

August 21, 2020



Missouri Department of Transportation
1711 S Highway 61
Hannibal, Missouri 63401

Attn: Mr. Jeff Gander, P.E.
(660) 651 0057
jeffery.gander@modot.mo.gov

Re: Geotechnical Data Report
Bridge H0551 – Route YY over Bear Creek
Gentry County, Missouri
MoDOT Project Number: J1S0596
Terracon Project Number: 0220P078

Dear Mr. Gander:

Terracon Consultants, Inc. (Terracon) has completed the subsurface exploration for the referenced bridge. This report presents the findings of the subsurface exploration.

PROJECT INFORMATION

This geotechnical data report presents the results of our subsurface exploration and laboratory testing program for the Route YY Bridge (H0551) over Bear Creek in Gentry County, Missouri. The subsurface exploration included the advancement of two (2) test borings to depths of approximately 100 feet below the existing ground surface. The purpose of the exploration was to obtain subsurface information for use in the preliminary design of a future bridge replacement.

Maps showing the site location and boring locations are shown in the **Site Location Plan** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs and test data sheets in the **Exploration Results** section of this report. The **General Comments** section provides an understanding of the report limitations.

Exploration Procedures

The exploration was performed with a track-mounted Central Mine Equipment Company (CME) drill rig. The boreholes were advanced using solid-stem augers and mud rotary drilling methods.

Terracon Consultants, Inc. 15620 W 113th Street Lenexa, Kansas 66219
P [913] 492 7777 F [913] 492 7443 terracon.com

Environmental



Facilities



Geotechnical



Materials

Geotechnical Data Report

H0551 – Route YY over Bear Creek ■ Gentry County, Missouri

August 21 2020 ■ Project No. 0220P078



The borings were terminated at depths of 100 feet below the ground surface. Upon completion, the borings were backfilled with bentonite chips and auger cuttings. The existing pavements were surface patched with asphalt cold patch product.

The northing/easting and ground surface elevations at the boring locations were provided by Crawford, Murphy, & Tilly.

Laboratory Testing

Classification of the soil samples was performed in accordance with the Unified Soil Classification System (USCS) based on the material's texture and plasticity. The following tests were performed on selected portions of the recovered soil samples:

- Moisture Content
- Atterberg limits (Liquid Limit, Plastic Limit, and Plasticity Index)
- Particle-Size Analysis

SUBSURFACE CONDITIONS

Approximately 6 inches of asphalt was encountered at the ground surface at the boring locations. The asphalt was underlain by approximately 10 to 13½ feet of existing fill materials composed of lean clay and silt. The existing fill materials were underlain by native clay and sand that extended to the boring termination depths. The boring location information and subsurface conditions are summarized in the following table:

Boring	Location	Total Depth (feet)	Top of Rock Elevation (feet)	Overburden Depth (feet)
B-401 (Northwest)	2807817.49 E 1524028.44 N	100	N/A	100+
B-402 (Southeast)	2807985.17 E 1523892.30 N	100		

Groundwater Conditions

The borings were observed during auger drilling for the presence and level of water. Groundwater was not observed while auger drilling. The borings were advanced below depths of approximately 10 feet using mud rotary drilling procedures. Introduction of water during mud rotary drilling procedures masks indications of naturally occurring groundwater. Due to the low permeability of some of the soils encountered in the borings, a relatively long period of time may be necessary for a groundwater level to develop and stabilize in a borehole. Long-term observations in piezometers or observation wells, sealed from the influence of surface water, are often required to define groundwater levels in materials of this type.

Geotechnical Data Report

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Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff, the water level in Bear Creek, and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be different than the levels indicated on the boring logs.

GENERAL COMMENTS

The data presented in this letter and attachments were obtained from borings performed at the indicated locations. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction.

This letter has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical exploration practices. No warranties, either express or implied, are intended or made.

We appreciate the opportunity to be of service to you on this project. Please contact us if you have any questions or if we can be of further assistance.

Sincerely,

Terracon Consultants, Inc.

Daniel A. Barnett, P.G.
Project Geologist
Missouri: 2007035892

Kole C. Berg, P.E.
Senior Engineer
Missouri: 2002016417

Attachments

- n Site Location Plan
- n Exploration Plan
- n Exploration Results
- n Supporting Information

SITE LOCATION PLAN

SITE LOCATION

H0551 – Route YY over Bear Creek ■ Gentry County, Missouri

August 21, 2020 August 20, 2020 ■ Terracon Project No. 0220P078



DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY
QUADRANGLES INCLUDE: GRANT CITY, MO (1/1/1984) and GENTRY, MO (1/1/1984).

EXPLORATION PLAN

EXPLORATION PLAN

H0551 – Route YY over Bear Creek ■ Gentry County, Missouri

August 21, 2020 August 20, 2020 ■ Terracon Project No. 0220P078

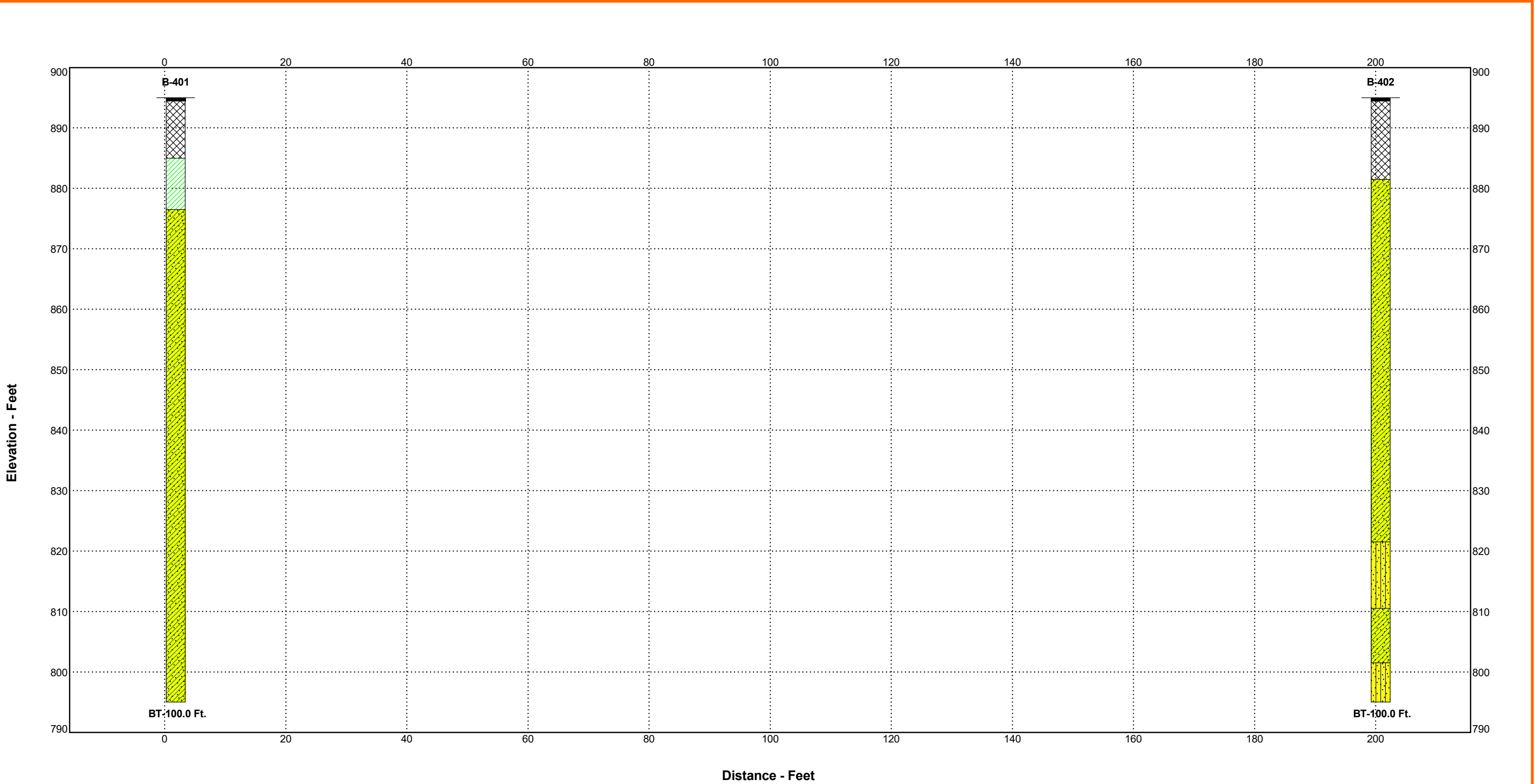


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS
NOT INTENDED FOR CONSTRUCTION PURPOSES

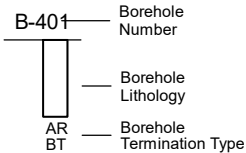
AERIAL PHOTOGRAPHY PROVIDED
BY MICROSOFT BING MAPS

EXPLORATION RESULTS

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT: SMART FENCE 0220P078 MODOT FARM BRIDGE.GPJ TERRACON_DATATEMPLATE.GDT 7/22/20



Explanation



- Asphalt
- Fill
- Lean Clay
- Sandy Lean Clay
- Silty Sand

NOTES:
See General Notes in [Supporting Information](#) for symbols and soil classifications.
Soils profile provided for illustration purposes only.
Soils between borings may differ
BT - Boring Termination

Project No.: 0220P078	<div>Terracon</div> <div>15620 W 113th St Lenexa, KS</div>	SUBSURFACE PROFILE
Date: 8/21/2020		H0551 - ROUTE YY OVER BEAR CREEK GENTRY COUNTY, MISSOURI
Scale: As shown		

BORING LOG NO. B-401

Page 1 of 2

PROJECT: MoDOT FARM Bridges Project

CLIENT: Missouri Department of Transportation
Hannibal, Missouri

SITE: Project J1S0596 - Bridge H0551
Gentry County, Missouri

GRAPHIC LOG	LOCATION See Exploration Plan Northing: 1524028.44 Easting: 2807817.49 Surface Elev.: 895.86 (Ft.) DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	BLOW COUNTS (N ₆₀)	COMPRESSIVE STRENGTH (psi)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	0.5' 6" ASPHALT	0.5			10		4-4-6 (15)		22.0		
	FILL - LEAN CLAY AND SILT , trace sand, dark brown, medium stiff to stiff				6		1-2-2 (6)		23.5		
					10		3-3-5 (12)		25.2	45-27-18	
	LEAN CLAY (CL) , brown and dark brown, medium stiff	10.0			14		2-3-5 (12)		27.6		
					14		2-1-2 (5)		35.5		
	SANDY LEAN CLAY (CL) , gray and dark gray, medium stiff to stiff	18.5			18		0-1-2 (5)		28.9		
					14		4-3-4 (11)		18.6		
	very soft from 33.5 to 40 feet				14		2-2-2 (6)		30.3		
					18		0-0-1 (2)		36.8		
	very stiff at 43.5 feet				18		0-0-0		27.4		
					12		3-6-8 (21)		16.9		
	trace fine gravel from 48.5 to 74.5 feet				14		2-3-4 (11)		22.9		
					18		1-3-4 (11)		22.1		
		60			18		2-3-5 (12)		20.6		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
0'-10': solid-stem flight augers
below 10': mud rotary

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite
Surface Capped with Asphalt

Elevations were provided by others.

Notes:

1) SPT hammer energy transfer ratio (ETR): 90%

WATER LEVEL OBSERVATIONS

Not encountered prior to initiating mud rotary advancement method

Terracon
15620 W 113th St
Lenexa, KS

Boring Started: 06-24-2020

Drill Rig: 850X

Project No.: 0220P078

Boring Completed: 06-24-2020

Driller: DB

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 0220P078 MODOT FARM BRIDGE GPJ TERRACON DATATEMPLATE GDT 8/21/20



BORING LOG NO. B-401

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PROJECT: MoDOT FARM Bridges Project

CLIENT: Missouri Department of Transportation
Hannibal, Missouri

SITE: Project J1S0596 - Bridge H0551
Gentry County, Missouri

GRAPHIC LOG	LOCATION See Exploration Plan Northing: 1524028.44 Easting: 2807817.49 Surface Elev.: 895.86 (Ft.) DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	BLOW COUNTS (N ₆₀)	COMPRESSIVE STRENGTH (psi)	WATER CONTENT (%)	ATTERBERG LIMITS	PERCENT FINES
										LL-PL-PI	
	SANDY LEAN CLAY (CL) , gray and dark gray, medium stiff to stiff (<i>continued</i>)			X	18		2-3-5 (12)				67
	very stiff to hard from 68.5 feet to 78.5 feet	70		X	18		3-5-9 (21)		18.5		
				X	16		9-15-17 (48)		17.9		
		80		X	18		3-4-5 (14)		19.6		
			X	18		2-3-5 (12)		20.2			
	very stiff to hard below 88.5 feet	90		X	18		11-15-30 (68)		23.8		
			X	18		6-7-9 (24)		27.3			
	100.0 796	100		X	18		9-19-28 (71)		13.1		
Boring Terminated at 100 Feet											
Stratification lines are approximate. In-situ, the transition may be gradual. Hammer Type: Automatic											
Advancement Method: 0'-10': solid-stem flight augers below 10': mud rotary			Elevations were provided by others.			Notes: 1) SPT hammer energy transfer ratio (ETR): 90%					
Abandonment Method: Boring backfilled with Auger Cuttings and/or Bentonite Surface Capped with Asphalt											
WATER LEVEL OBSERVATIONS			 15620 W 113th St Lenexa, KS			Boring Started: 06-24-2020			Boring Completed: 06-24-2020		
Not encountered prior to initiating mud rotary advancement method						Drill Rig: 850X			Driller: DB		
						Project No.: 0220P078					

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 0220P078 MODOT FARM BRIDGE GPJ TERRACON DATATEMPLATE GDT 8/21/20

BORING LOG NO. B-402

Page 1 of 2

PROJECT: MoDOT FARM Bridges Project

CLIENT: Missouri Department of Transportation
Hannibal, Missouri

SITE: Project J1S0596 - Bridge H0551
Gentry County, Missouri

GRAPHIC LOG	LOCATION See Exploration Plan Northing: 1523892.3 Easting: 2807985.17 Surface Elev.: 895.79 (Ft.) ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	BLOW COUNTS (N ₆₀)	COMPRESSIVE STRENGTH (psi)	WATER CONTENT (%)	ATTERBERG LIMITS	PERCENT FINES
										LL-PL-PI	
	0.5' 6" ASPHALT	895.5			10		3-3-4 (11)		18.2		
	FILL - LEAN CLAY AND SILT , trace gravel, brown and dark gray, soft to stiff				12		0-1-2 (5)		22.1		
					12		1-1-2 (5)		29.0	49-29-20	
					8		1-1-1 (3)		30.6		
	13.5' SANDY LEAN CLAY (CL) , gray and dark gray, soft to stiff	882.5			12		0-1-2 (5)		21.4		
					10		0-1-4 (8)		21.1		
					6		2-2-4 (9)		14.4		
					14		2-2-2 (6)		30.7		
					16		1-1-2 (5)		37.0		
					14		1-1-1 (3)		35.6		
					12		2-3-3 (9)		32.0		
					8		4-4-4 (12)		18.2		
					16		3-4-5 (14)		21.9		
					18		3-4-5 (14)		21.7		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
0'-10': solid-stem flight augers
below 10': mud rotary

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite
Surface Capped with Asphalt

Elevations were provided by others.

Notes:

1) SPT hammer energy transfer ratio (ETR): 90%

WATER LEVEL OBSERVATIONS

Not encountered prior to initiating mud rotary advancement method

Terracon
15620 W 113th St
Lenexa, KS

Boring Started: 06-23-2020

Drill Rig: 850X

Project No.: 0220P078

Boring Completed: 06-23-2020

Driller: DB

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 0220P078 MODOT FARM BRIDGE GPJ TERRACON DATATEMPLATE GDT 8/21/20

BORING LOG NO. B-402

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PROJECT: MoDOT FARM Bridges Project

**CLIENT: Missouri Department of Transportation
Hannibal, Missouri**

**SITE: Project J1S0596 - Bridge H0551
Gentry County, Missouri**

GRAPHIC LOG	LOCATION See Exploration Plan Northing: 1523892.3 Easting: 2807985.17 Surface Elev.: 895.79 (Ft.) DEPTH
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Stratification lines are approximate. In-situ, the transition may be gradual.

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0'-10': solid-stem flight augers
below 10': mud rotary

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Boring backfilled with Auger Cuttings and/or Bentonite
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Elevations were provided by others.

Notes:

1) SPT hammer energy transfer ratio (ETR): 90%

WATER LEVEL OBSERVATIONS

Not encountered prior to initiating mud rotary advancement method

Terracon
15620 W 113th St
Lenexa, KS

Boring Started: 06-23-2020

Boring Completed: 06-23-2020

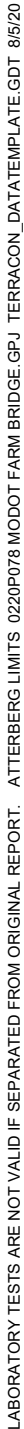
Drill Rig: 850X

Driller: DB

Project No.: 0220P078

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 0220P078 MODOT FARM BRIDGE GPJ TERRACON DATATEMPLATE GDT 8/21/20

ASTM D4318

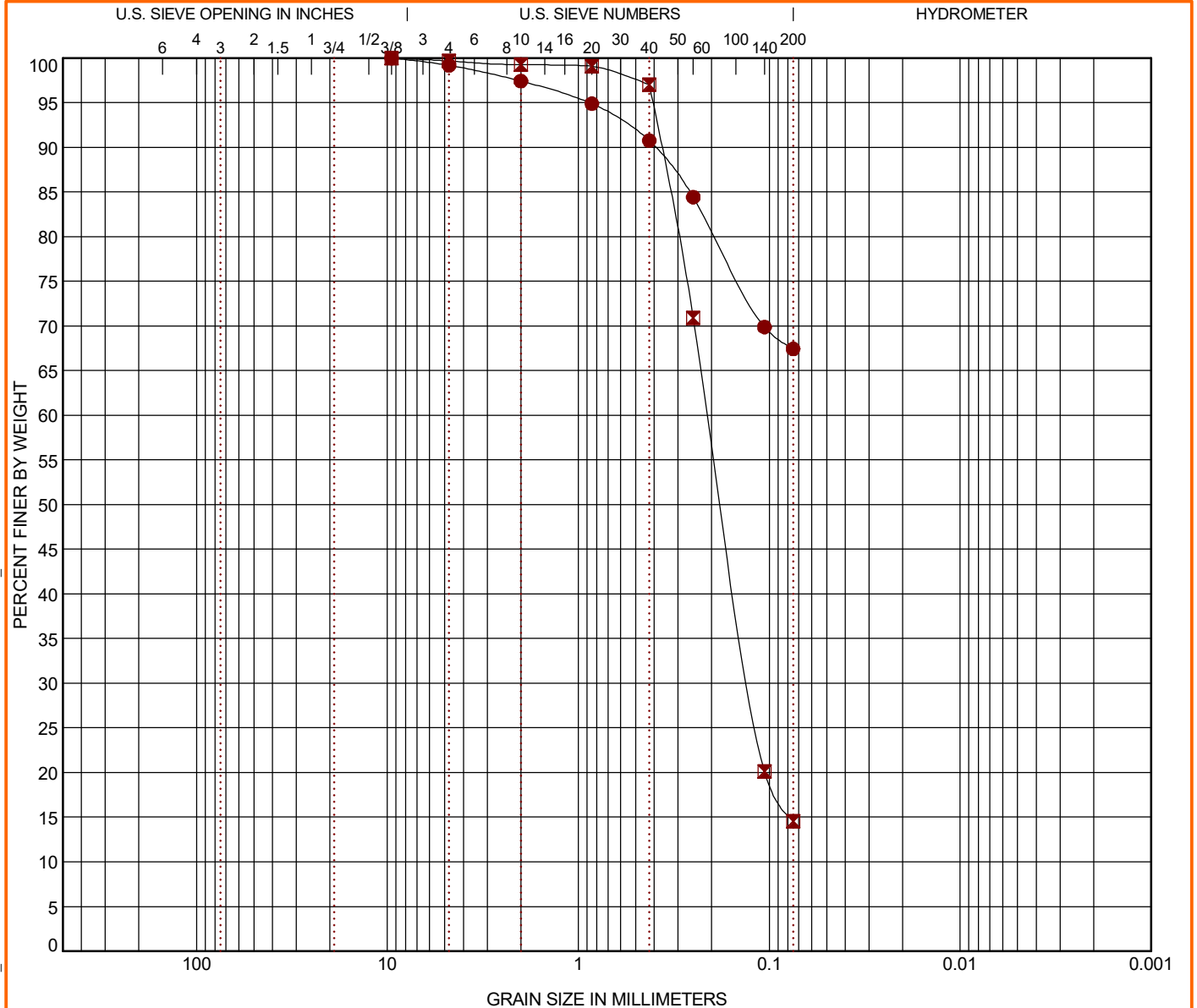


CLIENT: Missouri Department of Transportation
Hannibal, Missouri

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE USCS-2_SCOUR_0220P078 MODOT FARM BRIDGE.GPJ TERRACON_DATATEMPLATE.GDT 8/5/20








COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID	Depth	USCS Classification				WC (%)	LL	PL	PI	Cc	Cu
● B-401	63.5 - 65										
✕ B-402	73.5 - 75					23.8					
Boring ID	Depth	D ₉₀	D ₅₀	D ₃₀	D ₁₀	%Gravel	%Sand	%Silt	%Fines	%Clay	
● B-401	63.5 - 65	0.399				0.8	31.8		67.4		
✕ B-402	73.5 - 75	0.368	0.176	0.125		0.3	85.1		14.6		

PROJECT: MoDOT FARM Bridges Project	 15620 W 113th St Lenexa, KS	PROJECT NUMBER: 0220P078
SITE: Project J1S0596 - Bridge H0551 Gentry County, Missouri		CLIENT: Missouri Department of Transportation Hannibal, Missouri

SUPPORTING INFORMATION

GENERAL NOTES

SAMPLING	WATER LEVEL	FIELD TESTS
 Rock Core  Split Spoon	 Water Initially Encountered  Water Level After a Specified Period of Time  Water Level After a Specified Period of Time <p>Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.</p>	N Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer UC Unconfined Compressive Strength (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength q_u , (psf)	Standard Penetration or N-Value Blows/Ft.
Very Loose	0 - 3	Very Soft	less than 500	0 - 1
Loose	4 - 9	Soft	500 to 1,000	2 - 4
Medium Dense	10 - 29	Medium Stiff	1,000 to 2,000	4 - 8
Dense	30 - 50	Stiff	2,000 to 4,000	8 - 15
Very Dense	> 50	Very Stiff	4,000 to 8,000	15 - 30
		Hard	> 8,000	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL		RELATIVE PROPORTIONS OF FINES	
Descriptive Term(s) of other constituents	Percent of Dry Weight	Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	<15	Trace	<5
With	15-29	With	5-12
Modifier	>30	Modifier	>12
GRAIN SIZE TERMINOLOGY		PLASTICITY DESCRIPTION	
Major Component of Sample	Particle Size	Term	Plasticity Index
Boulders	Over 12 in. (300 mm)	Non-plastic	0
Cobbles	12 in. to 3 in. (300mm to 75mm)	Low	1 - 10
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)	Medium	11 - 30
Sand	#4 to #200 sieve (4.75mm to 0.075mm)	High	> 30
Silt or Clay	Passing #200 sieve (0.075mm)		

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A					Soil Classification	
					Group Symbol	Group Name ^B
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels:	Cu ³ 4 and 1 £ Cc £ 3 ^E		GW	Well-graded gravel ^F
		Less than 5% fines ^C	Cu < 4 and/or 1 > Cc > 3 ^E		GP	Poorly graded gravel ^F
		Gravels with Fines:	Fines classify as ML or MH		GM	Silty gravel ^{F, G, H}
		More than 12% fines ^C	Fines classify as CL or CH		GC	Clayey gravel ^{F, G, H}
	Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands:	Cu ³ 6 and 1 £ Cc £ 3 ^E		SW	Well-graded sand ^I
		Less than 5% fines ^D	Cu < 6 and/or 1 > Cc > 3 ^E		SP	Poorly graded sand ^I
		Sands with Fines:	Fines classify as ML or MH		SM	Silty sand ^{G, H, I}
		More than 12% fines ^D	Fines classify as CL or CH		SC	Clayey sand ^{G, H, I}
Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit less than 50	Inorganic:	PI > 7 and plots on or above “A”		CL	Lean clay ^{K, L, M}
			PI < 4 or plots below “A” line ^J		ML	Silt ^{K, L, M}
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay ^{K, L, M, N}
			Liquid limit - not dried		Organic silt ^{K, L, M, O}	
	Silts and Clays: Liquid limit 50 or more	Inorganic:	PI plots on or above “A” line		CH	Fat clay ^{K, L, M}
			PI plots below “A” line		MH	Elastic Silt ^{K, L, M}
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay ^{K, L, M, P}
			Liquid limit - not dried		Organic silt ^{K, L, M, Q}	
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

^A Based on the material passing the 3-inch (75-mm) sieve

^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^C Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

^D Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

$$^E Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

^F If soil contains ³ 15% sand, add "with sand" to group name.

^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^H If fines are organic, add "with organic fines" to group name.

^I If soil contains ³ 15% gravel, add "with gravel" to group name.

^J If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

^K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

^L If soil contains ³ 30% plus No. 200 predominantly sand, add "sandy" to group name.

^M If soil contains ³ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

^N PI ³ 4 and plots on or above "A" line.

^O PI < 4 or plots below "A" line.

^P PI plots on or above "A" line.

^Q PI plots below "A" line.

