STANDARD
ENGINEERING
+ FIELD SERVICES

SUBSURFACE EXPLORATION

New ODOT Maintenance and Residency Facilities
NE of the intersection of Interstate 35 and SH-59
McClain County, Oklahoma

PROJECT NO. 2430-0704

STANDARD
ENGINEERING
+FIELD SERVICES

Corporate Office
3400 N. Lincoln Blvd. • Oklahoma City, OK 73105
(405) 528-0541 • standardusa.com

January 3, 2025

Guernsey
5555 North Grand Boulevard
Oklahoma City, OK 73112

Attn: Mrs Angela Aikman, CIE, CSM
Vice President

Re: Subsurface Exploration
New ODOT Maintenance and Residency Facilities
NE of the intersection of Interstate 35 and SH-59
McClain County, Oklahoma

Dear Mrs Aikman:

Standard Engineering & Field Services, LLC (Standard) is pleased to present the report covering the subsurface exploration for the subject project. This study was authorized by Subconsultant Task Order, dated September 12, 2024.

Standard conducted a geotechnical investigation at the site of the New ODOT Maintenance and Residency Facilities project in McClain County, Oklahoma. This report contains the detailed results of the geotechnical investigation, including foundation recommendations, pavement recommendations, and construction considerations.

The subsurface soils consist of approximately 25 feet of lean to fat clay with various amounts of sand over very weathered shale and shale rock and exhibit moderately to highly plastic characteristics. The estimated potential vertical rise of the soil is 2.8 inch.

Foundation recommendations include: (1) Shallow Footings, (2) Concrete Mat Foundation, (3) Ring Wall Foundation, or (4) Drilled Pier Foundation.

We trust that the results and recommendations contained herein will permit adequate economical design and construction of the proposed structure. Unless you specify otherwise, we will keep samples obtained from these borings in our Oklahoma City laboratory for the next thirty (30) days.

We appreciate the opportunity to assist on this project. Please call on us if we can be of further service.

Respectfully submitted,
STANDARD ENGINEERING & FIELD SERVICES, LLC

Roy Khalife, P.E.
Geotechnical Engineer

Project No. 2430-0704
Account No. 0230GUE22

STANDARD ENGINEERING + FIELD SERVICES GEOTECHNICAL SERVICES

SUBSURFACE EXPLORATION

New ODOT Maintenance and Residency Facilities
NE of the intersection of Interstate 35 and SH-59
McClain County, Oklahoma

PROJECT NO. 2430-0704

PREPARED FOR

Guernsey
5555 North Grand Boulevard
Oklahoma City, OK 73112

PREPARED BY

STANDARD ENGINEERING & FIELD SERVICES, LLC
3400 N. Lincoln Blvd.
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Certificate of Authorization No. 7933, Expiration 6/30/2025
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LICENSED PROFESSIONAL ENGINEER
ROY KHALIFE
28446
OKLAHOMA

Prepared By:

Roy Khalife, P.E.
Geotechnical Engineer

I certify my e-signature for the study entitled "Subsurface Exploration."

Dated 1/3/2025

January 3, 2025

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Section 1

INTRODUCTION

1.1 Authorization

This report presents the results of a subsurface exploration performed by Standard Engineering & Field Services, LLC (Standard) in accordance with the proposal (P-2024-231) prepared for Mrs. Angela Aikman, dated July 29, 2024, and identified as Standard's project number 2430-0704. This geotechnical study was authorized by Subconsultant Task Order, dated September 12, 2024.

1.2 Purpose and Scope

A geotechnical investigation was performed for the purpose of (1) determining the subsurface conditions, (2) evaluating the bearing capacity and plasticity characteristics of the soils, and (3) making recommendations concerning the earthwork, pavements, and foundation systems for the facility.

Thirty (30) exploratory borings (building borings B-1 thru B-22, and paving borings P-1 thru P-8) were drilled to a depth of 5 to 25 feet. The boring depths and types of testing were performed according to the scope of work proposed by Standard and accepted by Mrs Aikman. Narrative descriptions of our findings and recommendations are contained in the body of this report. A site and boring location plan, the boring logs, the soil profile, and a summary sheet of laboratory test results are included in the Appendices of this report.

1.3 Project Location and Description

It is understood that the New ODOT Maintenance and Residency Facilities are proposed to be constructed at the NE portion of the intersection of Interstate 35 and SH-59 in McClain County, Oklahoma. the project consists of the construction of the following:

- New residency/maintenance administration facility
- 2-12 bay equipment sheds, 1 with wash bay, 1 with 2 shop bays
- 108' x 60' salt sheds
- 60' x 40' mix shed
- 1-14 bay hopper racks
- 1-10,000 gallon fuel tank with canopy
- Evaporative pond

Maximum column loads for the proposed facility are unknown while we are preparing this geotechnical report.

If the project is not as described or has changed, Standard must be notified in order to reevaluate the recommendations for the project.

Section 2

FIELD EXPLORATION

2.1 Drilling Information

The field exploration work was performed between the 19th of November, 2024 and 5th of December, 2024. Conditions at the site were investigated with Thirty (30) borings at the locations indicated on the site and boring location plan, included in Appendix "A." The boring surface elevations were measured with respect to a Temporary Bench Mark (TBM) established at an Existing iron pin in the ground labeled “BM 203” at coordinate location 34.91526°, -97.34084° . The Temporary Bench Mark (TBM) location is also shown in the site and boring location plan in Appendix “A.” Boring surface elevations, rounded to the nearest foot, are reported on the individual boring logs, included in Appendix “A.”

The benchmark has an assigned relative elevation of 100 feet. Boring depths were 5 to 25 feet within the facility’s footprint. For accurate sampling, cuttings were observed continuously during drilling with specific samples being taken at distinct lithologic changes. The equipment used, field tests performed, and soil samples taken are discussed below.

2.2 Equipment Used

Thirty (30) borings were drilled with a truck-mounted CME-45 rotary drilling unit equipped with 4”-6" solid flight augers (SFA), a track-mounted rig Diedrich D-50 rotary drilling unit equipped with 4" solid flight augers (SFA), and an all-terrain vehicle mounted CME-750 rotary drilling unit equipped with 4" solid flight augers (SFA). Standard penetration tests (SPT) used a 1.375" ID split spoon sampler driven by an automatic hammer utilizing a 140 lb. weight falling 30 inches.

2.3 Testing and Sampling Performed

Standard penetration tests were performed in order to estimate the shear strengths of the soils in their natural state. The test was conducted as specified by ASTM D1586, "Penetration Test and Split-Barrel Sampling of Soils." The in-situ bearing strength is related to the N-value from this test. "N" is the number of blows required to drive a split-spoon sampler twelve inches, after a 6-inch seating, into undisturbed soil. The soil samples recovered in the split-spoon barrel were removed from the sample tool in the field, visually classified, and labeled according to boring number and depth. Results of the standard penetration tests are denoted at their respective depths on the boring logs.

Thin-walled tube samples were collected as specified by ASTM D1587, “Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes.”

Depths of individual split spoon (standard penetration tests), thin-walled tube, and grab samples are indicated on the boring logs included in Appendix "B." All samples were labeled and sealed in water tight, protective containers and returned to the laboratory for further evaluation and testing.

2.4 Subsurface Conditions

The soils encountered consist of lean to fat clay with various amounts of sand over very weathered shale and shale rock. The cohesive soils were found to be firm to very stiff in consistency. Rock materials (i.e., defined by standard penetration test refusal) were encountered in the indicated borings at the relative elevation shown in the following table:

Table 1: Relative Elevation of Rock Material

Boring No.	Surface Elevation (feet)	Rock Depth (feet)	Rock Elevation (feet)	Rock Material
B-1	101.0	21.0	80.0	Shale
B-2	101.0	20.5	80.5	Shale
B-3	101.0	20.5	80.5	Shale
B-4	102.0	20.0	82.0	Shale
B-5	102.0	16.0	86.0	Shale
B-6	102.0	16.0	86.0	Shale
B-7	102.0	16.0	86.0	Shale
B-8	103.0	20.5	82.5	Shale
B-9	103.0	16.0	87.0	Shale
B-10	100.0	16.0	84.0	Shale
B-11	100.0	16.0	84.0	Shale
B-12	101.0	25.0	76.0	Shale
B-13	102.0	16.0	86.0	Shale
B-14	97.0	15.5	81.5	Shale
B-22	94.0	15.5	78.5	Shale

2.5 Groundwater

During drilling and at completion of drilling operations, groundwater was NOT encountered in the borings. However, due to the presence of high moisture contents in several borings within the high plasticity clay soils on site, presence of water should be anticipated in any excavation for this site. Water in highly plastic soils may take days to percolate and seep out into open excavations. Water travelling through soil (subsurface water) is often unpredictable and may be present at shallow depths. Due to the seasonal changes in groundwater and the unpredictable nature of groundwater paths, groundwater levels will fluctuate. Therefore, it is necessary during construction to be observant for groundwater seepage in excavations in order to assess the situation and make necessary changes. We cannot assume responsibility for difficulties experienced during construction or for future operational problems due to elevation or volume of water encountered.

Section 3

LABORATORY TESTING

Laboratory testing was performed in order to determine the plasticity characteristics of the subsurface materials as well as confirm the soil classifications.

3.1 Tests Performed

- Moisture content tests were performed on split spoon, thin-walled tube, and bag samples, in accordance with ASTM D2216, to determine the in-situ moisture conditions.

- Density tests were performed on intact split spoon, and thin-walled tube samples in accordance with ASTM D7263 Method A.

- Atterberg limits tests were performed on split spoon, thin-walled tube, and bag samples to determine the plasticity characteristics and swell potential of the soil. The tests were performed in accordance with ASTM D4318.

- Sieve analyses were performed on split spoon, thin-walled tube, and bag samples, in accordance with ASTM D2487, for aid in soil classification. These soils were classified according to the Unified Soil Classification System (USCS) and the American Association of State Highway and Transportation Officials (AASHTO) soil classification system.

- Laboratory pH and resistivity tests were conducted on composite soil sample. AASHTO T289 was used to determine the pH of the soil, while AASHTO T288 method was employed to determine the electrical resistivity of the sampled soil. pH and resistivity tests determine the corrosion potential of the on-site soils regard to underground structures and pipelines. The test results are summarized under Laboratory Testing Results in Section 4 of this report.

- Soluble sulfate content tests were performed on composite soil samples in accordance with OHDL-49. The test results are summarized under Laboratory Testing Results in Section 4 of this report.

- Unconfined compressive strength tests were conducted on thin-walled tube soil samples in accordance with ASTM D2166. The unconfined compressive strength as determined by this test, along with the results of the standard penetration test, is used to estimate the in-situ shear strength of the various soils encountered. The graphs in Appendix “D” depict the behavior of the tested soil under compression without confinement. The unconfined compressive strengths of the soils samples are presented on the boring logs and in the “Summary of Laboratory Test Results” table in Appendix “D.”

3.2 Laboratory Summary

General descriptions of the encountered soils together with visual and laboratory classifications and numerical values of the test results are on the boring logs and soil profile included in Appendix "B." A "Summary of Test Results" is included in Appendix "D."

Section 4

ENGINEERING EVALUATION AND RECOMMENDATIONS

4.1 Soil Conditions

A geotechnical concern at this site is the presence of expansive soils. The soils encountered in this investigation consist of lean to fat clay with various amounts of sand over very weathered shale and shale rock. The cohesive soils were found to be firm to very stiff in consistency. These near surface soils exhibit moderately to highly plastic characteristics. The plasticity characteristics of the soils encountered indicate that these soils are active for consideration of soil expansion on foundation design. The plasticity index (PI) of a soil indicates a soil's potential to shrink or swell with changes in its moisture content. The near-surface soils at this site generally display high plasticity characteristics and were found in a slightly moist to very moist condition. Atterberg limits test results indicate that on-site plastic soils have PI's up to 41. These soils should be considered active and should be expected to undergo significant volume change upon moisture variation.

These soils are expected to undergo expansion upon moisture increase and, conversely, contraction upon moisture decrease. Oklahoma is well known for its heaving clays and the foundation problems associated with soil expansion and uplift pressures. These soil characteristics accompanied with the seasonal variability in soil moisture content caused by the regional climatic conditions often result in foundation and structural damage. Accordingly, the swelling characteristic of the soil is a primary concern and the Potential Vertical Rise (PVR) becomes an important factor in the foundation design of the proposed facility.

The maximum PVR value computed for this site is 2.8 inches. The procedure used to predict the PVR was developed by Standard Testing based on AASHTO test method T258 and modified to incorporate our experience with actual Oklahoma soils. The displacement associated with the PVR is a relatively long-term effect, associated with significant moisture changes in the soil, and applies to free surface conditions. A maximum PVR of 0.75 inch or less is generally considered tolerable for most structures. These soils should be removed from underneath the slabs and replaced with inert fill as specified in the Earthwork Recommendations Section of this report.

4.2 Seismic Site Class

Based on the results of our investigation, this site is classified as Seismic Site Class C. This recommendation is based on the criteria given in Table 20.3-1 of the ASCE 7-16, entitled "Site Class Definitions". According to ASCE 7-16, if the subsurface data is not known for the full 100-foot depth, then engineering judgment may be used to classify the site. Based on the relatively shallow depth of rock at the site, and the assumption that rock continues in the subsurface past 100 feet in depth, the Seismic Site Class is assumed C. If any boring should indicate that rock material is not present beneath the depth, then Seismic Site Class D should not be used. The following are approximate mapped and design spectral acceleration parameters:

- The Approximate Mapped Spectral Acceleration for Short Periods, S_s=0.408
- The Approximate Mapped Spectral Acceleration for a 1-Second Period, S_1=0.092
- The Approximate Design Spectral Response Acceleration at Short Period, S_{ds}=0.354
- The Approximate Design Spectral Response Acceleration at 1-Second, Period, S_{d1}=0.092
- Site Coefficient, F_a=1.3
- Site Coefficient, F_v=1.5

4.3 Laboratory Testing Results

pH and Resistivity Test Results

The pH and resistivity of the soil samples tested are summarized in the following table:

Table 2: pH and Resistivity Content Test Results

Boring No.	Sample I.D.	Depth (feet)	pH	Resistivity (ohm-cm)	Corrosivity
B-1, B-2, B-3	Comp. 1	0.0-5.0	7.77	1162	Moderate
B-4, B-5, B-6, B-18	Comp. 2	0.0-5.0	7.81	1210	Moderate
B-7, B-8, B-9, B-19	Comp. 3	0.0-5.0	7.44	1026	Moderate
B-10, B-11, B-12, B-13	Comp. 4	0.0-5.0	7.72	523	Moderate
B-14, B-15, B-16, B-17	Comp. 5	0.0-5.0	7.87	644	Moderate

The pH and resistivity test results indicate that soils are moderately corrosive with regards to accelerated corrosion of metals.

Soluble Sulfate Test Results

The soluble sulfate results are included in the following table:

Table 3: Soluble Sulfate Test Results

Boring No.	Sample I.D.	Depth (feet)	Sulfate Content (ppm)
B-1, B-2, B-3	Comp. 1	0.0-5.0	51
B-4, B-5, B-6, B-18	Comp. 2	0.0-5.0	38
B-7, B-8, B-9, B-19	Comp. 3	0.0-5.0	158

B-10, B-11, B-12, B-13	Comp. 4	0.0-5.0	1,300
B-14, B-15, B-16, B-17	Comp. 5	0.0-5.0	221

The results of the sulfate content tests indicate that Type IL cement may be used for concrete and the sulfate levels are negligible in affecting lime stabilization of the soil. According to the National Lime Association's publication entitled "Technical Memorandum: Guidelines for Stabilization of Soils Containing Sulfates," which can be found on their website at www.lime.org/documents/publications/free_downloads/technical-memorandum.pdf, If the total level of soluble sulfates is below 0.3%, or 3,000 parts per million (ppm), by weight of soil, then lime stabilization should not be of significant concern. The potential for a harmful reaction is low."

Unconfined Compressive Strength of Soil Test Results

Unconfined compressive strength tests were conducted on thin-walled tube soil samples in accordance with ASTM D2166 testing method. The results are presented in the following table and are also presented in Appendix "D."

Table 4: Unconfined Compressive Strength Test Results

Boring No.	Depth (feet)	Moisture Content (%)	Dry Density (pcf)	Undrained Shear Strength, C_u (psf)	Strain at Max. Stress (%)
B-3	3.0	19.0	107.4	2,636	10.5
B-5	3.0	16.9	113.4	4,195	8.7
B-7	3.0	17.5	109.9	2,250	4.9
B-10	3.0	11.7	116.6	3,305	13.1
B-12	3.0	15.4	115.2	2,805	9.6
B-15	3.0	11.5	123.0	5,229	10.1
B-17	3.0	11.8	121.7	3,506	11.4
B-18	3.0	9.4	122.7	6,422	10.1
B-20	3.0	12.6	122.2	4,313	10.1
B-22	3.0	13.1	117.9	9,571	5.8

4.4 Earthwork Recommendations

Building Pad Construction

A critical geotechnical consideration at this site is the swelling soils. If slab-on-grade construction is to be used for the building floor at this site, construction of an inert fill building pad is advisable. The amount of ground surface movement that can be tolerated by the structure should be evaluated by the designer (a value of 0.75 inch or less may be used for most structures) and the corresponding amount of removal and replacement or over ground fill should be performed as indicated in the following options:

Option 1: Cut and Fill

- Remove the required amount of existing soil (see following table) and replace that soil with inert fill, meeting all requirements given herein,

Table 5: Cut and Fill Building Pad Requirements

Depth of Removal and Replacement Soil (feet)*	Estimated Potential Vertical Rise (PVR) (inches)
0.0	2.8
2.0	1.9
4.0	1.1
5.0	~~1.8~~
6.0	0.6

*** Below proposed building slab**

PER PHONE CONVERSATION WITH ROY KHALIFE, 2/11/2025, THIS VALUE SHOULD BE 0.8
CTW

or

Option 2: Fill Only

- Place the required amount or more of inert fill (see following table), meeting all requirements given herein, over the native soils.

Table 6: Over Ground Inert Fill Building Pad Requirements

Depth of Over Ground Inert Fill Building Pad (feet)**	Estimated Potential Vertical Rise (PVR) (inches)
0.0	2.8
2.0	1.9
4.0	1.3
5.0	1.0
6.0	0.75

**** Above existing site grade**

It is recommended that any fill sections under buildings above 5 feet in thickness be composed of no more than 5 feet of inert fill and the remaining section to be compacted ODOT Type A aggregate base in order to limit the consolidation settlement to approximately 1 inch. We recommend that the aggregate base be placed at the bottom of the fill section to provide improved structural capacity.

Only low plasticity on-site soils or imported inert fill should be used for fill under structure. Inert fill should meet the following requirements:

Inert Fill Requirements

Amount finer than 2-inch sieve	100%
Amount finer than No. 200 Sieve	12% minimum and, if PI ≤ 7, 60% maximum
Liquid Limit	35 maximum
Plasticity Index (PI)	5 to 15

Subgrade Preparation

The existing subgrade should be:

- Stripped of topsoil, vegetation and any other deleterious materials,
- Over-excavated to the required depth to reduce PVR to a level appropriate for the structural system to be used referring to the cut and fill building pad requirements and overground inert fill building pad requirements tables and extended to at least five (5) feet beyond building footprint,
- Proofrolled, including removing and replacing any soft material which exhibits permanent subgrade deformation exceeding 0.5 inch when traversed by a loaded truck with a rear axle load of approximately 16,000 lbs./axle, and
- Tested for moisture and density and, if deficient, scarified to a depth of 8 inches, moisture conditioned and compacted to 95 percent or more of standard Proctor maximum dry density (AASHTO T99).

When required during construction, removal of soft subgrade should not exceed a 3-foot depth below final top of subgrade elevation, nor extend below the static groundwater elevation. If such a depth is reached without encountering stable subgrade conditions, 3-inch diameter surge rock may be driven into the soft subgrade to provide a stable platform for construction equipment and then a minimum of 12 inches of ODOT Type A aggregate base should be placed in the bottom of the over-excavated area then suitable fill material placed and compacted to bring the subgrade to design elevation. In specific situations, geogrid may need to be placed on top of the subgrade, underneath the aggregate base material.

Compaction Requirements

All fill in the structural areas should be:

- Compacted to at least 95 percent of standard Proctor maximum dry density (AASHTO T99) at a moisture content within -2% to +2% of the optimum.
- Compacted to at least 95 percent of standard Proctor maximum dry density (AASHTO T99) at a moisture content near optimum for ODOT Type A aggregate base.
- Placed in lifts not to exceed eight (8) inches in compacted thickness.
- Tested for field density for each lift of fill at frequencies of every 1,500 sq. ft. in areas under structure and 2,500 sq. ft. in areas under pavement. Utility trenches should be tested for density once for every 150 linear feet of trench, or every 100 linear feet under pavement or structures.

Moisture should be maintained up until the placement of concrete in structural areas to prevent shrinkage (and subsequent post-construction swell) of the soil.

Drainage

The ground immediately adjacent to the foundation shall be sloped away from the buildings at a slope of not less than six (6) inches vertical fall in the first ten (10) feet measured perpendicular to the face of each wall. Trees and large bushes for landscaping should not be permitted within this 10-foot zone adjacent to the building. General site slopes, drainage swales, or storm drains shall be constructed to provide 1.0 percent slope, or more, along drainage paths which serve to discharge storm water from the site. If surface soil should be left exposed (e.g., flower beds) near the structure foundation, then it is suggested that efforts be taken to maintain such areas at a constant moisture in order to avoid swell/shrinkage of the soil that will affect the foundation system. If a non-expansive (inert fill) pad is constructed such that it extends below the adjacent higher plasticity soils, the bottom of such excavation shall be cut at a slope of not less than 1.0 percent to provide a subsurface sump. Drainage shall be provided from this sump in the base of the non-expansive pad by an underdrain with a slope of at least 1.0 percent discharging either to daylight or to a permanent, automated sump pump system. The underdrain at the sump shall extend below the excavation and shall consist of a perforated nonmetallic underdrain conduit (ODOT 726.02(b)6), 4.0 inches in diameter or larger, wrapped in drainage geotextile (ODOT 712.03) and surrounded by at least 6 inches of coarse cover aggregate (ODOT 703.04) on all sides.

The underdrain system mentioned in the above paragraph can be waived if a clay cap is placed surrounding the structures footprint and all utility line trenches sealed with a clay plug at the perimeter.

Clay cap should be:

- Over-excavated at least one foot deep below final grade and be extended horizontally to at least five (5) feet beyond edge of the exterior wall;
- Placed with geofabric over the excavated subgrade soils;
- Backfilled with compacted clays of PIs greater than twenty-five (25); and
- Sloped away from the structure at a slope of not less than six (6) inches vertical fall in the first ten (10) feet.

On-site clays with PI's greater than twenty-five may be used for the clay cap in order to avoid swell/shrinkage of the soil that will affect the foundation system.

4.5 Foundation Recommendations

Several borings (B-16, B-17, B-21) were drilled near an existing pond. Before the construction of any foundation system near those locations, the pond should be overexcavated, all soft and wet/saturated soils should be removed and then backfilled with properly compacted inert fill or ODOT Type A aggregate base. Foundations supporting structures near the above locations should be designed as recommended in the table below for Hopper Racks.

Considering the soils encountered and based on the test results of this exploration, the following foundation design parameters are recommended for the indicated foundation systems:

Footing Foundation System

Shallow foundations (e.g. spot or continuous cast-in-place concrete footings) may be used to support the new structures at this site. Footings must be placed a minimum of 2.0 feet below finished grade to provide adequate protection from frost action. Footings may be used with allowable net bearing capacities as presented in Table 7 below. Footings should have a width of at least 16 inches.

Continuous footings and spot footings are expected to undergo no more than 1.0 inch settlement when designed for the recommended bearing pressure when constructed on existing soil or no more than 5 feet of properly compacted inert fill. Standard Testing shall be provided with final grading plans and structural loads in order to re-evaluate our recommendations if deemed necessary.

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Table 7: Estimated Allowable Bearing Capacity

Bearing Location	Bearing Material	Allowable Bearing Capacity (psf)
Maintenance Building	Native Soils or Lime Stabilized Soils	2,500
	5 feet Compacted Inert Fills	2,000
	2.0 Feet of Properly Compacted ODOT Type A Aggregate Base	3,000
Shop Shed	Native Soils or Lime Stabilized Soils	3,000
	5 feet Compacted Inert Fills	2,000
	2.0 Feet of Properly Compacted ODOT Type A Aggregate Base	3,000
heavy pavement section Fueling Canopy	Native Soils or Lime Stabilized Soils	2,000
	Compacted Inert Fills	2,000
	2.0 Feet of Properly Compacted ODOT Type A Aggregate Base	3,000
Wash Bay	Native Soils or Lime Stabilized Soils	2,500
	5 feet Compacted Inert Fills	2,000
	2.0 Feet of Properly Compacted ODOT Type A Aggregate Base	3,000
heavy pavement section Salt Shed/Mixing Shed	Native Soils or Lime Stabilized Soils	2,500
	Compacted Inert Fills	2,000
	2.0 Feet of Properly Compacted ODOT Type A Aggregate Base	3,000
heavy pavement section Hopper Racks	Native Soils or Lime Stabilized Soils	1,500
	Compacted Inert Fills	2,000
	2.0 Feet of Properly Compacted ODOT Type A Aggregate Base	3,000

Concrete Mat Foundation System

Reinforced concrete mat foundation may be used to support the proposed structures at this site such as storage tanks, hopper racks, and pedestals. Mat foundation can be used with an allowable net bearing capacity of 2,000 psf bearing on existing soils or inert fill at 2-ft below existing ground surface. For mat foundation system, it is recommended that the combined weight of the footing plus the soil immediately above it exceed twice the maximum uplift forces. Unit weight of 125 pcf can be used to calculate the weight of the soil immediately above foundation. For the purpose of structural design, the modulus of subgrade reaction (k_S) should be taken as 70 pci for existing soils and 140 pci for inert fill and the coefficient of friction should be taken as 0.25 for on-site clayey soils and 0.35 for inert fill.

Mat foundation is expected to undergo no more than 1.0-inch settlement when designed for the recommended bearing pressure. Unsuitable bearing material, when encountered in the foundation excavation should be removed and replaced with concrete having compressive strength of at least 1,000 psi.

Ring Wall Foundation System – 10,000 Gal Tank

An earth foundation confined by a reinforced concrete ring wall may be used, with a maximum allowable net bearing pressure of 1,500 psf bearing on the existing subgrade soils, 2,000 psf bearing on compacted inert fill, and 3,000 psf bearing on compacted ODOT Type A aggregate base within the area enclosed by the outside face of the ring wall. The recommendation for ring wall is based on the total settlement not exceeding 1.0 inch.

Additional considerations for an earth foundation with ring wall are as follows:

- The thickness of the ring wall should be at least 18 inches.
- The center-to-center diameter of the ring wall should be equal to the nominal diameter of the tank.
- The depth of the ring wall should be sufficient to extend at least 5 feet below the site grade external to the ring wall.
- The ring wall should be reinforced for temperature and shrinkage and structurally to resist the lateral pressure of the confined fill and surcharge of the tank. This lateral pressure should be taken to be equal to 60% of the total weight of the tank, its maximum contents, and the subgrade materials contained within the ring wall all divided by the bearing area of the tank.
- Prior to construction of the ring wall, the subgrade should be cut or filled to an elevation to allow for a base course 12 inches thick below the tank bottom. The subgrade should be scarified and moisture conditioned to within 0 to +3 percentage points of standard Proctor optimum moisture and then compacted to at least 95 percent of standard Proctor maximum dry density for a depth of

approximately 6 inches. The subgrade should then be proof-rolled with a truck having an axle loading of approximately 16,000 lbs. The soil in any area which exhibits 0.25 inch or more permanent displacement in the wheel tracks should be removed and replaced with suitable material.

- After construction of the ring wall, at least 12 inches of aggregate base, uniformly blended to meet the requirements of Oklahoma Department of Transportation (ODOT) "Standard Specifications for Highway Construction" section 703.01, Type A, should be placed in two, 6 inches thick (compacted) lifts, each compacted to no less than 100 percent of standard Proctor maximum dry density. Water should be uniformly applied over the base materials during compaction in the amount necessary for proper consolidation.
- The surface grade within 6 feet immediately surrounding the ring wall should vary no more than 12 inches above or below the top of the ring wall.

Pier Foundation System

Structures may be designed to be supported by drilled cast-in-place concrete piers founded 3.0 feet or more below the depths indicated in the "Relative Elevation of Rock Material" table provided in Section 2.4 of this report. Using this type of foundation, each column is supported on a single drilled pier and the building walls are placed on grade beams supported by a series of piers. Loads applied to the piers are transmitted to the rock partially through skin friction along the sides of the pier and partially through end bearing pressure.

All drilled piers should:

- Extend at least 3.0 feet or at least one (1) pier diameter, whichever is deeper, beyond the elevation indicated in the "Relative Elevation of Rock Material" table provided in Section 2.4 of this report,
- Have an aspect ratio (length/diameter) between three (3) and thirty (30),
- Have a spacing between individual piers of three diameters or more (clear spacing),
- Be adequately reinforced with the reinforcement extending into the grade beams and/or pier caps, and
- Have a diameter of at least 18 inches.

Piers may be proportioned using an allowable net end bearing capacity of 22,600 psf and an allowable skin friction capacity of 1,360 psf for that portion of the pier in direct contact with the shale rock. The allowable net bearing capacity and allowable skin friction capacity both include a factor of safety of 3.0. Uplift of the piers can be resisted by using the same skin friction values plus for the pier weight (i.e. 150 pcf x Pier Area x length of Pier). Maximum service load vertical displacement of piers designed in this manner is expected to be on the order of 0.8% of the pier base diameter.

Drilled shafts may require casing or slurry-drilling methods. Concrete should be placed in pier holes as soon as practicable after completion of drilling to prevent weathering of the bearing stratum and relaxation of horizontal ground stresses.

If groundwater is encountered during pier excavation and cannot be dewatered, concrete may be placed by tremie-pipe method so as to assure no contamination of the fresh concrete by groundwater or drilling fluids. A sufficient head of plastic concrete should be maintained within the casing at all times during its extraction in order to overcome the hydrostatic groundwater pressure outside the casing.

4.6 Floor Slabs

Concrete slabs-on-grade for floors should be constructed as follows:

- The subgrade, inert fill, and/or soil building pad should be prepared as described in the Earthwork Recommendations section of this report.
- Four (4) inches or more of granular base, meeting the following requirements, should be placed over the subgrade:
  - passing the 1.5 inches sieve……………………………………………………100 %
  - passing the #200 sieve………………………………………………..15 % or less
  - plasticity index……………………………………………………………6 or less
- At the time of concrete placement, the granular base should be moist, but free of any standing water.
- The floor slab should be placed a minimum of four (4) inches thick in lightly loaded areas and up to six (6) inches thick in heavily loaded areas and should not be tied into the footings, stemwalls, or structural frame. If it is necessary to tie the floor slab into the foundation walls, exterior walls, and/or pitwalls, the slab should be jointed no more than 10 to 15 feet from the point of the restraint (ACI 360R-10, Section 14.7). Other control joints should be provided, each way, at a spacing of 24 to 36 times the slab thickness but no more than 18 feet. Refer to ACI 360R-10, Section 6.1.3 and Figure 6.6 for additional guidance on joint spacing.

If floor coverings susceptible to moisture damage by moist floor conditions (capillary moisture) are to be used, a vapor retarder consisting of one or more polyethylene or polypropylene fabric reinforcement layers with one or more bonded polyethylene film layers, at least 10 mils in total thickness, should be placed below the slab. The vapor retarder should be lapped 6 inches and taped at joints and fitted around all service openings. Section 5.2.3.2 of ACI 302.1R-15 provides the most current industry recommendations for use and placement of vapor retarders. Figure 5.2.3.2, in ACI 302.1R-15, provides guidance for determining whether to place the vapor retarder above or below the "granular material" below the slab.

Floor slabs can be designed using a modulus of subgrade reaction, k_s, of 140 pci for compacted inert fill described in the Earthwork Recommendations Section of this report or 70 pci for native soil.

Elevated Floor Slabs

Floor slabs may be constructed so as to be elevated at least four (4) inches from the natural ground surface to avoid contact with the swelling soils or non-engineered fills. This may best be accomplished by casting the concrete over cardboard carton forms or “void” boxes. Such floor slabs must be designed to span between supporting structural elements without the aid of soil support. If floor slabs are designed and constructed to be elevated in this manner and the foundation elements are designed to counteract the soil swelling pressures, then the inert fill subgrade provisions in the Earthwork Recommendations Section of this report may be waived. We recommend that the elevated floor slab be structurally connected to the foundation elements and grade beams.

4.7 Grade Beams

Grade beams, supported by shallow footings or pier foundation systems, may be constructed so as to be elevated at least four (4) inches from the ground to avoid contact with the swelling soils. This may be best accomplished by casting the concrete over cardboard carton forms or “void” boxes.

4.8 Pavement Recommendations

Subgrade Preparation

Prior to the placement of fill or preparation of pavement subbase:

- The natural subgrade should be stripped of all topsoil, vegetation and any other deleterious materials.
- The parking and drive areas should then be graded and shaped to facilitate drainage, with a minimum slope of 1/8 inch per foot.
- Next, the subgrade should be proofrolled, including removing and replacing any soft material which exhibits permanent subgrade deformation exceeding 0.5 inch when traversed by a loaded truck with a rear axle load of approximately 16,000 lbs./axle. Removal of soft subgrade should not exceed a 3-foot depth below final top of subgrade

elevation, nor extend below the static groundwater elevation. If such a depth is reached without encountering stable subgrade conditions, 12 inches of ODOT Type A aggregate base should be placed in the bottom of the overexcavated area and suitable fill material placed and compacted to bring the subgrade to design elevation.

- Once the subgrade has been satisfactorily proofrolled, the surface layer of the subgrade shall be scarified to a depth of 6 inches.

Pavement Sections

We estimate the CBR value of the near surface soils as 3.0 based on the paving borings P-1 through P-8. This would correspond to a modulus of subgrade reaction, k_s, of 70 pci, and a resilient modulus, M_r, of 4500 psi.

Pavement sections were evaluated based on the AASHTO 1993 guidelines with the following assumptions. If traffic loads are greater than used in the analysis, Standard Testing must be notified in order to reevaluate the recommendations.

- Design Period = 20 years
- Reliability Level = 85% (flexible and rigid)
- Initial Serviceability Index = 4.5 (flexible and rigid)
- Terminal Serviceability Index = 2.0 (flexible and rigid)
- Combined Standard Error (S_0) = 0.5 (flexible) and 0.4 (rigid)
- Light duty (car parking) total design ESALs (W_{18}) = 99,000 (flexible) and 150,000 (rigid)
- Heavy duty (truck parking) total design ESALs (W_{18}) = 348,000 (flexible) and 500,000 (rigid)

We recommend that the following pavement sections be used:

Table 8: Pavement Sections

Pavement Type	Light Duty (inches)	Heavy Duty (inches)
Flexible Pavement		
Surface Course (S4)	2.0	2.0
Intermediate Course (S3)	-	2.5
Base Course (S3)	3.0	2.5
Lime or Portland Cement Stabilized Subgrade*	8.0	8.0
Rigid Pavement		
Portland Cement Concrete	5.0	7.0

Lime or Portland Cement Stabilized Subgrade*	8.0	8.0

*** Based on the presence of A-7-6 near-surface soils across the site, ODOT OHD L-50 recommends Lime or Portland Cement stabilization, and a full mix design will be required for the treated subgrade mixture.**

***In order to utilize Portland Cement, a mix design must be performed to ensure that the cement stabilizer sufficiently reduces the soil plasticity.**

All access lanes subject to delivery trucks, fuel truck, refuse pickup trucks, or fire trucks should consist of heavy-duty rigid pavement.

Gravel Pavement sections were evaluated based on Tensar software and the AASHTO 1993 guidelines with the following assumptions.

- Aggregate California Bearing Ratio (CBR) = 50.0
- Subgrade California Bearing Ratio (CBR) = 3.0
- Design Period = 20 years
- Site Condition = Unsoaked

We recommend that the following gravel pavement sections be used:

Table 9: Gravel Pavement Section

Pavement Type	Pavement Section (inches)
Gravel Section	
ODOT Type A Aggregate	9.0
Tensar Biaxial Geogrid Class II (NX-750 or Equivalent)	-
Compacted Subgrade	8.0

It is imperative that the nominal maximum size of the ODOT Type A aggregate utilized be greater than the apparent opening size (AOS) of the selected geogrid. Continuous maintenance as well as possible reshaping may be required for the gravel section to maintain serviceability.

If the gravel pavement section is the selected option, existing areas of 6 inches or greater aggregate base may have an additional 6 inches of ODOT Type A aggregate placed over the site to meet the total design section. We recommend the placement of a geogrid after stabilizing and compacting the subgrade.

Materials and Construction

All materials and construction for base should be in accordance with the Oklahoma Department of Transportation (ODOT), "2019 Standard Specifications for Highway Construction," and the latest Special Provisions adopted by ODOT to supplement the Standard Specifications. ODOT Type "A" aggregate base should be compacted to not less than 95 percent standard Proctor maximum dry density (AASHTO T99). Treated/compacted subgrade should be compacted to not less than 95% of the standard Proctor maximum dry density (AASHTO T99) within -1 to +3 percentage points of the corresponding optimum moisture content. Treated/compacted subgrade should extend the full width of the pavement section (i.e., including curb and gutter).

Concrete for paving should have a modulus of rupture, M_r, of at least 550 psi (compressive strength of approximately 3,500 psi or more), should be air entrained with 4 to 7 percent air, should have a cementitious materials content of at least 564 pcy, and should have a maximum water to cementitious materials ratio of 0.45. The concrete mix design submittal should adequately address the criteria of ACI 301, section 4, including documentation of strength test results. Control joints should be saw cut at least one-eighth (0.125) inch wide and one-quarter of pavement thickness deep as soon as possible after concrete reaches final set (i.e., approximately 8 to 12 hours after placing the concrete), cleaned by high pressure air jet, and sealed with a suitable pavement joint sealing material to prevent intrusion of surface water into the pavement base. Control joints should be spaced as indicated in the following table:

Table 10: Recommended Transverse Joint Spacings

Concrete Thickness (inches)	Maximum Joint Spacing (feet)
5.0	12.5
7.0	15.0

4.9 Stabilization Recommendations

Application of Chemical Stabilizer and Initial Mixing

Assuming a 5% Lime or 4% Portland Cement (PC) mixture by dry weight of soil, the application rate of the stabilizer is approximately 33 lbs/square yard and 26 lbs/square yard respectively. Stabilizer must:

- Be applied so that it is uniformly mixed with the soil, the specified stabilizer content is obtained, and a sufficient quantity of lime or Portland Cement treated soil is produced to construct the compacted lime or Portland cement course conforming to the lines, grades, and cross section.
- Be spread only on areas where mixing operations can be completed during the same work shift or work day.
- Be applied as a slurry, and distributors are utilized in application of the slurry.
- Be applied by hand only if distributors are not able to access the area of application.

- Have no equipment pass over applied areas, except that used in spreading and mixing.
- Have adequate initial mixture to alleviate any dusting or wetting that may occur as a result of wind or inclement weather.

Water Application and Moist Mixing

Moisture content of the mixture must be determined prior to final mixing. Moisture in the mixture following final mixing shall not be less than the optimum moisture content (OMC), nor exceed the OMC by more than +2% of the optimum. Water must be added in increments as large as available equipment will permit; however, such increments of water shall be partially incorporated in the mix to avoid concentration of water near the surface of the mixture.

After the last increment of water has been added, continue mixing until water is uniformly distributed throughout the full depth of the mixture, including satisfactory moisture distribution along the edges of the cross section.

For lime stabilized soil, the soil shall be mixed in two stages, allowing for an intervening 24-to-48-hour mellowing period. The modified mixture should mellow sufficiently to allow the chemical reaction to break down the material. After mellowing, the soil should be remixed prior to compaction.

For cement stabilized soil, the mellowing requirement may be waived per the Geotechnical Engineer's permission.

4.10 Lateral Earth Pressure Parameters

Lateral earth pressure can be assumed to increase linearly with depth and may be represented as an equivalent fluid column equal to the effective unit weight of the soil times the appropriate coefficient of lateral earth pressure times the thickness of overlying soil at the depth in question. For consideration of lateral earth pressure, the effective unit weight of the soil is the weighted average, down to the depth in question, of the moist unit weight of the soil above the groundwater and the submerged unit weight of the soil below the groundwater. The following estimated parameters may be used for determining approximate lateral earth pressures for the retaining walls at this site:

High Plasticity Clay Soils

γ =	125 pcf	moist unit weight
ϕ =	8°	angle of internal friction
c =	3,200 psf	apparent cohesion
k_a =	0.76	coefficient of active lateral pressure

k_p = 1.32 coefficient of passive lateral pressure
k_0 = 0.86 coefficient lateral earth pressure at rest

Inert Fill
γ = 110 pcf moist unit weight
ϕ = 25° angle of internal friction
c = 500 psf apparent cohesion
k_a = 0.41 coefficient of active lateral pressure
k_p = 2.46 coefficient of passive lateral pressure
k_0 = 0.58 coefficient of lateral earth pressure at rest

The parameters for inert fill should be used only if the inert fill meets all requirements given in the Earthwork Recommendations Section of this report, testing has confirmed that the inert fill has an angle of internal friction of 25° or more, the slope of the native soil from the toe of the earth-retaining structure is no steeper than 1:1, and only inert fill is used in the backfill between the earth-retaining structure and the native soil slope. If these criteria are not met, then the appropriate parameters for the native soil should be used.

Note: P_{water} (Hydrostatic Pressure; psf) = 62.4 (pcf) x h (ft); h=depth below water level

Soil retaining structures (i.e., retaining walls, pits) will be subjected to horizontal loading due to lateral earth pressure. The magnitude of this lateral earth pressure depends on the natural and backfill soils, extent of the original excavation, and wall deflections (i.e., stiffness). The appropriate coefficient of lateral earth pressure will vary, based on these considerations, between the coefficient of active lateral earth pressure and the coefficient of lateral earth pressure at rest. Greater wall deflections result in the development of greater internal shear strength in the retained soil, thereby lowering the lateral pressure on the wall. Granular backfill and clay backfill require horizontal deflections of the top of the wall on the order of 0.2 percent and 2 percent, respectively, of the wall height to mobilize the full internal shear strength of the soil. Thus, at reasonably small wall deflections, a greater portion of the internal strength of granular backfill is mobilized reducing the lateral earth pressure on the wall for this type of material.

Retaining walls which are laterally supported and can be expected to undergo only a slight amount of deflection (i.e., less than 0.1 percent of wall height for granular soils or less than 1.0 percent of wall height for clay soils) should be designed for lateral loadings based on lateral earth pressure computed using the coefficient of lateral pressure at rest.

Retaining structures which can deflect sufficiently to mobilize the full active earth pressure condition should be designed for a smaller active lateral earth pressure computed using the coefficient of active lateral earth pressure. Walls designed for such loading must be detailed and specified such that (1) hydrostatic pressure cannot develop and (2) compaction effort used on backfill is limited to that required to achieve 95 percent of modified Proctor density.

If the slope of the undisturbed soil beyond the backfill behind retaining walls is steeper than the equivalent of a 1:1 slope measured from the base of the wall, then the active earth pressure should be based on the greater of the earth pressure value described above for backfill or the earth pressure computed based on the coefficient of lateral earth pressure at rest for the undisturbed soil.

A continuous back drain system should be installed at the heel of all walls to prevent water pressure build-up behind the walls. It is recommended that a free-draining, cohesionless material such as crushed stone having a gradation corresponding to ASTM C33, size 6, 7, or 67 be used to form a drainage blanket against the backside of the walls. The drainage blanket should have a minimum horizontal thickness of 12 inches and should extend from the bottom of the buried walls to within 18 inches of the finish ground surface. The crushed stone should be separated from soil surfaces by use of a fabric meeting the requirements of AASHTO M288 for a Class 2 subsurface drainage geotextile rated for soils with less than 50 percent passing the 0.075 mm sieve. A minimum 4 inch diameter, slotted or perforated, corrugated polyethylene pipe should be placed in the bottom of the drainage blanket to collect and transport groundwater to an appropriate point for disposal. Manufactured wall drain systems may be considered in lieu of the described gravel drainage blanket. With a drainage system in place, it is recommended that the buried walls be designed to resist lateral pressures equivalent to those produced by a fluid having a unit weight calculated from the parameters at the beginning of this section plus a uniform pressure equal to 40 percent of any anticipated surcharges adjacent to the walls.

Ultimate resistance to lateral sliding at the bottoms of footings may be calculated based on a coefficient of friction of 0.25. Sliding resistance may also include ultimate passive pressure against the front of the footings which can be calculated using an equivalent fluid unit weight seen in the table below. The designer may use the passive pressure in this zone only if there is a certainty of no loss of toe soil. If necessary, additional sliding stability may be derived from the use of a key embedded into soil beneath the base and utilizing the appropriate equivalent fluid unit weight for passive lateral earth pressure. A factor of safety of at least 1.5 should be used with stability calculations involving lateral earth pressures. The safety factor should be computed as the sum of resisting forces or moments divided by the sum of driving forces or moments.

Table 11: Equivalent Fluid Pressure

Soil Type/ State	At Rest psf	Active psf	Passive psf
Inert Fill / Drained	64	45	271
Highly Plastic Clay/ Drained	108	94	165
Inert Fill / Undrained	90	82	180
Highly Plastic Clay/ Undrained	116	110	145

4.11 Pond Recommendations

A total of three (3) borings (B-20 thru B-22) were drilled in the proposed evaporative pond footprints. Based on the information obtained from the borings, moderate to highly plastic lean and fat clays overlying very weathered shale were encountered. Groundwater was not encountered while drilling. Based on the laboratory test results, and the subsurface conditions encountered in the boring within the pond's proposed footprint, it is our opinion that the existing soils on the site are suitable for the construction of the pond. However, additional testing including hydraulic conductivity shall be performed during the construction and after the excavation is completed to confirm the hydraulic conductivity of pond liner.

Pond Design and Construction

Pond must be designed and constructed to meet the following requirements:

- Pond will not be liable, as far as practicable, to inundation or damage from flood waters,
- Contents of the pond will not overflow (unless overflow has been accounted for in the final design and normal operation) into waters or on land in an area where entering any waters would be a reasonable possibility,
- Pond will utilize an appropriate liner which achieves required permeability criteria and minimizes leakage
- Subgrade will be proof-rolled to determine any presence of zones that may require subgrade improvement,
- Subgrade must be free of aggregate and debris prior to placement of geosynthetic liner material and/or clay liner

Geosynthetic Liner Types – if used

Geosynthetic liners have the following types available:

- Geosynthetic clay liners (GCL) are fabricated by incorporating bentonite clay into a woven fabric. Powdered bentonite is preferred, but if availability is limited then granular bentonite is an acceptable alternative however granular bentonite must be hydrated prior to confinement to prevent leakage.

- Geomembranes are a common pond liner material and high-density polyethylene (HDPE) is the preferred type of geomembrane. However, this material could fail due to stress cracking and/or extended UV exposure.
- A combination of GCL and geomembranes are a third option.

Geosynthetic Liner Considerations

Geosynthetic liners have the following considerations:

- Geosynthetic liner must be anchored to cover the entire base and all slopes of the pond,
- Geosynthetic liner must be laid according to manufacturer specifications,
- All welded joints and seals must be watertight,
- Geomembranes must be free of blisters and contaminants,
- Geomembranes must be assessed for liner integrity, geoelectric testing via a liner integrity survey assessment (LISA) is recommended,
- GCL must be confined by at least 6-8 kpa. This can be achieved by applying a minimum 12 inches of non-dispersive fine-grained soil which will confine a swelling GCL once hydrated and ensure liner permeability and performance is maintained.

Clay Liner Considerations

Clay liners have the following considerations:

- Must be well-graded, of low permeability, and free of topsoil, roots, other organic matter and debris,
- Must be compacted to 95 percent or more of standard Proctor maximum dry density (AASHTO T99),
- Must be constructed in 6 inches lifts,
- Must have an in-situ permeability of less than 1.0 X 10^{-7} cm/s,
- Must apply the bentonite in the field at a rate that is at least 125% of the minimum rate determined in laboratory tests needed for stability and maximum hydraulic conductivity;
- Must be protected during and after construction due to desiccation or freezing.
- Must apply one-half of the mixture in one direction and the remaining half should be laid in the perpendicular direction. Several lifts may be required in each direction to achieve the design thickness of the soil and bentonite liner;
- Must test the application rate, water content, density, and hydraulic conductivity of the liner at least twice per lift or per acre;

- Must protect the liners by placing a minimum of 12 inches of soil on top of the liner and compacted it.

4.12 Excavation Requirements (OSHA Requirements)

Excavations adjacent to structures or public ways or to which personnel will enter which are more than 5 feet deep must be either supported (e.g., shoring or trench box) or laid back to a stable slope. If excavations less than 5 feet in depth appear to be unstable, they must also be shored or sloped sufficiently to protect the employees working within them. The recommended slopes provided herein on the Occupational Safety and Health Administration (OSHA) requirements and are intended for construction operations. Permanent slopes should not be constructed utilizing the slope angles described herein.

Trees, boulders, and other surface encumbrances, located so as to create a hazard to employees involved in excavation work or in the vicinity thereof at any time during operations, shall be removed or made safe before excavation begins. Existing underground utility lines shall also be protected during excavation. The excavation slopes specified herein have been determined to hold back the earth banks and not more than 2 feet of stockpiled soil within a distance of 5 feet from the edge of the excavation. Any excavated soil at the edge of the excavation must be stockpiled at a slope of 1.5 or more horizontal to 1.0 vertical. Additionally, no equipment should be allowed within 5 feet of the trench edge.

Someone capable of identifying existing and predictable hazards and who has the authorization to take prompt corrective measures (i.e., a "competent person") must inspect the excavations daily for any condition which may adversely affect the reliability and safety of the excavation. The excavations must also be inspected after each rainstorm or when any change in condition occurs that can increase the possibility of a cave-in or slide. If evidence of possible cave-ins or slides is apparent, all work in the excavation shall cease until the necessary precautions for sloping or bracing have been taken to safeguard the employees and the excavation. Any loose soil shall be scaled from the slope and removed from the excavation to protect workers against falling soil.

An adequate means of egress must be provided within 25 feet of lateral travel to any worker in all trench excavations 4 feet or more in depth. The means of egress may be a ladder or a ramp of stable soil having a slope which can be quickly traversed by personnel exiting the excavation under emergency conditions.

During excavation, the material encountered must be evaluated with respect to the soils encountered during the subsurface investigation as described on the boring logs. If material with different properties (e.g., fill soil, loose sand, etc.) is encountered, the recommendations given in this report may not be adequate to assure safe excavations.

Unless otherwise indicated all sloping requirements are given as a ratio of horizontal distance to vertical distance (i.e., H:V). OSHA soil classifications for the various soil and groundwater conditions encountered in the borings are indicated in the OSHA Soil Classification table:

Sloping requirements for excavation up to 20 feet in depth for the soils encountered are tabulated as follows:

Table 12: OSHA Soil Classification

Boring No.	Depth Range (feet)	Soil Description	OSHA Soil Type
All Borings	Surface to Top of Rock	All Soils	Type B
All Borings	Shale Rock	All Soils	Stable Rock

Sloping requirements for excavation up to 20 feet in depth for the soils encountered are tabulated as follows:

Table 13: Maximum Allowable Slopes

OSHA Soil Type	Maximum Allowable Slopes (H:V)* for Excavations Less Than 20 Feet Deep**
A	¾:1 (53°)
B	1:1 (45°)
C	1.5:1 (34°)

*** Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from horizontal. Angles are given to the nearest degree.**

**** Sloping or benching for excavations greater than 20 feet deep shall be designed by a registered professional engineer using the conditions unique to the specific excavation.**

OSHA requires that all excavation slopes for any soil type overlying an exposed Type C soil follow Type C recommendations and for all Type A soils overlying an exposed Type B soil to follow Type B recommendations. All soils which are submerged are to be considered Type C.

All water should be continuously removed from the excavations to prevent softening and weakening of the excavation face. All excavations should be protected from rain and groundwater by surface diversion ditches or dikes and appropriate de-watering systems. Water shall be continuously removed to keep the water level below excavation depth. The groundwater levels shown on the boring logs represent its location on the day indicated. Groundwater levels will fluctuate with the seasons and may be encountered during construction at a level other than that shown on the boring logs. Workers should be prohibited from working in excavations where water has accumulated or is accumulating.

4.13 Construction Procedures and Considerations

If ground water is encountered during excavation of the footings and trenches, water should be removed from the excavation area and Standard Testing should be contacted to verify to inspection the bearing soils and verify the recommended bearing capacity before the construction of the foundations is resumed.

Unless otherwise indicated all sloping requirements are given in horizontal: vertical. The OSHA Soil Classification for the soil and groundwater conditions encountered in the borings is a type B.

We recommend a slope no steeper than 1.5:1 for the subsurface conditions encountered. Sloping or benching for excavations greater than 20 feet deep shall be explicitly designed by a registered professional engineer.

The soils encountered are susceptible to rapid erosion from rainfall. Excavation slopes should be protected from erosion by some type of impermeable covering, such as plastic sheeting.

If space limitations prevent a 1.5:1 excavation side slope, use of shoring or sheet piles will be necessary.

Section 5

BASIS FOR RECOMMENDATIONS

5.1 General Comments

The recommendations and conclusions contained in this report are based on the borings drilled and tests performed. We would point out that there may be variations in material properties over the site and would caution that there may be unknown conditions in existence which differ seriously from those encountered by the test borings. Such conditions, if indeed they exist at all, cannot be, and have not been, accounted for in this report. Therefore, the descriptions, recommendations, and conclusions contained herein should be considered as generalized, applying only to the immediate vicinity of the borings.

5.2 Limitations

Since this report is being prepared in advance of much of the detailed design, the finalized soil and structure parameters (i.e., floor elevation, structural system and loading, vertical movement tolerance, etc.) may differ from the ones considered during the preparation of this report. If such a design variance is substantial, Standard would request the opportunity to review the plans and specifications of the proposed facility for applicability to the soil conditions in this report, and assurance of consistency with its intent.

It is recommended that Standard be retained for testing and observation during earthwork and foundation construction phases, to help determine that the design requirements are fulfilled. It is also recommended that Standard Testing’s pier inspector be present during the pier drilling operations to verify the hardness of the support soil stratum and the proper depth of embedment.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical practice.

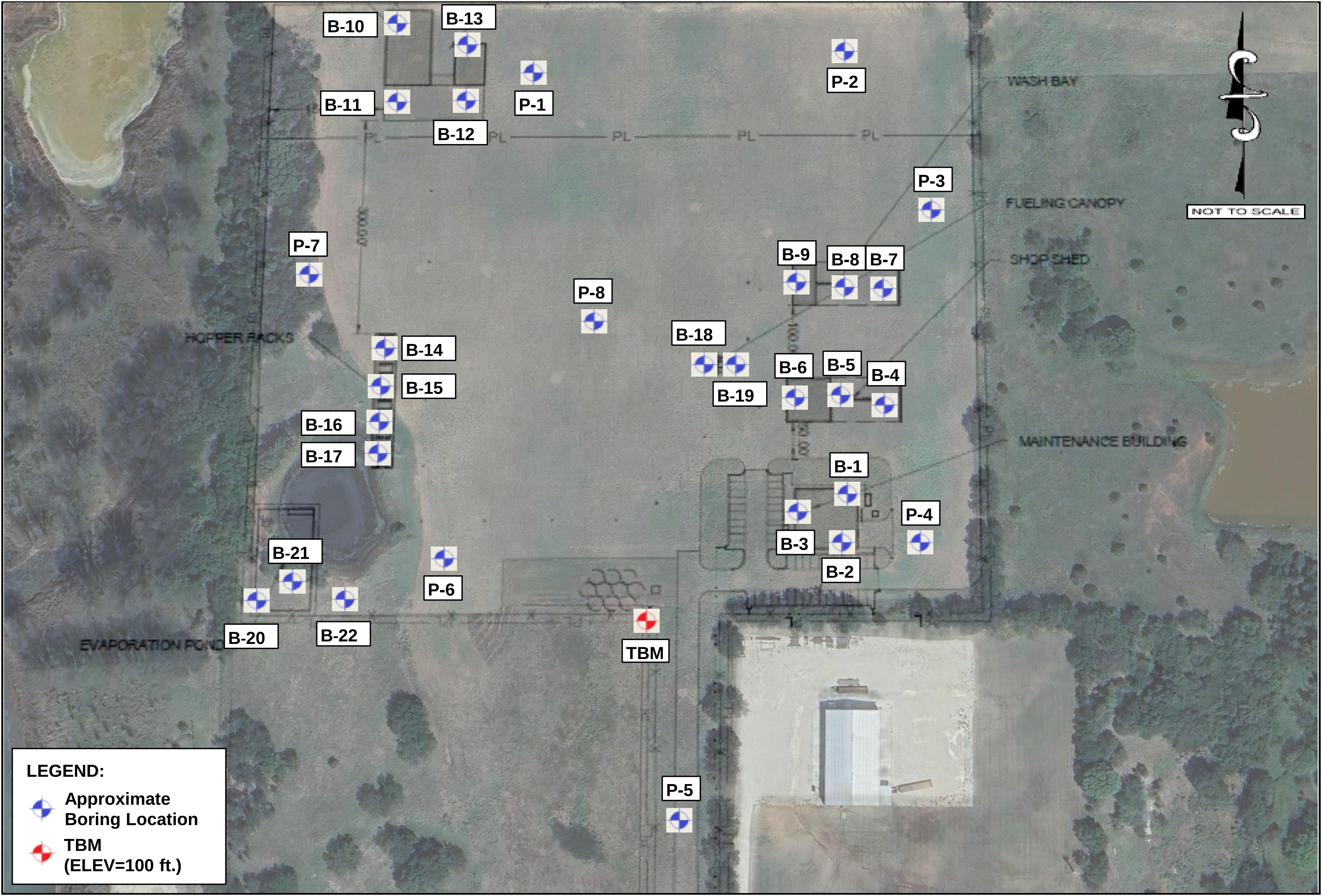
APPENDIX A

Vicinity Map
Site and Boring Location Plan

Vicinity Map

Project Name: New Residency & Maintenance Facility
Project Location: McClain County
Project No.: 2430-0704

STANDARD ENGINEERING + FIELD SERVICES



Site and Boring Location Plan

Project Name:	**New Residency & Maintenance Facility**
Project Location:	**N. of 28774 OK-59, Wayne, OK 73095**
Project No.:	**2430-0704**

STANDARD ENGINEERING + FIELD SERVICES

APPENDIX B

Boring Logs
Soil Profile
Definition of Descriptive Terms

STANDARD ENGINEERING + FIELD SERVICES

standardusa.com

BORING LOG B-1

(1 of 1)

PROJECT NAME: New Residency & Maintenance Facility
PROJECT NUMBER: 2430-0704
PROJECT LOCATION: N. of 28774 OK-59, Wayne, OK 73095
CLIENT: Guernsey

SAMPLER SYMBOLS

☒ Grab	■ ST	▯ RC
⧗ SS	▽ TC	◧ HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENETROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0	100	✓✓✓✓✓		(Short Grass)										
		▨	CL	Dk. Brn. LEAN CLAY Stiff	☒	A				26.9				
		▨			⧗	B	5-5-9 (14)		100	20.6				
		▨		V. Moist, Moderate Plasticity	■	C			54	22.6	97		94.9	46-17-29
5	95	▨		Reddish Brn.	⧗	D	4-7-8 (15)		100	19.2				
		▨			☒	E				19.6				
10	90	▨			⧗	F	5-6-9 (15)		100	17.1				
15	85	≡		Reddish Brn. VERY WEATHERED SHALE V.Soft Rock	⧗	G	18-29-41 (70)		100	12.8				
20	80	≡	CL	Sl. Moist, Moderate Plasticity	⧗	H	24-43-50/4.00"		100	14.2			94.4	46-16-30
		≡		(ROCK) Reddish Brn. SHALE Soft Rock										
25	75	≡			⧗	I	34-50/4.50"		100					
				Bottom of borehole at 25.9 feet										
30	70													

WATER LEVELS

WD	▽	Dry
AD	▼	Dry
24 Hrs	▽	
> 24 Hrs	▽	

ELEVATIONS / LOCATIONS

GROUND ELEVATION: 101
TBM: BM 203 Iron Pin (Elevation = 100 ft.)
GPS: 34.915713, -97.340004
STA: **OFFSET:**

DRILLING

DRILL START:	11/20/24	**LOGGER:**	RF
DRILLED END:	11/20/24	**DRILLER:**	CS
DRILL RIG:	D-50	**HOLE SIZE:**	4"
DRILL METHOD:	S.F.A.		

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BORING LOG B-2

(1 of 1)

PROJECT NAME: New Residency & Maintenance Facility
PROJECT NUMBER: 2430-0704
PROJECT LOCATION: N. of 28774 OK-59, Wayne, OK 73095
CLIENT: Guernsey

SAMPLER SYMBOLS

⊠ Grab	■ ST	◫ RC
⧓ SS	⧗ TC	◨ HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENTROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0				(Short Grass)										
	100		CH	Dk. Brn. FAT CLAY Moist, High Plasticity, Stiff	⊠	A				25.0				
					⧓	B	4-4-6 (10)		100	20.3	105		95.5	52-16-36
					■	C			88	21.0				
5	95			Brn. to Reddish Brn. CLAY Stiff	⧓	D	5-7-10 (17)		100	20.6				
					⊠	E				18.6				
10	90			Reddish Brn. V. Stiff	⧓	F	6-8-14 (22)		100	13.6				
15	85			Reddish Brn. VERY WEATHERED SHALE Soft Rock	⧓	G	21-32-50 (82)		100					
20	80			(ROCK) Reddish Brn. SHALE Soft Rock	⧓	H	30-50/5.00"		100					
25	75			Med. Hard Rock Bottom of borehole at 25.3 feet	⧓	I	50/3.00"		100					
30	70													

WATER LEVELS		
WD	▽	Dry
AD	▼	Dry
24 Hrs	▽	
> 24 Hrs	▽	

ELEVATIONS / LOCATIONS	
GROUND ELEVATION:	101
TBM:	BM 203 Iron Pin (Elevation = 100 ft.)
GPS:	34.915541, -97.340021
STA:	OFFSET:

DRILLING			
DRILL START:	11/20/24	LOGGER:	RF
DRILLED END:	11/20/24	DRILLER:	CS
DRILL RIG:	D-50	HOLE SIZE:	4"
DRILL METHOD:	S.F.A.		

STANDARD ENGINEERING + FIELD SERVICES

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BORING LOG B-3

(1 of 1)

PROJECT NAME: New Residency & Maintenance Facility
PROJECT NUMBER: 2430-0704
PROJECT LOCATION: N. of 28774 OK-59, Wayne, OK 73095
CLIENT: Guernsey

SAMPLER SYMBOLS

☒	Grab	■	ST	◫	RC
⧓	SS	▽	TC	◧	HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENETROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0	100	✓✓✓✓✓		(Short Grass)										
		▨		Dk. Brn. LEAN CLAY Stiff	☒	A				24.1				
		▨			⧓	B	4-4-7 (11)		100	20.3				
		▨			■	C			96	19.0	107	5271		
5	95	▨	CL	Reddish Brn. Moist, High Plasticity, V. Stiff	⧓	D	5-9-11 (20)		100	18.2	111		93.0	49-16-33
		▨			☒	E				17.5				
10	90	▨			⧓	F	7-8-12 (20)		100	15.6				
15	85	☰		Reddish Brn. VERY WEATHERED SHALE V. Soft Rock	⧓	G	18-25-39 (64)		100					
20	80	☰			⧓	H	43-50/4.75"		100					
		☰		(ROCK) Reddish Brn. SHALE Soft Rock										
25	75	☰		Med. Hard Rock	⧓	I	50/2.50"		100					
				Bottom of borehole at 25.2 feet										
30	70													

WATER LEVELS		
WD	▽	Dry
AD	▼	Dry
24 Hrs	▽	
> 24 Hrs	▽	

ELEVATIONS / LOCATIONS

GROUND ELEVATION: 101
TBM: BM 203 Iron Pin (Elevation = 100 ft.)
GPS: 34.915637, -97.340203
STA: **OFFSET:**

DRILLING

DRILL START:	11/20/24	**LOGGER:**	CS
DRILLED END:	11/20/24	**DRILLER:**	RF
DRILL RIG:	D-50	**HOLE SIZE:**	4"
DRILL METHOD:	S.F.A.		

STANDARD ENGINEERING + FIELD SERVICES

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BORING LOG B-4

(1 of 1)

PROJECT NAME: New Residency & Maintenance Facility
PROJECT NUMBER: 2430-0704
PROJECT LOCATION: N. of 28774 OK-59, Wayne, OK 73095
CLIENT: Guernsey

SAMPLER SYMBOLS

☒ Grab	■ ST	RC
⧗ SS	TC	HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENTROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0				(Short Grass)										
				Dk. Brn. FAT CLAY V. Stiff	☒	A				25.6				
	100													
					⧗	B	9-11-12 (23)		100	14.9				
					■	C			75	20.7				
5														
			CH	Reddish Brn. Moist, High Plasticity	⧗	D	10-12-15 (27)		100	14.0	117		89.3	51-16-35
	95													
					☒	E				17.5				
10														
				Reddish Brn. VERY WEATHERED SHALE V. Soft Rock	⧗	F	10-14-20 (34)		100	12.3				
	90													
15														
					⧗	G	17-26-42 (68)		100					
	85													
20														
				(ROCK) Reddish Brn. SHALE Soft Rock	⧗	H	50/6.00"		100					
	80													
25														
				Med. Hard Rock Bottom of borehole at 25.2 feet	⧗	I	50/2.50"		100					
	75													
30														

WATER LEVELS

WD	▽	Dry
AD	▼	Dry
24 Hrs	▽	
> 24 Hrs	▽	

ELEVATIONS / LOCATIONS

GROUND ELEVATION: 102
TBM: BM 203 Iron Pin (Elevation = 100 ft.)
GPS: 34.916063, -97.339856
STA: OFFSET:

DRILLING

DRILL START:	11/20/24	LOGGER:	CS
DRILLED END:	11/20/24	DRILLER:	RF
DRILL RIG:	D-50	HOLE SIZE:	4"
DRILL METHOD:	S.F.A.		

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BORING LOG B-5

(1 of 1)

PROJECT NAME:	New Residency & Maintenance Facility
PROJECT NUMBER:	2430-0704
PROJECT LOCATION:	N. of 28774 OK-59, Wayne, OK 73095
CLIENT:	Guernsey

SAMPLER SYMBOLS

☒ Grab	■ ST	◫ RC
⧗ SS	▽ TC	◧ HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENETROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0														
				(Short Grass)										
			CH	Dk. Brn. FAT CLAY	☒	A				22.3				
	100			Moist, High Plasticity, Stiff	⧗	B	5-7-9 (16)		100	18.7	106		93.7	50-16-34
					■	C			100	16.9	113	8389		
5														
				Reddish Brn. V. Stiff	⧗	D	8-11-14 (25)		100	17.6				
	95													
					☒	E				15.1				
10														
				Reddish Brn. VERY WEATHERED SHALE V. Soft Rock	⧗	F	13-16-22 (38)		100	12.4				
	90													
15														
					⧗	G	22-27-50/5.00"		94					
				(ROCK) Reddish Brn. SHALE Soft Rock										
	85													
20														
					⧗	H	25-50/5.50"		100					
	80													
25														
					⧗	I	27-50/5.50"		100					
				Bottom of borehole at 26.0 feet										
	75													
30														

WATER LEVELS		
WD	▽	Dry
AD	▼	Dry
24 Hrs	▽	
> 24 Hrs	▽	

ELEVATIONS / LOCATIONS	
GROUND ELEVATION: 102	
TBM: BM 203 Iron Pin (Elevation = 100 ft.)	
GPS: 34.916068, -97.340051	
STA:	**OFFSET:**

DRILLING			
DRILL START:	12/02/24	**LOGGER:**	CS
DRILLED END:	12/02/24	**DRILLER:**	RF
DRILL RIG:	D-50	**HOLE SIZE:**	4"
DRILL METHOD:	S.F.A.		

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BORING LOG B-6

(1 of 1)

PROJECT NAME: New Residency & Maintenance Facility
PROJECT NUMBER: 2430-0704
PROJECT LOCATION: N. of 28774 OK-59, Wayne, OK 73095
CLIENT: Guernsey

SAMPLER SYMBOLS

☒ Grab	■ ST	◫ RC
⧗ SS	⧨ TC	◧ HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENTROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0				(Short Grass)										
			CH	Dk. Brn. FAT CLAY V. Stiff	☒	A				21.7				
	100				⧗	B	7-11-12 (23)		100	19.9	106			
				Brn. Moist, High Plasticity	■	C			100	18.4			96.6	50-16-34
5					⧗	D	11-13-16 (29)		100	14.4				
	95													
				Reddish Brn.	☒	E				13.9				
10				Reddish Brn. VERY WEATHERED SHALE V. Soft Rock	⧗	F	13-18-21 (39)		100	9.0				
	90													
15					⧗	G	25-46-50/5.00"		94					
	85			(ROCK) Reddish Brn. SHALE Soft Rock										
20					⧗	H	21-34-50/4.50"		91					
	80													
25				Med. Hard Rock	⧗	I	50/2.50"		100					
				Bottom of borehole at 25.2 feet										
	75													
30														

WATER LEVELS

WD	▽	Dry
AD	▼	Dry
24 Hrs	▽	
> 24 Hrs	▽	

ELEVATIONS / LOCATIONS

GROUND ELEVATION: 102
TBM: BM 203 Iron Pin (Elevation = 100 ft.)
GPS: 34.916073, -97.340232
STA: **OFFSET:**

DRILLING

DRILL START:	12/02/24	LOGGER:	RF
DRILLED END:	12/02/24	DRILLER:	CS
DRILL RIG:	D-50	HOLE SIZE:	4"
DRILL METHOD:	S.F.A.		

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BORING LOG B-7

(1 of 1)

PROJECT NAME: New Residency & Maintenance Facility
PROJECT NUMBER: 2430-0704
PROJECT LOCATION: N. of 28774 OK-59, Wayne, OK 73095
CLIENT: Guernsey

SAMPLER SYMBOLS

☒ Grab ■ ST ◫ RC
⧗ SS ▼ TC ◧ HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENETROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0														
				(Short Grass)										
				Dk. Brn. LEAN CLAY Moist, Moderate Plasticity, Stiff	☒	A				20.4				
	100		CL		⧗	B	3-4-5 (9)		100	21.7	105		96.0	47-17-30
					■	C			100	17.5	110	4499		
5				Reddish Brn. V. Stiff	⧗	D	6-8-10 (18)		100	21.0				
	95													
					☒	E				18.2				
10				Reddish Brn. VERY WEATHERED SHALE V. Soft Rock	⧗	F	12-14-21 (35)		100	13.2				
	90													
15					⧗	G	16-22-50/6.00" (72)		100					
	85			(ROCK) Reddish Brn. SHALE Soft Rock										
20					⧗	H	39-50/4.50"		100					
	80													
25					⧗	I	50/3.50"		100					
	75			Bottom of borehole at 25.3 feet										
30														

WATER LEVELS		
WD	▽	Dry
AD	▼	Dry
24 Hrs	▽	
> 24 Hrs	▽	

ELEVATIONS / LOCATIONS

GROUND ELEVATION: 102
TBM: BM 203 Iron Pin (Elevation = 100 ft.)
GPS: 34.916506, -97.339851
STA: OFFSET:

DRILLING			
DRILL START:	12/03/24	LOGGER:	CS
DRILLED END:	12/03/24	DRILLER:	BY
DRILL RIG:	D-50	HOLE SIZE:	4"
DRILL METHOD:	S.F.A.		

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BORING LOG B-8

(1 of 1)

PROJECT NAME: New Residency & Maintenance Facility
PROJECT NUMBER: 2430-0704
PROJECT LOCATION: N. of 28774 OK-59, Wayne, OK 73095
CLIENT: Guernsey

SAMPLER SYMBOLS

☒ Grab ■ ST ◫ RC
⧓ SS ▼ TC ◧ HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENETROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0				(Short Grass) Dk. Brn. FAT CLAY Stiff	☒	A				19.2				
	100				⧓	B	4-6-6 (12)		100	18.9				
5					■	C			58	20.2				
			CH	Reddish Brn. Sl. Moist, High Plasticity, Hard	⧓	D	9-13-17 (30)		100	16.3	116		87.5	50-15-35
	95			Reddish Brn. CLAY V. Stiff	☒	E				15.5				
10					⧓	F	10-12-17 (29)		100	13.9				
	90													
15				Reddish Brn. VERY WEATHERED SHALE V. Soft Rock	⧓	G	18-23-38 (61)		100					
	85													
20				(ROCK) Reddish Brn. SHALE Soft Rock	⧓	H	42-50/5.00"		100					
	80													
25				Med. Hard Rock	⧓	I	50/3.00"		100					
				Bottom of borehole at 25.3 feet										
	75													
30														

WATER LEVELS

WD	▽	Dry
AD	▼	Dry
24 Hrs	▽	
> 24 Hrs	▽	

ELEVATIONS / LOCATIONS

GROUND ELEVATION: 103
TBM: BM 203 Iron Pin (Elevation = 100 ft.)
GPS: 34.916504, -97.340045
STA: **OFFSET:**

DRILLING

DRILL START:	12/03/24	**LOGGER:**	BY
DRILLED END:	12/03/24	**DRILLER:**	CS
DRILL RIG:	D-50	**HOLE SIZE:**	4"
DRILL METHOD:	S.F.A.		

STANDARD ENGINEERING + FIELD SERVICES

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BORING LOG B-9

(1 of 1)

PROJECT NAME: New Residency & Maintenance Facility
PROJECT NUMBER: 2430-0704
PROJECT LOCATION: N. of 28774 OK-59, Wayne, OK 73095
CLIENT: Guernsey

SAMPLER SYMBOLS

☒	Grab	■	ST	◫	RC
⧗	SS	▽	TC	◧	HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENTROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0														
				(Short Grass) Dk. Brn. FAT CLAY	☒	A				24.5				
	100			Brn. V. Stiff Moist, High PLasticity	⧗	B	6-9-12 (21)		100	15.9	114			
			CH		■	C			98	20.3			92.9	54-16-38
5					⧗	D	9-12-16 (28)		100	17.1				
	95													
				Reddish Brn. CLAY	☒	E				14.7				
10				V. Stiff	⧗	F	8-9-13 (22)		100	14.2				
	90													
15					⧗	G	20-33-50/6.00" (83)		100					
				(ROCK) Reddish Brn. SHALE Soft Rock										
	85													
20				Hard Rock	⧗	H	37-50/2.00"		100					
	80													
25				Med. Hard Rock	⧗	I	50/3.00"		100					
				Bottom of borehole at 25.3 feet										
	75													
30														

WATER LEVELS		
WD	▽	Dry
AD	▼	Dry
24 Hrs	▽	
> 24 Hrs	▽	

ELEVATIONS / LOCATIONS	
GROUND ELEVATION: 103	
TBM: BM 203 Iron Pin (Elevation = 100 ft.)	
GPS: 34.916501, -97.340211	
STA:	OFFSET:

DRILLING			
DRILL START:	12/03/24	LOGGER:	BY
DRILLED END:	12/03/24	DRILLER:	CS
DRILL RIG:	D-50	HOLE SIZE:	4"
DRILL METHOD:	S.F.A.		

STANDARD ENGINEERING + FIELD SERVICES

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BORING LOG B-10

(1 of 1)

PROJECT NAME: New Residency & Maintenance Facility
PROJECT NUMBER: 2430-0704
PROJECT LOCATION: N. of 28774 OK-59, Wayne, OK 73095
CLIENT: Guernsey

SAMPLER SYMBOLS

☒	Grab	■	ST	▯	RC
⧗	SS	▽	TC	◧	HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENTROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0	100													
			CL	(Short Grass) Brn. LEAN CLAY W/ SAND W/O SAND V. Moist, Moderate Plasticity, Stiff Brn. to Reddish Brn.	☒	A				17.8				
					⧗	B	3-4-5 (9)		100	22.6			95.0	39-16-23
					■	C			71	11.7	116	6611		
5	95			V. Stiff	⧗	D	5-9-12 (21)		100	16.3	116			
					☒	E				15.3				
10	90			Reddish Brn. VERY WEATHERED SHALE V. Soft Rock	⧗	F	11-20-35 (55)		100	11.8				
15	85				⧗	G	20-40-50/4.50"		97					
				(ROCK) Reddish Brn. SHALE Soft Rock										
20	80			Med. Hard Rock	⧗	H	30-44-50/3.00"		100					
25	75			Soft Rock	⧗	I	50/5.00"		100					
				Bottom of borehole at 25.4 feet										
30	70													

WATER LEVELS			ELEVATIONS / LOCATIONS	DRILLING			
WD	▽	Dry	GROUND ELEVATION: 100	DRILL START:	12/03/24	LOGGER:	RF
AD	▼	Dry	TBM: BM 203 Iron Pin (Elevation = 100 ft.)	DRILLED END:	12/03/24	DRILLER:	RJ
24 Hrs	▽		GPS: 34.917561, -97.341992	DRILL RIG:	CME-750	HOLE SIZE:	4"
> 24 Hrs	▽		STA: OFFSET:	DRILL METHOD:	S.F.A.		

STANDARD ENGINEERING + FIELD SERVICES

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BORING LOG B-11

(1 of 1)

PROJECT NAME: New Residency & Maintenance Facility
PROJECT NUMBER: 2430-0704
PROJECT LOCATION: N. of 28774 OK-59, Wayne, OK 73095
CLIENT: Guernsey

SAMPLER SYMBOLS

☒ Grab	■ ST	◫ RC
⧓ SS	▼ TC	◨ HA

DEPTH (FT)	ELEVATION (FT)	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENETROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0	100												
			(Short Grass) Brn. FAT CLAY V. Stiff	☒	A				22.5				
				⧓	B	5-8-9 (17)		100	20.5	111			
		CH	Reddish Brn. V. Moist, High Plasticity	☒	C				21.5			95.5	56-15-41
5	95												
			Stiff	⧓	D	5-6-8 (14)		56	15.4				
				☒	E				15.1				
10	90												
			Reddish Brn. VERY WEATHERED SHALE V. Soft Rock	⧓	F	16-28-42 (70)		100	11.7				
15	85												
		CL	Sl. Moist, Moderate Plasticity	⧓	G	20-34-50/4.00"		100	10.7			96.4	36-14-22
			(ROCK) Reddish Brn. SHALE Soft Rock										
20	80			⧓	H	50/6.00"		100					
25	75												
			Med. Hard Rock	⧓	I	30-50/3.00"		100					
			Bottom of borehole at 25.8 feet										
30	70												

WATER LEVELS			ELEVATIONS / LOCATIONS	DRILLING			
WD	▽	Dry	GROUND ELEVATION: 100	DRILL START:	12/03/24	LOGGER:	Corbin
AD	▼	Dry	TBM: BM 203 Iron Pin (Elevation = 100 ft.)	DRILLED END:	12/03/24	DRILLER:	Brandon
24 Hrs	▽		GPS: 34.917226, -97.341935	DRILL RIG:	CME 45B	HOLE SIZE:	6"
> 24 Hrs	▽		STA: OFFSET:	DRILL METHOD:	S.F.A.		

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BORING LOG B-12

(1 of 1)

PROJECT NAME: New Residency & Maintenance Facility
PROJECT NUMBER: 2430-0704
PROJECT LOCATION: N. of 28774 OK-59, Wayne, OK 73095
CLIENT: Guernsey

SAMPLER SYMBOLS

☒ Grab	■ ST	◫ RC
⧓ SS	▽ TC	◧ HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENTROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0	100			(Short Grass)										
				Brn. LEAN CLAY Firm	☒	A				21.9				
					⧓	B	2-3-4 (7)		100	21.6	102			
				Reddish Brn.	■	C			100	15.4	115	5610		
5	95		CL	Moist, High Plasticity, V. Stiff	⧓	D	6-8-10 (18)		100	20.1			91.1	47-15-32
					☒	E				17.4				
10	90				⧓	F	5-10-17 (27)		100	15.1				
15	85			Reddish Brn. VERY WEATHERED SHALE Soft Rock	⧓	G	22-50/6.00"		100					
20	80			V. Soft Rock	⧓	H	25-31-35 (66)		89					
25	75			(ROCK) Reddish Brn. SHALE Soft Rock	⧓	I	50/6.00"		100					
				Bottom of borehole at 25.5 feet										
30	70													

WATER LEVELS

WD	▽	Dry
AD	▼	Dry
24 Hrs	▽	
> 24 Hrs	▽	

ELEVATIONS / LOCATIONS

GROUND ELEVATION: 101
TBM: BM 203 Iron Pin (Elevation = 100 ft.)
GPS: 34.917214, -97.341670
STA: **OFFSET:**

DRILLING

DRILL START:	12/03/24	LOGGER:	Corbin
DRILLED END:	12/03/24	DRILLER:	Brandon
DRILL RIG:	CME 45B	HOLE SIZE:	6"
DRILL METHOD:	S.F.A.		

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BORING LOG B-13

(1 of 1)

PROJECT NAME: New Residency & Maintenance Facility
PROJECT NUMBER: 2430-0704
PROJECT LOCATION: N. of 28774 OK-59, Wayne, OK 73095
CLIENT: Guernsey

SAMPLER SYMBOLS

☒ Grab	■ ST	◫ RC
⧓ SS	⧨ TC	◧ HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENETROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0														
				(Short Grass)										
			CH	Dk. Brn. FAT CLAY Brn. Sl. Moist, High Plasticity, V. Stiff	Grab	A				23.3				
	100				SS	B	6-11-13 (24)		100	12.9	117		94.1	50-15-35
5					ST	C			100	20.1				
				Reddish Brn. VERY WEATHERED SHALE V. Soft Rock	SS	D	11-15-17 (32)		100	12.5				
	95													
					Grab	E				14.3				
10					SS	F	11-21-27 (48)		100	12.0				
	90													
15					SS	G	17-37-50/5.00"		100					
	85			(ROCK) Reddish Brn. SHALE Soft Rock										
20					SS	H	26-46-50/4.00"		100					
	80													
25					SS	I	17-50/4.00"		100					
				Bottom of borehole at 25.8 feet										
	75													
30														

WATER LEVELS			ELEVATIONS / LOCATIONS		DRILLING			
WD	▽	Dry	GROUND ELEVATION:	102	DRILL START:	12/04/24	LOGGER:	BY
AD	▼	Dry	TBM:	BM 203 Iron Pin (Elevation = 100 ft.)	DRILLED END:	12/04/24	DRILLER:	CS
24 Hrs	▽		GPS:	34.917422, -97.341655	DRILL RIG:	CME-750	HOLE SIZE:	4"
> 24 Hrs	▽		STA:	OFFSET:	DRILL METHOD:	S.F.A.		

BORING LOG B-14

(1 of 1)

PROJECT NAME: New Residency & Maintenance Facility
PROJECT NUMBER: 2430-0704
PROJECT LOCATION: N. of 28774 OK-59, Wayne, OK 73095
CLIENT: Guernsey

SAMPLER SYMBOLS

☒ Grab	■ ST	◫ RC
⧓ SS	⧗ TC	◧ HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENETROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0		✓✓✓✓		(Short Grass)										
		▨	CH	Brn. FAT CLAY Firm	☒	A				21.9				
	95	▨			⧓	B	2-2-4 (6)		67	20.6				
		▨		Reddish Brn. Sl. Moist, High Plasticity	■	C			50	14.3			94.1	52-17-35
5		▨		V. Stiff	⧓	D	7-3-19 (22)		78	15.3	118			
	90	▨												
		▨			☒	E				12.9				
10		☰		Reddish Brn. VERY WEATHERED SHALE V. Soft Rock	⧓	F	12-18-30 (48)		100	12.5				
	85	☰												
15		☰			⧓	G	28-50/5.00"		82					
				(ROCK) Reddish Brn. SHALE Soft Rock Bottom of borehole at 15.9 feet										
	80													
20														
	75													
25														
	70													
30														

WATER LEVELS

WD	▽	Dry
AD	▼	Dry
24 Hrs	▽	
> 24 Hrs	▽	

ELEVATIONS / LOCATIONS

GROUND ELEVATION: 97
TBM: BM 203 Iron Pin (Elevation = 100 ft.)
GPS: 34.916276, -97.341975
STA: **OFFSET:**

DRILLING

DRILL START:	12/03/24	LOGGER:	Frank
DRILLED END:	12/03/24	DRILLER:	Houston
DRILL RIG:	45C	HOLE SIZE:	4"
DRILL METHOD:	S.F.A.		

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BORING LOG B-15

(1 of 1)

PROJECT NAME: New Residency & Maintenance Facility
PROJECT NUMBER: 2430-0704
PROJECT LOCATION: N. of 28774 OK-59, Wayne, OK 73095
CLIENT: Guernsey

SAMPLER SYMBOLS

☒	Grab	■	ST	◫	RC
⧓	SS	⧗	TC	◧	HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENTROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0	95	✓✓✓✓✓		(Short Grass) Brn. LEAN CLAY Reddish Brn. Firm	☒	A				20.7				
		▨			⧓	B	2-2-3 (5)		67	19.1	109			
		▨			■	C			67	11.5	123	10458		
5	90	▨	CL	SL. Moist, High Plasticity	⧓	D	7-12-14 (26)		89	12.9			96.5	46-15-31
		▨			☒	E				13.2				
10	85	☰		Reddish Brn. VERY WEATHERED SHALE V. Soft Rock	⧓	F	21-24-30 (54)		100	11.3				
15	80	☰			⧓	G	21-30-42 (72)		100					
20 25 30	75 70 65			Bottom of borehole at 16.5 feet										

WATER LEVELS		
WD	▽	Dry
AD	▼	Dry
24 Hrs	▽	
> 24 Hrs	▽	

ELEVATIONS / LOCATIONS	
GROUND ELEVATION:	96
TBM:	BM 203 Iron Pin (Elevation = 100 ft.)
GPS:	34.916146, -97.341984
STA:	OFFSET:

DRILLING			
DRILL START:	12/03/24	LOGGER:	Frank
DRILLED END:	12/03/24	DRILLER:	Houston
DRILL RIG:	45C	HOLE SIZE:	4"
DRILL METHOD:	S.F.A.		

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BORING LOG B-16

(1 of 1)

PROJECT NAME: New Residency & Maintenance Facility
PROJECT NUMBER: 2430-0704
PROJECT LOCATION: N. of 28774 OK-59, Wayne, OK 73095
CLIENT: Guernsey

SAMPLER SYMBOLS

☒	Grab	■	ST	◫	RC
⧓	SS	⧗	TC	◧	HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENETROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0	95	✓✓✓✓✓		(Short Grass)										
		▨		Dk. Brn. CLAY Reddish Brn. Firm	☒	A				21.8				
		▨			⧓	B	2-3-3 (6)		89	18.9				
		▨			■	C			79	19.0				
5	90	☰	CL	Reddish Brn. VERY WEATHERED SHALE Sl. Moist, Moderate Plasticity, V. Soft Rock	⧓	D	10-14-17 (31)		89	11.1			98.5	43-15-28
		☰			☒	E				12.0				
10	85	☰			⧓	F	13-18-28 (46)		94	11.8				
15	80	☰			⧓	G	12-48-21 (69)		100					
				Bottom of borehole at 16.5 feet										
20	75													
25	70													
30	65													

WATER LEVELS		
WD	▽	Dry
AD	▼	Dry
24 Hrs	▽	
> 24 Hrs	▽	

ELEVATIONS / LOCATIONS	
GROUND ELEVATION:	96
TBM:	BM 203 Iron Pin (Elevation = 100 ft.)
GPS:	34.916024, -97.341993
STA:	OFFSET:

DRILLING			
DRILL START:	12/03/24	LOGGER:	Frank
DRILLED END:	12/03/24	DRILLER:	Houston
DRILL RIG:	45C	HOLE SIZE:	4"
DRILL METHOD:	S.F.A.		

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BORING LOG B-17

(1 of 1)

PROJECT NAME:	New Residency & Maintenance Facility
PROJECT NUMBER:	2430-0704
PROJECT LOCATION:	N. of 28774 OK-59, Wayne, OK 73095
CLIENT:	Guernsey

SAMPLER SYMBOLS

☒ Grab ■ ST ◫ RC

⧓ SS ▼ TC ◧ HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENETROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0														
	95			(Short Grass) Dk. Brn. LEAN CLAY	☒	A				27.7				
				Reddish Brn. Firm	⧓	B	3-3-4 (7)		89	21.0	106			
			CL	V. Moist, High Plasticity	■	C			71	20.5	122	7012	91.3	46-15-31
5	90			Reddish Brn. VERY WEATHERED SHALE V. Soft Rock	⧓	D	11-15-22 (37)		100	12.1				
					☒	E				18.4				
10	85				⧓	F	15-25-34 (59)		94	13.7				
15	80				⧓	G	20-29-43 (72)		100	12.9				
				Bottom of borehole at 16.5 feet										
20	75													
25	70													
30	65													

WATER LEVELS

WD	▽	Dry
AD	▼	Dry
24 Hrs	▽	
> 24 Hrs	▽	

ELEVATIONS / LOCATIONS

GROUND ELEVATION: 96

TBM: BM 203 Iron Pin (Elevation = 100 ft.)

GPS: 34.915880, -97.341980

STA: **OFFSET:**

DRILLING

DRILL START:	12/05/24	**LOGGER:**	RF
DRILLED END:	12/05/24	**DRILLER:**	RJ
DRILL RIG:	D-50	**HOLE SIZE:**	4"
DRILL METHOD:	S.F.A.		

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BORING LOG B-18

(1 of 1)

PROJECT NAME: New Residency & Maintenance Facility
PROJECT NUMBER: 2430-0704
PROJECT LOCATION: N. of 28774 OK-59, Wayne, OK 73095
CLIENT: Guernsey

SAMPLER SYMBOLS

☒	Grab	■	ST	◫	RC
⧓	SS	▼	TC	◨	HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENETROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0														
			CH	(Short Grass) Dk. Brn. FAT CLAY	☒	A				23.2				
	100			V. Moist, High Plasticity, Soft	⧓	B	2-2-2 (4)		100	22.6			93.3	51-14-37
5				Brn. to Reddish Brn.	■	C			63	9.4	123	12845		
				V. Stiff	⧓	D	5-8-9 (17)		100	15.6	116			
	95													
10					☒	E				18.3				
				Reddish Brn. Stiff	⧓	F	5-6-7 (13)			20.3				
	90													
15														
				Reddish Brn. VERY WEATHERED SHALE V. Soft Rock	⧓	G	13-19-23 (42)		100	17.6				
	85			Bottom of borehole at 16.5 feet										
20														
	80													
25														
	75													
30														

WATER LEVELS		
WD	▽	Dry
AD	▼	Dry
24 Hrs	▽	
> 24 Hrs	▼	

ELEVATIONS / LOCATIONS	
GROUND ELEVATION:	102
TBM:	BM 203 Iron Pin (Elevation = 100 ft.)
GPS:	34.916192, -97.340671
STA:	OFFSET:

DRILLING			
DRILL START:	12/03/24	LOGGER:	Frank
DRILLED END:	12/03/24	DRILLER:	Houston
DRILL RIG:	45C	HOLE SIZE:	4"
DRILL METHOD:	S.F.A.		

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BORING LOG B-19

(1 of 1)

PROJECT NAME: New Residency & Maintenance Facility
PROJECT NUMBER: 2430-0704
PROJECT LOCATION: N. of 28774 OK-59, Wayne, OK 73095
CLIENT: Guernsey

SAMPLER SYMBOLS

☒	Grab	■	ST	◫	RC
⧓	SS	⧗	TC	◧	HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENTROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0		✓✓✓✓✓		(Short Grass)										
		▨	CH	Brn. FAT CLAY Moist, High Plasticity, Firm	☒	A				22.8				
	100	▨			⧓	B	2-3-4 (7)		100	20.2	107		94.9	51-16-35
		▨		Reddish Brn.	■	C			67	18.2				
5		▨		V. Stiff	⧓	D	5-9-11 (20)		100	17.1				
	95	▨			☒	E				16.5				
10		▨		Reddish Brn. CLAY V. Stiff	⧓	F	5-7-11 (18)		100	16.0				
15	90	▨			☒	G				11.5				
	85			Bottom of borehole at 16.5 feet										
20	80													
25	75													
30														

WATER LEVELS

WD	▽	Dry
AD	▼	Dry
24 Hrs	▽	
> 24 Hrs	▼	

ELEVATIONS / LOCATIONS

GROUND ELEVATION: 103
TBM: BM 203 Iron Pin (Elevation = 100 ft.)
GPS: 34.916199, -97.340474
STA: **OFFSET:**

DRILLING

DRILL START:	12/03/24	**LOGGER:**	Frank
DRILLED END:	12/03/24	**DRILLER:**	Houston
DRILL RIG:	45C	**HOLE SIZE:**	4"
DRILL METHOD:	S.F.A.		

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BORING LOG B-20

(1 of 1)

PROJECT NAME: New Residency & Maintenance Facility
PROJECT NUMBER: 2430-0704
PROJECT LOCATION: N. of 28774 OK-59, Wayne, OK 73095
CLIENT: Guernsey

SAMPLER SYMBOLS

☒	Grab	■	ST	◫	RC
⧓	SS	⧗	TC	◧	HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENTROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0														
	90			(Short Grass) Dk. Brn. LEAN CLAY Firm	☒	A				31.0				
					⧓	B	2-3-4 (7)		89	23.1	106			
			CL	Moist, High Plasticity	■	C			58	20.1	122	8626	95.2	47-17-30
5				Reddish Brn. V. Stiff	⧓	D	6-9-13 (22)		100	15.4				
	85													
					☒	E				13.9				
10				Reddish Brn. VERY WEATHERED SHALE V. Soft Rock	⧓	F	15-17-23 (40)		100	12.9				
	80													
15					⧓	G	23-30-38 (68)			10.6				
	75			Bottom of borehole at 16.5 feet										
20														
	70													
25														
	65													
30														

WATER LEVELS

WD	▽	Dry
AD	▼	Dry
24 Hrs	▽	
> 24 Hrs	▽	

ELEVATIONS / LOCATIONS

GROUND ELEVATION: 92
TBM: BM 203 Iron Pin (Elevation = 100 ft.)
GPS: 34.915312, -97.342456
STA: OFFSET:

DRILLING

DRILL START:	12/03/24	LOGGER:	Frank
DRILLED END:	12/03/24	DRILLER:	Houston
DRILL RIG:	45C	HOLE SIZE:	4"
DRILL METHOD:	S.F.A.		

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BORING LOG B-21

(1 of 1)

PROJECT NAME: New Residency & Maintenance Facility
PROJECT NUMBER: 2430-0704
PROJECT LOCATION: N. of 28774 OK-59, Wayne, OK 73095
CLIENT: Guernsey

SAMPLER SYMBOLS

☒	Grab	■	ST	◫	RC
⧓	SS	▽	TC	◧	HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENETROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0		✓✓✓✓✓		(Short Grass)										
		▨		Dk. Brn. LEAN CLAY	☒	A				24.4				
	90	▨		Brn. Firm	⧓	B	1-2-4 (6)		78	18.7	107			
5		▨			■	C			63	16.9				
		▨	CL	Reddish Brn. Moist, Moderate Plasticity, V. Stiff	⧓	D	5-8-10 (18)		89	15.9			86.5	40-17-23
	85	▨												
10		▨			☒	E				14.0				
		☰		Reddish Brn. VERY WEATHERED SHALE V. Soft Rock	⧓	F	11-20-20 (40)		100	11.7				
15	80	☰												
		☰			⧓	G	18-23-32 (55)		100	11.9				
	75			Bottom of borehole at 16.5 feet										
20	70													
25	65													
30														

WATER LEVELS

WD	▽	Dry
AD	▼	Dry
24 Hrs	▽	
> 24 Hrs	▽	

ELEVATIONS / LOCATIONS

GROUND ELEVATION: 93
TBM: BM 203 Iron Pin (Elevation = 100 ft.)
GPS: 34.915367, -97.342303
STA: **OFFSET:**

DRILLING

DRILL START:	12/03/24	**LOGGER:**	Frank
DRILLED END:	12/03/24	**DRILLER:**	Houston
DRILL RIG:	CME-45C	**HOLE SIZE:**	4"
DRILL METHOD:	S.F.A.		

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BORING LOG B-22

(1 of 1)

PROJECT NAME: New Residency & Maintenance Facility
PROJECT NUMBER: 2430-0704
PROJECT LOCATION: N. of 28774 OK-59, Wayne, OK 73095
CLIENT: Guernsey

SAMPLER SYMBOLS

☒ Grab	■ ST	◫ RC
⧓ SS	▼ TC	◧ HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENETROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0				(Short Grass)										
			CH	Dk. Brn. FAT CLAY Brn. Sl. Moist, High Plasticity, V. Stiff Brn. to Reddish Brn.	☒	A				26.9				
					⧓	B	5-10-14 (24)		100	14.5	115		92.5	54-17-37
	90				■	C			71	13.1	118	19142		
5				Reddish Brn. VERY WEATHERED SHALE V. Soft Rock	⧓	D	9-15-22 (37)		100	17.7				
	85				☒	E				15.0				
10					⧓	F	18-24-30 (54)		100	11.7				
	80													
15				(ROCK) Reddish Brn. SHALE Soft Rock	⧓	G	26-50/6.00"		100					
				Bottom of borehole at 16.0 feet										
	75													
20														
	70													
25														
	65													
30														

WATER LEVELS

WD	▽	Dry
AD	▼	Dry
24 Hrs	▽	
> 24 Hrs	▽	

ELEVATIONS / LOCATIONS

GROUND ELEVATION: 94
TBM: BM 203 Iron Pin (Elevation = 100 ft.)
GPS: 34.915322, -97.342137
STA: **OFFSET:**

DRILLING

DRILL START:	12/05/24	**LOGGER:**	RF
DRILLED END:	12/05/24	**DRILLER:**	RJ
DRILL RIG:	D-50	**HOLE SIZE:**	4"
DRILL METHOD:	S.F.A.		

STANDARD ENGINEERING + FIELD SERVICES

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BORING LOG P-1

(1 of 1)

PROJECT NAME: New Residency & Maintenance Facility
PROJECT NUMBER: 2430-0704
PROJECT LOCATION: N. of 28774 OK-59, Wayne, OK 73095
CLIENT: Guernsey

SAMPLER SYMBOLS

☒	Grab	■	ST	◫	RC
⧗	SS	▽	TC	◧	HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENTROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0		✓✓✓✓✓		(Short Grass)										
		▨	CL	Dk. Brn. LEAN CLAY Moist, Moderate Plasticity Brn.	☒	A				21.1			95.9	36-20-16
		▨			☒	B				20.9				
5		▨			☒	C				19.9				
				Bottom of borehole at 5.0 feet										
10														
15														
20														
25														
30														

WATER LEVELS		
WD	▽	Dry
AD	▼	Dry
24 Hrs	▽	
> 24 Hrs	▼	

ELEVATIONS / LOCATIONS	
GROUND ELEVATION: -	
TBM: -	
GPS: 34.917317, -97.341311	
STA:	OFFSET:

DRILLING			
DRILL START:	12/03/24	LOGGER:	Corbin
DRILLED END:	12/03/24	DRILLER:	Brandon
DRILL RIG:	CME 45B	HOLE SIZE:	6"
DRILL METHOD:	S.F.A.		

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BORING LOG P-2

(1 of 1)

PROJECT NAME: New Residency & Maintenance Facility
PROJECT NUMBER: 2430-0704
PROJECT LOCATION: N. of 28774 OK-59, Wayne, OK 73095
CLIENT: Guernsey

SAMPLER SYMBOLS

☒ Grab ■ ST ◫ RC
⧓ SS ▼ TC ◨ HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENTROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0				(Short Grass)										
			CL	Reddish Brn. LEAN CLAY Moist, Moderate Plasticity	☒	A				20.1				
					☒	B				16.9			92.7	47-18-29
5					☒	C				18.7				
				Bottom of borehole at 5.0 feet										
10														
15														
20														
25														
30														

WATER LEVELS		
WD	▽	Dry
AD	▼	Dry
24 Hrs	▽	
> 24 Hrs	▽	

ELEVATIONS / LOCATIONS

GROUND ELEVATION: -
TBM: -
GPS: 34.917379, -97.340068
STA: OFFSET:

DRILLING			
DRILL START:	12/03/24	LOGGER:	Corbin
DRILLED END:	12/03/24	DRILLER:	Brandon
DRILL RIG:	CME 45B	HOLE SIZE:	6"
DRILL METHOD:	S.F.A.		

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BORING LOG P-3
(1 of 1)

PROJECT NAME: New Residency & Maintenance Facility
PROJECT NUMBER: 2430-0704
PROJECT LOCATION: N. of 28774 OK-59, Wayne, OK 73095
CLIENT: Guernsey

SAMPLER SYMBOLS

☒ Grab ■ ST ◫ RC
⧓ SS ⧨ TC ◧ HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENTROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0				(Short Grass)										
				Dk. Brn. FAT CLAY	☒	A				21.8				
				Brn. to Reddish Brn.	☒	B				22.4				
				Moist, High Plasticity										
5			CH		☒	C				22.2			94.1	55-17-38
				Bottom of borehole at 5.0 feet										
10														
15														
20														
25														
30														

WATER LEVELS

WD	▽	Dry
AD	▼	Dry
24 Hrs	▽	
> 24 Hrs	▼	

ELEVATIONS / LOCATIONS

GROUND ELEVATION: -
TBM: -
GPS: 34.916803, -97.339613
STA: OFFSET:

DRILLING

DRILL START:	12/03/24	LOGGER:	Corbin
DRILLED END:	12/03/24	DRILLER:	Brandon
DRILL RIG:	CME 45B	HOLE SIZE:	6"
DRILL METHOD:	S.F.A.		

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BORING LOG P-4

(1 of 1)

PROJECT NAME: New Residency & Maintenance Facility
PROJECT NUMBER: 2430-0704
PROJECT LOCATION: N. of 28774 OK-59, Wayne, OK 73095
CLIENT: Guernsey

SAMPLER SYMBOLS

☒	Grab	■	ST	◫	RC
⧓	SS	▼	TC	◧	HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENETROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0		✓✓✓✓✓		(Short Grass)										
		▨	CH	Dk. Brn. FAT CLAY Brn. Moist, High Plasticity	☒	A				19.7				
		▨			☒	B				20.5			95.7	54-17-37
5		▨			☒	C				18.7				
				Bottom of borehole at 5.0 feet										
10														
15														
20														
25														
30														

WATER LEVELS

WD	▽	Dry
AD	▼	Dry
24 Hrs	▽	
> 24 Hrs	▼	

ELEVATIONS / LOCATIONS

GROUND ELEVATION: -
TBM: -
GPS: 34.915536, -97.339696
STA: **OFFSET:**

DRILLING

DRILL START:	12/03/24	**LOGGER:**	Corbin
DRILLED END:	12/03/24	**DRILLER:**	Brandon
DRILL RIG:	CME 45B	**HOLE SIZE:**	6"
DRILL METHOD:	S.F.A.		

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BORING LOG P-5

(1 of 1)

PROJECT NAME: New Residency & Maintenance Facility
PROJECT NUMBER: 2430-0704
PROJECT LOCATION: N. of 28774 OK-59, Wayne, OK 73095
CLIENT: Guernsey

SAMPLER SYMBOLS

☒	Grab	■	ST	◫	RC
⧓	SS	▼	TC	◧	HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENETROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0														
		✓✓✓✓✓		(Short Grass)										
		▨		Brn. FAT CLAY	☒	A				31.3				
		▨			☒	B				31.4				
		▨	CH	Brn. to Reddish Brn. Moist, High Plasticity	☒	C				17.6			94.5	52-16-36
5														
				Bottom of borehole at 5.0 feet										
10														
15														
20														
25														
30														

WATER LEVELS

WD	▽	Dry
AD	▼	Dry
24 Hrs	▽	
> 24 Hrs	▼	

ELEVATIONS / LOCATIONS

GROUND ELEVATION: -
TBM: -
GPS: 34.914459, -97.340674
STA: OFFSET:

DRILLING

DRILL START:	11/19/24	LOGGER:	CS
DRILLED END:	11/19/24	DRILLER:	RF
DRILL RIG:	D-50	HOLE SIZE:	4"
DRILL METHOD:	S.F.A.		

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BORING LOG P-6

(1 of 1)

PROJECT NAME:	New Residency & Maintenance Facility
PROJECT NUMBER:	2430-0704
PROJECT LOCATION:	N. of 28774 OK-59, Wayne, OK 73095
CLIENT:	Guernsey

SAMPLER SYMBOLS

☒ Grab ■ ST ◫ RC

⧓ SS ▼ TC ◧ HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENTROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0														
		▨	CL	(Short Grass) Dk. Brn LEAN CLAY V. Moist, Moderate Plasticity Brn.	☒	A				23.0			97.0	40-15-25
		▨			☒	B				25.0				
5		▨			☒	C				23.5				
				Bottom of borehole at 5.0 feet										
10														
15														
20														
25														
30														

WATER LEVELS		
WD	▽	Dry
AD	▼	Dry
24 Hrs	▽	
> 24 Hrs	▼	

ELEVATIONS / LOCATIONS

GROUND ELEVATION: -

TBM: -

GPS: 34.915499, -97.341676

STA: **OFFSET:**

DRILLING			
DRILL START:	12/03/24	**LOGGER:**	Corbin
DRILLED END:	12/03/24	**DRILLER:**	Brandon
DRILL RIG:	CME 45B	**HOLE SIZE:**	6"
DRILL METHOD:	S.F.A.		

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BORING LOG P-7

(1 of 1)

PROJECT NAME: New Residency & Maintenance Facility
PROJECT NUMBER: 2430-0704
PROJECT LOCATION: N. of 28774 OK-59, Wayne, OK 73095
CLIENT: Guernsey

SAMPLER SYMBOLS

☒ Grab	■ ST	◫ RC
⧓ SS	▼ TC	◧ HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENTROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0														
		✓✓✓✓✓		(Short Grass)										
		▨	CL	Brn. LEAN CLAY Reddish Brn. Moist, Moderate Plasticity	☒	A				21.4				
		▨			☒	B				15.8			90.4	39-13-26
		▨			☒	C				16.7				
5				Bottom of borehole at 5.0 feet										
10														
15														
20														
25														
30														

WATER LEVELS

WD	▽	Dry
AD	▼	Dry
24 Hrs	▽	
> 24 Hrs	▼	

ELEVATIONS / LOCATIONS

GROUND ELEVATION: -
TBM: -
GPS: 34.916534, -97.342313
STA: OFFSET:

DRILLING

DRILL START:	12/03/24	LOGGER:	Corbin
DRILLED END:	12/03/24	DRILLER:	Brandon
DRILL RIG:	CME 45B	HOLE SIZE:	6"
DRILL METHOD:	S.F.A.		

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BORING LOG P-8

(1 of 1)

PROJECT NAME:	New Residency & Maintenance Facility
PROJECT NUMBER:	2430-0704
PROJECT LOCATION:	N. of 28774 OK-59, Wayne, OK 73095
CLIENT:	Guernsey

SAMPLER SYMBOLS

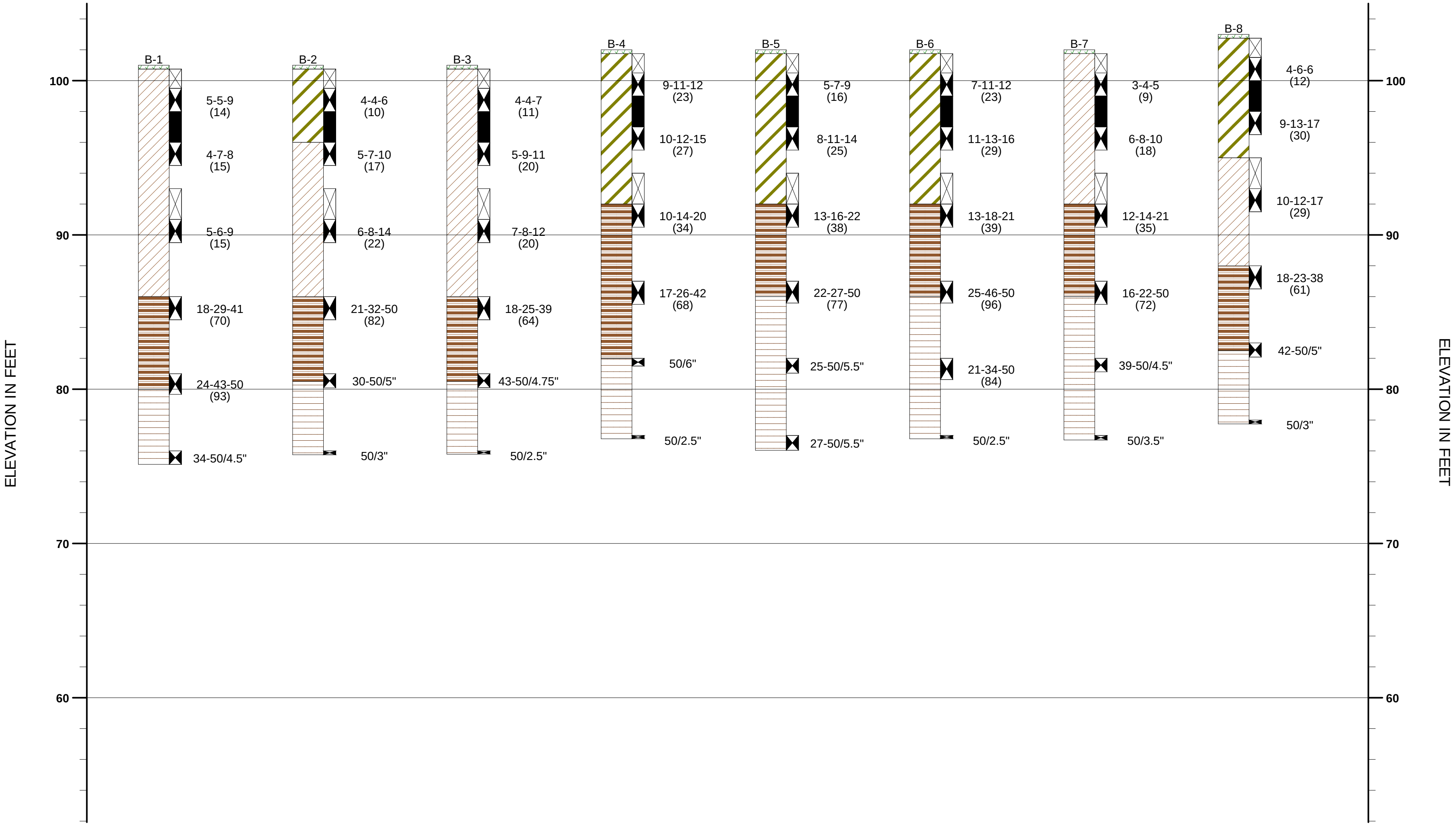
☒ Grab	■ ST	◫ RC
⧗ SS	▼ TC	◧ HA

DEPTH (FT)	ELEVATION (FT)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS (N)	POCKET PENTROMETER (tsf)	RECOVERY % / RQD	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	UCS (psf)	-#200 SIEVE (%)	ATTERBERG LIMITS LL-PL-PI
0				(Short Grass)										
		▨		Dk. Brn. LEAN CLAY	☒	A				21.0				
		▨		Brn.	☒	B				21.6				
5		▨	CL	Moist, Moderate Plasticity	☒	C				20.8			96.2	48-19-29
				Bottom of borehole at 5.0 feet										
10														
15														
20														
25														
30														

WATER LEVELS		
WD	▽	Dry
AD	▼	Dry
24 Hrs	▽	
> 24 Hrs	▼	

ELEVATIONS / LOCATIONS	
GROUND ELEVATION: -	
TBM: -	
GPS: 34.916434, -97.341067	
STA:	OFFSET:

DRILLING			
DRILL START:	12/03/24	LOGGER:	Corbin
DRILLED END:	12/03/24	DRILLER:	Brandon
DRILL RIG:	CME 45B	HOLE SIZE:	6"
DRILL METHOD:	S.F.A.		



▨ Topsoil

▨ Fat Clay

▨ Lean Clay

▨ Weathered Shale

▨ Shale

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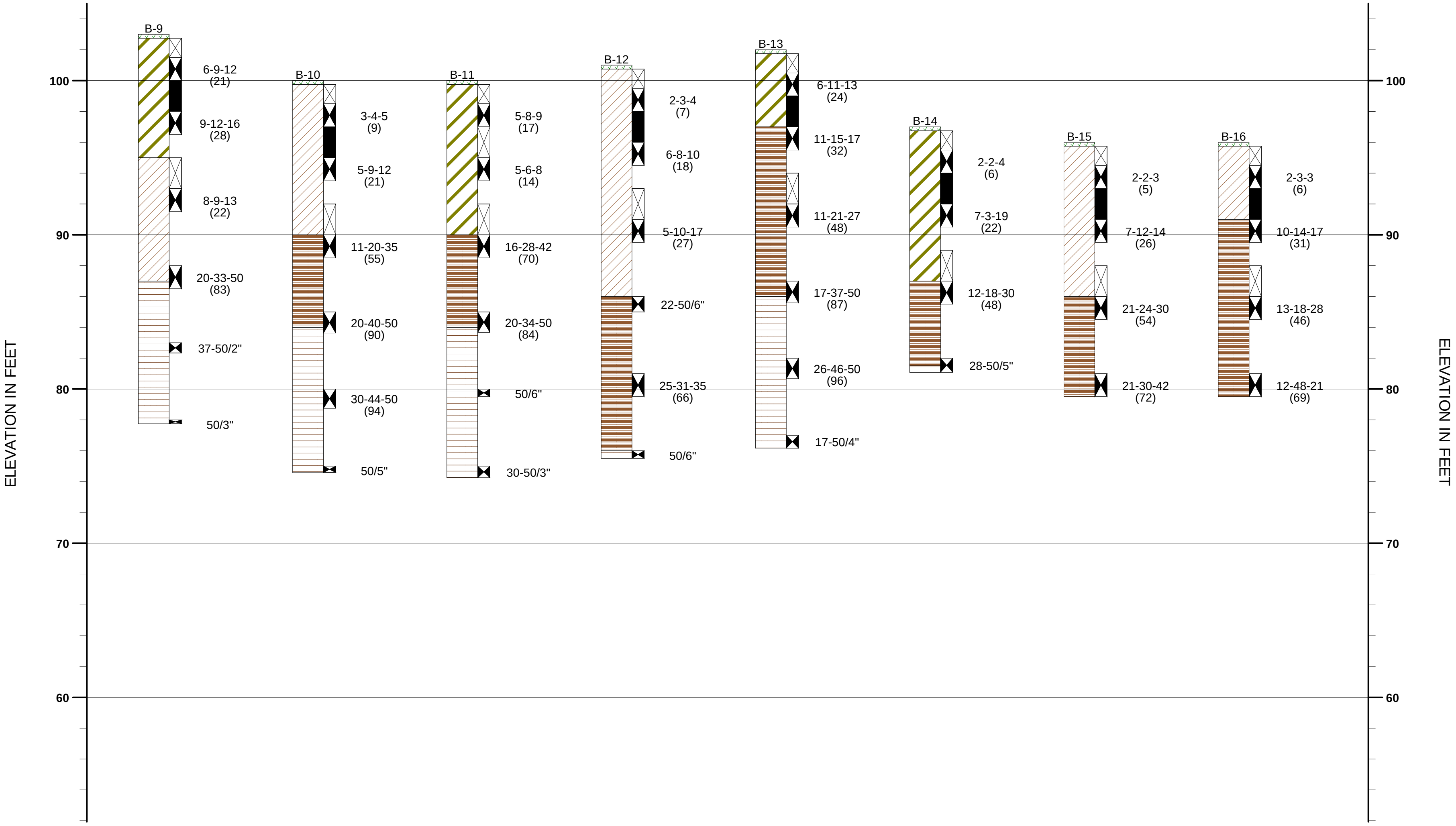
SOIL PROFILE

New Residency & Maintenance Facility

PROJECT NO. 2430-0704

HORIZONTAL SCALE:	VERTICAL SCALE: 1"=10'



▨ Topsoil

▨ Fat Clay

▨ Lean Clay

▨ Shale

▨ Weathered Shale

STANDARD
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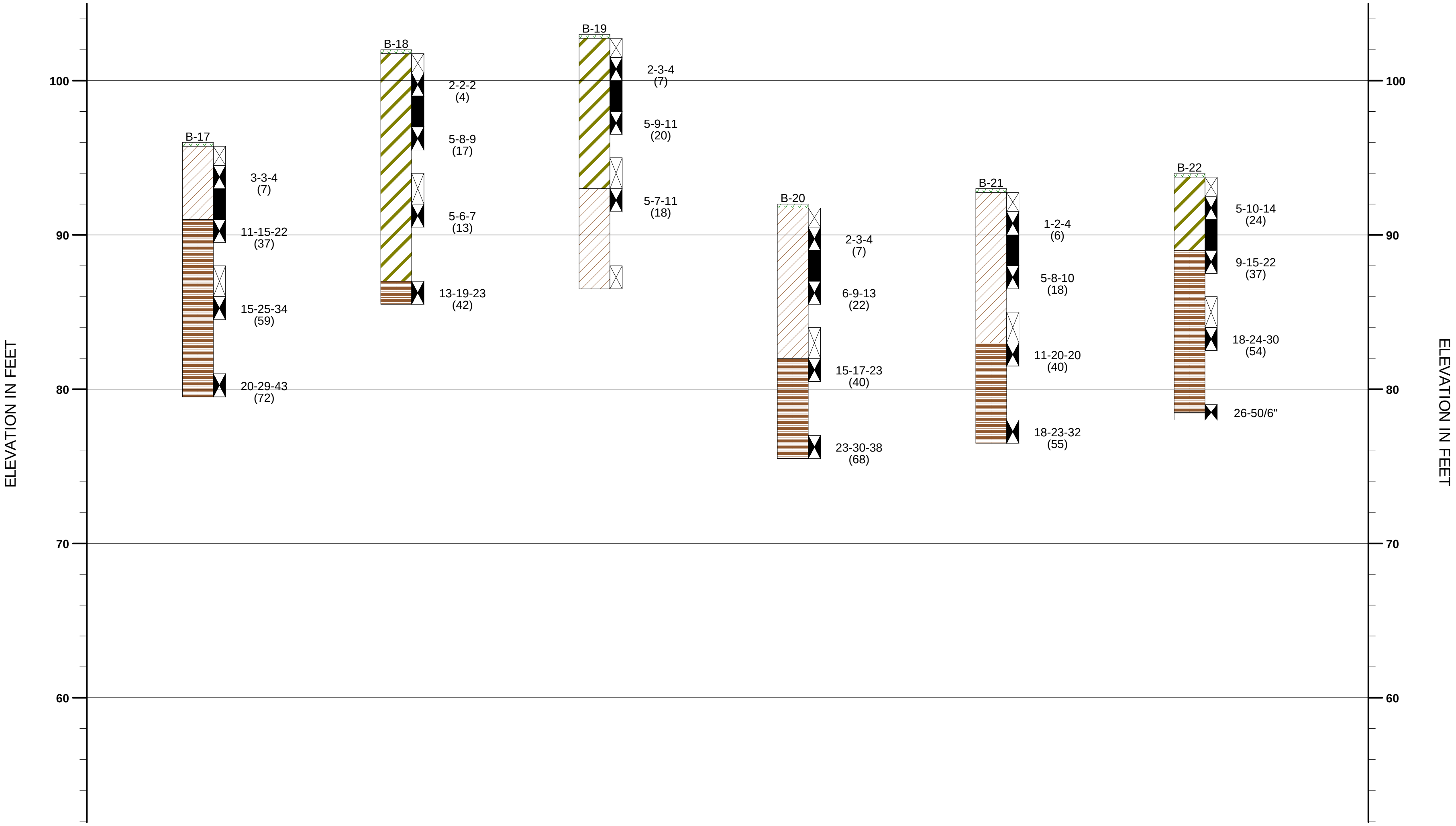
SOIL PROFILE

New Residency & Maintenance Facility

PROJECT NO. 2430-0704

HORIZONTAL	VERTICAL
SCALE:	SCALE: 1"=10'



▨	Topsoil
▨	Lean Clay
▤	Weathered Shale
▨	Fat Clay
▤	Shale

STANDARD
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SOIL PROFILE

New Residency & Maintenance Facility

PROJECT NO. 2430-0704

HORIZONTAL SCALE:	VERTICAL SCALE: 1"=10'

DEFINITION OF DESCRIPTIVE TERMS

Consistency of Cohesive Soils (at moisture content near plastic limit):
Very Soft - Easily penetrated 4" to 6" by fist; tall core will sag under its own weight.
Soft - Easily molded by fingers.
Firm - Can be penetrated 2" to 3" by thumb with moderate effort, imprinted with fingers.
Stiff - Readily indented by thumb but penetrated only with great effort.
Very Stiff - Readily indented by thumbnail, imprinted very slightly with pressure from fingers.
Hard - Indented with difficulty by thumbnail, cannot be imprinted with fingers.

Density of Cohesionless Soils:
Very Loose - less than 4 SPT "N" value corrected for overburden.
Loose - 5 to 10 SPT "N" value corrected for overburden.
Medium Dense - 11 to 30 SPT "N" value corrected for overburden.
Dense - 31 to 50 SPT "N" value corrected for overburden.
Very Dense - 51 to 50/6" SPT "N" value corrected for overburden.
Hard - less than 6" penetration in 50 SPT "N" blows corrected for overburden (cemented).

Hardness of Rock:
Very Soft - can be scratched readily by fingernail
Soft - can be grooved readily by knife or pick
Medium - can be grooved 0.05" deep by firm pressure of knife
Moderately Hard - can be scratched by knife
Hard - can be scratched by knife or pick only with difficulty
Very Hard - cannot be scratched by knife or sharp pick

Other Terms Descriptive of Consistency:
Brittle - Ruptures with little deformation
Friable - Crumbles or pulverizes easily.
Elastic - Returns to original length after small deformation.
Spongy - Is very porous, loose and elastic.
Sticky - Adheres or sticks to tools or hands.

In-Situ Moisture Descriptions:
Dry - powdery
Slightly Moist - water not readily absorbed by paper
Moist - water readily absorbed by paper
Very Moist - water condenses on sample tray
Wet - water drips from sample

Degree of Plasticity When Moist to Very Moist:
Nonplastic - cannot be rolled into a ball
Trace of Plasticity - can be rolled into a ball but not into a 1/8" thread
Low Plasticity - barely holds its shape when rolled into a 1/8" thread
Fairly Low Plasticity - 1/8" thread quickly ruptures when bent
Medium Plasticity - 1/8" thread withstands considerable deformation without rupture.
Fairly High Plasticity - difficult to rupture a 1/8" thread by bending.
High Plasticity - can be kneaded without rupture; greasy texture.

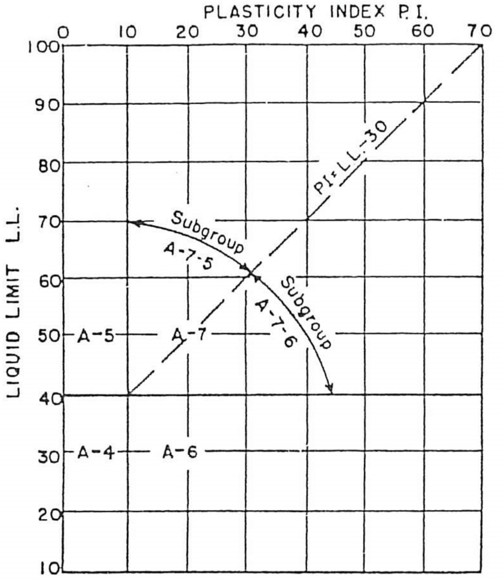
Abbreviations:
V. - Very
Tr. - Trace
Fl. - Fairly
Sl. - Slightly
Dk. - Dark
Lt. - Light
Med. - Medium
Blk. - Black
Brn. - Brown

APPENDIX C

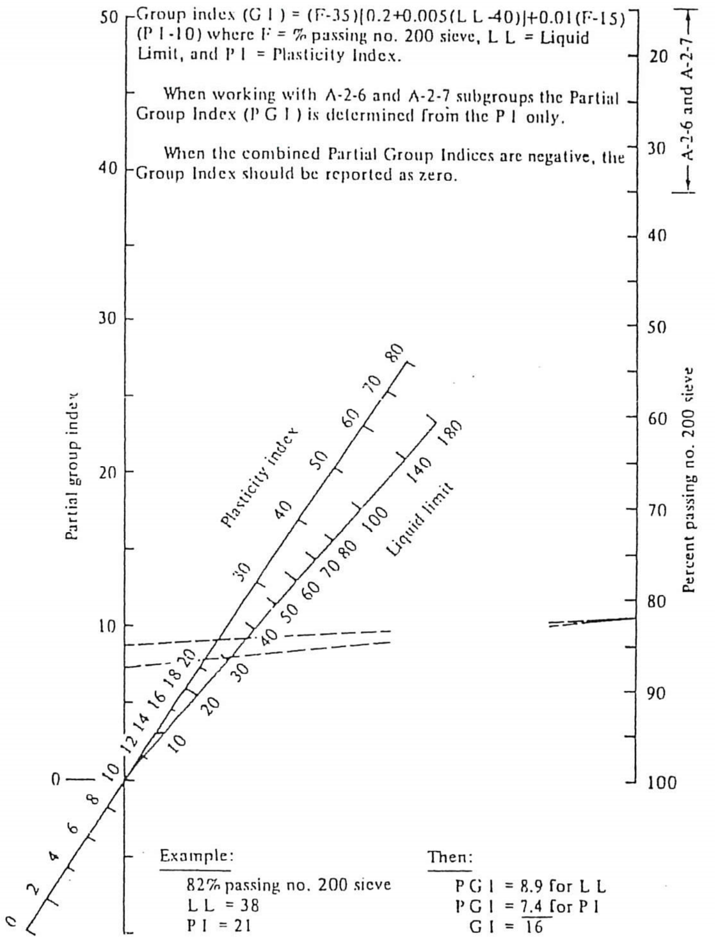
AASHTO Soil Classification System
Unified Soil Classification System

Soil Classification System — American Association of State Highway and Transportation Officials

The tables and charts given below are from AASHTO Designation: M 145-83, The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes. More detailed information as to the background and application of the system may be obtained from the report.



Liquid-limit and plasticity-index ranges for the A-4, A-5, A-6 and A-7 subgrade groups.



Group index (G I) = (F-35)[0.2+0.005(L L-40)]+0.01(F-15)(P I -10) where F = % passing no. 200 sieve, L L = Liquid Limit, and P I = Plasticity Index.

When working with A-2-6 and A-2-7 subgroups the Partial Group Index (P G I) is determined from the P I only.

When the combined Partial Group Indices are negative, the Group Index should be reported as zero.

Example:
82% passing no. 200 sieve
L L = 38
P I = 21

Then:
P G I = 8.9 for L L
P G I = 7.4 for P I
G I = 16

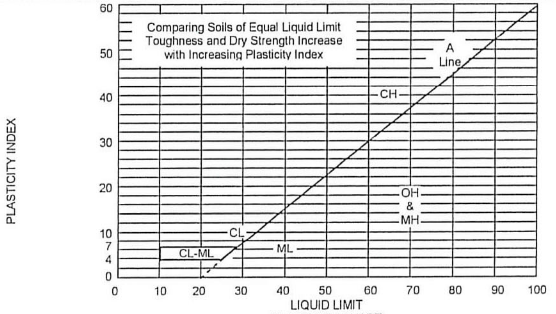
Group index chart

Classification of Soils and Soil-Aggregate Mixtures (with Suggested Subgroups)

General classification	Granular materials (35 per cent or less passing No. 200)							Silt-clay materials (More than 35 per cent passing No. 200)			
Group classification	A-1		A-3	A-2				A-4	A-5	A-6	A-7
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5; A-7-6
Sieve analysis: Per cent passing:											
No. 10	50 max.	—	—	—	—	—	—	—	—	—	—
No. 40	30 max.	50 max.	51 min.	—	—	—	—	—	—	—	—
No. 200	15 max.	25 max.	10 max.	35 max.	35 max.	35 max.	35 max.	36 min.	36 min.	36 min.	36 min.
Characteristics of fraction passing No. 40:											
Liquid limit	—		—	40 max.	41 min.	40 max.	41 min.	40 max.	41 min.	40 max.	41 min.
Plasticity index	6 max.		NP	10 max.	10 max.	11 min.	11 min.	10 max.	10 max.	11 min.	11 min.*
Usual types of significant constituent materials	Stone fragments, gravel and sand		Fine sand	Silty or clayey gravel and sand				Silty soils		Clayey soils	
General rating as subgrade	Excellent to good					Fair to poor					

*P.I. of A-7-5 subgroup is equal to or less than L.L. minus 30. P.I. of A-7-6 subgroup is greater than L.L. minus 30

UNIFIED SOIL CLASSIFICATION
(Including Identification and Description)

Major Divisions				Group Symbols	Typical Names	Field Identification Procedures (Excluding particles larger than 3 inches and basing fractions on estimated weights)			Information Required for Describing Soils	Laboratory Classification Criteria			
1	2			3	4	5			6	7			
Coarse-grained Soils More than half of material is larger than No. 200 sieve size.	The No. 200 sieve size is about the smallest particle visible to the naked eye.	Gravels More than half of coarse fraction is larger than No. 4 sieve size.	(For visual classification, the ¼-in size may be used as equivalent to the No. 4 sieve size)	Clean Gravels (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.	Wide range in grain sizes and substantial amounts of all intermediate particle sizes.		For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics	Use grain-size curve in identifying the fractions as given under field identification	Determine percentages of gravel and sand from grain size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size) coarse-grained soils are classified as follows:	GW, GP, SW, SP GM, GC SM, SC Borderline cases require use of dual symbols	$C_u = \frac{D_{60}}{D_{10}}$ Greater than 4 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
					GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines.	Predominantly one size or a range of sizes with some intermediate sizes missing.						Not meeting all gradation requirements for GW
				Gravels with Fines (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures.	Nonplastic fines or fines with low plasticity (for identification procedures see ML below).		Give typical name; indicate approximate percentages of sand and gravel, maximum size, angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information; and symbol in parentheses.				Atterberg limits below "A" line or PI less than 4 Above "A" Line with PI between 4 and 7 are borderline cases requiring use of dual symbols
					GC	Clayey gravels, gravel-sand-clay mixtures.	Plastic fines (for identification procedures see CL below).						Atterberg limits above "A" line or PI greater than 7
		Sands More than half of coarse fraction is smaller than No. 4 sieve size.		Clean Sands (Little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines.	Wide range in grain size and substantial amounts of all intermediate particle sizes.						$C_u = \frac{D_{60}}{D_{10}}$ Greater than 6 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
					SP	Poorly-graded sands, gravelly sands, little or no fines.	Predominantly one size or a range of sizes with some intermediate sizes missing.		Example: Silty sand, gravelly; about 20% hard, angular gravel particles ½-in. maximum size; rounded and subangular sand grains coarse to fine; about 15% nonplastic fines with low dry strength; well compacted and moist in place; alluvial sand; (SM).				Not meeting all gradation requirements for SW
				Sands with Fines (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures.	Nonplastic fines or fines with low plasticity (for identification procedures see ML below).					Less than 5% More than 12% 5% to 12%	Atterberg limits below "A" line or PI less than 4 Limits plotting in hatched zone with PI between 4 and 7 are borderline cases requiring use of dual symbols
					SC	Clayey sands, sand-clay mixtures.	Plastic fines (for identification procedures see CL below).						Atterberg limits above "A" line or PI greater than 7
Fine-grained Soils More than half of material is smaller than No. 200 sieve size.							Identification Procedures On Fractions Smaller than No. 40 Sieve Sizes						
							Dry Strength (Crushing characteristics)	Dilatancy (Reaction to shaking)	Toughness (Consistency near PL)				
		Silts and Clays Liquid limit less than 50			ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.	None to slight	Quick to slow	None	Give typical name, indicate degree and character of plasticity, amount and maximum size of coarse grains, color in wet condition, odor if any, local or geologic name, and other pertinent descriptive information; and symbol in parentheses.		 PLASTICITY CHART For laboratory classification of fine-grained soils	
					CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.	Medium to high	None to very slow	Medium				
					OL	Organic silts and organic silty clays of low plasticity.	Slight to medium	Slow	Slight				
		Silts and Clays Liquid limit greater than 50			MH	Inorganic silts, micoceous or diotomoceous fine sandy or silty soils, elastic silts.	Slight to medium	Slow to none	Slight to Medium	For undisturbed soils add information on structure, stratification, consistency in undisturbed and remolded states, moisture and drainage conditions.			
					CH	Inorganic clays of high plasticity, fat clays.	High to very high	None	High				
					OH	Organic clays of medium to high plasticity, organic silts.	Medium to high	None to very slow	Slight to medium	Example: Clayey silt, brown, slightly plastic, small percentage of fine sand, numerous vertical root holes, firm and dry in place, loess, (ML).			
Highly Organic Soils					PI	Peat and other high organic soils.	Readily identified by color, odor, spongy feel and frequently by fibrous texture.						

(1) Boundary Classifications: Soils possessing characteristics of two groups are designated by combinations of group symbols. For example GW-GC, well-graded gravel-sand mixture with clay binder. (2) All sieve sizes on this chart are U.S. Standard

FIELD IDENTIFICATION PROCEDURES FOR FINE-GRAINED SOILS OR FRACTIONS

These procedures are to be performed on the minus No. 40 sieve size particles, approximately 1/64 in. For field classification purposes, screening is not intended, simply remove by hand the coarse particles that interfere with the tests.

Dilatancy (Reaction to shaking)

After removing particles larger than No. 40 sieve size, prepare a pat of moist soil with a volume of about one-half cubic inch. Add enough water if necessary to make the soil soft but not sticky. Place the pat in the open palm of one hand and shake horizontally, striking vigorously against the other hand several times. A positive reaction consists of the appearance of water on the surface of the pat, which changes to a livery consistency and becomes glossy. When the sample is squeezed between the fingers, the water and glass disappear from the surface, the pat stiffens, and finally it cracks or crumbles. The rapidity of appearance of water during shaking and of its disappearance during squeezing assist in identifying the character of the fines in a soil.

Very fine clean sands give the quickest and most distinct reactions whereas a plastic clay has no reaction. Inorganic silts, such as a typical rock flour show a moderately quick reaction.

Dry Strength (Crushing Characteristics)

After removing particles larger than No. 40 sieve size, mold a pat of soil to the consistency of putty, adding water if necessary. Allow the pat to dry completely by oven, sun, or air drying, and then test its strength by breaking and crumbling between the fingers. This strength is a measure of the character and quantity of the colloidal fraction contained in the soil. The dry strength increases with increasing plasticity.

High dry strength is characteristic for clays of the CH group. A typical inorganic silt possesses only very slight dry strength. Silty fine sands and silts have about the same slight dry strength, but can be distinguished by the feel when powdering the dried specimen. Fine sand feels gritty, whereas a typical silt has the smooth feel of flour.

Toughness (Consistency near plastic limit)

After removing particles larger than the No. 40 sieve size, a specimen of soil about one-half inch cube in size is molded to the consistency of putty. If too dry, water must be added and if sticky, specimen should be spread out in a thin layer and allowed to lose some moisture by evaporation. Then the specimen is rolled out by hand on a smooth surface or between the palms into a thread about one-eighth inch in diameter. The thread is then folded and rerolled repeatedly. During this manipulation the moisture content is gradually reduced and the specimen stiffens, finally loses it's plasticity, and crumbles when the plastic limit is reached.

After the thread crumbles, the pieces should be lumped together and slight kneading action continued until lump crumbles.

The tougher the thread near the plastic limit and the stiffer the lump when it finally crumbles, the more potent is the colloidal clay fraction in the soil. Weakness of the thread at plastic limit and quick loss of coherence of the lump below the plastic limit indicate either inorganic clay of low plasticity, or materials such as kaolin-type clays and organic clays which occur below the A-line.

Highly organic clays have a very weak and spongy feel at the plastic limit.

Adopted by Corps of Engineers and Bureau of Reclamation January 1952

APPENDIX D

Summary of Test Results

STANDARD ENGINEERING +FIELD SERVICES

SUMMARY OF LABORATORY TEST RESULTS

Client: Guernsey **Date:** 1/2/2025

Project: New Residency & Maintenance Facility **Project No.:** 2430-0704

Boring No.	Sample No.	Depth (ft)	Moisture Content (%)	Dry Density (pcf)	Atterberg Limits (% Moisture)			Sieve Analysis (% Passing)					Soil Classification		UCT	
					LL	PL	PI	#4	#10	#40	#100	#200	USCS	AASHTO	Stress (psf)	Strain (%)
B-1																
	A	0.3-1.5	26.9													
	B	1.5-3.0	20.6													
	C	3.0-5.0	22.6	97	46	17	29	100	100	99	98	94.9	CL	A-7-6(29)		
	D	5.0-6.5	19.2													
	E	8.0-10.0	19.6													
	F	10.0-11.5	17.1													
	G	15.0-16.5	12.8													
	H	20.0-21.3	14.2		46	16	30	100	100	96	95	94.4	CL	A-7-6(29)		
B-2																
	A	0.3-1.5	25.0													
	B	1.5-3.0	20.3	105	52	16	36	100	99	99	98	95.5	CH	A-7-6(37)		
	C	3.0-5.0	21.0													
	D	5.0-6.5	20.6													
	E	8.0-10.0	18.6													
	F	10.0-11.5	13.6													
B-3																
	A	0.3-1.5	24.1													
	B	1.5-3.0	20.3													
	C	3.0-5.0	19.0	107											5271	10.5
	D	5.0-6.5	18.2	111	49	16	33	100	99	99	98	93.0	CL	A-7-6(32)		
	E	8.0-10.0	17.5													
	F	10.0-11.5	15.6													
B-4																
	A	0.3-1.5	25.6													
	B	1.5-3.0	14.9													
	C	3.0-5.0	20.7													
	D	5.0-6.5	14.0	117	51	16	35	100	100	99	98	89.3	CH	A-7-6(32)		
	E	8.0-10.0	17.5													
	F	10.0-11.5	12.3													

SUMMARY OF LABORATORY TEST RESULTS

Client: Guernsey

Date: 1/2/2025

Project: New Residency & Maintenance Facility

Project No.: 2430-0704

Boring No.	Sample No.	Depth (ft)	Moisture Content (%)	Dry Density (pcf)	Atterberg Limits (% Moisture)			Sieve Analysis (% Passing)					Soil Classification		UCT	
					LL	PL	PI	#4	#10	#40	#100	#200	USCS	AASHTO	Stress (psf)	Strain (%)
B-5																
	A	0.3-1.5	22.3													
	B	1.5-3.0	18.7	106	50	16	34	100	99	98	98	93.7	CH	A-7-6(34)		
	C	3.0-5.0	16.9	113											8389	8.7
	D	5.0-6.5	17.6													
	E	8.0-10.0	15.1													
	F	10.0-11.5	12.4													
B-6																
	A	0.3-1.5	21.7													
	B	1.5-3.0	19.9	106												
	C	3.0-5.0	18.4		50	16	34	100	100	100	99	96.6	CH	A-7-6(35)		
	D	5.0-6.5	14.4													
	E	8.0-10.0	13.9													
	F	10.0-11.5	9.0													
B-7																
	A	0.3-1.5	20.4													
	B	1.5-3.0	21.7	105	47	17	30	100	100	99	98	96.0	CL	A-7-6(31)		
	C	3.0-5.0	17.5	110											4499	4.9
	D	5.0-6.5	21.0													
	E	8.0-10.0	18.2													
	F	10.0-11.5	13.2													
B-8																
	A	0.3-1.5	19.2													
	B	1.5-3.0	18.9													
	C	3.0-5.0	20.2													
	D	5.0-6.5	16.3	116	50	15	35	95	95	94	93	87.5	CH	A-7-6(32)		
	E	8.0-10.0	15.5													
	F	10.0-11.5	13.9													
B-9																
	A	0.3-1.5	24.5													

SUMMARY OF LABORATORY TEST RESULTS

Client: Guernsey **Date:** 1/2/2025

Project: New Residency & Maintenance Facility **Project No.:** 2430-0704

Boring No.	Sample No.	Depth (ft)	Moisture Content (%)	Dry Density (pcf)	Atterberg Limits (% Moisture)			Sieve Analysis (% Passing)					Soil Classification		UCT	
					LL	PL	PI	#4	#10	#40	#100	#200	USCS	AASHTO	Stress (psf)	Strain (%)
	B	1.5-3.0	15.9	114												
	C	3.0-5.0	20.3		54	16	38	100	98	96	95	92.9	CH	A-7-6(38)		
	D	5.0-6.5	17.1													
	E	8.0-10.0	14.7													
	F	10.0-11.5	14.2													
B-10																
	A	0.3-1.5	17.8													
	B	1.5-3.0	22.6		39	16	23	100	100	99	98	95.0	CL	A-6(22)		
	C	3.0-5.0	11.7	116											6611	13.1
	D	5.0-6.5	16.3	116												
	E	8.0-10.0	15.3													
	F	10.0-11.5	11.8													
B-11																
	A	0.3-1.5	22.5													
	B	1.5-3.0	20.5	111												
	C	3.0-5.0	21.5		56	15	41	100	100	99	99	95.5	CH	A-7-6(42)		
	D	5.0-6.5	15.4													
	E	8.0-10.0	15.1													
	F	10.0-11.5	11.7													
	G	15.0-16.3	10.7		36	14	22	100	99	99	98	96.4	CL	A-6(21)		
B-12																
	A	0.3-1.5	21.9													
	B	1.5-3.0	21.6	102												
	C	3.0-5.0	15.4	115											5610	9.6
	D	5.0-6.5	20.1		47	15	32	100	100	98	96	91.1	CL	A-7-6(30)		
	E	8.0-10.0	17.4													
	F	10.0-11.5	15.1													
B-13																
	A	0.3-1.5	23.3													
	B	1.5-3.0	12.9	117	50	15	35	100	100	99	99	94.1	CH	A-7-6(34)		

STANDARD ENGINEERING + FIELD SERVICES

SUMMARY OF LABORATORY TEST RESULTS

Client: Guernsey

Date: 1/2/2025

Project: New Residency & Maintenance Facility

Project No.: 2430-0704

Boring No.	Sample No.	Depth (ft)	Moisture Content (%)	Dry Density (pcf)	Atterberg Limits (% Moisture)			Sieve Analysis (% Passing)					Soil Classification		UCT	
					LL	PL	PI	#4	#10	#40	#100	#200	USCS	AASHTO	Stress (psf)	Strain (%)
	C	3.0-5.0	20.1													
	D	5.0-6.5	12.5													
	E	8.0-10.0	14.3													
	F	10.0-11.5	12.0													
B-14																
	A	0.3-1.5	21.9													
	B	1.5-3.0	20.6													
	C	3.0-5.0	14.3		52	17	35	100	100	99	98	94.1	CH	A-7-6(35)		
	D	5.0-6.5	15.3	118												
	E	8.0-10.0	12.9													
	F	10.0-11.5	12.5													
B-15																
	A	0.3-1.5	20.7													
	B	1.5-3.0	19.1	109												
	C	3.0-5.0	11.5	123											10458	10.1
	D	5.0-6.5	12.9		46	15	31	100	100	100	99	96.5	CL	A-7-6(31)		
	E	8.0-10.0	13.2													
	F	10.0-11.5	11.3													
B-16																
	A	0.3-1.5	21.8													
	B	1.5-3.0	18.9													
	C	3.0-5.0	19.0													
	D	5.0-6.5	11.1		43	15	28	100	100	100	99	98.5	CL	A-7-6(28)		
	E	8.0-10.0	12.0													
	F	10.0-11.5	11.8													
B-17																
	A	0.3-1.5	27.7													
	B	1.5-3.0	21.0	106												
	C	3.0-5.0	20.5	122	46	15	31	100	98	97	96	91.3	CL	A-7-6(29)	7012	11.4
	D	5.0-6.5	12.1													

SUMMARY OF LABORATORY TEST RESULTS

Client: Guernsey

Date: 1/2/2025

Project: New Residency & Maintenance Facility

Project No.: 2430-0704

Boring No.	Sample No.	Depth (ft)	Moisture Content (%)	Dry Density (pcf)	Atterberg Limits (% Moisture)			Sieve Analysis (% Passing)					Soil Classification		UCT	
					LL	PL	PI	#4	#10	#40	#100	#200	USCS	AASHTO	Stress (psf)	Strain (%)
	E	8.0-10.0	18.4													
	F	10.0-11.5	13.7													
	G	15.0-16.5	12.9													
B-18																
	A	0.3-1.5	23.2													
	B	1.5-3.0	22.6		51	14	37	99	98	97	96	93.3	CH	A-7-6(36)		
	C	3.0-5.0	9.4	123											12845	10.1
	D	5.0-6.5	15.6	116												
	E	8.0-10.0	18.3													
	F	10.0-11.5	20.3													
	G	15.0-16.5	17.6													
B-19																
	A	0.3-1.5	22.8													
	B	1.5-3.0	20.2	107	51	16	35	100	100	99	98	94.9	CH	A-7-6(35)		
	C	3.0-5.0	18.2													
	D	5.0-6.5	17.1													
	E	8.0-10.0	16.5													
	F	10.0-11.5	16.0													
	G	15.0-16.5	11.5													
B-20																
	A	0.3-1.5	31.0													
	B	1.5-3.0	23.1	106												
	C	3.0-5.0	20.1	122	47	17	30	100	100	100	99	95.2	CL	A-7-6(30)	8626	10.1
	D	5.0-6.5	15.4													
	E	8.0-10.0	13.9													
	F	10.0-11.5	12.9													
	G	15.0-16.5	10.6													
B-21																
	A	0.3-1.5	24.4													
	B	1.5-3.0	18.7	107												

STANDARD ENGINEERING + FIELD SERVICES

SUMMARY OF LABORATORY TEST RESULTS

Client: Guernsey

Date: 1/2/2025

Project: New Residency & Maintenance Facility

Project No.: 2430-0704

Boring No.	Sample No.	Depth (ft)	Moisture Content (%)	Dry Density (pcf)	Atterberg Limits (% Moisture)			Sieve Analysis (% Passing)					Soil Classification		UCT	
					LL	PL	PI	#4	#10	#40	#100	#200	USCS	AASHTO	Stress (psf)	Strain (%)
	C	3.0-5.0	16.9													
	D	5.0-6.5	15.9		40	17	23	97	96	95	92	86.5	CL	A-6(19)		
	E	8.0-10.0	14.0													
	F	10.0-11.5	11.7													
	G	15.0-16.5	11.9													
B-22																
	A	0.3-1.5	26.9													
	B	1.5-3.0	14.5	115	54	17	37	100	99	98	97	92.5	CH	A-7-6(36)		
	C	3.0-5.0	13.1	118											19142	5.8
	D	5.0-6.5	17.7													
	E	8.0-10.0	15.0													
	F	10.0-11.5	11.7													
P-1																
	A	0.3-1.5	21.1		36	20	16	100	100	100	99	95.9	CL	A-6(16)		
	B	1.5-3.0	20.9													
	C	3.5-5.0	19.9													
P-2																
	A	0.3-1.5	20.1													
	B	1.5-3.0	16.9		47	18	29	100	99	98	97	92.7	CL	A-7-6(28)		
	C	3.5-5.0	18.7													
P-3																
	A	0.3-1.5	21.8													
	B	1.5-3.0	22.4													
	C	3.5-5.0	22.2		55	17	38	100	100	100	99	94.1	CH	A-7-6(38)		
P-4																
	A	0.3-1.5	19.7													
	B	1.5-3.0	20.5		54	17	37	100	99	98	98	95.7	CH	A-7-6(38)		
	C	3.5-5.0	18.7													
P-5																

SUMMARY OF LABORATORY TEST RESULTS

Client: Guernsey

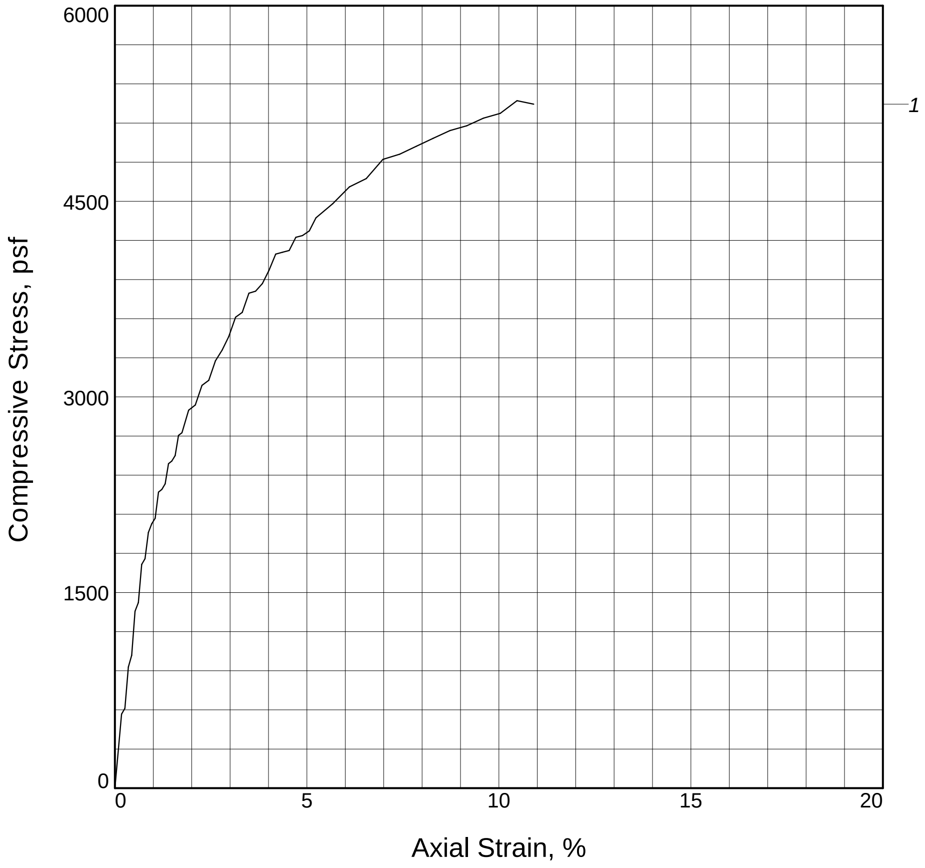
Date: 1/2/2025

Project: New Residency & Maintenance Facility

Project No.: 2430-0704

Boring No.	Sample No.	Depth (ft)	Moisture Content (%)	Dry Density (pcf)	Atterberg Limits (% Moisture)			Sieve Analysis (% Passing)					Soil Classification		UCT	
					LL	PL	PI	#4	#10	#40	#100	#200	USCS	AASHTO	Stress (psf)	Strain (%)
	A	0.3-1.5	31.3													
	B	1.5-3.0	31.4													
	C	3.0-5.0	17.6		52	16	36	99	99	98	97	94.5	CH	A-7-6(36)		
P-6																
	A	0.3-1.5	23.0		40	15	25	100	100	99	99	97.0	CL	A-6(25)		
	B	1.5-3.0	25.0													
	C	3.5-5.0	23.5													
P-7																
	A	0.3-1.5	21.4													
	B	1.5-3.0	15.8		39	13	26	96	96	95	94	90.4	CL	A-6(23)		
	C	3.5-5.0	16.7													
P-8																
	A	0.3-1.5	21.0													
	B	1.5-3.0	21.6													
	C	3.5-5.0	20.8		48	19	29	100	100	99	99	96.2	CL	A-7-6(30)		

UNCONFINED COMPRESSION TEST



Stage	1			
Unconfined strength, psf	5271			
Undrained shear strength, psf	2636			
Failure strain, %	10.5			
Strain rate, in./min.	0.052			
Water content, %	19.0			
Wet density, pcf	127.9			
Dry density, pcf	107.4			
Saturation, %	93.4			
Void ratio	0.5396			
Specimen diameter, in.	2.84			
Specimen height, in.	5.73			
Height/diameter ratio	2.02			

Description:

LL = **PL =** **PI =** **Assumed GS=** 2.65 **Type:**

Project No.: 2430-0704

Date Sampled:

Remarks:

Figure ________

Client: Guernsey

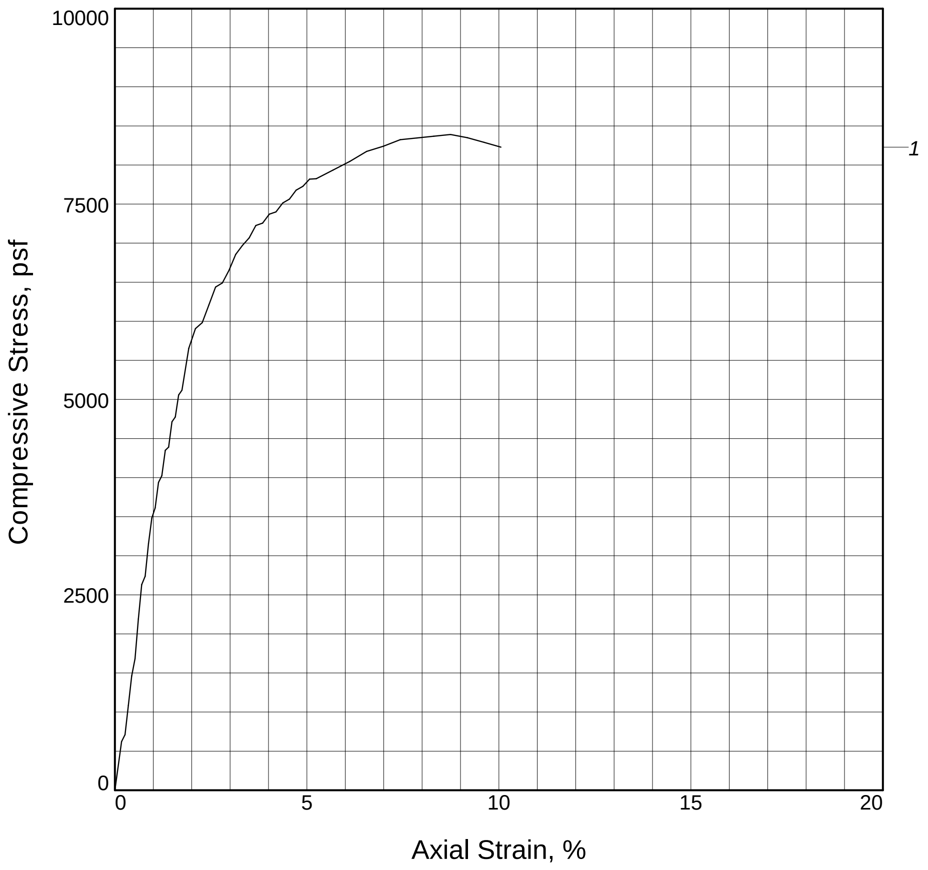
Project: New Residency & Maintenance Facility

Source of Sample: B-3 **Depth:** 3

Sample Number: C

STANDARD ENGINEERING + FIELD SERVICES

UNCONFINED COMPRESSION TEST



Stage	1			
Unconfined strength, psf	8389			
Undrained shear strength, psf	4195			
Failure strain, %	8.7			
Strain rate, in./min.	0.052			
Water content, %	16.9			
Wet density, pcf	132.5			
Dry density, pcf	113.4			
Saturation, %	97.4			
Void ratio	0.4588			
Specimen diameter, in.	2.87			
Specimen height, in.	5.72			
Height/diameter ratio	1.99			

Description:

LL =	**PL =**	**PI =**	**Assumed GS=** 2.65	**Type:**

Project No.: 2430-0704

Date Sampled:

Remarks:

Figure ________

Client: Guernsey

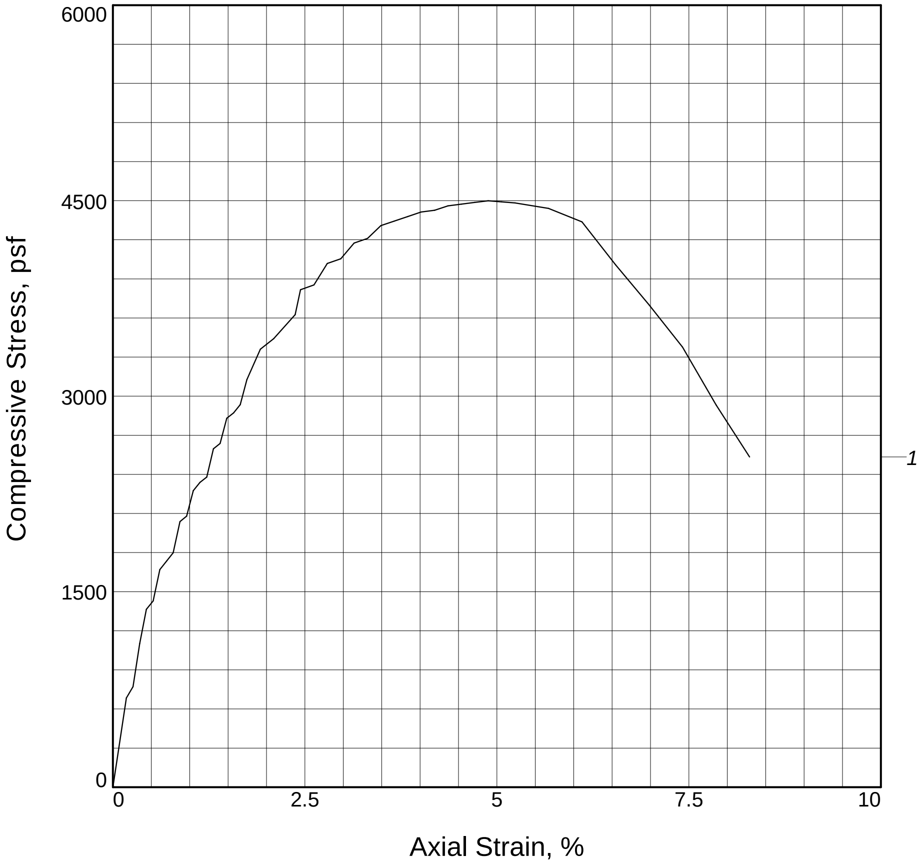
Project: New Residency & Maintenance Facility

Source of Sample: B-5 **Depth:** 3

Sample Number: C

STANDARD
ENGINEERING
+FIELD SERVICES

UNCONFINED COMPRESSION TEST



Stage	1			
Unconfined strength, psf	4499			
Undrained shear strength, psf	2250			
Failure strain, %	4.9			
Strain rate, in./min.	0.052			
Water content, %	17.5			
Wet density, pcf	129.1			
Dry density, pcf	109.9			
Saturation, %	91.7			
Void ratio	0.5059			
Specimen diameter, in.	2.88			
Specimen height, in.	5.73			
Height/diameter ratio	1.99			

Description:

LL =

PL =

PI =

Assumed GS= 2.65

Type:

Project No.: 2430-0704

Date Sampled:

Remarks:

Figure ________

Client: Guernsey

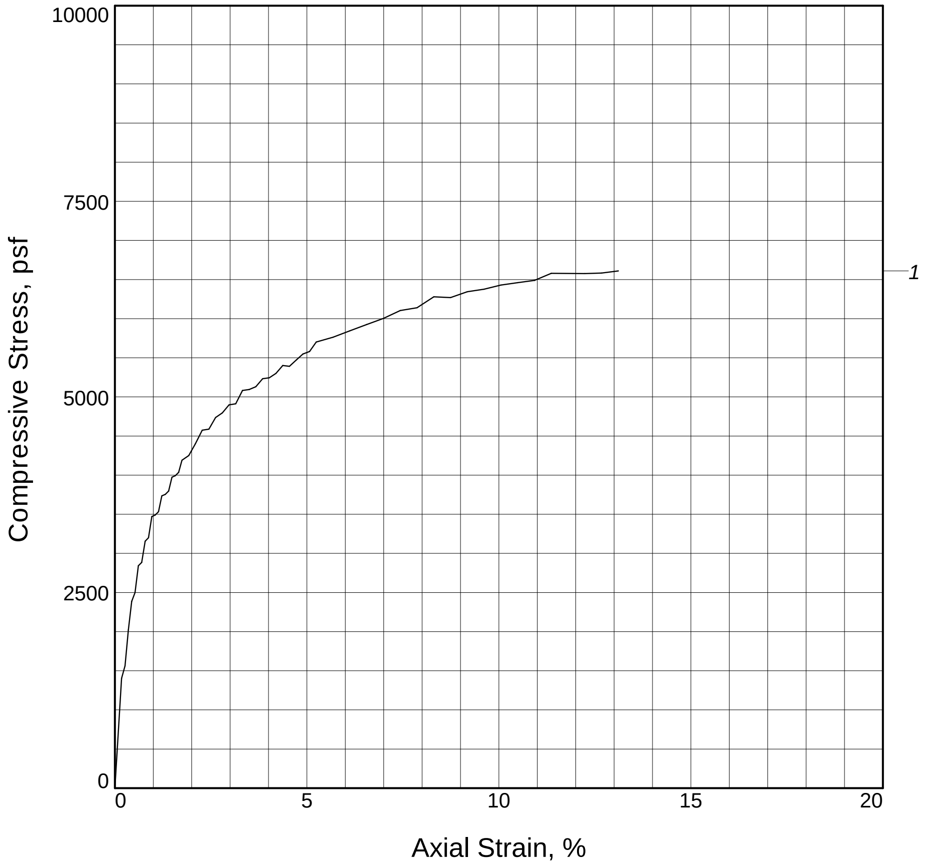
Project: New Residency & Maintenance Facility

Source of Sample: B-7 **Depth:** 3

Sample Number: C

STANDARD ENGINEERING + FIELD SERVICES

UNCONFINED COMPRESSION TEST



Stage	1			
Unconfined strength, psf	6611			
Undrained shear strength, psf	3305			
Failure strain, %	13.1			
Strain rate, in./min.	0.052			
Water content, %	11.7			
Wet density, pcf	130.3			
Dry density, pcf	116.6			
Saturation, %	74.1			
Void ratio	0.4184			
Specimen diameter, in.	2.82			
Specimen height, in.	5.72			
Height/diameter ratio	2.03			

Description: Brn. to Reddish Brn.

LL =	**PL =**	**PI =**	**Assumed GS=** 2.65	**Type:**

Project No.: 2430-0704

Date Sampled:

Remarks:

Figure ________

Client: Guernsey

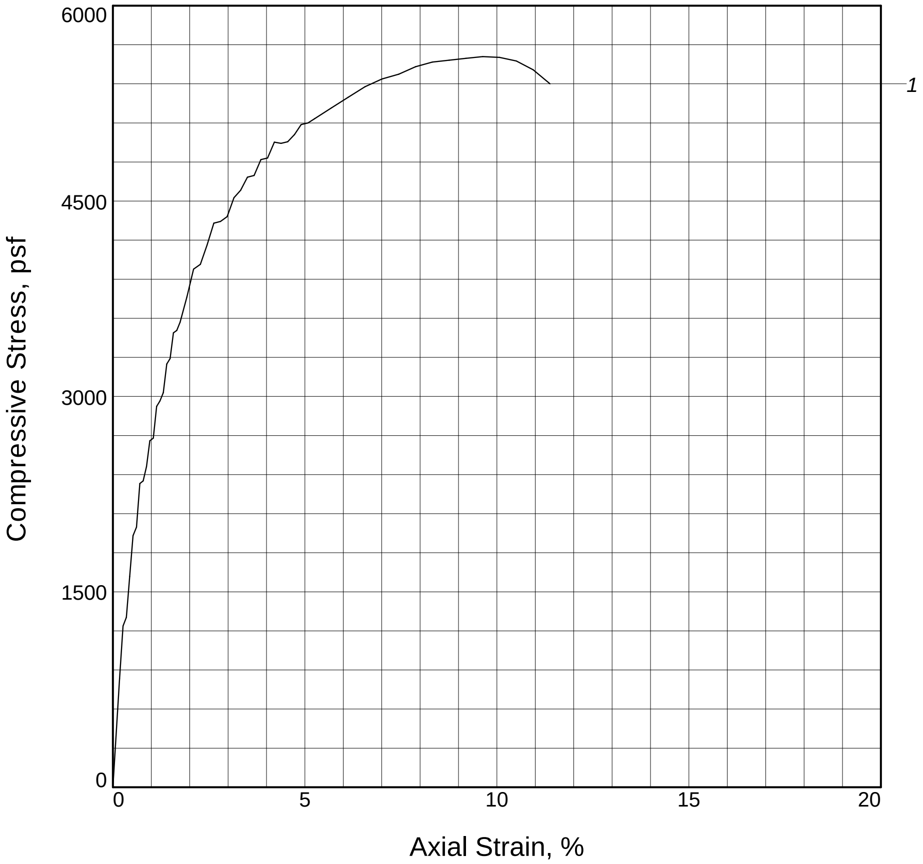
Project: New Residency & Maintenance Facility

Source of Sample: B-10 **Depth:** 3

Sample Number: C

STANDARD ENGINEERING + FIELD SERVICES

UNCONFINED COMPRESSION TEST



Stage	1			
Unconfined strength, psf	5610			
Undrained shear strength, psf	2805			
Failure strain, %	9.6			
Strain rate, in./min.	0.052			
Water content, %	15.4			
Wet density, pcf	133.0			
Dry density, pcf	115.2			
Saturation, %	93.9			
Void ratio	0.4359			
Specimen diameter, in.	2.85			
Specimen height, in.	5.71			
Height/diameter ratio	2.00			

Description: Reddish Brn.

LL = **PL =** **PI =** **Assumed GS=** 2.65 **Type:**

Project No.: 2430-0704

Date Sampled:

Remarks:

Figure ________

Client: Guernsey

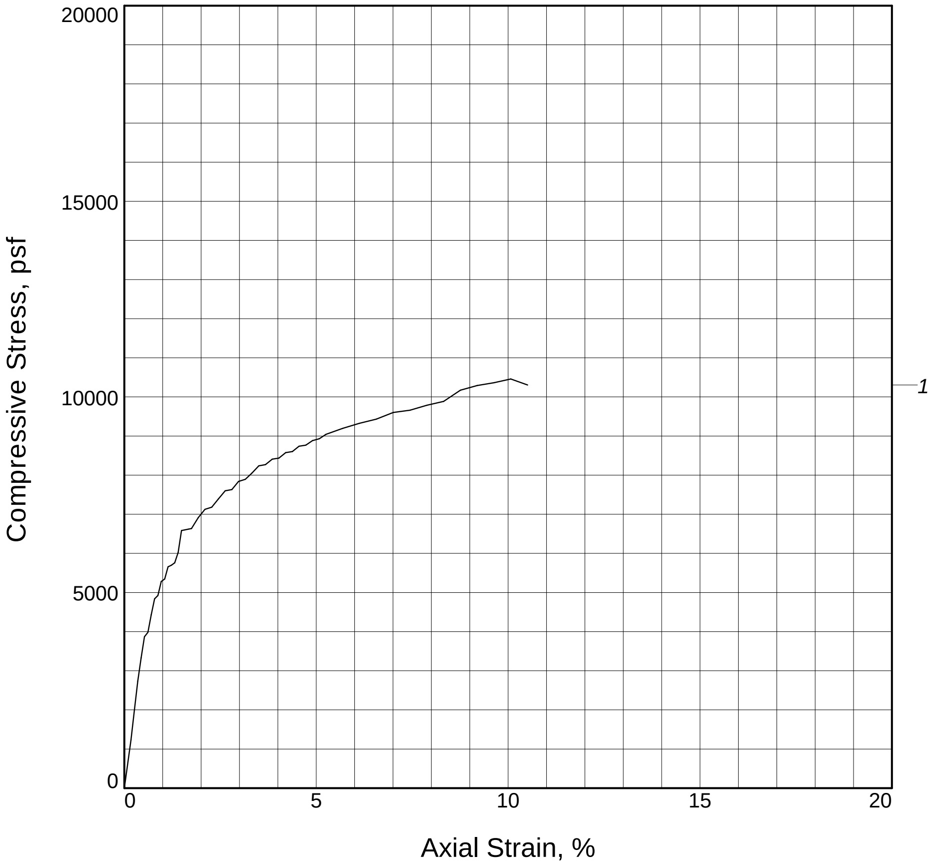
Project: New Residency & Maintenance Facility

Source of Sample: B-12 **Depth:** 3

Sample Number: C

STANDARD ENGINEERING + FIELD SERVICES

UNCONFINED COMPRESSION TEST



Stage	1			
Unconfined strength, psf	10458			
Undrained shear strength, psf	5229			
Failure strain, %	10.1			
Strain rate, in./min.	0.052			
Water content, %	11.5			
Wet density, pcf	137.1			
Dry density, pcf	123.0			
Saturation, %	88.5			
Void ratio	0.3454			
Specimen diameter, in.	2.83			
Specimen height, in.	5.71			
Height/diameter ratio	2.02			

Description:

LL =	**PL =**	**PI =**	**Assumed GS=** 2.65	**Type:**

Project No.: 2430-0704

Date Sampled:

Remarks:

Figure ________

Client: Guernsey

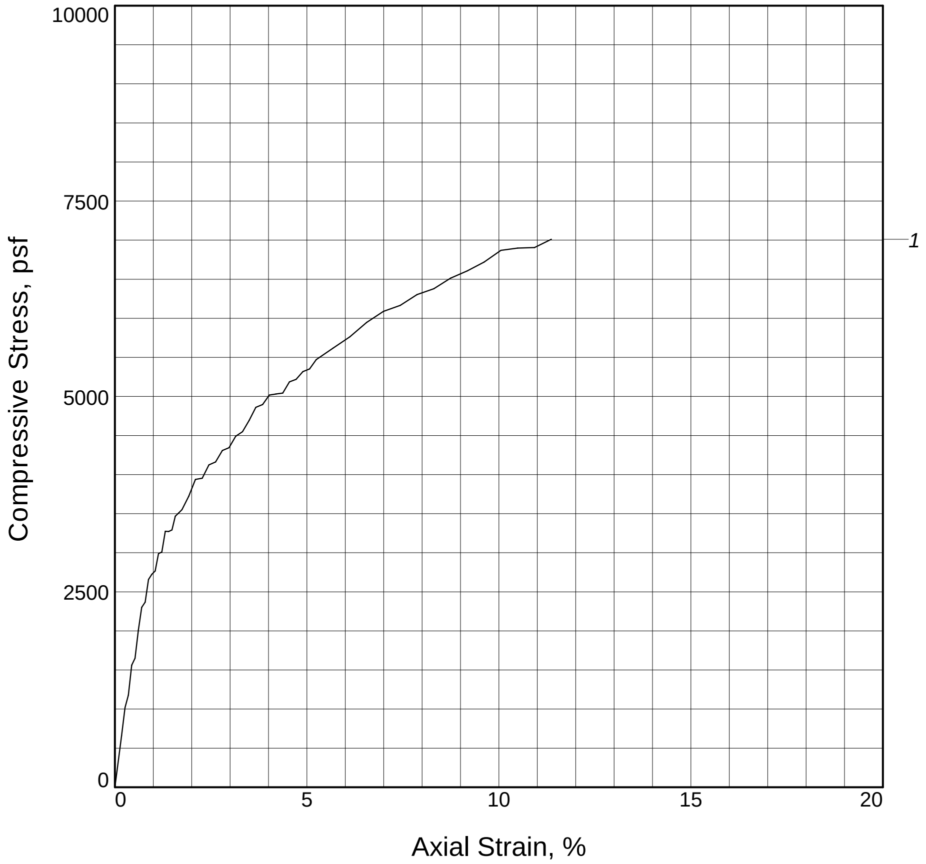
Project: New Residency & Maintenance Facility

Source of Sample: B-15 **Depth:** 3

Sample Number: C

STANDARD ENGINEERING + FIELD SERVICES

UNCONFINED COMPRESSION TEST



Stage	1			
Unconfined strength, psf	7012			
Undrained shear strength, psf	3506			
Failure strain, %	11.4			
Strain rate, in./min.	0.052			
Water content, %	11.8			
Wet density, pcf	136.0			
Dry density, pcf	121.7			
Saturation, %	86.9			
Void ratio	0.3595			
Specimen diameter, in.	2.84			
Specimen height, in.	5.72			
Height/diameter ratio	2.01			

Description: V. Moist, High Plasticity

LL = 46	**PL =** 15	**PI =** 31	**Assumed GS=** 2.65	**Type:**

Project No.: 2430-0704
Date Sampled:
Remarks:

Figure ________

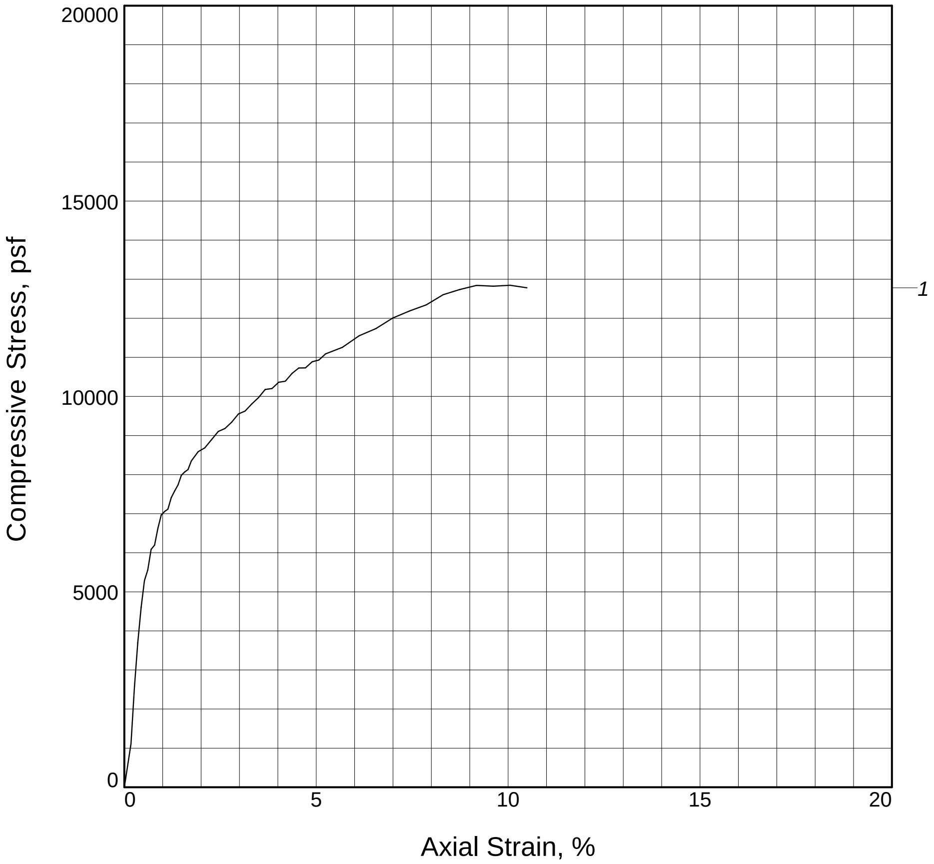
Client: Guernsey

Project: New Residency & Maintenance Facility

Source of Sample: B-17 **Depth:** 3
Sample Number: C

STANDARD ENGINEERING + FIELD SERVICES

UNCONFINED COMPRESSION TEST



Stage	1			
Unconfined strength, psf	12845			
Undrained shear strength, psf	6422			
Failure strain, %	10.1			
Strain rate, in./min.	0.052			
Water content, %	9.4			
Wet density, pcf	134.3			
Dry density, pcf	122.7			
Saturation, %	71.7			
Void ratio	0.3481			
Specimen diameter, in.	2.81			
Specimen height, in.	5.72			
Height/diameter ratio	2.04			

Description: Brn. to Reddish Brn.

LL =	**PL =**	**PI =**	**Assumed GS=** 2.65	**Type:**

Project No.: 2430-0704
Date Sampled:
Remarks:

Figure ________

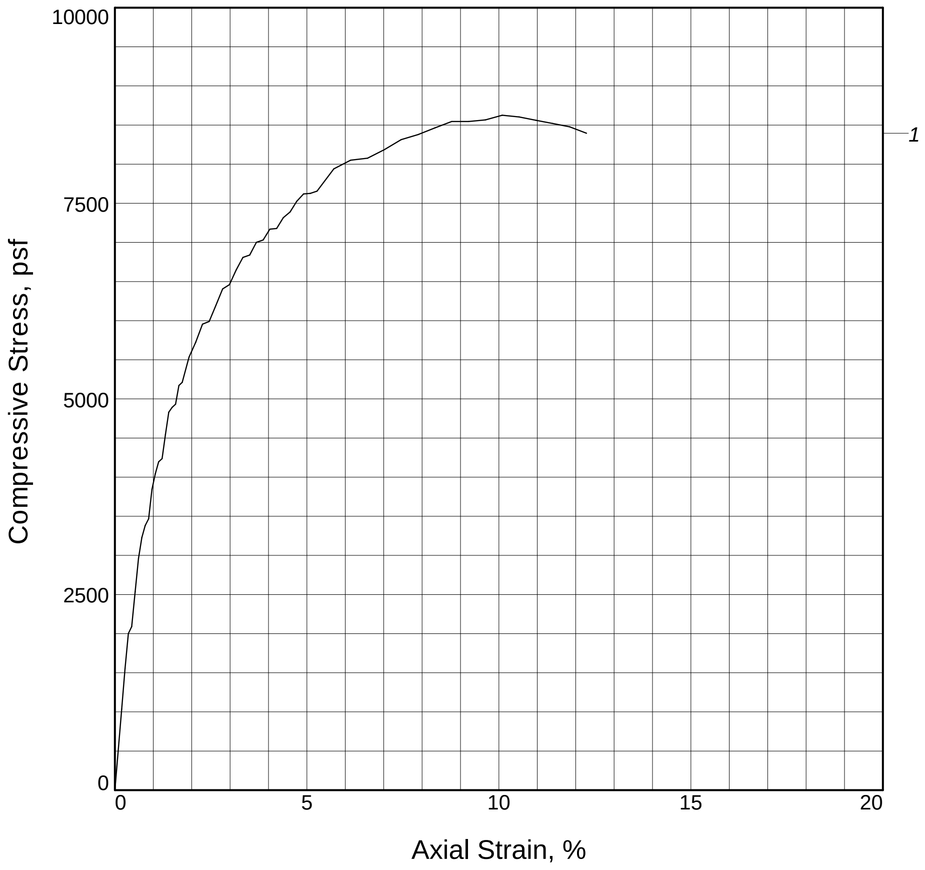
Client: Guernsey

Project: New Residency & Maintenance Facility

Source of Sample: B-18 **Depth:** 3
Sample Number: C

STANDARD ENGINEERING + FIELD SERVICES

UNCONFINED COMPRESSION TEST



Stage	1			
Unconfined strength, psf	8626			
Undrained shear strength, psf	4313			
Failure strain, %	10.1			
Strain rate, in./min.	0.052			
Water content, %	12.6			
Wet density, pcf	137.6			
Dry density, pcf	122.2			
Saturation, %	94.3			
Void ratio	0.3538			
Specimen diameter, in.	2.85			
Specimen height, in.	5.70			
Height/diameter ratio	2.00			

Description: Moist, High Plasticity

LL = 47 | **PL =** 17 | **PI =** 30 | **Assumed GS=** 2.65 | **Type:**

Project No.: 2430-0704
Date Sampled:
Remarks:

Figure ________

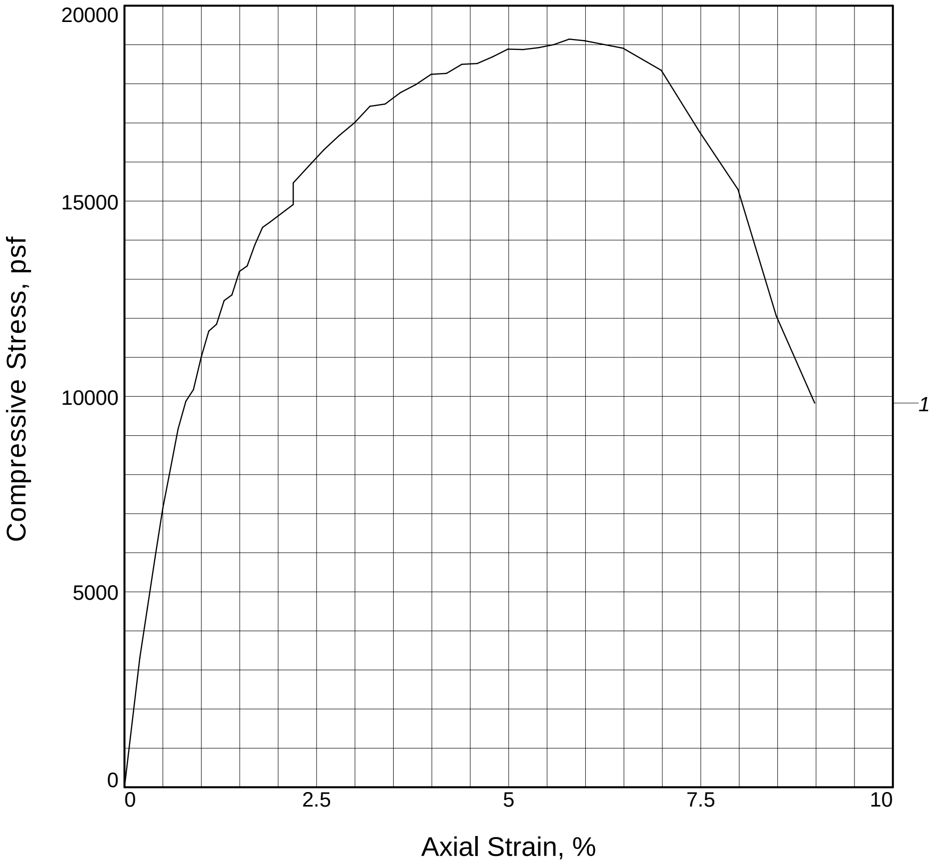
Client: Guernsey

Project: New Residency & Maintenance Facility

Source of Sample: B-20 **Depth:** 3
Sample Number: C

STANDARD ENGINEERING + FIELD SERVICES

UNCONFINED COMPRESSION TEST



Stage	1			
Unconfined strength, psf	19142			
Undrained shear strength, psf	9571			
Failure strain, %	5.8			
Strain rate, in./min.	0.052			
Water content, %	13.1			
Wet density, pcf	133.4			
Dry density, pcf	117.9			
Saturation, %	86.1			
Void ratio	0.4027			
Specimen diameter, in.	2.42			
Specimen height, in.	5.01			
Height/diameter ratio	2.07			

Description: Brn. to Reddish Brn.

LL =	**PL =**	**PI =**	**Assumed GS=** 2.65	**Type:**

Project No.: 2430-0704

Date Sampled:

Remarks:

Figure ________

Client: Guernsey

Project: New Residency & Maintenance Facility

Source of Sample: B-22 **Depth:** 3

Sample Number: C

STANDARD ENGINEERING + FIELD SERVICES

Report On: pH & Resistivity of Soils (AASHTO T-289 and ASTM G57)

Project Name: New Residency & Maintenance Facility
Project No.: 2430-0704
File ID:
Boring No.: B-1, B-2, B-3
Sample No.: Comp Bulk 1
Depth (ft): 0.0-5.0

Material Description:

pH Test (AASHTO T-289)

pH reading of sample in water	7.77

Resistivity Test (ASTM G57)

Resistance of Soil in Soil Box, Ohms	1200
Soil Box Geometric Factor	0.9683 cm
Resistivity of Soil, Ohms * cm	1162

Interpreted Corrosivity:

Moderately Corrosive

Report On: pH & Resistivity of Soils (AASHTO T-289 and ASTM G57)

Project Name: New Residency & Maintenance Facility

Project No.: 2430-0704

File ID:

Boring No.: B-4, B-5, B-6, B-18

Sample No.: Comp Bulk 2

Depth (ft): 0.0-5.0

Material Description:

pH Test (AASHTO T-289)

pH reading of sample in water	7.81

Resistivity Test (ASTM G57)

Resistance of Soil in Soil Box, Ohms	1250
Soil Box Geometric Factor	0.9683 cm
Resistivity of Soil, Ohms * cm	1210

Interpreted Corrosivity:

Moderately Corrosive

Report On: pH & Resistivity of Soils (AASHTO T-289 and ASTM G57)

Project Name: New Residency & Maintenance Facility

Project No.: 2430-0704

File ID:

Boring No.: B-7, B-8, B-9, B-19

Sample No.: Comp Bulk 3

Depth (ft): 0.0-5.0

Material Description:

pH Test (AASHTO T-289)

pH reading of sample in water	7.44

Resistivity Test (ASTM G57)

Resistance of Soil in Soil Box, Ohms	1060
Soil Box Geometric Factor	0.9683 cm
Resistivity of Soil, Ohms * cm	1026

Interpreted Corrosivity:

Moderately Corrosive

Report On: pH & Resistivity of Soils (AASHTO T-289 and ASTM G57)

Project Name: New Residency & Maintenance Facility

Project No.: 2430-0704

File ID:

Boring No.: B-10, B-11, B-12, B-13

Sample No.: Comp Bulk 4

Depth (ft): 0.0-5.0

Material Description:

pH Test (AASHTO T-289)

pH reading of sample in water	7.72

Resistivity Test (ASTM G57)

Resistance of Soil in Soil Box, Ohms	540
Soil Box Geometric Factor	0.9683 cm
Resistivity of Soil, Ohms * cm	523

Interpreted Corrosivity:

Moderately Corrosive

Report On: pH & Resistivity of Soils (AASHTO T-289 and ASTM G57)

Project Name: New Residency & Maintenance Facility
Project No.: 2430-0704
File ID:
Boring No.: B-14, B-15, B-16, B-17
Sample No.: Comp Bulk 5
Depth (ft): 0.0-5.0

Material Description:

pH Test (AASHTO T-289)

pH reading of sample in water	7.87

Resistivity Test (ASTM G57)

Resistance of Soil in Soil Box, Ohms	665
Soil Box Geometric Factor	0.9683 cm
Resistivity of Soil, Ohms * cm	644

Interpreted Corrosivity:

Moderately Corrosive

Report On: Determining Soluble Sulfate Content in Soil (OHD-L49)

Project Name: New Residency &
File ID:
Material:

Boring No.: B-1, B-2, B-3
Sample No.: Comp Bulk 1
Depth (ft): 0.0-5.0

Test Method: OHD L-49
Material Represented:

Mass of Air-Dried Sample Passing #10 Sieve (W_s): 5.08 g

Mass of Deionized Water Used in Slurry (W_w): 200.23 g

Average Colorimeter Reading (R): 1.3 ppm

Volume of Original Filtrate Used (V_f): N/A ml

Volume of Deionized Water Added to Filtrate (V_w): N/A ml

Colorimeter Reading on Diluted Filtrate (R_d): N/A ppm

$C = [R * (W_w / W_s)]$ or $[R_d * (W_w / W_s) * (V_f + V_w) / V_f]$

Sulfate Concentration in Air-Dry Soil, (C): 51 ppm

Report On: Determining Soluble Sulfate Content in Soil (OHD-L49)

Project Name: New Residency &

File ID:

Material:

Boring No.: B-4, B-5, B-6, B-18

Sample No.: Comp Bulk 2

Depth (ft): 0.0-5.0

Test Method: OHD L-49

Material Represented:

Mass of Air-Dried Sample Passing #10 Sieve (W_s): 5.33 g

Mass of Deionized Water Used in Slurry (W_w): 200.44 g

Average Colorimeter Reading (R): 1 ppm

Volume of Original Filtrate Used (V_f): N/A ml

Volume of Deionized Water Added to Filtrate (V_w): N/A ml

Colorimeter Reading on Diluted Filtrate (R_d): N/A ppm

$C = [R * (W_w / W_s)]$ or $[R_d * (W_w / W_s) * (V_f + V_w) / V_f]$

Sulfate Concentration in Air-Dry Soil, (C): 38 ppm

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Report On: Determining Soluble Sulfate Content in Soil (OHD-L49)

Project Name: New Residency &

File ID:

Material:

Boring No.: B-7, B-8, B-9, B-19

Sample No.: Comp Bulk 3

Depth (ft): 0.0-5.0

Test Method: OHD L-49

Material Represented:

Mass of Air-Dried Sample Passing #10 Sieve (W_s): 5.07 g

Mass of Deionized Water Used in Slurry (W_w): 200.7 g

Average Colorimeter Reading (R): 4 ppm

Volume of Original Filtrate Used (V_f): N/A ml

Volume of Deionized Water Added to Filtrate (V_w): N/A ml

Colorimeter Reading on Diluted Filtrate (R_d): N/A ppm

$C = [R * (W_w / W_s)]$ or $[R_d * (W_w / W_s) * (V_f + V_w) / V_f]$

Sulfate Concentration in Air-Dry Soil, (C): 158 ppm

Report On: Determining Soluble Sulfate Content in Soil (OHD-L49)

Project Name: New Residency &

File ID:

Material:

Boring No.: B-10, B-11, B-12, B-13

Sample No.: Comp Bulk 4

Depth (ft): 0.0-5.0

Test Method: OHD L-49

Material Represented:

Mass of Air-Dried Sample Passing #10 Sieve (W_s): 5.13 g

Mass of Deionized Water Used in Slurry (W_w): 200.16 g

Average Colorimeter Reading (R): 33.33 ppm

Volume of Original Filtrate Used (V_f): N/A ml

Volume of Deionized Water Added to Filtrate (V_w): N/A ml

Colorimeter Reading on Diluted Filtrate (R_d): N/A ppm

$C = [R * (W_w / W_s)]$ or $[R_d * (W_w / W_s) * (V_f + V_w) / V_f]$

Sulfate Concentration in Air-Dry Soil, (C): 1300 ppm

Report On: Determining Soluble Sulfate Content in Soil (OHD-L49)

Project Name: New Residency &

File ID:

Material:

Boring No.: B-14, B-15, B-16, B-17

Sample No.: Comp Bulk 5

Depth (ft): 0.0-5.0

Test Method: OHD L-49

Material Represented:

Mass of Air-Dried Sample Passing #10 Sieve (W_s): 5.13 g

Mass of Deionized Water Used in Slurry (W_w): 200.06 g

Average Colorimeter Reading (R): 5.67 ppm

Volume of Original Filtrate Used (V_f): N/A ml

Volume of Deionized Water Added to Filtrate (V_w): N/A ml

Colorimeter Reading on Diluted Filtrate (R_d): N/A ppm

$C = [R * (W_w / W_s)]$ or $[R_d * (W_w / W_s) * (V_f + V_w) / V_f]$

Sulfate Concentration in Air-Dry Soil, (C): 221 ppm