MSE of Kentucky, Inc.

Engineers/Architects/Planners

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Lexington,
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859-223-5694
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E-Mail: mseinc@mselex.com

Addendum No. 4
London-Laurel County Economic Development Authority
McDaniel Industrial Park Access Road Grade, Drain and Paving
Bid Date: August 25, 2025
Addendum Issue Date: August 22, 2025

The Contractor shall conform to the following changes, as same shall become binding upon the Contract to be issued in response to this invitation.

Specifications:

Item 1: Attached is the geotechnical report.

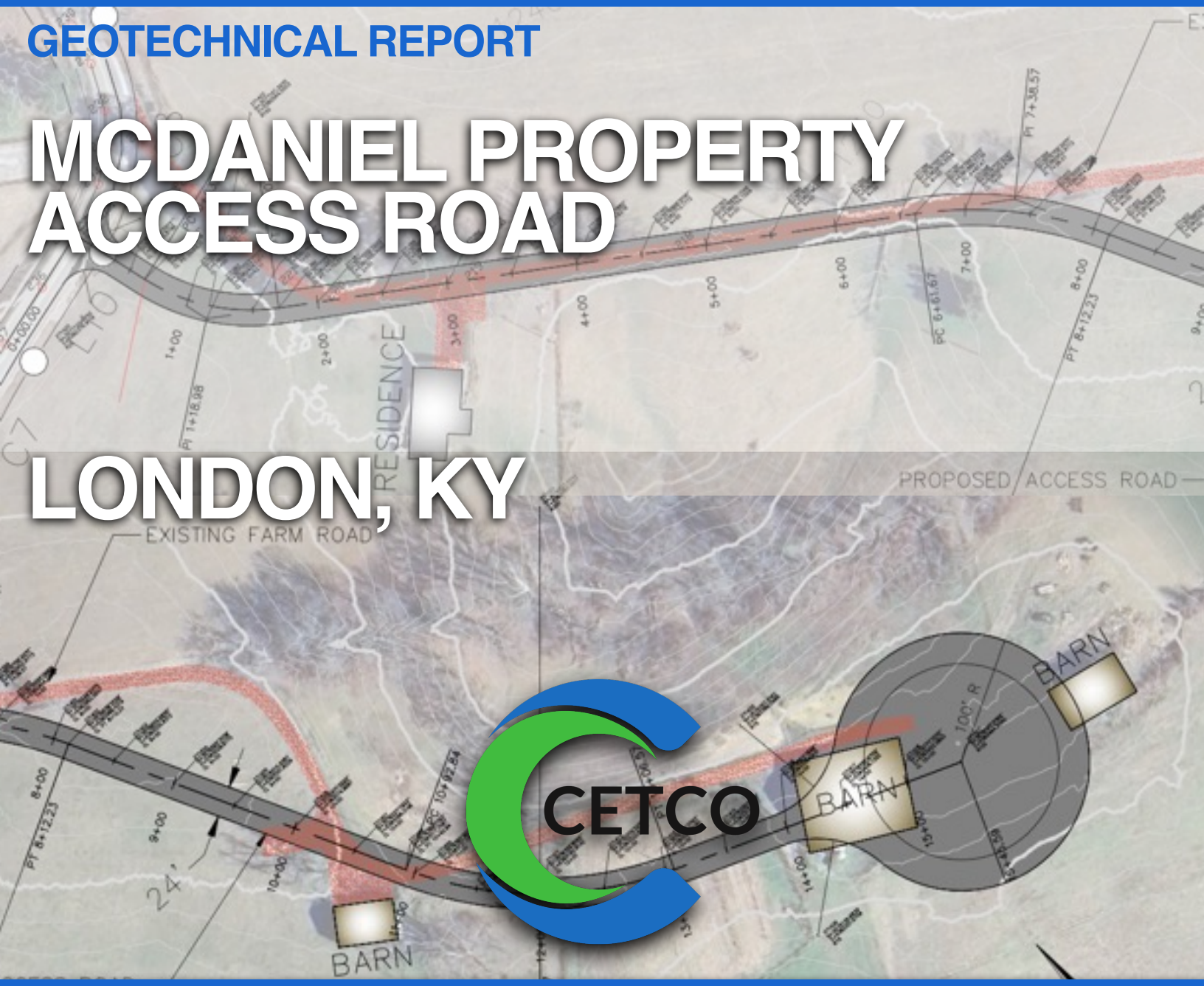
END OF ADDENDUM NO. 4

August 21, 2025

GEOTECHNICAL REPORT

MCDANIEL PROPERTY ACCESS ROAD

LONDON, KY



CETCO

Cooke Engineering and Testing Company

August 21, 2025

London-Laurel County Economic Development Authority
Sent to: Paula Thompson, Executive Director
via email: paula@lookatlondonky.com

Subject: **Geotechnical Report**
Proposed McDaniel Property Access Road
London, Laurel County, Kentucky
CETCO Project No. 1776-25-0139

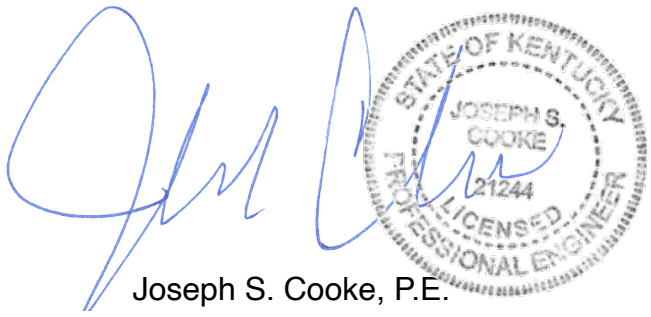
Dear Paula and the EDA Board:

CETCO appreciates the opportunity to provide our services to you and the Owner (London - Laurel County Economic Development Authority). As follows, we are providing our geotechnical report. Our services were provided in general accordance with our proposal number 1776-25-0361, dated, July 8, 2025. Also, please note the report appendix which contains many detailed findings as well as our standard of care for providing our services.

We appreciate the opportunity to provide our geotechnical services to you and the project team. Please do not hesitate to contact us for questions or comments about the information contained herein.

Cordially,

Hunter Hawkins, SI
Staff Geologist



Joseph S. Cooke, P.E.
Principal
Licensed KY 21244

Attachments: Geotechnical Report and Appendix
cc: Mr. Glen Ross, PE, with MSE

Cooke Engineering and Testing Company

TABLE OF CONTENTS

McDaniel Property Access Road

LONDON, KENTUCKY

GEOTECHNICAL REPORT SUMMARY

We provided our services in general accordance with our previous discussions and our proposal number 1776-25-0361, dated July 8, 2025 and approved by the your office on July 10. CETCO has consulted with the design engineer (MSE) and discussed the need for CETCO to provide geotechnical services including sampling and exploration with soil test borings, a site field services by our office, lab testing and analysis and providing a geotechnical report. These services included providing our opinion of the conditions encountered for the purpose of design and development of a vacant property into a proposed industrial access road for the property. The project plans may change. CETCO should be advised on any changes from the information presented in our report.

The site is located off of Sinking Creek Road on the west side of London, Kentucky. This introductory section, which has previously been discussed with your office, provides a brief summary for quick reference. The report that follows provides much greater details for design and construction purposes. In general, we encountered the typical, “thin” mostly brown lean clay found in London. No groundwater was encountered in the soil overburden or in our borings. Sandstone bedrock was encountered at about 4 to 12 feet deep at the site. The native clay soils were typically stiff.

The primary concerns for the site are the “normal” London, KY risks of: shallow bedrock and silty/sandy soils. Also, some wet conditions are expected at or near the top of the bedrock surface. Normal construction and planning practices of the London area are expected. Details for these issues and recommendations for design and construction as well as our other recommendations are discussed in the report.

We are providing guidance for each of these issues. Please review this report in detail, and please contact us to discuss any questions or additional information for the project or for our services and report.

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1 PROJECT BACKGROUND

1.1 CETCO SCOPE OF SERVICES

Our scope of services included conducting an exploration of the subsurface conditions for the proposed new industrial access road off of Sinking Creek Road. This including using eight (8) soil test borings, observing site and site area conditions and providing geotechnical analysis. We have completed our field work, analysis and we are issuing the geotechnical report as follows.

1.2 PROVIDED INFORMATION

Provided Document	Source
Site drawings show the access road for the proposed industrial site off of Sinking Creek Road.	MSE
Site specifications and 2 addendums from the MSE web site (bid documents)	MSE

Condition	Specifics
Access Road Information	An approximate 1,500 foot long road is planned off of Sinking Creek Road and leading east throughout the property to a planned cul-de-sac. There is an existing asphalt road that the “proposed” road will follow for approximately 700 feet. The proposed road will serve as an “industrial type” road with provided design thickness of 4 inches of asphalt pavement over 8 inches of compacted DGA gravel base.
Site Grading	The road is 24 foot wide asphalt road with 2 foot gravel shoulders on both sides. Mass grading shown on the drawings indicate areas of up to about 5 feet of cut and fill are expected.

If any of the aforementioned information is incorrect or requires modification, please let CETCO know. Changes to our reporting, recommendations and opinions may be required.

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1.3 PUBLISHED SITE AND AREA INFORMATION

We have reviewed the following published/public domain site information.

AREA TOPOGRAPHY AND PHYSIOGRAPHY

The site is located in the Eastern Kentucky Coal Field region of Kentucky. These areas can have resistant Pennsylvanian-age sandstones with steep and generally stable slopes, but also have soft, shale or siltstone bedrock areas with “unstable” slopes. These areas can have wooded mountainous slopes that are carved by ravines and steep valley bottoms typical of the Cumberland Mountains. This region is dissected by headstreams of the Kentucky and Cumberland Rivers and often contain, springs, entrenched rivers, and sinking streams. Elevations generally range from 1100 to 1300 feet in London, which is consistent with the site vicinity.

SITE GEOLOGY

The Kentucky Geologic Survey public information was reviewed including the USGS mapped geologic information for the site (the Bernstadt Geological Quadrangle). The site is underlain by the Breathitt Formation as well as the Corbin Sandstone Member of the Lee Formation. The Breathitt Formation at the site area is mapped as primarily shale, siltstone and sandstone with some minor coal beds. The Corbin Member is primarily sandstone, conglomerate (sandstone with shale mixtures) and shale. Shale and siltstone is primarily gray in coloring and the sandstone is commonly gray to buff, with pink weathering, and is fine to medium grained.

Mining: Historical mine mapping shows that previous strip and auger coal mining also occurred within close vicinity of the site locations, likely in the Colony Coal Bed (see geologic mapping on the next page, mapped just northwest of the site). Mining permits are on file with the commonwealth for nearby areas, but none are on file for the site and no active mining is listed as being on site or in the site vicinity. The primary coal zone/seam is the “Colony Coal Bed”.

Geologic mapping is shown on the following page.

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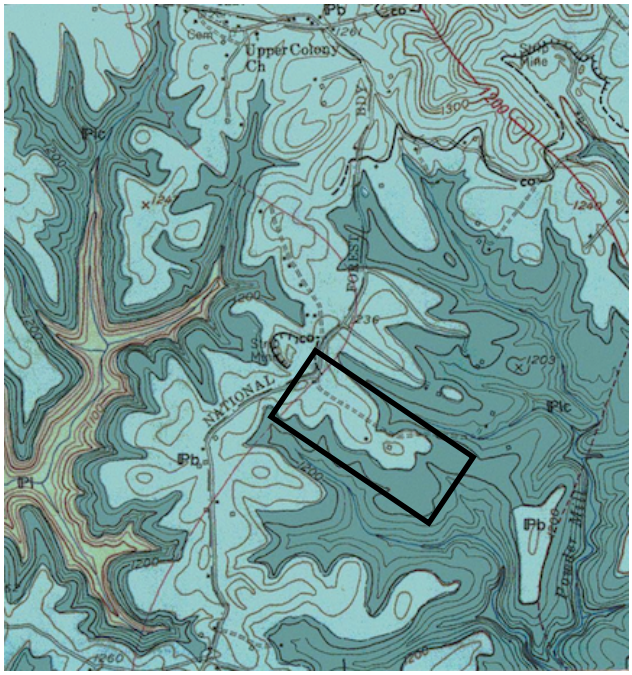
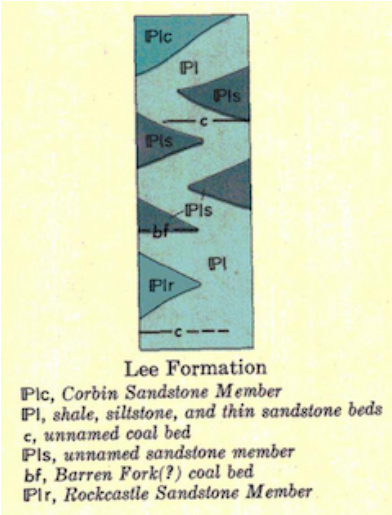
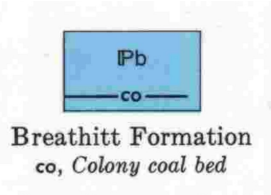
GEOLOGIC MAPPING



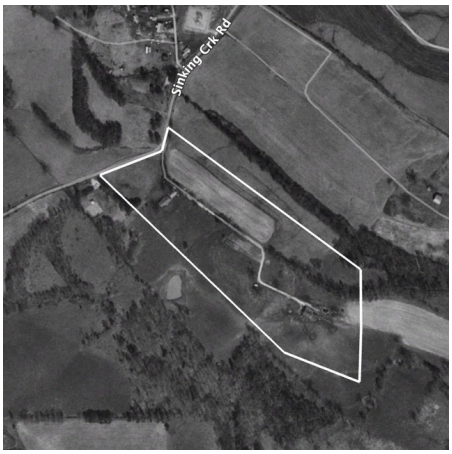
Geologic Mapping (from the KGS), with the site shown in the black rectangle.





AERIAL MAPPING

Aerial information back as far as 1997 was readily available for the site. Images below show site progression. Photo on the left is the aerial from 1997, showing undeveloped farm land with a few structures throughout the outlined area. The aerials suggests that majority of this property was used as farmland/pastureland. The road that runs through the central portion of the property is still showing in the most recent aerial. Throughout the remaining aerials, the site conditions appear to be very similar to current day. Please reference the pictures below.



1997: Aerial from Google Earth

2017: Aerial from Google Earth

2025: Aerial from Google Earth

SITE SOIL SURVEY MAPPING

The Soil Survey of the site area was also reviewed. Issues affecting the site development included: shrink-swell of soils, shallow depth to bedrock and slope construction. Shallow water is also common in the site area. We are providing recommendations to address these issues. According to the USDA-NCRS website, the soils underlying the site vicinity consist of at least 10 soil series. Depth to the water table for these soil series is generally listed at more than 200 inches, except for the Latham series. The majority series include: Whitley silt loam, Wallen-Clifftop complex, Lily fine sandy loam and Latham silt loam. Corrosion of concrete is listed as moderate for the site soils. This is usually controlled by having at least 3 inches concrete cover over reinforcing steel (i.e., additional concrete beyond the design required thickness).

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2 CETCO FINDINGS

We provided a site and area reconnaissance, logged soil test borings and explored the site using those boring with proximity to the proposed access road. The following sections discuss our findings. Mr. Hunter Hawkins, staff geologist, provided our field services including a site reconnaissance and logging of the borings in the field, during the exploration on August 1, 2025. Mr. Joe Cooke, PE, our Principal Engineer, also observed site conditions and recovered soil samples.

2.1 CURRENT SITE SURFACE CONDITIONS AND OBSERVATIONS

The site is located off of Sinking Creek Road, where there is a single lane asphalt road that leads through the property. The overall property is a broad “ridge top” going northwest to southeast. The corresponding hillsides slope gradually downward to drain into the nearby Powder Mill Creek. In recent months, the private residence near the existing entrance has been “razed” and removed and minimal evidence of construction materials was observed. The barns at the end of the road have been demolished, however there is one concrete slab and some construction debris remaining. The proposed road station numbers were flagged during our time onsite. Station 01+00 is in the grassy field west of the existing road, where it meets up around Station 03+00 and follows along the road until approximately Station 08+00 where it crosses into an open grassy field before meeting back up with the asphalt road. The road turns into a “gravel” road around Station 11+00. The proposed cul-de-sac area is where the barns were demolished on the far east end.

Several utility lines were marked within and near the site area including: overhead electric and buried gas. The grassy cover was recently mowed within about 30 feet of the existing paved road, but higher (waist to neck high) grasses and weeds were present beyond.

The ground surface appeared to be “firm” and did not appreciably rut under the weight of the drill rig during our drilling operations. The existing pavement had minimal to no cracking.

The following page shows photos of the area at the time of our field work.

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Project Photos

Description	Photo
Showing example view of Sinking Creek Road on the left side of the image and the existing paved entrance on the right side of the image. Facing north. Also a recent sewer and gas line were installed that follows the right side of Sinking Creek Road shown where the arrows are.	
Example showing the new gas line that runs near the proposed entrance. The black arrow represents Station 0+00 for the proposed road. The yellow arrow represents the gas line. Facing west.	

Description	Photo
Example view taken from station 01+00 facing east towards the existing road.	
Example view taken from station 05+00 along the road. Also approximate location of B-6. Facing east.	

Description	Photo
Example view of B-4 location where the proposed road is in an open grassy field. Facing east.	
Example view of Station 10+00 and station 11+00 where the drill rig is located. This located is where the paved road meets the gravel road. Facing east.	

Description	Photo
Example view showing the barn has been demolished and the concrete pad.	
Example view showing Station 15+00 and B-1 location. Some scattered construction debris is left behind where one of the barns was demolished. Facing west.	

2.2 SUBSURFACE INFORMATION SUMMARY

A total of eight (8) soil boring tests were utilized to explore the subsurface conditions at the site. The borings were drilled in locations to provide an indication of the site subsurface conditions with proximity to the proposed new access road for the industrial park. The boring location plan in the appendix shows the approximate drilling locations.

SUBSURFACE CONDITIONS: At our sampling locations, we encountered native soils, that were generally brown to grayish orange in coloring (with typically an upper strata and a lower strata), overlying weathered pink sandstone bedrock. Shale was encountered in one boring. Below is a table summarizing the soil conditions at the site. Detailed findings are in the Appendix boring logs and laboratory testing pages.

Strata	Thickness	Notes
Topsoil:	Typically 4 to 8 inches.	
Fill: One boring showed previously placed fill: sampled as silty clay with some construction debris, “slightly moist” and “stiff”.	3 feet	B-1 only (previous barn location)
Upper Strata of Native Soils: mostly silty lean clay, of various brown shades of coloring. Some orange coloring was observed in isolated areas. The soils were generally “moist” and “stiff”.	About 2 to 6 feet on average.	
Lower Strata of Native Soils: mostly silty clay, brownish orange in coloring with some hard sandstone and siltstone lenses. The soils were generally “slightly moist” and “very stiff to hard”.	About 1 to 3 feet on average	
Bedrock: Sandstone	N/A	7 of 8 borings observed
Bedrock: Shale	N/A	1 of 8 borings observed

BEDROCK CONDITIONS: Auger refusal was encountered in all borings. Auger refusal is interpreted at the top of harder sandstone bedrock. In all of our borings, we also encountered “soft” bedrock above this elevaiton. The tables below show depth to bedrock.

Boring Number	Depth to top of Soft Bedrock (ft.)	Depth to Auger Refusal (AR, ft.)
B-1	9.5	10.4
B-2	3.2	9.1
B-3	4.7	10.1
B-4	4.5	5.3

Boring Number	Depth to top of Soft Bedrock (ft.)	Depth to Auger Refusal (AR, ft.)
B-5	4.2	7.4
B-6	2.7	4.2
B-7	3.0	4.1
B-8	6.5	13.9

GROUNDWATER CONDITIONS: Borings did not encounter wet or free water conditions at completion of drilling. However, the soil survey and our site/area experience suggest that shallow wet or water conditions can occur at the site. This is especially the case at or near the top of bedrock and in low-lying areas of the site.

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3 OPINIONS AND DISCUSSION

SUMMARY: In general, the project site is suitable for the proposed new road development and site improvements.

3.1 PRIMARY GEOTECHNICAL ISSUES

The following issues are our opinion of the primary geotechnical-related issues at the site. Other issues are likely present, but we believe the following represent the greatest impact to the project budget, schedule, design and construction. Our recommendations address these issues.

- Shallow depth to bedrock
- Silty and Sandy Soils
- Previous Roadway Construction
- Shrink-Swell of Clay Soils

Shallow Depth to Bedrock

Our borings encountered the top of hard bedrock from 4 feet to 12 feet deep across the site. Softer bedrock was present just above these depths (see the tables on page 12 as well as our boring logs in the appendix). This upper “soft” bedrock shown on the logs can have zones that are rip-able with a large dozer’s rip blade and in some cases can be removed with a large excavator. However, excavations at or near the auger refusal depths will encounter resistant (hard) sandstone bedrock which may require “rock removal” techniques such as blasting or hoe-ramming to remove.

Silty and Sandy Soils

The site and site areas soils are “silty” and can have “sandy” pockets. These soils can the appearance of pumping and rutting, despite being stable. The soils also have a relatively low CBR (near 2). This means they behave poorly (unstable) when wet of optimum moisture content. **Construction during wet seasons (winter and spring months) of the year should be avoided.** An earthwork contractor and geotechnical engineer with experience in Laurel County is a must to avoid unnecessary undercutting and earthwork costs.

Deeper excavations (utility lines, storm structures, etc.) will require means of sidewall stabilization while excavating and the use of trench boxes due to the sandy soil conditions. Also, sandy pockets can tend to hold small water tables/wet zones.

Previous Roadway Construction / Building Demolition

Several areas of previous site improvements/development were present at the site. This includes: a private residence near the property entrance (reportedly removed sometime between 2023 and present day), at least 2 barns just east of the paved road, about 3 feet of previously placed fill was observed at the B-1 location, as well as the remaining slab at the east end of the road and the existing single lane asphalt road. **These disturbed areas will require removal of all former site improvements, the existing roadway and existing building remnants. Wet pockets of soil as well as isolated areas of "darker" (urban disturbed soils) should be expected. These will also require removal.**

Shrink-Swell of Clay Soils

Most of the soil on-site has a low to moderate potential for swelling and shrinkage due to the moderate plasticity of the soil (fat clay soil). Means to limit this potential include a strict moisture control of the soils during mass fill placement/earthwork and slab subgrade preparation. Also, maintaining the construction schedule to avoid final paving placement during the hottest/driest times of the year (typically avoiding July, August and September) is a prudent means to limit "drying" of the soil subgrade prior slab placement. It should be noted that no wide-spread reported "heaving or swelling" issues have been reported in the area.

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4 RECOMMENDATIONS

The following recommendations are provided to assist in the planning, design and construction of the project.

4.1 SITE PREPARATION

We recommend that site grading should take place between about late April to early November. The site soils are silty, with a relatively low CBR value and the site is prone to have some shallow water conditions. These are indicative of very poor (expensive and slow) earthwork and sub grade construction conditions. Earthwork taking place outside this time period will likely encounter wet conditions and weather conditions that will provide little to no assistance with drying the soils.

Additionally, the following bulleted items are critical to prepare the site for earthwork and additional construction.

- Topsoil and organic materials should be removed (stripped) from the construction area and all structural fill areas. These materials should be wasted from the site or used as topsoil in landscape areas;
- Former building remnants, all site improvements and the asphalt from the existing single lane road should be removed. The existing pavement gravel may remain in place.
- Areas ready to receive new fill should be proofolled with a loaded dump truck or similar equipment judged acceptable by CETCO;
- The site soils have a relatively low CBR. **This, along with area experience, suggest that the soils perform poorly when wet of optimum. Proofrolling should not be performed on wet subgrade. If possible, perform proof rolls after suitable dry weather periods of time**;
- **Some undercutting of low-lying areas, especially during wet periods of the year, should be expected. The area also likely has "thicker" topsoil**;
- CETCO should determine amounts of undercutting (if any) for any area which pumps or ruts. CETCO should also determine acceptable backfill materials and backfill methods. In general any backfill should be accomplished in general accordance with section 4.2;
- Remove deleterious materials or materials that are unsuitable for use in supporting the overlying new fill. The backfill should be consistent with the requirements listed in section 4.2;

- CETCO should observe the proofrolling operations and make recommendations for any unstable or unsuitable conditions encountered.

4.2 EARTHWORK

Before new fill construction, representative samples should be obtained of the proposed fill material to determine the moisture-density and overall classification of the material. The tests also would assist in determining if the material is suitable for use as structural fill.

We are providing the following recommendations for any mass earthwork/filling. After the subgrade has been approved to receive new fill, the fill may commence with the following procedures and guidelines recommended:

Mass Earthwork

- Based on our observations and laboratory testing, the on-site soils appear to be suitable for use as structural fill;
- Fill placement guidelines:
    - Structural fill should be placed in maximum 8-inch thick loose lifts;
    - Maximum particle size of the soil should be limited to 8 inches in any dimension;
    - Materials should have a plasticity index (PI) of less than 25.
- Quality control testing guidelines:
    - Density testing of newly placed clay soils should be performed. The rate of testing should be at least 3 per lift and at least one per 10,000 square feet of soil placement. Soil should be compacted to at least **95 percent** of standard Proctor (ASTM D698) maximum dry density. **Moisture content should be from minus 3 to plus 1 percent of optimum moisture content (range is such due to silty soils on site)**;
    - Soil should never be placed “dry” (dusty). CETCO should observe fill placement to determine acceptable soil moisture;
- Observation of fill “stability” is critical. The roller and earthwork equipment traversing over the new fill should be observed to document minimal movement occurs. This includes sheepsfoot roller action observed to ensure the compactor is “walking out” of each lift;
- CETCO should observe and document fill placement and compaction operations.

Backfill Construction

These materials are placed in more confined areas than mass earthwork materials and therefore cannot be placed in full compliance with the previous recommendations. The following are general recommendations for backfill areas:

- Gravel/granular materials are recommended for confined fill areas;
- Fill lift thicknesses will vary dependent on compaction equipment available and material types, but in no case should exceed 8 inches;
- For crushed stone/aggregate backfills in trenches or wall backfill, the lift thickness should not exceed 4 inches;
- Observation of stability and moisture should be similar to those mentioned previously;
- CETCO should provide addition recommendations for backfill.

Again, we recommend that site grading be started in the period from about late April to about November in order to prevent additional undercutting due to wet conditions. Drying of the site soils during other portions of the year is typically difficult.

Slopes

We have assumed that no large slopes (those greater than 10 feet high or steeper than 2H:1V) are planned. If such large slopes are planned, CETCO should be contacted for additional recommendations. A slope stability analysis may be needed. Such analysis was beyond our scope of services. However, in general, soil slopes should be no steeper than 3H:1V.

Site Drainage

Site drainage (water flow into, along and from the site) is key to minimize damaging effects of water flow. Excess water ponding can destabilize soils. Excessive water flow can erode soils and destabilize soils, especially at or near slopes.

For shallow groundwater seepage (less than 5 feet deep or so), the water encroaching upon construction excavations can be removed by placing a sump near the source of seepage and then pumping from the sump. Should heavy seepage occur, or should there be evidence of soil particle migration such as silting of the sump, then the geotechnical engineer should be contacted.

The following are general guidelines for site drainage.

- For all earthwork operations, positive surface drainage is prudent to keep water from ponding on the surface and to assist in maintaining surface stability;
- The surface should be sealed prior to expected wet weather. This can usually be accomplished with rubber-tired construction equipment or a steel-drum roller;
- During construction, water should not be allowed to pond in excavations or undercutting will likely be required;
- Diversion ditches should be used at the toe of all slopes to keep surface water from accumulating at or near site structures;
- For excavations during construction, most free water from the subsurface conditions could likely be removed via sump pumps and open channel flow (ditches) at or near the source of seepage. However, if normal dewatering measures prove insufficient, CETCO should be retained to provide recommendations on the issue;
- Due to possible shallow water conditions, dewatering (or drying) means such as aeration of soils or the use of french drains (rock-lined trenches) for draining wet areas may be needed;

4.3 PAVEMENT RECOMMENDATIONS

The new road will be minimally used until industrial development occurs. At that time, the road would be used for various “industrial park” traffic. This includes anticipated larger amounts of tractor trailers.

The subsurface conditions on-site include some areas of “old fill” and previously developed areas. Former improvements and construction remnants should be removed. This includes the existing single lane paved road (asphalt). The underlying gravel may remain in place.

Adequate soil/subgrade support is critical for any pavement area. Please refer the Earthwork section of this report for subgrade preparation. Prior to stone base placement we recommend an additional proofroll of the subgrade should be performed to verify subgrade conditions. Recommendations for undercutting/repair of the subgrade can be made at that time by CETCO. Again, the site sub grade construction/grading should take place during drier portions of the year (typically summer or fall).

We have tested the site soils and have calculated a CBR of from 2 to 3 for the soil conditions. We have also assumed a 15 year life with the “relatively low” EAL.

Adequate drainage and slope of the pavement subgrade and pavement section should be provided to promote adequate drainage. Roads and shoulders should have sufficient slopes and grading to minimize water ponding.

Recommended Pavement Sections

We understand that the typical pavement section for industrial type roads (4 inches of asphalt and 8 inches of compacted DGA stone base) is proposed. We believe that this section is adequate for the intended usage. However, if wet weather occurs during construction or wet conditions are encountered, the soils will become unstable and some amount of soil stabilization will be required. This is typically select undercutting and replacement with stone, the use of geogrid or the use thicker pavement sections in those unstable areas.

4.4 POST-REPORT GEOTECHNICAL CONSULTING

CETCO services as “geotechnical engineer of record” include answering questions pertaining to the materials presented in this report and the appendix. However, if conditions arise during construction that are different than those encountered during our exploration or if additional recommendations are needed, CETCO should be retained to provide that guidance. Construction observation and testing are beyond the typical scope of the geotechnical engineer, but are essential to completing the geotechnical engineer’s anticipated completion of their recommendations. CETCO should always be contracted as the testing/inspection firm for any project that applies their geotechnical report information. This always saves time, risk and project costs.

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5 NOTES ON THE REPORT

The assessment of site environmental conditions or the presence of contaminants in the soil, rock, surface water or groundwater of the site was beyond the scope of this exploration.

The recommendations provided are based in part on project information provided to us and they only apply to the specific project and site discussed in this report. If the project information section in this report contains incorrect information or if additional information is available, you should convey the correct or additional information to us and retain us to review our recommendations. We can then modify our recommendations if they are inappropriate for the proposed project.

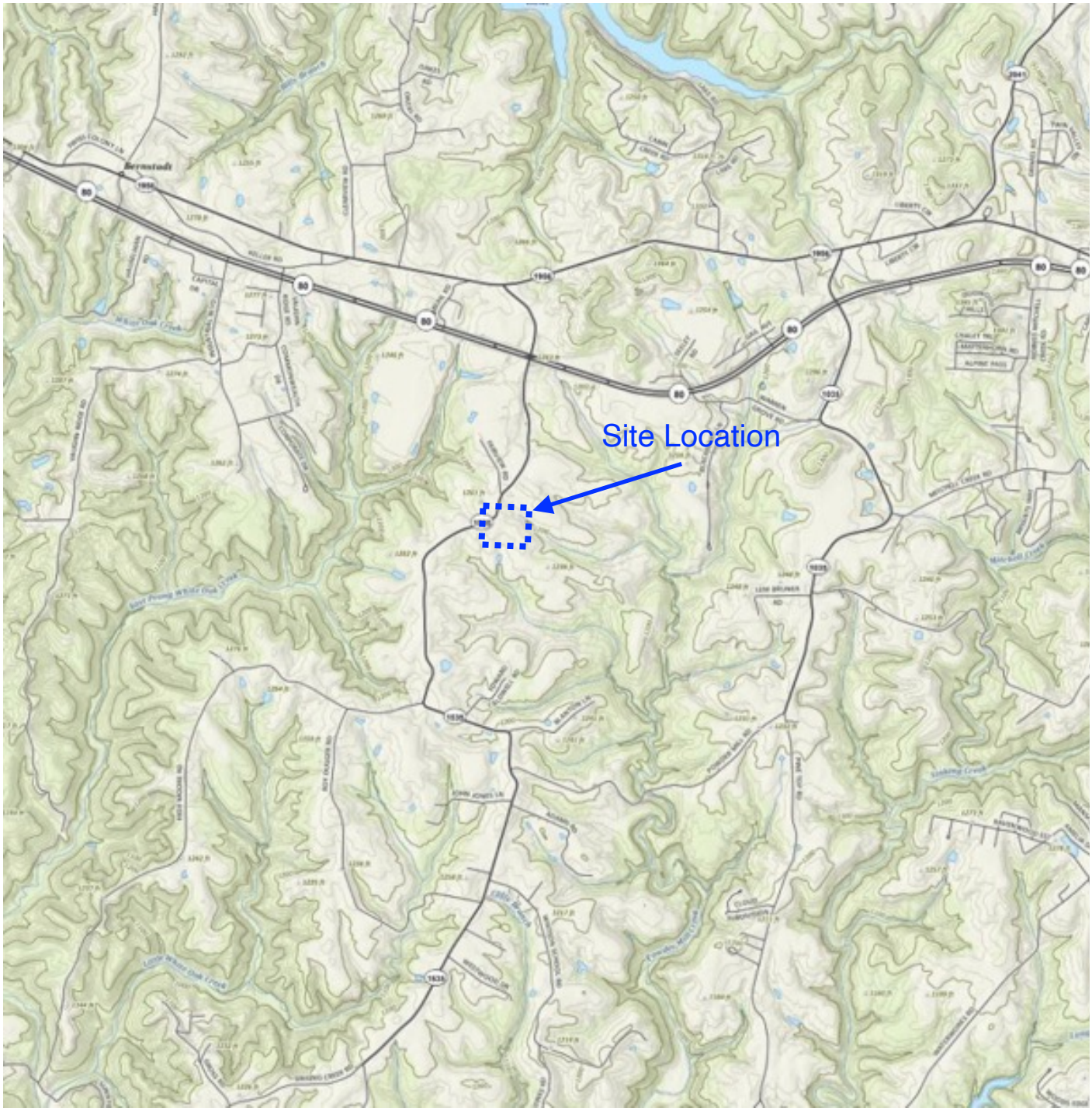
Regardless of the thoroughness of a geotechnical exploration, there is always a possibility that conditions between borings/test pits will be different from those at specific boring/test pit locations and that conditions will not be as anticipated by the designers or contractors. In addition, the construction process may itself alter soil conditions. Therefore, experienced geotechnical personnel should observe and document the construction procedures used and the conditions encountered. Unanticipated conditions and inadequate procedures should be reported to the design team along with timely recommendations to solve the problems created. We recommend that the owner retain CETCO to provide this service based upon our familiarity with the project, the subsurface conditions and the intent of the recommendations.

We recommend that this complete report be provided to the various design team members, the contractors and the project owner. Potential contractors should be informed of this report in the "instructions to bidders" section of the bid documents. The report should not be included or referenced in the actual contract documents.

We wish to remind you that our exploration services include storing the samples collected and making them available for inspection for 30 days. The samples are then discarded unless you request otherwise.

APPENDIX

SITE LOCATION PLAN
BORING LOCATION PLAN
TEST BORING LOGS
FIELD STANDARDS
LABORATORY TESTING
LABORATORY STANDARDS



Site location plan adapted from Kentucky Geological Survey, with further adaptations from CETCO professionals.

N

CETCO, PLLC
624 Wellington Way
Lexington, KY 40515
859.475.3933
www.cetcopllc.com

SITE LOCATION PLAN
for McDaniel Property
Access Road

London, Kentucky

CETCO Project: 1776-25-0139
Date: July 14, 2025
Drawn by: Mason Ross
Checked by: Joe Cooke, PE
Drawing: 1 of 1

Legend

- **Boring B-X**
- **10' Contour**
- **2' Contour**

Boring location plan adapted from Google Earth and GeoSync, with further adaptations from CETCO professionals. Drilling locations were collected on-site using GPS equipment

This work product represents only generalized locations of features, objects or boundaries, and should not be relied upon as being legally authoritative for the precise location of any feature, object or boundary.

N

CETCO,PLLC
624 Welllington Way
Lexington, KY 40503
859.475.3933
www.cetcopllc.com

BORING LOCATION PLAN

For McDaniel Property Access Road
London, KY

CETCO Project #: 1776-25-0139
Date: August 4, 2025
Drawn by: Hunter Hawkins
Checked by: Joe Cooke, PE
Drawing: 1 of 1
Scale: NTS

CETCO
624 Wellington Way
Lexington, KY 40503
Telephone: 859-475-3933

BORING NUMBER B-1

CLIENT London-Laurel EDA
PROJECT NAME McDaniel Property Access Road
PROJECT NUMBER 1776-25-0139
PROJECT LOCATION London, Kentucky
DATE STARTED 8/1/25 **COMPLETED** 8/1/25
GROUND ELEVATION 1234 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Cloudy, 70s
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0.0		Previously Placed FILL: Sampled as brown LEAN CLAY (CL), with few gravel, slighlt moist, STIFF	SPT S-1	33	5-7-7 (14)		
			SPT S-2	50	6-7-10 (17)		
2.5		Brownish orange LEAN CLAY (CL), silty, moist, VERY STIFF					
			SPT S-3	100	10-15-25 (40)		
5.0		Brownish orange LEAN CLAY (CL), with some interbedded siltstone lenses, slightly moist, HARD into VERY STIFF					
			SPT S-4	100	9-12-16 (28)		
7.5							
			SPT S-5	100	11-21-50/3"		
10.0		Brownish orange SILTSTONE, SOFT					
		Pink weathered SANDSTONE					

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

>>

Refusal at 10.1 feet.
Bottom of borehole at 10.4 feet.

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CETCO
624 Wellington Way
Lexington, KY 40503
Telephone: 859-475-3933

BORING NUMBER B-2

CLIENT London-Laurel EDA
PROJECT NAME McDaniel Property Access Road
PROJECT NUMBER 1776-25-0139
PROJECT LOCATION London, Kentucky
DATE STARTED 8/1/25 **COMPLETED** 8/1/25
GROUND ELEVATION 1233 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Cloudy, 70s
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0.0		TOPSOIL (8")					
		Brown LEAN CLAY (CL), silty, moist, FIRM	SPT S-1	100	1-3-4 (7)		
		Brownish orange LEAN CLAY, silty, slightly moist, VERY STIFF	SPT S-2	94	3-5-19 (24)		
2.5		Pink and tan SANDSTONE lens					
		Brownish tan slightly layered SILTSTONE, with some interbedded SANDSONE lenses, SOFT	SPT S-3	100	16-13-19 (32)		
5.0							
			SPT S-4	100	8-12-18 (30)		
7.5							
		Tan SANDSTONE	SPT S-5	200	5/1"		

Refusal at 9.1 feet.
Bottom of borehole at 9.1 feet.

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

CETCO
624 Wellington Way
Lexington, KY 40503
Telephone: 859-475-3933

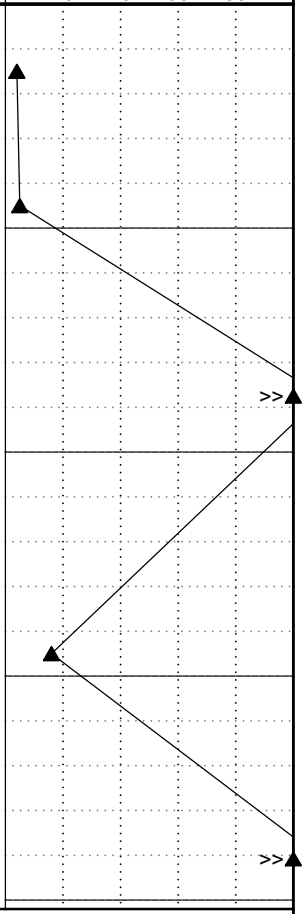
BORING NUMBER B-3

CLIENT London-Laurel EDA
PROJECT NAME McDaniel Property Access Road
PROJECT NUMBER 1776-25-0139
PROJECT LOCATION London, Kentucky
DATE STARTED 8/1/25 **COMPLETED** 8/1/25
GROUND ELEVATION 1237 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Cloudy, 70s
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0.0		TOPSOIL (10")	SPT S-1	100	2-3-1 (4)		
		Brown to dark brown LEAN CLAY (CL), silty, with trace organics, slightly moist to moist, SOFT					
		Brown LEAN CLAY (CL), silty, with trace fine sand, moist, FIRM	SPT S-2	61	1-2-3 (5)		
2.5							
		Tan and orange SILTY SAND (SM), with few sandstone lenses, VERY DENSE	SPT S-3	100	23-50/3"		
5.0		Tan and orange SANDSTONE lens					
		Brownish orange and gray slightly layered SILTSTONE, SOFT					
7.5			SPT S-4	100	5-5-11 (16)		
			SPT S-5	100	12-20-50/1"		
10.0		Tan SANDSTONE					

Refusal at 10.1 feet.
Bottom of borehole at 10.1 feet.

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80



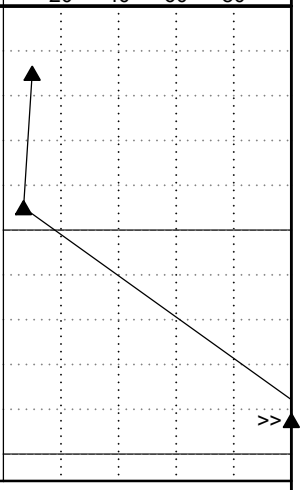
CETCO
624 Wellington Way
Lexington, KY 40503
Telephone: 859-475-3933

BORING NUMBER B-4

CLIENT London-Laurel EDA
PROJECT NAME McDaniel Property Access Road
PROJECT NUMBER 1776-25-0139
PROJECT LOCATION London, Kentucky
DATE STARTED 8/1/25 **COMPLETED** 8/1/25
GROUND ELEVATION 1244 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Cloudy, 70s
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0.0		TOPSOIL (5")					
		Brown LEAN CLAY (CL), with trace fine organics, slightly moist, STIFF	SPT S-1	100	3-5-5 (10)		
		Brownish orange LEAN CLAY (CL), silty, with few red sandstone inclusions, slightly moist, FIRM	SPT S-2	100	4-3-4 (7)		
2.5							
		Brownish orange and gray SANDY LEAN CLAY (CLS), with some pink sandstone lenses, moist, VERY STIFF	SPT S-3	100	6-45-50/3"		
5.0		Pink and orange weathered SANDSTONE					
		Refusal at 5.3 feet. Bottom of borehole at 5.3 feet.					

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80



CETCO
624 Wellington Way
Lexington, KY 40503
Telephone: 859-475-3933

BORING NUMBER B-5

CLIENT London-Laurel EDA
PROJECT NAME McDaniel Property Access Road
PROJECT NUMBER 1776-25-0139
PROJECT LOCATION London, Kentucky
DATE STARTED 8/1/25 **COMPLETED** 8/1/25
GROUND ELEVATION 1240 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Cloudy, 70s
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0.0		TOPSOIL (7")					
		Brown LEAN CLAY (CL), silty, with trace fine organics, slightly moist, STIFF	SPT S-1	94	2-4-5 (9)		
2.5		Brownish orange LEAN CLAY, silty, with trace fine sand, slightly moist, STIFF	SPT S-2	100	2-4-10 (14)		
		Brownish orange SANDY LEAN CLAY (CLS), with gray silty lenses, moist, STIFF					
		Pink and tan SANDSTONE lens	SPT S-3	100	50/5"		
5.0		Tan and orange SILTY SAND (SM), with interbedded sandstone lenses, slightly moist, VERY DENSE					
			SPT S-4	100	25-50/5"		
		Brownish red SANDSTONE					

Refusal at 4.4 feet.
Bottom of borehole at 7.4 feet.

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

>>
>>

CETCO
624 Wellington Way
Lexington, KY 40503
Telephone: 859-475-3933

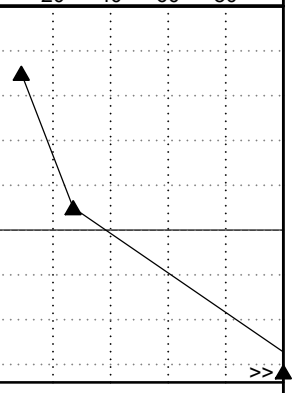
BORING NUMBER B-6

CLIENT London-Laurel EDA
PROJECT NAME McDaniel Property Access Road
PROJECT NUMBER 1776-25-0139
PROJECT LOCATION London, Kentucky
DATE STARTED 8/1/25 **COMPLETED** 8/1/25
GROUND ELEVATION 1242 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Cloudy, 70s
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0.0		TOPSOIL (5")					
		Brown LEAN CLAY (CL), silty, with trace fine organics and gravel, slightly moist, STIFF	SPT S-1	83	3-6-3 (9)		
2.5		Brownish orange LEAN CLAY (CL), silty, with trace sandstone lenses, slightly moist, VERY STIFF	SPT S-2	89	5-9-18 (27)		
		Pink and tan SANDSTONE lens					
		Brownish red SANDSTONE	SPT S-3	100	50/2"		

Refusal at 4.2 feet.
Bottom of borehole at 4.2 feet.

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80



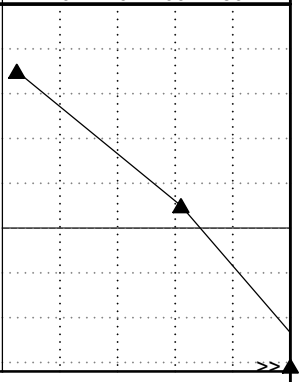
CETCO
624 Wellington Way
Lexington, KY 40503
Telephone: 859-475-3933

BORING NUMBER B-7

CLIENT London-Laurel EDA
PROJECT NAME McDaniel Property Access Road
PROJECT NUMBER 1776-25-0139
PROJECT LOCATION London, Kentucky
DATE STARTED 8/1/25 **COMPLETED** 8/1/25
GROUND ELEVATION 1246 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Cloudy, 70s
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0.0		TOPSOIL (1")					
		Brown LEAN CLAY (CL), silty, with trace fine organics and gravel, slightly moist, FIRM	SPT S-1	94	2-3-2 (5)		
		Brown LEAN CLAY (CL), silty, with few red streaks, slightly moist to moist, STIFF					
2.5		Brownish orange SANDY LEAN CLAY (CLS), slightly moist, VERY STIFF	SPT S-2	89	8-12-50 (62)		
		Pink and tan SILTY SAND (SM) with some interbedded sandstone lenses, slighty moist, VERY DENSE					
		Tan and pink SANDSTONE	SPT S-3	1800	50/1"		
		Refusal at 4.1 feet.					
		Bottom of borehole at 4.1 feet.					

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80



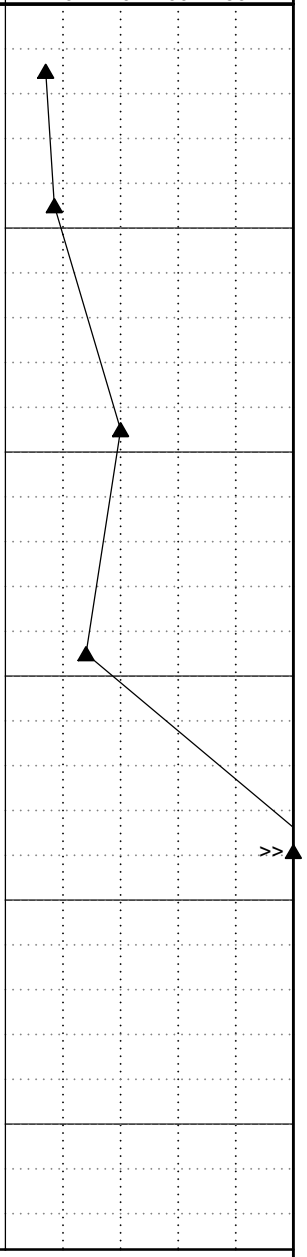
CETCO
624 Wellington Way
Lexington, KY 40503
Telephone: 859-475-3933

BORING NUMBER B-8

CLIENT London-Laurel EDA
PROJECT NAME McDaniel Property Access Road
PROJECT NUMBER 1776-25-0139
PROJECT LOCATION London, Kentucky
DATE STARTED 8/1/25 **COMPLETED** 8/1/25
GROUND ELEVATION 1251 ft **HOLE SIZE** 4
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Hunter Hawkins **CHECKED BY** Joe Cooke, PE
AT END OF DRILLING --- Dry upon completion of drilling
NOTES Cloudy, 70s
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0.0		TOPSOIL (10")	SPT S-1	100	5-7-7 (14)		
		Previously Placed FILL: Sampled as dark brown LEAN CLAY (CL), with few organics, moist to very moist, STIFF					
2.5		Brownish orange and gray LEAN CLAY (CL), with few red inclusions, moist, VERY STIFF into HARD	SPT S-2	94	6-7-10 (17)		
5.0			SPT S-3	100	10-15-25 (40)		
7.5		Brownish gray slightly layered SILTSTONE, SOFT	SPT S-4	100	9-12-16 (28)		
10.0		Brownish gray slightly layered SILTSTONE, SOFT to MEDIUM HARD	SPT S-5	100	11-21-50/0"		
12.5		Gray weathered SHALE					

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80



Refusal at 13.9 feet.
Bottom of borehole at 13.9 feet.

Cooke Engineering and Testing Company

Laboratory Testing Summary Table

Project Name:	McDaniel Access Road	Date:	August 18, 2025
Project Location:	London, Kentucky	Reviewed by:	Joe Cooke, PE
Client:	London-Laurel EDA	CETCO Project Number:	1776-25-0139

Sample ID	Depth (ft)	Natural Moisture Content (%)	Liquid Limit	Plastic Limit	Percent Passing #200 (%)	CBR	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
P-1 (at B-4)	1-4	19.0	47	23	86.3	2.1	106.8	17.6
B-2	0.0-1.5	13.7						
B-2	1.5-3.0	12.5						
B-2	4.0-5.5	18.5	40	22	78.2			
B-2	6.5-8.0	21.4						
B-4	0.0-1.5	13.5						
B-4	1.5-3.0	20.5						
B-4	4.0-5.3	13.0						
B-6	0.0-1.5	12.7						
B-6	1.5-3.0	13.0						
B-8	0.0-1.5	15.8						
B-8	1.5-3.0	16.4						
B-8	4.0-5.5	17.4						
B-8	6.5-8.0	19.5						

Cooke Engineering and Testing Company

Atterberg Limits Chart

Project Name:	McDaniel Access Road	Date:	July 15, 2025
Project Location:	London, Kentucky	Reviewed by:	Joe Cooke, PE
Client:	London-Laurel EDA	CETCO Project Number:	1776-25-0139
		“Atterberg Limits”, ASTM D4318	

Sample ID	Depth (ft)	Natural Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	% Finer than #200 Sieve
P-1, 1’-4’ (at B-4) ▲	1-4	19.0	47	23	24	86.3
B-2, 4.0’-5.5’ ★	4.0-5.5	18.5	40	22	18	78.2

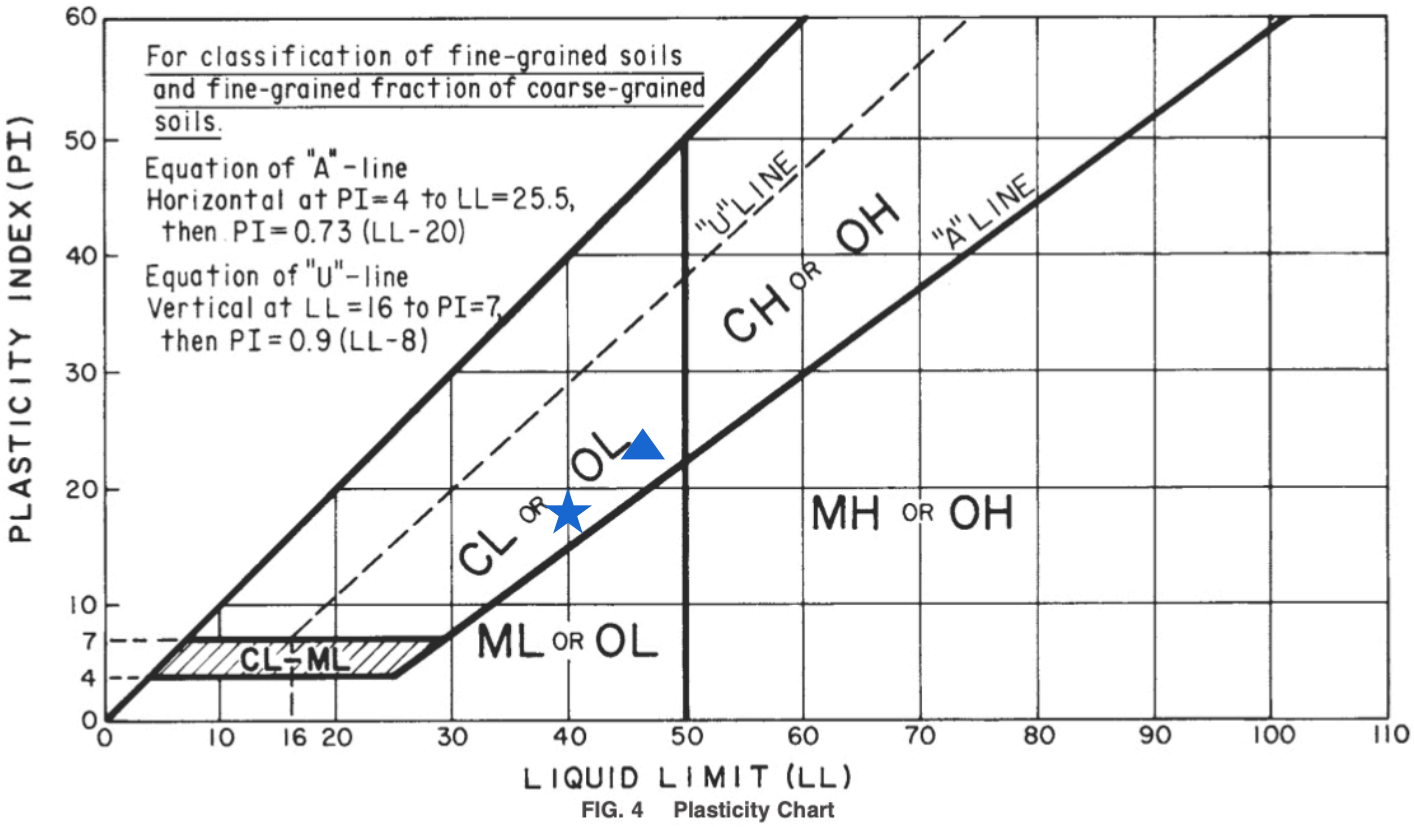


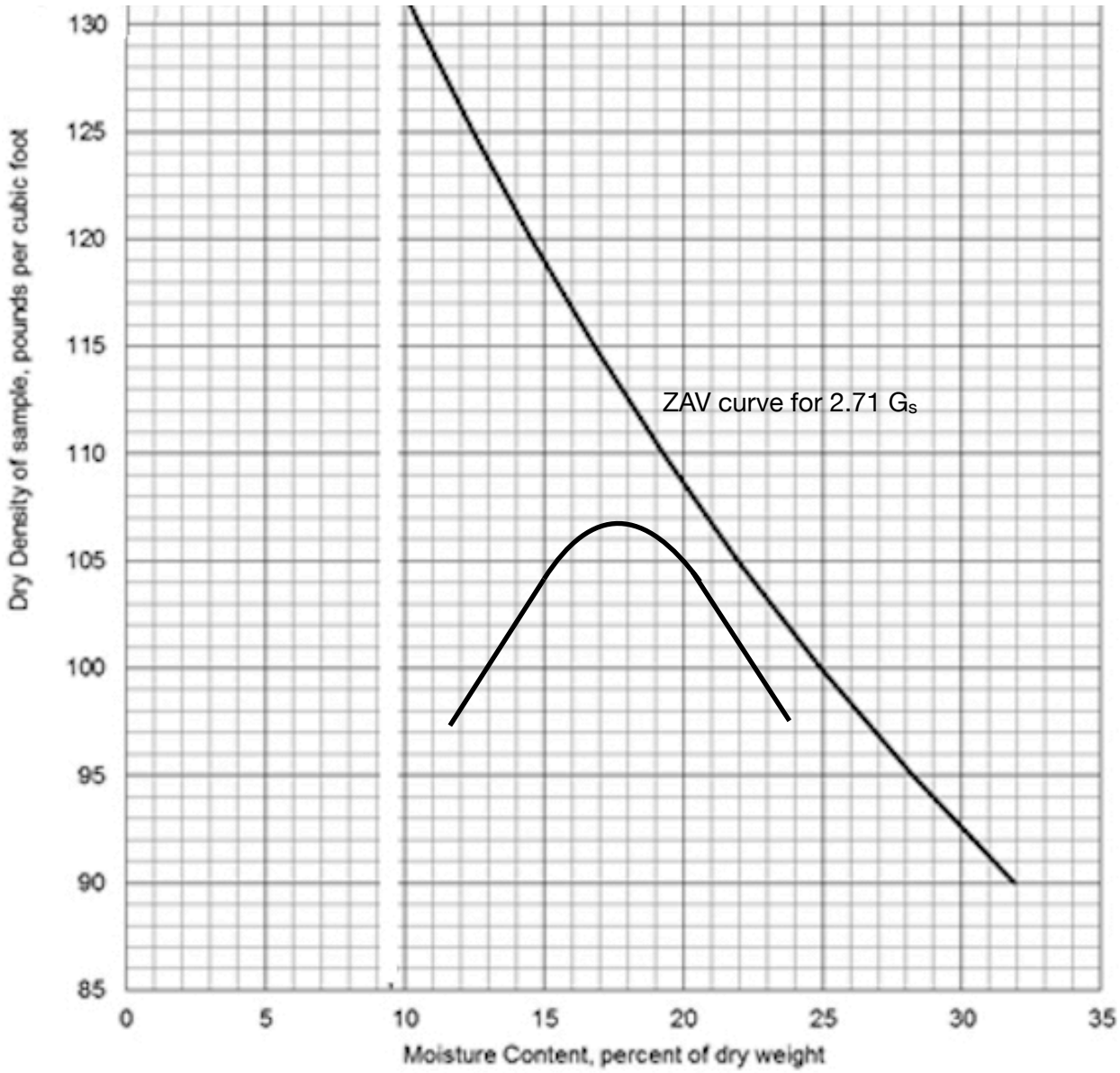
FIG. 4 Plasticity Chart

Cooke Engineering and Testing Company

Moisture-Density (“Proctor”) Sheet

Project Name:	McDaniel Access Road	Date:	August 14, 2025
Project Location:	London, Kentucky	Reviewed by:	Joe Cooke, PE
Client:	London-Laurel EDA	CETCO Project Number:	1776-25-0139
Yellow Brown Lean Clay with Fine Sand (CL)		“Proctor”, ASTM D698-A	

Sample ID	Natural Moisture Content (%)	Liquid Limit (%)	Plasticity Index	Maximum Dry Density (pcf)	Optimum Moisture Content (%)	% Finer than #200 Sieve
P-1, 1’-4’ (at B-4)	19.0	47	24	106.8	17.6	86.3



LABORATORY STANDARDS AND PROCEDURES

Soil Classification: Soil classifications provide a general guide to the engineering properties of various soil types and enable the engineer to apply past experience to current problems. In our investigations, samples obtained during drilling operations are examined in our laboratory and visually classified by an engineer. The soils are classified according to consistency (based on number of blows from standard penetration tests or “by hand” stiffness), color and texture. These classification descriptions are included on our "Boring Logs” or “Test Pit Logs”

The classification system discussed above is primarily qualitative and for detailed soil classification two laboratory tests are necessary: grain size tests and plasticity tests. Using these test results the soil can be classified according to the AASHTO or Unified Classification Systems (ASTM D2487). Each of these classification systems and the in-place physical soil properties provides an index for estimating the soil's behavior. The soil classification and physical properties obtained are presented in this report.

Atterberg Limits: Portions of the samples are taken for Atterberg Limits testing to determine the plasticity characteristics of the soil. The plasticity index (PI) is the range of moisture content over which the soil deforms as a plastic material. It is bracketed by the liquid limit (LL) and the plastic limit (PL). The liquid limit is the moisture content at which the soil becomes sufficiently "wet" to flow as a heavy viscous fluid. The plastic limit is the lowest moisture content at which the soil is sufficiently plastic to be manually rolled into tiny threads. The liquid limit and plastic limit are determined in accordance with ASTM D4318.

Moisture Content: The Moisture Content is determined according to ASTM D2216.

Percent Finer Than 200 Sieve: Selected samples of soils are washed through a number 200 sieve to determine the percentage of material less than 0.074 mm in diameter.

“Proctor” (Moisture-Density Test): Often called by it’s original author’s name, the “Proctor” test is a moisture-density relationship test to determine “maximum dry density” and “optimum moisture content” curves using a set amount of force of “compaction” at variable moisture contents in a pre-determined mold size. The test is typically ASTM D698, method A, for standard effort. For a “modified” effort (higher amount of force), ASTM D 1557, again method A, is usually used. Due to high amounts of clay as well as typical compaction construction equipment used, the standard Proctor (ASTM D698) is the most common method used. For materials with larger grain sizes, methods B, C and D of each ASTM method can be used.

CBR: California Bearing Ratio (CBR) testing is often performed on soils to assist in pavement design. The test involves compacting soil into an approximate “0.075 cubic foot” volume at specified density and moisture content and then soaking the compacted sample with a surcharge weight (for a time period of usually at least 96 hours). Then, the sample is “loaded” using a fixed strain penetration piston and the penetration resistance and stress is recorded (as stress in pounds per square inch-psi) at 0.1 inches and 0.2 inches penetration. The resistant stress is then compared (as a “ratio”) to the standard resistant stress, hence the value is reported as unit-less. The test is typically conducted in general accordance with ASTM D1883.

Rock Strength Tests: To obtain strength data for rock materials encountered, unconfined compression tests are performed on selected samples. In the unconfined compression test, a cylindrical portion of the rock core is subjected to increasing axial load until it fails. The pressure required to produce failure is recorded, corrected for the length to diameter ratio of the core and reported.

FIELD SERVICES STANDARDS AND PROCEDURES

Field Operations: The general field procedures employed by CETCO are summarized in ASTM D420 which is entitled "Investigating and Sampling Soils and Rocks for Engineering Purposes." This recommended practice lists recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical, in situ methods and test pits as well as borings.

Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the subsurface conditions. These techniques typically include:

a. Continuous 2-1/2 or 3-1/4 inch I.D. hollow stem augers;
b. Wash borings using roller cone or drag bits (mud or water);
c. Continuous flight augers (ASTM D 1425).

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

The subsurface conditions encountered during drilling are reported on a field test boring record by our field personnel (typically engineers). The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soils in general accordance with the procedures outlined in ASTM D2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designating the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

The detailed data collection methods using during this study are discussed on the following pages.

Soil Test Borings: Soil test borings were made at the site at locations shown on the attached Boring Plan. Soil sampling and penetration testing were performed in accordance with ASTM D1586.

The borings were made by mechanically twisting a hollow stem steel auger into the soil. At regular intervals, the drilling tools were removed and soil samples obtained with a standard 1.4 inch I.D., 2 inch O.D., split tube sampler. The sampler was first seated 6 inches to penetrate any loose cuttings, then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot was recorded and is designated the "penetration resistance". The penetration resistance, when properly evaluated, is an index to the soil strength and foundation supporting capability.

Representative portions of the soil samples, thus obtained, were placed in glass jars and transported to the laboratory. In the laboratory, the samples were examined to verify the driller's field classifications. Test Boring Records are attached which graphically show the soil descriptions and penetration resistances.

Core Drilling: Refusal materials are materials that cannot be penetrated with the soil drilling methods employed. Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Prior to coring, casing is set in the drilled hole through the overburden soils, if necessary, to keep the hole from caving. Refusal materials are then cored according to ASTM D2113 using a diamond-studded bit fastened to the end of a hollow

double tube core barrel. This device is rotated at high speeds, and the cuttings are brought to the surface by circulating water. Core samples of the material penetrated are protected and retained in the swivel-mounted inner tube. Upon completion of each drill run, the core barrel is brought to the surface, the core recovered is measured, the samples are removed and the core is placed in boxes for storage.

The core samples are returned to our laboratory where the refusal material is identified and the percent core recovery and rock quality designation is determined by a soils engineer or geologist. the percent core recovery is the ratio of the sample length obtained to the depth drilled, expressed as a percent. The rock quality designation (RQD) is obtained by summing up the length of core recovered, including only the pieces of core which are four inches or longer, and dividing by the total length drilled. The percent core recovery and RQD are related to soundness and continuity of the refusal material. Refusal material descriptions, recoveries, and RQDs are shown on the "Test Boring Records".

Water Level Readings: Water table readings are normally taken in conjunction with borings and are recorded on the "Boring Logs". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of the hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The time of boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using an electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Rock Classification: Rock classifications (if any) provide a general guide to the engineering properties of various rock types and enable the engineer to apply past experience to current situations. In our explorations, rock core samples obtained during drilling operations are examined in our laboratory and visually classified by an engineer. The rock cores are classified according to relative hardness and RQD (see Guide to Rock Classification Terminology), color, and texture. These classification descriptions are included on our Boring Records.

Test Pits: Occasionally, our field sampling includes the use of “test pits”. Similarly to soil test borings, our classifications on the materials observed and sampled are performed in general accordance with ASTM standards. These excavations are performed by excavators of various sizes and the width/length/depth of the excavations vary as well. Typically, only the soil or “loose” rock areas can be sampled or excavated. The samples taken are usually taken at highly variable depths and the engineer or field personnel have extreme discretion on the sample sizes and locations. These are typically sealed in “zip lock” type baggies and transported back to our office for lab testing and further classification. Visual descriptions of rock materials (sand, gravel, cobbles, boulders, etc.) are provided on both samples taken and observations of spoils removed and sides of excavations. Typically, photos of both the mass excavation and spoil pile are provide on the test pit logs in our reports. Groundwater levels are noted and can include water flow at the excavation bottom or at points of depth in the excavation sides. “Refusal” usually means that the excavator cannot remove additional materials at the excavation bottom. Some excavations may also have very large boulders than cannot be removed by the excavator used. Depths indicated on the logs are usually measured with steel tape or cloth tape. Final complete details of the test pit findings and opinions are provided in the “Test Pit Logs” in our reports. Lastly, test pit excavations have no set standards and are performed at our engineers discretion.

Field and Lab Procedures