Fairfield Township Multi-Commercial Retail

Geotechnical Report

Prepared for

BASIS Companies, LLC
7770 Cooper Road, Ste 9
Cincinnati, Ohio 45242

April 25, 2022

Project No. CN220067

April 25, 2022

BASIS Companies, LLC
7770 Cooper Road, Ste 9
Cincinnati, Ohio 45242

Attention: Mr. Ryan Lucas
Sent via e-mail: Ryan@basiscompanies.com

Subject: Geotechnical Report for
Fairfield Township Multi-Commercial Retail
3100 Princeton Road Fairfield Township, Ohio 45011
CSI Project No. CN220067

Dear Mr. Lucas,

Consulting Services Incorporated of Cincinnati (CSI) is pleased to present our geotechnical report for the Fairfield Township Multi-Commercial Retail development in Fairfield Township, Ohio. We provided our services in general accordance the CSI Proposal 7795, dated April 06, 2022.

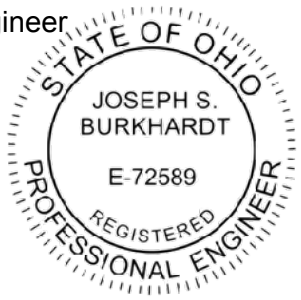
Our report represents information provided to us, readily available published data relevant to the site and site area, our observations and subsurface conditions encountered and our opinion of primary geotechnical conditions (discussion and recommendations) affecting site work.

Again, we greatly appreciate the opportunity to provide our services and look forward to working with you and the project team on this (and hopefully) more projects in the future. Please do not hesitate to contact us for questions or comments about the information contained herein.

Cordially,

Logan Loeloff, E.I.T.
Staff Engineer

Joseph S. Burkhardt, P.E.
Principal Geotechnical Engineer



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INTRODUCTION

1 SCOPE OF THE GEOTECHNICAL EXPLORATION

As proposed, CSI conducted a geotechnical exploration for the proposed Fairfield Township Multi-Commercial Retail development in Fairfield Township, Ohio. Our services included a review of the project information provided, conducting a subsurface exploration that utilized soil test borings to obtain samples for modeling the soil conditions at the proposed development, an analysis of data and information obtained, providing foundation types for the site conditions and providing recommendations for site earth work. At this time, final grading plans and structural details have not been provided. CSI should review final grading and structural details to determine if modifications to the recommendations outlined in the report are necessary.

2 SITE AND PROJECT INFORMATION

In preparing for this report, CSI was provided with multiple concept design plans dated from August 06, 2021 to March 16, 2022. In addition, CSI reviewed the subsurface conditions encountered in our previous geotechnical report titled, “Bridgewater Church Property Development”, dated December 14, 2018, for the entire site. A summary of the site and project information is summarized in Tables 1 and 2 below.

Table 1: Site Information

Item	Description
Site Location	The site is located at 3100 Princeton road in Fairfield Township, OH
Size of Site	Total site area is approximately 4.62 acres in size
Surrounding Area	The surrounding area is characterized by an asphalt parking lot and the existing church to the east of the proposed development. Princeton Road is located directly south of the property.
Existing Ground Conditions	The site is currently a vacant open field area with the eastern portion of the site occupied by a parking lot and shed like structure. Surface elevations of the property span from 749 to 770 ft across the site indicating the site to be relatively flat.
Existing/Previous Structures(s)	An existing small shed like structure and parking lot is located in the eastern part of the property where the proposed Starbucks is to be placed
Existing/Previous Utilities	Underground utilities were not observed in the vicinity of our borings

Table 2: Project Information

Item	Description
Site Layout and Grading	See Boring Location Plan
Proposed Structure(s)	Three (3) new commercial retail buildings are to be built along with associated parking and a private driveway. The size of the buildings are approximately 5,700, 2.225, and 15,500 square feet (SF)
Building Construction	Wood framed and/or masonry structures (assumed)
Finish Floor Elevations	At this time finished floor elevations have not been provided, however due to the relatively flat nature of the site, finished floor elevations have been assumed to be close to existing grades.
Maximum Loads	Continuous loads: 3 kips per linear foot or less (assumed) Floor Slab: 100 psf or less (assumed)

3 AREA/SITE INFORMATION

3A AREA TOPOGRAPHY / PHYSIOGRAPHY

The site is located within the Southern Ohio Loamy Till Plain area. This area is characterized surficial loamy till, boulder belts, relatively steep valleyed streams filled with outwash, and buried valleys. Published mapping reviewed indicates the elevation is approximately 749 feet to 770 feet across the site. Below is a figure of the location of the site with respect to the regional physiography.

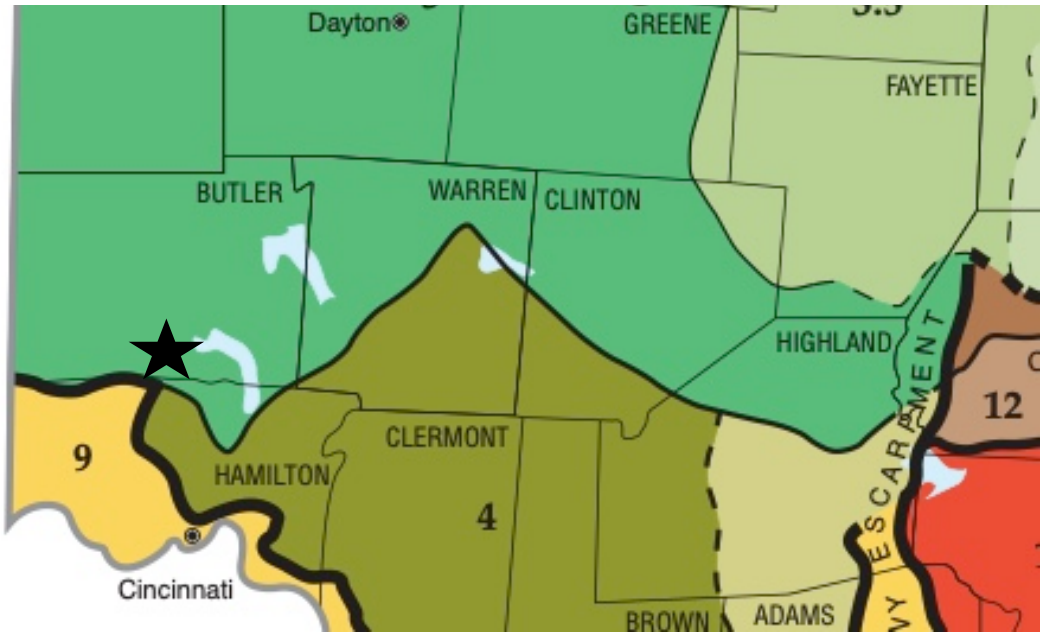


Figure 1 - Ohio Physiographic Map (site vicinity shown with star)

3B SITE GEOLOGY

Review of the *Surficial Geology of the Ohio Portions of the Cincinnati and Falmouth 30 x 60 Minute Quadrangles* shown in **Figure 2** below indicates the site is primarily underlain by Wisconsinan age glacial till comprised primarily of clay with varying amounts of rounded gravel, silt, and sand to depths of up to approximately 50 feet. Underlying the till material is bedrock, consisting of limestone with interbedded shale.

A review of the *Ohio Division of Geological Survey Online Mapping* shown in **Figure 3**, indicates the bedrock at the project site belongs entirely to the Grant Lake Formation, Miamitown Shale, and Fairview Formation undivided complex (Ogm). The Ogm complex consist of different ratios of limestone with interbedded shale.

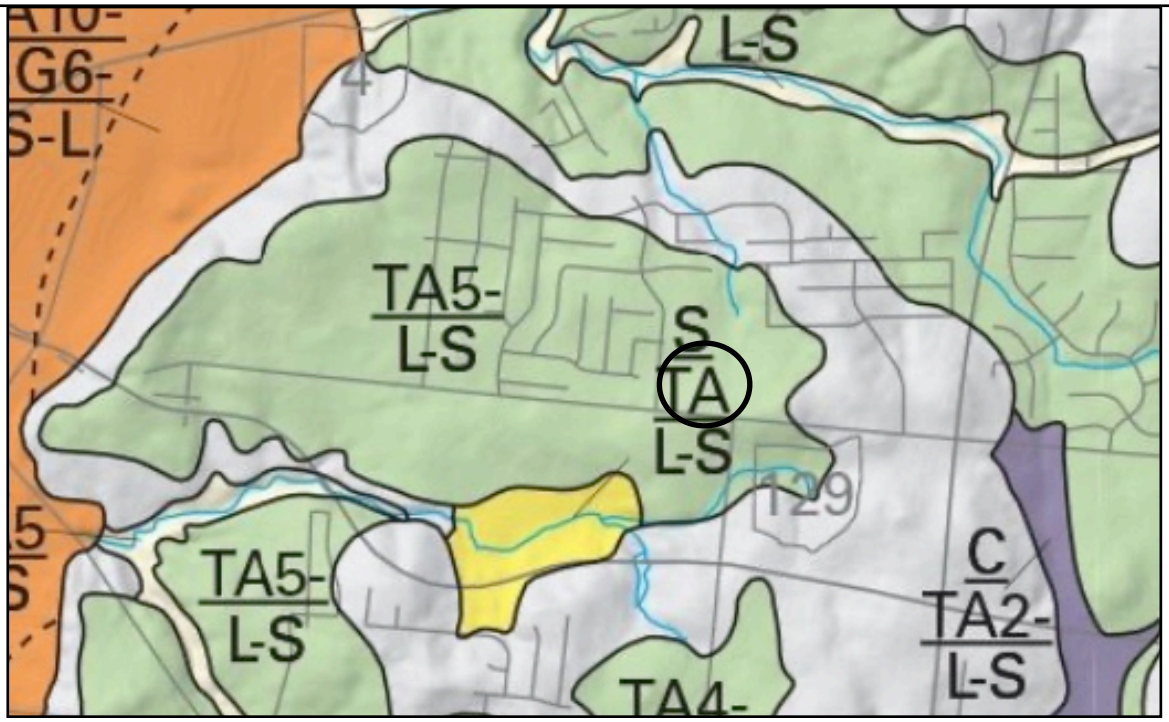


Figure 2: Site Geology Map

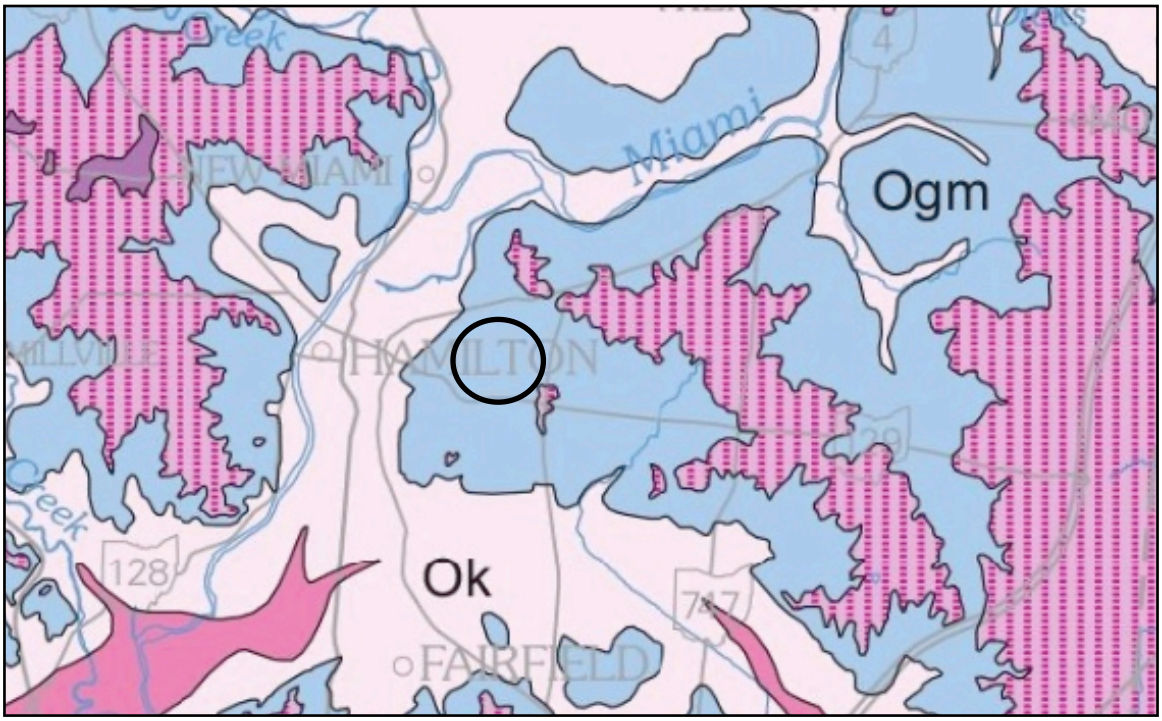


Figure 3: Site Bedrock Map

3C PUBLISHED SITE SOIL CONDITIONS

Review of the USDA Soil Survey of Butler County, Ohio (NRCS website) shows that natural soils directly underlying the site consist mostly of the Wynn series (WyB2 and WYC2) with the Dana Series (DaB) present onsite as well. The Wynn Series is located on the eastern portion of the property and the Dana series is on the northwestern portion.

Below is a table of the soils present on-site along with a map of the soils on-site.

Table 3: USDA Soil Survey - Soil Series

Soil Series	Symbol	Slope (%)	Parent Material	Percent of Site (%)	Depth to Restrictive Feature (in.)	Depth to Water Table (in)
Dana Silt Loam	DaB	2 to 6	Loess Over Loamy Till Derived From Sedimentary Rock	31.3	37 to 55 inches to densic material	24 to 36
Wynn Silt Loam	WyB2	2 to 6	Loess Over Loamy Till Over Residuum Weathered From Limestone and Shale	68.6	28 to 33 inches to paralytic bedrock	>80
Wynn Silt Loam	WyC2	6 to 12	Loess Over Loamy Till Over Residuum Weathered From Limestone and Shale	0.1	32 to 34 inches to paralytic bedrock	>80

Figure 4: USDA Soil Survey Map

3D AERIAL PHOTOGRAPHS (GOOGLE EARTH)

Review of historical aerial images since 1994 indicate that there appears to have been some development of the property over the years. It appears that between 2000 and 2006, multiple disturbances have occurred on the property in correlation to the Bridgewater church located to the east of the site. In this time a parking lot and small building have been constructed on the eastern portion of the project site. Beyond 2006, no further development or disturbances seemed to have occurred.

Figure 5: Aerial Image Dated 2000

Figure 6: Aerial Image Dated 2006

Figure 7: Aerial Image Dated 2019

Figure 8: Aerial Image Dated 2021

4 SITE PHOTOS

Photos of the site from April 12, 2022 are shown below.

Photo 1: View of property location and existing conditions

Photo 2: View of boring location near existing church

Photo 3: View of boring location near existing small structure

Photo 4: Additional view of boring location

FINDINGS

5 SUBSURFACE CONDITIONS

CSI performed eight (8) soil test borings to explore the subsurface conditions at the site. In general, our borings encountered previously placed fill underlain by glacial soils and shale/ limestone bedrock.

5A STRATA INFORMATION

The subsurface conditions encountered at the test boring locations are shown in the Test Boring Log in the Appendix. These records represent our interpretation of the subsurface conditions based on the field logs, visual examination of field samples by an engineer, and tests of the samples collected. The letters in parentheses following the soil descriptions are the soil classifications in general accordance with the Unified Soil Classification System (USCS). Dashed stratification lines shown on the soil boring log represent approximate transitions between material types. In-situ stratum changes could occur gradually or at slightly different depths. Boring elevations and locations were determined using a Real Time Kinematic GPS unit.

TOPSOIL

Topsoil was encountered at each boring at depths of up to 2 inches thick.

PREVIOUSLY PLACED FILL

Previously placed fill material was encountered underlying the surficial cover in all borings except B-6, B-7, and B-8 to depths of 5.5 to 10 feet. The fill was generally described to be brown and gray lean clay with varying amounts of sand, root hairs, black oxide nodules, rounded gravel, and rock fragments. Standard Penetration Testing (SPT) N-Values ranged from 7 to more than 50 blows per foot (bpf), indicating a firm to hard consistency. It should be noted that samples which had N-Values of more than 50 typically encountered a large cobble within the sample, which likely influenced the higher than average blow count. Laboratory testing of representative samples indicates Liquid Limits (LL) of 37 to 50 percent, with Plasticity Indices (PI) of 18 to 31 percent. Natural moisture contents were reported to range from 10.6 to 25.2 percent. At this time, documentation as to whether the fill was placed in an engineered manner has not been provided. However, based upon the consistency of the materials, it was likely placed with some engineering controls.

GLACIAL TILL

Glacial soils were encountered underlying the surficial cover and fill material in each of our boring locations. In general, the glacial soils were described to be brown and gray lean clay with varying amounts of sand, root hairs, rounded gravel, and rock fragments. SPT N-Values ranged from 11 to more than 50 bpf, indicating a stiff to hard consistency. Laboratory testing of representative samples indicates a Liquid Limit (LL) of 35 percent, with a Plasticity Index of 335percent. Natural moisture contents were reported to range from 10.8 to 22.8 percent.

WEATHERED SHALE/LIMESTONE BEDROCK

Highly weathered brown and gray clayey shale samples were recovered in borings B-6 and B-8 at depths of about 8 feet. Auger refusal was encountered on what has been assumed to be

competent limestone in all borings B-3, B-4, B-5, B-6, B-7, and B-8 at depths ranging from 7.1 to 12.7 feet below grade

For details of subsurface conditions encountered at a particular boring location please refer to the boring logs contained in Appendix A. It should be noted that our borings were drilled and sampled according to the procedures presented in the appendix. The boring locations shown in the appendix should be considered accurate only to the degree implied by the method used.

5B GROUNDWATER CONDITIONS

Upon completion of subsurface exploration, no groundwater was present in any of our borings. In many areas of Southern Ohio with similar geology, water conditions that can affect construction and performance of projects is often related to trapped/perched water zones, which can be erratic, but often observed in granular soils. Perched water sources are typically not linked to the more continuous relatively stable ground water table that typically occurs at greater depths. In addition to perched water surfaces, groundwater may also be encountered at the soil/bedrock interface. Site excavation activities or ground disturbance can expose these features and the resulting seepage can vary greatly. Groundwater issues are also dependent upon recent rainfall activity and surface and subsurface drainage patterns in the area that may change depending on climatic conditions.

6 LABORATORY TESTING

Laboratory tests were performed on selected recovered samples from the borings to provide recommendations for earthwork and to determine index properties of the soils. Details for the test methods and results are shown in the Appendix. Tests performed included:

- 19 Moisture Content Tests
- 4 Grain Size Analyses (-200 Sieve)
- 4 Atterberg Limits Tests

GEOTECHNICAL DISCUSSION AND RECOMMENDATIONS

7 DISCUSSION—GEOTECHNICAL ISSUES

Based on our experience with similar projects and the conditions observed during our subsurface exploration, we believe the property limits explored are suitable for the proposed structures. We have outlined in this report some of the expected risks and concerns of the project site. The primary geotechnical concerns are:

- **EXISTING DEVELOPMENT**
- **PREVIOUSLY PLACED FILL**

7A EXISTING DEVELOPMENT

As mentioned above, an existing building is present onsite along with a parking lot in the eastern area of the project site. The proposed buildings and driveway are to be constructed around and where the existing building and parking lot are located. Therefore, developing sites in which structures once occupied or have been disturbed presents a risk with the consistency and composition of the soils surrounding the building area(s) along with encountering old foundations, cisterns, wells, uncontrolled fill and other unknown features. Past experience has shown that direct support within and/or over such features poses risks with excessive differential and total settlement due to nonuniform support conditions and possible deleterious materials.

7B PREVIOUSLY PLACED FILL

Previously placed fill was visually observed in all borings except B-6, B-7, and B-8 to depths of 5.5 to 10 feet. Based upon the consistency of the fill, it was likely placed with at least some engineering control; however, the reliability of consistency across the site is unknown. Uncontrolled fill materials are often improperly compacted, commonly contain organics and debris, and are poor bearing materials. Fills placed in an uncontrolled manner have proven to be problematic. The problems generally arise not from general settlement, but from erratic differential settling of the fill. The settlement of old fill masses is dependent upon several factors such as fill thickness, degree of compaction, fill contents, and age of the fill mass. Given the lightly loaded nature of the parking lots, we recommend the areas be thoroughly proof rolled prior to any new fill and/or pavement sections.

8 EARTHWORK

Historically, more change orders (in orders and costs) occur during the earthwork portion of construction than in almost any other part of the project. Further, the site preparation phase of construction always affects the future performance of project structures and pavements. Add into this, the fact that earthwork is the portion of work most influenced by wet weather and unknown conditions and time-wise, this section of the report could be the most important to prevent and minimize delays and costs during construction and for the life of the project.

Please review the geotechnical concerns listed in Section 7 prior to reading the following recommendations. Once available, we recommend the grading plan be reviewed by us to further evaluate the proposed cuts and fills with respect to the subsurface conditions encountered. If problems occur and the recommendations do not address or do not adequately remedy, please contact CSI as soon as possible.

8A EXCAVATIONS

Normal earth excavation equipment should be suitable for excavation operations that are associated with the overburden soils. All excavations should comply with OSHA requirements. For below-grade excavations, the fill material should be classified as a Type C soil and sloped at a minimum of 1.5H:1V and the clay soils should be classified as an OSHA Type B soil with slope

excavations of 1H:1V. If soil types other than what has been mentioned above are encountered, CSI should be contacted to evaluate stability.

8B SITE PREPARATION (WORK PRIOR TO FILLING)

- Vegetative cover, topsoil, organic and deleterious materials should be stripped prior to commencing fill operations
- If encountered, any free or ponded water should be removed and the site allowed to dry prior to placing fill or concrete
- Areas ready to receive new fill should be proofrolled with a heavily loaded dump truck or similar equipment judged acceptable by the geotechnical engineer
- The level of proofroll should be determined by the geotechnical engineer on a case-by-case basis
- Perform the proofrolling after a suitable period of dry weather to avoid degrading the subgrade
- Areas which pump, rut, or wave during proofrolling may require undercutting, depending on the location of the area and the use of the area, so the geotechnical engineer should be contacted for guidance
- Retain CSI to observe the proofrolling operations and make recommendations for any unstable or unsuitable conditions encountered---this can save time on the construction schedule and save unnecessary undercutting
- 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

8C NEW FILL OPERATIONS (MASS EARTHWORK)

Before new fill construction, representative samples should be obtained of the proposed fill material to determine the moisture-density, classification of the material, and whether the material is suitable to be used as structural fill. After the subgrade has been approved to receive new fill, the fill may commence with the following procedures and guidelines recommended:

- Place cohesive fill (clay) in maximum 8-inch thick loose lifts. Granular soils may be placed in maximum 12 inch loose lifts provided properly sized equipment is used in the compaction process
- Fill lifts should be compacted to at least 98 percent of the soil's maximum dry density with a moisture content of plus or minus 2 percent of the Optimum Moisture (ASTM D 698) in areas beneath structures (buildings and pavements)
- Non-structural areas (i.e. grassed and/or landscape areas) can utilize a lower compaction requirement of 90 percent. Non-structural areas should be considered 5 feet

beyond the limits of structural entities (i.e. buildings, pavements, sidewalks, retaining walls, etc)

- Maximum particle size of the soil should be limited to half the lift thickness. Equipment should be large enough that any limestone slabs are thoroughly broken up. Large pieces not able to be satisfactorily broken up should be removed from the fill
- Density testing should be performed as a means to verify percent compaction and moisture content of the material as it is being placed and compacted
- Observation of fill "stability" is also critical, so it is recommended to observe the operation of the filling equipment traversing over the new fill to document movement (similar to proof rolling)
- Density testing should be performed at a rate of at least one per 10,000 square feet per lift with a minimum of 3 tests per lift
- Soils should not be "over compacted" and construction traffic should be kept to minimum to assure compaction is achieved and that the soil is not allowed to "break down"; and
- Retain a representative of CSI to observe and document fill placement and compaction operations

8D BACKFILL OPERATIONS (FOUNDATION WALLS, UTILITIES, ETC.)

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

- Fill lift thicknesses will vary dependent on compaction equipment available and material types, but in no case should exceed 8 inches for clay and 12 inches for granular soils;
- For crushed stone/aggregate backfills in trenches or wall backfill and when using smaller compaction equipment the lift thickness should be based on the type of aggregate and equipment. For well-graded granular soils such as Dense Grade Aggregate, a thickness of 4 to 6 inches is typically required. If open-graded stone is used, the lift thickness may be able to be increased. This should be evaluated by the geotechnical engineer;
- Fill lifts should be compacted to at least 98 percent of the soil's maximum dry density (ASTM D 698) in areas beneath structures (buildings, equipment foundations and pavements);
- For granular and lean clay soils, maintain the moisture content of compacted fill between minus 2 and plus 2 percent of optimum moisture;
- Maximum particle size of the soil should be limited to half the lift thickness. Equipment should be large enough that any large particles are thoroughly broken up. Large pieces not able to be satisfactorily broken up should be removed from the fill;
- Density testing should be performed as a means to verify percent compaction and moisture content of the material as it is being placed and compacted;

- Density testing should be performed at a rate of at least 3 tests per lift; CSI should be retained to provide additional recommendations for backfill;

8E GENERAL NOTES

- 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
- If any soil placement problems occur, CSI should be retained to provide additional recommendations, as needed

9 SITE DRAINAGE

During construction, water should not be allowed to pond in excavations and fill areas 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.

For excavations during construction, most free water from the subsurface conditions could likely be removed via sump pumps and open channel flow (if possible) at or near the source of seepage. However, if normal dewatering measures prove insufficient, CSI should be retained to provide recommendations on the issue.

10 FOUNDATIONS

Based on the lightly loaded nature of the proposed structures, our previous geotechnical exploration and the subsurface conditions encountered during this exploration, conventional spread footings bearing on stiff or better previously placed fill/glacial soils or engineered fill placed over the fill/glacial soils will be suitable, provided a thorough foundation inspection is performed. This could include dynamic cone penetrometer (DCP) testing and/or the excavation of shallow test pits within or near foundations. Based upon the conditions encountered in the borings, some of the upper soils exhibited softer conditions, which may require some undercutting. If there are any changes in the project criteria or building locations, CSI should be allowed to review the recommendations to determine if any modifications are required. In addition, CSI should review the final grading plans and structural details to determine if changes to recommendations in this report may be necessary.

10A SHALLOW FOUNDATIONS

Shallow spread footings may be sized using a maximum net allowable bearing pressure of 2,000 pounds per square foot (psf). If softer soils are encountered they should be undercut as necessary and backfilled with minimum 1,500 psi lean concrete.

10B GENERAL FOUNDATION RECOMMENDATIONS

Detailed settlement analysis was beyond the scope of this exploration. However, based on the estimated structure loads, the anticipated behavior of soil types encountered during field

activities, and our experience with similar projects, we expect that total settlements will not exceed 1 inch, and that differential settlements will not exceed 3⁄4 inch between columns or along continuous footing distances of 25 feet. We recommend the structures be designed to accommodate this magnitude of total and differential settlement.

Settlement estimates are based, in part, upon the assumption that site preparation is performed in accordance with our recommendations and with good quality control of the earthworks.

Additional design considerations for project foundations are outlined as follows:

- Design all footings with a minimum 18 inches width;
- All exterior footing bottoms should bear at least 30 inches below finished exterior grading for frost protection.
- Interior footings (those not exposed to freezing) may be placed at nominal depths provided they bear on suitable material as recommended in this report;
- Include control joints at suitable intervals in the walls of structures and in areas where changes in support from native soil to fill are anticipated, to help accommodate differential foundation movements.

10C SHALLOW FOUNDATION NOTES

In general, soils tend to lose strength if they become wet. We recommend the foundation subgrades be protected from exposure to water. For foundations construction, we also recommend the following procedures.

- For soils that will remain exposed overnight or for an extended period of time, place a "lean" concrete mudmat (1 to 2 inches) over the bearing areas. Flowable fill concrete or low-strength concrete is suitable for this cover, as conditions allow;
- Foundation bearing conditions should be benched level;
- Areas loosened by excavation operations should be recompacted prior to reinforcing steel placement;
- Loose soil, debris, and excess surface water should be removed from the bearing surface prior to concrete placement;
- Retain the geotechnical engineer to observe all foundation excavations and provide recommendations for treatment of any unsuitable conditions encountered;
- The bearing conditions should be checked by means of portable dynamic cone penetration (DCP) testing or at the direction of the geotechnical engineer;
- Even though fill soils placed for foundation support have likely been checked for compaction at the time of placement, these soils may have become wet or lost some level of strength since that time. The areas should be hand probed to check for surface hardness/strength;

11 GRADE SUPPORTED FLOOR SLABS

Grade supported floor slabs are suitable for the proposed structures, provided the subgrade is prepared according to the recommendations contained within this report. Building pads should be proof rolled prior to placing any new fill or once final cuts are made. Areas that pump or rut should be remediated based upon the geotechnical engineer's recommendations. We recommend the floor slabs be supported on a minimum of 4 inches of compacted granular base. The slab should be designed to be structurally independent of any building footings or walls and should be appropriately reinforced to support the proposed loads.

The following features are also recommended as part of the floor slab construction:

- Provide isolation joints between the slab and columns and along footing supported walls.
- Adequate joint patterns (ACI and ICC guidelines) should be used to permit slab movement due to normal soil settlement, normal subgrade disturbance and material expansion/contraction.
- 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.
- *DO NOT allow soils directly below the slab to become overly wet or dry prior to placement of concrete;* and
- Retain CSI to review the actual subgrade conditions prior to slab construction and make recommendations for any unsuitable conditions encountered.

Note: Slab subgrade conditions are also considered earthwork areas and the recommendations contained in the Earthwork section of the report should be followed

12 PAVEMENT SUBGRADE

It is our understanding that the project will also include construction of a vehicle parking lots along with a private driveway, which we anticipate will be relatively lightly loaded. 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. We recommend under-drains be considered at low points of the pavement to facilitate drainage.

For earthwork associated with pavements, recommendations outlined above should be followed. Borings indicate that some areas had softer soils near the surface, which may require undercutting or stabilization prior to placing fill or pavement sections. CSI can provide specific recommendations based upon the field conditions, if necessary.

13 NOTES ON THE REPORT AND 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. A geotechnical exploration, such as the one we performed, used one boring to attempt to model the subsurface conditions at the site. Because no exploration contains complete data or a complete model, there is always a possibility that conditions between borings will be different from those at specific boring locations. Thus, it is possible that some subsurface conditions will not be as anticipated by the project team or contractor. If this report is included or referenced in the actual contract documents, it shall be explicitly understood that this report is for informational purposes only. CSI shall not be responsible for the opinions of, or conclusions drawn by others.

It has been our experience that the construction process often disturbs soil conditions and this process, no matter how much experience we use to anticipate construction methodology, is not completely predictable. Therefore, changes or modifications to our recommendations are likely needed due to these possible variances. Experienced CSI geotechnical personnel should be used to observe and document the construction procedures 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 CSI to provide this service based upon our familiarity with the project, the subsurface conditions and the intent of our recommendations.

This report is based on the supplied project information, the subsurface conditions observed at the time of the report, and our experience with similar conditions. As such, it cannot be applied to other project sites, types, or combinations thereof. 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. Our recommendations may then require modification.

No section or portion of this report (including Appendix information) can be used as a stand alone article to make distinct changes or assumptions. The entire report and Appendix should be used together as one resource. We wish to remind you that our exploration services include storing the soil samples collected and making them available for inspection for 30 days. The soil samples are then discarded unless you request otherwise. Please inform us if you wish to keep any of the obtained samples.

While this report deals with samples of subsurface materials and some comments on water conditions at the site, no assessment of site environmental conditions or the presence of contaminants were performed.

We wish to remind you that our exploration services include storing the soil samples collected and making them available for inspection for 30 days. The samples are then discarded unless you request otherwise. Please inform us if you wish to keep any of the obtained samples.

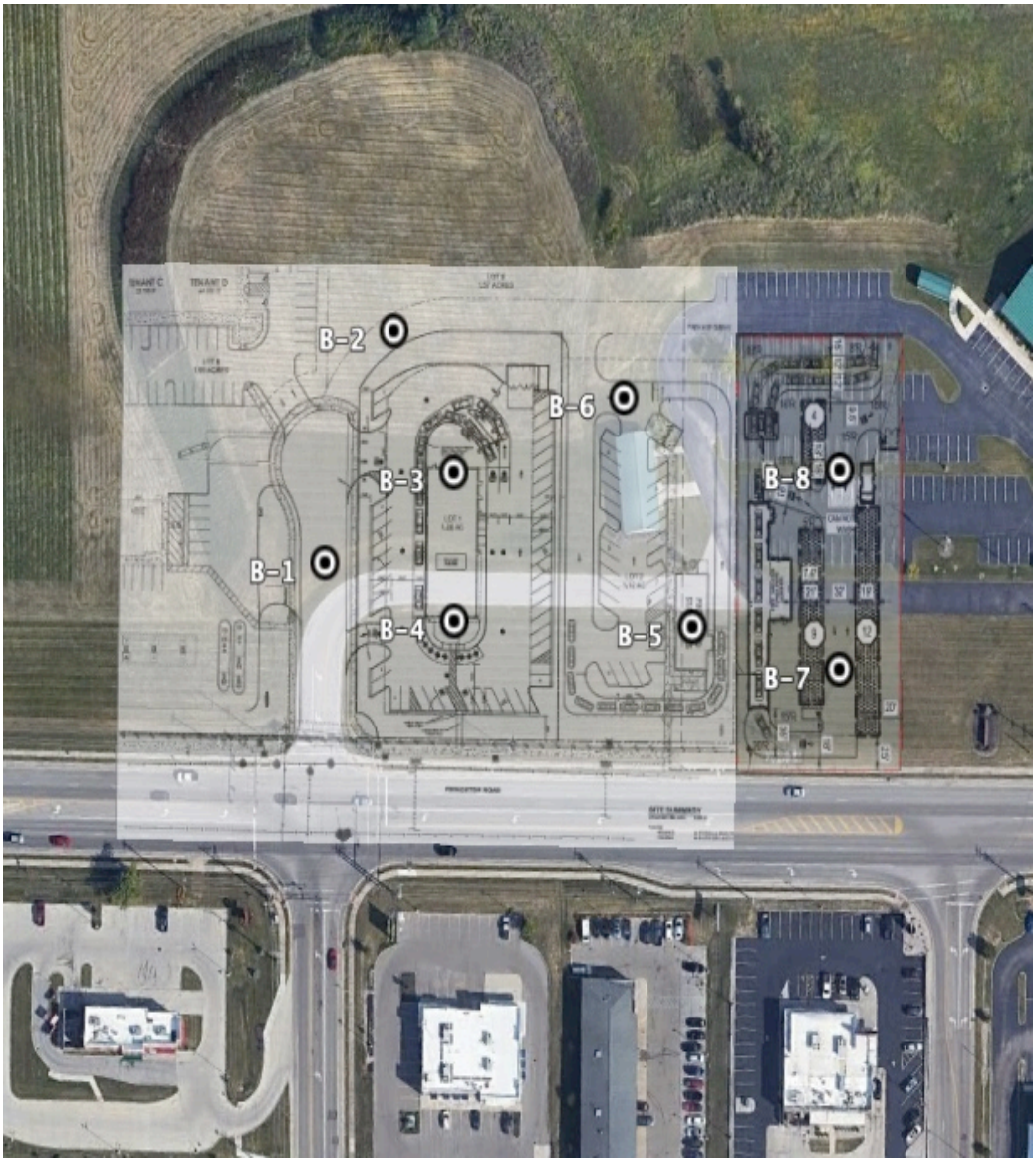
SITE LOCATION PLAN
BORING LOCATION PLAN
GEOTECHNICAL BORING INFORMATION SHEET
GENERAL BORING PROFILES
TEST BORING LOGS
FIELD TESTING PROCEDURES
LIQUID AND PLASTIC LIMITS REPORT
SUMMARY OF LABORATORY RESULTS
LABORATORY TESTING PROCEDURES

Adapted from Topographic Mapping

FOR ILLUSTRATION PURPOSES ONLY

CSI Cincinnati, LLC
11785 Highway Drive Cincinnati, Ohio 45241
513.252.2059 Office|888.792.3121 Fax
www.csiohio.com

TITLE: SITE LOCATION PLAN		Project No: CN220067	Drawn By: LL
PROJECT: Fairfield Township Multi-Commercial Retail Fairfield Township, Ohio		Date: 04-21-22	Checked By: JB
		Scale: Not To Scale	Drawing No: 1 of 2



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Adapted from Aerial Imagery

FOR ILLUSTRATION PURPOSES ONLY

LEGEND	
B-XX	BORING LOCATIONS

CSI Cincinnati, LLC
11785 Highway Drive Cincinnati, Ohio 45241
513.252.2059 Office|888.792.3121 Fax
www.csiohio.com

TITLE: BORING LOCATION PLAN		Project No: CN220067	Drawn By: LL
PROJECT:	Fairfield Township Multi-Commercial Retail Fairfield Township, Ohio	Date: 04-21-22	Checked By: JB
		Scale: Not To Scale	Drawing No: 2 of 2

Consulting Services Incorporated
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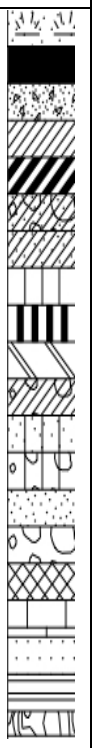
Geotechnical Boring Information Sheet

Sample Type Symbols	
Splitspoon (SPT)	
Shelby Tube	
Grab	
Rock Core	
Auger Cuttings	

Surface Symbols	
Topsoil	
Asphalt	
Concrete	
Lean Clay	
Fat Clay	
Glacial Till	
Sandy Clay	
Silt	
Elastic Silt	
Lean Clay to Fat Clay	
Gravelly Clay	
Sandy Silt	
Gravelly Silt	
Sand	
Gravel	
Fill	
Limestone	
Sandstone	
Shale/Siltstone	
Weathered Rock	

Samples Strength Descriptors	
Cohesive Soils:	**N**
Very Soft	0-1
Soft	2-4
Firm	5-8
Stiff	9-15
Very Stiff	16-30
Hard	31+
Non-cohesive Soils:	
Very Loose	0-4
Loose	5-10
Firm	11-20
Very Firm	21-30
Dense	30-50
Very Dense	51+

Definitions

SPT-"Splitspoon" or standard penetration test. Blow counts are number of drops required for a 140 lb hammer dropping 30 inches to drive the sampler 6 inches.

N-value is the addition of the last two intervals of the 18-inch sample.

Shelby tubes are often called "undisturbed samples". They are directly pushed into the ground, twisted, allowed to rest for a small period of time and then pulled out of the ground. Tops and bottoms are cleaned and then sealed.

Sample classification is done in general accordance with ASTM D2487 and 2488 using the Unified Soil Classification System (USCS) as a general guide.

Soil moisture descriptions are based on the recovered sample observations. The descriptors are dry, slightly moist, moist, very moist and wet. These are typically based on relative estimates of the moisture condition of a visual estimation of the soils optimum moisture content (EOMC). Dry is almost in a "dusty" condition usually 6 or more percent below EOMC. Slightly moist is from about 6 to 2 percent below EOMC at a point at which the soil color does not readily change with the addition of water. Moist is usually 2 percent below to 2 percent above EOMC and the point at which the soil will tend to begin forming "balls" under some pressure in the hand. Very moist is usually from about 2 percent to 6 percent above EOMC and also the point at which it's often considered "muddy". Wet soil is usually 6 or more percent above EOMC and often contains free water or the soil is in a saturated state.

Silt or Clay is defined at material finer than a standard #200 US sieve (<0.075mm) Sand is defined as material between the size of #200 sieve up to #4 sieve. Gravel is from #4 size sieve material to 3". Cobbles are from 3" to 12". Boulders are over 12".

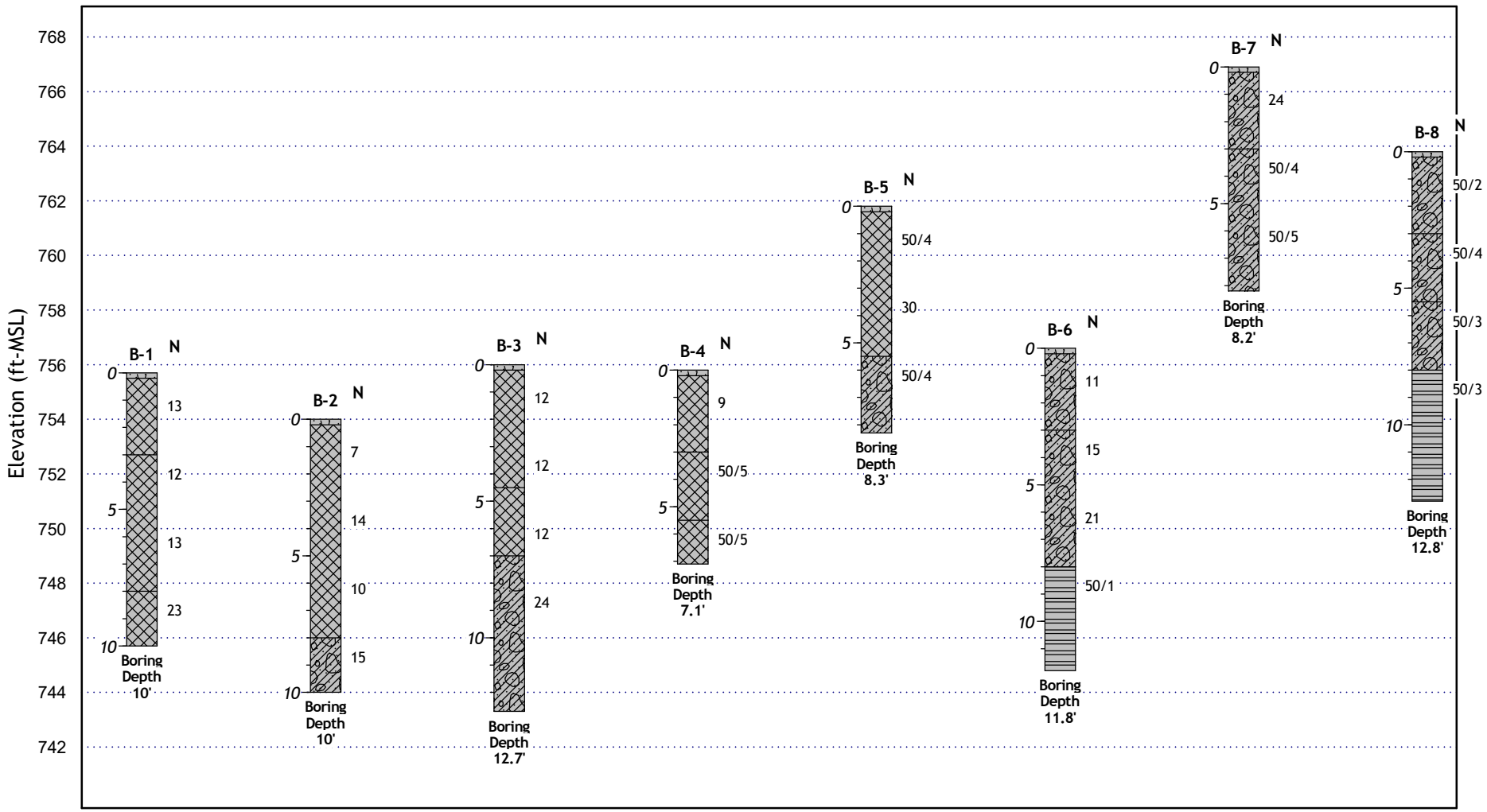
Rock hardness is classified as follows:

Very Soft:	Easily broken by hand pressure
Soft:	Ends can be broken by hand pressure; easily broken with hammer
Medium:	Ends easily broken with hammer; middle requires moderate blow
Hard:	Ends require moderate hammer blow; middle requires several blows
Very Hard:	Many blows with a hammer required to break core

Rock Quality Designation (RQD) is defined as total combined length of 4" or longer pieces of core divided by the total core run length; defined in percentage.

Water or cave-in observed in borings is at completion of drilling each boring unless otherwise noted.

Strata lengths shown on borings represents a rough estimate. Transition may be more abrupt or gradual. Soil borings are representative of that estimated location at that time and are based on recovered samples. Conditions may be different between borings and between sample intervals. Boring information is not to be considered stand alone but should be taken in context with comments and information in the geotechnical report and the means by which the borings are logged, sampled and drilled.



SOIL TYPES

(Shown in Graphic Log)

- Fill
- Asphalt
- Topsoil
- Gravel
- Sand
- Silt
- Lean Clay
- Fat Clay
- Silty Sand
- Clayey Sand
- Sandy Silt
- Clayey Silt
- Sandy Clay
- Silty Clay
- Limestone
- Sandstone
- Siltstone
- Shale

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Fairfield Township Multi
Commercial Retail
CN220067

BORING PROFILE

Fig. 1

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TEST BORING LOG

CLIENT **Basis Companies, LLC**
PROJECT NAME **Fairfield Township Multi Commercial Retail**
PROJECT LOCATION **Fairfield Township, Ohio**

BORING # **B-1**
JOB # **CN220067**
LOGGED BY **LL**
APPROVED BY **JB**

DRILLING and SAMPLING INFORMATION

Date Started	4/12/2022	Contractor	CSI
Date Completed	4/12/2022	Boring Size	3.25 in.
Drill Rig	D-50	Boring Method	ID HSA
Weather	Sunny, 50s-60s	Hammer Type	Automatic

SOIL CLASSIFICATION

SURFACE ELEVATION: 755.7

Elev. (ft)	Depth Scale	Water Level	Sample No.	Sample Type	Sample Graphics	Recovery (in)	Standard Penetration Test Blows per 6" [*N-Value*] *blows/foot*	Qu-tsf Unconfined (Pocket Pen.) Compressive Strength	Moisture Content %	Liquid Limit (LL)	Plasticity Index (PI)	Percent Passing #200 Sieve	Remarks
754	2		1	SS		16	6-5-8 [*13*]		12.1				
752	4		2	SS		16	5-5-7 [*12*]						
750	6		3	SS		12	3-3-10 [*13*]		14.0	37	22	82	
748	8		4	SS		10	7-13-10 [*23*]						
746	10												
744	12												
742	14												
740	16												
738	18												
736													

Topsoil (2 inches)

FILL: Brown and gray LEAN CLAY (CL) with rock fragments, some silt, and sand - moist, stiff

FILL: Brown and gray LEAN CLAY (CL) with rounded gravel and some sand - moist, stiff

FILL: Dark brown and gray LEAN CLAY (CL) with rounded gravel and sand - moist, very stiff

Boring Terminated at 10 feet; No Refusal

Depth to Groundwater
- Noted on Drilling Tools _____ ft.
- At Completion _____ ft.
- After _____ hours _____ ft.
- Cave Depth _____ ft.

Sample Type
- SPT- Standard Penetration Test
- SS- Split Spoon
- ST- Shelby Tube
- RC- Rock Core
- CU- Auger Cuttings

Boring Method
- HSA- Hollow Stem Augers
- CFA- Continuous Flight Augers
- MD- Mud Drilling

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Fax: 888.792.3121

TEST BORING LOG

CLIENT **Basis Companies, LLC**
PROJECT NAME **Fairfield Township Multi Commercial Retail**
PROJECT LOCATION **Fairfield Township, Ohio**

BORING # **B-2**
JOB # **CN220067**
LOGGED BY **LL**
APPROVED BY **JB**

DRILLING and SAMPLING INFORMATION

Date Started	4/12/2022	Contractor	CSI
Date Completed	4/12/2022	Boring Size	3.25 in.
Drill Rig	D-50	Boring Method	ID HSA
Weather	Sunny, 50s-60s	Hammer Type	Automatic

SOIL CLASSIFICATION

SURFACE ELEVATION: 754.0

Elev. (ft)	Depth Scale	Water Level	Sample No.	Sample Type	Sample Graphics	Recovery (in)	Standard Penetration Test Blows per 6" [*N-Value*] *blows/foot*	Qu-tsf Unconfined (Pocket Pen.) Compressive Strength	Moisture Content %	Liquid Limit (LL)	Plasticity Index (PI)	Percent Passing #200 Sieve	Remarks
752	2		1	SS		18	5-3-4 [*7*]						
750	4		2	SS		18	5-8-6 [*14*]		10.6				
748	6		3	SS		10	5-3-7 [*10*]						
746	8		4	SS		10	5-7-8 [*15*]		14.9				
744	10												
742	12												
740	14												
738	16												
736	18												

Topsoil (2 inches)

FILL: Dark brown and gray LEAN CLAY (CL) with root hairs, rock fragments, and some silt - moist, stiff

Brown and gray LEAN CLAY (CL) with rounded gravel, rock fragments, and some sand {Glacial Till} - moist, stiff

Boring Terminated at 10 feet; No Refusal

Depth to Groundwater
- Noted on Drilling Tools _____ ft.
- At Completion _____ ft.
- After _____ hours _____ ft.
- Cave Depth _____ ft.

Sample Type
- SPT- Standard Penetration Test
- SS- Split Spoon
- ST- Shelby Tube
- RC- Rock Core
- CU- Auger Cuttings

Boring Method
- HSA- Hollow Stem Augers
- CFA- Continuous Flight Augers
- MD- Mud Drilling

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TEST BORING LOG

CLIENT **Basis Companies, LLC**
PROJECT NAME **Fairfield Township Multi Commercial Retail**
PROJECT LOCATION **Fairfield Township, Ohio**

BORING # **B-3**
JOB # **CN220067**
LOGGED BY **LL**
APPROVED BY **JB**

DRILLING and SAMPLING INFORMATION

Date Started	4/12/2022	Contractor	CSI
Date Completed	4/12/2022	Boring Size	3.25 in.
Drill Rig	D-50	Boring Method	ID HSA
Weather	Sunny, 50s-60s	Hammer Type	Automatic

Elev. (ft)	Depth Scale	Water Level	SOIL CLASSIFICATION / SURFACE ELEVATION: 756.0	Sample No.	Sample Type	Sample Graphics	Recovery (in)	Standard Penetration Test Blows per 6" [*N-Value*] *blows/foot*	Qu-tsf Unconfined (Pocket Pen.) Compressive Strength	Moisture Content %	Liquid Limit (LL)	Plasticity Index (PI)	Percent Passing #200 Sieve	Remarks
			Topsoil (2 inches)											
754	2		FILL: Brown and gray LEAN CLAY (CL) with rock fragments and some root hairs - moist, stiff	1	SS		18	4-5-7 [*12*]		14.8				
752	4			2	SS		14	4-5-7 [*12*]		11.7	36	18	82	
750	6		FILL: Gray LEAN CLAY (CL) with rock fragments - moist, stiff	3	SS		18	7-6-6 [*12*]		25.2				
748	8		Brown and gray LEAN CLAY (CL) with rock fragments, rounded gravel, root hairs, and some sand {Glacial Till} - moist, stiff to very stiff	4	SS		16	9-11-13 [*24*]						
746	10													
744	12													
742	14		Auger Refusal at 12.7 feet; Boring Terminated											
740	16													
738	18													

Depth to Groundwater
- Noted on Drilling Tools _____ ft.
- At Completion _____ ft.
- After _____ hours _____ ft.
- Cave Depth _____ ft.

Sample Type
- SPT- Standard Penetration Test
- SS- Split Spoon
- ST- Shelby Tube
- RC- Rock Core
- CU- Auger Cuttings

Boring Method
- HSA- Hollow Stem Augers
- CFA- Continuous Flight Augers
- MD- Mud Drilling

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TEST BORING LOG

CLIENT: **Basis Companies, LLC**
PROJECT NAME: **Fairfield Township Multi Commercial Retail**
PROJECT LOCATION: **Fairfield Township, Ohio**

BORING #: **B-4**
JOB #: **CN220067**
LOGGED BY: **LL**
APPROVED BY: **JB**

DRILLING and SAMPLING INFORMATION

Date Started	4/12/2022	Contractor	CSI
Date Completed	4/12/2022	Boring Size	3.25 in.
Drill Rig	D-50	Boring Method	ID HSA
Weather	Sunny, 50s-60s	Hammer Type	Automatic

SOIL CLASSIFICATION

SURFACE ELEVATION: 755.8

Elev. (ft)	Depth Scale	Water Level	Soil Description	Sample No.	Sample Type	Sample Graphics	Recovery (in)	Standard Penetration Test Blows per 6" [*N-Value*] *blows/foot*	Qu-tsf Unconfined (Pocket Pen.) Compressive Strength	Moisture Content %	Liquid Limit (LL)	Plasticity Index (PI)	Percent Passing #200 Sieve	Remarks
754	2		Topsoil (2 inches) FILL: Brown LEAN CLAY (CL) with black oxide nodules and trace sand - moist, stiff	1	SS		10	3-4-5 [*9*]		18.6	50	31	84	
752	4		FILL: Dark brown LEAN CLAY (CL) with rock fragments and some sand - moist, hard	2	SS		2	10-50/5- [*50/5*]						
750	6		FILL: Brown and gray clay with rounded gravel, rock fragments, and trace sand - moist, hard	3	SS		4	50/5-- [*50/5*]		10.7				
748	8		Auger Refusal at 7.1 feet; Boring Terminated											
746	10													
744	12													
742	14													
740	16													
738	18													
736														

Depth to Groundwater
- Noted on Drilling Tools _____ ft.
- At Completion _____ ft.
- After _____ hours _____ ft.
- Cave Depth _____ ft.

Sample Type
- SPT- Standard Penetration Test
- SS- Split Spoon
- ST- Shelby Tube
- RC- Rock Core
- CU- Auger Cuttings

Boring Method
- HSA- Hollow Stem Augers
- CFA- Continuous Flight Augers
- MD- Mud Drilling

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TEST BORING LOG

CLIENT **Basis Companies, LLC**
PROJECT NAME **Fairfield Township Multi Commercial Retail**
PROJECT LOCATION **Fairfield Township, Ohio**

BORING # **B-5**
JOB # **CN220067**
LOGGED BY **LL**
APPROVED BY **JB**

DRILLING and SAMPLING INFORMATION

Date Started	4/12/2022	Contractor	CSI
Date Completed	4/12/2022	Boring Size	3.25 in.
Drill Rig	D-50	Boring Method	ID HSA
Weather	Sunny, 50s-60s	Hammer Type	Automatic

SOIL CLASSIFICATION

SURFACE ELEVATION: 761.8

Topsoil (2 inches)

FILL: Brown LEAN CLAY (CL) with rock fragments, root hairs, and some sand - moist, very stiff to hard

Brown and gray LEAN CLAY (CL) with rock fragments, rounded gravel, and trace sand {Glacial Till} - moist, hard

Auger Refusal at 8.3 feet; Boring Terminated

TEST DATA

Sample No.	Sample Type	Sample Graphics	Recovery (in)	Standard Penetration Test Blows per 6" [*N-Value*] *blows/foot*	Qu-tsf Unconfined (Pocket Pen.) Compressive Strength	Moisture Content %	Liquid Limit (LL)	Plasticity Index (PI)	Percent Passing #200 Sieve	Remarks
1	SS		4	50/4-- [*50/4*]						
2	SS		10	6-15-15 [*30*]		11.9				
3	SS		16	7-16-50/4 [*50/4*]		10.8				

Depth to Groundwater
- Noted on Drilling Tools _____ ft.
- At Completion _____ ft.
- After _____ hours _____ ft.
- Cave Depth _____ ft.

Sample Type
- SPT- Standard Penetration Test
- SS- Split Spoon
- ST- Shelby Tube
- RC- Rock Core
- CU- Auger Cuttings

Boring Method
- HSA- Hollow Stem Augers
- CFA- Continuous Flight Augers
- MD- Mud Drilling

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TEST BORING LOG

CLIENT **Basis Companies, LLC**
PROJECT NAME **Fairfield Township Multi Commercial Retail**
PROJECT LOCATION **Fairfield Township, Ohio**

BORING # **B-6**
JOB # **CN220067**
LOGGED BY **LL**
APPROVED BY **JB**

DRILLING and SAMPLING INFORMATION

Date Started	4/12/2022	Contractor	CSI
Date Completed	4/12/2022	Boring Size	3.25 in.
Drill Rig	D-50	Boring Method	ID HSA
Weather	Sunny, 50s-60s	Hammer Type	Automatic

SOIL CLASSIFICATION

SURFACE ELEVATION: 756.6

Elev. (ft)	Depth Scale	Water Level	Sample No.	Sample Type	Sample Graphics	Recovery (in)	Standard Penetration Test Blows per 6" [*N-Value*] *blows/foot*	Qu-tsf Unconfined (Pocket Pen.) Compressive Strength	Moisture Content %	Liquid Limit (LL)	Plasticity Index (PI)	Percent Passing #200 Sieve	Remarks
756	0												
													Topsoil (2 inches)
													Brown to reddish brown LEAN CLAY (CL) with root hairs and some rounded gravel {Glacial Till} - moist, stiff
754	2		1	SS		16	4-6-5 [*11*]		22.8				
													Brown and gray LEAN CLAY (CL) with sand, rounded gravel, and some rock fragments {Glaical Till} - moist, stiff to very stiff
752	4		2	SS		18	5-6-9 [*15*]		15.9				
	6												
750			3	SS		18	6-9-12 [*21*]						
	8												
748			4	SS		2	50/1-- [*50/1*]		22.9				Brown highly weathered SHALE - dry, soft
	10												
746													
	12												
744													Auger Refusal at 11.8 feet; Boring Terminated
	14												
742													
	16												
740													
	18												
738													

Depth to Groundwater
- Noted on Drilling Tools _____ ft.
- At Completion _____ ft.
- After _____ hours _____ ft.
- Cave Depth _____ ft.

Sample Type
- SPT- Standard Penetration Test
- SS- Split Spoon
- ST- Shelby Tube
- RC- Rock Core
- CU- Auger Cuttings

Boring Method
- HSA- Hollow Stem Augers
- CFA- Continuous Flight Augers
- MD- Mud Drilling

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TEST BORING LOG

CLIENT **Basis Companies, LLC**
PROJECT NAME **Fairfield Township Multi Commercial Retail**
PROJECT LOCATION **Fairfield Township, Ohio**

BORING # **B-7**
JOB # **CN220067**
LOGGED BY **LL**
APPROVED BY **JB**

DRILLING and SAMPLING INFORMATION

Date Started	4/12/2022	Contractor	CSI
Date Completed	4/12/2022	Boring Size	3.25 in.
Drill Rig	D-50	Boring Method	ID HSA
Weather	Sunny, 50s-60s	Hammer Type	Automatic

SOIL CLASSIFICATION

SURFACE ELEVATION: 766.9

Elev. (ft)	Depth Scale	Water Level	Sample No.	Sample Type	Sample Graphics	Recovery (in)	Standard Penetration Test Blows per 6" [*N-Value*] *blows/foot*	Qu-tsf Unconfined (Pocket Pen.) Compressive Strength	Moisture Content %	Liquid Limit (LL)	Plasticity Index (PI)	Percent Passing #200 Sieve	Remarks
766	0												
													Topsoil (2 inches)
	2		1	SS		18	4-10-14 [*24*]		10.8				Brown and gray LEAN CLAY (CL) with rock fragments, rounded gravel, and sand {Glacial Till} - moist, very stiff
764													
	4		2	SS		12	4-50/4- [*50/4*]						Brown LEAN CLAY (CL) with rock fragments, sand, and rounded gravel {Glacial Till} - moist, hard
762													
	6		3	SS		6	50/5-- [*50/5*]		12.3				
760													
	8												
758													Auger Refusal at 8.2 feet; Boring Terminated
	10												
756													
	12												
754													
	14												
752													
	16												
750													
	18												
748													

Depth to Groundwater
- Noted on Drilling Tools _____ ft.
- At Completion _____ ft.
- After _____ hours _____ ft.
- Cave Depth _____ ft.

Sample Type
- SPT- Standard Penetration Test
- SS- Split Spoon
- ST- Shelby Tube
- RC- Rock Core
- CU- Auger Cuttings

Boring Method
- HSA- Hollow Stem Augers
- CFA- Continuous Flight Augers
- MD- Mud Drilling

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TEST BORING LOG

CLIENT **Basis Companies, LLC**
PROJECT NAME **Fairfield Township Multi Commercial Retail**
PROJECT LOCATION **Fairfield Township, Ohio**

BORING # **B-8**
JOB # **CN220067**
LOGGED BY **LL**
APPROVED BY **JB**

DRILLING and SAMPLING INFORMATION

Date Started	4/12/2022	Contractor	CSI
Date Completed	4/12/2022	Boring Size	3.25 in.
Drill Rig	D-50	Boring Method	ID HSA
Weather	Sunny, 50s-60s	Hammer Type	Automatic

SOIL CLASSIFICATION

SURFACE ELEVATION: 763.8

Elev. (ft)	Depth Scale	Water Level	Soil Classification
762	2		Topsoil (2 inches)
			Brown and Gray LEAN CLAY (CL) with root hairs and rock fragments {Glacial Till} - moist, hard
760	4		Brown and Gray LEAN CLAY (CL) with root hairs, sand, and rock fragments {Glacial Till} - moist, hard
758	6		Brown LEAN CLAY (CL) with rounded gravel and some sand {Glacial Till} - moist, hard
756	8		Gray highly weathered SHALE - dry, soft
754	10		
752	12		
750	14		Auger Refusal at 12.8 feet; Boring Terminated
748	16		
746	18		
744			

TEST DATA

Sample No.	Sample Type	Sample Graphics	Recovery (in)	Standard Penetration Test Blows per 6" [*N-Value*] *blows/foot*	Qu-tsf Unconfined (Pocket Pen.) Compressive Strength	Moisture Content %	Liquid Limit (LL)	Plasticity Index (PI)	Percent Passing #200 Sieve	Remarks
1	SS	X	16	4-4-50/2 [*50/2*]						
2	SS	X	12	9-50/4- [*50/4*]		14.1	35	22	85	
3	SS	X	8	19-50/3- [*50/3*]		9.8				
4	SS	X	8	19-50/3- [*50/3*]		11.4				

Depth to Groundwater
- Noted on Drilling Tools _____ ft.
- At Completion _____ ft.
- After _____ hours _____ ft.
- Cave Depth _____ ft.

Sample Type
- SPT- Standard Penetration Test
- SS- Split Spoon
- ST- Shelby Tube
- RC- Rock Core
- CU- Auger Cuttings

Boring Method
- HSA- Hollow Stem Augers
- CFA- Continuous Flight Augers
- MD- Mud Drilling

FIELD TESTING PROCEDURES

Field Operations: The general field procedures employed by CSI are summarized in ASTM D 420 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 and in situ methods as well as borings.

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

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 the chief driller. 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 D 2488 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 D 1586.

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 D 2113 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".

Hand Auger Borings and Dynamic Cone Penetration Testing: Hand auger borings are performed manually by CSI field personnel. This consists of manually twisting hand auger tools into the subsurface and extracting “grab” or baggie samples at intervals determined by the project engineer. At the sample intervals, dynamic cone penetration (DCP) testing is performed. This testing involves the manual raising and dropping of a 20 pound hammer, 18 inches. This “driver” head drives a solid-1¾ inch diameter cone into the ground. DCP “counts” are the number of drops it takes for the hammer to drive three 1¾ inch increments, recorded as X-Y-Z values.

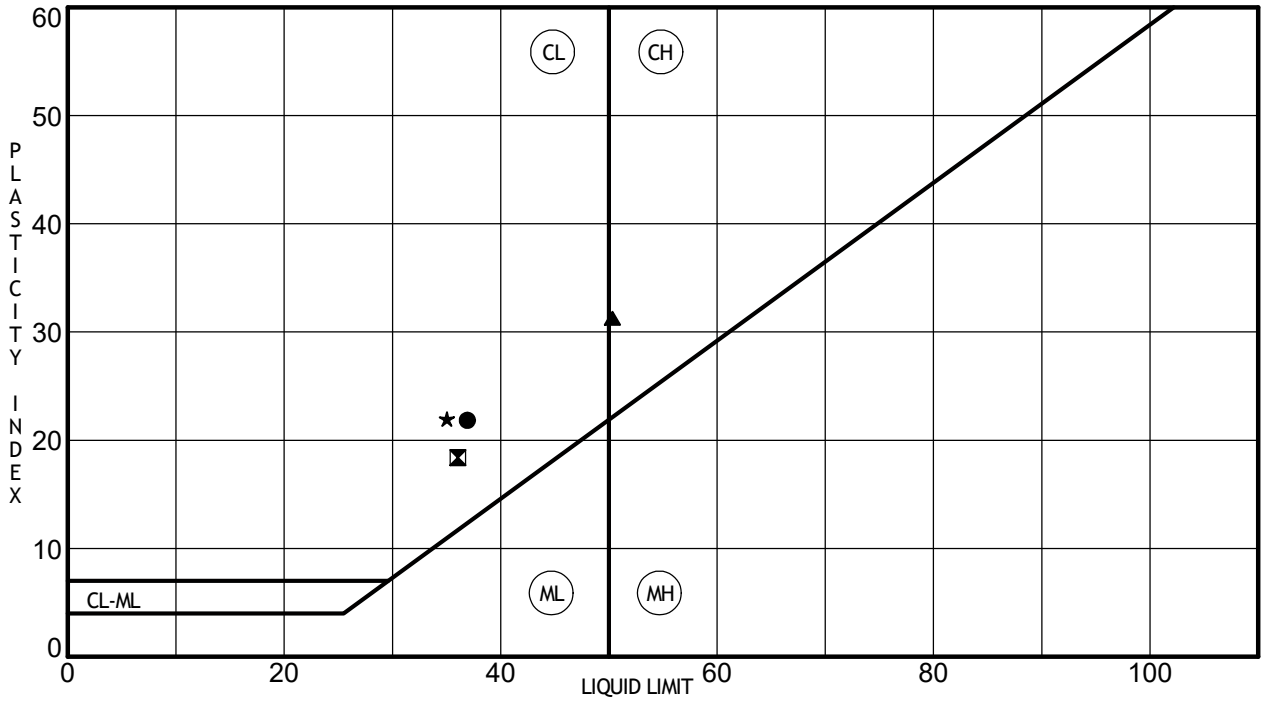
Test Pits: Test pits are excavated by the equipment available, often a backhoe or trackhoe. The dimensions of the test pits are based on the equipment used and the power capacity of the equipment. Samples are taken from the spoils of typical buckets of the excavator and sealed in jars or “Ziplock” baggies. Dynamic Cone Penetration or hand probe testing is often performed in the upper few feet as OSHA standards allow. Refusal is deemed as the lack of advancement of the equipment with reasonable to full machine effort.

Water Level Readings: Water table readings are normally taken in conjunction with borings and are recorded on the "Test Boring Records". 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.

Liquid and Plastic Limits Test Report



	Boring	Depth (ft)	LL	PL	PI	Water Content	% < #40	% < #200	USCS	Description
●	B-1	6.0	37	15	22	14.0		82		LEAN CLAY with SAND(CL)
⊠	B-3	3.5	36	18	18	11.7		82		LEAN CLAY with SAND(CL)
▲	B-4	1.0	50	19	31	18.6		84		FAT CLAY with SAND(CH)
★	B-8	3.5	35	13	22	14.1		85		LEAN CLAY with SAND(CL)

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11785 Highway Drive
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PROJECT INFORMATION

Client: Basis Companies, LLC
Project Name: Fairfield Township Multi Commercial Retail
Project Number: CN220067
Project Location: Fairfield Township, Ohio

Summary of Laboratory Results

Borehole	Depth	Sample Type	Liquid Limit	Plastic Limit	Plasticity Index	Classification	Water Content (%)	Unconfined Compressive Strength (tsf)	Dry Density (pcf)	Wet Density (pcf)	Max. Dry Density (pcf)	Opt. Water Content (%)	CBR	Swell (%)	RQD	Percent Recovery	Percent Finer (No. 200)
B-1	1.0	SS					12.1										
B-1	6.0	SS	37	15	22	LEAN CLAY with SAND(CL)	14.0										82
B-2	3.5	SS					10.6										
B-2	8.5	SS					14.9										
B-3	1.0	SS					14.8										
B-3	3.5	SS	36	18	18	LEAN CLAY with SAND(CL)	11.7										82
B-3	6.0	SS					25.2										
B-4	1.0	SS	50	19	31	FAT CLAY with SAND(CH)	18.6										84
B-4	6.0	SS					10.7										
B-5	3.5	SS					11.9										
B-5	6.0	SS					10.8										
B-6	1.0	SS					22.8										
B-6	3.5	SS					15.9										
B-6	8.5	SS					22.9										
B-7	1.0	SS					10.8										
B-7	6.0	SS					12.3										
B-8	3.5	SS	35	13	22	LEAN CLAY with SAND(CL)	14.1										85
B-8	6.0	SS					9.8										
B-8	8.5	SS					11.4										

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SS - Split Spoon Sample
GRAB - Bulk Grab Sample

PROJECT INFORMATION

Client: Basis Companies, LLC
Project Name: Fairfield Township Multi Commercial Retail
Project Number: CN220067
Project Location: Fairfield Township, Ohio

LABORATORY TESTING 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), color and texture. These classification descriptions are included on our "Test Boring Records."

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 D 2487). 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.

Rock Classification: Rock classifications 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 Test Boring Records.

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 D 4318.

Moisture Content: The Moisture Content is determined according to ASTM D 2216.

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.

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.

Compaction Tests: Compaction tests are run on representative soil samples to determine the dry density obtained by a uniform compactive effort at varying moisture contents. The results of the test are used to determine the moisture content and unit weight desired in the field for similar soils. Proper field compaction is necessary to decrease future settlements, increase the shear strength of the soil and decrease the permeability of the soil.

The two most commonly used compaction tests are the Standard Proctor test and the Modified Proctor test. They are performed in accordance with ASTM D 698 and D 1557, respectively. Generally, the Standard Proctor compaction test is run on samples from building or parking areas where small compaction equipment is anticipated. The Modified compaction test is generally performed for heavy structures, highways, and other areas where large compaction equipment is expected. In both tests a representative soil sample is placed in a mold and compacted with a compaction hammer. Both tests have three alternate methods.

Test	Method	Hammer Wt./Fall	Mold Diam.	Run on Material Finer Than	No. of Layers	No. of Blows/ Layer
Standard	A	5.5 lb./12"	4"	No. 4 sieve	3	25
D 698	B	5.5 lb./12"	4"	3/8" sieve	3	25
	C	5.5 lb./12"	6"	3/4" sieve	3	56

Test	Method	Hammer Wt./Fall	Mold Diam.	Run on Material Finer Than	No. of Layers	No. of Blows/ Layer
Modified	A	10 lb./18"	4"	No. 4 sieve	5	25
D 1557	B	10 lb./18"	4"	3/8" sieve	5	25
	C	10 lb./18"	6"	3/4" sieve	5	56

The moisture content and unit weight of each compacted sample is determined. Usually 4 to 5 such tests are run at different moisture contents. Test results are presented in the form of a dry unit weight versus moisture content curve. The compaction method used and any deviations from the recommended procedures are noted in this report.

Laboratory California Bearing Ratio Tests: The California Bearing Ratio, generally abbreviated to CBR, is a punching shear test and is a comparative measure of the shearing resistance of a soil. It provides data that is a semi-empirical index of the strength and deflection characteristics of a soil. The CBR is used with empirical curves to design pavement structures.

A laboratory CBR test is performed according to ASTM D 1883. The results of the compaction tests are utilized in compacting the test sample to the desired density and moisture content for the laboratory California Bearing Ratio test. A representative sample is compacted to a specified density at a specified moisture content. The test is performed on a 6-inch diameter, 4.58-inch-thick disc of compacted soil that is confined in a cylindrical steel mold. The sample is compacted in accordance with Method C of ASTM D 698 or D 1557.

CBR tests may be run on the compacted samples in either soaked or unsoaked conditions. During testing, a piston approximately 2 inches in diameter is forced into the soil sample at the rate of 0.05 inch per minute to a depth of 0.5 inch to determine the resistance to penetration. The CBR is the percentage of the load it takes to penetrate the soil to a 0.1 inch depth compared to the load it takes to penetrate a standard crushed stone to the same depth. Test results are typically shown graphically.