Germantown Crossing Geotechnical Report

Prepared for

Model Group
1826 Race Street
Cincinnati, Ohio

September 26, 2022

Project No. CN220187

CONSULTING SERVICES INCORPORATED
Geotechnical & Materials Engineering | IBC Special Inspection | Material Testing

September 26, 2022

David Daugherty
Model Group
1826 Race Street
Cincinnati, Ohio

Attention: Mr. David Daugherty
Sent via e-mail: ddaugherty@modelgroup.net

Subject: Geotechnical Report for Germantown Crossing
1520 Germantown Street
Dayton, Ohio
CSI Project No. CN220187

Dear Mr. Daugherty,

Consulting Services Incorporated of Cincinnati (CSI) is pleased to present our geotechnical report for the proposed Germantown Crossing project located at 1520 Germantown Street, Dayton, Ohio. We provided our services in general accordance the CSI Proposal 7981, dated July 12, 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 and foundation design for the project.

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,

James P. Haines

James P. Haines, P.E.
Senior Project Engineer

STATE OF OHIO
JAMES P.
HAINES
P.E. 81881
REGISTERED
PROFESSIONAL ENGINEER

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

TABLE OF CONTENTS

APPENDICES, FIGURES AND TABLES

Appendices

List of Figures

List of Tables

INTRODUCTION

1 SCOPE OF THE GEOTECHNICAL EXPLORATION

As proposed, CSI conducted a geotechnical exploration for the proposed Germantown Crossing development located at 1520 Germantown Street in Dayton, Ohio. Our services included a review of the project information provided, conducting a subsurface exploration that utilized soil borings to obtain samples for modeling the soil conditions at the proposed development, an analysis of data and information obtained, providing foundation recommendations for the site conditions and providing recommendations for site earth work.

2 SITE AND PROJECT INFORMATION

In preparing for this final report, CSI was provided with a Site Plan titled “Germantown Crossing Dayton Ohio” Sheet C101 prepared by tc Architects dated 6/28/2022 which depicts the layout of the proposed development. Based on the provided information, CSI understands the proposed project consists of a 50 unit 3-story L-shaped building with associated surface parking. A summary of the site and project information is presented in Tables 1 and 2 below.

Table 1: Site Information

Item	Description
Site Location	The site is located at the southwest quadrant of the intersection between Germantown Street and S. Paul Laurence Dunbar Street at address 1520 Germantown Street, Dayton, Ohio.
Size of Site	The overall property is approximately 1.5 acres.
Surrounding Area	The site is bordered by Germantown Street to the north, S. Paul Laurence Dunbar Street to the east and Willard Street to the south. An open and vacant grass covered area neighbors the site to the west.
Existing Conditions	The property is currently occupied by a vacant 3-story building situated within the central/northern portion of the site and is surrounded by asphalt and concrete pavement. There is approximately 10 feet of downward relief across the site from north to south ranging in elevation of about 756 feet amsl to 746 feet amsl.
Existing/Previous Structures(s)	A 3-story building currently occupies the central/northern portion of the site with the remainder of the site comprised of asphalt and concrete pavement. The lower level of the 3-story building is below grade at the north end of the building that transitions to an at grade level along the south end of the building. Prior to the existing development, the contained a rectangular shaped building oriented in a north-south direction that extended the full length of the site.
Existing/Previous Utilities	The site contains several existing underground utilities consisting of electric, gas, water and sewer. Overhead power is also present along the north side of the property.
Previous Site Use	The existing development was formerly the Day-Mont Behavioral Health Care.

Table 2: Project Information

Item	Description
Site Layout and Grading	See Boring Location Plan included within the appendix for depiction of the plan layout of the proposed structure and pavements. Proposed final grading and finish floor elevation was not provided at the time of this report.
Proposed Structure(s)	The proposed building will consist of a 50 unit 3-story L-shaped building positioned along the north and east sides of the site that occupies a footprint of 52,500 square feet. Proposed parking and drive lanes will occupy the remainder of the site.
Building Construction	It is assumed the building will be wood framed with a slab on grade floor.
Finish Floor Elevation	Not provided. It is assumed the finish floor will closely match existing grades.
Maximum Loads	Structure loads were not provided; therefore, CSI assumes Continuous loads: 2 kips per linear foot or less; Column loads: 150 kips or less; Floor Slab: 120 psf or less

3 AREA/SITE INFORMATION

3A AREA PHYSIOGRAPHY / TOPOGRAPHY

The site is located within the Southern Ohio Loamy Till Plain. This area is characterized by WIsconsinan age till, outwash and loess over lower Paleozoic age carbonate rocks and shales in the east. Surface of loamy till, end and recessional moraines, commonly associated with boulder belts, between relatively flat lying ground moraine, cut by steep valleyed large streams fill with outwash. The existing ground surface within the limits of the site provides gentle relief from north to south ranging from about elevation 756 feet amsl to 746 feet amsl. The open grass area at the southwest corner of the site is somewhat elevated in comparison to the existing pavement area to the east and is at about elevation 756 to 754 feet amsl. Figures 1 and 2 below depict the location of the site with respect to the regional physiography and existing topography, respectively.

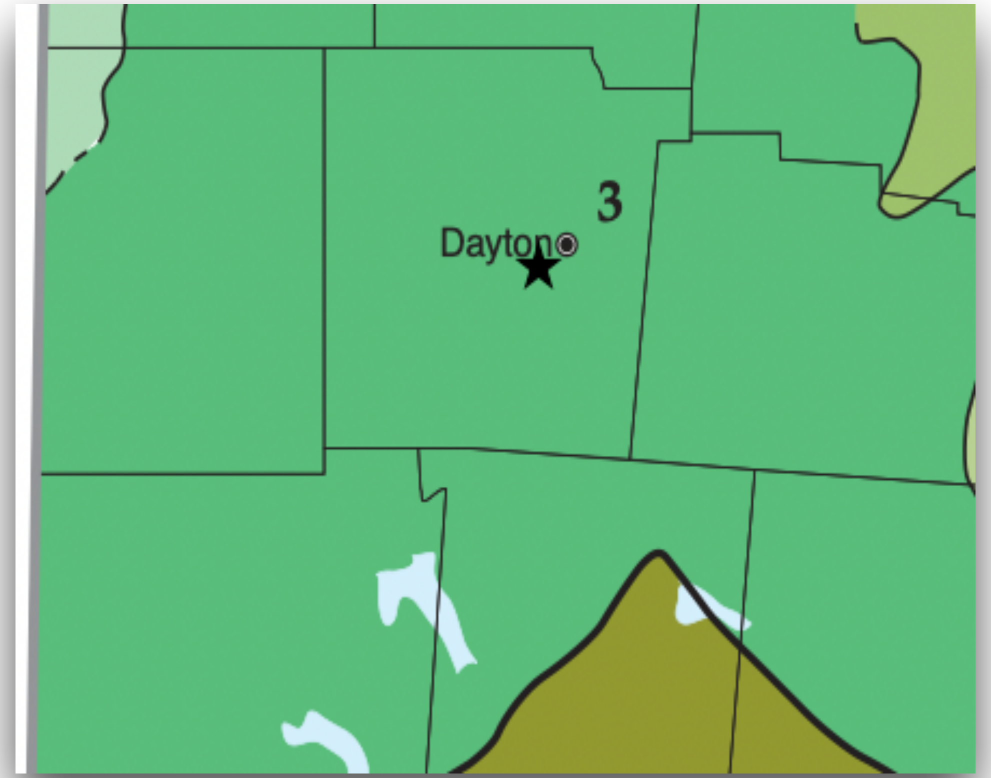


Figure 1: Ohio Physiographic Map (Approximate Site Location Shown With Star)

Figure 2: Montgomery County GIS 2017 Topography

3B SITE GEOLOGY

A review of the *Surficial Geology of the Ohio Portions of the Dayton Quadrangle* shown in **Figure 3**, indicates the site is mapped with deep Wisconsinan age deposits of sand and gravel with discontinuous layers containing unsorted mixtures of silt, clay, sand, gravel and boulders. Based on this mapping, the underlying limestone interbedded with shale bedrock is ordovician age and estimated to be in excess of 200 feet.

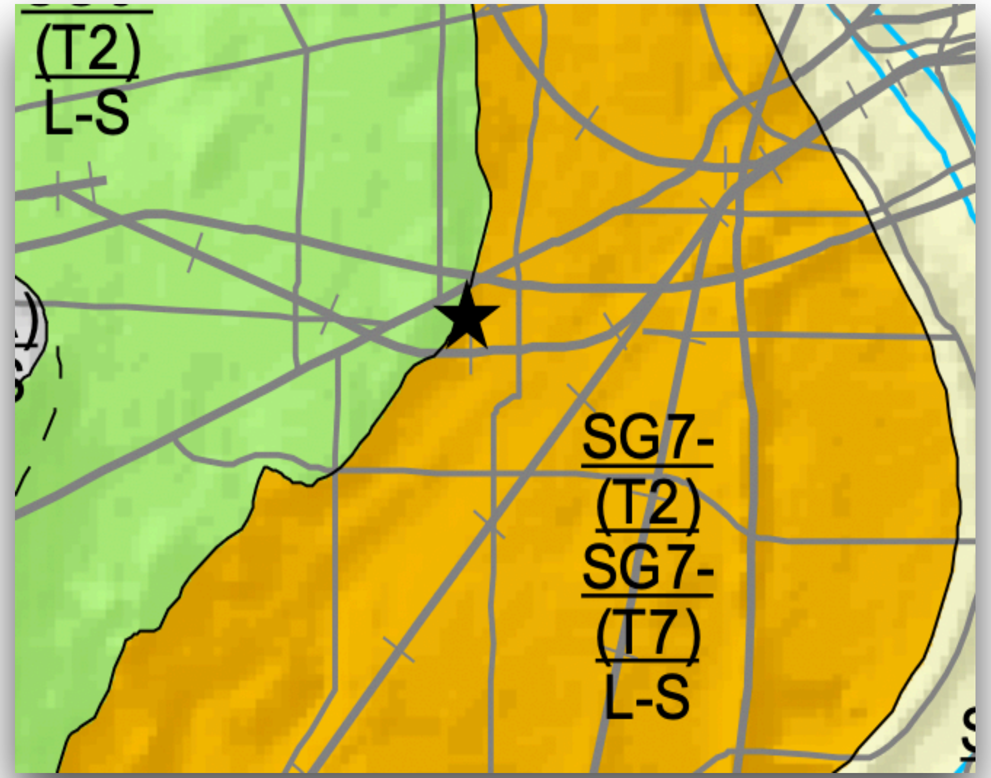


Figure 3: Site Geology (Approximate Site Location Shown With Star)

3C PUBLISHED SITE SOIL CONDITIONS

Published surficial soil mapping from the USDA soil survey indicates the surficial soils on the site are associated with Crosby- and Miamian-Urban Land Complex. Sites mapped with the Urban Land Complex designated are those that have been associated with prior and existing developments. Figure 4 on the following page depicts the USDA soil survey mapping of the site. Table 3 below summarizes relevant information for the Crosby and Miamian soil series.

Figure 4: USDA Soil Survey Map

Table 3: Summary of USDA Soil Survey

Soil Series	Abbreviation	Slope (%)	Parent Material	Percentage of Site (%)	Depth to Restrictive Feature (in.)	Depth to Water Table (in.)
Crosby	Cu	0 to 2	Silty material or loess over loamy till	80.6	24 to 40	6 to 24
Miamian	MoB	2 to 6	Silty loess over loamy till	19.4	>80	>80

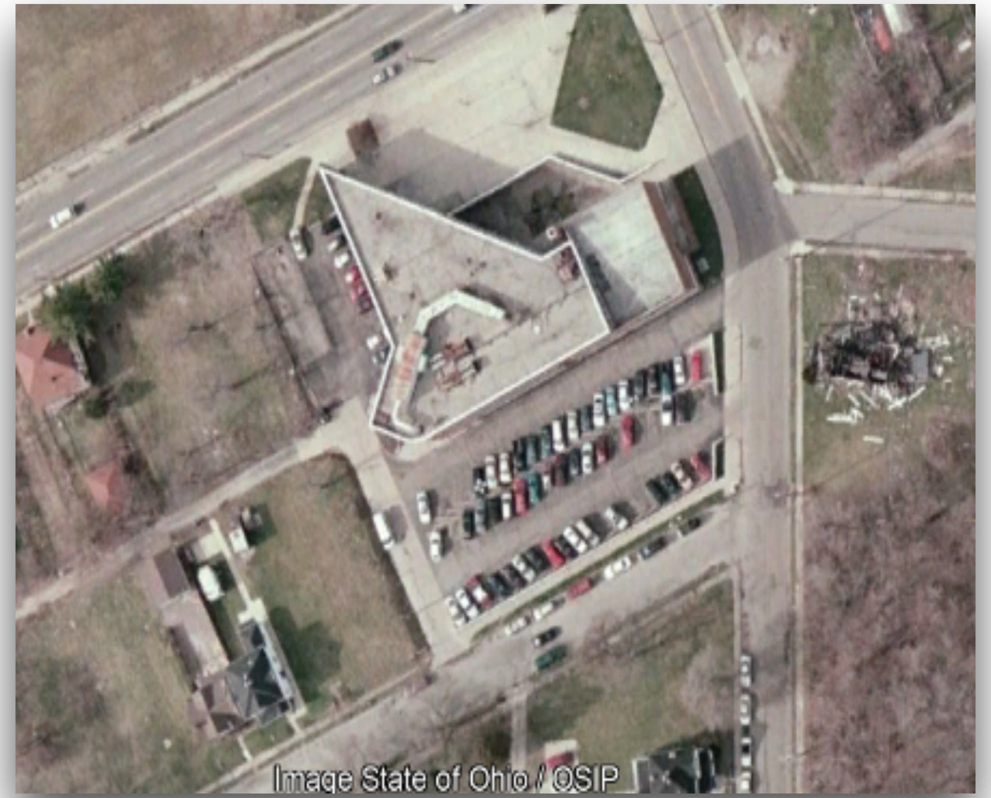
3D AERIAL PHOTOGRAPHS (GOOGLE EARTH)

Review of historical aerial images since the 1950's indicate that the site was developed prior to 1956 with a rectangular shaped building the appears to encompass much of the site. The referenced building appears to have been demolished prior to 1968 and the site was vacant as shown in the 1968 aerial. The 1994 image shows the building the is currently on the site. There does not appear to have been much change to the site or current development since 1994.

1956 Aerial

1968 Aerial

March 1994 Aerial



March 2005 Aerial

November 2020 Aerial

4 SITE PHOTOGRAPHS

Representative photographs of the site from August 17, 2022 are shown below.

Photo 1: Standing at Boring B-4 facing West to Boring B-2.

Photo 2: Northwest Portion of the Site Facing East

Photo 3: Northwest Portion of the Site Facing South.

Photo 4: Southwest Corner of Existing Building Facing East.

Photo 5: Southern Portion of the Site.

Photo 6: Northeast Corner of Existing Building Facing West Depicting Lower Level.

FINDINGS

5 SUBSURFACE CONDITIONS

CSI performed ten (10) soil test borings to explore the subsurface conditions at the site. In general, our borings encountered either topsoil, concrete or asphalt pavement at the ground surface that was underlain by either previously placed fill or natural granular deposits of medium dense to dense sand and gravelly sand.

5A SUBSURFACE STRATA INFORMATION

The subsurface conditions encountered at the test boring locations are shown on the Test Boring Logs 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 field and laboratory 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). It should be noted that dashed stratification lines shown on the soil boring logs and Cross Sections A-A' and B-B' in the appendix represent approximate transitions between material types. In-situ stratum changes could occur gradually or at slightly different depths. Boring location coordinates and ground surface elevations were determined using a Real Time Kinetics (RTK) type GPS unit.

SURFICIAL MATERIALS

The surficial materials at the site consist of either topsoil, concrete or asphalt pavement. Topsoil was present at the ground surface at Borings B-3, B-4, B-7 and B-8 and was generally 6 inches thick. Concrete pavement comprises the majority of the north portion of the site in between the existing building and Germantown Street and was measured to be about 3 inches thick at Boring B-2. Asphalt pavement is present within majority of the western and southern portion of the site and measured about 2 to 4 inches thick within Borings B-1, B-5, B-6, B-9 and B-10. Underlying the asphalt pavement at Borings B-5, B-6, B-9 and B-10, an approximate 3 to 5 inch thick aggregate base layer was present. The surficial materials and associated thickness encountered at each boring location is included on the boring logs within the appendix.

EXISTING FILL

Existing fill soils were encountered underlying the existing pavement and/or topsoil at Borings B-1, B-2, and B-7 through B-10 that extended to depths between about 3.5 and 6 feet bgs (corresponding to elevations between about 750 and 751.5 feet amsl). The existing fill in Borings B-7, B-9 and B-10 extended to the maximum explored depth of about 5 feet bgs (elevations between about 741 and 751 feet amsl). Based on the referenced boring locations, the existing fill appears to be relatively sparatic across the site. The fill soil was generally described to be brown and gray sandy lean clay, lean clay, silt, or clayey sand with varying amounts of gravel. At isolated depths and locations the existing fill contained few roots, brick and rock fragments. Standard Penetration Test (SPT) N-Values were reported to generally range from 3 to 15 blows per foot (bpf). Split spoon refusal (I.e., greater than 50 blows per 6-inch increment) was encountered at one sample at Boring B-2 due to a rock floater. The consistency of the cohesive fill ranged from soft to stiff and the relative density of the granular fill is considered very loose to medium dense. Unconfined compressive strengths of the cohesive existing fill (estimated using a Hand Penetrometer) ranged from 0.5 to 2.5 tons per square foot (tsf). The in-situ moisture contents were reported to range between 6 and 18.2 percent.

GLACIAL OUTWASH

Natural soils designated as glacial outwash were encountered underlying the topsoil and/or pavement within Borings B-3 through B-6 or underlying the existing fill within Borings B-1, B-2 and B-8 and extended to the maximum explored depth of about 5 to 30 feet bgs (elevations between about 725 and 749 feet amsl). The glacial outwash is generally described as medium dense sand and clayey sand with trace amounts of gravel that transition to medium dense to very dense gravelly sand containing trace amounts of clay and silt below a depth of about 6 to 8.5 feet bgs (between about elevations 746.5 and 750 feet amsl). At Borings B-3 and B-4, an approximate 2.5 foot thick layer of very stiff to hard silt was encountered prior to transitioning into the gravelly sand. Standard Penetration (SPT) N-Values were reported to range from 11 to 43 bpf within the upper portion of the glacial outwash strata (i.e., sand, clayey sand and silt), and ranged from 12 to 62 bpf within the gravelly sand. Overall, the SPT values increased with depth. Two moisture content tests were performed on the samples of silt obtained from Borings B-3 and B-4 which were 19.4 percent and 18.3 percent, respectively.

For details of subsurface conditions encountered at a particular boring location please refer to the boring logs contained in the Appendix. 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

Groundwater was not encountered in any of the borings. In many areas of 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 interface between existing fill and natural soil. 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 assist with classification of the soils and provide recommendations for earthwork. Details for the test methods and results are shown in the Appendix. Tests performed included:

- 8 Moisture Content Tests
- 6 Particle Size Distribution 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 site is suitable for the proposed construction, provided the recommendations outlined in this report are followed. The primary geotechnical concerns are:

- **EXISTING FILL**
- **SITE DEMOLITION AND TEMPORARY EARTH RETENTION**

7A EXISTING FILL

Previously placed fill material was encountered within Borings B-1, B-2 and B-7 through B-10 to depths ranging from about 3.5 to 6 feet bgs. The existing fill is generally comprised of clay, silt and sand mixtures and contained trace amounts of roots, rock and brick fragments. The existing fill is considered variable with respect to strength and moisture content as noted by N values ranging from 3 to 12 bpf, unconfined compressive strengths ranging from 0.5 to 2.5 tsf and moisture contents ranging from about 6 to 18.2 percent. Based on the location of the proposed building in relation to the borings that encountered existing fill, it is expected the existing fill will be most prominent within the north/east portion of the new building that borders Germantown Street.

Due to the inconsistencies/variability with respect to strength and moisture content, it is CSI's opinion that the existing fill was not placed as an engineered fill with the intent to support new structures. In general, the existing fill will be subject to unpredictable total and differential settlement that could exceed typical design settlement tolerances when subject to new loads associated with building foundations and/or floor slabs. Assuming that the proposed finish floor elevation for the new building will be relatively close to the existing ground surface, it is expected that existing fill will be present at the design foundation elevation and floor slab subgrade, specifically within the north and eastern portions of the building. In general, where previously placed fill is present at or below the foundation bearing surface, building foundations will need to be extended or lowered, as needed, to penetrate the existing fill and bear directly atop natural soil. Given the existing fill appears to be localized within the north and eastern portion of the new building, consideration should be given to removing the existing fill within the building footprint to avoid differential subgrade support between the existing fill and medium dense natural soils. If the owner is willing to accept some risk associated with differential floor slab settlement, the fill may remain in place within the building footprint provided the earthwork recommendations contained in Section 9 are followed.

7B SITE DEMOLITION AND TEMPORARY EARTH RETENTION

Demolition and removal of the existing building, foundations, pavements underground utilities, etc., within the planned development areas will be critical to the successful long term performance of the new structure and associated development. It is understood the existing structure has a lower level; however, CSI is unaware of the extent/limits of the lower level, elevation of the lower level, and how it compares with the surrounding existing grades and site boundaries. Given that the existing building boarders portions of the property boundary and existing roadway and the subsurface profile consists of granular soils, it is possible that excavations and demolition activities required to remove the existing buildings lower level may not allow for minimum temporary slopes needed to protect adjacent property boundaries, easements, underground utilities and roadway. As a result, it is possible that a temporary earth retention system may be required in some areas prior to or as the excavations associated with the demolition activities are made. Based on the existing building location, it appears that one critical location of the site may be along the east property boundary. For this project, a feasible temporary earth retention system to consider is driven sheet piles or H-piles with wood lagging. Recommendations regarding site demolition are provided in Section 7. Lateral earth pressure recommendations for use in design of temporary or permanent soil retention/retaining walls are provided in Section 13.

8 SITE DEMOLITION

In accordance with the discussions section of this report, demolition and removal of the existing building, pavements, underground utilities, etc., within the planned development footprint will be required prior to earthwork, foundation and building construction. It is important that both the existing at-grade and below-ground structures are removed and the associated debris is hauled to an appropriate landfill, properly recycled or stockpiled in an approved area of the site. CSI recommends that below ground and at grade structures (building foundations, floor slabs, underground utilities, sidewalks, pavements, etc.) be completely removed from within the planned building footprint including a 10-feet wide buffer, where possible. CSI recommends that prior to demolition activities, the limits of the lower level of the existing building be evaluated in comparison with the existing grades, easement and/or property boundaries and associated underground utilities to determine if the minimum temporary slope recommendations contained in Section 9B can be adequately maintained and/or if a temporary earth retention system is required.

Existing structures and underground utilities located at least 10 feet beyond the building limits and extending at least 2 feet below the planned finish grades may remain in place, if approved by the Geotechnical Engineer and owner. CSI recommends any pipe or cavity left in place (beyond the building limits) must be fully grouted or backfilled with engineered fill. Construction debris generated demolition activities is not considered suitable for use in on-site fills.

9 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. We recommend that cuts and fills should not be performed without being evaluated by CSI. If problems occur and the recommendations do not address or do not adequately remedy, please contact CSI as soon as possible.

9A EXCAVATIONS TO REMOVE EXISTING FILL

As discussed in Section 7A, existing fill is present within portions of the proposed structure. The existing fill was primarily encountered within the north and east portions of the new building and is un suitable for direct support of the building foundations. The existing fill may be left in place to provide support for the planned floor slab provided the owner is willing to accept the risk of potential differential floor slab settlement associated with the existing fill and differential subgrade support conditions between the existing fill and natural soils and the earthwork and engineered fill recommendations contained in Section 9 are followed. Provided the owner is not willing to accept the risk of differential floor slab settlement, associated cracks and/or distortions, CSI recommends that the existing fill be completely removed from with the building footprint, including 10 feet beyond the building limits, prior to building and foundation construction. Based on encountered existing fill thickness, CSI expects the excavations to remove the existing fill will range from about 3 to 6 feet. Once the existing fill is removed, the associated excavation should be backfilled with engineered fill meeting the requirements contained in Section 9C and 9D of this report.

9B TEMPORARY EXCAVATIONS

Normal earth excavation equipment should be suitable for excavation operations that are associated with the on-site soils. All excavations should comply with OSHA requirements. For below-grade excavations, the existing fill soils and granular natural soils should be classified as an OSHA Type C soil with slope excavations of 1½ H:1V. If soil types other than what has been mentioned above are encountered, CSI should be contacted to evaluate stability.

9C SITE PREPARATION (WORK PRIOR TO FILLING)

- Site demolition should be performed in accordance with the recommendations contained within Section 8;
- The area should be stripped of any topsoil and/or vegetative cover prior to commencing fill operations;
- 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.
- Backfill of undercut areas should be done in accordance with section 9D;
- Deleterious materials such as topsoil, roots, wood or other materials that will decay should be removed from the site;
- 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.

9D 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 thick 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 (ASTM D698) in areas beneath structures (buildings and pavements). If necessary due to material or equipment size, a modified Proctor may also be considered. CSI can provide specific recommendations if needed.
- Non-structural areas (i.e., grassed and/or landscape areas) can utilize a lower compaction requirement of 90 percent if approved by the owner and geotechnical engineer. In general, non-structural areas should be considered 5 feet beyond the limits of structural entities (i.e., building, pavements, sidewalks, etc.).
- For soils which are high plasticity, maintain the moisture content of compacted fill between minus 1 and plus 2 percent of optimum moisture. Lower plasticity soils can have a variance of plus or minus 2 percent of optimum moisture;
- Soils with a plasticity index (PI) of greater than 35 should not be used in the upper 4 feet of new fill within roadways or buildings where the slab will be within 4 feet of the exterior surface grade. The on-site soils are generally non-plastic; however, CSI recommends any import soils that will be used as engineered fill be evaluated and tested by CSI prior to use to confirm plasticity;
- 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”.

- Retain a representative of CSI to observe and document fill placement and compaction operations.

9E 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

9F PERMANENT CUT/FILL SLOPES

The following are general slope construction guidelines:

- Any permanent cut or fill slope should be designed and constructed no steeper than a gradient of 3H:1V.
- Any area within 10 horizontal feet of a structure should be slightly sloped to allow surface water drainage away from the structure;

9G 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

10 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.

11 FOUNDATIONS

Based on the information provided and the conditions encountered, conventional spread footings should be a suitable foundation system to support the proposed building addition. As mentioned above, existing fill soils are present at the site that will require over-excavation if the existing fill is exposed at the design bearing elevation. Assuming the finish floor elevation of the new structure is relatively close to existing grade, over-excavation depths below typical frost depth are expected to be required within the north and east portions of the new building unless the existing fill is removed during the earthwork phase of the project as discussed in Section 9A. 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.

11A SHALLOW FOUNDATION RECOMMENDATIONS

Spread footings may be sized using a maximum net allowable bearing pressure of 3,000 pounds per square foot (psf). Foundations should bear on the medium dense to dense glacial outwash or better natural soils or engineered fill placed over the medium dense to dense natural soils. 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 or less. 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 earthwork. Additional design considerations for project foundations are outlined as follows:

- 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.

11B SHALLOW FOUNDATION NOTES

In general, cohesive soils, if present, 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 a hand auger in conjunction with field unconfined compression strength testing using a Hand Penetrometer 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.

12 GRADE SUPPORTED FLOOR SLABS

Grade supported floor slabs are suitable for the proposed structure, provided the subgrade is prepared according to the recommendations contained within this report. As noted in this report, if the owner is willing to accept the risk of potential floor slab settlement and associated cracks, distortions, etc., the existing fill may be left in place to provide support for the floor slab provided the existing fill passes a thorough proofroll and a minimum 2 feet of newly placed engineered fill is placed to provide the immediate subgrade support for the floor slab. Alternately the existing fill can be removed and replaced with engineered fill as discussed in Section 9A. We recommend the floor slab 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

13 TEMPORARY AND PERMANENT EARTH RETENTION AND RETAINING WALLS

CSI recommends that temporary or permanent soil retention structures and retaining walls for the project be designed to meet the site needs including maximum retention height, location, tolerable deflection at the top of the structure, and constructibility. It is recommended that the retention structure(s) or retaining wall(s) be designed and sealed by a professional engineer licensed in the state of Ohio acknowledging that the appropriate internal, external, and global stability factors of safety for the particular retaining wall structure or soil retention system are met.

Soil retention structures and retaining walls should be designed to resist lateral loads imposed by the surrounding soils, hydrostatic pressure (if adequate drainage of the backfill is not provided), and surface surcharge loads adjacent to the wall (i.e., structures, foundations, pavements, traffic loads, stockpiles, inclined backfill, etc.). Depending on the lateral movement acceptance criteria, the structure may be designed as: 1) cantilevered (not fixed at the top allowing lateral deflection); or, 2) restrained or anchored (fixed at the top). With respect to the lateral earth pressure design, CSI recommends that "active" earth pressures be used for cantilevered designs and “at-rest” lateral earth pressures be used for restrained/anchored designs (i.e., basement foundation walls). Should wall backfill be placed before floor joists are constructed, it may be necessary to provide temporary bracing if the walls cannot accommodate construction phase stresses, or the walls should be designed for the active earth pressure condition as self-supporting cantilever walls.

The lateral earth pressure coefficients should be selected based on the predominate soil within the retained zone of the soil retention structure or retaining wall. The retained zone should be considered as an imaginary line drawn upward at a 45 degree angle from the top of footing. The following table presents granular backfill and on-site materials earth pressure design parameters for Equivalent Fluid Density's (EFD's) and Earth Pressure coefficients. The values given assume the backfill surface is level, drained or undrained backfill, the zone of backfill conforms to the minimum zone size given above, and no surcharge is placed on the backfill.

Table 4: Equivalent Fluid Density (EFD) and Earth Pressure Coefficient

Condition	Granular Backfill		On-Site Materials (1)		
	Coefficients	EFD (Drained) (pcf)	Coefficients	EFD (Drained) (pcf)	EFD (Undrained) (pcf)
At-Rest	Ko = 0.35	45	Ko = 0.50	63	94
Active	Ka = 0.22	30	Ka = 0.33	42	83
Passive	Kp = 2.75	300	Kp = 3.00	375	250

(1) On-site soil having a unit weight of 125 pcf and friction angle of 30 degrees.

The above table provides drained and undrained (i.e., includes hydrostatic pressure of 62.4 pcf) lateral earth pressure design parameters. For all retaining walls, where possible, CSI recommends that the wall design include sufficient drainage of the backfill soils to relieve hydrostatic pressure. For this purpose, CSI recommends that drainage backfill be constructed immediately behind the wall and extend from the foundation elevation to the top of the wall. This backfill should be effectively drained using a piping system connected to a storm sewer, gravity outlet, weep holes or a sump. Where possible, CSI recommends that the immediate backfill soils (within a minimum of 2 feet laterally from the wall) consist of a free-draining compacted granular material. The free-draining granular material should consist of a uniformly-graded aggregate that is between ½ inch to 1-inch in size and contain less than 5 percent passing a #200 size sieve. The free draining granular backfill should be separated from clayey soil using a non-woven geotextile filter fabric. Alternately, a drainage geocomposite may be used as the drainage layer behind the back face of the wall. CSI recommends that the drainage system be comprised of a minimum 8 inch diameter perforated pipe placed at the base of the free draining granular backfill (i.e., adjacent to and continuously along the wall foundation) or geocomposite and gravity drained to a storm outlet, weep holes or sump.

With respect to global stability of the site retaining walls, CSI recommends that the retaining wall design meet a minimum factor of safety (FS) of 1.5 for global stability. CSI recommends that the wall designer submit the design plans to the Geotechnical Engineer of Record for review to confirm that the final design achieves a global stability FS of 1.5.

14 PAVEMENTS

Proper support of pavement structures will be critical to the long term performance of the roadway. This begins with appropriate earthwork procedures including fill placement and proof rolling to identify soft and yielding areas per Section 9 of this report. Existing fill is expected to be present in portions of the site at the pavement subgrade elevation that will likely yield to proof rolls and construction traffic that will require localized over-excavation and replacement or stabilization prior to placing the aggregate base layer. In addition to proper earthwork procedures, adequate pavement drainage will also have a significant role in the future performance. If the subgrade beneath the pavement becomes wet, it will lose strength and stability and make the overlying pavement structure susceptible to breakup under imposed loads. For surface drainage, we recommend the pavements be constructed/designed in a manner that allows the water to flow away from the pavement so that water does not collect and pond at the edges. This is typically achieved by crowning the center of the pavement and having a minimum 2% slope in each direction toward a curb and gutter system with positive drainage.

The design traffic loads for this project were not available at the time of this report; therefore, specific pavement designs were not performed. In absence of a specific pavement and evaluation design, CSI has provided some suggested minimums, based on our experience with similar projects and subgrade soil conditions. For light duty pavements (cars and light trucks only), a traffic load of 25,000 equivalent single-axle loads (ESALs) has been assumed. For heavy duty pavements subjected to occasional truck traffic, a traffic load of 100,000 ESALs is assumed. However, CSI recommends that a specific design be performed to confirm that the minimum pavement sections provided herein are sufficient.

The following recommended pavement sections are based on a properly prepared subgrade having a California Bearing Ratio (CBR) value of at least 3. Based on the defined limitations and our assumptions, CSI suggests the minimum pavement section thicknesses described below.

Table 5: Summary of Recommended Pavement Sections

Pavement Application	Minimum Asphalt Concrete/ Aggregate Base Course Thickness (inches)	Minimum Portland cement Concrete/Aggregate Base Course Thickness (inches)
Light Duty(1)	4/8	6/6
Heavy Duty(2)	6/8	6/6

15 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 ten borings 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.

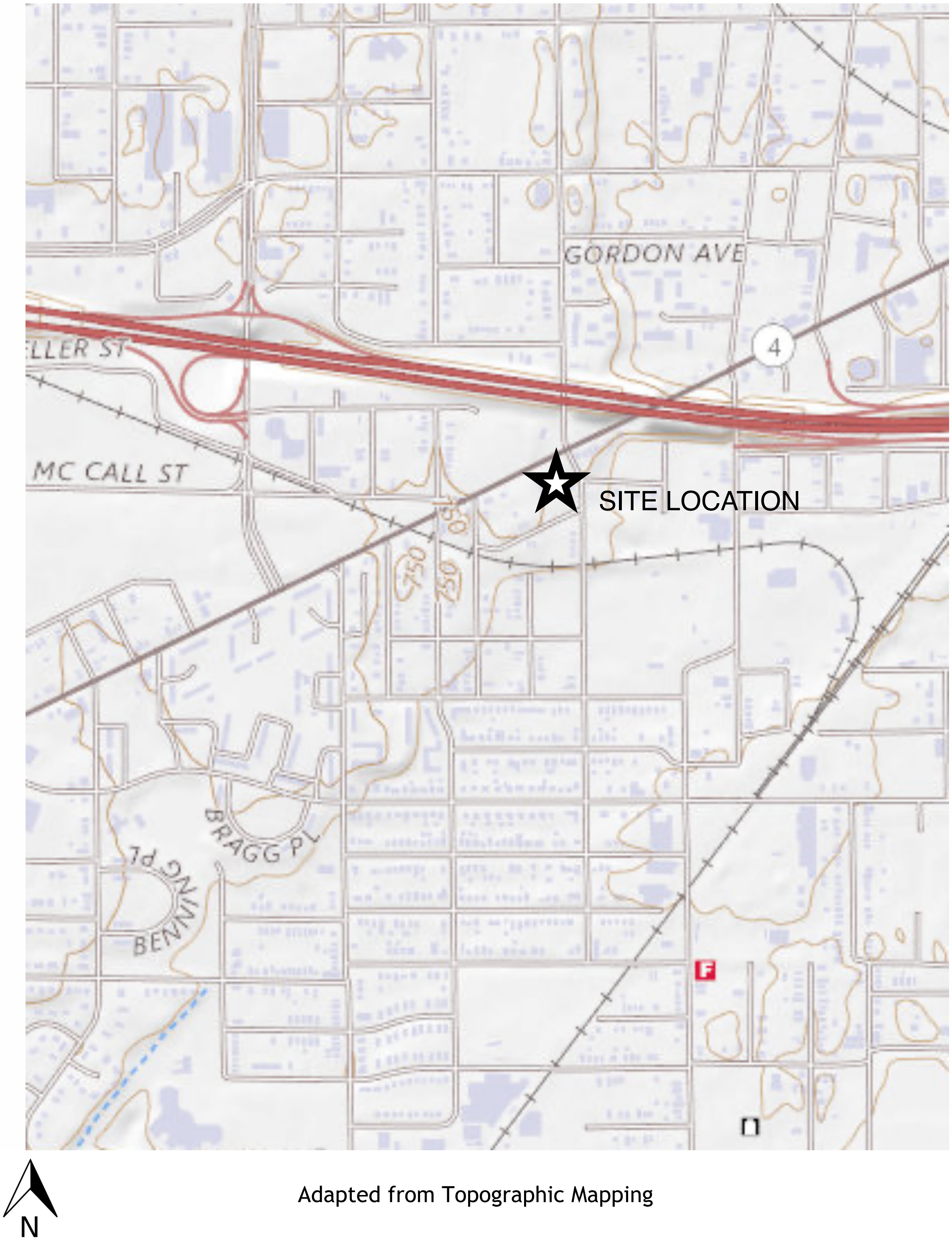
This report is based on the supplied project information, the subsurface conditions observed at the time of the report, and our experience with similar conditions. As such, it cannot be applied to other project sites, types, or combinations thereof. If the Project Information section in this report contains 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.

APPENDIX

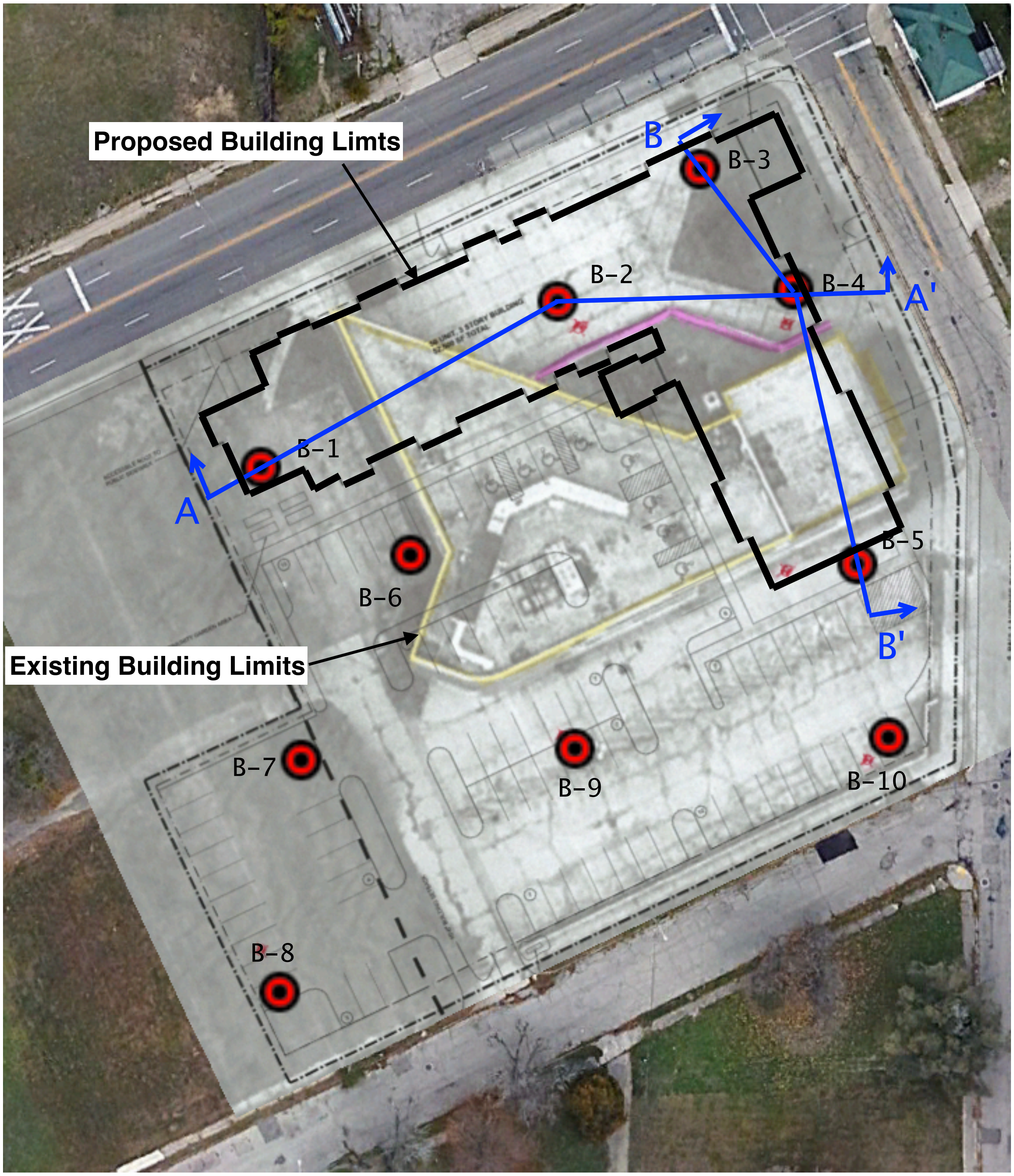


Adapted from Topographic Mapping

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: CN220187	Drawn By: JPH	
	PROJECT: Germantown Crossing 1520 Germantown Street, Dayton, Ohio	Date: 9/21/2022	Checked By: JB	
		Scale: Not To Scale	Drawing No: 1 of 2	

This drawing is being furnished for this specific project only. Any party accepting this document does so in confidence and agrees that it shall not be duplicated in whole or in part, nor disclosed to others without the consent of Consulting Services Incorporated of Ohio.



N

Adapted from Aerial Imagery & Sheet C101

FOR ILLUSTRATION PURPOSES ONLY

LEGEND	
B-XX	BORING LOCATION

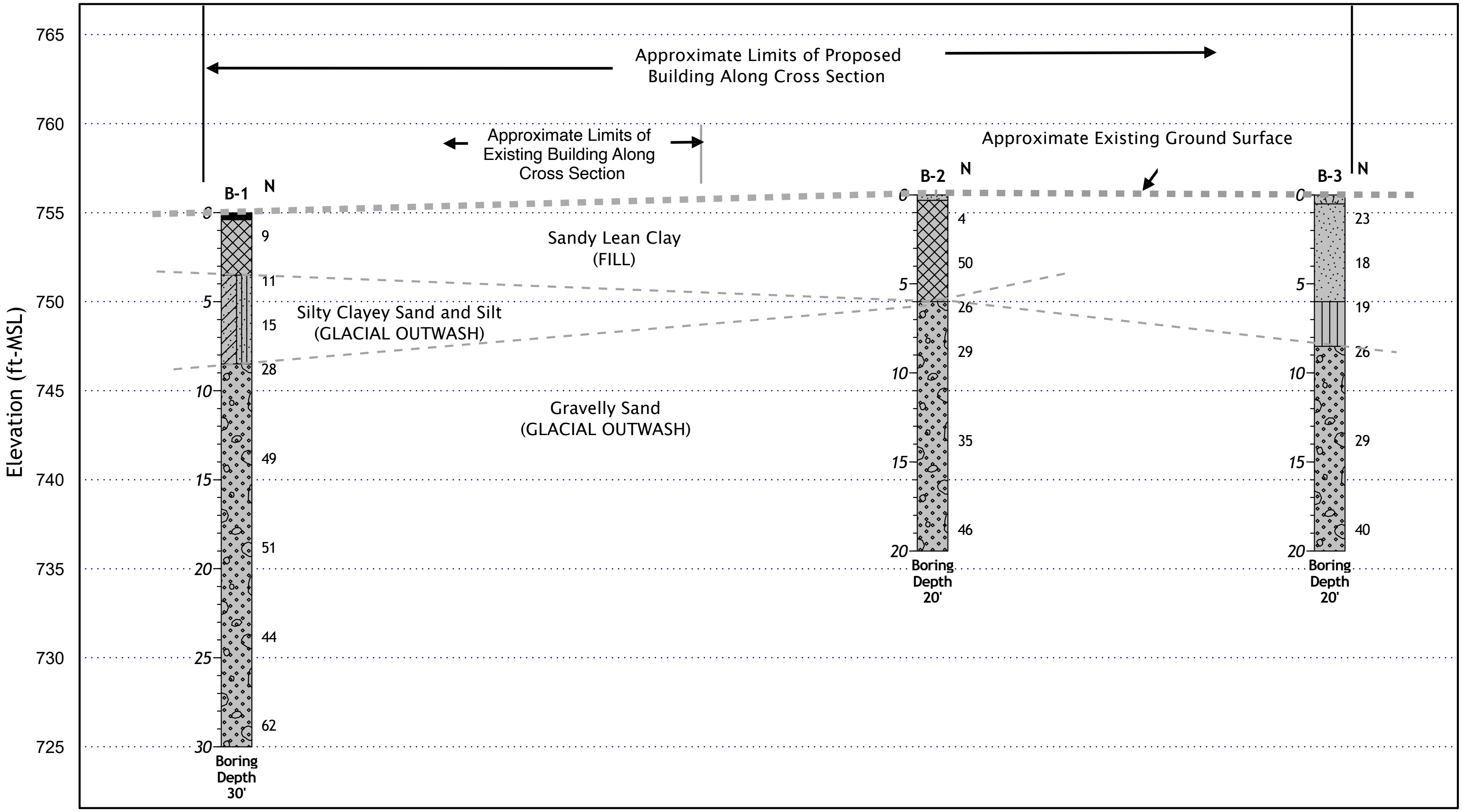
CSI Cincinnati, LLC
11785 Highway Drive Cincinnati, Ohio 45241
513.252.2059 Office|888.792.3121 Fax
www.csiohio.com

TITLE: BORING LOCATION PLAN

PROJECT: Germantown Crossing
1520 Germantown Street,
Dayton, Ohio

Project No: CN220187	Drawn By: JPH
Date: 9/21/2022	Checked By: JB
Scale: Not To Scale	Drawing No: 2 of 2

Cross Section A-A'
N.T.S.



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

CSI of Cincinnati
11785 Highway Drive
Cincinnati, OH 45241
Phone: 513.252.2059
Fax: 888.792.3121

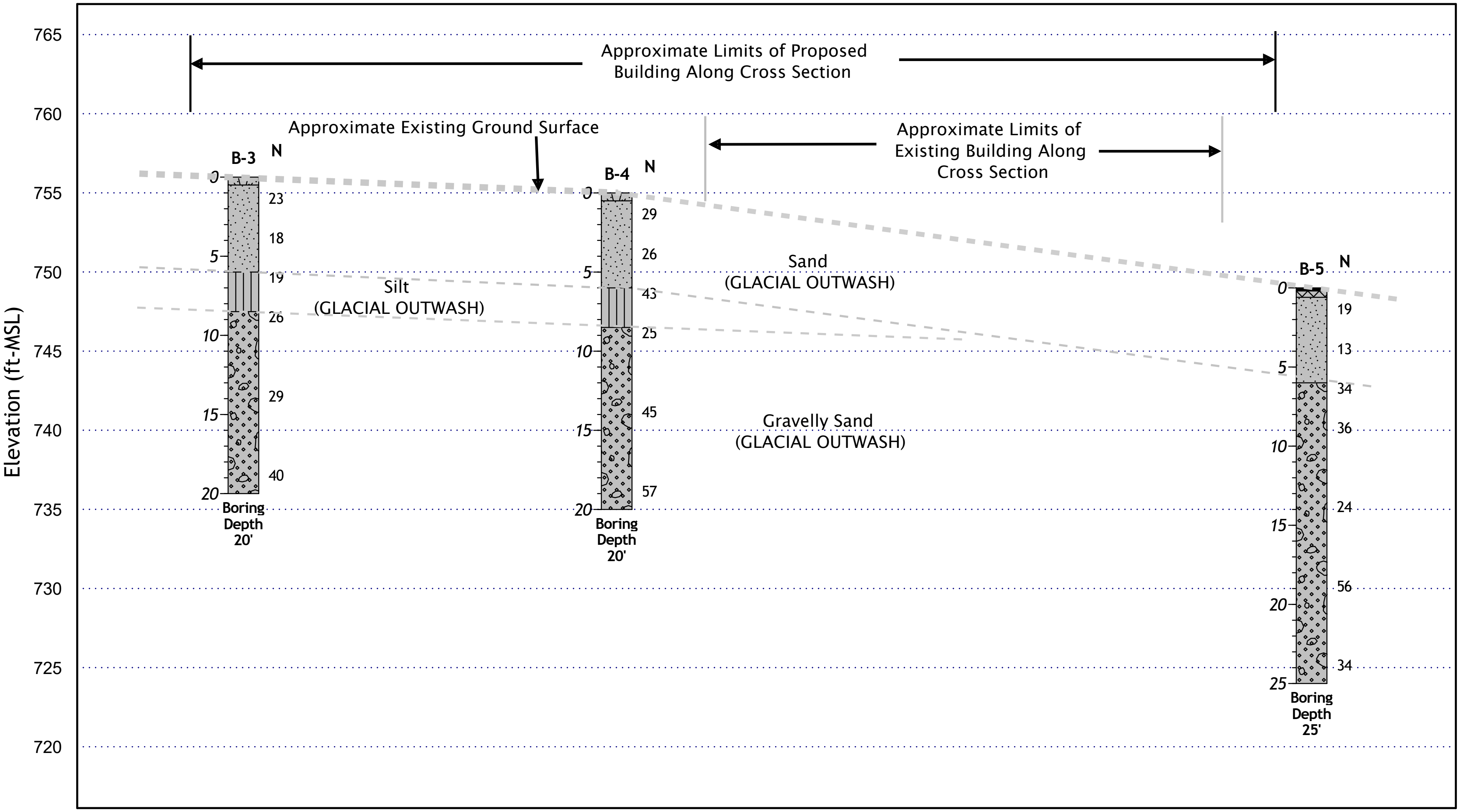
Germantown Crossing
CN220187

BORING PROFILE

Fig. 1

Cross Section B-B'

N.T.S.



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

CSI of Cincinnati
11785 Highway Drive
Cincinnati, OH 45241
Phone: 513.252.2059
Fax: 888.792.3121

Germantown Crossing
CN220187

BORING PROFILE

Fig. 1

CSI STRATIGRAPHY (GINT 7) CN220187 GERMANTOWN CROSSING.GPJ GINT STD US LAB.GDT 9/22/22

Consulting Services Incorporated
LEXINGTON | LOUISVILLE | CINCINNATI

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.

CSI of Cincinnati
11785 Highway Drive
Cincinnati, OH 45241
Phone: 513.252.2059
Fax: 888.792.3121

TEST BORING LOG

CLIENT **Model Group**

PROJECT NAME **Germantown Crossing**

PROJECT LOCATION **1520 Germantown Street, Dayton, Ohio**

BORING # **B-1**

JOB # **CN220187**

LOGGED BY **CG**

APPROVED BY **JPH**

DRILLING and SAMPLING INFORMATION

Date Started	**8/22/2022**	Contractor	**CSI**
Date Completed	**8/22/2022**	Boring Size	**6** in.
Drill Rig	**Mobile B-57**	Boring Method	**3.25" I.D. HSA**
Weather	**Overcast**	Hammer Type	**Automatic**

SOIL CLASSIFICATION / TEST DATA

Elev. (ft)	Depth Scale	Water Level	SURFACE ELEVATION: 755.0	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
754			ASPHALT (4 inches)											
752	2		Brown SANDY LEAN CLAY (CLS) with trace gravel, noted brick fragment [FILL] - moist, stiff	1	SS	☒	14	4-4-5 [*9*]	2.5	11.3				
750	4		Brown SILTY CLAYEY SAND (SC-SM) with trace gravel [GLACIAL OUTWASH] - moist, medium dense	2	SS	☒	16	3-5-6 [*11*]	2.5				58	
748	6 8			3	SS	☒	13	3-6-9 [*15*]	2					
746 744	10 12		Brown well graded GRAVELLY SAND (SWG), trace silt, trace clay [GLACIAL OUTWASH] - dry, medium dense to very dense	4	SS	☒	13	11-14-14 [*28*]					10	
742 740	14 16			5	SS	☒	14	19-21-28 [*49*]						
738 736 734	18 20			6	SS	☒	9	20-22-29 [*51*]						
732 730	22 24 26			7	SS	☒	10	15-19-25 [*44*]					25	
728 726	28			8	SS	☒	12	21-29-33 [*62*]						
724 722	30 32 34		Boring Terminated at 30 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

CSI of Cincinnati
11785 Highway Drive
Cincinnati, OH 45241
Phone: 513.252.2059
Fax: 888.792.3121

TEST BORING LOG

CLIENT **Model Group**

PROJECT NAME **Germantown Crossing**

PROJECT LOCATION **1520 Germantown Street, Dayton, Ohio**

BORING # **B-2**

JOB # **CN220187**

LOGGED BY **CG**

APPROVED BY **JPH**

DRILLING and SAMPLING INFORMATION

Date Started **8/22/2022**
Contractor **CSI**
Date Completed **8/22/2022**
Boring Size **6** in.
Drill Rig **Mobile B-57**
Boring Method **3.25" I.D. HSA**
Weather **Overcast**
Hammer Type **Automatic**

SOIL CLASSIFICATION

SURFACE ELEVATION: 756.0

CONCRETE (3 inches)

Brown SANDY LEAN CLAY (CLS) with gravel [FILL] - moist, soft

Noted rock fragment at about 4 feet

Brown and gray well graded GRAAVELLY SAND (SWG), trace silt, trace clay [GLACIAL OUTWASH] - dry, medium dense to very dense

Boring Terminated at 20 feet - No Refusal

TEST DATA

Sample No.	Sample Type	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	5	3-2-2 [*4*]		9.5				
2	SS	6	3-50- [*50*]	1					
3	SS	10	15-12-14 [*26*]						
4	SS	12	8-16-13 [*29*]						
5	SS	11	8-16-19 [*35*]						
6	SS	14	15-24-22 [*46*]						

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

CSI of Cincinnati
11785 Highway Drive
Cincinnati, OH 45241
Phone: 513.252.2059
Fax: 888.792.3121

TEST BORING LOG

CLIENT **Model Group**
PROJECT NAME **Germantown Crossing**
PROJECT LOCATION **1520 Germantown Street, Dayton, Ohio**

BORING # **B-3**
JOB # **CN220187**
LOGGED BY **CG**
APPROVED BY **JPH**

DRILLING and SAMPLING INFORMATION

Date Started	8/22/2022	Contractor	CSI
Date Completed	8/22/2022	Boring Size	6 in.
Drill Rig	Mobile B-57	Boring Method	3.25" I.D. HSA
Weather	Overcast	Hammer Type	Automatic

SOIL CLASSIFICATION / TEST DATA

SURFACE ELEVATION: 756.0

Elev. (ft)	Depth Scale	Water Level	SOIL CLASSIFICATION	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 (6 inches)											
754	2		Brown poorly graded SAND (SP) with trace gravel, trace silt, trace clay [GLACIAL OUTWASH] - moist to dry, medium dense	1	SS	☒	16	10-12-11 [*23*]					21	
752	4			2	SS	☒	14	7-10-8 [*18*]						
750	6		Brown SILT (ML) with trace sand [GLACIAL OUTWASH] - moist, very stiff	3	SS	☒	14	8-9-10 [*19*]		19.4			87	
748	8		Brown and gray well graded GRAVELLY SAND (SWG) with trace silt, trace clay [GLACIAL OUTWASH] - dry, medium dense to dense											
746	10			4	SS	☒	12	13-14-12 [*26*]						
744	12													
742	14			5	SS	☒	11	15-14-15 [*29*]						
740	16													
738	18													
736	20			6	SS	☒	8	19-19-21 [*40*]						
734	22		Boring Terminated at 20 feet - No Refusal											
732	24													
730	26													
728	28													
726	30													
724	32													
722	34													

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

CSI of Cincinnati
11785 Highway Drive
Cincinnati, OH 45241
Phone: 513.252.2059
Fax: 888.792.3121

TEST BORING LOG

CLIENT **Model Group**

PROJECT NAME **Germantown Crossing**

PROJECT LOCATION **1520 Germantown Street, Dayton, Ohio**

BORING # **B-4**

JOB # **CN220187**

LOGGED BY **CG**

APPROVED BY **JPH**

DRILLING and SAMPLING INFORMATION

Date Started	**8/22/2022**	Contractor	**CSI**
Date Completed	**8/22/2022**	Boring Size	**6** in.
Drill Rig	**Mobile B-57**	Boring Method	**3.25" I.D. HSA**
Weather	**Overcast**	Hammer Type	**Automatic**

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION: 755.0	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 (6 inches)											
Brown poorly graded SAND with trace gravel, trace silt, trace clay [GLACIAL OUTWASH] - dry, medium dense	1	SS	☒	11	13-14-15 [*29*]						
	2	SS	☒	14	3-19-7 [*26*]						
Brown SILT (ML) with trace clay, trace sand [GLACIAL OUTWASH] - moist, hard	3	SS	☒	12	3-19-24 [*43*]		18.3				
Brown and gray well graded GRAVELLY SAND (SWG) with trace silt, trace clay [GLACIAL OUTWASH] - dry, medium dense to very dense	4	SS	☒	14	10-11-14 [*25*]						
	5	SS	☒	14	23-23-22 [*45*]						
	6	SS	☒	12	21-29-28 [*57*]						
Boring Terminated at 20 feet - No Refusal											

Elev. (ft): 754, 752, 750, 748, 746, 744, 742, 740, 738, 736, 734, 732, 730, 728, 726, 724, 722

Depth Scale: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34

Water Level

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

CSI of Cincinnati
11785 Highway Drive
Cincinnati, OH 45241
Phone: 513.252.2059
Fax: 888.792.3121

TEST BORING LOG

CLIENT **Model Group**
PROJECT NAME **Germantown Crossing**
PROJECT LOCATION **1520 Germantown Street, Dayton, Ohio**

BORING # **B-5**
JOB # **CN220187**
LOGGED BY **CG**
APPROVED BY **JPH**

DRILLING and SAMPLING INFORMATION

Date Started	8/22/2022	Contractor	CSI
Date Completed	8/22/2022	Boring Size	6 in.
Drill Rig	Mobile B-57	Boring Method	3.25" I.D. HSA
Weather	Overcast	Hammer Type	Automatic

SOIL CLASSIFICATION

SURFACE ELEVATION: 749.0

Elev. (ft)	Depth Scale
748	
	2
746	
	4
744	
	6
742	
	8
740	
	10
738	
	12
736	
	14
734	
	16
732	
	18
730	
	20
728	
	22
726	
	24
724	
	26
722	
	28
720	
	30
718	
	32
716	
	34

TEST DATA

Soil Classification	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
ASPHALT (2 inches)											
Gravel Base (5 inches)											
Brown poorly graded SAND (SP) with gravel, trace silt, trace clay [GLACIAL OUTWASH] - dry, medium dense	1	SS	☒	12	8-9-10 [*19*]						
	2	SS	☒	10	6-6-7 [*13*]					9	
Brown and gray well graded GRAVELLY SAND (SWG) with trace silt, trace clay [GLACIAL OUTWASH] - dry medium dense to very dense	3	SS	☒	13	6-15-19 [*34*]						
	4	SS	☒	11	14-17-19 [*36*]						
	5	SS	☒	14	7-10-14 [*24*]						
	6	SS	☒	11	22-25-31 [*56*]						
	7	SS	☒	14	8-15-19 [*34*]						
Boring Terminated at 25 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

CSI of Cincinnati
11785 Highway Drive
Cincinnati, OH 45241
Phone: 513.252.2059
Fax: 888.792.3121

TEST BORING LOG

CLIENT **Model Group**
PROJECT NAME **Germantown Crossing**
PROJECT LOCATION **1520 Germantown Street, Dayton, Ohio**

BORING # **B-6**
JOB # **CN220187**
LOGGED BY **CG**
APPROVED BY **JPH**

DRILLING and SAMPLING INFORMATION

Date Started	8/22/2022	Contractor	CSI
Date Completed	8/22/2022	Boring Size	6 in.
Drill Rig	Mobile B-57	Boring Method	3.25" I.D. HSA
Weather	Overcast	Hammer Type	Automatic

TEST DATA

SOIL CLASSIFICATION

Elev. (ft)	Depth Scale	Water Level	SURFACE ELEVATION: 753.0	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
752			ASPHALT (2 inches)											
	2		Gravel Base (3 inches)	1	SS	☒	6	7-6-6 [12]						
750			Brown and gray well graded GRAVELLY SAND (SWG) with trace silt, trace clay [GLACIAL OUTWASH] - dey medium dense											
	4			2	SS	☒	12	9-11-16 [27]						
748														
	6													
746			Boring Terminated at 5 feet - No Refusal											
	8													
744														
	10													
742														
	12													
740														
	14													
738														
	16													
736														
	18													
734														
	20													
732														
	22													
730														
	24													
728														
	26													
726														
	28													
724														
	30													
722														
	32													
720														
	34													

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

CSI of Cincinnati
11785 Highway Drive
Cincinnati, OH 45241
Phone: 513.252.2059
Fax: 888.792.3121

TEST BORING LOG

CLIENT **Model Group**
PROJECT NAME **Germantown Crossing**
PROJECT LOCATION **1520 Germantown Street, Dayton, Ohio**

BORING # **B-7**
JOB # **CN220187**
LOGGED BY **CG**
APPROVED BY **JPH**

DRILLING and SAMPLING INFORMATION

Date Started	8/22/2022	Contractor	CSI
Date Completed	8/22/2022	Boring Size	6 in.
Drill Rig	Mobile B-57	Boring Method	3.25" I.D. HSA
Weather	Overcast	Hammer Type	Automatic

SOIL CLASSIFICATION / TEST DATA

Elev. (ft)	Depth Scale	Water Level	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 (6 inches)											
754	2		Light brown SILT (ML) with sand, trace roots [FILL] - dry, stiff	1	SS	☒	12	5-6-9 [*15*]		7.9				
752	4			4	SS	☒	10	4-4-6 [*10*]		6.0				
750	6													
748	8		Boring Terminated at 5 feet - No Refusal											
746	10													
744	12													
742	14													
740	16													
738	18													
736	20													
734	22													
732	24													
730	26													
728	28													
726	30													
724	32													
722	34													

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

CSI of Cincinnati
11785 Highway Drive
Cincinnati, OH 45241
Phone: 513.252.2059
Fax: 888.792.3121

TEST BORING LOG

CLIENT **Model Group**
PROJECT NAME **Germantown Crossing**
PROJECT LOCATION **1520 Germantown Street, Dayton, Ohio**
BORING # **B-8**
JOB # **CN220187**
LOGGED BY **CG**
APPROVED BY **JPH**

DRILLING and SAMPLING INFORMATION

Date Started **8/22/2022**
Date Completed **8/22/2022**
Drill Rig **Mobile B-57**
Weather **Overcast**
Contractor **CSI**
Boring Size **6** in.
Boring Method **3.25" I.D. HSA**
Hammer Type **Automatic**

Elev. (ft)	Depth Scale	Water Level	SOIL CLASSIFICATION SURFACE ELEVATION: 754.0	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 (6 inches)											
752	2		Brown CLAYEY SAND (SC) with gravel [FILL] - moist, medium dense	1	SS	☒	11	7-8-4 [*12*]						
750	4		Brown CLAYEY SAND (SC) with gravel [GLACIAL OUTWASH] - moist, medium dense	2	SS	☒	13	3-5-7 [*12*]						
748	6													
746	8		Boring Terminated at 5 feet - No Refusal											
744	10													
742	12													
740	14													
738	16													
736	18													
734	20													
732	22													
730	24													
728	26													
726	28													
724	30													
722	32													
720	34													

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

CSI of Cincinnati
11785 Highway Drive
Cincinnati, OH 45241
Phone: 513.252.2059
Fax: 888.792.3121

TEST BORING LOG

CLIENT **Model Group**

PROJECT NAME **Germantown Crossing**

PROJECT LOCATION **1520 Germantown Street, Dayton, Ohio**

BORING # **B-9**

JOB # **CN220187**

LOGGED BY **CG**

APPROVED BY **JPH**

DRILLING and SAMPLING INFORMATION

Date Started	8/22/2022	Contractor	CSI
Date Completed	8/22/2022	Boring Size	6 in.
Drill Rig	Mobile B-57	Boring Method	3.25" I.D. HSA
Weather	Overcast	Hammer Type	Automatic

TEST DATA

SOIL CLASSIFICATION

SURFACE ELEVATION: 749.0	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
ASPHALT (2 inches)											
Gravel Base (5 inches)	1	SS	☒	13	6-4-3 [7]	2	12.2				
Brown SANDY LEAN CLAY (CLS) with trace gravel, noted brick fragment [FILL] - moist, firm	2	SS	☒	14	2-2-2 [4]						
Brown CLAYEY SAND (SC) with gravel [FILL] - moist, very loose											
Boring Terminated at 5 feet - No Refusal											

Elev. (ft)	Depth Scale	Water Level
748		
	2	
746		
	4	
744		
	6	
742		
	8	
740		
	10	
738		
	12	
736		
	14	
734		
	16	
732		
	18	
730		
	20	
728		
	22	
726		
	24	
724		
	26	
722		
	28	
720		
	30	
718		
	32	
716		
	34	

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

CSI of Cincinnati
11785 Highway Drive
Cincinnati, OH 45241
Phone: 513.252.2059
Fax: 888.792.3121

TEST BORING LOG

CLIENT **Model Group**
PROJECT NAME **Germantown Crossing**
PROJECT LOCATION **1520 Germantown Street, Dayton, Ohio**

BORING # **B-10**
JOB # **CN220187**
LOGGED BY **CG**
APPROVED BY **JPH**

DRILLING and SAMPLING INFORMATION

Date Started **8/22/2022**
Date Completed **8/22/2022**
Drill Rig **Mobile B-57**
Weather **Overcast**
Contractor **CSI**
Boring Size **6** in.
Boring Method **3.25" I.D. HSA**
Hammer Type **Automatic**

TEST DATA

SOIL CLASSIFICATION

Elev. (ft)	Depth Scale	Water Level	SURFACE ELEVATION: 746.0	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
			ASPHALT (2 inches)											
744	2		Gravel Base (4 inches)	1	SS	☒	11	2-1-2 [*3*]	1	18.2				
742	4		Brown LEAN CLAY (CL) with sand, noted brick fragment [FILL] - moist, soft	2	SS	☒	13	1-2-2 [*4*]	0.5					
740	6		Dark brown and dark gray LEAN CLAY (CL) with sand, roots and organics [FILL] - most, soft											
738	8		Boring Terminated at 5 feet - No Refusal											
736	10													
734	12													
732	14													
730	16													
728	18													
726	20													
724	22													
722	24													
720	26													
718	28													
716	30													
714	32													
712	34													

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.

Summary of Laboratory Results

Sheet 1 of 1

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						11.3										
B-1	3.5																58
B-1	8.5																10
B-1	23.5																25
B-2	1.0						9.5										
B-3	1.0																21
B-3	6.0						19.4										87
B-4	6.0						18.3										
B-5	3.5																9
B-7	1.0						7.9										
B-7	3.5						6.0										
B-9	1.0						12.2										
B-10	1.0						18.2										

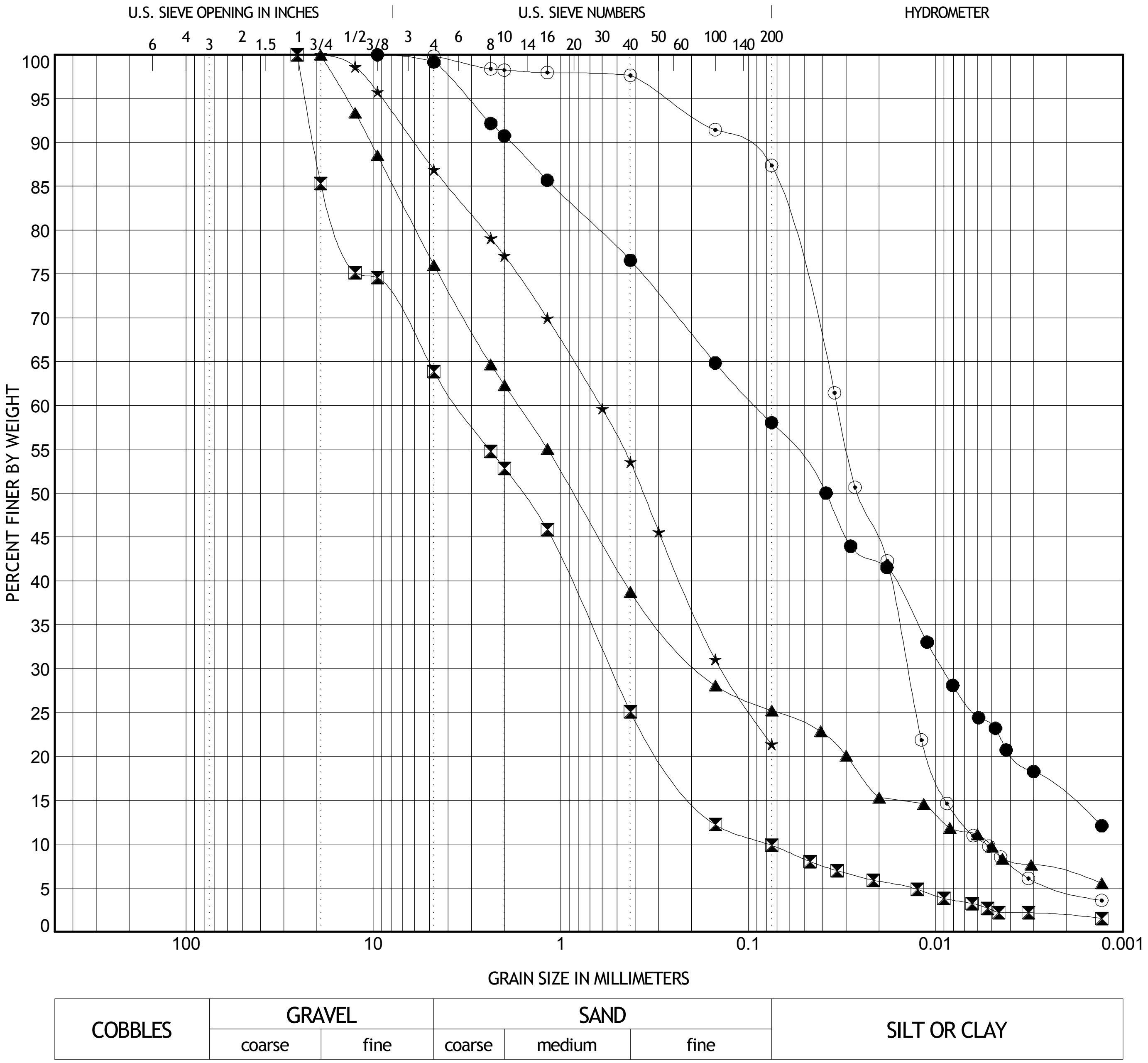
CSI of Cincinnati
11785 Highway Drive
Cincinnati, OH 45241
Phone: 513.252.2059
Fax: 888.792.3121

SS - Split Spoon Sample
GRAB - Bulk Grab Sample

PROJECT INFORMATION

Client: Model Group
Project Name: Germantown Crossing
Project Number: CN220187
Project Location: Dayton, OH

GRAIN SIZE DISTRIBUTION



	Boring	Depth (ft)	Classification	LL	PL	PI	Cc	Cu
●	B-1	3.5						
⧗	B-1	8.5					1.06	45.02
▲	B-1	23.5					3.74	325.27
★	B-3	1.0						
⊙	B-3	6.0					1.09	6.19

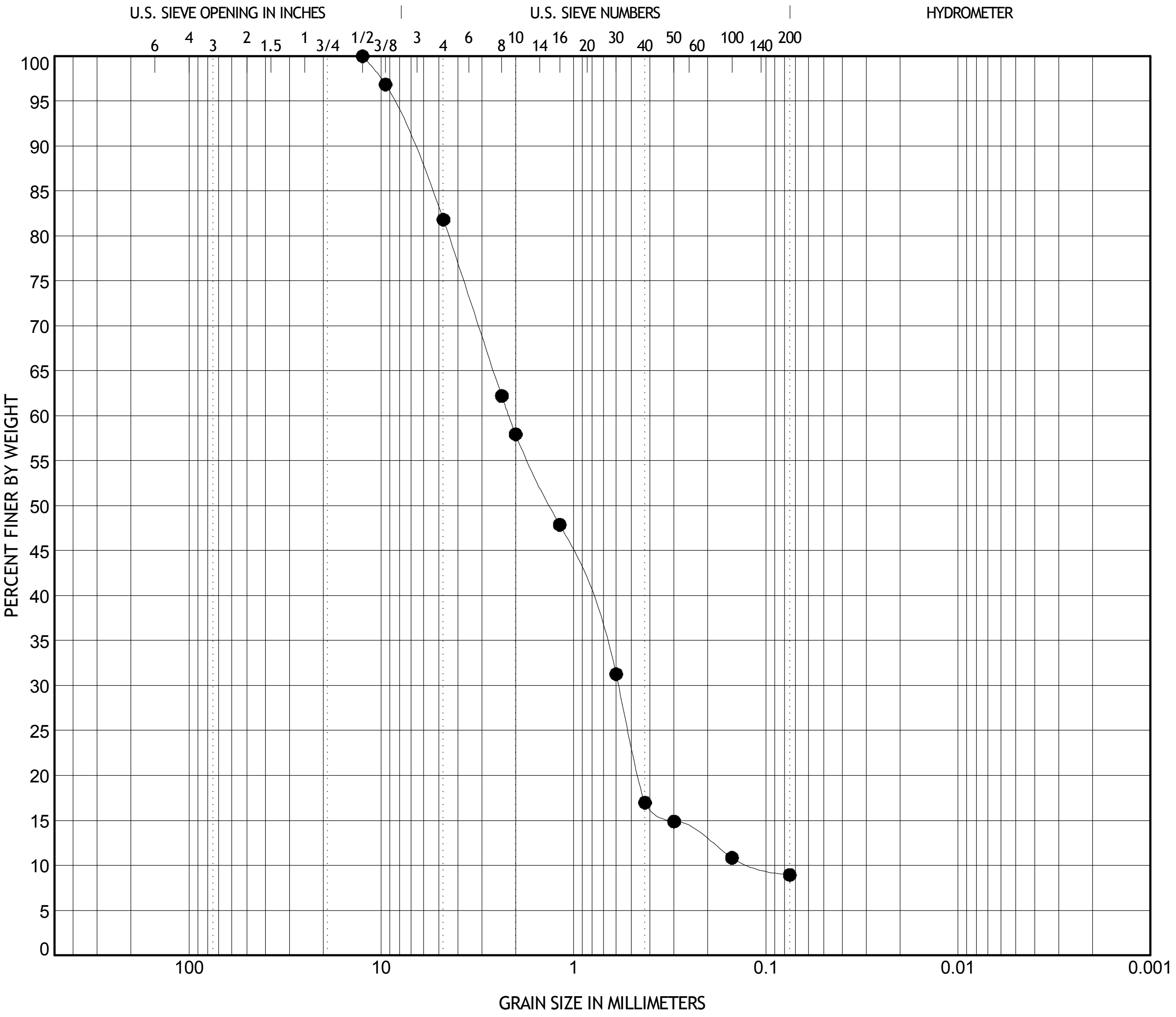
	Boring	Depth (ft)	D95	D60	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-1	3.5	3.131	0.091	0.038	0.009		0.8	41.1	34.6	23.4
⧗	B-1	8.5	23.049	3.522	1.611	0.541	0.078	36.1	54.0	7.4	2.5
▲	B-1	23.5	13.853	1.687	0.859	0.181	0.005	24.0	50.8	15.5	9.7
★	B-3	1.0	8.931	0.613	0.364	0.139		13.1	65.5	21.4	
⊙	B-3	6.0	0.272	0.033	0.026	0.014	0.005	0.2	12.4	78.0	9.4

CSI of Cincinnati
11785 Highway Drive
Cincinnati, OH 45241
Phone: 513.252.2059
Fax: 888.792.3121

PROJECT INFORMATION

Client: Model Group
Project Name: Germantown Crossing
Project Number: CN220187
Project Location: Dayton, OH

GRAIN SIZE DISTRIBUTION



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Depth (ft)	Classification	LL	PL	PI	Cc	Cu
●	**B-5**	**3.5**					**1.41**	**19.58**

	Boring	Depth (ft)	D95	D60	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-5**	**3.5**	**8.719**	**2.166**	**1.318**	**0.582**	**0.111**	**18.2**	**72.9**	**8.9**	

CSI of Cincinnati
11785 Highway Drive
Cincinnati, OH 45241
Phone: 513.252.2059
Fax: 888.792.3121

PROJECT INFORMATION

Client: Model Group
Project Name: Germantown Crossing
Project Number: CN220187
Project Location: Dayton, OH

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 D 698	A	5.5 lb./12"	4"	No. 4 sieve	3	25
	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 D 1557	A	10 lb./18"	4"	No. 4 sieve	5	25
	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.