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**PRELIMINARY SOIL, GEOLOGY, GEOLOGIC HAZARD,
AND WASTEWATER STUDY,
GRANDVIEW RESERVE
PARCEL NO. 42000-00-396
0 EASTONVILLE ROAD
EL PASO COUNTY, COLORADO**

Prepared for

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Respectfully Submitted,

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1.0 SUMMARY

Project Location

The project site lies in portions of Sections 21, 22, 27 and 28, Township 12 South, Range 64 West of the 6th Principal Meridian, in El Paso County, Colorado. The site is located approximately 4 miles northeast of Falcon, Colorado, northwest of Highway 24, east of Eastonville Road and west of Elbert Road.

Project Description

Total acreage involved in the project is approximately 765 acres. The proposed site development consists of one-hundred and eighty-four (184) single-family rural residential lots with park and open space areas. The development will utilize individual wells and on-site wastewater treatment systems.

Scope of Report

This report presents the results of our geologic evaluation, treatment of engineering geologic hazard study and wastewater study for individual on-site wastewater treatment systems.

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 some constraints on development and land use. These include areas of artificial fill, potentially expansive soils, unstable slopes, floodplain, seasonal and potentially seasonal shallow groundwater, and areas of ponded water. Based on the proposed development plan, it appears that these areas will have some 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 are either avoided or properly mitigated. All recommendations are subject to the limitations discussed in the report.

2.0 GENERAL SITE CONDITIONS AND PROJECT DESCRIPTION

The site is located in portions of Sections 21, 22, 27 and 28, Township 12 South, Range 64 West of the 6th Principal Meridian, of the 6th Principal Meridian in El Paso County, Colorado. The site is located approximately 4 miles northeast of Falcon, Colorado, northwest of Highway 24, east of Eastonville Road and west of Elbert Road. The location of the site is as shown on the Vicinity Map, Figure 1.

The topography of the site consists of gentle areas to rolling hills that vary from gradually to moderately sloping generally to the southeast. Steep slopes are located along some of the drainages in the eastern portions of the site. The drainages on site flow in southeasterly directions through the site. Water was observed flowing in the drainage in the northeast portion of the site, however, no water was observed flowing in the other drainages. Water was observed ponded behind an earthen dam in the southeastern portion of the site at the time of this investigation. The site boundaries are indicated on the USGS Map, Figure 2. Previous land uses have included grazing and pasture land. The site contains primarily field grasses and weeds. Site photographs, taken December 13, 2018, are included in Appendix A.

Total acreage involved in the proposed development is approximately 765 acres. One hundred and eighty-four (184) single-family rural residential lots with park and open space areas are proposed. The proposed residential lots are approximately 2.5 to 5 acres in size. The area will be serviced by individual wells and on-site wastewater treatment systems. The proposed Site Plan/Testing Location Map is presented in Figure 3.

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.
- The site will be evaluated for individual on-site wastewater treatment systems in accordance with El Paso Land Development Code.

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 Geology/Engineering Geology Map which identified pertinent geologic conditions affecting development. The field mapping was performed by personnel of Entech Engineering, Inc. on December 13, 2018.

Ten (10) test borings and eight (8) tactile test pits were performed on the site to determine soil and bedrock characteristics and general suitability of the site for the use of on-site wastewater treatment systems. The locations of the test borings and test pits are indicated on the Site Plan/Testing Location Map, Figure 3. The Test Boring and Test Pit Logs are presented in Appendix B. Results of this testing will be discussed later in this report.

Laboratory testing was also performed on select soil samples to classify and determine the soils engineering characteristics. Laboratory tests included grain-size analysis, ASTM D-422 and FHA Swell Testing. Results of the laboratory testing are included in Appendix C. A Summary of Laboratory Test Results is presented in Table 1.

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 18 miles to the west is a major structural feature known as the 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 southeastern edge of a large structural feature known as the Denver Basin. Bedrock in the area tends to be very gently dipping in a northerly direction (Reference 1). The rocks in the area of the site are sedimentary in nature

and typically Tertiary to Upper Cretaceous in age. The bedrock underlying the site consists of the Dawson Arkose Formation. Overlying this formation are unconsolidated deposits of residual soils, man-made, sheetwash deposits, eolian sands, and alluvial soils of the Quaternary Age. The residual soils are produced by the in-situ action of weathering of the bedrock on site. The alluvial soils were deposited by water in the drainages on the site and as stream terrace deposits and sheetwash deposits. Eolian sands are deposited by the action of prevailing winds. Man-made soils exist as earthen dams and berms. 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 three soil types on the site (Figure 4). In general, they vary from loam, loamy sands, and sandy loam. The soils are described as follows:

<u>Type</u>	<u>Description</u>
8	Blakeland Loamy Sands, 1-9% slopes
19	Columbine Gravelly Sandy Loam, 0 to 3% slopes
83	Stapleton Sandy Loam, 3 to 8% slopes

Complete descriptions of each soil type are presented in Appendix D. The soils have generally been described to typically have rapid permeabilities. The majority of the soils have been described as good for urban development. Limitations include the hazard of flooding on Soil Type No. 19 in some areas. Some areas of Soil Type 19 have mapped in the floodplain zones that are designated as open space. Roads may need to be designed to minimize frost-heave potential. 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 Falcon Quadrangle Geology Map showing the site is presented in Figure 5 (Reference 4). The Geology Map prepared for the site is presented in Figure 6. Seven mappable units were identified on this site which are described as follows:

- Qaf Recent Artificial Fill of Holocene Age:** These are man-made fill deposits associated with earthen dams and berms on-site.
- Qal Recent Alluvium of Late Holocene Age:** These materials consist of water deposited sands located along some of the minor drainages across the site.
- Qp Piney Creek Alluvium (Alluvium One and Two) of Early Holocene Age:** These materials consist of low stream-terrace deposits above the current stream channel. The materials typically consist of silty to well graded sand.
- Qb Broadway Alluvium (Alluvium Three) of Late Pleistocene Age:** These materials consist of middle steam terrace deposits. The materials typically consist of silty to clayey gravelly sands.
- Qsw Sheetwash Deposits of Holocene to Late Pleistocene Age:** These materials consist of silty to clayey sands with some cobbles. The material was deposited by the action of sheetwash.
- Qes Eolian Sand of Pleistocene Age:** These materials consist of windblown sand deposits. The materials typically consist of light brown, well-sorted silty sands. The windblown sand deposits tend to have low density and low bearing characteristics.
- Qc/Tkd Colluvium of Quaternary Age overlying Dawson Formation of Tertiary to Cretaceous Age:** The Dawson Formation typically consists of arkosic sandstone with interbedded fine-grained sandstone, siltstone and claystone. Overlying this formation is a variable layer of residual soil. The residual soils were derived from the in-situ weathering of the bedrock materials on-site. These soils consisted of silty to clayey sands, sandy clays and sandy silts.

The soils listed above were mapped from site-specific mapping, the *Geologic Map of the Falcon Quadrangle* distributed by the Colorado Geological Survey in 2012 (Reference 4), and the *Geologic Map of the Denver 1⁰ x 2⁰ Quadrangle*, distributed by the US Geological Survey in 1981 (Reference 5). The Test Pits were also used in evaluating the site and are included in Appendix B. The Geology Map prepared for the site is presented in Figure 6.

5.4 Soil Conditions

The soils encountered in the test borings and test pits can be grouped into four general soil and rock types. The soils were classified using the Unified Soil Classification System (USCS). The test pit soils were also classified using the USDA Textural Soil Classification.

Soil Type 1 is well-graded, slightly silty to silty and clayey sand (SW, SM-SW, SM, SC, SC-SM-SW). This material was encountered in all of the test borings and in six of the test pits. The sand was encountered at the existing surface and extended to depths ranging from 1 to 9 feet in the test borings and 2 feet to the termination of the test pits (8 feet). These soils were encountered at medium dense to dense states and at dry to very moist conditions. Samples tested had 5 to 40 percent of the soil size particles passing the No. 200 Sieve. Atterberg Limits Testing resulted in a liquid limit of 17 and a plastic index of 5. FHA Swell Testing on samples of the sand resulted in expansion pressures of 110 and 130 psf, indicating low expansion potential.

Soil Type 2 is a sandy clay (CL). This material was encountered in two of the test borings and four of the test pits. The clays were encountered at depths ranging from the existing surface grade in the test pits and at 9 feet in the test borings and extended to depths up to 9 feet in the test pits and 14 feet in the test borings. The clays were encountered at very stiff consistencies and moist conditions. The samples tested had 74 to 85 percent of the soil size particles passing the No. 200 sieve. Atterberg Limits Testing resulted in a liquid limit of 44 and a plastic index of 22. FHA Swell Testing resulted in an expansion pressure of 1020 psf, indicating moderate expansion potential.

Soil Type 3 is a silty to clayey sandstone and very clayey sandstone (SM, SC). This material was encountered nine of the test borings and in two of the test pits. The sandstone was encountered at depths ranging from 1 to 14 feet bgs and extended to depths ranging from 14 to 19 feet or to the termination of the borings and pits (6 to 20 feet). The sandstone was encountered at very dense states and moist to wet conditions. Samples tested had 13 to 42 percent of the soil size particles passing the No. 200 sieve. Atterberg Limits Testing resulted in a liquid limit of 28 and a plastic index of 15.

Soil Type 4 is a sandy to very sandy claystone (CL). This material was encountered six of the test borings and Test Pit No. 6. The claystone was encountered at depths ranging from 9 to 19

feet in the test borings and 2 feet in the test pit and extended to depths ranging from 14 feet to the depths explored (5 to 20 feet). The claystone was encountered at hard consistencies and moist conditions. Samples tested had 59 to 72 percent of the soil size particles passing the No. 200 sieve. Atterberg limits testing resulted in a liquid limit of 35 and a plastic index of 21. FHA Swell Testing resulted in expansion pressures 950 and 1580 psf. Swell/Consolidation Testing resulted in a volume change of 0.7 percent. These results indicate the claystone exhibits low to high expansion potential.

The Test Pit Logs are presented in Appendix B. Laboratory Test Results are presented in Appendix C. A Summary of Laboratory Test Results is presented in Table 1. Bedrock depths are summarized in Table 2.

5.5 Groundwater

Groundwater was encountered in seven of the test borings at depths ranging from 4.5 to 19 feet. Additionally, groundwater was encountered in Test Pit Nos. 2, 3 and 7 at 7.5, 8.5 and 6.5 feet respectively. Groundwater was not encountered in the remaining test borings or test pits which were drilled/excavated to depths ranging from 5 to 20 feet. Groundwater depths are summarized in Table 2. Areas of seasonal and potentially seasonal shallow groundwater have been mapped in 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

As mentioned previously, detailed mapping has been performed on this site to produce an Geology/Engineering Geology Map (Figure 6). This map shows the location of various geologic conditions of which the developers should be cognizant during the planning, design and construction stages of the project. These hazards and the recommended mitigation techniques are as follows:

Artificial Fill

These are man-made fill deposits associated with earthen dams and berms on-site.

Mitigation: Berms were observed along Eastonville Road that can be avoided or easily removed or penetrated by foundations. The earthen dams lie within areas designated as open space and will be avoided by development. Should any uncontrolled fill be encountered beneath foundations, removal and recompaction at 95 percent of its maximum Modified Proctor Dry Density, ASTM D-1557 will be required.

Loose or Collapsible Soils

Loose soils were not encountered in the test pits, however, the windblown sand deposits are known to have low density. Any loose or collapsible soils encountered beneath foundations or floor slabs will require mitigation.

Mitigation: Any loose or collapsible soils encountered beneath foundations or floor slabs should be overexcavated 2 to 3 feet, moisture-conditioned and recompacted. The soils should be recompacted to 95 percent of the soils maximum Modified Proctor Dry Density ASTM D-1557 at ± 2 percent of optimum moisture content. The reconditioned soils on this site should be observed and tested to verify adequate compaction. Areas requiring recompaction should be determined during the excavation observation.

Expansive Soils

Clays and claystone were encountered in some of the test pits excavated on-site that are potentially expansive. Expansive claystone is commonly encountered within the Dawson Formation. These occurrences are typically sporadic; therefore, none have been indicated on the

maps. These expansive soils, if encountered beneath foundations, can cause differential movement in the structure foundation. These occurrences should be identified and mitigated on an individual basis.

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. Another alternative in areas of highly expansive soils is the use of drilled pier foundation systems. 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 should be considered for basement construction on highly expansive clays. Final recommendations should be determined after additional investigation of each building site.

Slope Stability and Landslide Hazard

The majority of the slopes in the building areas on site are gently to moderately sloping and do not exhibit any past or potential unstable slopes or landslides. However, the steeply sloping areas along the drainage in the eastern portion of the site have been identified as unstable slopes. These areas are identified on the Geology/Engineering Geology Map, Figure 6. The recommendations for these areas are as follows:

- Unstable Slope Area

The area identified with this hazard is located along a portion of a minor drainage where cut banks have created unstable slopes. Considerable care must be exercised in these areas not to create a condition which would tend to activate instability.

Mitigation: Building should be avoided in these areas. The lots most significantly affected by unstable slopes are Lots 18, 84, 106 and 107. The structures on these lots should be set back a minimum of 30 feet from the crest of these slopes. It appears there is sufficient room on the lots to avoid this hazard. Proper control of drainage at both the surface above the slope and the subsurface is extremely important. Areas of ponded water at the surface should be avoided. Utility trenches, basement excavations and other subsurface features should not

be permitted to become water traps which may promote saturation of the subsurface materials. Drainage should not be permitted over the potentially unstable slope but directed in a non-erosive manner away from the slope. Irrigation above these slopes should be kept to a minimum to prevent saturation of the subsurface soils. The use of xeriscape landscaping utilizing native plantings is recommended to reduce the need for irrigation.

Floodplain and Drainage Areas

Portions of the site associated with some of the drainages are mapped within a floodplain zones according to the FEMA Map No. 08041CO556G, dated December 7, 2018 (Figure 7, Reference 6). The floodplain areas have been designated as open space and/or can be avoided by construction. An area of ponded water exists in the floodplain that is designated as open space and will be avoided by development. Additionally, areas of seasonal and potentially seasonal shallow groundwater were observed across the site. In these areas, we would anticipate the potential for periodically high subsurface moisture conditions and frost heave potential. These areas lie within the low-lying areas and minor drainages across the site. Water was observed in the drainage in the northeastern portion of the site, but was not observed in any of the other minor drainages at the time of our site investigation, however, water was observed ponded behind an earthen dam in the southeastern portion of the site. These areas can likely be avoided or properly mitigated by development. The floodplain should be avoided by construction unless site-specific floodplain determination and drainage studies are performed. The potential exists for high groundwater levels during high moisture periods and should structures encroach on these areas the following precautions should be followed.

Mitigation: Foundations must have a minimum 30-inch depth for frost protection. In areas where high subsurface moisture conditions are anticipated periodically, subsurface perimeter drains are recommended to help prevent the intrusion of water into areas below grade. Typical drain details are presented in Figure 8. Some of the minor drainage swales can be avoided or regraded. The main drainage that bisects the site is designated as open space and will be avoided. Any grading in these areas should be done to direct surface flow around construction to avoid areas of ponded water. Finished floors must be located at least one foot above floodplain levels. Specific drainage studies and exact floodplain locations are beyond the scope of this report.

6.1 Relevance of Geologic Conditions to Land Use Planning

We understand that the development will be rural residential lots with areas of park and open space. 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 drainages on site that can be avoided or properly mitigated during construction on each lot. Other hazards on site may be satisfactorily mitigated through proper engineering design and construction practices or avoidance.

The upper materials in the area are typically at medium dense to dense states. Areas of loose soils may be encountered that may require recompaction. The medium dense to dense granular soils encountered in the upper soil profiles of the test pits should provide good support for foundations. Loose soils, if encountered beneath foundations or slabs, will require removal of the upper 2 to 3 feet of material and recompaction. Any uncontrolled fill encountered beneath foundations will require complete removal and recompaction. Expansive soils, although sporadic, were encountered. Expansive clayey sandstone, claystone and associated clayey residual soils are common in the Dawson Formation, and may require mitigation. Foundations anticipated for the site are standard spread footings possibly in conjunction with overexcavation in areas of expansive soils or loose soils. Areas of artificial fill, if encountered beneath foundations will require penetration or recompaction. Areas containing arkosic sandstone will have high allowable bearing conditions. Expansive layers may also be encountered in the soil and bedrock on this site. Expansive soils, if encountered, will require special foundation design and/or overexcavation. These soils will not prohibit development.

Unstable slopes exist along portions of the drainage in the eastern portion of the site where the drainage has eroded cut banks. A 30-foot building setback is recommended from the crest of the unstable slopes. Septic fields should not be located within the building setback as well. The slopes primarily affect Lots 18, 84, 106 and 107. It appears there is sufficient room on the lots to avoid the unstable slopes. Additional reinforcement may be necessary in the foundation to account for additional pressures due to sloping conditions. Tie-beams and/or buttresses may be necessary, depending on site conditions and grading plans.

Areas of seasonal shallow groundwater and potentially seasonal shallow groundwater were encountered on site. Additionally, portions of the site have been mapped in floodplain zones. The floodplain areas are in the designated open space area and can be avoided by development. Water was observed ponded behind an earthen dam in the eastern portion of the site during our site investigation. This area lies in an area designated as open space and will be avoided by development. Due to the size of the lots and the proposed development, the majority of the areas mapped as seasonal or potentially seasonal shallow groundwater can be avoided by construction on the lots. Septic systems are not recommended in these areas due to the potential for shallow groundwater. Regrading can also mitigate some minor drainages on some of the lots. Structures should not block drainages. Any site grading should be done in such a manner as to not create areas of ponded water around structures or septic fields. Finished floor levels must be a minimum of one foot above the floodplain level. Septic fields should not be located in drainage areas due to the potential for periodic high groundwater conditions. Specific floodplain locations and drainage studies are beyond the scope of this report.

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. Investigation on each lot is recommended prior to construction.

7.0 ON-SITE WASTEWATER TREATMENT

The site was evaluated for individual and commercial on-site wastewater treatment systems in accordance with El Paso Land Development Code. Eight (8) tactile test pits were performed on the property. The test pits were located in potential locations of future systems. The approximate locations of the test pits are indicated on Figure 3, on the Geology/Engineering Geology Map, Figure 6, and on the Septic Suitability Map, Figure 9. A table showing the results of the Tactile Test Pits is presented in Table 2. Test Pit Logs are included in Appendix B.

The Natural Resource Conservation Service (Reference 2), previously the Soil Conservation Service (Reference 3) has been mapped with three soil descriptions. The Soil Survey Map (Reference 2) is presented in Figure 4, and the Soil Survey Descriptions are presented in Appendix D. The soils are described as having rapid percolation rates. The majority of the soils have been described with moderate permeabilities.

Soils encountered in the tactile test pits consisted of loamy sand to gravelly loamy sand, gravelly sand, sandy clay loam, very sandy clay, silty to very clayey sandstone and sandy claystone. Bedrock was encountered in three of the test pits at depths ranging from 2 to 4 feet. The limiting layers encountered in the test pits are the sandy loam (Soil Type 2), sandy clay loam (Soil Type 3A), sandy clay, silty to clayey sandstone and sandy claystone (Soil Type 4A) which corresponds to LTAR values of 0.80 to 0.15 gallons per day per square foot. The conditions encountered in the Test Pit Nos. 1 and 5 through 8 will require a designed system. Groundwater was encountered in Test Pit Nos. 2, 3 and 7 at depths ranging from 6.5 to 8.5 feet. Areas where shallow bedrock or groundwater are encountered may require designed systems. Additional investigation may identify areas where suitable for conventional systems could be used.

In summary, it is our opinion the site is suitable for individual on-site wastewater treatment systems (OWTS) and that contamination of surface and subsurface water resources should not occur provided the OWTS sites are evaluated and installed according to El Paso County and State Guidelines and properly maintained. Based on the testing performed as part of this investigation designed systems will likely be required for many of the lots. A Septic Suitability Map is presented in Figure 9. Areas where OWTS sites are not recommended are indicated on Figure 9. Individual soil testing is required on the lots prior to construction. Absorption fields must be located a minimum of 100 feet from any well, including those on adjacent properties. Absorption fields must also be located a minimum of 50 feet from any drainages, floodplains or ponded areas and 25 feet from dry gulches.

8.0 ECONOMIC MINERAL RESOURCES

Some of the sandy materials on-site could be considered a low-grade sand resource. According to the *El Paso County Aggregate Resource Evaluation Map* (Reference 7), the area is mapped with upland deposits. According to the *Atlas of Sand, Gravel and Quarry Aggregate Resources, Colorado Front Range Counties* distributed by the Colorado Geological Survey (Reference 8), areas of the site are mapped with upland deposits: probable aggregate resource (U4). According to the *Evaluation of Mineral and Mineral Fuel Potential* (Reference 9), the area of the site has been mapped with some areas as "Good" and some as "Little or No Potential" for industrial minerals depending on geologic deposits. Considering the abundance of similar materials through

the region and the close proximity to developed land, 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 9), 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 the site (Reference 9).

The site has been mapped as "Fair" for oil and gas resources (Reference 9). 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.

9.0 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 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 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.

10.0 CLOSURE

It is our opinion that the existing geologic engineering and geologic conditions will impose some minor constraints on development and construction of the site. The majority of these conditions can be avoided by construction. Others can be mitigated through proper engineering design and construction practices. The proposed development and use is 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 and septic systems 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 4 Site Investments, LLC for application to the proposed project in accordance with generally accepted geologic soil and engineering practices. No other warranty expressed or implied is made.

We trust 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.

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5. Bryant, Bruce; McGrew, Laura W. and Wobus, Reinhard A. 1981. *Geologic Map of the Denver 1° x 2° Quadrangle, North-Central Colorado*. U.S. Geologic Survey. Map 1-1163.
6. Federal Emergency Management Agency. December 7, 2018. *Flood Insurance Rate Maps for the City of Colorado Springs, Colorado*. Map Number 08041CO556G.
7. El Paso County Planning Development. December 1995. *El Paso County Aggregate Resource Evaluation Maps*.
8. 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.
9. Keller, John W.; TerBest, Harry and Garrison, Rachel E. 2003. *Evaluation of Mineral and Mineral Fuel Potential of El Paso County State Mineral Lands Administered by the Colorado State Land Board*. Colorado Geological Survey. Open-File Report 03-07.

TABLES

TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

CLIENT 4 SITE INVESTMENTS, LLC
PROJECT GRANDVIEW RESERVE
JOB NO. 181951

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 (%)	USDA SOIL TYPE	UNIFIED CLASS.	SOIL DESCRIPTION
1	TP-2	2-3			5.8						2A	SM-SW	SAND, SLIGHTLY SILTY
1	TP-3	2-3			6.5						2A	SM-SW	SAND, SLIGHTLY SILTY
1	TP-3	8-9			18.4						3A	SC	SAND, CLAYEY
1	TP-4	5-6			4.9						1	SW	SAND
1	TP-7	5-6			17.5						2A	SM	SAND, SILTY
1	3	2-3			23.3							SM	SAND, SILTY
1	6	5			20.9							SM	SAND, SILTY
1	1	5			12.1				130			SM	SAND, SILTY
1	4	2-3			7.1							SM	SAND, SILTY
1	5	5			9.9	17	5	0.02				SM-SW	SAND, SLIGHTLY SILTY
1	8	5			19.2							SC-SM-SW	SAND, SLIGHTLY SILTY, CLAYEY
1	9	5			39.8				110			SM	SAND, VERY SILTY
2	TP-8	5-6			84.8				1020		4A	CL	CLAY, SANDY
2	10	10			73.6	44	22	<0.01				CL	CLAY, SANDY
3	TP-1	4-5			16.2						4A	SM	SANDSTONE, SILTY
3	TP-5	4-5			42.3						4A	SC	SANDSTONE, VERY CLAYEY
3	3	10			15.2							SM	SANDSTONE, SILTY
3	6	20			35.8							SC	SANDSTONE, CLAYEY
3	2	2-3			14.0	28	15	<0.01				SC	SANDSTONE, CLAYEY
3	4	15			12.9							SM	SANDSTONE, SILTY
3	7	2-3			14.4							SM	SANDSTONE, SILTY
4	3	15	12.8	112.7						0.7%		CL	CLAYSTONE, SANDY
4	TP-6	2-3			61.6				950		4A	CL	CLAYSTONE, VERY SANDY
4	9	15			71.9				1580			CL	CLAYSTONE, SANDY
4	1	10			59.0							CL	CLAYSTONE, VERY SANDY
4	2	10			62.3	35	21	0.00				CL	CLAYSTONE, SANDY

Table 2: Summary of Depths to Bedrock and Groundwater

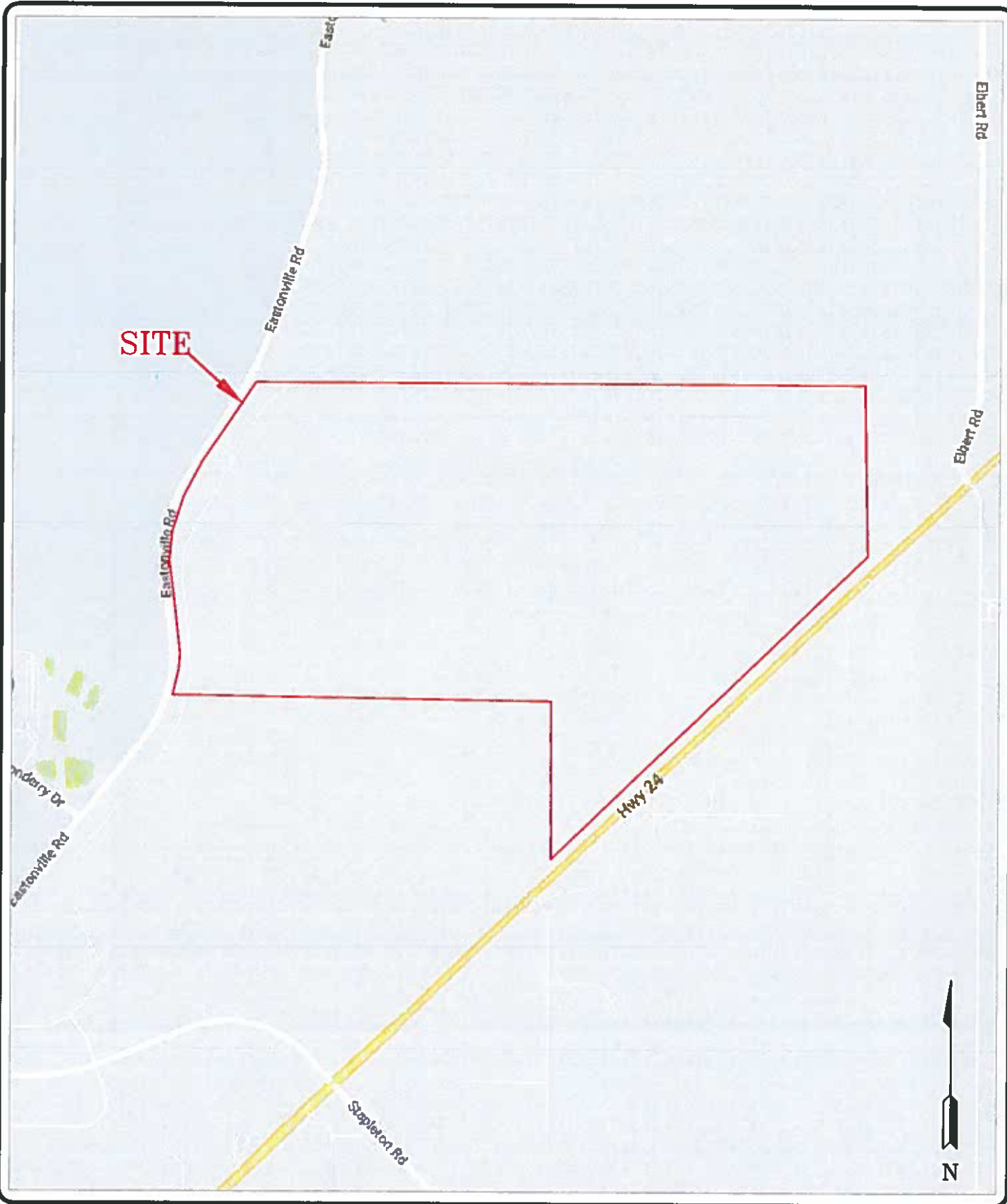
Test No.	Depth to Bedrock (ft.)	Depth to Groundwater (ft.)
TB-1	9	6
TB-2	1	12.5
TB-3	8	>20
TB-4	9	11.5
TB-5	9	13
TB-6	8	>20
TB-7	1	8
TB-8	14	4.5
TB-9	9	>15
TB-10	14	19
TP-1	4	>6
TP-2	>8	7.5
TP-3	>9	8.5
TP-4	>8	>8
TP-5	4	>6
TP-6	2	>5
TP-7	>8	6.5
TP-8	>8	>8

Table 3: Summary Tactile Test Pit Results

Test Pit No.	USDA Soil Type	LTAR Value	Depth to Bedrock (ft.)	Depth to Seasonally Occurring Groundwater (ft.)
1	4A*	0.15*	4*	N/A
2	2A	0.60	N/A	7.5
3	2A	0.60	N/A	8.5
4	2A	0.60	N/A	N/A
5	4A*	0.15*	4*	N/A
6	4A*	0.15*	2*	N/A
7	4A*	0.15*	N/A	6.5
8	4A*	0.15*	N/A	N/A

*- Conditions that will require an engineered OWTS

FIGURES



ENTECH
ENGINEERING, INC.
 505 ELKTON DRIVE
 COLORADO SPRINGS, CO. 80907 (719) 531-9599

VICINITY MAP
 GRANDVIEW RESERVE
 EASTONVILLE ROAD
 EL PASO COUNTY, CO.
 FOR: 4 SITE INVESTMETNS, LLC

DRAWN:
 LLL

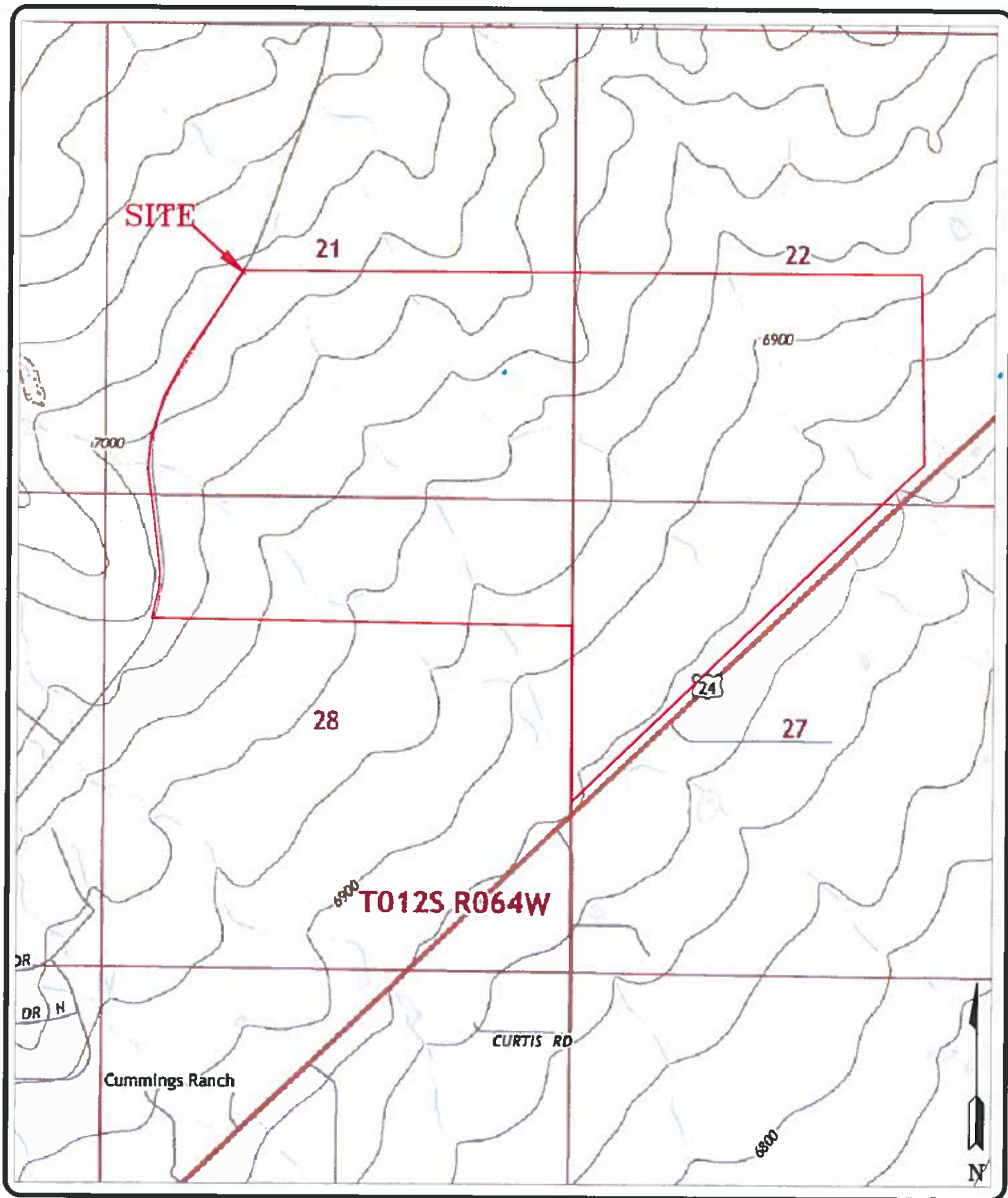
DATE:
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DATE:
 1/15/19

JOB NO.:
 181951

FIG NO.:
 1



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 505 ELKTON DRIVE
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USGS MAP
 GRANDVIEW RESERVE
 EASTONVILLE ROAD
 EL PASO COUNTY, CO.
 FOR: 4 SITE INVESTMETNS, LLC

DRAWN:
 LLL

DATE:
 12/12/18

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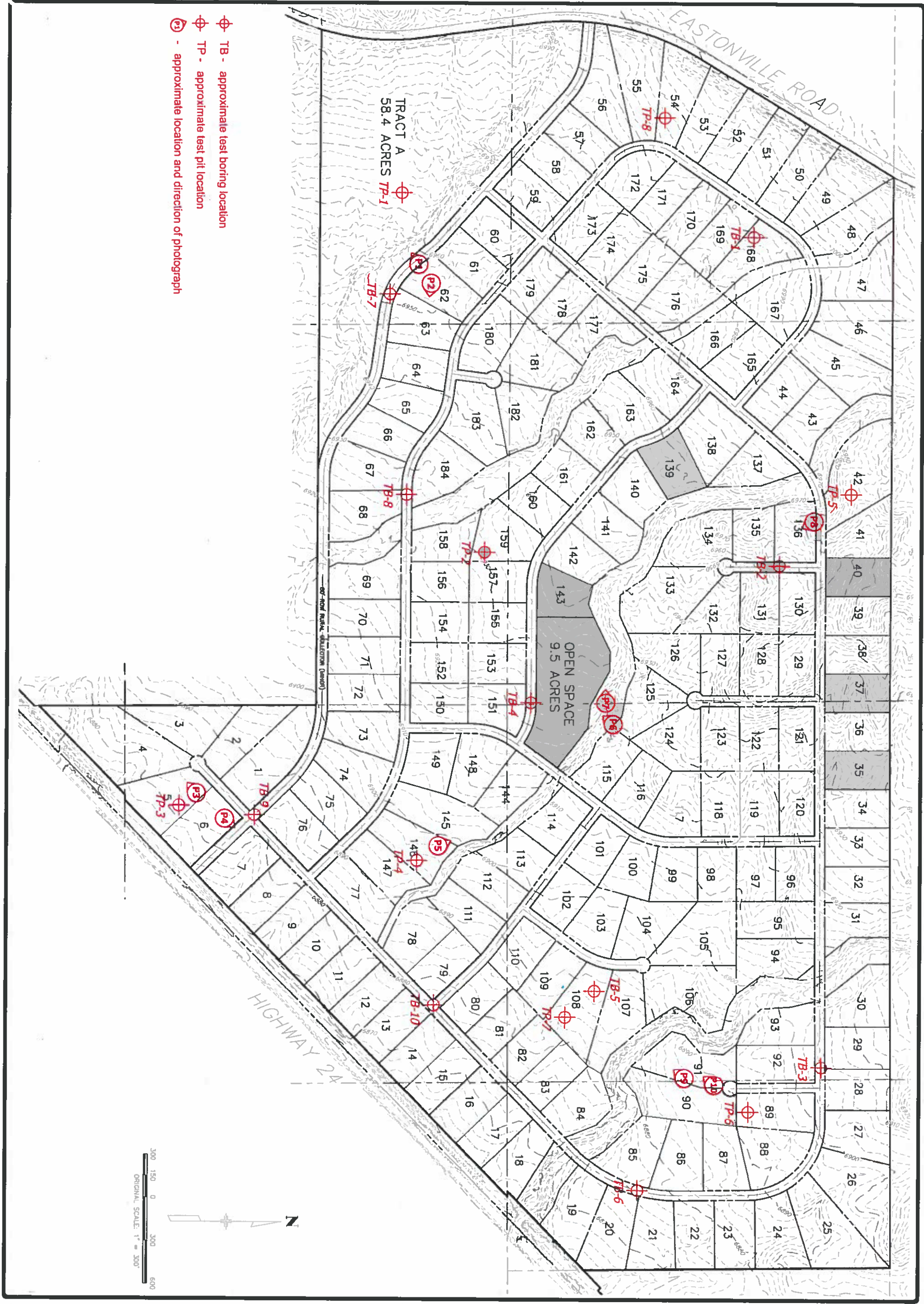
n

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1/15/19

JOB NO.:
 181951

FIG NO.:
 2

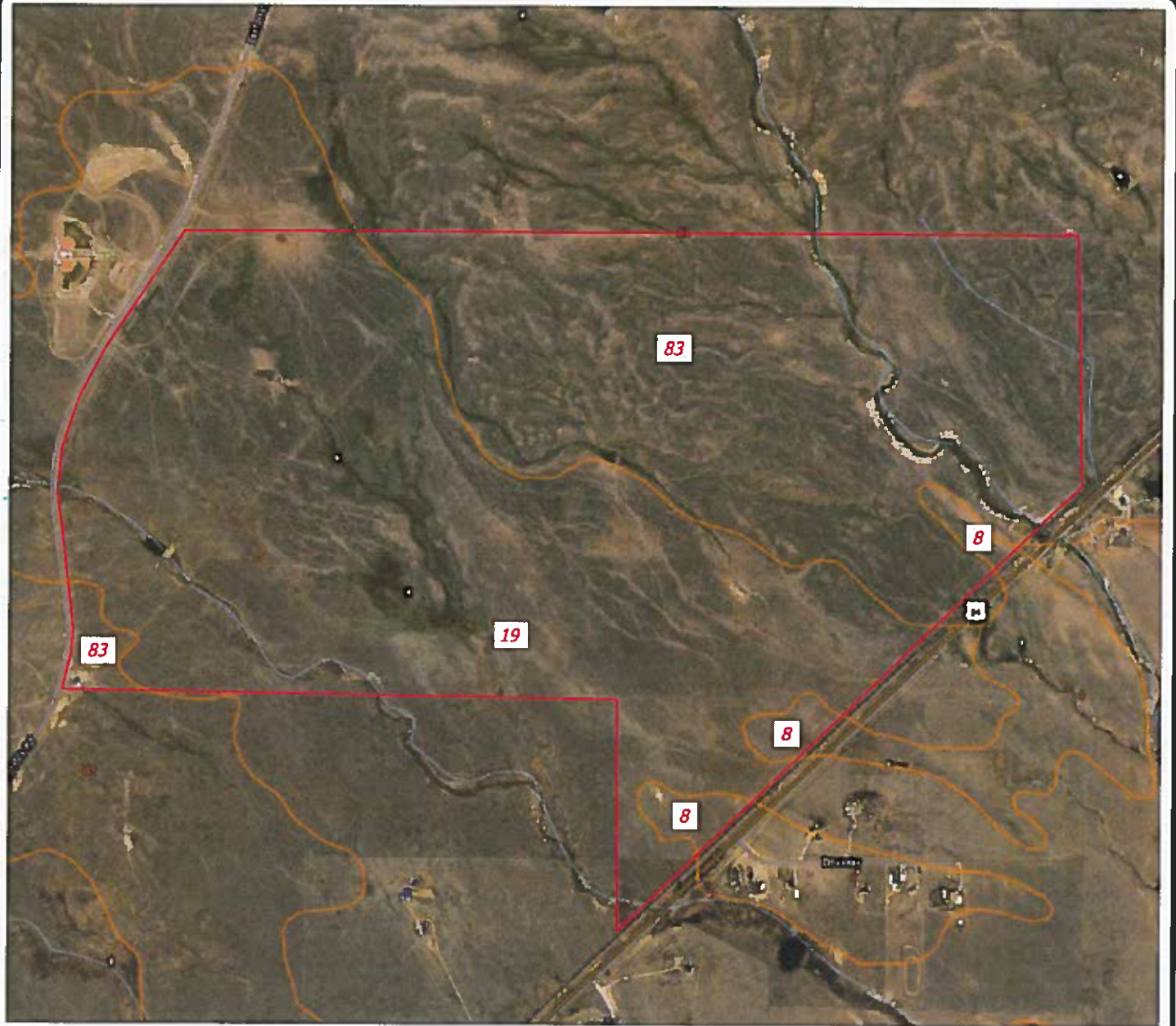


DATE	1/14/19
SCALE	AS SHOWN
BY	AS SHOWN
PROJECT NO.	101951
REVISED	3

SITE PLAN/TESTING LOCATION MAP
GRANDVIEW RESERVE
EASTONVILLE ROAD
EL PASO COUNTY, CO.
FOR: 4 SITE INVESTMETNS, LLC

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

REVISION	BY

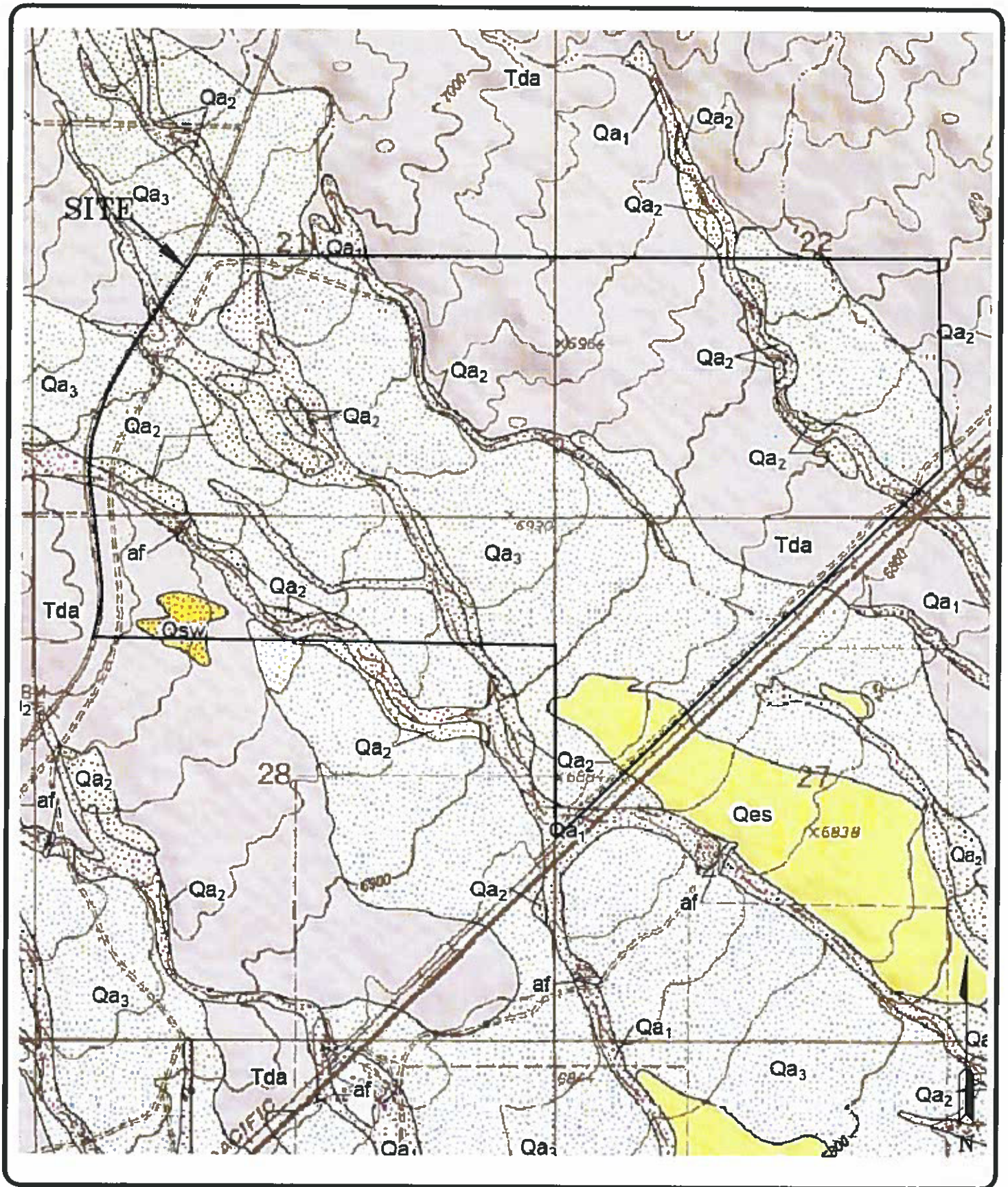


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 505 ELKTON DRIVE
 COLORADO SPRINGS, CO. 80907 (719) 531-9399

SOIL SURVEY MAP
 GRANDVIEW RESERVE
 EASTONVILLE ROAD
 EL PASO COUNTY, CO.
 FOR: 4 SITE INVESTMETNS, LLC

DRAWN: LLL	DATE: 12/12/18	CHECKED: <i>[Signature]</i>	DATE: 1/14/19
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JOB NO.:
 181951
 FIG NO.:
 4



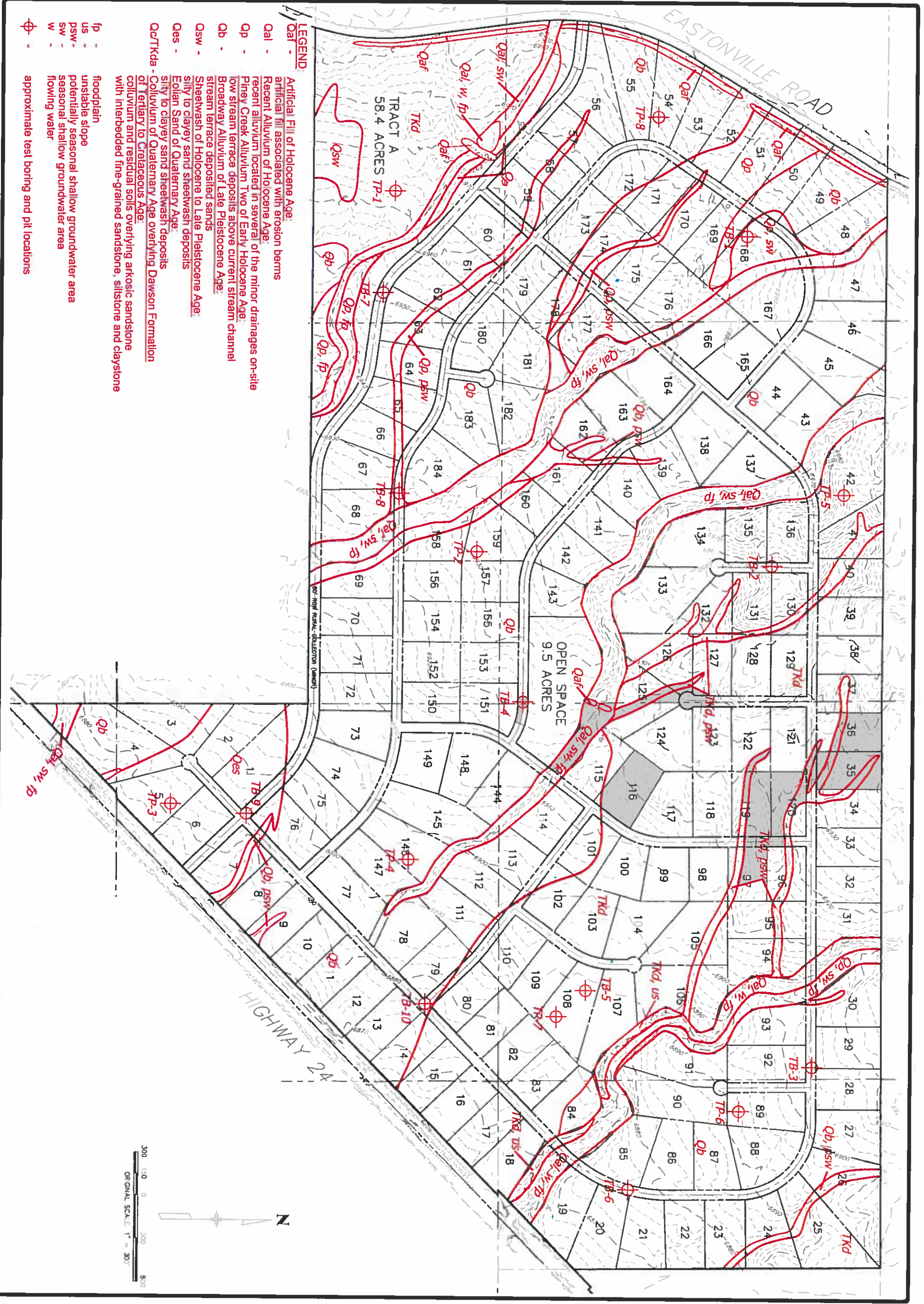
ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

FALCON QUADRANGLE GEOLOGIC MAP
GRANDVIEW RESERVE
EASTONVILLE ROAD
EL PASO COUNTY, CO.
FOR: 4 SITE INVESTMETNS, LLC

DRAWN: LLL	DATE: 12/12/18	CHECKED: <i>[Signature]</i>	DATE: 1/14/19
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JOB NO.:
181951

FIG NO.:
5



LEGEND

Qaf - Artificial fill of Holocene Age:
 erosion beams

Qal - Recent Alluvium of Holocene Age:
 recent alluvium located in several of the minor drainages on-site

Qp - Plney Creek Alluvium Two of Early Holocene Age:
 low stream terrace deposits above current stream channel

Qb - Broadway Alluvium of Late Pleistocene Age:
 stream terrace deposited sands

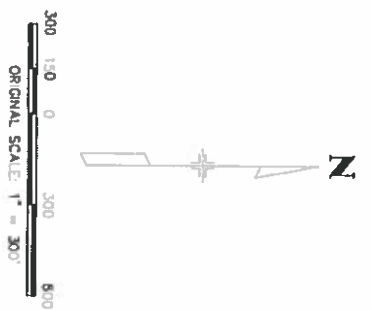
Qsw - Sheetwash of Holocene to Late Pleistocene Age:
 silt to clayey sand sheetwash deposits

Qes - Eolian Sand of Quaternary Age:
 silty to clayey sand sheetwash deposits

Qc/Tkd - Colluvium of Quaternary Age overlying Dawson Formation
 of Tertiary to Cretaceous Age:
 colluvium and residual soils overlying arkosic sandstone
 with interbedded fine-grained sandstone, siltstone and claystone

fp - floodplain
 us - unstable slope
 psw - potentially seasonal shallow groundwater area
 sw - seasonal shallow groundwater area
 w - flowing water

⊕ - approximate test boring and pit locations



DATE	1/16/19
SCALE	AS SHOWN
JOB NO.	181951
PROJECT	TRACT A
6	

GEOLOGY/ENGINEERING GEOLOGY MAP
GRANDVIEW RESERVE
EASTONVILLE ROAD
EL PASO COUNTY, CO.
FOR: 4 SITE INVESTMETNS, LLC

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

REVISION	BY

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AV, X, and VE. The Base Flood Elevation is the mean-surface elevation of the 1% annual chance flood.

ZONE A
No Base Flood Elevations determined.

ZONE AE
Base Flood Elevations determined.

ZONE AH
Flood depths of 1 to 3 feet (usually areas of ponding). Base Flood Elevations determined.

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

ZONE AV
Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently deactivated. Zone AV indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE V
Areas to be protected from 1% annual chance flood by a Federal flood protection system under construction. No Base Flood Elevations determined.

ZONE VE
Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X
Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X
Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D
Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

Floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

513 (E.L. 987)

Base Flood Elevation line and value; elevation in feet.

Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

Cross section line

Traverse line

Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)

479pmN

1000-meter Universal Transverse Mercator grid ticks, zone 13

5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection

DX5510 X

Bench mark (see explanation in notes to users section of this FIRM panel)

M1.5

River Mile

MAP REPOSITORIES

Refer to Map Repositories list on Map Index

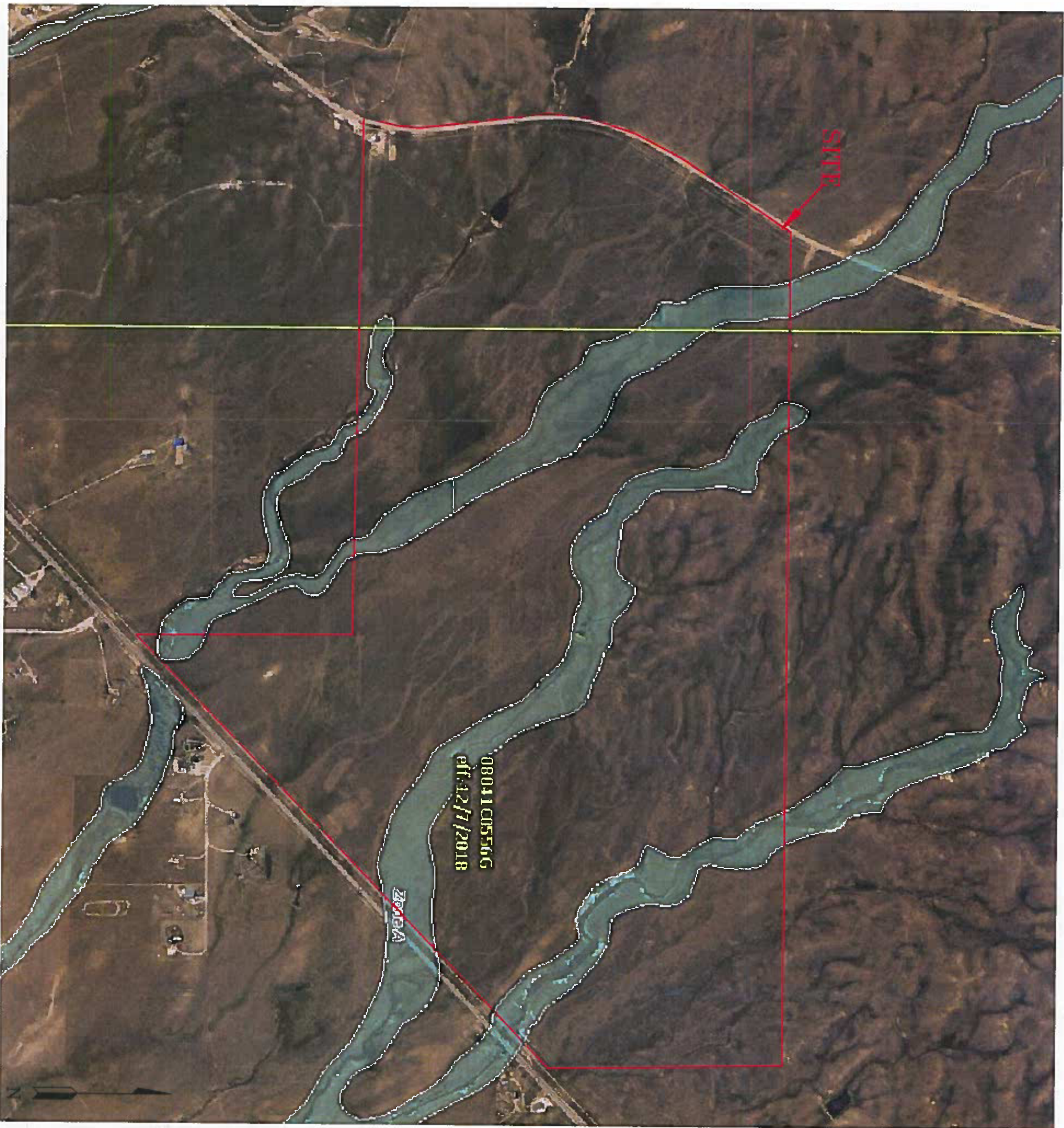
EFFECTIVE DATE OF COUNTY-WIDE FLOOD INSURANCE RATE MAP

MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL.

DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to community mapping, refer to the Community Map History Table located in the Flood Insurance Study report for this jurisdiction. To determine if flood insurance is available in the community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

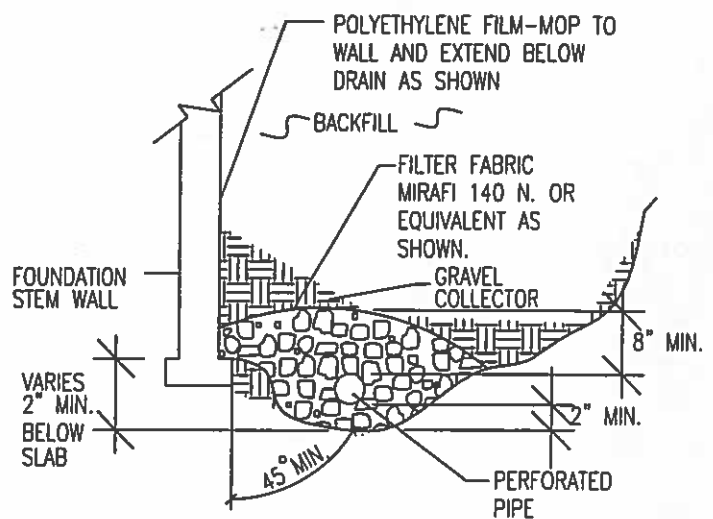
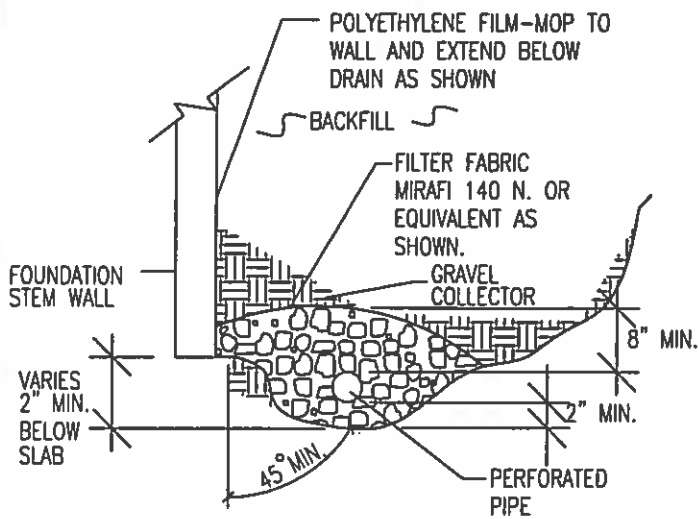


REVISION	BY

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

FLOODPLAIN MAP
GRANDVIEW RESERVE
EASTONVILLE ROAD
EL PASO COUNTY, CO.
FOR: 4 SITE INVESTMETNS, LLC

DATE	12/12/18
BY	AS SEBOW
JOB NO.	181001
DATE	12/12/18
BY	AS SEBOW



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 OUFALL IS NOT AVAILABLE.



ENTECH
ENGINEERING, INC.

545 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-3599

PERIMETER DRAIN DETAIL

DRAWN:

DATE:

2/19/18

DESIGNED:

DS

CHECKED:

W

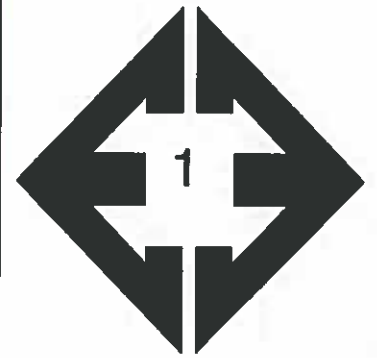
JOB NO.:

181951

FIG NO.:

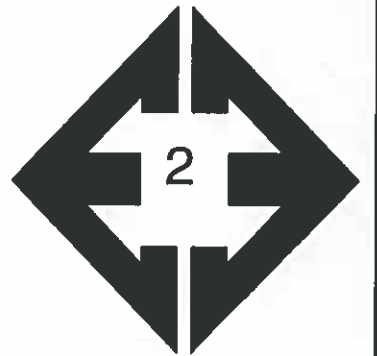
8

APPENDIX A: Site Photographs



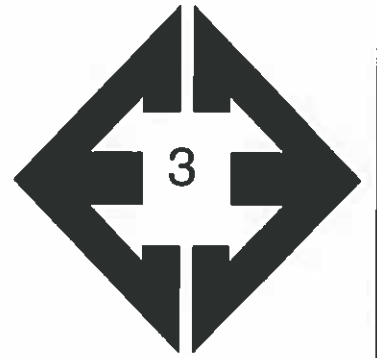
Looking west from the southwestern portion of the site.

December 13, 2018



Looking northeast from the southwestern portion of the site.

December 13, 2018



**Looking southwest
from the southeastern
portion of the site.**

December 13, 2018



**Looking northeast
from the southeastern
portion of the site.**

December 13, 2018



**Looking northwest
along drainage in
eastern portion of the
site.**

December 13, 2018



**Looking southwest
along man-made dam
in the central portion
of the site.**

December 13, 2018



Looking west from the central portion of the site.

December 13, 2018



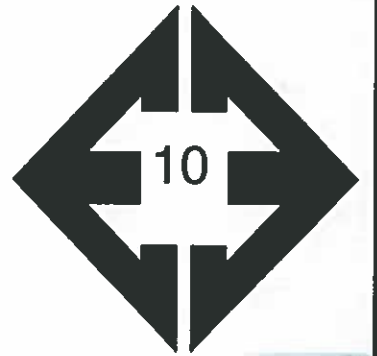
Looking southeast from the northwestern portion of the site.

December 13, 2018



Looking west from the northeastern portion of the site.

December 13, 2018



Looking northeast from the northeastern portion of the site.

December 13, 2018

APPENDIX B: Test Boring and Test Pit Logs

TEST BORING NO. 1
 DATE DRILLED 11/28/2018
 Job # 181951

TEST BORING NO. 2
 DATE DRILLED 11/28/2018
 CLIENT 4 SITE INVESTMENTS, LLC
 LOCATION GRANDVIEW RESERVE

REMARKS

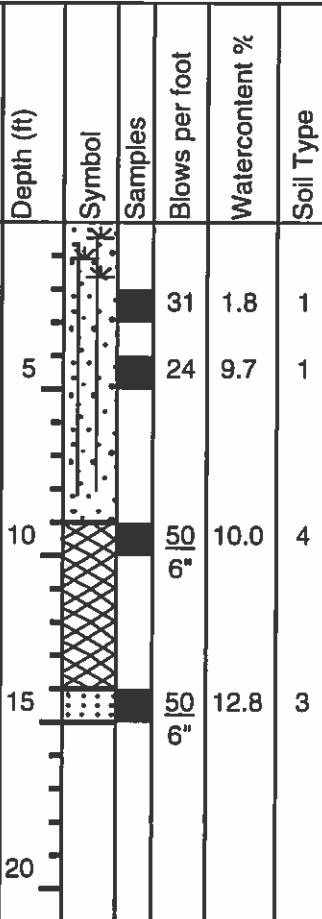
38° 59' 16" N,
 104° 33' 49" W

WATER @ 6', 11/30/18

2' TOPSOIL, SAND, SILTY FINE TO
 COARSE GRAINED, BROWN TO
 TAN, DENSE TO MEDIUM DENSE,
 DRY TO VERY MOIST
 MEDIUM DENSE, DRY TO MOIST

CLAYSTONE, VERY SANDY, BLUE
 GRAY, HARD, MOIST

SANDSTONE, CLAYEY, FINE TO
 COARSE GRAINED, GRAY, VERY
 DENSE, WET



REMARKS

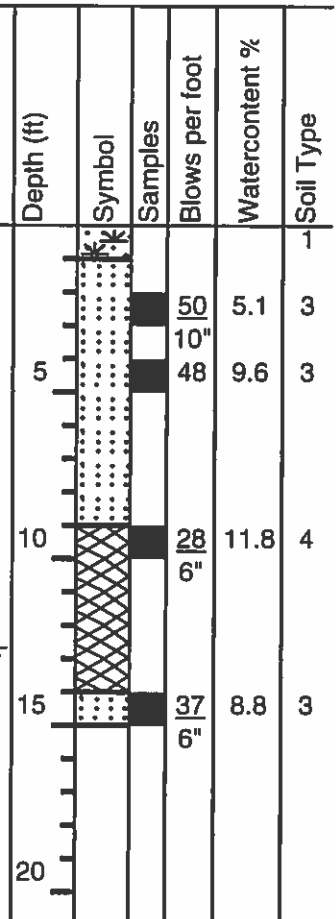
38° 59' 19" N,
 104° 33' 22" W

WATER @ 12.5', 11/30/18

1' TOPSOIL, SAND, SILTY, BROWN
 SANDSTONE, CLAYEY, FINE
 TO COARSE GRAINED, TAN, VERY
 DENSE TO DENSE, MOIST

CLAYSTONE, SANDY, GRAY
 BROWN, HARD, MOIST

SANDSTONE, SILTY, FINE TO
 COARSE GRAINED, BROWN,
 VERY DENSE, MOIST



ENTECH
ENGINEERING, INC.

505 ELKTON DRIVE
 COLORADO SPRINGS, COLORADO 80907

TEST BORING LOG

DRAWN:

DATE:

CHECKED: *[Signature]*

DATE: 11/15/19

JOB NO:
 181951

FIG NO:
 B- 1

TEST BORING NO. 3
 DATE DRILLED 11/28/2018
 Job # 181951

TEST BORING NO. 4
 DATE DRILLED 11/28/2018
 CLIENT 4 SITE INVESTMENTS, LLC
 LOCATION GRANDVIEW RESERVE

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 20', 12/18/18							38° 59' 04" N, 104° 33' 09" W						
SAND, SILTY TO CLAYEY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE, MOIST				25	4.7	1	WATER @ 11.5', 11/30/18						
VERY MOIST LENSES	5			21	11.8	1	1' TOPSOIL, SAND, SLIGHTLY SILTY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE, DRY TO MOIST	5			23	2.2	1
											20	3.4	1
SANDSTONE, SILTY, FINE TO COARSE GRAINED, BROWN, VERY DENSE, MOIST	10			50 6"	8.8	3	SANDSTONE, SILTY, FINE TO COARSE GRAINED, TAN, VERY DENSE, MOIST	10			50	10.5	3
CLAYSTONE, SANDY, BROWN TO GRAY BROWN, HARD, MOIST	15			50 5"	13.8	4		15			30 3"	8.3	3
	20			50 5"	12.3	4	CLAYSTONE, SANDY, BLUE GRAY, HARD, MOIST	20			40 7"	12.3	4



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ENGINEERING, INC.

505 ELKTON DRIVE
 COLORADO SPRINGS, COLORADO 80907

TEST BORING LOG

DRAWN:

DATE:

CHECKED: *[Signature]*

DATE 11/15/19

JOB NO.: 181951

FIG NO.: B-2

TEST BORING NO. 5
 DATE DRILLED 11/28/2018
 Job # 181951

TEST BORING NO. 6
 DATE DRILLED 11/28/2018
 CLIENT 4 SITE INVESTMENTS, LLC
 LOCATION GRANDVIEW RESERVE

REMARKS

38° 59' 05" N,
 104° 32' 44" W

WATER @ 13', 11/30/18

1" TOPSOIL, SAND, SLIGHTLY
 SILTY, SLIGHTLY CLAYEY, FINE
 TO COARSE GRAINED, GRAY
 BROWN, MEDIUM DENSE, MOIST

CLAY LENSES

SANDSTONE, SILTY, FINE TO
 COARSE GRAINED, GRAY BROWN,
 VERY DENSE, VERY MOIST



CLAYSTONE, SANDY, GRAY,
 HARD, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
0-6"	[Symbol]		25	12.7	1
5-6"	[Symbol]		20	7.9	1
10-10"	[Symbol]		50	12.3	3
15-15"	[Symbol]		50 11"	13.2	4
20					

REMARKS

DRY TO 20', 12/18/18

6" TOPSOIL, SAND, SILTY, FINE
 TO COARSE GRAINED, BROWN,
 DENSE, DRY TO MOIST

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

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
0-6"	[Symbol]		34	0.7	1
5-6"	[Symbol]		31	3.9	1
10-10"	[Symbol]		50 7"	13.7	3
15-15"	[Symbol]		50 7"	10.9	3
20-20"	[Symbol]		50 3"	12.4	3



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 ENGINEERING, INC.

505 ELKTON DRIVE
 COLORADO SPRINGS, COLORADO 80907

TEST BORING LOG

DRAWN:

DATE:

CHECKED: *[Signature]*

DATE: 11/15/19

JOB NO:
 181951

FIG NO.:
 B-3

TEST BORING NO. 7
 DATE DRILLED 11/28/2018
 Job # 181951

TEST BORING NO. 8
 DATE DRILLED 11/28/2018
 CLIENT 4 SITE INVESTMENTS, LLC
 LOCATION GRANDVIEW RESERVE

REMARKS

38° 58' 52" N,
 104° 33' 44" W

WATER @ 8', 11/30/18

1' TOPSOIL, SAND, SILTY, BROWN
 SANDSTONE, SILTY, FINE TO
 COARSE GRAINED, TAN, VERY
 DENSE, MOIST TO VERY MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
0	*				1
5			50 6"	3.8	3
5			50 9"	9.6	3
10			50 11"	10.9	3
15					
20					



REMARKS

38° 58' 48" N,
 104° 33' 25" W

WATER @ 4.5', 11/30/18

1.5' TOPSOIL, SAND, SILTY, FINE
 TO COARSE GRAINED, GRAY
 BROWN, MEDIUM DENSE, MOIST
 TO VERY MOIST

CLAY, SANDY, GRAY BROWN,
 VERY STIFF, MOIST

SANDSTONE, CLAYEY, FINE TO
 COARSE GRAINED, GRAY BROWN,
 VERY DENSE, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
0	*				1
5			21	7.7	1
5			16	10.0	1
10			40	14.1	2
15			50 6"	9.0	3
20					



ENTECH
ENGINEERING, INC.

505 ELKTON DRIVE
 COLORADO SPRINGS, COLORADO 80907

TEST BORING LOG

DRAWN:

DATE:

CHECKED: *u*

DATE: 11/27/19

JOB NO.:
 181951

FIG NO.:
 B- 4

TEST BORING NO. 9
 DATE DRILLED 11/28/2018
 Job # 181951

TEST BORING NO. 10
 DATE DRILLED 11/28/2018
 CLIENT 4 SITE INVESTMENTS, LLC
 LOCATION GRANDVIEW RESERVE

REMARKS

38° 58' 44" N,
 104° 32' 59" W

DRY TO 15.5', 11/30/18

1' TOPSOIL, SAND, SILTY, FINE TO
 COARSE GRAINED, TAN, MEDIUM
 DENSE, MOIST

SAND, VERY SILTY, FINE GRAINED,
 GRAY BROWN, MEDIUM DENSE,
 VERY MOIST

CLAYSTONE, SANDY, GRAY
 BROWN, HARD, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
0					
5			25	3.9	1
5			16	18.9	1
10			30 6"	12.1	4
15			50 10"	15.7	4
20					

REMARKS

38° 59' 05" N,
 104° 32' 44" W

WATER @ 19', 11/30/18

1' TOPSOIL, SAND, SILTY, FINE TO
 COARSE GRAINED, BROWN,
 MEDIUM DENSE, DRY TO MOIST

CLAY, SANDY, DARK BROWN,
 VERY STIFF, MOIST

SANDSTONE, CLAYEY, FINE TO
 MEDIUM GRAINED, BLUE GRAY,
 VERY DENSE, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
0					
5			17	1.4	1
5			18	3.7	1
10			30	19.9	2
15			32 6"	9.7	3
20			37 4"	10.4	3



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TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
		<i>[Signature]</i>	11/15/19

JOB NO.
 181951

FIG NO.
 B- 5

TEST PIT NO. 1
 DATE EXCAVATED 12/13/2018
 Job # 181951

TEST PIT NO. 2
 DATE EXCAVATED 12/13/2018
 CLIENT 4 Site Investments, LLC
 LOCATION Grandview Reserve

REMARKS	Depth (ft)	Symbol	Samples	Soil Structure Shape	Soil Structure Grade	USDA Soil Type	REMARKS	Depth (ft)	Symbol	Samples	Soil Structure Shape	Soil Structure Grade	USDA Soil Type
Dry to 6', 12/13/18							Water at 7.5', 12/13/18						
topsoil sandy loam, brown	1	[Symbol]		gr	w	2A	topsoil sandy loam, brown	1	[Symbol]		gr	w	2A
sandy loam, fine to coarse grained, tan	2	[Symbol]						2	[Symbol]				
	3	[Symbol]						3	[Symbol]				
	4	[Symbol]						4	[Symbol]				
weathered to formational silty sandstone, tan	5	[Symbol]		ma		4A		5	[Symbol]				
	6	[Symbol]					gravelly sand, fine to coarse grained, tan to gray	6	[Symbol]		sg		1
	7	[Symbol]						7	[Symbol]				
	8	[Symbol]					*groundwater at 7.5'	8	[Symbol]				
	9	[Symbol]						9	[Symbol]				
	10	[Symbol]						10	[Symbol]				

Soil Structure Shape

- granular - gr
- platy - pl
- blocky - bl
- prismatic - pr
- single grain - sg
- massive - ma

Soil Structure Grade

- weak - w
- moderate - m
- strong - s
- loose - l



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TEST PIT LOG

DRAWN:

DATE:

CHECKED: *ca*

DATE: 1/15/19

JOB NO.: 181951

FIG NO.: B-6

TEST PIT NO. 3
 DATE EXCAVATED 12/13/2018
 Job # 181951

TEST PIT NO. 4
 DATE EXCAVATED 12/13/2018
 CLIENT 4 Site Investments, LLC
 LOCATION Grandview Reserve

REMARKS	Depth (ft)	Symbol	Samples	Soil Structure Shape	Soil Structure Grade	USDA Soil Type	REMARKS	Depth (ft)	Symbol	Samples	Soil Structure Shape	Soil Structure Grade	USDA Soil Type
Water at 8.5', 12/13/18							Dry to 8', 12/13/18						
topsoil sandy loam, brown	1	[Symbol]					topsoil sandy loam, brown	1	[Symbol]				
gravelly sandy loam, fine to coarse grained, tan	2	[Symbol]		gr	w	2A	gravelly sandy loam, fine to coarse grained, tan	2	[Symbol]		gr	w	2A
	3	[Symbol]						3	[Symbol]				
	4	[Symbol]					gravelly sand, fine to coarse grained, tan	4	[Symbol]		sg		1
gravelly sand, fine to coarse grained, tan	5	[Symbol]		sg		1		5	[Symbol]				
	6	[Symbol]						6	[Symbol]				
	7	[Symbol]						7	[Symbol]				
gravelly sandy clay loam, fine to coarse grained, fgray	8	[Symbol]						8	[Symbol]				
*groundwater at 8.5'	9	[Symbol]		ma		3A		9	[Symbol]				
	10	[Symbol]						10	[Symbol]				

Soil Structure Shape

granular - gr
 platy - pl
 blocky - bl
 prismatic - pr
 single grain - sg
 massive - ma

Soil Structure Grade

weak - w
 moderate - m
 strong - s
 loose - l



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TEST PIT LOG

DRAWN:

DATE:

CHECKED: *h*

DATE: 1/15/19

JOB NO.:
 181951

FIG NO.:
 B-7

TEST PIT NO. 5
 DATE EXCAVATED 12/13/2018
 Job # 181951

TEST PIT NO. 6
 DATE EXCAVATED 12/13/2018
 CLIENT 4 Site Investments, LLC
 LOCATION Grandview Reserve

REMARKS	Depth (ft)	Symbol	Samples	Soil Structure Shape	Soil Structure Grade	USDA Soil Type	REMARKS	Depth (ft)	Symbol	Samples	Soil Structure Shape	Soil Structure Grade	USDA Soil Type
Dry to 6', 12/13/18							Dry to 5', 12/13/18						
topsoil sandy clay loam, brown	1	[Symbol]					topsoil sandy loam, brown	1	[Symbol]				
sandy clay loam, light brown	2	[Symbol]		gr	w	3A	sandy loam, fine to coarse grained, tan weathered to formational very sandy claystone, tan	2	[Symbol]		gr	w	2A
	3	[Symbol]						3	[Symbol]		ma		4A
weathered to formational very clayey sandstone, light brown	4	[Symbol]		ma		4A		4	[Symbol]				
	5	[Symbol]						5	[Symbol]				
	6	[Symbol]						6	[Symbol]				
	7	[Symbol]						7	[Symbol]				
	8	[Symbol]						8	[Symbol]				
	9	[Symbol]						9	[Symbol]				
	10	[Symbol]						10	[Symbol]				

Soil Structure Shape

- granular - gr
- platy - pl
- blocky - bl
- prismatic - pr
- single grain - sg
- massive - ma

Soil Structure Grade

- weak - w
- moderate - m
- strong - s
- loose - l



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TEST PIT LOG

DRAWN:

DATE:

CHECKED:

DATE:

n 1/15/19

JOB NO.:

181951

FIG NO.:

B-8

TEST PIT NO. 7
 DATE EXCAVATED 12/13/2018
 Job # 181951

TEST PIT NO. 8
 DATE EXCAVATED 12/13/2018
 CLIENT 4 Site Investments, LLC
 LOCATION Grandview Reserve

REMARKS	Depth (ft)	Symbol	Samples	Soil Structure Shape	Soil Structure Grade	USDA Soil Type	REMARKS	Depth (ft)	Symbol	Samples	Soil Structure Shape	Soil Structure Grade	USDA Soil Type
Water at 6.5', 12/13/18							Dry to 8', 12/13/18						
topsoil sandy loam, brown	1			gr	w	2A	topsoil sandy clay loam, brown	1			gr	m	3
gravelly sandy loam, fine to coarse grained, tan	2						sandy clay loam, light brown	2					
	3							3					
	4							4					
	5						very sandy clay, light brown	5			gr	w	4A
sandy clay, gray	6			ma		4A		6					
*groundwater at 6.5'	7							7					
	8							8					
	9							9					
	10							10					

Soil Structure Shape

- granular - gr
- platy - pl
- blocky - bl
- prismatic - pr
- single grain - sg
- massive - ma

Soil Structure Grade

- weak - w
- moderate - m
- strong - s
- loose - l



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TEST PIT LOG

DRAWN:

DATE:

CHECKED: *h*

DATE: 1/15/19

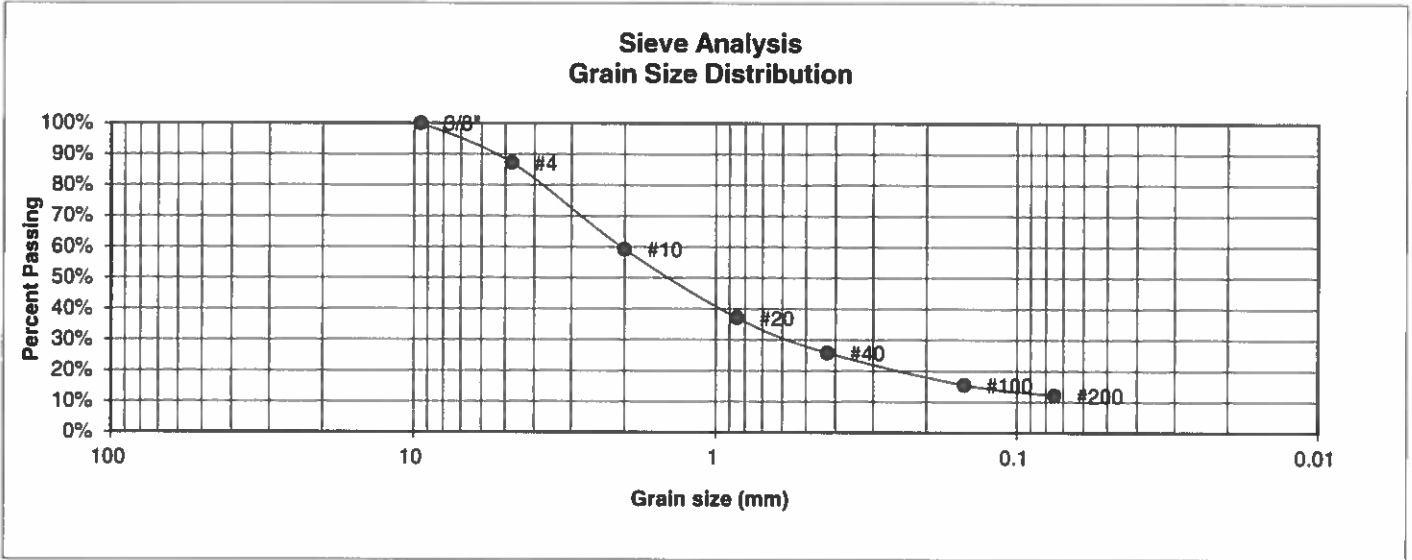
JOB NO.: 181951

FIG NO.:

B-9

APPENDIX C: Laboratory Test Results

UNIFIED CLASSIFICATION	SM	CLIENT	4 SITE INVESTMENTS, LLC
SOIL TYPE #	1	PROJECT	GRANDVIEW RESERVE
TEST BORING #	1	JOB NO.	181951
DEPTH (FT)	5	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	87.2%
10	59.3%
20	37.1%
40	25.9%
100	15.5%
200	12.1%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

Swell
 Moisture at start 7.2%
 Moisture at finish 17.8%
 Moisture increase 10.6%
 Initial dry density (pcf) 103
 Swell (psf) 130



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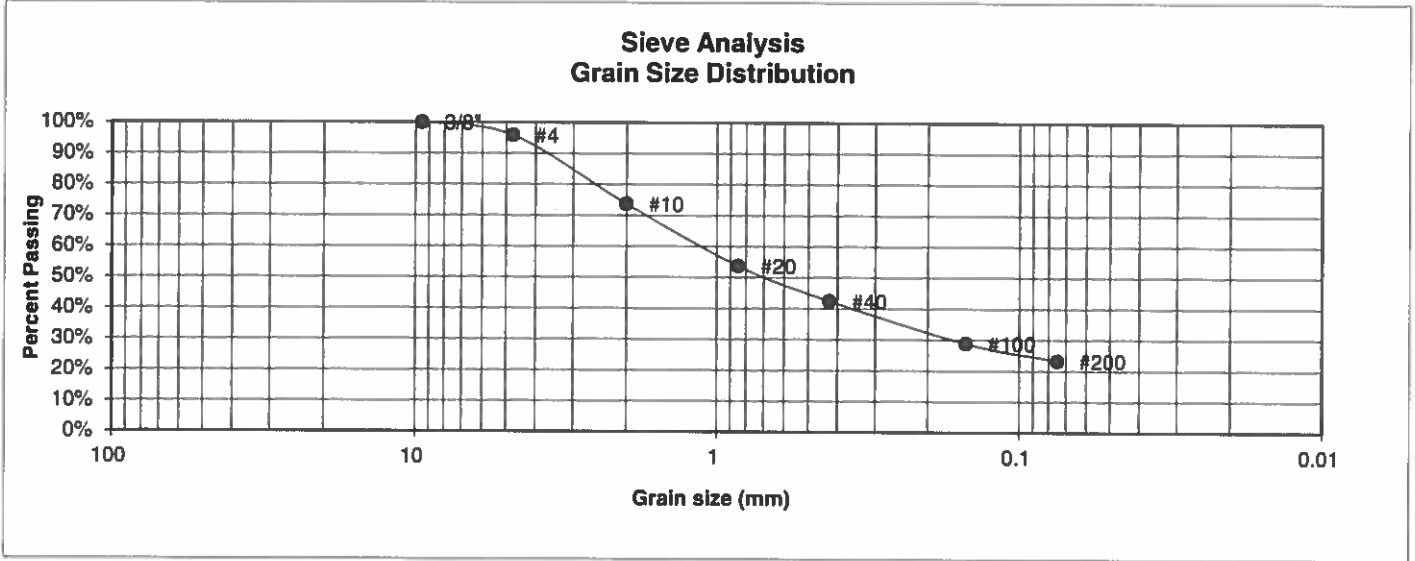
**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED: <i>W</i>	DATE: 1/15/19
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JOB NO:
181951

FIG NO:
C-1

UNIFIED CLASSIFICATION	SM	CLIENT	4 SITE INVESTMENTS, LLC
SOIL TYPE #	1	PROJECT	GRANDVIEW RESERVE
TEST BORING #	3	JOB NO.	181951
DEPTH (FT)	2-3	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	95.9%
10	73.7%
20	53.8%
40	42.4%
100	28.8%
200	23.3%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

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



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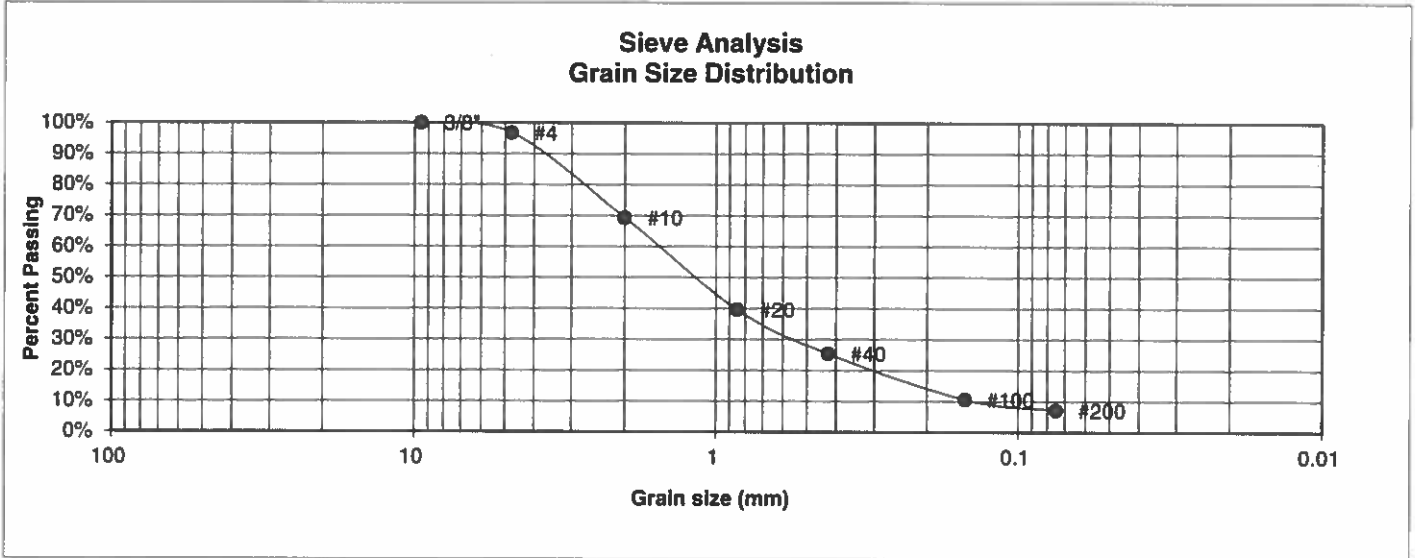
**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED: <i>h</i>	DATE: <i>1/25/19</i>
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JOB NO.:
181951

FIG NO.:
C-2

UNIFIED CLASSIFICATION	SM-SW	CLIENT	4 SITE INVESTMENTS, LLC
SOIL TYPE #	1	PROJECT	GRANDVIEW RESERVE
TEST BORING #	4	JOB NO.	181951
DEPTH (FT)	2-3	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	96.8%
10	69.3%
20	39.6%
40	25.4%
100	10.6%
200	7.1%

**Atterberg
Limits**
Plastic Limit
Liquid Limit
Plastic Index

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



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**LABORATORY TEST
RESULTS**

DRAWN:

DATE:

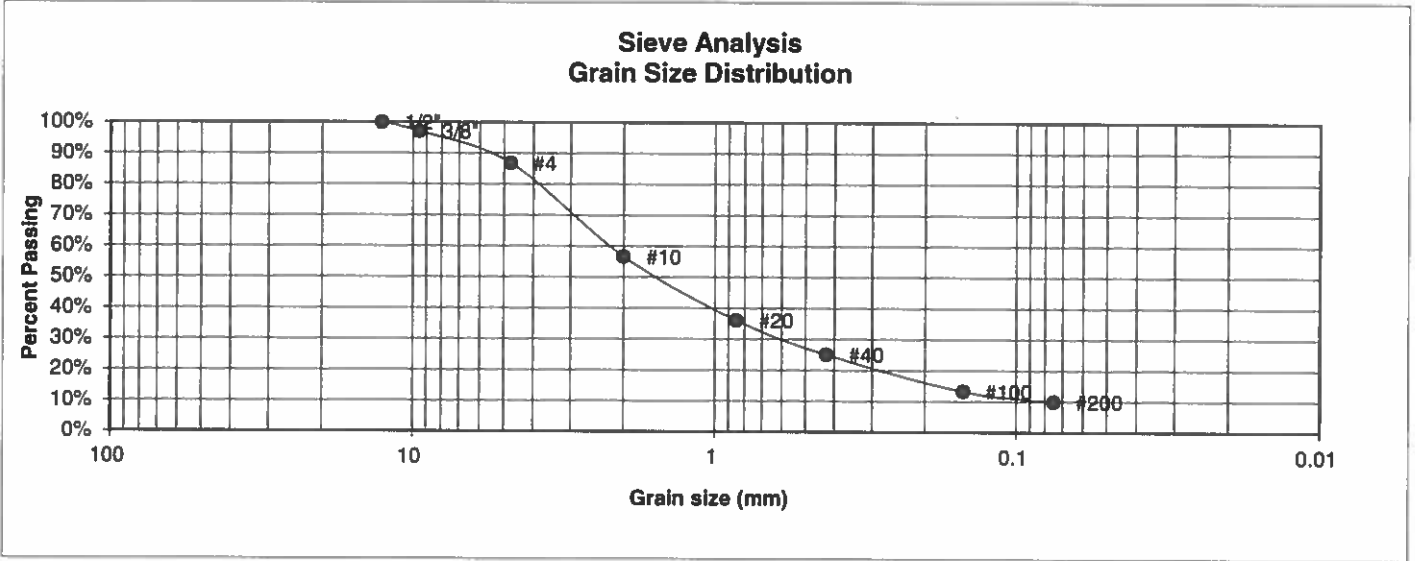
CHECKED: *W*

DATE: 1/15/19

JOB NO.:
181951

FIG NO.:
0-3

UNIFIED CLASSIFICATION	SC-SM-SW	CLIENT	4 SITE INVESTMENTS, LLC
SOIL TYPE #	1	PROJECT	GRANDVIEW RESERVE
TEST BORING #	5	JOB NO.	181951
DEPTH (FT)	5	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	97.1%
4	86.8%
10	56.6%
20	36.1%
40	25.1%
100	13.2%
200	9.9%

Atterberg Limits	
Plastic Limit	12
Liquid Limit	17
Plastic Index	5

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



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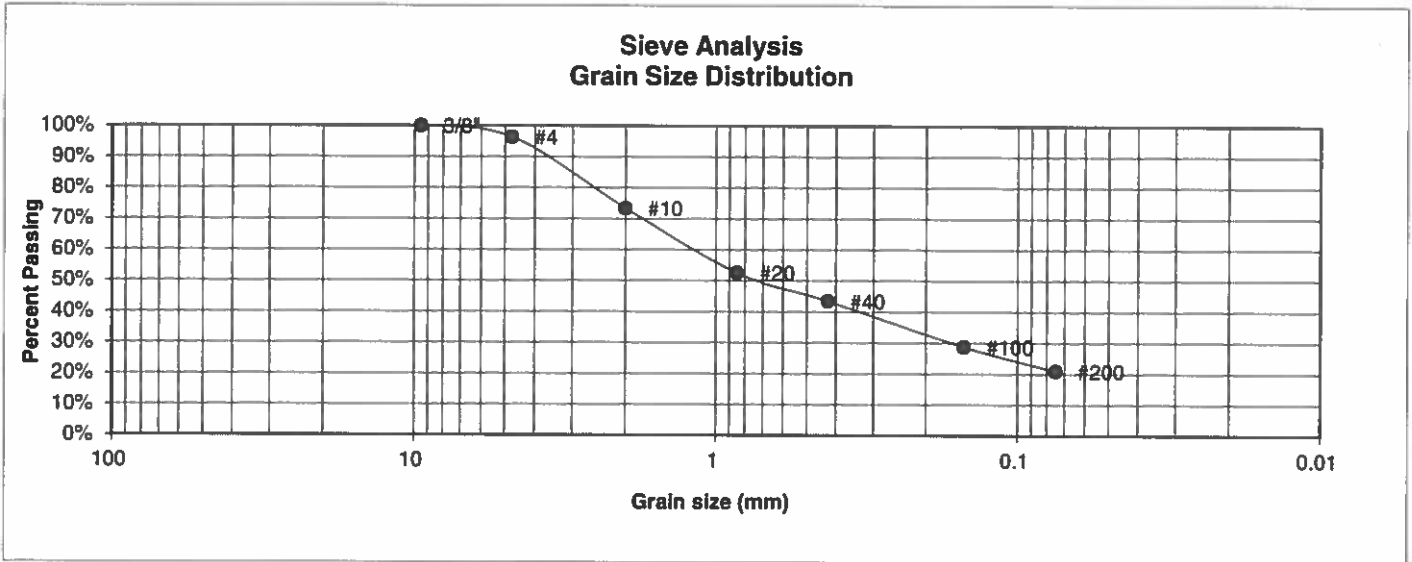
**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED: <i>W</i>	DATE: <i>1/15/19</i>
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JOB NO.:
181951

FIG NO.:
C-4

UNIFIED CLASSIFICATION	SM	CLIENT	4 SITE INVESTMENTS, LLC
SOIL TYPE #	1	PROJECT	GRANDVIEW RESERVE
TEST BORING #	6	JOB NO.	181951
DEPTH (FT)	5	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	96.4%
10	73.4%
20	52.6%
40	43.4%
100	28.8%
200	20.9%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

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



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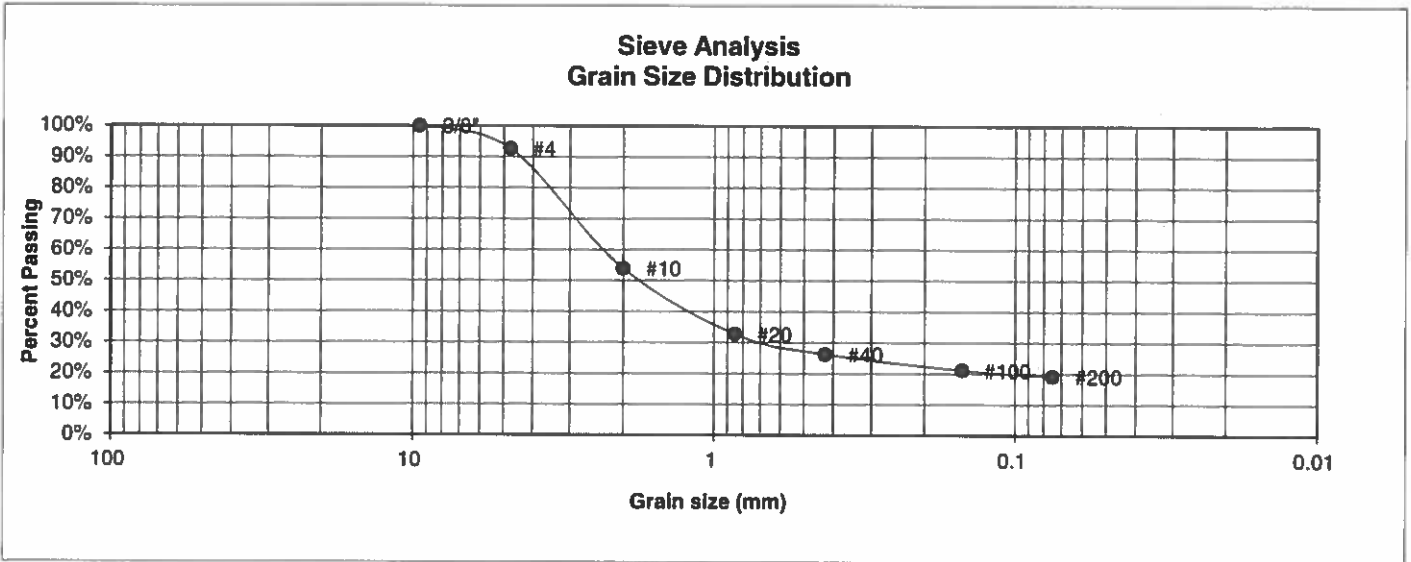
**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED: <i>W</i>	DATE: 1/15/19
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JOB NO:
181951

FIG NO:
C-5

UNIFIED CLASSIFICATION	SM	CLIENT	4 SITE INVESTMENTS, LLC
SOIL TYPE #	1	PROJECT	GRANDVIEW RESERVE
TEST BORING #	8	JOB NO.	181951
DEPTH (FT)	5	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	92.6%
10	53.9%
20	32.7%
40	26.3%
100	21.1%
200	19.2%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

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



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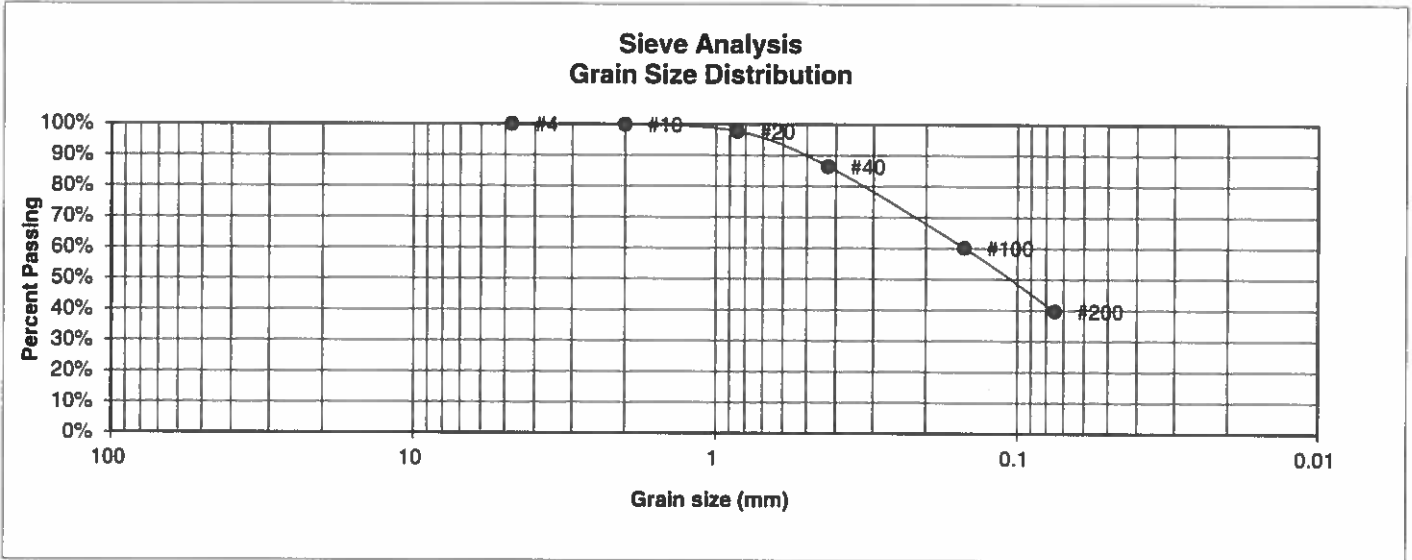
**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED: <i>W</i>	DATE: <i>1/5/17</i>
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JOB NO:
181951

FIG NO:
C-6

UNIFIED CLASSIFICATION	SM	CLIENT	4 SITE INVESTMENTS, LLC
SOIL TYPE #	1	PROJECT	GRANDVIEW RESERVE
TEST BORING #	9	JOB NO.	181951
DEPTH (FT)	5	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	99.9%
20	97.8%
40	86.5%
100	60.2%
200	39.8%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

Swell
 Moisture at start 9.0%
 Moisture at finish 20.3%
 Moisture increase 11.3%
 Initial dry density (pcf) 99
 Swell (psf) 110



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**LABORATORY TEST
RESULTS**

DRAWN:

DATE:

CHECKED: *h*

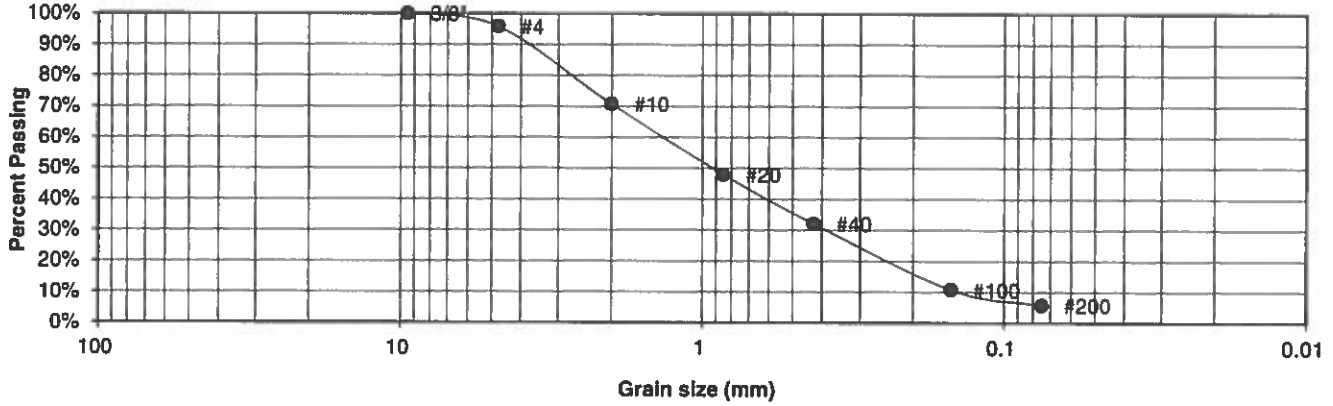
DATE: *1/25/19*

JOB NO.:
181951

FIG NO.:
C-7

UNIFIED CLASSIFICATION	SM-SW	CLIENT	4 SITE INVESTMENTS, LLC
SOIL TYPE #	1	PROJECT	GRANDVIEW RESERVE
TEST BORING #	TP-2	JOB NO.	181951
DEPTH (FT)	2-3	TEST BY	BL

**Sieve Analysis
Grain Size Distribution**



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	95.8%
10	70.7%
20	48.0%
40	32.0%
100	10.7%
200	5.8%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

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



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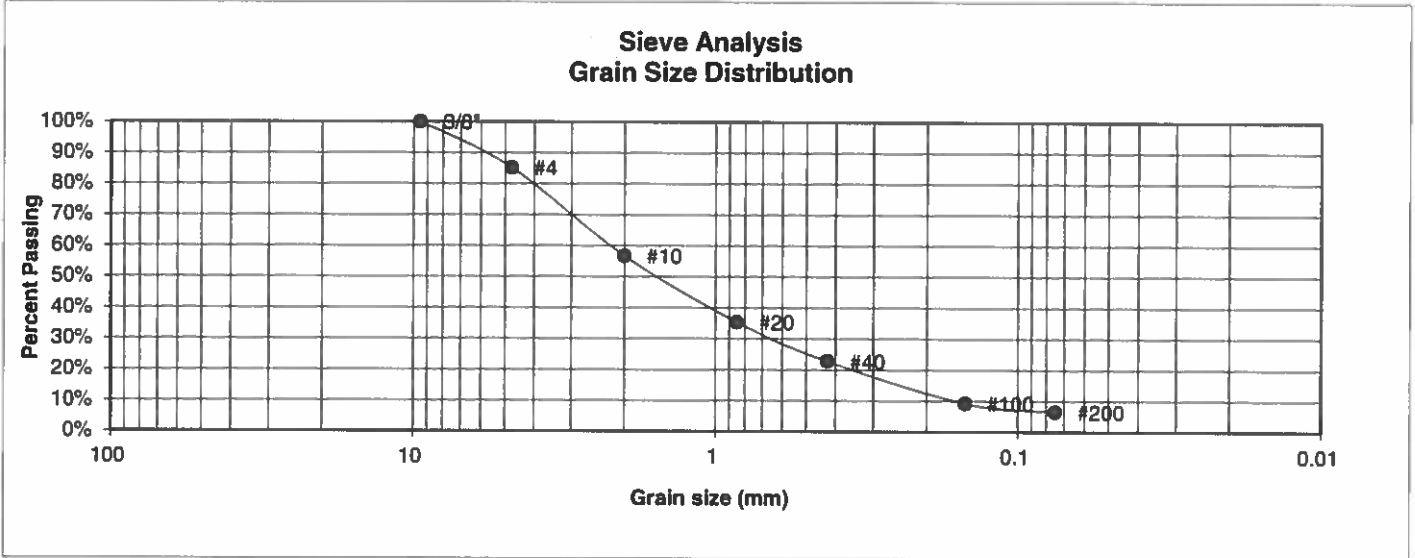
**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED: <i>h</i>	DATE: <i>1/15/19</i>
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JOB NO.:
181951

FIG NO.:
C-8

UNIFIED CLASSIFICATION	SM-SW	CLIENT	4 SITE INVESTMENTS, LLC
SOIL TYPE #	1	PROJECT	GRANDVIEW RESERVE
TEST BORING #	TP-3	JOB NO.	181951
DEPTH (FT)	2-3	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	85.2%
10	56.8%
20	35.4%
40	22.8%
100	9.2%
200	6.5%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

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



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 505 ELKTON DRIVE
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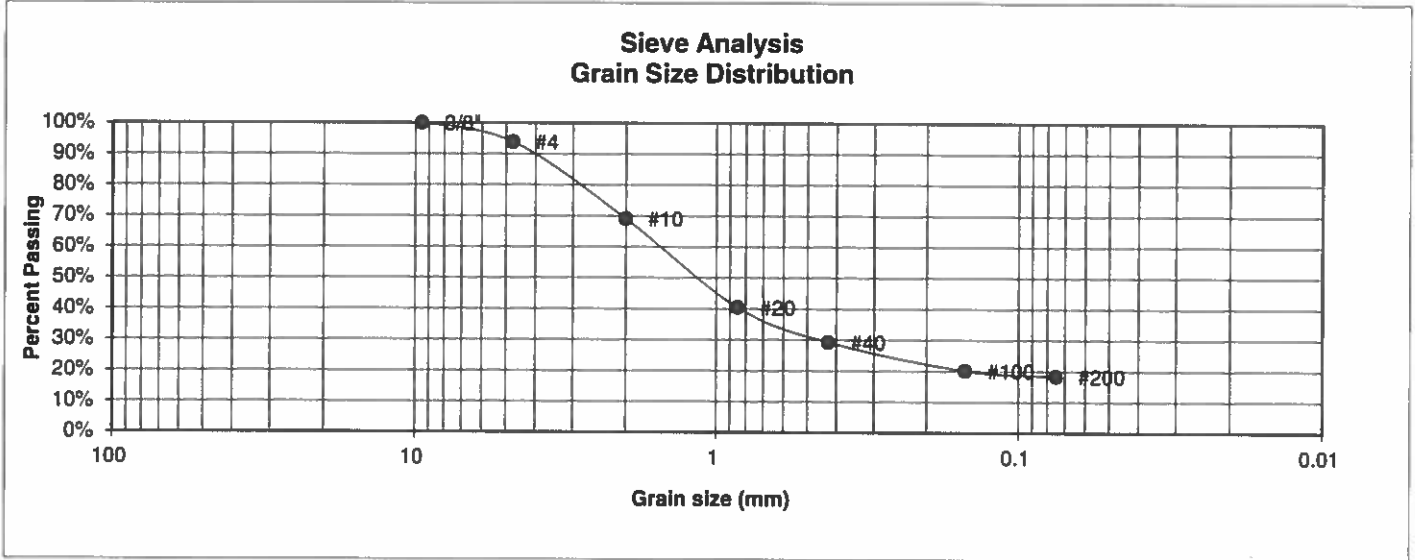
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED: <i>W</i>	DATE: 1/5/19
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JOB NO.: 181951

FIG NO.: C-9

UNIFIED CLASSIFICATION	SC	CLIENT	4 SITE INVESTMENTS, LLC
SOIL TYPE #	1	PROJECT	GRANDVIEW RESERVE
TEST BORING #	TP-3	JOB NO.	181951
DEPTH (FT)	8-9	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	93.9%
10	69.1%
20	40.4%
40	29.3%
100	20.1%
200	18.4%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

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



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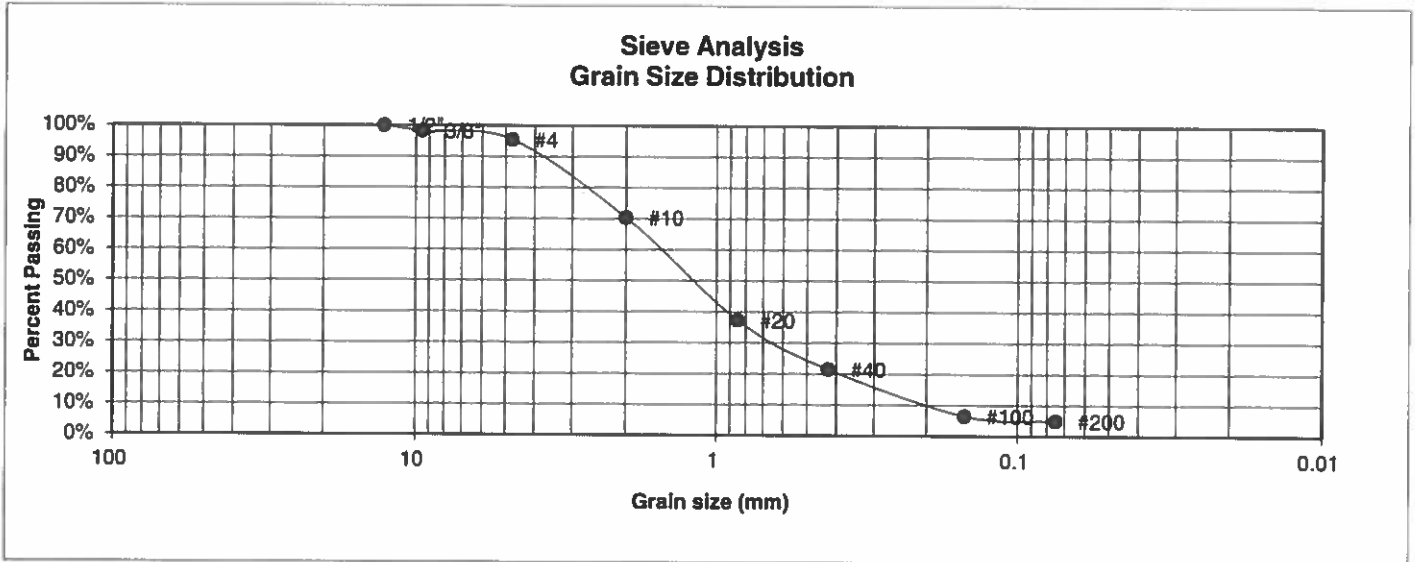
**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED:	DATE:
		<i>W</i>	1/15/19

JOB NO.:
181951

FIG NO.:
C-10

UNIFIED CLASSIFICATION	SW	CLIENT	4 SITE INVESTMENTS, LLC
SOIL TYPE #	1	PROJECT	GRANDVIEW RESERVE
TEST BORING #	TP-4	JOB NO.	181951
DEPTH (FT)	5-6	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	98.3%
4	95.5%
10	70.4%
20	37.3%
40	21.5%
100	6.5%
200	4.9%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

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



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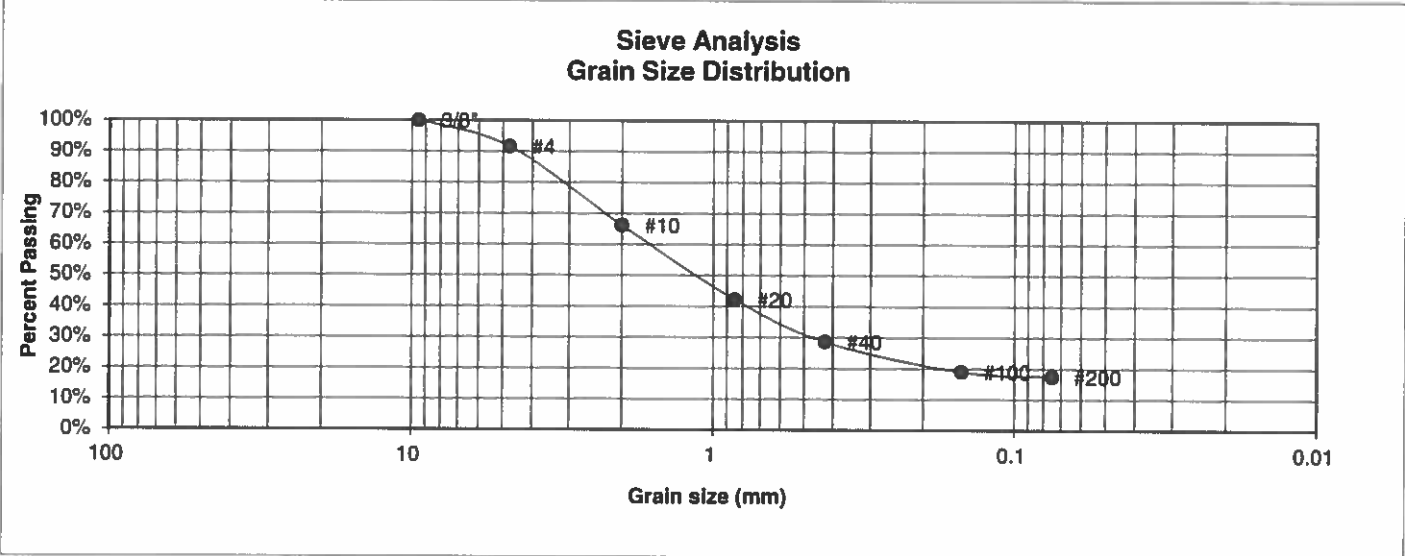
**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED: <i>[Signature]</i>	DATE: 1/15/19
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JOB NO:
181951

FIG NO:
C-11

UNIFIED CLASSIFICATION	SM	CLIENT	4 SITE INVESTMENTS, LLC
SOIL TYPE #	1	PROJECT	GRANDVIEW RESERVE
TEST BORING #	TP-7	JOB NO.	181951
DEPTH (FT)	5-6	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	91.6%
10	66.2%
20	42.2%
40	28.6%
100	18.9%
200	17.5%

**Atterberg
Limits**
Plastic Limit
Liquid Limit
Plastic Index

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



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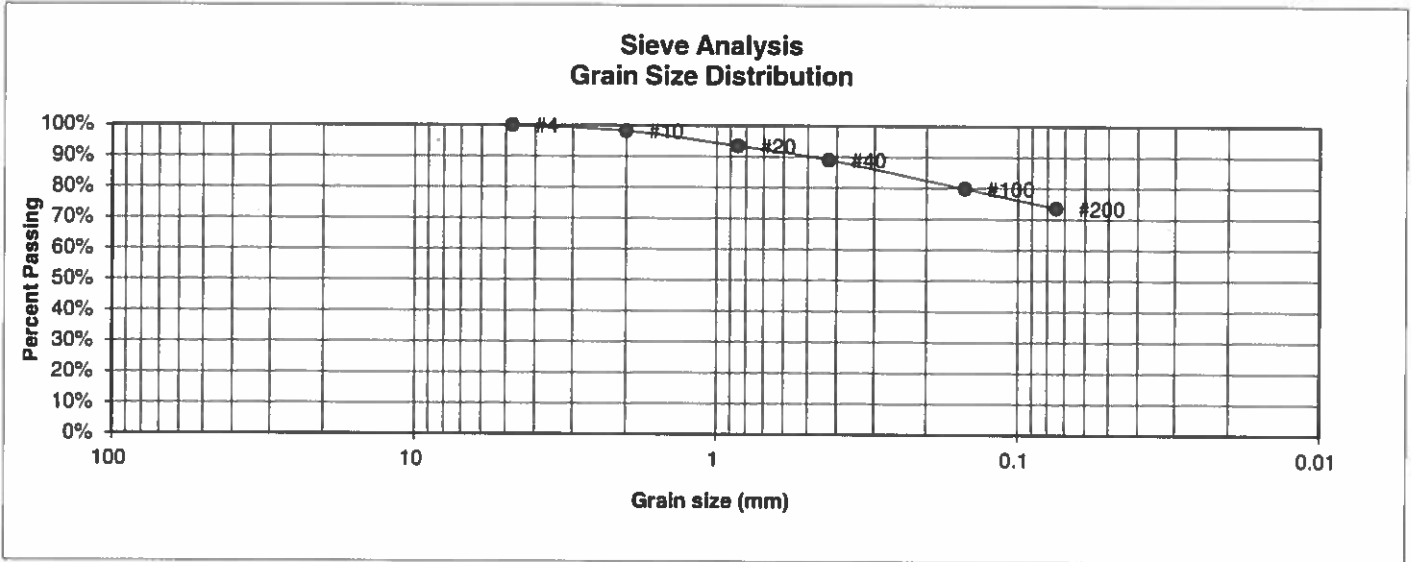
**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED: <i>W</i>	DATE: <i>1/15/19</i>
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JOB NO.:
181951

FIG NO.:
C-12

UNIFIED CLASSIFICATION	CL	CLIENT	4 SITE INVESTMENTS, LLC
SOIL TYPE #	2	PROJECT	GRANDVIEW RESERVE
TEST BORING #	10	JOB NO.	181951
DEPTH (FT)	10	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	98.2%
20	93.4%
40	89.0%
100	79.9%
200	73.6%

Atterberg Limits	
Plastic Limit	22
Liquid Limit	44
Plastic Index	22

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



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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

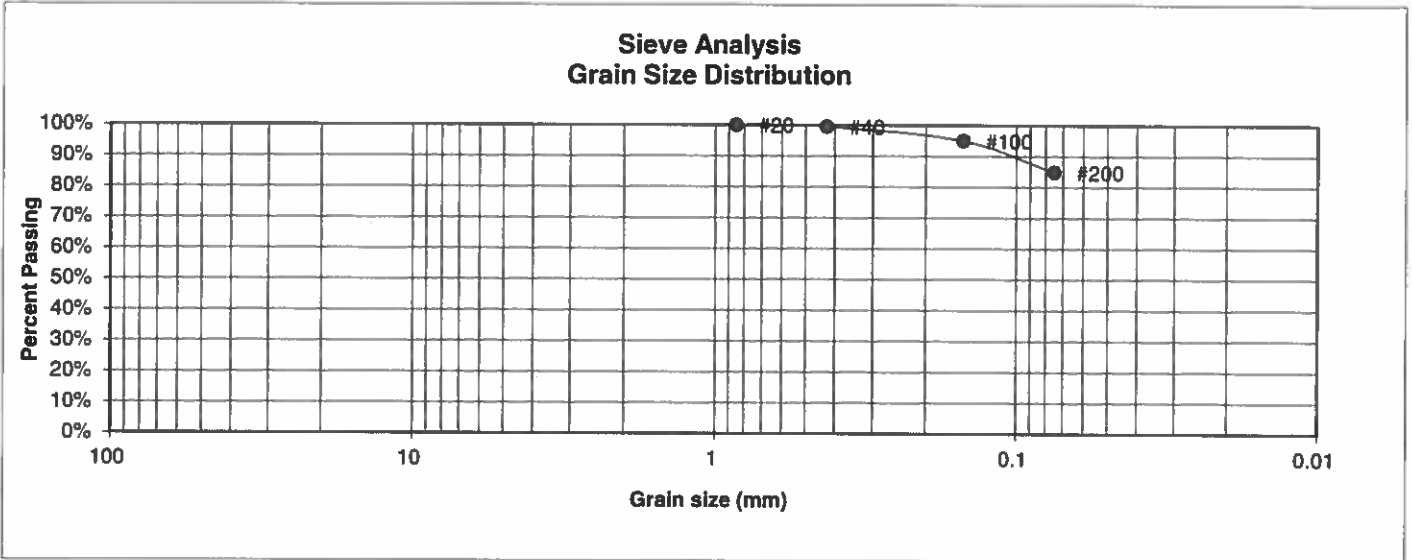
**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED:	DATE:
		<i>u</i>	1/15/19

JOB NO:
181951

FIG NO:
C-13

UNIFIED CLASSIFICATION	CL	CLIENT	4 SITE INVESTMENTS, LLC
SOIL TYPE #	2	PROJECT	GRANDVIEW RESERVE
TEST BORING #	TP-8	JOB NO.	181951
DEPTH (FT)	5-6	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	
10	
20	100.0%
40	99.5%
100	95.0%
200	84.8%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

Swell	
Moisture at start	11.3%
Moisture at finish	23.1%
Moisture increase	11.7%
Initial dry density (pcf)	99
Swell (psf)	1020



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COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED: <i>W</i>	DATE: 1/15/19
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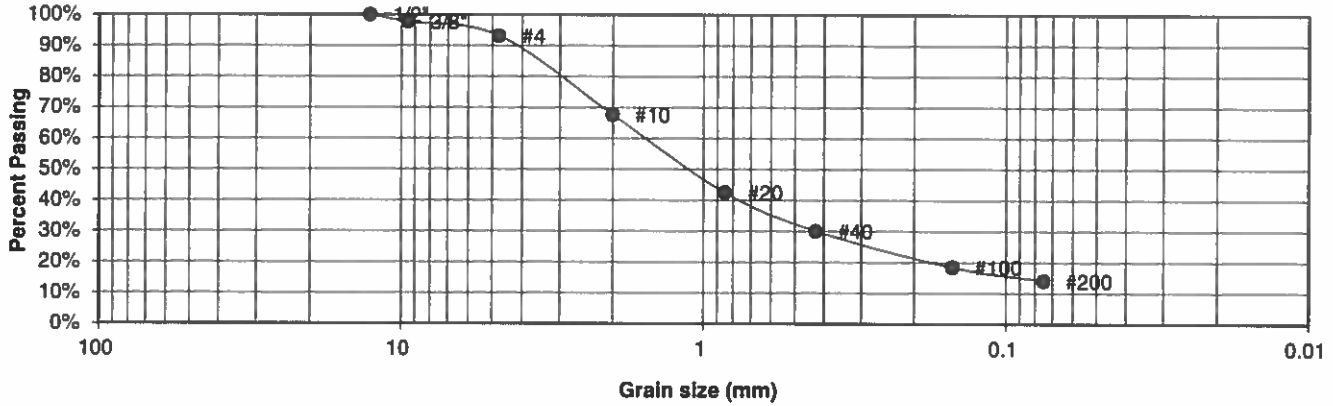
JOB NO.:
181951

FIG NO.:
C-14

UNIFIED CLASSIFICATION SC
SOIL TYPE # 3
TEST BORING # 2
DEPTH (FT) 2-3

CLIENT 4 SITE INVESTMENTS, LLC
PROJECT GRANDVIEW RESERVE
JOB NO. 181951
TEST BY BL

**Sieve Analysis
Grain Size Distribution**



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	97.7%
4	93.2%
10	67.7%
20	42.5%
40	30.1%
100	18.4%
200	14.0%

Atterberg Limits	
Plastic Limit	13
Liquid Limit	28
Plastic Index	15

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



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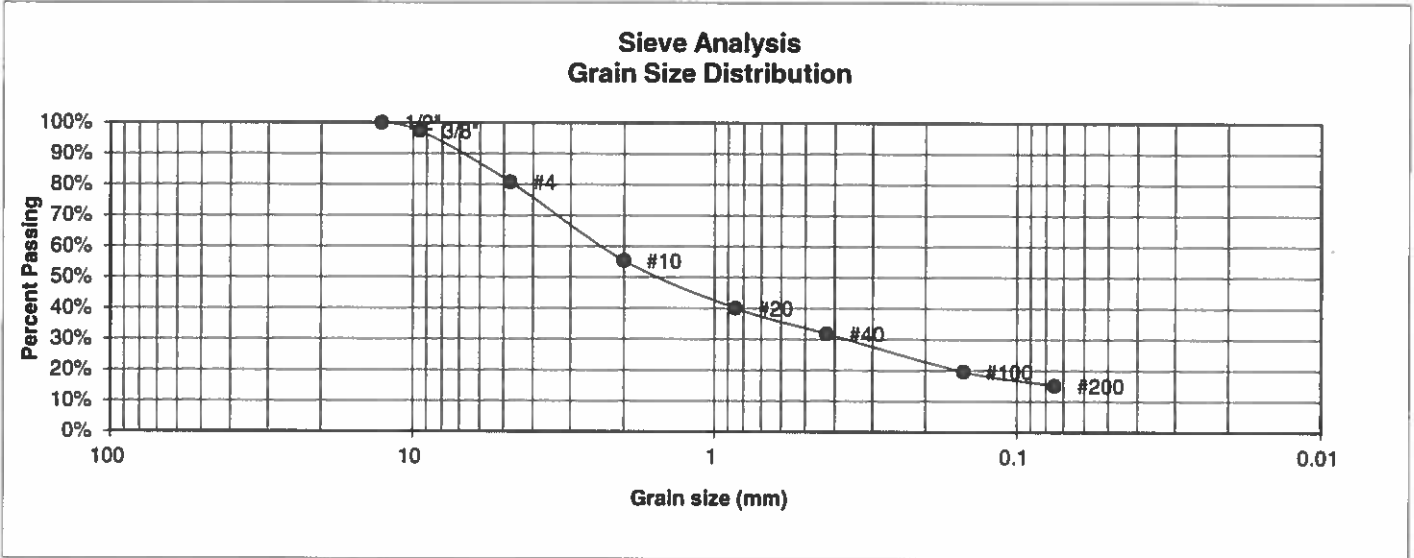
**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED: <i>W</i>	DATE: 1/15/19
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JOB NO:
181951

FIG NO:
C-15

UNIFIED CLASSIFICATION	SM	CLIENT	4 SITE INVESTMENTS, LLC
SOIL TYPE #	3	PROJECT	GRANDVIEW RESERVE
TEST BORING #	3	JOB NO.	181951
DEPTH (FT)	10	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	97.4%
4	80.8%
10	55.4%
20	40.1%
40	31.9%
100	19.6%
200	15.2%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

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



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 505 ELKTON DRIVE
 COLORADO SPRINGS, COLORADO 80907

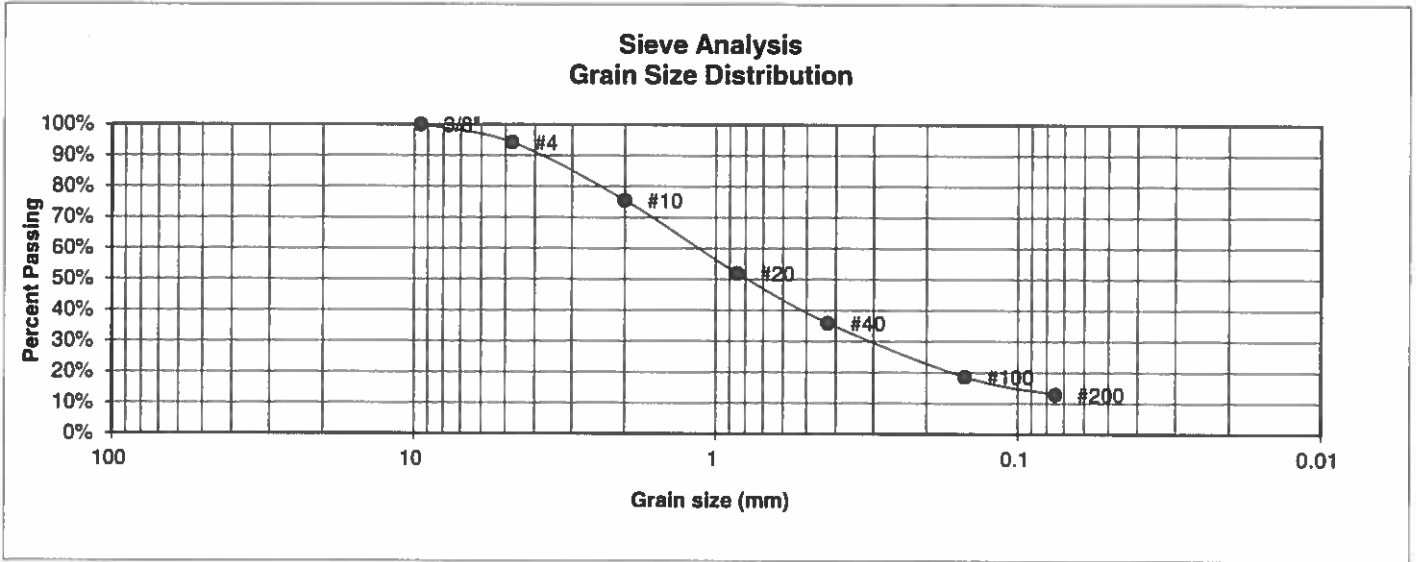
**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED: <i>u</i>	DATE: <i>7/8/14</i>
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JOB NO.:
181951

FIG NO.:
C-16

UNIFIED CLASSIFICATION	SM	CLIENT	4 SITE INVESTMENTS, LLC
SOIL TYPE #	3	PROJECT	GRANDVIEW RESERVE
TEST BORING #	4	JOB NO.	181951
DEPTH (FT)	15	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	94.2%
10	75.6%
20	52.0%
40	35.9%
100	18.6%
200	12.9%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

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



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 505 ELKTON DRIVE
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**LABORATORY TEST
RESULTS**

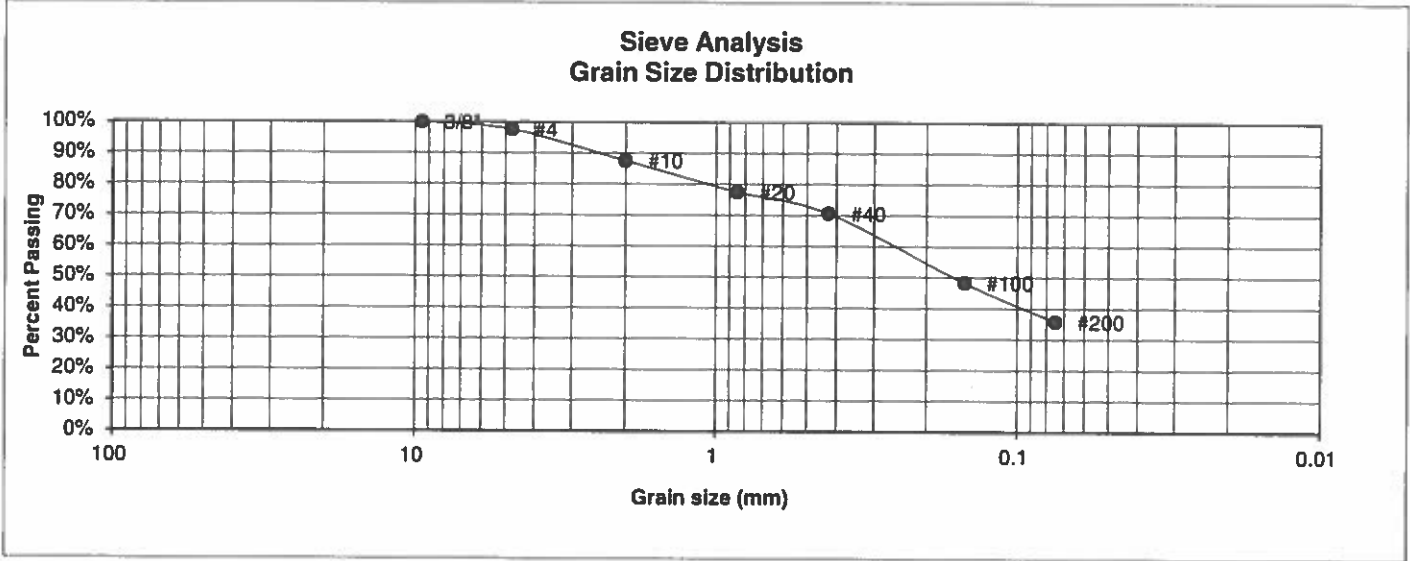
DRAWN:	DATE:	CHECKED:	DATE:
		<i>[Signature]</i>	1/15/19

JOB NO:
181951

FIG NO:
C-17

UNIFIED CLASSIFICATION SC
SOIL TYPE # 3
TEST BORING # 6
DEPTH (FT) 20

CLIENT 4 SITE INVESTMENTS, LLC
PROJECT GRANDVIEW RESERVE
JOB NO. 181951
TEST BY BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	97.6%
10	87.5%
20	77.5%
40	70.6%
100	48.3%
200	35.8%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

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



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505 ELKTON DRIVE
 COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST
 RESULTS**

DRAWN:	DATE:	CHECKED: <i>BL</i>	DATE: <i>1/15/19</i>
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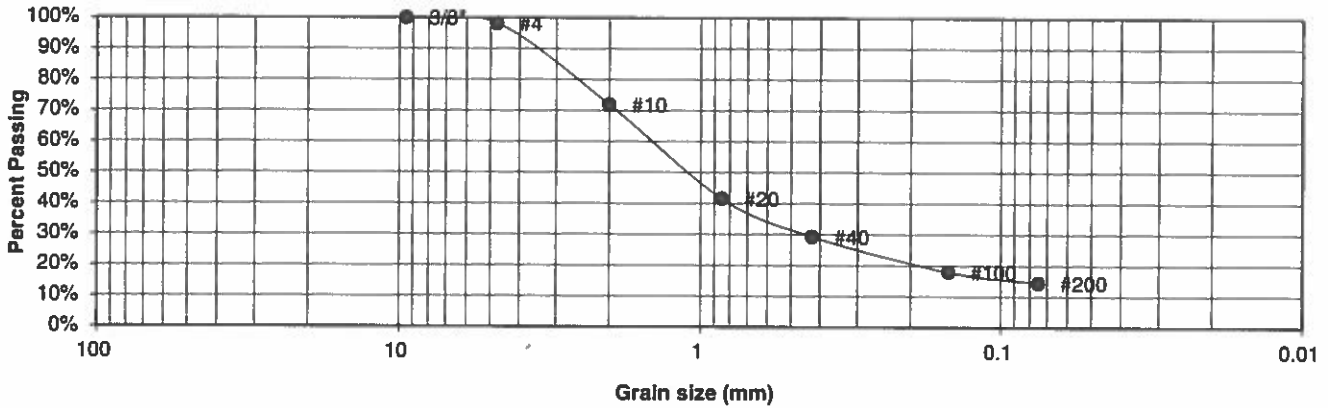
JOB NO.:
 181951

FIG NO.:
 C-18

UNIFIED CLASSIFICATION SM
SOIL TYPE # 3
TEST BORING # 7
DEPTH (FT) 2-3

CLIENT 4 SITE INVESTMENTS, LLC
PROJECT GRANDVIEW RESERVE
JOB NO. 181951
TEST BY BL

**Sieve Analysis
Grain Size Distribution**



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	98.2%
10	71.9%
20	41.5%
40	29.3%
100	17.9%
200	14.4%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

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



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505 ELKTON DRIVE
 COLORADO SPRINGS, COLORADO 80907

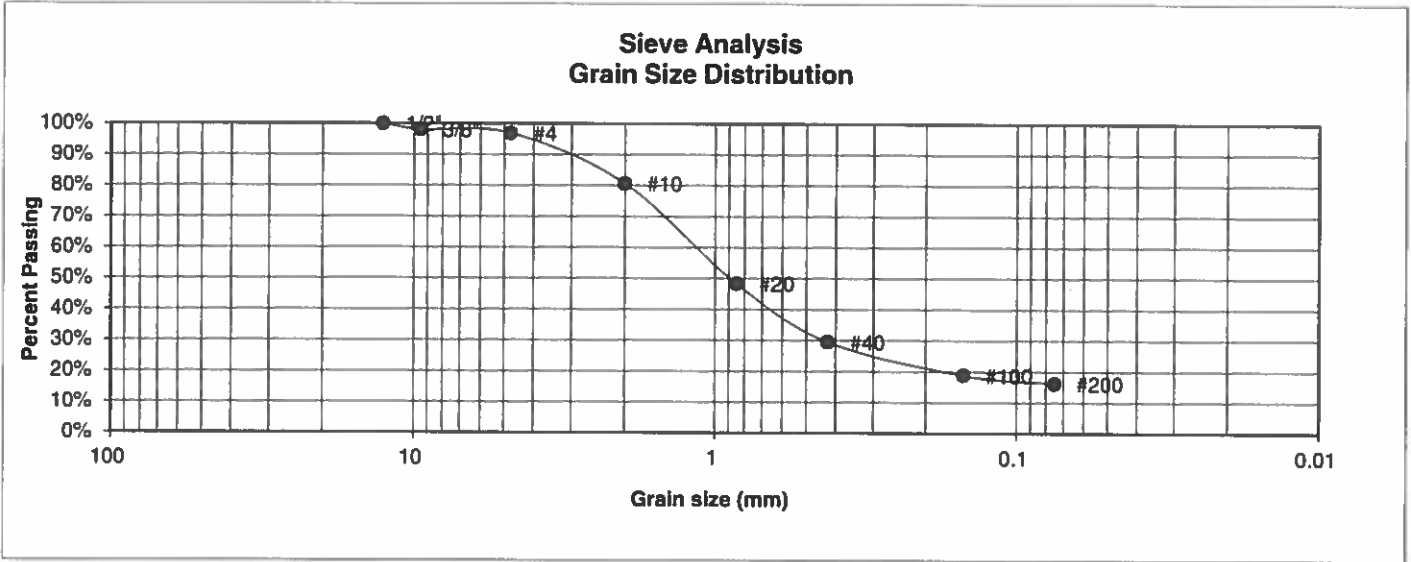
**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED: <i>BL</i>	DATE: 7/15/19
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JOB NO.: 181951

FIG NO.: C-19

UNIFIED CLASSIFICATION	SM	CLIENT	4 SITE INVESTMENTS, LLC
SOIL TYPE #	3	PROJECT	GRANDVIEW RESERVE
TEST BORING #	TP-1	JOB NO.	181951
DEPTH (FT)	4-5	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	98.1%
4	96.9%
10	80.7%
20	48.3%
40	29.5%
100	18.8%
200	16.2%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

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



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COLORADO SPRINGS, COLORADO 80907

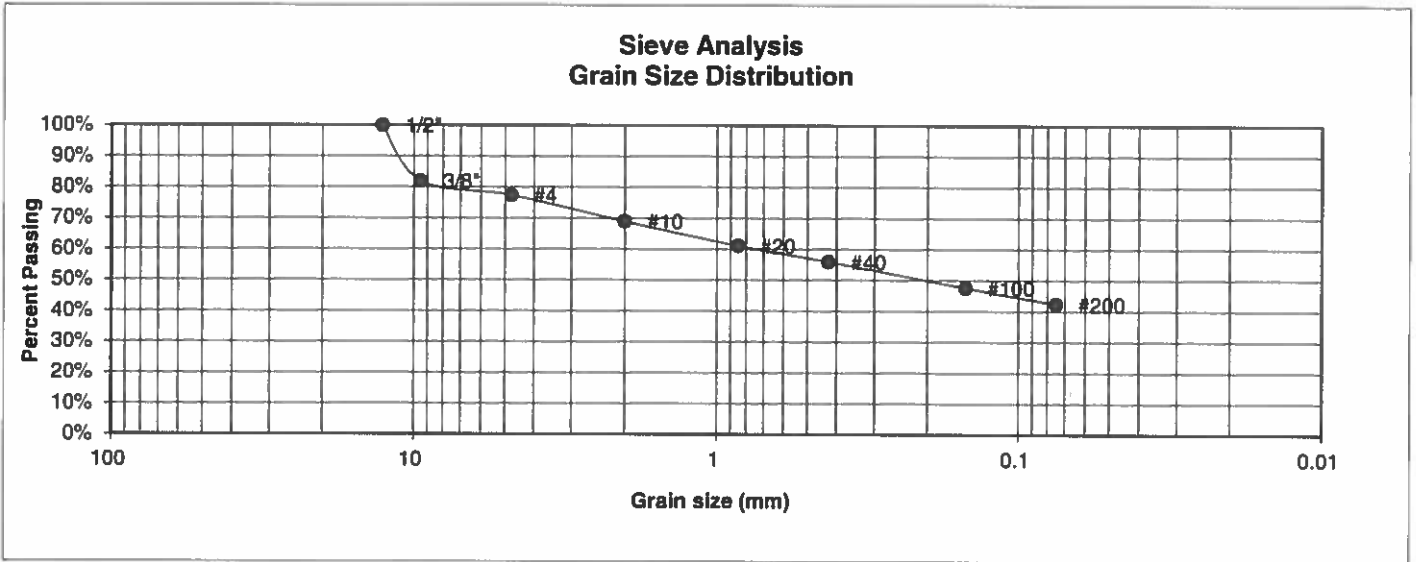
**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED: <i>BL</i>	DATE: 1/15/19
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JOB NO.:
181951

FIG NO.:
C-20

UNIFIED CLASSIFICATION	SC	CLIENT	4 SITE INVESTMENTS, LLC
SOIL TYPE #	3	PROJECT	GRANDVIEW RESERVE
TEST BORING #	TP-5	JOB NO.	181951
DEPTH (FT)	4-5	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	82.0%
4	77.4%
10	69.0%
20	61.1%
40	55.9%
100	47.6%
200	42.3%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

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



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**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED: <i>W</i>	DATE: 1/15/19
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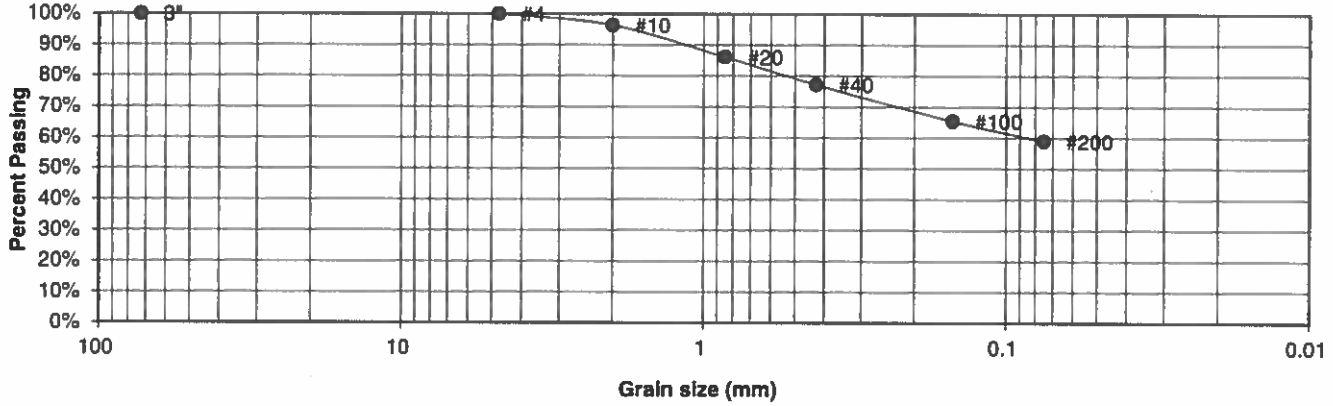
JOB NO.:
181951

FIG NO.:
C-21

UNIFIED CLASSIFICATION CL
SOIL TYPE # 4
TEST BORING # 1
DEPTH (FT) 10

CLIENT 4 SITE INVESTMENTS, LLC
PROJECT GRANDVIEW RESERVE
JOB NO. 181951
TEST BY BL

**Sieve Analysis
Grain Size Distribution**



U.S. Sieve #	Percent Finer
3"	100.0%
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	96.4%
20	86.1%
40	77.2%
100	65.4%
200	59.0%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

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



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COLORADO SPRINGS, COLORADO 80907

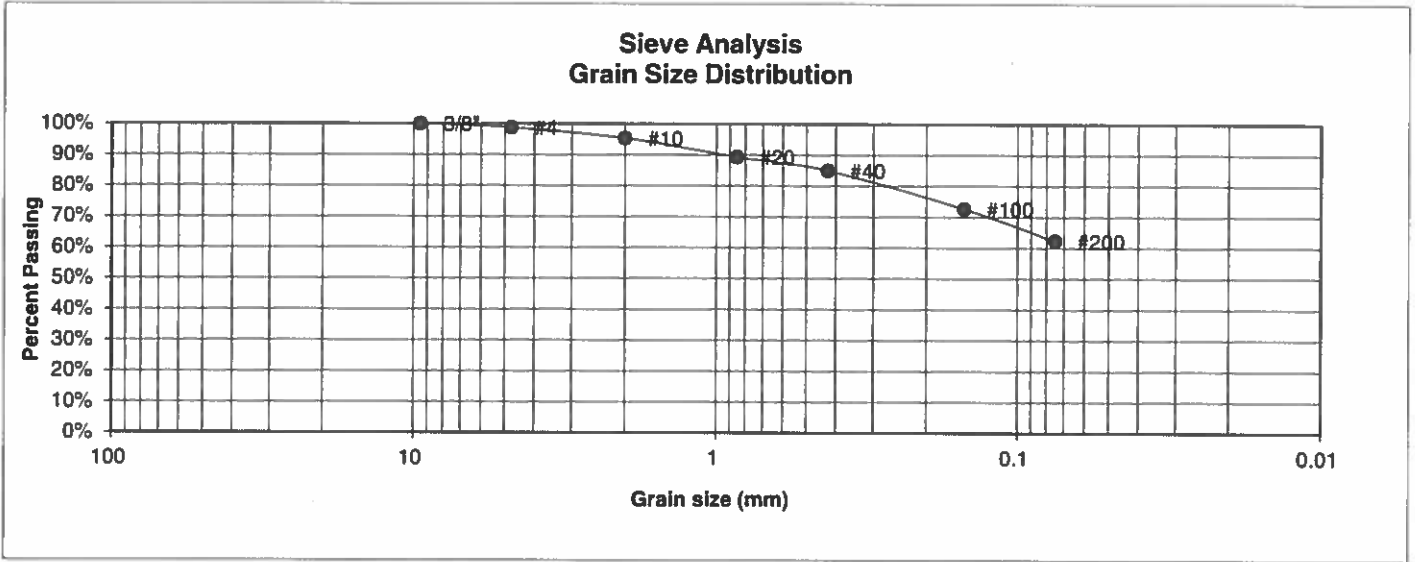
**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED:	DATE:
		u	1/15/19

JOB NO.:
181951

FIG NO.:
C-22

UNIFIED CLASSIFICATION	CL	CLIENT	4 SITE INVESTMENTS, LLC
SOIL TYPE #	4	PROJECT	GRANDVIEW RESERVE
TEST BORING #	2	JOB NO.	181951
DEPTH (FT)	10	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	98.8%
10	95.4%
20	89.3%
40	85.0%
100	72.6%
200	62.3%

Atterberg Limits	
Plastic Limit	14
Liquid Limit	35
Plastic Index	21

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



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**LABORATORY TEST
RESULTS**

DRAWN:

DATE:

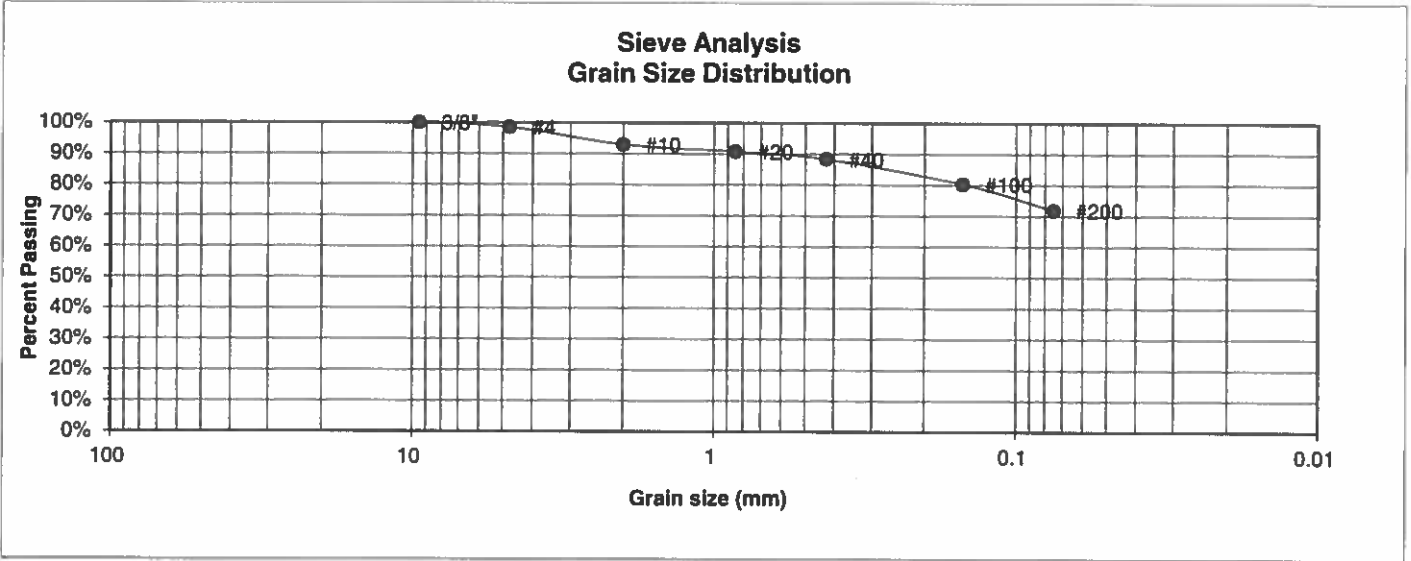
CHECKED: *[Signature]*

DATE: 1/15/19

JOB NO.:
181951

FIG NO.:
C-23

UNIFIED CLASSIFICATION	CL	CLIENT	4 SITE INVESTMENTS, LLC
SOIL TYPE #	4	PROJECT	GRANDVIEW RESERVE
TEST BORING #	9	JOB NO.	181951
DEPTH (FT)	15	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	98.5%
10	93.0%
20	90.8%
40	88.3%
100	80.3%
200	71.9%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

Swell
 Moisture at start 7.9%
 Moisture at finish 15.7%
 Moisture increase 7.8%
 Initial dry density (pcf) 99
 Swell (psf) 1580



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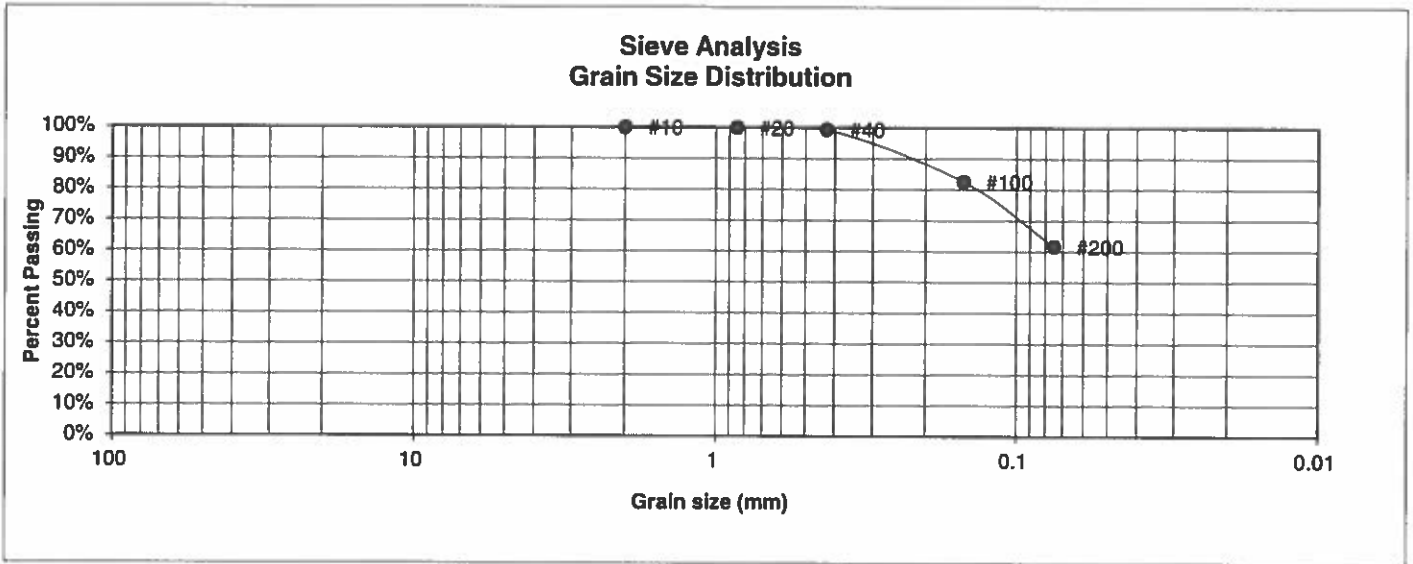
**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED: <i>CL</i>	DATE: 1/15/19
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JOB NO:
181951

FIG NO:
C-24

UNIFIED CLASSIFICATION	CL	CLIENT	4 SITE INVESTMENTS, LLC
SOIL TYPE #	4	PROJECT	GRANDVIEW RESERVE
TEST BORING #	TP-6	JOB NO.	181951
DEPTH (FT)	2-3	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	
10	100.0%
20	99.9%
40	99.4%
100	82.6%
200	61.6%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

Swell	
Moisture at start	9.3%
Moisture at finish	26.4%
Moisture increase	17.1%
Initial dry density (pcf)	95
Swell (psf)	950



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COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED: <i>u</i>	DATE: 1/15/19
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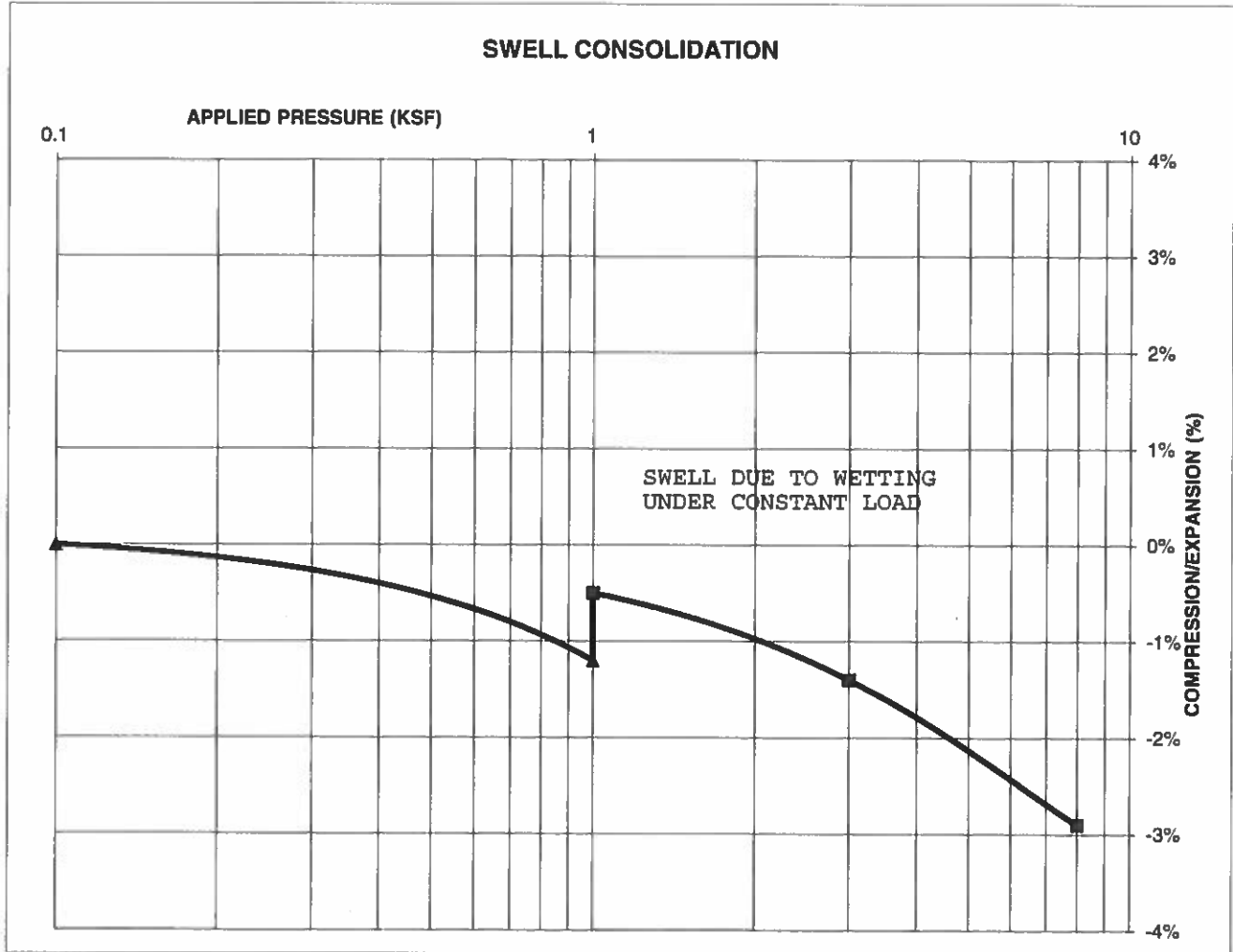
JOB NO.:
181951

FIG NO.:
C-25

CONSOLIDATION TEST RESULTS

TEST BORING #	3	DEPTH(ft)	15
DESCRIPTION	CL	SOIL TYPE	4
NATURAL UNIT DRY WEIGHT (PCF)	113		
NATURAL MOISTURE CONTENT	12.8%		
SWELL/CONSOLIDATION (%)	0.7%		

JOB NO. 181951
 CLIENT 4 SITE INVESTMENTS, LLC
 PROJECT GRANDVIEW RESERVE



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 COLORADO SPRINGS, COLORADO 80907

**SWELL CONSOLIDATION
TEST RESULTS**

DRAWN:

DATE:

CHECKED:

DATE:

u 1/5/19

JOB NO.:
181951

FIG NO.:
C-26

CLIENT	<u>4 SITE INVESTMENTS, LLC</u>	JOB NO.	<u>181951</u>
PROJECT	<u>GRANDVIEW RESERVE</u>	DATE	<u>12/4/2018</u>
LOCATION	<u>GRANDVIEW RESERVE</u>	TEST BY	<u>BL</u>

BORING NUMBER	DEPTH, (ft)	SOIL TYPE NUMBER	UNIFIED CLASSIFICATION	WATER SOLUBLE SULFATE, (wt%)
TB-2	2-3	3	SC	<0.01
TB-2	10	4	CL	0.00
TB-5	5	1	SC-SM-SW	0.02
TB-10	10	2	CL	<0.01

QC BLANK PASS



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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

LABORATORY TEST
SULFATE RESULTS

DRAWN:	DATE:	CHECKED: <i>h</i>	DATE: <i>1/15/19</i>
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JOB NO.:
181951

FIG NO.:
C-27

APPENDIX D: Soil Survey Descriptions

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

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

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

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

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

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

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

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

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

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



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SCS SOIL DESCRIPTION

Drawn	Date	Checked	Date
		<i>W</i>	12/28/10

Job No.

181951

Fig. No.

D-1

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

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

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

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

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

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

Proper location of livestock watering facilities helps to control grazing.

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

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

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



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SCS SOIL DESCRIPTION

Drawn	Date	Checked	Date
		LA	12/20/10

Job No.

181951

Fig. No.

D-2

83—Stapleton sandy loam, 3 to 8 percent slopes. This deep, noncalcareous, well drained soil formed in sandy alluvium derived from arkosic bedrock on uplands. Elevation ranges from 6,500 to 7,300 feet. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is about 135 days.

Typically, the surface layer is grayish brown sandy loam about 11 inches thick. The subsoil is grayish brown gravelly sandy loam about 6 inches thick. The substratum extends to a depth of 60 inches or more. It is pale brown gravelly sandy loam in the upper part and grades to gravelly loamy sand in the lower part.

Included with this soil in mapping are small areas of Louviers silty clay loam, 3 to 18 percent slopes; Blakeland loamy sand, 1 to 9 percent slopes; Columbine gravelly sandy loam, 0 to 3 percent slopes; and Fluvaquent Haplaquolls, nearly level. Also included are areas where arkose beds of sandstone and shale are at a depth of 0 to 40 inches. Included areas make up about 20 percent of the mapped acreage.

Permeability of this Stapleton soil is rapid. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is slow, and the hazards of erosion and soil blowing are moderate.

This soil is used as rangeland, for wildlife habitat, and as homesites.

Native vegetation is mainly western wheatgrass, side-outs grama, needleandthread, and little bluestem. The predominant shrub on this soil is true mountainmahogany. Yucca occurs in some areas.

Deferred grazing late in summer and in fall improves the condition of the range. Properly locating livestock watering facilities helps to control grazing.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing is the principal limitation for the establishment of trees and shrubs. This limitation can be overcome by cultivating only in the tree rows and leaving a strip of vegetation between the rows. Supplemental irrigation may be needed when planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

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

The main limitation of this soil for urban use is frost-action potential. Special design of roads and streets is necessary to minimize frost heave damage. Special practices must be provided to minimize water erosion and soil blowing on construction sites where vegetation has been removed. Access roads must have adequate cut-slope grade and be provided with drains to control surface runoff. Capability subclass IVe.



ENTECH
ENGINEERING, INC.

SCS SOIL DESCRIPTION

Drawn	Date	Checked	Date
		M	12/28/18

Job No.

181951

Fig. No.

D-3