. 191088
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1.0 SUMMARY

Project Location:

The project lies in portions of the SW ¼ Section 32 and the SE ¼ of Section 33, Township 12 South, Range 65 West and a portion of the NE ¼ of the NE ¼ of Section 5, Township 13 South, Range 65 West of the 6th Principal Meridian. The site is located east of Vollmer Road, north of Woodmen Road and northeast of Marksheffel Road and northwest of proposed Sterling Ranch Road in El Paso County, Colorado.

Project Description:

Total acreage involved in the project is approximately 19.67 acres. The proposed development is to consist of 138 single family residential structures on 138 individual lots. The development will be serviced by Sterling Ranch Metropolitan District.

Scope of Report:

The report presents the results of our geologic investigation and treatment of engineering geologic hazard study. This report presents the results of our geologic reconnaissance, a review of available maps, aerial photographs and our conclusions with respect to the impacts of the geologic conditions on development.

Land Use and Engineering Geology:

The site was found to be suitable for development. Geologic conditions will impose some constraints on development. These include areas of artificial fill, hydrocompaction, potential expansive soils, and shallow groundwater areas. Artificial fill is associated with recent grading. Hydrocompaction is associated with wind-blown sand deposits. Areas of shallow groundwater occur in a drainage in the eastern portion of the site and, due to current drainage issues, the majority of the site has the potential for shallow groundwater. Shallow bedrock will also be encountered on portions of the site. Site conditions will be discussed in greater detail in this report. All recommendations are subject to the limitations discussed in the report.

2.0 GENERAL SITE CONDITIONS AND PROJECT DESCRIPTION

The site is located in portions of the SW ¼ Section 32 and the SE ¼ of Section 33, Township 12 South, Range 65 West and a portion of the NE ¼ of the NE ¼ of Section 5, Township 13 South, Range 65 West of the 6th Principal Meridian, in El Paso County, Colorado. The site is located east of Vollmer Road, approximately one mile north of Woodmen Road and immediately north of the proposed Marksheffel Road. The location of the site is shown on the Vicinity Map, Figure 1.

The topography of the site is generally gently sloping to the south with a minor drainage along the eastern boundary of the site, which flows in a southerly direction. The area of the site is indicated on the USGS Map, Figure 2. Previous site uses have included aggregate extraction as a part of the Pioneer Sand Quarry. Existing sand and gravel quarries lie to the southeast of the site. The vegetation on site consists of low field grasses, weeds with areas where vegetation has been removed.

Total acreage involved in the proposed development is approximately 19.67 acres. The proposed development is to consist of 138 single family residential structures on 138 individual lots utilizing slab-on-grade construction. No basements below grade are proposed for this site. The development is to be serviced by Sterling Ranch Metropolitan District. The site development plan for Copper Chase at Sterling Ranch, Parcel 5 is presented in Figure 3. The development plan for Copper Chase and Sterling Ranch Filing No. 2 is presented in Figure 4. Site photographs, taken on January 8, 2020, are included in Appendix A. The approximate locations and directions of the photographs are indicated on Figure 4.

3.0 SCOPE OF THE REPORT

The scope of this report will include the following:

- A geologic analysis of the site utilizing published geologic data, and subsurface soils information.
- Detailed site-specific mapping of major geographic and geologic features.
- Identification of geologic hazards and impacts on the proposed development.
- Recommended mitigation of geologic hazards where they affect development.

4.0 FIELD INVESTIGATION

Our field investigation consisted of the preparation of a geologic map of bedrock features and significant surficial deposits. The Natural Resources Conservation Service (Reference 1), previously the Soil Conservation Service (Reference 2) survey was reviewed to evaluate the site.

The positions of mappable units within the subject property are shown on the Geologic Map. Our mapping procedures involved field reconnaissance, measurements and interpretation. The same mapping procedures have also been utilized to produce the Engineering Geology Map which identifies pertinent geologic conditions affecting development.

Four (4) test borings were drilled by Entech Engineering, Inc. in an investigation dated February 10, 2020, Entech Job No. 191088. Two of these borings were within the project referenced above. Two additional test borings were drilled on March 1, 2022 to analyze current groundwater conditions. The borings were drilled with a power-driven continuous flight auger drill rig to 20 feet. Samples were obtained during drilling using the Standard Penetration Test, ASTM D-1586, utilizing a 2-inch O.D. Split Barrel Sampler and a California Sampler. Results of the penetration tests are shown on the drilling logs to the right of the sampling point. The location of the test borings is shown on the Test Boring Location Plan, Figure 4. The drilling logs are included in Appendix B.

Laboratory testing was performed to classify and determine the soils engineering characteristic. Laboratory tests included moisture content, ASTM D-2216, grain size analysis, ASTM D-422, and Atterberg Limits, ASTM D-4318. Swell tests included FHA Swell Testing and Swell/Consolidation Testing, ASTM D-4546. Results of the laboratory testing are included in Appendix C. A Summary of Laboratory Test Results is presented in Table 1.

Geologic Hazard Studies were previously performed by Entech Engineering, Inc. for the entire Sterling Ranch development, October 31, 2006 (Reference 3) and January 20, 2009 (Reference 4). A Soil, Geology, and Geologic Hazard Study for Copper Chase and Sterling Ranch Filing No. 2 was also performed on February 10, 2020, Entech Job No. 191088. Two of the test borings from the previous investigations was located on the subject site (Test Boring Nos. 1 and

2). The location of the test boring is indicated on Figure 4. The Test Boring Log and Laboratory Test Results are included in Appendix D. Information from these reports was used in evaluating the site.

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 10 miles to the west is a major structural feature known as Rampart Range Fault. This fault marks the boundary between the Great Plains Physiographic Province and the Southern Rocky Mountain Province. The site exists within the southern edge of a large structural feature known as the Denver Basin. Bedrock in the area tends to be gently dipping in a northeasterly direction (Reference 5). The rocks in the area of the site are sedimentary in nature, and typically Tertiary to Cretaceous in age. The bedrock underlying the site itself is the Dawson Formation. Overlying the Dawson Formation are unconsolidated deposits of artificial fill, residual, eolian and alluvial soils. The site's stratigraphy will be discussed in more detail in Section 5.3.

5.2 Soil Survey

The Natural Resources Conservation Service (Reference 1), previously the Soil Conservation Service (Reference 2) has mapped three soil types on the site (Figure 5). In general, the soils consist of loamy sand. Soils are described as follows:

Soil Type	Description
8	Blakeland loamy sand, 1-9% slopes: Dark grayish brown to brown loamy sand. Permeability is rapid. Erosion hazard is moderate with soil blowing hazard severe. Good potential for home sites.
19	Columbine gravelly sandy loam, 0-3% slopes: Grayish brown gravelly sandy loam. Permeability is very rapid. Erosion hazard is slight to moderate. Hazard of flooding in areas of floodplains.

Complete descriptions of the soils are presented in Appendix E (Reference 2). The soils have generally been described to have rapid to very rapid permeabilities. Limitations to development are varied on the different soil types and include frost action potential. The hazard of flooding exists in some areas, particularly several areas in Soil Type 9. Soil Type 9 is mapped in the drainage area along the eastern edge of the site. Possible hazards with soil erosion are present on the site. The erosion potential can be controlled with vegetation. The soils have been described to have moderate erosion hazards.

5.3 Site Stratigraphy

The Falcon NW Quadrangle Geologic Map showing the site is presented in Figure 6 (Reference 6). The Geology Map prepared for the site is presented in Figure 7. Six mappable units were identified on this site, which are described as follows:

- **Qaf** **Artificial Fill of Quaternary Age:** These are man-made fill deposits associated with site grading. Other areas of fill may be encountered that are not indicated on the map.

- **Qal** **Recent Alluvium of Quaternary Age:** These are recent stream deposits that have been deposited in the drainage along the eastern boundary of the site. These materials consist of silty to clayey sands and sandy clays. Some of these alluviums may contain highly organic soils.

- **Qp** **Piney Creek Alluvium of Holocene Age:** This material is a water-deposited alluvium, typically classified as a silty to well-graded sand, brown to dark brown in color and of moderate density. The Piney Creek Alluvium can sometimes be very highly stratified containing thing layers of very silty and clayey soil.

- **Qb** **Broadway Alluvium of Pleistocene Age:** These materials consist of stream terrace deposits. The Broadway Alluvium typically consists of silty to clayey gravelly sands. This deposit is usually highly stratified and may contain lenses of silt, clay or cobbles.

- **Qes** **Eolian Sand of Quaternary Age:** These deposits are fine to medium grained soil deposited on the site by the action of the prevailing winds from the west and northeast. They typically occur as large dune deposits or narrow ridges. These soil types are typically tan to brown in color and tend to have very uniform or well-sorted gradation. These materials tend to have a relatively high permeability and low density.

- **Tkd** **Dawson Formation of Tertiary to Cretaceous Age:** The Dawson formation typically consists of arkosic sandstone with interbedded fine-grained sandstone, siltstone and claystone. Overlying this formation is a variable layer of residual and/or colluvium soils. The residual soils were derived from the in-situ weathering of the bedrock materials on-site. The colluvium soils have been transported by the action of sheetwash and gravity. These soils consisted of silty to clayey sands and sandy clays.

The soils listed above were mapped from site-specific mapping of the site, the *Geologic Map of the Falcon NW Quadrangle* by Madole, 2003 (Reference 6), the *Reconnaissance Geologic Map of Colorado Springs and Vicinity, Colorado* by Scott and Wobus in 1973 (Reference 7), and *the Geologic Map of the Colorado Springs-Castle Rock Area Front Range Urban Corridor, Colorado*, by Trimble and Machette, 1979 (Reference 8). The test borings from the subsurface investigation by Entech Engineering, Inc. were also used in evaluating the site.

5.4 Soil Conditions

Three soil and rock types were encountered in the test borings drilled on the site: Type 1A: silty sand fill (SM), Type 1: slightly silty to silty and clayey native sand (SM-SW, SM, SC); and Type 2: silty and clayey to very clayey sandstone bedrock (SM, SC). Sandy claystone bedrock (CL) was also encountered in a test boring drilled on the site as a part of the previous investigation (Reference 3, Appendix D). Each material type was classified using the results of the laboratory testing and the Unified Soil Classification System (USCS). The bedrock encountered in the borings was classified as soil in that the upper bedrock zone could be penetrated using conventional soil drilling and sampling techniques.

Soil Type 1A was classified as a silty sand fill (SM). The sand fill was encountered in Test Boring No. 1 at the existing ground surface and extending to 4 feet bgs. Standard Penetration Testing on the fill resulted in a N-Value of 8 bpf, indicating loose states. Water content and grain size testing resulted in a water content of 7 percent with approximately 15 percent of the soil size particles passing the No 200 severe. Atterberg limits testing resulted in non-plastic results.

Soil Type 1 classified as slightly silty to silty and clayey native sand (SM-SW, SM, SC). The native sands were encountered in all of the test borings at depths ranging from the existing ground surface to 4 feet and extending to depths ranging from 4 to 14 feet below ground surface (bgs). Standard Penetration Testing on the sand resulted in N-values of 14 to 35 blows per foot (bpf), indicating medium dense to dense states. Water content and grain size testing resulted in water contents of approximately 6 to 18 percent with approximately 7 percent of the soil size particles passing the No. 200 sieve. FHA Swell Testing resulted in a swell pressure of 30 psf, indicating low expansion potential.

Soil Type 2 was classified as silty and clayey to very clayey sandstone bedrock (SM, SC). The sandstone was encountered in all of the test borings drilled as a part of this investigation, below Soil Type 1, at depths of approximately 4 to 14 feet bgs and extending to the termination of the borings (20 feet). Standard Penetration Testing on the sandstone resulted in N-values of 50 to greater than 50 bpf indicating very dense states. Water content and grain size testing resulted in water contents of 11 to 24 percent with approximately 13 to 40 percent of the soil size particles passing the No. 200 sieve. Atterberg limits testing on the sandstone resulted in liquid limits of 30 to no value and plastic indexes of 10 to non-plastic. Swell/Consolidation testing resulted in consolidations of 0.0 to 0.6, indicating low consolidation potential.

Sandy claystone bedrock (CL) was encountered in Test Boring No. 1 from Job No. 82556 drilled previously on this site (Reference 3). The claystone was encountered at 2 feet and extending to the termination of the boring (15 feet). Standard Penetration Testing on the claystone resulted in N-values of 50 to greater than 50 bpf, indicating hard consistencies. Water content and grain size testing resulted in water contents of 10 to 13 percent with approximately 68 percent of the soil size particles passing the No. 200 Sieve. Swell/Consolidation Testing of the claystone resulted in a volume change of 0.9 percent, indicating low to moderate expansion potential.

Test Boring logs are included in Appendix B. A Summary of the Laboratory Test Results for each of the soil and rock types is summarized in Table 1 and included in Appendix C. The Test Boring Log and Laboratory Test Results from previous investigations (Reference 3) is included in Appendix D.

5.5 Groundwater

Groundwater was encountered at depths ranging from 2 to 19 feet in the test borings during drilling. In the test borings drilled on March 1, 2022 groundwater was encountered at 4 and 19 feet. Following precipitation events and runoff, groundwater was encountered at the surface in the test borings. Groundwater was measured again during dry periods subsequent to drilling at 3 to 6.5 feet. Groundwater depths are summarized in Table 2. Areas of shallow groundwater have been mapped on the site and are discussed later in this report. Fluctuations in the groundwater conditions may occur due to conditions such as variations in rainfall, precipitation infiltration and development of nearby areas. Areas of seasonal shallow groundwater have been identified on the site. These areas will be discussed in the following sections.

6.0 ENGINEERING GEOLOGY - IDENTIFICATION AND MITIGATION OF GEOLOGIC HAZARDS

As mentioned previously, detailed mapping has been performed on this site to produce an Engineering Geology Map (Figure 7). This map shows the location of various geologic conditions of which the developers and planners should be cognizant during the planning, design and construction stages of the project. The hazards identified on this site include artificial fill, hydrocompaction, potentially expansive soils, and shallow groundwater areas. The following hazards have been addressed:

Expansive Soils - Constraint

Expansive soils were encountered in some of the test borings drilled on-site and as a part of the previous investigation (References 3 and 4). The site is classified in areas of low to moderate swell potential according to the *Map of Potentially Swelling Soil and Rock in the Front Range Urban Corridor, Colorado* by Hart, 1974 (Reference 9); however, highly expansive clays and claystone are typically encountered in the area. These areas are sporadic; therefore, none have been indicated on the map. Expansive clays and claystone, if encountered, can cause differential movement in the structure foundation.

Mitigation:

Mitigation of expansive soils will require special foundation design. Overexcavation and replacement with non-expansive soils at a minimum 95 percent of its maximum Modified Proctor Dry Density, ASTM D-1557 is a suitable mitigation which is common in the area. Drilled piers are another option that is used in areas where highly expansive soils are encountered. Typical minimum pier depths are on the order of 25 feet or more and require penetration into the bedrock material a minimum of 4 to 6 feet, depending upon building loads. Floor slabs on expansive soils should be expected to experience movement. Overexcavation and replacement has been successful in minimizing slab movements. The use of structural floors can be considered for basement construction on highly expansive clays. Final recommendations should be determined after additional investigation of each building site.

Subsidence Area - Hazard

Based on a review of a Subsidence Investigation Report for the Colorado Springs area by Dames and Moore, 1985 (Reference 10) and the mining report for the Colorado Springs coalfield (Reference 11), the site is not undermined. The closest underground mines in the area are 6 miles to the southwest and the site is not mapped within any potential subsidence zones.

Slope Stability and Landslide Hazard - Hazard

The slopes on-site are gently sloping and do not exhibit any past or potential unstable slopes or landslides.

Debris Fans - Constraint

Based on-site observations, debris fans were not observed in this area.

Groundwater and Floodplain Areas - Constraint

Areas within the drainage swale east of the site have been identified as seasonal shallow groundwater areas. According to the erosion control plan Figure 4A, surface waters in this drainage are to be collected and piped along the eastern boundary to a detention pond southeast of the site. The Sand Creek drainage lies east of the site and has been mapped as a floodplain zone according to the FEMA Map No. 08041CO533G, Figure 8 (Reference 12). The site does not lie within the floodplain zone as indicated in Figure 8. Finished floor levels must be a minimum of one floor above the floodplain level. Exact floodplain locations by drainage studies are beyond the scope of this report. The majority of the site has been mapped as shallow groundwater due to shallow water encountered in the test borings and across the majority of the site after precipitation events. These areas are discussed as follows:

Shallow Groundwater - Constraint

In these areas, we would anticipate the potential for periodically high subsurface moisture conditions and possible frost heave potential, depending on the soil conditions. A drainage swale is located along the eastern boundary of the site. Shallow groundwater was encountered in all of the test borings at the time of drilling and following precipitation events subsequent to drilling. Groundwater depths are summarized in Table 2. Drainage from north of the site has been observed to back up onto the site from the drainage swale during periods of high runoff. According to the proposed grading plan, the drainage from the north of the site is to be intercepted, collected and piped along the eastern boundary of the site to a detention pond southeast of the site. A sewer underdrain should be considered to assist with controlling groundwater. Additionally, much of the area is to be filled, further raising the area above groundwater levels. According to the grading plans (Figure 4A), high areas in the extreme northern and western portions are to be cut 1 to 2 feet and low areas are to be filled. Most of the proposed fill depths range from 1 to 2 feet and deeper fill depths may be required to elevate foundations above the zone of groundwater influence. Areas of shallow groundwater may exhibit unstable subgrade conditions in terms of bearing support of construction equipment during overlot grading. Due to the presence of shallow groundwater, slab-on-grade and no below ground areas are proposed. Additionally, areas may experience seasonal perched groundwater conditions where water can flow through permeable sands on top of less permeable bedrock materials.

Mitigation:

In these locations, foundations 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 30 inches is recommended.

Foundations should be kept as high as possible. Areas may experience higher groundwater levels during period of higher precipitation where water can flow through permeable sands on top of less permeable bedrock materials. Subsurface perimeter drains may be necessary to prevent the intrusion of water into areas below grade. Typical drain details are presented in Figure 9. Where shallow groundwater is encountered, underslab drains or interceptor drains may be necessary. Typical drain details are presented in Figure 10 and 11. It is Entech's understanding that no basements and slab-on-grade construction will be utilized. Structures should not block drainages. Swales should be created to intercept surface runoff and carry it safely around and away from structures. Specific recommendations should be made after additional investigation and site grading has been completed. Additional investigation after grading is completed is recommended to provide final foundation recommendations. The suitability of the site for below-grade areas should be evaluated after additional investigation following site grading and storm sewer construction.

Artificial Fill - Constraint

Areas of artificial fill were observed in areas of the site. The majority of these areas are associated with recent grading.

Mitigation:

Fill records should be obtained to determine if the fill was placed in a controlled manner. Where uncontrolled fill is encountered beneath foundations, mitigation will be necessary. Mitigation typically involves removal and recompaction at a minimum of 95 percent of its maximum Modified Proctor Dry Density, ASTM D-1557.

Hydrocompaction - Constraint

Areas in which hydrocompaction have been identified are acceptable as building sites. 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.

Areas of loose or collapsible soils may also be encountered in these areas. Should loose or collapsible soils be encountered beneath foundations, removal and recompaction of the upper 2 to 3 feet with thorough moisture conditioning at a minimum of 95 percent of its maximum Modified Proctor Dry Density, ASTM D-1557 will be necessary. Specific recommendations should be made after additional investigation of each building site.

Faults - Hazard

The closest fault is the Rampart Range Fault, located approximately 10 miles to the west. No faults are mapped on the site itself. Previously, Colorado was mapped entirely within Seismic Zone 1, a very low seismic risk. Additionally, the International Residential Code (IRC), 2003, currently places this area in Design Category B, also a low seismic risk. According to a report by the Colorado Geological Survey by Kirkman and Rogers, 1981, (Reference 13) this area should be designed for Zone 2 due to more recent data on the potential for movement in this area, and any resultant earthquakes.

Dipping Bedrock - Hazard

The bedrock underlying the site is the Dawson Formation of Tertiary to Cretaceous Age. The bedrock in this area is gently dipping a northeasterly direction according to the *Geologic Structure Map of the Pueblo 1x2 Quadrangle*, *South-Central Colorado* (1978) (Reference 5). The bedrock encountered in the test borings did not exhibit steeply dipping characteristics; therefore, mitigation is not necessary.

Radioactivity - Constraint

Radon levels for the Colorado Geologic Survey in the Open-File have reported the area, Report No. 91-4 (Reference 14). Radon levels ranging from 0 to 20 pci/l have been measured in the area. Only two readings have been taken in the area. One reading was between 4 and 10 pci/l and the other was less than 4 pci/l. The minimal information from this report is not sufficient to determine if radon levels are higher for this site. An occurrence of radioactive minerals has been identified 4 miles northwest of the site (Reference 15). This occurrence is associated with a limonite deposit in the Dawson Formation. The radioactivity hazard was researched by CTL/Thompson, Inc. for Wolf Ranch, west of the site (Reference 16). It was determined that the area lies within a zone that may have small deposits of low intensity radioactivity. No known occurrences exist on the site, however, radon gas originating in the bedrock underlying the site could migrate up into the upper soil profile.

Mitigation:

The potential exists for radon gas to build up in areas of the site. Build-ups of radon gas can be mitigated by providing increased ventilation of basements and crawlspaces and sealing of joints. Specific requirements for mitigation should be based on-site specific testing after the site is constructed.

7.0 EROSION CONTROL

The soil types observed on the site are mildly to moderately 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 reestablished, 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 and weathered bedrock materials 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 re-vegetate 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.

8.0 ECONOMIC MINERAL RESOURCES

Some of the sandy materials on-site could be considered a low-grade sand resource. According to the *El Paso County Aggregate Resource Evaluation Map* (Reference 7), portions of the site are mapped as upland and floodplain deposits. According to the *Atlas of Sand, Gravel and Quarry Aggregate Resources, Colorado Front Range Counties* distributed by the

Colorado Geological Survey (Reference 18), portions of the site are mapped as U3 – Upland deposits: sand, and V3: valley fill deposits: sand. According to the *Evaluation of Mineral and Mineral Fuel Potential* (Reference 19), tracts in the area of the site have been mapped as "Good" for industrial minerals. Quarries exist on the site and in the area of the site for sand and gravel, particularly in the Eolian Sand and Alluvial deposits. Based on the depth of bedrock encountered in the test borings, it appears the majority of the thicker deposits have been excavated from the site.

According to *the Evaluation of Mineral and Mineral Fuel Potential of El Paso County State Mineral Lands* (Reference 19), the tracts in the area of the site have been mapped as "Poor" for coal resources and "Little or no Potential" metallic mineral resources.

The site has been mapped as "Fair" for oil and gas resources (Reference 19). No oil or gas fields have been discovered in the area of the site. The sedimentary rocks in the area lack the essential elements for oil or gas.

9.0 RELEVANCE OF GEOLOGIC AND SITE CONDITIONS TO LAND USE PLANNING

The existing geologic and geotechnical conditions at the site will likely impose some constraints on the proposed development and construction. Regrading and drain systems can mitigate hazards such as areas of shallow groundwater. Other constraints identified on the site such as expansive soils, hydrocompaction and artificial fill, can be mitigated through proper engineering design and construction.

The previous reports were reviewed by the Colorado Geological Survey (CGS), July 9, 2020 and March 10, 2021. The CGS comments are included in Appendices F and G, respectively.
The majority of the soils at typical foundation depths consist of sands, sandstone and claystone. Areas of shallow bedrock will be encountered on the site. Shallow sandstone will have higher bearing capacities. Difficult excavation is anticipated in areas of shallow bedrock, particularly sandstone. Overlot grading and excavation for utility trenches and foundations will be affected by shallow bedrock. The use of track-mounted equipment will likely be required.

Expansive soils may be encountered in areas of this site. The expansive soils encountered in the test borings were sporadic; therefore, none have been indicated on the maps. Expansive soils, if encountered, will require special foundation design and/or overexcavation and replacement with non-expansive soil compacted to a minimum of 95 percent of the maximum dry density as determined by the Modified Proctor Test (ASTM D-1557). Other options include drilled piers.

Areas of hydrocompaction have been identified on this site where there is the potential for settlement movements upon saturation of the surficial soils. Good surface and subsurface drainage is critical in these areas and the ground surface should be positively sloped away from structures at all points. Roof drains should be made to discharge well away from structures and planting and watering in the immediate vicinity of structures should be minimized.

Areas of shallow groundwater have been mapped in the drainage area along the eastern boundary of the site This area will be avoided by structures and the area regraded and drainage piped to the south, however, structures immediately adjacent to the drainage area may experience higher water levels during periods of high moisture. After reviewing the comments made by the CGS (Colorado Geological Survey) on July 9, 2020 and again on March 10, 2021, additional test borings were drilled (Test Boring Nos. 5 and 6). Groundwater was encountered at 4 and 19 feet, respectively. Additionally, shallow groundwater was encountered across the site after precipitation events in the past that caused runoff from the north to back up onto the site. According to the grading plan the area is to be filled and regraded and drainage from the north is to be intercepted, collected and piped to a detention pond southeast of the site. A sewer underdrain is proposed for the site to assist with controlling groundwater.

All soft or organic soils should be removed prior to fill placement. Unstable soils may be encountered where excavations approach the groundwater level. Shallow groundwater areas may also affect utility installation. Geo-grids or shotrock may be necessary to stabilize excavations. Foundations should be kept as high as possible. Foundations in or adjacent to shallow groundwater areas may require drains to control seepage within the foundation zone. Typical drain details are presented in Figures 9 through 11. Additional investigation is recommended after grading and the storm sewer (underdrain) is installed to evaluate groundwater conditions. The suitability of the site for below-grade areas, if needed, should be evaluated after additional investigation and site grading has been performed. As discussed, the proposed construction is slab-on-grade, which will not have below grade areas.

The floodplain areas of the Sand Creek drainage exist east of the site. According to the development plan, the lots are proposed well outside the floodplain zone. The site is not mapped in any floodplains as indication of the Floodplain Map, Figure 8. Finished floor elevations must be a minimum of one foot above the floodplain level. Specific floodplain locations and drainage studies are beyond the scope of this report.

In summary, development of the site can be achieved with slab-on-grade construction and the items discussed above are mitigated. These items can be mitigated through proper design and construction or by avoidance. Specific recommendations should be made after additional investigation prior to construction.

10.0 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 geologic hazards identified on the site can either be avoided by development or satisfactorily mitigated through proper engineering design and construction practices.

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. Discrepancies should be reported to Entech Engineering, Inc. soon after they are discovered so that the evaluation and recommendations presented can be reviewed and revised if necessary. Planning and design personnel should be made familiar with the contents of this report. In addition to lot investigations, additional subsurface soil investigation is recommended after the storm sewer is installed to evaluate groundwater conditions.

This report has been prepared for Morley – Bentley Investments, LLC 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 this report has provided you with all the information you required. Should you require additional information, please do not hesitate to contact Entech Engineering, Inc.

BIBLIOGRAPHY

1. Natural Resources Conservation Service. September 23, 2016. *Web Soil Survey.* United States Department of Agriculture. http:/websoilsurvey.sc.egov.usda.gov.

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

3. Entech Engineering, Inc. October 31, 2006. *Geologic Hazard/Land Use Study and Preliminary Subsurface Soil Investigation, Sterling Ranch. El Paso County, Colorado.* Entech Job No. 82556.

4. Entech Engineering, Inc. January 20, 2009. *Geologic Hazard Evaluation, Sterling Ranch Residential, El Paso County, Colorado.* Entech Job No. 30898.

5. Scott, Glen R.; Taylor, Richard B.; Epis, Rudy C. and Wobus, Reinhard A. 1978. *Geologic Structure Map of the Pueblo 1˚x2˚, South-Central Colorado.* Sheet 2. U.S. Geologic Survey. Map I-1022.

6. Madole, Richard F. 2003. *Geologic Map of the Falcon NW Quadrangle, El Paso County, Colorado. Colorado Geological Survey.* Open-File Report 03-8.

7. Scott, Glen R. and Wobus, Reinhard A. 1973. *Reconnaissance Geologic Map of Colorado Springs and Vicinity, Colorado.* US Geological Survey. Map MP-482.

8. Trimble, Donald E. and Machette, Michael N. 1979. *Geologic Map of the Colorado Springs-Castle Rock area, Front Range Urban Corridor, Colorad*o. U.S. Geological Survey. Map 1-847-F.

9. Hart, Stephen S. 1974. *Potentially Swelling Soil and Rock in the Front Range Urban Corridor, Colorado*. Colorado Springs – Castle Rock map. Colorado Geological Survey. Environmental Geology 7.

10. Dames and Moore. 1985. *Colorado Springs Subsidence Investigation*. State of Colorado Division of Mined Land Reclamation.

11. City of Colorado Springs Planning Department, August 1967. *Mining Report, Colorado Springs Coal Field.*

12. Federal Emergency Management Agency. December 7, 2018. *Flood Insurance Rate Maps for the City of Colorado Springs, Colorado*. Map Number 08041CO533G

13. Kirkman, Robert M. and Rogers, William P. 1981. *Earthquake Potential in Colorado*. Colorado Geological Survey. Bulletin 43.

14. Colorado Geological Survey. 1991. *Results of the 1987-88 EPA Supported Radon Study in Colorado*. Open-file Report 91-4.

15. Nelson-Moore, James L.; Collins, Donna Bishop; and Hernbaker, Al. 1978. *Radioactive Mineral Occurrences of Colorado and Bibliography*. Colorado Geological Survey. Bulletin 40.

16. CTL/Thompson. April 22, 1997. *Reconnaissance Geologic Hazards Study, Wolf Ranch Master Plan Area, Colorado Springs, Colorado.* Job. No. CS-7272.

17. El Paso County Planning Department. December 1995. *El Paso County Aggregate Resource Evaluation Maps.*

18. 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.

19. 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

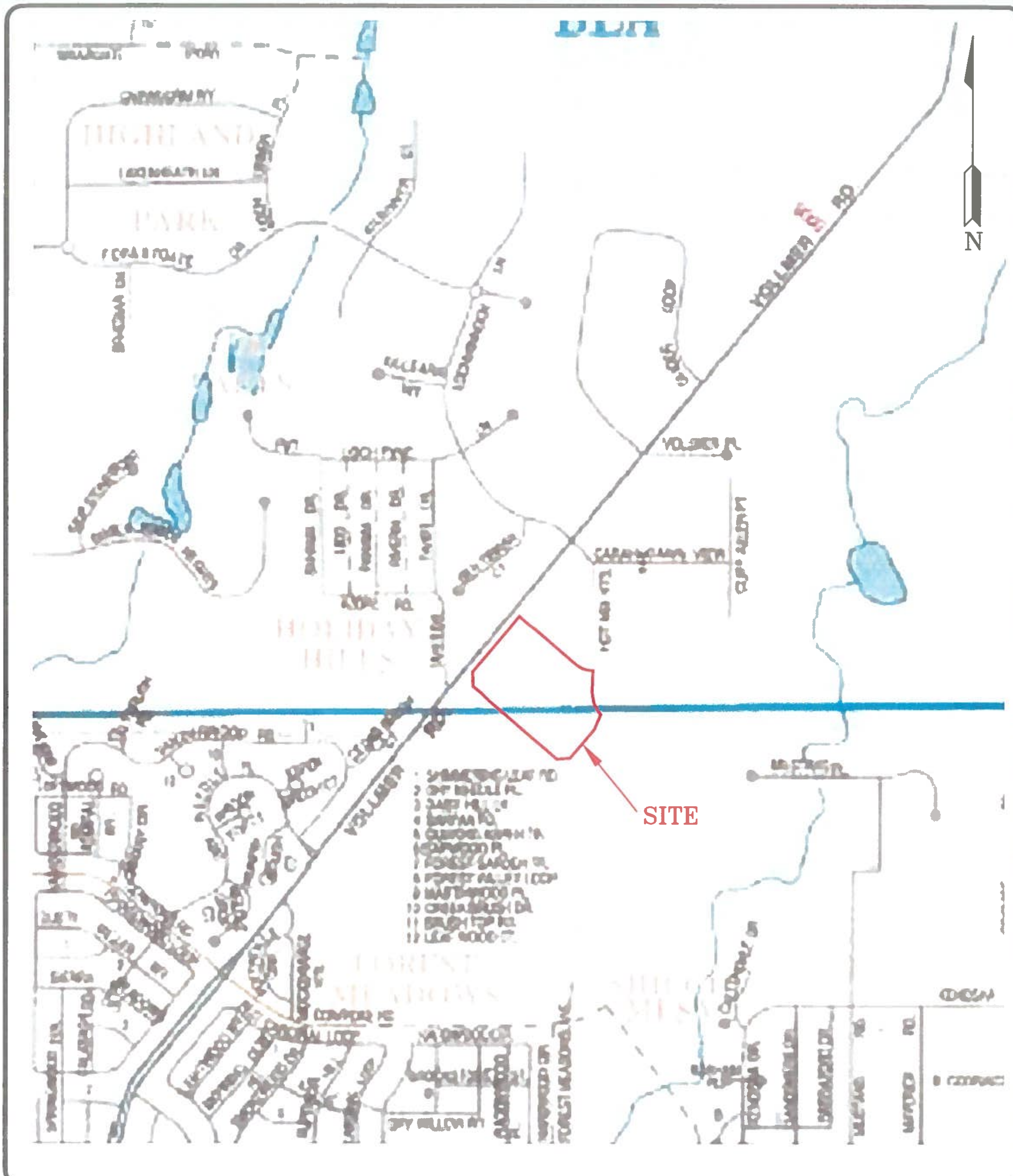
CLIENT MORLEY-BENTLEY INVEST.
PROJECT STERLING RANCH, F-2
JOB NO. 191088

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
1A	1	2-3			14.6	NV	NP	0.00			SM	FILL, SAND,S ILTY
1	3	2-3			7.1				30		SM-SW	SAND, SLIGHTLY SILTY
2	4	5			15.3						SM	SANDSTONE, SILTY
2	1	10	7.3	132.1	40.4	25	11	<0.01		-0.6	SC	SANDSTONE, VERY CLAYEY
2	2	10			12.7	NV	NP	<0.01			SM	SANDSTONE, SILTY
2	4	15	22.8	103.1	34.3	30	10	<0.01		0.0	SC	SANDSTONE, CLAYEY

Table 2: Summary of Groundwater Depths

Test Boring No.	Groundwater at drilling (7/12-17/19)	Groundwater at 8/7/19 (ft.)	Groundwater at 2/3/20 (ft.)	Groundwater at 3/1/22 (ft.)
1	8	surface	caved at 5,dry	-
2	8.5	surface	6.5	8
3	3.5	surface	3	-
4	2	surface	-	-
5	Dry	-	-	4
6	Dry	-	-	19
1 from 82556	6 (8/25/06)	-	-	

FIGURES



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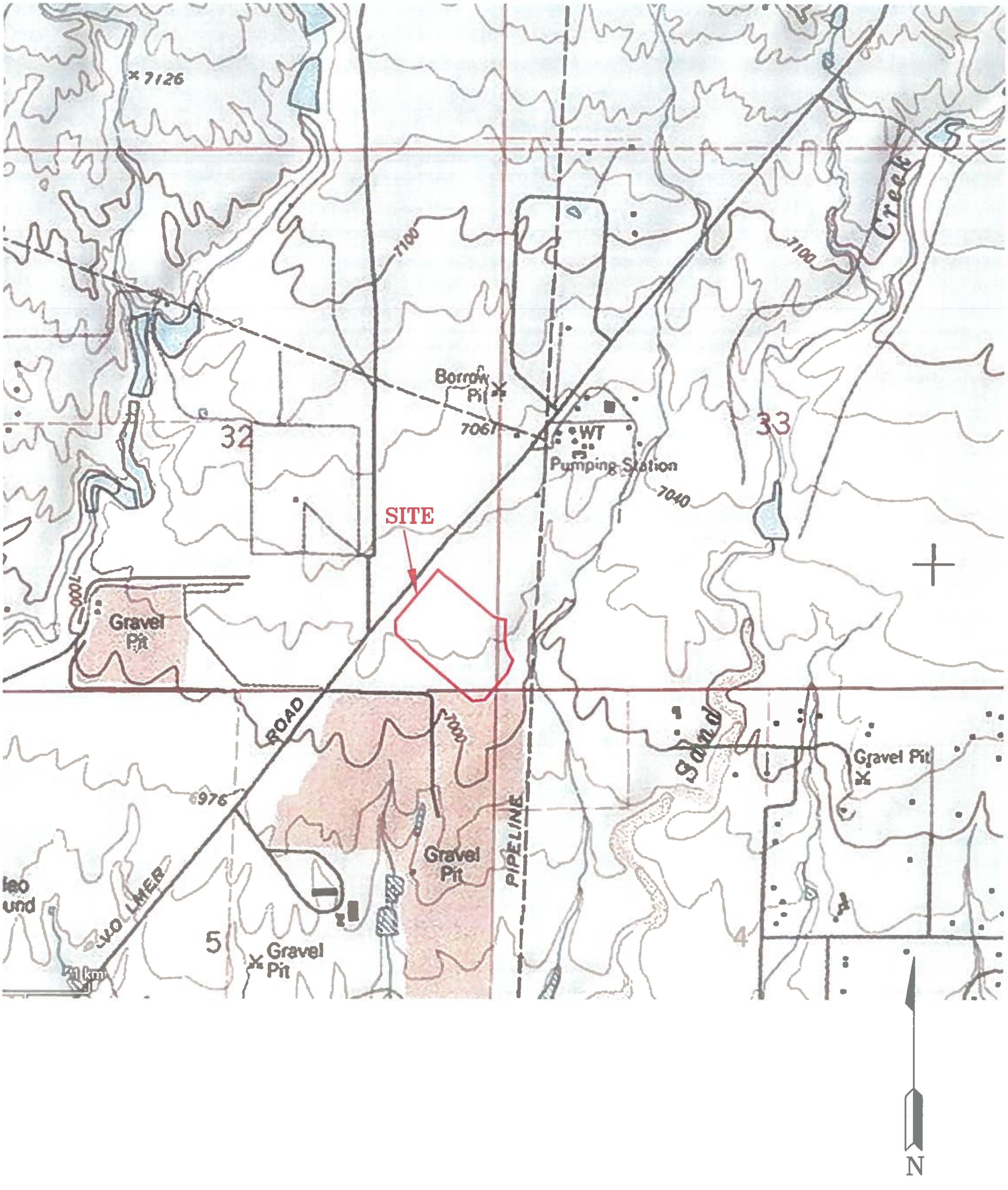
VICINITY MAP
COPPER CHASE AT STERLING RANCH
EL PASO COUNTY, CO.
FOR: MORLEY-BENTLEY INVESTMENTS, LLC

DRAWN:	DATE:	CHECKED:	DATE:
JAC	12/7/21	SW	12-9-21

JOB NO.:
191088

FIG NO.:
1



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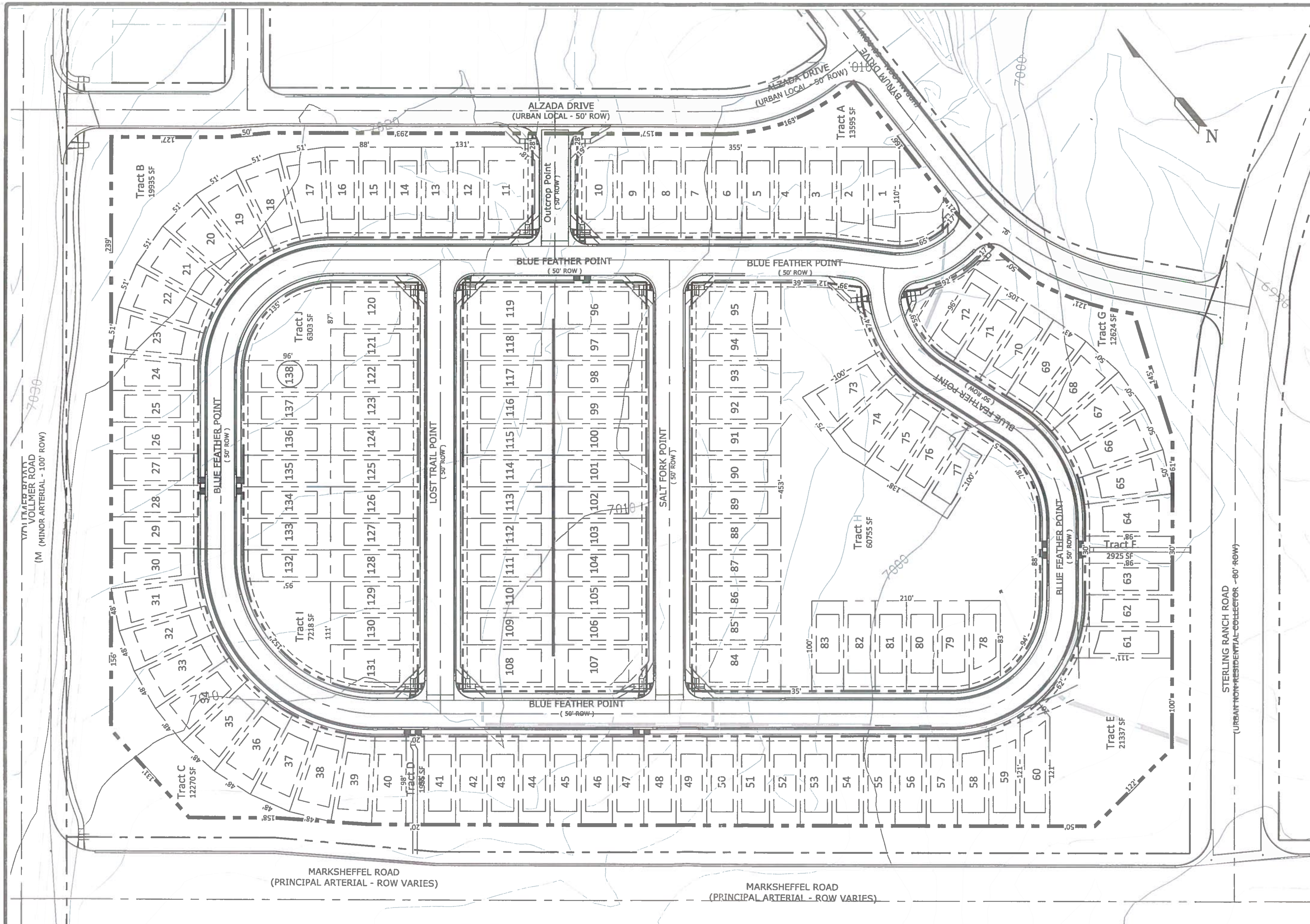
USGS MAP
COPPER CHASE AT STERLING RANCH
EL PASO COUNTY, CO.
FOR: MORLEY-BENTLEY INVESTMENTS, LLC

DRAWN:	DATE:	CHECKED:	DATE:
JAC	12/7/21	SW	12-9-21

JOB NO.: 191088

FIG NO.: 2



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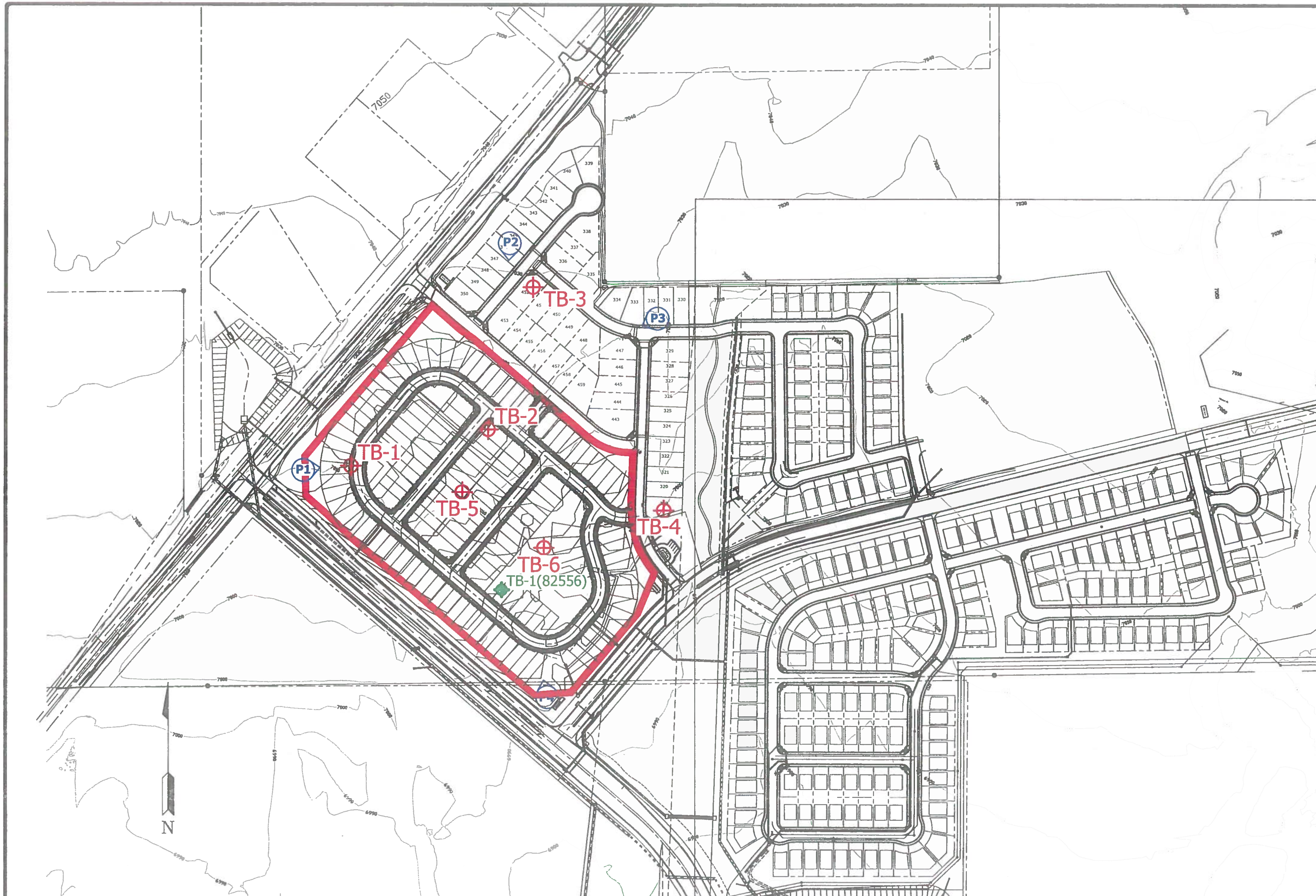
OVERALL SITE PLAN
COPPER CHASE AT STERLING RANCH
EL PASO COUNTY, CO.
FOR: MORLEY-BENTLEY INVESTMENTS, LLC

DRAWN
JAC
CHECKED
DPS
DATE
12/7/21
SCALE
AS SHOWN
JOB NO.
191088
FIGURE No.
3



TB-1- APPROXIMATE TEST BORING LOCATION AND NUMBER

TB5 = APPROXIMATE TEST BORING LOCATION AND NUMBER FROM ENTECH JOB NO. 825

P2 - APPROXIMATE PHOTOGRAPH LOCATION AND DIRECTION

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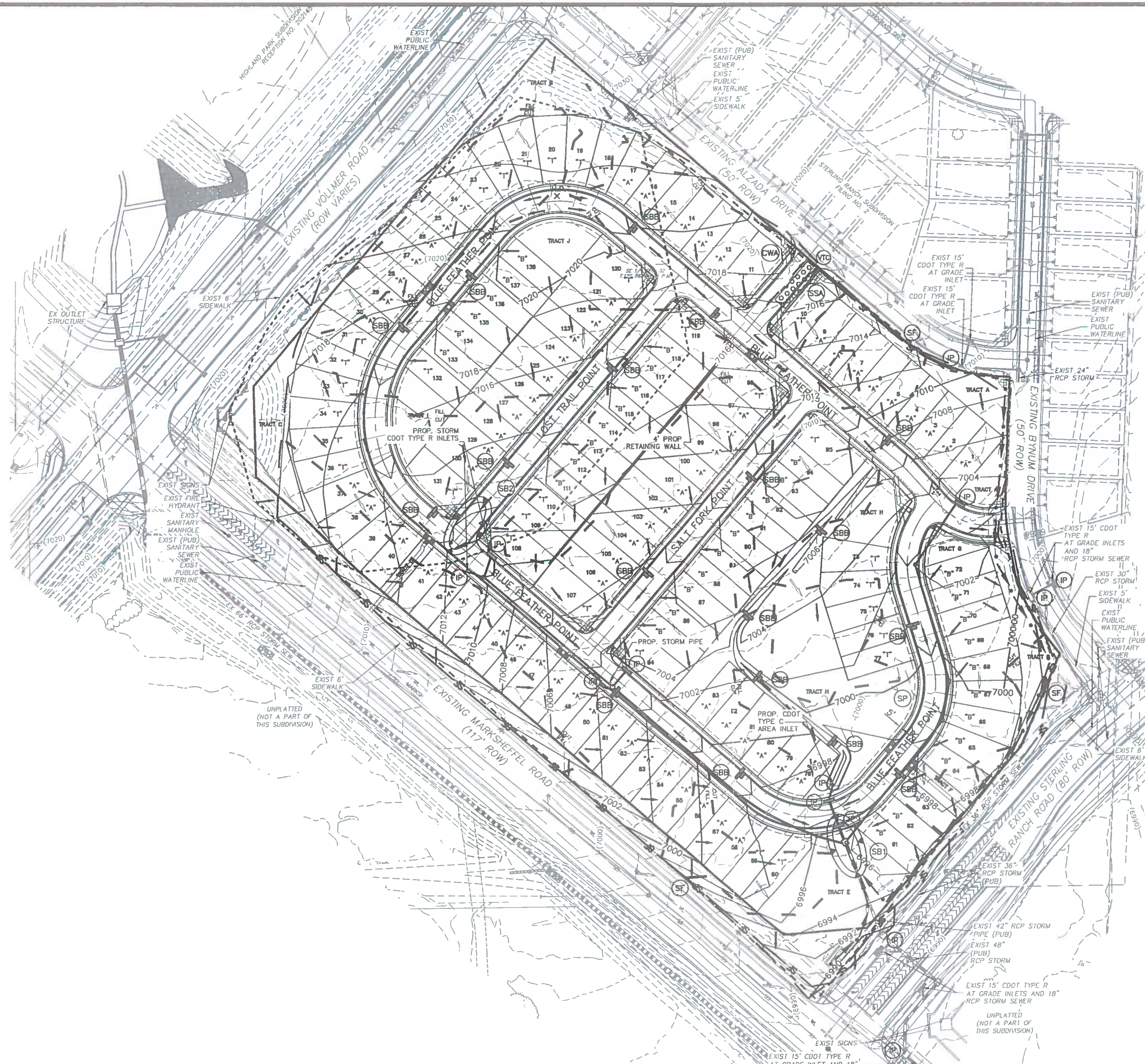
TEST BORING LOCATION MAP
COPPER CHASE AT STERLING RANCH
EL PASO COUNTY, CO.
FOR: MORLEY-BENTLEY INVESTMENTS, LLC

DRAWN
JAC
CHECKED
DPS
DATE
12/7/21
SCALE
1"=300'
JOB NO.
191088
FIGURE No.
4



N

37.5 0 75 150 300

1:150

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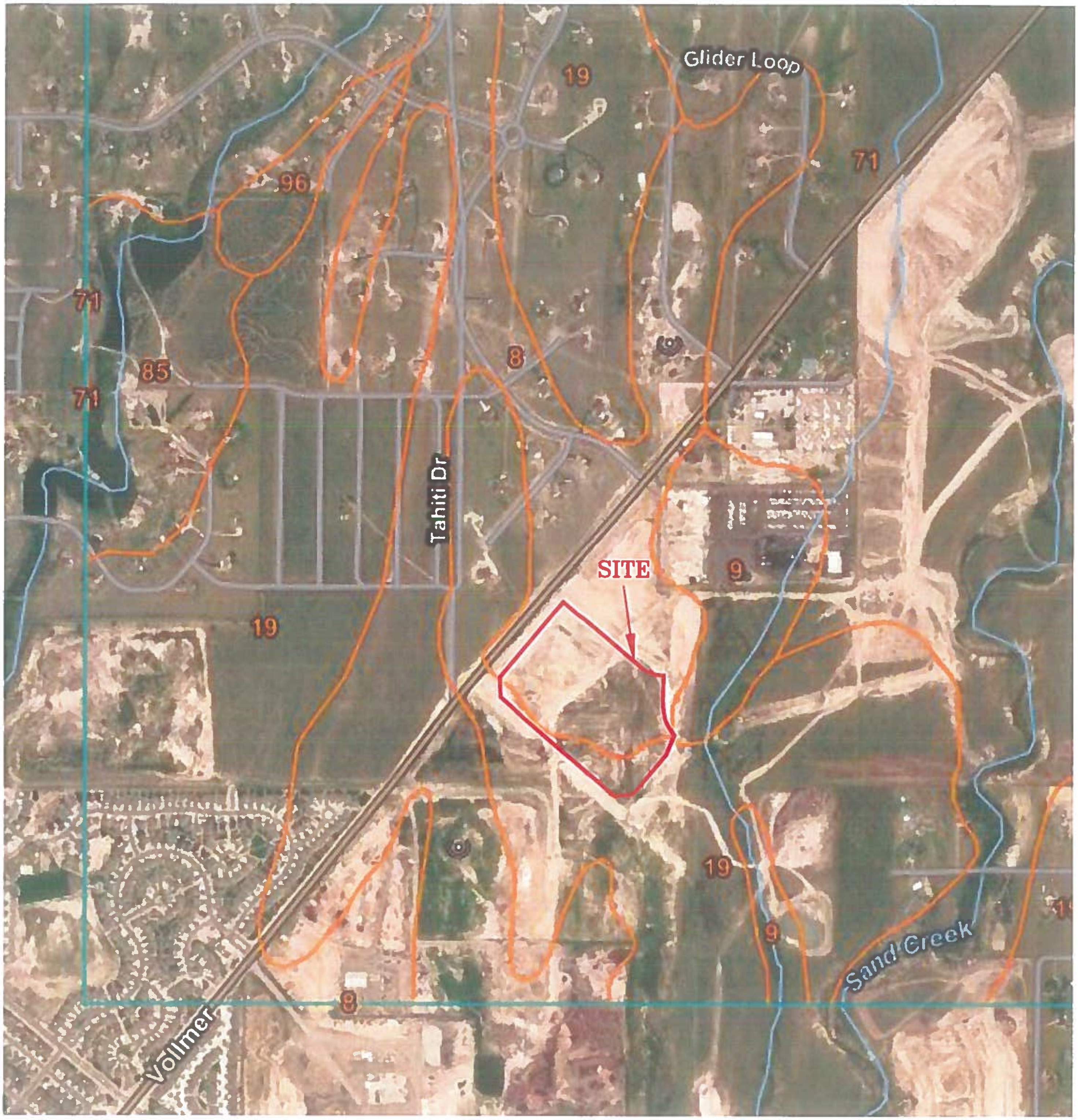
GRADING MAP
Copper Chase & Sterling Ranch F2
EL PASO, COLORADO
FOR: MORLEY-BENTLY INVESTMENTS

DRAWN
JAC
CHECKED
KAH
DATE
08/15/19
SCALE
1:150
JOB NO.
191088
FIGURE No.
4A



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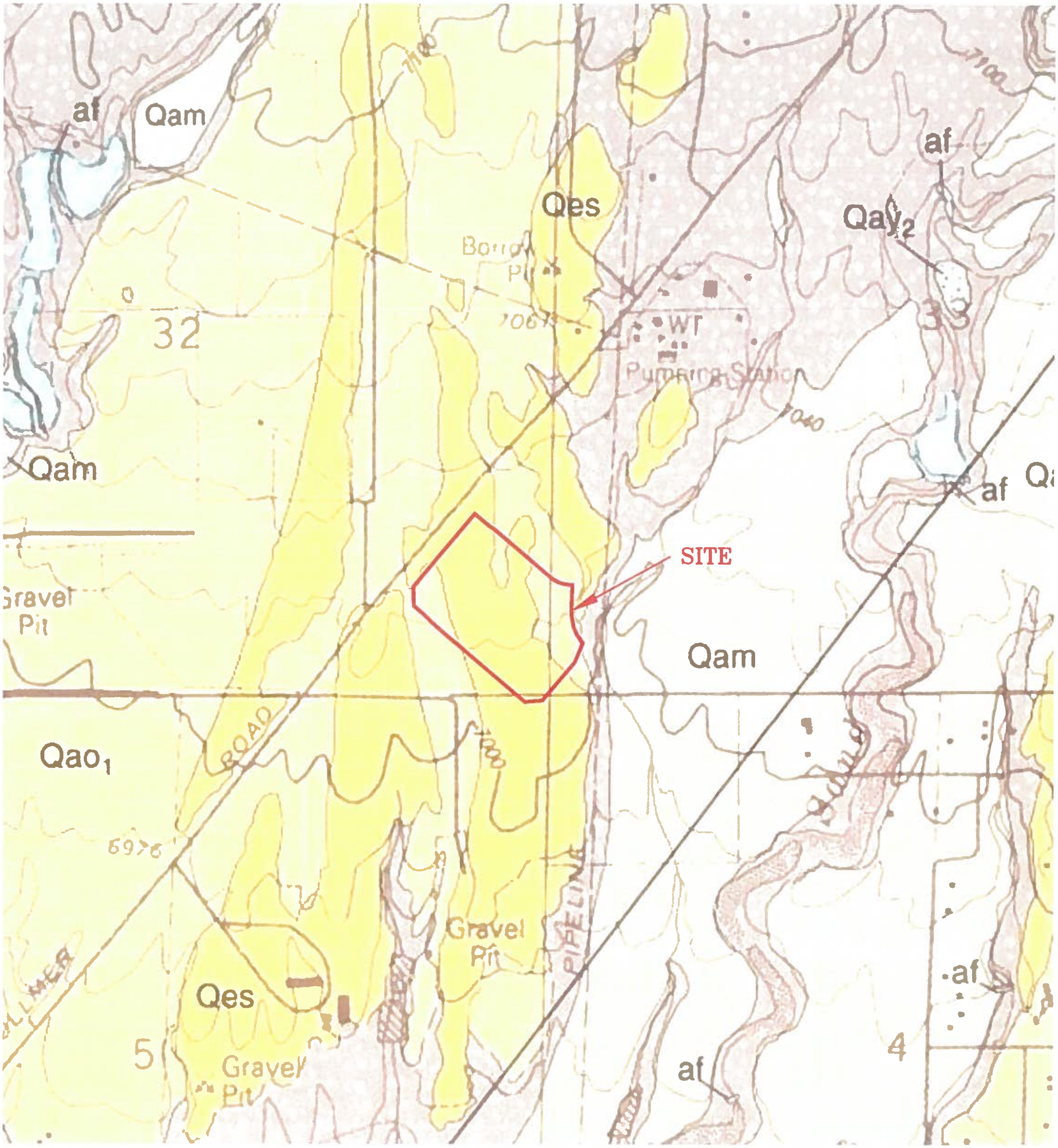
SOIL SURVEY MAP
COPPER CHASE AT STERLING RANCH
EL PASO COUNTY, CO.
FOR: MORLEY-BENTLEY INVESTMENTS, LLC

DRAWN:	DATE:	CHECKED:	DATE:
JAC	8/15/19	SW	12-9-21

JOB NO.: 191088

FIG NO.: 5



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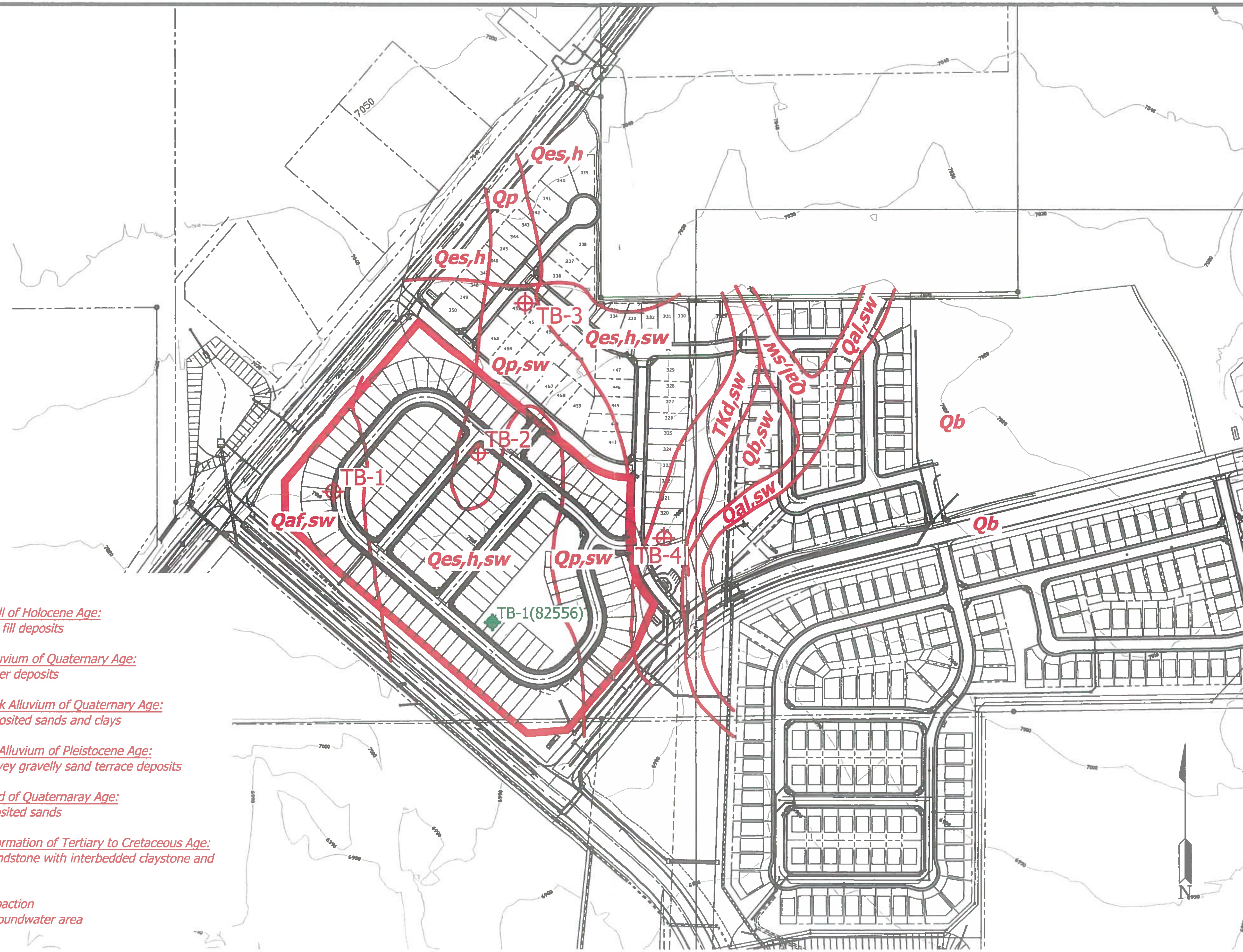
FALCON NW QUADRANGLE GEOLOGY MAP
COPPER CHASE AT STERLING RANCH
EL PASO COUNTY, CO.
FOR: MORLEY-BENTLEY INVESTMENTS, LLC

DRAWN:	DATE:	CHECKED:	DATE:
JAC	12/7/21	SW	12-9-21

JOB NO.: 191088

FIG NO.: 6



Legend:

Qaf -	*Artificial Fill of Holocene Age:*	*Man-made fill deposits*
Qal -	*Recent Alluvium of Quaternary Age:*	*recent water deposits*
Qp -	*Piney Creek Alluvium of Quaternary Age:*	*Water-deposited sands and clays*
Qb -	*Broadway Alluvium of Pleistocene Age:*	*silty to clayey gravelly sand terrace deposits*
Qes -	*Eolian Sand of Quaternaray Age:*	*Wind-deposited sands*
Tkd -	*Dawson Formation of Tertiary to Cretaceous Age:*	*Arkosic sandstone with interbedded claystone and siltstone*
h -	*hydrocompaction*	
sw -	*shallow groundwater area*	

TB-1- APPROXIMATE TEST BORING LOCATION AND NUMBER

TB5 = APPROXIMATE TEST BORING LOCATION AND NUMBER FROM ENTECH JOB NO 82556

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GEOLOGY/ENGINEERING GEOLOGY MAP
COPPER CHASE AT STERLING RANCH
EL PASO COUNTY, CO.
FOR: MORLEY-BENTLEY INVESTMENTS, LLC

DRAWN JAC
CHECKED DPS
DATE 12/7/21
SCALE 1" = 300'
JOB NO. 191088
FIGURE No. 7

LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

ZONE A No base flood elevations determined.

ZONE AE Base flood elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE A99 To be protected from 100-year flood by Federal flood protection system under construction; no base elevations determined.

ZONE V Coastal flood with velocity hazard (wave action); no base flood elevations determined.

ZONE VE Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

ZONE X Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

ZONE X Areas determined to be outside 500-year floodplain.

ZONE D Areas in which flood hazards are undetermined.

UNDEVELOPED COASTAL BARRIERS

Identified 1983 | Identified 1990 | Otherwise Protected Areas

Coastal barrier areas are normally located within or adjacent to Special Flood Hazard Areas.

Flood Boundary

Floodway Boundary

Zone D Boundary

Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.

~~~~513~~~~ Base Flood Elevation Line; Elevation in Feet. See Map Index for Elevation Datum.

(D)——(D) Cross Section Line

(EL 987) Base Flood Elevation in Feet Where Uniform Within Zone. See Map Index for Elevation Datum.

RM7 × Elevation Reference Mark

• M2 River Mile

97°07'30", 32°22'30" Horizontal Coordinates Based on North American Datum of 1927 (NAD 27) Projection.

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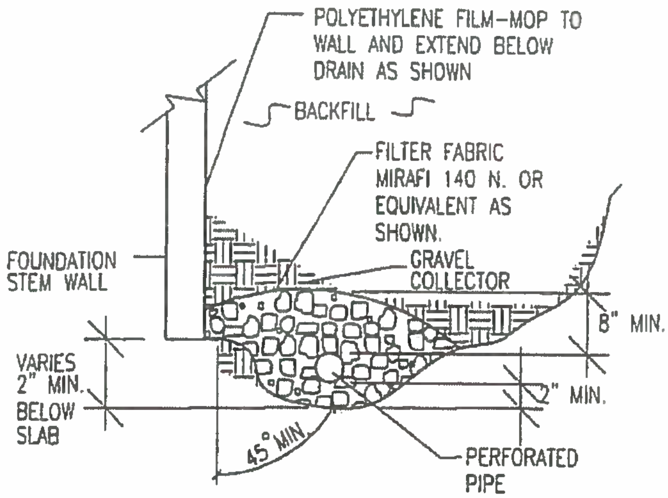
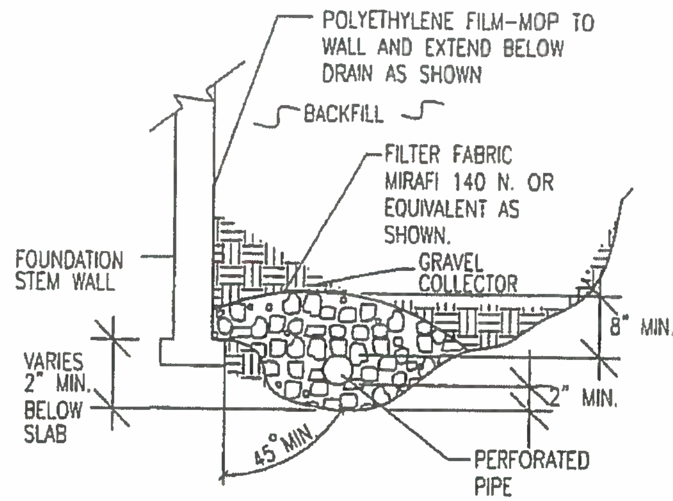
FLOODPLAIN MAP
COPPER CHASE AT STERLING RANCH
EL PASO COUNTY, CO.
FOR: MORLEY-BENTLEY INVESTMENTS, LLC

DRAWN JAC
CHECKED
DATE 8/15/19
SCALE AS SHOWN
JOB NO. 191088
FIGURE No. 8
~~~~





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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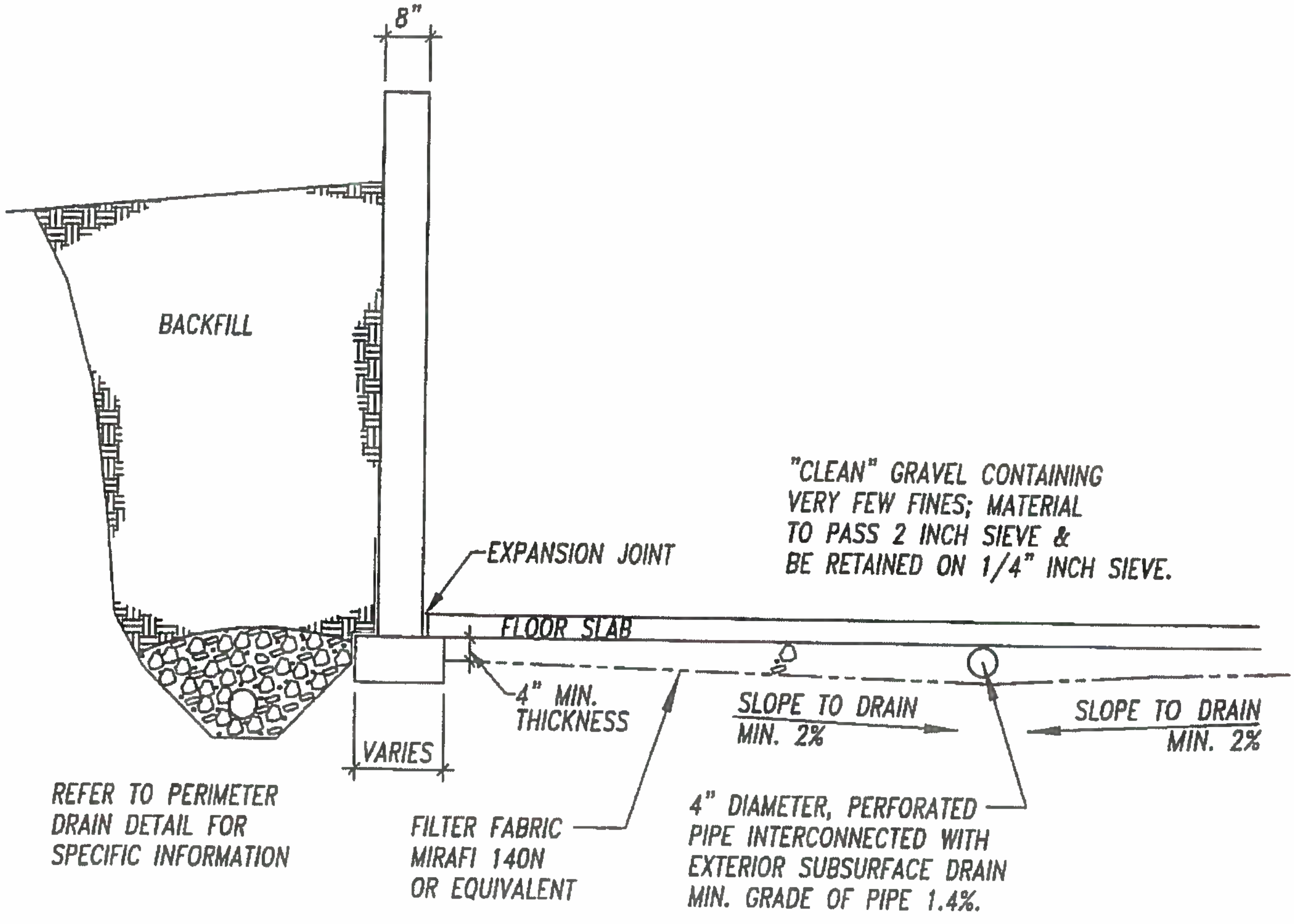
EXTERIOR PERIMETER DRAIN DETAIL

DRAWN:	DATE:	DESIGNED:	CHECKED:
M. VAN KAMPEN	1/23/20	DS	h

JOB NO.: 191088

FIG NO.: 9



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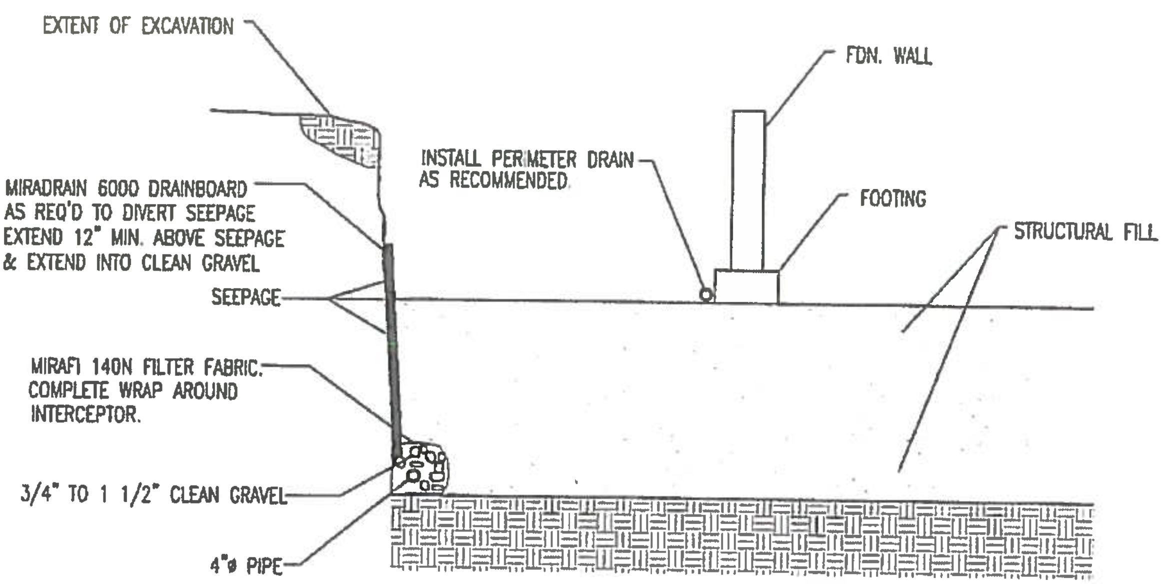
TYP. UNDERSLAB DRAINAGE
LAYER (CAPILLARY BREAK)

DRAWN:	DATE:	DESIGNED:	CHECKED:
	1/23/20	DS	

JOB NO.: 191088

FIG NO.: 10



NOTE:
EXTEND INTERCEPTOR DRAIN TO DAYLIGHT

INTERCEPTOR DRAIN DETAIL

N.T.S.

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COLORADO SPRINGS, CO. 80907 (719) 531-5599

INTERCEPTOR DRAIN DETAIL

DRAWN BY:	DATE DRAWN:		CHECKED:
			h

JOB NO.: 191088

FIG. NO.: 11

APPENDIX A: Site Photographs

1

Looking northeast from the western portion of the site.

January 8, 2020

2

Looking south from the northwest portion of the site.

January 8, 2020

Job No. 191088

3

Looking southwest from the northeast portion of the site.

January 8, 2020

4

Looking north from the southern portion of the site.

January 8, 2020

Job No. 191088

APPENDIX B: Test Boring Logs

TEST BORING NO. 1
DATE DRILLED 7/12/2019
Job # 191088

REMARKS

WATER @ 8', 7/12/19
WATER @ SURFACE, 8/7/19
CAVED TO 5', 2/3/20, DRY

Description	Depth (ft)	Blows per foot	Watercontent %	Soil Type
FILL 0-4', SAND, SILTY, FINE TO COARSE GRAINED, BROWN, LOOSE, MOIST		8	7.1	1A
SAND, SILTY, CLAYEY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE, MOIST	5	16	10.9	1
WATER AT 8', 7/12/19				
SANDSTONE, VERY CLAYEY, FINE TO COARSE GRAINED, GRAY BROWN, VERY DENSE, WET	10	50/6"	12.2	2
	15	50/4"	11.3	2
	20	50	12.1	2

TEST BORING NO. 2
DATE DRILLED 7/17/2019
CLIENT MORLEY-BENTLEY INVEST.
LOCATION STERLING RANCH, F-2

REMARKS

WATER @ 8.5', 7/17/19
WATER @ SURFACE, 8/7/19
WATER AT 6.5', 2/3/20

Description	Depth (ft)	Blows per foot	Watercontent %	Soil Type
SAND, SILTY TO CLAYEY, FINE TO COARSE GRAINED, BROWN, DENSE, MOIST		35	7.6	1
	5	33	18.2	1
WATER AT 6.5', 2/3/20				
WATER AT 8.5', 7/17/19				
SANDSTONE, SILTY, FINE TO COARSE GRAINED, TAN, VERY DENSE, WET	10	50/8"	16.7	2
	15	50/3"	10.8	2
	20	50/3"	11.9	2

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

TEST BORING LOG

DRAWN: DATE: CHECKED: DATE: 2/3/20

JOB NO. 191088
FIG NO. B- 1

TEST BORING NO. 3
DATE DRILLED 7/17/2019
Job # 191088

REMARKS

WATER @ 3.5', 7/17/19
WATER @ SURFACE, 8/7/19
WATER AT 3', 2/3/20

Description	Depth (ft)	Samples	Blows per foot	Watercontent %	Soil Type
SAND, SLIGHTLY SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE TO DENSE, MOIST TO WET			20	5.9	1
	5		34	10.0	1
	10		*	16.4	1
SANDSTONE, SILTY, FINE TO COARSE GRAINED, BROWN, VERY DENSE, MOIST	15		50/3"	10.5	2
	20		50/3"	13.0	2

* - BULK SAMPLE TAKEN

TEST BORING NO. 4
DATE DRILLED 7/17/2019
CLIENT MORLEY-BENTLEY INVEST.
LOCATION STERLING RANCH, F-2

REMARKS

WATER @ 2', 7/17/19
WATER @ SURFACE, 8/7/19

Description	Depth (ft)	Samples	Blows per foot	Watercontent %	Soil Type
SAND, SILTY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE, MOIST TO WET			14	11.0	1
SANDSTONE, SILTY, FINE TO COARSE GRAINED, BROWN, VERY DENSE, MOIST TO WET	5		50	11.7	2
	10		50/6"	13.8	2
SANDSTONE, CLAYEY, FINE TO COARSE GRAINED, GRAY BROWN, VERY DENSE, WET	15		50/3"	21.2	2
	20		*	23.6	2

* - BULK SAMPLE TAKEN

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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

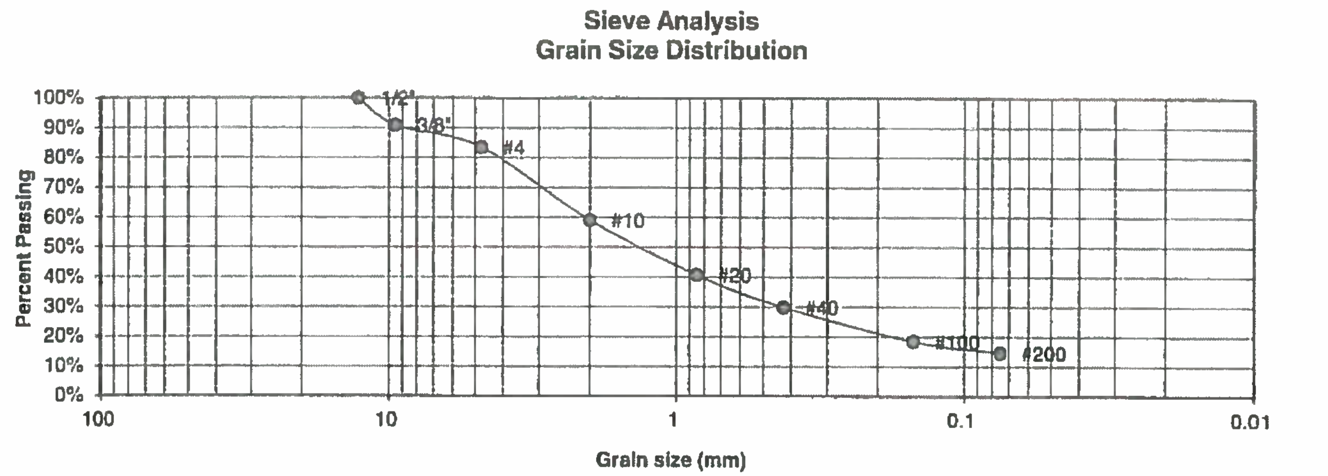
TEST BORING LOG

DRAWN:	DATE	CHECKED	DATE:
		h	2/3/20

JOB NO. 191088
FIG NO. B- 2

APPENDIX C: Laboratory Test Results

UNIFIED CLASSIFICATION	SM	CLIENT	MORLEY-BENTLEY INVEST.
SOIL TYPE #	1A	PROJECT	STERLING RANCH, F-2
TEST BORING #	1	JOB NO.	191088
DEPTH (FT)	2-3	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	90.9%
4	83.4%
10	59.0%
20	40.7%
40	29.9%
100	18.4%
200	14.6%

Atterberg
Limits

Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

Swell

Moisture at start

Moisture at finish

Moisture increase

Initial dry density (pcf)

Swell (psf)

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

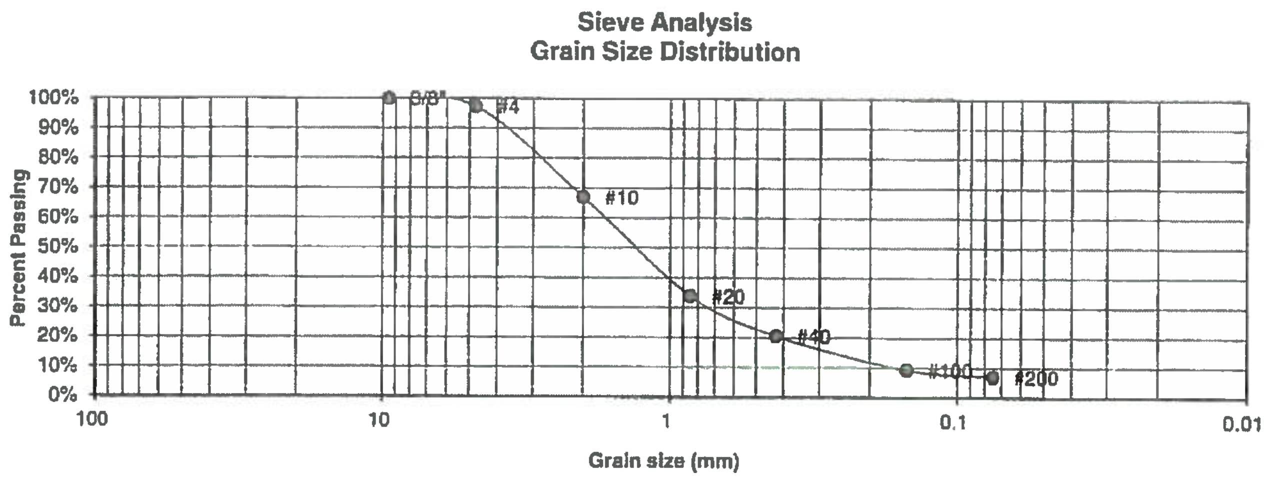
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		[illegible]	8/9/19

JOB NO.
191088

FIG NO.
C-1

UNIFIED CLASSIFICATION	SM-SW	CLIENT	MORLEY-BENTLEY INVEST.
SOIL TYPE #	1	PROJECT	STERLING RANCH, F-2
TEST BORING #	3	JOB NO.	191088
DEPTH (FT)	2-3	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	97.3%
10	67.0%
20	33.8%
40	20.5%
100	9.2%
200	7.1%

Atterberg Limits	
Plastic Limit	
Liquid Limit	
Plastic Index	

Swell	
Moisture at start	4.7%
Moisture at finish	18.7%
Moisture increase	14.0%
Initial dry density (pcf)	94
Swell (psf)	30

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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

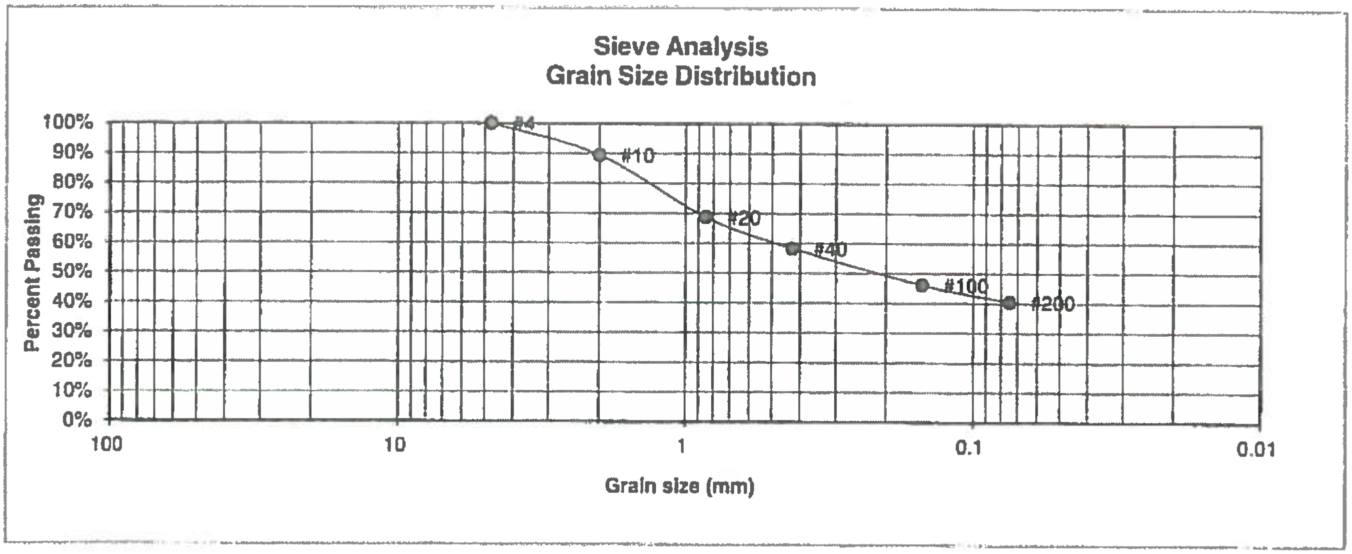
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED: L	DATE: 8/9/19

JOB NO 191088

FIG NO C-2

UNIFIED CLASSIFICATION	SC	CLIENT	MORLEY-BENTLEY INVEST.
SOIL TYPE #	2	PROJECT	STERLING RANCH, F-2
TEST BORING #	1	JOB NO.	191088
DEPTH (FT)	10	TEST BY	BL

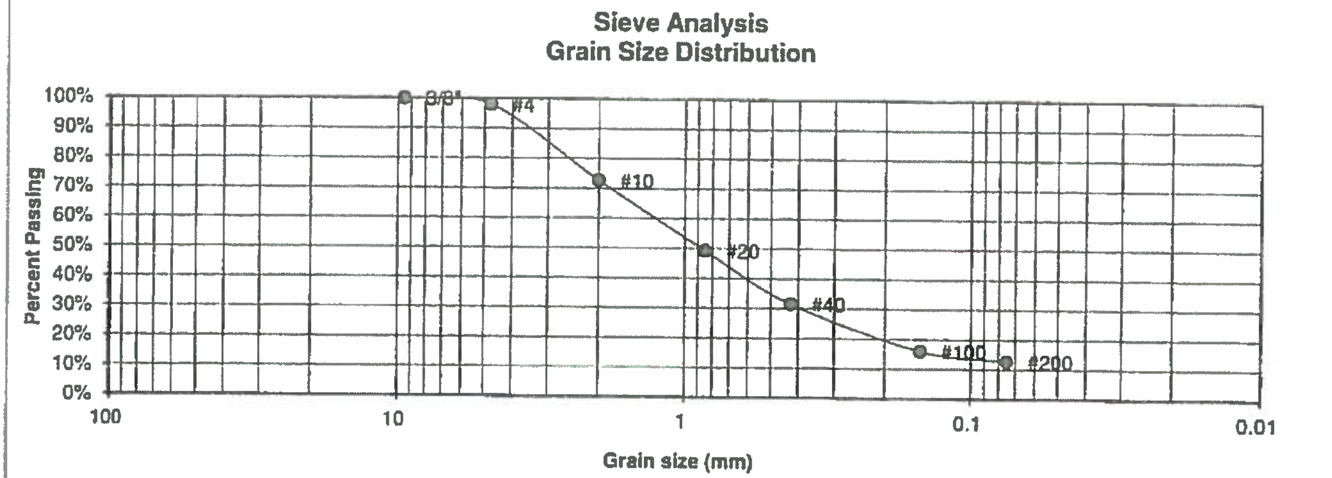


U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	89.5%
20	68.7%
40	58.3%
100	46.2%
200	40.4%

Atterberg Limits	
Plastic Limit	14
Liquid Limit	25
Plastic Index	11

Swell	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	

UNIFIED CLASSIFICATION	SM	CLIENT	MORLEY-BENTLEY INVEST.
SOIL TYPE #	2	PROJECT	STERLING RANCH, F-2
TEST BORING #	2	JOB NO.	191088
DEPTH (FT)	10	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	98.0%
10	72.7%
20	49.3%
40	31.5%
100	16.0%
200	12.7%

Atterberg Limits

Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

Swell

Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

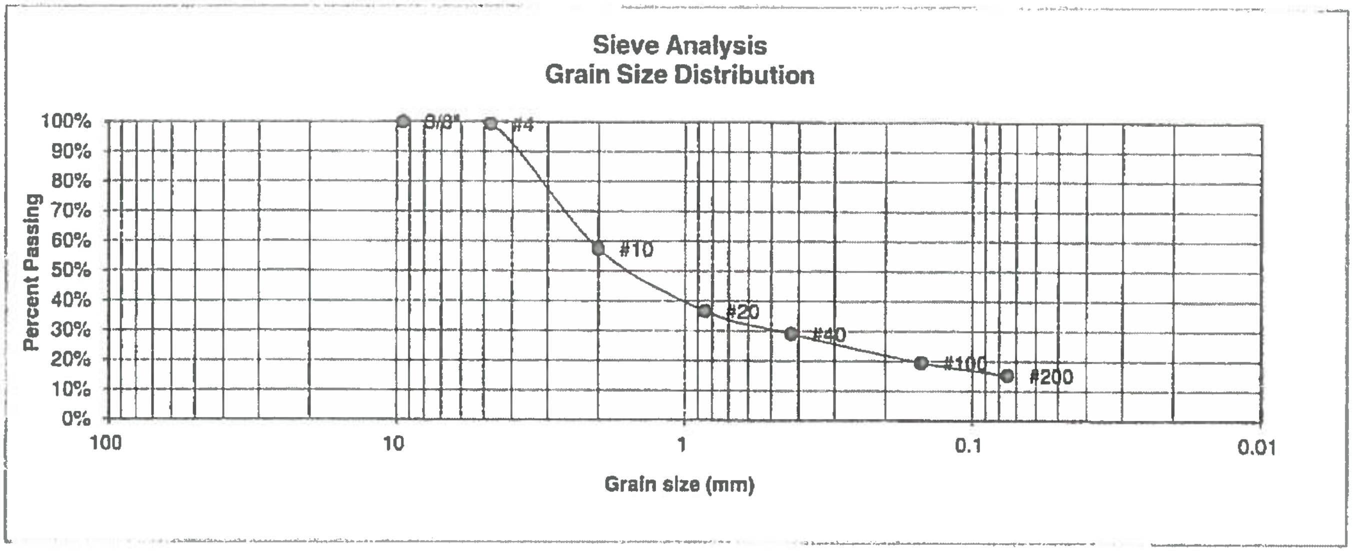
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		lr	8/9/19

JOB NO: 191088

FIG NO: C-4

UNIFIED CLASSIFICATION	SM	CLIENT	MORLEY-BENTLEY INVEST.
SOIL TYPE #	2	PROJECT	STERLING RANCH, F-2
TEST BORING #	4	JOB NO.	191088
DEPTH (FT)	5	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.2%
10	57.4%
20	36.7%
40	29.1%
100	19.5%
200	15.3%

Atterberg
Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

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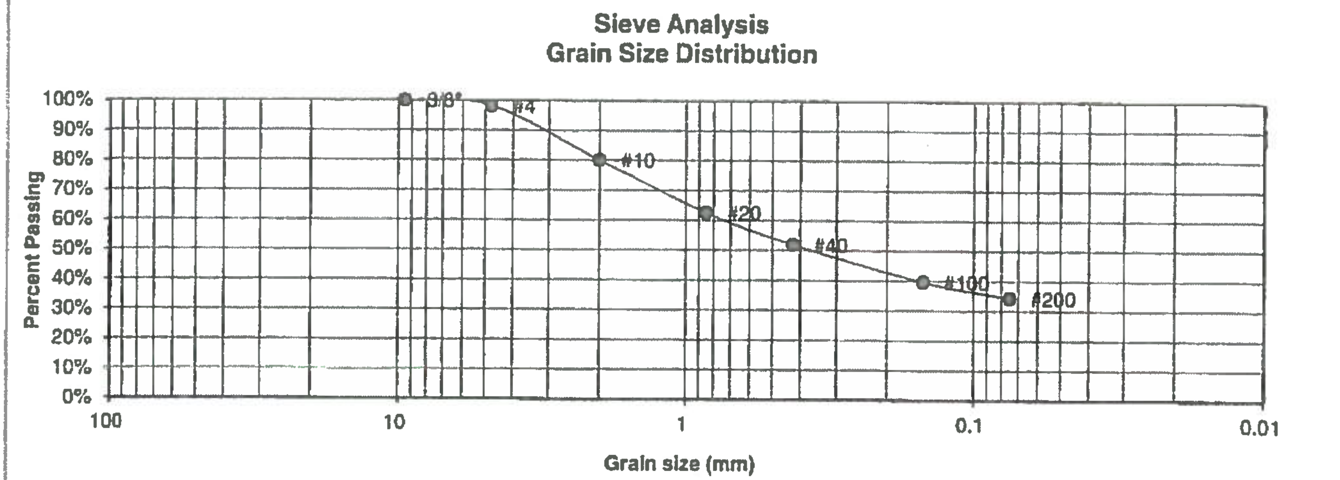
LABORATORY TEST RESULTS

DRAWN:	DATE	CHECKED:	DATE:
		lw	8/9/19

JOB NO. 191088

FIG NO. C-5

UNIFIED CLASSIFICATION	SC	CLIENT	MORLEY-BENTLEY INVEST.
SOIL TYPE #	2	PROJECT	STERLING RANCH, F-2
TEST BORING #	4	JOB NO.	191088
DEPTH (FT)	15	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	98.2%
10	80.1%
20	62.5%
40	52.0%
100	39.6%
200	34.3%

Atterberg Limits

Plastic Limit	20
Liquid Limit	30
Plastic Index	10

Swell

Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	

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LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		L	8/9/19

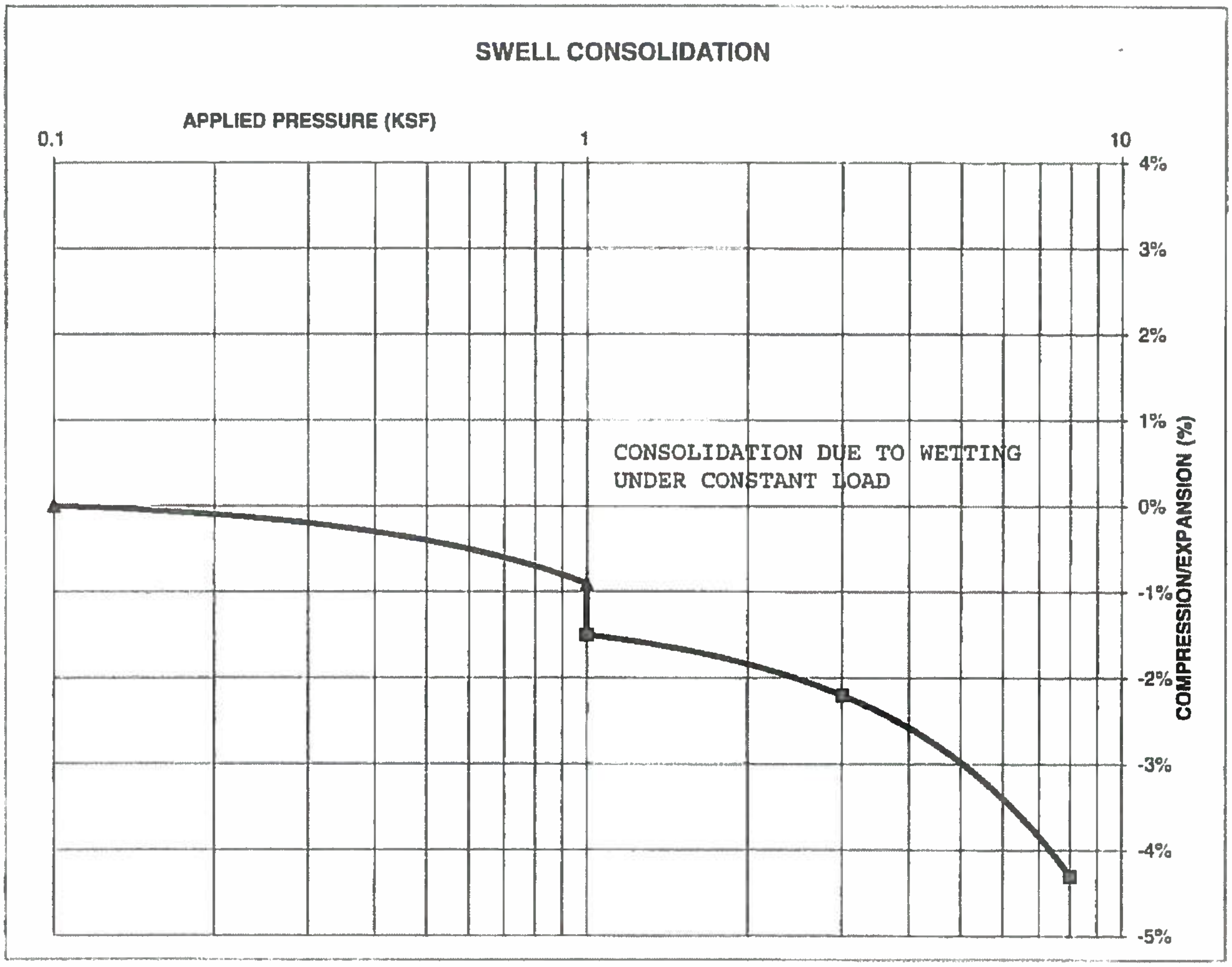
JOB NO. 191088

FIG NO. C-6

CONSOLIDATION TEST RESULTS

TEST BORING #	1	DEPTH(ft)	10
DESCRIPTION	SC	SOIL TYPE	2
NATURAL UNIT DRY WEIGHT (PCF)			132
NATURAL MOISTURE CONTENT			7.3%
SWELL/CONSOLIDATION (%)			-0.6%

JOB NO. 191088
CLIENT MORLEY-BENTLEY INVEST.
PROJECT STERLING RANCH, F-2



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COLORADO SPRINGS, COLORADO 80907

SWELL CONSOLIDATION
TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		[signature]	8/9/19

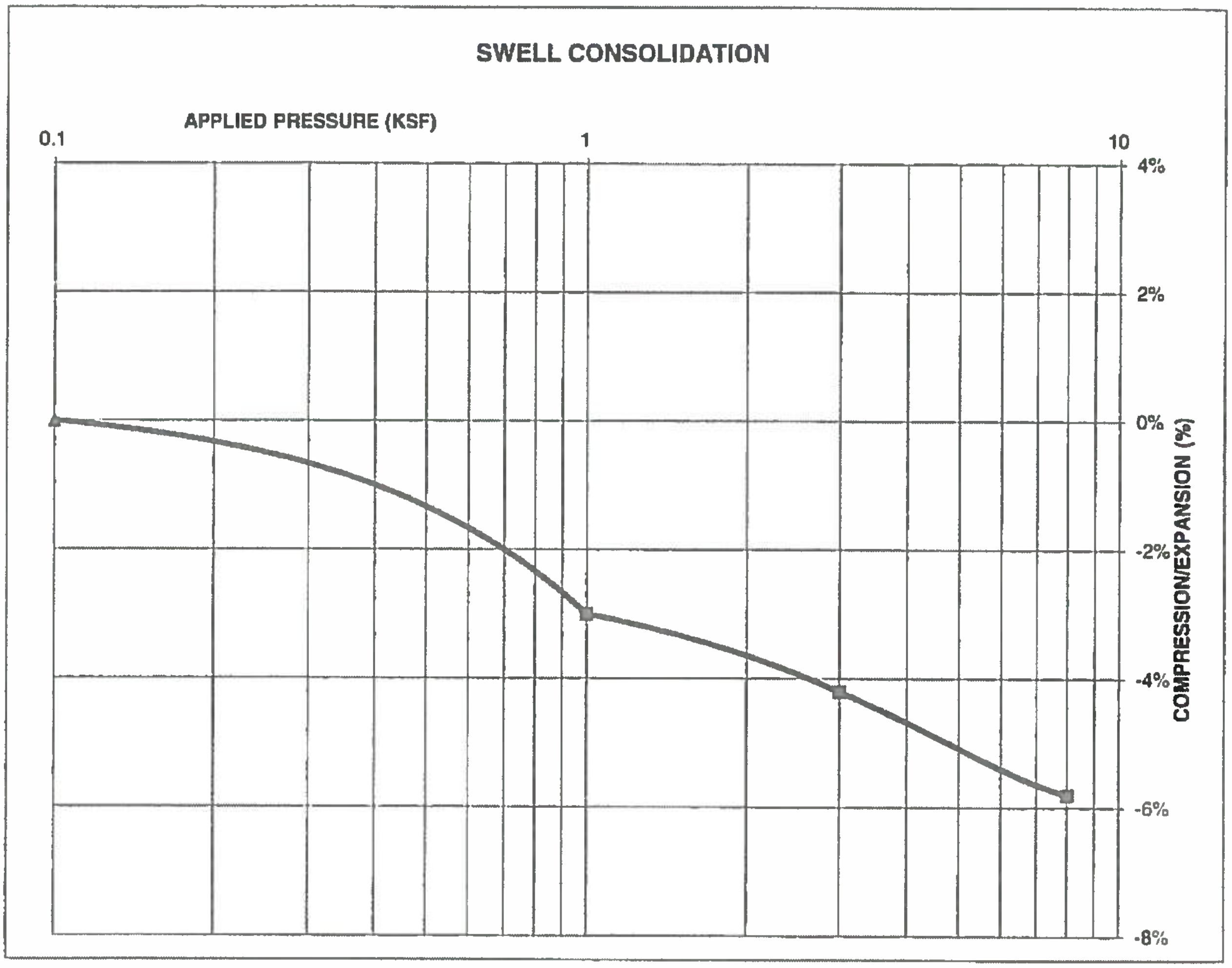
JOB NO. 191088

FIG NO. C-7

CONSOLIDATION TEST RESULTS

TEST BORING #	4	DEPTH(ft)	15
DESCRIPTION	SC	SOIL TYPE	2
NATURAL UNIT DRY WEIGHT (PCF)			103
NATURAL MOISTURE CONTENT			22.8%
SWELL/CONSOLIDATION (%)			0.0%

JOB NO. 191088
CLIENT MORLEY-BENTLEY INVEST.
PROJECT STERLING RANCH, F-2



CLIENT	MORLEY-BENTLEY INVEST.	JOB NO.	191088
PROJECT	STERLING RANCH, F-2	DATE	7/29/2019
LOCATION	STERLING RANCH, F-2	TEST BY	BL

BORING NUMBER	DEPTH, (ft)	SOIL TYPE NUMBER	UNIFIED CLASSIFICATION	WATER SOLUBLE SULFATE, (wt%)
TB-1	2-3	1A	SM	0.00
TB-1	10	2	SC	<0.01
TB-2	10	2	SM	<0.01
TB-4	15	2	SC	<0.01

QC BLANK PASS

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COLORADO SPRINGS, COLORADO 80907

LABORATORY TEST
SULFATE RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		L	8/9/19

JOB NO.
191088

FIG NO.
C-9

APPENDIX D: Test Boring Logs and Laboratory Test Results from Entech Job No. 82556

TEST BORING NO. 1
DATE DRILLED 8/23/2006
Job # 82556

REMARKS

WATER @ 6', 8/25/06

REMARKS	Depth (ft)	Blows per foot	Watercontent %	Soil Type
SAND, SILTY, TAN				1
CLAYSTONE, SANDY, GRAY BROWN, HARD, MOIST		50	12.1	4
	5	50/6"	11.2	4
	10	50/7"	13.1	4
	15	50/5"	9.8	4
	20			

TEST BORING NO. 2
DATE DRILLED 8/23/2006
CLIENT MORLEY BENTLEY
LOCATION STERLING RANCH

REMARKS

WATER @ 11', 8/25/06

REMARKS	Depth (ft)	Blows per foot	Watercontent %	Soil Type
SAND, SILTY, FINE TO COARSE GRAINED, DARK BROWN TO BROWN, MEDIUM DENSE, MOIST		12	2.0	1
WEATHERED CLAYSTONE, SANDY, GRAY, VERY STIFF, MOIST	5	30	13.3	4
SANDSTONE, CLAYEY, FINE TO COARSE GRAINED, LIGHT BROWN, VERY DENSE, MOIST TO VERY MOIST	10	50/6"	11.1	3
	15	50/5"	18.9	3
	20			

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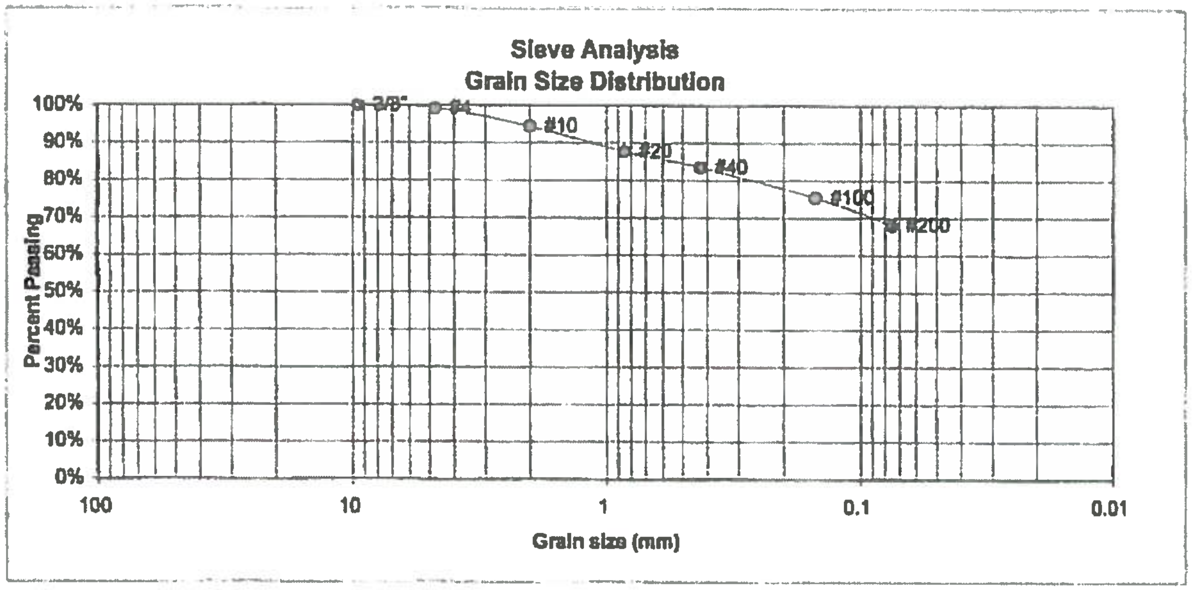
TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
		KAH	9/5/06

JOB NO.: 82556
FIG NO.: D-1

UNIFIED CLASSIFICATION	CL	CLIENT	MORLEY BENTLEY
SOIL TYPE #	4	PROJECT	STERLING RANCH
TEST BORING #	1	JOB NO.	82556
DEPTH (FT)	5	TEST BY	DG



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.2%
10	94.4%
20	87.7%
40	83.5%
100	75.5%
200	68.1%

Atterberg Limits

Plastic Limit

Liquid Limit

Plastic Index

Swell

Moisture at start

Moisture at finish

Moisture increase

Initial dry density (pcf)

Swell (psf)

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LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLA	9/5/06

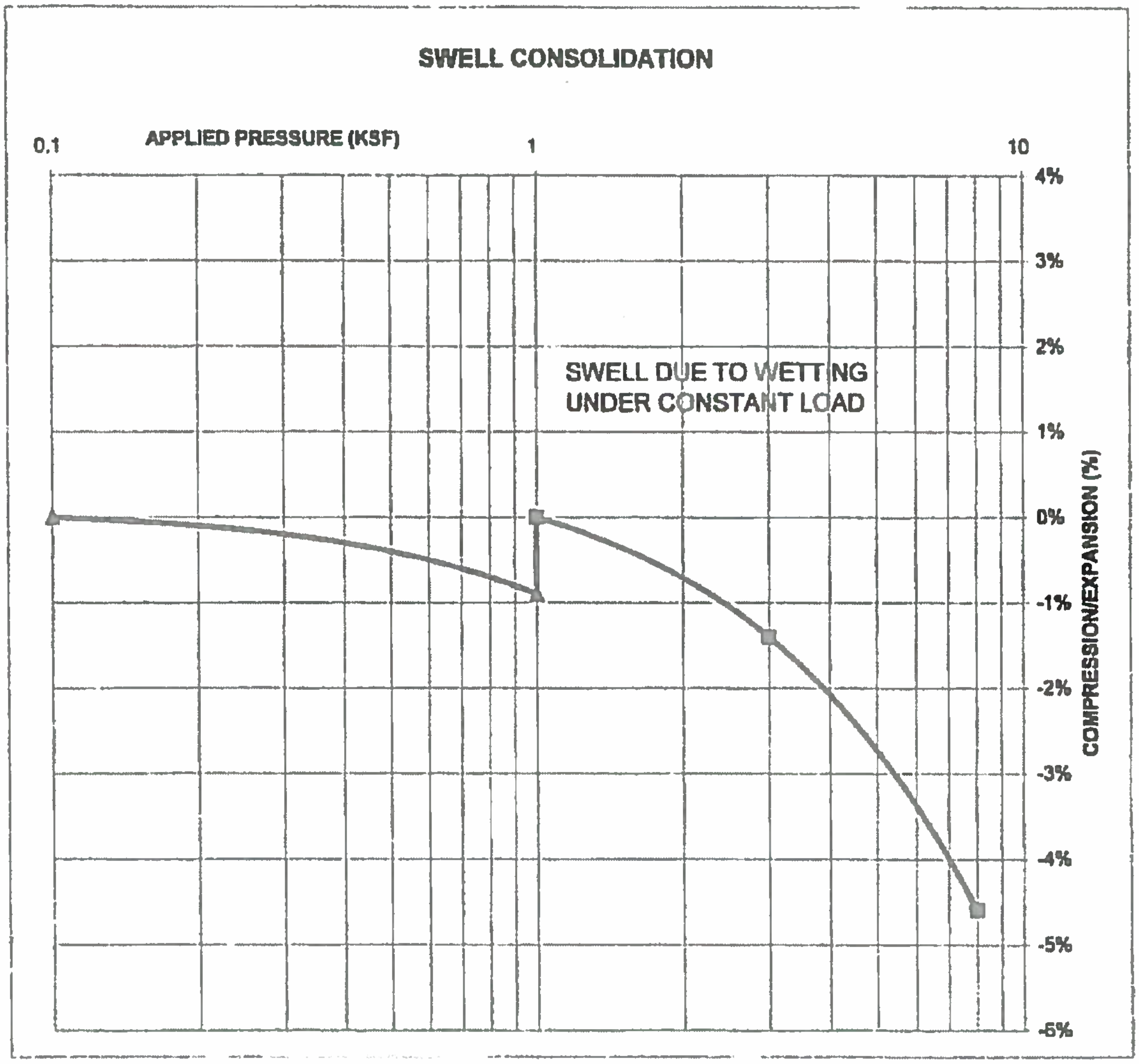
JOB NO.: 82556

FIG NO.: D-2

CONSOLIDATION TEST RESULTS

TEST BORING #	1	DEPTH(FT)	5
DESCRIPTION	CL	SOIL TYPE	4
NATURAL UNIT DRY WEIGHT (PCF)			118
NATURAL MOISTURE CONTENT			13.4%
SWELL/CONSOLIDATION (%)			0.9%

JOB NO. 82556
CLIENT MORLEY BENTLEY
PROJECT STERLING RANCH



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SWELL CONSOLIDATION TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		[illegible]	9/5/06

JOB NO.: 82556

FIG NO.: D-3

APPENDIX E: Soil Survey Descriptions

8—Blakeland loamy sand, 1 to 9 percent slopes. This deep, somewhat excessively drained soil formed in alluvial and eolian material derived from arkosic sedimentary rock on uplands. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is about 135 days.

Typically, the surface layer is dark grayish brown loamy sand about 11 inches thick. The substratum, to a depth of 27 inches, is brown loamy sand; it grades to pale brown sand that extends to a depth of 60 inches.

Included with this soil in mapping are small areas of Bresser sandy loam, 0 to 3 percent slopes; Bresser sandy loam, 3 to 5 percent slopes; Truckton sandy loam, 0 to 3 percent slopes; Truckton sandy loam, 3 to 9 percent slopes; and Stapleton sandy loam, 3 to 8 percent slopes. In some areas, mainly north of Colorado Springs in the Cottonwood Creek area, arkosic beds of sandstone and shale are at a depth of 0 to 40 inches.

Permeability of this Blakeland soil is rapid. Effective rooting depth is 60 inches or more. Available water capacity is low to moderate. Organic matter content of the surface layer is medium. Surface runoff is slow, the hazard of erosion is moderate, and the hazard of soil blowing is severe.

Most areas of this soil are used for range, homesites, and wildlife habitat.

Native vegetation is dominantly western wheatgrass, side-oats grama, and needleandthread. This soil is best suited to deep-rooted grasses.

Proper range management is necessary to prevent excessive removal of plant cover from the soil. Interseeding improves the existing vegetation. Deferment of grazing in spring increases plant vigor and soil stability. Proper location of livestock watering facilities helps to control grazing.

Windbreaks and environmental plantings are fairly well suited to this soil. Blowing sand and low available water capacity are the main limitations for the establishment of trees and shrubs. The soil is so loose that trees need to be planted in shallow furrows and plant cover needs to be maintained between the rows. Supplemental irrigation may be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

This soil is suited to wildlife habitat. It is best suited to habitat for openland and rangeland wildlife. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed.

This soil has good potential for urban development. Soil blowing is a hazard if protective vegetation is removed. Special erosion control practices must be provided to minimize soil losses. Capability subclass VIe.

9—Blakeland complex, 1 to 9 percent slopes. This complex is on uplands, mostly in the Falcon area. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the frost-free period is about 135 days.

This complex is about 60 percent Blakeland loamy sand, about 30 percent Fluvaquentic Haplaquolls, and 10 percent other soils.

Included with these soils in mapping are areas of Columbine gravelly sandy loam, 0 to 3 percent slopes, Ellicott loamy coarse sand, 0 to 5 percent slopes, and Ustic Torrifluvents, loamy.

The Blakeland soil is in the more sloping areas. It is deep and somewhat excessively drained. It formed in sandy alluvium and eolian material derived from arkosic sedimentary rock. Typically, the surface layer is dark grayish brown loamy sand about 11 inches thick. The substratum, to a depth of 27 inches, is brown loamy sand; it grades to pale brown sand that extends to a depth of 60 inches or more.

Permeability of the Blakeland soil is rapid. The effective rooting depth is more than 60 inches. The available water capacity is moderate to low. Surface runoff is slow, and the hazard of erosion is moderate.

The Fluvaquentic Haplaquolls are in swale areas. They are deep, poorly drained soils. They formed in alluvium derived from arkosic sedimentary rock. Typically, the surface layer is brown. The texture is variable throughout. The water table is at a depth of 0 to 3 feet.

The Blakeland soil is well suited to deep-rooted grasses. Native vegetation is dominantly western wheatgrass, side-oats grama, and needleandthread. Rangeland vegetation on the Fluvaquentic Haplaquolls is dominantly tall grasses, including sand bluestem, switchgrass, prairie cordgrass, little bluestem, and sand reedgrass. Cattails and bulrushes are common in the swampy areas.

Proper range management is needed to prevent excess removal of plant cover from these soils. It is also needed to maintain the productive grasses. Interseeding improves the existing vegetation. Deferment of grazing during the growing season increases plant vigor and soil stability, and it helps to maintain and improve range condition. Proper location of livestock watering facilities helps to control grazing of animals.

Windbreaks and environmental plantings are fairly well suited to these soils. Blowing sand and low available water capacity are the main limitations to the establishment of trees and shrubs. The soils are so loose that trees need to be planted in shallow furrows and plant cover needs to be maintained between the rows. Supplemental irrigation may be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

The Blakeland soil is well suited to wildlife habitat. It is best suited to habitat for openland and rangeland wildlife. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed. Wetland wildlife can be attracted to the Fluvaquentic Haplaquolls and the wetland habitat can be enhanced by several means. Shallow water developments can be created by digging or by blasting potholes to create open-water areas. Fencing to control livestock grazing is beneficial, and it allows wetland plants such as cattails, reed canarygrass, and rushes to grow. Control of unplanned burning and prevention of drainage that would remove water from the wetlands are good practices. Openland wildlife use the vegetation on these soils for nesting and escape cover. These shallow marsh areas are especially important for winter cover if natural vegetation is allowed to grow.

The Blakeland soil has good potential for homesites, roads, and streets. It needs to be protected from erosion when vegetation has been removed from building sites. The Fluvaquentic Haplaquolls have poor potential for homesites. Their main limitations for this use are the high water table and the hazard of flooding. Capability subclass VIe.

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ENGINEERING, INC.

SCS SOIL DESCRIPTION

Drawn	Date	Checked	Date
		[illegible]	1/27/20

Job No. 191088

Fig. No. E-2

19—Columbine gravelly sandy loam, 0 to 3 percent slopes. This deep, well drained to excessively drained soil formed in coarse textured material on alluvial terraces and fans and on flood plains. Elevation ranges from 6,500 to 7,300 feet. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is about 135 days.

Typically, the surface layer is grayish brown gravelly sandy loam about 14 inches thick. The underlying material is light yellowish brown very gravelly loamy sand.

Included with this soil in mapping are small areas of Stapleton sandy loam, 3 to 8 percent slopes; Blendon sandy loam, 0 to 3 percent slopes; Louviers silty clay loam, 3 to 18 percent slopes; and Fluvaquentic Haplaquolls, nearly level. In places the parent arkose beds of sandstone or shale are at a depth of 0 to 40 inches.

Permeability of this Columbine soil is very rapid. Effective rooting depth is 60 inches or more. Available water capacity is low to moderate. Surface runoff is slow, and the hazard of erosion is slight to moderate.

This soil is used mainly for grazing livestock and for wildlife habitat. It is also used for homesites.

Native vegetation is mainly western wheatgrass, sideoats grama, needleandthread, and little bluestem. The main shrub is true mountainmahogany.

Proper location of livestock watering facilities helps to control grazing.

Windbreaks and environmental plantings are fairly well suited to this soil. Blowing sand and low available water capacity are the principal limitations to the establishment of trees and shrubs. The soil is so loose that trees need to be planted in the rows. Supplemental irrigation may be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

Rangeland wildlife, such as pronghorn antelope, cottontail, coyote, and scaled quail, is best adapted to life on this droughty soil. Forage production is typically loam, and proper livestock grazing management is necessary if wildlife and livestock share the range. Livestock watering developments are also important and are used by various wildlife species.

The main limitation of this soil for urban development is a hazard of flooding in some areas. Care must be taken when locating septic tank absorption fields because of possible pollution as a result of the very rapid permeability of this soil. Capability subclass VIe.

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SCS SOIL DESRIPTION

Drawn	Date	Checked	Date
		h	1/27/20

Job No.
191088

Fig. No.
E-3

APPENDIX F: Colorado Geological Survey (CGS) Comments
July 9, 2020

CGS Comments 7.9.2020

Colorado Geological Survey review of Sterling Ranch Filing No. 2 (Phase 1) Final Plat SF2015 (Jill Carlson, carlson@mines.edu):

The available referral documents include a Soil, Geology, and Geologic Hazard Study, Copper Chase and Sterling Ranch Filing No. 2 (Entech Engineering, Job No. 191088, February 10, 2020), a set of Grading & Erosion Control Plans (JR Engineering, June 1, 2020), a set of six Sterling Ranch Filing No. 2 Final Plat sheets (JR Engineering, May 14, 2020), and other documents.

1) Shallow groundwater precludes below-grade (basement and crawl space) construction. Two of Entech's borings, TB-3 and TB-4, are located within the area of the 49 currently proposed residential lots. Groundwater was observed in TB-3 at three feet below the ground surface, and in TB-4 at two feet below the ground surface. Groundwater was observed in Entech's other three borings within Sterling Ranch Filing No. 2 at 8.5 feet below the ground surface and shallower. CGS disagrees with Entech's Figure 7, Geology/Engineering Geology Map, identifying the areas surrounding these borings as "potentially seasonal shallow groundwater areas." Entech's data indicate that most or all of Sterling Ranch Filing 2 is impacted by shallow groundwater.

Groundwater at the observed very shallow depths precludes below-grade (basement and crawl space) construction, unless grades will be raised through significant fill placement across the entire Filing 2 site. Based on Sheet 2 of the Grading Plans (JR Engineering, June 1, 2020), this does not appear to be the case; existing and proposed contours are poorly labelled, but areas of cuts and fills appear to be indicated. Since lowermost floor levels must be located at least three feet above shallowest anticipated groundwater levels, basements and crawl spaces should not be allowed within Sterling Ranch Filing No. 2. Individual foundation perimeter drains are intended to handle small amounts of intermittent water, and cannot be used to mitigate a persistent shallow groundwater condition.

2) Entech's Figures 4 and 7 show two locations labelled TB-1. One of these borings appears to be from a 2006 Entech investigation, and should be identified as such on the figures.

3) Plat Note 26 (Sterling Ranch Filing No. 2 Final Plat Sheet 2 of 6) is incomplete.

APPENDIX G: Colorado Geological Survey (CGS) Comments
March 10, 2021

Colorado Geological Survey

Colorado Geological Survey review of Sterling Ranch Filing No. 2 (Phase 1) Final Plat SF2015 Resubmittal (Jill Carlson, carlson@mines.edu):

The available referral documents include a revised Soil, Geology, and Geologic Hazard Study, Copper Chase and Sterling Ranch Filing No. 2 (Entech Engineering, Job No. 191088, September 25, 2020), a set of Grading & Erosion Control Plans (JR Engineering, February 1, 2021), a set of seven Sterling Ranch Filing No. 2 Final Plat sheets (JR Engineering, January 21, 2021), and other documents.

In response to CGS's 7/9/2020 review comments, Entech has revised their Soil, Geology, and Geologic Hazard Study as follows:

1. Added text (page 11) stating, "A sewer underdrain should be considered to assist with controlling groundwater," and "Where basements are considered, significant interceptor and underslab drains may be necessary... Specific recommendations should be made after additional investigation and site grading has been completed."

2. Entech's Figure 7 (mis-identified as Figure 2 in the title block) designates all previously identified "potentially seasonal shallow groundwater" areas as "seasonal shallow groundwater" areas.

As noted in our 7/9/2020 review, two of Entech's borings, TB-3 and TB-4, are located within the area of the 49 currently proposed residential lots. Groundwater was observed in TB-3 at three feet below the ground surface, and in TB-4 at two feet below the ground surface at the time of drilling, at the surface in both borings a few weeks later, and in TB-3 at three feet below the ground surface in February 2020. No water level observation was made in boring TB-4 in February 2020.

1. Entech's water level data do not support their characterization of the site's shallow groundwater condition as "seasonal." Entech's Figure 7, plat note 26 on sheet 2, and sheet 7 of the plat should be corrected to identify the entire Sterling Ranch Filing No. 2 (Phase 1) site as a shallow groundwater area.

2. Plat note 26 states, "In areas of high groundwater, all foundations shall incorporate an underground drainage system." Individual foundation perimeter drains are needed around any below-grade (basement) space determined to be feasible, and may discharge to an underdrain system, if constructed, but are intended to handle small amounts of intermittent, perched water and may NOT be used as sole mitigation of a persistent shallow groundwater condition such as exists on this site.

3. Based on Entech's water level observations, it is not clear that an underdrain system and interceptor drains will be effective at lowering water levels sufficiently to allow full-depth basement construction. CGS recommends that the County require the applicant's qualified consultant to verify that proposed mitigation will result in a separation distance of at least three feet between shallowest anticipated water levels and lowermost basement floor elevations, and that this separation distance can be maintained year-round, based on project grading, interceptor drain and underdrain plans, and proposed basement floor elevations.

4. No drawings were included with the current referral documents showing an underdrain system. An underdrain system should be allowed ONLY if it can gravity discharge to a daylight outfall, or is connected to an existing underdrain system that gravity discharges to a daylight outfall.

5. It remains unclear, based on the Grading & Erosion Control Plan (sheet 2, JR Engineering, 2/1/2021) that "much of the area is to be filled" (Entech, page 11). CGS recommends that the county require a cut and fill plan. It appears there will be up to 5 feet of fill in some areas, with similar cuts in other areas

(e.g. Lots 9 and 10) but the grading plan is very difficult to interpret, and it appears that contour intervals may be inconsistent (2 feet for existing grades and 1 foot for proposed grades).