SCI ENGINEERING, INC.
130 Point West Boulevard
St. Charles, Missouri 63301
636-949-8200
www.sciengineering.com

Preliminary Geotechnical Report

JSE0083 BRIDGE L0210 ROUTE 67 OVER OTTER CREEK
WAYNE COUNTY, MISSOURI

Timothy J. Barrett, P.E., CFM
(636) 757-1065

January 5, 2024

Prepared For
Lydia Brownell, P.E.
MoDOT – Geotechnical Section
1617 Missouri Boulevard
Jefferson City, Missouri 65109

SCI No. 2023-1428.10

STATE OF MISSOURI
TIMOTHY J. BARRETT
1/5/2024
NUMBER
PE-2011015698
PROFESSIONAL ENGINEER

DocuSigned by:
Tim J Barrett
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CONSTRUCTION SERVICES

January 5, 2024

Lydia Brownell, P.E.
MoDOT – Geotechnical Section
1617 Missouri Boulevard
Jefferson City, Missouri 65109

RE: Preliminary Geotechnical Report
JSE0083 Bridge L0210 Route 67 over Otter Creek
Wayne County, Missouri
SCI No. 2023-1428.10

Dear Lydia Brownell:

Please find enclosed our *Preliminary Geotechnical Report*, dated January 5, 2024.

If you have any questions, please do not hesitate to contact us.

Respectfully,

SCI ENGINEERING, INC.

Matthew G. Martin, E.I.T.
Staff Engineer

Timothy J. Barrett, P.E., CFM
Senior Engineer

MGM/TJB/snp

Enclosure
Preliminary Geotechnical Report

C: Seiji Shimbo, Missouri Department of Transportation

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Preliminary Geotechnical Report

JSE0083 BRIDGE L0210 ROUTE 67 OVER OTTER CREEK
WAYNE COUNTY, MISSOURI

1.0 PROJECT DESCRIPTION

A new bridge is currently planned to carry the northbound lane of Route 67 over Otter Creek in Wayne County, Missouri. The location of the site is shown on the *Vicinity and Topographic Map*, Figure 1. The existing bridge (L0210) is a five-span structure with a length of 272.5 feet, a width of 26 feet, and a concrete deck. Information regarding the proposed replacement bridge (JSE0083) was not available at the time of this report. The existing bridge was constructed in the 1950s and is supported by extended spread footing foundations, which bear on rock at elevations ranging from 361 to 368. The existing conditions are shown on the *Aerial Photograph*, Figure 2. Photographs of the existing conditions are included in Appendix A.

2.0 SUBSURFACE EXPLORATION

2.1 Area Geology

Documented geology, including the *Missouri Geological Survey GeoSciences Technical Resource Tool* (GeoSTRAT), indicates that the geology at the bridge location consists of the Gasconade Dolomite, which is a coarse-grained, crystalline dolomite interbedded with chert layers. The formation varies from 250 to 500 feet thick locally, based on a review of nearby well logs. Further, it should be noted that the Otter Creek Graben is located 0.4 miles south of the site; therefore, breccia or highly weathered rock may be encountered near the fault zone.

Auger refusal on dolomite bedrock was encountered in both borings at the depths summarized in Table 2.1. No rock coring was performed.

Table 2.1 – Auger Refusal Summary

Boring	Ground Surface Elevation (feet)	Approximate Auger Refusal Depth (feet)	Approximate Auger Refusal Elevation (feet)
B-1	397.1	19	378.1
B-2	399.3	36	363.3

2.2 Exploration Procedures

Two soil test borings (B-1 and B-2) and two pavement cores (P-1 and P-2) were drilled at the locations shown on the *Aerial Photograph.* The testing locations were located in the field using a handheld global positioning system with sub-meter accuracy. The "as-drilled" boring locations and ground surface elevations were provided by the Missouri Department of Transportation (MoDOT). The field exploration was performed in general accordance with the procedures outlined in the *MoDOT Field Policy Guide*.

A CME 550 all-terrain-mounted drill rig equipped with 4.25-inch inside diameter (ID) Continuous Flight Augers (CFA) was used to advance the borings. The field exploration was performed under the supervision of SCI geotechnical personnel. Standard Penetration Tests (SPTs) were performed with a split-spoon sampler with an automatic hammer. The SPT sampling was performed at 5-foot intervals. Relatively undisturbed Shelby tube samples were obtained at select locations in lieu of the SPTs. The borings were extended to the depths of refusal at 29 and 28 feet (approximate elevation 416.8 at each) in B-1 and B-2, respectively. The SPT soil samples were put into glass jars and the Shelby tubes sealed and capped. The soil samples were then transported to our laboratory for further testing. The boreholes were grouted upon completion.

2.3 Subsurface Conditions

Detailed information regarding the nature and thickness of the soils and rock encountered, and the results of the field sampling and laboratory testing, are shown on the *Boring Logs* contained in Appendix B. Further, the results of grain size analysis testing, performed on two samples from B-2, are also shown in Appendix B.

2.3.1 Existing Pavement

The existing pavement was cored at both P-1 and P-2 and consisted of 3 inches of asphaltic concrete pavement overlying 13 inches of concrete, for a total thickness of 16 inches, at each location. Photographs of the pavement cores are included in Appendix D. The concrete base was underlain by chert gravel and boulders. No aggregate base was encountered in the pavement borings.

2.3.2 Existing Fill

Existing fill was encountered in B-2 to a depth of 12 feet (approximate elevation 387.3) and consisted of clayey gravel, where the clay was fat, in the upper 8 feet and lean clay to a depth of 12 feet. The efficiency-corrected Standard Penetration Test (SPT) N_{60}-value in the clayey gravel fill was 9 blows per foot (bpf), characterizing the clayey gravel fill as loose; and the SPT N_{60}-value in the lean clay fill was 28 bpf, characterizing the lean clay fill as very stiff in consistency. The moisture contents in the fill were 12.2 and 19.4 percent, respectively. Existing fill was not encountered in B-1.

2.3.3 Native Soil Profile

The native soils varied significantly between the two borings. In B-1, the native soils consisted of clayey gravel (GC in accordance with the Unified Soil Classification System and ASTM D 2488), where the clay was fat, to a depth of 8 feet, overlying lean clay and fat clay (CL and CH), both containing varying amounts of sand and chert gravel, which extended to the depth of weathered bedrock at 18.5 feet.

In B-2, the native soils consisted of clayey sand (SC), where the clay was fat, to a depth of 17 feet, overlying sandy lean clay (CL) to 22 feet. Poorly graded gravel with clay and sand (GP) was then encountered to the depth of auger refusal on bedrock at 36 feet.

Efficiency-corrected Standard Penetration Test (SPT) N_{60}-values in the native gravel and sand soils ranged from 6 to 39 blows per foot (bpf), characterizing the gravel and sands as loose to dense. The SPT N_{60}-value in the native lean clay in B-1 was 16 bpf, and the unconfined compressive strengths of two Shelby tube samples in the native lean and fat clays ranged from 1.4 to 3.6 kips per square foot (ksf), characterizing the clays as medium stiff to very stiff in consistency. Moisture contents in the native gravels and sands ranged from 9.5 to 22.9 percent, while moisture contents in the native clays ranged from 16.5 to 36.2 percent.

Based on results from the United States Department of Agriculture – National Resources Conservation Service (USDA NRCS) Web Soil Survey, the native soils at the site predominantly consist of the Kaintuck loam, which features a fine sandy loam with 0 to 3 percent slopes with a portion of the southern abutment consisting of the Cornwall silt loam, which features 3 to 8 percent slopes. The Web Soil Survey map is attached in Appendix C.

2.4 Groundwater Conditions

Groundwater was observed in both borings during drilling at the depths summarized in Table 2.2. The water was perched at the top of bedrock in B-1 and within the gravel in B-2; however, it should be noted that the groundwater level is subject to seasonal and climatic variations and may be present at different depths in the future, and at this site most likely correlates to the water level in Otter Creek. In addition, without extended periods of observation, measurement of true groundwater levels may not be possible.

Table 2.2 – Groundwater Summary

Boring	Approximate Ground Surface Elevation (feet)	Approximate Groundwater Depth (feet)	Approximate Groundwater Elevation (feet)
B-1	397.1	18.5	378.6
B-2	399.3	28	371.3

3.0 PRELIMINARY GEOTECHNICAL EVALUATIONS

The following evaluations were performed based on available data collected and reviewed at the time of this report. This information includes the subsurface exploration performed by SCI, publicly available data sources, such as GeoSTRAT and the USDA NRCS Web Soil Survey, as well as the existing bridge plans provided by MoDOT.

3.1 Excavation, Grading, and Slope Recommendations

Based on the soils encountered during the exploration and the guidance provided in the MoDOT Engineering Policy Guide (EPG) Table 321.1, we recommend that the soils at the site be classified as "Residual Soil with Admixed Chert or Rock Fragments," which require a 2 horizontal to 1 vertical (2H:1V) backslope or fill side or spill slopes for routine design. **However, the relatively rock-free native fat clay encountered in B-1 at a depth 12 feet, if exposed, should be classified as Clay of High Plasticity and graded with caution.** The results of our laboratory testing indicate that this fat clay soil has a plasticity index (PI) greater than 50. If extended depths of this relatively rock-free fat clay are encountered, then consideration should be given to wasting the material, using a 3H:1V slope for backslopes and fill side slopes or a 2.5H:1V inclination for spill slopes, or using even flatter slopes if deemed necessary.

If the foundations for the proposed bridge will bear on rock at elevations similar to the existing bridge (361 to 368), then we anticipate that rock slopes in the Gasconade Dolomite may be required at the site, particularly in the vicinity of B-1. Vertical slopes, in accordance with EPG 321.1.2, should be adequate in the Gasconade Dolomite, where encountered.

3.2 Unsuitable Materials

Unsuitable materials encountered at the site include existing fill and expansive clay. Existing fill was encountered in B-2, and documentation regarding the placement and compaction of the existing fill was not available at the time of this report, and portions of the fill were loose in relative density. Therefore, the engineering properties and performance of the existing fill cannot be predicted with certainty, and there is some risk of settlement or other performance problems if the improvements are supported on the existing fill material. To eliminate the risks associated with the undocumented fill, the existing fill could be excavated in its entirety to native soils beneath the proposed structures and either recompacted or replaced. However, we anticipate that the proposed bridge will be founded on rock-bearing spread footings or deep foundations, such that remediation of the existing fill will not be required.

Finally, the existing fill could cause some distress in the pavement. The risk to the pavement is judged to be low provided the subgrade passes a proofroll, as discussed below, and the base is designed in accordance with EPG 350.2 or 350.5. The pavement subgrade should be proofrolled and any soft areas repaired prior to the placement of the crushed rock base and asphalt. Any soft areas identified during the proofroll should be removed to firmer soils and backfilled with engineered fill material.

Further, expansive clay was encountered in the native soils in B-1 at depths of 12 to 18.5 feet. These soils are susceptible to excessive volume change with variations in moisture content, which can lead to movement of concrete slabs and foundations of lightly loaded structures, retaining walls, or pavements. Typically, where bearing soils consist of relatively clean (≤ 50 percent volume gravel/rock fragments) fat clay, we recommend they be remediated to minimum depths of 2 feet beneath the bearing level of shallow spread footings. However, we anticipate that the proposed bridge will be founded on rock-bearing spread footings or deep foundations, such that remediation of the expansive clay will not be required. Also, the native expansive clay should not be used as backfill.

3.3 Settlement Investigation

We have assumed that the proposed new bridge at this site (JSE0083) will be supported on the bedrock. If that is the case, we do not anticipate that a settlement investigation of the foundations will be required. While the proposed improvement plans were not available at the time of this report, we understand that the vertical profile will not be significantly raised. However, if large amounts of grade raise fill will be placed to construct the new abutment approaches, we recommend a settlement investigation to determine the downdrag force on the foundations and the settlement of the pavement approaches at the abutments.

3.4 Foundations

No critical foundation issues were discovered during this survey.

3.5 Drainage and Erosion Control

No areas of slope instability or significant erosion were observed during fieldwork. Typical drainage standards for bridges should be adequate for this project. However, we anticipate that the surficial existing fill or gravelly soils will be prone to erosion if they are exposed to rainfall or flooding. We recommend that these soils, if exposed, be undercut to a depth of 1 foot and capped with cohesive soil or rip rap with filter fabric.

We anticipate that the existing fill and soils encountered will not be suitable for establishment of vegetation due to the gravel content. It may be necessary to undercut the existing ground surface on the order of 18 inches and replace with soils more suitable for vegetation. Seeding shall be per Missouri Standard Specification Section 805 for the region that corresponds with the project.

4.0 CONSTRUCTION CONSIDERATIONS

The construction activities should be performed in accordance with the current *Missouri Department of Transportation (MoDOT) Standard Specifications for Road and Bridge Construction* and any pertinent Special Provisions or policies.

5.0 LIMITATIONS

The results of our analysis and recommendations provided herein are for the exclusive use of MoDOT. They are specific only to the project described and are based on subsurface information obtained at four test locations at the project site, our understanding of the project as described herein, and geotechnical engineering practice consistent with the standard of care. No other warranty is expressed or implied. SCI should be contacted if conditions encountered during construction are not consistent with those described.

We should also be provided with the final plans, once they are available, to review whether the results of our analysis and recommendations have been understood and applied correctly, and to assess the need for additional exploration or analysis. Failure to provide these documents to SCI may nullify some or all the recommendations provided herein. In addition, any changes in the planned project or changed site conditions may require revised or additional recommendations on our part.

Appendix A

Photo 1. Southeast Bridge Approach

Photo 2. Southeast End Bent

Photo 3. Existing Bridge Deck

Photo 4. Existing Bridge Pavement

Photo 5. Northwest Bridge Approach

Photo 6. Northwest End Bent

Appendix B

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BORING LOG LEGEND AND NOMENCLATURE

Depth is in feet below ground surface. **Elevation** is in feet mean sea level, site datum, or as otherwise noted.

Sample Type

SS Split-spoon sample, disturbed, obtained by driving a 2-inch-O.D. split-spoon sampler (ASTM D 1586).
NX Diamond core bit, nominal 2-inch-diameter rock sample (ASTM D 2113).
ST Thin-walled (Shelby) tube sample, relatively undisturbed, obtained by pushing a 3-inch-diameter, tube (ASTM D 1587).
CS Continuous sample tube system, relatively undisturbed, obtained by split-barrel sampler in conjunction with auger advancement.
SV Shear vane, field test to determine strength of cohesive soil by pushing or driving a 2-inch-diameter vane, and then shearing by torquing soil in existing and remolded states (ASTM D 2573).
BS Bag sample, disturbed, obtained from cuttings.

Recovery is expressed as a ratio of the length recovered to the total length pushed, driven, cored.

Blows Numbers indicate blows per 6 inches of split-spoon sampler penetration when driven with a 140-pound hammer falling freely 30 inches. The number of total blows obtained for the second and third 6-inch increments is the N value (Standard Penetration Test or SPT) in blows per foot (ASTM D 1586). Practical refusal is considered to be 50 or more blows without achieving 6 inches of penetration, and is expressed as a ratio of 50 to actual penetration, e.g., 50/2 (50 blows for 2 inches).

For analysis, the N value is used when obtained by a cathead and rope system. When obtained by an automatic hammer, the N value may be increased by a factor of 1.3.

Vane Shear Strength is expressed as the peak strength (existing state) / the residual strength (remolded state).

Description indicates soil constituents and other classification characteristics (ASTM D 2488) and the Unified Soil Classification (ASTM D 2487). Secondary soil constituents (expressed as a percentage) are described as follows:

Trace	<5
Few	5-15
With	>15-30

Stratigraphic Breaks may be observed or interpreted, and are indicated by a dashed line. Transition between described materials may be gradual.

Laboratory Test Results

- Natural moisture content (ASTM D 2216) in percent.
- Dry density in pounds per cubic foot (pcf).
- Hand penetrometer value of apparently intact cohesive sample in kips per square foot (ksf).
- Unconfined compressive strength (ASTM D 2166) in kips per square foot (ksf).
- Liquid and Plastic Limits (ASTM D 4318) in percent.

RQD (Rock Quality Designation) is the ratio between the total length of core segments 4 inches or more in length and the total length of core drilled. RQD (expressed as a percentage) indicates insitu rock quality as follows:

Excellent	90 to 100
Good	75 to 90
Fair	50 to 75
Poor	25 to 50
Very Poor	0 to 25

Missouri Department of Transportation
Construction and Materials

Job No.: JSE0083 (SCI No. 2023-1428.10)
County: Wayne
Route: Route 67 Over Otter Creek
Design: L0210
Skew:
Location: Wayne County, Missouri
Bent:
Logged By: Ian Aubuchon
Operator: Midwest Drilling, Inc.
Station:
Northing: 421295.998
Date of Work: 11/13/23
Offset:
Easting: 835325.773
Depth to Water: 18.5
Elevation: 397.1
Requested Northing:
Depth Hole Open: 19
Requested Station:
Requested Easting:
Time Change:
Requested Offset:
Equipment: CME 550,Split-Spoon Sampler, Shelby Tube
Requested Elevation:
Location Note:
Drill No.:
Hammer Efficiency: 93.7%
Drilling Method: Continuous Flight Auger

Depth (ft)	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0.0–8.0	0.0-8.0' (GC) Reddish-brown, CLAYEY GRAVEL, fine to coarse chert, some fine- to coarse-grained sand, clay is fat	395						
3.5–5.0			Split-spoon	17	6-10-13 (36)			MC = 22.9%
		390						
8.0–12.0	8.0-12.0' (CL) Reddish-brown, LEAN CLAY, some fine- to medium-grained sand, some fine chert gravel							
8.5–10.0			Split-spoon	67	3-4-6 (16)		PP = 2.00 tsf	LL = 48 PL = 18 MC = 16.5%
12.0–18.5	12.0-18.5' (CH) Reddish-brown, FAT CLAY, some fine- to medium-grained sand, some fine chert gravel	385						
13.5–15.5			Shelby Tube	100		Qu Test Results UCS = 3.80 ksf MC = 36.2% γ_{moist} = 114.6804 pcf		LL = 97 PL = 33
		380						
18.5–19.0	18.5-19.0' WEAK ROCK, likely dolomite		Split-spoon	100	50/0.2'			
19.0	Refusal at 19.0 feet. Bottom of borehole at 19.0 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: U.S. State Plane 1983
Coordinate Zone: Missouri East
Coordinate Proj. Factor: 1.000
Coordinate Datum: NAD 83 (CONUS)
Coordinate Units: U.S. Survey Feet

* Persons using this information are cautioned that the materials shown are determined by the equipment noted and accuracy of the "log of materials" is limited thereby and by judgement of the operator. THIS INFORMATION IS FOR DESIGN PURPOSES ONLY.

Missouri Department of Transportation
Construction and Materials

BORING NO. B-2

Job No.: JSE0083 (SCI No. 2023-1428.10) **County:** Wayne **Route:** Route 67 Over Otter Creek
Design: L0210 **Skew:** **Location:** Wayne County, Missouri
Bent: **Logged By:** Ian Aubuchon **Operator:** Midwest Drilling, Inc.
Station: **Northing:** 421624.35 **Date of Work:** 11/13/23
Offset: **Easting:** 835255.215 **Depth to Water:** 28.0
Elevation: 399.3 **Requested Northing:** **Depth Hole Open:** 36
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 550,Split-Spoon Sampler, Shelby Tube
Requested Elevation: **Location Note:**
Drill No.: **Hammer Efficiency:** 93.7% **Drilling Method:** Continuous Flight Auger

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-9.5' (FILL) Reddish-brown, CLAYEY GRAVEL, fine to coarse, clay is fat							
5			395	Split-spoon	44	4-3-3 (9)			MC = 12.2% Sieve Analysis Sieve # % Passing #200 43.6
10			390	Split-spoon	78	4-7-11 (28)			LL = 39 PL = 18 MC = 19.4%
		9.5-12.0' (FILL): Gray, LEAN CLAY							
		12.0-17.0' (SC) Reddish-brown, CLAYEY SAND, fine- to coarse-grained, clay is fat							
15			385	Split-spoon	94	1-2-2 (6)			MC = 16.4% Sieve Analysis Sieve # % Passing 3/8-inch 100.0 #4 100.0 #10 99.5 #20 97.5 #40 88.5 #60 67.4 #100 48.8 #140 43.9 #200 41.7
		17.0-22.0' (CL) Reddish-brown, SANDY LEAN CLAY, sand is fine- to medium-grained							
20			380	Shelby tube	100		Qu Test Results UCS = 1.40 ksf MC = 21.7% γ_{moist} = 124.7425 pcf		LL = 24 PL = 18

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: U.S. State Plane 1983 **Coordinate Zone:** Missouri East **Coordinate Proj. Factor:** 1.000
Coordinate Datum: NAD 83 (CONUS) **Coordinate Units:** U.S. Survey Feet

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Design: L0210	**Skew:**	**Location:** Wayne County, Missouri
Bent:	**Logged By:** Ian Aubuchon	**Operator:** Midwest Drilling, Inc.
Station:	**Northing:** 421624.35	**Date of Work:** 11/13/23
Offset:	**Easting:** 835255.215	**Depth to Water:** 28.0
Elevation: 399.3	**Requested Northing:**	**Depth Hole Open:** 36
Requested Station:	**Requested Easting:**	**Time Change:**
Requested Offset:	**Equipment:** CME 550,Split-Spoon Sampler, Shelby Tube	
Requested Elevation:	**Location Note:**	
Drill No.:	**Hammer Efficiency:** 93.7%	**Drilling Method:** Continuous Flight Auger

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
20		17.0-22.0' (CL) Reddish-brown, SANDY LEAN CLAY, sand is fine- to medium-grained *(continued)*							
		22.0-36.0' (GP) Brown, POORLY GRADED GRAVEL WITH CLAY AND SAND, fine to coarse chert, sand is fine- to coarse-grained, clay is fat							
25			375	X	83	6-9-12 (33)			MC = 9.5% Sieve Analysis Sieve # % Passing 1-inch 100.0 3/4-inch 92.9 1/2-inch 75.4 3/8-inch 70.4 #4 50.0 #10 34.2 #20 24.6 #40 17.9 #60 13.8 #100 11.6 #140 10.5 #200 9.8
	▽	27.0' Clay becomes lean							
30			370	X	33	4-10-13 (36)			MC = 13.1% Sieve Analysis Sieve # % Passing #200 8.9
35		33.5' With weathered dolomite gravel	365	X	33	8-10-15 (39)			MC = 15.2%
		Refusal at 36.0 feet. Bottom of borehole at 36.0 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: U.S. State Plane 1983   **Coordinate Zone:** Missouri East   **Coordinate Proj. Factor:** 1.000

Coordinate Datum: NAD 83 (CONUS)   **Coordinate Units:** U.S. Survey Feet

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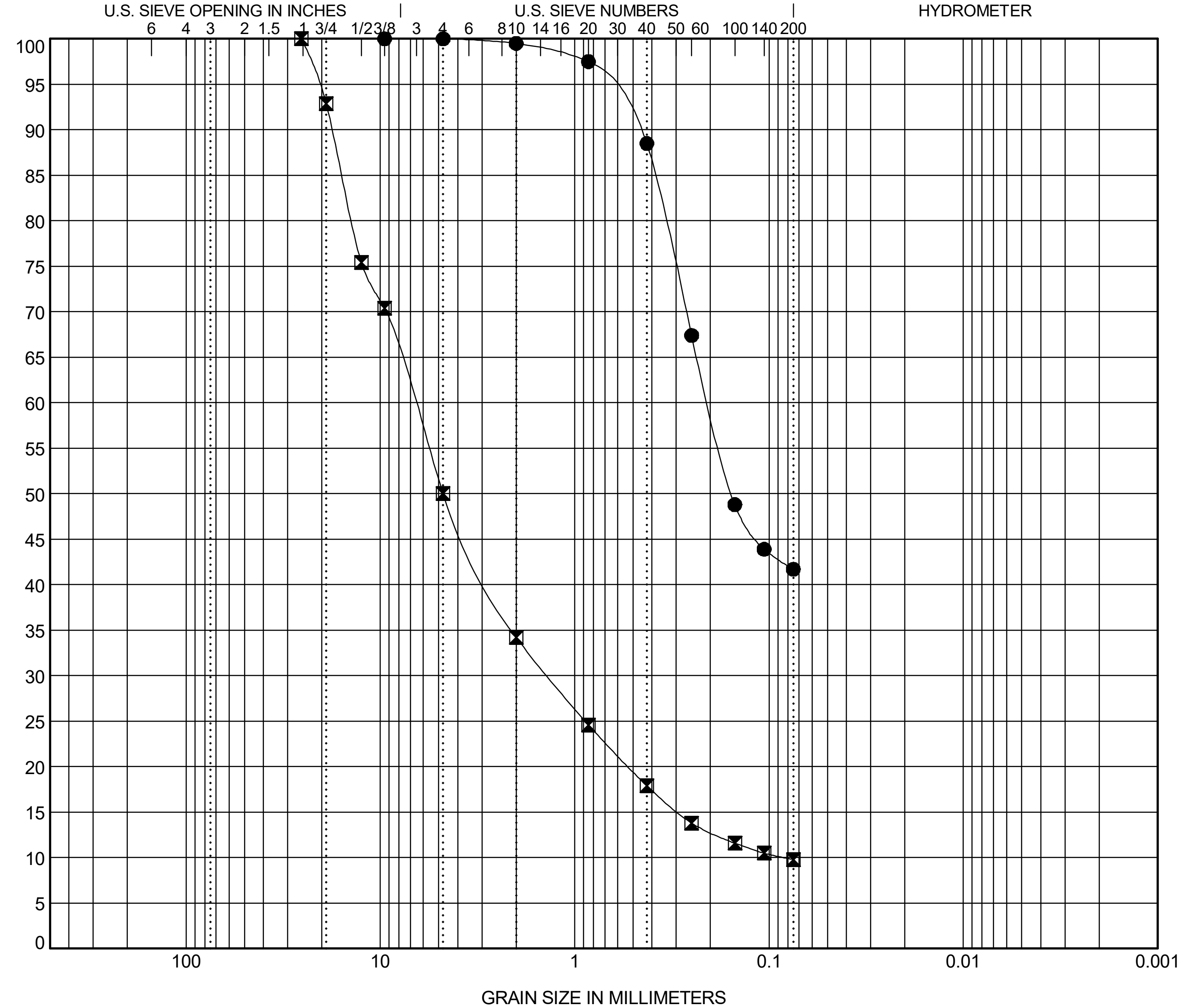
SCI Engineering

GRAIN SIZE DISTRIBUTION

CLIENT MODOT
PROJECT NAME JSE0083 Route 67 Over Otter Creek
PROJECT NUMBER JSE0083 (SCI No. 2023-1428.10)
PROJECT LOCATION Wayne County, Missouri



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		ASTM Classification	LL	PL	PI	Cc	Cu
●	**B-2**	**13.5**	**CLAYEY SAND (SC)**					
⊠	**B-2**	**23.5**	**POORLY GRADED GRAVEL WITH CLAY AND SAND (GP-GC)**				**3.42**	**80.59**

	Specimen Identification		D95	D90	D84	D50	%Gravel	%Sand	%Silt	%Clay
●	**B-2**	**13.5**	**0.701**	**0.477**	**0.380**	**0.155**	**0.0**	**58.3**	**41.7**	
⊠	**B-2**	**23.5**	**20.7**	**17.7**	**15.4**	**4.75**	**50.0**	**40.2**	**9.8**	

Appendix C

Soil Map—Wayne County, Missouri

Map Scale: 1:4,330 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 50, 100, 200, 300

Feet: 0, 200, 400, 800, 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

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 1:24,000.

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: Wayne County, Missouri
Survey Area Data: Version 26, Aug 23, 2023

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

Date(s) aerial images were photographed: Sep 18, 2022—Sep 25, 2022

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
73139	Poynor-Clarksville-Scholten complex, 8 to 15 percent slopes, stony	4.4	4.7%
73140	Clarksville-Scholten complex, 15 to 45 percent slopes, very stony	16.1	17.2%
74646	Cornwall silt loam, 3 to 8 percent slopes	3.0	3.2%
74679	Higdon silt loam, 0 to 2 percent slopes, rarely flooded	1.4	1.5%
75379	Kaintuck loam, 0 to 3 percent slopes, frequently flooded	49.5	52.8%
75381	Bearthicket silt loam, 0 to 2 percent slopes, rarely flooded	16.7	17.8%
75408	Secesh silt loam, 0 to 2 percent slopes, rarely flooded	2.6	2.8%
Totals for Area of Interest		**93.7**	**100.0%**

Appendix D

BORING P-1

SAMPLE NO.	LENGTH 1	LENGTH 2	LENGTH 3	AVERAGE
1	15.4	15.5	15.7	15.6

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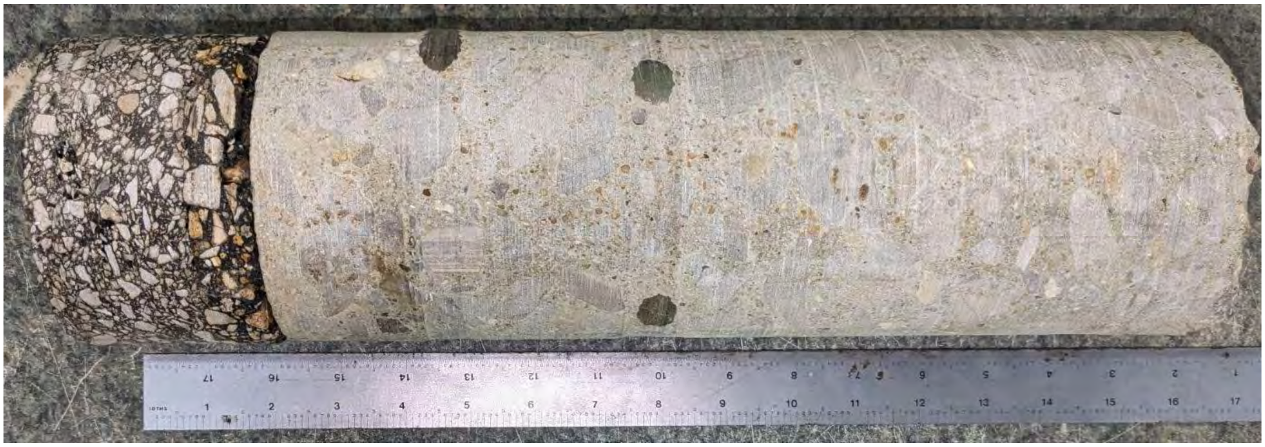
WAYNE COUNTY, MISSOURI

PAVEMENT CORES

DECEMBER 2023 SCI No. 2023-1428.10

BORING P-2



SAMPLE NO.	LENGTH 1	LENGTH 2	LENGTH 3	AVERAGE
1	15.0	15.2	14.9	15.1

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Important Information about This

Geotechnical-Engineering Report

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

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

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

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

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

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

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

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

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

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

This Report's Recommendations Are Confirmation-Dependent

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

This Report Could Be Misinterpreted

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

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

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

Give Constructors a Complete Report and Guidance

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

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

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Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org