GEOTECHNICAL REPORT
(Frost Project No. FGS-G 20016)

M.W. CUDE ENGINEERS, L.L.C 4122 Pond Hill Road, Suite 101 San Antonio, Texas 78231 210.681.2951 (tel) 210.523.7112 (fax)

GEOTECHNICAL ENGINEERING STUDY

MONTGOMERY ROAD EXTENSION
PHASE 1C, 1D & 2
BEXAR COUNTY, TEXAS
PAVEMENT DESIGN

FROST GEOSCIENCES, INC. PROJECT NO.: FGS-G 21106
MAY 7, 2021

Prepared Exclusively for:

CUDE ENGINEERING
Attn: Mr. Jeffrey McKinnie, P.E.
4122 Pond Hill Road. Suite 101
San Antonio, Texas 78231

Frost GeoSciences
Construction Materials ▪ Forensics
Environmental ▪ Geotechnical

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Frost GeoSciences

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TBPG Firm Registration # 50040

May 7, 2021

Mr. Jeffrey McKinnie, P. E.
CUDE ENGINEERING
4122 Pond Hill Road, Suite # 101
San Antonio, Texas 78231

SUBJECT:
Geotechnical Engineering Services
Montgomery Road Extension, Phase 1C, 1D, & 2
Bexar County, Texas
FGS Project No: FGS-G21106

Dear Mr. McKinnie;

Frost GeoSciences, Inc. (FGS) is a geotechnical engineering company registered with the Texas Board of Professional Engineers, with registration No. F-9227, and is pleased to submit the results of our Geotechnical Engineering Study for the above referenced project. This report includes the results of field and laboratory testing along with our recommendations for use in preparation of the appropriate design and construction documents for this project.

We appreciate the opportunity to be of service to you in this phase of your project and future projects. If you have any questions pertaining to this report, or if we may be of further service, please contact our office.

Respectfully submitted,
Frost GeoSciences, Inc.

F. J. Caballero, P.E.
Project Engineer

FGS-G-21106

Copies Submitted:
i. One (1) Electronic: Mr. Jeffrey McKinnie, P. E., CUDE ENGINEERING, San Antonio, Texas
ii. One (1) File

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PROJECT INFORMATION

Project Authorization:

Frost GeoSciences, Inc. (FGS) has completed a geotechnical engineering study for new pavements to be constructed on **Phase 1C, 1D, & 2 of the Montgomery Road Extension** **in** **Bexar County, Texas**. This project was authorized by **Mr. Jeffrey McKinnie, P. E. of CUDE ENGINEERING**, through acceptance of Frost GeoSciences **Proposal No.: FGS-P-G20089** **dated** **December 15, 2020.** Our scope of services for this project is as outlined in that proposal.

Project Description:

We understand that the **Phases 1C, 1D, & 2 of the Montgomery Road Extension** involves the design and construction of an **Arterial Street**. The pavement section design will be in accordance with the **Bexar County, Texas Flexible Pavement Design Criteria.** A Vicinity Map showing the location of the project is included in the section of this report entitled Illustrations.

Purpose and Scope of Services:

The purpose of the geotechnical investigation is to evaluate the subsurface conditions at the project site and develop geotechnical engineering recommendations and guidelines for use in preparing the appropriate design and other related construction documents for this project. Therefore, our scope of services for this project include the following:

- Drill borings and excavate test pits at selected locations within the project limits to evaluate subsurface conditions and to observe the potential presence of subsurface water;
- Perform geotechnical engineering laboratory tests on selected samples recovered during our field activities to evaluate their physical and engineering properties;
- Perform Engineering analyses to develop the appropriate geotechnical engineering recommendations and guidelines, to include:
- Appropriate pavement section thickness recommendations;
- Pavement section material requirements and specifications;
- General site and subgrade preparation within the construction limits; and
- General comments regarding construction methods, sequences and potential difficulties that may arise during overall construction as it relates to the geotechnical engineering aspects of this project.

- Prepare a written report that includes a boring location plan, boring log at each bore site, and results of the laboratory testing program, descriptions of the subsurface conditions encountered and our geotechnical engineering recommendations and guidelines developed for this project.

Our scope of services for this project did not include the assessment of any potential environmental concerns at this site. Therefore, such concerns are not addressed in this report.

SITE AND SUBSURFACE CONDITIONS

Site Description:

The site conditions were assessed using a combination of aerial photography and observations made by the FGS personnel during our field operations. The following site conditions were noted:

- The site is the Montgomery Road Extension, Phases 1C, 1D, & 2 located in Bexar County Texas.

Site Geology:

According to the Bureau of Economic Geology, Geologic Atlas of Texas – San Antonio Sheet (1982); the Site is located on the following geologic formation:

- The **Navarro Group and Marlbrook Marl ("upper Taylor marl") undivided (Kknm) -** This formation is made up of two parts. The upper part consists of marl, clay, sandstone, and siltstone. The marl and clay are typically glauconitic and contain concretions of limonite and siderite. The sandstone portion is fine-grained, and the siltstone portion is yellow-brown, with concretions of hard bluish-gray siliceous limestone 2-10' in diameter. Sandstone beds have little lateral continuity, becoming more abundant in the western portions. This formation's thickness can be up to 580'.

Soil Description:

According to the United States Department of Agricultural (USDA) Natural Resources Conservation Service (NRCS) Soil Survey of Comal and Hayes County (1984), the Site is located on the following soils:

- **The Houston Black gravelly clay, three to five percent slopes (HuC)** consists of claycy soils that are deep, dark gray to black and calcareous with some gravel. The surface layer is black and about 36" thick. Gravel ordinarily makes up 10-18% of this layer by volume. On a few minor ridge tops, gravel may compose of 60% of the soil. The subsurface layer is about 12" thick. Water intake is slow and erosion due to water is a hazard. The formation of plow pans is common.

- The **Hilly Gravelly Land (HgD)**. This soil consists of a bed of caliche or of gravelly, very strongly calcareous, loamy alluvium that is approximately 10-20' or more in thickness. The upper 3-12" of

the caliche layer is generally hard and platy. There are a few nearly level areas approximately 100' wide, and on these has formed a 4-8" thick mantle of limy, dark grayish brown loam or clay loam. On the slopes, there is very little soil; it is estimated that only approximately 15% of this land is actually soil. In some places, there is a 2-3' bed of weak conglomerate consisting of sediments cemented with calcium carbonate.

Subsurface Conditions:

Subsurface conditions at the site were evaluated by drilling a total of **Six (6)** soil borings to a depth of **Fifteen (15)** feet and **Three (3)** test pits to approximately **two (2) feet depth** were excavated to obtain **soil samples to determine the California Bearing Ratio (CBR)** of the soil samples. **One (1) test was taken on each phase of the project**. The number of borings and test pits, their locations and their depths were selected by FGS. The borings and test pits were located in the field by FGS personnel using Global Positioning System (GPS) technology. The borings were advanced using solid flight auger drilling methods and soil samples were routinely obtained during the drilling process; the test pits are routinely excavated to the appropriate depth. Drilling and sampling techniques were accomplished in general accordance with ASTM procedures. Logs of the borings are presented in the Appendix section at the end of the report. A Borehole Location Plan with the location of each boring is presented in the Illustrations section of this report.

The soil samples obtained during our field exploration were transported to our laboratory where they were reviewed by qualified geotechnical engineering personnel. Representative samples were selected and tested to determine pertinent engineering properties and characteristics for use in evaluating the project site. Laboratory testing and soil classification were accomplished in general accordance with ASTM procedures.

Based on the field and laboratory data, it is determined that the stratigraphy of the site is generally as follows:

Stratum	Range of Depth, (feet)	Stratum Description and Classification
I	0.0 to 5.0	Silty Clay (CL), Dark Brown
II	5.0 to 15.0	Silty Clay (CL), Tan

The subsurface descriptions shown above are general in nature and highlight major subsurface stratification features and material types. The boring logs included in Appendix A should be reviewed for specific information such as soil or rock material descriptions, stratifications, sampling depths and intervals, field test data and laboratory test data. The stratifications shown on each boring log only represent the conditions and approximate boundaries between strata at that actual boring location. The actual transitions between strata may be gradual. Variations will occur and should be expected at locations away from each boring location. Subsurface water level observations made during field operations are also

shown on the boring logs. The indicated stratum depths and any subsurface water levels are measured from the ground surface and are estimated to the nearest one-half (½) foot. Portions of any samples that are not altered or consumed by laboratory testing will be retained for 30 days from the date of issuance of this report. Unless otherwise requested by the client and/or depending upon project requirements, all soil samples will be discarded after that retention period.

The **P.I. values** obtained from the soil samples taken **near the surface ranged from 21 to 25 in** the **CLAY** subgrade soil. Due to the characteristics of the materials found in the area, FGS is of the opinion that the sulfate contents of the materials will **NOT** pose a problem if not treated with lime. In the case where the P.I. value of the material near the surface is greater than 20 the PI could be reduced if lime is applied to the subgrade material or the native Clay material is replaced with a more suitable material.

Subsurface Water Information:

The borings were advanced using dry drilling techniques to their full depths in an attempt to detect the potential presence of subsurface water in the material. Subsurface **water was not encountered** either during or upon completion of drilling or sampling operations. The boreholes were backfilled with soil cuttings upon completion of drilling and sampling operations. Short-term field observations generally do not provide accurate subsurface water levels for evaluation at most sites. Subsurface water levels are generally influenced by seasonal and climatic conditions that result in fluctuations of subsurface water levels over time. The earthwork contractor should check for subsurface water during excavation activities especially when sand and/or gravel are encountered. No specific notations concerning subsurface water are indicated on the boring logs in Appendix A since **no subsurface water was observed.**

ENGINEERING ANALYSIS AND RECOMMENDATIONS

Pavement Design:

Flexible pavements should be designed and constructed in accordance with the requirements established by local municipalities and the American Association of State Highway and Transportation Officials (AASHTO) "Guide for Design of Pavement Structures", for this project, the Bexar County Flexible Pavement Design Criteria was used.

Below is a table which outlines the Bexar County Flexible Pavement Design Criteria, which was used in the design of the proposed street sections for this project:

Input Parameters used in Asphalt Pavement Section Calculation

Pavement Specifications								
	Primary and Secondary Arterials		Collector Streets		Local Type "B"		Local Type "A" Streets with Bus Traffic	
W18	ESAL = 3,000,000		ESAL = 2,000,000		ESAL = 2,000,000		ESAL = 1,000,000	
R	95%		90%		90%		70%	
So	Flexible	Rigid	Flexible	Rigid	Flexible	Rigid	Flexible	Rigid
	0.45	0.35	0.45	0.35	0.45	0.35	0.45	0.35
Po	4.2	4.5	4.2	4.5	4.2	4.5	4.2	4.5
Pt	2.5	2.5	2.5	2.5	2.0	2.5	2.0	2.0
ΔPSI	1.7	2.0	1.7	2.0	2.2	2.0	2.2	2.5
T	20		20		20		20	
SN	Min.	Max	Min.	Max.	Min.	Max.	Min.	Max.
	3.80	5.76	2.92	5.05	2.98	5.05	2.58	4.20

In addition to the parameters shown above, the soil resilient modulus, M_R, of the subgrade soil, must be determined. Typically, this value is obtained through California Bearing Ratio (CBR) testing. Field investigations show that all the soil samples obtained within the subgrade at the site are very similar with very similar (CBR) values. These soils are **Dark Brown Silty Clay (CL)** **with similar Plasticity and CBR values. The CBR values range between 3.3 and 4.0.** We will **use a CBR of 3.8 for all phases of** our pavement design. Information regarding the moisture density relationships of the bulk samples of subgrade soil collected at this site and the CBR test results are presented in the Appendix section of this report.

The Pavement Sections for Clay soils with a **CBR value of 3.8** are presented in the tables below. **It should be noted, the P.I. value of the Clay subgrade at this site varies between 21 and 25**. The subgrade soils with a **P.I. value greater than 20 should be treated with lime to reduce their P.I.** value or be replaced with better material approved by the Project Engineer. It will be important that once the field work starts, personnel from FGS be present to identify the areas where lime should be applied to reduce the P.I. value of the subgrade soil.

For the purposes of developing layer thicknesses for the pavement sections shown below, we have used the following structural coefficients in the calculation of pavement structural numbers:

Material Type	Structural Coefficient	Drainage Coefficient
TXDOT Item 340, Hot Mixed Asphaltic Concrete	0.44	1.00
TXDOT Items 292 or 340, Asphalt Treated Base	0.38	1.00
TXDOT Item 247, Flexible Base - Crushed Limestone	0.14	1.00
TXDOT Item 247, Flexible Base	0.08	1.00
Lime Stabilized Subgrade, (6 inch Min.)	0.08	1.00

Bexar County Minimum Layer Thickness Requirements:
For
ARTERIAL STREETS

Pavement Layer	Minimum Thickness (inches)
Hot Mixed Asphaltic Concrete Surface	4.0
Asphalt Treated Base	6.0
Aggregate Base Course	8.0
Moisture Condition Subgrade	6.0
Lime and Cement Treated Subgrade	6.0

THE NEW TENSAR PROGRAM CALCULATE THE RESILIENT MODULUS (MR) VALUE WITH THE USE OF THE LABORATORY CALIFORNIA BEARING RATIO, (CBR). In this case the **MR value calculates to be 5,700 psi.**

WE WILL USE MR=5,700 PSI FOR OUR PAVEMENT DESIGN.

In accordance with the **Bexar County, Texas** design parameters we have developed the following flexible pavement recommendations for an **"ARTERIAL STREET"** on a Clay subgrade.

COMPONENT	FLEXIBLE DESIGN SECTION (inches)			
	ARTERIAL, (Phases 1C, 1D, & 2)			
	Option # 1	Option # 2	Option # 3	Option # 4
Type D HMAC Surface	4.0 inches	4.0 inches		
Type B HMAC Base	6.0 inches	N/A		
Flexible Base, (Type A or Type B, Grade 2)	8.0 inches	13.5 inches		
Lime Stabilized Subgrade (6 inch Min.)	YES	YES		
*3 X 5 Rock Wrapped in Mirafi 180N Filter Fabric	NO	NO		
TENSAR GEOGRID (TX-7)	NO	YES		
Design ESAL Value	3,000,000	3,000,000		
Actual ESAL Value	4,804,300	3,002,400		

Pavement Analysis:

The pavement designs presented in the previous paragraphs include designs for lime stabilized subgrade and lime treated subgrade, to be used on pavement sections with a Clay subgrade and a P.I. value greater than 20. The **Bexar County pavement design criteria** requires that a minimum of six (6) inches of subgrade soil below the pavement structure be treated or stabilized if the subgrade has a P.I. value greater than 20. If a Geogrid fabric is used to reduce the base course thickness, treatment or stabilization of the underlying high P.I. soil is still required. In the case that subgrade fill is required to bring the subgrade elevation up to final grade, fills should be made with flexible base, on-site Chalk millings or other material approved by the Project Engineer. Fill material compaction shall be in accordance with subgrade compaction requirement for **Bexar County, Texas.**

Pavement Material Specifications:

The following guidelines have been prepared for use in the selection and preparation of various materials that may be used to construct the pavement sections. Submittals should be made for each pavement material and should be reviewed by the Geotechnical Engineer and other appropriate members of the design team. The submittals should provide the test information necessary to verify full compliance of the materials with the recommended or specified material properties.

Fill Material - If fill is used to raise the grade, approved fill material underneath the pavement should be used. The fill should be free of deleterious material with a **minimum CBR value of 3.8** and preferably a **Plastic Index below 20**. If the material has a PI greater than 20 the lime application rates should be re-evaluated and sulfate content tested for the fill material. The material should be placed as per applicable city or county guidelines.

Hot-Mix Asphaltic Surface Course – Asphaltic concrete should be plant mixed, hot laid, **Type D** meeting the 2014 TX DOT Standard Specification Item 340. Mix should be compacted to between 92 and 97 percent of the maximum theoretical density as determined by TEX-227-F.

Asphalt Treated Base – Asphalt treated base should be placed in **maximum six (6) inch compacted lifts**. These materials should conform to the requirements of the 2014 TX DOT Standard Specification Item 292, Grade 1 or Item 340, Type A or B.

Flexible Base Course – Flexible base materials should be placed in maximum eight (8) inch **compacted lifts.** The base materials should be compacted to at least 95 percent of the maximum dry density as determined by ASTM D 1557. Flexible base materials should be moisture conditioned to between plus or minus two (+-2) percentage points of the optimum moisture content. Flexible base materials should meet all requirements specified in 2014 TX DOT Standard Specification Item 247, Type A or B, Grade 1 or 2.

Lime Treated Subgrade – Clay subgrade (with P.I. values greater than 20) should be treated with hydrated lime to reduce its plasticity and improve its strength and load carrying ability. Hydrated lime should be mixed with the subgrade soils in accordance with Bexar County Specifications for Lime Treatment to reduce the P.I. value to 20 or less.

Lime Stabilized Subgrade – Clay subgrade **(with P.I. values greater than 20)** should be stabilized with hydrated lime to reduce its plasticity and improve its strength and load carrying ability. Hydrated lime should be mixed with the subgrade soils **in accordance with BEXAR COUNTY, Texas Specifications for Lime Stabilization.** We estimate that approximately **Four (4) percent** (by weight) hydrated lime will be required to properly stabilize these soils. This is equivalent to **about 18 pounds of hydrated lime per square yard for a six (6) inch depth.** The optimum lime content should result in a soil-lime mixture with a pH of at least 12.4 when tested in accordance with ASTM C 977, Appendix XI and should reduce the P.I. to 20 or less.

3 X 5 Rock Wrapped in Filter Fabric – The City may allow 3 X 5 rock wrapped in Filter Fabric instead of lime stabilization, however the **wrapping fabric must be Mirafi 180N Filter Fabric or equal, and prior approval must be obtained.**

Geogrid – **Tensar TX7** geogrid may be used to provide additional structural support to flexible base materials. The geogrid should be placed as per manufacturer's recommendations at the interface between the flexible base and subgrade.

Moisture Conditioned Subgrade – Exposed subgrade soils that do not need to be stabilized or treated should be scarified and moisture conditioned to between plus or minus three (+-3) percentage points of optimum to a depth of at least six (6) inches. The soils should then be compacted to at least 95 percent of the maximum dry density as determined by ASTM D 698.

Lime Series Curve and Unconfined Compressive Strength:

A Lime Series Curve was developed for the project to determine the optimum amount of hydrated lime required to stabilize the subgrade in accordance with **Bexar County, Texas** design criteria. The optimum lime content should result in a soil-lime mixture with a pH of at least 12.4 when tested in accordance with ASTM C 977 and should reduce the Plasticity Index to 20 or less. The lime series curve depicts the percent lime added to the subgrade and the resulting pH/P.I. A strength verification test was performed on the lime stabilized subgrade to determine the Unconfined Compressive Strength (UCS) of the soil-lime mixture. **Bexar County requires an UCS of 160 psi, a pH of 12.4 or greater and a P.I. of 20 or less. Results of the** Lime Series Curve and the Unconfined Compressive Strength test are presented in the Appendix section of this report. **A 4 % of lime is required to reduce the plasticity value**, this translates into **approximately 18 lbs. of lime per square yard** of subgrade. Additional field verification testing will be required during the subgrade stabilization process once the project has started.

Subgrade Preparation:

The pavement alignment should be stripped of topsoil, vegetation, roots, loose or soft soils and any other deleterious materials. The stripped materials should be removed from the site and properly disposed of or

used elsewhere on site. Upon completion of stripping operations, the alignment may be either excavated or filled as necessary to achieve the desired pavement elevation. Prior to the placement of any fill for grade adjustments or the construction of the pavement section, the exposed subgrade should be proof rolled with appropriate construction equipment weighing at least 20 tons. Unstable or non-uniform areas should be removed to expose stable soils and may be replaced with clean, properly compacted flexible base material or other more suitable material approved by the Project Engineer. All fill placed within the paved areas should be free of any deleterious materials and should not contain stones larger than the maximum lift thickness. The fill materials should be placed on prepared surfaces in lifts not to exceed eight (8) inches compacted measure. All fill materials placed in paved areas should be moisture conditioned to between plus or minus three (+-3) percentage points of the optimum moisture content and compacted to at least 95 percent of the maximum dry density as determined by ASTM D 698.

Drainage:

Proper pavement perimeter drainage should be provided and maintained to minimize the infiltration of surface water into the pavement section from surrounding unpaved areas. The infiltration of water into the pavement section typically results in the accelerated degradation of the section with time as vehicular traffic traverses the infiltrated area. Curbs used in paved areas should extend at least three (3) inches into the base materials to help reduce the potential for water infiltration into the pavement section. Prefabricated strip drains or small “French” drains may also be installed behind curbs to intercept and remove water from the pavement perimeter before water infiltrates the pavement section. Furthermore, all concrete and asphalt interfaces should be sealed using a sealant that is compatible with both asphalt and concrete.

Proper pavement drainage is a critical component in the long-term performance of a pavement section. The pavement section recommendations shown above are based on generally recognized structural coefficients. These coefficients reflect the relative strength of each pavement material type and their contribution to the structural integrity of the pavement. The infiltration of water into these pavement materials will generally weaken the materials and result in the degradation of the pavement's performance. Therefore, proper drainage of the pavement should be carefully considered by the project design team to ensure that water rapidly drains from the pavement and does not pond on or around the pavement.

Utilities:

Care should be exercised to make sure that utility lines do not serve as conduits that transmit water beneath foundations or pavements at this site. Secondary backfill for utility lines that are located beneath pavement, sidewalk and building areas should consist of lean clay (CL), flowable fill or other material in accordance with local municipality or utility provider specifications. Proper compaction of trench backfill is essential in pavement areas where settlement of the trench backfill can cause significant distress to the overlaying pavement. Flowable fill materials should be as described in the American Concrete Institute ACI 229R. Granular materials such as sand or gravel are not recommended as secondary backfill in utility trenches located in building pad or pavement areas.

Excavations:

As was discussed previously, these materials that are penetrated by geotechnical augers can generally be excavated with conventional earthmoving equipment. It should be noted that excavation equipment varies and field conditions may vary. Generally, geologic processes (such as faulting, weathering, etc.) are erratic and large variations can occur in small lateral distances. Details regarding "means and methods" to accomplish the work (such as excavation equipment and technique selection) are the sole responsibility of the project contractor.

The Occupational Safety and Health Administration (OSHA) Safety and Health Standards (29 CFR Part 1926, Revised October 1989), require that excavations be constructed in accordance with the current OSHA guidelines. Furthermore, the State of Texas requires that detailed plans and specifications meeting OSHA standards be prepared for trench and excavation retention systems used during construction. The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's "responsible person", as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavation as part of the contractor's safety procedures.

In no case should slope height, slope inclination or excavation depth exceed those specified in local, state and Federal safety regulations. OSHA addresses the construction of slopes in large excavations that are less than 20 feet deep on OSHA Table B-1. We have provided this information solely as a service to our client. The OSHA regulations and OSHA Table B-1 should be consulted prior to any excavations that

would be subject to OSHA regulations. FGS does not assume responsibility for construction site safety or the contractor's or other parties' compliance with local, state and Federal safety or other regulations.

QUALITY CONTROL

Document Review:

Due to the uniqueness of each project and construction site, it is important that all engineering reports, drawings, specifications, change orders and other related documents accurately reflect the recommendations intended by the respective design professionals involved in the project. The performance of the pavements planned for this project will depend on the correct interpretation and implementation of our geotechnical engineering report and guidelines. We should be provided the opportunity to review the final design and construction documents to check that our geotechnical recommendations are properly interpreted and implemented in these documents. This review is not a part of our scope of services for this project and would be an additional service. We cannot be responsible for misinterpretation of our geotechnical recommendations if we have not had an opportunity to review these documents.

Construction Materials Testing:

As the Geotechnical Engineer of Record, we recommend that Frost GeoSciences be retained to monitor the pavement installation and earthwork related activities for this project. Due to our familiarity with this project, it is important that FGS provide these services to make certain that our geotechnical recommendations are interpreted properly and to make certain that actual field conditions are those described in our geotechnical report. We believe this technical overview and on-site surveillance during these activities is essential to provide well-constructed pavements and to check that the intent of these geotechnical recommendations is met.

REPORT LIMITATIONS

The recommendations and guidelines submitted in this report are based on the available subsurface information developed by FGS and project information provided by the client. If there are any changes in the nature, design or location of the project, the opinions, conclusions, recommendations and guidelines submitted in this report should not be used until we are able to review the changes and respond in writing as to whether the information contained within this report remains applicable.

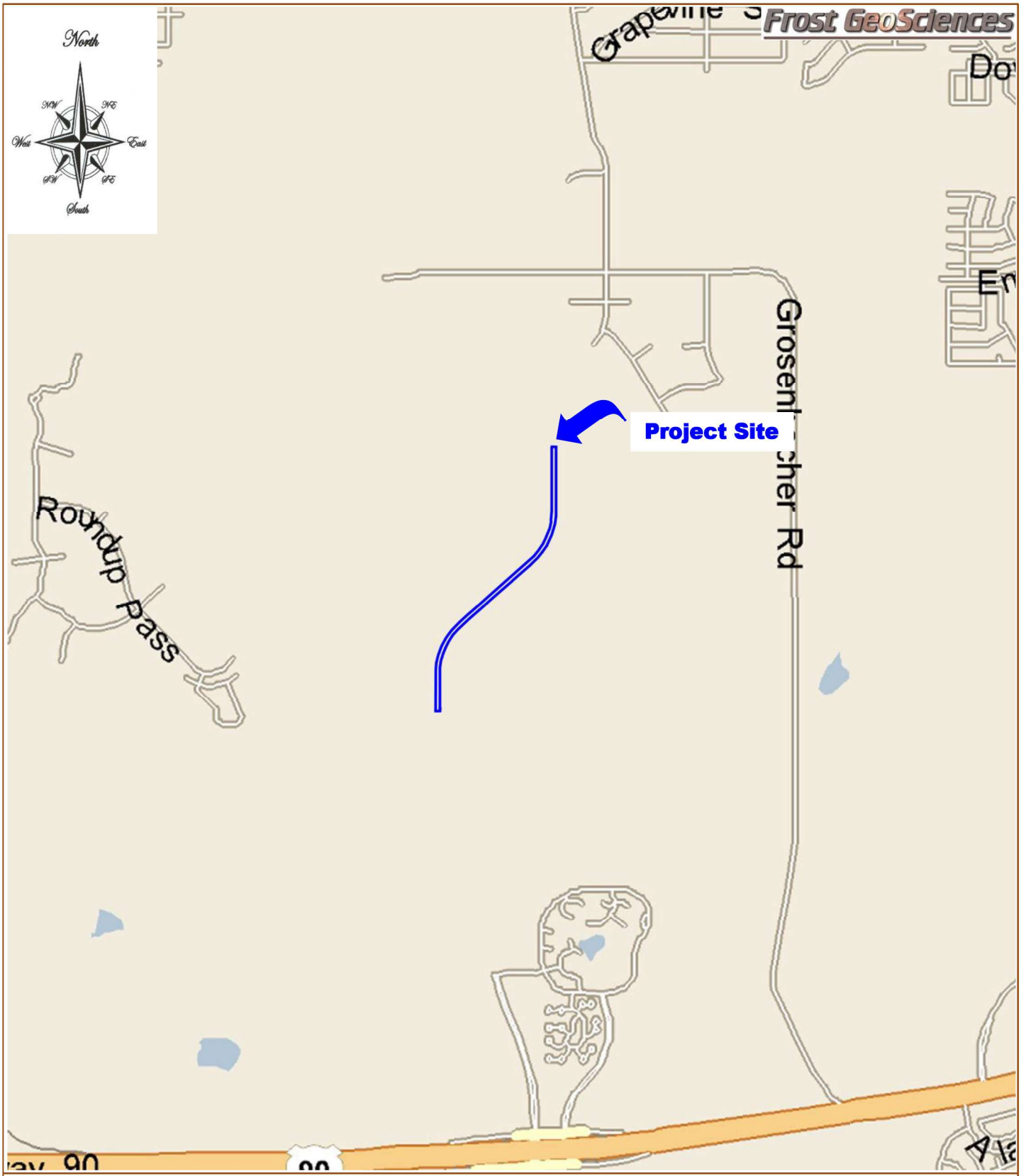
Subsurface conditions at this site have been observed and interpreted at the Boring Locations only. Substantial variations in subsurface materials resulting from local geologic conditions or previous site use may occur away from the boring locations. These variations may not become evident until construction begins. Therefore, any conditions that vary significantly from those described in our report should be reported to FGS immediately. FGS will then determine whether our conclusions, opinions and recommendations remain valid or whether additional investigation and/or engineering analysis is required.

This study has been performed in accordance with accepted geotechnical engineering practice using the standard of care and skill currently exercised by geotechnical engineers practicing in this area. No warranty, expressed or implied, is made or intended. This report has been prepared exclusively for the specified client; project and client's authorized project team for use in preparing the appropriate design and construction documents for this project. This report may be included in the construction documents for this project provided the report is reproduced in its entirety. This report shall not be reproduced or used for any other purpose without the express written consent of Frost GeoSciences, Inc.

ILLUSTRATIONS

Vicinity Map
Boring Location Plan

VICINITY MAP



PROJECT NAME:

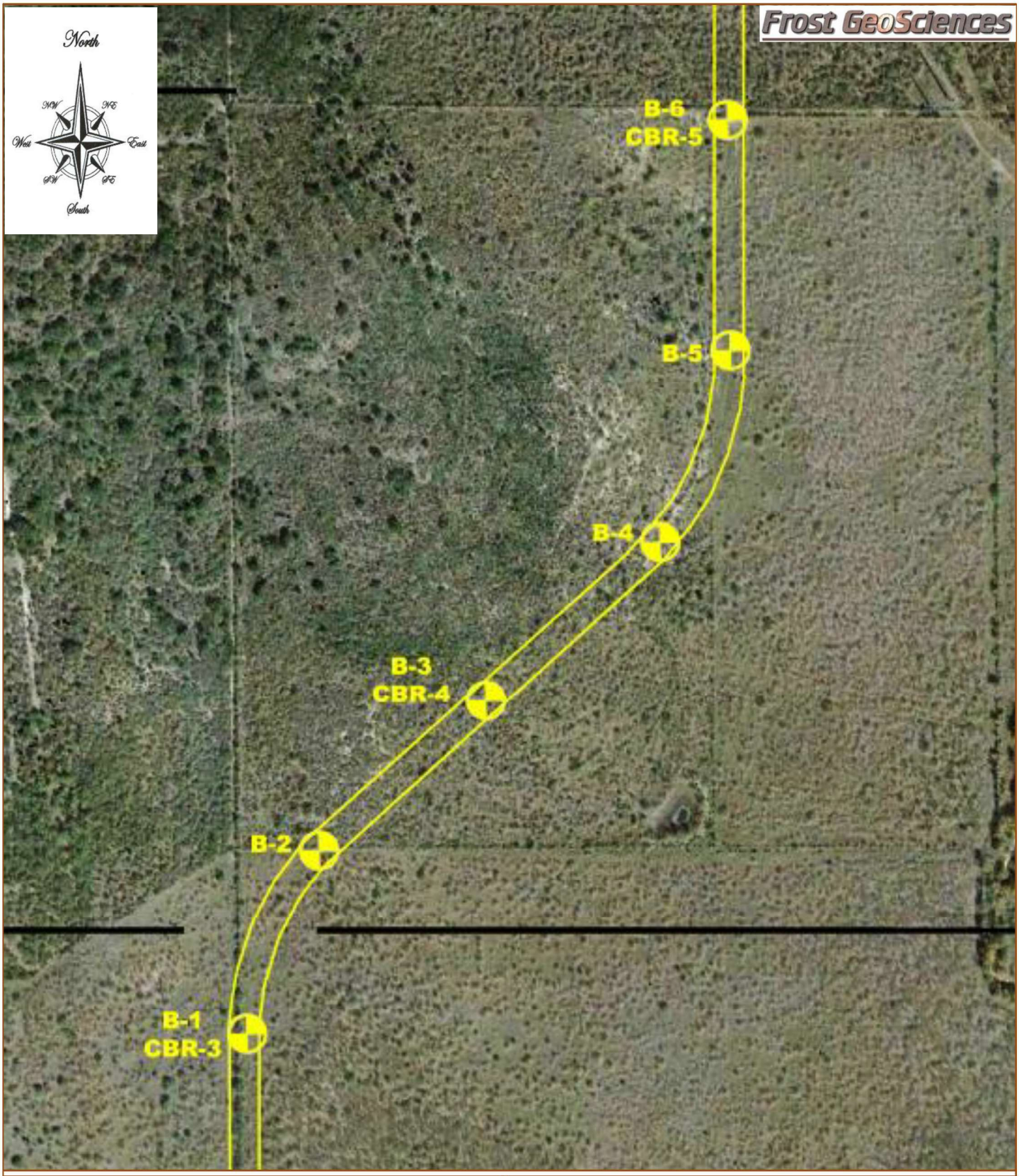
Geotechnical Investigation
Montgomery Rd Phase 1C, 1D & 2
+/- 4,600 Linear Feet, Bexar County, Texas

VICINITY MAP

PROJECT NO.:	DATE CREATED:
FGS-G21106	May 7, 2021

BORING PLAN

FGS Project No: FGS-G21106



PROJECT NAME:

Geotechnical Investigation
Montgomery Rd Phase 1C, 1D & 2
+/- 4,600 Linear Feet, Bexar County, Texas

BORING LOCATION

PROJECT NO.:	DATE CREATED:
FGS-G21106	May 7, 2021

APPENDIX "A"

Boring Logs
PVR Values
Symbol Key Sheet

BORING LOGS

FGS Project No.: FGS-G21106

LOG OF BORING

Frost GeoSciences
Geotechnical • Construction Materials
Geologic • Environmental

PROJECT: Montgomery Road Phase 1C, 1D & 2

CLIENT: Cude Engineering

PROJECT NO.: FGS-G 21106
BORING NO.: B-01
DRILLING DATE: 4/5/2021
SURFACE EVALUATION:
GPS LOCATION (UTM): 14R 0524916 E 3251777 N

DRILLING METHOD(S):
Dry auger techniques were used to the termination depth of the boring.

SUBSURFACE WATER INFORMATION:
Subsurface water was not encountered either during or upon completion of drilling operations and subsurface water observations.

FIELD DATA				LABORATORY DATA									
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: Blows R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY (POUNDS/CU.FT)	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
				12	44	21	23						Dark brown clay to 4'
				12									Dark brown clay
	5			16	40	21	19						Grayish tan clay to 8'
				18									Tan clay to 15'
	10												
				21	49	17	32						Tan clay
	15												
													Boring Terminated at 15 feet of Depth

N-STANDARDS PENETRATION TEST RESISTANCE
P-POCKET PENETROMETER RESISTANCE
T-TXDOT CONE PENETRATION RESISTANCE
R-ROCK CORE RECOVERY
RQD-ROCK QUALITY DESIGNATION

REMARKS:

LOG OF BORING

PROJECT: Montgomery Road Phase 1C, 1D & 2

PROJECT NO.: FGS-G 21106

BORING NO.: B-02

DRILLING DATE: 4/5/2021

SURFACE EVALUATION:

CLIENT: Cude Engineering

GPS LOCATION (UTM): 14R 0524986 E 3251974 N

DRILLING METHOD(S):

Dry auger techniques were used to the termination depth of the boring.

SUBSURFACE WATER INFORMATION:

Subsurface water was not encountered either during or upon completion of drilling operations and subsurface water observations.

FIELD DATA			LABORATORY DATA									
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: Blows R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY (POUNDS/CU.FT)	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
				7									Gravelly dark brown clay to 2'
				10	40	21	19						Grayish calcareous clay to 8'
	5			10									Grayish calcareous clay
				19	45	20	25						Grayish and tan calcareous clay to 15'
	10												
				22									Grayish and tan calcareous clay
	15												
													Boring Terminated at 15 feet of Depth

N-STANDARDS PENETRATION TEST RESISTANCE
P-POCKET PENETROMETER RESISTANCE
T-TXDOT CONE PENETRATION RESISTANCE
R-ROCK CORE RECOVERY
RQD-ROCK QUALITY DESIGNATION

REMARKS:

LOG OF BORING

PROJECT: Montgomery Road Phase 1C, 1D & 2

PROJECT NO.: FGS-G 21106

BORING NO.: B-03

DRILLING DATE: 4/5/2021

SURFACE EVALUATION:

CLIENT: Cude Engineering

GPS LOCATION (UTM): 14R 0525166 E 3252136 N

DRILLING METHOD(S):

Dry auger techniques were used to the termination depth of the boring.

SUBSURFACE WATER INFORMATION:

Subsurface water was not encountered either during or upon completion of drilling operations and subsurface water observations.

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: Blows R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY (POUNDS/CU.FT)	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
				7	45	20	25						Medium brown clay to 1'
				7	43	20	23						Medium to light brown silty clay at 1'
	5			3	44	20	24						Gravel at 4'
													Stiff light gray to white chalky marly clay at 5' Auger refural at 5' Boring Terminated at 5 feet of Depth
	10												
	15												

N-STANDARDS PENETRATION TEST RESISTANCE
P-POCKET PENETROMETER RESISTANCE
T-TXDOT CONE PENETRATION RESISTANCE
R-ROCK CORE RECOVERY
RQD-ROCK QUALITY DESIGNATION

REMARKS:

LOG OF BORING

PROJECT: Montgomery Road Phase 1C, 1D & 2

PROJECT NO.: FGS-G 21106

BORING NO.: B-4

DRILLING DATE: 4/5/2021

SURFACE EVALUATION:

CLIENT: Cude Engineering

GPS LOCATION (UTM): 14R 0525398 E 3252350 N

DRILLING METHOD(S):

Dry auger techniques were used to the termination depth of the boring.

SUBSURFACE WATER INFORMATION:

Subsurface water was not encountered either during or upon completion of drilling operations and subsurface water observations.

FIELD DATA				LABORATORY DATA									
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: Blows R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY (POUNDS/CU.FT)	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
				8									Light brown silty clay to 4'
				7	45	22	23						Light brown silty clay
	5			10									Light yellow marly clay at 6.5'
				19	45	20	25						Light yellowish marly clay
	10												
				22									Light yellowish marly clay
	15												Boring Terminated at 15 feet of Depth

N-STANDARDS PENETRATION TEST RESISTANCE
P-POCKET PENETROMETER RESISTANCE
T-TXDOT CONE PENETRATION RESISTANCE
R-ROCK CORE RECOVERY
RQD-ROCK QUALITY DESIGNATION

REMARKS:

LOG OF BORING

Frost GeoSciences
Geotechnical • Construction Materials
Geologic • Environmental

PROJECT: Montgomery Road Phase 1C, 1D & 2

CLIENT: Cude Engineering

PROJECT NO.: FGS-G 21106
BORING NO.: B-5
DRILLING DATE: 4/5/2021
SURFACE EVALUATION:
GPS LOCATION (UTM): 14R 0525441 E 3252508 N

FIELD DATA			LABORATORY DATA									
				ATTERBERG LIMITS								
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: Blows R: % RQD: %	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	DRY DENSITY (POUNDS/CU.FT)	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)
					LL	PL	PI					

DEPTH (FT)	MOISTURE CONTENT (%)	LL	PL	PI	DESCRIPTION OF STRATUM
	6	43	22	21	Light brown silty clay to 2.5'
	7				Light yellow marly clay at 2.5'
5	5	48	17	31	Light yellow marly clay
	9				Tan clay at 8'
10					
	10	49	17	32	Tan clay at 13'
15					
					Boring Terminated at 15 feet of Depth

DRILLING METHOD(S):
Dry auger techniques were used to the termination depth of the boring.

SUBSURFACE WATER INFORMATION:
Subsurface water was not encountered either during or upon completion of drilling operations and subsurface water observations.

N-STANDARDS PENETRATION TEST RESISTANCE
P-POCKET PENETROMETER RESISTANCE
T-TXDOT CONE PENETRATION RESISTANCE
R-ROCK CORE RECOVERY
RQD-ROCK QUALITY DESIGNATION

REMARKS:

LOG OF BORING

Frost GeoSciences
Geotechnical • Construction Materials
Geologic • Environmental

PROJECT: Montgomery Road Phase 1C, 1D & 2

CLIENT: Cude Engineering

PROJECT NO.: FGS-G 21106
BORING NO.: B-6
DRILLING DATE: 4/5/2021
SURFACE EVALUATION:
GPS LOCATION (UTM): 14R 0525430 E 3252756 N

FIELD DATA			LABORATORY DATA									
				ATTERBERG LIMITS								
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: Blows R: % RQD: %	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	DRY DENSITY (POUNDS/CU.FT)	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)
					LL	PL	PI					
				6	43	22	21					
				7								
	5			5	48	17	31					
				9								
	10											
				10	49	17	32					
	15											

DRILLING METHOD(S):
Dry auger techniques were used to the termination depth of the boring.

SUBSURFACE WATER INFORMATION:
Subsurface water was not encountered either during or upon completion of drilling operations and subsurface water observations.

DESCRIPTION OF STRATUM

Light brown silty clay to 1.5'

Light yellow marly clay at 2'

Light yellow marly clay

Tan marl at 7.5'

Tan clay at 13'

Boring Terminated at 15 feet of Depth

N-STANDARDS PENETRATION TEST RESISTANCE
P-POCKET PENETROMETER RESISTANCE
T-TXDOT CONE PENETRATION RESISTANCE
R-ROCK CORE RECOVERY
RQD-ROCK QUALITY DESIGNATION

REMARKS:

This log is not valid if separated from the report

PVR VALUES

FGS Project No.: FGS-G21106

PVR Calculator

Frost GeoSciences, Inc.
13402 Western Oak
Helotes, Texas 78023

Project Name:	MONTGOMERY ROAD, Phase 1C, 1D, & 2
Project Location:	BEXAR COUNTY
Project City:	SAN ANTONIO
Project Number:	FGS-G-21106
Boring Number:	B - 1

Surcharge Pressure: 1.00 psi **Climatic Rating, C_w:** 16

Stratum	Plasticity Index	Bottom Depth (feet)	Moisture Condition		
			Dry	Average	Optimum
I	23	2.0	X		
II	23	4.0	X		
III	19	8.0		X	
IV	32	12.0		X	
V	32	15.0			X
VI					
VII					
VIII					

PVR Results

PVR = **1.00** inches

Effective Plasticity Index

BRAB	PCI
25	25

Soil Support Index

BRAB	PCI
0.90	0.90

Soil/Climatic Rating Factor

$1 - C_w$ = **0.10**

RULES

1.) Depths should not extend greater than 15 feet.
2.) Use only one moisture condition per stratum.
3.) Moisture conditions must be selected using an "x".
4.) Integers or one-half foot intervals must be used.
5.) Use PI = 8 for none expansive layers.
6.) DO NOT USE PI = 0 FOR NON-EXPANSIVE LAYERS.
7.) **Error checking is limited.**

PVR Calculator

Frost GeoSciences, Inc.
13402 Western Oak
Helotes, Texas 78023

Project Name:	MONTGOMERY ROAD, Phase 1C, 1D, & 2
Project Location:	BEXAR COUNTY
Project City:	SAN ANTONIO
Project Number:	FGS-G-21106
Boring Number:	B - 2

Surcharge Pressure: 1.00 psi **Climatic Rating, C_w:** 16

Stratum	Plasticity Index	Bottom Depth (feet)	Moisture Condition		
			Dry	Average	Optimum
I	8	2.0	X		
II	19	4.0	X		
III	19	8.0		X	
IV	25	12.0		X	
V	25	15.0			X
VI					
VII					
VIII					

PVR Results

PVR = **0.41** inches

Effective Plasticity Index

BRAB	PCI
20	20

Soil Support Index

BRAB	PCI
0.94	0.94

Soil/Climatic Rating Factor

$1 - C_w$ = **0.06**

RULES

1.) Depths should not extend greater than 15 feet.
2.) Use only one moisture condition per stratum.
3.) Moisture conditions must be selected using an "x".
4.) Integers or one-half foot intervals must be used.
5.) Use PI = 8 for none expansive layers.
6.) DO NOT USE PI = 0 FOR NON-EXPANSIVE LAYERS.
7.) **Error checking is limited.**

PVR Calculator

Frost GeoSciences, Inc.
13402 Western Oak
Helotes, Texas 78023

Project Name:	MONTGOMERY ROAD, Phase 1C, 1D, & 2
Project Location:	BEXAR COUNTY
Project City:	SAN ANTONIO
Project Number:	FGS-G-21106
Boring Number:	B - 3

Surcharge Pressure: 1.00 psi **Climatic Rating, C_w:** 16

Stratum	Plasticity Index	Bottom Depth (feet)	Moisture Condition		
			Dry	Average	Optimum
I	25	1.0	X		
II	23	3.0	X		
III	24	5.0		X	
IV	8	12.0		X	
V	8	15.0			X
VI					
VII					
VIII					

PVR Results

PVR = **0.74** inches

Effective Plasticity Index

BRAB	PCI
25	19

Soil Support Index

BRAB	PCI
0.89	0.96

Soil/Climatic Rating Factor

$1 - C_w$ = **0.04**

RULES

1.) Depths should not extend greater than 15 feet.
2.) Use only one moisture condition per stratum.
3.) Moisture conditions must be selected using an "x".
4.) Integers or one-half foot intervals must be used.
5.) Use PI = 8 for none expansive layers.
6.) DO NOT USE PI = 0 FOR NON-EXPANSIVE LAYERS.
7.) **Error checking is limited.**

PVR Calculator

Frost GeoSciences, Inc.
13402 Western Oak
Helotes, Texas 78023

Project Name:	MONTGOMERY ROAD, Phase 1C, 1D, & 2
Project Location:	BEXAR COUNTY
Project City:	SAN ANTONIO
Project Number:	FGS-G-21106
Boring Number:	B - 4

Surcharge Pressure: 1.00 psi **Climatic Rating, C_w:** 16

Stratum	Plasticity Index	Bottom Depth (feet)	Moisture Condition		
			Dry	Average	Optimum
I	23	2.0	X		
II	22	4.0	X		
III	25	8.0		X	
IV	25	12.0		X	
V	22	15.0			X
VI					
VII					
VIII					

PVR Results

PVR = 0.98 inches

Effective Plasticity Index

BRAB	PCI
24	24

Soil Support Index

BRAB	PCI
0.91	0.91

Soil/Climatic Rating Factor

$1 - C_w$ = 0.09

RULES

1.) Depths should not extend greater than 15 feet.
2.) Use only one moisture condition per stratum.
3.) Moisture conditions must be selected using an "x".
4.) Integers or one-half foot intervals must be used.
5.) Use PI = 8 for none expansive layers.
6.) DO NOT USE PI = 0 FOR NON-EXPANSIVE LAYERS.
7.) **Error checking is limited.**

PVR Calculator

Frost GeoSciences, Inc.
13402 Western Oak
Helotes, Texas 78023

Project Name:	MONTGOMERY ROAD, Phase 1C, 1D, & 2
Project Location:	BEXAR COUNTY
Project City:	SAN ANTONIO
Project Number:	FGS-G-21106
Boring Number:	B - 5

Surcharge Pressure: 1.00 psi **Climatic Rating, C_w:** 16

Stratum	Plasticity Index	Bottom Depth (feet)	Moisture Condition		
			Dry	Average	Optimum
I	21	3.0	X		
II	31	5.0	X		
III	31	8.0		X	
IV	32	12.0		X	
V	32	15.0			X
VI					
VII					
VIII					

PVR Results

PVR = **1.45** inches

Effective Plasticity Index

BRAB	PCI
28	28

Soil Support Index

BRAB	PCI
0.86	0.86

Soil/Climatic Rating Factor

$1 - C_w$ = **0.14**

RULES

1.) Depths should not extend greater than 15 feet.
2.) Use only one moisture condition per stratum.
3.) Moisture conditions must be selected using an "x".
4.) Integers or one-half foot intervals must be used.
5.) Use PI = 8 for none expansive layers.
6.) DO NOT USE PI = 0 FOR NON-EXPANSIVE LAYERS.
7.) **Error checking is limited.**

PVR Calculator

Frost GeoSciences, Inc.
13402 Western Oak
Helotes, Texas 78023

Project Name:	MONTGOMERY ROAD, Phase 1C, 1D, & 2
Project Location:	BEXAR COUNTY
Project City:	SAN ANTONIO
Project Number:	FGS-G-21106
Boring Number:	B - 6

Surcharge Pressure: 1.00 psi **Climatic Rating, C_w:** 16

Stratum	Plasticity Index	Bottom Depth (feet)	Moisture Condition		
			Dry	Average	Optimum
I	21	2.0	X		
II	31	5.0	X		
III	31	8.0		X	
IV	32	12.0		X	
V	32	15.0			X
VI					
VII					
VIII					

PVR Results

PVR = **1.55** inches

Effective Plasticity Index

BRAB	PCI
29	29

Soil Support Index

BRAB	PCI
0.85	0.85

Soil/Climatic Rating Factor

1 - C_w = **0.15**

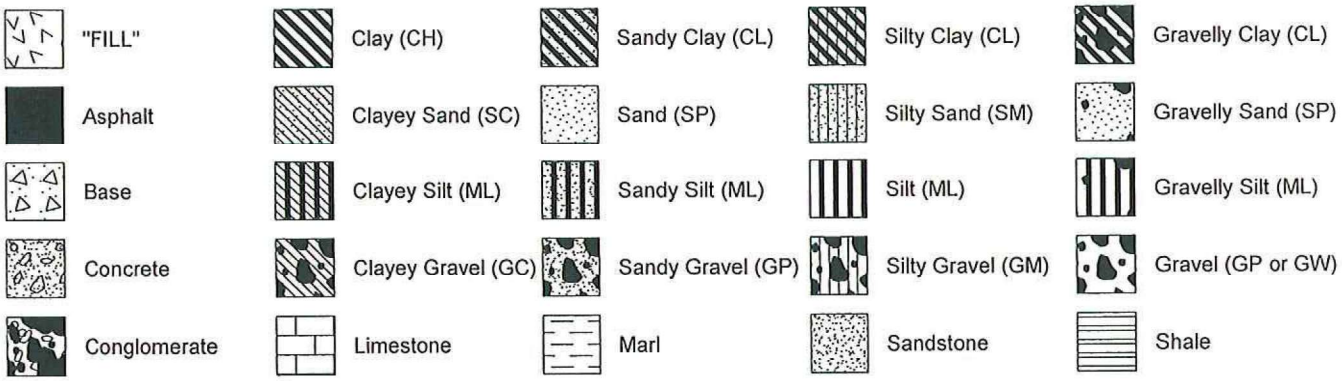
RULES

1.) Depths should not extend greater than 15 feet.
2.) Use only one moisture condition per stratum.
3.) Moisture conditions must be selected using an "x".
4.) Integers or one-half foot intervals must be used.
5.) Use PI = 8 for none expansive layers.
6.) DO NOT USE PI = 0 FOR NON-EXPANSIVE LAYERS.
7.) **Error checking is limited.**

SYMBOL KEY

Symbol Key Sheet

Material Symbols



Strength of Cohesive Soils

Consistency	Undrained Shear Strength, KSF
Very Soft	less than 0.25
Soft	0.25 to 0.50
Firm	0.50 to 1.00
Stiff	1.00 to 2.00
Very Stiff	2.00 to 4.00
Hard	greater than 4.00

Soil Plasticity

Degree of Plasticity	Plasticity Index (PI)
None	0 to 5
Low	5 to 10
Moderate	10 to 20
Plastic	20 to 40
Highly Plastic	more than 40

Density of Granular Soils

Descriptive Term	SPT Blow Count (blows/ft)
Very Loose	less than 4
Loose	4 to 10
Medium Dense	10 to 30
Dense	30 to 50
Very Dense	more than 50

Standard Penetration Test (ASTM D 1586) Driving Record

Note: Driving is limited to 50 blows per interval, or 25 blows for 0.25 inch advancement, whichever controls. This is done to avoid damaging sampling tools.

Blows Per Foot	Description
25	Sampler was seated 6 inches, then 25 blows were required to advance the sampler 12 inches.
75/8"	Sampler was seated 6 inches, 25 blows were required for the second 6 inch increment and the 50 blow limit was reached at 2 inches of the last increment.
Ref/2"	Sampler could only be driven 2 inches of the 6 inch seating penetration before the 50 blow limit was reached.

Terms Characterizing Structure

Soil Terms	Description
Blocky	Contains cracks or failure planes resulting in rough cubes of material.
Calcareous	Contains appreciable quantities of calcium carbonate.
Fissured	Contains shrinkage cracks, which are frequently filled with fine sand or silt. The fissures are usually near vertical in orientation.
Interbedded	Composed of alternating layers of different soil types.
Laminated	Composed of thin layers of varying color and texture.
Nodules	Secondary inclusions that appear as small lumps about 0.1 to 0.3 inch in diameter.
Partings	Inclusion of different material less than 1/8 inch thick extending through the sample.
Pockets	Inclusion of different material that is smaller than the diameter of the sample.
Seams	Inclusion of different material between 1/8 and 3 inches thick, and extends through the sample.
Slickensided	Has inclined planes of weakness that are slick and glossy in appearance. Slickensides are commonly thought to be randomly oriented.
Streaks or Stains	Stains of limited extent that appear as short stripes, spots or blotches.

Rock Terms	
Bedding Plane	A surface parallel to the surface of deposition, generally marked by changes in color or grain size.
Fracture	A natural break in rock along which no displacement has occurred.
Joint	A natural break along which no displacement has occurred, and which generally intersects primary surfaces.
% Recovery	The ratio of total length of recovery to the total length of core run, expressed as a percentage.
RQD - Rock Quality Designation	The ratio of total recovered length of fragments longer than 4 inches to the total run length, expressed as a percentage.
Weathering	The process by which rock is broken down and decomposed.

Sampler Symbols

APPENDIX "B"

Moisture Density Relationship
CBR Test Results
Lime Series Curve
Sulfate Report
Spectra Pave Design Analysis

Frost GeoSciences

MOISTURE DENSITY

FGS Project No.: FGS-G21106

13406 Western Oak
Helotes, TX 78023
(210) 372-1315 phone (210) 372-1318 fax

Frost GeoSciences
Construction Materials ▪ Forensics
Environmental ▪ Geotechnical

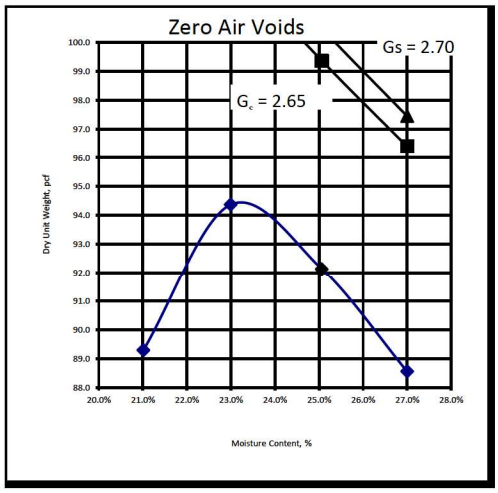
Project #: **FGS-G-21106**

Project: **MONTGOMERY ROAD**

Report Date: 5/5/2021
Sample Date: 1/0/1900

Client:	Cude Engineering		
Report:	ASTM - Standard Proctor	LAB NO:	4102
Material:	Subgrade	Report #:	S3

Moisture-Density Relationship - Subgrade Soil



Test Results

% Moisture	Dry Density Lbs./ft^3
21.0%	89.3
23.0%	94.4
25.1%	92.1
27.0%	88.6

Optimum = 23.3

Maximum = 94.5

Sieve	% Passing
3 inch	100.0%
3/4 inch	100.0%
3/8 inch	100.0%
No. 4	100.0%
No.10	56.3%
No. 40	16.3%
No.100	1.7%
No.200	0.8%

Color: Dark Brown
Description: Clay

Liquid Limit: 45
Plastic Limit: 22
Plasticity Index: 23

Location: Project Site

Desc of Rammer: Mechanical
Preparation Method: Dry
Remarks: No comments at this time.

Test Method (As Applicable): ASTM D-698 A
ASTM D-4318

Respectfully Submitted,
Frost GeoSciences, Inc.

F.J.Caballero, P. E. , Project Manager

13406 Western Oak
Helotes, TX 78023
(210) 372-1315 phone (210) 372-1318 fax

Frost GeoSciences
Construction Materials ▪ Forensics
Environmental ▪ Geotechnical

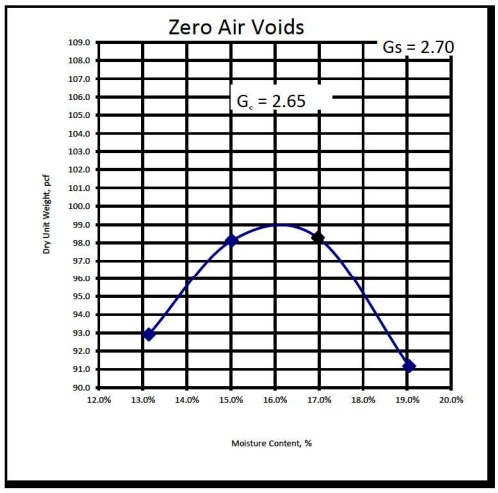
Project #: **FGS-G-21106**

Project: **MONTGOMERY ROAD**

Report Date: 5/5/2021
Sample Date: 1/0/1900

Client:	Cude Engineering		
Report:	ASTM - Standard Proctor	LAB NO:	4102
Material:	Subgrade	Report #:	S4

Moisture-Density Relationship - Subgrade Soil



Test Results

% Moisture	Dry Density Lbs./ft^3
13.1%	92.9
15.0%	98.1
17.0%	98.3
19.0%	91.2

Optimum = 16

Maximum = 99

Sieve	% Passing
3 inch	100.0%
3/4 inch	100.0%
3/8 inch	100.0%
No. 4	100.0%
No.10	57.1%
No. 40	24.6%
No.100	4.3%
No.200	0.9%

Color:	Light Brown
Description:	Clay
Liquid Limit:	36
Plastic Limit:	20
Plasticity Index:	16

Desc of Rammer: Mechanical
Preparation Method: Dry
Remarks: No comments at this time.

Location: Project Site

Test Method (As Applicable): ASTM D-698 A
ASTM D-4318

Respectfully Submitted,
Frost GeoSciences, Inc.

F.J.Caballero, P. E. , Project Manager

13406 Western Oak
Helotes, TX 78023
(210) 372-1315 phone (210) 372-1318 fax

Frost GeoSciences
Construction Materials ▪ Forensics
Environmental ▪ Geotechnical

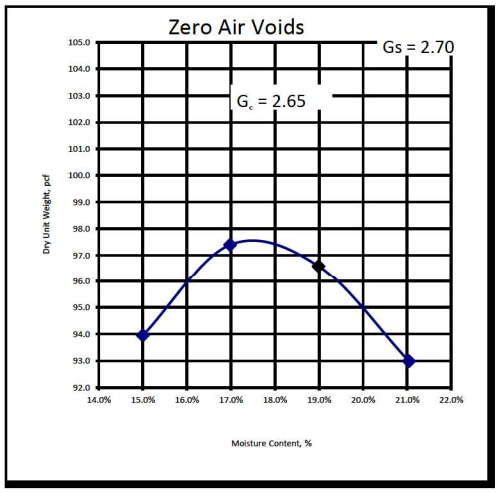
Project #: **FGS-G-21106**

Project: **MONTGOMERY ROAD**

Report Date: 5/5/2021
Sample Date: 1/0/1900

Client:	Cude Engineering		
Report:	ASTM - Standard Proctor	LAB NO:	4102
Material:	Subgrade	Report #:	S5

Moisture-Density Relationship - Subgrade Soil



Test Results

% Moisture	Dry Density Lbs./ft^3
15.0%	94.0
17.0%	97.4
19.0%	96.6
21.0%	93.0

Optimum = 17.5

Maximum = 97.6

Sieve	% Passing
3 inch	100.0%
3/4 inch	100.0%
3/8 inch	100.0%
No. 4	100.0%
No.10	37.3%
No. 40	14.3%
No.100	2.6%
No.200	0.4%

Color: Light Brown
Description: Clay

Liquid Limit: 33
Plastic Limit: 18
Plasticity Index: 15

Location: Project Site

Desc of Rammer: Mechanical
Preparation Method: Dry
Remarks: No comments at this time.

Test Method (As Applicable): ASTM D-698 A
ASTM D-4318

Respectfully Submitted,
Frost GeoSciences, Inc.

F.J.Caballero, P. E. , Project Manager

CBR RESULTS

FGS Project No.: FGS-G21106

Frost GeoSciences, Inc.
13402 Western Oak
Helotes, Texas 78023

CBR (California Bearing Ratio)
ASTM D1883

Project Name: Montgomery Road
Project #: FGS-G-21106
Soil Desc. Dark Brown Clay CBR # 3
Tested By: Miguel Gonzalez Jr
Test Date: 04/21/21

Compaction Energy: Rammer: 5.5 lbs. # layers: 3 Blows: 56
w at compaction: 23.30% Mold Dia. 6 in. Soil Ht. 4.584 in.
Volume 0.075 ft.^{3} Opt. M.C. 23.3
Opt. Dry Unit wt. 94.5

	Initial	Final	%S
Date/Time	4/21/21 9:15am	4/24/21 9:30am	
Swell Data	0.000	0.055	1.20

Mold #	3
Surcharge, lbs.	10
Initial mass of wet soil + mold, lbs.	26.135
Final mass of wet soil + mold, lbs.	26.727
Mass of Mold, lbs.	18.06
Initial mass of wet soil, lbs.	8.075

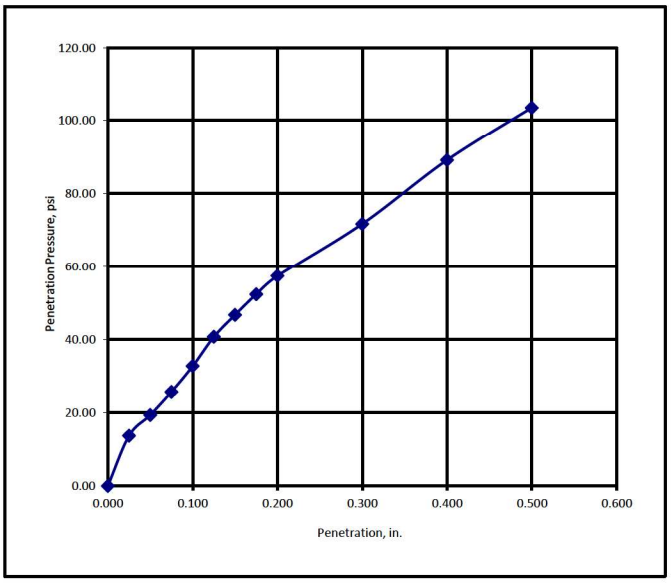
Dry density = 94.4 Comp. 0.99894
Moisture = 23.3 Points Opt. -0.04083

ASTM D2216 Moisture Content

Compaction	Project #	Can No.	Wet Wt. (1)	Dry Wt. (2)	Tare Wt. (3)	(1) - (2) = A	(2) - (3) = B	%MC = A/B*100
Before	GS-G-21106		515.22	422	126.12	93.22	295.88	31.50602
After	GS-G-21106		458.21	415	127.17	43.21	287.83	15.01233

ASTM D1883 Date: 4/24/2021
Time: 10:00am

Strain, in.	Load, lbs	Stress, psi	CBR
0.000	0.00	0.00	
0.025	41.00	13.67	
0.050	58.00	19.33	
0.075	77.00	25.67	
0.100	98.00	32.67	3.3
0.125	122.00	40.67	
0.150	140.00	46.67	
0.175	157.00	52.33	
0.200	172.00	57.33	3.8
0.300	215.00	71.67	
0.400	267.00	89.00	
0.500	310.00	103.33	



Frost GeoSciences, Inc.
13402 Western Oak
Helotes, Texas 78023

CBR (California Bearing Ratio)
ASTM D1883

Project Name: Montgomery Road | Project #: FGS-G-21106
Soil Desc. Light Brown Clay CBR # 4
Tested By: Miguel Gonzalez Jr | Test Date: 04/21/21

Compaction Energy: Rammer: 5.5 lbs. # layers: 3 Blows: 56
w at compaction: 16.00% Mold Dia. 6 in. Soil Ht. 4.584 in.
Volume 0.075 $ft.^3$ Opt. M.C. 16.0
Opt. Dry Unit wt. 99

	Initial	Final	%S
Date/Time	4/21/21 9:45am	4/24/21 10:00am	
Swell Data	0.000	0.07	1.53

Mold #	4
Surcharge, lbs.	10
Initial mass of wet soil + mold, lbs.	26.638
Final mass of wet soil + mold, lbs.	27.134
Mass of Mold, lbs.	18.15
Initial mass of wet soil, lbs.	8.488

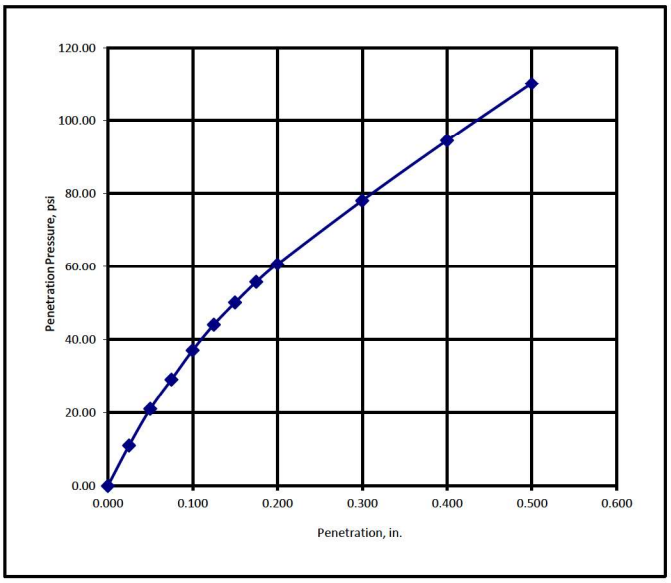
Dry density = 98.0 Comp. 0.9899
Moisture = 16.0 Points Opt. 0.03379

ASTM D2216 Moisture Content

Compaction	Project #	Can No.	Wet Wt. (1)	Dry Wt. (2)	Tare Wt. (3)	(1) - (2) = A	(2) - (3) = B	%MC = A/B*100
Before	GS-G-21106		551.19	496.01	128.05	55.18	367.96	14.9962
After	GS-G-21106		494.05	440.62	127.64	53.43	312.98	17.07138

ASTM D1883 Date: 4/24/2021
Time: 10:15am

Strain, in.	Load, lbs	Stress, psi	CBR
0.000	0.00	0.00	
0.025	33.00	11.00	
0.050	63.00	21.00	
0.075	87.00	29.00	
0.100	111.00	37.00	3.7
0.125	132.00	44.00	
0.150	150.00	50.00	
0.175	167.00	55.67	
0.200	182.00	60.67	4.0
0.300	234.00	78.00	
0.400	283.00	94.33	
0.500	330.00	110.00	



Frost GeoSciences, Inc.
13406 Western Oak
Helotes, Texas 78023

CBR (California Bearing Ratio)
ASTM D1883

Project Name: Montgomery Road — Project #: FGS-G21106
Soil Desc. Light Brown Clay CBR # 5
Tested By: Miguel Gonzalez Jr — Test Date: 04/21/21

Compaction Energy: Rammer: 5.5 lbs. # layers: 3 Blows: 56
w at compaction: 17.50% Mold Dia. 6 in. Soil Ht. 4.584 in.
Volume 0.075 ft.^{3} Opt. M.C. 17.5
Opt. Dry Unit wt. 97.6

	Initial	Final	%S
Date/Time	4/21/21 10:15am	4/24/21 10:30am	
Swell Data	0.000	0.075	1.64

Mold #	5
Surcharge, lbs.	10
Initial mass of wet soil + mold, lbs.	27.111
Final mass of wet soil + mold, lbs.	27.333
Mass of Mold, lbs.	18.15
Initial mass of wet soil, lbs.	8.961

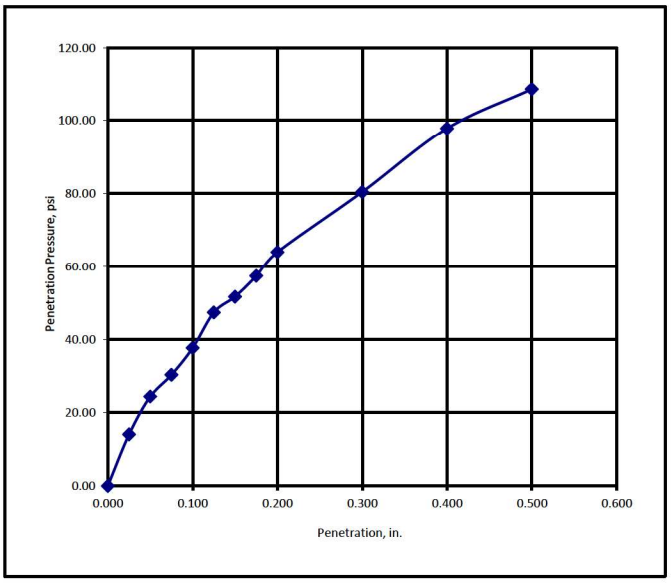
Dry density = 97.5 Comp. 0.99898
Moisture = 17.0 Points Opt. -0.5

ASTM D2216 Moisture Content

Compaction	Project #	Can No.	Wet Wt. (1)	Dry Wt. (2)	Tare Wt. (3)	(1) - (2) = A	(2) - (3) = B	%MC = A/B*100
Before	GS-G21006		561.12	423.15	127.22	137.97	295.93	46.62251
After	GS-G21006		512.18	485.36	126.05	26.82	359.31	7.464307

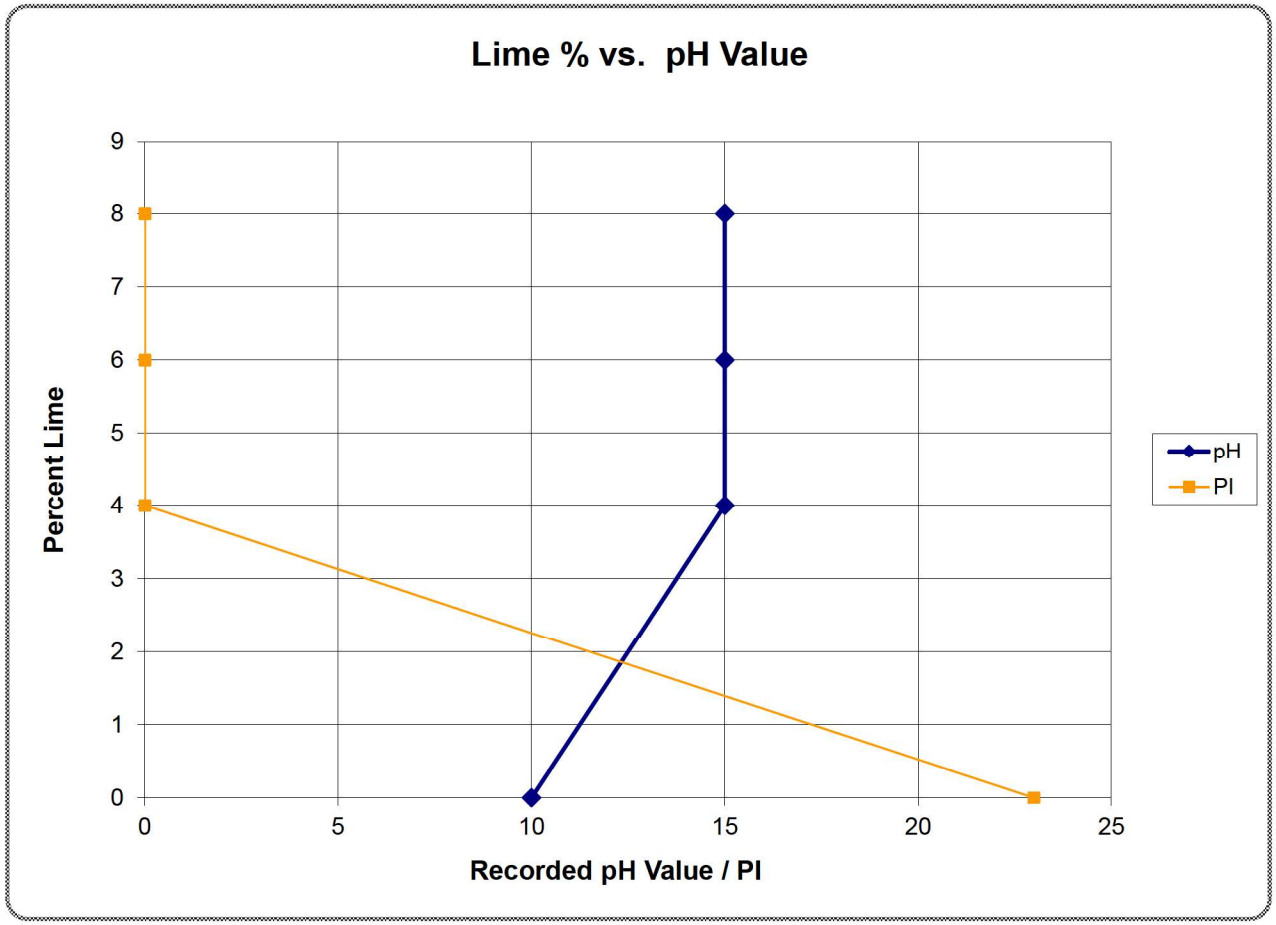
ASTM D1883 Date: 4/24/2021
Time: 10:45am

Strain, in.	Load, lbs	Stress, psi	CBR
0.000	0.00	0.00	
0.025	42.00	14.00	
0.050	73.00	24.33	
0.075	91.00	30.33	
0.100	113.00	37.67	3.8
0.125	142.00	47.33	
0.150	155.00	51.67	
0.175	172.00	57.33	
0.200	192.00	64.00	4.3
0.300	241.00	80.33	
0.400	293.00	97.67	
0.500	325.00	108.33	



LIME SERIES CURVE

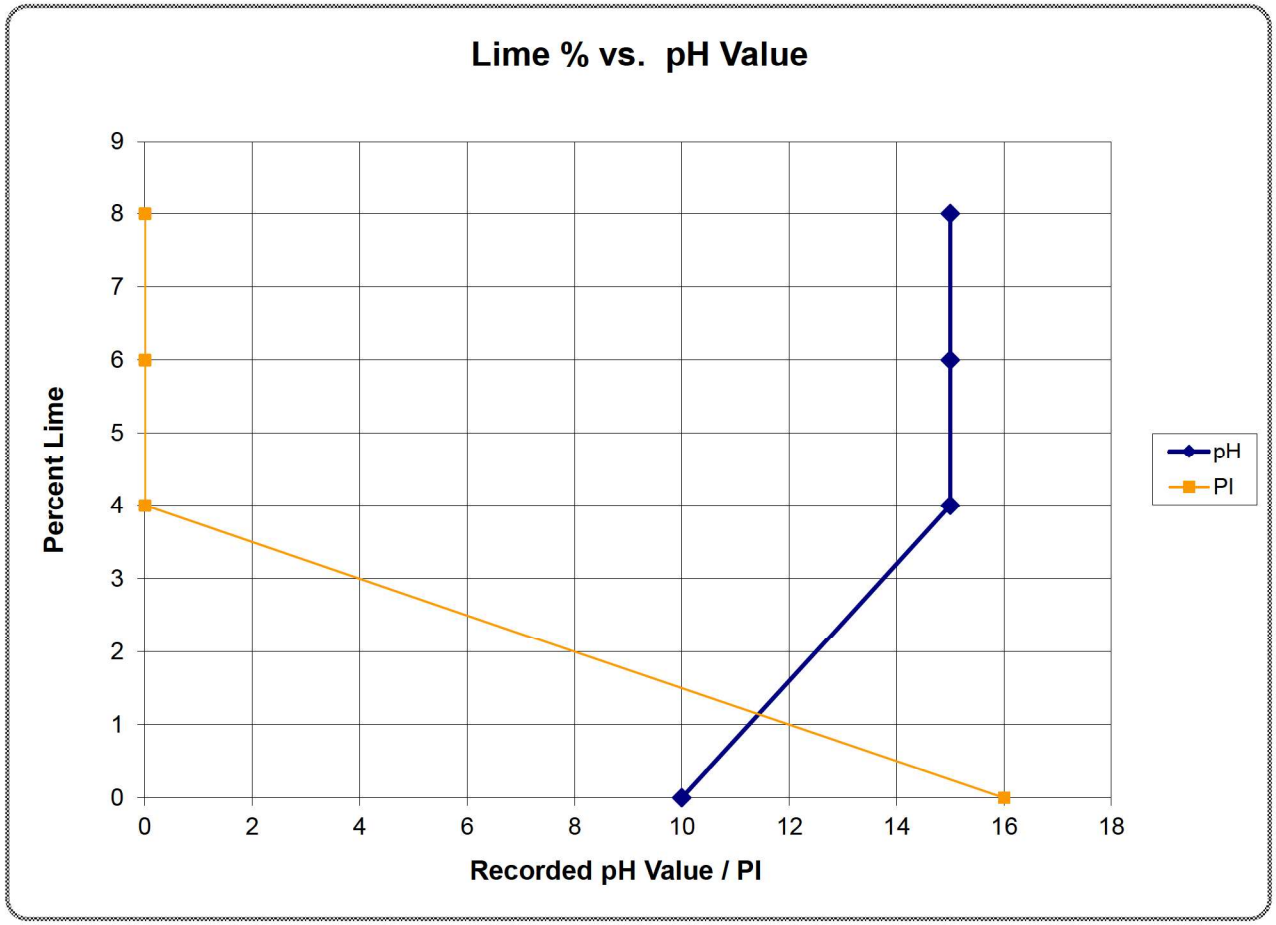
FGS Project No.: FGS-G21106



Project Name: Montgomery Road
Project Number: FGS-G-21106
Soil Description: Dark Brown Clay S3

%Lime	pH	PI
0	10	23
4	15	0
6	15	0
8	15	0

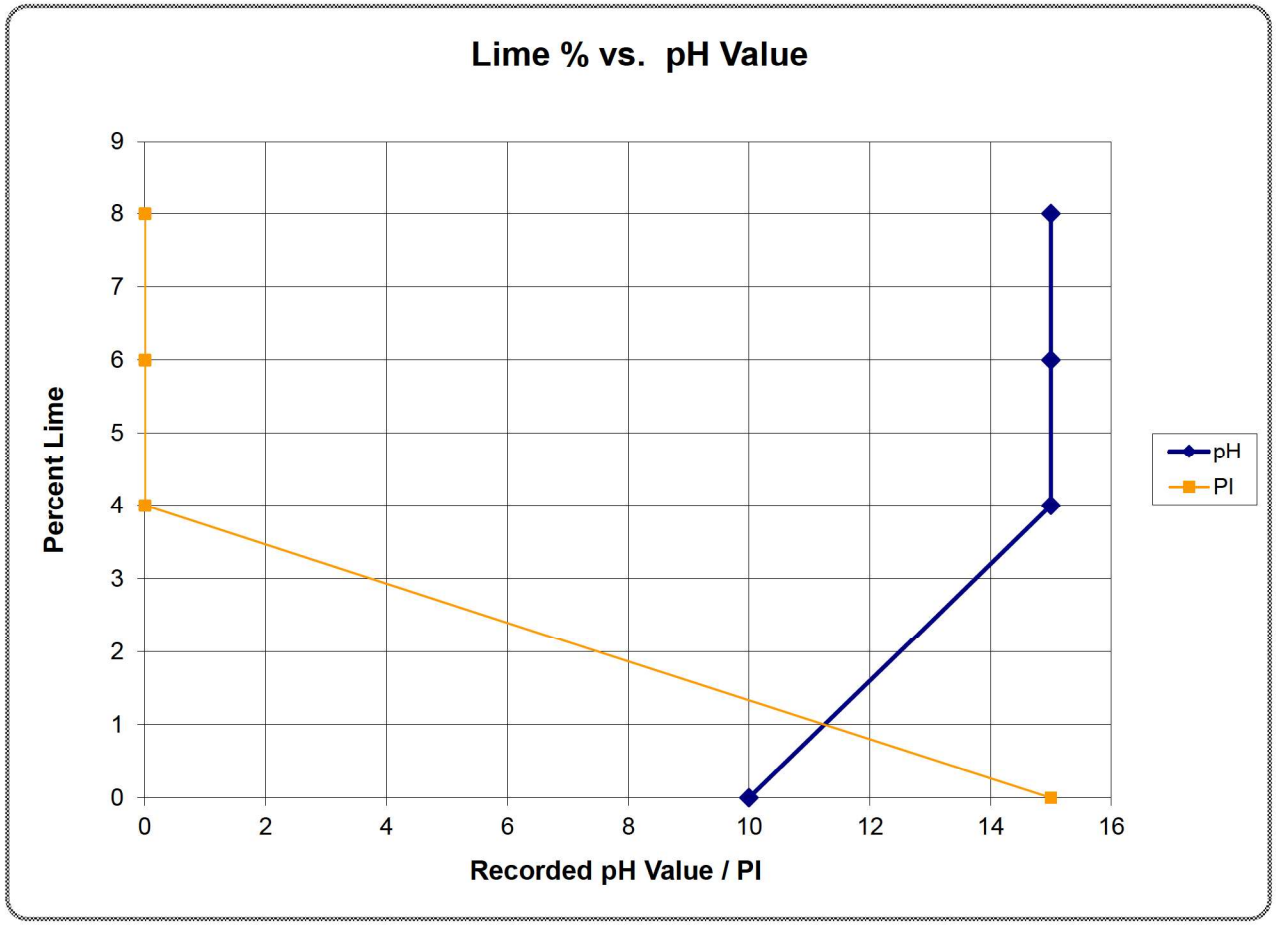
	6%	8%
Set #1	190psi	225psi
Set #2	200psi	230psi



Project Name: Montgomery Road
Project Number: FGS-G-21106
Soil Description: Light Brown Clay S4

%Lime	pH	PI
0	10	16
4	15	0
6	15	0
8	15	0

	6%	8%
Set #1	220psi	245psi
Set #2	205psi	240psi



Project Name: Montgomery Road
Project Number: FGS-G-21106
Soil Description: Light Brown Clay S5

%Lime	pH	PI
0	10	15
4	15	0
6	15	0
8	15	0

	6%	8%
Set #1	225psi	240psi
Set #2	215psi	240psi

Frost GeoSciences

SULFATE REPORT

FGS Project No.: FGS-G21106

SAN ANTONIO TESTING LABORATORY

April 21, 2021

Miguel Gonzalez
Frost GeoSciences, Inc
13406 Western Oak
Helotes, TX 78023

SATL Report No.: 2104102
RE: Montgomery Rd San Antonio TX
Project Number: FGS6-21005, 21006

Dear Miguel Gonzalez

SATL received 2 Sample(s) on 04/07/2021 for analyses identified on the chain of custody. The analyses were performed using methods indicated on the laboratory report. Any deviations observed at sample receiving are notated on the Sample Receipt Checklist and/or Chain of Custody documents attached as part of this analytical report.

Any deviations observed at sample receiving are notated on the Sample Receipt Checklist and/or Chain of Custody documents attached as part of this analytical report.

Sincerely,

For San Antonio Testing Laboratory, Inc.

Richard Hawk,
General Manager

NELAC Cert. No.: **T104704360**

Frost GeoSciences, Inc
13406 Western Oak
Helotes TX, 78023

Project Manager: Miguel Gonzalez
Project: Montgomery Rd San Antonio TX
Project Number: FGS6-21005, 21006

Reported:
04/21/21 10:31
Received:
04/07/21 11:36

Additional Notes:

Report No. 2104102

SAMPLE SUMMARY

Total Samples received in this work order: **2**

The following samples were requested for analysis as per the CoC. Any re-runs or re-analyses requested are identified as such.

Sample ID	Laboratory ID	Matrix	Sampling Method	Date Sampled	Date Received
S1 (Boring #4)	2104102-01	Solid	Grab	04/07/21 11:07	04/07/21 11:36
S2 (Boring #8)	2104102-02	Solid	Grab	04/07/21 11:08	04/07/21 11:36

Notes

All quality control samples and checks are within acceptance limits unless otherwise indicated.
Test results pertain only to those items tested.
All samples were in good condition when received by the laboratory unless otherwise noted.

NELAC Cert. No.: **T104704360**

Frost GeoSciences, Inc
13406 Western Oak
Helotes TX, 78023

Additional Notes:

Project Manager: Miguel Gonzalez
Project: Montgomery Rd San Antonio TX
Project Number: FGS6-21005, 21006

Reported:
04/21/21 10:31
Received:
04/07/21 11:36

Report No. 2104102

Sample ID #: S1 (Boring #4) **Sampling Method: Grab** **Lab Sample ID #: 2104102-01**

Sample Matrix: Solid **Date/Time Collected: 04/07/21 11:07**

Analyte	Result	Units	PQL	Prep Method	Batch	Analyzed	Method	Analyst	Notes
Anions by Ion Chromatography									
Sulfate *	16.3	mg/kg	0.10	EPA 1010	B117142	04/17/21 02:42	EPA 300.0	JL	

NELAC Cert. No.: **T104704360**

Frost GeoSciences, Inc
13406 Western Oak
Helotes TX, 78023

Additional Notes:

Project Manager: Miguel Gonzalez
Project: Montgomery Rd San Antonio TX
Project Number: FGS6-21005, 21006

Reported:
04/21/21 10:31
Received:
04/07/21 11:36

Report No. 2104102

Sample ID #: S2 (Boring #8) **Sampling Method: Grab** **Lab Sample ID #: 2104102-02**

Sample Matrix: Solid **Date/Time Collected: 04/07/21 11:08**

Analyte	Result	Units	PQL	Prep Method	Batch	Analyzed	Method	Analyst	Notes
Anions by Ion Chromatography									
Sulfate *	4.15	mg/kg	0.10	EPA 1010	B117142	04/17/21 03:18	EPA 300.0	JL	

NELAC Cert. No.: **T104704360**

Frost GeoSciences, Inc
13406 Western Oak
Helotes TX, 78023

Additional Notes:

Project Manager: Miguel Gonzalez
Project: Montgomery Rd San Antonio TX
Project Number: FGS6-21005, 21006

Reported:
04/21/21 10:31
Received:
04/07/21 11:36

Report No. 2104102

Anions by Ion Chromatography - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B117142 - EPA 1010									
Blank (B117142-BLK1)				Prepared: 04/16/21 16:00		Analyzed: 04/17/21 00:55			
Sulfate	<0.10	0.10	mg/kg						
LCS (B117142-BS1)				Prepared: 04/16/21 16:00		Analyzed: 04/17/21 01:13			
Sulfate	50.3	0.10	mg/kg	50.0		101	90-110		
LCS Dup (B117142-BSD1)				Prepared: 04/16/21 16:00		Analyzed: 04/17/21 01:30			
Sulfate	50.2	0.10	mg/kg	50.0		100	90-110	0.2	30
Duplicate (B117142-DUP1)		**Source: 2104084-01**		Prepared: 04/16/21 16:00		Analyzed: 04/17/21 02:06			
Sulfate	37.1	0.10	mg/kg		36.8			0.7	20
Matrix Spike (B117142-MS1)		**Source: 2104084-01**		Prepared: 04/16/21 16:00		Analyzed: 04/17/21 02:24			
Sulfate	85.1	0.10	mg/kg	50.0	36.8	96	90-110		

NELAC Cert. No.: **T104704360**

Frost GeoSciences, Inc
13406 Western Oak
Helotes TX, 78023

Additional Notes:

Project Manager: Miguel Gonzalez
Project: Montgomery Rd San Antonio TX
Project Number: FGS6-21005, 21006

Reported:
04/21/21 10:31
Received:
04/07/21 11:36

Report No. 2104102

DEFINITIONS

*	TNI / NELAC accredited analyte
PQL	Practical Quantitation Limit
MCL	Maximum Contaminant Level
mg/Kg	Milligrams per Kilogram (Parts per Million)
mg/L	Milligrams per Liter (Parts per Million)
PPM	Parts per Million
L	LCS recovery is outside QC acceptance limits, the results may have a slight bias.
M	MS recovery is outside QC limits, the results may have a slight bias due to possible matrix interferences.
NR	Not Recovered due to source sample concentration exceeds spiked concentration.
RMCCL	Recommended Maximum Concentration of Contaminants Level
Surr L	Surrogate recovery is low outside QC limits.
Surr H	Surrogate recovery is high outside QC limits.
HT	Sample received past holdtime
IC	Improper Container
IT	Improper Temperature
V	Inssuficient Volume
B	Sample collected in Bulk
S	RPD is outside QC limits.
AB	VOA Vial contained air bubbles.
OP	ortho-Phosphate was not filtered in the field within 15minutes of collection.
CCV	Continuing Calibration Verification Standard.
ICV	Initial Calibration Verification Standard.

Test Methods followed by the laboratory are referenced in the following approved methodology, unless otherwise specified.

Standard Methods for the Examination of Water and Wastewater, 22nd Edition
Methods for Chemical Analysis of Water and Wastes, EPA 600/4-79-020, Rev. March 1983
EPA SW Test Methods for the Examination of Solid Waste, SW-846, 1996

Aimee Landon For Marcela Gracia Hawk, President For

Richard Hawk, General Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

CHAIN-OF-CUSTODY RECORD

SAN ANTONIO TESTING LABORATORY, LLC

1610 S. Laredo Street, San Antonio, Texas 78207
(210) 229-9920 • Fax (210) 229-9921
www.satestinglab.com

REPORT TO:	INVOICE TO:	P.O. #
COMPANY: Frost Geosciences	COMPANY:	REPORT NUMBER: 2104102
ADDRESS: 13406 Western Oaks	ADDRESS: SAME	
CITY: Helotes STATE: TX ZIP: 78023	CITY: STATE: ZIP:	E-MAIL: mgonzalez@frostgeosciences.com
ATTN: Miguel Gonzalez PHONE #: (210) 372-1315	ATTN: PHONE #:	

REQUESTED TURNAROUND TIME IN BUSINESS DAYS & SURCHARGE: ❑ 7-10 Days REG | X 5 Days +25% | ❑ 4 Days +50% | ❑ 3 DAYS +75% | ❑ 2 DAYS +100% | ❑ Next Day +150% | ❑ SAME DAY WHEN POSSIBLE +300%

PROJECT NAME/LOCATION/SITE: Montgomery Rd. San Antonio Tx.

THE TURNAROUND TIME FOR SAMPLES RECEIVED AFTER 3:00 PM SHALL BEGIN AT 8:00 AM THE FOLLOWING BUSINESS DAY / SPECIAL REQ.:

FOR STATE COMPLIANCE ❑ YES ❑ X NO

PROJECT NO.: FOS 6-21005, 21006

SAMPLE TEMPERATURE WITHIN COMPLIANCE (> 0°C ≤ 6°C) ❑ YES ❑ NO — INITIAL TO AUTHORIZE BULK ANALYSIS _____ — INSUFFICIENT SAMPLE AMOUNT: ❑ YES ❑ NO — AUTHORIZE TO PROCEED _____

PROPER CONTAINERS ❑ YES ❑ NO — IF NO, INITIAL HERE TO AUTHORIZE ANALYSIS _____

SAMPLED BY: Miguel Gonzalez

OBSERVED TEMP. 5.4°C / CORRECTED TEMP. 5.2°C / TEMP. I.R. GUN # 7 / SAMPLE ICED ❑ YES ❑ NO

TRRP 13 ❑ LPST PCLS ❑ PST ❑ TSDF Class 2 ❑

SAMPLE NUMBER	COLLECTED: DATE	COLLECTED: TIME	MATRIX: DRINKING WATER	MATRIX: NON-POTABLE WATER	MATRIX: PAINT CHIPS	MATRIX: OIL	MATRIX: ORGANIC LIQUID	MATRIX: SOLID	MATRIX: SLUDGE	MATRIX: OTHER	SAMPLING METHOD: COMPOSITE	SAMPLING METHOD: GRAB	SAMPLING METHOD: CORE	SAMPLING METHOD: OTHER	SAMPLE IDENTIFICATION	NUMBER OF CONTAINERS	SAMPLE AMOUNT	CONTAINER SIZE	ANALYSIS REQUESTED: BTEX/MTBE 8260 / TPH TX1005/TX1006	Metals 8 / 11 / 12 / 13 / TCLP / SPLP / Total	PAH / SVOC / 8270 / 625 / TCLP / SPLP / Total	VOC / 8260 / 624 / TCLP / SPLP / Total	Water Quality - Drinking / Livestock / Irrigation	Coli / TC / FC / HPC / EColi / Enterococci / Q-Tray	Br / Cl / F / NO3 / NO2/O-P / SO4	PCB / 608 / 8082A	OC Pest / 608 / 8081A / TCLP / SPLP / Total	Sulfide (SO4)	PRESERVED WITH: HCl	HNO3	H2SO4	NaOH	NaHSO4	Zn(OAc)2 + NaOH	PRESERVED IN THE LAB	COMPOSITED IN THE LAB	FILTERED IN THE LAB	FILTERED IN THE FIELD	REMARKS
1	4-7-21	11:07 AM						X				X			S1 (Boring #4)	1	402	402									✓											X	
2	4-7-21	11:08 AM						X				X			S2 (Boring #8)	1	402	402									✓											X	

RELINQUISHED BY (SIGNATURE)	DATE / TIME	RECEIVED BY (SIGNATURE)	DATE / TIME	RELINQUISHED BY (SIGNATURE)	DATE / TIME	RECEIVED BY (SIGNATURE)	DATE / TIME
[signature]	4-7-21 11:34 AM	[signature]	040721				
RELINQUISHED BY (PRINT NAME)	DATE / TIME	RECEIVED BY (PRINT NAME)	DATE / TIME	RELINQUISHED BY (PRINT NAME)	DATE / TIME	RECEIVED BY (PRINT NAME)	DATE / TIME
Miguel Gonzalez	4-7-21 11:34 AM	S. Morales Felix	1136				
RELINQUISHED BY (SIGNATURE)	DATE / TIME	RECEIVED BY (SIGNATURE)	DATE / TIME	METHOD OF SHIPMENT: walk-in		SUBCONTRACTED ❑ YES ❑ NO	
RELINQUISHED BY (PRINT NAME)	DATE / TIME	RECEIVED BY (PRINT NAME)	DATE / TIME	SAMPLED IN 5035 CONTAINERS ❑ YES ❑ NO ❑ N/A		CUSTODY SEAL IN PLACE & INTACT ❑ YES ❑ NO	

FORM: COC REV 02/2018 — WHITE - LAB — CANARY - CLIENT

SAN ANTONIO TESTING LABORATORY, INC.

Sample Receipt Checklist

Client: Frost GeoSciences — Report Number: 2104102

Project Name: — Date Received: 04/07/21

Shipped via: ☐FedEx ☐UPS ☐Lonestar ☑Hand Delivered ☐DHL ☐SATL ☐Other — Date Due: 04/14/21

Rush: ☐ Specify: ☐3-5 ☐2 ☐1

Items to be checked upon Receipt: [Yes, No, N/A]

1. Custody Seals present?	Yes	✓	No		NA		If NA–reason:		
2. Custody Seals intact?	Yes	✓	No		NA		If NA–reason:		
3. Air Bill included in folder, if received?	Yes		No	✓	NA		If NA–reason:		
4. Is COC included with samples?	Yes	✓	No		NA		If NA–reason:		
5. Is COC signed and dated by client?	Yes	✓	No		NA		If NA–reason:		
6. Sample temperature: Thermal preservation between >0° - 6°C? (Samples that are delivered to the laboratory on the same day that they are collected may not meet this criterion, but are acceptable if they arrive on ice.)	Yes	✓	No		NA		Temp:	5.9	°C
7. Samples received with ice ☑ ice packs ☐ other cooling ☐	Yes	✓	No		NA		If NA–reason:		
8. Is the COC filled out correctly, and completely?	Yes	✓	No		NA		If NA–reason:		
9. Information on the COC matches the samples?	Yes	✓	No		NA		If NA–reason:		
10. Samples received within holding time?	Yes	✓	No		NA		If NA–reason:		
11. Samples properly labeled?	Yes	✓	No		NA		If NA–reason:		
12. Samples submitted with chemical preservation? (e.g. pH adjusted, or sodium thiosulfate added for microbiological tests)	Yes		No	✓	NA		If NA–reason:		
13. Proper sample containers used?	Yes	✓	No		NA		If NA–reason:		
14. All samples received intact, containers not damaged or leaking?	Yes	✓	No		NA		If NA–reason:		
15. VOA vials (requesting BTEX/VOC analysis) received with no air bubbles? Bubbles acceptable on VOA vials for TPH.	Yes		No	✓	NA	✓	If NA–reason:		
16. Preservative for THMs only ($Na_2S_2O_3$)	Yes		No	✓	NA	✓	If NA–reason:		
17. Sample volume sufficient for requested analysis?	Yes	✓	No		NA		If NA–reason:		
18. Sample amount sufficient for TCLP analysis?	Yes		No	✓	N/A	✓	If NA- reason		
19. Subcontracted Samples: [if Yes, complete the next section]	Yes		No	✓	NA		If NA–reason:		

Analyses Subcontracted Out: _____ No. of Samples _____

Samples sent to: _____ Sent By: _____

Date samples sent: _____ Samples shipped via: _____

TAT Requested: _____

Tracking number [if any]: _____

Comments:

Received By: [signature] Date: 04/07/21

Labeled By: _____ Date: _____

Logged into LIMS By: _____ Date: _____

Logged into RF By: _____ Date: _____

Frost GeoSciences

SPECTRA PAVE

FGS Project No.: FGS-G21106

Pavement Optimization

Design Analysis

Parameters

Project Information

Subgrade resilient modulus	Target ESALs	Reliability	Standard deviation	Serviceability	
				Initial	Terminal
5,700 psi	3,000,000	95%	0.45	4.2	2.5

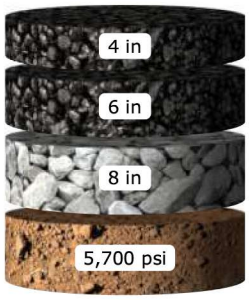
Results

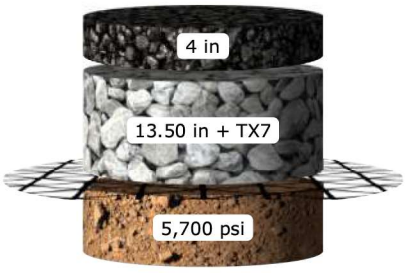
Unstabilized Pavement Section

	Thickness	Coeff.	SN
HMA layer 1	4 in	0.440	1.760
HMA layer 2	6 in	0.380	2.280
Aggregate base	8 in	0.140	1.120
Structural number (SN)			5.160
Calculated traffic (ESALs)			4,804,300

TriAx Stabilized Pavement Section

	Thickness	Coeff.	SN
HMA layer 1	4 in	0.440	1.760
Mechanically stabilized layer	13.50 in	0.227	3.064
Structural number (SN)			4.824
Calculated traffic (ESALs)			3,002,400





Total HMA thickness should be within the same range on both pavement sections for accurate comparison [2-3 in | 3-6 in | 6-14 in]

Limitations of this Report
The designs, illustration, and other content included in this report are necessarily general and conceptual in nature and do not constitute engineering advice or any design intended for actual construction. Specific design recommendations can be provided as the project develops.

Design	ARTERIAL	**Project**	MONTGOMERY ROAD EXTENSION, PHASES 1C, 1D, & 2
Company	FROST GEOSCIENCES, Inc.	**Location**	Bexar County, TX, USA
Designer	FLORENTINO CABALLERO, P. E.	**Date**	5/7/2021

This report was prepared using the Tensar app.

Pavement Optimization

Cost Analysis

Parameters

Project Size

Project length	2,500 ft
Project width	25 ft

Unstabilized Pavement Section Costs

HMA layer 1	$90/ton
HMA layer 2	$75/ton
Aggregate base	$20/ton

Stabilized Pavement Section Costs

HMA layer 1	$90/ton
Mechanically stabilized layer	$20/ton

Grading Requirements

Grade offset	Meet existing grade
Excavation cost	$5/yd³

Geosynthetic Costs

TX7	$5/yd²

Results

Initial Construction Costs

	Unstabilized	Stabilized
HMA layer 1	$138,766	$138,766
HMA layer 2	$173,457	$0
Aggregate base	$56,237	$94,900
Geogrid		$34,722
Excavation	$17,361	$16,879
Total cost	$385,821	$285,267
Unit cost	$55.56/yd²	$41.08/yd²
Savings		$100,554 (26%)

Additional Considerations

	Unstabilized	Stabilized
Construction time	26 days	24 days
Dump truck trips	738	727
Fuel required	1,010 gal	922 gal
Water required	38,587 gal	65,116 gal

Lifecycle Cost

	Unstabilized	Stabilized
Total	$1,531,654	$1,083,878
Net present value	$1,280,260	$934,061

Design	ARTERIAL	**Project**	MONTGOMERY ROAD EXTENSION, PHASES 1C, 1D, & 2
Company	FROST GEOSCIENCES, Inc.	**Location**	Bexar County, TX, USA
Designer	FLORENTINO CABALLERO, P. E.	**Date**	5/7/2021