SUBSURFACE EXPLORATION AND RECOMMENDATIONS

PROPOSED TACO BELL RESTAURANT
5505 North Grape Road
Mishawaka, IN

GME TESTING PROJECT NO.
G21-090897

PREPARED FOR:

Delight TB Indiana LLC
P.O. Box 780023
Wichita, Kansas 67278
Attn.: Richard Krumholz, Co-President

February 21, 2022

GME TESTING

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Dear Mr. Krumholz:

In compliance with your request and authorization, Geotechnical and Materials Engineers, Inc. (dba ***GME Testing)*** is pleased to submit this report of our subsurface exploration and recommendations for the above referenced project. Our work was performed in accordance with our proposal GMEP21-090473 dated September 17, 2021. Our work was authorized by your acceptance of our proposal agreement on September 20, 2021.

The opinions and recommendations submitted in this report are based, in part, on our interpretation of the subsurface information revealed by the subsurface test borings shown on Figure 1 included in Appendix A of this report. Understandably, this report does not reflect variations in subsurface conditions between or beyond the extent of the test boring locations. Therefore, variations in these conditions can be expected, and fluctuation of the groundwater level will occur with time.

1.0 INTRODUCTION

Geotechnical and Materials Engineers, Inc. (dba., ***GME Testing***) has performed a geotechnical engineering evaluation at the site of the proposed Taco Bell restaurant that is planned for design and construction at the above-refenced project site. This evaluation consisted of performing six (6) designated vertical soil test boreholes, laboratory testing, engineering analysis and preparation of this report.

2.0 PURPOSE OF WORK

The general purpose of this evaluation was to develop geotechnical recommendations for the foundations, slabs, and pavement design for this project. Our scope of services included:

- Performing six (6) small-diameter, vertical soil test boreholes (designated as borings B-1 through B-6) to observe the subsurface conditions at their respective locations;
- Evaluating the physical properties of the soils by performing field and laboratory tests;
- Summarizing the results of the subsurface exploratory program;
- Analyzing the data from the field and laboratory tests to provide geotechnical recommendations; and
- Preparing this engineering report that contains information on the subsurface conditions, conclusions, and geotechnical related recommendations regarding the proposed project.

3.0 SITE CONDITIONS AND PROJECT DESCRIPTION

3.1 Site Conditions

At the time of our field investigation, the proposed site was an asphalt-covered parking lot and part of the existing shopping mall. The project site is generally flat to gently sloping. Drainage is primarily along the existing pavement surface.

The above description of site conditions is derived from our field investigation and our review of publicly available geologic and topographic maps.

3.2 Project Description

Based on preliminary information and site plans presented to us by the client as part of our geotechnical scope of work, it is our understanding that the proposed project will consist of the construction of an approximately 2,150 sq. feet, single-story, slab-on-grade (i.e., with no below ground level) wood-frame restaurant building with a brick veneer. The project site is known as 5505 North Grape Road in Mishawaka, Indiana.

No structural loading information was available at this time. For the purposes of this report, the anticipated maximum column load, wall load and floor load for the proposed building will be light.

Parking and driveway areas including a drive thru is also planned around the proposed restaurant building. Access to the site will be probably from Grape Road. Traffic criteria were not available at this submittal. Repeated heavy truck traffic is not expected. For design purposes, an equivalent axle loading (EAL) of 10,000 (mostly automobiles) has been assumed. We have also assumed that all pavement and paving materials will be in accordance with applicable City of Mishawaka or Indiana Department of Transportation (INDOT) Standards and Specifications.

A dumpster enclosure and a monopole-style monument sign (of unknown height and loadings) will also be included as part of the proposed construction and will be located approximately west and north-east of the proposed restaurant building, respectively. Based on our past experience with similar projects, it is anticipated that the sign foundation will be subjected to overturning and lateral loading of unknown magnitude.

Where new storm sewer and/or inlets are planned, they are anticipated to be constructed by conventional open-trench and backfill methods following applicable OSHA standards.

Neither the existing nor the finished floor elevations and grading plans for the proposed project were available at this time. It is anticipated that final grades will be established approximately at or slightly above the existing ground surface elevation. GME Testing should be allowed to review final grading plans after they are developed.

All depths and elevations referred to in this report are referenced from the ground surface existing at the time of this report was prepared, unless otherwise stated.

The development of the site for the proposed construction may require re-location of existing utilities in accordance with the project specifications and good construction practice.

GME Testing should be contacted to review design information that conflicts with our stated understanding presented in this report.

4.0 SUBSURFACE CONDITIONS

The subsurface conditions for the proposed construction were explored by performing six (6) vertical soil test borings to depths of approximately 5 to 20-feet below the existing ground surface. Table 1 summarizes the boring arrangements at each perspective construction areas.

Table 1: Assigned Boring Arrangements

Proposed Feature	Boring Number	Boring Depth, feet
Building	B-1 and B-2	±20
Parking Lot and Driveway Area	B-3 and B-4	±5
Dumpster Enclosure	B-5	±20
Monument Sign	B-6	±20

The planned locations of the test borings were determined by others and established in the field by GME Testing. The site plan provided to us by the client was projected onto aerials provided by the Google Earth website allowing for the correlation of the approximate latitude and longitude coordinates with each boring location. These coordinates were then assigned as waypoints and uploaded into a handheld GPS unit. Utilizing the handheld GPS unit, the locations referred to on our boring logs and presented on Figure 1, included in Appendix A of this report.

Additional details of field exploration, laboratory testing, and geologic conditions are provided in Appendix A of this report.

The lines of demarcation shown on the logs represent approximate boundaries between the various classifications. The stratification of soils, as shown on the accompanying test borehole logs, represents the soil conditions at the drilled borehole locations, and variations may occur between the boreholes. In-situ strata changes could occur gradually or at different levels. Also, it should be noted that the boreholes depict conditions at the particular locations and times indicated.

4.1 Generalized Soil Profile

Surficial Materials: Beneath existing heavy snow, the borings disclosed 2 to 9-inches of asphalt surface underlain by 6 to 13-inches of gravely sand base product.

The surficial asphalt and gravelly sand product thickness measured at the boring locations may or may not be representative of the overall average thickness at the site. Therefore, it is possible that the actual asphalt pavement stripping/removal depth could slightly vary from this data.

Fill Soils: Beneath existing asphalt pavement borings B-4 through B-6 disclosed fill materials consisting of sandy clay, silty sand, clayey sand and gravel to depths as shown on the boring logs.

Native Soils: Beneath existing asphalt pavement and fill, the soils generally consisted of fine sands, fine silty sands, clayey sands, and clayey silts that extended throughout the terminal depths of the borings were encountered.

Occasional cohesive soils consisting of silty clay and sandy silty clay were encountered in boring B-2.

The relative densities of existing granular soils were loose to medium dense a. However, in boring B-1 dense and very dense sands were disclosed.

The consistencies and relative densities of the encountered soils were based on the Standard Penetration Test, N-values, according to ASTM D-1586.

The foregoing discussions of subsurface conditions on this site represent generalized soil profiles at the test boring locations. A more detailed description and data for each test boring can be found on the individual Borehole Logs in Appendix B of this report.

4.2 Groundwater Conditions

Groundwater measurements were taken during our field operations by noting the depth of water on the rods and in open boreholes following withdrawal of the drilling augers after the completion of drilling activities in test borings.

Free groundwater was encountered during or following our drilling program only in borings B-1, B-2, B-5, and B-6 between depths of about 16 to 17-feet beneath the ground surface, as shown on Table 2 below and the boring logs, included in Appendix B of this report. No groundwater was encountered during or following our drilling program in the remaining borings.

Table 2: Groundwater Depths in the Borings at Time of Drilling

Boring No.	*Groundwater Depth, ft		Boring No.	*Groundwater Depth, ft	
	During Drilling	Immediately Following Drilling		During Drilling	Immediately Following Drilling
B-1	±16.5	†NO	B-4	NO	NO
B-2	±16	NO	P-1	±16	NO
B-3	NO	NO	P-2	±17	NO

**Depths referenced below existing ground surface.*
† *Not Observed (NO)*

The groundwater depths shown on the boring logs reflect groundwater levels only for the date which the borings were drilled.

It must be noted, however, that short term groundwater level observations made in test borings are not necessarily a reliable indication of the actual groundwater elevation. Based upon the engineering characteristics of the encountered soils, shallow trapped "perched" groundwater readings may also be present during wet periods of the year. Fluctuations in the level of groundwater typically occur due to variations in rainfall, water level and other factors. Shallow trapped water may become evident during wet periods of the year, within interbedded sands, soft clays, and loose granular soils.

5.0 EVALUATION AND RECOMMENDATIONS

The following design recommendations have been developed in order to assist in the design and development of the proposed project. They are intended for use with regard to the specific project discussed herein and any substantial changes in the project description, location, or assumed grades should be brought to our attention so that we may evaluate how such changes may affect our evaluation.

5.1 Geotechnical Analysis

After the site is stripped from existing asphalt pavement surface and any underlying wet or unsuitable materials, we recommended that the exposed subgrade be proofrolled and evaluated by GME Testing geotechnical engineer or designee to determine the extent of mitigation that will be required before filling or construction on site. Any areas that are evaluated by GME Testing to be unsuitable, pumping, compressible wet and/or containing organics should be properly removed and replaced.

For satisfactory subgrade performance, the existing soils moisture content should be maintained at approximately ±2 percent of optimum moisture content per ASTM D-1557. In general, above optimum moisture native soils can be re-used after they are properly conditioned, aerated, and prepared by adequate compaction and testing.

All new fill materials should be placed and compacting to achieve a dry density of 95 percent as evaluated by ASTM D-1557.

Based on the test boring results, the existing near surface soils that are generally consisting of silty sands, clayey sands and clayey silty sands are expected to deteriorate when moisture contents exceed 2 percent of optimum moisture as evaluated by ASTM D-1557. If these soils will show elevated moisture exceeding optimum moisture content, they should be mitigated by aerating and drying if weather conditions will permit. If adverse weather conditions will be experienced and these soils cannot be naturally mitigated, they can be removed and replaced with approved engineered fill.

If low strength clayey soils are observed in footing grade, extending them below to suitable firm soils will be needed.

If very loose and loose granular soils in the dry condition are encountered in the proposed footing excavations, densification of these sands to achieve a dry density of 95 percent as evaluated by ASTM D-1557 should be expected.

Sloughing and cave-ins of existing loose sands and generally fine granular soils should be expected. To reduce settlements, it is critical that all bearing surfaces be densified by means of suitable heavy compaction equipment to achieve desired densities.

After the existing pavement is removed, it is possible that trapped water in aggregate base may be present. This is typically noticeable if construction will start at or during wet period of the year. If water seepage is experienced in footing excavations, it should be removed using suitable dewatering means. If significant water inflow is experienced, softening and deterioration of existing silty and clayey soils will occur, and aggressive dewatering will be required.

5.2 General Earthwork Recommendations

5.2.1 Site Subgrade Preparation Recommendations

The following recommendations for earthwork and site preparation were developed based on our understanding of the project and the site conditions as interpreted in our field investigation.

- After all existing asphalt pavement surface and any underlying unsuitable materials and fill debris are removed below the proposed construction areas, GME Testing recommends that the resulting grades be evaluated prior to placing any new grade raise fill.

- Prior to fill placement in fill areas, and after rough grade has been achieved in cut areas, the subgrade should be thoroughly proofrolled.

- Any areas that exhibit excessive pumping and yielding during proofrolling should be stabilized by aerating, drying, and compaction if weather conditions are favorable or removal and replacement with engineered fill.

- Wherever unsuitable soils are observed, they should be undercut and replaced as described in this report.

- Organic soils (e.g., soils with greater than 5 percent organics content) should be removed below proposed building pad and settlement-sensitive construction areas.

- Backfill placed in utility excavations, confined areas and against foundations should be non-organic and free of debris and consist of an approved clean granular material.

- We recommend that the materials used as engineered fill meet all criteria as discussed in **Engineered Fill**, Section 5.2.2 of this report.

- Care must be exercised during grading and fill placement operations. Repeated heavy construction traffic over subgrade could cause the subgrade to pump, yield, and weak areas to develop and therefore should be avoided. Heavy construction traffic should use designated areas as directed by contractor.

- The exposed subgrade should be evaluated by a GME Testing engineering technician after stripping of topsoil but prior to placing any new grade raise fill on site.

In general, the site conditioning procedures discussed above are expected to result in fairly stable subgrade conditions throughout most of the site. However, the on-site sands and silty sand soils are sensitive when wet or when disturbed by construction traffic.

The earthwork recommendations may require modifications based on the field observations during construction. The appropriate course of action should be determined by the geotechnical engineer at the time of construction.

All earthwork operations must be performed under adequate specifications and be properly monitored by the geotechnical engineers' field representative.

5.2.2 Engineered Fill

All engineered fill needed to replace undercut materials or as a grade-raise fill should be approved by GME Testing prior to placement on site. Samples of the proposed fill materials should be tested prior to initiating the earthwork and backfilling operations to determine the classification, the natural and optimum moisture contents and maximum dry density and overall suitability as a structural fill.

To achieve the recommended compaction of the structural fill, we suggest that the fill be placed and compacted in layers not exceeding 8 inches in loose thickness (the loose lift thickness should be reduced to 6 inches when utilizing small hand compactors) and within the range of 2 percentage (%) points below or above the optimum moisture content value. All fill placements should be monitored by a GME Testing representative. ***Each lift should be tested for proper compaction at these following frequencies:***

- ***Building Area:*** *At least one (1) test every 750 square feet (ft^2) per lift;*
- ***Parking & Roadway:*** *At least one (1) test every 5,000 square feet (ft^2) per lift;*
- ***Utility Installation:*** *At a frequency of at least one (1) test for every 50 linear feet.*

Under no circumstances should a bulldozer or similar tracked vehicles be used as compacting equipment. Material containing an excess of water so the specified compaction limits cannot be attained shall be dried to a moisture content that will permit proper compaction.

All fill shall be compacted to the specified percent of the maximum density obtained in accordance with ASTM D 1557 as indicated in Table 3 below:

Table 3: Compaction Criteria

Below and above Footing Level	95%
Paving	95%
Utility Trenches Backfill	90%
Landscape Areas	85%
Sidewalks and Slabs	95%

Should the results of the in-place density tests indicate that the specified compaction limits are not achieved, the areas represented by such tests shall be reworked, aerated, and retested as required until the specified limits are reached.

5.3 Foundations Design Recommendations

Based on available soil conditions encountered in building test borings B-1 and B-2, it is possible that the proposed construction can be supported on conventional footings and slabs, provided that our recommendations are followed. Additionally, the new grade-raise fill required to establish design grades within the proposed construction areas must be approved and consist of suitable engineered fill materials that are placed on approved subgrade and compacted as discussed in in this report.

A GME Testing geotechnical engineer or designee shall be retained to provide geotechnical related field-testing during construction.

Conventional footings and slabs can be supported on existing native firm approved (properly compacted) granular soils and/or over engineered fill extending from approved subgrade. Unsuitable soils that consist of frozen, soft, organics, wet, and/or compressible materials are not to be use for support of foundations, slabs, and pavements.

Footings prepared and installed as recommended above may be designed and proportioned for a maximum net allowable soil bearing pressure of **1,500 pounds per square foot (psf)** for both column (square type) and strip (wall type) footings.

The following general foundation design and construction recommendations are offered. If significant changes are evident, modifications to our recommendations may be warranted.

- The exact depth to suitable bearing soils must be evaluated at time of construction and foundation excavation by a GME Testing representative.

- Any footings that will encounter unsuitable wet, soft, loose, or compressible soils will need to be removed and replaced, deepened and/or the footings extended below to competent soils. The extent and depth to reach suitable soils should be evaluated by inspection and testing under the observations of a GME Testing engineering technician.

- Note that if very loose and loose sands in the dry condition are encountered in the proposed footing excavations, densification of these sands by means of suitable compaction equipment should be expected.

- Where it is necessary to replace any unsuitable materials below footings, lean concrete mix (i.e., 2,000 psi compressive strength after 28 days) or engineered fill extending from approved native soils may be used.

- All footings should be designed by a qualified professional structural engineer for maximum required loads.

- **The final depth of footings should be checked in the field by a GME Testing geotechnical engineer or a qualified engineering technician during foundation installation.**

- All footings should be suitably reinforced and installed as discussed in **Foundation Excavations and Monitoring,** Section 5.9 of this report and as called for on project plans and specifications.

- All exterior footings and footings in unheated areas should be located at a depth of 3.5-feet below final exterior grade for frost protection. All footings should be adequately protected from frost penetration during and after construction and should bear on firm material.

- It is essential that new fill soil below, above, and surrounding the footing consist of approved material, placed, and compacted in accordance with this report.

- Note, seismic site class “D” may be used for this project, and additional details of seismicity are provided in Appendix B of this report.

  The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100-feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7. Seismic report is included in Appendix B of this report.

Description	Value
2012 International Building Code Site Classification (IBC)	**D**[1]
Site Latitude	41.710483
Site Longitude	-86.188145
Ss	0.095g
S_1	0.056g
S_{DS}	0.102
S_{D1}	0.090

1. The 2012 IBC uses a site profile extending to a depth of 100 feet for seismic site classification. Borings at this site were extended to a maximum depth of 20-feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area.

In applying net allowable soil bearing pressure in the footing design, the weight of the footings and backfill over the footings, including the floor slab, need not be included in total loads for dimensioning footings.

A suitable hand penetration device should be used to check that the bearing soils at the base of the footings are consistent with the recommendations provided in this report.

We strongly recommend that GME Testing be retained to check the foundation bearing soils for consistency with the conditions observed in our test borings, as well as other earthwork related matters during construction.

Provided that our recommendations in this report and project specifications are followed, total foundation settlements are not expected to exceed about (1) inch with differential settlements of up to (½) inch. Field control and proper footing proportions will contribute substantially to minimizing total and differential settlements.

5.4 Floor Slabs

All asphalt pavement surface, fill, debris, and utility corridors should be properly removed. The near surface or shallow subgrade soils (below existing parking lot pavement surface) encountered within the proposed building footprints generally consist of loose to medium dense fine sands, which if properly compacted are suitable for floor slab support.

Any soils unsuitable for the support of floor slabs will require undercutting and replacement prior to floor slab construction. Depending on weather conditions at time of construction, other means of in place stabilization of near surface soils may be required.

As discussed above, it is anticipated that ground-supported slabs can either be supported over properly prepared and approved native subgrade and/or over structural fill following site preparation and successful filling operations.

The following minimum recommendations are offered, and the slab subgrade should be prepared in accordance with the **Site Subgrade Preparation Recommendations,** Section 5.2.1 of this report and applicable project specifications.

- The floor slabs should be designed by a qualified structural engineer for the anticipated loadings.
- Floor slabs-on-grade may be designed as floating slabs, which are structurally independent of any building footings or walls, and appropriately reinforced to support imposed loads.
- The building slab subgrade will need to be comprehensively evaluated by proofrolling and testing until no yielding or pumping is observed prior to pouring slabs concrete. If pumping and yielding is observed below floor slabs, the unsuitable materials should be either undercut and replaced

with new compacted engineered fill or aerated and conditioned then compacted to 95 percent as evaluated by ASTM D-1557.

- The floor slab subgrade should be properly prepared. **GME Testing should inspect the subgrade prior to filling and any unsuitable materials should be removed and replaced with approved engineered fill.**

- We recommend the slab-on-grade subgrade soils be protected from frost during winter construction. Frozen soils must be thawed and compacted or removed and replaced prior to slab-on-grade construction.

- Depending on the choice of floor finishes, it may be appropriate to incorporate a moisture barrier below the floor slab. This decision should be evaluated by the architect and structural engineer based on the intended floor usage, planned finishes, and in accordance with ACI recommendations.

- Isolation joints should be provided at the junctions of the slab and foundation system so that a small amount of independent movement can occur without causing damage.

- Special attention should be made to the placement of backfill against the building foundations and walls as inadequate compaction of these locations may cause cracking of the slab edges and corners due to subsidence of the backfill.

Provided the subgrade areas are prepared in accordance with our recommendations, we recommend using a minimum of 6-inches of free-draining granular material. Suitable clean, free-draining soil should contain 5 to 10 percent fines, by weight, passing the No. 200 U.S. Standard sieve. A modulus of subgrade reaction (K_{30}) of 115 pci may be used for design. Utilizing the aggregate layer between the slabs will provide improved stability and greater protection of the subgrade. The thickness of aggregate needed to provide a stable construction platform at the exposed subgrade elevation will depend on the condition of the subgrade during construction and the type and volume of construction equipment expected to traffic the prepared subgrade. The above is a minimum stone thickness and may be increased if needed or to replace any unsuitable soils on site.

5.5 Pavement Subgrade and Design Considerations (Borings B-3 and B-4)

The installation of pavement surfaces for the proposed parking lot and driveway areas should be in accordance with project plans and specifications.

Based on existing soil conditions found in test borings B-3 and B-4, it is anticipated that the subgrade that will be the results of satisfactory proofrolling and compaction should be acceptable for new pavement support for the proposed parking lot and driveway areas. This is provided that earthwork and subgrade preparation in the pavement areas will take place during a dry weather and that the subgrade is prepared as discussed in this report

The quality of the pavement subgrade will be impacted by a combination of factors including weather conditions, construction equipment, and quality of the fill being utilized, and satisfactory compaction results achieved during placement as recommended in this report.

Please note that all pavements require regular maintenance and repair due to the normal wear and tear. Periodic maintenance of the pavements over the course of its life cycle should be anticipated. Any post construction cracks should be properly sealed to help prevent further deterioration.

In general, the following minimum recommendations are offered. If significant changes are evident, modifications to our recommendations may be warranted.

- Placing new grade raise fill and pavement base material should be done after satisfactory proofrolling demonstrated by a subgrade that is firm and exhibit sufficient strength and stability to avoid deterioration from construction traffic and to support paving equipment.

- Any areas that become wet and over trafficked by heavy equipment may require mitigation by removing soils that are rutting and/or conditioning and aerating followed by satisfactory compaction. In addition, the entire pavement sections must resist freeze/thaw cycles.

- The best pavement mitigation method should be determined by the geotechnical engineer at time of construction.

- The appropriate thickness of stone to be incorporated with geotextile products will depend on several factors including weather condition. For example, the following products of geotextiles are provided and may be selected as necessary and may include but not limited to BX1200, BX1300, TriAx® TX140, TX150 or TX190. Other approved geotextile products (i.e., Mirafi®) can also be used as specified by the engineer.

- A California Bearing Ratio (CBR) value of approximately 2 percent may be used for design of the proposed pavement section based on correlation obtained from our field and laboratory testing, provided that the subgrade is properly prepared and new fill is compacted as recommended in this report. Using the traffic criteria and assumptions given in this report, the asphalt and concrete pavement provided in Table 4 are recommended.

Table 4: Recommended Minimum Pavement Sections

Area	Combined Asphalt/Graded Aggregate Section	*Concrete Section
Car Parking and Driveway Areas not Subject to Heavy Truck Traffic	1-inch surface over 4-inches binder over 10-inches graded aggregate base over recompacted subgrade	6-inches Portland Cement Concrete over 4-inches free-draining sand layer over a firm non-pumping subgrade

**All concrete shall be 4000 psi or better*

- Based on the soils encountered on site, it is recommended that concrete pavement section would be a viable option to be considered for this project.

Some modifications to the recommendations presented in this report may be needed as weather dictates and based on actual soil conditions at time of construction.

Pavement Drainage

Positive drainage on site is essential both during and post construction to prolong the pavement life. Therefore, water infiltration into pavement subgrade soils should be directed away from the pavement section and into adequate drainage structures to minimize any increase in moisture content of the pavement soils.

Underdrains are useful tool to facilitate drainage below pavement and prolong the pavement life but should be evaluated by the designer as they will require maintenance and will add a cost to the project. The subgrade surface should be uniformly sloped to facilitate drainage through the granular base to the shoulders or inlets and to avoid any ponding of water beneath the pavement.

5.6 Dumpster Enclosure (Boring B-5)

- It is recommended that the final subgrade below this structure be evaluated by GME Testing.

- All fill, soft, loose, compressible and/or yielding soils (when encountered), must be undercut, and replaced with engineered fill in accordance with the recommendations provided in this report.

- After all fill and unsuitable materials are removed, and the subgrade is properly prepared, it is recommended that the proposed dumpster be supported on conventional Portland Cement Slab and thickened as appropriate for any edge support.

- We recommend that compacted granular material be placed beneath the concrete slab consisting of approximately 4 or more inches of clean (with less than 10 percent passing No. 200 Sieve) sand and gravel or crushed limestone aggregate meeting INDOT No. 53.

- The concrete slab subgrade should be compacted to achieve 95 or more percent as determined by ASTM D-1557.

- The concrete should consist of a Portland Cement mixture properly air-entrained with an appropriate water/cement ratio for both strength and finishing considerations.

5.7 Monument Sign (Boring B-6)

It is recommended that the proposed monument sign structure can be supported on straight-sided drilled piers (caisson) extending below the existing fill soils.

Drilled Pier (Caisson)

- Drilled, straight-sided caisson should be designed utilizing both end bearing and skin friction components and should resist imposed sign loadings. Due to existing granular nature, sloughing will be experienced, and the pier will need to be cased until concrete is placed to desired top of caisson elevation.

- **Establishing the means, sequences, techniques, and methods of pier installation is the responsibility of the foundation contractor.** Again, steel casing should be made available to case unsupported portion of the shaft due to water and sloughing.

- Due care should be exercised during drilled pier installation to ensure that the bearing soils are adequate for pier support. This will require appropriate equipment, including a clean-out bucket.

- It is estimated that drilled straight-sided shafts will tip at or below a depth of approximately 10-feet or more beneath existing ground surface in borings. The drilled piers can be designed for a maximum net allowable soil bearing pressure of **2,500 psf**, for preliminary design purposes.

- Under no circumstances should the pier tip within soft, very loose and/or unsuitable wet soils. However, the designer shall determine the appropriate embedment depths of the drilled piers that will be necessary to resist imposed structural loadings.

- The stated end bearing pressure refers to the total design load (dead plus live load) and is net pressure. Therefore, the weight of the pier below the ground surface may be ignored in proportioning the pier. The bearing pressure is based on the assumption that the pier will be installed in accordance with the recommendations provided in this report.

- Table 5 summarizes recommended soil parameter values, which should assist the foundation designer in analyzing lateral resistance for the various strata encountered in the test borings.

Table 5: Summary of Recommended Soil Strength Parameters

Boring No.	Approximate Depth Below Existing Ground Surface (ft)	Angle of Internal Friction (ϕ), deg	Average Cohesion, (C), psf	Moist Soil Unit Weight, (γ), pcf	Allowable Side Resistance, psf
B-6	0 - 2.5	28	0	105	50
	2.5 - 17	30	0	115	250
	17 - 20	32	0	110	400

It is important to note that some of these values are estimated based upon the Standard Penetration Test (SPT) results and soil type and were not directly measured. It should be noted that the values provided for angle of internal friction, cohesion and total soil unit weight are ultimate values and appropriate factors of safety should be used in conjunction with these values. Please note that the buoyant unit weights need to be used for any soils below the water table.

- Pier friction between the ground surface and the 5-feet depth should be neglected when calculating the pier friction in downward axial compression.

- Please note that the allowable pier resistance used for the upward load should be about 70 percent of the allowable side resistance values.

- With the indicated pier capacities, total settlements should be about one (1)-inch or less for properly constructed pier. Settlement response of drilled pier is impacted greatly by the quality of construction than the soil-structure interaction.

- Concrete should be tremied immediately upon completion of the drilling. However, the contractor should select a method of construction suitable to the project, and the base of the piers should be assured by the selected method.

- Drilled pier excavations will not remain open and, therefore, probably cannot be constructed “in the dry”. The slurry method of construction would be necessary to install drilled pier below the groundwater table at this site.

- Steel casing should be made available during the construction of the drilled pier to temporarily case the unstable portion of the pier and to reduce the extent of seepage water from entering the pier. The contractor should be prepared to dewater the drilled pier base prior to the concrete placement.

- When temporary casing is used, the concrete slump should be within good workability and consistent with standard practice. The casing must not be pulled out until the piers are gradually filled with concrete with specified flow characteristics and consistent with standard practice. Furthermore, the casing must not be pulled in such a way that necking of the concrete or voids are created. In no case should concrete be placed in more than 3-inches of water unless the tremie method is used.

- Under no circumstances should the piers be left open for an extended period of time and concrete should be placed continuously in the drilled piers (to specified elevation) immediately upon completion of the drilling.

5.8 Excavations and Trenches

All excavations should be monitored by a “Competent Person”, as defined by the OSHA standard, and appropriate shoring or sloping techniques used to prevent cave-ins.

5.9 Foundation Excavations and Monitoring

In general, the following foundation excavations and monitoring recommendations are offered for support of new building and associated construction elements:

- Each foundation excavation should be evaluated by GME Testing to ensure that all unsuitable materials are removed, and that the foundation will bear on satisfactory material before forming and/or placing steel or concrete.

- Wherever unsuitable materials are encountered, undercutting and/or extending the footings to undisturbed stiff and very stiff soils will be required.

- The footings may be extended through unsuitable fill soils, soft, weak, or organic-containing materials to firm natural soils below or constructed on engineered fill placed in the undercut sized as shown in Figure 2, included in Appendix A. Alternately, lean concrete (i.e., 2,000 or more psi mix) may be used to reestablish desired bottom of footings to expedite construction activities.

- If possible, all concrete for foundations should be poured the same day as the bearing surfaces are approved. If this is not practical, the foundation excavation should be adequately protected.

- Soils exposed in the bases of all excavations must be protected against any detrimental change in conditions such as from disturbance, rain, and freezing. Surface run-off water must be drained away and not allowed to pond in the excavations.

- Concrete strength and consistency tests should also be carried out, in accordance with the project specifications.

- Water must not be allowed to pond on or adjacent to the structure. Water infiltration if encountered in the footing excavations should be removed by adequate sumps placed outside the limits of the main footing excavations.

- Positive drainage of surface water, including downspout discharge, should be maintained away from structure foundations to avoid wetting and weakening of the foundation soils both during construction and after construction is complete.

5.10 Construction Dewatering

- Groundwater related difficulties are not anticipated for any excavations made above groundwater levels in borings. However, it is possible that seasonal variations will cause fluctuations in the water table.

- Minor water accumulation may be removed by pumping from sumps in good working condition placed outside the main excavation.

- It is recommended that the appropriate dewatering system if needed on site must be determined by the contractor at the time of construction based upon actual field conditions.

- When designing site drainage patterns, site runoff should be diverted away from the foundations and directed to on-site retention areas or storm sewer systems. It is anticipated that these measures can reduce the potential for softening and possible erosion of the foundation subgrade soils. It is necessary that water is not permitted to pond near the building areas and foundations.

6.0 LIMITATIONS

This field evaluation, laboratory testing, and geotechnical analyses presented in this geotechnical report have been conducted in general accordance with current practice and the standard of care exercised by geotechnical consultants performing similar tasks in the project area. No other warranty, expressed or implied, is made regarding the conclusions, recommendations, and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be encountered during construction. Additional subsurface evaluation will be performed upon request.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. GME Testing should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document.

Our geotechnical recommendations and opinions are based on an analysis of the observed site conditions. If geotechnical conditions different from those described in this report are encountered, our office should be notified and additional recommendations, if warranted, will be provided upon request.

Although general constructability issues have been considered in this report, the means, methods, techniques, sequences and operations of construction, safety precautions, and all items incidental thereto and consequences of, are the responsibility of parties to the Project other than GME Testing. This office should be contacted if additional guidance is needed in these matters.

The scope of our services does not include any environmental assessments or investigations for the possible presence of toxic materials in the soil, groundwater or surface water within or in the general vicinity of the site studied. Any statements made in this report or shown on the test borehole logs regarding unusual subsurface conditions and/or composition, odor, staining, origin, or other characteristics of the surface and/or subsurface materials are strictly for the information of our client.

We wish to remind you that we will store the samples for 30 days after which time they will be discarded unless you request otherwise.

We appreciate the opportunity to be of service on this project. Should you have any questions related to this report, please contact us at your convenience.

Sincerely,
GME Testing

Rami M. Anabtawi, P.E., D.GE
Principal Engineer

RAMI M. ANABTAWI
REGISTERED
No. 920294
STATE OF INDIANA
PROFESSIONAL ENGINEER

S M Naziur Mahmud, E.I.T.
Project Engineer

APPENDIX A

I. FIELD EXPLORATION

Drilling and Sampling Procedures

The test borings were drilled using conventional augers to advance the holes and representative samples of the soils were obtained employing split-barrel sampling techniques in accordance with ASTM procedures D-1586-84. After completion of the borings and water level readings, the auger holes were backfilled with auger cuttings.

The description and depths of soil strata encountered and levels at which samples were recovered are indicated on the accompanying borehole log sheets in the Appendix B. In the column "Soil/Material Description" on the drill borehole log, the horizontal lines represent stratum changes. A solid line represents an observed change, and a dashed line represents an estimated change. An explanation of the symbols and terms used on the boring log sheets is given in Appendix B of this report.

Field Tests and Measurements

Standard Penetration Test: During the sampling procedures, Standard Penetration Test (SPT) was performed at regular intervals through the depth of the borings. The SPT value ("N"-value) is defined as the number of blows required to advance a 2-inch O.D., split-barrel sampler a distance of one foot by a 140-pound hammer falling 30-inches. These values provide a useful preliminary indication of the consistency or relative density of most soil deposits and are included on the Borehole Logs in Appendix B.

Water Level Measurements: Groundwater level observations were made in the boring holes during and upon completion of the boring operations. The groundwater level measurements are noted on the boring logs presented herein.

All recovered samples were returned to GME Testing laboratory for visual examination and subsequent laboratory testing.

II. LABORATORY TESTING

Selected soil samples obtained from the drilling and sampling program were tested in the laboratory to evaluate additional pertinent engineering characteristics of the foundation materials necessary in estimating the engineering properties of these materials.

Soil Laboratory Tests and Measurements

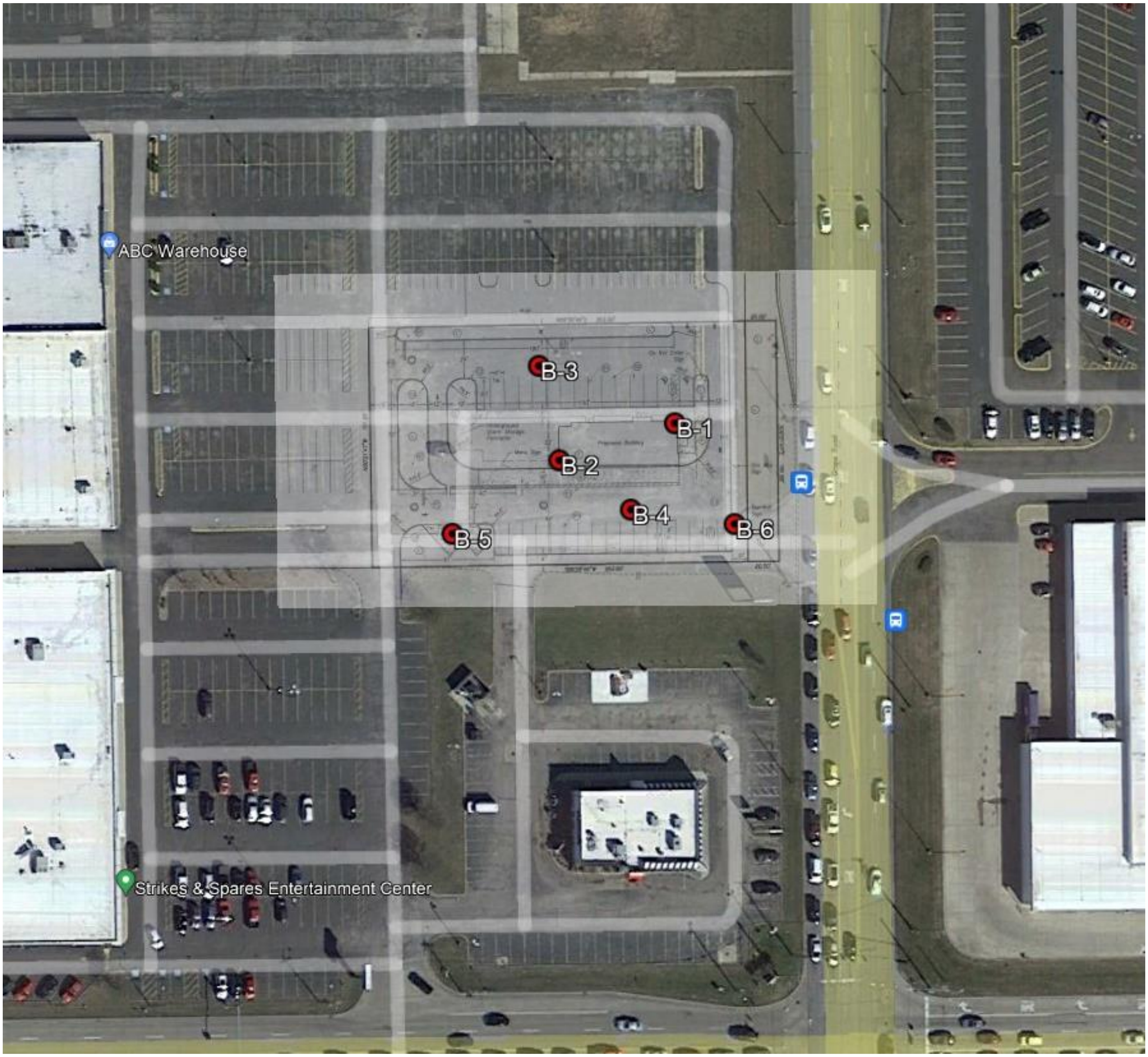
Visual Classification: All samples were visually classified by a geotechnical engineer in general accordance with ASTM D-2488, and on the Borehole Logs, which are located in the Appendix B of this report.

Moisture Content Tests: The natural moisture content of selected samples was determined by ASTM method D-2216 and is recorded on the Borehole Logs as a percentage of dry weight of soil under the “MC”.

Hand Penetration Tests: Samples of cohesive soils obtained from the split spoon sampler were tested with a calibrated hand penetrometer to aid in evaluating the soil strength characteristics. The results from this testing are tabulated on the Borehole Logs under the heading “Q_P”.

III. GEOLOGIC CONDITIONS

According to the *United States Department of Agriculture (USDA) Soil Survey and Natural Resources Conservation Service (NRCS),* the natural soils covering the majority of the site are classified as Urban land-Tyner complex (UgvA), 0 to 1 percent slopes type soils. A copy of the *Custom Soil Resource Report for St. Joseph County, Indiana* has been included in Appendix B of this report.



VICINITY MAP (NOT TO SCALE)	NOTES	N

1. All test boring locations are approximate.
2. Vicinity map generated using imagery from google.com/maps.

LEGEND

B-1 Test Boring Location and Designation

FIGURE 1 – APPROXIMATE BORING LOCATION MAP

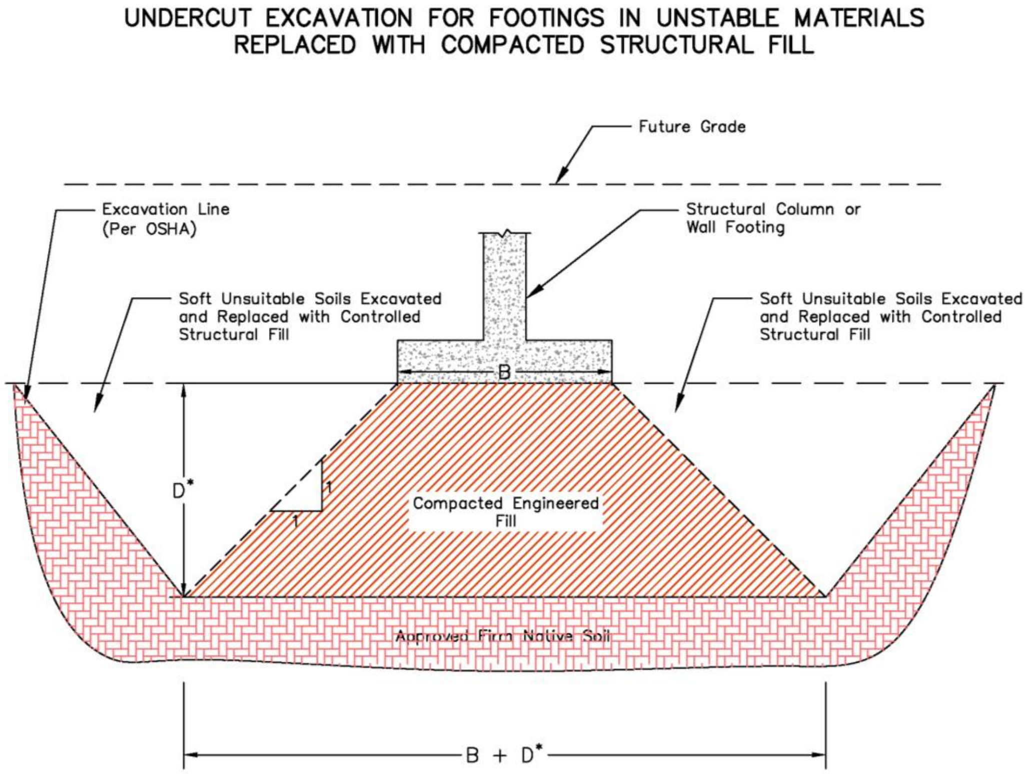
Project Name: Proposed Taco Bell Restaurant

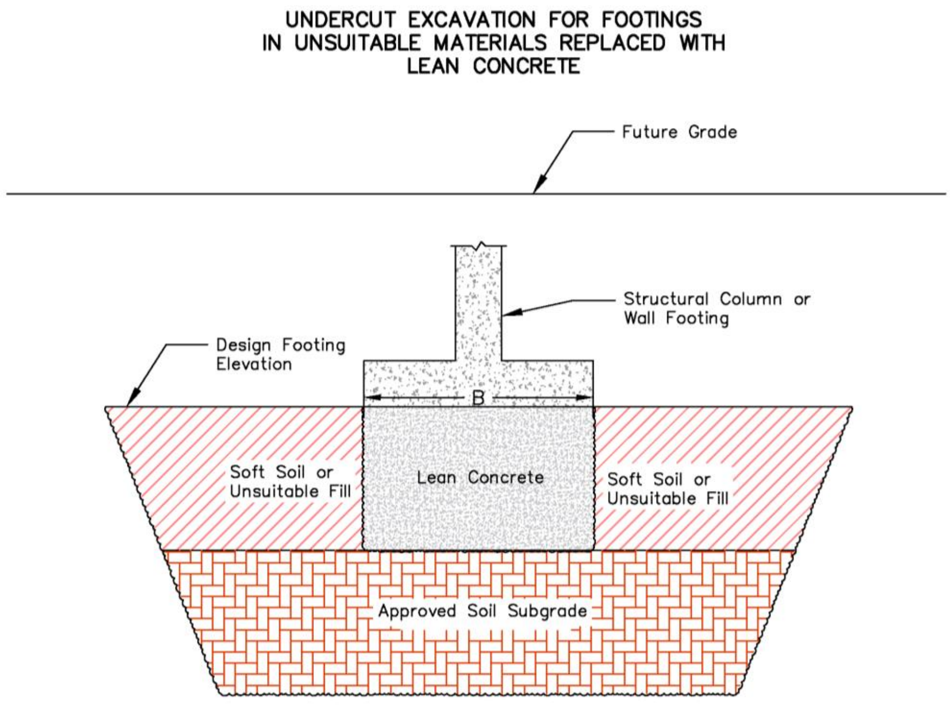
Location: 5505 North Grape Road, Mishawaka, IN

Client Name: Delight TB Indiana LLC

GME Project Number: G21-090897

GME TESTING





GME TESTING

FIGURE 2 - UNDERCUT EXCAVATION BELOW FOOTINGS

GME PROJECT NO.
G21-090897

APPENDIX B

TEST BORING LOG

GME TESTING

BORING NO.: B-1
SHEET 1 OF 1
GME PROJECT NO: G21-090897
STRUCTURE
DATUM :
DATE STARTED : 02-18-22
DRILLER/INSP : RS/DM

CLIENT: Delight TB Indiana LLC
PROJECT TYPE : Proposed Taco Bell Restaurant
LOCATION : 5505 North Grape Road, Mishawaka, IN

ELEVATION :
STATION :
OFFSET :
LINE :
DEPTH : 20.0 ft

BORING METHOD : ASTM D-1586
RIG TYPE : Skid
CASING DIA. : 3.3 in
HAMMER : Auto

LATITUDE : 41.710525
LONGITUDE : -86.188011

GROUNDWATER: Encountered at 16.5 ft; At completion Dry; Caved in at 14.0 ft

STRATUM ELEVATION	SAMPLE DEPTH	SOIL/MATERIAL DESCRIPTION	SAMPLE NUMBER	SPT per 6" (N)	% RECOVERY	MOISTURE CONTENT	UNCONF. COMP., tsf	Qp (tsf)	REMARKS
		±5" SNOW. (0.4)							
		±4" ASPHALT Product. (0.8)							
	2.5	±13" GRAVELY SAND. (1.8)	SS 1	18-14-10 (24)	100	5.2			
	5.0	Brown, Moist, Fine SAND.	SS 2	5-5-5 (10)	100	11.0			
	7.5	(8.0)	SS 3	3-3-4 (7)	100	12.9			
	10.0	Brown, Fine SILTY SAND. (12.0)	SS 4	4-4-4 (8)	100	5.9			
	12.5, 15.0	Brown, Fine SAND. (16.0)	SS 5	6-7-8 (15)	100	5.8			
	17.5, 20.0	Brown, Wet, Fine SILTY SAND. (20.0)	SS 6	10-15-21 (36)	100				
	22.5, 25.0	Bottom of Boring at 20.0 ft							

GME TESTING

TEST BORING LOG

BORING NO.: **B-2**
SHEET 1 OF 1
GME PROJECT NO: G21-090897
STRUCTURE
DATUM :
DATE STARTED : 02-18-22
DRILLER/INSP : RS/DM

CLIENT: Delight TB Indiana LLC
PROJECT TYPE : Proposed Taco Bell Restaurant
LOCATION : 5505 North Grape Road, Mishawaka, IN

ELEVATION :	BORING METHOD : ASTM D-1586	LATITUDE : 41.710461
STATION :	RIG TYPE : Skid	LONGITUDE : -86.188281
OFFSET :	CASING DIA. : 3.3 in	
LINE :	HAMMER : Auto	
DEPTH : 20.0 ft		

GROUNDWATER: Encountered at 16.0 ft | At completion Dry | Caved in at 13.0 ft

STRATUM ELEVATION	SAMPLE DEPTH	SOIL/MATERIAL DESCRIPTION	Depth (ft)	SAMPLE NUMBER	SPT per 6" (N)	% RECOVERY	MOISTURE CONTENT	UNCONF. COMP., tsf	Qp (tsf)	REMARKS
		±5" SNOW.	0.4							
		±2" ASPHALT.	0.6							
		±12" GRAVELY SAND.	1.6							
	2.5	Brown, CLAYEY SILT, and SANDY CLAY.	2.0	SS 1	11-10-6 (16)	100	8.5		4.5	
	5.0	Brown, Fine SAND and SILTY SAND.	5.5	SS 2	3-4-4 (8)	100	16.1			
	7.5	Brown, Very Moist, SANDY SILTY CLAY.	8.0	SS 3	3-5-4 (9)	100	18.5		1.0	
	10.0	Brown, Moist, Fine SILTY SAND Wet @ 16'.		SS 4	3-5-4 (9)	100	11.7			
	15.0			SS 5	6-5-5 (10)	100	14.6			
	20.0		20.0	SS 6	6-10-11 (21)	100				
		Bottom of Boring at 20.0 ft								

Depth scale: 2.5, 5.0, 7.5, 10.0, 12.5, 15.0, 17.5, 20.0, 22.5, 25.0

GME
GME TESTING

TEST BORING LOG

BORING NO.: B-3
SHEET 1 OF 1
GME PROJECT NO: G21-090897
STRUCTURE
DATUM :
DATE STARTED : 02-18-22
DRILLER/INSP : RS/DM

CLIENT: Delight TB Indiana LLC
PROJECT TYPE : Proposed Taco Bell Restaurant
LOCATION : 5505 North Grape Road, Mishawaka, IN

ELEVATION :
STATION :
OFFSET :
LINE :
DEPTH : 5.0 ft

BORING METHOD : ASTM D-1586
RIG TYPE : Skid
CASING DIA. : 3.3 in
HAMMER : Auto

LATITUDE : 41.710625
LONGITUDE : -86.188328

GROUNDWATER: ▽ Encountered at Dry ▼ At completion Dry

STRATUM ELEVATION	SAMPLE DEPTH	SOIL/MATERIAL DESCRIPTION		SAMPLE NUMBER	SPT per 6" (N)	% RECOVERY	MOISTURE CONTENT	UNCONF. COMP., tsf	Qp (tsf)	REMARKS
		±5" SNOW.	0.4							
		±2" ASPHALT.	0.6							
		±12" GRAVELY SAND.	1.6							
		Brown, Fine SILTY SAND.	2.0	SS 1	9-10-7 (17)	100	6.9			
	2.5									
		Brown, Moist, CLAYEY SAND.		SS 2	5-5-7 (12)	100	13.3			
	5.0		5.0							
		Bottom of Boring at 5.0 ft								
	7.5									
	10.0									
	12.5									
	15.0									
	17.5									
	20.0									
	22.5									
	25.0									

GME TESTING

TEST BORING LOG

BORING NO.: **B-4**
SHEET 1 OF 1
GME PROJECT NO: G21-090897
STRUCTURE
DATUM :
DATE STARTED : 02-18-22
DRILLER/INSP : RS/DM

CLIENT: Delight TB Indiana LLC
PROJECT TYPE : Proposed Taco Bell Restaurant
LOCATION : 5505 North Grape Road, Mishawaka, IN

ELEVATION :	BORING METHOD : ASTM D-1586	LATITUDE : 41.710375
STATION :	RIG TYPE : Skid	LONGITUDE : -86.188114
OFFSET :	CASING DIA. : 3.3 in	
LINE :		
DEPTH : 5.0 ft	HAMMER : Auto	

GROUNDWATER: Encountered at Dry At completion Dry

STRATUM ELEVATION	SAMPLE DEPTH	SOIL/MATERIAL DESCRIPTION	Depth (ft)	SAMPLE NUMBER	SPT per 6" (N)	% RECOVERY	MOISTURE CONTENT	UNCONF. COMP., tsf	Qp (tsf)	REMARKS
		±5" SNOW.	0.4							
		±2.5" ASPHALT.	0.6							
		±12" GRAVELY SAND.	1.6							
	2.5	FILL: Dark Gray, Sandy Clay, Trace Sand and Gravel.	2.0	SS 1	18-23-16 (39)	100	8.6			
	5.0	Brown, Fine SILTY SAND.	5.0	SS 2	6-6-7 (13)	100	10.8			
		Bottom of Boring at 5.0 ft								

Depth scale: 2.5, 5.0, 7.5, 10.0, 12.5, 15.0, 17.5, 20.0, 22.5, 25.0

TEST BORING LOG

GME TESTING

BORING NO.: B-5
SHEET 1 OF 1
GME PROJECT NO: G21-090897
STRUCTURE
DATUM :
DATE STARTED : 02-18-22
DRILLER/INSP : RS/DM

CLIENT: Delight TB Indiana LLC
PROJECT TYPE : Proposed Taco Bell Restaurant
LOCATION : 5505 North Grape Road, Mishawaka, IN

ELEVATION :	BORING METHOD : ASTM D-1586	LATITUDE : 41.710333
STATION :	RIG TYPE : Skid	LONGITUDE : -86.188531
OFFSET :	CASING DIA. : 3.3 in	
LINE :		
DEPTH : 20.0 ft	HAMMER : Auto	

GROUNDWATER: Encountered at 16.0 ft; At completion Dry; Caved in at 12.5 ft

STRATUM ELEVATION	SAMPLE DEPTH	SOIL/MATERIAL DESCRIPTION	SAMPLE NUMBER	SPT per 6" (N)	% RECOVERY	MOISTURE CONTENT	UNCONF. COMP., tsf	Qp (tsf)	REMARKS
		±2" SNOW. (0.2)							
		±9" ASPHALT. (0.9)							
	2.5	POSSIBLE FILL: Dark Brown and Gray, Silty Sand. (2.5)	SS 1	13-9-8 (17)	100	10.3			
	5.0	Brown, Moist, CLAYEY SAND, and Fine SILTY SAND.	SS 2	4-3-3 (6)	100	12.6			
	7.5	(8.0)	SS 3	4-5-6 (11)	100	9.0			
	10.0	Brown, Fine SAND.	SS 4	5-6-5 (11)	100	17.0			
	12.5								
	15.0	(16.0)	SS 5	7-8-7 (15)	100	14.7			
	17.5	Brown, Wet, Fine SILTY SAND.							
	20.0	(20.0)	SS 6	8-12-20 (32)	100				
		Bottom of Boring at 20.0 ft							
	22.5								
	25.0								

TEST BORING LOG

GME TESTING

BORING NO.:	B-6
SHEET	1 OF 1
GME PROJECT NO:	**G21-090897**
STRUCTURE	
DATUM :	
DATE STARTED	: 02-18-22
DRILLER/INSP	: RS/DM

CLIENT: Delight TB Indiana LLC

PROJECT TYPE : Proposed Taco Bell Restaurant

LOCATION : 5505 North Grape Road, Mishawaka, IN

ELEVATION :		BORING METHOD	: ASTM D-1586	LATITUDE	: 41.71035
STATION :		RIG TYPE	: Skid	LONGITUDE	: -86.187872
OFFSET :		CASING DIA.	: 3.3 in		
LINE :					
DEPTH :	20.0 ft	HAMMER	: Auto		

GROUNDWATER: Encountered at 17.0 ft   At completion Dry   Caved in at 14.0 ft

STRATUM ELEVATION	SAMPLE DEPTH	SOIL/MATERIAL DESCRIPTION	SAMPLE NUMBER	SPT per 6" (N)	% RECOVERY	MOISTURE CONTENT	UNCONF. COMP., tsf	Qp (tsf)	REMARKS
		±6" SNOW. 0.5							
		±6" ASPHALT. 1.0							
		±6" SAND and GRAVEL. 1.5							
	2.5	FILL: Dark Brown and Gray, Clayey Sand and Gravel. 2.5	SS 1	6-11-8 (19)	100	8.6			
	5.0	Brown, Fine SAND.	SS 2	3-4-3 (7)	100	14.3			
	7.5		SS 3	6-7-7 (14)	100	11.8			
	10.0		SS 4	4-5-5 (10)	100	5.0			
	12.5								
	15.0	17.0	SS 5	7-6-9 (15)	100	6.6			
	17.5	Brown, Wet, Fine SILTY SAND.							
	20.0	20.0	SS 6	7-8-12 (20)	100				
	22.5	Bottom of Boring at 20.0 ft							
	25.0								

GENERAL NOTES

SAMPLE IDENTIFICATION

Visual soil classifications are made in general accordance with the United States Soil Classification System on the basis of textural and particle size categorization, and various soil behavior and characteristics. Visual classifications should be made by appropriate laboratory testing when more exact soil identification is required to satisfy specific project applications criteria.

RELATIVE PROPORTIONS OF COHESIONLESS SOILS

Term	Defining Range by % of Weight
Trace	1-10 %
Little	11-20 %
Some	21-35 %
And	36-50 %

WATER LEVEL MEASUREMENT

NE	No Water Encountered
BF	Backfilled upon Completion

DRILLING AND SAMPLING SYMBOLS

AS	Auger Sample
BS	Bag Sample
PID	Photo ionization Detector (Hnu meter) volatile vapor level,(PPM)
COA	Clean-Out Auger
CS	Continuous Sampling
FA	Flight Auger
HA	Hand Auger
HAS	Hollow Stem Auger
NR	No Recovery
PT	3” O.D. Piston Tube Sample
RB	Rock Bit
RC	Rock Coring
REC	Recovery
RQD	Rock Quality Designation
RS	Rock Sounding
S	Soil Sounding
SS	2”O.D. Split-Barrel Sample
2ST	2”O.D. Tin-Walled Tube Sample
3ST	3” O.D. Thin-Walled Tube Sample
VS	Vane Shear Test
DB	Diamond Bit
WS	Wash Sample
RB	Roller Bit
ST	Shelby Tube, 2” O.D. or 3” O.D.
CB	Carbide Bit
WOH	Weight of the Hammer

ORGANIC CONTENT BY COMBUSTION METHOD

Soil Description	LOI
w/ organic matter	4-15 %
Organic Soil (A-8)	16-30 %
Peat (A-8)	More than 30%

LABORATORY TESTS

Qp	Penetrometer Reading, tsf
Qu	Unconfined Strength, tsf
MC	Moisture Content, %
LL	Liquid Limit, %
PL	Plastic Limit, %
PI	Plastic Index
SL	Shrinkage Limit, %
pH	Measure of Soil Alkalinity/Acidity
γ	Dry Unit Weight, pcf
LOI	Loss of Ignition, %

GRAIN SIZE TERMINOLOGY

Soil fraction	Particle size	Us standard sieve size
Boulders	larger than 75 mm	Larger than 3”
Gravel	2mm to 75 mm	#10 to 75 mm
Coarse Sand	0.425 mm to 2 mm	#40 to #10
Fine Sand	0.075mm to 0.425 mm	#200 to #40
Silt	0.002 mm to 0.075 mm	Smaller than #200
Clay	Smaller than 0.002 mm	Smaller than #200

RELATIVE DENSITY

Term	“N” Value
Very Loose	0-5
Loose	6-10
Medium Dense	11-30
Dense	31-50
Very Dense	51+

CONSISTENCY

Term	“N” Value
Very Soft	0-3
Soft	4-5
Medium Stiff	6-10
Stiff	11-15
Very Stiff	16-30
Hard	31+

PLASTICITY

Term	Plastic Index
None to Slight	0-4
Slight	5-7
Medium	8-22
High/Very High	Over 22

Note(s):
The penetration resistance, “N” Value, is the summation of the number of blows required to effect two successive 6-inch penetrations of the 2-inch split-barrel sampler. The sampler is driven with a 140-lb. weight falling 30-inches and is seated to a depth of 6-inches before commencing the standard penetration test.
Water level measurements shown on the boring logs represent conditions at the time indicated and may not reflect static levels, especially in cohesive soils

GME TESTING
3517 Focus Drive
Fort Wayne, IN 46818
(260) 497- 8127▪ (877) 660-4GME▪ (260) 497- 0826 fax
Division of ***GEOTECHNICAL & MATERIALS ENGINEERS, INC.***
www.gmetesting.com

GME TESTING

SOIL CLASSIFICATION CHART

<table>
<tr><th colspan="3" rowspan="2">MAJOR DIVISIONS</th><th colspan="2">SYMBOLS</th><th rowspan="2">TYPICAL DESCRIPTIONS</th></tr>
<tr><th>GRAPH</th><th>LETTER</th></tr>
<tr><td rowspan="8">COARSE GRAINED SOILS

MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE</td><td rowspan="4">GRAVEL AND GRAVELLY SOILS

MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE</td><td rowspan="2">CLEAN GRAVELS

(LITTLE OR NO FINES)</td><td></td><td>GW</td><td>WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES</td></tr>
<tr><td></td><td>GP</td><td>POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES</td></tr>
<tr><td rowspan="2">GRAVELS WITH FINES

(APPRECIABLE AMOUNT OF FINES)</td><td></td><td>GM</td><td>SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES</td></tr>
<tr><td></td><td>GC</td><td>CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES</td></tr>
<tr><td rowspan="4">SAND AND SANDY SOILS

MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE</td><td rowspan="2">CLEAN SANDS

(LITTLE OR NO FINES)</td><td></td><td>SW</td><td>WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES</td></tr>
<tr><td></td><td>SP</td><td>POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES</td></tr>
<tr><td rowspan="2">SANDS WITH FINES

(APPRECIABLE AMOUNT OF FINES)</td><td></td><td>SM</td><td>SILTY SANDS, SAND - SILT MIXTURES</td></tr>
<tr><td></td><td>SC</td><td>CLAYEY SANDS, SAND - CLAY MIXTURES</td></tr>
<tr><td rowspan="6">FINE GRAINED SOILS

MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE</td><td rowspan="3">SILTS AND CLAYS</td><td rowspan="3">LIQUID LIMIT LESS THAN 50</td><td></td><td>ML</td><td>INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY</td></tr>
<tr><td></td><td>CL</td><td>INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS</td></tr>
<tr><td></td><td>OL</td><td>ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY</td></tr>
<tr><td rowspan="3">SILTS AND CLAYS</td><td rowspan="3">LIQUID LIMIT GREATER THAN 50</td><td></td><td>MH</td><td>INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS</td></tr>
<tr><td></td><td>CH</td><td>INORGANIC CLAYS OF HIGH PLASTICITY</td></tr>
<tr><td></td><td>OH</td><td>ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS</td></tr>
<tr><td colspan="3">HIGHLY ORGANIC SOILS</td><td></td><td>PT</td><td>PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS</td></tr>
</table>

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

Latitude, Longitude: 41.710483, -86.188145

Date	2/21/2022, 9:50:43 AM
Design Code Reference Document	IBC-2012
Risk Category	III
Site Class	D - Stiff Soil

Type	Value	Description
S_S	0.095	MCE_R ground motion. (for 0.2 second period)
S_1	0.056	MCE_R ground motion. (for 1.0s period)
S_{MS}	0.153	Site-modified spectral acceleration value
S_{M1}	0.135	Site-modified spectral acceleration value
S_{DS}	0.102	Numeric seismic design value at 0.2 second SA
S_{D1}	0.09	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	B	Seismic design category
F_a	1.6	Site amplification factor at 0.2 second
F_v	2.4	Site amplification factor at 1.0 second
PGA	0.044	MCE_G peak ground acceleration
F_{PGA}	1.6	Site amplification factor at PGA
PGA_M	0.07	Site modified peak ground acceleration
T_L	12	Long-period transition period in seconds
SsRT	0.095	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	0.104	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.056	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.065	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.6	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	0.916	Mapped value of the risk coefficient at short periods
C_{R1}	0.873	Mapped value of the risk coefficient at a period of 1 s

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United States Department of Agriculture

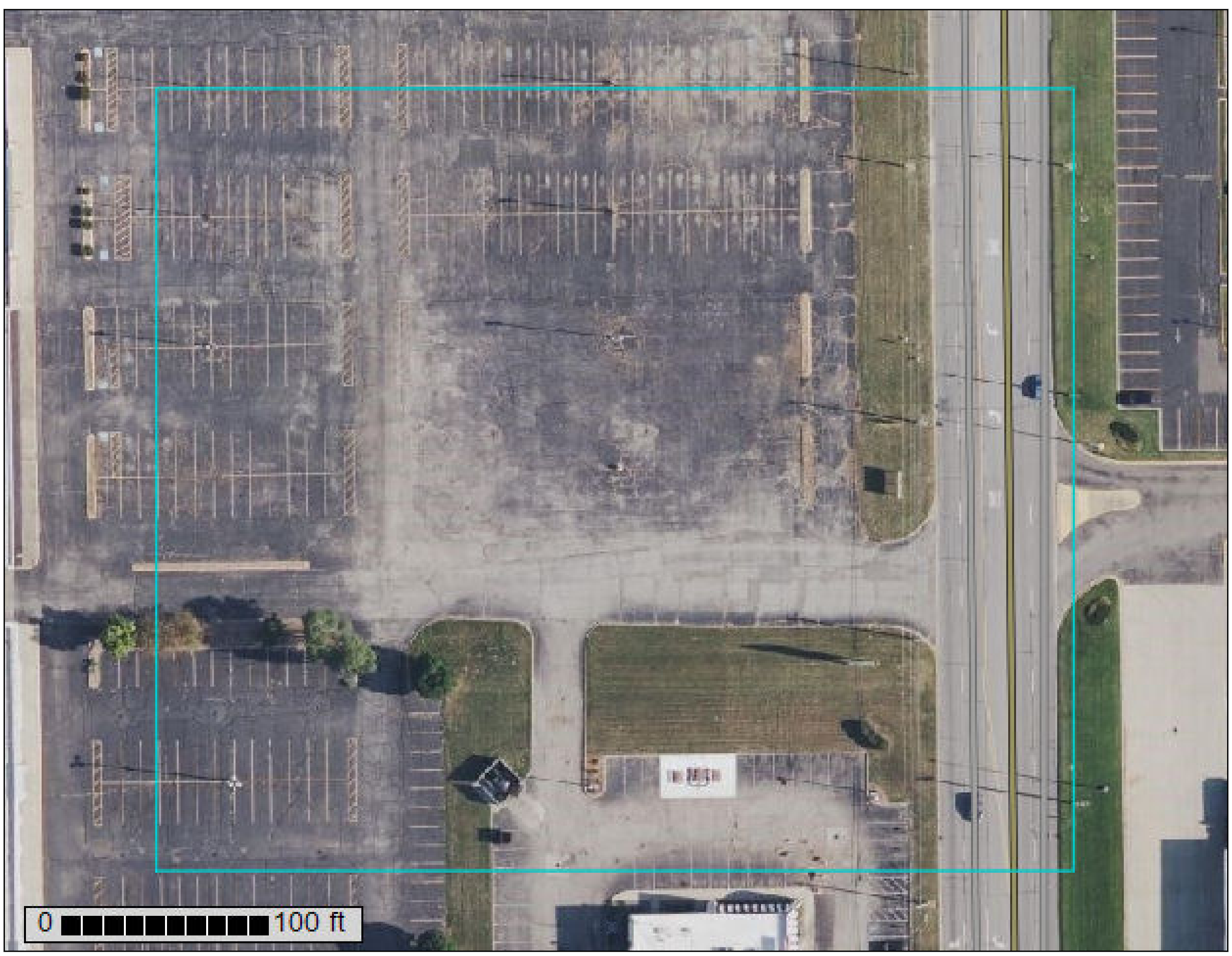
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

St. Joseph County, Indiana



February 21, 2022

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

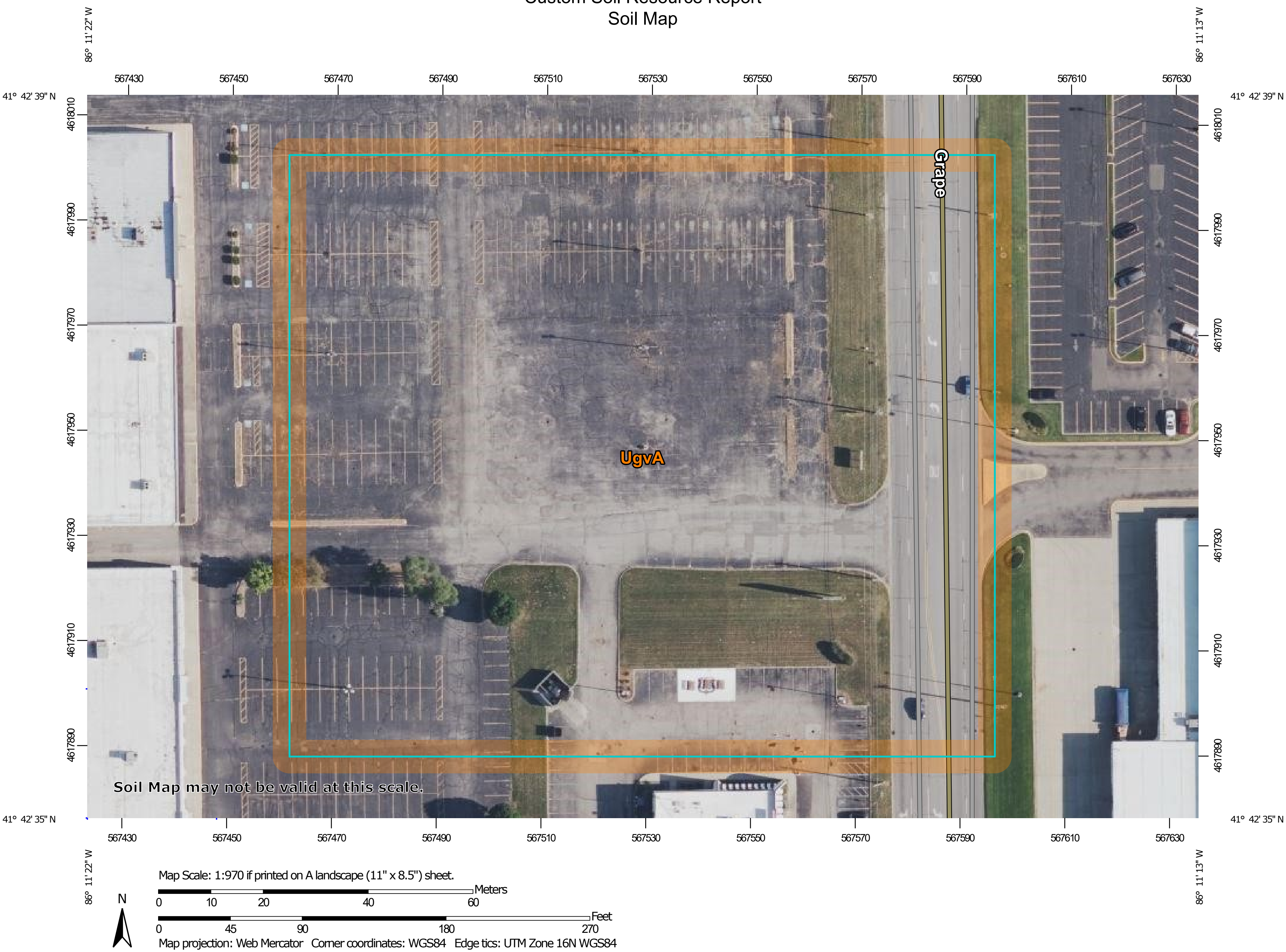
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: St. Joseph County, Indiana
Survey Area Data: Version 25, Sep 9, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 13, 2020—Aug 19, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
UgvA	Urban land-Tyner complex, 0 to 1 percent slopes	3.8	100.0%
Totals for Area of Interest		**3.8**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

St. Joseph County, Indiana

UgvA—Urban land-Tyner complex, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: nk2s
Elevation: 570 to 1,540 feet
Mean annual precipitation: 34 to 40 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 140 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 50 percent
Tyner and similar soils: 40 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Landform: Outwash plains

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Other vegetative classification: Trees/Timber (Woody Vegetation)
Hydric soil rating: Unranked

Description of Tyner

Setting

Landform: Outwash plains
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy outwash

Typical profile

Ap - 0 to 12 inches: loamy sand
Bw1 - 12 to 20 inches: loamy sand
Bw2 - 20 to 41 inches: sand
Bw3 - 41 to 80 inches: sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Ecological site: F098XA014MI - Dry Sandy Drift Plains
Other vegetative classification: Trees/Timber (Woody Vegetation)
Hydric soil rating: No

Minor Components

Osolo

Percent of map unit: 5 percent
Landform: Outwash plains, outwash terraces
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: Trees/Timber (Woody Vegetation)
Hydric soil rating: No

Bristol

Percent of map unit: 3 percent
Landform: Outwash terraces, outwash plains
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: Trees/Timber (Woody Vegetation)
Hydric soil rating: No

Coloma

Percent of map unit: 2 percent
Landform: Moraines, outwash plains
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: Trees/Timber (Woody Vegetation)
Hydric soil rating: No

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