ADDENDUM NO. 1
Water Treatment Plant GAC Facility
City of Cynthiana
Cynthiana, Kentucky

BID DATE: **Wednesday, June 17, 2026 - 10:00 a.m. (Local Time)**

This Supplement to Addendum No. 1 and its noted revisions and attachments to the Drawings and Specifications shall supplement, amend, and become a part of the Bidding Documents, Drawings, and Specifications. All Bids and Construction Contracts shall be based on these modifications.

REVISIONS AND ATTACHMENTS

1. Specifications, Add Appendix A – Cynthiana WTP Geotechnical Report

RFI/RESPONSES – SEE ATTACHED

Ryan Carr

Ryan Carr, PE
Project Engineer
Kentucky Engineering Group, PLLC
P.O. Box 1034
Versailles, KY 40383
Email: rcarr@kyengr.com

May 29, 2026

RFI'S FROM CONTRACTORS
ADDENDUM NO. 1

WATER TREATMENT PLANT GAC FACILITY
City of Cynthiana
Cynthiana, Kentucky

<u>General Questions</u>

1. *Does the plant have a contact and time that contractors are permitted to perform a pre-bid walk on site?*

   RESPONSE: Yes, 8:00 am to 5:00 pm Monday through Friday, Cynthiana Water Treatment Plant, (859) 234-7159

2. *Does the engineer have a design estimate?*

   RESPONSE: $13.2 million

3. *Time of completion does not seem sufficient for the associated scope of work for: excavation, micropile foundation, erection, and installation of equipment for a newly constructed facility. Can you please advise if you have secured lead-times on the Calgon Carbon 12-40 System as well as the expectancy of delivery on the Vertical turbine pumps and equipment panels? If long lead times are anticipated for both, the sequence of construction at the facility would be greatly impacted.*

   RESPONSE: This question will be addressed in a future addendum

4. *Please confirm what special inspections the contractor would be required to supply if any? It is observed that the Owner is responsible for the inspection agency and quality control over structural steel, geotechnical, and cast-in-place concrete.*

   RESPONSE: All special inspections to be covered by the Owner/Engineer.

5. *Please advise if a geotechnical report has been provided with the project bid documents. No appendix has been found.*

   RESPONSE: Appendix A – Geotechnical Report included with Addendum No 1

REPORT OF GEOTECHNICAL EXPLORATION

Cynthiana Water Treatment Plant

Cynthiana, Harrison County, Kentucky

Prepared for: Kentucky Engineering Group, PLLC

September 16, 2025

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APPENDICES

September 16, 2025

Mr. Ryan C. Carr, PE
Kentucky Engineering Group, PLLC
P.O. Box 1034
Versailles, KY 40383
e. rcarr@kyengr.com

Subject: **Report of Geotechnical Exploration**
Granular Activated Carbon (GAC) Facility
Cynthiana Water Treatment Plant
Cynthiana, Harrison County, Kentucky
Solid Ground Project No.: 25-384

Mr. Carr,

Solid Ground Consulting Engineers (Solid Ground) is pleased to present our Report of Geotechnical Exploration. This report is for the proposed Cynthiana Water Treatment Plant development located in Cynthiana, Kentucky. The geotechnical exploration was conducted in general accordance with the scope of work agreed upon via Solid Ground Proposal No. 118425 dated August 15, 2025.

This report contains our findings and recommendations for the referenced project detailed above. Once completed, it is recommended that Solid Ground have the opportunity to review plans and specifications. In addition, it is recommended that Solid Ground be retained to perform observations during earthwork, foundations, and slab-on-grade construction. Solid Ground will not be held responsible for interpretations and field observations made by others.

We appreciate the opportunity to provide our consulting services to you. We look forward to working with you on this and future projects.

Sincerely,
SOLID GROUND CONSULTING ENGINEERS,

STATE OF KENTUCKY
RICHARD R. FARRELL
39392
LICENSED
PROFESSIONAL ENGINEER

Richard Farrell

Rich Farrell, PE
Senior Engineer
Kentucky License Number 39392

Nathaniel O'Leary

Nathaniel O'Leary M.S., GIT
Staff Geologist

1.0 Executive Summary

Solid Ground Consulting Engineers performed a geotechnical exploration in support of the proposed Granular Activated Carbon (GAC) facility at the Cynthiana Water Treatment Plant development located at 200 Williamstown Road in Cynthiana, Harrison County, Kentucky. The approximate coordinates are 38.376220°N, -84.303495°W.

1.1 Summary of Findings

Solid Ground conducted a total of six (6) soil test borings. One (1) of the soil borings was extended beyond auger refusal to include rock coring. All borings were located within the approximate project boundaries.

Soil overburden generally consisted of a layer of topsoil underlain by natural soils described as Lean Clay (CL), Clayey Gravel (GC), and Poorly Graded Sand (SP) with varying amounts of sand, gravel, and silt to auger refusal/boring termination depths.

Three (3) of the borings encountered auger refusal at depth from 15.4 to 17.5 feet, with one (1) of the borings advanced beyond auger refusal to include 10 feet of rock coring. The remaining three (3) borings were terminated at a depth of 15.0 feet.

The preliminary finished floor elevation (FFE) of the granular activated carbon (GAC) facility is currently set at 716.0 feet. The lower pump storage rooms' FFE is set at 697.0 feet. Based on existing grades, minor site grading may be required to facilitate construction as well as achieve the finished grades. Based on existing grades, minor site grading may be required. It should be noted that the preliminary FFE's of 716.0 and 697.0 feet are below the FEMA Zone AE Base Flood Elevation of 718.3 and this condition should be addressed in final design for compliance and resiliency.

2.0 Project Information

2.1 Purpose and Scope of Services

The purpose of this subsurface exploration was to prepare recommendations for design and construction of foundations and floor slabs for the proposed development. Our scope of work included the following:

- A discussion of site surface conditions.

- A discussion of subsurface conditions encountered as well as a discussion of the published geologic conditions at the site including frost penetration depth.
- A summary of field and laboratory testing results including a brief review of our test procedures.
- Boring logs and laboratory tests will be summarized in the report and listed in the appendix.
- A discussion of specific geotechnical conditions and concerns which may affect the design or construction of the project.
- General recommendations for site preparation and construction of compacted fills including use of alternative construction practices.
- Groundwater management recommendations.
- Liquefaction potential and mitigation recommendations.
- Recommendations for foundation design including bearing capacity.
- Anticipated immediate settlement and immediate differential estimates.
- A recommendation for seismic site class according to International Building Code which was adopted by the 2018 Kentucky Building Code (KBC).
- A brief review of our test procedures and the results of all testing conducted.

2.2 Project Description

The project consists of the new construction of a GAC facility at the water treatment plant located at 200 Williamstown Road in Cynthiana, Harrison County, Kentucky. The approximate site location is depicted below in Figure 1.

Figure 1: Approximate Site Location

2.3 Site Conditions

Solid Ground personnel visited the site throughout the geotechnical exploration to observe existing conditions, to help interpret the subsurface data, and to detect conditions which could affect recommendations.

The site is located at 200 Williamstown Road in Cynthiana, Harrison County, Kentucky. The site is currently covered in grass and gravel with a small outbuilding and other miscellaneous materials.

2.4 Structural Loading Information

Based on discussions with the project team, structural loading for the GAC system is anticipated to be 400 kips for each GAC vessel system (which includes two vessels per system) excluding valves and appurtenances.

2.5 Site Grading and Topography

The preliminary finished floor elevation (FFE) of the GAC facility is currently set at 716.0 feet. The lower pump storage rooms' FFE is set at 697.0 feet. Based on existing grades, minor site grading may be required to facilitate construction as well as achieve the finished grades.

3.0 Subsurface Findings and Encountered Conditions

3.1 Review of Previous Site Development and Historical Information

Based on review of historical maps provided by the United States Geological Survey (USGS) (Figures 2 & 3) and historical imagery provided by Google Earth (Figures 4 & 5), it appears the site has remained relatively unchanged in recent years. Historical imagery shows the site has served as a portion of a gravel parking lot since the 1980's. Imagery also shows miscellaneous materials covering the site.

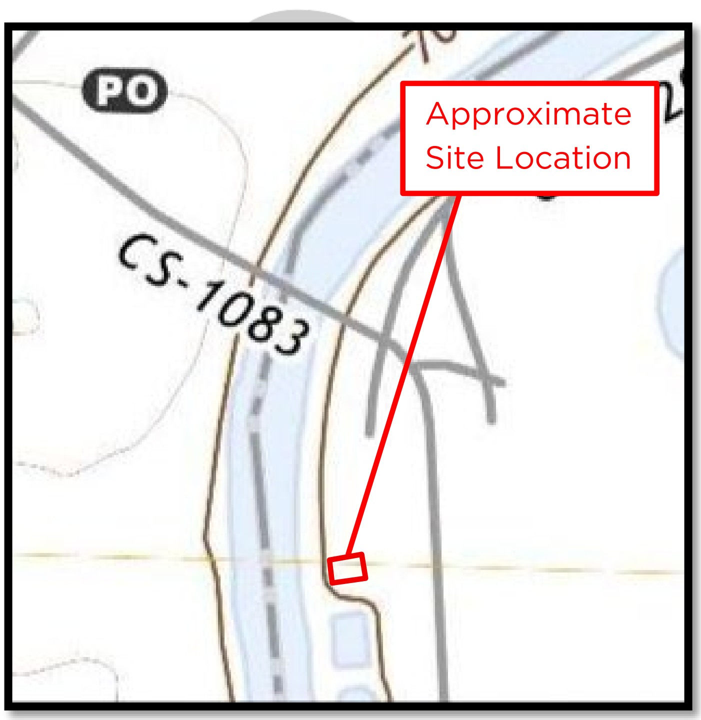

Figure 2: 2022 USGS Topographic Map of Cynthiana Quadrangle

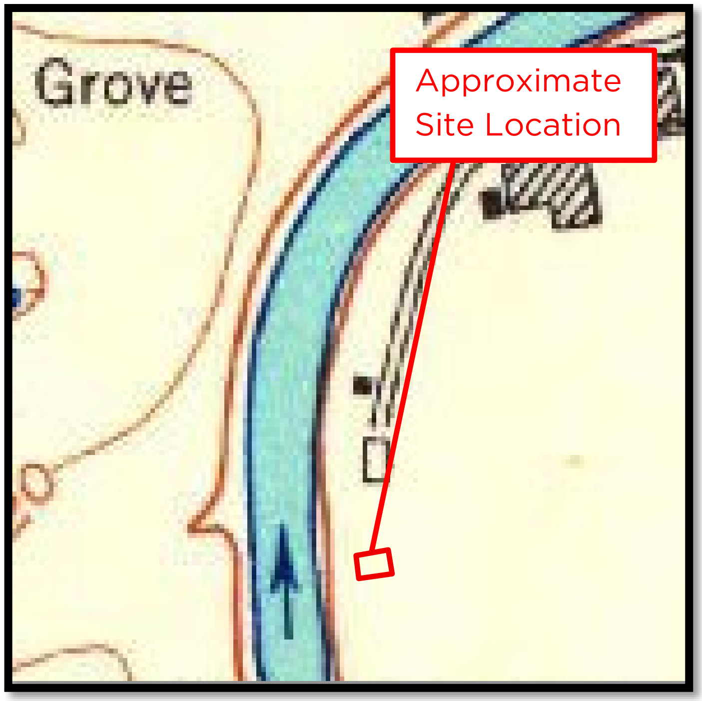

Figure 3: 1961 USGS Topographic Map of Cynthiana Quadrangle

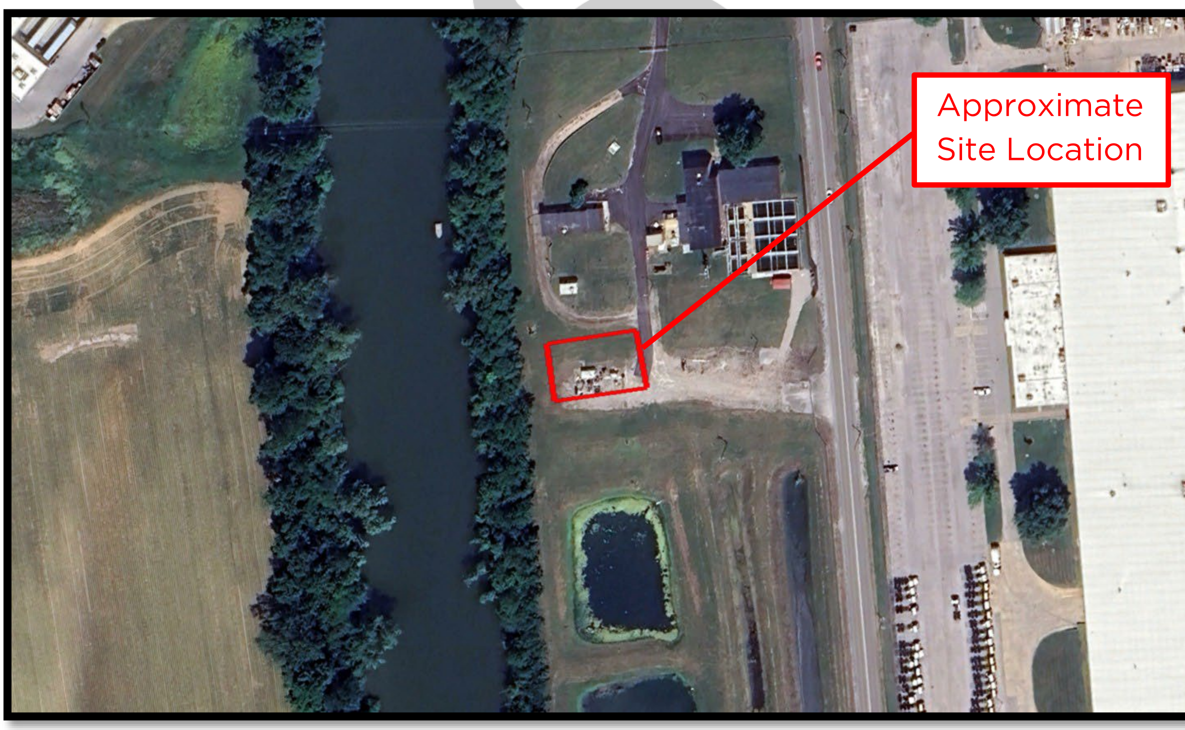

Figure 4: 2023 Google Earth Imagery

Figure 5: 1997 Google Earth Imagery

3.2 Published Geologic Information

Geologic information was referenced from the Kentucky Geological Survey (KGS), geologic maps of the Cynthiana Quadrangle, Harrison County, Kentucky (Figure 6). The site is underlain by Alluvium, with outcroppings of the Upper part of the Lexington Limestone adjacent to the site. Locally, Alluvium is described as silt, clay, sand, and gravel, Quaternary in age. Locally, the Upper part of the Lexington Limestone is described as interbedded shale and limestone.

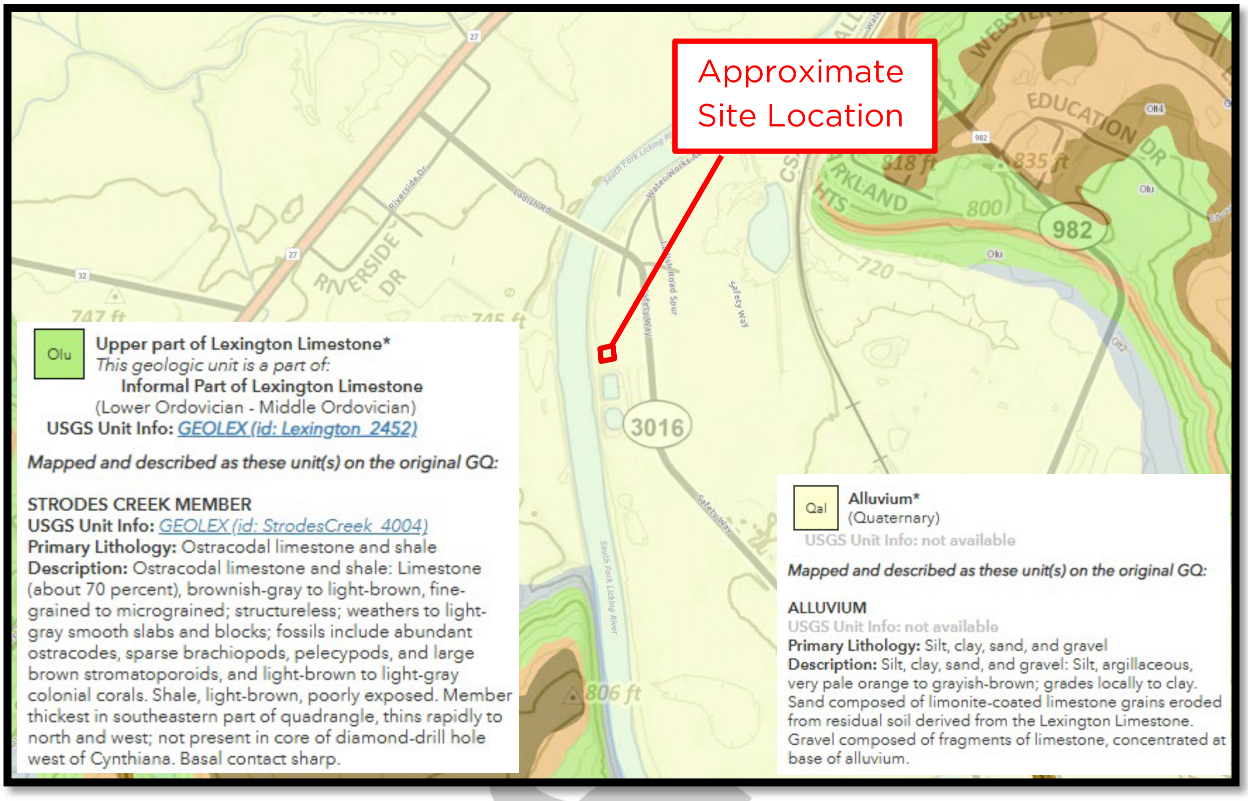

Figure 6: KGS Geologic Mapping

KGS mapping (Figures 6 and 7) indicates the site is mantled by alluvium overlying the Upper part of the Lexington Limestone. The KGS General Karst Potential map classifies the site area as non-karst, though three (3) mapped sinkholes occur nearby and the Lexington Limestone adjacent to the site is rated as having intense karst potential. Core samples from our borings recovered interbedded limestone and shale consistent with the Upper Lexington Limestone.

While widespread karst activity at the site is not indicated, isolated solution features beneath the alluvial cover cannot be ruled out. Although the site itself is classified as non-karst, the presence of mapped sinkholes nearby and the karst-prone Lexington Limestone indicates a non-negligible risk. Isolated solution features beneath the alluvial cover should be anticipated, and mitigation methods such as over-excavation, inverted filters, or grouting may be required if encountered. If voids, raveling soils, loss of circulation, or unexpected grade loss are encountered during construction, contact Solid Ground for evaluation and remediation recommendations.

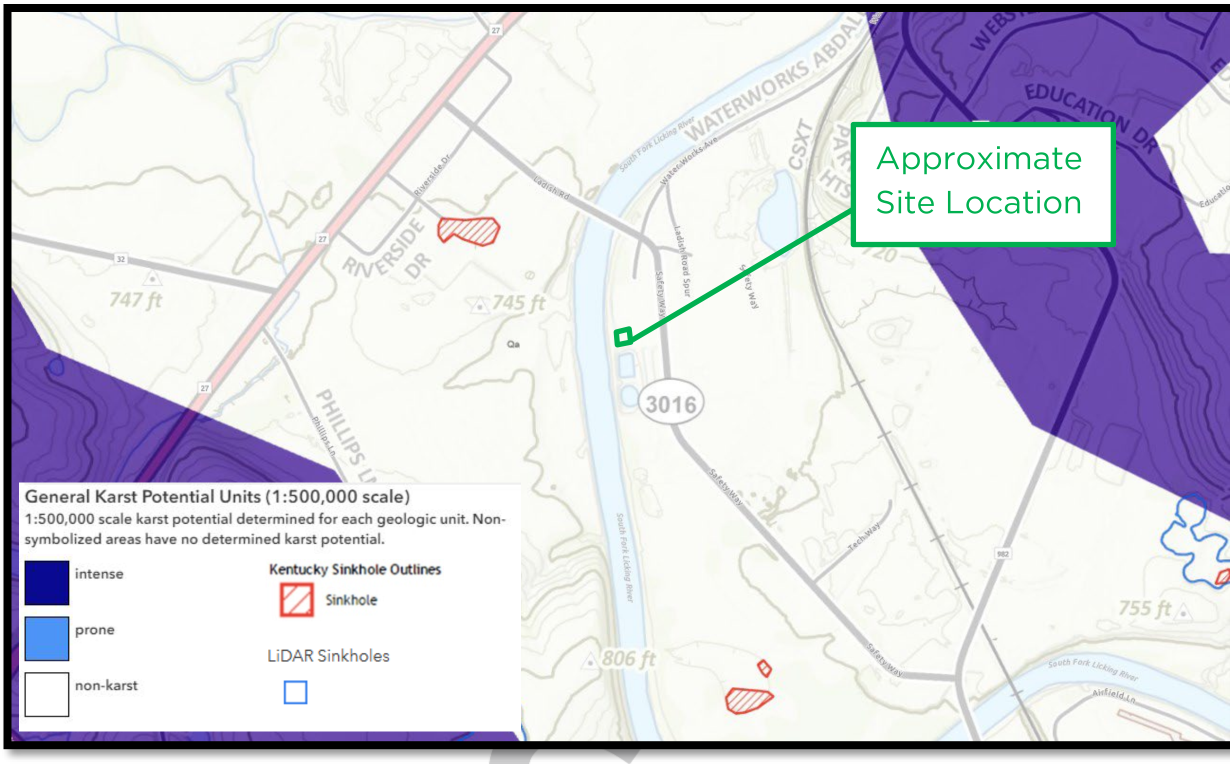

Figure 7: KGS Karst Potential Mapping

3.3 Subsurface Exploration Program

Solid Ground conducted a total of six (6) soil test borings, all located within the approximate site location. One (1) of the soil borings was extended beyond auger refusal to perform rock coring. Borings were located as close to the proposed project as site conditions allowed.

Boring surface elevations were estimated using ArcGIS utilizing LiDAR data. Therefore, the boring locations and surface elevations should be considered approximate. It should be noted that the subsurface conditions will vary between borings, and the representative profile is based upon the borings drilled during the field operations. Boring locations are shown in Figure 8 below.

Figure 8: Approximate Boring Locations

3.4 Subsurface Conditions

The soil samples were classified by Solid Ground personnel according to the Unified Soil Classification System (USCS ASTM D2488; USCS ASTM 2487 for select samples). A description of each soil layer is as follows.

Surficial Materials – The borings encountered a thin surficial layer of topsoil (1-3 inches) in some areas and gravel in others (1-3 inches). It should be noted that thicknesses of these materials may vary across the site. The thicknesses presented in this report should be considered approximate.

Natural Soils - The borings encountered natural soils underlying the surficial materials layer described as Lean Clay (CL), Clayey Gravel (GC), and Poorly Graded Sand (SP) with varying amounts of sand, gravel, and silt to auger refusal/boring termination depths.

The SPT N-values ranged from 3 to over 50 blows per foot, with a consistency of soft to hard/very dense.

Auger Refusal/Boring Termination – Three (3) of the borings encountered auger refusal at depths from 15.4 to 17.5 feet. The remaining three (3) borings were terminated at a depth of 15.0 feet. Table 1 outlines the depths and elevations for the borings.

Bedrock – Boring B-2 had rock coring performed at auger refusal (see Table 1). B-2 encountered slightly weathered to fresh interbedded limestone and shale. The bedrock samples had recoveries of 80% to 92% and rock quality designations of 27% to 98%, indicating poor to excellent rock quality.

Groundwater – Groundwater was not encountered in any of the six (6) borings. Free groundwater levels fluctuate with seasonal weather conditions and may vary. Therefore, the borings may not be representative of the actual free water levels. To achieve an accurate measurement of free groundwater levels, water wells or piezometers should be installed.

Solid Ground should be contacted if groundwater is encountered during earthwork operations. Please note, the groundwater table can fluctuate significantly which could have an impact on the subsurface soils. Table 1 summarizes our findings.

Table 1: Boring Summary

Boring Number	Approximate Surface Elevation (ft)	Auger Refusal Depth (ft)	Auger Refusal/ Termination Elevation (ft)	Total Coring Length (ft)
B-1	714.9	17.5	697.4	--
B-2	713.7	16.3	697.4	10.0
B-3	712.8	15.4	697.4	--
B-4	713.5	15.0*	698.5	--
B-5	714.1	15.0*	699.1	--
B-6	713.9	15.0*	698.9	--

**Indicates Boring Termination*

4.0 Geotechnical Concerns and Considerations

Based on the results of the subsurface exploration and experience with similar projects, we believe the project site is generally suitable for the proposed development. However, some concerns exist with the subsurface conditions as discussed below.

4.1 Surficial Materials

Based on the information gathered from the soil borings, the site has a surficial layer of topsoil (1-3 inches) in some areas and gravel in others (1-3 inches). These thicknesses are representative of conditions encountered at the boring locations only, thickness and aerial extent of the strata may vary across the site. Construction plans should adequately address stripping and the disposal of these materials prior to earthwork operations. Topsoil should only be used as fill in landscaping areas.

4.2 Construction in Cut/Fill Areas

Cut areas have the potential to be overcut, disturbing the in-situ soils to depths below proposed finished grade. Areas to receive fill are stripped of topsoil and are also sometimes disturbed to depths deeper than intended. Both cut and fill areas should be proof rolled prior to construction. Soft, loose, or wet areas should be identified and remediated in accordance with the recommendations provided in the "5.1 Earthwork" section of this report.

4.3 Construction During Wet Conditions

It is understood that potential development could occur during wet conditions. Based on experience with construction projects during wet conditions, subgrade remediation is often required. In addition, delays of earthwork/foundation operations could occur. Clays swell and silts break down when high moisture conditions are present. To stabilize the subgrade materials, drying and recompacting could be required. During wet conditions, the on-site materials may become saturated and are unable to dry in a timely manner. Temporary stabilization strategies such as lime treatment or scheduling work during dry periods should be considered.

Typically, remediation methods consist of undercutting soft and/or saturated soils, moisture conditioning, and recompacting or replacing with a granular stone that is "capped" with dense graded aggregate (DGA). The extent and depth of the undercut is on a case-by-case basis depending on the soil conditions. We recommend contracting Solid Ground to observe earthwork operations and foundation and slab-on-grade construction. In addition, we recommend that the earthwork contractor and the design team adequately budget for remediation repairs.

4.4 Preliminary Liquefaction Potential and Settlement

Liquefaction is the phenomenon where saturated soils develop high pore-water pressures during seismic shaking and lose their strength characteristics. This phenomenon generally occurs in areas of high seismicity where groundwater is shallow. Liquefaction can produce excessive settlement, ground rupture, lateral spreading, or failure of shallow spread foundations.

Three conditions are generally required for liquefaction to occur:

1. The soil must be saturated (relatively shallow groundwater)
2. The soil must be loosely packed (low density)
3. Ground shaking of sufficient intensity must occur to function as a trigger mechanism.

Based on our recommendations for the foundations, the soils should be considered to have low to moderate liquefaction potential.

4.5 Site and Foundation Drainage

Experience has shown that the onsite materials are prone to degradation during wet periods of the year and/or under heavy traffic. Surface and ground water should be controlled while the subgrade fill materials are exposed and use only enough compactive effort to achieve stability and job site requirements for compaction. In addition, it is recommended that foundation concrete, or a concrete bearing medium, be placed the same day that foundation excavation is performed.

The final grade should be sloped away from the structure and pavements a minimum of two percent to promote positive drainage. Roof drains and foundation drains should be installed and should discharge surface runoff away from the structure to provide positive site drainage. It should be noted that drainage should be designed and constructed without impacting neighboring properties. Drainage design is beyond our scope of work.

It is imperative that dewatering be maintained during construction and after development. If positive dewatering methods are not continually applied and maintained, the potential of remedial subgrade measures and long-term settlement is greatly increased.

We anticipate that the primary concern and difficulty during construction will be properly dewatering the site. The contractor should observe the site and understand this report. Drainage design is beyond our scope of services, but Solid Ground can provide drainage design for additional negotiated fees.

4.6 Underground Utilities

Design and Construction plans should adequately address the concern of potential settlement of underground utilities. Please note, all excavations should adhere to applicable codes such as OSHA.

4.7 Soil Compaction Equipment

The soil compaction equipment should be selected by the type of fill anticipated for the site. We anticipate utilizing a sheepsfoot roller at this site for the on-site materials and a smooth drum roller for dense graded aggregate fill.

4.8 Off Site Borrow Material

There is a possibility fill material may be required to achieve the FFE and proposed grading. Offsite borrow material could be required. Construction plans should include this consideration as well as ensure the offsite borrow material meets the recommendations detailed in this report.

4.9 Soil Plasticity

Some of the subsurface soils were classified as lean clay. These soils can have high plasticity characteristics and be subject to volume changes with fluctuations in moisture content. The near surface on-site material is not considered highly plastic. Care should still be taken to mitigate subgrade degradation and reduce subgrade remediation. Therefore, we recommend minimal mitigation efforts consisting of the following:

- Improved site drainage to minimize exposure of these soils to moisture fluctuations, especially near building foundations and slab on grade.
- Minimize exposure of these soils to excessive wetting or drying.
- Deepen soil supported footings past the seasonal moisture change zone.

4.10 Granular Material

Some of the on-site soils consisted of granular material (gravel and sand). This material often does not allow “neat” excavations for foundations and utilities and will slump from the banks into the excavation. We anticipate that this will require additional backfill material and time to backfill. The contractor should account for this additional material and time during the pre-construction phase. If the gravel is to be reused as structural fill, it will likely require blending with the fine-grained soils to allow for proper compaction.

4.11 Silty Material

Some of the onsite soils are comprised of silty material which is prone to breaking down under high moisture and repeated traffic. Care should be taken to not allow water to pond on the site and to reduce the construction traffic across the building pad and paving areas.

4.12 Development within a Karst Region

Solution activity in areas underlain by limestone generally results from a slow process of dissolving the underlying rock units by surface runoff or rainwater. Sinkholes at the ground surface are caused from either a general raveling failure within the soil unit or by rock collapse. Either phenomenon typically results in depressions at the ground surface, which, if large enough, can be identified on topographic maps. In addition to the natural causes of sinkhole development previously discussed, sinkholes may form as a result from water leaking from subsurface piping and drainage systems such as buried water and sewer pipes, septic lateral fields, and roof drains beneath the building and floor slabs.

As previously stated, the Kentucky Geological Survey rates the site as not being prone to karst development, but underlying units cored included karst prone samples of limestone. It is not possible to remove all risk associated with construction over known sinkholes or in karst areas. Our experience indicates that the limestone formations mapped underlying the site pose a high risk for solution activity and sinkhole formation. The natural rising and lowering of the ground water table and surface water migration downward through the subsurface soils can create the risk of continued soil migration into solution voids in the underlying limestone.

There is potential for sinkholes to be encountered during construction, especially in cut areas and along the northern portion of the site. Solid Ground should be contacted if a solution feature or other karst feature is encountered during construction. Repair methods of sinkholes and other karst features exist. When sinkholes are encountered, the common practice is to excavate the soil from within the solution feature down to hard bedrock. The two most common methods of remediation are a concrete plug or an inverted filter.

We believe the risk with this development is no greater than for similar developments in the area. To further reduce the risk of unidentified sinkholes at the site would require the implementation of more sophisticated and expensive geotechnical exploration methods including borings or test pits on a tightly spaced grid or geophysical methods.

4.13 Flood Zone

The site sits within Zone AE, the 1% Special Flood Hazard Area which correlates with the 100-year flood. The base flood elevation for Zone AE in this area is approximately 718.3 feet. Since the planned finished floor elevations of 716.0 ft and 697.0 ft are below the mapped base flood elevation of 718.3 ft, the proposed structure is technically below the 100-year flood elevation. Additional measures such as raising the FFE, incorporating floodproofing, or coordinating with FEMA/local floodplain authorities should be considered. This issue may also impact permitting and insurability.

4.14 Temporary Shoring of Excavation

We anticipate that temporary shoring and or cofferdams may be required for the construction of the proposed facility. Groundwater will likely be a concern for excavations due to the proximity of the South Fork Licking River to the proposed facility. If a sloped or benched excavation is utilized, the excavation should comply with local, state, and federal safety regulations including the OSHA excavation safety standard under OSHA 1926 Subpart P. The shoring system may need to be substantial due to the excavation depth, potential groundwater influence, and potential surcharge loading from construction equipment. Construction plans should explicitly address these considerations, and it is strongly recommended that the structural engineer, specialty structural engineer, or contractor design a system that accommodates these conditions.

Earthwork contractors should be aware that vertical and near-vertical cuts in granular soils are prone to raveling and may experience significant caving failures under unfavorable conditions. Appropriate precautions should be taken to shore the excavation to ensure safety and stability. All shoring and bracing systems should comply with applicable local, state, and federal safety regulations, including OSHA excavation and trench safety standards under OSHA 1926 Subpart P. The design and construction of temporary or permanent shoring or dewatering systems is the responsibility of the contractor and is beyond the scope of this geotechnical exploration. Construction plans should also address the potential for undermining existing structures, roadways, and hardscapes adjacent to the site. Solid Ground is available to provide a competent person to evaluate temporary and permanent slopes in the field, as required.

4.15 Excavation Bottom Heave

The excavation for the proposed facility poses potential concerns for bottom heave, particularly since the excavation will likely be dewatered and the soils are expected to consist of sands, clays, and gravels. These soil types may experience upward pressure from the underlying groundwater and stress redistribution during dewatering, leading to heave. The extent of heave will depend on the permeability and stiffness of the soils, as well as the depth of the excavation and the efficiency of the dewatering system. To mitigate this risk, a detailed analysis of the excavation and shoring system is recommended. Construction sequencing and stabilization measures, such as temporary over-excavation with structural backfill or ground improvement techniques, may also be required to control heave and maintain the stability of the excavation.

4.16 Uplift Considerations

The proposed structures should be evaluated for potential uplift forces resulting from buoyancy due to the presence of groundwater. There is potential for groundwater elevations to vary significantly with the river elevations. Floodwaters are also a concern due to the structure FFE's sitting within the Zone AE Special Flood Hazard Area. Given that groundwater levels may fluctuate seasonally or due to site-specific hydrogeological conditions, the design should ensure that the structure's weight, combined with any soil overburden and anchoring measures, adequately counteracts the potential uplift forces. The use of a heavier bottom slab, additional ballast, or anchoring systems should be considered to mitigate the risk of flotation. Site-specific hydrostatic pressures should be calculated to verify stability under the most critical groundwater conditions. With the groundwater information available at the time of this report, it may be necessary to consider the Zone AE flood elevations for hydrostatic pressures during design. Monitoring wells or piezometers can be installed to gather groundwater data to assist in design.

5.0 Confirmation-Dependent Recommendations

The following recommendations are based on the information gathered and subsurface conditions encountered during this limited exploration. We have developed these recommendations under the assumption that our sampling performed on the site accurately portrays conditions that are not immediately visible due to earth, rock, water, or time. It should be noted that Solid Ground cannot be held liable for fill placed or performance of the subgrade without observations to confirm that conditions in the field are consistent with inferences from the samples we obtained. **It is recommended to retain Solid Ground to observe proof rolling of the building pads and pavement areas, prior to and during fill placement.**

It is recommended to retain Solid Ground to perform construction materials testing and special inspection for the duration of construction to both maintain speed of construction and overall project costs. Please note, if earthwork construction begins during wet weather conditions there is a possibility that the schedule will be prolonged and extensive remediation, or a more robust geotechnical recommendation will be required.

5.1 Earthwork

5.1.1 Site Preparation

- Topsoil and other surficial materials should be stripped to prepare the site for construction.
    - In-place density testing should be performed to check that the previously recommended compaction criteria have been achieved.
    - Fill placement should be monitored on a full-time basis by Solid Ground during site grading.
    - Fill placement should extend to a minimum of 10 feet beyond the building footprint.
- After stripping and cutting operations, the subgrade should be evaluated by Solid Ground. Possible remediation methods may be required if the subgrade and site soils are exposed to wet weather conditions.
- Possible remediation methods may be required if the subgrade and site soils are exposed to wet weather conditions.

- The building pad may require stabilization prior to new fill placement or slab-on-grade construction. Solid Ground should be consulted to assist in selecting the most appropriate method for site conditions. These methods may consist of any or combination of the following:
  - Tensar geogrid reinforcement.
  - "Walking" No. 2 stone into the soft subgrade.
  - Application of compacted DGA.

5.1.2 Structural Fill Placement

The preliminary FFE of the GAC facility is currently set at 716.0 feet. The lower pump storage rooms' FFE is set at 697.0 feet. We anticipate minor site grading and the addition of 3-4 feet of engineered fill will be required to achieve finished grade. Backfill materials for structural fill placement may consist of soil or durable crushed stone. The following steps are recommended for fill placement within the building pads. **The onsite soils are expected to meet the requirements of structural fill. Offsite borrow material may be necessary to achieve finished grade but cannot be ruled out without a review of the final site grading plans.**

Structural fill material is defined as the following:

- Inorganic natural soil with maximum particle sizes of 3 inches.
- Liquid Limit no greater than 50 percent and Plasticity Index no greater than 30 percent.
- Fill should be virtually free of organic material.
- Solid Ground should observe the material to confirm the soils meet applicable standards for structural fill.
- Other sources of structural fill should be verified by Solid Ground.
  - If other sources of structural fill are anticipated, Solid Ground should collect a bulk sample for Standard Proctor testing.

The following are recommendations for placement of soil structural fill:

- Structural fill should be placed in no greater than 8-inch-thick layers.
- Structural fill should be compacted to at least 98 percent of the soil's maximum dry density as determined by the Standard Proctor Compaction test (ASTM D698).
- The moisture content of the fill material should be maintained within 2 percent (above or below) of its Standard Proctor optimum moisture content depending on the results of the Proctor tests.

- In-place density testing should be performed to check that the previously recommended compaction criteria have been achieved.
- Fill placement should be monitored on a full-time basis during site grading.
- Fill placement should extend to a minimum of 10 feet beyond the building footprints.

5.1.3 Protection of Earthwork

Common earthwork construction practices can leave soils exposed for long periods of time while work is performed in other areas of a site. Care should be taken during the earthwork phase to protect soils from degradation caused by sunlight, wind, precipitation, and other factors. Solid Ground recommends that any exposed soil be protected by straw, seeding, rock, or other methods if the area the soil is in will be left unattended for more than three days. Any soil left unattended or unprotected for more than three days should be re-evaluated prior to continuation of work.

5.2 Foundations

5.2.1 Discussion

Given the anticipated heavy equipment loads and the presence of soft to low consistency alluvial soils over bedrock at depth, we recommend supporting the proposed tanks and structure footings on deep foundations that bear in competent bedrock. Two systems are suitable for this site: grouted micropiles or drilled shafts with rock sockets. Either system can be designed to resist the required vertical loads as well as lateral and seismic demands. The final selection can be made during design after considering access, contractor means and methods, schedule, and cost. Foundations for the tanks and structure footings should be structurally isolated from adjacent slabs or other elements on shallow foundations to limit differential settlement, and isolation joints should be provided so shallow founded elements can move independently. Final element sizing, tip elevations, and verification testing will be established after confirmation of bedrock quality. Due to the anticipated FFE of the lower pump rooms, we anticipate the lower pump rooms can utilize mat foundations bearing directly on bedrock. Please note mat foundations may require uplift anchors or significant ballast to resist buoyancy from hydrostatic pressures.

5.2.1.1 Micropiles

Micropiles are a deep foundation element constructed using high-strength, small diameter steel casing and/or threaded bars. The micropile casing generally has a diameter in the range of 3 to 10 inches. Typically, the casing is advanced to the design depth utilizing a duplex drilling technique where the casing and drill rod inside the casing are advanced simultaneously. The casing may extend the full depth or end above the bond zone with the reinforcing bar(s) extending to the full depth or several feet into the bottom of the casing.

- Micropiles utilize a steel pile cap that is cast into the concrete foundation.
- We do anticipate some false shallow refusal during installation. The micropiles should be designed to be cased through the overburden and fill.
- Micropile design should be verified through a testing program that includes verification and proof testing performed in accordance with the design engineer and manufacturer's recommendations as well as per the building code requirements.
- Micropile design should include analysis of the casing joints in situations where a bending moment and/or shear force is applied across the casing joint.
- Micropile design should consider any potential down drag forces exerted on the micropile due to settlement of the soils surrounding the micropile.

We recommend using a preliminary ultimate grout to ground bond strength of 75 PSI (pounds per square inch) for the micropile bond zone in competent limestone with interbedded shale. The ultimate grout to ground bond strength can likely be increased through verification testing of sacrificial micropiles. The micropile casing should extend a minimum of 2 feet (plunge depth) into competent rock and the bond may start at the bottom of the micropile casing. Each micropile should have a minimum bond length of 5 feet in competent limestone below the casing plunge depth. Actual bond lengths will be determined during the micropile design.

Micropile testing should be observed, and test results should be approved by the Geotechnical Engineer of Record. A detailed settlement analysis was beyond the scope of this report. Micropiles should have estimated immediate settlement of less than 0.25 inches, long-term settlement of less than 0.5 inches, and differential settlement of less than 0.5 inches. Once the design is finalized, we recommend allowing us to review the plans and specifications.

Table 2 – Generalized Micropile Design Parameters for Competent Bedrock

Bedrock Description	Preliminary Ultimate Bond Strength, PSI	Minimum Casing Plunge Depth (ft)	Minimum Bond Length in Bedrock (ft)
Interbedded Limestone and Shale	75	2	5

Spacing Requirements

Due to the potential for Karst geology and potential fractured bedrock, we recommend a minimum center-to-center pile spacing of 30 inches or 3 pile diameters, whichever is larger. This restriction is necessary to limit group effects and damage to adjacent micropiles.

Quality Control Requirements

Each micropile installation should be observed by the Geotechnical Engineer of Record to ensure the design bond length is established in competent limestone bedrock. The number of micropile verification tests should vary with the size of the area being supported with micropiles, varying diameters of micropiles, and changes in drilling methods. Verification test results should be sent to the Geotechnical Engineer of Record for approval. Once verification tests are approved, a certain percentage (typically 5 percent) of the production micropiles should be proof tested. Solid Ground personnel performing inspections can determine in the field if the micropile is bonded in the appropriate material or if the micropile needs to be installed deeper.

We recommend that the micropile construction be observed by Solid Ground. The observation should address the following items:

- Correct plan dimensions
- Plumbness within tolerances
- Materials excavated agree with borings
- Verification of bond zone material
- Construction procedure

Discussion with Design Team for Micropiles

Due to the variable loading and structure information for this site we recommend that the structural engineer work with the micropile design engineer to develop the micropile and pile cap design as the optimization of both designs are dependent on each other and could have cost savings to the owner.

5.2.1.2 Drilled Shafts

We recommend using a maximum net allowable **competent bedrock** bearing pressure of **25,000 PSF** (pounds per square foot) for foundations utilizing drilled shafts. Any capacity from the soil overburden should be neglected for drilled shafts. Competent bedrock can be used for end bearing, provided the appropriate net allowable bearing capacity. Each drilled shaft should have a minimum rock socket depth of 1D (D being the Diameter of the Drilled Shaft). We recommend that a 5-foot test hole or rock core be observed at each shaft once bottom of shaft elevation is achieved.

This allowable bearing pressure assumes that the bearing material for each drilled shaft will be observed and approved by the geotechnical engineer of record. A net allowable skin friction of 2,000 PSF is available for rock socket capacity considerations. **However, the end-bearing should be at least 65 percent of the total design capacity.**

Competent bedrock is defined as slightly weathered or better limestone with interbedded shale bedrock, a RQD (rock quality designation) of 70% or better, and with no fractures in excess of 6 inches. Competent bedrock should be verified by the Geotechnical Engineer during foundation placement.

Total and differential settlements of foundations bearing on continuous limestone with interbedded shale, using the recommended bearing pressure, should be about 1/2 inch or less. Once the design is finalized, we recommend allowing us to review the plans and specifications.

Table 3 – Generalized Design Parameters for Competent Bedrock

Bedrock Description	Net Allowable Skin Friction, PSF	Net Allowable Uplift Skin Friction, PSF	Net Allowable Bearing Capacity, PSF	Lateral Bearing Capacity, PSF/ft
Limestone with Interbedded Shale	2,000	750	25,000	600

Drilled Shaft Construction Considerations

Given that drilled shafts are anticipated to bear upon limestone with interbedded shale bedrock, the drilled shafts should be placed the same day that they are open or no later than 12 hours after opening. If the rock socket of the shafts appears to be degraded within the first 12 hours after opening, an additional 1 vertical foot of over-excavation will be required. It is imperative to excavate, and place concrete the same day to ensure the bearing is protected from wet weather that could potentially cause degradation of the bedrock.

Construction Considerations (Dry Method)

- Clean the foundation bearing area so it is nearly level or suitably benched and is free of ponded water or loose material.
- Provide a minimum drilled shaft diameter of 30 inches for cleaning, bottom preparation, and inspection. If the drilled shaft is less than 36 inches an air test hole can be performed either with an air track rig or by coring to observe the end bearing conditions at each drilled shaft.
- Make provisions for ground water removal from the drilled shaft excavation. Ground water conditions at this site will require the use of special procedures to achieve a satisfactory foundation installation.
    - If water is flowing into the drilled shaft at less than 20 gallons per minute, pumps may be used to maintain less than 2 inches of water in the drilled shaft during cleaning and inspection.

After approval of the bearing surface, the pumps should be pulled, and concreting commenced immediately.

  - If more than 20 gallons per minute are flowing into the drilled hole, the water level should be allowed to stabilize before attempting to place the concrete. For this condition, concrete placement should be accomplished using a tremie pipe or concrete pumping equipment.

- Specify concrete slumps ranging from 4 to 7 inches for the drilled shaft construction.
- Retain Solid Ground to observe foundation excavations after the bottom of the hole is leveled, cleaned of any mud, and dewatered.
- Install a temporary protective steel casing to prevent side wall collapse, prevent excessive mud and water intrusion, and to allow workers to safely clean and inspect the drilled shaft.
- Clean the socket "face" prior to concrete placements. Cleaning will require washing if a mud smear forms on the face of the rock. Solid Ground should approve the rock socket surface prior to concrete placement.
- The protective steel casing may be extracted as the concrete is placed provided a sufficient head of concrete is maintained inside the steel casing to prevent soil or water intrusion into the newly placed concrete.
- Direct the concrete placement into the drilled hole through a centering chute to reduce side flow or segregation.
- Solid Ground recommends a 15 percent concrete overage allowance for seams and cracks in surrounding bedrock.

Construction Considerations (Slurry Method)

- Provide a temporary steel casing to prevent side wall collapse, above the ground water level.
- Prior to drilling, install the temporary steel casing to a minimum depth of 10 feet below the expected ground water level using driving techniques.

- Use a bentonite slurry suspension to support the uncased portion of the drilled shaft.
- Circulate or agitate the bentonite slurry to prevent silt- and sand-sized particles from settling of the suspension prior to concreting.
- Pump or tremie the concrete to the bottom of the driller shaft. If a tremie is used, place a plug in the tremie pipe to reduce exposure of the concrete to water.
- Use a concrete mix with a design slump of 5 to 7 inches for drilled shaft concrete.
- Extract the temporary steel casing as the concrete is placed. Maintain a positive head of concrete above the casing bottom as the casing is extracted.
- The protective steel casing may be extracted as the concrete is placed provided a sufficient head of concrete is maintained inside the steel casing to prevent soil or water intrusion into the newly placed concrete.
- Overfill the drilled shaft with concrete to aid in wasting drilled shaft concrete contaminated by exposure to the slurry solution and suspended sediment. We recommend that project planning include a minimum of 15 percent concrete waste. The actual quantity of contaminated concrete removed from the drilled shaft should be governed by site observations of the geotechnical engineer monitoring the drilled shaft installation.
- Solid Ground recommends a 15 percent concrete overage allowance for seams and cracks in surrounding bedrock.

Rock Excavation

Our borings encountered varying depth to refusal. Our experience with the underlying bedrock formation indicates the rock will be slightly to moderately weathered. Typically, an average depth of rock removal of 1/4 to 1 shaft diameters should be anticipated to provide a level bottom and rock suitable to achieve the allowable bearing pressure. In some cases, the depth of rock removal may extend.

Our experience indicates general drilled shaft construction and delineation of "rock" in the excavation is greatly facilitated if suitable drilling equipment is used.

We recommend the use of a drill capable of producing at least 500,000-inch pounds of torque and 35,000 pounds of downward force. Additionally, we recommend that rock be defined as material which cannot be penetrated by a heavy-duty earth auger with hardened teeth at a rate in excess of 6 inches per minute.

Quality Control Requirements

Each drilled shaft should be excavated to appropriate bearing medium as outlined in this section and be inspected by Solid Ground. We recommend that all drilled shaft locations have probe holes performed to remove the need for costly and time-consuming down hole inspections. **We do not recommend downhole inspections**. Solid Ground personnel performing inspections can determine in the field if the shaft is on appropriate bearing material or if the shaft needs to be excavated deeper. The geotechnical engineer will evaluate the condition of the bearing material.

We recommend that the drilled shaft construction be observed by Solid Ground. The observation should address the following items:

- Correct plan dimensions
- Plumbness within tolerances
- Materials excavated agree with borings
- Statement of bottom cleanliness
- Construction procedure

5.2.1.3 Lower Pump Room Mat Foundations

Based on the subsurface conditions encountered, information gathered during this exploration, and past knowledge of the site's development, we recommend that the lower pump room foundations be designed as mat style slabs bearing on bedrock. If bedrock is not at the bottom of slab elevation, flowable fill can be utilized from the bedrock surface up to the bottom of slab elevation. As previously mentioned, uplift anchors and/or additional ballast may be required to resist buoyancy forces from hydrostatic pressures.

We recommend the use of a maximum net allowable bearing pressure of 3,000 PSF (pounds per square foot) for foundations bearing on these materials.

A detailed settlement analysis was beyond the scope of this report. Based on the assumed structural loads, the available site grading information, the recommended bearing pressure, knowledge of the site's development and empirical correlation for the subsurface conditions encountered beneath the proposed structure, we estimate the total settlement of the foundation to be about 1/2 inch or less and differential settlement of the foundation to be about 1/4 inch or less.

Once the design is finalized, we recommend allowing Solid Ground the opportunity to review the plans and specifications.

5.3 Slab-on-Grade

We assume that the slab on grade will be utilized for light loads with 150 pounds per square foot maximum. If this assumption is incorrect, Solid Ground should be contacted to modify recommendations.

- It should be noted that if the site soils are exposed to wet weather conditions or continuous construction traffic, the soils have potential to degrade and will lose their strength. This could require a more robust subgrade improvement design.
- It is imperative that dewatering be continuous and construction traffic be controlled away from the building pad.
- It should be noted that the means and methods of construction that will be performed by others will heavily dictate the suitability and sustainability of the site conditions and building service life during and after construction.

The following recommendations should be followed:

- Solid Ground should observe the finished subgrade utilizing proof rolling once grading is completed. If excessive pumping and/or rutting is observed remediation may be required. Typical remediation methods consist of undercutting the unsuitable soil and placing recompacted soil or granular material.
- If construction is to take place during wet periods of the year, there is a potential that remediation methods will be required to stabilize the soil subgrade. Solid Ground should be consulted to assist in selecting the most appropriate method for site conditions. These methods may consist of any or combination of the following:

  - Tensar geogrid reinforcement.
  - "Walking" No. 2 stone into the soft subgrade.
  - Application of compacted DGA.
- It is imperative that quality control be performed specifically for the slab on grade to ensure that moisture contents, as well as compaction efforts, are within optimum.
- It is recommended that the floor slab be constructed with an open graded stone base of a minimum of **6 inches** in thickness. The floor slab should be constructed with a minimum of **4 inches** of reinforced concrete.
- A subgrade modulus, *k,* of 70 pounds per cubic inch (pci) for design of the floor slab supported by granular material.
- Control joints should be placed per the most recent ACI standards and guidance.
- The floor slab should be fully ground-supported. This will reduce the possibility of cracking and displacement of the floor slab due to differential settlement.

It is recommended to perform proof rolling prior to placing stone to serve as the slab working base, and again immediately prior to constructing the slab.

5.4 Seismic Site Classification

The Seismic Site Classification assumes shallow soil bearing mat foundations will be utilized. This classification is based on the seismic standards and design values from the 2009 NEHRP Recommended Seismic Provisions and the 2010 ASCE-7 Standard. Based on the results of our exploration and the geology of the area, we assign a site seismic classification of "D". Seismic site classification is anticipated to improve to an "A" with the utilization of a deep foundation system.

5.5 Below Grade Walls

Based on our understanding of the project, below grade walls will be required for this development. The potential for groundwater may make it necessary to consider hydrostatic pressure in the wall design, as undrained conditions may not be able to be avoided. The following recommendations provide guidance for the design of below grade walls under drained conditions, but the wall system should also account for hydrostatic pressures under fluctuating groundwater levels.

Hydrostatic and Earth Pressure Design

The following table (Table 4) presents equivalent fluid pressure (EFP) values for at-rest, active, and passive conditions for typical backfill materials. For undrained conditions, hydrostatic pressure should be combined with these EFP values in the wall design. Additionally, surcharge loads generated by construction equipment, adjacent structures, and infrastructure should be considered, and a factor of safety should be incorporated into the design. These factors are not addressed in this report and should be determined by the structural engineer of record.

Table 4 – Equivalent Fluid Pressures

Backfill Material	At Rest (PCF) Drained Condition	Active (PCF) Drained Condition	Passive (PCF) Drained Condition
Anticipated Well Graded Gravel sloping towards the wall (Φ = 38°)	50	30	600
Anticipated Alluvial soil sloping towards the wall (Φ = 26°)	70	50	320

Foundation support and Sliding Resistance

It is assumed the retaining walls will be supported by mat foundations. Below grade wall foundations should utilize the foundation recommendations outlined in Section 5.2. To resist sliding, a coefficient of friction of 0.35 between bedrock and concrete may be used.

Design Considerations

Given the potential inability to drain water from behind the walls, the structure design should consider hydrostatic uplift and lateral hydrostatic pressures. The design should include the following considerations:

- **Hydrostatic Pressure**: Account for the groundwater height relative to the bottom of the structure.

- **Structural Reinforcement**: Provide sufficient wall reinforcement to resist combined earth and hydrostatic loads.
- **Bottom Slab**: The bottom slab should be designed to counteract buoyancy forces due to groundwater uplift.
- **Waterproofing**: The walls and slab should be constructed of watertight concrete or treated with appropriate waterproofing systems to ensure durability under constant submersion.

Temporary shoring and dewatering systems will be critical during construction to maintain excavation stability and manage groundwater intrusion. The design of these systems should account for the significant hydrostatic pressures and seepage forces that will occur during excavation. Construction sequencing should be planned to minimize the time the excavation is exposed to groundwater

5.6 Plan Review

To better ensure confirmation of the final design documents with the recommendations contained in this report, and to better comply with the building department's requirements, Solid Ground should review the completed project plans prior to construction. The plans should be made available for our review as soon as possible after completion so that we can better assist in keeping your project schedule on track.

We recommend that the following project-specific note be added to the architectural, structural, and civil plans: "The geotechnical aspects of the project, including site grading, utility and foundation excavations, slab on grade construction, placement and compaction of engineered fill, installation of site drainage should be performed in accordance with the recommendations of the *"Geotechnical Report prepared by Solid Ground Consulting Engineers, dated September 16, 2025."*

5.7 Construction Monitoring and Observations

Based on experience, in order to obtain the Certificate of Occupancy for this development, you will be required to directly contract a qualified and certified inspection firm to provide special inspection items consisting of observing the following:

- Soil Fill Placement

- Foundation Construction
- Concrete Placement
- Reinforcement Placement
- Masonry Construction
- Steel Construction

It is advantageous to the owner to contract with Solid Ground to provide construction monitoring and observations for this project. Some of those benefits are as follows:

- As the Geotechnical Engineer of Record (GEoR) for this project, we will provide confirmation that subsurface conditions exposed during construction are substantially the same as those interpolated from our limited subsurface exploration, on which the analysis and design were based.
- The recommendations in this report are based on limited subsurface information. The nature and extent of variation across the site may not become evident until construction. If variations are then exposed, it will be necessary to re-evaluate our recommendations. If subsurface conditions differ from those anticipated, we as the GEoR will provide recommendations if deemed necessary.

6.0 Report Limitations

This report has been prepared for the exclusive use of the *Kentucky Engineering Group, PLLC and Mr. Ryan Carr* for specific application to the project site. Our recommendations have been prepared using generally accepted standards of geotechnical engineering practice in the Commonwealth of Kentucky. No other warranty is expressed or implied.

The recommendations provided are based on the subsurface information and other findings obtained by Solid Ground as well as the information provided by you. If there are revisions to the plans for this project or if subsurface conditions detailed in this report are encountered during construction that are different than our exploration, we should be notified immediately to modify the foundation recommendations if deemed necessary. We cannot be held responsible for the impact of those conditions on the project if those impacts are not made known to us.

The scope of services did not include an environmental assessment for determining the presence or absence of wetlands or hazardous or toxic materials. Any statements in this report or on the boring logs regarding odors, colors, and unusual or suspicious items or conditions are strictly for informational purposes.

7.0 Associated Geotechnical Risks

The analytical tools which are used by the geotechnical engineer in this area are generally empirical and must be used in conjunction with professional engineering judgment and experience. Therefore, the recommendations presented in this geotechnical exploration should not be considered risk-free and are not a guarantee that the proposed structure will perform as planned. The engineering recommendations presented in this are based on the information gathered during the subsurface exploration, information provided by you and experience with similar projects.

APPENDICES

APPENDIX A – BORING LOGS

APPENDIX B – LAB RESULTS

Soil Boring: B-1

SOLID GROUND CONSULTING ENGINEERS

Project: Cynthiana Water Treatment Plant
Location: Cynthiana, Kentucky
Project Number: 25-384

Date Started: 08/22/2025	Date Completed: 08/22/2025	Coordinates: 38.376160, -84.303635
Location Accuracy: Estimated from Google Maps	Client Name: Kentucky Engineering Group, PLLC	Hammer Type: Auto
Method: Auger	Depth: 17.5'	

Rig Type: Diedrich D-50
Tooling: 4" Solid Stem Auger
Surface Elevation: 714.9'

Depth (ft)	Elevation (ft)	Graphic Log	Visual Classification and Remarks	Depth of Sample (ft)	Sample Graphic	Blow Counts	Uncorrected N-Value	Moisture Content (%)
0	714.9	Topsoil	**Topsoil** (0.2)	0 ft	SS	14-9-9	18	
0.2		CL	**Silty Lean Clay**, very stiff, dry, brown (CL)					
3.5		CL	3.5': moist, firm	3.5 ft	SS	3-4-4-4	8	21.6
5	710							
6		CL	6': moist	6 ft	SS	2-4-4-4	8	
8.5		CL	8.5': greenish brown, soft	8.5 ft	SS	1-1-2-2	3	
10	705							
13				13 ft	SS	2-2-2-2	4	28.8
13.5		CL	13.5': little sand					
15	700							
17.5			17.5					

Auger refusal at 17.5'

Graphics Legend

- CL
- Topsoil
- SS - Small Split Spoon

Water Levels

- ∇ -
- ▼ -

Soil Boring: B-2

SOLID GROUND CONSULTING ENGINEERS

Project: Cynthiana Water Treatment Plant
Location: Cynthiana, Kentucky
Project Number: 25-384

Date Started: 08/22/2025	Date Completed: 08/22/2025	Coordinates: 38.376246, -84.303601
Location Accuracy: Estimated from Google Maps	Client Name: Kentucky Engineering Group, PLLC	Hammer Type: Auto
Method: Auger	Depth: 26.3'	

Rig Type: Diedrich D-50
Tooling: 4" Solid Stem Auger
Surface Elevation: 713.7'

Depth (ft)	Elevation (ft)	Visual Classification and Remarks	Depth of Sample (ft)	Sample Graphic	Blow Counts	% Recovery	% RQD	Uncorrected N-Value	% Fines	Moisture Content (%)
0–0.3		**Topsoil** (0.3)	0 ft	SS	20-50/0.3'			50		4.0
0.3–13.5	710, 705, 700	**Lean Clay**, hard, moist, light brown, little gravel (CL)								
		3.5': firm, brown	3.5 ft	SS	3-4-4-5			8	87.9	
			6 ft	SS	3-4-4-5			8		23.1
		8.5': trace gravel, trace sand, firm to stiff (13.5)	8.5 ft	SS	9-5-5-5			10		
13.5–16.3		**Lean Clay with Sand and Gravel**, wet, greenish brown (CL) (16.3)	13.5 ft	SS	4-5-5-3			10		21.7
16.3–21.3	695	**Interbedded Limestone and Shale**, ***Very Thinly Bedded***, fine to coarse grained, LIGHT GRAY, slightly weathered to fresh (21.3)	16.3 ft	Core		80	27			
21.3–26.3	690	**Interbedded Limestone and Shale**, ***Very Thinly Bedded***, fine grained, LIGHT GRAY, fresh (26.3)	21.3 ft	Core		92	98			

Boring terminated at 26.3'

Graphics Legend

- Interbedded Limestone and
- CL
- Topsoil
- Core - Core Sample
- SS - Small Split Spoon

Water Levels

- ∇ -
- ▼ -

Soil Boring: B-3

SOLID GROUND CONSULTING ENGINEERS

Project: Cynthiana Water Treatment Plant
Location: Cynthiana, Kentucky
Project Number: 25-384

Date Started: 08/22/2025	Date Completed: 08/22/2025	Coordinates: 38.376300, -84.303507
Location Accuracy: Estimated from Google Maps	Client Name: Kentucky Engineering Group, PLLC	Hammer Type: Auto
Method: Auger	Depth: 14.8'	

Rig Type: Diedrich D-50
Tooling: 4" Solid Stem Auger
Surface Elevation: 712.8'

Depth (ft)	Elevation (ft)	Graphic Log	Visual Classification and Remarks	Samples: Depth of Sample (ft)	Sample Graphic	Blow Counts	Uncorrected N-Value	Lab: Moisture Content (%)
0	712.8	Topsoil	**Topsoil** (0.3)	0 ft	SS	8-6-5-7	11	
	710	CL	**Lean Clay**, stiff, dry, brown (CL)					
		CL	3.5': firm	3.5 ft	SS	3-4-3-3	7	11.8
5		CL	(6.0)					
		CL	**Silty Lean Clay**, firm, moist, brown, trace sand, black mottling (CL)	6 ft	SS	3-4-4-3	8	28.1
	705	CL	8.5': some sand	8.5 ft	SS	3-6-6-7	12	19.4
10	700	CL	(13.5)					
		CL	**Silty Lean Clay with Sand and Gravel**, greenish brown, petroleum smell (CL) (15.4)	13.5 ft	SS	6-9-50/0.3'	59	
15								

Auger refusal at 15.4'

Graphics Legend

- CL
- Topsoil
- SS - Small Split Spoon

Water Levels

- ▽ -
- ▼ -

Soil Boring: B-4

Project: Cynthiana Water Treatment Plant
Location: Cynthiana, Kentucky
Project Number: 25-384

Date Started: 08/22/2025	Date Completed: 08/22/2025	Coordinates: 38.376259, -84.303394
Location Accuracy: Estimated from Google Maps	Client Name: Kentucky Engineering Group, PLLC	Hammer Type: Auto
Method: Auger	Depth: 15'	

Rig Type: Diedrich D-50
Tooling: 4" Solid Stem Auger
Surface Elevation: 713.5'

Depth (ft)	Elevation (ft)	Graphic Log	Visual Classification and Remarks	Depth of Sample (ft)	Sample Graphic	Blow Counts	Uncorrected N-Value	% Fines	Moisture Content (%)
		Topsoil	**Topsoil** 0.1	0 ft	SS	14-8-5-3	13		9.2
	710	CL	**Lean Clay**, stiff, dry, brown, trace gravel (CL)						
5		CL	3.5': firm; 6.0	3.5 ft	SS	5-5-3-3	8		
	705	CL	**Silty Lean Clay**, soft, moist, brown, trace gravel (CL); 8.5	6 ft	SS	3-2-2-2	4		
10		GC	**Clayey Gravel with Sand**, loose, green and black (GC)	8.5 ft	SS	2-3-4-4	7	25.8	19.9
	700	GC	13.5': very dense; 15.0	13.5 ft	SS	3-50/0.3'	50		
15			Boring terminated at 15'						

Graphics Legend

- Topsoil
- CL
- GC
- SS - Small Split Spoon

Water Levels

- ∇ -
- ▼ -

Soil Boring: B-5

SOLID GROUND CONSULTING ENGINEERS

Project: Cynthiana Water Treatment Plant
Location: Cynthiana, Kentucky
Project Number: 25-384

Date Started: 08/22/2025	Date Completed: 08/22/2025	Coordinates: 38.376189, -84.303348
Location Accuracy: Estimated from Google Maps	Client Name: Kentucky Engineering Group, PLLC	Hammer Type: Auto
Method: Auger	Depth: 15'	

Rig Type: Diedrich D-50
Tooling: 4" Solid Stem Auger
Surface Elevation: 714.1'

Depth (ft)	Elevation (ft)	Graphic Log	Visual Classification and Remarks	Samples: Depth of Sample (ft)	Samples: Sample Graphic	Samples: Blow Counts	Samples: Uncorrected N-Value	Lab: Moisture Content (%)
0		Topsoil	**Topsoil** (0.1)	0 ft	SS	50/0.4'	50	2.8
		SP	**Poorly Graded Sand with Gravel**, very dense, dry to moist (SP) (3.5)					
	710	CL	**Silty Lean Clay**, stiff, moist, brown, trace sand (CL)	3.5 ft	SS	4-5-6-6	11	20.3
5		CL	6': moist, firm, greenish brown mottling, petroleum smell	6 ft	SS	4-3-4-6	7	
	705	CL	(13.5)	8.5 ft	SS	4-4-4-5	8	28.2
10	700	CL	**Lean Clay with Sand**, firm, moist, greenish brown, some gravel, petroleum smell (CL) (15.0)	13.5 ft	SS	3-4-5	9	
15			Boring terminated at 15'					

Graphics Legend

- Topsoil
- SP
- CL
- SS - Small Split Spoon

Water Levels

- ∇ -
- ▼ -

Soil Boring: B-6

SOLID GROUND CONSULTING ENGINEERS

Project: Cynthiana Water Treatment Plant
Location: Cynthiana, Kentucky
Project Number: 25-384

Date Started: 08/22/2025	Date Completed: 08/22/2025	Coordinates: 38.376166, -84.303491
Location Accuracy: Estimated from Google Maps	Client Name: Kentucky Engineering Group, PLLC	Hammer Type: Auto
Method: Auger	Depth: 15'	

Rig Type	Diedrich D-50
Tooling	4" Solid Stem Auger
Surface Elevation	713.9'

Depth (ft)	Elevation (ft)	Graphic Log	Visual Classification and Remarks	Depth of Sample (ft)	Sample Graphic	Blow Counts	Uncorrected N-Value	Moisture Content (%)
0		Gravel	**Gravel** 0.1					
		CL	**Silty Lean Clay**, firm, moist, brown (CL)	0 ft	SS	6-4-5-6	9	
	710	CL		3.5 ft	SS	5-4-4-4	8	22.8
5		CL		6 ft	SS	3-4-5-6	9	
	705	CL	8.5					
		CL	**Lean Clay**, firm to stiff, greenish brown, some sand, some gravel (CL)	8.5 ft	SS	3-7-3-4	10	
10		CL						
	700	CL	13.5': wet, stiff	13.5 ft	SS	6-8-4	12	22.3
15			15.0					

Boring terminated at 15'

Graphics Legend

CL

Gravel

SS - Small Split Spoon

Water Levels

- -
- -

SOLID GROUND
— CONSULTING ENGINEERS —

Distribution:

Report of Percent Passing No. 200 Sieve
ASTM D1140

Project Name: Cynthiana WTP — Project #: 25-384

Sample #: B2 — Depth: 3.5'-5.5'

Soil Description: Brown LEAN CLAY — Method A or B: B

Date Sample Received: 8/26/2025 — Date Tested: 8/28/2025

Boring/Sample No.	B2					
Depth (From-To)	3.5'-5.5'					

#200 DATA						
Tare Number	LRP					
Wet Soil + Tare, g	550.3					
Dry Soil + Tare, g	346.4					
Wt. of Tare	322.8					
Wt. of Dry Soil, g	23.6					
Soak Time, hours	24					

% MOISTURE DATA						
Tare Number	7	21				
Wet Soil + Tare, g	71.2	72.4				
Dry Soil + Tare, g	63.0	64.0				
Wt of Water	8.2	8.4				
Wt of Tare	13.8	13.8				
Wt. of Dry Soil, g	49.2	50.2				
% Moisture	16.7	16.7				

CALCULATIONS						
Dry Wt. Before, g	194.94					
Dry Wt. After, g	23.60					
% Retained	12.1					
% Passing	87.9					

SOLID GROUND
— CONSULTING ENGINEERS —

Distribution:

Report of Percent Passing No. 200 Sieve
ASTM D1140

Project Name: Cynthiana WTP
Project #: 25-384

Sample #: B4
Depth: 8.5'-10.5'

Soil Description: Green and Black CLAYEY GRAVEL with sand
Method A or B: B

Date Sample Received: 8/26/2025
Date Tested: 8/28/2025

Boring/Sample No.	B4					
Depth (From-To)	8.5'-10.5'					

#200 DATA						
Tare Number	LRP					
Wet Soil + Tare, g	719.3					
Dry Soil + Tare, g	611.3					
Wt. of Tare	436.0					
Wt. of Dry Soil, g	175.3					
Soak Time, hours	24					

% MOISTURE DATA						
Tare Number	13	7				
Wet Soil + Tare, g	71.1	69.3				
Dry Soil + Tare, g	62.0	59.7				
Wt of Water	9.1	9.6				
Wt of Tare	13.9	13.5				
Wt. of Dry Soil, g	48.1	46.2				
% Moisture	18.9	20.8				

CALCULATIONS						
Dry Wt. Before, g	236.38					
Dry Wt. After, g	175.30					
% Retained	74.2					
% Passing	25.8					

Natural Moisture Content Determination (ASTM D2216)

Project Name: Cynthiana WTP
Date: 8/28/2025
Project Number: 25-384
Page: 1 of 1

Boring Number	Sample Depth (ft)	Can ID Number	Can Weight	Wet Weight + Can	Dry Weight + Can	Moisture %
B1	3.5-5.5	27	13.8	69.4	59.5	21.7
		3	13.5	70.7	60.6	21.4
B1	13.5-15.5	37	13.4	70.1	57.6	28.3
		46	13.5	71.8	58.6	29.3
B2	0.0-0.8	40	13.8	71.7	69.4	4.1
		126	13.7	70.3	68.2	3.9
B2	6.0-8.0	139	13.6	71.7	60.7	23.4
		4	13.9	70.7	60.2	22.7
B2	13.5-15.5	43	13.5	70.6	60.6	21.2
		54	13.5	68.3	58.3	22.3
B3	3.5-5.5	25	13.3	68.6	63.0	11.3
		116	13.9	70.4	64.2	12.3
B3	6.0-8.0	233	13.8	69.3	56.1	31.2
		133	13.4	69.4	58.2	25.0
B3	8.5-10.5	113	13.7	70.2	62.7	15.3
		32	13.6	70.9	60.0	23.5
B4	0.0-2.0	60	13.8	68.2	63.9	8.6
		10	13.5	69.5	64.5	9.8
B4	8.5-10.5	13	13.9	71.1	62.0	18.9
		7	13.5	69.3	59.7	20.8
B5	0.0-0.4	24	13.5	70.7	69.2	2.7
		39	13.8	70.0	68.4	2.9
B5	3.5-5.5	53	13.4	69.8	60.2	20.5
		50	13.7	70.8	61.3	20.0
B5	8.5-10.5	21	13.9	69.8	57.3	28.8
		254	13.8	70.2	58.0	27.6
B6	3.5-5.5	16	13.8	71.4	60.7	22.8
		6	13.8	70.8	60.2	22.8
B6	13.5-15.0	3	13.6	69.9	59.8	21.9
		36	13.8	70.7	60.2	22.6