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December 22, 2021

Todd Markevicz, PE
APD Engineering & Architecture, PLLC
615 Fishers Run
Victor, New York 14564

Subject: **GEOTECHNICAL INVESTIGATION REPORT**
Pennsburg Burger King
322 Pottstown Avenue
Pennsburg, Pennsylvania 18073
APD Project No. 21-0327
Converse Project No. 21-17194-01

Dear Mr. Markevicz,

Converse Consultants (Converse) is pleased to submit this geotechnical investigation report to assist with the design and construction of the proposed commercial facility structure located in Pennsburg Borough, Montgomery County, Pennsylvania. This report was prepared in accordance with our proposal dated September 8, 2021 and the APD subcontract signed November 11, 2021.

From a geotechnical standpoint, based on our field investigation, laboratory data, and engineering analysis, the proposed project is considered feasible provided the recommendations presented in this report are incorporated during the design and construction phases of the above referenced project.

Our assumptions, conclusions, and recommendations presented herein are based upon our evaluation and interpretation of the results of the limited field exploration; and prepared in accordance with generally accepted professional engineering and geological principles and practices.

We appreciate the opportunity to be of service to APD Engineering & Architecture, PLLC. If you have any questions, please do not hesitate to contact us at (814) 234-3223.

Sincerely,

CONVERSE CONSULTANTS

Orion B. Cook, P.E.
Senior Engineer

Ian J. Keating, GIT
Senior Staff Geologist

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PROFESSIONAL CERTIFICATION

This report has been prepared by the following professional whose seal and signature appear hereon.

The findings, recommendations, specifications, and professional opinions contained in this report were prepared in accordance with the generally accepted professional engineering and geological principles and practices in this area of Pennsylvania. We make no other warranty, either expressed or implied.

ORION B. COOK
PE080577

Orion B. Cook, P.E.
Senior Engineer

EXECUTIVE SUMMARY

The following is a summary of our geotechnical investigation, conclusions, and recommendations, as presented in the body of this report. Please refer to the appropriate sections of the report for complete conclusions and recommendations. In the event of a conflict between this summary and the report, or an omission in the summary, the report shall prevail.

- The purpose of this investigation was to evaluate the nature and engineering properties of the subsurface soils, bedrock, and groundwater conditions in order to provide geotechnical recommendations for the design and construction of the proposed commercial structure.
- The project will include the construction of a new, single-story commercial structure to be constructed bearing on cast-in-place concrete spread footings. Supplemental utility, asphalt paving, and landscaping improvements have also been included in this scope of work.
- The site has coordinates of approximately 40.393983 latitude by -75.500698 longitude, and a surface elevation of approximately 325 feet above mean sea level (AMSL). The proposed structure is located at 322 Pottstown Avenue, Pennsburg, Pennsylvania 18073, approximately 65 feet east of the intersection of Washington Street and Pottstown Avenue.
- Seven (7) exploratory borings (B-1 through B-7) were drilled on December 8, 2021 to assess subsurface conditions at the site. Each boring was planned to a terminal depth of between ten and twenty (10’ – 20’) feet below ground surface (ft-bgs). Continuous split-spoon sampling procedures were implemented from the ground surface to a depth of ten feet (10’). After this depth was achieved, noncontinuous, incremental sampling at five feet intervals was implemented until the termination depth of each boring. NQ-II rock coring was not performed during our field investigation.
- The site is overlain by a surficial gravel subbase layer, not identified as a significant stratum for the purpose of this analysis. The first significant stratum identified during our field investigation (Stratum A) is a cut-fill stratum comprised of clayey sand with gravel (SC). The second significant stratum (Stratum B) is a native material comprised of a clayey sand (SC) or clayey sand with gravel (SC). Gravel content and particle-size generally increase with depth. Overall, the materials encountered within the test borings were generally consistent between borings. Split-spoon refusal was encountered in:
    - Boring B-1 at a depth of eight and nine tenths (8.9) ft-bgs.
    - Boring B-2 at a depth of seven and eight tenths (7.8) ft-bgs.
    - Boring B-3 at a depth of eight and three tenths (8.3) ft-bgs.
    - Boring B-4 at a depth of eight and four tenths (8.4) ft-bgs.
    - Boring B-5 at a depth of eighteen and four tenths (18.4) ft-bgs.
    - Boring B-6 at a depth of six and nine tenths (6.9) ft-bgs.
    - Boring B-7 at a depth of eighteen and four tenths (18.4) ft-bgs.
    - Boring B-8 at a depth of nine and one tenth (9.1) ft-bgs.

- The underlying bedrock at the site is categorized as the Brunswick Formation (JTrb) which consists of reddish-brown shale, mudstone, and siltstone layers, with beds of green shale and brown shale.
- At the time of our investigation, groundwater was encountered at a depth of three and twenty-nine hundredths (3.29’) ft-bgs in boring B-2 and at a depth of two and seventy-five hundredths (2.75’) ft-bgs in boring B-6. No other groundwater was encountered in during our field investigation.
- Based on our laboratory analysis, visual classification, and experience with similar soils, we anticipate the site soils to have a “low” expansion potential.
- There are no known active faults projecting toward or extending across the project site. The property is in a geographic area of 0.01g to 0.02g peak acceleration, expressed as a fraction of gravity (g), according to the United State Geological Survey (USGS) Ten-Percent Probability of Exceedance in 50 Years Map.
- Based on our subsurface exploration, we anticipate that site soils will be excavatable with conventional heavy-duty earth-working and trenching equipment.
- Flatwork and asphalt paving should be placed on at least six (6) inches of clean, properly placed, and compacted fill material, similar in composition to PennDOT 2A subbase, in conformance with Publication 408. Footings should be placed on at least twelve (12) inches of material similar to PennDOT 2A subbase, rested on prepared, native, subgrade material. Subgrade material should be cleared of all oversized particles (cobbles and boulders) greater than six (6) inches along the largest axis and any deleterious materials.
- Subgrade, fill subbase soils, and subbase fill beneath all footings should be placed on properly prepared and properly excavated subgrades with the uppermost six inches (6”) of subbase are moisture conditioned and compacted to at least ninety percent (90%) of the laboratory maximum dry density (ASTM D1557).
- Based on the loading parameters for the given project and our knowledge of the encountered native soils, shrinkage of approximately two percent (2%), settlement/subsidence of approximately one inch (1”), and differential settlement of five tenths of an inch (0.5”), may be used for earthwork estimation.
- The commercial structure is proposed to be supported directly on continuous or isolated footings. An allowable bearing capacity of 2,000 pounds per square foot (psf) may be utilized for bearing structures.
- Existing subsurface structures or utilities that are not proposed to be utilized for the construction of the commercial structure should be removed prior to fill material placement.
- The site is considered suitable from a geotechnical standpoint for the proposed structure provided the recommendations presented herein are incorporated in the design and construction phases of this project.

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1.0 INTRODUCTION

This report contains the analyses, findings, and recommendations of our geotechnical investigation performed at the site of the Pennsburg Burger King, located in Pennsburg Borough, Montgomery County, Pennsylvania, as shown in Figure No. 1, *Site Location Map*.

The purpose of this investigation was to evaluate the nature and engineering properties of the subsurface soils, bedrock, and groundwater conditions in order to provide geotechnical recommendations for the design and construction of the proposed commercial structure. This report is written for the project described herein and is intended for use solely by APD Engineering and Architecture PLLC.

2.0 SITE DESCRIPTION

The project site is located approximately 65 feet east of the intersection of Washington Street and Pottstown Avenue at 322 Pottstown Avenue, Pennsburg, Pennsylvania 18073. The site is encompassed by an urban, developed, and paved areas in all directions. The site exhibits a descending grade to the south and southwest. The site has coordinates of approximately 40.393983 latitude by -75.500698 longitude, and a surface elevation of approximately 325 feet above mean sea level (AMSL).

3.0 PROJECT DESCRIPTION

The proposed project will include the construction of a new, single-story commercial structure placed on continuous or isolated footings (or combination thereof). The new 3,475 square feet structure will be constructed of structural wood framing, placed on cast-in-place concrete footings.

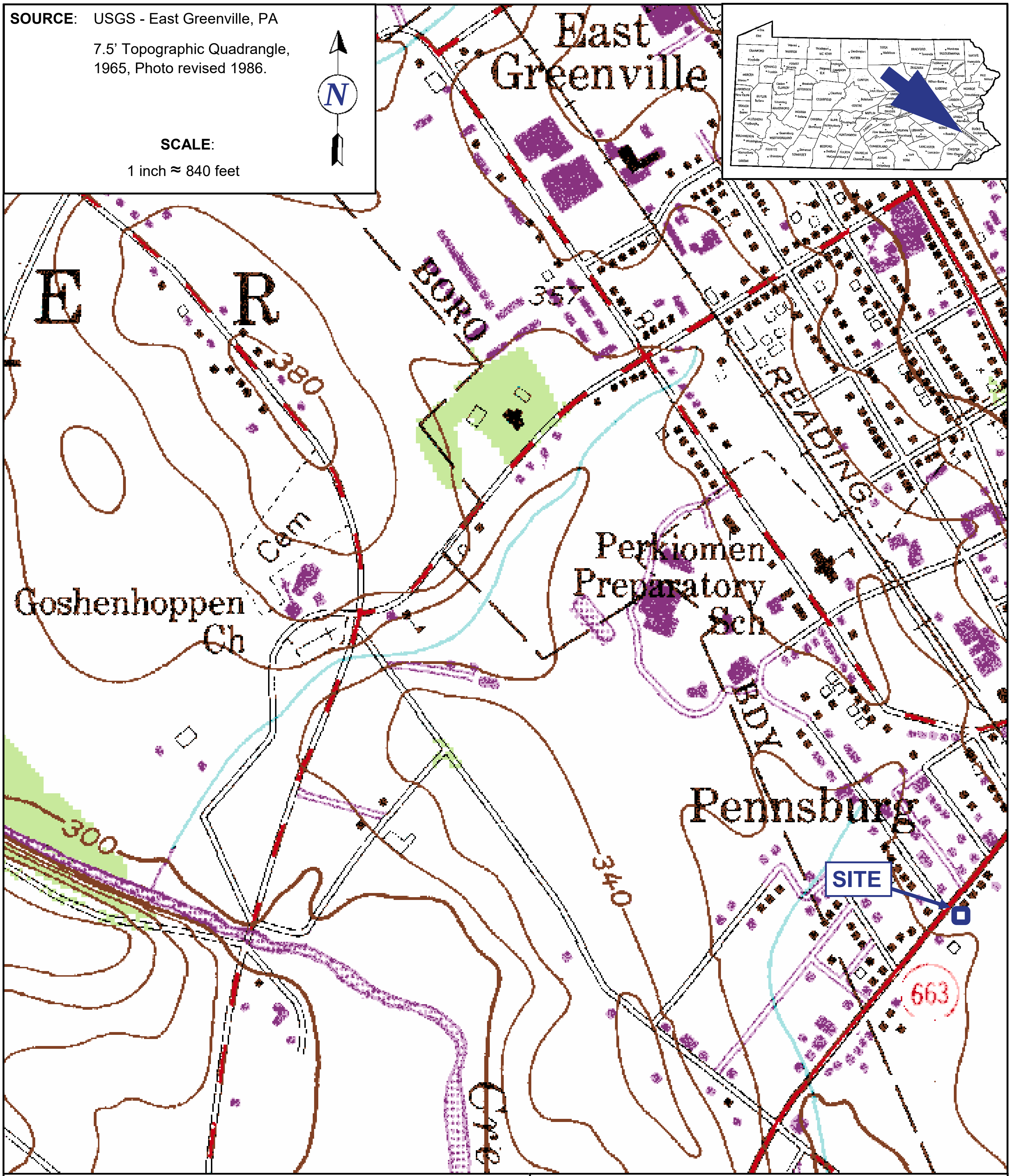
Associated utility improvements, asphalt pavement, and associated landscaping developments will also be included as supplemental items with the construction of the proposed commercial structure. Stormwater management, erosion, and sediment control should comply with best management practices and local requirements.

4.0 SCOPE OF WORK

Our scope of work consisted of project set-up/contract initiation, subsurface exploration, laboratory analysis, engineering analysis, and preparation of this report, as described in the following subsections. Formal groundwater, aquifer, and hydrological testing/investigative techniques were not implemented as part of this scope of work.

4.1 Subsurface Exploration

Eight (8) exploratory borings were drilled, on December 8, 2021 by Allied Well Drilling utilizing a Dietrich D-50 turbo track-mounted drill rig. All exploratory borings were completed using hollow-stem auger drilling methods. Representative soil samples were recovered using the Standard Penetration Testing (SPT) Method and split-barrel sampling of soils in accordance with the American Society for Testing and Materials (ASTM) method D-1586.



SOURCE: USGS - East Greenville, PA
7.5' Topographic Quadrangle,
1965, Photo revised 1986.

SCALE:
1 inch ≈ 840 feet

Figure 1: Site Location Map

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The borings were planned to terminate at depths of between ten (10) and twenty (20) feet below ground surface (ft-bgs), or where spoon refusal was encountered.

Continuous split-spoon sampling procedures were implemented from the ground surface to a depth of ten (10') ft-bgs, then noncontinuous (incremental) sampling procedures at five feet intervals was used until spoon refusal was encountered. If auger refusal was encountered prior to five (5') ft-bgs of the proposed termination depth, bedrock coring was proposed at Converse's discretion. No rock coring was completed during the field investigation and borings were terminated where split-spoon refusal was encountered. Split-spoon refusal (and termination depth) was encountered in:

- Boring B-1 at a depth of eight and nine tenths (8.9) ft-bgs.
- Boring B-2 at a depth of seven and eight tenths (7.8) ft-bgs.
- Boring B-3 at a depth of eight and three tenths (8.3) ft-bgs.
- Boring B-4 at a depth of eight and four tenths (8.4) ft-bgs.
- Boring B-5 at a depth of eighteen and four tenths (18.4) ft-bgs.
- Boring B-6 at a depth of six and nine tenths (6.9) ft-bgs.
- Boring B-7 at a depth of eighteen and four tenths (18.4) ft-bgs.
- Boring B-8 at a depth of nine and one tenth (9.1) ft-bgs.

Borings were continuously logged in the field by a Converse representative, in accordance with the visual method of the Unified Soil Classification System (USCS). The approximate elevation of the ground surface at each boring was recorded using a handheld GPS unit. Borings were then backfilled with native material and bentonite to match adjacent surface conditions.

The approximate boring locations are presented on Figure No. 2, *Pennsburg Boring Location Map.* Detailed descriptions and boring logs of the subsurface exploration are presented in Appendix A, *Field Exploration*.

5.0 SITE CONDITIONS

A general description of the subsurface conditions and the various materials encountered during our field exploration are presented in the following subsections.

5.1 Subsurface Profile

The site is overlain by a surficial gravel subbase layer similar in composition to 2A subbase (with the exception of boring B-5 that was overlain by topsoil), these are neglected as significant stratums for the purpose of this analysis. The first identified significant subsurface (Stratum A), is comprised of a cut-fill layer of clayey sand with gravel (SC). Following the cut-fill was Stratum B, comprised of clayey sand (SC) or a clayey sand with gravel (SC). Gravel content and particle-size generally increased with depth in all borings. No bedrock material was encountered prior to the termination depth of each boring.

This investigation identified two (2) significant soil strata which are interpreted as follows:

SOURCE: Google Maps

Scale

1 inch ≈ 52 feet

Figure 2: Pennsburg Boring Location Map

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Stratum A (cut-fill) –clayey sand with gravel (SC)

This material was found in all borings (B-1 through B-8) and is comprised of a clayey sand with gravel (SC), likely native material that was cut from the site and reused as fill. This stratum ranged from two tenths (0.2) and five tenths (0.5) ft-bgs to two (2) and six (6) ft-bgs and had an average thickness of approximately three and two tenths (3.2) feet.

Stratum B (Residual) – clayey sand (SC) or clayey sand with gravel (SC)

Stratum B was found in all borings and was comprised of a clayey sand (SC) or a clayey sand with gravel (SC). This stratum is presumably deposited from the weathering of the underlying bedrock material. This stratum ranged in depth from two (2) and six (6) ft-bgs to six and nine tenths (6.9) ft-bgs and eighteen and four tenths (18.4) ft-bgs. Stratum B did not produce a known thickness, because each boring was terminated prior to reaching the lower elevation of this stratum.

The following table depicts the strata found within both borings:

Table No. 1: Summary of Site Strata

Stratum	Depth of Stratum	Description
Stratum A	(B-1) 0.5’ – 2.0’ (B-2) 0.5’ – 6.0’ (B-3) 0.5’ – 2.5’ (B-4) 0.5’ – 4.0’ (B-5) 0.2’ – 4.0’ (B-6) 0.5’ – 4.0’ (B-7) 0.5’ – 3.0’ (B-8) 0.5’ – 4.0’	Red and brown clayey sand with gravel, dry to moist, medium dense to very dense
Stratum B	(B-1) 2.0’ – 8.9’ (B-2) 6.0’ – 7.8’ (B-3) 2.5’ – 8.3’ (B-4) 4.0’ – 8.4’ (B-5) 4.0’ – 18.4’ (B-6) 4.0’ – 6.9’ (B-7) 3.0’ – 18.4’ (B-8) 4.0’ – 9.1’	Red and brown, clayey sand or clayey sand with gravel, dry to wet, loose to very dense

For a detailed description of the subsurface materials encountered in the exploratory borings, see Boring Logs in Appendix A, *Field Exploration.*

5.2 Groundwater

During our field investigation, groundwater was measured in boring B-2 at a depth of three and twenty-nine hundredths (3.29) ft-bgs and in boring B-6 at a depth of two and seventy-five hundredths (2.75) ft-bgs. Groundwater was not encountered in any other borings prior to backfilling operations or subsurface caving.

Care should be taken to not allow water to pool or flow into site excavations, which could potentially create a solution channel and weaken the subsurface materials. Groundwater levels fluctuate seasonally as a function of precipitation, the permeability of subsurface materials, and the proximity to nearby waterbodies.

The Pennsylvania Groundwater Information System (PaGWIS) was reviewed to evaluate the historical groundwater levels. Regional groundwater data within approximately three tenths (0.3) of a mile radius from the site yielded seventeen (17) wells with a reported static water level and are as follows:

- Groundwater monitoring wells (PA IDs 474989 through 474992, 497135, 497137 through 497140, 497628, 497633, 497634, and 498193 through 498195) with total well depths ranging from ten to fifty-three (10 to 53) ft-bgs reported static groundwater levels between five to twelve (8 to 12) ft-bgs.
- A domestic groundwater well (PA ID 174971) with a total well depth of 120 ft-bgs had a reported static groundwater level of twenty (20) ft-bgs.
- A domestic groundwater well (PA ID 174970) with a total well depth of 140 ft-bgs had a reported static groundwater level of forty (40) ft-bgs.

5.3 Excavatability

Based on our subsurface exploration, we anticipate that the natural soils at the site to be excavatable with conventional heavy-duty, earth-working, and trenching equipment. If encountered, bedrock at the site could prove more challenging.

The phrase “conventional heavy-duty excavation equipment” is intended to include commonly used equipment such as excavators, scrapers, and trenching machines. It does not include hydraulic hammers, jackhammers, blasting, or other specialized equipment and techniques used to excavate hard earth materials. Selection of an appropriate excavation equipment models should be done by an experienced earthwork contractor.

5.4 Subsurface Variations

Based on the results of the subsurface exploration and our professional experience, variations in the continuity and nature of subsurface materials within the project site should be anticipated. Care should be exercised in interpolating or extrapolating subsurface conditions as presented in this report, because of uncertainties involved in the nature and depositional characteristics of subsurface, earth materials at the site. Overall, the encountered subsurface material was similar in composition and elevation throughout the borings.

6.0 LABORATORY TEST RESULTS

Soil samples obtained from the borings were transported to Converse’s AASHTO-certified material testing laboratory for further examination, testing, and classification. Discussions of the various test results are presented in the following subsections.

6.1 Physical Testing

Results of the various laboratory tests are presented in Appendix B, *Laboratory Testing Program*. The results are also discussed below:

- USCS Soil Classification (ASTM D2487) – Three (3) composite, representative, soil samples were classifed as clayey sand (SC) and clayey sand with gravel (SC) under the USCS Classification System. These results are presented in the Grain-Size Distribution results in Appendix B: *Laboratory Testing Program*.
- Moisture Content (ASTM D2216) – Soil moisture content analyses were performed on thirty-seven (37) split-spoon samples. Moisture ranged from three percent to thirty-nine percent (3% - 39%) and the site exhibited an average moisture content of approximately fifteen and three tenths percent (15.3%). Results of the moisture content tests are presented in the boring logs in Appendix A, *Field Exploration.*
- Particle-Size Analysis (ASTM D422) – Three (3) representative soil samples were tested to determine the relative grain size distribution at the site. Test sample ”A” was selected from B-1 through B-8 at depths ranging between ground surface and four (4) ft-bgs, test sample ”B” was selected from B-1 through B-8 at depths ranging between four (4) and six (6) ft-bgs, and sample ”C” was selected from B-1 through B-8 at depths ranging between six (6) and ten (10) ft-bgs. Test results indicated a clayey sand (SC) in the ”B” composite sample and a clayey sand with gravel (SC) in the ”A” and ”C” composite sample. These results are detailed and graphically presented in the Grain Size Distribution results in Appendix B, *Laboratory Testing Program*.
- Atterberg Limits (ASTM D4318) – Atterberg Limits were performed on three (3) samples in accordance with the above referenced standard. Results of the Atterberg Limits tests are presented on the Atterberg Limits’ Results, in Appendix B, *Laboratory Testing Program*.

Additional information with respect to the laboratory testing is included in the boring logs in Appendix A, *Field Exploration* and in Appendix B*, Laboratory Testing Program*.

6.2 Chemical Testing

A chemical analysis was performed on selected soil samples. Test results for the acidic or alkaline results are presented in the table below:

Table No. 2: Corrosive Properties of Site Soil

Matrix	pH (ASTM D4972)	Sulfate Ion (EPA 9056A)
Soil	6.53 – 8.62	N/A mg/l

Standard Test Method for pH of Soils (ASTM D4972) – Six (6) pH tests were performed on composite soil samples from the site in accordance with the above refrenced standard. These tests were performed in order to determine the acidity or alkalinity of the soil material encountered at the site to determine this aspect of the materials corrosive characteristics.

Results of the pH tests ranged from neutral to modeately alkaline which are not indictive of corrosive soils; these are presented in the boring logs in Appendix A, *Field Exploration.*

7.0 GEOLOGIC SETTING

The regional/local geology and the subsurface soil material are further discussed in the following subsections.

7.1 Regional Geology

According to the Department of Conservation of Natural Resources (DCNR), Office of Resources Management, Bureau of Topographic and Geologic Survey (1982), the bedrock formation that underlies the site is the Brunswick Formation (JTrb).

The Brunswick Formation is documented to be comprised of reddish-brown shale, mudstone, and siltstone layers, with beds of green shale and brown shale. Near its base, the rock is tough, red argillite interbedded in some places with dark-gray argillite. Near diabase intrusives, it has been altered to a hard, dark-colored hornfels. Bedding is moderately well developed, thin, and flaggy. The maximum thickness has been estimated at between 6,000 and 16,000 feet (Geyer and Wilshusen, 1982; Low and others, 2002).

Bedrock material was not encountered at the site. Overall, the formation is moderate to slightly resistant to weathering; the more coarse-grained siltstone is moderately resistant to weathering, whereas the finer-grained shale and mudstone are more susceptible to weathering. Excavation is completed with relative ease or is slightly difficult overall. It possesses fair to good foundation stability, cut-slope stability is fair, but the finer-grained components of the formation should be identified and competent during construction.

7.2 Site Soils

The soils at the site are classified as Urban land (UgB), 0 to 8 percent slopes (UgB), according to the United States Department of Agriculture (USDA), Natural Resources Conservation Service, Web Soil Survey. Overlying cut-fill materials were encountered at the site during our field investigation. Care should be taken to stabilize or provide remedial efforts to repair loosely compacted or soft existing fill materials.

Appropriate selection of an experienced contractor, with the correct earth-working equipment is imperative as the presence of oversized material and variations in the subsurface could present challenges within the excavation of the subsurface environment.

Standard Penetration Test (SPT) “N-Value” results were obtained during our field investigation and are represented as follows:

- Boring B-1 soils were generally medium dense (N = 11 to 26) from ground surface to six (0 – 6) ft-bgs and medium dense to very dense (N = 26 to 50+) from six to eight and nine tenths (6 – 8.9) ft-bgs.

- Boring B-2 soils were generally loose to medium dense (N = 6 to 17) from ground surface to six (0 – 6) ft-bgs and very dense (N = 51 from six to seven and eight tenths (6 – 7.8) ft-bgs.
- Boring B-3 soils were generally medium dense (N = 11 to 27) from ground surface to four (0 – 4.0) ft-bgs and very dense (N = 63 to 50+) from four to eight and three tenths (4.0 – 8.3) ft-bgs.
- Boring B-4 soils were generally medium dense to very dense (N = 27 to 62) from ground surface to four (0 – 4.0) ft-bgs and very dense (N = 50+) from four to eight and four tenths (4.0 – 8.4) ft-bgs.
- Boring B-5 soils were generally medium dense (N = 15 to 21) from ground surface to four (0 – 4.0) ft-bgs, loose (N = 6) from four to six (4.0 – 6.0) ft-bgs, and very dense (N = 50+) from six to eighteen and four tenths (6.0 – 18.4) ft-bgs.
- Boring B-6 soils were generally medium dense (N = 23 to 28) from ground surface to four (0 – 4.0) ft-bgs, loose (N = 8) from four to six (4.0 – 6.0) ft-bgs, and very dense (N = 50+) from six to six and nine tenths (6.0 – 6.9) ft-bgs.
- Boring B-7 soils were generally medium dense (N = 17) from ground surface to three (0 – 3.0) ft-bgs, loose to medium dense (N = 10 to 11) from three to six (3.0 – 6.0) ft-bgs, and medium dense to very dense (N = 20 to 50+) from six to eighteen and four tenths (6.0 – 18.4) ft-bgs.
- Boring B-8 soils were generally medium dense to dense (N = 21 to 30) from ground surface to four (0 – 4.0) ft-bgs, medium dense (N = 18) from four to six (4.0 – 6.0) ft-bgs, and dense to very dense (N = 40 to 50+) from six to nine and one tenth (6.0 – 9.1) ft-bgs.

8.0 SEISMICITY

The project site is located in an area of low seismicity. There have been minor earthquakes reported in Montgomery County, Pennsylvania since 1931. This site is located in a geographic area of 0.02g to 0.03g peak acceleration, expressed as a fraction of gravity (g), (USGS, 2021b). USGS Seismic Design Mapping system provided output files and 50-year map (USGS, 2021c).

Mapped acceleration parameters based on the 2018 International Building Code (IBC) and ASCE 7-16 are provided in Appendix C, *Seismic Information* of this document. These parameters were determined for the site coordinates and site class using the ATC Hazards online calculator for the Maximum Considered Earthquake (MCE), a seismic ground motion associated with a probability of exceedance of 2% in 50 years.

9.0 EARTHWORK RECOMMENDATIONS

Recommendations pertaining to site earthwork, remedial grading, compacted fill, imported fill materials and temporary excavations are presented in the following sections.

9.1 General Evaluation

Based on our field exploration, laboratory testing, and analyses of subsurface conditions at the site, remedial grading will be required to prepare the site for support of the proposed structure that is planned to be constructed white structural wood framing placed on cast-in-place concrete spread footings. To reduce differential settlement, variations in the soil type, degree of compaction, and thickness of the compacted fill, the thickness of compacted fill placed underneath the footings should be kept uniform across the entire structure footprint.

Prior to the start of construction, all debris, surface vegetation, deleterious material, organic matter, existing fill, wet or frozen material and surficial soils containing roots and perishable materials should be stripped and removed from the work location. Deleterious material, including organics, and debris generated during excavation, should not be reused as fill.

All existing underground utilities and appurtenances should be located at the project site. Such utilities should either be protected in-place or removed and replaced during construction as required by the project specifications. All excavations should be conducted in such a manner so as to not cause loss of bearing and/or lateral support of any existing structures or utilities.

It is recommended that excavations occur to a depth removing all loose, unconsolidated soils and fill material within at least one (1) foot below the bearing material. The final exposed subgrades of all excavations should be observed and approved by the project geotechnical engineer prior to the placement of all footings or subbase fill material. Proof-rolling subgrades or localized, over-excavation may become necessary if unsuitable, soft, or compressible soils are encountered during construction at the lowest excavation elevation. Based on these observations, localized areas may require remedial grading deeper than indicated herein. Therefore, some variations in the depth and lateral extent of excavation recommended in this report should be anticipated.

9.2 Dewatering Methods

It is anticipated that groundwater will be encountered during construction due to the groundwater encountered in borings B-2 and B-6. The contractor shall have responsibility for determining the method of dewatering and the equipment to be used during construction. Methods of dewatering may include, but are not limited to, deep wells, well points, subdrains with sumps and seepage cutoffs. The contractor may select a combination of dewatering systems. The failure of any dewatering system to provide construction conditions described in these recommendations shall not relieve the contractor from replacing selected dewatering measures with a more effective system. The following are potential dewatering methods that may be utilized for the site.

Subdrains & Sump Systems:

Subdrains may provide a suitable option during construction, but only as a supplemental method used in conjunction with another primary method of dewatering. Any subdrain system should include a perforated drainpipe that is a minimum of six (6) inches in diameter with perforations having a maximum width of one-hundred and twenty-five thousandths (0.125) inches. The subdrain trench shall be wrapped with filter fabric (Mirafi 140N or approved equivalent fabric) and include a graded filter material meeting technical specifications described in EM 110-2-1901 (1986). The subdrain trench should convey water to an appropriately sized sump completed with manhole and pump access to the surface.

Seepage Cutoffs:

Regardless of which primary dewatering method is implemented by the contractor, effective groundwater control may be supplemented by constructing a seepage cutoff system to reduce the time and rate of dewatering. A seepage cutoff would also be an effective way to reduce the variable recharge coming from the nearby surface water source. When used in support of construction dewatering the cutoff should be located far enough away from the open excavation to maintain a stable slope or wall. The cutoff should penetrate at least three (3) feet below the lowest point of excavation.

The most common method of cutoff is a slurry trench, which requires excavation of a trench that is filled with a slurry mix extending a minimum of three (3) feet above the water table. A slurry trench is ideal for silty sand conditions. During excavation, a bentonite slurry mixture is added to the trench in place of native soils. The mixed slurry should have a Marsh funnel viscosity on the order of forty (40) seconds, and a specific gravity of approximately 1.05 (Powers, 2007).

9.3 Remedial Grading

Prior to the start of construction, all loose soils, cut-fill material, and soils disturbed during initial grading should be removed and replaced with compacted fill soils or to approved native subgrades. Native soils are considered reusable as fill for this project if conditioned to the parameters outlined in this report.

To provide uniform support for footings, any existing fill material and loose native soils should be excavated and replaced with compacted fill. The footings of the commercial structure can be placed directly on at least twelve (12) inches of a material similar to PennDOT 2A subbase. Footings should be placed at least three feet (3’) below adjacent surface elevations (below the frost line depth). Structures placed on native soil materials should be verified by the project geotechnical engineer prior to further material placement. The depth of excavation should be uniform for the structures being placed. If existing fill is encountered or the native soils are soft or saturated, over-excavations may become necessary, as determined by the project geotechnical engineer.

Remedial grading should not extend within a projected 1.5:1 (horizontal to vertical) plane projected down from the outer edge of adjacent improvements. If loose, yielding soil conditions are encountered at the excavation bottom, the following options can be considered:

- Over-excavate until a firm, dry, well-compacted subgrade is achieved.
- Utilize a PennDOT class B flow fill to provide a firm, uniform working base.

9.4 Subgrade Preparation

Final subgrade soils for structural elements should be uniform and non-yielding. To obtain a uniform subgrade, soils should be well mixed and uniformly compacted. The subgrade soils should be non-expansive and consist of well-draining material. No surface or groundwater should intrude into the subgrade excavations prior to further material placement. The final exposed subgrades of the excavation should be verified by the geotechnical consultant, prior to the placement of cementitious material or subbase.

Prior to placement of footings or additional fill materials, exposed subgrades should be scarified, and moisture conditioned from 0 to 2 percent above optimum moisture content for fine-grained fill soils, or within 3 percent of the optimum moisture content for coarse-grained fill soils. In structural areas, the conditioned subsurface should then be recompacted to at least ninety-five percent (95%) of the material's maximum dry density, as determined by the modified proctor method (ASTM D1557).

9.5 Compacted Fill Placement

Excavated on-site native soils (SC) are generally considered suitable for re-use as compacted fill if cleared of debris, organic matter (less than one percent by weight), and cobbles or boulders larger than six inches (nominal maximum size). Gravel larger than two inches (nominal maximum size) should not be placed within the upper twelve inches (12") of fill beneath footings, structural areas, or within the upper six inches (6") of fill under paved areas.

Any imported fill material should be tested and approved by the project geotechnical consultant prior to delivery to the site. Soils used as fill should be thoroughly mixed and evenly spread in 8-inch maximum, loose, horizontal lifts. Fill soils should be moisture conditioned from two to three percent (2% to 3%) within the optimum moisture content as determined by the modified proctor test method (ASTM D1557). Fill placed at the site under landscaped and non-structural areas should be compacted to least ninety percent (90%) of the laboratory maximum dry density as determined by the modified proctor test method (ASTM D1557). Fill placed at the site directly under footings, flatwork, paved, and structural areas should be compacted to least ninety-five percent (95%) of the laboratory maximum dry density as determined by the modified proctor (ASTM D1557) test method.

Fill materials should not be placed, spread, or compacted during unfavorable weather conditions (e.g., heavy rain, snow, freezing temperatures, etc.). When site grading is interrupted by unfavorable weather, fill operations should not resume until the geotechnical consultant approves the moisture and density conditions of the previously placed fill.

9.6 Imported Fill Materials

PennDOT 2A subbase, or similar material, should be used as structural fill placement, conforming to Publication 408. Structural fill material used as imported fill material should be predominantly coarse-grained and meet the following criteria:

- USCS Classification of GW, GM, GC, SW and SM or combination thereof.

- Expansion index of less than 20.
- Free of all deleterious materials, including organic matter and debris.
- Contain no particles larger than 2.0 inches in the largest dimension.
- Contain less than thirty percent (30%) by weight retained on 3/4-inch sieve.
- Contain at least fifteen percent (15%) fines (passing #200 sieve)
- Have a plasticity index of 10 or less.
- Corrosive potential similar or better than on-site soils.

Any imported fill material should be approved by the project geotechnical engineer and verified to be of conformance to these above criteria by an American Association of State Highways and Transportation Officials (AASHTO) certified laboratory, prior to delivery to the site or use in construction.

9.7 Temporary Excavations

Surfaces exposed in slope excavations should be kept damp but not saturated to impede raveling and sloughing during construction. Adequate provisions, such as trench-boxes, should be made to protect the slopes from erosion during periods of precipitation. Surcharge loads, including construction equipment and materials, should not be placed within a horizontal distance from an unsupported trench edge equal to the depth of the trench (1:1 ratio). The maximum slopes provided in this section are based on a maximum height of approximately six feet (6') of stockpiled soils placed at least five feet (5') from the trench edge.

Temporary excavations may be constructed according to the slope ratios presented in the following table. Temporary cuts encountering loose fill or sediments may require gradients that are less steep than indicated in the table below.

Table No. 3: Slope Ratios for Temporary Excavations

Soil Type	Maximum Depth of Cut (feet)	Maximum Slope Ratio [1] (horizontal: vertical)
Clayey SAND with Gravel (SC) or Clayey SAND	**0-3**	**1:1**
	3-10	**1.5:1**
Well-Graded SAND with Gravel (SW)	0-3	1.5:1
	3-10	2:1
Well-Graded GRAVEL with Sand (GW)	0-3	1.5:1
	3-10	2:1

[1] Slope ratio is assumed to be uniform from top to toe of slope.

All applicable requirements of the state and local building codes, general industry safety orders and the Occupational Safety and Health Act should be followed.

9.8 Utility Trench Backfill

The following subsections present earthwork recommendations for utility trench backfill, trench subgrade preparation, and trench-zone backfill.

Open trenches, adjacent to existing pavement, temporary roadways, or building perimeters are not recommended to have a slope ratio steeper than 1:1 (h:v).

Excavated soil material from trench excavations should not be stockpiled more than 6 feet in height or within a horizontal distance from the trench edge equal to the depth of the trench. Excavated soil material should not be stockpiled behind shoring, if any is utilized, within a horizontal distance equal to the depth of the trench, unless the shoring has been designed to withstand such loads.

9.8.1 Pipeline Subgrade Preparation

The final subgrade surface should be level, firm, uniform, free of loose materials, and properly graded to provide uniform bearing and support to the entire section of the pipe placed on the bedding material. Protruding oversize particles larger than two (2) inches across the largest dimension, if any, should be removed from the base of the trench and replaced with compacted native materials meeting the criteria discussed in Section 9.5, *Compacted Fill Placement*.

Any loose, soft, or unsuitable materials encountered in the exposed trench subgrade should be removed and replaced with a suitable bedding material. During the excavation of depressions, for proper sealing of the pipe joints, the pipe should rest on a properly prepared subbase for as near its full length as is practicable.

9.8.2 Pipe Bedding

Bedding is defined as the material supporting and surrounding the pipe, spanning to 12 inches above the pipe. Specifications for bedding materials, including required backfill requirements surrounding the pipe, should be specified by the design engineer in accordance with the pipe manufacturer’s guideline.

Free-draining granular soil should be used as pipe bedding material to provide uniform and firm support for the entire length of the pipe. For flexible pipes, predominantly sandy materials may be used as bedding materials. Clean, crushed gravel may be used for rigid pipe bedding. Bedding material for the pipes should be free from oversized particles greater than two (2) inches in nominal maximum dimension. Pipe design bedding material should generally have a sand equivalent of 30 percent by weight or greater.

9.8.3 Trench Zone Backfill

The trench zone is defined as the portion of the trench above the pipe bedding and extending up to the final grade of the trench surface. Excavated on-site native soils free of particles larger than 6 inches (across its largest dimension) and free of deleterious material may be used to backfill the trench zone. Imported trench backfill, if utilized, should be approved by the geotechnical consultant prior to delivery to the site.

Trench excavations to receive backfill should be free of refuse, debris, or other unsuitable materials at the time of backfill placement. Trench backfill should be thoroughly mixed and spread evenly in 8-inch maximum, loose, horizontal lifts. Fine-grained fill materials should be moisture conditioned to within 2 to 3 percent above optimum moisture content.

Gravel fragments larger than two (2) inches should not be placed within: twelve (12) inches of the top of the pipe or within the upper six (6) inches of subbase located below pavement and flatwork sections. No more than fifty (50) percent of the backfill volume by weight should be larger than ¾-inch. Gravel and oversized fragments shall be properly mixed with finer soils to ensure even consistency and provide a more uniform gradation, to avoid the formation of void spaces.

Trench backfill should be compacted to a minimum of 90 percent of the laboratory maximum dry density (ASTM D1557) by mechanical methods, such as sheepsfoot, vibrating or pneumatic rollers, or mechanical tampers. Trench backfill should be compacted to a minimum of 98 percent of the laboratory maximum dry density if the trench passes under any proposed structures. The contractor should select proper equipment and work processes to achieve the specified density without damaging adjacent areas and completed material placements. It should be the contractor’s responsibility to maintain safe working conditions during excavation or during fill placement operations at the site.

Trench backfill should not be placed, spread, or rolled during unfavorable weather conditions (e.g., heavy rain, snow, and freezing temperatures, etc.). When the work is interrupted by heavy rain, snow, and/or freezing temperatures, fill operations should not be resumed until field tests by the project geotechnical consultant indicate that the moisture content and maximum dry density of the fill are as previously specified.

10.0 DESIGN RECOMMENDATIONS

Design recommendations for the proposed commercial structure are described in the following subsections.

10.1 General Evaluation

Based on the results of our site investigation, subsurface exploration, laboratory testing, geotechnical analyses, and project scope, it is our opinion that the project is considered feasible and without remedial effort from a geotechnical standpoint, provided the following conclusions and recommendations are incorporated into the design and construction phases of the project. The proposed commercial structure and site improvements may be supported by continuous or isolated footings placed on compacted subbase.

The various design recommendations provided in this section assume that the above earthwork recommendations will be implemented during construction.

10.2 Foundation Type and Bearing Pressures

Structural elements should extend at least three (3') feet below lowest adjacent ground surface elevations (below the frost line depth). Footings placed on compacted fill may be designed using an allowable bearing capacity of 2,000 pounds per square foot (psf). Continuous or isolated footings should possess a minimum width of two (2) feet.

The allowable net bearing capacity is defined as the maximum allowable net bearing pressure on the ground. It is obtained by dividing the net ultimate bearing capacity by a safety factor. The ultimate bearing capacity is the bearing stress at which the ground fails by shear stress, or when it experiences a limiting amount of settlement at the foundation. The net ultimate bearing capacity is obtained by subtracting the total overburden pressure on a horizontal plane at the foundation level from the ultimate bearing capacity. The net allowable bearing values indicated above are for the dead load and frequently applied live loads and are obtained by applying a factor of safety of 3.0 to the net ultimate bearing capacity. If normal code requirements are applied for design, the above vertical bearing value may be increased by 33 percent for short-duration loading, which would include loading induced by wind or seismic forces.

10.3 Lateral Earth Pressures and Resistance to Lateral Loads

Lateral earth pressures and resistances to lateral loads are estimated in the following subsections by assuming the on-site native soils were compacted to an average of ninety-five percent (95%) of the laboratory maximum dry density, as determined by the modified proctor test method (ASTM D1557).

10.3.1 Active Earth Pressures

The active earth pressure behind any buried wall depends primarily on the allowable movement, type of backfill materials, backfill slopes, wall inclination, surcharges, and any hydrostatic pressures. The earth pressures recommended for use in the design of the project are presented in the following table.

Table No. 4: Lateral Earth Pressures

Material Type (In-Situ)	Saturated Unit Weight (pcf)	Undrained Angle of Internal Friction (degrees)	Cohesion (psf)	At-Rest Earth Pressure Coefficient (K_o)	Active Earth Pressure Coefficient (K_A)	Passive Earth Pressure Coefficient (K_P)	Sliding Friction Coefficient with Footing
PennDOT 2A Subbase	130	38	0	0.38	0.24	4.20	0.55
Native Soil (SC)	120	32	0	0.47	0.31	3.25	0.40

These pressures assume a level ground surface behind the wall for a distance greater than the wall height, no surcharge, no hydrostatic pressure, and a soil expansion index (EI) less than or equal to 15. If water pressure is allowed to build-up, the active pressures should be reduced by 50 percent and added to the full hydrostatic pressure to compute the design pressures against the wall.

10.3.2 Passive Earth Pressure

Resistance to lateral loads can be assumed to be provided by friction acting at the base of foundations and by passive earth pressure. An ultimate coefficient of friction of 0.4 between cast-in-place concrete and soil may be used with the dead load forces. An allowable passive earth pressure of 300 psf per foot of depth may be used for the sides of footings placed against recompacted native soils. A factor of safety of 1.5 was applied in calculating passive earth pressure. The maximum value of the passive earth pressure should be limited to 2,000 psf.

Vertical and lateral bearing values indicated above are for the total dead loads and frequently applied live loads. For our analysis we used 50-kip column loads and 2 kips per lineal foot for wall loads, as supplied by APD Engineering & Architecture, PLLC. If normal code requirements are applied for design, the above vertical bearing and lateral resistance values may be increased by 33 percent for short duration loading, which will include the effect of wind or seismic forces. Due to the low overburden stress of the soil at shallow depth, the upper 1 foot of passive resistance should be neglected unless the soil is confined by a material such as asphaltic pavement or cementitious slabs.

10.4 Site Drainage

Adequate positive drainage should be maintained during excavation and construction processes. Trenching areas to prevent ponding should be utilized to reduce percolation of water into the soils adjacent to structural elements. These areas should have a gradient of at least 2 percent towards drainage facilities. A desirable drainage gradient is 1 percent for paved areas and 2 percent in landscaped areas. Surface drainage should be directed to suitable, less erosive areas, such as to the South of the project site.

10.5 Pavement Design

Pavement subgrade should be prepared in accordance with Section 301 of the Standard Specifications for Public Works Construction (SSPWC) Public Works Standards (SSPWC, 2018). The upper six (6) inches of subbase should be compacted to at least 95 percent of the laboratory maximum dry density as per the modified proctor (ASTM Standard D1557) test method.

Base materials should conform to Section 200-2.2, "Crushed Aggregate Base," of the current SSPWC and should be placed in accordance with Section 301.2 of the SSPWC.

Asphaltic materials should conform to Section 203 of the SSPWC and should be placed in accordance with Section 302.5 of the SSPWC. An R-value of 10 was utilized when calculating the asphaltic pavement structural sections in relationship to anticipated traffic indices (TI), which are summarized in the following table:

Table No. 5: Recommended Preliminary Pavement Sections

Traffic Index (T.I.)	Preliminary Pavement Section (R=10)		
	Asphalt (inches)	Aggregate Base (inches)	Full Depth Asphalt (inches)
5.0	2.0	4.0	4.0
6.0	3.0	6.0	5.0
7.0	5.0	8.0	7.0
8.0	6.0	12.0	8.0

11.0 PLAN REVIEW AND CONSTRUCTION INSPECTION SERVICES

This report has been prepared to aid in the evaluation of the site, to prepare engineering recommendations, and to assist in the design of the proposed development. It is recommended that Converse Consultants be given the opportunity to review the future site plans and specifications to verify if the recommendations presented herein are appropriate for the planned site development.

Recommendations presented herein are based upon the assumptions that earthwork and construction-phase monitoring will be provided by a qualified geotechnical consultant. All excavation of site soils should be observed and tested by a representative of the geotechnical consultant prior to fill placement. Structural fill and backfill should be placed and compacted during continuous observation and testing. It is recommended that excavations within the structural footprint should be observed by a geotechnical consultant prior to placement of steel reinforcement and concrete, so that structures are founded on satisfactory materials. The geotechnical consultant should also verify structural excavations are free of loose, unstable, and unconsolidated materials. All base course and subbase materials used for pavement structures should be tested and approved by the geotechnical engineer. Where compaction is less than that specified, additional effort should be applied with adjustment of the moisture content as necessary, until the specified compaction is obtained as recommended in this report.

12.0 CLOSURE

The findings and recommendations of this report were prepared in accordance with generally accepted professional engineering and geological principles and practices. We make no other warranty, either expressed or implied. If conditions encountered during construction appear to be different from those described in this report, this office should be notified.

As the project evolves, a continued consultation and construction monitoring program, led by a qualified geotechnical consultant should be considered an extension of geotechnical investigation services performed to date. Where significant design changes occur, Converse may be required to augment or modify the recommendations presented herein. Subsurface conditions may differ in some locations from those encountered in the exploration locations and may require additional analyses and potentially substantiate the modification of the design recommendations.

If the scope of the project changes, if project completion is to be delayed, or if the report is to be used for another purpose, this office should be consulted.

This report was prepared solely for APD Engineering & Architecture, PLLC for the subject project described herein. We appreciate the opportunity to be of service and to assist with the design of this project.

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Appendix A

Field Exploration

APPENDIX A

FIELD EXPLORATION

Our field investigation included a site reconnaissance and a subsurface exploration program which consisted of drilling soil borings and conducting standard penetration testing (SPT) in accordance with ASTM D-1586. During site reconnaissance the site access, surface conditions, and exploratory boring test locations were identified using handheld GPS technology.

Eight (8) exploratory borings (B-1 through B-8) were drilled on December 8, 2021 by Allied Well Drilling, utilizing a Dietrich D-50 track-mounted drill rig. The exploratory borings were completed using hollow-stem auger drilling methods. Representative soil samples were recovered using the Standard Penetration Testing (SPT) Method and split-barrel sampling of soils in accordance with the American Society for Testing and Materials (ASTM) Procedure D1586. The borings were planned to terminal depths ranging between ten and twenty (10 – 20) feet below ground surface (ft-bgs). Borings were terminated in the field upon spoon refusal.

Continuous split-spoon sampling procedures were implemented from the ground surface to a depth of ten feet (10’), where non-continuous incremental sampling at five feet intervals were implemented until spoon refusal. If auger refusal was encountered prior to five (5’) ft-bgs of the proposed termination depth, bedrock coring was proposed at Converse’s discretion. No rock coring was completed during the field investigation and borings were terminated where split-spoon refusal was encountered. Split-spoon refusal (and termination depth) was encountered in:

- Boring B-1 at a depth of eight and nine tenths (8.9) ft-bgs.
- Boring B-2 at a depth of seven and eight tenths (7.8) ft-bgs.
- Boring B-3 at a depth of eight and three tenths (8.3) ft-bgs.
- Boring B-4 at a depth of eight and four tenths (8.4) ft-bgs.
- Boring B-5 at a depth of eighteen and four tenths (18.4) ft-bgs.
- Boring B-6 at a depth of six and nine tenths (6.9) ft-bgs.
- Boring B-7 at a depth of eighteen and four tenths (18.4) ft-bgs.
- Boring B-8 at a depth of nine and one tenth (9.1) ft-bgs.

Subsurface soils were continuously logged, collected, and classified in the field by a Converse representative and were based on visual and manual examination in accordance with the Unified Soil Classification System (USCS). Field descriptions have been modified, where appropriate, to reflect laboratory classification.

The approximate boring locations are presented on Figure No. 2, Pennsburg Boring Location Map. The approximate elevation of the ground surface at each boring was recorded using a handheld GPS unit. Detailed descriptions, laboratory test results, and a graphically representation are located on the boring logs which is presented in Appendix A, Field Exploration.

Standard Penetration Tests (SPTs) were performed to the terminal depth of each boring. A SPT utilizes a standard two feet long split-spoon sampler (1.375 inches inside diameter and 2.0 inches outside diameter) which was driven into the ground with successive drops of a 140-pound auto-hammer falling thirty inches. The number of hammer blows required for each six-inch penetration of the sampler is shown on the boring logs. The sum of the blows required to drive the sampler for the second and third interval (12- and 18-inch increments) of penetration is termed the “Standard Penetration Resistance” or the “N-value”. This procedure obtains slightly disturbed, representative soil samples and quantifies their density characteristics numerically.

It should be noted that the exact depths at which material changes occur in borings cannot always be established accurately, due to the undulating nature of depositional environments in the subsurface. Unless a more precise depth can be established by other means, changes in material conditions that occur between driven samples are indicated in the log at the top of the next drive sample or where field measurements of spilt spoon observation determine otherwise.

The borings were backfilled with auger cuttings and bentonite. We recommend that the Client or Owner of the property monitor the boring locations and backfill any settlement or depressions that might occur or provide fencing around the boring locations to prevent harmful accidents from occurring near the area of any potential settlement.

For a key to soil symbols and terminology used in the boring logs, refer to the *Unified Soil Classification Chart* in the following pages of this Appendix A. The boring logs are also contained in this Appendix.

UNIFIED SOIL CLASSIFICATION CHART

MAJOR DIVISIONS					GROUP SYMBOLS (ASTM D2487)	TYPICAL DESCRIPTIONS
COARSE-GRAINED SOILS	MORE THAN 50% RETAINED ON NO. 200 SIEVE*	**GRAVELS**	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	**CLEAN GRAVELS**	GW	WELL-GRADED GRAVELS & GRAVEL-SAND MIXTURES, LESS THAN 5% FINES
					GP	POORLY GRADED GRAVELS & GRAVEL-SAND MIXTURES, LESS THAN 5% FINES
				GRAVELS WITH FINES	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
					GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
		SANDS	MORE THAN 50% OF COURSE FRACTION PASSES NO. 4 SIEVE	**CLEAN SANDS**	SW	WELL-GRADED SANDS & GRAVELLY SANDS, LESS THAN 5% FINES
					SP	POORLY GRADED SANDS & GRAVELLY SANDS, LESS THAN 5% FINES
				SANDS WITH FINES	SM	SILTY SANDS, SAND-SILT MIXTURES
					SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE-GRAINED SOILS	50% OR MORE PASSES NO. 200 SIEVE*	**SILTS & CLAYS**	LIQUID LIMIT 50 OR LESS		ML	INORGANIC SILTS, VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS
					CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
					OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
		SILTS & CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDS OR SILTS, ELASTIC SILTS
					CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
					OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS					PT	PEAT, HUMUS & OTHER HIGHLY ORGANIC SOILS

*BASED ON MATERIAL PASSING THE 3" (75MM) SIEVE

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

GRADATION**

TERM	% BY WEIGHT		
TRACE	0	To	5
FEW	5	To	10
LITTLE	15	To	25
SOME	25	To	45

COMPACTNESS OF COARSED-GRAINED SOILS

TERM	CORRECTED SPT PENETRATION		
VERY LOOSE	0	To	4
LOOSE	4	To	10
MEDIUM DENSE	10	To	30
DENSE	30	To	50
VERY DENSE		>50	

CONSISTENCY OF FINE-GRAINED SOILS

TERM	SPT PENETRATION		
VERY SOFT	0	To	2
SOFT	2	To	4
MEDIUM	4	To	8
STIFF	8	To	15
VERY STIFF	15	To	30
HARD		>30	

** VALUES ARE FROM LABORATORY TEST OR FIELD DATA, WHERE APPLICABLE. WHEN NO TESTING WAS PERFORMED, VALUES ARE ESTIMATED.

SPT – STANDARD PENETRATION TEST (blows/foot)

LEGEND OF ROCK MATERIALS

⊠	IGNEOUS ROCK
☰	SEDIMENTARY ROCK
▨	METAMORPHIC ROCK

BEDDING SPACING

Description	Thickness/Spacing
Massive	Greater than 10 ft
Very Thickly Bedded	3 ft - 10 ft
Thickly Bedded	1 ft - 3 ft
Moderately Bedded	4 in - 1 ft
Thinly Bedded	1 in - 4 in
Very Thinly Bedded	1/4 in - 1 in
Laminated	Less than 1/4 in

WEATHERING DESCRIPTORS FOR INTACT ROCK

	Diagnostic Features					
	Chemical Weathering-Discoloration-Oxidation		Mechanical Weathering and Grain Boundary Conditions	Texture and Leaching		
Description	Body of Rock	Fracture Surfaces		Texture	Leaching	General Characteristics
Fresh	No discoloration, not oxidized	No discoloration or oxidation	No separation, intact (tight)	No change	No leaching	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull	Minor to complete discoloration or oxidation of most surfaces	No visible separation, intact (tight)	Preserved	Minor leaching of some soluble minerals	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty"; feldspar crystals are "cloudy"	All fracture surfaces are discolored or oxidized	Partial separation of boundaries visible	Generally preserved	Soluble minerals may be mostly leached	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in situ disaggregation, grain boundary conditions	All fracture surfaces are discolored or oxidized; surfaces friable	Partial separation, rock is friable; in semi-arid conditions, granitics are disaggregated	Texture altered by chemical disintegration (hydration, argillation)	Leaching of soluble minerals may be complete	Dull sound when struck with hammer; usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures or veinlets. Rock is significantly weakened.
Decomposed	Discolored of oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay		Complete separation of grain boundaries (disaggregated)	Resembles a soil; partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes".

PERCENT CORE RECOVERY (REC)

$$\frac{\Sigma \text{ Length of the recovered core pieces (in.)}}{\text{Total length of core run (in.)}} \times 100$$

ROCK QUALITY DESIGNATION (RQD)

$$\frac{\Sigma \text{ Length of intact core pieces } \geq 4 \text{ in.}}{\text{Total length of core run (in.)}} \times 100$$

RQD* indicates soundness criteria not met.

ROCK HARDNESS

Description	Criteria
Extremely Hard	Cannot be scratched with a pocketknife or sharp pick. Can only be chipped with repeated heavy hammer blows
Very Hard	Cannot be scratched with a pocketknife or sharp pick. Breaks with repeated heavy hammer blows.
Hard	Can be scratched with a pocketknife or sharp pick with difficulty (heavy pressure). Breaks with heavy hammer blows.
Moderately Hard	Can be scratched with a pocketknife or sharp pick with light or moderate pressure. Breaks with moderate hammer blows
Moderately Soft	Can be grooved 1/16 in. deep with a pocketknife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Can be grooved or gouged easily with a pocketknife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very Soft	Can be readily indented, grooved or gouged with fingernail, or carved with a pocketknife. Breaks with light manual pressure.

Fracturing Spacing

Description	Observed Fracture Density
Unfractured	No fractures
Very Slightly Fractured	Core lengths greater than 3 ft.
Slightly Fractured	Core lengths mostly from 1 to 3 ft.
Moderately Fractured	Core lengths mostly 4 in. to 1 ft.
Intensely Fractured	Core lengths mostly from 1 to 4 in.
Very Intensely Fractured	Mostly chips and fragments.

REFERENCE: Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010).

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BORING NUMBER B-1

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CLIENT ADP Engineering and Architecture PLLC
PROJECT NAME Pennsburg Burger King
PROJECT NUMBER 21-17194-01
PROJECT LOCATION Pennsburg Borough, Montgomery County, Pennsylvania
DATE STARTED 12/8/21 **COMPLETED** 12/8/21
GROUND ELEVATION 323 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Allied Well Drilling
GROUND WATER LEVELS:
DRILLING METHOD ASTM D-1586
AT TIME OF DRILLING ---
LOGGED BY G. V. Lutty, GIT **CHECKED BY** Ian J. Keating, GIT
AT END OF DRILLING --- 2.63' Caved.
NOTES Jay Torres - Diedrich D-50 Turbo Track Rig
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	
0.0						2A gravel subbase.	
	SPT S-1	88	3-15-11-12 (26)	MC = 12% LL = 26 PL = 18 Fines = 21% pH = 7.21 - 7.61	0.5	(FILL) **(SC)** Clayey **SAND** with gravel; fine-grained sand, subangular, fine to medium-grained siltstone gravel, medium dense, dry, red and brown.	322.5
2.5	SPT S-2	63	6-7-4-5 (11)	MC = 21% LL = 30 PL = 21 Fines = 49% pH = 6.53 - 6.73	2.0	**(SC)** Clayey **SAND**; fine-grained sand, medium dense, moist, gray, red, and brown.	321.0
					4.0	Clayey **SAND** with gravel; fine-grained sand, subangular, fine to medium-grained siltstone gravel, medium dense, dry to moist, red and brown.	319.0
5.0	SPT S-3	88	4-4-10-20 (14)	MC = 13%			
	SPT S-4	50	8-9-17-14 (26)	MC = 13% LL = 27 PL = 18 Fines = 21% pH = 8.01 - 8.62	6.0	**(SC)** Clayey **SAND** with gravel; fine to medium-grained sand, subangular, medium-grained siltstone gravel, medium dense to very dense, dry, red.	317.0
7.5							
	SPT S-5	56	7-50/5"	MC = 15%			
					8.9		314.1

Spoon Refusal at 8.9 feet.
Bottom of borehole at 8.9 feet.

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BORING NUMBER B-2

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CLIENT ADP Engineering and Architecture PLLC

PROJECT NAME Pennsburg Burger King

PROJECT NUMBER 21-17194-01

PROJECT LOCATION Pennsburg Borough, Montgomery County, Pennsylvania

DATE STARTED 12/8/21 **COMPLETED** 12/8/21

GROUND ELEVATION 323.5 ft **HOLE SIZE** 6 inches

DRILLING CONTRACTOR Allied Well Drilling

GROUND WATER LEVELS:

DRILLING METHOD ASTM D-1586

AT TIME OF DRILLING ---

LOGGED BY G. V. Lutty, GIT **CHECKED BY** Ian J. Keating, GIT

▼ **AT END OF DRILLING** 3.29 ft / Elev 320.21 ft

NOTES Jay Torres - Diedrich D-50 Turbo Track Rig

AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0					0.5	2A gravel subbase. 323.0
	SPT S-1	92	3-8-9-11 (17)	MC = 13% LL = 26 PL = 18 Fines = 21% pH = 7.21 - 7.61		(FILL) **(SC)** Clayey **SAND** with gravel; fine-grained sand, subangular, fine to medium-grained siltstone gravel, loose to medium dense, moist, red and brown.
2.5	SPT S-2	58	7-7-6-6 (13)	MC = 17%		Wet at 5.0'. ▼
5.0	SPT S-3	96	3-3-3-3 (6)	MC = 37%	6.0	317.5
7.5	SPT S-4	56	9-13-38- 50/4"	MC = 16% LL = 27 PL = 18 Fines = 21% pH = 8.01 - 8.62	7.8	**(SC)** Clayey **SAND** with gravel; fine to medium-grained sand, subangular, medium-grained siltstone gravel, very dense, moist to wet, red. 315.7

Spoon Refusal at 7.8 feet.
Bottom of borehole at 7.8 feet.

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BORING NUMBER B-3

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PROJECT NAME Pennsburg Burger King

PROJECT NUMBER 21-17194-01

PROJECT LOCATION Pennsburg Borough, Montgomery County, Pennsylvania

DATE STARTED 12/8/21 **COMPLETED** 12/8/21

GROUND ELEVATION 325 ft **HOLE SIZE** 6 inches

DRILLING CONTRACTOR Allied Well Drilling

GROUND WATER LEVELS:

DRILLING METHOD ASTM D-1586

AT TIME OF DRILLING ---

LOGGED BY G. V. Lutty, GIT **CHECKED BY** Ian J. Keating, GIT

AT END OF DRILLING --- 4.95' Caved.

NOTES Jay Torres - Diedrich D-50 Turbo Track Rig

AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0	SPT S-1	71	9-11-16-9 (27)	MC = 12% LL = 26 PL = 18 Fines = 21% pH = 7.21 - 7.61		2A gravel subbase. 0.5 324.5 (FILL) **(SC)** Clayey **SAND** with gravel; fine to medium-grained sand, subangular, fine to medium-grained siltstone gravel, medium dense, dry to moist, red and brown.
2.5	SPT S-2	67	6-7-4-5 (11)	MC = 39% LL = 30 PL = 21 Fines = 49% pH = 6.53 - 6.73		2.5 322.5 **(SC)** Clayey **SAND**; fine-grained sand, medium dense, moist, gray, red, and brown.
5.0	SPT S-3	88	11-33-30-38 (63)	MC = 10%		4.0 321.0 Clayey **SAND** with gravel; fine-grained sand, subangular, fine to medium-grained siltstone gravel, very dense, moist, red and brown.
	SPT S-4	46	34-50/5"	MC = 12% LL = 27 PL = 18 Fines = 21% pH = 8.01 - 8.62		6.0 319.0 **(SC)** Clayey **SAND** with gravel; fine to medium-grained sand, subangular, medium-grained siltstone gravel, very dense, dry, red.
7.5	AU A-1					
	SPT S-5	0	50/3"			8.3 316.8

Spoon Refusal at 8.3 feet.
Bottom of borehole at 8.3 feet.

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BORING NUMBER B-4

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CLIENT ADP Engineering and Architecture PLLC
PROJECT NAME Pennsburg Burger King
PROJECT NUMBER 21-17194-01
PROJECT LOCATION Pennsburg Borough, Montgomery County, Pennsylvania
DATE STARTED 12/8/21 **COMPLETED** 12/8/21
GROUND ELEVATION 327 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Allied Well Drilling
GROUND WATER LEVELS:
DRILLING METHOD ASTM D-1586
AT TIME OF DRILLING ---
LOGGED BY G. V. Lutty, GIT **CHECKED BY** Ian J. Keating, GIT
AT END OF DRILLING --- 4.6' Caved.
NOTES Jay Torres - Diedrich D-50 Turbo Track Rig
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0						2A gravel subbase.
						0.5 326.5
	SPT S-1	92	9-15-12-11 (27)	MC = 12% LL = 26 PL = 18 Fines = 21% pH = 7.21 - 7.61		(FILL) **(SC)** Clayey **SAND** with gravel; fine to medium-grained sand, subangular, fine to medium-grained siltstone gravel, medium dense to very dense, dry to moist, red and gray.
2.5	SPT S-2	75	9-24-38-23 (62)	MC = 11%		
						4.0 323.0
	SPT S-3	0	50/1"			**(SC)** Clayey **SAND** with gravel; fine-grained sand, subangular, medium-grained siltstone gravel, very dense, moist, red.
5.0	AU A-1			LL = 27 PL = 18 Fines = 21% pH = 8.01 - 8.62		
7.5						
	SPT S-5	104	50/5"			
						8.4 318.6

Spoon Refusal at 8.4 feet.
Bottom of borehole at 8.4 feet.

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BORING NUMBER B-5

CLIENT ADP Engineering and Architecture PLLC

PROJECT NAME Pennsburg Burger King

PROJECT NUMBER 21-17194-01

PROJECT LOCATION Pennsburg Borough, Montgomery County, Pennsylvania

DATE STARTED 12/8/21 **COMPLETED** 12/8/21

GROUND ELEVATION 326 ft **HOLE SIZE** 6 inches

DRILLING CONTRACTOR Allied Well Drilling

GROUND WATER LEVELS:

DRILLING METHOD ASTM D-1586

AT TIME OF DRILLING ---

LOGGED BY G. V. Lutty, GIT **CHECKED BY** Ian J. Keating, GIT

AT END OF DRILLING --- 11.98' Caved.

NOTES Jay Torres - Diedrich D-50 Turbo Track Rig

AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	GRAPHIC LOG		MATERIAL DESCRIPTION	
0	SPT S-1	90	8-14-7-7 (21)	MC = 12% LL = 26 PL = 18 Fines = 21% pH = 7.21 - 7.61		0.2	Topsoil.	325.8
							(FILL) **(SC)** Clayey **SAND** with gravel; fine to medium-grained sand, subangular, fine to medium-grained siltstone gravel, medium dense, moist to wet, red and brown.	
	SPT S-2	70	5-7-8-7 (15)	MC = 14%			wet 3.0'-4.0'.	
						4.0		322.0
5	SPT S-3	75	2-2-4-7 (6)	MC = 26% LL = 30 PL = 21 Fines = 49% pH = 6.53 - 6.73			**(SC)** Clayey **SAND**; fine-grained sand, loose, moist, gray and red, and brown.	
						6.0		320.0
	SPT S-4	78	17-45- 50/5"	MC = 12% LL = 27 PL = 18 Fines = 21% pH = 8.01 - 8.62			**(SC)** Clayey **SAND** with gravel; fine-grained sand, subangular, medium-grained siltstone gravel, very dense, dry to moist, red.	
	AU A-1							
	SPT S-5	51	18-50/1"	MC = 5%				
10	AU A-2							
	SPT S-6	69	30-50/1"	MC = 3%				
15	AU A-3							
	SPT S-7	50	50/5"	MC = 8%		18.4		307.6

Spoon Refusal at 18.4 feet.
Bottom of borehole at 18.4 feet.

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BORING NUMBER B-6

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PROJECT NAME Pennsburg Burger King

PROJECT NUMBER 21-17194-01

PROJECT LOCATION Pennsburg Borough, Montgomery County, Pennsylvania

DATE STARTED 12/8/21 **COMPLETED** 12/8/21

GROUND ELEVATION 325 ft **HOLE SIZE** 6 inches

DRILLING CONTRACTOR Allied Well Drilling

GROUND WATER LEVELS:

DRILLING METHOD ASTM D-1586

AT TIME OF DRILLING ---

LOGGED BY G. V. Lutty, GIT **CHECKED BY** Ian J. Keating, GIT

▼ **AT END OF DRILLING** 2.75 ft / Elev 322.25 ft

NOTES Jay Torres - Diedrich D-50 Turbo Track Rig

AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0					○	2A gravel subbase.
0.5	SPT S-1	95	10-15-13-13 (28)	MC = 11% LL = 26 PL = 18 Fines = 21% pH = 7.21 - 7.61	▩	324.5 (FILL) **(SC)** Clayey **SAND** with gravel; fine to medium-grained sand, subangular, fine to medium-grained siltstone gravel, medium dense, dry to moist, red and brown.
2.5	SPT S-2	70	8-11-12-6 (23)	MC = 14%	▩	▼
4.0	SPT S-3	100	4-4-4-11 (8)	MC = 25% LL = 30 PL = 21 Fines = 49% pH = 6.53 - 6.73	▨	321.0 **(SC)** Clayey **SAND**; fine-grained sand, loose, moist to wet, gray, red, and brown.
5.0					▨	
6.0	SPT S-4	56	21-50/5"	MC = 18% LL = 27 PL = 18 Fines = 21% pH = 8.01 - 8.62	▨	319.0 **(SC)** Clayey **SAND** with gravel; fine to medium-grained sand, subangular, medium-grained siltstone gravel, very dense, moist to wet, red.
6.9						318.1

Spoon Refusal at 6.9 feet.
Bottom of borehole at 6.9 feet.

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BORING NUMBER B-7

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CLIENT ADP Engineering and Architecture PLLC

PROJECT NAME Pennsburg Burger King

PROJECT NUMBER 21-17194-01

PROJECT LOCATION Pennsburg Borough, Montgomery County, Pennsylvania

DATE STARTED 12/8/21 **COMPLETED** 12/8/21

GROUND ELEVATION 325 ft **HOLE SIZE** 6 inches

DRILLING CONTRACTOR Allied Well Drilling

GROUND WATER LEVELS:

DRILLING METHOD ASTM D-1586

AT TIME OF DRILLING ---

LOGGED BY G. V. Lutty, GIT **CHECKED BY** Ian J. Keating, GIT

AT END OF DRILLING --- Dry.

NOTES Jay Torres - Diedrich D-50 Turbo Track Rig

AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS
0	SPT S-1	65	5-7-10-5 (17)	MC = 12% LL = 26 PL = 18 Fines = 21% pH = 7.21 - 7.61
	SPT S-2	70	3-5-5-6 (10)	MC = 25% LL = 30 PL = 21 Fines = 49% pH = 6.53 - 6.73
5	SPT S-3	60	7-6-5-5 (11)	MC = 24%
	SPT S-4	80	7-8-12-18 (20)	MC = 13% LL = 27 PL = 18 Fines = 21% pH = 8.01 - 8.62
	SPT S-5	83	10-50/1"	MC = 17%
10	AU A-1			
	SPT S-6	0	50/1"	
15	AU A-2			
	SPT S-7	25	50/5"	MC = 6%

DEPTH (ft)	MATERIAL DESCRIPTION	ELEVATION
0.0 - 0.5	2A gravel subbase.	324.5
0.5 - 3.0	(FILL) **(SC)** Clayey **SAND** with gravel; fine to medium-grained sand, subangular, fine to medium-grained siltstone gravel, medium dense, dry to moist, red, gray, and brown.	322.0
3.0 - 6.0	**(SC)** Clayey **SAND**; fine-grained sand, loose to medium dense, moist, gray, red, and brown.	319.0
6.0 - 18.4	**(SC)** Clayey **SAND** with gravel; fine-grained sand, subangular, medium-grained siltstone gravel, medium dense to very dense, moist, red and brown.	306.6

Spoon Refusal at 18.4 feet.
Bottom of borehole at 18.4 feet.

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BORING NUMBER B-8

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CLIENT ADP Engineering and Architecture PLLC

PROJECT NAME Pennsburg Burger King

PROJECT NUMBER 21-17194-01

PROJECT LOCATION Pennsburg Borough, Montgomery County, Pennsylvania

DATE STARTED 12/8/21 **COMPLETED** 12/8/21

GROUND ELEVATION 324 ft **HOLE SIZE** 6 inches

DRILLING CONTRACTOR Allied Well Drilling

GROUND WATER LEVELS:

DRILLING METHOD ASTM D-1586

AT TIME OF DRILLING ---

LOGGED BY G. V. Lutty, GIT **CHECKED BY** Ian J. Keating, GIT

AT END OF DRILLING --- 7.3' Caved.

NOTES Jay Torres - Diedrich D-50 Turbo Track Rig

AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS AND REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0						2A gravel subbase.
					0.5	323.5
	SPT S-1	80	10-18-12-11 (30)	MC = 12% LL = 26 PL = 18 Fines = 21% pH = 7.21 - 7.61		(FILL) **(SC)** Clayey **SAND** with gravel; fine to medium-grained sand, subangular, fine to medium-grained siltstone gravel, medium dense to dense, moist, red and brown.
2.5	SPT S-2	75	9-10-11-8 (21)	MC = 7% LL = 30 PL = 21 Fines = 49% pH = 6.53 - 6.73		
					4.0	320.0
5.0	SPT S-3	95	5-7-11-11 (18)	MC = 25%		**(SC)** Clayey **SAND**; fine-grained sand, medium dense, moist, gray, red, and brown.
					6.0	318.0
7.5	SPT S-4	100	13-15-25-28 (40)	MC = 13% LL = 27 PL = 18 Fines = 21% pH = 8.01 - 8.62		**(SC)** Clayey **SAND** with gravel; fine-grained sand, subangular, fine to medium-grained siltstone gravel, dense to very dense, dry to moist, red.
	SPT S-5	91	21-33-50/1"	MC = 11%		
					9.1	314.9

Spoon Refusal at 9.1 feet.
Bottom of borehole at 9.1 feet.

Appendix B

Laboratory Testing Program

APPENDIX B

LABORATORY TESTING PROGRAM

Tests were conducted in our AASHTO-certified laboratory on representative soil samples for the purpose of classification and evaluation of their relevant characteristics and engineering properties. The amount and selection of tests were based on the geotechnical requirements of the project, our proposal, and encountered subsurface conditions. Test results are presented herein and on the boring logs in Appendix A: *Field Exploration*. The following is a summary of the laboratory tests conducted for this project.

USCS Classification (ASTM D2487)

USCS Classifications in accordance with ASTM D2487, were performed on three (3) relatively undisturbed samples and was used to classify the on-site soils, and to provide qualitative measurements of the *in-situ* characteristics of site soils. The alphanumerical designations can be seen on the following pages of this Appendix B.

Moisture Content (ASTM D2216)

Moisture content tests, in accordance with ASTM D2216, were performed on thirty-seven (37) representative split-spoon samples in accordance with the above referenced standard. These tests were performed to aid in the classification of subsurface materials and to provide quantitative measurements of the in-situ moisture characteristics of the site soils. Moisture content is expressed as a percentage and is determined by dividing the total weight of moisture by the total weight of dry soil.

Moisture ranged from three percent to thirty-nine percent (3% - 39%) and the site exhibited an average moisture content of approximately fifteen and three tenths percent (15.3%). The test results can be seen on the boring logs which are presented in Appendix A (represented by MC = X%).

Particle-Size Analysis (ASTM D422)

To assist in classification of soils, mechanical grain-size analyses was performed on three (3) selected samples. Testing was performed in general accordance with the ASTM Standard D422 test method. Test results indicated a clayey sand (SC) in the ”B” composite sample and a clayey sand with gravel (SC) in the ”A” and ”C” composite sample. Test sample ”A” was selected from B-1 through B-8 at depths ranging between ground surface and four (4) ft-bgs, test sample ”B” was selected from B-1 through B-8 at depths ranging between four (4) and six (6) ft-bgs, and sample ”C” was selected from B-1 through B-8 at depths ranging between six (6) and ten (10) ft-bgs.

- The “A” composite sample had a particle distribution as follows: gravel-sized particles comprised 37.8%, sand-sized particles comprised 40.7%, silt-sized particles comprised 11.7%, and clay-sized particles comprised 9.8% of the total sample.
- The “B” composite sample had a particle distribution as follows: gravel-sized particles comprised 12.7%, sand-sized particles comprised 38.2%, silt-sized

particles comprised 27.1%, and clay-sized particles comprised 22.0% of the total sample.

- The “C” composite sample had a particle distribution as follows: gravel-sized particles comprised 26.1%, sand-sized particles comprised 52.5%, silt-sized particles comprised 11.7%, and clay-sized particles comprised 9.7% of the total sample.

Grain-size curves are shown in the *Grain Size Distribution* figure that is presented in the following pages of this Appendix B.

Atterberg Limits (ASTM D4318)

In accordance with ASTM D4318, the site soils plasticity index was performed on three (3) representative samples. Liquid limit is defined as the limiting water content at which the soil transitions from a plastic state to a viscous liquid state of soil consistency. Plastic limit is defined as the water content at which a soil transitions from a plastic state to a semi-solid state of consistency. Plasticity Index (PI) is the difference in moisture content, between the liquid limit and the plastic limit. Test results indicate that:

- The “A” composite sample had a LL of 26, a plastic limit PL of 18, and a plasticity index PI of 8,
- The “B” composite sample had a LL of 30, a plastic limit PL of 21, and a plasticity index PI of 9,
- The “C” composite sample had a LL of 27, a plastic limit PL of 18, and a plasticity index PI of 9.

These results are then used to plot a point on a graph of Liquid Limit (X-axis) versus the Plasticity Index (Y-axis), which determines if the fine-grained constituents (smaller than #200 sieve) are CL, CH, ML, MH, or CL-ML. The test results are shown on the Atterberg Limits’ Results figure that is presented in the following pages of this Appendix B.

Standard Test Method for pH of Soils (ASTM D4972)

Six (6) pH tests were performed on composite soil samples from the site in accordance with the above refrenced standard. These tests were performed in order to determine the acidity or alkalinity of the soil material encountered at the site to determine this aspect of the materials corrosive characteristics. Lower and upper pH limits of the subsurface material are presented as follows:

- Ground surface to two (2) ft-bgs produced a pH range of 7.21 – 7.61.
- Two to six (2 – 6) ft-bgs produced a pH range of 6.53 – 6.73.
- Six to ten (6 – 10) ft-bgs produced a pH range of 8.01 – 8.62.

Results of the pH tests ranged from neutral to modeately alkaline which are not indictive of corrosive soils; these are presented in the boring logs in Appendix A, *Field Exploration.*

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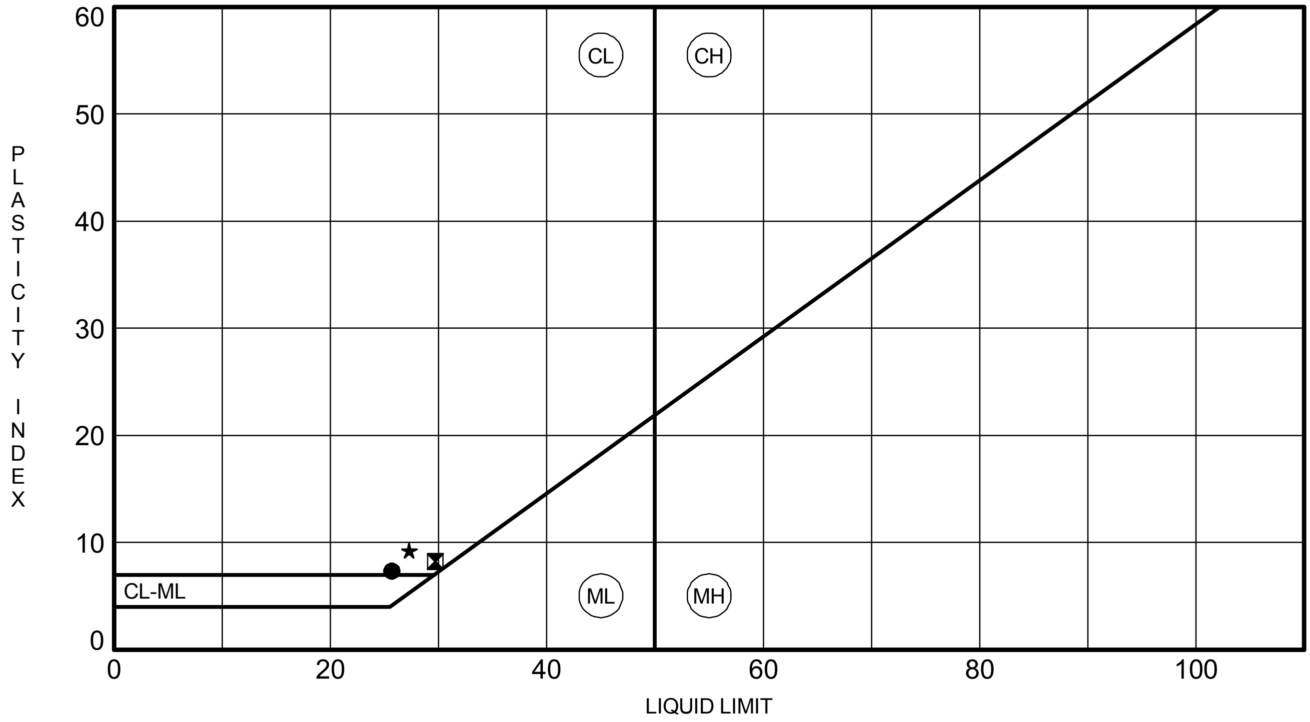
ATTERBERG LIMITS' RESULTS

CLIENT ADP Engineering and Architecture PLLC

PROJECT NAME Pennsburg Burger King

PROJECT NUMBER 21-17194-01

PROJECT LOCATION Pennsburg Borough, Montgomery County, Pennsylvania



	BOREHOLE	AVG. DEPTH	LL	PL	PI	Fines	Classification
●	**Composite Sample A**	**1.0**	**26**	**18**	**8**	**21**	**CLAYEY SAND with GRAVEL(SC)**
☒	**Composite Sample B**	**3.5**	**30**	**21**	**9**	**49**	**CLAYEY SAND(SC)**
★	**Composite Sample C**	**6.5**	**27**	**18**	**9**	**21**	**CLAYEY SAND with GRAVEL(SC)**

ATTERBERG LIMITS - GINT STD US LAB.GDT - 12/15/21 13:58 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\21-17194-01 PENNSBURG BURGER KING.GPJ

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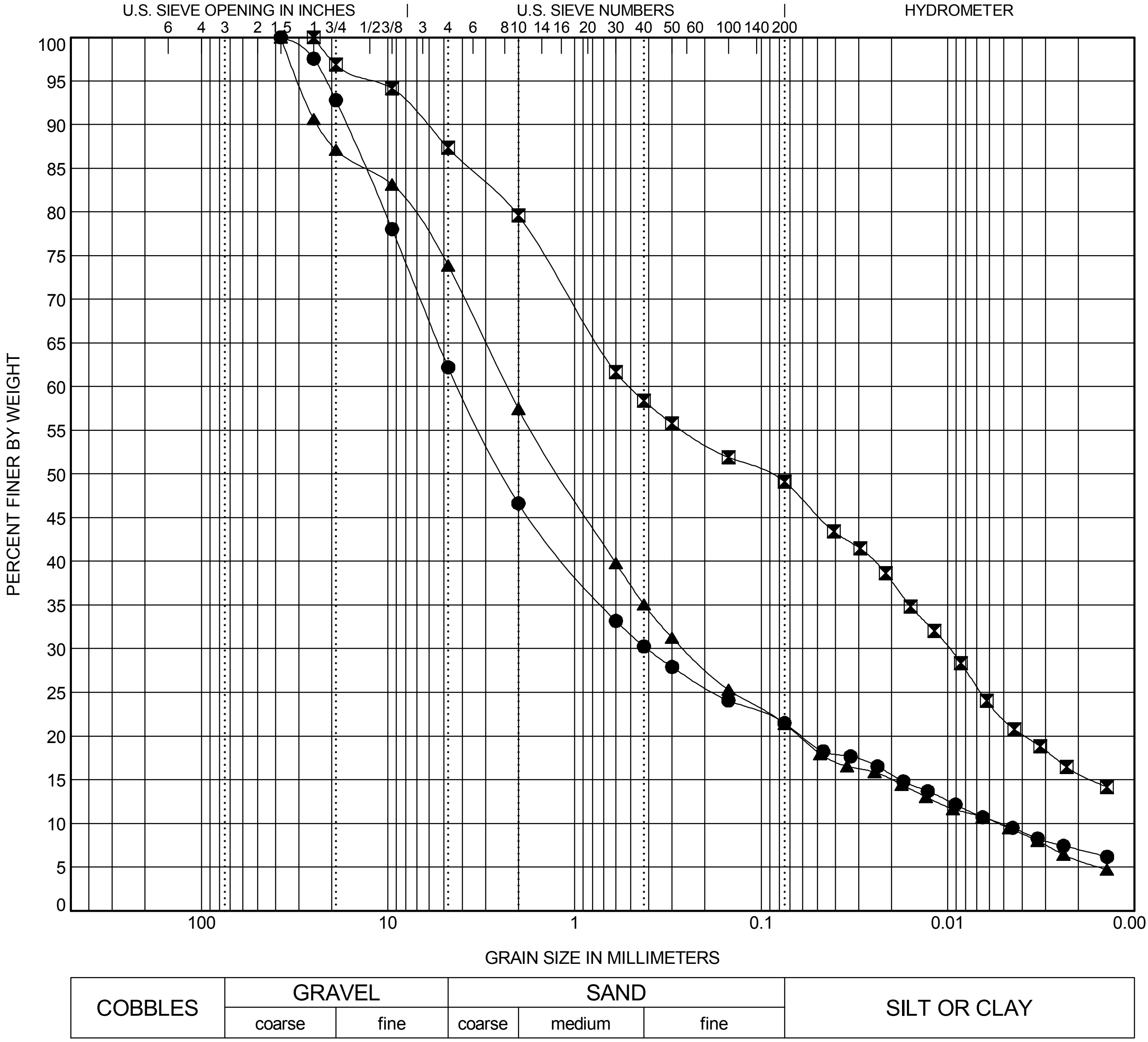
GRAIN SIZE DISTRIBUTION

CLIENT ADP Engineering and Architecture PLLC

PROJECT NAME Pennsburg Burger King

PROJECT NUMBER 21-17194-01

PROJECT LOCATION Pennsburg Borough, Montgomery County, Pennsylvania

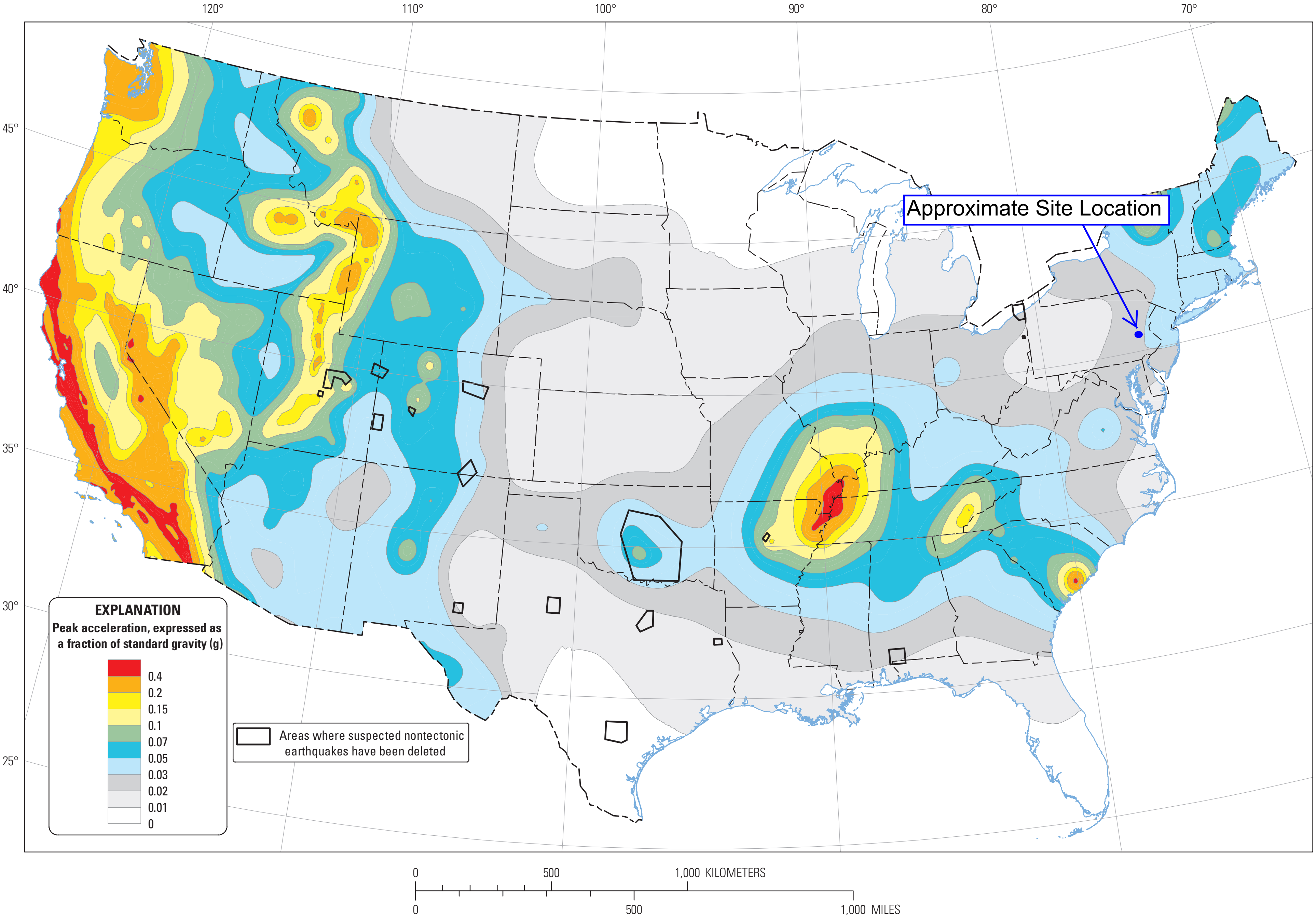


BOREHOLE	AVG. DEPTH	Classification	LL	PL	PI	Cc	Cu
● **Composite Sample A**	**1.0**	**CLAYEY SAND with GRAVEL(SC)**	**26**	**18**	**8**	**7.59**	**798.31**
☒ **Composite Sample B**	**3.5**	**CLAYEY SAND(SC)**	**30**	**21**	**9**		
▲ **Composite Sample C**	**6.5**	**CLAYEY SAND with GRAVEL(SC)**	**27**	**18**	**9**	**5.44**	**422.37**

BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **SB-6**	**1.0**	**37.5**	**4.202**	**0.41**	**0.005**	**37.8**	**40.7**	**11.7**	**9.8**
☒ **SB-6**	**3.5**	**25**	**0.504**	**0.01**		**12.7**	**38.2**	**27.1**	**22.0**
▲ **SB-6**	**6.5**	**37.5**	**2.287**	**0.26**	**0.005**	**26.1**	**52.5**	**11.7**	**9.7**

Appendix C

Seismic Information

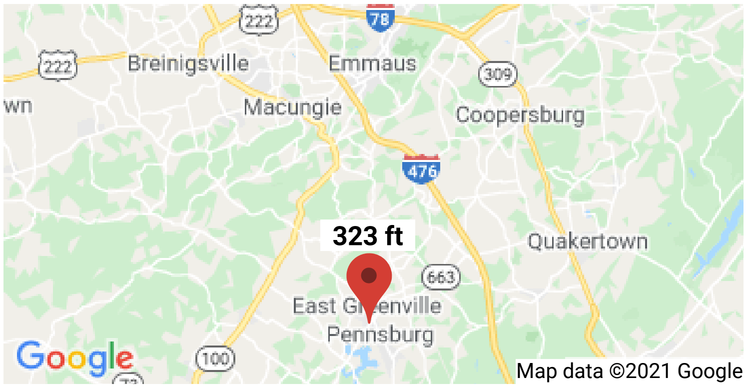


Ten-percent probability of exceedance in 50 years map of peak ground acceleration

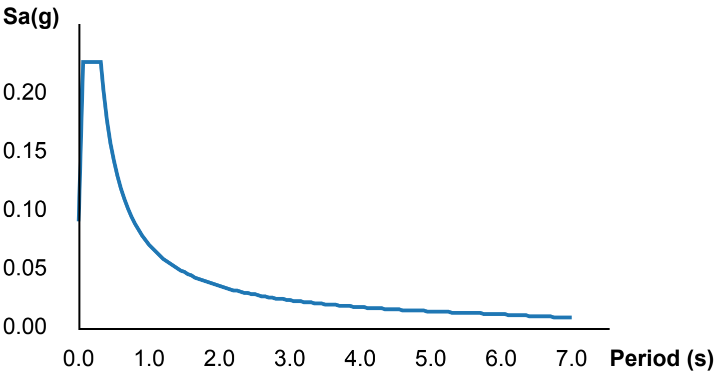
Hazards by Location

Search Information

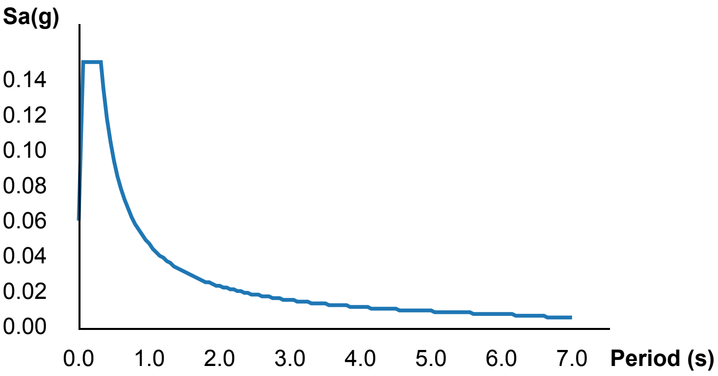
Coordinates:	40.393983, -75.500698
Elevation:	323 ft
Timestamp:	2021-12-20T17:35:16.878Z
Hazard Type:	Seismic
Reference Document:	ASCE7-16
Risk Category:	II
Site Class:	C



MCER Horizontal Response Spectrum



Design Horizontal Response Spectrum



Basic Parameters

Name	Value	Description
S_S	0.175	MCE_R ground motion (period=0.2s)
S_1	0.048	MCE_R ground motion (period=1.0s)
S_{MS}	0.227	Site-modified spectral acceleration value
S_{M1}	0.071	Site-modified spectral acceleration value
S_{DS}	0.151	Numeric seismic design value at 0.2s SA
S_{D1}	0.048	Numeric seismic design value at 1.0s SA

▾Additional Information

Name	Value	Description
SDC	A	Seismic design category
F_a	1.3	Site amplification factor at 0.2s
F_v	1.5	Site amplification factor at 1.0s
CR_S	0.94	Coefficient of risk (0.2s)

CR_1	0.934	Coefficient of risk (1.0s)
PGA	0.096	MCE_G peak ground acceleration
F_{PGA}	1.3	Site amplification factor at PGA
PGA_M	0.125	Site modified peak ground acceleration
T_L	6	Long-period transition period (s)
SsRT	0.175	Probabilistic risk-targeted ground motion (0.2s)
SsUH	0.186	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	1.5	Factored deterministic acceleration value (0.2s)
S1RT	0.048	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.051	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	0.6	Factored deterministic acceleration value (1.0s)
PGAd	0.5	Factored deterministic acceleration value (PGA)

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Disclaimer

Hazard loads are provided by the U.S. Geological Survey Seismic Design Web Services.

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Appendix D

Geotechnical Engineering Report Insert

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled.* No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

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