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# SOILS AND GEOLOGY STUDY

## 515 Struthers Loop
## Pair-A-Dise Subdivision Filing No. 1
## El Paso County, Colorado

## PREPARED FOR:

**Aaron Atwood**
**515 Struthers Loop**
**Colorado Springs, CO 80921**

## JOB NO. 188423

## April 8, 2022


**Respectfully Submitted,**

**RMG – Rocky Mountain Group**

Kelli Zigler

**Kelli Zigler**
**Project Geologist**

**Reviewed by,**

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# 1.0 GENERAL SITE AND PROJECT DESCRIPTION

### 1.1 Project Location

The project lies in the NW ¼ of the NE ¼ of Section 36, Township 11 South, Range 67 West of the 6th Principal Meridian in El Paso County, Colorado, and is generally located southeast of the intersection of Struthers Road and Baptist Road. The approximate location of the site is shown on the Site Vicinity Map, Figure 1.

### 1.2 Existing and Proposed Land Use

The site currently consists of one parcel (per the El Paso County Assessor's website) of approximately 5 acres:

- Schedule No. 7136002005, current land use is classified as a vacant residential lot

The current zoning is *"RR-2.5" – Residential Rural.* The parcel is currently undeveloped, vacant land. The future zoning designation is to remain "*RR-2.5".*

### 1.3 Project Description

It is our understanding that the property is to be subdivided into two lots of approximately 2.504 and 2.502 acres, respectively. Each new lot is to be developed with a new single-family residence, well, and on-site wastewater treatment system (OWTS). Lot 2 is to be accessed from Struthers Loop from an individual driveway and lot 1 is to be accessed from an access easement along the east side of lot 2. The Proposed Lot Layout Plan is presented in Figure 2.

### 1.4 Previous Investigations

Reports of previous geotechnical engineering/geologic investigations for this site were available for our review and are listed below:

1. *Soils Report for Aaron Atwood, Lot #38, Chaparral Hills Subdivision, 515 Struthers Loop, El Paso County, Colorado*, prepared by Geoquest, LLC, Job No. 21-0794, last dated July 30, 2021.
2. *Soils Report for Aaron Atwood, Lot #38, Chaparral Hills Subdivision, 515 Struthers Loop, El Paso County, Colorado*, prepared by Geoquest, LLC, Job No. 21-0795, last dated July 30, 2021.

# 2.0 QUALIFICATIONS OF PREPARERS

This Soils and Geology Study was prepared by a professional geologist as defined by Colorado Revised Statures section 34-1-201(3) and by a qualified geotechnical engineer as defined by policy statement 15, "Engineering in Designated Natural Hazards Areas" of the Colorado State Board of Registration for Professional Engineers and Professional Land Surveyors. (Ord. 96-74; Ord. 01-42)

The principle investigators for this study are Kelli Zigler P.G., and Tony Munger, P.E. Ms. Zigler is a Professional Geologist as defined by State Statute (C.R.S 34-1-201) with over 21 years of experience in the geological and geotechnical engineering field. Ms. Kelli Zigler holds a B.S. in Geology from the

University of Tulsa. Ms. Zigler has supervised and performed numerous geological and geotechnical field investigations throughout Colorado.

Tony Munger, P.E. is a licensed professional engineer with over 21 years of experience in the construction engineering (residential) field. Mr. Munger holds a B.S. in Architectural Engineering from the University of Wyoming

# 3.0 STUDY OVERVIEW

The purpose of this investigation is to characterize the general geotechnical, geologic site conditions, and on-site wastewater treatment system (OWTS) feasibility and present our opinions of the potential effect of these conditions on the proposed development within El Paso County, Colorado. As such, our services exclude evaluation of the environmental and/or human, health related work products or recommendations previously prepared, by others, for this project.

Revisions to the conclusions presented in this report may be issued based upon submission of the Development Plan. This study has been prepared in accordance with the requirements outlined in the El Paso County Land Development Code (LDC) specifically Chapter 8, last updated August 27, 2019. Applicable sections include 8.4.8 and 8.4.9, and the El Paso County Engineering Criteria Manual (ECM), specifically Appendix C last updated July 9, 2019.

### 3.1 Scope and Objective

The scope of this study is to include a physical reconnaissance of the site and a review of pertinent, publically available documents including, but not limited to, previous geologic and geotechnical reports, overhead and remote sensing imagery, published geology and/or hazard maps, design documents, etc.

The objectives of our study are to:

- Identify geologic conditions present on the site
- Analyze potential negative impacts of these conditions on the proposed site development
- Analyze potential negative impacts to surrounding properties and/or public services resulting from the proposed site development as it relates to existing geologic conditions
- Provide our opinion of suitable techniques that may be utilized to mitigate any potential negative impacts identified herein

This report presents the findings of the study performed by RMG-Rocky Mountain Group relating to the geologic conditions of the above-referenced site. Revisions and modifications to this report may be issued subsequently by RMG, based upon:

- Additional observations made during grading and construction which may indicate conditions that require re-evaluation of some of the criteria presented in this report
- Review of pertinent documents (development plans, plat maps, drainage reports/plans, etc.) not available at the time of this study
- Comments received from the governing jurisdiction and/or their consultants subsequent to submission of this document

### 3.2 Site Evaluation Techniques

The information included in this report has been compiled from several sources, including:

- Field reconnaissance
- Geologic and topographic maps
- Review of selected publicly available, pertinent engineering reports
- Available aerial photographs
- Subsurface exploration
- Visual and tactile characterization of representative site soil and rock samples
- Geologic research and analysis
- Replat, Pair-A-Dise Subdivision, Filing No. 1, Project No. 61155, dated October 12, 2021, provided by MVE, Inc. Engineers and Surveyors

Geophysical investigations were not considered necessary for characterization of the site geology. Monitoring programs, which typically include instrumentation and/or observations for changes in groundwater, surface water flows, slope stability, subsidence, and similar conditions, are not known to exist and were not considered applicable for the scope of this report.

### 3.3 Additional Documents

Additional documents reviewed during the performance of this study are included in Appendix A.

## 4.0 SITE CONDITIONS

### 4.1 Existing Site Conditions

The site is undeveloped. The site is generally located southeast of the intersection of Struthers Road and Baptist Road in El Paso County, Colorado and comprises approximately 5 acres. The site is currently zoned RR-2.5, residential rural and is to remain RR-2.5, in the future. Adjacent properties to the north, south, east, and west are zoned RR-2.5.

### 4.2 Topography

Based on our site reconnaissance on March 2, 2022 and USGS 2019 topographic map of the Monument Quadrangle, the site generally slopes down to the west with an overall elevation change of approximately 18 feet. A drainage channel runs through the site in the northwest corner, as shown in Figure 5, Engineering and Geology Map. The water level in the drainage channel is anticipated to vary, depending upon local precipitation events.

### 4.3 Vegetation

The site vegetation primarily consists of native grasses, weeds, and other prairie-type vegetation. A dense stand of deciduous trees is located along the drainage channel in the northern portion of the site.

### 4.4 Aerial Photographs and Remote-Sensing Imagery

Personnel of RMG reviewed aerial photos available through Google Earth Pro dating back to 1999, CGS surficial geologic mapping, and historical photos by historicaerials.com dating back to 1947. Historically, the site has remained vacant, undeveloped land.

# 5.0 SUBSURFACE SOIL INVESTIGATIONS

### 5.1 Field and Laboratory Testing

The subsurface conditions below the subject site were investigated by Geoquest, LLC. on July 5, 2021 as part of the site-specific *Soils Reports* referenced above and included in Appendix C.

# 6.0 SOIL, GEOLOGY, AND ENGINEERING GEOLOGY

The site is located within the central portion of the Great Plains Physiographic Province. A major structural feature known as the Rampart Range Fault is located approximately 4 miles west of the site. The Rampart Range Fault marks the boundary between the Great Plains Physiographic Province and the Southern Rocky Mountain Province. The site exists within the southern portion of a large structural feature known as the Denver Basin. In general, the geology at the site consists of Louviers and Slocum alluvium composed of sand, silt, clay, and gravel with loamy colluvium that overlies the Dawson Formation.

### 6.1 Subsurface Soil Conditions

Based on the Geoquest reports referenced above, the on-site soil on proposed lot 2 is anticipated to be silty sand with underlying clayey sand and the on-site soil on proposed lot 1 is anticipated to be silty sand with underlying low-plasticity clay.

### 6.2 Bedrock Conditions

Bedrock (as defined by USDA) was not encountered in the profile pit excavations performed by Geoquest, LLC for the property. In general, the bedrock beneath the site is considered to be part of the Dawson formation. The Dawson formation is thick-bedded to massive, generally light colored arkose. The sandstones are poorly sorted with variable clay contents. The sandstone is generally permeable, well drained, and has good foundation support characteristics. The Dawson sandstone is generally not considered a limiting layer for OWTS.

### 6.3 U.S. Soil Conservation Service

The USDA/NRCS soil survey identifies the site soils as:

- 68 – Peyton-Pring complex, 3 to 8 percent slopes. Properties of the complex include well drained soils, depth of the water table is anticipated to be greater than 80 inches, runoff is anticipated to be low, frequency of flooding and ponding is none, and landforms include hills.
- 93 – Tomah-Crowfoot complex, 8 to 15 percent slopes. Properties of the complex include well drained soils, depth of the water table is anticipated to be greater than 80 inches, runoff is anticipated to be medium, frequency of flooding and ponding is none, and landforms include alluvial fans and hills.

The USDA Soil Survey Map is presented in Figure 4.

### 6.4 General Geologic Conditions

Based on our field observations and review of relevant geologic maps, we identified the geologic conditions (listed below) affecting the development, as shown on the Engineering and Geology Map, Figure 5.

The site generally consists of alluvium and colluvium deposits of the Quaternary overlying the Dawson Arkose Formation of Tertiary age. Four geologic units were mapped at the site as:

- *ags* – Alluvial sand, silt, clay and gravel (Louviers and Slocum Alluviums, undivided; late middle Pleistocene)
- *cac* – Arkosic loamy colluvium and sheetwash alluvium (Holocene)
- *Tkda3* – Dawson Formation Facies Unit Three (Paleocene) – Unit consists of sub-equal amounts of thick and very thick-bedded, massive and cross-bedded, white, tan, and light-gray arkose and pebbly arkose; thin to thick beds of light-green to olive-gray clay-rich, fine- to medium-grained micaceous and feldspathic sandstone; and thin to thick beds of dark-gray to greenish-gray sandy claystone. Very thick-bedded, massive or cross-bedded, light-colored arkose beds in facies unit three resemble those in facies unit one but are finer grained and generally thinner. Facies unit three may have occasional thin, poorly developed, paleosols; reported coaly strata are not exposed at the surface. Unit is 500 to 600 feet thick in the area and thins towards the northwest as it interfingers with facies unit one and facies unit four.
- *SW* –Seasonally Wet Area

### 6.5 Engineering Geology

Two engineering geology units were mapped at the site as:

- *p Qs* – Slocum Alluvium
- *1A* – Stable alluvium, colluvium and bedrock on flat to gentle slopes (0-5%)

The map unit descriptions for these units are provided by Charles Robinson and Associates (1977).

### 6.6 Structural Features

Structural features such as schistocity, folds, zones of contortion or crushing, joints, shear zones or faults were not observed by RMG on the site or in the surrounding area.

### 6.7 Surficial (Unconsolidated) Deposits

Lake and pond sediments, swamp accumulations, sand dunes, marine terrace deposits, talus accumulations, creep, or slope wash were not observed on the site. Slump and slide debris were also not observed on the site.

### 6.8 Features of Special Significance

Features of special significance such as accelerated erosion, (advancing gully head, badlands, or cliff reentrants) were not observed on the property. Features indicating settlement or subsidence such as fissures, scarplets, and offset reference features were not observed on the study site or surrounding areas. Features indicating creep, slump, or slide masses in bedrock and surficial deposits were not observed on the property.

### 6.9 Drainage of Water and Groundwater

The overall topography of the site slopes down to the northwest and west. It is anticipated the direction of surface water and groundwater is to flow in the same direction. Groundwater was not reported in the test borings performed for the *Soils Reports* by Geoquest, referenced above, and is not anticipated to affect shallow foundations.

A natural drainage channel runs through the site in the northwest corner. The drainage channel was dry at the time of the site recon performed by RMG. The USGS Topo Map is presented in Figure 3.

### 6.10 Flooding and Surface Drainage

Based on our review of the Federal Emergency Management Agency (FEMA) Community Panel No. 08041C0287G and the online ArcGIS El Paso County Risk Map, the site lies outside of a 100-year floodplain. The site is within the boundaries of Zone X. The FEMA Map is presented in Figure 6.

Zone X is defined by FEMA as an area of minimal flood hazard that is determined to be outside the Special Flood Hazard Area and higher than the elevation of the 0.2-percent-annual-chance (or 500-year) flood.

# 7.0 ECONOMIC MINERAL RESOURCES

Under the provision of House Bill 1529, it was made a policy by the State of Colorado to preserve for extraction commercial mineral resources located in a populous county. Review of the *El Paso Aggregate Resource Evaluation Map, Master Plan for Mineral Extraction*, *Map 1* indicates the site is identified as Upland Deposits. The deposits are composed of sand, gravel with silt and clay. These deposits are remnants of older streams deposited on topographic highs or bench like features. The tract is underlain primarily by the Dawson Arkose, a sedimentary formation of Tertiary age related to uplift and erosion of the Front Range.

According to the *Evaluation of Mineral and Mineral Fuel Potential of El Paso County State Mineral Lands*, the site is mapped within the Denver Basin Coal Region, the tract identifier is 41-02. However, the area of the site has been mapped “Poor" for coal resources. In this part of the Denver coal region, coal resources are locally present within the lower part of the Laramie Formation of Upper Cretaceous age. The area contains strata that may contain coal. This area is not prospective for metallic mineral resources. No oil and gas wells are drilled in the area, or within two miles of it. Alluvial deposits are commonly mined in the region for sand and gravel. There are no active or inactive gravel pits in the area, but there are several within a three mile radius of it. Alluvial deposits containing gravel and/or sand cover approximately 112 acres of tract 41-02. Assuming a mineable thickness of 15 feet, this represents 4.1 million tons of potentially useable resource. The quality of the resource has not been determined. In the vicinity of this area, the coal-bearing beds of the Laramie Formation lie at a depth of approximately 1,500

feet (Kirkham and Ladwig, 1979). It is possible that the tract contains coal resources at this depth. The coal seams in the Laramie Formation tend to be lenticular and discontinuous in comparison to areas currently being mined in western Colorado.

# 8.0 IDENTIFICATION AND MITIGATION OF POTENTIAL GEOLOGIC CONDITIONS

The El Paso County Engineering Criteria Manual recognizes and delineates the difference between geologic hazards and constraints. A *geologic hazard* is one of several types of adverse geologic conditions capable of causing significant damage or loss of property and life. Geologic hazards are defined in Section C.2.2 Sub-section E.1 of the ECM. A *geologic constraint* is one of several types of adverse geologic conditions capable of limiting or restricting construction on a particular site. Geologic constraints are defined in Section C.2.2 Sub-section E.2 of the ECM (1.15 Definitions of Specific Terms and Phrases). The following geologic constraints were considered in the preparation of this report. They are not are not anticipated to pose a significant risk to the proposed development:

- Avalanches
- Debris Flow-Fans/Mudslides
- Ground Subsidence and Abandoned Mining Activity
- Landslides
- Rockfall
- Flood Prone Area
- Groundwater Springs or Seeps
- Shallow Groundwater Tables
- Ponding water
- Steeply Dipping Bedrock
- Unstable or Potentially Unstable Slopes
- Scour, Erosion, Accelerated Erosion Along Creek Banks and Drainageways
- History of Landfill or Uncontrolled/Undocumented Fill Placement
- Valley Fill
- Downhill/Down-slope Creep
- Soil Slumps and Undercutting
- Corrosive Minerals

The following sections present the geologic conditions that have been identified on the property:

### 8.1 Compressible Soils

Based on the Geoquest for the *Soils Reports* referenced above and our experience with similar materials in this area, the on-site soils generally possess low compressibility potential. If compressible materials are encountered in the excavations for the proposed residences, they can readily be mitigated with typical construction practices common to this region of El Paso County, Colorado.

It is unknown at this time whether the proposed single-family residences will have crawlspaces, basements, or a combination of both. Foundation design and construction are typically adjusted for collapsible soils.

Mitigation
Mitigation of compressible soils may include overexcavation and replacement with non-expansive structural fill. Drilled piers are not anticipated. Floor slabs bearing directly on compressible soils are expected to experience movement. Overexcavation and replacement with compacted non-expansive soils can be successful in reducing this slab movement.

The lot-specific subsurface soil investigation performed for each proposed structure should consider mitigation of compressible soils.

**8.2 Expansive Soils**

Based on the Geoquest *Soils Reports* referenced above and our experience with similar materials in this area, the on-site soils generally possess low to moderate swell potential. The Dawson formation is known to have moderate to high swell potential in some locations. It is anticipated that expansive soils/bedrock may be encountered at depths that may affect residential foundations. If these materials are encountered in the excavations for the proposed residences, they can readily be mitigated with typical construction practices common to this region of El Paso County, Colorado.

Mitigation
Foundation design and construction are typically adjusted for expansive soils. Mitigation of expansive soils may include overexcavation and replacement with non-expansive structural fill. Drilled piers are not anticipated. Floor slabs bearing directly on expansive soils are expected to experience movement. Overexcavation and replacement with compacted non-expansive soils can be successful in reducing slab movement.

If expansive soils or bedrock are encountered during construction, mitigation of these expansive materials should follow the recommendations presented in a lot-specific subsurface soil investigation performed for each proposed structure.

**8.3 Faults and Seismicity**

Based on review of the Earthquake and Late Cenozoic Fault and Fold Map Server provided by CGS located at http://dnrwebmapgdev.state.co.us/CGSOnline/ and the recorded information dating back to November of 1900, Colorado Springs has not experienced a recorded earthquake with a magnitude greater than 1.6 during that period. The nearest recorded earthquakes over 1.6 occurred in December of 1995 in Manitou Springs, which experienced magnitudes ranging between 2.8 to 3.5. Additional earthquakes over 1.6 occurred between 1926 and 2001 in Woodland Park, which experienced magnitudes ranging from 2.7 to 3.3. Both of these locations are located near the Ute Pass Fault, which is greater than 10 miles from the subject site. Earthquakes felt at this site will most likely result from minor shifting of the granite mass within the Pikes Peak Batholith, which includes pull from minor movements along faults found in the Denver basin. It is our opinion that ground motions resulting from minor earthquakes may affect structures (and the surrounding area) at this site if minor shifting were to occur.

Mitigation
The Pikes Peak Regional Building Code, 2017 Edition, indicates maximum considered earthquake spectral response accelerations of 0.213g for a short period ($S_s$) and 0.059g for a 1-second period ($S_1$). Based on the results of our experience with similar subsurface conditions, we recommend the site be classified as Site Class B, with average shear wave velocities ranging from 2,500 to 5,000 feet per second for the materials in the upper 100 feet.

### 8.4 Radon

***"Radon Act 51** passed by Congress set the natural outdoor level of radon gas (0.4 pCi/L) as the target radon level for indoor radon levels".*

Northern El Paso County and the 80921 zip code in which the site is located, has an EPA assigned Radon Zone of *1*. A radon Zone of *1* predicts an average indoor radon screening level greater than 0.4 pCi/L (picocuries per liter), which is above the recommended levels assigned by the EPA. *The EPA recommends corrective measures to reduce exposure to radon gas.*

All of the State of Colorado is considered EPA Zone 1 based on the information provided at https://county-radon.info/CO/El_Paso.html. Elevated hazardous levels of radon from naturally occurring sources are not anticipated at this site.

Mitigation

Radon hazards are best mitigated at the building design and construction phases. Providing increased ventilation of basements, crawlspaces, creating slightly positive pressures within structures, and sealing of joints and cracks in the foundations and below-grade walls can help mitigate radon hazards. Passive radon mitigation systems are also available.

Passive and active mitigation procedures are commonly employed in this region to effectively reduce the buildup of radon gas. Measures that can be taken after the residence is enclosed during construction include installing a blower connected to the foundation drain and sealing the joints and cracks in concrete floors and foundation walls. If the occurrence of radon is a concern, it is recommended that the residence be tested after they are enclosed and commonly utilized techniques are in place to minimize the risk.

# 9.0 BEARING OF GEOLOGIC CONDITIONS UPON PROPOSED DEVELOPMENT

Geologic hazards (as described in section 8 of this report) found to be present at this site include faults and seismicity and radon. Geologic conditions (as described in section 8 of this report) found to be present at this site include compressible soils and expansive soils. It is our opinion that the existing geologic and engineering conditions can be satisfactorily mitigated through proper engineering, design, and construction practices.

# 10.0 ADDITIONAL STUDIES

The findings, conclusions, and recommendations presented in this report were provided to evaluate the suitability of the site for future development. Unless indicated otherwise, the test borings, laboratory test results, conclusions and recommendations presented in this report are not intended for use for design and construction. Site-specific subsurface soil investigations have been completed by Geoquest, LLC, and are included in Appendix C.

# 11.0 CONCLUSIONS

Based upon our evaluation of the geologic conditions, it is our opinion that the proposed development is feasible. The geologic conditions identified are considered typical for the Front Range region of Colorado. Mitigation of geologic conditions is most effectively accomplished by avoidance. However, where avoidance is not a practical or acceptable alternative, geologic conditions should be mitigated by implementing appropriate planning, engineering, and suitable construction practices.

In addition to the previously identified mitigation alternatives, surface and subsurface drainage systems should be considered. Exterior, perimeter foundation drains should be installed around below-grade habitable or storage spaces. A typical perimeter drain detail is presented in Figure 7. Surface water should be efficiently removed from the building area to prevent ponding and infiltration into the subsurface soil.

We believe the sandy clay loam will classify as Type A material and the sandy loam will classify as Type B material as defined by OSHA in 29 CFR Part 1926. OSHA requires that temporary excavations made in Type A and B materials be laid back at ratios no steeper than 3/4:1 (horizontal to vertical) and 1:1 (horizontal to vertical), respectively, unless the excavation is shored and braced. Excavations deeper than 20 feet, or when water is present, should always be braced or the slope designed by a professional engineer.

Long term cut slopes in the upper soil should be limited to no steeper than 3:1 (horizontal to vertical). Flatter slopes will likely be necessary should groundwater conditions occur. It is recommended that long term fill slopes be no steeper than 3:1 (horizontal to vertical).

Revisions and modifications to the conclusions and recommendations presented in this report may be issued subsequently by RMG based upon additional observations made during grading and construction, which may indicate conditions that require re-evaluation of some of the criteria presented in this report.

It is important for the Owner(s) of the property to read and understand this report, and to carefully familiarize themselves with the geologic hazards associated with construction in this area. This report only addresses the geologic constraints contained within the boundaries of the site referenced above.

***The foundation systems for the proposed single-family residential structures and any retention/detention facilities should be designed and constructed based upon the recommendations developed in the site-specific subsurface soil investigation prepared by Geoquest, LLC included as Appendix C.***

# 12.0 CLOSING

This report is for the exclusive purpose of providing geologic hazards information and preliminary geotechnical engineering recommendations. The scope of services did not include, either specifically or by implication, evaluation of wild fire hazards, environmental assessment of the site, or identification of contaminated or hazardous materials or conditions. Development of recommendations for the mitigation of environmentally related conditions, including but not limited to, biological or toxicological issues, are beyond the scope of this report. If the owner is concerned about the potential for such contamination or conditions, other studies should be undertaken.

This report has been prepared for **Aaron Atwood** in accordance with generally accepted geotechnical engineering and engineering geology practices. The conclusions and recommendations in this report are

based in part upon data obtained from review of available topographic and geologic maps, review of available reports of previous studies conducted in the site vicinity, a site reconnaissance, and research of available published information, soil test borings, soil laboratory testing, and engineering analyses. The nature and extent of variations may not become evident until construction activities begin. If variations then become evident, RMG should be retained to re-evaluate the recommendations of this report, if necessary.

Our professional services were performed using that degree of care and skill ordinarily exercised, under similar circumstances, by geotechnical engineers and engineering geologists practicing in this or similar localities. RMG does not warrant the work of regulatory agencies or other third parties supplying information which may have been used during the preparation of this report. No warranty, express or implied, is made by the preparation of this report. Third parties reviewing this report should draw their own conclusions regarding site conditions and specific construction techniques to be used on this project.

# FIGURES

NOT TO SCALE

Architecture
Structural
Geotechnical

Materials Testing
Forensics
Civil / Planning

**Engineers / Architects**

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# SITE VICINITY MAP

515 STRUTHERS LOOP
PAIR-A-DISE SUBDIVISION FILING NO. 1
EL PASO COUNTY, COLORADO
AARON ATWOOD

JOB No. 188423

FIG No. 1

DATE 4-8-2022

NOT TO SCALE

Architecture
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Civil / Planning

**Engineers / Architects**
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# PROPOSED LOT LAYOUT PLAN

515 STRUTHERS LOOP
PAIR-A-DISE SUBDIVISION FILING NO. 1
EL PASO COUNTY, COLORADO
AARON ATWOOD

JOB No. 188423

FIG No. 2

DATE 4-8-2022

NOT TO SCALE

Architecture
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# USGS TOPO MAP

515 STRUTHERS LOOP
PAIR-A-DISE SUBDIVISION FILING NO. 1
EL PASO COUNTY, COLORADO
AARON ATWOOD

JOB No. 188423

FIG No. 3

DATE 4-8-2022

68 - PEYTON-PRING COMPLEX, 3 TO 8 PERCENT SLOPES

93 - TOMAH-CROWFOOT COMPLEX, 8 TO 15 PERCENT SLOPES

NOT TO SCALE

Architecture
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# USDA SOIL SURVEY MAP

515 STRUTHERS LOOP
PAIR-A-DISE SUBDIVISION FILING NO. 1
EL PASO COUNTY, COLORADO
AARON ATWOOD

JOB No. 188423

FIG No. 4

DATE 4-8-2022

REFERENCE
NOT TO SCALE

## Geologic Conditions

ags - Alluvial sand, silt, clay and gravel (Louviers and Slocum Alluviums: late middle Pleistocene)

cac - Arkosic loamy colluvium and sheetwash alluvium (Holocene)

Tkda3 - Dawson Formation Facies Unit Three (Paleocene)

SW - Seasonally Wet Area

## Engineering Conditions

p Qs - Slocum Alluvium

1A - Stable alluvium, colluvium and bedrock on flat to gentle slopes (0-5%)

JOB No. 188423

RMG
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Forensics
Civil / Planning
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Structural
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2910 AUSTIN BLUFFS PKWY, SUITE 100,
COLORADO SPRINGS, CO 80918
(719) 548-0600 ~ WWW.RMGENGINEERS.COM
SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

515 STRUTHERS LOOP
PAIR-A-DISE SUBDIVISION
FILING NO. 1

EL PASO COUNTY, COLORADO
AARON ATWOOD

| | |
|---|---|
| ENGINEER: | TPM |
| DRAWN BY: | KCR |
| CHECKED BY: | TPM |
| ISSUED: | 4-8-2022 |

ENGINEERING AND GEOLOGY MAP

SHEET No.
FIG-5

# National Flood Hazard Layer FIRMette

FEMA

*Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020*

## Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

**SPECIAL FLOOD HAZARD AREAS**
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

**OTHER AREAS OF FLOOD HAZARD**
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

**OTHER AREAS**
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

**GENERAL STRUCTURES**
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

**OTHER FEATURES**
- B 20.2 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

**MAP PANELS**
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 3/1/2022 at 5:26 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

NOT TO SCALE


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# FEMA MAP

515 STRUTHERS LOOP
PAIR-A-DISE SUBDIVISION FILING NO. 1
EL PASO COUNTY, COLORADO
AARON ATWOOD

JOB No. 188423

FIG No. 6

DATE 4-8-2022

GENERAL NOTES:

1. BOTTOM OF DRAIN PIPE SHALL BE AT OR BELOW BOTTOM OF FOOTING AT ALL LOCATIONS
2. ALL DRAIN PIPE SHALL BE PERFORATED PLASTIC, WITH THE EXCEPTION OF THE DISCHARGE PORTION WHICH SHALL BE SOLID, NON-PERFORATED PIPE.
3. DRAIN PIPE SHALL HAVE POSITIVE FALL THROUGHOUT.
4. DRAIN PIPE SHALL BE PROVIDED WITH A FREE GRAVITY OUTFALL, IF POSSIBLE. IF A GRAVITY OUTFALL CANNOT BE ACHIEVED, THEN A SUMP PIT AND PUMP SHALL BE USED. THE OUTFALL SHOULD EXTEND PAST BACKFILL ZONES AND DISCHARGE TO A LOCATION THAT IS GRADED TO DIRECT WATER OFF-SITE.
5. ALL DRAIN COMPONENTS SHALL BE RATED/APPROVED BY THE MANUFACTURER FOR THE INSTALLED DEPTH AND APPLICATION
6. DRAIN SYSTEM, INCLUDING THE OUTFALL OF THE DRAIN, SHALL BE OBSERVED BY QUALIFIED PERSONNEL PRIOR TO BACKFILLING TO VERIFY INSTALLATION.
7. A VERTICAL SEGMENT OF PERFORATED DRAIN PIPE, CAPPED AT THE TOP, SHALL EXTEND TO FINISH GRADE WITHIN ALL WINDOW WELLS.

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Southern Colorado, Denver Metro, Northern Colorado

# PERIMETER DRAIN

FIG No. 7

# APPENDIX A

Additional Reference Documents


1. *Replat Map, Pair-A-Dise Subdivision Filing No. 1, a re-plat of lot 38, Chaparral Hills, El Paso County, Colorado,* prepared by MVE, Inc. Engineers and Surveyors, last dated October 12, 2021.
2. *Soils Report for Aaron Atwood, Lot #38, Chaparral Hills Subdivision, 515 Struthers Loop, El Paso County, Colorado*, prepared by Geoquest, LLC, Job No. 21-0794, last dated July 30, 2021.
3. *Soils Report for Aaron Atwood, Lot #38, Chaparral Hills Subdivision, 515 Struthers Loop, El Paso County, Colorado*, prepared by Geoquest, LLC, Job No. 21-0795, last dated July 30, 2021.
4. *Flood Insurance Rate Map, El Paso County, Colorado and Unincorporated Areas, Community Panel No. 08041C0287G,* Federal Emergency Management Agency (FEMA), effective December 7, 2018.
5. *Surficial Geologic Map of the Denver 1-degree X 2-degree Quadrangle, Colorado. U.S. Geological Survey, Moore, D.W., Straub, A.W., Berry, M.E., Baker, M.L., and Brandt, T.R., MF-2388, 2001*
6. *Geologic Map of the Monument Quadrangle, El Paso County, Colorado,* Thorson, J.P., and Madole, R.F., Colorado Geological Survey, Open-File Report OF02-04, 2004.
7. *Environmental and Engineering Geologic Map for Land Use*, compiled by Dale M. Cochran, Charles S. Robinson & Associates, Inc., Golden, Colorado, 1977.
8. *Map of Potential Geologic Hazards and Surficial Deposits,* compiled by Dale M. Cochran, Charles S. Robinson & Associates, Inc., Golden, Colorado, 1977.
9. *Pikes Peak Regional Building Department:* https://www.pprbd.org/.
10. El Paso County Assessor Website
    https://property.spatialest.com/co/elpaso/#/property/71360002005
    Schedule No. 71360002005
11. *Colorado Geological Survey, USGS Geologic Map Viewer*:
    http://coloradogeologicalsurvey.org/geologic-mapping/6347-2/.
12. *Historical Aerials:* https://www.historicaerials.com/viewer, Images dated 1947, 1952, 1953, 1955, 1960, 1969, 1983, 1999, 2005, 2009, 2011, 2013, 2011, 2013, 2015, 2017, and 2019.
13. *USGS Historical Topographic Map Explorer:* http://historicalmaps.arcgis.com/usgs/ El Paso County, Monument Quadrangle, 2019.
14. *Google Earth Pro*, Imagery dated 1999, 2003, 2004, 2005, 2006, 2011, 2015, 2017, 2019 and 2020.
15. Kirkham, R.M., and Ladwig, L.R., 1979, Coal resources of the Denver and Cheyenne basins, Colorado: Colorado Geological Survey Resource Series 5, 70 p., 5 plates
16. Keller, J.W., Phillips, R.C., and Morgan, Karen, 2002, Digital inventory of industrial mineral mines and mine permit locations in Colorado: Colorado Geological Survey Information Series IS-62, CD ROM.
17. Mason, G. T., and Arndt, R. E., 1996, Mineral resource data system (MRDS): U.S. Geological Survey Digital Data Series DDS-20 (CD-ROM).
18. *Evaluation of Mineral and Mineral Fuel Potential of El Paso County State Mineral Lands*
19. The *El Paso Aggregate Resource Evaluation Map, Master Plan for Mineral Extraction*, *Map 1*

# APPENDIX B

Site Reconnaissance Photos

SE
S
SW
120
150
180
210
240
183°S (T)
39°3'10"N, 104°50'11"W ±13ft
6910ft
Site access off of
Struthers Loop
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 8:51:38 AM

E
SE
S
90
120
150
180
131°SE (T)
39°3'9"N, 104°50'11"W ±13ft
6916ft
SE boundary looking SE
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 8:52:14 AM

NW
N
NE
330
0
30
60
14°N (T)
39°3'9"N, 104°50'11"W ±13ft
6909ft
SE boundary looking North
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 8:52:46 AM

W
NW
N
240
270
330
0
300°NW (T)
39°3'9"N, 104°50'11"W ±9ft
6911ft
SE boundary looking West
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 8:53:06 AM

NW
N
NE
330
0
30
60
13°N (T) 39°3'9"N, 104°50'11"W ±13ft 6911ft
Telecommunications box in
SE corner
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 8:54:18 AM

NW
N
NE
330
0
30
60
14°N (T) 39°3'10"N, 104°50'13"W ±13ft 6900ft
SW boundary looking north
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 8:56:16 AM

SE
S
SW
150
180
210
240
194°S (T) 39°3'9"N, 104°50'11"W ±9ft 6912ft
SE boundary looking Sourh
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 8:53:25 AM

NW
N
NE
300
330
0
30
60
9°N (T) 39°3'9"N, 104°50'11"W ±9ft 6912ft
SE boundary looking
Into property
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 8:53:42 AM

NE
E
SE
60
90
120
150
106°E (T)
39°3'10"N, 104°50'13"W ±9ft
6901ft
SW boundary looking east
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 8:56:37 AM

SE
S
SW
120
150
180
210
240
187°S (T)
39°3'10"N, 104°50'13"W ±13ft
6900ft
SW boundary looking south
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 8:56:52 AM

SW
W
NW
210
240
270
300
330
275°W (T) 39°3'10"N, 104°50'13"W ±9ft 6903ft
SW boundary looking west
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 8:57:05 AM

N
NE
E
0
30
60
90
43°NE (T) 39°3'10"N, 104°50'13"W ±9ft 6904ft
SW boundary looking
into property
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 8:57:17 AM

E
SE
S
60
90
120
150
180
118°SE (T) 39°3'10"N, 104°50'13"W ±13ft 6902ft
Concrete sink SW boundary
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 8:57:32 AM

S
SW
W
NW
180
210
240
270
300
248°W (T) 39°3'13"N, 104°50'9"W ±13ft 6921ft
Eastern boundary looking
into property
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 9:00:18 AM

S
SW
W
150
180
210
240
270
209°SW (T) 39°3'13"N, 104°50'9"W ±9ft 6925ft
Eastern boundary looking
into property
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 9:00:35 AM

W
NW
N
270
300
330
0
320°NW (T) 39°3'13"N, 104°50'9"W ±9ft 6927ft
Eastern boundary looking
into property
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 9:00:40 AM

E
SE
S
60
90
120
150
180
119°SE (T) 39°3'15"N, 104°50'8"W ±13ft 6919ft
NE boundary adjacent property
runoff into subject property
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 9:01:48 AM

W
NW
N
240
270
300
330
0
302°NW (T) 39°3'15"N, 104°50'8"W ±9ft 6920ft
Access road NE boundary area
heading west
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 9:02:23 AM

NE
E
SE
30
60
90
120
150
88°E (T)
39°3'16"N, 104°50'7"W ±13ft
6924ft
NE boundary looking east
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 9:03:51 AM

NW
N
NE
330
0
30
60
12°N (T)
39°3'16"N, 104°50'7"W ±9ft
6936ft
NE boundary looking north
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 9:04:09 AM

SE S SW W
150 180 210 240 270
201°S (T) 39°3'16"N, 104°50'7"W ±13ft 6934ft
NE boundary looking south
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 9:04:22 AM

SW W NW
210 240 270 300 330
270°W (T) 39°3'16"N, 104°50'7"W ±9ft 6931ft
NE boundary looking west
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 9:04:31 AM

S
SW
W
150
180
210
240
270
219°SW (T) 39°3'15"N, 104°50'9"W ±13ft 6917ft
tex
TGHU 867204 0
Shipping container near
NE boundary
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 9:06:04 AM

SW
W
NW
210
240
270
300
254°W (T) 39°3'15"N, 104°50'9"W ±13ft 6916ft
Miscellaneous equipment near
shipping container
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 9:06:36 AM

S
SW
W
180
210
240
270
300
237°SW (T) 39°3'16"N, 104°50'10"W ±13ft 6910ft
Wooded area along
northern boundary
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 9:07:29 AM

N
NE
E
330
0
30
60
90
35°NE (T) 39°3'16"N, 104°50'10"W ±9ft 6909ft
Wooded area along
northern boundary
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 9:07:44 AM

NW
N
NE
300
330
0
30
60
351°N (T) 39°3'16"N, 104°50'10"W ±13ft 6908ft
Northern boundary
property fence
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 9:08:29 AM

W
NW
N
NE
270
300
330
0
30
339°N (T) 39°3'16"N, 104°50'12"W ±29ft 6850ft
Wetland type vegetation around
NW boundary
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 9:11:26 AM

SE S SW
150 180 210 240
198°S (T) 39°3'15"N, 104°50'12"W ±13ft 6904ft
Remnants of 2021 Geoquest
test pit on lot 1
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 9:12:26 AM

NW N NE
330 0 30 60
16°N (T) 39°3'14"N, 104°50'12"W ±9ft 6892ft
Geoquest Test pit from 2021
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 9:14:14 AM

SE
S
SW
120
150
180
210
240
183°S (T) 39°3'12"N, 104°50'11"W ±13ft 6906ft
Geoquest test pit on proposed lot 2
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 9:16:02 AM

NW
N
NE
300
330
0
30
60
353°N (T) 39°3'11"N, 104°50'13"W ±13ft 6901ft
Second Geoquest test pit on proposed lot 2 near western boundary
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 9:18:10 AM

NW
N
NE
300
330
0
30
60
6°N (T)
39°3'12"N, 104°50'12"W ±42ft
6912ft
Site overview from front
of property
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 9:19:51 AM

N
NE
E
0
30
60
90
12
49°NE (T)
39°3'10"N, 104°50'11"W ±13ft
6889ft
Site overview from front
of property
Kyle Reamer-Staff
Geologist-RMG
188423 - 515 Struthers Loop
02 Mar 2022, 9:20:14 AM

# APPENDIX C

*Soils Reports for Aaron Atwood, Lot #38, Chaparral Hills Subdivision, 515 Struthers Loop, El Paso County, Colorado*, prepared by Geoquest, LLC, Job No. 21-0794 and 21-0795, last dated July 30, 2021.

28 July 2021

GEOQUEST, LLC

6825 Silver Ponds Heights #101
Colorado Springs, CO 80908
(719) 481-4560

Aaron Atwood
701 Airman Lane
Colorado Springs, Colorado 80921

RE: Soil Test Receipt, 515 Struthers Loop, Geoquest #21-0794

To Whom It May Concern:

Thank you for choosing Geoquest, LLC to perform the Soils Report for the property at the above location.

The attached Soils Report provided by Geoquest, LLC, has been prepared in accordance with the standard of practice. This report does not address possible geologic hazards, environmental hazards, or drainage that exist on-site. There are specific requirements for the design and construction of the foundation of a structure at the location noted in the report. Some of these requirements are placed on the homeowner of the property and may be outside of the builders' control. **Accordingly, we are requiring both the builder and the homeowner to sign this letter indicating both parties have accepted a copy of the report, have read and understood the contents, and know they each have specific responsibilities. Failure to follow the recommendations and requirements of the report by any party can result in unsatisfactory performance of the foundation or building components. The Builder and Owner understand the risks, as noted in the Soils Report, and accept all risk, including movement of slabs.**

After the excavation has been completed an **Open Hole Observation is required** to be performed by the Soils Engineer. **After the Open Hole Observation is complete, the owner/builder should inform the Foundation Engineer of any changes to the soil conditions or allowable bearing. The Open Hole Observation is an additional cost.**

**Geoquest, LLC, will not provide any documentation for site inspections until we have received this letter with the required signatures.** If the property is being developed as a speculative investment and no homeowner has been contracted to purchase the property, you can indicate that under the homeowner signature line. Upon the sale of the property the builder understands that both this letter and a copy of the Soils Report shall be provided to the buyer, and a homeowner signed copy returned to Geoquest, LLC.

If you have any questions, feel free to contact us at (719) 481-4560.

Sincerely,

Charles E. Milligan, P.E.

Builder Representatives

Homeowner(s)

_____ _____

_____ _____

GEOQUEST, LLC

6825 Silver Ponds Heights #101
Colorado Springs, CO 80908
(719) 481-4560

# SOILS REPORT

# FOR

# AARON ATWOOD

**JOB #21-0794**

Lot #38,
Chaparral Hills Subdivision,
515 Struthers Loop,
El Paso County,
Colorado

Sincerely,

Charles E. Milligan, P.E.

COLORADO REGISTERED
CHARLES E. MILLIGAN
34608
30JUL21
PROFESSIONAL ENGINEER

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DESIGN AND CONSTRUCTION CONSIDERATIONS ..... 2
RECOMMENDATION REMARKS ..... 3
COLD TEMPERATURE CONSIDERATIONS ..... 3
SURFACE DRAINAGE ..... 3
SUBSURFACE DRAINAGE ..... 4
REINFORCING ..... 4
FOOTING DESIGN ..... 4
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## INTRODUCTION

**The owners must be made aware of the contents of this report. If there are any questions or concerns regarding the information in this report, please contact Geoquest, LLC.** It is the responsibility of the contractor on this project to make subsequent owners aware of the contents of this report. This is to ensure that the recommendations and requirements of the report, especially regarding the surface drainage, are acknowledged and followed. This report is prepared for **Aaron Atwood, owner, on Lot #38, Chaparral Hills Subdivision, 515 Struthers Loop, El Paso County, Colorado.** This report is prepared with the understanding that a single-family residence is planned for this site. The site does not have existing structures.

## CONCLUSIONS

**The soil profile of this site has shallow unsuitable very low density material, to the depth of 5 feet. The excavation and the placement of the foundation components must penetrate the very low density silty sand (SM) in Test Hole #1 (TH-1). If this unsuitable material is encountered, it must be removed and replaced, compaction testing will be required, and a bearing of 1,000 pounds per square foot will be used. The over-excavated area shall extend to a minimum depth of 4 feet below the bottom of the foundation elevation and 4 feet laterally from the foundation. If the foundation will penetrate the unsuitable soil, then a soils bearing of 1,000 pounds per square foot should be used and 4 feet of lateral separation must be maintained.**

A satisfactory foundation for this structure is a properly designed shallow foundation system consisting of foundation components resting directly on undisturbed materials. Foundation components resting directly on undisturbed low to moderate density materials shall be designed for a loading of not greater than **1,500 pounds per square foot.** Foundation components resting directly on undisturbed moderate density materials shall be designed for a loading of not greater than **2,000 pounds per square foot. Any design by any engineer is subject to revision based on the results of the open hole observation.** The compressibility of this material is low. This bearing capacity is calculated with a safety factor of three. The type of foundation configuration used depends on the building loads applied. The depth of foundation elements shall be determined by the foundation engineer but should be at least as deep as the minimum depth required by the governing building authority. **The laboratory testing revealed that the on-site soil is silty sand with underlying clayey sand (U.S.C.S. Classification Symbol SM, SC). The unit weight of equivalent fluid soil pressure of this material is 45 (SM) and 85 (SC) pounds per cubic foot. The native SC is not suitable and shall not be used as backfill material around the perimeter of the foundation.** The actual equivalent fluid soil pressure was not determined. The expected values are from ASCE 7-10, Table 3.2-1. **Foundation components should bear on soils of similar bearing capacity. Foundation components bearing on dissimilar soils should be avoided. The owners shall be made aware that movement will occur if surface or subsurface water is allowed to collect around the foundation wall.**

## GENERAL

The investigation was made to reveal important characteristics of the soils and of the site influencing the foundation design. Also evaluated during the investigation were subsurface conditions that affect the depth of the foundation and subsequent loading design, such as ground water levels, soil types, and other factors which affect the bearing capacity of the soils. Design loadings are based on soils characteristics and represent the maximum permissible loads for these conditions. The bearing capacity is calculated with a safety factor of three.

## FIELD AND LABORATORY INVESTIGATION

Two exploratory holes were drilled on July 5, 2021, at the locations shown on the enclosed site map. The location of these test holes was determined by Aaron Atwood. The test holes were drilled with a 3-inch diameter auger. At intervals anticipated to be the foundation depths, and as determined by the soils conditions, the drill tools were removed, and samples were taken by the use of a 2-inch split barrel sampler connected to a 140-pound drop-hammer. This hammer is dropped 30 inches to drive the penetration sampler into the soil **(ASTM D-1586).** The depths and descriptions of the materials encountered in each test boring at which the samples were taken are shown on the enclosed log sheets. All samples were classified both in the field and in the laboratory to evaluate the physical and mechanical properties of the materials encountered.

## TOPOGRAPHY

The topography of this site is that of an incline sloping down towards the southwest at 6%.

## WEATHER

The weather at the time of the soil examination consisted of clear skies with warm temperatures.

## DESIGN AND CONSTRUCTION CONSIDERATIONS

Slabs-on-grade may move and crack. Vertical slab movement of up to one and a half inches should be expected for native soils with low expansion potential. In some cases, vertical movement may exceed this range. If movement and associated damage to basement floors and finishes cannot be tolerated, a structural floor system should be installed. If compaction is not performed, settlement may occur causing cracking of foundation walls and floors. Soil located beneath concrete walls shall be compacted to at least 95% Modified Proctor density **(ASTM D-1557)**. Soil located beneath concrete slabs shall be compacted to at least 85% Modified Proctor density. Special care is to be taken to re-compact the material above utility lines to a minimum of 85% Modified Proctor density. During construction, conditions that could cause settlement shall be eliminated. Interior non-bearing partition walls shall be constructed such that they do not transmit floor slab movement to the roof or overlying floor. The gap or void (1.5 inch min.) installed in these non-bearing partitions may require re-construction over the life of the structure to re-establish the gap or void to allow for vertical slab movement. Stairwells, doorways, and sheeted walls should be designed for this movement.

The following are general recommendations of on-grade slabs:

1. Slabs shall be placed on well-compacted, non-expansive materials, and all soft spots shall be thoroughly excavated and replaced with non-expansive fill materials as stated above.

2. Slabs shall be separated from all foundation walls, load bearing members, and utility lines.

3. At intervals not to exceed 12 feet in each direction, provide control joints to reduce problems with shrinkage and curling as recommended by the American Concrete Institute **(ACI 360R-10)**. Moisten the ground beneath the slab prior to the placement of concrete.

4. All concrete placed must be cured properly as recommended by the American Concrete Institute **(ACI 360R-10)**. Separate load bearing members from slabs, as discussed above. Care must be exercised to prevent excess moisture from entering the soil under the structure, both during and after construction.

5. Due to the exposure of exterior concrete to variations in moisture fluctuations, heaving and cracking of exterior slabs-on-grade should be expected. Placement of at least 3 feet of non-expansive fill beneath the slabs can help to reduce the impact of differential movement and cracking but may not eliminate movement. Exterior concrete shall slope away from the structure a minimum of 2% grade.

6. The clayey sand (SC) has been analyzed for its expansion and/or consolidation potential. Basement slabs, garage slabs, and all concrete floor slabs, however, exert a very low dead-load pressure on the soil. Since this soil contains at least a small amount of swell potential, slabs will crack and heave or settle if excess water is allowed to penetrate the sub-grade. For example, column openings to pads below the placed slab, if exposed to precipitation during construction, will conduct water to the sub-grade, possibly causing it to expand. Also, if the slab is placed with concrete too wet, expansion may occur. We recommend 3,000 psi concrete placed at a maximum slump of 4 inches.

## RECOMMENDATION REMARKS

The recommendations provided in this report are based upon the observed soil parameters, anticipated foundation loads, and accepted engineering procedures. The recommendations are intended to minimize differential movement resulting from the heaving of expansive soil or from the settlement induced by the application of loads. **It must be recognized that the foundation will undergo some movement on all soil types.** In addition, concrete floor slabs will move vertically, therefore, adherence to those recommendations which isolate floor slabs from columns, walls, partitions or other structural components is extremely important if damage to the superstructure is to be minimized.

Any subsequent owners should be apprised of the soil conditions and advised to maintain good practice in the future with regard to surface and subsurface drainage and partition framing, drywall and finish work above floor slabs.

Geoquest, LLC does not assure that the contractor and/or homeowner will comply with the recommendations provided in this report. Geoquest, LLC provides recommendations only and does not supervise, direct or control the implementation of the recommendations.

**Failure to follow the recommendation provided by Geoquest, LLC and follow observation requirements may jeopardize the construction project and Geoquest, LLC shall be absolved from any and all responsibility for any damages arising from the failure to obtain proper site observation and follow recommendations.**

## COLD TEMPERATURE CONSIDERATIONS

1. Concrete shall not be placed upon wet or frozen soil.

2. Concrete shall be protected from freezing until it has been allowed to cure for at least 7 days after placement in forms.

3. Snow or other frozen water shall not be allowed in the forms during placement of concrete.

4. Concrete shall be cured in forms for at least 72 hours.

5. Concrete shall be vibrated or rodded in forms to avoid segregation and cold joints.

6. The site shall be kept well drained at all times. Ponding of water should be avoided in the excavation area.

## SURFACE DRAINAGE

After construction of foundation walls, the backfill material shall be well compacted to 80% Modified Proctor density, to reduce future settlement. Any areas that settle after construction shall be filled to eliminate ponding of water adjacent to the foundation walls. **The finished grade shall have a positive slope away from the structure with an initial slope of 6 inch in the first 10 feet.** If a 10 foot zone is not possible on the upslope side of the structure, then a well-defined swale should be created a minimum of 5 feet from the foundation and sloped parallel with the wall at a 2% grade to intercept the surface water and carry it around and away from the structure. Homeowners shall maintain the surface grading and drainage installed by the builder to prevent water from being directed in the wrong direction. All downspouts shall have extensions that will remove runoff to the outside of the backfilled areas. Shrubs and plants requiring minimal watering shall be established in this area. Irrigated grass shall not be located within 5 feet of the foundation. Sprinklers shall not discharge water within 5 feet of the foundation. Irrigation should be limited to the minimum amount sufficient to maintain vegetation. Application of more water will increase the likelihood of floor slab and foundation movement.

All exterior grading and location of downspouts and their performance shall be inspected by Geoquest, LLC. **The native clayey sand (SC) material is not suitable and shall not be used as backfill material around the perimeter of the foundation.** If on-site soils are not suitable for the backfill, the backfill material shall consist of clean non-cohesive granular soils or road base material as described previously. Imported material is to be approved by Geoquest, LLC prior to placement. **We recommend imported granular backfill with a maximum unit weight of 45 pounds per cubic foot**. It is the responsibility of the contractor to schedule all inspections.

## SUBSURFACE DRAINAGE

Perimeter drains are required around all walls of the habitable or usable area portion of the structure that are below finished grade including all common wall(s) adjacent to the basement. Crawlspaces are considered usable area. Walkout areas need not be drained unless specified at the time of the Open Hole Observation. The final determination of the necessity for perimeter drains will be made at the time of the Open Hole Observation. An Exterior Drain Detail is provided in this report. Drains should daylight away from the structure or discharge to a sump pump.

## REINFORCING

The concrete foundation walls shall be properly reinforced as per the specific design for this foundation by a **Colorado Registered Professional Engineer. Exact requirements are a function of the design of the structure. Questions concerning the specific design requirements shall be referred to the design engineer.**

## FOOTING DESIGN

The design for footings, pads, and/or piers for this structure is determined by applying the dead load and full live load to the foundation walls.

## CONSTRUCTION DETAILS

It is necessary with any soils investigation to assume that the materials from the test holes are representative of the materials in the area. On occasion variations in the subsurface materials do occur, therefore, should such variations become apparent during construction, the owner is advised to contact this office for a determination as to whether these variations will affect the design of the structure's foundation. If anomalies are observed during the excavation for the structure, this office should be contacted to determine whether the layers will adversely affect the design.

## MINIMUM MATERIALS SPECIFICATIONS

1. Minimum materials specifications of the concrete, reinforcing, etc., shall be determined by the Professional Foundation Design Engineer.
2. Compact beneath foundation walls a minimum of 95% Modified Proctor density to prevent settlement.
3. Compact all backfill material located around the perimeter of the foundation to a minimum of 80% Modified Proctor density.
4. Concrete shall be vibrated or rodded in forms to avoid segregation and cold joints.
5. The site shall be kept well drained at all times.

## OPEN HOLE OBSERVATION (added cost)

**If anyone other than Geoquest, LLC, performs the Open Hole Observation, that person/company assumes liability for the soils, and any possible changes to the foundation design.**

The owner, or a representative of the construction company shall contact **Geoquest, LLC** a minimum of **24 hours** prior to excavating for the foundation. An Open Hole Observation must be performed on each individual structure prior to the placement of concrete, and preferably prior to the placement of forms in the excavated area. **The failure to request or obtain an Open Hole Observation prior to the placement of foundation components may result in this Soils Report being declared null and void.** This is to ensure that soft areas, anomalies, etc., are not present in the foundation region. At the time of the open hole observation the **foundation type recommendations, maximum allowable bearing capacity may be revised** according to soil conditions found at that time. If revisions are made to the Soils Report due to the soil conditions of the excavation, **the Foundation Design Engineer must be notified of all revisions.**

**COMPACTION TESTING (added cost)**

Geoquest, LLC shall perform compaction testing on any replaced material. Soil shall be compacted in maximum 6-inch lifts. Testing shall be performed at intervals not to exceed 24 inches (or as required by the design engineer). Modified Proctor Density must be provided to Geoquest, LLC prior to compaction testing, see below.

The owner, or a representative of the construction, shall contact Geoquest, LLC a **minimum of 24 hours prior to the time the compaction test is requested. The failure to properly compact and/or obtain proper compaction testing may result in this Soils Report being declared null and void.**

**MODIFIED PROCTOR DENSITY TESTING (added cost)**

**Modified Proctor Density test must be provided to Geoquest, LLC prior to compaction testing.** If a Proctor cannot be provided, a Modified Proctor Density test must be completed prior to compaction testing. Two 5-gallon valid samples of the soil to be used, must be provided for testing, at least 2 weeks prior to the placement and compaction of the material.

**The failure to provide this data may result in this Soils Report being declared null and void.**

**FINAL OBSERVATIONS (added cost)**

The owner, or a representative of the construction company, shall contact Geoquest, LLC at the time final grading and landscaping procedures are completed. This is to ensure that sprinkler systems are not installed adjacent to the structure and that only shrubs or plants that require minimal watering are established in this area. All exterior grading as well as the location of downspouts and their performance shall be inspected by Geoquest, LLC. Any additional landscaping or grading changes performed by subsequent contractors and/or owners shall be inspected and approved. It is the responsible of the contractor and/or owner to schedule all these inspections at the appropriate times. **The failure to obtain this inspection may result in this Soils Report being declared null and void.**

**LIMITATIONS**

This report is issued based on the understanding that the owner or his representative will bring the information, data, and recommendations contained in this report to the attention of the project engineer and architect, in order that they may be incorporated into the plans for the structure. It is also the owner's responsibility to ensure that all contractors and sub-contractors carry out these recommendations during the construction phase.

This report was prepared in accordance with generally accepted professional geotechnical/engineering methods. However, Geoquest, LLC makes no other warranty, express or implied, as to the findings, data, specifications, or professional advice rendered hereunder. **Due to circumstances outside of Geoquest, LLC's control, including improper construction, failure to follow recommendations, and unforeseen events, the Limits of Liability extend only to fees rendered for the professional services provided.**

This report is considered valid as of the present date. The owner acknowledges, however, that changes in the conditions of the property might occur with the passage of time, such as those caused by natural effects or man-made changes, both on this land and on abutting properties. Further, changes in acceptable tolerances or standards might arise as the result of new legislative actions, new engineering advances, or the broadening of geotechnical knowledge. Thus, certain developments beyond our control may invalidate this report, in whole or in part.

This report and its recommendations do not apply to any other site than the one described herein and are predicated on the assumption that the soil conditions do not deviate from those described. In the event that any variations or undesirable conditions should be detected during the construction phase or if the proposed construction varies from that planned as of this report date, the owner shall immediately notify Geoquest, LLC in order that supplemental recommendations can be provided, if so required.

This report excludes possible environmental issues, geologic hazards, flooding, or any other natural or man-made hazards that affect this site. These are outside the scope of work, for this report.

## APPENDIX

GEOQUEST, inc
481-4560

# DRILL LOGS

JOB #: 21-0794

TEST BORING
NO.: TH-1

DATE: 7/5/2021

**0"-8" Topsoil**

**8"-5' Sand**

Fine-coarse grained
Very low density
Low moisture content
Low-moderate clay content
Low-moderate plasticity
Tan color

**5'- 15' Sand (SC)**

Fine-coarse grained
Moderate density
High moisture content
Moderate clay content
Moderate plasticity
Brown Grey color

| DEPTH (in ft.) | SYMBOL | SAMPLES | BLOW COUNT | WATER % | SOIL TYPE |
|---|---|---|---|---|---|
| 2 | | | | | |
| 4 | | ■ | 5/12" | 4.7 | |
| 6 | | | | | |
| 8 | | | | | |
| 10 | | | | | |
| 12 | | ■ | 28/12" | 26.8 | SC |
| 14 | | | | | |
| 16 | | | | | |
| 18 | | | | | |
| 20 | | | | | |

JOB #: 21-0794

TEST BORING
NO.: TH-2

DATE: 7/5/2021

**0"-8" Topsoil**

**8"-6' Sand (SM)**

Fine-coarse grained
Low-moderate density
Low moisture content
Low-moderate clay content
Low-moderate plasticity
Tan color

**6'- 15' Sand**

Fine-coarse grained
Moderate density
High moisture content
Moderate clay content
Moderate plasticity
Brown Grey color

| DEPTH (in ft.) | SYMBOL | SAMPLES | BLOW COUNT | WATER % | SOIL TYPE |
|---|---|---|---|---|---|
| 2 | | | | | |
| 4 | | ■ | 18/12" | 3.3 | SM |
| 6 | | | | | |
| 8 | | | | | |
| 10 | | | | | |
| 12 | | | | | |
| 14 | | ■ | 26/12" | 24.2 | |
| 16 | | | | | |
| 18 | | | | | |
| 20 | | | | | |

GEOQUEST LLC

**SITE MAP**

Lot 38
Chaparral Hills
515 Struthers Loop
El Paso County
Colorado
Job #21-0794

# GEOQUEST LLC
## GRADATION TEST RESULTS

**CLASSIFICATION** SC

**GRAVEL** 2.7 %

**SAND** 57.4 %

**FINES** 39.9 %

**SAMPLE #** 1 **HOLE #** TH-1 **DEPTH** 12 **FEET**

**NOTES:** 26.8 % Moisture Content

**CLASSIFICATION** SM

**GRAVEL** 0.0 %

**SAND** 80.9 %

**FINES** 19.1 %

**SAMPLE #** 1 **HOLE #** TH- 2 **DEPTH** 4 **FEET**

**NOTES:** 3.3 % Moisture Content

**Job #:** 21-0794 **By:** MJ **7/5/2021**

GEOQUEST, LLC
481-4560

# EXTERIOR DRAIN DETAIL

1. Gravel to be Not More Than 1-1/2" and Not Less Than 1/2" Diameter.

2. Perforated Pipe Diameter Varies With Expected Seepage. 3"Ø and 4"Ø are Most Common. ABS and PVC are Most Common Materials for Pipe. We approve the use of an "EZ Flow Drainage System" by Infiltrator. All specifications in this drain detail are still applicable.

3. Pipe to be Laid out in a Minimum Slope of 1" in 10'.

4. Gravity Outfall is Desired if Possible. Portion of Pipe in Area Not Drained Shall be Non-Perforated. Daylight Must be Maintained Clear of Debris in Order to Function Properly.

5. If Gravity Outfall is Not Possible, Provide a Sump With Operational Pump. Pump May Not Connect to Any Sanitary or Storm Sewer.

6. Soil Backfill Should be Compacted to at Least 80% of the Modified Proctor Denisty in the Upper Three Feet of Fill.

7. Filter Fabric to be Mirafi 140s or Approved Equivalent. Roofing Felt and Sheet Plastic are Not Acceptable.

8. Drain Pipe Shall be Laid Below Protected Area, as Shown in The Detail Above.

9. Mop Polyethylene Film to Wall Approximately One Foot Above Joint of Footing and Wall (Do Not Pull Plastic Tight) and Carry Beneath Gravel and Pipe.

10. The Polyethylene Film Shall be Continued to the Edge of the Excavation.

28 July 2021

GEOQUEST, LLC

6825 Silver Ponds Heights #101
Colorado Springs, CO 80908
(719) 481-4560

Aaron Atwood
701 Airman Lane
Colorado Springs, Colorado 80921

RE: Soil Test Receipt, 515 Struthers Loop, Geoquest #21-0795

To Whom It May Concern:

Thank you for choosing Geoquest, LLC to perform the Soils Report for the property at the above location.

The attached Soils Report provided by Geoquest, LLC, has been prepared in accordance with the standard of practice. This report does not address possible geologic hazards, environmental hazards, or drainage that exist on-site. There are specific requirements for the design and construction of the foundation of a structure at the location noted in the report. Some of these requirements are placed on the homeowner of the property and may be outside of the builders' control. **Accordingly, we are requiring both the builder and the homeowner to sign this letter indicating both parties have accepted a copy of the report, have read and understood the contents, and know they each have specific responsibilities. Failure to follow the recommendations and requirements of the report by any party can result in unsatisfactory performance of the foundation or building components. The Builder and Owner understand the risks, as noted in the Soils Report, and accept all risk, including movement of slabs.**

After the excavation has been completed an **Open Hole Observation and Compaction Testing are required** to be performed by the Soils Engineer. **After the Final Compaction Test is complete, the owner/builder should inform the Foundation Engineer of any changes to the soil conditions or allowable bearing. The Open Hole Observation and Compaction Tests are an additional cost.**

**Geoquest, LLC, will not provide any documentation for site inspections until we have received this letter with the required signatures.** If the property is being developed as a speculative investment and no homeowner has been contracted to purchase the property, you can indicate that under the homeowner signature line. Upon the sale of the property the builder understands that both this letter and a copy of the Soils Report shall be provided to the buyer, and a homeowner signed copy returned to Geoquest, LLC.

If you have any questions, feel free to contact us at (719) 481-4560.

Sincerely,

Charles E. Milligan, P.E.

Builder Representatives

Homeowner(s)

_____ _____

_____ _____

GEOQUEST, LLC

6825 Silver Ponds Heights #101
Colorado Springs, CO 80908
(719) 481-4560

# SOILS REPORT

# FOR

# AARON ATWOOD

**JOB #21-0795**

Lot #38,
Chaparral Hills Subdivision,
515 Struthers Loop,
El Paso County,
Colorado

Sincerely,

Charles E. Milligan, P.E.

COLORADO REGISTERED
CHARLES E. MILLIGAN
34608
30JUL21
PROFESSIONAL ENGINEER

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## INTRODUCTION

**The owners must be made aware of the contents of this report. If there are any questions or concerns regarding the information in this report, please call Geoquest, LLC.** It is the responsibility of the contractor on this project to make subsequent homeowners aware of the contents of this report. This is to ensure that the recommendations and requirements of the report, especially regarding the surface drainage, are acknowledged and followed. This report is prepared for **Aaron Atwood, owner, on Lot #38, Chaparral Hills Subdivision, 515 Struthers Loop, El Paso County, Colorado.** This report is prepared with the understanding that a single-family residence is planned for this site. The site does not have existing structures.

## CONCLUSIONS

**Additional drainage will be required during construction due to the high moisture content. If the bottom of the excavation becomes unstable, the use of 1' to 2' of 4" to 8" ballast rock will be required.**

A satisfactory foundation for this structure is a properly designed shallow foundation system consisting of foundation components resting directly on over-excavated and replaced materials. This over-excavation and replaced materials scheme is necessary due to the low expansive on-site material. This over-excavation and replaced materials scheme will reduce, but not eliminate the potential for movement with moisture fluctuations in the unstable subgrade soils. Since those materials will remain in-place beneath the fill, a potential remains that moisture changes in these deeper unstable materials will cause some movement in the overlying fill and structure. **Vertical slab movement of up to three inches should be expected of soils of low expansion potential and for compacted structural fill after the removal of the expansive soils. In some cases, vertical movement may exceed this range. If movement and associated damage to basement floors and finishes cannot be tolerated, a structural floor system shall be installed.** This material has a swell potential of approximately **1.7% expansion potential with a dead load of 3,700 pounds per square foot (ASTM D-4546). The over-excavated area shall extend to a minimum depth of 4 feet below the bottom of the foundation elevation and 4 feet laterally from the location of the foundation walls.** The material to be compacted in the excavation shall meet or exceed CDOT Class 5 or Class 6 Road Base per CDOT 2019 Standard Specifications Table 703-2. This material shall be compacted to a minimum of 95% of its Modified Proctor density **(ASTM D-1557). Modified Proctor testing (additional cost) will be required on a sample of the replacement material to be used for this over-excavation scheme. Two 5-gallon valid samples of the soil to be used, must be provided for testing (unless a previous proctor test can be provided) at least 2 weeks prior to the placement and compaction of the material.** The compressibility of the over-excavated and replaced material shall be taken to be low. A maximum allowable bearing capacity for the over-excavated and replaced material is a presumptive value of **1,500 pounds per square foot.** This bearing capacity is calculated with a safety factor of three. The type of foundation configuration used depends on the building loads applied. The depth of foundation elements shall be determined by the foundation engineer but should be at least as deep as the minimum depth required by the governing building authority. **The laboratory testing revealed that the on-site soil is silty sand with underlying low-plasticity clay (U.S.C.S. Classification Symbol SM, CL). The unit weight of equivalent fluid soil pressure of this material is 45 (SM) and 100 (CL) pounds per cubic foot. The native CL is not suitable and shall not be used as backfill material around the perimeter of the foundation.** The actual equivalent fluid soil pressure was not determined. The expected values are from ASCE 7-10, Table 3.2-1. **Foundation components should bear on soils of similar bearing capacity. Foundation components bearing on dissimilar soils should be avoided. The owners shall be made aware that movement will definitely occur if surface or subsurface water is allowed to collect around the foundation or in the over-excavated area.**

## GENERAL

The investigation was made to reveal important characteristics of the soils and of the site influencing the foundation design. Also evaluated during the investigation were subsurface conditions which affect the depth of the foundation and subsequent loading design, such as ground water levels, soil types, and other factors which affect the bearing capacity of the soils. Design loadings are based on soils characteristics and represent the maximum permissible loads for these conditions. The bearing capacity is calculated with a safety factor of three.

## FIELD AND LABORATORY INVESTIGATION

Two exploratory holes were drilled on July 5, 2021, at the locations shown on the enclosed site map. The location of these test holes was determined by Aaron Atwood. The test holes were drilled with a 3-inch diameter auger. At intervals anticipated to be the foundation depths, and as determined by the soils conditions, the drill tools were removed, and samples were taken by the use of a 2 inch "split barrel" sampler connected to a 140-pound drop-hammer. This hammer is dropped 30 inches to drive the penetration sampler into the soil **(ASTM D-1586).** The depths and descriptions of the materials encountered in each test boring at which the samples were taken are shown on the enclosed log sheets. All samples were classified both in the field and in the laboratory to evaluate the physical and mechanical properties of the materials encountered.

## TOPOGRAPHY

The topography of this site is that of an incline sloping down towards the west at 5%.

## WEATHER

The weather at the time of the soil examination consisted of clear skies with hot temperatures.

## DESIGN AND CONSTRUCTION CONSIDERATIONS

Slabs-on-grade may move and crack. Vertical slab movement of up to three inches should be expected for soils of low expansion potential and for compacted structural fill after removal of expansive soils. In some cases, vertical movement may exceed this range. If movement and associated damage to basement floors and finishes cannot be tolerated, a structural floor system shall be installed. The native materials encountered during the exploratory testing are not suitable for the support of residential construction. If compaction is not performed, settlement may occur causing cracking of foundation walls and floors. Personnel of Geoquest, LLC shall inspect the base of the over-excavation prior to any placement of any fill materials. All backfill material and over excavated and replaced material shall be properly tested by Geoquest, LLC at the time of installation of said material. Soil located beneath concrete walls shall be compacted to at least 95% Modified Proctor density **(ASTM D-1557)**. Soil located beneath concrete slabs shall be compacted to at least 85% Modified Proctor density. Special care is to be taken to re-compact the material above utility lines to a minimum of 85% Modified Proctor density. During construction, conditions that could cause settlement shall be eliminated. Interior non-bearing partition walls shall be constructed such that they do not transmit floor slab movement to the roof or overlying floor. The gap or void (1.5-inch min.) installed in these non-bearing partitions may require re-construction over the life of the structure to re-establish the gap or void to allow for vertical slab movement. Stairwells, doorways, and sheeted walls should be designed for this movement.

The following are general recommendations of on-grade slabs:

1. Slabs shall be placed on a minimum of three feet of road base material and be tested to meet Modified Proctor density of 85%. All loose or soft spots shall be thoroughly excavated and replaced with non-expansive soil. **Up to 3 inches of movement of the slabs and exterior concrete can be expected.**

2. Slabs shall be separated from all foundation walls, load bearing members, and utility lines.

3. At intervals not to exceed 12 feet in each direction, provide control joints to reduce problems with shrinkage and curling as recommended by the American Concrete Institute **(ACI 360R-10)**. Moisten the ground beneath the slab prior to the placement of concrete.

4. All concrete placed must be cured properly as recommended by the American Concrete Institute **(ACI 360R-10)**. Separate load bearing members from slabs, as discussed above. Care must be exercised to prevent excess moisture from entering the soil under the structure, both during and after construction.

5. Due to the exposure of exterior concrete to variations in moisture fluctuations, heaving and cracking of exterior slabs-on-grade should be expected. Placement of at least 3 feet of non-expansive fill beneath the slabs can help to reduce the impact of differential movement and cracking but may not eliminate movement. Exterior concrete shall slope away from the structure a minimum of 2% grade.

6. **The low-plasticity clay (CL) has been tested for its expansion and/or consolidation potential. This material has a 1.7% expansion potential with a dead load of 3,700 pounds per square foot.** Basement slabs, garage slabs, and all concrete floor slabs, exert a very low dead-load pressure on the soil. Since this soil contains a small amount of swell potential, slabs will crack and heave or settle if excess water is allowed to penetrate the subgrade. For example, column openings to pads below the placed slab, if exposed to precipitation during construction, will conduct water to the subgrade, possibly causing it to expand. Also, if the slab is placed with concrete too wet, expansion may occur. We recommend 3,000 psi concrete placed at a maximum slump of 4 inches.

**RECOMMENDATION REMARKS**

The recommendations provided in this report are based upon the observed soil parameters, anticipated foundation loads and accepted engineering procedures. The recommendations are intended to minimize differential movement resulting from the heaving of expansive soil or from the settlement induced by the application of loads. **It must be recognized that the foundation will undergo some movement on all soil types.** In addition, concrete floor slabs will move vertically, therefore, adherence to those recommendations which isolate floor slabs from columns, walls, partitions or other structural components is extremely important, if damage to the superstructure is to be minimized. Any subsequent owners should be apprised of the soil conditions and advised to maintain good practice in the future with regard to surface and subsurface drainage and partition framing, drywall and finish work above floor slabs.

Geoquest, LLC does not assure that the contractor and/or homeowner will comply with the recommendations provided in this report. Geoquest, LLC provides recommendations only and does not supervise, direct or control the implementation of the recommendations.

**Failure to follow the recommendation provided by Geoquest, LLC and follow observation requirements may jeopardize the construction project and Geoquest, LLC shall be absolved from any and all responsibility for any damages arising from the failure to obtain proper site observation and follow recommendations.**

**COLD TEMPERATURE CONSIDERATIONS**

1. Concrete shall not be placed upon wet or frozen soil.

2. Concrete shall be protected from freezing until it has been allowed to cure for at least 7 days after placement in forms.

3. Snow or other frozen water shall not be allowed in the forms during placement of concrete.

4. Concrete shall be cured in forms for at least 72 hours.

5. Concrete shall be vibrated or rodded in forms to avoid segregation and cold joints.

6. The site shall be kept well drained at all times. Ponding of water should be avoided in the excavation area.

## SURFACE DRAINAGE

After construction of foundation walls, the backfill material shall be well compacted to 80% Modified Proctor density, to reduce future settlement. Any areas that settle after construction shall be filled to eliminate ponding of water adjacent to the foundation walls. **The finished grade shall have a positive slope away from the structure with an initial slope of 6 inch in the first 10 feet.** If a 10 foot zone is not possible on the upslope side of the structure, then a well-defined swale should be created a minimum of 5 feet from the foundation and sloped parallel with the wall at a 2% grade to intercept the surface water and carry it around and away from the structure. Homeowners shall maintain the surface grading and drainage installed by the builder to prevent water from being directed in the wrong direction. All downspouts shall have extensions that will remove runoff to the outside of the backfilled areas. Shrubs and plants requiring minimal watering shall be established in this area. Irrigated grass shall not be located within 5 feet of the foundation. Sprinklers shall not discharge water within 5 feet of the foundation. Irrigation should be limited to the minimum amount sufficient to maintain vegetation. Application of more water will increase the likelihood of floor slab and foundation movement.

All exterior grading and location of downspouts and their performance shall be inspected by Geoquest, LLC. **The native low-plasticity clay (CL) material is not suitable and shall not be used as backfill material around the perimeter of the foundation.** If on-site soils are not suitable for the backfill, the backfill material shall consist of clean non-cohesive granular soils or road base material as described previously. Imported material is to be approved by Geoquest, LLC prior to placement. **We recommend imported granular backfill with a maximum unit weight of 45 pounds per cubic foot**. It is the responsibility of the contractor to schedule all inspections.

## SUBSURFACE DRAINAGE

Perimeter drains are required around all walls of the habitable or usable area portion of the structure that are below finished grade including all common wall(s) adjacent to the basement. Crawlspaces are considered usable area. Walkout areas need not be drained unless specified at the time of the Open Hole Observation. The final determination of the necessity for perimeter drains will be made at the time of the Open Hole Observation. An Exterior Drain Detail is provided in this report. Drains should daylight away from the structure or discharge to a sump pump.

## REINFORCING

The concrete foundation walls shall be properly reinforced as per the specific design for this foundation by a **Colorado Registered Professional Engineer. Exact requirements are a function of the design of the structure. Questions concerning the specific design requirements shall be referred to the design engineer.**

## FOOTING DESIGN

The design for footings, pads, and/or piers for this structure is determined by applying the dead load and full live load to the foundation walls.

## CONSTRUCTION DETAILS

It is necessary with any soils investigation to assume that the materials from the test holes are representative of the materials in the area. On occasion variations in the subsurface materials do occur, therefore, should such variations become apparent during construction, the owner is advised to contact this office for a determination as to whether these variations will affect the design of the structure's foundation. If anomalies are observed during the excavation for the structure, this office should be contacted to determine whether this may adversely affect the design.

## MINIMUM MATERIALS SPECIFICATIONS

1. Minimum materials specifications of the concrete, reinforcing, etc., shall be determined by the Professional Foundation Design Engineer.

2. Compact beneath foundation walls a minimum of 95% Modified Proctor density to prevent settlement.

3. Compact all backfill material located around the perimeter of the foundation to 80% Modified Proctor density.

4. Concrete shall be vibrated or rodded in forms to avoid segregation and cold joints.

5. The site shall be kept well drained at all times.

## OPEN HOLE OBSERVATION (added cost)

**If anyone other than Geoquest, LLC performs the Open Hole Observation and/or compaction testing, that person/company assumes liability for the soils, and any possible changes to the foundation design.**

The owner, or a representative of the construction company shall contact **Geoquest, LLC** a minimum of **24 hours** prior to excavating for the foundation. An Open Hole Observation must be performed on each individual structure prior to the placement of concrete, and preferably prior to the placement of forms in the excavated area. **The failure to request or obtain an Open Hole Observation prior to the placement of foundation components may result in this Soils Report being declared null and void.** This is to ensure that soft areas, anomalies, etc., are not present in the foundation region. At the time of the open hole observation the **foundation type recommendations, maximum allowable bearing capacity may be revised** according to soil conditions found at that time. If revisions are made to the Soils Report due to the soil conditions of the excavation, **the Foundation Design Engineer must be notified of all revisions.**

## COMPACTION TESTING (added cost)

Geoquest, LLC shall perform compaction testing on the replaced material. Soil shall be compacted in maximum 6-inch lifts. Testing shall be performed at intervals not to exceed 24 inches (or as required by the design engineer). Modified Proctor Density must be provided to Geoquest, LLC prior to compaction testing, see below.

The owner, or a representative of the construction, shall contact Geoquest, LLC a **minimum of 24 hours prior to the time the compaction test is requested. The failure to properly compact and/or obtain proper compaction testing may result in this Soils Report being declared null and void.**

## MODIFIED PROCTOR DENSITY TESTING (added cost)

**Modified Proctor Density test must be provided to Geoquest, LLC prior to compaction testing.** If a Proctor cannot be provided, a Modified Proctor Density test must be completed prior to compaction testing. Two 5-gallon valid samples of the soil to be used, must be provided for testing, at least 2 weeks prior to the placement and compaction of the material.

**The failure to provide this data may result in this Soils Report being declared null and void.**

## FINAL OBSERVATIONS (added cost)

The owner, or a representative of the construction company, shall contact Geoquest, LLC at the time final grading and landscaping procedures are completed. This is to ensure that sprinkler systems are not installed adjacent to the structure and that only shrubs or plants that require minimal watering are established in this area. All exterior grading as well as the location of downspouts and their performance shall be inspected by Geoquest, LLC. Any additional landscaping or grading changes performed by subsequent contractors and/or owners shall be inspected and approved. It is the responsible of the contractor and/or owner to schedule all these inspections at the appropriate times. **The failure to obtain this inspection may result in this Soils Report being declared null and void.**

## LIMITATIONS

This report is issued based on the understanding that the owner or his representative will bring the information, data, and recommendations contained in this report to the attention of the project engineer and architect, in order that they may be incorporated into the plans for the structure. It is also the owner's responsibility to ensure that all contractors and sub-contractors carry out these recommendations during the construction phase.

This report was prepared in accordance with generally accepted professional geotechnical/engineering methods. However, Geoquest, LLC makes no other warranty, express or implied, as to the findings, data, specifications, or professional advice rendered hereunder. **Due to circumstances outside of Geoquest, LLC's control, including improper construction, failure to follow recommendations, and unforeseen events, the Limits of Liability extend only to fees rendered for the professional services provided.**

This report is considered valid as of the present date. The owner acknowledges, however, that changes in the conditions of the property might occur with the passage of time, such as those caused by natural effects or man-made changes, both on this land and on abutting properties. Further, changes in acceptable tolerances or standards might arise as the result of new legislative actions, new engineering advances, or the broadening of geotechnical knowledge. Thus, certain developments beyond our control may invalidate this report, in whole or in part.

This report and its recommendations do not apply to any other site than the one described herein and are predicated on the assumption that the soil conditions do not deviate from those described. In the event that any variations or undesirable conditions should be detected during the construction phase or if the proposed construction varies from that planned as of this report date, the owner shall immediately notify Geoquest, LLC in order that supplemental recommendations can be provided, if so required.

This report excludes possible environmental issues, geologic hazards, flooding, or any other natural or man-made hazards that affect this site. These are outside the scope of work, for this report.

## APPENDIX

GEOQUEST, LLC
481-4560

# DRILL LOGS

JOB #: 21-0795

TEST BORING
NO.: TH-1

DATE: 7/5/2021

**0"-6" Topsoil**

**6"-5' Sand**

Fine-coarse grained
Very low density
Low moisture content
Low-moderate clay content
Low-moderate plasticity
Light Brown color

**5'- 15' Clay (CL)**

Fine-medium grained
Moderate density
High moisture content
Low-moderate sand content
Moderate-high plasticity
Brownish Grey color

| DEPTH (in ft.) | SYMBOL | SAMPLES | BLOW COUNT | WATER % | SOIL TYPE |
|---|---|---|---|---|---|
| 2 | | | | | |
| 4 | | | 8/12" | 3.3 | |
| 6 | | | | | |
| 8 | | | | | |
| 10 | | | | | |
| 12 | | | 25/12" | 22.6 | CL |
| 14 | | | | | |
| 16 | | | | | |
| 18 | | | | | |
| 20 | | | | | |

JOB #: 21-0795

TEST BORING
NO.: TH-2

DATE: 7/5/2021

**0"-6" Topsoil**

**6"-5' Sand (SM)**

Fine-coarse grained
Low density
Low-moderate moisture content
Low-moderate clay content
Low-moderate plasticity
Light Brown color

**5'- 15' Clay**

Fine-medium grained
Moderate density
Moderate moisture content
Low-moderate sand content
Moderate-high plasticity
Brownish Grey color

| DEPTH (in ft.) | SYMBOL | SAMPLES | BLOW COUNT | WATER % | SOIL TYPE |
|---|---|---|---|---|---|
| 2 | | | | | |
| 4 | | | 12/12" | 6.5 | SM |
| 6 | | | | | |
| 8 | | | | | |
| 10 | | | | | |
| 12 | | | | | |
| 14 | | | 22/12" | 11.8 | |
| 16 | | | | | |
| 18 | | | | | |
| 20 | | | | | |

GEOQUEST LLC

**SITE MAP**

Lot 38
Chaparral Hills
515 Struthers Loop
El Paso County
Colorado
Job #21-0795

# GEOQUEST LLC
## GRADATION TEST RESULTS

| CLAY TO SILT | SAND | | | GRAVEL | | COBBLES |
|---|---|---|---|---|---|---|
| | FINE | MEDIUM | COARSE | FINE | COARSE | |

**CLASSIFICATION** CL

**GRAVEL** 7.6 %

**SAND** 40.9 %

**FINES** 51.5 %

**SAMPLE #** 1 **HOLE #** TH-1 **DEPTH** 12 **FEET**

**NOTES:** 22.6 % Moisture Content

LL = 38.5

PL = 24.1

PI = 14.4

| CLAY TO SILT | SAND | | | GRAVEL | | COBBLES |
|---|---|---|---|---|---|---|
| | FINE | MEDIUM | COARSE | FINE | COARSE | |

**CLASSIFICATION** SM

**GRAVEL** 0.6 %

**SAND** 71.4 %

**FINES** 28.0 %

**SAMPLE #** 1 **HOLE #** TH- 2 **DEPTH** 4 **FEET**

**NOTES:** 6.5 % Moisture Content

**Job #:** 21-0795 **By:** MJ 7/5/2021

GEOQUEST LLC

**SWELL-CONSOLIDATION TEST RESULTS**

GEOQUEST, LLC
481-4560

# EXTERIOR DRAIN DETAIL

1. Gravel to be Not More Than 1-1/2" and Not Less Than 1/2" Diameter.

2. Perforated Pipe Diameter Varies With Expected Seepage. 3"Ø and 4"Ø are Most Common. ABS and PVC are Most Common Materials for Pipe. We approve the use of an "EZ Flow Drainage System" by Infiltrator. All specifications in this drain detail are still applicable.

3. Pipe to be Laid out in a Minimum Slope of 1" in 10'.

4. Gravity Outfall is Desired if Possible. Portion of Pipe in Area Not Drained Shall be Non-Perforated. Daylight Must be Maintained Clear of Debris in Order to Function Properly.

5. If Gravity Outfall is Not Possible, Provide a Sump With Operational Pump. Pump May Not Connect to Any Sanitary or Storm Sewer.

6. Soil Backfill Should be Compacted to at Least 80% of the Modified Proctor Denisty in the Upper Three Feet of Fill.

7. Filter Fabric to be Mirafi 140s or Approved Equivalent. Roofing Felt and Sheet Plastic are Not Acceptable.

8. Drain Pipe Shall be Laid Below Protected Area, as Shown in The Detail Above.

9. Mop Polyethylene Film to Wall Approximately One Foot Above Joint of Footing and Wall (Do Not Pull Plastic Tight) and Carry Beneath Gravel and Pipe.

10. The Polyethylene Film Shall be Continued to the Edge of the Excavation.