GEOTECHNICAL ENGINEERING SERVICES REPORT

PROPOSED CITY OF MOORE ANIMAL SHELTER
1316 SE 34TH STREET
CLEVELAND COUNTY, OKLAHOMA

Prepared For:
City of Moore

Prepared By:
EST, Inc.

Approved by:

Bryce Hanlon, P.E.
Geotechnical Engineer

EST PROJECT NUMBER
6010697

December 31, 2020

Comprehensive Engineering Services

615 N. Hudson, Suite 300
Oklahoma City, Oklahoma 73102
P (405) 815.3600 F (405) 815.4080
C.A. 3639, Ren. Date 06/30/2020

December 31, 2020

City of Moore
301 N. Broadway
Moore, Oklahoma 73160

Attn: Mr. Brooks Mitchell

RE: Geotechnical Engineering Services Report
Proposed City of Moore Animal Shelter
1316 SE 34th Street
Moore, Oklahoma
EST Project Number: 6010697

Dear Mr. Mitchell:

EST has completed the geotechnical engineering services for the proposed animal shelter building to be located at 1316 SE 34th Street in Moore, Oklahoma.

The purpose of the subsurface exploration was to estimate the geotechnical engineering properties of the near surface soils for the above referenced project. The laboratory results and engineer's review provide the information needed to evaluate the potential for soil shrink/swell with variation in soil moisture content and to estimate parameters for foundation design. Additionally, we have provided pavement design recommendations for the proposed parking lots and access drives.

This geotechnical report should be read in its entirety prior to utilizing any presented information for design or construction purposes. Additionally, we recommend that EST be retained to provide construction monitoring and testing services to verify that soil conditions are consistent with our geotechnical report. EST will not be responsible for the misinterpretation of the recommendations for this project. Furthermore, EST is not responsible for any conditions that deviate from those described in this report.

Mr. Mitchell, we appreciate the opportunity to work with you on this project, and at your request, we are prepared to provide the proper construction monitoring and testing services. If you have any questions regarding the information contained in this report or if we can be of further assistance, please call us at (405) 815-3600.

Respectfully,
EST, Inc.

Bryce R. Hanlon, P.E.
Geotechnical Engineer

TABLE OF CONTENTS

1.0 Executive Summary

The geotechnical engineering services are complete for the proposed animal shelter building to be located at 1316 SE 34th Street in Moore, Oklahoma. This report describes the subsurface conditions encountered in the borings, furnishes the laboratory data acquired, and provides geotechnical recommendations for building pad development and foundation design. Additionally, we have provided recommended pavement sections for the proposed parking lot and access drives.

Exploration of the subsurface materials at the project site consisted of a total of ten (10) borings located throughout the project site. Six (6) structural building borings (B-01 through B-06) were advanced in the proposed building area to a depth of 20 feet below the existing ground surface elevations. Additionally, four (4) pavement borings (P-01 through P-04) were advanced in the proposed parking and access drive areas to a depth of approximately 5 feet. Samples obtained from the borings were brought to our laboratory for further processing and/or testing. Groundwater was encountered in four of the structural borings at depths ranging from 17.5 to 18 feet below the existing ground surface elevation. The results of the laboratory tests and the final boring logs along with a diagram showing the approximate locations of the borings are included in the appendices of this report.

Evaluation and test results indicate the subsurface materials generally consist of clayey sands and sandy lean clays. Based on the encountered soil conditions, shallow footing foundations with slab-on-grade floors can be used to support the proposed building. Specific geotechnical recommendations are presented further in this report.

2.0 Project Description

We understand that the proposed project consists of constructing a new animal shelter building at 1316 SE 34th Street in Moore, Oklahoma. At the time of this report, no structural loading information was provided. However, we expect the building to be lightly loaded.

3.0 Subsurface Exploration

The subsurface exploration was performed on December 8, 2020. The exploration at the site consisted of ten (10) exploratory borings located by an EST Engineer based on the plans provided.

The project was accessible to a CME-55 track-mounted, rotary drill rig used to perform the borings. The borings were advanced using 4-inch hollow stem augers. Representative soil samples were obtained using the standard penetration test (SPT) sampling procedures in general accordance with ASTM Specifications D-1586.

The SPT sampling process requires a split-barrel (two-piece) sampling tube be used to obtain soil samples. A 2-inch outside diameter sampling tube is hammered, using an automatic drive hammer, into the bottom of the boring with a 140-pound weight falling 30 inches. The number of blows required to advance the tube the last 12 inches of an 18-inch sampling interval or a portion thereof, is recorded as the standard penetration resistance value, N. The in-situ relative density of granular soils, the consistency of cohesive soils, and the hardness of weathered bedrock can be estimated from the N value. The uncorrected, N values recorded for each test are shown on the attached boring logs at their relative sampling depths.

A CME automatic drive hammer was used to perform the standard penetration tests. A greater mechanical efficiency is achieved with the automatic drive hammer when compared to a conventional safety drive hammer operated with a cathead and rope. The effect of this higher efficiency has on the N-values have been considered in our interpretation and analysis of the subsurface information provided in this report.

The locations of the borings have been identified and are shown on the approximate boring location diagram included in Appendix A of this report.

As part of the drilling operations, the field personnel prepared field boring logs. The field personnel examined the samples retrieved during drilling operations and recorded a soil description on the field logs. The split-barrel samples were packaged in plastic bags to reduce moisture loss, tagged for identification and transported to our laboratory for further evaluation. The field logs also include visual classifications of the materials encountered during drilling and the engineer's interpretation of the subsurface conditions between samples. This report contains the final boring logs that represent modifications based on the engineer's review and laboratory test results.

4.0 Subsurface Conditions

4.1 Soil Conditions

The near-surface soils generally consist of clayey sands and sandy lean clays. It should be noted that concrete and asphalt debris was encountered in borings B-01 and B-02 at depths between 1 to 5 feet beneath the existing surface. We recommend this debris be removed within the proposed structural areas prior to building construction.

4.2 Seismic Classification

Based on the subsurface materials encountered during our investigation and Table 1613.5.2 entitled "Site Class Definitions" in the 2012/2015 International Building Code, we recommend using a seismic site classification for the project of Site Class "D". The geotechnical parameters presented in Table I can be used, and were estimated based on the 2015 International Building Code (IBC).

TABLE I

Seismic Site Class (Table 1613.5.2 of the 2015 IBC)		D
Estimated Site Coordinates	Latitude	35.303984°N
	Longitude	97.489049°W
S_s – Short Period Spectral Acceleration		0.273g
S_{MS} – Short Period, Site Class Modified Spectral Acceleration		0.432g
S_{DS} – Short Period, Five Percent Damping, Spectral Acceleration		0.288g
S_1 – 1 Second Period Spectral Acceleration		0.079g
S_{M1} – 1 Second Period, Site Class Modified Spectral Acceleration		0.189g
S_{D1} – 1 Second Period, Five Percent Damping, Spectral Acceleration		0.126g
F_a		1.6
F_v		2.4
Seismic Design Category		B

4.3 Groundwater Conditions

Groundwater was encountered in B-01, B-02, B-05, and B-06 at depths ranging from 17.5 to 18 feet below the existing grade. Groundwater level fluctuations and/or perched water conditions may occur due to seasonal variations in the amount of rainfall and other factors such as drainage characteristics. To obtain more accurate groundwater level information, long-term observations in a monitoring well or piezometer that is sealed from the influence of surface water would be needed. The possibility of groundwater level fluctuations should be considered during the preparation of construction plans. The borings were plugged per Oklahoma Water Resources Board (OWRB) requirements after drilling operations were completed.

4.4 Corrosion Potential/Cement Type

To estimate the corrosion potential of the onsite soils, we utilized the United States Department of Agriculture's (USDA) Web Soil Survey to determine susceptibility of the soil to concrete and steel corrosion. According to the USDA Web Soil Survey, the on-site materials present a high risk of corrosion to steel and a low exposure of concrete to sulfate containing solutions.

Additionally, we tested several samples for Soluble Sulfate Content. The results of these tests are provided in Table II:

TABLE II

Sample ID	Soluble Sulfate Concentration (ppm)
B-02 S-01 (0-1')	240
B-05 S-01 (0-1')	240
B-06 S-01 (0-1')	280
P-01 S-01 (0-2.5')	267
P-02 S-01 (0-2.5')	280
P-03 S-01 (0-2.5')	267
P-04 S-01 (0-2.5')	280

For steel elements in contact with the on-site soils, we recommend that preventive measures against steel corrosion be considered. In many cases, polyethylene encasement or epoxy-coated resin has been used to protect buried ferrous metals or ductile iron pipes.

For concrete elements in contact with the on-site soils, we recommend using an ASTM C150 Type I Portland cement concrete with a maximum water-to-cement ratio (W/C) of 0.50 and a minimum compressive strength of 3,000 psi. We recommend that routine tests be performed to verify that sulfate concentrations are within acceptable ranges for Type I cement. The USDA Soil Survey output files can be found in Appendix D of this report.

4.5 Potential for Vertical Rise (PVR)

The existing near surface soils generally consist of low to moderate plasticity soils for which volume changes in excess of 1 inch are not expected to occur with variations in soil moisture content.

5.0 Laboratory Evaluation

All samples obtained from the project site were transferred to our laboratory for processing and/or testing. Laboratory tests were performed on select soil samples in agreement and applicable to ASTM, and AASHTO testing procedures. Laboratory tests included estimation of the natural moisture content (ASTM D2216), Atterberg limits (ASTM D4318), sieve analysis (ASTM D2487), and soluble sulfates (OHDL 49). These results are provided in Section 4.4 and Appendix B of this report.

6.0 Evaluation and Recommendations

Based on the subsurface materials encountered a shallow footing foundation system with slab-on-grade floors can be used at this site. The following presents geotechnical recommendations concerning these and other geotechnical issues related to the project.

6.1 Earthwork

Any fill required to develop final grade lines should consist of low volume change (LVC) soils that are free of organic matter and debris. Low PI material would be cohesive materials having a liquid limit less than 35 and a plasticity index between 5 and 17. Fill should be placed in lifts not exceeding 8 to 9 inches in loose thickness and compacted to at least 95 percent of the material's maximum dry density at a moisture content within 2 percent of optimum. Any soft or loose areas observed, or over-saturated, rutting or pumping soils observed during compaction operations should be removed and replaced or stabilized. On-site soils can generally be used as fill material.

During compaction operations, the exposed subgrade and each lift of compacted fill should be tested for moisture and density, and reworked as necessary until that surface is approved by the Geotechnical Engineer's representative prior to the placement of additional lifts. We recommend the scarified surface and each lift of fill be tested for density and moisture content at a rate of one test per 2,000 square feet of compacted area with a minimum of two tests per compacted area. In addition, we recommend one test for every 100 linear feet of compacted utility trench backfill.

6.1.1 General Site Development

We recommend removing all existing trees, vegetation, topsoil, pavements, concrete debris, asphalt debrisand any other unsuitable materials from the construction areas. We also recommend removing any existing stumps, roots larger than 2 inches in diameter, rocks larger than 3 inches in diameter, and any matted roots from the proposed construction area. It should be noted that concrete and asphalt debris was encountered in borings B-01 and B-02 at depths between 1 to 5 feet beneath the existing surface. We recommend this debris be removed within the proposed structural areas prior to building construction.

After removing all the unsuitable materials, we recommend proof-rolling the exposed subgrade. EST should be notified to witness the removal of the unsuitable materials and the proof-rolling process. Proof-rolling should be performed in overlapping passes and in mutually perpendicular directions using equipment with a minimum subgrade loading of 25 tons. After the exposed subgrade is approved by an EST representative, additional recommendations provided in the following sections should be observed.

6.1.2 Floor Slab Development

After performing any required cuts, the exposed subgrade should be scarified to a minimum depth of 8 inches and re-compacted to at least 95 percent of the material's maximum dry density as determined by the test method ASTM D-698 at a moisture content of within two percent above optimum. The

recompacted and tested subgrade should be proof-rolled as described in the previous section to ensure compaction. The pad preparation should extend at least 5 feet laterally from the building pad edges. If proper compaction and pad preparation of the on-site soils cannot be achieved due to pumping or wet conditions, then we recommend either using LVC soil instead of native on-site soils or stabilizing the existing subgrade soils.

The ground surface should be sloped away from the building on all sides to prevent water from collecting near the building. Water should not be allowed to pond near the building during or after construction. In addition, the moisture content of the soil should be maintained until the slab is constructed. Therefore, the building pad should always contain enough moisture so that surface cracks do not develop. We recommend the moisture content of the building pad be evaluated just before concrete for the slab is placed.

We recommend placing a waterproof membrane (15-mil Polyethylene) on top of 2 inches of clean sand immediately below the floor slab for a vapor barrier. The slab should be designed using a modulus of subgrade reaction, k_1, of 80 pci for the on-site soils based on a 1 foot by 1 foot plate load test. For different floor slab sizes, we recommend using the following equations:

$k_s = \frac{k_1}{B}$ (cohesive materials)

$k_s = \frac{k_1(1+B)^2}{2B}$ (cohesionless materials)

Where,

k_s = the desired modulus of subgrade reaction for the actual slab size
k_1 = the modulus of subgrade reaction from a 1 foot by 1 foot plate load test
B = the actual slab width in feet

To help minimize moisture migration, we recommend using a low-slump concrete designed with a water-to-cement ratio of 0.50 or less for the slab. Water curing the slab will help the curing process and should help reduce shrinkage cracks and slab curling. Before the floor covering is placed, we recommend slab moisture emission tests be conducted to confirm that moisture discharge levels are within the floor covering manufacturer's recommendation. These tests should be conducted after the building is considerably complete and the HVAC is operational. The tests should be run when the HVAC has been operating enough to provide typical temperature and humidity conditions representative of what the floor covering will be susceptible to under normal conditions.

6.2 Shallow Footing Foundations

Shallow footing foundations can be used to support the proposed building. A reinforced continuous footing, with isolated column footings bearing at least 24 inches below final outside grades will provide a system sufficient to carry the required loads. It is important to reinforce the footings to minimize the effects of movement within the foundation system. For the design of footings bearing in native soils, a maximum allowable net bearing pressure of 1,500 pounds per square foot can be used. This bearing pressure is the pressure that can be applied to the soil at the base of the footings in excess of the minimum surrounding overburden pressure.

To provide frost heave protection, reduce the amount of shrink/swell potential, and provide adequate confinement of the bearing materials, footings should be located at least 24 inches below final outside grade. Continuous footings should have a minimum width of 16 inches. Isolated column footings should have a minimum width of 30 inches.

Caution should be taken to prevent wetting or drying of the bearing materials. This can be accomplished by placing concrete into the footings as soon as they are excavated and approved by the Geotechnical Engineer's representative. Surface run-off water should drain away from the excavated areas. If the footing materials should become wet or dry and/or loose or disturbed, then this material should be removed before placing concrete. Any soft or loose areas observed should also be removed before placing concrete. If unsuitable material is encountered, the material should be removed and replaced with compacted fill or concrete. The footing excavation should not be allowed to remain open for more than 8 hours without approval of the Geotechnical Engineer. Shallow foundations constructed as recommended are expected to have long-term movements less than 1 inch. The differential movement across the structure may approach half of the long-term movement.

6.3 Pavement Design

The existing near surface soils encountered in the borings generally consists of low- to moderate-plasticity soils. The parking and access drive areas are expected to support both light duty and minor heavy duty traffic. After moisture-conditioning and compacting the subgrade and proof rolling the site as previously recommended in this report, one or more of the following pavement sections can be adopted.

TABLE III

MINIMUM PAVEMENT RECOMMENDATIONS (AGGREGATE BASE)		
	RIGID PAVEMENT	**FLEXIBLE PAVEMENT**
STANDARD DUTY PAVEMENT	4" of Portland Cement Concrete over 6" ODOT Type "A" Aggregate Base (compacted to 98% Std. Proctor) over 8" ODOT Subgrade Method "B" (Compacted to 95% Std. Proctor)	2" Superpave Type 'S4' Asphalt Concrete (PG 64-22 OK) over 3" Superpave Type 'S3' Asphalt Concrete (PG 64-22 OK) over 6" ODOT Type "A" Aggregate Base (compacted to 98% Std. Proctor) over 8" ODOT Subgrade Method "B" (Compacted to 95% Std. Proctor)
HEAVY-DUTY PAVEMENT	6" of Portland Cement Concrete over 6" ODOT Type "A" Aggregate Base (compacted to 98% Std. Proctor) over 8" ODOT Subgrade Method "B" (Compacted to 95% Std. Proctor)	2" Superpave Type 'S4' Asphalt Concrete (PG 64-22 OK) over 2.5" Superpave Type 'S3' Asphalt Concrete (PG 64-22 OK) over 2.5" Superpave Type 'S3' Asphalt Concrete (PG 64-22 OK) over 6" ODOT Type "A" Aggregate Base (compacted to 98% Std. Proctor) over over 8" ODOT Subgrade Method "B" (Compacted to 95% Std. Proctor)

TABLE IV

MINIMUM PAVEMENT RECOMMENDATIONS (SOIL STABILIZATION)		
	RIGID PAVEMENT	**FLEXIBLE PAVEMENT**
STANDARD DUTY PAVEMENT	4" of Portland Cement Concrete over 8" Stabilized Subgrade	2" Superpave Type 'S4' Asphalt Concrete (PG 64-22 OK) over 3" Superpave Type 'S3' Asphalt Concrete (PG 64-22 OK) over 8" Stabilized Subgrade
HEAVY-DUTY PAVEMENT	6" of Portland Cement Concrete over 8" Stabilized Subgrade	2" Superpave Type 'S4' Asphalt Concrete (PG 64-22 OK) over 2.5" Superpave Type 'S3' Asphalt Concrete (PG 64-22 OK) over 2.5" Superpave Type 'S3' Asphalt Concrete (PG 64-22 OK) over 8" Stabilized Subgrade
* Based on the soil classifications at the site, we estimate 3 to 4 percent Portland cement will be required to adequately stabilize the subgrade. The actual percentages should be determined at the time of construction via mix design.		

The maximum control joint spacing for the 5 inch and 7 inch thick Portland cement concrete pavements should be 15 feet. All materials and construction should be in accordance with the ODOT, "2009 Standard Specification for Highway Construction" and the latest special provisions adopted by ODOT to supplement the Standard Specifications.

All fill required to develop final grade lines in the proposed paving area should consist of on-site soils that are free of organic matter and debris. Fill should be placed in lifts not exceeding 9 inches in loose

thickness and compacted to at least 95 percent of the maximum dry density at a moisture content within 2 percent of optimum. Any soft or loose areas observed or over-saturated, rutting or pumping soils observed during compaction operations should be removed and replaced.

During compaction operations, each lift of compacted fill should be tested for moisture and density and reworked as necessary until that surface is approved by the geotechnical engineer's representative prior to the placement of additional lifts. We recommend aggregate base, and each lift of fill, be tested for density and moisture content at a rate of one test per 5,000 square feet of compacted area with a minimum of two tests per compacted area. In addition, we recommend one test per lift for every 100 linear feet of compacted utility trench backfill. The moisture content of the aggregate base should be maintained near optimum during construction. A prime coat can be used to help retain moisture within the exposed materials. As a check, we recommend the moisture content be evaluated immediately before pavements are placed.

Minimizing subgrade saturation is an important factor in maintaining subgrade strength. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and cause premature pavement deterioration. The pavement and subgrade should be sloped approximately 1/8 inch per foot to provide surface drainage, and positive surface drainage should be maintained away from the edge of the paved areas. Maintenance of the pavements will be required to obtain satisfactory design life. Maintenance should include crack sealing, surface patching of any deteriorated areas. Thicker pavements could also be used to reduce the required maintenance and extend the service life of the pavement.

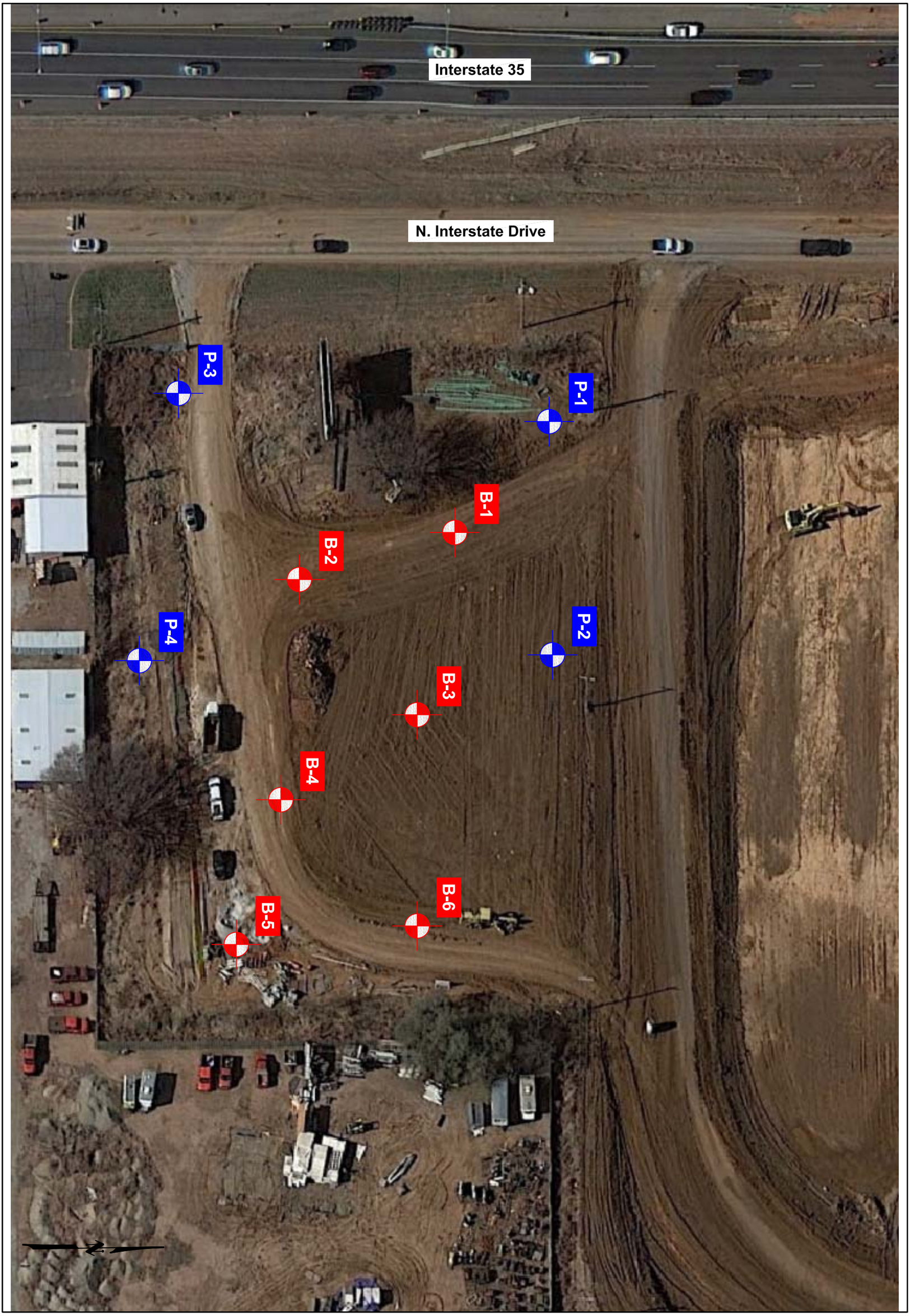
7.0 General

This report was prepared for the City of Moore in reference to the Proposed Animal Shelter Building to be located at 1316 SE 34th Street in Moore, Oklahoma. This report provides geotechnical recommendations based on the subsurface conditions encountered in the borings. It is not practical or economical to perform enough subsurface investigation borings to identify all conditions at the site. Subsurface conditions may vary with distance away from the borings completed for this report. Conditions that may affect the recommendations contained within the geotechnical report may exist and may not become known until construction. If variations appear during construction, it may be necessary to revise the recommendations contained in this report. Therefore, monitoring of subsurface conditions during construction should be performed by a geotechnical engineer or his representative to verify that conditions are consistent with the geotechnical report.

EST warrants that the findings and recommendations contained herein have been made with generally accepted professional geotechnical practices in the local area. No other warranties are implied or expressed. The scope of services and recommendations contained in this report do not include any environmental assessment or identification of contaminated or hazardous materials. Any statements in this report or in the boring logs concerning suspicious odors, colors, irregular textures or abnormal conditions are for informational purpose only and have not been verified by the engineer or testing.

Appendix A

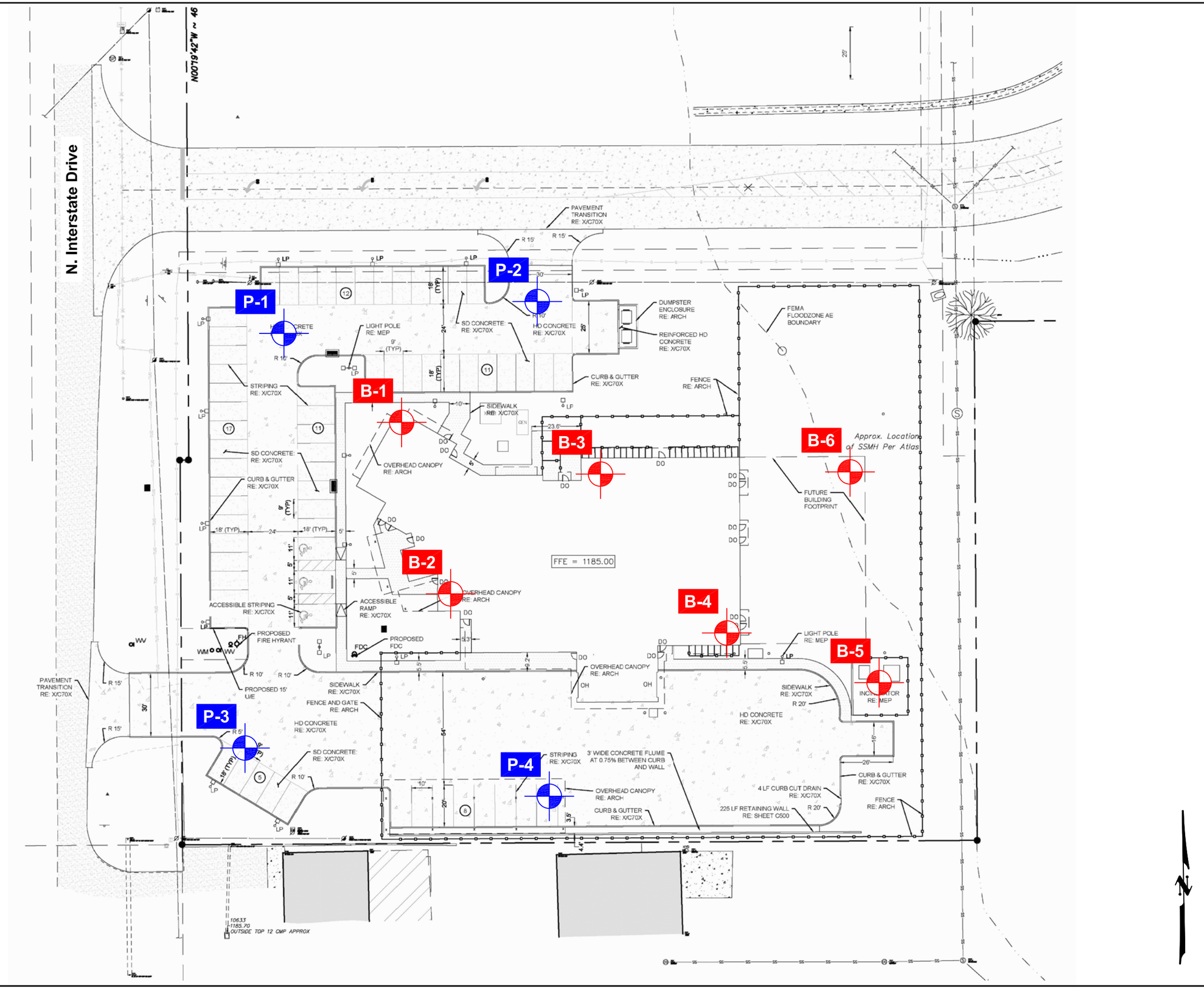
Approximate Boring Location Diagrams



PROJECT NUMBER	SCALE	DATE
6010697	NOT TO SCALE	12/31/2020

PROPOSED CITY OF MOORE ANIMAL SHELTER
1316 S.E. 34TH STREET
MOORE, OKLAHOMA
APPROXIMATE BORING LOCATION DIAGRAM (SHEET 1 OF 2)

615 N. HUDSON, SUITE 300
OKLAHOMA CITY, OK 73102
(405) 815-3600
CA# 3639 (PE/LS)
EXP. DATE 06/30/2022



615 N. HUDSON, SUITE 300
OKLAHOMA CITY, OK 73102
(405) 815-3600
CA# 3639 (PE/LS)
EXP. DATE 06/30/2022

PROPOSED CITY OF MOORE ANIMAL SHELTER
1316 S.E. 34TH STREET
MOORE, OKLAHOMA
APPROXIMATE BORING LOCATION DIAGRAM (SHEET 2 OF 2)

DATE
12/31/2020
SCALE
NOT TO SCALE
PROJECT NUMBER
6010697

Appendix B

Boring Logs

BORING LOG

BORING NO. B-01

CLIENT: City of Moore

ENGINEER: EST, Inc.

LOCATION: 1316 S.E. 34th Street, Moore, OK

PROJECT: Proposed City of Moore Animal Shelter

GRAPHICS LOG	LAYER / MATERIAL DESCRIPTION	DEPTH, FT.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, IN.	SAMPLES SPT- N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY, PCF	TESTS UNCONFINED STRENGTH, PSF	TESTS LIMITS (LL) (PL) INDEXES (PI) #200 SIEVE
	Surface Elev. = Vegetation Thickness : Grass Cover										
	Stiff, Brown, Lean Clay with Sand (Asphalt and Concrete Debris present between 3.5 and 5 feet)		ML	1	AS			17.8			LL = 37 PL = 25 PI = 12 -#200 = 82.1%
				2	SS	18	14	16.9			
					PA						
				3	SS	18	15	7.7			
	Stiff, Brown and Red, Lean Clay with Sand	5		4	SS	18	12	14.2			
					PA						
	Stiff, Reddish Brown, Lean Clay with Sand			5	SS	18	12	15.9			
		10			PA						
				6	SS	18	12	10.5			
		15			PA						
	▽ Soft, Reddish Brown, Lean Clay			7	SS	18	3	19.9			
	Bottom of Boring at 20.0 feet	20									

REMARKS: SOIL AND ROCK CLASSIFICATIONS ARE FROM DISTURBED SAMPLES. CORE SAMPLES AND FURTHER LABORATORY TESTING MAY REVEAL OTHER ROCK AND/OR SOIL TYPES. THE STRATIFICATION SHOWN IN THE SOIL AND ROCK ABOVE IS AN ESTIMATION OF IN-SITU CONDITIONS. THEREFORE, THE NATURAL TRANSITION BETWEEN SOIL AND ROCK TYPES MAY BE GRADUAL.

615 N. Hudson, Ste. 300
Oklahoma City, Oklahoma 73102
(Off.) (405) 815-3600 (FAX) (405) 815-4080

WATER LEVEL OBSERVATIONS			BORING STARTED 12/8/20	
WL	▽ 18 ft. - WD	▼ N/A - AB	BORING COMPLETED 12/8/20	
WL	▼		RIG CME-55	FOREMAN A.K.
WL			APPROVED BRH	JOB# 6010697

L:\GEOTECH\2020 GEOTECH PROJECTS\OKLAHOMA PROJECTS\6010697 - PROPOSED ANIMAL SHELTER - MOORE, OK\GINT\GINT 6010697.GPJ FIRE

BORING LOG

BORING NO. B-02

CLIENT: City of Moore

ENGINEER: EST, Inc.

LOCATION: 1316 S.E. 34th Street, Moore, OK

PROJECT: Proposed City of Moore Animal Shelter

GRAPHICS LOG	LAYER / MATERIAL DESCRIPTION	DEPTH, FT.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, IN.	SAMPLES SPT- N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY, PCF	TESTS UNCONFINED STRENGTH, PSF	TESTS LIMITS (LL) (PL) INDEXES (PI) #200 SIEVE
	Surface Elev. = Vegetation Thickness : Grass Cover										
	Brown, Lean Clay with Sand		CL	1	AS			13.3			LL = 31 PL = 20 PI = 11 -#200 = 72.8%
	Medium Stiff to Stiff, Brown and Red, Lean Clay with Sand (Asphaltic Debris present from 1 to 3 feet)			2	SS	18	10	15.5			
					PA						
	Soft to Medium Stiff, Brown and Dark Brown, Lean Clay		ML	3	SS	18	5	22.4			LL = 42 PL = 28 PI = 14 -#200 = 86.5%
		5		4	SS	18	12	19.8			
	Stiff, Brown and Dark Brown, Lean Clay				PA						
				5	SS	18	14	18.1			
		10			PA						
	Very Soft to Soft, Reddish Brown, Lean Clay with Sand			6	SS	18	2	22.6			
		15			PA						
	▽ Soft, Reddish Brown, Lean Clay (Gravel Present)			7	SS	18	3	16.0			
	Bottom of Boring at 20.0 feet	20									

REMARKS: SOIL AND ROCK CLASSIFICATIONS ARE FROM DISTURBED SAMPLES. CORE SAMPLES AND FURTHER LABORATORY TESTING MAY REVEAL OTHER ROCK AND/OR SOIL TYPES. THE STRATIFICATION SHOWN IN THE SOIL AND ROCK ABOVE IS AN ESTIMATION OF IN-SITU CONDITIONS. THEREFORE, THE NATURAL TRANSITION BETWEEN SOIL AND ROCK TYPES MAY BE GRADUAL.

EST
615 N. Hudson, Ste. 300
Oklahoma City, Oklahoma 73102
(Off.) (405) 815-3600 (FAX) (405) 815-4080

WATER LEVEL OBSERVATIONS			BORING STARTED 12/8/20	
WL	▽ 17.5 ft. - WD	▼ N/A - AB	BORING COMPLETED 12/8/20	
WL	▼		RIG CME-55	FOREMAN A.K.
WL			APPROVED BRH	JOB# 6010697

BORING LOG

BORING NO. B-03

CLIENT: City of Moore

ENGINEER: EST, Inc.

LOCATION: 1316 S.E. 34th Street, Moore, OK

PROJECT: Proposed City of Moore Animal Shelter

GRAPHICS LOG	LAYER / MATERIAL DESCRIPTION	DEPTH, FT.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, IN.	SAMPLES SPT- N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY, PCF	TESTS UNCONFINED STRENGTH, PSF	TESTS LIMITS (LL) (PL) INDEXES (PI) #200 SIEVE
	Surface Elev. = Vegetation Thickness : Grass Cover										
	Medium Stiff, Reddish Brown, Lean Clay with Sand		CL	1	AS			17.7			LL = 37 PL = 23 PI = 14 -#200 = 74.5%
				2	SS	18	8	22.0			
					PA						
	Medium Stiff, Dark Brown, Lean Clay	5		3	SS	18	7	22.7			
				4	SS	18	8	23.7			
					PA						
	Stiff, Reddish Brown, Lean Clay		CL	5	SS	18	11	14.4			LL = 28 PL = 18 PI = 10 -#200 = 87.6%
		10			PA						
	Medium Stiff, Reddish Brown, Lean Clay with Sand			6	SS	18	7	18.4			
		15			PA						
	Soft, Reddish Brown, Lean Clay			7	SS	18	3	23.4			
	Bottom of Boring at 20.0 feet	20									

REMARKS: SOIL AND ROCK CLASSIFICATIONS ARE FROM DISTURBED SAMPLES. CORE SAMPLES AND FURTHER LABORATORY TESTING MAY REVEAL OTHER ROCK AND/OR SOIL TYPES. THE STRATIFICATION SHOWN IN THE SOIL AND ROCK ABOVE IS AN ESTIMATION OF IN-SITU CONDITIONS. THEREFORE, THE NATURAL TRANSITION BETWEEN SOIL AND ROCK TYPES MAY BE GRADUAL.

EST
615 N. Hudson, Ste. 300
Oklahoma City, Oklahoma 73102
(Off.) (405) 815-3600 (FAX) (405) 815-4080

WATER LEVEL OBSERVATIONS			BORING STARTED 12/8/20	
WL	None ft. - WD	N/A - AB	BORING COMPLETED 12/8/20	
WL			RIG CME-55	FOREMAN A.K.
WL			APPROVED BRH	JOB# 6010697

L:\GEOTECH\2020 GEOTECH PROJECTS\OKLAHOMA PROJECTS\6010697 - PROPOSED ANIMAL SHELTER - MOORE, OK\GINT\GINT 6010697.GPJ FIRE

BORING LOG

BORING NO. B-04

CLIENT: City of Moore

ENGINEER: EST, Inc.

LOCATION: 1316 S.E. 34th Street, Moore, OK

PROJECT: Proposed City of Moore Animal Shelter

GRAPHICS LOG	LAYER / MATERIAL DESCRIPTION	DEPTH, FT.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, IN.	SAMPLES SPT- N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY, PCF	TESTS UNCONFINED STRENGTH, PSF	TESTS LIMITS (LL) (PL) INDEXES (PI) #200 SIEVE
	Surface Elev. = Vegetation Thickness : Grass Cover										
	Loose, Reddish Brown, Clayey Sand			1	AS			16.0			
				2	SS	18	9				
					PA						
	Loose, Dark Brown, Clayey Sand		SC	3	SS	18	5	17.3			LL = 30 PL = 21 PI = 9 -#200 = 45.2%
		5		4	SS	18	10	22.2			
					PA						
	Medium Dense, Reddish Brown, Clayey Sand			5	SS	18	12	19.8			
		10			PA						
	Stiff, Reddish Brown, Lean Clay with Sand			6	SS	18	12	15.3			
		15			PA						
	Medium Stiff, Reddish Brown, Lean Clay			7	SS	18	6	18.3			
		20									
	Bottom of Boring at 20.0 feet										

REMARKS: SOIL AND ROCK CLASSIFICATIONS ARE FROM DISTURBED SAMPLES. CORE SAMPLES AND FURTHER LABORATORY TESTING MAY REVEAL OTHER ROCK AND/OR SOIL TYPES. THE STRATIFICATION SHOWN IN THE SOIL AND ROCK ABOVE IS AN ESTIMATION OF IN-SITU CONDITIONS. THEREFORE, THE NATURAL TRANSITION BETWEEN SOIL AND ROCK TYPES MAY BE GRADUAL.

EST
615 N. Hudson, Ste. 300
Oklahoma City, Oklahoma 73102
(Off.) (405) 815-3600 (FAX) (405) 815-4080

WATER LEVEL OBSERVATIONS			BORING STARTED 12/8/20	
WL	▽ None ft. - WD	▼ N/A - AB	BORING COMPLETED 12/8/20	
WL	▼		RIG CME-55	FOREMAN A.K.
WL			APPROVED BRH	JOB# 6010697

L:\GEOTECH\2020 GEOTECH PROJECTS\OKLAHOMA PROJECTS\6010697 - PROPOSED ANIMAL SHELTER - MOORE, OK\GINT\GINT 6010697.GPJ FIRE

BORING LOG

BORING NO. B-05

CLIENT: City of Moore

ENGINEER: EST, Inc.

LOCATION: 1316 S.E. 34th Street, Moore, OK

PROJECT: Proposed City of Moore Animal Shelter

GRAPHICS LOG	LAYER / MATERIAL DESCRIPTION	DEPTH, FT.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, IN.	SAMPLES SPT- N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY, PCF	TESTS UNCONFINED STRENGTH, PSF	TESTS LIMITS (LL) (PL) INDEXES (PI) #200 SIEVE
	Surface Elev. = Vegetation Thickness : Grass Cover										
	Reddish Brown, Lean Clay with Sand		CL	1	AS			17.0			LL = 35 PL = 23 PI = 12 -#200 = 76.1%
	Medium Stiff, Reddish Brown, Lean Clay (Gravel Present)			2	SS	18	7	16.9			
					PA						
	Soft to Medium Stiff, Dark Brown and Red, Lean Clay	5		3	SS	18	5	21.6			
				4	SS	18	6	21.9			
					PA						
	Stiff, Dark Brown with Red, Lean Clay	10		5	SS	18	16	17.5			
					PA						
	Stiff, Reddish Brown, Lean Clay with Sand	15		6	SS	18	12	9.4			
					PA						
	▽ Medium Stiff, Reddish Brown, Lean Clay		CL	7	SS	18	6	19.9			LL = 28 PL = 18 PI = 10 -#200 = 86.5%
	Bottom of Boring at 20.0 feet	20									

REMARKS: SOIL AND ROCK CLASSIFICATIONS ARE FROM DISTURBED SAMPLES. CORE SAMPLES AND FURTHER LABORATORY TESTING MAY REVEAL OTHER ROCK AND/OR SOIL TYPES. THE STRATIFICATION SHOWN IN THE SOIL AND ROCK ABOVE IS AN ESTIMATION OF IN-SITU CONDITIONS. THEREFORE, THE NATURAL TRANSITION BETWEEN SOIL AND ROCK TYPES MAY BE GRADUAL.

EST
615 N. Hudson, Ste. 300
Oklahoma City, Oklahoma 73102
(Off.) (405) 815-3600 (FAX) (405) 815-4080

WATER LEVEL OBSERVATIONS			BORING STARTED 12/8/20	
WL	▽ 18 ft. - WD	▼ N/A - AB	BORING COMPLETED 12/8/20	
WL	▼		RIG CME-55	FOREMAN A.K.
WL			APPROVED BRH	JOB# 6010697

L:\GEOTECH\2020 GEOTECH PROJECTS\OKLAHOMA PROJECTS\6010697 - PROPOSED ANIMAL SHELTER - MOORE, OK\GINT\GINT 6010697.GPJ FIRE

BORING LOG

BORING NO. B-06

CLIENT: City of Moore

ENGINEER: EST, Inc.

LOCATION: 1316 S.E. 34th Street, Moore, OK

PROJECT: Proposed City of Moore Animal Shelter

GRAPHICS LOG	LAYER / MATERIAL DESCRIPTION	DEPTH, FT.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, IN.	SAMPLES SPT- N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY, PCF	TESTS UNCONFINED STRENGTH, PSF	TESTS LIMITS (LL) (PL) INDEXES (PI) #200 SIEVE
	Surface Elev. = Vegetation Thickness : Grass Cover										
	Stiff, Brown, Lean Clay with Sand		CL	1	AS			16.0			LL = 37 PL = 17 PI = 20 -#200 = 74.2%
				2	SS	18	13	14.9			
					PA						
	Medium Stiff, Brown to Reddish Brown, Lean Clay with Sand	5		3	SS	18	6	17.2			
				4	SS	18	6	21.6			
					PA						
	Medium Stiff, Dark Brown, Lean Clay		CL	5	SS	18	6	19.5			LL = 31 PL = 21 PI = 10 -#200 = 86.4%
		10			PA						
	Medium Stiff, Reddish Brown, Lean Clay with Sand			6	SS	18	7	17.7			
		15			PA						
▽	Medium Stiff, Reddish Brown, Lean Clay			7	SS	18	6	21.0			
		20									
	Bottom of Boring at 20.0 feet										

REMARKS: SOIL AND ROCK CLASSIFICATIONS ARE FROM DISTURBED SAMPLES. CORE SAMPLES AND FURTHER LABORATORY TESTING MAY REVEAL OTHER ROCK AND/OR SOIL TYPES. THE STRATIFICATION SHOWN IN THE SOIL AND ROCK ABOVE IS AN ESTIMATION OF IN-SITU CONDITIONS. THEREFORE, THE NATURAL TRANSITION BETWEEN SOIL AND ROCK TYPES MAY BE GRADUAL.

EST
615 N. Hudson, Ste. 300
Oklahoma City, Oklahoma 73102
(Off.) (405) 815-3600 (FAX) (405) 815-4080

WATER LEVEL OBSERVATIONS			BORING STARTED 12/8/20	
WL	▽ 18 ft. - WD	▼ N/A - AB	BORING COMPLETED 12/8/20	
WL	▼		RIG CME-55	FOREMAN A.K.
WL			APPROVED BRH	JOB# 6010697

L:\GEOTECH\2020 GEOTECH PROJECTS\OKLAHOMA PROJECTS\6010697 - PROPOSED ANIMAL SHELTER - MOORE, OK\GINT\GINT 6010697.GPJ FIRE

BORING LOG

BORING NO. P-01

CLIENT: City of Moore

ENGINEER: EST, Inc.

LOCATION: 1316 S.E. 34th Street, Moore, OK

PROJECT: Proposed City of Moore Animal Shelter

GRAPHICS LOG	LAYER / MATERIAL DESCRIPTION	DEPTH, FT.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, IN.	SAMPLES SPT- N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY, PCF	TESTS UNCONFINED STRENGTH, PSF	TESTS LIMITS (LL) (PL) INDEXES (PI) #200 SIEVE
	Surface Elev. = Vegetation Thickness : Grass Cover										
	Reddish Brown, Lean Clay with Sand		CL		AS			16.7			LL = 37 PL = 20 PI = 17 *-#200 = 80.6%*
					AS			18.0			
		5									
	Bottom of Boring at 5.0 feet										

REMARKS: SOIL AND ROCK CLASSIFICATIONS ARE FROM DISTURBED SAMPLES. CORE SAMPLES AND FURTHER LABORATORY TESTING MAY REVEAL OTHER ROCK AND/OR SOIL TYPES. THE STRATIFICATION SHOWN IN THE SOIL AND ROCK ABOVE IS AN ESTIMATION OF IN-SITU CONDITIONS. THEREFORE, THE NATURAL TRANSITION BETWEEN SOIL AND ROCK TYPES MAY BE GRADUAL.

EST
615 N. Hudson, Ste. 300
Oklahoma City, Oklahoma 73102
(Off.) (405) 815-3600 (FAX) (405) 815-4080

WATER LEVEL OBSERVATIONS			BORING STARTED 12/8/20	
WL	▽ None ft. - WD	▼ N/A - AB	BORING COMPLETED 12/8/20	
WL	▼		RIG CME-55	FOREMAN A.K.
WL			APPROVED BRH	JOB# 6010697

L:\GEOTECH\2020 GEOTECH PROJECTS\OKLAHOMA PROJECTS\6010697 - PROPOSED ANIMAL SHELTER - MOORE, OK\GINT\GINT 6010697.GPJ FIRE

BORING LOG

BORING NO. P-02

CLIENT: City of Moore

ENGINEER: EST, Inc.

LOCATION: 1316 S.E. 34th Street, Moore, OK

PROJECT: Proposed City of Moore Animal Shelter

GRAPHICS LOG	LAYER / MATERIAL DESCRIPTION	DEPTH, FT.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, IN.	SAMPLES SPT- N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY, PCF	TESTS UNCONFINED STRENGTH, PSF	TESTS LIMITS (LL) (PL) INDEXES (PI) #200 SIEVE
	Surface Elev. = Vegetation Thickness : Grass Cover										
	Brown, Lean Clay with Sand		CL		AS			15.9			LL = 38 PL = 21 PI = 17 -#200 = 74.6%
	Reddish Brown, Lean Clay with Sand	5			AS			18.2			
	Bottom of Boring at 5.0 feet										

REMARKS: SOIL AND ROCK CLASSIFICATIONS ARE FROM DISTURBED SAMPLES. CORE SAMPLES AND FURTHER LABORATORY TESTING MAY REVEAL OTHER ROCK AND/OR SOIL TYPES. THE STRATIFICATION SHOWN IN THE SOIL AND ROCK ABOVE IS AN ESTIMATION OF IN-SITU CONDITIONS. THEREFORE, THE NATURAL TRANSITION BETWEEN SOIL AND ROCK TYPES MAY BE GRADUAL.

EST
615 N. Hudson, Ste. 300
Oklahoma City, Oklahoma 73102
(Off.) (405) 815-3600 (FAX) (405) 815-4080

WATER LEVEL OBSERVATIONS			BORING STARTED 12/8/20	
WL	▽ None ft. - WD	▼ N/A - AB	BORING COMPLETED 12/8/20	
WL	▼		RIG CME-55	FOREMAN A.K.
WL			APPROVED BRH	JOB# 6010697

L:\GEOTECH\2020 GEOTECH PROJECTS\OKLAHOMA PROJECTS\6010697 - PROPOSED ANIMAL SHELTER - MOORE, OK\GINT\GINT 6010697.GPJ FIRE

BORING LOG

BORING NO. P-03

CLIENT: City of Moore

ENGINEER: EST, Inc.

LOCATION: 1316 S.E. 34th Street, Moore, OK

PROJECT: Proposed City of Moore Animal Shelter

GRAPHICS LOG	LAYER / MATERIAL DESCRIPTION	DEPTH, FT.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, IN.	SAMPLES SPT- N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY, PCF	TESTS UNCONFINED STRENGTH, PSF	TESTS LIMITS (LL) (PL) INDEXES (PI) #200 SIEVE
	Surface Elev. = Vegetation Thickness : Grass Cover										
	Brown, Lean Clay with Sand		CL		AS			21.3			LL = 42 PL = 21 PI = 21 -#200 = 80.8%
					AS			23.0			
		5									
	Bottom of Boring at 5.0 feet										

REMARKS: SOIL AND ROCK CLASSIFICATIONS ARE FROM DISTURBED SAMPLES. CORE SAMPLES AND FURTHER LABORATORY TESTING MAY REVEAL OTHER ROCK AND/OR SOIL TYPES. THE STRATIFICATION SHOWN IN THE SOIL AND ROCK ABOVE IS AN ESTIMATION OF IN-SITU CONDITIONS. THEREFORE, THE NATURAL TRANSITION BETWEEN SOIL AND ROCK TYPES MAY BE GRADUAL.

EST
615 N. Hudson, Ste. 300
Oklahoma City, Oklahoma 73102
(Off.) (405) 815-3600 (FAX) (405) 815-4080

WATER LEVEL OBSERVATIONS			BORING STARTED 12/8/20	
WL	▽ None ft. - WD	▼ N/A - AB	BORING COMPLETED 12/8/20	
WL	▼		RIG CME-55	FOREMAN A.K.
WL			APPROVED BRH	JOB# 6010697

L:\GEOTECH\2020 GEOTECH PROJECTS\OKLAHOMA PROJECTS\6010697 - PROPOSED ANIMAL SHELTER - MOORE, OK\GINT\GINT 6010697.GPJ FIRE

BORING LOG

BORING NO. P-04

CLIENT: City of Moore

ENGINEER: EST, Inc.

LOCATION: 1316 S.E. 34th Street, Moore, OK

PROJECT: Proposed City of Moore Animal Shelter

GRAPHICS LOG	LAYER / MATERIAL DESCRIPTION	DEPTH, FT.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, IN.	SAMPLES SPT- N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY, PCF	TESTS UNCONFINED STRENGTH, PSF	TESTS LIMITS (LL) (PL) INDEXES (PI) #200 SIEVE
	Surface Elev. = Vegetation Thickness : Grass Cover										
	Reddish Brown, Clayey Sand (Gravel Present)		SC		AS			11.9			LL = 36 PL = 18 PI = 18 -#200 = 48.7%
					AS			17.9			
		5									
	Bottom of Boring at 5.0 feet										

REMARKS: SOIL AND ROCK CLASSIFICATIONS ARE FROM DISTURBED SAMPLES. CORE SAMPLES AND FURTHER LABORATORY TESTING MAY REVEAL OTHER ROCK AND/OR SOIL TYPES. THE STRATIFICATION SHOWN IN THE SOIL AND ROCK ABOVE IS AN ESTIMATION OF IN-SITU CONDITIONS. THEREFORE, THE NATURAL TRANSITION BETWEEN SOIL AND ROCK TYPES MAY BE GRADUAL.

EST
615 N. Hudson, Ste. 300
Oklahoma City, Oklahoma 73102
(Off.) (405) 815-3600 (FAX) (405) 815-4080

WATER LEVEL OBSERVATIONS			BORING STARTED 12/8/20	
WL	▽ None ft. - WD	▼ N/A - AB	BORING COMPLETED 12/8/20	
WL	▼		RIG CME-55	FOREMAN A.K.
WL			APPROVED BRH	JOB# 6010697

L:\GEOTECH\2020 GEOTECH PROJECTS\OKLAHOMA PROJECTS\6010697 - PROPOSED ANIMAL SHELTER - MOORE, OK\GINT\GINT 6010697.GPJ FIRE

Appendix C

General Notes
Boring Log Acronym Library
General Notes for Rock Classification

GENERAL NOTES

Water levels measured in low permeability soils (clays & unfractured rock) may require long term observations and therefore, the depths shown may not be accurate.

Sample Classification and Descriptions

- Soil Classification: The soil description and classification is based on the Unified Soil Classification System (USCS) unless noted otherwise
- Description Modifier: Trace - material slightly present in sample, less than 15%
- Rock: Rock samples are described according to the "General Notes for Rock Classification"

Consistency of Fine-Grained Soils:

Qu, Unconfined Compressive Strength (psf)	SPT	Consistency
< 500	0-2	Very Soft
500 - 1,000	2-5	Soft
1,001 - 2,000	5-10	Medium
2,001 - 4,000	10-20	Stiff
4,001 - 8,000	20-30	Very Stiff
8,001 - 16,000	30-60	Hard
> 16,000	> 60	Very Hard

Relative Density of Coarse-Grained Soils:

N-Blows/ft.	Relative Density
0-4	Very Loose
5-10	Loose
11-24	Medium Dense
25-50	Dense
51-80	Very Dense
80+	Extremely Dense

Grain Size Terminology:

Major Component of Sample	Size Range
Boulders	Over 12 in. (305mm)
Cobbles	12 in. to 3 in. (300mm to 76mm)
Gravel	3 in. to #4 sieve (75mm to 4.75mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 sieve (0.075mm)

BORING LOG ACRONYM LIBRARY

Boring Log Symbol Library

- SPT-N: Blow or strike count for the Standard Penetration Test or the Texas Cone Penetrometer Test. In general, the Standard Penetration Test "N" is the numbers of strikes required to advance a standard 2-inch outside diameter split-spoon a distance of 1-foot, or portion thereof, with a 140 pound hammer falling 30 inches. In general, the Texas Cone Penetrometer Test "N" is the numbers of strikes with penetration depths required to advance a solid steel three-inch diameter cone of standard dimensions with a170-pound weight falling 24-inches. Two 50 strike intervals or two 6-inch penetration intervals is recorded.
- WOH: Weight of Hammer
- WOR: Weight of Drilling Rod
- USCS Symbol: The Unified Soil Classification System Identification Symbol
- ATV: All-Terrain Vehicle Mounted Drill Rig
- EL: Elevation
- Lt: Left
- Rt: Right
- LL, PL, PI: Atterberg Limits (Liquid Limit, Plastic Limit, Plasticity Index)
- -#200: Percent Passing Standard No. 200 Sieve
- NP – Non Plastic

Drilling & Sampling Symbol Library

AS: Auger Sample
BS: Bucket Sample
DB: Diamond Drilling Bit (Truck Rotary Drilling using air or water to remove cuttings)
DCD: Diamond Core Barrel Drilling
HA: Hand Auger
HS: Hollow Stem Auger (Truck Rotary Drilling)
PA: Power Auger (Truck Rotary Drilling)
PM: Pressure Meter
RB: Rock Bit (Truck Rotary Drilling using air or water to remove cuttings)
RQD: Rock Quality Designation
SS: Standard Penetration Test (Split-Spoon): a $1^{3/8}$ inch I.D. and 2" O.D. tube, unless noted
ST: Thin-Wall Tube Sample (Shelby Tube): a 3" O.D. tube, unless noted otherwise
TCP: Texas Cone Penetrometer Test
WS: Wash Sample
WB: Wash Bore

Water Level Symbol Library

AB: After Boring Complete
DCI: Dry Cave In
WCI: Wet Cave In
WD: While Drilling
WL: Water Level Depth From Boring Surface Elevation
WS: While Sampling

GENERAL NOTES FOR ROCK CLASSIFICATION

Igneous Rock

Igneous rock is formed from the cooling process of molten material (magna) beneath the earth's surface (plutonic or intrusive rock) or from the rapid cooling at or near the earth's surface (volcanic or extrusive rock). The rate of cooling, mineral composition, and mode of deposition control the type, texture, and shape of Igneous rocks. However, the most common Igneous rocks are:

- Granite: Intrusive rock; very hard; generally coarse-grained; usually light colored (pink, red or gray); typically lighter weight than most rocks (specific gravity = 2.6); and for the most part composed of Quartz, Feldspar, and some dark minerals, usually Mica, crystalline texture; usually even-grained or grains are equal in size.
- Basalt: Extrusive rock; very hard; generally fine-grained; usually dark colored (green, gray, or black); typically heavier weight than most rocks (specific gravity = 2.9); and has a glassy texture.

Sedimentary Rock

Sedimentary rock is formed from the deposition of material (previous rock fragments, soil and minerals) by erosion or precipitation. The loose deposited material slowly hardens and develops into rock from the processes of compaction, cementation, and/or recrystallization. Sedimentary rocks are composted of cemented boulders, cobbles, gravels, sands, silts and clay size particles. The most common minerals composing Sedimentary rock are quartz, kaolinite, feldspar, mica, and iron oxides, together with those precipitated from solution such as carbonates (dolomite, calcite, and siderite) and the sulfates gypsum and anhydrite. The most common Sedimentary rocks are:

- Limestone: White to light gray or bluish-gray in color; crystalline to fine-grained texture; varies in hardness from soft to very hard; chiefly composed of calcium carbonate which will effervesce upon contact with dilute hydrochloric acid.
- Dolomite: Very similar to limestone. Usually harder than limestone and usually does not effervesce upon contact with dilute hydrochloric acid. However, will effervesce upon contact with dilute hydrochloric acid if in powered state.
- Shale: Light to dark colored; very fine-grained texture; composed of consolidated clay or silt; bedded in thin layers.
- Siltstone: Very similar to shale, but unlaminated. Usually more cemented and less cohesive to non-cohesive.
- Sandstone: Commonly light colored; coarse to fine-grained texture; composed of cemented sand size particles.
- Conglomerate: Varies in color; composed of boulder size material to silt, generally sand to cobble size; cemented together with various cementing agents.
- Chert: Light to dark colored; very fined-grained texture; common constituent of conglomerates; breaks conchoidally or into angular fragments; will scratch glass.

Degree of Weathering

- Slight: Noted predominantly by color change with no disintegrated zones. May have slight decomposition of parent material at joints.
- Moderate: Noted by color change throughout and some decomposition.
- High: Noted by complete color change throughout, highly decomposed, may be extremely broken, general appearance approaching soil.

Appendix D

Web Soil Survey Corrosion Maps


97° 29' 23" W
97° 29' 11" W
637310
637340
637370
637400
637430
637460
637490
637520
637550
637580
35° 18' 19" N
35° 18' 13" N
3907970
3907940
3907910
3907880
3907850
3907820
3907790
65
Sw 34th St
93
94
69
98
49
94
Soil Map may not be valid at this scale.
Map Scale: 1:1,350 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0 20 40 80 120
Feet
0 50 100 200 300
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 14N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

High

Moderate

Low

Not rated or not available

Soil Rating Lines

High

Moderate

Low

Not rated or not available

Soil Rating Points

High

Moderate

Low

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Cleveland County, Oklahoma
Survey Area Data: Version 18, May 27, 2020

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

Date(s) aerial images were photographed: Nov 20, 2018—Nov 27, 2018

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

Corrosion of Concrete

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
49	Kirkland-Urban land-Pawhuska complex, 0 to 3 percent slopes	Moderate	0.2	2.0%
65	Renfrow-Huska complex, 3 to 5 percent slopes, eroded	Low	0.1	0.7%
69	Renfrow-Urban land-Huska complex, 1 to 5 percent slopes	Low	3.4	41.5%
93	Port silt loam, 0 to 1 percent slopes, occasionally flooded	Low	0.4	5.0%
94	Port silt loam, 0 to 1 percent slopes, frequently flooded	Low	0.1	0.7%
98	Port-Urban land complex, 0 to 1 percent slopes, occasionally flooded	Low	4.1	50.1%
Totals for Area of Interest			**8.3**	**100.0%**

Description

"Risk of corrosion" pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens concrete. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The concrete in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the concrete in installations that are entirely within one kind of soil or within one soil layer.

The risk of corrosion is expressed as "low," "moderate," or "high."

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Map Scale: 1:1,350 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 20 40 80 120

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 14N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

High

Moderate

Low

Not rated or not available

Soil Rating Lines

High

Moderate

Low

Not rated or not available

Soil Rating Points

High

Moderate

Low

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Cleveland County, Oklahoma
Survey Area Data: Version 18, May 27, 2020

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

Date(s) aerial images were photographed: Nov 20, 2018—Nov 27, 2018

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

Corrosion of Steel

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
49	Kirkland-Urban land-Pawhuska complex, 0 to 3 percent slopes	High	0.2	2.0%
65	Renfrow-Huska complex, 3 to 5 percent slopes, eroded	High	0.1	0.7%
69	Renfrow-Urban land-Huska complex, 1 to 5 percent slopes	High	3.4	41.5%
93	Port silt loam, 0 to 1 percent slopes, occasionally flooded	Moderate	0.4	5.0%
94	Port silt loam, 0 to 1 percent slopes, frequently flooded	Moderate	0.1	0.7%
98	Port-Urban land complex, 0 to 1 percent slopes, occasionally flooded	High	4.1	50.1%
Totals for Area of Interest			**8.3**	**100.0%**

Description

"Risk of corrosion" pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens uncoated steel. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the steel in installations that are entirely within one kind of soil or within one soil layer.

The risk of corrosion is expressed as "low," "moderate," or "high."

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher