March 14, 2023

GEOTECHNICAL REPORT

CORBIN CENTER EXPANSION

CORBIN, KY

CETCO

Cooke Engineering and Testing Company

March 14, 2023

Mr. Marlon Sams, City Manager
City of Corbin
via email: sams@corbin-ky-gov

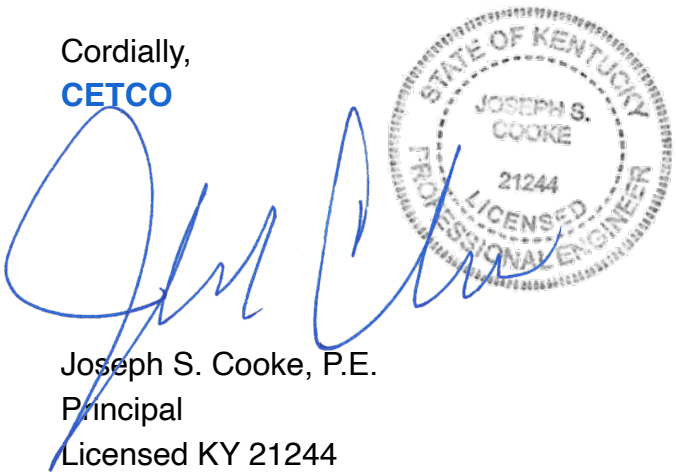
Subject: **Geotechnical Report**
Proposed Corbin Center Expansion
222 Corbin Center Drive, Corbin, Kentucky
CETCO Project No. 1776-23-0112

Dear Mr. Sams:

CETCO appreciates the opportunity to provide our services to you and the Owner (City of Corbin and Corbin EDA). As follows, we are providing our geotechnical report. Our services were provided in general accordance with our proposal number CET 1776-23-0175, dated, January 16, 2023. 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,
CETCO



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

Attachments: Geotechnical Report and Appendix

Cooke Engineering and Testing Company

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The Corbin Center Expansion

CORBIN, KENTUCKY

GEOTECHNICAL REPORT SUMMARY

We provided our services in general accordance with our previous discussions and our proposal number 1776-23-0175, dated - January 27, 2022 and approved by the your office on the same date. CETCO has consulted with your office and discussed the need for CETCO to provide geotechnical services including sampling and exploration with soil borings, a site field services by our office and analysis and providing a geotechnical report. These services included providing our opinion of the conditions encountered for the purpose of design and development vacant land adjacent to The Corbin Center into a potential expansion. The project plans are in the initial stages, and may change. CETCO should be advised on any changes from the information presented in our report. The site is located off of Corbin Center Drive in Corbin, Kentucky. Potential concept plans indicate the addition will be located on the west side of the existing building. The construction will match the existing building type and will be single story with a slab-on-grade floor and shallow spread footings. 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 a relatively thin layer of previously placed fill (derived from both former strip mining operations and the existing building construction) overlying shale and sandstone bedrock (a strip mine bedrock bench). No groundwater was encountered in the fill overburden or in our borings. Soft to medium hard, shale and sandstone bedrock was encountered at about 3 to 5 feet deep at the site. The fill materials, can likely support the new building addition, but **each footing excavation bottom must be thoroughly inspected** for “firm or better” bearing conditions and any soft areas should be undercut down to firm or better material.

Again, the site is suitable for the development. We believe shallow spread footings can be used for most single story building types. Conventional slab-on-grade floors would also be suitable for most new building types. The primary concerns for the site are: relatively shallow rock conditions, the mine spoil fill and potential shallow wet conditions (especially at or near the southern site areas). Mostly normal construction and planning practices of the Corbin area

are expected. Details for these issues and recommendations for design and construction as well as our other recommendations are discussed in the report.

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 expansion site. This including using soil borings to identify the depth of the strip mine bench, 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

We were provided information for the project as follows:

Provided Document	Source
Site drawings are in the “concept” stage. The provided sketch shows the potential footprint/building layout on the site for the new addition.	MSE of Lexington

The following information summarizes our understanding of the project conditions

Condition	Specifics
Building/Structure Information	The building will likely be at least 135 x 145 feet in size and will be single story. The framework will likely be a slab-on-grade floor, with stud walls/joist roofing and some masonry wall framing.
Site Grading	The site is relatively flat. Less than 2 feet of cut or fill is expected.
Foundations/Floor Slabs	At this stage in the project, foundation loading conditions have been assumed as: less than 25 kips for any isolated columns and less than 3 kips per linear foot for continuous footings. Floor slab loading would be expected to be less than 250 pounds per square foot.

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.

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 “Cumberland Plateau”, of the Eastern Kentucky Coal Field region of Kentucky. The Cumberland Plateau areas can have resistant Pennsylvanian-age sandstones with steep and generally stable slopes, but also have soft, shale 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. This region is also known for coal mining, where there are several coal seams mapped near the site.

SITE GEOLOGY

The Kentucky Geologic Survey public information was reviewed including the USGS mapped geologic information for the site (the Corbin and Viox Geological Quadrangles). The site is mapped as being underlain by gray shades of shale and siltstone and yellowish gray sandstone. These can have layers of clay shale materials. Coal seams, including the blue and little blue gem seams, area mapped in the area. The site has been previously mined, primarily by contour (strip) mining methods. The upper seams (above the site elevations) were also auger mined. Based on the mapping, the little blue gem seam is likely the portion mined at or near the site elevations. This would indicate possible bench elevations for the strip mine bench at or near the existing site elevations and a hollow fill area west of the site of at least 30 feet deep. The image below (next page) shows the site geology:

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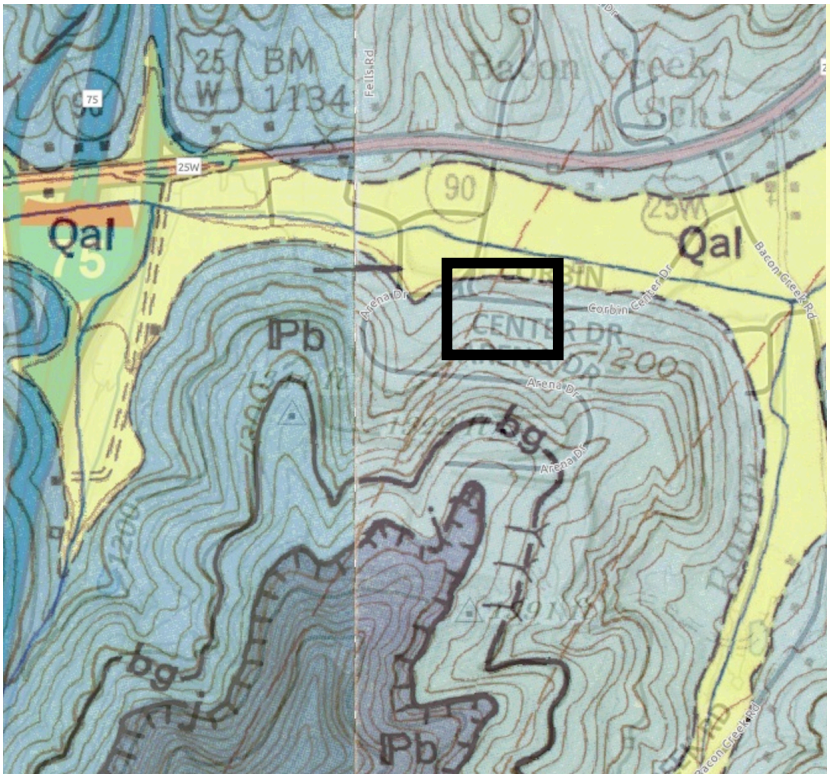

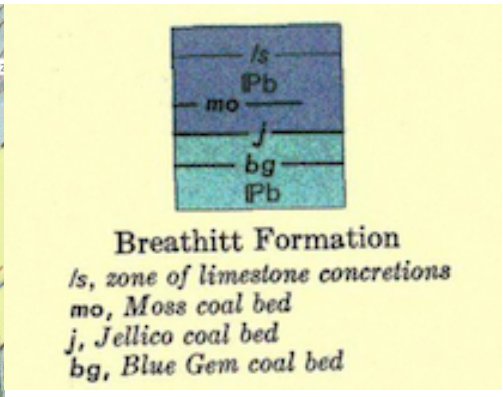

Image from the KGS website for geologic units: Site location is the black rectangle.

AERIAL MAPPING

Aerial information back as far as 1997 was readily available for the site. The mapping shows that the site was under construction starting in 2004 through 2008. In 2010, the Corbin Center building and roads were developed. Since the 2010 aerial, the the site has minimal changes. The 2021 aerial shows the site conditions as they appear today.

2006 : Aerial from Google Earth

2008 : Aerial from Google Earth

2021 : Aerial from Google Earth

SITE SOIL SURVEY MAPPING

The Soil Survey of the site area was also reviewed. Most of the conditions discussed in the soil survey are not relevant to the project due to the strip mining activities “re-grading” and “removing” almost all soil.

2 CETCO FINDINGS

We provided a site and area reconnaissance, logged 8 soil borings and explored the site using those borings. The borings were located to assist in verifying both the depth and location of the strip mine bench (i.e., top of bedrock). The following sections discuss our findings. Mr. Joe Cooke, PE, and Mr. Hunter Hawkins, provided our field services including a site reconnaissance and logging of the borings in the field, during the exploration on February 2, 2023. We also drilled an additional 8 borings on the site immediately to the west, to further identify the depth and edge of the strip mine bench.

2.1 CURRENT SITE SURFACE CONDITIONS AND OBSERVATIONS

The overall gravel lot adjacent to the existing building is about 2 to 2½ acres in size and consists of a somewhat “flat” area, mostly covered in quarried gravel. Steep wooded uphill slopes are located on the southern edge and a moderate uphill brush-covered slope on the western edge of the overall gravel lot. A rock high wall slope is located immediately on the southern edge behind the existing building. The addition area is entirely on the the flat gravel area. The top of ground appeared to be very hard with no obvious movement under the weight of a loaded tractor trailer (our drill rig and hauling truck). **The southern edge of the site had some wet areas/ponding water at the base of the steep slope and rock high wall.** The proposed addition area lot is bound by Corbin Center Drive on the north as well as a small parking lot and sidewalk for the existing building.

The site contained numerous underground utilities including gas and water lines. Several of these traverse through the middle of the site. A storm drain including a large grated manhole structure was also present just west of the site.

The following pages show photos of the area at the time of our field work.

Project Photos

Description	Photo
Showing southern section of the addition area, facing southeast. Note the utility boxes and roped off utility area.	
Showing the rock high wall south of the existing building and addition area. Note the dense weeds and some ponding water in the middle of the photo. This area remains wet most of the year. Facing southeast.	

Project Site Photos (cont.)

Description	Photo
Example view of the addition area. Facing north.	
Example view of the north area of the addition and the flat area to the west of the addition. Facing southwest.	

2.2 SUBSURFACE INFORMATION SUMMARY

A total of 8 borings were utilized to explore the subsurface conditions at the site. We also drilled 8 borings for another project on the site immediately to the west. The borings in both cases were drilled in locations to provide an indication of the depth and horizontal limits to the "strip mine bench". The borings also sampled the overburden conditions and the upper portion of the bedrock on the bench. The boring location plan in the appendix shows the approximate drilling locations.

SUBSURFACE CONDITIONS: At our sampling locations, we encountered mine spoil fill overlying what we believe is the bedrock bench from the previous strip mining operations. The mine spoil was mostly a mixture of granular rock fines and gravel and soil. The bedrock encountered was mostly shale but with some sandstone. 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
Mine spoil fill: mixture of brown and gray shale and sandstone and soil. Soil and soil-like shale was dry to moist and firm to stiff.	Ranged from about 2½ to 5 feet thick in our borings within the addition limits.	
Likely Bedrock: Either gray shale or brown sandstone	N/A	Not cored, but auger cutting, drill actions and nearby split spoon sampling indicate this material.

We encountered what we believed to be the top of soft to medium hard, native bedrock (likely the top of the strip mine bench) in all eight borings. The encountered material was consistent smooth, soft then harder, dry rock material of either sandstone or shale. This is consistent with the geologic mapping, mine mapping, seam elevations of the mined coal and our site observations of the rock high wall and site topography. The table below shows depth to our interpretation of the top of bedrock.

Boring Number	Depth to Top of Possible Bedrock (feet)	Depth to Medium Hard Bedrock (feet)
S-1	3	5
S-2	5	6
S-3	2 ½	8
S-4	4	6
S-5	3 ½	5
S-6	3 ½	5
S-7	3 ½	6 ½
S-8	2 ½	5

GROUNDWATER CONDITIONS: Free water or “wet” conditions were not encountered in any of the borings. The site was strip mine at or near a coal seam elevation. Typically, wet conditions are found near coal seams, especially in seeps or by gravity drainage along high wall ditches at these areas. We observed long-term wet conditions at the base of the site high wall. Excavations should expect wet conditions at or near this area. It has been our experience that wet pockets are also found in mine spoil fill masses just above more clayey pockets of soil and at or near the fill bottom.

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3 OPINIONS AND DISCUSSION

SUMMARY: In general, the project site is suitable for the proposed new development and site improvements. This includes the use of shallow spread footings and conventional building slab-on-grade floors.

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.

- Previously placed fill (Old Fill: “Mine Spoil Fill”)
- Shallow Bedrock
- Possible Wet Conditions

Previously Placed Fill (Old Fill: Mine Spoil Fill)

The entire site has been re-graded as part of strip mining operations in the early 2000’s. This operation created a “bench area” and “filled area”. The deeper filled area is located just west of the site and is part of an original large swale and consists of the spoils from the strip mining (i.e., mine spoil fill). However, a thin layer of fill is also located overlying the bench area (which appears to be all of the addition area). At our boring locations, this relatively thin fill is comprised of mostly shale and sandstone materials, with some soil. Typically, these materials include rock fines, sand, gravel, cobble and boulder mixtures. Boulders can be very large (many feet wide and thick). We did not observe evidence of large boulders in our borings, but they may be present in areas not sampled. Lastly, the fill is not placed in a “controlled” manner and no compactive effort applied to the layers of fill. It is simply end-dumped in one layer. For relatively thin fill such as the site addition area, the primary settlement risk is areas of differential settlement. **Foundations can bear on this “thin fill” but must have in-depth foundation bearing inspections to verify firm or better bearing conditions. Soft or loose conditions should be undercut down to firm or better materials.** Also, the materials have zones of clay-like material and zones of sandy/granular materials. This creates areas of water pockets. This also creates areas of granular materials that will slump in open excavations. Site

excavations deeper than about 5 feet will require the use of trench boxes or cutting back side walls.

Shallow Bedrock

Our borings encountered the top of bedrock at relatively shallow depths. Shale and sandstone bedrock is present as shallow as 2½ to 3 feet. Excavations at or near this depth will encounter bedrock. Our augers were able to penetrate several feet of the material. This usually indicates larger excavators or “ditch witch” type excavators can likely penetrate the material at a very slow pace. However, portions of the bedrock will likely be hard and will then require “rock removal” techniques such as blasting or hoe-ramming to remove.

Possible Wet Conditions

Wet surface conditions were observed along the high wall on the south edge of the site. Based on the vegetation present, this area remains wet most of the year. Also, mine spoil fill materials are known to have wet pockets within the fill mass and are usually wet at or near the bottom of the fill zone. Further, the site was mined at or near elevations of a coal seam (coincides with the top of the bedrock) which are usually found near wet areas. Excavations at or near any of these types of zones will likely encounter wet soils, soft soils and possibly larger water seeps.

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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 AND EARTHWORK

The site is relatively flat and is at or near the existing building's finished sub grade elevation. We have assumed minimal earthwork is needed. However, we are providing general notes for use if any filling is needed.

We recommend that site grading should take place between about late April to early November. 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.

- 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;
- Additional undercutting will likely be needed along the southern edge of the site (near the base of the high wall). The area appears to be remain wet year-round. Additional ditching or other drainage will be needed in the area;
- Areas ready to receive new fill should be proofolled with a loaded dump truck or similar equipment judged acceptable by CETCO;
- The on-site gravel can likely be re-used for building pad support. Also, **if the area passes a proof roll**, the gravel and soils should be suitable to support new slab areas;
- 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 that section of bullets on the next page;
- Remove deleterious materials or materials that are unsuitable for use in supporting the overlying new fill;
- CETCO should observe the proofrolling operations and make recommendations for any unstable or unsuitable conditions encountered;

Mass Earthwork (if any)

- 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 12-inch thick loose lifts;
    - Maximum particle size of the soil should be limited to 12 inches in any dimension;
    - Materials should have a plasticity index (PI) of less than 20.
- Quality control testing guidelines:
    - The fill should use a sheepsfoot roller due to the fine materials (soil-like shale and soil) to apply compactive effort;
    - Density testing of of rocky soils is often very problematic. However, visual indications of stability and proper moisture include:
        - 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;
        - Material moisture should be visually verified to ensure no mud/wet soil or “powder dry” soil is placed. Also the material should have enough moisture to allow compactive effort by the sheepsfoot roller (i.e., should appear near optimum moisture as determined by an experienced geotechnical engineer or their representative);
- 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 12 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.

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.

We recommend regrading the small "ditch" at the base of the high wall to allow for better drainage. The area appears to remain wet year-round.

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;
- During the life of the project, slope the subgrade and other site features so that surface water flows away from the site structures;
- **Future building structure roof drains should be piped into proper storm drainage systems (critical for managing the risk of future building performance and limiting "softening" of the underlying mine spoil materials);**

- 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;

4.2 SITE SEISMIC DESIGN

The Kentucky Building Code (KBC), as updated was reviewed to determine the Site Seismic Classification. Based on our review of geologic data, our experience, and subsurface conditions encountered, we recommend a Seismic SITE CLASS "B" for the site.

A detailed geotechnical earthquake engineering analysis was not performed. However, based on a review of published literature and our experience with similar subsurface conditions, we believe the potential for slope instability, liquefaction, and surface rupture due to faulting or lateral spreading resulting from earthquake motions is low.

4.3 FOUNDATIONS

The following recommendations are also based on the previously described project information, typical single story commercial building types, the subsurface conditions encountered in the borings, empirical correlations for the soil types encountered, and CETCO's analyses and experience.

Shallow Spread Footings

The site conditions encountered and/or newly/properly compacted engineered fill can support the proposed single story building addition with shallow spread footings. ***A maximum allowable net bearing pressure of 3,000 pounds per square foot (psf) is recommended for footings bearing on firm or better bearing materials.*** **Foundation bearing conditions must be verified as the entire footing bearing on firm or better material. Soft zones and loose materials are expected and should be undercut down to firm or better material.** Footing excavations that are undercut, may be backfilled back up to bottom of footing elevations with compacted DGA or lean concrete. Additional design considerations for project foundations are outlined as follows:

- Design footings with a minimum dimension of 24 inches wide;

- Place all exterior footing bottoms to at least 24 inches below finished exterior grade for frost considerations;

Shallow Foundation Construction Considerations

The soils encountered in this exploration may lose strength if they become wet during construction. Therefore, we recommend the foundation subgrades be protected from exposure to water. The following guides address protection of footing subgrades and our recommended remediation for any soft soils encountered.

- **Bearing condition evaluations must be conducted using probe rods, dynamic cone penetration (DCP) and hand auger borings at all footing locations.** This is due to mine spoil material bearing risks.
- To protect against “moisture loss” or “soil drying” during warmer months, foundation concrete should be placed the same day as excavation.
- Remove any soils disturbed by exposure prior to foundation concrete placement.
- Level or suitably bench the foundation bearing area.
- Remove loose materials, soft materials, debris, and excess surface water from the bearing surface prior to concrete placement.
- CETCO must observe all foundation excavations and provide recommendations for treatment of any unsuitable conditions encountered.
- CETCO should be retained to evaluate actual conditions.

4.4 FLOOR SLABS

Normal conventional type slabs can be supported by the site soils. This includes the gravel on the site at the time of drilling. Again, the areas should be proof rolled at the direction of CETCO prior to slab gravel base placement. Further, the subgrade should be prepared according to the recommendations contained within this report. The following features are recommended as part of the floor slab construction:

- Keep the crushed stone or gravel moist, but not wet, immediately prior to slab concrete placement to minimize curling of the slab due to differential curing conditions between the top and bottom of the slab.
- Retain CETCO to review the actual subgrade conditions prior to slab construction and make recommendations for any unsuitable conditions encountered.

4.5 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.

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. We are not providing evaluations of environmental site conditions as part of our services to the Client.

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.

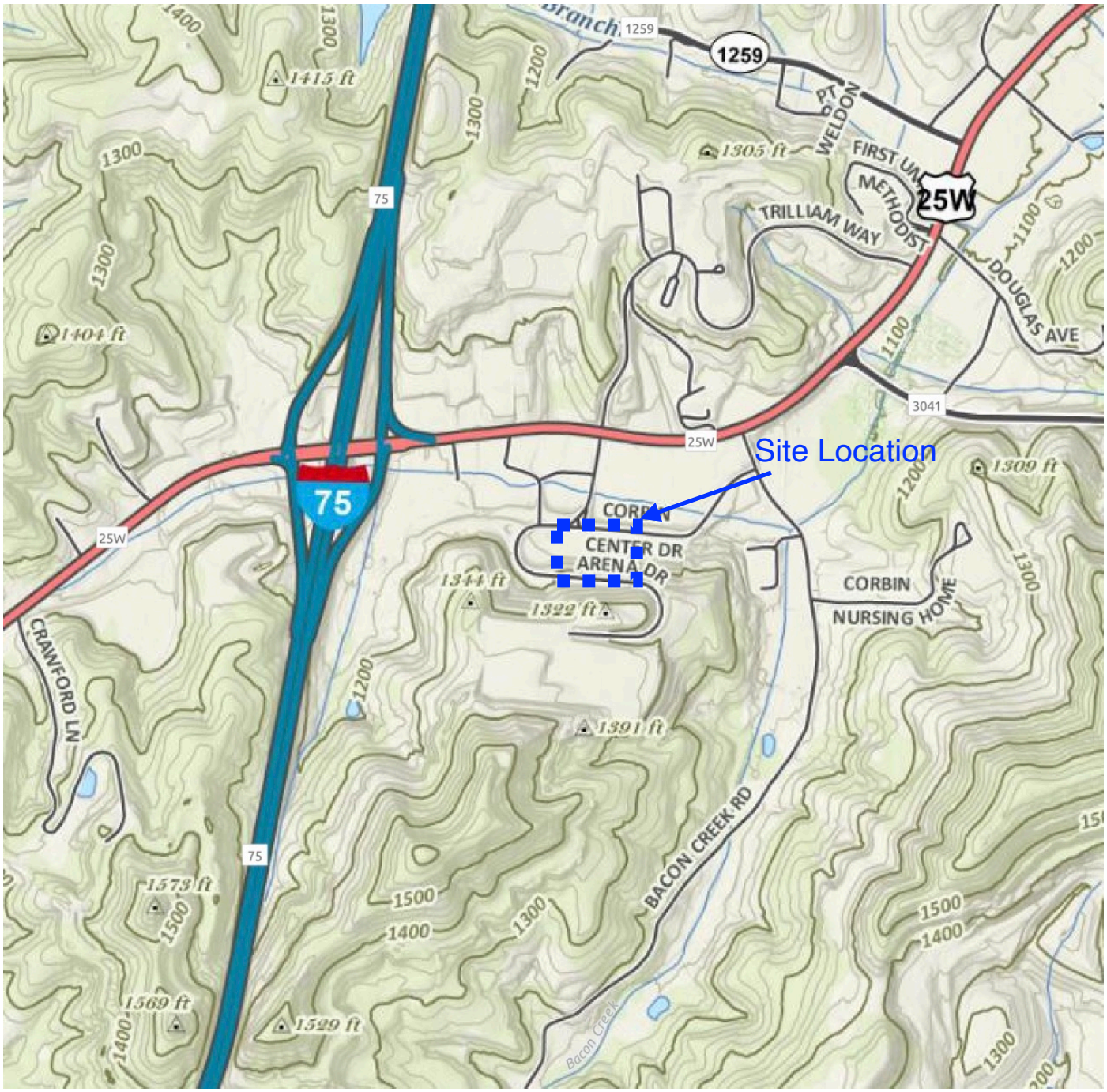
We recommend that this complete report be provided to the various design team members, the contractors and the project owner. Potential contractors should be informed of this report in the

"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
BORING LOGS
FIELD STANDARDS



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

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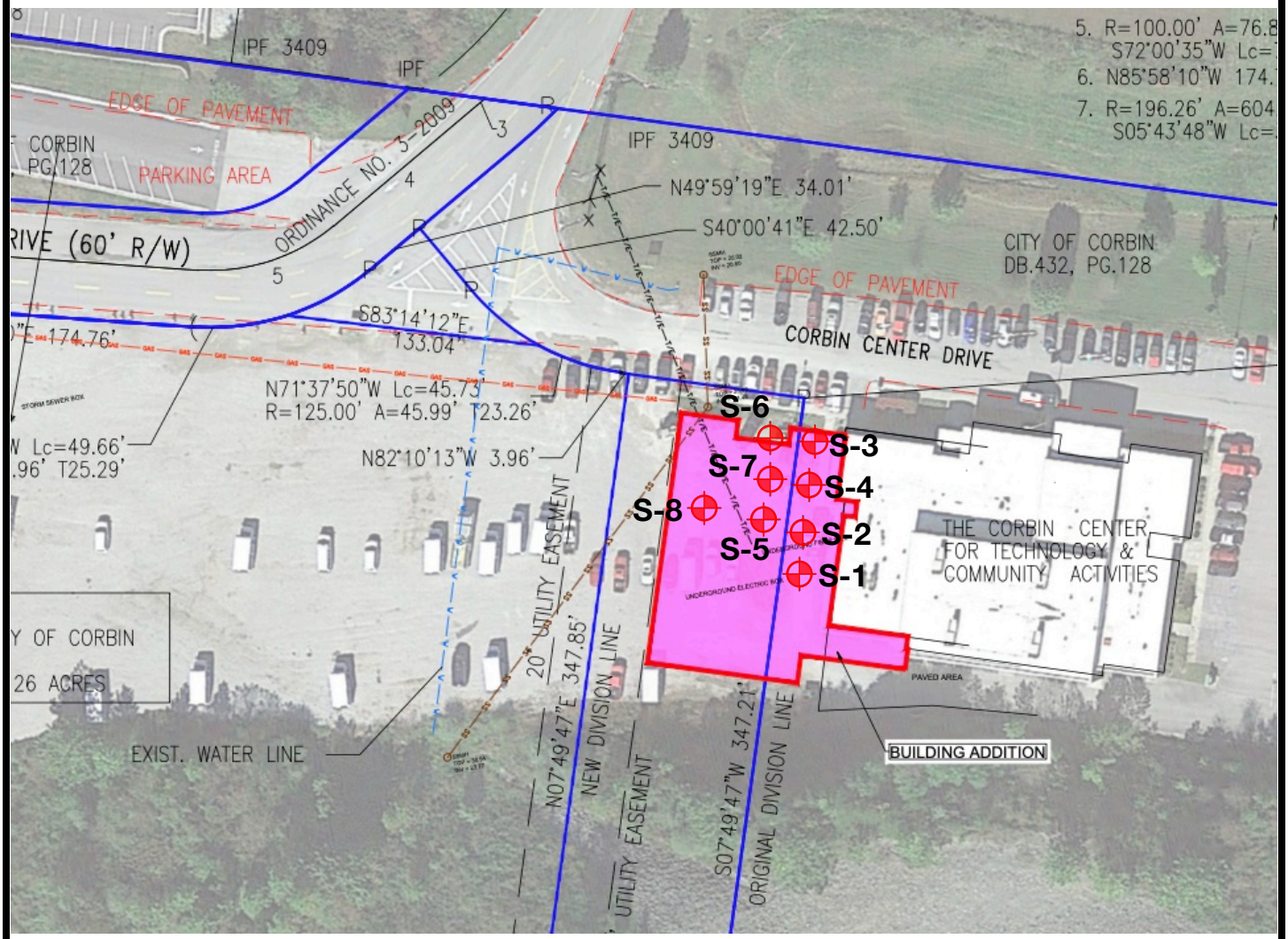
CETCO, PLLC
624 Wellington Way
Lexington, KY 40515
859.475.3933
www.cetcopllc.com

SITE LOCATION PLAN
for Corbin Center Extension

Corbin, Kentucky

CETCO Project: 1776-23-0112
Date: February 16, 2023
Checked by: JSC
Drawing: 1 of 1



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Boring location plan adapted from site plan drawing provided by MSE of Kentucky, Inc., with further adaptations from CETCO professionals.

Legend

Boring Location S-X

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

BORING LOCATION PLAN
for Corbin Center Addition

Corbin, Kentucky

CETCO Project: 1776-23-0112
Date: February 16, 2023
Checked by: HMH
Drawing: 1 of 1, Scale: NTS

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

BORING NUMBER S-1

CLIENT City of Corbin
PROJECT NAME Corbin Tech Center Addition
PROJECT NUMBER 1776-23-0110A
PROJECT LOCATION Corbin, Kentucky
DATE STARTED 2/2/23 **COMPLETED** 2/2/23
GROUND ELEVATION 1153 ft **HOLE SIZE** 4" inches
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight 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, 30s - Sounding Terminated at 10 feet
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0		GRAVEL (3")						
		SOUNDING ONLY: Cuttings appeared to be MINE SPOIL FILL - Olive gray soil like SHALE, powdery dry						
		SOUNDING ONLY: Gray SHALE: POSSIBLE TOP OF ROCK?						
5								
10		SOUNDING ONLY: Brown and gray SHALE						
		Bottom of borehole at 10.0 feet.						

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

BORING NUMBER S-2

CLIENT City of Corbin
PROJECT NAME Corbin Tech Center Addition
PROJECT NUMBER 1776-23-0110A
PROJECT LOCATION Corbin, Kentucky
DATE STARTED 2/2/23 **COMPLETED** 2/2/23
GROUND ELEVATION 1153 ft **HOLE SIZE** 4" inches
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight 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, 30s - Sounding Terminated at 13 feet
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0		GRAVEL (3")						
		SOUNDING ONLY: Cuttings appeared to be MINE SPOIL FILL - Olive gray soil like SHALE, powdery dry						
5		SOUNDING ONLY: Gray SHALE: POSSIBLE TOP OF ROCK?						
		SOUNDING ONLY: Brown and gray SHALE						
		SOUNDING ONLY: Gray SHALE						
10								

Bottom of borehole at 13.0 feet.

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

BORING NUMBER S-3

CLIENT City of Corbin
PROJECT NAME Corbin Tech Center Addition
PROJECT NUMBER 1776-23-0110A
PROJECT LOCATION Corbin, Kentucky
DATE STARTED 2/2/23 **COMPLETED** 2/2/23
GROUND ELEVATION 1153 ft **HOLE SIZE** 4" inches
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight 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, 30s - Sounding Terminated at 9.7 feet
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0		GRAVEL (3")						
		SOUNDING ONLY: Cuttings appeared to be MINE SPOIL FILL - Gray and brown soil like SHALE, powdery dry						
		SOUNDING ONLY: Brown SHALE: POSSIBLE TOP OF ROCK?						
5		SOUNDING ONLY: Brown and gray SHALE (soft zone around 7 feet)						

Bottom of borehole at 9.7 feet.

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

BORING NUMBER S-4

CLIENT City of Corbin
PROJECT NAME Corbin Tech Center Addition
PROJECT NUMBER 1776-23-0110A
PROJECT LOCATION Corbin, Kentucky
DATE STARTED 2/2/23 **COMPLETED** 2/2/23
GROUND ELEVATION 1153 ft **HOLE SIZE** 4" inches
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight 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, 30s - Sounding Terminated at 10 feet
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0		GRAVEL (5")						
		SOUNDING ONLY: Cuttings appeared to be MINE SPOIL FILL - Gray and brown soil like SHALE, powdery dry						
		SOUNDING ONLY: Brown SANDSTONE: POSSIBLE TOP OF ROCK?						
5		SOUNDING ONLY: Brown and gray sandy SHALE (soft zone around 6 feet)						
10								

Bottom of borehole at 10.0 feet.

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

BORING NUMBER S-5

CLIENT City of Corbin
PROJECT NAME Corbin Tech Center Addition
PROJECT NUMBER 1776-23-0110A
PROJECT LOCATION Corbin, Kentucky
DATE STARTED 2/2/23 **COMPLETED** 2/2/23
GROUND ELEVATION 1153 ft **HOLE SIZE** 4" inches
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight 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, 30s - Sounding Terminated at 10 feet
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0		GRAVEL (3")						
		SOUNDING ONLY: Cuttings appeared to be MINE SPOIL FILL - Gray and brown soil like SHALE, powdery dry						
		SOUNDING ONLY: Gray SHALE: POSSIBLE TOP OF ROCK?						
5								
10								

Bottom of borehole at 10.0 feet.

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

BORING NUMBER S-6

CLIENT City of Corbin
PROJECT NAME Corbin Tech Center Addition
PROJECT NUMBER 1776-23-0110A
PROJECT LOCATION Corbin, Kentucky
DATE STARTED 2/2/23 **COMPLETED** 2/2/23
GROUND ELEVATION 1153 ft **HOLE SIZE** 4" inches
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight 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, 30s - Sounding Terminated at 10 feet
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0		SOUNDING ONLY: GRAVEL						
		SOUNDING ONLY: Cuttings appeared to be MINE SPOIL FILL - Olive gray soil like SHALE, with some sand and gray sandstone fragments, powdery dry						
		SOUNDING ONLY: Gray SHALE: POSSIBLE TOP OF ROCK?						
5								
		SOUNDING ONLY: Brown and gray sandy SHALE						
10								

Bottom of borehole at 10.0 feet.

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

BORING NUMBER S-7

CLIENT City of Corbin
PROJECT NAME Corbin Tech Center Addition
PROJECT NUMBER 1776-23-0110A
PROJECT LOCATION Corbin, Kentucky
DATE STARTED 2/2/23 **COMPLETED** 2/2/23
GROUND ELEVATION 1153 ft **HOLE SIZE** 4" inches
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight 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, 30s - Sounding Terminated at 10 feet
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0		SOUNDING ONLY: GRAVEL						
		SOUNDING ONLY: Cuttings appeared to be MINE SPOIL FILL - Olive gray soil like SHALE, with some sand and gray sandstone fragments, powdery dry						
		SOUNDING ONLY: Gray SHALE: POSSIBLE TOP OF ROCK? (Something hard around 6.5 feet)						
5								
10								

Bottom of borehole at 10.0 feet.

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

BORING NUMBER S-8

CLIENT City of Corbin
PROJECT NAME Corbin Tech Center Addition
PROJECT NUMBER 1776-23-0110A
PROJECT LOCATION Corbin, Kentucky
DATE STARTED 2/2/23 **COMPLETED** 2/2/23
GROUND ELEVATION 1154 ft **HOLE SIZE** 4" inches
DRILLING CONTRACTOR Strata Group
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight 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, 30s - Sounding Terminated at 10 feet
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0		GRAVEL (3")						
		SOUNDING ONLY: Cuttings appeared to be MINE SPOIL FILL - Olive gray and brown soil like SHALE, with some sandstone fragments, powdery dry						
		SOUNDING ONLY: Gray SHALE: POSSIBLE TOP OF ROCK? (Something hard around 6 feet)						
5								
10								

Bottom of borehole at 10.0 feet.

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