



- GEOTECHNICAL ENGINEERING
- CONSTRUCTION MATERIALS ENGINEERING & TESTING
- SOILS • ASPHALT • CONCRETE

February 23, 2023

INK Civil
2021 SH 46 W, Ste. 105
New Braunfels, TX 78132

Attention: James Ingalls, P.E

**SUBJECT: SUBSURFACE EXPLORATION, LABORATORY TESTING PROGRAM
AND PAVEMENT EVALUATION
FOR THE PROPOSED WATERCOLOURS UNIT 1 ROADWAYS
FM 2722 & FM 2673
COMAL COUNTY, TEXAS
ROCK Project No.: G223051**

Dear Mr. Ingalls,

In accordance with our agreement, we have conducted a subsurface exploration and pavement evaluation for the above referenced project. The results of this exploration, together with our recommendations, are to be found in the accompanying report, an electronic copy of which is being transmitted herewith. Rock Engineering and Testing Laboratory, LLC (ROCK) will provide up to two (2) hard copies of this report at the request of the client.

Often, because of design and construction details that occur on a project, questions arise concerning soil conditions. ROCK would be pleased to continue its role as the Geotechnical Engineer during project implementation.

ROCK also has great interest in providing materials testing and observation services during the construction phase of this project. If you will advise us of the appropriate time to discuss these engineering services, we will be pleased to meet with you at your convenience.

Sincerely,

Kyle D. Hammock, P.E.
Vice President - San Antonio

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**SUBSURFACE EXPLORATION, LABORATORY TESTING PROGRAM,
AND PAVEMENT EVALUATION
FOR THE PROPOSED
WATERCOLOURS UNIT 1 ROADWAYS
FM 2722 & FM 2673
COMAL COUNTY, TEXAS**

ROCK PROJECT NUMBER: G223051

PREPARED FOR:

**INK CIVIL
2021 SH 46 W, STE. 105
NEW BRAUNFELS, TEXAS 78132**

FEBRUARY 23, 2023

PREPARED BY:

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**TEXAS BOARD OF PROFESSIONAL ENGINEERS
FIRM REGISTRATION NUMBER 2101**



**Kyle D. Hammock, P.E.
Vice President - San Antonio**



**Darren W. Lantz, P.E.
Senior Engineer**



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INTRODUCTION

This report presents the results of a subsurface exploration and pavement evaluation for the proposed Watercolours Unit 1 Roadways to be constructed near the intersection of FM 2722 & FM 2673 in Comal County, Texas. This study was conducted for INK Civil.

Authorization

The work for this project was performed in accordance with ROCK Proposal Number SGP011223A dated January 12, 2023. The proposal contained a scope of work, lump sum fee and limitations. The proposal was approved and signed by Mr. James Ingalls, P.E. on January 13, 2023 and returned to ROCK via email.

Purpose and Scope

The purpose of this exploration was to evaluate the soil conditions at the site and to provide pavement recommendations suitable for the proposed subdivision roadways.

The scope of the exploration and evaluation included the subsurface exploration, field and laboratory testing, engineering analysis and evaluation of the subsurface soils, provision of pavement recommendations, and preparation of this report.

The scope of services did not include an environmental assessment. Any statements in this report, or on the boring logs, regarding odors, colors, unusual or suspicious items or conditions are strictly for the information of the client.

General

The exploration and analysis of the subsurface conditions reported herein are considered sufficient in detail and scope to form a reasonable basis for the pavement design. The recommendations submitted for the proposed project are based on the available soil information and the preliminary design details provided by INK Civil. If the civil engineer requires additional soil parameters or other information to complete the pavement design, ROCK will provide the requested information as a supplement to this report.

The Geotechnical Engineer states that the findings, recommendations, specifications or professional advice contained herein, have been presented after being prepared in a manner consistent with the level of care and skill ordinarily exercised by reputable members of the Geotechnical Engineer's profession practicing contemporaneously under similar conditions in the locality of the project. ROCK operates in general accordance with "*Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction*", (ASTM D3740). No other representations are expressed or implied, and no warranty or guarantee is included or intended.

FIELD EXPLORATION

Scope

The field exploration, completed in order to evaluate the engineering characteristics of the subsurface materials, included a reconnaissance of the project site, drilling the test borings, and recovering disturbed split spoon samples.

A total of eleven (11) borings were performed at the site and were each drilled to a depth of 10-feet within the proposed new roadways. ROCK determined the number, depth and general location of the borings and staked the borings in the field. ROCK performed the boring operations. Upon completion of the drilling operations and obtaining the groundwater observations, the bore holes were backfilled with excavated soil and the site cleaned as required. A Boring Location Plan is provided in the Appendix of this report.

Drilling and Sampling Procedures

The borings were performed using a drilling rig equipped with a rotary head and air-rotary drilling methods were used to advance the boreholes to their desired depths. Disturbed samples were obtained employing split-barrel sampling procedures in general accordance with the procedures for "*Penetration Test and Split-Barrel Sampling of Soils*" (ASTM D1586). The samples were classified in the field, placed in plastic bags, marked according to their boring number, depth and any other pertinent field data, stored in special containers and delivered to the laboratory for testing.

Field Tests and Measurements

Penetration Tests - During the sampling procedures, standard penetration tests (SPT) were performed to obtain the standard penetration value of the soil. The standard penetration value (N) is defined as the number of blows of a 140-pound hammer falling 30 inches required to advance the split-barrel sampler 1-foot into the soil. The sampler is lowered to the bottom of the previously cleaned drill hole and advanced by blows from the hammer. The number of blows is recorded for each of three successive 6-inch penetrations. The "N" value is obtained by adding the second and third 6-inch increment number of blows. The results of standard penetration tests indicate the relative density of cohesionless soils and comparative consistency of cohesive soils, thereby providing a basis for estimating the relative strength and compressibility of the soil profile components.

Water Level Observations - Water level observations were obtained during the test boring operations and are noted on the boring logs provided in the Appendix. The amount of water in open boreholes largely depends on the permeability of the soils encountered at the boring locations. In relatively pervious soils, such as sandy soils, the indicated depths are usually reliable groundwater levels. In relatively impervious soils, a suitable estimate of the groundwater depth may not be possible, even after several days of observation. Seasonal variations, temperature, land-use, proximity to a body of water, and recent rainfall conditions may influence the depth to the groundwater.

Ground Surface Elevations - Ground surface elevations were not provided at the boring locations. All depths referred to in this report are reported from the actual ground surface elevations at the boring locations during the time of our field investigation.

LABORATORY TESTING PROGRAM

In addition to the field investigation, a laboratory-testing program was conducted to determine additional pertinent engineering characteristics of the subgrade materials necessary in developing the pavement recommendations for the roadways.

The laboratory-testing program included supplementary visual classification (ASTM D2487) on all samples. In addition, selected samples were subjected water content tests (ASTM D2216), Atterberg limits tests (ASTM D4318), percent material finer than the #200 sieve tests (ASTM D1140), moisture density relationship tests (ASTM D698), and California Bearing Ratio (CBR) tests (ASTM D1883).

All phases of the laboratory-testing program were conducted in general accordance with applicable ASTM Specifications. The results of the moisture content and index tests are to be found in this report or on the accompanying boring logs provided in the Appendix.

SUBSURFACE CONDITIONS

General

The types of subsurface materials encountered in the test borings have been visually classified and are described in detail on the boring logs. The results of the standard penetration tests, water level observations and laboratory tests are presented on the boring logs in numerical form.

Representative samples of the soils were placed in polyethylene bags and are now stored in the laboratory for further analysis, if desired. Unless notified to the contrary, all samples will be disposed of 3 months after issuance of this report.

The stratification of the soil, as shown on the boring logs, represents the soil conditions at the actual boring locations. Variations may occur between, or beyond, the boring locations. Lines of demarcation represent the approximate boundary between different soil types, but the transition may be gradual, or not clearly defined. It should be noted that, whereby the test borings were drilled and sampled by experienced technicians, it is sometimes difficult to record changes in stratification within narrow limits. In the absence of foreign substances, it is also difficult to distinguish between discolored soils and clean soil fill.

Generalized Soil Conditions

The soil conditions at the project site generally consist of an upper stratum of clayey soils underlain by severely weathered to unweathered limestone that extends to the boring termination depths of 10-feet. The upper clayey soils are highly variable and include sandy fat clay, clayey sand, silty clayey sand, fat clay with gravel and sandy lean clay. For the majority of the explored locations, these upper clayey soils are relatively thin and range in thickness between a few inches to approximately 2-feet. At Borings B-7, B-10 and B-11, the upper clayey soils extended to depths of approximately 5 to 8-feet before encountering limestone materials.

The clayey overburden soils are low to high in plasticity with tested plasticity index (PI) values ranging from 7 to 46 and have stiff to very hard consistencies based on Standard Penetration Test (SPT) "N"-values ranging from 9 to in excess of 50 blows per foot of penetration. The underlying severely weathered limestone, weathered limestone and limestone materials are generally non-plastic; however, they do contain some low plasticity soil inclusions where tested plasticity index (PI) values of 1 to 6 were obtained. The weathered limestone and limestone materials are typically very hard, with SPT "N"-values in excess of 50 blows per foot of penetration. Some of the severely weathered limestone, where soil inclusions are typically present, had stiff to hard consistency with SPT "N"-values of 8 and 33 blows per foot of penetration.

Detailed subsurface descriptions at the boring locations can be found on the boring logs included in the Appendix of this report.

Groundwater Observations

Groundwater was not encountered in the borings during the drilling nor observed to be present in the borings upon completion of the drilling. It should be noted that water levels in open boreholes may require anywhere from several hours to several days to stabilize depending on the permeability of the soils and that groundwater levels at this site may be subject to seasonal conditions, recent rainfall, drought or temperature effects.

PAVEMENT RECOMMENDATIONS

Based on the information provided to ROCK, the proposed project will consist of the construction of approximately 11,000 linear feet of flexible asphaltic concrete pavements for the subdivision roadways. In designing the proposed pavements, the existing subgrade conditions must be considered together with the expected traffic use and loading conditions.

The conditions that influence pavement design can be summarized as follows:

1. Bearing values of the subgrade. These values can be represented by a California Bearing Ratio (CBR) for the design of flexible asphalt pavements.

2. Vehicular traffic, in terms of the number and frequency of vehicles and their range of axle loads.
3. Probable increase in vehicular use over the life of the pavement.
4. The availability of suitable materials to be used in the construction of the pavement and their relative costs.

Specific laboratory testing to define the subgrade strength (i.e. CBR/K values) has been performed for this analysis. Based upon the CBR test results of two bulk samples collected from the site and representing the clayey overburden soils, a CBR value of 2.0 has been selected for design.

We have evaluated the proposed new flexible pavements using the criteria set forth in the City of San Antonio Design Guidance Manual for "Local Type A streets without bus traffic". The following pavement design parameters were selected:

| AASHTO PAVEMENT DESIGN PARAMETER | DESIGN VALUE |
|--|---------------------|
| Reliability (R) | 70% |
| Overall Deviation | 0.45 |
| Initial/Terminal Serviceability | 4.2 / 2.0 |
| Subgrade Design CBR | 2.0 |
| Subgrade Resilient Modulus (Mr) | 3,120 |
| Design Equivalent 18-kip Single Axle Loads (ESALs) | 100,000 |
| Implied Design Life | 20 years |

The following limestone base and hot mix asphaltic concrete layer coefficients were selected for the pavement design:

| Pavement Constituent | Layer Coefficient (α) |
|-----------------------------|--|
| Type C or D HMAC | 0.44 |
| Crushed Limestone Base | 0.14 |

If the owner or consultant provides considerations that conflict with the pavement design parameters presented in the tables above, then ROCK should be provided the appropriate design information and given the opportunity, prior to final issue of the plans and specifications, to determine if supplemental recommendations are warranted.

The recommended hot mixed asphaltic concrete (HMAC) pavement sections are provided in the following table:

| “LOCAL TYPE A STREET WITHOUT BUS TRAFFIC” (Required AASHTO 18-KIP ESAL = 100,000) | | |
|--|----------------------|----------------------|
| Subgrade Type | Soil Subgrade | Rock Subgrade |
| Hot Mix Asphaltic Concrete | 2" | 2" |
| Crushed Limestone Base | 10" | 10" |
| TENSAR TX-5 Triaxial Geogrid | Yes | --- |
| Compacted Subgrade | 8" | --- |
| Calculated AASHTO 18-kip ESAL | 111,000 | >150,000 |

ROCK recommends designing all of the planned pavement areas based on the “Soil Subgrade” condition as indicated in the above table. However, if grading plans result in large and continuous portions of the roadways at least 200-feet in length being in “cut” areas that expose severely weathered, weathered or unweathered limestone, the Tensar TX-5 triaxial geogrid can be omitted for those areas. Where the subgrade transitions between soil subgrade and rock subgrade, the geogrid should extend at least 50-feet beyond the transition.

Compacted Subgrade

After all surface organics and deleterious materials have been removed and the desired subgrade elevation has been achieved, the upper 8-inches of exposed subgrade soils should be compacted to a minimum density of 95-percent of the maximum dry unit weight of the subgrade soils as determined by ASTM D1557 and at or above the optimum moisture content. Any embankment fill required to achieve the final subgrade elevation shall be clean soils placed in maximum 8-inch loose lifts and compacted as specified above.

Triaxial Geogrid

The TENSAR TX-5 triaxial geogrid shall be placed in accordance with the manufacturer’s recommendations. Geogrid is recommended to reduce the magnitude of cracking, reduce maintenance costs and increase the life of flexible pavements. The geogrid should be placed in all areas containing soil subgrade and may be omitted in areas containing continuous limestone rock subgrade for a distance of at least 200-feet. Where the subgrade transitions from soil subgrade to rock subgrade, the geogrid should extend beyond the transition area and into the rock subgrade area for a minimum distance of 50-feet. Alternate geogrid products will not be considered unless the submittal contains a pavement design sealed by a licensed engineer.

Crushed Limestone Base

Limestone base materials should meet the requirements set forth in the Texas Department of Transportation (TxDOT) 2014 Standard Specifications for Construction of Highways, Streets and Bridges; Item 247, Type A, Grade 1-2. The base material should be placed in maximum 8-inch thick loose lifts and compacted to a minimum density of 95-percent of the maximum dry density as determined by ASTM D1557 within -2 to +2 percentage points of the optimum moisture content.

Hot Mix Asphalt

Hot mix asphaltic concrete should meet the requirements set forth in TxDOT Item 340 or Item 341; Type C or D surface course. The asphaltic concrete should be compacted to between 91.5 and 96.3-percent of the maximum theoretical density as determined by the Rice specific gravity.

Drainage

Proper drainage is very important for the adequate performance of asphaltic pavements. Ruts and birdbaths in asphalt pavements allow for quick deterioration of the pavement primarily due to saturation of the underlying base materials and subgrade soils.

The pavement design recommendations in this report are based on the assumption that the pavements will have good drainage. A minimum cross-slope of 2-percent in the pavement surface is recommended. In addition, full depth curbs extending through the base materials and at least 6-inches into the subgrade are recommended. If full depth curbs are not utilized, pavement edge drains or other moisture barriers are recommended.

GENERAL COMMENTS

If significant changes are made in the character or location of the proposed project, a consultation should be arranged to review any changes with respect to the prevailing soil conditions. At that time, it may be necessary to submit supplementary recommendations.

It is recommended that the services of ROCK be engaged to test and evaluate the subgrade soils in the pavement areas prior to placing pavement constituents in order to verify that the bearing soils are consistent with those encountered in the borings. ROCK cannot accept any responsibility for any conditions that deviate from those described in this report, nor for the performance of the pavements if not engaged to also provide construction observation and testing for this project. If it is required for ROCK to accept any liability, then ROCK must agree with the plans and perform such observation during construction as we recommend.

February 23, 2023
INK Civil
ROCK Project No.: G223051

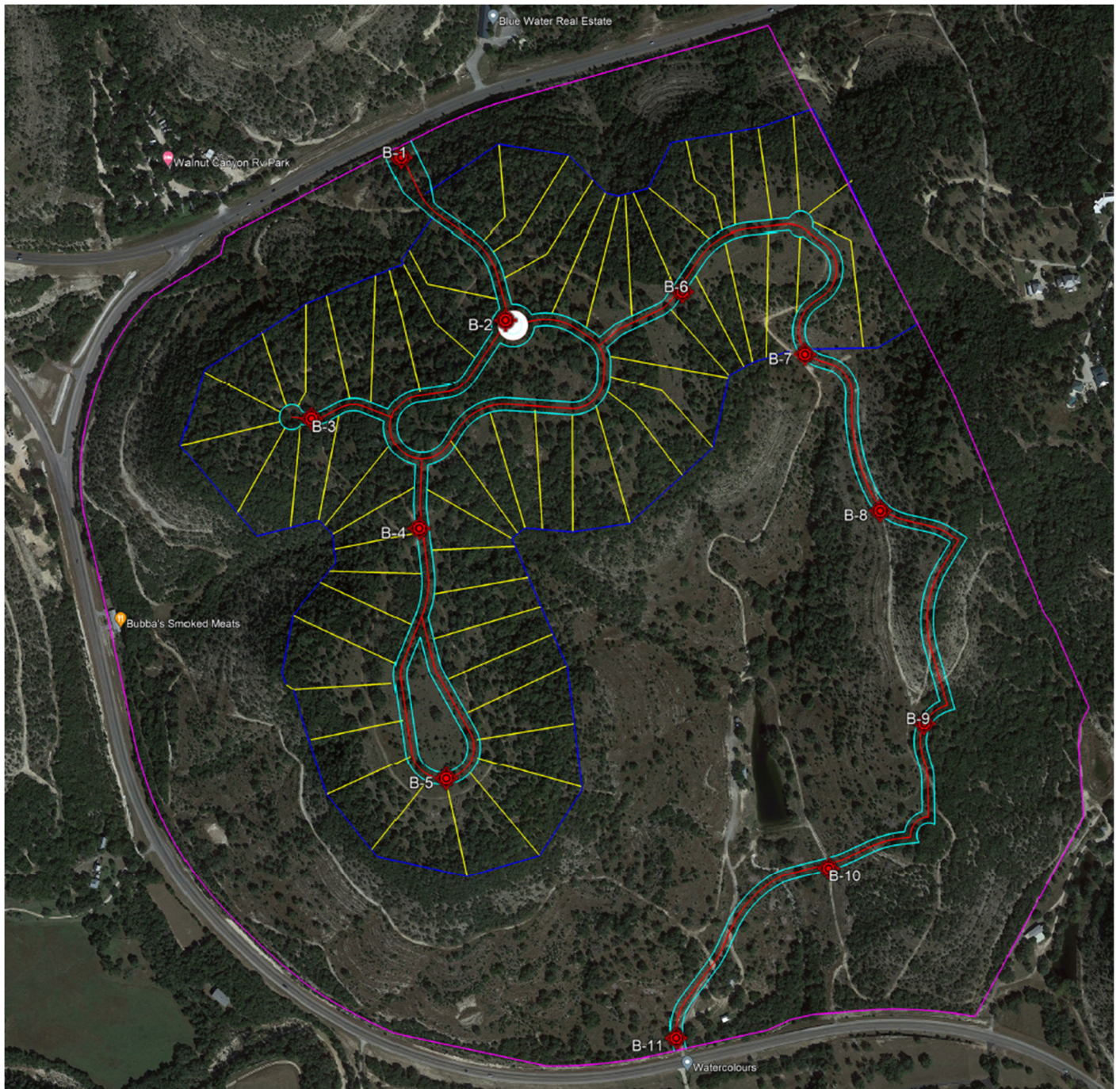
WATERCOLOURS UNIT 1 ROADWAYS
FM 2722 & FM 2673
Comal County, Texas

All sheeting, shoring and bracing of trenches, pits and excavations should be made the responsibility of the contractor and should comply with all current and applicable local, state and federal safety codes, regulations and practices, including the Occupational Safety and Health Administration.

APPENDIX

BORING LOCATION PLAN

NO SCALE
LOCATIONS ARE APPROXIMATE



February 23, 2023
INK Civil
RETL Project No.: G223047

WATERCOLOURS UNIT 1 ROADWAYS
FM 2722 & FM 2673
Comal County, Texas



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LOG OF BORING 01

SHEET 1 of 1

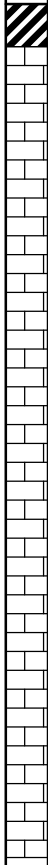


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A UES COMPANY

CLIENT: INK Civil
PROJECT: Watercolours Unit 1 Roadways
LOCATION: FM 2722 & FM 2673; Comal County, TX
NUMBER: G223051

DATE(S) DRILLED: 01/27/2023

| FIELD DATA | | | | LABORATORY DATA | | | | | | | DRILLING METHOD(S): | |
|--|------------|---------------|--|----------------------|-----------------|---------------|------------------|-----------------------------|---|-------------------------|---|--|
| SOIL SYMBOL | DEPTH (FT) | SAMPLE NUMBER | SAMPLES N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT Qc: TONS/SQ FT | MOISTURE CONTENT (%) | ATTEBERG LIMITS | | | DRY DENSITY POUNDS/CU.FT | COMPRESSIVE STRENGTH (TONS/SQ FT) | MINUS NO. 200 SIEVE (%) | Air Rotary | |
| | | | | | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | | | | GROUNDWATER INFORMATION: | |
| | | | | | LL | PL | PI | | | | Groundwater was not encountered during the drilling operations and the boring was dry upon completion of the drilling operations. | |
| | | | | | | | | | | | SURFACE ELEVATION: N/A | |
| | | | | | | | | | | | DESCRIPTION OF STRATUM | |
|  | 1 | SPT S-1 | N=50/3" | 12 | | | | | | | SANDY FAT CLAY , dark brown, moist. | |
| | 2 | | | | | | | | | | WEATHERED LIMESTONE , tan, dry, very hard. | |
| | 3 | SPT S-2 | N=50/3" | 7 | | | | | | 28 | Same as above. | |
| | 4 | | | | | | | | | | | |
| | 5 | SPT S-3 | N=50/3" | 7 | | | | | | | Same as above. | |
| | 6 | | | | | | | | | | | |
| | 7 | SPT S-4 | N=40-50/2" | 10 | | | | | | 71 | WEATHERED LIMESTONE , gray, moist, very hard. | |
| | 8 | | | | | | | | | | | |
| | 9 | SPT S-5 | N=50/3" | 12 | | | | | | | Same as above. | |
| | 10 | | | | | | | | | | Boring terminated at a depth of 10-feet. | |
| | | | | | | | | | | | REMARKS: | |
| N - STANDARD PENETRATION TEST RESISTANCE Qc - STATIC CONE PENETROMETER TEST INDEX P - POCKET PENETROMETER RESISTANCE | | | | | | | | | | | Boring location determined by ROCK. Drilling operations performed by ROCK. GPS Coordinates: N 29.833809°, W -98.240897° | |

DRILLING METHOD(S):

Air Rotary

GROUNDWATER INFORMATION:

Groundwater was not encountered during the drilling operations and the boring was dry upon completion of the drilling operations.

SURFACE ELEVATION: N/A

DESCRIPTION OF STRATUM

SANDY FAT CLAY, dark brown, moist.

WEATHERED LIMESTONE, tan, dry, very hard.

Same as above.

Same as above.

WEATHERED LIMESTONE, gray, moist, very hard.

Same as above.

Boring terminated at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
Qc - STATIC CONE PENETROMETER TEST INDEX
P - POCKET PENETROMETER RESISTANCE

LOG OF BORING G223051 LOGS.GPJ ROCK ETL GDT 2/23/23

LOG OF BORING 02

SHEET 1 of 1



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A UES COMPANY

CLIENT: INK Civil
PROJECT: Watercolours Unit 1 Roadways
LOCATION: FM 2722 & FM 2673; Comal County, TX
NUMBER: G223051

DATE(S) DRILLED: 01/26/2023

| FIELD DATA | | | | | LABORATORY DATA | | | | | | | DRILLING METHOD(S): | |
|--|------------|---------------|---------|---|----------------------|------------------|---------------|------------------|-----------------------------|---|-------------------------|---|--|
| SOIL SYMBOL | DEPTH (FT) | SAMPLE NUMBER | SAMPLES | N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT Qc: TONS/SQ FT | MOISTURE CONTENT (%) | ATTERBERG LIMITS | | | DRY DENSITY POUNDS/CU.FT | COMPRESSIVE STRENGTH (TONS/SQ FT) | MINUS NO. 200 SIEVE (%) | GROUNDWATER INFORMATION: | |
| | | | | | | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | | | | Groundwater was not encountered during the drilling operations and the boring was dry upon completion of the drilling operations. | |
| | | | | | | LL | PL | PI | | | | SURFACE ELEVATION: N/A | |
| | | | | | | | | | | | | DESCRIPTION OF STRATUM | |
| | 1 | SPT S-1 | N=16 | 23 | 57 | 18 | 39 | | | | 60 | <u>SANDY FAT CLAY</u> , dark brown, moist, very stiff. (CH) | |
| | 2 | | | | | | | | | | | | |
| | 3 | SPT S-2 | N=50/1" | 3 | | | | | | | | <u>LIMESTONE</u> , tan, dry, very hard. | |
| | 4 | | | | | | | | | | | | |
| | 5 | SPT S-3 | N=33 | 5 | 19 | 18 | 1 | | | | 40 | <u>SEVERELY WEATHERED LIMESTONE</u> , tan, dry, hard. | |
| | 6 | | | | | | | | | | | | |
| | 7 | SPT S-4 | N=8 | 11 | | | | | | | | Same as above, with calcareous material, light brown, moist, stiff. | |
| | 8 | | | | | | | | | | | | |
| | 9 | SPT S-5 | N=50/3" | 8 | | | | | | | | <u>WEATHERED LIMESTONE</u> , tan, dry, very hard. | |
| | 10 | | | | | | | | | | | Boring terminated at a depth of 10-feet. | |
| | | | | | | | | | | | | REMARKS: | |
| N - STANDARD PENETRATION TEST RESISTANCE Qc - STATIC CONE PENETROMETER TEST INDEX P - POCKET PENETROMETER RESISTANCE | | | | | | | | | | | | Boring location determined by ROCK. Drilling operations performed by ROCK. GPS Coordinates: N 29.831945°, W -98.239508° | |

LOG OF BORING G223051 LOGS.GPJ ROCK ETL GDT 2/23/23

LOG OF BORING 03

SHEET 1 of 1



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A UES COMPANY

CLIENT: INK Civil
PROJECT: Watercolours Unit 1 Roadways
LOCATION: FM 2722 & FM 2673; Comal County, TX
NUMBER: G223051

DATE(S) DRILLED: 01/26/2023

| FIELD DATA | | | | LABORATORY DATA | | | | | | | DRILLING METHOD(S): | |
|--|------------|---------------|--|----------------------|------------------|---------------|------------------|-----------------------------|---|-------------------------|---|--|
| SOIL SYMBOL | DEPTH (FT) | SAMPLE NUMBER | SAMPLES N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT Qc: TONS/SQ FT | MOISTURE CONTENT (%) | ATTERBERG LIMITS | | | DRY DENSITY POUNDS/CU.FT | COMPRESSIVE STRENGTH (TONS/SQ FT) | MINUS NO. 200 SIEVE (%) | Air Rotary | |
| | | | | | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | | | | GROUNDWATER INFORMATION: | |
| | | | | | | | | | | | Groundwater was not encountered during the drilling operations and the boring was dry upon completion of the drilling operations. | |
| | | | | | | | | | | | SURFACE ELEVATION: N/A | |
| | | | | | | | | | | | DESCRIPTION OF STRATUM | |
| | 1 | SPT S-1 | N=9-50/3" | 10 | | | | | | 28 | SANDY FAT CLAY , dark brown, moist. | |
| | 2 | | | | | | | | | | WEATHERED LIMESTONE , light brown, dry, very hard. | |
| | 3 | SPT S-2 | N=32-50/1" | 5 | | | | | | 31 | Same as above. | |
| | 4 | | | | | | | | | | | |
| | 5 | SPT S-3 | N=50/1" | 3 | | | | | | | LIMESTONE , light brown, dry, very hard. | |
| | 6 | | | | | | | | | | | |
| | 7 | SPT S-4 | N=50/1" | 2 | | | | | | | Same as above. | |
| | 8 | | | | | | | | | | | |
| | 9 | SPT S-5 | N=50/2" | 6 | | | | | | | Same as above. | |
| | 10 | | | | | | | | | | Boring terminated at a depth of 10-feet. | |
| | | | | | | | | | | | REMARKS: | |
| N - STANDARD PENETRATION TEST RESISTANCE Qc - STATIC CONE PENETROMETER TEST INDEX P - POCKET PENETROMETER RESISTANCE | | | | | | | | | | | Boring location determined by ROCK. Drilling operations performed by ROCK. GPS Coordinates: N 29.830872°, W -98.241946° | |

LOG OF BORING 04

SHEET 1 of 1

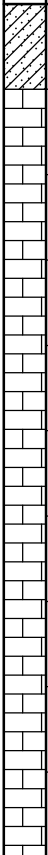


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CLIENT: INK Civil
PROJECT: Watercolours Unit 1 Roadways
LOCATION: FM 2722 & FM 2673; Comal County, TX
NUMBER: G223051

DATE(S) DRILLED: 01/27/2023

| FIELD DATA | | | | | LABORATORY DATA | | | | | | | DRILLING METHOD(S): | | |
|--|------------|---------------|------------|---|----------------------|------------------|---------------|------------------|-----------------------------|---|-------------------------|--|--|--|
| SOIL SYMBOL | DEPTH (FT) | SAMPLE NUMBER | SAMPLES | N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT Qc: TONS/SQ FT | MOISTURE CONTENT (%) | ATTERBERG LIMITS | | | DRY DENSITY POUNDS/CU.FT | COMPRESSIVE STRENGTH (TONS/SQ FT) | MINUS NO. 200 SIEVE (%) | GROUNDWATER INFORMATION: | | |
| | | | | | | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | | | | Groundwater was not encountered during the drilling operations and the boring was dry upon completion of the drilling operations. | | |
| | | | | | | | | | | | | SURFACE ELEVATION: N/A | | |
| DESCRIPTION OF STRATUM | | | | | | | | | | | | | | |
|  | 1 | SPT S-1 | N=11-50/4" | 10 | | | | | | | 41 | <u>CLAYEY SAND</u> , brown to light brown, moist, very hard. | | |
| | 2 | | | | | | | | | | | | | |
| | 3 | SPT S-2 | N=50/1" | 5 | | | | | | | | <u>LIMESTONE</u> , tan, dry, very hard. | | |
| | 4 | | | | | | | | | | | | | |
| | 5 | SPT S-3 | N=50/1" | 4 | | | | | | | | Same as above. | | |
| | 6 | | | | | | | | | | | | | |
| | 7 | SPT S-4 | N=50/1" | 4 | | | | | | | | Same as above. | | |
| | 8 | | | | | | | | | | | | | |
| | 9 | SPT S-5 | N=50/1" | 5 | | | | | | | | | <u>LIMESTONE</u> , tan, dry, very hard. | |
| | 10 | | | | | | | | | | | | Boring terminated at a depth of 10-feet. | |
| N - STANDARD PENETRATION TEST RESISTANCE Qc - STATIC CONE PENETROMETER TEST INDEX P - POCKET PENETROMETER RESISTANCE | | | | | | | | | | | | REMARKS: Boring location determined by ROCK. Drilling operations performed by ROCK. GPS Coordinates: N 29.829673°, W -98.240596° | | |

LOG OF BORING G223051 LOGS.GPJ ROCK ETL GDT 2/23/23

LOG OF BORING 05

SHEET 1 of 1



Rock Engineering & Testing Laboratory LLC
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

CLIENT: INK Civil
PROJECT: Watercolours Unit 1 Roadways
LOCATION: FM 2722 & FM 2673; Comal County, TX
NUMBER: G223051

DATE(S) DRILLED: 01/27/2023

DRILLING METHOD(S):


Air Rotary

GROUNDWATER INFORMATION:

Groundwater was not encountered during the drilling operations and the boring was dry upon completion of the drilling operations.

SURFACE ELEVATION: N/A

DESCRIPTION OF STRATUM

| FIELD DATA | | LABORATORY DATA | | | | | | | | DRILLING METHOD(S): | | |
|---|------------|-----------------|------------|---|----------------------|------------------|---------------|------------------|-----------------------------|---|---|---|
| SOIL SYMBOL | DEPTH (FT) | SAMPLE NUMBER | SAMPLES | N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT Qc: TONS/SQ FT | MOISTURE CONTENT (%) | ATTERBERG LIMITS | | | DRY DENSITY POUNDS/CU.FT | COMPRESSIVE STRENGTH (TONS/SQ FT) | MINUS NO. 200 SIEVE (%) | Air Rotary |
| | | | | | | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | | | | GROUNDWATER INFORMATION: Groundwater was not encountered during the drilling operations and the boring was dry upon completion of the drilling operations. |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| SURFACE ELEVATION: N/A | | | | | | | | | | | | DESCRIPTION OF STRATUM |
|  | 1 | SPT S-1 | N=9 | 13 | 29 | 22 | 7 | | | 46 | <u>SILTY CLAYEY SAND</u> , dark brown to brown, moist, stiff. (SC-SM) | |
| | 2 | | | | | | | | | | | |
| | 3 | SPT S-2 | N=50/4" | 8 | | | | | | | <u>WEATHERED LIMESTONE</u> , light brown, dry, very hard. | |
| | 4 | | | | | | | | | | | |
| | 5 | SPT S-3 | N=22-50/3" | 10 | | | | | | | Same as above, with clay seams, moist. | |
| | 6 | | | | | | | | | | | |
| | 7 | SPT S-4 | N=50/0" | 2 | | | | | | | <u>LIMESTONE</u> , light brown, dry, very hard. | |
| | 8 | | | | | | | | | | | |
| | 9 | SPT S-5 | N=50/1" | 2 | | | | | | | Same as above. | |
| | 10 | | | | | | | | | | Boring terminated at a depth of 10-feet. | |

N - STANDARD PENETRATION TEST RESISTANCE
Qc - STATIC CONE PENETROMETER TEST INDEX
P - POCKET PENETROMETER RESISTANCE

REMARKS:

Boring location determined by ROCK. Drilling operations performed by ROCK.
GPS Coordinates: N 29.826941°, W -98.240261°

LOG_OF_BORING G223051 LOGS.GPJ ROCK_ETL.GDT 2/23/23

LOG OF BORING 06

SHEET 1 of 1

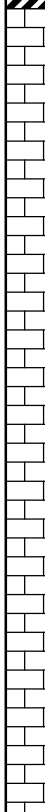


Rock Engineering & Testing Laboratory LLC
10856 Vandale Street
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Telephone: 210-495-8000
Fax: 210-495-8015

A UES COMPANY

CLIENT: INK Civil
PROJECT: Watercolours Unit 1 Roadways
LOCATION: FM 2722 & FM 2673; Comal County, TX
NUMBER: G223051

DATE(S) DRILLED: 01/26/2023

| FIELD DATA | | | | | LABORATORY DATA | | | | | | | DRILLING METHOD(S): Air Rotary | |
|--|------------|---------------|--|----------------------|------------------|---------------|------------------|-----------------------------|---|-------------------------|---|-----------------------------------|--|
| SOIL SYMBOL | DEPTH (FT) | SAMPLE NUMBER | SAMPLES N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT Qc: TONS/SQ FT | MOISTURE CONTENT (%) | ATTERBERG LIMITS | | | DRY DENSITY POUNDS/CU.FT | COMPRESSIVE STRENGTH (TONS/SQ FT) | MINUS NO. 200 SIEVE (%) | GROUNDWATER INFORMATION: Groundwater was not encountered during the drilling operations and the boring was dry upon completion of the drilling operations. | | |
| | | | | | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | | | | SURFACE ELEVATION: N/A | | |
| | | | | | LL | PL | PI | | | | DESCRIPTION OF STRATUM | | |
|  | 1 | SPT S-1 | N=18-50/3" | 19 | 75 | 29 | 46 | | | 72 | FAT CLAY WITH GRAVEL , dark brown, moist. (CH) | | |
| | 2 | | | | | | | | | | LIMESTONE , tan, dry, hard. | | |
| | 3 | SPT S-2 | N=50/1" | 1 | | | | | | | Same as above. | | |
| | 4 | | | | | | | | | | | | |
| | 5 | SPT S-3 | N=50/1" | 1 | | | | | | | Same as above. | | |
| | 6 | | | | | | | | | | | | |
| | 7 | SPT S-4 | N=50/1" | 1 | | | | | | | LIMESTONE , tan, dry, hard. | | |
| | 8 | | | | | | | | | | | | |
| | 9 | SPT S-5 | N=50/1" | 1 | | | | | | | Same as above. | | |
| | 10 | | | | | | | | | | Boring terminated at a depth of 10-feet. | | |
| N - STANDARD PENETRATION TEST RESISTANCE Qc - STATIC CONE PENETROMETER TEST INDEX P - POCKET PENETROMETER RESISTANCE | | | | | | | | | | | REMARKS: Boring location determined by ROCK. Drilling operations performed by ROCK. GPS Coordinates: N 29.832274°, W -98.237290° | | |

LOG OF BORING 07

SHEET 1 of 1



Rock Engineering & Testing Laboratory LLC
10856 Vandale Street
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Telephone: 210-495-8000
Fax: 210-495-8015

A UES COMPANY

CLIENT: INK Civil
PROJECT: Watercolours Unit 1 Roadways
LOCATION: FM 2722 & FM 2673; Comal County, TX
NUMBER: G223051

DATE(S) DRILLED: 01/26/2023

| FIELD DATA | | | | LABORATORY DATA | | | | | | | | DRILLING METHOD(S): Air Rotary | |
|--|------------|---------------|--|----------------------|------------------|---------------|------------------|-----------------------------|---|-------------------------|---|--|--|
| SOIL SYMBOL | DEPTH (FT) | SAMPLE NUMBER | SAMPLES N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT Qc: TONS/SQ FT | MOISTURE CONTENT (%) | ATTERBERG LIMITS | | | DRY DENSITY POUNDS/CU.FT | COMPRESSIVE STRENGTH (TONS/SQ FT) | MINUS NO. 200 SIEVE (%) | GROUNDWATER INFORMATION: Groundwater was not encountered during the drilling operations and the boring was dry upon completion of the drilling operations. | | |
| | | | | | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | | | | SURFACE ELEVATION: N/A | | |
| | | | | | LL | PL | PI | | | | DESCRIPTION OF STRATUM | | |
| | 1 | SPT S-1 | N=32 | 8 | 16 | 13 | 3 | | | 43 | <u>SEVERELY WEATHERED LIMESTONE</u> , light brown, dry, hard. | | |
| | 2 | | | | | | | | | | | | |
| | 3 | SPT S-2 | N=28 | 17 | | | | | | | <u>SILTY CLAY</u> , light brown, moist, very stiff. | | |
| | 4 | | | | | | | | | | | | |
| | 5 | SPT S-3 | N=36 | 14 | | | | | | 91 | Same as above, with weathered limestone. | | |
| | 6 | | | | | | | | | | | | |
| | 7 | SPT S-4 | N=38 | 14 | | | | | | | Same as above. | | |
| | 8 | | | | | | | | | | | | |
| | 9 | SPT S-5 | N=50/2" | 8 | | | | | | | <u>LIMESTONE</u> , light brown, dry, very hard. | | |
| | 10 | | | | | | | | | | Boring terminated at a depth of 10-feet. | | |
| | | | | | | | | | | | | REMARKS: Boring location determined by ROCK. Drilling operations performed by ROCK. GPS Coordinates: N 29.831631°, W -98.235713° | |
| N - STANDARD PENETRATION TEST RESISTANCE Qc - STATIC CONE PENETROMETER TEST INDEX P - POCKET PENETROMETER RESISTANCE | | | | | | | | | | | | | |

LOG OF BORING G223051 LOGS.GPJ ROCK ETL.GDT 2/23/23

LOG OF BORING 08

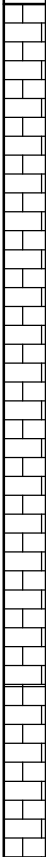
SHEET 1 of 1



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San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

A UES COMPANY

CLIENT: INK Civil
PROJECT: Watercolours Unit 1 Roadways
LOCATION: FM 2722 & FM 2673; Comal County, TX
NUMBER: G223051
DATE(S) DRILLED: 01/26/2023

| FIELD DATA | | | | LABORATORY DATA | | | | | | | DRILLING METHOD(S): | |
|--|------------|---------------|--|----------------------|-----------------|---------------|------------------|-----------------------------|---|-------------------------|--|--|
| SOIL SYMBOL | DEPTH (FT) | SAMPLE NUMBER | SAMPLES N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT Qc: TONS/SQ FT | MOISTURE CONTENT (%) | ATTEBERG LIMITS | | | DRY DENSITY POUNDS/CU.FT | COMPRESSIVE STRENGTH (TONS/SQ FT) | MINUS NO. 200 SIEVE (%) | GROUNDWATER INFORMATION: | |
| | | | | | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | | | | Groundwater was not encountered during the drilling operations and the boring was dry upon completion of the drilling operations. | |
| | | | | | LL | PL | PI | | | | SURFACE ELEVATION: N/A | |
| | | | | | | | | | | | DESCRIPTION OF STRATUM | |
|  | 1 | SPT S-1 | N=22-50/5" | 10 | | | | | | 32 | <u>SEVERELY WEATHERED LIMESTONE</u> , with silt, light brown, moist, very hard. | |
| | 2 | | | | | | | | | | | |
| | 3 | SPT S-2 | N=31-50/4" | 9 | 22 | 21 | 1 | | | 55 | Same as above, dry. | |
| | 4 | | | | | | | | | | | |
| | 5 | SPT S-3 | N=50/5" | 10 | | | | | | | Same as above, moist. | |
| | 6 | | | | | | | | | | | |
| | 7 | SPT S-4 | N=22-50/2" | 12 | | | | | | | <u>SEVERELY WEATHERED LIMESTONE</u> , with silt, light brown, moist, very hard. | |
| | 8 | | | | | | | | | | | |
| | 9 | SPT S-5 | N=50/2" | 5 | | | | | | | <u>LIMESTONE</u> , tan, dry, very hard. | |
| | 10 | | | | | | | | | | Boring terminated at a depth of 10-feet. | |
| | | | | | | | | | | | REMARKS: Boring location determined by ROCK. Drilling operations performed by ROCK. GPS Coordinates: N 29.829881°, W -98.234741° | |
| N - STANDARD PENETRATION TEST RESISTANCE Qc - STATIC CONE PENETROMETER TEST INDEX P - POCKET PENETROMETER RESISTANCE | | | | | | | | | | | | |

LOG OF BORING G223051 LOGS.GPJ ROCK ETL GDT 2/23/23

LOG OF BORING 09

SHEET 1 of 1



Rock Engineering & Testing Laboratory LLC
10856 Vandale Street
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Telephone: 210-495-8000
Fax: 210-495-8015

A UES COMPANY

CLIENT: INK Civil
PROJECT: Watercolours Unit 1 Roadways
LOCATION: FM 2722 & FM 2673; Comal County, TX
NUMBER: G223051

DATE(S) DRILLED: 01/26/2023

| FIELD DATA | | | | | LABORATORY DATA | | | | | | | DRILLING METHOD(S): | |
|--|------------|---------------|-----------|---|----------------------|-----------------|---------------|------------------|-----------------------------|---|-------------------------|---|--|
| SOIL SYMBOL | DEPTH (FT) | SAMPLE NUMBER | SAMPLES | N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT Qc: TONS/SQ FT | MOISTURE CONTENT (%) | ATTEBERG LIMITS | | | DRY DENSITY POUNDS/CU.FT | COMPRESSIVE STRENGTH (TONS/SQ FT) | MINUS NO. 200 SIEVE (%) | GROUNDWATER INFORMATION: | |
| | | | | | | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | | | | Groundwater was not encountered during the drilling operations and the boring was dry upon completion of the drilling operations. | |
| | | | | | | LL | PL | PI | | | | SURFACE ELEVATION: N/A | |
| | | | | | | | | | | | | DESCRIPTION OF STRATUM | |
| | 1 | SPT S-1 | N=9-50/3" | 11 | 32 | 26 | 6 | | | | 37 | SANDY FAT CLAY , dark brown. | |
| | 2 | | | | | | | | | | | WEATHERED LIMESTONE , light brown, moist, very hard. | |
| | 3 | SPT S-2 | N=50/2" | 7 | | | | | | | | Same as above, dry. | |
| | 4 | | | | | | | | | | | | |
| | 5 | SPT S-3 | N=50/1" | 7 | | | | | | | | Same as above. | |
| | 6 | | | | | | | | | | | | |
| | 7 | SPT S-4 | N=50/4" | 8 | | | | | | | | WEATHERED LIMESTONE , gray, dry, very hard. | |
| | 8 | | | | | | | | | | | | |
| | 9 | SPT S-5 | N=50/3" | 8 | | | | | | | | Same as above. | |
| | 10 | | | | | | | | | | | Boring terminated at a depth of 10-feet. | |
| | | | | | | | | | | | | REMARKS: | |
| N - STANDARD PENETRATION TEST RESISTANCE Qc - STATIC CONE PENETROMETER TEST INDEX P - POCKET PENETROMETER RESISTANCE | | | | | | | | | | | | Boring location determined by ROCK. Drilling operations performed by ROCK. GPS Coordinates: N 29.827509°, W -98.234172° | |

LOG OF BORING G223051 LOGS.GPJ ROCK ETL.GDT 2/23/23

LOG OF BORING 10

SHEET 1 of 1




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10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

CLIENT: INK Civil
PROJECT: Watercolours Unit 1 Roadways
LOCATION: FM 2722 & FM 2673; Comal County, TX
NUMBER: G223051

DATE(S) DRILLED: 01/26/2023

A UES COMPANY

| | | FIELD DATA | | LABORATORY DATA | | | | | | | | DRILLING METHOD(S): | |
|--|------------|---------------|------------------------|---|----------------------|------------------|---------------|------------------|-----------------------------|---|-------------------------|---|---|
| SOIL SYMBOL | DEPTH (FT) | SAMPLE NUMBER | SAMPLES | N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT Qc: TONS/SQ FT | MOISTURE CONTENT (%) | ATTERBERG LIMITS | | | DRY DENSITY POUNDS/CU.FT | COMPRESSIVE STRENGTH (TONS/SQ FT) | MINUS NO. 200 SIEVE (%) | Air Rotary | |
| | | | | | | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | | | | GROUNDWATER INFORMATION: Groundwater was not encountered during the drilling operations and the boring was dry upon completion of the drilling operations. | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| LL | PL | PI | SURFACE ELEVATION: N/A | | | | | | | | | | |
| DESCRIPTION OF STRATUM | | | | | | | | | | | | | |
|  | 1 | SPT S-1 | N=23 | 14 | 31 | 17 | 14 | | | | 68 | <u>SANDY LEAN CLAY</u> , brown to light brown, moist, very stiff. (CL) | |
| | 2 | | | | | | | | | | | | |
| | 3 | SPT S-2 | N=40-50/4" | 5 | | | | | | | | | Same as above, with weathered limestone, light brown, dry, very hard. |
| | 4 | | | | | | | | | | | | |
| | 5 | SPT S-3 | N=24-50/3" | 8 | 29 | 15 | 14 | | | | 58 | Same as above. (CL) | |
| | 6 | | | | | | | | | | | | |
| | 7 | SPT S-4 | N=50/2" | 6 | | | | | | | | <u>WEATHERED LIMESTONE</u> , tan, dry, very hard. | |
| | 8 | | | | | | | | | | | | |
| | 9 | SPT S-5 | N=50/3" | 10 | | | | | | | | | Same as above, moist. |
| | 10 | | | | | | | | | | | | |
| | | | | | | | | | | | | Boring terminated at a depth of 10-feet. | |
| N - STANDARD PENETRATION TEST RESISTANCE Qc - STATIC CONE PENETROMETER TEST INDEX P - POCKET PENETROMETER RESISTANCE | | | | | | | | | | | | REMARKS: Boring location determined by ROCK. Drilling operations performed by ROCK. GPS Coordinates: N 29.825831°, W -98.235373° | |

LOG OF BORING 11

SHEET 1 of 1



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10856 Vandale Street
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Fax: 210-495-8015

A UES COMPANY

CLIENT: INK Civil
PROJECT: Watercolours Unit 1 Roadways
LOCATION: FM 2722 & FM 2673; Comal County, TX
NUMBER: G223051

DATE(S) DRILLED: 01/26/2023

| FIELD DATA | | | | | LABORATORY DATA | | | | | | | DRILLING METHOD(S): | |
|--|------------|---------------|------------|---|----------------------|-----------------|---------------|------------------|-----------------------------|---|-------------------------|---|--|
| SOIL SYMBOL | DEPTH (FT) | SAMPLE NUMBER | SAMPLES | N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT Qc: TONS/SQ FT | MOISTURE CONTENT (%) | ATTEBERG LIMITS | | | DRY DENSITY POUNDS/CU.FT | COMPRESSIVE STRENGTH (TONS/SQ.FT) | MINUS NO. 200 SIEVE (%) | GROUNDWATER INFORMATION: | |
| | | | | | | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | | | | Groundwater was not encountered during the drilling operations and the boring was dry upon completion of the drilling operations. | |
| | | | | | | LL | PL | PI | | | | SURFACE ELEVATION: N/A | |
| | | | | | | | | | | | | DESCRIPTION OF STRATUM | |
| | 1 | SPT S-1 | N=35 | 13 | 32 | 20 | 12 | | | | 24 | CLAYEY SAND , with weathered limestone, dark brown to brown, moist, hard. (SC) | |
| | 2 | | | | | | | | | | | | |
| | 3 | SPT S-2 | N=16-50/2" | 12 | 24 | 15 | 9 | | | | 24 | Same as above, light brown, very hard. | |
| | 4 | | | | | | | | | | | | |
| | 5 | SPT S-3 | N=29-50/5" | 12 | | | | | | | | SILTY CLAY , light brown, moist, very hard. | |
| | 6 | | | | | | | | | | | | |
| | 7 | SPT S-4 | N=18-50/2" | 13 | | | | | | | | Same as above. | |
| | 8 | | | | | | | | | | | | |
| | 9 | SPT S-5 | N=50/3" | 10 | | | | | | | | Same as above, with marl. | |
| | 10 | | | | | | | | | | | Boring terminated at a depth of 10-feet. | |
| | | | | | | | | | | | | REMARKS: | |
| N - STANDARD PENETRATION TEST RESISTANCE Qc - STATIC CONE PENETROMETER TEST INDEX P - POCKET PENETROMETER RESISTANCE | | | | | | | | | | | | Boring location determined by ROCK. Drilling operations performed by ROCK. GPS Coordinates: N 29.823900°, W -98.237366° | |

N - STANDARD PENETRATION TEST RESISTANCE
Qc - STATIC CONE PENETROMETER TEST INDEX
P - POCKET PENETROMETER RESISTANCE

REMARKS:


























Boring location determined by ROCK. Drilling operations performed by ROCK.
GPS Coordinates: N 29.823900°, W -98.237366°



A UES COMPANY

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Telephone: 210-495-8000

KEY TO SOIL CLASSIFICATION AND SYMBOLS

| UNIFIED SOIL CLASSIFICATION SYSTEM | | | | TERMS CHARACTERIZING SOIL STRUCTURE | |
|---|----------------------------|---|---|---|---|
| MAJOR DIVISIONS | | SYMBOL | NAME | | |
| COARSE GRAINED SOILS | GRAVEL AND GRAVELLY SOILS | GW |  | Well Graded Gravels or Gravel-Sand mixtures, little or no fines | SLICKENSIDED - having inclined planes of weakness that are slick and glossy in appearance FISSURED - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical LAMINATED (VARVED) - composed of thin layers of varying color and texture, usually grading from sand or silt at the bottom to clay at the top CRUMBLY - cohesive soils which break into small blocks or crumbs on drying CALCAREOUS - containing appreciable quantities of calcium carbonate, generally nodular WELL GRADED - having wide range in grain sizes and substantial amounts of all intermediate particle sizes POORLY GRADED - predominantly of one grain size uniformly graded) or having a range of sizes with some intermediate size missing (gap or skip graded) |
| | | 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 | |
| | SAND AND SANDY SOILS | 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 | |
| SILTS AND CLAYS LL < 50 | SILTS AND CLAYS LL < 50 | ML |  | Inorganic Silts and very fine Sands, Rock Flour, Silty or Clayey fine Sands or Clayey Silts | |
| | | CL |  | Inorganic Clays of low to medium plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays | |
| | | OL |  | Organic Silts and Organic Silt-Clays of low plasticity | |
| | SILTS AND CLAYS LL > 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 of medium to high plasticity, Organic Silts | |
| NON USCS MATERIALS | |  | Limestone | | |
| | |  | Marl/Claystone | | |
| | |  | Sandstone | | |
| SYMBOLS FOR TEST DATA | | | | | |
|  — Groundwater Level (Initial Reading) | | | | | |
|  — Groundwater Level (Final Reading) | | | | | |
|  — Shelby Tube Sample | | | | | |
|  — SPT Samples | | | | | |
|  — Auger Sample | | | | | |
|  — Rock Core | | | | | |
|  — Texas Cone Penetrometer | | | | | |
|  — Grab Sample | | | | | |

TERMS DESCRIBING CONSISTENCY OF SOIL

| COARSE GRAINED SOILS | | FINE GRAINED SOILS | | |
|----------------------|----------------------------------|--------------------|----------------------------------|---|
| DESCRIPTIVE TERM | NO. BLOWS/FT. STANDARD PEN. TEST | DESCRIPTIVE TERM | NO. BLOWS/FT. STANDARD PEN. TEST | UNCONFINED COMPRESSION TONS PER SQ. FT. |
| Very Loose | 0 - 4 | Very Soft | < 2 | < 0.25 |
| Loose | 4 - 10 | Soft | 2 - 4 | 0.25 - 0.50 |
| Medium | 10 - 30 | Firm | 4 - 8 | 0.50 - 1.00 |
| Dense | 30 - 50 | Stiff | 8 - 15 | 1.00 - 2.00 |
| Very Dense | over 50 | Very Stiff | 15 - 30 | 2.00 - 4.00 |
| | | Hard | over 30 | over 4.00 |

Field Classification for "Consistency" of Fine Grained Soils is determined with a 0.25" diameter penetrometer