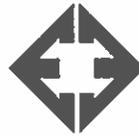


October 30, 2020

Collier McGehee
9845 Walker Road
Colorado Springs, CO 80908



ENTECH
ENGINEERING, INC.

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

Re: OWTS – Wastewater Study
16860 Thompson Road – 2 Lot Subdivision
Parcel No. 51190-04-002
El Paso County, Colorado

Dear Mr. McGehee:

GENERAL SITE CONDITIONS AND PROJECT DESCRIPTION

The site is located in a portion of the NW¼ of the SW¼ of Section 19, Township 11 South, Range 66 West of the 6th Principal Meridian in El Paso County, Colorado. The site is located 8 miles east of Monument, Colorado, on Thompson Road, north of Hodgen Road. The location of the site is as shown on the Vicinity Map, Figure 1.

The topography of the site varies from gently to moderately sloping generally to the south. A drainage exists in the southern portion of the site that flows in an easterly direction through the property. Water was not observed flowing in the drainage in the southern portion of the site. The site boundaries are indicated on the USGS Map, Figure 2. Previous land uses have included grazing and pasture land. The site contains primarily low grasses, and field weeds. Site photographs, taken August 26, 2020, are included in Appendix A. The approximate locations and directions of the photographs are indicated on Figure 3.

Total acreage involved in the proposed development is 10.5 acres. Two single-family rural residential lots are proposed. Lot sizes are approximately 5 acres. The lots will be serviced by individual wells and on-site wastewater treatment systems.

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 with regards to on-site wastewater treatment systems (OWTS).

FIELD INVESTIGATION

Our field investigation consisted of the preparation of a geologic map of 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 aerial photo reconnaissance and interpretation. The same mapping procedures have also been utilized to produce the Geology/Engineering Geology Map which identified pertinent geologic conditions

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16860 Thompson Road – 2 Lot Subdivision
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El Paso County, Colorado

affecting development. The field mapping was performed by personnel of Entech Engineering, Inc. on August 26, 2020.

Lot 2 was investigated by Entech Engineering, Inc. Two test borings were drilled in the proposed house location and two test pits were excavated in the proposed OWTS locations to determine general suitability for the use of on-site wastewater treatment systems and general soil characteristics for residential construction. The locations of the test pits are indicated on the Site Plan/Test Pit Location Map, Figure 3. The Test Boring and Test Pit Logs are presented in Appendix B.

Laboratory testing was also performed on some of the soils to classify and determine the soils engineering characteristics. Laboratory tests included grain-size analysis, ASTM D-422, and Atterberg Limits, ASTM D-4318. Results of the laboratory testing are included in Appendix C. A Summary of Laboratory Test Results is presented in Table 1.

PREVIOUS INVESTIGATIONS

Lot 1 was previously investigated by Parr Engineering & Consulting, Inc. in a Subsurface Soil Investigation dated April, 22, 2019 (Reference 1, Appendix D), and a STA Soil Evaluation, dated February 27, 2017 (Reference 2, Appendix E). Information from these reports were used in evaluating the site.

SOIL AND GEOLOGIC CONDITIONS

Soil Survey

The Natural Resource Conservation Service (NRCS) (Reference 3, Figure 4), previously the Soil Conservation Service (Reference 4) has mapped one soil type on the site. Complete descriptions of the soil type is presented in Appendix F. In general, they vary from sandy loam and loamy sand to clay loam. The soils are described as follows:

<u>Type</u>	<u>Description</u>
67	Peyton Sandy Loam, 5-9 % slopes

The soils have generally been described to have moderate permeabilities. Limitations on development include limited ability to support a load, and frost action 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 (Reference 4).

Soils

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

Soil Type 1 is a silt-sand (ML-CL), and sandy clay (CL) encountered in the upper 3 to 5 feet of the testing locations. These soils were encountered at stiff consistencies and at moist conditions. Samples tested had 50 to 63 percent of the soil sized particles passing the No. 200 Sieve. The silty and clay soils in the area are known to have the potential for collapse or expansion.

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OWTS – Wastewater Study
16860 Thompson Road – 2 Lot Subdivision
Parcel No. 51190-04-002
El Paso County, Colorado

Soil Type 2 is a weathered to formational silty sandstone (SM) encountered in all of testing locations at depths ranging from 1 to 5 feet. The sandstone was encountered at dense to very dense states and at moist conditions. Samples tested had 11 to 22 percent of the soil size particles passing the No. 200 Sieve. Highly expansive siltstone and claystone are commonly interbedded in the sandstone in this area.

The Test Boring and Test Pit Logs are presented in Appendix B, and the Laboratory test results are presented in Appendix C. A Summary of Laboratory Test Results is presented in Table 1.

Groundwater

Groundwater was not encountered in any of the Test Borings which were drilled to 20 feet. Signs of seasonally occurring groundwater was observed at 7.5 feet in Test Pit No. 1. Areas of seasonal and potentially seasonal shallow groundwater have been mapped in the drainage 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 or clays. 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.

Geology

Approximately 11 miles west of the site 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 a large structural feature known as the Denver Basin. Bedrock in the area is typically gently dipping in a northerly direction (Reference 5). The bedrock underlying the site consists of the Dawson Formation of Cretaceous Age. The Dawson Formation typically consists of coarse-grained arkosic sandstone with interbedded layers claystone or siltstone.

The geology of the site was evaluated using the *Geologic Map of the Black Forest*, by Thorson in 2003, (Reference 6, Figure 5). The Geology Map for the site is presented in Figure 6. Three mappable units were identified on this site which is described as follows:

- Qaf Artificial Fill of Quaternary Age:** These are man-made fill deposits associated with the earthen dam in the southeastern portion of the site.

- Qal Recent Alluvium of Quaternary Age:** These are recent stream deposits in the channel of the drainage in the southern portion of the site.

Qc/Tkd Colluvium of Quaternary Age overlying Dawson Formation of Tertiary to Cretaceous Age: The materials consist of colluvial or residual soils overlying the bedrock materials on-site. The colluvial soils were deposited by the action of sheetwash and gravity. The residual soils were derived from the in-situ weathering of the bedrock on site. These materials typically consist of silty to clayey sand with potential areas of sandy clays. The bedrock consists of the Dawson Formation. The Dawson Formation typically consists of coarse-grained, arkosic sandstone with interbedded lenses of fine-grained sandstone, siltstone and claystone.

The soils listed above were mapped from site-specific mapping, the *Geologic Map of the Black Forest Quadrangle* distributed by the Colorado Geologic Survey in 2003 (Reference 6, Figure 5), *The Geologic Map of the Colorado Springs-Castle Rock Area*, distributed by the US Geological Survey in 1979 (Reference 7), and the *Geologic Map of the Denver 1° x 2° Quadrangle*, distributed by the US Geological Survey in 1981 (Reference 8). The test borings and test pits were used in evaluating the site and is included in Appendix B. The Geology Map prepared for the site is presented in Figure 6.

Drainage Areas

A drainage exists in the southern portion of the site and a minor drainage in the central portion of the site that flows in easterly direction. No water was observed flowing in the drainages at the time of the investigation. This drainage has been mapped as seasonal and potentially seasonal shallow groundwater areas (Figures 6 & 8).

In potentially seasonal shallow groundwater and seasonally shallow groundwater areas, we would anticipate the potential for periodically high subsurface moisture conditions and highly organic soils. Due to the potential for seasonal high groundwater conditions, on-site wastewater treatment systems are not recommended in these areas. Due to lot sizes, it is anticipated these areas can be avoided. The site does not lie within any floodplain zones according to the FEMA Map No. 08041CO305G dated December 7, 2018 (Figure 7, Reference 9). Exact locations of floodplain and specific drainage studies are beyond the scope of this report. Individual wastewater treatment systems must be located a minimum of 25 feet from dry gulches and 50 feet from water courses or floodplains.

Areas must be dedicated as no-build and a plat note added that septic systems cannot be located within drainage area

ON-SITE WASTEWATER TREATMENT

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

Soils encountered in the tactile test pits consisted sandy clay. The limiting layers encountered in the test pits is the sandy clay, which corresponds with USDA Soil Type 4A with an LTAR values of 0.15 gallons per day per square foot. Bedrock was encountered at 3 to 5 feet in the test pits, and signs of seasonally occurring groundwater were observed in the Test Pit No. 1 at 7.5 feet. Absorption fields must be maintained a minimum of 4 feet above groundwater or bedrock, or confining layer. Should groundwater or bedrock be encountered within 6 feet of the surface, designed systems will be required. Soil Type 1A with an LTAR of 0.15 was also determined for Lot 1 in the previous investigation. Designed systems are anticipated for both of the lots due to

Collier McGehee
OWTS – Wastewater Study
16860 Thompson Road – 2 Lot Subdivision
Parcel No. 51190-04-002
El Paso County, Colorado

the highly clayey soils and shallow bedrock, however, areas may be encountered on the lots where conventional systems would be suitable.

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 designed systems will be required for the new lot. The Septic Suitability Map is presented in Figure 8. Areas that should be avoided by septic systems are indicated on the septic suitability map. A possible house location, water well, and two septic sites for the new lots are indicated on Figure 8. **Individual soil testing is required for proposed construction on each lot 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.

CLOSURE

This report has been prepared for Collier McGehee, 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.

Respectfully Submitted,

ENTECH ENGINEERING, INC.

Reviewed by:

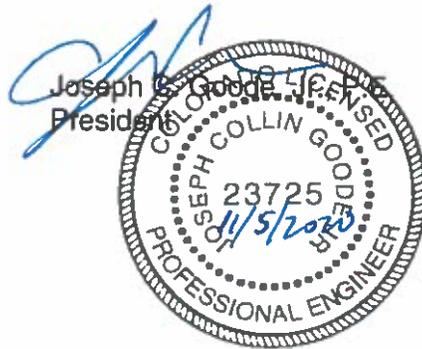


Logan L. Langford, P.G.
Geologist

LLL

Encl.

Entech Job No. 201695
AAprojects/2020/201695 wws



Collier McGehee
OWTS – Wastewater Study
16860 Thompson Road – 2 Lot Subdivision
Parcel No. 51190-04-002
El Paso County, Colorado

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1. Parr Engineering & Consulting, Inc. dated April 22, 2019. *Subsurface Soil Investigation, 16860 Thompson Road, Colorado Springs, Colorado*. Parr Job No. 19.144.
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4. United States Department of Agriculture Soil Conservation Service. June 1981. *Soil Survey of El Paso County Area, Colorado*.
5. Bryant, Bruce; McGrew, Laura W. and Wobus, Reinhard A. 1981. *Geologic Structure Map of the Denver 1° x 2° Quadrangle, North-Central Colorado*. U.S. Geologic Survey. Map I-1163. Sheet 2.
6. Thorson, Jon P., 2003. *Geologic Map of the Black Forest Quadrangle, El Paso County, Colorado*. Colorado Geological Survey. Open-File Report 03-6.
7. Trimble, Donald E. and Machette, Michael N. 1979. *Geologic Map of the Colorado Springs-Castle Rock Area, Front Range Urban Corridor, Colorado*. USGS, Map I-857-F.
8. 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 I-1163.
9. Federal Emergency Management Agency. December 7, 2018. *Flood Insurance Rate Maps for the City of Colorado Springs, Colorado*. Map Number 08041CO305G

TABLES

TABLE 1
SUMMARY OF LABORATORY TEST RESULTS

CLIENT COLLIER MCGEHEE
 PROJECT 16860 THOMPSON ROAD
 JOB NO. 201695

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			50.2						ML-SM	SILT-SAND
1	TP-1	3			62.5						CL	CLAY, SANDY
2	1	5			14.0						SM	SANDSTONE, SILTY
2	2	10			22.0						SM	SANDSTONE, SILTY
2	TP-1	7			10.9						SM-SW	SANDSTONE, SLIGHTLY SILTY

Table 2: 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*	N/A	N/A
2	4A*	0.15*	N/A	N/A

*- Conditions that will require an engineered OWTS

FIGURES

Franktown
Parker FPE-5
Reservoir

SITE

Wild Hair Apacas

Franktown
Parker FPE-2
Reservoir

39°04'00.0"N, 104°43'38.9"W (E: 06968, -104 72747)

1000 ft



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VICINITY MAP
16860 THOMPSON ROAD
EL PASO COUNTY, CO.
FOR: COLLIER MCGEHEE

DRAWN:
LLL

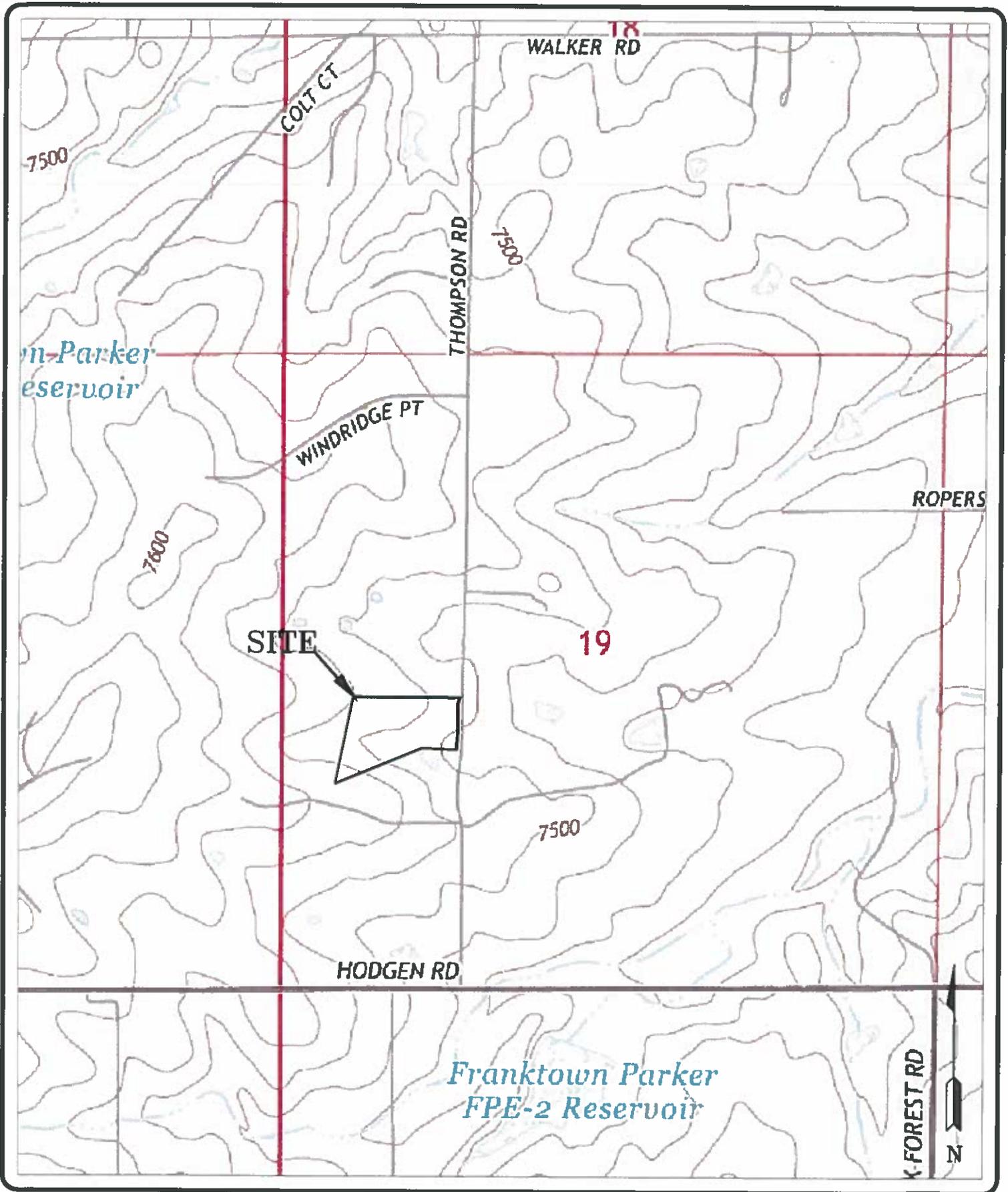
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10/15/20

CHECKED:

DATE:

JOB NO.:
201695

FIG NO.:
1



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USGS MAP
 18860 THOMPSON ROAD
 EL PASO COUNTY, CO.
 FOR: COLLIER MCGEHEE

JOB NO.:
 201695

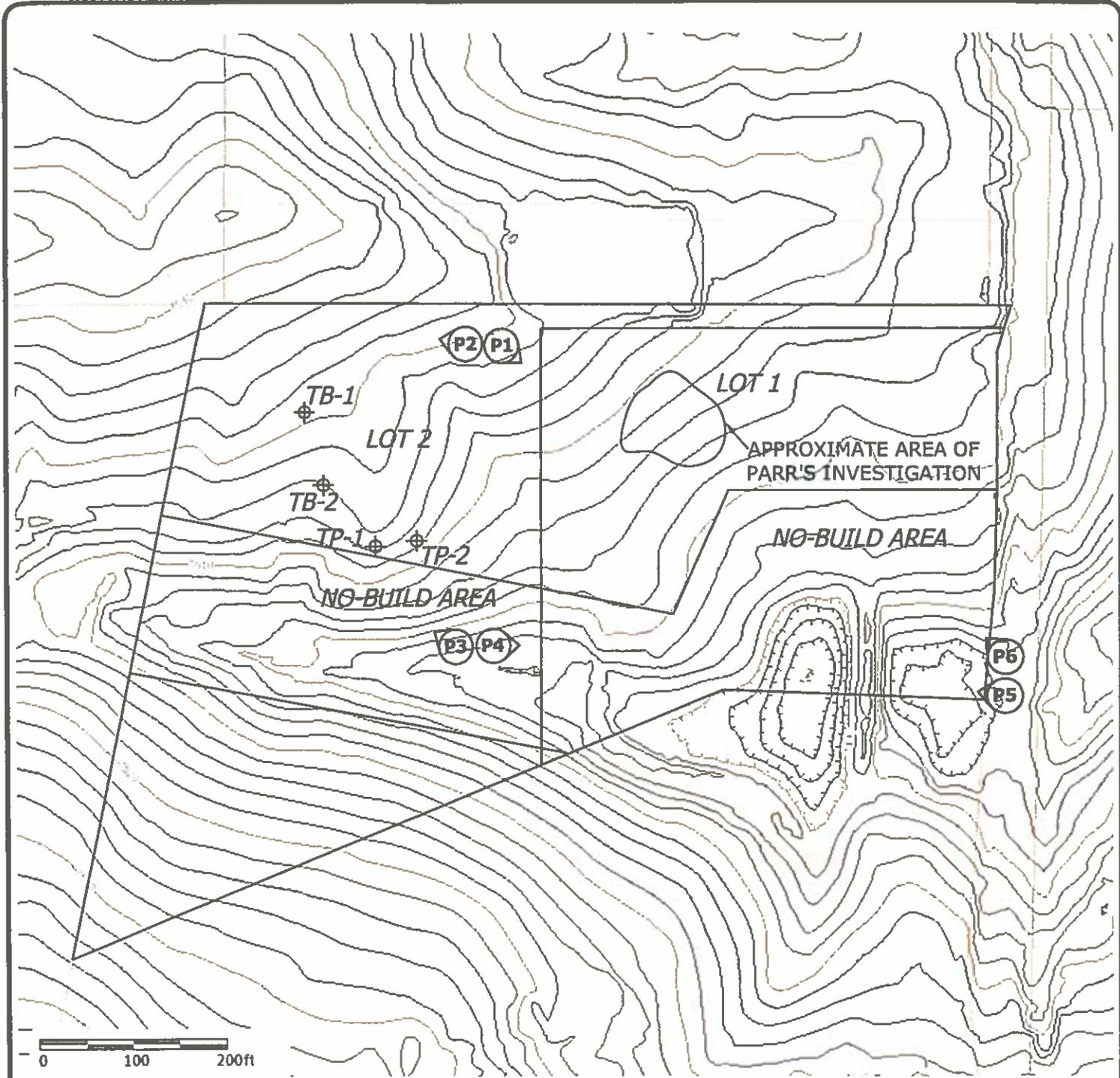
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 LLL

DATE:
 10/15/20

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DATE:

FIG NO.:
 2



-  TP- APPROXIMATE TEST PIT LOCATION AND NUMBER
-  - APPROXIMATE TEST PIT LOCATION AND NUMBER



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SITE PLAN
 16860 THOMPSON ROAD
 EL PASO COUNTY, CO.
 FOR: COLLIER MCGEHEE

JOB NO.:
 201695

FIG NO.:
 3

DRAWN:
LLL

DATE:
 10/15/20

CHECKED:

DATE:



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SOIL SURVEY MAP
16860 THOMPSON ROAD
EL PASO COUNTY, CO.
FOR: COLLIER MCGEHEE

DRAWN:
LLL

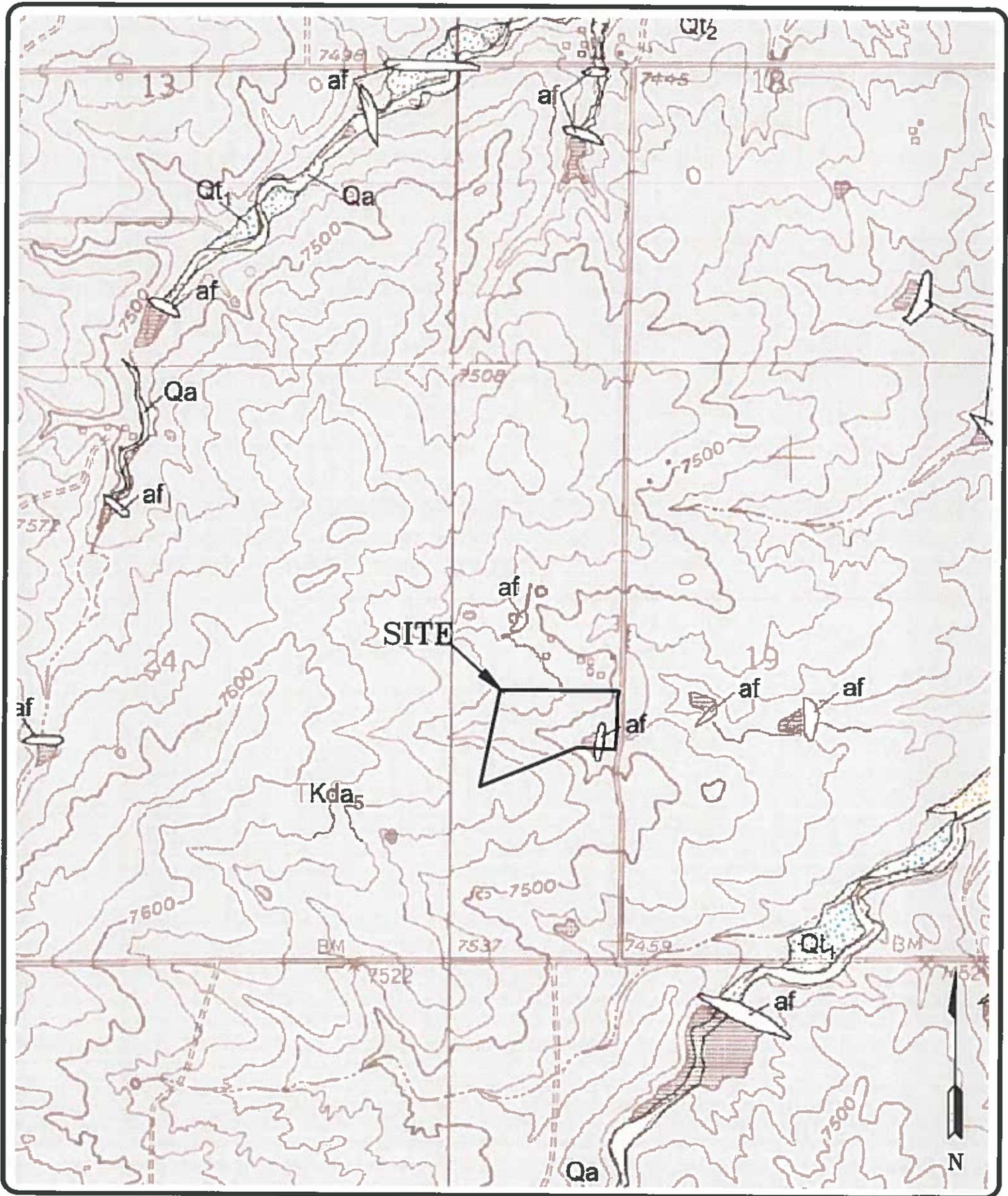
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10/15/20

CHECKED:

DATE:

JOB NO.:
201695

FIG NO.:
4



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BLACK FOREST QUADRANGLE GEOLOGIC MAP
 18860 THOMPSON ROAD
 EL PASO COUNTY, CO.
 FOR: COLLIER MCGEHEE

DRAWN:
 LLL

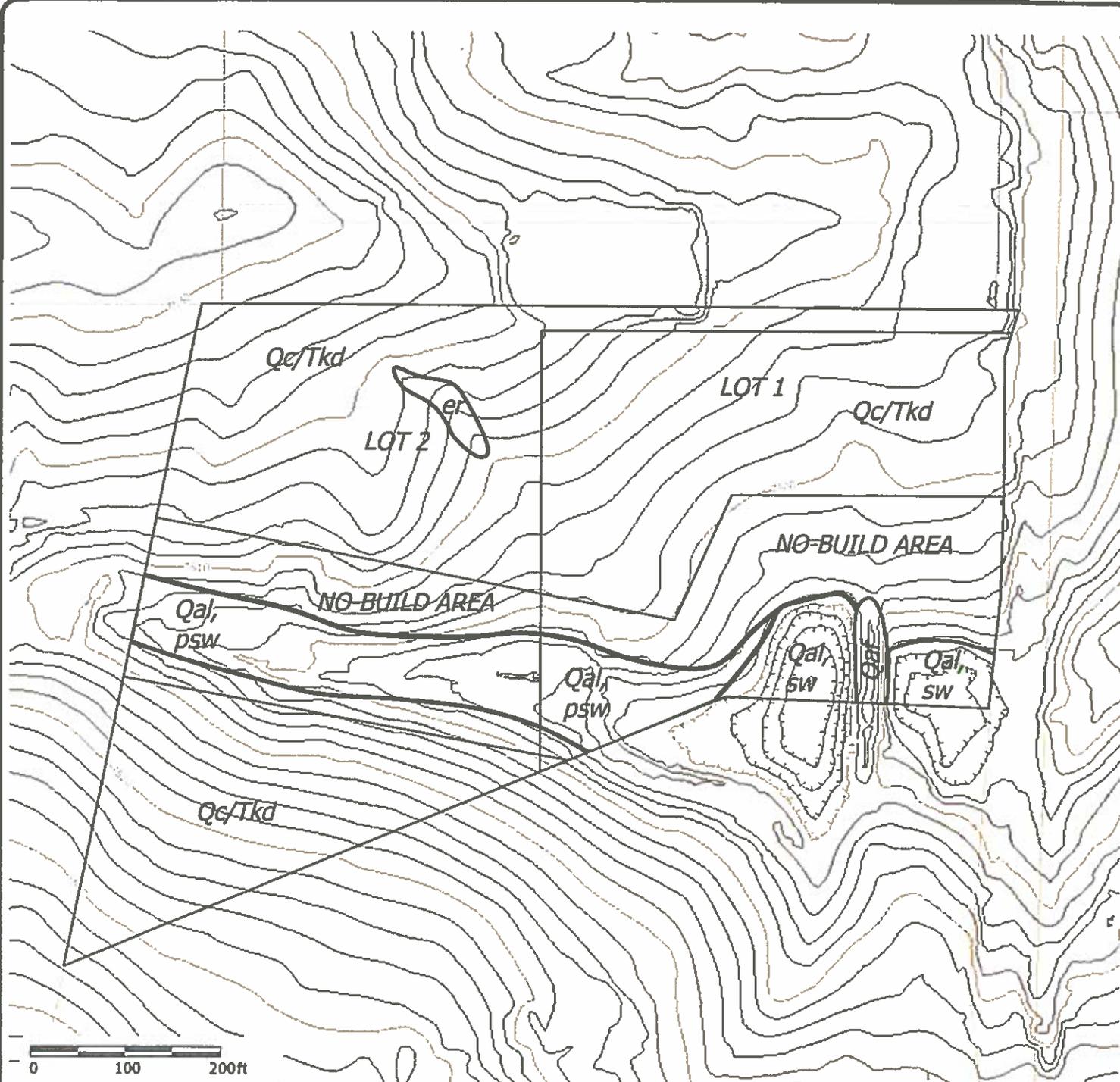
DATE:
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DATE:

JOB NO.:
 201695

FIG NO.:
 5



Legend:

- Qal - Artificial Fill of Holocene Age:
man-made fill deposits
- Qal - Alluvium of Holocene and Pleistocene Age:
recent alluvium associated with the drainages on site
- QcTKd - Colluvium of Quaternary Age overlying Dawson Formation of Tertiary to Cretaceous Age:
colluvial and residual soils overlying arkosic sandstone with interbedded fine-grained sandstone, siltstone and claystone

- psw - potentially shallow groundwater area
- sw - seasonal shallow groundwater area
- er - areas of erosion



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GEOLOGY/ENGINEERING GEOLOGY MAP
 16860 THOMPSON ROAD
 EL PASO COUNTY, CO.
 FOR: COLLIER MCGEEHEE

JOB NO.:
201695

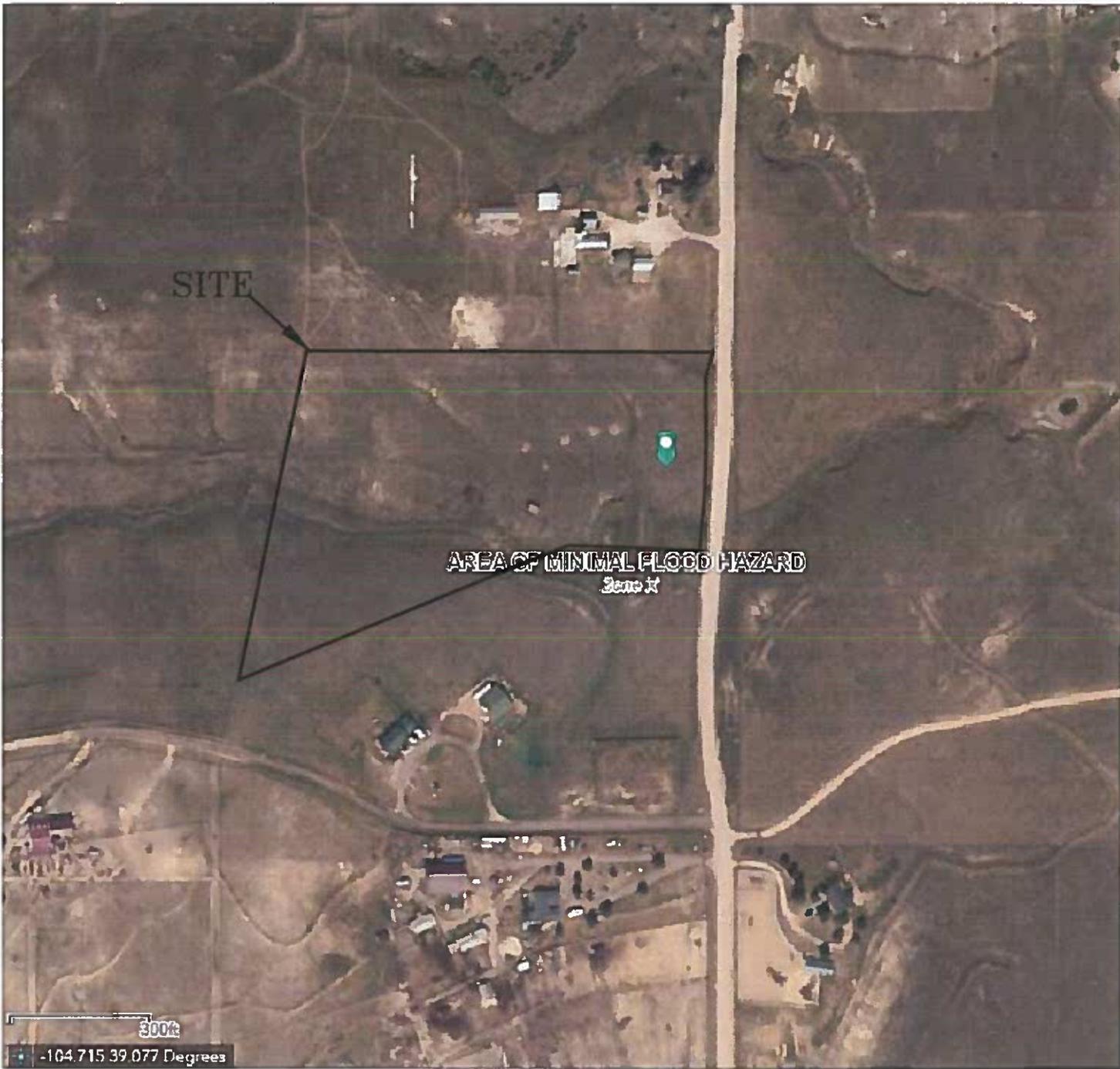
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FIG NO.:
6



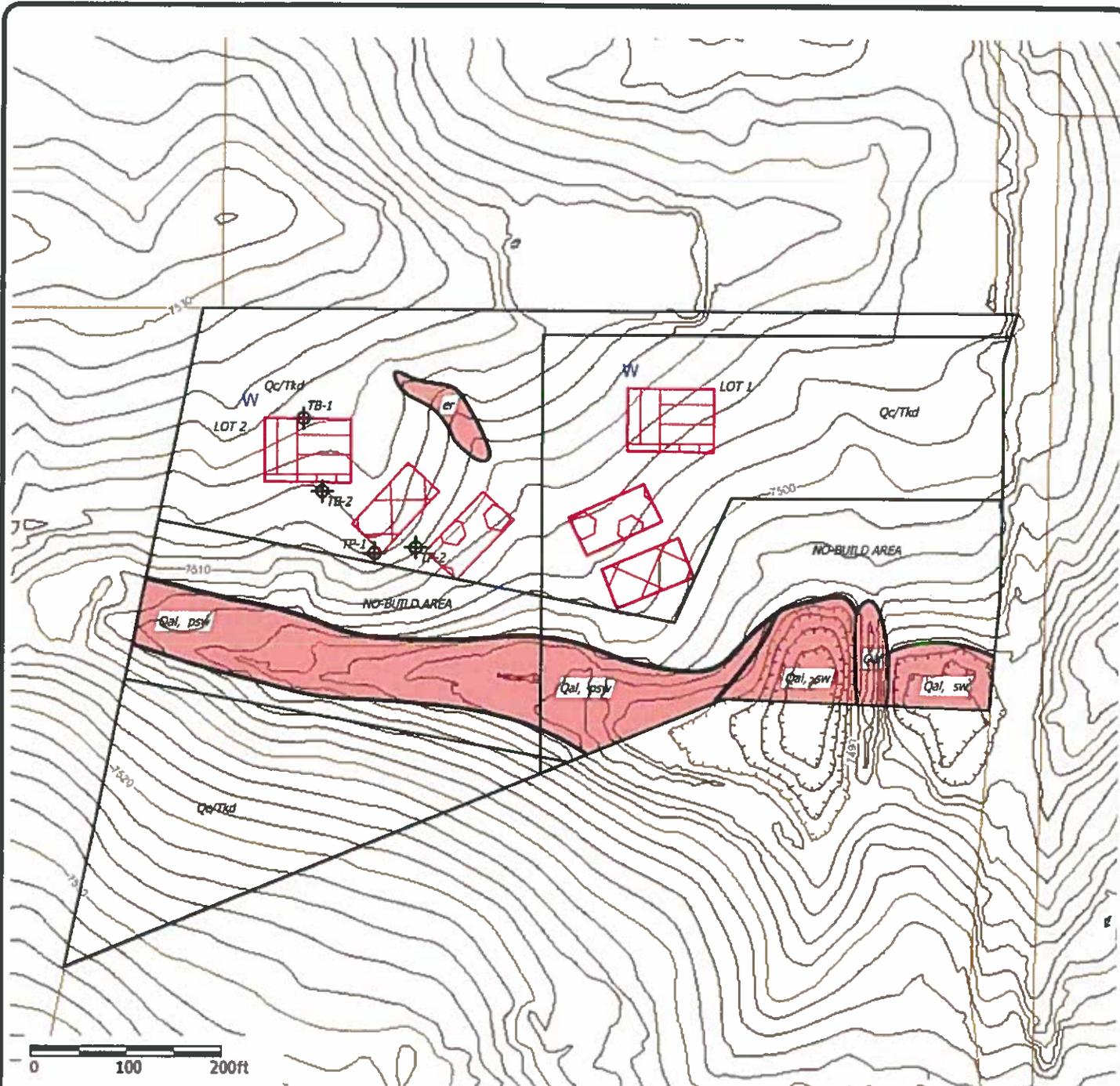

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FEMA FLOODPLAIN MAP
16860 THOMPSON ROAD
EL PASO COUNTY, CO.
FOR: COLLIER MCGEHEE

DRAWN: LLL	DATE: 10/15/20	CHECKED:	DATE:
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JOB NO.:
201695

FIG NO.:
7



LEGEND:

-  - POSSIBLE OWTS LOCATIONS
-  - POSSIBLE OWTS ALTERNATE LOCATIONS
-  - POSSIBLE HOUSE LOCATIONS
-  - AREAS WHERE OWTS ARE NOT RECOMMENDED

W * WATER WELLS MUST BE A MINIMUM OF 100 FT FROM OWTS ABSORPTION FIELDS



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685 CLIXTON DRIVE
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SEPTIC SUITABILITY MAP
 16860 THOMPSON ROAD
 EL PASO COUNTY, CO.
 FOR: COLLIER MCGEHEE

JOB NO.:
201695

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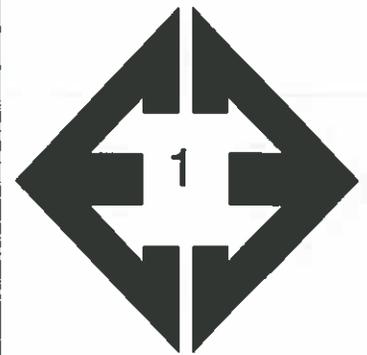
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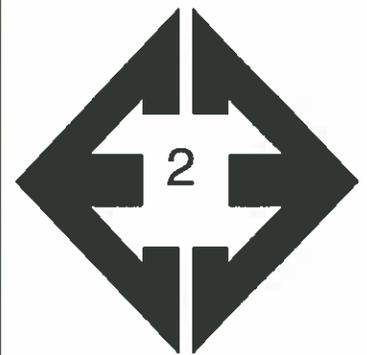
FIG NO.:
8

APPENDIX A: Photographs



Looking east from the northern portion of the site.

August 26, 2020



Looking west from the northern portion of the site.

August 26, 2020



Looking west from the drainage in the central portion of the site.

August 26, 2020



Looking east along the drainage in the central portion of the site.

August 26, 2020



**Looking west along
the drainage toward
earthen dam in the
southeastern side of
the site.**

August 26, 2020



**Looking northwest
from the southeastern
side of site.**

August 26, 2020

APPENDIX B: Test Boring and Test Pit Logs

TEST BORING NO. 1
 DATE DRILLED 9/23/2020
 Job # 201695

TEST BORING NO. 2
 DATE DRILLED 9/23/2020
 CLIENT COLLIER McGEHEE
 LOCATION 16860 THOMPSON ROAD

REMARKS

DRY TO 20', 9/23/20
 SILT-SAND, TAN
 WEATHERED TO FORMATIONAL
 SANDSTONE, SILTY, FINE TO
 COARSE GRAINED, TAN, DENSE
 TO VERY DENSE, DRY TO MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
					1
			48	2.1	2
5			50	2.2	2
			11"		
10			46	8.1	2
15			50	8.8	2
			6"		
20			50	10.4	2
			11"		

REMARKS

DRY TO 20', 9/23/20
 6" TOPSOIL, SILT-SAND, TAN,
 STIFF, MOIST
 WEATHERED TO FORMATIONAL
 SANDSTONE, SILTY, FINE TO
 COARSE GRAINED, TAN, DENSE
 TO VERY DENSE, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
					1
			20	5.6	1
5			40	4.5	2
10			45	8.5	2
15			50	7.9	2
			11"		
20			50	7.7	2
			9"		



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TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
		ELL	9/23/20

JOB NO. 201695

FIG NO. 3-1

TEST PIT NO. 1
 DATE EXCAVATED 8/26/2020
 Job # 201695

TEST PIT NO. 2
 DATE EXCAVATED 8/26/2020
 CLIENT COLLIER MCGEHEE
 LOCATION 16860 THOMPSON ROAD

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
topsoil sandy clay, dark brown	1	[diagonal lines]		ma	s	4A	topsoil sandy clay, dark brown	1	[diagonal lines]		ma	s	4A
sandy clay, brown	2	[diagonal lines]					sandy clay, brown	2	[diagonal lines]				
	3	[diagonal lines]						3	[diagonal lines]				
highly weathered to formational silty sandstone, light brown	4	[dotted]		gr	w	3A		4	[dotted]				
	5	[dotted]					highly weathered to formational silty sandstone, light brown	5	[dotted]				
	6	[dotted]						6	[dotted]		gr	w	3A
	7	[dotted]						7	[dotted]				
*-signs of seasonally occurring groundwater at 7.5'	8	[dotted]		ma		3A		8	[dotted]		ma		3A
	9	[dotted]						9	[dotted]				
	10	[dotted]						10	[dotted]				

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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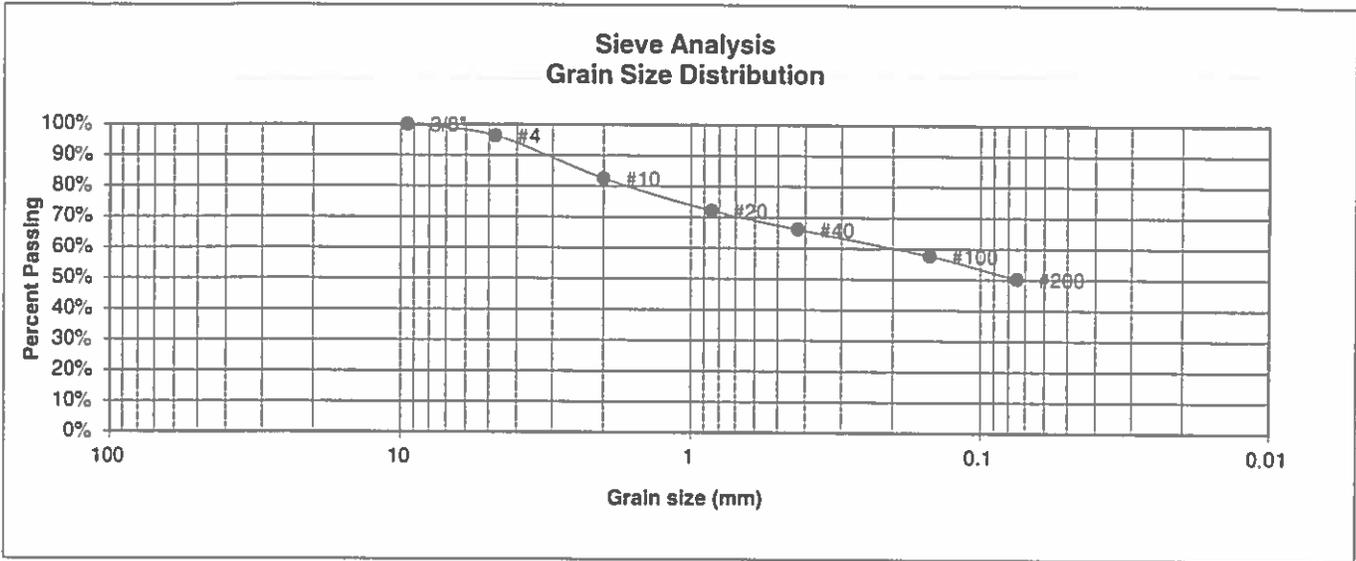
TEST PIT LOG

DRAWN	DATE	CHECKED	DATE
		LL	10/9/20

JOB NO.:
 201695
 FIG NO.:
 B-2

APPENDIX C: Laboratory Test Results

BORING NO.	2	UNIFIED CLASSIFICATION	ML-SM	TEST BY	BL
DEPTH(ft)	2-3	AASHTO CLASSIFICATION		JOB NO.	201695
CLIENT	COLLIER McGEHEE				
PROJECT	16860 THOMPSON ROAD				



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	96.3%
10	82.5%
20	72.1%
40	66.1%
100	57.7%
200	50.2%

- 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

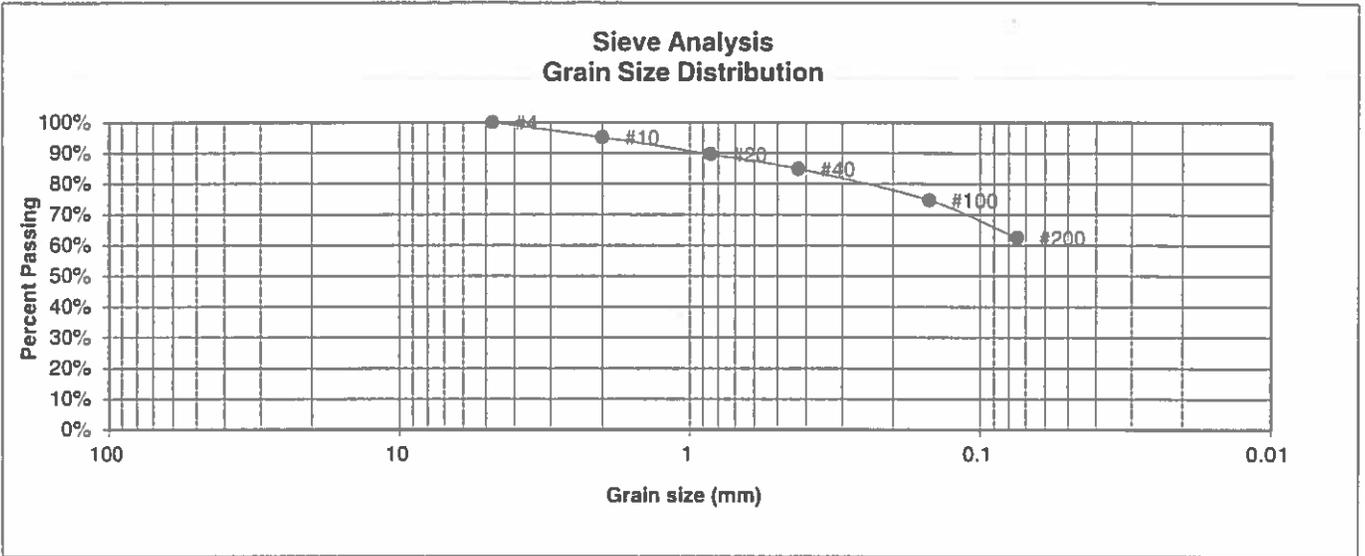
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED: LLL	DATE 10/1/20
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JOB NO:
201695

FIG NO:
C-1

BORING NO.	TP-1	<u>UNIFIED CLASSIFICATION</u>	CL	<u>TEST BY</u>	BL
DEPTH(ft)	3	<u>AASHTO CLASSIFICATION</u>		<u>JOB NO.</u>	201695
CLIENT	COLLIER McGEHEE				
PROJECT	16860 THOMPSON ROAD				



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	95.1%
20	89.6%
40	84.9%
100	74.7%
200	62.5%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

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



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

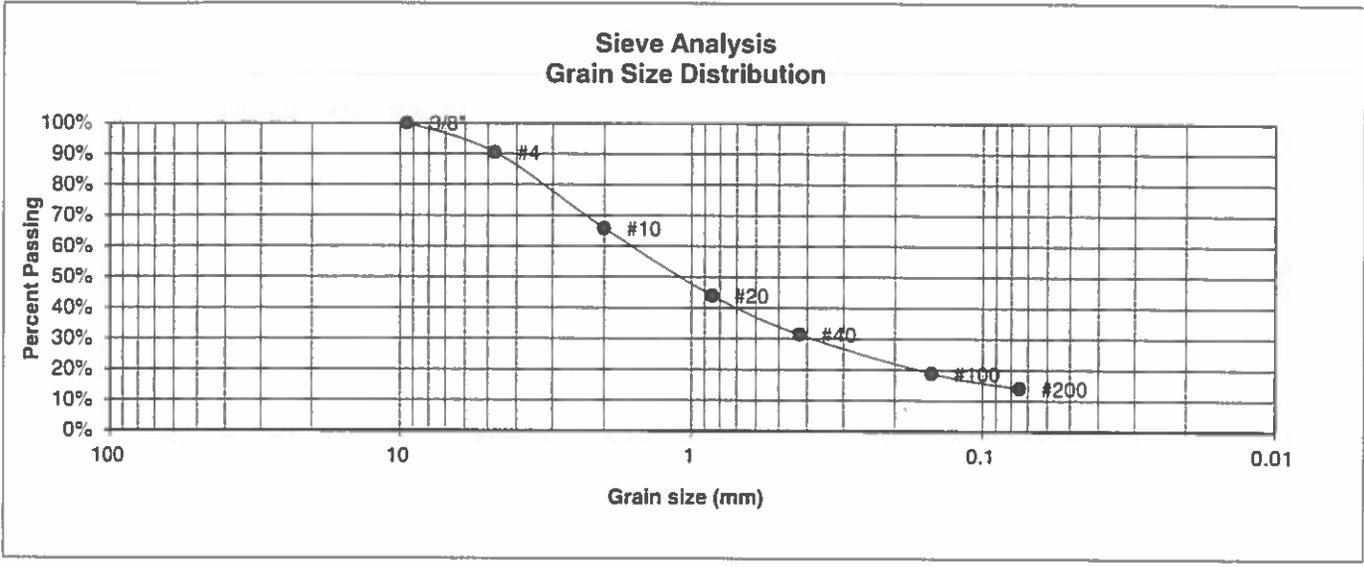
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		200	10/12/20

JOB NO:
201695

FIG NO:
C-2

BORING NO.	1	<u>UNIFIED CLASSIFICATION</u>	SM	<u>TEST BY</u>	BL
DEPTH(ft)	5	<u>AASHTO CLASSIFICATION</u>		<u>JOB NO.</u>	201695
CLIENT	COLLIER McGEHEE				
PROJECT	16860 THOMPSON ROAD				



U.S. Sieve #	Percent Finer	Atterberg Limits
3"		Plastic Limit
1 1/2"		Liquid Limit
3/4"		Plastic Index
1/2"		
3/8"	100.0%	
4	90.5%	<u>Swell</u>
10	65.8%	Moisture at start
20	44.0%	Moisture at finish
40	31.4%	Moisture increase
100	18.8%	Initial dry density (pcf)
200	14.0%	Swell (psf)



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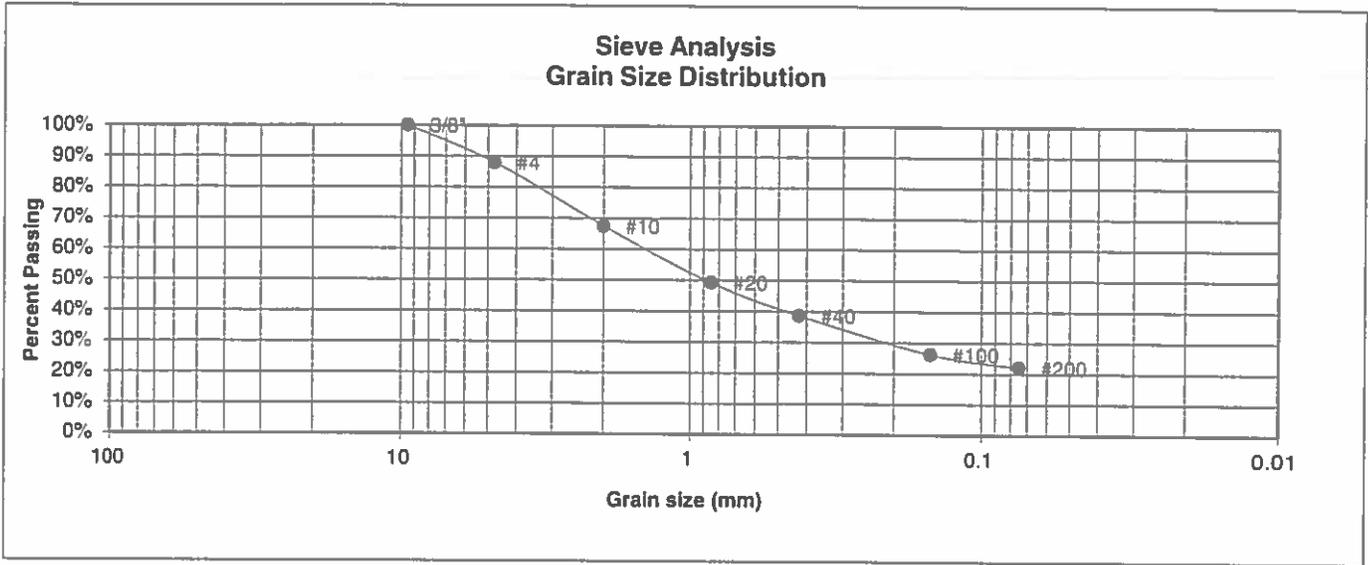
**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	10/9/20

JOB NO:
201695

FIG NO:
23

BORING NO. 2	UNIFIED CLASSIFICATION SM	TEST BY BL
DEPTH(ft) 10	AASHTO CLASSIFICATION	JOB NO. 201695
CLIENT COLLIER McGEHEE		
PROJECT 16860 THOMPSON ROAD		



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	88.0%
10	67.4%
20	49.3%
40	38.6%
100	26.2%
200	22.0%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

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



**ENTECH
ENGINEERING, INC.**

505 ELKTON DRIVE
 COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST
RESULTS**

DRAWN:

DATE:

CHECKED:
LLL

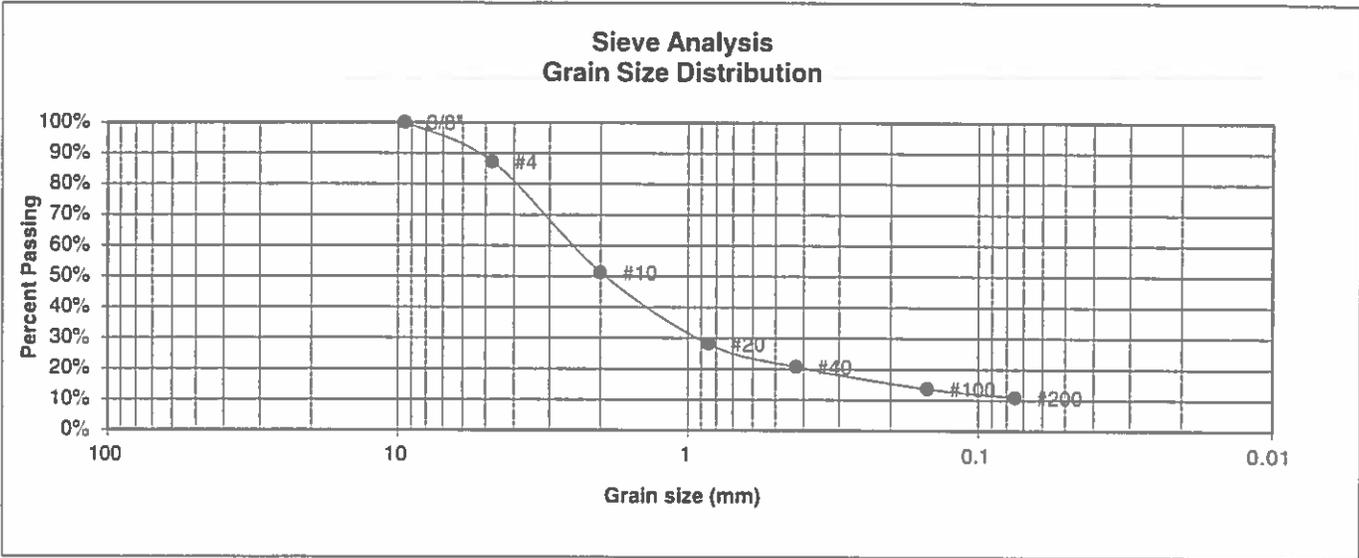
DATE:
10/9/20

JOB NO.:
201695

FIG NO:

C-4

BORING NO.	TP-1	<u>UNIFIED CLASSIFICATION</u>	SM-SW	<u>TEST BY</u>	BL
DEPTH(ft)	7	<u>AASHTO CLASSIFICATION</u>		<u>JOB NO.</u>	201695
CLIENT	COLLIER McGEHEE				
PROJECT	16860 THOMPSON ROAD				



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	87.2%
10	51.2%
20	28.2%
40	20.7%
100	13.7%
200	10.9%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

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



**ENTECH
ENGINEERING, INC.**

505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST
RESULTS**

DRAWN:

DATE:

CHECKED:

DATE:

JOB NO:
201695

FIG NO:
2-5

**APPENDIX D: Parr Engineering & Consulting, Inc. Subsurface Soil
Investigation, Parr Job No. 19.144**

PARR ENGINEERING & CONSULTING, INC.

Christopher L. Parr, P.E. Principal
11590 Black Forest Road, Suite 10
Colorado Springs, Colorado 80908
Office: 719-494-0404

Structural Engineering & Consulting
Geotechnical Engineering
On-Site Wastewater Treatment Design
Inspections & Technical Reports

April 22, 2019

JN 19.144

Project: **Subsurface Soil Investigation**
 16860 Thompson Road
 Colorado Springs, CO 80908

Attached is a formal soils report for the project referenced above. Included in this report is a review of the soils investigation and analysis for this location. The purpose of our investigation was to evaluate the conditions of the subsurface soil in order to establish design and construction criteria for the proposed structure(s). A discussion of the results of our investigation with construction recommendations is also included. If revisions to the design of the proposed structure take place, it is advised that our firm be contacted immediately to review the changes and to determine if the revised plans are acceptable.

If you have any questions concerning this report please feel free to contact our office at 719-494-0404.

Sincerely,

Jared R. Dumke, P.E.



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Purpose and Scope of Study

This report presents the results of a subsurface exploration program to provide foundation recommendations for the proposed structure to be located on the parcel of land referenced above.

The exploration program was conducted in order to obtain information regarding the subsurface conditions. Soil samples were retrieved from a soil boring(s) and analyzed to provide data on the classification and engineering characteristics of the on-site soils. The results of the field and laboratory investigation are presented herein.

This report has been prepared to summarize the data obtained and to present our conclusion and recommendations based on the proposed construction and the subsurface conditions encountered. Design criteria and a discussion of the geotechnical engineering considerations related to the construction of the proposed structure are included.

The information presented in this report is NOT intended to be used as a design. The foundation design requirements and all inspections associated with the foundation design is the responsibility of the Structural Engineer of Record.

Proposed Construction

Based on the information provided, the proposed construction will consist of a wood framed, single family residential structure supported on a reinforced concrete foundation system. We anticipate maximum structural loadings of 3000 pounds per lineal foot for distributive wall loads and 15 kips for concentrated column loads.

If the project features or loadings differ significantly from those above, our firm should be contacted to reevaluate the recommendations contained herein.

Field Investigation

The field investigation for this project was conducted on April 16, 2019.

A 4" diameter exploratory boring was drilled to approximately 20 feet below grade in the area of the proposed construction. Standard penetration testing (SPT) was conducted during the drilling process.

The SPT measures resistance to penetration of a standard split-spoon sampler that is driven by a 140 lbm hammer dropped from a height of 30 in. The number of blows required to drive the sampler a distance of 12 in. after an initial penetration of 6 in. is referred to as the N-value or standard penetration resistance in blows per foot.

The representative samples obtained from the SPT split-spoon sampler are saved for subsequent laboratory examination and testing.

Laboratory Investigation

The field samples obtained were analyzed and classified in the laboratory. Laboratory testing included standard property tests, natural water content, Atterberg limits and Expansion Index tests.

The laboratory testing was conducted in general accordance with ASTM specifications.

Subsurface Conditions

The following tables summarize information obtained about the subsurface conditions encountered:

Soil Classification	Sample Depth	Gravel	Sand	Fines	LL ¹	PI ²	EI ³	Expansive Potential
Clayey Sand (SC)	5 ft.	0.5%	69.2%	30.2%	29	13	52	Medium

LL – Liquid Limit ¹

PI – Plasticity Index ²

EI – Expansion Index ³

Soil Classification	Sample Depth	SPT N-Value	Relative Density	Moisture Content	Clay Content	Expansive Index	Expansion Potential
Clayey Sand (SC)	5 ft.	13/46	Dense	9.6%	Medium	52	Medium
Clayey Sand (SC)	10 ft.	12/40	Medium Dense	8.9%	Medium	N/A	N/A
Clayey Sand (SC)	15 ft.	N/A	Medium Dense	10.5%	Medium	N/A	N/A
Clayey Sand (SC)	20 ft.	N/A	Medium Dense	11.8%	Medium	N/A	N/A

Ground water was not encountered during the time of our investigation. This may be due to lack of moisture received in the area and subsequently may rise due to seasonal changes, degree of irrigation and/or other factors.

Foundation Recommendations

The information obtained indicates subsurface conditions consisting of soil with a medium potential for expansion at depths at and below the proposed bearing depth. Given the nature of the native soil conditions, the following foundation recommendations have been provided to minimize the potential for foundation movement.

Option 1: Overexcavation & Compacted Fill

The native expansive soil shall be over excavated and replaced with properly compacted, offsite structural fill material to a depth of 4 feet minimum below the foundation elements. The fill material shall be compacted to minimum 95% Modified Proctor density. **All foundation elements bearing directly on structural fill material shall be designed for a maximum allowable bearing pressure of 1500 psf.**

Foundation Recommendations (Cont.)

Option 2: Stem Wall Foundation with Voids on Native Soil

The proposed structure may be founded on a balanced, stem-wall foundation system with voids placed on native soil. Foundation elements shall be designed for a maximum allowable bearing pressure of 2300 lb/ft² and a minimum dead load bearing pressure of 300 lb/ft².

It must be emphasized that foundation movement is likely with Options 1 & 2 if moisture changes occur to the soil located below the foundation elements. If structural movement can not be tolerated, other design options should be considered. Contact Parr Engineering and Consulting, Inc. to discuss.

Structural Fill Gradation & Compaction

Structural Fill shall consist of a well graded mixture of sound mineral aggregate particles void of debris containing sufficient proper quality binding materials to secure a firm, stable foundation when placed and compacted. When tested with laboratory sieves, the material shall meet the following gradation requirements:

Standard Sieve Size	% Passing (by Weight)
2 inch	100
No. 4	30-100
No. 50	10-60
No. 200	5-20

Colorado Department of Transportation approved class 4, 5, or 6 base course materials typically meet the above specifications. A report showing the gradation analysis and test results for the materials proposed for structural fill shall be provided to Parr Engineering for review and approval prior to placement.

Imported structural fill shall be placed in 8" maximum uniform lifts and compacted to a minimum 95% Modified Proctor Density (ASTM D-1557) near optimum moisture content.

Compaction testing and confirmation is required at 24" intervals max. Results of the testing must be provided to Parr Engineering & Consulting when complete.

Foundation Walls

Foundation walls which are laterally supported and can be expected to undergo a minimal amount of deflection ("at-rest condition") may be designed for a lateral earth pressure computed on the basis of an equivalent fluid unit weight of 65 pcf for onsite material.

All foundation walls should be designed for appropriate hydrostatic and surcharge pressures such as adjacent buildings, traffic and construction materials and equipment. The pressures recommended above assume a relatively horizontal backfill surface.

The onsite excavated materials may be used as foundation wall backfill. Backfill shall be carefully placed in uniform lifts and properly compacted near optimum moisture content. Care should be taken not to over compact the backfill since this could cause excessive lateral pressure on the walls. Some settlement of deep foundation wall backfill will occur even if the material is placed correctly.

Open Excavation Observation

It is assumed that the results in this report are representative of the subsurface conditions throughout the site. However, variations across the site are a possibility and will not become evident until the foundation excavation is complete.

A representative of Parr Engineering & Consulting shall be contacted to inspect the completed foundation excavation prior to the placement of any formwork. Please contact our office a minimum of 24 hours prior to the requested site visit. This report may be rendered null and void if the open excavation observation is not completed.

The Open Excavation Observation Report will be billed additionally at the time services are complete and prior to the release of any documentation (either electronically or hard copy).

Floor System Recommendations

The natural on-site soils were determined to have a medium potential for expansion when inundated with water. If slab crack control is highly desired, a minimum 6" layer of gravel or aggregate base course shall be placed and compacted to at least 95% Modified Proctor Density (ASTM D-1557) prior to placement of a new slab-on grade. In addition, the new slab shall be reinforced with #3 bars @ 18" o.c. each way, or 4x4-W2.9xW2.9 W.W.F. (centered).

Floor Slabs should be provided with control joints to reduce damage that may occur as a result of shrinkage cracking. We suggest the spacing of the joints to be no more than 15 feet centers. The actual joint spacing should be based on the slab reinforcing design.

Given the nature of the potentially expansive soil conditions, interior slabs supported directly on the native soil can be expected to move and crack when exposed to moisture and should be avoided if possible. If floor movement and cracking cannot be tolerated, interior floor slabs (i.e., basement floors) shall be elevated over a crawl space and designed as structural systems supported independently of the underlying soil.

Surface Drainage

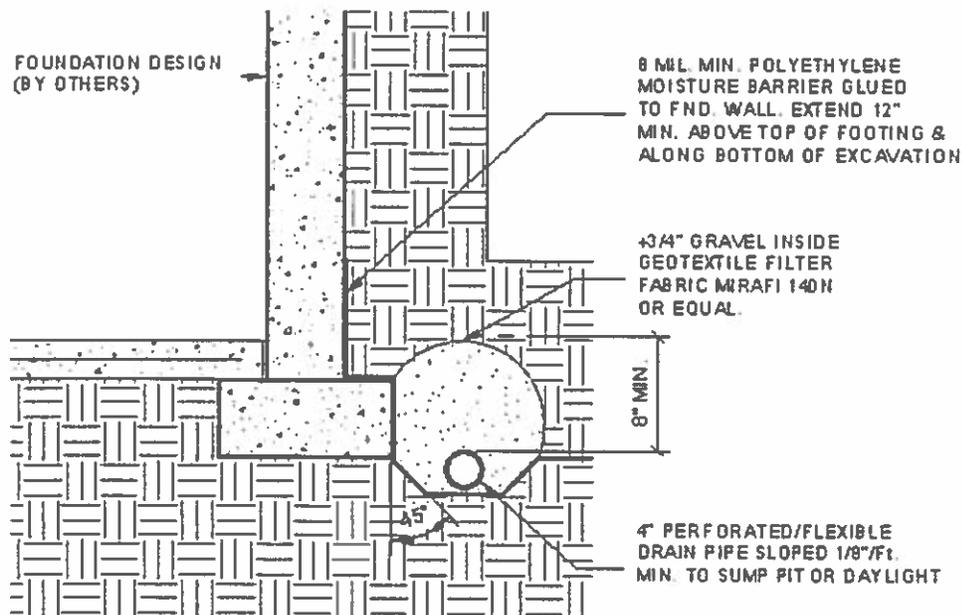
The following drainage precautions should be observed during the construction and maintained at all times after the residence has been completed.

- 1) Excessive wetting and drying of the foundation excavations and under slab areas should be avoided during construction.
- 2) The ground surface surrounding the exterior of the building should be sloped to drain away from the foundation in all directions. We recommend a minimum slope of 12 inches in the first 10 feet.
- 3) Roof downspouts and drains should discharge well beyond the limits of the backfill.
- 4) Landscaping which requires excessive watering should be located at least 10 feet from the house.
- 5) Plastic membranes should not be used to cover the ground surface adjacent to the foundation walls.

Subsurface Drainage

A subsurface foundation drain or equivalent protection measure is recommended around the perimeter of all habitable or storage spaces located below grade (including crawlspace areas). Actual drain requirements to be determined at the time of the open hole inspection.

A subsurface drain is designed to redirect moisture around and away from the foundation system. However, it should be noted that a properly functioning drain does not completely eliminate the potential for foundation movement if exposed to subsurface moisture.



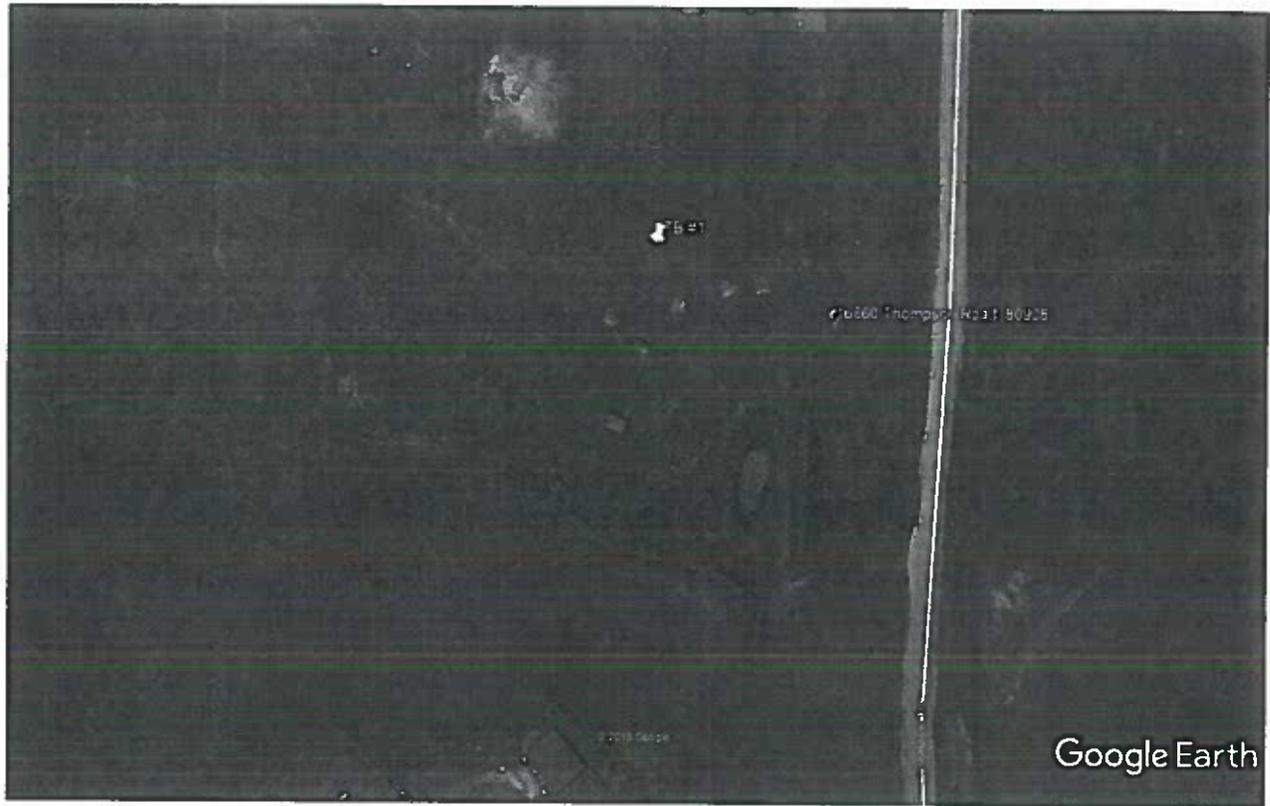
Limitations

This report has been prepared with generally accepted soil and foundation engineering practices in this area for use by the client for design purposes. The conclusions and recommendations presented are based on data obtained from the exploratory excavation. The nature and extent of variation from the exploratory boring may not become evident until excavation is performed. If during construction, soil, rock and groundwater conditions appear to be different from those described herein, our office should be advised immediately so that reevaluation of the recommendations may be made.

Although all laboratory procedures were performed under optimal conditions, it should be noted that precautions should be taken to accommodate for certain sources of failure such as inconsistencies in the properties/characteristics of the on-site soil, variations in groundwater levels due to seasonal changes, etc.

This report DOES NOT address the potential for geologic hazards or constraints (i.e., slope stability, landslides). It must be emphasized that such hazards and constraints are outside the scope of this investigation and must be investigated independently.

Site Map



Laboratory Analysis – Sieve Analysis

SOIL CLASSIFICATION

Location of Site	16860 Thompson Road, 80908	Tested By:	R. Jaquet
Legal Description	N/A	Date Tested	04/17/19
Job Number	19.144	Collected By	J. Dumke
		Date Collected	04/16/19

SITE INVESTIGATION

Test Hole Depth	20'-0"	Groundwater Table	N/A
Surface Layer Thickness	-	Volume of Soil Sample	1/2 cu.ft.
Soil System	Uniform	Visual Moisture Observation	Dry
Layer	Soil Type/Depth	Critical Layer	No. 1
Surface	-	Coloration	Tan
No. 1	SC/0 - 20'-0"	Gravel	Trace
No. 2	-	Organic Content	Little None
No. 3	-		

SIEVE ANALYSIS

Test Bore #:	TB #1	Bulk	Wet Weight of Soil (g)	524.3
Layer	No. 1		Dry Weight of Soil (g)	481.4
Depth of Sample	5'-0"		Natural Moisture Content	8.9%

Sieve #	Thickness (mm)	Mass Ret. (g)	% Ret.	% Pass	
4	4.750	2.6	0.5%	99.5%	Gravel
10	2.000	39.0	8.1%	91.4%	
40	0.425	149.1	31.0%	60.4%	Sand
60	0.250	47.1	9.8%	50.6%	
100	0.150	44.6	9.3%	41.3%	
200	0.075	53.2	11.1%	30.2%	
Pan	0.000	145.4	30.2%	0.0%	Fines
Pan	0.000		0.0%	0.0%	Organic

Totals	481.2	100.0%
---------------	-------	--------

% Gravel	0.5%	Retained on #200
% Sand	69.2%	
% Fines	30.2%	Passes #200
% Organic	0.0%	
Check	100.0%	

$$C_u = D_{60}/D_{10} = \underline{\hspace{2cm}} \text{ N/A}$$

$$C_c = D_{30}^2 / (D_{10})(D_{60}) = \underline{\hspace{2cm}} \text{ N/A}$$

Laboratory Analysis – Atterberg Limits

ATTERBERG LIMITS

LIQUID LIMIT - LL

Cup #	Tin Mass(g)			# Drops	Water Mass (g)	Solids Mass (g)	Water Content
	Empty	Wet Soil	Dry Soil				
1	13.7	60.1	49.3	16	10.8	35.6	0.30
2	13.5	68.8	54.8	6	14.0	41.3	0.34
3	13.6	65.5	53.8	23	11.7	40.2	0.29

Liquid Limit (from plot) 0.29

PLASTIC LIMIT - PL

Cup #	Tin Mass(g)			Water Mass (g)	Solids Mass (g)	Plastic Limit (PL)
	Empty	Wet Soil	Dry Soil			
1	13.3	16.6	16.4	0.46	3.04	0.15
2	13.5	16.5	16.1	0.40	2.57	0.16
Average						0.15

Plastic Limit 0.15

Note: Liquid Limit, Plastic Limit and Plasticity Index values have been rounded to nearest whole number when expressing as a percentage.

PLASTICITY INDEX - PI

Plasticity Index = Liquid Limit - Plastic Limit

Plasticity Index 0.13

MOISTURE CONTENT

Depth	Tin Mass(g)			Water Mass (g)	Solids Mass (g)	Water Content
	Empty	Wet Soil	Dry Soil			
5'-0"	13.6	69.6	64.7	4.9	51.1	9.6%
15'-0"	13.4	83.2	76.6	6.6	63.1	10.5%
20'-0"	13.4	71.8	65.6	6.2	52.2	11.8%

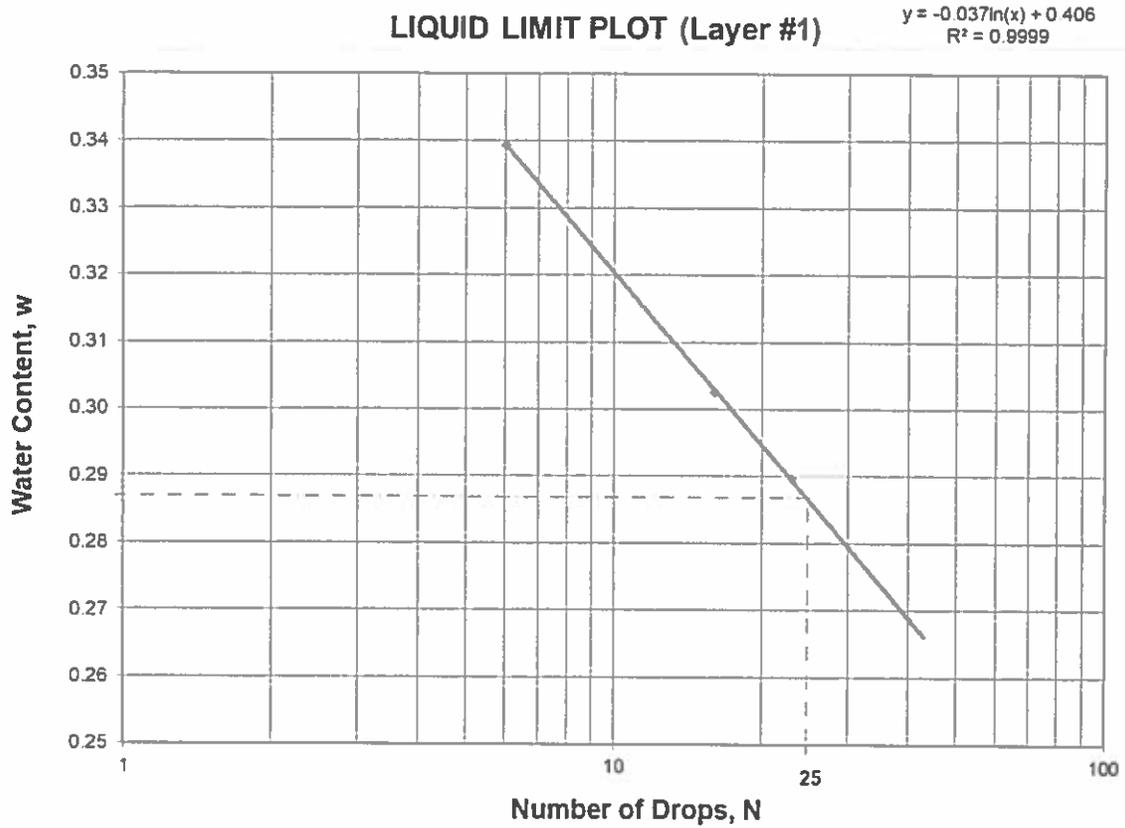
CLASSIFICATION

Plasticity Medium Plasticity

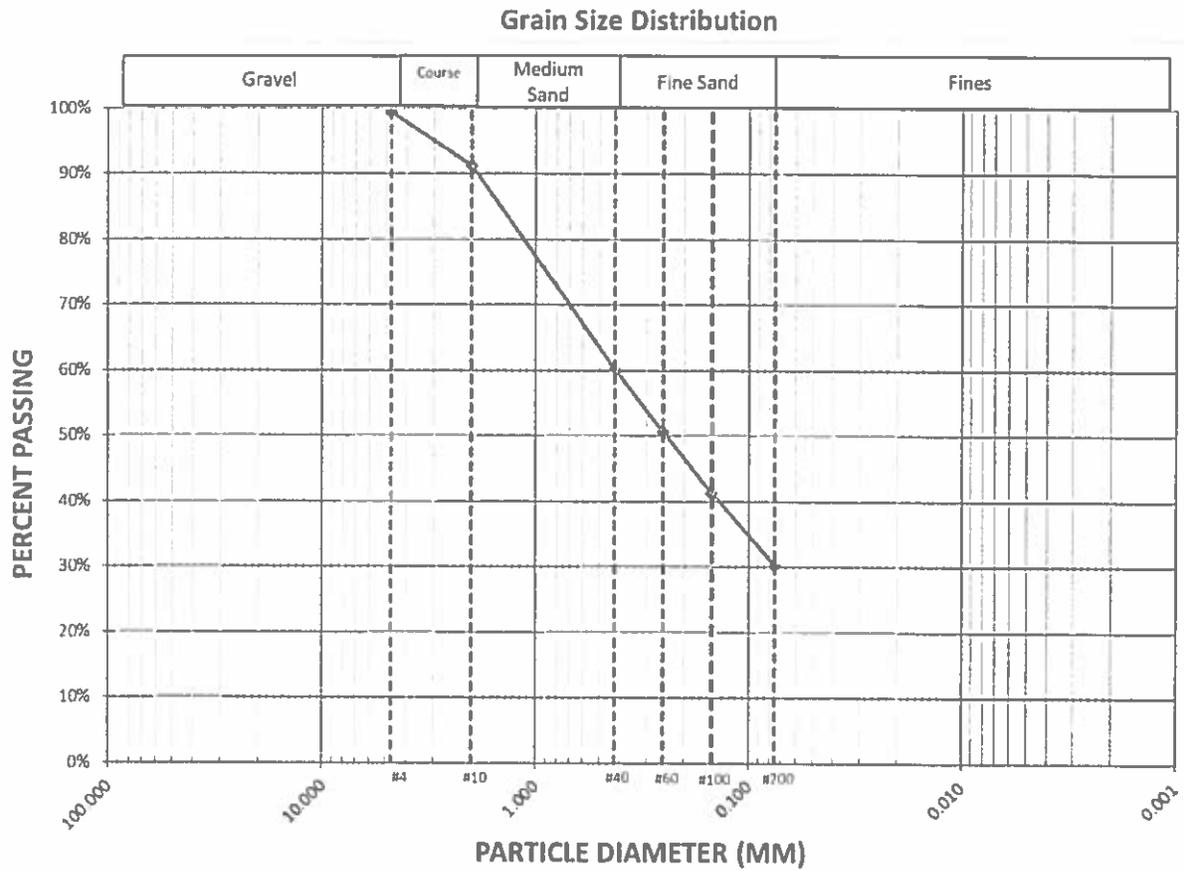
Group Symbol SC

Group Name Clayey Sand

Laboratory Analysis – Liquid Limit Plot



Laboratory Analysis – Grain Size Distribution



Drill Log – Test Bore #1

 Parr Engineering & Consulting, Inc. 11590 Black Forest Road, Suite 10 Colorado Springs, Colorado 80908 Phone: 719-494-0404			BORING LOG		
			Job Number:	19.144	
			Date Drilled:	04/16/19	
			Boring #:	TB #1	
Driller:	J.Dumke	Total Depth:	20'-0"		
Logged By:	J.Dumke	Groundwater Elevation:	N/A		
Method:	Boring	Latitude:	39° 4'38.02"N		
Auger & Size:	4" Solid Stem	Longitude:	104°42'55.75"W		
Depth (ft.)	Sample Interval	SPT Blows/12"	16860 Thompson Road, 80908		Additional Notes
			Sand, Fine-Grained, Clay, Trace Gravel, Dense, Medium Plasticity, Tan, Moist, (SC)		
5		13/46	<div style="text-align: center; font-size: 48px; opacity: 0.5;">Page 1</div>		
10		12/40	Sand, Fine-Grained, Clay, Trace Gravel, Medium Dense, Medium Plasticity, Tan, Moist, (SC)		
15		Grab			
20		Grab			
25					
			Total Depth= 20'-0"		

**APPENDIX E: Parr Engineering & Consulting, Inc. STA Soil
Evaluation, Parr Job No. 17.112**



PARR ENGINEERING & CONSULTING, INC.

Christopher L. Parr, P.E. Principal
 11590 Black Forest Road, Suite 10, Colorado Springs, CO 80908
 Office: 719-494-0404 Cell: 719-659-1313

STA SOIL EVALUATION

Date: February 27, 2017 **Job:** JN: 17.112

Site Location: 0 Thompson Road
 Black Forest Road, CO 80908

Purpose of Investigation: To determine general subsurface soil conditions at the site location & to formulate design criteria for the proposed On-Site Wastewater Treatment system (OWTS)

Field Procedure: The materials in the various strata of the soil profile pit were visually classified in accordance with the U.S. Department of Agriculture (USDA) standards.



Profile Pit	Yes
Perc Test	-

Date: (Profile Eval) February 20, 2017
Excavator G.Lauria
Evaluator J. Dumke

Depth to Groundwater (permanent or seasonal) Pit #1: Not Reached
Depth to Groundwater (permanent or seasonal) Pit #2: Not Reached

Depth to Bedrock - Pit #1: Not reached
Depth to Bedrock - Pit #2: Not reached

Other Terrain Features or Soil Conditions: See Attached Site Map

Endorsement: Christopher L. Parr P.E.

Profile Pit #1	
Latitude:	39° 4' 37.15" N
Longitude:	104° 42' 55.54" W
Layer	Soil Type & LTAR
0 - 1'	Topsoil
1' - 5'	Type 4A (0.15)
5' - 8'	Type 4A (0.15)
-	-

Profile Pit #2	
Latitude:	39° 4' 37.15" N
Longitude:	104° 42' 56.87" W
Layer	Soil Type & LTAR
0 - 1'	Topsoil
1' - 8'	Type 4A (0.15)

Location	
Latitude:	Longitude:
-	-
-	-
-	-

Perc #	N/A	Min./In.
Perc #1	N/A	Min./In.
Perc #2	N/A	Min./In.
Perc #3	N/A	Min./In.
Average:	N/A	Min./In.

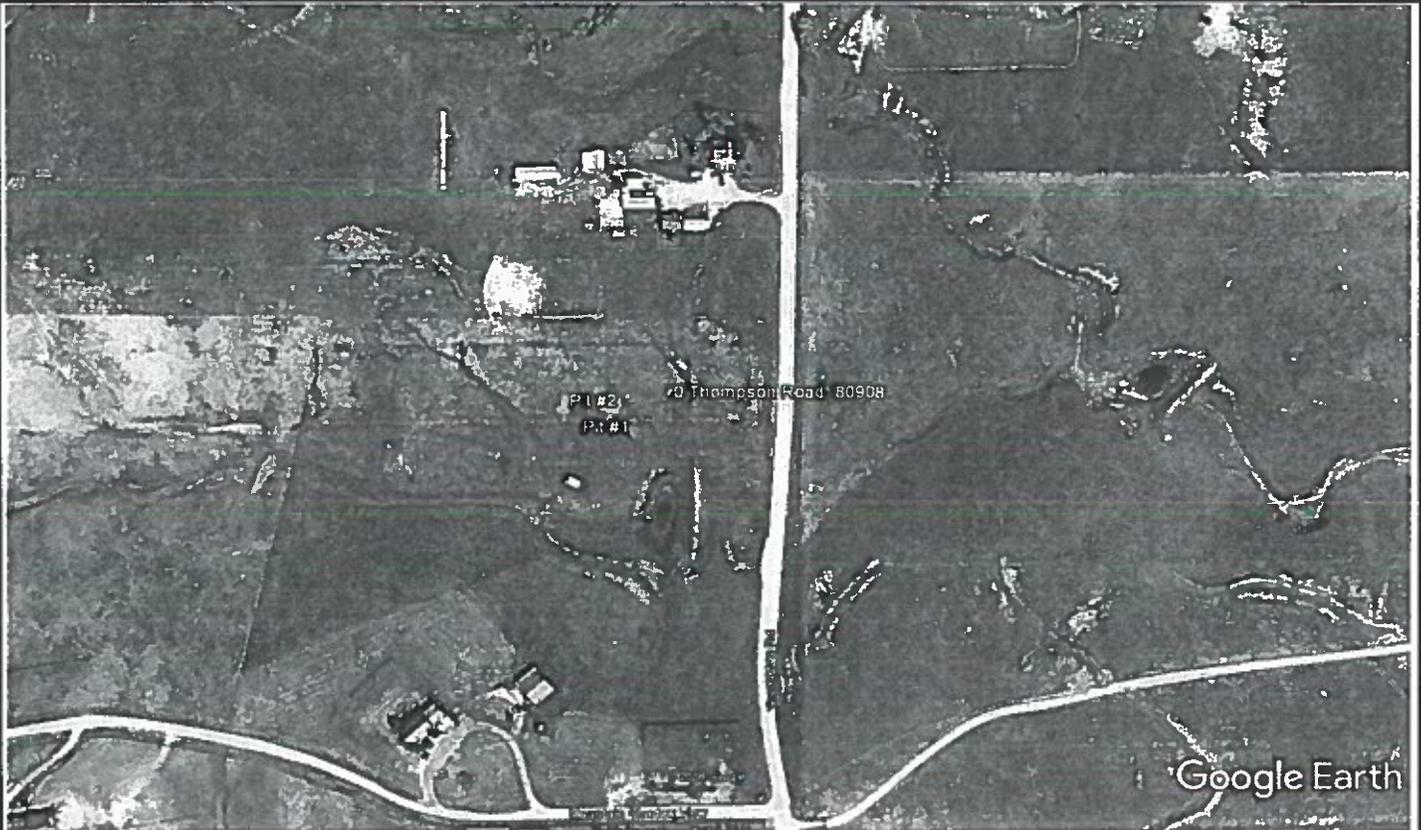
Recommendations: (1) An Engineered On-Site Wastewater Treatment system (OWTS) is required for this location due to: (a) Soil Type 4A identified in the treatment zone of Profile Pits #1 and #2.



PARR ENGINEERING & CONSULTING, INC.

Christopher L. Parr, P.E. Principal
11590 Black Forest Road, Suite 10, Colorado Springs, CO 80908
Office: 719-494-0404 Cell: 719-659-1313

Google Site Map





Parr Engineering & Consulting, Inc.
 11590 Black Forest Road, Suite 10
 Colorado Springs, Colorado 80908
 Phone: 719-494-0404

Profile Pit - Log

Job Number:	17.112
Date Evaluated:	02/20/17
Profile Pit#:	Pit #1

Excavator:	G. Lauria	Total Depth:	8'-0"
Logged By:	J. Dumke	STA Slope & Direction:	±4.0% S
Method:	Profile Pit	Latitude:	39° 4' 37.15" N
Auger & Size:	Mini Excavator	Longitude:	104° 42' 55.54" W

Depth (ft.)	Sample Interval	0 Thompson Road, 80908						
		USDA Soil Texture	USDA Soil Structure - Shape	Soil Structure Grade	Redoximorphic Features Present? (Y/N)	Soil Type (from Table 9 in O-14)	% Rock Frag.	Color
		Topsoil						
2		Sandy Clay	Blocky	Massive	No	Type 4A (LTAR = 0.15) Treatment Level 1	<35%	10YR5/4 (Moist)
4								
6		Sandy Clay	Granular	Weak	No	Type 4A (LTAR = 0.15) Treatment Level 1	<35%	2.5Y6/3 (Moist)
8								
		Total Depth = 8'-0"						
10								

Evidence of Groundwater:	Not Reached
Depth to Bedrock:	Not Reached

Additional Notes:



Parr Engineering & Consulting, Inc.
 11590 Black Forest Road, Suite 10
 Colorado Springs, Colorado 80908
 Phone: 719-494-0404

Profile Pit - Log

Job Number:	17.112
Date Evaluated:	02/20/17
Profile Pit#:	Pit #2

Excavator:	G. Lauria	Total Depth:	8'-0"
Logged By:	J. Dumke	STA Slope & Direction:	±4.0% S
Method:	Profile Pit	Latitude:	39° 4' 37.15" N
Auger & Size:	Mini Excavator	Longitude:	104° 42' 56.67" W

Depth (ft.)	Sample Interval	0 Thompson Road, 80908						
		USDA Soil Texture	USDA Soil Structure - Shape	Soil Structure Grade	Redoximorphic Features Present? (Y/N)	Soil Type (from Table 9 in O-14)	% Rock Frag.	Color

		Topsoil						
2		Sandy Clay	Blocky	Massive	No	Type 4A (LTAR = 0.15) Treatment Level 1	<35%	10YR5/4 (Moist)
4								
6								
		Total Depth = 8'-0"						
8								
10								

Evidence of Groundwater:	Not Reached
Depth to Bedrock:	Not Reached

Additional Notes:

APPENDIX F: Soil Survey Descriptions

El Paso County Area, Colorado

67—Peyton sandy loam, 5 to 9 percent slopes

Map Unit Setting

National map unit symbol: 369d
Elevation: 6,800 to 7,600 feet
Mean annual air temperature: 43 to 45 degrees F
Frost-free period: 115 to 125 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Peyton

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 12 inches: sandy loam
Bt - 12 to 25 inches: sandy clay loam
BC - 25 to 35 inches: sandy loam
C - 35 to 60 inches: sandy loam

Properties and qualities

Slope: 5 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 7.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R049XB216CO - Sandy Divide
Hydric soil rating: No

Minor Components

Pleasant

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

Other soils

Percent of map unit:
Hydric soil rating: No

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 18, Jun 5, 2020