Village of Pemberville
Pemberville, Ohio

Geotechnical Subsurface Investigation
Proposed Roadway Improvements
College Avenue and Hickory Street
Pemberville, Ohio

October 2019
October 17, 2019

Mayor Gordon Bowman
Village of Pemberville
115 Main Street, P.O. Box 109
Pemberville, Ohio 43450

Geotechnical Subsurface Investigation
Proposed Roadway Improvements
College Avenue and Hickory Street
Pemberville, Ohio

Dear Mayor Bowman:

TTL Associates, Inc. (TTL) has completed the geotechnical subsurface investigation for the referenced project. This study was performed in general accordance with TTL Proposal No. 1836301, dated May 23, 2019, and was authorized by you on August 7, 2019. This report includes descriptions of the investigative procedures and encountered conditions, as well as recommendations for resurfacing and reconstruction of pavements.

PROJECT DESCRIPTION

It is our understanding that the project consists of improvements to portions of Hickory Street and College Avenue in Pemberville, Ohio. The general project area is shown on the attached Site Location Map (Plate 1.0).

Milling and resurfacing is planned along Hickory Street, just north of College Avenue, and College Avenue, from approximately Elm Street to East Front Street. Full depth removal and replacement is planned for College Avenue, from approximately Hickory Street to Elm Street.

Consideration is also being given to incorporation of geosynthetics beneath the stone base to add longevity to the project and/or reduce the section thickness and optimize the costs. Traffic loads and volumes were not provided as part of the evaluations for this project.

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INVESTIGATIVE PROCEDURES

Field Procedures

This investigation included four (4) test borings that were performed on September 20, 2019 by TTL. The test borings were located within the existing pavement and are designated as B-1 through B-4. The borings were located in the field by TTL in accordance with a boring location plan provided by Feller, Finch & Associates, Inc. The approximate locations of the borings are shown on the attached Test Boring Location Plan (Plate 2.0).

Test borings were advance using a truck-mounted drill rig utilizing 3-inch diameter solid-stem augers. Soil samples were collected utilizing a split-spoon sampler continuously to termination at depths of 6.5 to 7.0 feet below top of pavement. Split-spoon (SS) samples were obtained by the Standard Penetration Test (SPT) Method (ASTM D 1586), which consists of driving a 2-inch outside diameter split-barrel sampler into the soil with a 140-pound weight falling freely through a distance of 30 inches. The sampler was driven in four successive 6-inch increments with the number of blows per increment being recorded. The sum of the number of blows required to advance the sampler the second and third 6-inch increments is termed the Standard Penetration Resistance (N-value) and is presented on the Logs of Test Borings attached to this report. The samples were sealed in jars and transported to our laboratory for further classification and testing.

Soil conditions encountered in the test borings are presented in the Logs of Test Borings, along with information related to sample data, SPT results, and laboratory test data. It should be noted that these logs have been prepared on the basis of laboratory testing along with the field logs of the encountered soils.

This investigation did not include an environmental assessment of the surface or subsurface materials at the site.

Laboratory Procedures

All of the recovered subsoil samples were tested for moisture content (ASTM D 2216) and visually classified in general accordance with the Ohio Department of Transportation (ODOT) soil classification system. An Atterberg limits test (ASTM D 4318) and a particle size analysis (ASTM D 422) were performed on representative samples from Boring B-2 (SS-1) and Boring B-3 (SS-1). Test results are presented on the Logs of Test Borings, Tabulation of Test Data sheet, and Grain Size Distribution sheet attached to this report.
ENCOUNTERED CONDITIONS

Based on observations during boring layout and site reconnaissance, the existing pavements appeared to be in fair to poor condition, with areas of longitudinal and transverse cracking. Alligator cracking was also noted in areas throughout the project corridor.

The surface materials encountered in the borings consisted of asphalt pavement ranging from 5.5 to 7.0 inches in thickness, underlain by crushed stone ranging from 3.0 to 6.5 inches in thickness.

Underlying the pavement materials, the subsoils consisted of predominantly cohesive soils to the termination depths of the borings. Zones of granular soils was encountered underlying the pavement in Boring B-4 to a depth of approximately 3 feet below top of pavement and in Boring B-2 from 4.3 to 7 feet.

The zones of granular soil were classified as medium dense to dense coarse and fine sand (ODOT A-3a). SPT N-values ranged from 18 to 44 blows per foot (bpf) and moisture contents ranging from 11 to 14 percent were determined for the recovered samples.

Underlying the pavement materials in Borings B-1 through B-3, as well as the granular soils in Boring B-4 cohesive soils consisting of silt and clay (ODOT A-6a, A-6b, and A-7-6) with varying amounts of sand and gravel were encountered to boring termination at a depth of 6.5 to 7 feet, with the exception of Boring B-2 as noted above. SPT N-values ranged from 9 to 42 bpf, and unconfined compressive strengths ranged from 8,000 to 9,000 pounds per square foot (psf) (maximum reading obtainable with the hand penetrometer), indicating stiff to hard consistency. Moisture contents ranged from approximately 9 to 21 percent.

Groundwater was not encountered during drilling or observed at the completion of drilling in any of the borings performed for this investigation. Based on the soil characteristics and moisture conditions encountered in the borings, it is our opinion that the “normal” groundwater level will generally be encountered at depths greater than the explored depth in the borings performed for this investigation. However, it should be noted that groundwater elevations can fluctuate with seasonal and climatic influences. In particular, “perched” water may be present within stone base or granular soils underlain by relatively impermeable cohesive soils. Therefore, the groundwater conditions may vary at different times of the year from those encountered during this investigation.
EVALUATIONS AND RECOMMENDATIONS

Existing Subgrades

Results of the test borings indicate that the subgrades underlying the pavement materials consist of both cohesive soils and granular soils, which are considered moderately suitable for support of pavements. Laboratory analyses for Boring B-2 (SS-1) and B-3 (SS-1), as well as visual descriptions of the upper soil profile, indicate that the cohesive subgrade soils may be generally classified as Group A-7-6 and A-6a, while the granular subgrade soils may be generally classified as Group A-3a in accordance with the Ohio Department of Transportation (ODOT) system of soil classification. The granular soils are considered fair to good as subgrade materials. The cohesive soils are considered fair to poor as subgrade materials because they have relatively low permeabilities and a high percentage of silt and clay particles, which makes them susceptible to moisture, frost penetration, and frost heave. Therefore, the cohesive soils will dictate pavement design.

At the time of this investigation, the moisture content determined for the lone near surface granular subgrade soil sample was on the order of 14 percent, while moisture contents in the upper 2½ feet of the cohesive subgrade soils were on the order of 14 to 21 percent. These moisture contents are estimated to vary from near to above the expected optimum moisture content for these soils. Therefore, remedial action should be anticipated to be required to adjust the moisture contents of the existing materials and achieve proper compaction of the subgrade.

Modified Subgrades

If soils are dry of optimum, water should be uniformly mixed into the subgrade. If soils wet of optimum are encountered, lowering the moisture content by scarification and aeration (discing and exposure to sun and wind) may be required. However, this may not be feasible if construction occurs during wet seasonal conditions. Very moist to wet soils will “pump” under the operation of heavy equipment, resulting in deep rutting and perhaps rendering the operation of grading and paving equipment difficult or impossible.

Therefore, other methods of subgrade modification may be required in areas of high moisture content. Modification may be achieved by undercutting and replacement with granular subbase (possibly in combination with a geotextile separation layer or geogrid reinforcement), mixing stone into the subgrade, or treating the subgrade with cement. The method of subgrade modification should be determined at the time of construction.
Subgrade modification should be completed in accordance with the “Site and Subgrade Preparation” section of this report.

**Flexible (Asphalt) Pavement Design**

Based on the results of the laboratory testing, we recommend a subgrade CBR value of 4 percent for flexible pavement design for the Group A-7-6 or better soils. This CBR value is based on subgrade compacted to at least 100 percent of the maximum dry density as determined by ASTM D 698 (Standard Proctor) or verified as stable through proof rolling.

It should be noted that we are not privy to the design traffic loads or intended design life, and the subgrade support recommendations indicated herein should be reviewed by the site engineer in conjunction with the design traffic criteria to determine the required pavement sections. In any case, we recommend that the roadway pavement cross-section consist of at least 4 inches of asphalt underlain by a minimum of 8 inches of aggregate base for even the lightest-duty roadway pavements based on our experience regarding environmental exposure and reasonable serviceability.

**Pavements (General)**

All paving operations should conform to Ohio Department of Transportation (ODOT) specifications. The pavement and subgrade preparation procedures outlined in this report should result in a reasonably workable and satisfactory pavement. It should be recognized, however, that all pavements need repairs or overlays from time to time as a result of progressive yielding under repeated traffic loads for a prolonged period of time, as well as exposure to weather conditions.

It is recommended that proof-rolling/compaction, placement of aggregate base, and placement of asphalt be performed within as short a time period as possible. Exposure of the aggregate base to rain, snow, or freezing conditions may lead to deterioration of the subgrade and/or aggregate base due to excessive moisture conditions and to difficulties in achieving the required compaction.

Based on the poorly-drained nature of the cohesive subgrade soils, it is anticipated that surface water infiltration may collect in the aggregate base course. Without adequate drainage, water will remain in the base for extended periods of time, creating localized wet, soft pockets. The presence of these pockets will increase the likelihood that pavement distress (cracking, potholes, etc.) will develop. Drainage features may include grading the subgrade surface to slope downward to the outside edge of pavements and/or providing longitudinal edge drains that discharge into storm sewers.
Site and Subgrade Preparation

The existing asphalt pavement, stone base, and deleterious non-soil materials should be removed from the proposed construction areas. Upon completion of removal, the areas intended to support new fill and pavements should be carefully inspected by a geotechnical engineer. At that time, the engineer should observe proof rolling/compaction of the granular subgrade soils utilizing a vibratory, smooth-drum roller. For the cohesive subgrade soils, proof rolling should be performed using a 20- to 30-ton loaded truck or other pneumatic-tired vehicle of similar size and weight. The roller or truck should make a minimum of two passes covering the proposed development area, with additional passes as necessary to achieve required compaction and/or subgrade stabilization.

The purpose of proof rolling the cohesive subgrade soils is to locate any weak, soft, or excessively wet soils that may be present at the time of construction. The purpose of vibratory compaction for the granular soils is to densify zones of loose materials that are encountered in the upper portion of the soil profile, thereby providing more uniform subgrade support. We recommend a roller with a minimum dead weight on the drums of 8 tons, vibrating at 30 Hz or greater, and traveling at speeds not exceeding approximately 4 feet per second (about 3 miles per hour). These operational criteria should provide sufficient dynamic compaction energy to alleviate loose soil conditions within the zone of influence for subgrade support.

Any unsuitable materials observed during the inspection and proof-rolling operations should be undercut and replaced with compacted fill or stabilized in place utilizing chemicals or conventional remedial measures such as discing, aeration, and recompaction. Once the site has been proof rolled, inspected, and stabilized, the proof-rolled or inspected subgrades should not be exposed to wet conditions. It should be recognized that during periods of wet weather, the cohesive soils that will be exposed at design subgrades will tend to pond water for short periods of time, with the potential to deteriorate the prepared subgrade.

The results of the inspection and proof-rolling/compaction operations will be dependent on the construction operations, the moisture content of the soils, and the weather conditions prevalent at the time. If pumping or rutting is encountered and difficulty is experienced in the operation of construction equipment, TTL should be notified in order to determine which method of subgrade modification may be best suited for the conditions encountered. Should such conditions be experienced, we may recommend that a small test area be used to determine the necessary depth of undercutting and stone replacement or other remedial action necessary to achieve a stable subgrade condition.
Groundwater Control

As stated previously, it is our opinion that the “normal” groundwater level will generally be encountered at depths greater than those explored by the borings performed for this investigation. It is our experience that adequate control of groundwater seepage, perched groundwater or surface water run-off into shallow excavations extending up to a few feet below the groundwater table within cohesive soils should be achievable by minor dewatering systems, such as pumping from prepared sumps. In the event excessive seepage or perched groundwater is encountered during construction, TTL may be notified to evaluate whether other dewatering methods are required.

Fill

Material for engineered fill or backfill required to achieve design grades may consist of any non-organic soils having a maximum dry density as determined by the Standard Proctor (ASTM D 698) of 90 pounds per cubic foot (pcf) or greater. On-site soils may be used as engineered fill materials provided that they are free of organic matter, debris, excessive moisture, and rock or stone fragments larger than 3 inches in diameter. Depending on seasonal conditions, the on-site soils could be wet of optimum and may require scarification and aeration to achieve satisfactory compaction. If the construction schedule does not allow for scarification and aeration activities, it may be more practical or economical to utilize imported granular fill.

Fill should be placed in uniform layers not more than 8 inches thick (loose measure) and adequately keyed into stripped and scarified soils. All fill placed within pavement areas should be compacted to a dry density of not less than 100 percent of the maximum dry density as determined by ASTM D 698 (Standard Proctor). The upper profile soils consist of cohesive soils and granular soils. The contractor should be prepared to use a sheepfoot roller for the on-site cohesive soils. Compaction for granular soils and aggregate base material should be performed with a vibratory smooth-drum roller.

Scarified subgrade soils and all fill material should be within 3 percent of the optimum moisture content to facilitate compaction. Furthermore, fill material should not be frozen or placed on a frozen base. It is recommended that all earthwork and site preparation activities be conducted under adequate specifications and properly monitored in the field by a qualified geotechnical testing firm.
QUALIFICATION OF RECOMMENDATIONS

Our evaluation of the pavement design and construction conditions has been based on our understanding of the site and project information and the data obtained during our field investigation. The general pavement cross-sections and subsurface conditions presented were based on interpretation of the data obtained from borings performed at specific locations. Regardless of the thoroughness of a subsurface investigation, there is the possibility that conditions between borings will differ from those at the boring locations, that conditions are not as anticipated by the designers, or that the construction process has altered the soil conditions. This is especially true for previously developed sites that may have included multiple generations of utility installations and pavement resurfacing. Therefore, experienced geotechnical engineers should observe earthwork and pavement construction to confirm that the conditions anticipated in design are noted. Otherwise, TTL assumes no responsibility for construction compliance with the design concepts, specifications, or recommendations.

The evaluations and recommendations in this report have been developed on the basis of the previously described project characteristics and subsurface conditions. If project criteria or locations change, TTL should be permitted to determine whether the recommendations must be modified. The findings of such a review will be presented in a supplemental report.

The nature and extent of variations between the borings may not become evident until the course of construction. If such variations are encountered, it will be necessary to reevaluate the recommendations of this report after on-site observations of the conditions.

Our professional services have been performed, our findings derived, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all other warranties either expressed or implied. TTL is not responsible for the conclusions, opinions, or recommendations of others based on this data.

Soil samples collected during this investigation will be stored at our laboratory for 90 days from the date of this report. The samples will be discarded after this time unless you request that they be saved or delivered to you.
Should you have any questions regarding this report or require additional information, please contact our office.

Sincerely,

TTL Associates, Inc.

Katherine C. Hennicken, P.E.
Geotechnical Engineer

Curtis E. Roupe, P.E.
Vice President

Attachments: Plate 1.0 Site Location Map
Plate 2.0 Test Boring Location Plan
Logs of Test Borings B-1 through B-4
Legend Key
Tabulation of Test Data
Grain Size Distribution

c.c.: Mr. Steven J. Darmofal, P.E. – Feller, Finch & Associates, Inc.

T:\Geotech\Projects 2019\1836301...\Report\1836301 TTL Geotech Report College Ave Hickory St Improvements Pemberville OH.doc
Boring Number B-1

Project Name: Proposed Roadway Improvements
Project Location: Pemberville, OH

Rig No.: 111

Ground Water Levels:
- At Time of Drilling: None
- At End of Drilling: None
- 0hrs After Drilling: Backfilled with Cuttings, Chips, and Patch

Elevation

<table>
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<tr>
<th>Depth (ft)</th>
<th>Graphic Log</th>
<th>Material Description</th>
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</thead>
<tbody>
<tr>
<td>0.0</td>
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<td>Asphalt - 6.25 inches</td>
</tr>
<tr>
<td>0.5</td>
<td></td>
<td>Crushed Stone - 5.75 inches</td>
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<tr>
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<td>Moist Stiff Gray CLAY w/Some Silt and Sand (A-7-6)</td>
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<tr>
<td>2.5</td>
<td></td>
<td>Moist Stiff to Very Stiff Gray SILTY CLAY (A-6b) w/Little Sand and Trace Gravel</td>
</tr>
<tr>
<td>2.8</td>
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<td>@3.3': Brown/Gray, w/Trace Iron Oxide Stain Seam</td>
</tr>
<tr>
<td>5.5</td>
<td></td>
<td>Moist Hard Gray/Brown SILTY CLAY (A-6b) w/Little Sand, Trace Gravel, and Shale Fragments</td>
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<tr>
<td>7.0</td>
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<td>Bottom of hole at 7.0 feet</td>
</tr>
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</table>

Sample Type | Recovery % | SLACK, CONTS. (m-value) | UNCONF. COMP. (S-value) | U.F. (gpa) |
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<tr>
<td>SS 1</td>
<td>58</td>
<td>3-5-5-8-6 (13)</td>
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<tr>
<td>SS 2</td>
<td>88</td>
<td>3-8-9-10 (16)</td>
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<tr>
<td>SS 3</td>
<td>100</td>
<td>15-20-20-21 (40)</td>
<td>&gt;4.5</td>
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Notes
BORING NUMBER B-2

CLIENT: Village of Pemberville
PROJECT NUMBER: 1836301

PROJECT NAME: Proposed Roadway Improvements
PROJECT LOCATION: Pemberville, OH
RIG NO.: 111

DRILLING CONTRACTOR: TTL Associates IC MBT6
DRILLING METHOD: Pavement Coring with 3 in. SSA
DATE STARTED: 9/20/19
LOGGED BY: KKC
COMPLETED: 9/20/19
CHECKED BY: CPI

GROUNDBORE LEVELS:
AT TIME OF DRILLING: None
AT END OF DRILLING: None
0hrs AFTER DRILLING: Backfilled w/Cuttings, Chips, and Patch

ELEVATION (ft) | DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION
---|---|---|---
0.0 | | | ASPHALT - 7 inches
2.0 | | | CRUSHED STONE - 3 inches
2.2 | | | Moist Medium Stiff Brown CLAY w/Some Silt and Sand (A-7-6)
2.3 | | | Moist Stiff to Very Stiff Brown CLAY w/Some Silt, Little Sand, Trace Gravel, and Iron Oxide Stain Seam A-7-6 (14)
3.2 | | | SS 1 71 3.4-5.6 (9) 4.25
3.9 | | | SS 2 88 3.5-12.20 (17) 4.00
5.0 | | | SS 3 100 18.20-24.28 (44) NP
7.0 | | | Bottom of hole at 7.0 feet.
Boring Number B-3

Client: Village of Pemberville
Project Name: Proposed Roadway Improvements
Project Location: Pemberville, OH

Drilling Contractor: TTL Associates IC MB/VT
Drilling Method: Pavement Coring with 3 in. SSA
Date Started: 9/20/19
Logged By: KKC
Checked By: CPI
Rig No.: 111

Ground Water Levels:
- AT TIME OF DRILLING: None
- AT END OF DRILLING: None
- 0 Hours After Drilling: Backfilled w/Cuttings, Chips, and Patch

<table>
<thead>
<tr>
<th>Elevation (ft)</th>
<th>Depth (ft)</th>
<th>Graphic Log</th>
<th>Material Description</th>
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<tbody>
<tr>
<td>0.0</td>
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<td>Asphalt - 5.75 Inches</td>
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<tr>
<td>0.5</td>
<td></td>
<td></td>
<td>Crushed Stone - 4.25 Inches</td>
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<tr>
<td>2.5</td>
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<td></td>
<td>Moist Stiff to Very Stiff Gray SILT and CLAY w/Some Sand, Trace Gravel, and Calcite Seam A-6a (7)</td>
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<td>5.0</td>
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<td></td>
<td>@3': Brown/Gray, w/Little Sand, Trace Iron Oxide Stain Seam</td>
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<td>6.0</td>
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<td>Moist Very Stiff to Hard Brown SILT and CLAY (A-6a) w/Little Sand and Trace Gravel</td>
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<td>7.0</td>
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<td></td>
<td>Bottom of hole at 7.0 feet.</td>
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<table>
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<tr>
<th>Sample Type Number</th>
<th>Recovery % (RCD)</th>
<th>Blow Counts (N Value)</th>
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<tbody>
<tr>
<td>SS 1</td>
<td>33</td>
<td>5-5-4-5 (9)</td>
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<tr>
<td>SS 2</td>
<td>67</td>
<td>4-6-8-9 (14)</td>
</tr>
<tr>
<td>SS 3</td>
<td>100</td>
<td>7-9-12-16 (21)</td>
</tr>
</tbody>
</table>

SPT N Value: 14

Dry Unit Weight (kg):
- PL: 20
- MC: 40
- LL: 60
- 80

Note: The table and diagram provide detailed information about the drilling sequence and materials encountered at each elevation level.
## Boring Number B-4

**Project Name:** Proposed Roadway Improvements  
**Project Location:** Pemberville, OH

**Client:** Village of Pemberville  
**Project Number:** 1836301  
**Drilling Contractor:** TTL Associates IC MB/TB  
**Drilling Method:** Pavement Coring with 3 in. SSA  
**Date Started:** 9/20/19  
**Completed:** 9/20/19  
**Logged By:** KKC  
**Checked By:** CPI

### Ground Water Levels:
- **At Time of Drilling:** None  
- **At End of Drilling:** None
- **0hrs After Drilling:** Backfilled w/Cuttings, Chips, and Patch

### Elevation vs. Depth

<table>
<thead>
<tr>
<th>Elevation (ft)</th>
<th>Depth (ft)</th>
<th>Graphic Log</th>
<th>Material Description</th>
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</thead>
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<tr>
<td>0.0</td>
<td>0.5'</td>
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<td>Asphalt - 5.5 Inches</td>
</tr>
<tr>
<td></td>
<td>1.0'</td>
<td></td>
<td>Crushed Stone - 6.5 Inches</td>
</tr>
<tr>
<td></td>
<td>2.6'</td>
<td></td>
<td>Moist Medium Dense Brown COARSE and FINE SAND (A-3a) w/Some Silt, Trace Gravel, and Clay</td>
</tr>
<tr>
<td></td>
<td>2.8'</td>
<td></td>
<td>Moist Very Stiff to Hard Brown SILTY CLAY (A-6b) w/Little Sand, Trace Gravel, and Iron Oxide Stain Seam</td>
</tr>
<tr>
<td></td>
<td>5.5'</td>
<td></td>
<td>Moist Hard Gray/Brown SILTY CLAY (A-5b) w/Little Sand, Trace Gravel, and Calcite Stain Seam</td>
</tr>
</tbody>
</table>

### Sample Type
- SS 1  
- SS 2  
- SS 3

### Recovery %
- 58  
- 92  
- 100

### Blow Counts (N Value)
- 15-10-8-6 (16)  
- 4-6-12-14 (18)  
- 14-18-24-28 (42)

### Unconf. Comp. Stat. (lb)
- NP  
- >4.5  
- >4.5

### Dry Unit Wt. (pcf)
- 14  
- 14  
- 14

Bottom of hole at 6.5 feet.
LEGGEND KEY

Ohio Department of Transportation Soil Symbols

Sample Symbols

Notes:
1. Exploratory borings were drilled on September 20, 2019, using 3-inch diameter solid-stem augers.
2. These logs are subject to the limitations, conclusions, and recommendations in the report and should not be interpreted separate from the report.
3. The boring locations were established in the field by Feller, Finch & Associates, Inc. (FFA) in general accordance with the provided plan.
4. Unconfined Compressive Strength (tsf):
   NP = Non Plastic
<table>
<thead>
<tr>
<th>Boring Number</th>
<th>Sample Number</th>
<th>Sample Interval Depth (ft)</th>
<th>Standard Penetration (blows per foot)</th>
<th>Natural Moisture Content (% of Dry Weight)</th>
<th>In Place Dry Density (pounds per cubic foot)</th>
<th>Unconfined Compressive Strength (pounds per square foot)</th>
<th>Particle Size Distribution (%)</th>
<th>Atterberg Limits (%)</th>
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<tr>
<td>B-1</td>
<td>SS-1</td>
<td>1.0-3.0</td>
<td>13</td>
<td>17.4</td>
<td>*8,000</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>SS-2</td>
<td>3.0-5.0</td>
<td>15</td>
<td>15.5</td>
<td>**9,000+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SS-3</td>
<td>5.0-7.0</td>
<td>40</td>
<td>14.4</td>
<td>**9,000+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-2</td>
<td>SS-1</td>
<td>1.0-3.0</td>
<td>9</td>
<td>20.8</td>
<td>*8,500</td>
<td></td>
<td>0</td>
<td>3</td>
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<td>SS-2</td>
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<td>17</td>
<td>9.0</td>
<td>*8,000</td>
<td></td>
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<tr>
<td></td>
<td>SS-3</td>
<td>5.0-7.0</td>
<td>44</td>
<td>10.6</td>
<td>**9,000+</td>
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<td>B-3</td>
<td>SS-1</td>
<td>1.0-3.0</td>
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<td>14.3</td>
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<td>SS-3</td>
<td>5.0-7.0</td>
<td>21</td>
<td>13.2</td>
<td>**9,000+</td>
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<tr>
<td>B-4</td>
<td>SS-1</td>
<td>0.5-2.5</td>
<td>18</td>
<td>13.5</td>
<td>**9,000+</td>
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<tr>
<td></td>
<td>SS-2</td>
<td>2.5-4.5</td>
<td>18</td>
<td>14.1</td>
<td>*9,000+</td>
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<tr>
<td></td>
<td>SS-3</td>
<td>4.5-6.5</td>
<td>42</td>
<td>13.9</td>
<td>**9,000+</td>
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*Unconfined compressive strength derived from a calibrated hand penetrometer.
GRAIN SIZE DISTRIBUTION

CLIENT: Village of Pemberville
PROJECT NAME: Proposed Roadway Improvements
PROJECT NUMBER: 1836301
PROJECT LOCATION: Pemberville, OH

GRAIN SIZE IN MILLIMETERS

<table>
<thead>
<tr>
<th>COBBLES</th>
<th>GRAVEL</th>
<th>SAND</th>
<th>SILT</th>
<th>CLAY</th>
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<tr>
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<td>coarse</td>
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<tr>
<td>fine</td>
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</tbody>
</table>

Specimen Identification | OHDOT Classification | LL | PL | PI | Cc | Cu
---|----------------------|----|----|----|----|----
B-2 | CLAY w/Some Silt and Little Sand A-7-6 (14) | 45 | 23 | 22 |
B-3 | SILT and CLAY w/Some Sand and Trace Gravel A-6a (7) | 26 | 15 | 11 |

Specimen Identification | D100 | D50 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay
---|------|-----|-----|-----|---------|-------|-------|------
B-2 | 1.0  | 4.75| 1.0 | 0.2 | 11.4    | 27.4  | 61.0  |
B-3 | 1.0  | 19 | 0.009| 5.5 | 28.5    | 25.2  | 40.9  |

SLT-CLAY BOUNDARY = 0.005 MILLIMETERS