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August 24, 2017

Mr. Clint Langley
Construction Manager
Taco Bell of America, Inc.
104 Lisa Court
McMurray, PA 15317

Re: Phase II Level II Investigation
Proposed Taco Bell
20733 E. 13 Mile Road
Roseville, Michigan
Taco Bell Site No. 312262
PSI Project No. 3811021

Dear Mr. Langley:

In accordance with the Project Agreement For Architectural/Engineering/Consultant Services (No. 17-007) dated July 14, 2017, PSI has conducted a Phase II Level II investigation for the above referenced property.

Thank you for choosing PSI as your consultant for this project. If you have any questions, or if we can be of additional service, please contact us at your earliest convenience.

Respectfully submitted,
Professional Service Industries, Inc.

Mr. Kevin Dubnicki, P.E.
Project Manager

Copy: Mr. Billy N. Mitchell – PSI, Inc. – Kennesaw, GA (1)
Ms. Mary Lattarulo – Taco Bell Corporation

PHASE II LEVEL II INVESTIGATION

FOR

PROPOSED TACO BELL
20733 E. 13 MILE ROAD
ROSEVILLE, MICHIGAN
TACO BELL SITE NO. 312262

PREPARED FOR

TACO BELL OF AMERICA, INC.
104 LISA COURT
MCMURRY, PA 15317

PREPARED BY

PROFESSIONAL SERVICE INDUSTRIES, INC.
37483 INTERCHANGE DRIVE
FARMINGTON HILLS, MICHIGAN, 48335
TELEPHONE (248) 957-9911

PSI NCG PROJECT NO. 03811021

AUGUST 24, 2017

Kevin F. Dubnicki, P.E.
Project Manager
MI No. 57718

Mahmoud El-Gamal, PhD., P.E.
Chief Engineer
MI No. 46372

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EXECUTIVE SUMMARY

PSI has completed a Phase II Level II Investigation of the proposed Taco Bell Site No. 312262 located in Roseville, Michigan. The assessment was performed in general accordance with the scope and limitations of Yum! Brands, Inc.'s Guidelines for Environmental Assessments and Geotechnical Engineering Studies, dated August 2006, to comply with the Project Agreement For Architectural/Engineering/Consultant Services No. 17-007 between PSI and Yum! Brands, Inc. dated July 14, 2017.

This summary does not contain all the information that is found in the full report. The report should be read in its entirety to obtain a more complete understanding of the information provided, and to aid in any decisions made or actions taken based on this information.

1. The site is located on the north side of the existing road at 20733 E. 13 Mile Road in the City of Roseville, Macomb County, Michigan. At the time of PSI's geotechnical investigation, the property consisted predominately of a vacant asphalt parking lot situated in front of an existing retail plaza. Access to the site was provided via an entrance driveway from E. 13 Mile Road on the south side of the proposed Taco Bell site and from adjacent retail plaza to the north and east of the proposed site. The topography of the site was relatively flat and exhibited an elevation difference of less than 1 foot based on visual observations.
2. The ground surface at the locations of Borings B-1 through B-5 was covered with approximately 1.3 to 5.5 inches of asphalt pavement. The pavement was underlain by approximately 4.5 to 11.5 inches of sand and gravel base. A layer of undocumented fill consisting of a mottled bluish gray, dark gray to black sandy clay with variable percentages of organics was encountered at the location of Borings B-1, B-3 and B-4. Loss-On-Ignition (LOI's) ranged from 4.8 to 8.1 percent (which is high). The old fill extended to a depth of approximately 4 feet below the exiting pavement surface. In addition, an apparently native bluish olivish gray sandy clay with trace amounts of organics was encountered below the undocumented fill and pavement section at the location of Borings B-1, B-4 and B-5 and extended to depths ranging from approximately 4 to 7.0 feet below the pavement surface. A stratum of apparently native brown, dark brown and yellowish brown sandy clay was encountered below the ground, pavement section and fill and apparently native soils with organics at the locations of Borings B-1 through B-6. The brown silty/sandy clay extended to depths typically ranging from approximately 11.5 to 14 feet below the existing ground surface. A stratum of gray silty/sandy clay was encountered below the native brown, dark brown and yellowish brown sandy clay at the locations of Borings B-1 through B-6. The gray silty/sandy clay extended through the final explored depth of approximately 20 feet below the existing ground surface.
3. Groundwater was encountered at a depth of approximately 18 feet at the location of Boring B-1. Groundwater was not encountered in the other borings. It should be noted that water levels in the boreholes may require additional time to stabilize depending on the permeability of the soils. However, due to the project schedule and for safety reasons, the boreholes were backfilled at the end of the investigation day. In addition, it should be noted that groundwater levels at this site may be subject to seasonal fluctuations or other mechanical control. Based on the groundwater observations at the time of PSI's fieldwork, groundwater will likely not affect site construction and difficulty with groundwater seepage is generally not anticipated during excavations associated with the proposed foundations and below-grade utilities.

4. The site is generally suitable for the planned construction following site preparation detailed in Section 5.9 of this report.

5. PSI understands that a shallow spread footing and grade beam system is the preferred foundation type for the proposed restaurant structure. The existing site conditions are not suitable for support of the proposed structure without removal and replacement of the encountered undocumented fill and potential native soils with organics.

   After the soils have been prepared as discussed above and in Section 5.9 of this report. conventional shallow spread footings or grade beams can be placed on the native very stiff to hard silty/sandy clay soils (provided they are stable at the time of construction) or on newly placed and properly compacted engineered fill. The footings or grade beams should be designed for a maximum allowable net bearing pressure of 2,500 psf for support of the proposed building, trash enclosure and monument sign.

Detailed analyses of subsurface conditions and pertinent design recommendations are included herein. PSI cannot be responsible for the interpretation or implementation of this report by others. PSI should be retained to perform services sufficient to determine compliance with its recommendations. If PSI is not so retained, it will not accept any responsibility for the performance of the structure.

SUMMARY OF RECOMMENDATIONS

Design Item	Recommended Parameter	Reference Page No.
Foundations:		
Allowable Bearing Pressure: Spread Footing Wall Footing	2,500 psf 2,500 psf	1,12,13
Foundation Type	Spread Footing	1,12,13
Bearing Materials	Engineered Fill or Native Sandy Clay	1,12,13
Ultimate Passive Lateral Resistance (EFP)	4,000 psf (Clay)	13
Coefficient of Friction	0.30	13
Soil Expansion Potential	Low	14
Geologic Hazards:		
Liquefaction Potential	Low	8
Nearest Fault and Magnitude	N/A	--
Fault Type	N/A	--
Seismic Zone	1	8
Soil Profile Type	S_D	8
Near-Source Distance	N/A	--
Seismic Coefficient, N_A	1.6	8
Seismic Coefficient, N_V	2.4	8
Subsidence Potential	NA	--
Pavement:		
AASHTO SN equal to or greater than 2.10 Light Traffic	3.5” AC / 8.0” AB Concrete: 5.0” PC / 6.0” AB	15,16,17
AASHTO SN equal to or greater than 2.94 Heavy Traffic	5.0” AC/ 8.0” AB Concrete: 6.0” PC /6.0” AB	15,16,17
Slabs:		
Building Floor Slabs	On engineered fill	14
Modulus of Subgrade Reaction	125 pci	14
Existing Site Conditions:		
Existing Fill	Varies	1,9,10
Groundwater Depth (Historical High)	Cave Depth of ~18’ during drilling; Seasonal high ~1-2 feet per SCS	1,10
Near-Surface Corrosivity	Steel – High (per SCS) Concrete – Low (per SCS)	--
Estimated Cut and Fill	To be determined after excavation	5,15,16
Existing Underground Structures	Unknown	--
Existing Aboveground Structures	Asphalt Pavement	4,18,19
Is the site in a 500 or 100-year flood plain	No	
Special Notes:		

1. INTRODUCTION

1.1 Authorization

Authorization to perform this assessment was given by Mr. Clint Langley, Taco Bell Construction Manager, on July 25, 2017 and performed in general accordance with the Project Agreement For Architectural / Engineering / Consultant Services Form No. 17-007, between Taco Bell of America, Inc. and PSI, and dated July 14, 2017.

1.2 Purpose and Scope of Work

The purpose of this study was to determine the geotechnical engineering parameters of the site. All work was conducted in accordance with Yum! Brands, Inc. Guidelines for Environmental Assessments and Geotechnical Engineering Studies, dated August 2006.

The scope of the geotechnical exploration and analysis included subsurface exploration, field and laboratory testing, and an engineering analysis and evaluation of the foundation materials.

1.3 Site Location

The site is located on the north side of the existing road at 20733 E. 13 Mile Road in the City of Roseville, Macomb County, Michigan. A site vicinity map is attached as Figure No. 1.

1.4 Site Description and Conditions

At the time of PSI's geotechnical investigation, the property consisted predominately of a vacant asphalt parking lot situated in front of an existing retail plaza. Access to the site was provided via an entrance driveway from E. 13 Mile Road on the south side of the proposed Taco Bell site and from adjacent retail plaza to the north and east of the proposed site. The topography of the site was relatively flat and exhibited an elevation difference of less than 1 foot based on visual observations. A boring location plan is attached as Figure No. 2.

1.5 Previous Geotechnical Data

No previous geotechnical engineering assessment was provided.

2. PROJECT DESIGN DATA

2.1 Development Plans

Based upon the information provided, it is understood that the proposed project consists of the construction of an Explorer Lite Medium 40 Taco Bell restaurant building with at-grade parking for 25 vehicles. A drive-thru lane will be constructed along the west side of the proposed building. Access to the site will be from E. 13 Mile Road, south of the proposed building and from adjacent retail plaza. The site is currently deteriorated asphalt pavement throughout the proposed site.

2.2 Structure Types

The building will be a single story, wood frame or masonry structure with a truss roof system supported on the exterior foundation only. The trusses span the transverse (short) direction of the building. At the front of the building, columns, which support beams and headers, are concealed within longitudinal exterior walls.

2.3 Foundation Loads

The maximum structural loads on longitudinal (side) bearing walls are about 1,300 pounds per linear foot (plf). Maximum column loads are approximately 20 kips. Maximum loads to the transverse (front and rear) non-bearing walls are about 300 plf (dead load only). The floor slab will carry a maximum design live load of 100 pounds per square foot (psf).

2.4 Grading and Slopes

Neither a site grading plan nor the finished floor elevation of the proposed building was provided at the time of our investigation. For the purposes of our analysis, PSI assumes that the proposed building finished floor will be constructed at or near the existing grade. Based on visual observations of the existing site topography, PSI anticipates that less than 1 foot of cut/engineered fill may be required to achieve the site grades within the proposed building footprint and associated pavement areas (exclusive of any cut/fill associated with removal of unsuitable soil sections). If any of this information is incorrect, please notify the geotechnical engineer so that he may determine if changes in the foundation recommendations are required.

2.5 Pavement

Depending on the site conditions, either of two types of pavements may be used: Flexible Asphalt Concrete (AC) surfaced pavement; or Rigid Portland Cement (PC) Concrete pavement. It is anticipated that the parking lot is divided into two areas: 1) driving lanes, 2) parking stalls. The driving lanes will be subjected to a minimum daily traffic of 1,000 cars and five 18,000 pounds single axle load from heavy trucks. The parking stalls will experience 100 cars per day. Parking stall pavements will only be used where there are portions of lots that will not receive truck traffic. The structural section design shall be based on a twenty-year design period to determine pavement thickness and subgrade preparation requirements.

Pavement structural sections are to be designed according to American Association of State Transportation and Highway Official Standards, Portland Cement Association procedures, or applicable design procedures used by local government or State Transportation Department. Repeated stopping and starting motions will be taken into account during the design.

3. SUBSURFACE INVESTIGATION

3.1 Soil Borings

A total of six (6) soil borings were performed with a truck mounted drilling rig equipped with a rotary head. Conventional hollow-stem augers were used to advance the holes. Boring B-5 was offset from its requested location due to a utility conflict at the time of our fieldwork.

Standard Penetration Tests were performed in accordance with ASTM designation D1586. Split spoon samples were collected in the field at the surface, at 2.5-foot intervals in the top 15 feet, and on five-foot centers thereafter. The samples were transported to our laboratory for visual classification and laboratory testing. The samples were identified according to boring number and depth, and sealed in glass jars to protect against moisture loss.

3.2 Field Testing

3.2.1 Strength Tests

During the field boring operations, Standard Penetration Tests were performed at all sample depths. A hand penetrometer was used in the laboratory on intact samples as an aid in estimating the shear strength of the soil.

3.2.2 Water Level Measurements

Water level depths were obtained during the test boring operations. They are noted on the test boring logs presented in the Appendix. In relatively pervious soils, such as sandy soils, the indicated depths are usually reliable groundwater levels. In relatively impervious soils, a suitable estimate of the groundwater depth may not be possible, even after several days of observation. Seasonal variations, temperature, land-use, proximity to a river, canal, or large body of water and recent rainfall conditions may influence the depths to the groundwater. Volumes of water will largely depend on the permeability of the soils.

3.2.3 Ground Surface Elevations

Ground surface elevations at the test boring locations were not provided. Prior to final design and construction, PSI recommends the elevation of the existing ground surface at the boring locations performed by determined by a professional land surveyor registered in the State of Michigan. References to depth of the various strata encountered are from existing grade at the time of our drilling operations.

3.3 Laboratory Testing

In addition to the field investigation, a supplemental laboratory testing program was conducted to determine additional pertinent engineering characteristics of the foundation materials necessary in analyzing the behavior of the foundation systems for the proposed restaurant.

The laboratory testing program included supplementary visual classification (ASTM D2487), water content tests (ASTM D2216), Loss-On-Ignition (organic content - ASTM D2974), unconfined compressive strength (ASTM D2166) and Atterberg limit tests (ASTM D4318) on selected samples.

Estimates of unconfined compressive strengths were made by the use of a calibrated hand penetrometer.

All phases of the laboratory testing program were conducted in general accordance with applicable ASTM Specifications. The results of these tests are to be found on the accompanying boring logs in the Appendix.

4. FINDINGS AND INTERPRETATION

4.1 Regional and Local Geology

The general geomorphology and near-surface geology of the site is associated with glaciation and deglaciation during the Wisconsinan Stage of the Pleistocene Series glacial episode. Macomb County consists of a nearly level glacial lake plain with occasional gently undulating to end moraine bands and outwash plains. The moraines are of the Saginaw and Huron-Erie systems and the outwash plains are the Commerce, Drayton and Oxford plains. The near surface geology of the site area belongs to the Blount Loam series according to the Soil Conservation Service (SCS) Soil Survey of Macomb County (Issued March 1971). The glacial drift is underlain by the Antrim Shale formed during the Late Devonian period (USGS On-line Spatial Data).

4.2 Seismicity

Macomb County, Michigan lies in the Central Stable Tectonic Region and in the Seismic Zone 1 of probable seismic activity of the Building Officials Congress of America (BOCA), National Building Code and the Uniform Building Code (UBC). This zone indicates that minor damages due to occasional earthquakes might be expected in this area.

Soil borings at the project site extended to a maximum depth of approximately 20 feet below the existing ground surface. Based on regional geologic mapping and past experience in the general project area, PSI anticipates that the subsurface conditions below the explored depth may generally consist of glacial outwash sand and gravel, end moraines of coarse textured till and post glacial alluvium underlain by the Coldwater shale bedrock formation at depths assumed to be greater than 100 feet. Based on our review of the available data, knowledge of regional geology, the Standard Penetration Test (SPT) N-values and unconfined compressive strength tests, we recommend that the seismic design for this project be based on **Site Class D**.

The 2012 IBC recommended seismic parameters for the site (which uses 2008 USGS hazard data) interpolated between the nearest four grid points from latitude 42.5006 and longitude -83.53951 and Site Class D obtained from the USGS geohazards web page (http://eqdesign.cr.usgs.gov/html/designmaps/us/application.php), are as follows (based on site class D):

Period (seconds)	**2% Probability of Event in 50 years* (%g)**	**Site Coefficients**	**Max. Spectral Acceleration Parameters**	**Design Spectral Acceleration Parameters**	
0.2 (S_s)	9.1	$F_a = 1.60$	$S_{ms} = 0.146$	$S_{Ds} = 0.097$	$T_0 = 0.151$
1.0 (S_1)	4.6	$F_v = 2.40$	$S_{m1} = 0.109$	$S_{D1} = 0.073$	$T_s = 0.752$

$S_{ms} = F_a S_s$ $S_{Ds} = 2/3 * S_{ms}$ $T_0 = 0.2 * S_{D1}/S_{Ds}$

$S_{m1} = F_v S_1$ $S_{D1} = 2/3 * S_{m1}$ $T_s = S_{D1}/S_{Ds}$

The site coefficients F_a and F_v were interpolated from the 2012 IBC Tables 1613.3.3(1) and 1613.3.3(2) as a function of the site classification and the mapped spectral response acceleration at the short (S_s) and 1 second (S_1) periods.

Based on the spectral response acceleration coefficients S_{Ds} and S_{D1} above, the Seismic Design Category for this site is **Category B** for occupancy categories I through III and **Category C** for occupancy category IV as prescribed by the 201 IBC Tables 1613.3.5(1) and 1613.3.5(2).

4.3 Subsurface Soil Conditions

4.3.1 General

The types of foundation bearing materials encountered in the test borings have been visually classified. They are described in detail on the boring records. The results of the field penetration tests, strength tests, water level observations, and other laboratory tests are presented on the boring records in numerical form. Representative samples of the soils were placed in glass containers and are now stored in the laboratory for further analysis, if desired. Unless notified to the contrary, all samples will be disposed after 3 months.

The stratification of the soil as shown on the boring records represents the soil conditions at the actual boring locations. Variations may occur between, or beyond, the borings. Lines of demarcation represent the approximate boundary between the soil types, but the transition may be gradual, or not clearly defined.

It is to be noted that, whereas the test borings are drilled and sampled by experienced drillers, it is sometimes difficult to record changes in stratification within narrow limits, especially at great depths. In the absence of foreign substances, it is also difficult to distinguish between discolored soils and clean soil fill.

4.3.2 Soil Conditions

The site was explored by drilling five (5) soil test borings. The following summarizes the approximate locations:

Boring Number	Existing Conditions	Proposed Location
B-1	Asphalt Pavement	Building Corner
B-2	Asphalt Pavement	Building Corner
B-3	Asphalt Pavement	Pavement Area
B-4	Asphalt Pavement	Trash Enclosure
B-5	Asphalt Pavement	Pavement Area
B-6	Topsoil	Pylon Sign

The ground surface at the locations of Borings B-1 through B-5 was covered with approximately 1.3 to 5.5 inches of asphalt pavement. The pavement was underlain by approximately 4.5 to 11.5 inches of sand and gravel base.

A layer of undocumented fill consisting of a mottled bluish gray, dark gray to black sandy clay with variable percentages of organics was encountered at the location of Borings B-1, B-3 and B-4. Loss-On-Ignition (LOI's) ranged from 4.8 to 8.1 percent (which is high). The old fill extended to a depth of approximately 4 feet below the exiting pavement surface. In addition, an apparently native bluish olivish gray sandy clay with trace amounts of organics was encountered below the undocumented fill and pavement section at the location of Borings B-1, B-4 and B-5 and extended to depths ranging from approximately 4 to 7.0 feet below the pavement surface. Standard Penetration Test values ("N"-values) ranged from 4 to 8 blows per foot. The un-drained shear strength of the apparently native bluish gray silty clay stratum ranged from 750 to 3,750 psf, thereby indicating consistencies of medium stiff to very stiff. The natural moisture contents of the tested soil samples from the old fill and apparently native soils with organics ranged from approximately 15 to 27 percent. The recovered soil samples visually appeared to be in a moist to very moist condition when examined in the laboratory.

A stratum of apparently native brown, dark brown and yellowish brown sandy clay was encountered below the ground, pavement section and fill and apparently native soils with organics at the locations of Borings B-1 through B-6. The brown silty/sandy clay extended to depths typically ranging from approximately 11.5 to 14 feet below the existing ground surface. Standard Penetration Test values ("N"-values) ranged from 10 to 47 blows per foot. The un-drained shear strength of the brown, dark brown and yellowish brown sandy clay stratum was greater than 4,500 psf, thereby indicating consistencies of hard. The natural moisture contents of the tested soil samples from the native brown, dark brown and yellowish brown sandy clay ranged from approximately 8 to 13 percent. The recovered soil samples visually appeared to be in a moist condition when examined in the laboratory.

A stratum of gray silty/sandy clay was encountered below the native brown, dark brown and yellowish brown sandy clay at the locations of Borings B-1 through B-6. The gray silty/sandy clay extended through the final explored depth of approximately 20 feet below the existing ground surface. Standard Penetration Test values ("N"-values) ranged from 8 to 26 blows per foot. The un-drained shear strength of the gray silty/sandy clay stratum ranged from approximately 4,500 psf to 1,750 psf, thereby indicating consistencies of hard to stiff. The soils generally became softer at deeper depths. The natural moisture contents of the tested soil samples from the gray silty/sandy clay ranged from approximately 9 to 19 percent. The recovered soil samples visually appeared to be in a moist condition when examined in the laboratory.

4.4 Groundwater Conditions

Groundwater was encountered at a depth of approximately 18 feet at the location of Boring B-1. Groundwater was not encountered in the other borings. It should be noted that water levels in the boreholes may require additional time to stabilize depending on the permeability of the soils. However, due to the project schedule and for safety reasons, the boreholes were backfilled at the end of the investigation day. In addition, it should be noted that groundwater levels at this site may be subject to seasonal fluctuations or other mechanical control.

5. ENGINEERING RECOMMENDATIONS

5.1 Special Conditions and Mitigating Measures

A layer of undocumented fill consisting of a mottled bluish gray, dark gray to black sandy clay with variable percentages of organics was encountered at the location of Borings B-1, B-3 and B-4. Loss-On-Ignition (LOI's) ranged from 4.8 to 8.1 percent (which is high). The old fill extended to a depth of approximately 4 feet below the exiting pavement surface. In addition, an apparently native bluish olivish gray sandy clay with trace amounts of organics was encountered below the undocumented fill and pavement section at the location of Borings B-1, B-4 and B-5 and extended to depths ranging from approximately 4.0 to 7.0 feet below the pavement surface.

Uncontrolled fills and native soils with organics may experience significant volume changes resulting in excessive settlement and poor foundation performance when subjected to loads from conventional spread footing foundations placed over them. In addition, the presence of organic soils and potential for variable soil conditions make the engineering characteristics of the old fill, including bearing capacity and settlement potential, likely to be extremely variable. **Therefore, in PSI's opinion, the existing fill is not considered suitable for direct support of the proposed structure on a conventional shallow foundation system or support of the proposed floor slab.** Where old fill, native soils containing organics or otherwise unsuitable soils are exposed following site stripping and excavation for foundations, the unsuitable soil sections should be over-excavated in their entirety from below the proposed building foundations and floor slab and be backfilled to the foundation bearing level with properly compacted engineered fill, well-graded granular materials or lean concrete. The excavation and backfilling should be performed under supervision of a PSI geotechnical engineering representative.

Where the removal of localized unsuitable bearing material is performed beneath the proposed footings and the excavation is backfilled with compacted fill materials, the excavation must extend laterally beyond the perimeter of the foundation for a distance equal to one-half of the thickness of the engineered backfill placed below the footing bottom. The over excavation is necessary for proper support of lateral loads exerted through the new fill by the foundations.

5.2 Foundation Design

5.2.1 Proposed Structure

PSI understands that a shallow spread footing and grade beam system is the preferred foundation type for the proposed restaurant structure. The existing site conditions are not suitable for support of the proposed structure without removal and replacement of the encountered undocumented fill and potential native soils with organics.

After the soils have been prepared as discussed above and in Section 5.9 of this report. conventional shallow spread footings or grade beams can be placed on the native very stiff to mhard silty/sandy clay soils (provided they are stable at the time of construction) or on newly placed and properly compacted engineered fill. The footings or grade beams should be designed for a maximum allowable net bearing pressure of 2,500 psf. A single isolated footing or a grade beam designed as discussed should experience a settlement of less than 1 inch. However, if a cluster of closely spaced footings is planned, PSI should be contacted to calculate the potential settlement.

Exterior footings and footings in unheated areas should be located at a minimum depth of 42 inches below the final exterior grade for proper protection against frost during normal winters.

Interior footings may be supported at a shallower depth, while providing necessary clearance for pavement and utility construction, provided they are bearing on suitable, undisturbed native soils or properly placed and compacted engineered fill. A minimum depth of 24 inches is recommended for stability. If the structures are to be constructed during the winter months or if footings will likely be subjected to freezing temperatures after foundation construction, then all footings should be adequately protected from freezing.

PSI recommends that the foundation inverts be compacted in place prior to placement of formwork or cast-in-place foundation concrete to densify any soils disturbed during excavation. The compaction should continue until no additional densification is observed with additional passes. However, depending on the groundwater conditions at the time of construction and the dewatering effort implemented, it may be necessary to compact the foundation bearing surfaces with a ‘static’ roller as vibration may cause moisture to be ‘wicked’ upward, resulting in subgrade instability.

Depending on the conditions of the exposed soils at the time of construction, it may be necessary to place a layer of crushed stone and geotextile separator fabric such as an Amoco 2000 series or locally available equivalent such as SKAPS GT180 at the bottom of the foundation excavations to maintain the stability of the bearing surface and create a working platform on which to construct the shallow spread footing foundations or grade beams.

5.2.2 Proposed Sign Area

At the time of this investigation, the exact loads for the sign pole were not available. However, we understand that the sign foundation typically consists of a shallow spread footing or drilled pier. Boring B-6 was drilled near the proposed sign location. The sign foundation should be placed a minimum of 4 feet below the existing ground surface. Spread footings should be designed for a maximum allowable net bearing pressure of 2,500 psf bearing on the native very stiff to hard sandy clay.

The horizontal loads on a shallow spread footing sign foundation will be resisted by the base friction and the passive soil resistance. For a spread footing placed below the existing ground surface onto the sandy clay, the ultimate adhesion can be taken as 1,000 psf and the coefficient of friction may be taken as 0.30. The ultimate passive earth pressure of the concrete cast against the sandy clay may be taken as 4,000 psf. For formed foundations backfilled with granular engineered fill, an ultimate passive earth pressure of the concrete cast against the sand may be taken as 360 pcf/ft. The upper 3 feet of soil should be neglected unless the area around the footing is paved. Also, the passive resistance of any uncompacted fill material should be neglected. A factor of safety of 2.0 should be applied to calculate the ultimate horizontal resistance.

The uplift resistance of a shallow foundation formed in an open excavation will be limited to the weight of the foundation and the soil above it. For design purposes, the ultimate uplift resistance should be based on effective unit weights of 120 and 150 pcf for soil and concrete, respectively. This value should then be reduced by a factor of safety of 2.0 to arrive at the allowable uplift load. For transient loads, the factor of safety is 1.5. If there is a chance of submergence, the unit weights should be taken as 60 and 90 pcf for the soil and concrete, respectively.

5.2.3 Proposed Trash Enclosure

Following proper site preparation as outlined in Section 5.9 of this report, the proposed trash enclosure masonry walls can be supported on conventional shallow spread footing foundations or grade beams can be extended through the encountered fill and placed on the native silty clay soils, provided they are stable at the time of construction, or on newly placed and properly compacted engineered fill. The footings or grade beams should be designed for a maximum allowable net bearing pressure of 2,500 psf. The footings should bear a minimum of 42 inches below existing grade for proper protection against frost during normal winters. PSI recommends that the foundation inverts be compacted in place prior to placement of formwork or cast-in-place foundation concrete to densify any soils disturbed during excavation as recommended above in Section 5.1.1 for the proposed building structure.

5.3 Concrete Slabs-on-Grade

The existing undocumented fill is not suitable for support of the proposed floor slabs. Following removal of the existing fill as indicated within Section 5.1 of this report, PSI anticipates the floor slab will be support by newly placed and properly compacted engineered fill. Floor slabs utilized in conjunction with a spread footing or grade beam foundation system may consist of a soil supported slab-on-grade. PSI recommends the placement of a minimum of 4 inches of crushed stone beneath the slabs. It may also be desirable to use polyethylene sheeting between the crushed stone and the slab as a vapor barrier. PSI recommends that a vertical subgrade modulus, k value of 125 pounds per cubic inch, as determined by a 1-foot by 1-foot plate load test, be used in floor slab-on-grade design calculations.

5.4 Expansive Soils

Not encountered at this project site.

5.5 Lateral Earth Pressures

This site does not require the design of geotechnical systems for lateral earth pressures and therefore, no information is provided.

5.6 Slopes

No slopes are planned to be a part of the final design for this site and therefore no information is provided.

5.7 Excavation De-Watering

Groundwater or perched water was encountered at a depth of approximately 18 feet below the existing ground surface at the location of Boring B-1. It should be noted that water levels in the boreholes may require additional time to stabilize depending on the permeability of the soils. However, due to the project schedule and for safety reasons, the boreholes were backfilled with soil cuttings at the end of the investigation day. Therefore, based on the groundwater observations at the time of PSI's fieldwork, groundwater will likely not affect site construction and difficulty with groundwater seepage is generally not anticipated during excavations associated with the proposed foundations and below-grade utilities.

It should be noted that groundwater levels at this site may be subject to seasonal fluctuations or other mechanical control. Based on the Soil Conservation Service (SCS) Soil Survey of Oakland County (Issued April 1972), seasonal high groundwater elevations may be encountered between 1 to 2 feet below the ground surface present at this site. PSI recommends that the contractor verify the actual groundwater and seepage conditions at the time of the construction activities and propose his site-specific groundwater control methods for the Engineer's approval, including the disposal of discharge water (if necessary).

Because the foundation materials and soils exposed in the bottom of undercut excavations generally tend to soften when exposed to free water, every effort should be made to keep any excavations dry if water is encountered or if storm water runoff enters the excavations. A gravity drainage system, sump pump, or other conventional minor dewatering procedure should be sufficient for excavations shallower than about 6 feet depending on the water table at the time of construction. Sloping excavations to one corner will aid in removal of accumulated groundwater or surface runoff.

5.8 Pavement Design

In designing the proposed parking lots or roadways, the existing subgrade conditions must be considered together with the expected traffic use and loading conditions.

The conditions that will influence the pavement design can be summarized as follows:

- Bearing values of the subgrade. These can be represented by a California Bearing Ratio (CBR) for the design of flexible pavements, or a Modulus of Subgrade Reaction (K) for rigid pavements.
- Vehicular traffic, in terms of the number and frequency of vehicles and their range of axle loads.
- Probable increase in vehicular use over the life of the pavement.
- The availability of suitable materials to be used in the construction of the pavement and their relative costs.

As indicated above, fill soils and apparently native soils with organics was encountered within the proposed parking lot. Depending on the type and extent of the encountered fill and if the owner is willing to accept the risk in doing so, a portion of the existing fill may remain in-place below the proposed site pavements. The long-term performance of the pavement section will typically be a function of the quality of the subgrade at the time of construction, and the quality, thickness and strength of the pavement section. The most critical portion of the subgrade is the upper 2 to 3-foot section. This zone provides the primary strength needed for support of the pavement section. PSI recommends that these soils be undercut and replaced with properly compacted engineered fill. Poorer soil conditions at depth may lead to general pavement subsidence, however, generally will not lead to direct pavement failure, provided a highly stable 2 to 3-foot thick subgrade layer is present or constructed below the proposed pavement section. Therefore, the risk of poor pavement performance can be reduced (but not completely eliminated) by partial depth undercutting of the critical upper 2 to 3 foot section of the subgrade and replacement of the existing old fill soils with clean imported engineered fill. Risk remains of poor pavement performance due to the inherent uncertainty associated with supporting the pavements over existing uncontrolled fill which the Owner must recognize and accept if some or the entire fill thickness is left in place.

Following undercutting operations, we recommend that the exposed surface be proofrolled and any soft areas removed. We recommend the upper 18 inches of the existing soils at the site be scarified and properly recompacted in place to not less than 95 percent of the maximum dry density as determined by ASTM D698 (Standard Proctor). The moisture content at the time of compaction should be within 2 percentage points of the optimum value. The removed fill should be replaced by compacted structural fill to arrive at the desired grade.

Based on the traffic information provided and the Yum! Brands minimum pavement requirements, the pavement thickness values are shown in the following tables. The pavement section thicknesses are being provided based on our experience with similar subgrade soil conditions in the project area. The recommended pavement sections meet or exceed the Yum! Brands minimum pavement requirements in terms of AASHTO structural number analysis methodology of 2.10 for the light duty section and 2.94 for the heavy-duty pavement section. The pavement design values presented below should be considered the minimum recommended thickness. Based on the traffic information provided, the pavement thickness values are shown in the following tables.

Light Duty Flexible Pavement Options	
Asphaltic Concrete Surface Course MDOT 5E03	1.5"
Asphaltic Concrete Binder Course MDOT 4E03	2”
Dense Aggregate Base Stone MDOT 21AA	8”
Compacted Subgrade (Minimum)	12"

Heavy Duty Flexible Pavement Options	
Asphaltic Concrete Surface Course MDOT 5E03	2"
Asphaltic Concrete Binder Course MDOT 4E03	3”
Dense Aggregate Base Stone MDOT 21AA	8”
Compacted Subgrade (Minimum)	12"

The recommended light and heavy-duty rigid concrete pavement sections are provided in the following table:

Rigid Pavement	**Light**	**Heavy**
Portland Cement Concrete	5”	6”
Dense Aggregate Base Stone, MDOT 21AA	6”	6”
Compacted Subgrade (Minimum)	12”	12”

Dense Aggregate Base materials in flexible pavement areas should be placed in maximum 8 inch loose lifts and compacted to at least 100% of the Standard Proctor (ASTM D 698) maximum dry density near optimum moisture content.

The use of concrete for paving has become more prevalent in recent years due to a decrease in the material cost of concrete and to the long-term maintenance cost benefits of concrete compared to asphaltic pavements. Should concrete pavement be utilized, the concrete should be properly jointed, and should have a minimum 28-day compressive strength of 3500 psi. Expansion joints should be sealed with a polyurethane sealant so that moisture infiltration into the subgrade soils and resultant concrete deterioration at the joints is minimized.

Allowances for proper drainage and proper material selection of base materials are most important for performance of asphaltic pavements. Ruts and birdbaths in asphalt pavement allow for quick deterioration of the pavement primarily due to saturation of the underlying base and subgrade. Concrete pavement at least eight (8) inches thick is recommended for the trash dump approach due to the high wheel and impact loads that this area receives. Concrete pavement is recommended in areas, which receive continuous repetitive traffic such as drive-through or loading lanes and parking lot entrances.

5.9 Site Grading

Prior to site grading activities or excavation for foundation elements, PSI recommends that existing underground utilities be identified and rerouted or properly abandoned in-place. Existing underground utilities that are not re-routed or abandoned should be adequately marked and protected to minimize the potential for damage during construction activities.

The site is currently developed with retail buildings adjacent to the west side of the proposed building footprint and drive-thru lane and asphalt pavement throughout the remainder of the site. PSI recommends that the existing pavement be stripped from the proposed development areas. In addition, the existing retail buildings, including their foundations and floor slabs, should be removed and all debris cleared from the site. Depressions resulting from the removal of these items, including any existing basement depressions, should be backfilled with properly compacted engineered fill or specified materials, such as lean concrete or grout, to the final design grade under supervision of a

PSI geotechnical representative. Engineered fill should be placed, compacted and tested as outlined in the following paragraphs of this report.

Where the removal of localized unsuitable bearing material is performed beneath the proposed footings and the excavation is backfilled with properly compacted engineered fill materials, the excavation must extend laterally beyond the perimeter of the foundation for a distance equal to one-half of the thickness of the engineered backfill placed below the footing bottom. The over excavation is necessary for proper support of lateral loads exerted through the new fill by the foundations. Removal of the old fill should be performed under full time supervision of PSI's geotechnical representative.

After site stripping and undercutting unstable soil sections (as necessary), the exposed soils should be thoroughly proof rolled/compacted with a large, heavy rubber-tired vehicle prior to the placement of new engineered fill or backfill required to achieve the proposed subgrade elevation. Areas that exhibit instability or are observed to rut or deflect excessively under the moving load should be further undercut, stabilized by aeration, drying (if wet) and additional compaction to attain a stable finished subgrade. The proof rolling/compacting and undercutting activities should be performed during a period of dry weather and should be performed under the supervision of the geotechnical engineer's representative.

Where subgrade conditions are not improved through aeration, drying and compaction, or where undercut and replacement is considered impractical due to the underlying soil and groundwater conditions, it will likely be necessary to stabilize localized areas of subgrade instability with a woven geotextile, geogrid and a layer of well graded crushed concrete or well graded coarse aggregate. The need for the use of geotextile, geogrid and the thickness and gradation requirements of the crushed aggregate layer required should be determined at the time of the subgrade preparation, based on the condition of the exposed subgrade at the time of construction. The subgrade should be stabilized prior to placement of engineered fill or aggregate base course.

New fill supporting at-grade structures should be an environmentally clean material, free of organic matter, frozen soil, or other deleterious material. The material proposed to be used as engineered fill should be evaluated and approved for use by a PSI geotechnical engineer or his representative prior to placement in the field. Fill materials should be placed in maximum horizontal lifts of 8 inches of loose material and should be compacted within the range of ±2% of the optimum moisture content value. Moisture contents should be adjusted to the proper levels prior to placement and compaction. Adequate compaction will not be achieved if the fill is in a saturated condition. Wet soils may require drying or mixing with dry soil to facilitate compaction. If water must be added to dry soil, it should be uniformly applied and thoroughly mixed into the soil by disking or scarifying prior to compaction.

Organic soils, old fill and other deleterious materials, which are removed or uncovered during site grading and subgrade undercut operations, foundation and utility excavations at this site, must be wasted in non-load bearing areas such as landscaped areas or removed from the site as directed by the project's engineer and should not be reused as engineered fill in other areas of the site.

The excavation side slopes should be sloped or benched in accordance with OSHA requirements. The bottom of the excavation should be sloped to drain toward one end in the event rain or natural groundwater seepage occurs while the excavation is open. The bottom of the excavation should then be compacted/proofrolled using a sheep's foot vibratory compactor making a minimum of 8 passes across the excavation. The area should be checked by a geotechnical engineer and judged suitable prior to placement of new compacted engineered fill. Engineered fill should then be placed in accordance with the guidelines and procedures found in the following paragraphs.

In parking and drive areas of the site, the subgrade should be proofrolled to detect zones of loose, soft or wet soils following undercutting and before placement of engineered fill. Proofrolling consists of repeated passes over the subgrade with a loaded dump truck. Areas, which rut or pump excessively should be further undercut and replaced with properly compacted fill. The near-surface soils are anticipated to consist predominately of fine and fine to medium grained granular soil. PSI generally does not anticipate difficulty in achieving a stable subgrade within these soils. However, to reduce the undercut depths in any isolated of subgrade instability, a geotextile fabric such as an Amoco 2000 series or locally available equivalent such as SKAPS GT180 may be used in lieu of undercutting greater than 2 feet below subgrade. The fabric would serve to reinforce the subgrade and provide a suitable working base for fill placement.

PSI recommends that all fill be compacted to a minimum of 95 percent of the soils standard Proctor maximum dry density (ASTM D698), with a moisture content within 2 percentage points of the optimum moisture. Lift thickness' should be 8 inches or less, loose measure. Fill soils should have the following characteristics:

- A liquid limit (LL) of less than 40 and a plasticity index (PI) of less than 20.
- A standard Proctor maximum dry density of at least 100 pounds per cubic foot.
- The fill soils have a maximum particle size of no more than 3 inches.

Fill placement should be monitored and tested during construction by experienced engineering technicians. Field density tests should be conducted as required to document compaction requirements with a minimum of 5 tests conducted for every lift of fill placed. Any area failing to achieve both the required compaction and moisture requirements should be recompacted or moisture conditioned and retested.

It will be important to maintain positive site drainage during construction. Storm water runoff should be diverted around the building and parking areas. The site should be graded at all times such that water is not allowed to pond. If any surface soils become wet due to rains, they should be removed or allowed to dry prior to further site work operations and/or fill placement.

5.10 Post Investigation Services

As indicated above within sections 5.2 and 5.7.

6. REPORT LIMITATIONS

The recommendations submitted in this report are based on the available subsurface information obtained by PSI and design details furnished by Taco Bell of America, Inc. for the purpose of this project. If there are any revisions to the plans for this project, or if deviations from the subsurface conditions noted in this report are encountered during construction, PSI should be notified immediately to determine if changes in the foundation recommendations are required. If PSI is not notified of such changes, PSI will not be responsible for the impact of those changes on the project.

Subsurface conditions may vary between boring locations. PSI recommends that the contract specifications include the following clause:

“The contractor will, upon becoming aware of subsurface or latent physical conditions differing from those disclosed by the original soil exploration work, promptly notify the owner verbally to permit verification of the conditions, and in writing, as to the nature of the differing conditions. No claim by the contractor for any conditions differing from those anticipated in the plans and specifications and disclosed by the soil studies will be allowed unless the contractor has so notified the owner, verbally and in writing, as required above, of such differing conditions.”

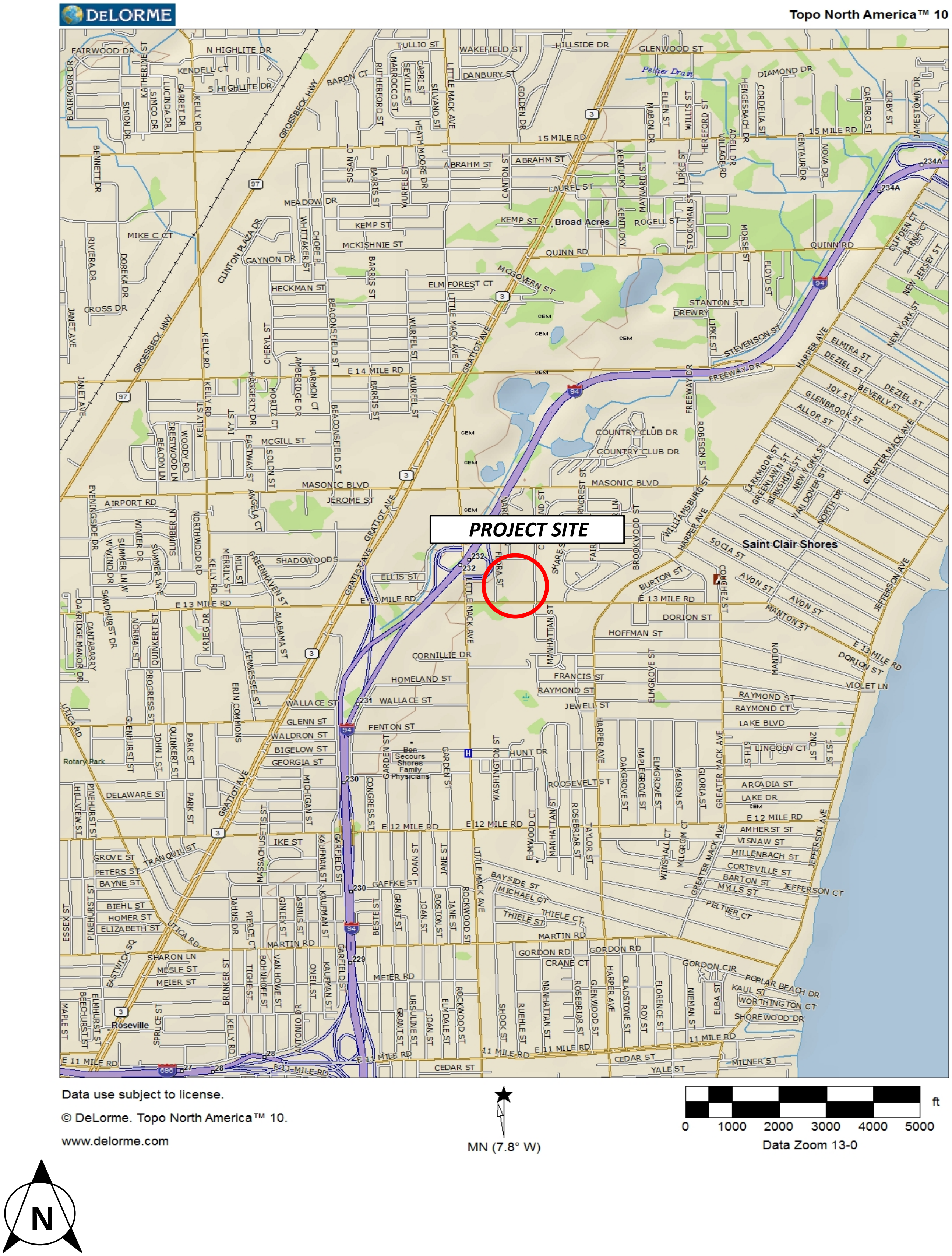
The geotechnical engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

After the plans and specifications are more complete, the geotechnical engineer should be retained and provided the opportunity to review the final design plans and specifications to check that our engineering recommendations have been properly incorporated into the design documents. At that time, it may be necessary to submit supplementary recommendations. If PSI is not retained to perform these functions, PSI will not be responsible for the impact of those conditions on the project. This report has been prepared for the exclusive use of the Taco Bell of America, Inc. for the specific application to the proposed Taco Bell Site #312262 to be located at 20733 E. 13 Mile Road in the City of Roseville, Macomb County, Michigan.

APPENDIX

SITE VICINITY SKETCH

SITE VICINITY MAP



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PROJECT NAME:

Proposed Taco Bell #312262

20733 E. 13 Mile Road

City of Roseville, Macomb County, Michigan

PROJECT NUMBER

03811021

Figure No.

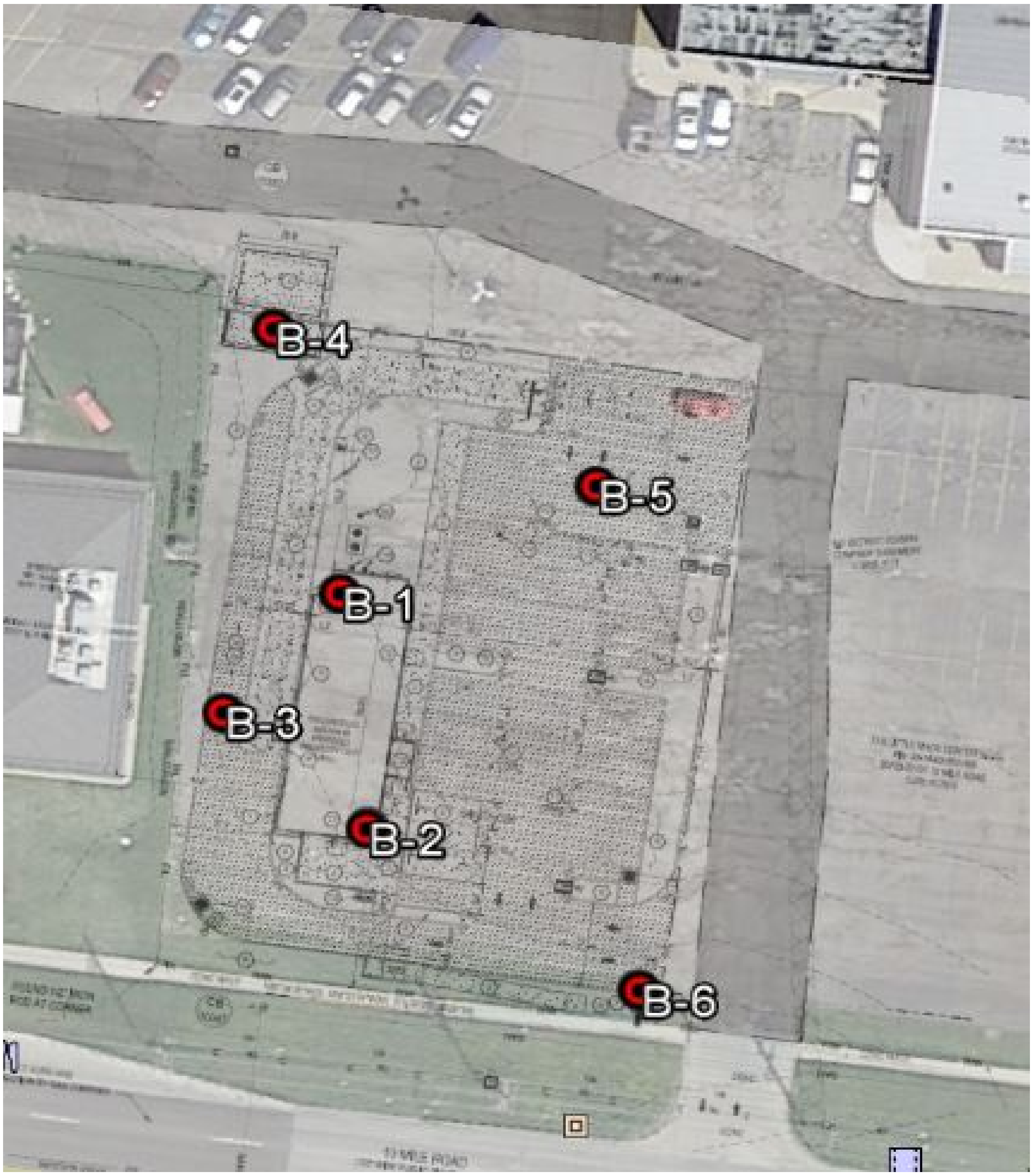
1

Date: August 01, 2017

psi

BORING LOCATION PLAN

BORING LOCATION PLAN



LEGEND:

● - APPROXIMATE BORING LOCATION

PROJECT NAME:		PROJECT NUMBER	Figure No.
Proposed Taco Bell #312262 20733 E. 13 Mile Road City of Roseville, Michigan	Produced by PSI from a Google Earth image for our use in the Geotechnical Exploration.	03811021	2
		Date: August 01, 2017	

Site Photographs

Photo No. 1 - Boring B-1 facing West

Photo No. 2 - Boring B-2 facing East (68' from the staked location)

PROJECT NAME:		PROJECT NUMBER	Sheet
Proposed Taco Bell #312262 20733 E. 13 Mile Road City of Roseville, Michigan	SITE PHOTOGRAPHS	03811021 Date: August 01, 2017	1

Site Photographs

Photo No. 3 - Boring B-3 facing East (17' from the staked location)

Photo No. 4 - Boring B-4 facing East (18' from the staked location)

PROJECT NAME: Proposed Taco Bell #312262 20733 E. 13 Mile Road City of Roseville, Michigan	SITE PHOTOGRAPHS	PROJECT NUMBER 03811021 Date: August 01, 2017	Sheet 2 psi

Site Photographs

Photo No. 5 - Boring B-5 Facing West

Photo No. 6 - Boring B-6 Facing North

PROJECT NAME: Proposed Taco Bell #312262 20733 E. 13 Mile Road City of Roseville, Michigan	SITE PHOTOGRAPHS	PROJECT NUMBER 03811021 Date: August 01, 2017	Sheet 3

BORING LOGS

DATE STARTED: 8/7/17
DATE COMPLETED: 8/7/17
COMPLETION DEPTH 20.5 ft
BENCHMARK: N/A
ELEVATION: N/A
LATITUDE:
LONGITUDE:
STATION: N/A **OFFSET:** N/A
REMARKS: Borehole backfilled with auger cuttings upon completion

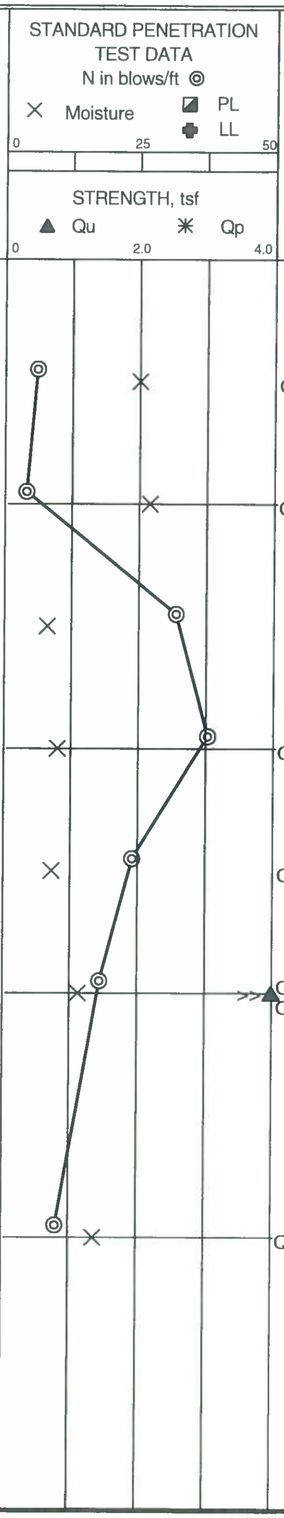
DRILL COMPANY: PSI, Inc.
DRILLER: J. Arsenault **LOGGED BY:** L. Al-Durzi
DRILL RIG: CME 75
DRILLING METHOD: 3.25" HSA
SAMPLING METHOD: 2" SS
HAMMER TYPE: Automatic
EFFICIENCY 82%
REVIEWED BY: K. Dubnicki

BORING B-1

Water		
▽	While Drilling	Dry
▼	Upon Completion	18 feet
▽	Delay	Wet cave @ 18 feet

BORING LOCATION:
See Boring Location Plan

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0					Approximately 5.5" of ASPHALT PAVEMENT				
						FILL - SAND - fine to coarse, with gravel and silt, brown, moist				
				1	15	FILL - SILTY CLAY - with sand and organics, trace gravel, mottled bluish gray, dark gray and black, moist LOI = 8.1% (1SS)		2,2,4 N=6	25	Qp = 1.5 tsf
	5			2	6	SILTY CLAY - with sand, trace gravel, grayish yellowish brown, moist, medium stiff	CL	2,2,2 N=4	27	Qp = 0.75 tsf
				3	18	SANDY CLAY - trace gravel, brown, moist, hard		2,12,20 N=32	8	
	10			4	18		CL	9,18,20 N=38	10	Qp = 4.5+ tsf
				5	18	SANDY CLAY - trace gravel, gray, moist, hard	CL	6,11,13 N=24	9	Qp = 4.5+ tsf
	15			6	18	SILTY CLAY - with sand, trace gravel, occasional gray sand seams, gray, moist, hard	CL	5,8,10 N=18	14	Q_u = 4.8 tsf Qp = 4.5+ tsf
					▼					
	20			7	18	SILTY CLAY - trace sand and gravel, gray, moist, stiff	CL	3,4,6 N=10	17	Qp = 1.75 tsf
						End of Boring				



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Professional Service Industries, Inc.
37483 Interchange Drive
Farmington Hills, MI 48335
Telephone: (248) 857-9911

PROJECT NO.: 03811021
PROJECT: Taco Bell - Site #312262
LOCATION: 20733 E. 13 Mile Road
City of Roseville
Macomb County, Michigan

The stratification lines represent approximate boundaries. The transition may be gradual.

DATE STARTED: 8/7/17
DATE COMPLETED: 8/7/17
COMPLETION DEPTH 20.5 ft
BENCHMARK: N/A
ELEVATION: N/A
LATITUDE:
LONGITUDE:
STATION: N/A **OFFSET:** N/A
REMARKS: Borehole backfilled with auger cuttings upon completion

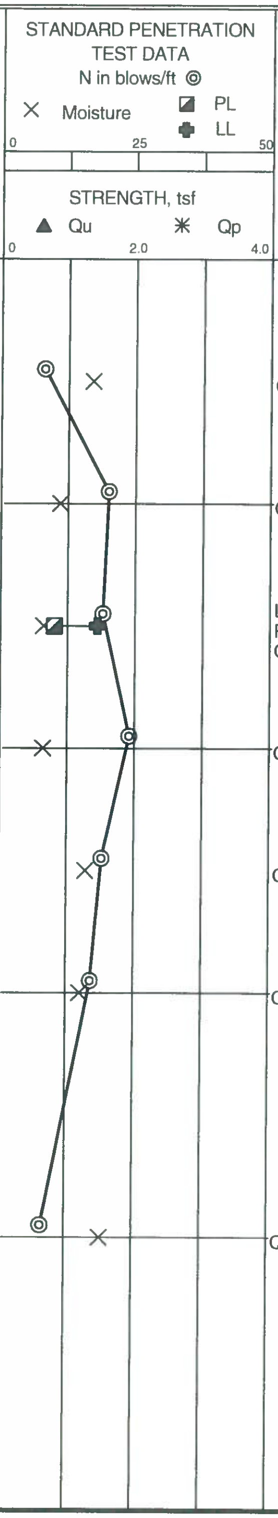
DRILL COMPANY: PSI, Inc.
DRILLER: J. Arsenault **LOGGED BY:** L. Al-Durzi
DRILL RIG: CME 75
DRILLING METHOD: 3.25" HSA
SAMPLING METHOD: 2" SS
HAMMER TYPE: Automatic
EFFICIENCY 82%
REVIEWED BY: K. Dubnicki

BORING B-2

Water		
∇	While Drilling	Dry
▼	Upon Completion	Dry
∇	Delay	Dry cave @ 18 feet

BORING LOCATION:
See Boring Location Plan

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0					Approximately 2.75" of ASPHALT PAVEMENT				
						FILL - SAND - fine to coarse, with gravel and silt, brown, moist				
			☒	1	18	SILTY CLAY - trace sand and gravel, grayish yellowish brown, moist, very stiff	CL	2,3,5 N=8	17	Qp = 3.75 tsf
	5		☒	2	18	SANDY CLAY - trace gravel, grayish yellowish brown, moist, hard	CL	6,9,11 N=20	11	Qp = 4.5+ tsf
			☒	3	18	SANDY CLAY - trace gravel, gray, moist, hard	CL	4,7,12 N=19	8	LL = 18 PL = 10 Qp = 4.5+ tsf
	10		☒	4	18			5,8,16 N=24	8	Qp = 4.5+ tsf
			☒	5	18	SILTY CLAY - trace sand and gravel, gray, moist, hard to stiff		4,8,11 N=19	16	Qp = 4.5+ tsf
	15		☒	6	18		CL	5,7,10 N=17	15	Qp = 4.5+ tsf
	20		☒	7	18			2,3,5 N=8	19	Qp = 1.75 tsf
						End of Boring				



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Telephone: (248) 857-9911

PROJECT NO.: 03811021
PROJECT: Taco Bell - Site #312262
LOCATION: 20733 E. 13 Mile Road
City of Roseville
Macomb County, Michigan

The stratification lines represent approximate boundaries. The transition may be gradual.

DATE STARTED: 8/7/17
DATE COMPLETED: 8/7/17
COMPLETION DEPTH 20.5 ft
BENCHMARK: N/A
ELEVATION: N/A
LATITUDE:
LONGITUDE:
STATION: N/A **OFFSET:** N/A
REMARKS: Borehole backfilled with auger cuttings upon completion

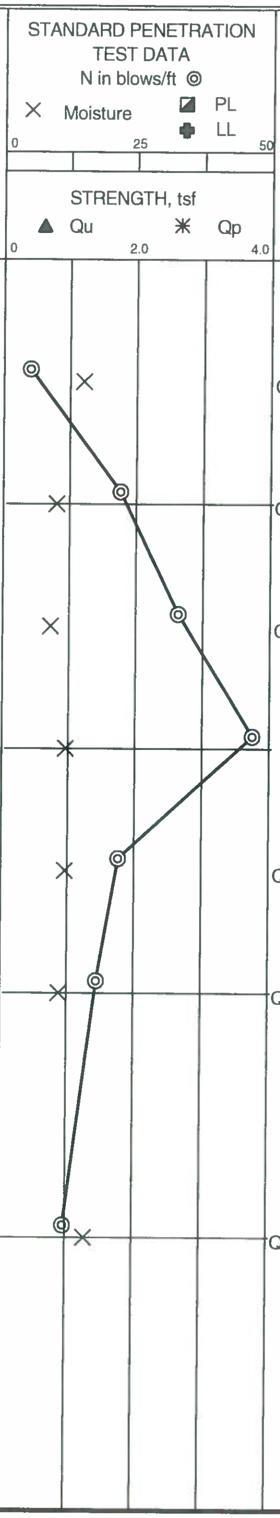
DRILL COMPANY: PSI, Inc.
DRILLER: J. Arsenault **LOGGED BY:** L. Al-Durzi
DRILL RIG: CME 75
DRILLING METHOD: 3.25" HSA
SAMPLING METHOD: 2" SS
HAMMER TYPE: Automatic
EFFICIENCY 82%
REVIEWED BY: K. Dubnicki

BORING B-3

Water		
▽ While Drilling		Dry
▼ Upon Completion		Dry
▽ Delay	Dry cave @ 18	feet

BORING LOCATION:
See Boring Location Plan

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0					Approximately 1.25" of ASPHALT PAVEMENT				
						FILL - SAND - fine to coarse, with gravel and silt, brown, moist				
				1	10	FILL - SILTY CLAY - with sand, trace organics and gravel, mottled bluish olivish gray, dark gray and black, moist LOI = 4.8% (1SS)		2,2,3 N=5	15	Qp = 1.5 tsf
	5			2	14	SANDY CLAY - trace gravel, brown to dark brown, moist, hard		5,8,14 N=22	10	Qp = 4.5+ tsf
				3	16		CL	12,17,16 N=33	9	Qp = 4.5+ tsf
	10			4	0			19,23,24 N=47	12	
				5	18	SILTY CLAY - with sand, trace gravel, gray, moist, hard to very stiff		8,10,12 N=22	12	Qp = 4.5+ tsf
	15			6	18		CL	8,8,10 N=18	11	Qp = 4.5+ tsf
	20			7	18	SILTY CLAY - trace sand and gravel, gray, moist, very stiff	CL	4,6,6 N=12	16	Qp = 3.0 tsf
						End of Boring				



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PROJECT NO.: 03811021
PROJECT: Taco Bell - Site #312262
LOCATION: 20733 E. 13 Mile Road
City of Roseville
Macomb County, Michigan

The stratification lines represent approximate boundaries. The transition may be gradual.

DATE STARTED: 8/7/17
DATE COMPLETED: 8/7/17
COMPLETION DEPTH 20.5 ft
BENCHMARK: N/A
ELEVATION: N/A
LATITUDE:
LONGITUDE:
STATION: N/A **OFFSET:** N/A
REMARKS: Borehole backfilled with auger cuttings upon completion

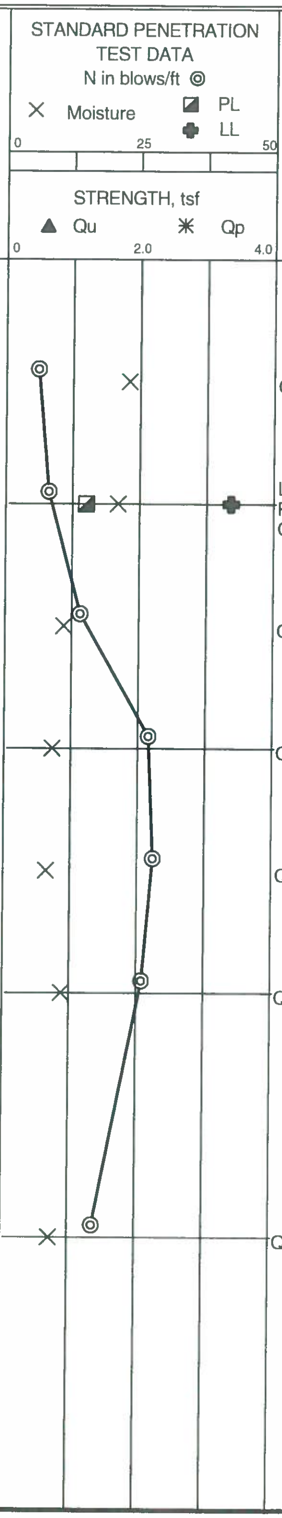
DRILL COMPANY: PSI, Inc.
DRILLER: J. Arsenault **LOGGED BY:** L. Al-Durzi
DRILL RIG: CME 75
DRILLING METHOD: 3.25" HSA
SAMPLING METHOD: 2" SS
HAMMER TYPE: Automatic
EFFICIENCY 82%
REVIEWED BY: K. Dubnicki

BORING B-4

Water		
▽	While Drilling	Dry
▼	Upon Completion	Dry
▽	Delay	Dry cave @ 18 feet

BORING LOCATION:
See Boring Location Plan

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0					Approximately 2.51" of ASPHALT PAVEMENT				
						FILL - SAND - fine to coarse, with gravel and silt, dark brown, moist				
				1	18	FILL - SANDY CLAY - with organics, trace gravel and wood, dark gray to black, moist LOI = 7.2% (1SS)		3,3,3 N=6	23	Qp = 2.75 tsf
	5			2	18	SILTY CLAY - with sand, trace gravel, bluish olivish gray, moist, very stiff	CL	2,3,5 N=8	21	LL = 42 PL = 15 Qp = 2.5 tsf
				3	17	SANDY CLAY - trace gravel, grayish brown to brown, moist, hard		2,6,8 N=14	11	Qp = 4.5+ tsf
	10			4	18		CL	6,10,17 N=27	9	Qp = 4.5+ tsf
				5	18			8,12,16 N=28	8	Qp = 4.5+ tsf
	15			6	18	SILTY CLAY - with sand, trace gravel, occasional gray sand seams, gray, moist, hard to very stiff		5,16,10 N=26	11	Qp = 4.5+ tsf
							CL			
	20			7	18			7,8,9 N=17	9	Qp = 3.5 tsf
						End of Boring				



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PROJECT NO.: 03811021
PROJECT: Taco Bell - Site #312262
LOCATION: 20733 E. 13 Mile Road
City of Roseville
Macomb County, Michigan

The stratification lines represent approximate boundaries. The transition may be gradual.

DATE STARTED:	8/7/17	**DRILL COMPANY:**	PSI, Inc.
DATE COMPLETED:	8/7/17	**DRILLER:** J. Arsenault **LOGGED BY:**	L. Al-Durzi
COMPLETION DEPTH	20.5 ft	**DRILL RIG:**	CME 75
BENCHMARK:	N/A	**DRILLING METHOD:**	3.25" HSA
ELEVATION:	N/A	**SAMPLING METHOD:**	2" SS
LATITUDE:		**HAMMER TYPE:**	Automatic
LONGITUDE:		**EFFICIENCY**	82%
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	K. Dubnicki

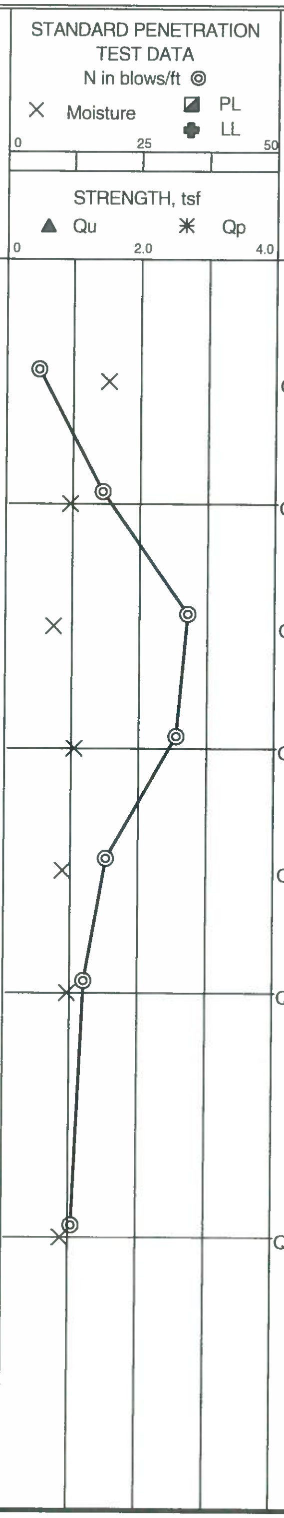
REMARKS: Borehole backfilled with auger cuttings upon completion

BORING B-5

Water		
▽	While Drilling	Dry
▼	Upon Completion	Dry
⊻	Delay	Dry cave @ 17 feet

BORING LOCATION:
See Boring Location Plan

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0					Approximately 4.0" of ASPHALT PAVEMENT				
						FILL - SAND - fine to coarse, with gravel and silt, brown, moist				
						SANDY CLAY - trace organics and gravel, bluish olivish gray, moist				
				1	18		CL	2,2,4 N=6	19	Qp = 2.5 tsf
						SANDY CLAY - trace gravel, yellowish grayish brown to dark brown, moist, hard * Gray sand seams @ 6.5'				
	5			2	18			3,6,12 N=18	12	Qp = 4.5+ tsf
				3	18		CL	12,16,18 N=34	9	Qp = 4.5+ tsf
	10			4	18			8,15,17 N=32	13	Qp = 4.5+ tsf
						SANDY CLAY - trace gravel, gray, moist, hard to very stiff				
				5	18			5,8,11 N=19	11	Qp = 4.5+ tsf
	15			6	18			5,7,8 N=15	12	Qp = 4.5+ tsf
							CL			
	20			7	18			4,6,7 N=13	11	Qp = 3.5 tsf
						End of Boring				



Professional Service Industries, Inc.
37483 Interchange Drive
Farmington Hills, MI 48335
Telephone: (248) 857-9911

PROJECT NO.: 03811021
PROJECT: Taco Bell - Site #312262
LOCATION: 20733 E. 13 Mile Road
City of Roseville
Macomb County, Michigan

The stratification lines represent approximate boundaries. The transition may be gradual.

DATE STARTED: 8/7/17
DATE COMPLETED: 8/7/17
COMPLETION DEPTH 20.5 ft
BENCHMARK: N/A
ELEVATION: N/A
LATITUDE:
LONGITUDE:
STATION: N/A **OFFSET:** N/A
REMARKS: Borehole backfilled with auger cuttings upon completion

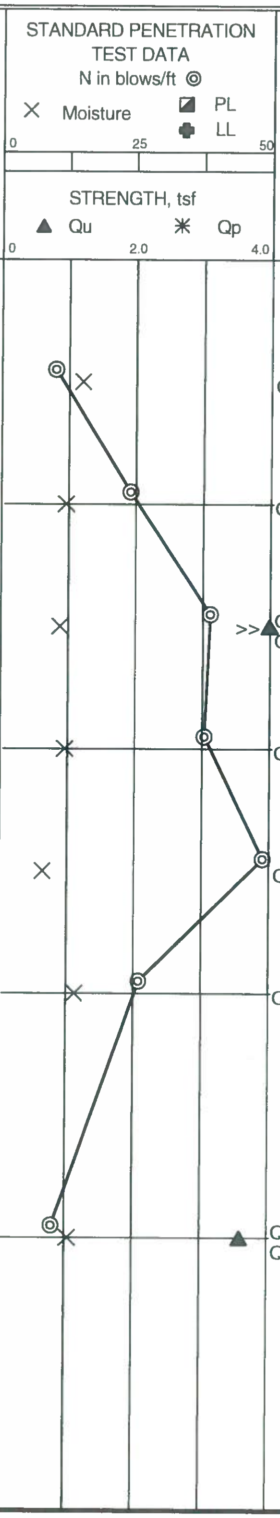
DRILL COMPANY: PSI, Inc.
DRILLER: J. Arsenault **LOGGED BY:** L. Al-Durzi
DRILL RIG: CME 75
DRILLING METHOD: 3.25" HSA
SAMPLING METHOD: 2" SS
HAMMER TYPE: Automatic
EFFICIENCY 82%
REVIEWED BY: K. Dubnicki

BORING B-6

Water		
∇	While Drilling	Dry
▼	Upon Completion	Dry
∇	Delay	Dry cave @ 17 feet

BORING LOCATION:
See Boring Location Plan

Elevation (feet)	Depth, (feet)	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0			Approximately 12.0" of light brown fine to medium SAND TOPSOIL, trace gravel and silt				
				FILL - SILTY CLAY - trace sand and gravel, gray, moist				
		1	18	SANDY CLAY - trace gravel, yellowish grayish brown to brown, moist, very stiff to hard		4,4,6 N=10	15	Qp = 2.0 tsf
	5	2	18			5,11,13 N=24	12	Qp = 4.5+ tsf
		3	18		CL	11,18,21 N=39	11	>> Q_u = 8.5 tsf Qp = 4.5+ tsf
	10	4	18			8,16,22 N=38	12	Qp = 4.5+ tsf
		5	18	SANDY CLAY - trace gravel, occasional gray sand seams, gray, moist, hard	CL	8,11,38 N=49	8	Qp = 4.5+ tsf
	15	6	18	SILTY CLAY - with sand, trace gravel, gray, moist, hard to very stiff		5,9,17 N=26	14	Qp = 4.5+ tsf
					CL			
	20	7	18			2,4,6 N=10	13	Q_u = 3.6 tsf Qp = 3.75 tsf
				End of Boring				



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LABORATORY TESTING

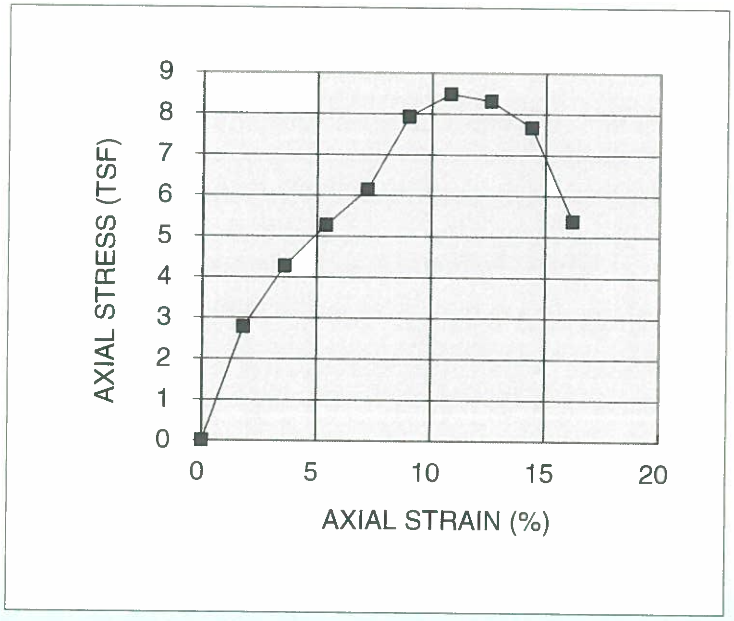
UNCONFINED COMPRESSIVE STRENGTH (ASTM D2166)

Project Name: Proposed Taco Bell #312262
Location: City of Roseville, Macomb County, Michigan
Project No.: 0381021
Source: B-6; 3SS **Sample Depth:** 6.5' - 8.0'
Description: SANDY CLAY (CL), trace gravel, yellowish grayish brown to brown
Qp (tsf): 4.5+
Wet Weight (gm): 150.09
Date Tested: 8/9/2017
Tested By: LA

Height:	2.779	inches	70.60	mm
Diameter:	1.357	inches	34.47	mm
Moisture Content:	11%		**Saturation (%):**	
Ht.-Diameter Ratio:	2.05		**Specific Gravity:**	
Dry Density:	128	pcf		

READING NUMBER	DEFORM. (in.)	LOAD DIAL READING	LOAD (lbs)	STRAIN (%)	CORRECTED AREA (in^2)	AXIAL STRESS (tsf)
0	0.000	0	0.0	0.00	1.446	0.00
1	0.050	178	57	1.80	1.473	2.79
2	0.100	285	89	3.60	1.500	4.27
3	0.150	359	112	5.40	1.529	5.27
4	0.200	416	133	7.20	1.558	6.14
5	0.250	480	175	8.99	1.589	7.93
6	0.300	504	191	10.79	1.621	8.48
7	0.350	503	191	12.59	1.655	8.31
8	0.400	488	180	14.39	1.689	7.67
9	0.450	410	129	16.19	1.726	5.38
10	0.500					
11	0.550					
12	0.600					
13	0.650					
14	0.700					
15	0.750					
16	0.800					
17	0.850					
18	0.900					
19	0.950					
20	1.000					

Qu = 8.48 tsf 812.26 kPa, Strain 10.79%



Failure Sketch

intertek psi
Total Quality. Assured.

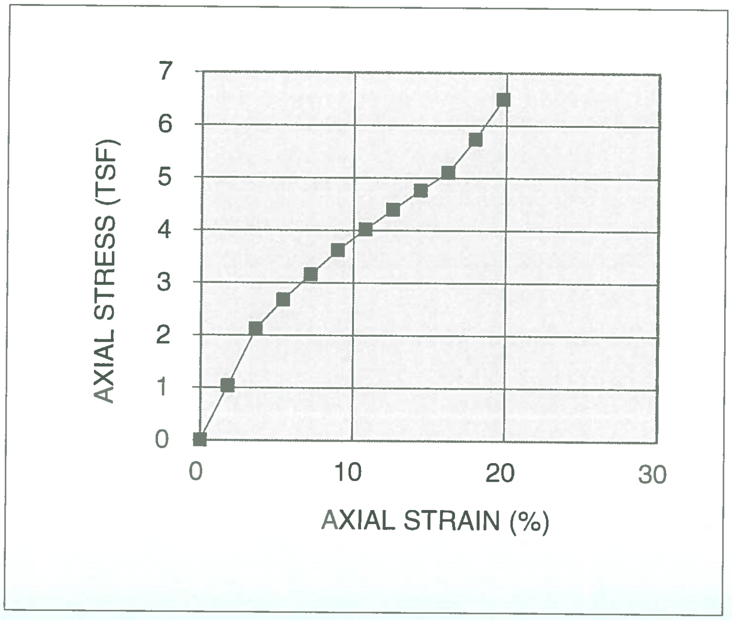
UNCONFINED COMPRESSIVE STRENGTH (ASTM D2166)

Project Name: Proposed Taco Bell #312262
Location: City of Roseville, Macomb County, Michigan
Project No.: 0381021
Source: B-1; 6SS **Sample Depth:** 14.0' - 15.5'
Description: SILTY CLAY (CL), with sand, occasional gray sand seams, gray
Qp (tsf): 4.5+
Wet Weight (gm): 152.37
Date Tested: 8/9/2017
Tested By: LA

Height: 2.783 inches 70.69 mm
Diameter: 1.383 inches 35.14 mm
Moisture Content: 14% **Saturation (%):**
Ht.-Diameter Ratio: 2.01 **Specific Gravity:**
Dry Density: 122 pcf

READING NUMBER	DEFORM. (in.)	LOAD DIAL READING	LOAD (lbs)	STRAIN (%)	CORRECTED AREA (in^2)	AXIAL STRESS (tsf)
0	0.000	0	0.0	0.00	1.503	0.00
1	0.050	67	22	1.80	1.530	1.03
2	0.100	143	46	3.59	1.559	2.12
3	0.150	186	59	5.39	1.589	2.67
4	0.200	226	71	7.19	1.619	3.16
5	0.250	264	83	8.98	1.651	3.62
6	0.300	300	94	10.78	1.685	4.02
7	0.350	338	105	12.58	1.719	4.40
8	0.400	372	116	14.37	1.755	4.76
9	0.450	407	127	16.17	1.793	5.10
10	0.500	437	146	17.97	1.832	5.74
11	0.550	471	169	19.76	1.873	6.50
12	0.600					
13	0.650					
14	0.700					
15	0.750					
16	0.800					
17	0.850					
18	0.900					
19	0.950					
20	1.000					

Qu = 4.76 tsf 455.66 kPa, Strain 15.00%



Failure Sketch

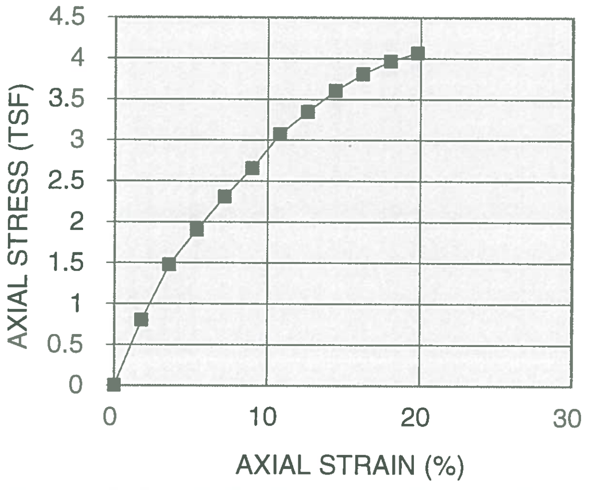
intertek psi
Total Quality. Assured.

UNCONFINED COMPRESSIVE STRENGTH (ASTM D2166)

Project Name: Proposed Taco Bell #312262
Location: City of Roseville, Macomb County, Michigan
Project No.: 0381021
Source: B-6; 7SS **Sample Depth:** 19.0'-20.5'
Description: SILTY CLAY (CL), with sand partings, trace gravel, gray
Qp (tsf): 3.75
Wet Weight (gm): 153.00
Date Tested: 8/9/2017
Tested By: LA

Height:	2.779	inches	70.59	mm
Diameter:	1.384	inches	35.16	mm
Moisture Content:	13%		**Saturation (%):**	
Ht.-Diameter Ratio:	2.01		**Specific Gravity:**	
Dry Density:	124 pcf			

READING NUMBER	DEFORM. (in.)	LOAD DIAL READING	LOAD (lbs)	STRAIN (%)	CORRECTED AREA (in^2)	AXIAL STRESS (tsf)
0	0.000	0	0.0	0.00	1.505	0.00
1	0.050	52	17	1.80	1.532	0.80
2	0.100	97	32	3.60	1.561	1.48
3	0.150	130	42	5.40	1.591	1.90
4	0.200	163	52	7.20	1.621	2.31
5	0.250	194	61	9.00	1.653	2.66
6	0.300	230	72	10.79	1.687	3.07
7	0.350	255	80	12.59	1.722	3.35
8	0.400	281	88	14.39	1.758	3.60
9	0.450	305	95	16.19	1.795	3.81
10	0.500	324	101	17.99	1.835	3.96
11	0.550	340	106	19.79	1.876	4.07
12	0.600					
13	0.650					
14	0.700					
15	0.750					
16	0.800					
17	0.850					
18	0.900					
19	0.950					
20	1.000					
Qu =	3.60 tsf		345.18 kPa,	Strain 15.00%		



Failure Sketch

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GENERAL NOTES

SAMPLE IDENTIFICATION

The Unified Soil Classification System (USCS), AASHTO 1988 and ASTM designations D2487 and D-2488 are used to identify the encountered materials unless otherwise noted. Coarse-grained soils are defined as having more than 50% of their dry weight retained on a #200 sieve (0.075mm); they are described as: boulders, cobbles, gravel or sand. Fine-grained soils have less than 50% of their dry weight retained on a #200 sieve; they are defined as silts or clay depending on their Atterberg Limit attributes. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size.

DRILLING AND SAMPLING SYMBOLS

SFA: Solid Flight Auger - typically 4" diameter flights, except where noted.
HSA: Hollow Stem Auger - typically 3¼" or 4¼ I.D. openings, except where noted.
M.R.: Mud Rotary - Uses a rotary head with Bentonite or Polymer Slurry
R.C.: Diamond Bit Core Sampler
H.A.: Hand Auger
P.A.: Power Auger - Handheld motorized auger

☒ SS: Split-Spoon - 1 3/8" I.D., 2" O.D., except where noted.
■ ST: Shelby Tube - 3" O.D., except where noted.
▯ RC: Rock Core
⇩ TC: Texas Cone
✋ BS: Bulk Sample
⁝ PM: Pressuremeter
CPT-U: Cone Penetrometer Testing with Pore-Pressure Readings

SOIL PROPERTY SYMBOLS

N: Standard "N" penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2-inch O.D. Split-Spoon.
N_{60}: A "N" penetration value corrected to an equivalent 60% hammer energy transfer efficiency (ETR)
Q_u: Unconfined compressive strength, TSF
Q_p: Pocket penetrometer value, unconfined compressive strength, TSF
w%: Moisture/water content, %
LL: Liquid Limit, %
PL: Plastic Limit, %
PI: Plasticity Index = (LL-PL),%
DD: Dry unit weight, pcf
▼,▽,▼ Apparent groundwater level at time noted

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Relative Density	N - Blows/foot
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	50 - 80
Extremely Dense	80+

ANGULARITY OF COARSE-GRAINED PARTICLES

Description	Criteria
Angular:	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular:	Particles are similar to angular description, but have rounded edges
Subrounded:	Particles have nearly plane sides, but have well-rounded corners and edges
Rounded:	Particles have smoothly curved sides and no edges

GRAIN-SIZE TERMINOLOGY

Component	Size Range
Boulders:	Over 300 mm (>12 in.)
Cobbles:	75 mm to 300 mm (3 in. to 12 in.)
Coarse-Grained Gravel:	19 mm to 75 mm (¾ in. to 3 in.)
Fine-Grained Gravel:	4.75 mm to 19 mm (No.4 to ¾ in.)
Coarse-Grained Sand:	2 mm to 4.75 mm (No.10 to No.4)
Medium-Grained Sand:	0.42 mm to 2 mm (No.40 to No.10)
Fine-Grained Sand:	0.075 mm to 0.42 mm (No. 200 to No.40)
Silt:	0.005 mm to 0.075 mm
Clay:	<0.005 mm

PARTICLE SHAPE

Description	Criteria
Flat:	Particles with width/thickness ratio > 3
Elongated:	Particles with length/width ratio > 3
Flat & Elongated:	Particles meet criteria for both flat and elongated

RELATIVE PROPORTIONS OF FINES

Descriptive Term	% Dry Weight
Trace:	< 5%
With:	5% to 12%
Modifier:	>12%

GENERAL NOTES

(Continued)

CONSISTENCY OF FINE-GRAINED SOILS

Q_U - TSF	N - Blows/foot	Consistency
0 - 0.25	0 - 2	Very Soft
0.25 - 0.50	2 - 4	Soft
0.50 - 1.00	4 - 8	Firm (Medium Stiff)
1.00 - 2.00	8 - 15	Stiff
2.00 - 4.00	15 - 30	Very Stiff
4.00 - 8.00	30 - 50	Hard
8.00+	50+	Very Hard

MOISTURE CONDITION DESCRIPTION

Description	Criteria
Dry:	Absence of moisture, dusty, dry to the touch
Moist:	Damp but no visible water
Wet:	Visible free water, usually soil is below water table

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term	% Dry Weight
Trace:	< 15%
With:	15% to 30%
Modifier:	>30%

STRUCTURE DESCRIPTION

Description	Criteria
Stratified:	Alternating layers of varying material or color with layers at least ¼-inch (6 mm) thick
Laminated:	Alternating layers of varying material or color with layers less than ¼-inch (6 mm) thick
Fissured:	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided:	Fracture planes appear polished or glossy, sometimes striated

Description	Criteria
Blocky:	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed:	Inclusion of small pockets of different soils
Layer:	Inclusion greater than 3 inches thick (75 mm)
Seam:	Inclusion 1/8-inch to 3 inches (3 to 75 mm) thick extending through the sample
Parting:	Inclusion less than 1/8-inch (3 mm) thick

SCALE OF RELATIVE ROCK HARDNESS

Q_U - TSF	Consistency
2.5 - 10	Extremely Soft
10 - 50	Very Soft
50 - 250	Soft
250 - 525	Medium Hard
525 - 1,050	Moderately Hard
1,050 - 2,600	Hard
>2,600	Very Hard

ROCK VOIDS

Voids	Void Diameter
Pit	<6 mm (<0.25 in)
Vug	6 mm to 50 mm (0.25 in to 2 in)
Cavity	50 mm to 600 mm (2 in to 24 in)
Cave	>600 mm (>24 in)

ROCK QUALITY DESCRIPTION

Rock Mass Description	RQD Value
Excellent	90 -100
Good	75 - 90
Fair	50 - 75
Poor	25 -50
Very Poor	Less than 25

ROCK BEDDING THICKNESSES

Description	Criteria
Very Thick Bedded	Greater than 3-foot (>1.0 m)
Thick Bedded	1-foot to 3-foot (0.3 m to 1.0 m)
Medium Bedded	4-inch to 1-foot (0.1 m to 0.3 m)
Thin Bedded	1¼-inch to 4-inch (30 mm to 100 mm)
Very Thin Bedded	½-inch to 1¼-inch (10 mm to 30 mm)
Thickly Laminated	1/8-inch to ½-inch (3 mm to 10 mm)
Thinly Laminated	1/8-inch or less "paper thin" (<3 mm)

GRAIN-SIZED TERMINOLOGY

(Typically Sedimentary Rock)

Component	Size Range
Very Coarse Grained	>4.76 mm
Coarse Grained	2.0 mm - 4.76 mm
Medium Grained	0.42 mm - 2.0 mm
Fine Grained	0.075 mm - 0.42 mm
Very Fine Grained	<0.075 mm

DEGREE OF WEATHERING

Slightly Weathered:	Rock generally fresh, joints stained and discoloration extends into rock up to 25 mm (1 in), open joints may contain clay, core rings under hammer impact.
Weathered:	Rock mass is decomposed 50% or less, significant portions of the rock show discoloration and weathering effects, cores cannot be broken by hand or scraped by knife.
Highly Weathered:	Rock mass is more than 50% decomposed, complete discoloration of rock fabric, core may be extremely broken and gives clunk sound when struck by hammer, may be shaved with a knife.

SOIL CLASSIFICATION CHART

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)	●	GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
			○	GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	▥	GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
			▨	GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)	░	SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			░	SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	▥	SM	SILTY SANDS, SAND - SILT MIXTURES
			▨	SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50	▥	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			▨	CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			▤	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50	▥	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
			▨	CH	INORGANIC CLAYS OF HIGH PLASTICITY
			≈	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			⁂	PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

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