



**ENTECH**  
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**SOIL, GEOLOGY, AND GEOLOGIC HAZARD STUDY  
THE GARDENS AT NORTH CAREFREE  
AKERS DRIVE AND NORTH CAREFREE CIRCLE  
EL PASO COUNTY, COLORADO**

Prepared for

**Mule Deer Investments, LLC**  
2727 Glen Arbor Drive  
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Attn: Heath Herber

October 25, 2017  
Revised August 6, 2018

Respectfully Submitted,

ENTECH ENGINEERING, INC.

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Encl.

Entech Job No. 171581  
AAprojects/2017/171581 countysoil/geo

Reviewed by:

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## **1.0 SUMMARY**

### ***Project Location***

The project lies in portions of the SW¼ of the SE¼ of Section 29, Township 13 South, Range 65 West of the 6<sup>th</sup> Principal Meridian in El Paso County, Colorado. The site is located in the eastern portion of Colorado Springs, Colorado.

### ***Project Description***

Total acreage involved in the project is approximately eleven acres. The proposed site development consists of seventy-one single family residential lots. The development will utilize municipal sewer and water.

### ***Scope of Report***

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

### ***Land Use and Engineering Geology***

This site was found to be suitable for the proposed development. Areas were encountered where the geologic conditions will impose some minor constraints on development and land use. These include areas of loose collapsible soils, artificial fill, and shallow bedrock. 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 the SW¼ of the SE¼ of Section 29, Township 15 South, Range 65 West of the 6<sup>th</sup> Principal Meridian in El Paso County, Colorado. The site is located in the eastern portion of Colorado Springs, Colorado, at the southeast corner of Akers Drive and North Carefree Circle. The location of the site is as shown on the Vicinity Map, Figure 1.

The topography of the site is generally gradually sloping to the west towards with moderate slopes along the northern and eastern side of the site. No drainages were observed on the site at the time of our 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, with a tree along Akers Drive. Site photographs, taken October 20, 2017, are included in Appendix A.

Total acreage involved in the proposed development is approximately eleven acres. Seventy-one single family lots are proposed. The area will be serviced municipal sewer and water. The Development Plan 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.

## **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 October 20, 2017.

Four Test Borings were drilled on the site to determine general soil and bedrock characteristics. The locations of the test borings are indicated on the Development Plan/Test Boring Location Map, Figure 3. The Test Boring Logs are presented in Appendix B. Results of this testing will be discussed later in this report.

Laboratory testing was also performed on some of the soils to classify and determine the soils engineering characteristics. Laboratory tests included grain-size analysis ASTM D-422, Atterberg Limits ASTM D-4318. Sulfate testing was performed on select samples to evaluate potential for below grade concrete degradation due to sulfate attack. 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 eleven 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 was encountered in the test borings at depths ranging from one to four feet below ground surface (bgs), which were drilled to depths of 20 feet. 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 Formation. Overlying this formation are unconsolidated deposits of man-made fill of Quaternary Age and small amounts of residual soils. Man-made fill piles located in the eastern and central portions of the site. The site's stratigraphy will be discussed in more detail in Section 5.3.

### 5.2 Soil Conservation Survey

The Natural Resource Conservation Service (Reference 2), previously the Soil Conservation Service (Reference 3) has mapped one soil type on the site (Figure 4). In general, the soils classified as loamy sand. The soils are described as follows:

<u>Type</u>	<u>Description</u>
97	Truckton sandy loam, 3 to 9% slopes

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

### 5.3 Site Stratigraphy

The Falcon Northwest 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. Two mappable units were identified on this site which are described as follows:

**Qaf Artificial Fill of Holocene Age:** These are recent deposits of man-made fill. The fill piles were observed along the eastern and central portions of the site.

**Tkd Dawson Formation of Tertiary to Cretaceous Age:** The Dawson Formation typically consists of arkosic sandstone with interbedded fine-grained sandstone, siltstone and claystone. Overlying this formation is a variable layer of residual soil. The residual soils were derived from the in-situ weathering of the bedrock materials on-site. These soils consisted of silty to very silty sands.

The soils listed above were mapped from site-specific mapping, the *Geologic Map of the Falcon Northwest Quadrangle* distributed by the Colorado Geological Survey in 2003 (Reference 4), the *Geologic Map of the Colorado Springs-Castle Rock Area*, distributed by the US Geological Survey in 1979 (Reference 5), and the *Geologic Map of the Denver 1<sup>o</sup> x 2<sup>o</sup> Quadrangle*, distributed by the US Geological Survey in 1981 (Reference 6). The Test Borings were also used in evaluating the site and are included in Appendix B. The Geology Map prepared for the site is presented in Figure 6.

### 5.4 Soil Conditions

The soils encountered in the Test Borings can be grouped into three general soil types. The soils were classified using the Unified Soil Classification System (USCS).

Soil Type 1 silty sand (SM), was encountered in all of Test Borings at the existing ground surface and extending to depths ranging from 1 foot to 4 feet bgs. These soils were encountered at loose to medium dense states and at moist conditions. Samples tested had 21 percent passing the No. 200 Sieve. Atterberg Limits Testing resulted in the sand fill being non-plastic.

Soil Type 2 sandy siltstone (ML), was encountered in Test Boring No. 1 at 1 foot and extended to 7 feet bgs. The siltstone was encountered at hard consistencies and moist conditions. Samples tested had 6 to 13 percent passing the No. 200 Sieve. Atterberg Limits Testing resulted in a liquid limit of 46 and a plastic index of 14.

Soil Type 3 very silty sandstone (SM), was encountered in all of the test borings at depths ranging from 1 to 7 feet bgs and extending to the termination of the test borings (20 feet). The sandstone was encountered at very dense states and at moist conditions. Samples tested had 39 to 43 percent passing the No. 200 Sieve. FHA Swell Testing resulted in an expansion pressure of 420 psf, which is in the low expansion range. Sulfate testing resulted in 0.01 percent sulfate by weight indicating the sandstone exhibits negligible potential for below grade concrete degradation.

The Test Boring 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.

### ***5.5 Groundwater***

Groundwater was encountered in two of the test borings at depths of 17 feet. Water was not encountered in the remaining borings which were drilled to 20 feet. 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 Engineering Geology Map Figure 7. 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 recent man-made fill deposits associated with fill piles located across the site. It is our understanding the fill will be removed during site grading.

Mitigation: Any uncontrolled fill encountered beneath foundations will require removal and recompaction at a minimum of 95% of its maximum Modified Procter Dry Density, ASTM D-1557.

### Collapsible Soils

The majority of the soils encountered on-site do not exhibit collapsible characteristics, however, areas of loose soils were encountered in the test borings drilled on site. Walls of trenches may collapse if not supported.

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

### Expansive Soils

Expansive soils were not encountered in the test borings drilled on site, but the potential for isolated claystone lenses does exist across the site. These occurrences are typically sporadic; therefore, none have been indicated on the maps. Expansive clays, if encountered at foundation grade, can cause differential movement in structures. These occurrences should be identified and mitigated on an individual basis.

Mitigation Should expansive soils be encountered beneath foundations, 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% of its maximum Modified Proctor Dry Density, ASTM D-1557 is a suitable mitigation, which is common in the area. Floor slabs on expansive soils should be expected to experience movement. Overexcavation and replacement has been successful in minimizing slab movements. 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.

#### Groundwater and Floodplain Areas

Groundwater was encountered at 17 feet in Test Boring Nos. 1 and 4. Groundwater is not anticipated to affect the construction of shallow foundations. No drainages were observed on the site. The site is not mapped within floodplain zones according to the FEMA Map No. 08041CO543F, Figure 7 (Reference 7).

### ***6.1 Relevance of Geologic Conditions to Land Use Planning***

As mentioned earlier in this report, we understand that the development will be single-family residential. It is our opinion that the existing geologic and engineering geologic conditions will impose some minor constraints on the proposed development and construction. The most significant problems affecting development will be those associated with the artificial fill and loose or collapsible soils encountered across the site. Other hazards on site can be satisfactorily mitigated through proper engineering design and construction practices.

The medium dense granular soils and very dense sandstone encountered in the upper soil profiles of the test borings should provide good support for foundations. Loose soils if encountered at or near foundation depth will require mitigation. Foundations anticipated for the site are standard spread footings possibly in conjunction with overexcavation in areas of expansive soils or loose soils. Overexcavation may also be necessary in areas of shallow bedrock to provide for similar bearing capacity. Excavation is anticipated to be moderate with rubber-tired equipment for the site sand materials, and difficult for the dense sandstone. Expansive layers may also be encountered in the soil and bedrock on this site. Areas of expansive soils encountered on site are sporadic; therefore, none have been indicated on the maps. Expansive soils, if encountered, will require special foundation design and/or overexcavation. These soils will not prohibit development.

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 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 8), the area is not mapped with any aggregate deposits. According to the *Atlas of Sand, Gravel and Quarry Aggregate Resources, Colorado Front Range Counties* distributed by the Colorado Geological Survey (Reference 9), areas of the site are not mapped with any resources. According to the *Evaluation of Mineral and Mineral Fuel Potential* (Reference 10), the area of the site has been mapped as "Fair" for industrial minerals. However, considering the silty nature of much of these materials and 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 10), the site is mapped within the Denver Basin Coal Region. However, the area of the site has been mapped as "Poor" for coal resources. No active mines have been mapped in the area of the site, several inactive mines are located approximately 4 to 5 miles south and southeast of the site. No metallic mineral resources have been mapped on-site (Reference 10).

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

## **8.0 EROSION CONTROL**

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

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

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

## **9.0 CLOSURE**

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

It should be pointed out that because of the nature of data obtained by random sampling of such variable and non-homogeneous materials as soil and rock, it is important that we be informed of any differences observed between surface and subsurface conditions encountered in construction and those assumed in the body of this report. Individual investigations for building sites will be required prior to construction. Construction and design personnel should be made familiar with the contents of this report.

This report has been prepared for Mule Deer 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.

## BIBLIOGRAPHY

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## TABLES

**TABLE 1**  
**SUMMARY OF LABORATORY TEST RESULTS**

CLIENT MULE DEER INVESTMENTS  
PROJECT AKERS & N. CAREFREE  
JOB NO. 171581

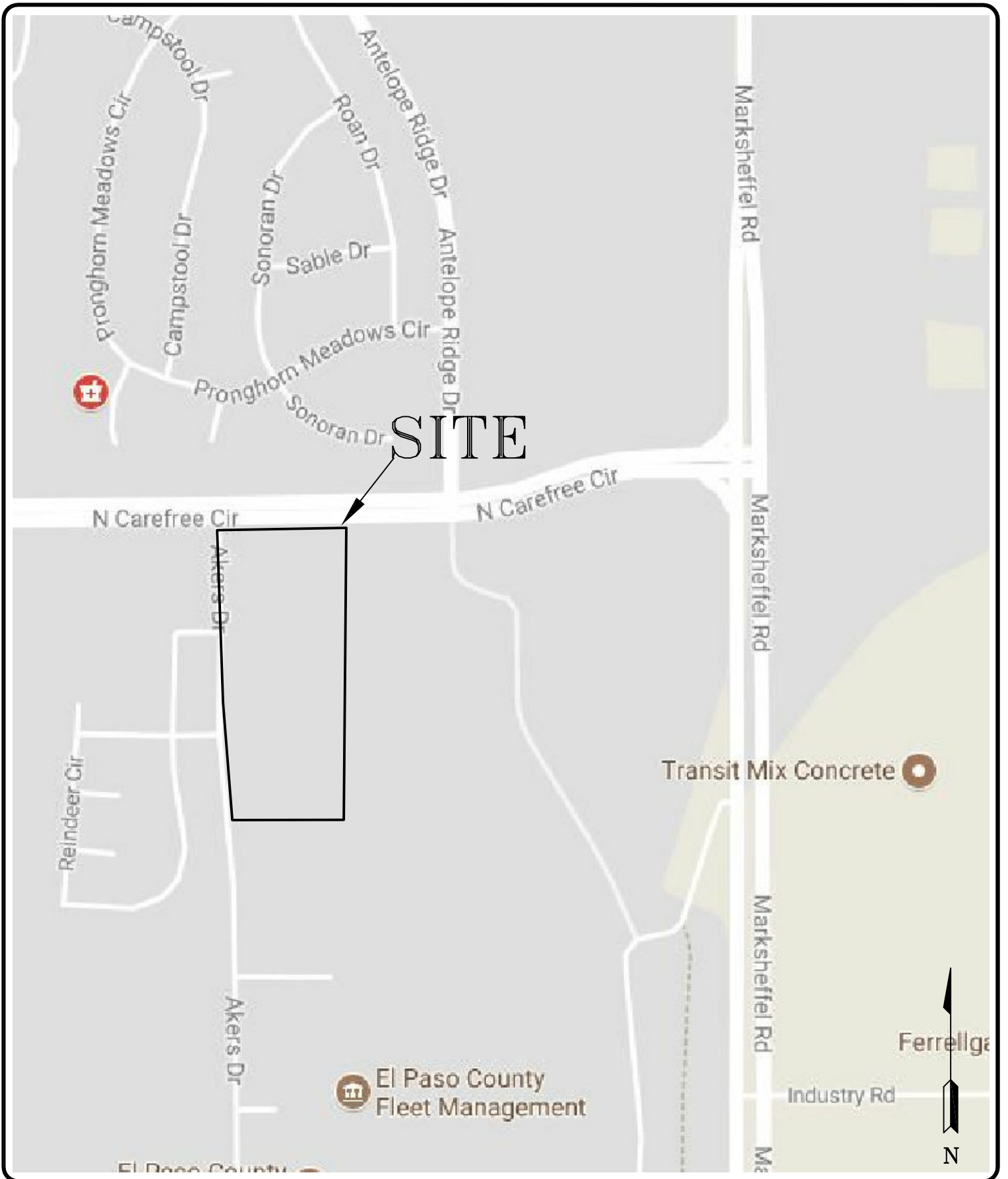

SOIL TYPE	TEST BORING NO.	DEPTH (FT)	WATER (%)	DRY DENSITY (PCF)	PASSING NO. 200 SIEVE (%)	LIQUID LIMIT (%)	PLASTIC INDEX (%)	SULFATE (WT %)	FHA SWELL (PSF)	SWELL/CONSOL (%)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION
1	2	2-3			20.7	NV	NP				SM	SAND, SILTY
2	1	2-3			79.8	46	14				ML	SILTSTONE, SANDY
3	2	10			41.7						SM	SANDSTONE, VERY SILTY
3	3	5			38.9						SM	SANDSTONE, VERY SILTY
3	3	15						420			SM	SANDSTONE, VERY SILTY
3	4	5			43.4			0.01			SM	SANDSTONE, VERY SILTY



**Table 2: Summary of Depth of Fill and Depth to Groundwater**

<b>Test Boring No.</b>	<b>Depth of Fill (ft.)</b>	<b>Depth to Bedrock (ft.)</b>	<b>Depth to Groundwater (ft.)</b>
1	N/A	1	17
2	N/A	4	N/A
3	N/A	4	N/A
4	N/A	1	17

## FIGURES

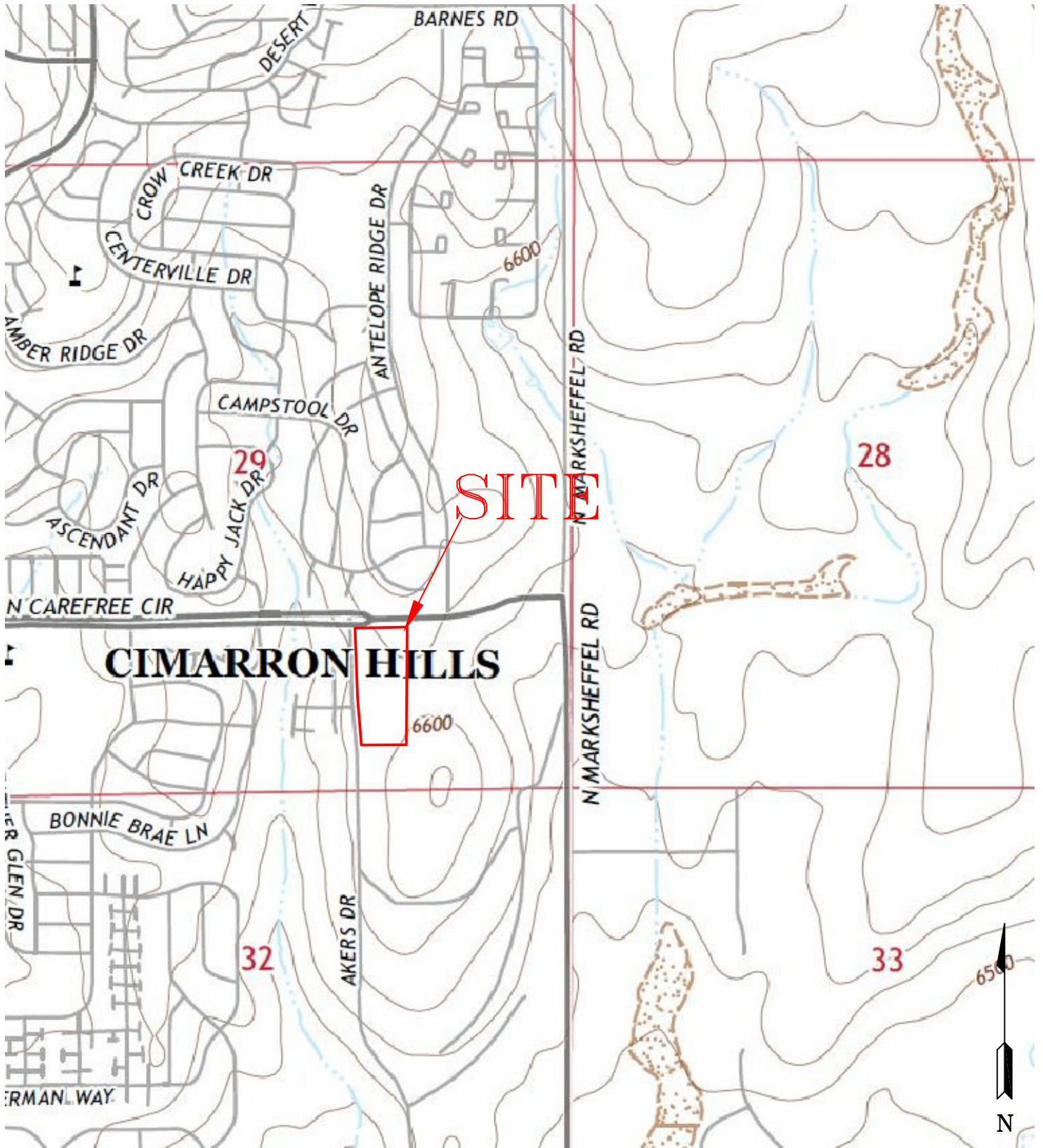
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VICINITY MAP  
THE GARDENS AT NORTH CAREFREE  
AKERS DRIVE AND NORTH CAREFREE CIRCLE  
EL PASO COUNTY, CO.  
FOR: MULE DEER INVESTMENTS, LLC

DRAWN: LLL	DATE: 8/6/18	CHECKED:	DATE:
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JOB NO.:  
171581

FIG NO.:  
1



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USGS MAP  
THE GARDENS AT NORTH CAREFREE  
AKERS DRIVE AND NORTH CAREFREE CIRCLE  
EL PASO COUNTY, CO.  
FOR: MULE DEER INVESTMENTS, LLC

DRAWN:  
LLL

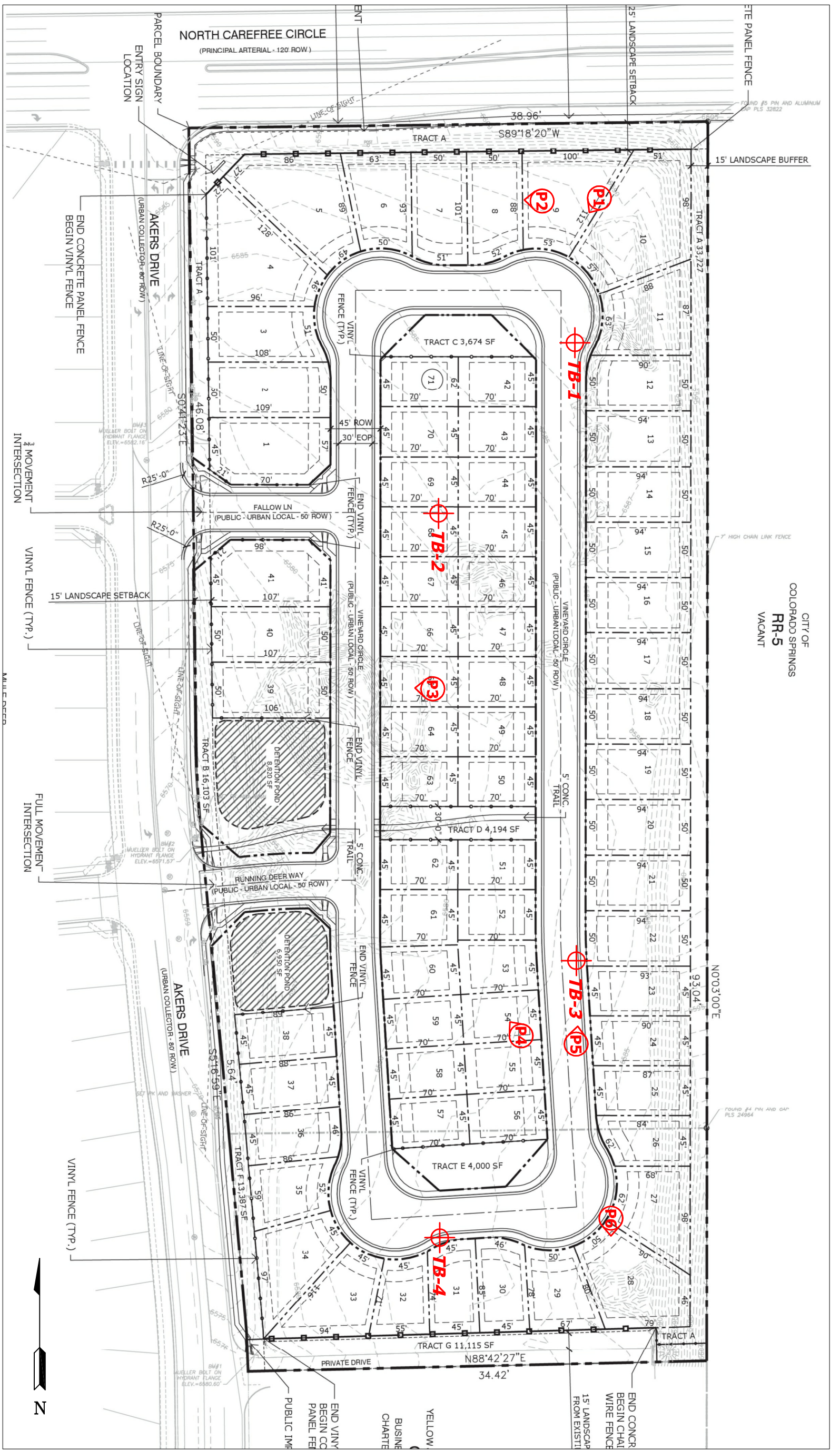
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DATE:

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171581

FIG NO.:  
2




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⊕ TB - APPROXIMATE TEST BORING LOCATION AND NUMBER  
 ⊕ P2 - APPROXIMATE PHOTOGRAPH LOCATION AND NUMBER

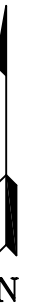
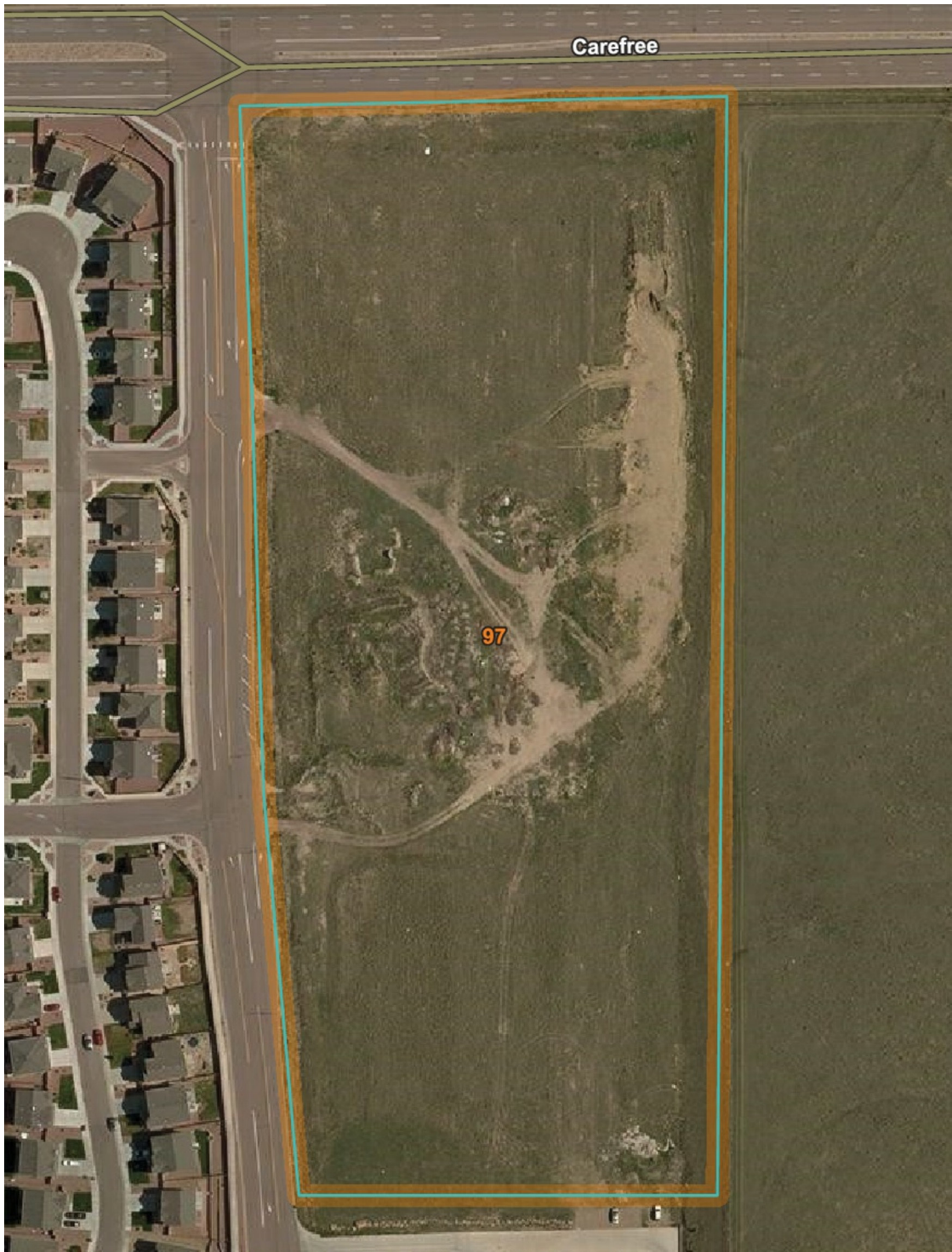
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171591	3

SITE PLAN/TEST BORING LOCATION MAP  
 THE GARDENS AT NORTH CAREFREE  
 AKERS DRIVE AND NORTH CAREFREE CIRCLE  
 EL PASO COUNTY, CO.  
 FOR: MULE DEER INVESTMENTS, LLC



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**SOIL SURVEY MAP**  
**THE GARDENS AT NORTH CAREFREE**  
**AKERS DRIVE AND NORTH CAREFREE CIRCLE**  
**EL PASO COUNTY, CO.**  
**FOR: MULE DEER INVESTMENTS, LLC**

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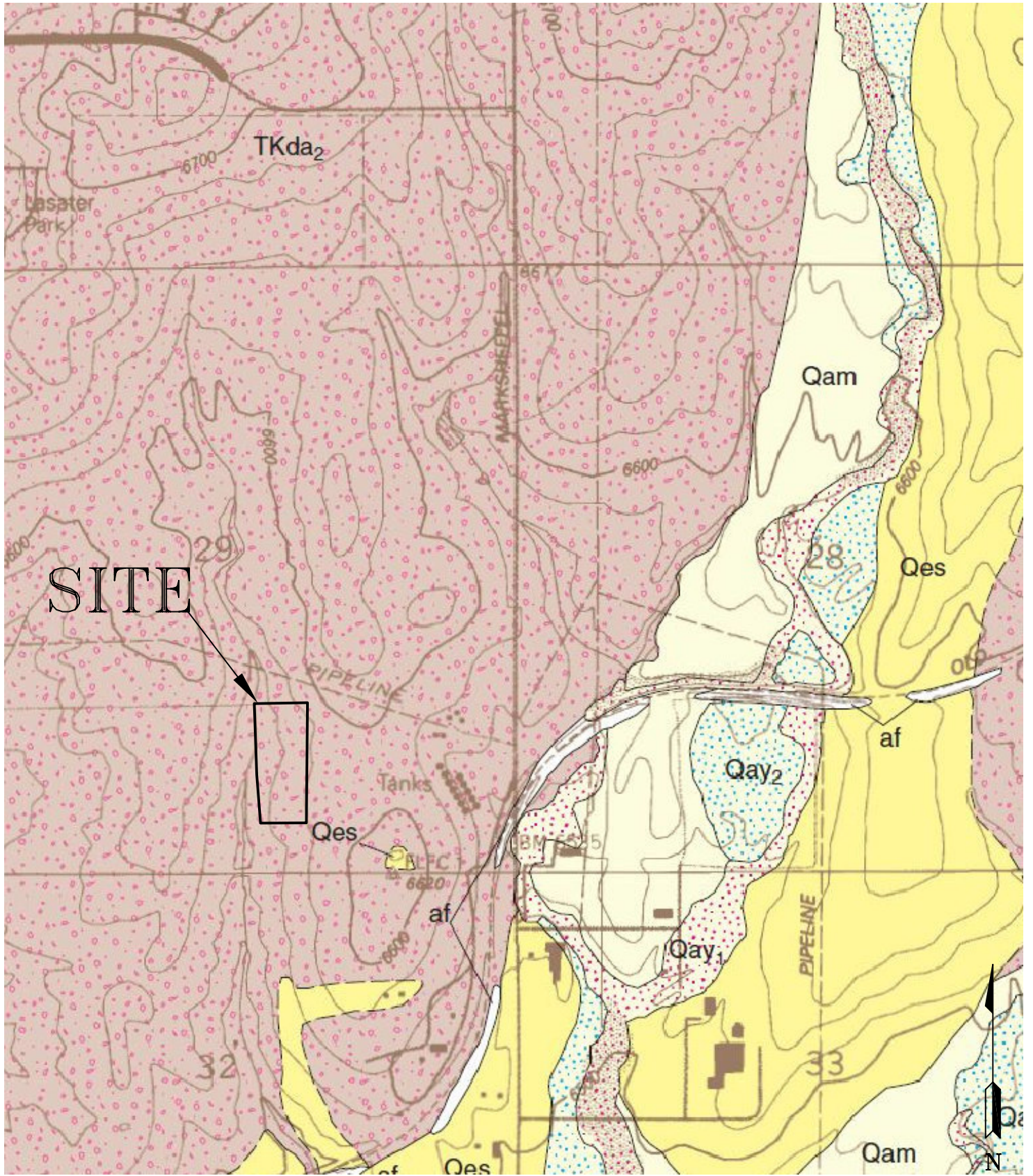
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171581

FIG NO.:  
4



SITE

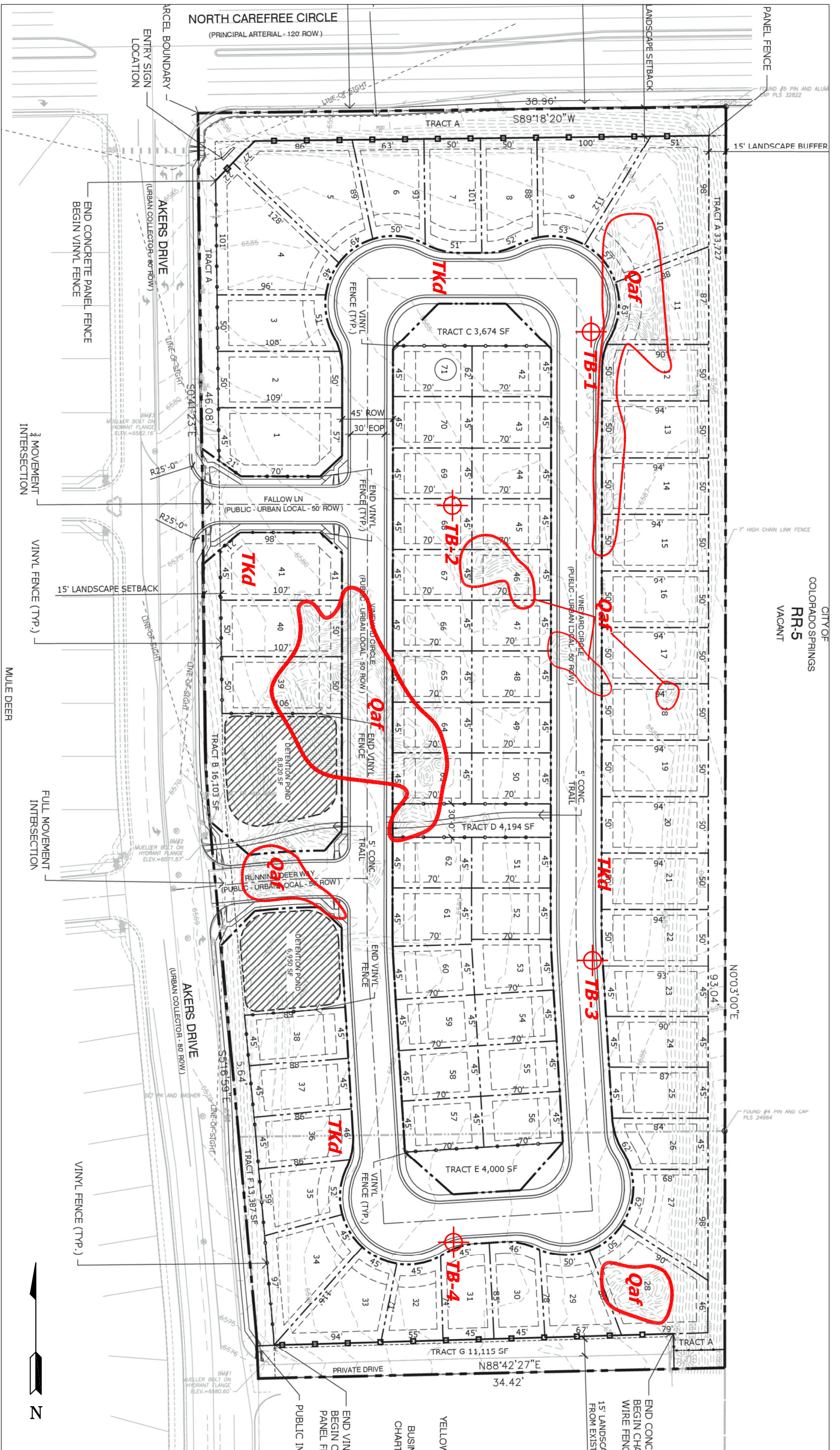


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FALCON NW QUADRANGLE GEOLOGY MAP  
 THE GARDENS AT NORTH CAREFREE  
 AKERS DRIVE AND NORTH CAREFREE CIRCLE  
 EL PASO COUNTY, CO.  
 FOR: MULE DEER INVESTMENTS, LLC

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JOB NO.:  
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 FIG NO.:  
 5




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**Legend:**

- Qaf- Artificial Fill Deposits of Holocene Age:  
 man-made fill deposits
- TKd- Dawson Formation of Tertiary and Cretaceous Age:  
 arkosic sandstone with siltstone and claystone lenses

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CHECKED	SCALE
	AS SHOWN
	JOB NO.
	171591
	FIGURE NO.
	6

**GEOLOGY/ENGINEERING GEOLOGY MAP**  
**THE GARDENS AT NORTH CAREFREE**  
**AKERS DRIVE AND NORTH CAREFREE CIRCLE**  
**EL PASO COUNTY, CO.**  
**FOR: MULE DEER INVESTMENTS, LLC**



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**LEGEND**

**SPECIAL FLOOD HAZARD AREAS 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 flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, AV, and VE. The Base Flood Elevation is the water-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 sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding velocities also determined.

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

**ZONE AV** 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**

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**

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.

1% annual chance floodplain boundary

0.2% annual chance floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations; flood depths or flood velocities.

Base Flood Elevation line and value; elevation in feet (L.E. 9807)

Base Flood Elevation value where uniform within areas; elevation in feet

Referenced to the National Geodetic Vertical Datum of 1929

Cross section line

Transect line

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

42762000

600000 FT

5000-foot grid tick values: Hawaii State Plane coordinate system, zone 3 (FPSZONE 5103), Transverse Mercator projection

Bench mark (see explanation in Notes to Users section of this FRM panel)

Coastal Mile marker

MAP REPOSITORY

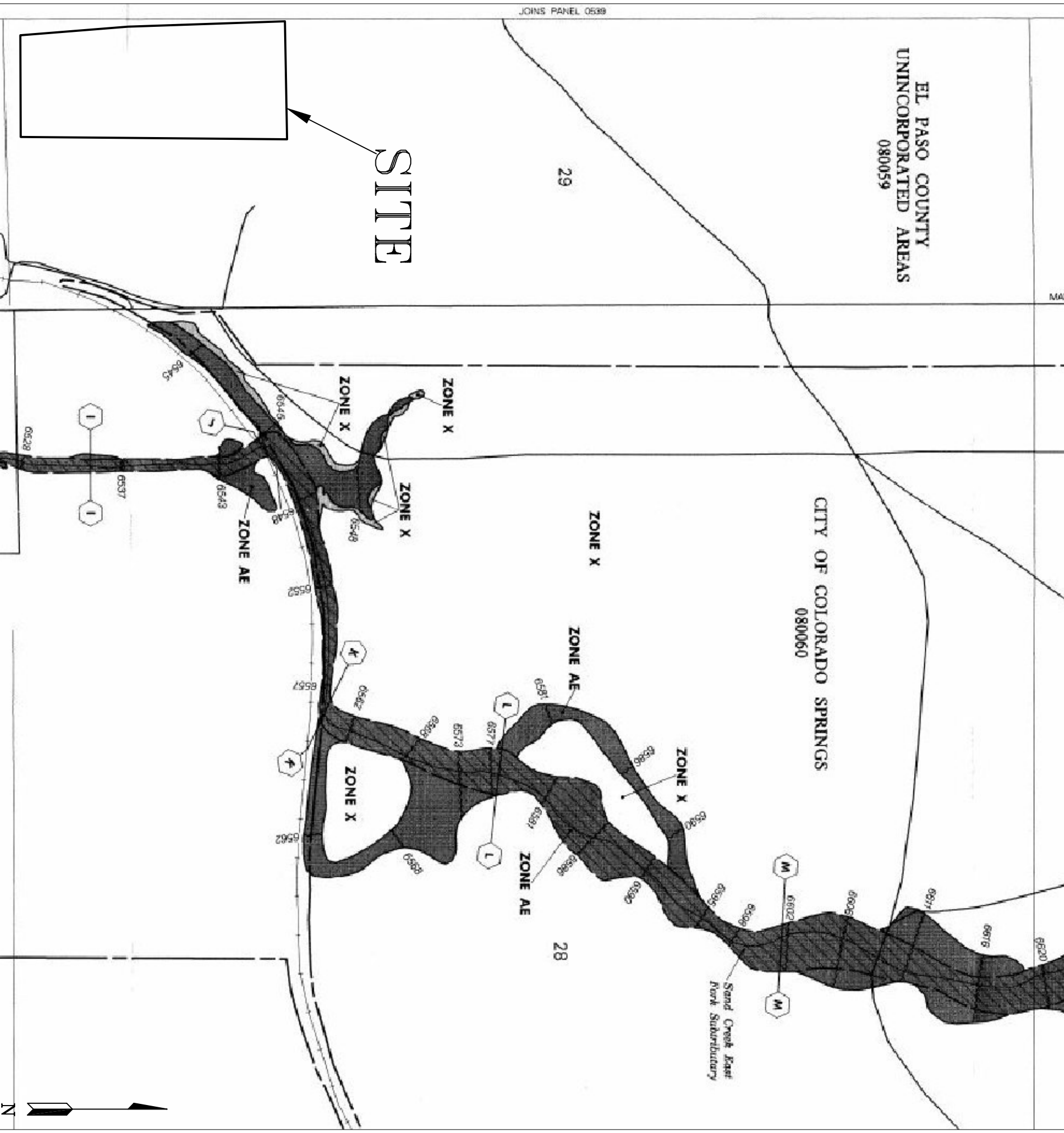
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP

November 20, 2000


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

September 30, 2004 - to change Special Flood Hazard Areas, to update map format, to reflect revised shoreline and to incorporate previously issued Letters of Map Revision.



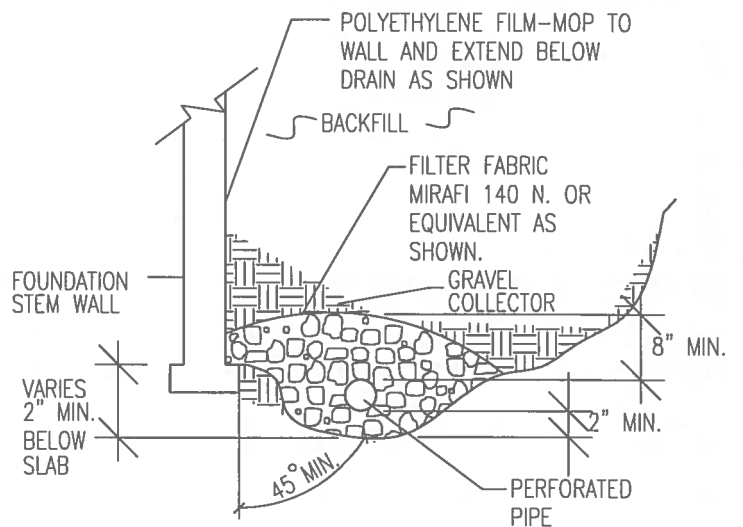
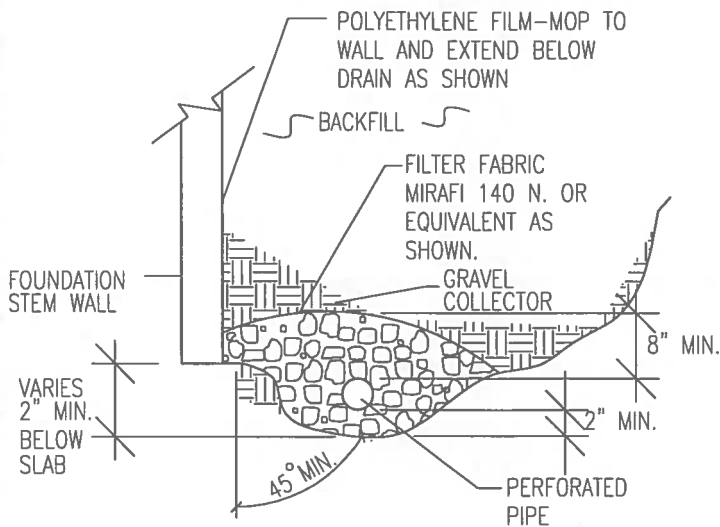
DRAWN	DATE
LLI	8/6/18
CHECKED	SCALE
	AS SHOWN
	JOB NO.
	171591
	FIGURE NO.
	7

**FLOODPLAIN MAP**  
**THE GARDENS AT NORTH CAREFREE**  
**AKERS DRIVE AND NORTH CAREFREE CIRCLE**  
**EL PASO COUNTY, CO.**  
**FOR: MULE DEER INVESTMENTS, LLC**



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

REVISION BY	



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 OUTFALL IS NOT AVAILABLE.



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*PERIMETER DRAIN DETAIL*

DRAWN:

DATE DRAWN:

DESIGNED BY:

CHECKED:

DS

LLL

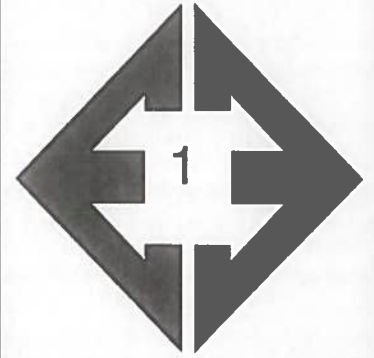
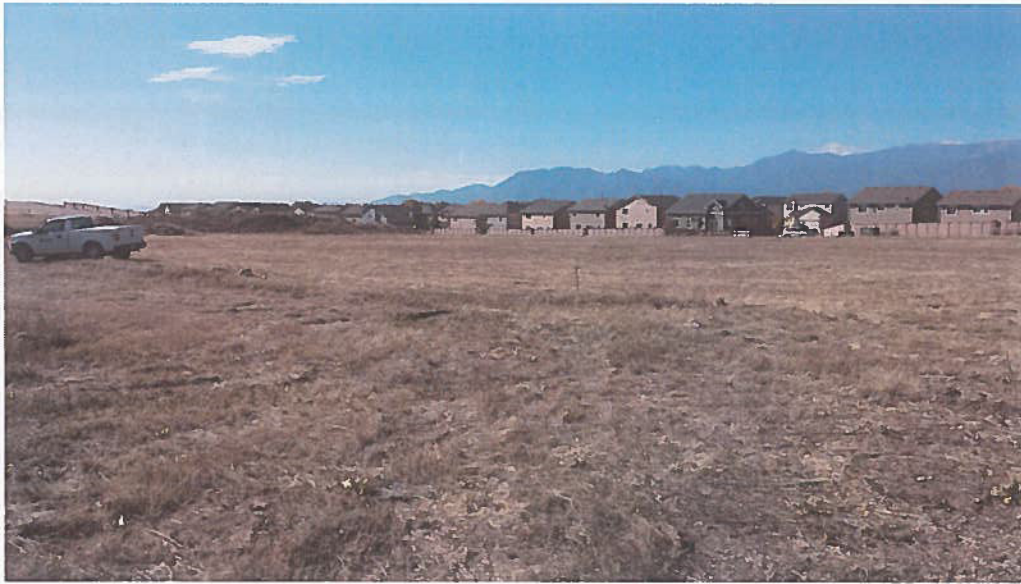
JOB NO.:

171581

FIG. NO.:

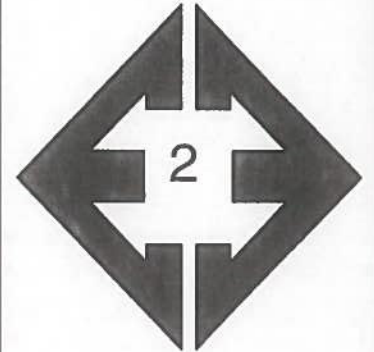
8

## **APPENDIX A: Site Photographs**



**Looking southwest  
from the northeastern  
side of the site.**

October 20, 2017



**Looking west from the  
northeastern side of  
the site.**

October 20, 2017



**Looking towards fill pile in central portion of the site.**

October 20, 2017



**Looking northwest from the southeastern portion of the.**

October 20, 2017



**Looking north from the southeast side of the site.**

October 20, 2017



**Looking south at fill pile in southeastern portion of the site.**

October 20, 2017

## **APPENDIX B: Test Boring Logs**

TEST BORING NO. 1  
 DATE DRILLED 10/11/2017  
 Job # 171581

TEST BORING NO. 2  
 DATE DRILLED 10/11/2017  
 CLIENT MULE DEER INVESTMENTS  
 LOCATION AKERS & N. CAREFREE

REMARKS

WATER AT 17', 10/20/17

SAND, SILTY, TAN  
 SILTSTONE, SANDY, TAN,  
 HARD, MOIST

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

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
5	[Symbol]		50 9"	24.0	2
5	[Symbol]		50 8"	21.3	2
10	[Symbol]		50 2"	13.5	3
15	[Symbol]		50 2"	13.4	3
20	[Symbol]		50 <1"	13.2	3

REMARKS

DRY TO 20', 10/20/17

SAND, SILTY, FINE TO COARSE  
 GRAINED, TAN, LOOSE, MOIST

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

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
5	[Symbol]		7 5"	10.6	1
5	[Symbol]		50 5"	12.1	3
10	[Symbol]		50 2"	11.3	3
15	[Symbol]		50 1"	11.6	3
20	[Symbol]		50 <1"	10.8	3



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TEST BORING LOG

DRAWN:

DATE:

CHECKED:  
 LLL

DATE:  
 10/20/17

JOB NO.:  
 171581

FIG NO.:  
 B- 1



TEST BORING NO. 3  
 DATE DRILLED 10/11/2017  
 Job # 171581

TEST BORING NO. 4  
 DATE DRILLED 10/11/2017  
 CLIENT MULE DEER INVESTMENTS  
 LOCATION AKERS & N. CAREFREE

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 20', 10/20/17						
SAND, SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, MOIST				22	15.0	1
SANDSTONE, VERY SILTY, FINE TO COARSE GRAINED, GRAY BROWN, VERY DENSE, MOIST	5			50 3"	12.7	3
	10			50 2"	16.2	3
	15			50 <1"	12.1	3
	20			*	13.1	3

\* - BULK SAMPLE TAKEN

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
WATER AT 17', 10/20/17						
SAND, SILTY, TAN SANDSTONE, VERY SILTY, FINE TO COARSE GRAINED, TAN, VERY DENSE, MOIST				50 2"	12.2	3
	5			50 4"	14.3	3
	10			50 6"	18.2	3
	15			50 6"	21.1	3
	20			50 5"	17.2	3



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TEST BORING LOG

DRAWN:

DATE:

CHECKED:

DATE:

LLL

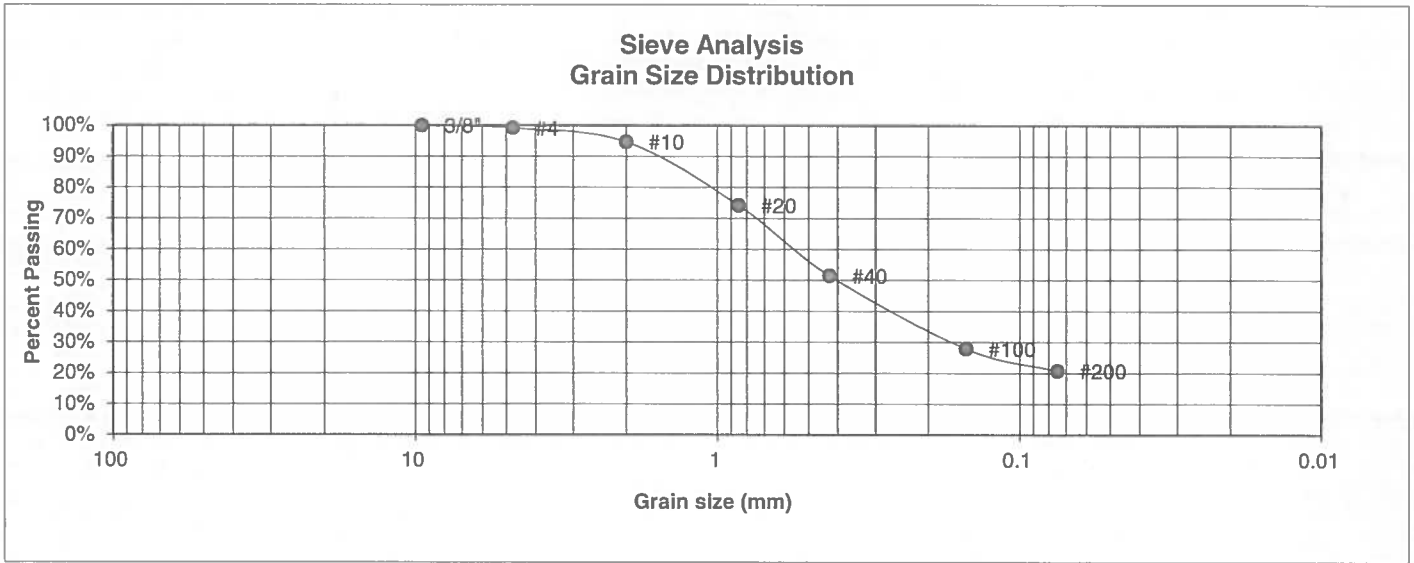
10/20/17

JOB NO.:  
 171581

FIG NO.:  
 B- 2

## **APPENDIX C: Laboratory Test Results**

<u>UNIFIED CLASSIFICATION</u>	SM	<u>CLIENT</u>	MULE DEER INVESTMENTS
<u>SOIL TYPE #</u>	1	<u>PROJECT</u>	AKERS & N. CAREFREE
<u>TEST BORING #</u>	2	<u>JOB NO.</u>	171581
<u>DEPTH (FT)</u>	2-3	<u>TEST BY</u>	BL



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.1%
10	94.7%
20	74.2%
40	51.4%
100	27.9%
200	20.7%

<u>Atterberg Limits</u>	
Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

<u>Swell</u>	
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**

<u>DRAWN:</u>	<u>DATE:</u>	<u>CHECKED:</u>	<u>DATE:</u>
		LLL	10/20/17

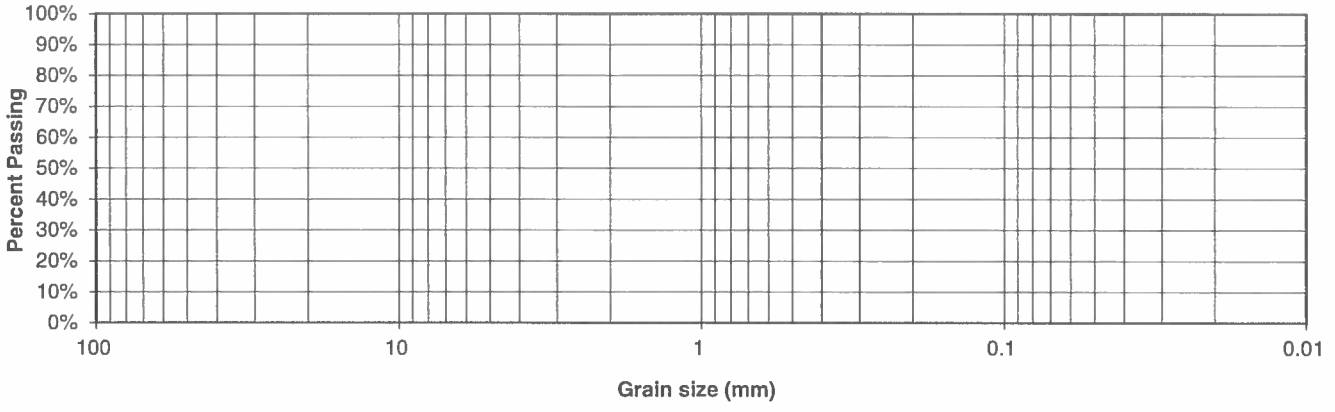
JOB NO.:  
171581

FIG NO.:

C-1

<u>UNIFIED CLASSIFICATION</u>	ML	<u>CLIENT</u>	MULE DEER INVESTMENTS
<u>SOIL TYPE #</u>	2	<u>PROJECT</u>	AKERS & N. CAREFREE
<u>TEST BORING #</u>	1	<u>JOB NO.</u>	171581
<u>DEPTH (FT)</u>	2-3	<u>TEST BY</u>	BL

**Sieve Analysis  
Grain Size Distribution**



U.S.  
Sieve #  
3"  
1 1/2"  
3/4"  
1/2"  
3/8"  
4  
10  
20  
40  
100  
200

Percent  
Finer

Atterberg  
Limits  
Plastic Limit            32  
Liquid Limit            46  
Plastic Index            14

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



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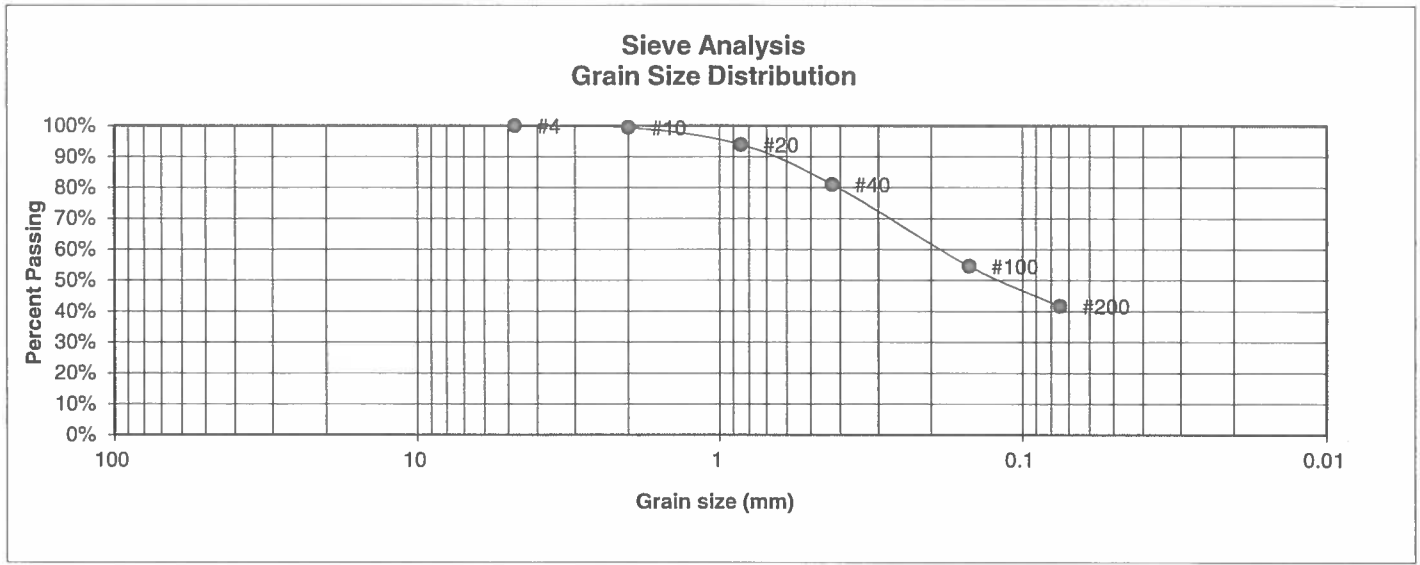
**LABORATORY TEST  
RESULTS**

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	10/27/17

JOB NO.:  
171581

FIG NO.:  
C-2

<u>UNIFIED CLASSIFICATION</u>	SM	<u>CLIENT</u>	MULE DEER INVESTMENTS
<u>SOIL TYPE #</u>	3	<u>PROJECT</u>	AKERS & N. CAREFREE
<u>TEST BORING #</u>	2	<u>JOB NO.</u>	171581
<u>DEPTH (FT)</u>	10	<u>TEST BY</u>	BL



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	99.4%
20	93.9%
40	81.0%
100	54.6%
200	41.7%

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**

<u>DRAWN:</u>	<u>DATE:</u>	<u>CHECKED:</u> LLL	<u>DATE:</u> 10/20/17
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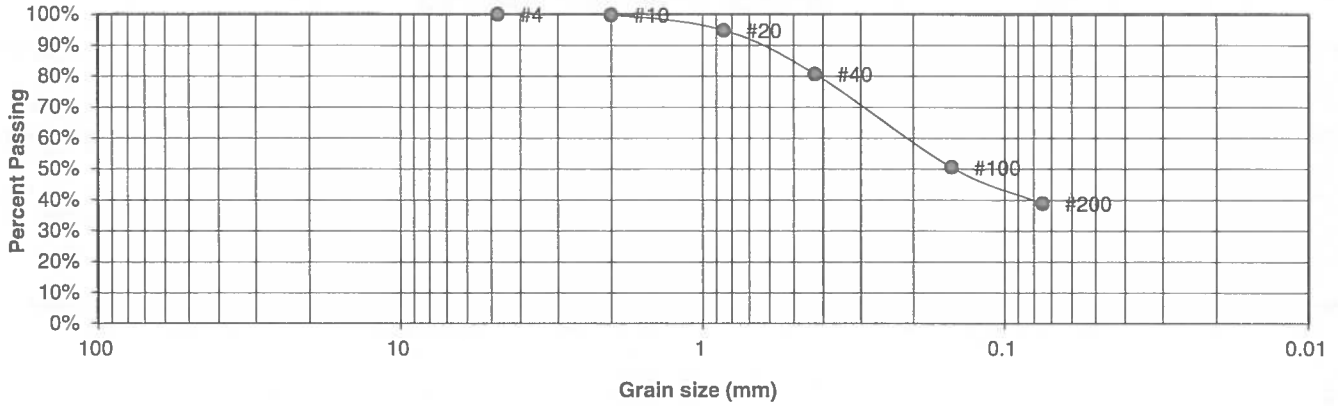
JOB NO.:  
171581

FIG NO.:

C-3

<u>UNIFIED CLASSIFICATION</u>	SM	<u>CLIENT</u>	MULE DEER INVESTMENTS
<u>SOIL TYPE #</u>	3	<u>PROJECT</u>	AKERS & N. CAREFREE
<u>TEST BORING #</u>	3	<u>JOB NO.</u>	171581
<u>DEPTH (FT)</u>	5	<u>TEST BY</u>	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"	
4	100.0%
10	99.8%
20	94.8%
40	80.7%
100	50.6%
200	38.9%

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**

<u>DRAWN:</u>	<u>DATE:</u>	<u>CHECKED:</u>	<u>DATE:</u>
		LLC	10/20/17

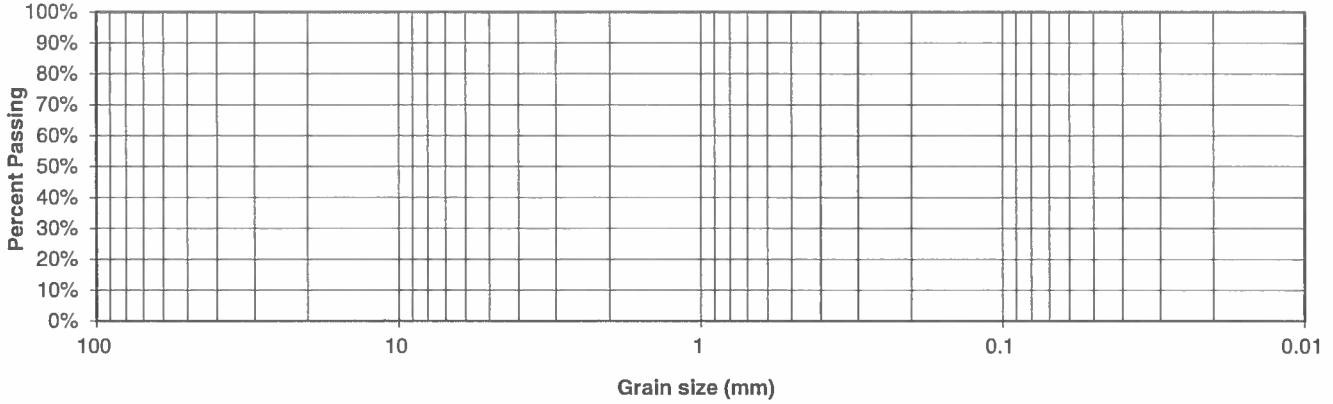
JOB NO.:  
171581

FIG NO.:

C-4

<u>UNIFIED CLASSIFICATION</u>	SM	<u>CLIENT</u>	MULE DEER INVESTMENTS
<u>SOIL TYPE #</u>	3	<u>PROJECT</u>	AKERS & N. CAREFREE
<u>TEST BORING #</u>	3	<u>JOB NO.</u>	171581
<u>DEPTH (FT)</u>	15	<u>TEST BY</u>	BL

**Sieve Analysis  
Grain Size Distribution**



<u>U.S. Sieve #</u>	<u>Percent Finer</u>	<u>Atterberg Limits</u>	
3"		Plastic Limit	
1 1/2"		Liquid Limit	
3/4"		Plastic Index	
1/2"			
3/8"		<u>Swell</u>	
4		Moisture at start	5.5%
10		Moisture at finish	15.0%
20		Moisture increase	9.5%
40		Initial dry density (pcf)	104
100		Swell (psf)	420
200			



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COLORADO SPRINGS, COLORADO 80907

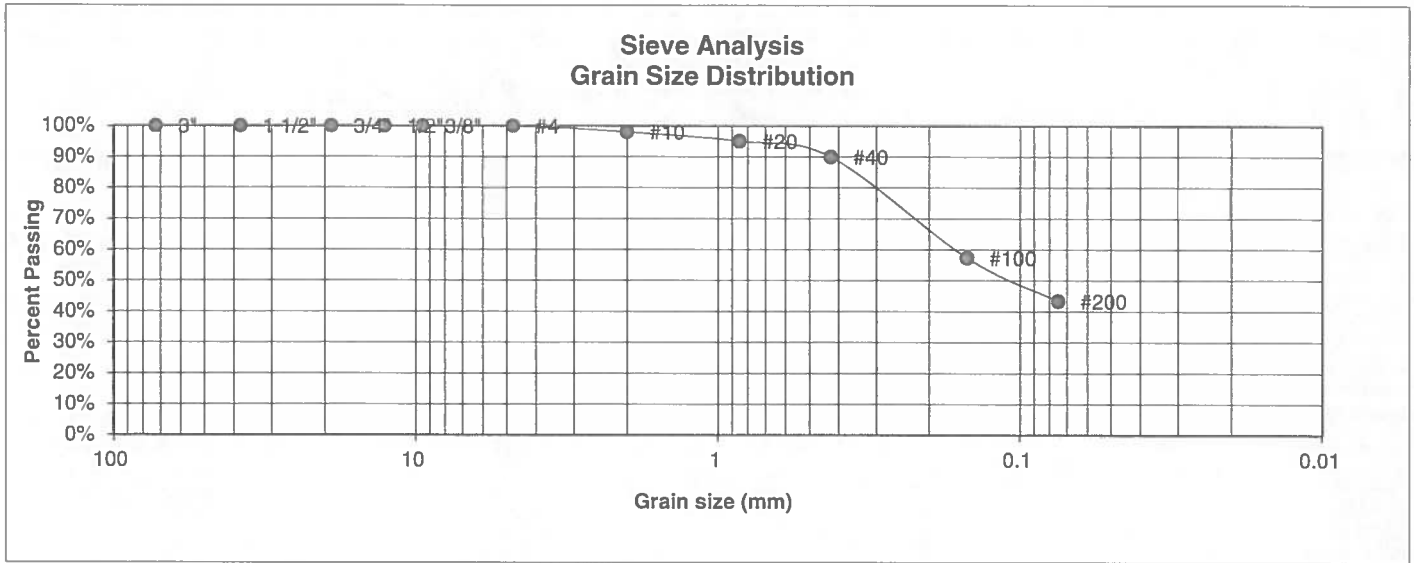
**LABORATORY TEST  
RESULTS**

DRAWN:	DATE:	CHECKED: <i>LLL</i>	DATE:
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JOB NO.:  
171581

FIG NO.:  
*L-5*

<u>UNIFIED CLASSIFICATION</u>	SM	<u>CLIENT</u>	MULE DEER INVESTMENTS
<u>SOIL TYPE #</u>	3	<u>PROJECT</u>	AKERS & N. CAREFREE
<u>TEST BORING #</u>	4	<u>JOB NO.</u>	171581
<u>DEPTH (FT)</u>	5	<u>TEST BY</u>	BL



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	100.0%
1 1/2"	100.0%
3/4"	100.0%
1/2"	100.0%
3/8"	100.0%
4	100.0%
10	98.0%
20	95.1%
40	89.9%
100	57.4%
200	43.4%

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**

<u>DRAWN:</u>	<u>DATE:</u>	<u>CHECKED:</u>	<u>DATE:</u>
		LLL	10/10/17

JOB NO.:  
171581

FIG NO.:

C-6



CLIENT	<u>MULE DEER INVESTMENTS</u>	JOB NO.	<u>171581</u>
PROJECT	<u>AKERS &amp; N. CAREFREE</u>	DATE	<u>10/19/2017</u>
LOCATION	<u>AKERS &amp; N. CAREFREE</u>	TEST BY	<u>BL</u>

BORING NUMBER	DEPTH, (ft)	SOIL TYPE NUMBER	UNIFIED CLASSIFICATION	WATER SOLUBLE SULFATE, (wt%)
TB-4	5	1	SM	0.01

QC BLANK PASS



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**LABORATORY TEST  
SULFATE RESULTS**

DRAWN:	DATE:	CHECKED: LLL	DATE: 10/20/17
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JOB NO.:  
171581  
 FIG NO.:  
C-7

## **APPENDIX D: Soil Survey Descriptions**

## El Paso County Area, Colorado

### 97—Truckton sandy loam, 3 to 9 percent slopes

#### Map Unit Setting

*National map unit symbol:* 36bg  
*Elevation:* 6,000 to 7,000 feet  
*Mean annual precipitation:* 14 to 16 inches  
*Mean annual air temperature:* 46 to 50 degrees F  
*Frost-free period:* 125 to 145 days  
*Farmland classification:* Not prime farmland

#### Map Unit Composition

*Truckton and similar soils:* 80 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

#### Description of Truckton

##### Setting

*Landform:* Hills  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Arkosic alluvium derived from sedimentary rock and/or arkosic residuum weathered from sedimentary rock

##### Typical profile

*A - 0 to 8 inches:* sandy loam  
*Bt - 8 to 24 inches:* sandy loam  
*C - 24 to 60 inches:* coarse sandy loam

##### Properties and qualities

*Slope:* 3 to 9 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Well drained  
*Runoff class:* Low  
*Capacity of the most limiting layer to transmit water (Ksat):* High  
(1.98 to 6.00 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water storage in profile:* Low (about 5.7 inches)

##### Interpretive groups

*Land capability classification (irrigated):* 4e  
*Land capability classification (nonirrigated):* 6e  
*Hydrologic Soil Group:* A  
*Ecological site:* Sandy Foothill (R049BY210CO)  
*Hydric soil rating:* No

### **Minor Components**

#### **Pleasant**

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

#### **Haplaquolls**

*Percent of map unit:*  
*Landform:* Marshes  
*Hydric soil rating:* Yes

#### **Other soils**

*Percent of map unit:*  
*Hydric soil rating:* No

## **Data Source Information**

Soil Survey Area: El Paso County Area, Colorado  
Survey Area Data: Version 14, Sep 23, 2016