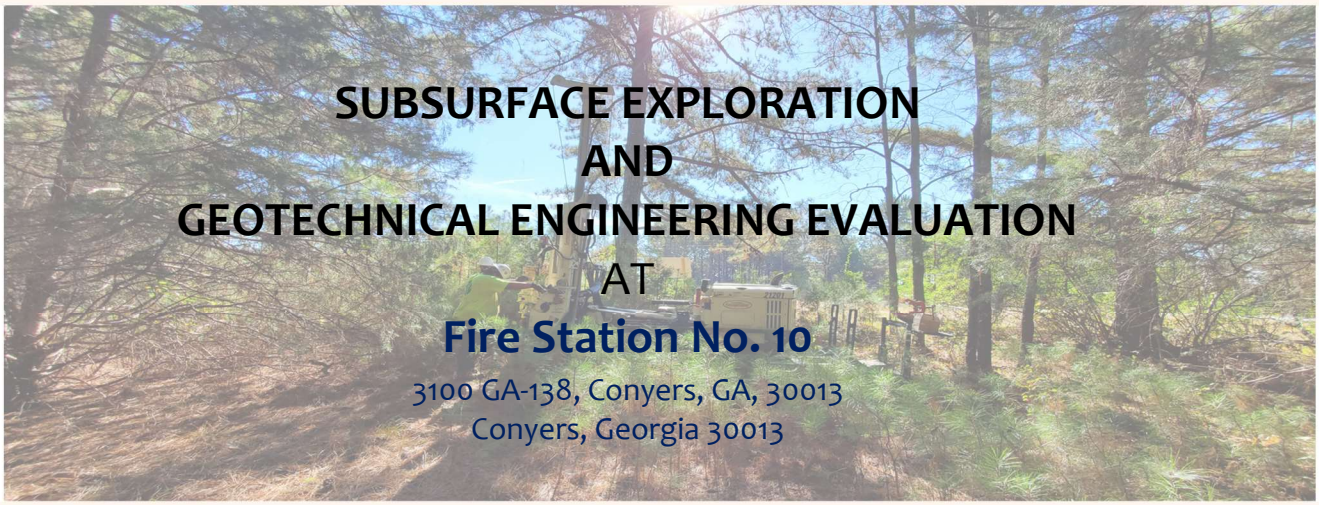

SUBSURFACE EXPLORATION
AND
GEOTECHNICAL ENGINEERING EVALUATION
AT

Fire Station No. 10

3100 GA-138, Conyers, GA, 30013
Conyers, Georgia 30013

Submitted to

Mr. Dominick Villano
Capital Projects Manager
Rockdale County
PO Box 289
Conyers, GA 30012

October 2022

MEG 301287.37

Matrix Engineering Group, Inc.
engineers | special inspectors | construction consultants

October 27, 2022

Mr. Dominick Villano
Capitals Project Manager
Rockdale County
PO Box 289
Conyers, GA 30012

Re: Subsurface Exploration and Geotechnical Engineering Evaluation
Proposed Fire Station No. 10
3100 GA-138, Conyers, GA, 30013
Matrix Engineering Group Project Number MEG-301287.37

Dear Mr. Villano:

Matrix Engineering Group, Inc. is pleased to submit this Subsurface Exploration Report for the proposed Fire station No. 10 located at 3100 GA-138, Conyers, GA, 30013. The scope of this work included the drilling of five (5) soil test borings within the areas planned for the project and providing the findings and recommendations regarding the geotechnical aspects of the proposed project.

This report describes our investigative procedures and presents our findings, conclusions and engineering recommendations.

Matrix Engineering Group, Inc. appreciates the opportunity to have worked with Rockdale County on this project and looks forward to our continued association. If you have any questions or need further assistance, please do not hesitate to call.

Best Regards,

MATRIX ENGINEERING GROUP, INC.

Ashraf Abukhalaf, PE
Project Engineer
ashraf@matrixengineeringgroup.com

GEORGIA REGISTERED No. 19197 PROFESSIONAL ENGINEER O. SAMIR ALYATEEM

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Distribution (email .PDF): Mr. Dominick Villano – Capitals Project Manager- Rockdale County.

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SUMMARY OF GEOTECHNICAL FINDINGS & RECOMMENDATIONS

–THIS SUMMARY DOES NOT REPLACE THE REPORT. THE READER IS URGED TO REFER TO THE APPROPRIATE SECTION IN THE BODY OF THE REPORT–

ITEM	DESCRIPTION/FINDINGS/RECOMMENDATIONS
PROJECT	Fire Station No. 10
Date of Report	10/27/2022
PLANNED DEVELOPMENT	One story fire station (8,377 SF), with two driveways, a parking lot, and a detention pond.
FINISHED FLOOR ELEVATIONS	871.4 ft MSL per the Layout and Staking Plan prepared by Georgia Civil dated 07/19/2022
EXISTING GRADE ELEVATIONS	858 ft MSL to 874 ft MSL (Per the Grading Plan Prepared by Georgia Civil dated 7-19-2022.
NO. OF BORINGS	Five (5) SPT Borings – Up to 20 ft Deep.
SUBSURFACE CONDITIONS	⌖ 2 - 3 inches of pine straw or 4 inches of grass and topsoil. ⌖ Man-Made Fill [6.0 to 13.5 ft BGS] (Medium Dense to Very Dense Silty Sand (SM)) ⌖ Residual Soil (Medium Dense to Very Dense, Micaceous, Silty Sand (SM) with Manganese Oxide.)
PWR & ROCK	⌖ Partially Weathered Rock (PWR) was encountered at boring B5 at approximately 18.5 ft BGS. ⌖ Auger Refusal was encountered at boring B5 at approximately 19 ft BGS.
GROUNDWATER	Groundwater was not encountered within the drilled depths at the time of drilling.
SEISMIC SITE CLASS	IBC2018 Seismic Site Class **D** **S_{DS} = 0.191 g** **S_{D1} = 0.133 g**
FOUNDATIONS	Site suitable for Shallow Foundations. Recommended Allowable Bearing Capacity: **3,000 psf.** ⌖ Minimum Foundation Dimensions: **18 inches (Continuous): 24 inches (Column)** ⌖ Minimum Embedment Depth of Foundation: **18 inches (exterior); 12 inches (interior)** ⌖ Differential Settlement < ½ Inches between Columns ⌖ **Total Predicted Settlement <1 Inches**
GRADING & STRUCTURAL FILL	⌖ The encountered man-made fills are generally suitable for reuse as structural Fill. ⌖ Inherent in the heterogeneity of man-made fill is the possibility of unsuitable soils presence at the time of mass-grading and/or excavation for underground utilities. When encountered, unsuitable soils should be evaluated by a qualified Geotechnical Engineer for assessment and remedial recommendations. ⌖ Recommended Compaction of Fill: 95% of Maximum Dry Density as Determined by Standard Proctor (ASTM D698). 98% for top 1 foot.
SLAB-ON-GRADE	⌖ Recommended Modulus of Subgrade Reaction, K = 110 pci. ⌖ Recommended Minimum 10 mil vapor barrier/retarder ⌖ Recommended 4 inches of clean, densely graded, granular material with balanced content of fines under concrete slab.
C.I.P. RETAINING WALLS	⌖ Φ' = 28º , c' = 200 psf, γ_w = 120 pcf, Ultimate Coefficient of Friction = 0.4 **Recommended Equivalent Fluid Earth Pressures (**EFEP**):** ⌖ $EFEP_{active}$ = 43.3 pcf, $EFEP_{at\text{-}rest}$ = 63.7 pcf, $EFEP_{passive}$ = 166 pcf
PAVEMENT DESIGN	⌖ Recommended CBR value of 4 – 98% ASTM D698 Relative Compaction for Soil Subgrade ⌖ 100% ASTM D1557C Relative Compaction of Graded Aggregate Base (GAB) ⌖ Refer to Report for Various Design Recommendations for Light, Medium and Heavy Duty Pavement.
SPECIAL CONDITIONS	⌖ Potential for Unsuitable Materials in unexplored areas. ⌖ When placing fill in horizontal lifts adjacent to areas sloping steeper than 5:1 (horizontal: vertical), horizontal keys and vertical benches should be excavated into the adjacent slope area.

TABLE OF CONTENTS

1.0 INTRODUCTION

Matrix Engineering Group, Inc. (Matrix) has completed the authorized Subsurface Exploration and Geotechnical Engineering Evaluation for the proposed Fire Station No. 10 located at 3100 GA-138, Conyers, GA, 30013. The objective was to explore the subsurface conditions by performing five (5) soil test borings and providing the findings and recommendations regarding the geotechnical aspects of the proposed development. This report describes our investigative procedures and presents our findings, conclusions and engineering recommendations.

This work was performed in general accordance with Matrix Proposal Number 101322-1, dated October 13, 2022 and the subsequent authorization to proceed by Mr. Dominick Villano, Capitals Project Manager, Rockdale County on October 19, 2022.

2.0 PROJECT DESCRIPTION

- It is our understanding that the county intends to build a new, 1-story Fire Station that includes both residential and office spaces. The development will also include a detention pond and parking.

- Anticipated building loads are as follows (based on preliminary drawings S001 prepared by Lyman Davidson Dooley, Inc., dated 05/05/2022)
    - Metal Building Dead Load: 6 psf
    - Additional Collateral Dead Load: 5 psf
    - Roof Live Load: 20 psf

- The Finished Floor Elevations (FFE) for the building is proposed to be at 871.4 feet MSL.

- Proposed underground stormwater utility are at a proposed lowest elevation of 858 ft MSL (based on the Stormwater Management System Profiles, prepared by Georgia Civil, dated 07/19/2022.

3.0 SCOPE OF WORK

The scope of work for this project consisted of:

- Drilling and sampling a total of five (5) soil test borings distributed within the proposed development to explore the subsurface conditions and provide geotechnical recommendations for the proposed development. The planned depths of the borings was 20 feet below the existing ground surface (BGS).

- Field testing to determine the characteristics of the soils encountered in the soil borings.

- Preparation of this geotechnical report based on the data gathered during the exploration.

The purpose of this report is to determine the site's subsurface conditions, to analyze and evaluate the data obtained, and to provide recommendations regarding the geotechnical aspects of the proposed development.

4.0 EXPLORATION AND TESTING PROGRAM

4.1 Subsurface Exploration

The geotechnical exploration program consisted of the drilling and sampling of a total of five (5) soil test borings spread throughout the proposed development. The locations of the soil borings were designated by the client and were field located by Matrix Staff. The approximate locations of the soil borings are shown on Figure 2 presented in the Appendix of this report. For exact locations, the owner may elect to survey the boring locations. Matrix should be informed of any deviations in order to evaluate and modify our recommendations, if necessary.

The test borings were performed utilizing a track rig mounted with a Geoprobe 7822DT drilling apparatus equipped with an automatic hammer in general accordance with ASTM D1586 standards. The planned depths of the borings ranged was 20 feet BGS. Borings were advanced by auguring through the soils with continuous flights of 3 $^{1}/_{4}$-inch ID augers. At regular intervals, soil samples were obtained through the center of the auger flights with a standard 1.4-inch I.D., 2-inch O.D., split-tube sampler. The sampler is first seated 6 inches to penetrate loosened strata before sampling, and then driven an additional foot with blows of a 140 -pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot is recorded and is designated as the Standard Penetration Resistance (N -Value). The penetration resistance, when properly evaluated, is an index of the soil strength, consistency and ability to support foundations.

Representative soil samples were obtained using split-spoon sampling techniques. The samples were classified in the field in general accordance with ASTM D2488 (Visual-Manual Procedure for Description of Soils). Representative portions of the soil samples were placed in sealable, plastic bags and transported to our laboratory. During the field operations, Matrix staff maintained a continuous log of the subsurface conditions including changes in the stratigraphy and any observed groundwater levels. Soil descriptions and penetration resistance values are presented graphically on the Soil Boring Records included in the Appendix of this report.

All borings were backfilled with the soil cuttings and a plastic hole plug by Matrix Engineering. Some consolidation of the backfilled soil column should be expected over time.

5.0 SITE DESCRIPTION AND GENERAL SITE GEOLOGY

5.1 Site Description

The site is located at 3100 GA-138, Conyers, GA, 30013. It is bound by North Rockdale Baptist Church from the East, Highway GA-138 from the South, and N Tower Way NE from the West. The site is wooded with trees and shrubs and the surfaces are covered with topsoil and grass. A drainage feature was noted along the southern boundary of the site draining stormwater along the highway. A small building (5 ft by 5 ft approximately) and a children playground are located at the proposed development area that will be demolished and/or relocated.

Based on the Grading Plan Prepared by Georgia Civil dated 7-19-2022 and our site visit, the topography of the site generally slopes gently downwards from an approximate elevation of 874 feet Mean Sea Level (MSL) at the Southeastern corner to an approximate elevation of 858 feet MSL at the Northwestern corner of the site.

5.2 General Site Geology

The subject site is located in the Piedmont Geologic Province, which contains the oldest rock formations in the Southeastern United States; refer to Figure 1. The parent rocks in the region are primarily comprised of the unconsolidated mass of quartz, feldspar, mica, and a wide variety of dark minerals such as hornblende and amphibole. The proportion of felsic and mafic minerals in these parent rocks, as well as of quartz that is very resistant to weathering, limits the amount of clay in the soils. Therefore, these soils are sandy and have faint horizons, and in small-scattered areas, hard rock is exposed.

Chemical decomposition initially occurs along the boundaries of individual mineral crystals. As a result, partially weathered rock has the appearance of dense sand (SM, SP). With further weathering, the individual crystals other than quartz are attacked and the mass becomes a micaceous silty sand (SM) or micaceous sandy silt (ML). In this stage, the original banding of the parent rock is apparent, but the original crystalline structure is not observed. Reflecting the composition of the original rock, mica flakes, rather than the quartz grains, often comprise the majority of the sand-size particles. Finally, in the more advanced stages of chemical weathering, the material is changed into a red or reddish-brown silty clay (CL or CH) or clayey silt (ML or MH). Depending on the quartz content, a sandy fraction will be present. In this

weathered stage, the banding and crystalline structure of the parent rocks is lost. Refer to Figure 1 in the appendix for the Geological Survey Map for the subject site.

6.0 GENERAL SUBSURFACE CONDITIONS

The subsurface conditions were characterized by visual-manual examination of the soils obtained from the split-spoon sampler and observation from the auger cutting during the drilling and auguring operations. The soil boring logs, designated as B1 to B5, are provided in the Appendix of this report. The subsurface conditions within the drilled borings are characterized as follows:

6.1 Surface Materials and Man-Made Fill

The ground at the subject site is covered with pine straw, topsoil, and grass. At borings B1 to B3, approximately 2 inches of pine straw was noted on the surface. At Borings B4, and B5, approximately 4 to 5 inches of grass and topsoil was encountered.

Man-made fill was encountered at all the soil test borings. The fill thickness generally ranged between **6.0 feet and 13.5 feet BGS**. The fill material consisted of Medium Dense to Very Dense Silty Sand (SM), exhibiting N-values ranging between 14 and 55 blows/ft (bpf).

6.2 Residual Material

Residual soils are those which have weathered in place from the parent rock. Residual soils were encountered at all the soil borings below the encountered fill materials or surficial cover. The residual soils generally consisted of Medium Dense to Very Dense, Micaceous, Silty Sand (SM). The residual material exhibited N-values ranging from 16 to 50/5" bpf.

6.3 Partially Weathered Rock and Bedrock

Partially Weathered Rock (PWR) is a regionally used term for residual material with a Standard Penetration Resistance (N-values) of 100 bpf or more, but which can be penetrated by the soil drilling equipment. PWR was encountered at test boring B5 at approximately 18.5 ft, and auger refusal was encountered at approximately 19 ft BGS. The exhibited N-value was 50 over 5 inches.

6.4 Groundwater

Groundwater was not encountered at any of the test borings within the explored depths at the time of drilling. The test boring holes caved-in at depth ranging between 5 and 7 feet BGS, apparently due to the presence of a dry coarse silty sand soils. Therefore, 48 groundwater readings were not possible. The

boreholes were backfilled with the drilled soil cuttings and installed a plastic hole plug at the conclusion of our field testing to prevent the test hole to consolidate and create a trip hazard. Some settlement of the backfilled soil columns should be anticipated over time.

6.5 Summary of Subsurface Conditions

The geologic profile described generally represents the conditions encountered in the soil borings. Some variations in the description should be expected. The stratification lines designating the interfaces between earth materials shown on the attached boring logs are approximate; in-situ transition may be gradual. Table 2 below summarizes the field findings from the soils test borings.

Table 2: Summary of test boring records.

Boring No.	Drilled Depth (ft)	Depth of Fill (ft)	Depth (ft) of Groundwater	Depth(ft) of PWR	Depth of Auger Refusal (ft)	Comment
B1	20	8.5	N/E	N/E	N/E	Proposed Building
B2	20	8.5	N/E	N/E	N/E	Proposed Building
B3	20	13.5	N/E	N/E	N/E	Proposed Building
B4	20	6.0	N/E	N/E	N/E	Proposed parking lot
B5	19	7.0	N/E	18.5	19	Proposed Detention Pond

(1): *N/E: Not Encountered*

7.0 FINDINGS AND RECOMMENDATIONS

The following recommendations are based on the information furnished to us, the data obtained from the subsurface exploration, and our past experience with similar projects. They were prepared in general accordance with established and accepted professional geotechnical engineering practice in this region. Our recommendations are based on findings from the dates referenced within this report and do not reflect any variations that would likely exist at later dates or between the pre-designated borings or unexplored areas.

If information becomes available which may impact our recommendations, Matrix Engineering Group shall be afforded the opportunity to review this information and re-evaluate the recommendations contained within this report and make any alterations deemed necessary by a Georgia Registered professional engineer. This report is intended for the use of Rockdale County and its current design team. No other warranty is expressed or implied. Matrix Engineering Group, Inc. is not responsible for conclusions, opinions, or recommendations made by others based on this report.

The following recommendations present general guidelines for the proposed development:

7.1 General Considerations

The site appears to be suitable for the proposed development. Man-made fill material was observed at some of the test borings. Therefore, recommend that any material which is excavated and planned for re-use as structural fill be examined by the geotechnical engineer of record at the time of excavation to determine its suitability.

The encountered man-made fill & residual soils appear to generally be suitable for re-use as structural fill provided, they are moisture conditioned at the time of use and are free of organics, construction debris, cobbles, or other deleterious materials. Man-made fill has the potential of including undocumented soils of variable consistencies. It is also possible that burial pits of organic debris are present on site that are difficult to ascertain by drilling soil test borings. **These materials can only be discovered during grading or by performing an extensive test pit exploration program.**

In general, excavation of the fill and residual soils encountered within the upper 20 feet of the subsurface (the maximum drilled depth of our soil test borings) should be possible with conventional grading equipment. However, it is possible to encounter rock or lenses thereof in unexplored areas. We therefore recommend that the following general specifications for rock excavation, or a variation thereof, be incorporated into the project documents:

(1) General Excavation: Any material occupying an original volume of more than one cubic yard which cannot be excavated with a single-tooth ripper drawn by a crawler tractor having a minimum draw bar pull rated at not less than 80,000 pounds (caterpillar D-8 or larger)

(2) Trench Excavation: Any material occupying an original volume of more than one cubic yard which cannot be excavated with a backhoe having a bucket curling force rated at not less than 40,000 pounds, using a rock bucket and rock teeth (a John Deere 790 or larger).

Rock quantification should be based on a surveyed profile of exposed rock that is verified as unrippable. Relying on rock blasting drill logs should not be permitted. Decomposed rock and partially weathered rock that can be removed by tractor-drawn ripper or power machinery, as previously defined, will be classified as earth excavation, and should be billed as such.

7.2 Groundwater & Dewatering

Because no groundwater was encountered at the time of this investigation, we do not anticipate groundwater to impact the construction of the proposed project. If encountered, groundwater levels should be maintained at a minimum of 3 feet below the bottom of any proposed excavation (only during construction) in order to protect the exposed subgrade's integrity. If groundwater is encountered during the installation of any utility lines, the water should be controlled with a localized sump and pump system, as required at the time of construction.

7.3 Subgrade Preparation

Subgrade preparation for the proposed development should be the removal of vegetation, topsoil, and any other structures present within the footprint of the development - as needed. **Any deleterious materials or buried debris, such as underground utility lines, septic tanks, or trash pits that may be encountered during the grading operation should be treated on an individual basis.**

After removal of the surface materials, the suitability of the exposed subgrade should be confirmed by proofrolling, which will discern any localized soft zones in the subgrade. The proofrolling should be performed by a loaded tandem-wheeled dump truck with an approximate weight of 25 tons. Any material that deflects excessively or ruts under the loaded truck should be densified or removed and replaced with well-compacted material.

Similarly, the suitability of all other areas of the exposed subgrade needs to be confirmed by proofrolling at the time of construction, after any unsuitable or softened materials are removed. The proofrolling should be observed by the geotechnical engineer. Structural fill procedures are provided in Section 8.1 of this report.

7.4 Slab-On-Grade Construction

The concrete slab-on-grade for the proposed structure(s) should be supported on compacted, and properly prepared, soil subgrade. Provided the fill material and/or existing subgrade is installed to a minimum of 98% of the Standard Proctor's maximum dry density, a modulus of subgrade reaction (k) of 110 pci can

be used for designing the floor slab-on-grade. Slab reinforcement and joint spacing should be carefully considered to control random cracking due to slab shrinkage. We recommend that a 10 mil vapor barrier/retarder (such as polyethylene) be installed below the (slab-on-grade) concrete to limit intrusion of water vapor through the slab. Beneath slab on-grade areas, a minimum of 4 inches of clean, densely-graded, granular material with a balanced content of fines is recommended to facilitate fine grading and provide stable surface for construction traffic and building loads-. **Open-graded bases (such as #57 stone) do not meet these requirements because they are relatively incompatible, difficult to trim, and are unstable for construction traffic.** It is also difficult to fine grade an open-graded base to a relatively uniform elevation, which can result in restraint to concrete movement as the concrete cools or dries, thus increasing the probability of out-of-joint cracking. If open-graded bases are specified, the surface of these bases should be choked off with a clean fine-graded material with at least 10 to 30% of the particles passing a No. 100 sieve, but not contaminated with clay, silt, or organic material.

7.5 Foundations

The drilled subsurface conditions consisted of residual and man-made fill. **Inherent in man-made fill is the potential for presence of buried deleterious materials.** Therefore, care should be exercised to ensure that adequate foundations testing is performed during construction and that all soils are properly evaluated by a registered Geotechnical Engineer.

Our findings reveal that, the proposed building may be supported on shallow foundations. The foundations should be situated in well compacted and properly tested soils and be designed for a maximum net allowable soil bearing pressure not to exceed **3,000 pounds per square foot (psf).** The net allowable soil bearing pressure refers to that pressure which may be transmitted to the foundation soils in excess of the final minimum surrounding overburden pressure.

A recommended shallow foundation inspection criterion is provided in Section 8.2 of this report. The net allowable soil bearing pressure refers to that pressure which may be transmitted to the foundation soils in excess of the final minimum surrounding overburden pressure. We recommend that all **continuous and column footings have a minimum width of 18 inches and 24 inches**, respectively. In order to prevent shear failure and to minimize the effects of frost, we further recommend a minimum embedment depth of 18 inches and 12 inches below subgrade elevations for exterior and interior foundations, respectively.

Total settlement of footing foundations is estimated to be on the order of 1 inch or less. Based on the subsurface conditions and our experience with similar soils, we do not anticipate differential settlements to exceed $^1/_2$ inch between column supports (assuming 50 foot spacing or less).

7.6 Pavement Design

We recommend that a **CBR value of 4** be used for pavement design of light and heavy-duty pavements. The thickness of the base course material under the pavement is dependent upon the pavement type, magnitude and frequency of loading, and expected pavement life. Based on our experience with projects of similar magnitude and soil conditions, we recommend the following design sections be considered in the design of pavements. These recommendations present a wide range of loading conditions. The architect/engineer should select the pavement section most appropriate to the development. Pavements should be constructed in accordance with all applicable specifications of the Asphalt Institute and the Georgia Department of Transportation:

Heavy Duty Asphalt Pavement:
98% compacted soil subgrade (Standard Proctor – ASTM D698)
6 inches Graded Aggregate Base (GAB), compacted to 100% of maximum dry density (Modified Proctor – ASTM D1557C)
2 inches 19mm SP Asphalt Base
1.5 inches 9.5mm SP II Asphalt Topping
Asphalt layers should be separated by a tack coat.

Light & Medium Duty Asphalt Pavement:
98% compacted soil subgrade (Standard Proctor – ASTM D698)
4 inches GAB, compacted to 100% of maximum dry density (Modified Proctor – ASTM D1557C)
2 inches 19mm SP Asphalt Base
1.5 inches 9.5mm SP II Asphalt Topping
Asphalt layers should be separated by a tack coat.

Heavy Duty Concrete Pavement:
98% compacted soil subgrade (Standard Proctor – ASTM D698)
6 inches GAB, compacted to 100% of maximum dry density (Modified Proctor – ASTM D1557C)
6 inches (4000 psi compressive strength) concrete with Welded Wire Fabric (6x6 – W2.9 x W2.9).

Subgrade preparation should be performed in accordance with our recommendations provided in Section 8.1 and 8.2 of Matrix geotechnical report.

Pavements sub-base (Graded Aggregate Base) should conform to Section 815 of the State of Georgia Department of Transportation Specifications for Road and Bridge Construction. The sub-base should be compacted to 100% of the maximum dry density for crushed stone as determined by the modified moisture-density relationship test (ASTM D1557). Additionally, proofrolling of the sub-base should be performed prior to paving in order to detect any soft spots or excessive rutting which may require stabilization.

Exterior pavements should be provided with the facilities for surface and subsurface drainage. Standing water on the pavement surface eventually may seep into the base course layer and softens the pavement subgrade which leads to premature deterioration of the pavement. In areas where landscape areas slope toward the pavement, a perimeter drain along the back of the curb intercepting migration of surface water should be provided to minimize seepage under the pavement.

7.7 Slope Stability

Slope stability analysis was beyond the scope of our study. Slopes which are limited to 2:1 (horizontal: vertical), or flatter, will have adequate long term slope stability, based on our experience with the type of soils encountered onsite. The slopes' crest should be protected against water ponding. Any proposed cut/fill slopes should incorporate only suitable fill, **clean of organics or any other vegetative content**. Topsoil should only be used to provide cover over the completed slope's free face so as to promote vegetative growth which in turn protects the slope's surface against scour and erosion. Slopes should be overbuilt and cut back to the proposed grades, exposing the firm compacted inner core.

When placing fill in horizontal lifts adjacent to areas sloping steeper than 5:1 (horizontal: vertical), horizontal keys and vertical benches should be excavated into the adjacent slope area. Materials generated by the benching operation should be moved sufficiently away from the bench area to allow the geotechnical engineer (testing agency) to properly inspect the area and ascertain that the benching is performed properly. We recommend that the fill is compacted to a minimum of 98% of the Standard Proctor Maximum Dry Density (ASTM Specifications D 698) in lifts not exceeding 8 inches in loose measure. Placement and compaction of fill should be continuously monitored and tested by qualified technicians working under the direction of a registered Geotechnical Engineer.

7.8 Retaining Walls and Lateral Earth Pressures

The design of any retaining wall is based on the determination of the lateral earth pressures that will act on the wall. These pressures are a function of the retained soils properties, and the structural design of the wall. Three common conditions are considered to exist behind a retaining wall depending on the wall's structural design; namely Active, At-Rest, and Passive earth pressure conditions. Active earth pressures are mobilized when a relatively flexible retaining structure such as a free standing wall is designed allowing for slight movement or deflection. At-rest conditions apply to restrained retaining wall design such as basement or tunnel walls. The passive state represents the maximum possible pressure when a structure is pushed against the soil, and is used in wall design to help resist at-rest or active pressures. Since significant movement has to occur before the passive earth pressure is mobilized, the total calculated passive pressure should be reduced by one-half to two-thirds for design purposes.

Based on our experience, wall movement (known as tilt) that is necessary for earth pressures to mobilize range from 0.01H to 0.02H for the Active state, and 0.02H to 0.04H for the Passive state. It is assumed that the ground surfaces behind retaining walls will be constructed relatively level and that soils like those encountered in our borings will be used for wall backfill. Based on our experience with similar soils, we recommend that an effective angle of internal friction **(Φ') = 28° and a cohesion c' = 200 psf** be used as design strength parameters for the silty fine sand (SM) and sandy silts (ML) encountered at the site. These strength parameters result in the following earth pressures coefficients and equivalent fluid pressure per foot of depth for compacted fill (based on a total **(wet) unit weight (γ_w) of 120 pcf). A coefficient of friction of 0.40** could be used between the wall foundations and the underlying soil, which includes a factor of safety of 1.5.

Table 3: Recommended Equivalent Earth Pressures

Earth Pressure Condition	*Coefficient*	*Recommended Equivalent Earth Pressure (pcf)*[1]
Active	(K_a) 0.36	43.3
At-Rest	(K_o) 0.53	63.7
Passive	(K_p) 2.77	166

[1] *Assumes a constantly functional drainage system.*

Backfill against the walls should be done carefully to minimize the horizontal load on the wall. Heavy equipment should not be used to compact the soil within 10 feet of the walls. The use of hand-tampers

should be sufficient to obtain the required density when working the 10-foot zone adjacent to the wall. Recommended structural fill specifications and procedures are provided in Section 8.1 of this report.

These retaining wall/below grade wall recommendations should not be correlated with soil parameters for use in Mechanically Stabilized Earth (MSE) wall design. We recommend that soil parameters for any MSE retaining wall design be established through appropriate laboratory testing by the wall designer.

8.0 CONSTRUCTION RECOMMENDATIONS

8.1 Structural Fill

Staged, methodical and well-planned grading is key to avoiding unnecessary costs and time delays. Areas should not be stripped or disturbed if the grading contractor is unable to properly seal the subgrade prior to departure each day. Exposure of soils to moisture from direct rainfall or runoff usually renders these soils un-usable for several days. This usually gets mischaracterized as an unsuitable soils condition which is inaccurate. Unsuitable soils are defined as those containing deleterious matter (such as organics, alluvium, debris and/or trash). Moisture related problems should be avoided by employing best management practices that involve maintaining positive drainage, installation of berms, diversion channels, and/or sealing the subgrade to avoid water infiltration. Other measures involve covering all stockpiled soils with heavy tarps or plastic to avoid saturating the soils in the event of rainfall. Means and methods of construction are certainly the contractor's jurisdiction; however, exposing otherwise suitable soils to excessive moisture or softening of existing subgrades as a result of unscrupulous construction traffic should be avoided and planned for.

We recommend that the following criteria be used for structural fill:

1. Adequate laboratory proctor density tests should be performed on representative samples of the proposed fill materials to provide data necessary for the quality control. The moisture content at the time of compaction should be within 3 percentage points of the optimum moisture content. In addition, we recommend that the fill soils be free of organics and rock boulder/cobbles larger than 2 inches in nominal size and relatively non-plastic with plasticity indices less than 20.

2. Suitable fill material should be placed in thin lifts (lift thickness depends on type of equipment used, but generally lifts of 8 inches loose measurements are recommended). The soils should be compacted by mechanical means such as sheepsfoot rollers.

3. Slopes that are limited to 2:1 (horizontal: vertical), or flatter, will have adequate long term slope stability, if limited in height to 15 feet, based on our experience with the type of soils encountered onsite. The slope's crest should be protected against water ponding. Proposed slopes should incorporate only suitable fill, clean of organics or any other vegetative content. Topsoil should only be used to provide cover over the completed slope's free face so as to promote vegetative growth which in turn protects the slope's surface against scour and erosion. Slopes should be overbuilt and cut back to the proposed grades, exposing the firm compacted inner core. The amount of overbuilding would vary depending on the site conditions at the time of construction, types of soils used, and degree of compaction achieved.

4. When placing fill in horizontal lifts adjacent to areas sloping steeper than 5:1 (horizontal: vertical), horizontal keys and vertical benches should be excavated into the adjacent slope area. Materials generated by the benching operation should be moved sufficiently away from the bench area to allow the geotechnical engineer (testing agency) to properly inspect the area and ascertain that the benching is performed properly.

5. We recommend that the fill be compacted to a minimum of 95% of the Standard Proctor Maximum Dry Density (ASTM Specifications D 698). The top 1 foot under pavements or structural areas should be compacted to a minimum of 98% of the Standard Proctor Test.

6. An experienced soil engineering inspector should take adequate density tests throughout the fill placement operation to ensure that the specified compaction is being achieved.

8.2 Construction Inspection and Testing

During construction, it is advisable that Matrix Engineering Group inspect the site preparation and foundation construction work in order to ensure that our recommended procedures are followed. The placement of any compacted fill should be inspected and tested. The utilization of acceptable on-site borrow materials, as well as adequate off-site selected fill must be verified.

Each footing excavation should be inspected by Matrix Engineering Group, Inc. in order to verify the availability of the required bearing pressure and to determine any special procedures required. At a minimum, Hand Auger and Dynamic Cone Penetrometer testing in accordance with ASTM STP 399 should be performed at each shallow column footing, and every 50 linear feet for wall footings, or as directed by the geotechnical engineer.

It is anticipated that the construction phase will be governed by an IBC 2018 Special Inspections Schedule. Such a schedule should include at a minimum the following earthwork and footing related items:

- Verify materials below footings are adequate to achieve the designed bearing capacity.
- Verify excavations are extended to proper depths and have reached proper material.
- Perform classification and testing of controlled fill materials.
- Verify use of proper materials, densities and lift thicknesses during placement and compaction of controlled fill.
- Prior to placement of controlled fill, observe subgrade and verify that the site has been properly prepared.

APPENDIX

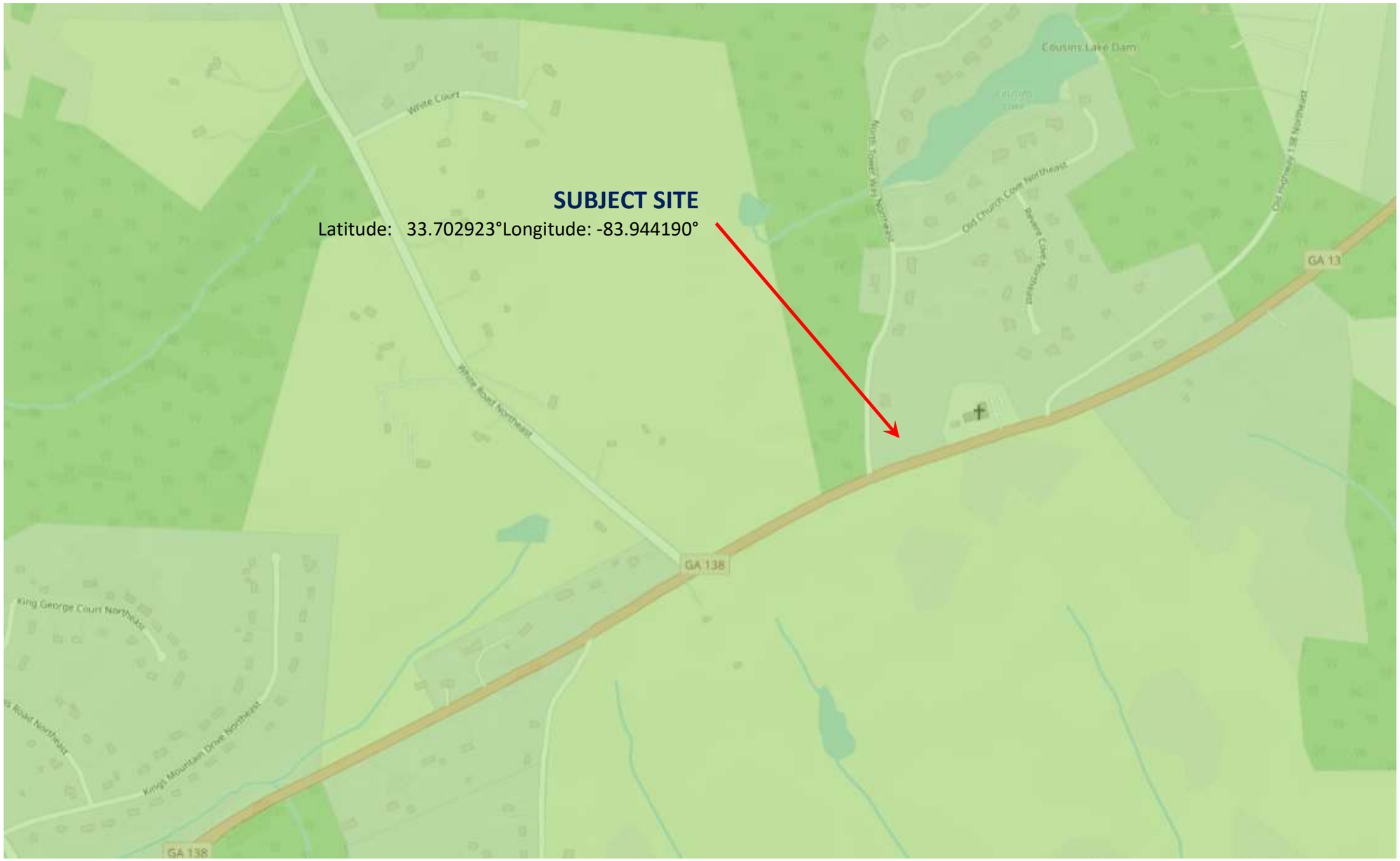
FIGURE 1: Site Streets and Geologic Map

FIGURE 2: Approximate Soil Borings Locations Plan

Correlation of Standard Penetration Resistance with Relative Compactness and Consistency

Soil Boring Logs

Site Photographs



URL: https://mrdata.usgs.gov/geology/state/map.html

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TITLE	Streets & Geologic Map
PROJECT	Fire Station No. 10
PROJECT #	MEG 301287.37
CLIENT	Rockdale County
	Not to Scale
PREPARED BY	Ashraf Abukhalaf, PE
REVIEWED BY	Sam Alyateem, PE
DATE	10/27/2022
ADDRESS	3100 GA-138, Conyers, GA 30013
FIGURE	1

LEGEND

Granitic Gneiss undifferentiated

matrix engineering group

TITLE	Approximate Soil Borings Locations Plan
PROJECT	Fire Station No. 10
PROJECT #	MEG 301287.37
CLIENT	Rockdale County
	Not to Scale
PREPARED BY	Ashraf Abukhalaf, PE
REVIEWED BY	Sam Alyateem, PE
DATE	10/27/2022
FIGURE	2

LEGEND

B1 Approximate Boring Location

MAJOR DIVISIONS		SYMBOLS	TYPICAL NAMES	CLASSIFICATION CHART
COARSE-GRAINED SOILS (More Than 1/2 of Soil > #200 Sieve)	**GRAVELS** (More Than 1/2 of Coarse Fraction > #4 Sieve)	GW	Well Graded Gravels or Gravel-Sand Mixtures; Little or no fines	
		GP	Poorly Graded Gravels or Gravel-Sand Mixtures; Little or no fines	
		GM	Silty Gravels, Gravel-Sand-Silt Mixtures	
		GC	Clayey Gravels, Gravel-Sand-Clay Mixtures	
	SANDS (MORE Than 1/2 of Coarse Fraction < #4 Sieve)	SW	Well Graded Sands or Gravelly Sands; Little or no fines	
		SP	Poorly Graded Sands or Gravelly Sands; Little or no fines	
		SM	Silty Sands, Sand-Silt Mixtures	
		SC	Clayey Sands, Sand-Clay Mixtures	
FINE-GRAINED SOILS (More Than 1/2 of Soil < #200 Sieve)	**SILTS & CLAYS** Liquid Limit Less Than 50	ML	Inorganic Silts and Very Fine Sands, Rock Flour, Silty or Clayey Fine Sands or Clayey Silts with Slight Plasticity	
		CL	Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays	
		OL	Organic Silts and Organic Silty Clays of Low Plasticity	
	SILTS & CLAYS Liquid Limit Greater Than 50	MH	Inorganic Silts, Micaceous or Diatomaceous Fine Sandy or Silty Soils, Elastic Silts	
		CH	Inorganic Clays of High Plasticity, Fat Clays	
		OH	Organic Clays or Medium to High Plasticity, Organic Silty Clays, Organic Silts	
HIGHLY ORGANIC SOILS		PT	Peat and Other Highly Organic Soils	

Relative Density of Cohesionless Soils from Standard Penetration Test	
Very Loose	≤ 4 bpf
Loose	5-10 bpf
Medium Dense	11-30 bpf
Dense	31-50 bpf
Very Dense	> 50 bpf
(bpf=blows per foot; ASTM D1586)	

Consistency of Cohesive Soils	
Very Soft	≤ 2 bpf
Soft	3-4 bpf
Firm	5-8 bpf
Stiff	9-15 bpf
Very Stiff	16-30 bpf
Hard	30-50 bpf
Very Hard	> 50 bpf

Relative Hardness of Rock	
Very Soft	Hard rock disintegrates or easily compresses to touch; can be hard to very hard soil
Soft	May be broken with fingers
Moderately Soft	May be scratched with a nail, corners and edges may be broken with fingers
Moderately Hard	Light Blow of hammer required to break samples
Hard	Hard blow of hammer required to break sample

Particle Size Identification	
Boulders	Larger than 12"
Cobbles	3"-12"
Gravel	
Coarse	3/4"-3"
Fine	4.76mm-3/4"
Sand	
Coarse	2.0-4.76 mm
Medium	0.42-2.00 mm
Fine	0.42-0.074 mm
Fines (Silt or Clay)	Smaller than 0.074 mm

Rock Continuity	
RECOVERY (%) = Total Length of Core x 100 / Length of Core Run	
Description	Core Recovery (%)
Incompetent	Less than 40
Competent	40-70
Fairly Continuous	71-90
Continnuous	91-100

Relative Quality of Rocks	
RQD (%) =((Total core, counting only pieces >4" long)/(Length of Core Run)) x 100	
Description	RQD (%)
Very Poor	0-25
Poor	25-50
Fair	50-75
Good	75-90
Excellent	90-100

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Correlation of Penetration Resistance with Relative Density and Consistency Sheet and Soil Classification Chart

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Geotechnical, Environmental & Construction Materials Consultants

DRILL HOLE LOG

BORING NO. B1

File: Fire Station No Date Printed: 10/31/2022

PROJECT: Fire Station No. 10 **PROJECT NO.:** MEG 301287.37
CLIENT: Rockdale County **DATE:** 10/24/2022
LOCATION: Proposed Building Footprint **ELEVATION:** 868 Feet MSL
DRILLER: Betts **LOGGED BY:** Ashraf Abukhalaf
DRILLING METHOD: ASTM D1586 with Automatic Hammer **STATION:**
DEPTH TO - WATER> INITIAL: **After 48+ Hours:** **CAVING>** C 4.6

ELEVATION (feet)	DEPTH (feet)	Description	SOIL TYPE	SOIL SYMBOL	SAMPLERS	TEST RESULTS	BLOW COUNTS (N)
868	0					Natural Moisture Content (%). ▲ Penetration - ● 10 20 30 40 50	
	1	**Approximately 2 inches of pine straw.**					
	2	**FILL - Medium Dense, Brown, Silty Sand.**	FILL				26
	3						
864	4						27
	5	C					
	6						
	7	**Soil changes to Mottled (Brown and White), Course, Silty Sand, dry.**					23
860	8						
	9	**Residual - Medium Dense, Mottled (White and Light Brown), with MnO.**	SM				25
	10						
	11						
856	12						
	13						
	14	**Color changes to Light Gray.**					16
	15						
852	16						
	17						
	18						
	19	**Becomes Dense.**					34
848	20						
	21	**Boring was terminated at 20 ft BGS.**					
	22						
	23						
844	24						
	25						
	26						

No groundwater was encountered within the drilled depths at the time of drilling. The boring was backfilled with soil cuttings and a hole plug at the conclusion of drilling. Boring caved at approximately 4.6 feet.

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DRILL HOLE LOG

BORING NO. B2

File: Fire Station No Date Printed: 10/31/2022

PROJECT: Fire Station No. 10 **PROJECT NO.:** MEG 301287.37
CLIENT: Rockdale County **DATE:** 10/24/2022
LOCATION: Proposed Building Footprint **ELEVATION:** 872 Feet MSL
DRILLER: Betts **LOGGED BY:** Ashraf Abukhalaf
DRILLING METHOD: ASTM D1586 with Automatic Hammer **STATION:**
DEPTH TO - WATER> INITIAL: ▽ _____ **After 48+ Hours:** ▼ _____ **CAVING>** C 5.5

ELEVATION (feet)	DEPTH (feet)	Description	SOIL TYPE	SOIL SYMBOL	SAMPLERS	TEST RESULTS (Natural Moisture Content (%). ▲ Penetration - ● 10 20 30 40 50)	BLOW COUNTS (N)
872	0						
	1	**Approximately 2 inches of pine straw.**					
	2	**FILL - Dense, Brown, Silty Sand.**	FILL				38
	3						
868	4	**Becomes Orange Brown and Micaceous.**					32
	5						
	6	C					
	7	**Becomes Medium Dense, Course, Brown, Silty Sand, dry.**					14
864	8						
	9	**Residual - Medium Dense, Light Gray, Silty Sand.**	SM				20
	10						
	11						
860	12						
	13						
	14						17
	15						
856	16						
	17						
	18						
	19	**Becomes Micaceous.**					25
852	20						
	21	**Boring was terminated at 20 ft BGS.**					
	22						
	23						
848	24						
	25						
	26						

No groundwater was encountered within the drilled depths at the time of drilling. The boring was backfilled with soil cuttings and a hole plug at the conclusion of drilling. Boring caved at approximately 5.5 ft.

MATRIX ENGINEERING GROUP, INC.
Geotechnical, Environmental & Construction Materials Consultants

DRILL HOLE LOG

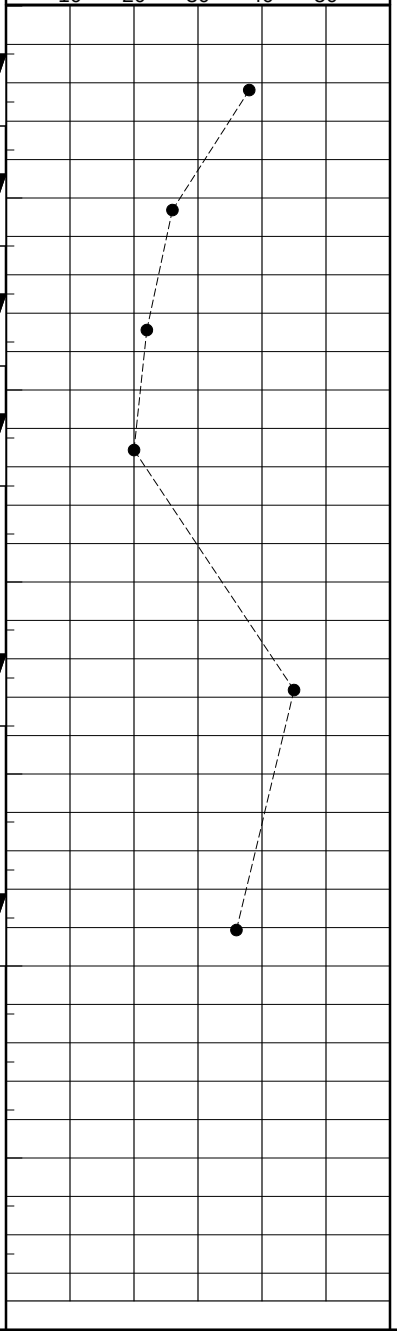
BORING NO. B3

File: Fire Station No Date Printed: 10/31/2022

PROJECT: Fire Station No. 10 **PROJECT NO.:** MEG 301287.37
CLIENT: Rockdale County **DATE:** 10/24/2022
LOCATION: Proposed Building Footprint **ELEVATION:** 870 Feet MSL
DRILLER: Betts **LOGGED BY:** Ashraf Abukhalaf
DRILLING METHOD: ASTM D1586 with Automatic Hammer **STATION:**
DEPTH TO - WATER> INITIAL: ▽ **After 48+ Hours:** ▼ **CAVING>** C 5.3

ELEVATION (feet)	DEPTH (feet)	Description	SOIL TYPE	SOIL SYMBOL	SAMPLERS	BLOW COUNTS (N)
	0					
	1	**Approximately 2 inches of pine straw.**				
868	2	**FILL - Dense, Brown, Micaceous, Silty Sand.**	FILL			38
	3					
	4	**Becomes Medium Dense.**				26
	5				C	
864	6					
	7	**Possible FILL - Orange Brown, Course, Silty Sand, dry.**				22
	8					
	9					20
860	10					
	11					
	12					
	13					
856	14	**Residual - Dense, Light Gray, Micaceous, Silty Sand.**	SM			45
	15					
	16					
	17					
852	18					
	19	**Containes MnO.**				36
	20					
	21	**Boring was terminated at 20 ft BGS.**				
848	22					
	23					
	24					
	25					
844	26					

TEST RESULTS
Natural Moisture Content (%). ▲
Penetration - ●
10 20 30 40 50



No groundwater was encountered within the drilled depths at the time of drilling. The boring was backfilled with soil cuttings and a hole plug at the conclusion of drilling. Boring caved at approximately 5.3 ft.

MATRIX ENGINEERING GROUP, INC.
Geotechnical, Environmental & Construction Materials Consultants

DRILL HOLE LOG

BORING NO. B4

File: Fire Station No Date Printed: 10/31/2022

PROJECT: Fire Station No. 10 **PROJECT NO.:** MEG 301287.37
CLIENT: Rockdale County **DATE:** 10/24/2022
LOCATION: Proposed Parking Lot Area **ELEVATION:** 868 Feet MSL
DRILLER: Betts **LOGGED BY:** Ashraf Abukhalaf
DRILLING METHOD: ASTM D1586 with Automatic Hammer **STATION:**
DEPTH TO - WATER> INITIAL: ▽ **After 48+ Hours:** ▼ **CAVING>** C 6.8

ELEVATION (feet)	DEPTH (feet)	Description	SOIL TYPE	SOIL SYMBOL	SAMPLERS	TEST RESULTS (Natural Moisture Content (%). ▲ Penetration - ● 10 20 30 40 50)	BLOW COUNTS (N)
868	0	Approximately 4 inches of grass and topsoil.					
	1	FILL - Dense, Brown, Micaceous, Silty Sand, with some roots.	FILL				
	2						43
	3						
864	4	Becomes Very Dense. No roots were noted.					55
	5						
	6						
	7	Residual - Dense, Grayish White, Micaceous, Course, Silty Sand, dry.	SM				48
860	8						
	9	Becomes Medium Dense.					27
	10						
	11						
856	12						
	13						
	14	Color changes to Light Gray.					28
	15						
852	16						
	17						
	18						
	19	Becomes Dense, and Gray.					40
848	20						
	21	Boring was terminated at 20 ft BGS.					
	22						
	23						
844	24						
	25						
	26						

No groundwater was encountered within the drilled depths at the time of drilling. The boring was backfilled with soil cuttings and a hole plug at the conclusion of drilling. Boring caved at approximately 6.8 ft.

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Geotechnical, Environmental & Construction Materials Consultants

DRILL HOLE LOG

BORING NO. B5

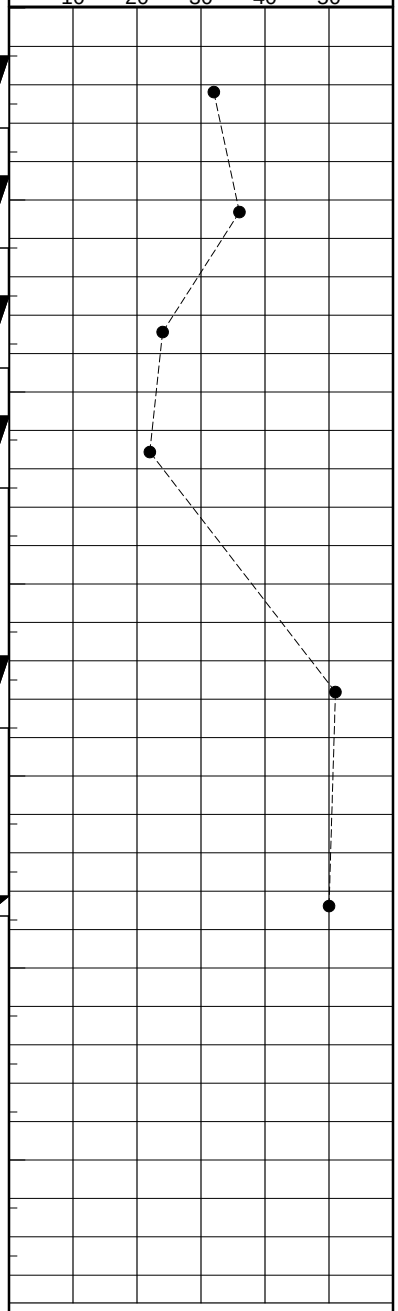
File: Fire Station No Date Printed: 10/31/2022

PROJECT: Fire Station No. 10 **PROJECT NO.:** MEG 301287.37
CLIENT: Rockdale County **DATE:** 10/24/2022
LOCATION: Proposed Detention Pond Area **ELEVATION:** 861 Feet MSL
DRILLER: Betts **LOGGED BY:** Ashraf Abukhalaf
DRILLING METHOD: ASTM D1586 with Automatic Hammer **STATION:**
DEPTH TO - WATER> INITIAL: ▽ **After 48+ Hours:** ▼ **CAVING>** C 6.5

ELEVATION (feet)	DEPTH (feet)	Description	SOIL TYPE	BLOW COUNTS (N)
	0	Approximately 4 inches of grass and topsoil.		
860	1	FILL - Dense, Brown, Micaceous, Silty Sand, with trace amounts of hairline roots.	FILL	
	2			32
	3			
	4	Dense, Orange Brown, Micaceous, Silty Sand.		36
856	5			
	6			
	7	Becomes Medium Dense.		24
	8	Residual - Light Gray, Course, Silty Sand, dry.	SM	
852	9	Becomes Mottled (Orange Brown and Light Gray), and Micaceous.		22
	10			
	11			
	12			
848	13			
	14	Becomes Very Dense, and Mottled (Light Gray and White)		51
	15			
	16			
844	17			
	18			
	19	Partially Weathered Rock (PWR) Sampled as Very Dense, Light Gray, Silty Sand.	PWR	50/5"
	20	Auger refusal was encountered at approximately 19 ft BGS.		
840	21			
	22			
	23			
	24			
836	25			
	26			

SAMPLERS

TEST RESULTS
Natural Moisture Content (%). ▲
Penetration - ●
10 20 30 40 50



No groundwater was encountered within the drilled depths at the time of drilling. The boring was backfilled with soil cuttings and a hole plug at the conclusion of drilling. Boring caved at approximately 6.5 ft.

Picture 1

Lat:	Long:	Bearing:	Date Taken:10/13/2022
Weather:			Taken By:Ashraf Abukhalaf
Tags:			

	Project Name:Rockdale County Fire Station No. 10	
	Project Location:2734 Oneal Rd SW, Conyers, GA 30094, USA	
	Client:Rockdale County	Project Code:MEG 301287.37
	Preparer:	Reviewer:
	Report Date:10/27/2022	Page Number:1 of 8

Picture 2

Lat:	Long:	Bearing:	Date Taken:10/13/2022
Weather:			Taken By:Ashraf Abukhalaf
Tags:			

	Project Name:Rockdale County Fire Station No. 10	
	Project Location:2734 Oneal Rd SW, Conyers, GA 30094, USA	
	Client:Rockdale County	Project Code:MEG 301287.37
	Preparer:	Reviewer:
	Report Date:10/27/2022	Page Number:2 of 8

Picture 3

Lat:	Long:	Bearing:	Date Taken:10/13/2022
Weather:			Taken By:Ashraf Abukhalaf
Tags:			

	Project Name:Rockdale County Fire Station No. 10	
	Project Location:2734 Oneal Rd SW, Conyers, GA 30094, USA	
	Client:Rockdale County	Project Code:MEG 301287.37
	Preparer:	Reviewer:
	Report Date:10/27/2022	Page Number:3 of 8

Picture 4

Lat:	Long:	Bearing:	Date Taken: 10/13/2022
Weather:			Taken By: Ashraf Abukhalaf
Tags:			

	Project Name: Rockdale County Fire Station No. 10	
	Project Location: 2734 Oneal Rd SW, Conyers, GA 30094, USA	
	Client: Rockdale County	Project Code: MEG 301287.37
	Preparer:	Reviewer:
	Report Date: 10/27/2022	Page Number: 4 of 8

Picture 5

Lat:	Long:	Bearing:	Date Taken:10/13/2022
Weather:			Taken By:Ashraf Abukhalaf
Tags:			

	Project Name:Rockdale County Fire Station No. 10	
	Project Location:2734 Oneal Rd SW, Conyers, GA 30094, USA	
	Client:Rockdale County	Project Code:MEG 301287.37
	Preparer:	Reviewer:
	Report Date:10/27/2022	Page Number:5 of 8

Picture 6

Lat:	Long:	Bearing:	Date Taken:10/13/2022
Weather:			Taken By:Ashraf Abukhalaf
Tags:			

	Project Name:Rockdale County Fire Station No. 10	
	Project Location:2734 Oneal Rd SW, Conyers, GA 30094, USA	
	Client:Rockdale County	Project Code:MEG 301287.37
	Preparer:	Reviewer:
	Report Date:10/27/2022	Page Number:6 of 8

Picture 7

Lat:	Long:	Bearing:	Date Taken:10/24/2022
Weather:			Taken By:Ashraf Abukhalaf
Tags:			

	Project Name:Rockdale County Fire Station No. 10	
	Project Location:2734 Oneal Rd SW, Conyers, GA 30094, USA	
	Client:Rockdale County	Project Code:MEG 301287.37
	Preparer:	Reviewer:
	Report Date:10/27/2022	Page Number:7 of 8

Picture 8

Lat:	Long:	Bearing:	Date Taken: 10/24/2022
Weather:			Taken By: Ashraf Abukhalaf
Tags:			

	Project Name: Rockdale County Fire Station No. 10	
	Project Location: 2734 Oneal Rd SW, Conyers, GA 30094, USA	
	Client: Rockdale County	Project Code: MEG 301287.37
	Preparer:	Reviewer:
	Report Date: 10/27/2022	Page Number: 8 of 8