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SOIL, GEOLOGY, AND GEOLOGIC HAZARD STUDY
STERLING RANCH FILING NO. 5
PARCEL 16
EL PASO COUNTY, COLORADO

Prepared for

Classic SRJ
2138 Flying Horse Club Drive
Colorado Springs, Colorado 80921

Attn: Loren Moreland

November 22, 2022
Revised December 1, 2023
Revised March 26, 2024

Respectfully Submitted,

ENTECH ENGINEERING, INC.

Logan L. Langford, P.G.
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Reviewed by:

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LLL

Encl.

Entech Job No. 222159
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1.0 SUMMARY

Project Location:

The project lies in portions of the SW ¼ Section 33, Township 12 South, Range 65 West of the 6th Principal Meridian. The site is located northwest of Dines Road and Sterling Ranch Road, in El Paso County, Colorado.

Project Description:

Total acreage involved in the project is 11.66 acres. The proposed development is to consist of seventy-two single-family residential lots with associated site improvements. 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 minor constraints on development. These include areas of potentially seasonal shallow groundwater areas, and shallow bedrock. Although expansive soils were not encountered in the test borings they are common in the area. Areas of potentially seasonal shallow groundwater occur in a drainage in the western portion of the site and in southern areas of the site. 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 project lies in portions of SW ¼ Section 33, Township 12 South, Range 65 West of the 6th Principal Meridian. The site is located northwest of Dines Road and Sterling Ranch Road, in El Paso County, Colorado. 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 low terrace ridge through the central portion of the site. A minor drainage swale is located in the northwestern portion of the site that flows in a southwesterly direction. The area of the site is indicated on the USGS Map, Figure 2. Previous site uses have included haul roads for the aggregate extraction as a part of the Pioneer Sand Quarry, and agricultural grazing land. Existing sand and gravel quarries lie to the east 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 11.66 acres. The proposed development is to consist of seventy-two single-family residential lots with associated site improvements. The development is to be serviced by Sterling Ranch Metropolitan District. The Site Plan/Test Boring Location Map is presented in Figure 3, and the proposed grading plan is presented in Figure 4. Site photographs, taken on November 15, 2022, are included in Appendix A. The approximate locations and directions of the photographs are indicated on Figure 4. The proposed grading is indicated on Figure 4.

3.0 SCOPE OF THE REPORT

The scope of this report includes 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. as a part of this investigation. The borings were drilled with a power-driven continuous flight auger drill rig to depths of 12 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 the Soil, Geology, and Geologic Hazard Study, Sterling Ranch Filing No. 4, revised date November 16, 2022 (Reference 4). 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 10.5 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, 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:

Type	Description
9	Blakeland Fluvaquentic Haplaquolls
19	Columbine Gravelly Sandy Loam, 0 to 3% slopes
71	Pring Coarse Sandy Loam, 3 to 8% slopes

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. 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 7). The Geology Map prepared for the site is presented in Figure 7. One mappable unit was identified on this site, which is described as follows:

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. This unit correlates to the Middle Alluvium on the Falcon NW Geologic Map (Figure 6).

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

Two soil and rock types were encountered in the test borings drilled on the site: Type 1: slightly silty sand (SM-SW), and Type 2: slightly silty sandstone bedrock (SM-SW. 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 1 was classified as a slightly silty sand (SM-SW). The sand was encountered in all of the test borings at the existing ground surface and extending to depths ranging from 3 to 7 feet bgs. Standard Penetration Testing on the sand resulted in N-Values of 26 to 39 bpf, indicating medium dense states. Water content and grain size testing resulted in a water contents of 3 to 6 percent with approximately 10 to 11 percent of the soil size particles passing the No 200 severe. Atterberg limits testing resulted in non-plastic results. Sulfate testing resulted in less than 0.01 percent soluble sulfate by weight, indicating the sand exhibits negligible potential for below grade concrete degradation due to sulfate attack.

Soil Type 2 was classified as slightly silty sandstone bedrock (SM-SW). The sandstone was encountered in all of the test borings at depths of approximately 3 to 7 feet bgs and extending to depths of the termination of the borings (12 to 20 feet). Standard Penetration Testing on the sandstone resulted in N-values of greater than 50 bpf indicating very dense states. Water content and grain size testing resulted in water contents of 3 to 13 percent with approximately 10 to 11 percent of the soil size particles passing the No. 200 sieve. Sulfate testing resulted in less than 0.01 percent soluble sulfate by weight, indicating the sand exhibits negligible potential for below grade concrete degradation due to sulfate attack.

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.

5.5 Groundwater

Groundwater was encountered at depths of 16 and 18.5 feet in two of the four test borings drilled across the filing. Groundwater was not encountered in the other two borings which were drilled to depths of 12 to 20 feet. Bedrock and groundwater depths are summarized in Table 2. An area of potentially seasonal shallow groundwater has been mapped on the site and is 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 and potentially 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 potentially expansive soils, potentially seasonal shallow groundwater areas, and shallow bedrock. The following hazards have been addressed:

Artificial Fill – Constraint

Areas of artificial fill were not observed on the site at the time of our field investigation.

<u>Mitigation</u>: 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. Any new fill added to the site should be placed on native or controlled fill soils, compacted as recommended above.

<u>Expansive Soils – Constraint</u>

Expansive soils were not encountered in of the test borings drilled on-site and as a part of the site investigation. 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. <u>Mitigation:</u> Expansive soils if encountered will require mitigation. 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.

<u>Subsidence Area – Hazard</u>

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.

<u>Slope Stability and Landslide Hazard</u>

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

Debris Fans – Hazard

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

Groundwater and Floodplain Areas – Constraint

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. A minor drainage swale is located in the northwestern portion of the site that flows in a southwesterly direction. The drainage from the site is diverted to detention pond number 5 which is located south of Sterling Ranch Filing No. 4. These areas are discussed as follows:

Potentially Seasonal Shallow Groundwater: Groundwater depths of 16 and 18.5 feet encountered in two of the test borings drilled on site which are summarized in Table 2. 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. According to the grading plan, these areas are to be filled, further raising foundations above the groundwater level.

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 a minimum of 3 feet above the highest anticipated groundwater level. 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 are recommended for any below grade useable space or crawlspaces, Figure 9. If groundwater conditions are encountered additional drains may be required. Typical drain details are presented in Figures 10 through 11. Structures should not block drainages. Swales should be created to intercept surface runoff and carry it safely around and away from structures. Additional investigation, after grading is completed, is recommended to provide final foundation and subsurface drain recommendations.

Faults - Hazard

The closest fault is the Rampart Range Fault, located approximately 10.5 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 - Constraint

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.

Shallow Bedrock

Bedrock was encountered in all the test borings and test pits at depths ranging from 3 to 7 feet. A Summary of the Depth to Bedrock is included in Table 2. Where shallow bedrock is encountered, excavation/grading may be difficult requiring track-mounted excavators. Bedrock may be encountered cuts for roadways and utility excavations.

Radioactivity – Hazard

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 17), 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 ROADWAY AND EMBANKMENT CONSTRUCTION RECOMMENDATIONS

In general, the site soils are suitable for the proposed roadways and embankments. Groundwater should be expected to be encountered in deeper cuts and along drainages and low-lying areas. Excavations into groundwater is not anticipated, however, if they do encroach on the groundwater levels unstable soil conditions may be encountered. Excavation of saturated soils will be difficult with rubber-tired equipment. Stabilization using shot rock or geogrids may be necessary.

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% of optimum moisture content and compacted to a minimum of 95% of its maximum Modified Proctor Dry Density, ASTM D-1557, prior to placing new fill. Areas receiving fill may require stabilization with rock or fabric if shallow groundwater conditions are encountered.

New fill should be placed in thin lifts not to exceed 6 inches after compaction while maintaining at least 95% of its maximum Modified Proctor Dry Density, ASTM D-1557. These materials should be placed at a moisture content conducive to compaction, usually 0 to ±2% 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 RELEVANCE OF GEOLOGIC AND SITE CONDITIONS TO LAND USE PLANNING

The existing geologic and geotechnical conditions at the site will impose some minor constraints on the proposed development and construction. On this site it is anticipated that regrading will mitigate many hazards such as areas of potentially unstable slopes, seasonal and potentially seasonal 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 floodplain in Sand Creek east of the site will be avoided.

The majority of the soils at typical foundation depths consist of sands and sandstone. Areas of shallow bedrock will be encountered on the site. Sandstone will have higher bearing capacities. Excavation of the harder sandstone or claystone bedrock may be more difficult in some areas. Difficult excavation is anticipated in areas of shallow bedrock, particularly areas with 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. 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.

An area of potentially seasonal shallow groundwater has been mapped in the drainage swale located in the northwestern of the site. Groundwater depths of 16 and 18.5 feet encountered in two of the test borings drilled on site which are summarized in Table 2. 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. According to the grading plan, these areas are to be filled. Subsurface perimeter drains are recommended for any below grade useable space below grade, Figure 9. If groundwater conditions are encountered additional drains may be required. Typical drain details are presented in Figures 10 through 11. Structures should not block drainages. Swales should be created to intercept surface runoff and carry it safely around and away from structures. Additional investigation, after grading is completed, is recommended to provide final foundation and subsurface drain recommendations

All soft or organic soils should be removed prior to fill placement. Unstable soils may be encountered if 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 seasonal or potentially seasonal shallow groundwater areas may require drains to control seepage within the foundation zone. Typical drain details are presented in Figures 9 through 11. Additional site investigation will be conducted as development plans are being prepared, and following completion of site grading. Drainage improvements along roads and utility underdrains will intercept potential shallow groundwater. Basement construction on the site appears feasibility based on the soil borings and the proposed grading.

In summary, the site can be developed based on the proposed plan if 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.

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 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. Additional subsurface soil investigation is recommended as the site is developed to provide building recommendations.

This report has been prepared for Classic SRJ 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.

REFERENCES

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. revised date November 16, 2022. *Soil, Geology, and Geologic Hazard Study, Sterling Ranch Filing No. 4, Parcel 10, El Paso County, Colorado.* Entech Job No. 220921.
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.A

TABLES

TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

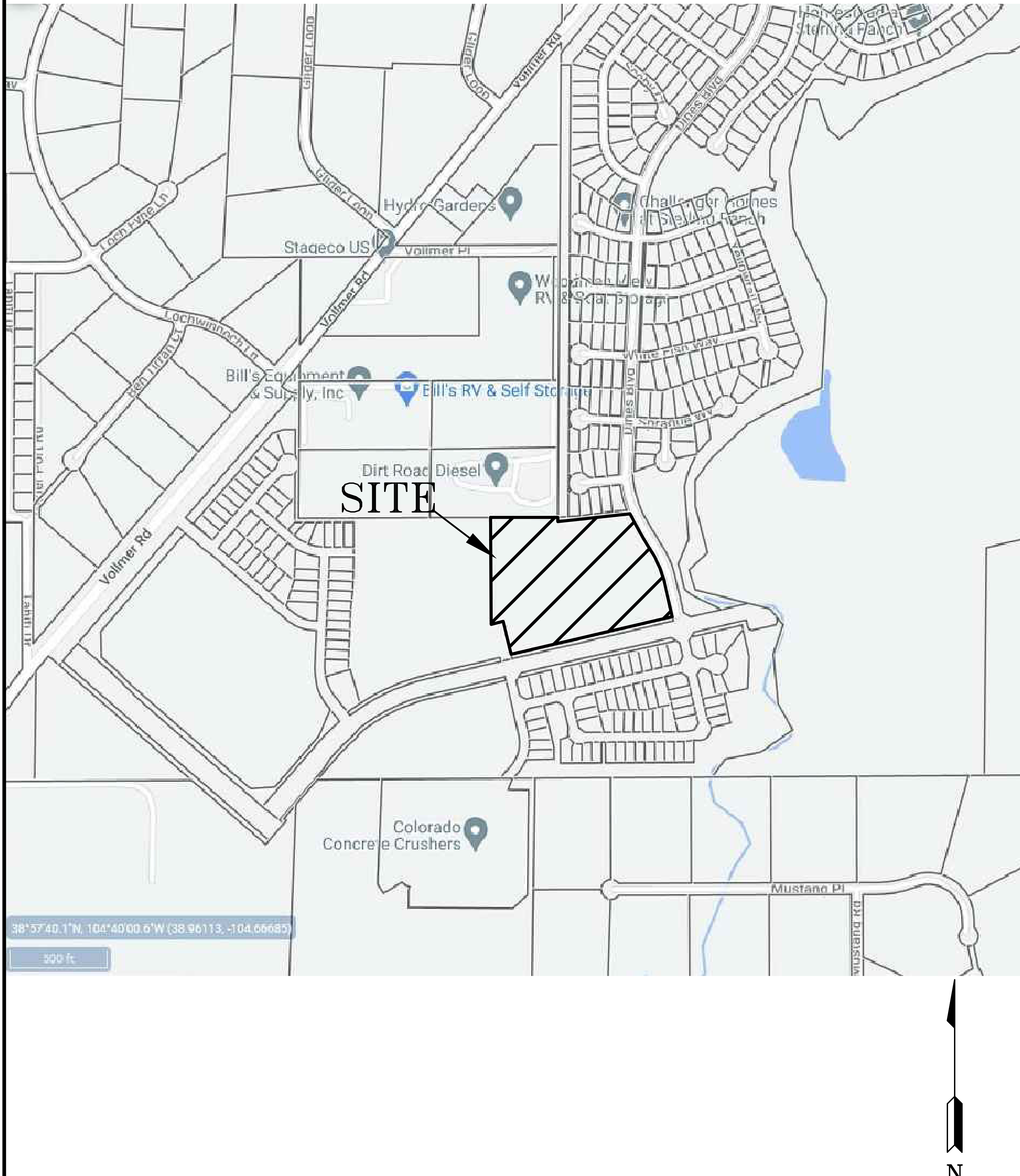
CLIENT CLASSIC SRJ
PROJECT DINES BLVD. & STERLING RANCH
JOB NO. 222159

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	1	2-3			10.0	NV	NP	<0.01			SM-SW	SAND, SLIGHTLY SILTY
1	3	5			11.0						SM-SW	SAND, SLIGHTLY SILTY
2	2	10			10.1			<0.01			SM-SW	SANDSTONE, SLIGHTLY SILTY
2	4	15			11.0						SM-SW	SANDSTONE, SLIGHTLY SILTY

TABLE 2: Summary of Bedrock and Groundwater Depths

Test Boring	Depth to Bedrock (ft)	Depth to Groundwater (ft)
1	3	>20
2	7	18.5
3	7	>11
4	3	16

FIGURES

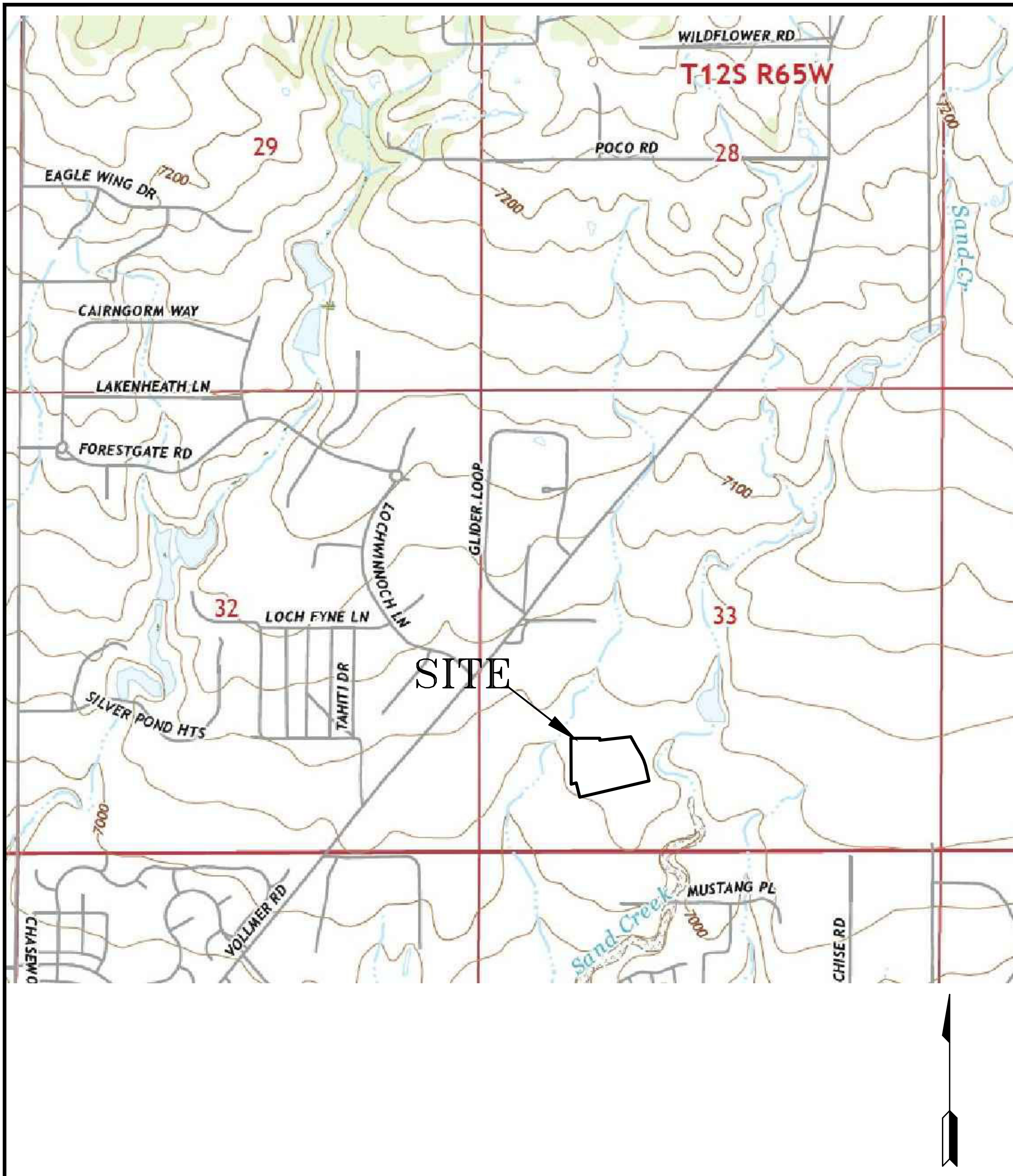


ENTECH ENGINEERING, INC.

VICINITY MAP
STERLING RANCH FILING NO. 5
PARCEL 16
COLORADO SPRINGS, CO
FOR: CLASSIC SRJ

JOB NO.
222159

FIG. 1

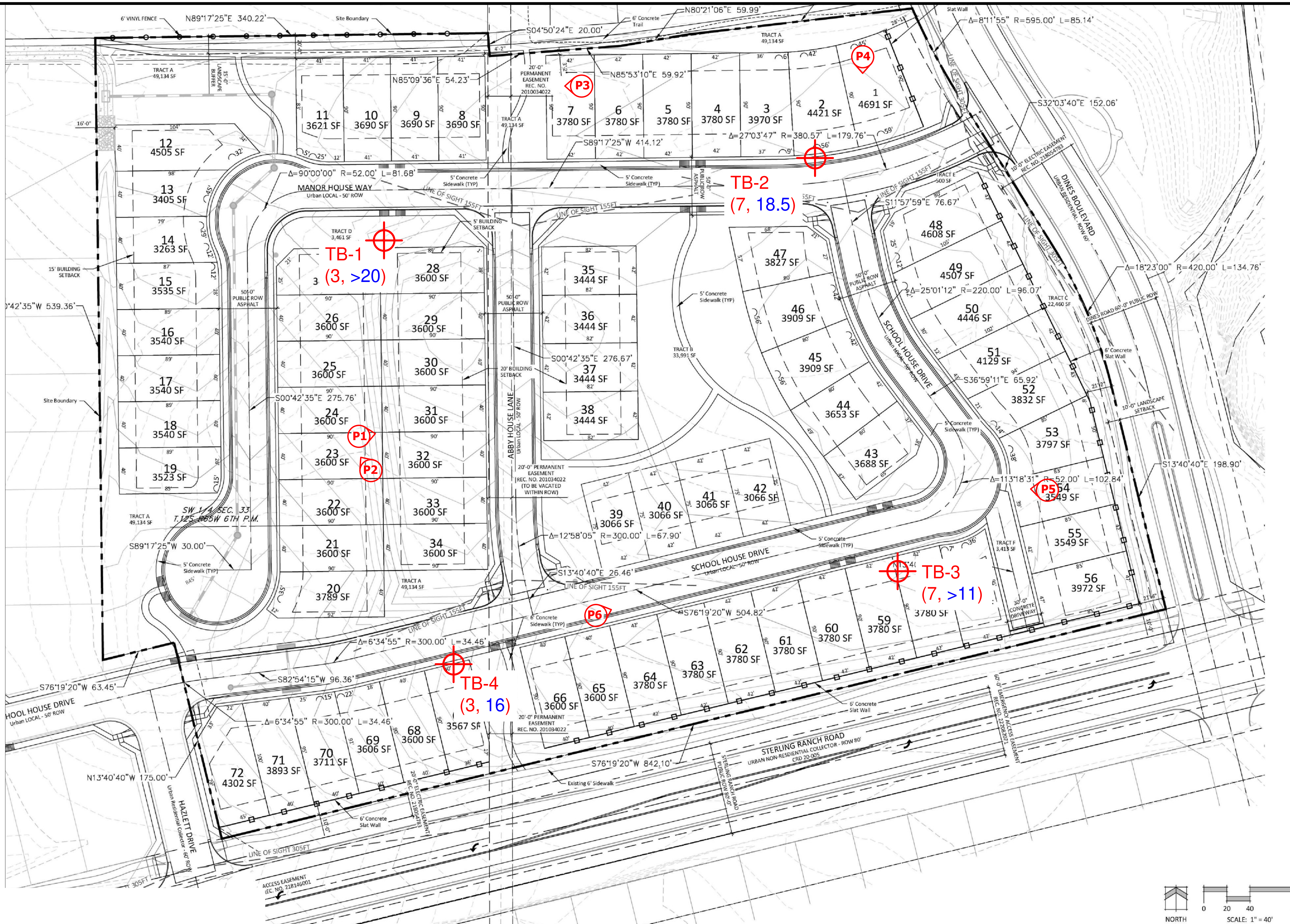


ENTECH ENGINEERING, INC.

USGS MAP
STERLING RANCH FILING NO. 5
PARCEL 16
COLORADO SPRINGS, CO
FOR: CLASSIC SRJ

JOB NO.
222159

FIG. 2



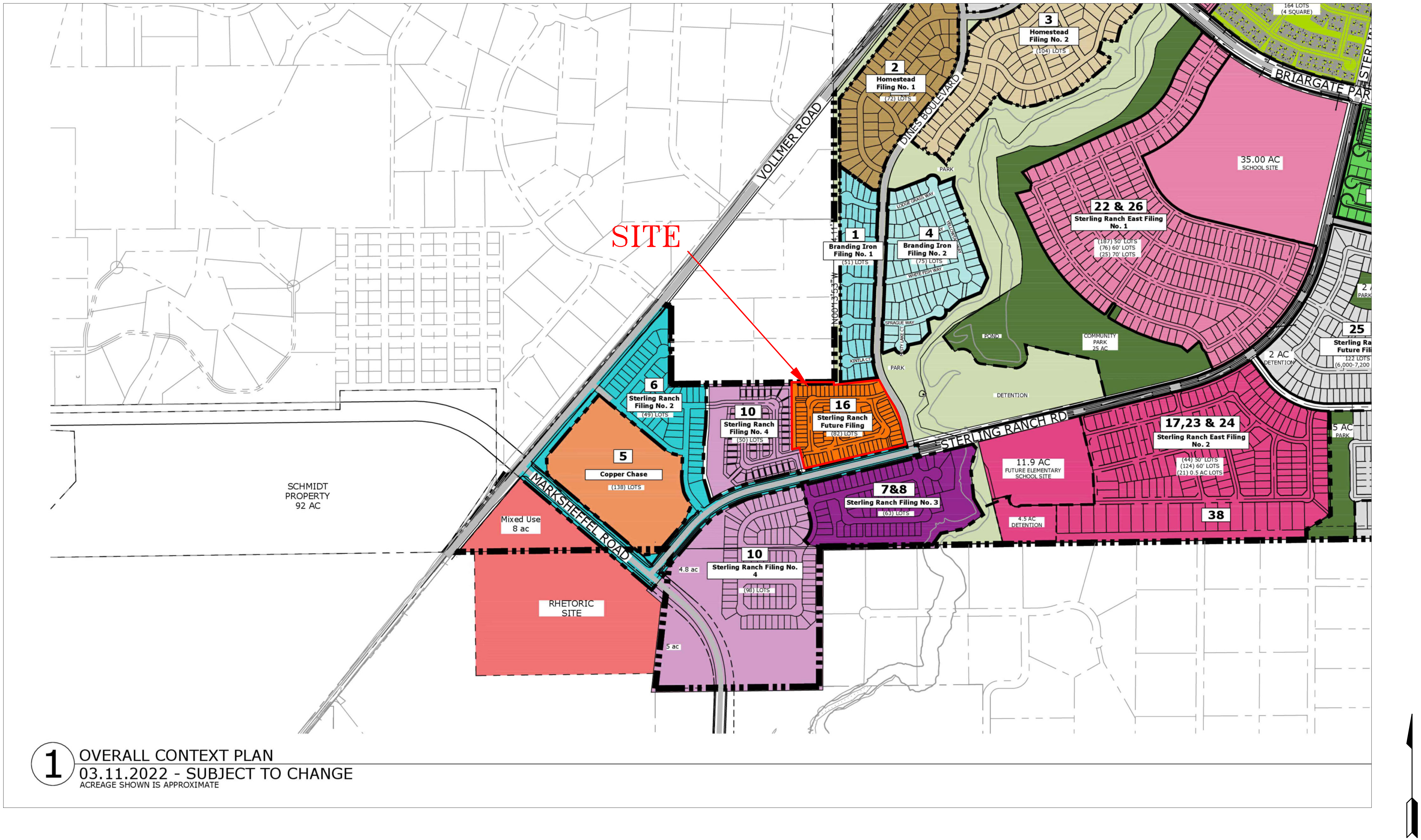
Legend:

TB - APPROXIMATE TEST BORING LOCATION AND NUMBER (DEPTH OF BEDROCK, DEPTH OF WATER)

P2 - APPROXIMATE PHOTOGRAPH LOCATION AND DIRECTION

ENTECH ENGINEERING, INC.

SITE PLAN/ TEST BORING LOCATION MAP	JOB NO. 222159
STERLING RANCH FILING NO. 5 PARCEL 16 COLORADO SPRINGS, CO FOR: CLASSIC SRJ	FIG. 4



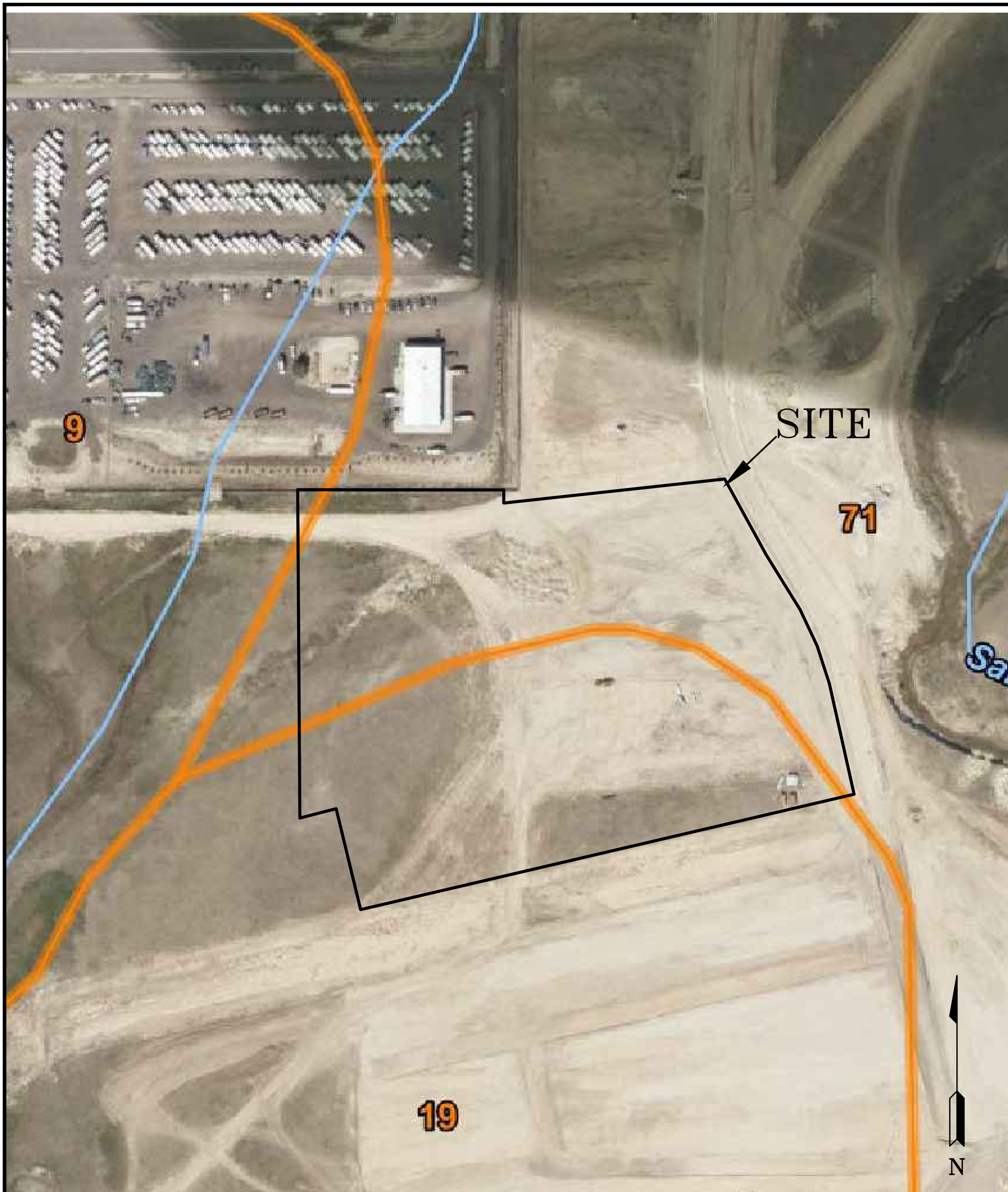
1 OVERALL CONTEXT PLAN
03.11.2022 - SUBJECT TO CHANGE
ACREAGE SHOWN IS APPROXIMATE

ENTECH ENGINEERING, INC.

DEVELOPMENT PLAN
STERLING RANCH FILING NO. 5
PARCEL 16
COLORADO SPRINGS, CO
FOR: CLASSIC SRJ

JOB NO.
222159

FIG. 3

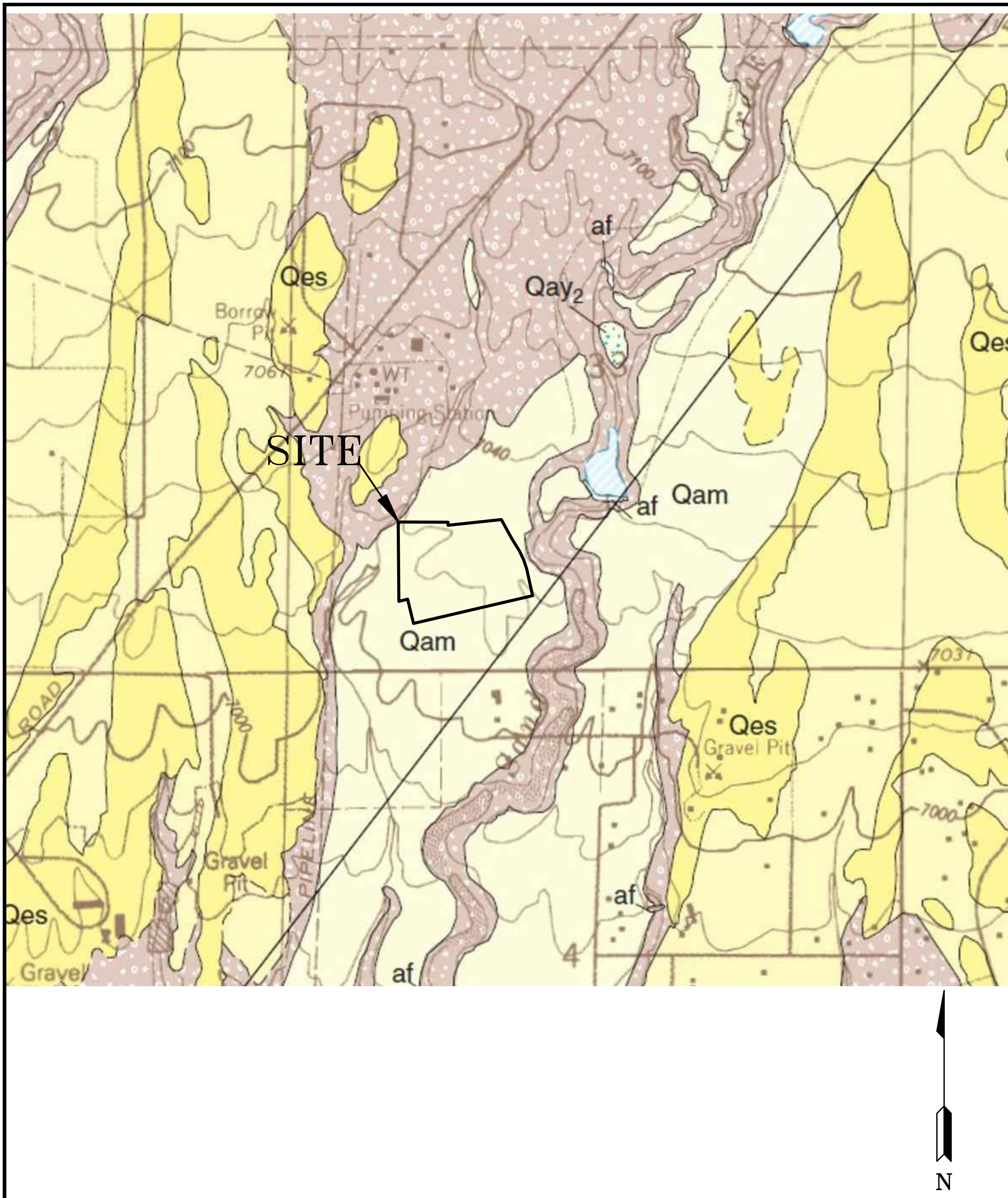


ENTECH ENGINEERING, INC.

SOIL SURVEY MAP
STERLING RANCH FILING NO. 5
PARCEL 16
COLORADO SPRINGS, CO
FOR: CLASSIC SRJ

JOB NO.
222159

FIG. 5



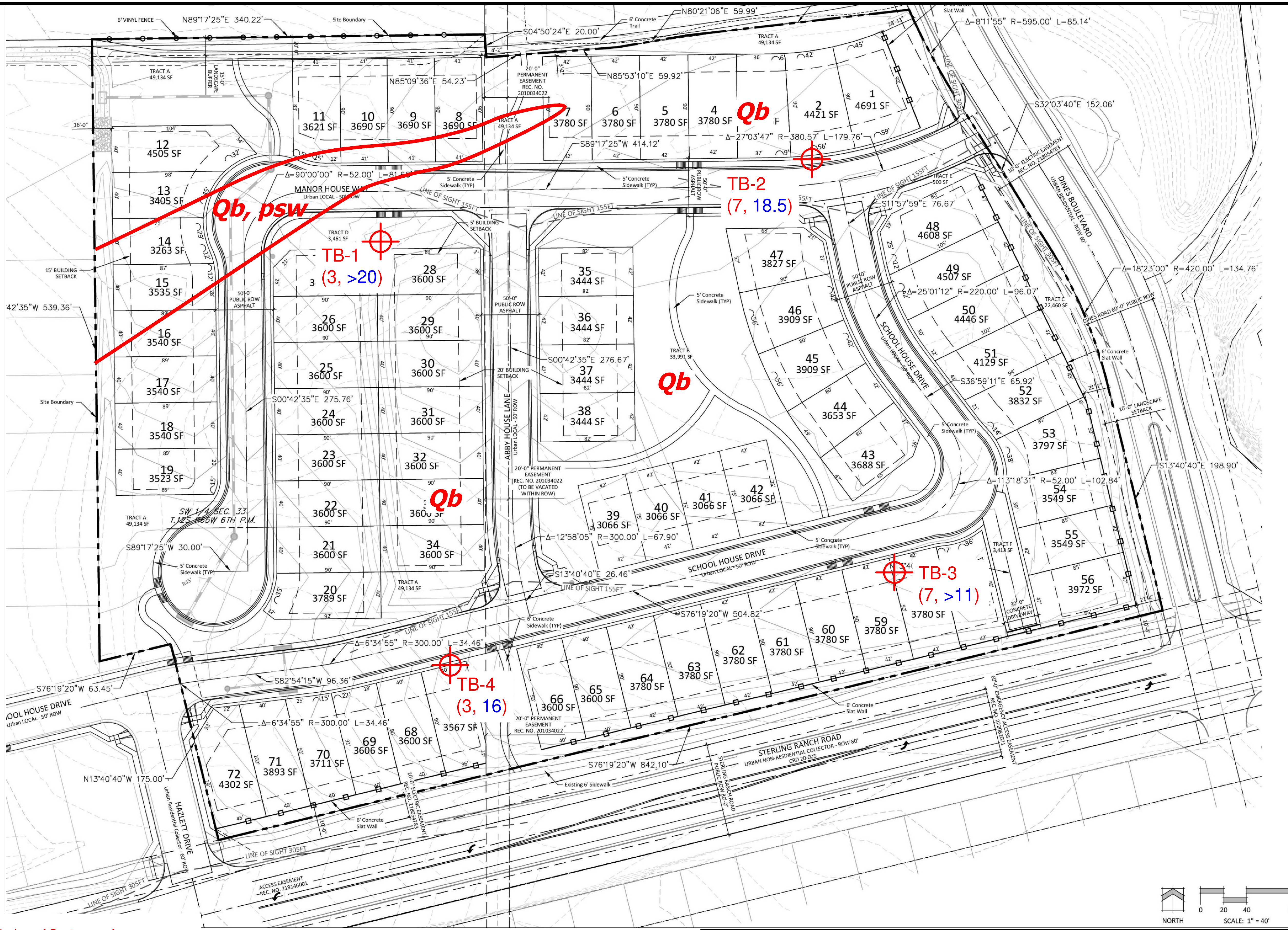
ENTECH ENGINEERING, INC.

FALCON NW QUADRANGLE GEOLOGIC MAP

STERLING RANCH FILING NO. 5
PARCEL 16
COLORADO SPRINGS, CO
FOR: CLASSIC SRJ

JOB NO.
222159

FIG. 6



Legend:

Qb - *Broadway Alluvium of Quaternary Age: water deposited sand, terrace deposits*

psw - *potentially seasoned shallow groundwater area*

TB - APPROXIMATE TEST BORING LOCATION AND NUMBER (DEPTH OF BEDROCK, DEPTH OF WATER)

ENTECH ENGINEERING, INC.

GEOLOGY/ ENGINEERING GEOLOGY MAP

STERLING RANCH FILING NO. 5

PARCEL 16

COLORADO SPRINGS, CO

FOR: CLASSIC SRJ

JOB NO. 222159

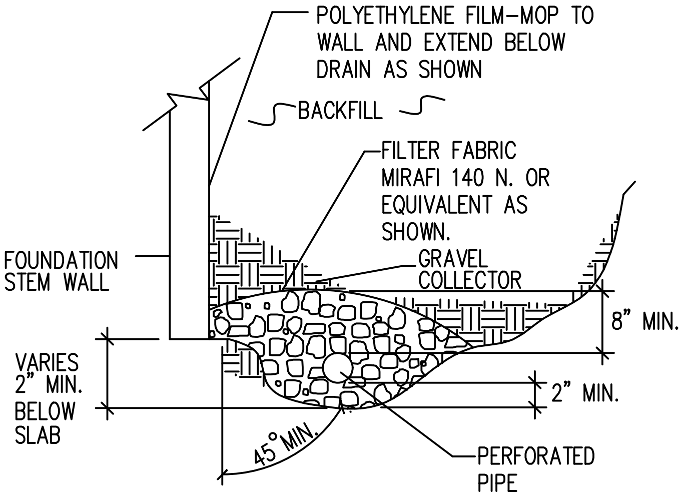
FIG. 7

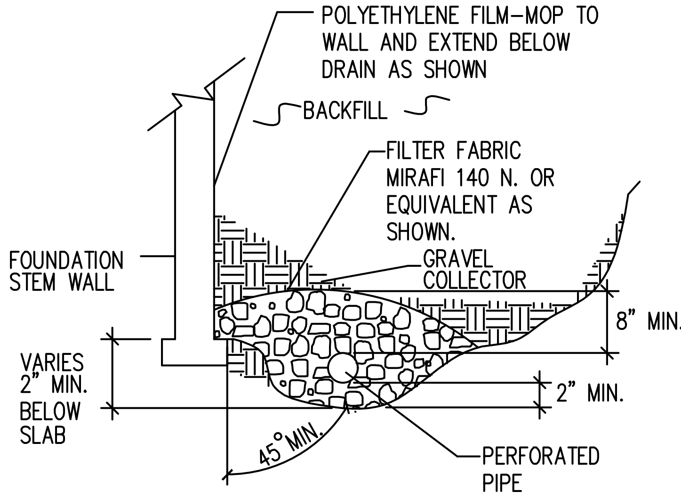
ENTECH ENGINEERING, INC.

FLOODPLAIN MAP
STERLING RANCH FILING NO. 5
PARCEL 16
COLORADO SPRINGS, CO
FOR: CLASSIC SRJ

JOB NO.
222159

FIG. 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.

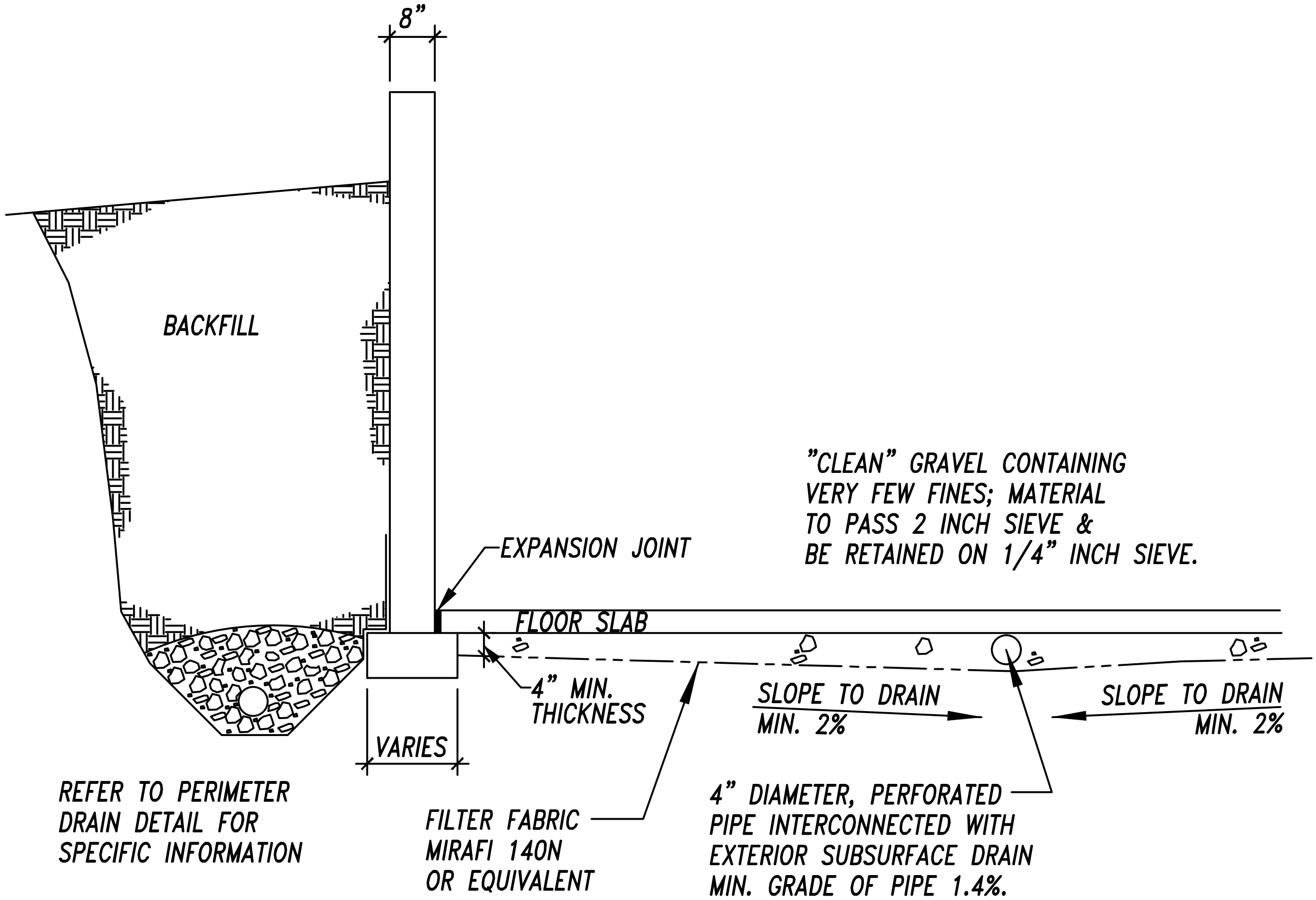
–ALL PIPE SHALL BE PERFORATED PLASTIC. THE DISCHARGE PORTION OF THE PIPE SHOULD BE NON–PERFORATED PIPE.

–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.

ENTECH ENGINEERING, INC.	**PERIMETER DRAIN DETAIL** STERLING RANCH FILING NO. 5 PARCEL 16 COLORADO SPRINGS, CO FOR: CLASSIC SRJ	JOB NO. 222159 **FIG. 9**



ENTECH
ENGINEERING, INC.

UNDERSLAB DRAINAGE LAYER

STERLING RANCH FILING NO. 5

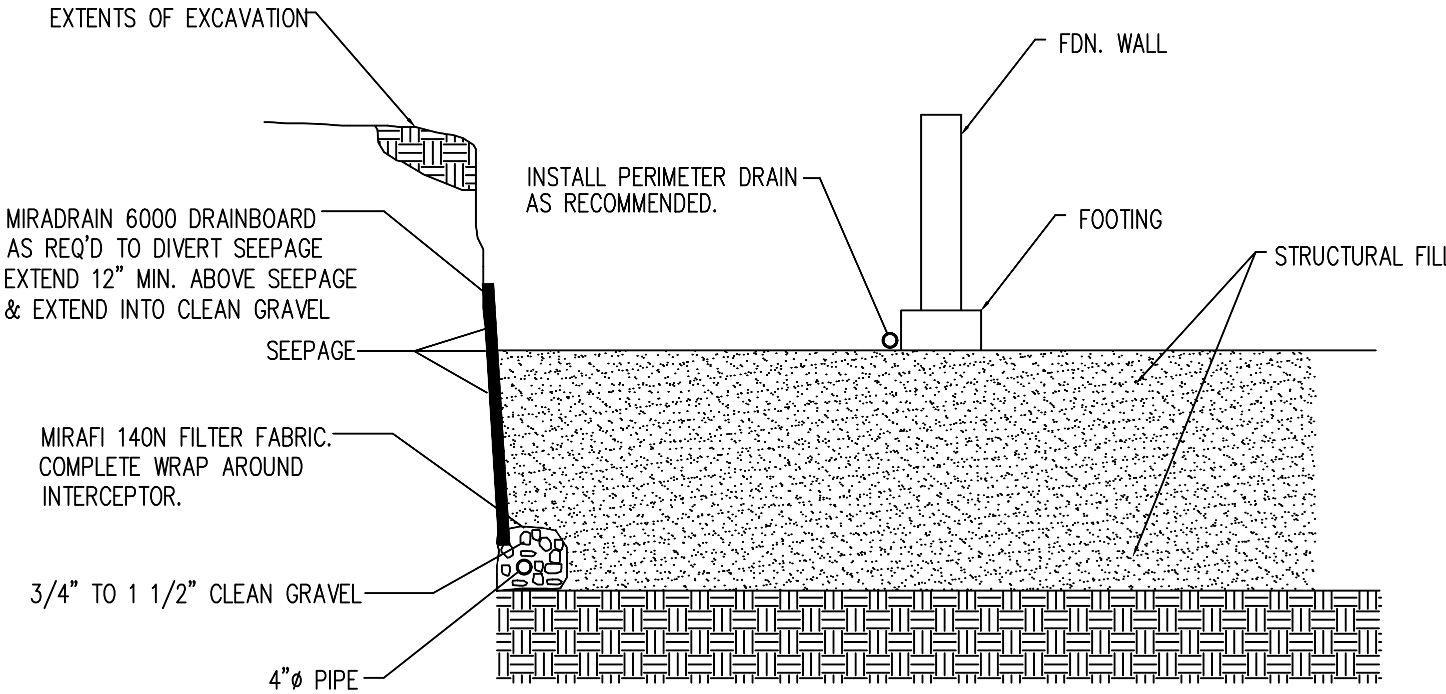
PARCEL 16

COLORADO SPRINGS, CO

FOR: CLASSIC SRJ

JOB NO.
222159

FIG. 10



NOTE:
EXTEND INTERCEPTOR DRAIN TO UNDERDRAIN OR TO SUMP.
BENCH DRAIN INTO NATIVE SOILS 12 INCHES MINIMUM.

INTERCEPTOR DRAIN DETAIL

N.T.S.

ENTECH ENGINEERING, INC.	**INTERCEPTOR DRAIN DETAIL** STERLING RANCH FILING NO. 5 PARCEL 16 COLORADO SPRINGS, CO FOR: CLASSIC SRJ	JOB NO. 222159 **FIG. 11**

APPENDIX A: Site Photographs

1

Looking east from the southwestern portion of the site.

November 15, 2022

2

Looking northwest from the southwestern portion of the site.

November 15, 2022

3

Looking west from the north central portion of the site.

November 15, 2022

4

Looking south from the northeastern portion of the site.

November 15, 2022

5

Looking west from the southeastern portion of the site.

November 15, 2022

6

Looking east from the southern portion of the site.

November 15, 2022

APPENDIX B: Test Boring Logs

TEST BORING NO. 1
DATE DRILLED 11/1/2022
Job # 222159

REMARKS

DRY TO 20', 11/2/22

Description	Depth (ft)	Blows per foot	Watercontent %	Soil Type
SAND, SLIGHTLY SILTY, FINE TO COARSE GRAINED, TAN, DENSE, MOIST		35	4.6	1
SANDSTONE, SLIGHTLY SILTY, FINE TO COARSE GRAINED, TAN, VERY DENSE, MOIST	5	50/7"	10.5	2
	10	50/6"	11.7	2
	15	50/6"	11.1	2
	20	50/3"	9.0	2

TEST BORING NO. 2
DATE DRILLED 11/1/2022
CLIENT CLASSIC SRJ
LOCATION DINES BLVD. & STERLING RANCH

REMARKS

WATER @ 18.5', 11/2/22

Description	Depth (ft)	Blows per foot	Watercontent %	Soil Type
SAND, SLIGHTLY SILTY, FINE TO COARSE GRAINED, TAN, DENSE, MOIST TO DRY		39	6.2	1
	5	36	2.5	1
SANDSTONE, SLIGHTLY SILTY, FINE TO COARSE GRAINED, TAN, VERY DENSE, MOIST	10	50/7"	11.4	2
	15	50/6"	13.4	2
	20	50/5"	11.5	2

TEST BORING NO.	3
DATE DRILLED	11/1/2022
Job #	222159

REMARKS

DRY TO 11', 11/2/22

Description	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
SAND, SLIGHTLY SILTY, FINE TO COARSE GRAINED, TAN, DENSE TO MEDIUM DENSE, MOIST				36	4.7	1
	5			28	5.1	1
SANDSTONE, SLIGHTLY SILTY, FINE TO COARSE GRAINED, TAN, VERY DENSE, MOIST	10			50/6"	8.7	2
	15					
	20					

TEST BORING NO.	4
DATE DRILLED	11/1/2022
CLIENT	CLASSIC SRJ
LOCATION	DINES BLVD. & STERLING RANCH

REMARKS

WATER @ 16', 11/2/22

Description	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
SAND, SLIGHTLY SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, MOIST				26	6.2	1
SANDSTONE, SLIGHTLY SILTY, FINE TO COARSE GRAINED, TAN, VERY DENSE, MOIST	5			50/5"	3.0	2
	10			50/5"	8.7	2
	15			50/5"	11.1	2
	20			50/4"	11.3	2

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

TEST BORING LOG

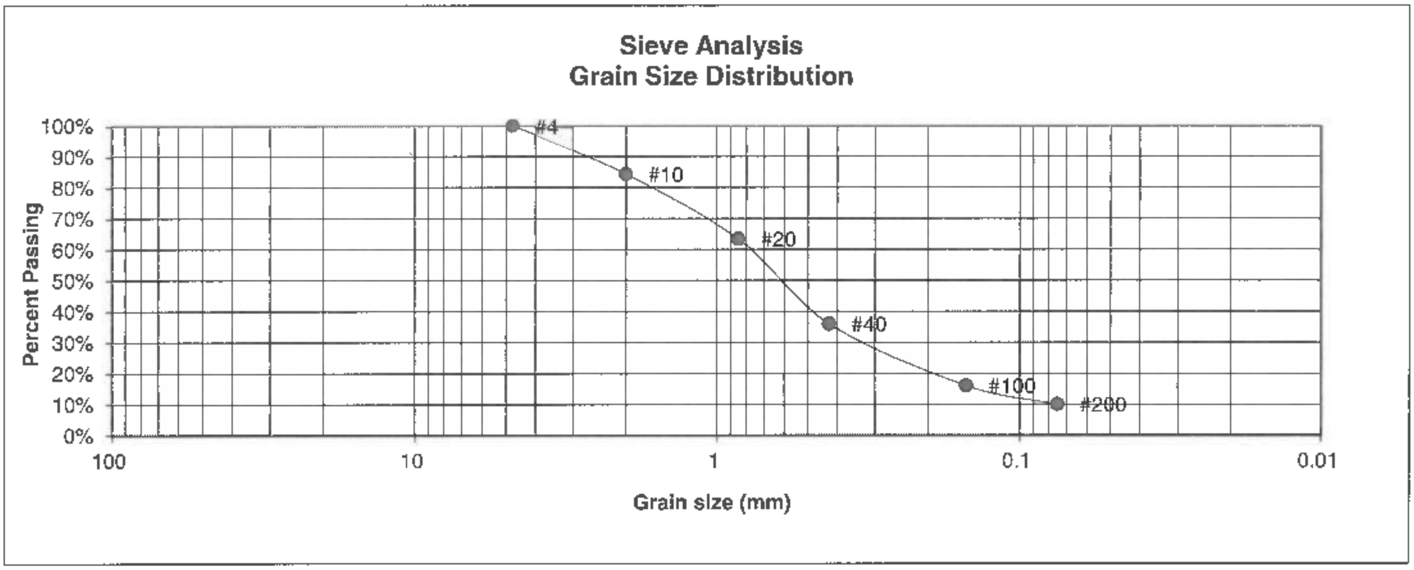
DRAWN:	DATE:	CHECKED: LLL	DATE: 11/11/22

JOB NO.: 222159

FIG NO.: B-2

APPENDIX C: Laboratory Test Results

UNIFIED CLASSIFICATION	SM-SW	CLIENT	CLASSIC SRJ
SOIL TYPE #	1	PROJECT	DINES BLVD. & STERLING RANCH
TEST BORING #	1	JOB NO.	222159
DEPTH (FT)	2-3	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	84.3%
20	63.4%
40	36.0%
100	16.0%
200	10.0%

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

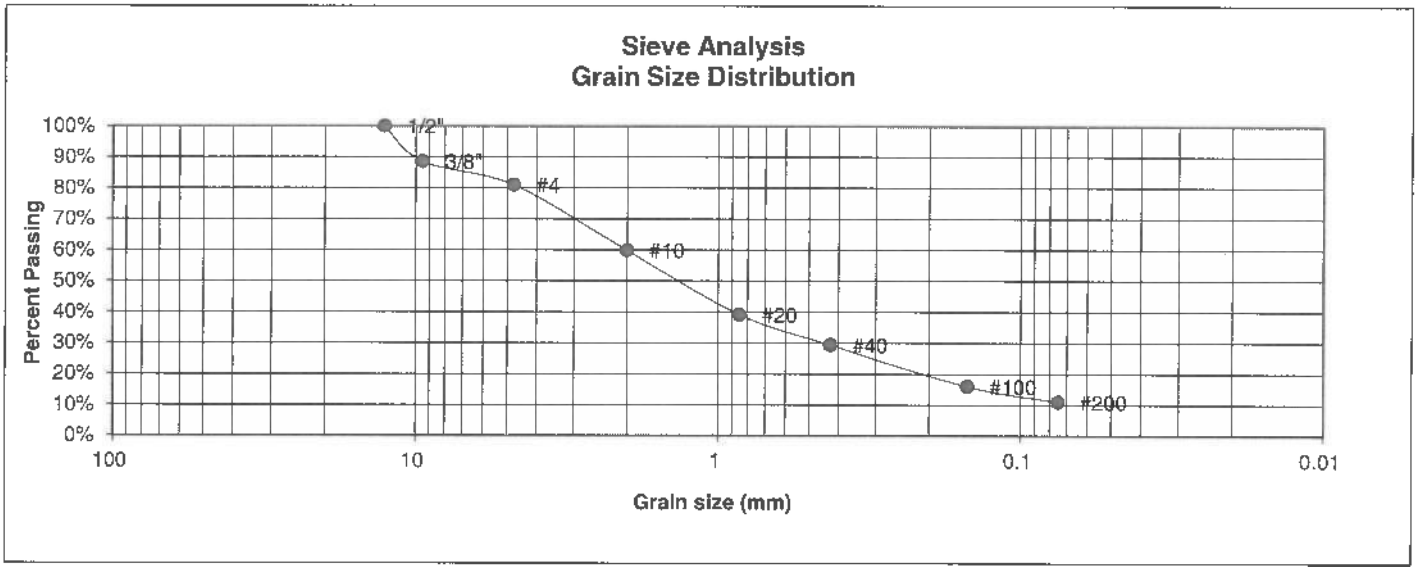
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	11/11/22

JOB NO.: 222159

FIG NO.: C-1

UNIFIED CLASSIFICATION	SM-SW	CLIENT	CLASSIC SRJ
SOIL TYPE #	1	PROJECT	DINES BLVD. & STERLING RANCH
TEST BORING #	3	JOB NO.	222159
DEPTH (FT)	5	TEST BY	BL

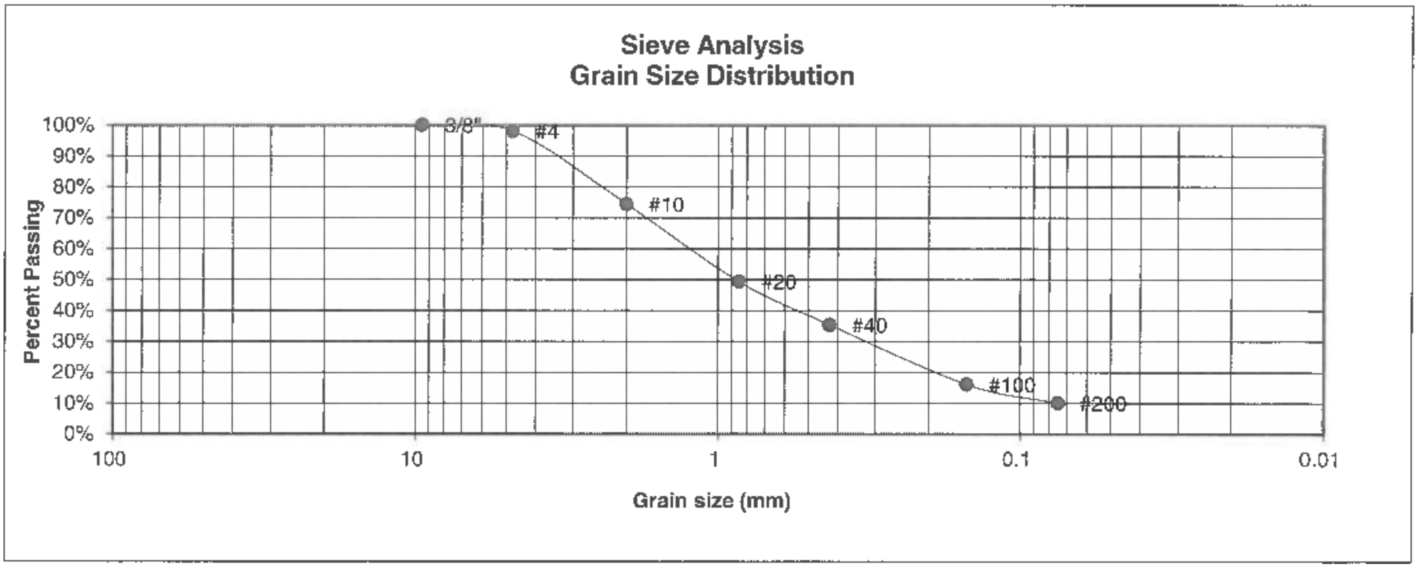


U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	88.5%
4	80.9%
10	59.8%
20	39.1%
40	29.4%
100	16.0%
200	11.0%

Atterberg
Limits
Plastic Limit
Liquid Limit
Plastic Index

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

UNIFIED CLASSIFICATION	SM-SW	CLIENT	CLASSIC SRJ
SOIL TYPE #	2	PROJECT	DINES BLVD. & STERLING RANCH
TEST BORING #	2	JOB NO.	222159
DEPTH (FT)	10	TEST BY	BL

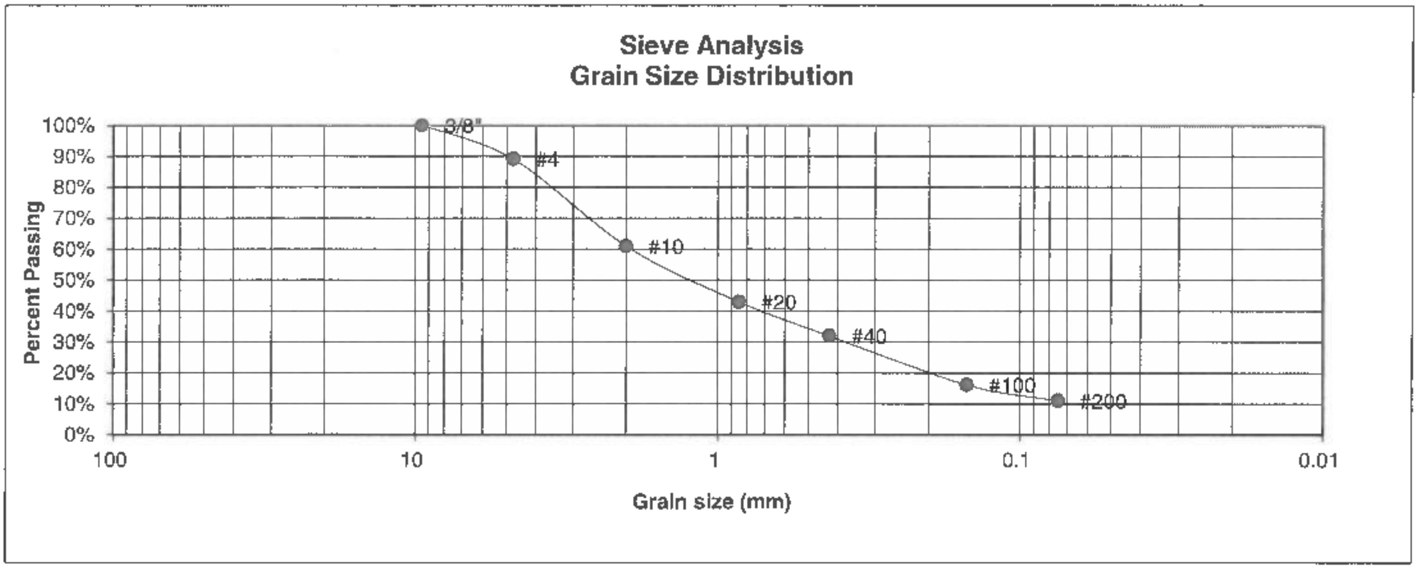


U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	98.1%
10	74.4%
20	49.4%
40	35.4%
100	16.1%
200	10.1%

Atterberg
Limits
Plastic Limit
Liquid Limit
Plastic Index

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

UNIFIED CLASSIFICATION	SM-SW	CLIENT	CLASSIC SRJ
SOIL TYPE #	2	PROJECT	DINES BLVD. & STERLING RANCH
TEST BORING #	4	JOB NO.	222159
DEPTH (FT)	15	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	89.1%
10	61.0%
20	42.9%
40	31.9%
100	16.2%
200	11.0%

Atterberg Limits
Plastic Limit
Liquid Limit
Plastic Index

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

CLIENT	CLASSIC SRJ	JOB NO.	222159
PROJECT	DINES BLVD. & STERLING RANCH	DATE	11/4/2022
LOCATION	DINES BLVD. & STERLING RANCH	TEST BY	BL

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

QC BLANK PASS

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

LABORATORY TEST SULFATE RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	11/11/22

JOB NO.: 222159

FIG NO.: C-5

APPENDIX D: Soil Survey Descriptions

El Paso County Area, Colorado

9—Blakeland-Fluvaquentic Haplaquolls

Map Unit Setting

National map unit symbol: 36b6
Elevation: 3,500 to 5,800 feet
Mean annual precipitation: 13 to 17 inches
Mean annual air temperature: 46 to 55 degrees F
Frost-free period: 110 to 165 days
Farmland classification: Not prime farmland

Map Unit Composition

Blakeland and similar soils: 60 percent
Fluvaquentic haplaquolls and similar soils: 38 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blakeland

Setting

Landform: Flats, hills
Landform position (three-dimensional): Side slope, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium derived from arkose and/or eolian deposits derived from arkose

Typical profile

A - 0 to 11 inches: loamy sand
AC - 11 to 27 inches: loamy sand
C - 27 to 60 inches: sand

Properties and qualities

Slope: 1 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Available water supply, 0 to 60 inches: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R049XB210CO - Sandy Foothill

Hydric soil rating: No

Description of Fluvaquentic Haplaquolls

Setting

Landform: Swales
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 12 inches: variable
H2 - 12 to 60 inches: stratified very gravelly sand to loam

Properties and qualities

Slope: 1 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 6.00 in/hr)
Depth to water table: About 0 to 24 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 6.2 inches)

Interpretive groups

Land capability classification (irrigated): 6w
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: D
Ecological site: R048AY241CO - Mountain Meadow
Hydric soil rating: Yes

Minor Components

Other soils

Percent of map unit: 1 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 20, Sep 2, 2022

El Paso County Area, Colorado

19—Columbine gravelly sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 367p
Elevation: 6,500 to 7,300 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Columbine and similar soils: 97 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Columbine

Setting

Landform: Fans, fan terraces, flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 14 inches: gravelly sandy loam
C - 14 to 60 inches: very gravelly loamy sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R049XY214CO - Gravelly Foothill
Hydric soil rating: No

Minor Components

Fluvaquentic haplaquolls

Percent of map unit: 1 percent

Landform: Swales
Hydric soil rating: Yes

Other soils

Percent of map unit: 1 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 20, Sep 2, 2022

El Paso County Area, Colorado

71—Pring coarse sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 369k
Elevation: 6,800 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Pring and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pring

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Arkosic alluvium derived from sedimentary rock

Typical profile

A - 0 to 14 inches: coarse sandy loam
C - 14 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: R048AY222CO - Loamy Park
Hydric soil rating: No

Minor Components

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

Other soils

Percent of map unit:

Hydric soil rating: No

Data Source Information

Soil Survey Area: El Paso County Area, Colorado

Survey Area Data: Version 20, Sep 2, 2022