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# GEOLOGY AND SOILS STUDY
# with Wastewater Study

## Lots 1-7, Fox Creek Estates
## Parcel No. 51929-30-003
## El Paso County, Colorado

## PREPARED FOR:

**Shay Miles**
**15630 Fox Creek Lane**
**Colorado Springs, CO 80908**

**JOB NO. 169372**

**September 3, 2019**
Revised September 18, 2020


**Respectfully Submitted,**

**RMG – Rocky Mountain Group**

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**Reviewed by,**

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**Geoff Webster, P.E.**
**Sr. Geotechnical Project Engineer**


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# 1.0 GENERAL SITE AND PROJECT DESCRIPTION

### 1.1 Project Location

The project lies in the south central portion of Section 29, Township 11 South, Range 65 West of the 6th Principal Meridian in El Paso County, Colorado. The site is located 0.35 miles to the east of the intersection of Black Forest Road and Terra Ridge Circle and directly north of Fox Creek Lane. The approximate location of the site is shown on the Site Vicinity Map, Figure 1.

### 1.2 Project Description

The total acreage involved in the project is approximately 39.7 acres. The proposed site development is to consist of seven single family rural residential lots and is to be named JeniShay Farms. The proposed lots are to be approximately 5 acres each. The development will utilize individual wells and on-site wastewater treatment systems.

Access to the lots is to be provided by extending the existing Fox Creek Lane to the north approximately 850 feet. The roadway access is to be constructed with a 60-foot improved public ROW that will be constructed to meet the requirements of an El Paso County Local Rural roadway, the road will terminate in a cul-de-sac, and a detention basin is to be located northeast of the proposed new cul-de-sac.

It is our understanding East Cherry Creek and its tributary to the west are to remain in their native state and no proposed improvements have been considered.

# 2.0 QUALIFICATIONS OF PREPARERS

This Geology and Soils report 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 Geoff Webster, P.E. Ms. Zigler is a Professional Geologist as defined by State Statute (C.R.S 34-1-201) with over 19 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.

Geoff Webster, P.E. is a licensed Professional Engineer with 34 years of experience in the structural and geotechnical engineering fields. Mr. Webster holds a Master's degree from the University of Central Florida. Mr. Webster has supervised and performed numerous geological and geotechnical field investigation programs in Colorado and other states.

# 3.0 STUDY OVERVIEW

The purpose of this investigation is to characterize the general geotechnical and geologic site conditions, and present our opinions of the potential effect of these conditions on the proposed development of single-family residences within the referenced site. 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 08/27/2019 applicable sections include 8.4.8 and 8.4.9. and the Engineering Criteria Manual (ECM), specifically Appendix C last updated July 9, 2019.

This report presents the findings of the study performed by RMG relating to the geotechnical and geologic conditions of the above-referenced site. 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.

### 3.1 Scope and Objective

This report present the results of our geologic evaluation and wastewater study for individual on-site wastewater treatment systems for the proposed single family development located in northern El Paso County, Colorado.

The purpose of our report is to adhere to the guidelines outlined in Appendix C of the ECM and Chapter 8.4.8 and 8.4.9 of the LDC. The occurrences of potential geologic hazards were evaluated and our opinions of the observed conditions on the proposed development with the respect to the intended usage are outlined in this report.

### 3.2 Site Evaluation Techniques

The information included in this report has been compiled from:

- Field reconnaissance
- Geologic and topographic maps
- Review of selected publicly available, pertinent engineering reports
- Available aerial photographs
- Exploratory soil test borings by others
- Laboratory testing of representative site soil and rock samples by others
- Geologic research and analysis
- Site development plans prepared by others

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 Previous Studies and Field Investigation

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

1. *Soils Report, Subdivision Report, 15630 Fox Creek Lane, El Paso County, Colorado,* prepared by Geoquest, LLC., Job#18-0975, dated November 16, 2018.
2. *Subdivision Profile Pit Evaluation, 15630 Fox Creek Lane, El Paso County, Colorado,* prepared by Geoquest, LLC., Job#18-0975, dated July 11, 2019.

# 4.0 SITE CONDITIONS

### 4.1 Proposed Land Use and Zoning

It is our understanding the 39.7 acre parcel is to be subdivided into seven new parcels. The proposed site development is to consist of seven single family rural residential lots. The proposed lots are to be approximately 5 acres each. The development is to utilize individual wells and on-site wastewater treatment systems. Figure 1 presents the general boundaries of our investigation.

### 4.2 Topography

Based on our site observation on July 18, 2019, in general, the site topography consists of rolling hills that vary from gradually to moderately sloping down from the north to the south with slopes of 8 to 20 percent across the site. The approximate elevation difference from the northwest corner to the southeast corner of the property is 138 feet. East Cherry Creek is located and transverses through the northeastern portion of the property and meanders south along the eastern property line. A dendritic tributary of the East Cherry Creek approaches the site from the north and meanders through the central portion of the property and transverses south through the western portion of the property. Isolated areas along the creek banks may exceed 20 percent.

### 4.3 Vegetation

The majority of the site consists of tall grasses and weeds. Very few deciduous trees are located across the property.

# 5.0 FIELD INVESTIGATION AND LABORATORY TESTING

### 5.1 Drilling

The subsurface conditions below the subject site were investigated by Geoquest, LLC on October 10, 2018 as part of the site specific *Soils Report*. Geoquest test borings extended to depths of approximately 15 feet below the existing ground surface. The Soils Report is presented in Appendix A. The approximate locations of the Geoquest test borings locations are presented on the General Engineering and Geology Map, Figure 3.

### 5.2 Profile Pit Excavations

Three profile pits were performed to explore the subsurface soils underlying the proposed Onsite Wastewater Treatment Systems. The number of test pits is in accordance with Regulations of the El Paso County Board of Health, Chapter 8, Onsite Wastewater Treatment Systems (OWTS) as required by 8.5.D.3.a.

The three profile pit locations were determined by Shay Miles according to the Geoquest, LLC Subdivision Profile Pit Evaluation (referenced above). The Profile Pits were excavated to approximately 8 feet and the locations are presented in the Engineering and Geology Map, Figure 3.

### 5.3 OWTS Visual and Tactile Evaluation

A visual and tactile evaluation performed by Geoquest, LLC, is to be used in conjunction with this investigation. The soils were evaluated to determine the soils types and structure. Bedrock or restrictive layers were not encountered in the profile pits. Evidence of seasonal high groundwater was observed in Profile Pit-2 and Profile Pit-3 at depths ranging between 5 to 7 feet. Groundwater was encountered in Profile Pit-1 at approximately 7 feet. The soil descriptions of the profile pit evaluation are presented in Appendix B.

### 5.4 Groundwater

Groundwater was not encountered in the test borings during Geoquest, LLC field exploration, however groundwater and seasonal variations of groundwater were observed in the profile pit excavations. Fluctuations in groundwater and subsurface moisture conditions may occur due to variations in rainfall and other factors not readily apparent at this time. Development of the property and adjacent properties may also affect groundwater levels.

Note, the profile pits observed by Geoquest, LLC were completed in July, 2019. July 2019 received above average rainfall and the groundwater elevations observed may represent higher than normal groundwater conditions. Test Borings performed by Geoquest, LLC in November 2018, indicate lower groundwater levels, which may be more representative of normal season groundwater conditions.

## 6.0 SOIL, GEOLOGY AND ENGINEERING GEOLOGY

The site physiographically lies in the western portion of the Great Plains Physiographic Province south of the Palmer Divide. Approximately 11 miles to the west is a major structural feature known as the Rampart Range Fault. The fault marks the boundary between the Great Plains Physiographic and Southern Rocky Mountain Province. The site exists within the southeastern edge of a large structural feature known as the Denver Basin. The bedrock underlying the site consists of the Dawson Arkose Formation. Overlying this formation are unconsolidated deposits of residual soils and alluvial soils of the Holocene and late Pleistocene Age. The residual soils are produced by the in-situ action of weathering of the bedrock onsite. The alluvial soils were deposited by water in the major drainage on the site and as stream terraces along East Cherry Creek.

### 6.1 Subsurface Soil Conditions

The subsurface soils encountered in the Geoquest, LLC drill holes and profile pit excavations were classified using the Unified Soil Classification System (USCS). The laboratory testing performed by Geoquest, LLC revealed the onsite soils classified as clayey sand (SC) well graded silty sand (SW), low plasticity clay (CL) and silty sand (SM).

Additional descriptions and the interpreted distribution (approximate depths) of the subsurface materials are presented in the Soils Report by Geoquest, LLC presented in Appendix A. The classifications shown

on the logs are based upon the engineer's classification of the samples at the depths indicated. Stratification lines shown on the logs represent the approximate boundaries between material types and the actual transitions may be gradual and vary with location.

### 6.2 Bedrock Conditions

Bedrock (as defined by USDA Soil Structure and Grade) was not encountered in the profile pit excavations used for this investigation. In general, the bedrock (as defined by Colorado Geologic Survey) beneath the site is considered to be part of the Dawson Formation – facies unit five which consists of silty sandstone. The Dawson formation is thick-bedded to massive, generally light colored arkose, pebbly, and pebble conglomerate. The sandstones are poorly sorted with high clay contents. The sandstone is generally permeable, well drained, and has good foundation characteristics. The Dawson sandstone is generally not considered a restrictive layer for OWTS.

### 6.3 U.S. Soil Conservation Service

The U.S. Soil Conservation Service along with United States Department of Agriculture (USDA) has identified the soils on the property 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 6.5 feet, run-off is anticipated to be low, frequency of flooding and/or ponding is none, and landforms include hills.

- 92 – Tomah-Crowfoot loamy sands, 3 to 8 percent slopes. Properties of the loamy sands include, well drained soils, depth Qtof the water table is anticipated to be greater than 6.5 feet, run-off is anticipated to be medium, frequency of flooding and/or 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, review of reports by Geoquest, LLC, the U.S. Soil Conservation Service, United States Department of Agriculture (USDA) and the Geologic Map of the Black Forest Quadrangle, El Paso County, Colorado a geologic map of significant surficial deposits and features were mapped. The identified geologic conditions affecting the development are presented in the Engineering and Geology Map, Figure 3.

The site generally consists of silty to clayey sand (alluvium) overlying the Dawson Formation. Three geologic units and one additional unit were mapped at the site as:

- Qa - Channel and floodplain alluvium (late Holocene)
- $Qt_1$ - Terrace alluvium one (Holocene and late Pleistocene)
- $Tkda_5$- Dawson Formation facies unit five (early to middle? Eocene) – upper part of the Dawson Formation is dominated by fine grained arkosic sandstone with interbedded thin beds of green claystone.
- psw- areas where potentially seasonal shallow groundwater and/or surficial water within East Cherry Creek and tributaries may occur.

### 6.5 Structural Features

Structural features such as schistocity, folds, zones of contortion or crushing, joints, shear zones or faults were not observed on the site or the surrounding the site or in the soil samples collected for laboratory testing.

### 6.6 Surficial (Unconsolidated) Deposits

Various lake and pond sediments, swamp accumulations, sand dunes, marine and non-marine terrace deposits, talus accumulations, creep or slope wash were not observed on the site. Slump and slide debris were not observed on the site. However, a major drainage and a tributary of East Cherry Creek do meander across a portion of each lot proposed for the development. The drainage and tributary was dry at the time of the site visit.

### 6.7 Engineering Geology

Charles Robinson and Associates (1977) have mapped three environmental engineering units at the site as:

- 1A – Stable alluvium, colluvium and bedrock on flat to gentle slopes (0 to 5%).
- 3B – Expansive and potentially expansive soil and bedrock on flat to moderate slopes (0 to 12%).
- 7A – Physiographic floodplain where erosion and deposition presently occur and is generally subject to recurrent flooding. Includes 100-year floodplain along major streams where floodplain studies have been conducted.

The Engineering Geology is presented in the Engineering and Geology Map, Figure 3.

### 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 also not observed on the property.

Features indicating creep, slump or slide masses in bedrock and surficial deposits were also not observed on the property.

East Cherry Creek and a tributary thereof meander across a portion of each lot proposed for the development. The Creek should be a deciding factor in the placement of the proposed residence and OWTS locations.

### 6.9 Drainage of Water and Groundwater

The overall topography of the site slopes down from the north to the south towards East Cherry Creek. East Cherry Creek is currently a defined drainage way that is located along the eastern property boundary. A dendritic tributary of East Cherry Creek lies to the west of East Cherry Creek. Both drainageways may adversely impact the placement of the residence and the OWTS locations on all the lots in the subdivision.

Groundwater and indications of seasonally shallow groundwater were observed in the profile pit excavations by Geoquest, LLC at the time of their field observation.

# 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 2* indicates the site is not identified as an aggregate resource. Extraction of the sand and sandstone resources are not considered to be economical compared to materials available elsewhere within the county.

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. However, the area of the site has been mapped "Poor" for coal resources, no active or inactive mines have been mapped in the area of the site. No metallic mineral resources have been mapped on the site.

# 8.0 IDENTIFICATION AND MITIGATION OF POTENTIAL GEOLOGIC HAZARDS AND CONDITIONS

The El Paso County Engineering Criteria Manual recognizes and delineates the difference between 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. The following geologic hazards were not identified on the parcel:

- Landslides
- Rockfall
- Debris Flow and Debris Fans
- Steeply Dipping Bedrock
- Ground Subsidence
- Unstable or Potentially Unstable Slopes
- Scour, Erosion, accelerated erosion along creek banks and drainageways
- Artificial Fill

The following geologic constraints were identified on the property:

### 8.1 Expansive Soils and Bedrock

Based on the Drill Logs and laboratory testing performed on the site by Geoquest, LLC, the silty to clayey sand generally possesses low swell potential and the sandy clay generally possess low to moderate swell potential. Bedrock was not encountered on this site. Should expansive soils be encountered beneath foundations, mitigation will be required.

Mitigation

The Soils Report by Geoquest, LLC recommended in the Geoquest, LLC report that if expansive soils were encountered overexcavation and replacement with 4-feet of non-expansive soils structural fill would be required.

Provided that the foundation systems are implemented as recommended in the Geoquest, LLC report, the presence of expansive soils/bedrock (if encountered) is not considered to pose a risk to the proposed structures.

### 8.2 Hydrocompactive Soils (Moisture Sensitive Soils)

The subsurface materials at the site generally consist of silty to clayey sand and sandy clay overlying the Dawson Formation. Based on the Drill Logs and Profile Pits performed on site by Geoquest, LLC, the silty to clayey sand generally possess low swell potential. The sandy clay generally possesses low to moderate swell potential. It is anticipated that if these materials are encountered they can readily be mitigated with typical construction practices common to this region of El Paso County, Colorado.

Mitigation
Shallow foundations are anticipated for structures within this development. Foundation design and construction are typically adjusted for hydrocompactive soils. If loose sands are encountered, mitigation of hydrocompactive soils can be accomplished by overexcavation and replacement with structural fill, subexcavation and replacement with on-site moisture-conditioned soils, and/or the use of a geogrid reinforced fill.

### 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. 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 in the vicinity of the Ute Pass Fault, but 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 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 0.185g 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, CO and the 80908 zip code located in El Paso County, has an EPA assigned Radon Zone of 1. A radon zone of 1 predicts an average indoor radon screening level greater than 4 pCi/L, which is above the recommended levels assigned by the EPA. Black Forest is located in a high risk area of the country. *The EPA recommends you take corrective measures to reduce your exposure to radon gas.*

Most of Colorado is generally considered to have the potential of high levels of radon gas, based on the information provided at: http://county-radon.info/CO/El_Paso.html. There is not believed to be unusually hazardous levels of radon from naturally occurring sources 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.

## 8.5 Flooding and Surface Drainage

Based on our review of the Federal Emergency Management Agency (FEMA) Community Panel No. 08041C0305G effective December 7, 2018 and the online ArcGIS El Paso County Risk Map, the entire property lies outside the 100 or 500-year floodplain of East Cherry Creek.

Although the property does not lay within a designated floodway East Cherry Creek and its dendritic drainages should be taken into consideration when considering the placement of the residences and OWTS treatment areas on each individual lot.

Mitigation
Due to the size of the lots within the proposed development, the drainage areas should and can be avoided by construction. Minor drainage swales can be regraded. Structures should not block the drainageways. Any site grading should be done in a manner to avoid ponding of water around the structures and treatment areas. Treatment areas are not to be located in the drainageways due to the potential for seasonally wet conditions and/or potential for periodic high groundwater conditions.

The western tributary of East Cherry Creek more than likely will need to be channelized and re-routed and/or contained. This might consist of check dams to reduce flow velocities, as well as provide small traps for containing sediment. The determination of the amount, location and placement of check dams and/or special erosion control features should be performed by or in conjunction with the drainage engineer who is familiar with the flow quantities and velocities of East Cherry Creek and its western tributary.

## 8.6 Springs and High Groundwater

Based on the site observations, review of the Black Forest Quadrangle and Google Earth images dating back to September 1999, springs do not appear to originate on the subject site. Groundwater was encountered in the Profile Pits at the time of the observation during the excavations by Geoquest, LLC.

Groundwater was not encountered at the time of drilling for the Soils Report; however fluctuations in groundwater and subsurface moisture conditions may occur due to variations in rainfall and other factors not readily apparent at this time. Development of the property and adjacent properties may also affect groundwater levels.

Mitigation
If groundwater conditions encountered at the time of foundation excavation result in either water flow into the excavation or destabilization of the foundation bearing soils, stabilization techniques should be implemented. Various stabilization methods can be employed and can be discussed at the time of construction. However, a method that affords potentially a reduced amount of overexcavation (versus other methods) and provides increased performance under moderately to severely unstable conditions is the use of a layered geogrid and structural fill system.

Additionally, dependent upon the rate of groundwater flow into the excavation, a geosynthetic vertical drain and an overexcavation perimeter drain may be required around the lower portions of the excavation to allow for installation of the layered geogrid and structural fill system.

In general, if groundwater was encountered within 4 to 6 feet of the proposed foundation slab elevation, an underslab drain should be anticipated in conjunction with the perimeter drain. Perimeter drains are anticipated for each individual lot to prevent the infiltration of water and to help control wetting of potentially expansive and hydrocompactive soils in the immediate vicinity of foundation elements. It must be understood that the drain is designed to intercept some types of subsurface moisture and not others. Therefore, the drain could operate properly and not mitigate all moisture problems relating to foundation performance or moisture intrusion into the basement area.

### 8.7 Corrosive Minerals

The upper sands encountered at the site may contain corrosive minerals. The Dawson sandstone, if encountered, at this site typically has low resistivity values (less than 2,000 ohm-cm) and is likely to be potentially corrosive to buried, ferrous metal piping and utilities.

Mitigation:
Sulfate resistant cement will aid in the mitigation for corrosive (sulfate) minerals on concrete.

### 8.8 Erosion

Due to the fine-grain nature of the soils on the site it is anticipated that the majority of the surficial soils (silty to clayey sand) will be subject to erosion by water. The alluvial soils that underlie the site can be erosive and erosion control measures should be implemented for all disturbed area.

Mitigation:
During construction disturbance of the site most likely will occur around the building sites and more than likely will require regrading and revegetation. With regard to water erosion, loosely compacted soils will be most susceptible to water erosion, residually weathered soils and weathered bedrock materials become increasingly less susceptible to water erosion.

The soils encountered during Geoquest, LLC investigations were silty to clayey sand and sandy clay. The permeability of the silty to clayey sand is anticipated to be moderate to high. The permeability of the sandy clay is anticipated to be low. Depending on the type of vegetation established after

construction, some form of channel lining material may be required to reduce erosion potential along East Cherry Creek and the tributary to the west. These may consist of some synthetic channel lining materials or conventional riprap.

Minor wind erosion and dust problem may arise during and immediately after construction. If the problem becomes severe during this time, watering of the cut area may be required to control dust.

### 8.9 Fill Soils

Fill soils were described in the Geoquest, LLC reports. However, if fill soils are encountered in the OWTS areas and/or excavation for the single-family residences, they may be considered unsuitable for a variety of reasons. These include (but are not limited to) non-engineered fills, fill soils containing trash or debris, fill soils that appear to have been improperly placed and/or compacted, etc. If unsuitable soils are encountered during the Open Excavation Observations, they may require removal (overexcavation) and replacement with compacted structural fill.

Mitigation

If fill is encountered, it is considered unsuitable for support of foundations. If unsuitable fill soils are encountered during construction, they should be removed (overexcavated) and replaced with compacted structural fill. The onsite soils, once removed, replaced and recompacted are generally suitable as structural fill. The zone of overexcavation shall extend to the bottom of the unsuitable fill zone and shall extend at least that same distance beyond the building perimeter. Provided that this recommendation is implemented, the presence of fill is not considered to pose a risk to proposed structures.

### 8.10 Surface Grading and Drainage

Surface grading and drainage should follow the recommendations presented in the Soils Report by Geoquest, LLC as indicated below:

**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 feet zone is not possible on the upslope site 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 directed in the wrong direction. All downspouts shall have splash blocks that will remove runoff to outside the foundation area and carried across backfill zones. No irrigation devices shall be placed within 10 feet of the foundation. 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 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) and low plasticity clay (CL) material is not suitable and shall not be used as backfill material around the perimeter of the foundation.** It is the responsibility of the contractor to schedule all inspections. Also, the backfill material shall consist of road base material as described previously.

### 8.11 Proposed Grading, Erosion Control, Cuts and Masses of Fill

Preliminary grading plans were not provided and reviewed at the time the report was issued. It is assumed based on the soils information by Geoquest, LLC that the excavations will encounter silty to clayey sands near the surface with interbedded sandy clay seams. Depth of sandstone bedrock was not determined. The on-site sand soils can be used as site grading fill.

Mass cut and fill areas are not anticipated for the development. Removal and/or recompaction of the existing materials is not anticipated other than in the excavations as needed.

# 9.0 ON-SITE WASTEWATER TREATMENT

It is our understanding that On-site Wastewater Treatment Systems (OWTS) is proposed. An individual well and septic system is proposed for each single family residence. The site was evaluated by Geoquest, LLC in general accordance with the El Paso Land Development Code, specifically sections 8.4.8. Three profile pits were performed across the site to obtain a general understanding of the soil and bedrock conditions. The Profile Pit Logs are presented in Appendix B.

### 9.1 Subsurface Materials

The subsurface materials encountered in the profile pit excavations evaluated by Geoquest, LLC were classified using Table 10-1 Soil Treatment Area Long-term Acceptance Rates from the EPCDHE Chapter 8, OWTS Regulations and the USDA Soil Structure Shape and Grade. The materials were grouped into the following general categories:

- *Clayey, Sand:*
  USDA Soil Texture: Sandy Clay Loam
  USDA Soil Type: 3A
  USDA Structure Shape/Grade: Granular (1) to Massive (0)
  Non-cemented

- *Sand:*
  USDA Soil Texture: Sandy Loam to Loamy Sand
  USDA Soil Type: 1 to 2A
  USDA Structure Shape/Grade: Single Grain (0) to Massive (0)
  Non-cemented

- *Clay:*
  USDA Soil Texture: Sandy Clay
  USDA Soil Type: 4A
  USDA Structure Shape/Grade: Blocky (1) to Massive (0)
  Non-cemented

Additional descriptions and the interpreted distribution (approximate depths) of the subsurface materials are presented in Appendix B. The descriptions shown on the logs are based upon the engineer's classification of the samples at the depths indicated. Stratification lines shown on the logs represent the approximate boundaries between material types and the actual transitions may be gradual and vary with location.

The soils on the property were identified as loam, sandy clay loam, and clay as indicated by the USDA. According to Geoquest, LLC, limiting layers were not encountered in the profile pits. The long term acceptance rates (LTAR) associated with the soils observed in the profile pits range from 0.80 to 0.30 gallons per day per square foot (gpd/sf) for the sand to clayey sand (Soil Types 1, 2A and 3A) and 0.15 for the clay (Soil Type 4A). Groundwater and indications of seasonally shallow groundwater were observed in the profile pit excavations by Geoquest, LLC at the time of their field observation.

### 9.2 Bedrock Conditions

Bedrock (as defined by USDA Soil Structure and Grade) was not encountered in the profile pit excavations used for this investigation. In general, the bedrock (as defined by Colorado Geologic Survey) beneath the site is considered to be part of the Dawson Formation – facies unit five which consists of silty sandstone. The Dawson formation is thick-bedded to massive, generally light colored arkose, pebbly, and pebble conglomerate. The sandstones are poorly sorted with high clay contents. The sandstone is generally permeable and well drained. The Dawson sandstone is generally not considered a restrictive layer for OWTS.

### 9.3 Treatment Areas

Treatment areas at a minimum must achieve the following:

- The treatment areas must be 4 feet above groundwater or bedrock as defined by the Definitions 8.3.4 of the Regulations of the El Paso County Board of Health, Chapter 8 OWTS Regulations, most recently amended amended May 23, 2018;
- Prior to construction of an OWTS, an OWTS design prepared per *the Regulations of the El Paso County Board of Health, Chapter 8 OWTS Regulations* will need to be completed. A scaled site plan and engineered design will also be required prior to obtaining a building permit.
- Comply with any physical setback requirements of Table 7-1 of the El Paso County Department of Health and Environment (EPCHDE);
- Treatment areas are to be located a minimum 100 feet from any well (existing or proposed), including those located on adjacent properties per Table 7-2 per the EPCHDE;
- Treatment areas must also be located a minimum 50 feet from any drainages, floodplains, or ponded areas, and 25 feet from dry gulches.
- The new parcels shall be laid out to insure that a minimum of 2 sites are appropriate for an OWTS and do not fall within any restricted areas, (e.g. utility easements, right of ways). Based on the profile pit observations performed by Geoquest, LLC, the parcels have a minimum of two locations for the OWTS as presented on the OWTS Suitability Map, Figure 7.

Contamination of surface and subsurface water resources should not occur provided the OWTS sites are evaluated and installed according to the El Paso County Guidelines and property maintained. Areas where OWTS sites are not recommended are also indicated on Figure 7.

In summary, it is our opinion the sites are suitable for individual on-site wastewater treatment systems within the cited limitations; however groundwater conditions may restrict the type of system that can be installed. It should be noted that the LTAR values stated above are for the profile pit locations performed for Geoquest, LLC report only. The LTAR values may change throughout the site. If an LTAR value of less than 0.35 (or soil types 3 to 5) or groundwater are encountered at the time of the site specific OWTS evaluation an "engineered system" will be required.

This does not constitute an OWTS design. An individual OWTS design should be performed for each individual lot.

# 10.0 BEARING OF GEOLOGIC CONDITIONS UPON PROPOSED DEVELOPMENT

Geologic hazards (as described in Section 8.0 of this report) were not found to be present at this site. Geologic constraints (also as described in section 8.0 of this report) such as: expansive and hydrocompactive soils, faults, seismicity, radon, potentially shallow groundwater, corrosive minerals, and erosion were found on the site. These hazards can be satisfactorily mitigated through proper engineering and design contraction practices and avoidance when deemed necessary.

It is our opinion that the existing geologic and engineering conditions may pose constraints on the residences and OWTS locations for each lot within the proposed development.

# 11.0 BURIED UTILITIES

Based upon the conditions encountered in the exploratory drilling and profile pits by Geoquest, LLC we anticipate that the soils encountered in individual utility trench excavation will consist of native silty to clayey sand with interbedded sandy clay. It is anticipated the sands will be encountered at loose to medium dense relative densities, the sandy clay at stiff to very stiff densities and sandstone (if encountered) at medium hard to hard relative densities.

We believe the sand will classify as Type C materials and the clay as Type B materials as defined by OSHA in 29 CFR Part 1926. OSHA requires that temporary excavations made in Type B and C materials be laid back at ratios no steeper than 1:1 (horizontal to vertical) and 1½:1 (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.

Each new parcel is to have an individual well and septic. Utility mains such as water and sanitary sewer lines are not anticipated to be placed beneath paved roadways.

# 12.0 PAVEMENTS

The proposed extension of Fox Creek Lane is not currently graded. The 850 foot extension of Fox Creek Lane to the north of the existing Fox Creek Lane cul-de-sac will require a new pavement design prepared in accordance with the El Paso County regulations. It anticipated driveways extending from Fox Creek Lane are to be paved.

Roadways throughout the proposed new development are anticipated to be classified as Rural Local in accordance with Appendix D of the El Paso County Engineering Criteria Manual. The actual pavement section design for individual streets will be completed following overlot grading and rough cutting of the street subgrade.

For preliminary planning purposes, estimated composite asphalt pavement and gravel sections have been evaluated based on current design criteria. For purposes of this report, we anticipate the subgrade soils will primarily have American Association of State Highway and Transportation Officials (AASHTO)

Soil Classifications of A-2-6 and A-1-b with an estimated design subgrade "R-values" on the order of approximately 20 to 25.

| **Estimated Pavement Section** | | |
|---|---|---|
| **Classification** | **Composite Sections Asphalt/Base (in.)** | **Gravel Roads** |
| Rural Local – Extension of Fox Creek Lane | 3.0 in. / 4.0 in. | 6.0 in. min. |

[1]Minimum section thickness per El Paso County ECM

The above values are for preliminary planning purposes only and may vary in the final design, dependent upon the soil material used for subgrade construction.

# 13.0 ANTICIPATED FOUNDATION SYSTEMS

Based on the information presented previously, conventional shallow foundation systems consisting of standard spread footings/stemwalls are anticipated to be suitable for the proposed residential structures. It is assumed that if a basement is proposed the excavation cut will be approximately 6 to 8 feet below the final ground surface not including overexcavation, if needed.

Expansive clay and claystone were not encountered in the soil report or profile pits performed by Geouqest, LLC. If expansive soils are encountered near foundation or floor slab bearing levels, overexcavation and replacement with nonexpansive structural fill will be required. Overexcavation depths of 4 feet should be anticipated; however this is to be determined at the time of the Open Excavation Observations to be performed by the Geotechnical Engineer of Record, Geoquest, LLC.

If loose sands are encountered, they may require additional compaction to achieve the allowable bearing pressure as indicated in Geoquest, LLC Soils Report. In some cases, removal and recompaction may be required for loose soils. Similarly, if shallow groundwater conditions are encountered and result in unstable soils unsuitable for bearing of residential foundations, these soils may require stabilization prior to construction of foundation components.

***The foundation system for the single family residences should be designed and constructed based upon recommendations developed in the Soils Report by Geoquest, LLC.*** The recommendations presented in the Soils Report should be verified following the excavation on the parcel and evaluation of the building loads.

### 13.1 Subexcavation and Moisture-Conditioned Fill

Based upon the field exploration by Geoquest, LLC subexcavation and replacement is not anticipated. However, prior to performing excavation and/or filling operations, vegetation, organic and deleterious material shall be cleared and disposed of in accordance with applicable requirements. The excavation should extend to a minimum depth below and laterally beyond the bottom of the foundation as determined based on final grading plans.

### 13.2 Uncontrolled Fill

If man-placed (uncontrolled) fill is encountered during construction, it will be assumed that this fill was not moisture conditioned and compacted in a manner consistent with the **Structural Fill** recommendations contained within this report, unless appropriate documentation can be provided. If such fill is encountered, it is not considered suitable for support of shallow foundations. This unsuitable fill will require removal (overexcavation) and replacement with non-expansive, granular structural fill below foundation components and floor slabs. The structural fill should be observed and tested during placement as indicated under the **Structural Fill** section of this report, to ensure proper compaction.

Following completion of the overexcavation and moisture conditioning process, it is imperative that the "as-compacted" moisture content be maintained prior to construction.

### 13.3 Foundation Stabilization

Groundwater was encountered in the Profile Pits that were excavated to 8 feet. It is anticipated the groundwater may have adequate separation from the bottom of a crawlspace foundation components and floor slabs. However, adequate separation from groundwater to a basement foundation may not be sufficient. If moisture conditions encountered at the time of the foundation excavation result in water flow into the excavation and/or destabilization of the foundation bearing soils, stabilization techniques should be implemented. Various stabilization methods can be employed, and can be discussed at the time of construction. However, a method that affords potentially a reduced amount of overexcavation (versus other methods) and provides increased performance under moderately to severely unstable conditions is the use of a layered geogrid and structural fill system.

Additionally, dependent upon the rate of groundwater flow into the excavation, a geosynthetic vertical drain and an overexcavation perimeter drain may be required around the lower portions of the excavation to allow for installation of the layered geogrid and structural fill system.

### 13.4 Foundations Drains

A subsurface perimeter drain is recommended around portions of the structure which will have habitable or storage space located below the finished ground surface. This includes crawlspace areas but not the walkout trench, if applicable.

Shallow groundwater conditions were not encountered in the test pits at the time of field exploration. Depending on the conditions encountered during the lot specific Subsurface Soil Investigation and the conditions observed at the time of the Open Excavation Observation, additional subsurface drainage systems may be recommended.

One such system is an underslab drainage layer to help intercept groundwater before it enters the slab area should the groundwater levels rise. In general, if groundwater was encountered within 4 to 6 feet of the proposed basement slab elevation, an underslab drain should be anticipated. Another such system would consist of a subsurface drain and/or vertical drain board placed around the perimeter of the overexcavation to help intercept groundwater and allow for proper placement and compaction of the replacement structural fill. Careful attention should be paid to grade and discharge of the drain pipes of these systems.

It must be understood that the drain systems are designed to intercept some types of subsurface moisture and not others. Therefore, the drains could operate properly and not mitigate all moisture problems relating to foundation performance or moisture intrusion into the basement area.

### 13.5 Structural Fill

Areas to receive structural fill should have topsoil, organic material, or debris removed. The upper 6 inches of the exposed surface soils should be scarified and moisture conditioned to facilitate compaction (usually within 2 percent of the optimum moisture content) and compacted to a minimum of 95 percent of the maximum dry density as determined by the Standard Proctor test (ASTM D-698) or to a minimum of 92 percent of the maximum dry density as determined by the Modified Proctor test (ASTM D-1557) prior to placing structural fill.

Structural fill placed on slopes should be benched into the slope. Maximum bench heights should not exceed 4 feet, and bench widths should be wide enough to accommodate compaction equipment.

Structural fill shall consist of granular, non-expansive material. It should be placed in loose lifts not exceeding 8 to 12 inches, moisture conditioned to facilitate compaction (usually within 2 percent of the optimum moisture content) and compacted to a minimum of 92 percent of the maximum dry density as determined by the Modified Proctor test, ASTM D-1557. The materials should be compacted by mechanical means.

Materials used for structural fill should be approved by RMG prior to use. Structural fill should not be placed on frozen subgrade or allowed to freeze during moisture conditioning and placement.

### 13.6 Design Parameters

The allowable bearing pressure of the surface sands should be determined by a detailed site specific Subsurface Soil Investigation. Bearing directly on the clay and/or hydrocompactive sands is not recommended.

## 14.0 ADDITIONAL STUDIES

The findings, conclusions and recommendations presented in this report were provided to evaluate the suitability of the site for future development. The drill logs, profile pits, and visual tactile classifications, conclusions and recommendations presented by Geoquest, LLC are intended for use for design and construction.

***A site specific Onsite Wastewater Treatment System evaluation will be required for all proposed septic areas.***

## 15.0 CONCLUSIONS

Based upon our evaluation of the geologic conditions, it is our opinion that the proposed development is feasible. Except for the potential of expansive and hydrocompactive soils, faults, seismicity, radon, potentially shallow groundwater, corrosive minerals, and erosion, the geologic hazards identified are not considered unusual for the Front Range region of Colorado. Mitigation of geologic hazards is most

effectively accomplished by avoidance. However, where avoidance is not a practical or acceptable alternative, geologic hazards should be mitigated by implementing appropriate planning, engineering, and local construction practices.

Foundation selection and design should consider the potential for subsurface expansive soil-related movements and shallow groundwater. Mitigation techniques commonly used in the Colorado Springs area include drilled piers, micropiles with structural floors and/or overexcavation and replacement with structural fill as indicated in the Soils Report by Geoquest, LLC.

Long term fill slopes should be limited to areas supported by foundation walls or other engineered components, unless adequately benched into the bedrock. Long term cut slopes in the upper soil should be limited to no steeper than 3:1 (horizontal:vertical).

We believe the surficial sand soils will classify as Type C materials and the clay soils will classify as Type B as defined by OSHA in 29CFR Part 1926, date January 2, 1990. OSHA requires temporary slopes made in Type C materials be laid back at ratios no steeper than 1.5:1 (horizontal to vertical) and slopes made in Type B materials be laid back at ratios no steeper than 1:1 (horizontal to vertical) unless the excavation is shored or braced. Flatter slopes will likely be necessary should groundwater conditions occur.

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.

# 16.0 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 **Shay Miles** 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.

If we can be of further assistance in discussing the contents of this report or analysis of the proposed development, from a geotechnical engineering point-of-view, please feel free to contact us.

# FIGURES


NOT TO SCALE

ARCHITECTS RMG ENGINEERS
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*Northern Office:*
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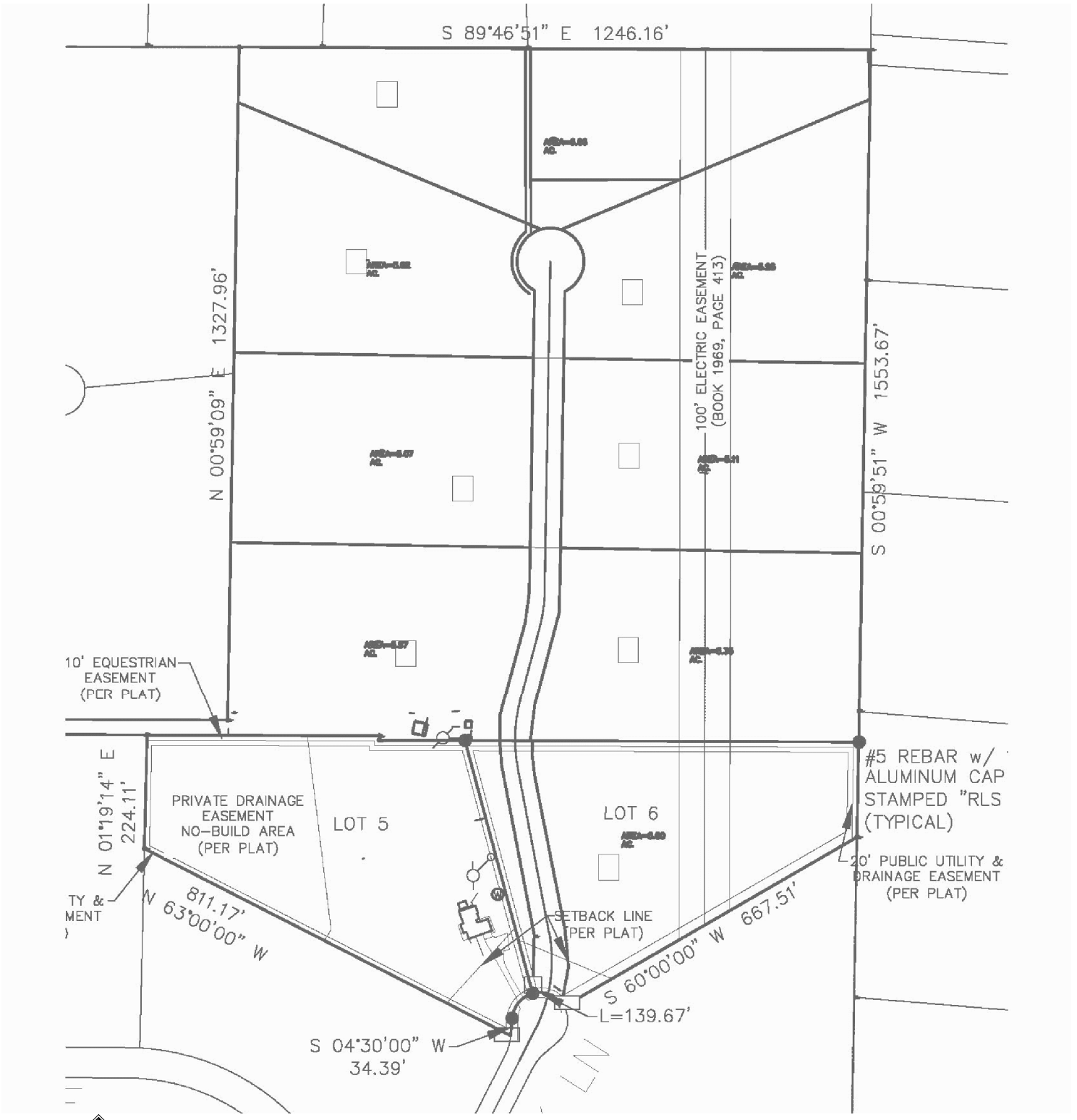
# SITE VICINITY MAP

LOTS 1-7, JENISHAY FARMS
PARCEL NO. 51929-30-003
EL PASO COUNTY, COLORADO
SHAY MILES

JOB No. 169372

FIG No. 1

DATE 8-30-2019
REVISED 9-18-2020




NOT TO SCALE

BASE MAP PROVIDED BY:
SHAY MILES

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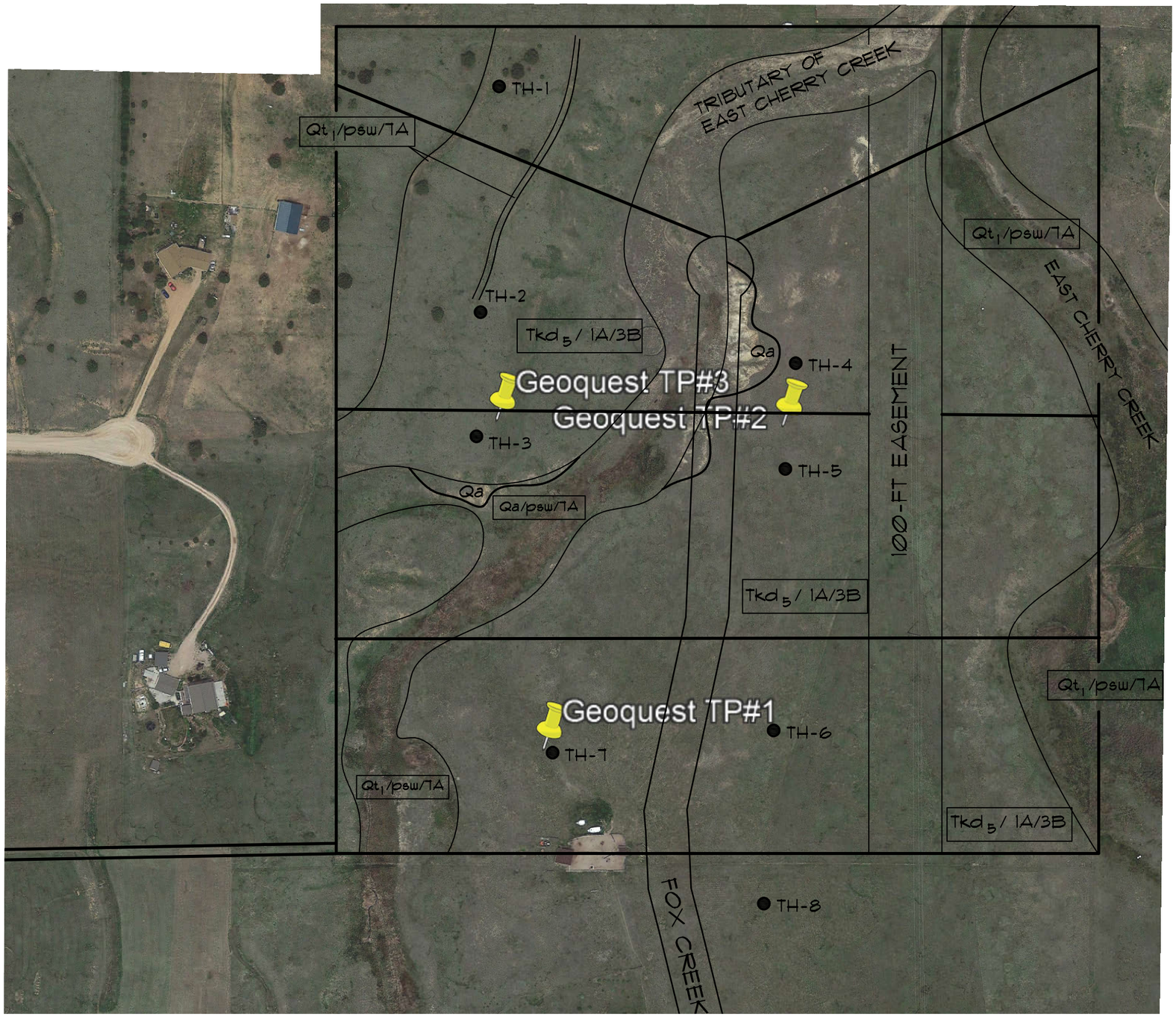
# TEST BORING LOCATION PLAN

LOTS 1-7, JENISHAY FARMS
PARCEL NO. 51929-30-003
EL PASO COUNTY, COLORADO
SHAY MILES

JOB No. 169372

FIG No. 2

DATE 8-30-2019
REVISED 9-18-2020




GRAPHICAL REPRESENTATION ONLY
(ALL LOCATIONS ARE APPROXIMATE)

NOT TO SCALE
BASE MAP PROVIDED BY: GOOGLE

## General Geologic

Qa - Channel and floodplain alluvium (late Holocene)

$Qt_1$ - Terrace alluvium one (Holocene and late Pleistocene)

Tkda - Dawson Formation facies unit five (early to middle? Eocene) - upper part of the Dawson Formation dominated by fine grained arkosic sandstone with interbedded thin beds of green claystone (underlies entire site but was not encountered in the test borings by Geoquest, LLC)

## Engineering Geology

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

3B - Expansive and potentially expansive soil and bedrock on flat to moderate slopes (0 to 5%)

7A - Physiographic floodplain where erosion and deposition presently occur and is generally subject to recurrent flooding. Includes 100-year along major streams where floodplain studies have been conducted.

psw - areas where potentially seasonal shallow groundwater and/or surficial water within East Cherry Creek and tributaries may occur

● DENOTES APPROXIMATE LOCATION OF TEST HOLES BASED ON GEOQUEST, LLC SOILS REPORT, JOB #18-0975 DATED NOVEMBER 16, 2018

Geoq DENOTES APPROXIMATE LOCATION OF PROFILE PITS BASED ON GPS COORDINATES GIVEN IN GEOQUEST, LLC SUBDIVISION PROFILE PIT EVALUATION, JOB #18-0975 DATED JULY 11, 2019

JOB No. 169372

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*Monument Office:*
(719) 488-2145
*Pueblo / Canon City:*
(719) 544-7750

LOTS 1-7
JENISHAY FARMS
PARCEL NO. 51929-30-003

EL PASO COUNTY, CO
SHAY MILES

| | |
|---|---|
| ENGINEER: | GGW |
| DRAWN BY: | KMZ |
| CHECKED BY: | GGW |
| ISSUED: | 9-3-2019 |
| REVISION: | DATE: / JOB #: |

ENGINEERING AND GEOLOGY MAP

SHEET No.
FIG-3


68 - Peyton-Pring complex
3 to 8% slopes

92 - Tomah-Crowfoor
3 to 8% slopes

NOT TO SCALE

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# USDA SOILS SURVEY MAP

LOTS 1-7, JENISHAY FARMS
PARCEL NO. 51929-30-003
EL PASO COUNTY, COLORADO
SHAY MILES

JOB No. 169372

FIG No. 4

DATE 8-30-2019
REVISED 9-18-2020


$Qt_1$ - Terrace alluvium one (Holocene and late Pleistocene)

Qa - Channel and floodplain alluvium (late Holocene)

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# BLACK FOREST QUADRANGLE

LOTS 1-7, JENISHAY FARMS
PARCEL NO. 51929-30-003
EL PASO COUNTY, COLORADO
SHAY MILES

JOB No. 169372

FIG No. 5

DATE 8-30-2019
REVISED 9-18-2020


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# FEMA MAP

LOTS 1-7, JENISHAY FARMS
PARCEL NO. 51929-30-003
EL PASO COUNTY, COLORADO
SHAY MILES

JOB No. 169372

FIG No. 6

DATE 8-30-2019
REVISED 9-18-2020


DENOTES POSSIBLE LOCATION OF HOUSE

DENOTES POSSIBLE LOCATION(S) OF OWTS

DENOTES AREAS WHERE OWTS ARE NOT RECOMMENDED

NOT TO SCALE

BASE MAP PROVIDED BY: GOOGLE

GRAPHICAL REPRESENTATION ONLY
(ALL LOCATIONS ARE APPROXIMATE AND TO BE DETERMINED AT THE TIME OF THE SITE SPECIFIC OWTS EVLAUATION)

Geoq DENOTES APPROXIMATE LOCATION OF PROFILE PITS BASED ON GPS COORDINATES GIVEN IN GEOQUEST, LLC SUBDIVISION PROFILE PIT EVALUATION, JOB #18-0975 DATED JULY 11, 2019

JOB No. 169372

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(719) 544-7750

LOTS 1-7
JENISHAY FARMS
PARCEL NO. 51929-30-003

EL PASO COUNTY, CO
SHAY MILES

| | |
|---|---|
| ENGINEER: | GGW |
| DRAWN BY: | KMZ |
| CHECKED BY: | GGW |
| ISSUED: | 8-30-2019 |
| REVISION: | DATE: |
| | JOB #: |

OWTS SUITABILITY MAP

SHEET No.
FIG-7

# APPENDIX A

*Soils Report, Subdivision Report, 15630 Fox Creek Lane, El Paso County, Colorado,*
prepared by Geoquest, LLC, Job#18-0975, dated November 16, 2018.

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

16 November 2018

Shay Miles
15630 Fox Creek Lane
Colorado Springs, Colorado 80908

RE: Soil Test Receipt, 15630 Fox Creek Lane, Geoquest #18-0975

Dear Shay,

The attached soil test report provided by Geoquest, LLC, has a number of specific requirements for the design and construction of the foundation of a structure at the location noted on 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 requiting both you as the builder and the homeowner to sign this letter indicating you have accepted a copy of the report, have read and understood the contents, and know you 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.

**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.

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

Sincerely,

Charles E. Milligan, P.E.
Civil Engineer

Builder Representatives

Homeowner(s)

_____ _____

_____ _____

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

# SOILS REPORT

# FOR

# SHAY MILES

**JOB #18-0975**

Subdivision Report,
15630 Fox Creek Lane,
El Paso County,
Colorado

Sincerely,

Charles E. Milligan, P.E.
Civil Engineer

COLORADO REGISTERED
CHARLES E. MILLIGAN
34608
PROFESSIONAL ENGINEER

**TABLE OF CONTENTS**

## INTRODUCTION

**The owners must be made aware of the contents of this report.** It is the responsibility of the contractor on this project to make subsequent home 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 **Shay Miles, owner, on Lot #5, Filing #1, Tierra Ridge Subdivision, 15630 Fox Creek Lane, El Paso County, Colorado.** It is my understanding that an eight-lot subdivision is planned for this site. Each lot is planned for residential construction. The site is currently occupied.

## CONCLUSIONS

**This Over Excavation Scheme may be revised or rescinded pending the results of the Open Hole Observation. Separate Open Hole Observations are required for each lot.**

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 to moderate 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 one to three inches is considered normal of soils of low to moderate 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 an expansion potential values ranging from **0.2-2.9% expansion potential with a dead load of 400-6100 pounds per square foot. 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.** It may be necessary to place approximately 1-2 feet of 4-12-inch diameter crushed rock in the bottom of the excavation to stabilize the native soil material. The material to be compacted in the excavation shall meet or exceed CDOT Class 6 Road Base Materials specifications. This material shall be compacted to a minimum of 95% of its modified Proctor density. **Proctor testing will be required on a sample of the replacement material to be used for this over-excavation scheme. A 5-gallon valid sample of the soil to be used, must be provided for testing (unless a previous proctor test can be provided) at least 7 days 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 clayey sand, well graded silty sand, low plasticity clay and silty sand (U.S. Classification Symbol SC, SW, CL, SM). The unit weight of equivalent fluid soil pressure of this material is 45 (SC), 39 (SW), 100 (CL) and 40 (SM) pounds per cubic foot. The owners shall be made aware that movement will definitely occur if surface or subsurface water is allowed to collect around 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.

## FIELD AND LABORATORY INVESTIGATION

Eight exploratory holes were drilled on October 12, 2018, at the locations shown on the enclosed site map. The location of these test holes was determined by Shay Miles. 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 varied.

## WEATHER

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

## DESIGN AND CONSTRUCTION CONSIDERATIONS

Slabs-on-grade may move and crack. Vertical slab movement of one to three inches is considered normal for soils of low to moderate 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 finish 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 and floors shall be compacted to at least 95% Modified Proctor density. Other backfill materials 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 90% 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. Exterior concrete shall slope away from the structure the same amount as requirements of soil.

2. The slab 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). Moisten the ground beneath the slab prior to placement of concrete.

## DESIGN AND CONSTRUCTION CONSIDERATIONS (CONTINUED)

4. All concrete placed must be cured properly as recommended by the American Concrete Institute (ACI). 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. Concrete shall be vibrated or rodded in forms to avoid segregation and cold joints.

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.

6. **The clayey sand (SC) and Low plasticity clay (CL) in Test Holes #1, #2, #3, #5, #6 and #8 have been tested for their expansion and/or consolidation potential. In Test Holes #1 the clayey sand (SC) has a 0.7% expansion potential with a dead load of 400 pounds per square foot. In Test Holes #2 the low plasticity clay (CL) has a 0.7% expansion potential with a dead load of 1600 pounds per square foot. In Test Holes #3 the clayey sand (SC) has a 0.2% expansion potential with a dead load of 1300 pounds per square foot. In Test Holes #5 the low plasticity clay (CL) has a 0.4% expansion potential with a dead load of 2100 pounds per square foot. In Test Holes #6 the low plasticity clay (CL) has a 2.9% expansion potential with a dead load of 6100 pounds per square foot. In Test Holes #8 the low plasticity clay (CL) has a 1.3% expansion potential with a dead load of 2400 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 to moderate 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 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.

**COLD TEMPERATURE CONSIDERATIONS**

1. Concrete shall not be placed upon 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.

**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 feet zone is not possible on the upslope site 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 directed in the wrong direction. All downspouts shall have splash blocks that will remove runoff to outside the foundation area and carried across backfill zones. No irrigation devices shall be placed within 10 feet of the foundation. 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 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) and low plasticity clay (CL) material is not suitable and shall not be used as backfill material around the perimeter of the foundation.** It is the responsibility of the contractor to schedule all inspections. Also, the backfill material shall consist of road base material as described previously.

**SUBSURFACE DRAINAGE**

The necessity for perimeter drains will be determined at the time of the Open Hole Observation.

**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 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 dwelling, 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 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)

**Open Hole Observations are required at the time of construction for each individual lot.**
**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, shall contact Geoquest, LLC, **24 hours (prior to excavating)** for the foundation. An open hole observation must be performed prior to the placement of replaced materials. All inspections shall be performed described herein.

## 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 18 inches (or as required by the design engineer).
The owner, or a representative of the construction, shall contact Geoquest, LLC, **24 hours (prior to excavating)** for the foundation.

## FINAL OBSERVATIONS

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.

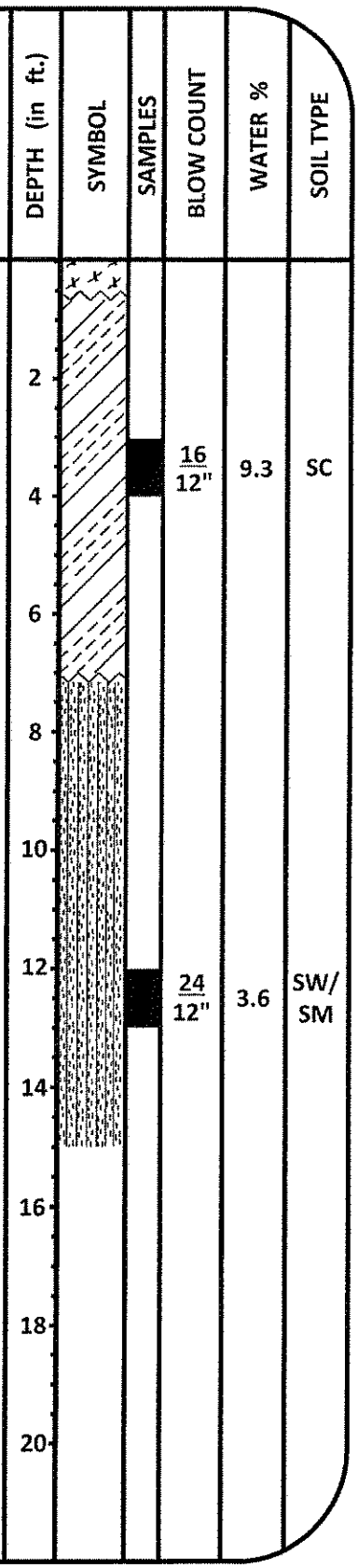
GEOQUEST, inc
481-4560

# DRILL LOGS

JOB #: 18-0975

TEST BORING
NO.: TH-1

DATE: 10/12/2018




0"-6" Topsoil

6"-7' Sand (SC)

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

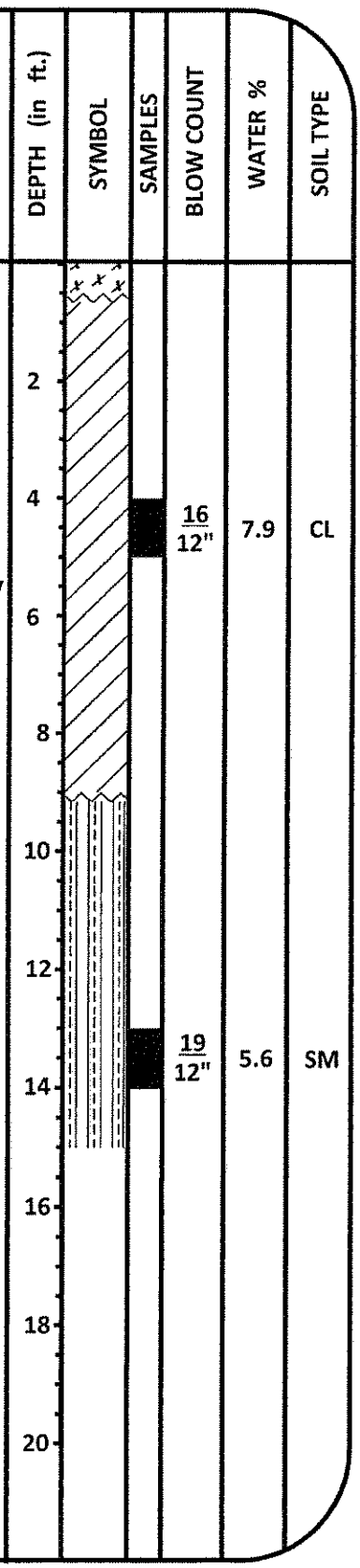
7'- 15' Sand (SW/SM)

Fine-coarse grained
Moderate density
Low moisture content
Low clay content
Low plasticity
Greyish Brown color

JOB #: 18-0975

TEST BORING
NO.: TH-2

DATE: 10/12/2018




0"-6" Topsoil

6"-9' Clay (CL)

Fine-coarse grained
Moderate density
Moderate moisture content
Low-moderate sand content
Moderate-high plasticity
Brown color

9'- 15' Sand (SM)

Fine-coarse grained
Moderate density
Low-moderate moisture content
Low-moderate clay content
Low-moderate plasticity
Strong Brown color
Oxidized @ 10'

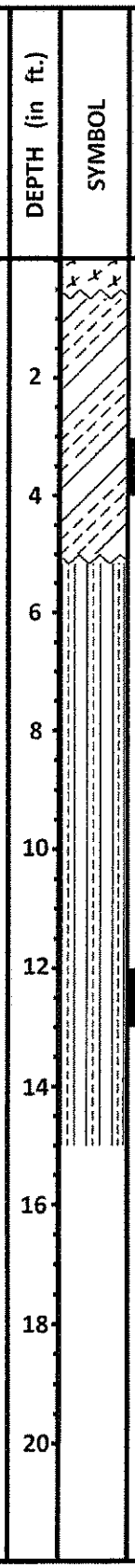
GEOQUEST, inc 481-4560

# DRILL LOGS

JOB #: 18-0975

TEST BORING NO.: TH-3

DATE: 10/12/2018




0"-6" Topsoil

6"-5' Sand (SC)

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

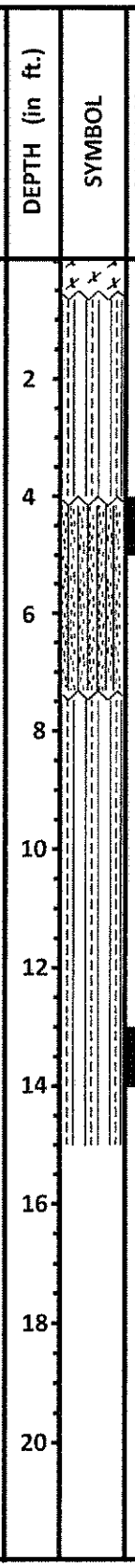
5'- 15' Sand (SM)

Fine-coarse grained
Moderate density
Low moisture content
Low-moderate clay content
Low plasticity
Brown color
Oxidized @ 9'

JOB #: 18-0975

TEST BORING NO.: TH-4

DATE: 10/12/2018




0"-6" Topsoil

6"-4' Sand

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

4'- 7' Sand (SW/SM)

Fine-coarse grained
Very high density
Low moisture content
Low clay content
Low plasticity
Brown color

7'- 15' Sand (SM)

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

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481-4560

# DRILL LOGS

JOB #: 18-0975

TEST BORING
NO.: TH-5

DATE: 10/12/2018

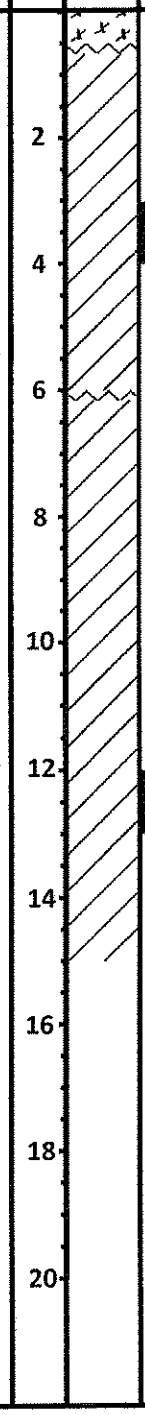
0"-6" Topsoil

6"-6' Clay (CL)

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

6'- 15' Clay (CL)

Fine-medium grained
High density
Moderate-high moisture content
Low-moderate sand content
Moderate-high plasticity
Strong Brown color




JOB #: 18-0975

TEST BORING
NO.: TH-6

DATE: 10/12/2018

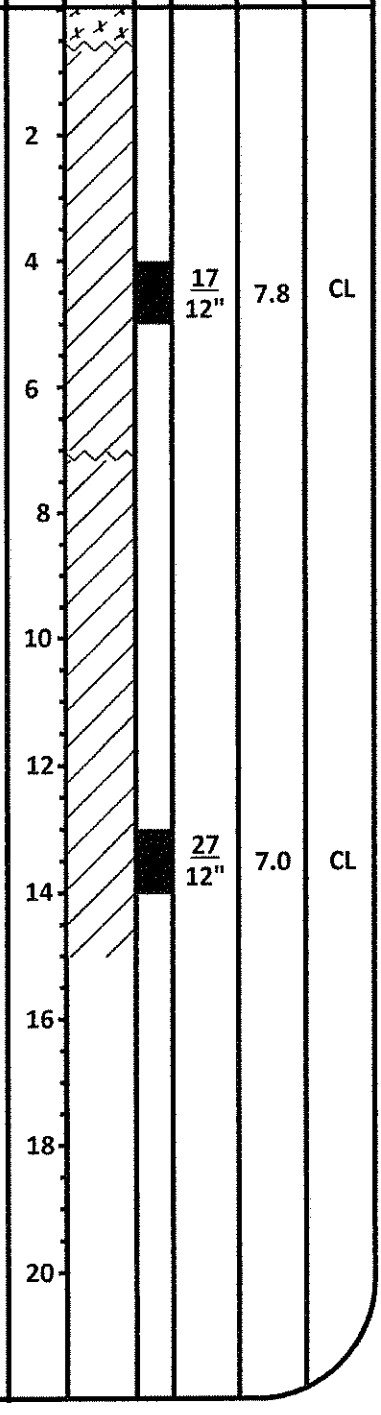
0"-6" Topsoil

6"-7' Clay (CL)

Fine-coarse grained
Moderate density
Moderate moisture content
Low-moderate sand content
Moderate-high plasticity
Brown color

7'- 15' Clay (CL)

Fine-medium grained
Moderate-high density
Moderate moisture content
Low-moderate sand content
Moderate-high plasticity
Greyish Brown color



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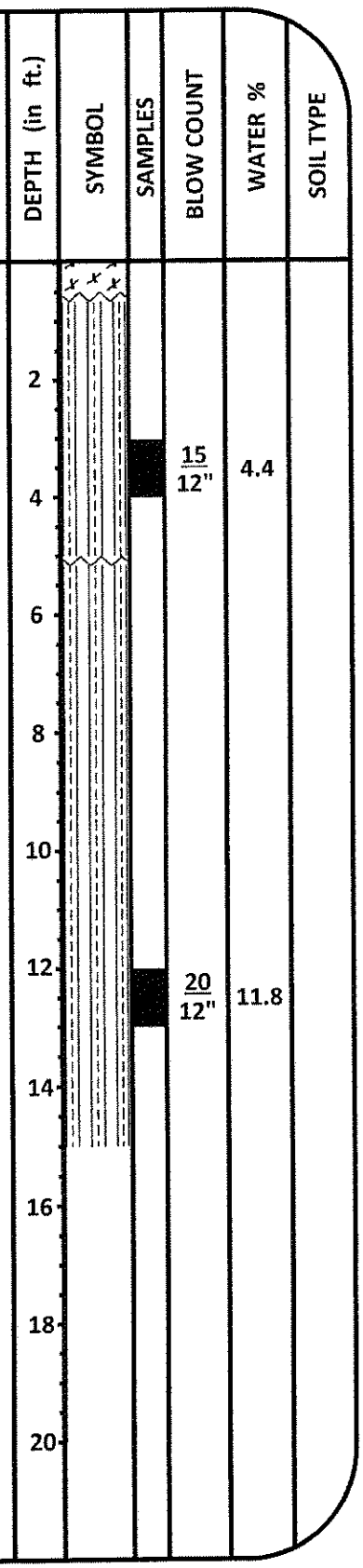
# DRILL LOGS

JOB #: 18-0975

TEST BORING
NO.: TH-7

DATE: 10/12/2018




0"-6" Topsoil

6"-5' Sand (SM)

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

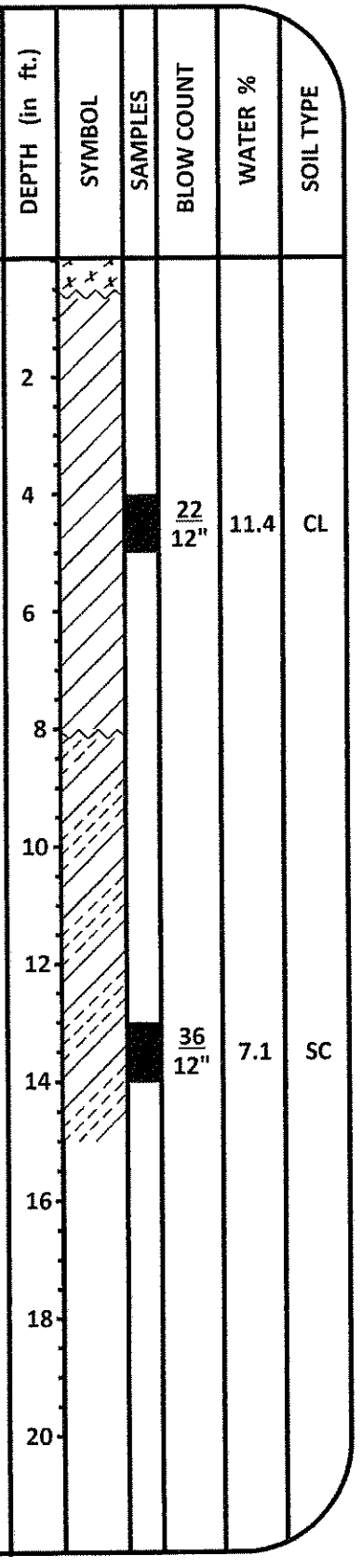
5'- 15' Sand (SM)

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

JOB #: 18-0975

TEST BORING
NO.: TH-8

DATE: 10/12/2018




0"-6" Topsoil

6"-8' Clay (CL)

Fine-coarse grained
Moderate density
Moderate-high moisture content
Low-moderate sand content
Moderate-high plasticity
Brown color

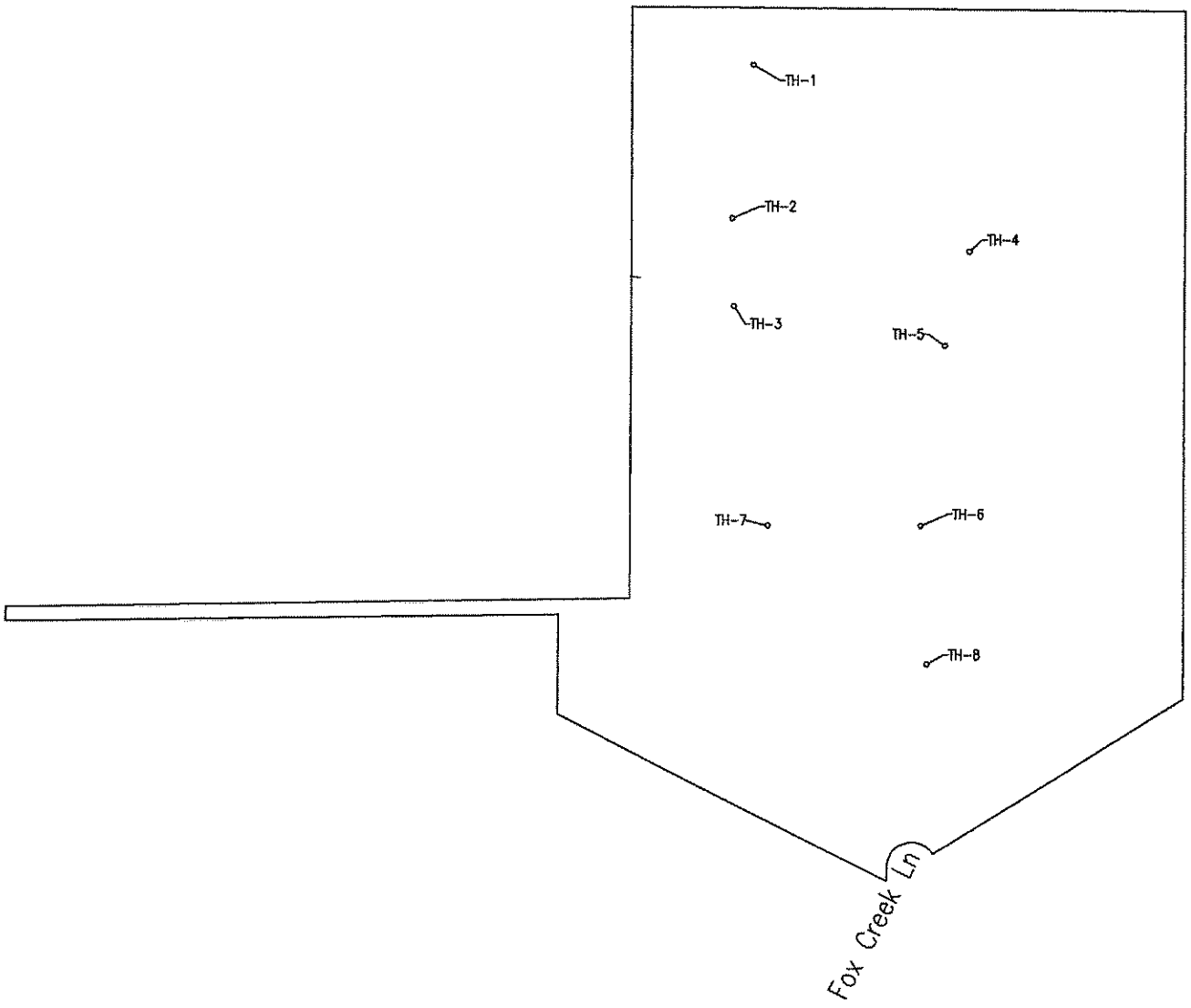
8'- 15' Sand (SC)

Fine-coarse grained
Moderate-high density
Moderate moisture content
Moderate clay content
Moderate plasticity
Greyish Brown color

GEOQUEST LLC

**SITE MAP**

15630 Fox Creek Ln
El Paso County
Colorado
Job #18-0975

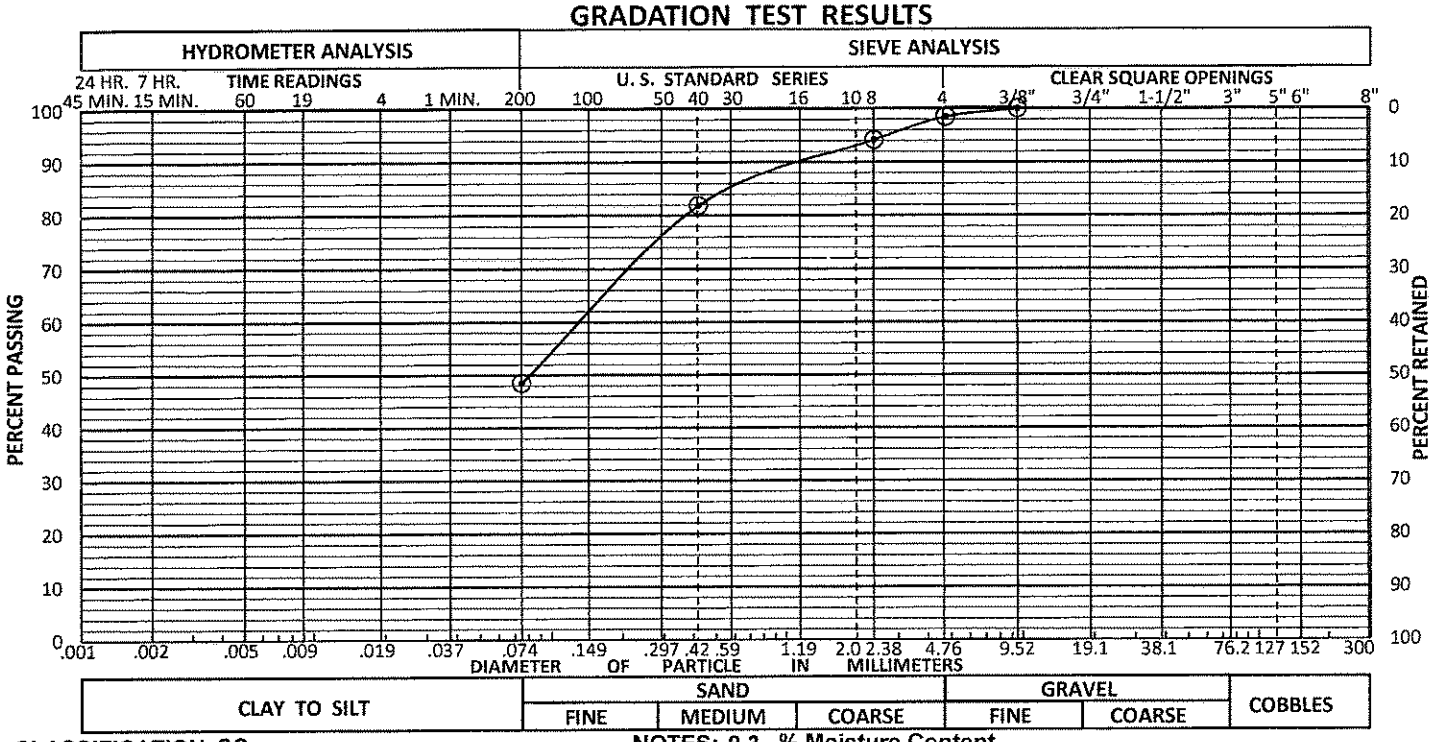



N

0 100 200 300 400
GRAPHIC SCALE IN FEET
SCALE: 1" = 400'

# GEOQUEST LLC

## GRADATION TEST RESULTS




CLASSIFICATION SC

GRAVEL 1.5 %

SAND 50.1 %

FINES 48.4 %

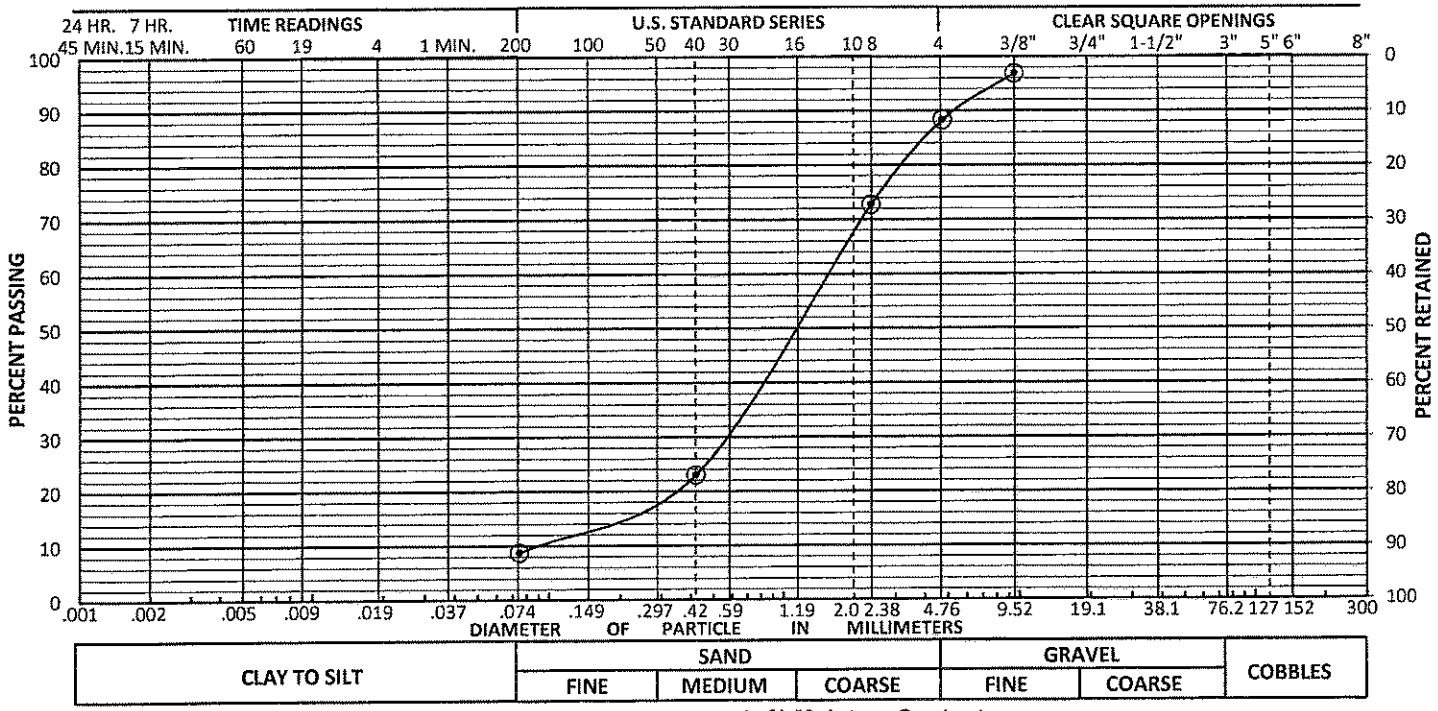
SAMPLE # 1 HOLE # TH-1 DEPTH 3 FEET

NOTES: 9.3 % Moisture Content

LL = 38.2

PL = 24.0

PI = 14.2




CLASSIFICATION SW/ SM

GRAVEL 11.7 %

SAND 79.6 %

FINES 8.7 %

SAMPLE # 1 HOLE # TH- 1 DEPTH 12 FEET

NOTES: 3.6 % Moisture Content

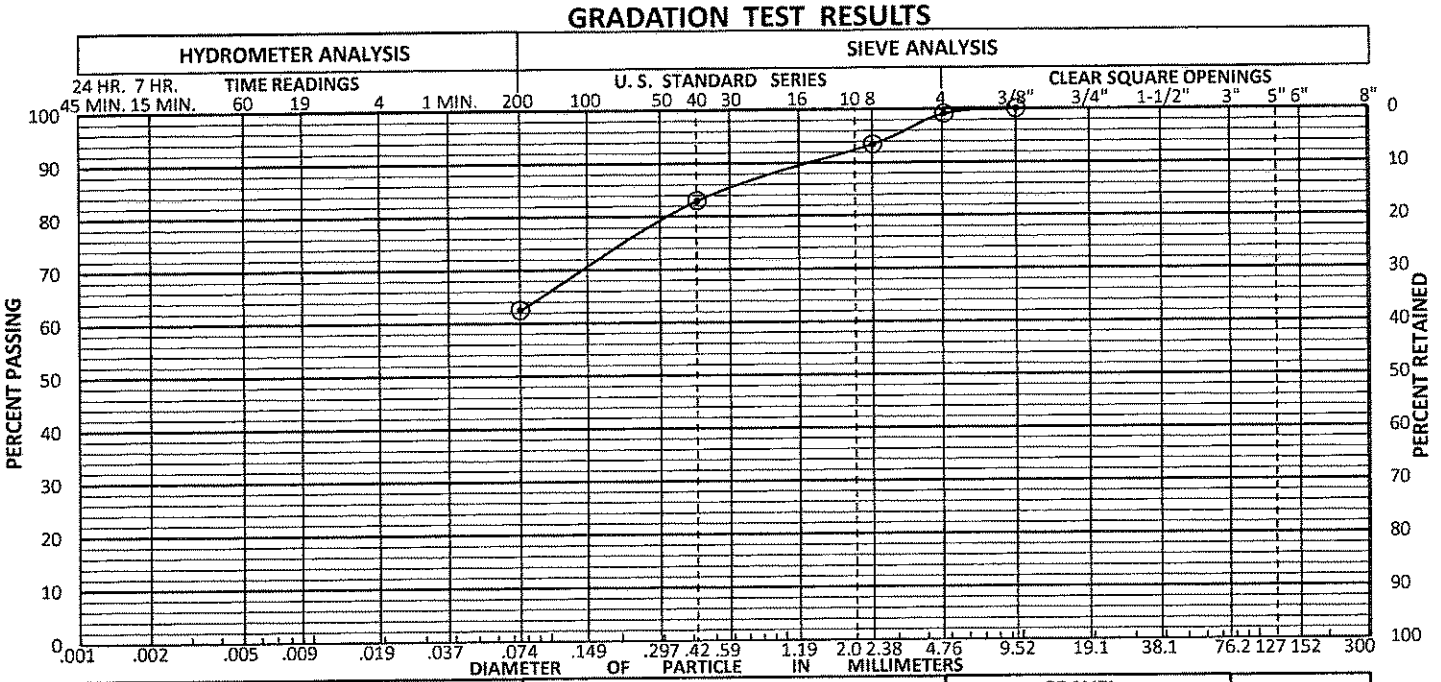
Cu = 16.3

Cc = 2.2

Job #: 18-0975 By: MJ 10/12/2018

# GEOQUEST LLC

## GRADATION TEST RESULTS




CLASSIFICATION CL

GRAVEL 0.9 %

SAND 36.6 %

FINES 62.5 %

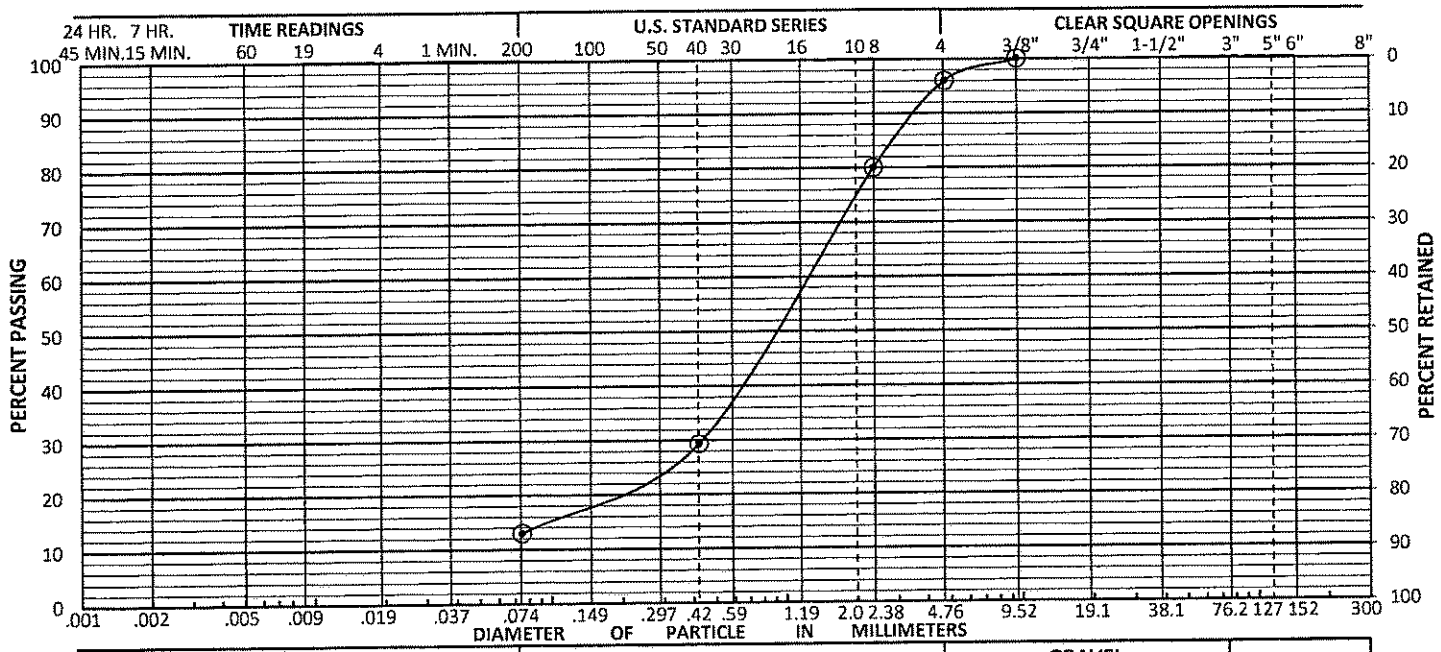
SAMPLE # 1 HOLE # TH-2 DEPTH 4 FEET

NOTES: 7.9 % Moisture Content

LL = 48.8

PL = 26.2

PI = 22.6




CLASSIFICATION SM

GRAVEL 4.0 %

SAND 83.0 %

FINES 13.0 %

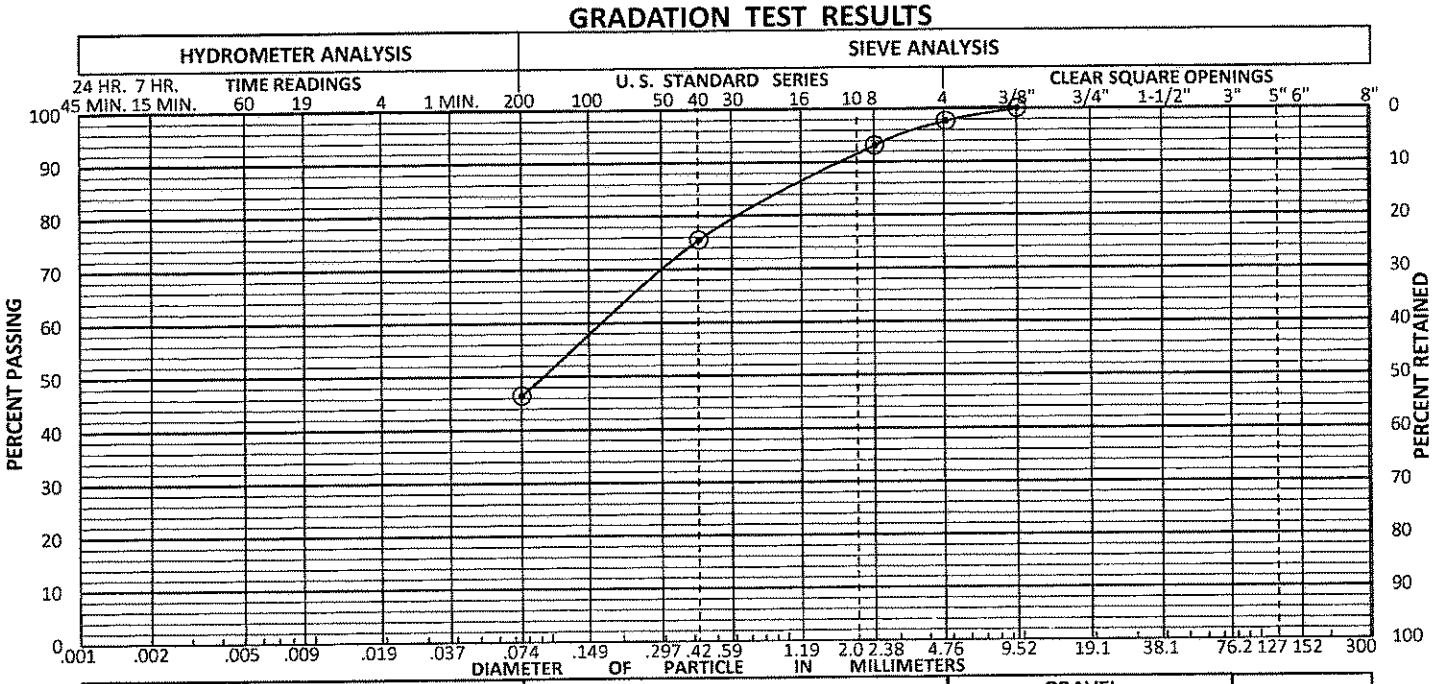
SAMPLE # 1 HOLE # TH-2 DEPTH 13 FEET

NOTES: 5.6 % Moisture Content

Job #: 18-0975 By: MJ 10/12/2018

# GEOQUEST LLC

## GRADATION TEST RESULTS




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

CLASSIFICATION SC

GRAVEL 2.3 %

SAND 51.3 %

FINES 46.4 %

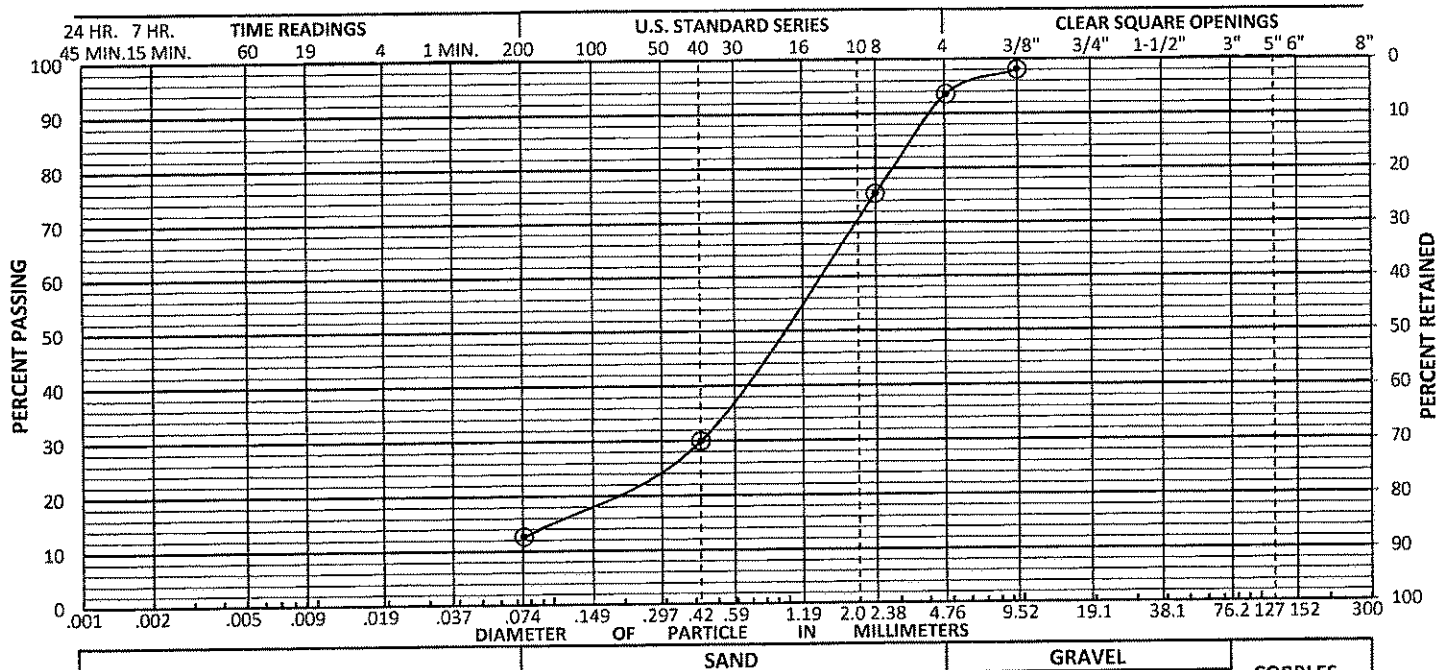
SAMPLE # 1 HOLE # TH-3 DEPTH 3 FEET

NOTES: 5.0 % Moisture Content

LL = 37.9

PL = 19.6

PI = 18.3




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

CLASSIFICATION SM

GRAVEL 6.5 %

SAND 80.9 %

FINES 12.6 %

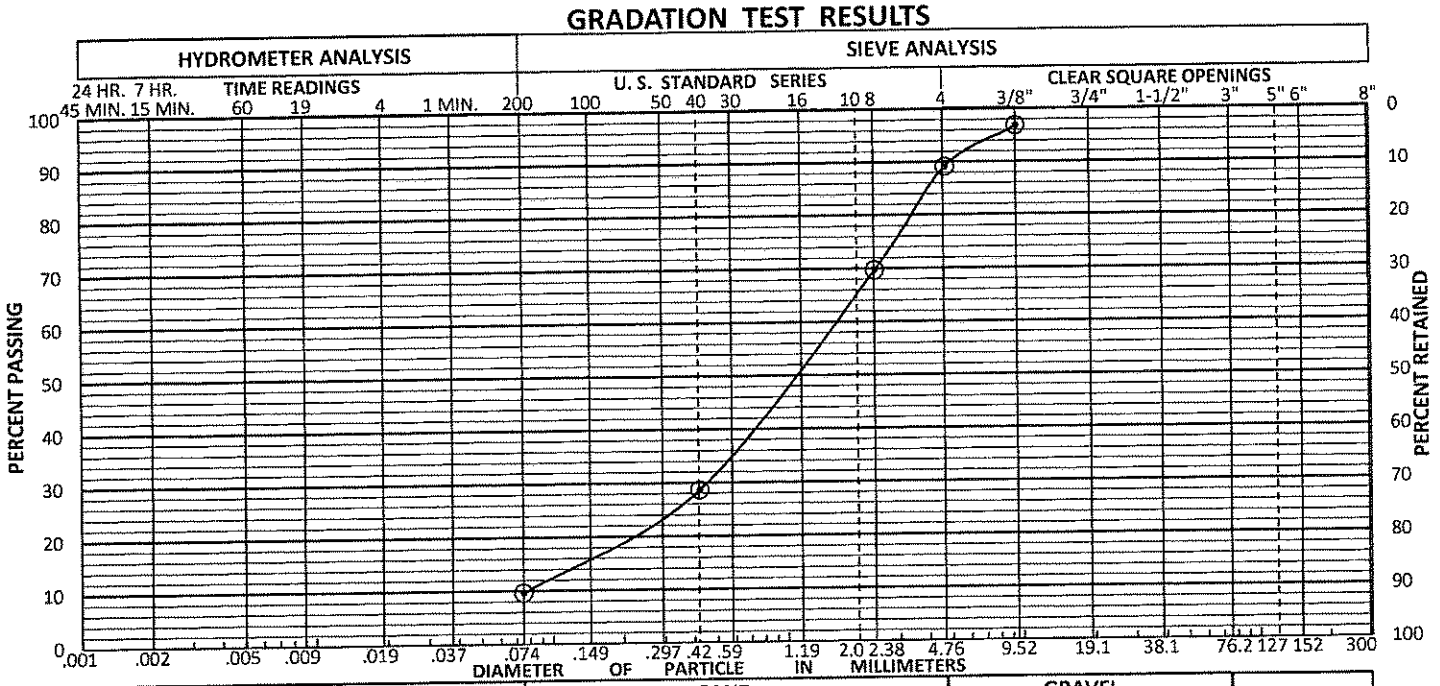
SAMPLE # 1 HOLE # TH-3 DEPTH 12 FEET

NOTES: 2.7 % Moisture Content

Job #: 18-0975 By: MJ 10/12/2018

# GEOQUEST LLC

## GRADATION TEST RESULTS




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

CLASSIFICATION SW/ SM

GRAVEL 11.0 %

SAND 79.5 %

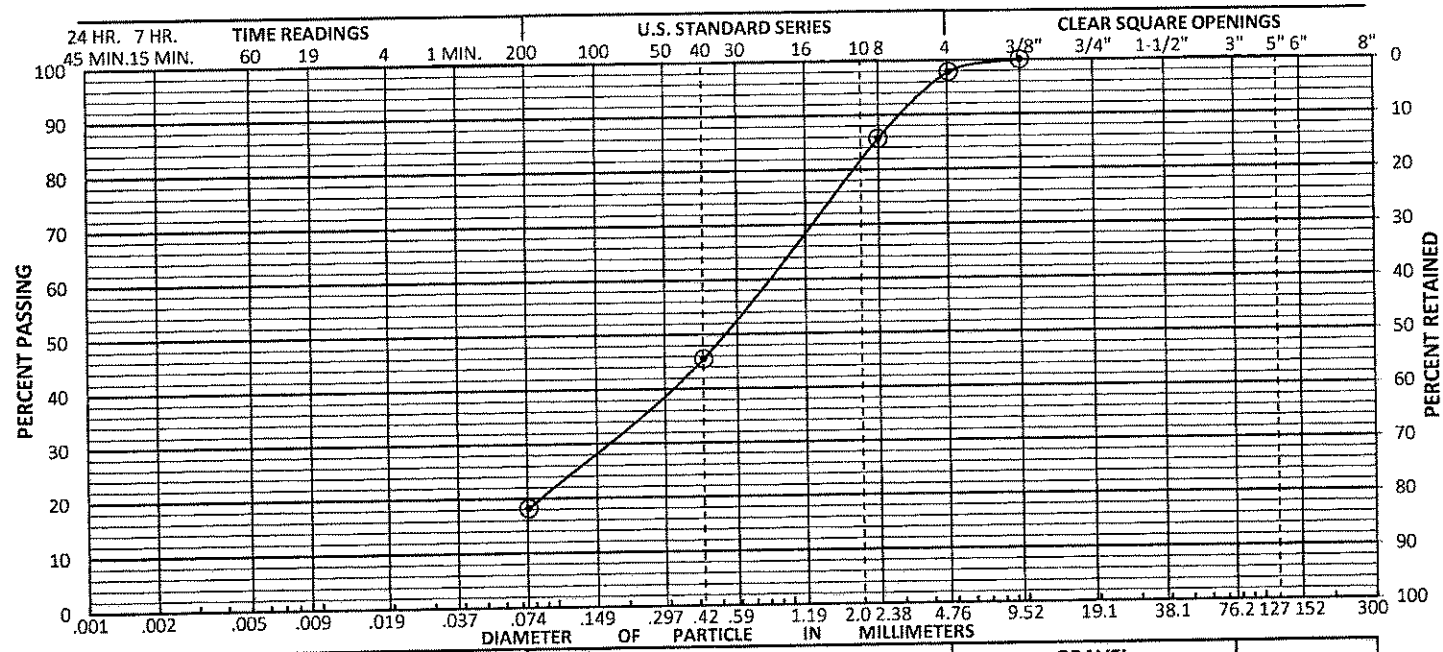
FINES 9.5 %

SAMPLE # 1 HOLE # TH-4 DEPTH 4 FEET

NOTES: 3.5 % Moisture Content

Cu = 21.6

Cc = 1.5




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

CLASSIFICATION SM

GRAVEL 2.2 %

SAND 79.7 %

FINES 18.1 %

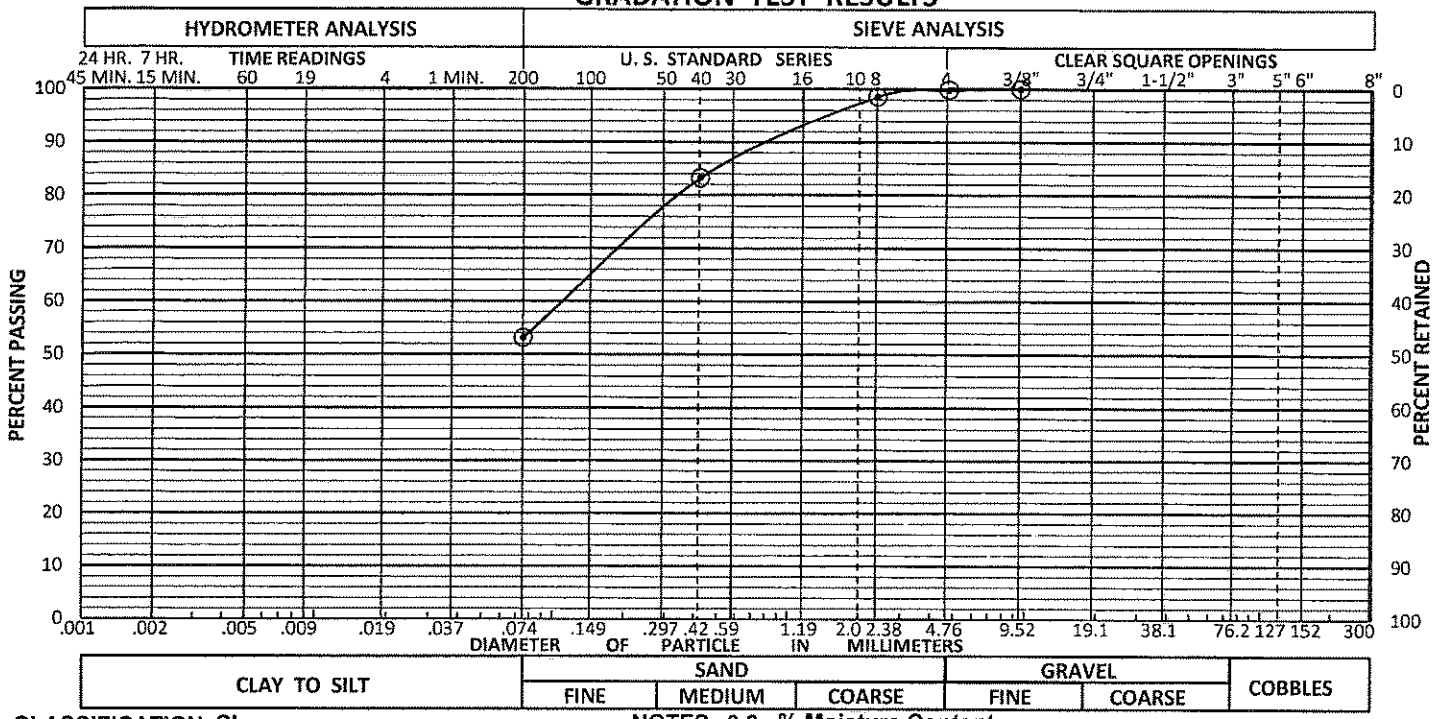
SAMPLE # 1 HOLE # TH- 4 DEPTH 13 FEET

NOTES: 5.6 % Moisture Content

Job #: 18-0975 By: MJ 10/12/2018

# GEOQUEST LLC

## GRADATION TEST RESULTS




CLASSIFICATION CL

GRAVEL 0.2 %

SAND 46.7 %

FINES 53.1 %

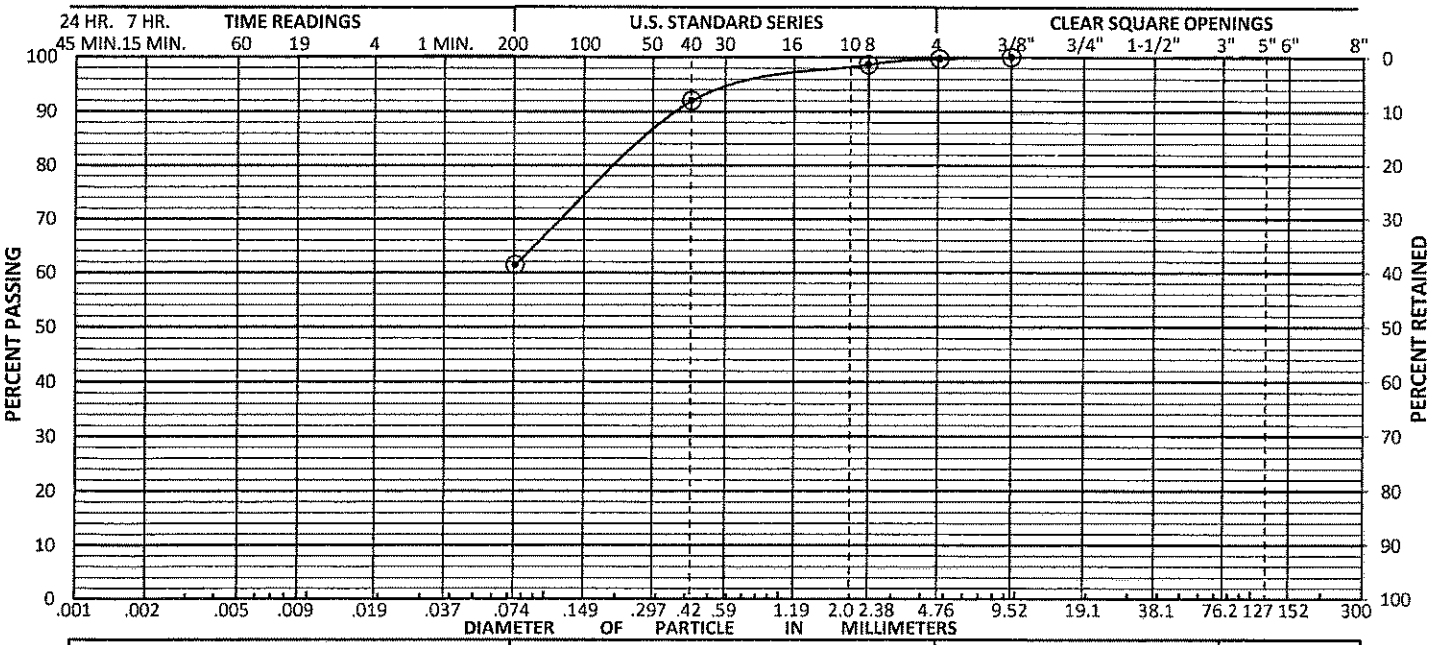
SAMPLE # 1 HOLE # TH-5 DEPTH 3 FEET

NOTES: 6.2 % Moisture Content

LL = 41.2

PL = 17.3

PI = 23.9




CLASSIFICATION CL

GRAVEL 0.3 %

SAND 38.3 %

FINES 61.4 %

SAMPLE # 1 HOLE # TH- 5 DEPTH 12 FEET

NOTES: 15.7 % Moisture Content

LL = 47.6

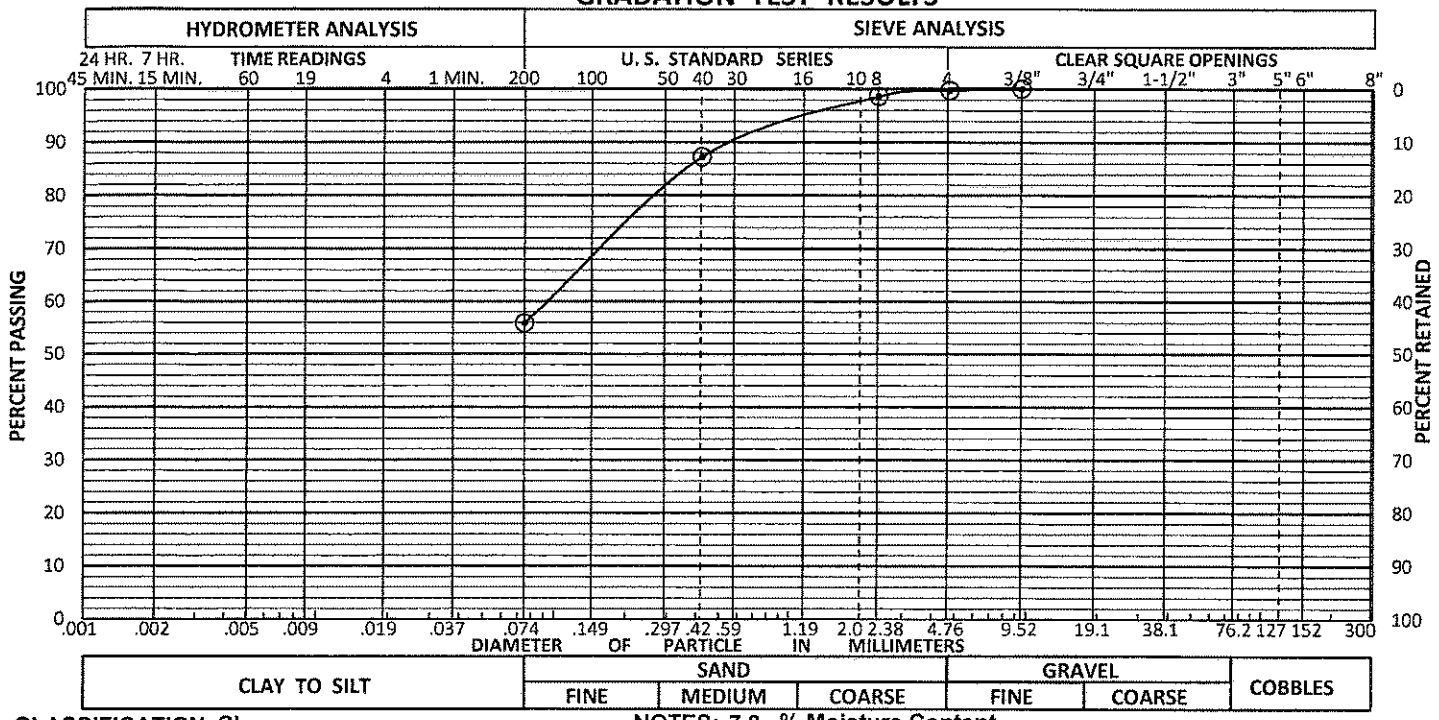
PL = 20.8

PI = 26.8

Job #: 18-0975 By: MJ 10/12/2018

# GEOQUEST LLC

## GRADATION TEST RESULTS




CLASSIFICATION CL

GRAVEL 0.3 %

SAND 43.9 %

FINES 55.8 %

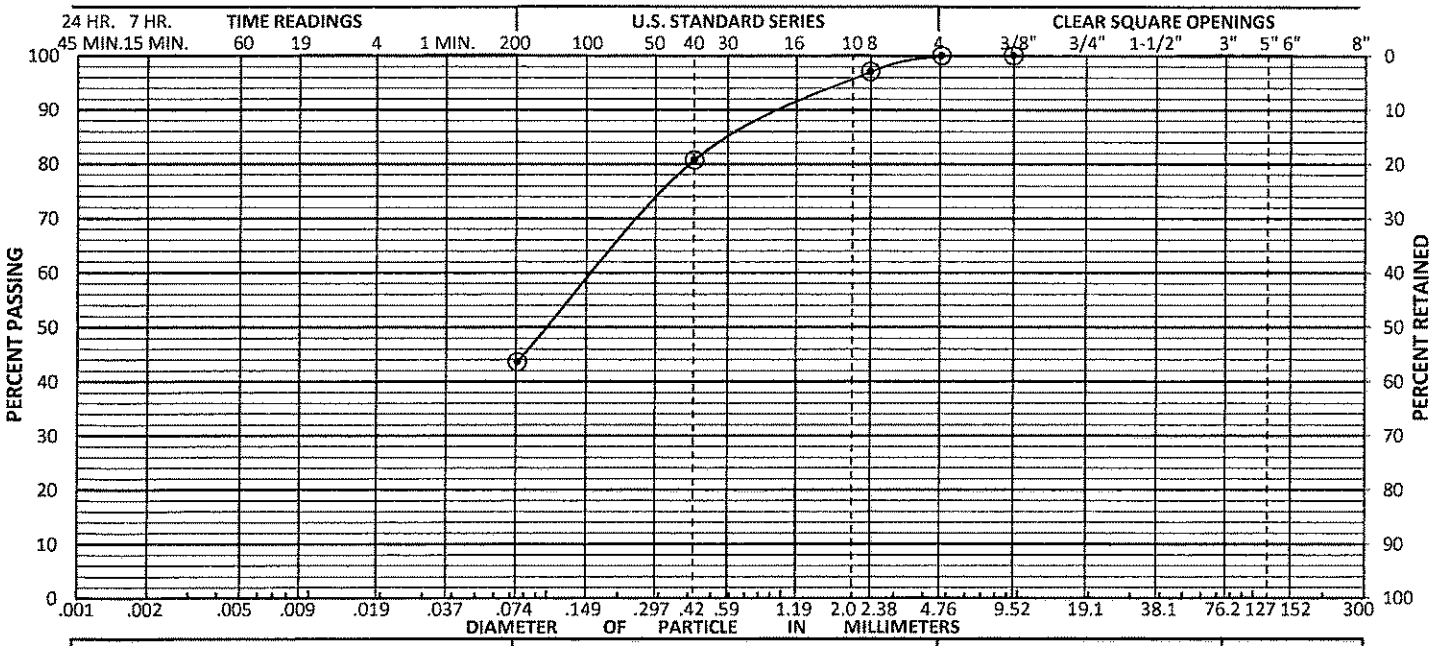
SAMPLE # 1 HOLE # TH-6 DEPTH 4 FEET

NOTES: 7.8 % Moisture Content

LL = 40.1

PL = 15.7

PI = 24.4




CLASSIFICATION SC

GRAVEL 0.0 %

SAND 56.4 %

FINES 43.6 %

SAMPLE # 1 HOLE # TH-6 DEPTH 13 FEET

NOTES: 7.0 % Moisture Content

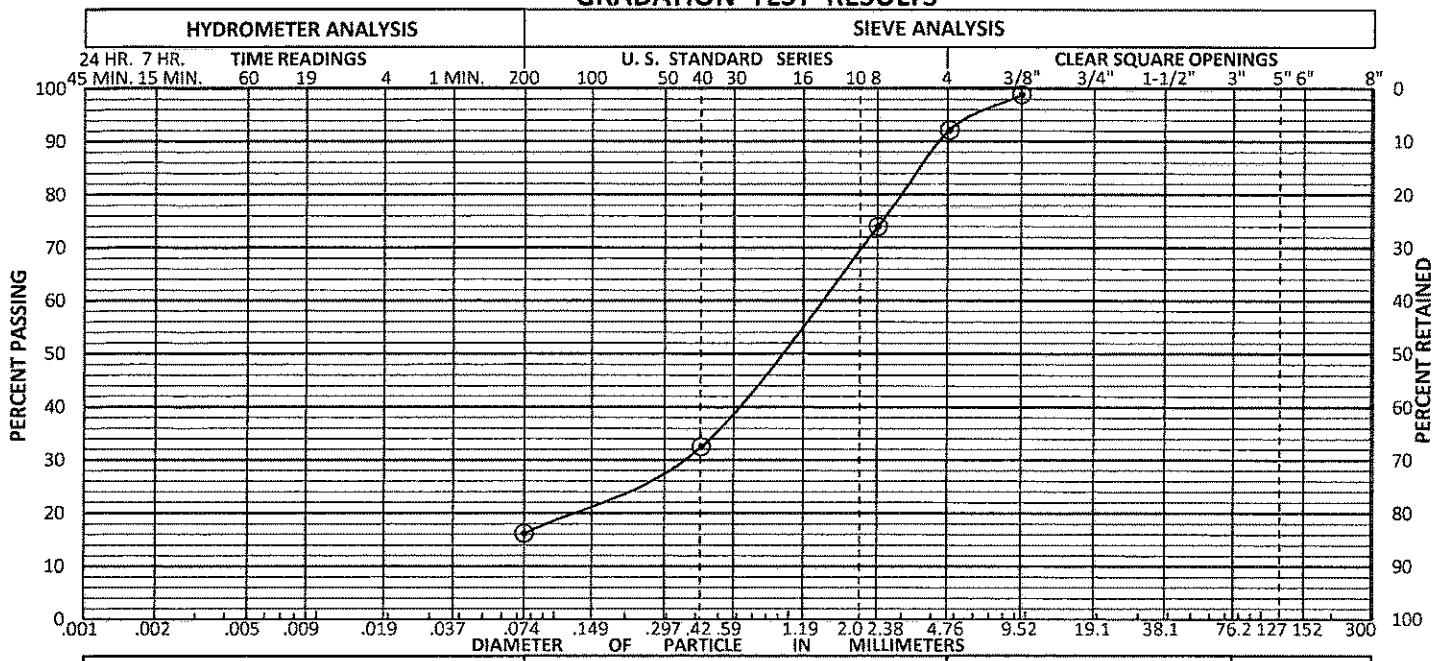
LL = 34.2

PL = 23.5

PI = 10.7

Job #: 18-0975 By: MJ 10/12/2018

# GEOQUEST LLC
## GRADATION TEST RESULTS




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

CLASSIFICATION SM

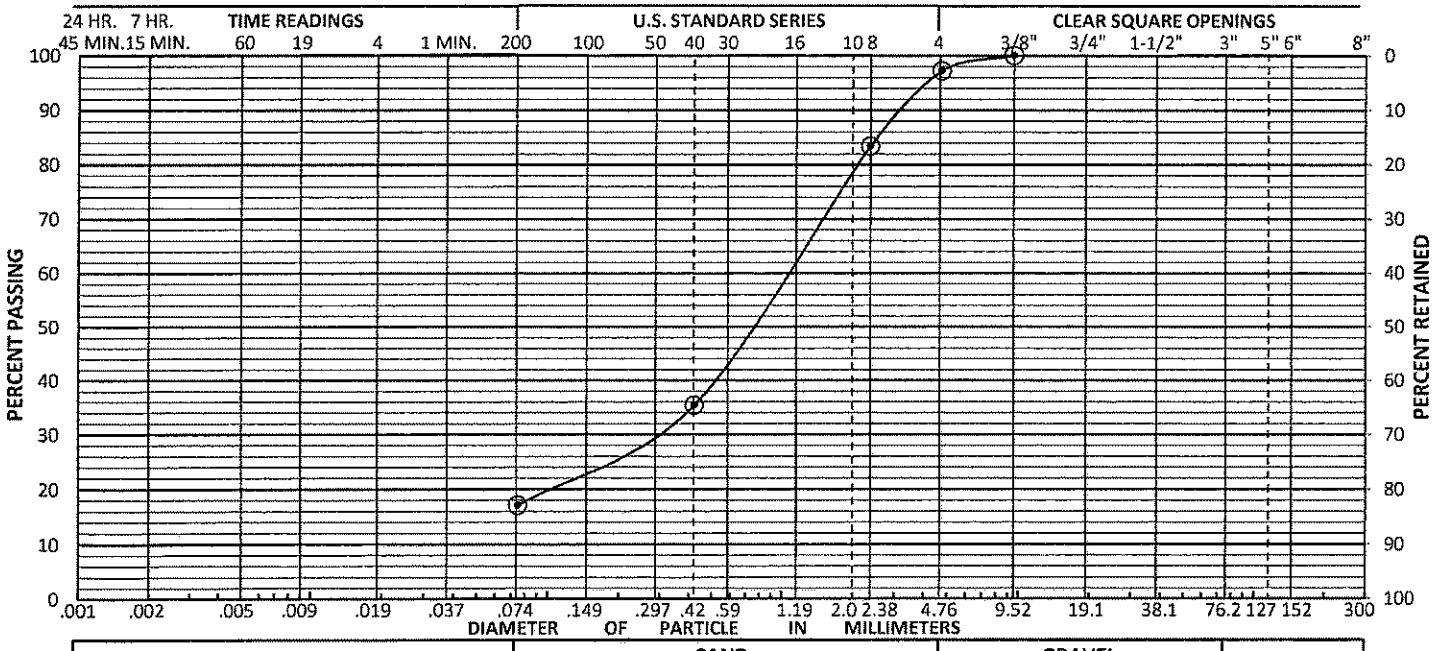
GRAVEL 7.9 %

SAND 76.0 %

FINES 16.1 %

SAMPLE # 1 HOLE # TH-7 DEPTH 3 FEET

NOTES: 4.4 % Moisture Content




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

CLASSIFICATION SM

GRAVEL 2.8 %

SAND 80.2 %

FINES 17.0 %

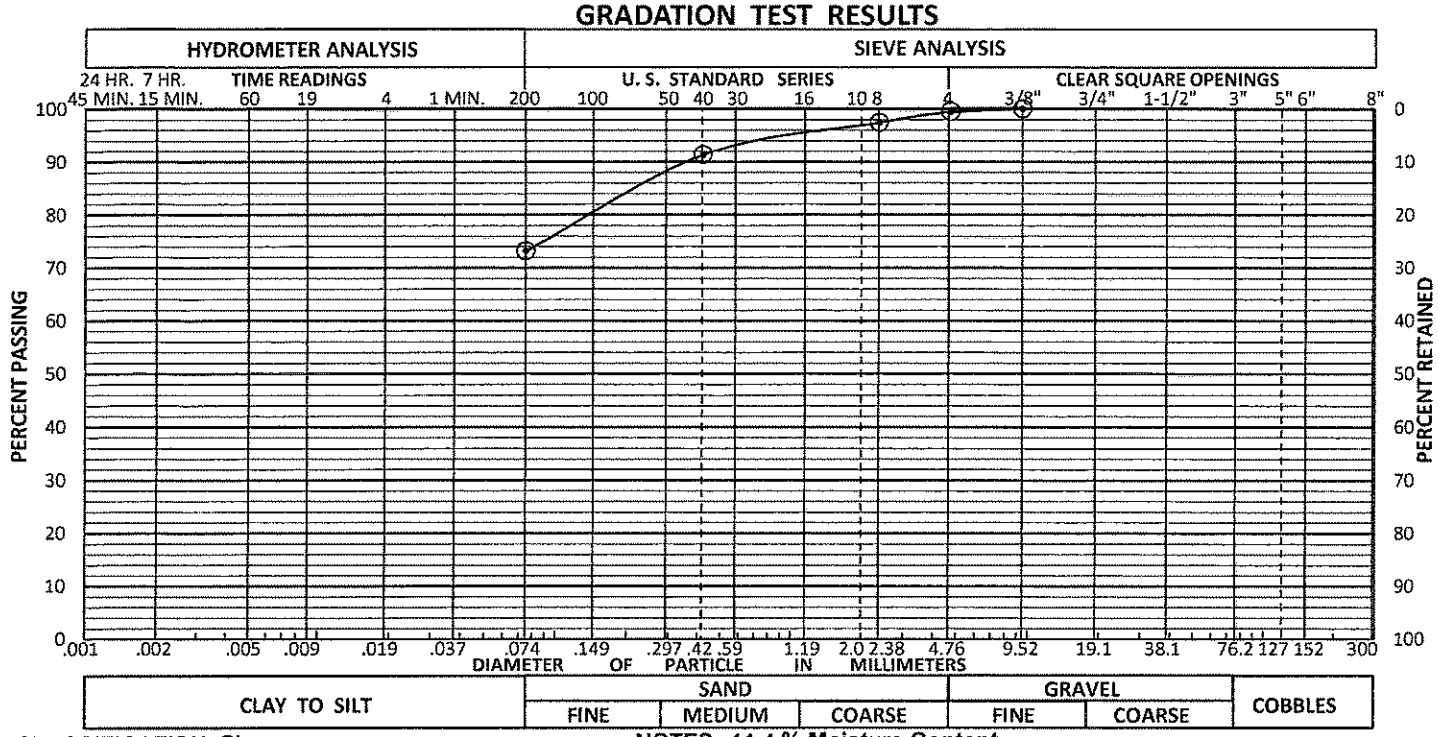
SAMPLE # 1 HOLE # TH-7 DEPTH 12 FEET

NOTES: 11.8 % Moisture Content

Job #: 18-0975 By: MJ 10/12/2018

# GEOQUEST LLC

## GRADATION TEST RESULTS




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

CLASSIFICATION CL

GRAVEL 0.5 %

SAND 26.4 %

FINES 73.1 %

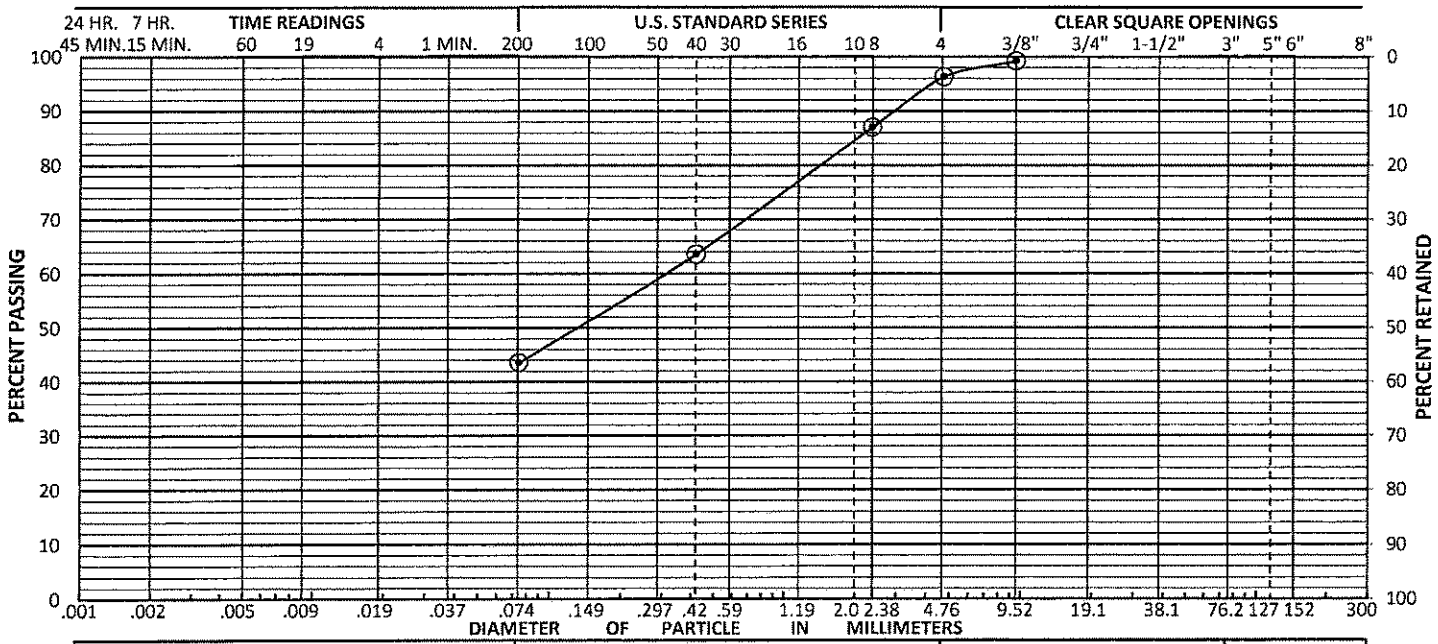
SAMPLE # 1 HOLE # TH-8 DEPTH 4 FEET

NOTES: 11.4 % Moisture Content

LL = 45.9

PL = 25.7

PI = 20.2




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

CLASSIFICATION SC

GRAVEL 3.7 %

SAND 52.8 %

FINES 43.5 %

SAMPLE # 1 HOLE # TH-8 DEPTH 13 FEET

NOTES: 7.1 % Moisture Content

LL = 21.6

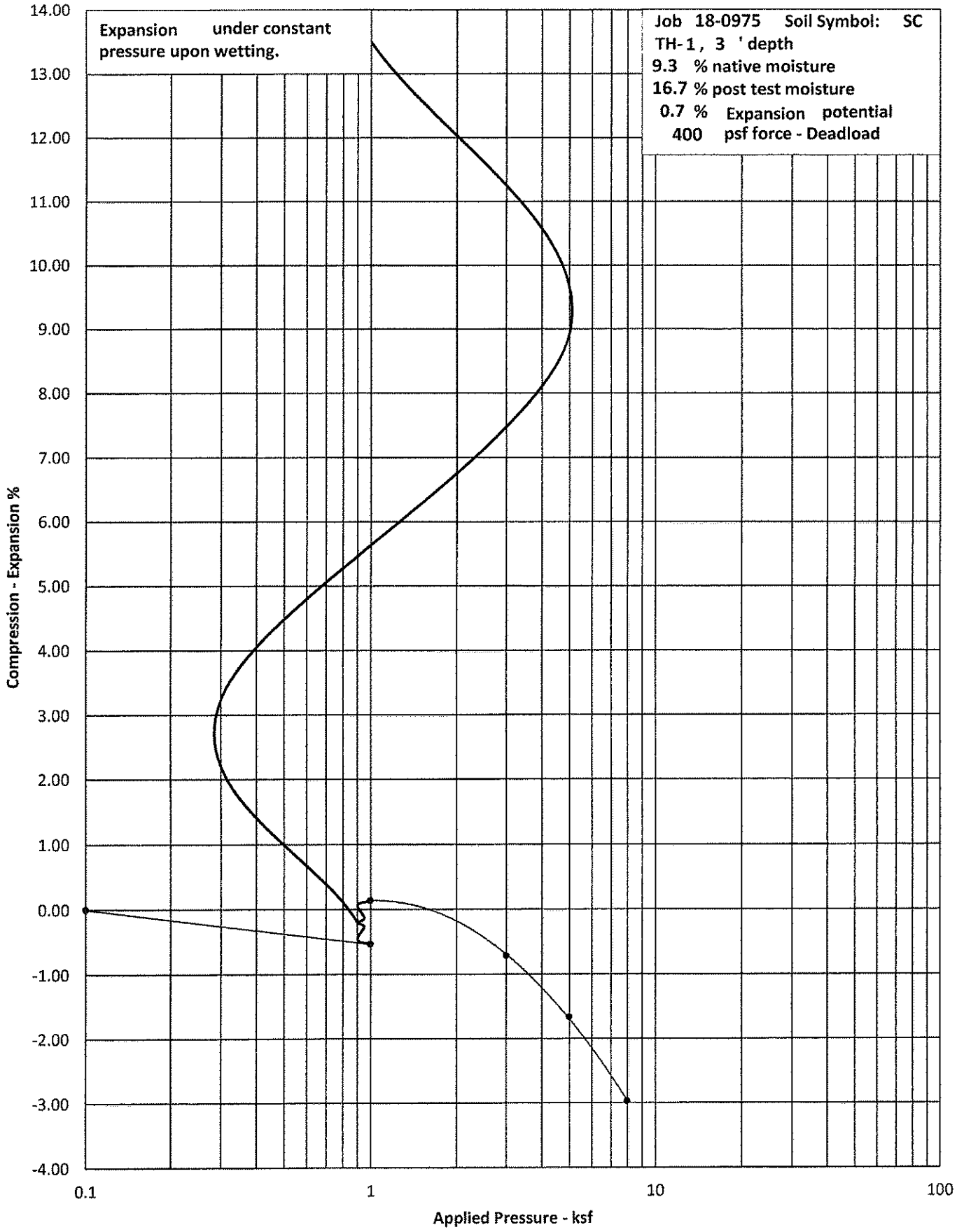
PL = 13.0

PI = 8.6

Job #: 18-0975 By: MJ 10/12/2018

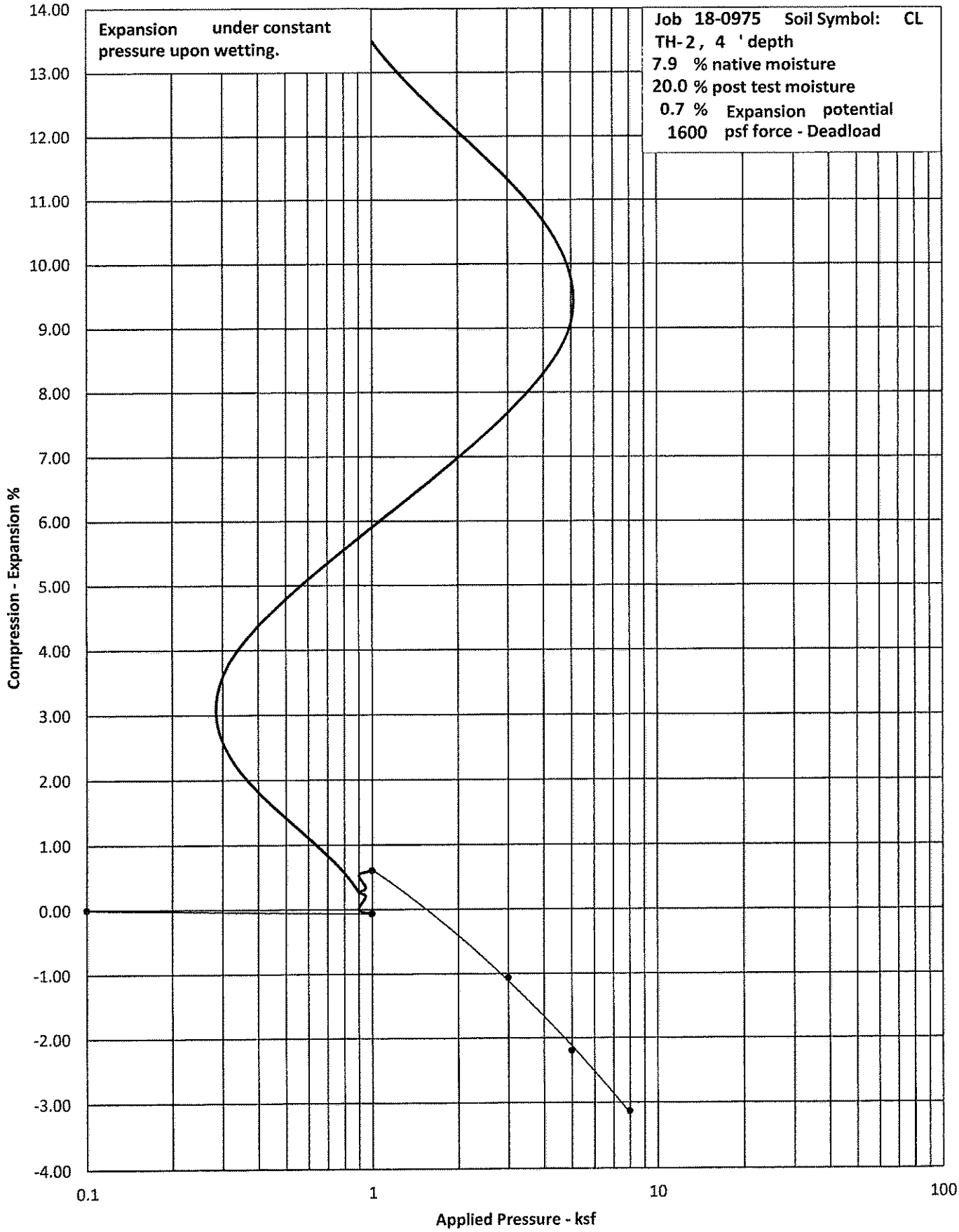
GEOQUEST LLC

**SWELL-CONSOLIDATION TEST RESULTS**



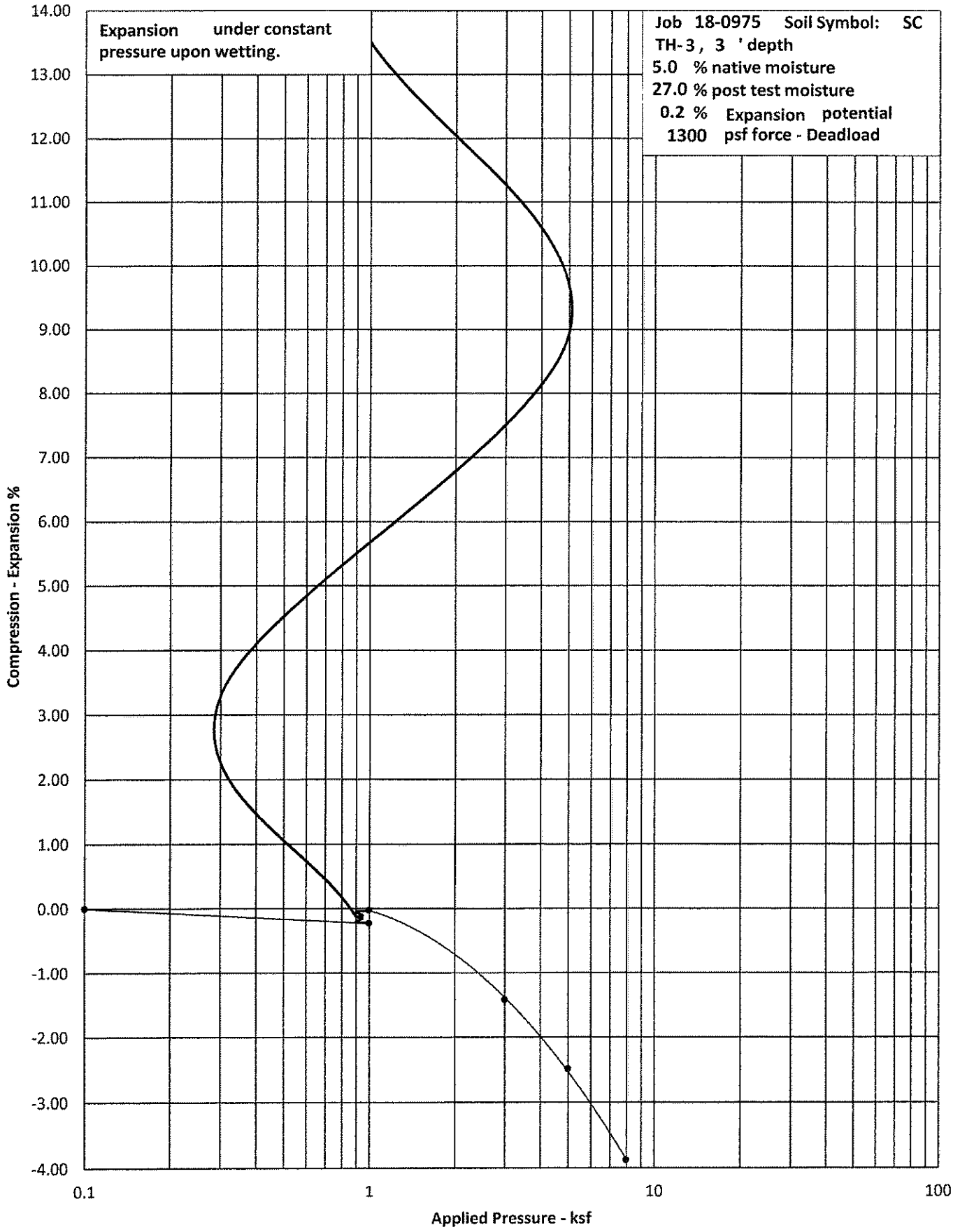
GEOQUEST LLC

**SWELL-CONSOLIDATION TEST RESULTS**



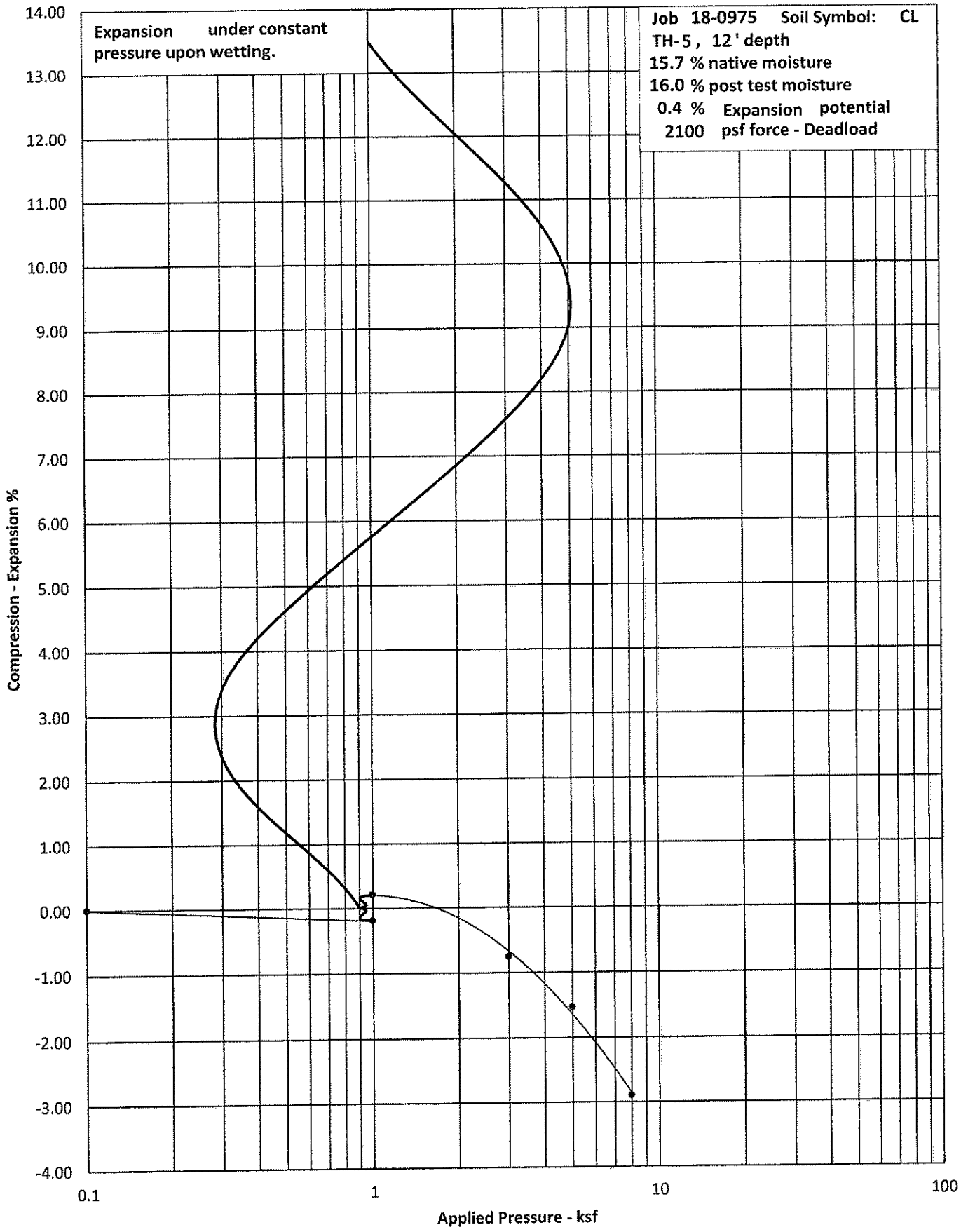
GEOQUEST LLC

**SWELL-CONSOLIDATION TEST RESULTS**



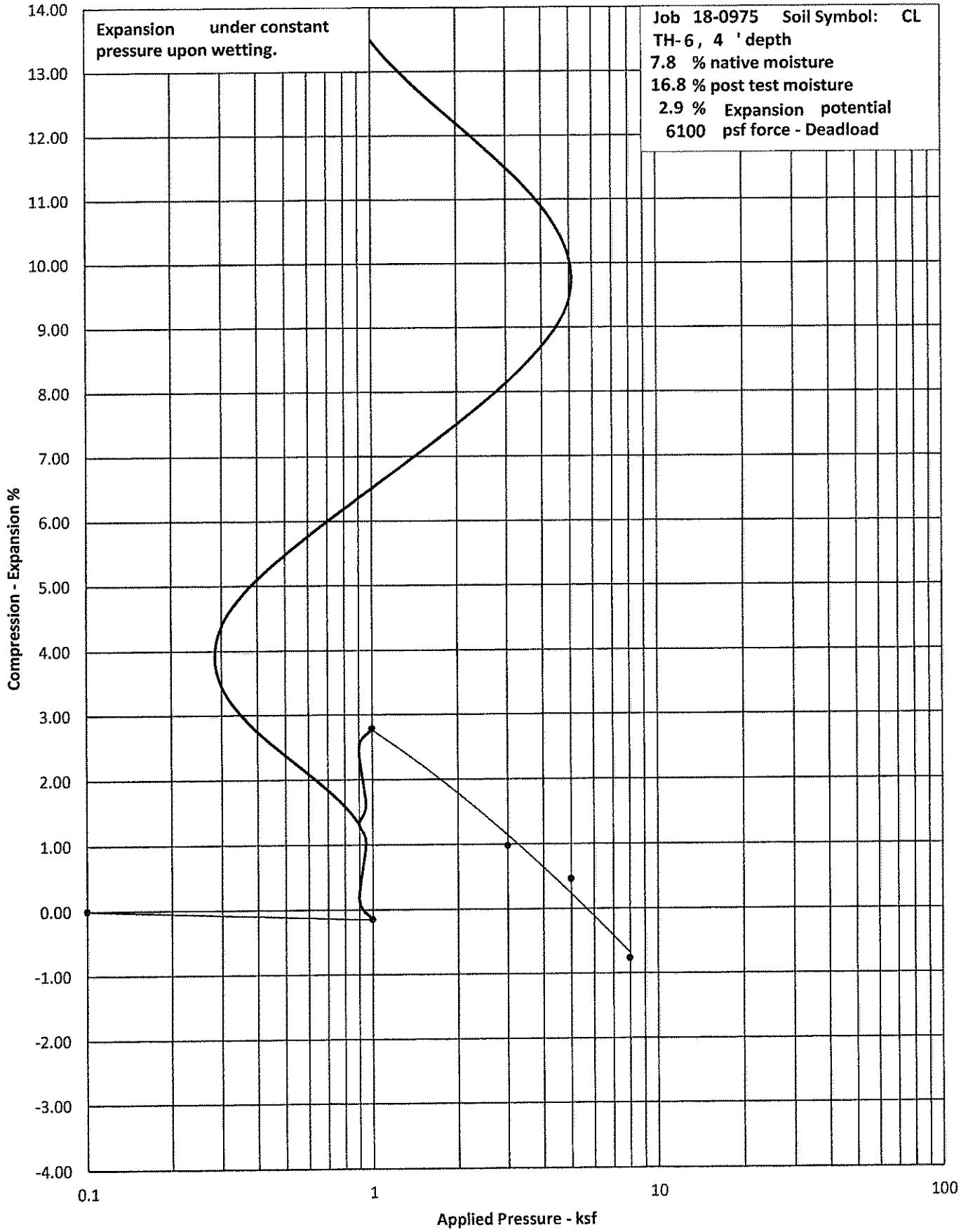
GEOQUEST LLC

**SWELL-CONSOLIDATION TEST RESULTS**



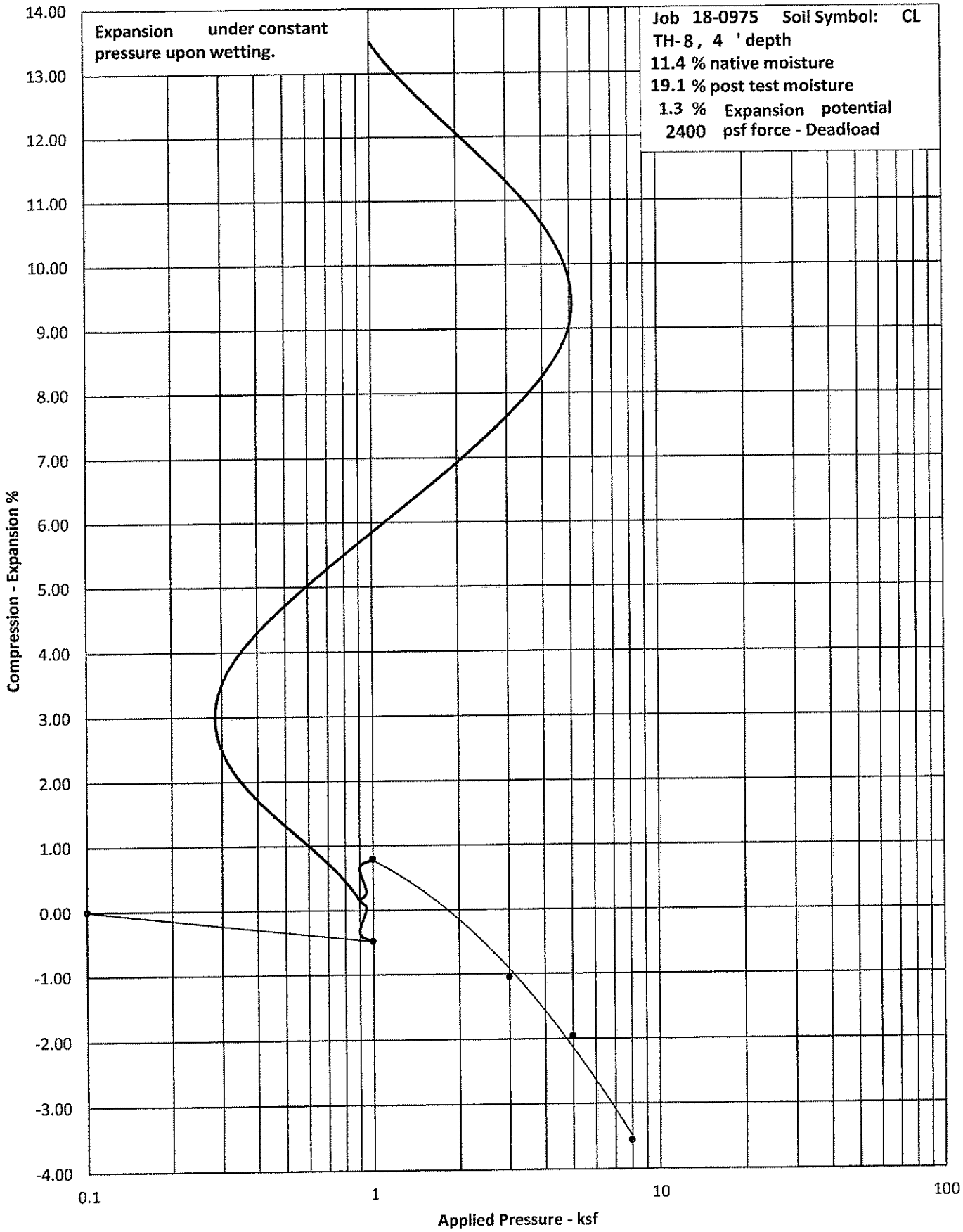
GEOQUEST LLC

**SWELL-CONSOLIDATION TEST RESULTS**



GEOQUEST LLC

**SWELL-CONSOLIDATION TEST RESULTS**

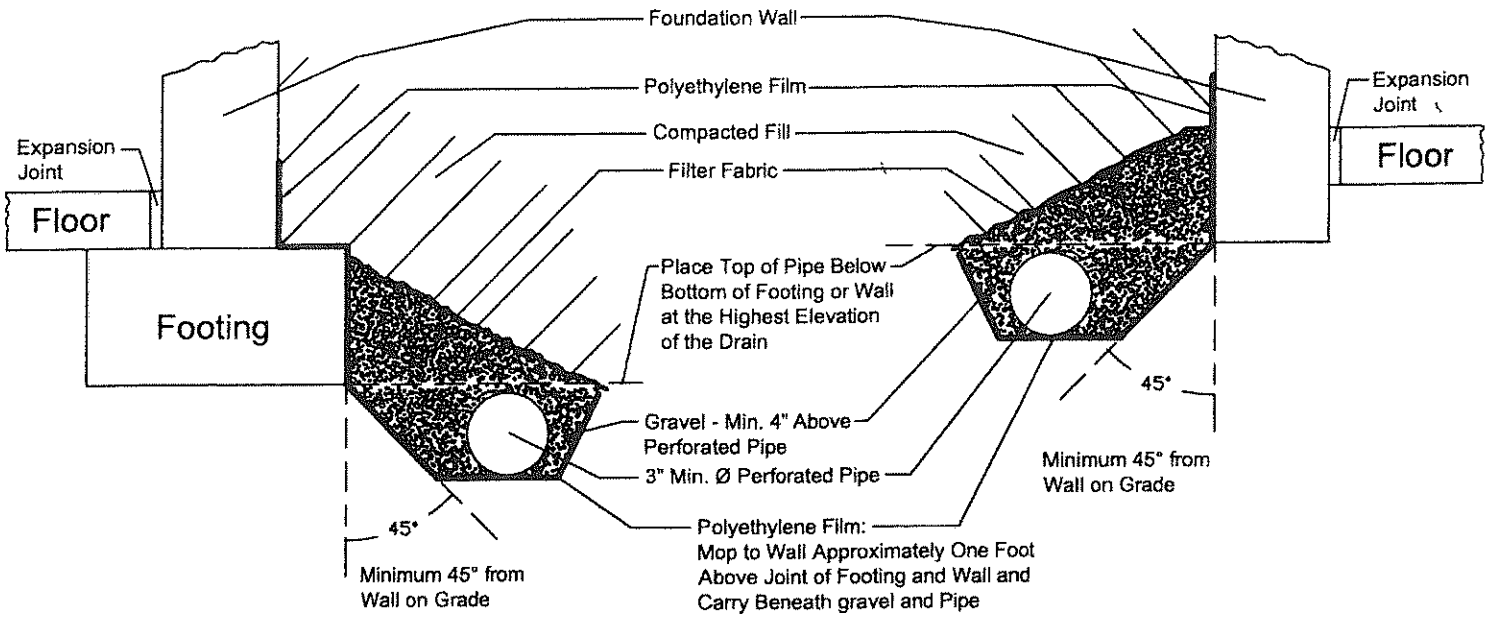


GEOQUEST, LLC
481-4560

# EXTERIOR DRAIN DETAIL

## SPREAD FOOTING TYPE

## WALL ON GRADE TYPE




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.

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 and Carry Beneath Gravel and Pipe.

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

**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.

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.

# APPENDIX B

*Subdivision Profile Pit Evaluation, 15630 Fox Creek Lane, El Paso County, Colorado,*
prepared by Geoquest, LLC, Job#18-0975, dated July 11, 2019.

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

# SUBDIVISION PROFILE PIT EVALUATION

## FOR

## SHAY MILES

**JOB #18-0975**

15630 Fox Creek Lane,
El Paso County,
Colorado

Sincerely,

Charles E. Milligan, P.E.
Civil Engineer

COLORADO REGISTERED
CHARLES E. MILLIGAN
34608
PROFESSIONAL ENGINEER

**PROFILE PIT FINDINGS**

Enclosed are the results of the subdivision profile pit report for the septic systems to be installed at **15630 Fox Creek Lane, El Paso County, Colorado. This report is for planning purposes for the development of the subdivision. Two profile pits will be required on each plotted lot prior to issuance of permits.** The location of the test pits was determined by Shay Miles. The residences will not be on a public water system. The number of bedrooms in the design for the residences is unknown. Due to the natural slope of the property, the system near Profile Pit #1 will feed to the northwest at approximately 8%, the system near Profile Pit #2 will feed to the southwest at approximately 6%, and the system near Profile Pit #3 will feed to the southeast at approximately 11%. All applicable portions of the El Paso County Health Department Onsite Wastewater Treatment System Regulations (OWTS) must be complied with for the installation of the treatment system.

The inspection was performed on May 28, 2019, in accordance with Table 10-1 of the **E.P.C.P.H. OWTS Regulations.**

Soil Profile #1:

**0 to 6"** - Topsoil - loam, organic composition.

**6" to 28"** - USDA soil texture sandy clay loam, soil type 3A, structure shape granular, structure grade 1, non-cemented, LTAR 0.30, dark brown in color, 7.5 YR 3/2, organics.

**28" to 68"** - USDA soil texture sandy loam, soil type 2A, structure shape massive, structure grade 0, non-cemented, LTAR 0.50, light yellowish brown in color, 10 YR 6/4, ~ 15% gravel.

**68" to 8'** - USDA soil texture sandy clay loam, soil type 3A, structure shape massive, structure grade 0, non-cemented, LTAR 0.30, pale brown in color, 10 YR 6/3, zones of clay, high moisture at 78 inches, groundwater at 86 inches.

Soil Profile #2:

**0 to 12"** - Topsoil - loam, organic composition.

**12" to 52"** - USDA soil texture loamy sand, soil type 1, structure shape single grain, structure grade 0, non-cemented, LTAR 0.80, strong brown in color, 7.5 YR 4/6, ~ 20% gravel.

**52" to 62"** - USDA soil texture sandy loam, soil type 2A, structure shape massive, structure grade 0, non-cemented, LTAR 0.50, brown in color, 7.5 YR 5/3, redoximorphic features at 60 inches.

**62" to 8'** - USDA soil texture loamy sand, soil type 1, structure shape single grain, structure grade 0, non-cemented, LTAR 0.80, yellowish brown in color, 10 YR 5/4, ~ 30% gravel.

Soil Profile #3:

**0 to 10"** - Topsoil - loam, organic composition.

**10" to 40"** - USDA soil texture sandy clay, soil type 4A, structure shape massive, structure grade 0, non-cemented, LTAR 0.15, dark yellowish brown in color, 10 YR 4/4.

**40" to 84"** - USDA soil texture sandy clay, soil type 4A, structure shape blocky, structure grade 1, non-cemented, LTAR 0.15, yellowish brown in color, 10 YR 5/4, redoximorphic features at 80 inches.

**84" to 8'** - USDA soil texture sandy clay, soil type 4A, structure shape massive, structure grade 0, non-cemented, LTAR 0.15, yellowish brown in color, 10 YR 5/4.

Groundwater was encountered at the depth of 86 inches in Profile Pit #1 during the inspection. Groundwater evidence was encountered at the depth of 60 inches in Profile Pit #2 and 80 inches in Profile Pit #3 during the inspection. Bedrock was not encountered during the inspection. No known wells were observed within 100 feet of the proposed systems. **All setbacks shall conform to county regulations.**

**Designs by Colorado Registered Professional Engineers are likely required due to encountered soil types and groundwater. Maximum depths are expected to range from 12 inches to 36 inches, though anomalies may occur. Long Term Acceptance Rates (LTAR) are expected to range from 0.50 GPD/SF for sandy loam to 0.15 GPD/SF for sandy clay.**

Weather conditions at the time of the test consisted of clear skies with warm temperatures.

A Natural Resources Conservation Service Soil Survey Map is appended to this report.

# PROFILE PIT LOG - Profile Pit #1

JOB#: 18-0975
DATE EVALUATED: 28 MAY 2019
EQUIPMENT USED: MINI EXCAVATOR

0"-6" **TOPSOIL**
Loam
Organic Composition

6"- 28" **Clayey Sand**
Fine-very coarse Grained
Moderate Density
Low-moderate Moisture Content
Moderate Clay Content
Moderate Cohesion
Moderate Plasticity
Dark Brown Color
7.5YR 3/2

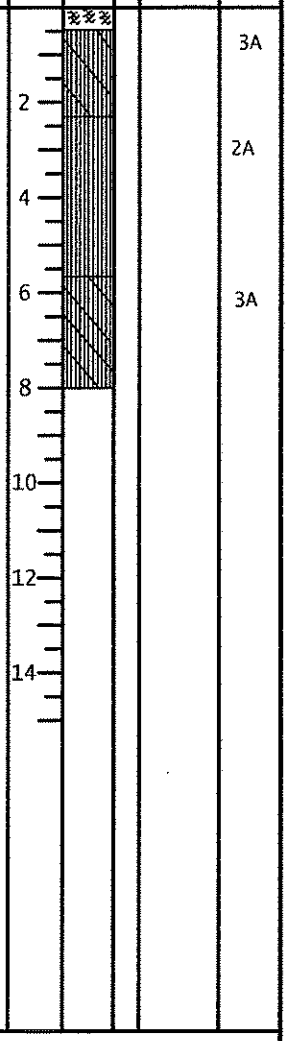
USDA Soil Texture: Sandy Clay Loam
USDA Soil Type: 3A
USDA Structure Shape: Granular
USDA Structure Grade: 1
Cementation Class: Non-cemented
Long Term Acceptance Rate (LTAR, Treatment Level 1):0.30
Organics

28"- 68" **Sand**
Fine-very coarse Grained
High Density
Low Moisture Content
Low Clay Content
Low Cohesion
Low Plasticity
Light Yellowish Brown Color
10YR 6/4

USDA Soil Texture: Sandy Loam
USDA Soil Type: 2A
USDA Structure Shape: Massive
USDA Structure Grade: 0
Cementation Class: Non-cemented
Long Term Acceptance Rate (LTAR, Treatment Level 1):0.50
~15% gravel

68"- 8' **Clayey Sand**
Fine-very coarse Grained
High Density
Moderate-high Moisture Content
Low-moderate Clay Content
Low-moderate Cohesion
Low-moderate Plasticity
Pale Brown Color
10YR 6/3

USDA Soil Texture: Sandy Clay Loam
USDA Soil Type: 3A
USDA Structure Shape: Massive
USDA Structure Grade: 0
Cementation Class: Non-cemented
Long Term Acceptance Rate (LTAR, Treatment Level 1):0.30
Zones of Clay
High moisture @ 78"
Groundwater @ 86"




**LTAR** to be Used for OWTS Sizing: **0.30GPD/SF (USDA Type 3A, Treatment soil, Treatment Level 1)**
**Depth to Groundwater (Permanent or Seasonal):** Permanent @ 86"
**Depth to Bedrock and Type:** Not Encountered
**Depth to Proposed Infiltrative Surface from Ground Surface:** Max. 30" Deep
**Soil Treatment Area Slope and Direction:** Northwest @ 8%

Note: See El Paso County Board of Health Regulation Chapter 8: On-Site Wastewater Treaments Systems (OWTS) Regulations for Additional Information. Refer to Table 10-1 for Corresponding LTAR if Treatment Level 2, 2N, 3, or 3N will be Implemented in the Design of the OWTS. System Sizing Depends on a Number of Factors (i.e. LTAR, # of Bedrooms, Type of Soil Treament Area (STA), Method of Transfer to the STA (Gravity, Dosed, or Pressure Dosed), and Type of Storage / Distribution Media Used in the STA)

| |
|---|
| Project: 18-0975 |
| Sheet: 1 of 3 |
| Date: 3 June 2019 |
| |
| |
| Scale: 1/4" = 1' |
| Drawn by: rah |
| Checked by: cem |

Project Name and Address
Shay Miles

15630 Fox Creek Lane
Sch. No. 51293000002
El Paso County, Colorado


GEOQUEST, LLC.
6825 SILVER PONDS HEIGHTS
SUITE 101
COLORADO SPRINGS, CO
80908

OFFICE: (719) 481-4560
FAX: (719) 481-9204

# PROFILE PIT LOG - Profile Pit #2

JOB#: 18-0975
DATE EVALUATED: 28 MAY 2019
EQUIPMENT USED: MINI EXCAVATOR

0"-12" **TOPSOIL**
Loam
Organic Composition

12"- 52" **Sand**

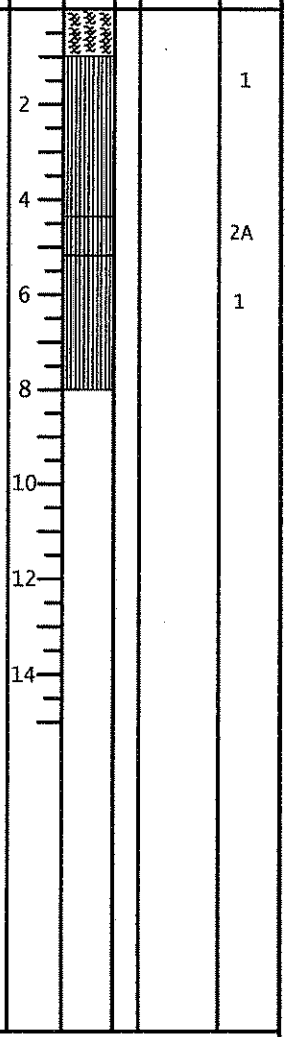
| | |
|---|---|
| Fine-very coarse Grained | USDA Soil Texture: Loamy Sand |
| Low Density | USDA Soil Type: 1 |
| Moderate-high Moisture Content | USDA Structure Shape: Single Grain |
| Low Clay Content | USDA Structure Grade: 0 |
| Low Cohesion | Cementation Class: Non-cemented |
| Low Plasticity | Long Term Acceptance Rate (LTAR, Treatment Level 1):0.80 |
| Strong Brown Color 7.5YR 4/6 | ~ 20% gravel |

52"- 62" **Sand**

| | |
|---|---|
| Fine-coarse Grained | USDA Soil Texture: Sandy Loam |
| Moderate-high Density | USDA Soil Type: 2A |
| Low Moisture Content | USDA Structure Shape: Massive |
| Low Clay Content | USDA Structure Grade: 0 |
| Low Cohesion | Cementation Class: Non-cemented |
| Low Plasticity | Long Term Acceptance Rate (LTAR, Treatment Level 1):0.50 |
| Brown Color 7.5YR 5/3 | Redox @ 60" |

62"- 8' **Sand**

| | |
|---|---|
| Fine-very coarse Grained | USDA Soil Texture: Loamy Sand |
| Low Density | USDA Soil Type: 1 |
| Low Moisture Content | USDA Structure Shape: Single Grain |
| Low Clay Content | USDA Structure Grade: 0 |
| Low Cohesion | Cementation Class: Non-cemented |
| Low Plasticity | Long Term Acceptance Rate (LTAR, Treatment Level 1):0.80 |
| Yellowish Brown Color 10YR 5/4 | ~ 30% gravel |




**LTAR** to be Used for OWTS Sizing: **0.50GPD/SF (USDA Type 2A, Treatment soil, Treatment Level 1)**
**Depth to Groundwater (Permanent or Seasonal):** Seasonal @ 60"
**Depth to Bedrock and Type:** Not Encountered
**Depth to Proposed Infiltrative Surface from Ground Surface:** Max. 12" Deep
**Soil Treatment Area Slope and Direction:** Southwest @ 6%

Note: See El Paso County Board of Health Regulation Chapter 8: On-Site Wastewater Treaments Systems (OWTS) Regulations for Additional Information. Refer to Table 10-1 for Corresponding LTAR if Treatment Level 2, 2N, 3, or 3N will be Implemented in the Design of the OWTS. System Sizing Depends on a Number of Factors (i.e. LTAR, # of Bedrooms, Type of Soil Treament Area (STA), Method of Transfer to the STA (Gravity, Dosed, or Pressure Dosed), and Type of Storage / Distribution Media Used in the STA)

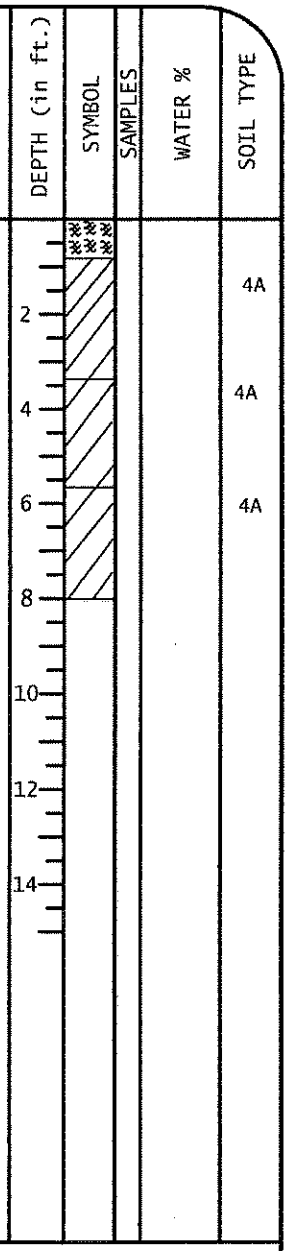
| | |
|---|---|
| Project: 18-0975 | Project Name and Address |
| Sheet: 2 of 3 | Shay Miles |
| Date: 3 June 2019 | |
| | 15630 Fox Creek Lane |
| | Sch. No. 51293000002 |
| Scale: 1/4" = 1' | El Paso County, Colorado |
| Drawn by: rah | |
| Checked by: cem | |


GEOQUEST, LLC.
6825 SILVER PONDS HEIGHTS
SUITE 101
COLORADO SPRINGS, CO
80908

OFFICE: (719) 481-4560
FAX: (719) 481-9204

# PROFILE PIT LOG - Profile Pit #3

JOB#: 18-0975
DATE EVALUATED: 28 MAY 2019
EQUIPMENT USED: MINI EXCAVATOR




0"-10" **TOPSOIL**
Loam
Organic Composition

10"- 40" **Clay**
Fine-coarse Grained
Moderate Density
Low-moderate Moisture Content
High Clay Content
High Cohesion
High Plasticity
Dark Yellowish Brown Color
10YR 4/4

USDA Soil Texture: Sandy Clay
USDA Soil Type: 4A
USDA Structure Shape: Massive
USDA Structure Grade: 0
Cementation Class: Non-cemented
Long Term Acceptance Rate (LTAR, Treatment Level 1):0.15

40"- 84" **Clay**
Fine-coarse Grained
Very High Density
Low Moisture Content
High Clay Content
High Cohesion
High Plasticity
Yellowish Brown Color
10YR 5/4

USDA Soil Texture: Sandy Clay
USDA Soil Type: 4A
USDA Structure Shape: Blocky
USDA Structure Grade: 1
Cementation Class: Non-cemented
Long Term Acceptance Rate (LTAR, Treatment Level 1):0.15
Redox @ 80"

84"- 8' **Clay**
Fine coarse Grained
Moderate-high Density
Low-moderate Moisture Content
High Clay Content
High Cohesion
High Plasticity
Yellowish Brown Color
10YR 5/4

USDA Soil Texture: Sandy Clay
USDA Soil Type: 4A
USDA Structure Shape: Massive
USDA Structure Grade: 0
Cementation Class: Non-cemented
Long Term Acceptance Rate (LTAR, Treatment Level 1):0.15

**LTAR** to be Used for OWTS Sizing: **0.15GPD/SF (USDA Type 4A, Treatment soil, Treatment Level 1)**
**Depth to Groundwater (Permanent or Seasonal):** Seasonal @ 80"
**Depth to Bedrock and Type:** Not Encountered
**Depth to Proposed Infiltrative Surface from Ground Surface:** Max. 32" Deep
**Soil Treatment Area Slope and Direction:** Southeast @ 11%

Note: See El Paso County Board of Health Regulation Chapter 8: On-Site Wastewater Treaments Systems (OWTS) Regulations for Additional Information. Refer to Table 10-1 for Corresponding LTAR if Treatment Level 2, 2N, 3, or 3N will be Implemented in the Design of the OWTS. System Sizing Depends on a Number of Factors (i.e. LTAR, # of Bedrooms, Type of Soil Treament Area (STA), Method of Transfer to the STA (Gravity, Dosed, or Pressure Dosed), and Type of Storage / Distribution Media Used in the STA)

| |
|---|
| Project: 18-0975 |
| Sheet: 3 of 3 |
| Date: 3 June 2019 |
| |
| |
| Scale: 1/4" = 1' |
| Drawn by: rah |
| Checked by: cem |

Project Name and Address
Shay Miles

15630 Fox Creek Lane
Sch. No. 51293000002
El Paso County, Colorado

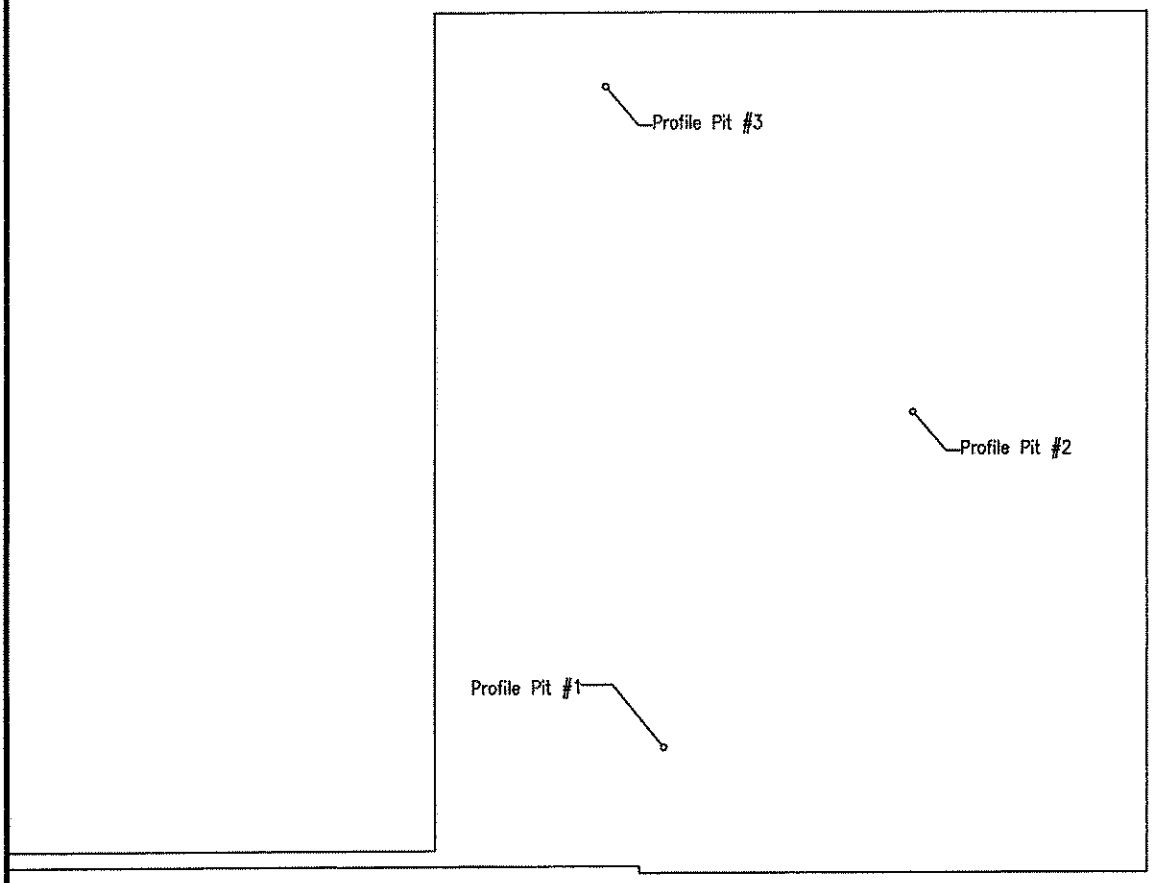
GEOQUEST, LLC.
6825 SILVER PONDS HEIGHTS
SUITE 101
COLORADO SPRINGS, CO
80908

OFFICE: (719) 481-4560
FAX: (719) 481-9204

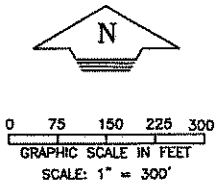
GEOQUEST LLC

**SITE MAP**

15630 Fox Creek Lane
El Paso County,
Colorado
Job #18-0975




Location from Northwest Lot Corner to Profile Pit #1:
S. 73° E. – 1188'
Location from Profile Pit #1 to Profile Pit #2:
N. 54° E. – 645'
Location from Profile Pit #2 to Profile Pit #3:
N. 47° W. – 690'
GPS Coordinates:
Pit 1; N. 39° 03' 38.47" W. 104° 41' 39.06"
Pit 2; N. 39° 03' 43.84" W. 104° 41' 34.07"
Pit 3; N. 39° 03' 48.88" W. 104° 41' 40.09"



United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

# Custom Soil Resource Report for El Paso County Area, Colorado


June 6, 2019

# Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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# Contents

# How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

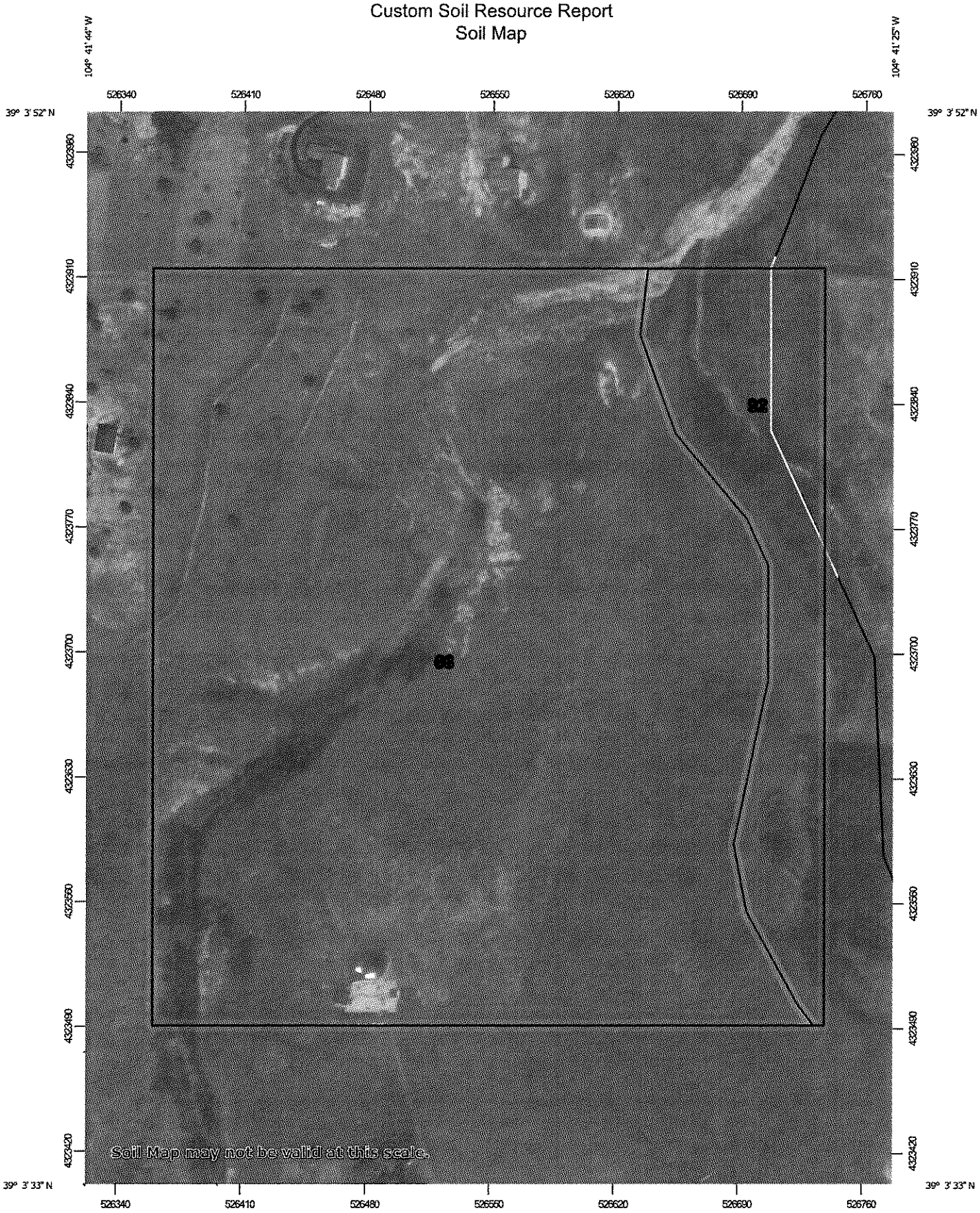
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

# Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.




Map Scale: 1:2,930 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 40 80 160 240

Feet: 0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

## MAP LEGEND

**Area of Interest (AOI)**
- Area of Interest (AOI)

**Soils**
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

**Special Point Features**
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

**Water Features**
- Streams and Canals

**Transportation**
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

**Background**
- Aerial Photography

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 16, Sep 10, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 7, 2016—Aug 17, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

# Map Unit Legend

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|---|---|---|---|
| 68 | Peyton-Pring complex, 3 to 8 percent slopes | 34.3 | 86.0% |
| 92 | Tomah-Crowfoot loamy sands, 3 to 8 percent slopes | 5.6 | 14.0% |
| **Totals for Area of Interest** | | **39.8** | **100.0%** |

# Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however,

onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

# El Paso County Area, Colorado

## 68—Peyton-Pring complex, 3 to 8 percent slopes

### Map Unit Setting

*National map unit symbol:* 369f
*Elevation:* 6,800 to 7,600 feet
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Peyton and similar soils:* 40 percent
*Pring and similar soils:* 30 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Peyton

#### Setting

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

#### Typical profile

*A - 0 to 12 inches:* sandy loam
*Bt - 12 to 25 inches:* sandy clay loam
*BC - 25 to 35 inches:* sandy loam
*C - 35 to 60 inches:* sandy loam

#### Properties and qualities

*Slope:* 3 to 5 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Well drained
*Runoff class:* Low
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.60 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water storage in profile:* Moderate (about 7.3 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 4c
*Hydrologic Soil Group:* B
*Ecological site:* Sandy Divide (R049BY216CO)
*Hydric soil rating:* No

### Description of Pring

#### Setting

*Landform:* Hills
*Landform position (three-dimensional):* Side slope
*Down-slope shape:* Linear
*Across-slope shape:* Linear

*Parent material:* Arkosic alluvium derived from sedimentary rock

**Typical profile**

*A - 0 to 14 inches:* coarse sandy loam
*C - 14 to 60 inches:* gravelly sandy loam

**Properties and qualities**

*Slope:* 3 to 8 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Well drained
*Runoff class:* Low
*Capacity of the most limiting layer to transmit water (Ksat):* High (2.00 to 6.00 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water storage in profile:* Low (about 6.0 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 3e
*Hydrologic Soil Group:* B
*Ecological site:* Loamy Park (R048AY222CO)
*Hydric soil rating:* No

**Minor Components**

**Other soils**

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

**Pleasant**

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

## 92—Tomah-Crowfoot loamy sands, 3 to 8 percent slopes

**Map Unit Setting**

*National map unit symbol:* 36b9
*Elevation:* 7,300 to 7,600 feet
*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Tomah and similar soils:* 50 percent
*Crowfoot and similar soils:* 30 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Tomah

#### Setting

*Landform:* Alluvial fans, hills
*Landform position (three-dimensional):* Side slope, crest
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Parent material:* Alluvium derived from arkose and/or residuum weathered from arkose

#### Typical profile

*A - 0 to 10 inches:* loamy sand
*E - 10 to 22 inches:* coarse sand
*C - 48 to 60 inches:* coarse sand

#### Properties and qualities

*Slope:* 3 to 8 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Well drained
*Runoff class:* Medium
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.60 to 2.00 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water storage in profile:* Very low (about 2.0 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 4e
*Hydrologic Soil Group:* B
*Ecological site:* Sandy Divide (R049BY216CO)
*Hydric soil rating:* No

### Description of Crowfoot

#### Setting

*Landform:* Alluvial fans, hills
*Landform position (three-dimensional):* Side slope, crest
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Parent material:* Alluvium

#### Typical profile

*A - 0 to 12 inches:* loamy sand
*E - 12 to 23 inches:* sand
*Bt - 23 to 36 inches:* sandy clay loam
*C - 36 to 60 inches:* coarse sand

#### Properties and qualities

*Slope:* 3 to 8 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Well drained
*Runoff class:* Medium
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.60 to 2.00 in/hr)
*Depth to water table:* More than 80 inches

*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water storage in profile:* Low (about 4.7 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 4e
*Hydrologic Soil Group:* B
*Ecological site:* Sandy Divide (R049BY216CO)
*Hydric soil rating:* No

**Minor Components**

**Other soils**

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

**Pleasant**

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

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