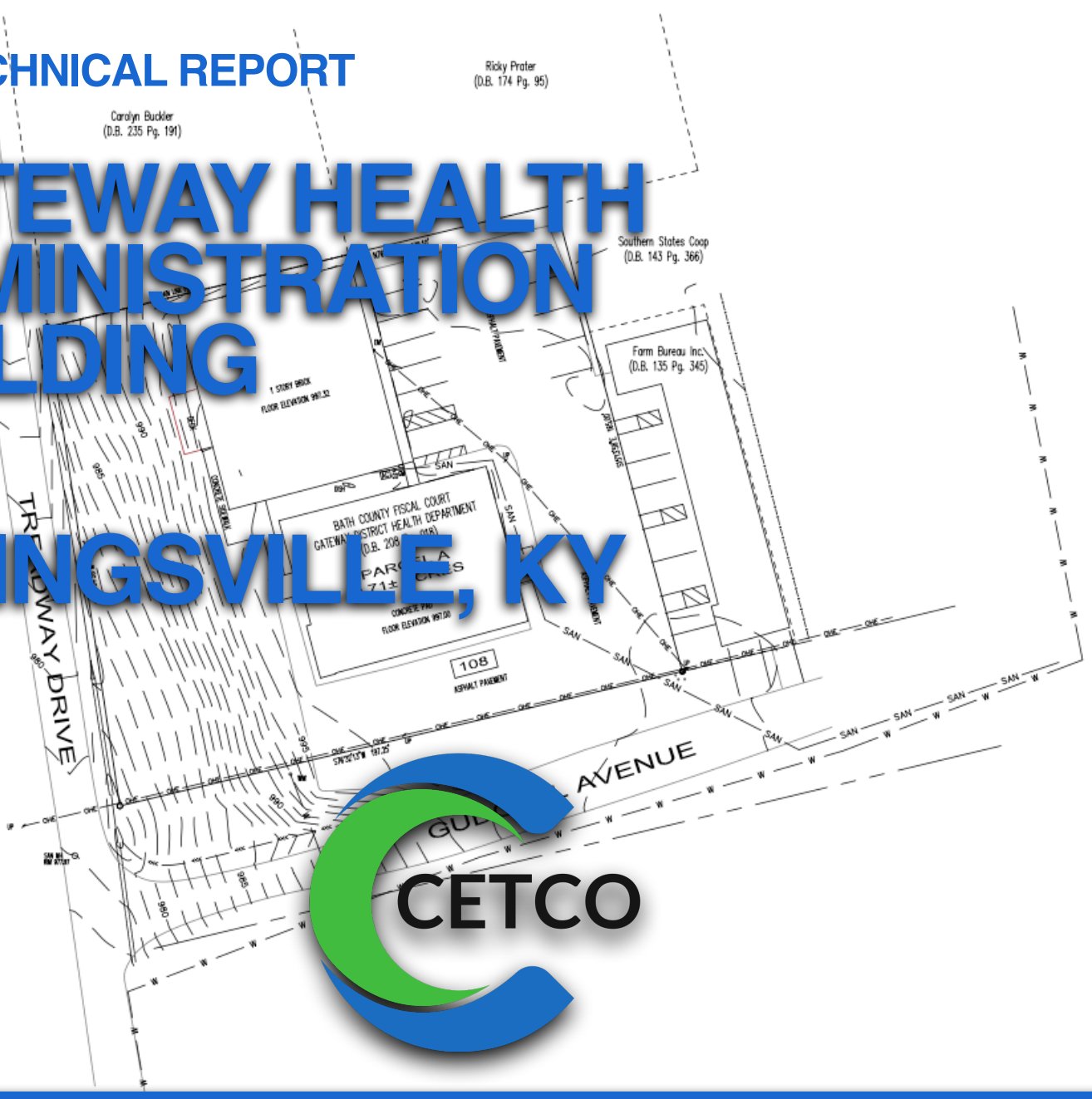
October 1, 2024

GEOTECHNICAL REPORT

GATEWAY HEALTH ADMINISTRATION BUILDING

OWINGSVILLE, KY



CETCO

Cooke Engineering and Testing Company

October 1, 2024

Mr. Marty Friedman
MSE of Kentucky, Inc
via email: mfriedman@mselex.com

Subject: **Geotechnical Report**
Gateway Health Administration Building
Owingsville, Kentucky
CETCO Project No. 1776-24-0136

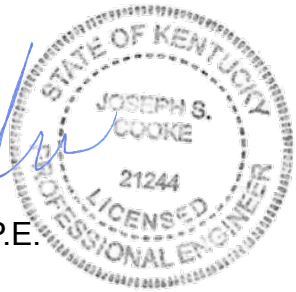
Dear Mr. Friedman:

CETCO appreciates the opportunity to provide our services to you and the Owner (Gateway Health District). As follows, we are providing our geotechnical report. Our services were provided in general accordance with our proposal number CET 1776-24-0299, dated, August 13, 2024. 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

Hunter Hawkins, SI
Staff Geologist



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

Attachments: Geotechnical Report and Appendix

Cooke Engineering and Testing Company

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Gateway Health Administrative Building

OWINGSVILLE, KENTUCKY

GEOTECHNICAL REPORT SUMMARY

We provided our services in general accordance with our previous discussions and our proposal number 1776-24-0299, dated August 13, 2024, and approved by the Owner on August 15, 2024. CETCO has consulted with your office 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 an existing slab covered vacant lot into the new administrative building for the Gateway District Health Department. The project plans are in the design stage, but may change. CETCO should be advised on any changes from the information presented in our report. The site is located off of Gudgell Avenue in Owingsville, Kentucky. Plans indicate a new single story building at the site with a footprint of about 3,500 square feet. 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, mostly brown lean to fat clay found in Owingsville. No groundwater was encountered in the soil overburden or in our borings. Shale bedrock was encountered at about 18 feet at the site. The native clay soils were typically stiff to very stiff.

The site is suitable for the development. Once the pad is leveled and filled properly, we believe shallow spread footings can be used for the proposed new building, as well as a conventional slab-on-grade floor.

The primary concerns for the site are normal for the downtown area of Owingsville, Kentucky. These include construction in a developed area, potential swelling clay soils and a small level of karst (sinkhole) risks. Again, these are normal for the area and normal construction and planning practices of the 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 Gateway Health building addition. This included using six 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

We were provided information for the project as follows:

Provided Document	Source
Building drawings showing the plan and side views of the proposed project.	MSE
Site/property “plat” topographic imagery as well as property boundaries.	Palmer Engineering

The following information summarizes our understanding of the project conditions:

Condition	Specifics
Building/Structure Information	The building is single story and will be about 3,500 square feet in size. Initial plans indicate a slab-on-grade floor, shallow spread foundations, stud framed walls and overall wood framework is expected.
Site Grading	The site has been previously graded and there is an existing concrete slab. The concrete slab will need to be removed along with any deleterious material. Based on the site being somewhat flat, less than 5 feet of cut/fill is expected.
Building Loading and Traffic Conditions	The building loads are likely to be less than 3 kips per linear foot for foundations, with floor slab loads of less than 250 pounds per square foot. Traffic conditions are primarily passenger cars in parking areas with added occasional “UPS” type delivery trucks and weekly garbage trucks on main roads and loading/dumpster areas.

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 Eastern Kentucky Coal Field Region of northeastern Kentucky where the Outer Bluegrass region meets the “Pottsville Escarpment”. This area shows a dramatic change in topography (steep hillsides and narrow valleys) in this transition area from “mountainous” of the coal field region to “rolling hills” in the Bluegrass Region (to the west). The overall area can have resistant Pennsylvanian-age sandstones with steep and generally stable slopes, but also have soft shale or siltstone bedrock with “unstable” slopes. This region is dissected by headstreams of the Licking, Kentucky and Cumberland rivers and often contain springs, entrenched rivers, and sinking streams. The valleys of the Licking River are commonly the lowest elevations just under 600 feet with ridge tops being the highest elevations over 1400 feet. The immediate site vicinity ranged from 980 to 1000 feet according to provided topography, our site GPS measurements and published mapping.

SITE GEOLOGY

The Kentucky Geologic Survey public information was reviewed including the USGS mapped geologic information for the site (the Owingsville Geological Quadrangle, 1975). Available geologic mapping indicates the site vicinity is underlain by the Boyle Dolomite the Boyle formation and the Upper (and possibly Lower) part of the Crab Orchard formation. Boyle Dolomite can be described as light gray, in part cherty, that weathers grayish orange to dark yellowish orange. Most of the Crab Orchard is shale and can be described as greenish gray, microcrystalline, in part dolomitic, that weathers yellowish gray. The site vicinity includes the Drowning Creek Formation apart of the lower part of the Crab Orchard Formation and Brassfield Formation.

Geologic Risks: This area is karst prone, however the are no mapped sinkholes as shown in the geologic mapping on the following page. Also, the Crab Orchard formation is known for “slope issues”. Any new or existing construction at new or disturbed cut slopes or fill slopes will require additional care for drainage and possibly “keying” into bedrock surfaces. Our report address both of these geologic risks.

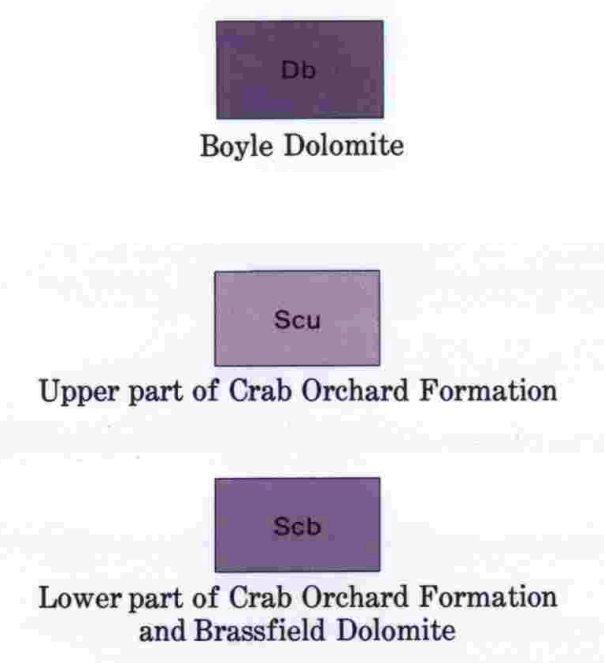

Image from the KGS website showing current aerial overlaying Original Geological Quadrangle Site location is the black rectangle.

Image from the KGS website showing karst potential: Site location is the black rectangle.

AERIAL MAPPING

Aerial information back as far as 1995 was readily available for the site. Images showing site progression. Photo on the left is the aerial from 1995, showing the previous building was present until sometime between 2021 and the most recent aerial in 2023. The site vicinity had minimal changes overall with exception of the building being demolished. Since 2023, it appears that there have not been any obvious changes, and site conditions are as they appear.

1995 : Aerial from Google Earth

2013 : Aerial from Google Earth

2023 : Aerial from Google Earth

SITE SOIL SURVEY MAPPING

The Soil Survey of the site area was also reviewed. The site and close vicinity have been re-graded and are mapped as Urban Land-Aflic Udarents Complex consisting of clayey substratum over soft bedrock. As such the soil mapping, and subsequent issues discussed is not accurate for this site. However, we reviewed immediate/adjacent soil series and mapping and some of these mapping/soil series issues listed may still be in effect for the site. These issues include slope construction and shrink-swell of soils, as well as urban fill stability. We are providing recommendations to address these issues. Also, the soil survey lists the site vicinity as having “moderate risks” for corrosion of steel. Typically, the main risk for corrosion would be for steel reinforcement in concrete foundations and slabs. The primary means to address this risk is to specify at least 3 inches of concrete cover over all steel reinforcement for concrete exposed to soil. The depth to water table was listed as more than 80 inches.

2 CETCO FINDINGS

We provided a site and area reconnaissance, logged soil test borings and explored the site using those borings. The following sections discuss our findings. Mr. Hunter Hawkins, SI, Staff Geologist, provided our field services including a site reconnaissance and logging of the borings in the field, during the exploration on September 3, 2024. Mr. Joe Cooke, PE, our Principle Engineer, is also familiar with site conditions and observed recovered soil samples.

2.1 CURRENT SITE SURFACE CONDITIONS AND OBSERVATIONS

The site is located off of Gudgell Avenue and Treadway Drive in Owingsville, Kentucky. The proposed new building's site is located on a hilltop and edge of the hilltop. The existing Gateway Health Department building is located a few feet north of the proposed new building. The Bath County Farm Bureau is east across the parking lot. The proposed addition is currently overlain by a concrete slab from the previously demolished building. The asphalt pavement and slab area are mostly flat, however there is moderate to steep downhill slope just west of the site leading down to Treadway Avenue. Gudgell Avenue is located south of the site location. The site vicinity is in a moderately hilly to steep residential area along with narrow to broad ridge tops.

The existing slab showed the typical "long-term" small amounts of cracking, but no obvious structural distress or movement cracking due to settlement, slope movement or overall instabilities. The existing asphalt appeared similarly. We also observed several overhead utility lines around the project edges.

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

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Project Photos

Description	Photo
Photo example showing the building pad with the existing Gateway Health building just beyond. Bath Co. Farm Bureau is located on the right side of the image. Facing north.	
Photo example taken showing the parking lot with the northeast corner of the slab shown. Facing north.	

Project Site Photos (cont.)-1

Description	Photo
Photo example taken from the southeast corner of the building pad showing the parking lot entrance off of Gudgell Avenue. Facing southeast.	
Photo overview of the concrete slab taken from the southeast corner. Facing northwest.	

Project Site Photos (cont.)

Description	Photo
Photo example showing the concrete pad from the southwest corner. Facing northeast.	
Example view showing the slope west of the building to Treadway Drive (foreground). Facing upslope east.	

2.2 SUBSURFACE INFORMATION SUMMARY

A total of 6 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 4 building pad corners and 2 near the center. The boring location plan in the appendix shows the approximate drilling locations.

SUBSURFACE CONDITIONS: At our sampling locations, we encountered a thin layer of "clean" previously placed fill (aka: old fill) under the concrete slab, overlying native soils. The native soils were generally brown to reddish brown lean to fat clay, overlying weathered shale bedrock. 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
Concrete Slab (former building slab)	4-5 inches	All borings were drilled in the existing slab area
DGA: Crushed stone	9 inches	All borings showed this strata
Previously placed fill (old fill): Appeared to be mostly "clean fill" generally sampled as brown shades of lean to fat clay with some gravel and generally "moist" and "firm".	1 to 4 feet	All borings showed this strata
Native soils: mostly lean to fat clay, brownish red in coloring and generally "moist" and "stiff" to "very stiff". Soils contained a few chert lenses.	Up to 12 feet	All borings encountered native soils, however most borings were terminated after reaching several feet into this strata
Bedrock: gray weathered shale	N/A	

BEDROCK AND GROUNDWATER CONDITIONS: Soft shale bedrock was encountered in one boring at around 18 feet deep. Free water or "wet" conditions were not encountered in any of the borings.

It is likely (based on geologic mapping and our area experience) that some amount of wet conditions should be expected at or near the bedrock surface, along the original swale edge (likely toward the west of the project site) and possibly at the old fill/native soil interface.

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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.

- Previous Construction in an Urban Area (including old fill)
- Shrink-Swell of Clay Soils
- Karst Risks

Previously Construction in an Urban Area (including old fill)

The existing slab and former building foundations should be removed within 5 horizontal feet of the new building footprint and all new construction areas (new utilities, pavements, sidewalks, etc.). Former utility lines should be abandoned and removed.

Under the existing slab, our borings encountered previously placed fill (old fill), as thick as 5 feet deep, at the site (most likely 2-3 feet deep on average). The fill is at least 25 years old and is likely a derivative of the previous grading that took place when constructing the building. The fill appears to be relatively “clean” and “stiff” material, therefore the fill can likely be “re-usable”. **The building pad could likely bear on this material (if it passes a proof roll), but foundations should not bear on this material, which may require a few feet of undercutting in foundation trenches (down to firm or better native soils).** These can simply be backfilled up to the bottom of footing elevations with compacted gravel (DGA or #2 stone).

Shrink-Swell of Clay Soils

Most of the soil on-site has a moderate (or higher) potential for swelling and shrinkage due to the moderate plasticity of the soil (fat clay soil). Soils with a plasticity index (PI) of greater than 30 are often considered “high potential”. Samples tested showed PI limits of up to 28 and area mapping PI limits are up to 30 to 32 on the soil survey.

The swelling/shrinkage risk is most prevalent when the soils “change” in moisture during the life of the building. Drying conditions cause shrinkage and wetting conditions cause swelling. **Foundations bottom elevations should be at least 36 inches from the top of ground (exterior building grades).** At this depth, the soil conditions fluctuate a minor amount during the hot and dry to cold and wet seasons.

The areas most prone to swell/shrink are building slabs. Means to limit this potential include a strict moisture control of the soils during any mass fill placement/earthwork and slab subgrade preparation. Also, maintaining the construction schedule to **avoid slab concrete placement during the hottest/driest times of the year (typically avoiding July, August and September)** is a prudent means to limit “drying” of the slab subgrade prior slab placement. Lastly, roof gutter downspouts should be piped/carried directly into storm drains and not flow onto site soils within 15 feet of the building pad AND no sprinkler irrigation system should be used for landscaping areas. These are further discussed throughout the report.

Karst Risks

As with most of Bath County, the area is located in a “karst prone” risk area. Karst is a geologic condition whereby the bedrock can erode, leaving “sinkholes” or similar erratic top of rock profiles such as rock pinnacles, slots in the bedrock or “breaks” in the rock profile. The condition can also create springs or other water features.

Although no sinkhole are mapped in the immediate site area and no obvious surface indications were observed at or adjacent to the site, the site geology contains dolomitic limestone and shale bedrock of karst prone geology and the possibility of future drop out features is always present. **We are providing recommendations (see the next page) for construction in a karst area to assist in lowering (but not eliminating) these future risks.**

4 RECOMMENDATIONS

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

Karst Region Recommendations

As discussed previously, the site is in a “karst prone area”. The notes that follow (prior to section 4.1) should be considered for the planning and construction of the entire site. Levels of risk associated with Karst are difficult to assess, especially with our limited scope. So the Owner must assume that there is always a level of risk of sinkholes or soil dropouts which could cause damage to completed structures or pavements in any limestone (or similar bedrock) Karst area. The use of suitable precautionary measures can reduce this risk. Some of these measures include:

- Typically the risk of sinkhole drop-out formation is reduced in filled areas and increased in cut areas. Designing the site layout so that buildings are constructed to the greatest extent on filled areas is preferable from a sinkhole risk standpoint.
- Water flow considerations (both surface and subsurface) are a key factor to try to reduce Karst associated risks when planning. CETCO should be retained to assess civil plans of water flow to provide guidance with regards to potential increases to Karst risks.
- Final building gutters/downspouts should be directed into storm drains and not allowed to flow directly onto the site soils. The concentrated streams of water can increase the risks of sinkhole formation. Also, parking/pavement areas should drain into storm drains and not simply “sheet flow” off onto grassy areas.
- Avoid using irrigation systems for site landscaping.
- A simple way to assess near surface potential dropouts is to conduct a ***heavy and strict proofroll of all construction areas after clearing and topsoil removal***. Cut areas should be re-proofrolled after planned subgrade is reached. If possible, this second proofrolling should be performed after several cycles of rainy and fair weather.
- Soil-bearing foundation bearing conditions should be checked using Dynamic Cone Penetration (DCP) testing and hand auger borings to check for typical “sinkhole” type soils and unusual soft conditions.
- If a sinkhole/dropout is encountered, the most effective repair method is usually to excavate to bedrock, and then construct a suitable concrete "plug" or rock-fill filter over the bedrock

opening. However, the geotechnical engineer should be consulted before performing any repairs.

- Specific procedure used to repair drop-outs will depend on the specific condition encountered. The project geotechnical engineer should be contacted if drop-outs form or suspect old drop-outs are encountered.

4.1 SITE PREPARATION

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

- The existing concrete slab and building remnants (such as foundations and former utility lines) should be removed from the construction area. These materials should be wasted from the site. Upon removing the concrete slab, CETCO should be contacted to observe sub grade conditions and the initial proofroll.
- 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
- Areas ready to receive new fill should be proofolled with a loaded dump truck or similar equipment judged acceptable by CETCO;
- Proofrolling should not be performed on wet subgrade. If possible, perform proof rolls after suitable dry weather periods of time;
- As stated, the on-site pavement areas and new slab can likely be supported by the upper “old fill” layer if the layer passes a proof roll;
- 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

The site has been previously graded and is "level/flat" across the existing concrete slab. We are providing the following recommendations for any mass earthwork/filling. After the concrete slab has been removed and 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 35.**
    - Some of the soils tested on-site were close to this 35 limit. Therefore, it should be assumed that some of the on-site soils (especially those deeper than about 2 feet) may not meet the requirement.
- 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 1 to plus 3 percent of optimum moisture content (range is such due to moderately high plasticity of the on-site clay soils)**;
    - 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.

Existing Site Slope Area

An in-depth slope analysis of the existing slope was beyond our scope of services. However, the area geology and soil survey mapping suggest that disturbance of existing older slopes (such as the site's western slope) and exposing slopes to new loading conditions can create unstable conditions. **We are recommending to avoid any new construction or disturbance within 10 feet of the crest/top of the existing slope. Also, the area should be remain vegetated during construction and increased water flow over the slope should be avoided.**

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;
- 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 karst/sinkhole future formation);
- Also, pavement areas should drain into storm drains and avoid simply sheet flow off of the pavement;
- 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;

4.3 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 "D" 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 (sandy soils at the site are very clayey),

and surface rupture due to faulting or lateral spreading resulting from earthquake motions is low.

4.4 FOUNDATIONS

The following recommendations are also based on the previously described project information, typical single story building types, the subsurface conditions encountered in the borings, the results of laboratory testing, 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 commercial building 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 native soils or compacted engineered fill.

Again, foundations should not bear on the old fill materials. The old fill extended to 4½ feet deep (western edge of the existing slab). The eastern half the building appears to have less than 2 feet of old fill. Footing trenches may be backfilled up to design bottom of footing depth with compacted stone or flowable fill/lean concrete. This appears to be needed at about ½ of the building limits and about 12-18 inches thick of backfill.

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 36 inches below finished exterior grade (due to soil swelling 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 dynamic cone penetration (DCP) and hand auger borings at all footing locations. **This is due to karst 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 soil, 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.

4.5 FLOOR SLABS

Normal conventional type slabs can be supported by engineered fill soils or native/existing soils. Again, the areas should be proof rolled at the direction of CETCO after the slab is removed and 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:

- If possible, avoid construction of slabs during the hottest/driest months (typically July, August or September) due to potential “dry soil” conditions.
- 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.

4.6 NEW PAVEMENT RECOMMENDATIONS

New light duty (passenger car traffic) areas of parking as well as medium duty (passenger cars and delivery trucks) are planned for the site. The most significant areas of traffic are the main entrances and main intersections of the parking lot and we have considered these to be the “medium duty” areas. Please note, we are also providing recommendation for dumpster areas in the last portion of this section.

The subsurface conditions on-site include the surface layer of “old fill”. As sampled, the material is mostly clay soil. If the area “passes” a proof roll, the materials appear to be suitable to support the new pavement areas. 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.

We have have assumed a CBR of 3 for the area. 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. Edges of the pavement should be provided a means of water outlet by extending the aggregate base course through to side ditches or providing drain pipes and weep holes at catch basin walls.

Light Duty Parking

Based on the above traffic and design parameters and our experience with similar projects, we recommend using the following pavement section for parking lot areas:

Component	Parking Lots Only
Surface Course	1
Asphalt Base Course	2
Base Material (DGA)	6

The asphalt should be mixed, placed, and compacted in accordance with Kentucky Transportation Cabinet Standard Specifications. Also, the dense graded aggregate (DGA) should be placed and compacted in accordance with KyTC Specifications.

Medium Duty: Entrances, and Intersections Areas

The main entrances and intersection areas will received the bulk of heavy forces, twisting and turning and large-scale stopping and starting that typically wear down pavement areas and create failures in pavement sections. For these areas, we recommend a thicker pavement section (increase the stone by 2 inches ***OR*** the base asphalt by ½ inches), or alternatively the areas can add a layer of Tensar InterAx NX750 geogrid.

Dumpster Area

The dumpster pad and dumpster unloading area should be concrete pavement. At least 6 inches of concrete thickness should be used overlying at least 6 inches of compacted DGA

base stone. Extend the concrete in the unloading area to at least 2 feet beyond the full length of both axles of conventional garbage trucks and at least 3 feet beyond the conventional width (each side).

4.7 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.

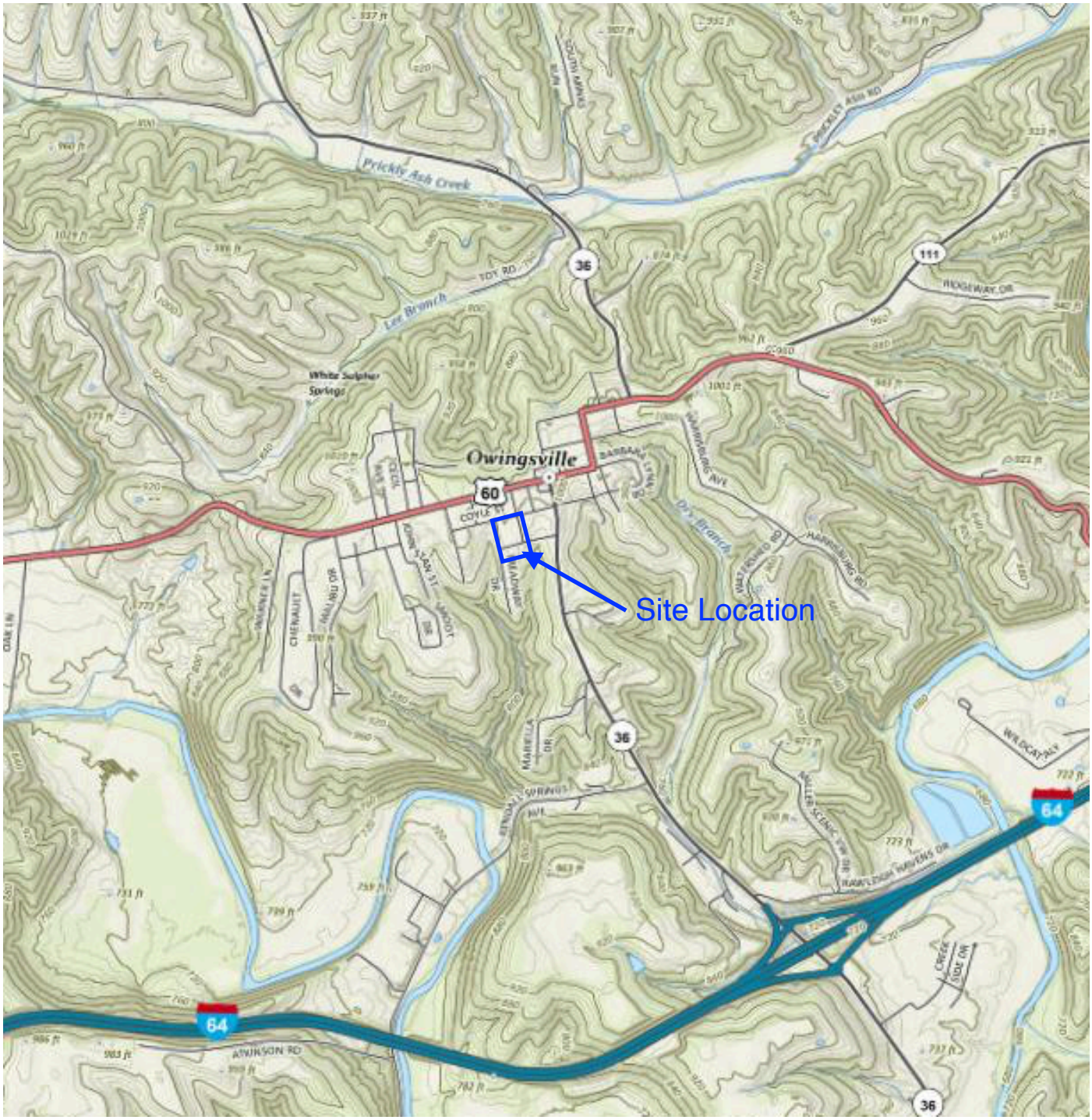
Regardless of the thoroughness of a geotechnical exploration, there is always a possibility that conditions between borings/test pits will be different from those at specific boring/test pit locations and that conditions will not be as anticipated by the designers or contractors. In addition, the construction 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.

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

SITE LOCATION PLAN
for Gateway Health

Owingsville, Kentucky

CETCO Project: 1776-24-0136
Date: August 19 2024
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.

N

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

BORING LOCATION PLAN

For Gateway ADD

Owingsville, Kentucky

CETCO Project:	1776-24-0136
Date:	September 27, 2024
Drawn by:	Mason Ross
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 Gateway Health
PROJECT NAME Gateway Health Add On
PROJECT NUMBER 1776-24-0136
PROJECT LOCATION Owingsville, Kentucky
DATE STARTED 9/3/24 **COMPLETED** 9/3/24
GROUND ELEVATION 997 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 Mostly Sunny, 70's
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		CONCRETE - 4.5 inches					
		DGA - 9 inches					
		Previously Placed FILL: Brown LEAN to FAT CLAY (CL-CH), with trace gravel and black oxides, moist, SOFT	SPT S-1	100	2-2-2 (4)		
2.5		Brown LEAN to FAT CLAY (CL-CH), with some black oxides, moist, VERY STIFF	SPT S-2	89	6-9-12 (21)		
5.0							
7.5		Brownish red LEAN to FAT CLAY (CL-CH), with some black oxides and chert lenses, slightly moist to moist, VERY STIFF	SPT S-3	56	7-8-14 (22)		
10.0			SPT S-4	100	12-6-18 (24)		
12.5							
15.0		Light brownish gray LEAN to FAT CLAY (CL-CH), with few black oxide streaks, slightly moist, VERY STIFF	SPT S-5	100	5-9-14 (23)		

▲ 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

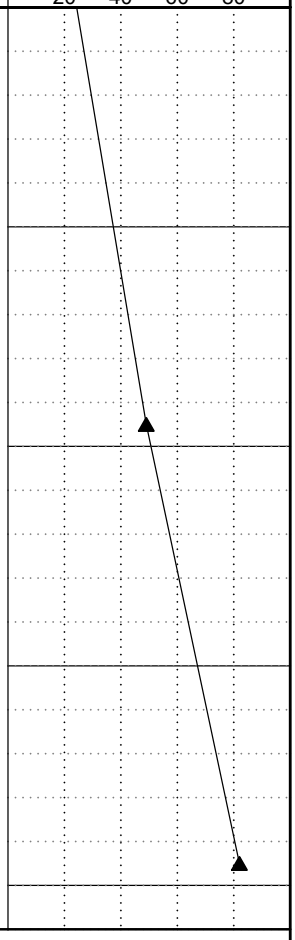
BORING NUMBER B-1

CLIENT Gateway Health **PROJECT NAME** Gateway Health Add On

PROJECT NUMBER 1776-24-0136 **PROJECT LOCATION** Owingsville, Kentucky

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
15.0		Light brownish gray LEAN to FAT CLAY (CL-CH), with few black oxide streaks, slightly moist, VERY STIFF *(continued)*					
17.5							
20.0		Gray weathered SHALE	SPT S-4	100	14-19-30 (49)		
22.5							
25.0			SPT S-5	100	20-36-46 (82)		

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



Bottom of borehole at 25.5 feet.

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

BORING NUMBER B-2

CLIENT Gateway Health
PROJECT NAME Gateway Health Add On
PROJECT NUMBER 1776-24-0136
PROJECT LOCATION Owingsville, Kentucky
DATE STARTED 9/3/24 **COMPLETED** 9/3/24
GROUND ELEVATION 997 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 Mostly Sunny, 70's
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		CONCRETE - 4.5 inches					
		DGA - 9 inches					
		Previously Placed FILL: Dark brown LEAN to FAT CLAY (CL-CH), with trace gravel and black oxides, moist, STIFF	SPT S-1	94	2-3-6 (9)		
2.5		Brownish red LEAN to FAT CLAY (CL-CH), with some black oxides and chert lenses, slightly moist to moist, VERY STIFF	SPT S-2	72	5-6-6 (12)		
5.0			SPT S-3	100	5-9-16 (25)		
7.5							

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

Bottom of borehole at 8.0 feet.

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

BORING NUMBER B-3

CLIENT Gateway Health
PROJECT NAME Gateway Health Add On
PROJECT NUMBER 1776-24-0136
PROJECT LOCATION Owingsville, Kentucky
DATE STARTED 9/3/24 **COMPLETED** 9/3/24
GROUND ELEVATION 997 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 Mostly Sunny, 70's
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		CONCRETE - 4.5 inches					
		DGA - 9 inches					
		Previously Placed FILL: Dark brown LEAN to FAT CLAY (CL-CH), with trace gravel and black oxides, moist, VERY SOFT	SPT S-1	94	1-1-1 (2)		
2.5		Brownish red LEAN to FAT CLAY (CL-CH), with some black oxides and some chert lenses, moist, STIFF into VERY STIFF					
			SPT S-2	72	3-6-8 (14)		
5.0							
			SPT S-3	100	4-8-9 (17)		
7.5							

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

Bottom of borehole at 8.0 feet.

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

BORING NUMBER B-4

CLIENT Gateway Health
PROJECT NAME Gateway Health Add On
PROJECT NUMBER 1776-24-0136
PROJECT LOCATION Owingsville, Kentucky
DATE STARTED 9/3/24 **COMPLETED** 9/3/24
GROUND ELEVATION 997 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 Mostly Sunny, 70's
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		CONCRETE - 4.5 inches					
		DGA - 9 inches					
		Previously Placed FILL: Dark brown LEAN to FAT CLAY (CL-CH), with trace gravel and black oxides, moist, FIRM	SPT S-1	94	2-2-3 (5)		
2.5							
5.0		Brownish red LEAN to FAT CLAY (CL-CH), with some black oxides and chert lenses, moist, FIRM	SPT S-2	72	1-3-3 (6)		
7.5		Reddish brown LEAN to FAT CLAY (CL-CH), with some chert lenses, moist, STIFF	SPT S-3	100	3-4-5 (9)		

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

Bottom of borehole at 8.0 feet.

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

BORING NUMBER B-5

CLIENT Gateway Health
PROJECT NAME Gateway Health Add On
PROJECT NUMBER 1776-24-0136
PROJECT LOCATION Owingsville, Kentucky
DATE STARTED 9/3/24 **COMPLETED** 9/3/24
GROUND ELEVATION 997 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 Mostly Sunny, 70's
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		CONCRETE - 4.5 inches					
		DGA - 9 inches					
		Previously Placed FILL: Dark brown LEAN to FAT CLAY (CL-CH), with trace gravel and black oxides, moist, FIRM					
2.5		Brownish red LEAN to FAT CLAY (CL-CH), with some black oxides and trace chert lenses, moist, STIFF	SPT S-1	94	1-2-4 (6)		
5.0			SPT S-2	72	5-6-9 (15)		

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

Bottom of borehole at 5.5 feet.

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

BORING NUMBER B-6

CLIENT Gateway Health
PROJECT NAME Gateway Health Add On
PROJECT NUMBER 1776-24-0136
PROJECT LOCATION Owingsville, Kentucky
DATE STARTED 9/3/24 **COMPLETED** 9/3/24
GROUND ELEVATION 997 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 Mostly Sunny, 70's
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		CONCRETE - 4.5 inches					
		DGA - 9 inches					
		Previously Placed FILL: Dark brown LEAN to FAT CLAY (CL-CH), with trace gravel and black oxides, moist, FIRM					
2.5		Brownish red LEAN to FAT CLAY (CL-CH), with some black oxides and trace chert lenses, moist, STIFF	SPT S-1	94	1-2-3 (5)		
5.0			SPT S-2	72	4-6-6 (12)		

Bottom of borehole at 5.5 feet.

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

Cooke Engineering and Testing Company

Laboratory Testing Summary Table

Project Name:	Gateway Health Dist.	Date:	September 30, 2024
Project Location:	Owingsville, KY	Reviewed by:	Joe Cooke, PE
Client:	Gateway Health Dist.	CETCO Project Number:	1776-24-0136

Sample ID	Depth (ft)	Natural Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	% Finer than #200 Sieve
B-1	1.5-3.0	23.9	42	18	24	88.3
B-1	4.0-5.5	26.1				
B-1	6.5-8.0	26.6	62	34	28	75.1
B-1	9.0-10.5	20.9				
B-2	1.5-3.0	24.6				
B-2	4.0-5.5	28.6				
B-2	6.5-8.0	34.2				
B-3	1.5-3.0	28.2				
B-3	4.0-5.5	28.2				
B-4	1.5-3.0	21.2				
B-4	4.0-5.5	34.7				
B-5	1.5-3.0	24.9				
B-5	4.0-5.5	27.3				
B-6	1.5-3.0	24.0				
B-6	4.0-5.5	27.6				

Cooke Engineering and Testing Company

Atterberg Limits Chart

Project Name:	Gateway Health Dist.	Date:	September 30, 2024
Project Location:	Owingsville, KY	Reviewed by:	Joe Cooke, PE
Client:	Gateway Health Dist.	CETCO Project Number: 1776-24-0136	
		“Atterberg Limits”, ASTM D4318	

Sample ID	Depth (ft)	Natural Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	% Finer than #200 Sieve
B-1, 1.5’-3.0’ ▲	1.5-3.0	23.9	42	18	24	88.3
B-1, 6.5’-8.0’ ★	6.5-8.0	26.6	62	34	28	75.1

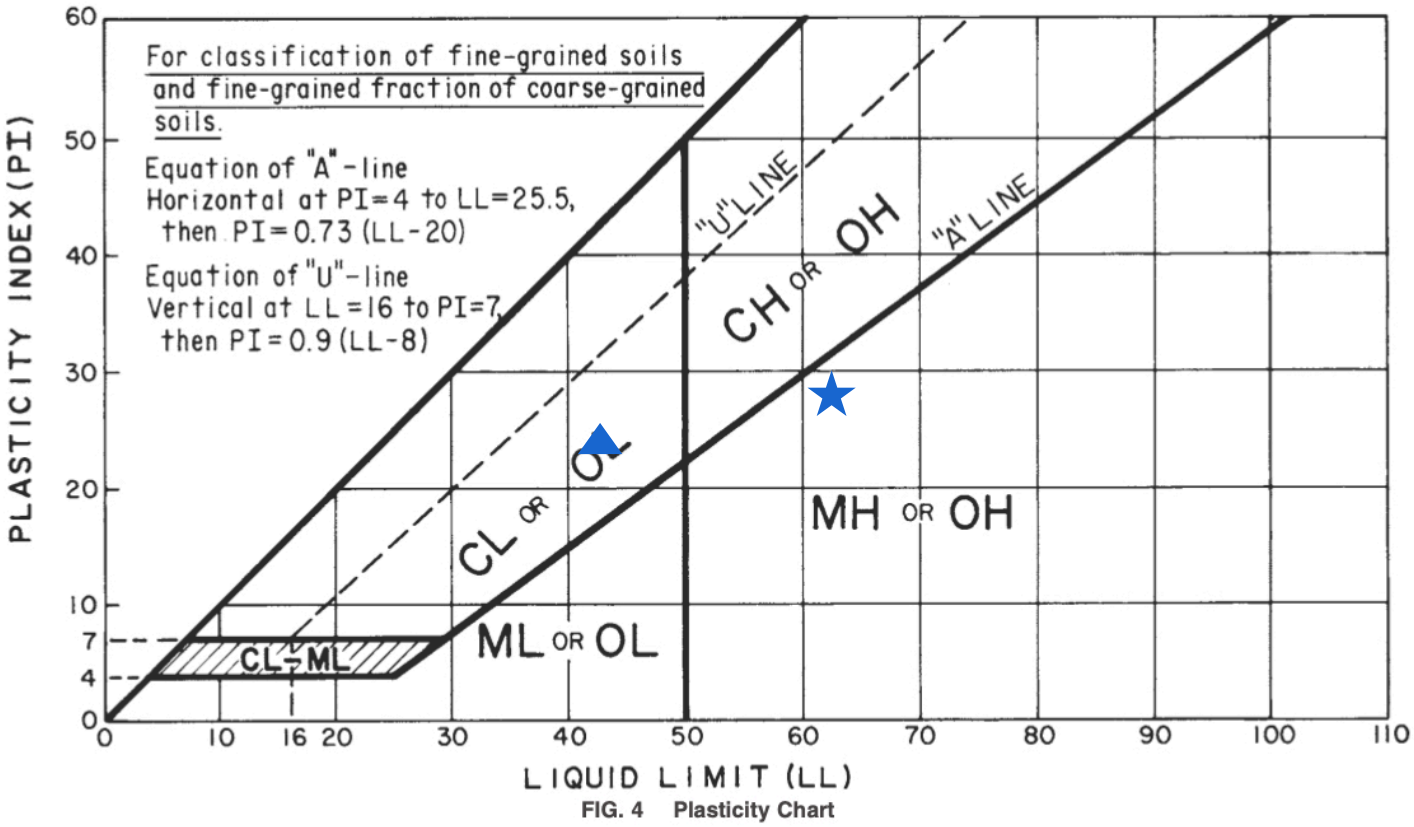


FIG. 4 Plasticity Chart

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