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

SOIL, GEOLOGY, AND GEOLOGIC HAZARD
WATERVIEW NORTH
PARCEL NOS. 55000-00-332 & 55000-00-414
SOUTH POWERS BOULEVARD AND BRADLEY ROAD
EL PASO COUNTY, COLORADO

Prepared for:

CPR Entitlements, LLC
31 North Tejon Street, Suite 500
Colorado Springs, Colorado 80903

Attn: PA Koscielski

May 15, 2020
Revised: October 1, 2020

Respectfully Submitted,

ENTECH ENGINEERING, INC.

Logan L. Langford, P.G.
Geologist

Kristen A. Andrew-Hoeser, P.G.
Senior Geologist

Reviewed by:

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

COLORADO LICENSED
JOSEPH COLLIN GOODE JR
23725
10.1.2020
PROFESSIONAL ENGINEER

LLL/am

Encl.

Entech Job No. 200599
AAprojects/2020/200599 county soil/geo -rev 10.1.20

TABLE OF CONTENTS

1.0 SUMMARY ***2***

2.0 GENERAL SITE CONDITIONS AND PROJECT DESCRIPTION ***3***

3.0 SCOPE OF THE REPORT ***3***

4.0 FIELD INVESTIGATION ***4***

5.0 SOIL, GEOLOGY AND ENGINEERING GEOLOGY ***4***

5.1 General Geology 4

5.2 Soil Conservation Survey 5

5.3 Site Stratigraphy 5

5.4 Soil Conditions 6

5.5 Groundwater 8

6.0 ENGINEERING GEOLOGY – IDENTIFICATION AND MITIGATION OF GEOLOGIC HAZARDS ***8***

6.1 Relevance of Geologic Conditions to Land Use Planning 11

7.0 ECONOMIC MINERAL RESOURCES ***12***

8.0 EROSION CONTROL ***13***

9.0 ROADWAY AND EMBANKMENT CONSTRUCTION RECOMMENDATIONS ***14***

10.0 CLOSURE ***16***

BIBLIOGRAPHY ***17***

Figures
Figure 1: Vicinity Map
Figure 2: USGS Map
Figure 3: Site Map/Test Boring Location Map
Figure 4: Sketch Plan
Figure 5: Soil Survey Map
Figure 6: Elsmere Quadrangle Geology Map
Figure 7: Geology Map/Engineering Geology
Figure 7A: Sketch Plan/Geology Map/Engineering Geology
Figure 8: Floodplain Map
Figure 9: Typical Perimeter Drain Detail

APPENDIX A: Site Photographs
APPENDIX B: Summary of Laboratory Test Results and Test Boring Logs, Entech Job No. 200599
APPENDIX C: Soil Survey Descriptions

1.0 SUMMARY

Project Location

The project lies in portions of the NE¼ of Section 8 and the NW¼ of Section 9, Township 15 South, Range 65 West of the 6th Principal Meridian in El Paso County, Colorado. The site is located approximately 2½ miles east of Security-Widefield, Colorado, just south of the Colorado Springs city limits.

Project Description

Total acreage involved in the project is approximately 118 acres. The proposed site development consists of a combination of industrial, commercial, and residential development and associated site improvements. The development will utilize municipal sewer and water.

Scope of Report

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

Land Use and Engineering Geology

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

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

2.0 GENERAL SITE CONDITIONS AND PROJECT DESCRIPTION

The site is in portions of the NE¼ of Section 8 and the NW¼ of Section 9, Township 15 South, Range 65 West of the 6th Principal Meridian in El Paso County, Colorado. The site is located approximately 2½ miles east of Security-Widefield, Colorado just south of the Colorado Springs city limits, at the northeastern corner of South Powers Boulevard and Bradley Road. The location of the site is as shown on the Vicinity Map, Figure 1.

The topography of the site is generally gradually to moderately sloping to the east and south along a small ridge in the western portion of the site. Minor drainages are located in the northern and southern portions of the site. A low area is also located in the northwestern portion of the site near a box culvert located under Powers Boulevard. The drainages on site flow in southerly and southeasterly directions. Water was not observed in the drainages or low areas at the time of this investigation. The site boundaries are indicated on the USGS Map, Figure 2. Previous land uses have included grazing and pasture land. The site contains primarily field grasses, weeds, cacti, and yuccas. Site photographs, taken March 27, 2020, are included in Appendix A.

Total acreage involved in the proposed development is approximately 118 acres. The proposed site development consists of a combination of industrial, commercial, and residential development and associated site improvements. The industrial lots will be located in the northwestern portion of the site; the commercial lots will be located in the southwestern portion of the site, and the residential lots will be located in the eastern portions of the site. Twenty-five (25) Test Borings were performed on the site to determine general soil and bedrock characteristics. The locations of the test borings are indicated on the Site Map/Test Boring Location Map, Figure 3. The Sketch Plan is presented in Figure 4.

3.0 SCOPE OF THE REPORT

The scope of the report will include the following:

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

4.0 FIELD INVESTIGATION

Our field investigation consisted of the preparation of a geologic map of any bedrock features and significant surficial deposits. The Natural Resource Conservation Service (NRCS), previously the Soil Conservation Service (SCS) survey was also reviewed to evaluate the site. The position of mappable units within the subject property are shown on the Geologic Map. Our mapping procedures involved both field reconnaissance and measurements and air photo reconnaissance and interpretation. The same mapping procedures have also been utilized to produce the Engineering Geology Map which identified pertinent geologic conditions affecting development. The field mapping was performed by personnel of Entech Engineering, Inc. on March 27, 2020.

Twenty-five (25) Test Borings were performed on the site to determine general soil and bedrock characteristics. The locations of the test borings are indicated on the Site Map/Test Boring Location Map, Figure 3. The Test Boring Logs are presented in Appendix B. Results of this testing will be discussed later in this report.

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

5.0 SOIL, GEOLOGY AND ENGINEERING GEOLOGY

5.1 General Geology

Physiographically, the site lies in the western portion of the Great Plains Physiographic Province. Approximately 9 miles to the west is a major structural feature known as the Ute Pass Fault. This fault marks the boundary between the Great Plains Physiographic Province and the Southern Rocky Mountain Province. The site exists within the southeastern edge of a large structural feature known as the Denver Basin. Bedrock in the area tends to be very gently dipping in a northeasterly direction (Reference 1). The rocks in the area of the site are sedimentary in nature and typically Upper Cretaceous in age. The bedrock underlying the site consists of the Pierre Shale Formation. Overlying this formation are unconsolidated deposits of residual soils, alluvial, and eolian soils of Quaternary Age. The alluvial soils were deposited by water along the drainages on-site. The site's stratigraphy will be discussed in more detail in Section 5.3.

5.2 Soil Conservation Survey

The Natural Resource Conservation Service (Reference 2), previously the Soil Conservation Service (Reference 3) has mapped five soil types on the site Figure 5. In general, the soils classify as loamy sand, sandy loam, loam, and clay loam. The soils are described as follows:

Type	Description
8	Blakeland Loamy Sand, 0 to 3% slopes
31	Fort Collins Loam, 3 to 8% slopes
56	Nelson-Tassel Fine Sandy Loams, 3 to 18% slopes
86	Stoneham Sandy Loam, 3 to 8% slopes
108	Wiley Silty Loam, 3 to 9% slopes

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

5.3 Site Stratigraphy

The Elsmere Quadrangle Geology Map showing the site is presented in Figure 6 (Reference 4). The Geology Map prepared for the site is presented in Figure 7 and 7A. Five mappable units were identified on this site which are described as follows:

Qam **Middle Alluvium of Late Pleistocene Age:** These materials consist of lower stream terrace deposits. The alluvium typically consists of silty to clayey gravelly sands. This deposit correlates with the Broadway Alluvium.

Qao_2 **Older Alluvium Two of Middle to Early? Pleistocene Age:** These are stream deposited material typically occurring as terrace deposits on portions of the site. The

Old Alluvium Two typically consists of brown to light-yellowish brown silty to clayey sands and gravel.

Qav **Valley-Side Alluvium, undivided of Holocene and Late Pleistocene Age:** These materials are water deposited alluvium, typically classified as pale-brown to strong brown fine to very coarse sand, silty and clayey sand, and gravel.

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

Kp **Pierre Shale of Cretaceous Age:** This formation consists of olive brown to gray claystone and shale. These materials were deposited in a marine environment associated with the Cretaceous Seaway. Typically, there is a layer of residually weathered soil present above the Pierre Shale. The soils and bedrock associated with this formation are typically expansive.

The soils listed above were mapped from site-specific mapping, the *Geologic Map of the Elsmere Quadrangle* distributed by the Colorado Geological Survey in 2002 (Reference 4), the *Geologic Map of the Colorado Springs-Castle Rock Area*, distributed by the US Geological Survey in 1979 (Reference 5), and the *Geologic Map of the Pueblo 1^0 x 2^0 Quadrangle*, distributed by the US Geological Survey in 1978 (Reference 6). The Test Borings were also used in evaluating the site and are included in Appendix B. The Geology Map prepared for the site is presented in Figure 7 and 7A.

5.4 Soil Conditions

The soils and bedrock encountered in the test borings can be grouped into three general soil and rock types. The soils were classified using the Unified Soil Classification System (USCS).

<u>Soil Type 1</u> classified as a silty, clayey sand to very silty, clayey sand, silty to very silty sand, and very clayey, silty sand (SM-SC, SM, SC-SM). The sands were encountered in eleven of the test borings at depths ranging from the existing surface to 18 feet and extending to depths

ranging from 4 to the termination of the test borings (20 feet). Standard penetration testing on the sands resulted in N-values of 5 to 31 blows per foot (bpf), indicating loose to dense states. Water content and grain size testing resulted in water contents of 1 to 9 percent with approximately 29 to 47 percent of the soil size particles passing the No. 200 sieve. Atterberg Limits Testing resulted in liquid limits of 22 to 25 and plastic indexes of 3 to 7. FHA Swell testing resulted in an expansion pressure of 150 psf. These results indicate the sand soils have a low expansion potential.

Soil Type 2 classified as a sandy to very sandy clay (CL). The clays were encountered in twenty-three of test borings at depths ranging from the existing ground surface to 19 feet and extending to depths ranging from 4 to the termination of the test borings (20 feet). Standard penetration testing on the clay resulted in N-values of 4 to 38 bpf, indicating soft to very stiff consistencies. Water content and grain size testing resulted in water contents of 4 to 25 percent with approximately 57 to 98 percent of the soil size particles passing the No. 200 sieve. Atterberg Limits Testing resulted in liquid limits of 29 to 38 and plastic indexes of 11 to 22. FHA Swell testing resulted in an expansion pressure of 670 psf. Swell/Consolidation Testing on select samples resulted in a consolidation of 0.6 percent, and expansions of 0.4 to 5.6 percent. These results indicate the clay soils have a low consolidation potential and a low to very high expansion potential. Sulfate testing resulted in 0.00 to less than 0.01 percent sulfate by weight indicating the clay exhibits negligible potential for below grade concrete degradation.

Soil Type 3 classified as a sandy claystone (CL, CH). The claystone was encountered in sixteen of the test borings at depths ranging from 4 to 19 feet and extending to the termination of the test borings (20 feet). Standard penetration testing on the claystone resulted in N-values of 37 to greater than 50 bpf, indicating very stiff to hard consistencies. Water content and grain size testing resulted in water contents of 10 to 40 percent with approximately 85 to 97 percent of the soil size particles passing the No. 200 sieve. Atterberg Limits Testing resulted in liquid limits of 40 to 54 and plastic indexes of 15 to 36. Swell/Consolidation Testing resulted in volume changes of 0.7 to 6.1 percent. These results indicate that the claystone have a low to very high expansion potential. Sulfate testing resulted in less than 0.01 to 0.03 percent sulfate by weight indicating the clay exhibits negligible potential for below grade concrete degradation.

A Summary of Laboratory Test Results and the Test Boring Logs are presented in Appendix B.

5.5 Groundwater

Groundwater was not encountered in the test borings which were drilled to depths of 20 feet. Areas of potential seasonal shallow groundwater water have been mapped along the drainages on-site. These areas are discussed in the following section. Fluctuation in groundwater conditions may occur due to variations in rainfall and other factors not readily apparent at this time.

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

6.0 ENGINEERING GEOLOGY – IDENTIFICATION AND MITIGATION OF GEOLOGIC HAZARDS

Detailed mapping has been performed on this site to produce an Engineering Geology Map Figure 7 and 7A. This map shows the location of various geologic conditions of which the developers should be cognizant during the planning, design and construction stages of the project. Hazards include areas of collapsible soils/hydrocompaction, highly expansive soils, potential seasonal shallow groundwater, and shallow bedrock. Minor areas of erosion were also observed. These hazards and the recommended mitigation techniques are as follows:

<u>Collapsible Soils/Hydrocompaction</u>

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.

<u>Mitigation:</u> 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.

The majority of the soils encountered on-site do not exhibit collapsible characteristics; however, areas of soils with consolidation potential were encountered in the test borings drilled on site. Areas in the northwestern portion of the site that have been mapped as Qes (eolian sands) are known to have the potential for consolidation upon loading.

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

Expansive Soils

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

Mitigation Should expansive soils be encountered beneath the foundation; mitigation will be necessary. Mitigation of expansive soils will require special foundation design. Overexcavation and replacement with non-expansive soils at a minimum of 95 percent of its maximum Modified Proctor Dry Density, ASTM D-1557 is a suitable mitigation, which is common in the area. Floor slabs on expansive soils should be expected to experience movement. Overexcavation and replacement has been successful in minimizing slab movements. Overexcavation depths of 4 to 6 feet are anticipated for the site. Mitigation may also include moisture conditioning and recompaction of the clay soils. The use of structural floors should be considered for basement construction on highly expansive clays.

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. Final recommendations should be determined after additional investigation of the lots.

Groundwater and Floodplain Areas

Areas within the drainages and a low area on-site have been identified as areas of potential seasonally shallow groundwater areas. Water was not flowing in the drainages at the time of this investigation. The site is not mapped within floodplain zones according to the FEMA Map Nos. 08041CO764G and 08041CO768G, Figure 8 (Reference 7). These areas are discussed as follows:

Potentially Seasonal Shallow Groundwater

The areas mapped with this hazard are located along the minor drainages in the northern and southern portion of the site, and in the low area in the northwestern portion of the site adjacent to the box culvert located under Powers Boulevard. In these areas, we would anticipate the potential for periodically high subsurface moisture conditions and possible frost heave potential, depending on the soil conditions.

Mitigation In these locations, foundations in areas subject to severe frost heave potential should penetrate sufficient depth so as to discourage the formation of ice lenses beneath foundations. At this location and elevation, a foundation depth for frost protection of 2.5 feet is recommended. In areas where high subsurface moisture conditions are anticipated periodically, a subsurface perimeter drain will be necessary to help prevent the intrusion of water into areas located below grade. A typical perimeter drain detail is presented in Figure 9. Additionally, swales should be created to intercept surface runoff and carry it safely around and away from structures. It is anticipated that the site grading will likely mitigate the dry drainages on the site, and a detention pond is proposed in the northwestern portion of the site. Lots adjacent to the detention pond may also require drains to help prevent the intrusion of water into areas below grade during periods of high moisture.

Areas of Erosion

These are areas that are undergoing erosion by water and sheetwash producing gullies. This is an area in a minor drainage in the northern portion of the site. It is anticipated this area will be regraded as a part of the development.

Mitigation: Due to the nature of the soils on this site, virtually all the soils are subject to erosion by wind and water. Other minor areas of erosion were observed on site other than those mapped, particularly where some rill erosion has occurred. Areas of erosion can occur across the entire site, particularly if the soils are disturbed during construction. Vegetation reduces the potential for erosion. The areas identified where erosion is actually taking place may require check dams, regrading and revegetation using channel lining mats to anchor vegetation. Further recommendations for erosion control are discussed under Section 9.0 "Erosion Control" of this report. Recommendations pertaining to revegetation may require input from a qualified landscape architect and/or the Natural Resource Conservation Service (previously Soil Conservation Service).

6.1 Relevance of Geologic Conditions to Land Use Planning

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

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

Areas of potential seasonally shallow groundwater were observed in dry drainages and low areas in portions of the site. These areas will likely be mitigated with site grading and proper stormwater planning. Grading plans were not available at this time.

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 are 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.

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

7.0 ECONOMIC MINERAL RESOURCES

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

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

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

8.0 EROSION CONTROL

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

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

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

9.0 ROADWAY AND EMBANKMENT CONSTRUCTION RECOMMENDATIONS

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

Soils encountered in the area of the proposed detention pond (TB-6) consisted of very silty, clayey sand. Groundwater was not encountered in Test Boring No. 6, however, the low-lying area near the proposed pond has been mapped as potential seasonal shallow groundwater area.

Swell/Consolidation testing was conducted on the site subgrade soils which showed swells ranging between 0.4 and 6.1 percent. Many samples were above the level in which mitigation is required (2.0 percent) with a majority of the soils exceeding the swell threshold. These results indicate that soil mitigation due to expansive soils may be required for the roadways. Overexcavation and cement-stabilization are suitable mitigation methods for the expansive soils in the roadways. Additional investigation for the proposed roadways will be required once site grading has been completed and utilities have been installed.

Any areas to receive fill should have all topsoil, organic material or debris removed. Prior to fill placement Entech should observe the subgrade. Fill must be properly benched and compacted to minimize potentially unstable conditions in slope areas. Fill slopes should be 3:1. The subgrade should be scarified and moisture conditioned to within 2 percent of optimum moisture content and compacted to a minimum of 95 percent of its maximum 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 percent of its maximum Modified Proctor Dry Density, ASTM D-1557 for sandy soils, and clay soils should be compacted to a minimum of 95 percent of its maximum Standard Proctor Dry Density, ASTM D-698 at 0 to 4 percent of optimum moisture content. These materials should be placed at a moisture content conducive to compaction, usually 0 to ±2 percent of Proctor optimum moisture content. The placement and compaction of fill should be observed and tested by Entech during construction. Entech should approve any import materials prior to placing or hauling them to the site. Additional investigation will be required for pavement designs once roadway grading is completed and utilities are installed.

10.0 CLOSURE

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

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

This report has been prepared for CPR Entitlements, 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 that this report has provided you with all the information that you required. Should you require additional information, please do not hesitate to contact Entech Engineering, Inc.

BIBLIOGRAPHY

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

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

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

4. Madole, Richard F. and Thorson, Jon P., 2003. *Geologic Map of the Elsmere Quadrangle, El Paso County, Colorado.* Colorado Geological Survey. Open-File Report 02-2.

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

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

7. Federal Emergency Management Agency. December 7, 2018. *Flood Insurance Rate Maps for El Paso County, Colorado and Incorporated Areas.* Map Numbers 08041CO764G & 08041CO768G

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

9. 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.

10. 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.

FIGURES

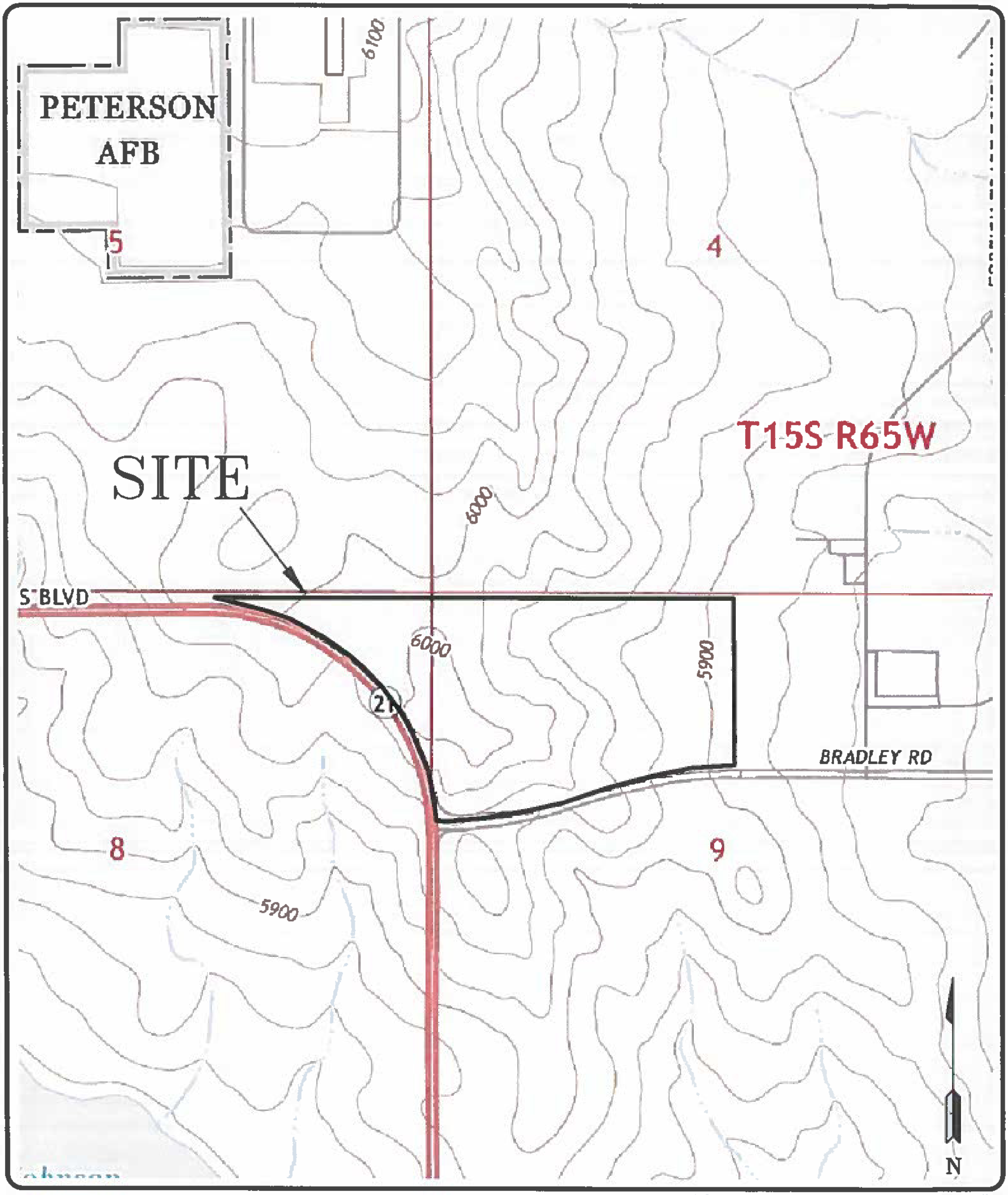
ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

VICINITY MAP
WATERVIEW NORTH
POWERS BOULEVARD AND BRADLEY ROAD
EL PASO COUNTY, CO.
FOR: CPR ENTITLEMENTS, LLC

DRAWN:	DATE:	CHECKED:	DATE:
LLL	5/5/20		

JOB NO.: 200599

FIG NO.: 1



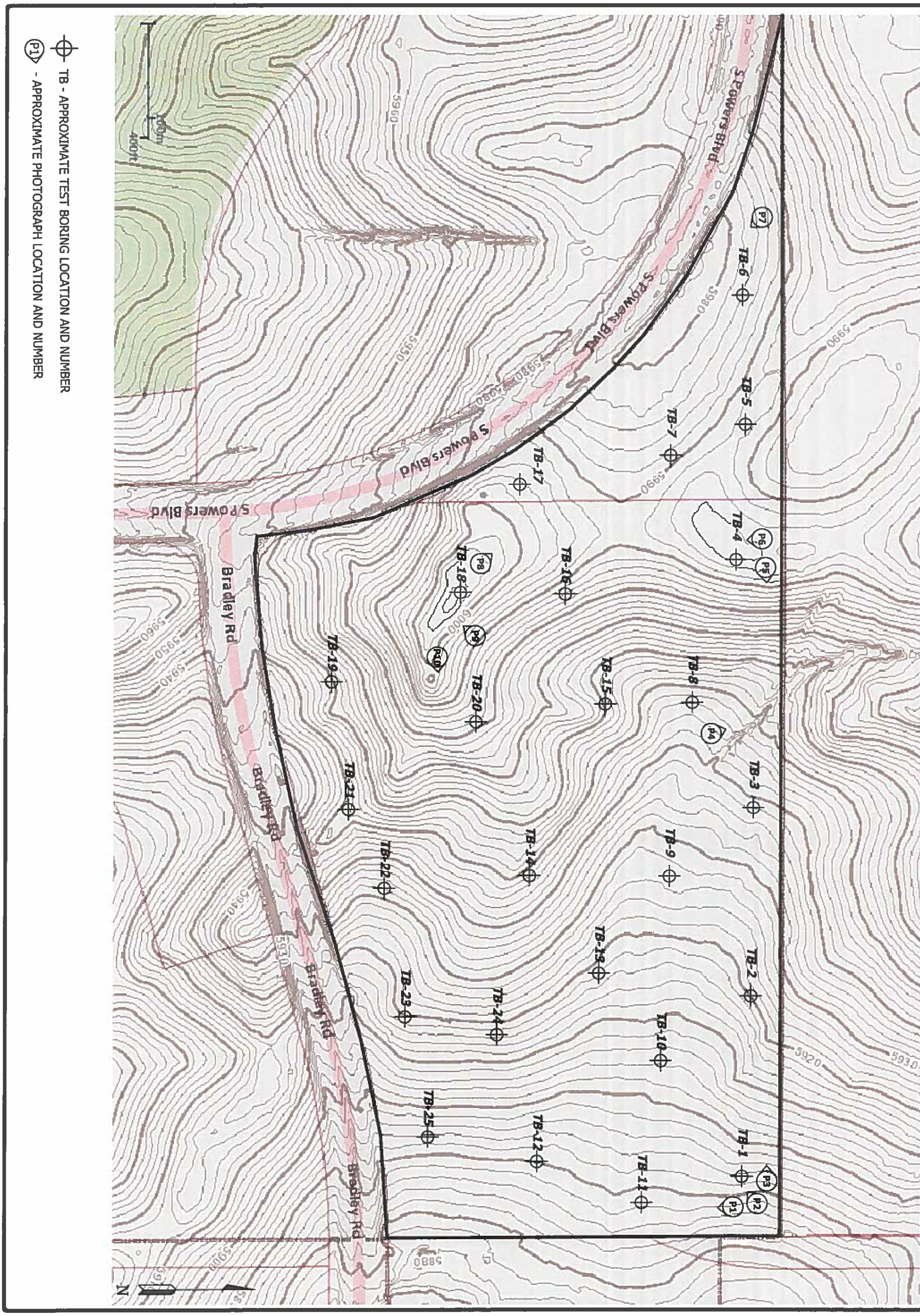
ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

USGS MAP
WATERVIEW NORTH
POWERS BOULEVARD AND BRADLEY ROAD
EL PASO COUNTY, CO.
FOR: CPR ENTITLEMENTS, LLC

DRAWN:	DATE:	CHECKED:	DATE:
LLL	5/5/20		

JOB NO.: 200599

FIG NO.: 2

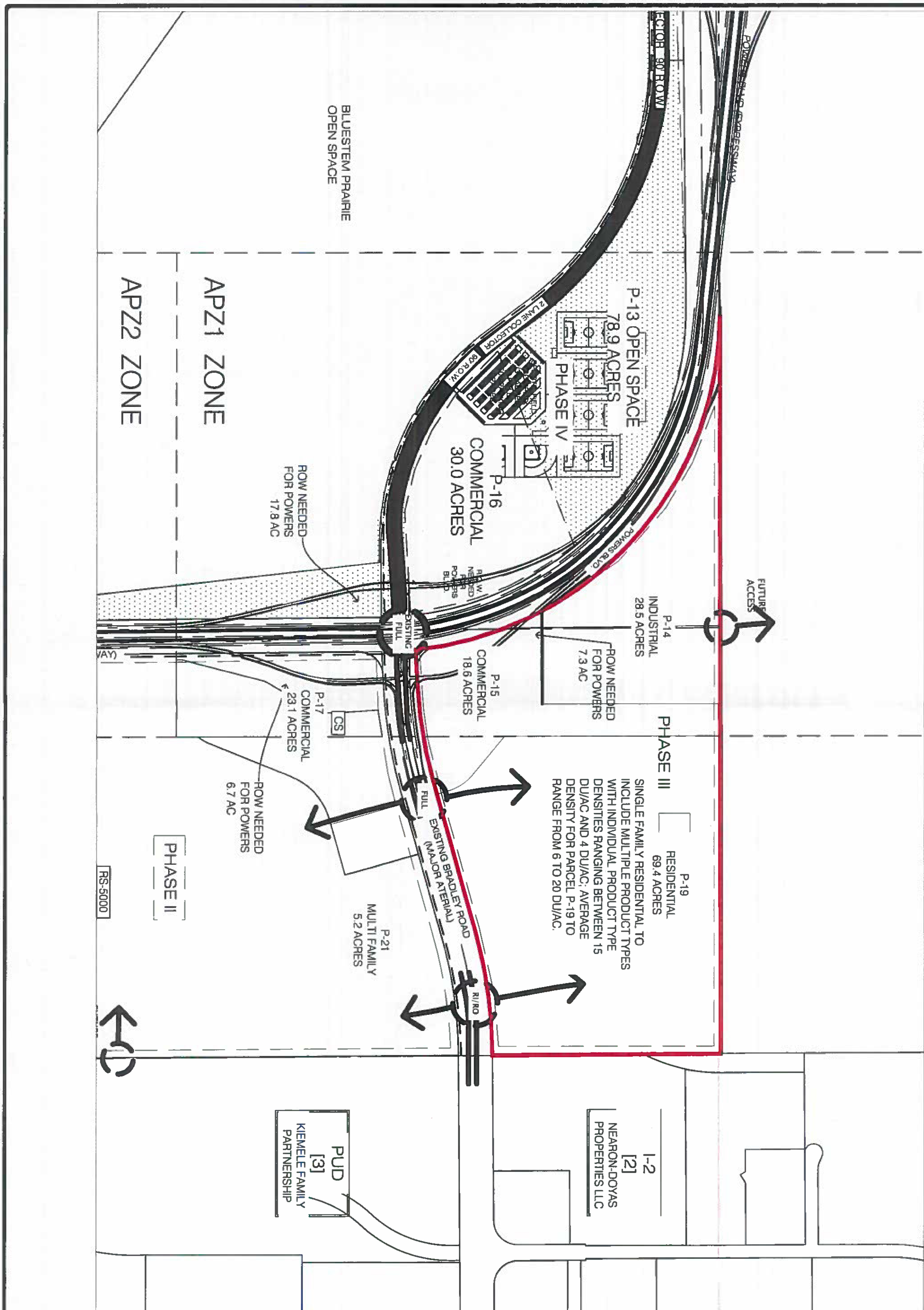


DRAWN: T.I.I.
CHECKED:
DATE: 5/5/20
SCALE: AS SHOWN
JOB NO. 200600
FIGURE No. 3

SITE MAP/TEST BORING LOCATION MAP
WATERVIEW NORTH
POWERS BOULEVARD AND BRADLEY ROAD
EL PASO COUNTY, CO.
FOR: CPR ENTITLEMENTS, LLC

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

REVISION	BY

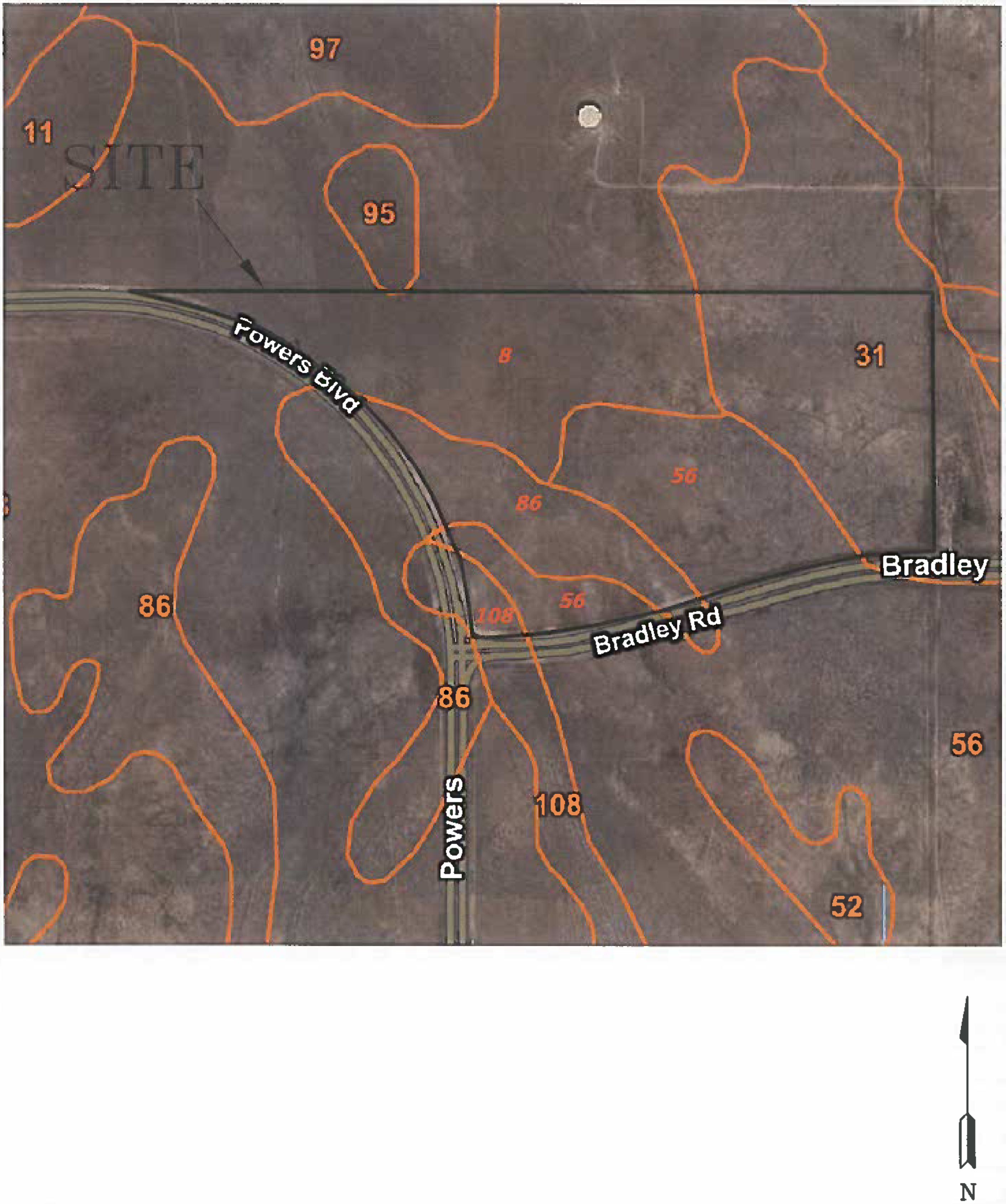


REVISION | BY

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

SKETCH PLAN
WATERVIEW NORTH
POWERS BOULEVARD AND BRADLEY ROAD
EL PASO COUNTY, CO.
FOR: CPR ENTITLEMENTS, LLC

DRAWN: | CHECKED: | DATE: 5/6/20 | SCALE: AS SHOWN | JOB NO.: | FIGURE NO.: 4



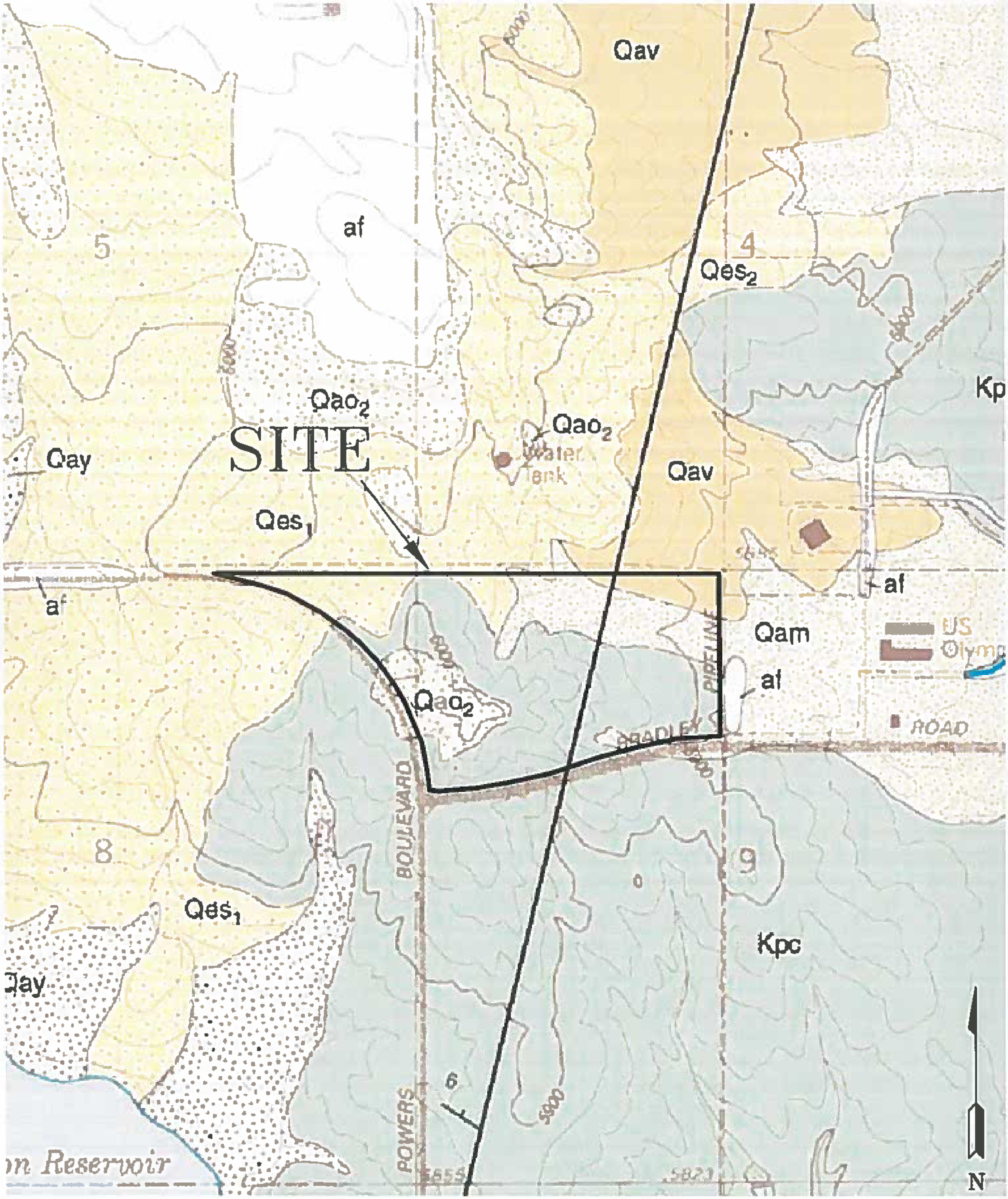
ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907
(719) 531-5599

SOIL SURVERY MAP
WATERVIEW NORTH
POWERS BOULEVARD AND BRADLEY ROAD
EL PASO COUNTY, CO.
FOR: CPR ENTITLEMENTS, LLC

DRAWN:	DATE:	CHECKED:	DATE:
LLL	5/5/20		

JOB NO.: 200599

FIG NO.: 5



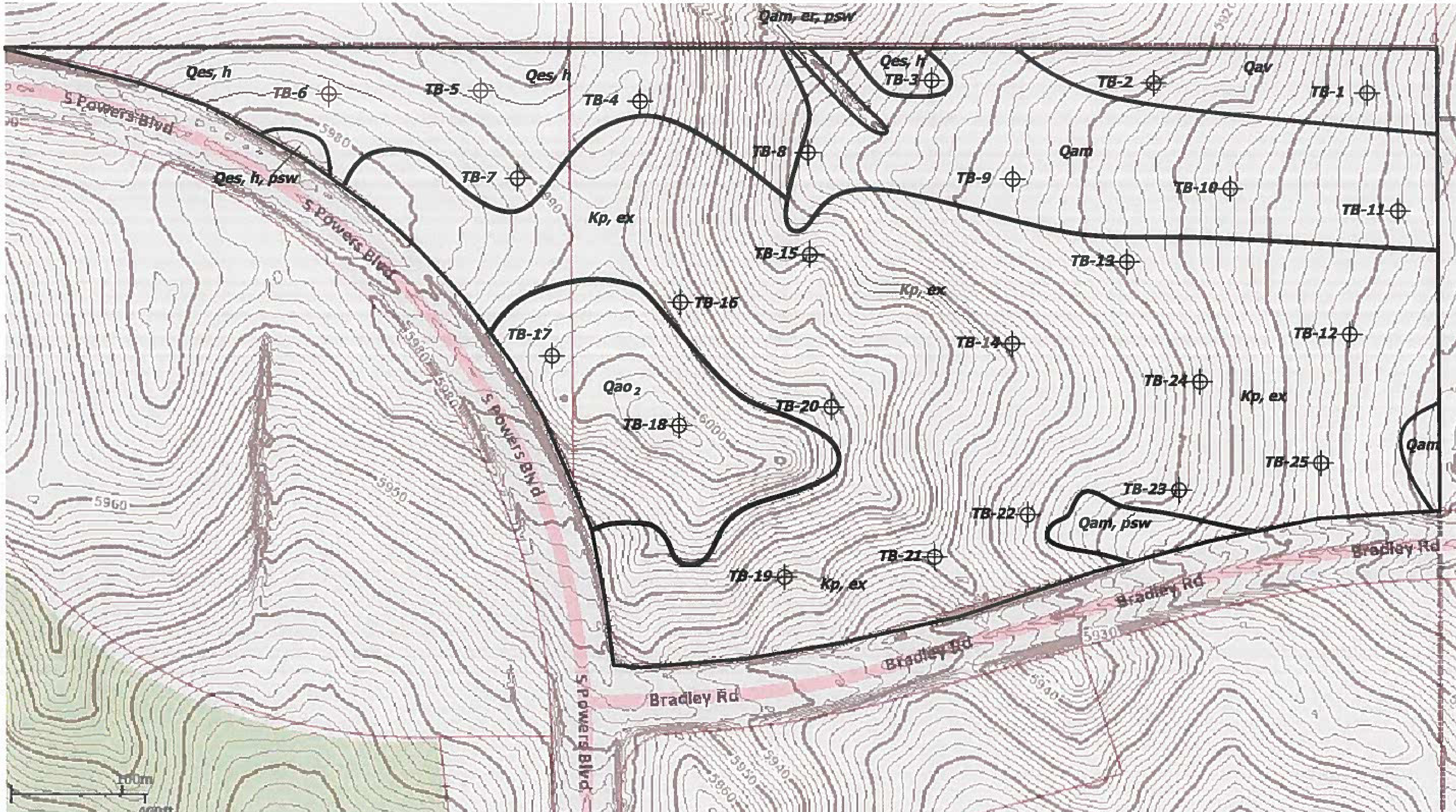
ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

ELSMERE QUADRANGLE GEOLOGY MAP
WATERVIEW NORTH
POWERS BOULEVARD AND BRADLEY ROAD
EL PASO COUNTY, CO.
FOR: CPR ENTITLEMENTS, LLC

DRAWN:	DATE:	CHECKED:	DATE:
LLL	5/5/20		

JOB NO.: 200599

FIG NO.: 6



Legend:

Qam - Middle Alluvium of Late Pleistocene Age:
water deposited sand, terrace deposits

Qao_2 - Old Alluvium Two of Middle & Early? Pleistocene Age:
water deposited sand, terrace deposits

Qav - Valley-Side Alluvium, undivided of Holocene and Late Pleistocene Age:
water deposited alluvium associated with nearby abandoned paleovalley

Qes - *Eolian Sand of Middle & Early Holocene and Late? Pleistocene Age:*
windblown sand deposits

Kp - Pierre Shale of Cretaceous Age:
marine deposited claystone and shale

er - erosion
ex - expansive soil
h - hydrocompaction
psw - potentially seasonal shallow groundwater area

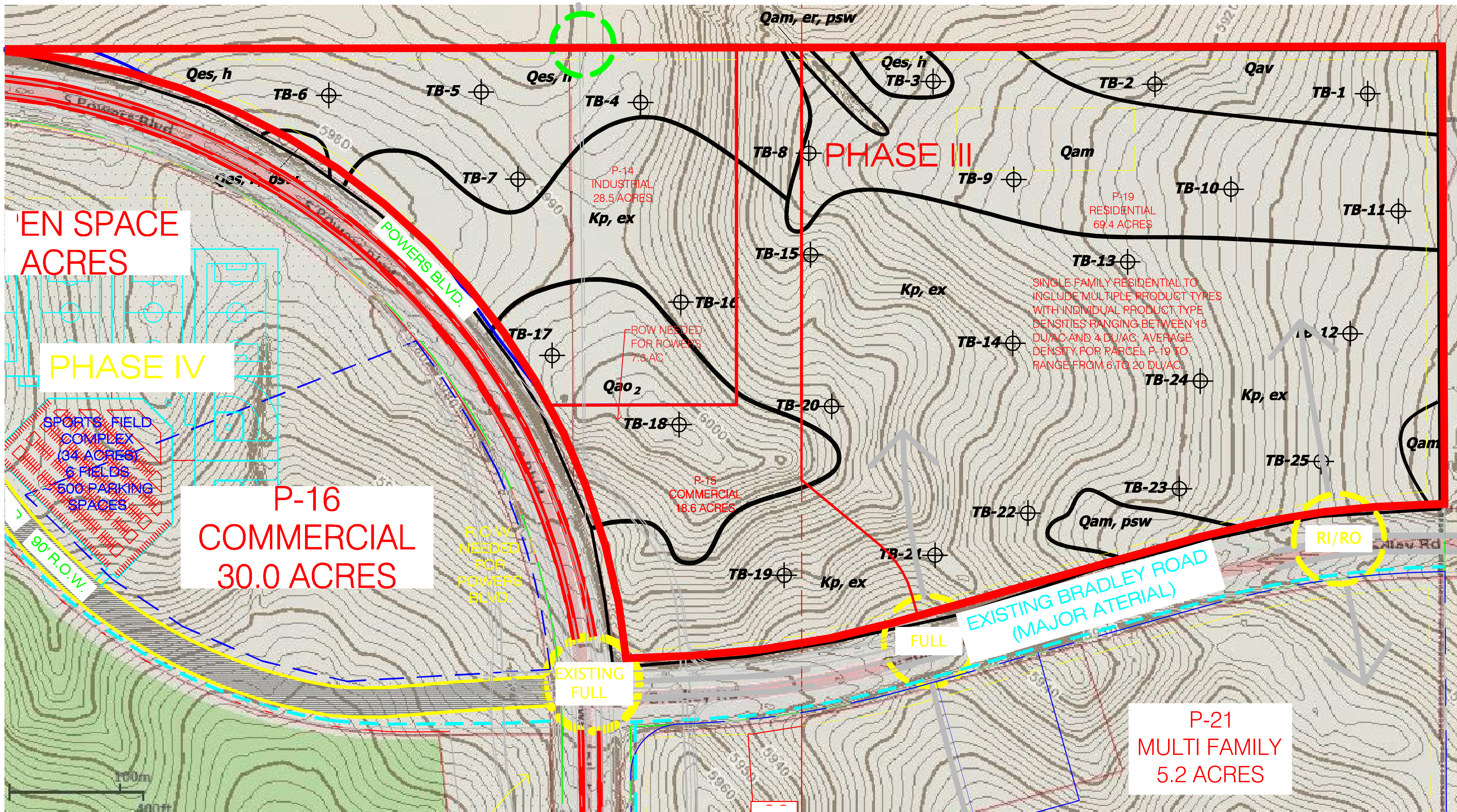
N

REVISION	BY

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

ENGINEERING GEOLOGY MAP
WATERVIEW NORTH
S POWERS BOULEVARD AND BRADLEY ROAD
EL PASO COUNTY, CO.
FOR: CPR ENTITLEMENTS, LLC

DRAWN LLL
CHECKED
DATE 5/5/20
SCALE AS SHOWN
JOB NO. 200599
FIGURE No. 7



Legend:

Qam	-	Middle Alluvium of Late Pleistocene Age: *water deposited sand, terrace deposits*
Qao_2	-	Old Alluvium Two of Middle & Early? Pleistocene Age: *water deposited sand, terrace deposits*
Qav	-	Valley-Side Alluvium, undivided of Holocene and Late Pleistocene Age: water deposited alluvium associated with nearby abandoned paleovalley
Qes	-	*Eolian Sand of Middle & Early Holocene and Late? Pleistocene Age: windblown sand deposits*
Kp	-	Pierre Shale of Cretaceous Age: marine deposited claystone and shale
er	-	erosion
ex	-	expansive soil
h	-	hydrocompaction
psw	-	potentially seasonal shallow groundwater area

N

REVISION	BY

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

SKETCH PLAN/ENGINEERING GEOLOGY MAP
WATERVIEW NORTH
S POWERS BOULEVARD AND BRADLEY ROAD
EL PASO COUNTY, CO.
FOR: CPR ENTITLEMENTS, LLC

DRAWN LLL
CHECKED
DATE 5/5/20
SCALE AS SHOWN
JOB NO. 200599
FIGURE No. 7A

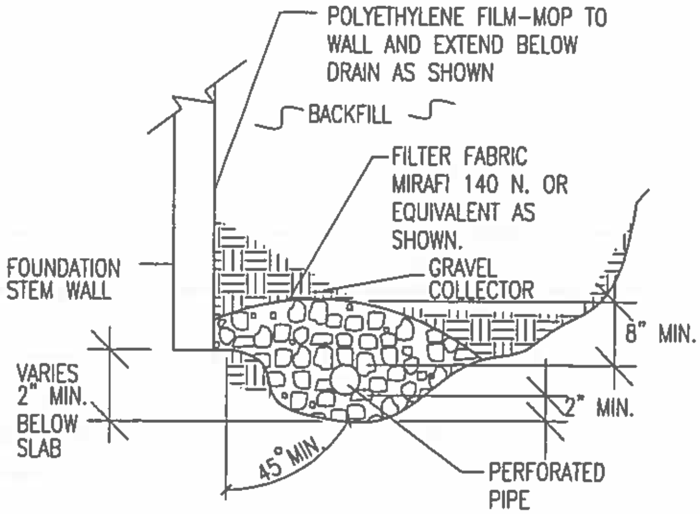
ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

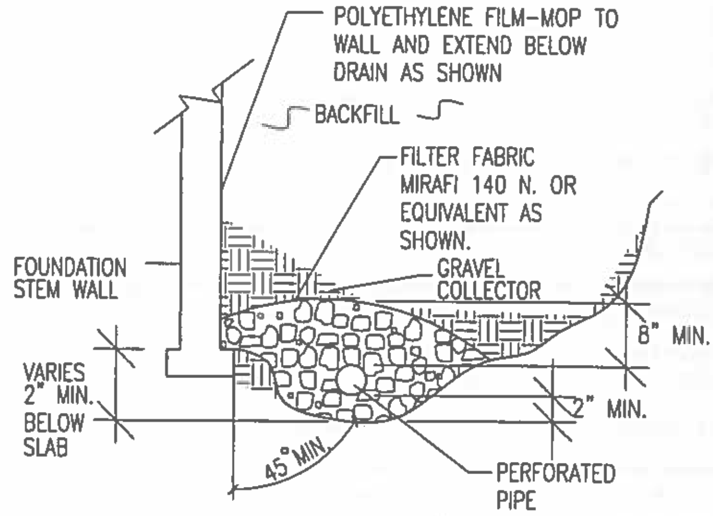
FLOODPLAIN MAP
WATERVIEW NORTH
POWERS BOULEVARD AND BRADLEY ROAD
EL PASO COUNTY, CO.
FOR: CPR ENTITLEMENTS, LLC

DRAWN:	DATE:	CHECKED:	DATE:
LLL	5/5/20		

JOB NO.: 200599

FIG 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.

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

PERIMETER DRAIN DETAIL

DRAWN:	DATE:	DESIGNED:	CHECKED:
		DS	LLL

JOB NO.: 200599

FIG NO.: 9

APPENDIX A: Site Photographs

Looking south from the northeast portion of the site.

March 27, 2020

Looking southwest from the northeast portion of the site.

March 27, 2020

3

Looking west from the northeast portion of the site.

March 27, 2020

4

Looking north from the north central portion of the site.

March 27, 2020

5

Looking east from the northern side of the site.

March 27, 2020

6

Looking south from the northeastern portion of the site.

March 27, 2020

7

Looking southeast from the northwestern portion of the site.

March 27, 2020

8

Looking east from the northern portion of the site.

March 27, 2020

Job No. 200599

9

Looking southwest from the southern portion of the site.

March 27, 2020

10

Looking east from the southern portion of the site.

March 27, 2020

APPENDIX B: Laboratory Test Results and Test Boring Logs, PSSI Entech Job No. 200599

TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

CLIENT CPR ENTITLEMENTS
PROJECT WATERVIEW NORTH
JOB NO. 200599

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	5	2-3			29.0	25	7				SM-SC	SAND, SILTY, CLAYEY
1	6	5			40.2	24	7				SM-SC	SAND, VERY SILTY, CLAYEY
1	9	2-3			30.6				150		SM	SAND, SILTY
1	16	5			31.9	22	3				SM	SAND, SILTY
1	17	2-3			42.4	25	5				SC-SM	SAND, VERY CLAYEY, SILTY
1	18	2-3			47.1						SM	SAND, VERY SILTY
2	1	5			72.8	29	11				CL	CLAY, SANDY
2	2	2-3	7.9	82.2	88.4	31	13			2.5	CL	CLAY, SANDY
2	3	10	9.1	99.6	63.2			0.00		-0.6	CL	CLAY, SANDY
2	8	10	11.3	111.7	95.9					4.2	CL	CLAY, SANDY
2	10	10			56.9						CL	CLAY, VERY SANDY
2	11	5	15.2	99.0	94.3	38	22	<0.01		4.4	CL	CLAY, SANDY
2	12	5			78.9				670		CL	CLAY, SANDY
2	14	5			68.8	33	18	<0.01			CL	CLAY, SANDY
2	20	5	13.2	110.0	96.1					5.6	CL	CLAY, SANDY
2	22	10			78.9	32	17				CL	CLAY, SANDY
2	25	2-3			70.5						CL	CLAY, SANDY
2	25	10	12.7	95.4	83.8					0.4	CL	CLAY, SANDY
2	7	20			57.9						CL	CLAY, VERY SANDY
2	18	15	16.2	113.9	97.7					1.9	CL	CLAY, SANDY
2	23	15			80.6						CL	CLAY, SANDY
3	15	5	14.5	117.8	96.4					6.1	CL	CLAYSTONE, SANDY
3	19	10	10.5	116.3	90.2					0.7	CL	CLAYSTONE, SANDY
3	21	5	13.0	119.9	85.3					1.5	CL	CLAYSTONE, SANDY
3	24	10	19.2	112.3	96.5	54	36			4.6	CH	CLAYSTONE, SANDY
3	4	20	18.7	108.0	91.4	50	26	0.03		2.9	CH	CLAYSTONE, SANDY
3	13	15	13.4	112.4	94.2	40	15			3.5	CL	CLAYSTONE, SANDY
3	14	15	19.8	105.8	97.0	52	31	<0.01		0.9	CH	CLAYSTONE, SANDY

TEST BORING NO. 1
DATE DRILLED 3/20/2020
Job # 200599

REMARKS

DRY TO 20', 3/30/20

Remarks	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
CLAY, SANDY, TAN, STIFF TO FIRM, DRY				16	6.0	2
	5			11	6.6	2
	10			21	6.2	2
CLAYSTONE, SANDY, TAN, HARD, MOIST	15			50/10"	13.9	3
	20			50/7"	14.3	3

TEST BORING NO. 2
DATE DRILLED 3/25/2020
CLIENT CPR ENTITLEMENTS
LOCATION WATERVIEW NORTH

REMARKS

DRY TO 20', 3/30/20

Remarks	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
CLAY, SANDY, LIGHT BROWN, FIRM TO VERY STIFF, DRY				14	6.2	2
	5			18	6.5	2
	10			18	7.4	2
	15			24	7.8	2
	20			35	6.6	2

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

TEST BORING LOG

DRAWN:	DATE:	CHECKED: L	DATE: 4/16/20

JOB NO. 200599
FIG NO.: B-1

TEST BORING NO. 3

DATE DRILLED 3/25/2020
Job # 200599

REMARKS

DRY TO 20', 3/30/20

Description	Depth (ft)	Samples	Blows per foot	Watercontent %	Soil Type
CLAY, SANDY, BROWN, VERY STIFF TO FIRM, MOIST TO DRY	0–15				
	~3	■	19	9.9	2
	5	■	37	10.9	2
	10	■	14	3.5	2
CLAYSTONE, SANDY, GRAY BROWN, HARD, MOIST	15	■	17	12.7	2
	20	■	50/9"	14.4	3

TEST BORING NO. 4

DATE DRILLED 3/25/2020
CLIENT CPR ENTITLEMENTS
LOCATION WATERVIEW NORTH

REMARKS

DRY TO 20', 3/30/20

Description	Depth (ft)	Samples	Blows per foot	Watercontent %	Soil Type
SAND, SILTY TO CLAYEY, FINE GRAINED, LIGHT BROWN, LOOSE, DRY TO MOIST	0–17.5				
	~3	■	6	6.0	1
	5	■	9	2.3	1
	10	■	6	5.7	1
	15	■	5	6.2	1
WEATHERED CLAYSTONE, SANDY, GRAY BROWN, VERY STIFF, MOIST	20	■	37	18.0	3

TEST BORING NO. 5
DATE DRILLED 3/25/2020
Job # 200599

REMARKS

DRY TO 20', 3/30/20

Description	Depth (ft)	Blows per foot	Watercontent %	Soil Type
SAND, SILTY, CLAYEY, FINE GRAINED, BROWN, LOOSE, MOIST		9	3.2	1
	5	9	3.2	1
CLAY, SANDY, DARK BROWN TO BROWN, SOFT TO FIRM, MOIST	10	4	12.7	2
	15	11	16.2	2
	20	15	17.3	2

TEST BORING NO. 6
DATE DRILLED 3/25/2020
CLIENT CPR ENTITLEMENTS
LOCATION WATERVIEW NORTH

REMARKS

DRY TO 20', 3/30/20

Description	Depth (ft)	Blows per foot	Watercontent %	Soil Type
SAND, VERY SILTY, CLAYEY, FINE TO MEDIUM GRAINED, BROWN TO TAN, MEDIUM DENSE TO DENSE, DRY TO MOIST		16	2.8	1
	5	31	3.6	1
	10	12	2.6	1
	15	8	3.7	1
	20	9	5.0	1

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

TEST BORING LOG

DRAWN: DATE: CHECKED: L DATE: 4/16/20

JOB NO.: 200599
FIG NO.: B - 3

TEST BORING NO. 7
DATE DRILLED 3/25/2020
Job # 200599

REMARKS

DRY TO 20', 3/30/20

Description	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
SAND, CLAYEY, FINE GRAINED, DARK BROWN TO BROWN, MEDIUM DENSE, DRY TO MOIST						
				17	1.9	1
	5			27	1.7	1
	10			14	3.8	1
	15			19	5.7	1
CLAY, SANDY, VERY STIFF, BROWN, MOIST	20			34	25.1	2

TEST BORING NO. 8
DATE DRILLED 3/25/2020
CLIENT CPR ENTITLEMENTS
LOCATION WATERVIEW NORTH

REMARKS

DRY TO 20', 3/30/20

Description	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
CLAY, SANDY, DARK BROWN TO BROWN, STIFF, DRY TO MOIST						
				22	5.6	2
	5			17	6.0	2
	10			23	9.0	2
	15			24	17.0	2
CLAYSTONE, SANDY, DARK BROWN, HARD, MOIST	20			50/11"	18.9	3

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

TEST BORING LOG

DRAWN: DATE: CHECKED: L DATE: 4/16/20

JOB NO.: 200599
FIG NO.: B-4

TEST BORING NO. 9
DATE DRILLED 3/25/2020
Job # 200599

REMARKS

DRY TO 20', 3/30/20

Description	Depth (ft)	Blows per foot	Watercontent %	Soil Type
SAND, SILTY, FINE GRAINED, BROWN, MEDIUM DENSE, MOIST		14	3.1	1
	5	15	5.7	1
CLAY, SANDY, BROWN, STIFF, MOIST	10	14	9.0	2
	15	16	15.9	2
	20	18	17.9	2

TEST BORING NO. 10
DATE DRILLED 3/25/2020
CLIENT CPR ENTITLEMENTS
LOCATION WATERVIEW NORTH

REMARKS

DRY TO 20', 3/30/20

Description	Depth (ft)	Blows per foot	Watercontent %	Soil Type
SAND, VERY CLAYEY TO CLAYEY, FINE GRAINED, BROWN, MEDIUM DENSE, MOIST		25	9.4	1
	5	24	3.6	1
CLAY, VERY SANDY, BROWN TO TAN, STIFF TO FIRM, DRY TO MOIST	10	16	7.3	2
	15	13	12.2	2
SAND, SILTY, FINE TO MEDIUM GRAINED, TAN, MEDIUM DENSE, MOIST	20	22	5.6	1

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

TEST BORING LOG

DRAWN: DATE: CHECKED: DATE: 4/16/20

JOB NO.: 200599
FIG NO.: B - 5

TEST BORING NO. 11
DATE DRILLED 3/27/2020
Job # 200599

REMARKS

DRY TO 20', 3/30/20

Description	Depth (ft)	Blows per foot	Watercontent %	Soil Type
SAND, SILTY, FINE TO MEDIUM GRAINED, TAN, MEDIUM DENSE, DRY		26	1.2	1
CLAY, SANDY, LIGHT BROWN, VERY STIFF TO FIRM, MOIST	5	36	13.0	2
	10	9	9.3	2
	15	27	6.9	2
SAND, SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, MOIST	20	18	4.7	1

TEST BORING NO. 12
DATE DRILLED 3/27/2020
CLIENT CPR ENTITLEMENTS
LOCATION WATERVIEW NORTH

REMARKS

DRY TO 20', 3/30/20

Description	Depth (ft)	Blows per foot	Watercontent %	Soil Type
CLAY, SANDY, DARK BROWN TO BROWN, SOFT TO STIFF, MOIST		4	11.4	2
	5	4	12.8	2
	10	26	18.3	2
	15	13	17.4	2
	20	16	14.1	2

TEST BORING NO. 13
DATE DRILLED 3/25/2020
Job # 200599

REMARKS

DRY TO 20', 3/30/20

Description	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
CLAY, SANDY, TAN, FIRM TO STIFF, MOIST						
				14	14.2	2
	5			11	7.8	2
	10			17	10.3	2
WEATHERED TO FORMATIONAL CLAYSTONE, SANDY, BROWN, VERY STIFF TO HARD, MOIST	15			40	39.7	3
	20			50/7"	9.8	3

TEST BORING NO. 14
DATE DRILLED 3/27/2020
CLIENT CPR ENTITLEMENTS
LOCATION WATERVIEW NORTH

REMARKS

DRY TO 20', 3/30/20

Description	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
CLAY, SANDY, LIGHT BROWN, FIRM TO STIFF, MOIST						
				14	6.1	2
	5			13	7.4	2
	10			15	15.3	2
CLAYSTONE, SANDY, BROWN, HARD, MOIST	15			50/9"	16.6	3
	20			50/8"	16.9	3

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

TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
		[illegible]	4/16/20

JOB NO.: 200599
FIG NO.: B-7

TEST BORING NO. 15
DATE DRILLED 3/25/2020
Job # 200599

REMARKS

DRY TO 20', 3/30/20

Description	Depth (ft)	Samples	Blows per foot	Watercontent %	Soil Type
CLAY, SANDY, BROWN, STIFF, MOIST		■	22	11.1	2
WEATHERED TO FORMATIONAL CLAYSTONE, SANDY, BROWN TO DARK BROWN, VERY STIFF TO HARD, MOIST	5	■	47	12.5	3
	10	■	50/11"	12.0	3
	15	■	50/7"	14.0	3
	20	■	50/9"	15.8	3

TEST BORING NO. 16
DATE DRILLED 3/27/2020
CLIENT CPR ENTITLEMENTS
LOCATION WATERVIEW NORTH

REMARKS

DRY TO 20', 3/30/20

Description	Depth (ft)	Samples	Blows per foot	Watercontent %	Soil Type
SAND, SILTY, FINE GRAINED, DARK BROWN, MEDIUM DENSE, DRY TO MOIST		■	14	3.1	1
	5	■	14	4.2	1
SAND, SILTY, FINE TO MEDIUM GRAINED, TAN, MEDIUM DENSE, MOIST	10	■	11	6.9	1
	15	■	13	7.1	1
CLAYSTONE, SANDY, DARK BROWN, HARD, MOIST	20	■	50/10"	17.9	3

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

TEST BORING LOG

DRAWN: DATE: CHECKED: [signature] DATE: 4/16/20

JOB NO.: 200599
FIG NO.: B- 8

TEST BORING NO. 17
DATE DRILLED 3/25/2020
Job # 200599

REMARKS	Depth (ft)	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 20', 3/30/20					
SAND, VERY CLAYEY, SILTY, FINE GRAINED, TAN, MEDIUM DENSE, MOIST		■	21	4.5	1
	5	■	20	5.1	1
CLAY, SANDY, TAN, STIFF, MOIST	10	■	22	8.5	2
CLAYSTONE, SANDY, BROWN, HARD, MOIST	15	■	50	15.6	3
	20	■	50/9"	16.0	3

TEST BORING NO. 18
DATE DRILLED 3/27/2020
CLIENT CPR ENTITLEMENTS
LOCATION WATERVIEW NORTH

REMARKS	Depth (ft)	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 20', 3/30/20					
SAND, VERY SILTY TO SILTY, FINE TO MEDIUM GRAINED, TAN, MEDIUM DENSE, MOIST		■	15	5.3	1
	5	■	10	3.1	1
	10	■	20	5.8	1
CLAY, SANDY, BROWN, STIFF, MOIST	15	■	21	14.5	2
CLAYSTONE, SANDY, BROWN, HARD, MOIST	20	■	50/9"	14.0	3

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

TEST BORING LOG

DRAWN: DATE: CHECKED: h DATE: 4/16/20

JOB NO.: 200599
FIG NO.: B- 10

TEST BORING NO. 19
DATE DRILLED 3/27/2020
Job # 200599

REMARKS

DRY TO 20', 3/30/20

Description	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
CLAY, SANDY, TAN, VERY STIFF, MOIST				38	8.5	2
CLAYSTONE, SANDY, BROWN, HARD, MOIST	5			50/8"	9.5	3
	10			50/4"	9.9	3
	15			50/4"	10.4	3
	20			50/4"	11.7	3

TEST BORING NO. 20
DATE DRILLED 3/25/2020
CLIENT CPR ENTITLEMENTS
LOCATION WATERVIEW NORTH

REMARKS

DRY TO 20', 3/30/20

Description	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
CLAY, SANDY, LIGHT BROWN, STIFF, MOIST				22	9.4	2
	5			23	11.2	2
CLAYSTONE, SANDY, BROWN, HARD, MOIST	10			50	14.6	3
	15			50/9"	15.3	3
	20			50/5"	13.7	3

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

TEST BORING LOG

DRAWN: DATE: CHECKED: h DATE: 4/16/20

JOB NO.: 200599
FIG NO.: B- 11

TEST BORING NO. 21
DATE DRILLED 3/27/2020
Job # 200599

REMARKS

DRY TO 20', 3/30/20

Description	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
CLAY, SANDY, DARK BROWN, STIFF, MOIST				29	9.9	2
CLAYSTONE, SANDY, DARK BROWN, HARD, MOIST	5			50/11"	11.7	3
	10			50/6"	11.7	3
	15			50/5"	11.3	3
	20			50/5"	11.1	3

TEST BORING NO. 22
DATE DRILLED 3/27/2020
CLIENT CPR ENTITLEMENTS
LOCATION WATERVIEW NORTH

REMARKS

DRY TO 20', 3/30/20

Description	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
CLAY, SANDY, BROWN, STIFF, MOIST				22	10.0	2
SAND, SILTY, FINE TO MEDIUM GRAINED, BROWN, MEDIUM DENSE, MOIST	5			28	4.6	1
CLAY, SANDY, LIGHT BROWN, STIFF, MOIST	10			18	7.0	2
	15			22	7.3	2
CLAYSTONE, SANDY, DARK BROWN, HARD, MOIST	20			50/6"	13.3	3

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

TEST BORING LOG

DRAWN: DATE: CHECKED: *h* DATE: *4/16/20*

JOB NO. 200599

FIG NO. B- 12

TEST BORING NO. 23
DATE DRILLED 3/25/2020
Job # 200599

REMARKS

DRY TO 20', 3/30/20

Description	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
CLAY, SANDY, BROWN TO LIGHT BROWN, STIFF, MOIST						
			■	18	10.4	2
	5		■	22	11.1	2
	10		■	19	9.1	2
	15		■	15	12.8	2
	20		■	28	14.6	2

TEST BORING NO. 24
DATE DRILLED 3/27/2020
CLIENT CPR ENTITLEMENTS
LOCATION WATERVIEW NORTH

REMARKS

DRY TO 20', 3/30/20

Description	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
CLAY, SANDY, GRAY BROWN, STIFF, MOIST						
			■	27	10.8	2
WEATHERED TO FORMATIONAL CLAYSTONE, SANDY, BROWN, VERY STIFF TO HARD, MOIST	5		■	47	14.7	3
	10		■	50/11"	17.6	3
	15		■	50/3"	11.4	3
	20		■	50/5"	10.5	3

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

TEST BORING LOG

DRAWN: DATE: CHECKED: [illegible] DATE: 4/16/20

JOB NO.: 200599
FIG NO.: B - 13

TEST BORING NO. 25
DATE DRILLED 3/27/2020
Job # 200599

REMARKS

DRY TO 20', 3/30/20

Description	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
CLAY, SANDY, TAN TO DARK BROWN, STIFF, MOIST						
				15	6.8	2
	5			23	7.9	2
	10			28	10.4	2
CLAYSTONE, SANDY, DARK BROWN, HARD, MOIST	15			50/7"	9.6	3
	20			50/4"	9.6	3

TEST BORING NO.
DATE DRILLED
CLIENT CPR ENTITLEMENTS
LOCATION WATERVIEW NORTH
REMARKS

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
5					
10					
15					
20					

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

TEST BORING LOG

DRAWN: DATE: CHECKED: DATE: 4/16/20

JOB NO.: 200599
FIG NO.: B - 15

APPENDIX C: Soil Survey Descriptions

El Paso County Area, Colorado

8—Blakeland loamy sand, 1 to 9 percent slopes

Map Unit Setting

National map unit symbol: 369v
Elevation: 4,600 to 5,800 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Blakeland and similar soils: 98 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blakeland

Setting

Landform: Hills, flats
Landform position (three-dimensional): Side slope, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock and/or eolian deposits derived from sedimentary rock

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
Natural 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 in profile: 5 percent
Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: Sandy Foothill (R049BY210CO)
Hydric soil rating: No

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 17, Sep 13, 2019

El Paso County Area, Colorado

31—Fort Collins loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 3684
Elevation: 5,200 to 6,500 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 48 to 52 degrees F
Farmland classification: Not prime farmland

Map Unit Composition

Fort collins and similar soils: 98 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fort Collins

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium

Typical profile

A - 0 to 9 inches: loam
Bt - 9 to 16 inches: clay loam
Bk - 16 to 21 inches: clay loam
Ck - 21 to 60 inches: loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: Loamy Plains (R067BY002CO)

Other vegetative classification: LOAMY PLAINS (069AY006CO)
Hydric soil rating: No

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 17, Sep 13, 2019

El Paso County Area, Colorado

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

Map Unit Setting

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

Map Unit Composition

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

Description of Nelson

Setting

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

Typical profile

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

Properties and qualities

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

Interpretive groups

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

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

Description of Tassel

Setting

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

Typical profile

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

Properties and qualities

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

Interpretive groups

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

Minor Components

Other soils

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

Pleasant

Percent of map unit: 1 percent
Landform: Depressions

Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 17, Sep 13, 2019

El Paso County Area, Colorado

86—Stoneham sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 36b2
Elevation: 5,100 to 6,500 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Stoneham and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Stoneham

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous loamy alluvium

Typical profile

A - 0 to 4 inches: sandy loam
Bt - 4 to 8 inches: sandy clay loam
Btk - 8 to 11 inches: sandy clay loam
Ck - 11 to 60 inches: loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 9.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B

Ecological site: Sandy Plains (R067BY024CO)
Other vegetative classification: SANDY PLAINS (069AY026CO)
Hydric soil rating: No

Minor Components

Other soils

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

Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 17, Sep 13, 2019

El Paso County Area, Colorado

108—Wiley silt loam, 3 to 9 percent slopes

Map Unit Setting

National map unit symbol: 367b
Elevation: 5,200 to 6,200 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Wiley and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wiley

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous silty eolian deposits

Typical profile

A - 0 to 4 inches: silt loam
Bt - 4 to 16 inches: silt loam
Bk - 16 to 60 inches: silt loam

Properties and qualities

Slope: 3 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.5 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: Loamy Plains (R067BY002CO)

Other vegetative classification: LOAMY PLAINS (069AY006CO)
Hydric soil rating: No

Minor Components

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

Pleasant
Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 17, Sep 13, 2019