

RED ROCK CONSULTING

Report of Geotechnical Investigation

OF THE

**STATE HIGHWAY 100 BRIDGE OVER ARKANSAS RIVER
MUSKOGEE AND SEQUOYAH COUNTIES, OKLAHOMA**

32100(04)

Prepared For:

CEC
4555 West Memorial Road
Oklahoma City, Oklahoma 73142
Attention: Mr. Chad Grinsteiner, PE

Prepared By:

Red Rock Consulting, LLC
PO Box 30591
Edmond, Oklahoma 73003
(405) 562-3328

October 14, 2022
Project No. 20059

RED ROCK CONSULTING

October 14, 2022

CEC
4555 West Memorial Road
Oklahoma City, Oklahoma 73142

Attention: Mr. Chad Grinsteiner, PE

Re: Report of Geotechnical Investigation
State Highway 100 Bridge over Arkansas River
Muskogee and Sequoyah Counties, Oklahoma
32100(04)
Project No. 20059

Dear Mr. Grinsteiner:

I am pleased to submit herewith this report entitled "Geotechnical Investigation, State Highway 100 Bridge over Arkansas River, Muskogee and Sequoyah Counties, Oklahoma, 32100(04)".

In an effort to provide a more environmentally friendly service, this report has been provided electronically.

It has been our pleasure to assist you with this project. Should you have any questions regarding the contents of this report, please contact Red Rock Consulting.

Yours very truly,
RED ROCK CONSULTING, LLC
CA No. 5707 Exp. 06/30/23



Emma Coggin, EI
Project Specialist



Jeremy Basler, PE
Geotechnical Manager
Oklahoma PE No. 20233



REPORT OF GEOTECHNICAL INVESTIGATION
SH 100 BRIDGE OVER ARKANSAS RIVER
MUSKOGEE AND SEQUOYAH COUNTIES, OKLAHOMA

32100(04)

PROJECT NO. 20059

INTRODUCTION.....	1
GENERAL.....	1
PROPOSED CONSTRUCTION	1
SCOPE OF WORK	1
FIELD AND LABORATORY INVESTIGATIONS	2
FIELD EXPLORATION	2
LABORATORY TESTING.....	4
SITE DESCRIPTION.....	5
SURFACE CONDITIONS.....	5
SITE GEOLOGY	5
SUBSURFACE CONDITIONS.....	6
GROUNDWATER CONDITIONS	8
INTERNATIONAL BUILDING CODE SITE CLASS	9
CLOSURE.....	10

APPENDICES

APPENDIX A – Field Investigation
APPENDIX B – Laboratory Results
APPENDIX C – Rock Core Photographs
APPENDIX D – General Notes

REPORT OF GEOTECHNICAL INVESTIGATION
SH 100 BRIDGE OVER ARKANSAS RIVER
MUSKOGEE AND SEQUOYAH COUNTIES, OKLAHOMA

32100(04)

PROJECT NO. 20059

INTRODUCTION

General

This report presents the results of the geotechnical investigation performed for the proposed replacement of a fifteen-span bridge along SH 100 over the Arkansas River, located at the Muskogee/Sequoyah County line east of Webbers Falls, in Muskogee and Sequoyah Counties, Oklahoma. The purpose of this investigation is to evaluate the subsurface conditions at the site and to provide information pertaining to the geotechnical aspects of the proposed project.

Proposed Construction

The project will include the proposed replacement of a fifteen-span bridge along SH 100 over the Arkansas River, located at the Muskogee/Sequoyah County line east of Webbers Falls, in Muskogee and Sequoyah Counties, Oklahoma. The new bridge will be a seven-span bridge on the existing alignment.

Scope of Work

The scope of this investigation includes the following:

1. Review of previous geotechnical and geological information of sites near this site. This was augmented with data obtained during the field investigation phase of the project.
2. Investigation of the subsurface soils by drilling and testing a total of 8 boreholes within the planned project area.
3. A laboratory testing program consisting of moisture content, Atterberg limits, and full sieve tests on the overburden soils encountered. Also included were unconfined compressive strength tests on select rock core samples.
4. International Building Code (IBC) site classification for seismic design.

FIELD AND LABORATORY INVESTIGATIONS

Field Exploration

Subsurface exploration was performed on March 8th to 9th and September 13th to 14th, 2022. The borings were located in the field by a representative of Red Rock Consulting by measuring distances from known site reference points as depicted on plans that were provided by CEC. The locations of the borings should be considered accurate only to the degree implied by the methods used to define them.

The subsurface exploration program consisted of drilling 8 borings under the full-time supervision of an engineer. Borings B-1 and B-8 were drilled near the proposed abutment locations on land through the embankment of the existing bridge before crossing the Arkansas River. All the remaining borings were drilled near the proposed pier locations. One boring was drilled at each of the proposed pier locations. A self-propelled draft jack barge was used to access the pier borings. All the borings were used to test both the overburden and the rock.

Boring B-1 was drilled 35 feet west of the proposed location. Borings B-2, B-4 and B-6 were drilled 10 feet south of the proposed locations and B-8 was drilled 20 feet north of the proposed location due to a powerline running along the south side of the existing bridge.

Dozer work was not needed to access any of the borings. Traffic control was needed to drill borings B-1 and B-8. The borings are shown on the Boring Location Diagram, which is included in Appendix A.

All the borings were advanced at least 30 feet into bedrock with termination depths ranging between 52.3 and 117 feet. The subsurface conditions are shown on the Boring Logs in Appendix A and are explained in greater detail in the Subsurface Conditions section of this report. The borings were advanced using wet rotary and hollow-stem auger drilling methods from an all-terrain vehicle (ATV) mounted CME-750 drill rig equipped with an automatic hammer. The pier borings that were drilled from the self-propelled draft jack barge were cased with steel pipes from the barge deck to bedrock.

Samples of the overburden were obtained in the borings as per Oklahoma Department of Transportation (ODOT) specifications as modified by Bridge Division. Representative samples of the overburden materials were obtained by split-barrel sampling procedures (Standard Penetration Test, SPT) in general accordance with ASTM Specifications D-1586. After SPT refusal was attained in borings B-5A and B-8, a 3-inch diameter continuous sampler was used to obtain bedrock samples. The bedrock was cored in 5-

foot sections for a total depth of 30 feet in boring B-5A. In boring B-8, the bedrock was cored in 5-foot sections for a total depth of 22 feet. In the remaining borings a diamond bit was needed to drill through the very hard layers encountered in the shale. The hardness of the bedrock was evaluated using the Texas Cone Penetrometer (TCP).

The SPT test uses a standard, 2-inch outside diameter, split-barrel sampling spoon that is driven into the bottom of the boring with a 140-pound automatic drive hammer that falls 30 inches. The blows per foot, N, is the number of hammer blows required to advance the sampling spoon the last 12 inches, or less, of an 18-inch sampling interval. The N value is used to estimate the in-situ relative density of granular soils, the consistency of cohesive soils, and the hardness of weathered bedrock.

Drilling equipment and methods have evolved considerably over the past 65 years following the development of the first SPT empirical design correlations. As a result, the automatic drive hammers on modern geotechnical drilling rigs must be calibrated for efficiency. The efficiency of an automatic drive hammer is specific to each hammer and is expressed by an energy efficiency ratio. The energy efficiency ratio is calculated by dividing the actual measured energy delivered to the drill rod by the theoretical energy delivered by a 140-pound automatic drive hammer that falls 30 inches. The hammer efficiency can be used to convert a SPT value into an N value with a nominal 60 percent efficiency, the N_{60} value. The N_{60} value is rarely used in engineering practice but is widely considered to be more accurate and more representative of the N values used to develop the original SPT empirical design correlations. Both the N and N_{60} values are presented on the Boring Logs in Appendix A.

The TCP test was developed by the Texas Highway Department in accordance with the AASHTO Manual on Subsurface Investigation and was modified by the Oklahoma Department Transportation. The TCP test is a dynamic penetration test performed to determine the in-situ properties of subsurface soils and to evaluate the consistency or hardness of the bedrock material. The TCP test drives a penetrometer cone into the undisturbed cohesive overburden soil or bedrock material with a 140-pound automatic drive hammer that falls 30 inches. The cone is seated into the undisturbed cohesive soil or bedrock material by driving the cone 10 blows or 12 inches, whichever is achieved first, into the soil/bedrock. The cone is then driven an additional 12 inches or 100 blows, whichever is reached first. If the cone is driven the full 12 inches, the number of blows required to drive each 6 inches of penetration up to 12 inches is recorded. The total number of blows required for the two 6-inch increments are then recorded as the TCP blow count. If the cone is unable to be driven the full 12 inches, the penetration is recorded after every 50 blows up to 100 blows.

After performing SPT and TCP tests, the holes were backfilled with grout and cuttings as required by the Oklahoma State Statutes for Geotechnical drilling.

Samples were collected and transported back to the lab for further classification and testing. The final boring logs were developed from the draft logs, observations and test results of the samples returned to the laboratory. The stratigraphic contacts indicated are only for the specific dates and locations reported, and therefore, are not necessarily representative of other locations and times. The boring logs, presenting conditions encountered at each location explored, are included in Appendix A.

Laboratory Testing

Representative soil samples were tested to refine the field classifications and evaluate physical properties of the soils which may affect the geotechnical aspects of project design and construction. The laboratory testing program included the following:

- Moisture content (ASTM D2216)
- Liquid limit and plastic limit (ASTM D4318)
- Full sieve (ASTM D422)
- Uniaxial compressive strength of intact rock core (ASTM D7012 Method C)

The results of the physical laboratory tests conducted are shown on the Boring Logs in Appendix A and are included in Appendix B.

The above laboratory tests were performed in general accordance with applicable ASTM procedures, or generally accepted practice. It should be noted that reference to ASTM procedures does not imply that all cross-referenced procedures in ASTM standards have been used, or that all ASTM procedures used have been followed exactly. Only those ASTM procedures and/or portions of procedures, which, in the professional judgment of the geotechnical engineer of record for this report, are applicable, appropriate, and necessary for this project, have been used or followed.

SITE DESCRIPTION

Surface Conditions

At the time of the field investigation, a 15-span bridge was present along SH 100 over the Arkansas River. The existing bridge was 2 lanes wide. The traffic along SH 100 was moderate with the majority of it being passenger cars and a lesser amount being semi-trucks during drilling activities. The City of Webbers Falls was located on the west end of the bridge and the City of Gore was located on the east side of the bridge.

In general, the area of the project was agricultural with some industrial and commercial areas in the Cities of Webbers Falls and Gore.

The surface elevations at the abutment boring locations were determined using differential leveling procedures. The existing western and eastern bridge abutments were used as benchmarks. BM 1, the western abutment, had an elevation of 528.61 feet. BM 2, the eastern abutment, had an elevation of 517.31 feet. The elevation of the benchmarks were provided by the client. Based on these benchmarks, the elevations of the abutment borings ranged from 515.7 to 526.9 feet. The elevation of the water level of the Arkansas River at the SH 100 bridge was obtained through the USACE gage data for the Arkansas River at Gore. The water elevation on September 13th was 459.84 feet and on September 14th was 459.90 feet. The depth from the surface of the barge deck to the surface of the Arkansas River was used to find the elevations for borings B-2 to B-7. The approximate elevation at each boring location is shown on the Boring Logs and on the Boring Location Diagram in Appendix A.

Site Geology

The geology of the project site was researched using the "Division One Engineering Classification of Geological Materials", published by the Oklahoma Department of Transportation (ODOT) and the Geologic Map of the "Hydrologic Atlas 1 of Oklahoma, Reconnaissance of the Water Resources of the Fort Smith quadrangle, east-central Oklahoma," by Melvin V. Marcher, U.S. Geological Survey, 1969.

ODOT

The ODOT publication indicates the project site is Alluvium (Qas) underlain by the Atoka Unit (Pa). The geologic units are described therein as follows:

Alluvium consists of recent deposits of sands, silts, clays, gravels, or mixtures of these. These deposits are present along stream beds and flood plains.

The Atoka unit consists of sandstone, siltstone, shale and a few thin beds of limestone. The sandstone beds are soft to hard, brown to gray in color, locally limy and are from a few inches thick to approximately 20 feet thick with sequences of beds, separated by thin stringers of shale, up to 115 feet thick. The siltstone beds are generally hard, brown to gray in color and usually less than one foot thick. The shales for the most part are fissile, locally clayey, brown to black in color and range in thickness from a few inches to 300 feet or more. Generally most shale zones will contain thin siltstone, sandstone and/or limestone beds less than one foot thick.

The Atoka unit ranges in thickness from only a few feet in the northern portion of Division One to as much as 9,000 feet in Pittsburg County.

The Atoka unit outcrops in all counties of Division One except Okmulgee. The topography of this unit is generally hills capped with sandstones and the slopes and valleys formed in the shales. Where the unit is mostly shale, prairies are present.

USGS

The USGS map indicates that the project site consists of Alluvium (Qal) which is underlain by the Atoka Formation (Pa). The geologic formations are described therein as follows:

Alluvium consists of gravel, sand, silt, and clay. Yields large amount of water of good quality along the Arkansas River and probably will yield moderate to large amounts along the Canadian River.

The Atoka Formation consists of shale and sandstone. Yields limited amounts of water of poor quality.

Subsurface Conditions

Information collected during the field investigation indicates that the overburden in the existing embankments consisted of silt with various amounts of sand, silty sand with various amounts of gravel, poorly-graded sand with various amounts of silt and gravel, and lean clay with various amounts of gravel that extended from the surface to the top of bedrock. The overburden in the pier borings consisted of well-graded sand with silt and gravel, well-graded gravel with sand, sand with various amounts of silt and clay, and poorly-graded sand that extended from the surface to the top of bedrock. Approximately 50 feet of fill was observed in boring B-1 and approximately 25 feet of fill was observed in boring B-8.

The top of bedrock was encountered at elevations ranging between 436 and 447.7 feet. The bedrock encountered in the borings consisted predominately of soft to very hard shale. A layer of coal was encountered in boring B-4 at 54 feet. The approximate depths to bedrock and conditions are summarized in Table 1.

The unconfined compressive strength of the bedrock cores recovered ranged between 508 to 18,434 psi in boring B-5A and 3,598 to 19,670 in boring B-8. These results are shown in Table 1, on the Boring Logs in Appendix A and in the Lab Results in Appendix B.

A diamond bit was needed to drill though the very hard shale layers encountered in the borings. The high unconfined compression strength values of some of the test is also an indicator of the very hard shale layers. A heavy-duty pier drilling rig equipped with a rock auger and a core barrel will likely be required to penetrate the bedrock for a rock socket.

Table 1 – Depth to Bedrock and Conditions

Boring	Depth to Bedrock (ft)	Elevation (ft)	Type of Bedrock	Hardness	UC Compressive Strength (psi)
B-1	87.5	439.4	Shale	Hard to very hard	
B-2	25.5	440.2	Shale	Moderately hard to very hard	
B-3	25.5	439.7	Shale	Hard to very hard	
B-4	29.4	436	Shale	Soft to very hard	
	54	411.4	Coal	Very soft	
	55	410.4	Shale	Hard	
B-5/5A	24	442.8	Shale		508 to 18,434
B-6	23	441.8	Shale	Moderately hard to very hard	
B-7	22.1	442.1	Shale	Hard to very hard	
B-8	68	447.7	Shale	Hard to very hard	3,598 to 19,670

*Depth to bedrock for borings B-2 to B-7 from barge deck

Groundwater Conditions

Groundwater conditions were monitored in the borings following completion of drilling operations. The water levels of borings B-2 through B-7 represent the water level of the Arkansas River at the time of field exploration. The approximate groundwater levels are summarized in Table 2. It should be noted that the delayed groundwater levels measured may not be precise due to the nature of wet rotary drilling of the borings.

Table 2 – Groundwater Levels

Boring	During Drilling		After Drilling		
	Depth (ft)	Elevation (ft)	Hours After	Depth (ft)	Elevation (ft)
B-1	60	466.9 ^A	--	--	--
B-2	5.9	459.8 ^B	0	5.9	459.8 ^B
B-3	5.4	459.8 ^B	0	5.4	459.8 ^B
B-4	5.6	459.8 ^B	0	5.6	459.8 ^B
B-5/5A	6.9	459.9 ^B	0	6.9	459.9 ^B
B-6	4.9	459.9 ^B	0	4.9	459.9 ^B
B-7	4.3	459.9 ^B	0	4.3	459.9 ^B
B-8	--	--	24	35	480.7 ^A

^A From the ground surface

^B River level at the time of site investigation

One of the borings caved in as shown in Table 3. The remaining borings remained open following drilling or were closed before cave in occurred.

Table 3 – Cave In Depths

Boring	Hours After	Depth (ft)	Elevation (ft)
B-8	0	48	467.7

To obtain accurate groundwater level information, long-term observations in a well or piezometer that is sealed from the influence of surface water would be needed. Fluctuations in groundwater levels can occur due to seasonal variations in the amount of rainfall, runoff, altered drainage paths, and other factors not evident at the time borings were advanced. Consequently, the contractor should be aware of this possibility while constructing this project.

SH 100 Bridge over Arkansas River
Muskogee and Sequoyah Counties, Oklahoma
32100(04)
RRC Project No. 20059
October 14, 2022

International Building Code Site Class

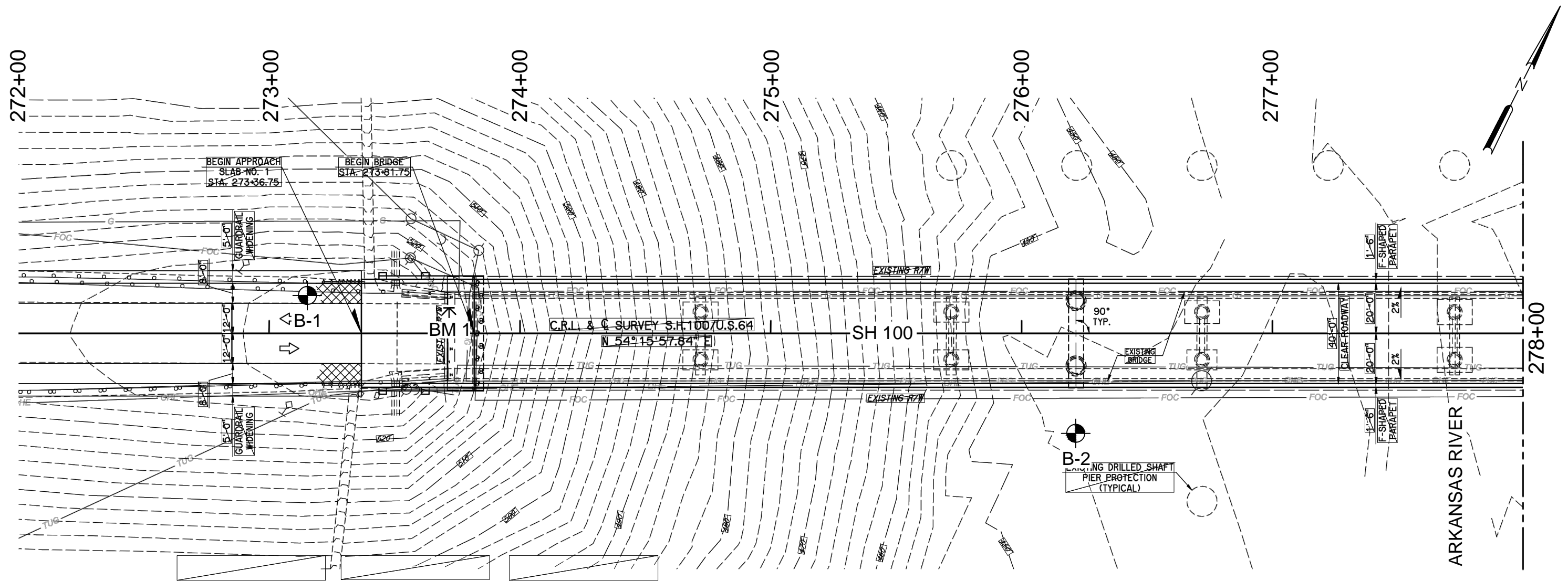
From the geotechnical investigation and subsequent laboratory tests, the onsite soils yield an **International Building Code (IBC) Site Class “D”**. This site class is based on an average standard penetration resistance (SPT) procedure. **This site class does not account for induced earth movement, such as the recent earthquakes due to injection wells.** To obtain a more accurate site class, more extensive testing must be used to evaluate the subsurface conditions.

CLOSURE

The data presented in this report are based on the negotiated scope for this project and site conditions as they existed at the time of the field exploration. The conditions encountered in the exploratory borings are assumed to be representative subsurface conditions within the study area.

This report was prepared for the exclusive use of CEC and their agents and consultants. It should be made available to prospective contractors for information and factual data only and not as a warranty of subsurface conditions similar to those interpreted from the boring logs or discussions presented herein.

APPENDIX A



BORING LOCATIONS AND ELEVATIONS			
Boring	Station	SH 100 CL Survey	Elevation
B-1	273+15	15' left	526.9'
B-2	276+22	40' right	465.7'

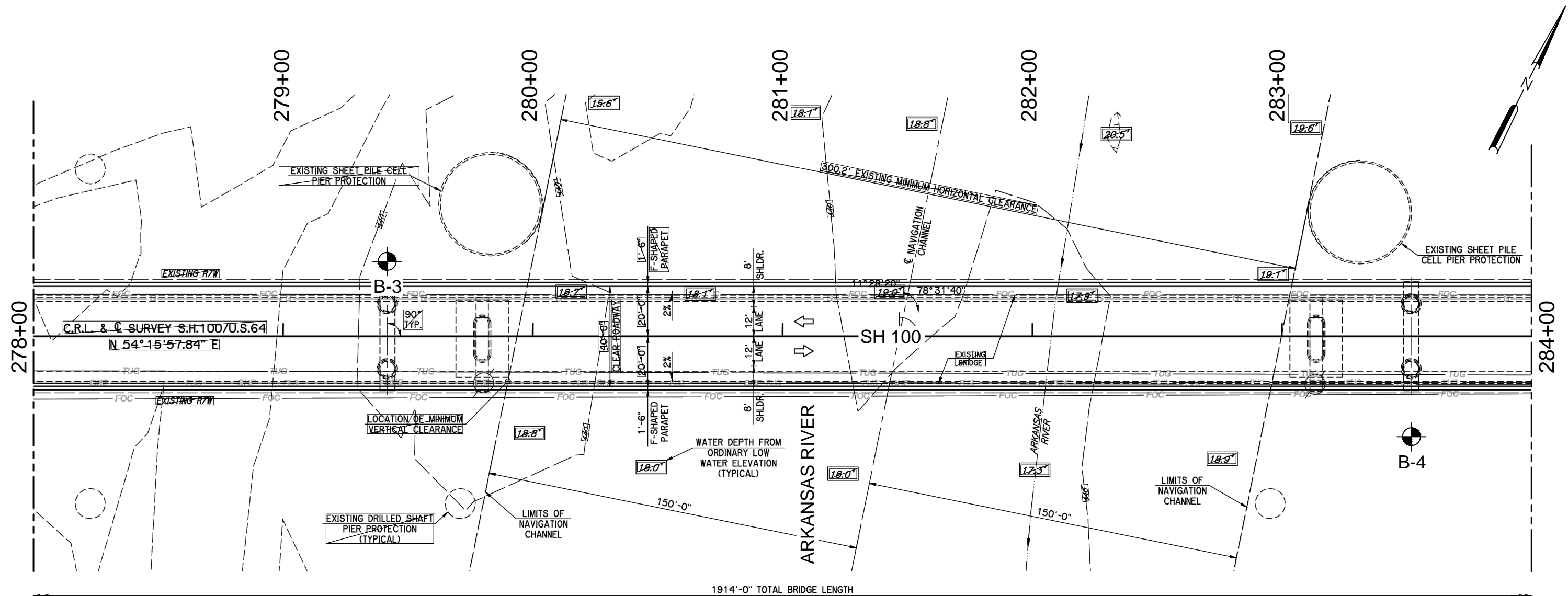
Stations and offsets estimated from plans provided by CEC
BM 1: Paved surface at southwest abutment
Elevation = 528.61 feet
BM 2: Paved surface at northeast abutment
Elevation = 517.31 feet

RED ROCK CONSULTING

PO Box 30591
Edmond, Oklahoma 73003
(405) 562-3328

BORING LOCATION DIAGRAM
SH 100 BRIDGE OVER ARKANSAS RIVER
MUSKOGEE AND SEQUOYAH COUNTIES, OKLAHOMA
32100(04)

Project Mngr:	KKB	RRC Project No.	20059
Designed By:	EDC	Scale:	NOT TO SCALE
Checked By:	JWB	Date:	10/7/2022
Approved By:	JWB	Page No:	1/4



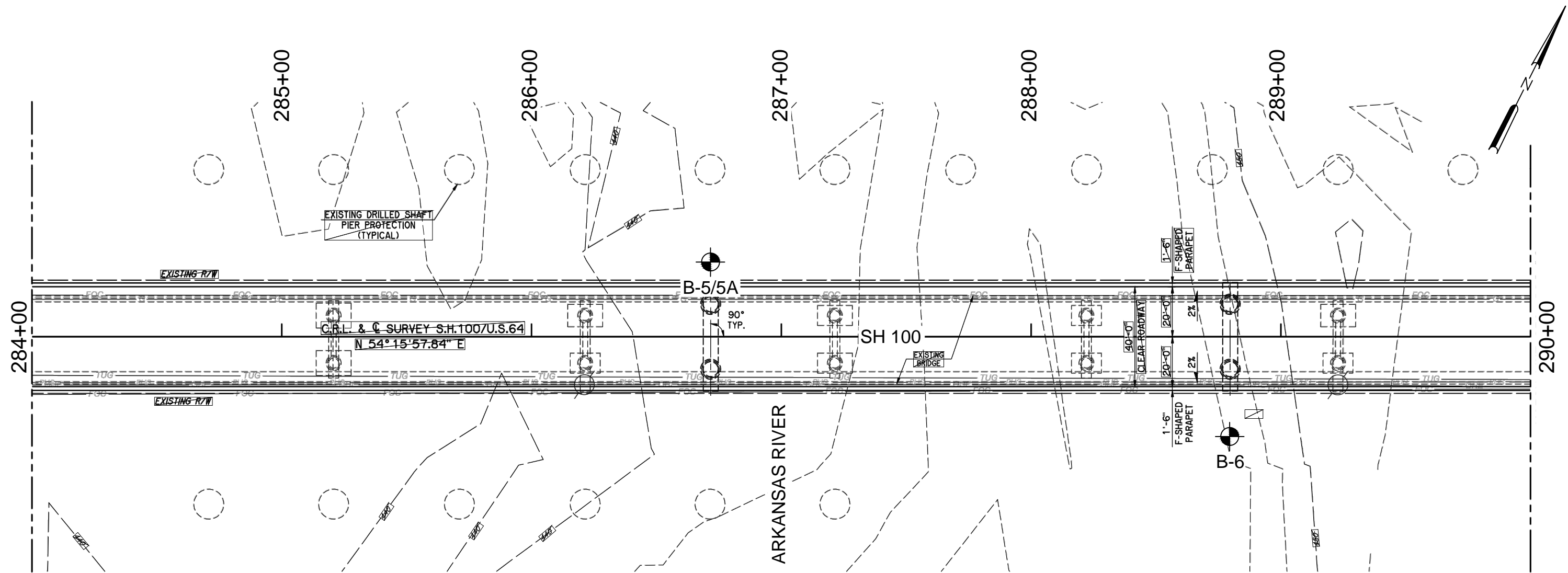
BORING LOCATIONS AND ELEVATIONS			
Boring	Station	SH 100 CL Survey	Elevation
B-3	279+41	30' left	465.2'
B-4	283+52	40' right	465.4'

Stations and offsets estimated from plans provided by CEC
BM 1: Paved surface at southwest abutment
Elevation = 528.61 feet
BM 2: Paved surface at northeast abutment
Elevation = 517.31 feet

RED ROCK
CONSULTING
PO Box 30591
Edmond, Oklahoma 73003
(405) 562-3328

BORING LOCATION DIAGRAM
SH 100 BRIDGE OVER ARKANSAS RIVER
MUSKOGEE AND SEQUOYAH COUNTIES, OKLAHOMA
32100(04)

Project Mngr:	KKB	RRC Project No.	20059
Designed By:	EDC	Scale:	NOT TO SCALE
Checked By:	JWB	Date:	10/7/2022
Approved By:	JWB	Page No:	2/4



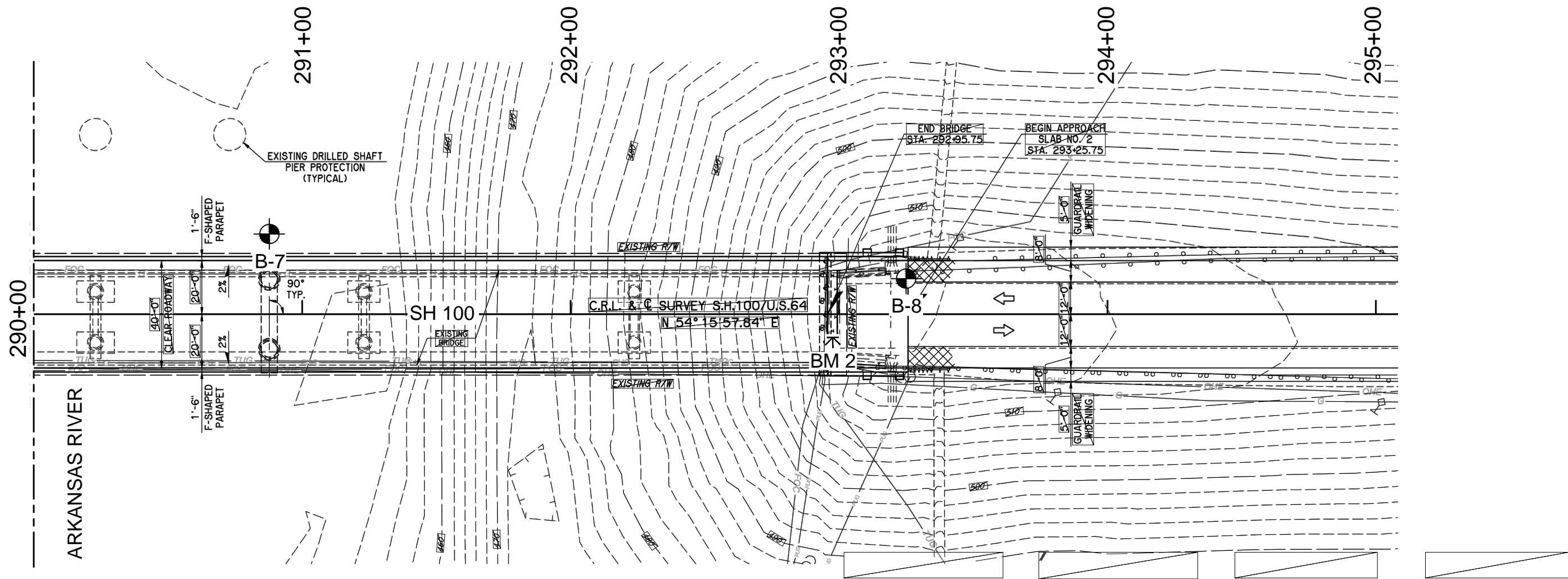
BORING LOCATIONS AND ELEVATIONS			
Boring	Station	SH 100 CL Survey	Elevation
B-5/5A	286+72	30' left	466.8'
B-6	288+80	40' right	464.8'

Stations and offsets estimated from plans provided by CEC
BM 1: Paved surface at southwest abutment
Elevation = 528.61 feet
BM 2: Paved surface at northeast abutment
Elevation = 517.31 feet

RED ROCK
CONSULTING
PO Box 30591
Edmond, Oklahoma 73003
(405) 562-3328

BORING LOCATION DIAGRAM
SH 100 BRIDGE OVER ARKANSAS RIVER
MUSKOGEE AND SEQUOYAH COUNTIES, OKLAHOMA
32100(04)

Project Mngr:	KKB	RRC Project No.	20059
Designed By:	EDC	Scale:	NOT TO SCALE
Checked By:	JWB	Date:	10/7/2022
Approved By:	JWB	Page No:	3/4



BORING LOCATIONS AND ELEVATIONS			
Boring	Station	SH 100 CL Survey	Elevation
B-7	290+88	30' left	464.2'
B-8	293+25	13' left	515.7'

Stations and offsets estimated from plans provided by CEC

BM 1: Paved surface at southwest abutment
Elevation = 528.61 feet

BM 2: Paved surface at northeast abutment
Elevation = 517.31 feet

**RED ROCK
CONSULTING**

PO Box 30591
Edmond, Oklahoma 73003
(405) 562-3328

BORING LOCATION DIAGRAM
SH 100 BRIDGE OVER ARKANSAS RIVER
MUSKOGEE AND SEQUOYAH COUNTIES, OKLAHOMA
32100(04)

Project Mngr:	KKB	RRC Project No.	20059
Designed By:	EDC	Scale:	NOT TO SCALE
Checked By:	JWB	Date:	10/7/2022
Approved By:	JWB	Page No:	4/4

CLIENT CEC **PROJECT NAME** SH 100 Bridge over Arkansas River
PROJECT NUMBER 20059 **PROJECT LOCATION** Muskogee and Sequoyah Counties, Oklahoma
DATE STARTED 3/9/22 **COMPLETED** 3/9/22 **GROUND ELEVATION** 526.9 ft **STATION** 273+15 **OFFSET** 15' left
DRILLING CONTRACTOR DSO - Drilling Services of Oklahoma **GROUND WATER LEVELS:**
DRILLING METHOD HSA to 85 ft, wet rotary to BTd - CME 750 ATV ∇ **DURING DRILLING** 60 ft / Elev 466.9 ft
LOGGED BY MAJ **CHECKED BY** JWB
NOTES J/P# 32100(04), Diamond bit was used for very hard shale layers

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (ft)	SAMPLE TYPE	BLOW COUNTS	BLOW COUNTS N60	MOISTURE CONTENT (%)	ATTERBERG LIMITS			PASSING #200 SIEVE (%)
									LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
	0		19" PORTLAND CEMENT CONCRETE	526.9'								
			SANDY SILT , light brown (7.5 YR 6/2), medium dense *POSSIBLE FILL*	525.3'								
520					⊗ SPT	16	21	18	0	0	NP	68.3
	10		SILTY SAND , light brown (7.5 YR 6/2), medium dense *POSSIBLE FILL*	518.9'								
					⊗ SPT	18	24	15	0	0	NP	49.2
510			SANDY SILT , brown (7.5 YR 5/2), medium dense *POSSIBLE FILL*	511.9'	⊗ SPT	17	23	18	0	0	NP	62.1
	20		SILTY SAND , brown (7.5 YR 5/2), dense *POSSIBLE FILL*	506.9'	⊗ SPT	34	46	6	0	0	NP	12.1
500			SANDY SILT , brown (7.5 YR 5/2), dense *POSSIBLE FILL*	501.9'	⊗ SPT	44	59	14	0	0	NP	58.0
	30		SILTY SAND , brown (7.5 YR 5/2), medium dense to very dense *POSSIBLE FILL*	496.9'	⊗ SPT	40	54	8	0	0	NP	19.9
490					⊗ SPT	55	74	15	0	0	NP	46.0
	40				⊗ SPT	29	39	9	0	0	NP	36.9
480					⊗ SPT	53	71	8	0	0	NP	24.3
	50		SILT with SAND , brown (7.5 YR 5/2), medium dense	476.9'	⊗ SPT	22	29	21	0	0	NP	78.1
470					⊗ SPT	22	29	22	0	0	NP	84.9
	60		SILTY SAND , brown (7.5 YR 5/2), dense	466.9'	⊗ SPT	31	42	19	0	0	NP	47.8

1 RED ROCK LOG 20059 LOGS.GPJ REDROCK.GDT 10/12/22

(Continued Next Page)

CLIENT CEC

PROJECT NAME SH 100 Bridge over Arkansas River

PROJECT NUMBER 20059

PROJECT LOCATION Muskogee and Sequoyah Counties, Oklahoma

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	BLOW COUNTS N60	MOISTURE CONTENT (%)	ATTERBERG LIMITS			PASSING #200 SIEVE (%)
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
460	70		SANDY SILT , brown (7.5 YR 5/2), medium dense to dense 461.9'	⊗ SPT	33	44	18	0	0	NP	57.0
				⊗ SPT	24	32	17	0	0	NP	67.6
450	80		SILTY CLAY , brown (7.5 YR 5/2), very stiff 451.9'	⊗ SPT	23	31	30	21	16	5	95.0
			SILTY SAND , brown (7.5 YR 5/2), medium dense 446.9'	⊗ SPT	26	35	16	0	0	NP	18.7
440			SANDY SILTY CLAY , brown (7.5 YR 5/2), very stiff 442.9'								
430	90		SHALE , dark gray (7.5 YR 4/1), hard to very hard 439.4'	⊗ SPT ▼ TC	15 20		9	26	19	7	51.0
				TC	50/5"						
				TC	50/0.5"						
				TC	50/0.5"						
				TC	50/0.4"						
				TC	50/0.3"						
420	100			TC	50/0.8"						
				TC	50/0.3"						
				TC	50/0.4"						
				TC	50/0.1"						
410	110			TC	50/0.4"						
				TC	50/0.1"						
				TC	50/0.1"						
				TC	50/0.3"						
				TC	50/0.1"						
			Boring Termination Depth = 117 feet Boring Completed and Grouted on 3/9/2022	TC	50/0.3"						
				TC	50/0.1"						
400											
390											

CLIENT CEC **PROJECT NAME** SH 100 Bridge over Arkansas River
PROJECT NUMBER 20059 **PROJECT LOCATION** Muskogee and Sequoyah Counties, Oklahoma
DATE STARTED 9/13/22 **COMPLETED** 9/13/22 **GROUND ELEVATION** 465.7 ft **STATION** 276+22 **OFFSET** 40' right
DRILLING CONTRACTOR DSO - Drilling Services of Oklahoma **GROUND WATER LEVELS:**
DRILLING METHOD Casing to 25.5 ft, wet rotary - CME 750 ATV **▽ DURING DRILLING** 5.9 ft / Elev 459.8 ft
LOGGED BY DLW **CHECKED BY** JWB **▽ 0 hrs AFTER DRILLING** 5.9 ft / Elev 459.8 ft
NOTES J/P# 32100(04), Diamond bit was used for very hard shale layers

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	BLOW COUNTS N60	MOISTURE CONTENT (%)	ATTERBERG LIMITS			PASSING #200 SIEVE (%)
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0	0		BARGE DECK								
460	10		WATER								
450	20		WELL-GRADED SAND with SILT and GRAVEL , brown with dark gray (7.5 YR 5/6 with 7.5 YR 4/1), very loose	⊗ SPT	3	4	7				6.2
440			WELL-GRADED GRAVEL with SAND , brown (7.5 YR 5/2), dense	⊗ SPT			8				0.3
440	30		CLAYEY SAND , brown (7.5 YR 5/2), very dense	⊗ SPT	47		12	24	16	8	44.7
440			SHALE , dark gray (7.5 YR 4/1), moderately hard to very hard	TC	50/4" 50/1.3" 50/1"						
430				▼ TC	50/0.5" 50/0.3"						
420				▼ TC	50/0.5" 50/0.3"						
410				▼ TC	50/0.4" 50/0.1"						
				▼ TC	50/0.1" 50/0.1"						
				▼ TC	50/1.5" 50/1.5"						
				▼ TC	50/0.4" 50/0.3"						
			Boring Termination Depth = 55.8 feet Boring Completed and Backfilled on 9/13/2022	▼ TC							

CLIENT CEC **PROJECT NAME** SH 100 Bridge over Arkansas River
PROJECT NUMBER 20059 **PROJECT LOCATION** Muskogee and Sequoyah Counties, Oklahoma
DATE STARTED 9/13/22 **COMPLETED** 9/13/22 **GROUND ELEVATION** 465.2 ft **STATION** 279+41 **OFFSET** 30' left
DRILLING CONTRACTOR DSO - Drilling Services of Oklahoma **GROUND WATER LEVELS:**
DRILLING METHOD Casing to 25.5 ft, wet rotary - CME 750 ATV **▽ DURING DRILLING** 5.4 ft / Elev 459.8 ft
LOGGED BY DLW **CHECKED BY** JWB **▽ 0 hrs AFTER DRILLING** 5.4 ft / Elev 459.8 ft
NOTES J/P# 32100(04), Diamond bit was used for very hard shale layers

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	BLOW COUNTS N60	MOISTURE CONTENT (%)	ATTERBERG LIMITS			PASSING #200 SIEVE (%)
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0	0										
			BARGE DECK 465.2'								
460		▼	WATER 459.8'								
10											
450											
20											
440		XXXX	CLAYEY SAND , brown (7.5 YR 5/2) 440.4'	▼ SPT	50/3"		8	26	17	9	39.6
			SHALE , dark gray (7.5 YR 4/1), hard to very hard 439.7'	TC	50/1" 50/0.5"						
30				▼ TC	50/0.4" 50/0.1"						
430				▼ TC	50/0.8" 50/0.1"						
40				▼ TC	50/0.3" 50/0.3"						
420				▼ TC	50/0.1" 50/0.1"						
50				▼ TC	50/0.5" 50/0.4"						
410				▼ TC	50/0.5" 50/0.1"						
			Boring Termination Depth = 55.7 feet Boring Completed and Backfilled on 9/13/2022								

CLIENT CEC **PROJECT NAME** SH 100 Bridge over Arkansas River
PROJECT NUMBER 20059 **PROJECT LOCATION** Muskogee and Sequoyah Counties, Oklahoma
DATE STARTED 9/13/22 **COMPLETED** 9/13/22 **GROUND ELEVATION** 465.4 ft **STATION** 283+52 **OFFSET** 40' right
DRILLING CONTRACTOR DSO - Drilling Services of Oklahoma **GROUND WATER LEVELS:**
DRILLING METHOD Casing to 29.4 ft, wet rotary - CME 750 ATV **▽ DURING DRILLING** 5.6 ft / Elev 459.8 ft
LOGGED BY DLW **CHECKED BY** JWB **▽ 0 hrs AFTER DRILLING** 5.6 ft / Elev 459.8 ft
NOTES J/P# 32100(04), Diamond bit was used for very hard shale layers

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	BLOW COUNTS N60	MOISTURE CONTENT (%)	ATTERBERG LIMITS			PASSING #200 SIEVE (%)
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0	0		BARGE DECK 465.4'								
460		▼	WATER 459.8'								
450	10										
440	20										
430	30		SILTY, CLAYEY SAND , brown (7.5 YR 5/2) 436.5'	SPT	37		10	25	18	7	32.2
			SHALE , dark gray (7.5 YR 4/1), soft to very hard 436'	TC	50/2.5"						
					50/2"						
					50/1.3"						
430		▼		TC	50/0.4"						
					50/0.1"						
440	40	▼		TC	50/0.5"						
					50/0.4"						
420	50	▼		TC	50/0.1"						
					50/0.1"						
410		▼	COAL , very dark gray (5 Y 3/1), very soft 411.4'	TC	50/5"						
			SHALE , dark gray (7.5 YR 4/1), hard 410.4'		50/0.8"						
		▼	Boring Termination Depth = 59.6 feet	TC	50/0.8"						
			Boring Completed and Backfilled on 9/13/2022		50/0.3"						

CLIENT CEC	PROJECT NAME SH 100 Bridge over Arkansas River
PROJECT NUMBER 20059	PROJECT LOCATION Muskogee and Sequoyah Counties, Oklahoma
DATE STARTED 9/14/22 COMPLETED 9/14/22	GROUND ELEVATION 466.8 ft STATION 286+72 OFFSET 30' left
DRILLING CONTRACTOR DSO - Drilling Services of Oklahoma	GROUND WATER LEVELS:
DRILLING METHOD Casing to 24 ft, wet rotary - CME 750 ATV	▽ DURING DRILLING 6.9 ft / Elev 459.9 ft
LOGGED BY DLW CHECKED BY JWB	▼ 0 hrs AFTER DRILLING 6.9 ft / Elev 459.9 ft
NOTES J/P# 32100(04)	

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	BLOW COUNTS N60	MOISTURE CONTENT (%)	ATTERBERG LIMITS			PASSING #200 SIEVE (%)
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
	0		BARGE DECK 466.8'								
460	10	▼	WATER 459.9'								
450	20										
440	30		SILTY, CLAYEY SAND , brown (7.5 YR 5/2) 443'	▼ SPT	50/2"		10	22	16	6	34.6
			SHALE , dark gray (7.5 YR 4/1), very hard 442.8'	TC	50/0.3" 50/0.1"						
430	40			▼ TC	50/0.3" 50/0.3"						
				▼ TC	50/0.3" 50/0.1"						
420	50			▼ TC	50/0.5" 50/0.3"						
				▼ TC	50/0.5" 50/0.4"						
410			Boring Termination Depth = 54.2 feet Boring Completed and Backfilled on 9/14/2022	▼ TC	50/0.4" 50/0.3"						

CLIENT CEC	PROJECT NAME SH 100 Bridge over Arkansas River
PROJECT NUMBER 20059	PROJECT LOCATION Muskogee and Sequoyah Counties, Oklahoma
DATE STARTED 9/14/22 COMPLETED 9/14/22	GROUND ELEVATION 466.8 ft STATION 286+72 OFFSET 30' left
DRILLING CONTRACTOR DSO - Drilling Services of Oklahoma	GROUND WATER LEVELS:
DRILLING METHOD Casing to 24 ft, wet rotary - CME 750 ATV	▽ DURING DRILLING 6.9 ft / Elev 459.9 ft
LOGGED BY DLW CHECKED BY JWB	▽ 0 hrs AFTER DRILLING 6.9 ft / Elev 459.9 ft
NOTES J/P# 32100(04)	

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS & CORE RECOVERY	BLOW COUNTS N60	MOISTURE CONTENT (%)	ATTERBERG LIMITS			PASSING #200 SIEVE (%)
0								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
			BARGE DECK								
460		▼	WATER								
450	10										
440	20		SILTY, CLAYEY SAND , brown (7.5 YR 5/2)								
440			SHALE , very dark gray to dark gray (7.5 YR 3/1 to 7.5 YR 4/1), weak to very strong	RC	Total= 49 in. Rec= 82% RQD= 23%						
430	30		* Unconfined compressive strength at 24.7 feet = 900 psi *	RC	Total= 54.5 in. Rec= 91% RQD= 28%						
430			* Unconfined compressive strength at 33.2 feet = 508 psi *	RC	Total= 56 in. Rec= 93% RQD= 78%						
430	40		* Unconfined compressive strength at 35.7 feet = 18,434 psi *	RC	Total= 55.5 in. Rec= 93% RQD= 83%						
420	50		* Unconfined compressive strength at 41.2 feet = 9,547 psi *	RC	Total= 58 in. Rec= 97% RQD= 55%						
420			* Unconfined compressive strength at 45.2 feet = 10,036 psi *	RC	Total= 54 in. Rec= 90% RQD= 33%						
410	50		* Unconfined compressive strength at 49.2 feet = 1,034 psi *	RC							
			* Unconfined compressive strength at 53.2 feet = 923 psi *								
			Boring Termination Depth = 54.2 feet Boring Completed and Backfilled on 9/14/2022								

CLIENT CEC **PROJECT NAME** SH 100 Bridge over Arkansas River
PROJECT NUMBER 20059 **PROJECT LOCATION** Muskogee and Sequoyah Counties, Oklahoma
DATE STARTED 9/14/22 **COMPLETED** 9/14/22 **GROUND ELEVATION** 464.8 ft **STATION** 288+80 **OFFSET** 40' right
DRILLING CONTRACTOR DSO - Drilling Services of Oklahoma **GROUND WATER LEVELS:**
DRILLING METHOD Casing to 23 ft, wet rotary - CME 750 ATV **▽ DURING DRILLING** 4.9 ft / Elev 459.9 ft
LOGGED BY DLW **CHECKED BY** JWB **▽ 0 hrs AFTER DRILLING** 4.9 ft / Elev 459.9 ft
NOTES J/P# 32100(04), Diamond bit was used for very hard shale layers

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	BLOW COUNTS N60	MOISTURE CONTENT (%)	ATTERBERG LIMITS			PASSING #200 SIEVE (%)
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0	0		BARGE DECK 464.8'								
460		▼	WATER 459.9'								
10											
450											
20			POORLY-GRADED SAND , brown (10 YR 5/3), dense 448.7'	⊗ SPT	45	60	16	0	0	NP	1.9
440			SHALE , dark gray (7.5 YR 4/1), moderately hard to very hard 441.8'	▼ SPT	50/1"	50/0.3"	50/0.3"				
30				▼ TC	50/0.3"	50/0.1"					
430				▼ TC	50/0.3"	50/0.1"					
40				▼ TC	50/0.4"	50/0.1"					
420				▼ TC	50/1"	50/0.4"					
50				▼ TC	50/1.1"	50/0.5"					
410			Boring Termination Depth = 53.1 feet Boring Completed and Backfilled on 9/14/2022	▼ TC	50/1.4"	50/1"					
400											

CLIENT CEC **PROJECT NAME** SH 100 Bridge over Arkansas River
PROJECT NUMBER 20059 **PROJECT LOCATION** Muskogee and Sequoyah Counties, Oklahoma
DATE STARTED 9/14/22 **COMPLETED** 9/14/22 **GROUND ELEVATION** 464.2 ft **STATION** 290+88 **OFFSET** 30' left
DRILLING CONTRACTOR DSO - Drilling Services of Oklahoma **GROUND WATER LEVELS:**
DRILLING METHOD Casing to 22.1 ft, wet rotary - CME 750 ATV **▽ DURING DRILLING** 4.3 ft / Elev 459.9 ft
LOGGED BY DLW **CHECKED BY** JWB **▽ 0 hrs AFTER DRILLING** 4.3 ft / Elev 459.9 ft
NOTES J/P# 32100(04), Diamond bit was used for very hard shale layers

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	BLOW COUNTS N60	MOISTURE CONTENT (%)	ATTERBERG LIMITS			PASSING #200 SIEVE (%)
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0	0		BARGE DECK								
460		▼	WATER								
440			SILTY SAND with GRAVEL , brown (10 YR 5/3) SHALE , dark gray (7.5 YR 4/1), hard to very hard	▼ SPT TC	50/0.3" 50/0.8" 50/0.5"		9	0	0	NP	30.6
430				▼ TC	50/0.4" 50/0.3"						
420				▼ TC	50/0.3" 50/0.3"						
410				▼ TC	50/0.8" 50/0.5"						
400				▼ TC	50/0.5" 50/0.3"						
				▼ TC	50/0.8" 50/0.5"						
			Boring Termination Depth = 52.3 feet Boring Completed and Backfilled on 9/14/2022	▼ TC	50/1" 50/0.5"						

CLIENT CEC

PROJECT NAME SH 100 Bridge over Arkansas River

PROJECT NUMBER 20059

PROJECT LOCATION Muskogee and Sequoyah Counties, Oklahoma

DATE STARTED 3/8/22 COMPLETED 3/9/22

GROUND ELEVATION 515.7 ft STATION 293+25 OFFSET 13' left

DRILLING CONTRACTOR DSO - Drilling Services of Oklahoma

GROUND WATER LEVELS:

DRILLING METHOD HSA to 68 ft, wet rotary to LTD - CME 750 ATV

▼ 24 hrs AFTER DRILLING 35 ft / Elev 480.7 ft

LOGGED BY MAJ CHECKED BY JWB

▼ Cave In Depth 48 ft / Elev 467.7 ft

NOTES J/P# 32100(04), Diamond bit was used for very hard shale layers

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS & CORE RECOVERY	BLOW COUNTS N60	MOISTURE CONTENT (%)	ATTERBERG LIMITS			PASSING #200 SIEVE (%)
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
	0		12" PORTLAND CEMENT CONCRETE 515.7'								
			SILTY SAND , light brown (7.5 YR 6/2), medium dense *POSSIBLE FILL* 514.7'								
510				⊗ SPT	18	24	9	0	0	NP	30.6
			SANDY SILT , light brown (7.5 YR 6/2), medium dense *POSSIBLE FILL* 508.7'								
				⊗ SPT	12	16	20	0	0	NP	69.9
500			POORLY-GRADED SAND with SILT and GRAVEL , brown (7.5 YR 5/2), medium dense *POSSIBLE FILL* 500.7'	⊗ SPT	21	28	8	0	0	NP	10.3
			SILTY SAND , brown (7.5 YR 5/2), medium dense *POSSIBLE FILL* 495.7'	⊗ SPT	13	17	16	0	0	NP	13.4
490			POORLY-GRADED SAND with SILT , brown (7.5 YR 5/2), medium dense 490.7'	⊗ SPT	14	19	22	0	0	NP	11.3
			GRAVELLY LEAN CLAY , brown (7.5 YR 5/2), stiff 485.7'	⊗ SPT	12	16	18	29	18	11	55.9
480			SILTY SAND with GRAVEL , brown (7.5 YR 5/2), medium dense 480.7'	▼ TC	13						
				⊗ SPT	30	40	17	0	0	NP	39.4
470			SANDY SILT , brown (7.5 YR 5/2), medium dense 475.7'	⊗ SPT	24	32	19	0	0	NP	69.3
				⊗ SPT	15	20	11	0	0	NP	68.7
50			LEAN CLAY , brown (7.5 YR 5/2), soft 465.7'	⊗ SPT	4	5	35	29	20	9	97.6
460			POORLY-GRADED SAND with SILT , brown (7.5 YR 5/2), loose 460.7'	⊗ SPT	8	11	16	0	0	NP	7.4
60			CLAYEY SAND with GRAVEL , brown (7.5 YR 5/2), loose 455.7'	⊗ SPT	9	12	8	26	15	11	17.2

(Continued Next Page)

CLIENT CEC

PROJECT NAME SH 100 Bridge over Arkansas River

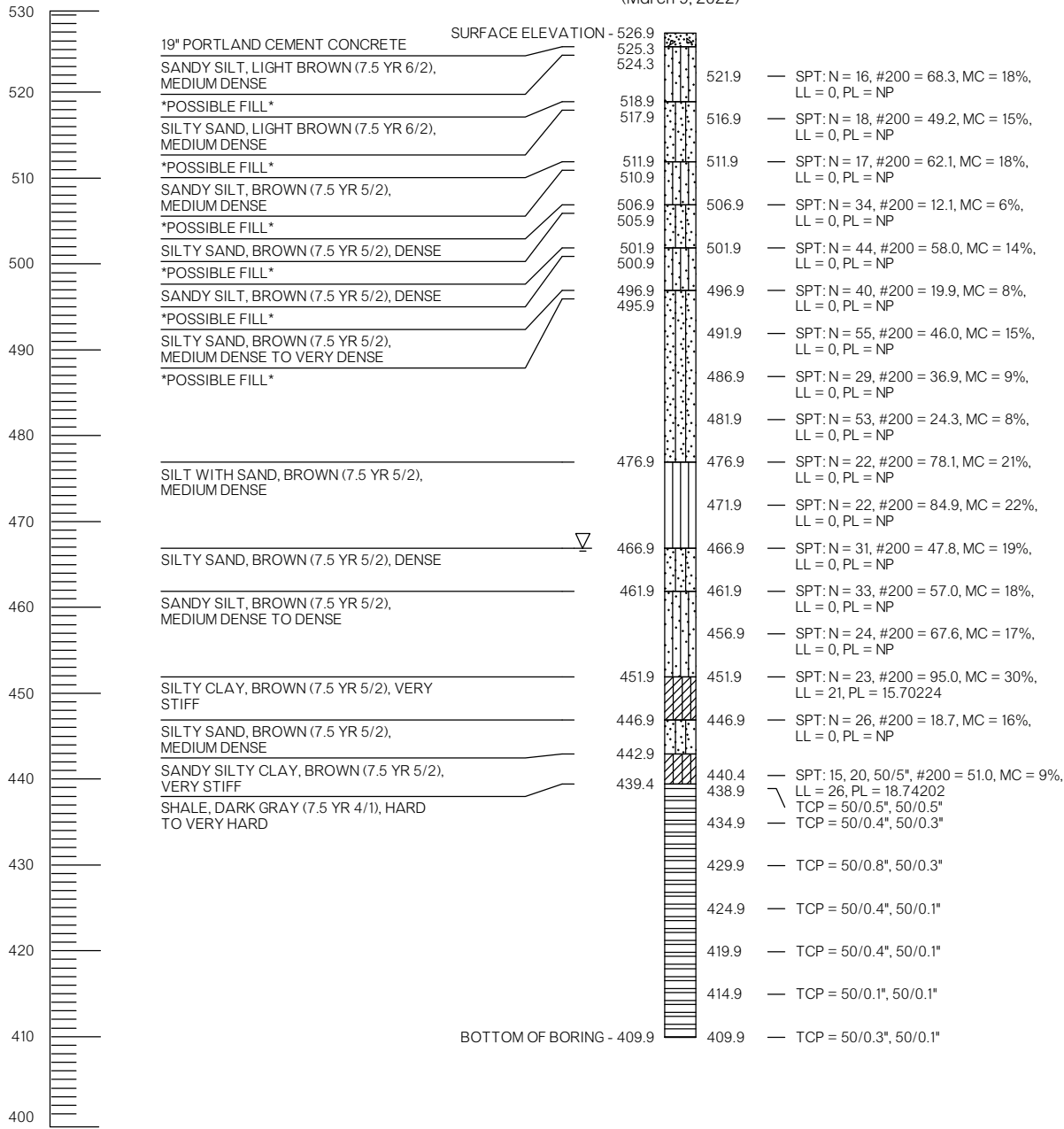
PROJECT NUMBER 20059

PROJECT LOCATION Muskogee and Sequoyah Counties, Oklahoma

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS & CORE RECOVERY	BLOW COUNTS N60	MOISTURE CONTENT (%)	ATTERBERG LIMITS			PASSING #200 SIEVE (%)
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
450			CLAYEY SAND with GRAVEL , brown (7.5 YR 5/2), loose (continued)	⊗ SPT	11	15					
70			SHALE , dark gray (7.5 YR 4/1), hard to very hard * Unconfined compressive strength at 68.5 feet = 13,220 psi * * Unconfined compressive strength at 71 feet = 19,670 psi *	447.7 SPT	50/1"						
				TC	50/0.3"						
				RC	50/0.1"						
				TC	Total=						
				RC	18 in.						
				TC	Rec=						
				RC	100%						
				TC	RQD=						
				RC	69%						
				TC	50/0.1"						
				RC	50/0.1"						
				TC	Total=						
				RC	53 in.						
				TC	Rec=						
				RC	88%						
				TC	RQD=						
				RC	21%						
				TC	50/0.1"						
				RC	50/0.1"						
				TC	Total=						
				RC	60 in.						
				TC	Rec=						
				RC	100%						
				TC	RQD=						
				RC	0%						
				TC	50/0.8"						
				RC	50/0.3"						
				TC	Total=						
				RC	44 in.						
				TC	Rec=						
				RC	73%						
				TC	RQD=						
				RC	0%						
				TC	50/0.5"						
				RC	50/0.3"						
				TC	Total=						
				RC	43 in.						
				TC	Rec=						
				RC	72%						
				TC	RQD=						
				RC	23%						
				TC	50/1"						
				RC	50/0.6"						
				TC	50/0.5"						
				RC	50/0.3"						
				TC	50/0.8"						
				RC	50/0.4"						
			Boring Termination Depth = 98.5 feet Boring Completed and Grouted on 3/9/2022	TC							

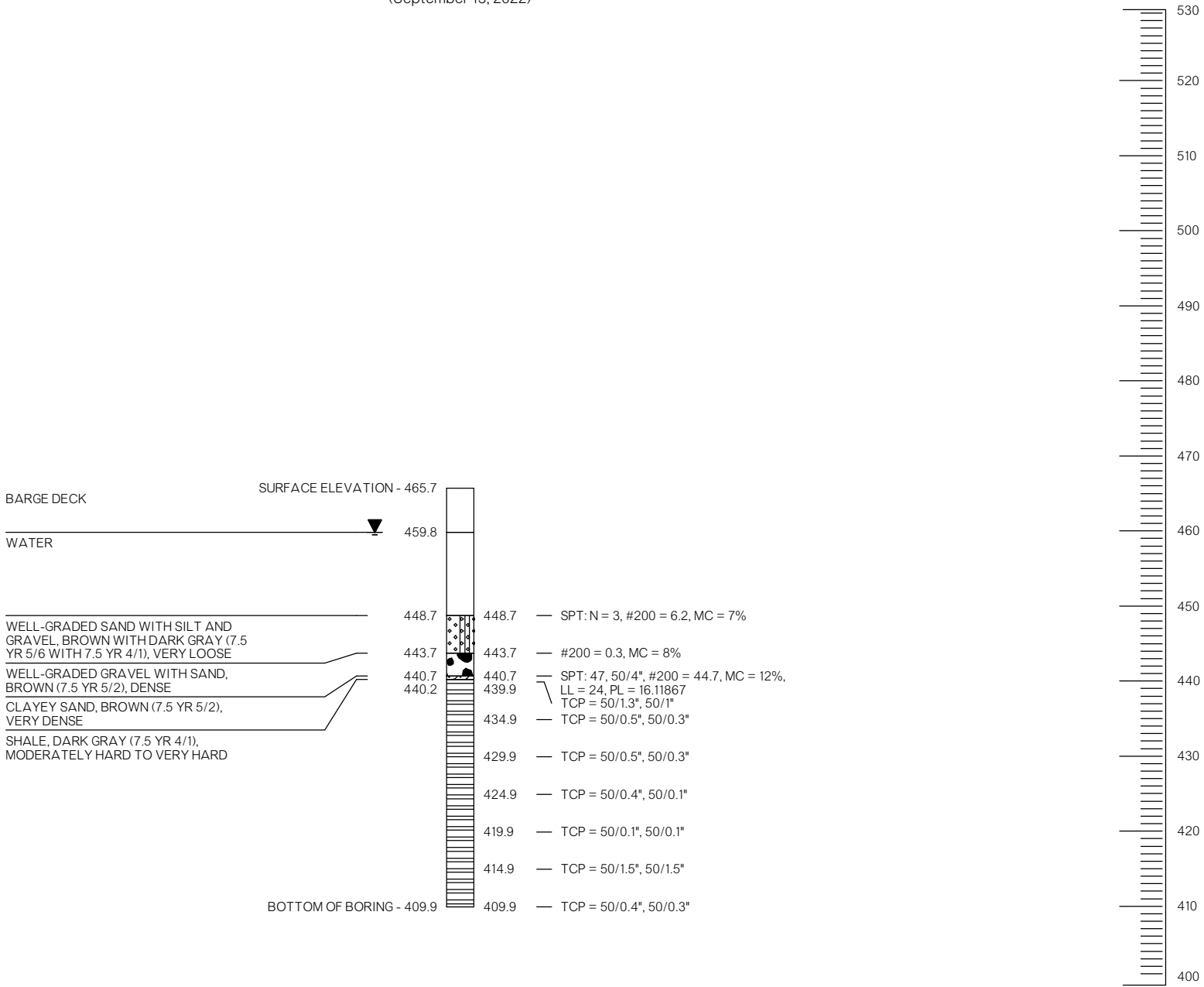
BORING NO. B-01

STATION 273+15, 15' left of C SURVEY
(March 9, 2022)



BORING NO. B-02

STATION 276+22, 40' right of C SURVEY
(September 13, 2022)



SITE GEOLOGY

THE GEOLOGY OF THE PROJECT SITE WAS RESEARCHED USING THE "DIVISION ONE ENGINEERING CLASSIFICATION OF GEOLOGICAL MATERIALS", PUBLISHED BY THE OKLAHOMA DEPARTMENT OF TRANSPORTATION (ODOT) AND THE GEOLOGIC MAP OF THE "HYDROLOGIC ATLAS 1 OF OKLAHOMA, RECONNAISSANCE OF THE WATER RESOURCES OF THE FORT SMITH QUADRANGLE, EAST-CENTRAL OKLAHOMA," BY MELVIN V. MARCHER, U.S. GEOLOGICAL SURVEY, 1969.

ODOT

THE ODOT PUBLICATION INDICATES THE PROJECT SITE IS ALLUVIUM (QAS) UNDERLAIN BY THE ATOKA UNIT (PA). THE GEOLOGIC UNITS ARE DESCRIBED THEREIN AS FOLLOWS:

ALLUVIUM CONSISTS OF RECENT DEPOSITS OF SANDS, SILTS, CLAYS, GRAVELS, OR MIXTURES OF THESE. THESE DEPOSITS ARE PRESENT ALONG STREAM BEDS AND FLOOD PLAINS.

THE ATOKA UNIT CONSISTS OF SANDSTONE, SILTSTONE, SHALE AND A FEW THIN BEDS OF LIMESTONE. THE SANDSTONE BEDS ARE SOFT TO HARD, BROWN TO GRAY IN COLOR, LOCALLY LIMY AND ARE FROM A FEW INCHES THICK TO APPROXIMATELY 20 FEET THICK WITH SEQUENCES OF BEDS, SEPARATED BY THIN STRINGERS OF SHALE, UP TO 115 FEET THICK. THE SILTSTONE BEDS ARE GENERALLY HARD, BROWN TO GRAY IN COLOR AND USUALLY LESS THAN ONE FOOT THICK. THE SHALES FOR THE MOST PART ARE FISSILE, LOCALLY CLAYEY, BROWN TO BLACK IN COLOR AND RANGE IN THICKNESS FROM A FEW INCHES TO 300 FEET OR MORE. GENERALLY MOST SHALE ZONES WILL CONTAIN THIN SILTSTONE, SANDSTONE AND/OR LIMESTONE BEDS LESS THAN ONE FOOT THICK.

THE ATOKA UNIT RANGES IN THICKNESS FROM ONLY A FEW FEET IN THE NORTHERN PORTION OF DIVISION ONE TO AS MUCH AS 9,000 FEET IN PITTSBURG COUNTY.

THE ATOKA UNIT OUTCROPS IN ALL COUNTIES OF DIVISION ONE EXCEPT OKMULGEE. THE TOPOGRAPHY OF THIS UNIT IS GENERALLY HILLS CAPPED WITH SANDSTONES AND THE SLOPES AND VALLEYS FORMED IN THE SHALES. WHERE THE UNIT IS MOSTLY SHALE, PRAIRIES ARE PRESENT.

USGS

THE USGS MAP INDICATES THAT THE PROJECT SITE CONSISTS OF ALLUVIUM (QAL) WHICH IS UNDERLAIN BY THE ATOKA FORMATION (PA). THE GEOLOGIC FORMATIONS ARE DESCRIBED THEREIN AS FOLLOWS:

ALLUVIUM CONSISTS OF GRAVEL, SAND, SILT, AND CLAY. YIELDS LARGE AMOUNT OF WATER OF GOOD QUALITY ALONG THE ARKANSAS RIVER AND PROBABLY WILL YIELD MODERATE TO LARGE AMOUNTS ALONG THE CANADIAN RIVER.

THE ATOKA FORMATION CONSISTS OF SHALE AND SANDSTONE. YIELDS LIMITED AMOUNTS OF WATER OF POOR QUALITY.

LEGEND

V. = VERY
FL. = FAIRLY
SL. = SLIGHTLY
LT. = LIGHT
MED. = MEDIUM
BRN. = BROWN
TR. = TRACE
DRK. = DARK
BLK. = BLACK

DCD = DIAMOND CORE DRILLING, ASTM D2113-83
SPT = STANDARD PENETRATION TEST, ASTM D1586
SS = SPLIT SPOON SAMPLER
N = NUMBER OF BLOWS PER 12 INCHES
MC = MOISTURE CONTENT
LL = LIQUID LIMIT
PL = PLASTIC LIMIT (NP=NO PLASTICITY)
#200 = PERCENT PASSING #200 SIEVE
UCS = UNCONFINED COMPRESSIVE STRENGTH
TCP = TEXAS CONE PENETROMETER
WCI = WET CAVE IN
▽ = WATER LEVEL WHILE DRILLING OR SAMPLING
▼ = WATER LEVEL AFTER DRILLING
▽ = WATER LEVEL 24 HOURS AFTER DRILLING
≡ = TOP OF ROCK

NOTE: WATER LEVEL ELEVATIONS SHOWN WERE OBTAINED AT THE TIME THE BORINGS WERE DRILLED AND MAY FLUCTUATE THROUGHOUT THE YEAR.

NOTE: "SS" DENOTES STANDARD PENETRATION TEST, AASHTO D1586-84. "TCP" DENOTES TEXAS CONE PENETRATION TEST.

* NOTE: TOP OF ROCK LINE SHOWN FOR ESTIMATING PURPOSES ONLY.

** NOTE: WATER LEVEL ELEVATION SHOWN WERE OBTAINED AT THE TIME THE BORINGS WERE DRILLED AND MAY FLUCTUATE THROUGHOUT THE YEAR.

*** NOTE: ROCK CLASSIFICATION IS BASED ON DRILLING CHARACTERISTICS AND VISUAL OBSERVATION OF ROCK CORE SAMPLES. PETROGRAPHIC ANALYSIS OF THIN SECTIONS OF THE ROCK CORE SAMPLES MAY REVEAL OTHER TYPES.

GEOTECHNICAL REPORT

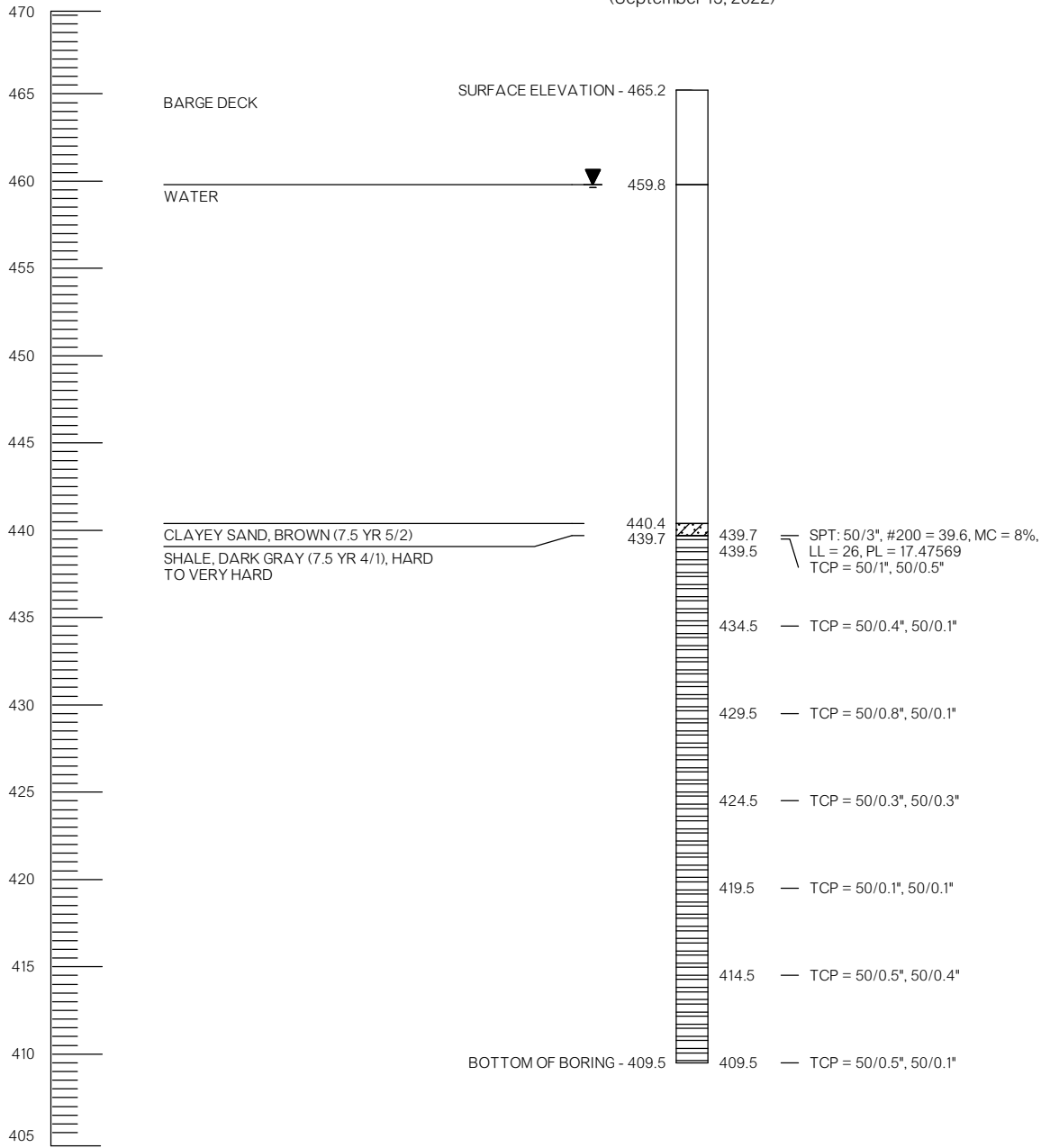
ALL GEOTECHNICAL INFORMATION CONTAINED ON THIS SHEET IS COVERED BY THE ENGINEERING SEAL AFFIXED TO AN ORIGINAL GEOTECHNICAL ENGINEERING REPORT THAT HAS BEEN STAMPED AND SEALED BY A PROFESSIONAL ENGINEER LICENSED IN OKLAHOMA. TO OBTAIN A COPY OF THE COMPLETE REPORT, CONTACT THE ODOT OFFICE ENGINEER AT (405) 521-2625. THE CONTRACTOR SHOULD BE FULLY AWARE OF THE SITE CONDITIONS PRIOR TO BEGINNING WORK. ANY ADDITIONAL GEOTECHNICAL INFORMATION WHICH MAY BE DESIRED IS THE RESPONSIBILITY OF THE CONTRACTOR.

RED ROCK
CONSULTING

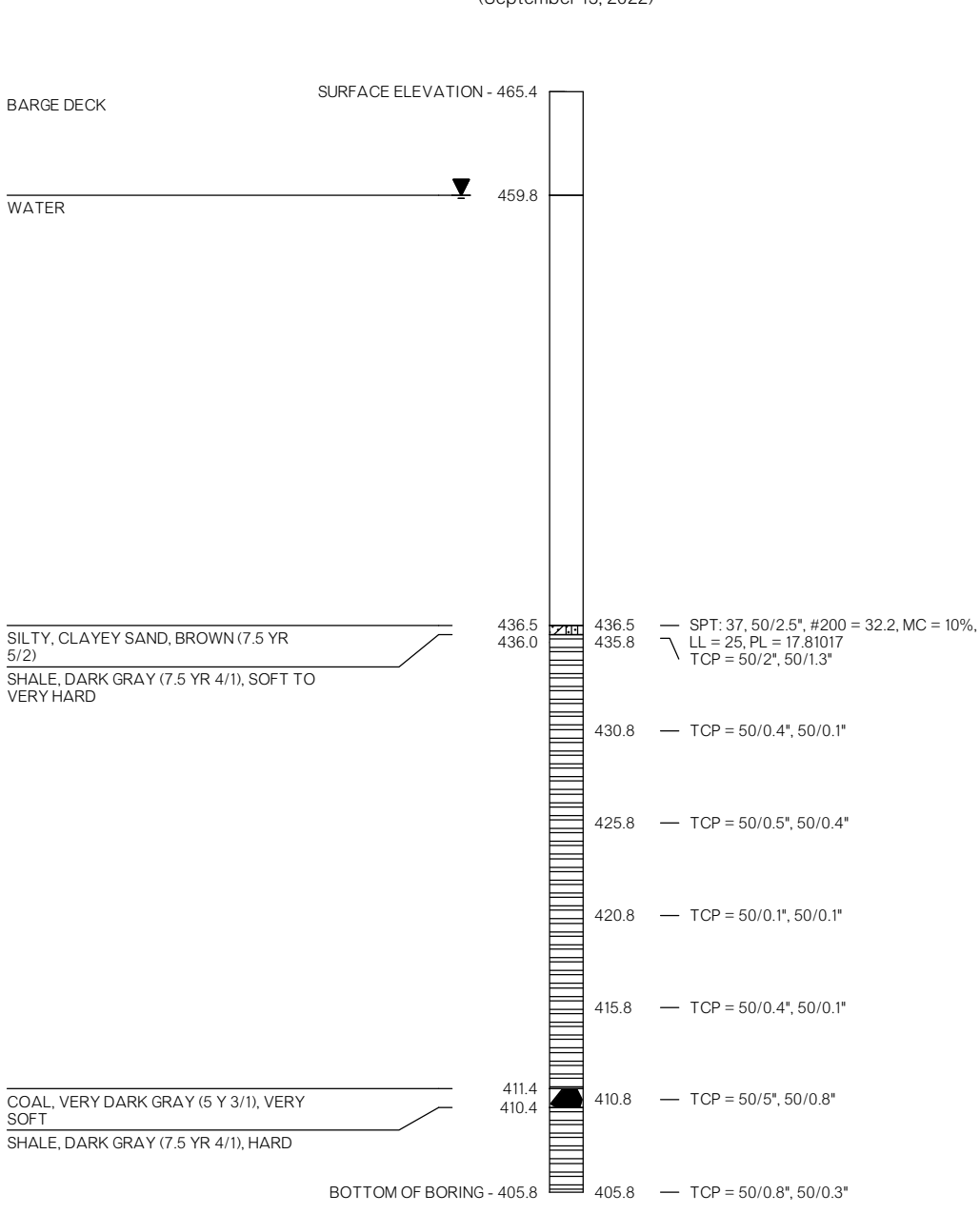
SH 100 BRIDGE OVER ARKANSAS RIVER	MUSKOGEE AND SEQUOYAH COUNTIES, OKLAHOMA	Design	EDC	10/22
		Detail	EDC	10/22
		Check	JWB	10/22
		Squad:		
		Engr.:		
STATE OF OKLAHOMA	DEPARTMENT OF TRANSPORTATION	JOB PIECE NO. 32100(04)		SHEET NO. 1

REVISIONS		
REV. NO.	DESCRIPTION	DATE

BORING NO. B-03
STATION 279+41, 30' left of \varnothing SURVEY
(September 13, 2022)



BORING NO. B-04
STATION 283+52, 40' right of \varnothing SURVEY
(September 13, 2022)



SITE GEOLOGY

THE GEOLOGY OF THE PROJECT SITE WAS RESEARCHED USING THE "DIVISION ONE ENGINEERING CLASSIFICATION OF GEOLOGICAL MATERIALS", PUBLISHED BY THE OKLAHOMA DEPARTMENT OF TRANSPORTATION (ODOT) AND THE GEOLOGIC MAP OF THE "HYDROLOGIC ATLAS 1 OF OKLAHOMA, RECONNAISSANCE OF THE WATER RESOURCES OF THE FORT SMITH QUADRANGLE, EAST-CENTRAL OKLAHOMA," BY MELVIN V. MARCHER, U.S. GEOLOGICAL SURVEY, 1969.

ODOT

THE ODOT PUBLICATION INDICATES THE PROJECT SITE IS ALLUVIUM (QAS) UNDERLAIN BY THE ATOKA UNIT (PA). THE GEOLOGIC UNITS ARE DESCRIBED THEREIN AS FOLLOWS:

ALLUVIUM CONSISTS OF RECENT DEPOSITS OF SANDS, SILTS, CLAYS, GRAVELS, OR MIXTURES OF THESE. THESE DEPOSITS ARE PRESENT ALONG STREAM BEDS AND FLOOD PLAINS.

THE ATOKA UNIT CONSISTS OF SANDSTONE, SILTSTONE, SHALE AND A FEW THIN BEDS OF LIMESTONE. THE SANDSTONE BEDS ARE SOFT TO HARD, BROWN TO GRAY IN COLOR, LOCALLY LIMY AND ARE FROM A FEW INCHES THICK TO APPROXIMATELY 20 FEET THICK WITH SEQUENCES OF BEDS, SEPARATED BY THIN STRINGERS OF SHALE, UP TO 115 FEET THICK. THE SILTSTONE BEDS ARE GENERALLY HARD, BROWN TO GRAY IN COLOR AND USUALLY LESS THAN ONE FOOT THICK. THE SHALES FOR THE MOST PART ARE FISSILE, LOCALLY CLAYEY, BROWN TO BLACK IN COLOR AND RANGE IN THICKNESS FROM A FEW INCHES TO 300 FEET OR MORE. GENERALLY MOST SHALE ZONES WILL CONTAIN THIN SILTSTONE, SANDSTONE AND/OR LIMESTONE BEDS LESS THAN ONE FOOT THICK.

THE ATOKA UNIT RANGES IN THICKNESS FROM ONLY A FEW FEET IN THE NORTHERN PORTION OF DIVISION ONE TO AS MUCH AS 9,000 FEET IN PITTSBURG COUNTY.

THE ATOKA UNIT OUTCROPS IN ALL COUNTIES OF DIVISION ONE EXCEPT OKMULGEE. THE TOPOGRAPHY OF THIS UNIT IS GENERALLY HILLS CAPPED WITH SANDSTONES AND THE SLOPES AND VALLEYS FORMED IN THE SHALES. WHERE THE UNIT IS MOSTLY SHALE, PRAIRIES ARE PRESENT.

USGS

THE USGS MAP INDICATES THAT THE PROJECT SITE CONSISTS OF ALLUVIUM (QAL) WHICH IS UNDERLAIN BY THE ATOKA FORMATION (PA). THE GEOLOGIC FORMATIONS ARE DESCRIBED THEREIN AS FOLLOWS:

ALLUVIUM CONSISTS OF GRAVEL, SAND, SILT, AND CLAY. YIELDS LARGE AMOUNT OF WATER OF GOOD QUALITY ALONG THE ARKANSAS RIVER AND PROBABLY WILL YIELD MODERATE TO LARGE AMOUNTS ALONG THE CANADIAN RIVER.

THE ATOKA FORMATION CONSISTS OF SHALE AND SANDSTONE. YIELDS LIMITED AMOUNTS OF WATER OF POOR QUALITY.

LEGEND

- | | | | | |
|------|------------|------|--|---|
| V. | = VERY | DCD | = DIAMOND CORE DRILLING, ASTM D2113-83 | NOTE: WATER LEVEL ELEVATIONS SHOWN WERE OBTAINED AT THE TIME THE BORINGS WERE DRILLED AND MAY FLUCTUATE THROUGHOUT THE YEAR. |
| FL. | = FAIRLY | SPT | = STANDARD PENETRATION TEST, ASTM D1586 | NOTE: "SS" DENOTES STANDARD PENETRATION TEST, AASHTO D1586-84. "TCP" DENOTES TEXAS CONE PENETRATION TEST. |
| SL. | = SLIGHTLY | SS | = SPLIT SPOON SAMPLER | * NOTE: TOP OF ROCK LINE SHOWN FOR ESTIMATING PURPOSES ONLY. |
| LT. | = LIGHT | N | = NUMBER OF BLOWS PER 12 INCHES | ** NOTE: WATER LEVEL ELEVATION SHOWN WERE OBTAINED AT THE TIME THE BORINGS WERE DRILLED AND MAY FLUCTUATE THROUGHOUT THE YEAR. |
| MED. | = MEDIUM | MC | = MOISTURE CONTENT | *** NOTE: ROCK CLASSIFICATION IS BASED ON DRILLING CHARACTERISTICS AND VISUAL OBSERVATION OF ROCK CORE SAMPLES. PETROGRAPHIC ANALYSIS OF THIN SECTIONS OF THE ROCK CORE SAMPLES MAY REVEAL OTHER TYPES. |
| BRN. | = BROWN | LL | = LIQUID LIMIT | |
| TR. | = TRACE | PL | = PLASTIC LIMIT (NP=NO PLASTICITY) | |
| DRK. | = DARK | #200 | = PERCENT PASSING #200 SIEVE | |
| BLK. | = BLACK | UCS | = UNCONFINED COMPRESSIVE STRENGTH | |
| | | TCP | = TEXAS CONE PENETROMETER | |
| | | WCI | = WET CAVE IN | |
| | | | = WATER LEVEL WHILE DRILLING OR SAMPLING | |
| | | | = WATER LEVEL AFTER DRILLING | |
| | | | = WATER LEVEL 24 HOURS AFTER DRILLING | |
| | | | = TOP OF ROCK | |

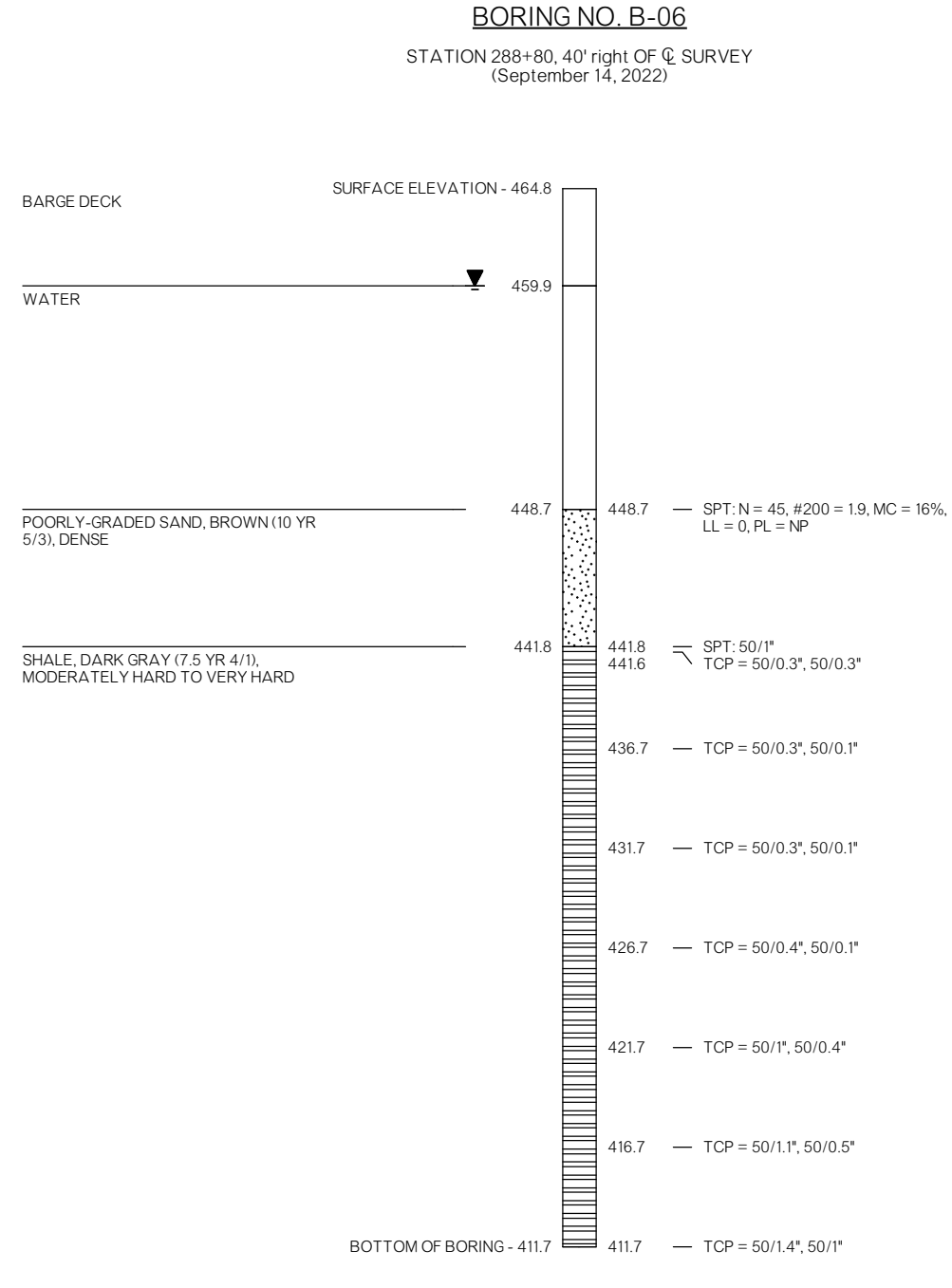
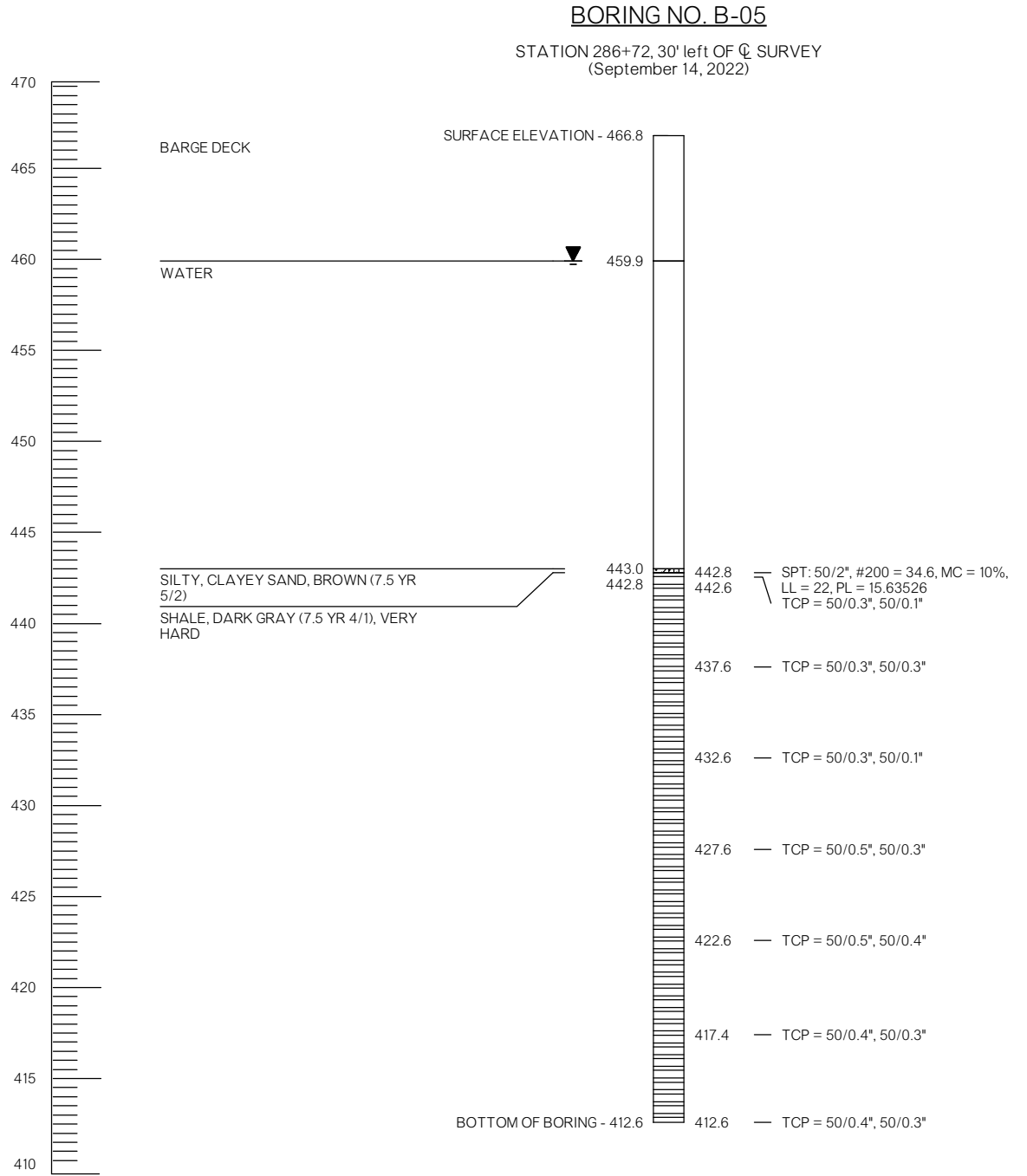
GEOTECHNICAL REPORT

ALL GEOTECHNICAL INFORMATION CONTAINED ON THIS SHEET IS COVERED BY THE ENGINEERING SEAL AFFIXED TO AN ORIGINAL GEOTECHNICAL ENGINEERING REPORT THAT HAS BEEN STAMPED AND SEALED BY A PROFESSIONAL ENGINEER LICENSED IN OKLAHOMA. TO OBTAIN A COPY OF THE COMPLETE REPORT, CONTACT THE ODOT OFFICE ENGINEER AT (405) 521-2625. THE CONTRACTOR SHOULD BE FULLY AWARE OF THE SITE CONDITIONS PRIOR TO BEGINNING WORK. ANY ADDITIONAL GEOTECHNICAL INFORMATION WHICH MAY BE DESIRED IS THE RESPONSIBILITY OF THE CONTRACTOR.



SH 100 BRIDGE OVER ARKANSAS RIVER		MUSKOGEE AND SEQUOYAH COUNTIES, OKLAHOMA		Design	EDC	10/22
SUBSURFACE PROFILE (SHEET 2 OF 5)				Detail	EDC	10/22
				Check	JWB	10/22
				Squad:		
				Engr.:		
STATE OF OKLAHOMA		DEPARTMENT OF TRANSPORTATION				
		JOB PIECE NO. 32100(04)				SHEET NO. 2

REVISIONS		
REV. NO.	DESCRIPTION	DATE



SITE GEOLOGY

THE GEOLOGY OF THE PROJECT SITE WAS RESEARCHED USING THE "DIVISION ONE ENGINEERING CLASSIFICATION OF GEOLOGICAL MATERIALS", PUBLISHED BY THE OKLAHOMA DEPARTMENT OF TRANSPORTATION (ODOT) AND THE GEOLOGIC MAP OF THE "HYDROLOGIC ATLAS 1 OF OKLAHOMA, RECONNAISSANCE OF THE WATER RESOURCES OF THE FORT SMITH QUADRANGLE, EAST-CENTRAL OKLAHOMA," BY MELVIN V. MARCHER, U.S. GEOLOGICAL SURVEY, 1969.

ODOT

THE ODOT PUBLICATION INDICATES THE PROJECT SITE IS ALLUVIUM (QAS) UNDERLAIN BY THE ATOKA UNIT (PA). THE GEOLOGIC UNITS ARE DESCRIBED THEREIN AS FOLLOWS:

ALLUVIUM CONSISTS OF RECENT DEPOSITS OF SANDS, SILTS, CLAYS, GRAVELS, OR MIXTURES OF THESE. THESE DEPOSITS ARE PRESENT ALONG STREAM BEDS AND FLOOD PLAINS.

THE ATOKA UNIT CONSISTS OF SANDSTONE, SILTSTONE, SHALE AND A FEW THIN BEDS OF LIMESTONE. THE SANDSTONE BEDS ARE SOFT TO HARD, BROWN TO GRAY IN COLOR, LOCALLY LIMY AND ARE FROM A FEW INCHES THICK TO APPROXIMATELY 20 FEET THICK WITH SEQUENCES OF BEDS, SEPARATED BY THIN STRINGERS OF SHALE, UP TO 115 FEET THICK. THE SILTSTONE BEDS ARE GENERALLY HARD, BROWN TO GRAY IN COLOR AND USUALLY LESS THAN ONE FOOT THICK. THE SHALES FOR THE MOST PART ARE FISSILE, LOCALLY CLAYEY, BROWN TO BLACK IN COLOR AND RANGE IN THICKNESS FROM A FEW INCHES TO 300 FEET OR MORE. GENERALLY MOST SHALE ZONES WILL CONTAIN THIN SILTSTONE, SANDSTONE AND/OR LIMESTONE BEDS LESS THAN ONE FOOT THICK.

THE ATOKA UNIT RANGES IN THICKNESS FROM ONLY A FEW FEET IN THE NORTHERN PORTION OF DIVISION ONE TO AS MUCH AS 9,000 FEET IN PITTSBURG COUNTY.

THE ATOKA UNIT OUTCROPS IN ALL COUNTIES OF DIVISION ONE EXCEPT OKMULGEE. THE TOPOGRAPHY OF THIS UNIT IS GENERALLY HILLS CAPPED WITH SANDSTONES AND THE SLOPES AND VALLEYS FORMED IN THE SHALES. WHERE THE UNIT IS MOSTLY SHALE, PRAIRIES ARE PRESENT.

USGS

THE USGS MAP INDICATES THAT THE PROJECT SITE CONSISTS OF ALLUVIUM (QAL) WHICH IS UNDERLAIN BY THE ATOKA FORMATION (PA). THE GEOLOGIC FORMATIONS ARE DESCRIBED THEREIN AS FOLLOWS:

ALLUVIUM CONSISTS OF GRAVEL, SAND, SILT, AND CLAY. YIELDS LARGE AMOUNT OF WATER OF GOOD QUALITY ALONG THE ARKANSAS RIVER AND PROBABLY WILL YIELD MODERATE TO LARGE AMOUNTS ALONG THE CANADIAN RIVER.

THE ATOKA FORMATION CONSISTS OF SHALE AND SANDSTONE. YIELDS LIMITED AMOUNTS OF WATER OF POOR QUALITY.

LEGEND

- V. = VERY
FL. = FAIRLY
SL. = SLIGHTLY
LT. = LIGHT
MED. = MEDIUM
BRN. = BROWN
TR. = TRACE
DRK. = DARK
BLK. = BLACK
- DCD = DIAMOND CORE DRILLING, ASTM D2113-83
SPT = STANDARD PENETRATION TEST, ASTM D1586
SS = SPLIT SPOON SAMPLER
N = NUMBER OF BLOWS PER 12 INCHES
MC = MOISTURE CONTENT
LL = LIQUID LIMIT
PL = PLASTIC LIMIT (NP=NO PLASTICITY)
#200 = PERCENT PASSING #200 SIEVE
UCS = UNCONFINED COMPRESSIVE STRENGTH
TCP = TEXAS CONE PENETROMETER
WCI = WET CAVE IN
 ∇ = WATER LEVEL WHILE DRILLING OR SAMPLING
 \blacktriangledown = WATER LEVEL AFTER DRILLING
 \blacktriangledown = WATER LEVEL 24 HOURS AFTER DRILLING
 ||||| = TOP OF ROCK

NOTE: WATER LEVEL ELEVATIONS SHOWN WERE OBTAINED AT THE TIME THE BORINGS WERE DRILLED AND MAY FLUCTUATE THROUGHOUT THE YEAR.

NOTE: "SS" DENOTES STANDARD PENETRATION TEST, AASHTO D1586-84. "TCP" DENOTES TEXAS CONE PENETRATION TEST.

* NOTE: TOP OF ROCK LINE SHOWN FOR ESTIMATING PURPOSES ONLY.

** NOTE: WATER LEVEL ELEVATION SHOWN WERE OBTAINED AT THE TIME THE BORINGS WERE DRILLED AND MAY FLUCTUATE THROUGHOUT THE YEAR.

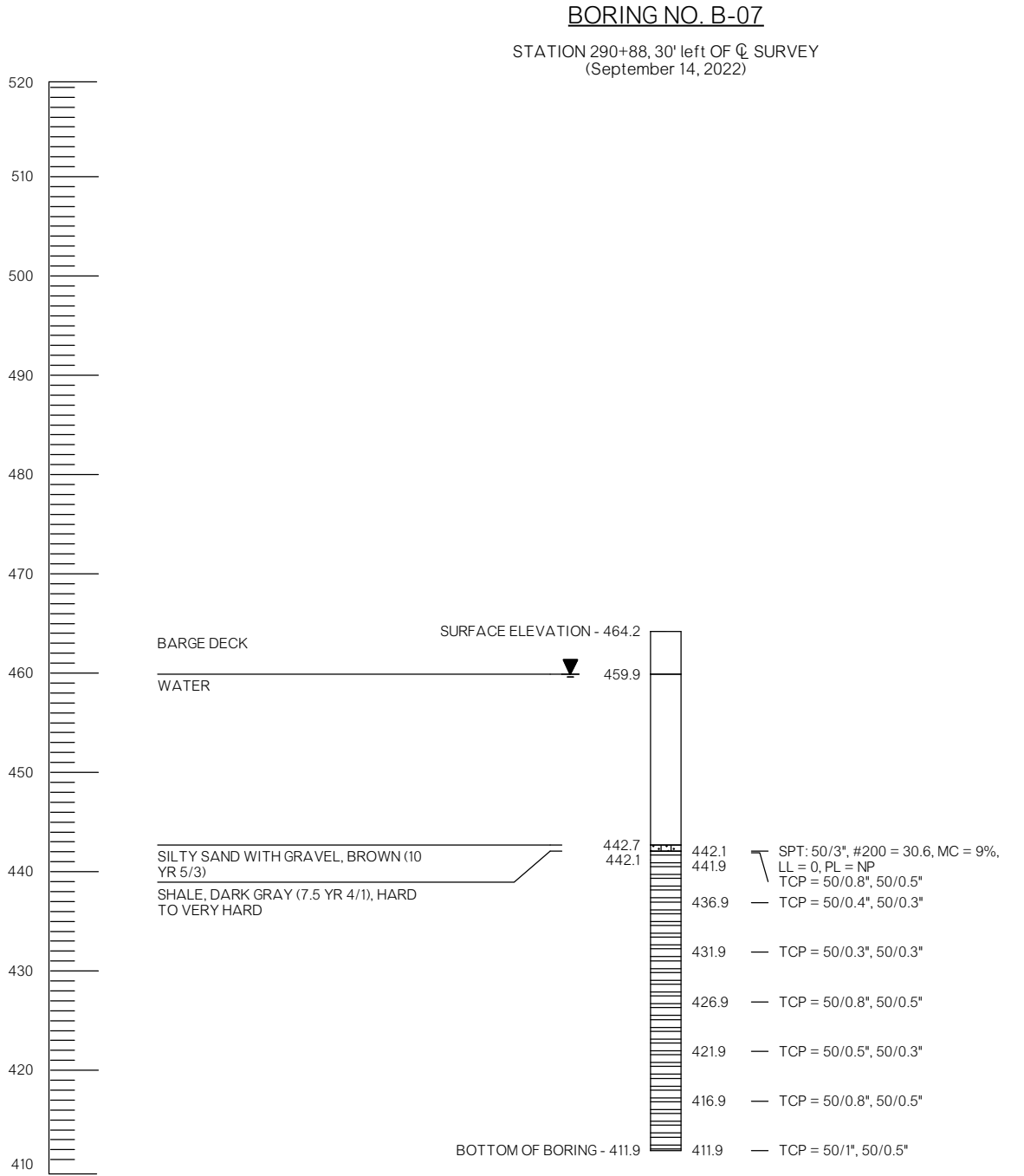
*** NOTE: ROCK CLASSIFICATION IS BASED ON DRILLING CHARACTERISTICS AND VISUAL OBSERVATION OF ROCK CORE SAMPLES. PETROGRAPHIC ANALYSIS OF THIN SECTIONS OF THE ROCK CORE SAMPLES MAY REVEAL OTHER TYPES.

GEOTECHNICAL REPORT

ALL GEOTECHNICAL INFORMATION CONTAINED ON THIS SHEET IS COVERED BY THE ENGINEERING SEAL AFFIXED TO AN ORIGINAL GEOTECHNICAL ENGINEERING REPORT THAT HAS BEEN STAMPED AND SEALED BY A PROFESSIONAL ENGINEER LICENSED IN OKLAHOMA. TO OBTAIN A COPY OF THE COMPLETE REPORT, CONTACT THE ODOT OFFICE ENGINEER AT (405) 521-2625. THE CONTRACTOR SHOULD BE FULLY AWARE OF THE SITE CONDITIONS PRIOR TO BEGINNING WORK. ANY ADDITIONAL GEOTECHNICAL INFORMATION WHICH MAY BE DESIRED IS THE RESPONSIBILITY OF THE CONTRACTOR.

**RED ROCK
CONSULTING**

SH 100 BRIDGE OVER ARKANSAS RIVER		MUSKOGEE AND SEQUOYAH COUNTIES, OKLAHOMA		Design	EDC	10/22
SUBSURFACE PROFILE (SHEET 3 OF 5)				Detail	EDC	10/22
				Check	JWB	10/22
				Squad:		
				Engr.:		
STATE OF OKLAHOMA		DEPARTMENT OF TRANSPORTATION				
		JOB PIECE NO. 32100(04)				SHEET NO. 3



SITE GEOLOGY

THE GEOLOGY OF THE PROJECT SITE WAS RESEARCHED USING THE "DIVISION ONE ENGINEERING CLASSIFICATION OF GEOLOGICAL MATERIALS", PUBLISHED BY THE OKLAHOMA DEPARTMENT OF TRANSPORTATION (ODOT) AND THE GEOLOGIC MAP OF THE "HYDROLOGIC ATLAS 1 OF OKLAHOMA, RECONNAISSANCE OF THE WATER RESOURCES OF THE FORT SMITH QUADRANGLE, EAST-CENTRAL OKLAHOMA," BY MELVIN V. MARCHER, U.S. GEOLOGICAL SURVEY, 1969.

ODOT

THE ODOT PUBLICATION INDICATES THE PROJECT SITE IS ALLUVIUM (QAS) UNDERLAIN BY THE ATOKA UNIT (PA). THE GEOLOGIC UNITS ARE DESCRIBED THEREIN AS FOLLOWS:

ALLUVIUM CONSISTS OF RECENT DEPOSITS OF SANDS, SILTS, CLAYS, GRAVELS, OR MIXTURES OF THESE. THESE DEPOSITS ARE PRESENT ALONG STREAM BEDS AND FLOOD PLAINS.

THE ATOKA UNIT CONSISTS OF SANDSTONE, SILTSTONE, SHALE AND A FEW THIN BEDS OF LIMESTONE. THE SANDSTONE BEDS ARE SOFT TO HARD, BROWN TO GRAY IN COLOR, LOCALLY LIMY AND ARE FROM A FEW INCHES THICK TO APPROXIMATELY 20 FEET THICK WITH SEQUENCES OF BEDS, SEPARATED BY THIN STRINGERS OF SHALE, UP TO 115 FEET THICK. THE SILTSTONE BEDS ARE GENERALLY HARD, BROWN TO GRAY IN COLOR AND USUALLY LESS THAN ONE FOOT THICK. THE SHALES FOR THE MOST PART ARE FISSILE, LOCALLY CLAYEY, BROWN TO BLACK IN COLOR AND RANGE IN THICKNESS FROM A FEW INCHES TO 300 FEET OR MORE. GENERALLY MOST SHALE ZONES WILL CONTAIN THIN SILTSTONE, SANDSTONE AND/OR LIMESTONE BEDS LESS THAN ONE FOOT THICK.

THE ATOKA UNIT RANGES IN THICKNESS FROM ONLY A FEW FEET IN THE NORTHERN PORTION OF DIVISION ONE TO AS MUCH AS 9,000 FEET IN PITTSBURG COUNTY.

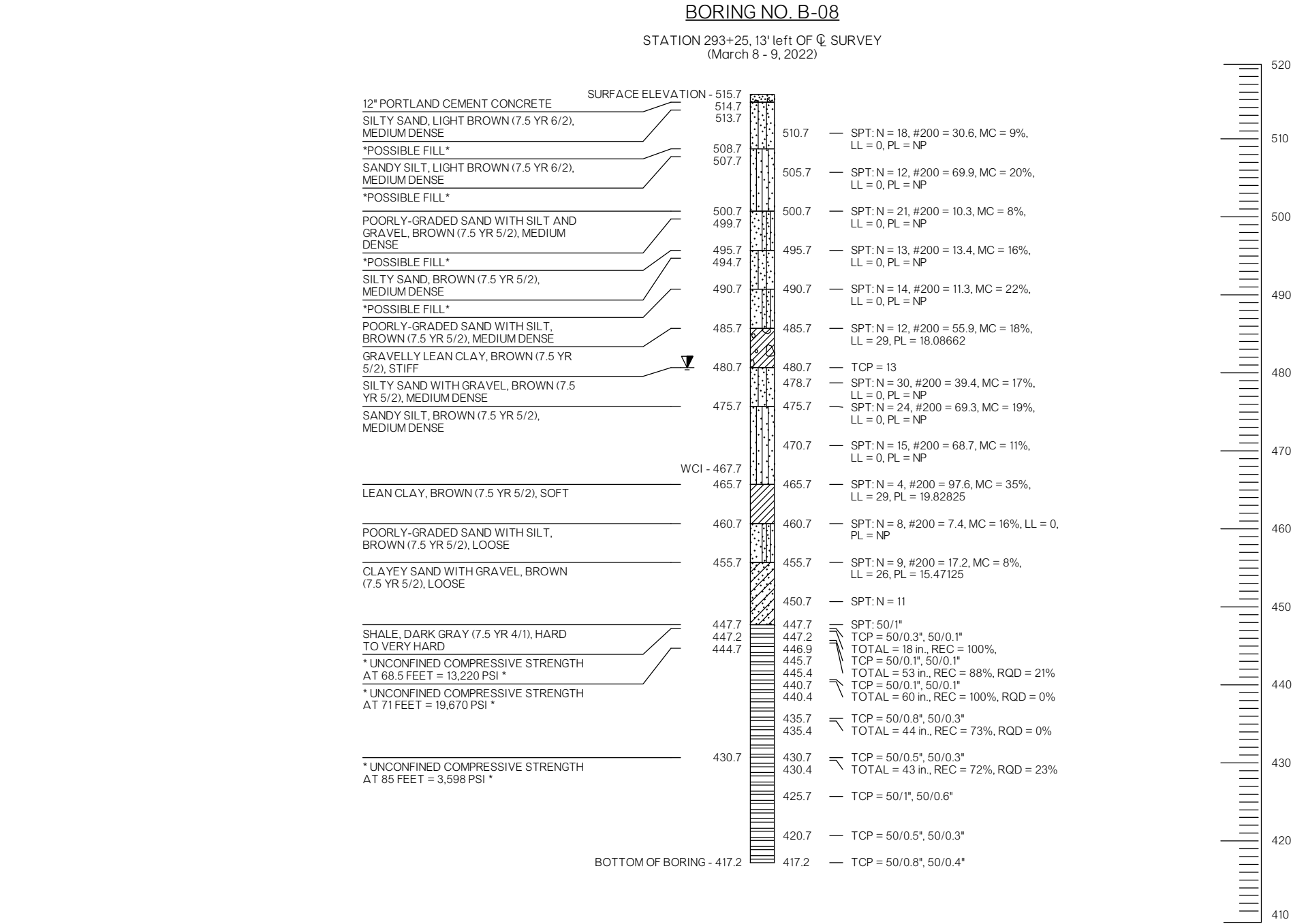
THE ATOKA UNIT OUTCROPS IN ALL COUNTIES OF DIVISION ONE EXCEPT OKMULGEE. THE TOPOGRAPHY OF THIS UNIT IS GENERALLY HILLS CAPPED WITH SANDSTONES AND THE SLOPES AND VALLEYS FORMED IN THE SHALES. WHERE THE UNIT IS MOSTLY SHALE, PRAIRIES ARE PRESENT.

USGS

THE USGS MAP INDICATES THAT THE PROJECT SITE CONSISTS OF ALLUVIUM (QAL) WHICH IS UNDERLAIN BY THE ATOKA FORMATION (PA). THE GEOLOGIC FORMATIONS ARE DESCRIBED THEREIN AS FOLLOWS:

ALLUVIUM CONSISTS OF GRAVEL, SAND, SILT, AND CLAY. YIELDS LARGE AMOUNT OF WATER OF GOOD QUALITY ALONG THE ARKANSAS RIVER AND PROBABLY WILL YIELD MODERATE TO LARGE AMOUNTS ALONG THE CANADIAN RIVER.

THE ATOKA FORMATION CONSISTS OF SHALE AND SANDSTONE. YIELDS LIMITED AMOUNTS OF WATER OF POOR QUALITY.



LEGEND

V. = VERY
FL. = FAIRLY
SL. = SLIGHTLY
LT. = LIGHT
MED. = MEDIUM
BRN. = BROWN
TR. = TRACE
DRK. = DARK
BLK. = BLACK

DCD = DIAMOND CORE DRILLING, ASTM D2113-83
SPT = STANDARD PENETRATION TEST, ASTM D1586
SS = SPLIT SPOON SAMPLER
N = NUMBER OF BLOWS PER 12 INCHES
MC = MOISTURE CONTENT
LL = LIQUID LIMIT
PL = PLASTIC LIMIT (NP=NO PLASTICITY)
#200 = PERCENT PASSING #200 SIEVE
UCS = UNCONFINED COMPRESSIVE STRENGTH
TCP = TEXAS CONE PENETROMETER
WCI = WET CAVE IN
 ∇ = WATER LEVEL WHILE DRILLING OR SAMPLING
 ∇ = WATER LEVEL AFTER DRILLING
 ∇ = WATER LEVEL 24 HOURS AFTER DRILLING
 ∇ = TOP OF ROCK

NOTE: WATER LEVEL ELEVATIONS SHOWN WERE OBTAINED AT THE TIME THE BORINGS WERE DRILLED AND MAY FLUCTUATE THROUGHOUT THE YEAR.

NOTE: "SS" DENOTES STANDARD PENETRATION TEST, AASHTO D1586-84. "TCP" DENOTES TEXAS CONE PENETRATION TEST.

* NOTE: TOP OF ROCK LINE SHOWN FOR ESTIMATING PURPOSES ONLY.

** NOTE: WATER LEVEL ELEVATION SHOWN WERE OBTAINED AT THE TIME THE BORINGS WERE DRILLED AND MAY FLUCTUATE THROUGHOUT THE YEAR.

*** NOTE: ROCK CLASSIFICATION IS BASED ON DRILLING CHARACTERISTICS AND VISUAL OBSERVATION OF ROCK CORE SAMPLES. PETROGRAPHIC ANALYSIS OF THIN SECTIONS OF THE ROCK CORE SAMPLES MAY REVEAL OTHER TYPES.

RED ROCK CONSULTING

SH 100 BRIDGE OVER ARKANSAS RIVER
MUSKOGEE AND SEQUOYAH COUNTIES, OKLAHOMA

SUBSURFACE PROFILE (SHEET 4 OF 5)

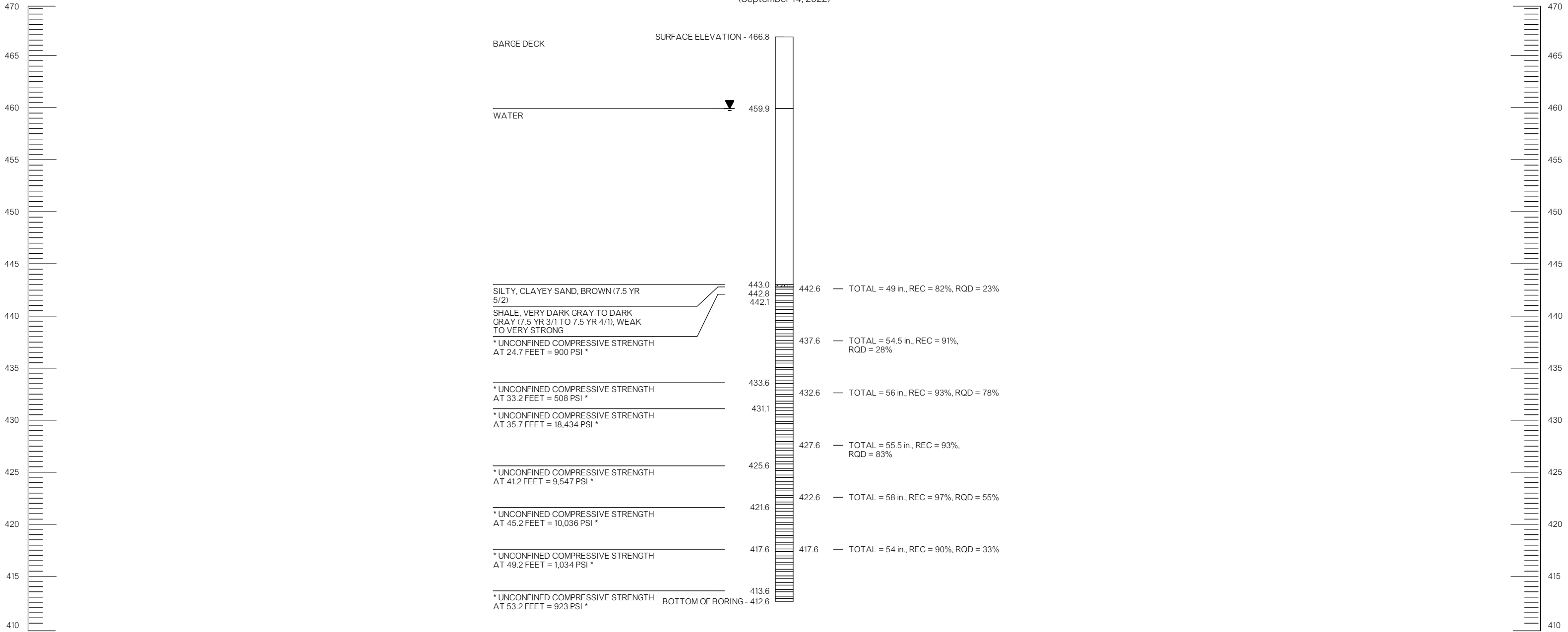
STATE OF OKLAHOMA
DEPARTMENT OF TRANSPORTATION
JOB PIECE NO. 32100(04)
SHEET NO. 4

Design	EDC	10/22
Detail	EDC	10/22
Check	JWB	10/22
Squad		
Engr.		

REVISIONS		
REV. NO.	DESCRIPTION	DATE

BORING NO. B-05A

STATION 286+72, 30' left of \overline{C} SURVEY
(September 14, 2022)



SITE GEOLOGY

THE GEOLOGY OF THE PROJECT SITE WAS RESEARCHED USING THE "DIVISION ONE ENGINEERING CLASSIFICATION OF GEOLOGICAL MATERIALS", PUBLISHED BY THE OKLAHOMA DEPARTMENT OF TRANSPORTATION (ODOT) AND THE GEOLOGIC MAP OF THE "HYDROLOGIC ATLAS 1 OF OKLAHOMA, RECONNAISSANCE OF THE WATER RESOURCES OF THE FORT SMITH QUADRANGLE, EAST-CENTRAL OKLAHOMA," BY MELVIN V. MARCHER, U.S. GEOLOGICAL SURVEY, 1969.

ODOT

THE ODOT PUBLICATION INDICATES THE PROJECT SITE IS ALLUVIUM (QAS) UNDERLAIN BY THE ATOKA UNIT (PA). THE GEOLOGIC UNITS ARE DESCRIBED THEREIN AS FOLLOWS:
ALLUVIUM CONSISTS OF RECENT DEPOSITS OF SANDS, SILTS, CLAYS, GRAVELS, OR MIXTURES OF THESE. THESE DEPOSITS ARE PRESENT ALONG STREAM BEDS AND FLOOD PLAINS.

THE ATOKA UNIT CONSISTS OF SANDSTONE, SILTSTONE, SHALE AND A FEW THIN BEDS OF LIMESTONE. THE SANDSTONE BEDS ARE SOFT TO HARD, BROWN TO GRAY IN COLOR, LOCALLY LIMY AND ARE FROM A FEW INCHES THICK TO APPROXIMATELY 20 FEET THICK WITH SEQUENCES OF BEDS, SEPARATED BY THIN STRINGERS OF SHALE, UP TO 115 FEET THICK. THE SILTSTONE BEDS ARE GENERALLY HARD, BROWN TO GRAY IN COLOR AND USUALLY LESS THAN ONE FOOT THICK. THE SHALES FOR THE MOST PART ARE FISSILE, LOCALLY CLAYEY, BROWN TO BLACK IN COLOR AND RANGE IN THICKNESS FROM A FEW INCHES TO 300 FEET OR MORE. GENERALLY MOST SHALE ZONES WILL CONTAIN THIN SILTSTONE, SANDSTONE AND/OR LIMESTONE BEDS LESS THAN ONE FOOT THICK.

THE ATOKA UNIT RANGES IN THICKNESS FROM ONLY A FEW FEET IN THE NORTHERN PORTION OF DIVISION ONE TO AS MUCH AS 9,000 FEET IN PITTSBURG COUNTY.

THE ATOKA UNIT OUTCROPS IN ALL COUNTIES OF DIVISION ONE EXCEPT OKMULGEE. THE TOPOGRAPHY OF THIS UNIT IS GENERALLY HILLS CAPPED WITH SANDSTONES AND THE SLOPES AND VALLEYS FORMED IN THE SHALES. WHERE THE UNIT IS MOSTLY SHALE, PRAIRIES ARE PRESENT.

USGS

THE USGS MAP INDICATES THAT THE PROJECT SITE CONSISTS OF ALLUVIUM (QAL) WHICH IS UNDERLAIN BY THE ATOKA FORMATION (PA). THE GEOLOGIC FORMATIONS ARE DESCRIBED THEREIN AS FOLLOWS:

ALLUVIUM CONSISTS OF GRAVEL, SAND, SILT, AND CLAY. YIELDS LARGE AMOUNT OF WATER OF GOOD QUALITY ALONG THE ARKANSAS RIVER AND PROBABLY WILL YIELD MODERATE TO LARGE AMOUNTS ALONG THE CANADIAN RIVER.

THE ATOKA FORMATION CONSISTS OF SHALE AND SANDSTONE. YIELDS LIMITED AMOUNTS OF WATER OF POOR QUALITY.

LEGEND

- V. = VERY
- FL. = FAIRLY
- SL. = SLIGHTLY
- LT. = LIGHT
- MED. = MEDIUM
- BRN. = BROWN
- TR. = TRACE
- DRK. = DARK
- BLK. = BLACK

- DCD = DIAMOND CORE DRILLING, ASTM D2113-83
- SPT = STANDARD PENETRATION TEST, ASTM D1586
- SS = SPLIT SPOON SAMPLER
- N = NUMBER OF BLOWS PER 12 INCHES
- MC = MOISTURE CONTENT
- LL = LIQUID LIMIT
- PL = PLASTIC LIMIT (NP=NO PLASTICITY)
- #200 = PERCENT PASSING #200 SIEVE
- UCS = UNCONFINED COMPRESSIVE STRENGTH
- TCP = TEXAS CONE PENETROMETER
- WCI = WET CAVE IN
- = WATER LEVEL WHILE DRILLING OR SAMPLING
- = WATER LEVEL AFTER DRILLING
- = WATER LEVEL 24 HOURS AFTER DRILLING
- = TOP OF ROCK

NOTE: WATER LEVEL ELEVATIONS SHOWN WERE OBTAINED AT THE TIME THE BORINGS WERE DRILLED AND MAY FLUCTUATE THROUGHOUT THE YEAR.

NOTE: "SS" DENOTES STANDARD PENETRATION TEST, AASHTO D1586-84. "TCP" DENOTES TEXAS CONE PENETRATION TEST.

- * NOTE: TOP OF ROCK LINE SHOWN FOR ESTIMATING PURPOSES ONLY.
- ** NOTE: WATER LEVEL ELEVATION SHOWN WERE OBTAINED AT THE TIME THE BORINGS WERE DRILLED AND MAY FLUCTUATE THROUGHOUT THE YEAR.
- *** NOTE: ROCK CLASSIFICATION IS BASED ON DRILLING CHARACTERISTICS AND VISUAL OBSERVATION OF ROCK CORE SAMPLES. PETROGRAPHIC ANALYSIS OF THIN SECTIONS OF THE ROCK CORE SAMPLES MAY REVEAL OTHER TYPES.

RED ROCK
CONSULTING

GEOTECHNICAL REPORT

ALL GEOTECHNICAL INFORMATION CONTAINED ON THIS SHEET IS COVERED BY THE ENGINEERING SEAL AFFIXED TO AN ORIGINAL GEOTECHNICAL ENGINEERING REPORT THAT HAS BEEN STAMPED AND SEALED BY A PROFESSIONAL ENGINEER LICENSED IN OKLAHOMA. TO OBTAIN A COPY OF THE COMPLETE REPORT, CONTACT THE ODOT OFFICE ENGINEER AT (405) 521-2625. THE CONTRACTOR SHOULD BE FULLY AWARE OF THE SITE CONDITIONS PRIOR TO BEGINNING WORK. ANY ADDITIONAL GEOTECHNICAL INFORMATION WHICH MAY BE DESIRED IS THE RESPONSIBILITY OF THE CONTRACTOR.

SH 100 BRIDGE OVER ARKANSAS RIVER		MUSKOGEE AND SEQUOYAH COUNTIES, OKLAHOMA		Design	EDC	10/22
SUBSURFACE PROFILE (SHEET 5 OF 5)				Detail	EDC	10/22
				Check	JWB	10/22
				Squad:		
				Engr.:		
STATE OF OKLAHOMA		DEPARTMENT OF TRANSPORTATION				
		JOB PIECE NO. 32100(04)				SHEET NO. 5

APPENDIX B

SUMMARY OF LABORATORY RESULTS

PAGE 1 OF 1

CLIENT CEC

PROJECT NAME SH 100 Bridge over Arkansas River

PROJECT NUMBER 20059

PROJECT LOCATION Muskogee and Sequoyah Counties, Oklahoma

Borehole	Depth (ft)	% Moist.	Liquid Limit	Plastic Limit	Plasticity Index	-3" Sieve	- 3/4" Sieve	-1/2" Sieve	-4 Sieve	-10 Sieve	-40 Sieve	-200 Sieve
B-01	5.0	17.7	NV	NP	NP	100	100	97	92	91	88	68.3
B-01	10.0	14.7	NV	NP	NP	100	100	100	97	93	86	49.2
B-01	15.0	17.7	NV	NP	NP	100	100	100	100	99	95	62.1
B-01	20.0	5.8	NV	NP	NP	100	100	100	99	98	82	12.1
B-01	25.0	14.2	NV	NP	NP	100	100	100	100	99	93	58.0
B-01	30.0	8.1	NV	NP	NP	100	100	100	98	96	85	19.9
B-01	35.0	14.8	NV	NP	NP	100	100	100	100	99	92	46.0
B-01	40.0	9.1	NV	NP	NP	100	100	100	98	93	74	36.9
B-01	45.0	8.0	NV	NP	NP	100	100	100	99	94	73	24.3
B-01	50.0	21.1	NV	NP	NP	100	100	100	100	100	100	78.1
B-01	55.0	21.8	NV	NP	NP	100	100	100	100	100	100	84.9
B-01	60.0	18.8	NV	NP	NP	100	100	100	100	99	95	47.8
B-01	65.0	17.8	NV	NP	NP	100	100	100	100	100	99	57.0
B-01	70.0	16.8	NV	NP	NP	100	100	100	100	100	100	67.6
B-01	75.0	30.3	21	16	5	100	100	100	100	100	100	95.0
B-01	80.0	15.9	NV	NP	NP	100	100	100	97	96	89	18.7
B-01	86.5	9.4	26	19	7	100	100	100	98	88	67	51.0
B-02	17.0	6.9				100	100	100	63	43	10	6.2
B-02	22.0	8.0				100	59	43	18	11	2	0.3
B-02	25.0	11.5	24	16	8	100	100	100	95	83	61	44.7
B-03	25.5	7.8	26	17	9	100	100	100	98	79	52	39.6
B-04	28.9	10.0	25	18	7	100	100	100	99	77	44	32.2
B-05	24.0	9.9	22	16	6	100	100	100	90	69	46	34.6
B-06	16.1	15.9	NV	NP	NP	100	100	100	99	97	77	1.9
B-07	22.1	9.1	NV	NP	NP	100	100	100	80	61	46	30.6
B-08	5.0	9.3	NV	NP	NP	100	100	94	89	87	71	30.6
B-08	10.0	20.1	NV	NP	NP	100	100	100	100	99	97	69.9
B-08	15.0	7.7	NV	NP	NP	100	100	83	61	47	26	10.3
B-08	20.0	16.3	NV	NP	NP	100	100	98	97	94	54	13.4
B-08	25.0	22.0	NV	NP	NP	100	100	100	100	93	52	11.3
B-08	30.0	18.0	29	18	11	100	91	87	76	74	73	55.9
B-08	37.0	17.4	NV	NP	NP	100	87	80	58	47	45	39.4
B-08	40.0	18.6	NV	NP	NP	100	100	100	100	100	99	69.3
B-08	45.0	11.4	NV	NP	NP	100	100	100	100	100	100	68.7
B-08	50.0	35.2	29	20	9	100	100	100	99	99	98	97.6
B-08	55.0	16.0	NV	NP	NP	100	100	100	100	100	50	7.4
B-08	60.0	7.6	26	15	11	100	100	100	75	41	24	17.2

SUMMARY OF UNIAXIAL COMPRESSIVE STRENGTH TEST RESULTS



PO Box 30591
Edmond, OK 73003
405-562-3328

RRC PROJECT NO 20059

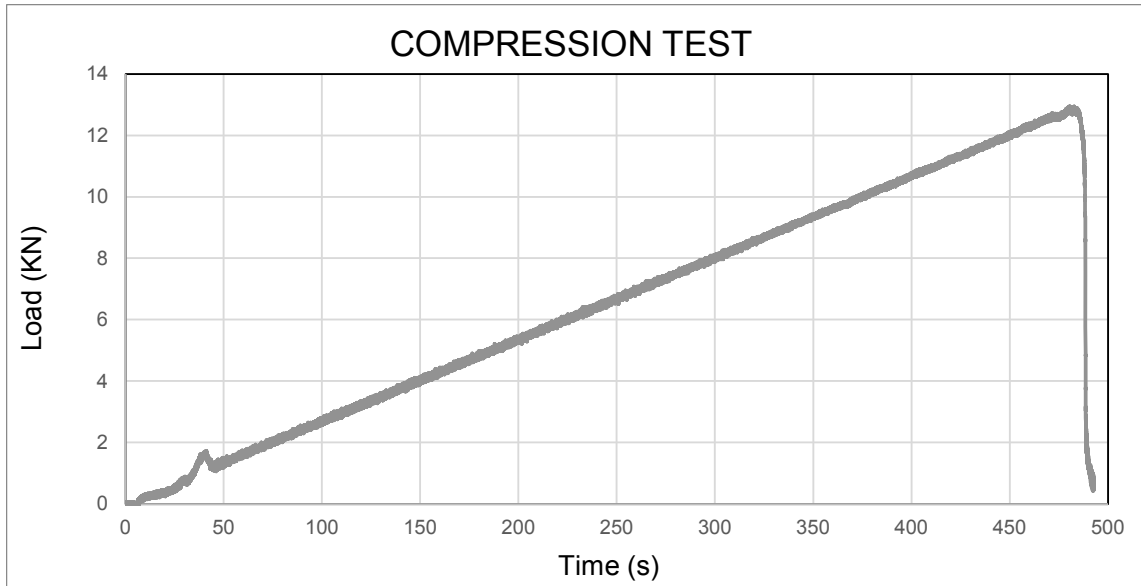
PROJECT NAME
CLIENT

SH 100 Bridge over Arkansas River
CEC

Boring	Depth	Length	Diameter	L/D	Moisture	Unit Weight	Loading Rate	Un Comp Strength	Un Comp Strength	Correction Factor Applied	Straight	Flat	Perpend
	(ft)	(in)	(in)		%	(pcf)	(KN/sec)	(Mpa)	(psi)				
B-5A	24.7	4.209	2.0292	2	5.8%	153.1	0.03	6.2	900	1	Pass	Pass	Pass
	33.2	4.1122	2.0297	2	6.1%	150.7	0.03	3.5	508	1	Pass	Pass	Pass
	35.7	4.1653	2.0447	2	0.5%	164.0	0.08	127.1	18,434	1	Pass	Pass	Pass
	41.2	4.1227	2.0383	2	1.5%	161.4	0.09	65.8	9,547	1	Pass	Pass	Pass
	45.2	4.1268	2.037	2	1.1%	165.5	0.10	69.2	10,036	1	Pass	Pass	Pass
	49.2	4.1867	2.0068	2	5.0%	154.8	0.03	7.1	1,034	1	Pass	Pass	Pass
B-8	53.2	3.936	1.88833	2	3.8%	156.9	0.02	6.4	923	1	Pass	Pass	Pass
	68.5	4.2398	2.0465	2	0.3%	164.2	0.05	91.2	13,220	1	Pass	Pass	Pass
	71	4.2227	2.0462	2	0.2%	162.4	0.08	135.6	19,670	1	Pass	Pass	Pass
	85	3.8887	1.7912	2	2.6%	157.1	0.02	24.8	3,598	1	Pass	Pass	Pass

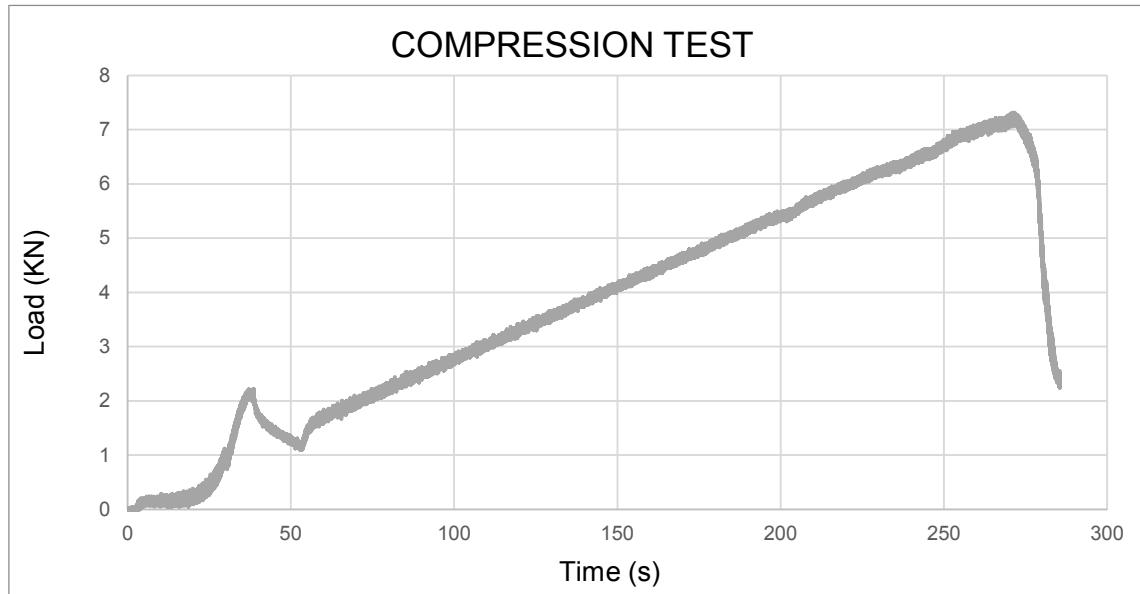
UC Compressive Strength



ASTM D 7012 Method C



Compressive Strength = 900 psi		Photo After Test
Test Conditions <p> Procedure S1 - Side Straightness = Pass Procedure FP2 - Flatness = Pass Procedure P2 - Perpendicularity = Pass Load Direction = Vertical Loading Rate = 0.03 KN/sec Time of Failure = 497.5 seconds Temperature at Testing = 25 °C </p> ASTM Tolerance Limits <p> Procedures: S1, FP2, P2 Side Tolerance (Straightness): Not to exceed 0.020 inch Perpendicularity Deviation: Not to exceed 0.250° Deviation from Flatness: Not to exceed 0.001 inch Parallelism Deviation: Not to exceed 0.25° </p> Equipment Used <p> Cut Saw - Chicago Electric 46225 Caliper - General No. 143 Feeler Gauge Compression Machine - Besmak BCO-113/3 </p>		
SAMPLE DATA		PROJECT INFORMATION
SAMPLE LOCATION: B-5A at 24.7 ft SAMPLE DESCRIPTION: Shale, very dark gray MOISTURE CONTENT: 5.8% UNIT WEIGHT (PCF): 153.1 DIAMETER (IN): 2.0292 LENGTH (IN): 4.209 L/D RATIO: 2		PROJECT: SH 100 Bridge over Arkansas River LOCATION: Muskogee and Sequoyah Counties, Oklahoma PROJECT NO.: 20059 CLIENT: CEC TESTED BY: AB DATE: 9/29/2022

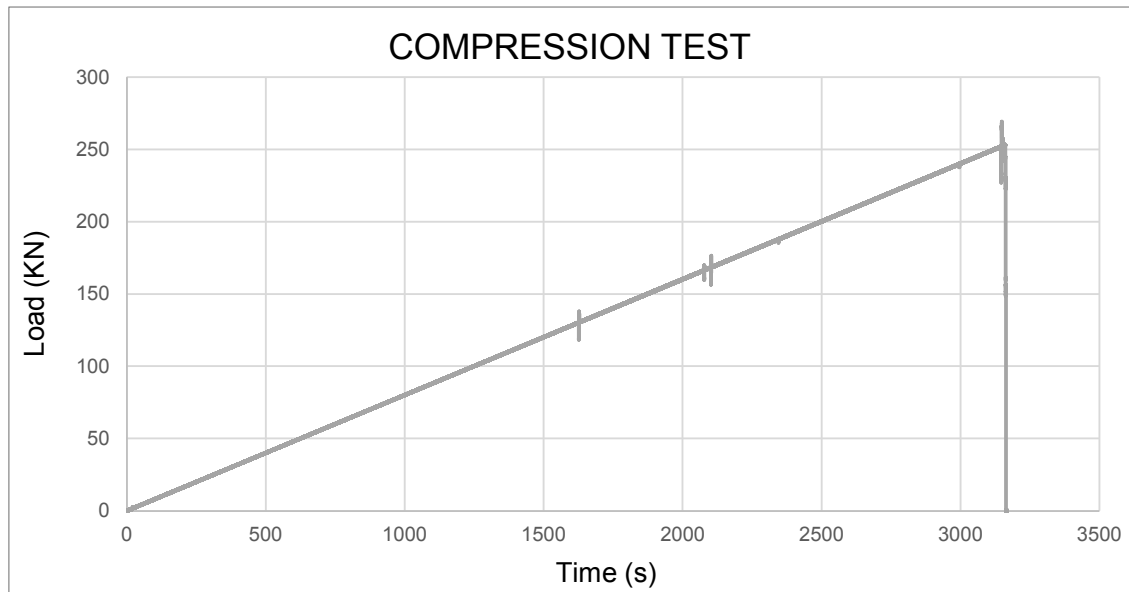
UC Compressive Strength ASTM D 7012 Method C



Compressive Strength = 508 psi		Photo After Test	
Test Conditions Procedure S1 - Side Staightness = Pass Procedure FP2 - Flatness = Pass Procedure P2 - Perpendicularity = Pass Load Direction = Vertical Loading Rate = 0.03 KN/sec Time of Failure = 288.3 seconds Temperature at Testing = 25 °C			
ASTM Tolerance Limits Procedures: S1, FP2, P2 Side Tolerance (Straightness): Not to exceed 0.020 inch Perpendicularity Deviation: Not to exceed 0.250° Deviation from Flatness: Not to exceed 0.001 inch Parallelism Deviation: Not to exceed 0.25°			
Equipment Used Cut Saw - Chicago Electric 46225 Caliper - General No. 143 Feeler Gauge Compression Machine - Besmak BCO-113/3			
SAMPLE DATA		PROJECT INFORMATION	
SAMPLE LOCATION:	B-5A at 33.2 ft	PROJECT:	SH 100 Bridge over Arkansas River
SAMPLE DESCRIPTION:	Shale, very dark gray	LOCATION:	Muskogee and Sequoyah Counties, Oklahoma
MOISTURE CONTENT:	6.1%	PROJECT NO.:	20059
UNIT WEIGHT (PCF):	150.7	CLIENT:	CEC
DIAMETER (IN):	2.0297	TESTED BY:	AB
LENGTH (IN):	4.1122	DATE:	9/29/2022
L/D RATIO:	2		

UC Compressive Strength

ASTM D 7012 Method C



Compressive Strength = 18,434 psi

Photo After Test

Test Conditions

Procedure S1 - Side Straightness = Pass
 Procedure FP2 - Flatness = Pass
 Procedure P2 - Perpendicularity = Pass
 Load Direction = Vertical
 Loading Rate = 0.08 KN/sec
 Time of Failure = 3199.3 seconds
 Temperature at Testing = 25 °C

ASTM Tolerance Limits

Procedures: S1, FP2, P2
 Side Tolerance (Straightness): Not to exceed 0.020 inch
 Perpendicularity Deviation: Not to exceed 0.250°
 Deviation from Flatness: Not to exceed 0.001 inch
 Parallelism Deviation: Not to exceed 0.25°

Equipment Used

Cut Saw - Chicago Electric 46225
 Caliper - General No. 143
 Feeler Gauge
 Compression Machine - Besmak BCO-113/3



SAMPLE DATA

SAMPLE LOCATION: B-5A at 35.7 ft
 SAMPLE DESCRIPTION: Shale, very dark gray
 MOISTURE CONTENT: 0.5%
 UNIT WEIGHT (PCF): 164.0
 DIAMETER (IN): 2.0447
 LENGTH (IN): 4.1653
 L/D RATIO: 2

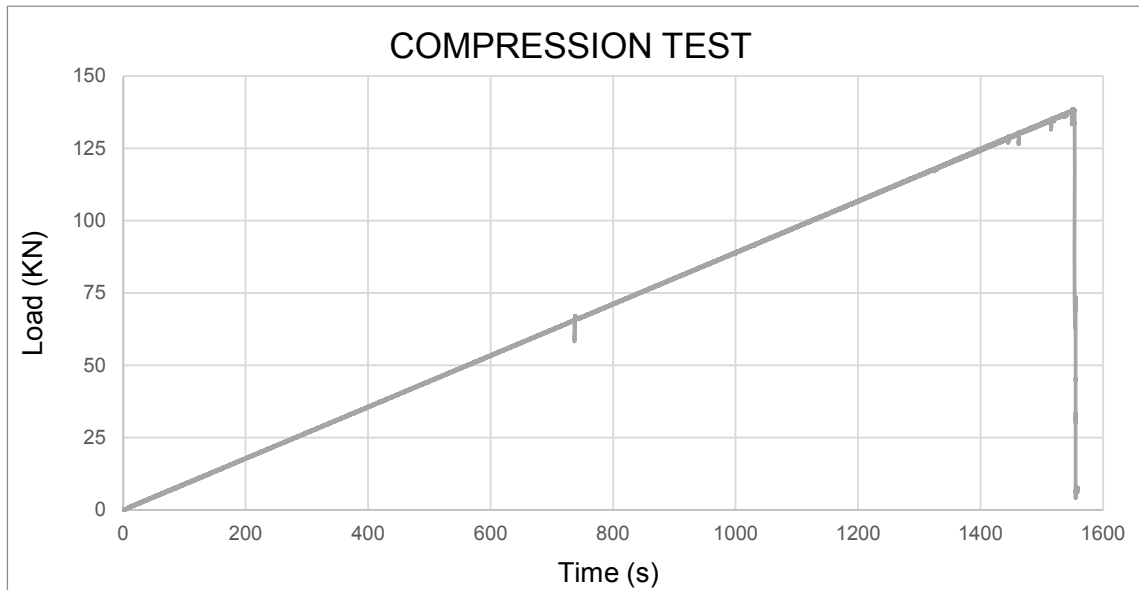
PROJECT INFORMATION



PROJECT: SH 100 Bridge over Arkansas River
 LOCATION: Muskogee and Sequoyah Counties, Oklahoma
 PROJECT NO.: 20059
 CLIENT: CEC
 TESTED BY: AB
 DATE: 9/29/2022

RED ROCK
CONSULTING

UC Compressive Strength

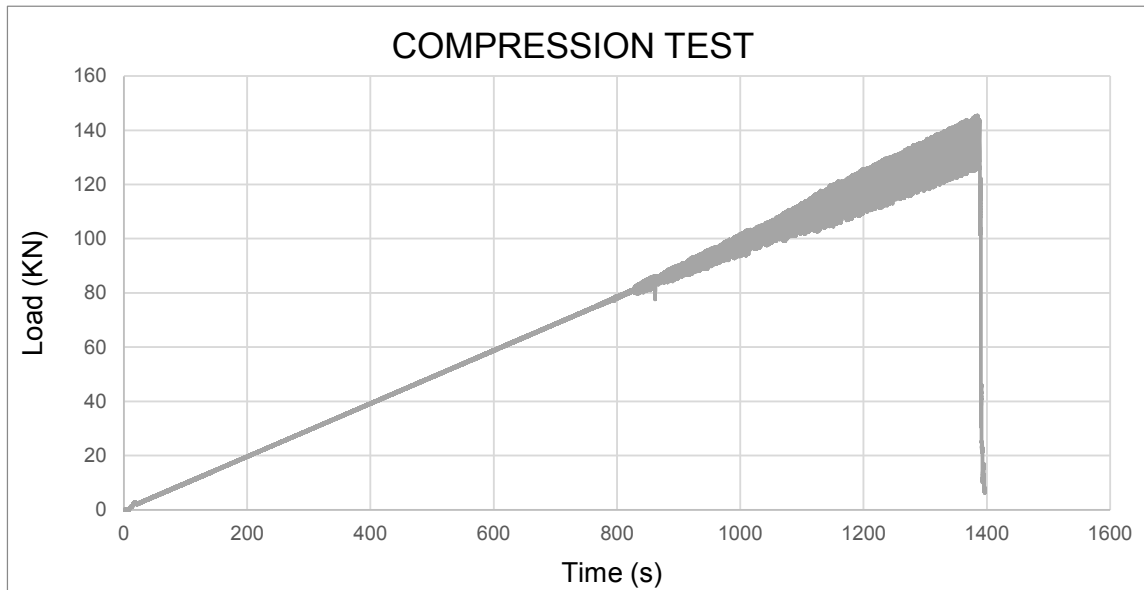
ASTM D 7012 Method C



Compressive Strength = 9,547 psi		Photo After Test	
Test Conditions Procedure S1 - Side Staightness = Pass Procedure FP2 - Flatness = Pass Procedure P2 - Perpendicularity = Pass Load Direction = Vertical Loading Rate = 0.09 KN/sec Time of Failure = 1574.2 seconds Temperature at Testing = 25 °C			
ASTM Tolerance Limits Procedures: S1, FP2, P2 Side Tolerance (Straightness): Not to exceed 0.020 inch Perpendicularity Deviation: Not to exceed 0.250° Deviation from Flatness: Not to exceed 0.001 inch Parallelism Deviation: Not to exceed 0.25°			
Equipment Used Cut Saw - Chicago Electric 46225 Caliper - General No. 143 Feeler Gauge Compression Machine - Besmak BCO-113/3			
SAMPLE DATA		PROJECT INFORMATION	
SAMPLE LOCATION:	B-5A at 41.2 ft	PROJECT:	SH 100 Bridge over Arkansas River
SAMPLE DESCRIPTION:	Shale, dark gray	LOCATION:	Muskogee and Sequoyah Counties, Oklahoma
MOISTURE CONTENT:	1.5%	PROJECT NO.:	20059
UNIT WEIGHT (PCF):	161.4	CLIENT:	CEC
DIAMETER (IN):	2.0383	TESTED BY:	AB
LENGTH (IN):	4.1227	DATE:	9/29/2022
L/D RATIO:	2		

UC Compressive Strength

ASTM D 7012 Method C



Compressive Strength = 10,036 psi

Photo After Test

Test Conditions

Procedure S1 - Side Straightness = Pass
 Procedure FP2 - Flatness = Pass
 Procedure P2 - Perpendicularity = Pass
 Load Direction = Vertical
 Loading Rate = 0.10 KN/sec
 Time of Failure = 1410.6 seconds
 Temperature at Testing = 25 °C

ASTM Tolerance Limits

Procedures: S1, FP2, P2
 Side Tolerance (Straightness): Not to exceed 0.020 inch
 Perpendicularity Deviation: Not to exceed 0.25°
 Deviation from Flatness: Not to exceed 0.001 inch
 Parallelism Deviation: Not to exceed 0.25°

Equipment Used

Cut Saw - Chicago Electric 46225
 Caliper - General No. 143
 Feeler Gauge
 Compression Machine - Besmak BCO-113/3



SAMPLE DATA

SAMPLE LOCATION: B-5A at 45.2 ft
 SAMPLE DESCRIPTION: Shale, dark gray
 MOISTURE CONTENT: 1.1%
 UNIT WEIGHT (PCF): 165.5
 DIAMETER (IN): 2.037
 LENGTH (IN): 4.1268
 L/D RATIO: 2

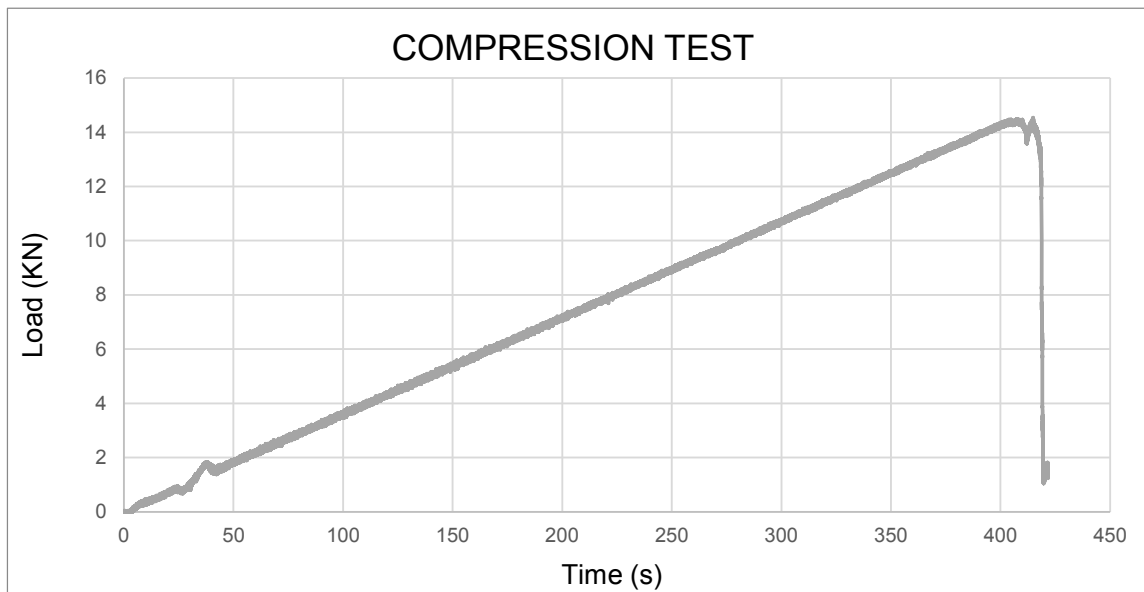
PROJECT INFORMATION

PROJECT: SH 100 Bridge over Arkansas River
 LOCATION: Muskogee and Sequoyah Counties, Oklahoma
 PROJECT NO.: 20059
 CLIENT: CEC
 TESTED BY: AB
 DATE: 9/29/2022

RED ROCK
CONSULTING

UC Compressive Strength

ASTM D 7012 Method C



Compressive Strength = 1,034 psi

Photo After Test

Test Conditions

Procedure S1 - Side Straightness = Pass
 Procedure FP2 - Flatness = Pass
 Procedure P2 - Perpendicularity = Pass
 Load Direction = Vertical
 Loading Rate = 0.03 KN/sec
 Time of Failure = 425.9 seconds
 Temperature at Testing = 25 °C

ASTM Tolerance Limits

Procedures: S1, FP2, P2
 Side Tolerance (Straightness): Not to exceed 0.020 inch
 Perpendicularity Deviation: Not to exceed 0.25°
 Deviation from Flatness: Not to exceed 0.001 inch
 Parallelism Deviation: Not to exceed 0.25°

Equipment Used

Cut Saw - Chicago Electric 46225
 Caliper - General No. 143
 Feeler Gauge
 Compression Machine - Besmak BCO-113/3



SAMPLE DATA

SAMPLE LOCATION: B-5A at 49.2 ft
 SAMPLE DESCRIPTION: Shale, very dark gray
 MOISTURE CONTENT: 5.0%
 UNIT WEIGHT (PCF): 154.8
 DIAMETER (IN): 2.0068
 LENGTH (IN): 4.1867
 L/D RATIO: 2

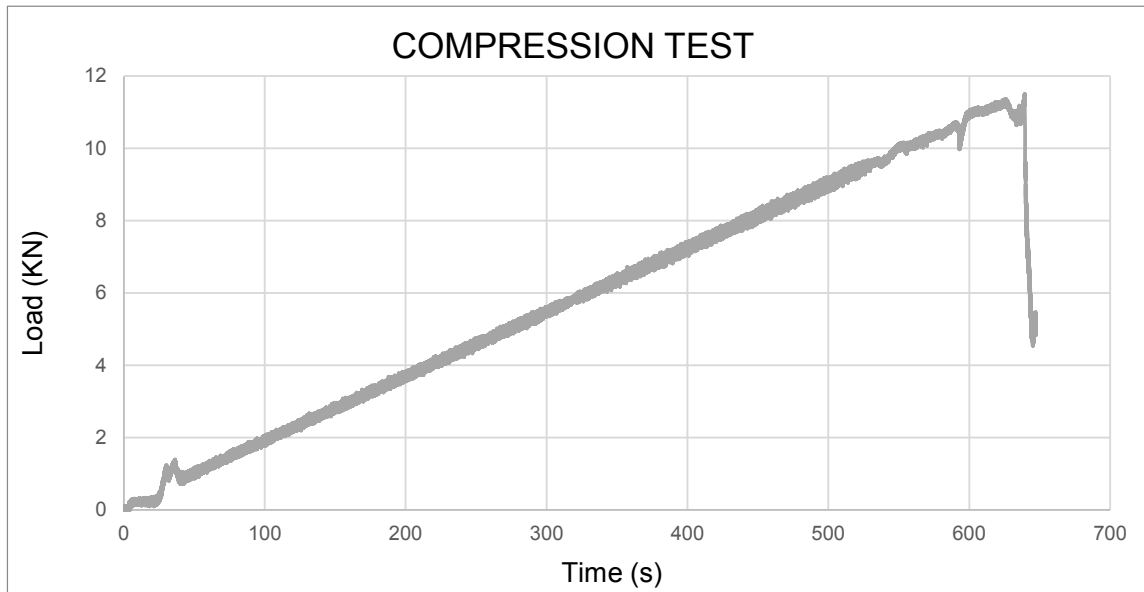
PROJECT INFORMATION

PROJECT: SH 100 Bridge over Arkansas River
 LOCATION: Muskogee and Sequoyah Counties, Oklahoma
 PROJECT NO.: 20059
 CLIENT: CEC
 TESTED BY: AB
 DATE: 9/29/2022

RED ROCK
CONSULTING

UC Compressive Strength

ASTM D 7012 Method C



Compressive Strength = 923 psi

Photo After Test

Test Conditions

Procedure S1 - Side Straightness = Pass
 Procedure FP2 - Flatness = Pass
 Procedure P2 - Perpendicularity = Pass
 Load Direction = Vertical
 Loading Rate = 0.02 KN/sec
 Time of Failure = 653.8 seconds
 Temperature at Testing = 25 °C

ASTM Tolerance Limits

Procedures: S1, FP2, P2
 Side Tolerance (Straightness): Not to exceed 0.020 inch
 Perpendicularity Deviation: Not to exceed 0.25°
 Deviation from Flatness: Not to exceed 0.001 inch
 Parallelism Deviation: Not to exceed 0.25°

Equipment Used

Cut Saw - Chicago Electric 46225
 Caliper - General No. 143
 Feeler Gauge
 Compression Machine - Besmak BCO-113/3



SAMPLE DATA

SAMPLE LOCATION: B-5A at 53.2 ft
 SAMPLE DESCRIPTION: Shale, very dark gray
 MOISTURE CONTENT: 3.8%
 UNIT WEIGHT (PCF): 156.9
 DIAMETER (IN): 1.88833
 LENGTH (IN): 3.936
 L/D RATIO: 2

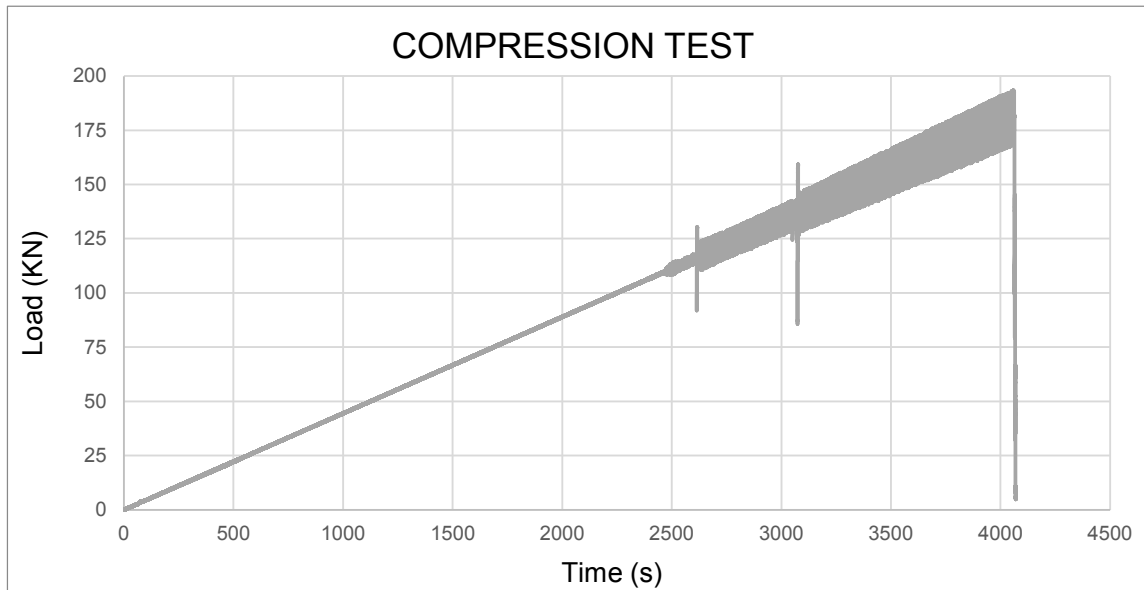
PROJECT INFORMATION

PROJECT: SH 100 Bridge over Arkansas River
 LOCATION: Muskogee and Sequoyah Counties, Oklahoma
 PROJECT NO.: 20059
 CLIENT: CEC
 TESTED BY: AB
 DATE: 9/29/2022

RED ROCK
CONSULTING

UC Compressive Strength

ASTM D 7012 Method C



Compressive Strength = 13,220 psi

Photo After Test

Test Conditions

Procedure S1 - Side Straightness = Pass
 Procedure FP2 - Flatness = Pass
 Procedure P2 - Perpendicularity = Pass
 Load Direction = Vertical
 Loading Rate = 0.05 KN/sec
 Time of Failure = 4110.1 seconds
 Temperature at Testing = 25 °C

ASTM Tolerance Limits

Procedures: S1, FP2, P2
 Side Tolerance (Straightness): Not to exceed 0.020 inch
 Perpendicularity Deviation: Not to exceed 0.250°
 Deviation from Flatness: Not to exceed 0.001 inch
 Parallelism Deviation: Not to exceed 0.25°

Equipment Used

Cut Saw - Chicago Electric 46225
 Caliper - General No. 143
 Feeler Gauge
 Compression Machine - Besmak BCO-113/3



SAMPLE DATA

SAMPLE LOCATION: B-8 at 68.5 ft
 SAMPLE DESCRIPTION: Shale, very dark gray
 MOISTURE CONTENT: 0.3%
 UNIT WEIGHT (PCF): 164.2
 DIAMETER (IN): 2.0465
 LENGTH (IN): 4.2398
 L/D RATIO: 2

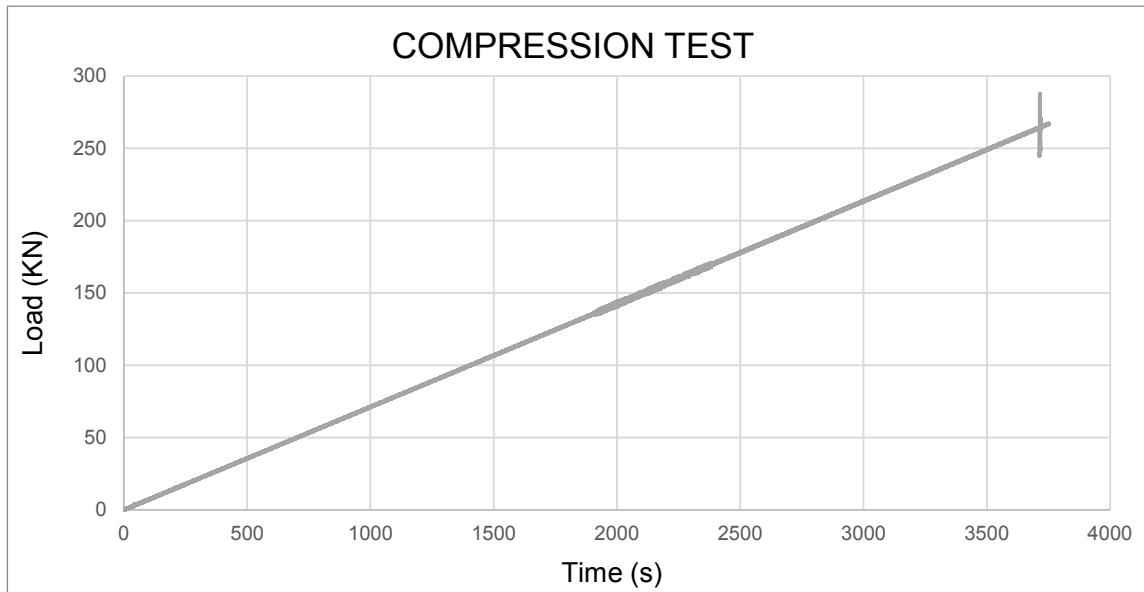
PROJECT INFORMATION

PROJECT: SH 100 Bridge over Arkansas River
 LOCATION: Muskogee and Sequoyah Counties, Oklahoma
 PROJECT NO.: 20059
 CLIENT: CEC
 TESTED BY: AB
 DATE: 9/29/2022

RED ROCK
CONSULTING

UC Compressive Strength

ASTM D 7012 Method C



Compressive Strength = 19,670 psi

Photo After Test

Test Conditions

Procedure S1 - Side Straightness = Pass
 Procedure FP2 - Flatness = Pass
 Procedure P2 - Perpendicularity = Pass
 Load Direction = Vertical
 Loading Rate = 0.08 KN/sec
 Time of Failure = 3788.4 seconds
 Temperature at Testing = 25 °C

ASTM Tolerance Limits

Procedures: S1, FP2, P2
 Side Tolerance (Straightness): Not to exceed 0.020 inch
 Perpendicularity Deviation: Not to exceed 0.250°
 Deviation from Flatness: Not to exceed 0.001 inch
 Parallelism Deviation: Not to exceed 0.25°

Equipment Used

Cut Saw - Chicago Electric 46225
 Caliper - General No. 143
 Feeler Gauge
 Compression Machine - Besmak BCO-113/3



SAMPLE DATA

SAMPLE LOCATION: B-8 at 71 ft
 SAMPLE DESCRIPTION: Shale, dark gray
 MOISTURE CONTENT: 0.2%
 UNIT WEIGHT (PCF): 162.4
 DIAMETER (IN): 2.0462
 LENGTH (IN): 4.2227
 L/D RATIO: 2

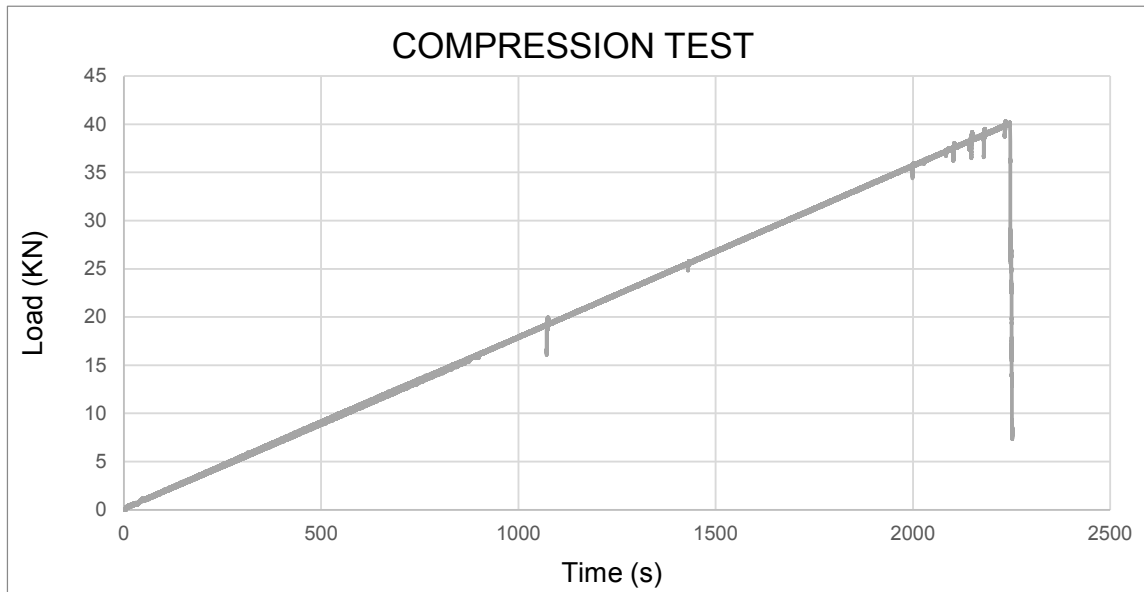
PROJECT INFORMATION

PROJECT: SH 100 Bridge over Arkansas River
 LOCATION: Muskogee and Sequoyah Counties, Oklahoma
 PROJECT NO.: 20059
 CLIENT: CEC
 TESTED BY: AB
 DATE: 9/29/2022

RED ROCK
CONSULTING

UC Compressive Strength

ASTM D 7012 Method C



Compressive Strength = 3,598 psi

Photo After Test

Test Conditions

Procedure S1 - Side Straightness = Pass
 Procedure FP2 - Flatness = Pass
 Procedure P2 - Perpendicularity = Pass
 Load Direction = Vertical
 Loading Rate = 0.02 KN/sec
 Time of Failure = 2274.5 seconds
 Temperature at Testing = 25 °C

ASTM Tolerance Limits

Procedures: S1, FP2, P2
 Side Tolerance (Straightness): Not to exceed 0.020 inch
 Perpendicularity Deviation: Not to exceed 0.25°
 Deviation from Flatness: Not to exceed 0.001 inch
 Parallelism Deviation: Not to exceed 0.25°

Equipment Used

Cut Saw - Chicago Electric 46225
 Caliper - General No. 143
 Feeler Gauge
 Compression Machine - Besmak BCO-113/3



SAMPLE DATA

SAMPLE LOCATION: B-8 at 85 ft
 SAMPLE DESCRIPTION: Shale, very dark gray
 MOISTURE CONTENT: 2.6%
 UNIT WEIGHT (PCF): 157.1
 DIAMETER (IN): 1.7912
 LENGTH (IN): 3.8887
 L/D RATIO: 2

PROJECT INFORMATION

PROJECT: SH 100 Bridge over Arkansas River
 LOCATION: Muskogee and Sequoyah Counties, Oklahoma
 PROJECT NO.: 20059
 CLIENT: CEC
 TESTED BY: EDC
 DATE: 9/29/2022

RED ROCK
CONSULTING

APPENDIX C

Rock Core Photographs



Photo # 1 Run 1 of boring B-5A was from 24.2 to 29.2 feet. Run 1 had a recovery of 82% and an RQD of 23%.



Photo # 2 Run 2 of boring B-5A was from 29.2 to 34.2 feet. Run 2 had a recovery of 91% and an RQD of 28%.



Photo # 3 Run 3 of boring B-5A was from 34.2 to 39.2 feet. Run 3 had a recovery of 93% and an RQD of 78%.

Rock Core Photographs



Photo # 4 Run 4 of boring B-5A was from 39.2 to 44.2 feet. Run 4 had a recovery of 93% and an RQD of 83%.



Photo # 5 Run 5 of boring B-5A was from 44.2 to 49.2 feet. Run 5 had a recovery of 97% and an RQD of 55%.



Photo # 6 Run 6 of boring B-5A was from 49.2 to 54.2 feet. Run 6 had a recovery of 90% and an RQD of 33%.

Rock Core Photographs



Photo # 1 Run 1 of boring B-8 was from 68.5 to 70 feet. Run 1 had a recovery of 100% and an RQD of 69%.



Photo # 2 Run 2 of boring B-8 was from 70 to 75 feet. Run 2 had a recovery of 88% and an RQD of 21%.



Photo # 3 Run 3 of boring B-8 was from 75 to 80 feet. Run 3 had a recovery of 100% and an RQD of 0%.

Rock Core Photographs



Photo # 4 Run 4 of boring B-8 was from 80 to 85 feet. Run 4 had a recovery of 73% and an RQD of 0%.



Photo # 5 Run 5 of boring B-8 was from 85 to 90 feet. Run 5 had a recovery of 72% and an RQD of 23%.

APPENDIX D

GENERAL NOTES

SOIL PROPERTY ABBREVIATIONS

N	Uncorrected SPT Penetration, blows per foot
N ₆₀	Corrected SPT Penetration, blows per foot
Q _u	Unconfined Compressive Strength, psf
Mc	Moisture Content, %
LL	Liquid Limit, %
PL	Plastic Limit, %
PI	Plasticity Index, %

DRILLING & SAMPLING ABBREVIATIONS

BS	Bag Sample
SPT	Split Spoon Sample
ST	Shelby Tube Sample
AU	Auger Sample
TC	Texas Cone Penetrometer
DCP	Dynamic Cone Penetrometer

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

-- used to classify all soils unless otherwise noted --

Major Divisions			Group Symbol	Typical Names
Course-Grained Soils >50% retained on #200 sieve	Gravels 50% + of course fraction retained on #4 sieve	Clean Gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		Gravels with Fines	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sands 50% + of course fraction passes #4 sieve	Clean Sands	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly graded sands and gravelly sands, little or no fines
		Sands with Fines	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
Fine-Grained Soils <50% passes #200 sieve	Silts and Clays Liquid Limit ≤ 50%		ML	Inorganic silts, very fine sands, rock four, silty or clayey fine sands
			CL	Inorganic clays of low to medium plasticity, gravelly/sandy/silty/lean clays
			OL	Organic silts and organic silty clays of low plasticity
	Silts and Clays Liquid Limit > 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
			CH	Inorganic clays or high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
Highly Organic Soils			PT	Peat, muck, and other highly organic soils

Prefix: G = Gravel, S = Sand, M = Silt, C = Clay, O = Organic **Suffix:** W = Well Graded, P = Poorly Graded, M = Silty, L = Clay, LL < 50%, H = Clay, LL > 50%

PLASTICITY OF COHESIVE SOIL

Degree of Plasticity	Plasticity Index	Swell Potential
None	0 to 4	Very Low
Slight	5 to 9	Low
Medium	10 to 19	Low to Medium
High	20 to 39	Medium to High
Very High	40+	Very High

CONSISTENCY - COHESIVE SOILS

Consistency	SPT
Very Soft	<2
Soft	2 to 4
Medium Stiff	5 to 8
Stiff	9 to 14
Very Stiff	15 to 30
Hard	31+

ROCK HARDNESS

SPT (in/50)	TCP (in/100)	Rock Description
6+	6+	Very Soft / Very Poorly Cemented
5 - 6	3 - 6	Soft / Poorly Cemented
4 - 5	2 - 3	Moderately Hard / Cemented
3 - 4	1 - 2	Hard / Well Cemented
<3	<1	Very Hard / Very Well Cemented

MOISTURE OF COHESIVE SOIL

Description	Condition	Moisture Content
Dry, Dusty	Dry	0 to 10%
Damp	Moist	10 to 30%
Free Water	Wet	30 to 70%

DENSITY - COHESIONLESS SOILS

Relative Density	SPT
Very Loose	<4
Loose	4 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	51+

ROCK CORE QUALITY

Core Quality	RQD
Excellent Quality	90 – 100%
Good Quality	75 – 90%
Fair Quality	50 – 75%
Poor Quality	25 – 50%
Very Poor Quality	<25%