ARKANSAS DEPARTMENT OF TRANSPORTATION

SUBSURFACE INVESTIGATION

STATE JOB NO. 090069

FEDERAL AID PROJECT NO. CPFCDS-0004(80)

NORTHWEST ARKANSAS NATIONAL AIRPORT ACCESS (F)

STATE HIGHWAY NEW **SECTION** NEW

IN BENTON **COUNTY**

The information contained herein was obtained by the Department for design and estimating purposes only. It is being furnished with the express understanding that said information does not constitute a part of the Proposal or Contract and represents only the best knowledge of the Department as to the location, character and depth of the materials encountered. The information is only included and made available so that bidders may have access to subsurface information obtained by the Department and is not intended to be a substitute for personal investigation, interpretation and judgment of the bidder. The bidder should be cognizant of the possibility that conditions affecting the cost and/or quantities of work to be performed may differ from those indicated herein.

ARKANSAS DEPARTMENT OF TRANSPORTATION
ArDOT.gov | IDriveArkansas.com | Lorie H. Tudor, P.E., Director
MATERIALS DIVISION
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November 10, 2021

TO: Mr. Trinity Smith, Engineer of Roadway Design

SUBJECT: Job No. 090069
Northwest Arkansas National Airport Access (F)
Route X Section N/A
Benton County

Based on soil information from projects in the surrounding area, an estimated R-Value of 20 is appropriate for pavement design.

Listed below is the additional information requested for use in developing the plans:

Asphalt Concrete Hot Mix **PG 76-22**

Type	**Asphalt Cement %**	**Mineral Aggregate %**
Surface Course	5.3	94.7
Binder Course	4.5	95.5
Base Course	4.1	95.9

Jonathan A. Annable
Materials Engineer

JAA:yz:bjj
Attachment
cc: State Constr. Eng. – Master File Copy
District 9 Engineer
System Information and Research Div.
G. C. File

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

Materials Testing
Geotechnical Engineering
Environmental
Building Sciences & Safety
Inspections & Code Compliance
Virtual Design Consulting

September 30, 2023
Job No. 19-118

Garver LLC
4701 Northshore Drive
North Little Rock, Arkansas 72118

Attn: Mr. Adam Wierciak, P.E.

RESULTS of GEOTECHNICAL INVESTIGATION
ARDOT JOB 090069
XNA ACCESS ROAD - ROADWAY
BENTON COUNTY, ARKANSAS

INTRODUCTION

Provided herewith are the final results of the geotechnical investigation performed for the roadway portion of the XNA Access Road in Benton County, Arkansas. This investigation is one facet of the ARDOT Job 090069 Northwest Arkansas Regional Airport Access (Benton Co) (F). This geotechnical investigation was authorized by the Garver, LCC Subconsultant Agreement for Task Order No. 061 on August 27, 2019. Notice to proceed with the field studies was received on August 30, 2019. Results and recommendations have been provided throughout the course of this study. A preliminary report providing recommendations for subgrade support was submitted on February 18, 2023.

The project consists of construction of a new access road extending from the Northwest Arkansas Regional Airport (XNA) approximately 4 miles southeast to the planned terminus at Highways 70 and 71. The south end of the project begins at approximately Sta 100+00 and ends to the north at approximately Sta 310+00. For the most part, the main lane roadway section will consist of two (2), 12-ft-wide traffic lanes, a 6-ft-wide inside shoulder and, generally, a 10-ft-wide outside shoulder for each directional lane. The directional main lanes will be separated by a concrete median barrier or 48-ft-wide median.

Site grading in the roadway will include significant cut and fill. Fills on the order of 42 ft are anticipated near Sta 107, 53 ft at Sta 125, 57 ft near Sta 215, 55 ft near Sta 267 and 37 ft near Sta 284. Cuts on the order of 33 ft near Sta 135, 43 ft near Sta 170, and 22 ft near Sta 252 are expected.

The purposes of this study phase have been to develop geotechnical recommendations related to development of project roadways. To accomplish these purposes, the following multi-phased study has been performed.

- Sample borings were drilled along the proposed roadway alignments to define soil, rock, and groundwater conditions.
- Bulk samples were obtained from representative locations along the project alignment for use in laboratory testing used to develop subgrade support parameter recommendations.
- A laboratory testing program was performed to establish general soil classification and basic engineering properties for use in developing geotechnical parameters for roadway design and construction.
- The results of the field and laboratory studies were utilized in engineering analyses performed to develop conclusions and recommendations related to roadway design and site grading planning.

The results of the roadway study are discussed in the following report sections. Recommendations for design and construction are provided in subsequent report sections.

SUBSURFACE EXPLORATION

Subsurface conditions in the XNA Access Road project alignment were explored by drilling a total of 66 sample borings. Of these borings, 14 were drilled for bridge ends (designated as "S" borings). The remainder of the borings were drilled for the roadway alignment. In addition, bulk samples for use in laboratory testing were obtained from five (5) test pits. The site vicinity is shown on Plate 1. The approximate boring locations are shown on the Plans of Borings, Plates 2a through 2k. The subsurface exploration program is summarized in Appendix A.

Logs of the roadway borings, presenting descriptions of the subsurface conditions encountered and the results of field and laboratory tests, are included as Plates 3 through 54. Logs of the end bent borings of the bridges are included as Plates 55 through 78. The centerline station and offset of the boring locations and approximate ground surface elevation, as inferred from the topographic information provided by the Engineer (Garver, LLC) or as inferred from available topographic information, are also shown on the logs. It must be recognized that the surface elevations shown are approximate and actual elevations may vary. Keys to the terms and symbols used on the logs are presented as Plates 79 and 80.

The borings were drilled with CME-55 HTX and SIMCO 2800 truck-mounted drill rigs and CME-55, CME-850, and Geoprobe 3230DT track-mounted drill rigs. Sample borings were advanced using dry-auger drilling procedures or a combination of dry-auger and rotary-wash drilling methods.. Samples were obtained at approximately 2-ft intervals to 10-ft depth and at 5-ft intervals thereafter. The boring completion depths are shown on the summary in Appendix A.

Soil and weathered rock samples were obtained using a combination of dry-auger and rotary-wash drilling methods. Samples were typically obtained at 2-ft intervals to 10-ft depth and at 5-ft intervals thereafter. Samples were recovered using a 2-in.-diameter split-barrel sampler driven into the strata by blows of a 140-lb automatic hammer with 30-in. drop in accordance with Standard Penetration Test (SPT) procedures. The number of blows required to drive the standard split-barrel sampler the final 12 in. of an 18-in. total drive, or a portion thereof, is defined as the Standard Penetration Number (N). Recorded N-values are shown on the boring logs in the "Blows Per Ft" column.

At selected locations where cut was anticipated, samples of the cherty limestone bedrock were obtained using a 5-ft-long NQ-size double-tube core barrel with a diamond bit. For each core run, the percent recovery was determined as the ratio of recovery to total length of core run. Rock Quality Designation (RQD) was also determined for the core run as the sum of intact, sound rock core greater than 4-in. length divided by the total length of the run and expressed in percent. Both these values are presented in the right-hand columns of the log forms, opposite the corresponding core run. Photographs of the recovered rock cores are provided in Appendix B.

All samples were removed from sampling tools in the field, examined and visually classified by the field geologist or field engineer. Samples were then placed in appropriate containers to prevent moisture loss and/or change in condition during transfer to our laboratory for further examination and testing.

As noted, the roadway borings were advanced using dry-auger drilling procedures to the extent possible to facilitate evaluation of groundwater conditions. Observations regarding groundwater levels are noted in the lower-right portion of each log and are discussed in subsequent sections of this report. All boreholes were backfilled after obtaining the final water level readings.

LABORATORY TESTING

To evaluate pertinent properties of the soil and rock encountered in the roadway borings, laboratory tests consisting of classification and natural water content determinations were performed. A total of 246 natural water content determinations were performed to develop information on *in-*

situ soil water content in the borings. Water content results are plotted on the log forms in accordance with the scale and symbols shown in the legend located in the upper-right corner of the logs.

To verify field classification and to evaluate soil plasticity, 70 Atterberg limit (liquid and plastic limits) determinations and 77 sieve analyses were performed on selected representative soil and weathered rock samples. The Atterberg limits are plotted on the boring logs as plus signs connected with a dashed line. The percentage by weight of soil passing the No. 200 sieve is noted in the "- No. 200%" column on the far-right side of the log forms.

A summary of classification test results and classification by the Unified Soil Classification System and AASHTO Classification System is presented in Appendix C. Grain-size distribution curves are also included in Appendix C.

To develop information on the range of subgrade support properties, five (5) laboratory Moisture-Density Relationship (Proctor) tests were performed on representative bulk samples. These tests were performed in accordance with AASHTO T 99 and T 180 methods, depending on sample gradation. Pavement subgrade support properties were evaluated by performing nine (9) California Bearing Ratio (CBR) tests (AASHTO T 193). For the CBR tests, the specimens were molded at approximately the optimum water content and 95 percent of the maximum dry density as determined by the laboratory Proctor tests.

The Proctor and CBR test results are summarized in Appendix D. The test results for both the Proctor and CBR tests are also shown graphically in Appendix D.

GENERAL SITE and SUBSURFACE CONDITIONS

Site Conditions

The project begins at the Highways 70 and 71 interchange, Sta 100+00, and extends north to Airport Boulevard, Sta 310+00. The alignment locale consists of a mixture of undeveloped pasture and woodlands with scattered residential houses. The alignment crosses several rural roads: Wager, Haden, Holmes, and Malone. The existing roads are generally bordered by shallow ditches. The alignment also crosses Osage Creek and Little Osage Creek. The site terrain consists of steep, rolling hills with deep valleys. Surface drainage of the project area is highly variable, with drainage varying from poor to good.

Site Geology

The project alignment is located in the mapped exposure of the Boone Formation. The early and middle Mississippian Period Boone consists of fine- to coarse-grained limestone interbedded with chert. The chert content can vary widely, both horizontally and vertically, and limestone or chert may be predominant. The Boone Formation is known for dissolutional features such as sinkholes, caves, and enlarged fissures. Typically, the limestone/cherty limestone units of the Boone decompose (weather) to erratic blends of chert fragments and clay/silty clay. The residual soil mantle may extend to significant depths on higher terrain and may contain hard chert seams and/or layers. The thickness of the Boone Formation is reported to be 300 to 350 ft in northern Arkansas. The Boone is generally disconformable to the underlying Chattanooga Shale and St. Joe Limestone member, with some areas having a conformable contact.

Subsurface Conditions

The subsurface conditions revealed by the roadway borings are shown in detail on the boring logs. The surficial soils in the roadway alignment consist primarily of loose to dense silt and fine sandy silt and soft to stiff clayey silt and silty clay. This stratum contains variable chert fragments. The silt and clayey silt exhibit low plasticity, moderate to high compressibility, and low shear strength. The low-plasticity and silty soils are moisture-sensitive and will lose considerable strength when saturated. Some of this material is locally fill. The compactness of the fill ranges from poor to fair.

Below the surficial silty soils is firm to very stiff clay, silty clay and fine sandy clay units with variable, but generally numerous, chert fragments and discontinuous chert seams and layers. The clay, silty clay, and fine sandy clay are residual in origin and have weathered from the underlying cherty limestone bedrock. The predominant silty clay exhibits low plasticity. However, the localized clay units have moderate plasticity. The potential for volume change with changes in water content is considered low due to the presence of numerous limestone and chert fragments.

The overburden soils are underlain by low hardness to moderately hard gray and light gray weathered cherty limestone. The weathered cherty limestone exhibits differential weathering with frequent chert and clay seams and layers, which represent zones of completely weathered limestone. Rock core recovery values range from 10 to 55 percent and rock quality designation (RQD) values were 0 percent. These RQD values are indicative of very poor to poor rock quality. Rock quality generally increases with depth.

Based on the results of the borings, the subgrade soil classification varies from AASHTO Soil Classification A-1-b, A-2-6, A-2-7, A-4, A-6, A-7-5, and A-7-6. The predominant subgrade soils in the project alignment appear to be A-2-4 and A-4 soils, which correlate with variable excellent to poor soils. Given these classifications and the determination of CBR values ranging from approximately 8 to 16 for the on-site soils, subgrade conditions are considered to be medium to good.

Groundwater Conditions

The roadway borings were advanced by dry-auger procedures to the extent possible to facilitate observation of groundwater conditions. Groundwater was locally encountered at 7.9- to 10.2-ft depth in March 2022 through July 2023 (see Borings R23 and R34). This likely represents perched water on top of the cherty limestone bedrock. However, given the rolling terrain over the alignment and the variable depth to rock, downgradient seepage through the overburden soils and fractured zones of the weathered limestone is considered likely. Seasonal seeps and springs could develop in the areas of lower terrain, hillside slopes, and/or on exposed cut slopes. Groundwater conditions will vary with seasonal precipitation, surface runoff and infiltration, and water levels in nearby streams and drainage features.

ANALYSES and RECOMMENDATIONS

General Considerations

It is understood that the scope of the roadway phase of this project includes site grading, subgrade preparation, and pavement construction. The conclusions and recommendations developed in this study phase are discussed in the following report sections.

Embankment Slopes

The project scope includes cuts of up to 43 feet and fills of up to 57 ft. it is understood that embankment configurations of 3-horizontal to 1-vertical (3H:1V) are generally planned along the roadway. Where cuts are advanced through competent cherty limestone, consideration may be given to the use of near-vertical cuts with horizontal benches at approximately 15-ft vertical intervals. However, it must be recognized that rock conditions are highly variable and the height and configuration of cut slopes in rock are likely to require field adjustment.

To evaluate suitability of the plan slope configurations, slope stability analyses were performed using the computer program SLOPE/W 2020[1] and utilizing a Morgenstern-Price analysis. Representative sections of cut and fill were selected for analysis. The selected sections are summarized in Appendix E. For the embankment slopes, three (3) general loading conditions were evaluated, i.e., End of Construction, Long Term, and Seismic Conditions were evaluated. A 250 lbs

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[1] Slope/W 2020; GEO-SLOPE International; 2020.

per sq ft uniform surcharge from vehicles was included for the purposes of stability analyses. For analysis of the seismic condition, a horizontal seismic acceleration coefficient (k_h) of one-half the peak acceleration (A_s) was used, a value of 0.025.

The stability analyses results summarized in Appendix E include the results of evaluation of embankment slopes. The results of the stability analyses indicate that plan configurations of the slopes are acceptable with respect to stability of all loading conditions evaluated. The analyses also indicate that a cut slope in rock with near-vertical 15-ft cuts and nominal 10-ft horizontal benches is a stable configuration.

Pavement Subgrade Support

Site grading includes both cut and fill. Based on the results of the borings and test pits, the on-site subgrade soils are expected to be predominantly silt, clayey silt, clay, and silty clay with chert fragments (AASHTO A-2-6, A-4, A-6, and A-7-6). Locally-available borrow, which is likely to be used as unclassified embankment fill, is expected to have similar classification.

In light of the results of the borings, laboratory CBR tests, and correlation with the AASHTO classification of the on-site and anticipated subgrade soils, subgrade support in the road alignments is expected to be medium to good. In light of the correlation with medium to good subgrade support and factoring for environmental and serviceability criteria, the following subgrade support parameters are recommended.

CBR:	8.3
Resilient Modulus (M_R):	3260 lbs per sq in.
R value:	13
Modulus of Subgrade Reaction (k):	100 lbs per cu in.

Subgrade preparation and site grading should be performed in accordance with ARDOT criteria (ARDOT Standard Specifications Sections 210 and 214) and the recommendations of the Site Grading and Subgrade Preparation section of this report. We recommend that soils classifying as A-7-5 or A-7-6 with a plasticity index (PI) in excess of 18 be excluded from use as subgrade within 18 in. of the plan subgrade elevation. The top 18 in. of subgrade soils should have a maximum plasticity index (PI) of 18. The as-built pavement subgrade should be evaluated by the Engineer. Areas of unsuitable subgrade should be improved by undercut and replacement or addition of stabilization additives.

Site Grading and Subgrade Preparation

In areas where silty soils comprise the subgrade, these surface soils are moisture-sensitive. Site grading operations will be more difficult to perform during wet seasons of the year.

Site preparation will require some clearing and grubbing and stripping the zone of organic-containing soils. The depth of stripping will be variable, with deeper stripping depths in wooded areas, and less stripping required in open areas. In general, the stripping depth is estimated to be about 6 to 9 inches in clear areas but may be 18 to 24 in. or more in areas where trees and thick underbrush are present. The zone of organic surface soils should be completely stripped in the embankment footprint areas and at least 5 ft beyond the projected embankment toes. Particular care must be taken to muck out all saturated and/or organic-laden soils in existing drainage features. Site preparation may include demolition of some existing buildings. All areas where abandoned utilities or foundations are removed should be properly backfilled. Hillsides should be benched to allow placement of embankment fill in horizontal lifts. The maximum vertical cut on benches should be limited to about 18 to 24 inches.

Following demolition, stripping, and any cut, and prior to fill placement, the extent of weak and unsuitable soils should be determined. Thorough proof-rolling should be performed to verify subgrade stability. Proof-rolling should be performed with a loaded tandem-wheel dump truck or similar equipment. Unstable soils exhibiting a tendency to rut and/or pump should be undercut and replaced with suitable fill. Care should be taken that undercuts, stump holes, and other excavations or low areas resulting from subgrade preparation are properly backfilled with compacted fill.

Depending on seasonal conditions and site grading plans, undercuts of 2 to 6 ft below existing grades, more or less, could be required. General undercuts for site grading may be backfilled with unclassified borrow as used for embankment fill. As-built undercut or improvement requirements will depend on seasonal site conditions and final site grading plans. The required depth of improvement will vary with seasonal site conditions and final grading plans and must be field verified.

In lieu of undercutting and replacing unsuitable soils, consideration may be given to using additives to improve soil workability and stabilize weak areas. Hydrated lime, quick lime, Portland cement, fly ash, or suitable alternate materials may be used as verified by appropriate testing and approved by the Engineer. Additives can be effective where the depth of unstable soils is relatively shallow. Treatment will be less effective in areas where the zone of unstable soils is deep. The optimum application rate of stabilization additive must be determined by specific laboratory tests performed on the alignment subgrade soils.

All roadway subgrade should be evaluated by the Engineer or Department during site grading operations. Specific improvement requirements must be field verified. Subgrade preparation and mass undercuts should extend at least 5 ft beyond the embankment toes to the extent possible. Subgrade preparation for the approach roads should extend at least 3 ft outside pavement shoulder edges to the extent possible.

Fill and backfill may consist of unclassified borrow free of organics and other deleterious materials as per ARDOT Standard Specifications Subsection 210.06. Where A-7-5 or A-7-6 soils are encountered at the subgrade elevation, we recommend that these soils be undercut as required to provide at least 18 in. of suitable low-plasticity subgrade soils, i.e., with a maximum PI of 18, or approved “hillside” cherty clay with a maximum of 35 percent passing the No. 200 sieve. Alternatively, stabilization additives may be utilized to develop a stable subgrade with a PI of 18 or less. Granular soils must be protected from erosion with a minimum 18-in.-thick armor of clayey soil.

Subgrade preparation should comply with ARDOT Standard Specifications Section 212. Embankments should be constructed in accordance with ARDOT criteria (ARDOT Standard Specifications Section 210). Fill and backfill should be placed in nominal 6- to 10-in.-thick loose lifts. All fill and backfill must be placed in horizontal lifts. Hillsides and cut slopes should be benched as required to facilitate placing horizontal fill lifts. The in-place density and water content should be determined for each lift and should be tested to verify compliance with the specified density and water content prior to placement of subsequent lifts.

CONSTRUCTION CONSIDERATIONS

Positive surface drainage should be established at the start of the work, be maintained during construction and following completion of the work to prevent surface water ponding and subsequent saturation of subgrade soils. Density and water content of all earthwork should be maintained until embankments and pavements are completed.

Localized perched groundwater was encountered between 8- to 10-ft in March 2022 through July 2023. Shallow perched groundwater may be encountered in the near-surface soils, particularly during wet seasons. The volume of groundwater produced can be highly variable depending on the condition of the soil in the immediate vicinity of the excavation. In addition, seasonal surface seeps or springs could develop.

Seepage into excavations and cuts can typically be controlled by ditching or sump-and-pump methods. If seepage infiltration cannot be controlled, construction of drains and/or the use of Select Granular Backfill (AASHTO M 43 No. 57), stone backfill (ARDOT Standard Specifications Section 207), or approved alternates to an elevation above the inflow of seepage will be warranted. In areas of seepage infiltration, the granular fill should be encapsulated with a filter fabric complying with ARDOT Standard Specifications Subsection 625.02, Type 2 and vented to positive discharge. Where surface seeps or springs are encountered during site grading, we recommend the seepage be directed via French drains or blanket drains to positive discharge at daylight or to storm drainage lines.

Site preparation should also include construction of blanket drains in all existing drainage features which will be covered by fill. All loose and/or organic materials should be excavated from drainage features prior to drain construction. Blanket drains should consist of at least 8 to 12 in. of select granular backfill (AASHTO M 43 No. 57) fully encapsulated by a filter fabric. A fabric complying with ARDOT Standard Specifications Subsection 625.02, Type 2 is recommended. Drains should direct water to positive discharge at daylight or into storm drain lines.

The results of the roadway borings indicate that the silt, clay, and silty clay overburden soils can be excavated with conventional heavy-duty excavation equipment. The low hardness highly weathered limestone can also typically be excavated with conventional heavy-duty excavation equipment. Where cuts or excavations encounter moderately hard weathered cherty limestone and cherty limestone, rock excavation methods will likely be required. This may include use of a hoeram, jackhammers, blasting, or other rock excavation methods.

The potential for rock excavation should be anticipated. Contract documents should include a unit price for removal and disposal of materials and obstructions that cannot be excavated with conventional heavy-duty excavating equipment. The conventional heavy-duty excavating equipment may be defined as a Caterpillar D-7 bulldozer with single tooth ripper, a Caterpillar 312 track excavator equipped with rock teeth, or equipment of similar power and capability. Rock excavation volumes should be determined based on in-place measurements via cross sectioning. If excavation is to be unclassified, the Contractor must be responsible for assessing rock excavation requirements.

CLOSURE

The Engineer or Department should monitor site grading, subgrade preparation, and all pavement construction. Subsurface conditions significantly at variance with those encountered in the borings should be brought to the attention of the Geotechnical Engineer. The conclusions and recommendations of this report should then be reviewed in light of the new information.

* * * *

We appreciate the opportunity to be of service to you in this phase of the project. Should you have any questions regarding this report, or if we may be of additional assistance during final design or construction, please call on us.

Sincerely,
GRUBBS, HOSKYN,
BARTON & WYATT, INC.

Velleta M. Scott

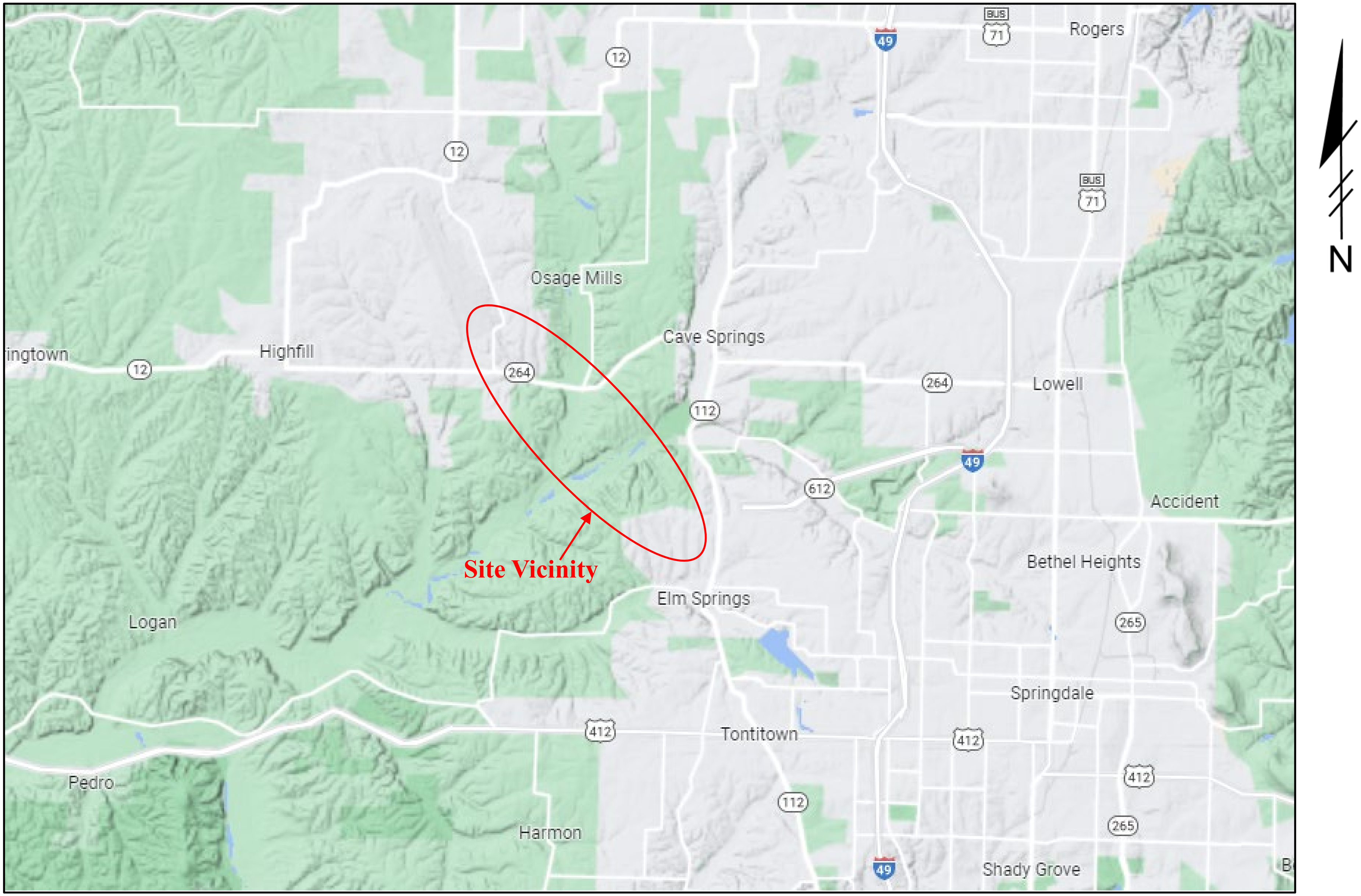
Velleta M. Scott, P.E.
Sr. Project Engineer

STATE OF ARKANSAS
REGISTERED PROFESSIONAL ENGINEER
No. 7791
MARK E. WYATT

Mark E. Wyatt, P.E.
President

VMS/MEW:jw

Copies Submitted: Garver LLC
Attn: Mr. Adam Wierciak, P.E. (1-email)
Attn: Mr. Joel Skinner, P.E. (1-email)

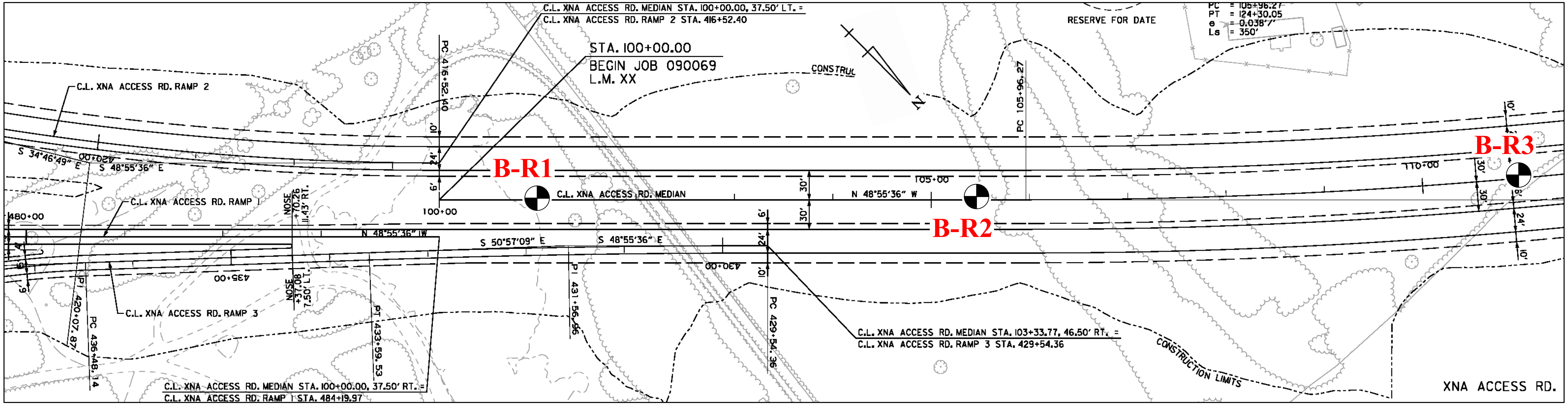


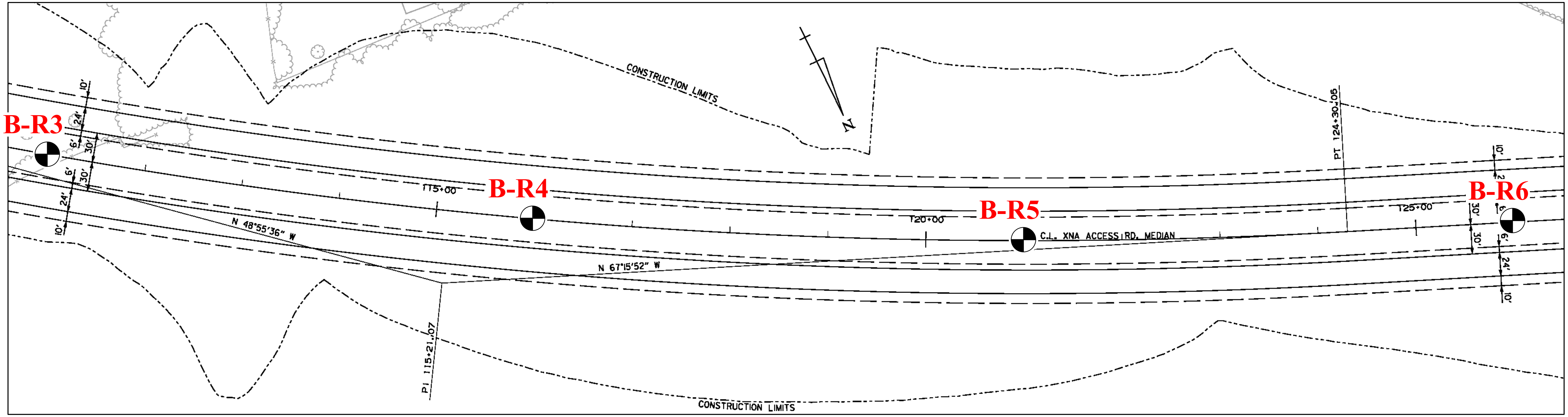
Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

SITE VICINITY MAP
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate 1





Note: Borings R2, R3, R4, R5, and R6 not accessible.

50 0 50 100 ft

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CONSULTING ENGINEERS
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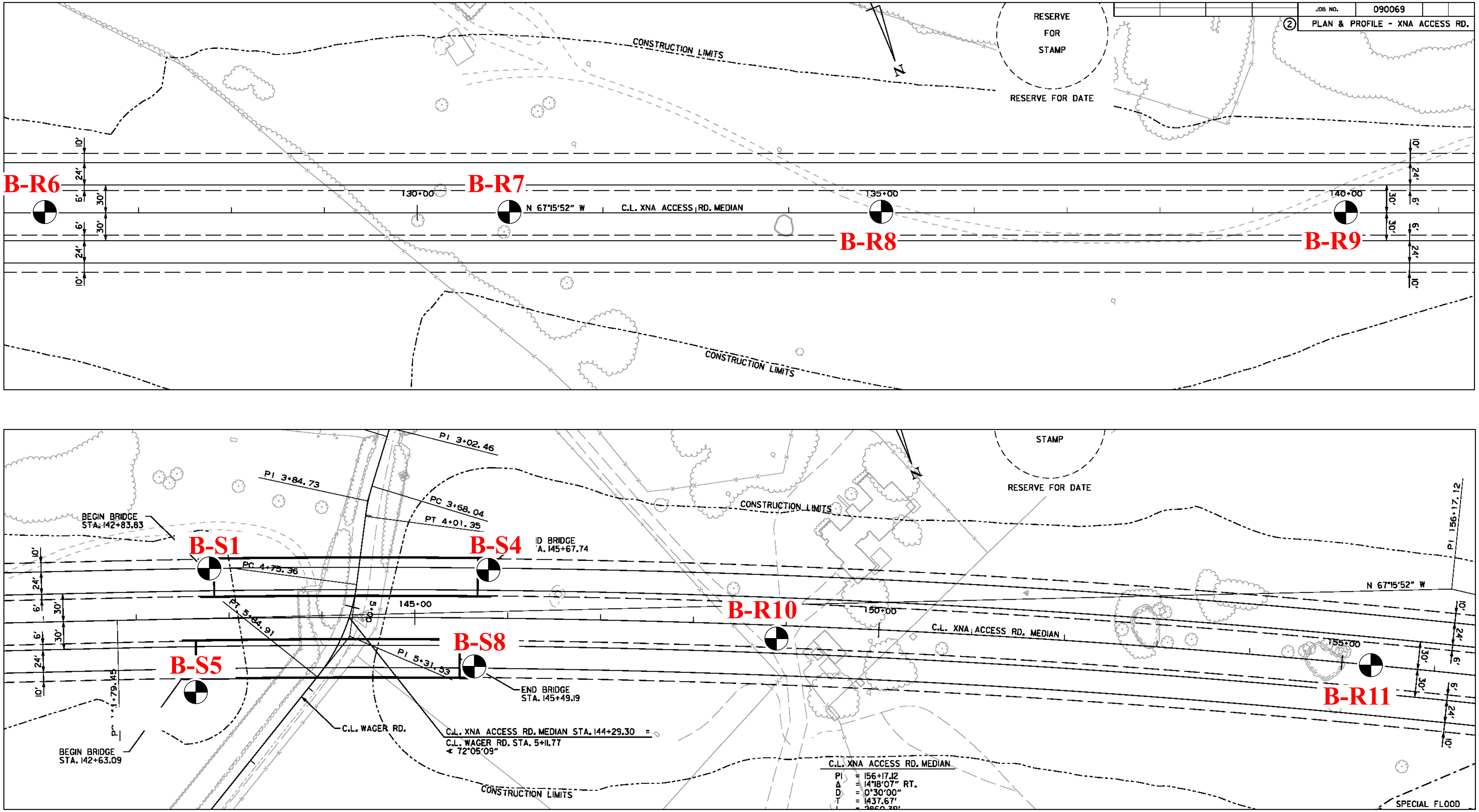
PLAN of BORINGS
090069 XNA Access Road
Benton County, Arkansas

Scale: As shown

Job No. 19-118

PLATE 2a



Note: Borings R6 and R9 not accessible.

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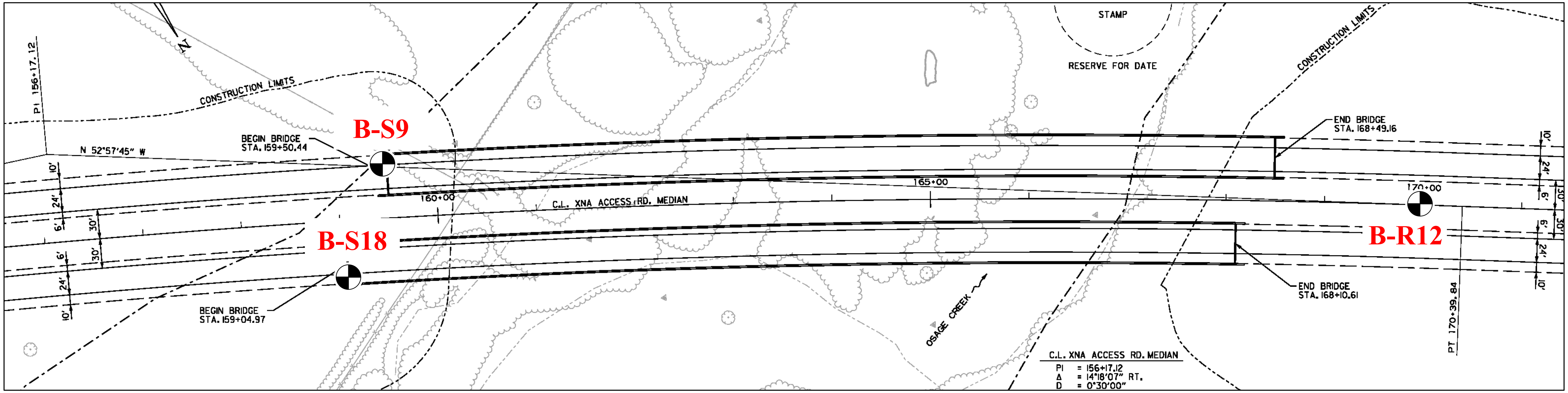
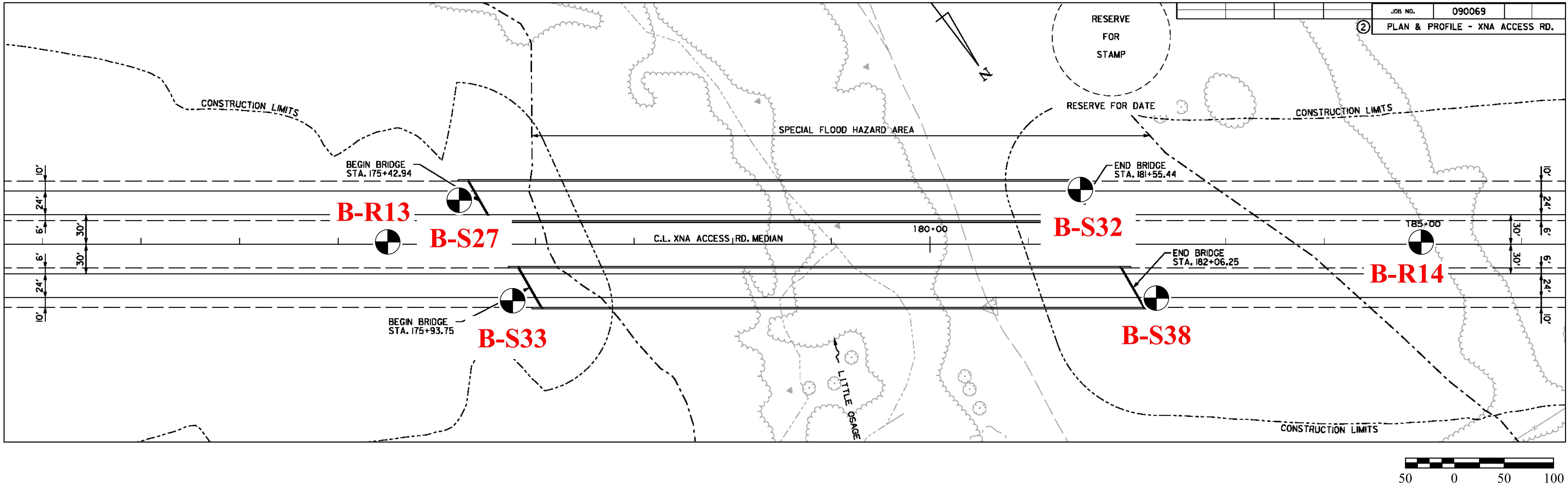
PLAN of BORINGS
090069 XNA Access Road
Benton County, Arkansas

Scale: As shown

Job No. 19-118

PLATE 2b





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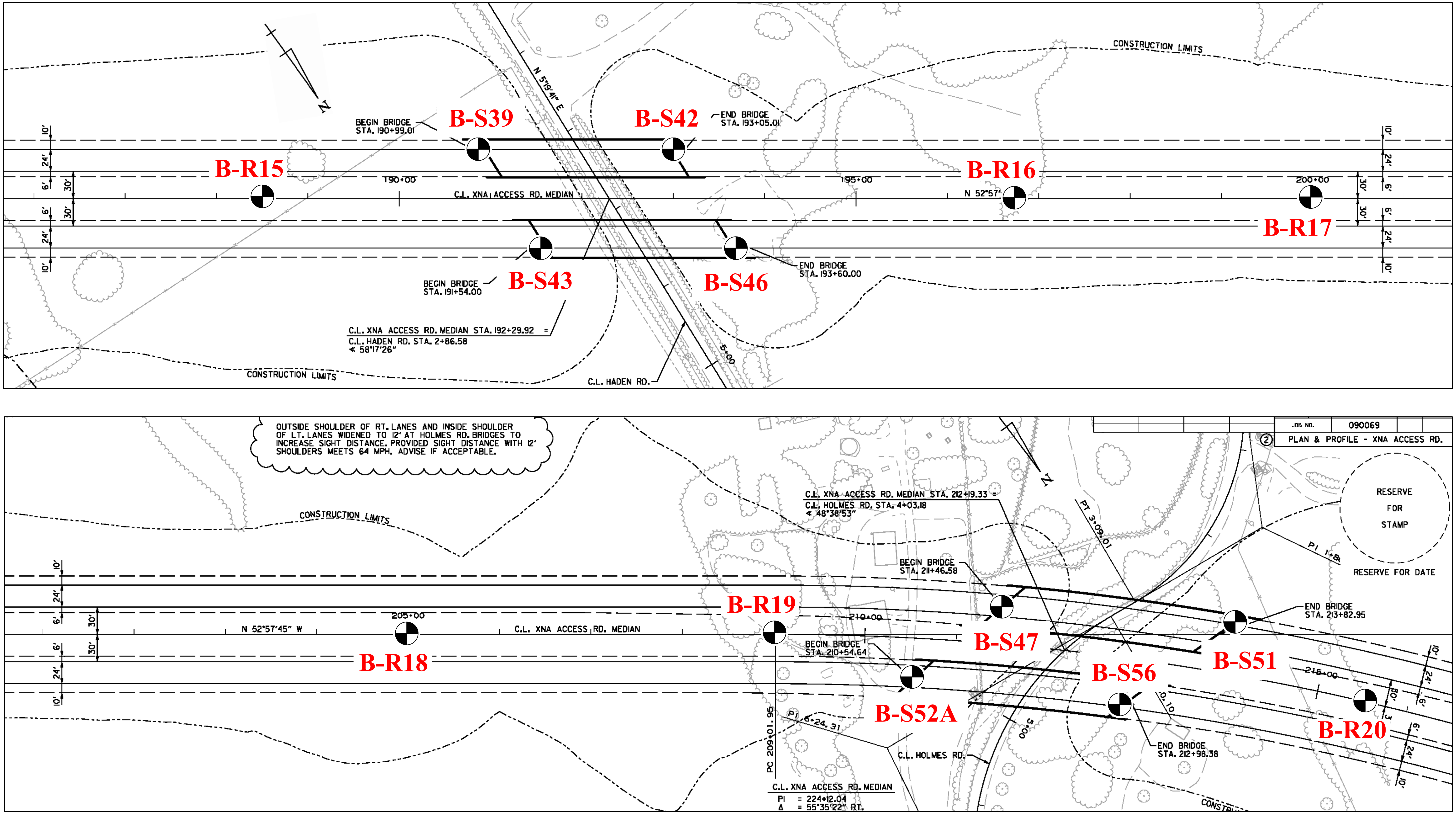
PLAN of BORINGS
090069 XNA Access Road
Benton County, Arkansas

Scale: As shown

Job No. 19-118

PLATE 2c



Note: Borings R18 and R20 not accessible.

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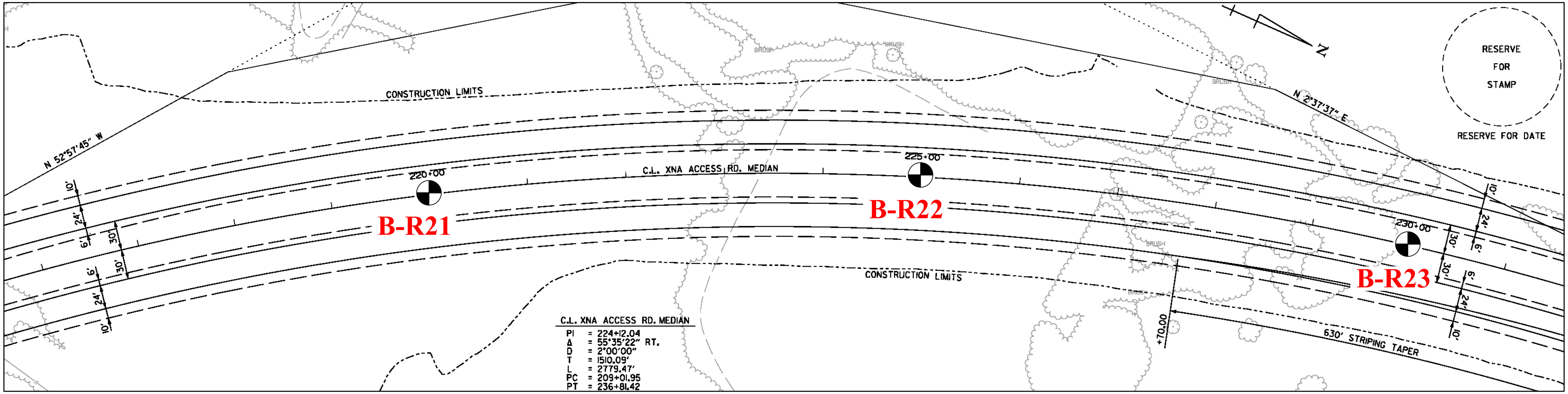
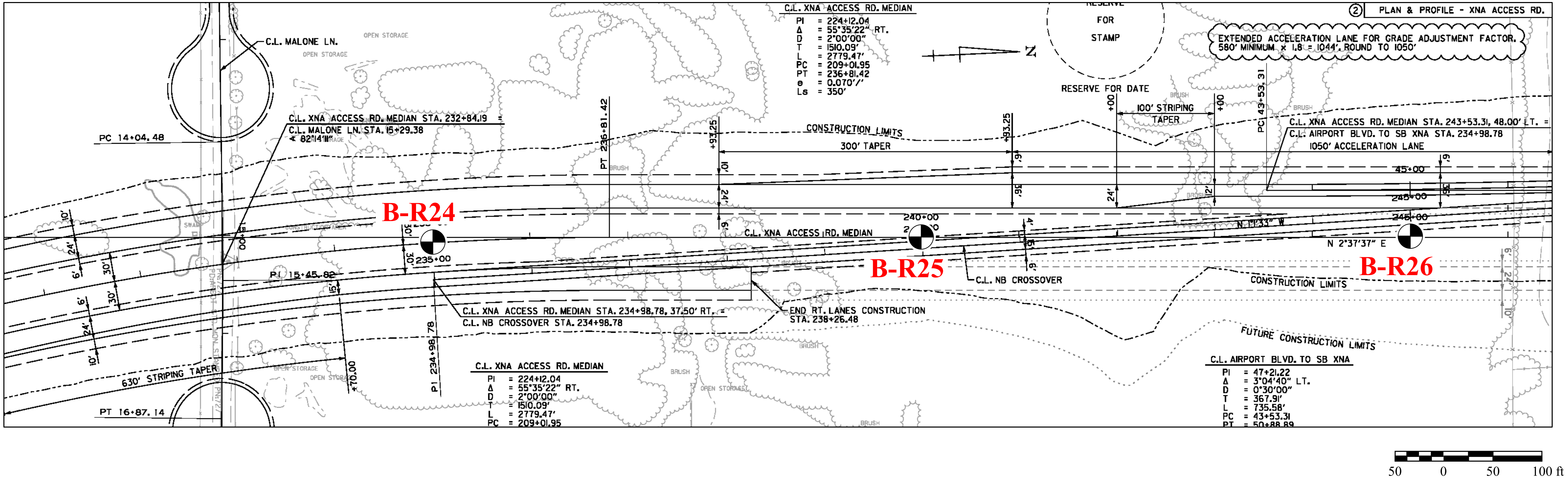
PLAN of BORINGS
090069 XNA Access Road
Benton County, Arkansas

Scale: As shown

Job No. 19-118

PLATE 2d





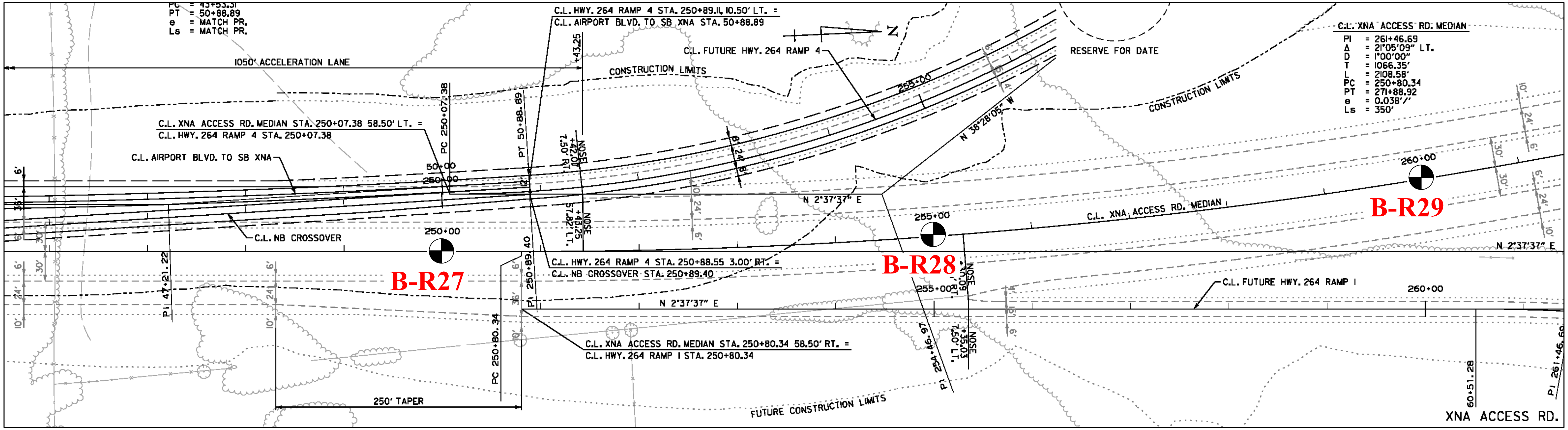
Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

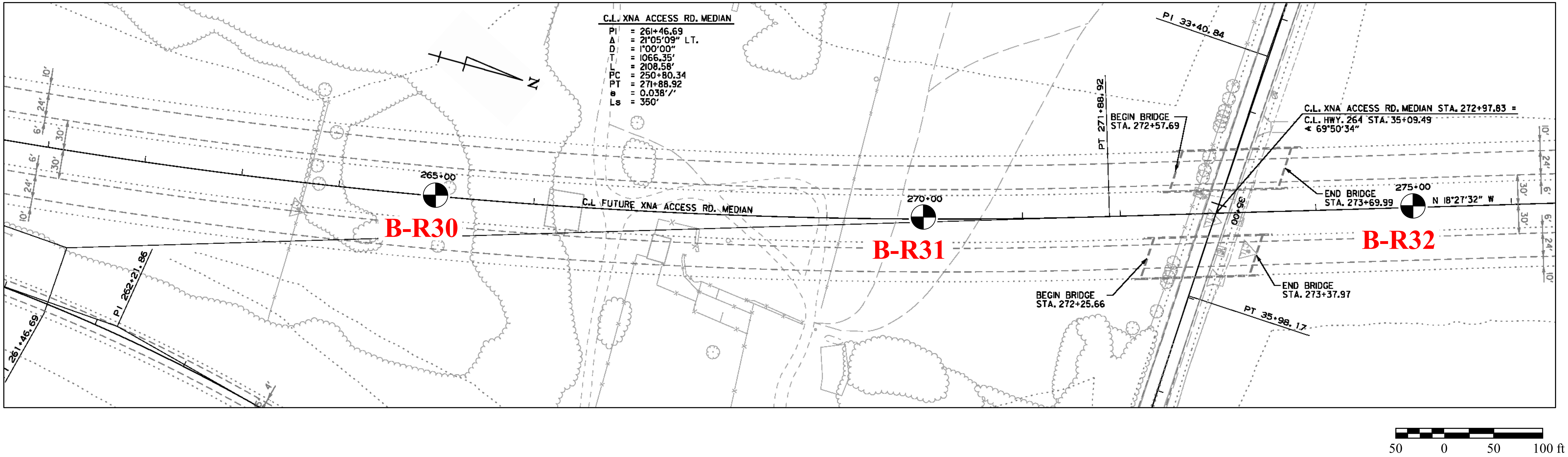
PLAN of BORINGS
090069 XNA Access Road
Benton County, Arkansas

Scale: As shown

Job No. 19-118

PLATE 2e





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CONSULTING ENGINEERS
A UES Company

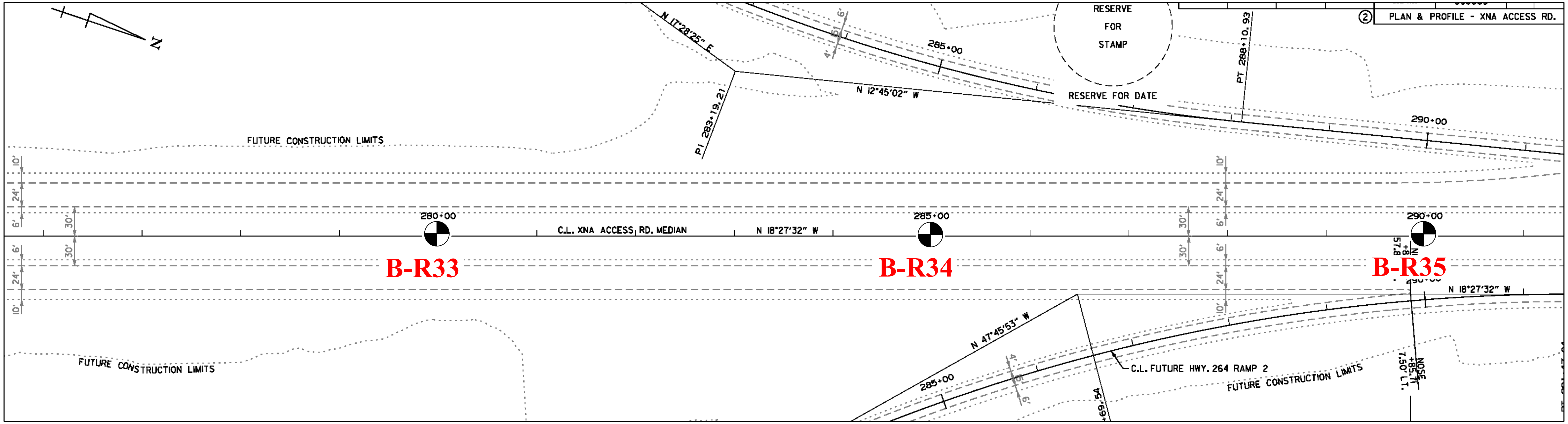
PLAN of BORINGS

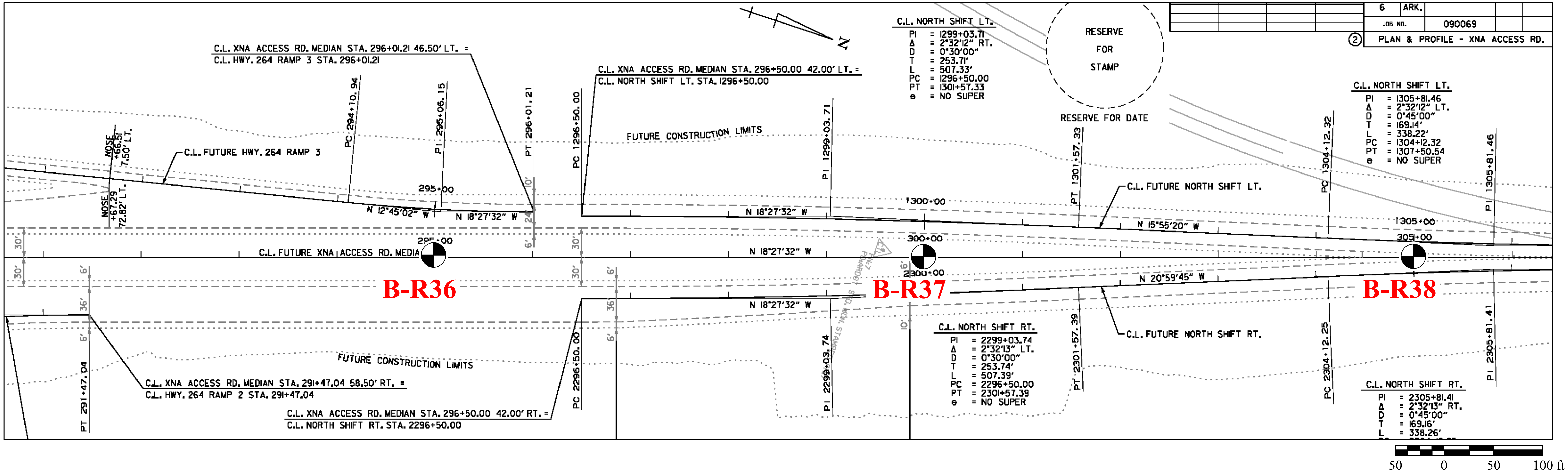
090069 XNA Access Road
Benton County, Arkansas

Scale: As shown

Job No. 19-118

PLATE 2f





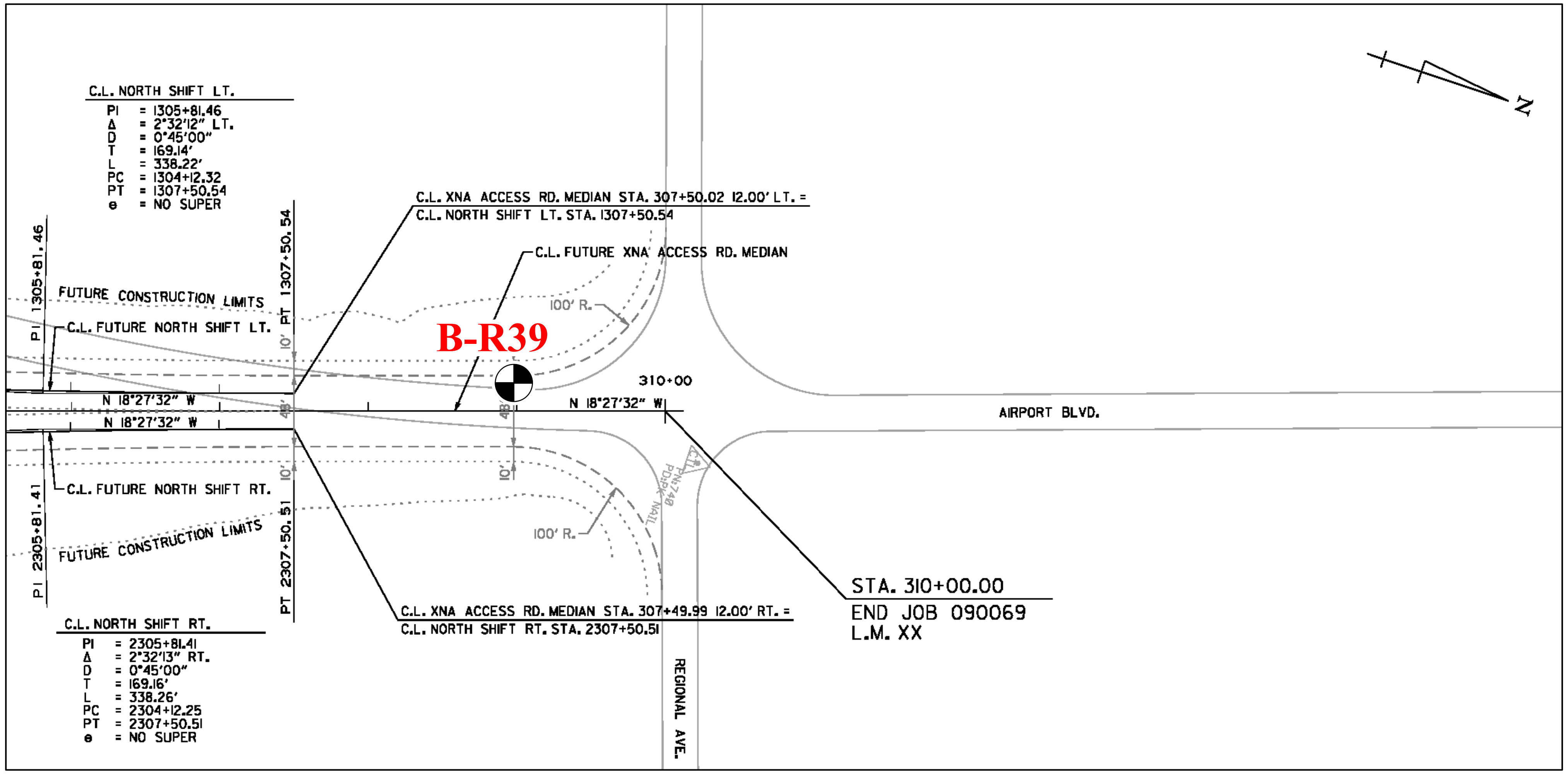
Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

PLAN of BORINGS
090069 XNA Access Road
Benton County, Arkansas

Scale: As shown

Job No. 19-118

PLATE 2g



50 0 50 100 ft

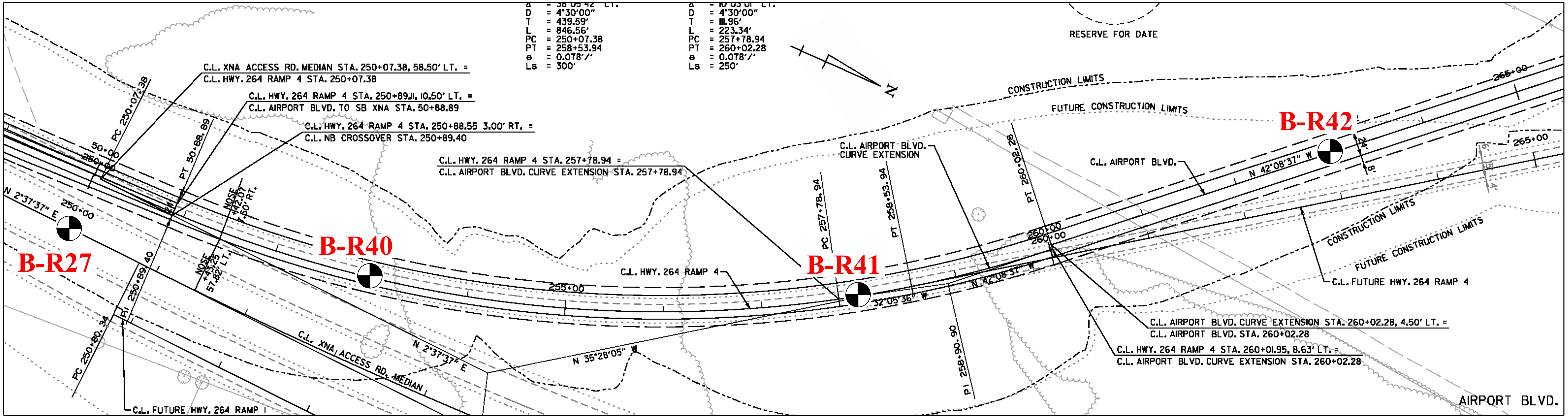
Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

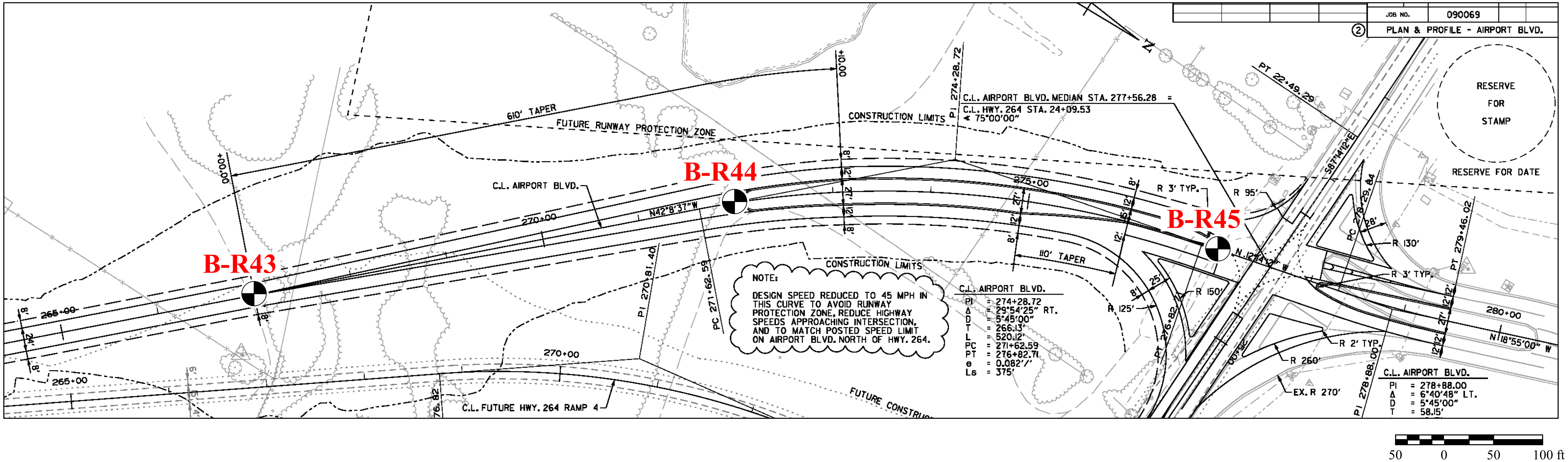
PLAN of BORINGS
090069 XNA Access Road
Benton County, Arkansas

Scale: As shown

Job No. 19-118

PLATE 2h





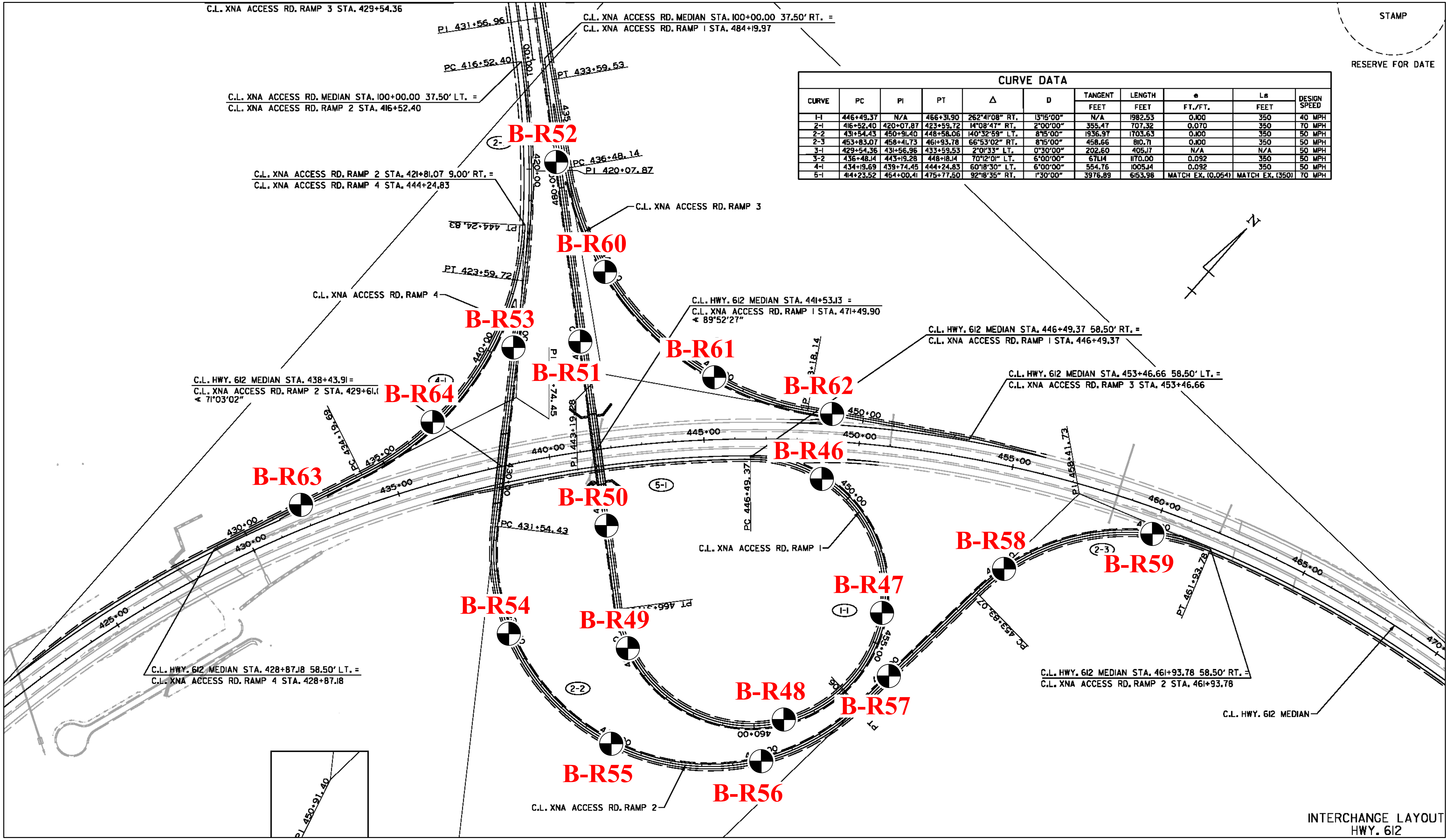
Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

PLAN of BORINGS
090069 XNA Access Road
Benton County, Arkansas

Scale: As shown

Job No. 19-118

PLATE 2i



CURVE DATA										
CURVE	PC	PI	PT	Δ	D	TANGENT	LENGTH	e	Ls	DESIGN SPEED
						FEET	FEET	FT./FT.	FEET	
1-1	446+49.37	N/A	466+31.90	262°41'08" RT.	13°15'00"	N/A	1982.53	0.100	350	40 MPH
2-1	416+52.40	420+07.87	423+59.72	14°08'47" RT.	2°00'00"	355.47	707.32	0.070	350	70 MPH
2-2	431+54.43	450+91.40	448+58.06	140°32'59" LT.	8°15'00"	1936.97	1703.63	0.100	350	50 MPH
2-3	453+83.07	458+41.73	461+93.78	66°53'02" RT.	8°15'00"	458.66	810.71	0.100	350	50 MPH
3-1	429+54.36	431+56.96	433+59.53	2°01'33" LT.	0°30'00"	202.60	405.17	N/A	N/A	50 MPH
3-2	436+48.14	443+19.28	448+18.14	70°12'01" LT.	6°00'00"	671.14	1170.00	0.092	350	50 MPH
4-1	434+19.69	439+74.45	444+24.83	60°18'30" LT.	6°00'00"	554.76	1005.14	0.092	350	50 MPH
5-1	414+23.52	454+00.41	475+77.50	92°18'35" RT.	1°30'00"	3976.89	6153.98	MATCH EX. (0.054)	MATCH EX. (350)	70 MPH

Note: Borings R46, R47, R52, R57, R58, R59, and R62 not accessible.

150 0 150 300 ft

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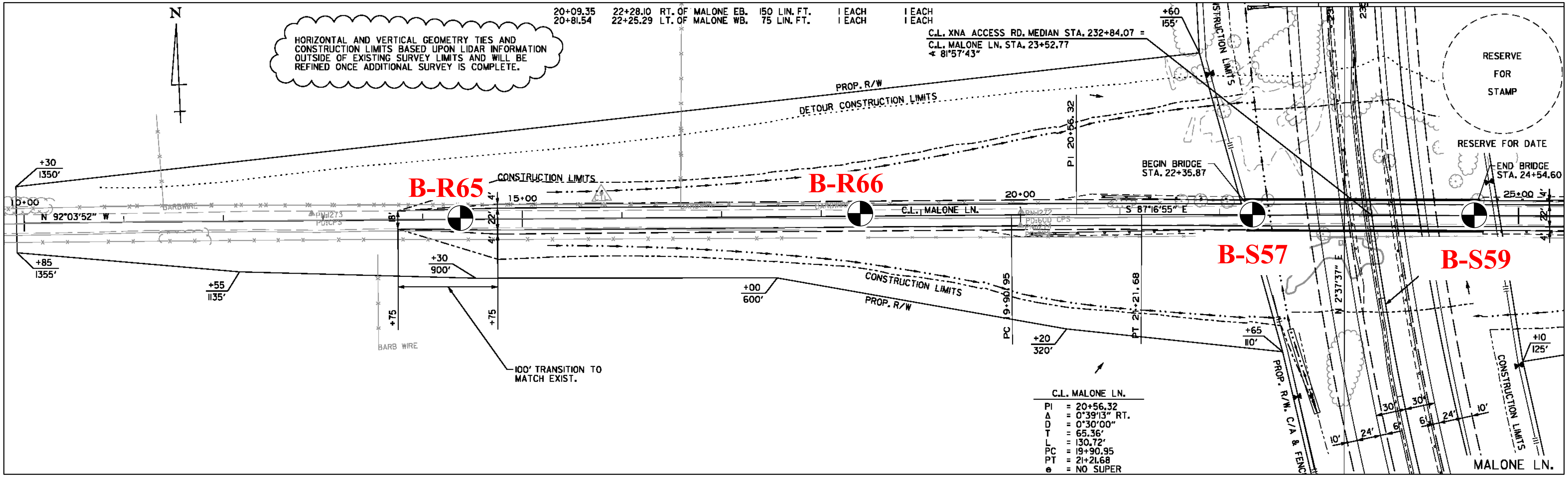
A UES Company

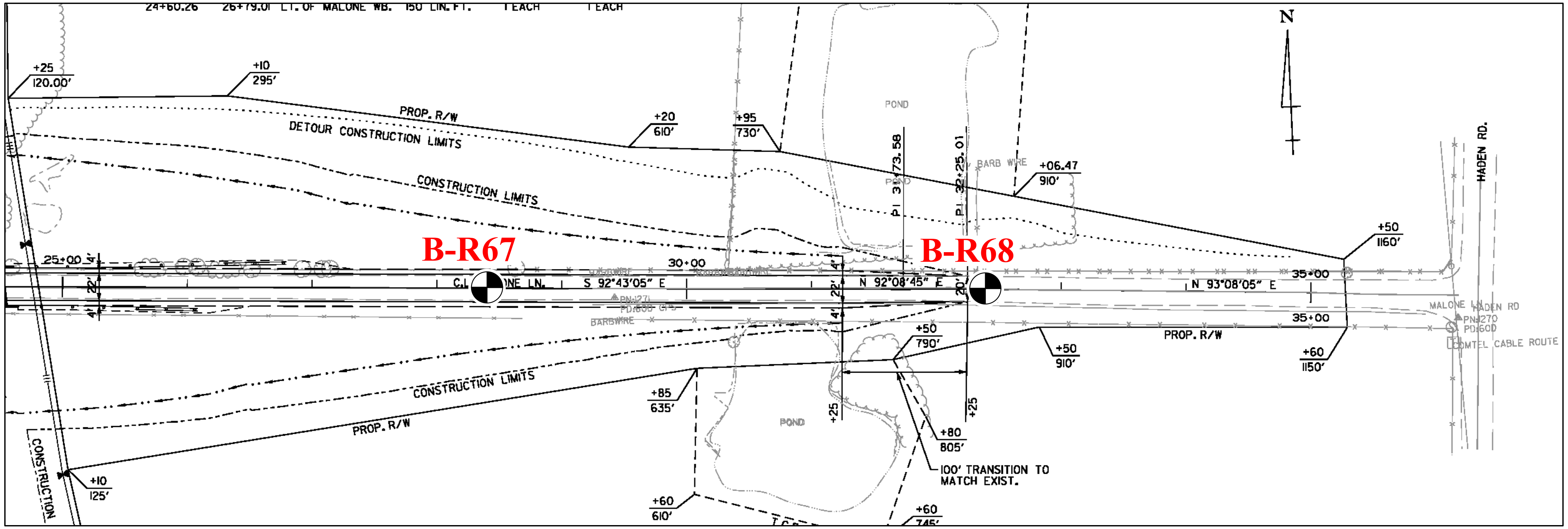
PLAN of BORINGS
090069 XNA Access Road
Benton County, Arkansas

Scale: As shown

Job No. 19-118

PLATE 2j





50 0 50 100 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

PLAN of BORINGS
090069 XNA Access Road
Benton County, Arkansas

Scale: As shown

Job No. 19-118

PLATE 2k

19-118

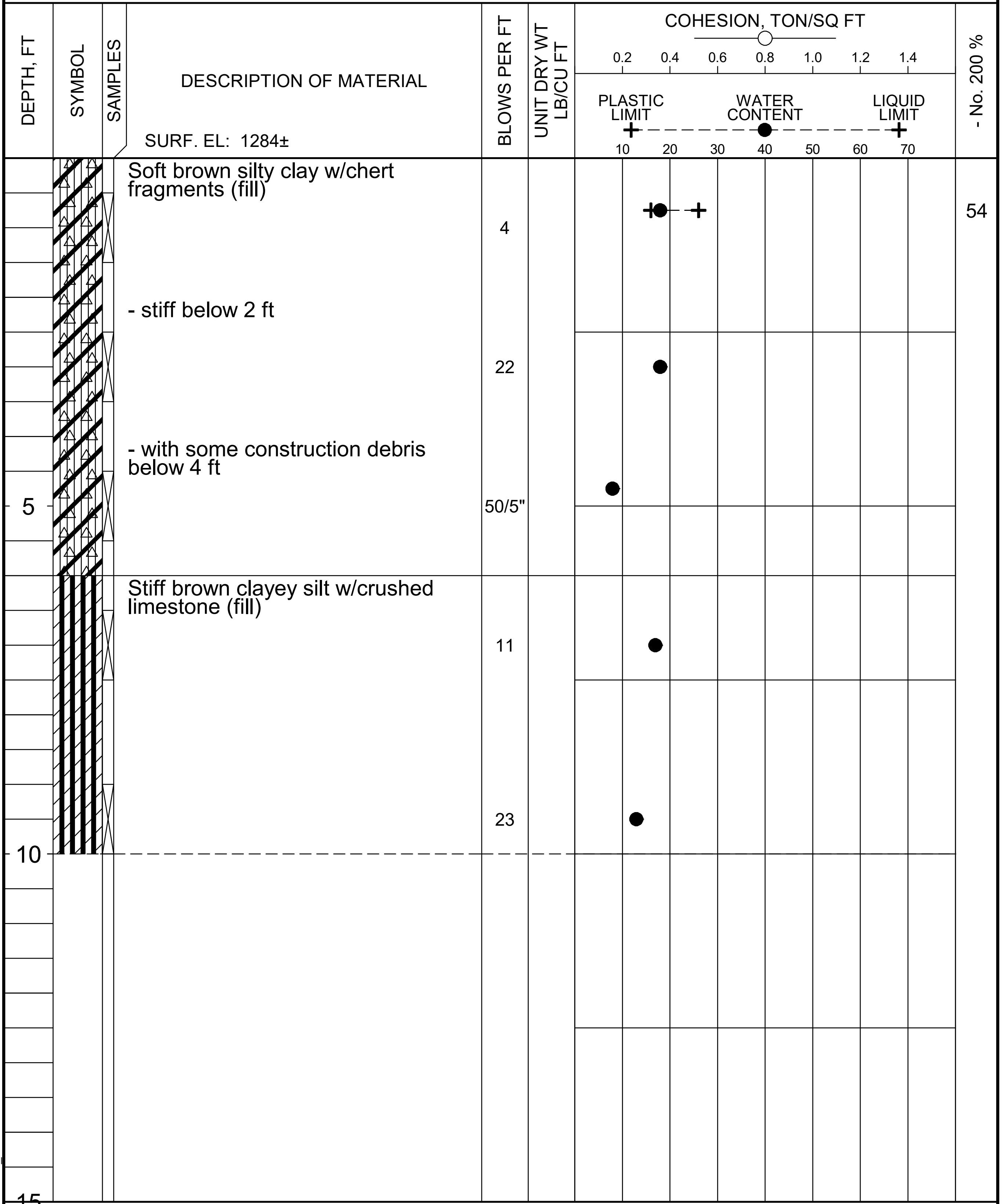
Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R1

090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 101+00, CL



Soft brown silty clay w/chert fragments (fill)

- stiff below 2 ft

- with some construction debris below 4 ft

Stiff brown clayey silt w/crushed limestone (fill)

COMPLETION DEPTH: 10.0 ft
DATE: 11-6-23

DEPTH TO WATER
IN BORING: Dry

DATE: 11/6/2023

LGBNEW 19-118_ROAD HOLES.GPJ 9-27-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R7

090069 XNA Access Road
Benton Co., Arkansas

TYPE: HSA to 8.5 ft /Core

LOCATION: Approx Sta 131+00, CL

SURF. EL: 1219±

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
			Stiff brown, reddish brown, and red clayey silt w/chert fragments and nodules	15 20 29					
			Stiff to very stiff red and reddish tan clay w/chert nodules, fragments, and seams	50/4" 50/2"					
			Low hardness to moderately hard light gray and gray highly weathered cherty limestone w/red clay seams and pockets					44 10	0 0

COMPLETION DEPTH: 14.0 ft
DATE: 8-21-23

DEPTH TO WATER
IN BORING: Dry to 8.5 ft

DATE: 8/21/2023

19-118

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R8

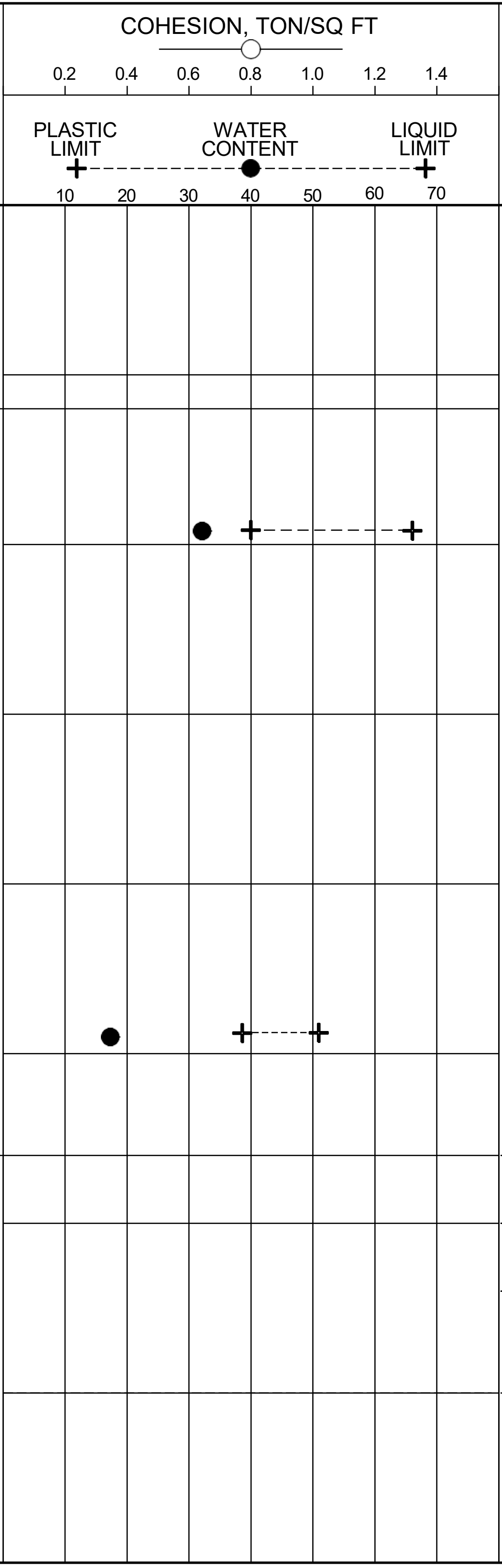
090069 XNA Access Road
Benton Co., Arkansas

TYPE: HSA to 28 ft /Core

LOCATION: Approx Sta 135+00, CL

SURF. EL: 1220±

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
Stiff red clay w/numerous chert fragments and nodules	11				
- firm at 2 to 4 ft	9				
- stiff below 4 ft	11				
Stiff red and reddish tan clay	13				
	23		55		
- with chert fragments and nodules below 10 ft					
- soft at 13 to 18 ft	5				
- stiff below 18 ft	11				
	17		19		
	50/1"				
Moderately hard gray highly weathered cherty limestone w/red clay seams				50	0
				33	0
				42	0



DEPTH, FT: 5, 10, 15, 20, 25, 30, 35

COMPLETION DEPTH: 35.0 ft
DATE: 8-21-23

DEPTH TO WATER
IN BORING: Dry to 28 ft

DATE: 8/20/2023

RECRQDN200-2 19-118_ROAD HOLES.GPJ 9-27-23

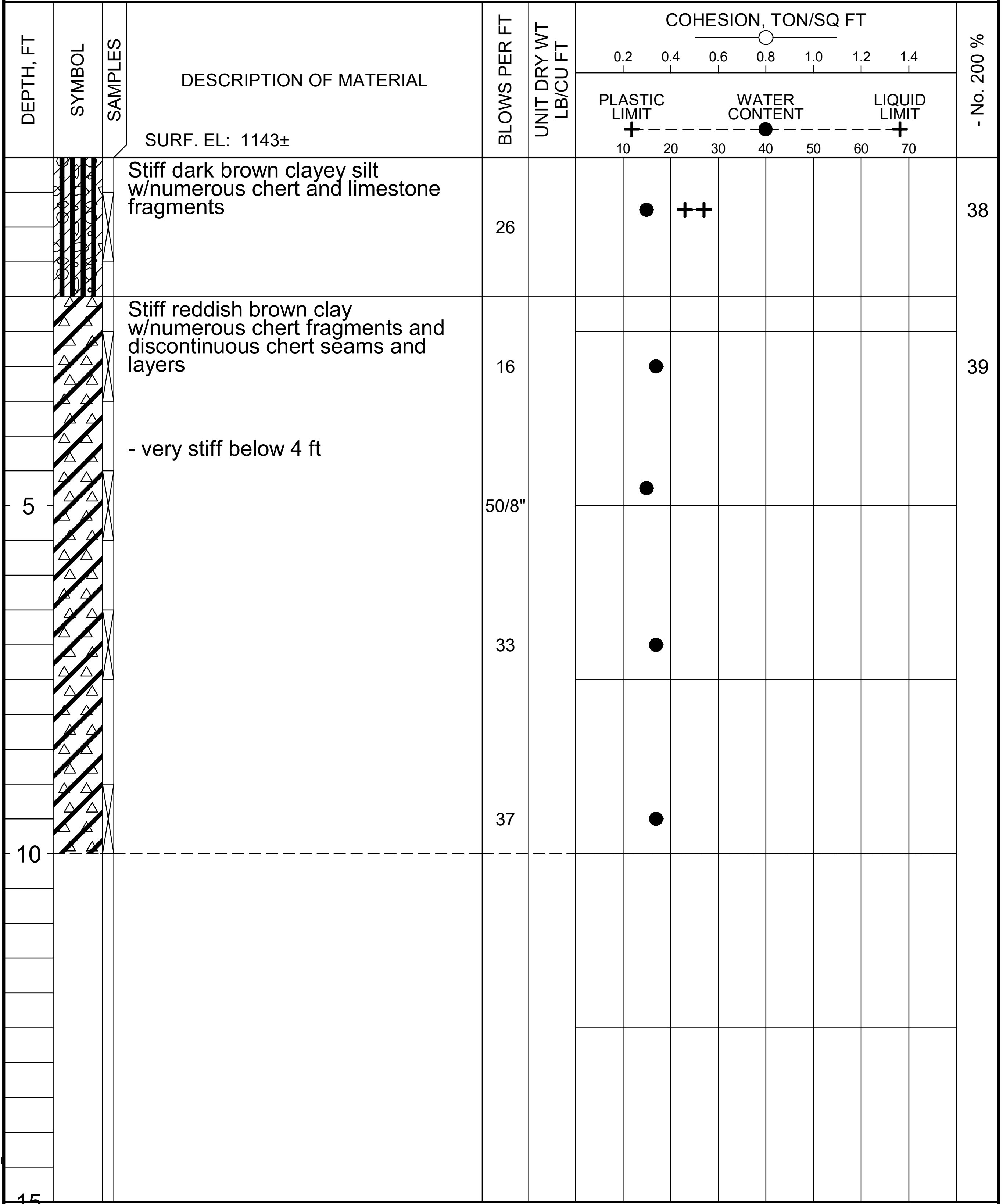
Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R10

090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 148+90, 20 ft Rt



DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
	Stiff dark brown clayey silt w/numerous chert and limestone fragments	26		38
	Stiff reddish brown clay w/numerous chert fragments and discontinuous chert seams and layers	16		39
	- very stiff below 4 ft			
5		50/8"		
		33		
		37		
10				
15				

COMPLETION DEPTH: 10.0 ft
DATE: 1-10-23

DEPTH TO WATER
IN BORING: Dry

DATE: 1/12/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R11

090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 155+30, CL

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 1096±	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT ○ 0.2 0.4 0.6 0.8 1.0 1.2 1.4 PLASTIC LIMIT + — WATER CONTENT ● — LIQUID LIMIT + 10 20 30 40 50 60 70	- No. 200 %
			Firm red silty clay w/chert fragments and nodules				
				7			
			- stiff at 2 to 4 ft				
				13			
			- soft below 4 ft				
5				6			
			Very stiff reddish brown silty clay w/numerous chert fragments and nodules and discontinuous chert seams				
				31			
				50/8"			
10							
				25/2"			
			Note: Refusal at 11 ft on apparent cherty limestone				
15							

COMPLETION DEPTH: 11.0 ft
DATE: 8-20-23

DEPTH TO WATER
IN BORING: Dry

DATE: 8/20/2023

**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**
Consulting Engineers

LOG OF BORING NO. R12

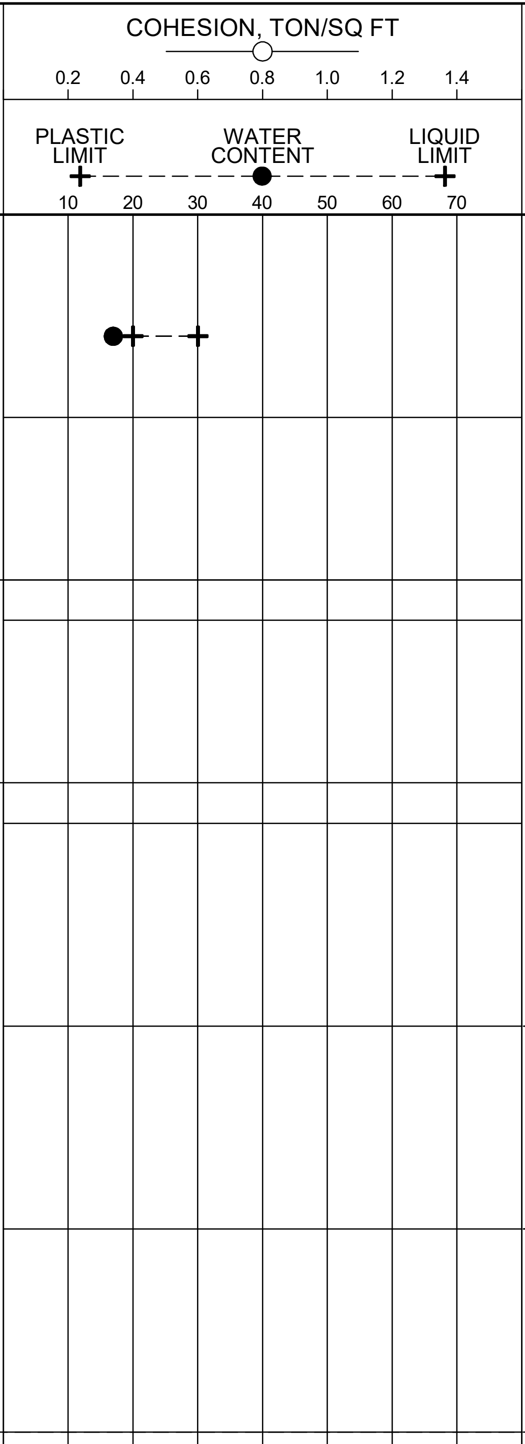
090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger to 5 ft /Wash to 20 ft /Core

LOCATION: Approx Sta 170+00, CL

SURF. EL: 1146±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Very soft reddish brown silty clay	2				
	- very stiff with chert fragments below 2 ft	27		49		
5	- with numerous chert fragments below 4 ft	50/10"				
		50/4"				
10	Moderately hard light gray and tan weathered cherty limestone, fractured w/some silty clay filled fractures	50/3"				
		25/0"				
15	Moderately hard to hard tan and light gray weathered chert and limestone, flat bedded, highly fractured w/red clay infill					
20	- with some calcareous seams below 20 ft					
					52	0
25						
					50	0
30						



COMPLETION DEPTH: 30.0 ft
DATE: 3-13-23

DEPTH TO WATER
IN BORING: Dry to 5 ft

DATE: 3/13/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R13

090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger to 10 ft /Wash

LOCATION: Approx Sta 174+50, CL

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 1126±	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT ○ 0.2 0.4 0.6 0.8 1.0 1.2 1.4 PLASTIC LIMIT + WATER CONTENT ● LIQUID LIMIT + 10 20 30 40 50 60 70	- No. 200 %
			Soft reddish brown silty clay w/chert fragments	4			
			Very stiff reddish brown and tan silty clay w/numerous chert fragments	32			
5				50/6"			
			- with chert layers below 6 ft	50/8"			
10			Moderately hard tan and gray weathered limestone w/reddish brown silty clay filled fractures and seams	50/10"			
15				25/0"			
20				25/0"			
25							

COMPLETION DEPTH: 20.0 ft
DATE: 3-7-23

DEPTH TO WATER
IN BORING: Dry to 10 ft

DATE: 3/7/2023

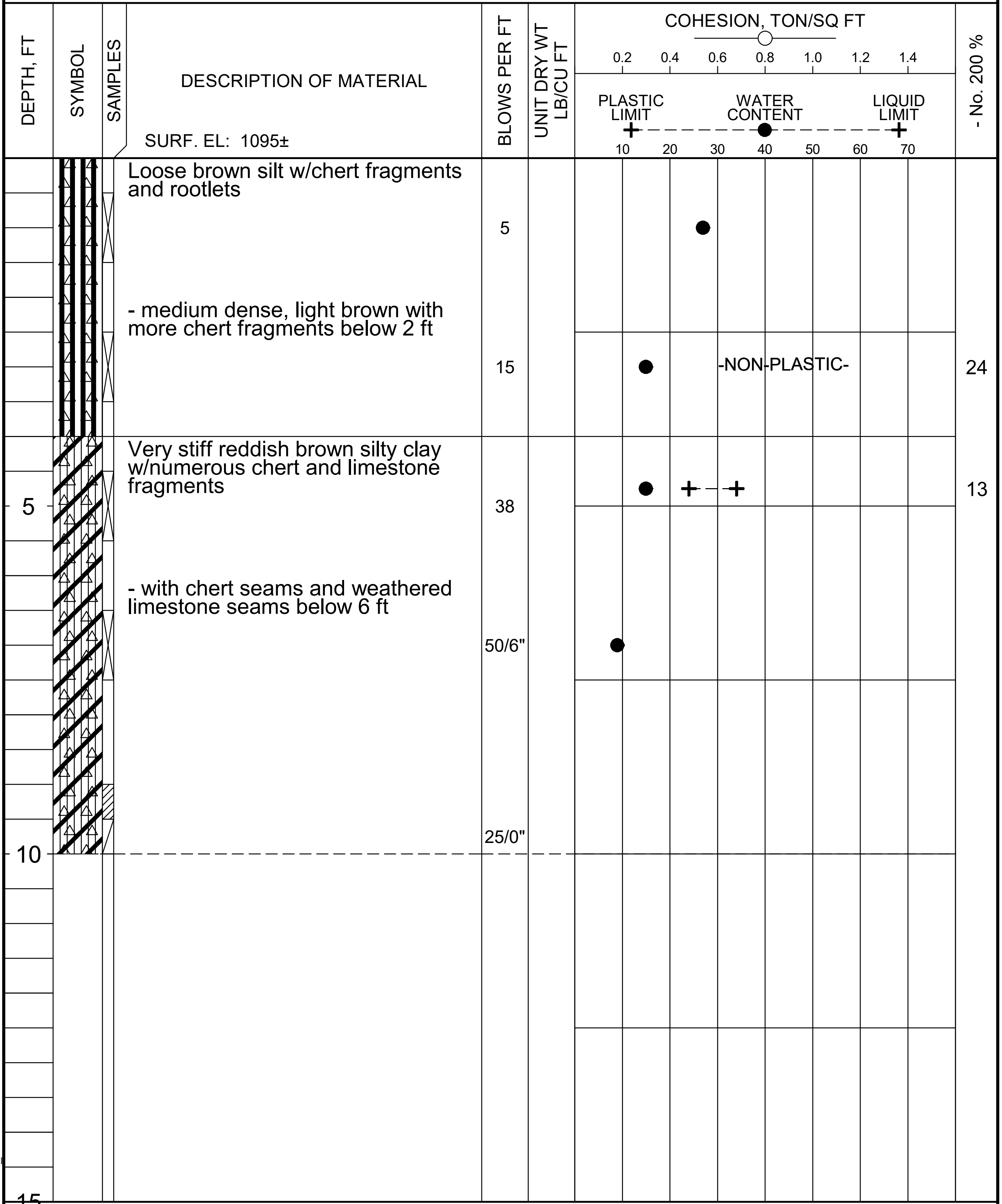
Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R14

090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 185+00, CL



SURF. EL: 1095±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %
	Loose brown silt w/chert fragments and rootlets	5			
	- medium dense, light brown with more chert fragments below 2 ft	15		-NON-PLASTIC-	24
5	Very stiff reddish brown silty clay w/numerous chert and limestone fragments	38			13
	- with chert seams and weathered limestone seams below 6 ft	50/6"			
10		25/0"			
15					

COMPLETION DEPTH: 10.0 ft
DATE: 4-21-22

DEPTH TO WATER
IN BORING: Dry

DATE: 4/21/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R15

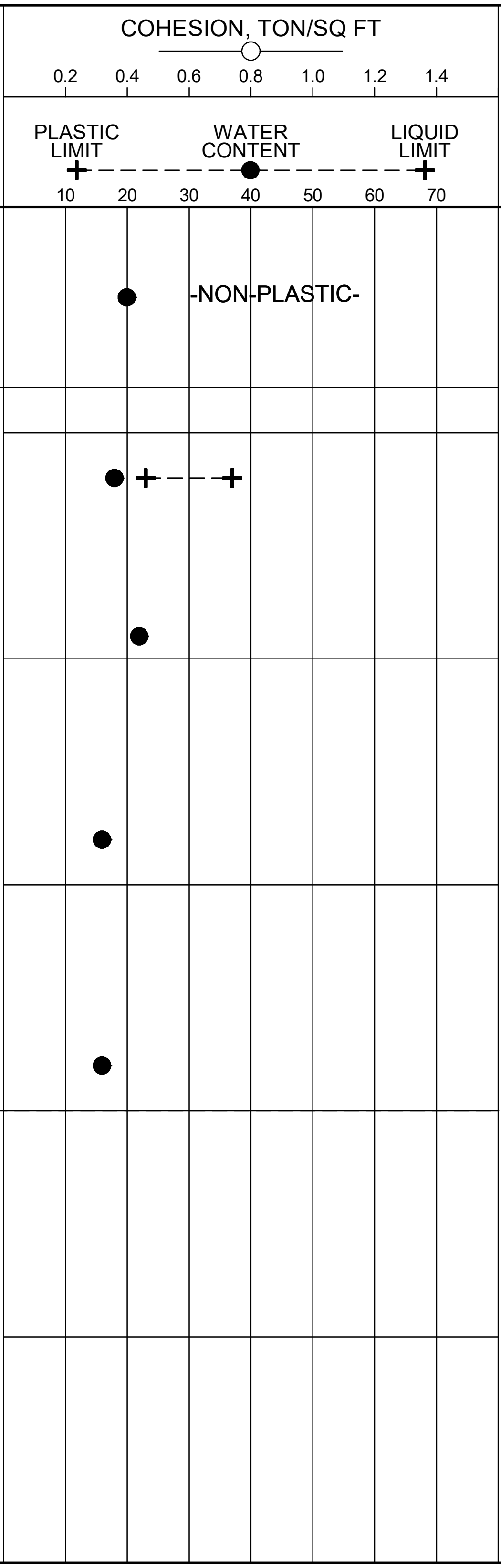
090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 188+50, CL

SURF. EL: 1101±

DEPTH, FT	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
	☒	Very loose to loose brown silt w/rootlets and occasional chert fragments	4		63
	☒	Firm reddish brown and light brown silty clay w/numerous chert and limestone fragments	9		25
5	☒	- stiff to very stiff, reddish brown below 4 ft	17		
	☒		35		
10	☒		26		
15					



COMPLETION DEPTH: 10.0 ft
DATE: 4-21-22

DEPTH TO WATER
IN BORING: Dry

DATE: 4/21/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

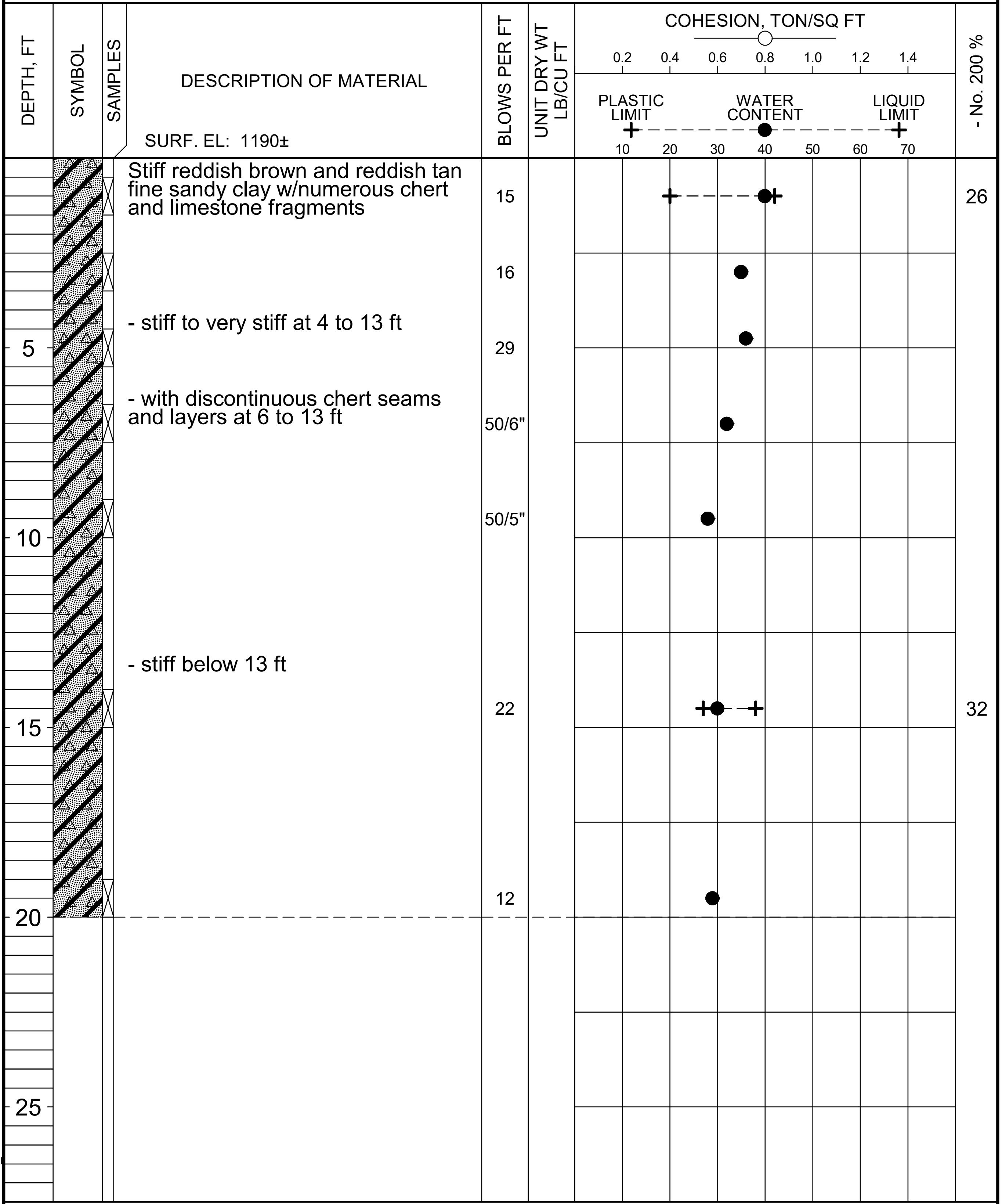
LOG OF BORING NO. R16

090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 196+75, CL

SURF. EL: 1190±



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
Stiff reddish brown and reddish tan fine sandy clay w/numerous chert and limestone fragments	15		26
	16		
- stiff to very stiff at 4 to 13 ft	29		
- with discontinuous chert seams and layers at 6 to 13 ft	50/6"		
	50/5"		
- stiff below 13 ft	22		32
	12		

COMPLETION DEPTH: 20.0 ft
DATE: 4-6-22

DEPTH TO WATER
IN BORING: Dry

DATE: 4/6/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

L O G O F B O R I N G N O. R17

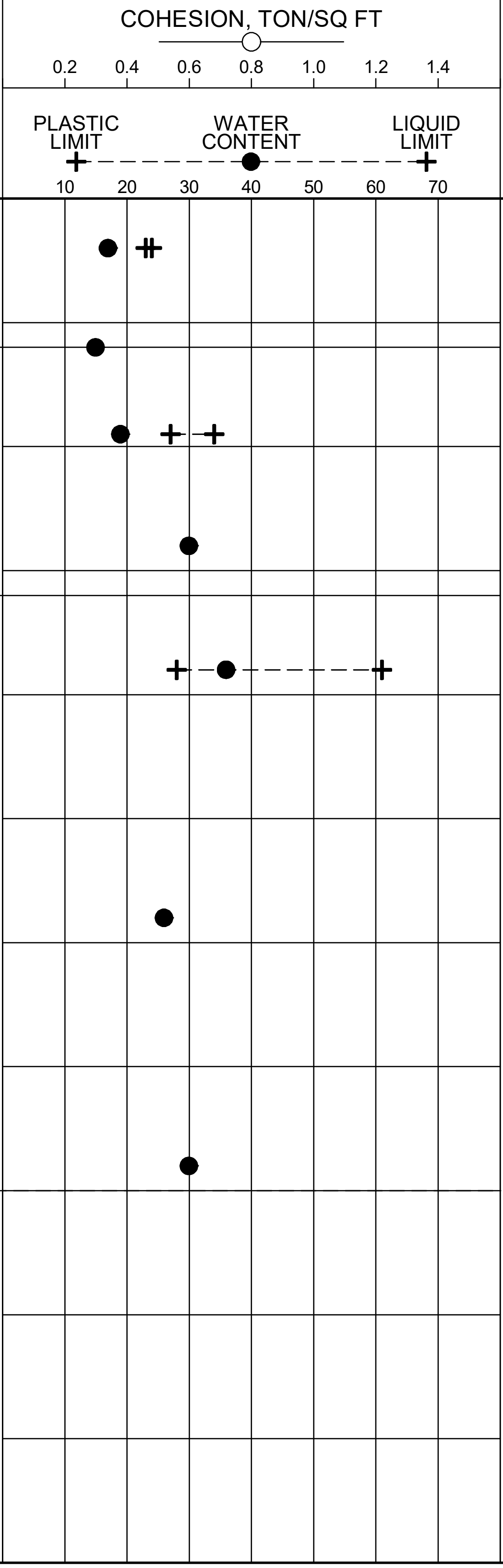
090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 200+00, CL

SURF. EL: 1202±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
	Medium dense light grayish brown fine sandy silt w/chert fragments	15		36
	Stiff to very stiff reddish brown silty clay w/numerous chert and limestone fragments and occasional clay pockets	24		
5		27		17
		39		
	Stiff reddish brown clay w/chert and limestone fragments	13		63
10				
	- with more chert and limestone fragments below 13 ft			
15		17		
20		12		
25				



COMPLETION DEPTH: 20.0 ft
DATE: 5-11-22

DEPTH TO WATER
IN BORING: Dry

DATE: 5/11/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R19

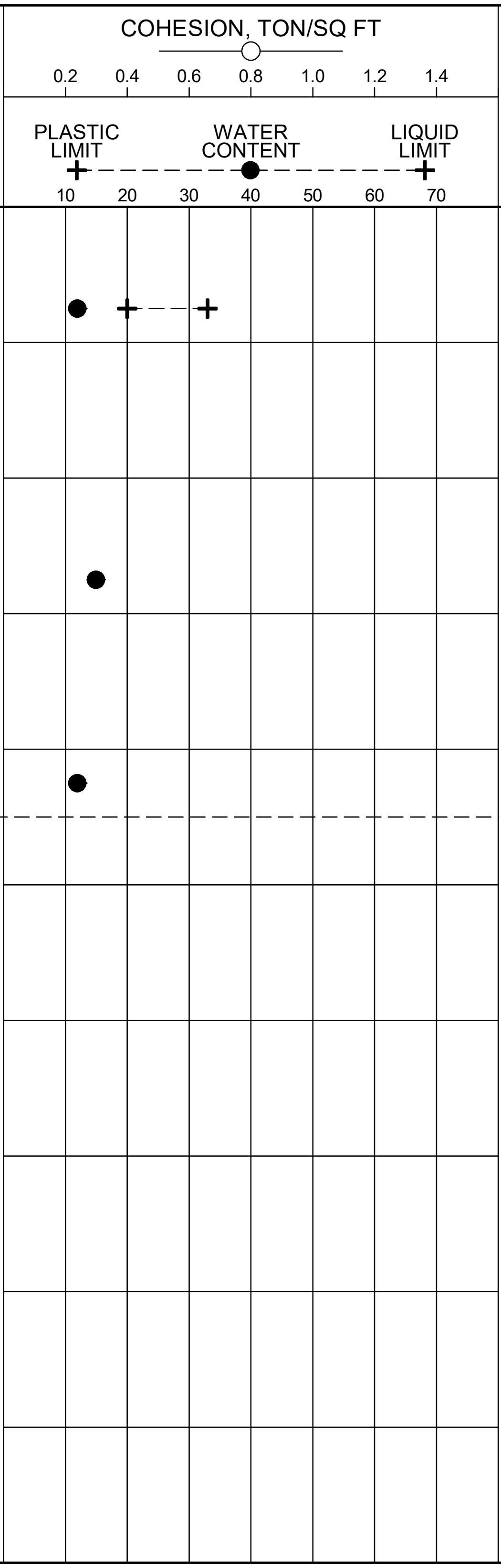
090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 209+00, CL

SURF. EL: 1215±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
0	Stiff tan and reddish brown silty clay w/numerous chert fragments and occasional organics			
1		14		33
2	- reddish brown, less silty with fewer organics below 2 ft			
3		50/3"		
4		25/0"		
4.5	- auger refusal in cherty limestone at 4.5 ft			



COMPLETION DEPTH: 4.5 ft
DATE: 3-15-22

DEPTH TO WATER
IN BORING: Dry

DATE: 3/15/2022

LGBNEW 19-118_ROAD HOLES.GPJ 9-27-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R21

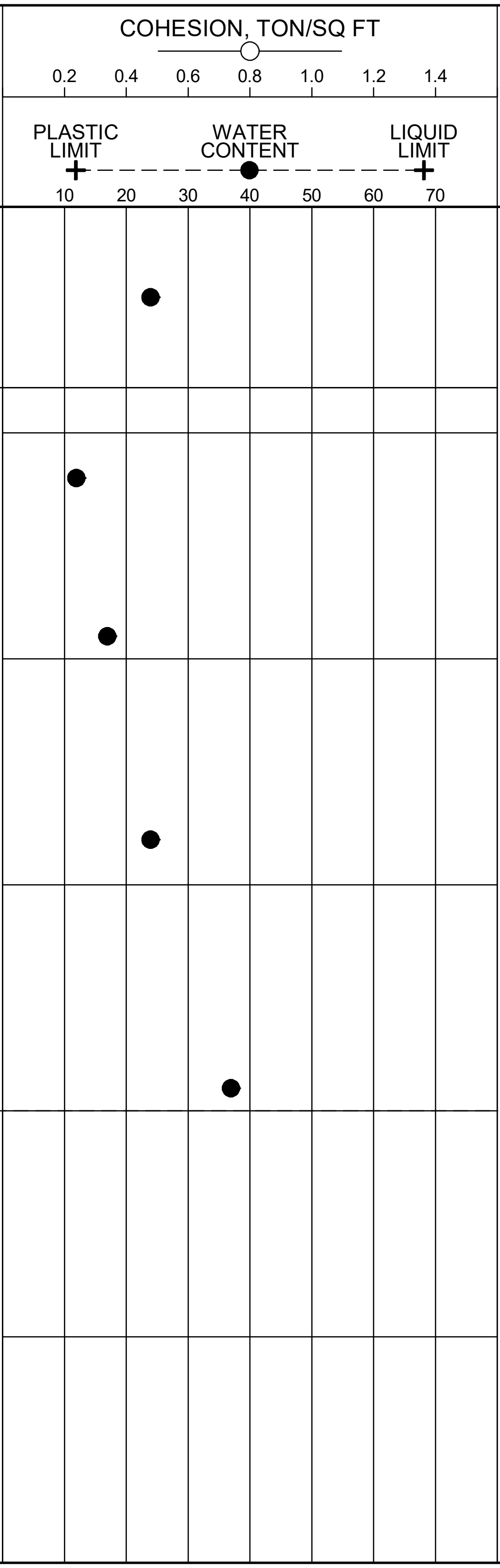
090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 220+00, CL

SURF. EL: 1236±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
0–2	Very soft brown clayey silt w/numerous chert fragments	3		33
2–10	Very stiff reddish tan silty clay w/numerous chert fragments	29		
5		45		
	- with discontinuous chert seams and layers below 6 ft	50/3"		
10		25/0"		



COMPLETION DEPTH: 10.0 ft
DATE: 2-22-23

DEPTH TO WATER
IN BORING: Dry

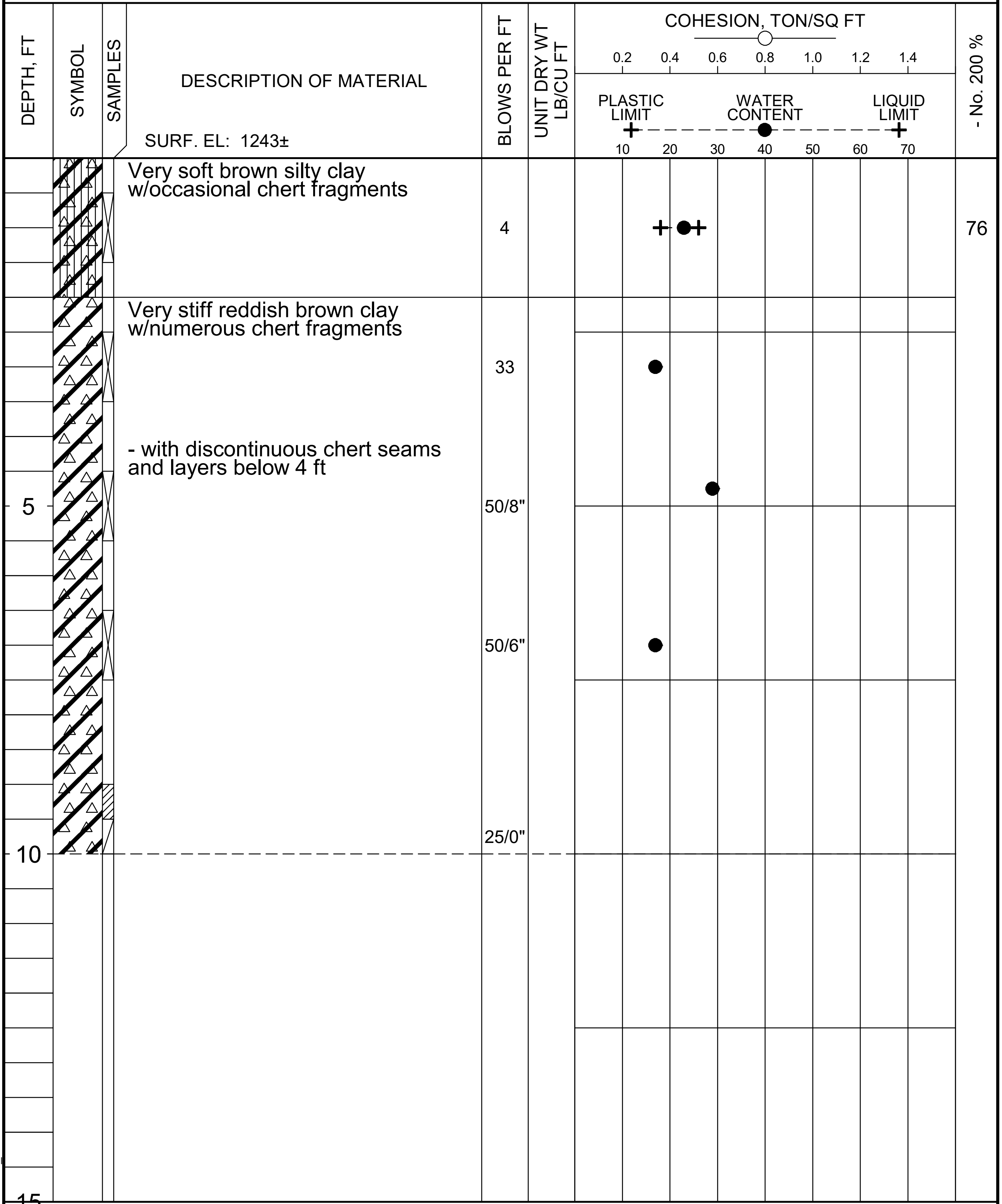
DATE: 2/22/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R22

090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger
LOCATION: Approx Sta 225+00, CL



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
SURF. EL: 1243±			
Very soft brown silty clay w/occasional chert fragments	4		76
Very stiff reddish brown clay w/numerous chert fragments	33		
- with discontinuous chert seams and layers below 4 ft	50/8"		
	50/6"		
	25/0"		

COMPLETION DEPTH: 10.0 ft
DATE: 2-23-23

DEPTH TO WATER
IN BORING: Dry

DATE: 2/23/2023

LGBNEW 19-118_ROAD HOLES.GPJ 9-27-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R23

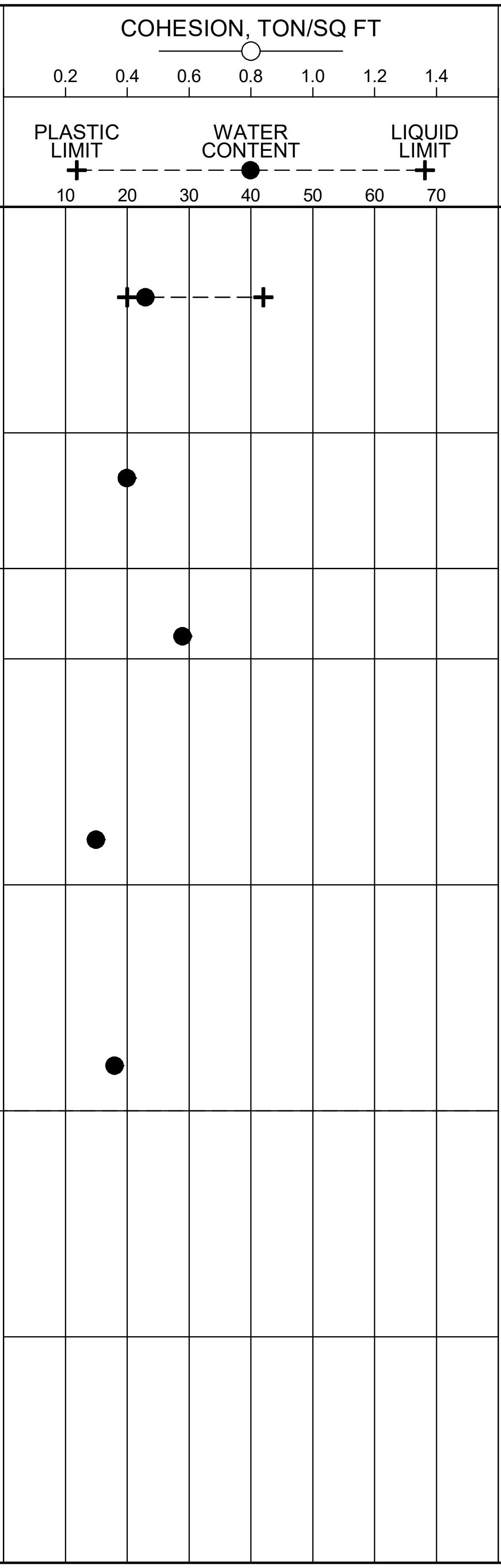
090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 230+00, CL

SURF. EL: 1245±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
	Stiff tan and brown silty clay w/occasional chert fragments	20		88
	- with more chert fragments below 2.5 ft	12		
	Stiff reddish brown clay w/numerous chert fragments			
5		21		
		20		
	- with discontinuous chert seams and layers below 8.5 ft	50/5"		
10				
15				



COMPLETION DEPTH: 10.0 ft
DATE: 2-23-23

DEPTH TO WATER
IN BORING: 7.9 ft

DATE: 2/23/2023

19-118

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R24

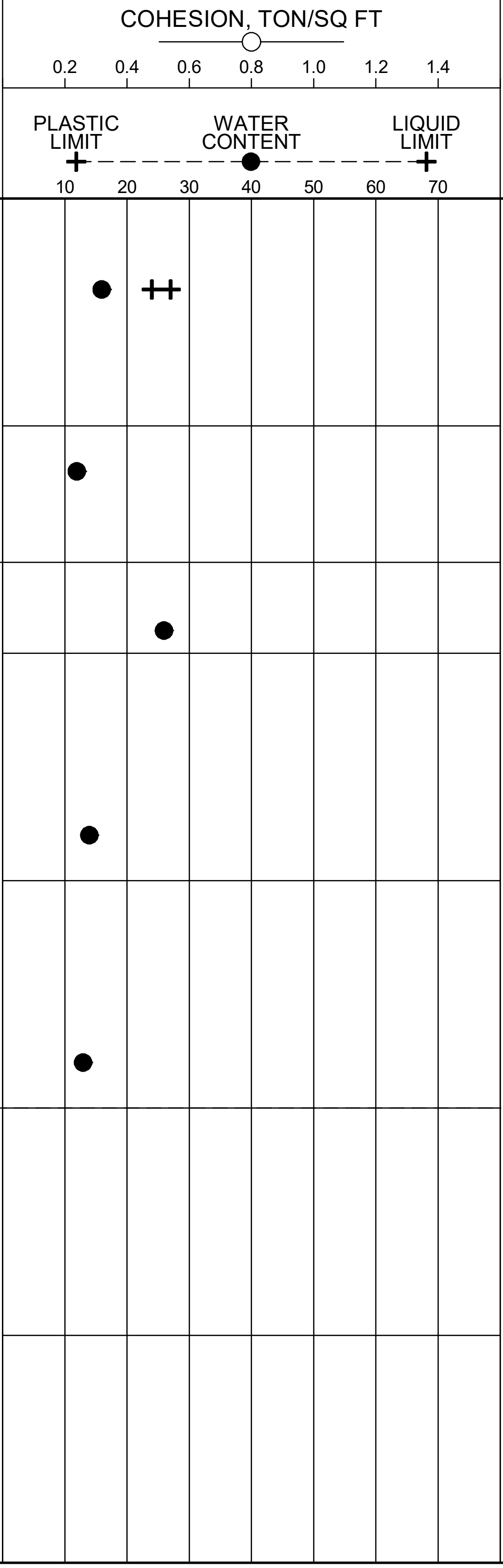
090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 235+00, CL

SURF. EL: 1233±

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
			Medium dense brown w/reddish tan fine sandy silt, slightly clayey w/chert fragments			
				18		51
			- dense below 2 ft			
				41		
			Very stiff reddish brown clay, slightly silty w/numerous chert fragments			
5				40		
			- with discontinuous chert seams and layers below 6 ft			
				50/6"		
			- with less silt below 8 ft			
				50/10"		
10						
15						



COMPLETION DEPTH: 10.0 ft
DATE: 2-27-23

DEPTH TO WATER
IN BORING: Dry

DATE: 2/27/2023

LGBNEW 19-118 ROAD HOLES.GPJ 9-27-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

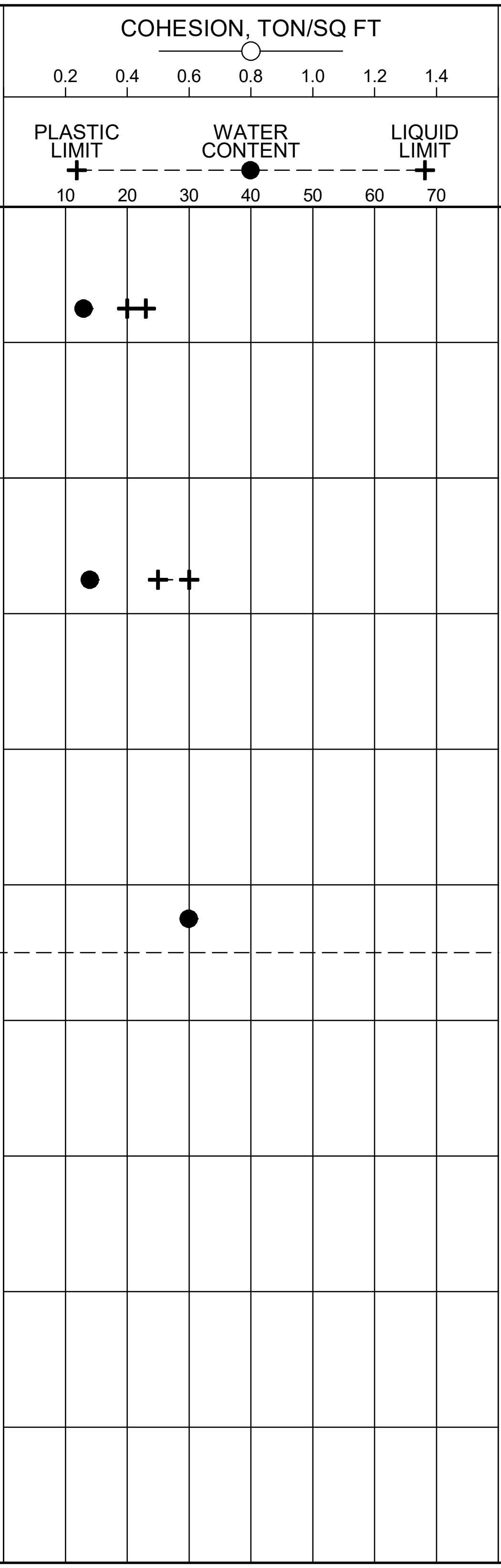
LOG OF BORING NO. R25

090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 240+00, CL

DEPTH, FT	DESCRIPTION OF MATERIAL SURF. EL.: 1221±	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
	Dense tan fine sandy silt, slightly clayey w/numerous chert fragments			
1		35		32
2	Very stiff reddish brown silty clay w/numerous chert fragments			
3		35		
4				
5		50/6"		48
6				
7	NOTE: Auger refusal in cherty limestone layer.			
8				
9				



COMPLETION DEPTH: 5.5 ft
DATE: 2-28-23

DEPTH TO WATER
IN BORING: Dry

DATE: 2/28/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R26

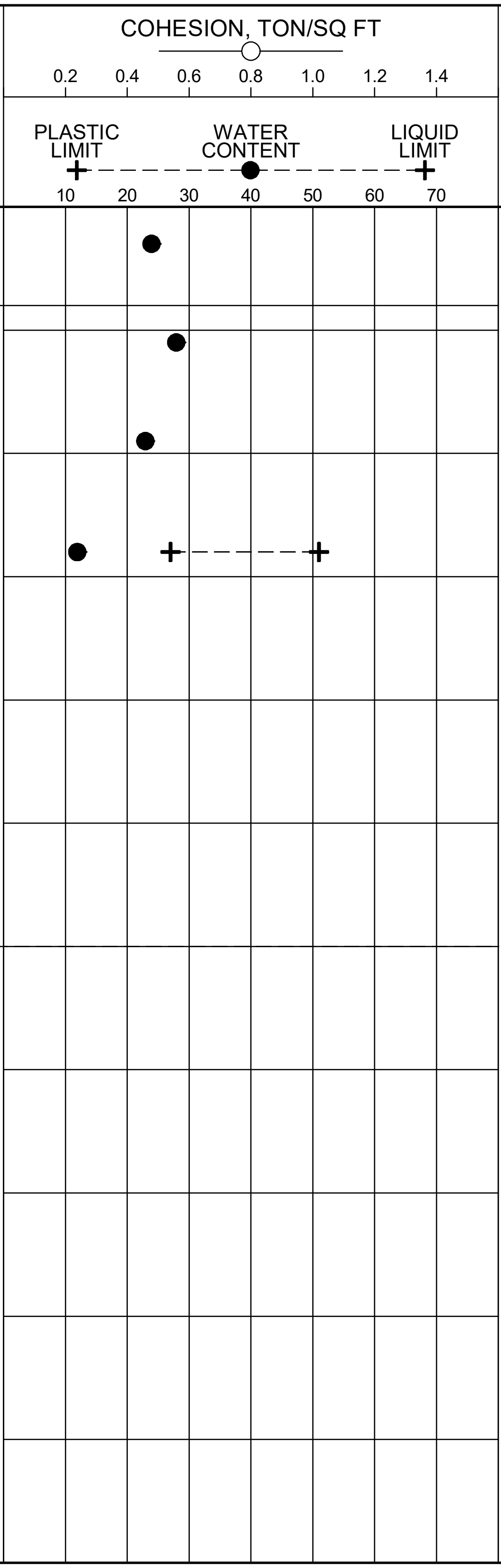
090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 245+00, CL

SURF. EL: 1237±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
	Soft reddish brown silty clay	5		
	Stiff reddish brown clay w/numerous chert fragments	18		
5	- stiff to very stiff with discontinuous chert seams and layers below 4 ft	50/10"		
		50/6"		20
10		50/3"		
		25/0"		
15				
20				
25				



COMPLETION DEPTH: 15.0 ft
DATE: 2-28-23

DEPTH TO WATER
IN BORING: Dry

DATE: 2/28/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R27

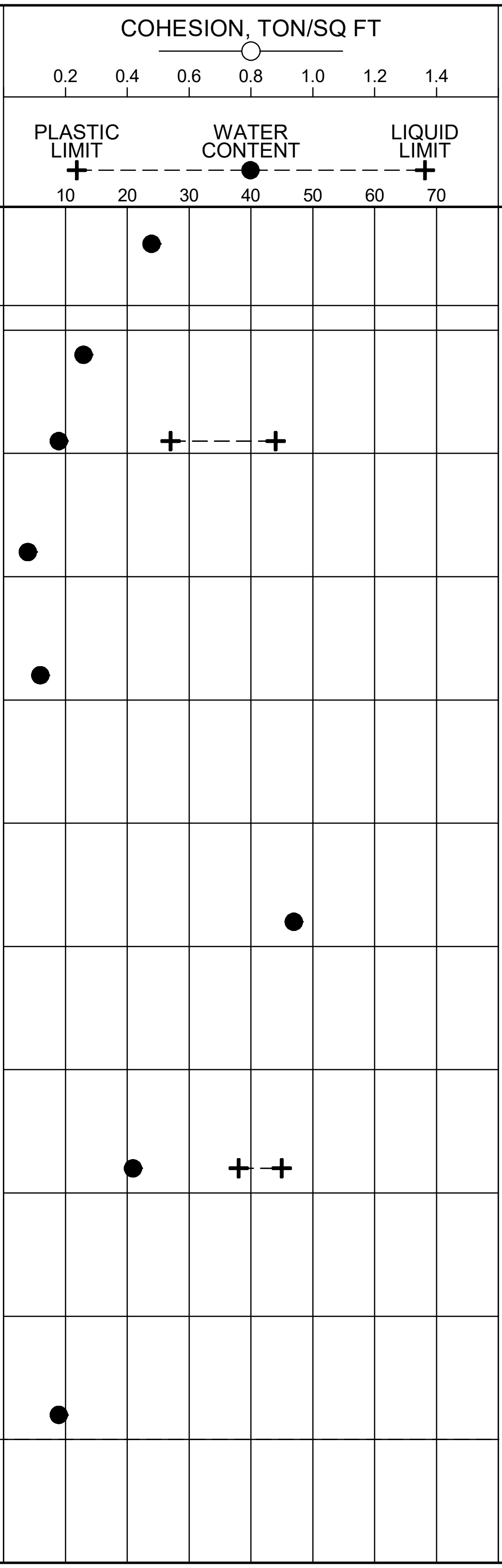
090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 250+00, CL

SURF. EL: 1233±

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
Loose brown clayey silt w/occasional chert fragments	9		
Very stiff reddish brown silty clay w/numerous chert fragments and discontinuous chert seams and layers	50/5"		
	50/4"		15
	50/3"		
	25/0"		
- with more silt at 12 to 17 ft			
	50/5"		
	34		18
	50/6"		



COMPLETION DEPTH: 25.0 ft
DATE: 2-28-23

DEPTH TO WATER
IN BORING: Dry

DATE: 2/28/2023

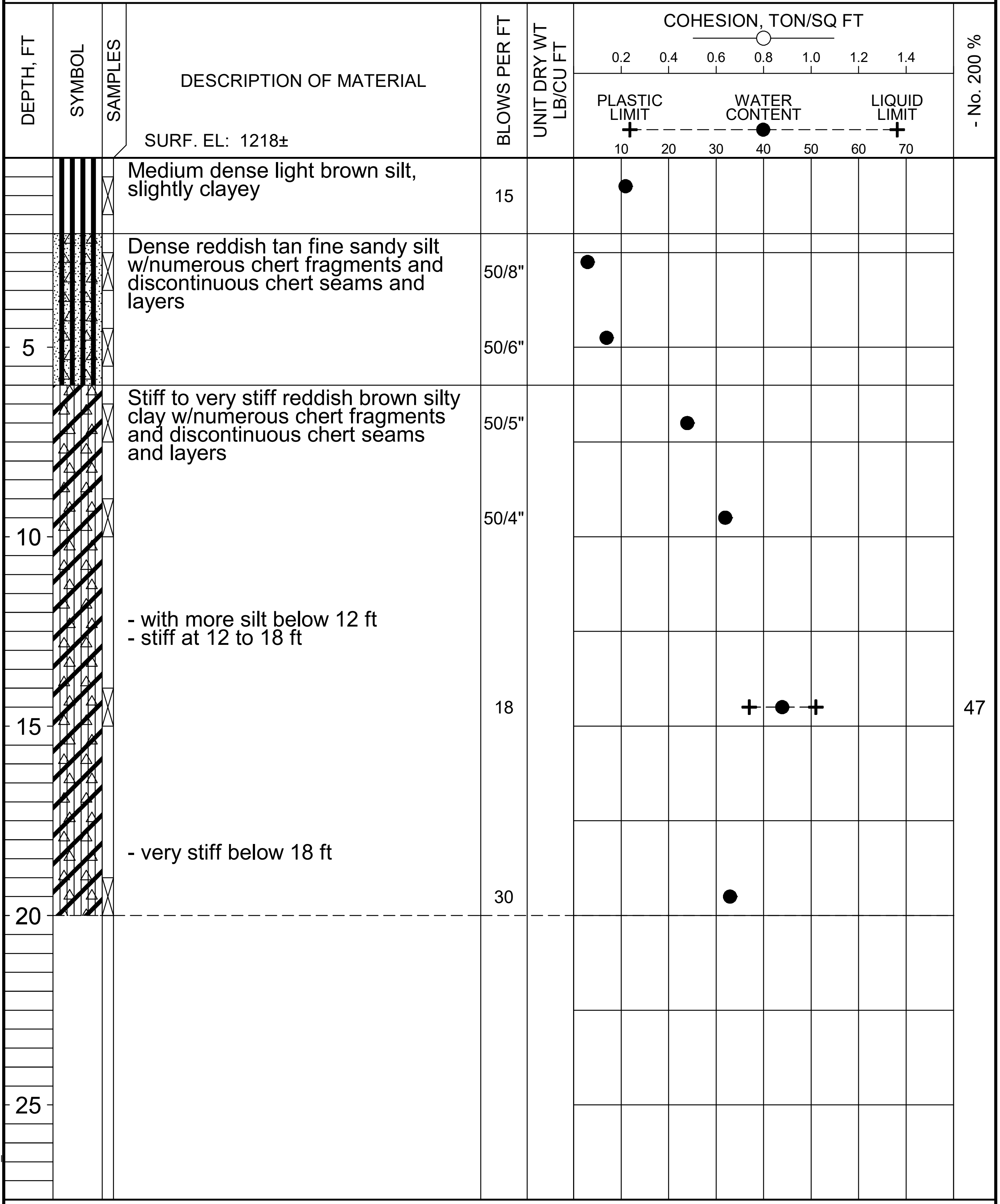
Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R29

090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 260+00, CL



DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	- No. 200 %
0–2	Medium dense light brown silt, slightly clayey	15	
2–6	Dense reddish tan fine sandy silt w/numerous chert fragments and discontinuous chert seams and layers	50/8" 50/6"	
6–20	Stiff to very stiff reddish brown silty clay w/numerous chert fragments and discontinuous chert seams and layers	50/5" 50/4"	
	- with more silt below 12 ft - stiff at 12 to 18 ft	18	47
	- very stiff below 18 ft	30	

COMPLETION DEPTH: 20.0 ft
DATE: 3-1-23

DEPTH TO WATER
IN BORING: Dry

DATE: 3/1/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

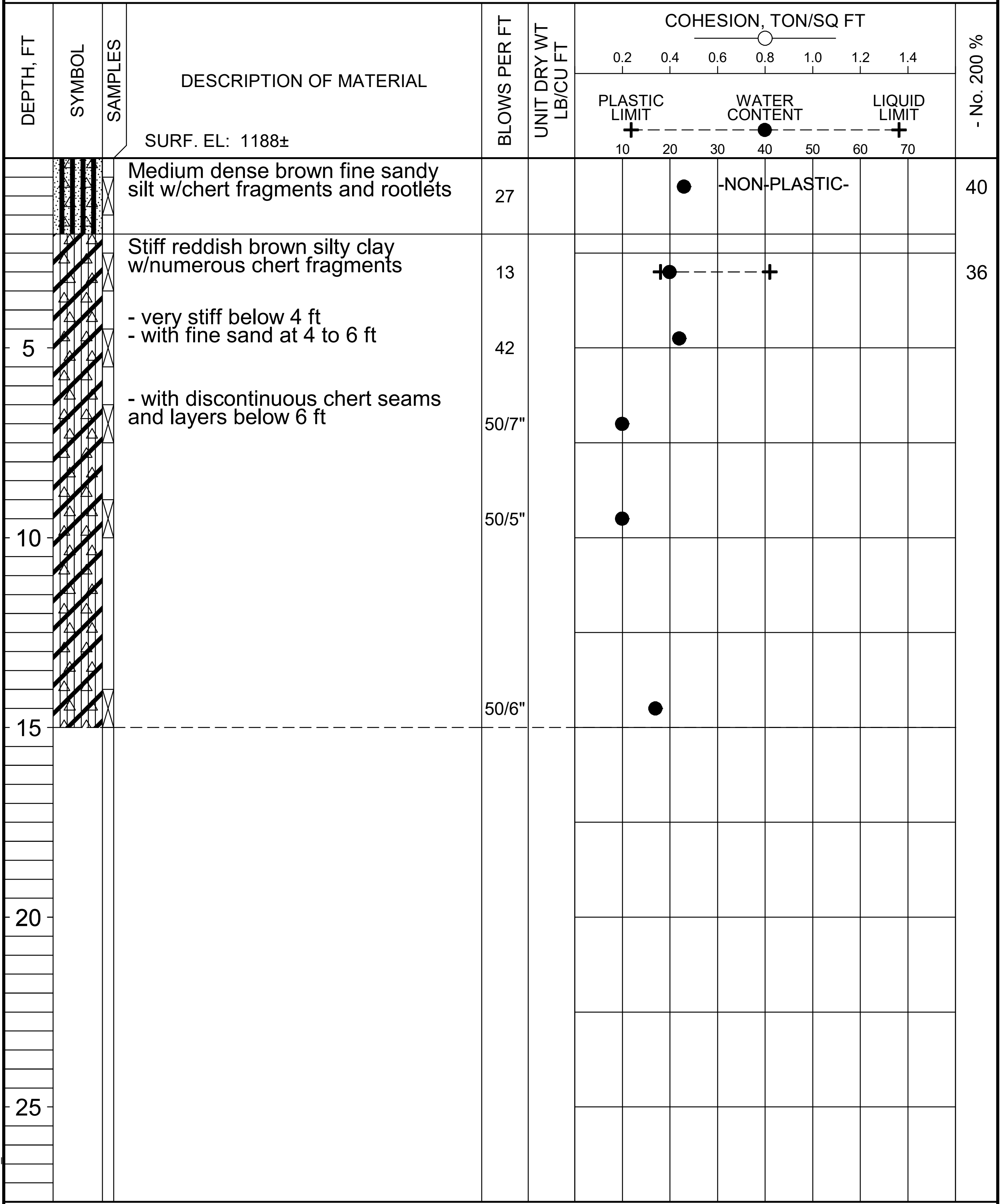
LOG OF BORING NO. R30

090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 265+00, CL

SURF. EL: 1188±



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
Medium dense brown fine sandy silt w/chert fragments and rootlets	27		40
Stiff reddish brown silty clay w/numerous chert fragments	13		36
- very stiff below 4 ft - with fine sand at 4 to 6 ft	42		
- with discontinuous chert seams and layers below 6 ft	50/7"		
	50/5"		
	50/6"		

COMPLETION DEPTH: 15.0 ft
DATE: 3-1-23

DEPTH TO WATER
IN BORING: Dry

DATE: 3/1/2023

19-118

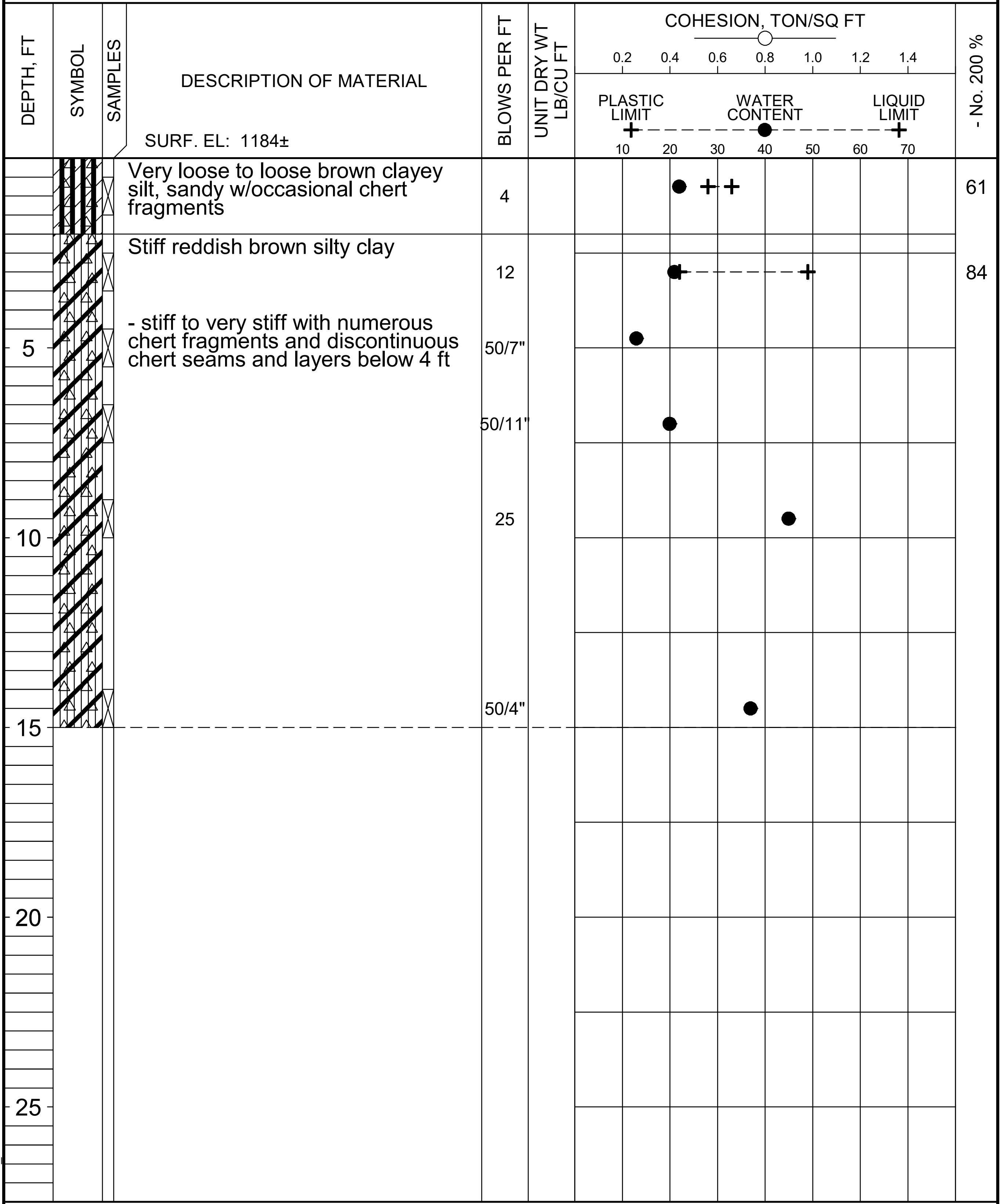
Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

L O G O F B O R I N G N O. R31

090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 270+00, CL



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
SURF. EL: 1184±			
Very loose to loose brown clayey silt, sandy w/occasional chert fragments	4		61
Stiff reddish brown silty clay	12		84
- stiff to very stiff with numerous chert fragments and discontinuous chert seams and layers below 4 ft	50/7"		
	50/11"		
	25		
	50/4"		

COMPLETION DEPTH: 15.0 ft
DATE: 3-1-23

DEPTH TO WATER
IN BORING: Dry

DATE: 3/1/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

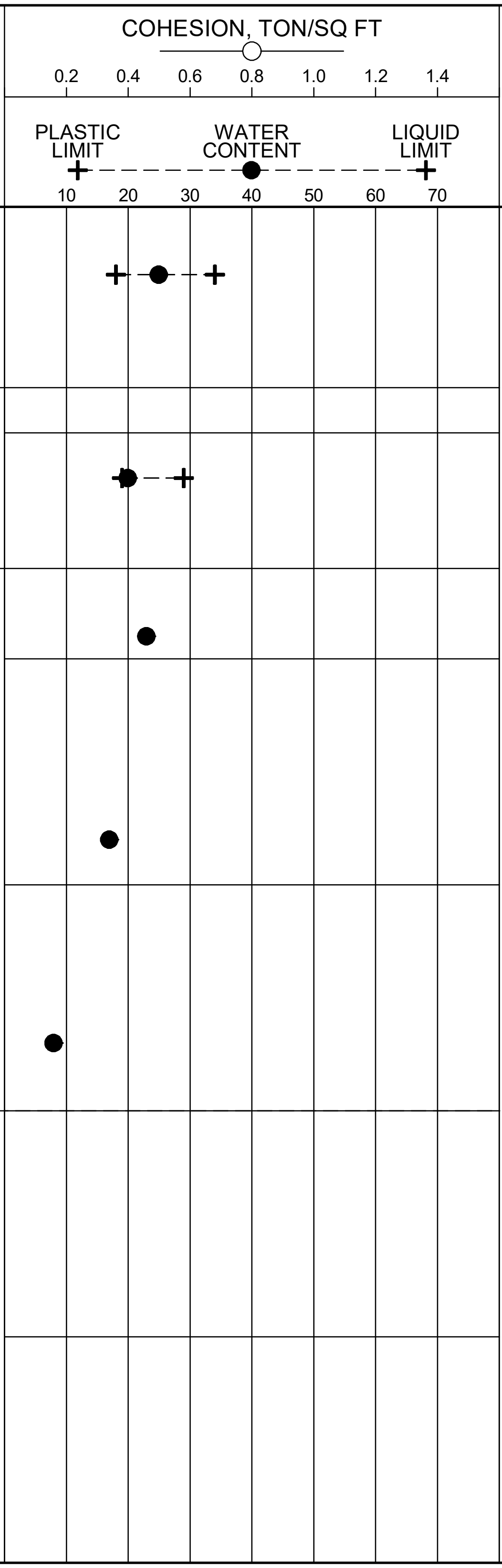
LOG OF BORING NO. R32

090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 275+00, CL

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 1210±	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
			Very soft reddish tan silty clay w/occasional chert fragments	3		73
			Stiff reddish tan and gray silty clay w/chert fragments	12		65
5			Stiff to very stiff reddish brown silty clay w/numerous chert fragments and discontinuous chert seams and layers	50/10"		
				50/5"		
				25/0"		
10						
15						



COMPLETION DEPTH: 10.0 ft
DATE: 3-4-23

DEPTH TO WATER
IN BORING: Dry

DATE: 3/4/2023

19-118

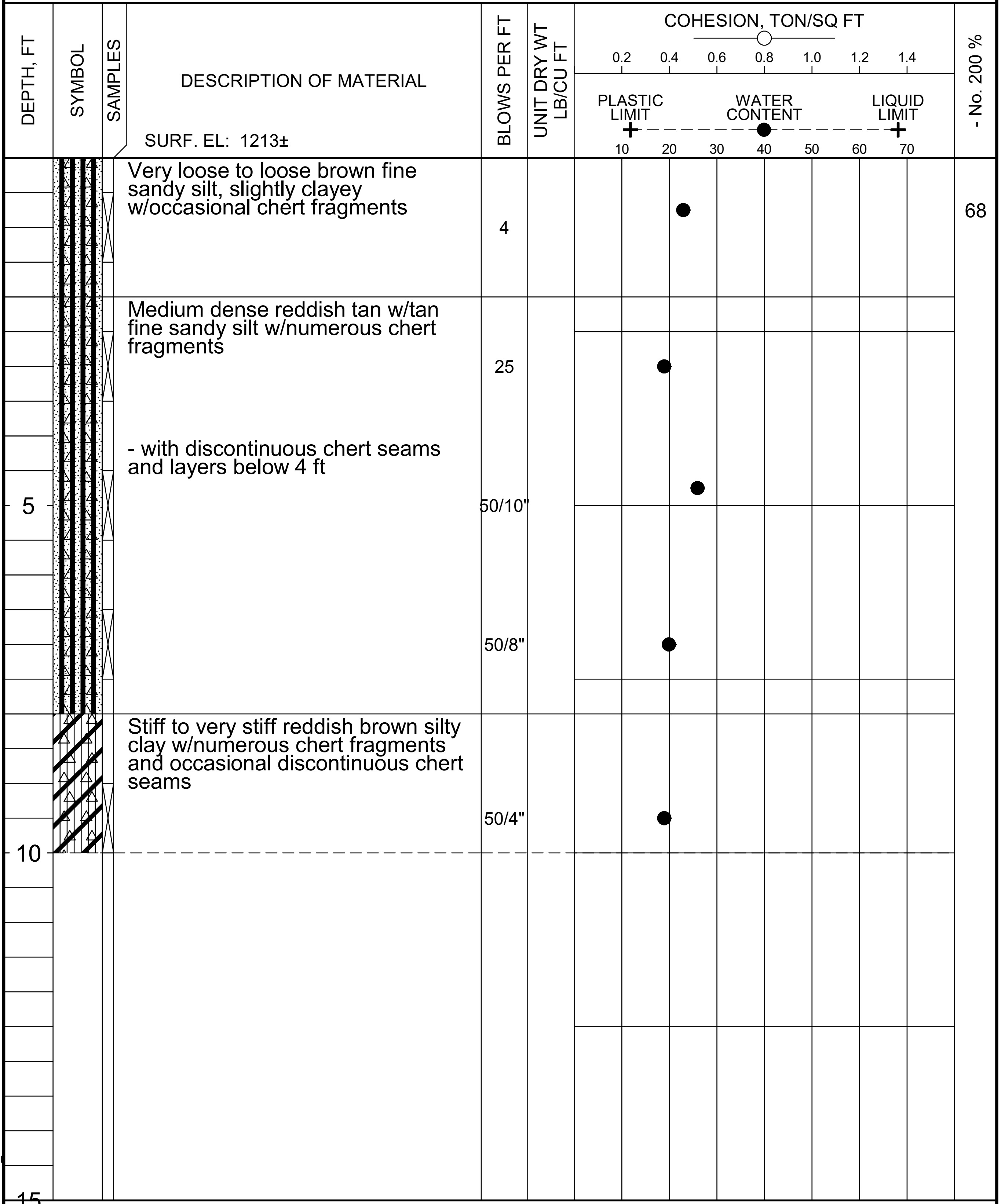
Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

L O G O F B O R I N G N O. R33

090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 280+00, CL



SURF. EL: 1213±

DESCRIPTION OF MATERIAL	BLOWS PER FT	- No. 200 %
Very loose to loose brown fine sandy silt, slightly clayey w/occasional chert fragments	4	68
Medium dense reddish tan w/tan fine sandy silt w/numerous chert fragments	25	
- with discontinuous chert seams and layers below 4 ft	50/10"	
	50/8"	
Stiff to very stiff reddish brown silty clay w/numerous chert fragments and occasional discontinuous chert seams	50/4"	

COMPLETION DEPTH: 10.0 ft
DATE: 3-4-23

DEPTH TO WATER
IN BORING: Dry

DATE: 3/4/2023

LGBNEW 19-118_ROAD HOLES.GPJ 9-27-23

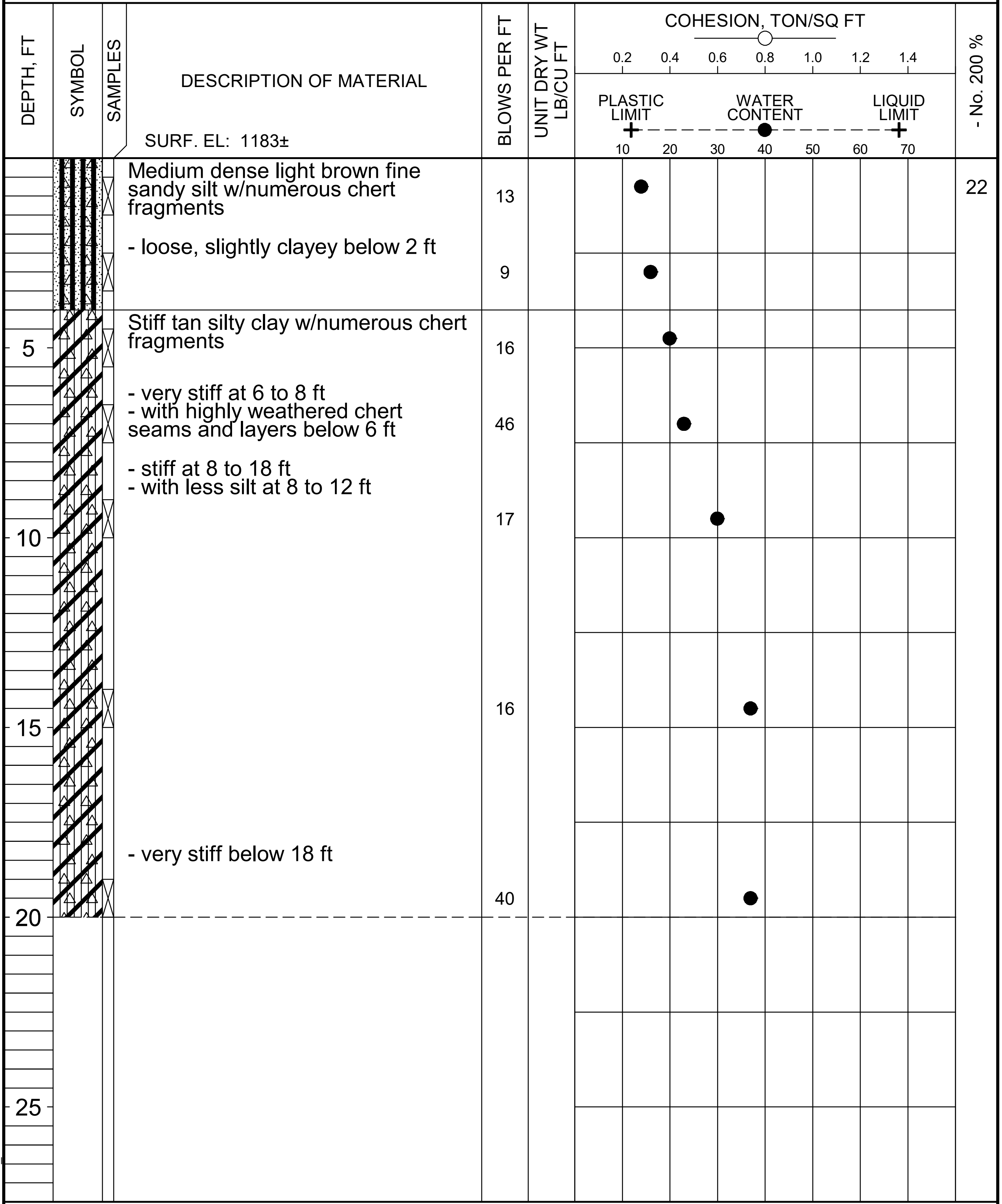
Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R34

090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger
LOCATION: Approx Sta 285+00, CL

SURF. EL: 1183±



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
Medium dense light brown fine sandy silt w/numerous chert fragments	13		22
- loose, slightly clayey below 2 ft	9		
Stiff tan silty clay w/numerous chert fragments	16		
- very stiff at 6 to 8 ft - with highly weathered chert seams and layers below 6 ft	46		
- stiff at 8 to 18 ft - with less silt at 8 to 12 ft	17		
	16		
- very stiff below 18 ft	40		

COMPLETION DEPTH: 20.0 ft
DATE: 3-4-23

DEPTH TO WATER
IN BORING: 10.2 ft

DATE: 3/4/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

L O G O F B O R I N G N O. R35

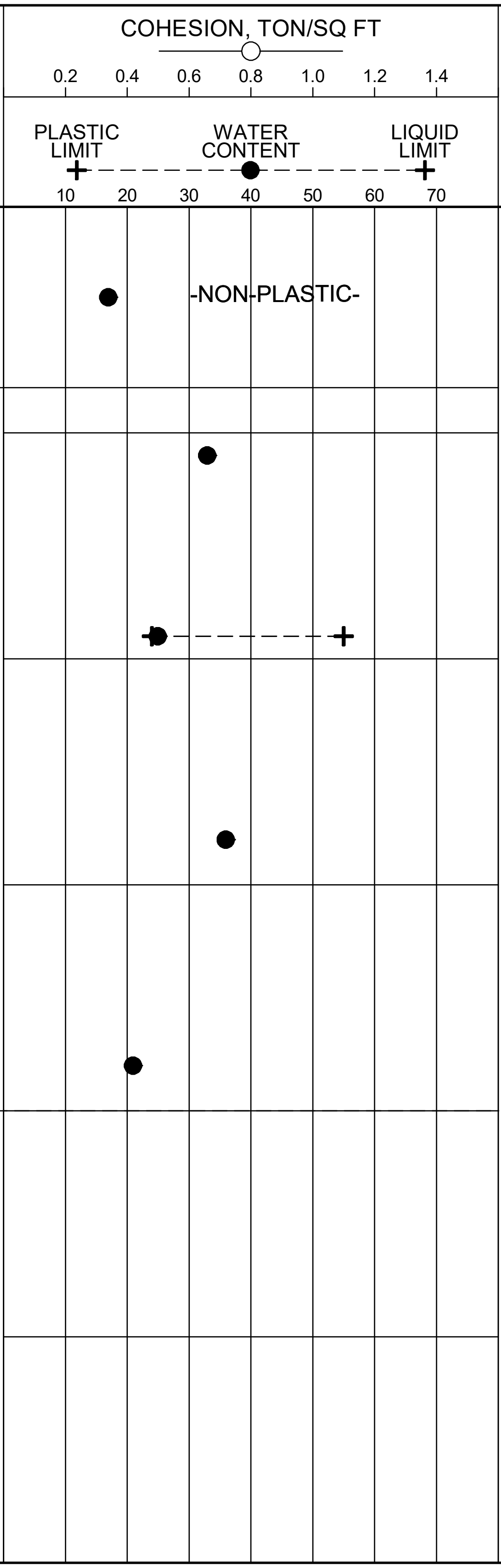
090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 290+00, CL

SURF. EL: 1217±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
	Medium dense tan fine sandy silt w/chert fragments (fill)	21		43
	Very stiff reddish brown silty clay w/numerous chert fragments	40		
	- with larger chert fragments and some chert seams below 4 ft			41
5		25/0"		
		30		
		25/0"		
10				
15				



COMPLETION DEPTH: 10.0 ft
DATE: 3-4-22

DEPTH TO WATER
IN BORING: Dry

DATE: 3/4/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

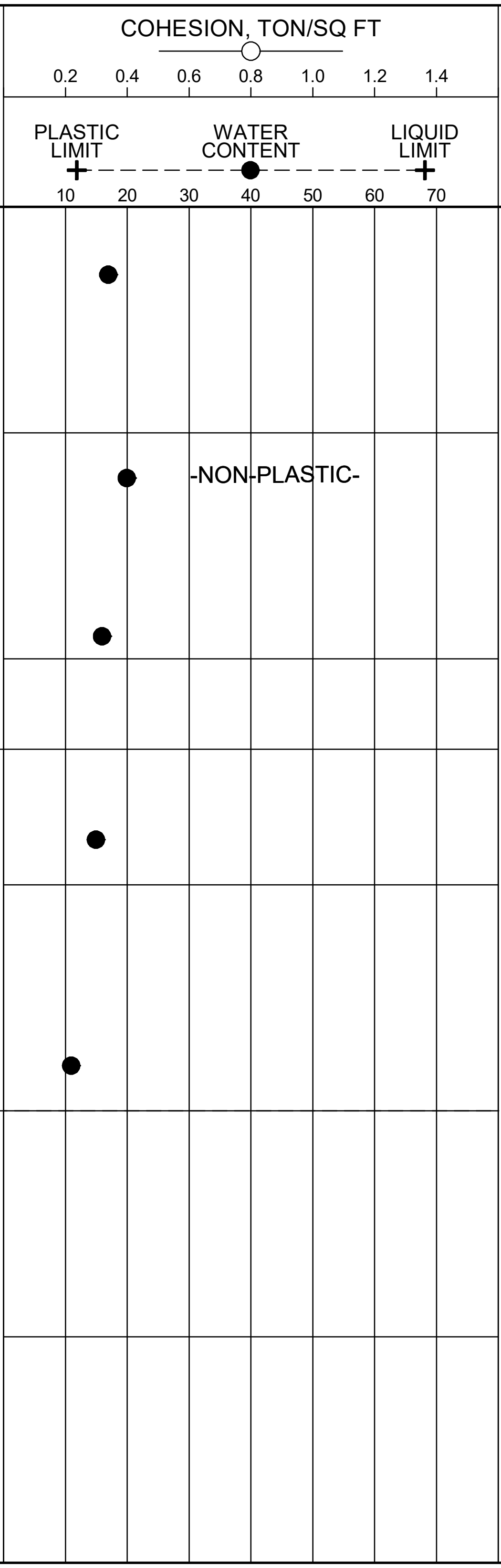
LOG OF BORING NO. R36

090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger
LOCATION: Approx Sta 295+00, CL

SURF. EL: 1221±

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
			Stiff brown and reddish tan silty clay w/chert fragments (fill)			
				14		
			- with silt pockets below 2 ft			
				19		45
5				23		
			Very stiff reddish brown silty clay w/numerous chert fragments and chert seams and layers			
				50/8"		
				50/4"		
10						
15						



COMPLETION DEPTH: 10.0 ft
DATE: 3-3-22

DEPTH TO WATER
IN BORING: Dry

DATE: 3/4/2022

LGBNEW 19-118 ROAD HOLES.GPJ 9-27-23

19-118

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

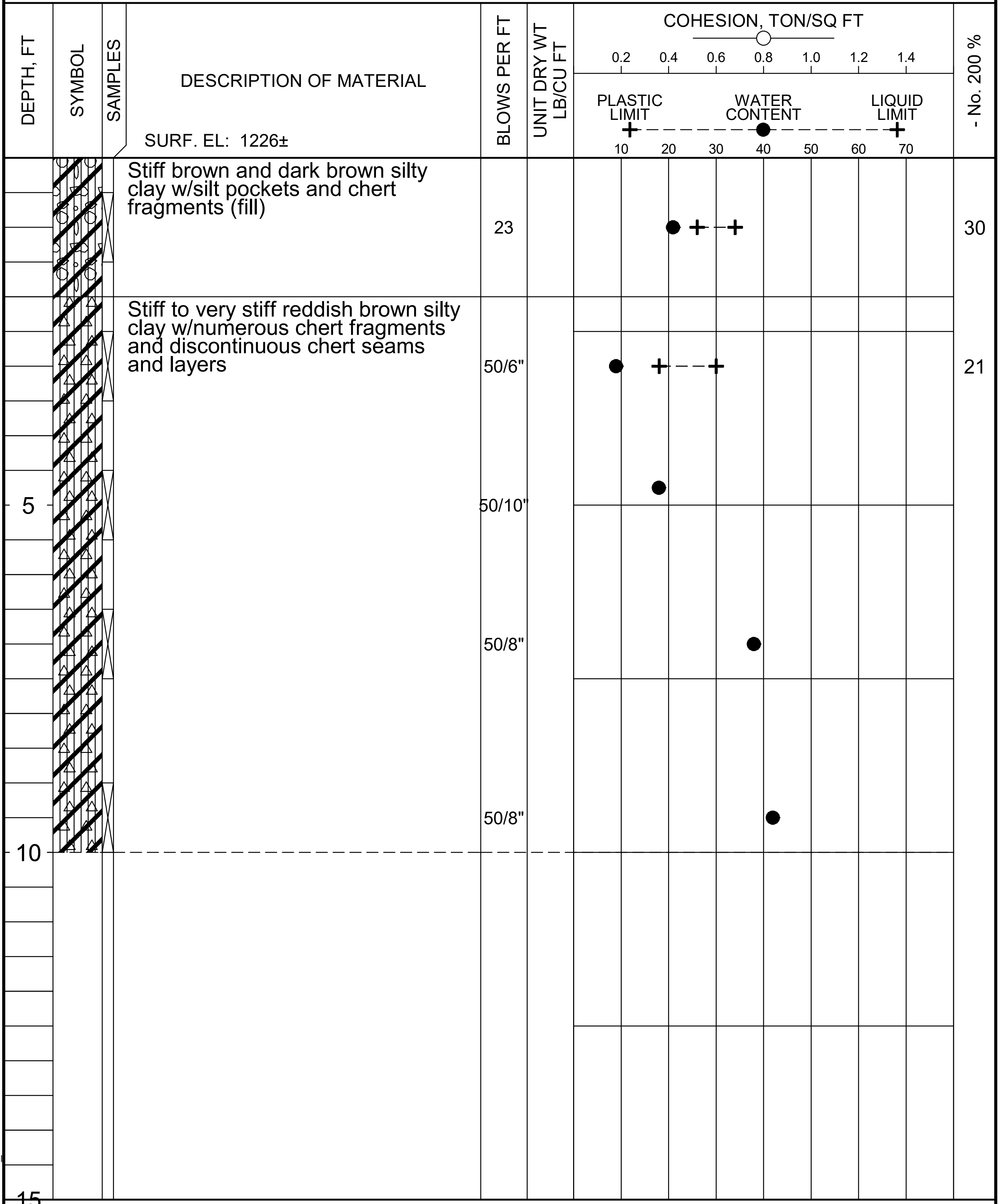
LOG OF BORING NO. R37

090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 300+00, CL

SURF. EL: 1226±



Stiff brown and dark brown silty clay w/silt pockets and chert fragments (fill)

Stiff to very stiff reddish brown silty clay w/numerous chert fragments and discontinuous chert seams and layers

COMPLETION DEPTH: 10.0 ft
DATE: 3-4-22

DEPTH TO WATER
IN BORING: Dry

DATE: 3/4/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R38

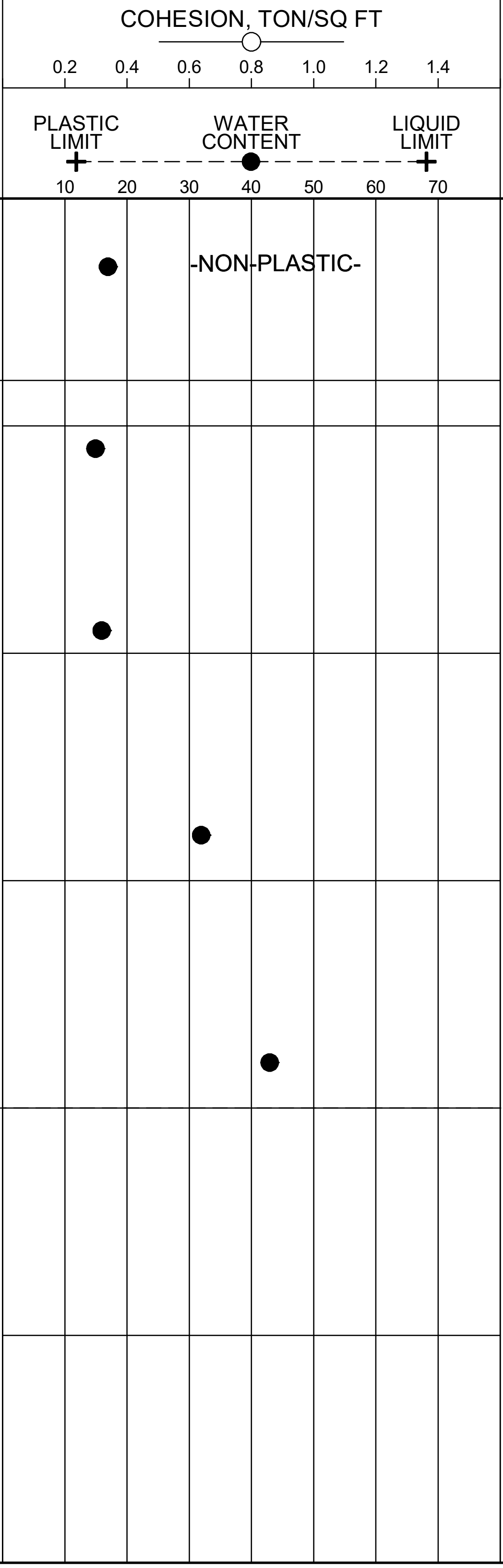
090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 305+00, CL

SURF. EL: 1225±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
	Medium dense brown and dark brown silt w/chert fragments (fill)	19		31
	Very stiff reddish brown silty clay w/numerous chert fragments	35		
5		47		
	- with more chert fragments and chert seams below 6 ft	50		
		50/11"		
10				
15				



COMPLETION DEPTH: 10.0 ft
DATE: 3-3-22

DEPTH TO WATER
IN BORING: Dry

DATE: 3/3/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

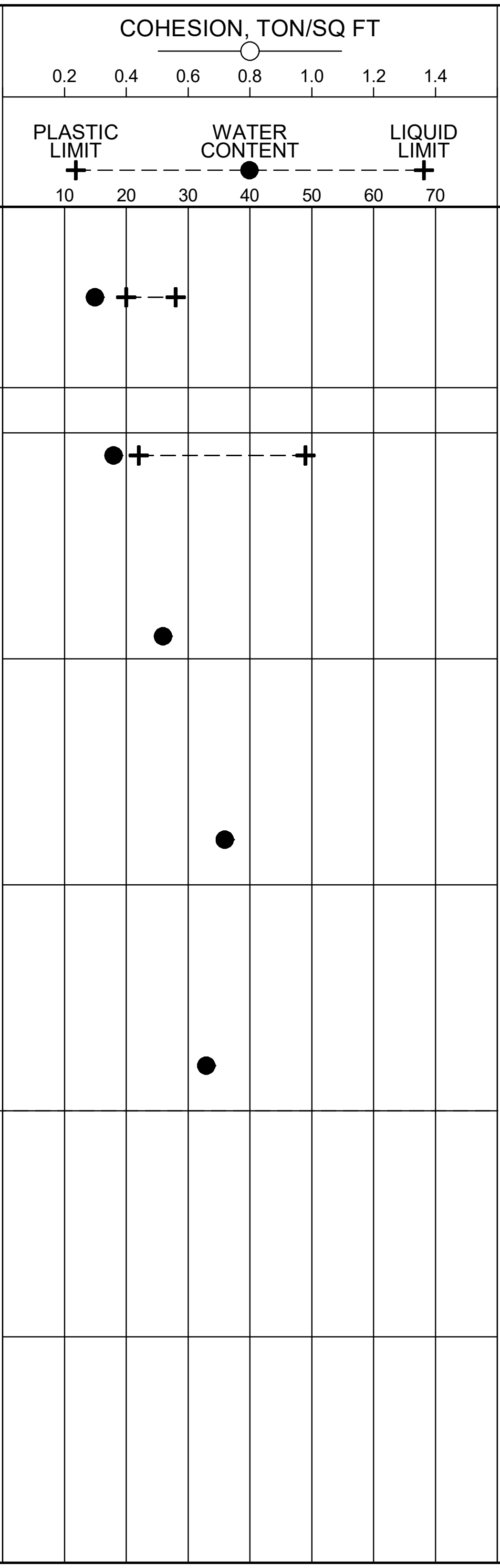
LOG OF BORING NO. R39

090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 309+00, 20 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 1235±	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
			Very stiff brown and tan silty clay w/chert fragments (fill)			
				26		42
			Stiff to very stiff reddish brown silty clay w/numerous chert fragments			
				25		41
5				22		
				35		
				44		
10						
15						



COMPLETION DEPTH: 10.0 ft
DATE: 3-3-22

DEPTH TO WATER
IN BORING: Dry

DATE: 3/2/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

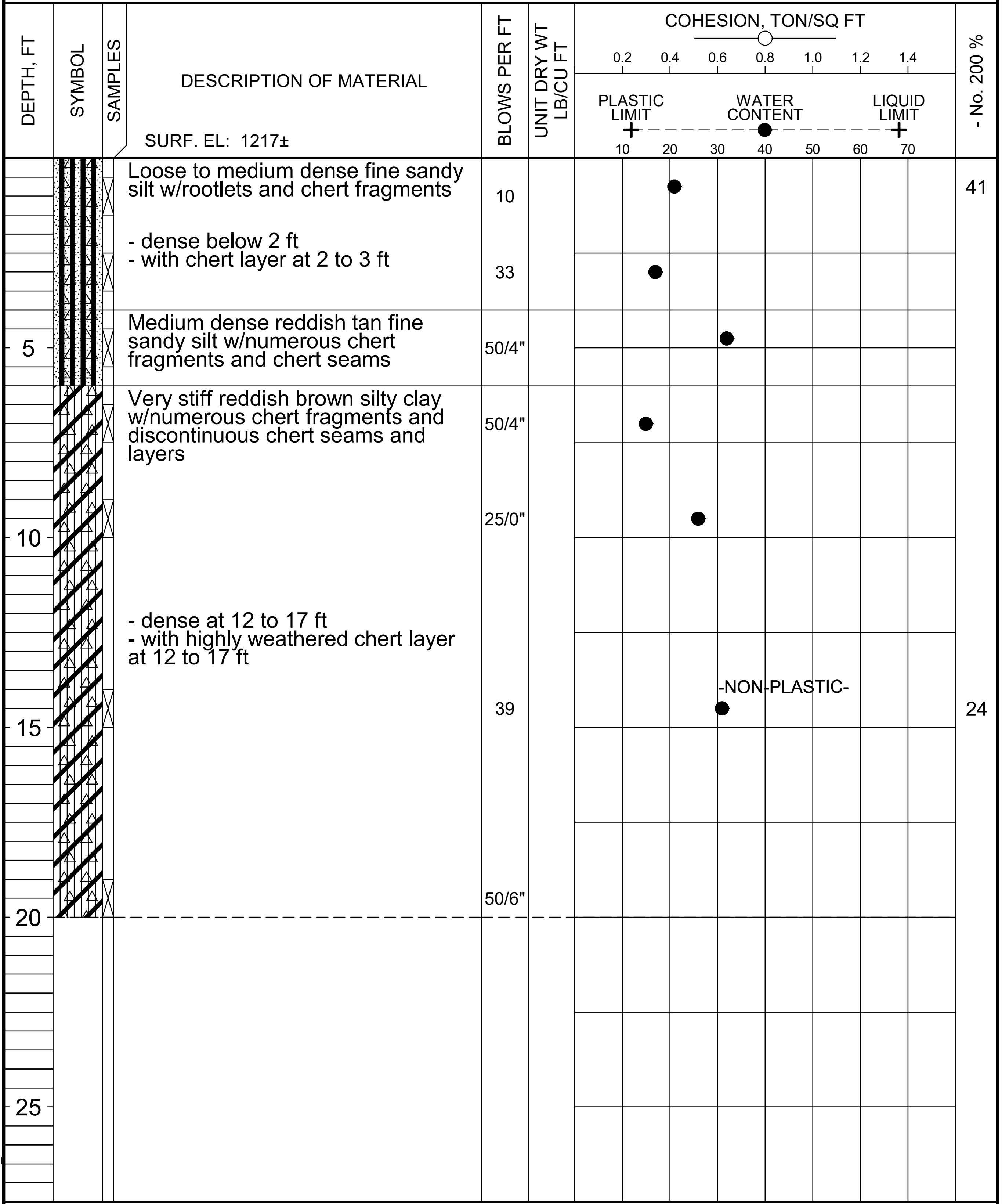
LOG OF BORING NO. R40

090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 253+00, CL - Airport Blvd

SURF. EL: 1217±



Description of Material	Blows per ft	- No. 200 %
Loose to medium dense fine sandy silt w/rootlets and chert fragments	10	41
- dense below 2 ft - with chert layer at 2 to 3 ft	33	
Medium dense reddish tan fine sandy silt w/numerous chert fragments and chert seams	50/4"	
Very stiff reddish brown silty clay w/numerous chert fragments and discontinuous chert seams and layers	50/4"	
	25/0"	
- dense at 12 to 17 ft - with highly weathered chert layer at 12 to 17 ft	39	24
	50/6"	

COMPLETION DEPTH: 20.0 ft
DATE: 3-3-23

DEPTH TO WATER
IN BORING: Dry

DATE: 3/3/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R41

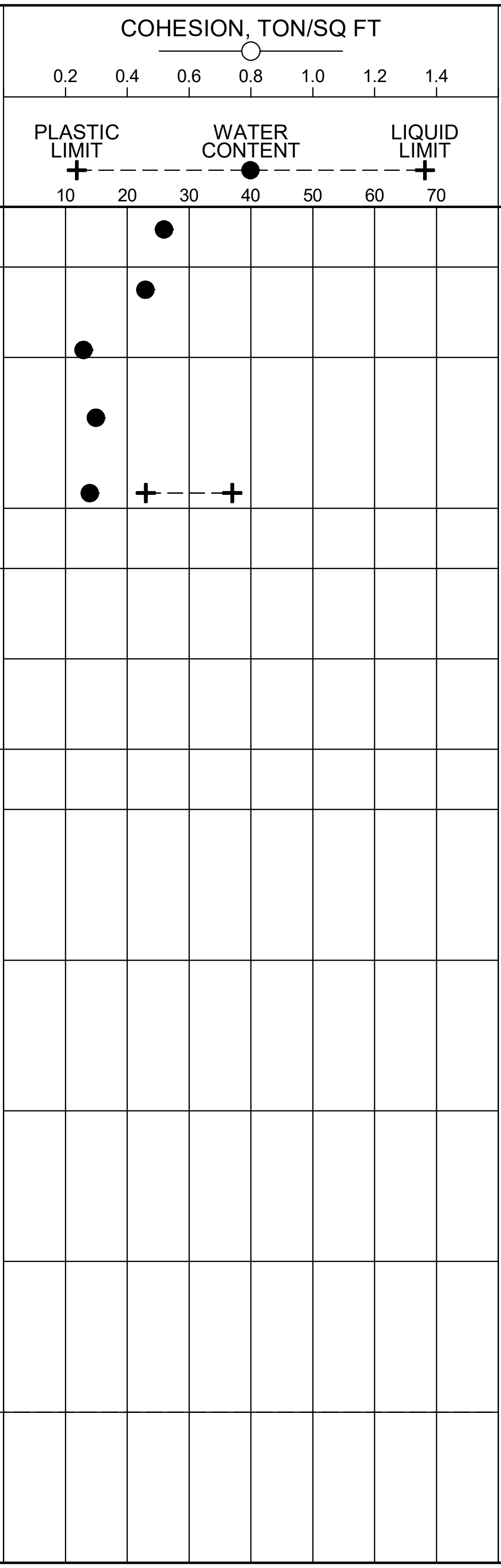
090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger to 10 ft /Wash

LOCATION: Approx Sta 258+00, CL - Airport Blvd

SURF. EL: 1229±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
	Soft reddish brown and tan silty clay w/numerous chert fragments	6		
	Very stiff reddish brown silty clay w/discontinuous chert seams and layers and highly weathered chert seams	42		
5		50/4"		
		50/6"		
10		50/5"		17
	Dense to very dense reddish tan fine sandy silt w/numerous chert fragments and chert seams and layers			
15		50/10"		
	Moderately hard tan and reddish tan weathered cherty limestone w/red silty clay seams, clay-filled fractures, occasional vugs and discontinuous chert seams and layers			
20		25/0"		
25		25/0"		
30		25/0"		
35		25/0"		
40		25/0"		



COMPLETION DEPTH: 40.0 ft
DATE: 3-3-23

DEPTH TO WATER
IN BORING: Dry to 10 ft

DATE: 3/3/2023

**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**
Consulting Engineers

LOG OF BORING NO. R42

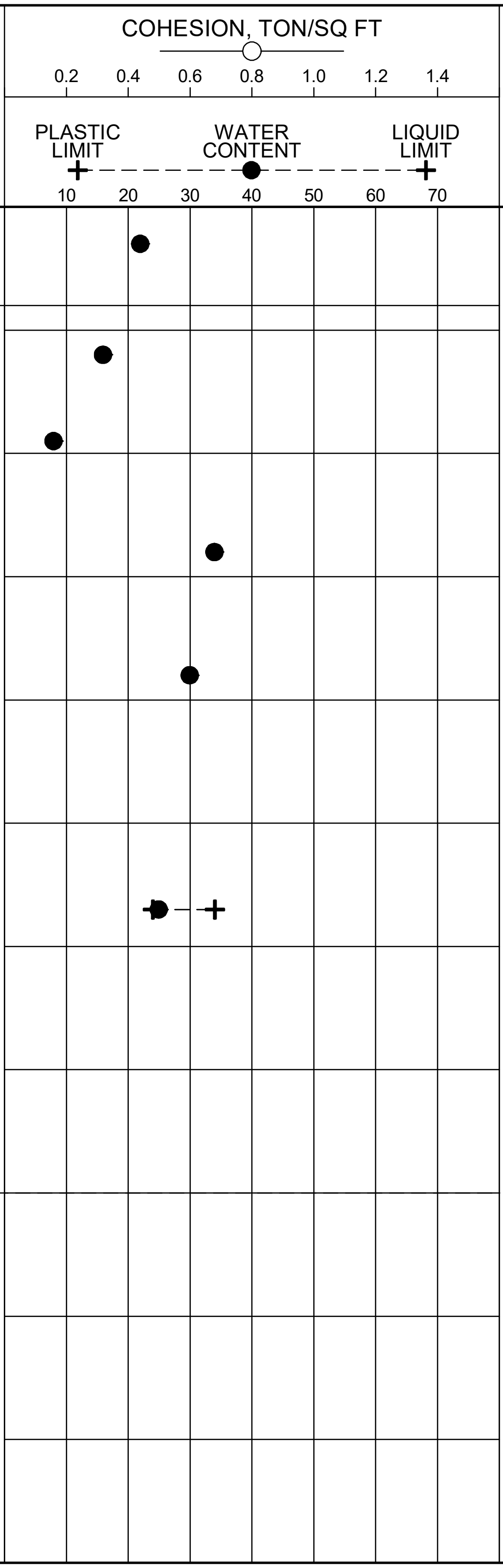
090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 263+00, CL - Airport Blvd

SURF. EL: 1212±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
	Loose light brown fine sandy silt w/occasional chert fragments	5		
	Very stiff reddish brown w/tan silty clay w/numerous chert fragments	42		
5	- with discontinuous chert seams and layers below 4 ft	50/6"		
		50/4"		
10		50/5"		
15		25/0"		55
20		50/6"		
25				



COMPLETION DEPTH: 20.0 ft
DATE: 3-2-23

DEPTH TO WATER
IN BORING: Dry

DATE: 3/2/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R43

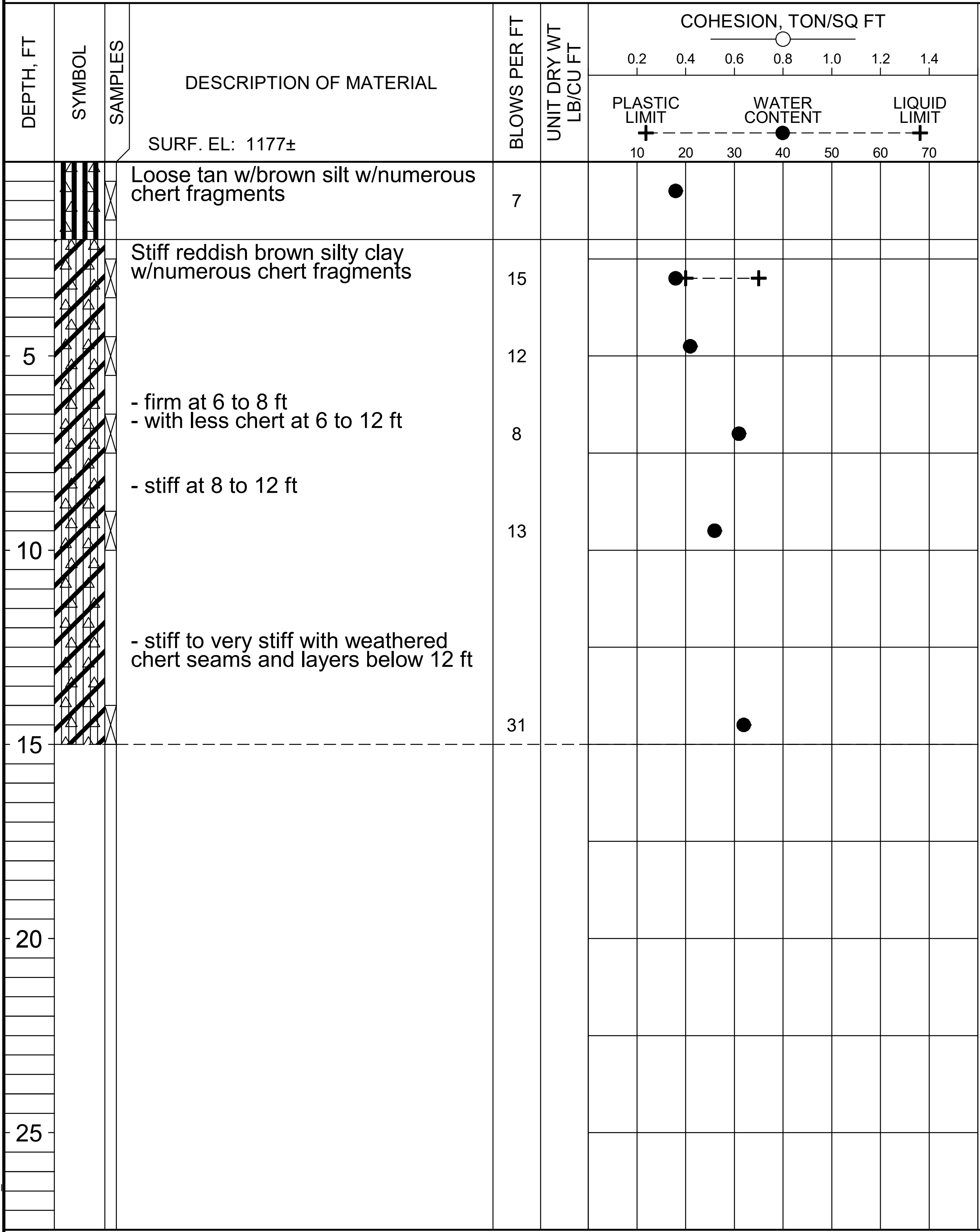
090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 267+00, CL - Airport Blvd

SURF. EL: 1177±

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
Loose tan w/brown silt w/numerous chert fragments	7		44
Stiff reddish brown silty clay w/numerous chert fragments	15		38
	12		
- firm at 6 to 8 ft - with less chert at 6 to 12 ft	8		
- stiff at 8 to 12 ft	13		
- stiff to very stiff with weathered chert seams and layers below 12 ft	31		



COMPLETION DEPTH: 15.0 ft
DATE: 3-2-23

DEPTH TO WATER
IN BORING: Dry

DATE: 3/2/2023

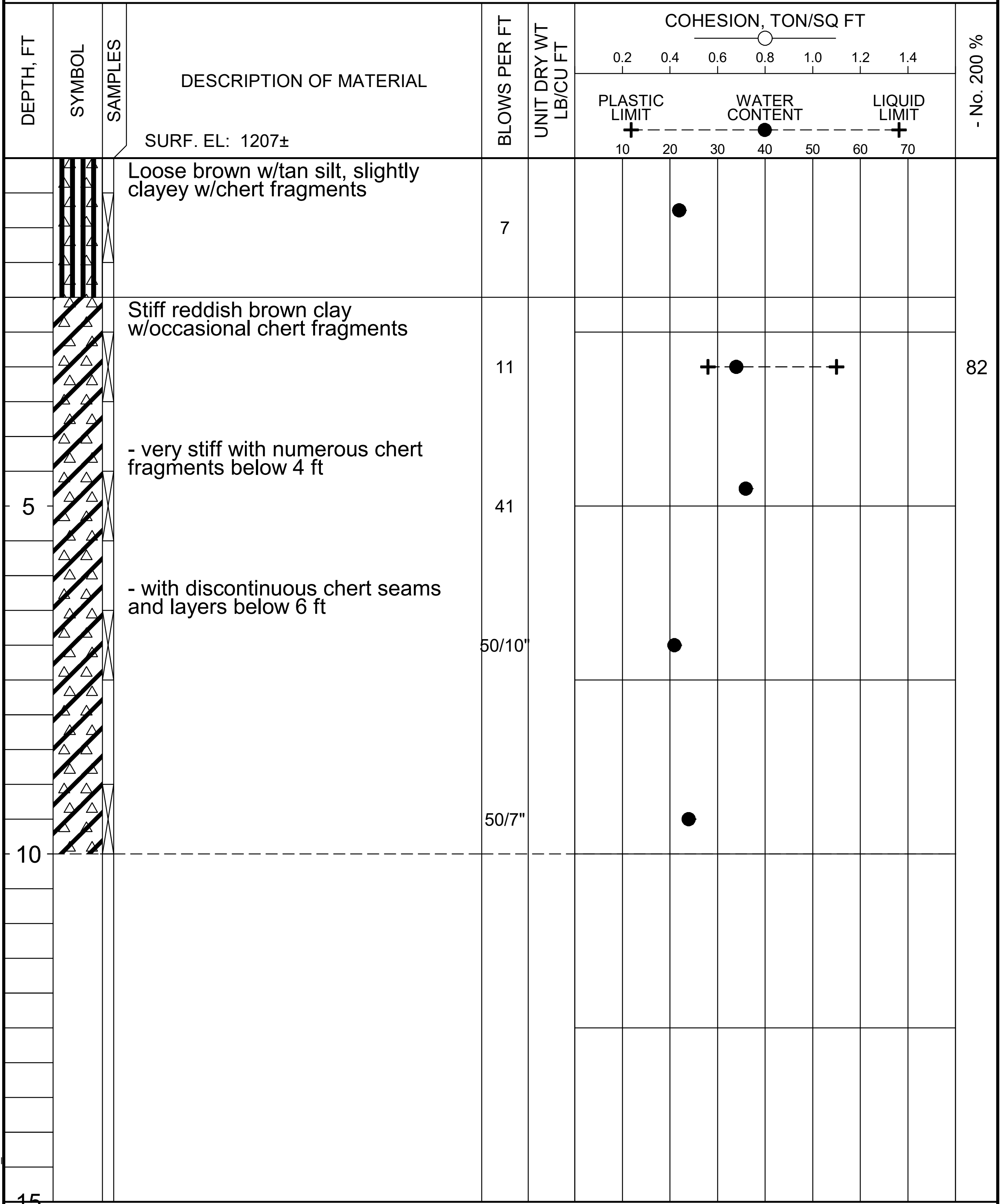
Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R44

090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 272+00, CL - Airport Blvd



DESCRIPTION OF MATERIAL	BLOWS PER FT	- No. 200 %
Loose brown w/tan silt, slightly clayey w/chert fragments	7	
Stiff reddish brown clay w/occasional chert fragments	11	82
- very stiff with numerous chert fragments below 4 ft	41	
- with discontinuous chert seams and layers below 6 ft	50/10"	
	50/7"	

COMPLETION DEPTH: 10.0 ft
DATE: 3-2-23

DEPTH TO WATER
IN BORING: Dry

DATE: 3/2/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

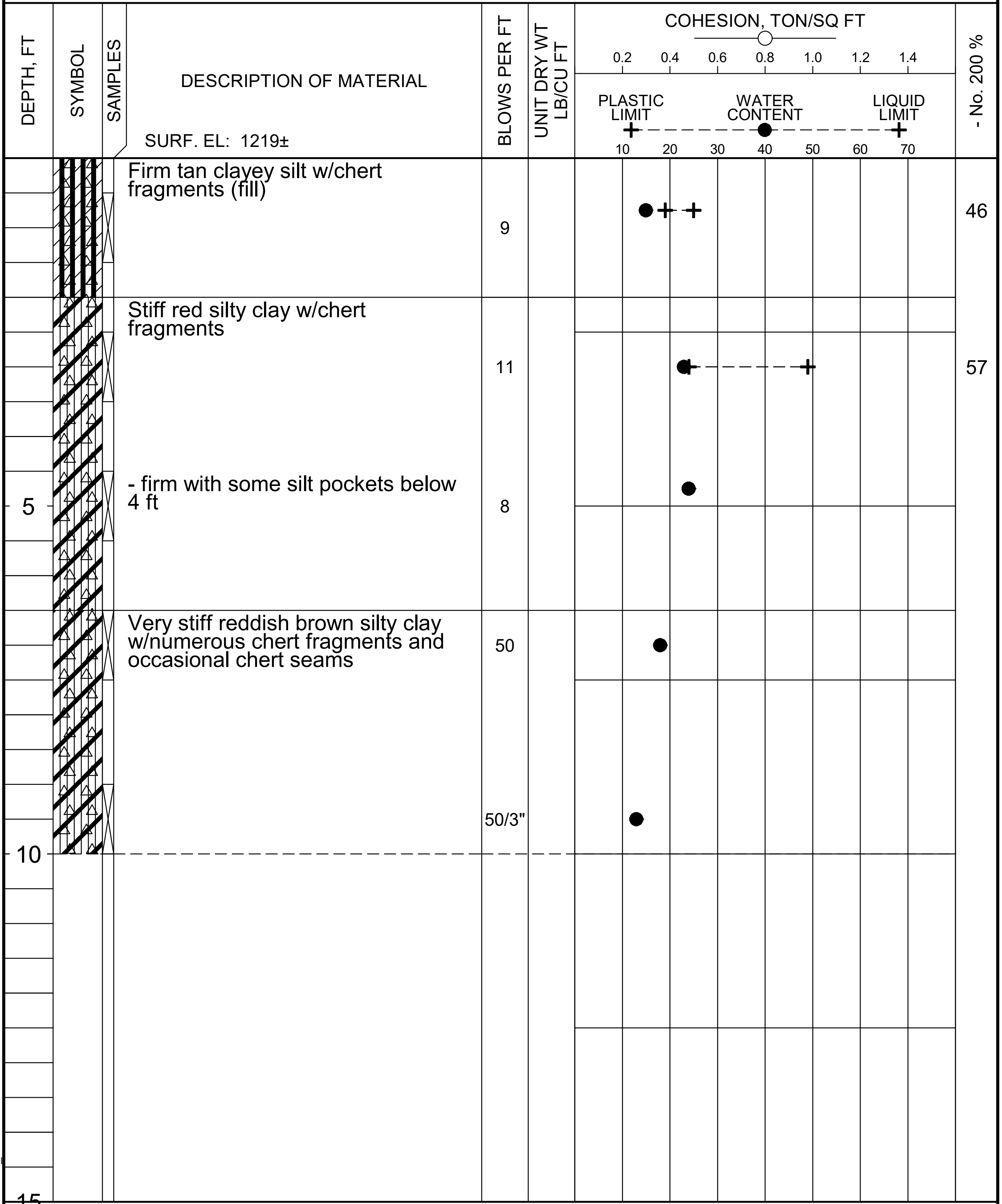
LOG OF BORING NO. R45

090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 277+00, CL - Airport Blvd

SURF. EL: 1219±



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
Firm tan clayey silt w/chert fragments (fill)	9		46
Stiff red silty clay w/chert fragments	11		57
- firm with some silt pockets below 4 ft	8		
Very stiff reddish brown silty clay w/numerous chert fragments and occasional chert seams	50		
	50/3"		

COMPLETION DEPTH: 10.0 ft
DATE: 3-3-22

DEPTH TO WATER
IN BORING: Dry

DATE: 3/3/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R48

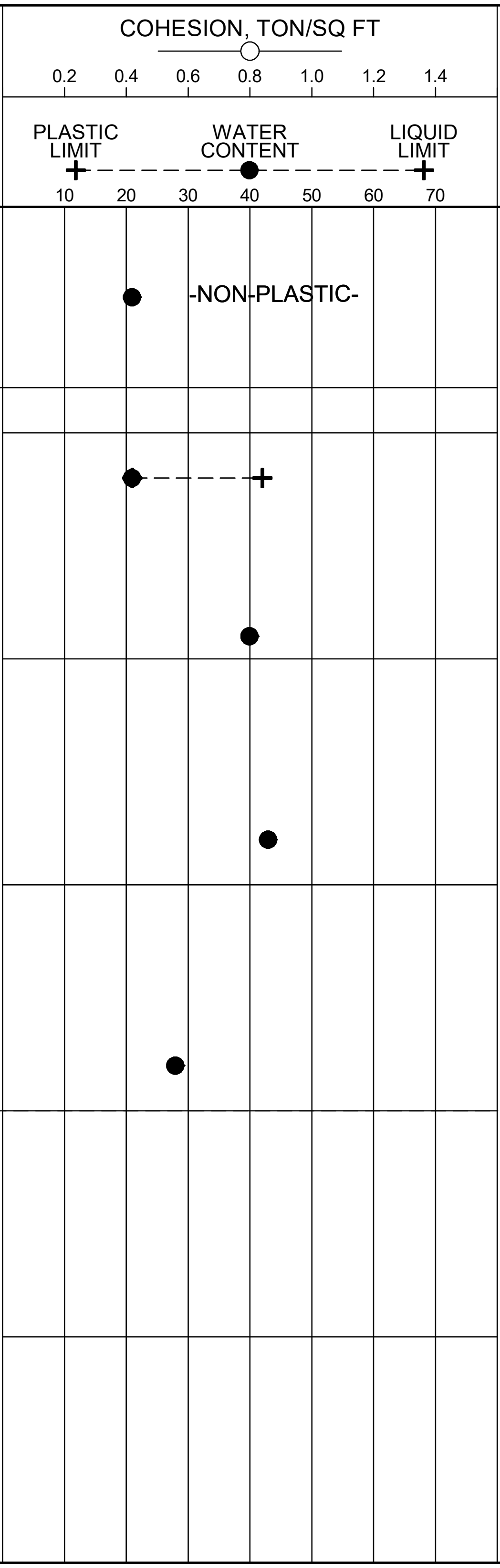
090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 459+00, CL - Ramp 1

SURF. EL: 1267±

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
			Medium dense brown and gray fine sandy silt w/chert fragments (fill)	11		44
			Very stiff reddish brown silty clay w/numerous chert nodules and fragments	32		47
5				47		
				40		
10				50		
15						



COMPLETION DEPTH: 10.0 ft
DATE: 3-3-22

DEPTH TO WATER
IN BORING: Dry

DATE: 3/3/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R49

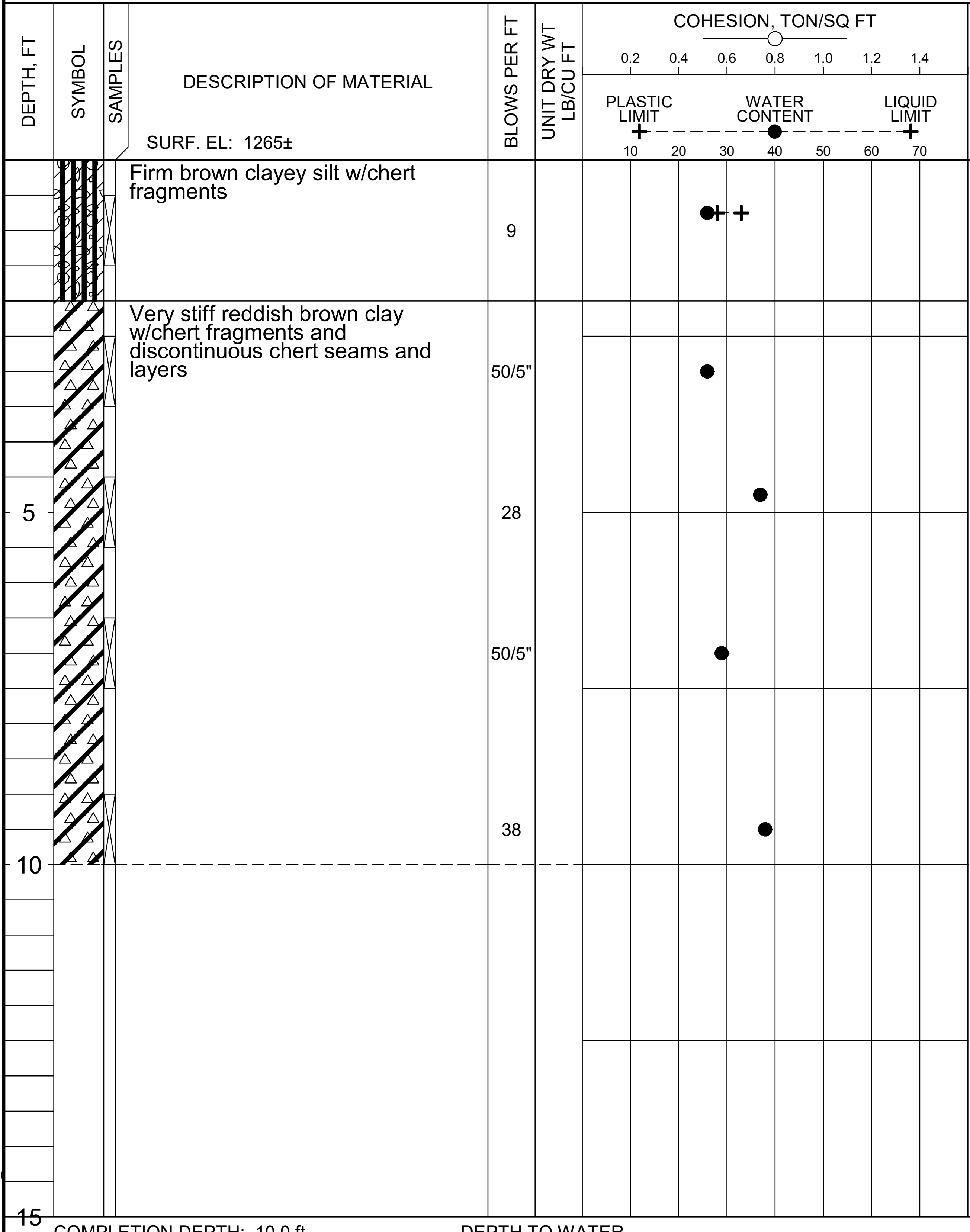
090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 465+00, CL - Ramp 1

SURF. EL: 1265±

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
Firm brown clayey silt w/chert fragments	9		52
Very stiff reddish brown clay w/chert fragments and discontinuous chert seams and layers	50/5" 28 50/5" 38		



COMPLETION DEPTH: 10.0 ft
DATE: 1-11-23

DEPTH TO WATER
IN BORING: Dry

DATE: 1/12/2023

19-118

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R50

090069 XNA Access Road
Benton Co., Arkansas

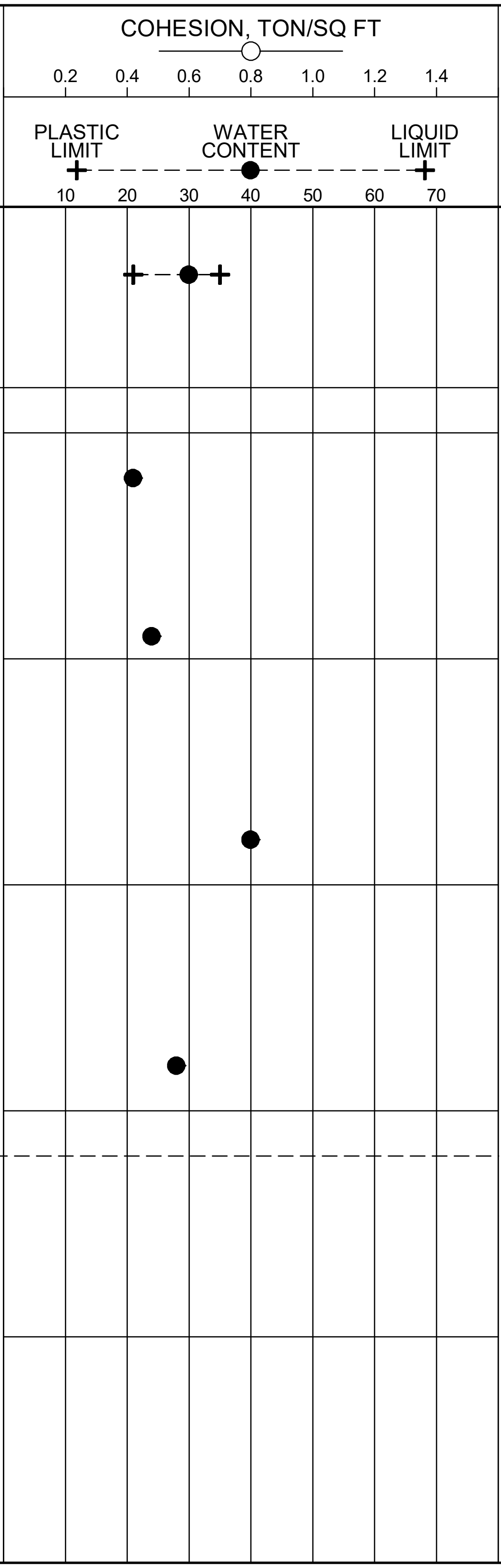
TYPE: Auger

LOCATION: Approx Sta 469+00, CL - Ramp 1

SURF. EL: 1271±

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
Stiff brown silty clay w/chert fragments	12		64
Very stiff reddish brown clay w/chert fragments and discontinuous chert seams and layers	50/11"		
	50/7"		
- stiff at 6 to 8 ft	23		
- very stiff below 8 ft			
- auger refusal in limestone at 10.5 ft	50/10"		
	50/6"		

DEPTH, FT: 5, 10, 15



COMPLETION DEPTH: 10.5 ft
DATE: 1-13-23

DEPTH TO WATER
IN BORING: Dry

DATE: 1/12/2023

19-118

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

L O G O F B O R I N G N O. R51

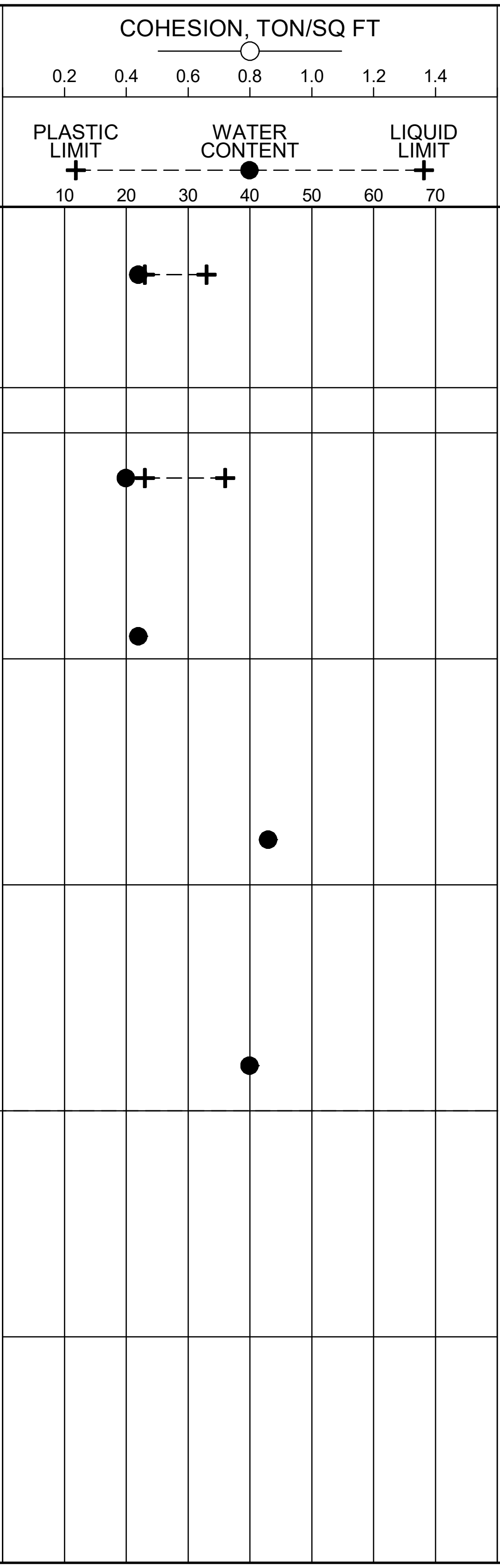
090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 475+00, CL - Ramp 1

SURF. EL: 1288±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
	Firm brown silty clay w/chert fragments and some rootlets (possible fill)	8		50
	Very stiff reddish brown and reddish tan silty clay w/chert fragments and chert seams and layers	31		54
5		50/11"		
		50/2"		
10		40		
15				



COMPLETION DEPTH: 10.0 ft
DATE: 3-4-22

DEPTH TO WATER
IN BORING: Dry

DATE: 3/4/2022

LGBNEW 19-118 ROAD HOLES.GPJ 9-27-23

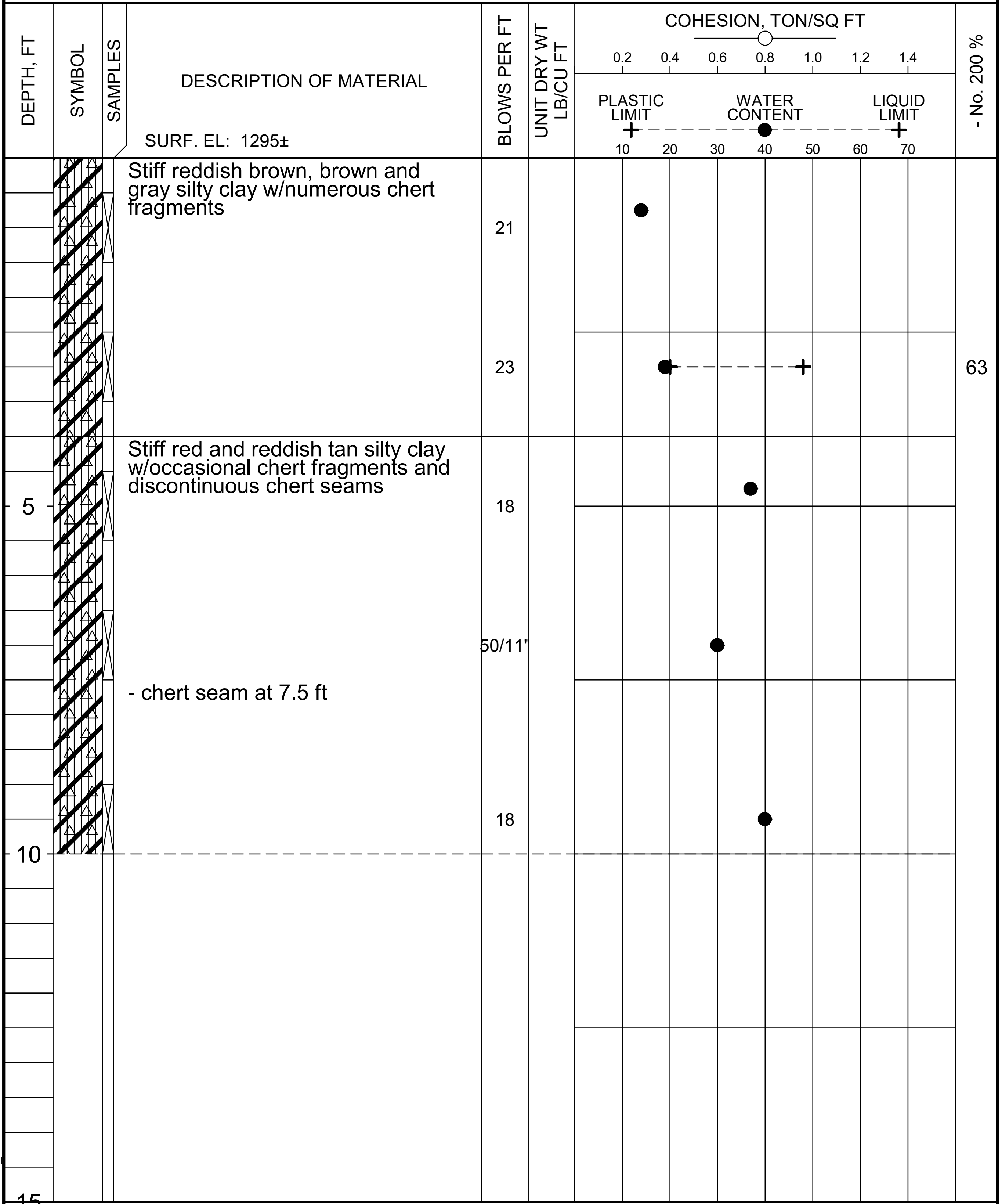
Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R53

090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 425+75, CL - Ramp 2



Stiff reddish brown, brown and gray silty clay w/numerous chert fragments

Stiff red and reddish tan silty clay w/occasional chert fragments and discontinuous chert seams

- chert seam at 7.5 ft

COMPLETION DEPTH: 10.0 ft
DATE: 11-4-22

DEPTH TO WATER
IN BORING: Dry

DATE: 11/4/2022

LGBNEW 19-118_ROAD HOLES.GPJ 9-27-23

**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**
Consulting Engineers

LOG OF BORING NO. R54

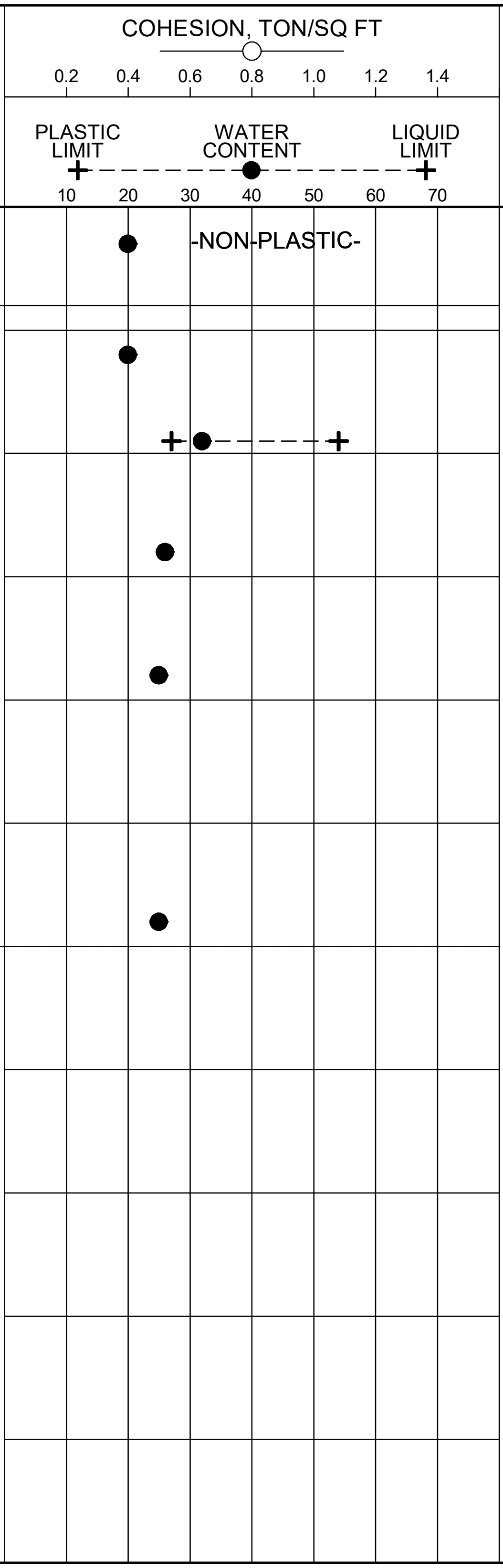
090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 435+00, CL - Ramp 2

SURF. EL: 1268±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
	Medium dense brown fine sandy silt w/chert fragments	12		59
	Stiff reddish brown clay w/chert fragments	19		
5		21		41
	- with discontinuous chert seams and layers below 6 ft	50/10"		
10		50/8"		
15		50/5"		
20				
25				



COMPLETION DEPTH: 15.0 ft
DATE: 1-13-23

DEPTH TO WATER
IN BORING: Dry

DATE: 1/12/2023

19-118

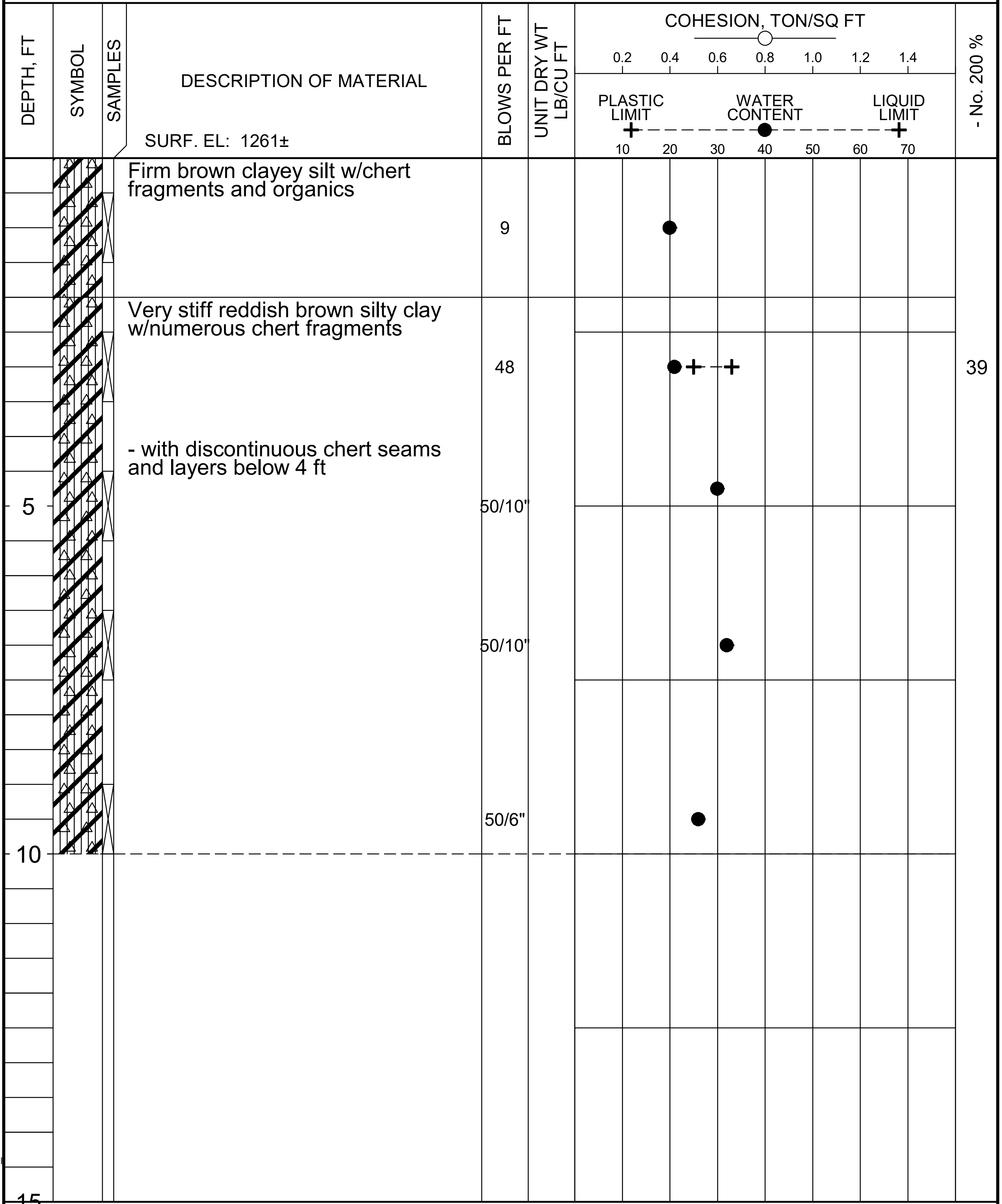
Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R55

090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 440+00, CL - Ramp 2



Firm brown clayey silt w/chert fragments and organics

Very stiff reddish brown silty clay w/numerous chert fragments

- with discontinuous chert seams and layers below 4 ft

COMPLETION DEPTH: 10.0 ft
DATE: 3-3-22

DEPTH TO WATER
IN BORING: Dry

DATE: 3/3/2022

LGBNEW 19-118_ROAD HOLES.GPJ 9-27-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

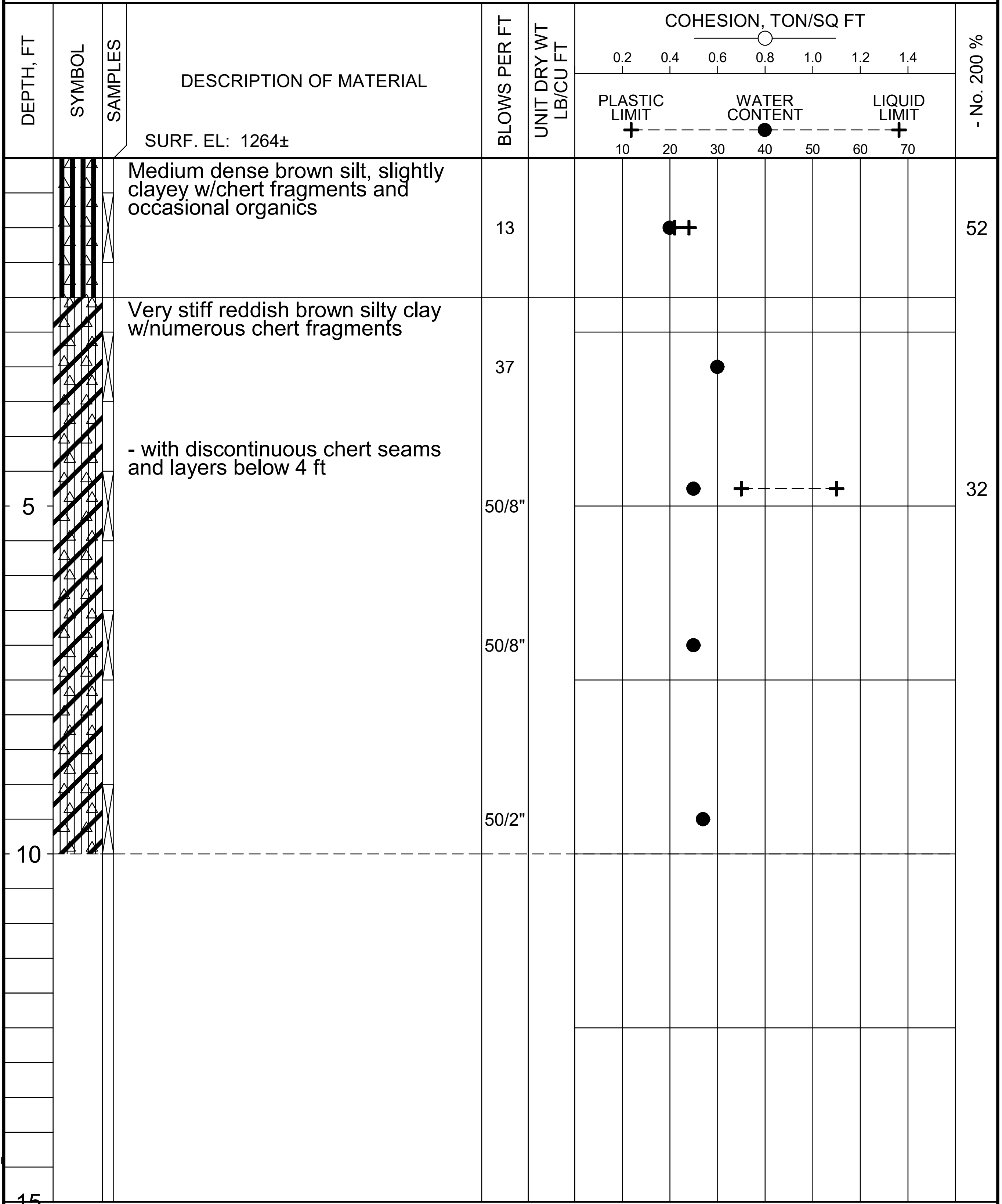
LOG OF BORING NO. R56

090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 445+00, CL - Ramp 2

SURF. EL: 1264±



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
Medium dense brown silt, slightly clayey w/chert fragments and occasional organics	13		52
Very stiff reddish brown silty clay w/numerous chert fragments	37		
- with discontinuous chert seams and layers below 4 ft	50/8"		32
	50/8"		
	50/2"		

COMPLETION DEPTH: 10.0 ft
DATE: 3-3-22

DEPTH TO WATER
IN BORING: Dry

DATE: 3/3/2022

19-118

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R60

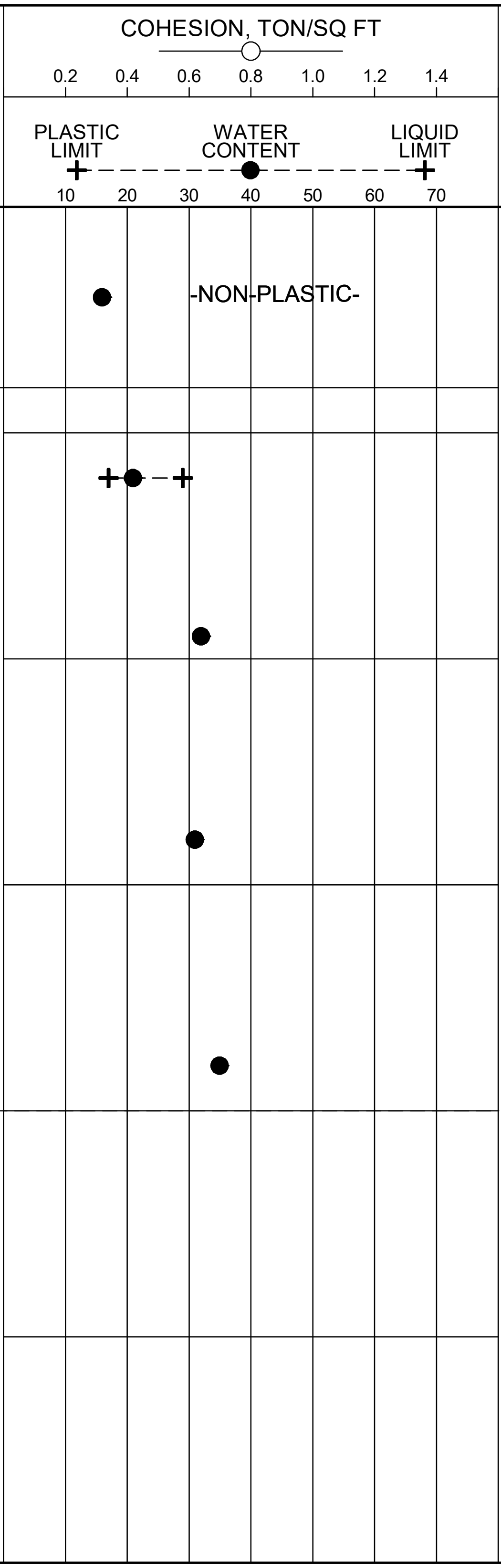
090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 440+00, CL - Ramp 3

SURF. EL: 1299±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
	Stiff reddish brown and tan silty clay w/silt pockets and chert fragments (possible fill)	23		42
	Stiff reddish brown silty clay w/numerous chert fragments	21		35
5	- with more chert fragments and discontinuous chert seams and layers below 4 ft	50/10"		
		50/8"		
		39		
10				
15				



COMPLETION DEPTH: 10.0 ft
DATE: 3-4-22

DEPTH TO WATER
IN BORING: Dry

DATE: 3/4/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R61

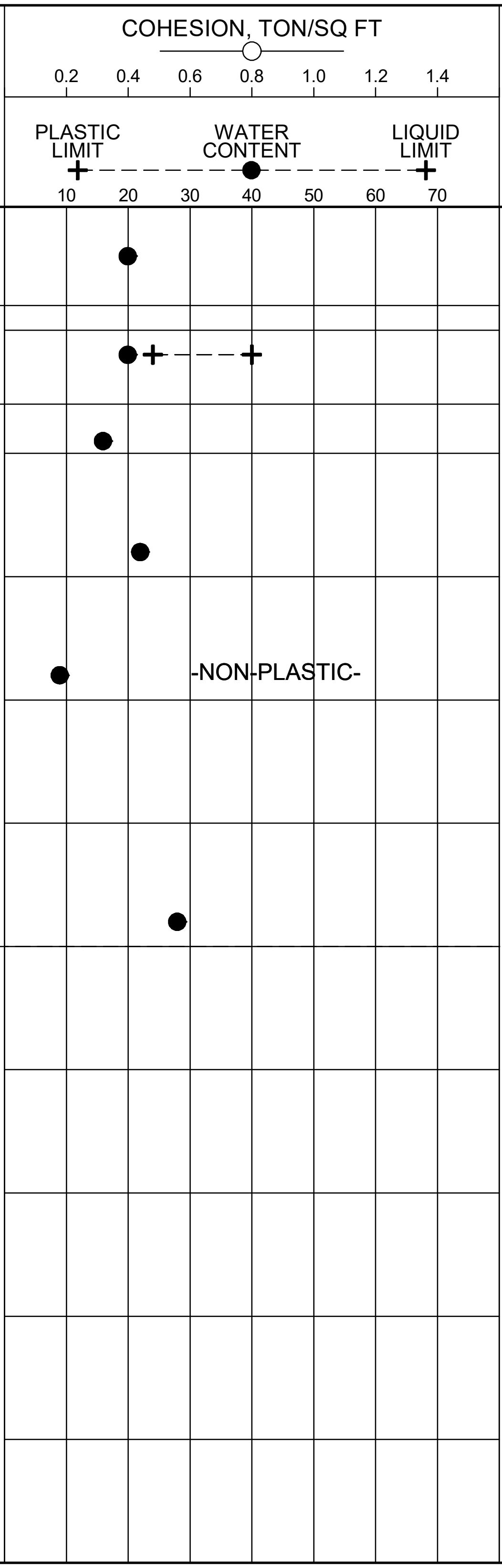
090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 445+00, CL - Ramp 3

SURF. EL: 1290±

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
Firm tan clayey silt w/some chert fragments	8		
Very stiff brown and gray silty clay w/chert fragments	30		40
Stiff to very stiff reddish brown silty clay w/numerous chert fragments	50/10"		
- with discontinuous chert seams and layers below 6 ft	50/8"		
	50/6"		20
	40		



DEPTH, FT: 5, 10, 15, 20, 25

COMPLETION DEPTH: 15.0 ft
DATE: 3-4-22

DEPTH TO WATER
IN BORING: Dry

DATE: 3/4/2022

LGBNEW 19-118_ROAD HOLES.GPJ 9-27-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R63

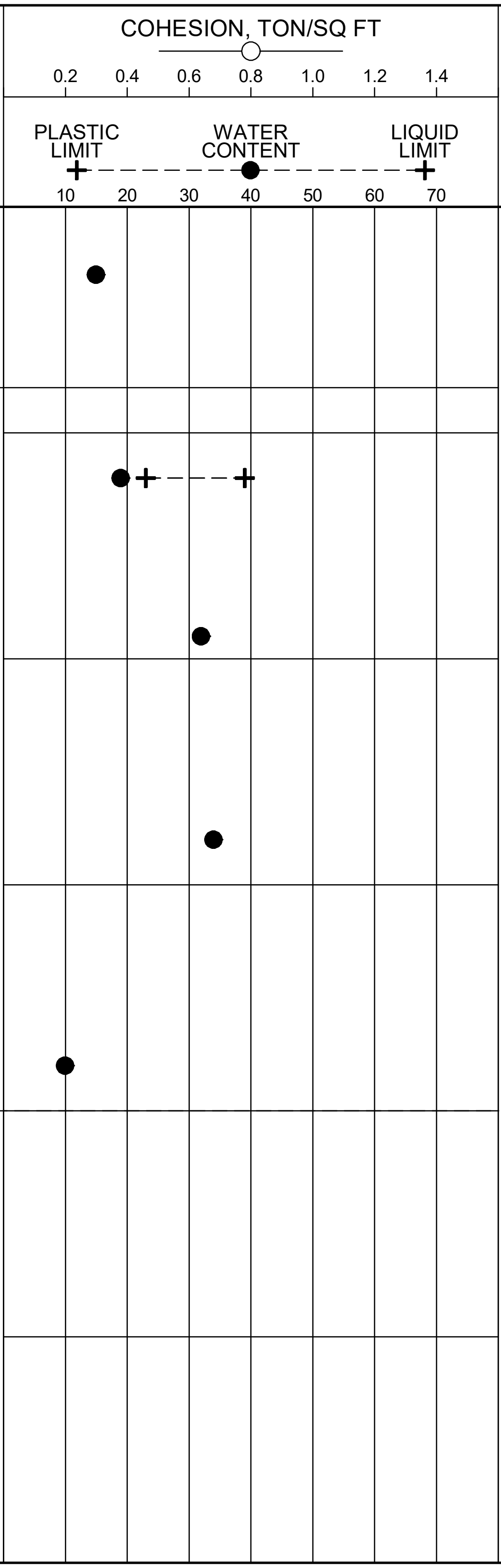
090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 432+00, CL - Ramp 4

SURF. EL: 1268±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
	Medium dense tan w/reddish tan fine sandy silt w/numerous chert fragments	11		40
	Very stiff reddish brown silty clay w/numerous chert fragments	30		44
	- with discontinuous chert seams and layers below 4 ft			
5		50/10"		
		50/8"		
	- with more chert seams and layers below 8 ft			
		50/9"		
10				
15				



COMPLETION DEPTH: 10.0 ft
DATE: 11-4-22

DEPTH TO WATER
IN BORING: Dry

DATE: 11/4/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R64

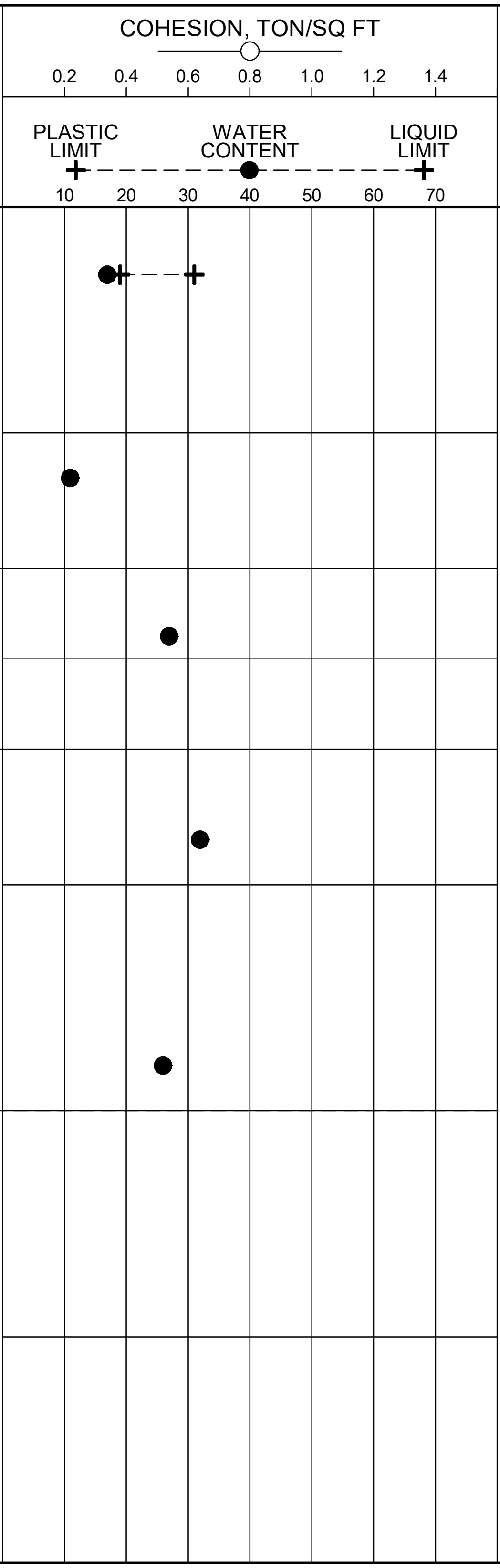
090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 437+00, CL - Ramp 4

SURF. EL: 1290±

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
			Stiff tan silty clay w/chert nodules and fragments	11		67
			- very stiff with discontinuous weathered chert seams below 2 ft	36		
5			Stiff to very stiff reddish brown clay w/numerous chert nodules and fragments	37		
			Stiff to very stiff reddish tan silty clay w/chert nodules and fragments and discontinuous chert seams	50/9"		
				37		
10						
15						



COMPLETION DEPTH: 10.0 ft
DATE: 11-4-22

DEPTH TO WATER
IN BORING: Dry

DATE: 11/4/2022

LGBNEW 19-118_ROAD HOLES.GPJ 9-27-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

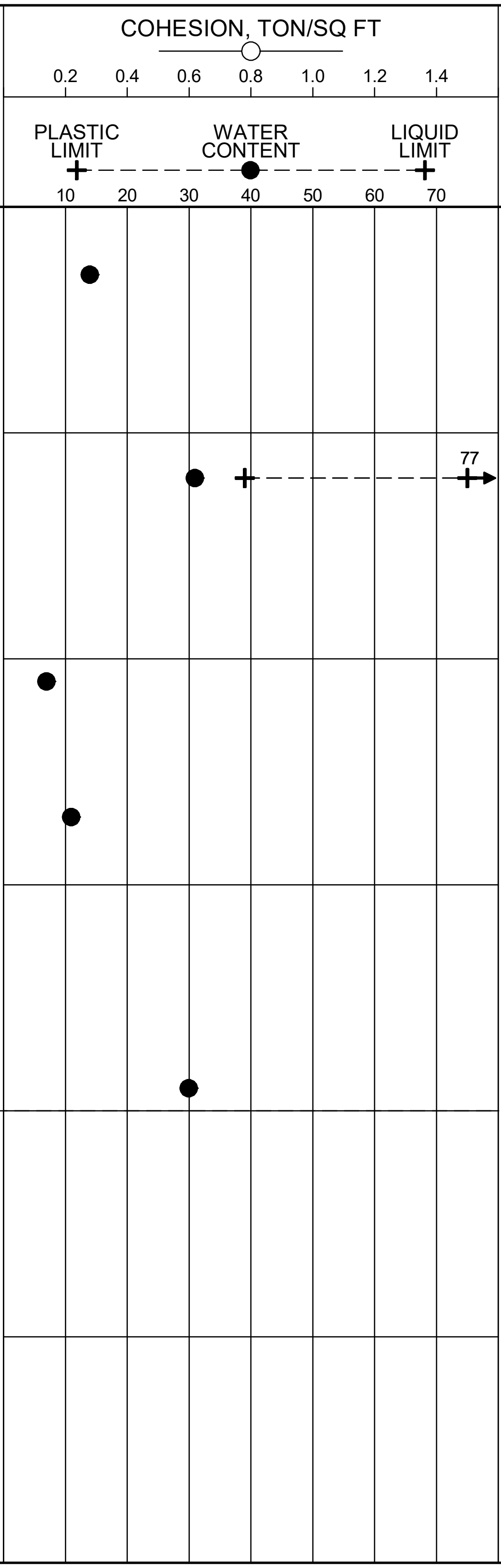
LOG OF BORING NO. R65

090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 14+40, CL - Malone Ln

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 1250±	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
			Stiff to very stiff reddish brown and tan clay w/chert nodules and fragments and discontinuous chert seams and layers	50/8"		
				50/10"		66
5				25/0"		
				50/5"		
10				50/4"		
15						



COMPLETION DEPTH: 10.0 ft
DATE: 1-24-23

DEPTH TO WATER
IN BORING: Dry

DATE: 1/24/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R66

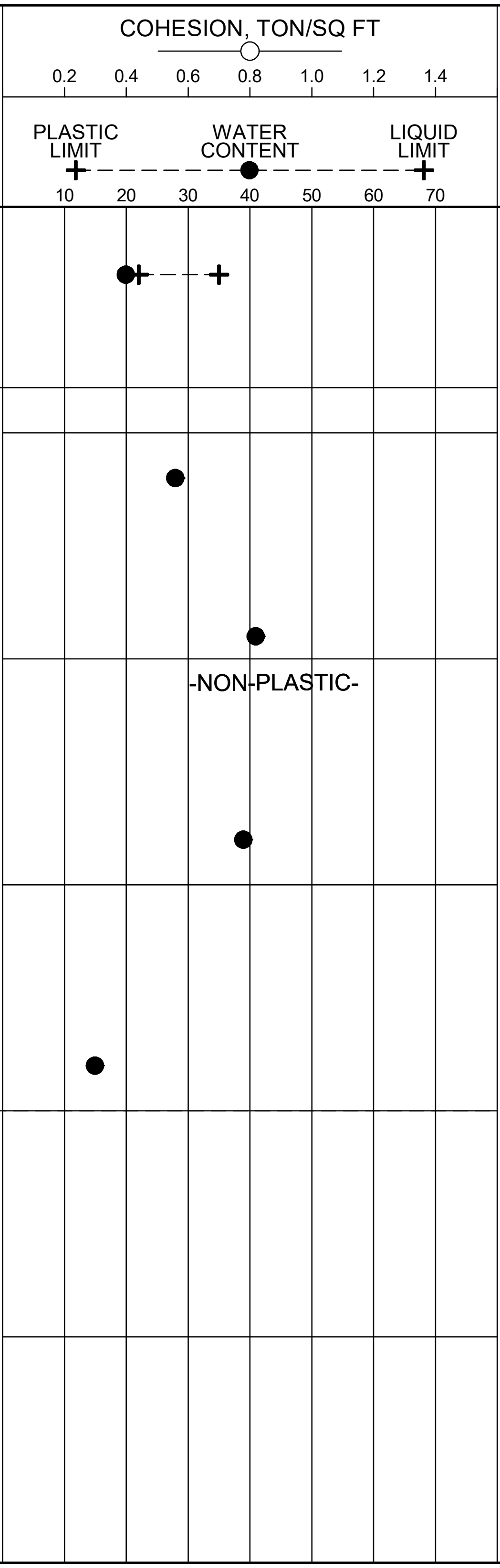
090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 18+40, CL - Malone Ln

SURF. EL: 1244±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
0	Stiff tan silty clay w/chert fragments (fill)	19		87
4	Very stiff reddish brown and tan clay w/chert nodules and fragments and discontinuous chert seams	50/9"		
5		47		30
		38		
		50/8"		
10				
15				



COMPLETION DEPTH: 10.0 ft
DATE: 1-24-23

DEPTH TO WATER
IN BORING: Dry

DATE: 1/24/2023

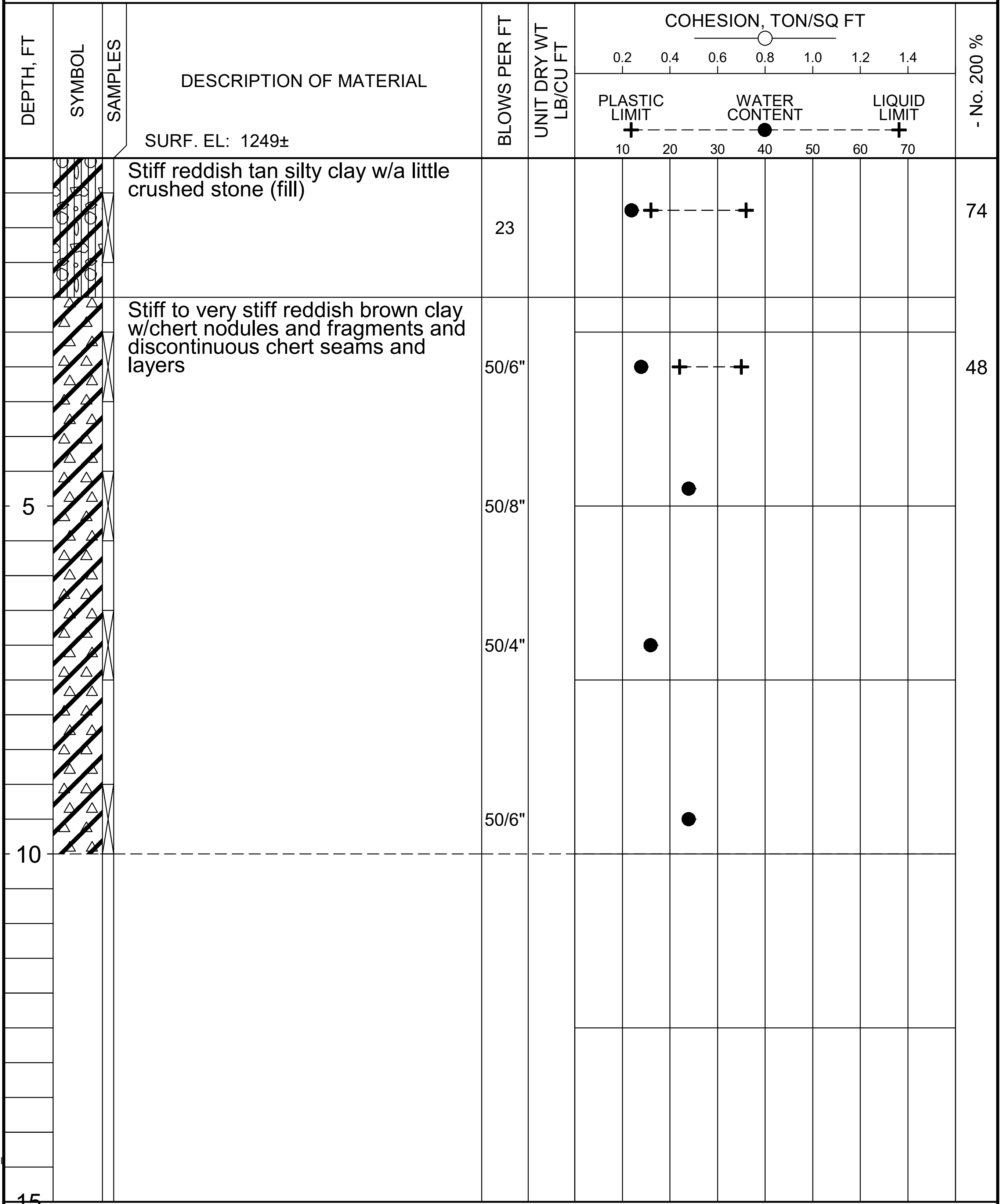
Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R67

090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 28+40, CL - Malone Ln



DESCRIPTION OF MATERIAL	BLOWS PER FT	- No. 200 %
Stiff reddish tan silty clay w/a little crushed stone (fill)	23	74
Stiff to very stiff reddish brown clay w/chert nodules and fragments and discontinuous chert seams and layers	50/6"	48
	50/8"	
	50/4"	
	50/6"	

COMPLETION DEPTH: 10.0 ft
DATE: 1-23-23

DEPTH TO WATER
IN BORING: Dry

DATE: 1/23/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R68

090069 XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 32+40, CL - Malone Ln

SURF. EL: 1246±

COHESION, TON/SQ FT ○ 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT + - - WATER CONTENT ● - - LIQUID LIMIT + 10 20 30 40 50 60 70

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT	- No. 200 %
			Medium dense brown fine sandy silt w/silty clay pockets and crushed stone (fill)	23		● -NON-PLASTIC-	68
			Firm to stiff brown and tan silty clay w/some chert nodules and fragments	10		●+- - - -+	56
5			Stiiff to very stiff reddish brown and tan clay w/chert nodules and fragments and discontinuous chert seams and layers	50/6"			
				50/5"			
10				25/0"			
15							

COMPLETION DEPTH: 8.5 ft
DATE: 1-23-23

DEPTH TO WATER
IN BORING: Dry

DATE: 1/23/2023

LGBNEW 19-118 ROAD HOLES.GPJ 9-27-23

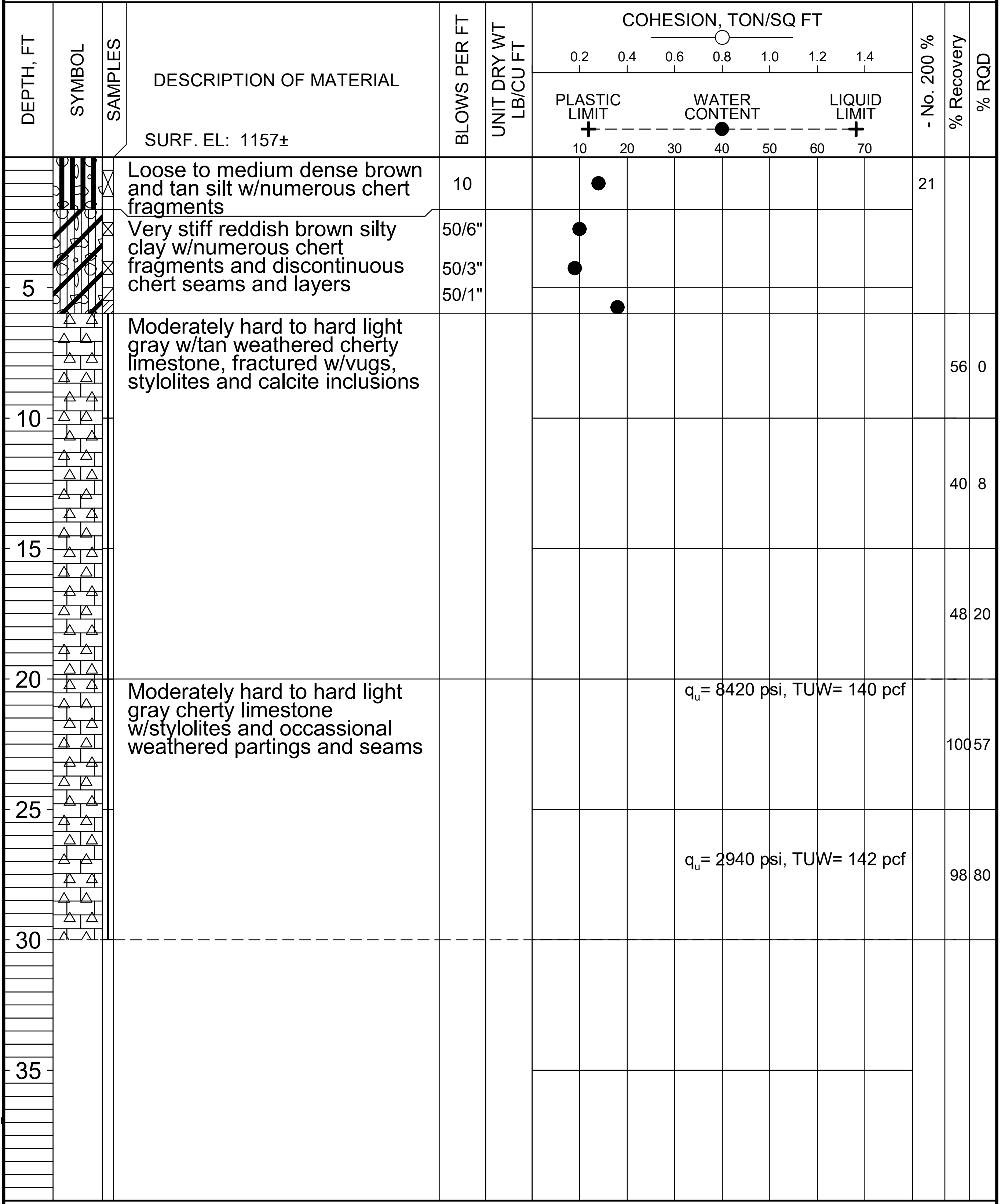
Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S1

090069 XNA Access Road over Wager Rd
Benton Co., Arkansas

TYPE: Auger to 6 ft /Core

LOCATION: Approx Sta 142+80, 60 ft Lt



SURF. EL: 1157±

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
Loose to medium dense brown and tan silt w/numerous chert fragments	10		21		
Very stiff reddish brown silty clay w/numerous chert fragments and discontinuous chert seams and layers	50/6" 50/3" 50/1"				
Moderately hard to hard light gray w/tan weathered cherty limestone, fractured w/vugs, stylolites and calcite inclusions				56 40 48	0 8 20
Moderately hard to hard light gray cherty limestone w/stylolites and occassional weathered partings and seams				100 98	57 80

q_u= 8420 psi, TUW= 140 pcf

q_u= 2940 psi, TUW= 142 pcf

COMPLETION DEPTH: 30.0 ft
DATE: 7-20-23

DEPTH TO WATER
IN BORING: Dry to 6 ft

DATE: 7/20/2023

RECRQDN200-2 19-118 WAGER ROAD.GPJ 8-10-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S4

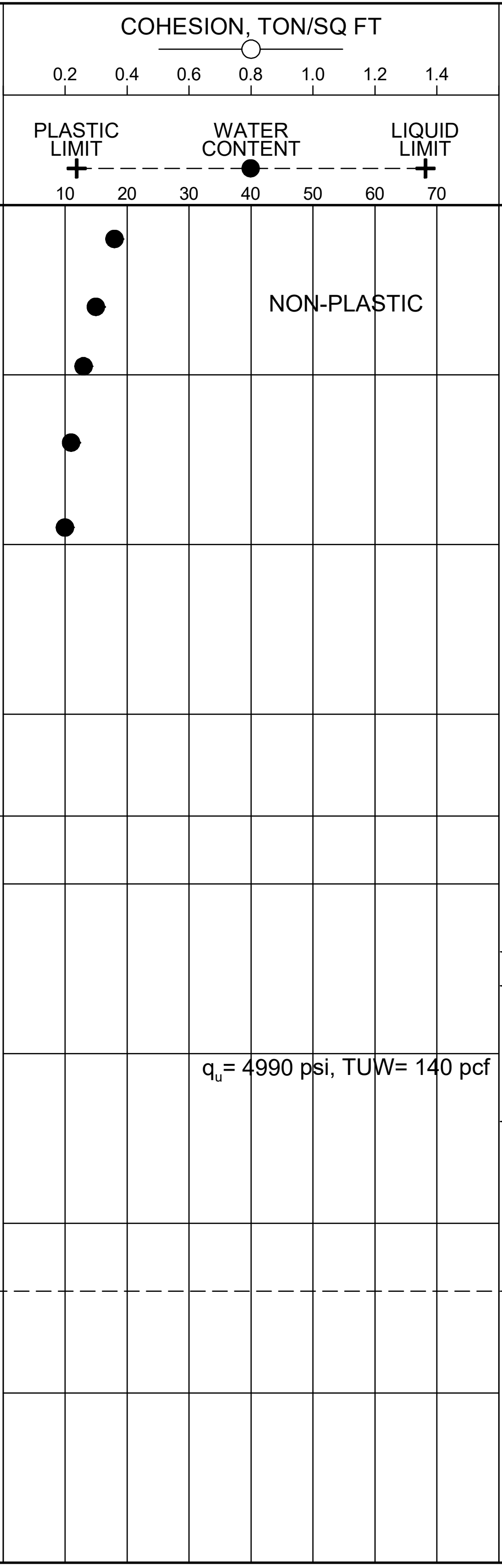
090069 XNA Access Road over Wager Rd
Benton Co., Arkansas

TYPE: Auger to 22 ft /Core

LOCATION: Approx Sta 145+75, 60 ft Lt

SURF. EL: 1123±

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
Loose brown silt w/numerous chert fragments	9				
- medium dense below 2 ft	13		38		
	13				
	22				
	19				
	19				
Moderately hard to hard light gray slightly weathered cherty limestone, fractured w/vugs and stylolites	50/1"				
	50/1"				
				83	0
				10	0
- less fractured with fewer vugs below 27 ft				100	85



q_u= 4990 psi, TUW= 140 pcf

DEPTH, FT: 5, 10, 15, 20, 25, 30, 35

COMPLETION DEPTH: 32.0 ft
DATE: 7-19-23

DEPTH TO WATER
IN BORING: Dry to 22 ft

DATE: 7/19/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

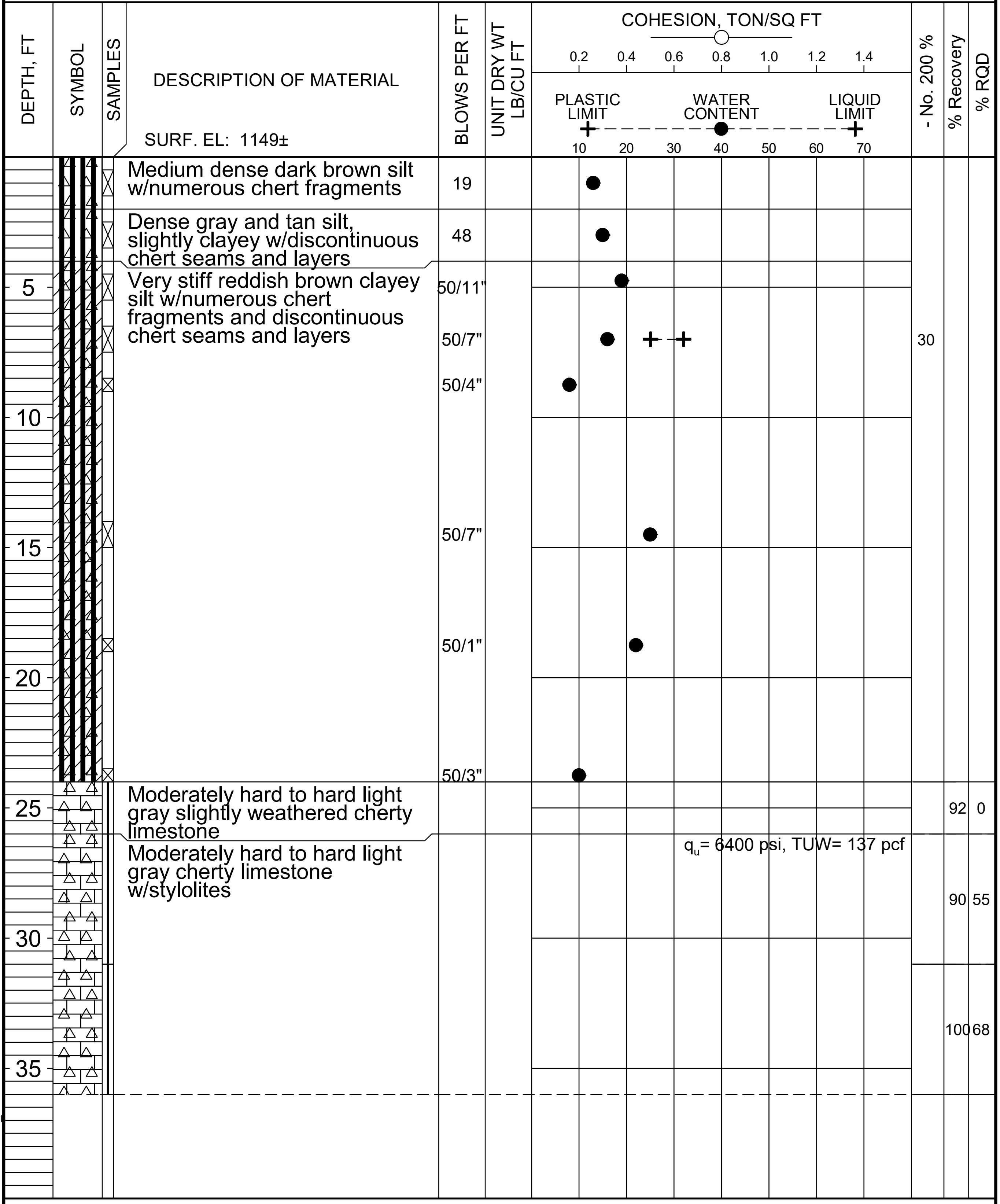
L O G O F B O R I N G N O. S5

090069 XNA Access Road over Wager Rd
Benton Co., Arkansas

TYPE: Auger to 24 ft /Core

LOCATION: Approx Sta 142+60, 70 ft Rt

SURF. EL: 1149±



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
Medium dense dark brown silt w/numerous chert fragments	19				
Dense gray and tan silt, slightly clayey w/discontinuous chert seams and layers	48				
Very stiff reddish brown clayey silt w/numerous chert fragments and discontinuous chert seams and layers	50/11" 50/7" 50/4" 50/7" 50/1" 50/3"		30		
Moderately hard to hard light gray slightly weathered cherty limestone				92	0
Moderately hard to hard light gray cherty limestone w/stylolites				90 100	55 68

q_u= 6400 psi, TUW= 137 pcf

COMPLETION DEPTH: 36.0 ft
DATE: 7-20-23

DEPTH TO WATER
IN BORING: Dry to 24 ft

DATE: 7/20/2023

RECRQDN200-2 19-118 WAGER ROAD.GPJ 8-10-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S8

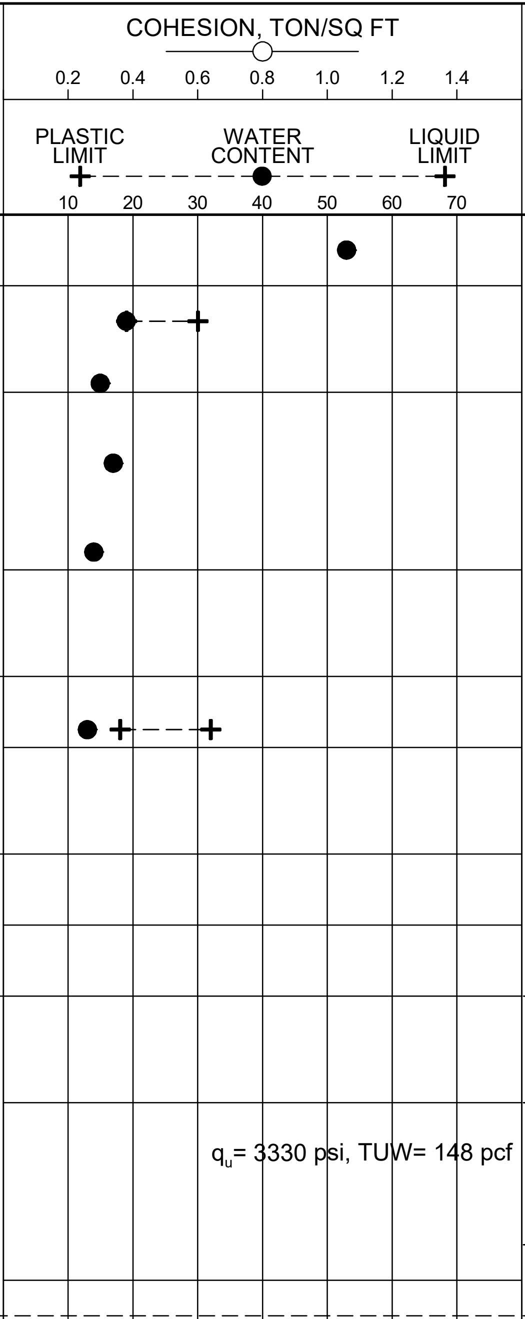
090069 XNA Access Road over Wager Rd
Benton Co., Arkansas

TYPE: Auger to 22 ft /Core

LOCATION: Approx Sta 145+55, 60 ft Rt

SURF. EL: 1120±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	- No. 200 %	% Recovery	% RQD
0–2	Loose dark brown silt w/rootlets and occasional chert fragments	5			
2–13	Firm to stiff tan and brown silty clay w/numerous chert fragments - stiff from 4 to 8 ft - with reddish brown below 6 ft - very stiff below 8 ft	10 13 11 40	49		
13–18	Stiff tan and reddish brown silty clay w/numerous chert fragments	16	20		
18–22	Moderately hard light gray w/tan highly weathered cherty limestone w/silty clay filled fractures	50/6" 50/1"			
22–31	Moderately hard to hard gray cherty limestone			94 88 88	0 46 42



qu= 3330 psi, TUW= 148 pcf

COMPLETION DEPTH: 31.0 ft
DATE: 7-19-23

DEPTH TO WATER
IN BORING: Dry to 22 ft

DATE: 7/19/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S9

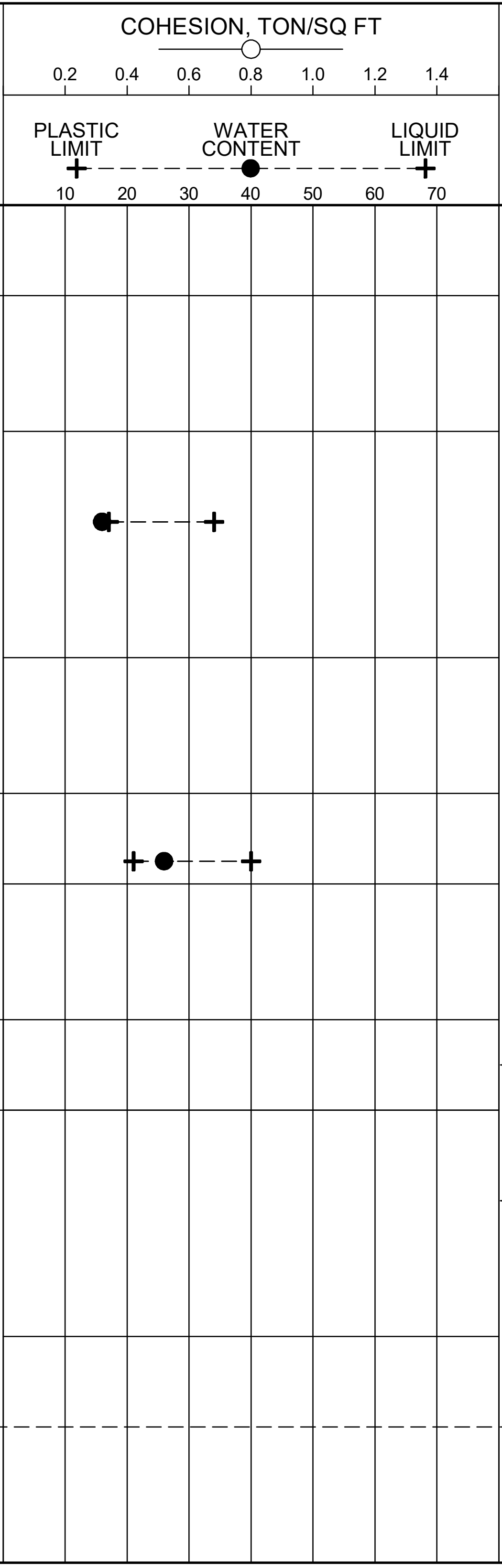
090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: HSA to 18.5 ft /Core

LOCATION: Approx Sta 158+30, 60 ft Lt

SURF. EL: 1098±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Medium dense reddish tan silt w/numerous chert fragments	15				
	Stiff to very stiff reddish brown silty clay w/numerous chert nodules and fragments	22				
5		29				
		29		27		
10		11				
15	Very soft brown and tan silty clay w/occasional chert fragments	2		86		
	Moderately hard light gray and gray slightly weathered cherty limestone	50/4"				
20	Moderately hard to hard light gray and gray cherty limestone w/very close argilaceous inclusions and layers - with medium close stylolites below 22.5 ft				64	44
25					98	77



COMPLETION DEPTH: 27.0 ft
DATE: 8-15-23

DEPTH TO WATER
IN BORING: 18 ft

DATE: 8/15/2023

19-118

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

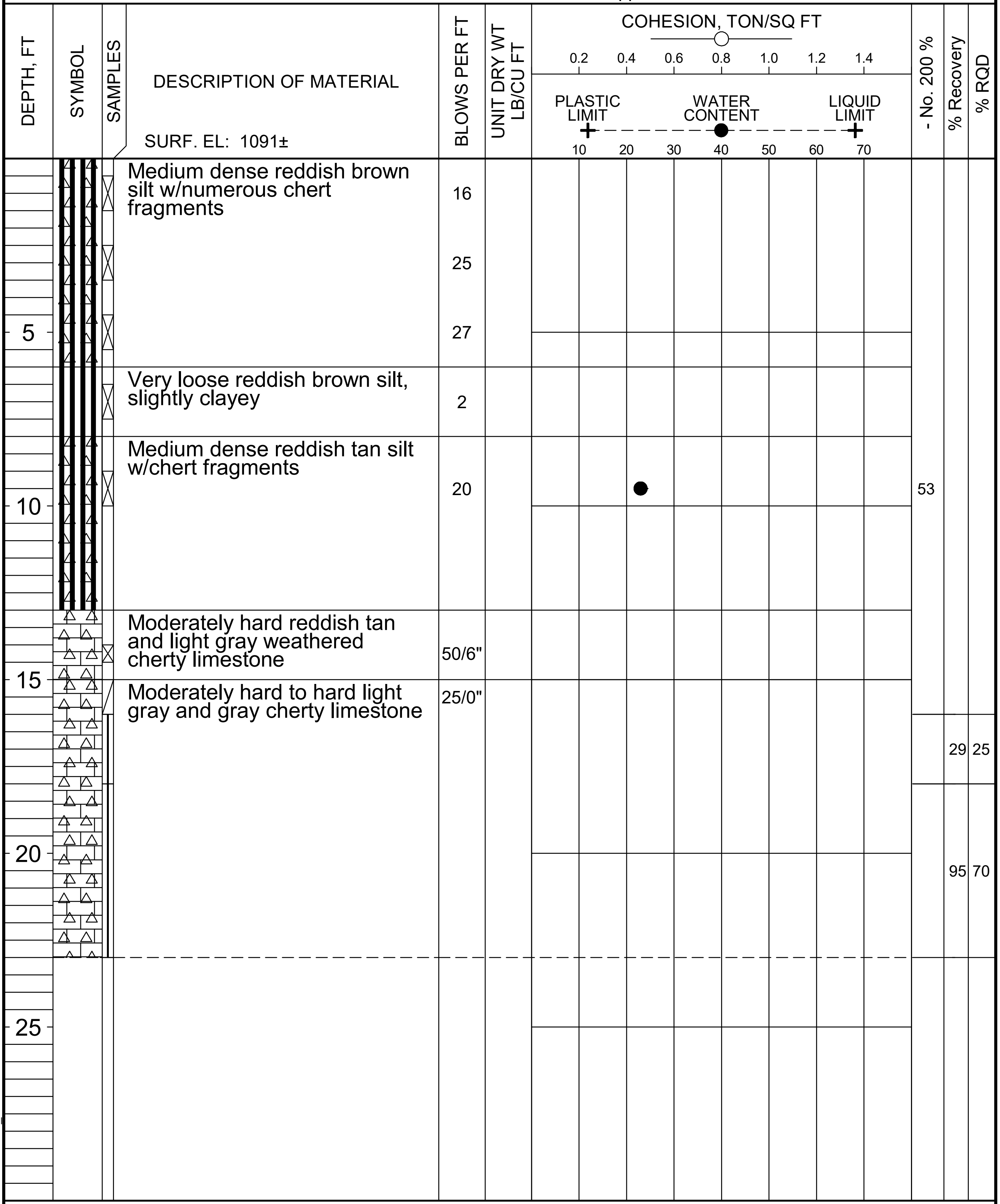
L O G O F B O R I N G N O. S18

090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: HSA to 16 ft /Core

LOCATION: Approx Sta 157+85, 60 ft Rt

SURF. EL: 1091±



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
Medium dense reddish brown silt w/numerous chert fragments	16 25 27				
Very loose reddish brown silt, slightly clayey	2				
Medium dense reddish tan silt w/chert fragments	20		53		
Moderately hard reddish tan and light gray weathered cherty limestone	50/6"				
Moderately hard to hard light gray and gray cherty limestone	25/0"			29 95	25 70

COMPLETION DEPTH: 23.0 ft
DATE: 8-17-23

DEPTH TO WATER
IN BORING: 13.7 ft

DATE: 8/17/2023

RECRQDN200-2 19-118 OSAGE CREEK.GPJ 8-30-23

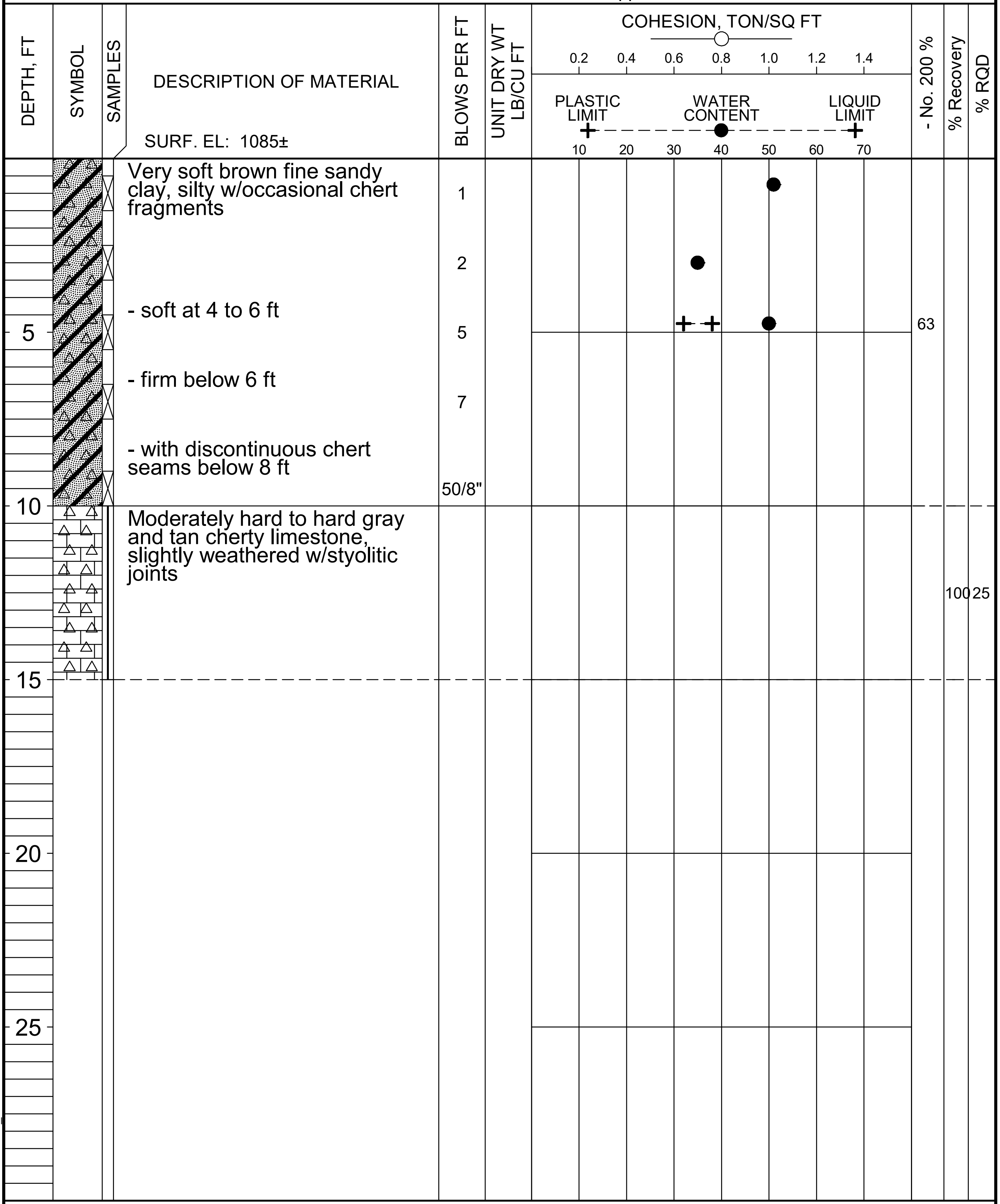
Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S27

090069 XNA Access Road over Little Osage Creek
Benton Co., Arkansas

TYPE: Auger to 10 ft /Core
LOCATION: Approx Sta 175+45, 45 ft Lt

SURF. EL: 1085±



DESCRIPTION OF MATERIAL	BLOWS PER FT	- No. 200 %	% Recovery	% RQD
Very soft brown fine sandy clay, silty w/occasional chert fragments	1			
	2			
- soft at 4 to 6 ft	5	63		
- firm below 6 ft	7			
- with discontinuous chert seams below 8 ft	50/8"			
Moderately hard to hard gray and tan cherty limestone, slightly weathered w/styolitic joints			100	25

COMPLETION DEPTH: 15.0 ft
DATE: 4-4-23

DEPTH TO WATER
IN BORING: 1 ft

DATE: 4/11/2023

RECRQDN200-2 19-118_LITTLE OSAGE CREEK.GPJ 9-26-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

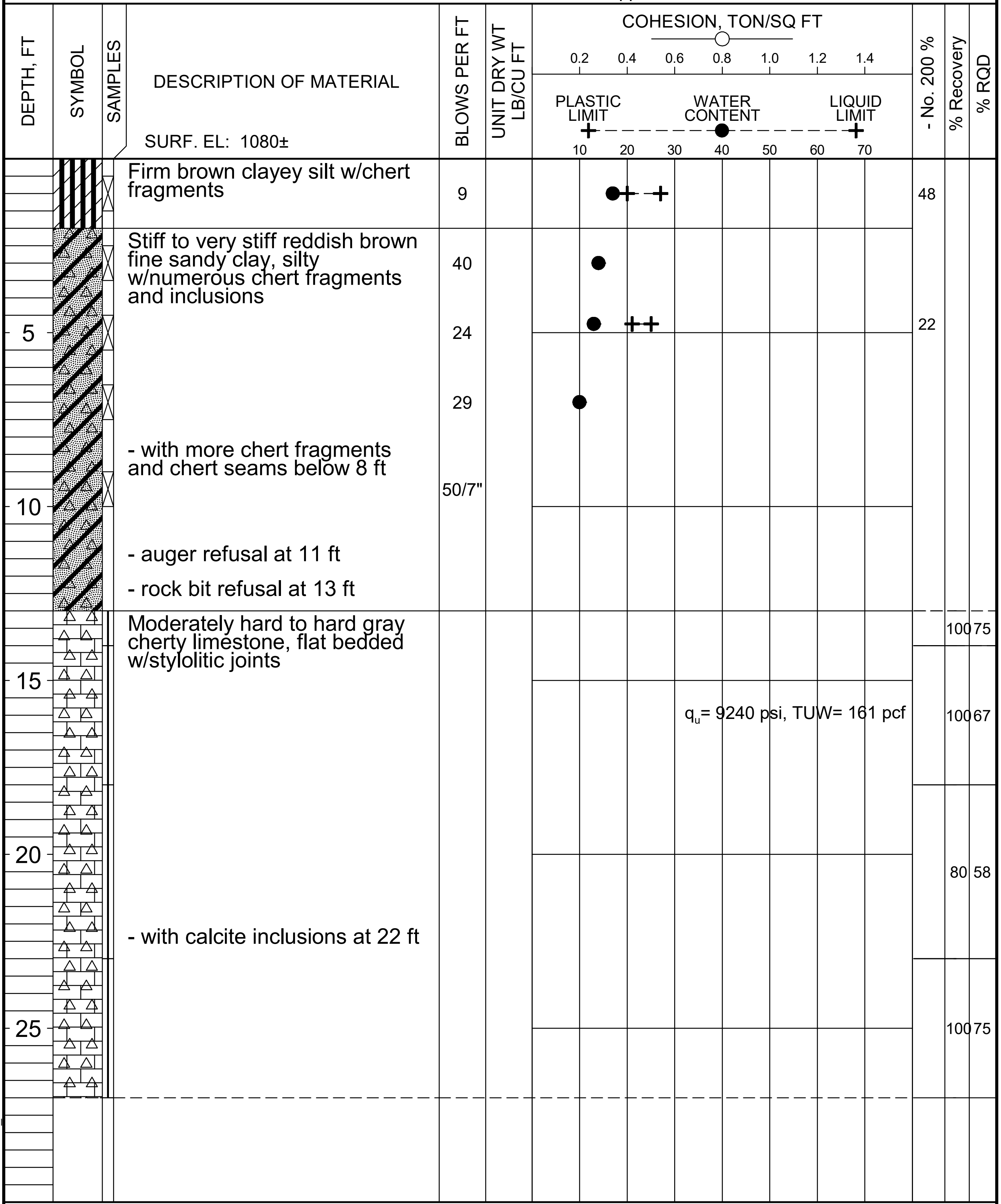
LOG OF BORING NO. S32

090069 XNA Access Road over Little Osage Creek
Benton Co., Arkansas

TYPE: Auger to 11 ft /Wash to 13 ft /Core

LOCATION: Approx Sta 181+45, 60 ft Lt

SURF. EL: 1080±



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
Firm brown clayey silt w/chert fragments	9		48		
Stiff to very stiff reddish brown fine sandy clay, silty w/numerous chert fragments and inclusions	40				
	24		22		
	29				
- with more chert fragments and chert seams below 8 ft	50/7"				
- auger refusal at 11 ft					
- rock bit refusal at 13 ft					
Moderately hard to hard gray cherty limestone, flat bedded w/stylolitic joints				100	75
q_u= 9240 psi, TUW= 161 pcf				100	67
				80	58
- with calcite inclusions at 22 ft					
				100	75

COMPLETION DEPTH: 27.0 ft
DATE: 4-7-22

DEPTH TO WATER
IN BORING: 10 ft

DATE: 4/8/2022

RECRQDN200-2 19-118_LITTLE OSAGE CREEK.GPJ 9-26-23

19-118

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S33

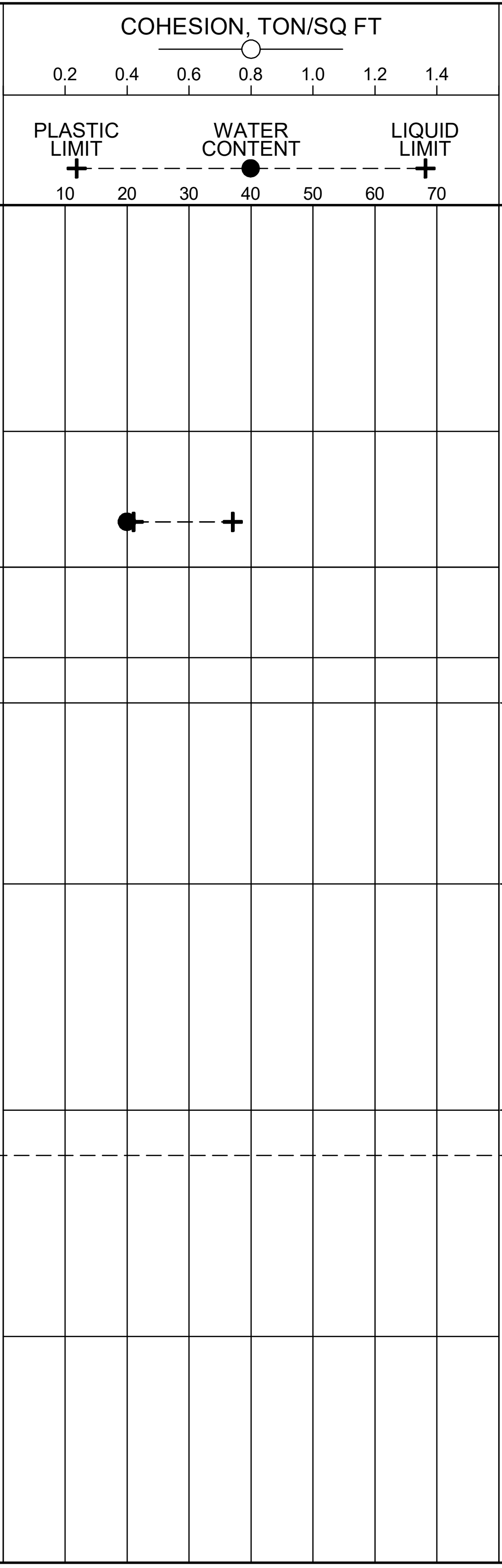
090069 XNA Access Road over Little Osage Creek
Benton Co., Arkansas

TYPE: Auger to 11 ft /Core

LOCATION: Approx Sta 176+00, 60 ft Rt

SURF. EL: 1078±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Very soft to soft brown clayey silt w/trace fine to coarse gravel	4				
	- very soft at 2 to 4 ft	2				
5	- with numerous chert fragments below 4 ft - soft at 4 to 6 ft	6				
	- stiff below 6 ft	14		28		
	Very loose to loose tan sandy fine to coarse chert gravel, silty	4				
10						
	Moderately hard light gray and gray cherty limestone, flat bedded w/stylolites and rehealed fractures				100	71
15						
					100	85
20					100	100
25						



COMPLETION DEPTH: 21.0 ft
DATE: 9-18-23

DEPTH TO WATER
IN BORING: 5.8 ft

DATE: 9/18/2023

RECRQDN200-2 19-118_LITTLE OSAGE CREEK.GPJ 9-26-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S38

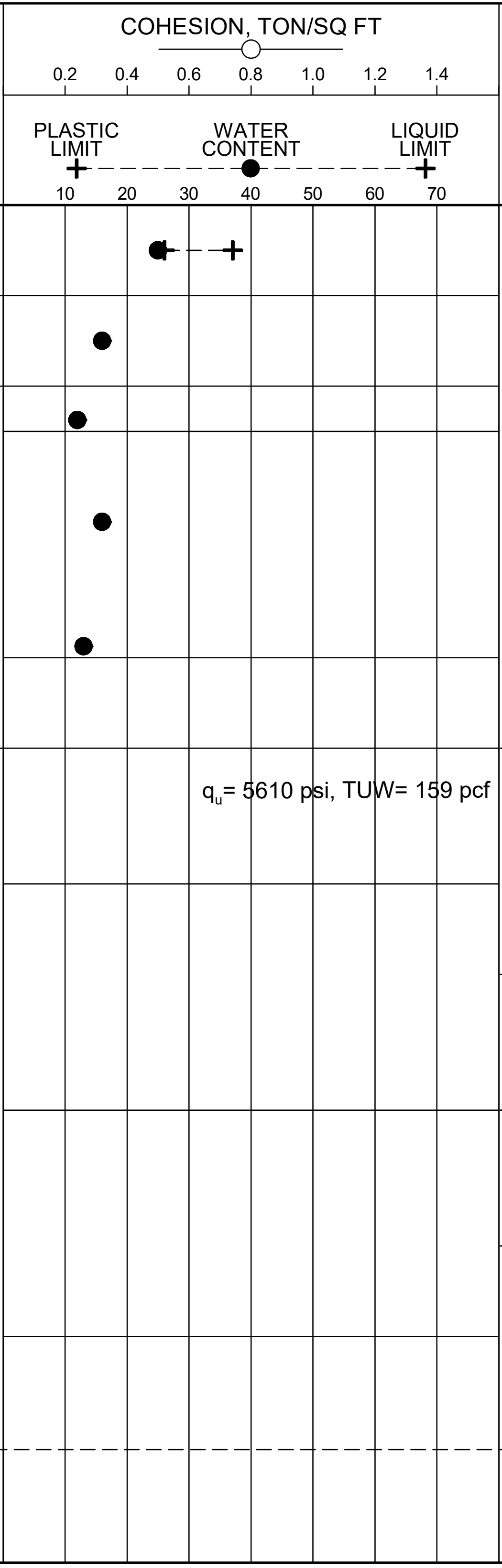
090069 XNA Access Road over Little Osage Creek
Benton Co., Arkansas

TYPE: Auger to 10 ft /Wash to 12 ft /Core

LOCATION: Approx Sta 182+15, 60 ft Rt

SURF. EL: 1080±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Very soft to soft brown clayey silt w/occasional rootlets	4		90		
	Stiff to very stiff reddish brown silty clay w/numerous chert and limestone fragments	32				
5	Stiff to very stiff reddish brown fine sandy clay w/numerous chert and limestone fragments	45				
	- with discontinuous chert seams and layers below 6 ft	50/6"				
		25/0"				
10	- auger refusal at 10 ft					
	Moderately hard to hard gray cherty limestone, flat bedded w/stylolitic joints					
15					100	83
					100	92
20					100	94
25					87	85



q_u= 5610 psi, TUW= 159 pcf

COMPLETION DEPTH: 27.5 ft
DATE: 4-8-22

DEPTH TO WATER
IN BORING: Dry to 10 ft

DATE: 4/5/2022

RECRQDN200-2 19-118_LITTLE OSAGE CREEK.GPJ 9-26-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S39

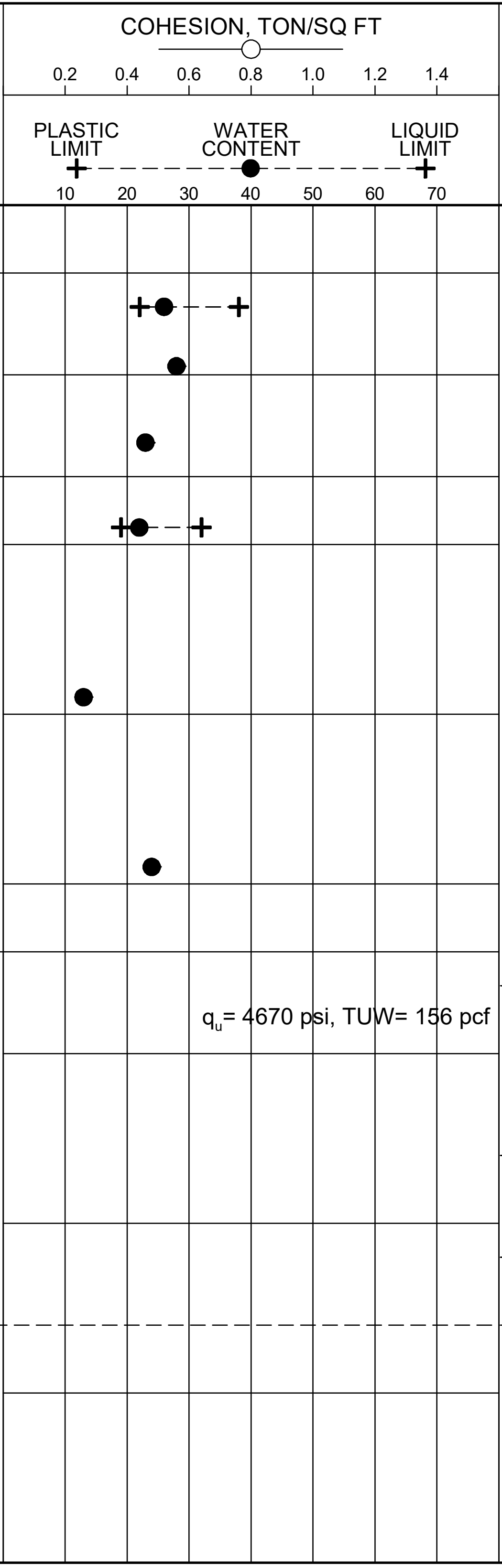
090069 XNA Access Road over Haden Rd.
Benton Co., Arkansas

TYPE: HSA to 22 ft /Wash to 23 ft /Core

LOCATION: Approx Sta 190+90, 60 ft Lt

SURF. EL: 1106±

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
Very soft to soft brown and reddish brown clay w/rootlets	4				
Soft brown, reddish brown and gray silty clay w/chert fragments and nodules and ferrous stains	5		77		
- stiff to very stiff below 4 ft	11				
- with more chert fragments below 6 ft	27				
Firm to stiff tan and brown silty clay w/some chert fragments and nodules	10		90		
- stiff to very stiff below 13 ft - with numerous chert fragments at 13 to 18 ft	41				
- with more clay and fewer chert fragments below 18 ft	13				
- HSA refusal at 22 ft					
Moderately hard to hard light gray cherty limestone, stylolitic joints - chert seam at 24 ft				97	87
				89	78
				96	83



q_u= 4670 psi, TUW= 156 pcf

COMPLETION DEPTH: 33.0 ft
DATE: 4-26-22

DEPTH TO WATER
IN BORING: 19.5 ft

DATE: 4/26/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S42

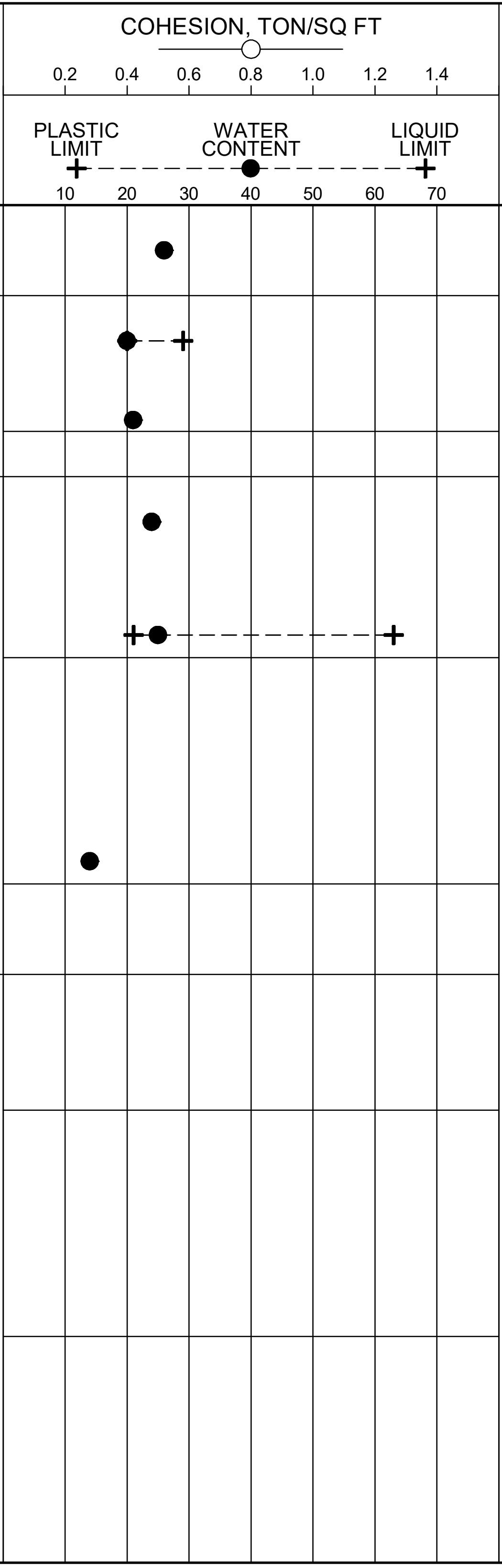
090069 XNA Access Road over Haden Rd.
Benton Co., Arkansas

TYPE: HSA to 30 ft /Core

LOCATION: Approx Sta 193+20, 60 ft Lt

SURF. EL: 1126±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Stiff brown silty clay w/rootlets and cherty limestone fragments	14				
	Stiff light brown silty clay w/numerous chert and limestone fragments	21		36		
5	- very stiff, reddish tan below 4 ft	27				
	Stiff reddish brown clay w/numerous chert and limestone fragments	23				
10		21		52		
15	- with discontinuous chert seams below 13 ft	50/4"				
20	Stiff to very stiff tan and light gray silty clay w/numerous chert and limestone fragments and chert seams and layers (completely weathered limestone)	27				
25	- soft to firm below 22 ft	5				
		25/0"				



COMPLETION DEPTH: 45.0 ft
DATE: 4-20-22

DEPTH TO WATER
IN BORING: Dry to 30 ft

DATE: 4/20/2022

Grubbs, Hoskyn,
Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S42

090069 XNA Access Road over Haden Rd.
Benton Co., Arkansas

TYPE: HSA to 30 ft /Core

LOCATION: Approx Sta 193+20, 60 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT 0.2 0.4 0.6 0.8 1.0 1.2 1.4 PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT 10 20 30 40 50 60 70	- No. 200 %	% Recovery	% RQD
			Moderately hard to hard light gray w/gray cherty limestone, stylolitic joints						
								85	28
35									
								98	88
40									
								100	77
45									
50									
55									

COMPLETION DEPTH: 45.0 ft
DATE: 4-20-22

DEPTH TO WATER
IN BORING: Dry to 30 ft

DATE: 4/20/2022

19-118

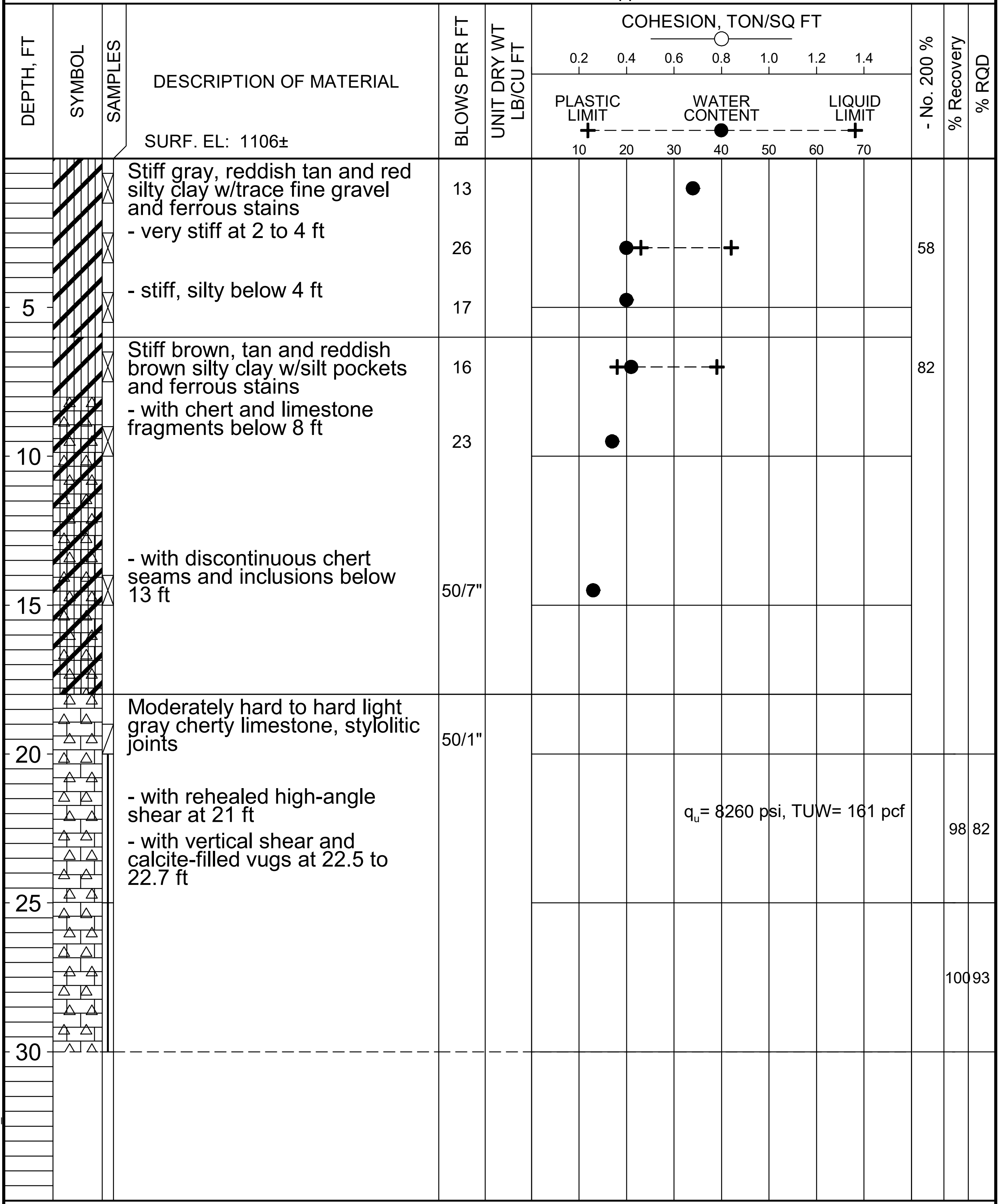
Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

L O G O F B O R I N G N O. S43

090069 XNA Access Road over Haden Rd.
Benton Co., Arkansas

TYPE: HSA to 20 ft /Core

LOCATION: Approx Sta 191+60, 60 ft Rt



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / WATER CONTENT	- No. 200 %	% Recovery	% RQD
Stiff gray, reddish tan and red silty clay w/trace fine gravel and ferrous stains	13					
- very stiff at 2 to 4 ft	26			58		
- stiff, silty below 4 ft	17					
Stiff brown, tan and reddish brown silty clay w/silt pockets and ferrous stains	16			82		
- with chert and limestone fragments below 8 ft	23					
- with discontinuous chert seams and inclusions below 13 ft	50/7"					
Moderately hard to hard light gray cherty limestone, stylolitic joints	50/1"					
- with rehealed high-angle shear at 21 ft			q_u= 8260 psi, TUW= 161 pcf		98	82
- with vertical shear and calcite-filled vugs at 22.5 to 22.7 ft						
					100	93

COMPLETION DEPTH: 30.0 ft
DATE: 4-29-22

DEPTH TO WATER
IN BORING: 13.8 ft

DATE: 4/29/2022

RECRQDN200-2 19-118_HADEN RD.GPJ 6-5-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

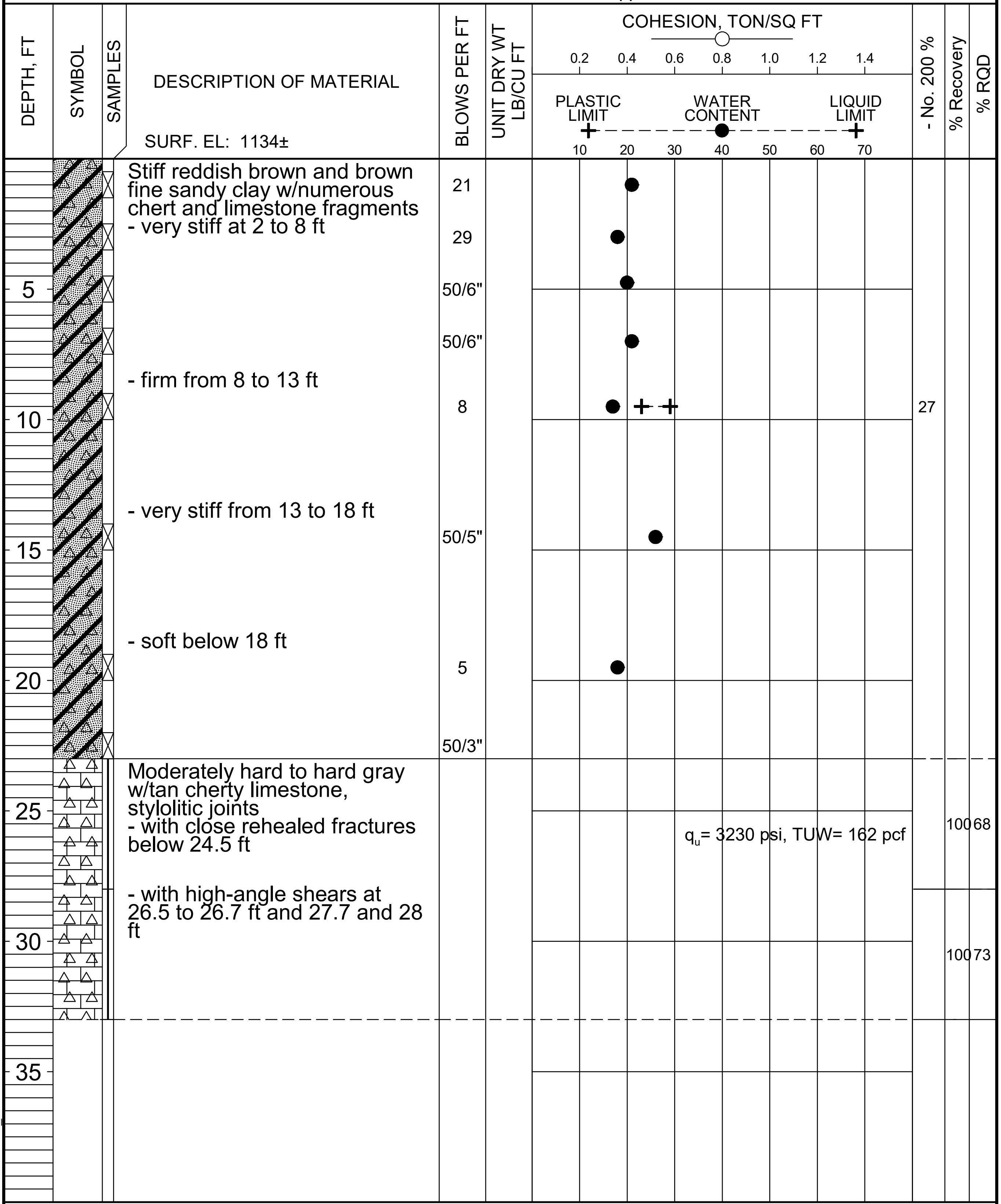
LOG OF BORING NO. S46

090069 XNA Access Road over Haden Rd.
Benton Co., Arkansas

TYPE: HSA to 23 ft /Core

LOCATION: Approx Sta 193+90, 60 ft Rt

SURF. EL: 1134±



DESCRIPTION OF MATERIAL	BLOWS PER FT	- No. 200 %	% Recovery	% RQD
Stiff reddish brown and brown fine sandy clay w/numerous chert and limestone fragments	21			
- very stiff at 2 to 8 ft	29			
	50/6"			
	50/6"			
- firm from 8 to 13 ft	8	27		
- very stiff from 13 to 18 ft	50/5"			
- soft below 18 ft	5			
	50/3"			
Moderately hard to hard gray w/tan cherty limestone, stylolitic joints - with close rehealed fractures below 24.5 ft q$_u$= 3230 psi, TUW= 162 pcf			100	68
- with high-angle shears at 26.5 to 26.7 ft and 27.7 and 28 ft			100	73

COMPLETION DEPTH: 33.0 ft
DATE: 4-28-22

DEPTH TO WATER
IN BORING: Dry to 23 ft

DATE: 4/28/2022

**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**
Consulting Engineers

LOG OF BORING NO. S47

090069 XNA Access Road over Holmes Rd.
Benton Co., Arkansas

TYPE: HSA to 51 ft /Wash

LOCATION: Approx Sta 211+40, 40 ft Lt

SURF. EL: 1220±

COHESION, TON/SQ FT ○ (0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4)

PLASTIC LIMIT + — WATER CONTENT ● — LIQUID LIMIT + (10, 20, 30, 40, 50, 60, 70)

DEPTH, FT	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / WATER CONTENT	- No. 200 %	% Recovery	% RQD
0–2	☒	Very stiff light brown clayey silt w/chert nodules and fragments, dry	32					
2–18	☒	Very stiff red silty clay w/numerous chert nodules and fragments	66					
5	☒		50/2"					
	☒	- with discontinuous chert seams and layers below 4 ft	50/6"					
10	☒		80					
15	☒		43					
18–20	☒	Low hardness light yellowish red and very light gray highly weathered cherty limestone w/red silty clay seams	64					
20–38		Stiff to very stiff red silty clay w/chert nodules and fragments						
25	☒		28					
30	☒		19					
35	☒		19					
38–	☒	Very soft light gray and light yellowish red highly weathered cherty limestone, fractured w/red silty clay seams	9					
40		- with grayish brown below 42 ft						
	☒		11					

COMPLETION DEPTH: 61.0 ft
DATE: 7-28-23

DEPTH TO WATER
IN BORING: Dry to 51 ft

DATE: 7/28/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S47

090069 XNA Access Road over Holmes Rd.
Benton Co., Arkansas

TYPE: HSA to 51 ft /Wash

LOCATION: Approx Sta 211+40, 40 ft Lt

COHESION, TON/SQ FT ○: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT + — WATER CONTENT ● — LIQUID LIMIT +: 10 20 30 40 50 60 70

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
50			- auger refusal at 51 ft	11					
			Moderately hard to hard gray cherty limestone					100	92
55						q_u= 4760 psi, TUW= 152 pcf		92	62
			- chert layers at 58.2 to 58.5 ft and 59.2 to 59.4 ft					100	55
60									
65									
70									
75									
80									
85									

COMPLETION DEPTH: 61.0 ft
DATE: 7-28-23

DEPTH TO WATER
IN BORING: Dry to 51 ft

DATE: 7/28/2023

19-118

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S51

090069 XNA Access Road over Holmes Rd.
Benton Co., Arkansas

TYPE: HSA to 28 ft /Wash

LOCATION: Approx Sta 214+80, 55 ft Lt

SURF. EL: 1182±

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION / WATER CONTENT	- No. 200 %	% Recovery	% RQD
Stiff brown and tan clayey silt w/organics and numerous chert nodules and fragments - fewer organics below 2 ft	13 11					
Medium dense brown fine to medium sand w/fine limestone gravel and numerous chert nodules and fragments	14					
Medium dense reddish brown sandy fine to coarse chert fragments w/red silty clay seams	23 17					
Stiff to very stiff yellowish red fine to coarse sandy clay w/numerous chert nodules and fragments - moist at 18 to 20 ft - very soft to soft below 23 ft - auger refusal at 28 ft	32 17 4					
Moderately hard gray slightly weathered cherty limestone - chert layer at 37.3 ft			q_u= 5290 psi, TUW= 166 pcf		89 97 100	89 90 50

COMPLETION DEPTH: 38.7 ft
DATE: 7-26-23

DEPTH TO WATER
IN BORING: Dry to 28 ft

DATE: 7/26/2023

RECRQDN200-2 19-118_HOLMES RD.GPJ 8-10-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S52A

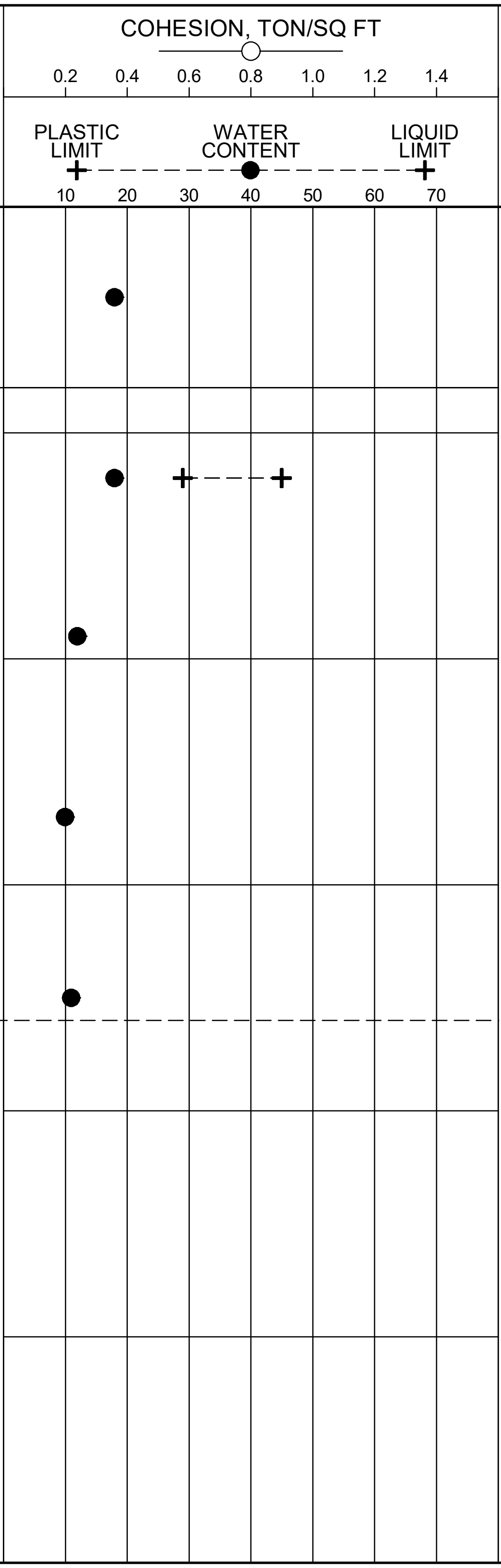
090069 XNA Access Road over Holmes Rd.
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 210+55, 45 ft Rt

SURF. EL: 1229±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
	Firm to stiff light brown clayey silt w/chert nodules and fragments and occasional organics	10		
	Stiff to very stiff red and brownish gray silty clay w/chert fragments and discontinuous chert seams and layers	50/5"		31
5	- red and reddish brown with very close chert inclusions, seams, and layers below 4 ft	25/0"		
		25/0"		
		25/0"		
	- auger refusal in cherty limestone at 9 ft			
10	NOTE: Boring abandoned			
15				



COMPLETION DEPTH: 9.0 ft
DATE: 3-15-22

DEPTH TO WATER
IN BORING: Dry

DATE: 3/15/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S56

090069 XNA Access Road over Holmes Rd.
Benton Co., Arkansas

TYPE: HSA to 31.5 ft /Wash

LOCATION: Approx Sta 213+65, 55 ft Rt

SURF. EL: 1208±

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
Stiff dark brown silty clay w/chert nodules and fragments	20				
Stiff to very stiff red clay w/numerous chert nodules and fragments	28 60				
Medium dense to dense reddish brown and light gray clayey fine to coarse sand w/numerous chert nodules and fragments	35 16				
Stiff to very stiff reddish brown and light gray fine to medium sandy clay w/numerous chert nodules and fragments - with highly weathered cherty limestone seams and layers below 23 ft - moist below 26 ft - chert layer at 28 ft - auger refusal at 31.5 ft	50 19 17 50/5"				
Moderately hard to hard gray cherty limestone				73 100 91	65 100 67

q_u= 5930 psi, TUW= 166 pcf

q_u= 10,990 psi, TUW= 156 pcf

COMPLETION DEPTH: 42.5 ft
DATE: 7-31-23

DEPTH TO WATER
IN BORING: Dry to 31.5 ft

DATE: 7/31/2023

19-118

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

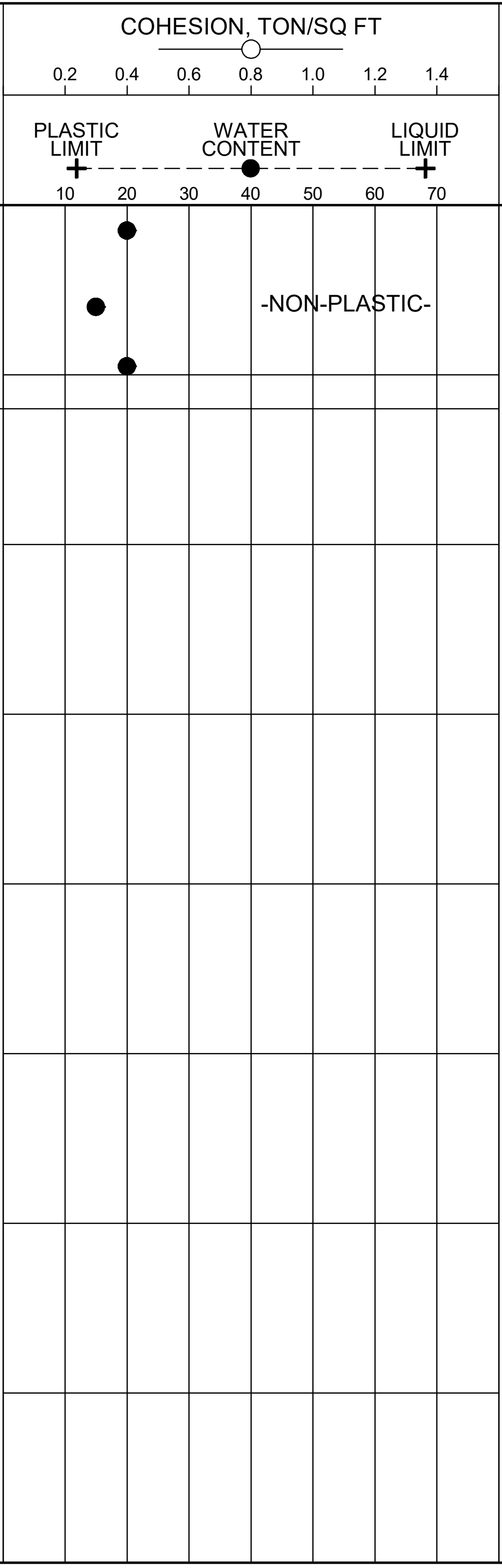
LOG OF BORING NO. S57

090069 Malone Lane over XNA Access Road
Benton Co., Arkansas

TYPE: Auger to 15 ft /Wash

LOCATION: Approx Sta 22+36, CL

DEPTH, FT	DESCRIPTION OF MATERIAL SURF. EL.: 1241±	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Medium dense reddish brown silt w/chert nodules and fragments	17 15 26		39		
5						
	Moderately hard very light gray weathered cherty limestone w/very close reddish brown cherty clay seams and layers and discontinuous chert beds	50/5" 50/5"				
10						
15		50/3"				
20		25/0"				
25		25/0"				
30		25/0"				
35		25/0" 25/0"				



COMPLETION DEPTH: 62.0 ft
DATE: 2-15-23

DEPTH TO WATER
IN BORING: Dry to 15 ft

DATE: 2/15/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S57

090069 Malone Lane over XNA Access Road
Benton Co., Arkansas

TYPE: Auger to 15 ft /Wash

LOCATION: Approx Sta 22+36, CL

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %	% Recovery	% RQD
45				25/0"					
			Moderately hard gray and tan weathered cherty limestone w/clay seams and pockets	25/0"					
50			Moderately hard gray cherty limestone, flat bedded					33	0
55			- highly fractured with clay laminations and seams to 55 ft			q_u= 5840 psi, TUW= 153 pcf		100	100
60								99	85
65									
70									
75									

COMPLETION DEPTH: 62.0 ft
DATE: 2-15-23

DEPTH TO WATER
IN BORING: Dry to 15 ft

DATE: 2/15/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S59

090069 Malone Lane over XNA Access Road
Benton Co., Arkansas

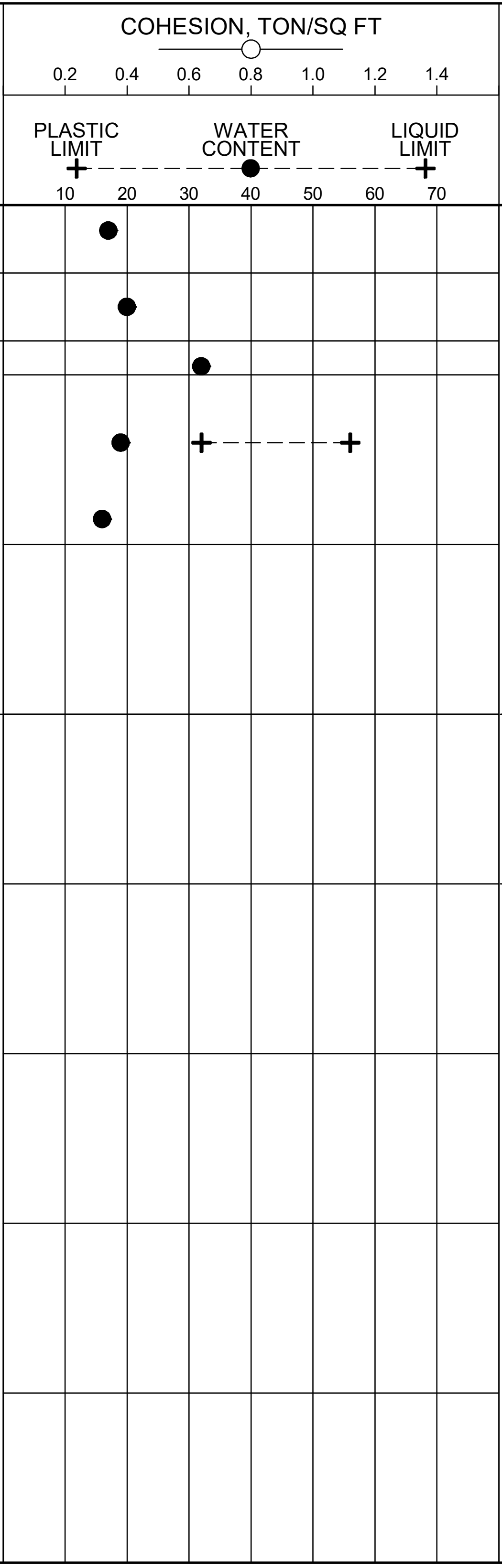
TYPE: Auger to 15 ft /Wash

LOCATION: Approx Sta 24+57, CL

SURF. EL: 1243±

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
Firm brown and tan clayey silt w/occasional chert fragments	8				
Stiff to very stiff reddish brown silty clay w/chert fragments and nodules	50/4"				
Stiff to very stiff reddish brown clay w/numerous chert fragments and discontinuous chert seams and layers	50/7"				
	50/5"		36		
	25/0"				
	25/0"				
Moderately hard reddish brown and light gray weathered cherty limestone w/very close reddish brown cherty clay seams and layers and discontinuous chert beds				30	0
- highly fractured, limited core recovery					
	25/0"				
	25/0"				
	25/0"				
	25/0"				

Depth scale, ft: 5, 10, 15, 20, 25, 30, 35



COMPLETION DEPTH: 55.0 ft
DATE: 1-25-23

DEPTH TO WATER
IN BORING: Dry to 15 ft

DATE: 1/25/2023

RECRQDN200-2 19-118_MALONE RD.GPJ 6-5-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S59

090069 Malone Lane over XNA Access Road
Benton Co., Arkansas

TYPE: Auger to 15 ft /Wash

LOCATION: Approx Sta 24+57, CL

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT 0.2 0.4 0.6 0.8 1.0 1.2 1.4 PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT 10 20 30 40 50 60 70	- No. 200 %	% Recovery	% RQD
				25/0"					
45			Moderately hard light gray and gray slightly weathered cherty limestone, flat bedded						
								87	70
50									
								97	55
55									
60									
65									
70									
75									

COMPLETION DEPTH: 55.0 ft
DATE: 1-25-23

DEPTH TO WATER
IN BORING: Dry to 15 ft

DATE: 1/25/2023

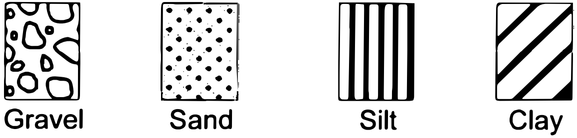
RECRQDN200-2 19-118_MALONE RD.GPJ 6-5-23

**Grubbs, Hoskyn,
Barton & Wyatt, Inc.
Consulting Engineers**

SYMBOLS AND TERMS USED ON BORING LOGS

SOIL TYPES

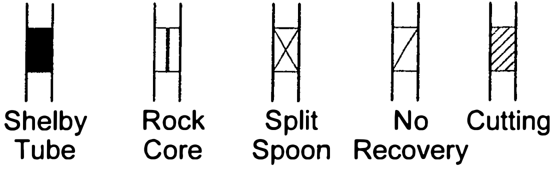
(SHOWN IN SYMBOLS COLUMN)



Predominant type shown heavy

SAMPLER TYPES

(SHOWN ON SAMPLES COLUMN)



TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on No. 200 sieve): Includes (I) Clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as determined by laboratory tests.

DESCRIPTIVE TERM	N-VALUE	RELATIVE DENSITY
VERY LOOSE	0-4	0-15%
LOOSE	4-10	15-35%
MEDIUM DENSE	10-30	35-65%
DENSE	30-50	65-85%
VERY DENSE	50 and above	85-100%

FINE GRAINED SOILS (major portion passing No. 200 sieve): Includes (1) Inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests.

DESCRIPTIVE TERM	UNCONFINED COMPRESSIVE STRENGTH TON/SQ. FT.
VERY SOFT	Less than 0.25
SOFT	0.25-0.50
FIRM	0.50-1.00
STIFF	1.00-2.00
VERY STIFF	2.00-4.00
HARD	4.00 and higher

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

TERMS CHARACTERIZING SOIL STRUCTURE

SLICKENSIDED - having inclined planes of weakness that are slick and glossy in appearance.
FISSURED - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
LAMINATED - composed of thin layers of varying color and texture.
INTERBEDDED - composed of alternate layers of different soil types.
CALCAREOUS - containing appreciable quantities of calcium carbonate.
WELL GRADED - having a wide range in grain sizes and substantial amounts of all intermediate particle sizes.
POORLY GRADED - predominantly of one grain size, or having a range of sizes with some intermediate sizes missing.

Terms used on this report for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No.3-357, Waterways Experiment Station, March 1953

Grubbs, Hoskyn,
Barton & Wyatt, Inc.
Consulting Engineers

BORING LOG TERMS – ROCK

ROCK TYPES
(SHOWN IN SYMBOLS COLUMN)

Joint Characteristics –

Spacing	
Very Close	0.75 to 2.5 in.
Close	2.5 to 8 in.
Moderately Close	8 to 24 in.
Wide	2 to 6 ft
Very Wide	More than 6 ft

Bedding Characteristics –

Very Thin	0.75 to 2.5 in.
Thin	2.5 to 8 in.
Medium	8 to 24 in.
Thick	2 to 6 ft
Massive	More than 6 ft

Lithologic Characteristics –

- Clayey
- Shaly
- Calcareous (limy)
- Siliceous
- Sandy (Arenaceous)
- Silty
- Plastic Seams

Parting –	Less than 1/1 6inch
Seam –	1/1 6 to 1/2inch
Layer –	1/2 to 1 2inches
Stratum –	Greater than 1 2inches

Hardness–

Soft (S) – Reserved for plastic material alone.

Friable (F) – Easily crumbled by hand, pulverized or reduced to powder and is too soft to be cut with a pocket knife.

Low Hardness (LH) – Can be gouged deeply or carved with a pocket knife.

Moderately Hard (MH) – Can be readily scratched by a knife blade; scratch leaves a heavy trace of dust and scratch is readily visible after the powder has been blown away.

Hard (H) – Can be scratched with difficulty; scratch produces little powder and is often faintly visible; traces of the knife steel may be visible.

Very hard (VH) – Cannot be scratched with a pocket knife. Knife steel marks left on surface.

Texture –

Fine – Barely seen with naked eye
Medium – Barely seen up to 1/8 in.
Coarse – 1/8 in. to 1/4 in.

Structure –

- Bedding
  - Flat – 0° – 5°
  - Gently Dipping – 5° – 35°
  - Moderately Dipping – 55° – 85°
  - Steeply Dipping – 55° – 85°
- Fractures, scattered
  - Open
  - Cemented or Tight
- Fractures, closely spaced
  - Open
  - Cemented or Tight
- Brecciated (Sheared and Fragmented)
  - Open
  - Cemented or Tight
- Joints
  - Faulted
  - Slickensides

Degree of Weathering –

Fresh – No visible signs of decomposition or discoloration. Rings under hammer impact.

Slighty Weathered – Slight discoloration inwards from open fractures, otherwise similar to fresh.

Moderately Weathered – Discoloration throughout. Weaker minerals such as feldspar decomposed. Strength somewhat less than fresh rock, but cores cannot be broken by hand or scraped by knife. Texture preserved.

Highly Weathered – Most minerals somewhat decomposed. Specimens can be broken by hand with effort or shaved with knife. Core stones present in rock mass. Texture becoming indistinct but fabric

Completely Weathered – Minerals decomposed to soil but fabric and structure preserved (Saprolite). Specimens easily crumbled or penetrated.

Residual Soil – Advanced state of decomposition resulting in plastic soils. Rock fabric and structure completely destroyed. Large volume change.

Solution and Void Conditions –

- Solid, contains no voids
- Vuggy (pitted)
- Vesicular (igneous)
- Porous
- Cavities
- Cavernous

Swelling Properties –

- Nonswelling
- Swelling

Slaking Properties –

- Nonslaking
- Slakes slowly on exposure
- Slakes readily on exposure

Rock Quality Designation (RQD) –

RQD (Percent)	Diagnostic Description
Greater than 90	Excellent
75 – 90	Good
50 – 75	Fair
25 – 50	Poor
Less than 25	Very Poor

KEYROCK FHWA 3-2-12

APPENDIX A

Summary of Roadway Exploration Program

ARDOT 090069 XNA Access Road - Roadway
GHBW Job No. 19-118
Benton County, Arkansas

Boring No.	Approx Sta	Approx Offset, ft	Approx Surf El, ft	Completion Depth, ft
R1	101+00	CL	1284	10
R7	131+00	CL	1219	14
R8	135+00	CL	1220	35
S1	142+80	60 Lt	1157	30
S4	145+75	60 Rt	1123	32
S5	142+60	70 Rt	1149	36
S8	145+55	60 Rt	1120	31
R10	148+90	20 Rt	1143	10
R11	155+30	CL	1098	11
S9	158+30	60 Lt	1098	27
S18	157+85	60 Rt	1091	23
R12	170+00	CL	1146	30
R13	174+50	CL	1126	20
S27	175+45	45 Lt	1085	15
S32	181+45	60 Lt	1080	27
S33	176+00	60 Rt	1078	21
S38	182+15	60 Rt	1080	27.5
R14	185+00	CL	1095	10
R15	188+50	CL	1101	10
S39	190+90	60 Lt	1106	33
S42	193+20	60 Lt	1126	45
S43	191+60	60 Rt	1106	30
S46	193+90	60 Rt	1134	33
R16	196+75	CL	1190	20
R17	200+00	CL	1202	20
R19	209+00	CL	1215	4.5
R21	220+00	CL	1236	10
R22	225+00	CL	1243	10
R23	230+00	CL	1245	10
R24	235+00	CL	1233	10
R25	240+00	CL	1221	5.5
R26	245+00	CL	1237	15
R27	250+00	CL	1233	25
R29	260+00	CL	1218	20
R30	265+00	CL	1188	15
R31	270+00	CL	1184	15
R32	275+00	CL	1210	10

Summary of Roadway Exploration Program

ARDOT 090069 XNA Access Road - Roadway

GHBW Job No. 19-118

Benton County, Arkansas

Boring No.	Approx Sta	Approx Offset, ft	Approx Surf El, ft	Completion Depth, ft
R33	280+00	CL	1213	10
R34	285+00	CL	1183	20
R35	290+00	CL	1217	10
R36	295+00	CL	1221	10
R37	300+00	CL	1226	10
R38	305+00	CL	1225	10
R39	309+00	20 L	1235	10
R40	253+00	CL	1217	20
R41	258+00	CL	1229	40
R42	263+00	CL	1212	20
R43	267+00	CL	1177	15
R44	272+00	CL	1207	10
R45	277+00	CL	1219	10
R48	459+00	CL	1267	10
R49	465+00	CL	1265	10
R50	469+00	CL	1271	10.5
R51	475+00	CL	1289	10
R53	425+75	CL	1295	10
R54	435+00	CL	1268	15
R55	440+00	CL	1261	10
R56	445+00	CL	1264	10
R60	440+00	CL	1299	10
R61	445+00	CL	1290	15
R63	432+00	CL	1268	10
R64	437+00	CL	1290	10
R65	14+40	CL	1250	10
R66	18+40	CL	1244	10
R67	28+40	CL	1249	10
R68	32+40	CL	1246	8.5

APPENDIX B

B-R7: Run 1 (8.5-11.5 ft), Run 2 (11.5-14 ft), Run 3 (14-18 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-R8: Run 1 (28-30 ft), Run 2 (30-32 ft), Run 3 (32-35 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-R12: Run 1 (20-25 ft), Run 2 (25-30 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

APPENDIX C

SUMMARY of CLASSIFICATION TEST RESULTS

PROJECT: 090069 XNA Access Road
LOCATION: Benton County, Arkansas
GHBW JOB NUMBER: 19-118

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING							USCS CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
R1	0.5-1.5	18	26	16	10	---	---	---	92	---	---	54	CL	A-4
R8	9-10	32	67	40	27	---	---	---	69	---	---	55	MH	A-7-5
R8	24-25	18	51	38	13	---	---	---	46	---	---	19	MH	A-7-5
R10	0.5-1.5	15	27	23	4	---	---	---	73	---	---	38	SM	A-4
R10	2.5-3.5	17	---	---	---	---	---	---	63	---	---	39	GC	A-7-6
R12	2.5-3.5	17.3	30	20	10	---	---	---	82	---	---	49	SC	A-4
R14	2.5-3.5	15	---NON-PLASTIC---			---	---	---	44	---	---	24	GM	A-1-b
R14	4.5-5.5	15	34	24	10	---	---	---	30	---	---	13	GM	A-2-4
R15	0.5-1.5	20	---NON-PLASTIC---			---	---	---	78	---	---	63	ML	A-4
R15	2.5-3.5	18	37	23	14	---	---	---	37	---	---	25	GC	A-2-6
R16	0.5-1.5	40	42	20	22	---	---	---	46	---	---	26	GC	A-2-7
R16	14-15	30	38	27	11	---	---	---	64	---	---	32	GM	A-2-6
R17	0.5-1.5	17	24	23	1	---	---	---	60	---	---	36	GM	A-4
R17	4.5-5.5	19	34	27	7	---	---	---	30	---	---	17	GM	A-2-4
R17	9-10	36	61	28	33	---	---	---	81	---	---	63	CH	A-7-6
R19	0.5-1.5	12	35	20	15	---	---	---	67	---	---	33	SC	A-2-6
R21	0.5-1.5	24	---	---	---	---	---	---	57	---	---	33	GM-GC	A-2-4
R22	0.5-1.5	23	26	18	8	---	---	---	91	---	---	76	CL	A-4

Grubbs, Hoskyn,
Barton & Wyatt, LLC
CONSULTING ENGINEERS

PLATE

SUMMARY of CLASSIFICATION TEST RESULTS

PROJECT: 090069 XNA Access Road
LOCATION: Benton County, Arkansas
GHBW JOB NUMBER: 19-118

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING							USCS CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
R23	0.5-1.5	23	42	20	22	---	---	---	96	---	---	88	CL	A-7-6
R24	0.5-1.5	16	27	24	3	---	---	---	74	---	---	51	ML	A-4
R25	0.5-1.5	13	23	20	3	100	100	89	76	53	37	32	SM	A-2-4
R25	2.5-3.5	14	30	25	5	---	---	---	---	---	---	---	SM	A-4
R25	4.5-5.5	30	---	---	---	---	---	---	79	---	---	48	SM	A-4
R26	6.5-7.5	12	51	27	24	---	---	---	81	---	---	20	SC	A-2-7
R27	4.5-5.5	9	44	27	17	---	---	---	78	---	---	15	SM	A-2-7
R27	19-20	21	45	38	7	---	---	---	70	---	---	18	SM	A-2-5
R29	14-15	44	51	37	14	---	---	---	91	---	---	47	SM	A-2-7
R30	0.5-1.5	23	---NON-PLASTIC---			---	---	---	71	---	---	40	SM	A-4
R30	2.5-3.5	20	41	18	23	---	---	---	70	---	---	36	SC	A-7-6
R31	0.5-1.5	22	33	28	5	---	---	---	85	---	---	61	ML	A-4
R31	2.5-3.5	21	49	22	27	---	---	---	98	---	---	84	CL	A-7-6
R32	0.5-1.5	25	34	18	16	---	---	---	86	---	---	73	CL	A-6
R32	2.5-3.5	20	29	19	10	---	---	---	82	---	---	65	CL	A-4
R33	0.5-1.5	23	---	---	---	100	89	86	79	75	71	68	ML	A-4
R34	0.5-1.5	14	---	---	---	---	---	---	40	---	---	22	GM	A-1-b

SUMMARY of CLASSIFICATION TEST RESULTS

PROJECT: 090069 XNA Access Road
LOCATION: Benton County, Arkansas
GHBW JOB NUMBER: 19-118

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING							USCS CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
R35	0.5-1.5	17	---NON-PLASTIC---			100	100	82	73	59	47	43	SM	A-4
R35	4.5-5.5	25	55	24	31	---	---	---	79	---	---	41	SC	A-7-6
R36	2.5-3.5	20	---NON-PLASTIC---			---	---	---	94	---	---	45	SM	A-4
R37	0.5-1.5	21	34	26	8	---	---	---	77	---	---	30	SM	A-2-4
R37	2.5-3.5	9	30	18	12	---	---	---	73	---	---	21	SC	A-2-6
R38	0.5-1.5	17	---NON-PLASTIC---			---	---	---	57	---	---	31	GM	A-2-4
R39	0.5-1.5	15	28	20	8	---	---	---	82	---	---	42	SC	A-4
R39	2.5-3.5	18	49	22	27	---	---	---	76	---	---	41	SC	A-7-6
R40	0.5-1.5	21	---	---	---	---	---	---	62	---	---	41	GM	A-4
R40	14-15	31	---NON-PLASTIC---			---	---	---	72	---	---	24	SM	A-2-4
R41	9-10	14	37	23	14	---	---	---	73	---	---	17	SC	A-2-6
R42	14-15	25	34	24	10	---	---	---	94	---	---	55	ML	A-4
R43	0.5-1.5	18	---	---	---	100	86	77	63	54	47	44	GM	A-4
R43	2.5-3.5	18	35	20	15	---	---	---	79	---	---	38	SC	A-6
R44	2.5-3.5	34	55	28	27	---	---	---	97	---	---	82	CH	A-7-6
R45	0.5-1.5	15	25	19	6	---	---	---	65	---	---	46	GM-GC	A-4
R45	2.5-3.5	23	49	24	25	---	---	---	80	---	---	57	CL	A-7-6

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PLATE

SUMMARY of CLASSIFICATION TEST RESULTS

PROJECT: 090069 XNA Access Road
LOCATION: Benton County, Arkansas
GHBW JOB NUMBER: 19-118

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING							USCS CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
R48	0.5-1.5	21	---NON-PLASTIC---			---	---	---	75	---	---	44	SM	A-4
R48	2.5-3.5	21	42	21	21	---	---	---	76	---	---	47	SC	A-7-6
R49	0.5-1.5	26	33	28	5	---	---	---	70	---	---	52	ML	A-4
R50	0.5-1.5	30	35	21	14	---	---	---	86	---	---	64	CL	A-6
R51	0.5-1.5	22	33	23	10	---	---	---	76	---	---	50	SC	A-4
R51	2.5-3.5	20	36	23	13	---	---	---	93	---	---	54	CL	A-6
R53	2.5-3.5	19	48	20	28	---	---	---	79	---	---	63	CL	A-7-6
R54	0.5-1.5	20	---NON-PLASTIC---						83			59	ML	A-4
R54	4.5-5.5	32	54	27	27	---	---	---	82	---	---	41	SC	A-7-6
R55	2.5-3.5	21	33	25	8	---	---	---	79	---	---	39	SM	A-4
R56	0.5-1.5	20	24	21	3	---	---	---	71	---	---	52	ML	A-4
R56	4.5-5.5	25	55	35	20	---	---	---	74	---	---	32	SM	A-2-7
R60	0.5-1.5	16	---NON-PLASTIC---			---	---	---	61	---	---	42	GM	A-4
R60	2.5-3.5	21	29	17	12	---	---	---	65	---	---	35	GC	A-2-6
R61	2.5-3.5	20	40	24	16	---	---	---	77	---	---	40	SC	A-6
R61	9-10	9	---NON-PLASTIC---			100	100	92	72	53	29	20	SM	A-1-b
R63	0.5-1.5	15	---	---	---	---	---	---	54	---	---	40	GM	A-4
R63	2.5-3.5	19	39	23	16	---	---	---	70	---	---	44	GC	A-6

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PLATE

SUMMARY of CLASSIFICATION TEST RESULTS

PROJECT: 090069 XNA Access Road
LOCATION: Benton County, Arkansas
GHBW JOB NUMBER: 19-118

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING							USCS CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
R64	0.5-1.5	17	31	19	12	---	---	---	78	---	---	67	CL	A-6
R65	2.5-3.5	31	77	39	38	100	100	100	92	86	72	66	CH	A-7-5
R66	0.5-1.5	20	35	22	13	---	---	---	97	---	---	87	CL	A-6
R66	4.5-5.5	41	---NON-PLASTIC---			---	---	---	80	---	---	30	ML	A-4
R67	0.5-1.5	12	36	16	20	---	---	---	95	---	---	74	CL	A-6
R67	2.5-3.5	14	35	22	13	100	100	92	79	67	55	48	SC	A-6
R68	0.5-1.5	17	---NON-PLASTIC---			---	---	---	94	---	---	68	ML	A-4
R68	2.5-3.5	19	39	21	18	---	---	---	81	---	---	56	CL	A-6
S1	0.5-1.5	14	---	---	---	---	---	---	45	---	---	21	GM	A-1-b
S4	2.5-3.5	15	NON-PLASTIC			---	---	---	57	---	---	38	GM	A-4
S5	6.5-7.5	16	32	25	7	---	---	---	74	---	---	30	SM	A-2-4
S8	2.5-3.5	19	30	19	11	---	---	---	77	---	---	49	SC	A-6
S8	14-15	13	32	18	14	---	---	---	65	---	---	20	SC	A-2-6
S9	6.5-7.5	16	34	17	17	---	---	---	71	---	---	27	SC	A-2-6
S9	14-15	26	40	21	19	---	---	---	98	---	---	86	CL	A-6
S18	9-10	23	---	---	---	100	100	87	83	78	62	53	ML	A-4
S27	4.5-5.5	50	38	32	6	---	---	---	100	---	---	63	ML	A-4

SUMMARY of CLASSIFICATION TEST RESULTS

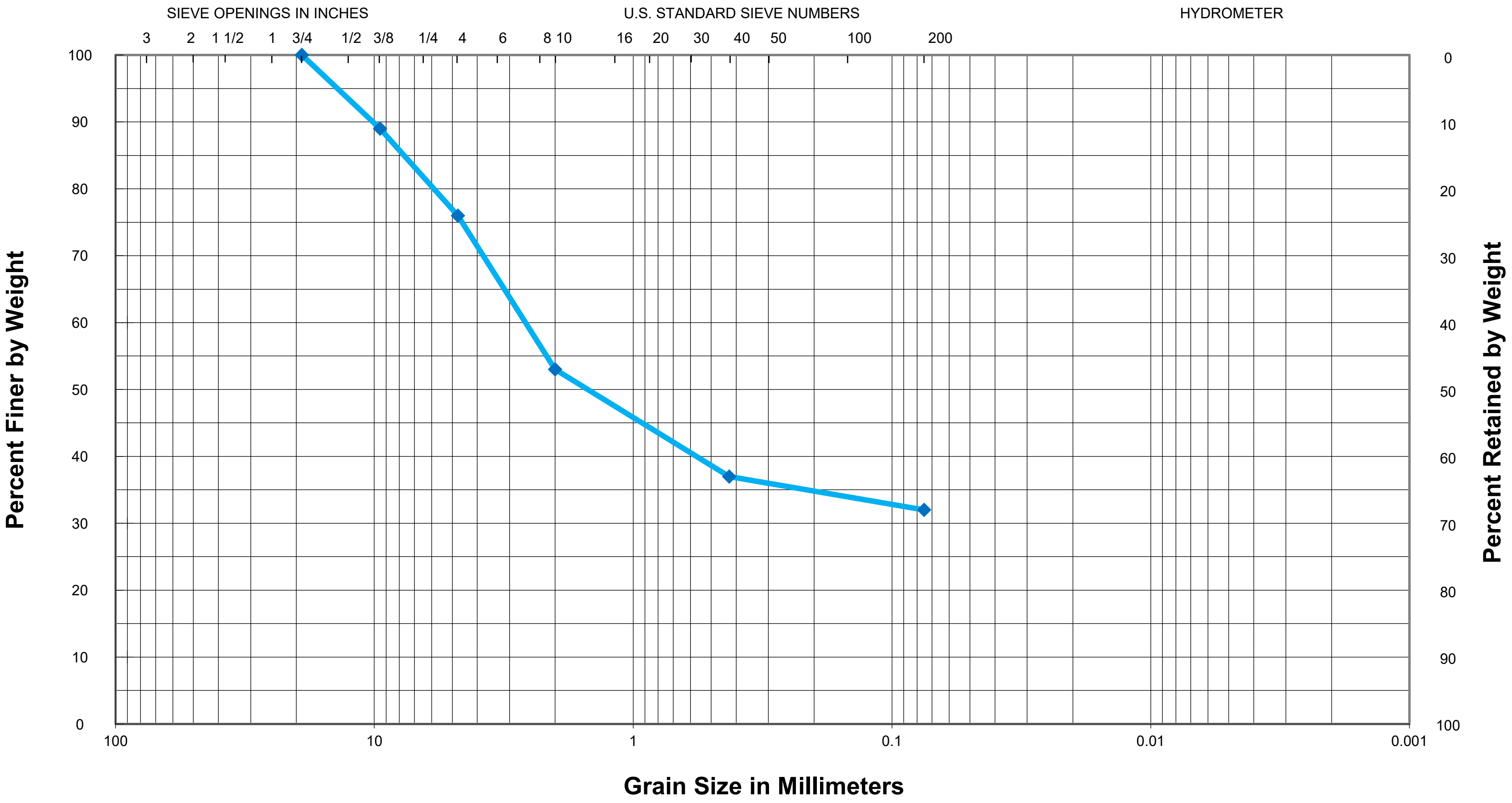
PROJECT: 090069 XNA Access Road
LOCATION: Benton County, Arkansas
GHBW JOB NUMBER: 19-118

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING							USCS CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
S32	0.5-1.5	17	27	20	7	---	---	---	64	---	---	48	GM-GC	A-4
S32	4.5-5.5	13	25	21	4	---	---	---	58	---	---	22	GM-GC	A-1-b
S33	6.5-7.5	20	37	21	16	---	---	---	50	---	---	28	SC	A-2-6
S38	0.5-1.5	25	37	26	11	---	---	---	98	---	---	90	ML	A-6
S39	2.5-3.5	26	38	22	16	---	---	---	100	---	---	77	CL	A-6
S39	9-10	22	32	19	13	---	---	---	98	---	---	90	CL	A-6
S42	2.5-3.5	20	29	20	9	---	---	---	60	---	---	36	GC	A-4
S42	9-10	25	63	21	42	---	---	---	72	---	---	52	CH	A-7-6
S43	2.5-3.5	20	42	23	19	---	---	---	94	---	---	58	CL	A-7-6
S43	6.5-7.5	21	39	18	21	---	---	---	97	---	---	82	CL	A-6
S46	9-10	17	29	23	6	---	---	---	58	---	---	27	GM	A-2-4
S52A	2.5-3.5	18	45	29	16	---	---	---	52	---	---	31	GM	A-2-7
S57	2.5-3.5	15	---NON-PLASTIC---			---	---	---	73	---	---	39	SM	A-4
S59	6.5-7.5	19	56	32	24	---	---	---	80	---	---	36	SM	A-7-5

19-118

GRAIN SIZE CURVE

Grubbs, Hoskyn,
Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

Sample: Boring R25, 0.5-1.5 ft; LL=23, PL=20, PI=3
Description: Tan SILT, slightly clayey w/ numerous chert fragments

USCS Classification = SM
AASHTO Classification = A-2-4

19-118

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
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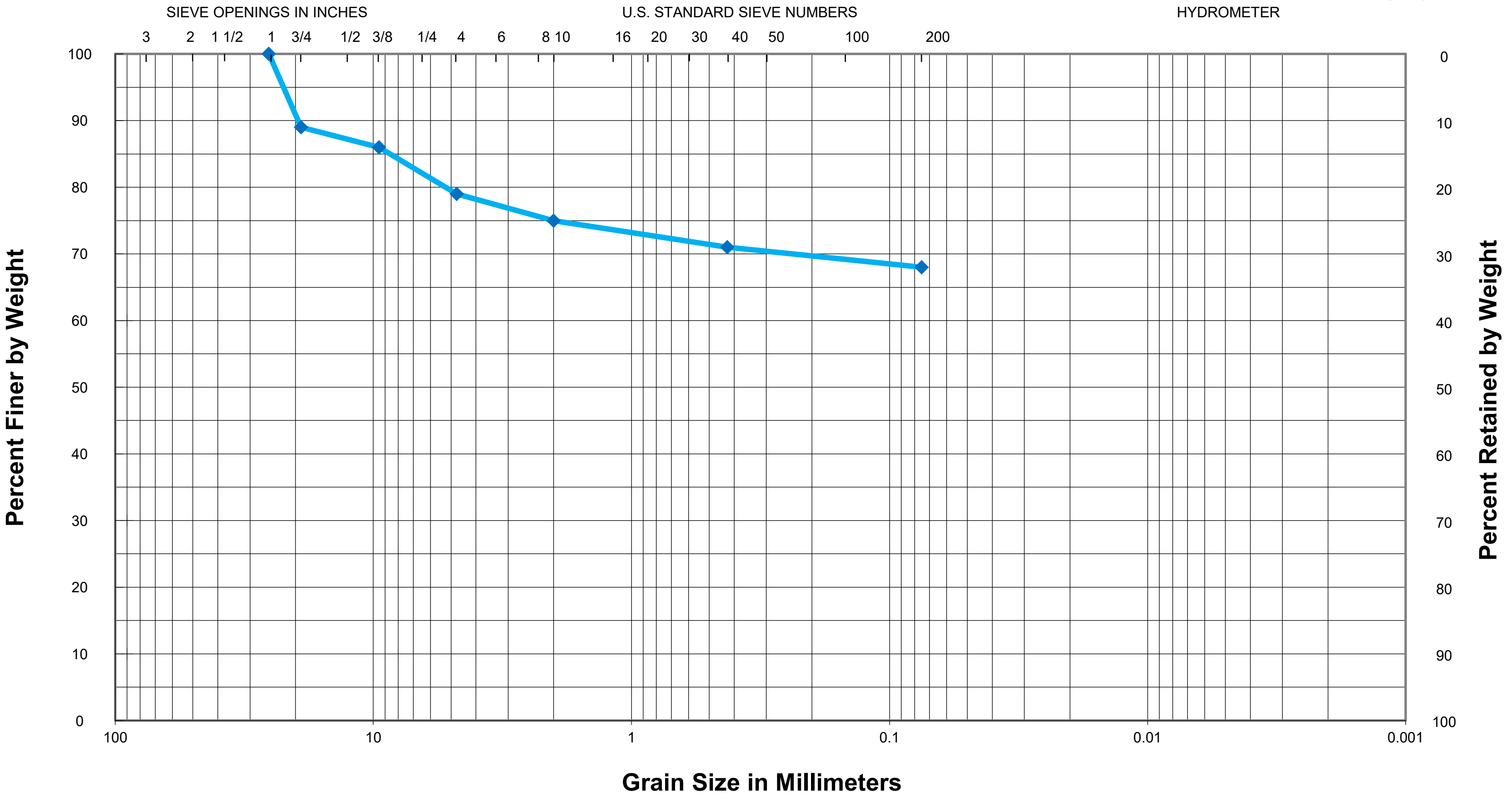


GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

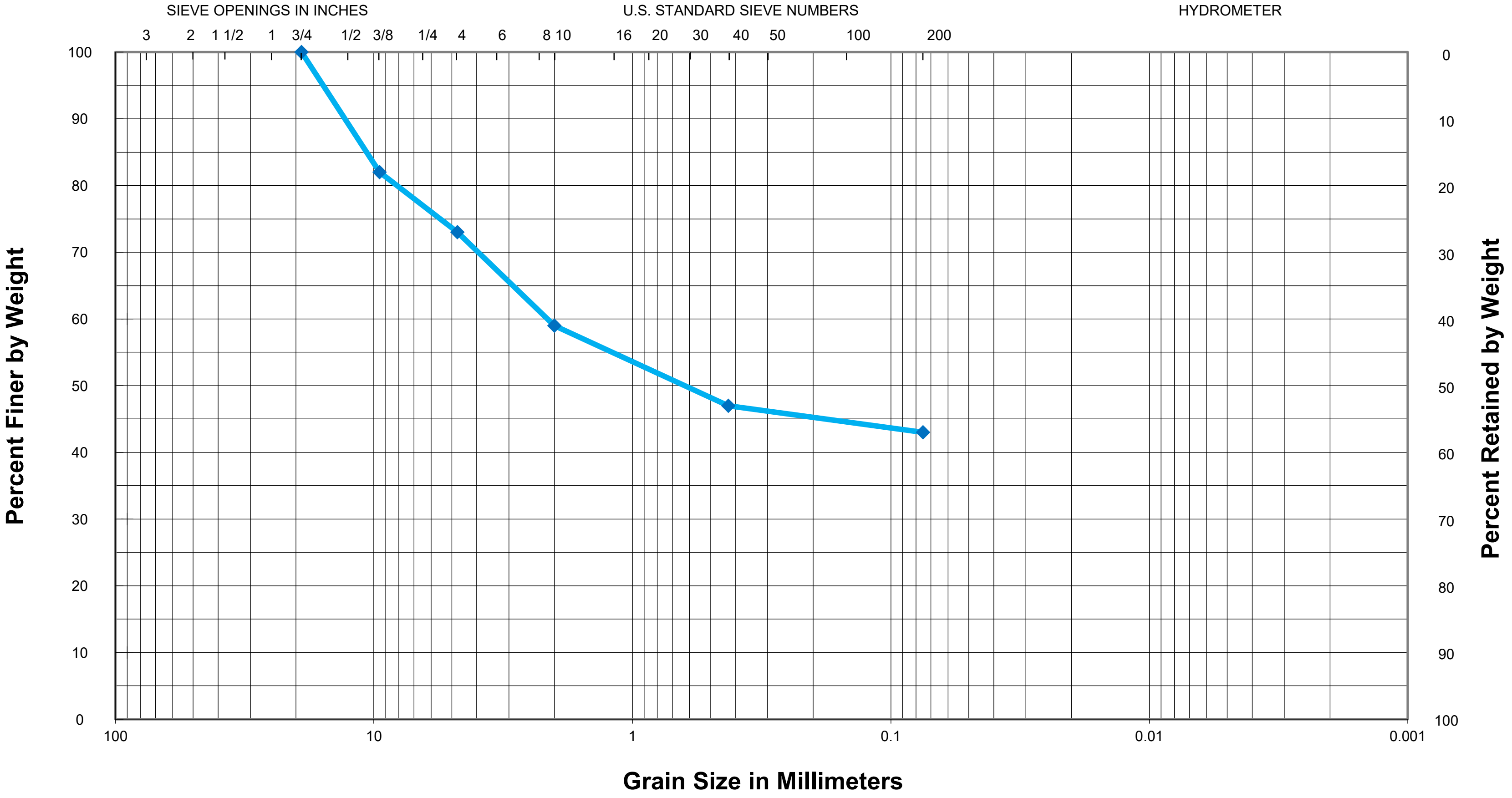
Sample: Boring R33, 0.5-1.5 ft
Description: Brown SILT w/ trace clay and occasional chert fragments

USCS Classification = ML
AASHTO Classification = A-4

19-118

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

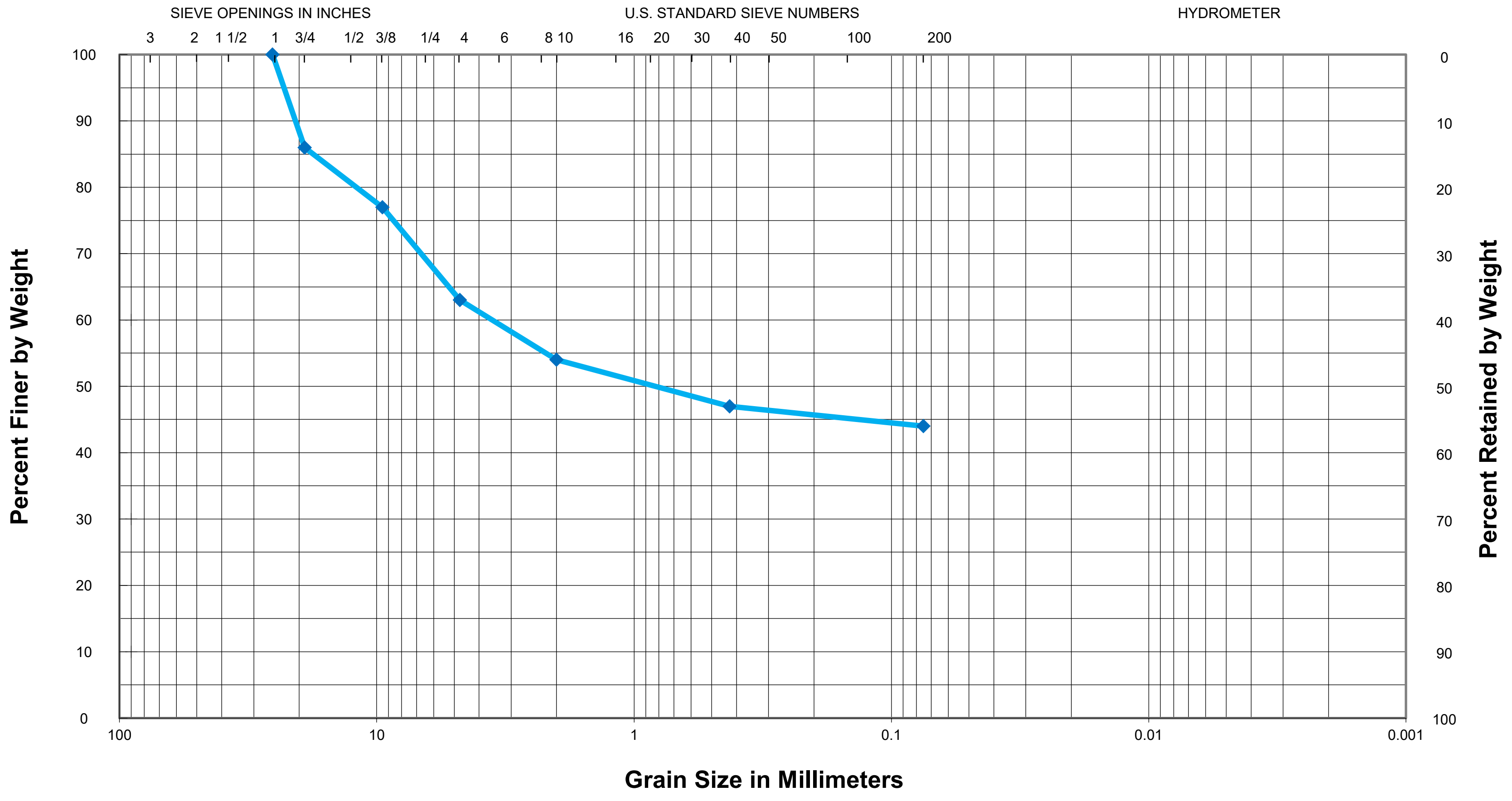
Sample: Boring R35, 0.5-1.5 ft; NON-PLASTIC
Description: Tan SILT w/ chert fragments (fill)

USCS Classification = SM
AASHTO Classification = A-4

19-118

GRAIN SIZE CURVE

Grubbs, Hoskyn,
Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

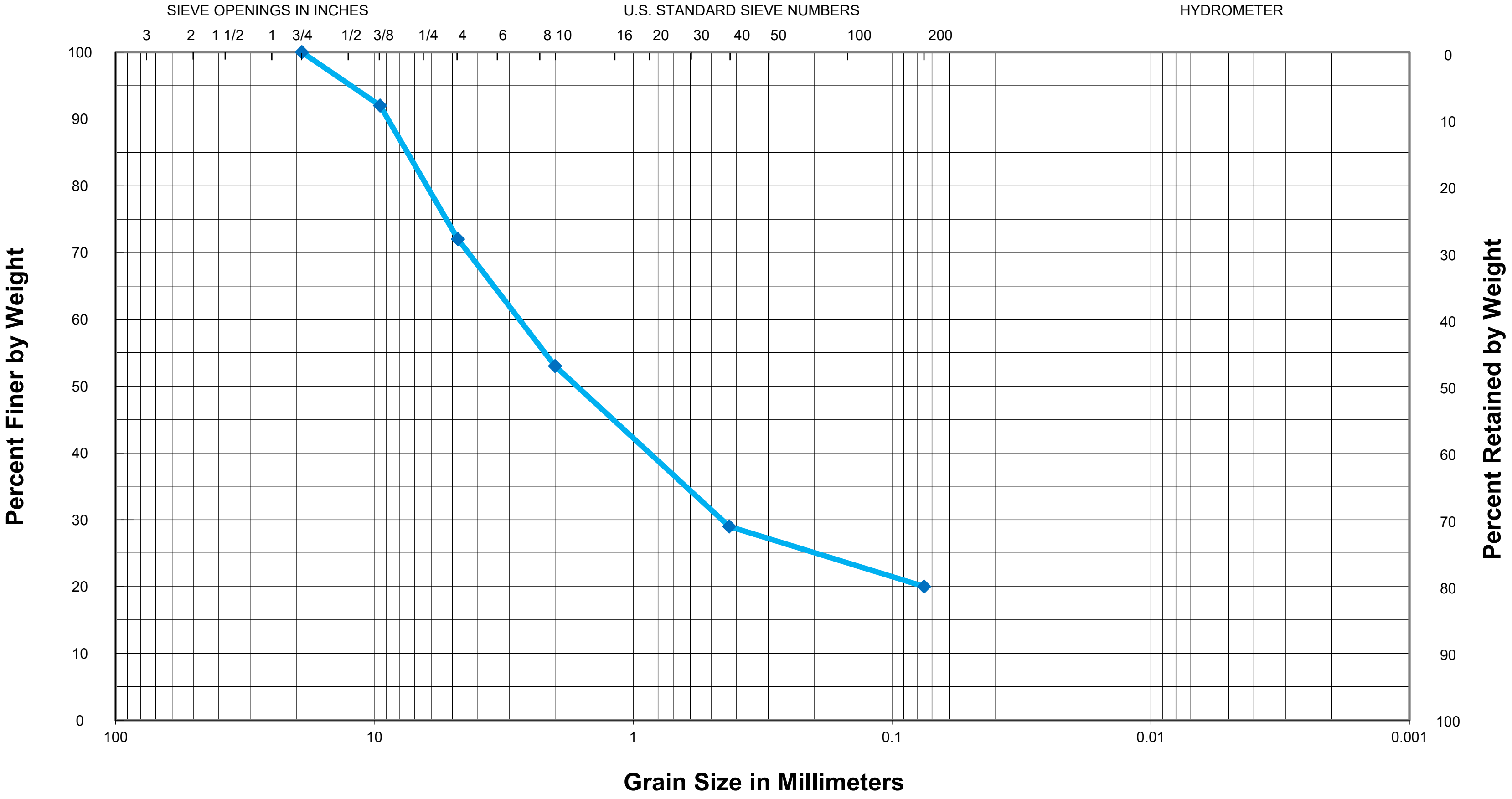
Sample: Boring R43, 0.5-1.5 ft
Description: Tan w/ brown SILT w/ numerous chert fragments

USCS Classification = GM
AASHTO Classification = A-4

19-118

GRAIN SIZE CURVE

Grubbs, Hoskyn,
Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



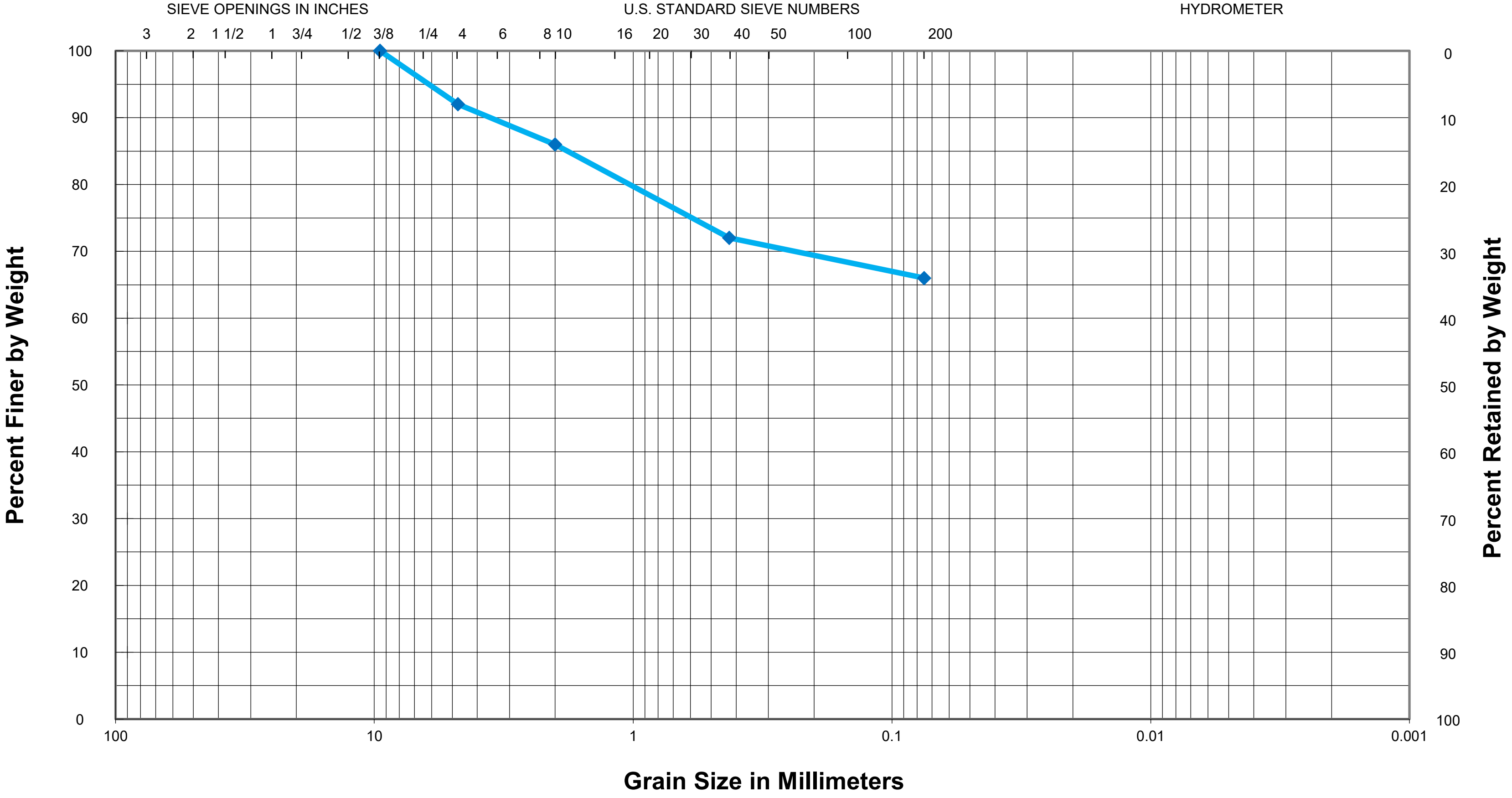
GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

Sample: Boring R61, 9-10 ft; NON-PLASTIC
Description: Reddish brown silty CLAY w/ numerous chert fragments and chert seams and layers

USCS Classification = SM
AASHTO Classification = A-1-b

19-118

GRAIN SIZE CURVE



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

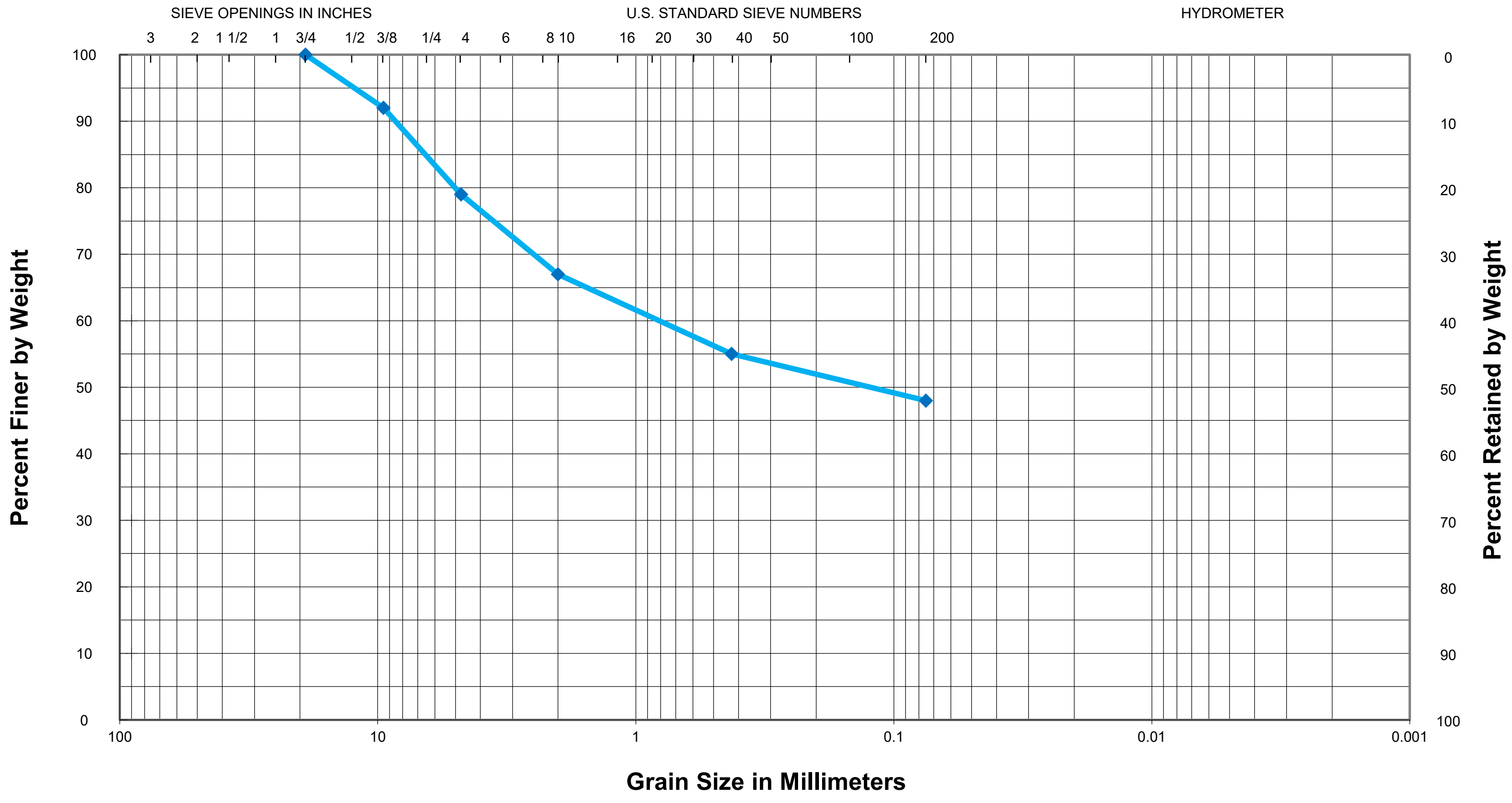
Sample: Boring R65, 2.5-3.5 ft; LL=77, PL=39, PI=38
Description: Reddish brown and tan CLAY w/ chert nodules and fragments

USCS Classification = CH
AASHTO Classification = A-7-5

19-118

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

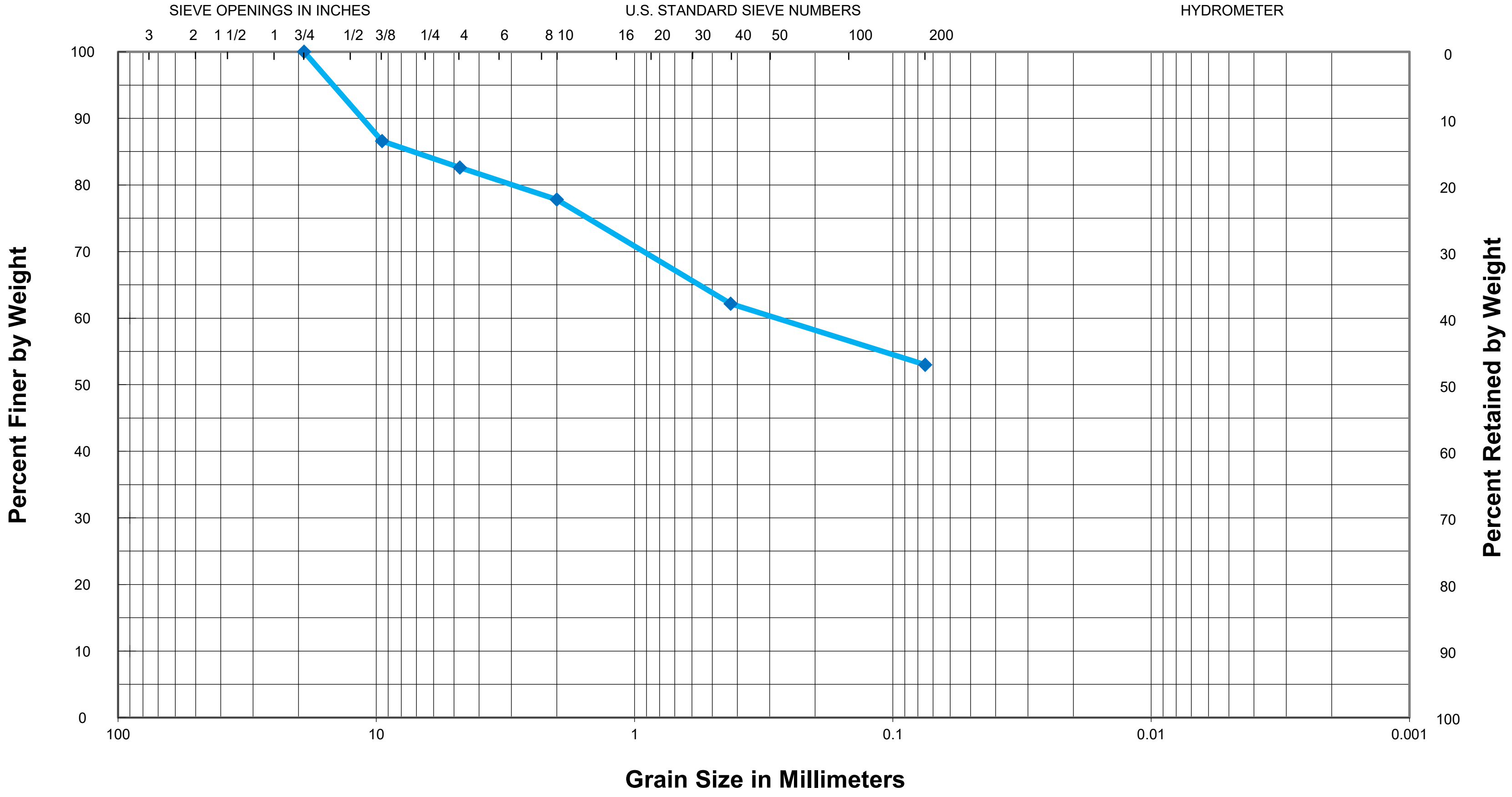
Sample: Boring R67, 2.5-3.5 ft; LL=35, PL=22, PI=13
Description: Reddish brown silty CLAY w/ chert nodules and fragments

USCS Classification = SC
AASHTO Classification = A-6

19-118

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

Sample: S18, 9-10 ft
Description: Medium dense reddish tan SILT with numerous chert fragments

USCS Classification = ML
AASHTO Classification = A-4

APPENDIX D

SUMMARY of PROCTOR and CBR TEST RESULTS

PROJECT: 090069 XNA Access Road
LOCATION: Benton County, Arkansas
GHBW JOB NUMBER: 19-118

													PROCTOR TEST RESULTS		CBR TEST RESULTS	
						ATTERBERG LIMITS										
TEST PIT No.	SAMPLE DEPTH (ft)	APPROX STATION	APPROX OFFSET (ft)	SOIL DESCRIPTION	WATER CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PERCENT RETAINED #4	PERCENT PASSING #200	UNIFIED CLASS.	AASHTO CLASS.	MAX DRY UNIT WT (pcf)	OPTIMUM MOISTURE (%)	PERCENT COMPACTION of MAX DRY UNIT WT	LABORATORY CBR VALUE
1/5A	0.5-1.5	305+00	CL	Brown clayey SILT w/ fine to coarse chert gravel	22	34	24	10	37	51	ML	A-4	110.2	13.2	95.0	7.8
1/5A	0.5-1.5	305+00	CL	Brown clayey SILT w/ fine to coarse chert gravel	22	34	24	10	37	51	ML	A-4	110.2	13.2	91.6	3.6
1/5A	0.5-1.5	305+00	CL	Brown clayey SILT w/ fine to coarse chert gravel	22	34	24	10	37	51	ML	A-4	110.2	13.2	96.0	9.0
1/5A	0.5-1.5	305+00	CL	Brown clayey SILT w/ fine to coarse chert gravel	22	34	24	10	37	51	ML	A-4	110.2	13.2	98.3	14.2
1/5B	0.5-1.5	445+00	CL	Reddish brown and reddish tan clayey chert GRAVEL, sandy	20	37	23	14	35	46	GC	A-6	111.2	12.4	95.0	10.9
1/5B	0.5-1.5	445+00	CL	Reddish brown and reddish tan clayey chert GRAVEL, sandy	20	37	23	14	35	46	GC	A-6	111.2	12.4	90.1	9.9
1/5B	0.5-1.5	445+00	CL	Reddish brown and reddish tan clayey chert GRAVEL, sandy	20	37	23	14	35	46	GC	A-6	111.2	12.4	95.5	11.0
1/5B	0.5-1.5	445+00	CL	Reddish brown and reddish tan clayey chert GRAVEL, sandy	20	37	23	14	35	46	GC	A-6	111.2	12.4	98.7	13.4
1/7A	0.5-2.0	245+00	CL	Brown SILT, slightly sandy, with some chert fragments	22	--Non-Plastic--			5	85	ML	A-4	106.6	14.5	96.5	13.0
1/7B	0.5-2.0	185+00	CL	Brown silty chert GRAVEL, sandy	22	--Non-Plastic--			37	49	GM	A-4	105.2	14.6	96.6	14.8
1/7C	0.5-2.0	121+00	CL	Tan and brown SILT with numerous chert fragments	23	--Non-Plastic--			32	57	ML	A-4	107.3	11.9	96.9	16.0

GRUBBS, HOSKYN,
BARTON & WYATT, LLC
CONSULTING ENGINEERS

REPORT OF MODIFIED PROCTOR (AASHTO T 180)

Project: 090069 XNA Access Road - Benton County, Arkansas Job No: 19-118
Material Description: Brown clayey SILT w/ fine to coarse chert gravel and rootlets
Location Sampled/Source: On-Site (Approx Sta 305+00, CL)
Sample No: 01/05A
Date Sampled: 1/5/2022
Sampled By: JDF
Date Tested: 1/9/2022
Tested By: Robert Brewer (CTTP #2516)
Report Date: 1/26/2022

LAB COMPACTION PROCEDURE: AASHTO T 180 Method: D	
Maximum Unit Dry Wt. (pcf):	**110.2**
Optimum Water Content (%):	**13.2**

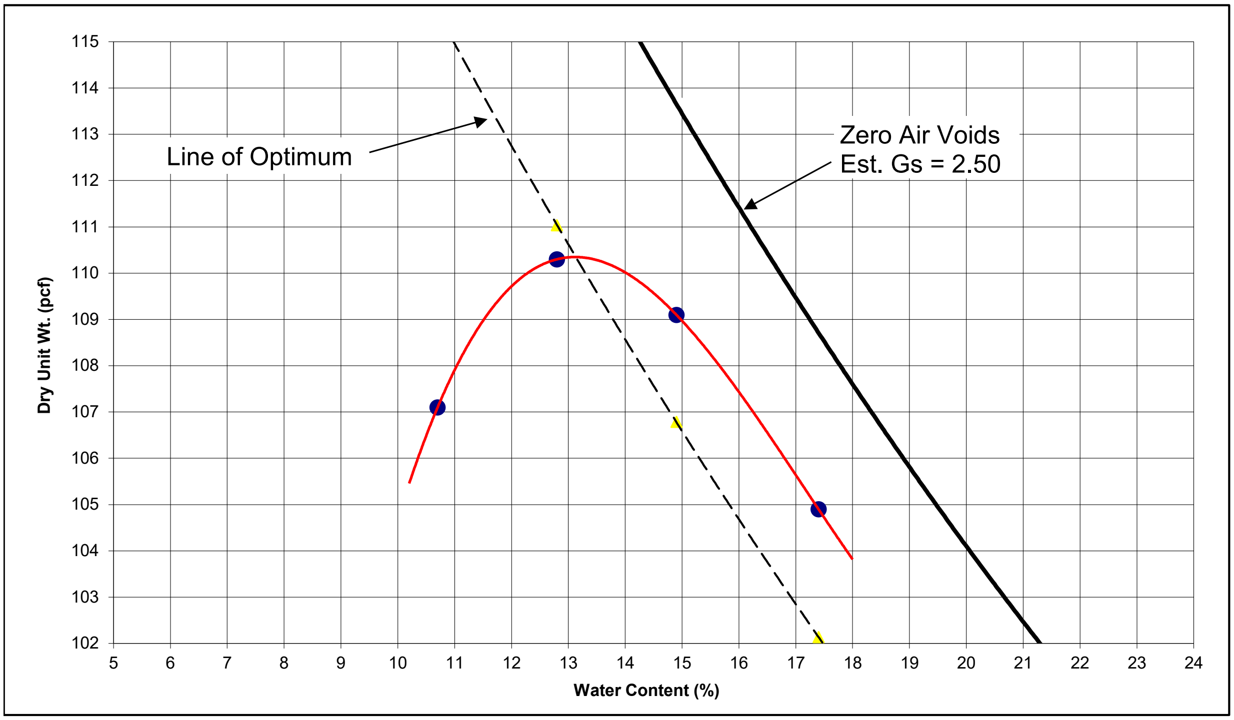
*Includes rock replacement of +3/4" Material

ATTERBERG LIMITS AASHTO T 89, T 90
Liquid Limit: 34
Plastic Limit: 24
Plasticity Index: 10

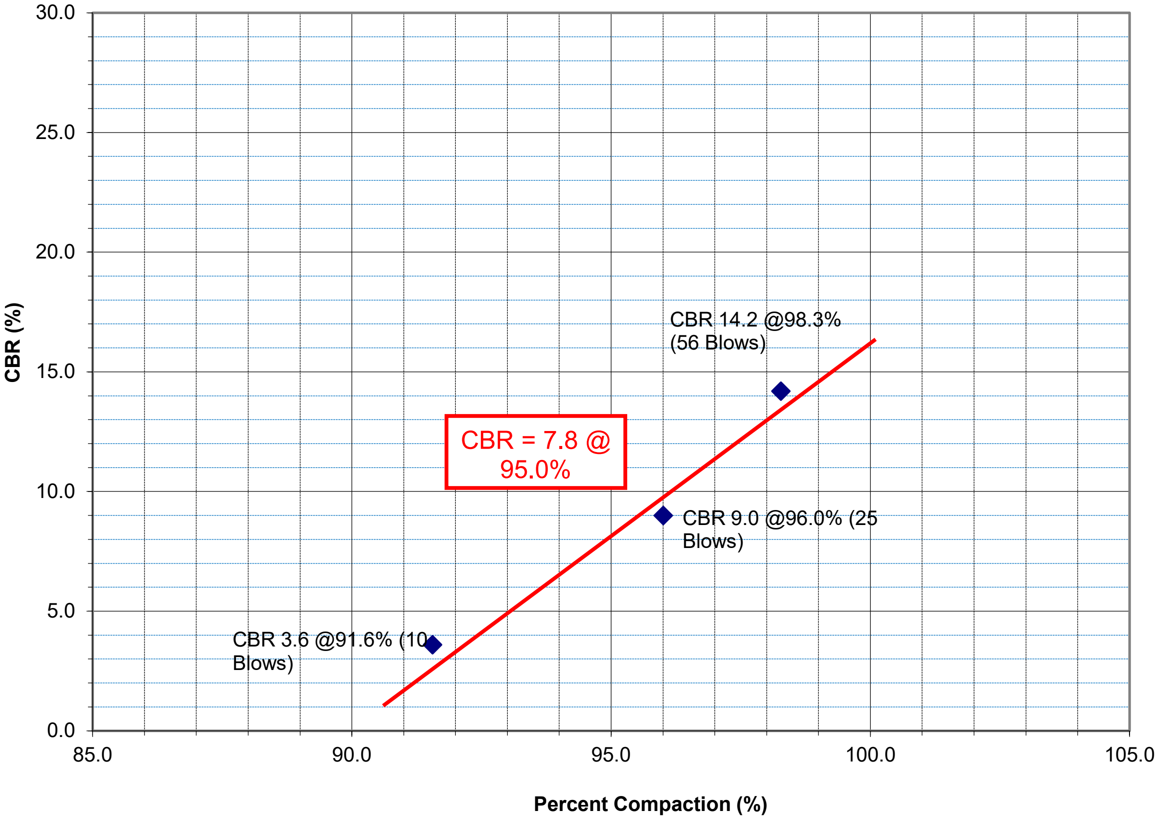
Unified Classification/ AASHTO M145-91	
ML	A-4

GRADATION AASHTO T 11, T 27	
Sieve Number	Percent Passing
2"	**96**
1 1/2"	**86**
1"	**82**
3/4"	**78**
3/8"	**71**
#4	**63**
#10	**57**
#40	**53**
#200	**51**

As Received Water Content: **21.5%**



California Bearing Ratio Test Report
Sample 01/05A (Sta. 305+00,CL) Summary
(AASHTO T 193)



Test Sample Data

Location	Classification		As-Is Moisture Content, %	Assumed Specific Gravity	Liquid Limit, %	Plastic Limit, %	% Passing 3/4"	% Passing No.200
	USCS	AASHTO						
On-site (0.5' - 1.5')	ML	A-4	21.5	2.50	34	24	78	51

PROCTOR TEST RESULTS (AASHTO T 180 Method D)	**MATERIAL DESCRIPTION**
Max Dry Density = 110.2 pcf, Opt Moisture Content = 13.2 %	Brown clayey SILT w/ fine to coarse chert gravel and rootlets

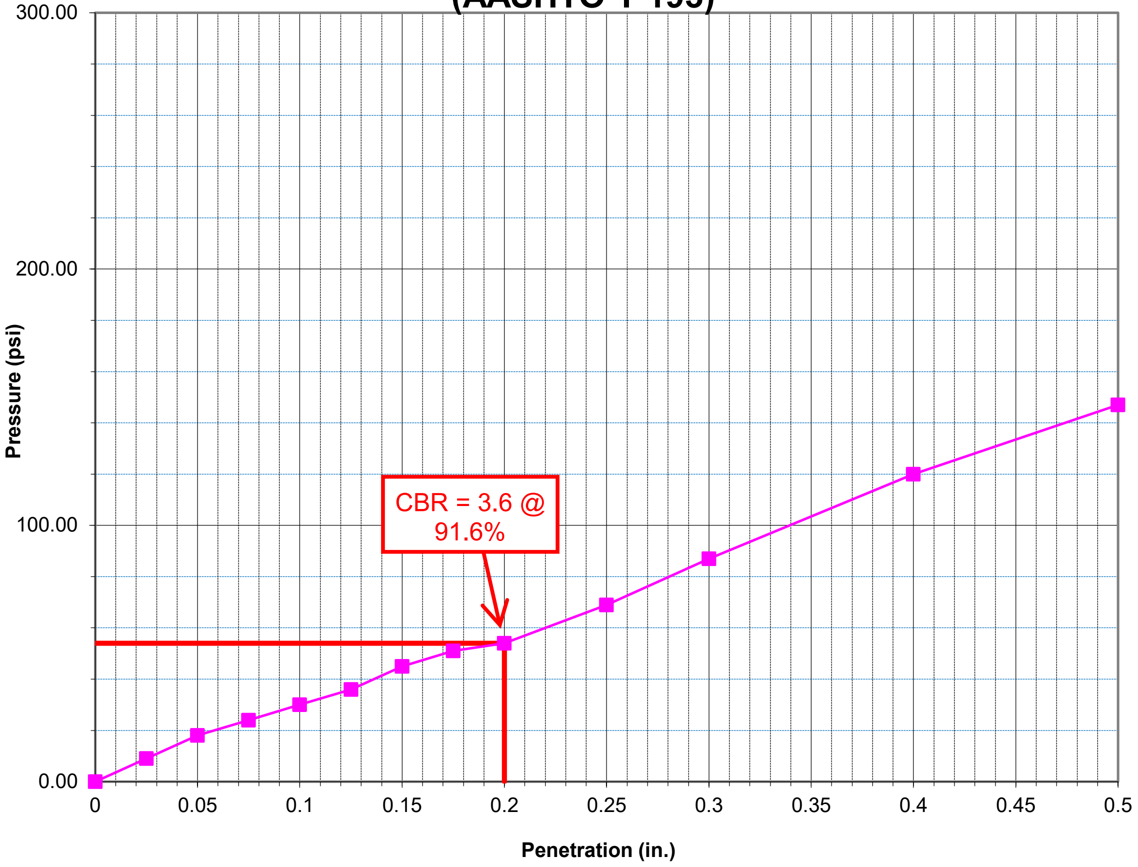
CBR Test Results

Sample ID	Molding Data			Surcharge	CBR		Percent Compaction	Percent Swell
	Blows	Dry Density	Moisture		0.10 in	0.20 in		
01/05A-A	10	100.9	16.0%	20 lbs	3.0	3.6	91.6	0.349
01/05A-B	25	105.8	16.0%	20 lbs	7.2	9.0	96.0	0.524
01/05A-C	56	108.3	16.1%	20 lbs	10.5	14.2	98.3	0.502

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

Project: 090069 XNA Access Road
Project No.: 19-118
Location: Benton County, Arkansas
Sample Date: 1/5/2022
Test Date: 1/25/2022

Laboratory CBR Test Report
Sample 01/05A (Sta. 305+00, CL)
(AASHTO T 193)



Location	Classification		As-Is Moisture Content, %	Assumed Specific Gravity	Liquid Limit, %	Plastic Limit, %	% Passing 3/4"	% Passing No.200
	USCS	AASHTO						
On-site (0.5' - 1.5')	ML	A-4	21.5	2.50	34	24	78	51

PROCTOR TEST RESULTS (AASHTO T 180)	MATERIAL DESCRIPTION
Optimum Moisture Content = 13.2 % Maximum Dry Density = 110.2 pcf	Brown clayey SILT w/ fine to coarse chert gravel and rootlets

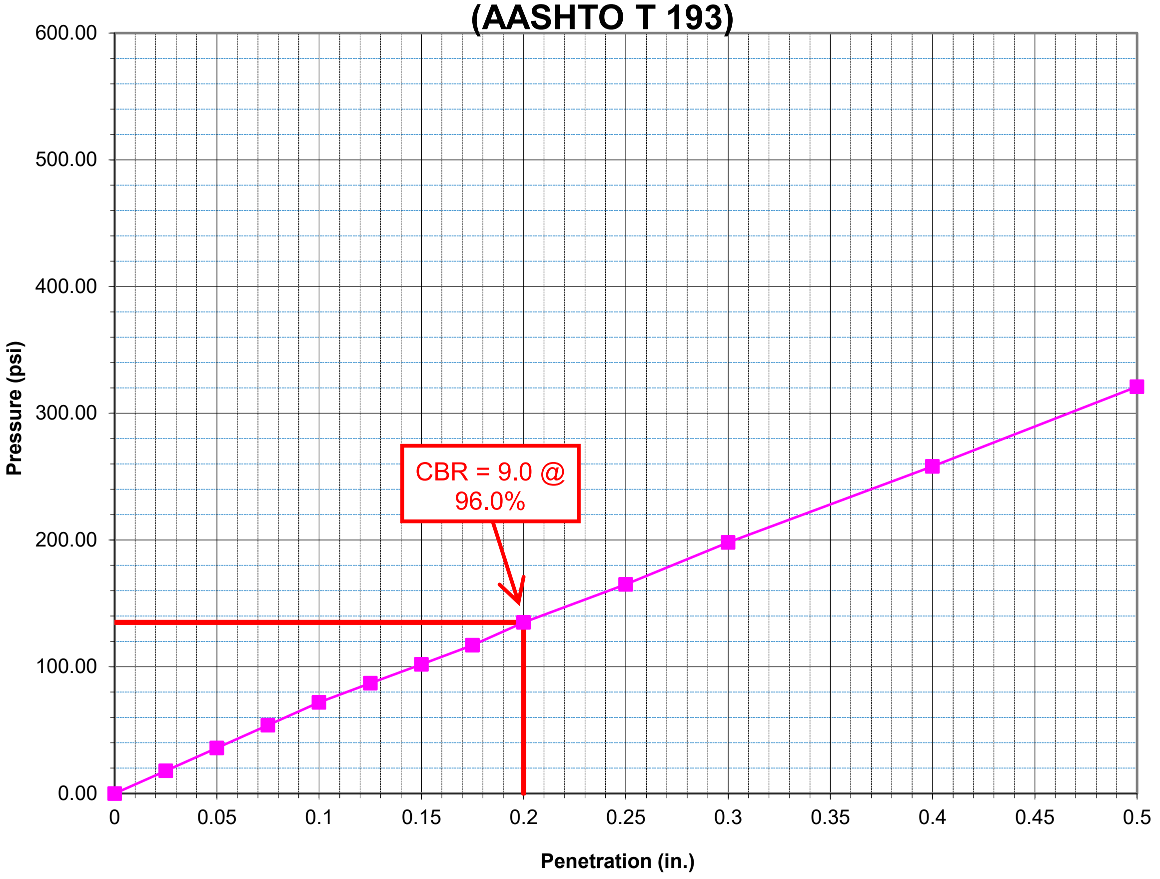
Remarks:

As remolded (10 Blows): Dry Density, γ_d = 100.9 pcf; Moisture Content, w = 16.0 %

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

Project: 090069 XNA Access Road
Project No.: 19-118
Location: Benton County, Arkansas
Sample Date: 1/5/2022
Test Date: 1/25/2022

Laboratory CBR Test Report
Sample 01/05A (Sta. 305+00, CL)
(AASHTO T 193)



Location	Classification		As-Is Moisture Content, %	Assumed Specific Gravity	Liquid Limit, %	Plastic Limit, %	% Passing 3/4"	% Passing No.200
	USCS	AASHTO						
On-site (0.5' - 1.5')	ML	A-4	21.5	2.50	34	24	78	51

PROCTOR TEST RESULTS (AASHTO T 180)	MATERIAL DESCRIPTION
Optimum Moisture Content = 13.2 % Maximum Dry Density = 110.2 pcf	Brown clayey SILT w/ fine to coarse chert gravel and rootlets

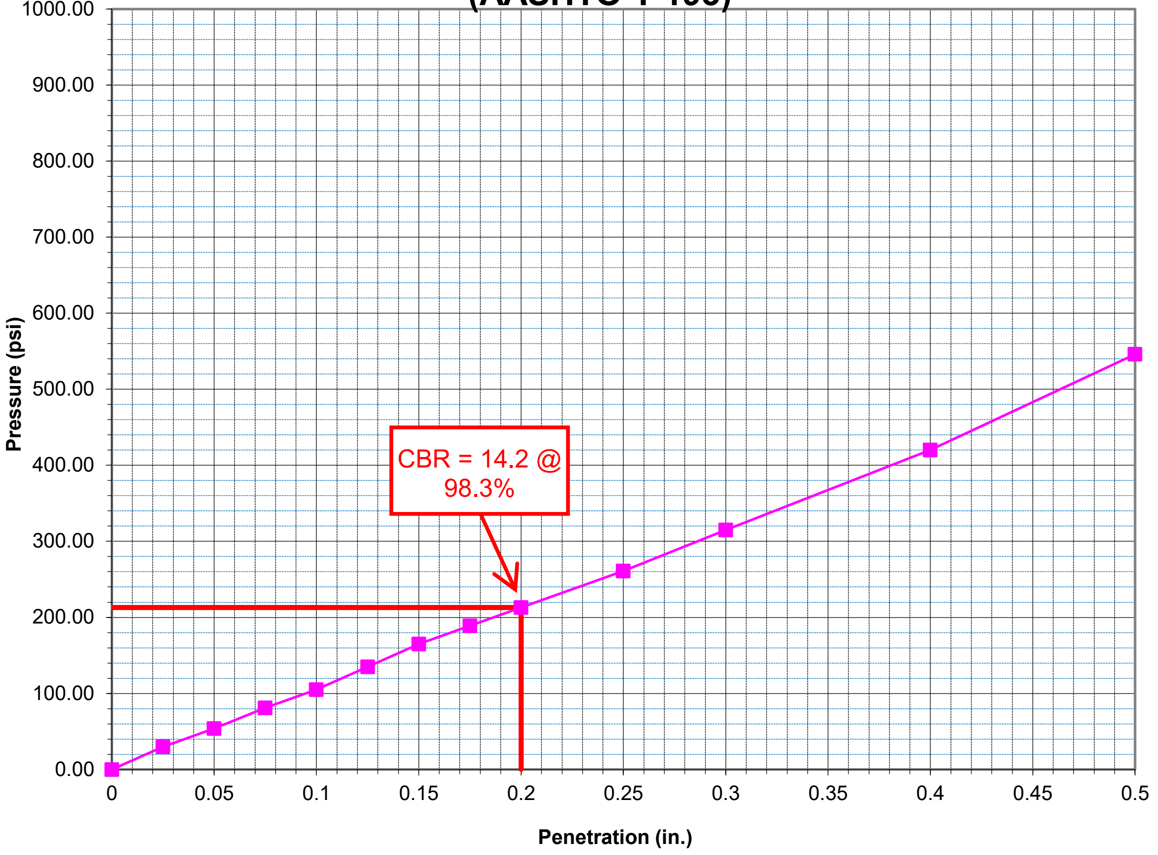
Remarks:

As remolded (10 Blows): Dry Density, γ_d = 105.8 pcf; Moisture Content, w = 16.0 %

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

Project: 090069 XNA Access Road
Project No.: 19-118
Location: Benton County, Arkansas
Sample Date: 1/5/2022
Test Date: 1/25/2022

Laboratory CBR Test Report
Sample 01/05A (Sta. 305+00, CL)
(AASHTO T 193)



Location	Classification		As-Is Moisture Content, %	Assumed Specific Gravity	Liquid Limit, %	Plastic Limit, %	% Passing 3/4"	% Passing No.200
	USCS	AASHTO						
On-site (0.5' - 1.5')	ML	A-4	21.5	2.50	34	24	78	51

PROCTOR TEST RESULTS (AASHTO T 180)	MATERIAL DESCRIPTION
Optimum Moisture Content = 13.2 % Maximum Dry Density = 110.2 pcf	Brown clayey SILT w/ fine to coarse chert gravel and rootlets

Remarks:

As remolded (10 Blows): Dry Density, γ_d = 108.3 pcf; Moisture Content, w = 16.1 %

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

Project: 090069 XNA Access Road
Project No.: 19-118
Location: Benton County, Arkansas
Sample Date: 1/5/2022
Test Date: 1/25/2022

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

REPORT OF MODIFIED PROCTOR (AASHTO T 180)

Project: 090069 XNA Access Road - Benton County, Arkansas
Job No: 19-118
Material Description: Reddish Brown and Reddish Tan clayey chert GRAVEL, sandy
Location Sampled/Source: On-Site (Approx Sta 445+00, CL)
Sample No: 01/05B
Date Sampled: 1/5/2022
Sampled By: JDF
Date Tested: 1/9/2022
Tested By: Robert Brewer (CTTP #2516)
Report Date: 1/10/2022

LAB COMPACTION PROCEDURE: AASHTO T 180 Method: D	
Maximum Unit Dry Wt. (pcf):	**111.2**
Optimum Water Content (%):	**12.4**

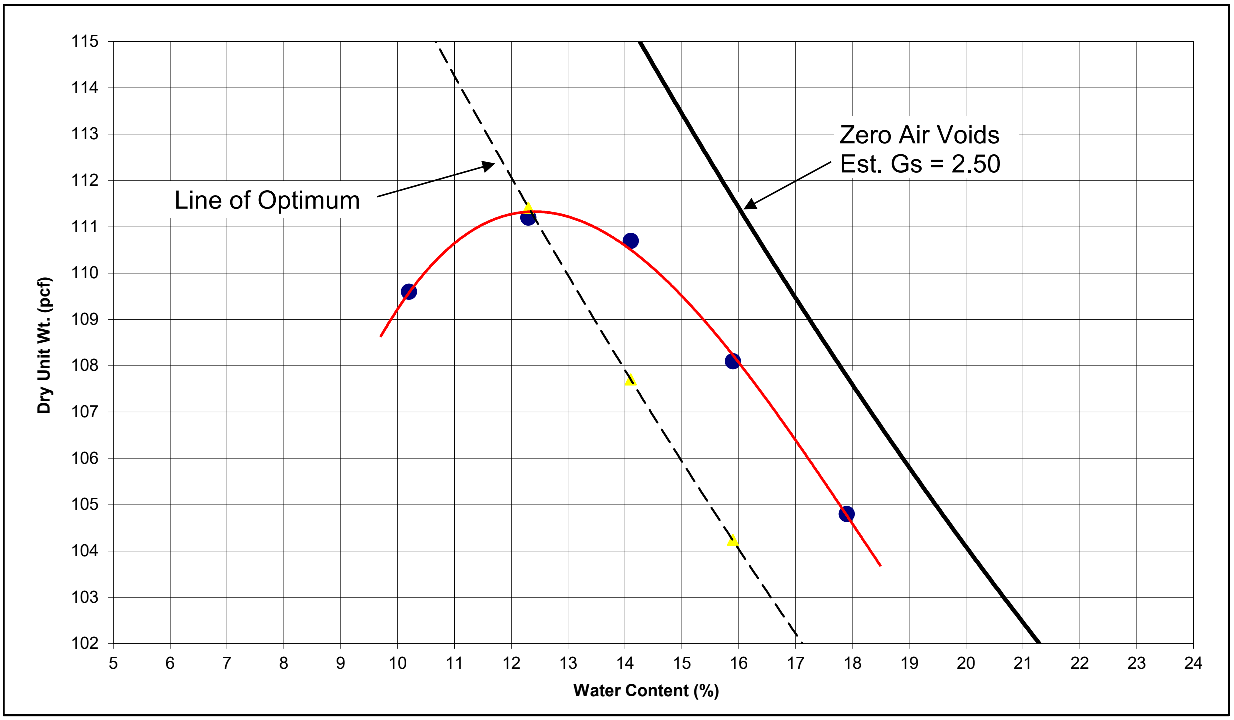
*Includes rock replacement of +3/4" Material

ATTERBERG LIMITS AASHTO T 89, T 90
Liquid Limit: 37
Plastic Limit: 23
Plasticity Index: 14

Unified Classification/ AASHTO M145-91	
GC	A-6

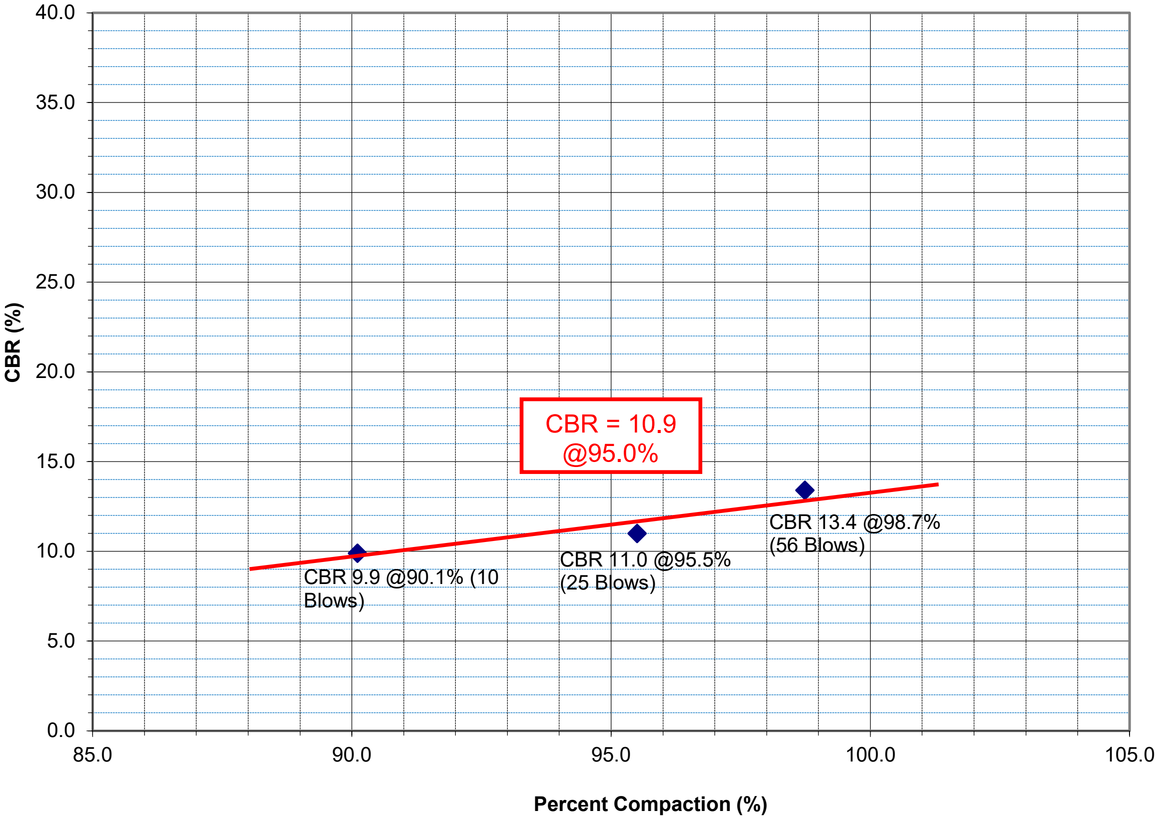
GRADATION AASHTO T 11, T 27	
Sieve Number	Percent Passing
2"	**100**
1 1/2"	**95**
1"	**91**
3/4"	**87**
3/8"	**77**
#4	**65**
#10	**55**
#40	**50**
#200	**46**

As Received Water Content: **20.4%**



PLATE

California Bearing Ratio Test Report
Sample 01/05B (Sta. 445+00,CL) Summary
(AASHTO T 193)



Test Sample Data

Location	Classification		As-Is Moisture Content, %	Assumed Specific Gravity	Liquid Limit, %	Plastic Limit, %	% Passing 3/4"	% Passing No.200
	USCS	AASHTO						
On-site (0.5' - 1.5')	GC	A-6	12.4	2.50	37	23	87	46

PROCTOR TEST RESULTS (AASHTO T 180 Method D)	**MATERIAL DESCRIPTION**
Max Dry Density = 111.2 pcf, Opt Moisture Content = 12.4 %	Reddish Brown and Reddish Tan clayey chert GRAVEL, sandy

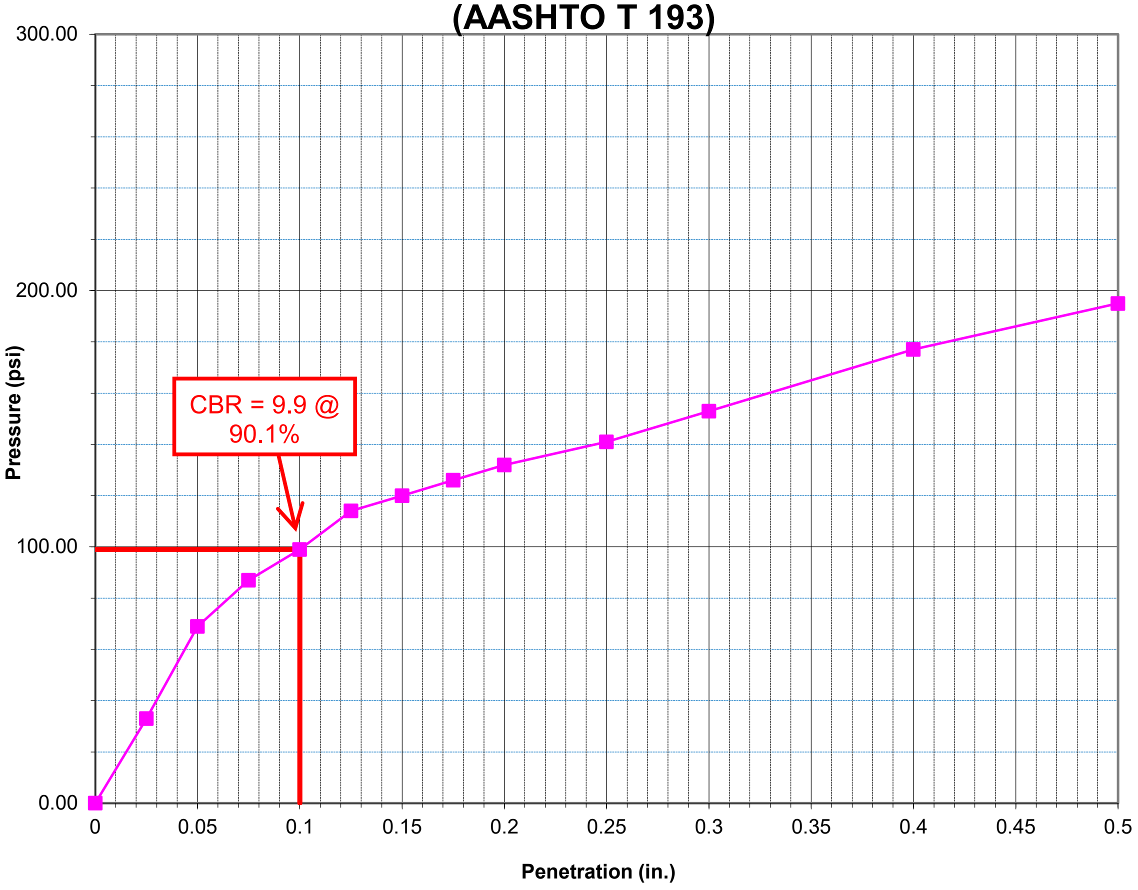
CBR Test Results

Sample ID	Molding Data			Surcharge	CBR		Percent Compaction	Percent Swell
	Blows	Dry Density	Moisture		0.10 in	0.20 in		
01/05B-A	10	100.2	14.8%	20 lbs	9.9	8.8	90.1	0.305
01/05B-B	25	106.2	15.0%	20 lbs	9.6	11.0	95.5	0.065
01/05B-C	56	109.8	14.2%	20 lbs	10.5	13.40	98.7	0.044

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

Project: 090069 XNA Access Road
Project No.: 19-118
Location: Benton County, Arkansas
Sample Date: 1/5/2022
Test Date: 1/21/2022

Laboratory CBR Test Report
Sample 01/05B (Sta. 445+00, CL)
(AASHTO T 193)



CBR = 9.9 @ 90.1%

Location	Classification		As-Is Moisture Content, %	Assumed Specific Gravity	Liquid Limit, %	Plastic Limit, %	% Passing 3/4"	% Passing No.200
	USCS	AASHTO						
On-site (0.5' - 1.5')	GC	A-6	20.4	2.50	37	23	87	46

PROCTOR TEST RESULTS (AASHTO T 180)	MATERIAL DESCRIPTION
Optimum Moisture Content = 12.4 % Maximum Dry Density = 111.2 pcf	Reddish Brown and Reddish Tan clayey chert GRAVEL, sandy

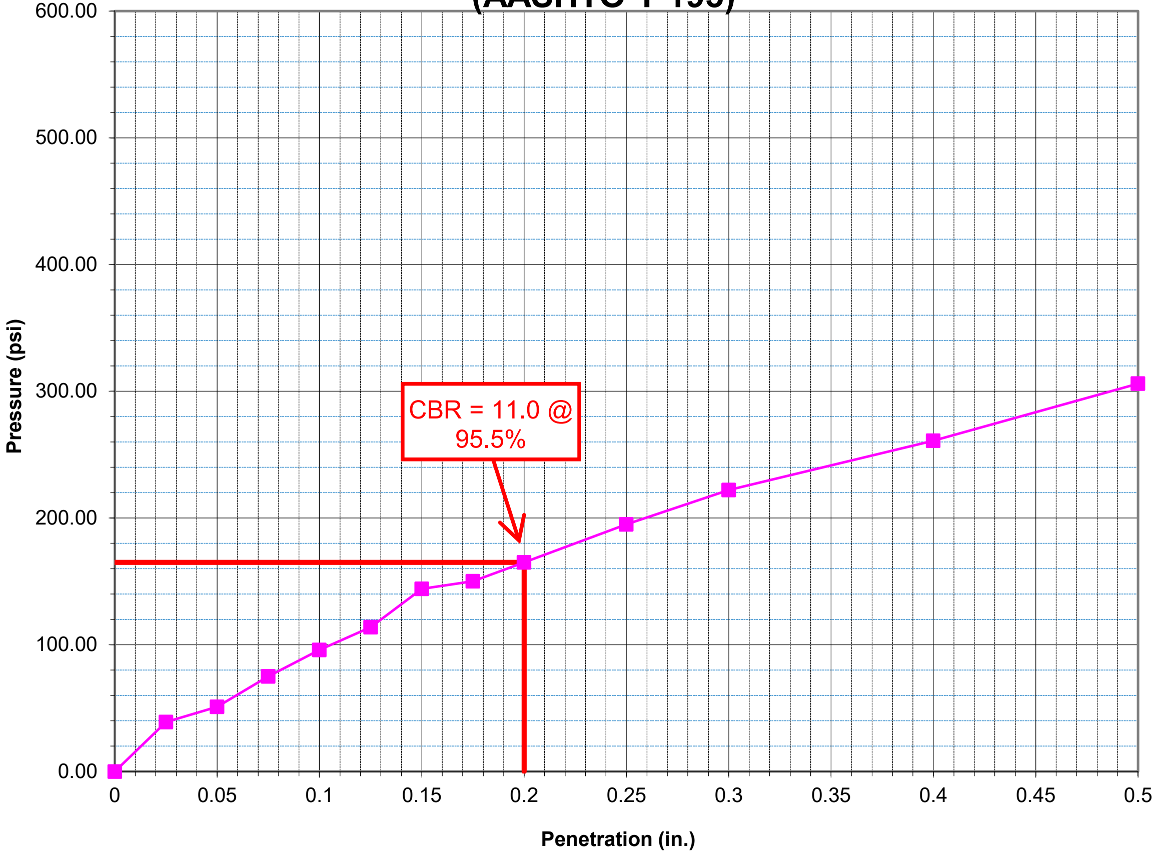
Remarks:

As remolded (10 Blows): Dry Density, γ_d = 100.2 pcf; Moisture Content, w = 14.8 %

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

Project: 090069 XNA Access Road
Project No.: 19-118
Location: Benton County, Arkansas
Sample Date: 1/5/2022
Test Date: 1/21/2022

Laboratory CBR Test Report
Sample 01/05B (Sta. 445+00, CL)
(AASHTO T 193)



Location	Classification		As-Is Moisture Content, %	Assumed Specific Gravity	Liquid Limit, %	Plastic Limit, %	% Passing 3/4"	% Passing No.200
	USCS	AASHTO						
On-site (0.5' - 1.5')	GC	A-6	20.4	2.50	37	23	87	46

PROCTOR TEST RESULTS (AASHTO T 180)	MATERIAL DESCRIPTION
Optimum Moisture Content = 12.4 % Maximum Dry Density = 111.2 pcf	Reddish Brown and Reddish Tan clayey chert GRAVEL, sandy

Remarks:

As remolded (25 Blows): Dry Density, γ_d = 106.2 pcf; Moisture Content, w = 15.0 %

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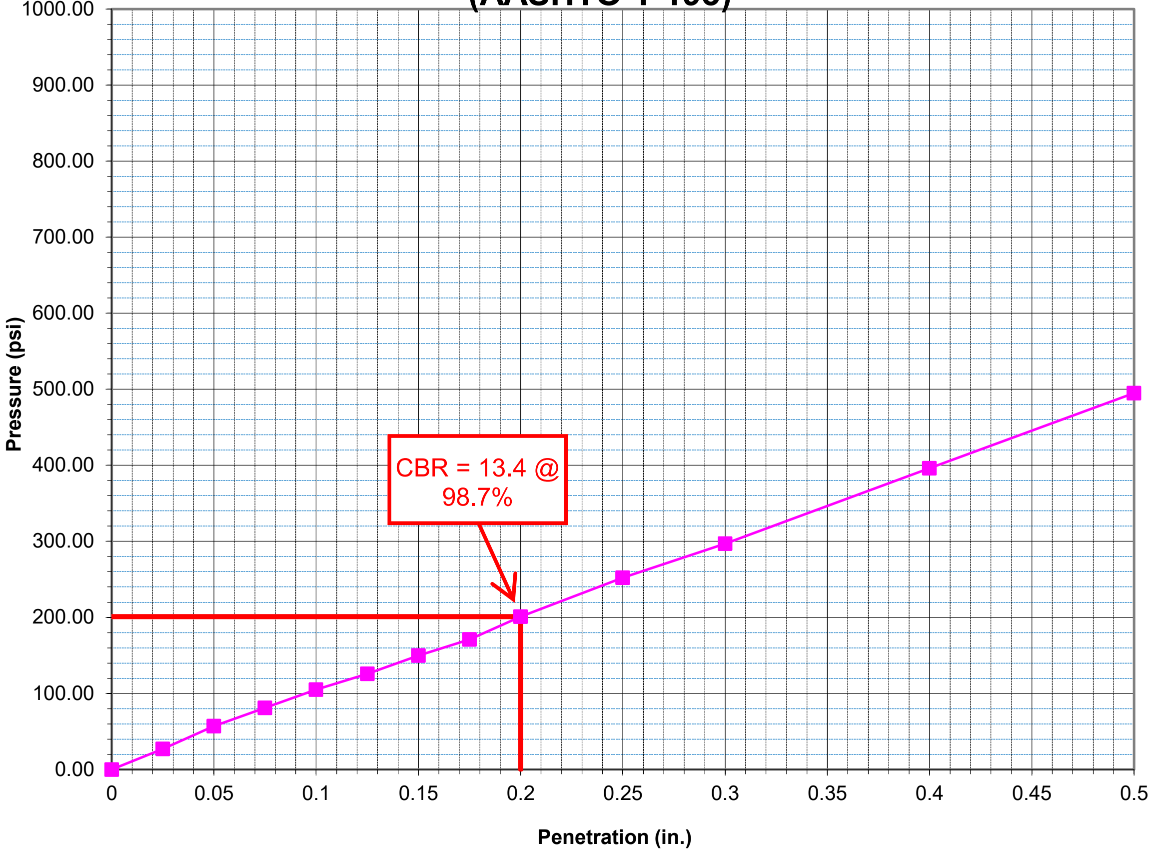
CONSULTING ENGINEERS
A UES Company

Project: 090069 XNA Access Road
Project No.: 19-118
Location: Benton County, Arkansas
Sample Date: 1/5/2022
Test Date: 1/21/2022

Laboratory CBR Test Report
Sample 01/05B (Sta. 445+00, CL)
(AASHTO T 193)



Location	Classification		As-Is Moisture Content, %	Assumed Specific Gravity	Liquid Limit, %	Plastic Limit, %	% Passing 3/4"	% Passing No.200
	USCS	AASHTO						
On-site (0.5' - 1.5')	GC	A-6	20.4	2.50	37	23	87	46

PROCTOR TEST RESULTS (AASHTO T 180)	MATERIAL DESCRIPTION
Optimum Moisture Content = 12.4 % Maximum Dry Density = 111.2 pcf	Reddish Brown and Reddish Tan clayey chert GRAVEL, sandy

Remarks:

As remolded (56 Blows): Dry Density, γ_d = 109.8 pcf; Moisture Content, w = 14.2 %

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

Project: 090069 XNA Access Road
Project No.: 19-118
Location: Benton County, Arkansas
Sample Date: 1/5/2022
Test Date: 1/21/2022

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

REPORT OF STANDARD PROCTOR (AASHTO T 99)

Project: 090069 XNA Access Road - Benton County, Arkansas
Job No: 19-118
Material Description: Brown SILT, slighty sandy, with some chert fragments
Location Sampled/Source: Boring R26 (Approx Sta 245+00, CL)
Sample No: 01/07A
Date Sampled: 1/7/2023
Sampled By: JDF
Date Tested: 2/10/2023
Tested By: Robert Brewer (CTTP #2516)
Report Date: 2/20/2023

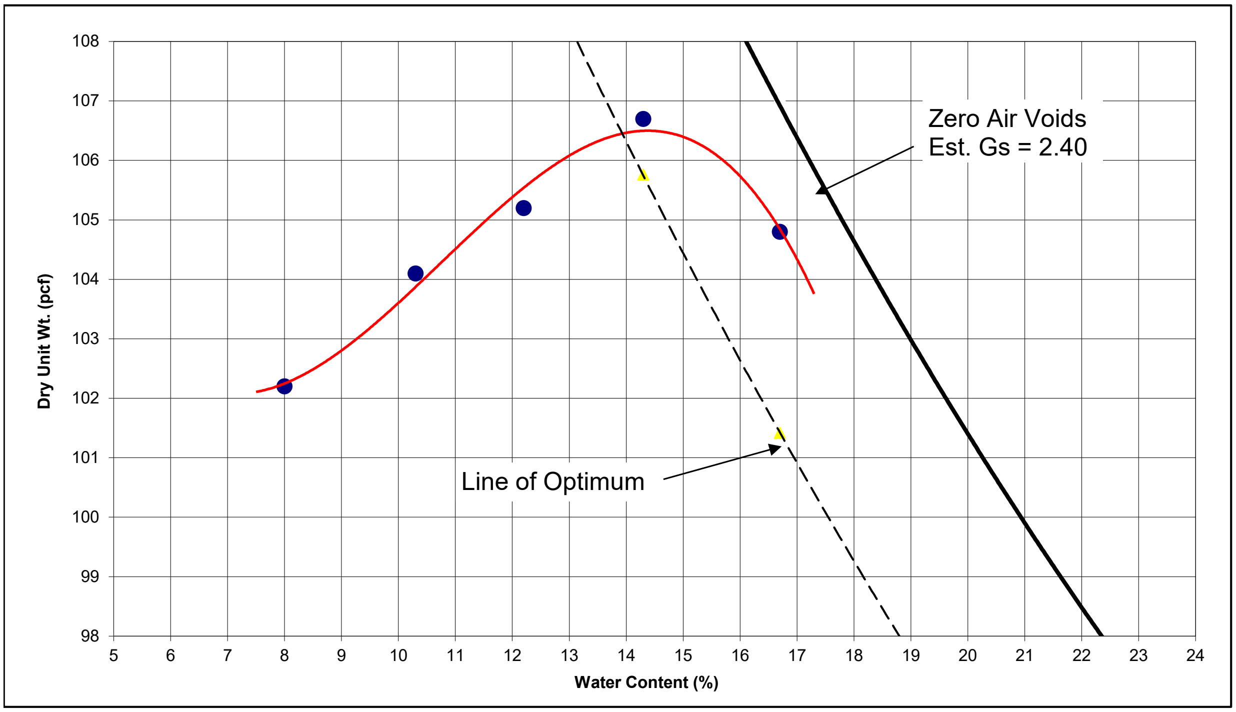
LAB COMPACTION PROCEDURE: AASHTO T 99 Method: D	
Maximum Unit Dry Wt. (pcf):	**106.6**
Optimum Water Content (%):	**14.5**

ATTERBERG LIMITS AASHTO T 89, T 90
Liquid Limit: NP
Plastic Limit: NP
Plasticity Index: NP

Unified Classification/ AASHTO M145-91	
ML	A-4

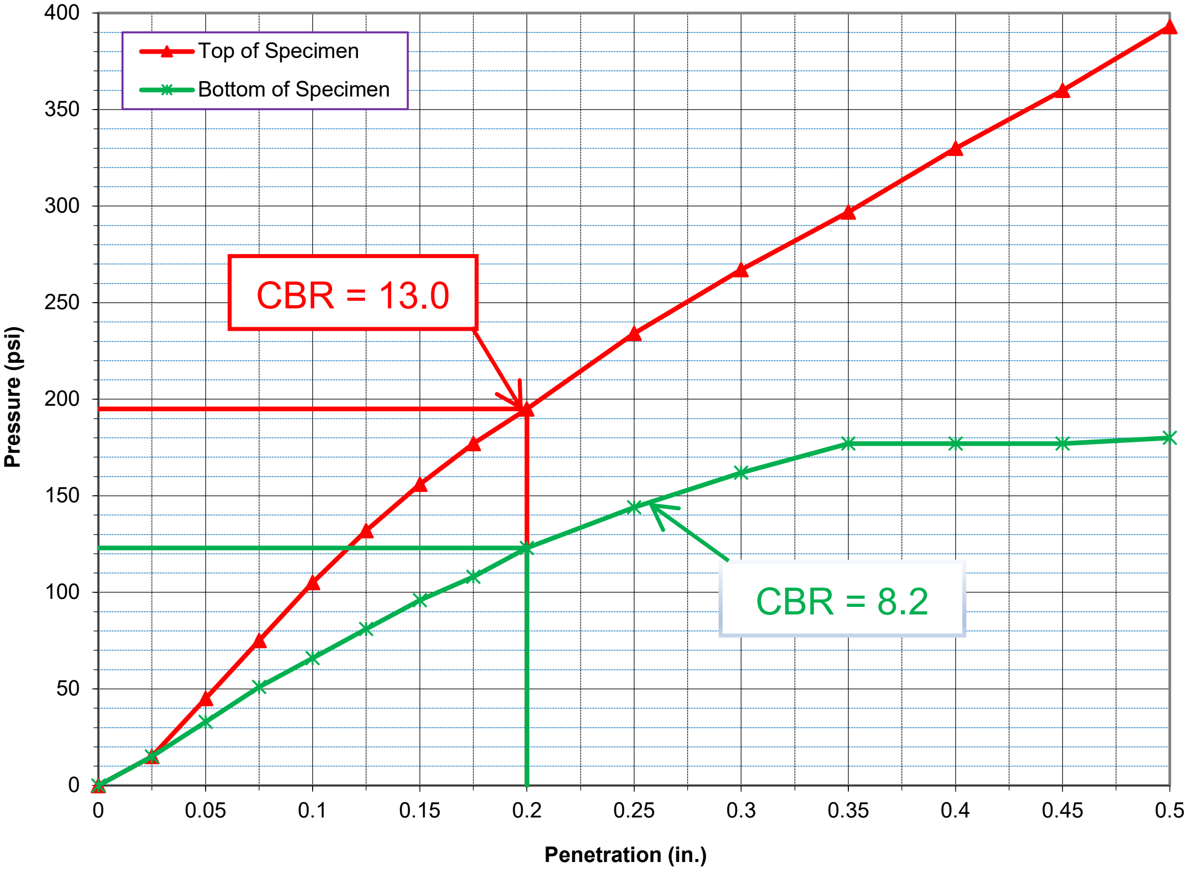
GRADATION AASHTO T 11, T 27	
Sieve Number	Percent Passing
2"	**100**
1 1/2"	**100**
1"	**100**
3/4"	**99**
3/8"	**98**
#4	**95**
#10	**92**
#40	**88**
#200	**85**

As Received Water Content: **22.1%**



PLATE

Laboratory CBR Test Report
(AASHTO T 193)



Test Pit No./Depth, ft	Classification		Natural Moisture Content, %	Specific Gravity	Liquid Limit, %	Plastic Limit, %	% Retained No.4	% Passing No.200
	USCS	AASHTO						
01/07A / 0.5-2.0	ML	A-4	22.1	2.40	Non-plastic		5	85

PROCTOR TEST RESULTS (AASHTO T 99)	**MATERIAL DESCRIPTION**
Optimum Moisture Content = 14.5% Maximum Dry Density = 106.6 pcf	Brown SILT, slighty sandy, with some chert fragments

Remarks:

As Molded: γ_d = 102.9 pcf @ 16.2%; Percent swell: 0.04%

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	Project: 090069 XNA Access Road
	GHBW Project Number: 19-118
	Location: Benton County, Arkansas
	Sample Date: 01/07/2023
	Test Date: 02/15/23

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

REPORT OF MODIFIED PROCTOR
(AASHTO T 180)

Project: 090069 XNA Access Road - Benton County, Arkansas

Job No: 19-118

Material Description: Brown silty chert GRAVEL, sandy

Location Sampled/Source: Boring R14 (Approx Sta 185+00, CL)

Sample No: 01/07B

Date Sampled: 1/7/2023

Sampled By: JDF

Date Tested: 2/8/2023

Tested By: Robert Brewer (CTTP #2516)

Report Date: 2/20/2023

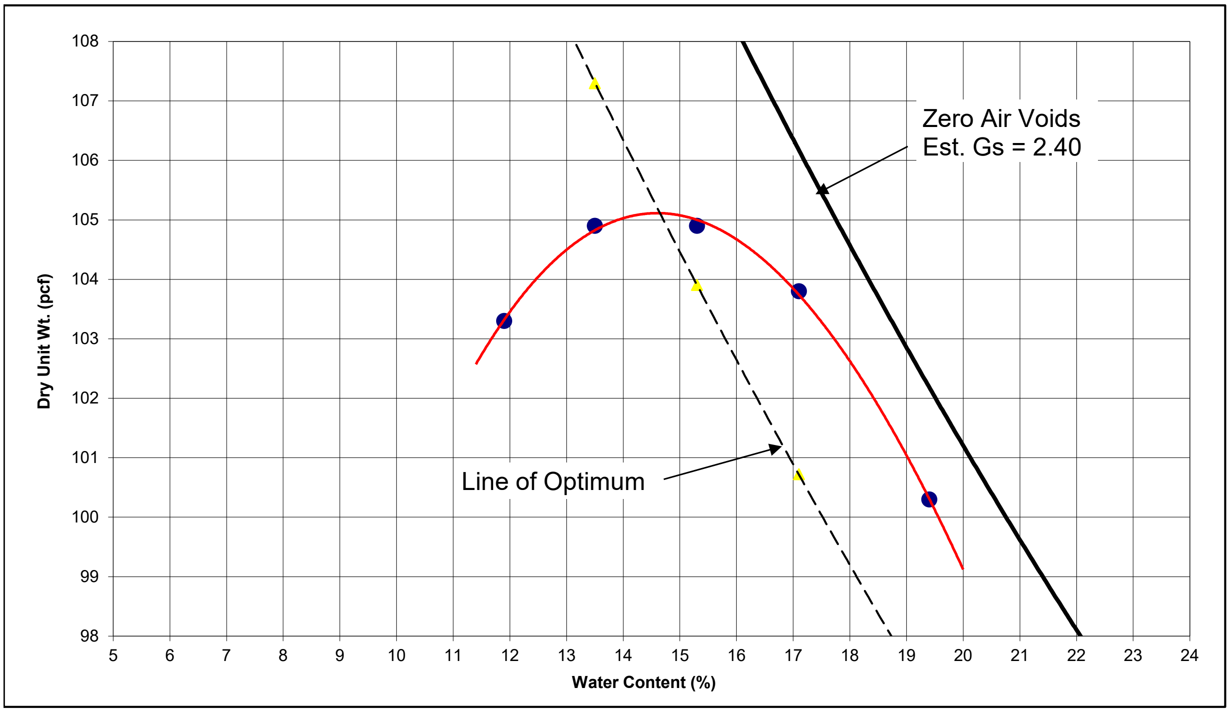
LAB COMPACTION PROCEDURE: AASHTO T 180 Method: D	
Maximum Unit Dry Wt. (pcf):	**105.2**
Optimum Water Content (%):	**14.6**

ATTERBERG LIMITS AASHTO T 89, T 90
Liquid Limit: NP
Plastic Limit: NP
Plasticity Index: NP

Unified Classification/ AASHTO M145-91	
GM	A-4

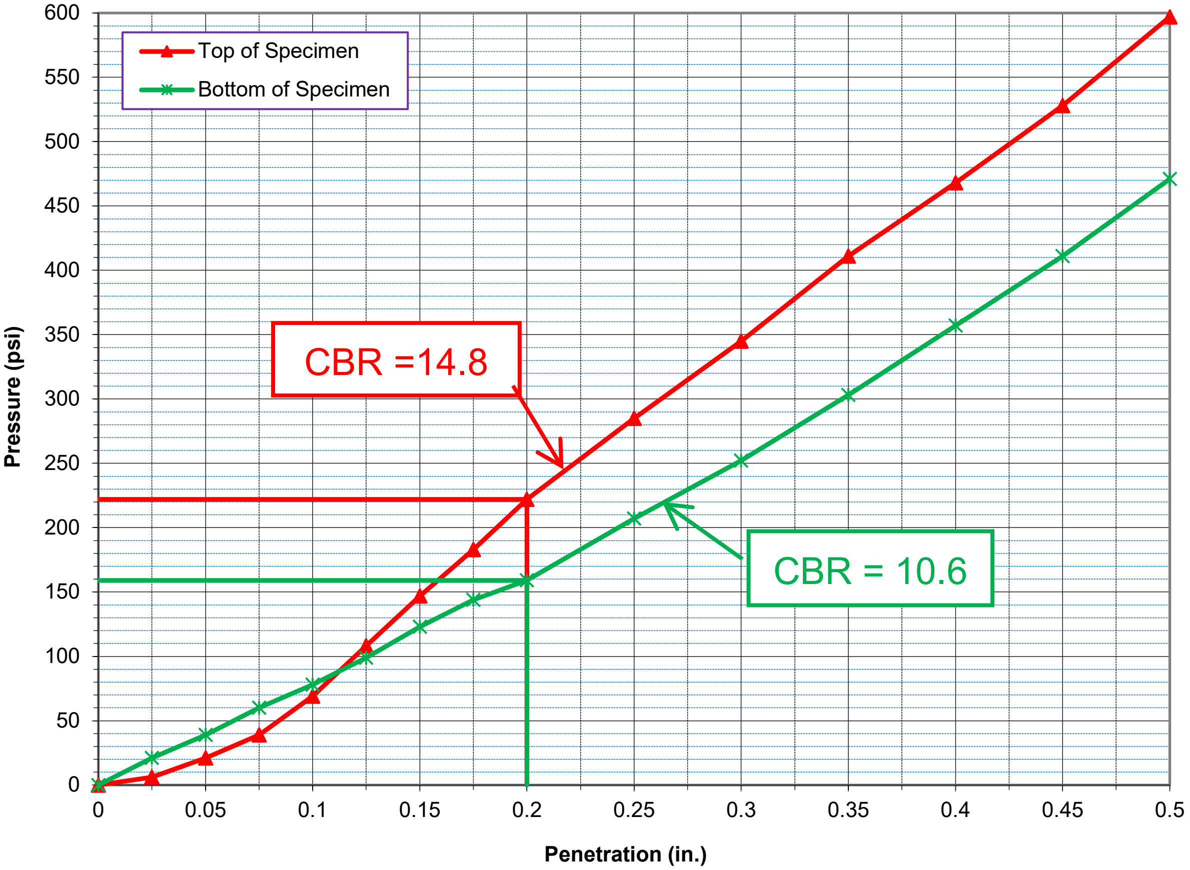
GRADATION AASHTO T 11, T 27	
Sieve Number	Percent Passing
2"	**100**
1 1/2"	**95**
1"	**91**
3/4"	**85**
3/8"	**72**
#4	**64**
#10	**56**
#40	**52**
#200	**49**

As Received Water Content: **22.1%**



PLATE

Laboratory CBR Test Report
(AASHTO T 193)



Test Pit No./Depth, ft	Classification		Natural Moisture Content, %	Specific Gravity	Liquid Limit, %	Plastic Limit, %	% Retained No.4	% Passing No.200
	USCS	AASHTO						
01/07B / 0.5-2.0	GM	A-4	22.1	2.40	Non-plastic		37	49

PROCTOR TEST RESULTS (AASHTO T 180)	**MATERIAL DESCRIPTION**
Optimum Moisture Content = 14.6% Maximum Dry Density = 105.2 pcf	Brown silty chert GRAVEL, sandy

Remarks:

As Molded: γ_d = 101.6 pcf @ 18.0%; Percent swell: 0.09%

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

Project: 090069 XNA Access Road
GHBW Project Number: 19-118
Location: Benton County, Arkansas
Sample Date: 01/07/23
Test Date: 2/15/23

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

REPORT OF MODIFIED PROCTOR (AASHTO T 180)

Project: 090069 XNA Access Road - Benton County, Arkansas   Job No: 19-118
Material Description: Tan and brown SILT with numerous chert fragments
Location Sampled/Source: Boring R5 (Approx Sta 121+00, CL)
Sample No: 01/07C
Date Sampled: 1/7/2023
Sampled By: JDF
Date Tested: 2/10/2023
Tested By: Robert Brewer (CTTP #2516)
Report Date: 2/20/2023

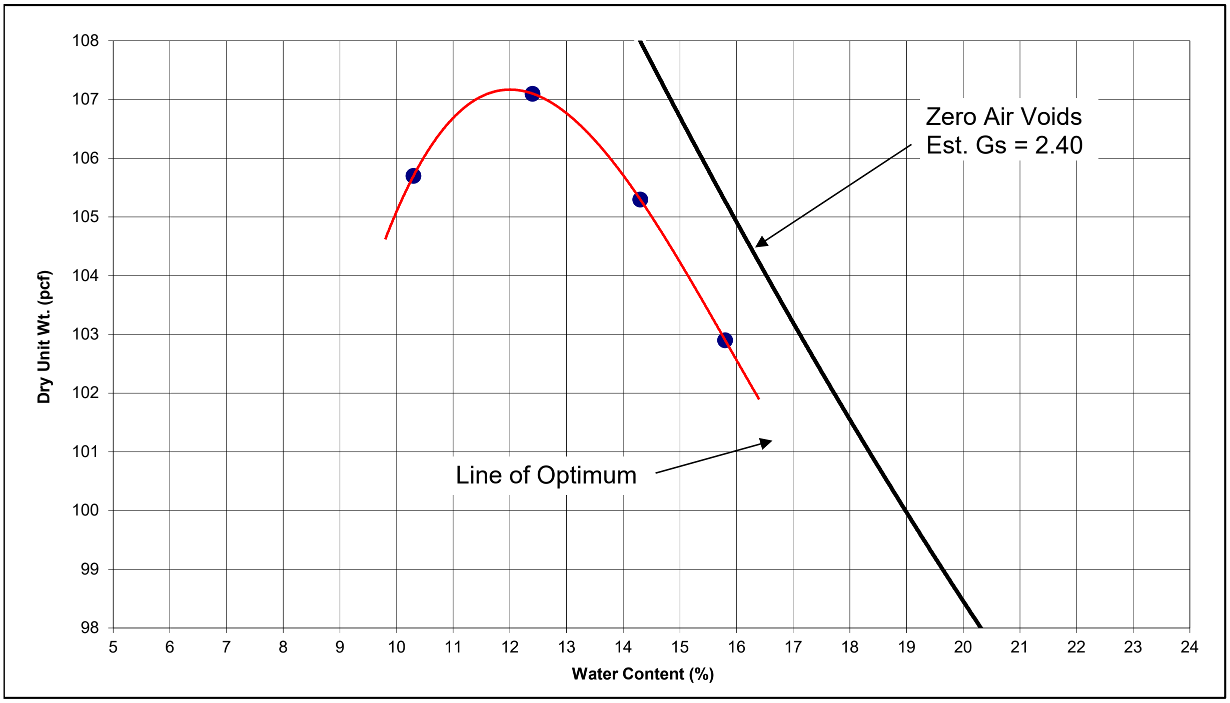
LAB COMPACTION PROCEDURE: AASHTO T 180 Method: D	
Maximum Unit Dry Wt. (pcf):	**107.3**
Optimum Water Content (%):	**11.9**

ATTERBERG LIMITS AASHTO T 89, T 90
Liquid Limit: NP
Plastic Limit: NP
Plasticity Index: NP

Unified Classification/ AASHTO M145-91	
ML	A-4

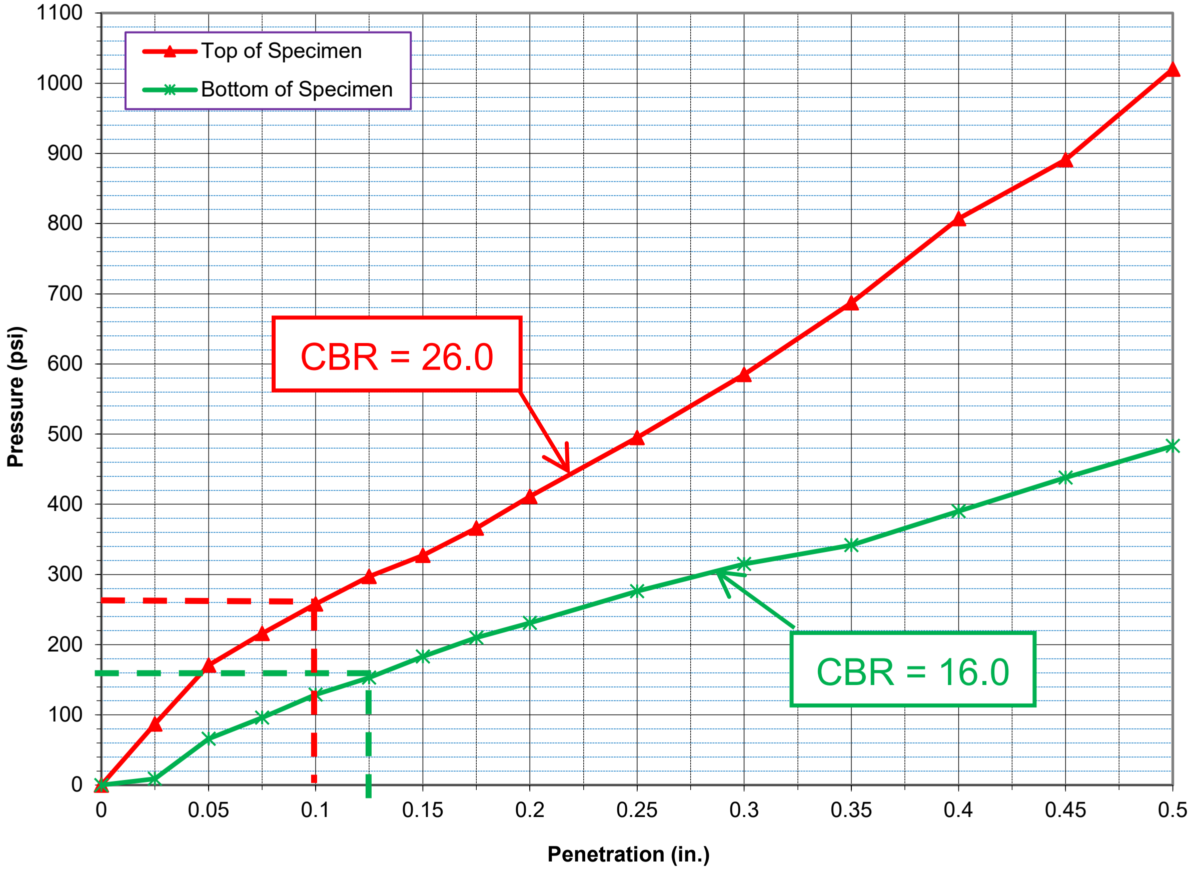
GRADATION AASHTO T 11, T 27	
Sieve Number	Percent Passing
2"	**100**
1 1/2"	**99**
1"	**93**
3/4"	**88**
3/8"	**77**
#4	**68**
#10	**62**
#40	**59**
#200	**57**

As Received Water Content: **22.8%**



PLATE

Laboratory CBR Test Report
(AASHTO T 193)



Test Pit No./Depth, ft	Classification		Natural Moisture Content, %	Specific Gravity	Liquid Limit, %	Plastic Limit, %	% Retained No.4	% Passing No.200
	USCS	AASHTO						
01/07C / 0.5-2.0	ML	A-4	22.8	2.30	Non-plastic		32	57

PROCTOR TEST RESULTS (AASHTO T 180)	**MATERIAL DESCRIPTION**
Optimum Moisture Content = 11.9% Maximum Dry Density = 107.3 pcf	Tan and brown SILT with numerous chert fragments

Remarks:

As Molded: γ_d = 104.0 pcf @ 12.3%; Percent swell: 0.09%

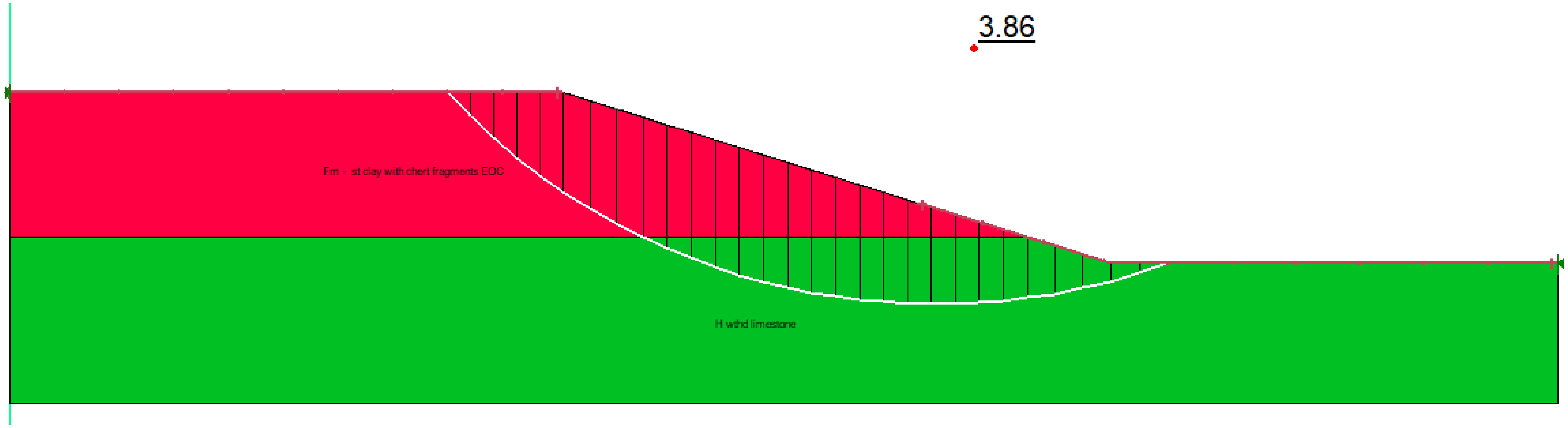
Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

Project: 090069 XNA Access Road
GHBW Project Number: 19-118
Location: Benton County, Arkansas
Sample Date: 01/07/2023
Test Date: 2/15/23

APPENDIX E

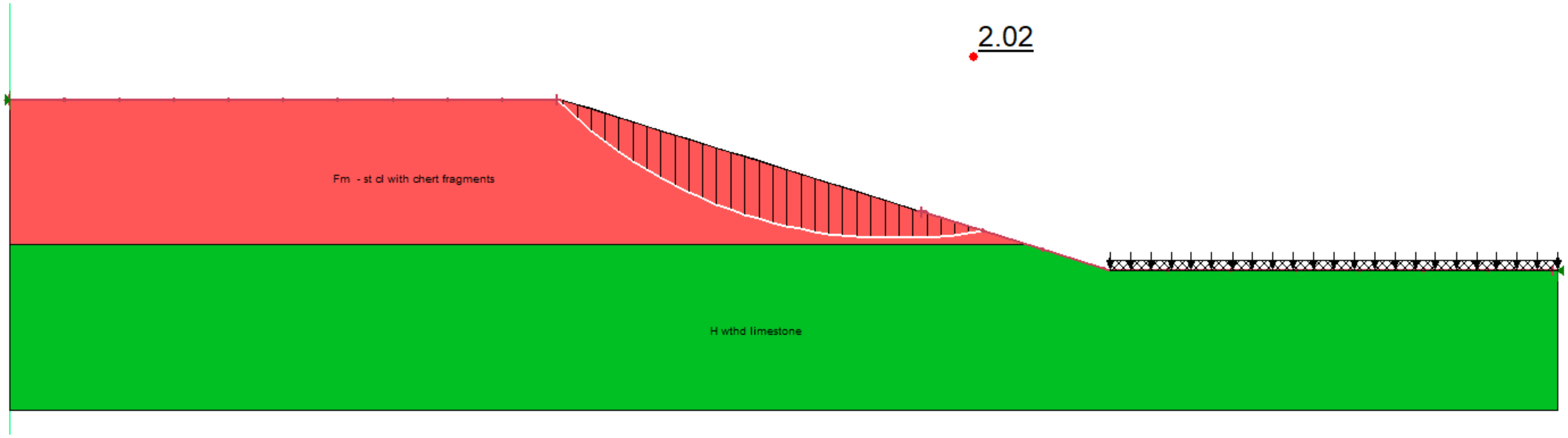
Summary of Stability Analysis Results
ARDOT 090069 XNA Access Road: Roadway Sections
GHBW Job No. 19-118
Benton County, Arkansas

	Design Loading Condition	**Calculated Minimum Factor of Safety**
STA 135+00 Cut Slope; H = 33 ft 3H:1V	End of Construction	3.86
	Long Term	2.02
	Seismic ($k_h = A_S/2 = 0.025$)	3.54
STA 170+00 Cut Slope; H=43 ft 3H:1V	End of Construction	3.09
	Long Term	2.55
	Seismic ($k_h = A_S/2 = 0.025$)	3.01
STA 215+40 Fill Slope; H = 57 ft 3H:1V	End of Construction	2.50
	Long Term	2.37
	Seismic ($k_h = A_S/2 = 0.025$)	2.29
STA 252+00 Cut Slope; H = 22 ft 3H:1V	End of Construction	5.93
	Long Term	3.36
	Seismic ($k_h = A_S/2 = 0.025$)	5.25
STA 266+60 Fill Slope; H = 53 ft 3H:1V	End of Construction	2.44
	Long Term	2.41
	Seismic ($k_h = A_S/2 = 0.025$)	2.23



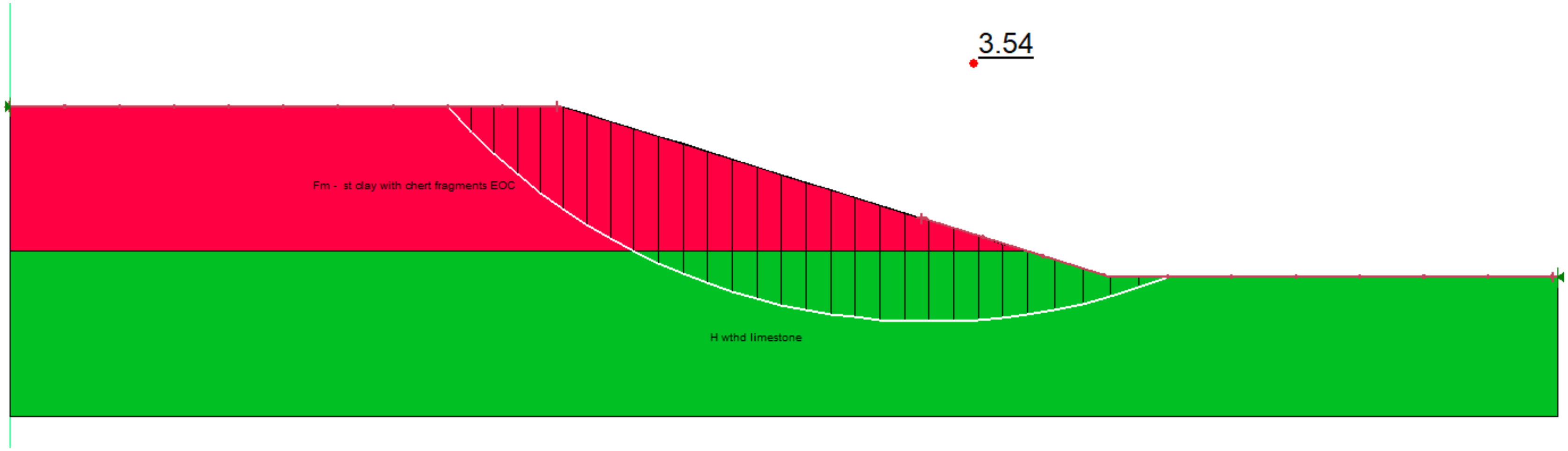
Results of Stability Analyses – End of Construction
STA 135+00
3H:1V Slope, H=33 ft ±
19-118 – ARDOT 090069 XNA Access Road – Roadway Section

Grubbs, Hoskyn,
Barton & Wyatt, LLC
CONSULTING ENGINEERS

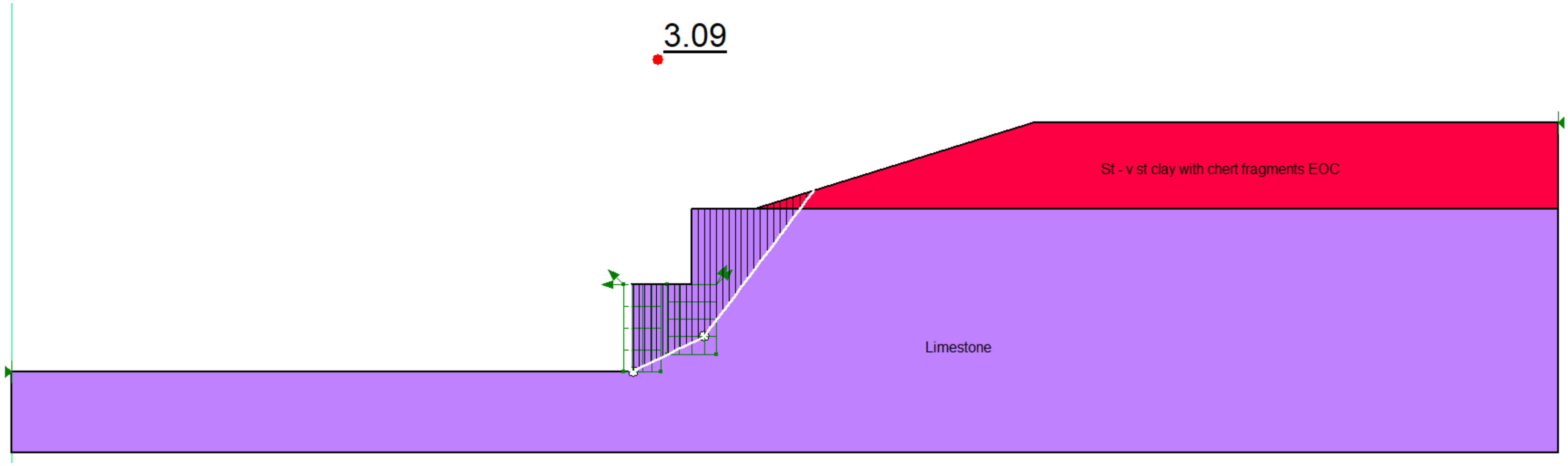


Results of Stability Analyses – Long Term Condition
STA 135+00
3H:1V Slope, H=33 ft ±
19-118 – ARDOT 090069 XNA Access Road – Roadway Section

Grubbs, Hoskyn,
Barton & Wyatt, LLC
CONSULTING ENGINEERS

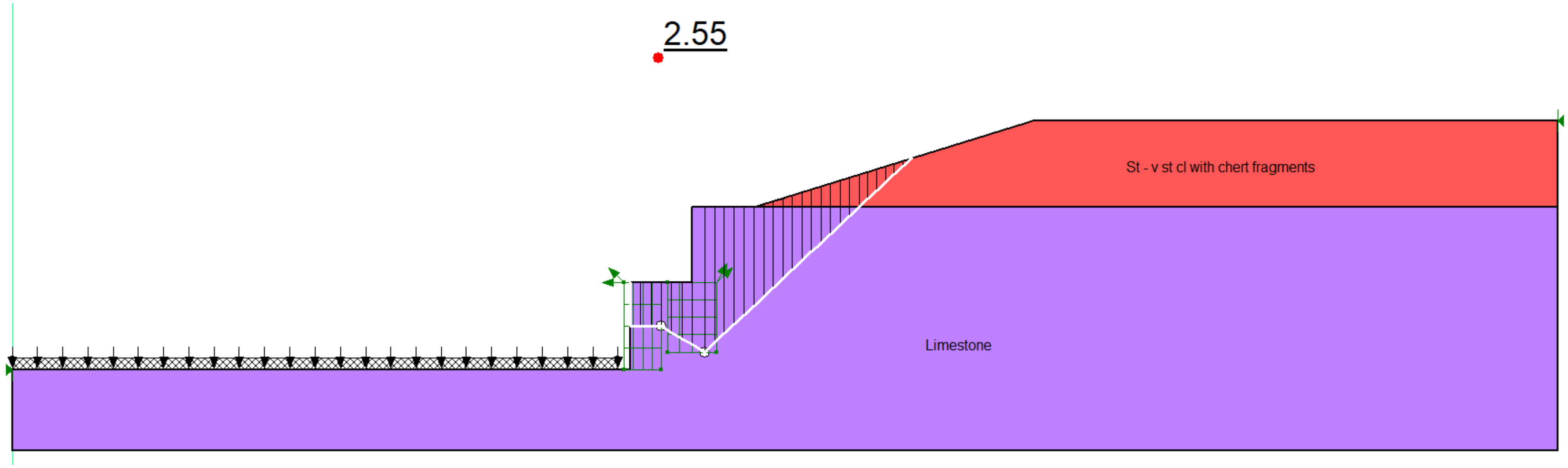


Results of Stability Analyses – Seismic Condition ($k_h = A_S /2= 0.025$)
STA 135+00
3H:1V Slope, H=33 ft ±
19-118 – ARDOT 090069 XNA Access Road – Roadway Section

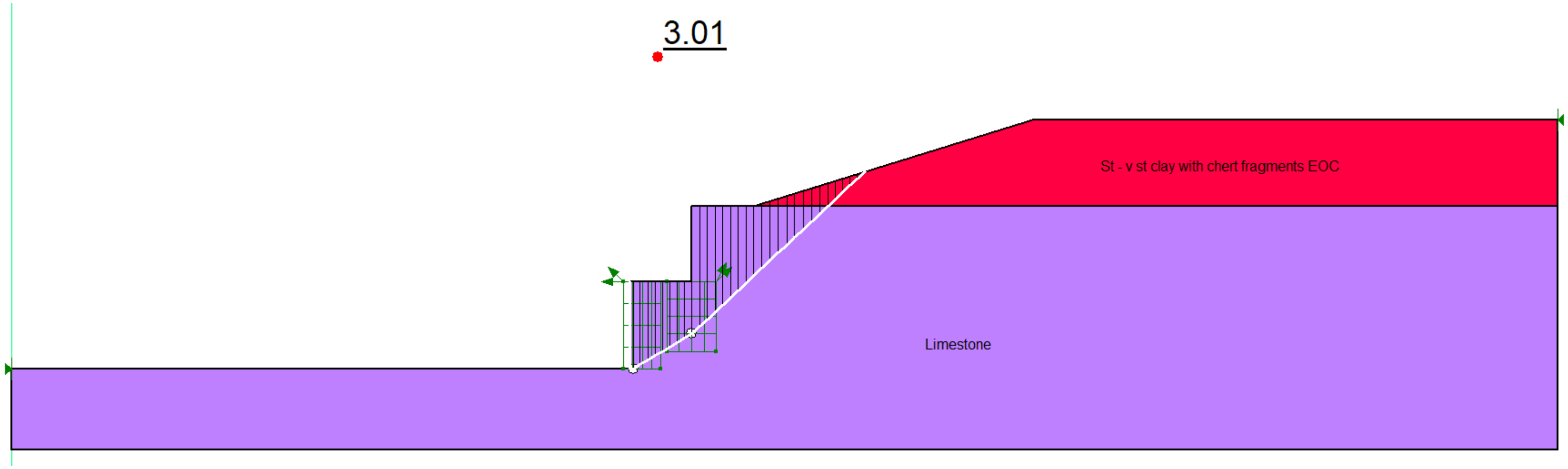


Results of Stability Analyses – End of Construction
STA 170+00
3H:1V Slope, H=43 ft ±
19-118 – ARDOT 090069 XNA Access Road – Roadway Section

Grubbs, Hoskyn,
Barton & Wyatt, LLC
CONSULTING ENGINEERS

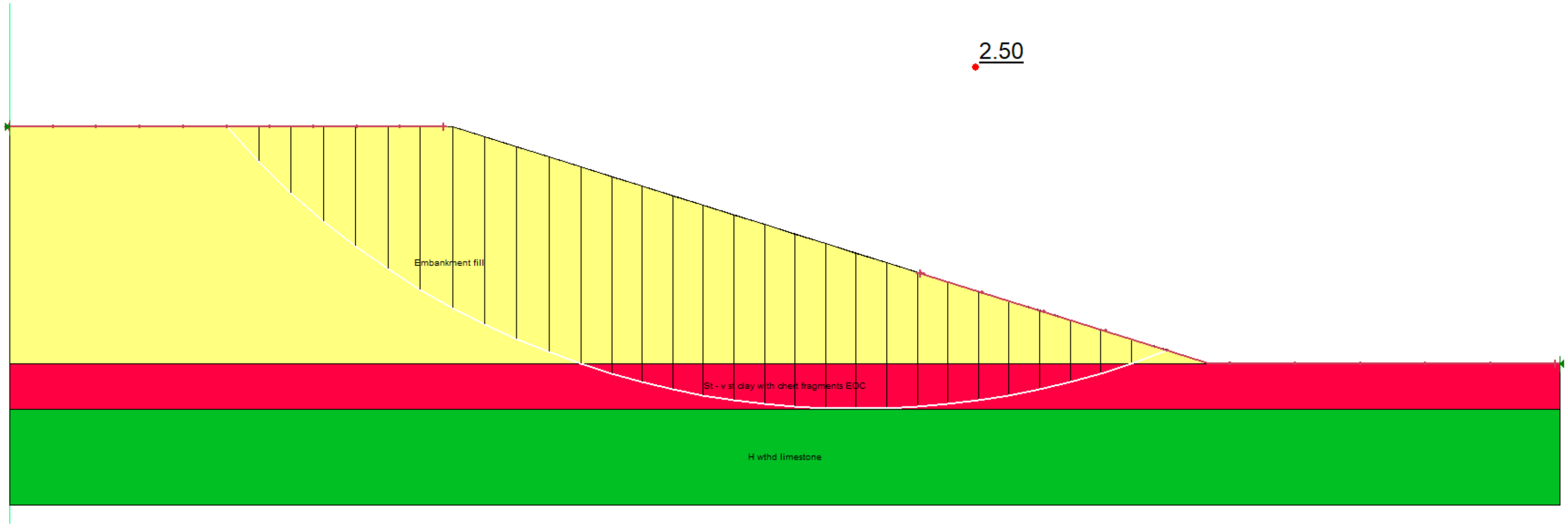


Results of Stability Analyses – Long Term Condition
STA 170+00
3H:1V Slope, H=43 ft ±
19-118 – ARDOT 090069 XNA Access Road – Roadway Section

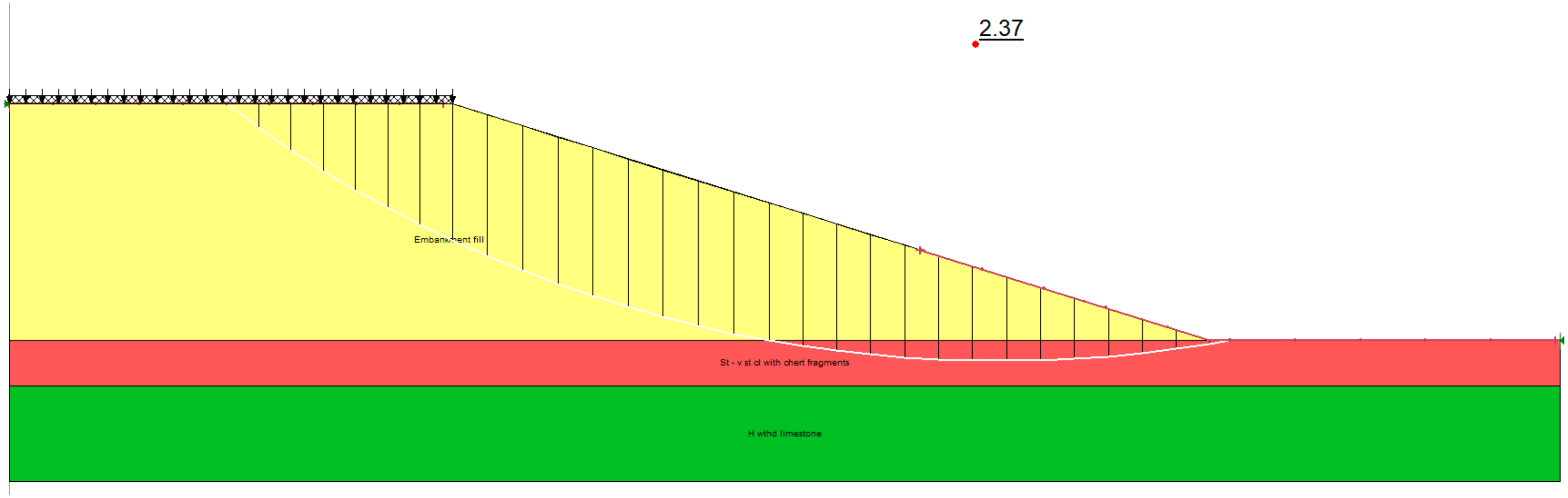


Results of Stability Analyses – Seismic Condition (k_h = A_S /2= 0.025)
STA 170+00
3H:1V Slope, H=43 ft ±
19-118 – ARDOT 090069 XNA Access Road – Roadway Section

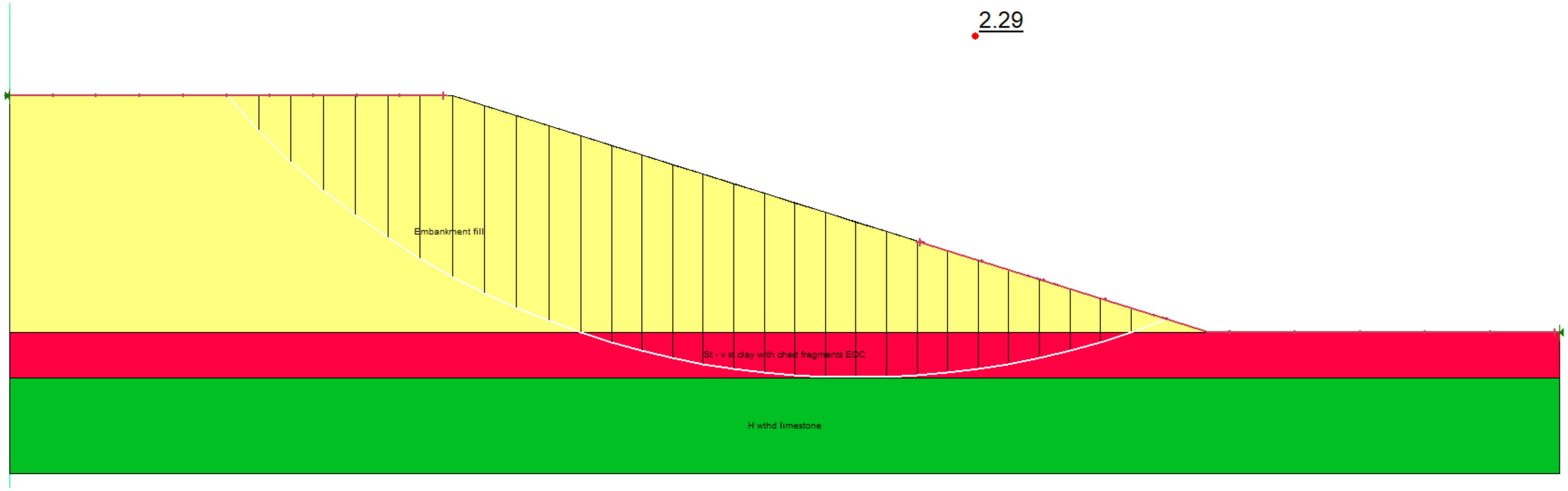
Grubbs, Hoskyn,
Barton & Wyatt, LLC
CONSULTING ENGINEERS



Results of Stability Analyses – End of Construction
STA 215+40
3H:1V Slope, H=57 ft ±
19-118 – ARDOT 090069 XNA Access Road – Roadway Section

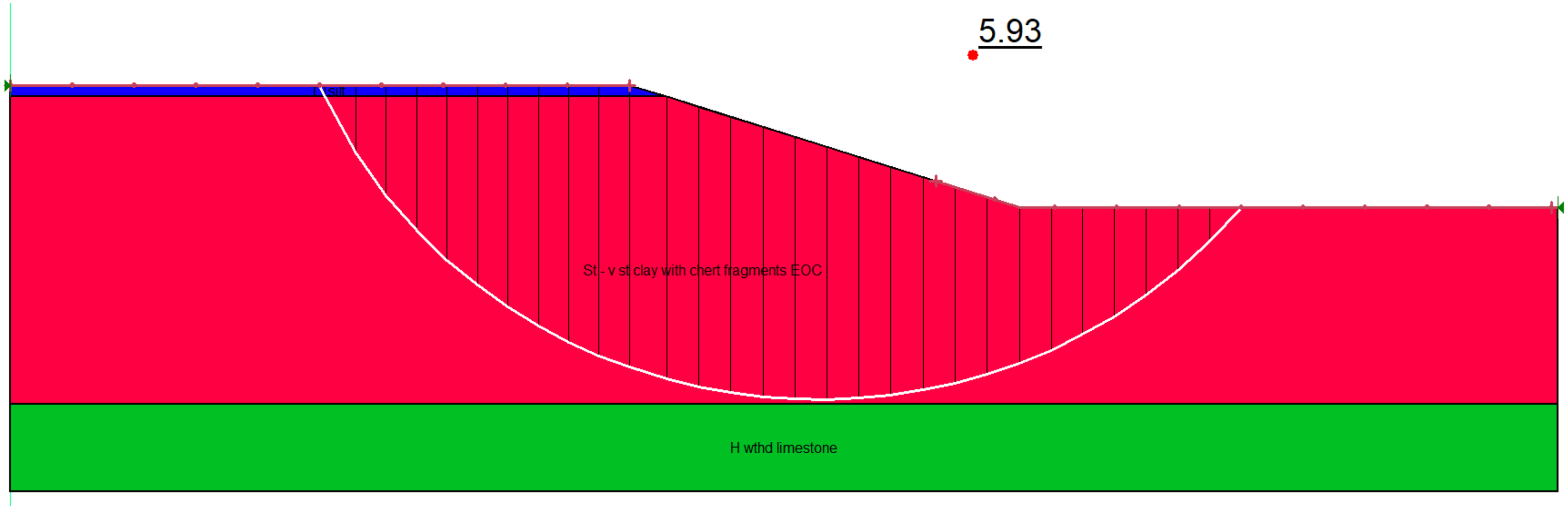


Results of Stability Analyses – Long Term Condition
STA 215+40
3H:1V Slope, H=57 ft ±
19-118 – ARDOT 090069 XNA Access Road – Roadway Section



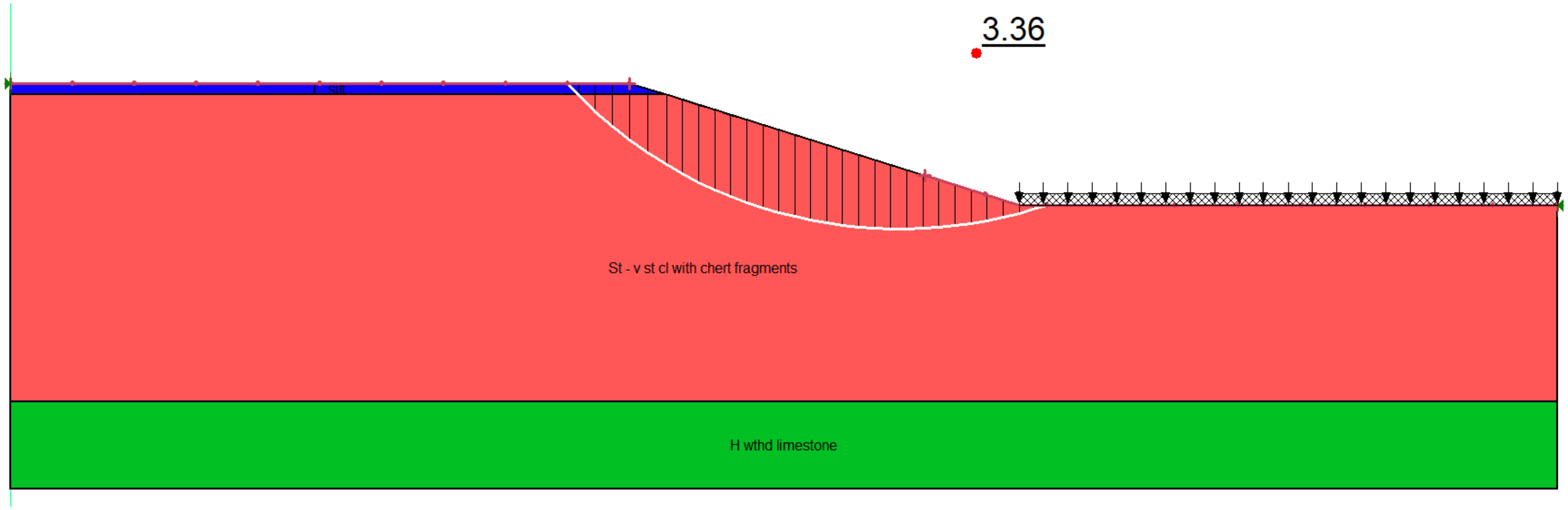
Results of Stability Analyses – Seismic Condition ($k_h = A_S /2= 0.025$)
STA 215+40
3H:1V Slope, H=57 ft ±
19-118 – ARDOT 090069 XNA Access Road – Roadway Section

Grubbs, Hoskyn,
Barton & Wyatt, LLC
CONSULTING ENGINEERS



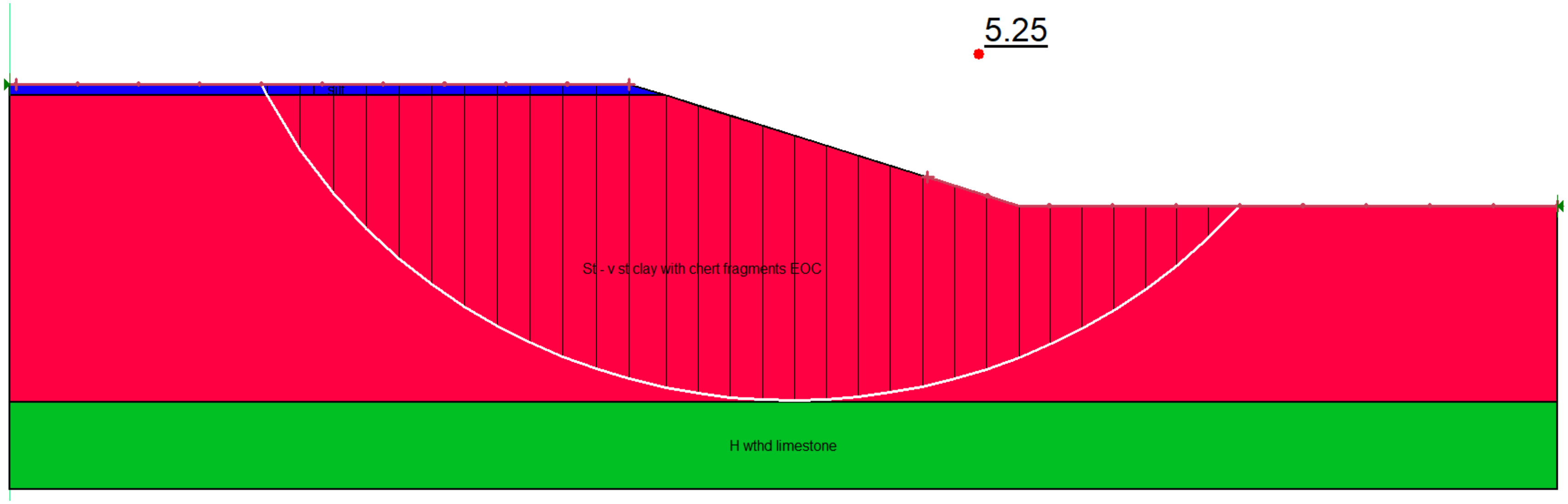
Results of Stability Analyses – End of Construction
STA 252+00
3H:1V Slope, H=22 ft ±
19-118 – ARDOT 090069 XNA Access Road – Roadway Section

Grubbs, Hoskyn,
Barton & Wyatt, LLC
CONSULTING ENGINEERS



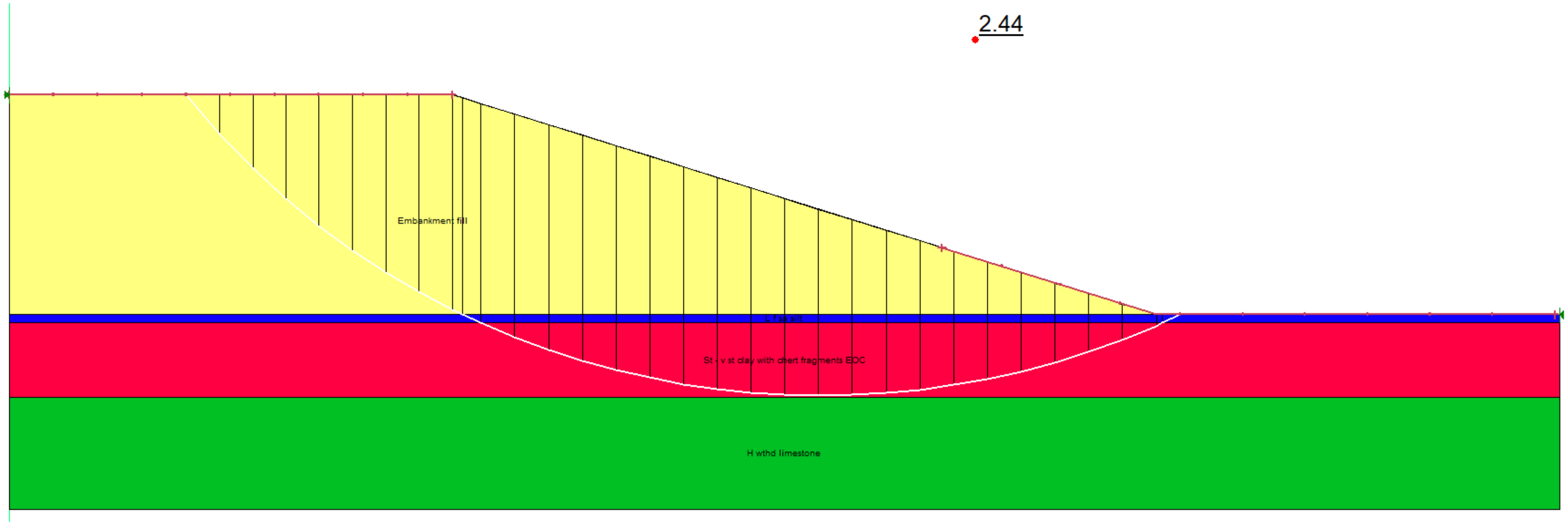
Results of Stability Analyses – Long Term Condition
STA 252+00
3H:1V Slope, H=22 ft ±
19-118 – ARDOT 090069 XNA Access Road – Roadway Section

Grubbs, Hoskyn,
Barton & Wyatt, LLC
CONSULTING ENGINEERS



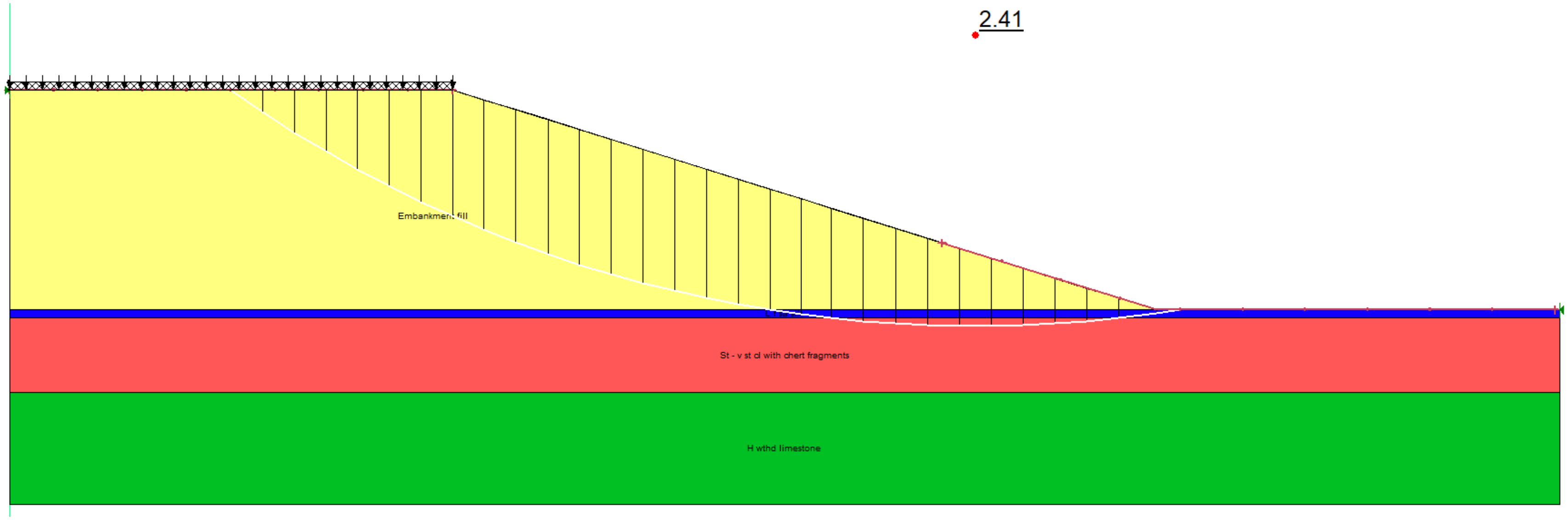
Results of Stability Analyses – Seismic Condition ($k_h = A_S /2= 0.025$)
STA 252+00
3H:1V Slope, H=22 ft ±
19-118 – ARDOT 090069 XNA Access Road – Roadway Section

Grubbs, Hoskyn,
Barton & Wyatt, LLC
CONSULTING ENGINEERS

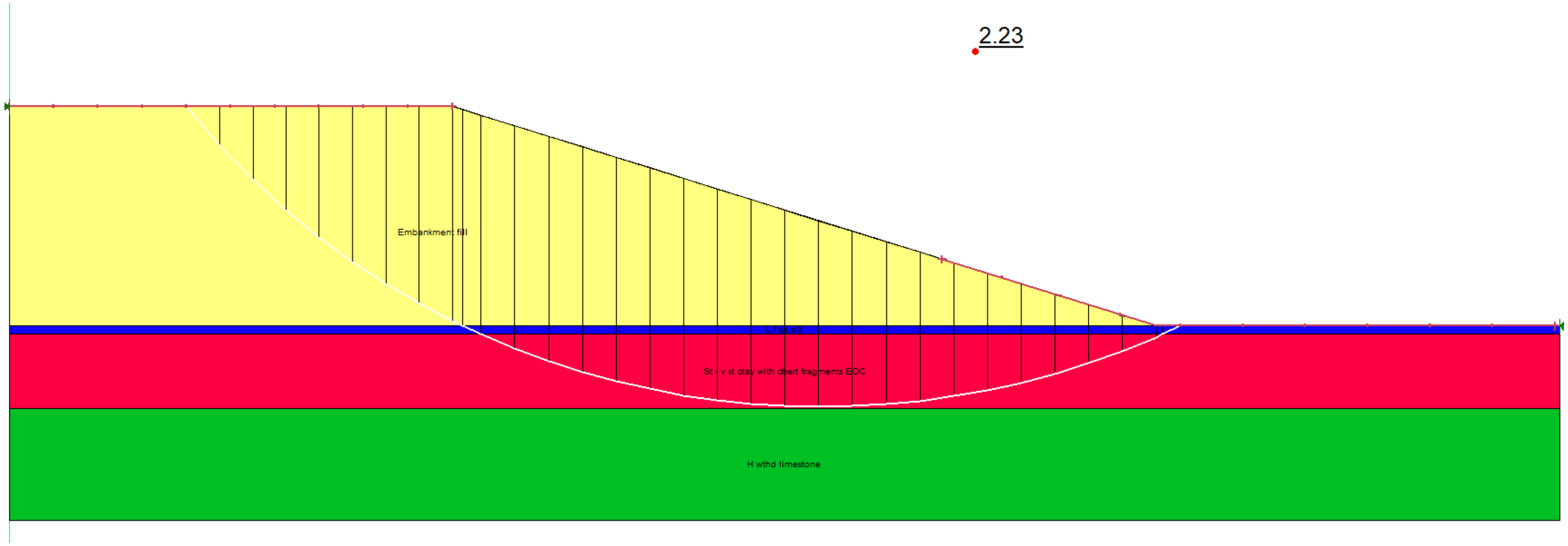


Results of Stability Analyses – End of Construction
STA 266+60
3H:1V Slope, H=53 ft ±
19-118 – ARDOT 090069 XNA Access Road – Roadway Section

Grubbs, Hoskyn,
Barton & Wyatt, LLC
CONSULTING ENGINEERS



Results of Stability Analyses – Long Term Condition
STA 266+60
3H:1V Slope, H=53 ft ±
19-118 – ARDOT 090069 XNA Access Road – Roadway Section



Results of Stability Analyses – Seismic Condition ($k_h = A_S /2= 0.025$)
STA 266+60
3H:1V Slope, H=53 ft ±
19-118 – ARDOT 090069 XNA Access Road – Roadway Section

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

Materials Testing
Geotechnical Engineering
Environmental
Building Sciences & Safety
Inspections & Code Compliance
Virtual Design Consulting

September 26, 2023
Job No. 19-118

Garver LLC
4701 Northshore Drive
North Little Rock, Arkansas 72118

Attn: Mr. Joel Skinner, P.E.

RESULTS of GEOTECHNICAL INVESTIGATION
ARDOT JOB 090069
XNA ACCESS ROAD OVER WAGER ROAD BRIDGE
BENTON COUNTY, ARKANSAS

INTRODUCTION

The results of the geotechnical investigation performed for the XNA Access Road over Wager Road twin bridges in Benton County, Arkansas are provided in this report. The Wager Road overpass is one facet of ARDOT Job 090069 Northwest Arkansas Regional Airport Access (Benton Co) (F). This geotechnical investigation was authorized by the Garver, LCC Subconsultant Agreement for Task Order No. 061 of August 27, 2019. Notice to proceed with the field studies was initially received on August 30, 2019. Results and recommendations have been provided throughout the course of this study. A preliminary report for the Wager Road bridge was submitted on August 23, 2023.

We understand the new Wager Road twin bridges will be continuous plate girder structures with four (4) bents, three (3) spans, and a total length of approximately 257 to 257.5 feet. We also understand that a foundation system consisting of steel H-piles is planned. Foundation loads of the new bridges are anticipated to be moderate. The new Wager Road twin bridges will include simple slopes with 2-horizontal to 1-vertical (2H:1V) and 3-horizontal to 1-vertical (3H:1V) configurations for the embankment ends and sides, respectively. Site grading is expected to include up to 35 ft of fill. Preliminary bridge layouts are provided in Appendix A.

The purposes of this study phase were to explore subsurface conditions in the alignments of the twin bridges and to develop recommendations to guide design and construction of foundations and earthwork. These purposes have been achieved by a multi-phased study that included the following.

- ♦ Drilling sample and core borings at the planned bridge locations to evaluate subsurface conditions and obtain samples of the subgrade and foundation soil and rock for laboratory testing.
- ♦ Performing laboratory tests to evaluate pertinent engineering properties of the foundation and subgrade strata.
- ♦ Analyzing field and laboratory data to develop recommendations for seismic site class, seismic performance zone/seismic design category, foundation and subgrade support, slope stability, site grading, and construction considerations.

The relationship of these factors to design and construction of the new bridge has been considered in developing the recommendations and considerations discussed in the following report sections.

SUBSURFACE EXPLORATION

Subsurface conditions at the Wager Road twin bridge locations were investigated by drilling eight (8) sample and core borings to depths of 28 to 43 ft below existing grades. The Wager Road site vicinity is shown on Plate 1. The approximate boring locations are shown on the bridge layout drawing on Plate 2. The subsurface exploration program is summarized in Table 1 below.

Table 1: Summary of Exploration Program

Boring No.	Approx Sta	Approx Offset, ft	Approx Surf El, ft	Completion Depth, ft
S1	142+80	60 L	1157	30
S2	143+70	60 L	1144	28
S3	144+83	15 L	1126	35
S4	145+75	60 L	1123	32
S5	142+60	70 R	1149	36
S6	143+50	60 R	1137	43
S7	144+66	60 R	1128	39
S8	145+55	60 R	1120	31

The boring logs, presenting descriptions of the soil and rock strata encountered in the borings and the results of the field and laboratory tests, are included as Plates 3 through 10. The centerline station and offset of the boring locations and approximate ground surface elevation, as inferred from the topographic information provided by the Engineer (Garver, LLC) or as inferred from available topographic information, are also shown on the logs. It must be recognized that the surface elevations shown are approximate and actual elevations may vary. Keys to the terms and symbols used on the logs are presented as Plates 11 and 12.

The borings were drilled with a track-mounted CME 850 rotary-drilling rig and a truck-mounted SIMCO 2800 rotary-drilling rig using a combination of dry-auger and rotary-wash drilling methods. Samples were typically obtained at 2-ft intervals to 10-ft depth and at 5-ft intervals thereafter. Samples were recovered using a 2-in.-diameter split-barrel sampler driven into the strata by blows of a 140-lb automatic hammer with 30-in. drop in accordance with Standard Penetration Test (SPT) procedures. The number of blows required to drive the standard split-barrel sampler the final 12 in. of an 18-in. total drive, or a portion thereof, is defined as the Standard Penetration Number (N). Recorded N-values are shown on the boring logs in the "Blows Per Ft" column.

Representative samples of the cherty limestone/limestone bedrock were obtained using a 5-ft-long NQWL-size double-tube core barrel with a diamond bit. For each core run, the percent recovery was determined as the ratio of recovery to total length of core run. Rock Quality Designation (RQD) was also determined for the core run as the sum of intact, sound rock core greater than 4-in. length divided by the total length of the run and expressed in percent. Both these values are presented in the right-hand columns of the log forms, opposite the corresponding core run. Selected photographs of the recovered rock cores are provided in Appendix B.

All samples were removed from sampling tools in the field, examined and visually classified by the field geologist. Samples were then placed in appropriate containers to prevent moisture loss and/or change in condition during transfer to our laboratory for further examination and testing.

The borings were advanced using dry-auger procedures to the extent possible to facilitate evaluation of shallow groundwater conditions. Observations regarding groundwater levels are noted in the lower-right portion of each log and are discussed in subsequent sections of this report. All boreholes were backfilled after obtaining the final water level readings.

LABORATORY TESTING

Laboratory testing was performed to evaluate subgrade and foundation plasticity and to confirm visual classification. The testing program included natural water content determinations (AASHTO T 265), liquid and plastic (Atterberg) limit determinations (AASHTO T 89 and T 90), and sieve analyses through the No. 200 sieve (AASHTO T 88). Soil shear strength was estimated in the field using SPT results.

A total of 32 natural water content determinations were performed to develop information on *in-situ* soil water content for each boring. Water content results are plotted on the boring log forms in accordance with the scale and symbols shown in the legend located in the upper-right corner of the logs.

To verify field classification and to evaluate soil plasticity, six (6) liquid and plastic limit (Atterberg limits) determinations and eight (8) sieve analyses were performed on selected representative samples. The Atterberg limits are plotted on the logs as pluses inter-connected with a dashed line using the water content scale. The percentage of soil passing through the No. 200 Sieve is noted in the "- No. 200 %" column on the appropriate log forms.

A summary of classification test results and classification by the Unified Soil Classification System and AASHTO Classification System is presented in Appendix C. Grain-size distribution curves are also included in Appendix C.

GENERAL SITE and SUBSURFACE CONDITIONS

Site Conditions

The overall alignment of the XNA Access Road extends from the Northwest Arkansas Regional Airport (XNA) about 4 miles southeast to the planned project terminus at Highways 70 and 71. The Wager Bridge site crosses Wager Road approximately 4750 ft west of the intersection of Wager Road and Robbins Road. The site locale is presently open, agricultural pastureland with a few mature trees. A farm lane and house are located west of the proposed alignment, and a barn is located north of the site. The site terrain is highest to the southeast and slopes steeply to the north and northwest, with a total change in elevation of approximately 42 ft over the length of the bridge alignment. Surface drainage is considered good.

Site Geology

The project alignment is located in the mapped exposure of the Boone Formation. The early and middle Mississippian Period Boone consists of fine- to coarse-grained limestone interbedded with chert. The chert content can vary widely, both horizontally and vertically, and limestone or chert may be predominant. The Boone Formation is known for dissolutional features such as sinkholes, caves, and enlarged fissures. Typically, the limestone/cherty limestone units of the Boone decompose (weather) to erratic blends of chert fragments and clay/silty clay. The residual soil mantle may extend to significant depths on higher terrain and may contain hard chert seams and/or layers. The thickness of the Boone Formation is reported to be 300 to 350 ft in northern Arkansas. The Boone is generally disconformable to the underlying Chattanooga Shale and St. Joe Limestone member, with some areas having a conformable contact.

Seismic Conditions

In light of the results of the borings, a Seismic Site Class C (very dense soil and soft rock profile) is considered applicable for the site with respect to the criteria of the AASHTO LRFD Bridge Design Specifications Eighth Edition 2017[1].

Given the location and AASHTO code-based values, the 1.0-sec period spectral acceleration coefficient for Site Class C (S_1) is 0.049 and the 1.0-sec period spectral acceleration coefficient (S_{D1}) value for Site Class C is 0.051. Utilizing these parameters, Table 3.10.6-1[2] indicates that a Seismic Performance Zone 1 is fitting for the Wager Road bridge site. In reference to the 2012 edition of the AASHTO Guide Specifications, the Peak Ground Acceleration (PGA) having a 7 percent chance of exceedance in 75 years (or mean return period of approximately 1000 years) is predicted to be 0.049 for a Seismic Site Class C for the bridge location. The liquefaction potential is considered low for the predominantly cohesive overburden soils and underlying rock units encountered in the borings drilled for this study.

Subsurface Conditions

Based on the results of the borings, the subsurface stratigraphy may be generalized into three (3) primary strata as follows.

Stratum I:	The Stratum I soils extend to depths of 1 to 18 ft and are comprised of loose to dense brown, dark brown, gray, tan, and reddish tan silt and stiff brown clayey silt. This stratum has variable, but generally numerous chert fragments and organics. The subgrade soils typically classify as A-1-b, A-2-4, A-4, and A-6 by the AASHTO classification system. The silt and clayey silt exhibit low plasticity, moderate to high compressibility, and low shear strength. The low-plasticity and silty soils are moisture-sensitive and will lose considerable strength when saturated.
Stratum II:	Below the surficial silty soils to 6- to 32-ft depth is a localized stratum of firm to very stiff brown, reddish brown, and tan silty clay and clayey silt with variable content of chert fragments. This stratum contains increasing chert seams and layers with depth. The silty clay and clayey silt are residual in origin and have weathered from the underlying cherty limestone bedrock. The Stratum II silty clay and clayey silt have low to moderate plasticity, low to moderate shear strength, and low compressibility. The potential for volume change with changes in water content is considered low due to the

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[1] AASHTO LRFD Bridge Design Specifications, 8th Edition; AASHTO; 2017

[2] AASHTO LRFD Bridge Design Specification, AASHTO; 2012

relatively high content of limestone and chert fragments. This stratum was not encountered in Borings S2 or S4.

Stratum III: The basal stratum encountered in the borings is moderately hard to hard gray and light gray cherty limestone. The cherty limestone is flat bedded. Rock core recovery values range from 10 to 100 percent and rock quality designation (RQD) values range from 0 to 85 percent. These RQD values are indicative of variable poor to fair rock quality. Rock quality generally increases with depth.

To aid in visualizing subsurface conditions, generalized subsurface profiles are presented in Appendix D. It should be recognized that the stratigraphy illustrated by the profiles has been inferred between discrete boring locations. In view of the natural variations in stratigraphy and conditions, variations from the stratigraphy illustrated by the profiles should be anticipated. Additionally, the natural transition between strata is generally gradual, and the stratigraphy described in the sections above may vary.

Groundwater Conditions

Groundwater was not encountered within the dry auger range of the borings drilled in January and July 2023. It has been our experience in the area that localized shallow perched groundwater can be present in the silty overburden soils and fractured zones of the cherty limestone. Given the variable site terrain, seasonal seeps or springs could develop during wet seasons and as infiltrated surface water migrates downgradient. Groundwater levels will vary, depending on seasonal precipitation and surface runoff and infiltration.

ANALYSES and RECOMMENDATIONS

Foundation Design

Foundations for the new bridge must satisfy two (2) basic and independent design criteria: a) foundations must have an acceptable factor of safety against bearing failure under maximum design loads, and b) foundation movement due to consolidation or swelling of the underlying strata should not exceed tolerable limits for the structures. Construction factors, such as installation of foundations, excavation procedures and surface and groundwater conditions, must also be considered.

Based on the results of the borings performed at the Wager Road bridge site and our understanding of the project, we recommend that foundation loads at the abutments and interior bents be supported on steel piling. Recommendations for pile foundations are discussed in the following report sections.

Piling Foundations

The foundation loads of the bridge may appropriately be supported on steel piles. We understand that HP12x53 steel piles are planned for the end bents and HP14x73 steel piles are planned for the intermediate bents. Point-bearing steel piles driven to refusal should extend through any new embankment fill, the natural overburden soils (Strata I and II), and zones of low hardness weathered cherty limestone with clay seams and layers to develop safe bearing capacity in the competent moderately hard slightly weathered cherty limestone or cherty limestone (Stratum III). End-bearing piles should be driven to practical refusal. All steel piles should be fitted with rock points. Hard driving or preboring should be anticipated.

Steel piles driven to refusal should be designed for the structural capacity of the pile, as per applicable AASHTO Load and Resistance Factor Design (LRFD) procedures[3]. An effective resistance factor (φ_c) of 0.50 is recommended for structural determination of factored bearing capacities. This effective resistance factor for steel piles has been based on the assumption of severe driving conditions.

For determination of bearing capacities of steel piles driven to refusal, we recommend that nominal resistance (P_n) of HP piles be determined based on the yield strength of steel H piles (f_y) and the net end area (A_{net}) of the section. It has been our experience that allowable pile capacities of 96 tons for HP12x53 piles and 133 tons for HP14x73 piles are typical for f_y = 50 ksi steel pile sections. These capacities are based on allowable stress design (ASD). However, the appropriate factored bearing capacity should be confirmed by the Engineer. Post-construction settlement of piles driven to refusal will be negligible.

The nominal axial capacities are based on single, isolated foundations. Piles spaced closer than three (3) pile widths may develop lower individual capacity due to group effects. The potential for group capacity reductions should be evaluated for pile spacing closer than three (3) widths (center to center).

Preboring should be anticipated for pile installation. Prebores should extend to the required minimum tip elevation in the competent moderately hard slightly weathered cherty limestone or cherty limestone (Stratum III) as field verified by the Engineer or Department. The depth to the moderately hard slightly weathered cherty limestone and cherty limestone can vary widely and

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[3] Load and Resistance Factor Design (LRFD) for Highway Bridge Substructures, Publication No. FHWA HI-98-032, National Highway Institute, May 2001.

required prebore depth could vary as well. Where the Contractor drives a heavy pile section (HP14x73 or heavier) through the cherty clay (Stratum II) to the recommended bearing stratum, the depth of piles should be consistent with the results of the borings. Where piles encounter refusal at unusually shallow depths, the suitability of the bearing stratum should be verified by drilling soundings or probe holes to confirm the bearing stratum.

Estimated prebore depths and pile tip elevations are summarized below in Table 2.

Bridge	**Bent No.**	**Estimated Prebore depth, ft (below existing grade)**	**Estimated Pile Tip Elevation, ft**	**Comments**
A	1A (South Bridge End)	12	1144	Refusal in moderately hard cherty limestone
	2A	23	1120	Refusal in moderately hard weathered cherty limestone
	3A	18	1107	Refusal in moderately hard slightly weathered cherty limestone
	4A (North Bridge End)	0	1105	Refusal in moderately hard slightly weathered cherty limestone
B	1B (South Bridge End)	24	1125	Refusal in hard cherty limestone or chert
	2B	0	1105	Refusal in moderately hard weathered cherty limestone
	3B	0	1100	Refusal in moderately hard cherty limestone
	4B (North Bridge End)	0	1102	Refusal in moderately hard cherty limestone

It should be noted that the prebore depths and tip elevations shown in the table above are estimates only based on the results of the relevant borings and the inferred surface elevations at the particular locations. The estimated prebore depth is based on achieving required pile embedment to refusal for compression loads only. Additional prebore depths could be required to develop specified uplift resistance. Pile refusal and final depth must be field verified.

Steel piles may be subjected to uplift loads. Nominal single pile uplift capacity curves for steel HP piles are provided in Appendix E. Where preboring is expected for pile installation, uplift capacities are based upon a prebored section. In this case, the prebore annulus around steel piles must be backfilled with approved grout or concrete.

Nominal axial pile uplift capacities have been developed using static pile capacity formulae, the results of the borings, and the plan pile caps elevations shown on the preliminary bridge layout drawings. Based on AASHTO LRFD geotechnical design procedures, a resistance factor (φ_{up}) of 0.25 is recommended for evaluation of factored uplift capacity. This resistance factor is based on Strength Limit States. For Extreme Events Limit States such as earthquake loading and collision, a resistance factor of 0.8 for uplift is recommended.

Piles should be installed in compliance with Standard Specifications for Highway Construction, 2014 Edition, Section 805. We recommend a hammer delivering a minimum energy of 34,000 ft-lbs per blow. A specific review and analysis of the pile-hammer system proposed by the Contractor should be performed by the Engineer prior to hammer acceptance and start of driving. We recommend that all piles be fitted with rock points.

A minimum pile length of 10 ft is recommended. As noted, preboring will be required for some piles to facilitate installation through more resistant chert seams, layers, and beds that may be encountered at shallow depth. Rock drilling methods could be required for prebores extending through thicker intervals of chert and/or weathered limestone. Following pile acceptance, the annulus around the installed piles in prebores should be expeditiously backfilled with grout or concrete as per ARDOT Standard Specifications Section 805. The grout should have a minimum compressive strength pf 4000 psi, as per ARDOT Section 501 or an alternate approved by the Engineer.

As a minimum, safe bearing capacity of piles should be determined by ARDOT Standard Specifications Section 805.09, Method A. Driving records should be available for review by the Engineer during pile installation. Blow counts on steel piles should be limited to about 20 blows per inch. Practical pile refusal may be defined as a penetration of 0.5 in. or less for the final 10 blows. Driving records should be available for review by the Engineer during pile installation.

Embankment Slopes

The project scope includes new embankments at each bridge end. Bridge end embankment configurations are 2-horizontal to 1-vertical (2H:1V) with 3-horizontal to 1-vertical (3H:1V) side slope configurations. The embankment heights are expected to be a maximum of 35 feet.

To evaluate suitability of the plan earth slope configurations, slope stability analyses have been performed. A 250 lbs per sq ft uniform surcharge from vehicles was included for the stability analyses. Stability analyses were performed using the computer program SLOPE/W 2021[4] and a Morgenstern-Price analysis. For the embankment slopes, three (3) general loading conditions were evaluated, i.e., End of Construction, Long Term, and Seismic. For analysis of the seismic

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[4] Slope/W 2021; GEOSLOPE Ltd.

condition, a horizontal seismic acceleration coefficient (k_h) of one-half the peak acceleration (A_s) was used, a value of 0.0245.

Stability analyses results are summarized and presented graphically in Appendix F. The results of the stability analyses indicate that plan configurations of the embankment end and side slopes are acceptable with respect to stability of all loading conditions evaluated.

Subgrade Support

The results of the borings indicate the on-site subgrade soils generally consist of silt, clayey silt, and silty clay with chert fragments (AASHTO A-2-6, A-4, and A-6). Given the anticipated new embankment, the approach roadway subgrade is likely to consist of embankment fill. Locally-available borrow, which is likely to be used as unclassified embankment fill, is expected to have similar classification.

We recommend that any soils classifying as A-7-5 or A-7-6 soils be excluded from use as subgrade within 18 in. of the plan subgrade elevation. The top 18 in. of subgrade soils should have a maximum plasticity index (PI) of 18. The as-built pavement subgrade should be evaluated by the Engineer. Areas of unstable or otherwise unsuitable subgrade should be improved by undercut and replacement or treatment with additives approved by the Engineer.

Based on the results of previous laboratory CBR tests on the silty clay with chert fragments subgrade and correlation with the AASHTO classification, we recommend the following parameters for use in design of pavements.

- CBR: 8.3
- Resilient Modulus (M_R): 3260 lbs per sq in.
- R value: 13
- Modulus of Subgrade Reaction (k): 100 lbs per cu in.

Site Grading and Subgrade Preparation

As noted, the surface soils are moisture-sensitive. Though stable in dry conditions, at elevated water contents the silt and clayey silt subgrade is likely to be soft and unstable. Consequently, site grading operations will be significantly easier to perform during dry seasons of the year.

Site preparation will require localized clearing and grubbing and stripping the zone of organic-containing soils. The depth of stripping will be variable, with deeper stripping depths in wooded areas, and less stripping required in open land. In general, the stripping depth is estimated to be about 6 to 9 inches in clear areas but may be 18 to 24 in. or more in the localized areas where trees are present. The zone of organic surface soils should be completely stripped in the embankment footprint areas and at least 5 ft beyond the projected embankment toes.

Following stripping and prior to fill placement, the extent of weak and unsuitable soils should be determined. Thorough proof-rolling should be performed to verify subgrade stability. Proof-rolling should be performed with a loaded tandem-wheel dump truck or similar equipment. Unstable soils exhibiting a tendency to rut and/or pump should be undercut and replaced with suitable fill. Care should be taken that undercuts, stump holes, and other excavations or low areas resulting from subgrade preparation are properly backfilled with compacted fill.

Depending on seasonal conditions, undercuts of about 2 to 4 ft below existing grades, more or less, could be required. Deeper undercuts may be required in wet seasons. General undercuts for site grading may be backfilled with unclassified borrow used for embankment fill.

In lieu of undercutting and replacing unsuitable soils in approach road alignments, consideration may be given to using additives to improve soil workability and to stabilize weak areas. Hydrated lime, quick lime, Portland cement, fly ash, or suitable alternate materials may be used as verified by appropriate testing and approved by the Engineer. Additives can be effective where the depth of unstable soils is relatively shallow. Treatment will be less effective in areas where the zone of unstable soils is deep. The optimum application rate of stabilization additive must be determined by specific laboratory tests performed on the alignment subgrade soils. We recommend a minimum treatment depth of 8 inches.

Subgrade preparation and mass undercuts should extend at least 5 ft beyond the embankment toes to the extent possible. Subgrade preparation for the approach roads should extend at least 3 ft outside pavement shoulder edges to the extent possible.

Fill and backfill may consist of unclassified borrow free of organics and other deleterious materials as per ARDOT Standard Specifications Subsection 210.06. Where A-7-5 or A-7-6 soils are encountered at the subgrade elevation, we recommend that these soils be undercut as required to provide at least 18 in. of suitable low-plasticity subgrade soils, i.e., with a maximum PI of 18, or approved “hillside” cherty clay with a maximum of 35 percent passing the No. 200 sieve. Alternatively, stabilization additives may be utilized to develop a stable subgrade with a PI of 18 or less. Granular soils must be protected from erosion with a minimum 18-in.-thick armor of clayey soil.

Subgrade preparation should comply with ARDOT Standard Specifications Section 212. Embankments should be constructed in accordance with ARDOT criteria (ARDOT Standard

Specifications Section 210). Fill and backfill should be placed in nominal 6- to 10-in.-thick loose lifts. All fill and backfill must be placed in horizontal lifts. The in-place density and water content should be determined for each lift and should be tested to verify compliance with the specified density and water content prior to placement of subsequent lifts.

CONSTRUCTION CONSIDERATIONS

Groundwater and Seepage Control

Positive surface drainage should be established at the start of the work, be maintained during construction and following completion of the work to prevent surface water ponding and subsequent saturation of subgrade soils. Density and water content of all earthwork should be maintained until embankments, bridge work, and pavements are completed.

Shallow groundwater was not encountered in the borings drilled in January and July 2023. Shallow perched groundwater may be encountered in the near-surface soils, particularly during wet seasons. Seepage into excavations and cuts can typically be controlled by ditching or sump-and-pump methods. If seepage infiltration cannot be controlled, construction of drains and/or the use of Select Granular Backfill (AASHTO M 43 No. 57), stone backfill (ARDOT Standard Specifications Section 207), or approved alternates to an elevation above the inflow of seepage will be warranted. In areas of seepage infiltration, the granular fill should be encapsulated with a filter fabric complying with ARDOT Standard Specifications Subsection 625.02, Type 2 and vented to positive discharge. Where surface seeps or springs are encountered during site grading, we recommend the seepage be directed via French drains or blanket drains to positive discharge at daylight or to storm drainage lines.

Site preparation should also include construction of blanket drains in all existing drainage features which will be covered by fill. All loose and/or organic materials should be excavated from drainage features prior to drain construction. Blanket drains should consist of at least 8 to 12 in. of select granular backfill (AASHTO M 43 No. 57) fully encapsulated by a filter fabric. A fabric complying with ARDOT Standard Specifications Subsection 625.02, Type 2 is recommended. Drains should direct water to positive discharge at daylight or into storm drain lines.

Piling

Piles should be installed in compliance with ARDOT Standard Specifications, Section 805. Piles should be carefully examined prior to driving and piles with structural defects should be rejected. Any splices in steel piles should develop the full cross-sectional capacity of un-spliced piles. Preboring should be anticipated for pile installation. Some rock drilling could be required for prebores. Where piles are prebored to develop uplift resistance, the annulus between the steel piles and the prebore should be expeditiously backfilled with approved grout or concrete.

Pile installation should be monitored by qualified personnel to maintain specific and complete driving records and observe pile installation procedures. Safe bearing capacity of production piles should be determined by ARDOT Standard Specifications Section 805.09, Method A. Driving records should be available for review by the Engineer during pile installation. For driving steel piles on this project, we recommend a minimum hammer energy of 34,000 ft-lbs per blow. Blow counts on steel piles should be limited to about 20 blows per inch. Practical pile refusal may be defined as a penetration of 0.5 in. or less for the final 10 blows.

CLOSURE

The Engineer or Department or a designated representative thereof should monitor site preparation, grading work and foundation and bridge construction. Subsurface conditions significantly at variance with those encountered in the borings should be brought to the attention of the Geotechnical Engineer. The conclusions and recommendations of this report should then be reviewed in light of the new information.

The following illustrations are attached and complete this final report.

Plate 1	Site Vicinity
Plate 2	Plan of Borings
Plates 3 through 10	Boring Logs
Plates 11 and 12	Keys to Terms and Symbols
Appendix A	Preliminary Bridge Layout
Appendix B	Selected Rock Core Photographs
Appendix C	Classification Test Results
Appendix D	Generalized Subsurface Profile
Appendix E	Nominal Uplift Pile Capacity Curves
Appendix F	Stability Analyses Results

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We appreciate the opportunity to be of service to you on this project. Should you have any questions regarding this report, or if we may be of additional assistance, please call on us.

Sincerely,

GRUBBS, HOSKYN,
BARTON &WYATT, LLC

Velleta M. Scott

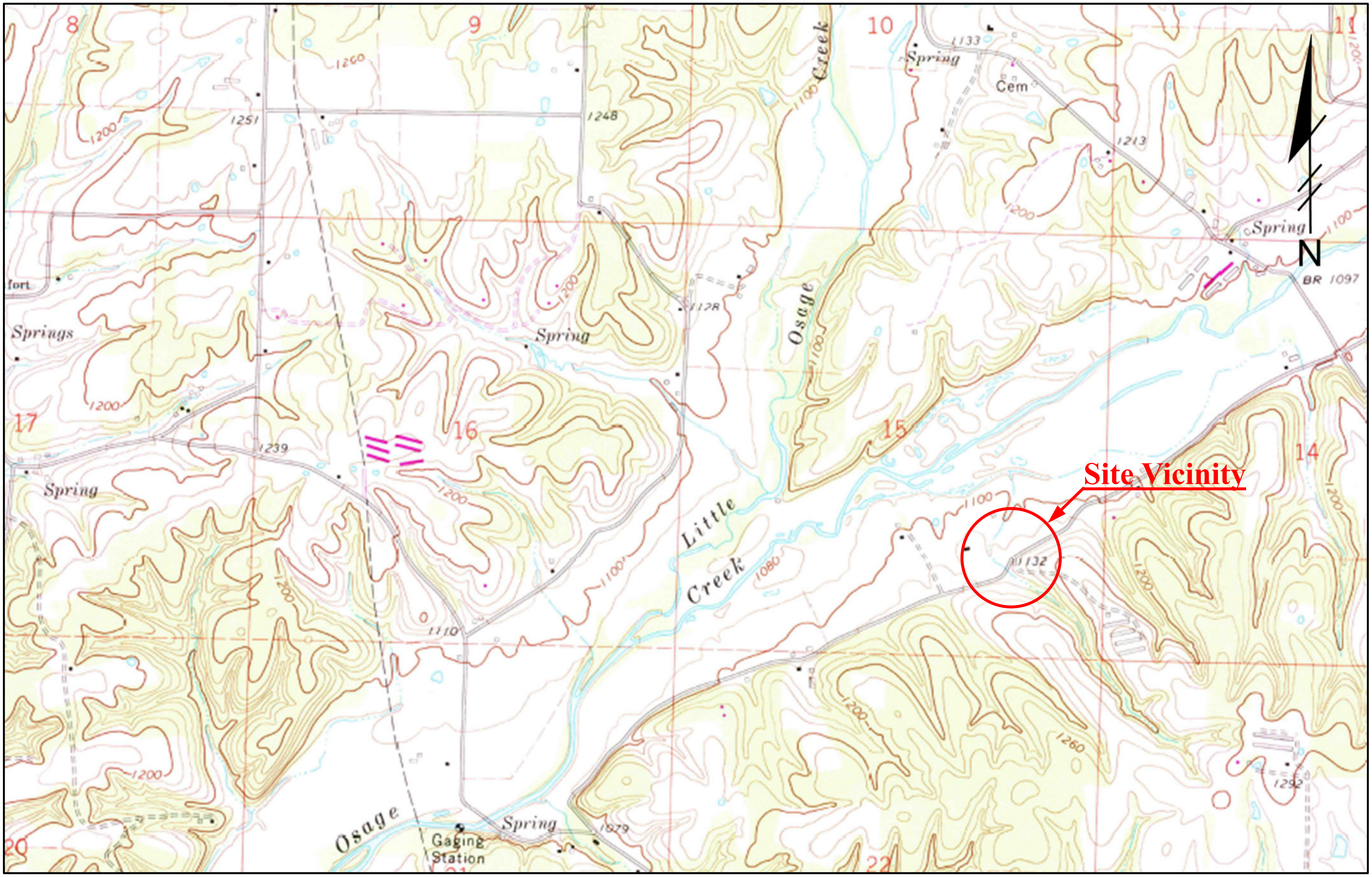
Velleta M. Scott, P.E.
Sr. Project Engineer

Mark E. Wyatt, P.E.
President

STATE OF ARKANSAS
REGISTERED PROFESSIONAL ENGINEER
No. 7791
MARK E. WYATT

VMS/MEW:jw

Copies Submitted:	Garver LLC		
	Attn:	Mr. Joel Skinner, P.E.	(1-email)
	Attn:	Mr. Lawren Wilcox, P.E.	(1-email)
	Attn:	Mr. John H. Ruddell, P.E., S.E.	(1-email)
	Attn:	Mr. Adam Wierciak, P.E.	(1-email)

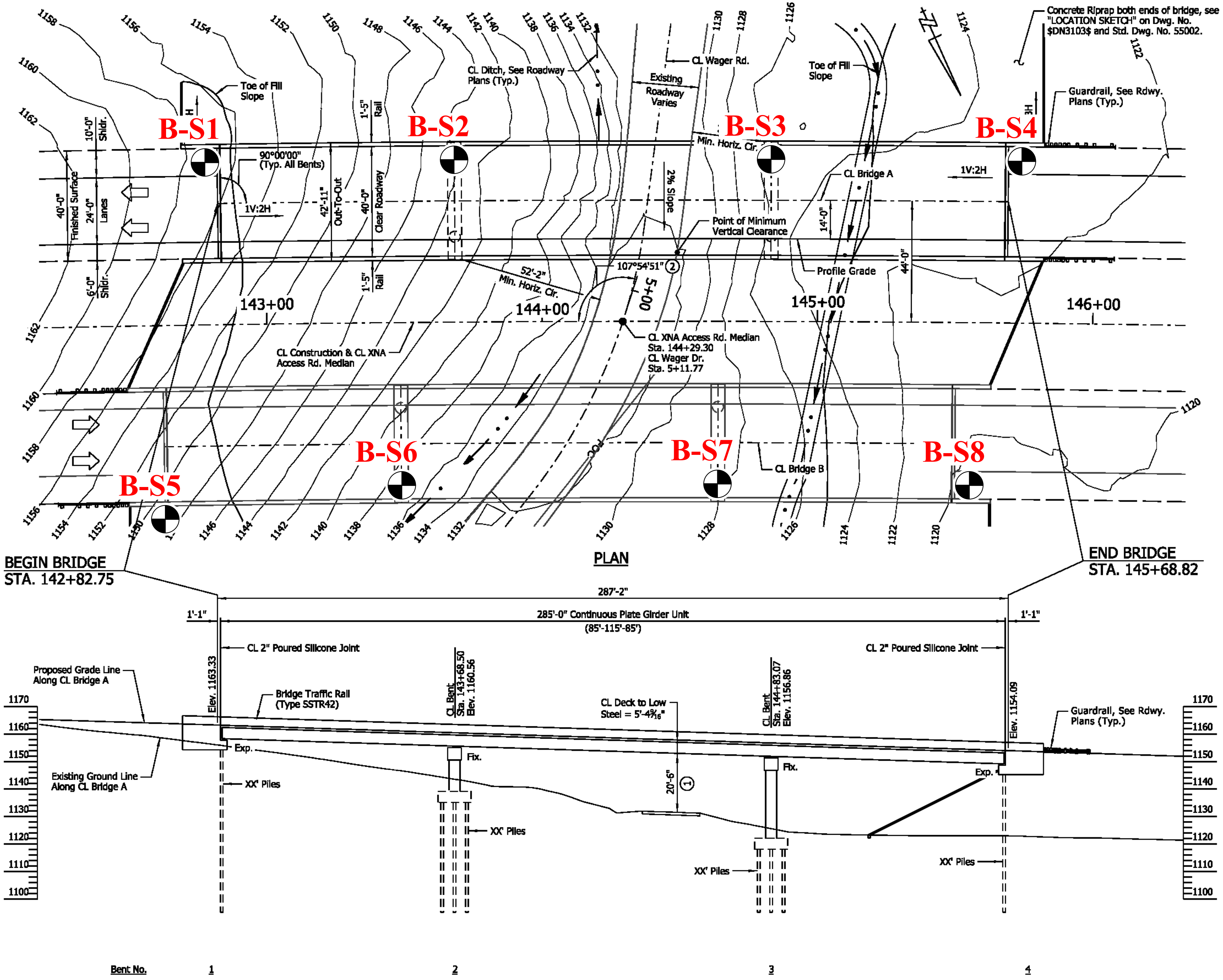


Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

SITE VICINITY MAP
090069 XNA Access Road over Wager Road
Benton County, Arkansas

Job No. 19-118

Plate 1



20 0 20 40 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

PLAN of BORINGS
090069 XNA Access Road over Wager Road
Benton County, Arkansas

Scale: As shown

Job No. 19-118

PLATE 2

19-118

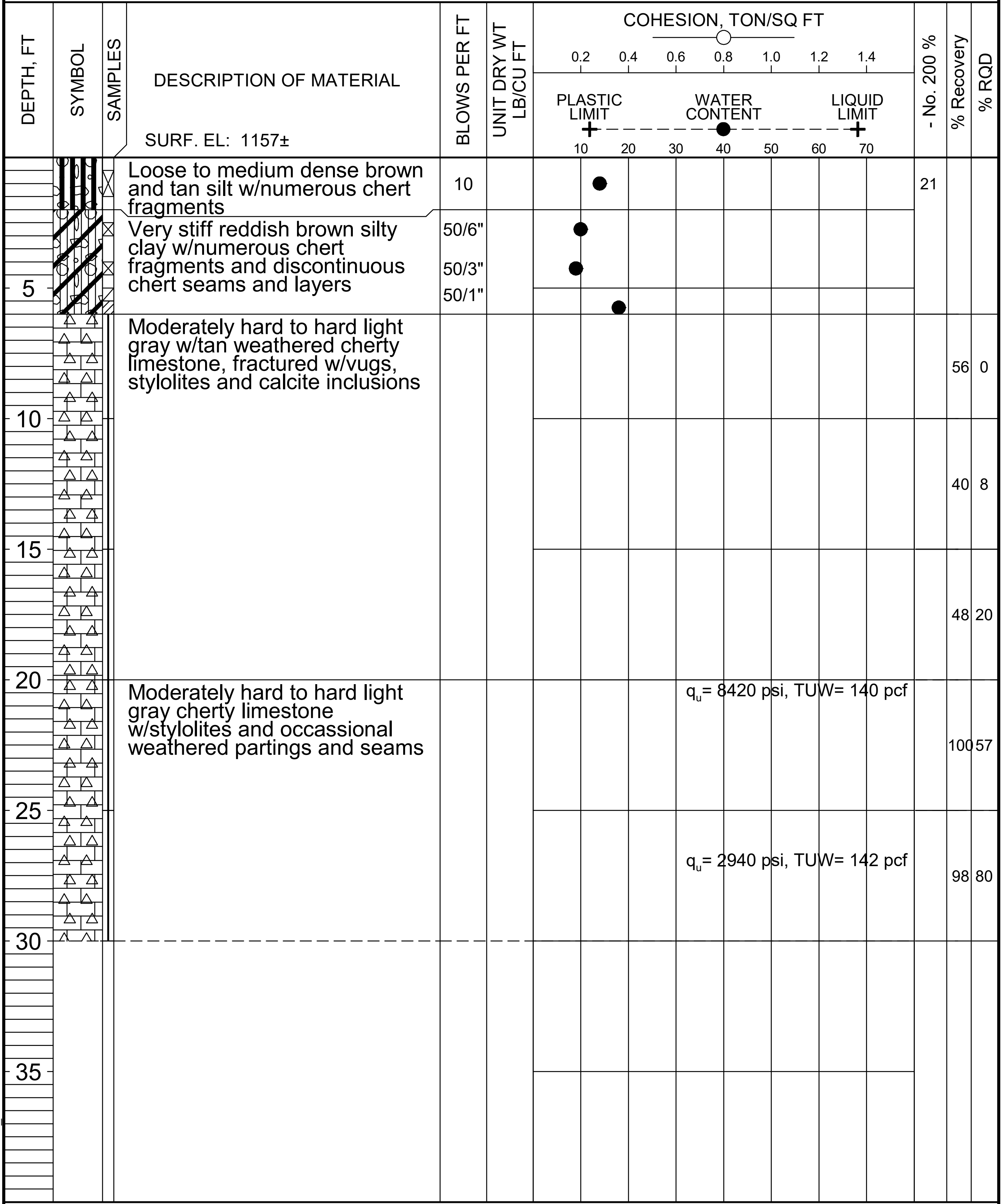
Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S1

090069 XNA Access Road over Wager Rd
Benton Co., Arkansas

TYPE: Auger to 6 ft /Core

LOCATION: Approx Sta 142+80, 60 ft Lt



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
SURF. EL: 1157±					
Loose to medium dense brown and tan silt w/numerous chert fragments	10		21		
Very stiff reddish brown silty clay w/numerous chert fragments and discontinuous chert seams and layers	50/6" 50/3" 50/1"				
Moderately hard to hard light gray w/tan weathered cherty limestone, fractured w/vugs, stylolites and calcite inclusions				56 40 48	0 8 20
Moderately hard to hard light gray cherty limestone w/stylolites and occassional weathered partings and seams				100 98	57 80

q_u= 8420 psi, TUW= 140 pcf

q_u= 2940 psi, TUW= 142 pcf

COMPLETION DEPTH: 30.0 ft
DATE: 7-20-23

DEPTH TO WATER
IN BORING: Dry to 6 ft

DATE: 7/20/2023

RECRQDN200-2 19-118 WAGER ROAD.GPJ 8-10-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S2

090069 XNA Access Road over Wager Rd
Benton Co., Arkansas

TYPE: Auger to 5 ft /Core

LOCATION: Approx Sta 143+70, 60 ft Lt

DEPTH, FT	DESCRIPTION OF MATERIAL SURF. EL: 1144±	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %	% Recovery	% RQD
0–5	Medium dense tan silt w/numerous chert fragments - dense below 2 ft	23 50/7" 50/3"					
5–10	Moderately hard to hard light gray w/tan slightly weathered cherty limestone					72	0
10–15	- with vugs below 10 ft					32	0
15–20	Moderately hard to hard gray w/light gray cherty limestone, slightly weathered, w/some rehealed fractures and stylolites			q_u= 2690 psi, TUW= 145 pcf		77	43
20–25						83	17
23–28	Moderately hard to hard gray and light gray cherty limestone					83	75

COMPLETION DEPTH: 28.0 ft
DATE: 7-26-23

DEPTH TO WATER
IN BORING: Dry to 5 ft

DATE: 7/26/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

L O G O F B O R I N G N O. S3

090069 XNA Access Road over Wager Rd
Benton Co., Arkansas

TYPE: HSA to 23 ft /Wash

LOCATION: Approx Sta 144+83, 15 ft Lt

SURF. EL: 1126±

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT + — WATER CONTENT ● — LIQUID LIMIT +: 10 20 30 40 50 60 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION / WATER CONTENT	- No. 200 %	% Recovery	% RQD
0 – 1	Medium dense brown silt w/numerous chert fragments	11					
1 – 17	Stiff to very stiff reddish brown silty clay w/highly weathered limestone seams and chert nodules and fragments - very stiff below 4 ft	24 24 37 46 20					
17 – 23	Moderately hard gray, light gray and tan weathered cherty limestone w/silty clay-filled fractures and joints	50/2" 25/0"					
23 – 35	Moderately hard to hard light gray and gray cherty limestone w/stylolitic joints and occasional calcareous nodules and inclusions			q_u= 3820 psi, TUW= 142 pcf		88 100 100	0 75 83

COMPLETION DEPTH: 35.0 ft
DATE: 7-24-23

DEPTH TO WATER
IN BORING: Dry to 23 ft

DATE: 7/24/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

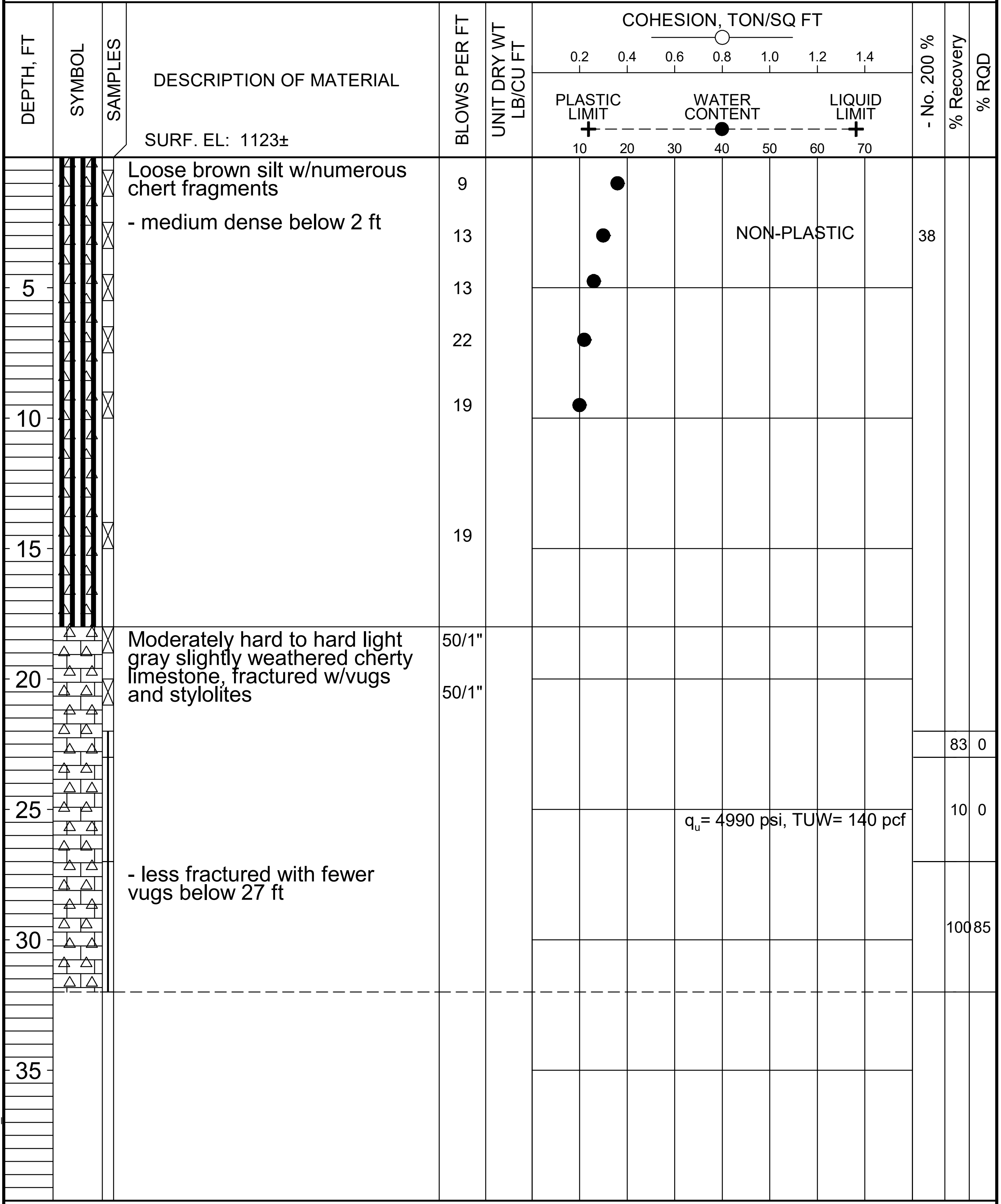
LOG OF BORING NO. S4

090069 XNA Access Road over Wager Rd
Benton Co., Arkansas

TYPE: Auger to 22 ft /Core

LOCATION: Approx Sta 145+75, 60 ft Lt

SURF. EL: 1123±



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT		- No. 200 %	% Recovery	% RQD
Loose brown silt w/numerous chert fragments	9					
- medium dense below 2 ft	13		NON-PLASTIC	38		
	13					
	22					
	19					
	19					
Moderately hard to hard light gray slightly weathered cherty limestone, fractured w/vugs and stylolites	50/1"					
	50/1"					
					83	0
			q_u= 4990 psi, TUW= 140 pcf		10	0
- less fractured with fewer vugs below 27 ft					100	85

COMPLETION DEPTH: 32.0 ft
DATE: 7-19-23

DEPTH TO WATER
IN BORING: Dry to 22 ft

DATE: 7/19/2023

19-118

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Consulting Engineers

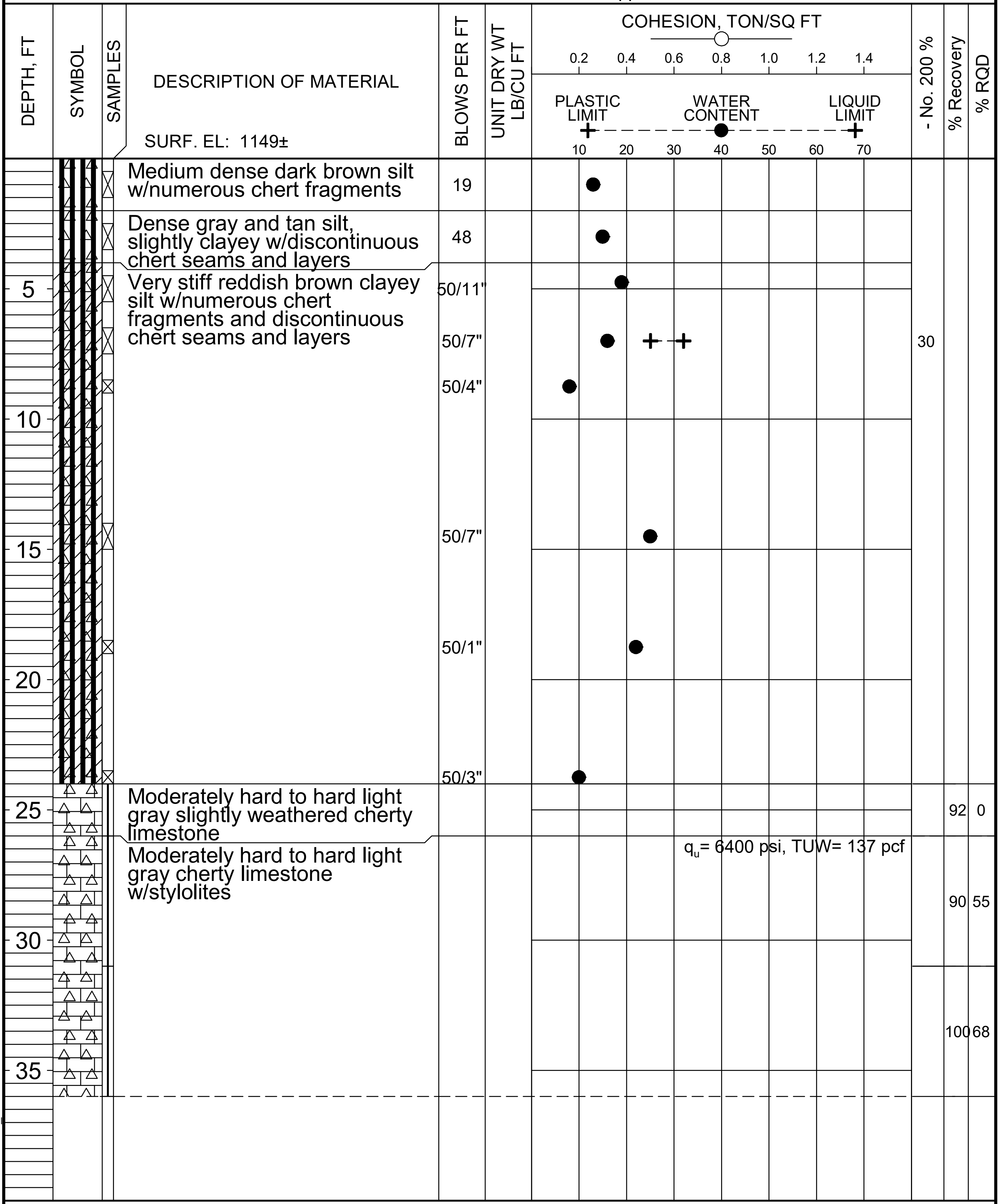
L O G O F B O R I N G N O. S5

090069 XNA Access Road over Wager Rd
Benton Co., Arkansas

TYPE: Auger to 24 ft /Core

LOCATION: Approx Sta 142+60, 70 ft Rt

SURF. EL: 1149±



DESCRIPTION OF MATERIAL	BLOWS PER FT	- No. 200 %	% Recovery	% RQD
Medium dense dark brown silt w/numerous chert fragments	19			
Dense gray and tan silt, slightly clayey w/discontinuous chert seams and layers	48			
Very stiff reddish brown clayey silt w/numerous chert fragments and discontinuous chert seams and layers	50/11"			
	50/7"	30		
	50/4"			
	50/7"			
	50/1"			
	50/3"			
Moderately hard to hard light gray slightly weathered cherty limestone			92	0
Moderately hard to hard light gray cherty limestone w/stylolites			90	55
			100	68

q_u= 6400 psi, TUW= 137 pcf

COMPLETION DEPTH: 36.0 ft
DATE: 7-20-23

DEPTH TO WATER
IN BORING: Dry to 24 ft

DATE: 7/20/2023

RECRQDN200-2 19-118 WAGER ROAD.GPJ 8-10-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

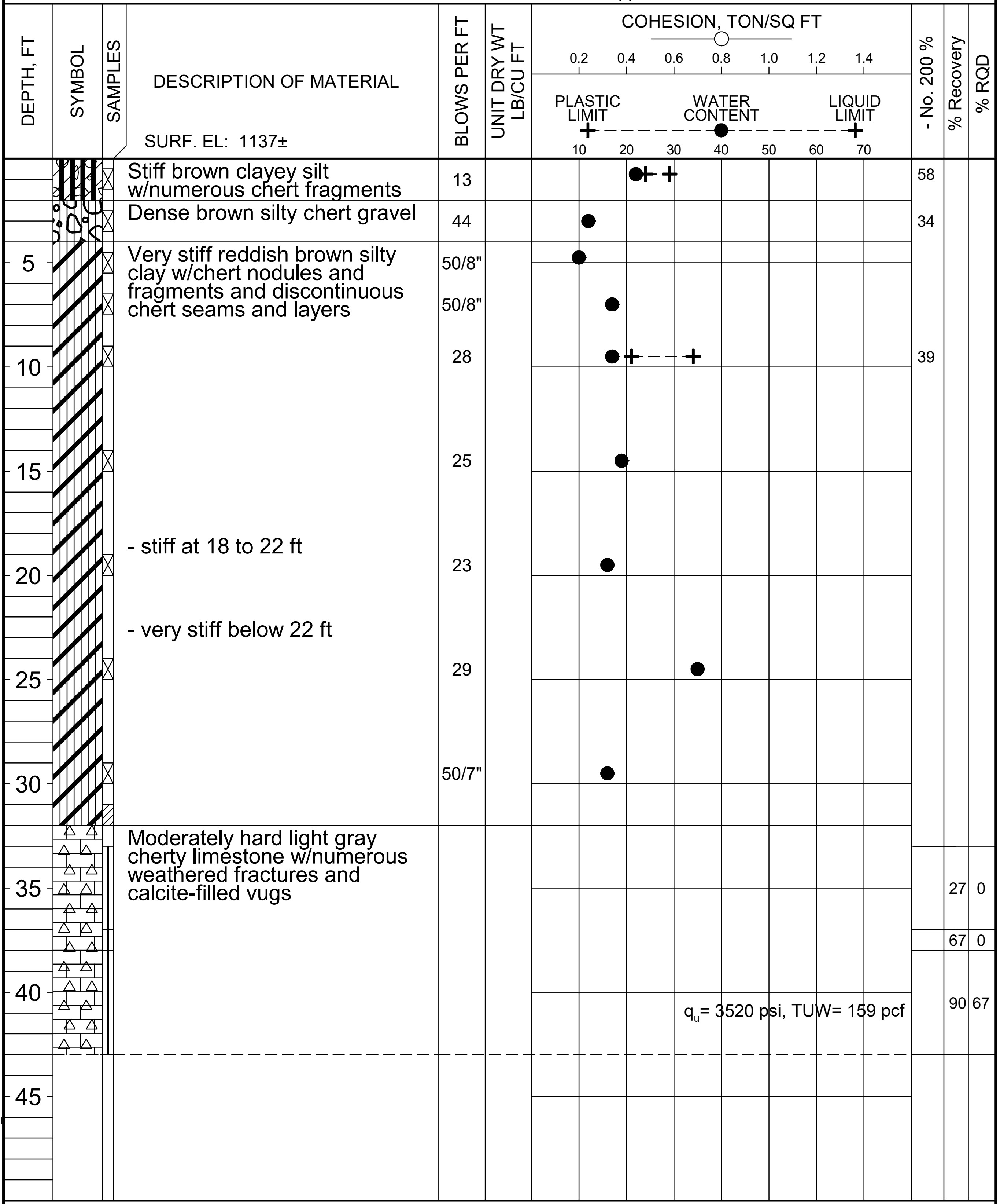
L O G O F B O R I N G N O. S6

090069 XNA Access Road over Wager Rd
Benton Co., Arkansas

TYPE: Auger to 32 ft /Wash

LOCATION: Approx Sta143+50, 60 ft Rt

SURF. EL: 1137±



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
Stiff brown clayey silt w/numerous chert fragments	13		58		
Dense brown silty chert gravel	44		34		
Very stiff reddish brown silty clay w/chert nodules and fragments and discontinuous chert seams and layers	50/8"				
	50/8"				
	28		39		
	25				
- stiff at 18 to 22 ft	23				
- very stiff below 22 ft	29				
	50/7"				
Moderately hard light gray cherty limestone w/numerous weathered fractures and calcite-filled vugs				27	0
				67	0
q_u= 3520 psi, TUW= 159 pcf				90	67

COMPLETION DEPTH: 43.0 ft
DATE: 1-10-23

DEPTH TO WATER
IN BORING: Dry to 32 ft

DATE: 1/10/2023

RECRQDN200-2 19-118 WAGER ROAD.GPJ 8-10-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S7

090069 XNA Access Road over Wager Rd
Benton Co., Arkansas

TYPE: HSA to 28 ft /Wash

LOCATION: Approx Sta 144+66, 60 ft Rt

DEPTH, FT	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 1128±	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %	% Recovery	% RQD
	☒	Loose reddish tan silt w/chert nodules and fragments	9					
	☒	- loose to medium dense below 2 ft	10					
5	☒	Stiff to very stiff reddish brown silty clay w/numerous chert nodules and fragments	33					
	☒		15					
10	☒	- with discontinuous chert seams below 8.5 ft	50/8"					
15	☒		35					
		- less chert at 18 to 22 ft						
20	☒		13					
25	☒		25					
		Moderately hard to hard light gray and gray cherty limestone w/stylolitic joints and very close re-healed fractures	50/4"					
30							78	0
					q_u= 5490 psi, TUW= 156 pcf		93	58
35							90	52

COMPLETION DEPTH: 39.0 ft
DATE: 7-25-23

DEPTH TO WATER
IN BORING: Dry to 28.5 ft

DATE: 7/25/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

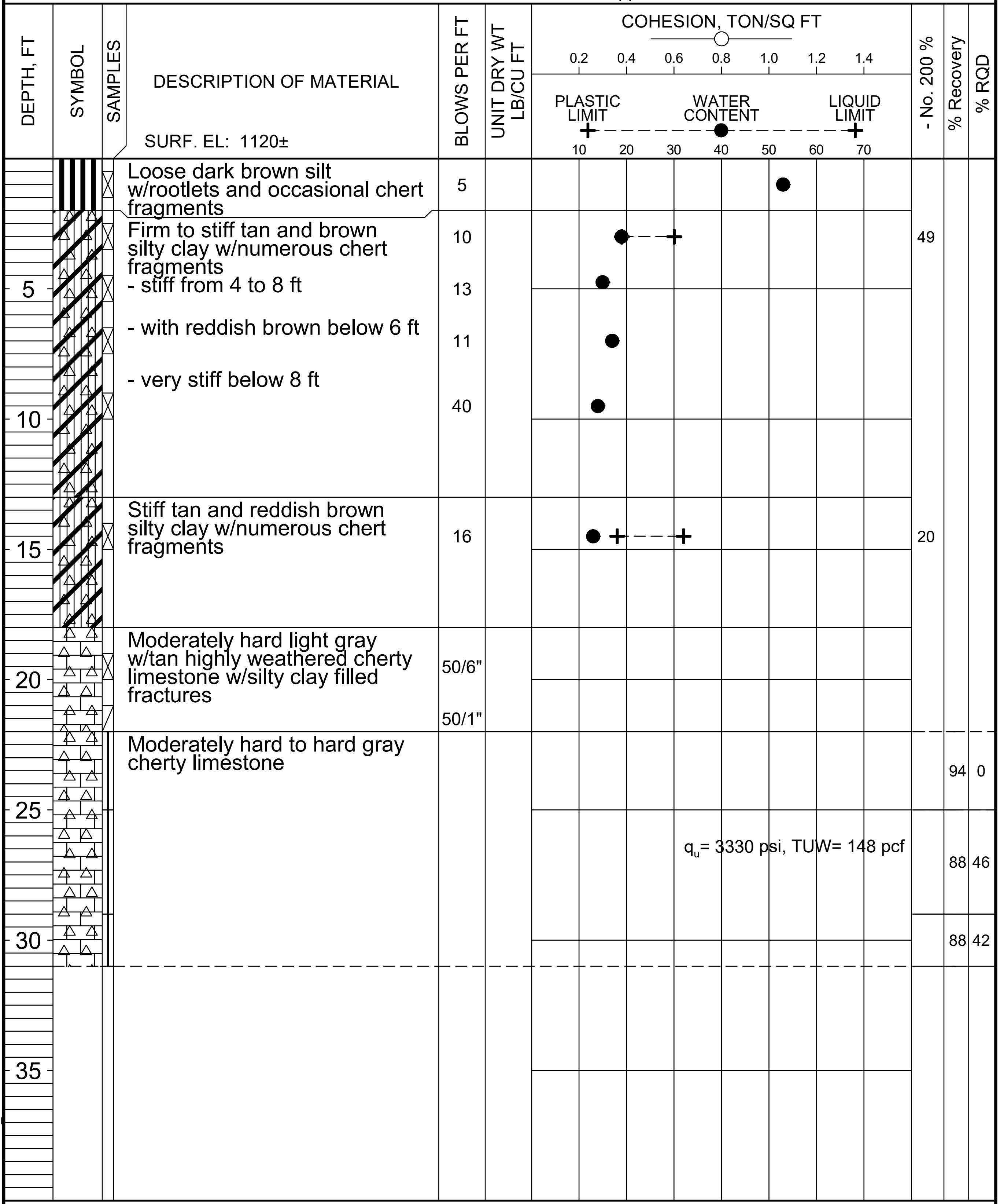
LOG OF BORING NO. S8

090069 XNA Access Road over Wager Rd
Benton Co., Arkansas

TYPE: Auger to 22 ft /Core

LOCATION: Approx Sta 145+55, 60 ft Rt

SURF. EL: 1120±



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
Loose dark brown silt w/rootlets and occasional chert fragments	5				
Firm to stiff tan and brown silty clay w/numerous chert fragments	10		49		
- stiff from 4 to 8 ft	13				
- with reddish brown below 6 ft	11				
- very stiff below 8 ft	40				
Stiff tan and reddish brown silty clay w/numerous chert fragments	16		20		
Moderately hard light gray w/tan highly weathered cherty limestone w/silty clay filled fractures	50/6" 50/1"				
Moderately hard to hard gray cherty limestone				94	0
q_u= 3330 psi, TUW= 148 pcf				88	46
				88	42

COMPLETION DEPTH: 31.0 ft
DATE: 7-19-23

DEPTH TO WATER
IN BORING: Dry to 22 ft

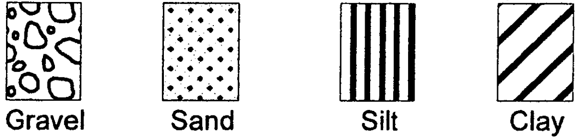
DATE: 7/19/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

SYMBOLS AND TERMS USED ON BORING LOGS

SOIL TYPES

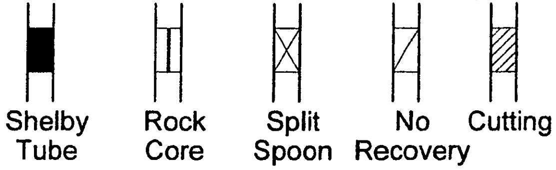
(SHOWN IN SYMBOLS COLUMN)



Predominant type shown heavy

SAMPLER TYPES

(SHOWN ON SAMPLES COLUMN)



TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on No. 200 sieve): Includes (l) Clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as determined by laboratory tests.

DESCRIPTIVE TERM	N-VALUE	RELATIVE DENSITY
VERY LOOSE	0-4	0-15%
LOOSE	4-10	15-35%
MEDIUM DENSE	10-30	35-65%
DENSE	30-50	65-85%
VERY DENSE	50 and above	85-100%

FINE GRAINED SOILS (major portion passing No. 200 sieve): Includes (1) Inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests.

DESCRIPTIVE TERM	UNCONFINED COMPRESSIVE STRENGTH TON/SQ. FT.
VERY SOFT	Less than 0.25
SOFT	0.25-0.50
FIRM	0.50-1.00
STIFF	1.00-2.00
VERY STIFF	2.00-4.00
HARD	4.00 and higher

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

TERMS CHARACTERIZING SOIL STRUCTURE

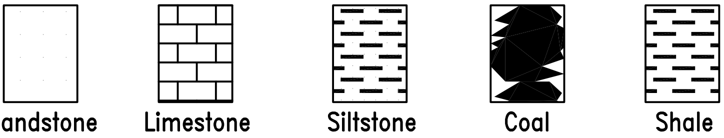
SLICKENSIDED - having inclined planes of weakness that are slick and glossy in appearance.
FISSURED - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
LAMINATED - composed of thin layers of varying color and texture.
INTERBEDDED - composed of alternate layers of different soil types.
CALCAREOUS - containing appreciable quantities of calcium carbonate.
WELL GRADED - having a wide range in grain sizes and substantial amounts of all intermediate particle sizes.
POORLY GRADED - predominantly of one grain size, or having a range of sizes with some intermediate sizes missing.

Terms used on this report for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No.3-357, Waterways Experiment Station, March 1953

KEY 3-4-03

BORING LOG TERMS – ROCK

ROCK TYPES
(SHOWN IN SYMBOLS COLUMN)



Joint Characteristics –

Spacing	
Very Close	0.75 to 2.5 in.
Close	2.5 to 8 in.
Moderately Close	8 to 24 in.
Wide	2 to 6 ft
Very Wide	More than 6 ft

Bedding Characteristics –

Very Thin	0.75 to 2.5 in.
Thin	2.5 to 8 in.
Medium	8 to 24 in.
Thick	2 to 6 ft
Massive	More than 6 ft

Lithologic Characteristics –

- Clayey
- Shaly
- Calcareous (limy)
- Siliceous
- Sandy (Arenaceous)
- Silty
- Plastic Seams

Parting –	Less than 1/16 inch
Seam –	1/16 to 1/2 inch
Layer –	1/2 to 12 inches
Stratum –	Greater than 12 inches

Hardness–

Soft (S) – Reserved for plastic material alone.

Friable (F) – Easily crumbled by hand, pulverized or reduced to powder and is too soft to be cut with a pocket knife.

Low Hardness (LH) – Can be gouged deeply or carved with a pocket knife.

Moderately Hard (MH) – Can be readily scratched by a knife blade; scratch leaves a heavy trace of dust and scratch is readily visible after the powder has been blown away.

Hard (H) – Can be scratched with difficulty; scratch produces little powder and is often faintly visible; traces of the knife steel may be visible.

Very hard (VH) – Cannot be scratched with a pocket knife. Knife steel marks left on surface.

Texture –

Fine – Barely seen with naked eye
Medium – Barely seen up to 1/8 in.
Coarse – 1/8 in. to 1/4 in.

Structure –

- Bedding
  - Flat – 0° – 5°
  - Gently Dipping – 5° – 35°
  - Moderately Dipping – 55° – 85°
  - Steeply Dipping – 55° – 85°
- Fractures, scattered
  - Open
  - Cemented or Tight
- Fractures, closely spaced
  - Open
  - Cemented or Tight
- Brecciated (Sheared and Fragmented)
  - Open
  - Cemented or Tight
- Joints
  - Faulted
  - Slickensides

Degree of Weathering –

Fresh – No visible signs of decomposition or discoloration. Rings under hammer impact.

Slighty Weathered – Slight discoloration inwards from open fractures, otherwise similar to fresh.

Moderately Weathered – Discoloration throughout. Weaker minerals such as feldspar decomposed. Strength somewhat less than fresh rock, but cores cannot be broken by hand or scraped by knife. Texture preserved.

Highly Weathered – Most minerals somewhat decomposed. Specimens can be broken by hand with effort or shaved with knife. Core stones present in rock mass. Texture becoming indistinct but fabric

Completely Weathered – Minerals decomposed to soil but fabric and structure preserved (Saprolite). Specimens easily crumbled or penetrated.

Residual Soil – Advanced state of decomposition resulting in plastic soils. Rock fabric and structure completely destroyed. Large volume change.

Solution and Void Conditions –

- Solid, contains no voids
- Vuggy (pitted)
- Vesicular (igneous)
- Porous
- Cavities
- Cavernous

Swelling Properties –

- Nonswelling
- Swelling

Slaking Properties –

- Nonslaking
- Slakes slowly on exposure
- Slakes readily on exposure

Rock Quality Designation (RQD) –

RQD (Percent)	Diagnostic Description
Greater than 90	Excellent
75 – 90	Good
50 – 75	Fair
25 – 50	Poor
Less than 25	Very Poor

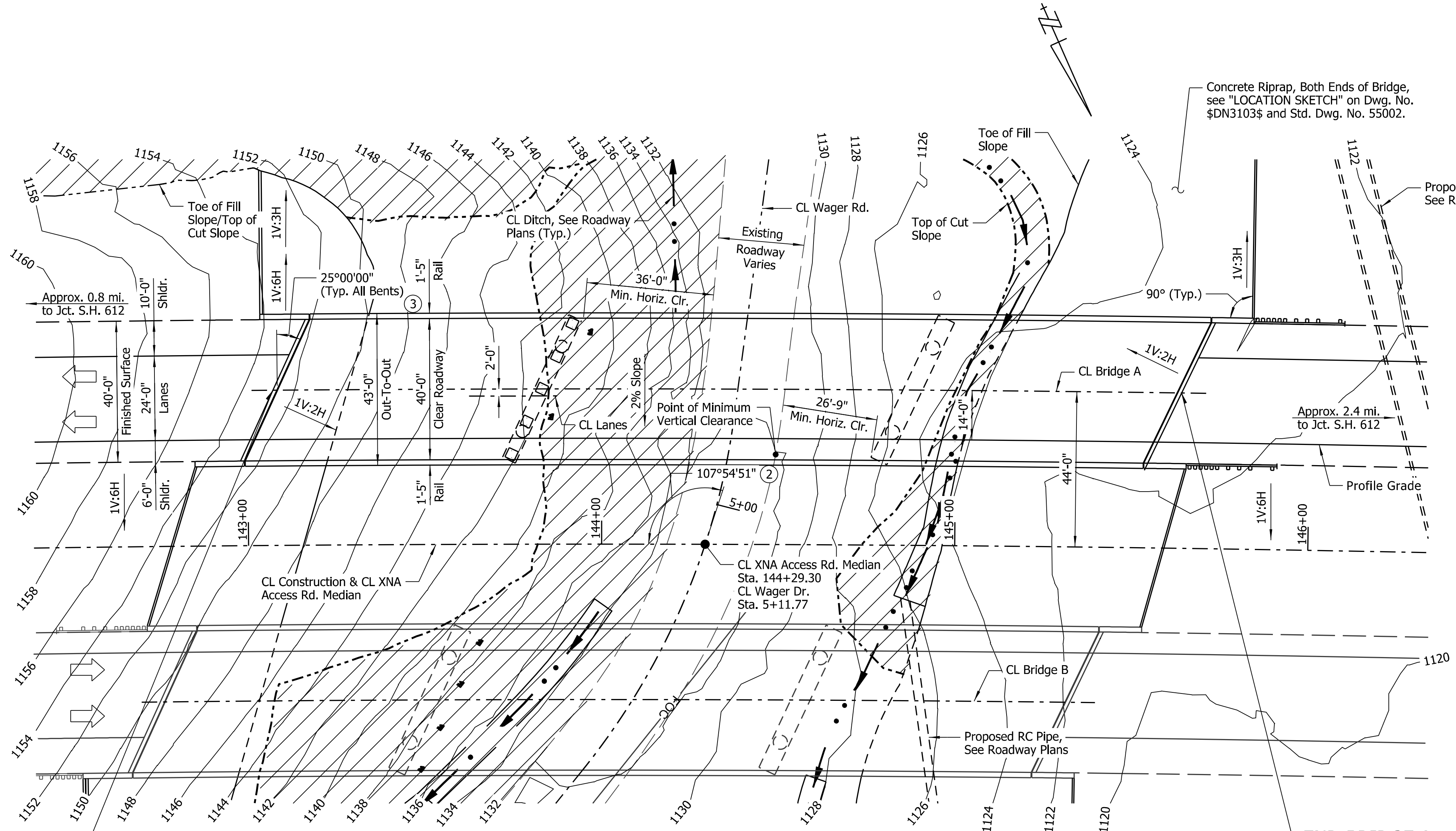
KEYROCK FHWA 3-2-12

APPENDIX A

DATE REVISED	DATE REVISED	FED. ROAD DIST. NO.	STATE	JOB NO.	SHEET NO.	TOTAL SHEETS
		6	ARK.	090069	$SN3101$	ST
		$BN03A$		LAYOUT		$DN3101$

NOTES:
Use Type F Approach Slab at each end of bridge. See Std. Dwg. No. 55040F1.

Use Type F Approach Gutters at each end of bridge. See Std. Dwg. No. 55030F.



BEGIN BRIDGE A
STA. 143+07.25

PLAN - BRIDGE A

END BRIDGE A
STA. 145+63.66

EXISTING UTILITIES LEGEND

FOC = Fiber Optic Cable

NOTE:
Utilities shown are based on locations at time of survey and do not reflect any potential utility relocations prior to construction.

HORIZONTAL CURVE DATA

XNA Access Rd. Median
PI = 156+17.12
Δ = 14°18'07" Rt.
D = 0°30'00"
T = 1437.67'
L = 2860.39'
e = 0.02%
R = 11459.16'

NOTES:
For "PROJECT GENERAL NOTES", see Dwg. No. $DN0201$.

For "GENERAL NOTES" and "LOCATION SKETCH", see Dwg. No. $DN3103$.

For "ELEVATION OF SOIL BORINGS - BRIDGE A", "BORING LEGEND" and "N-VALUES", see Dwg. No. $DN3104$.

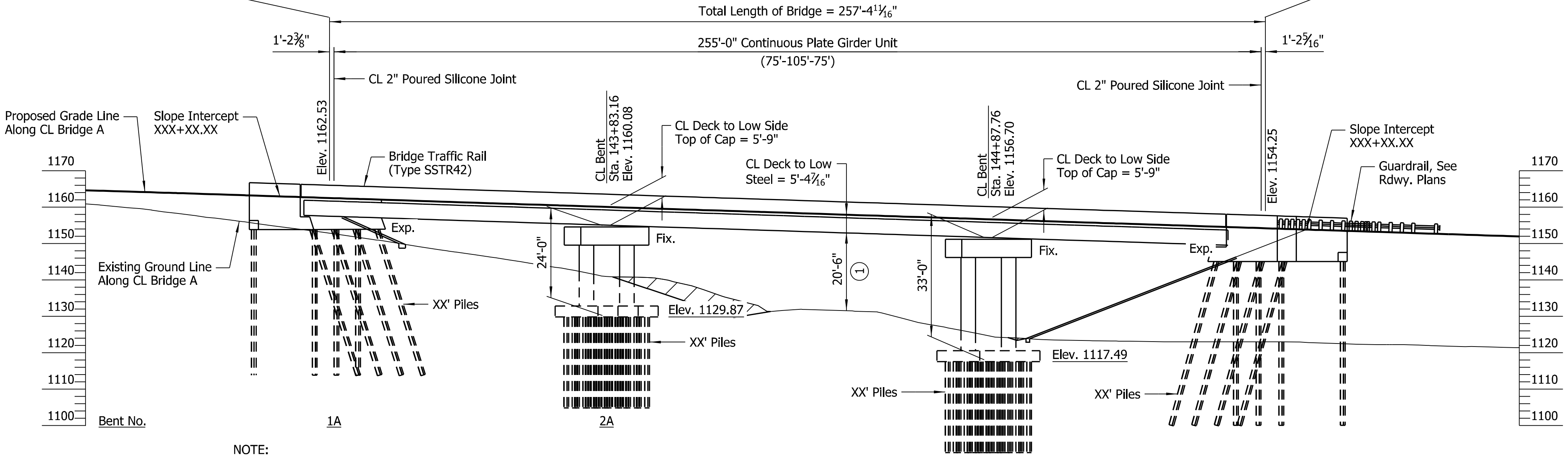
CL Construction is on a 0°30'00" curve right. CL Girders and the longitudinal lines of the bridge and approach slabs and gutters shall be constructed on curves concentric with CL Construction.

① Point of Minimum Vertical Clearance

② Angle measured at point of intersection between line tangent to CL XNA Access Rd. Median and line tangent to CL Wager Rd

③ For Bents 1A & 4A:
Measured from CL Joint to a line radial to CL Bridge A at CL Joint.

For Bents 2A & 3A:
Measured from CL Bent to a line radial to CL Bridge A at CL Bent.

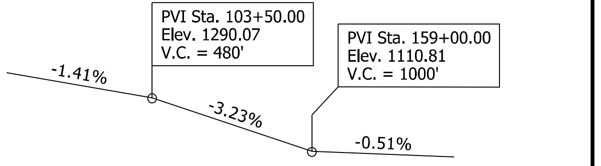


NOTE:
Stations shown are along CL Construction. Elevations shown are actual top of deck elevations at CL Bridge A. Any vertical dimension referenced to CL Deck is based on actual top of deck elevation at CL Bridge A.

ELEVATION - BRIDGE A

143+00 144+00 145+00 146+00

FOR R/W DATA, SEE ROADWAY PLANS



VERTICAL CURVE DATA

XNA Access Rd.
(Profile Grade 14' Right of CL Bridge A)

SOIL BORINGS NOT AVAILABLE AT TIME OF PRINTING

PRELIMINARY
NOT FOR
CONSTRUCTION

BRIDGE ENGINEER

SHEET 1 OF 4
LAYOUT OF BRIDGES
XNA ACCESS RD. OVER WAGER RD.
NORTHWEST ARKANSAS
NATIONAL AIRPORT ACCESS (F)
BENTON COUNTY

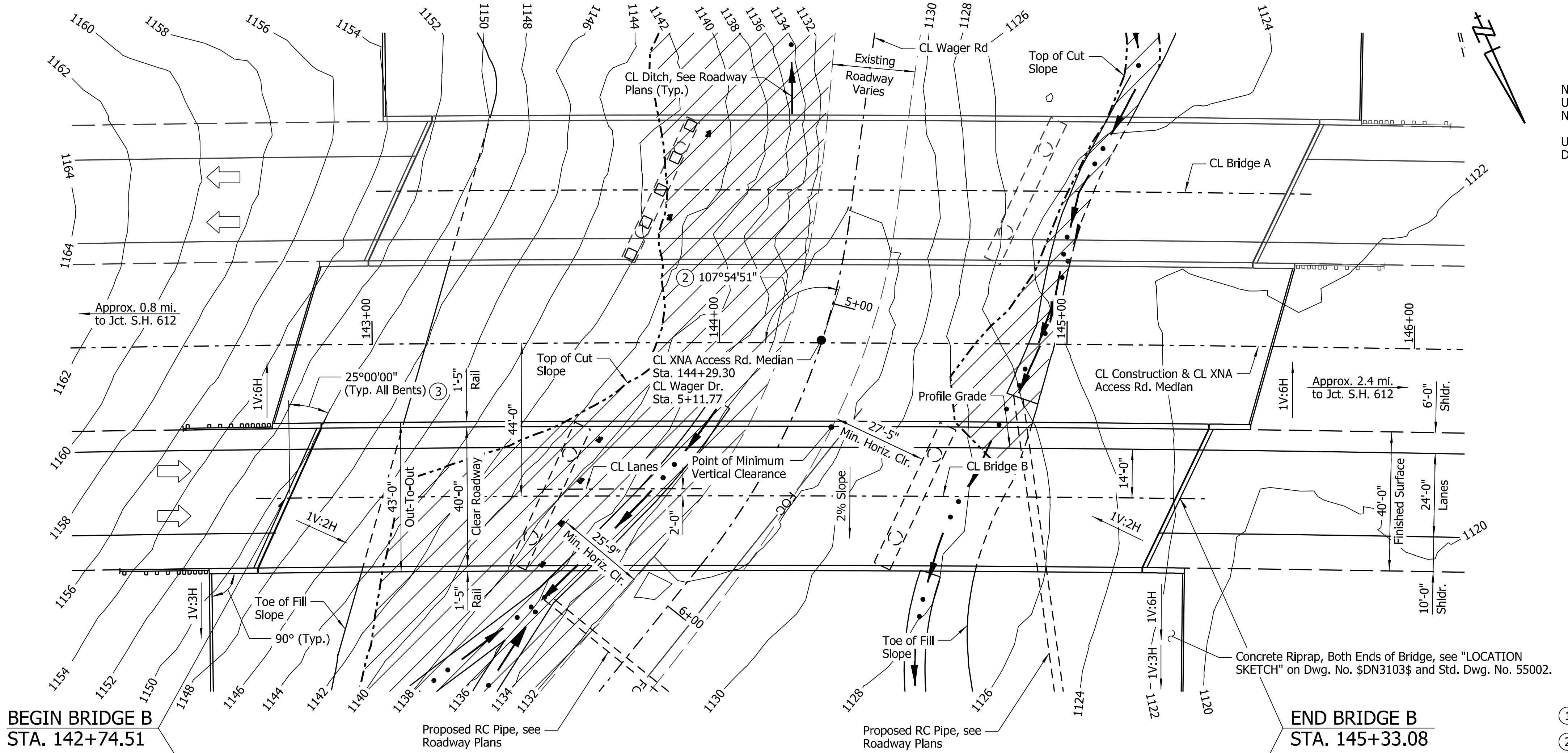
ROUTE RTSEC. SC

ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

DRAWN BY: CSW DATE: MAR. 2022 FILENAME: b090069x3_L1.dgn
CHECKED BY: MRA DATE: JULY 2022 SCALE: 1" = 20'-0"
DESIGNED BY: CSW DATE: MAR. 2022
BRIDGE NO. $BN03A$ DRAWING NO. $DN3101$

JESkInner 8/4/2023 3:25:16 PM
WORKSPACE: ARDOT Bridge (2019)
L:\2017\17017600 - XNA Access - NEPA\Drawings\b090069x3_S101_LO.dgn
REVISED DATE:

DATE REVISED	DATE REVISED	FED. ROAD DIST. NO.	STATE	JOB NO.	SHEET NO.	TOTAL SHEETS
		6	ARK.	090069	$SN3102$	ST
		$BN03B$		LAYOUT		$DN3102$



BEGIN BRIDGE B
STA. 142+74.51

END BRIDGE B
STA. 145+33.08

PLAN - BRIDGE B

NOTES:
Use Type F Approach Slab at each end of bridge. See Std. Dwg. No. 55040F1.

Use Type F Approach Gutters at each end of bridge. See Std. Dwg. No. 55030F.

EXISTING UTILITIES LEGEND

FOC = Fiber Optic Cable

NOTE:
Utilities shown are based on locations at time of survey and do not reflect any potential utility relocations prior to construction.

HORIZONTAL CURVE DATA

XNA Access Rd. Median
PI = 156+17.12
Δ = 14°18'07" Rt.
D = 0°30'00"
T = 1437.67'
L = 2860.39'
e = 0.02%
R = 11459.16'

NOTES:
For "PROJECT GENERAL NOTES", see Dwg. No. $DN0201$.

For "GENERAL NOTES" & "LOCATION SKETCH", see Dwg. No. $DN3103$.

For "ELEVATION OF SOIL BORINGS - BRIDGE B", BORING LEGEND" and "N-VALUES", see Dwg. No. $DN3104$.

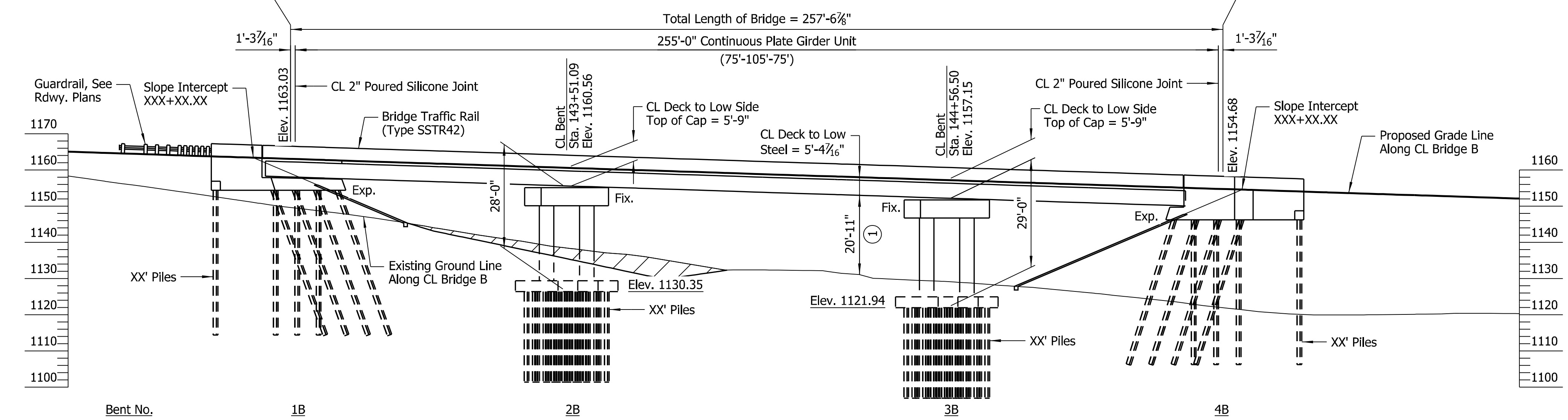
CL Construction is on a 0°30'00" curve right. CL Girders and the longitudinal lines of the bridge and approach slabs and gutters shall be constructed on curves concentric with CL Construction.

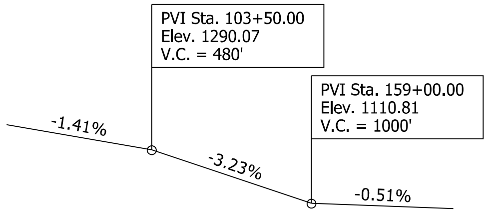
① Point of Minimum Vertical Clearance

② Angle measured at point of intersection between line tangent to CL XNA Access Rd. Median and line tangent to CL Wager Rd

③ For Bents 1B & 4B:
Measured from CL Joint to a line radial to CL Bridge B at CL Joint.

For Bents 2B & 3B:
Measured from CL Bent to a line radial to CL Bridge B at CL Bent.





VERTICAL CURVE DATA

XNA Access Rd.
(Profile Grade 14' Left of CL Bridge B)

SOIL BORINGS NOT AVAILABLE AT TIME OF PRINTING

NOTE:
Stations shown are along CL Construction. Elevations shown are actual top of deck elevations at CL Bridge B. Any vertical dimension referenced to CL Deck is based on actual top of deck elevation at CL Bridge B.

ELEVATION - BRIDGE B

143+00
144+00
145+00
146+00

FOR R/W DATA, SEE ROADWAY PLANS

JESkInner 8/4/2023 3:25:17 PM
WORKSPACE: ARDOT Bridge (2019)
L:\2017\170176600 - XNA Access - NEPA\Drawings\b090069x3_S102_LO.dgn
REVISED DATE:

PRELIMINARY
NOT FOR
CONSTRUCTION

BRIDGE ENGINEER

SHEET 2 OF 4
LAYOUT OF BRIDGES
XNA ACCESS RD. OVER WAGER RD.
NORTHWEST ARKANSAS
NATIONAL AIRPORT ACCESS (F)
BENTON COUNTY

ROUTE RTSEC. SC

ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

DRAWN BY: CSW DATE: MAR. 2022 FILENAME: b090069x3_L2.dgn
CHECKED BY: MRA DATE: JULY 2022 SCALE: 1" = 20'-0"
DESIGNED BY: CSW DATE: MAR. 2022

BRIDGE NO. $BN03B$ DRAWING NO. $DN3102$

APPENDIX B

B-S1: Run 1 (6-10 ft), Run 2 (10-15 ft), Run 3 (15-20 ft)

B-S1: Run 4 (20-25 ft), Run 5 (25-30 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S2: Run 1 (5-10 ft), Run 2 (10-15 ft)

B-S2: Run 3 (15-20 ft), Run 4 (20-25 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **090069 XNA Access Road** **Benton County, Arkansas**	**Job No. 19-118** **Plate**

B-S2: Run 5 (25-28 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S3: Run 1 (23-25 ft), Run 2 (25-30 ft)

B-S3: Run (30-35 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S4: Run 1 (5-10 ft), Run 2 (10-15 ft)

B-S4: Run 3 (15-20 ft), Run 4 (20-25 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S4: Run 1 (22-24 ft), Run 2 (23-27 ft), Run 3 (27-32 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S5: Run 1 (24-26 ft), Run 2 (26-31 ft), Run 3 (31-34 ft)

B-S5: Run 4 (34-36 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S6: Run 1 (33-37 ft), Run 2 (37-38 ft), Run 3 (38-43 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S7: Run 1 (28.5-30 ft), Run 2 (30-35 ft)

B-S7: Run 3 (35-38.5 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

<u>ROCK CORE PHOTOS</u>
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S8: Run 1 (22-25 ft), Run 2 (25-29 ft), Run 3 (29-31 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

APPENDIX C

SUMMARY of CLASSIFICATION TEST RESULTS

PROJECT: 090069 XNA Access Road
LOCATION: Benton County, Arkansas
GHBW JOB NUMBER: 19-118

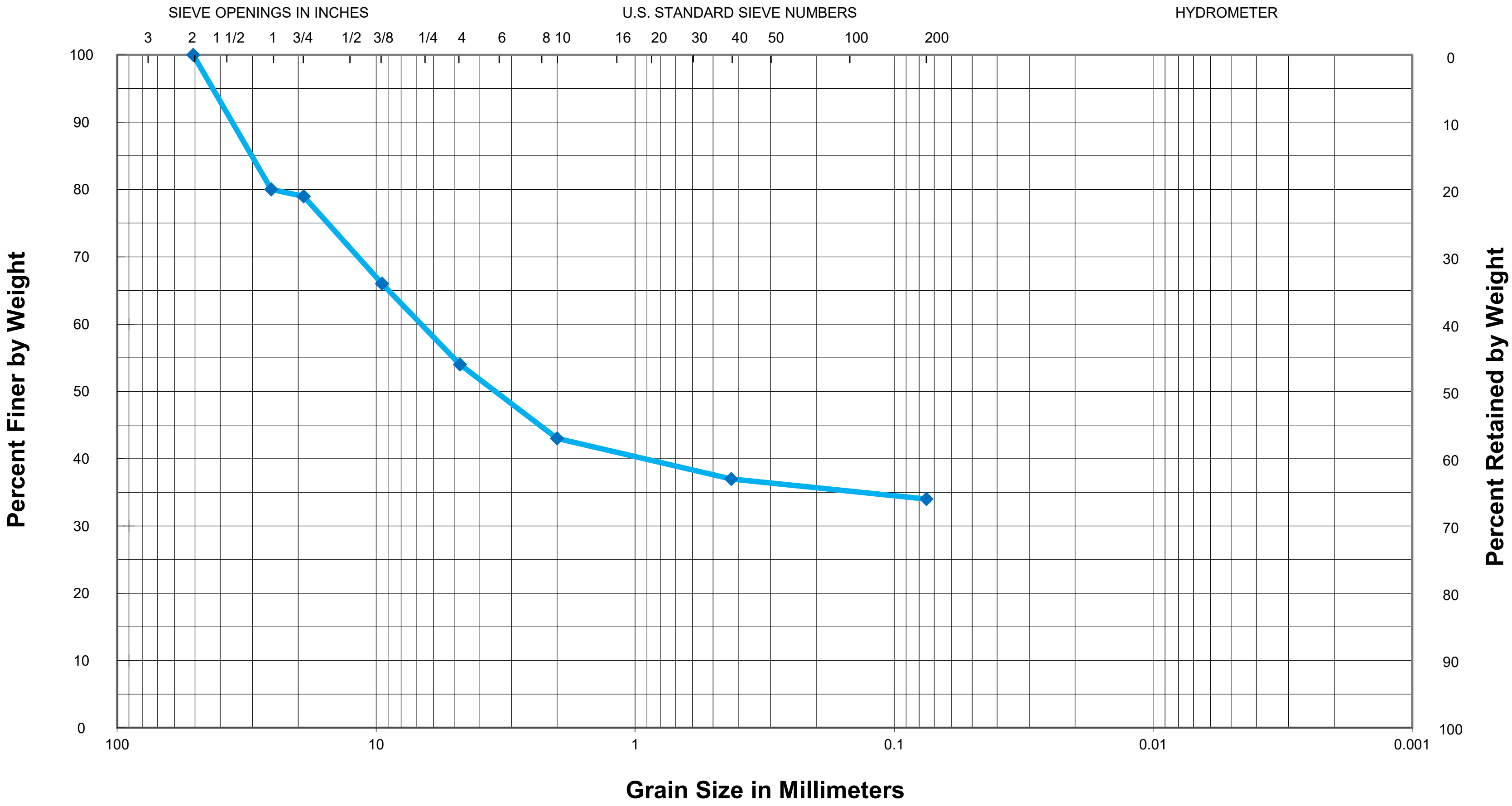
BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING								USCS CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
S1	0.5-1.5	14	---	---	---	---	---	---	---	45	---	---	21	GM	A-1-b
S4	2.5-3.5	15	NON-PLASTIC			---	---	---	---	57	---	---	38	GM	A-4
S5	6.5-7.5	16	32	25	7	---	---	---	---	74	---	---	30	SM	A-2-4
S6	0.5-1.5	22	29	24	5	---	---	---	---	85	---	---	58	CL-ML	A-4
S6	2.5-3.5	12	---	---	---	100	80	79	66	54	43	37	34	SM	A-2-4
S6	9-10	17	34	21	13	---	---	---	---	67	---	---	39	SC	A-6
S8	2.5-3.5	19	30	19	11	---	---	---	---	77	---	---	49	SC	A-6
S8	14-15	13	32	18	14	---	---	---	---	65	---	---	20	SC	A-2-6

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

PLATE

19-118

GRAIN SIZE CURVE

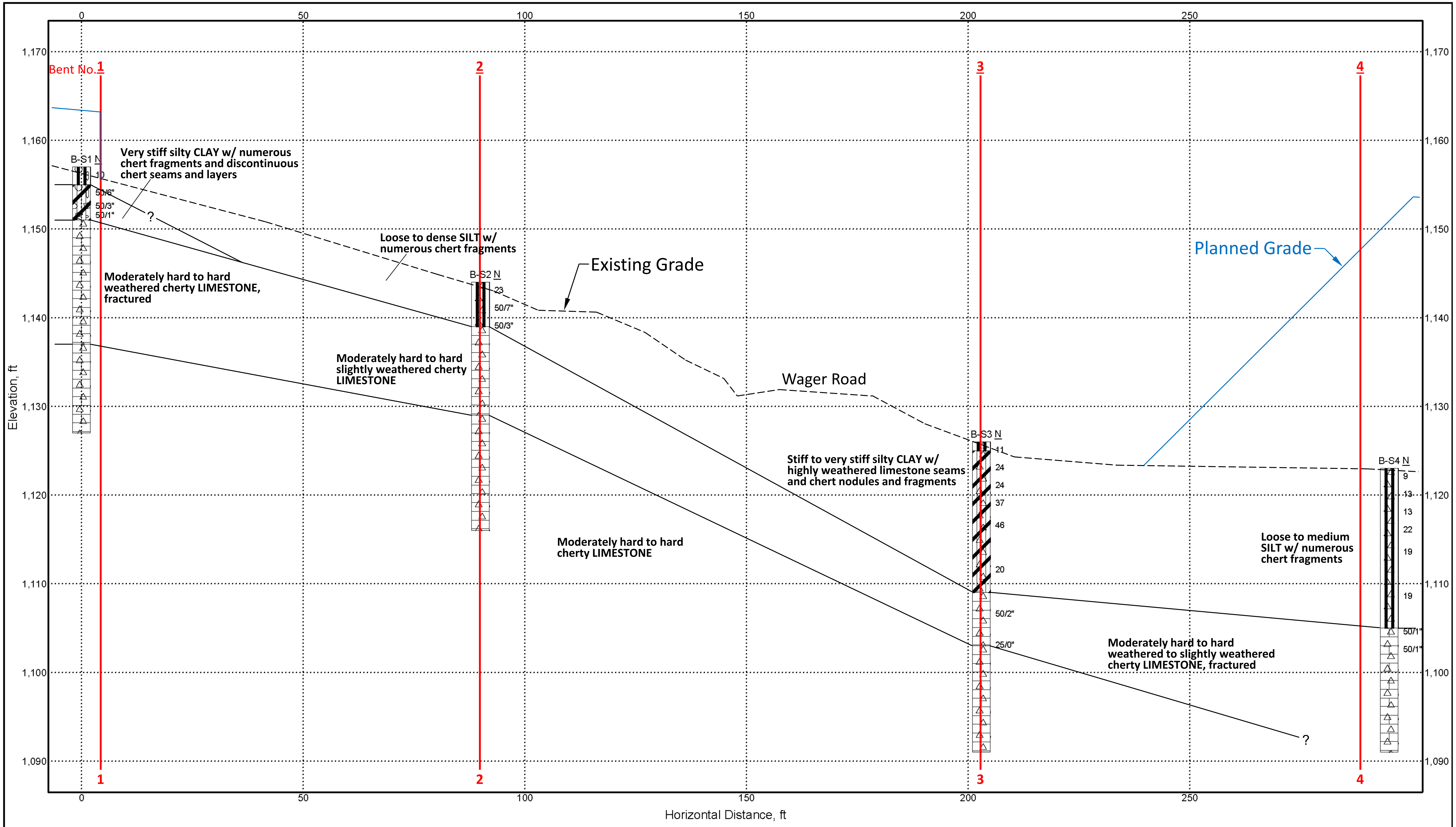


GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

Sample: Boring S6, 2.5-3.5 ft;
Description: Brown silty chert gravel

USCS Classification = SM
AASHTO Classification = A-2-4

APPENDIX D

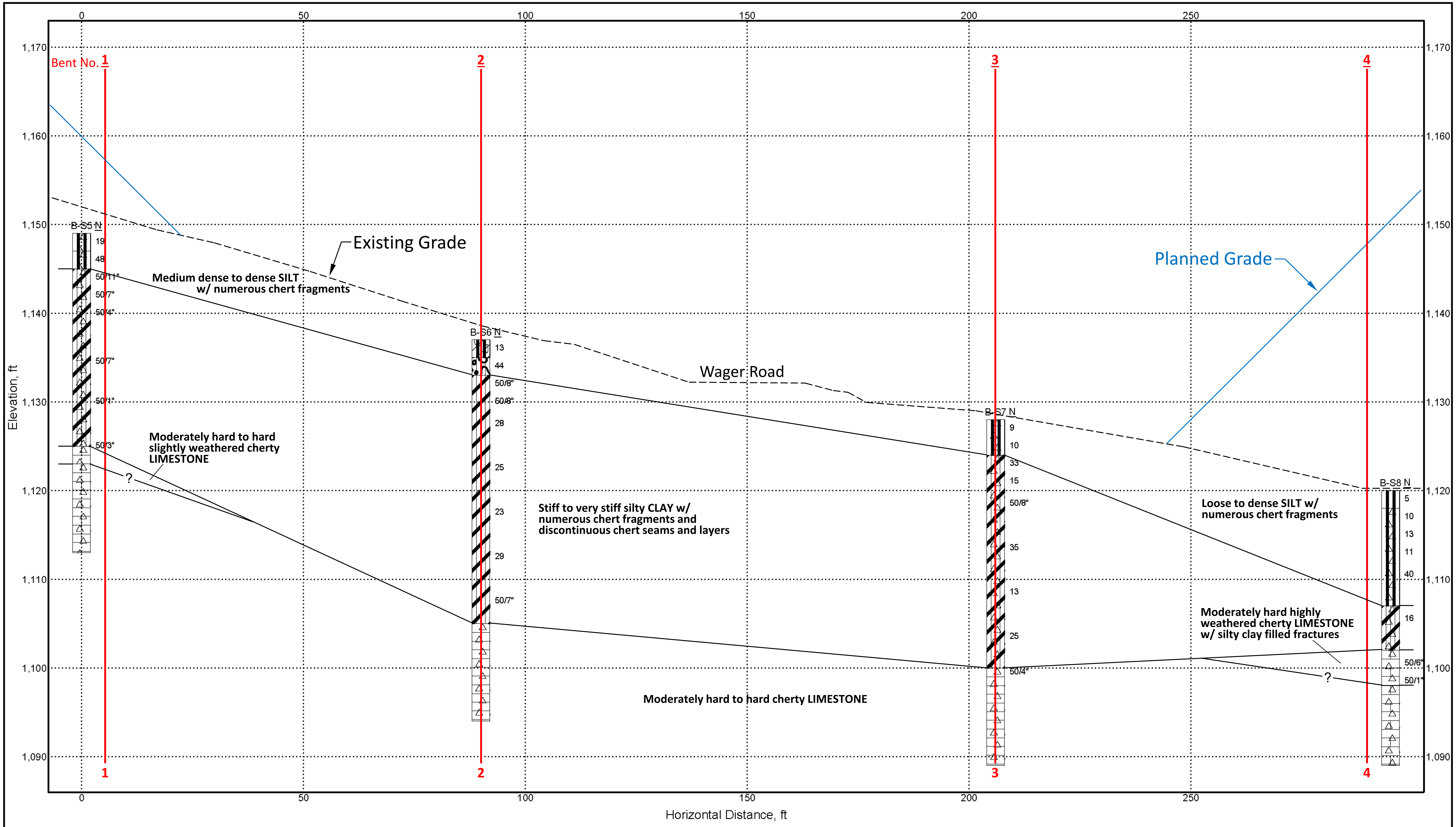


Grubbs, Hoskyn,
Barton & Wyatt, LLC

NOTES:
1. Subsurface conditions have been inferred between discrete boring locations. Actual conditions may vary.
2. Ground surface approximate.

SCALE:
1" = 20' Horizontal
1" = 10' Vertical

Generalized Subsurface Profile - Bridge A
090069 XNA Access Road over Wager Rd
Benton Co., Arkansas
Project Number: 19-118



Grubbs, Hoskyn,
Barton & Wyatt, LLC

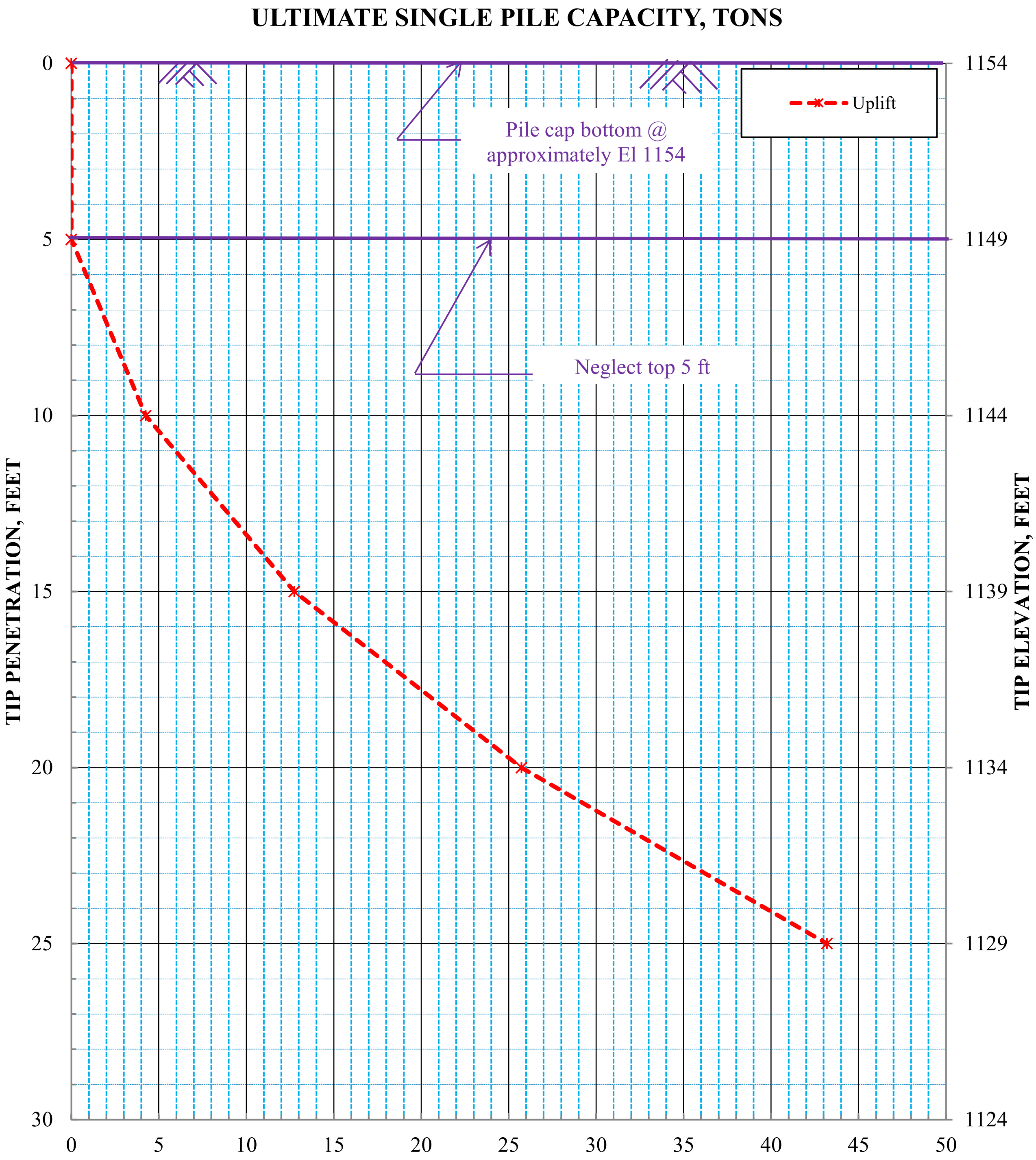
NOTES:
1. Subsurface conditions have been inferred between discrete boring locations. Actual conditions may vary.
2. Ground surface approximate.

SCALE:
1" = 20' Horizontal
1" = 10' Vertical

Generalized Subsurface Profile - Bridge B
090069 XNA Access Road over Wager Rd
Benton Co., Arkansas

Project Number: 19-118

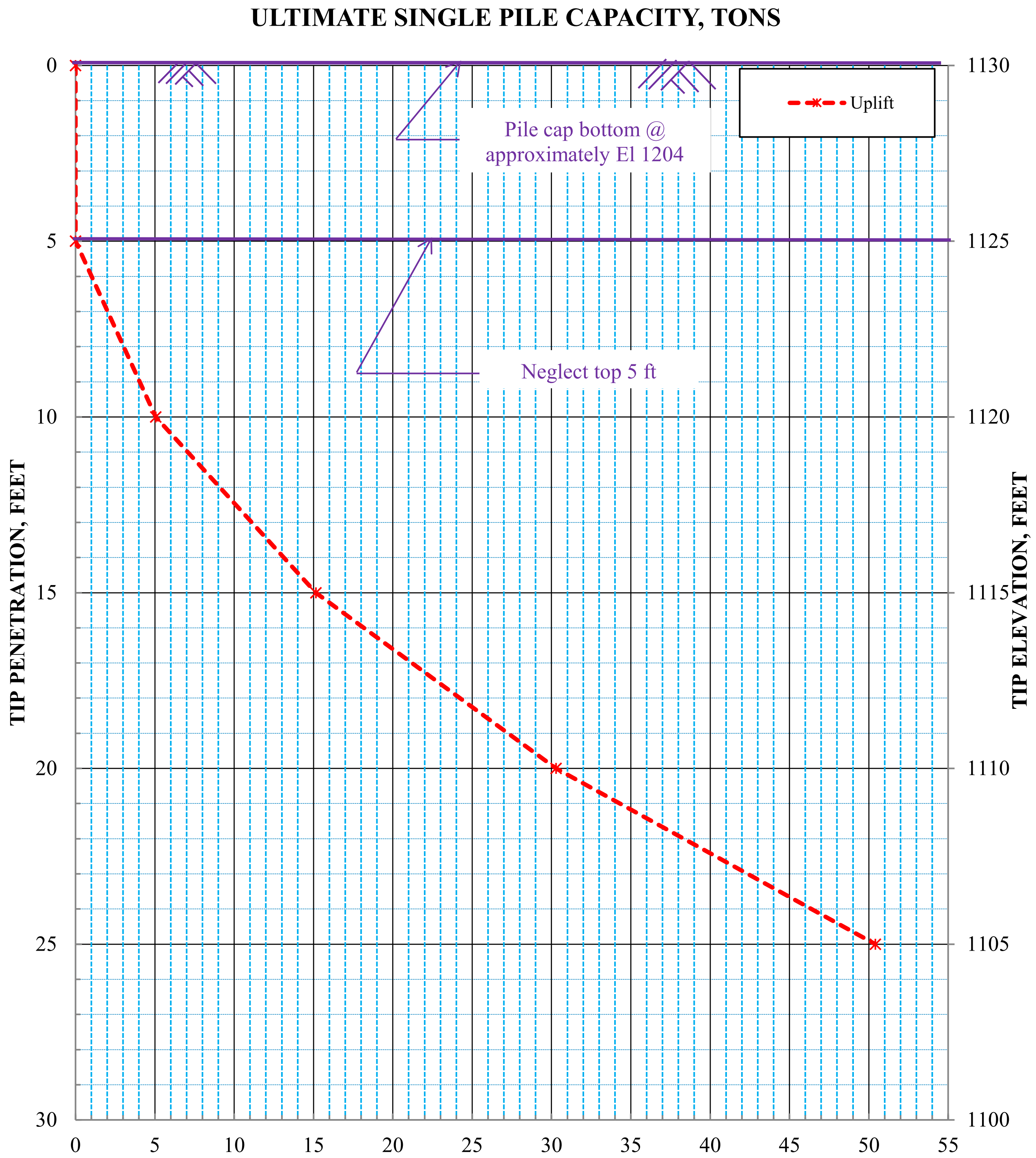
APPENDIX E



ULTIMATE SINGLE PILE CAPACITY, TONS
Grouted HP12x53 Steel Piles - Uplift
090069 XNA Access Road over Wager Road
Bent 1A (South Bent)
Benton County, Arkansas

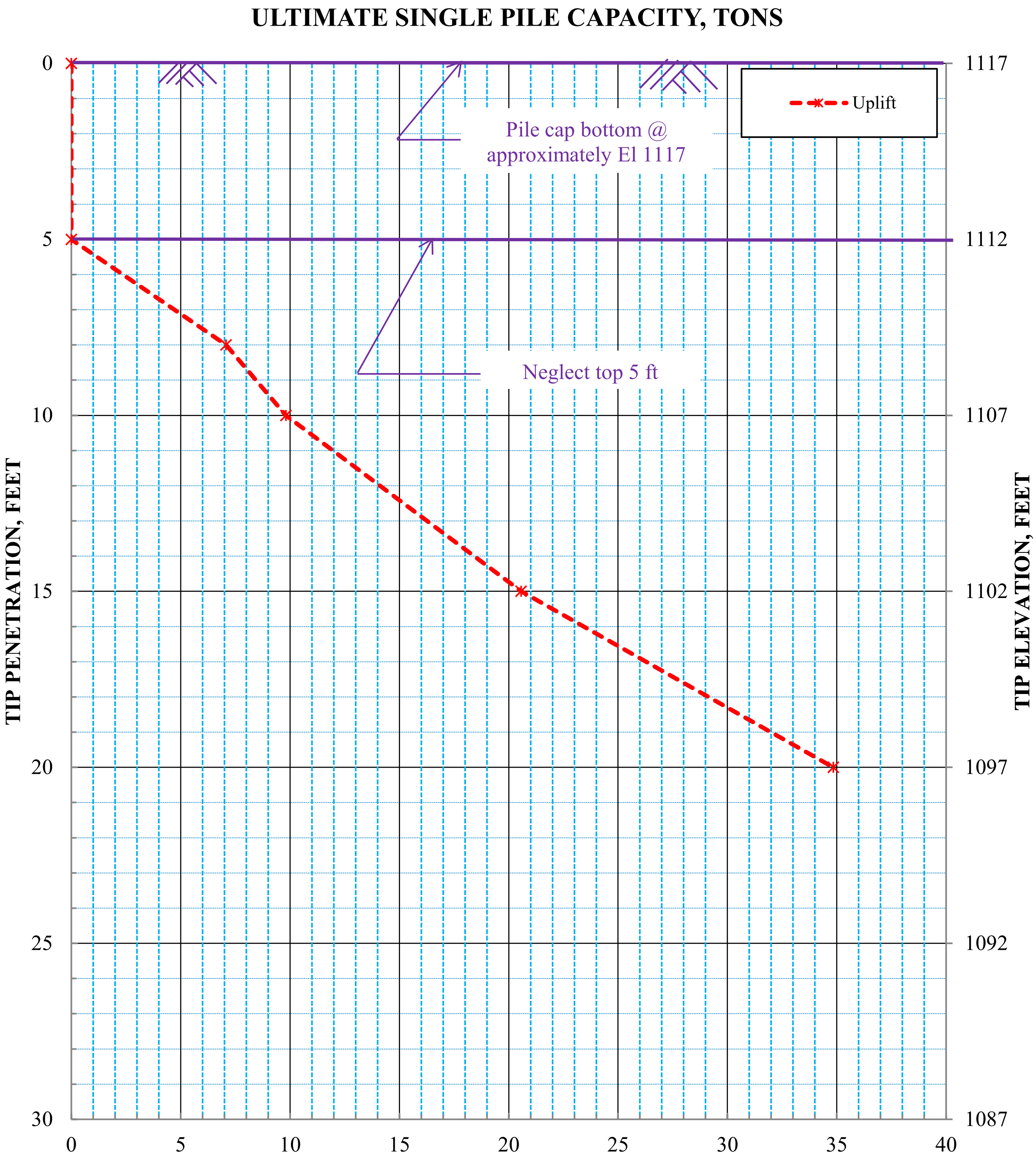
Note: 1. Piles driven from cap bottom elevation
2. Preboring and grouting required in moderately hard weathered limestone below El. 1151±

Grubbs, Hoskyn, Barton & Wyatt, LLC
Consulting Engineers



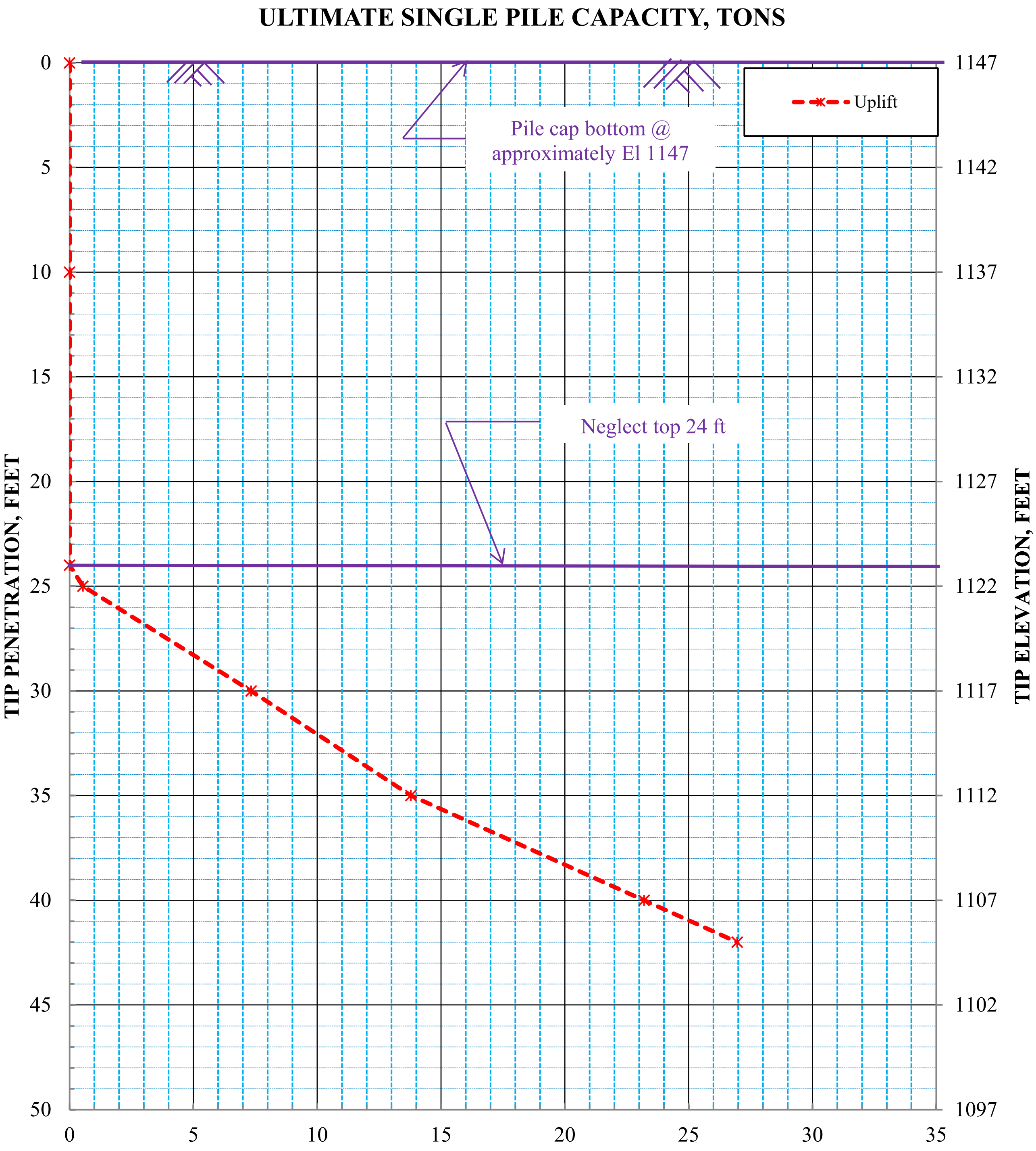
ULTIMATE SINGLE PILE CAPACITY, TONS
Grouted HP14x73 Steel Piles - Uplift
090069 XNA Access Road over Wager Road
Bent 2A (Interior Bent)
Benton County, Arkansas

Note: 1. Piles driven from cap bottom elevation
2. Preboring and grouting required in moderately hard weathered limestone below El. 1139±



ULTIMATE SINGLE PILE CAPACITY, TONS
Grouted HP14x73 Steel Piles - Uplift
090069 XNA Access Road over Wager Road
Bent 3A (Interior Bent)
Benton County, Arkansas

Note: 1. Piles driven from cap bottom elevation
2. Preboring and grouting required in moderately hard weathered limestone below El. 1109±

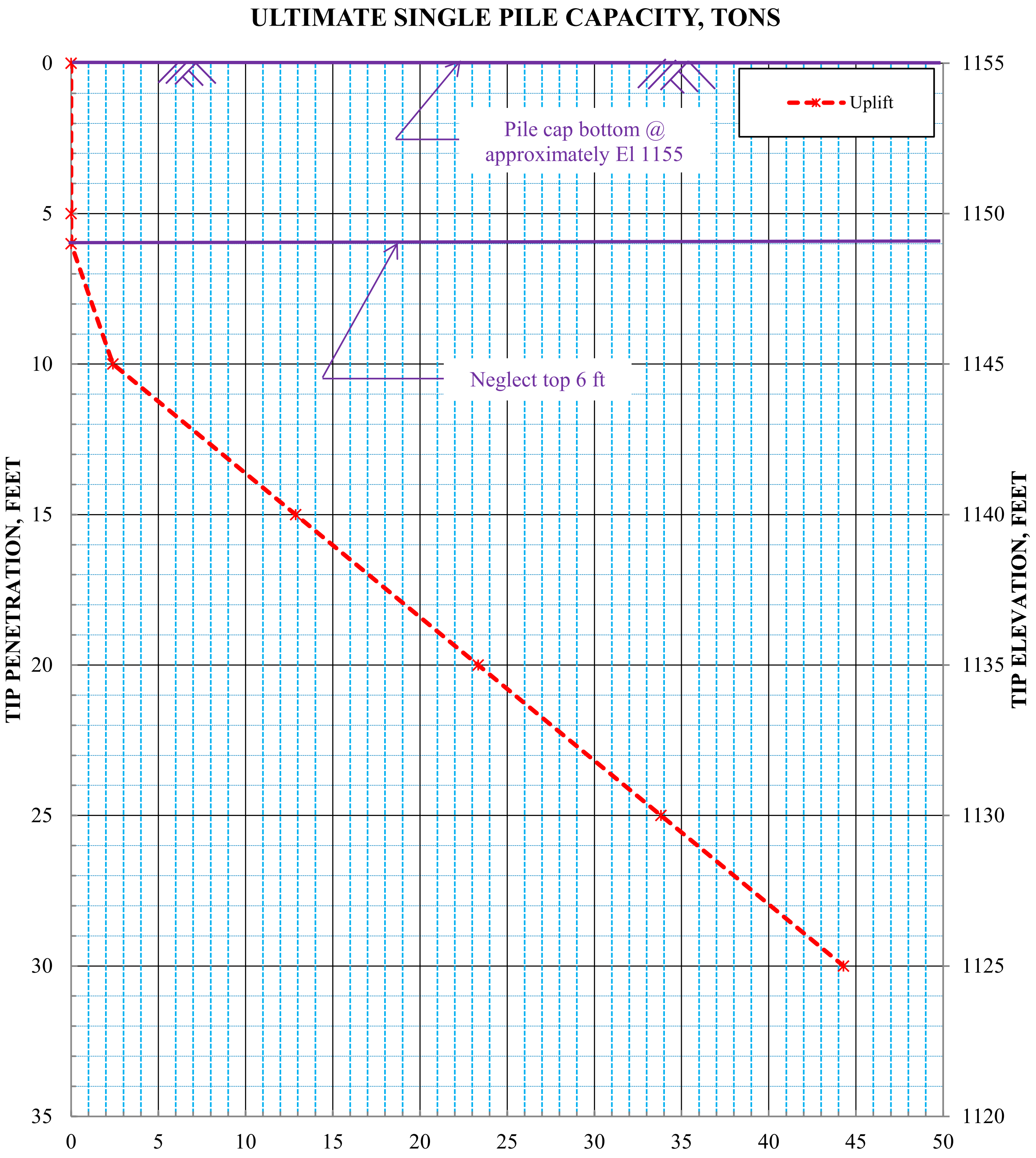


ULTIMATE SINGLE PILE CAPACITY, TONS

HP14x73 Steel Piles - Uplift
090069 XNA Access Road over Wager Road
Bent 4A (North Bent)
Benton County, Arkansas

Note: 1. Piles driven from cap bottom elevation
2. Pile penetration limited in moderately hard weathered limestone below El. 1105±

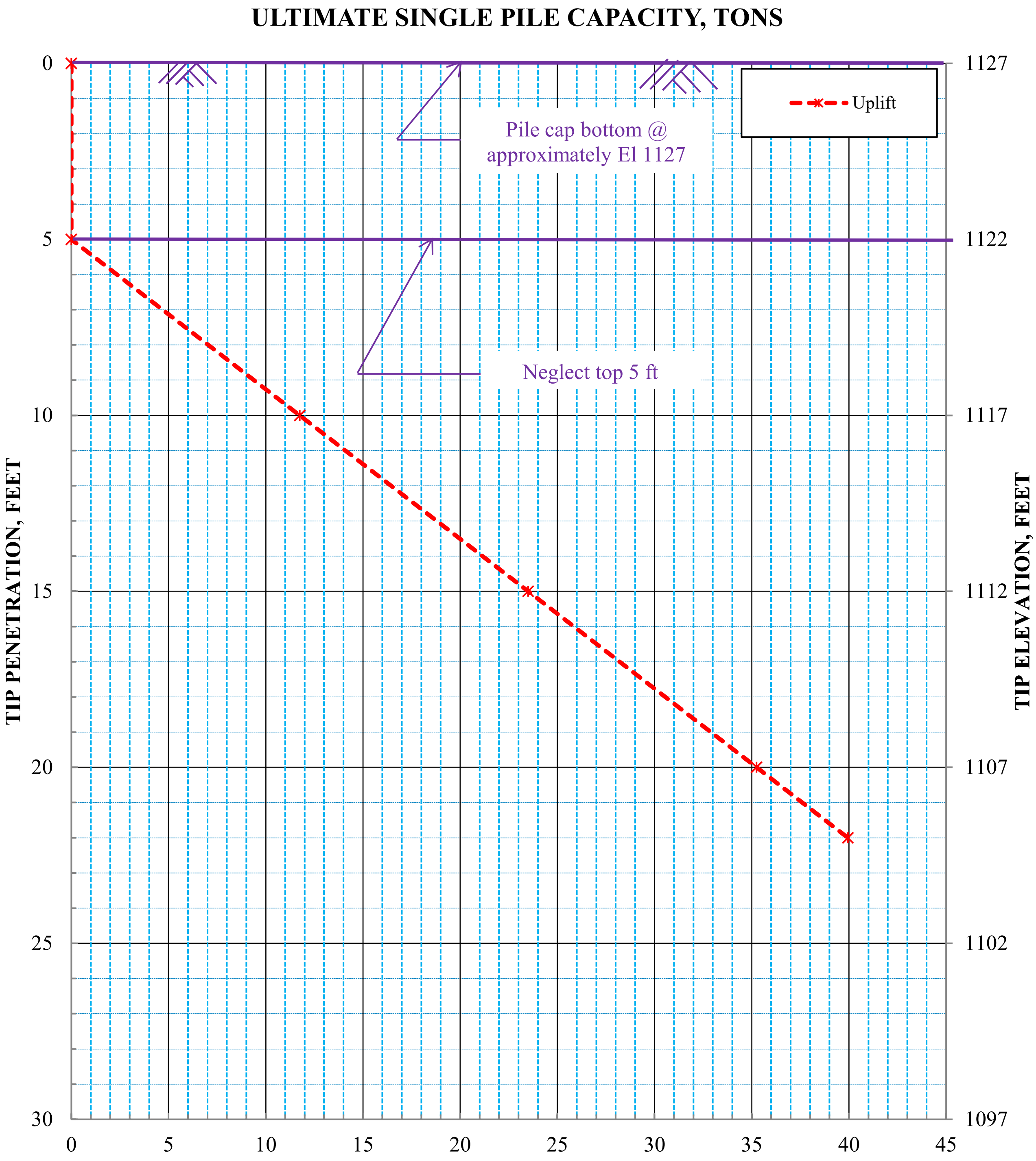
Grubbs, Hoskyn, Barton & Wyatt, LLC
Consulting Engineers



ULTIMATE SINGLE PILE CAPACITY, TONS

Grouted HP12x53 Steel Piles - Uplift
090069 XNA Access Road over Wager Road
Bent 1B (South Bent)
Benton County, Arkansas

Note: 1. Piles driven from cap bottom elevation
2. Pile penetration limited in moderately hard weathered limestone below El. 1125±



ULTIMATE SINGLE PILE CAPACITY, TONS

HP14x73 Steel Piles - Uplift

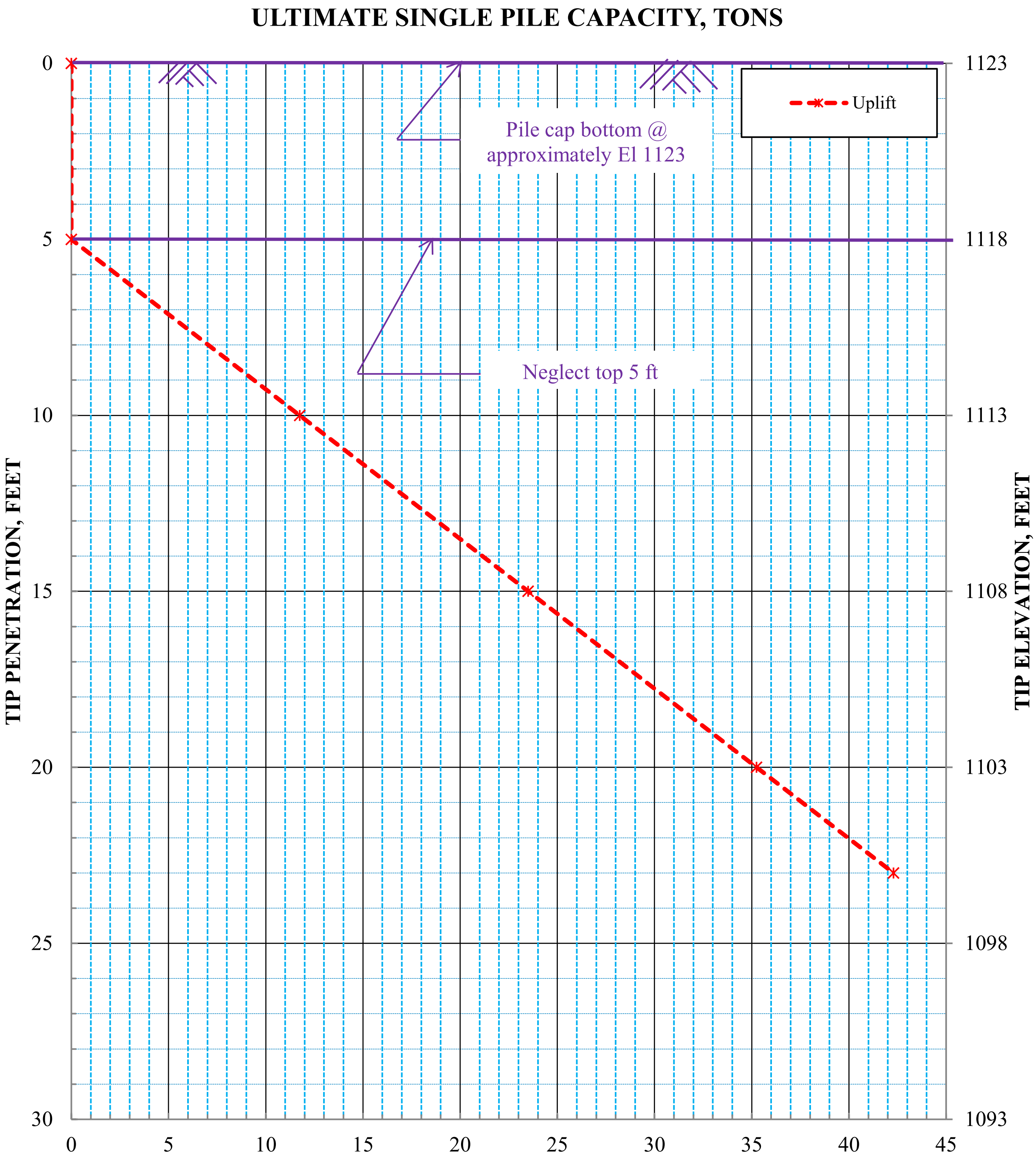
090069 XNA Access Road over Wager Road

Bent 2B (Interior Bent)

Benton County, Arkansas

Note: 1. Piles driven from cap bottom elevation

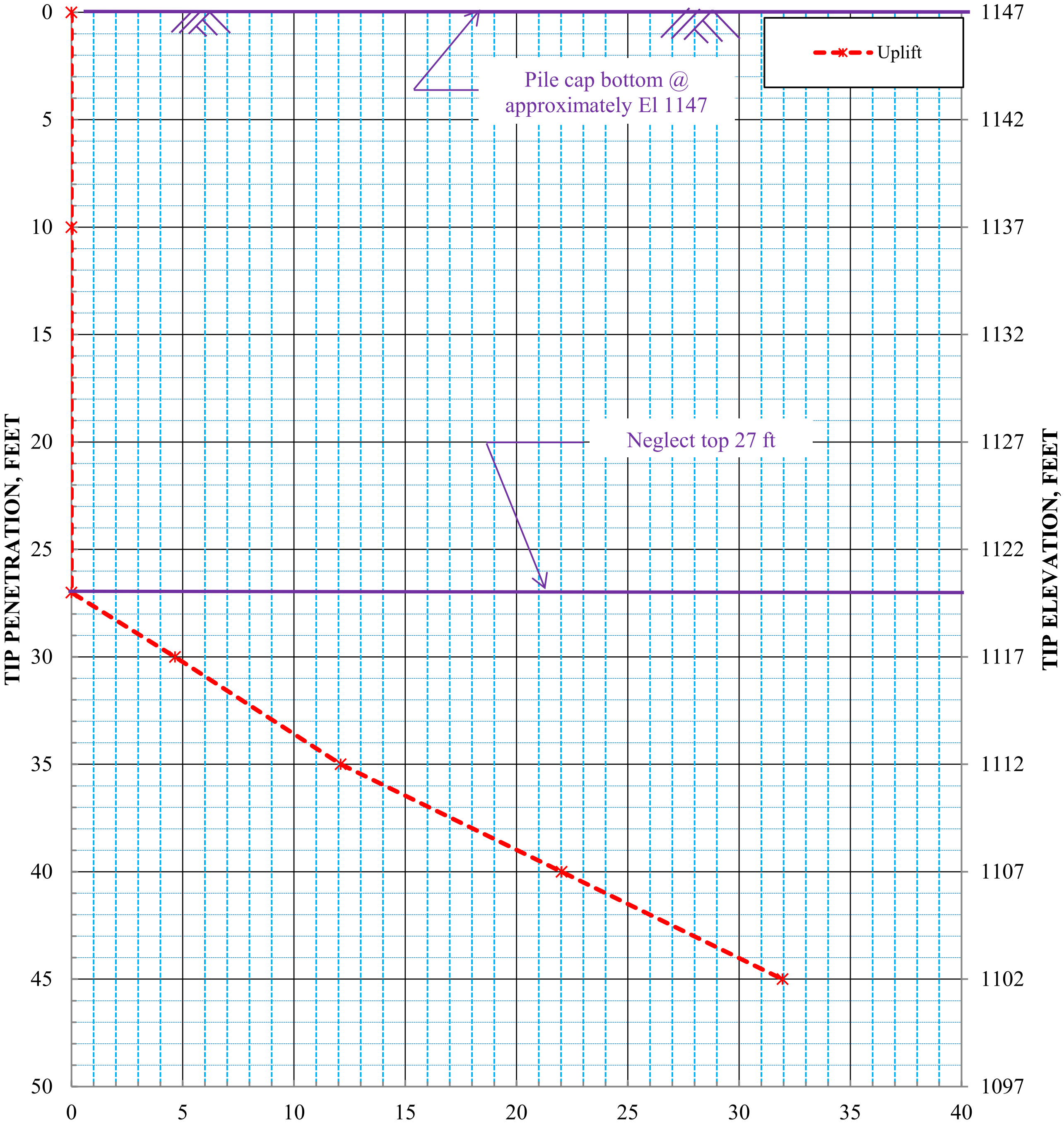
2. Pile penetration limited in moderately hard weathered limestone below El. 1105±



ULTIMATE SINGLE PILE CAPACITY, TONS
HP14x73 Steel Piles - Uplift
090069 XNA Access Road over Wager Road
Bent 3B (Interior Bent)
Benton County, Arkansas

Note: 1. Piles driven from cap bottom elevation
2. Pile penetration limited in moderately hard weathered limestone below El. 1100±

ULTIMATE SINGLE PILE CAPACITY, TONS



ULTIMATE SINGLE PILE CAPACITY, TONS
HP14x73 Steel Piles - Uplift
090069 XNA Access Road over Wager Road
Bent 4B (North Bent)
Benton County, Arkansas

Note: 1. Piles driven from cap bottom elevation
2. Pile penetration limited in moderately hard weathered limestone below El. 1102±

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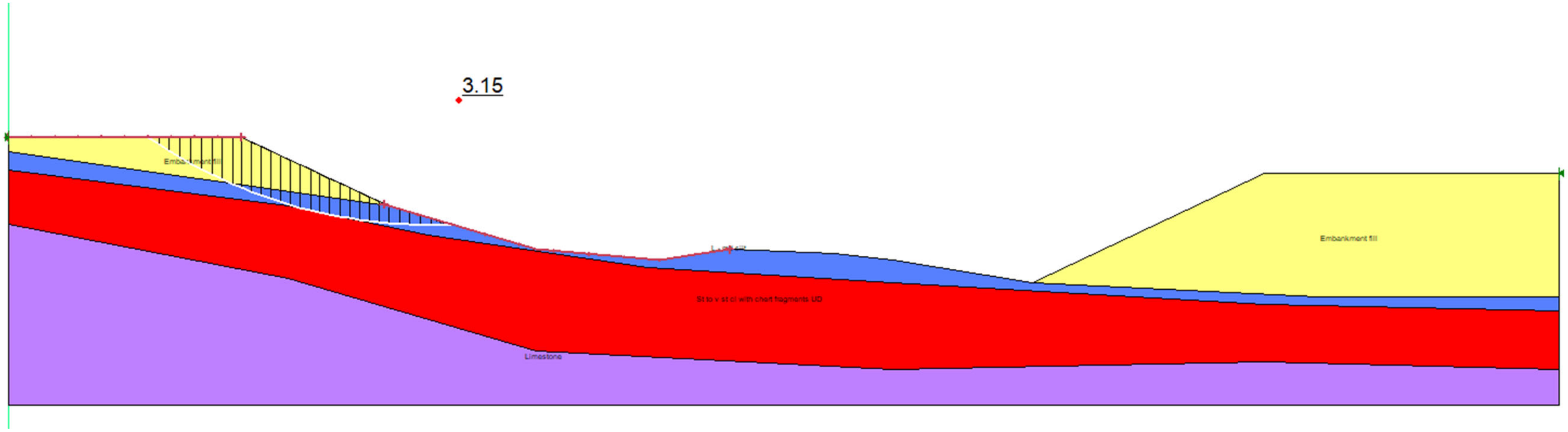
Consulting Engineers

APPENDIX F

Summary of Stability Analysis Results
ARDOT 090069 XNA Access Road over Wager Road
GHBW Job No. 19-118
Benton County, Arkansas

	Design Loading Condition	**Calculated Minimum Factor of Safety**
South End Slope (Bent 1) (2H:1V)	End of Construction	3.15
	Long Term	2.59
	Seismic ($k_h = A_S/2 = 0.0245$)	2.90
South Side Slope (Bent 1) (3H:1V)	End of Construction	4.65
	Long Term	3.97
	Seismic ($k_h = A_S/2 = 0.0245$)	4.50
North End Slope (Bent 5) (2H:1V)	End of Construction	2.78
	Long Term	2.55
	Seismic ($k_h = A_S/2 = 0.0245$)	2.63
North Side Slope (Bent 5) (3H:1V)	End of Construction	2.93
	Long Term	2.76
	Seismic ($k_h = A_S/2 = 0.0245$)	2.69



Results of Stability Analyses – End of Construction
Bent 1 End Slope
2H:1V Slope, H=34 ft ±
19-118 – ARDOT Job No.090069 – XNA Access Road over Wager Road

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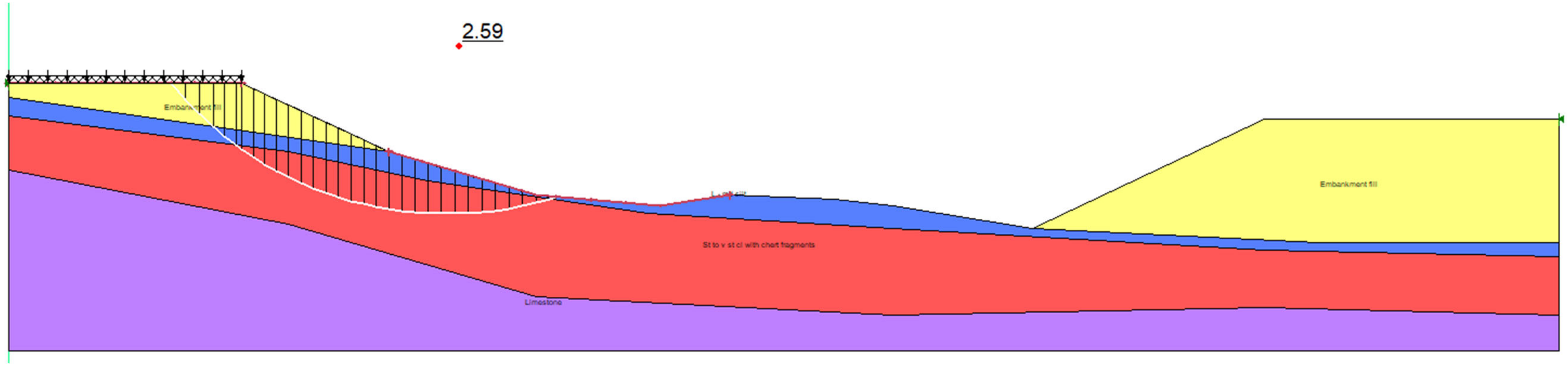
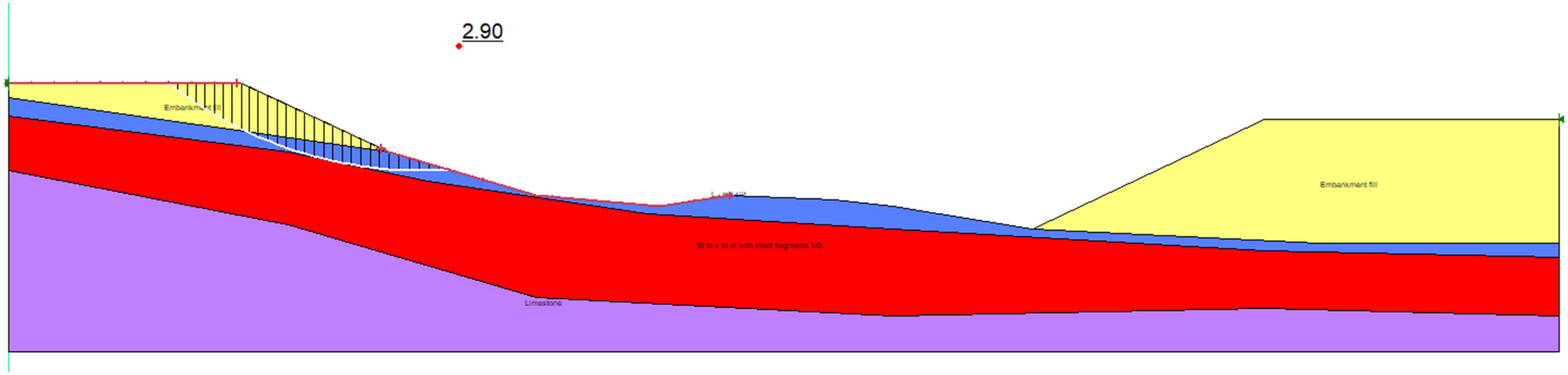
A UES Company

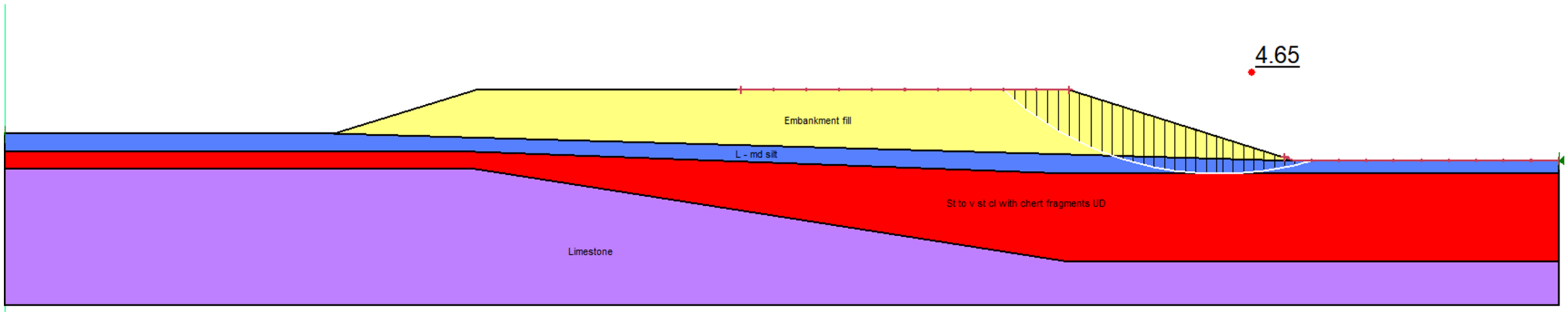


Results of Stability Analyses – Long Term Condition
Bent 1 End Slope
2H:1V Slope, H=34 ft ±
19-118 – ARDOT Job No.090069 – XNA Access Road over Wager Road

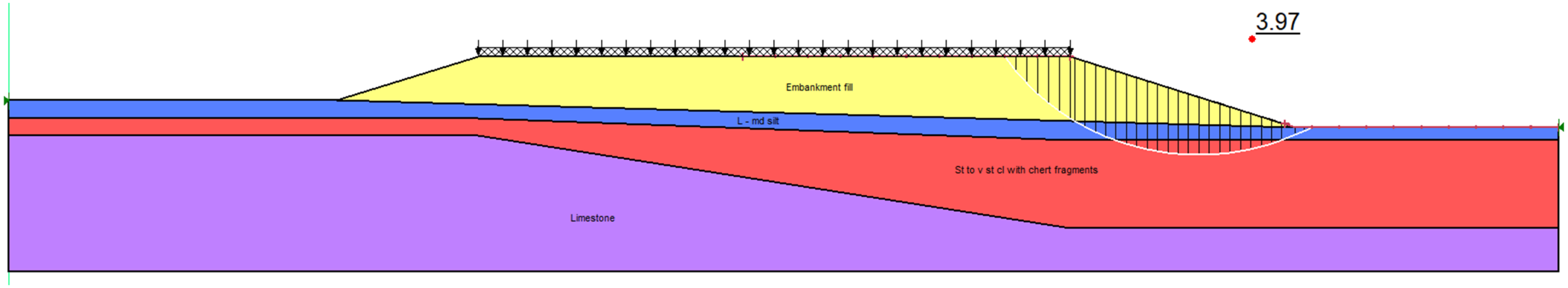
Grubbs, Hoskyn,
Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



Results of Stability Analyses – Seismic Condition ($k_h = A_S /2= 0.0245$)
Bent 1 End Slope
2H:1V Slope, H=34 ft ±
19-118 – ARDOT Job No.090069 – XNA Access Road over Wager Road



Results of Stability Analyses – End of Construction
Bent 1 Side Slope
3H:1V Slope, H=16 ft ±
19-118 – ARDOT Job No.090069 – XNA Access Road over Wager Road



Results of Stability Analyses – Long Term Condition
Bent 1 Side Slope
3H:1V Slope, H=16 ft ±
19-118 – ARDOT Job No.090069 – XNA Access Road over Wager Road
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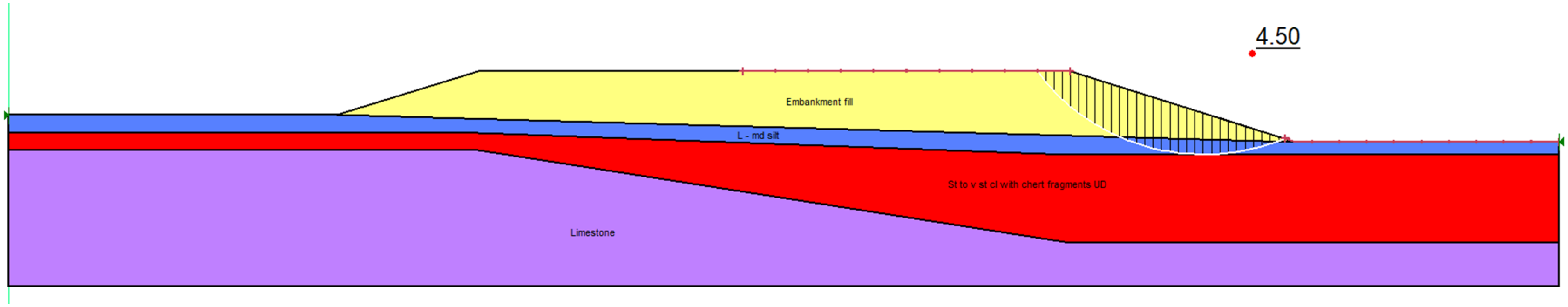
Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



Results of Stability Analyses – Seismic Condition (k_h = A_S /2= 0.0245)
Bent 1 Side Slope
3H:1V Slope, H=16 ft ±
19-118 – ARDOT Job No.090069 – XNA Access Road over Wager Road

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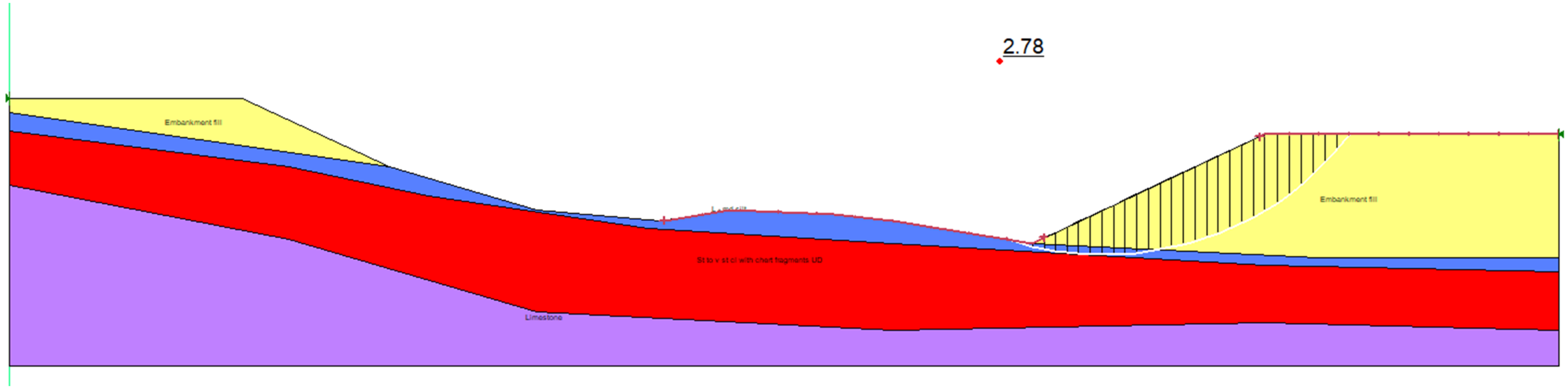
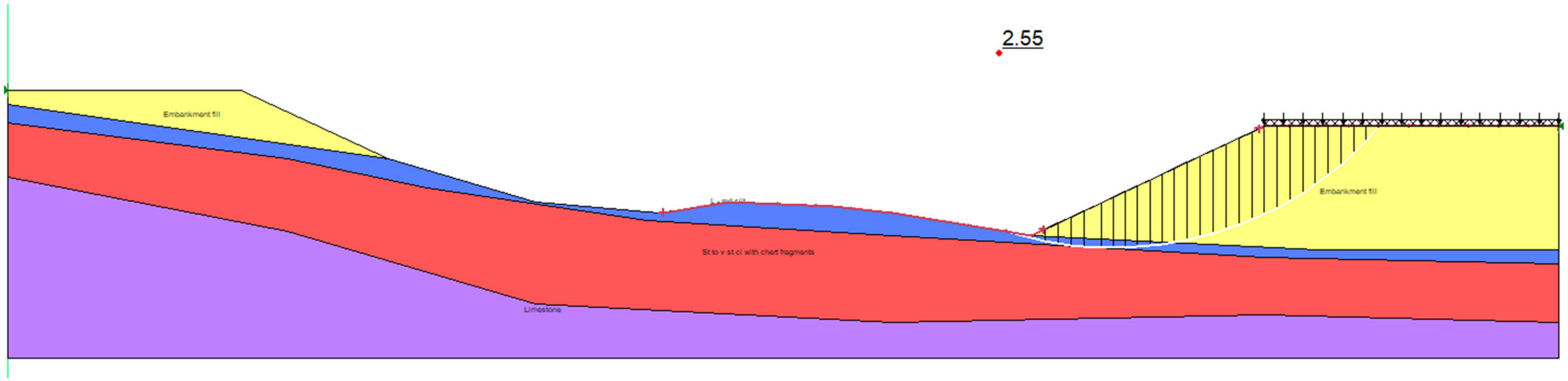


Results of Stability Analyses – End of Construction
Bent 4 End Slope
2H:1V Slope, H=30 ft ±
19-118 – ARDOT Job No.090069 – XNA Access Road over Wager Road



Results of Stability Analyses – Long Term Condition
Bent 4 End Slope
2H:1V Slope, H=30 ft ±
19-118 – ARDOT Job No.090069 – XNA Access Road over Wager Road

Grubbs, Hoskyn, Barton & Wyatt, LLC
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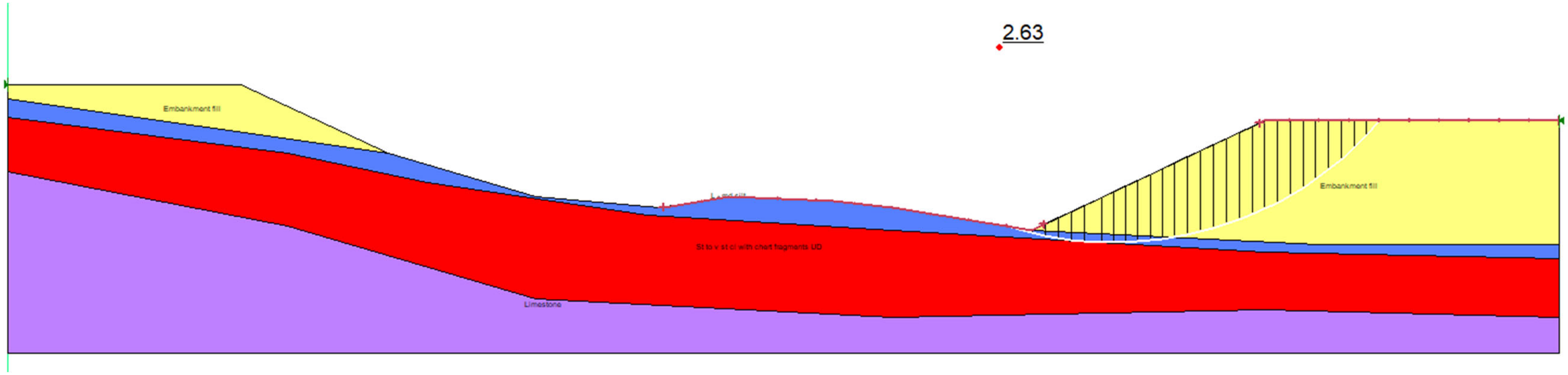
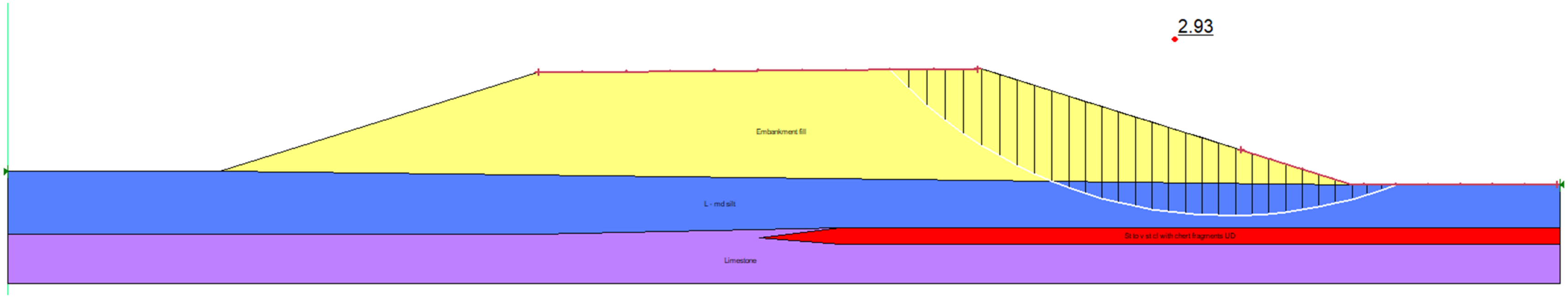
A UES Company

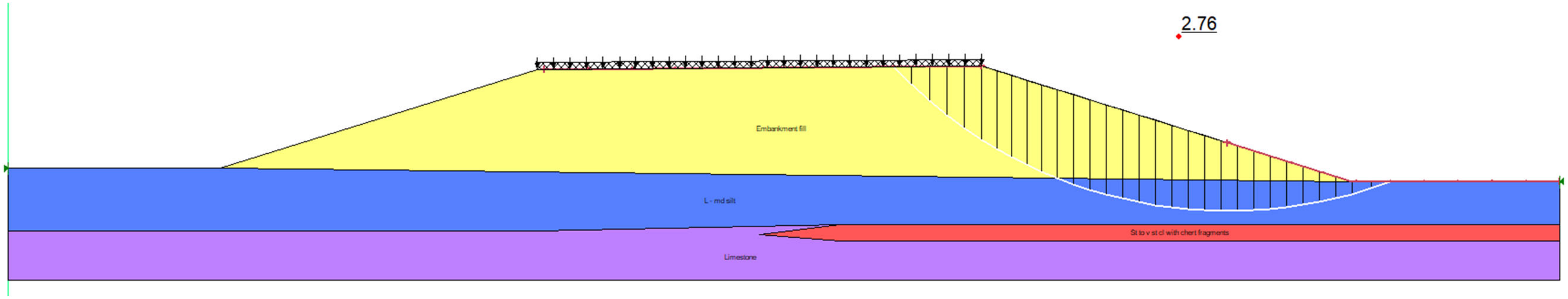


Results of Stability Analyses – Seismic Condition ($k_h = A_S /2= 0.0245$)
Bent 4 End Slope
2H:1V Slope, H=30 ft ±
19-118 – ARDOT Job No.090069 – XNA Access Road over Wager Road

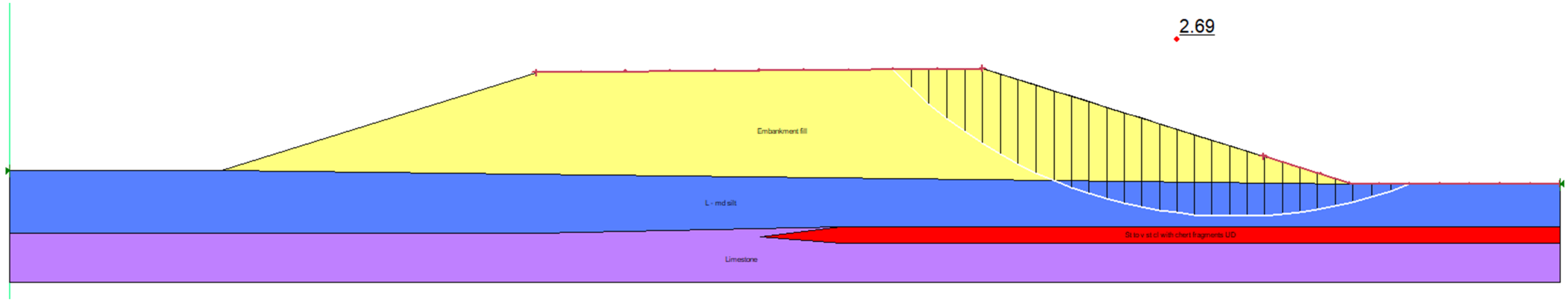
Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



Results of Stability Analyses – End of Construction
Bent 4 Side Slope
3H:1V Slope, H=35 ft ±
19-118 – ARDOT Job No.090069 – XNA Access Road over Wager Road



Results of Stability Analyses – Long Term Condition
Bent 4 Side Slope
3H:1V Slope, H=35 ft ±
19-118 – ARDOT Job No.090069 – XNA Access Road over Wager Road



Results of Stability Analyses – Seismic Condition ($k_h = A_S /2 = 0.0245$)
Bent 4 Side Slope
3H:1V Slope, H=35 ft ±
19-118 – ARDOT Job No.090069 – XNA Access Road over Wager Road

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CONSULTING ENGINEERS
A UES Company

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

Materials Testing
Geotechnical Engineering
Environmental
Building Sciences & Safety
Inspections & Code Compliance
Virtual Design Consulting

September 28, 2023
Job No. 19-118

Garver LLC
4701 Northshore Drive
North Little Rock, Arkansas 72118

Attn: Mr. Joel Skinner, P.E.

RESULTS of GEOTECHNICAL INVESTIGATION
ARDOT JOB 090069
XNA ACCESS ROAD BRIDGE OVER OSAGE CREEK
BENTON COUNTY, ARKANSAS

INTRODUCTION

Submitted herein are the final results of the geotechnical investigation performed for the XNA Access Road Twin Bridges over Osage Creek in Benton County, Arkansas. The Osage Creek bridge is one facet of ARDOT Job 090069 Northwest Arkansas Regional Airport Access (Benton Co) (F). This geotechnical investigation was authorized by the Garver, LCC Subconsultant Agreement for Task Order No. 061 on August 27, 2019. Notice to proceed with the field studies was received on August 30, 2019. Results and recommendations have been provided throughout the course of this study. A preliminary report was submitted on August 31, 2023.

We understand the new bridges will be continuous plate girder structures with nine (9) bents, eight (8) spans, and total bridge lengths of approximately 1022 ft each. We also understand that a foundation system consisting of steel piles and drilled piers are planned at the bridge ends and intermediate bents, respectively. Foundation loads of the new bridge are anticipated to be moderate. The bridge end embankments will utilize simple slopes with end slopes at approximate 2-horizontal to 1-vertical (2H:1V) configurations and side slopes at 3-horizontal to 1-vertical (3H:1V) configurations. Site grading is expected to include up to 34 ft of embankment fill and 42 ft of cut. Preliminary bridge layouts are provided in Appendix A.

The purposes of this study were to explore subsurface conditions in the twin bridge alignments and to develop recommendations to guide design and construction of foundations and earthwork. These purposes have been achieved by a multi-phased study that included the following.

- Drilling sample and core borings at the planned bridge location to evaluate subsurface conditions and obtain samples of the subgrade and foundation soil and rock for laboratory testing.
- Performing laboratory tests to evaluate pertinent engineering properties of the foundation and subgrade strata.
- Analyzing field and laboratory data to develop recommendations for seismic site class, seismic performance zone/seismic design category, foundation and subgrade support, slope stability, site grading, and construction considerations.

The relationship of these factors to design and construction of the new bridges has been considered in developing the recommendations and considerations discussed in the following report sections.

SUBSURFACE EXPLORATION

Subsurface conditions at the Osage Creek bridge location were investigated by drilling 16 sample and core borings to depths of 23 to 55 feet. The site vicinity is shown on Plate 1. The approximate boring locations are shown on the bridge layout drawings on Plates 2a and 2b. The planned Boring S12 was not drilled due to the boring location in the creek channel with steep banks and seasonally high water levels. Planned Borings S17 and S26 were located on a steep hillside and were not accessible to drilling equipment. Boring R12, a roadway boring, was drilled about 150 ft north of the north bridge ends and was utilized to develop subsurface profiles at the A and B Bridges.

The subsurface exploration program is summarized in Table 1 below.

Table 1: Summary of Osage Creek Bridges Exploration Program

Boring No.	Approx Sta	Approx Offset, ft	Approx Surf El, ft	Completion Depth, ft
R12	170+99	CL	1146	30
S9	158+30	60 Lt	1098	27
S10	159+40	60 Lt	1089	52
S11	160+85	60 Lt	1080	52
S13	163+40	60 Lt	1079	55
S14	164+50	60 Lt	1078	51
S15	165+95	60 Lt	1078	52
S16	166+95	65 Lt	1072	44.2
S18	157+85	60 Rt	1091	23

Boring No.	**Approx Sta**	**Approx Offset, ft**	**Approx Surf El, ft**	**Completion Depth, ft**
S19	158+95	60 Rt	1084	48
S20	160+20	10 Rt	1078	46
S21	161+85	45 Rt	1078	52
S22	162+95	60 Rt	1072	50
S23	164+05	75 Rt	1078	48
S24	165+50	60 Rt	1076	50
S25	166+24	60 Rt	1070	48

The boring logs, presenting descriptions of the soil and rock strata encountered in the borings and the results of the field and laboratory tests, are included as Plates 3 through 31. The centerline station and offset of the boring locations and approximate ground surface elevation, as inferred from the topographic information provided by the Engineer (Garver, LLC) or as inferred from available topographic information, are also shown on the logs. It must be recognized that the surface elevations shown are approximate and actual elevations may vary. Keys to the terms and symbols used on the logs are presented as Plates 32 and 33.

The borings were drilled with a truck-mounted CME-55 HTX and a track-mounted Geoprobe 3230DT rotary-drilling rigs using a combination of dry-auger and rotary-wash drilling methods. Samples were typically obtained at 2-ft intervals to 10-ft depth and at 5-ft intervals thereafter. Samples were recovered using a 2-in.-diameter split-barrel sampler driven into the strata by blows of a 140-lb automatic hammer with 30-in. drop in accordance with Standard Penetration Test (SPT) procedures. The number of blows required to drive the standard split-barrel sampler the final 12 in. of an 18-in. total drive, or a portion thereof, is defined as the Standard Penetration Number (N). Recorded N-values are shown on the boring logs in the "Blows Per Ft" column.

Representative samples of the cherty limestone bedrock were obtained using a 5-ft-long NQ2-size double-tube core barrel with a diamond bit. For each core run, the percent recovery was determined as the ratio of recovery to total length of core run. Rock Quality Designation (RQD) was also determined for the core run as the sum of intact, sound rock core greater than 4-in. length divided by the total length of the run and expressed in percent. Both these values are presented in the right-hand columns of the log forms, opposite the corresponding core run. Selected photographs of the recovered rock cores are provided in Appendix B.

All samples were removed from sampling tools in the field, examined and visually classified by the field geologist or field engineer. Samples were then placed in appropriate containers to prevent moisture loss and/or change in condition during transfer to our laboratory for further examination and testing.

The borings were advanced using dry-auger procedures to the extent possible to facilitate evaluation of shallow groundwater conditions. Observations regarding groundwater levels are noted in the lower-right portion of each log and are discussed in subsequent sections of this report. All boreholes were backfilled after obtaining the final water level readings.

LABORATORY TESTING

Laboratory testing was performed to evaluate subgrade and foundation plasticity and to confirm visual classification. The testing program included natural water content determinations (AASHTO T 265), liquid and plastic (Atterberg) limit determinations (AASHTO T 89 and T 90), and sieve analyses through the No. 200 sieve (AASHTO T 88). Soil shear strength was estimated in the field using SPT results.

A total of 16 natural water content determinations were performed to develop information on *in-situ* soil water content in the borings. Water content results are plotted on the boring log forms in accordance with the scale and symbols shown in the legend located in the upper-right corner of the logs.

To verify field classification and to evaluate soil plasticity, seven (7) liquid and plastic limit (Atterberg limits) determinations and 14 sieve analyses were performed on selected representative samples. The Atterberg limits are plotted on the logs as pluses inter-connected with a dashed line using the water content scale. The percentage of soil passing through the No. 200 Sieve is noted in the "- No. 200 %" column on the appropriate log forms.

A summary of classification test results and classification by the Unified Soil Classification System and AASHTO Classification System is presented in Appendix C. Grain-size distribution curves are also included in Appendix C.

Results of the laboratory compression tests are shown in lbs per sq inch at the appropriate depth on the boring logs. The total unit weight of intact cores was also measured and these data are also shown on the logs.

GENERAL SITE and SUBSURFACE CONDITIONS

Site Conditions

The overall alignment of the XNA Access Road extends from the Northwest Arkansas Regional Airport (XNA) about 4 miles southeast to the planned terminus at Highways 70 and 71. The bridge alignments cross Osage Creek approximately 5300 ft northeast of the intersection of Haden Road and Snavely Road. The site locale is presently open agricultural and pastureland away from the creek; the immediate vicinity of the creek is covered with mature trees. The Osage Creek channel at the bridge location is narrow with well-defined banks. The banks are steep with tall grass and thick underbrush. Shifting gravel bars are in the channel and stream levels fluctuated broadly during drilling operations. The site terrain slopes gently to the creek from the northwest and the southeast. Surface drainage is considered very poor to good.

Site Geology

The project alignment is located in the mapped exposure of the Boone Formation. The early and middle Mississippian Period Boone consists of fine- to coarse-grained limestone interbedded with chert. The chert content can vary widely, both horizontally and vertically, and limestone or chert may be predominant. The Boone Formation is known for dissolutional features such as sinkholes, caves, and enlarged fissures. Typically, the limestone/cherty limestone units of the Boone decompose (weather) to erratic blends of chert fragments and clay/silty clay. The residual soil mantle may extend to significant depths on higher terrain and may contain hard chert seams and/or layers. The thickness of the Boone Formation is reported to be 300 to 350 ft in northern Arkansas. The Boone is generally disconformable to the underlying Chattanooga Shale and St. Joe Limestone member, with some areas having a conformable contact.

Seismic Conditions

In light of the results of the borings performed for the Osage bridge, a Seismic Site Class B (rock profile) is considered applicable for the site with respect to the criteria of the AASHTO LRFD Bridge Design Specifications Eighth Edition 2017[1].

Given the location and AASHTO code-based values, the 1.0-sec period spectral acceleration coefficient for Site Class B (S_1) is 0.051 and the 1.0-sec period spectral acceleration coefficient (S_{D1}) value for Site Class B is 0.051. Utilizing these parameters, Table 3.10.6-1[2]

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[1] AASHTO LRFD Bridge Design Specifications, 8th Edition; AASHTO; 2017

[2] AASHTO LRFD Bridge Design Specification, AASHTO; 2012

indicates that a Seismic Performance Zone 1 is fitting for the Osage Creek bridge site. In reference to the 2011 edition of the AASHTO Guide Specifications, the Peak Ground Acceleration (PGA) having a 7 percent chance of exceedance in 75 years (or mean return period of approximately 1000 years) is predicted to be 0.049 for a Seismic Site Class B for the bridge location. The liquefaction potential is considered low for the predominantly cohesive overburden soils and underlying rock units encountered in the borings drilled for this study.

Subsurface Conditions

The results of the borings indicate that the surface and near-surface soils in the new twin bridge alignments typically consist of natural very soft to soft brown, reddish brown, and tan clayey silt and silty clay and very loose to medium dense tan, brown, reddish brown, and reddish tan silt, fine sandy silt, silty fine sand, and silty, sandy fine to coarse gravel to 2- to 13-ft depth. This stratum contains variable chert fragments and cobbles. This stratum represents recent stream bed deposits, which typically classify as A-1-a, A-1-b, A-2-4, A-4, and A-6 by the AASHTO classification system. The silt and clayey silt exhibit low plasticity, moderate to high compressibility, and low shear strength. The low-plasticity and silty soils are moisture-sensitive and will lose considerable strength when saturated.

Below the silt/clayey silt, silty sand, and gravel to approximately 9- to 18-ft depth is very soft to very stiff brown, reddish brown, and tan silty clay with numerous chert fragments. These soils typically classify as A-2-6, A-4, and A-6 by the AASHTO classification system. The natural surface and near-surface soils are highly variable with respect to strength and subgrade support for pavement structures. Some areas will warrant localized undercut for subgrade preparation.

The overburden soils are underlain by moderately hard to hard gray and light gray weathered to fresh cherty limestone. The competence of the cherty limestone increases with depth. The cherty limestone is flat-bedded with healed fractures and interbedded chert inclusions, seams, and layers. The core sample recovery ranges from 29 to 100 percent and the core sample RQD ranges from 0 to 100 percent in this stratum. The cherty limestone exhibits high strength with laboratory compressive strength values ranging from 3920 to 8480 lbs per sq inch.

To aid in visualizing subsurface conditions, generalized subsurface profiles are presented in Appendix D. It should be recognized that the stratigraphy illustrated by the profiles has been inferred between discrete boring locations. In view of the natural variations in stratigraphy and conditions, variations from the stratigraphy illustrated by the profiles should be anticipated.

Additionally, the natural transition between strata is generally gradual, and the stratigraphy described in the sections above may vary.

Groundwater Conditions

Groundwater was encountered at variable depths ranging from 3 ft to 18 ft in March, April, July, and August 2023. It has been our experience in the area that localized shallow perched groundwater can be present in the silty overburden soils and fractured zones of the cherty limestone. Groundwater levels will vary, depending on seasonal precipitation, surface runoff and infiltration, and stream levels in Osage Creek.

ANALYSES and RECOMMENDATIONS

Foundation Design

Foundations for the new bridge must satisfy two (2) basic and independent design criteria: a) foundations must have an acceptable factor of safety against bearing failure under maximum design loads, and b) foundation movement due to consolidation or swelling of the underlying strata should not exceed tolerable limits for the structures. Construction factors, such as installation of foundations, excavation procedures and surface and groundwater conditions, must also be considered.

Based on the results of the borings performed at the Osage Creek bridge site and our understanding of the project, we recommend that foundation loads at the south bridge ends (Bents 1A and 1B) be supported on steel piles. At the north bridge ends (Bents 9A and 9B), foundation loads may be supported on footings. Alternatively, steel piles may be used in conjunction with preboring. The foundation loads at the intermediate bents (Bents 2 through 8) may be supported on drilled shaft foundations. Recommendations for foundations are discussed in the following report sections.

Piling Foundations

We recommend that the foundation loads at the south bridge end be supported on HP12x53 steel piles. Point-bearing steel piles driven to refusal should extend through any new embankment fill, the natural overburden soils, and any zones of highly weathered cherty limestone to develop safe bearing capacity in the competent moderately hard to hard limestone. End-bearing piles should be driven to practical refusal in the moderately hard to hard limestone. We recommend that all steel piles be fitted with rock points.

Steel piles driven to refusal should be designed for the structural capacity of the pile, as per applicable AASHTO Load and Resistance Factor Design (LRFD) procedures[3]. An effective resistance factor (φ_c) of 0.50 is recommended for structural determination of factored bearing capacities. This effective resistance factor for steel piles has been based on the assumption of severe driving conditions.

For determination of bearing capacities of steel piles driven to refusal, we recommend that nominal (ultimate) resistance (P_n) of HP piles be determined based on the yield strength of steel H piles (f_y) and the net end area (A_{net}) of the section. It has been our experience that allowable pile capacities of 96 tons for HP12x53 piles are typical for f_y = 50 ksi steel pile sections. These capacities are based on allowable stress design (ASD). However, the appropriate factored bearing capacity should be confirmed by the Engineer. Post-construction settlement of piles driven to refusal will be negligible.

The nominal axial capacities are based on single, isolated foundations. Piles spaced closer than three (3) pile widths may develop lower individual capacity due to group effects. The potential for group capacity reductions should be evaluated for pile spacing closer than three (3) widths (center to center).

Estimated pile tip elevations are summarized below in Table 2.

Table 2: Estimated Tip Elevations of Steel Piles Driven to Refusal

Bent No.	Estimated Pile Tip Elevation, ft	Comments
1A (South Bridge End)	1078	Refusal in moderately hard to hard slightly weathered cherty limestone
1B (South Bridge End)	1076	Refusal in moderately hard to hard cherty limestone
9A (North Bridge End)	1088	Prebore 10 ft into hard cherty limestone
9B (North Bridge End)	1185	Prebore 10 ft into hard cherty limestone

It should be noted that the prebore depths and tip elevations shown in the table above are estimates only based on the results of the relevant borings and the inferred surface elevations at the particular locations. Pile refusal and final pile depth must be field verified.

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[3] Load and Resistance Factor Design (LRFD) for Highway Bridge Substructures, Publication No. FHWA HI-98-032, National Highway Institute, May 2001.

Steel piles at the end bents may be subjected to uplift loads. Nominal single pile uplift capacity curves for steel HP12x53 piles are provided in Appendix E. Nominal axial pile capacities have been developed using static pile capacity formulae, the results of the borings, and the plan site grading shown on the preliminary bridge layout drawings. We recommend that compression loads be designed for end-bearing alone, as discussed above.

Based on AASHTO LRFD geotechnical design procedures, a resistance factor (φ_{up}) of 0.25 is recommended for evaluation of factored uplift capacity. This resistance factor is based on Strength Limit States. For Extreme Events Limit States such as earthquake loading and collision, a resistance factor of 0.8 for uplift is recommended.

Given the anticipated site grading raising grades at the south bridge ends, downdrag loads from embankment and overburden soil settlement are anticipated. We recommend a minimum period of 45 days after completion of fill placement before pile driving. Alternatively, piling may be installed prior to the recommended 45 days if piles are pre-bored to the cherty limestone bearing stratum. Downdrag loads on piles constructed as recommended are expected to be negligible. Pre-boring is not expected to be required for pile installation on the south bent other than installing pile casing.

A minimum pile length of 10 ft is recommended. As noted, preboring is expected to be required for pile installation at the north bent. Rock drilling methods will be required for prebores extending through the competent limestone. Following pile acceptance, the annulus around the installed piles in prebores should be expeditiously backfilled with grout as per ARDOT Standard Specifications Section 805. The grout should have a minimum compressive strength pf 4000 psi, as per AHTD Section 501 or an alternate approved by the Engineer.

Piles should be installed in compliance with Standard Specifications for Highway Construction, 2014 Edition, Section 805. We recommend a hammer delivering a minimum energy of 22,000 ft-lbs per blow. A specific review and analysis of the pile-hammer system proposed by the Contractor should be performed by the Engineer prior to hammer acceptance and start of driving. We recommend that all piles be fitted with rock points.

As a minimum, safe bearing capacity of piles should be determined by ARDOT Standard Specifications Section 805.09, Method A. Driving records should be available for review by the Engineer during pile installation. Blow counts on steel piles should be limited to about 20 blows per inch. Practical pile refusal may be defined as a penetration of 0.5 in. or less for the final 10 blows. Driving records should be available for review by the Engineer during pile installation.

Footings – Bents 9A and 9B

The results of the borings indicate that moderately hard to hard cherty limestone is present at the plan cap bottom elevations. Consequently, consideration can be given to supporting the end bent foundation loads on footings bearing in the cherty limestone.

Footings founded with a minimum embedment of 1 ft into the moderately hard to hard cherty limestone may be sized based on a maximum nominal bearing pressure (q_n) of 20 kips per sq foot. A resistance factor (φ_b) of 0.45 is recommended for footings fully bearing in the competent moderately hard limestone. Accordingly, a factored unit bearing resistance (q_R) of 9 kips per sq ft is anticipated. Post-construction settlement of footings bearing in the recommended bearing strata is expected to be less than 0.5 inch. Final footing bottom elevations and suitable bearing must be field verified.

Uplift resistance of footings will be developed by the weight of the structure and the foundation units. The passive resistance of the overburden soils and rock within 2 ft below final grade should be neglected. In excess of depths at least 2 ft below lowest adjacent grade, resistance to sliding can be evaluated using a nominal friction factor (tan δ) value of 0.49 between the foundation concrete and the competent cherty limestone bearing stratum. A resistance factor (φ_τ) of 0.80 should be applied to sliding resistance. The passive resistance of the upper 2 ft of limestone embedment should be neglected. Below the greater depth, a nominal unit passive resistance of 2000 lbs per sq ft of foundation area in hard contact with the competent limestone can be utilized. A resistance factor (φ_{ep}) of 0.50 should be applied to passive resistance.

Footings must extend through the overburden soils and any weathered limestone or chert zones to bear in competent moderately hard to hard limestone. A minimum embedment of 12 in. into the competent weathered limestone is recommended. Any overexcavation of footings must be backfilled with concrete. Weathered zones or open fractures in the limestone bearing stratum which are exposed at the bearing elevation should be excavated, cleaned out, and filled with concrete. Footing bottoms should be essentially horizontal. Use of dental concrete to level footing bottoms and to repair minor deficient areas is suitable.

Footings should have a minimum width of 5 feet. All footing excavations should be observed by the Engineer or Department to verify suitable bearing. Any footing undercuts or overbreaks should be backfilled with concrete.

Drilled Shaft Foundations – Bents 2 through 8

Drilled straight shafts are recommended for support of foundation loads at the intermediate bents, Bents 2 through 8. Drilled shafts should be founded with a minimum embedment of 1.5 shaft diameters or 6 ft, whichever is greater, into the moderately hard to hard gray and tan cherty limestone. Drilled shafts founded as recommended may be sized using a maximum nominal end-bearing pressure (R_n) of 125 kips per sq foot. A resistance factor (φ_{stat}) of 0.50 is recommended for drilled shaft end bearing. Total and differential settlement of properly installed drilled shafts founded in the competent moderately hard to hard limestone as recommended is expected to be negligible. We also recommend that drilled shafts be sized for axial compression loads based on end bearing alone.

Resistance to uplift loads will be developed by circumferential shaft friction. Drilled shafts will penetrate the overburden soils to bear in the competent moderately hard to hard cherty limestone. Uplift resistance for the top 5 ft of shaft length, all penetration through the overburden soils, and the length of permanent casing should be neglected. For shaft penetration through the competent cherty limestone, a maximum nominal skin resistance value of 12 kips per sq ft is recommended. For evaluation of uplift capacity, a resistance factor (φ_{up}) of 0.40 is recommended for shaft skin friction.

A minimum shaft rock socket length of 1.5 shaft diameters or 6 ft, whichever is greater, is recommended for drilled shafts. The as-built shaft length will vary with location and depth of overburden. In general, rock strata are 7 to 10 ft below the ground line at the bent locations. It is expected that permanent casing will extend to the top of rock and slightly into the rock.

The depths to suitable rock strata are estimates only, and are based on the results of the borings, the inferred surface elevation at the particular bent location, and existing grades. Suitable bearing stratum and final shaft lengths must be field verified. Plan shaft lengths and shaft tip elevations must be based on the magnitude of foundation loads, specific subsurface conditions, and actual shaft diameters. Depending on specific subsurface conditions and rock quality, localized deepening or shortening of shaft depths can be warranted.

All drilled shaft excavations should be observed by the Engineer to verify suitable bearing and adequate penetration. Heavy-duty drilling equipment will be required to advance the shaft excavations. The moderately hard to hard limestone bearing stratum will be resistant to drilling and rock drilling methods are expected to be required to achieve the required shaft penetration.

To verify competence of the moderately hard to hard limestone bearing stratum, we recommend that all shaft excavations be probed. Probe holes should consist of continuous rock core borings advanced from the shaft bottom elevation into the bearing stratum a depth of at least one-and-one-half (1.5) shaft diameters. Rock cores from probe holes should be reviewed by the Engineer to verify foundation stratum competence and suitability of the plan shaft bottom elevation.

Embankment Slopes

The south bridge embankments will utilize simple slopes of 2-horizontal to 1-vertical (2H:1V) and 3-horizontal to 1-vertical (3H:1V) configurations on the embankment end and side slopes, respectively. Site grading on the south embankment is expected to include up to 34 ft of fill. The north embankment is expected to have cuts of up to 42 ft, with near-vertical cuts on the end embankment and 3-horizontal to 1-vertical (3H:1V) configurations on the side embankment.

To evaluate suitability of the side slope plan configurations, slope stability analyses were performed using the computer program SLOPE/W 2020[4] and utilizing a Morgenstern-Price analysis. For the embankment slopes, four (4) general loading conditions were evaluated, i.e., End of Construction, Long Term, Rapid Drawdown, and Seismic Conditions were evaluated. A 250 lbs per sq ft uniform surcharge from vehicles was included for the purposes of stability analyses. For analysis of the seismic condition, a horizontal seismic acceleration coefficient (k_h) of one-half the peak acceleration (A_s) was used, a value of 0.0245. For evaluation of the rapid drawdown condition, a water surface elevation drop from El 1085 to El 1074 was assumed.

The stability analyses results summarized in Appendix F include the results of evaluation of side slopes. The results of the stability analyses indicate that plan configurations of the slopes are acceptable with respect to stability of all loading conditions evaluated.

Subgrade Support

The results of the borings indicate the on-site subgrade soils generally consist of silt, clay and silty clay with chert fragments (AASHTO A-2-6, A-4, A-6, and A-7-5). Given the anticipated new embankment, the approach roadway subgrade is likely to consist of embankment fill. Locally-available borrow, which is likely to be used as unclassified embankment fill, is expected to have similar classification.

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[4] *ibid*

We recommend that any soils classifying as A-7-5 or A-7-6 soils be excluded from use as subgrade within 18 in. of the plan subgrade elevation. The top 18 in. of subgrade soils should have a maximum plasticity index (PI) of 18. The as-built pavement subgrade should be evaluated by the Engineer. Areas of unstable or otherwise unsuitable subgrade should be improved by undercut and replacement or treatment with additives approved by the Engineer.

Based on the results of previous laboratory CBR tests on the silty clay with chert fragments subgrade and correlation with the AASHTO classification, we recommend the following parameters for use in design of pavements.

- CBR: 8.3
- Resilient Modulus (M_R): 3260 lbs per sq in.
- R value: 13
- Modulus of Subgrade Reaction (k): 100 lbs per cu in.

Site Grading and Subgrade Preparation

As noted, the surface soils are moisture-sensitive. Though presently stable, at elevated water contents the silt, fine sandy silt, and clayey silt subgrade are likely to be soft and unstable. Consequently, site grading operations will be significantly easier to perform during dry seasons of the year.

Site preparation will require some clearing and grubbing and stripping the zone of organic-containing soils. The depth of stripping will be variable, with deeper stripping depths in wooded areas, and less stripping required in open areas. In general, the stripping depth is estimated to be about 6 to 9 inches in clear areas but may be 18 to 24 in. or more in the localized areas where trees and thick underbrush are present. The zone of organic surface soils should be completely stripped in the embankment footprint areas and at least 5 ft beyond the projected embankment toes. Particular care must be taken to muck out all saturated and/or organic-laden soils in the existing drainage features. Hillsides should be benched to allow placement of embankment fill in horizontal lifts. The maximum vertical cut on benches should be limited to about 18 to 24 inches.

Following stripping and prior to fill placement, the extent of weak and unsuitable soils should be determined. Thorough proof-rolling should be performed to verify subgrade stability. Proof-rolling should be performed with a loaded tandem-wheel dump truck or similar equipment. Unstable soils exhibiting a tendency to rut and/or pump should be undercut and replaced with suitable fill. Care should be taken that undercuts, stump holes, and other excavations or low areas resulting from subgrade preparation are properly backfilled with compacted fill.

Depending on seasonal conditions, undercuts of about 2 to 3 ft below existing grades, more or less, could be required. Deeper undercuts may be required in wet seasons. General undercuts for site grading may be backfilled with unclassified borrow used for embankment fill.

In lieu of undercutting and replacing unsuitable soils in approach road alignments, consideration may be given to using additives to improve soil workability and to stabilize weak areas. Hydrated lime, quick lime, Portland cement, fly ash, or suitable alternate materials may be used as verified by appropriate testing and approved by the Engineer. Additives can be effective where the depth of unstable soils is relatively shallow. Treatment will be less effective in areas where the zone of unstable soils is deep. The optimum application rate of stabilization additive must be determined by specific laboratory tests performed on the alignment subgrade soils. We recommend a minimum treatment depth of 8 inches.

Subgrade preparation and mass undercuts should extend at least 5 ft beyond the embankment toes to the extent possible. Subgrade preparation for the approach roads should extend at least 3 ft outside pavement shoulder edges to the extent possible.

Fill and backfill may consist of unclassified borrow free of organics and other deleterious materials as per ARDOT Standard Specifications Subsection 210.06. Where A-7-5 or A-7-6 soils are encountered at the subgrade elevation, we recommend that these soils be undercut as required to provide at least 18 in. of suitable low-plasticity subgrade soils, i.e., with a maximum PI of 18, or approved "hillside" cherty clay with a maximum of 35 percent passing the No. 200 sieve. Alternatively, stabilization additives may be utilized to develop a stable subgrade with a PI of 18 or less. Granular soils must be protected from erosion with a minimum 18-in.-thick armor of clayey soil.

Subgrade preparation should comply with ARDOT Standard Specifications Section 212. Embankments should be constructed in accordance with ARDOT criteria (ARDOT Standard Specifications Section 210). Fill and backfill should be placed in nominal 6- to 10-in.-thick loose lifts. All fill and backfill must be placed in horizontal lifts. Hillsides should be benched as required to facilitate placing horizontal fill lifts. The in-place density and water content should be determined for each lift and should be tested to verify compliance with the specified density and water content prior to placement of subsequent lifts.

CONSTRUCTION CONSIDERATIONS

Groundwater and Seepage Control

Positive surface drainage should be established at the start of the work, be maintained during construction and following completion of the work to prevent surface water ponding and subsequent saturation of subgrade soils. Density and water content of all earthwork should be maintained until embankments, bridge work, and pavements are completed.

Groundwater was encountered between 3- to 18-ft depth in March, April, July, and August 2023. Shallow perched groundwater may be encountered in the near-surface soils, particularly during wet seasons. The volume of groundwater produced can be highly variable depending on the condition of the soil in the immediate vicinity of the excavation. In addition, seasonal surface seeps or springs could develop.

Seepage into excavations and cuts can typically be controlled by ditching or sump-and-pump methods. If seepage infiltration cannot be controlled, construction of drains and/or the use of Select Granular Backfill (AASHTO M 43 No. 57), stone backfill (ARDOT Standard Specifications Section 207), or approved alternates to an elevation above the inflow of seepage will be warranted. In areas of seepage infiltration, the granular fill should be encapsulated with a filter fabric complying with ARDOT Standard Specifications Subsection 625.02, Type 2 and vented to positive discharge. Where surface seeps or springs are encountered during site grading, we recommend the seepage be directed via French drains or blanket drains to positive discharge at daylight or to storm drainage lines.

Site preparation should also include construction of blanket drains in all existing drainage features which will be covered by fill. All loose and/or organic materials should be excavated from drainage features prior to drain construction. Blanket drains should consist of at least 8 to 12 in. of select granular backfill (AASHTO M 43 No. 57) fully encapsulated by a filter fabric. A fabric complying with ARDOT Standard Specifications Subsection 625.02, Type 2 is recommended. Drains should direct water to positive discharge at daylight or into storm drain lines.

Piling

Piles should be installed in compliance with ARDOT Standard Specifications, Section 805. Piles should be carefully examined prior to driving and piles with structural defects should be rejected. Any splices in steel piles should develop the full cross-sectional capacity of un-spliced piles. Preboring should be anticipated for pile installation on the north bents. Some rock drilling could be required for prebores. Where piles are prebored to develop uplift resistance, the annulus between the steel piles and the prebore should be expeditiously backfilled with approved grout or concrete.

Pile installation should be monitored by qualified personnel to maintain specific and complete driving records and observe pile installation procedures. Safe bearing capacity of production piles should be determined by ARDOT Standard Specifications Section 805.09, Method A. Driving records should be available for review by the Engineer during pile installation. For driving steel piles on this project, we recommend a minimum hammer energy of 34,000 ft-lbs per blow. Blow counts on steel piles should be limited to about 20 blows per inch. Practical pile refusal may be defined as a penetration of 0.5 in. or less for the final 10 blows.

Shallow Footings

All footing excavations should be observed by the Engineer to verify suitable bearing and adequate undercut. Concrete should be placed in footing excavations expeditiously following final clean up and approval to limit changes in foundation conditions. Footing excavations should be clean and dry at the time of concrete placement.

Drilled Shafts

As noted, groundwater was encountered in the bridge boring at about 3 – to 18-ft depth between March and August 2023. Groundwater could be encountered in drilled shaft excavations. Limited seepage into drilled shaft excavations can probably be controlled by close coordination of drilling, cleanup and concrete placement. We recommend that casing be on site in the event it is needed to control seepage and/or caving into shaft excavations. Drilled shaft excavations should essentially be dry at the time of concrete placement. Where more than about 3 in. of water is present in shaft excavations, the excavation should be dewatered prior to concrete placement. Where shaft excavations cannot be dewatered, underwater concrete placement should be performed with a concrete pump fitted with a rigid end extension. A muck bucket or similar tools should be utilized to clean the shaft excavation bottom prior to underwater concrete placement.

Some hard drilling will be experienced when advancing drilled shaft excavations into the moderately hard to hard limestone. Heavy-duty drilling equipment and rock drilling tools will be required to advance shaft excavations to the recommended minimum penetration into the competent limestone. Coring or other rock excavation methods will be required to achieve the recommended penetration into the rock bearing stratum. All drilled shaft excavations should be observed by the Engineer or Department to verify suitable bearing and adequate penetration.

CLOSURE

The Engineer or Department or a designated representative thereof should monitor site preparation, grading work and foundation and pavement construction. Subsurface conditions significantly at variance with those encountered in the borings should be brought to the attention of the Geotechnical Engineer. The conclusions and recommendations of this report should then be reviewed in light of the new information.

The following illustrations are attached and complete this final report.

Plate 1	Site Vicinity
Plates 2a and 2b	Plans of Borings
Plates 3 through 31	Boring Logs
Plates 32 and 33	Keys to Terms and Symbols
Appendix A	Preliminary Bridge Layout
Appendix B	Selected Rock Core Photographs
Appendix C	Classification Test Results
Appendix D	Generalized Subsurface Profiles
Appendix E	Nominal HP12x53 Uplift Pile Capacity Curves
Appendix F	Stability Analyses Results

* * * * *

We appreciate the opportunity to be of service to you on this project. Should you have any questions regarding this report, or if we may be of additional assistance, please call on us.

Sincerely,

GRUBBS, HOSKYN,
BARTON &WYATT, LLC

Velleta M. Scott

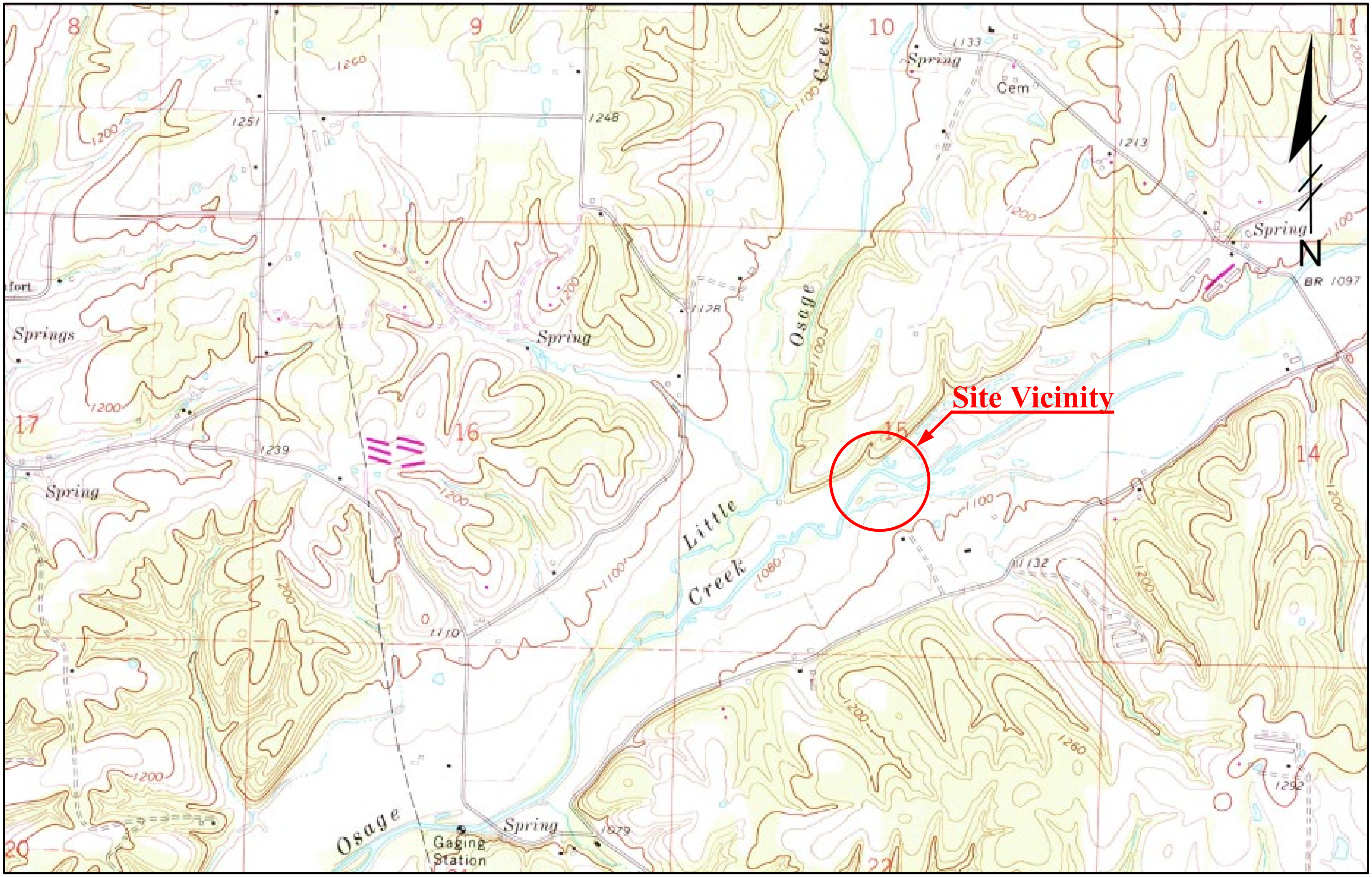
Velleta M. Scott, P.E.
Sr. Project Engineer

STATE OF ARKANSAS
No. 7791
MARK E. WYATT

Mark E. Wyatt, P.E.
President

VMS/MEW:jw

Copies Submitted: Garver LLC
Attn: Mr. Joel Skinner, P.E. (1-email)
Attn: Mr. Lawren Wilcox, P.E. (1-email)
Attn: Mr. Adam Wierciak, P.E. (1-email)



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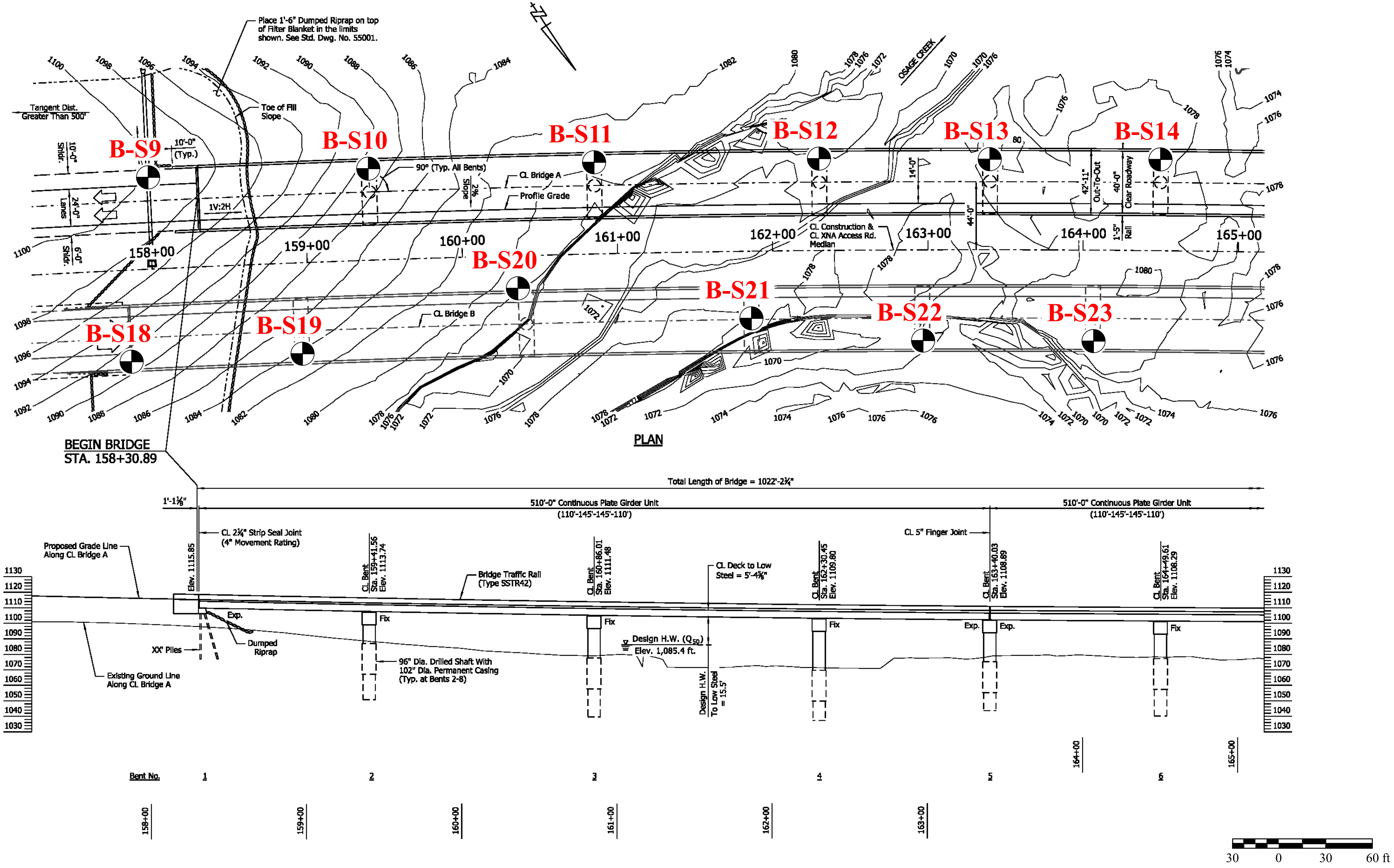
CONSULTING ENGINEERS
A UES Company

SITE VICINITY MAP
090069 XNA Access Road over Osage Creek
Benton County, Arkansas

Job No. 19-118

Plate 1



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A UES Company

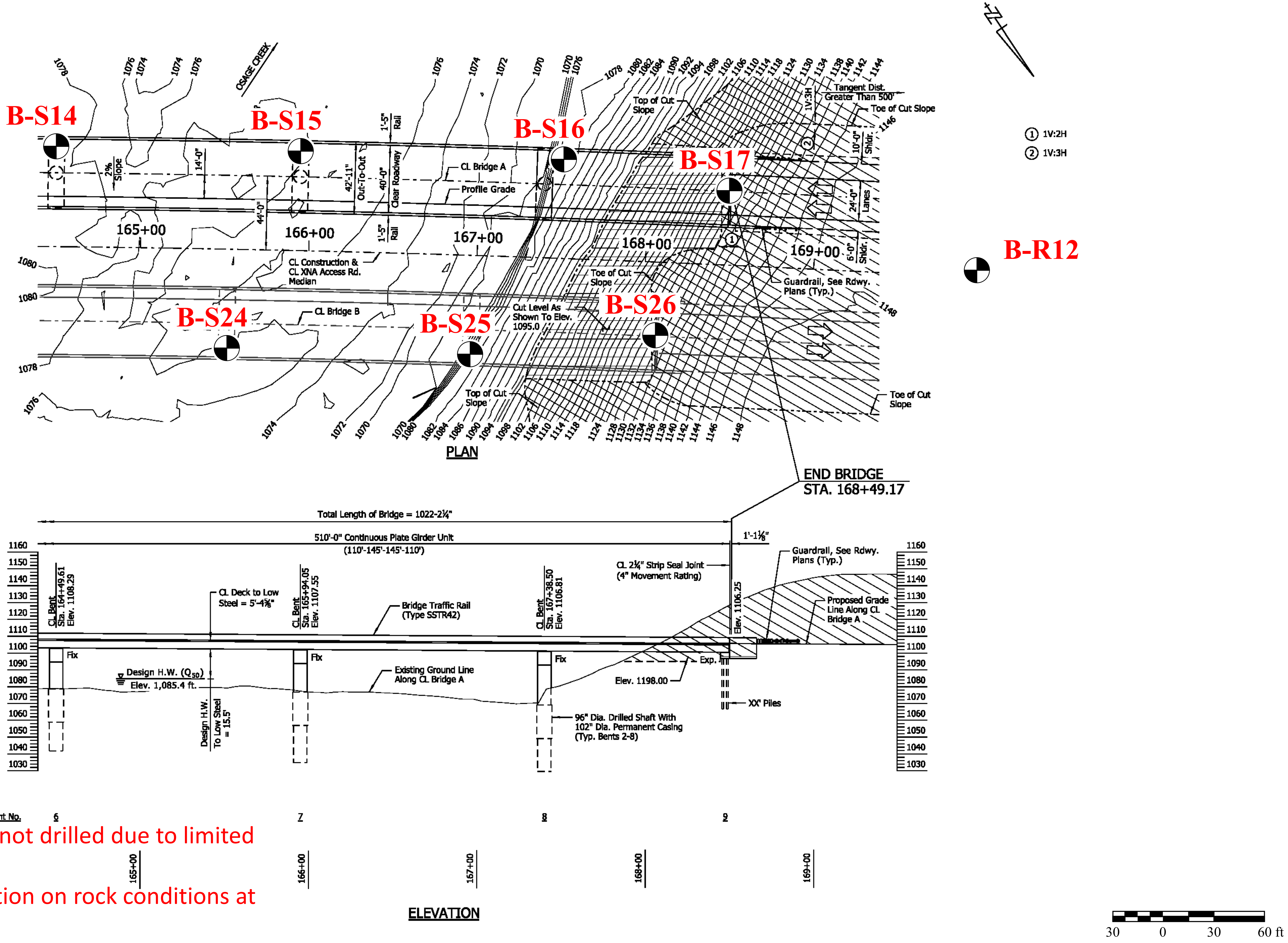
PLAN of BORINGS

090069 XNA Access Road Twin Bridges over Osage Creek
Benton County, Arkansas

Scale: As shown

Job No. 19-118

PLATE 2a



Note: Borings S12, S17, and S26 not drilled due to limited access.
Boring R12 included for information on rock conditions at north bridge end

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PLAN of BORINGS
090069 XNA Access Road Twin Bridges over Osage Creek
Benton County, Arkansas

Scale: As shown

Job No. 19-118

PLATE 2b

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LOG OF BORING NO. S9

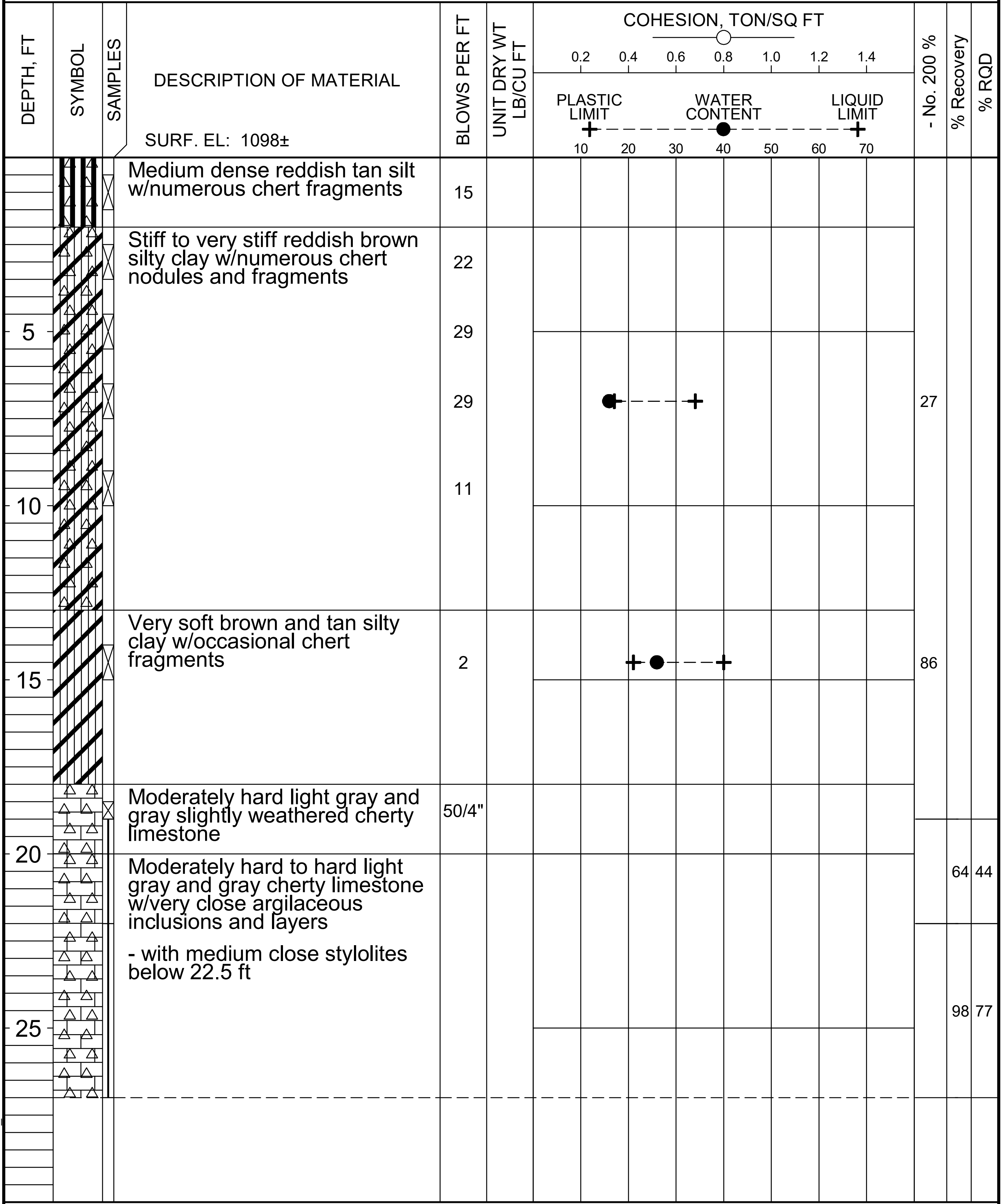
090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: HSA to 18.5 ft /Core

LOCATION: Approx Sta 158+30, 60 ft Lt

SURF. EL: 1098±

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
Medium dense reddish tan silt w/numerous chert fragments	15				
Stiff to very stiff reddish brown silty clay w/numerous chert nodules and fragments	22				
	29				
	29		27		
	11				
Very soft brown and tan silty clay w/occasional chert fragments	2		86		
Moderately hard light gray and gray slightly weathered cherty limestone	50/4"				
Moderately hard to hard light gray and gray cherty limestone w/very close argilaceous inclusions and layers				64	44
- with medium close stylolites below 22.5 ft				98	77



COMPLETION DEPTH: 27.0 ft
DATE: 8-15-23

DEPTH TO WATER
IN BORING: 18 ft

DATE: 8/15/2023

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Consulting Engineers

LOG OF BORING NO. S10

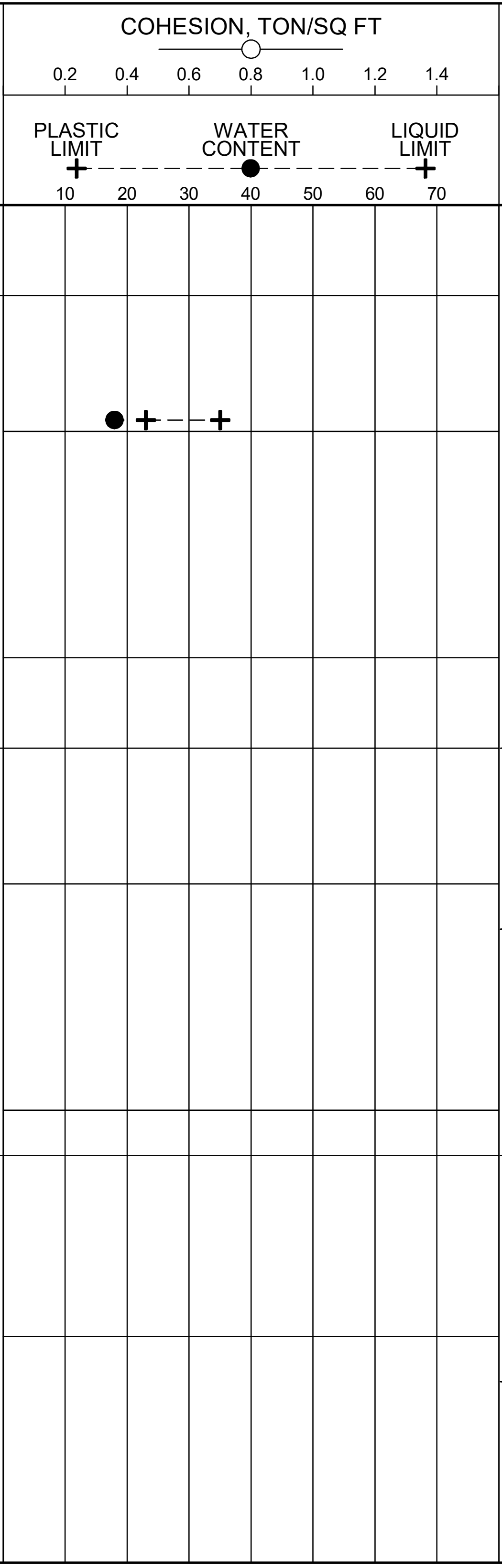
090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: HSA to 12 ft /Core

LOCATION: Approx Sta 159+40, 60 ft Lt

SURF. EL: 1089±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Medium dense tan silt w/numerous chert fragments and occasional organics	11				
	Stiff to very stiff reddish tan silty clay w/chert fragments and nodules	43				
5		24		55		
		23				
	- with discontinuous chert seams below 8 ft	50/2"				
10						
		50/1"				
	Moderately hard to hard light gray and very light gray cherty limestone and interbedded chert seams and layers				96	96
15						
					100	97
20						
	Moderately hard to hard light gray and gray cherty limestone w/very close chert seams and layers				100	100
25						
					100	100



COMPLETION DEPTH: 52.0 ft
DATE: 8-20-23

DEPTH TO WATER
IN BORING: Dry to 12 ft

DATE: 8/20/2023

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Consulting Engineers

LOG OF BORING NO. S10

090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: HSA to 12 ft /Core

LOCATION: Approx Sta 159+40, 60 ft Lt

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT + — — WATER CONTENT ● — — LIQUID LIMIT +: 10 20 30 40 50 60 70

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
			- with very close interbedded chert seams and layers below 31 ft					
							100	100
35								
							100	100
40								
							100	100
45								
							97	97
50								
							100	100
55								

COMPLETION DEPTH: 52.0 ft
DATE: 8-20-23

DEPTH TO WATER
IN BORING: Dry to 12 ft

DATE: 8/20/2023

RECRQDN200-2 19-118_OSAGE CREEK.GPJ 8-30-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S11

090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: HSA to 12.5 ft /Core

LOCATION: Approx Sta 160+85, 60 ft Lt

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 1080±	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
			Very soft to soft brown and tan clayey silt	4				
			- soft at 2 to 4 ft	5				
5			- very soft below 4 ft	2				
				2				
			Medium dense tan and brown silt w/chert fragments	18				
10								
				25/0"				
			Moderately hard to hard light gray and gray cherty limestone				100	71
15							83	71
							92	87
20			(Drilled to 21.5 ft on 08/22/23)					
			- with very close interbedded chert seams, layers, and inclusions below 21 ft					
							100	80
25								
							100	87

COMPLETION DEPTH: 52.0 ft
DATE: 8-29-23

DEPTH TO WATER
IN BORING: Dry to 12.5 ft

DATE: 8/22/2023

RECRQDN200-2 19-118 OSAGE CREEK.GPJ 8-30-23

Grubbs, Hoskyn,
Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S11

090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: HSA to 12.5 ft /Core

LOCATION: Approx Sta 160+85, 60 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %	% Recovery	% RQD
								98	82
35									
								100	75
40									
			- high-angle shear at 41.5 ft					100	98
45									
								100	88
50								100	58
55									

COMPLETION DEPTH: 52.0 ft
DATE: 8-29-23

DEPTH TO WATER
IN BORING: Dry to 12.5 ft

DATE: 8/22/2023

19-118

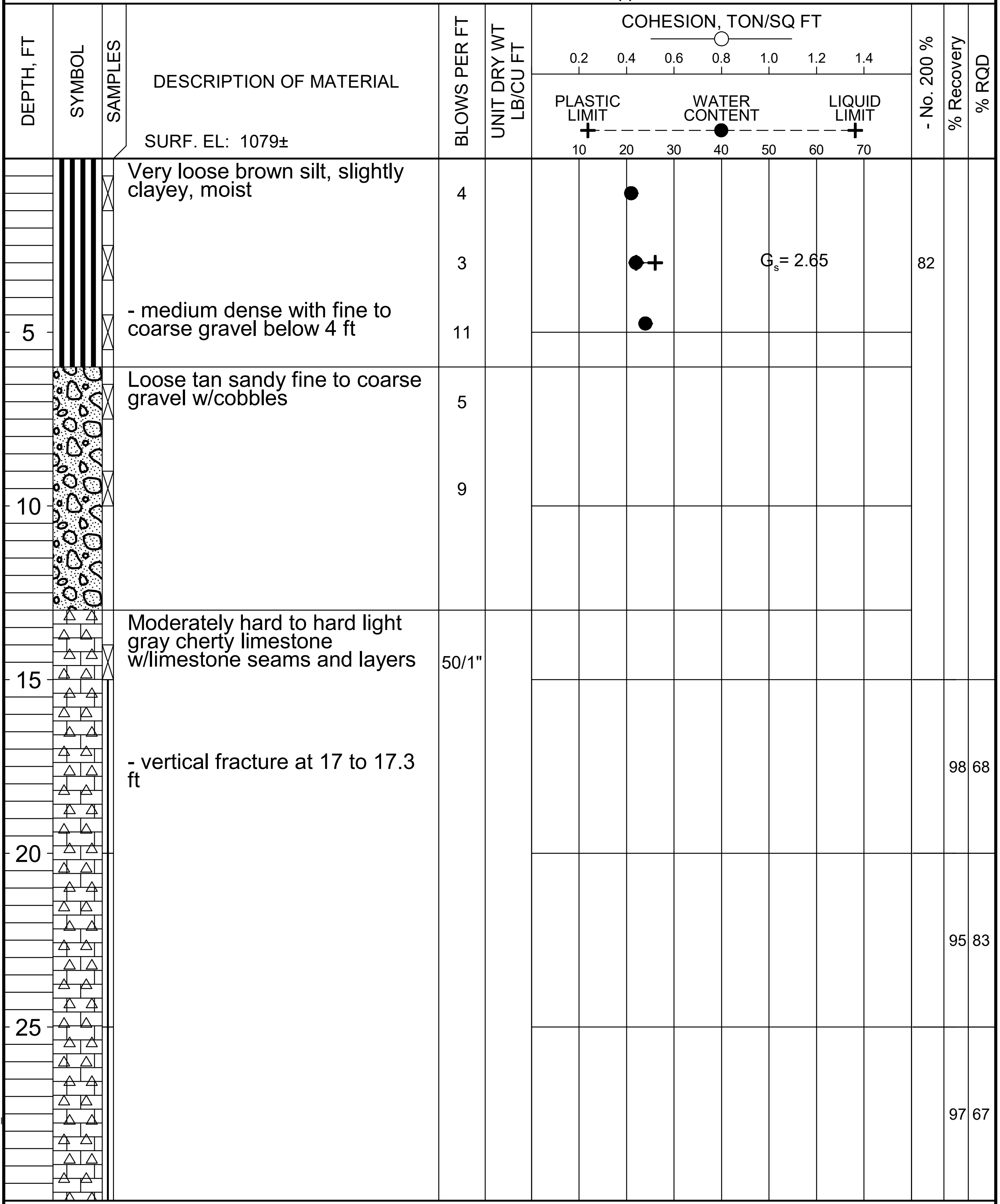
Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

L O G O F B O R I N G N O. S13

090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: HSA to 15 ft /Core

LOCATION: Approx Sta 163+40, 60 ft Lt



DESCRIPTION OF MATERIAL SURF. EL: 1079±	BLOWS PER FT	UNIT DRY WT LB/CU FT	Notes	- No. 200 %	% Recovery	% RQD
Very loose brown silt, slightly clayey, moist	4					
	3		G_s= 2.65	82		
- medium dense with fine to coarse gravel below 4 ft	11					
Loose tan sandy fine to coarse gravel w/cobbles	5					
	9					
Moderately hard to hard light gray cherty limestone w/limestone seams and layers	50/1"					
- vertical fracture at 17 to 17.3 ft					98	68
					95	83
					97	67

COMPLETION DEPTH: 55.0 ft
DATE: 8-23-23

DEPTH TO WATER
IN BORING: 6 ft

DATE: 7/31/2023

RECRQDN200-2 19-118 OSAGE CREEK.GPJ 8-30-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S13

090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: HSA to 15 ft /Core

LOCATION: Approx Sta 163+40, 60 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT ○ 0.2 0.4 0.6 0.8 1.0 1.2 1.4 PLASTIC LIMIT + — WATER CONTENT ● — LIQUID LIMIT + 10 20 30 40 50 60 70	- No. 200 %	% Recovery	% RQD
								100	90
35									
								100	97
40									
								98	92
45									
								98	95
50									
								100	95
55									

COMPLETION DEPTH: 55.0 ft
DATE: 8-23-23

DEPTH TO WATER
IN BORING: 6 ft

DATE: 7/31/2023

RECRQDN200-2 19-118 OSAGE CREEK.GPJ 8-30-23

**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**
Consulting Engineers

LOG OF BORING NO. S14

090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: HSA to 12 ft /Core

LOCATION: Approx Sta 164+50, 60 ft Lt

SURF. EL: 1078±

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Loose brown silt w/fine to coarse gravel	5				
	Very loose to loose brown and tan silty fine to coarse gravel, sandy	4				
	- loose at 4 to 8 ft					
5		5				
		8				
	- medium dense below 8 ft	15				
10						
	Moderately hard to hard gray and light gray cherty limestone w/very close interbedded chert seams and layers and close limestone seams, layers, and inclusions - vertical fracture at 12.8 to 13.3 ft				100	56
15						
					92	85
20						
					100	87
25						
					100	78

COMPLETION DEPTH: 51.0 ft
DATE: 8-24-23

DEPTH TO WATER
IN BORING: 6.5 ft

DATE: 8/24/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S14

090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: HSA to 12 ft /Core

LOCATION: Approx Sta 164+50, 60 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT 0.2 0.4 0.6 0.8 1.0 1.2 1.4 PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT 10 20 30 40 50 60 70	- No. 200 %	% Recovery	% RQD
			- with less chert at 32 to 35 ft					95	78
35									
								100	72
			- vertical fracture at 38.7 to 39.3 ft						
40									
								98	83
45									
								100	78
50								100	100
55									

RECRQDN200-2 19-118_OSAGE CREEK.GPJ 8-30-23

COMPLETION DEPTH: 51.0 ft
DATE: 8-24-23

DEPTH TO WATER
IN BORING: 6.5 ft

DATE: 8/24/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

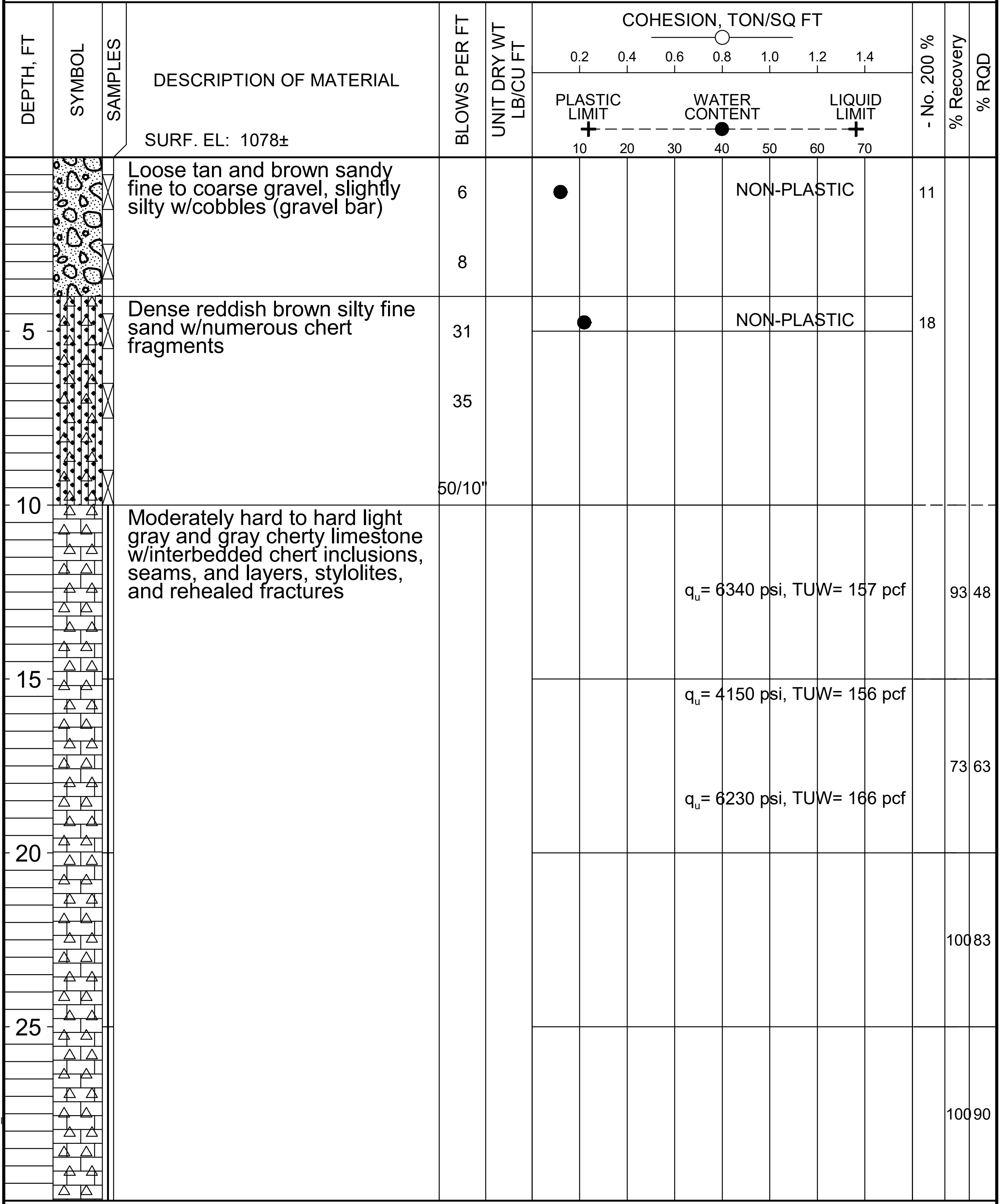
LOG OF BORING NO. S15

090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: Auger to 4 ft /Wash to 10 ft /Core

LOCATION: Approx Sta 165+95, 60 ft Lt

SURF. EL: 1078±



Description of Material	Blows per ft	Tests	- No. 200 %	% Recovery	% RQD
Loose tan and brown sandy fine to coarse gravel, slightly silty w/cobbles (gravel bar)	6	NON-PLASTIC	11		
	8				
Dense reddish brown silty fine sand w/numerous chert fragments	31	NON-PLASTIC	18		
	35				
	50/10"				
Moderately hard to hard light gray and gray cherty limestone w/interbedded chert inclusions, seams, and layers, stylolites, and rehealed fractures		q_u= 6340 psi, TUW= 157 pcf		93	48
		q_u= 4150 psi, TUW= 156 pcf			
		q_u= 6230 psi, TUW= 166 pcf		73	63
				100	83
				100	90

COMPLETION DEPTH: 52.0 ft
DATE: 8-27-23

DEPTH TO WATER
IN BORING: 3.2 ft

DATE: 4/25/2023

**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**
Consulting Engineers

LOG OF BORING NO. S15

090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: Auger to 4 ft /Wash to 10 ft /Core

LOCATION: Approx Sta 165+95, 60 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT ○ 0.2 0.4 0.6 0.8 1.0 1.2 1.4; PLASTIC LIMIT + WATER CONTENT ● LIQUID LIMIT + 10 20 30 40 50 60 70	- No. 200 %	% Recovery	% RQD
								97	93
35									
								100	68
40									
								95	82
45									
								100	75
50									
								96	96
55									

COMPLETION DEPTH: 52.0 ft
DATE: 8-27-23

DEPTH TO WATER
IN BORING: 3.2 ft

DATE: 4/25/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S16

090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: HSA to 10 ft /Core

LOCATION: Approx Sta 166+95, 65 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 1072±	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 – 1.4) PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 – 70)	- No. 200 %	% Recovery	% RQD
			Very loose to loose brown and tan silty fine sand w/fine to coarse gravel and cherty limestone cobbles - loose below 2 ft	4 9					
5			Loose tan sandy fine to coarse gravel, slightly silty w/cobbles	9 8 50/1"		●	5		
10			Moderately hard to hard gray w/light gray cherty limestone w/very close chert seams and layers and numerous stylolites			q_u= 6760 psi, TUW= 163 pcf		98	67
15			- with very close rehealed fractures at 15 to 16 ft					95	72
20						q_u= 8120 psi, TUW= 153 pcf		100	67
25						q_u= 6800 psi, TUW= 158 pcf		100	78

COMPLETION DEPTH: 44.2 ft
DATE: 7-27-23

DEPTH TO WATER
IN BORING: 6 ft

DATE: 7/27/2023

Grubbs, Hoskyn,
Barton & Wyatt, Inc.
Consulting Engineers

L O G O F B O R I N G N O. S16

090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: HSA to 10 ft /Core

LOCATION: Approx Sta 166+95, 65 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT 0.2 0.4 0.6 0.8 1.0 1.2 1.4 / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT 10 20 30 40 50 60 70	- No. 200 %	% Recovery	% RQD
			- with very close rehealed fractures below 30 ft					100	75
35									
								98	78
40									
								100	74
45			Note: Core barrel refusal at 44.2 ft on chert						
50									
55									

COMPLETION DEPTH: 44.2 ft
DATE: 7-27-23

DEPTH TO WATER
IN BORING: 6 ft

DATE: 7/27/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

L O G O F B O R I N G N O. S18

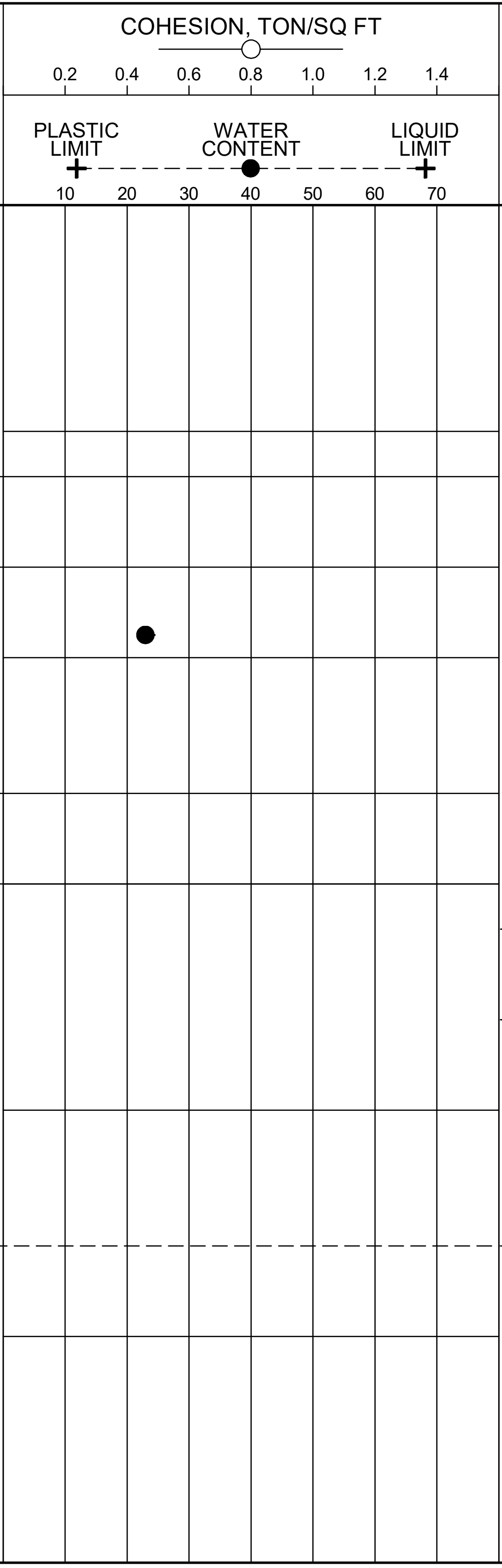
090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: HSA to 16 ft /Core

LOCATION: Approx Sta 157+85, 60 ft Rt

SURF. EL: 1091±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
0	Medium dense reddish brown silt w/numerous chert fragments	16 25 27				
6	Very loose reddish brown silt, slightly clayey	2				
8	Medium dense reddish tan silt w/chert fragments	20		53		
13	Moderately hard reddish tan and light gray weathered cherty limestone	50/6"				
15	Moderately hard to hard light gray and gray cherty limestone	25/0"			29 95	25 70



COMPLETION DEPTH: 23.0 ft
DATE: 8-17-23

DEPTH TO WATER
IN BORING: 13.7 ft

DATE: 8/17/2023

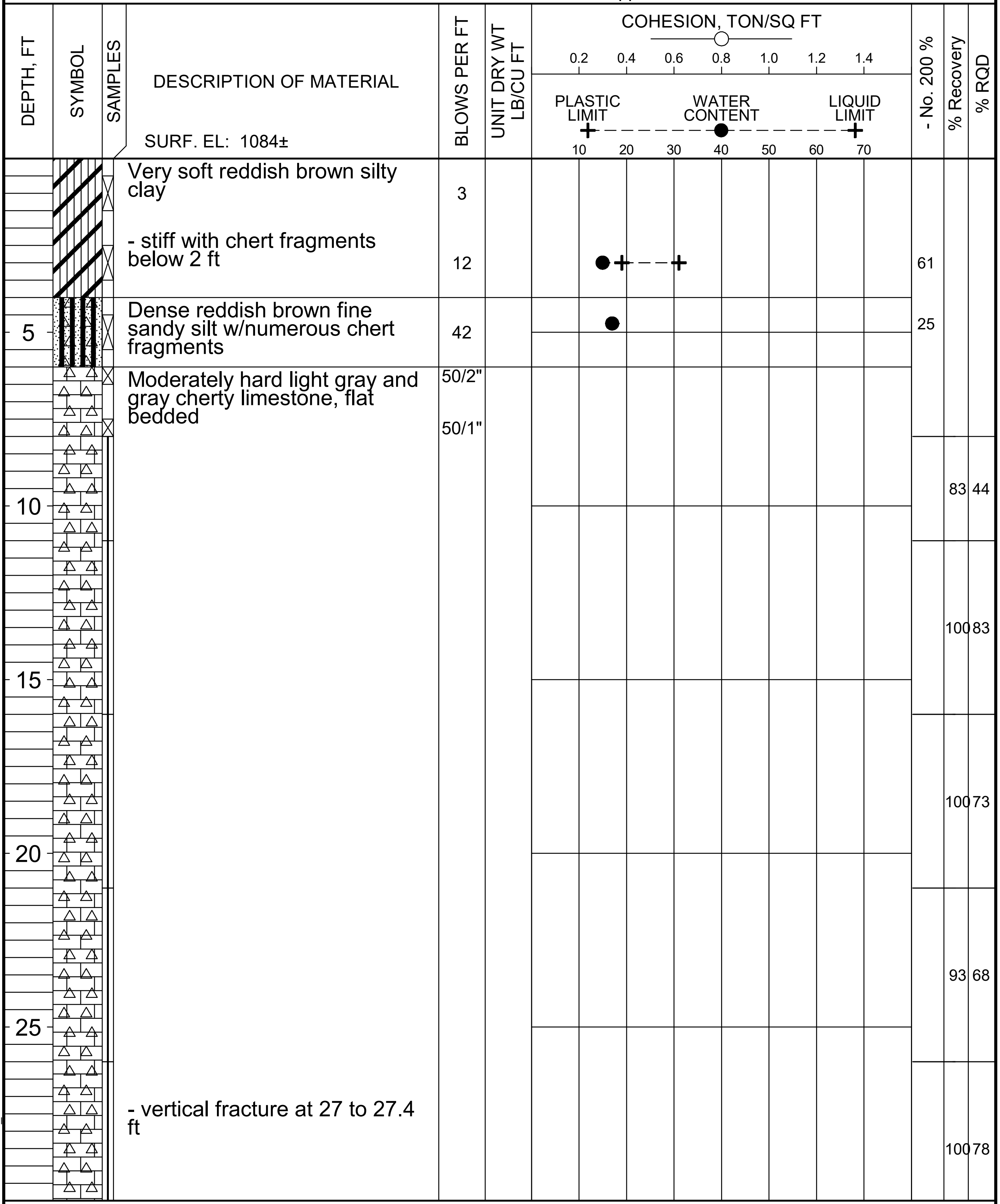
Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S19

090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: HSA to 8 ft /Core

LOCATION: Approx Sta 158+95, 60 ft Rt



DESCRIPTION OF MATERIAL	BLOWS PER FT	- No. 200 %	% Recovery	% RQD
Very soft reddish brown silty clay	3			
- stiff with chert fragments below 2 ft	12	61		
Dense reddish brown fine sandy silt w/numerous chert fragments	42	25		
Moderately hard light gray and gray cherty limestone, flat bedded	50/2"			
	50/1"			
			83	44
			100	83
			100	73
			93	68
- vertical fracture at 27 to 27.4 ft			100	78

COMPLETION DEPTH: 48.0 ft
DATE: 8-16-23

DEPTH TO WATER
IN BORING: Dry to 8 ft

DATE: 8/15/2023

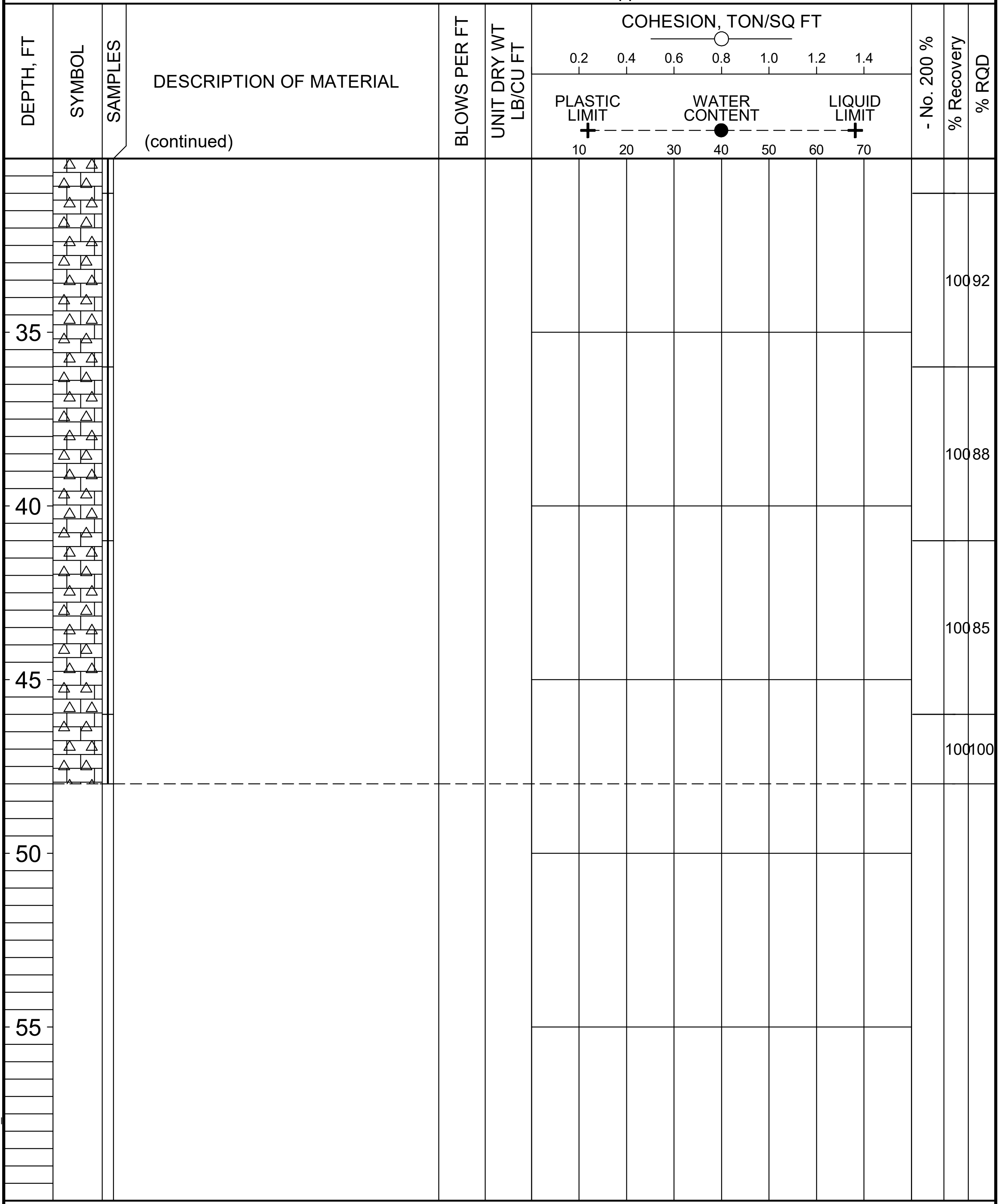
Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S19

090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: HSA to 8 ft /Core

LOCATION: Approx Sta 158+95, 60 ft Rt



% Recovery	% RQD
100	92
100	88
100	85
100	100

COMPLETION DEPTH: 48.0 ft
DATE: 8-16-23

DEPTH TO WATER
IN BORING: Dry to 8 ft

DATE: 8/15/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S20

090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: HSA to 6 ft /Core

LOCATION: Approx Sta 160+20, 10 ft Rt

SURF. EL: 1078±

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Loose brown silt w/numerous chert fragments	8				
	Medium dense tan fine sandy silt w/numerous chert fragments and nodules	26				
5	Moderately hard gray and light gray chert w/limestone seams and layers and rehealed fractures	50/3" 25/0"				
	Moderately hard to hard gray and light gray cherty limestone w/interbedded chert seams and layers with frequent rehealed fractures				97	80
10						
					97	57
15						
					98	83
20						
					100	82
25						
					93	87

COMPLETION DEPTH: 46.0 ft
DATE: 8-18-23

DEPTH TO WATER
IN BORING: Dry to 6 ft

DATE: 8/18/2023

19-118

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S20

090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: HSA to 6 ft /Core

LOCATION: Approx Sta 160+20, 10 ft Rt

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION / WATER CONTENT	- No. 200 %	% Recovery	% RQD
								95	73
35									
								98	80
			- with vertical fracture at 39 to 39.4 ft						
40									
								98	92
45									
50									
55									

COMPLETION DEPTH: 46.0 ft
DATE: 8-18-23

DEPTH TO WATER
IN BORING: Dry to 6 ft

DATE: 8/18/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

L O G O F B O R I N G N O. S21

090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: HSA to 12 ft /Core

LOCATION: Approx Sta 161+85, 45 ft Rt

SURF. EL: 1078±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %	% Recovery	% RQD
	Loose brown silt w/some fine to coarse gravel	5					
		5					
5	Firm brown and tan silty clay	9					
	Medium dense brown silty fine to coarse gravel, sandy	15					
10		14					
		25/0"					
	Moderately hard to hard gray and light gray cherty limestone w/very close interbedded chert seams, layers, and inclusions and close limestone seams and layers					100	17
15						100	65
20						95	88
25						100	98

COMPLETION DEPTH: 52.0 ft
DATE: 8-25-23

DEPTH TO WATER
IN BORING: 8 ft

DATE: 8/25/2023

RECRQDN200-2 19-118_OSAGE CREEK.GPJ 8-30-23

Grubbs, Hoskyn,
Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S21

090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: HSA to 12 ft /Core

LOCATION: Approx Sta 161+85, 45 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT 0.2 0.4 0.6 0.8 1.0 1.2 1.4 PLASTIC LIMIT + WATER CONTENT ● LIQUID LIMIT + 10 20 30 40 50 60 70	- No. 200 %	% Recovery	% RQD
	△							98	87
35	△								
	△							98	93
40	△								
	△							100	98
45	△								
	△							100	95
50	△								
	△							100	100
55									

COMPLETION DEPTH: 52.0 ft
DATE: 8-25-23

DEPTH TO WATER
IN BORING: 8 ft

DATE: 8/25/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S22

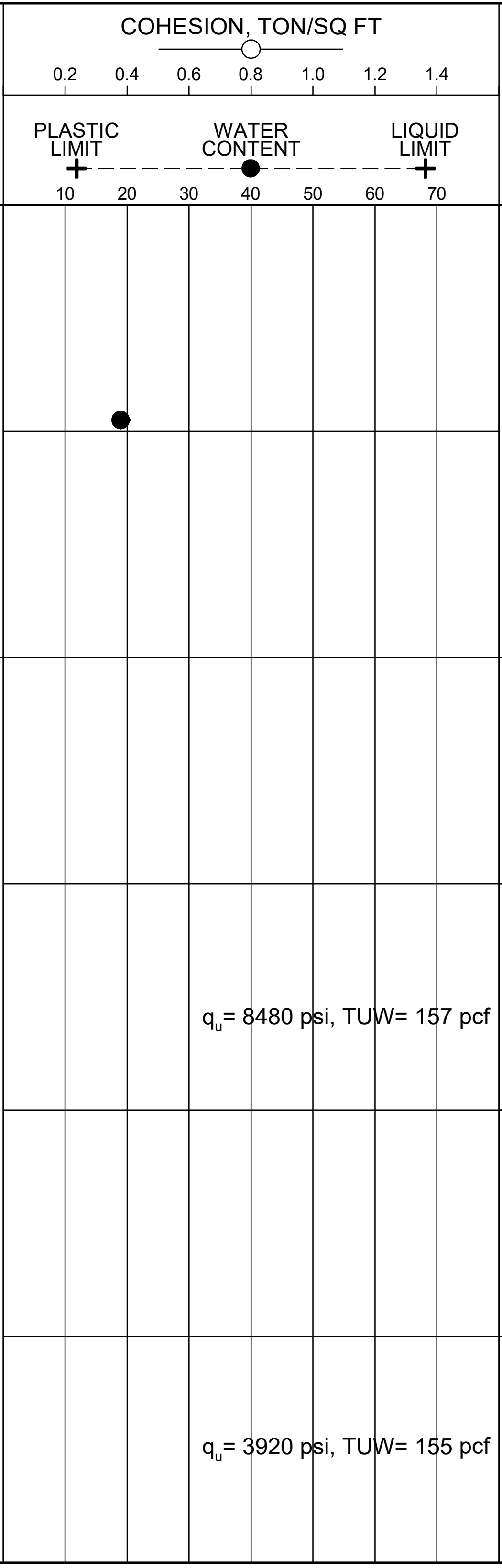
090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: HSA to 10 ft /Core

LOCATION: Approx Sta 162+95, 60 ft Rt

SURF. EL: 1072±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Very loose to loose brown and tan sandy fine to coarse gravel, slightly silty w/cobbles	4				
	- loose at 2 to 6 ft	7				
5		5		6		
	- very loose at 6 to 8 ft	0/WOH				
	- medium dense below 8 ft	14				
10	Moderately hard to hard light gray and gray cherty limestone w/ very close interbedded chert inclusions, seams, and layers, stylolites, and rehealed fractures				78	53
15					10	80
20					75	43
25					97	78



q_u= 8480 psi, TUW= 157 pcf

q_u= 3920 psi, TUW= 155 pcf

COMPLETION DEPTH: 50.0 ft
DATE: 7-31-23

DEPTH TO WATER
IN BORING: 6 ft

DATE: 7/31/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S22

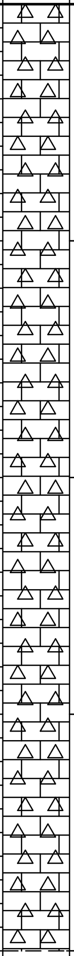
090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: HSA to 10 ft /Core

LOCATION: Approx Sta 162+95, 60 ft Rt

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70



DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / WATER CONTENT	- No. 200 %	% Recovery	% RQD
						100	90
35							
				q_u= 5490 psi, TUW= 156 pcf		100	70
40							
						100	93
45							
						98	85
50							
55							

COMPLETION DEPTH: 50.0 ft
DATE: 7-31-23

DEPTH TO WATER
IN BORING: 6 ft

DATE: 7/31/2023

RECRQDN200-2 19-118 OSAGE CREEK.GPJ 8-30-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S23

090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: HSA to 7 ft /Core

LOCATION: Approx Sta 164+05, 75 ft Rt

SURF. EL: 1078±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Loose tan sandy fine to coarse gravel	5				
		6				
5		5				
	Moderately hard gray and light gray cherty limestone w/stylolites, very close interbedded chert inclusions, seams and layers, and frequent rehealed fractures - moderately hard to hard below 8 ft - 4 in. void at 10 to 10.3 ft	50/5"			100	88
10					93	72
15					100	85
20					100	95
25					97	72

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

COMPLETION DEPTH: 48.0 ft
DATE: 8-26-23

DEPTH TO WATER
IN BORING: 4.0 ft

DATE: 8/25/2023

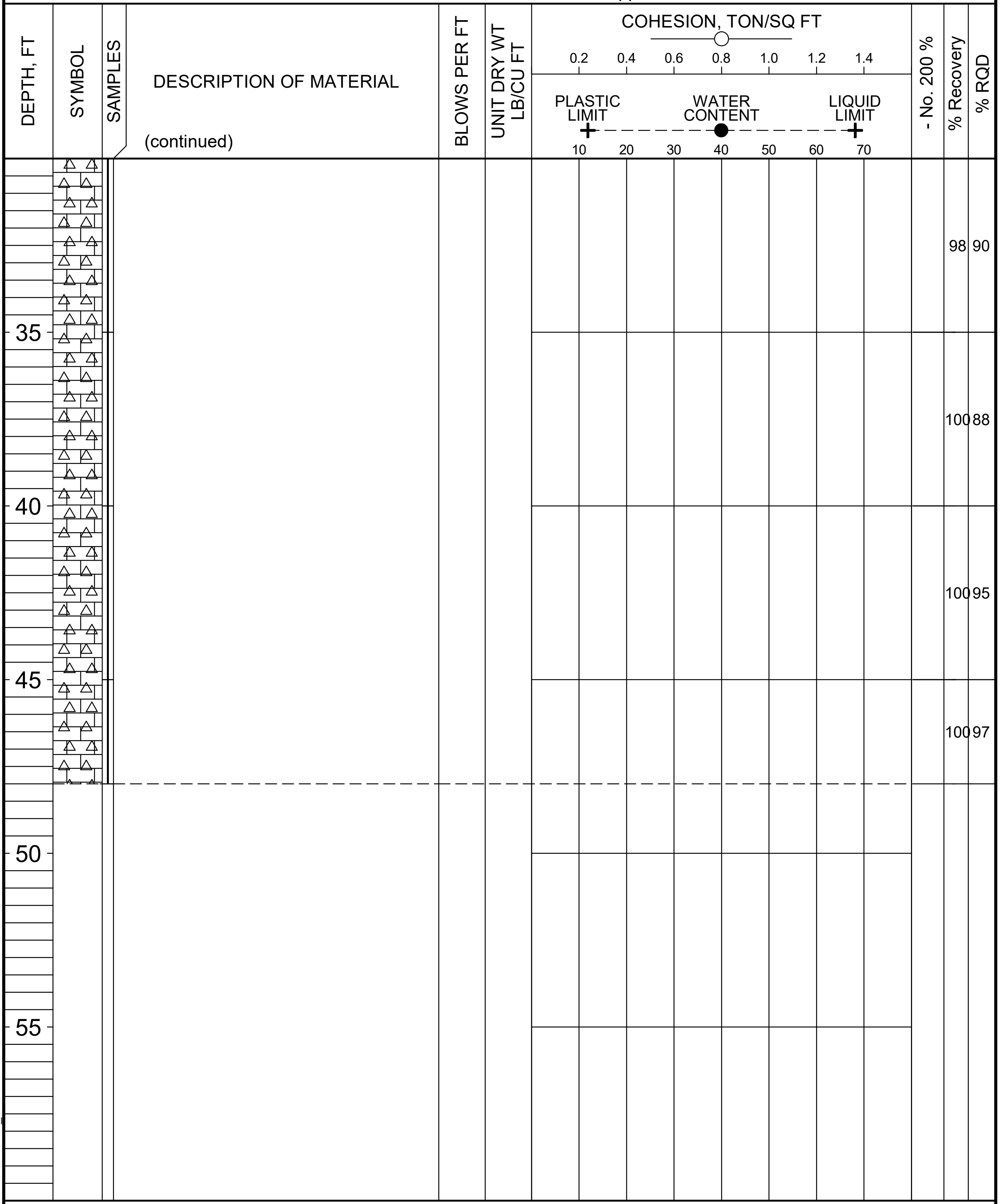
Grubbs, Hoskyn,
Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S23

090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: HSA to 7 ft /Core

LOCATION: Approx Sta 164+05, 75 ft Rt



COMPLETION DEPTH: 48.0 ft
DATE: 8-26-23

DEPTH TO WATER
IN BORING: 4.0 ft

DATE: 8/25/2023

RECRQDN200-2 19-118_OSAGE CREEK.GPJ 8-30-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S24

090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: HSA to 10 ft /Core

LOCATION: Approx Sta 165+50, 60 ft Rt

SURF. EL: 1076±

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4

PLASTIC LIMIT + – – WATER CONTENT ● – – LIQUID LIMIT +: 10, 20, 30, 40, 50, 60, 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION / WATER CONTENT	- No. 200 %	% Recovery	% RQD
	Loose brown silty fine to medium sand w/ fine to coarse gravel and cobbles	7					
		6					
5	Loose tan sandy fine to coarse gravel w/cobbles	5		●	4		
	- very loose below 6 ft	2					
	Moderately hard slightly weathered chert w/limestone seams and interbeds	50/3"					
10	Moderately hard to hard light gray and gray cherty limestone w/interbedded chert seams and layers, stylolites, and rehealed fractures					100	75
15							
				q_u= 6890 psi, TUW= 152 pcf		98	95
20							
						100	78
25							
				q_u= 6810 psi, TUW= 163 pcf		100	72

COMPLETION DEPTH: 50.0 ft
DATE: 7-29-23

DEPTH TO WATER
IN BORING: 5.5 ft

DATE: 7/29/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S24

090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: HSA to 10 ft /Core

LOCATION: Approx Sta 165+50, 60 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT ○ 0.2 0.4 0.6 0.8 1.0 1.2 1.4 / PLASTIC LIMIT + WATER CONTENT ● LIQUID LIMIT + 10 20 30 40 50 60 70	- No. 200 %	% Recovery	% RQD
								98	65
35						q_u= 6690 psi, TUW= 153 pcf		98	90
40								100	93
45								100	87
50									
55									

COMPLETION DEPTH: 50.0 ft
DATE: 7-29-23

DEPTH TO WATER
IN BORING: 5.5 ft

DATE: 7/29/2023

Grubbs, Hoskyn,
Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S25

090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: Auger to 10 ft /Core

LOCATION: Approx Sta 166+64, 60 ft Rt

SURF. EL: 1070±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
0	Loose tan and brown sandy fine to coarse gravel, slightly silty w/cobbles (gravel bar)	4					
		16			7		
4	Medium dense to dense reddish brown silty fine sand w/numerous chert fragments - dense below 6 ft	30		NON-PLASTIC	14		
		38					
8	Moderately hard light gray and tan slightly weathered cherty limestone, flat bedded w/some stylolites	25/0"					
				q_u= 6780 psi, TUW= 156 pcf		83	60
				q_u= 8040 psi, TUW= 151 pcf		80	75
						97	70
						100	93

COMPLETION DEPTH: 48.0 ft
DATE: 8-28-23

DEPTH TO WATER
IN BORING: 4.0 ft

DATE: 4/28/2023

RECRQDN200-2 19-118 OSAGE CREEK.GPJ 8-30-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S25

090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: Auger to 10 ft /Core

LOCATION: Approx Sta 166+64, 60 ft Rt

DESCRIPTION OF MATERIAL (continued)

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
							90	85
35								
							100	95
40								
							100	90
45								
							100	94
50								
55								

COMPLETION DEPTH: 48.0 ft
DATE: 8-28-23

DEPTH TO WATER
IN BORING: 4.0 ft

DATE: 4/28/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R12

090069 XNA Access Road over Osage Creek
Benton County, Arkansas

TYPE: Auger to 5 ft /Wash to 20 ft /Core

LOCATION: Approx Sta 170+00, CL

SURF. EL: 1146±

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Very soft reddish brown silty clay	2				
	- very stiff with chert fragments below 2 ft	27				
5	- with numerous chert fragments below 4 ft	50/10"				
		50/4"				
10	Moderately hard light gray and tan weathered cherty limestone, fractured w/some silty clay filled fractures	50/3"				
		25/0"				
15	Moderately hard to hard tan and light gray weathered chert and limestone, flat bedded, highly fractured w/red clay infill					
20						
					52	0
25						
					50	0
30						

COMPLETION DEPTH: 30.0 ft
DATE: 3-13-23

DEPTH TO WATER
IN BORING: Dry to 5 ft

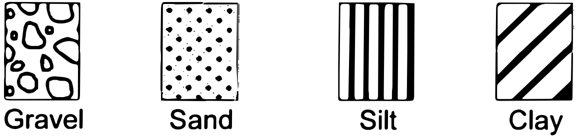
DATE: 3/13/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

SYMBOLS AND TERMS USED ON BORING LOGS

SOIL TYPES

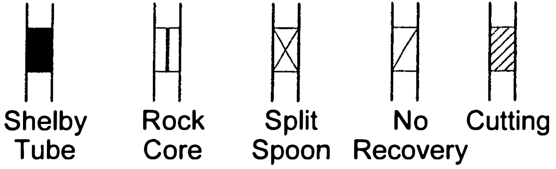
(SHOWN IN SYMBOLS COLUMN)



Predominant type shown heavy

SAMPLER TYPES

(SHOWN ON SAMPLES COLUMN)



TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on No. 200 sieve): Includes (I) Clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as determined by laboratory tests.

DESCRIPTIVE TERM	N-VALUE	RELATIVE DENSITY
VERY LOOSE	0-4	0-15%
LOOSE	4-10	15-35%
MEDIUM DENSE	10-30	35-65%
DENSE	30-50	65-85%
VERY DENSE	50 and above	85-100%

FINE GRAINED SOILS (major portion passing No. 200 sieve): Includes (1) Inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests.

DESCRIPTIVE TERM	UNCONFINED COMPRESSIVE STRENGTH TON/SQ. FT.
VERY SOFT	Less than 0.25
SOFT	0.25-0.50
FIRM	0.50-1.00
STIFF	1.00-2.00
VERY STIFF	2.00-4.00
HARD	4.00 and higher

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

TERMS CHARACTERIZING SOIL STRUCTURE

SLICKENSIDED - having inclined planes of weakness that are slick and glossy in appearance.
FISSURED - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
LAMINATED - composed of thin layers of varying color and texture.
INTERBEDDED - composed of alternate layers of different soil types.
CALCAREOUS - containing appreciable quantities of calcium carbonate.
WELL GRADED - having a wide range in grain sizes and substantial amounts of all intermediate particle sizes.
POORLY GRADED - predominantly of one grain size, or having a range of sizes with some intermediate sizes missing.

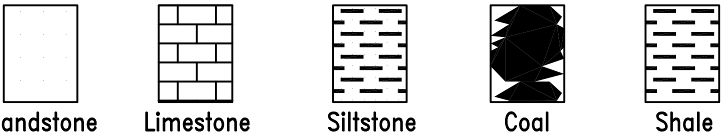
Terms used on this report for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No.3-357, Waterways Experiment Station, March 1953

KEY 3-4-03

Grubbs, Hoskyn,
Barton & Wyatt, Inc.
Consulting Engineers

BORING LOG TERMS – ROCK

ROCK TYPES
(SHOWN IN SYMBOLS COLUMN)



Joint Characteristics –

Spacing	
Very Close	0.75 to 2.5 in.
Close	2.5 to 8 in.
Moderately Close	8 to 24 in.
Wide	2 to 6 ft
Very Wide	More than 6 ft

Bedding Characteristics –

Very Thin	0.75 to 2.5 in.
Thin	2.5 to 8 in.
Medium	8 to 24 in.
Thick	2 to 6 ft
Massive	More than 6 ft

Lithologic Characteristics –

Clayey
Shaly
Calcareous (limy)
Siliceous
Sandy (Arenaceous)
Silty
Plastic Seams

Parting –	Less than 1/16 inch
Seam –	1/16 to 1/2 inch
Layer –	1/2 to 12 inches
Stratum –	Greater than 12 inches

Hardness–

Soft (S) – Reserved for plastic material alone.

Friable (F) – Easily crumbled by hand, pulverized or reduced to powder and is too soft to be cut with a pocket knife.

Low Hardness (LH) – Can be gouged deeply or carved with a pocket knife.

Moderately Hard (MH) – Can be readily scratched by a knife blade; scratch leaves a heavy trace of dust and scratch is readily visible after the powder has been blown away.

Hard (H) – Can be scratched with difficulty; scratch produces little powder and is often faintly visible; traces of the knife steel may be visible.

Very hard (VH) – Cannot be scratched with a pocket knife. Knife steel marks left on surface.

Texture –

Fine – Barely seen with naked eye
Medium – Barely seen up to 1/8 in.
Coarse – 1/8 in. to 1/4 in.

Structure –

- Bedding
  - Flat – 0° – 5°
  - Gently Dipping – 5° – 35°
  - Moderately Dipping – 55° – 85°
  - Steeply Dipping – 55° – 85°
- Fractures, scattered
  - Open
  - Cemented or Tight
- Fractures, closely spaced
  - Open
  - Cemented or Tight
- Brecciated (Sheared and Fragmented)
  - Open
  - Cemented or Tight
- Joints
  - Faulted
  - Slickensides

Degree of Weathering –

Fresh – No visible signs of decomposition or discoloration. Rings under hammer impact.

Slighty Weathered – Slight discoloration inwards from open fractures, otherwise similar to fresh.

Moderately Weathered – Discoloration throughout. Weaker minerals such as feldspar decomposed. Strength somewhat less than fresh rock, but cores cannot be broken by hand or scraped by knife. Texture preserved.

Highly Weathered – Most minerals somewhat decomposed. Specimens can be broken by hand with effort or shaved with knife. Core stones present in rock mass. Texture becoming indistinct but fabric

Completely Weathered – Minerals decomposed to soil but fabric and structure preserved (Saprolite). Specimens easily crumbled or penetrated.

Residual Soil – Advanced state of decomposition resulting in plastic soils. Rock fabric and structure completely destroyed. Large volume change.

Solution and Void Conditions –

Solid, contains no voids
Vuggy (pitted)
Vesicular (igneous)
Porous
Cavities
Cavernous

Swelling Properties –

Nonswelling
Swelling

Slaking Properties –

Nonslaking
Slakes slowly on exposure
Slakes readily on exposure

Rock Quality Designation (RQD) –

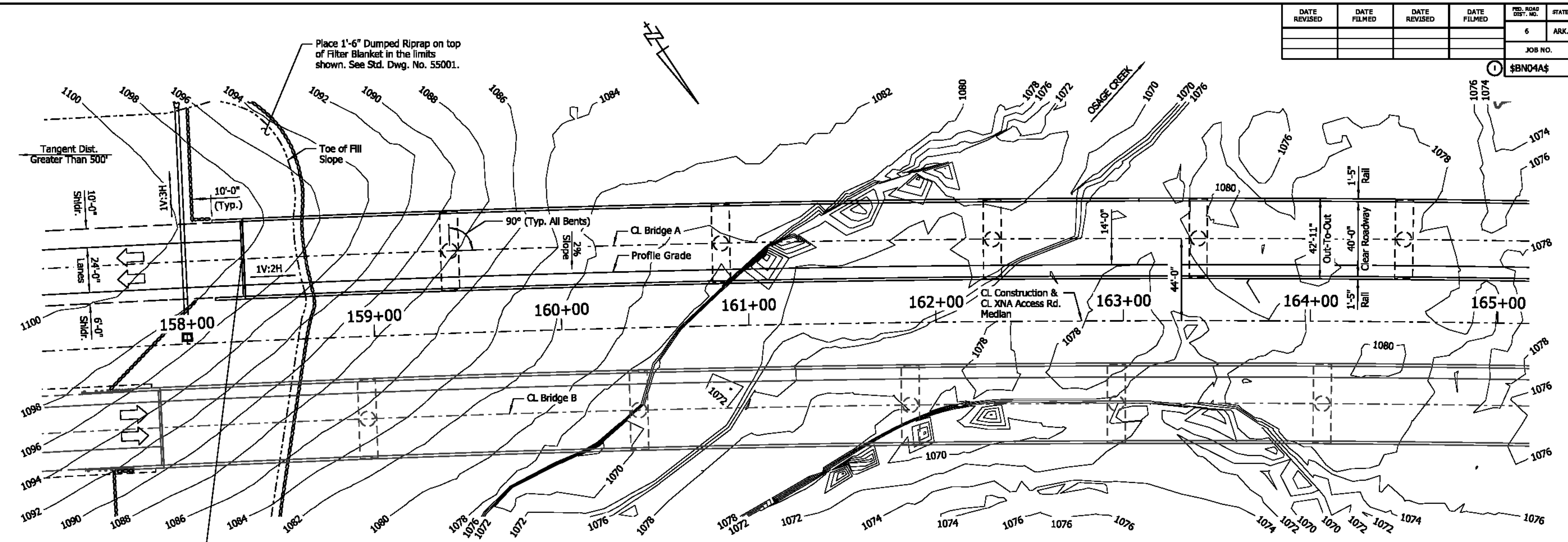
RQD (Percent)	Diagnostic Description
Greater than 90	Excellent
75 – 90	Good
50 – 75	Fair
25 – 50	Poor
Less than 25	Very Poor

KEYROCK FHWA 3-2-12

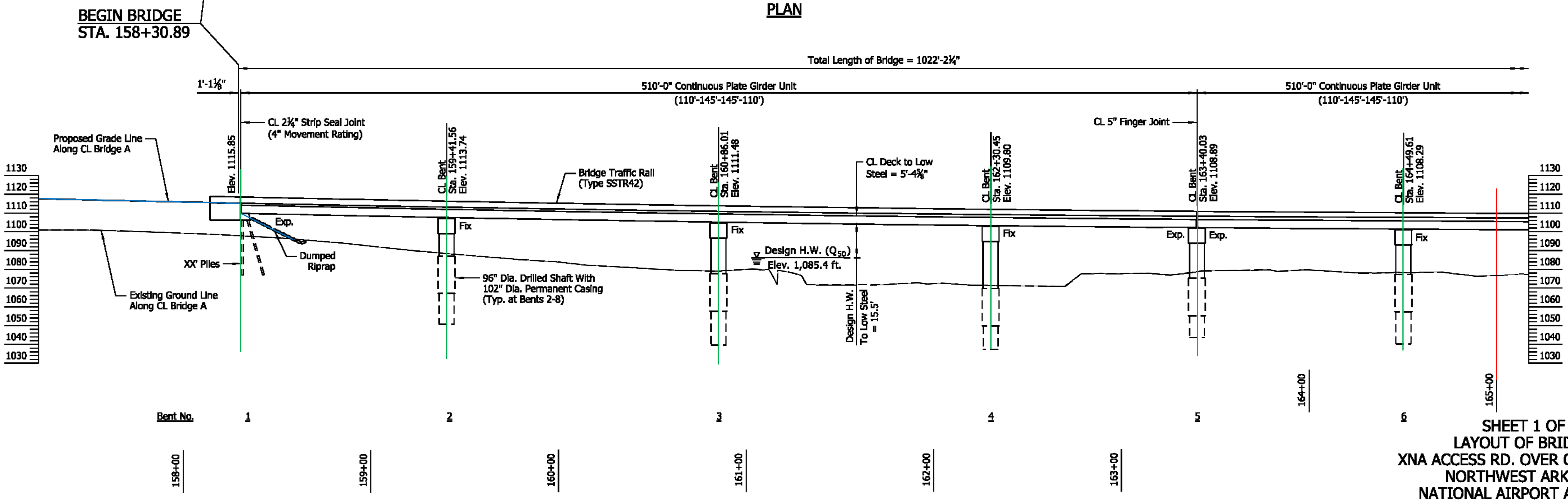
APPENDIX A

DATE REVISED	DATE FILMED	DATE REVISED	DATE FILMED	FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
				6	ARK.			
				JOB NO.		090069	$SN4101$	ST

① $BN04A$ LAYOUT $DN4101$



PLAN



ELEVATION

NOTE:
Stations shown are along CL Construction. Elevations shown are actual top of deck elevations at CL Bridge A. Any vertical dimension referenced to CL Deck is based on actual top of deck elevation at CL Bridge A.

For Horizontal and Vertical Curve Data, see Dwg. No. $DN4102$.

FOR R/W DATA, SEE ROADWAY PLANS

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WORKSPACE: ARDOT Bridge (2019)
L:\2017\17017600 - XNA Access - NEPA\Drawings\b090069a4_S101_LO.dgn
REVISED DATE:

PRELIMINARY NOT FOR CONSTRUCTION

BRIDGE ENGINEER

SHEET 1 OF 2
LAYOUT OF BRIDGE A
XNA ACCESS RD. OVER OSAGE CREEK
NORTHWEST ARKANSAS
NATIONAL AIRPORT ACCESS (F)
BENTON COUNTY

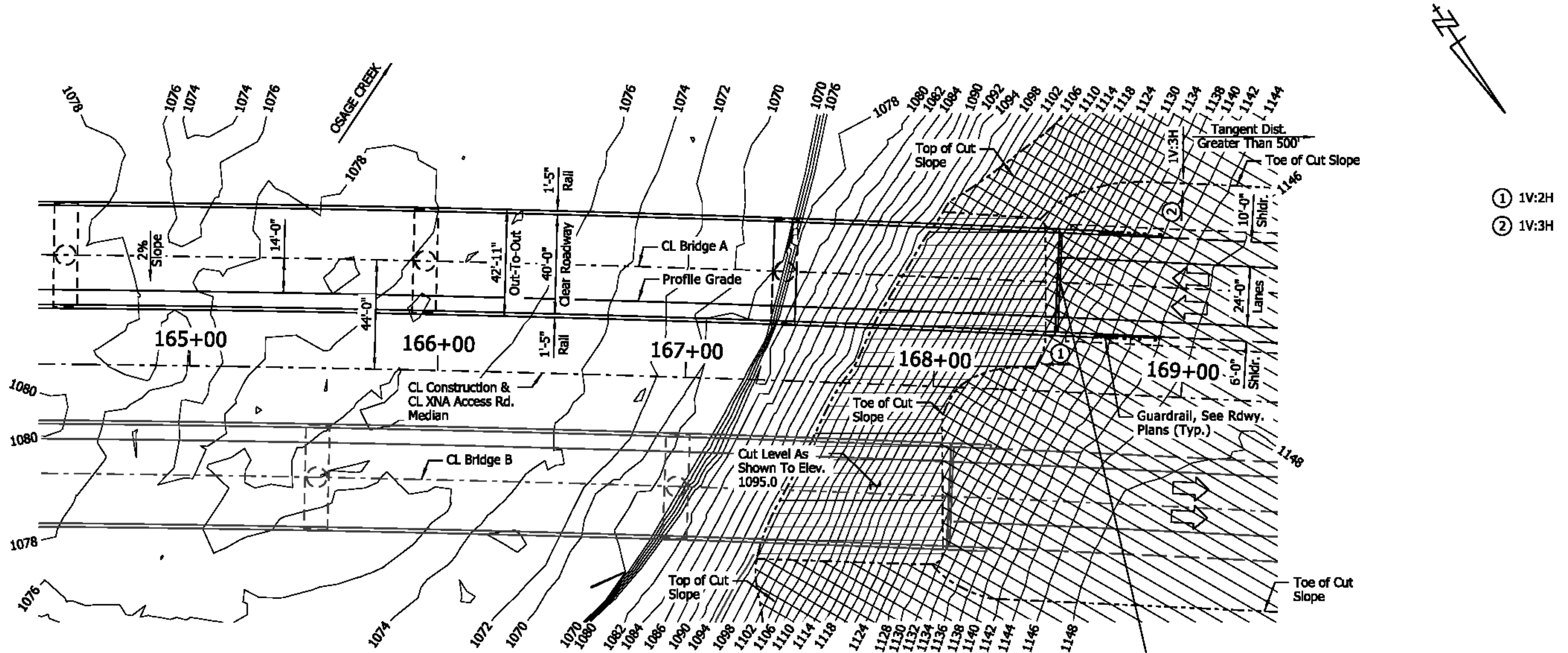
ROUTE SEC.

ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

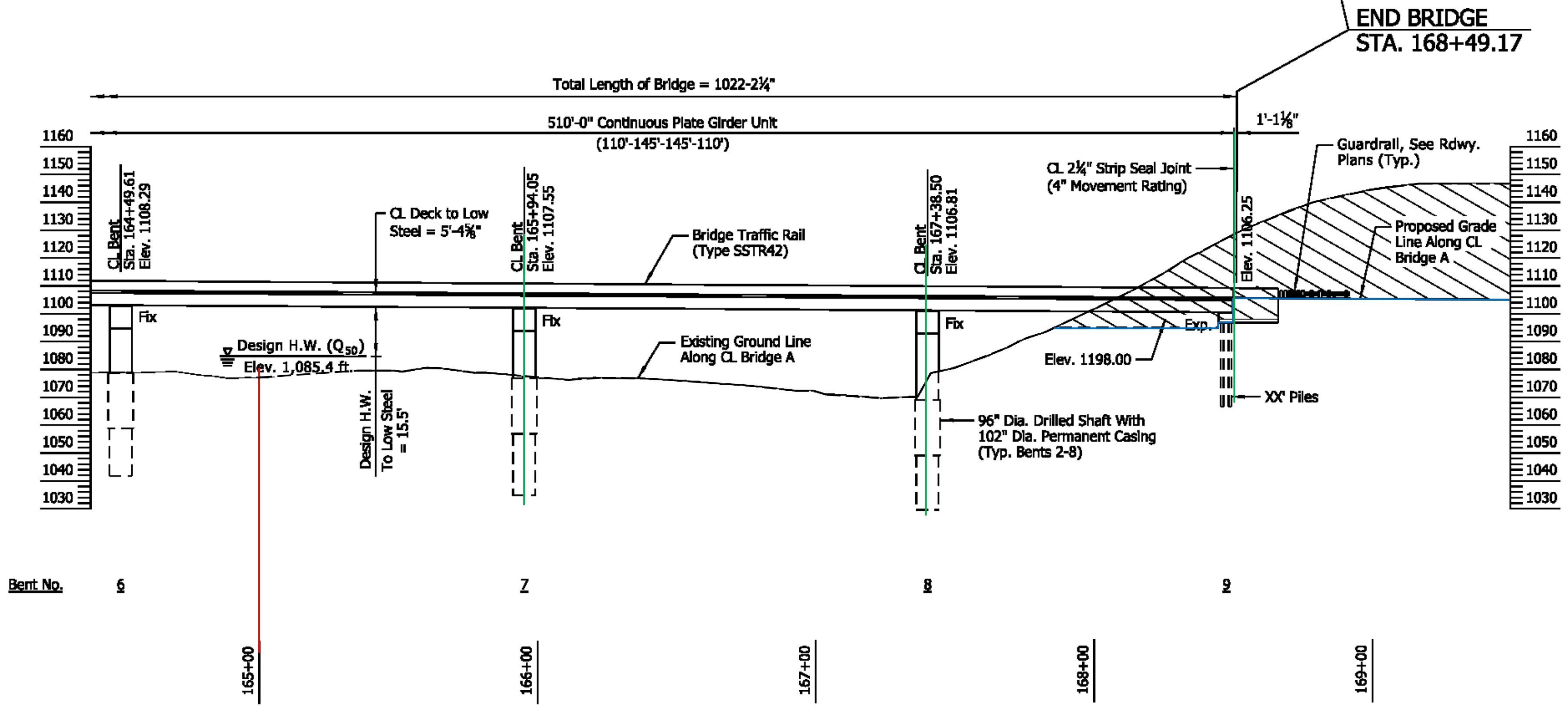
DRAWN BY: CWT DATE: SEPT. 2021 FILENAME: b090069A4_L1.dgn
CHECKED BY: JES DATE: SEPT. 2021 SCALE: 1" = 30'-0"
DESIGNED BY: ERM DATE: SEPT. 2021
BRIDGE NO. $BN04A$ DRAWING NO. $DN4101$

DATE REVISED	DATE FILMED	DATE REVISED	DATE FILMED	FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
				6	ARK.			
				JOB NO.		090069	$SN4102$	ST

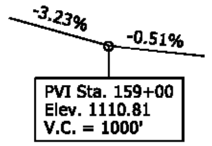
① $BN04B$ LAYOUT $DN4102$



PLAN



ELEVATION



HORIZONTAL CURVE DATA

XNA Access Rd. Median
PI = 156+17.12
Δ = 14°18'07" Rt.
D = 00°30'00"
T = 1437.67'
L = 2860.39'
e = 0.02 Ft./Ft.
R = 11459.16'

VERTICAL CURVE DATA

XNA Access Rd.
(Profile Grade 14' Right of CL Bridge A)

FOR R/W DATA, SEE ROADWAY PLANS

NOTE:
Stations shown are along CL Construction. Elevations shown are actual top of deck elevations at CL Bridge A. Any vertical dimension referenced to CL Deck is based on actual top of deck elevation at CL Bridge A.

PRELIMINARY
NOT FOR
CONSTRUCTION

BRIDGE ENGINEER

SHEET 2 OF 2
LAYOUT OF BRIDGE A
XNA ACCESS RD. OVER OSAGE CREEK
NORTHWEST ARKANSAS
NATIONAL AIRPORT ACCESS (F)
BENTON COUNTY

ROUTE SEC.

ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

DRAWN BY: CWT DATE: SEPT. 2021 FILENAME: b090069xA4_L2.dgn
CHECKED BY: JES DATE: SEPT. 2021 SCALE: 1" = 30'-0"
DESIGNED BY: ERM DATE: SEPT. 2021
BRIDGE NO. $BN04A$ DRAWING NO. $DN4102$

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REVISED DATE:

DATE REVISED	DATE FILMED	DATE REVISED	DATE FILMED	FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
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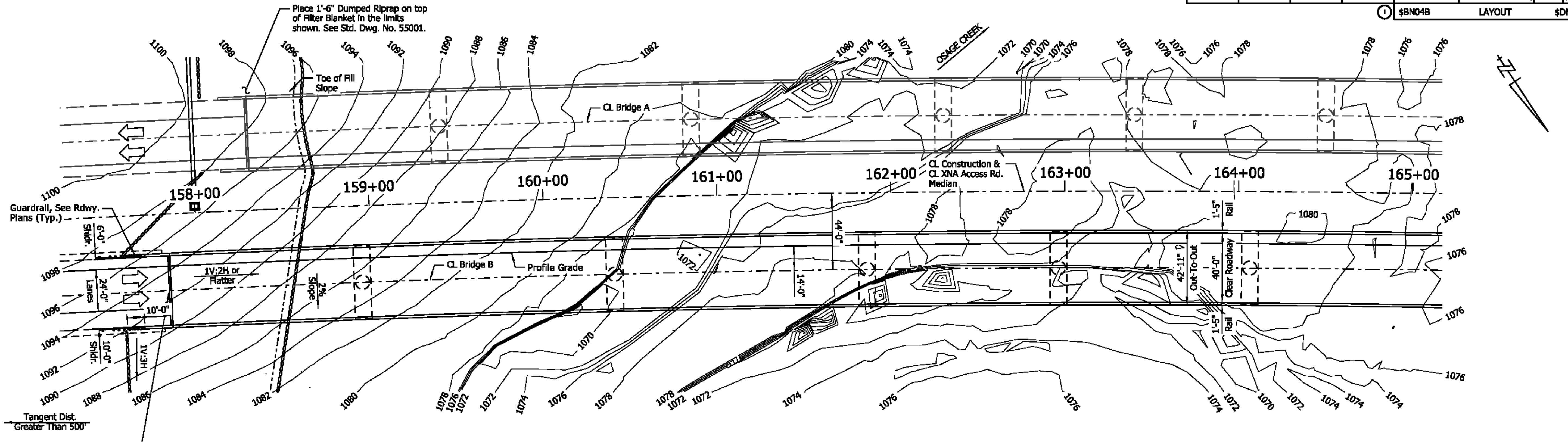
				JOB NO.		090069	$SN4103$	ST

① $BN04B LAYOUT $DN4103$



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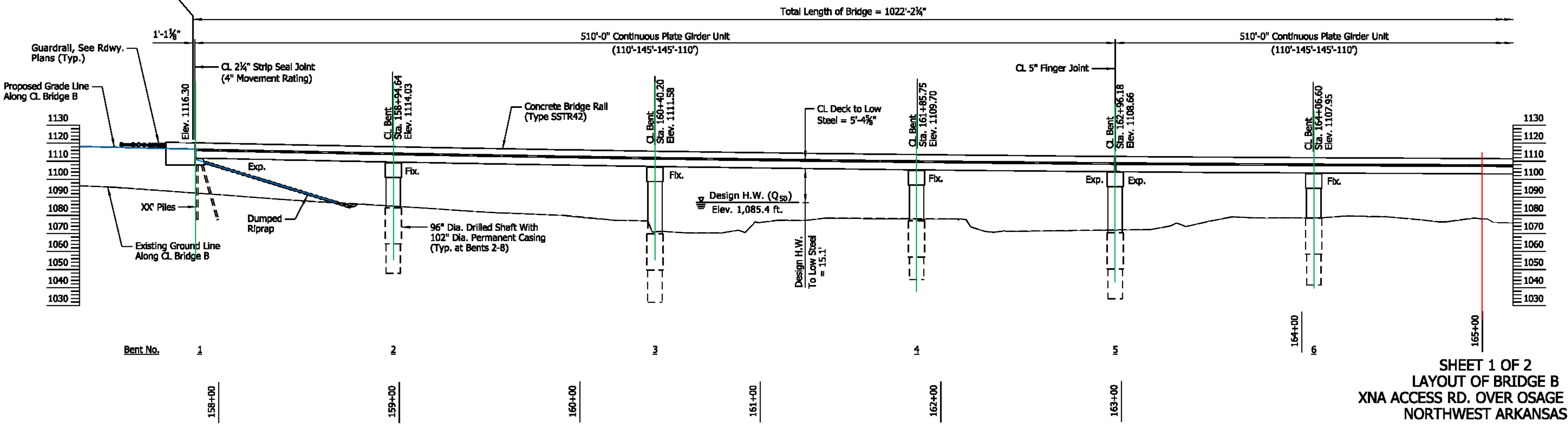

ELEVATION

NOTE:
Stations shown are along CL Construction. Elevations shown are actual top of deck elevations at CL Bridge B. Any vertical dimension referenced to CL Deck is based on actual top of deck elevation at CL Bridge B.

For Horizontal and Vertical Curve Data, see Dwg. No. $DN4104$.

FOR R/W DATA, SEE ROADWAY PLANS

PRELIMINARY
NOT FOR
CONSTRUCTION

BRIDGE ENGINEER

SHEET 1 OF 2
LAYOUT OF BRIDGE B
XNA ACCESS RD. OVER OSAGE CREEK
NORTHWEST ARKANSAS
NATIONAL AIRPORT ACCESS (F)
BENTON COUNTY
ROUTE RT SEC. SC
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

DRAWN BY: CWT DATE: SEPT. 2021 FILENAME: b090069B4_L1.dgn
CHECKED BY: JES DATE: SEPT. 2021 SCALE: 1" = 30'-0"
DESIGNED BY: ERM DATE: SEPT. 2021
BRIDGE NO. $BN04B$ DRAWING NO. $DN4103$

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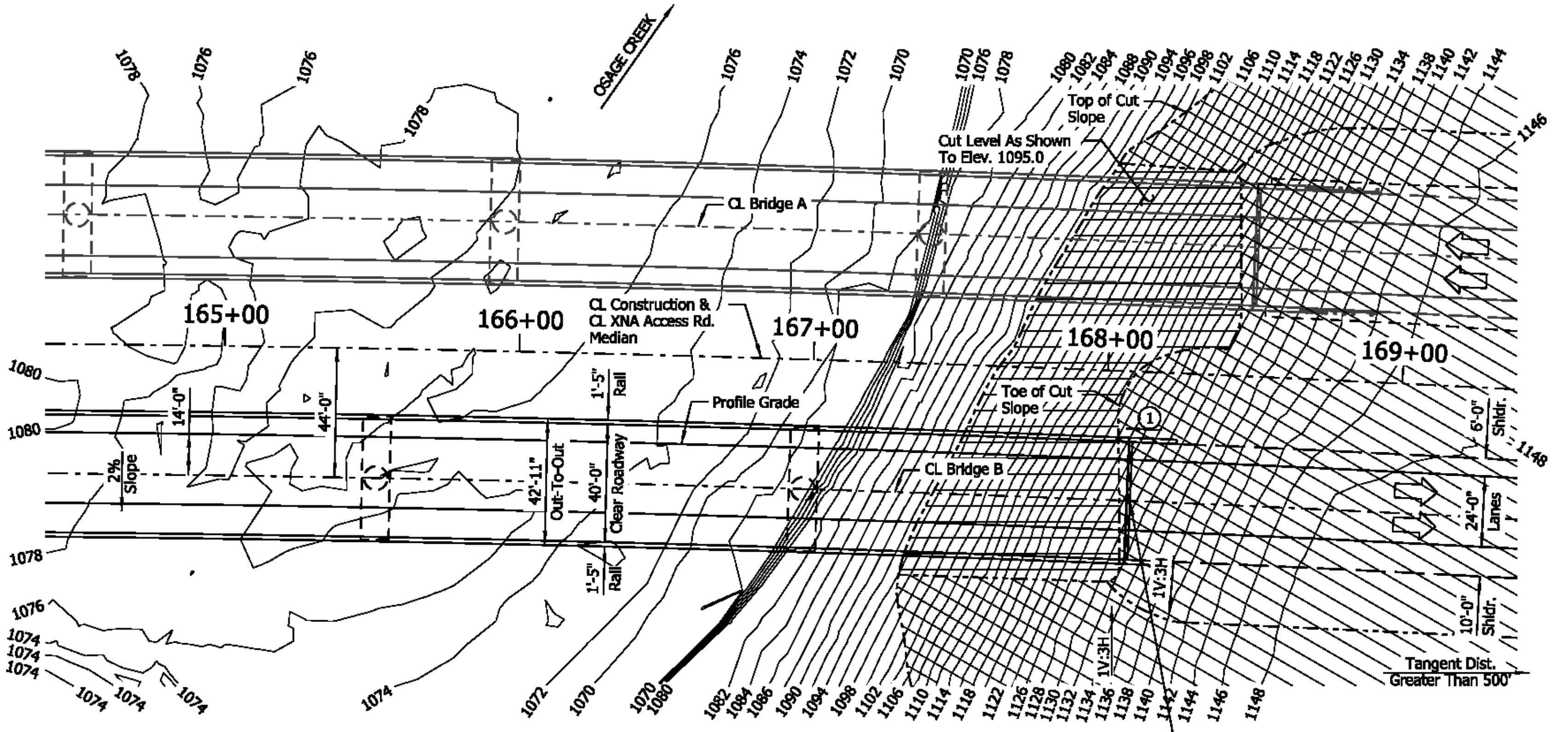
REVISED DATE:

DATE REVISED	DATE FILMED	DATE REVISED	DATE FILMED

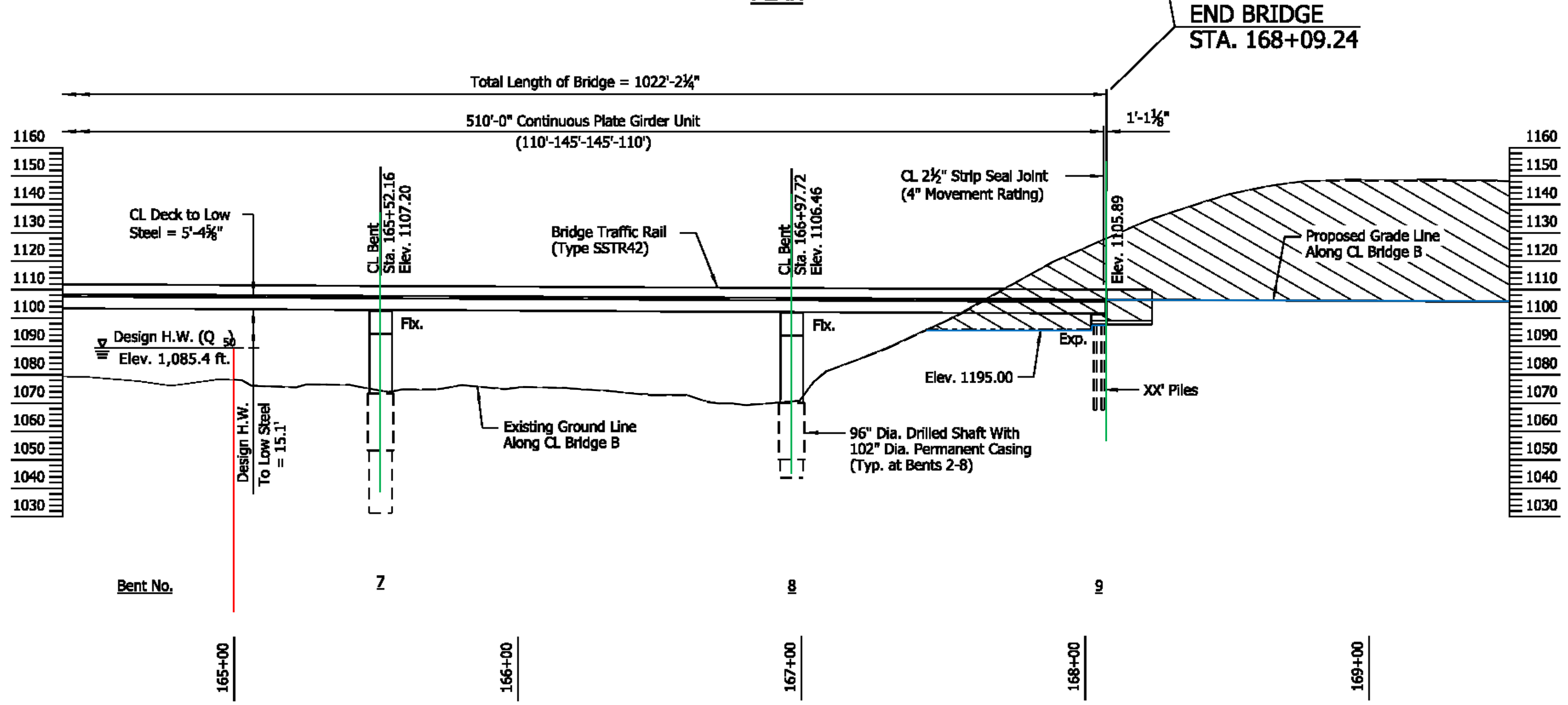
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
6	ARK.			
JOB NO.		090069	$SN4104$	ST

① $BN04B LAYOUT $DN4104$



PLAN

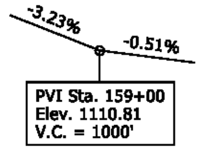
① 1V:2H



ELEVATION

FOR R/W DATA, SEE ROADWAY PLANS

NOTE:
Stations shown are along CL Construction. Elevations shown are actual top of deck elevations at CL Bridge B. Any vertical dimension referenced to CL Deck is based on actual top of deck elevation at CL Bridge B.



PVI Sta. 159+00
Elev. 1110.81
V.C. = 1000'

HORIZONTAL CURVE DATA

XNA Access Rd. Median
PI = 156+17.12
Δ = 14°18'07" Rt.
D = 00°30'00"
T = 1437.67'
L = 2860.39'
e = 0.02 Ft./Ft.
R = 11459.16'

VERTICAL CURVE DATA

XNA Access Rd.
(Profile Grade 14' Left of CL Bridge B)

SHEET 2 OF 2
LAYOUT OF BRIDGE B
XNA ACCESS RD. OVER OSAGE CREEK
NORTHWEST ARKANSAS
NATIONAL AIRPORT ACCESS (F)
BENTON COUNTY
ROUTE SEC.
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

PRELIMINARY
NOT FOR
CONSTRUCTION

BRIDGE ENGINEER

DRAWN BY: CWT DATE: SEPT. 2021 FILENAME: b090069B4_L2.dgn
CHECKED BY: JES DATE: SEPT. 2021 SCALE: 1" = 30'-0"
DESIGNED BY: ERM DATE: SEPT. 2021
BRIDGE NO. $BN04B$ DRAWING NO. $DN4104$

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WORKSPACE: ARDOT Bridge (2019)
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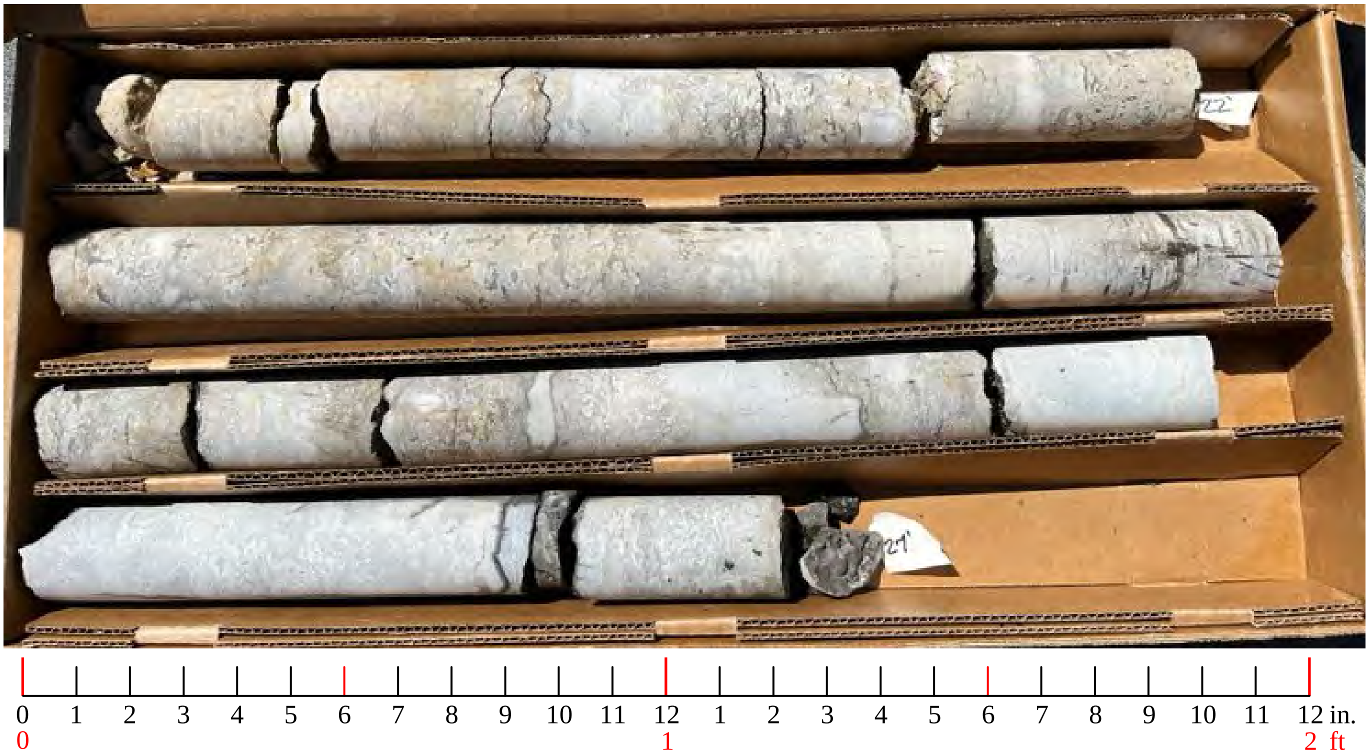
REVISED DATE:

APPENDIX B

B-S9: Run 1 (19-22 ft), Run 2 (22-27 ft)



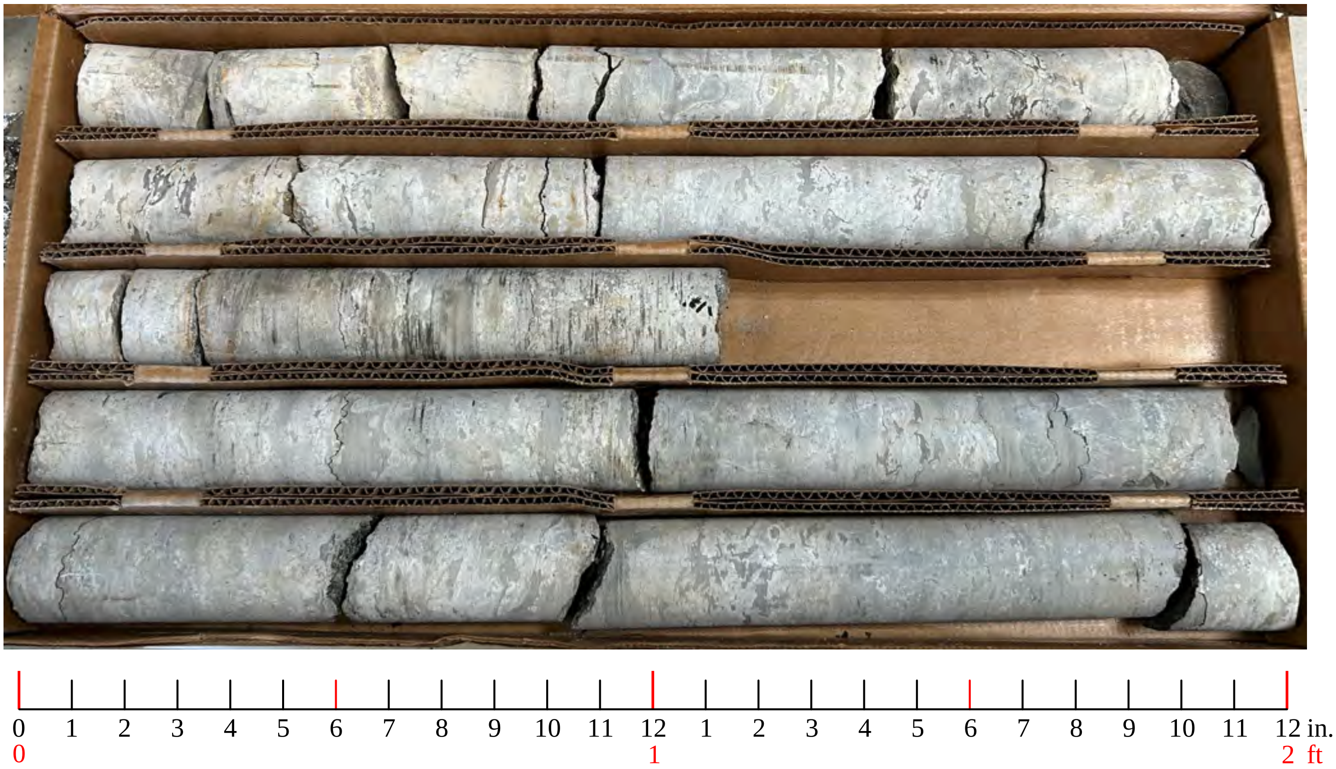
Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

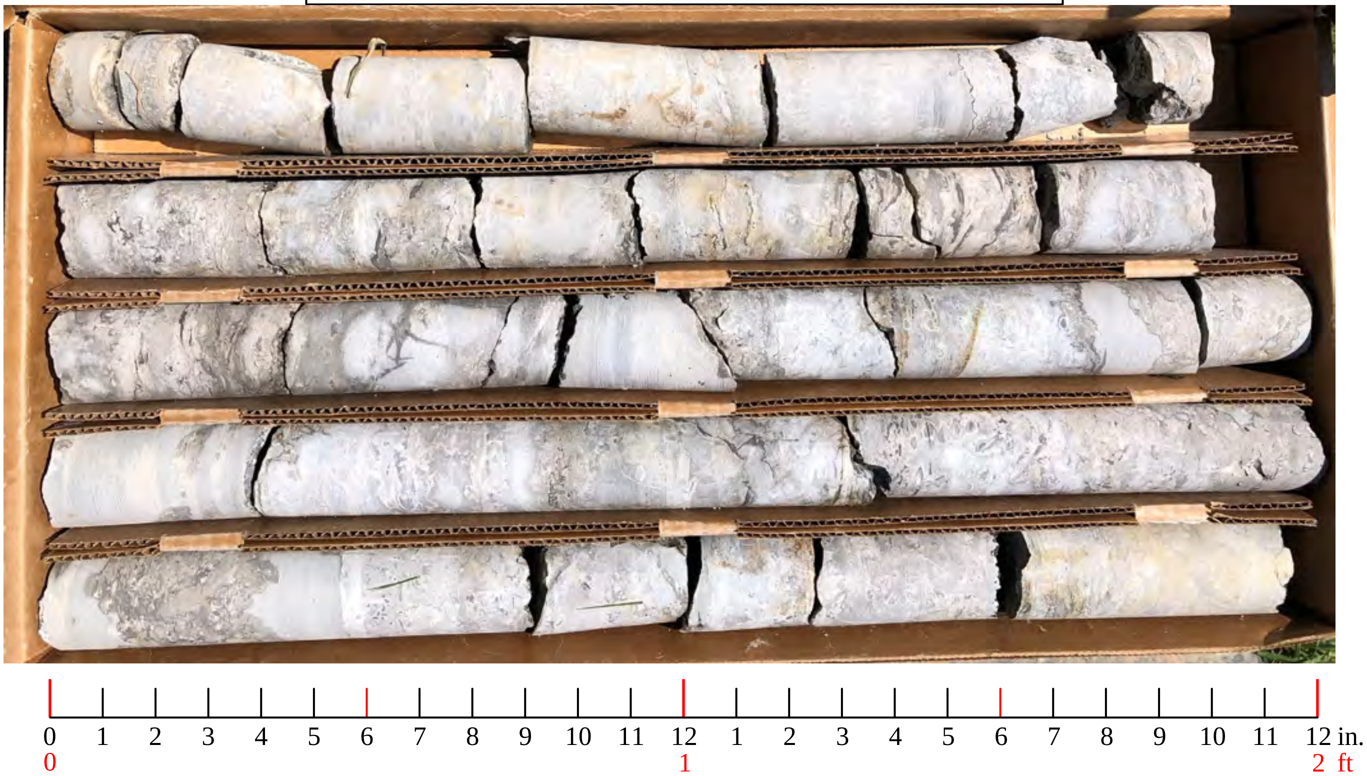
Job No. 19-118

Plate

B-S10: Run 1 (12-17 ft), Run 2 (17-21 ft)



B-S10: Run 3 (21-26 ft), Run 4 (26-31 ft)



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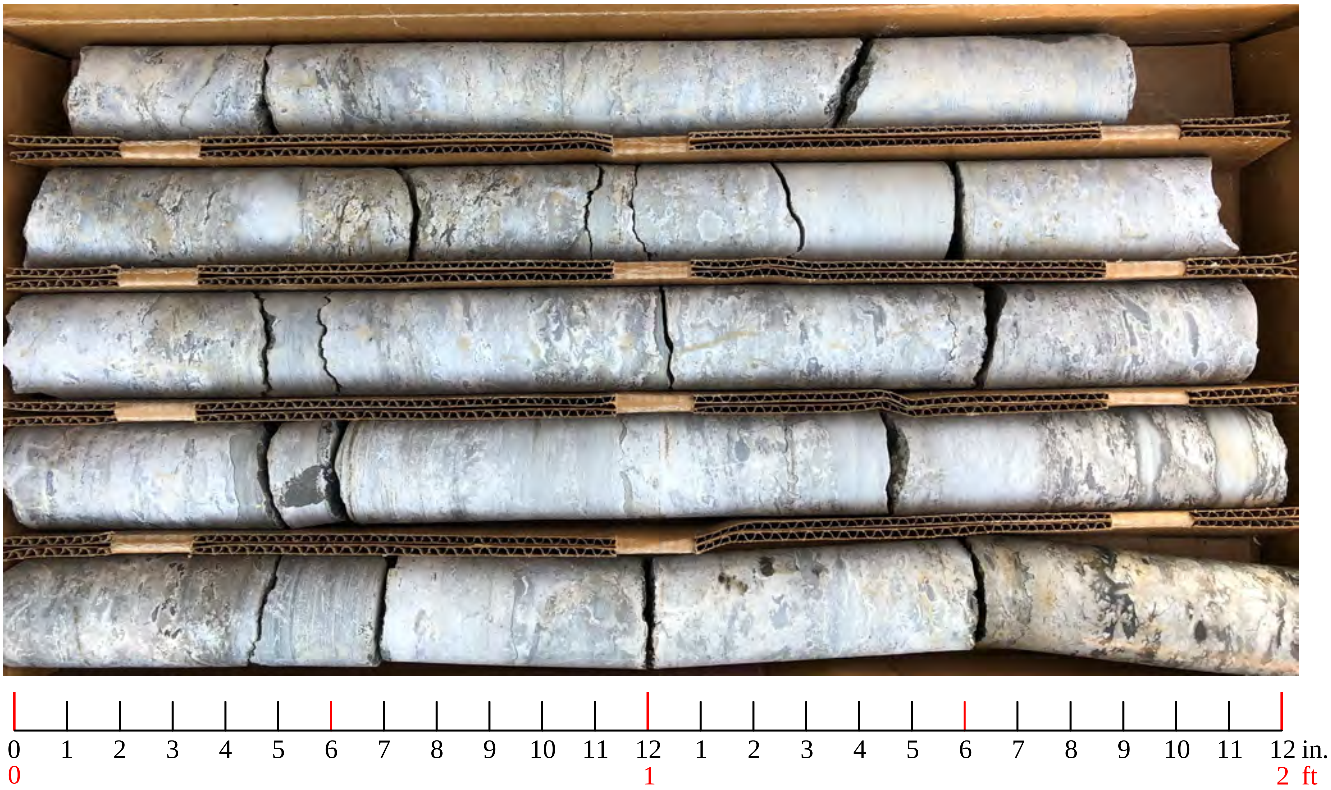
Benton County, Arkansas

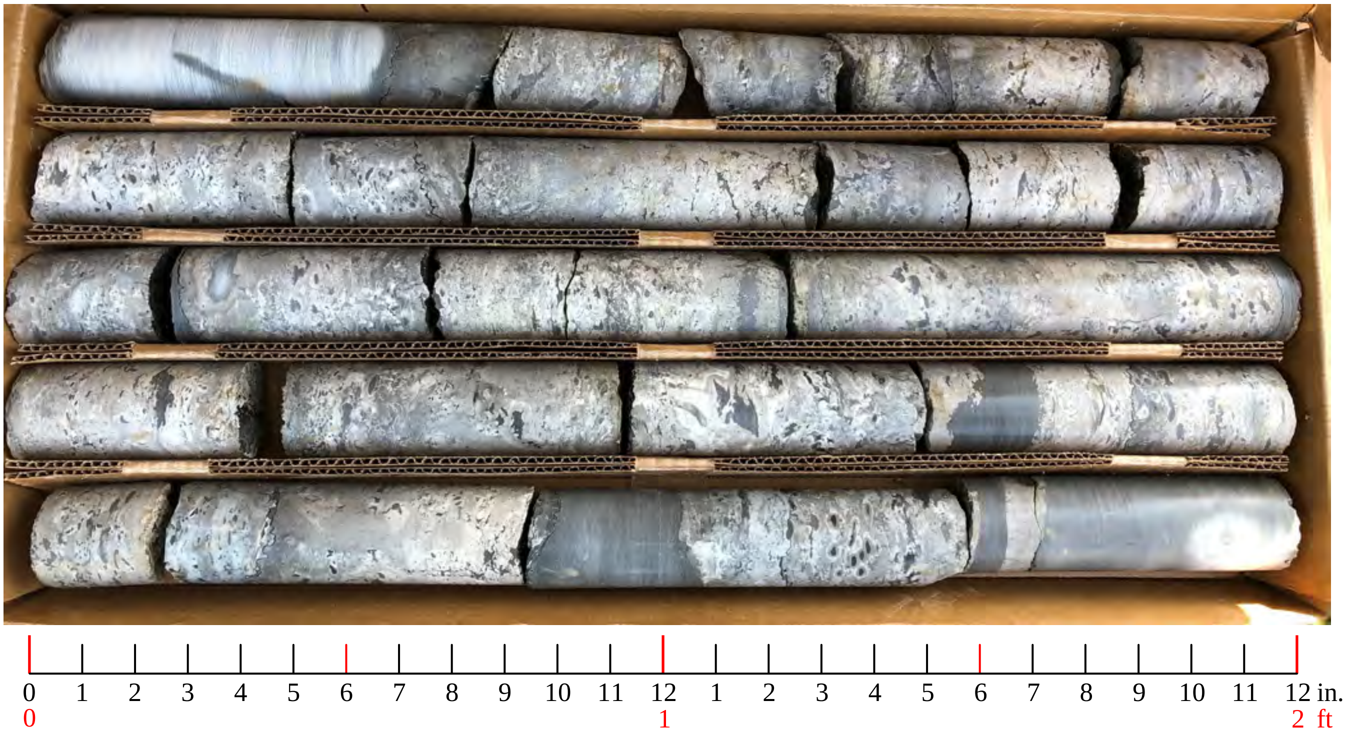
Job No. 19-118

Plate

B-S10: Run 5 (31-36 ft), Run 6 (30-41 ft)



B-S10: Run 7 (41-46 ft), Run 8 (46-51 ft)



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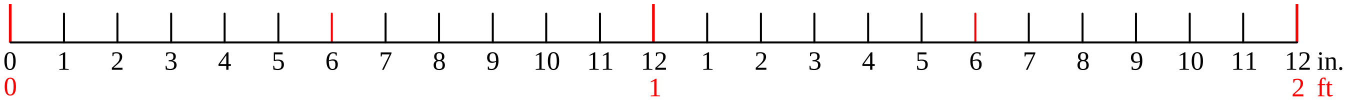
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S10: Run 9 (51-52 ft)



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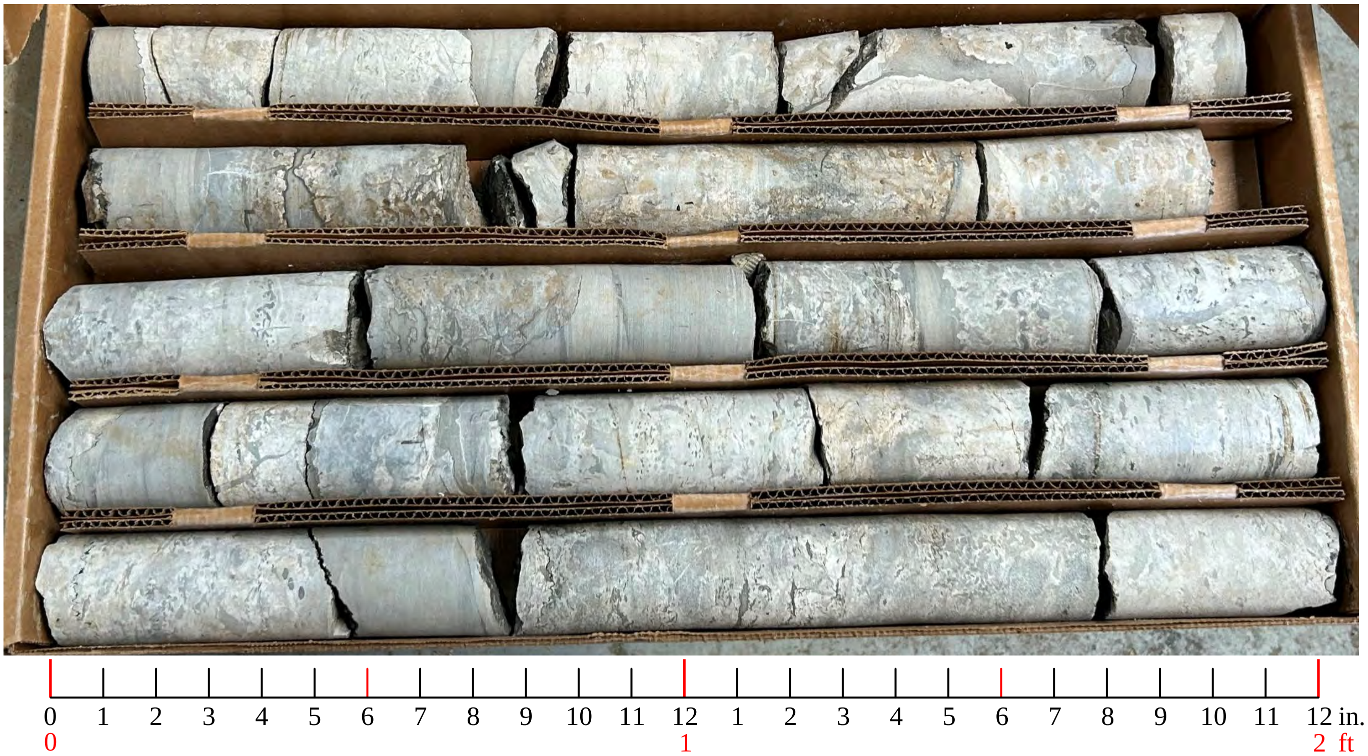
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S11B: Run 1 (12-15 ft), Run 2 (15-20 ft),

B-S11B: Run 3 (20-25 ft), Run 4 (25-30 ft)



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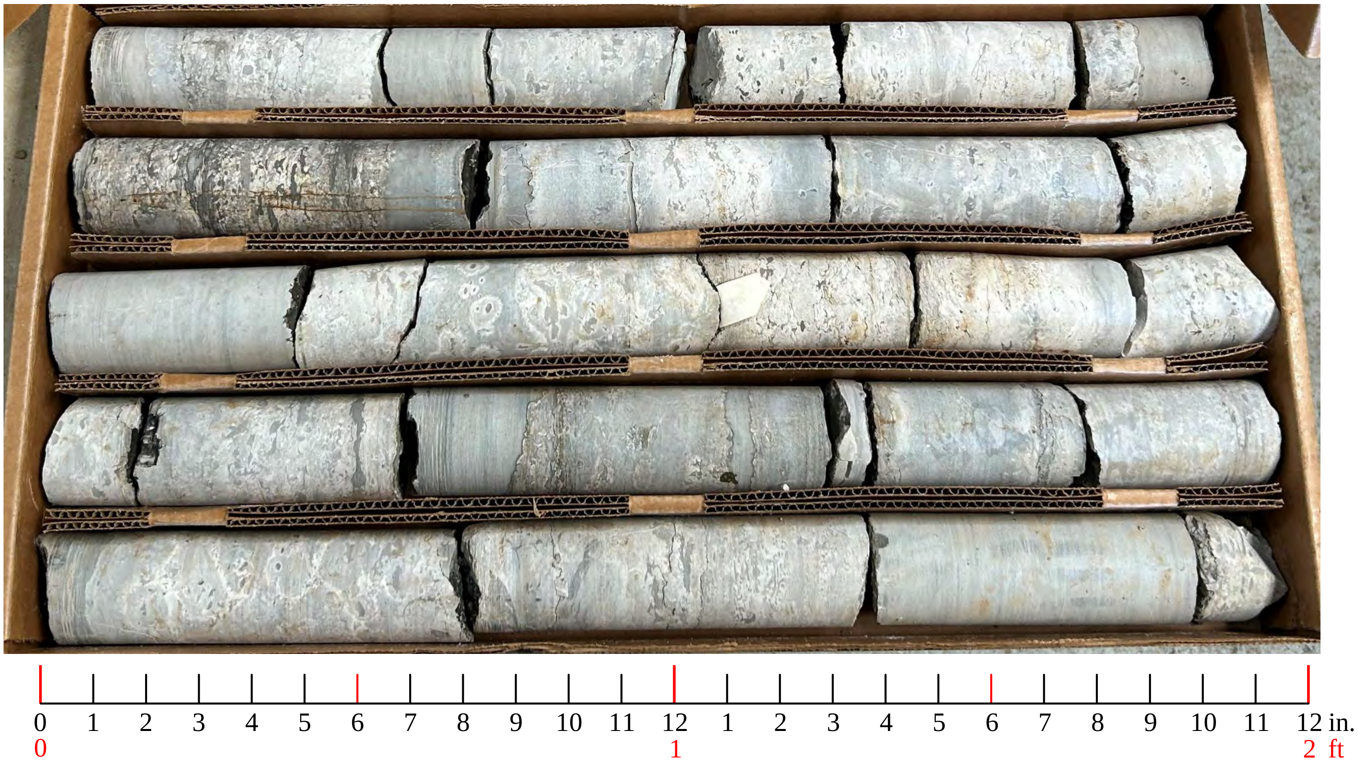
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S11B: Run 5 (30-35 ft), Run 6 (35-40 ft),

B-S11B: Run 7 (40-45 ft), Run 8 (45-50 ft)



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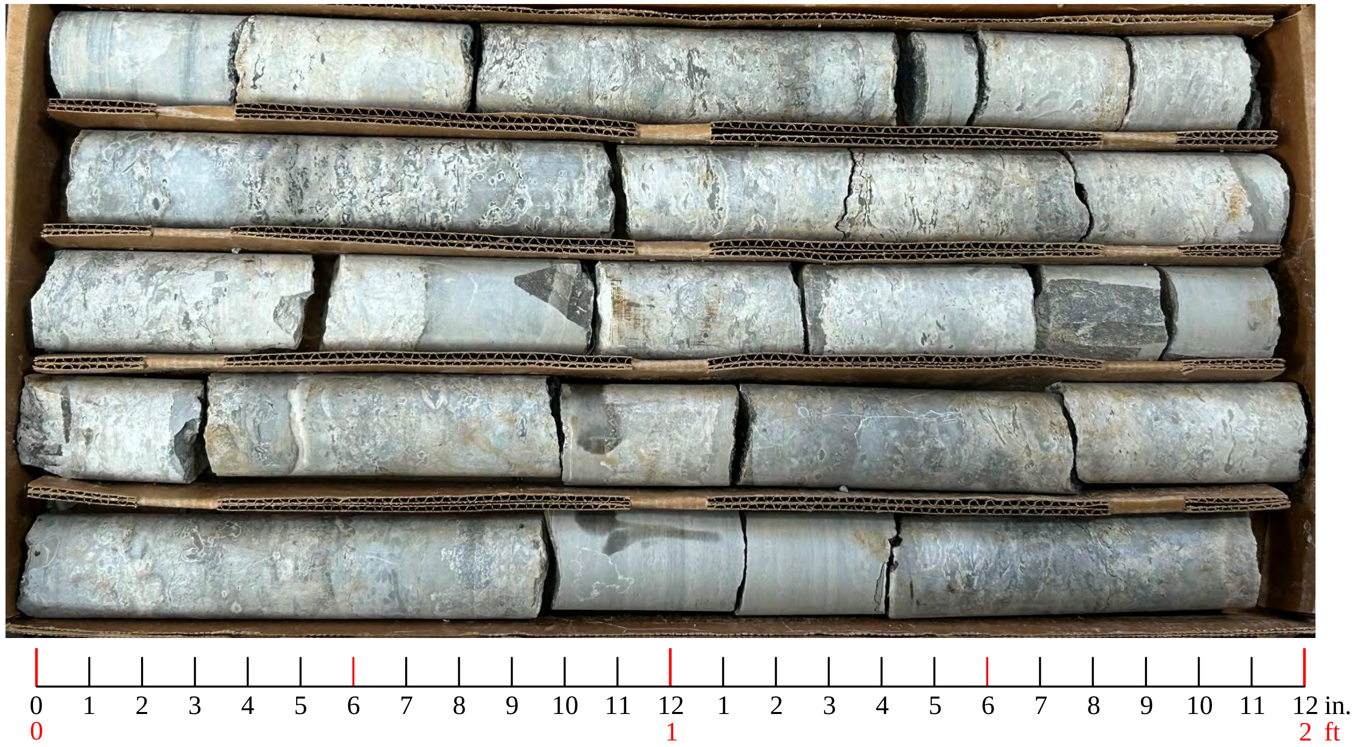
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S13: Run 1 (15-20 ft), Run 2 (20-25 ft)

B-S13: Run 3 (25-30 ft), Run 4 (30-35 ft)



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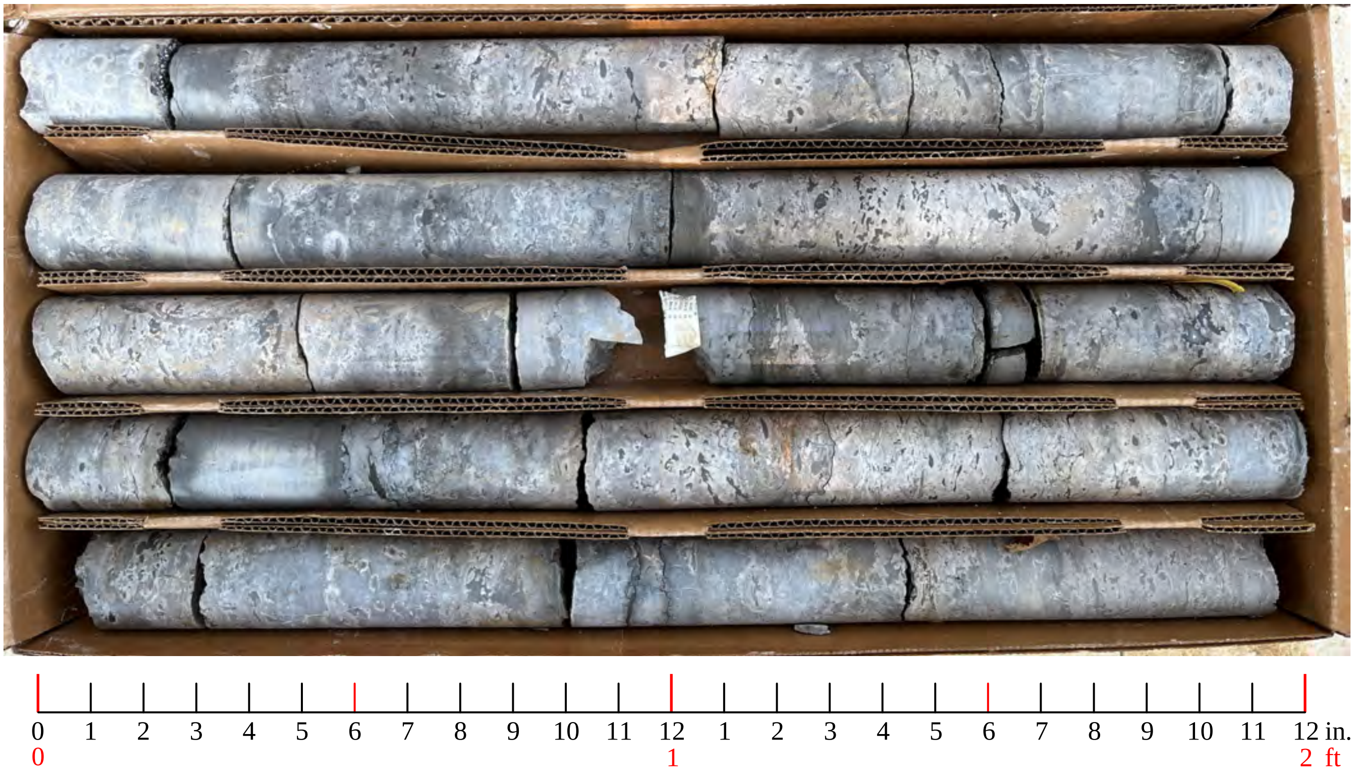
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

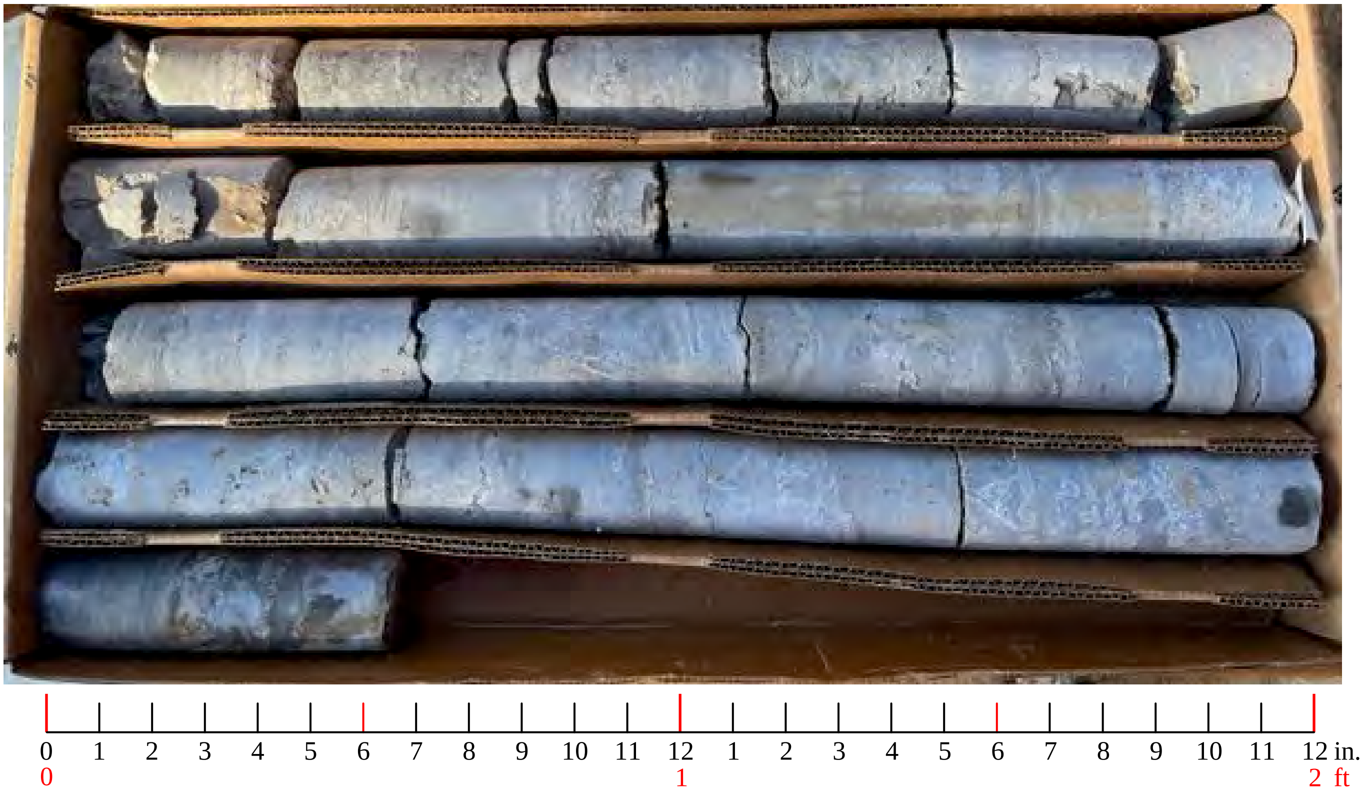
B-S13: Run 5 (35-40 ft), Run 6 (40-45 ft)



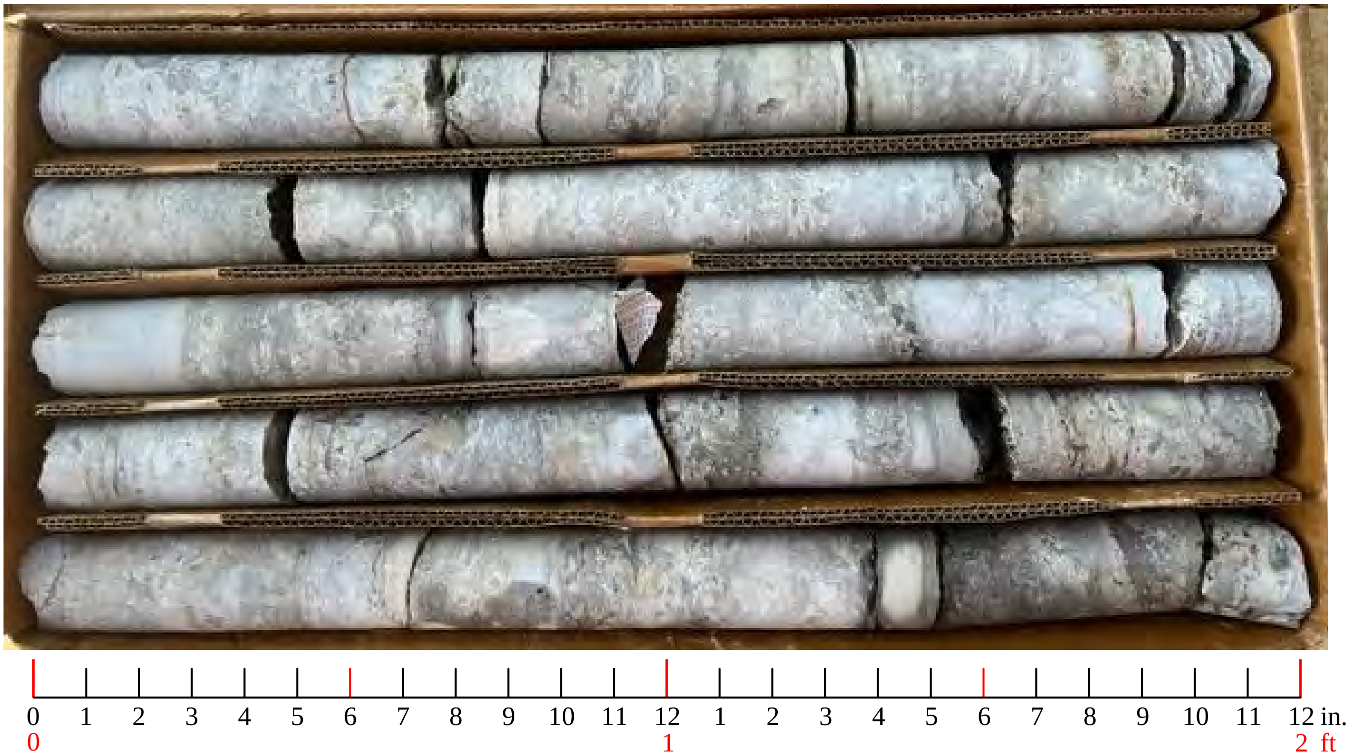
B-S13: Run 7 (45-50 ft), Run 8 (50-55 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	<u>**ROCK CORE PHOTOS**</u> **090069 XNA Access Road** **Benton County, Arkansas**	**Job No. 19-118** **Plate**

B-S14: Run 1 (11-15 ft), Run 2 (15-20 ft)

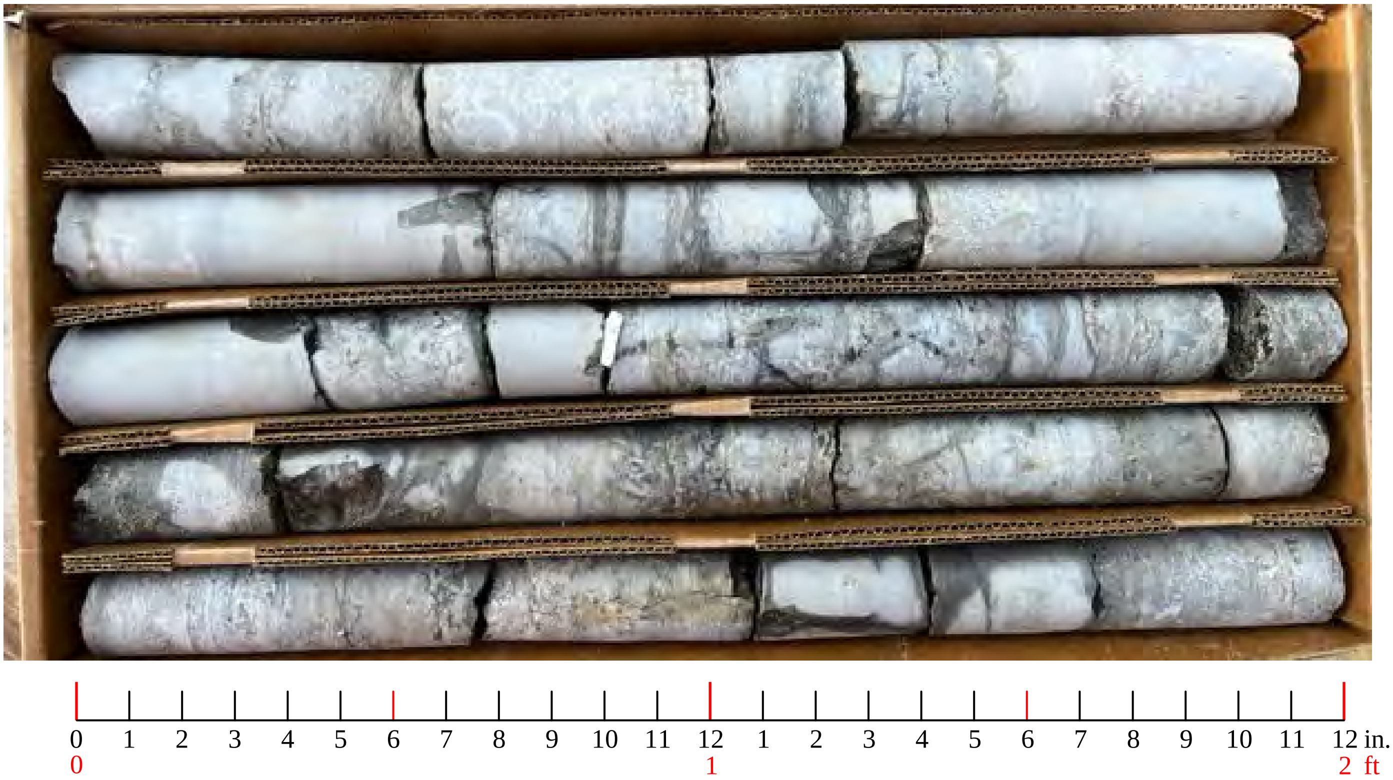


B-S14: Run 3 (20-25 ft), Run 4 (25-30 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	<u>ROCK CORE PHOTOS</u> **090069 XNA Access Road** **Benton County, Arkansas**	**Job No. 19-118** **Plate**

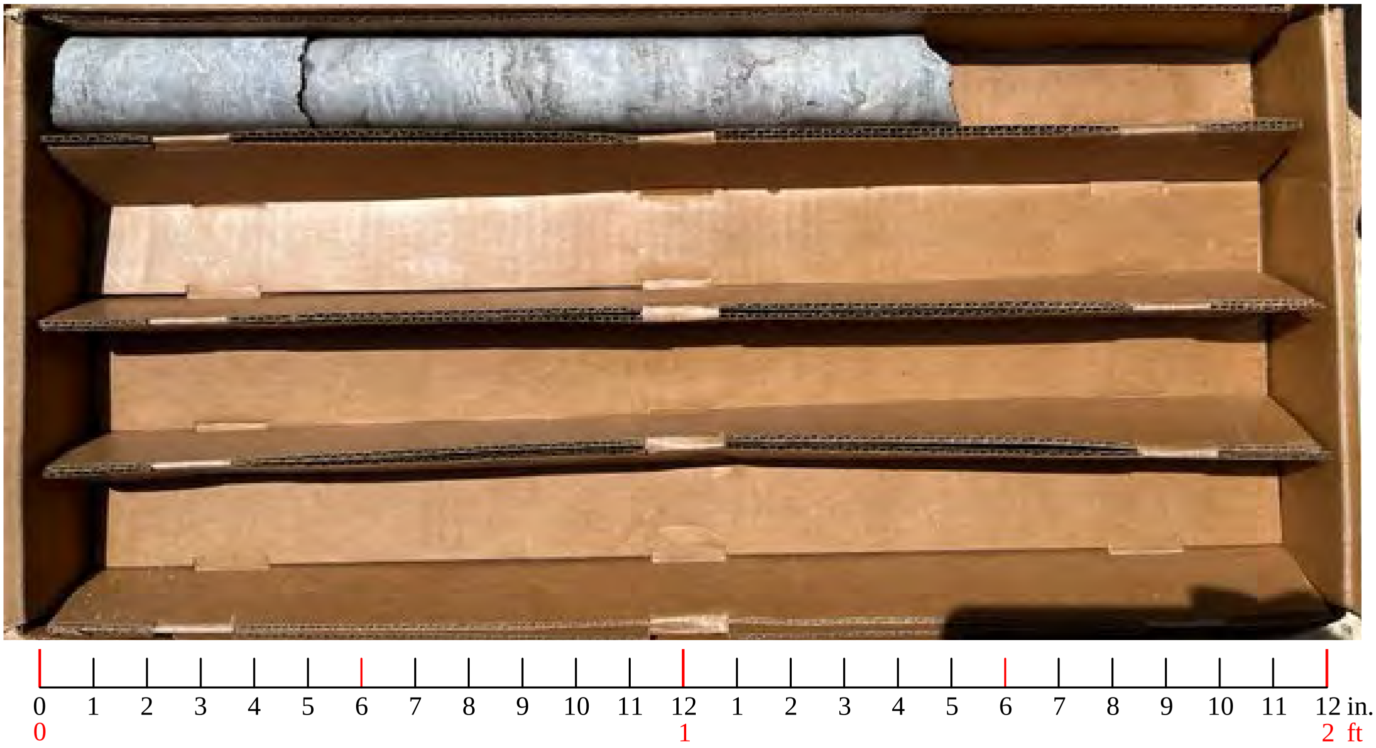
B-S14: Run 5 (30-35 ft), Run 6 (35-40 ft)



B-S14: Run 7 (40-45 ft), Run 8 (45-50 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **090069 XNA Access Road** **Benton County, Arkansas**	**Job No. 19-118** **Plate**

B-S14: Run 9 (50-51 ft)



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CONSULTING ENGINEERS
A UES Company

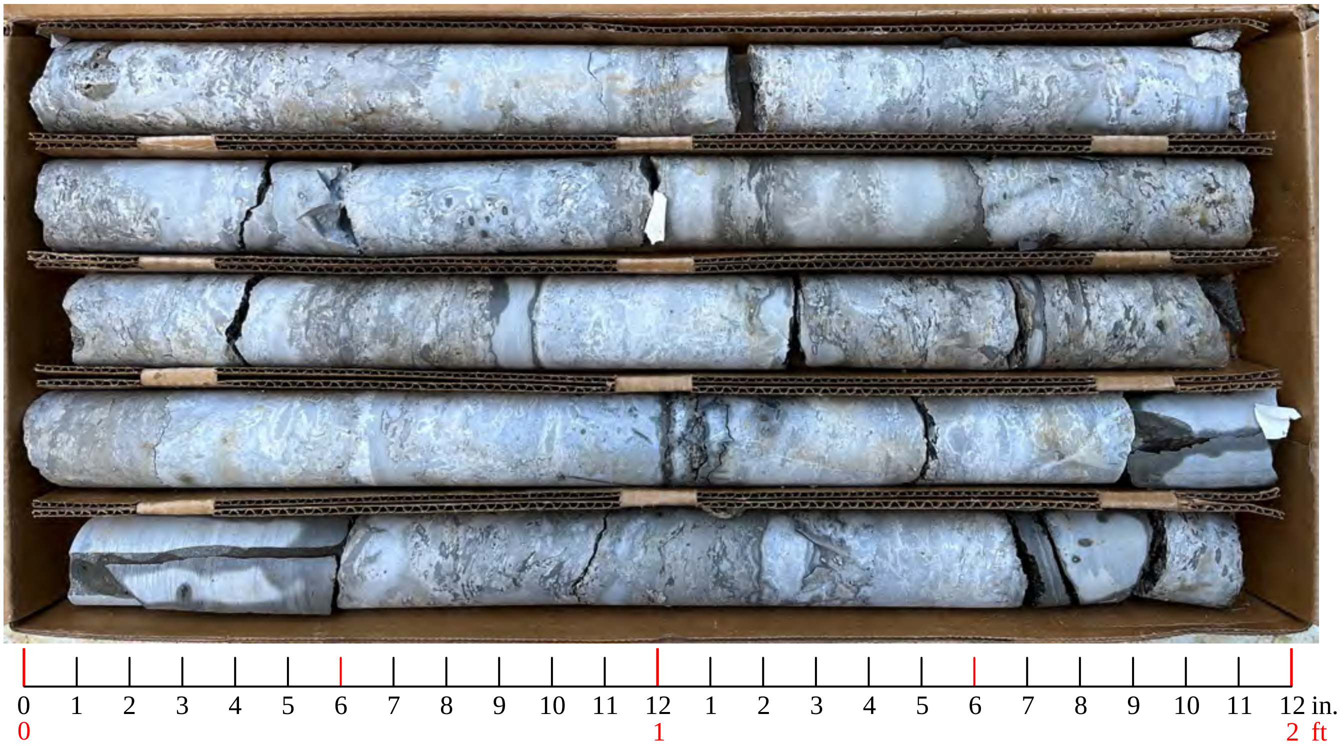
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S15B: Run 1 (12-15 ft), Run 2 (15-20 ft), Run 3 (20-22 ft)

B-S15B: Run 4 (22-25 ft), Run 5 (25-30 ft), Run 6 (30-32)



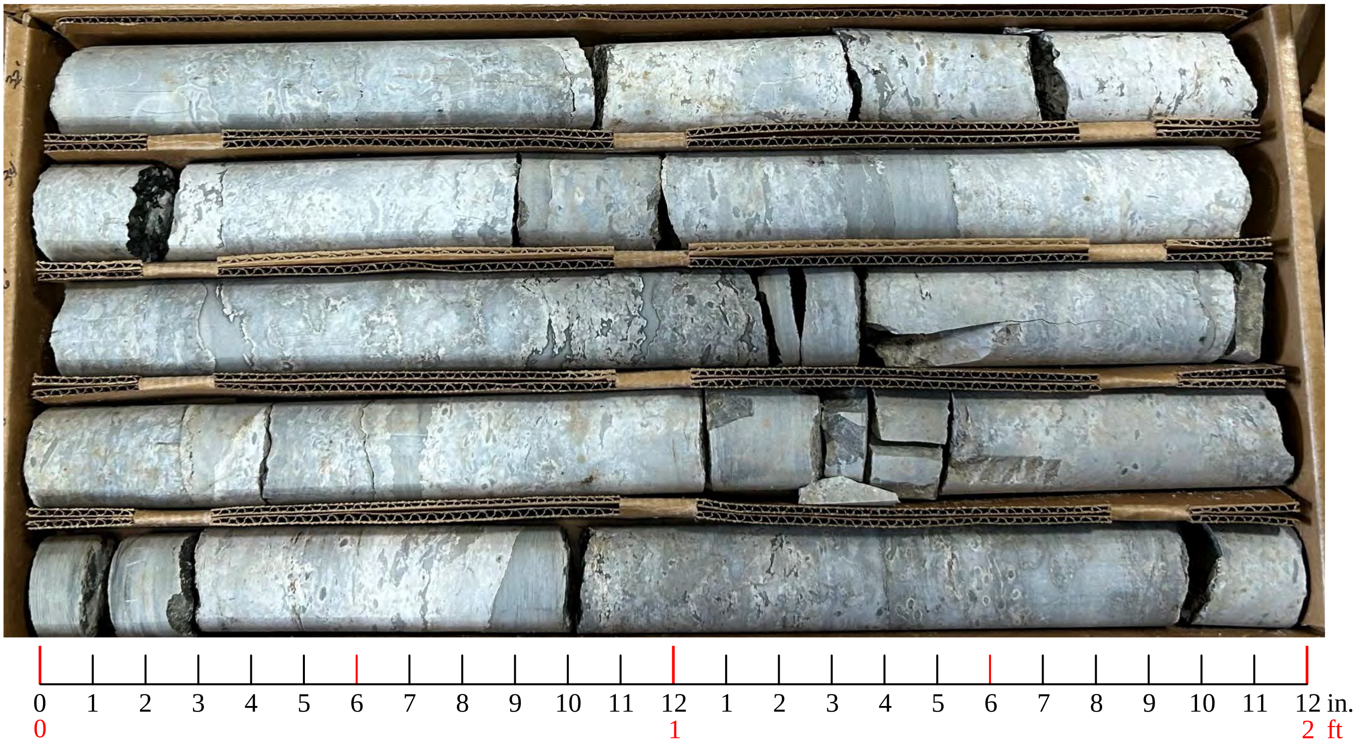
Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S15B: Run 7 (32-35 ft), Run 8 (35-40 ft), Run 9 (40-42 ft)



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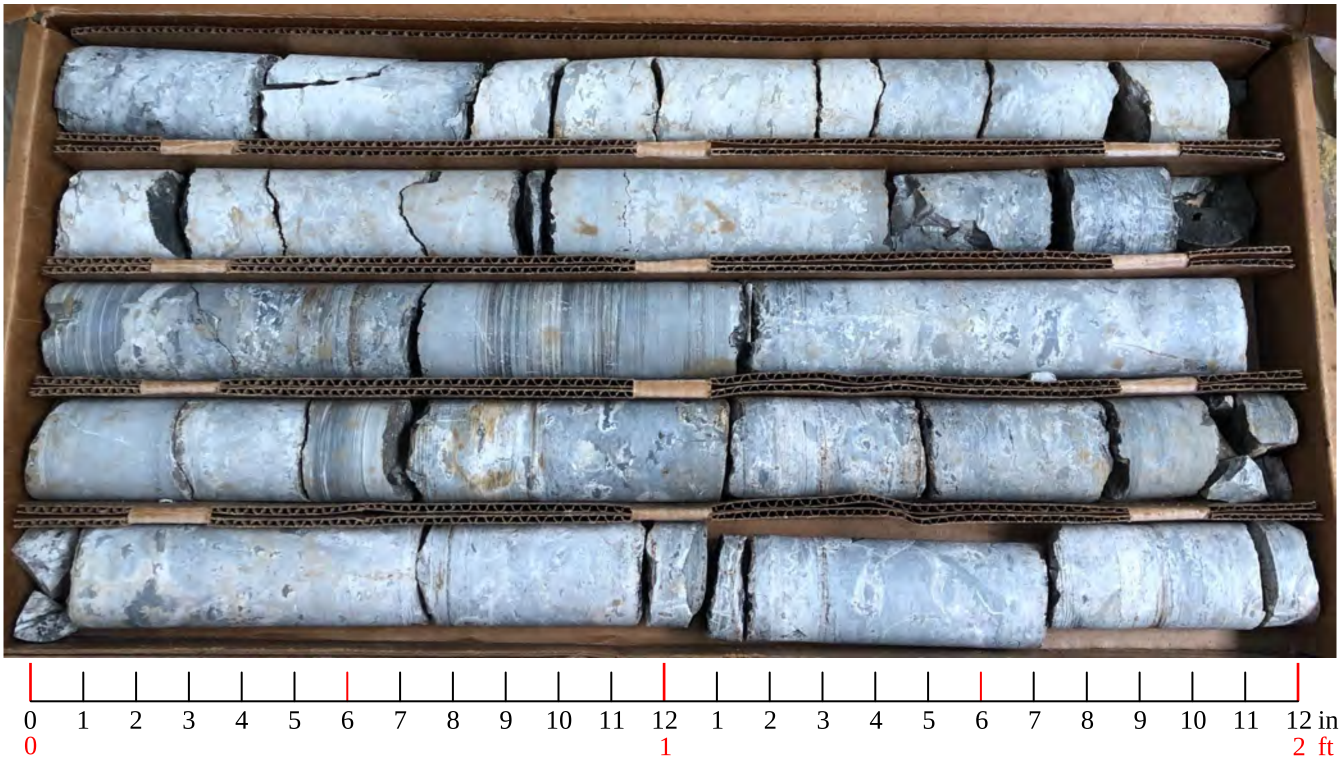
A UES Company

ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

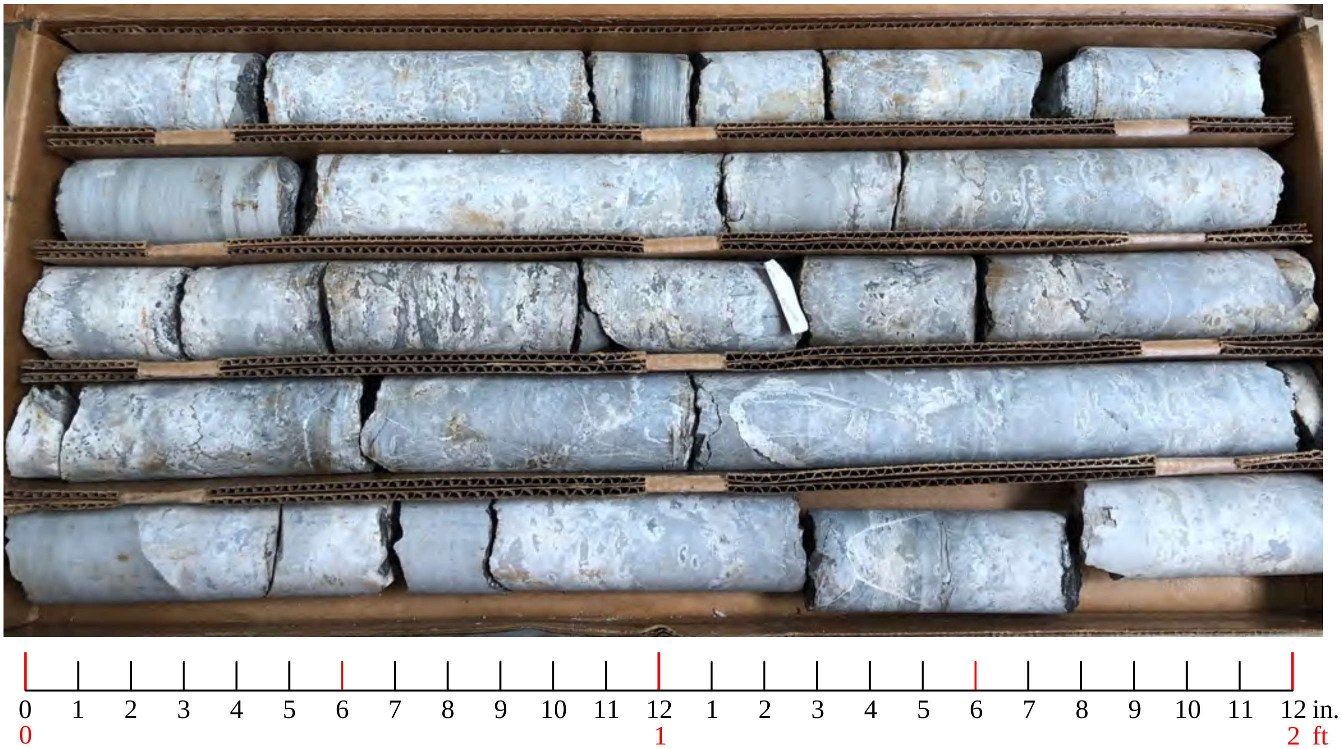
Job No. 19-118

Plate

B-S16: Run 1 (10-20 ft), Run 2 (15-20 ft)



B-16: Run 3 (20-25 ft), Run 4 (25-30 ft)



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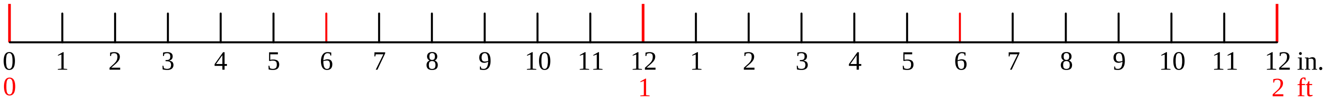
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

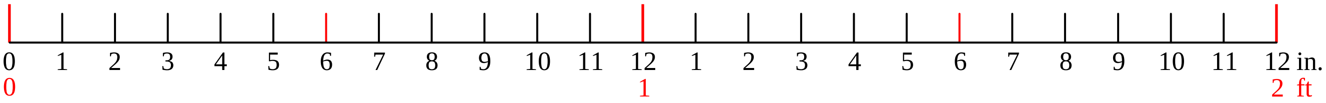
Job No. 19-118

Plate

B-S16: Run 5 (30-35 ft), Run 6 (35-40 ft)



B-S16: Run 7 (40-44 ft)



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090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S18: Run 1 (16-18 ft), Run 2 (18-23 ft)

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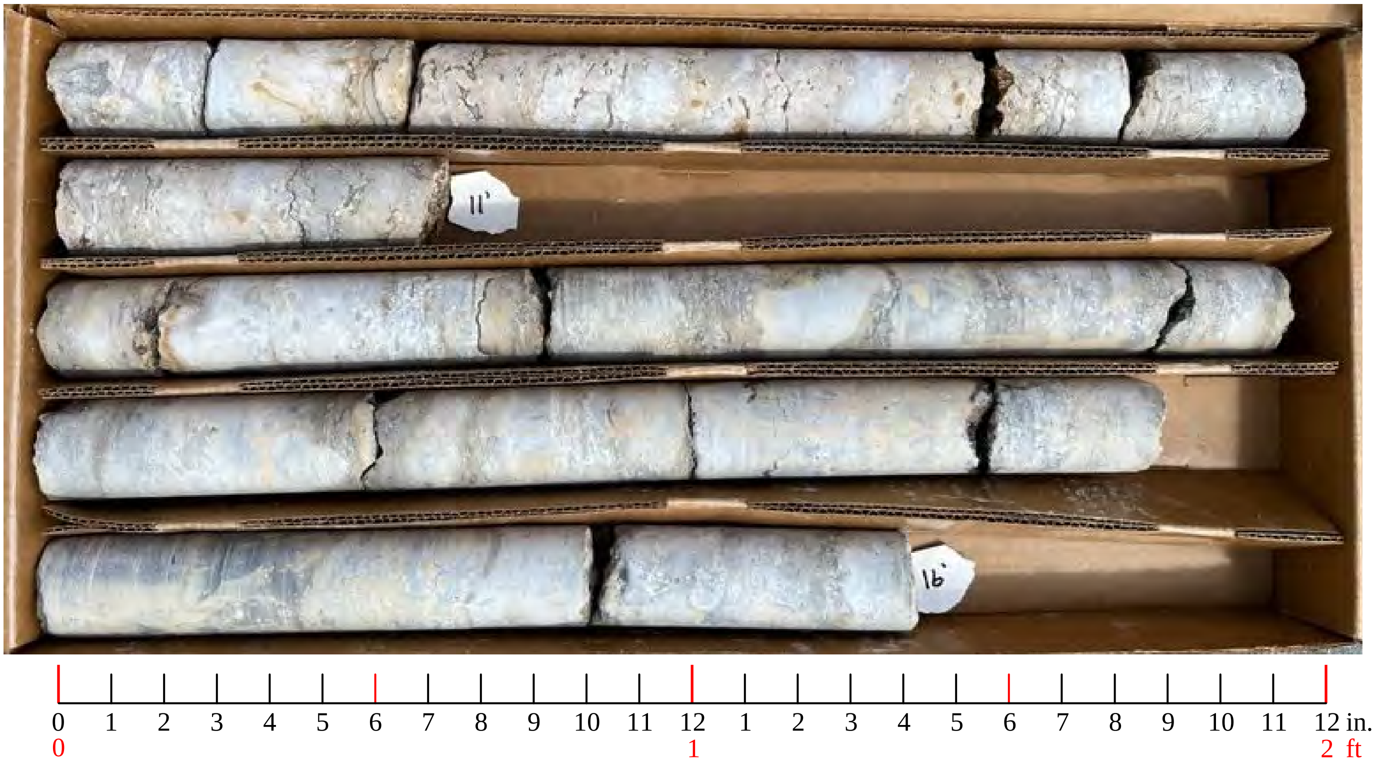
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S19: Run 1 (8-11 ft), Run 2 (11-16 ft)



B-S19: Run 3 (16-21ft), Run 4 (21-26 ft)

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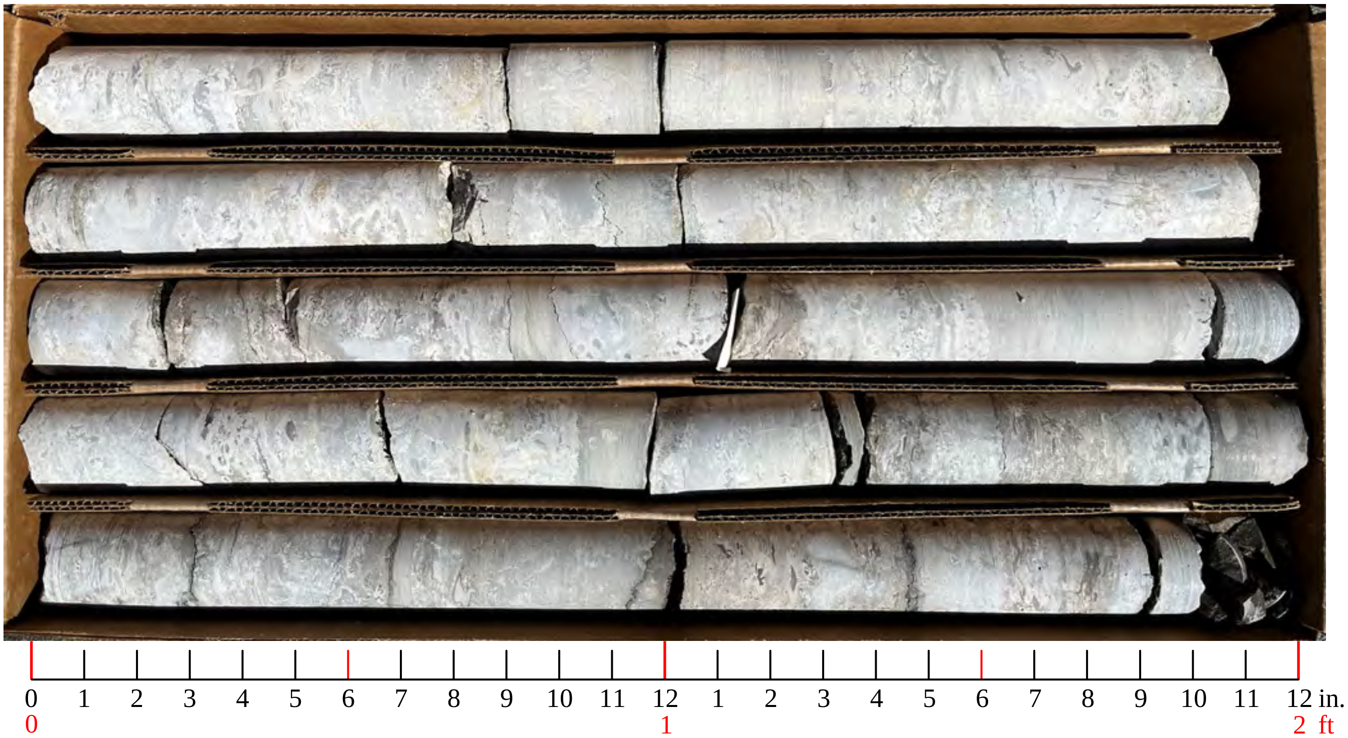
B-S19: Run 5 (26-31 ft), Run 6 (31-36 ft)

B-S19: Run 7 (36-41ft), Run 8 (41-46 ft)



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090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S19: Run 9 (46-48 ft

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<u>ROCK CORE PHOTOS</u>
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S20: Run 1 (16-21 ft), Run 2 (21-26 ft)

B-S20: Run 3 (26-31ft), Run 4 (31-36 ft)

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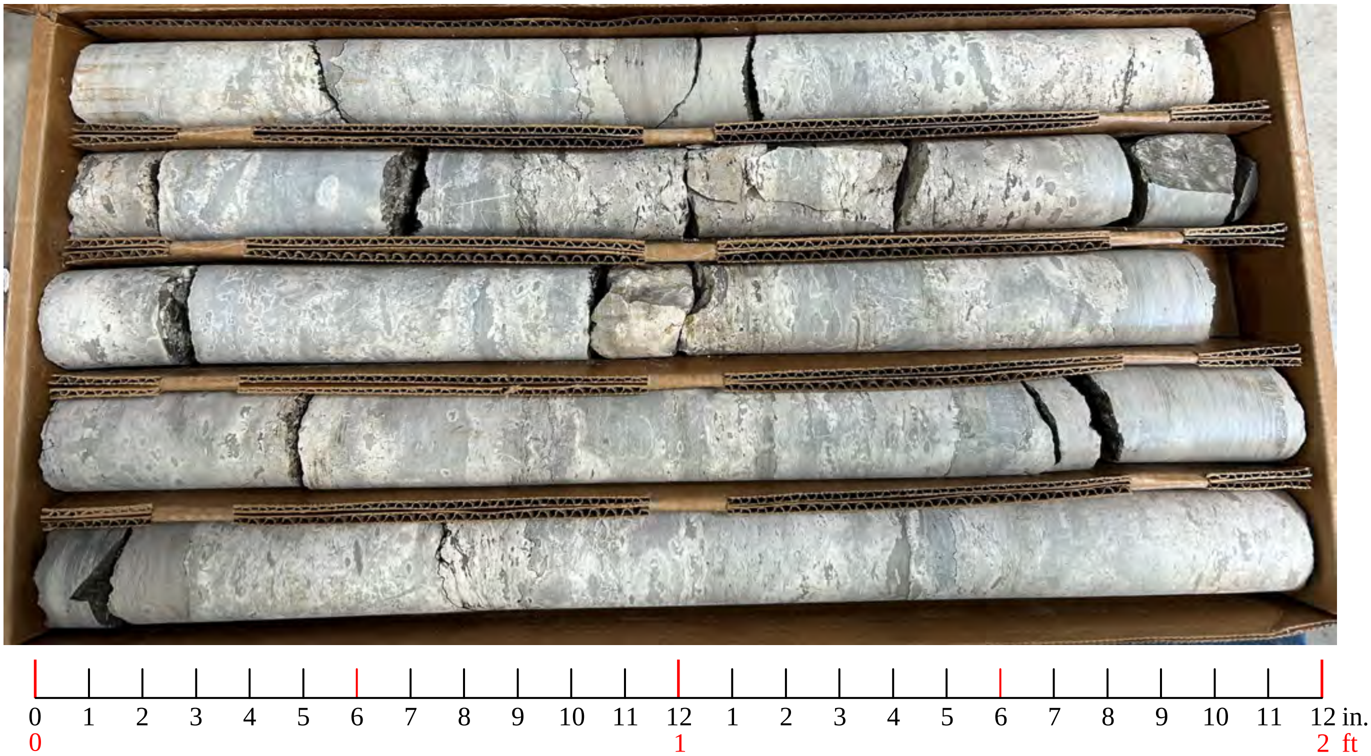
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S20: Run 7 (36-41 ft), Run 8 (41-46 ft)



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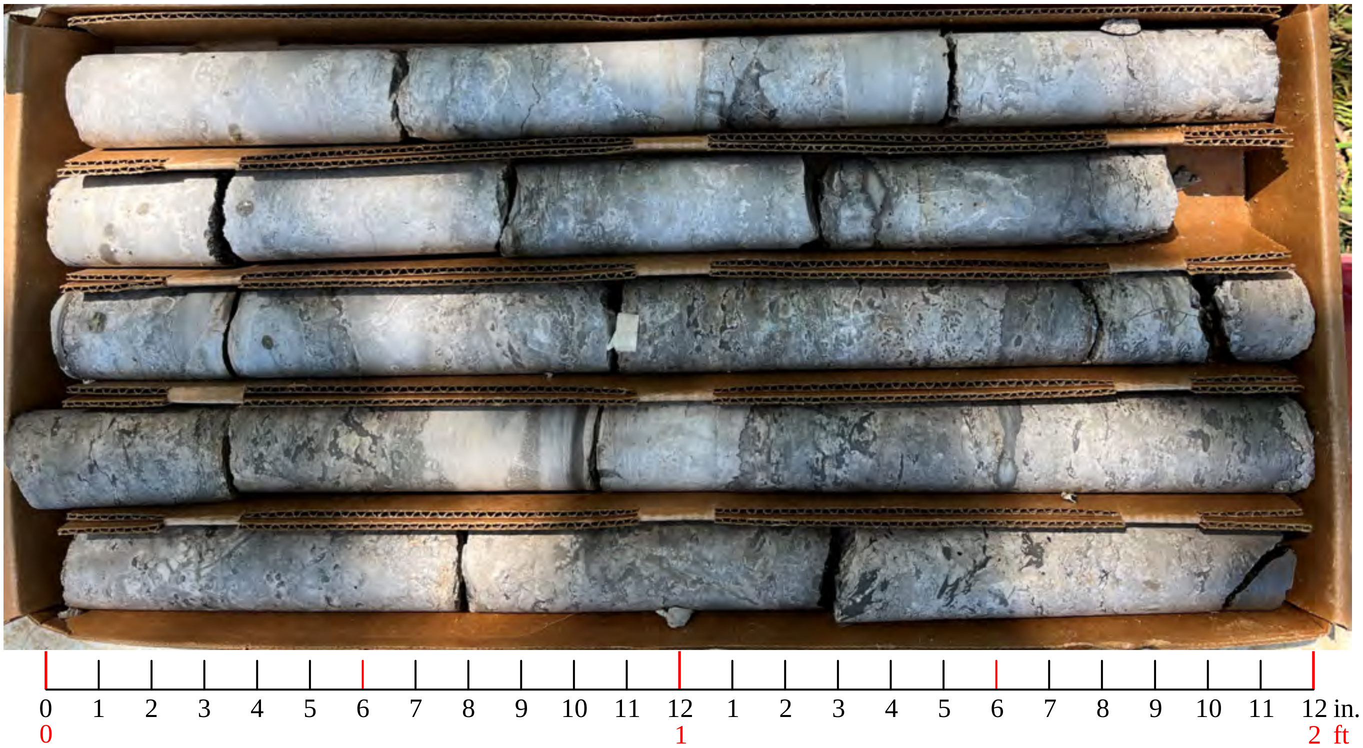
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S21: Run 1 (12-15 ft), Run 2 (15-20 ft)

B-21: Run 3 (20-25 ft), Run 4 (25-30 ft)



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ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S21: Run 5 (30-35 ft), Run 6 (35-40 ft)

B-21: Run 7 (40-45 ft), Run 8 (45-50 ft)

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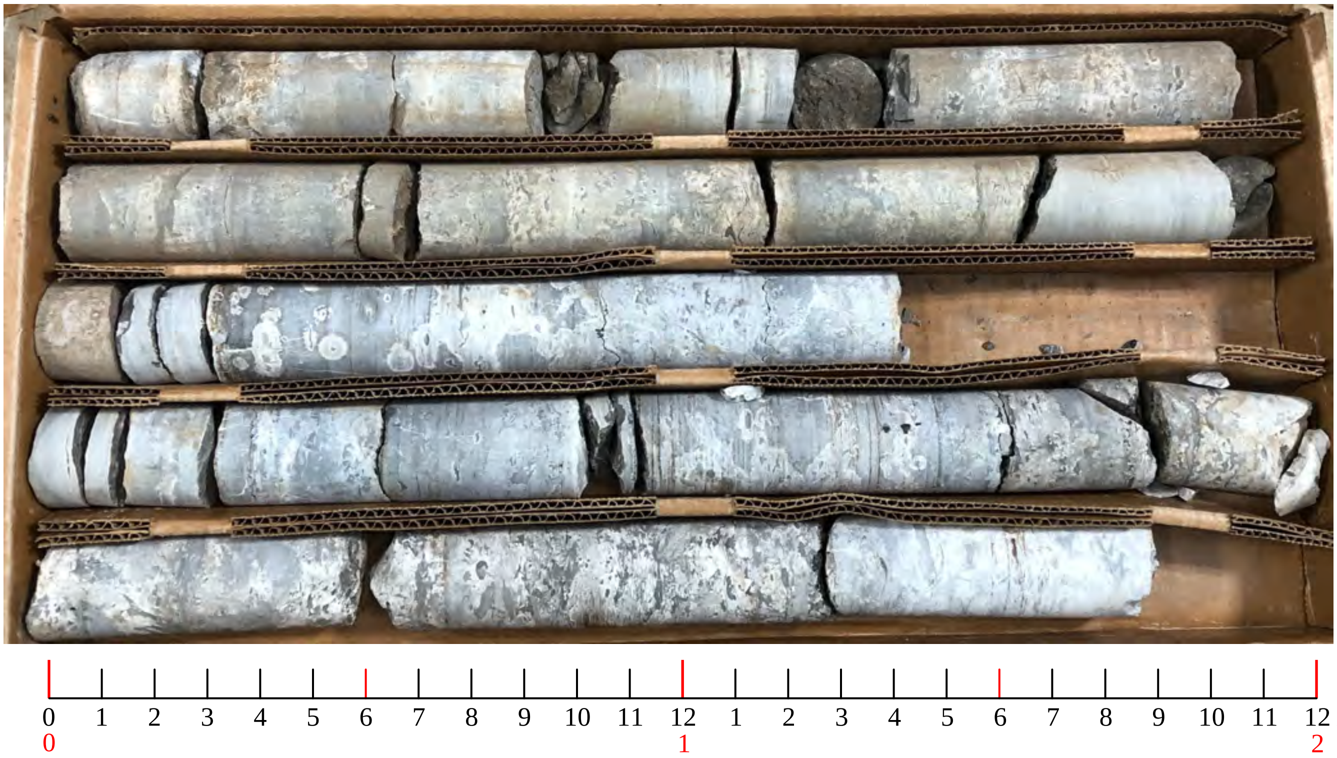
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S22: Run 1 (10-15 ft), Run 2 (15-20 ft)



B-S22: Run 3 (20-25 ft), Run 4 (25-30 ft)

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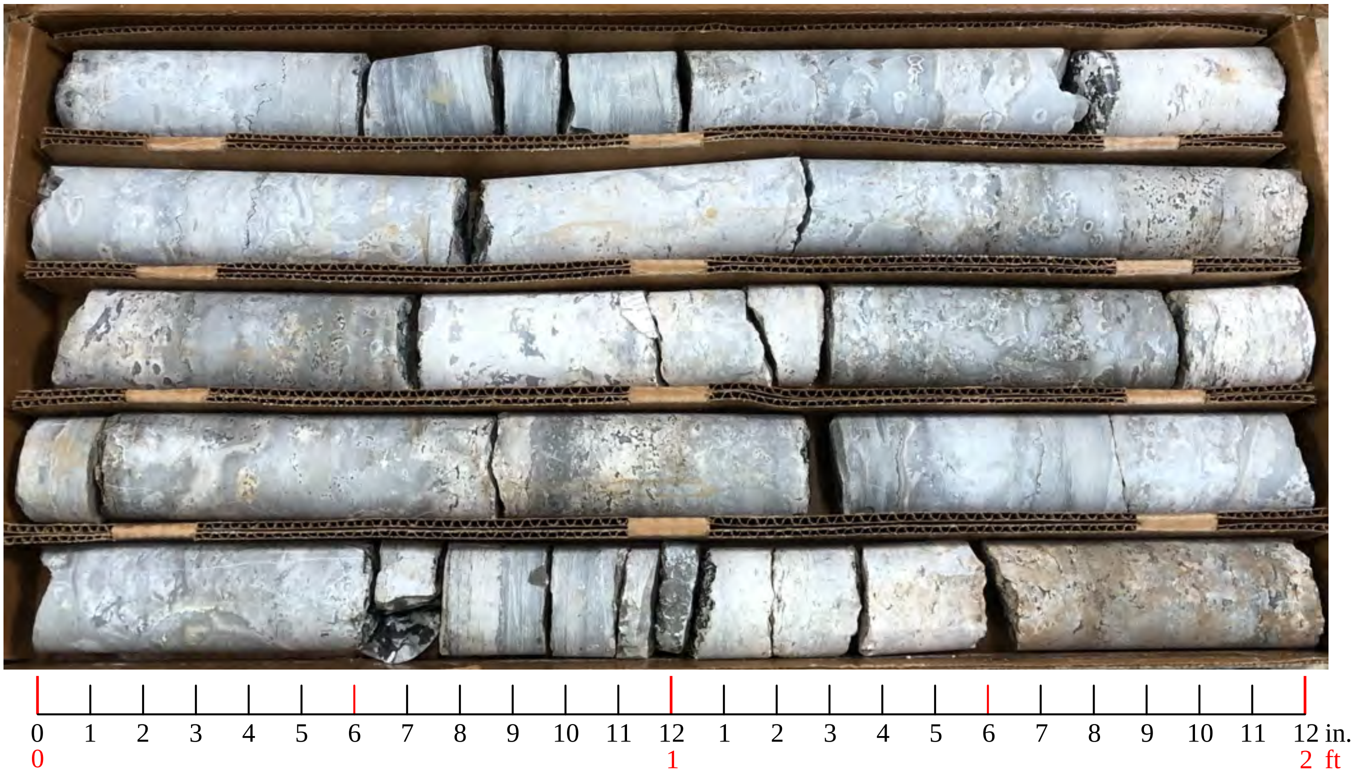
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

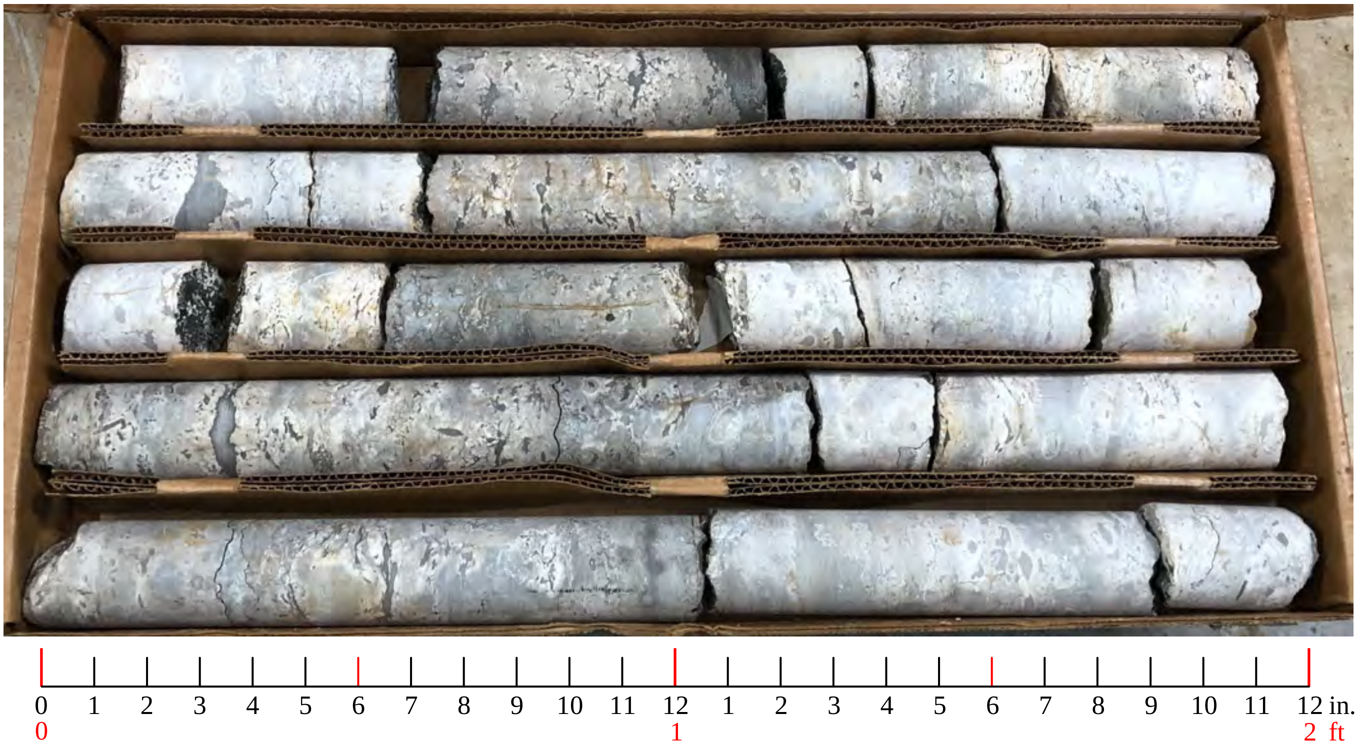
Job No. 19-118

Plate

B-S22: Run 5 (30-35 ft), Run 6 (35-40 ft)



B-S22: Run 7 (40-45 ft), Run 8 (45-50 ft)



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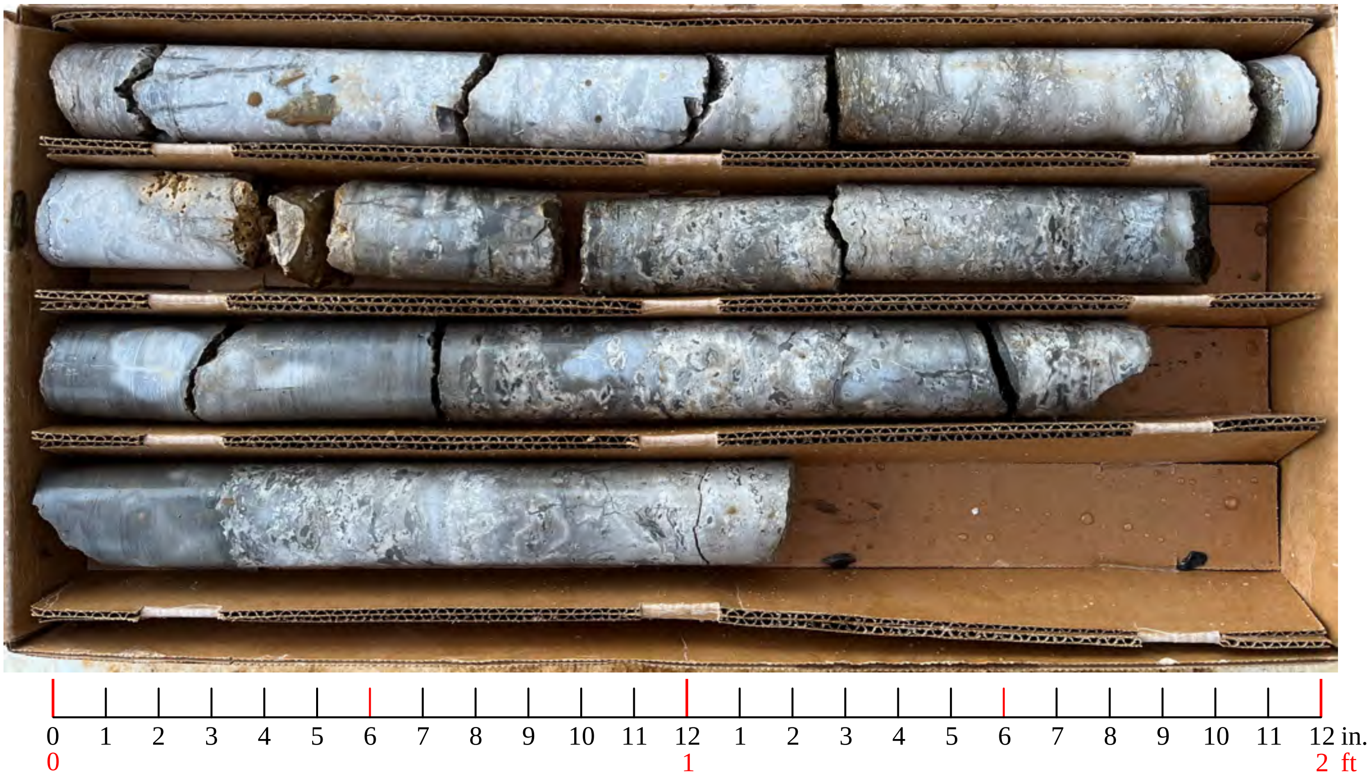
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

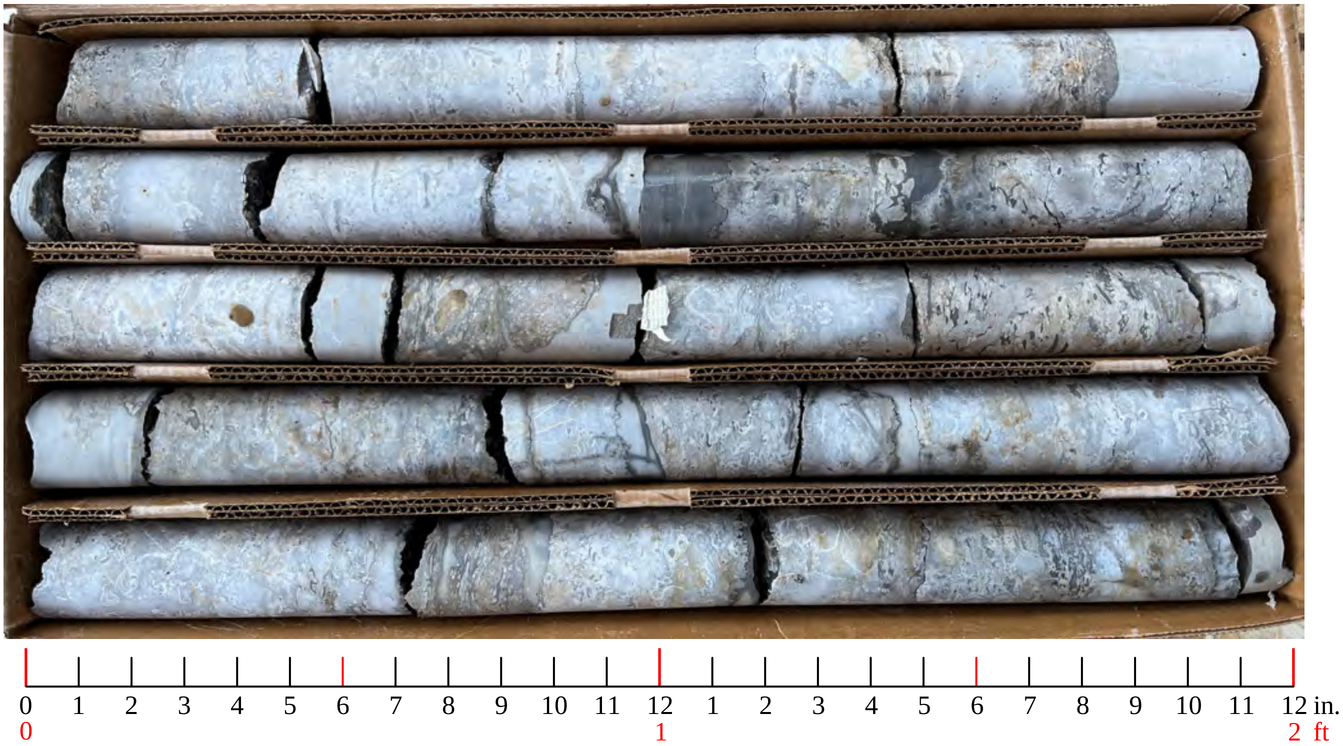
Job No. 19-118

Plate

B-S23: Run 1 (8-10 ft), Run 2 (10-15 ft)



B-S23: Run 3 (15-20 ft), Run 4 (20-25ft)



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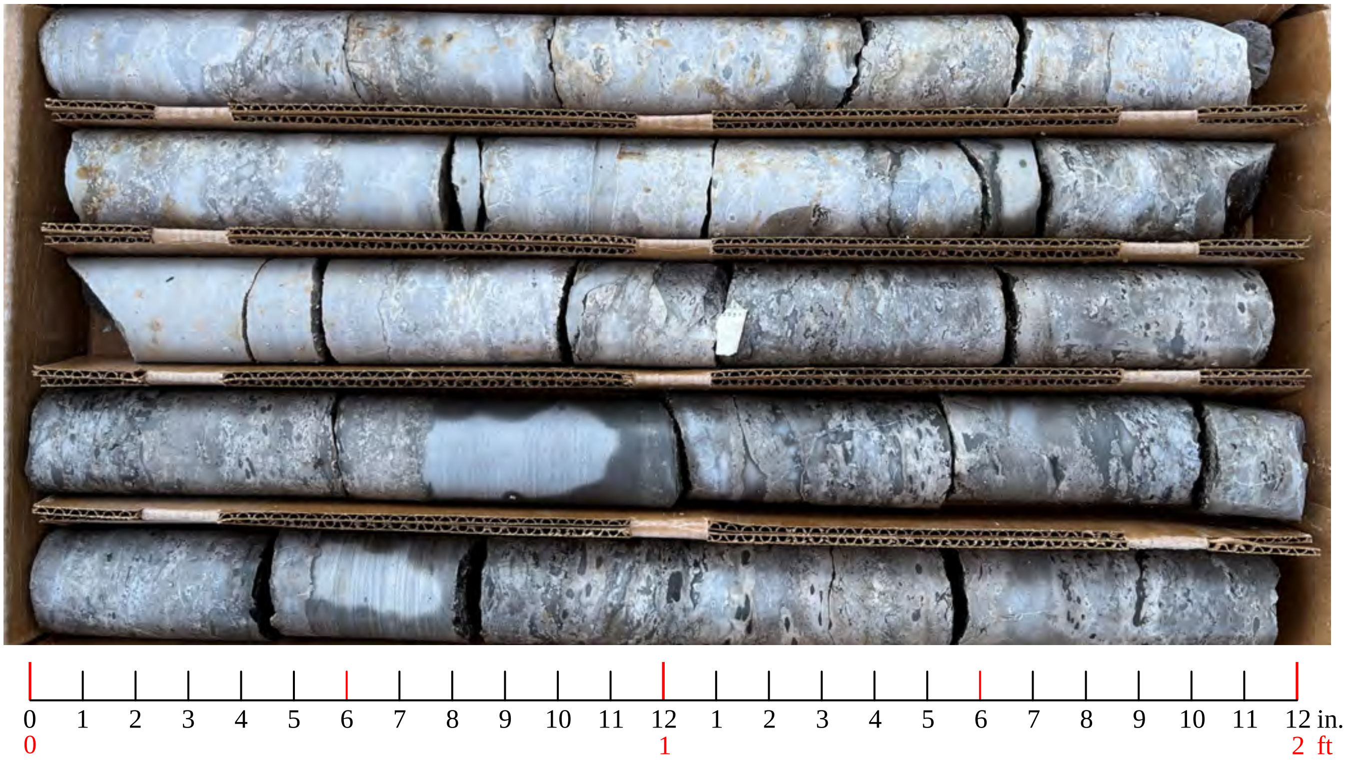
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

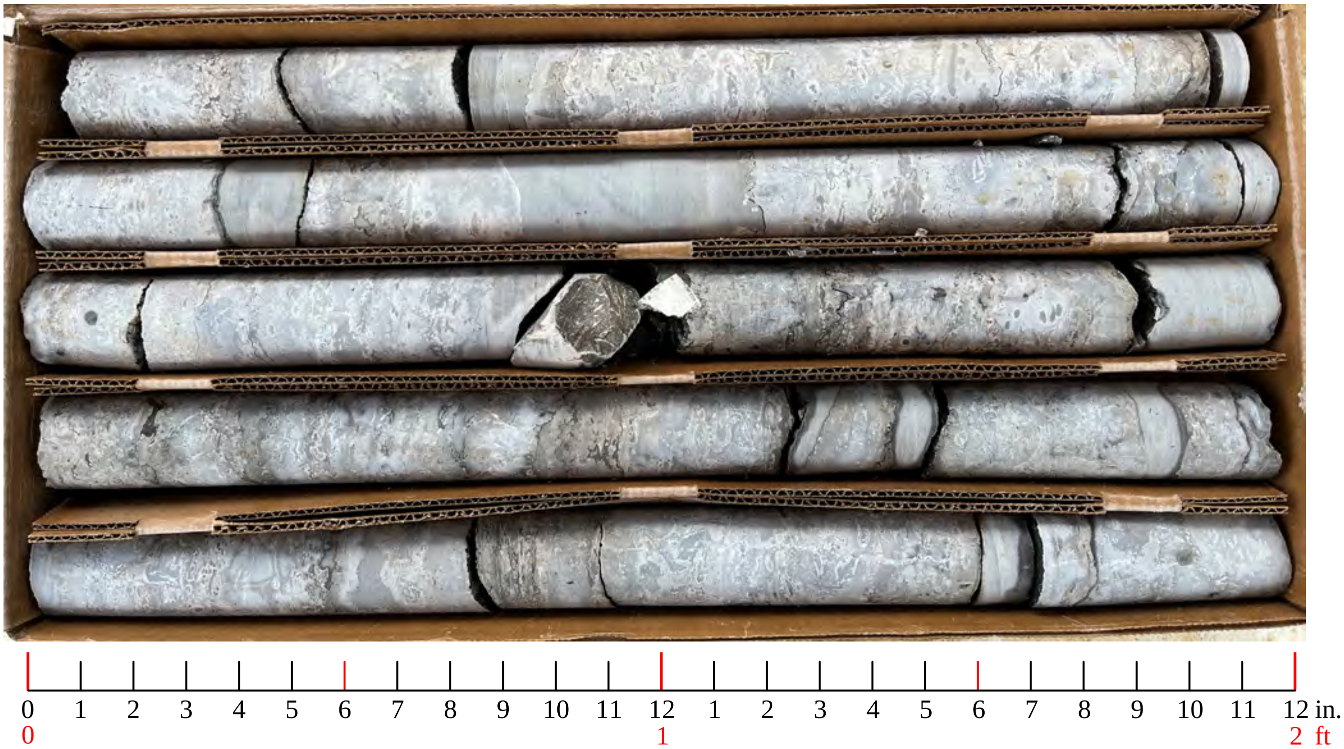
Job No. 19-118

Plate

B-S23: Run 5 (25-30 ft), Run 6 (30-35 ft)



B-S23: Run 7 (35-40 ft), Run 8 (40-45 ft)



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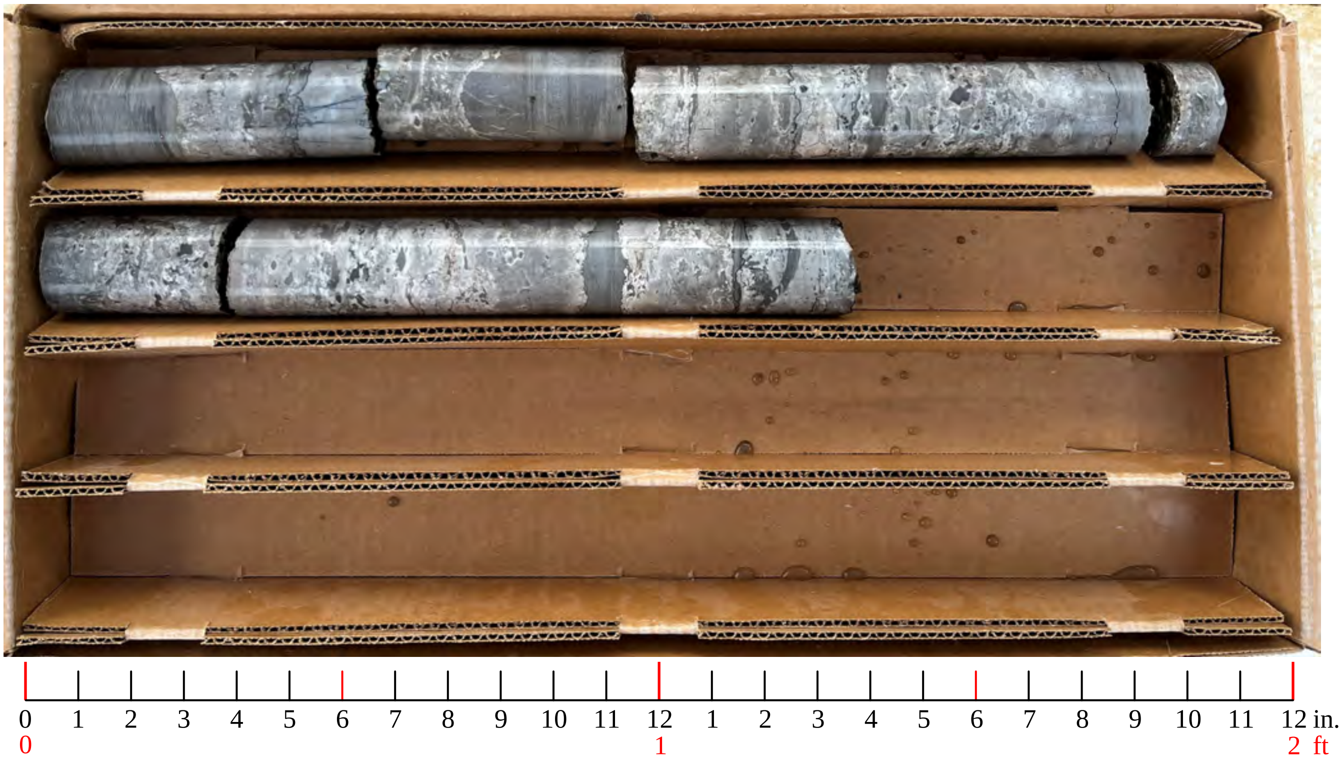
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S23: Run 9 (45-48 ft)



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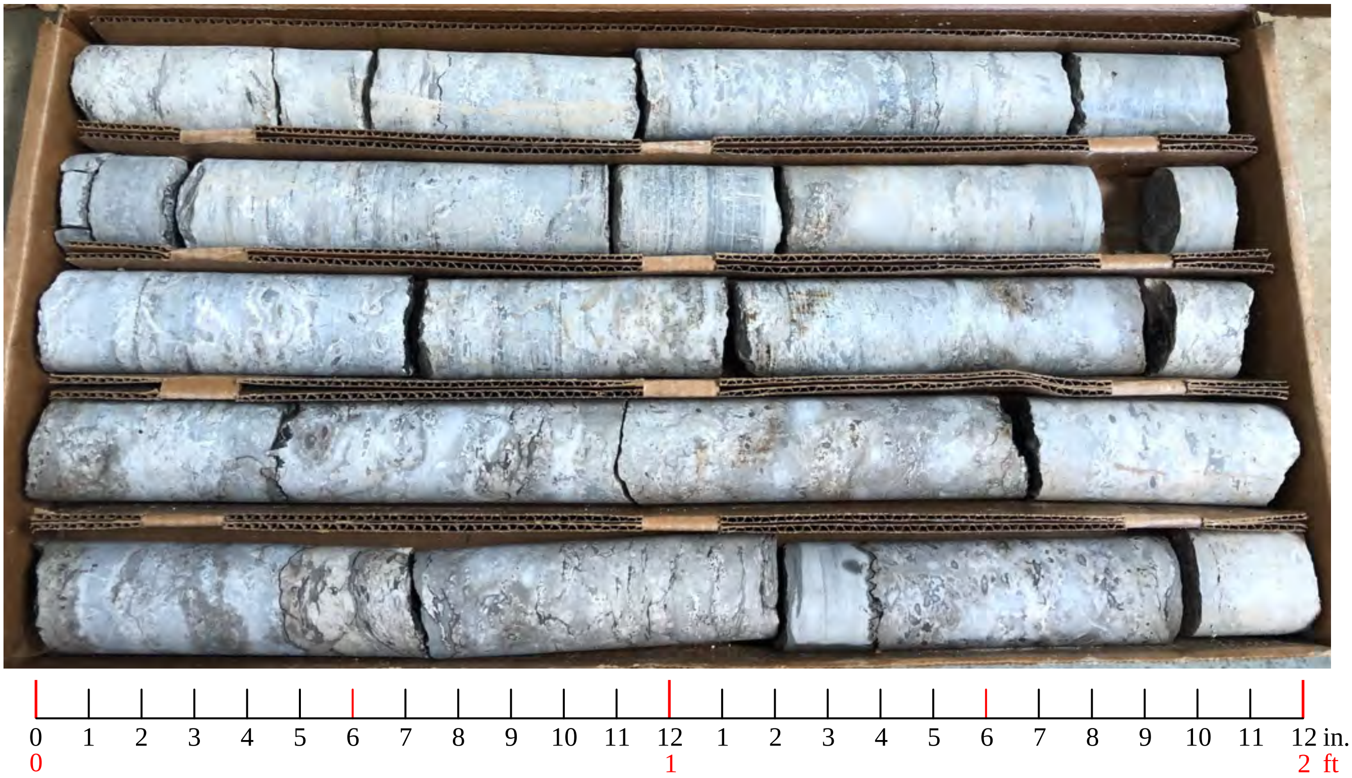
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118	
Plate	

B-S24: Run 1 (10-15 ft), Run 2 (15-20 ft)



B-S24: Run 3 (20-25 ft), Run 4 (25-30 ft)

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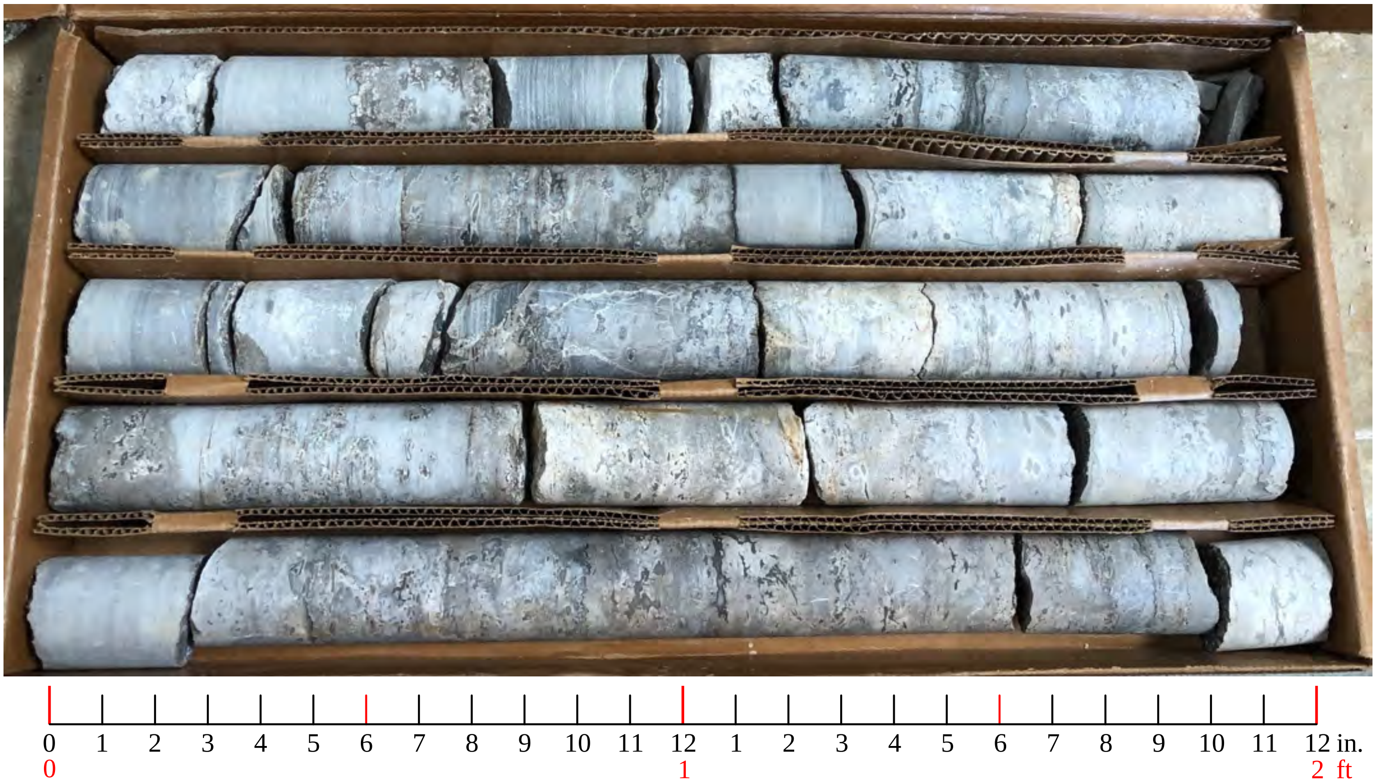
090069 XNA Access Road
Benton County, Arkansas

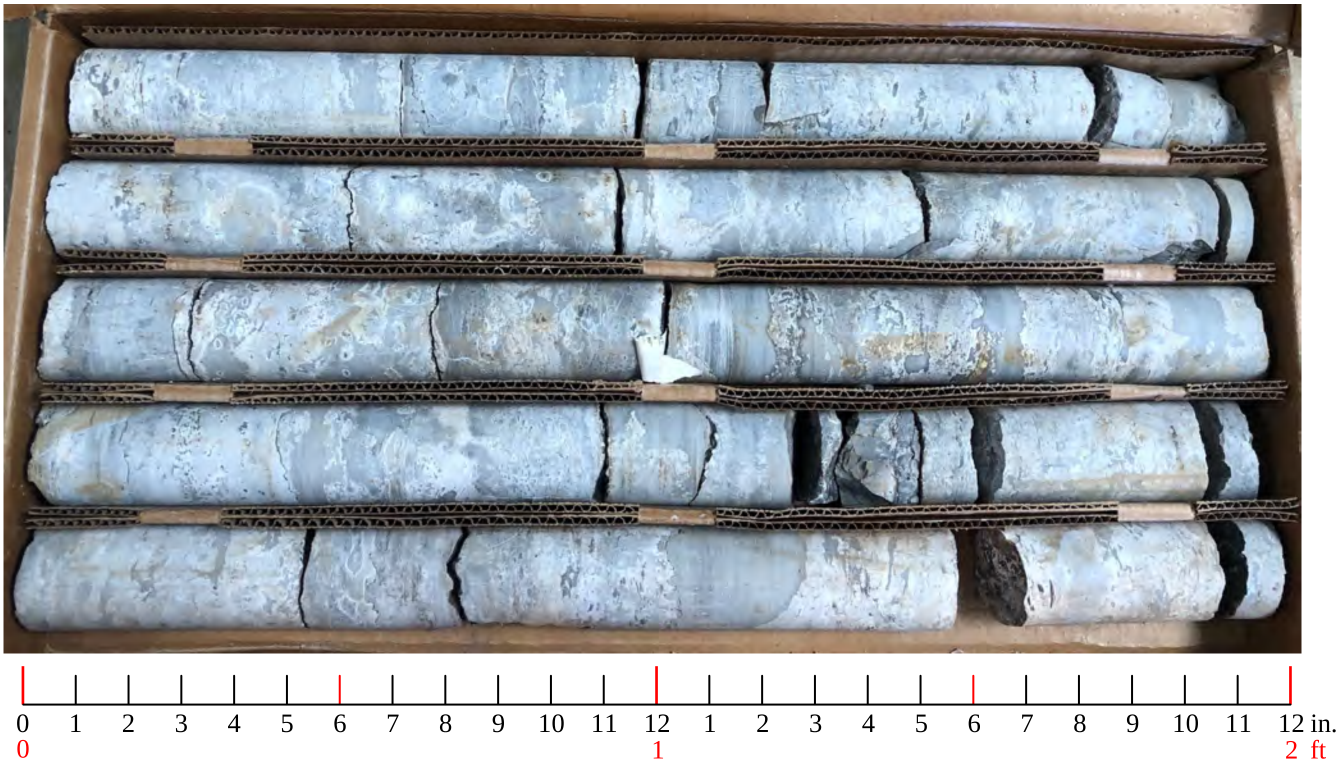
Job No. 19-118

Plate

B-S24: Run 5 (30-35 ft), Run 6 (35-40 ft)

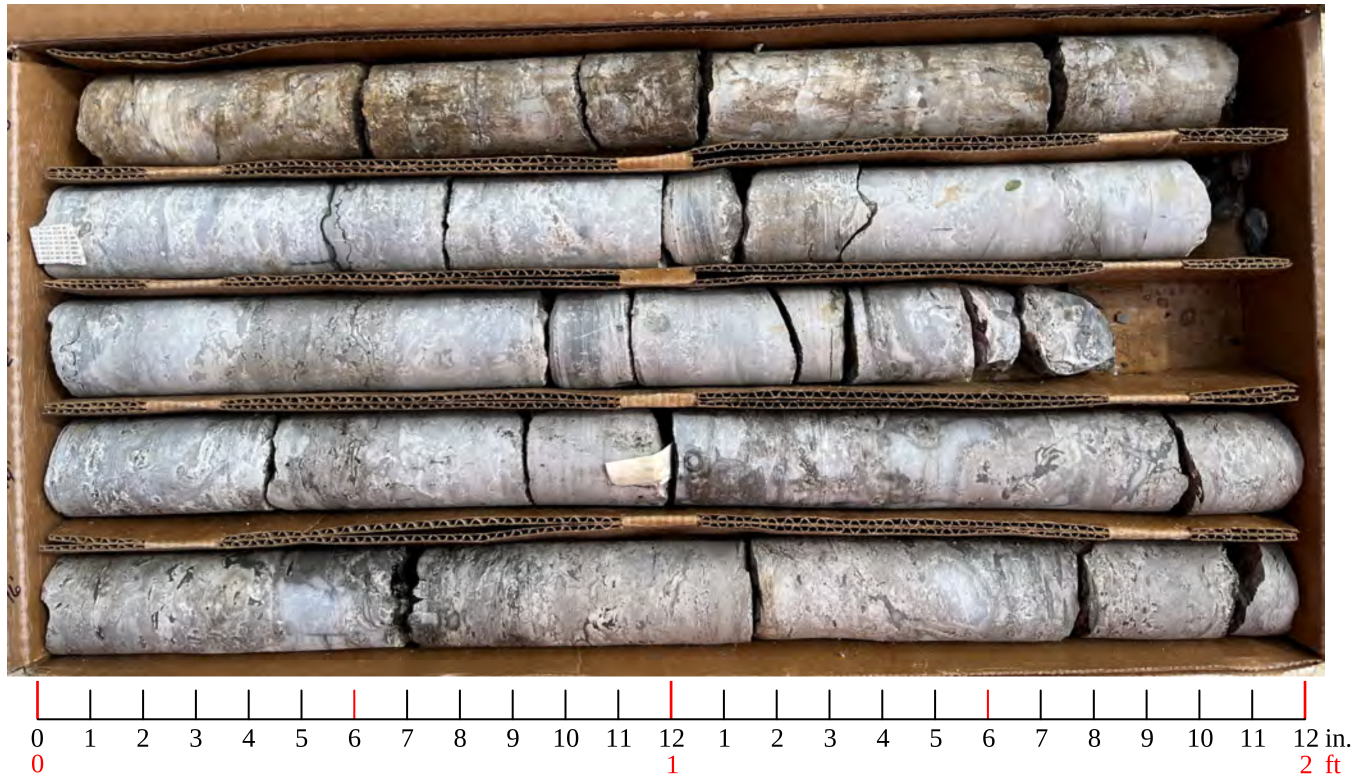


B-S24: Run 7 (40-45 ft), Run 8 (45-50 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **090069 XNA Access Road** **Benton County, Arkansas**	**Job No. 19-118** **Plate**

B-S25B: Run 1 (8-10 ft), Run 2 (10-15 ft), Run 3 (15-18 ft)



B-S25B: Run 4 (18-20 ft), Run 5 (20-25 ft), Run 6 (25-28 ft)

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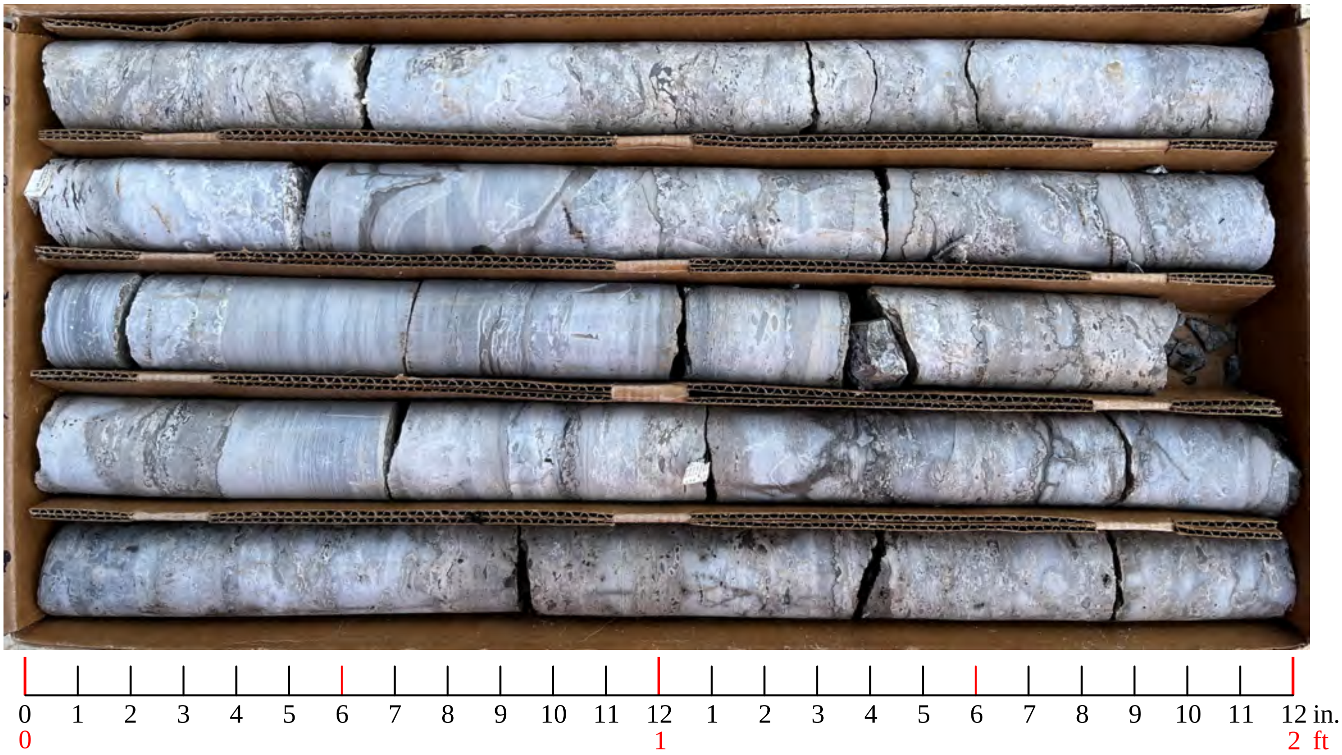
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

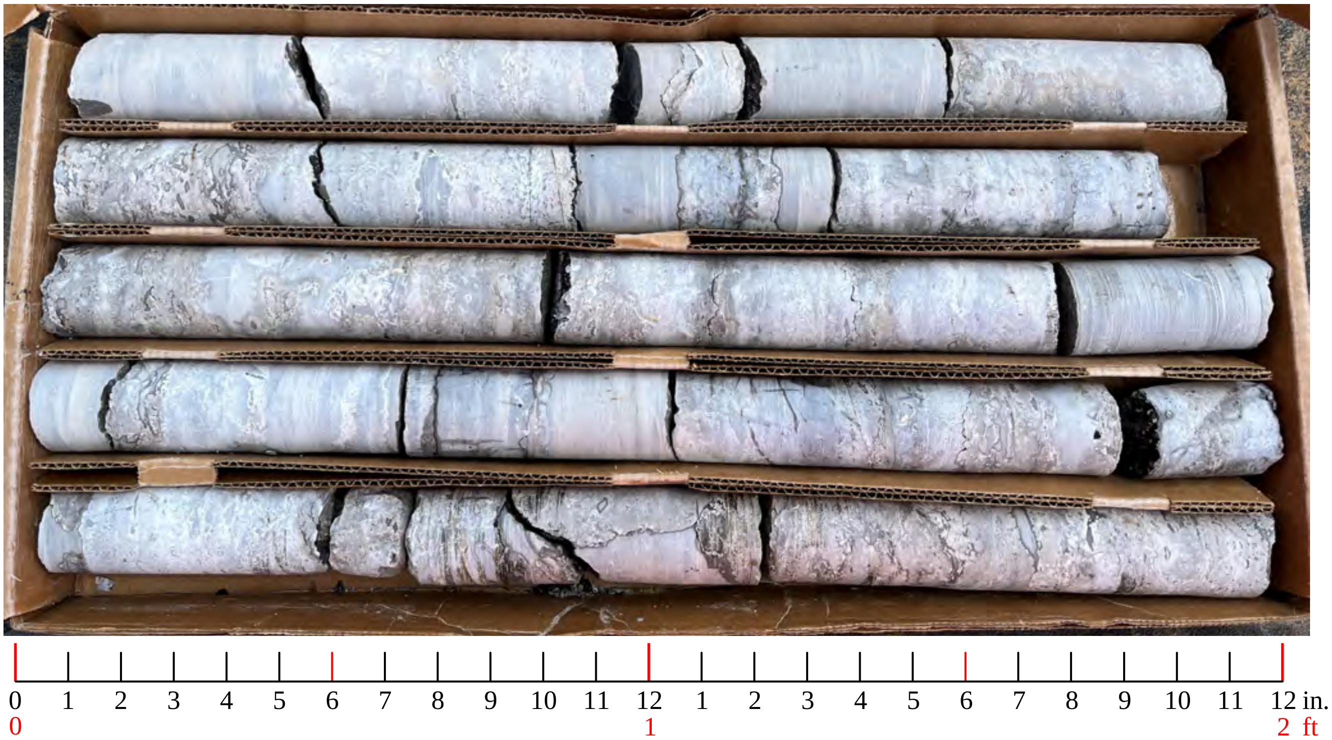
Job No. 19-118

Plate

B-S25B: Run 7 (28-30 ft), Run 8 (30-35 ft), Run 9 (35-38 ft)



B-S25B: Run 10 (38-40 ft), Run 11 (40-45 ft), Run 12 (45-48 ft)



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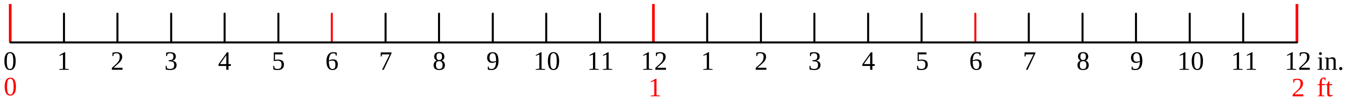
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-R12: Run 1 (20-25 ft), Run 2 (25-30 ft)



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ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

APPENDIX C

SUMMARY of CLASSIFICATION TEST RESULTS

PROJECT: 090069 XNA Access Road
LOCATION: Benton County, Arkansas
GHBW JOB NUMBER: 19-118

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING								USCS CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
R12	2.5-3.5	17.3	30	20	10	---	---	---	---	82	---	---	49	SC	A-4
S9	6.5-7.5	16	34	17	17	---	---	---	---	71	---	---	27	SC	A-2-6
S9	14-15	26	40	21	19	---	---	---	---	98	---	---	86	CL	A-6
S10	4.5-5.5	18	35	23	12	100	100	100	100	87	74	64	55	CL	A-6
S13	2.5-3.5	21	26	22	4	---	---	---	---	100	---	---	82	CL-ML	A-4
S15	1.5-4.5	11	---NON-PLASTIC---			---	---	---	---	79	---	---	18	SM	A-2-4
S16	4.5-5.5	13				100	61	55	46	31	18	10	5	GW-GM	A-1-b
S18	9-10	23	---	---	---	100	100	100	87	83	78	62	53	ML	A-4

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Barton & Wyatt, LLC
CONSULTING ENGINEERS

PLATE

SUMMARY of CLASSIFICATION TEST RESULTS

PROJECT: 090069 XNA Access Road
LOCATION: Benton County, Arkansas
GHBW JOB NUMBER: 19-118

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING								USCS CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
S19	2.5-3.5	15	---	---	---	---	---	---	---	83	---	---	61	CL	A-6
S19	4.5-5.5	17	---	---	---	---	---	---	---	56	---	---	25	SM	A-2-4
S22	4.5-5.5		---	---	---	100	89	77	43	32	21	11	6	GP-GM	A-1-b
S24	4.5-5.5	15	---	---	---	100	78	64	40	22	13	7	4	GW	A-1-a
S25	2.5-3.5	13	---	---	---	100	86	71	53	40	27	15	7	GM-GP	A-1-a
S25	4.5-5.5	16	---NON-PLASTIC---			---	---	---	---	78	---	---	14	GM	A-1-b

19-118

GRAIN SIZE CURVE

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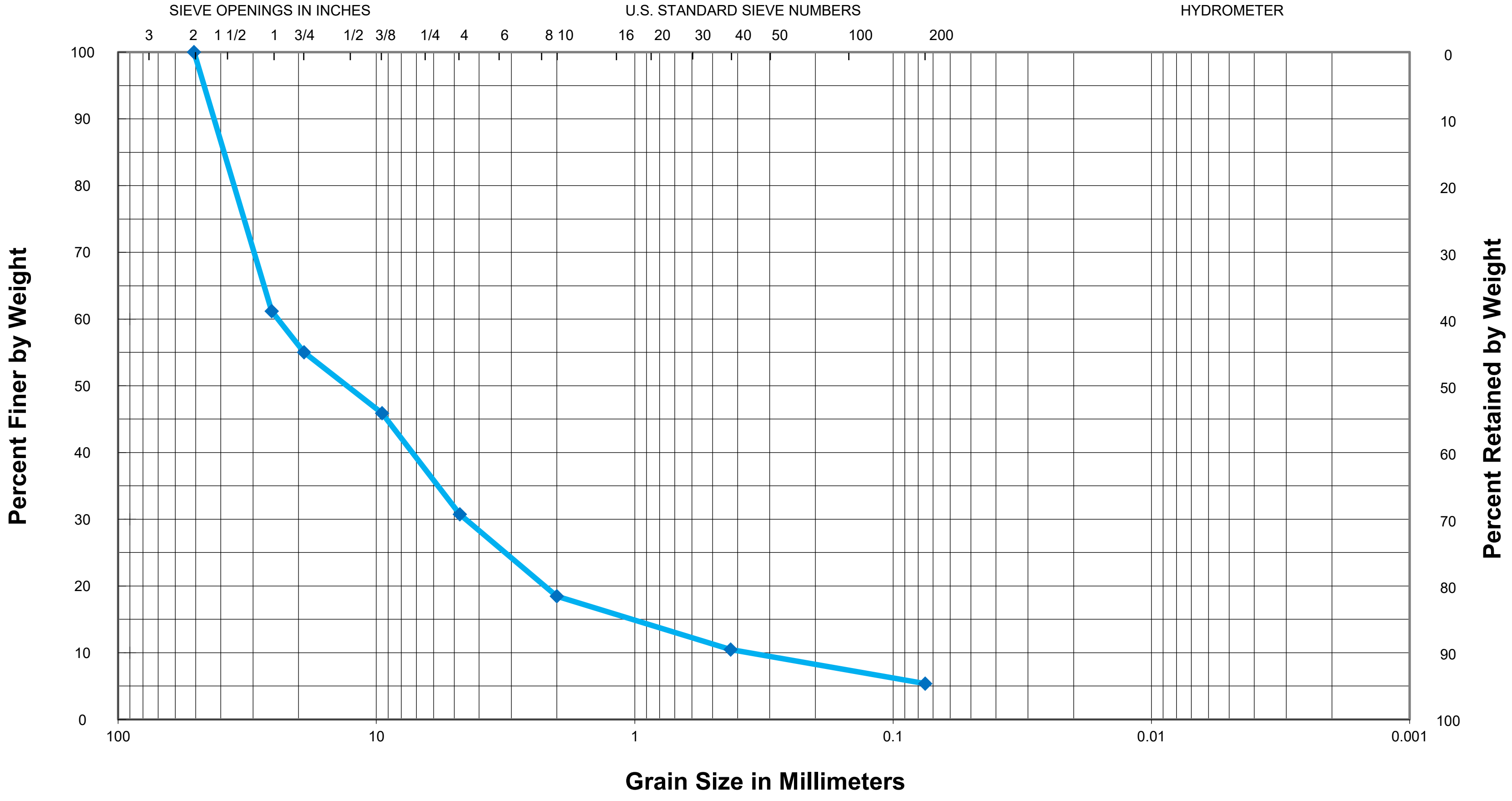
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

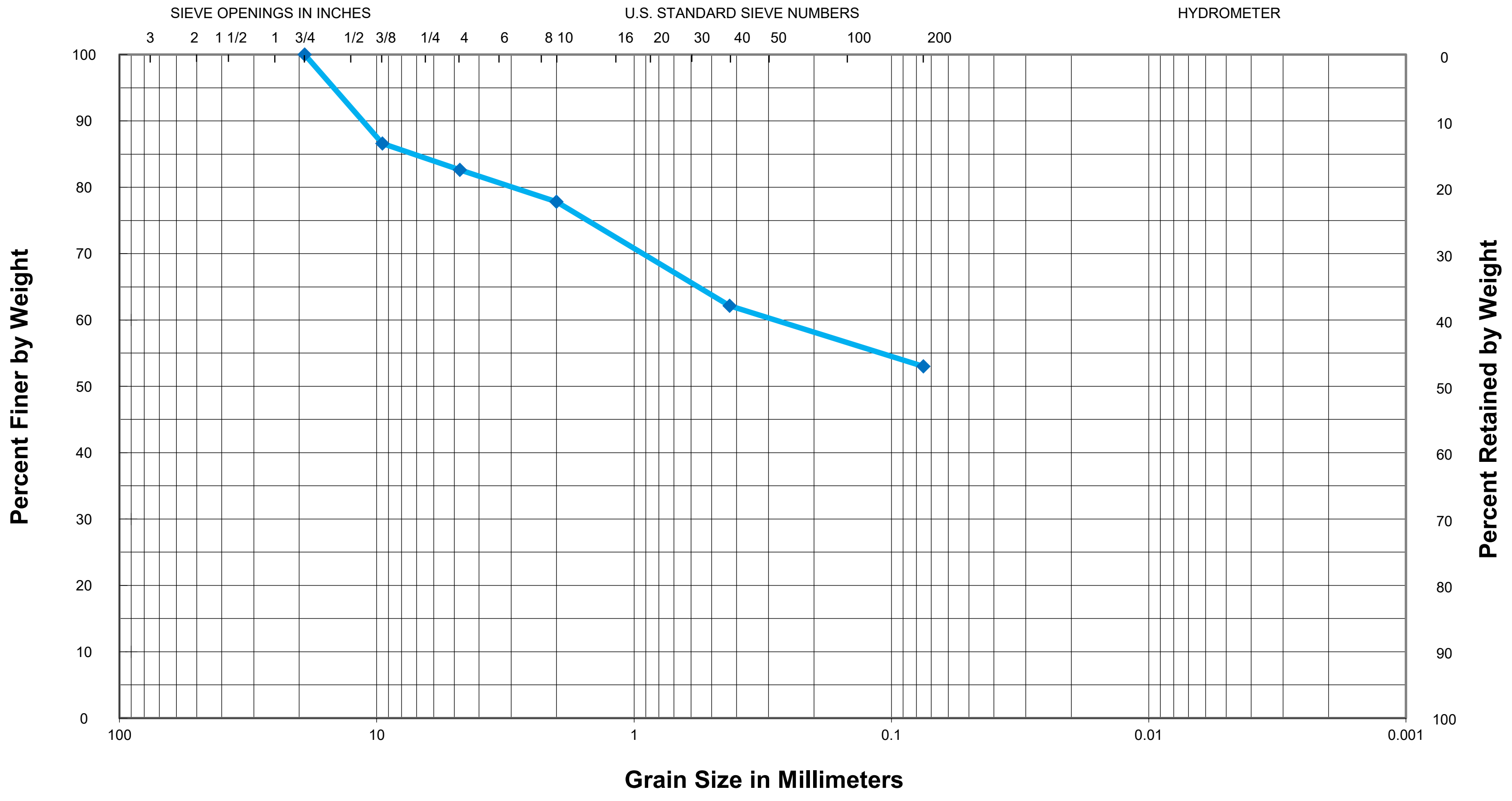
Sample: S16, 4.5-5.5 ft
Description: Loose tan cherty limestone cobbles with fine to coarse gravel, slightly sandy

USCS Classification = GW-GM
AASHTO Classification = A-1-b

19-118

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

Sample: S18, 9-10 ft
Description: Medium dense reddish tan SILT with numerous chert fragments

USCS Classification =
AASHTO Classification =

19-118

GRAIN SIZE CURVE

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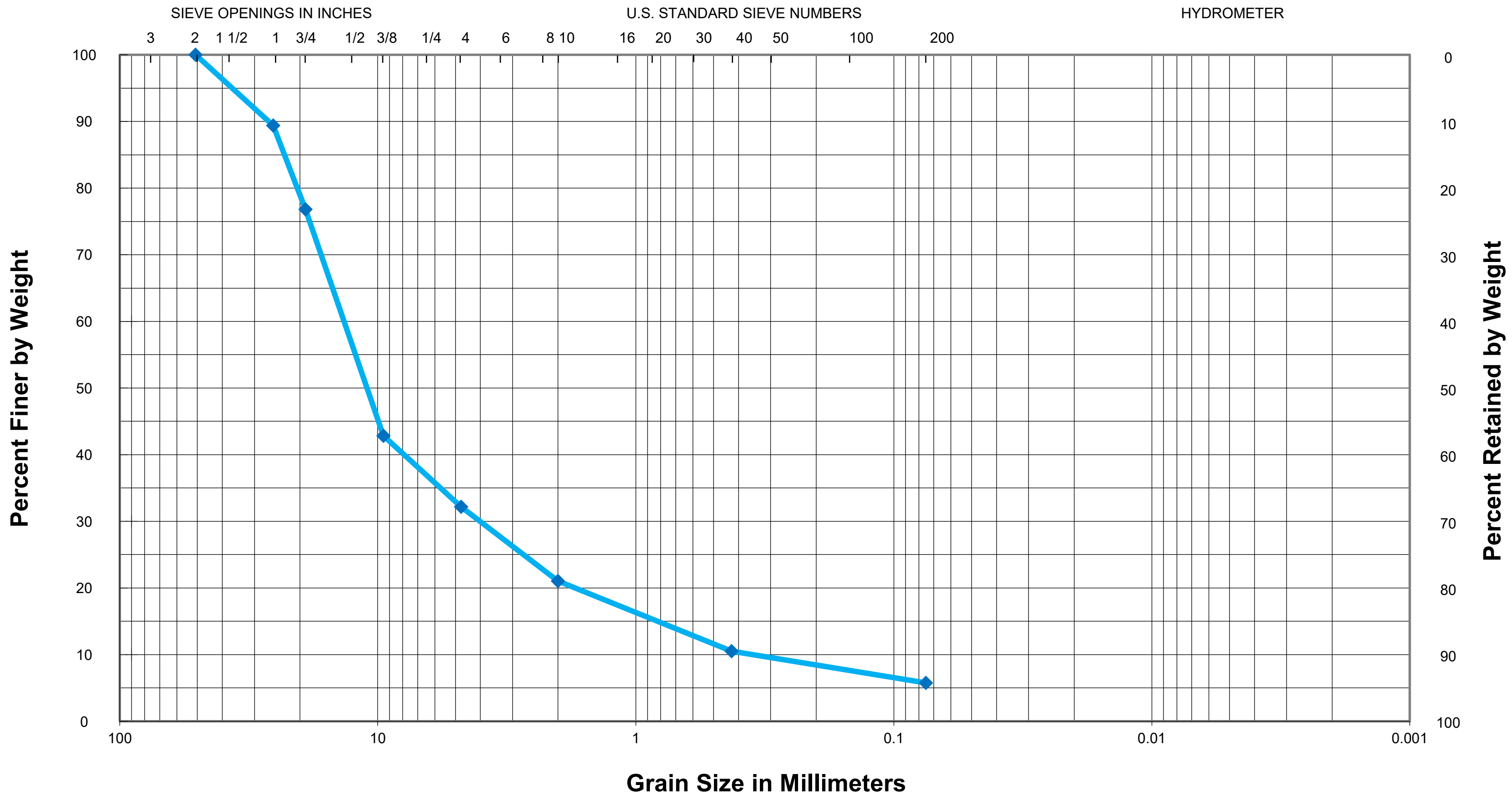
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

Sample: S22, 4.5-5.5 ft
Description: Very loose to loose brown tan sandy fine to coarse gravel, slightly silty with cobbles

USCS Classification = GP-GM
AASHTO Classification = A-1-b

19-118

GRAIN SIZE CURVE

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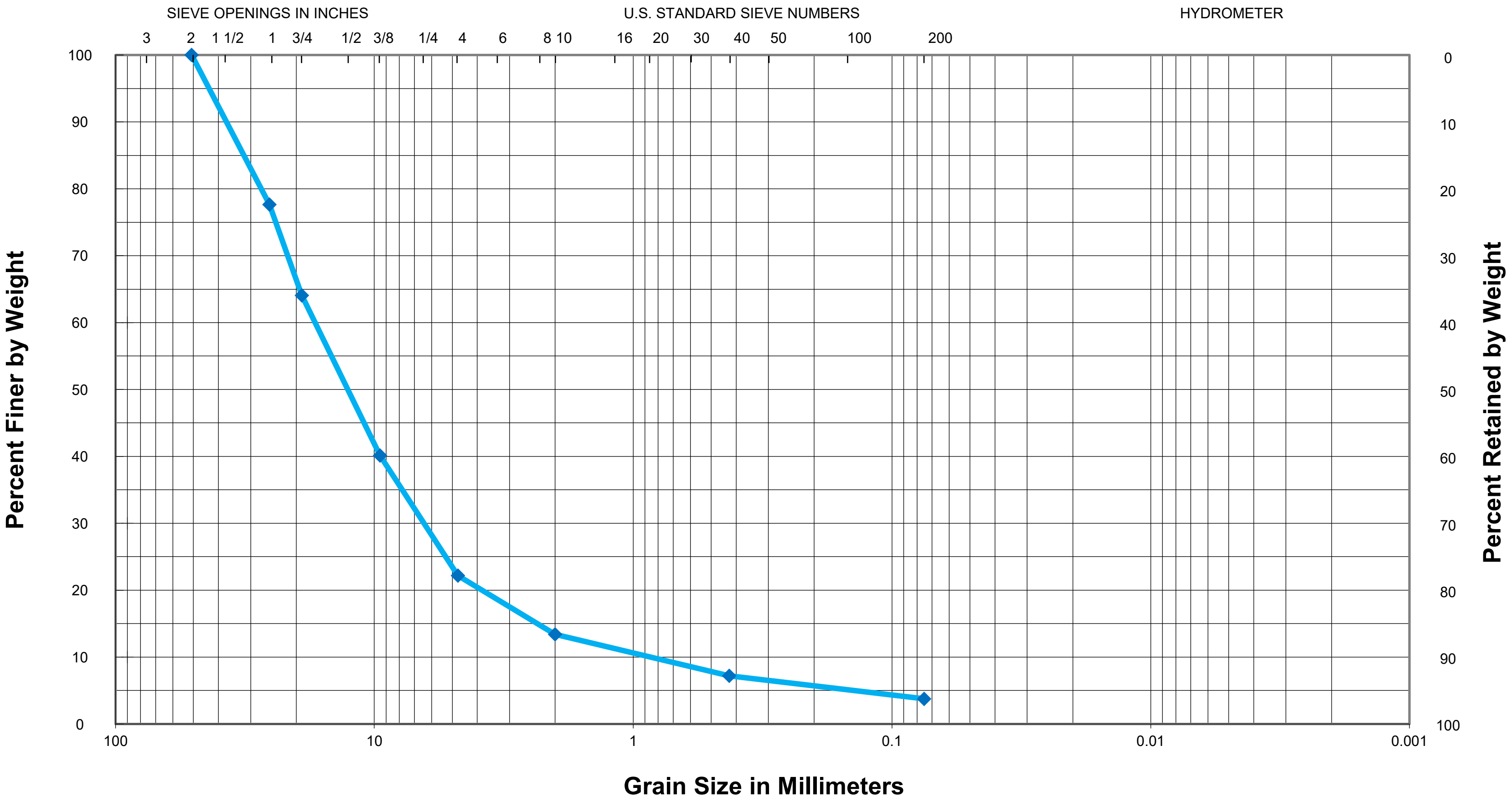
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

Sample: S24, 4.5-5.5 ft
Description: Loose tan fine to coarse gravel with cobbles, slightly sandy

USCS Classification = GW
AASHTO Classification = A-1-a

19-118

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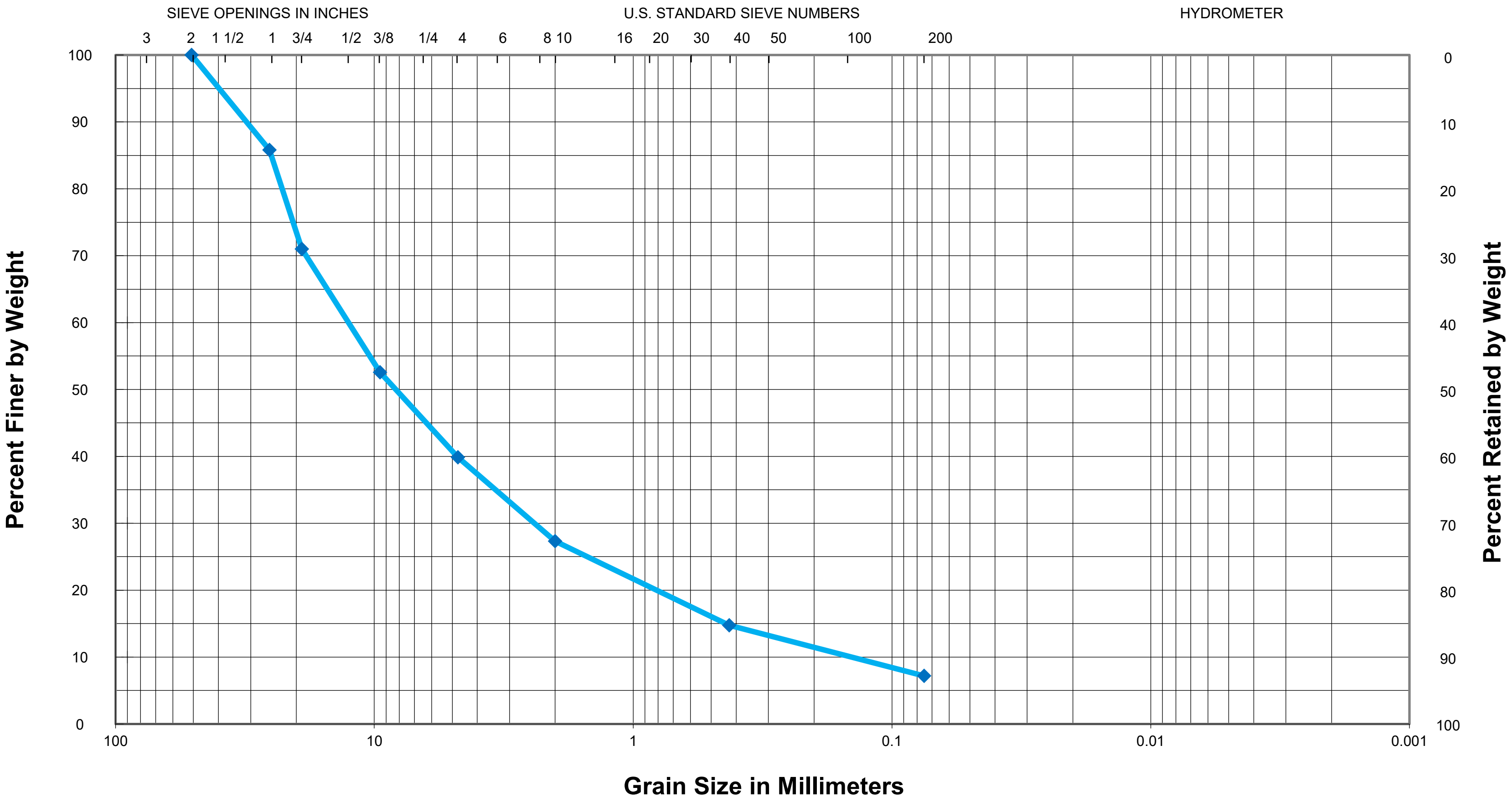
CONSULTING ENGINEERS
A UES Company

GRAIN SIZE CURVE

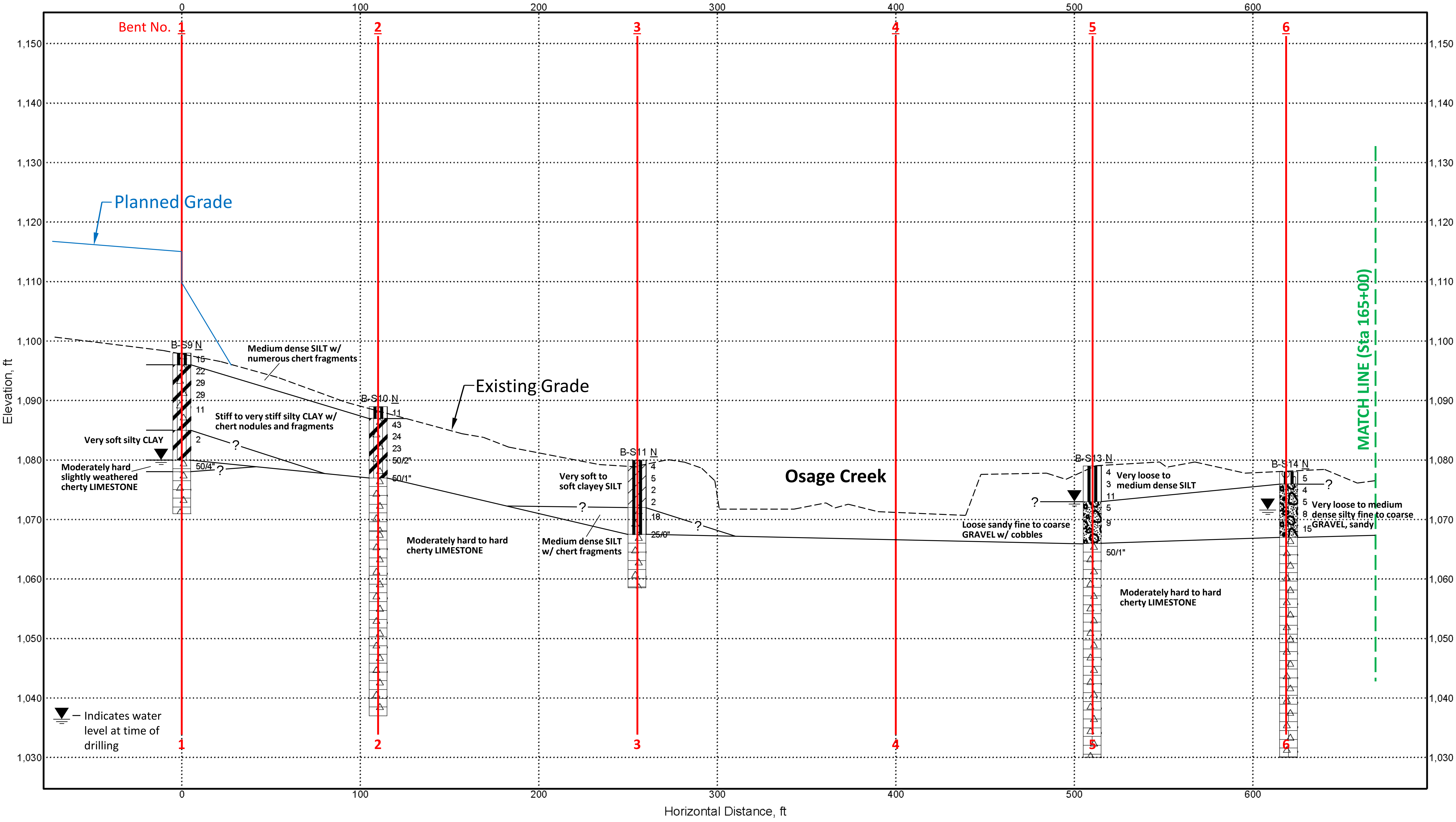


GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

Sample: Boring R25, 0.5-1.5 ft; LL=23, PL=20, PI=3
Description: Tan SILT, slightly clayey w/ numerous chert fragments

USCS Classification = SM
AASHTO Classification = A-2-4

APPENDIX D

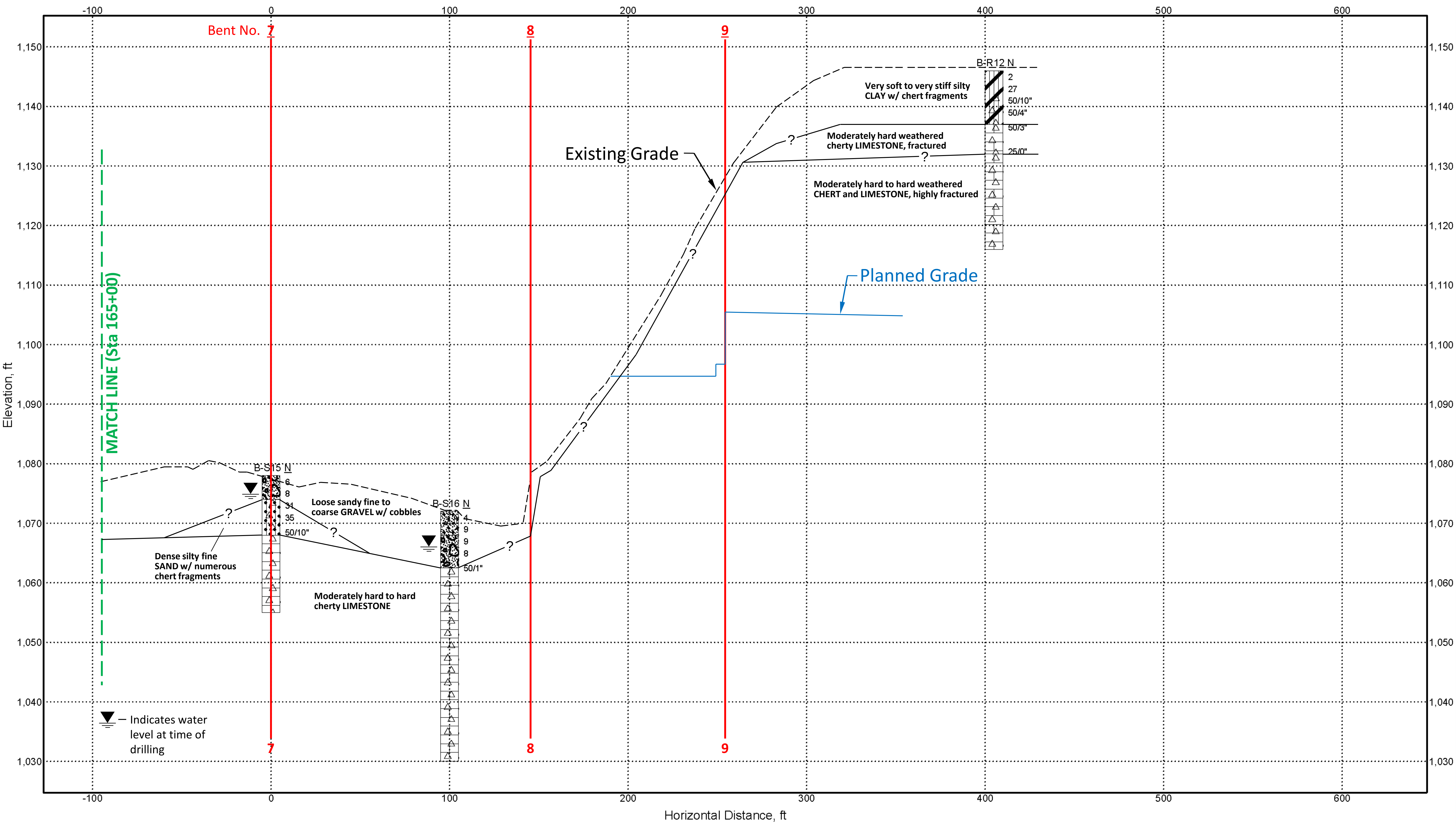


Grubbs, Hoskyn, Barton & Wyatt, LLC

NOTES:
1. Subsurface conditions have been inferred between discrete boring locations. Actual conditions may vary.
2. Ground surface approximate.

SCALE:
1" = 50' Horizontal
1" = 15' Vertical

Generalized Subsurface Profile - Bridge A
090069 XNA Access Road over Osage Creek
Benton County, Arkansas
Project Number: 19-118



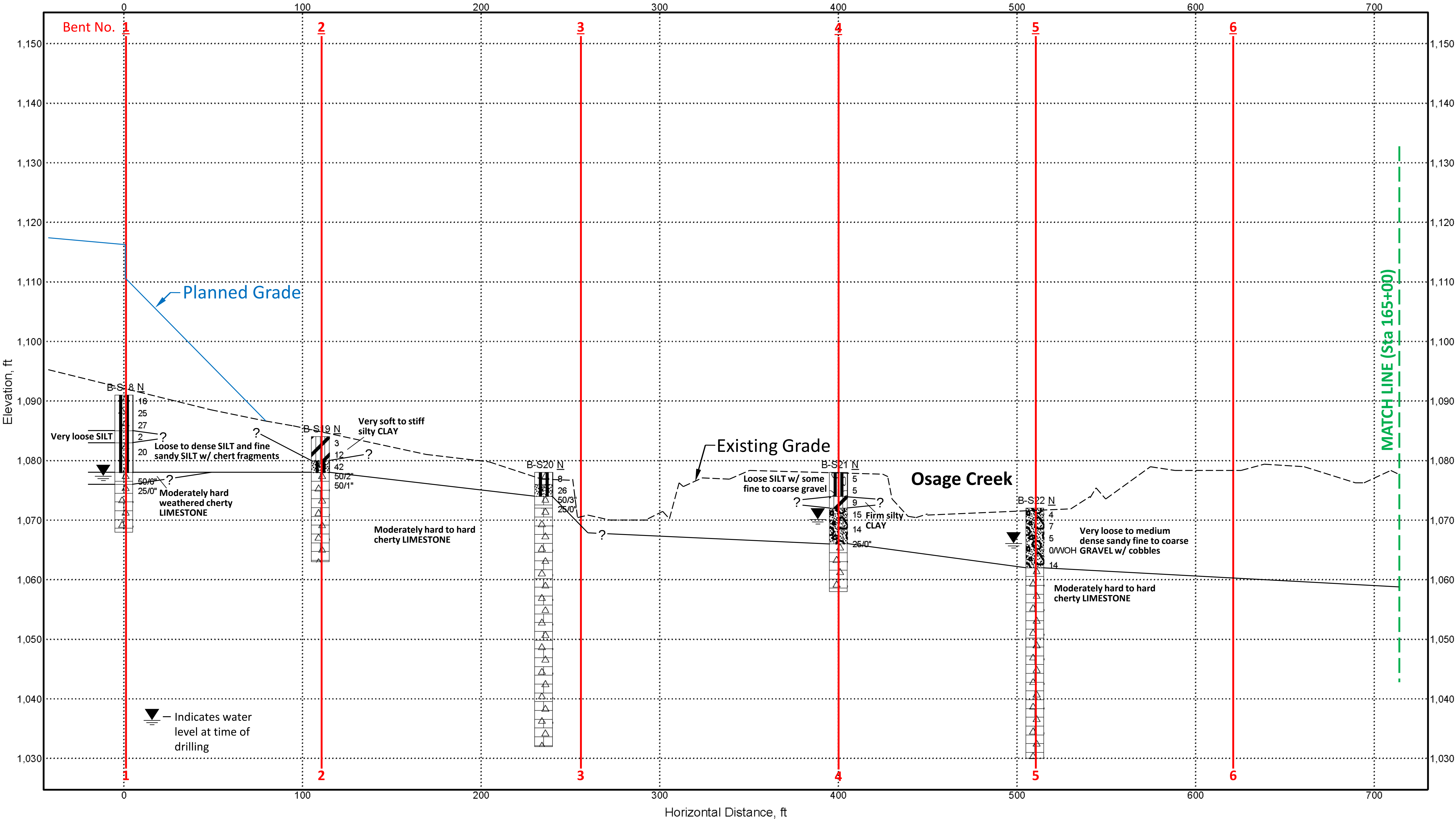
Grubbs, Hoskyn,
Barton & Wyatt, LLC

NOTES:
1. Subsurface conditions have been inferred between discrete boring locations. Actual conditions may vary.
2. Ground surface approximate.

SCALE:
1'' = 50' Horizontal
1'' = 15' Vertical

Generalized Subsurface Profile - Bridge A
090069 XNA Access Road over Osage Creek
Benton County, Arkansas

Project Number: 19-118

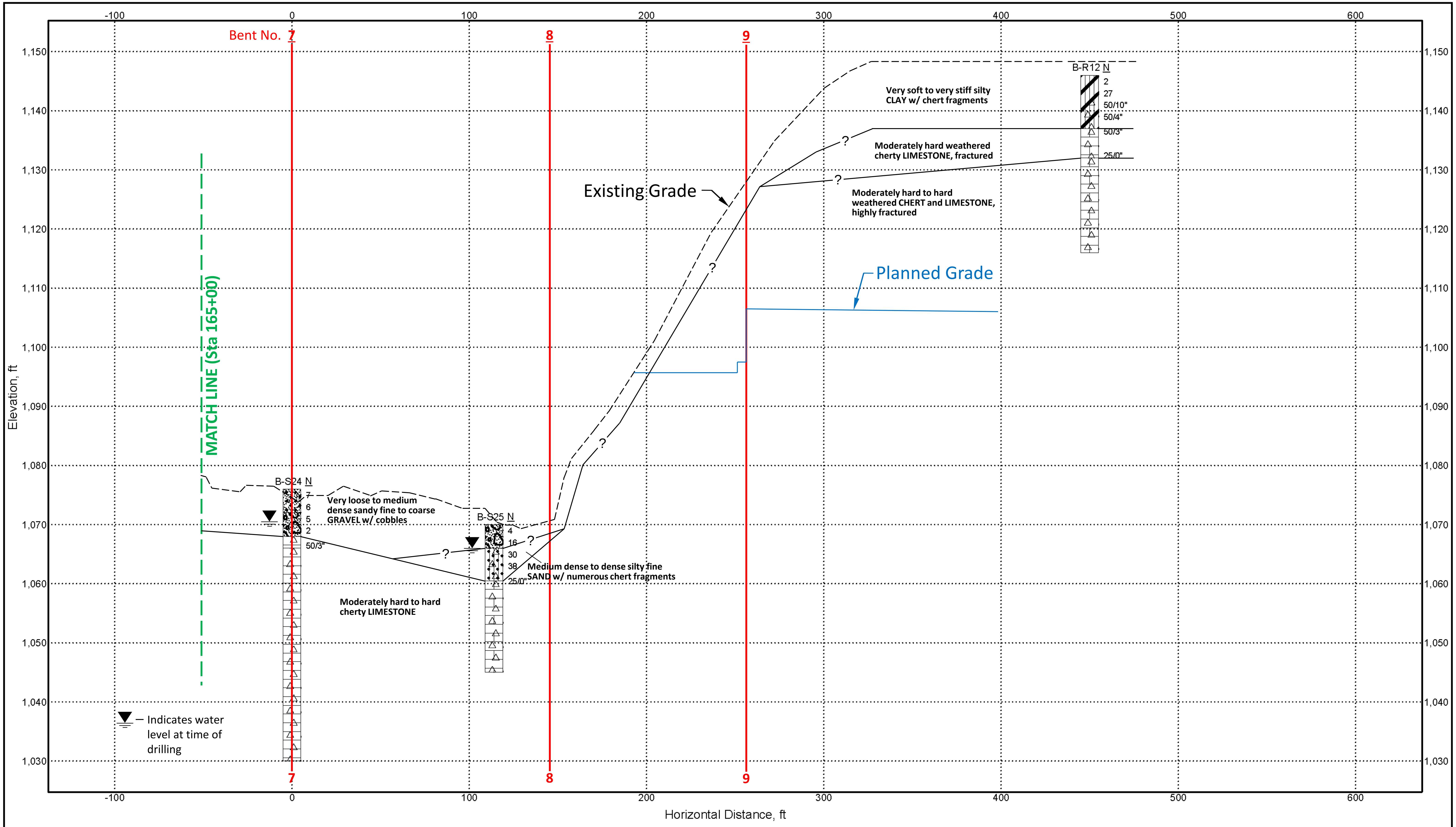


Grubbs, Hoskyn, Barton & Wyatt, LLC

NOTES:
1. Subsurface conditions have been inferred between discrete boring locations. Actual conditions may vary.
2. Ground surface approximate.

SCALE:
1" = 50' Horizontal
1" = 15' Vertical

Generalized Subsurface Profile - Bridge B
090069 XNA Access Road over Osage Creek
Benton County, Arkansas
Project Number: 19-118



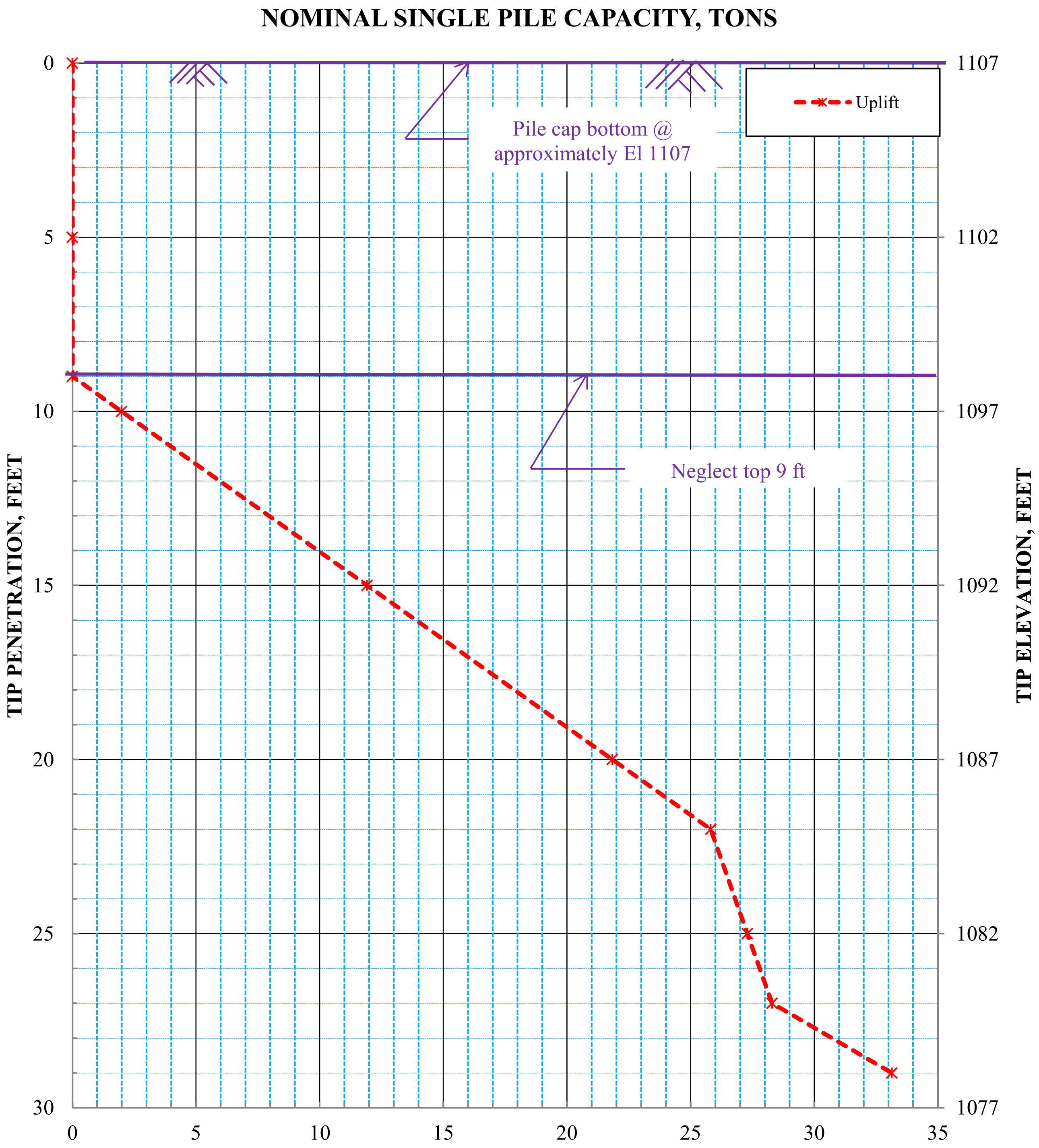
Grubbs, Hoskyn, Barton & Wyatt, LLC

NOTES:
1. Subsurface conditions have been inferred between discrete boring locations. Actual conditions may vary.
2. Ground surface approximate.

SCALE:
1" = 50' Horizontal
1" = 15' Vertical

Generalized Subsurface Profile - Bridge B
090069 XNA Access Road over Osage Creek
Benton County, Arkansas
Project Number: 19-118

APPENDIX E

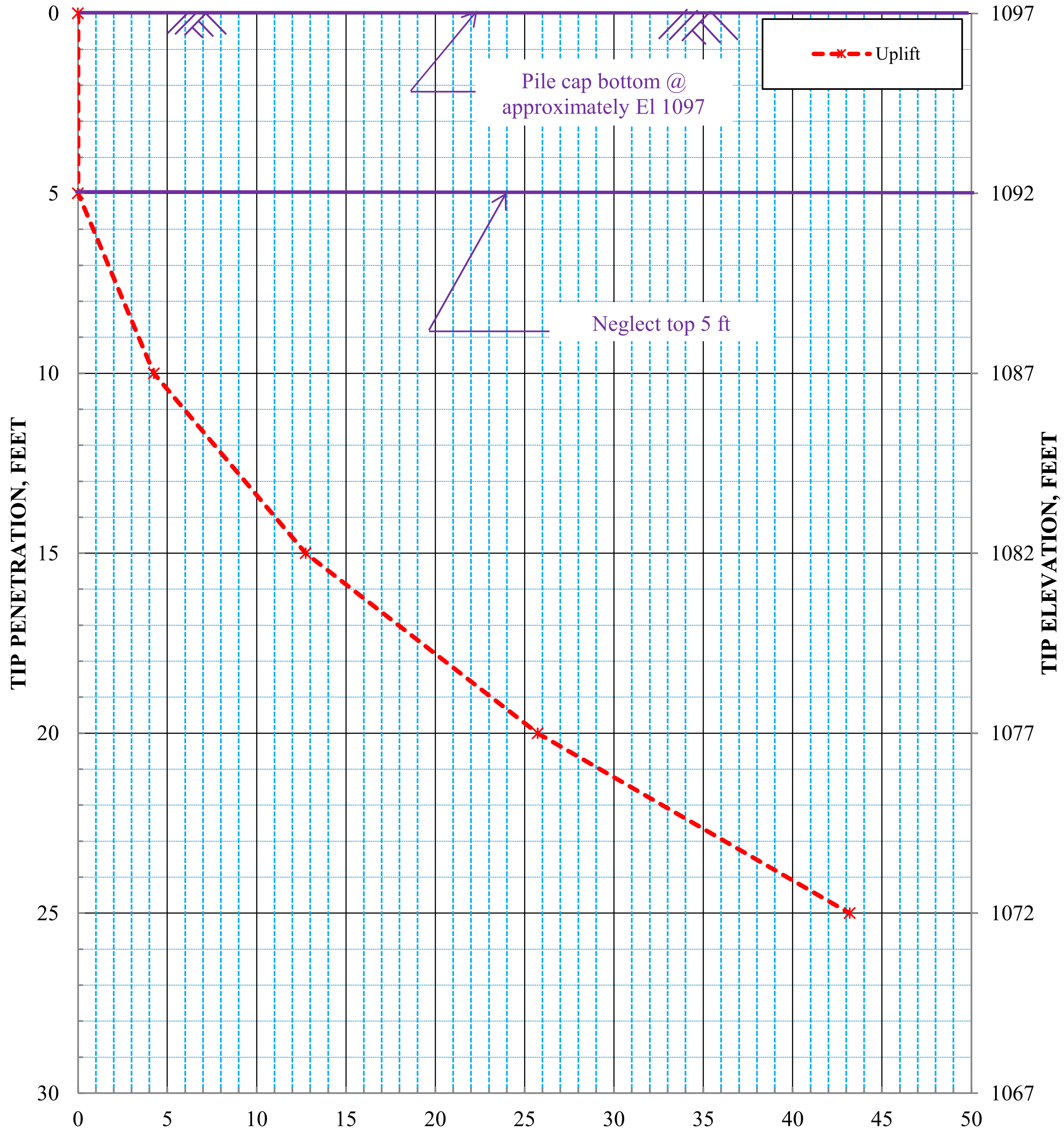


NOMINAL SINGLE PILE CAPACITY, TONS
HP12x53 Steel Piles - Uplift
090069 XNA Access Road over Osage Creek
Bent 1A (South Bent)
Benton County, Arkansas

Note: 1. Piles driven from cap bottom elevation
2. Pile penetration limited in moderately hard weathered limestone below El 1078±

Grubbs, Hoskyn,
Barton & Wyatt, LLC
Consulting Engineers

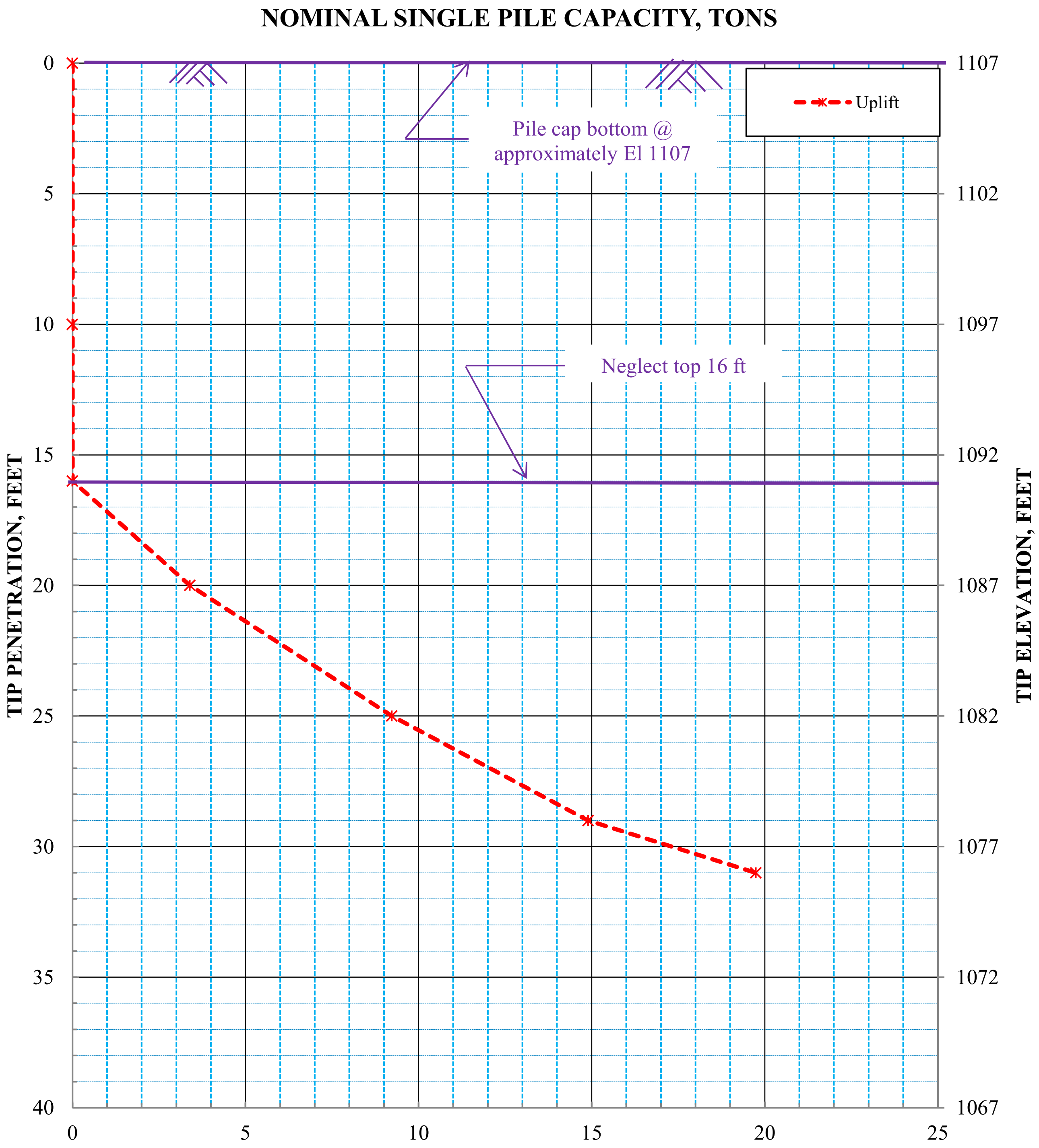
NOMINAL SINGLE PILE CAPACITY, TONS



NOMINAL SINGLE PILE CAPACITY, TONS
Grouted HP12x53 Steel Piles - Uplift
090069 XNA Access Road over Osage Creek
Bent 9A (North Bent)
Benton County, Arkansas

Note: 1. Piles driven from cap bottom elevation
2. Preboring and grouting required in moderately hard weathered limestone below El 1137±

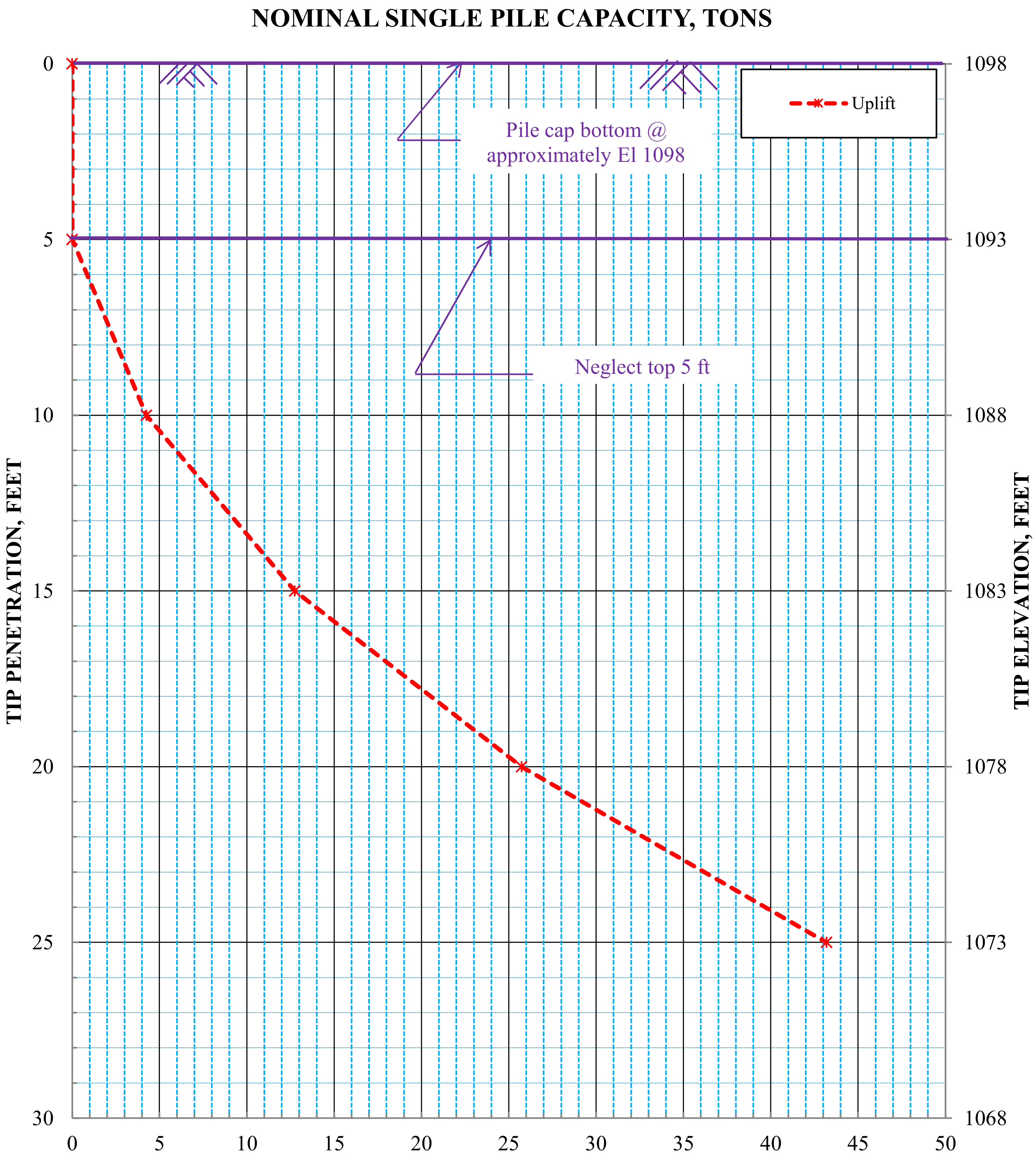
Grubbs, Hoskyn,
Barton & Wyatt, LLC
Consulting Engineers



NOMINAL SINGLE PILE CAPACITY, TONS
HP12x53 Steel Piles - Uplift
090069 XNA Access Road over Osage Creek
Bent 1B (South Bent)
Benton County, Arkansas

Note: 1. Piles driven from cap bottom elevation
2. Pile penetration limited in moderately hard weathered cherty limestone below El 1076±

Grubbs, Hoskyn,
Barton & Wyatt, LLC
Consulting Engineers



NOMINAL SINGLE PILE CAPACITY, TONS
Grouted HP12x53 Steel Piles - Uplift
090069 XNA Access Road over Osage Creek
Bent 9B (North Bent)
Benton County, Arkansas

Note: 1. Piles driven from cap bottom elevation. 2. Grouting required in moderately hard weathered cherty limestone below El 1088±.

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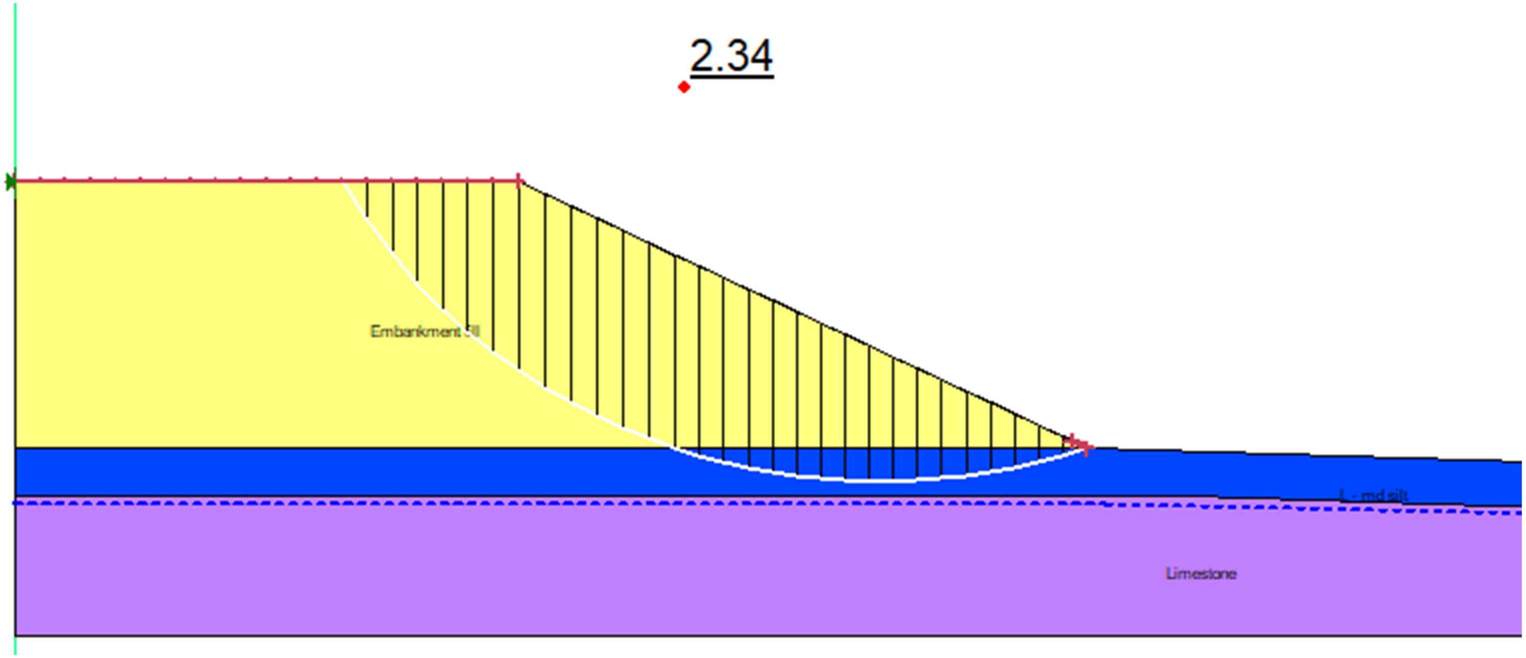
Barton & Wyatt, LLC
Consulting Engineers

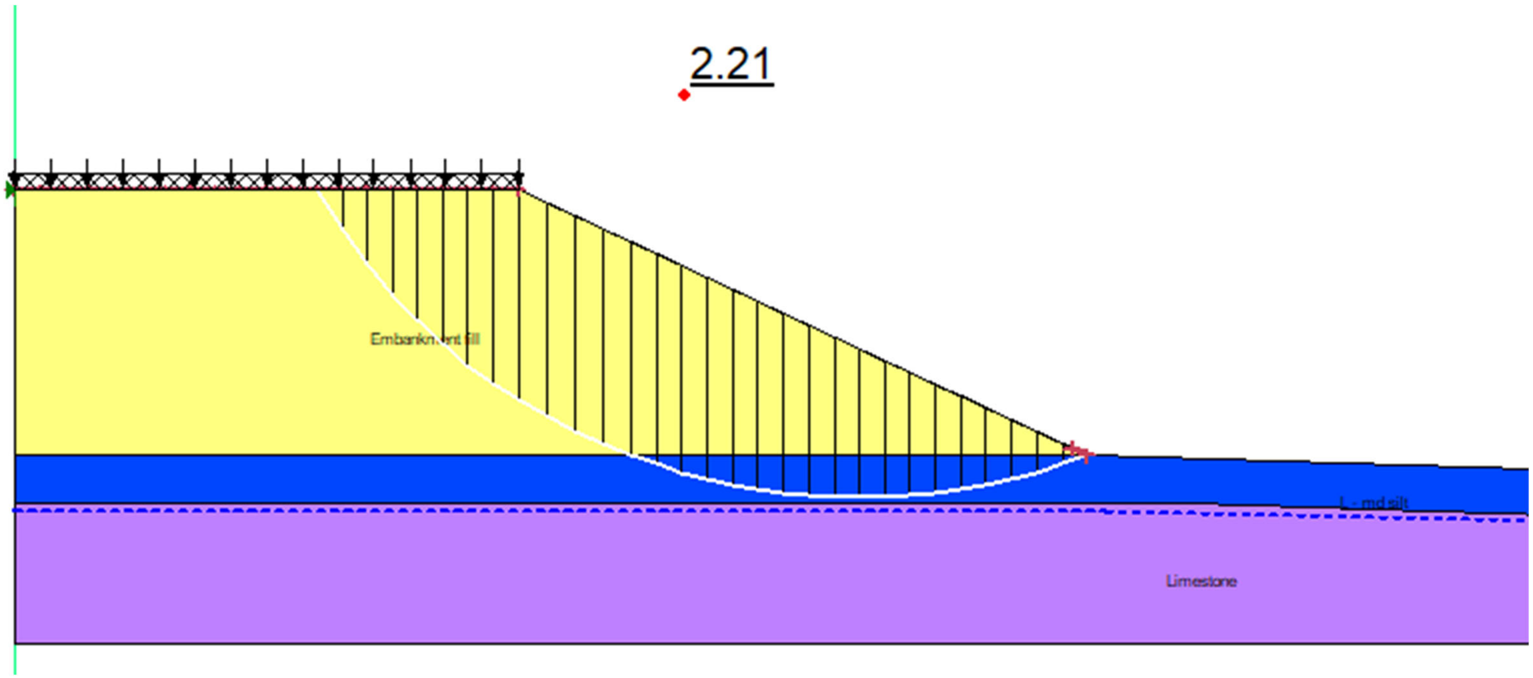
APPENDIX F

Summary of Stability Analysis Results
ARDOT 090069 XNA Access Road over Osage Creek
GHBW Job No. 19-118
Benton County, Arkansas

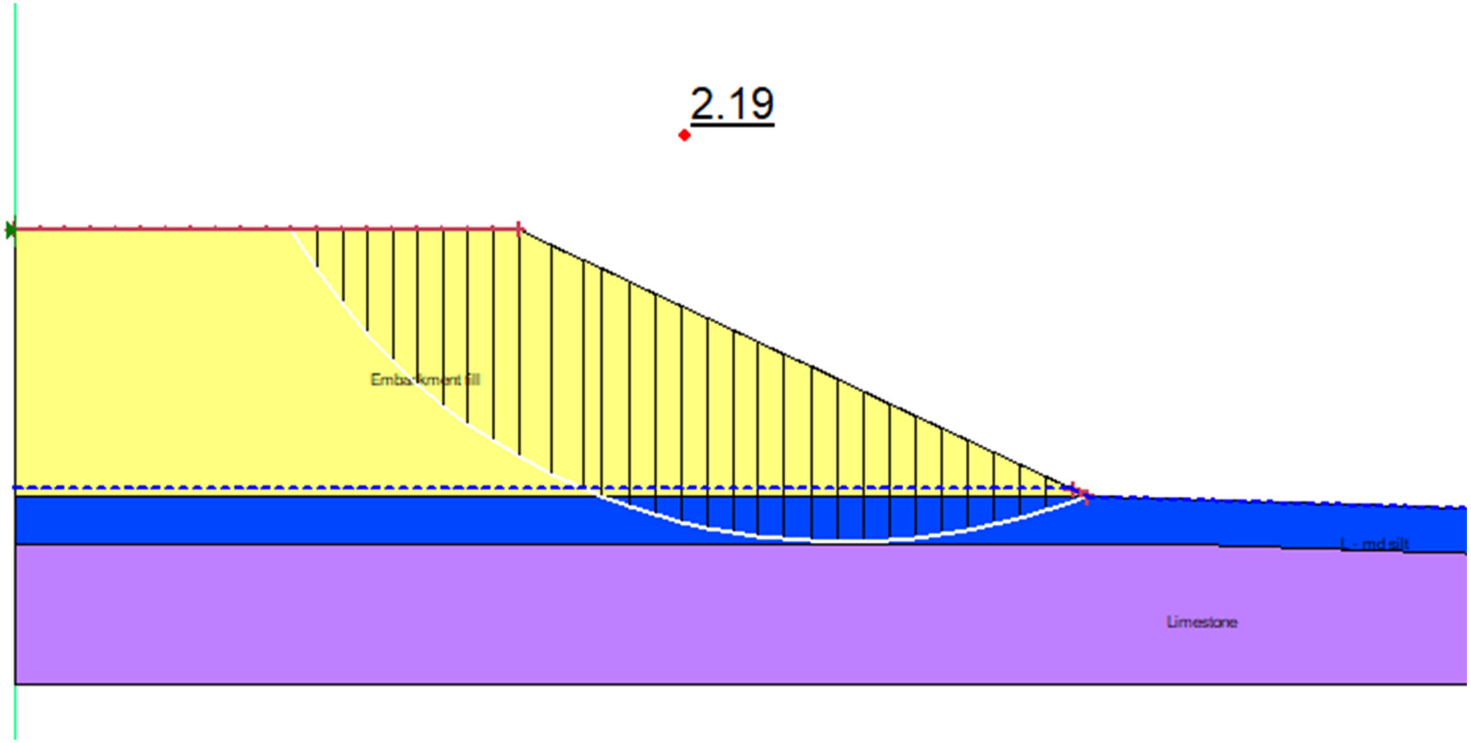
	Design Loading Condition	**Calculated Minimum Factor of Safety**
South End Slope (Bent 1) (2H:1V)	End of Construction	2.34
	Long Term	2.21
	Rapid Drawdown from El 1085 to El 1074	2.19
	Seismic (k_h =A_S/2 = 0.0245)	2.21
South Side Slope (Bent 1) (3H:1V)	End of Construction	2.79
	Long Term	2.64
	Rapid Drawdown from El 1085 to Existing Grade	2.57
	Seismic (k_h =A_S/2 = 0. 0245)	2.59
North End Slope (Bent 9) (Cut Slope)	End of Construction	4.70
	Long Term	4.70
	Rapid Drawdown from El 1085 to El 1074	4.27
	Seismic (k_h =A_S/2 = 0. 0245)	4.40
North Side Slope (Bent 9) (Cut Slope - 3H:1V)	End of Construction	5.14
	Long Term	4.91
	Seismic (k_h =A_S/2 = 0. 0245)	4.75



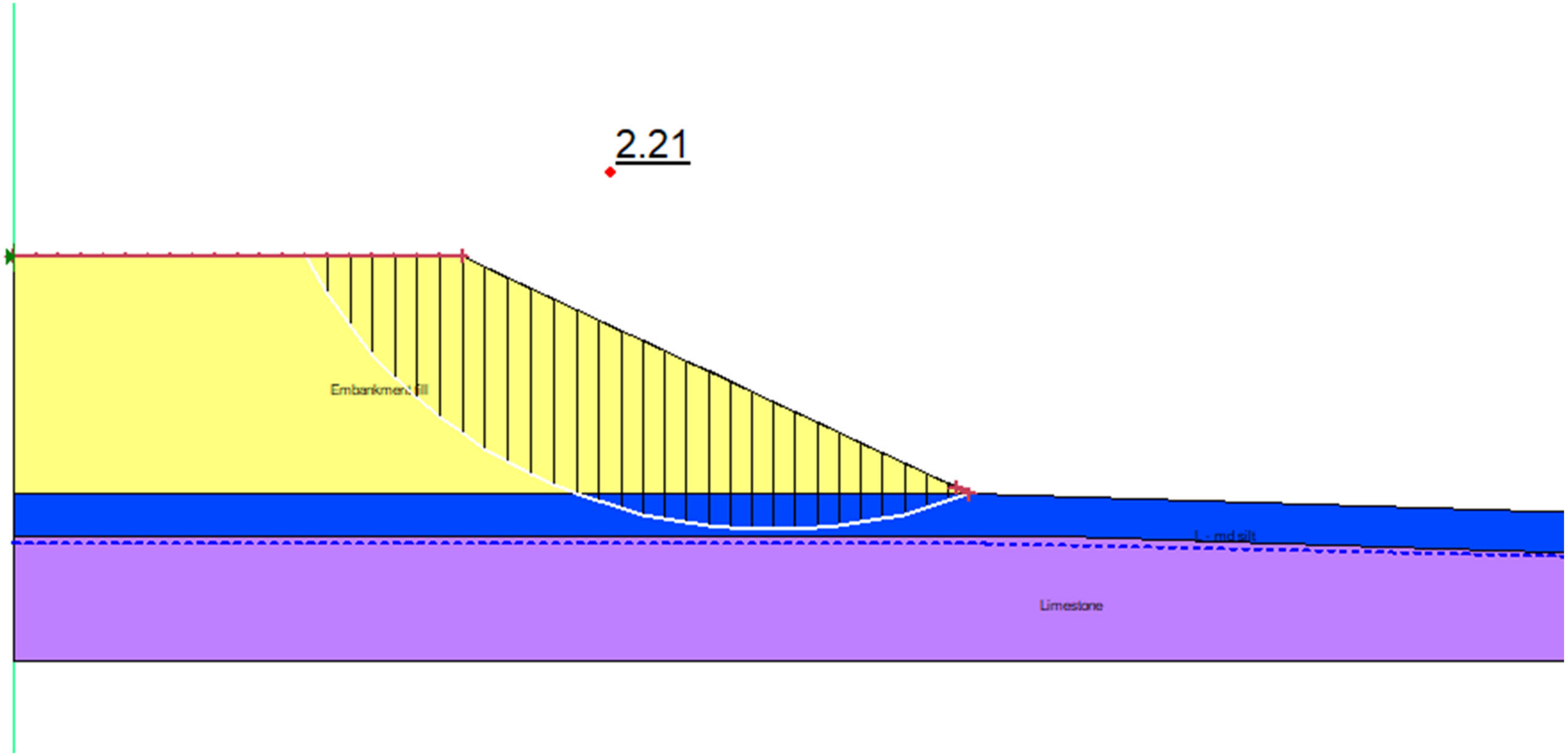
Results of Stability Analyses – End of Construction
Bent 1 End Slope
2H:1V Slope, H=34 ft ±
19-118 – ARDOT 090069 XNA Access Road over Osage Creek



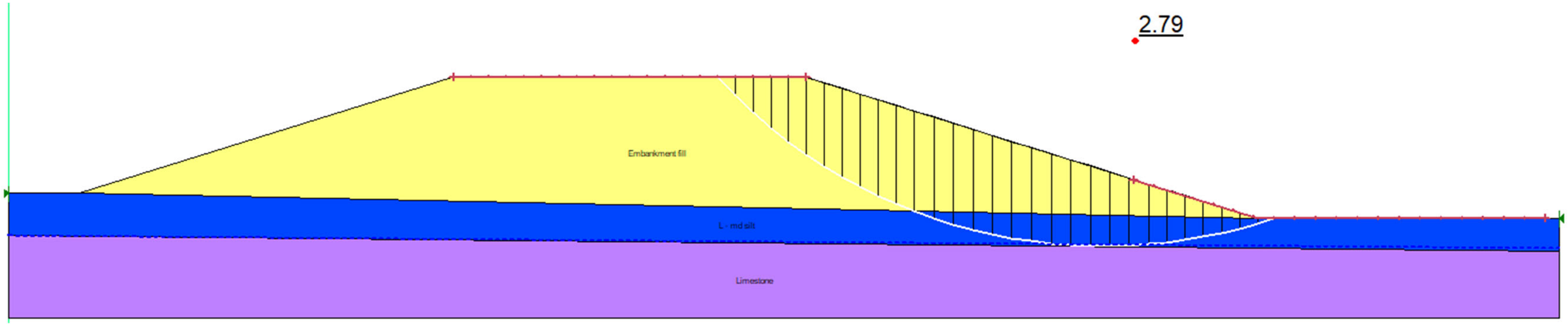
Results of Stability Analyses – Long Term Condition
Bent 1 End Slope
2H:1V Slope, H=34 ft ±
19-118 – ARDOT 090069 XNA Access Road over Osage Creek



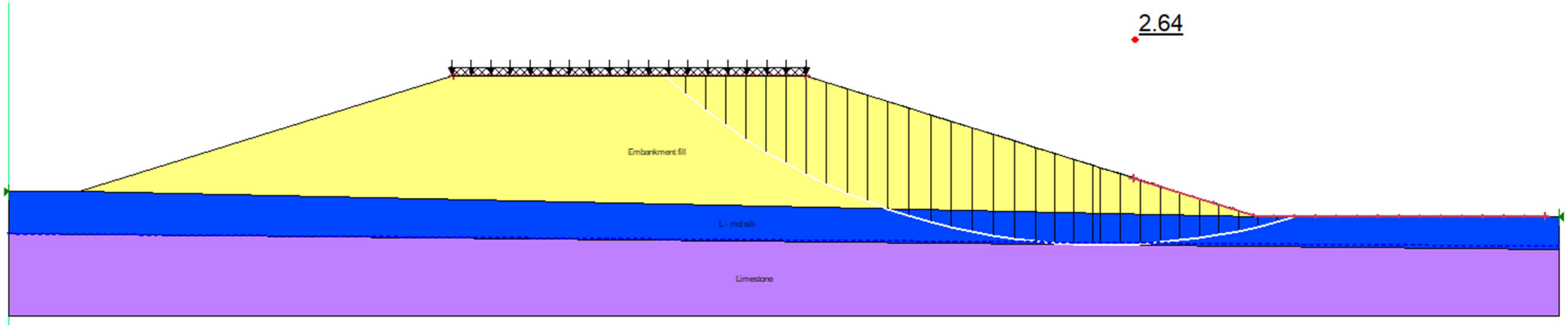
Results of Stability Analyses – Rapid Drawdown Condition from El 1085 to El 1074
Bent 1 End Slope
2H:1V Slope, H=34 ft ±
19-118 – ARDOT 090069 XNA Access Road over Osage Creek



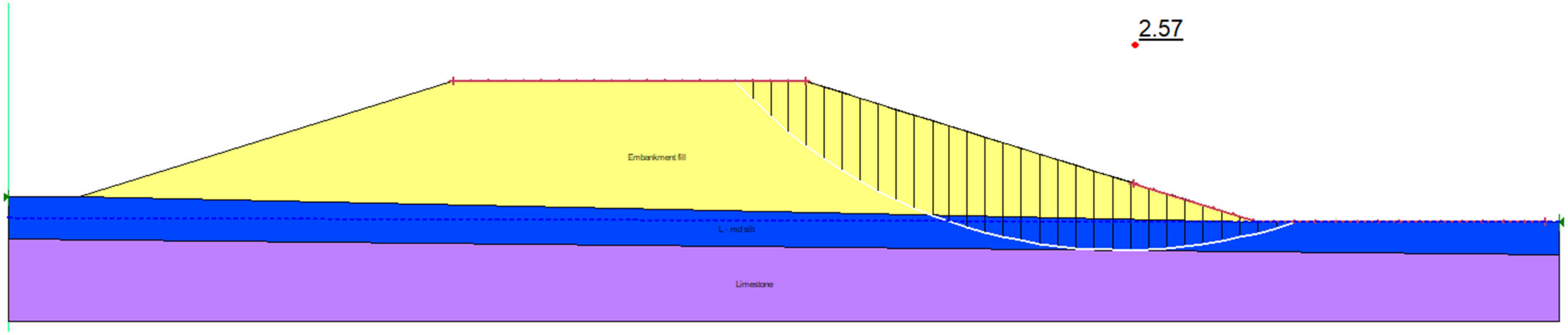
Results of Stability Analyses – Seismic Condition ($k_h = A_S /2= 0.0245$)
Bent 1 End Slope
2H:1V Slope, H=34 ft ±
19-118 – ARDOT 090069 XNA Access Road over Osage Creek



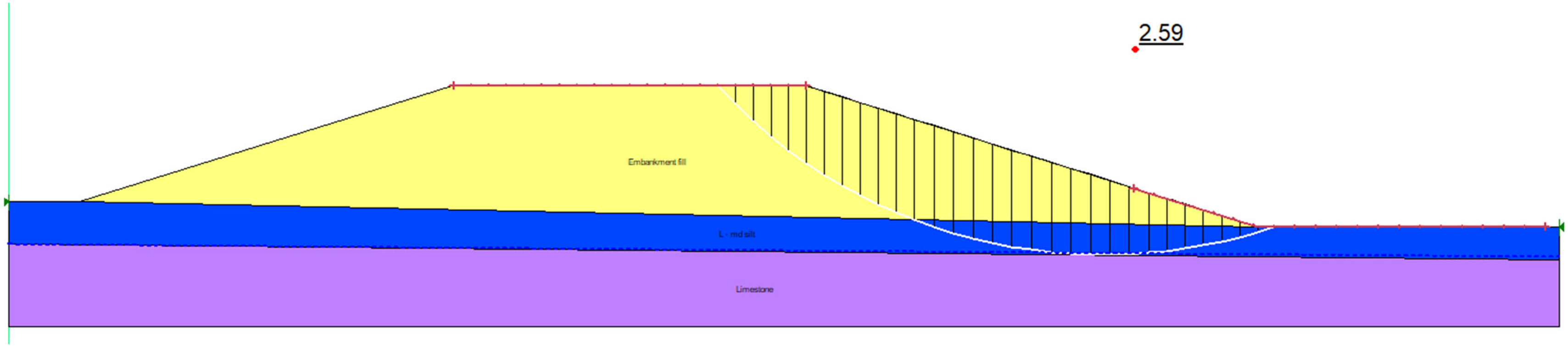
Results of Stability Analyses – End of Construction
Bent 1 Side Slope
3H:1V Slope, H=34 ft ±
19-118 – ARDOT 090069 XNA Access Road over Osage Creek



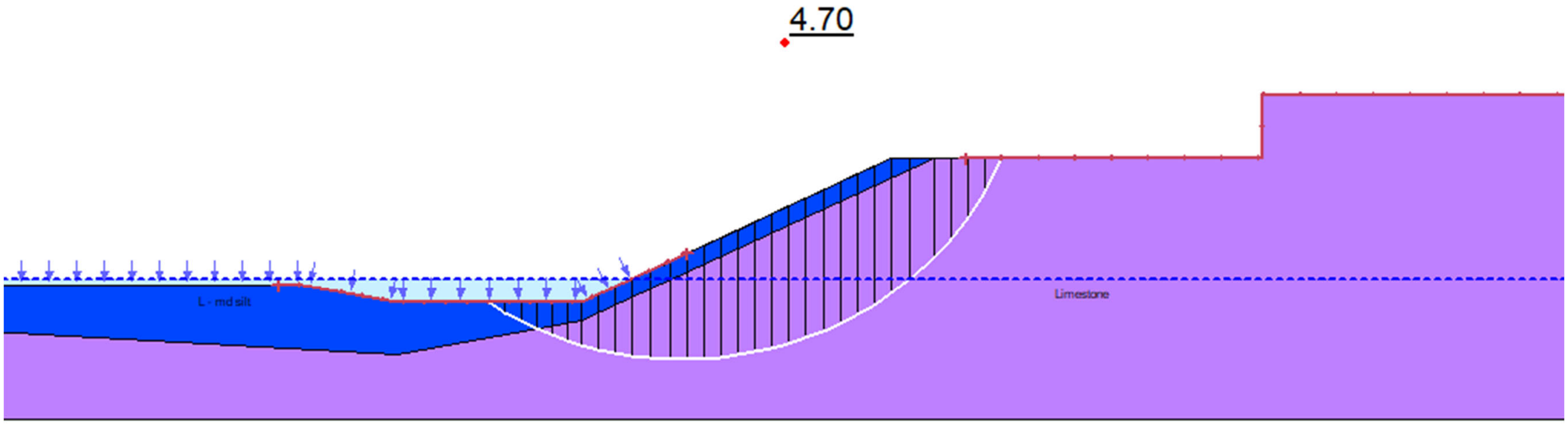
Results of Stability Analyses – Long Term Condition
Bent 1 Side Slope
3H:1V Slope, H=34 ft ±
19-118 – ARDOT 090069 XNA Access Road over Osage Creek



Results of Stability Analyses – Rapid Drawdown El 1085 to Existing Grade
Bent 1 Side Slope
3H:1V Slope, H=34 ft ±
19-118 – ARDOT 090069 XNA Access Road over Osage Creek

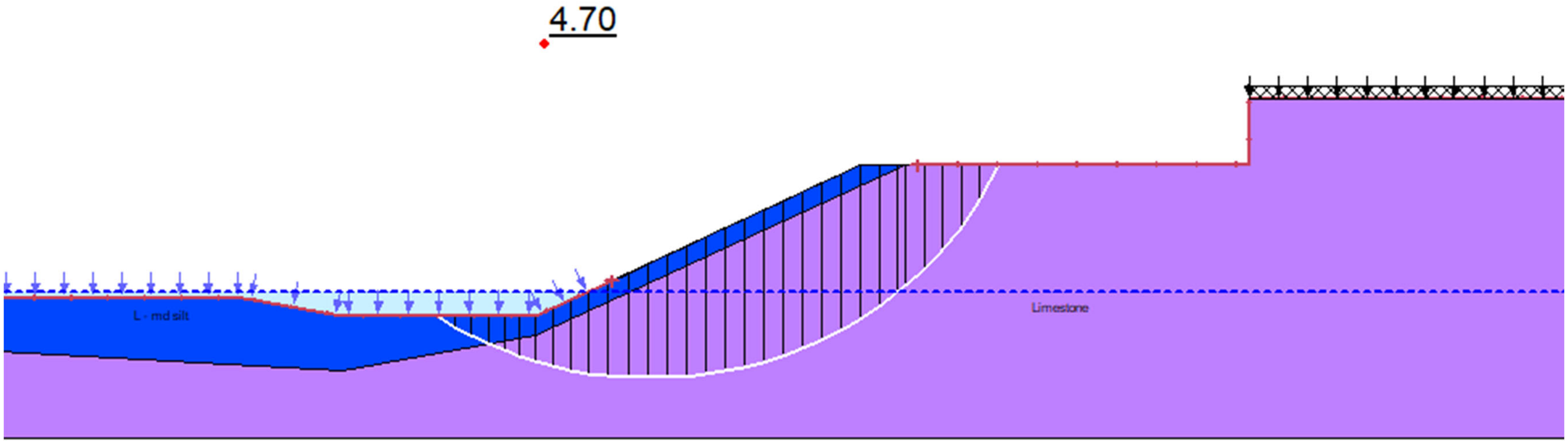


Results of Stability Analyses – Seismic Condition (k_h = A_S /2= 0.0245)
Bent 1 Side Slope
3H:1V Slope, H=34 ft ±
19-118 – ARDOT 090069 XNA Access Road over Osage Creek

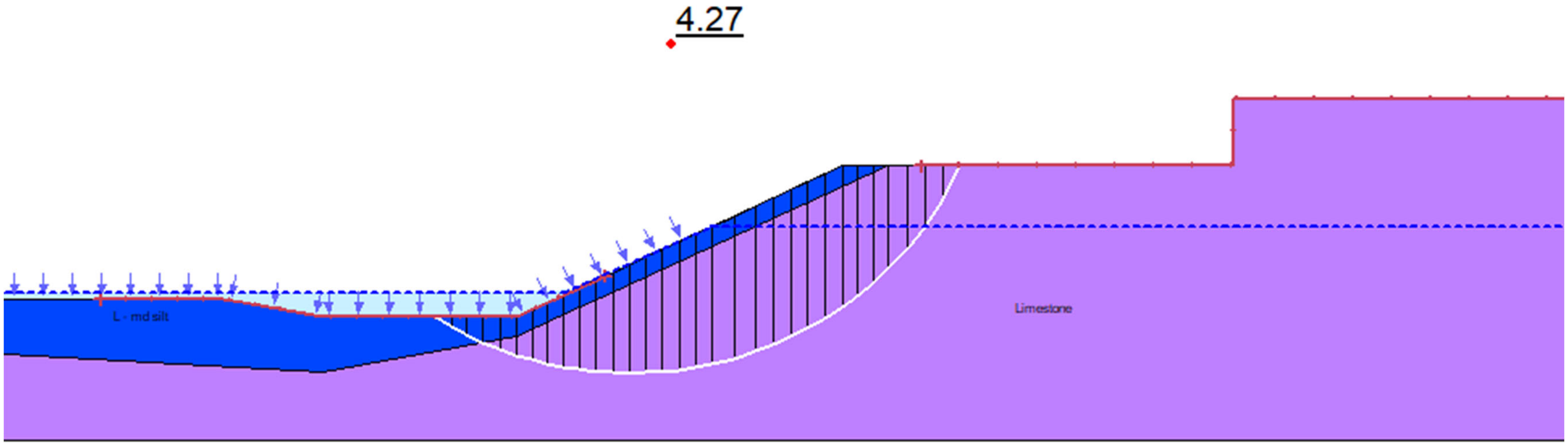


Results of Stability Analyses – End of Construction
Bent 4 End Slope
Cut Slope, H=36 ft ±
19-118 – ARDOT 090069 XNA Access Road over Osage Creek

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

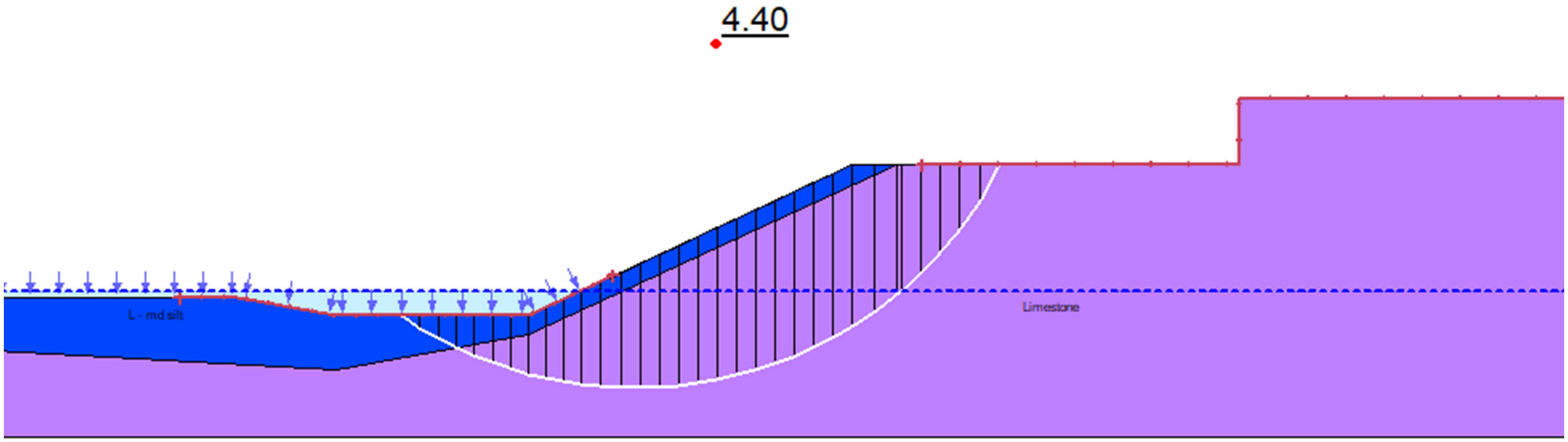


Results of Stability Analyses – Long Term Condition
Bent 4 End Slope
Cut Slope, H=36 ft ±
19-118 – ARDOT 090069 XNA Access Road over Osage Creek
r



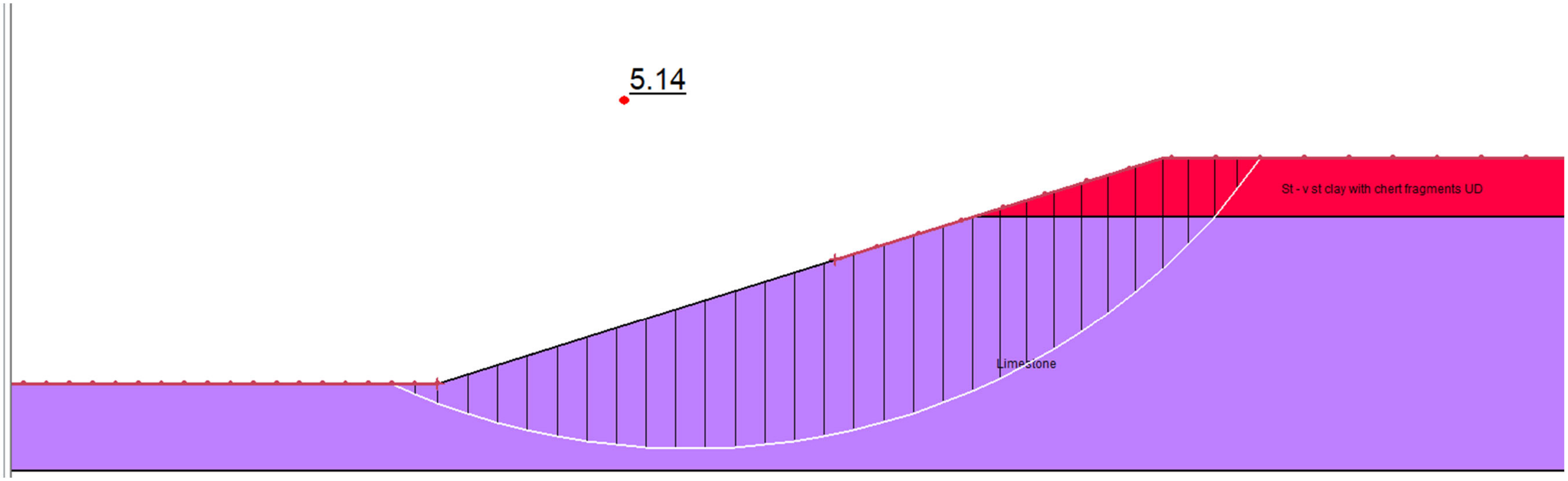
Results of Stability Analyses – Rapid Drawdown Condition, El 1085 to El 1074
Bent 4 End Slope
Cut Slope, H=36 ft ±
19-118 – ARDOT 090069 XNA Access Road over Osage Creek

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

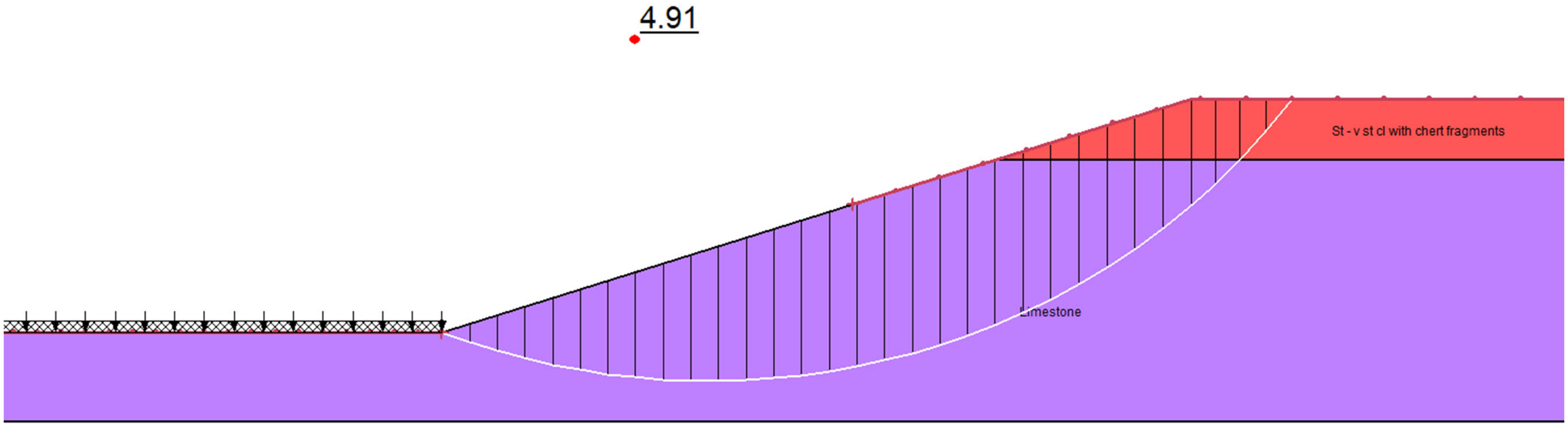


Results of Stability Analyses – Seismic Condition ($k_h = A_S /2 = 0.0245$)
Bent 4 End Slope
Cut Slope, H=36 ft ±
19-118 – ARDOT 090069 XNA Access Road over Osage Creek

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

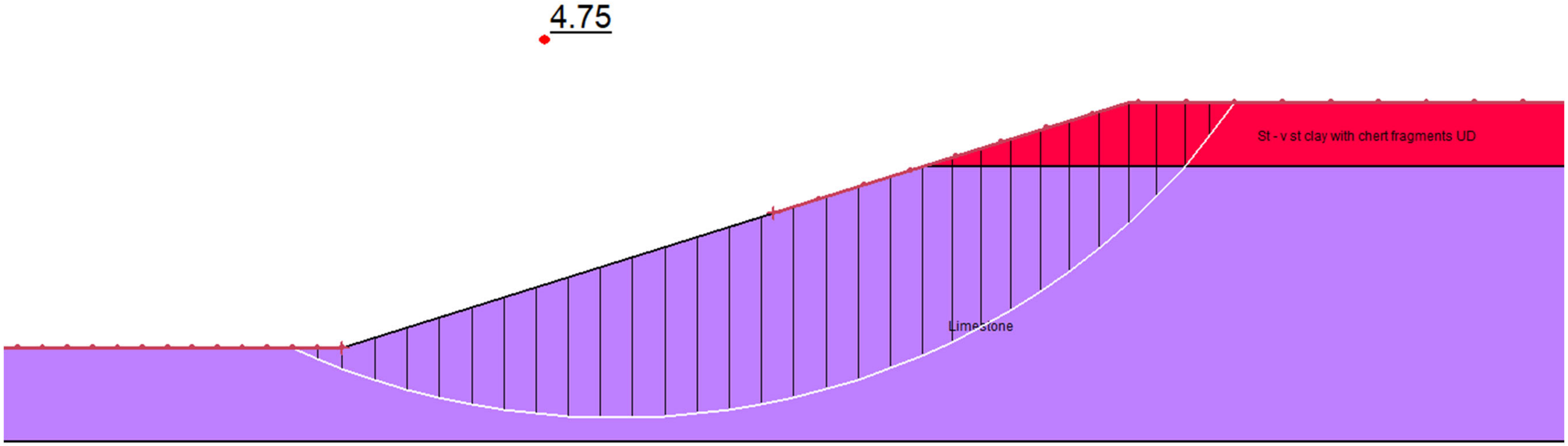


Results of Stability Analyses – End of Construction
Bent 4 Side Slope
3H:1V Slope, H=42 ft ±
19-118 – ARDOT 090069 XNA Access Road over Osage Creek



Results of Stability Analyses – Long Term Condition
Bent 4 Side Slope
3H:1V Slope, H=42 ft ±
19-118 – ARDOT 090069 XNA Access Road over Osage Creek

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



Results of Stability Analyses – Seismic Condition (k_h = A_S /2= 0.0245)
Bent 4 Side Slope
3H:1V Slope, H=42 ft ±
19-118 – ARDOT 090069 XNA Access Road over Osage Creek

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CONSULTING ENGINEERS
A UES Company

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

Materials Testing
Geotechnical Engineering
Environmental
Building Sciences & Safety
Inspections & Code Compliance
Virtual Design Consulting

September 29, 2023
Job No. 19-118

Garver LLC
4701 Northshore Dr
North Little Rock, Arkansas 72118

Attn: Mr. Joel Skinner, P.E.

RESULTS of GEOTECHNICAL INVESTIGATION
ARDOT JOB 090069
XNA ACCESS ROAD BRIDGE OVER LITTLE OSAGE CREEK
BENTON COUNTY, ARKANSAS

INTRODUCTION

This report provides the final results of the geotechnical investigation performed for the XNA Access Road Twin Bridges over Little Osage Creek in Benton County, Arkansas. The Little Osage Creek Bridges are one facet of the ARDOT Job 090069 Northwest Arkansas Regional Airport Access (Benton Co) (F). This geotechnical investigation was authorized by the Garver, LCC Subconsultant Agreement for Task Order No. 061 on August 27, 2019. Notice to proceed with the field studies was received on August 30, 2019. Results and recommendations have been provided throughout the course of this study. A preliminary report for the Little Osage Creek Bridges was submitted on July 18, 2023.

We understand the new bridges will be continuous plate girder structures with four (4) bents, three (3) spans, and total lengths of approximately 592.5 feet each. We also understand that a foundation system consisting of steel H-piles and drilled piers are planned at the bridge ends and intermediate bents, respectively. Foundation loads of the new bridge are anticipated to be moderate. The bridge end embankments will utilize simple slopes with end slopes at approximate 2-horizontal to 1-vertical (2H:1V) configurations and side slopes at 3-horizontal to 1-vertical (3H:1V) configurations. Site grading is expected to include up to 34 ft of embankment fill. Preliminary bridge layouts are provided in Appendix A.

The purposes of this study were to explore subsurface conditions in the bridge alignments and to develop recommendations to guide design and construction of foundations and earthwork. These purposes have been achieved by a multi-phased study that included the following.

- Drilling sample and core borings at the planned bridge location to evaluate subsurface conditions and obtain samples of the subgrade and foundation soil and rock for laboratory testing.
- Performing laboratory tests to evaluate pertinent engineering properties of the foundation and subgrade strata.
- Analyzing field and laboratory data to develop recommendations for seismic site class, seismic performance zone/seismic design category, foundation and subgrade support, slope stability, site grading, and construction considerations.

The relationship of these factors to design and construction of the new bridges has been considered in developing the recommendations and considerations discussed in the following report sections.

SUBSURFACE EXPLORATION

Subsurface conditions at the Little Osage Creek bridge location were investigated by drilling 13 sample and core borings to depths of 15 to 59 feet. The site vicinity is shown on Plate 1. The approximate boring locations are shown on the bridge layout drawing on Plate 2. Boring R13, a roadway boring, was drilled about 95 ft south of the south bridge ends and was utilized to develop subsurface profiles for the A and B Bridges. The subsurface exploration program is summarized in Table 1 below.

Table 1: Summary of Exploration Program

Boring No.	Approx Sta	Approx Offset, ft	Approx Surf El, ft	Completion Depth, ft
R13	174+50	CL	1126	20
S27	175+45	45 Lt	1085	15
S28	176+60	60 Lt	1076	48
S29	177+35	60 Lt	1076	57
S30	179+15	60 Lt	1078	45
S31	180+45	60 Lt	1078	56.5
S32	181+45	60 Lt	1080	27
S33	176+00	60 Rt	1078	21
S34	177+00	60 Rt	1076	59
S35	178+40	75 Rt	1075	51

Boring No.	**Approx Sta**	**Approx Offset, ft**	**Approx Surf El, ft**	**Completion Depth, ft**
S36	179+85	60 Rt	1074	58
S37	181+10	60 Rt	1079	58
S38	182+15	60 Rt	1080	27.5

The boring logs, presenting descriptions of the soil and rock strata encountered in the borings and the results of the field and laboratory tests, are included as Plates 3 through 23. The centerline station and offset of the boring locations and approximate ground surface elevation, as inferred from the topographic information provided by the Engineer (Garver, LLC) or as inferred from available topographic information, are also shown on the logs. It must be recognized that the surface elevations shown are approximate and actual elevations may vary. Keys to the terms and symbols used on the logs are presented as Plates 24 and 25.

The borings were drilled with a track-mounted CME 850 and Geoprobe 3230DT rotary-drilling rigs using a combination of dry-auger and rotary-wash drilling methods. Samples were typically obtained at 2-ft intervals to 10-ft depth and at 5-ft intervals thereafter. Samples were recovered using a 2-in.-diameter split-barrel sampler driven into the strata by blows of a 140-lb automatic hammer with 30-in. drop in accordance with Standard Penetration Test (SPT) procedures. The number of blows required to drive the standard split-barrel sampler the final 12 in. of an 18-in. total drive, or a portion thereof, is defined as the Standard Penetration Number (N). Recorded N-values are shown on the boring logs in the "Blows Per Ft" column.

Representative samples of the limestone bedrock were obtained using a 5-ft-long NQ-size double-tube core barrel with a diamond bit. For each core run, the percent recovery was determined as the ratio of recovery to total length of core run. Rock Quality Designation (RQD) was also determined for the core run as the sum of intact, sound rock core greater than 4-in. length divided by the total length of the run and expressed in percent. Both these values are presented in the right-hand columns of the log forms, opposite the corresponding core run. Selected photographs of the recovered rock cores are provided in Appendix B.

All samples were removed from sampling tools in the field, examined and visually classified by the field geologist or field engineer. Samples were then placed in appropriate containers to prevent moisture loss and/or change in condition during transfer to our laboratory for further examination and testing.

The borings were advanced using dry-auger procedures to the extent possible to facilitate evaluation of shallow groundwater conditions. Observations regarding groundwater levels are noted in the lower-right portion of each log and are discussed in subsequent sections of this report. All boreholes were backfilled after obtaining the final water level readings.

LABORATORY TESTING

Laboratory testing was performed to evaluate subgrade and foundation plasticity and to confirm visual classification. The testing program included natural water content determinations (AASHTO T 265), liquid and plastic (Atterberg) limit determinations (AASHTO T 89 and T 90), and sieve analyses through the No. 200 sieve (AASHTO T 88). Soil shear strength was estimated in the field using SPT results.

A total of 27 natural water content determinations were performed to develop information on *in-situ* soil water content in the borings. Water content results are plotted on the boring log forms in accordance with the scale and symbols shown in the legend located in the upper-right corner of the logs.

To verify field classification and to evaluate soil plasticity, 11 liquid and plastic limit (Atterberg limits) determinations and 12 sieve analyses were performed on selected representative samples. The Atterberg limits are plotted on the logs as pluses inter-connected with a dashed line using the water content scale. The percentage of soil passing through the No. 200 Sieve is noted in the "- No. 200 %" column on the appropriate log forms.

A summary of classification test results and classification by the Unified Soil Classification System and AASHTO Classification System is presented in Appendix C. Grain-size distribution curves are also included in Appendix C.

Results of the laboratory compression tests are shown in lbs per sq inch at the appropriate depth on the boring logs. The total unit weight of intact cores was also measured and these data are also shown on the logs. Compression results are also summarized in Appendix C.

GENERAL SITE and SUBSURFACE CONDITIONS

Site Conditions

The overall alignment of the XNA Access Road extends from the Northwest Arkansas Airport (XNA) about 4 miles southeast to the planned terminus at Highways 70 and 71. The bridge site crosses Little Osage Creek approximately 1400 ft southeast of Haden Road. The site locale is presently open agricultural/pasture land away from the creek; the immediate vicinity of the creek is covered with mature trees. The Little Osage Creek channel at the bridge location is narrow with poorly-defined banks. The creek channel banks are shallow with tall grass and thick underbrush. The site terrain slopes gently to the creek from the northeast to the southwest. Surface drainage is considered good overall, but there are some localized low areas with poor drainage.

Site Geology

The project alignment is located in the mapped exposure of the Boone Formation. The early and middle Mississippian Period Boone consists of fine- to coarse-grained limestone interbedded with chert. The chert content can vary widely, both horizontally and vertically, and limestone or chert may be predominant. The Boone Formation is known for dissolutional features such as sinkholes, caves, and enlarged fissures. Typically, the limestone/cherty limestone units of the Boone decompose (weather) to erratic blends of chert fragments and clay/silty clay. The residual soil mantle may extend to significant depths on higher terrain and may contain hard chert seams and/or layers. The thickness of the Boone Formation is reported to be 300 to 350 ft in northern Arkansas. The Boone is generally disconformable to the underlying Chattanooga Shale and St. Joe Limestone member, with some areas having a conformable contact.

Seismic Conditions

In light of the results of the borings performed for the Little Osage bridge, a Seismic Site Class B (rock profile) is considered applicable for the site with respect to the criteria of the AASHTO LRFD Bridge Design Specifications Seventh Edition 2014[1].

Given the location and AASHTO code-based values, the 1.0-sec period spectral acceleration coefficient for Site Class B (S_1) is 0.051 and the 1.0-sec period spectral acceleration coefficient (S_{D1}) value for Site Class B is 0.051. Utilizing these parameters, Table 3.10.6-1[2] indicates that a Seismic Performance Zone 1 is fitting for the Little Osage Creek bridge site. In reference to the 2011 edition of the AASHTO Guide Specifications, the Peak Ground Acceleration (PGA) having a 7 percent chance of exceedance in 75 years (or mean return period of approximately 1000 years) is predicted to be 0.049 for a Seismic Site Class B for the bridge location. The liquefaction potential is considered low for the predominantly cohesive overburden soils and underlying rock units encountered in the borings drilled for this study.

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[1] AASHTO LRFD Bridge Design Specifications, 8th Edition; AASHTO; 2017

[2] AASHTO LRFD Bridge Design Specification, AASHTO; 2012

Subsurface Conditions

The results of the borings indicate that the surface and near-surface soils in the new twin bridge alignments typically consist of natural very soft to firm brown, dark brown, and reddish brown clayey silt and silty clay and very loose to medium dense brown silt, fine sandy silt, and sandy fine to coarse gravel to 1- to 11-ft depth. This stratum contains variable chert fragments and cobbles. This stratum represents recent stream bed deposits, which typically classify as A-1-a, A-1-b, A-2-4, A-4, and A-6 by the AASHTO classification system. The silt and clayey silt exhibit low plasticity, moderate to high compressibility, and low shear strength. The low-plasticity and silty soils are moisture-sensitive and will lose considerable strength when saturated.

Below the silt/clayey silt and gravel to approximately 7- to 13-ft depth is very soft to very stiff brown, reddish brown, and tan silty clay and fine sandy clay with numerous chert fragments. These soils typically classify as A-2-6, A-4, and A-6 by the AASHTO classification system. The natural surface and near-surface soils are highly variable with respect to strength and subgrade support for pavement structures. Some areas will warrant localized undercut for subgrade preparation.

The overburden soils are underlain by low hardness to hard gray and tan weathered to fresh cherty limestone. The competence of the limestone increases with depth. The limestone is flat-bedded with healed fractures. The core sample recovery ranges from 53 to 100 percent and the core sample RQD ranges from 25 to 100 percent in this stratum. The cherty limestone exhibits high strength, with laboratory compressive strength values ranging from 4810 to 14,180 lbs per sq inch.

To aid in visualizing subsurface conditions, a generalized subsurface profile is presented in Appendix D. It should be recognized that the stratigraphy illustrated by the profile has been inferred between discrete boring locations. In view of the natural variations in stratigraphy and conditions, variations from the stratigraphy illustrated by the profile should be anticipated. Additionally, the natural transition between strata is generally gradual, and the stratigraphy described in the sections above may vary.

Groundwater Conditions

Localized perched groundwater was encountered at variable depths ranging from 1 ft to 10 ft in March and April 2023. It has been our experience in the area that localized shallow perched groundwater can be present in the silty overburden soils and fractured zones of the cherty limestone. Hillside seeps can also develop as infiltrated surface water from areas of higher terrain migrate downgradient. Groundwater levels will vary, depending on seasonal precipitation, surface runoff and infiltration, and water levels in Little Osage Creek.

ANALYSES and RECOMMENDATIONS

Foundation Design

Foundations for the new bridge must satisfy two (2) basic and independent design criteria: a) foundations must have an acceptable factor of safety against bearing failure under maximum design loads, and b) foundation movement due to consolidation or swelling of the underlying strata should not exceed tolerable limits for the structures. Construction factors, such as installation of foundations, excavation procedures and surface and groundwater conditions, must also be considered.

Based on the results of the borings completed at the Little Osage Creek location and our understanding of the project, we recommend that foundation loads at the bridge ends (Bents 1 and 4) be supported on steel piles. The foundation loads at the interior bents (Bents 2 and 3) may be supported on drilled shaft foundations. Recommendations for foundations are discussed in the following report sections.

Piling Foundations – Bents 1 and 4

We recommend that the foundation loads at the bridge ends be supported on HP12x53 steel piles. Point-bearing steel piles driven to refusal should extend through any new embankment fill, the natural overburden soils, and any zones of highly weathered cherty limestone to develop safe bearing capacity in the competent moderately hard to hard limestone. End-bearing piles should be driven to practical refusal in the moderately hard to hard limestone. We recommend that all steel piles be fitted with rock points.

Steel piles driven to refusal should be designed for the structural capacity of the pile, as per applicable AASHTO Load and Resistance Factor Design (LRFD) procedures[3]. An effective resistance factor (φ_c) of 0.50 is recommended for structural determination of factored bearing capacities. This effective resistance factor for steel piles has been based on the assumption of severe driving conditions.

For determination of bearing capacities of steel piles driven to refusal, we recommend that nominal (ultimate) resistance (P_n) of HP piles be determined based on the yield strength of steel H

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[3] Load and Resistance Factor Design (LRFD) for Highway Bridge Substructures, Publication No. FHWA HI-98-032, National Highway Institute, May 2001.

piles (f_y) and the net end area (A_{net}) of the section. It has been our experience that allowable pile capacities of 96 tons for HP12x53 piles are typical for f_y = 50 ksi steel pile sections. These capacities are based on allowable stress design (ASD). However, the appropriate factored bearing capacity should be confirmed by the Engineer. Post-construction settlement of piles driven to refusal will be negligible.

The nominal axial capacities are based on single, isolated foundations. Piles spaced closer than three (3) pile widths may develop lower individual capacity due to group effects. The potential for group capacity reductions should be evaluated for pile spacing closer than three (3) widths (center to center).

Estimated pile tip elevations are summarized below in Table 2 below.

Table 2: Estimated Tip Elevations of Steel Piles Driven to Refusal

Bent No.	Estimated Pile Tip Elevation, ft	Comments
1A (South Bridge End)	1075	Refusal in moderately hard cherty limestone
1B (South Bridge End)	1067	Refusal in moderately hard cherty limestone
4A (North Bridge End)	1067	Refusal in moderately hard cherty limestone
4B (North Bridge End)	1070	Refusal in moderately hard cherty limestone

It should be noted that the tip elevations shown in the table above are estimates only based on the results of the relevant borings and the inferred surface elevations at the particular locations. Pile refusal and final depth must be field verified. Additional pile depth may be required to resist uplift loads.

Steel piles at the end bents may be subjected to uplift loads. Nominal single pile uplift capacity curves for steel HP12x53 piles are provided in Appendix E. Nominal axial pile capacities have been developed using static pile capacity formulae, the results of the borings, and the plan site grading shown on the preliminary bridge layout drawings.

Based on AASHTO LRFD geotechnical design procedures, a resistance factor (φ_{up}) of 0.25 is recommended for evaluation of factored uplift capacity. This resistance factor is based on Strength Limit States. For Extreme Events Limit States such as earthquake loading and collision, a resistance factor of 0.8 for uplift is recommended.

Piles should be installed in compliance with Standard Specifications for Highway Construction, 2014 Edition, Section 805. We recommend a hammer delivering a minimum energy of 34,000 ft-lbs per blow. A specific review and analysis of the pile-hammer system proposed by the Contractor should be performed by the Engineer prior to hammer acceptance and start of driving. We recommend that all piles be fitted with rock points.

A minimum pile length of 10 ft is recommended. In general, preboring is not expected to be required for pile installation. Where insufficient soil axial capacity necessitates pile penetration into the resistant limestone, preboring could be required for pile installation. Rock drilling methods will be required for prebores extending through the competent limestone. Following pile acceptance, the annulus around the installed piles in prebores should be expeditiously backfilled with grout as per ARDOT Standard Specifications Section 805. The grout should have a minimum compressive strength pf 4000 psi, as per ARDOT Section 501 or an alternate approved by the Engineer.

As a minimum, safe bearing capacity of piles should be determined by ARDOT Standard Specifications Section 805.09, Method A. Driving records should be available for review by the Engineer during pile installation. Blow counts on steel piles should be limited to about 20 blows per inch. Practical pile refusal may be defined as a penetration of 0.5 in. or less for the final 10 blows. Driving records should be available for review by the Engineer during pile installation.

Drilled Shaft Foundations – Bents 2 and 3

Drilled straight shafts are recommended for support of foundation loads at the interior bents, Bents 2 and 3. Drilled shafts should be founded with a minimum embedment of 1.5 shaft diameters or 6 ft, whichever is greater, into the moderately hard to hard gray and tan cherty limestone. Drilled shafts founded as recommended may be sized using a maximum nominal end-bearing pressure (R_n) of 125 kips per sq foot. A resistance factor (φ_{stat}) of 0.50 is recommended for drilled shaft end bearing. Total and differential settlement of properly installed drilled shafts founded in the competent moderately hard to hard limestone as recommended is expected to be negligible. We also recommend that drilled shafts be sized for axial compression loads based on end bearing alone.

Resistance to uplift loads will be developed by circumferential shaft friction. Drilled shafts will penetrate the overburden soils to bear in the competent moderately hard to hard cherty limestone. Uplift resistance for the top 5 ft of shaft length, all penetration through the overburden soils, and the length of permanent casing should be neglected. For shaft penetration through the competent cherty limestone, a maximum nominal skin resistance value of 12 kips per sq ft is recommended. For evaluation of uplift capacity, a resistance factor (φ_{up}) of 0.40 is recommended for shaft skin friction.

A minimum shaft rock socket length of 1.5 shaft diameters or 6 ft, whichever is greater, is recommended for drilled shafts. The as-built shaft length will vary with location and depth of overburden. In general, rock strata are 7 to 10 ft below the ground line at the bent locations. It is expected that permanent casing will extend to the top of rock and slightly into the rock.

The depths to suitable rock strata are estimates only, and are based on the results of the borings, the inferred surface elevation at the particular bent location, and existing grades. Suitable bearing stratum and final shaft lengths must be field verified. Plan shaft lengths and shaft tip elevations must be based on the magnitude of foundation loads, specific subsurface conditions, and actual shaft diameters. Depending on specific subsurface conditions and rock quality, localized deepening or shortening of shaft depths can be warranted.

All drilled shaft excavations should be observed by the Engineer to verify suitable bearing and adequate penetration. Heavy-duty drilling equipment will be required to advance the shaft excavations. The moderately hard to hard limestone bearing stratum will be resistant to drilling and rock drilling methods are expected to be required to achieve the required shaft penetration.

To verify competence of the moderately hard to hard limestone bearing stratum, we recommend that all shaft excavations be probed. Probe holes should consist of continuous rock core borings advanced from the shaft bottom elevation into the bearing stratum a depth of at least one-and-one-half (1.5) shaft diameters. Rock cores from probe holes should be reviewed by the Engineer to verify foundation stratum competence and suitability of the plan shaft bottom elevation.

Embankment Slopes

The new bridges include embankments at each bridge end. Plan bridge end embankment configurations are 2-horizontal to 1-vertical (2H:1V) with 3-horizontal to 1-vertical (3H:1V) side slope configurations. The bridge embankments will have maximum heights of about 34 feet.

To evaluate suitability of the side slope plan configurations, slope stability analyses were performed using the computer program SLOPE/W 2020[4] and utilizing a Morgenstern-Price analysis. For the embankment slopes, four (4) general loading conditions were evaluated, i.e., End

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[4] *ibid*

of Construction, Long Term, Rapid Drawdown, and Seismic Conditions were evaluated. A 250 lbs per sq ft uniform surcharge from vehicles was included for the purposes of stability analyses. For analysis of the seismic condition, a horizontal seismic acceleration coefficient (k_h) of one-half the peak acceleration (A_s) was used, a value of 0.0245. For evaluation of the rapid drawdown condition, a water surface elevation drop from El 1085 to El 1074 was assumed.

The stability analyses results summarized in Appendix F include the results of evaluation of end and side slopes. The results of the stability analyses indicate that plan configurations of the slopes are acceptable with respect to stability of all loading conditions evaluated.

Subgrade Support

The results of the borings indicate the on-site subgrade soils generally consist of silt and silty clay with chert fragments (AASHTO A-2-6, A-4, and A-6). Given the anticipated new embankment, the approach roadway subgrade is likely to consist of embankment fill. Locally-available borrow, which is likely to be used as unclassified embankment fill, is expected to have similar classification.

We recommend that any soils classifying as A-7-5 or A-7-6 soils be excluded from use as subgrade within 18 in. of the plan subgrade elevation. The top 18 in. of subgrade soils should have a maximum plasticity index (PI) of 18. The as-built pavement subgrade should be evaluated by the Engineer. Areas of unstable or otherwise unsuitable subgrade should be improved by undercut and replacement or treatment with additives approved by the Engineer.

Based on the results of previous laboratory CBR tests on the silty clay with chert fragments subgrade and correlation with the AASHTO classification, we recommend the following parameters for use in design of pavements.

• CBR:	8.3
• Resilient Modulus (M_R):	3260 lbs per sq in.
• R value:	13
• Modulus of Subgrade Reaction (k):	100 lbs per cu in.

Site Grading and Subgrade Preparation

As noted, the surface soils are moisture-sensitive. Though presently stable, at elevated water contents the silt and clayey silt subgrade is likely to be soft and unstable. Consequently, site grading operations will be significantly easier to perform during dry seasons of the year.

Site preparation will require some clearing and grubbing and stripping the zone of organic-containing soils. The depth of stripping will be variable, with deeper stripping depths in wooded areas, and less stripping required in open areas. In general, the stripping depth is estimated to be about 6 to 9 inches in clear areas but may be 18 to 24 in. or more in the localized areas where trees and thick underbrush are present. The zone of organic surface soils should be completely stripped in the embankment footprint areas and at least 5 ft beyond the projected embankment toes. Particular care must be taken to muck out all saturated and/or organic-laden soils in the existing drainage features. Hillsides should be benched to allow placement of embankment fill in horizontal lifts. The maximum vertical cut on benches should be limited to about 18 to 24 inches.

Following stripping and prior to fill placement, the extent of weak and unsuitable soils should be determined. Thorough proof-rolling should be performed to verify subgrade stability. Proof-rolling should be performed with a loaded tandem-wheel dump truck or similar equipment. Unstable soils exhibiting a tendency to rut and/or pump should be undercut and replaced with suitable fill. Care should be taken that undercuts, stump holes, and other excavations or low areas resulting from subgrade preparation are properly backfilled with compacted fill.

Depending on seasonal conditions, undercuts of about 4 to 6 ft below existing grades, more or less, could be required in embankment areas. General undercuts for site grading may be backfilled with unclassified borrow used for embankment fill. Where embankment subgrade undercuts extend into wet subgrade areas or into the channel, use of stone backfill (ARDOT Standard Specifications Section 207) or shot rock fill will be warranted. An example special provision for shot rock fill is provided in Appendix G.

In lieu of undercutting and replacing unsuitable soils in the embankment subgrade or approach road alignments, consideration may be given to using additives to improve soil workability and to stabilize weak areas. Hydrated lime, quick lime, Portland cement, fly ash, or suitable alternate materials may be used as verified by appropriate testing and approved by the Engineer. Additives can be effective where the depth of unstable soils is relatively shallow. Treatment will be less effective in areas where the zone of unstable soils is deep. The optimum application rate of stabilization additive must be determined by specific laboratory tests performed on the alignment subgrade soils. We recommend a minimum treatment depth of 8 inches.

Subgrade preparation and mass undercuts should extend at least 5 ft beyond the embankment toes to the extent possible. Subgrade preparation for the approach roads should extend at least 3 ft outside pavement shoulder edges to the extent possible.

Fill and backfill may consist of unclassified borrow free of organics and other deleterious materials as per ARDOT Standard Specifications Subsection 210.06. Where A-7-5 or A-7-6 soils are encountered at the subgrade elevation, we recommend that these soils be undercut as required to provide at least 18 in. of suitable low-plasticity subgrade soils, i.e., with a maximum PI of 18, or approved "hillside" cherty clay with a maximum of 35 percent passing the No. 200 sieve. Alternatively, stabilization additives may be utilized to develop a stable subgrade with a PI of 18 or less. Granular soils must be protected from erosion with a minimum 18-in.-thick armor of clayey soil.

Subgrade preparation should comply with ARDOT Standard Specifications Section 212. Embankments should be constructed in accordance with ARDOT criteria (ARDOT Standard Specifications Section 210). Fill and backfill should be placed in nominal 6- to 10-in.-thick loose lifts. All fill and backfill must be placed in horizontal lifts. Hillsides should be benched as required to facilitate placing horizontal fill lifts. The in-place density and water content should be determined for each lift and should be tested to verify compliance with the specified density and water content prior to placement of subsequent lifts.

CONSTRUCTION CONSIDERATIONS

Groundwater and Seepage Control

Positive surface drainage should be established at the start of the work, be maintained during construction and following completion of the work to prevent surface water ponding and subsequent saturation of subgrade soils. Density and water content of all earthwork should be maintained until embankments, bridge work, and pavements are completed.

Localized perched groundwater was encountered between 1- to 10-ft in March and April 2023. Shallow perched groundwater may be encountered in the near-surface soils, particularly during wet seasons. The volume of groundwater produced can be highly variable depending on the condition of the soil in the immediate vicinity of the excavation. In addition, seasonal surface seeps or springs could develop.

Seepage into excavations and cuts can typically be controlled by ditching or sump-and-pump methods. If seepage infiltration cannot be controlled, construction of drains and/or the use of Select Granular Backfill (AASHTO M 43 No. 57), stone backfill (ARDOT Standard Specifications Section 207), or approved alternates to an elevation above the inflow of seepage will be warranted. In areas of seepage infiltration, the granular fill should be encapsulated with a filter fabric complying with ARDOT Standard Specifications Subsection 625.02, Type 2 and vented to positive discharge. Where surface seeps or springs are encountered during site grading, we recommend the seepage be directed via French drains or blanket drains to positive discharge at daylight or to storm drainage lines.

Site preparation should also include construction of blanket drains in all existing drainage features which will be covered by fill. All loose and/or organic materials should be excavated from drainage features prior to drain construction. Blanket drains should consist of at least 8 to 12 in. of select granular backfill (AASHTO M 43 No. 57) fully encapsulated by a filter fabric. A fabric complying with ARDOT Standard Specifications Subsection 625.02, Type 2 is recommended. Drains should direct water to positive discharge at daylight or into storm drain lines.

Piling

Piles should be installed in compliance with ARDOT Standard Specifications, Section 805. Piles should be carefully examined prior to driving and piles with structural defects should be rejected. Any splices in steel piles should develop the full cross-sectional capacity of un-spliced piles. Where piles are prebored to develop uplift resistance, the annulus between the steel piles and the prebore should be expeditiously backfilled with approved grout or concrete. Some rock drilling could be required for prebores. Where piles are prebored to develop uplift resistance, the annulus between the steel piles and the prebore should be expeditiously backfilled with approved grout or concrete.

Pile installation should be monitored by qualified personnel to maintain specific and complete driving records and observe pile installation procedures. Safe bearing capacity of production piles should be determined by ARDOT Standard Specifications Section 805.09, Method A. Driving records should be available for review by the Engineer during pile installation. For driving steel piles on this project, we recommend a minimum hammer energy of 34,000 ft-lbs per blow. Blow counts on steel piles should be limited to about 20 blows per inch. Practical pile refusal may be defined as a penetration of 0.5 in. or less for the final 10 blows.

Drilled Shafts

As noted, groundwater was encountered in the bridge borings at about 1- to 10-ft depth in March and April 2023. Groundwater could be encountered in drilled shaft excavations. Limited seepage into drilled shaft excavations can probably be controlled by close coordination of drilling, cleanup and concrete placement. We understand that the shaft construction will include permanent casing. Casing should extend to competent rock to the extent possible. Drilled shaft excavations should essentially be dry at the time of concrete placement. Where more than about 3 in. of water is present in shaft excavations, the excavation should be dewatered prior to concrete placement. Where shaft excavations cannot be dewatered, underwater concrete placement should be performed with a concrete pump fitted with a rigid end extension. A muck bucket or similar tools should be utilized to clean the shaft excavation bottom prior to underwater concrete placement.

Some hard drilling will be experienced when advancing drilled shaft excavations into the moderately hard to hard limestone. Heavy-duty drilling equipment and rock drilling tools will be required to advance shaft excavations to the recommended minimum penetration into the competent limestone. Coring or other rock excavation methods will be required to achieve the recommended penetration into the rock bearing stratum. All drilled shaft excavations should be observed by the Engineer or Department to verify suitable bearing and adequate penetration.

Rock Excavation

Rock excavation will likely be required for site grading. Cuts and excavations extending into the cherty limestone will be required to advance through hard rock zones which will require rock excavation methods. This may include ripping with a single-tooth ripper on a track excavator, a hoeram or jackhammer, or blasting.

The need for rock excavation should be anticipated. Contract documents should include a unit price for removal and disposal of materials and obstructions that cannot be excavated with conventional heavy-duty excavating equipment. The conventional heavy-duty excavating equipment may be defined as a Caterpillar D-7 bulldozer with single tooth ripper, a Caterpillar 312 track excavator equipped with rock teeth, or equipment of similar power and capability. Rock excavation volumes should be determined based on in-place measurements via cross sectioning. If excavation is to be unclassified, the Contractor must be responsible for assessing rock excavation requirements.

CLOSURE

The Engineer or Department or a designated representative thereof should monitor site preparation, grading work and all construction. Subsurface conditions significantly at variance with those encountered in the borings should be brought to the attention of the Geotechnical Engineer. The conclusions and recommendations of this report should then be reviewed in light of the new information.

The following attachments are included and complete this final submittal.

Plate 1	Site Vicinity
Plate 2	Plan of Borings
Plates 3 through 16	Boring Logs
Plates 17 and 18	Keys to Terms and Symbols
Appendix A	Preliminary Bridge Layout
Appendix B	Selected Rock Core Photographs
Appendix C	Classification Test Results
Appendix D	Generalized Subsurface Profile
Appendix E	Nominal HP12x53 Uplift Pile Capacity Curves
Appendix F	Stability Analyses Results
Appendix G	Example Special Provision – Shot Rock Fill

* * * * *

We appreciate the opportunity to be of service to you on this project phase. Should you have any questions regarding this report, or if we may be of additional assistance, please call on us.

Sincerely,

GRUBBS, HOSKYN,
BARTON &WYATT, LLC

Velleta M. Scott

Velleta M. Scott, P.E.
Sr. Project Engineer

Mark E. Wyatt, P.E.
President

STATE OF ARKANSAS
REGISTERED PROFESSIONAL ENGINEER
No. 7791
MARK E. WYATT

VMS/MEW:jw

Copies Submitted: Garver LLC

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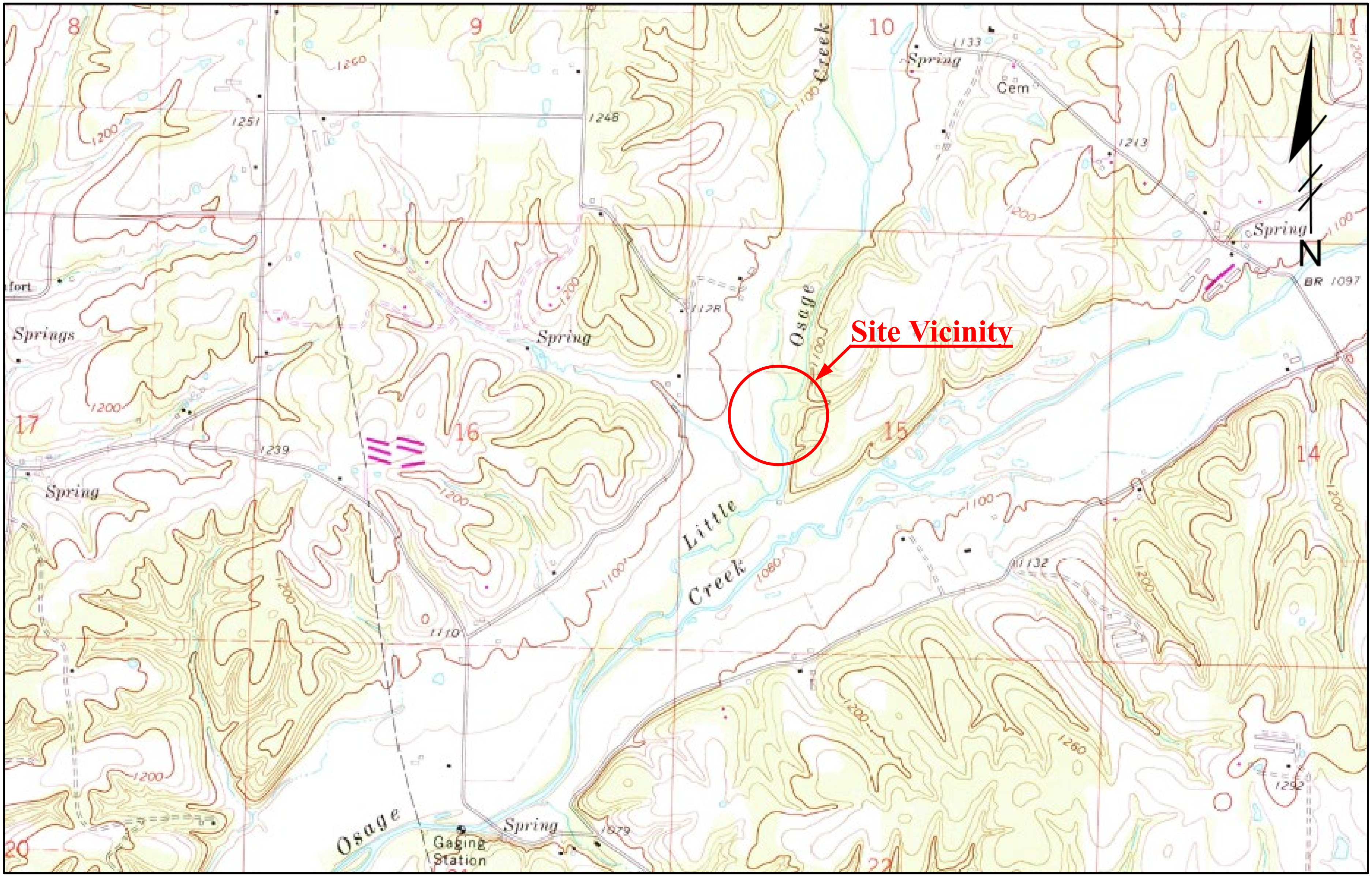
Attn:	Mr. Lawren Wilcox, P.E.	(1-email)
Attn:	Mr. Adam Wierciak, P.E.	(1-email)



SITE VICINITY MAP

090069 XNA Access Road over Little Osage Creek

Benton County, Arkansas

Job No. 19-118

Plate 1

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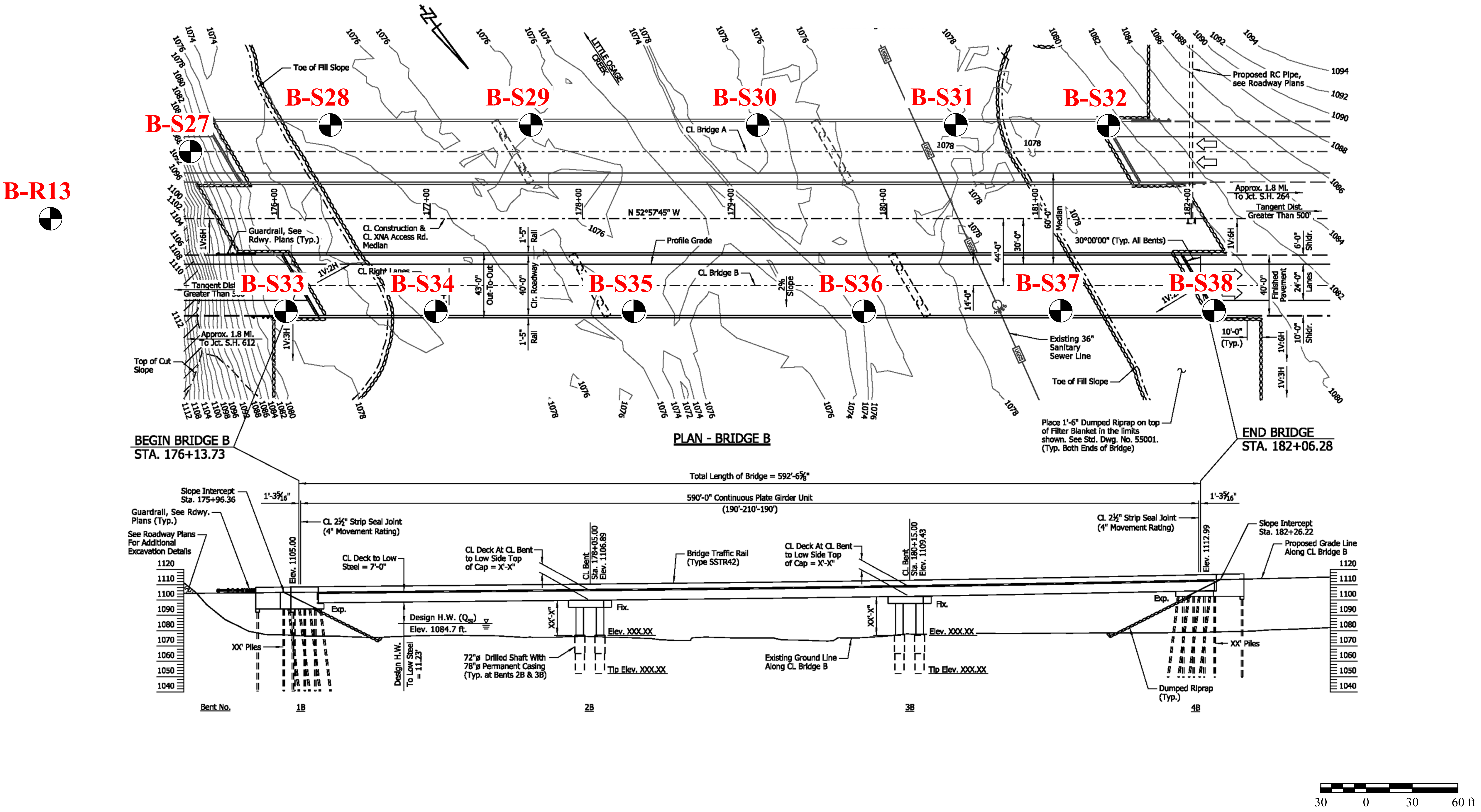
A UES Company



Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

PLAN of BORINGS

090069 XNA Access Road over Little Osage Creek
Benton County, Arkansas

Scale: As shown	Job No. 19-118	PLATE 2

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R13

090069 XNA Access Road over Little Osage Creek
Benton Co., Arkansas

TYPE: Auger to 10 ft /Wash

LOCATION: Approx Sta 174+50, CL

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 1126±	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT ○ 0.2 0.4 0.6 0.8 1.0 1.2 1.4 PLASTIC LIMIT + WATER CONTENT ● LIQUID LIMIT + 10 20 30 40 50 60 70	- No. 200 %	% Recovery	% RQD
			Soft reddish brown silty clay w/chert fragments	4					
			Very stiff reddish brown and tan silty clay w/numerous chert fragments	32					
5				50/6"					
			- with chert layers below 6 ft	50/8"					
10			Moderately hard tan and gray weathered limestone w/reddish brown silty clay filled fractures and seams	50/10"					
15				25/0"					
20				25/0"					
25									

COMPLETION DEPTH: 20.0 ft
DATE: 3-7-23

DEPTH TO WATER
IN BORING: Dry to 10 ft

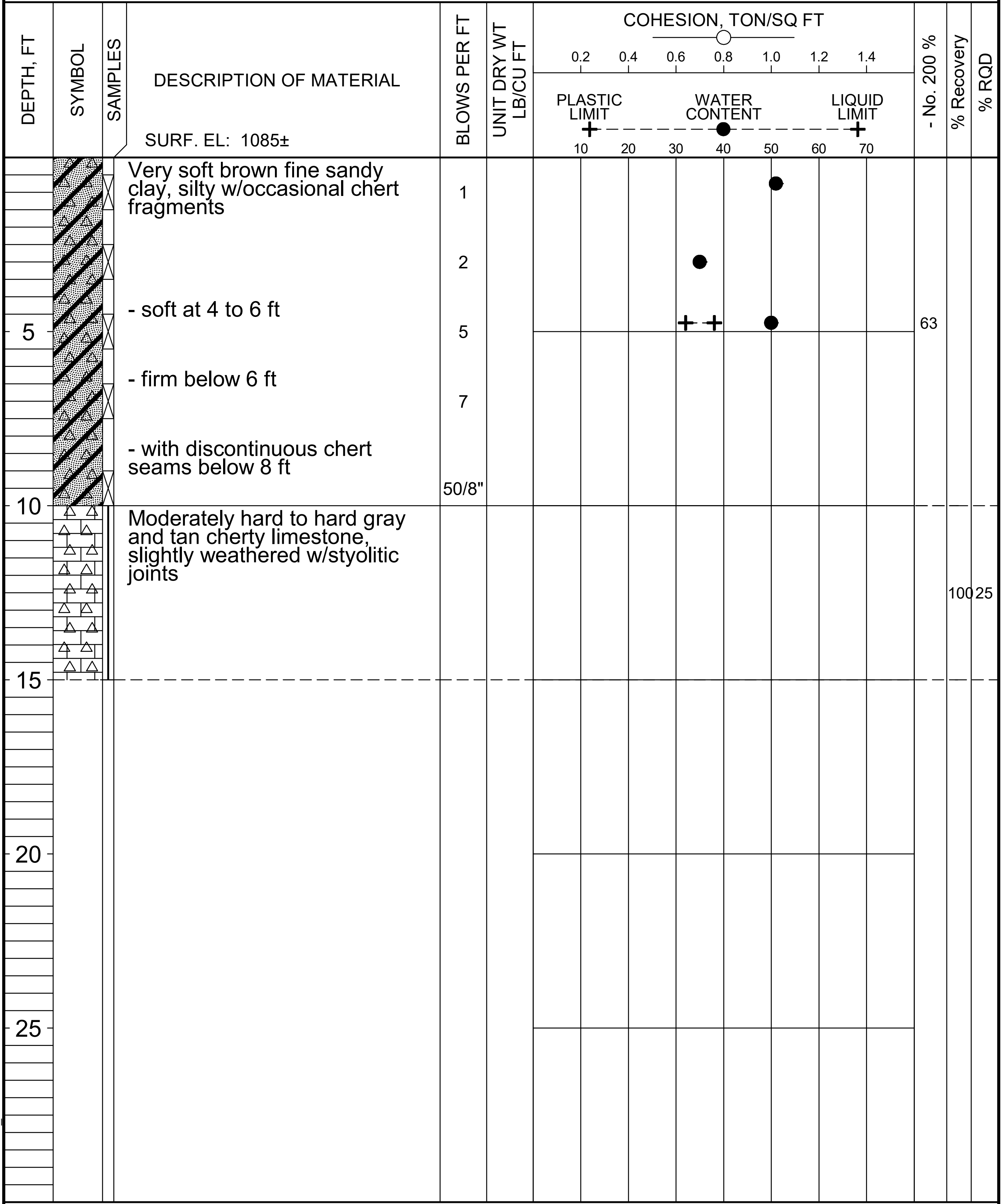
DATE: 3/7/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S27

090069 XNA Access Road over Little Osage Creek
Benton Co., Arkansas

TYPE: Auger to 10 ft /Core
LOCATION: Approx Sta 175+45, 45 ft Lt



DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	SURF. EL: 1085±					
0	Very soft brown fine sandy clay, silty w/occasional chert fragments	1				
		2				
	- soft at 4 to 6 ft	5		63		
	- firm below 6 ft	7				
	- with discontinuous chert seams below 8 ft	50/8"				
10	Moderately hard to hard gray and tan cherty limestone, slightly weathered w/styolitic joints				100	25
15						

COMPLETION DEPTH: 15.0 ft
DATE: 4-4-23

DEPTH TO WATER
IN BORING: 1 ft

DATE: 4/11/2023

RECRQDN200-2 19-118_LITTLE OSAGE CREEK.GPJ 9-21-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

L O G O F B O R I N G N O. S28

090069 XNA Access Road over Little Osage Creek
Benton Co., Arkansas

TYPE: Auger to 10 ft /Core

LOCATION: Approx Sta 176+35, 60 ft Lt

SURF. EL: 1076±

COHESION, TON/SQ FT ○: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT + – – WATER CONTENT ● – – LIQUID LIMIT +: 10 20 30 40 50 60 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Very soft brown clayey silt w/occasional chert fragments	3				
	- moist below 2 ft	0/WOH				
5	Firm brown silty clay w/chert fragments, wet	8				
	- firm to stiff below 6 ft	10				
	- auger refusal at 10 ft	50/5"				
10	Moderately hard gray and light gray weathered cherty limestone, fractured				92	52
15	Moderately hard to hard gray and light gray cherty liemstone w/stylolites and rehealed fractures				98	96
20					100	100
25					100	100

COMPLETION DEPTH: 48.0 ft
DATE: 9-16-23

DEPTH TO WATER
IN BORING: 5 ft

DATE: 9/16/2023

**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**
Consulting Engineers

L O G O F B O R I N G N O. S28

090069 XNA Access Road over Little Osage Creek
Benton Co., Arkansas

TYPE: Auger to 10 ft /Core

LOCATION: Approx Sta 176+35, 60 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4); PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %	% Recovery	% RQD
								100	92
35									
								100	100
40									
								95	80
45									
								100	100
50									
55									

COMPLETION DEPTH: 48.0 ft
DATE: 9-16-23

DEPTH TO WATER
IN BORING: 5 ft

DATE: 9/16/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S29

090069 XNA Access Road over Little Osage Creek
Benton Co., Arkansas

TYPE: Auger to 4 ft /Wash to 12 ft /Core

LOCATION: Approx Sta 177+35, 60 ft Lt

SURF. EL.: 1076±

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	- No. 200 %	% Recovery	% RQD
	Very soft dark brown clayey silt w/occasional decayed organics	2					
	- soft at 2 to 4 ft - with some fine to coarse gravel below 2 ft	5					
5	- firm at 4 to 6 ft - with more gravel below 4 ft	9					
	- stiff below 6 ft	14					
	Low hardness light gray weathered cherty limestone, flat bedded w/some stylolites	44					
10							
	- moderately hard below 12 ft						
						83	47
15				q_u= 7420 psi			
						88	80
20							
						93	93
25				q_u= 10740 psi, TUW= 147 pcf			
						97	97

COMPLETION DEPTH: 57.0 ft
DATE: 3-28-23

DEPTH TO WATER
IN BORING: 6 ft

DATE: 3/27/2023

19-118

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

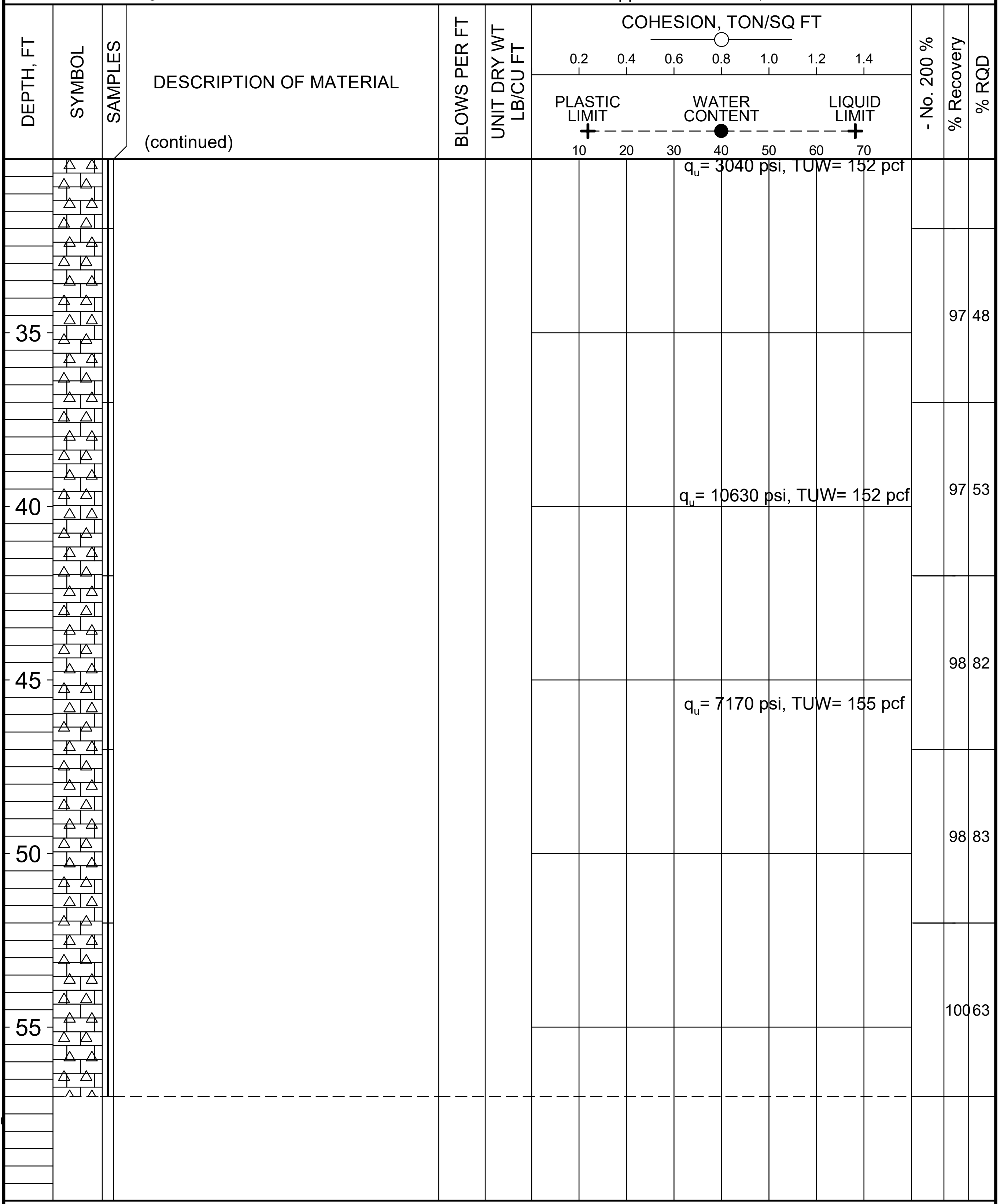
LOG OF BORING NO. S29

090069 XNA Access Road over Little Osage Creek
Benton Co., Arkansas

TYPE: Auger to 4 ft /Wash to 12 ft /Core

LOCATION: Approx Sta 177+35, 60 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
						q_u= 3040 psi, TUW= 152 pcf			
35								97	48
						q_u= 10630 psi, TUW= 152 pcf		97	53
40									
45								98	82
						q_u= 7170 psi, TUW= 155 pcf			
50								98	83
55								100	63



COMPLETION DEPTH: 57.0 ft
DATE: 3-28-23

DEPTH TO WATER
IN BORING: 6 ft

DATE: 3/27/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S30

090069 XNA Access Road over Little Osage Creek
Benton Co., Arkansas

TYPE: Auger to 8 ft /Core

LOCATION: Approx Sta 179+15, 60 ft Lt

SURF. EL: 1078±

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT + — WATER CONTENT ● — LIQUID LIMIT +: 10 20 30 40 50 60 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Medium dense brown silt, slightly clayey w/chert fragments, dry	14				
	Stiff reddish brown silty clay w/chert fragments, dry	18				
5	- with discontinuous chert seams and layers below 4 ft	50/4				
	- auger refusal at 8 ft	17				
	Moderately hard gray and light gray weathered cherty limestone, fractured				100	58
10	- void at 11 to 13 ft				53	30
15					65	47
20	Moderately hard to hard gray and light gray cherty limestone w/stylolites and rehealed fractures				100	100
25					95	88

COMPLETION DEPTH: 45.0 ft
DATE: 9-15-23

DEPTH TO WATER
IN BORING: Dry to 8 ft

DATE: 9/15/2023

RECRQDN200-2 19-118_LITTLE OSAGE CREEK.GPJ 9-21-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S30

090069 XNA Access Road over Little Osage Creek
Benton Co., Arkansas

TYPE: Auger to 8 ft /Core

LOCATION: Approx Sta 179+15, 60 ft Lt

DESCRIPTION OF MATERIAL

(continued)

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

DEPTH, FT	SYMBOL	SAMPLES	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
						100	95
35							
						97	83
40							
						100	82
45							
50							
55							

COMPLETION DEPTH: 45.0 ft
DATE: 9-15-23

DEPTH TO WATER
IN BORING: Dry to 8 ft

DATE: 9/15/2023

RECRQDN200-2 19-118_LITTLE OSAGE CREEK.GPJ 9-21-23

19-118

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

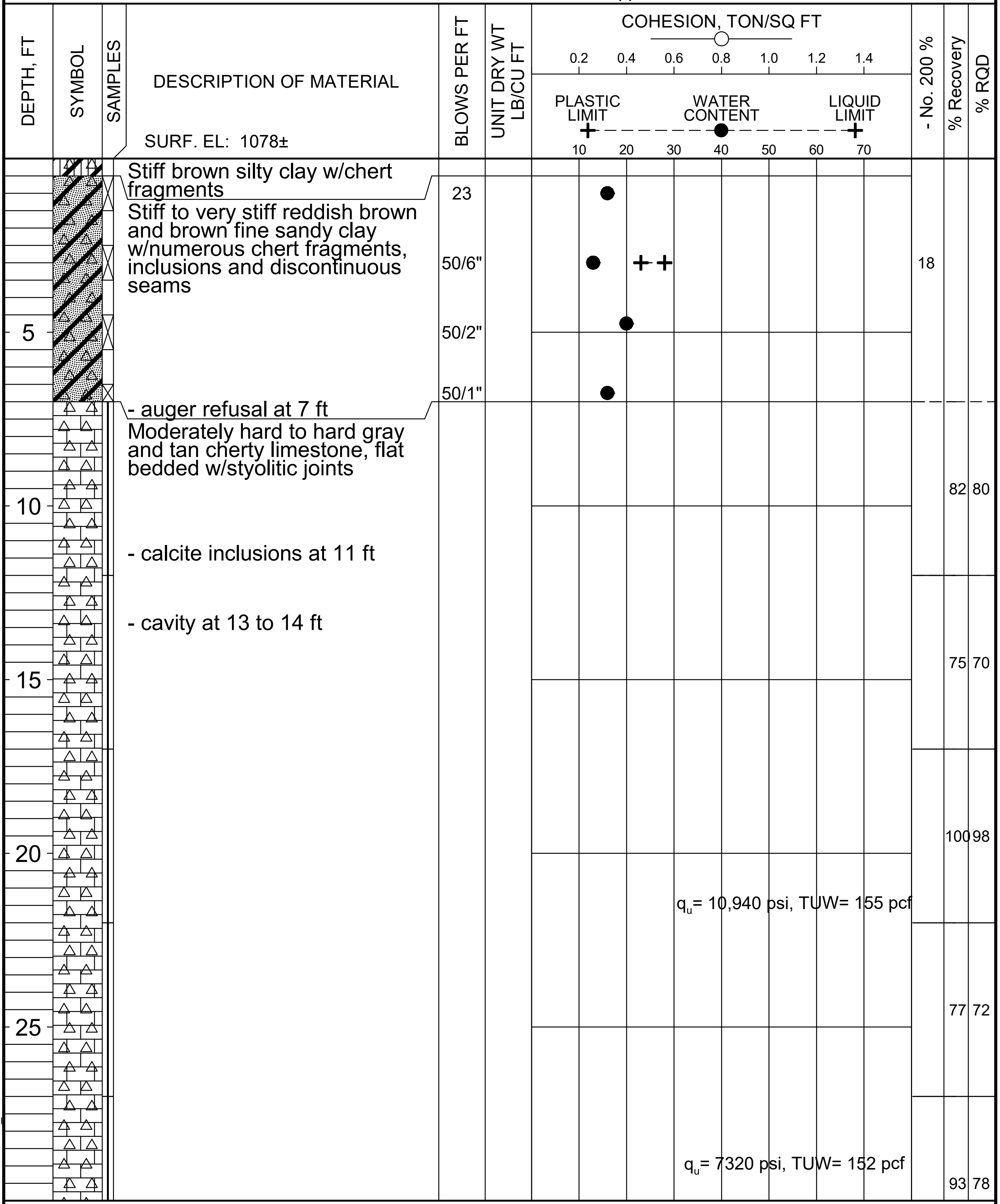
LOG OF BORING NO. S31

090069 XNA Access Road over Little Osage Creek
Benton Co., Arkansas

TYPE: Auger to 7 ft /Core

LOCATION: Approx Sta 180+45, 60 ft Lt

SURF. EL: 1078±



DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
0–1	Stiff brown silty clay w/chert fragments	23				
1–7	Stiff to very stiff reddish brown and brown fine sandy clay w/numerous chert fragments, inclusions and discontinuous seams	50/6"		18		
		50/2"				
	- auger refusal at 7 ft	50/1"				
7–	Moderately hard to hard gray and tan cherty limestone, flat bedded w/styolitic joints				82	80
	- calcite inclusions at 11 ft					
	- cavity at 13 to 14 ft				75	70
					100	98
	q_u= 10,940 psi, TUW= 155 pcf					
					77	72
	q_u= 7320 psi, TUW= 152 pcf				93	78

COMPLETION DEPTH: 56.5 ft
DATE: 4-14-22

DEPTH TO WATER
IN BORING: Dry to 7 ft

DATE: 4/5/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S31

090069 XNA Access Road over Little Osage Creek
Benton Co., Arkansas

TYPE: Auger to 7 ft /Core

LOCATION: Approx Sta 180+45, 60 ft Lt

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT 0.2 0.4 0.6 0.8 1.0 1.2 1.4 / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT 10 20 30 40 50 60 70	- No. 200 %	% Recovery	% RQD
35						98	88
						97	77
40				q_u= 9010 psi, TUW= 150 pcf		98	88
45	- vertical shear at 46 to 46.1 ft					90	85
50						100	96
55						90	70

COMPLETION DEPTH: 56.5 ft
DATE: 4-14-22

DEPTH TO WATER
IN BORING: Dry to 7 ft

DATE: 4/5/2022

Grubbs, Hoskyn,
Barton & Wyatt, Inc.
Consulting Engineers

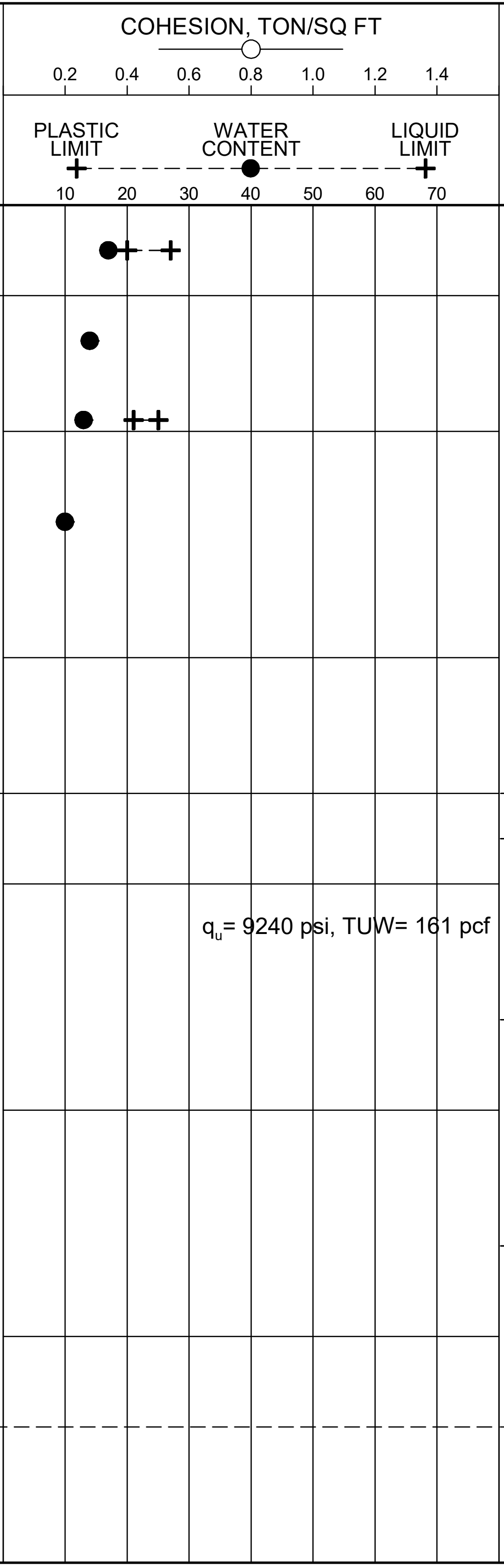
LOG OF BORING NO. S32

090069 XNA Access Road over Little Osage Creek
Benton Co., Arkansas

TYPE: Auger to 11 ft /Wash to 13 ft /Core

LOCATION: Approx Sta 181+45, 60 ft Lt

SURF. EL.: 1080±



q_u= 9240 psi, TUW= 161 pcf

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
			Firm brown clayey silt w/chert fragments	9		48		
			Stiff to very stiff reddish brown fine sandy clay w/numerous chert fragments and inclusions	40				
5				24		22		
				29				
			- silty with more chert fragments and chert seams below 8 ft	50/7"				
10								
			- auger refusal at 11 ft					
			- rock bit refusal at 13 ft					
			Moderately hard to hard gray cherty limestone, stylolitic joints				100	75
15							100	67
20							80	58
			- calcite inclusions at 22 ft					
25							100	75

COMPLETION DEPTH: 27.0 ft
DATE: 4-7-22

DEPTH TO WATER
IN BORING: 10 ft

DATE: 4/8/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S33

090069 XNA Access Road over Little Osage Creek
Benton Co., Arkansas

TYPE: Auger to 11 ft /Core

LOCATION: Approx Sta 176+00, 60 ft Rt

SURF. EL: 1078±

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Very soft to soft brown clayey silt w/trace fine to coarse gravel	4				
	- very soft at 2 to 4 ft	2				
5	- with chert fragments below 4 ft - soft at 4 to 6 ft	6				
	- stiff below 6 ft	14				
10	Very loose to loose tan sandy fine to coarse chert gravel, silty	4				
	Moderately hard light gray and gray cherty limestone w/stylolites and rehealed fractures				100	71
15						
					100	85
20					100	100
25						

COMPLETION DEPTH: 21.0 ft
DATE: 9-18-23

DEPTH TO WATER
IN BORING: 5.8 ft

DATE: 9/18/2023

RECRQDN200-2 19-118_LITTLE OSAGE CREEK.GPJ 9-21-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S34

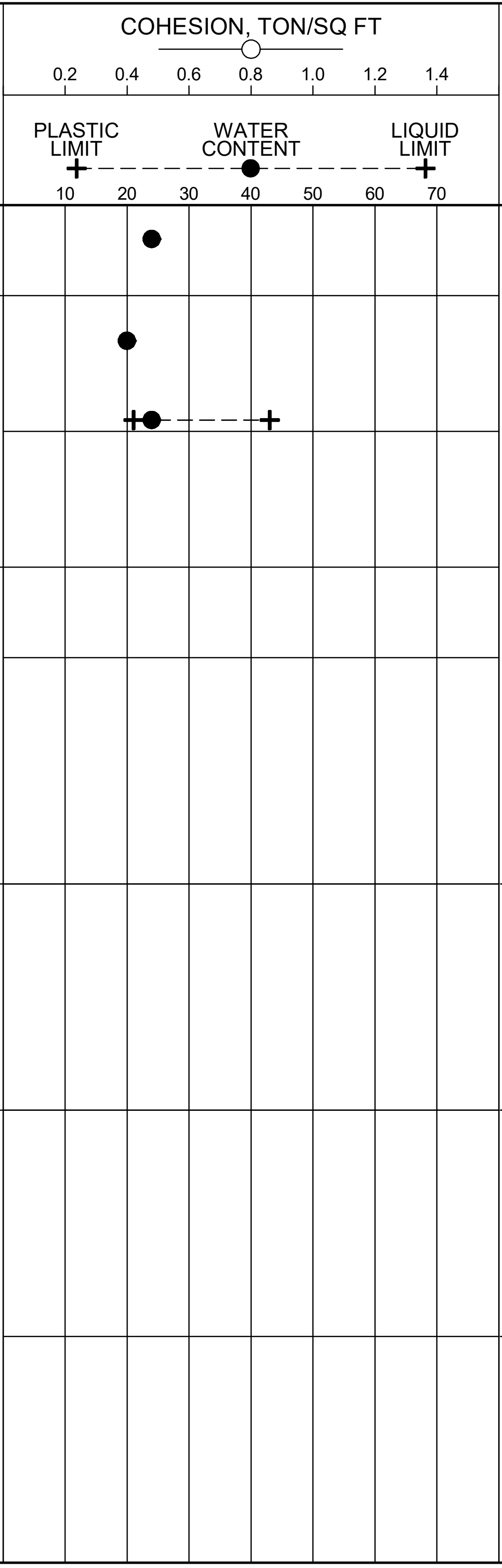
090069 XNA Access Road over Little Osage Creek
Benton Co., Arkansas

TYPE: Auger to 10 ft /Wash to 15 ft /Core

LOCATION: Approx Sta 177+00, 60 ft Rt

SURF. EL: 1076±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
0–2	Very loose brown fine sandy silt	2				
2–8	Soft brown silty clay w/numerous chert fragments	6				
	- stiff at 4 to 6 ft	23		20		
	- very stiff below 6 ft	26				
8–15	Moderately hard gray and tan highly weathered cherty limestone w/discontinuous chert seams and layers	50/4"				
	- moderately hard to hard below 13 ft	25/0"				
15–20	Moderately hard to hard gray and tan cherty limestone, slightly weathered w/some stylolitic joints, flat bedded				88	88
20–30	Moderately hard to hard gray and tan cherty limestone w/stylolitic joints, flat bedded				97	72
					100	92



COMPLETION DEPTH: 59.0 ft
DATE: 4-12-23

DEPTH TO WATER
IN BORING: Dry to 10 ft

DATE: 4/12/2023

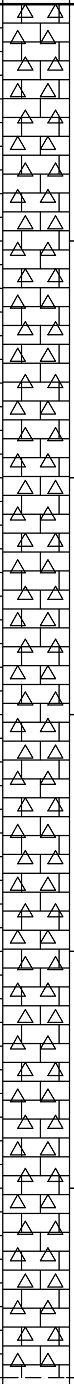
Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S34

090069 XNA Access Road over Little Osage Creek
Benton Co., Arkansas

TYPE: Auger to 10 ft /Wash to 15 ft /Core

LOCATION: Approx Sta 177+00, 60 ft Rt



DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT ○ 0.2 0.4 0.6 0.8 1.0 1.2 1.4 PLASTIC LIMIT + WATER CONTENT ● LIQUID LIMIT + 10 20 30 40 50 60 70	- No. 200 %	% Recovery	% RQD
						q_u= 8200 psi, TUW= 156 pcf q_u= 4810 psi, TUW= 154 pcf		100	92
35								98	68
40						q_u= 6970 psi, TUW= 156 pcf		97	93
45								88	75
50						q_u= 6220 psi, TUW= 160 pcf		98	98
55								98	98

COMPLETION DEPTH: 59.0 ft
DATE: 4-12-23

DEPTH TO WATER
IN BORING: Dry to 10 ft

DATE: 4/12/2023

RECRQDN200-2 19-118_LITTLE OSAGE CREEK.GPJ 9-21-23

Grubbs, Hoskyn,
Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S35

090069 XNA Access Road over Little Osage Creek
Benton Co., Arkansas

TYPE: Auger to 11 ft /Core

LOCATION: Approx Sta 178+40, 75 ft Rt

SURF. EL: 1075±

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	- No. 200 %	% Recovery	% RQD
			Medium dense brown and tan fine to coarse gravel w/cobbles						
			- sandy below 2 ft	13					
5			- very loose at 4 to 6 ft	2					
			- loose to medium dense, silty below 6 ft	10					
			Moderately hard gray and light gray cherty limestone w/rehealed fractures and stylolites	50/1"					
10									
								92	83
15									
								97	82
20									
								92	75
25									
								98	90

COMPLETION DEPTH: 51.0 ft
DATE: 9-19-23

DEPTH TO WATER
IN BORING: At Surface

DATE: 9/19/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S35

090069 XNA Access Road over Little Osage Creek
Benton Co., Arkansas

TYPE: Auger to 11 ft /Core

LOCATION: Approx Sta 178+40, 75 ft Rt

COHESION, TON/SQ FT ○ 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT + — WATER CONTENT ● — LIQUID LIMIT + 10 20 30 40 50 60 70

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
							98	93
35								
							97	68
40								
							97	93
45								
							100	90
50								
							100	100
55								

COMPLETION DEPTH: 51.0 ft
DATE: 9-19-23

DEPTH TO WATER
IN BORING: At Surface

DATE: 9/19/2023

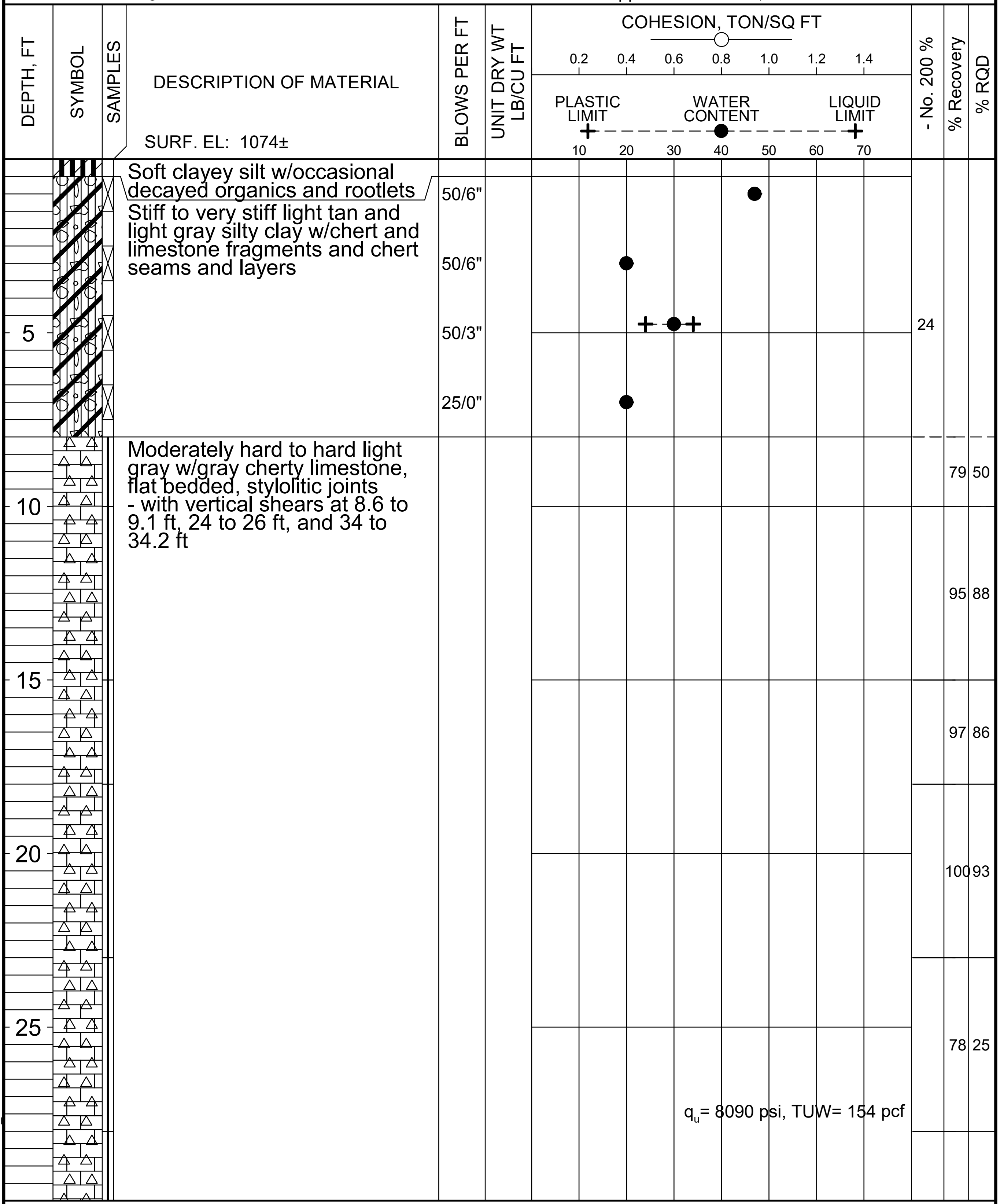
Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

L O G O F B O R I N G N O. S36

090069 XNA Access Road over Little Osage Creek
Benton Co., Arkansas

TYPE: Auger to 8 ft /Wash to 8 ft /Core

LOCATION: Approx Sta 179+85, 60 ft Rt



Soft clayey silt w/occasional decayed organics and rootlets

Stiff to very stiff light tan and light gray silty clay w/chert and limestone fragments and chert seams and layers

Moderately hard to hard light gray w/gray cherty limestone, flat bedded, stylolitic joints
- with vertical shears at 8.6 to 9.1 ft, 24 to 26 ft, and 34 to 34.2 ft

COMPLETION DEPTH: 58.0 ft
DATE: 4-19-22

DEPTH TO WATER
IN BORING: 2 ft

DATE: 4/19/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

L O G O F B O R I N G N O. S36

090069 XNA Access Road over Little Osage Creek
Benton Co., Arkansas

TYPE: Auger to 8 ft /Wash to 8 ft /Core

LOCATION: Approx Sta 179+85, 60 ft Rt

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / WATER CONTENT	- No. 200 %	% Recovery	% RQD
						100	100
				q_u= 7190 psi, TUW= 151 pcf			
35						98	95
				q_u= 3310 psi, TUW= 147 pcf			
40						100	93
				q_u= 8120 psi, TUW= 157 pcf			
45						90	90
	- with rehealed fractures below 48 ft						
50				q_u= 7710 psi, TUW= 149 pcf		100	100
55						95	95

COMPLETION DEPTH: 58.0 ft
DATE: 4-19-22

DEPTH TO WATER
IN BORING: 2 ft

DATE: 4/19/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S37

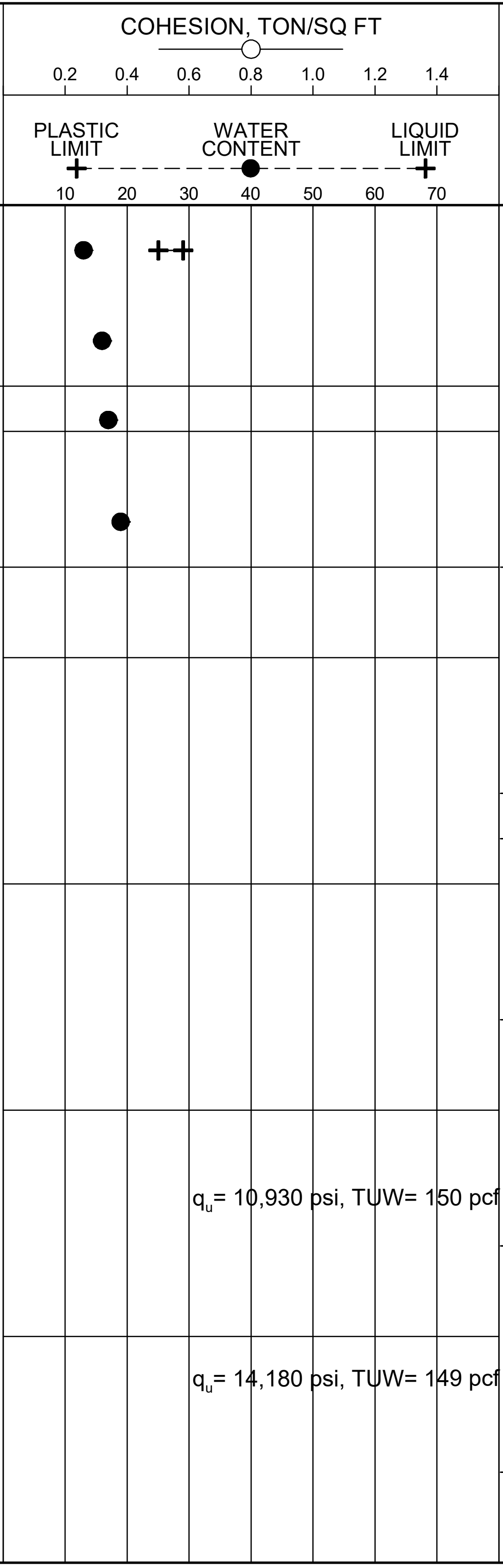
090069 XNA Access Road over Little Osage Creek
Benton Co., Arkansas

TYPE: Auger to 6.5 ft /Wash to 8 ft /Core

LOCATION: Approx Sta 181+10, 60 ft Rt

SURF. EL: 1079±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Stiff to very stiff reddish brown fine sandy clay w/numerous chert and limestone fragments	28		15		
		34				
5	Stiff to very stiff brown fine sandy clay w/chert and limestone fragments	50/3"				
	- with numerous chert and limestone fragments and chert seams below 6 ft - auger refusal at 6.5 ft	50/1"				
10	Moderately hard to hard gray and tan cherty limestone, stylolitic joints				97	60
	- calcite inclusions at 13.5 ft				67	0
15					90	63
20					98	87
25					95	92



q_u= 10,930 psi, TUW= 150 pcf

q_u= 14,180 psi, TUW= 149 pcf

COMPLETION DEPTH: 58.0 ft
DATE: 4-12-22

DEPTH TO WATER
IN BORING: Dry to 6.5 ft

DATE: 4/5/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

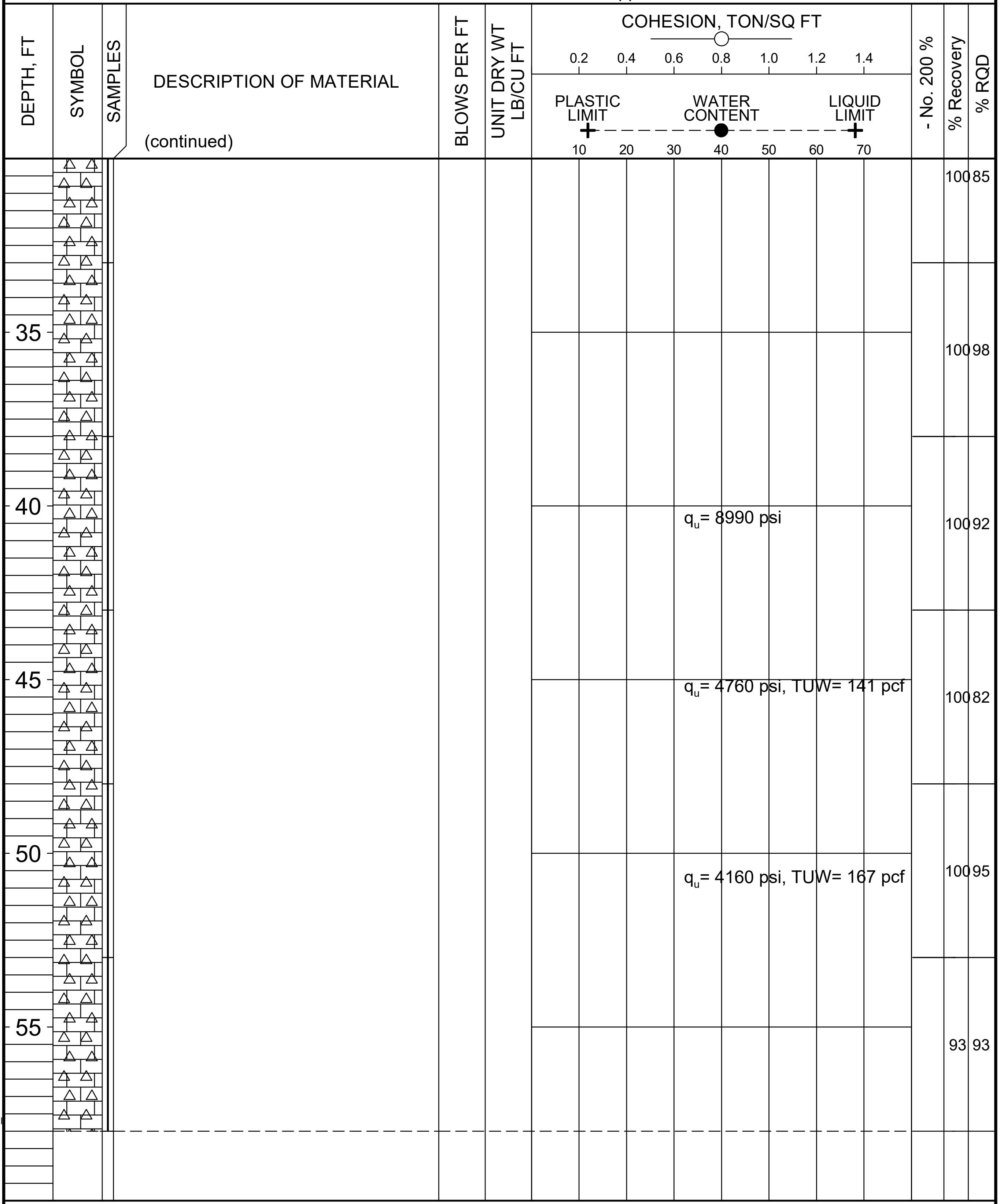
LOG OF BORING NO. S37

090069 XNA Access Road over Little Osage Creek
Benton Co., Arkansas

TYPE: Auger to 6.5 ft /Wash to 8 ft /Core

LOCATION: Approx Sta 181+10, 60 ft Rt

(continued)



q_u= 8990 psi

q_u= 4760 psi, TUW= 141 pcf

q_u= 4160 psi, TUW= 167 pcf

100	85
100	98
100	92
100	82
100	95
93	93

COMPLETION DEPTH: 58.0 ft
DATE: 4-12-22

DEPTH TO WATER
IN BORING: Dry to 6.5 ft

DATE: 4/5/2022

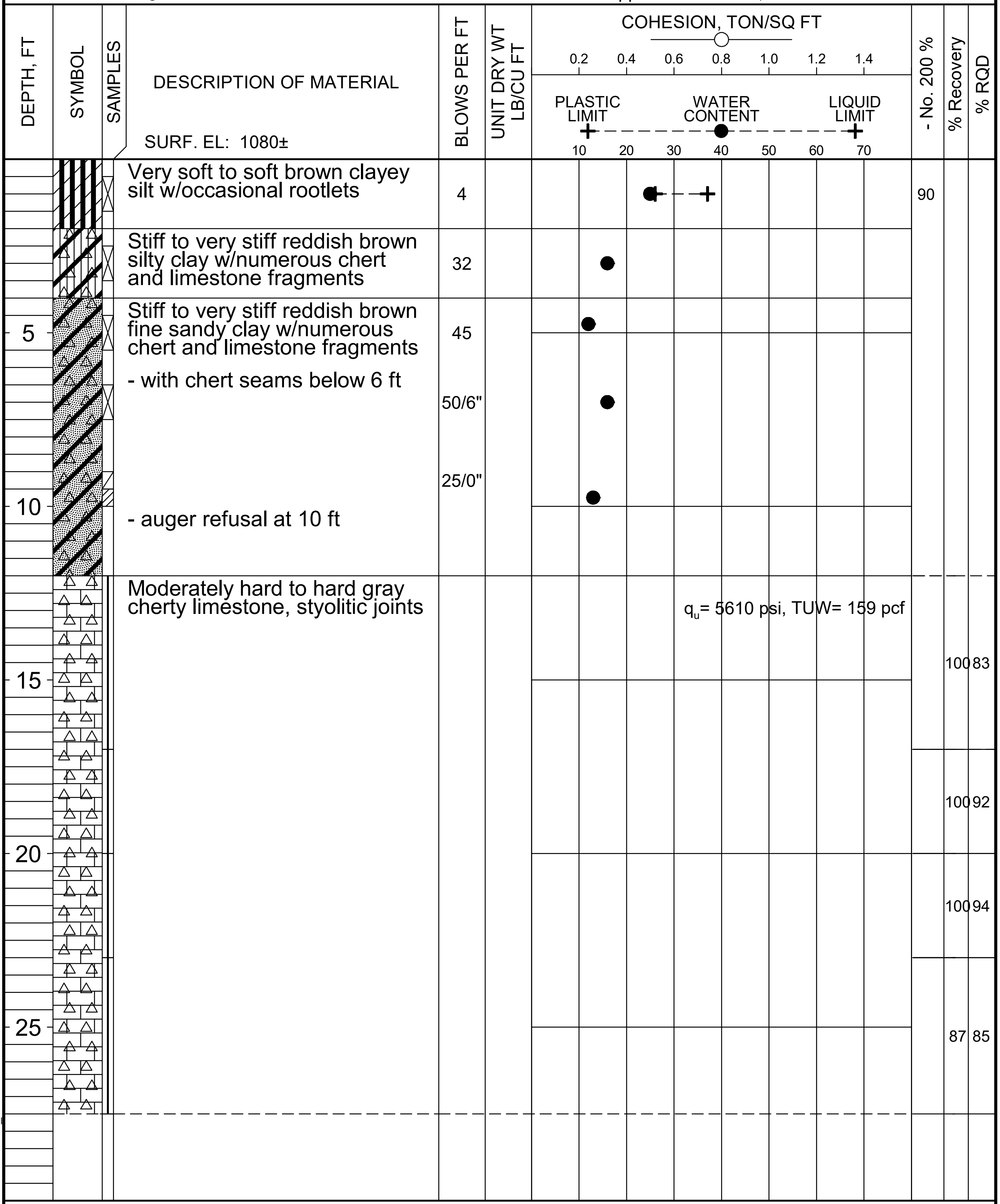
Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S38

090069 XNA Access Road over Little Osage Creek
Benton Co., Arkansas

TYPE: Auger to 10 ft /Wash to 12 ft /Core

LOCATION: Approx Sta 182+15, 60 ft Rt



DESCRIPTION OF MATERIAL	BLOWS PER FT	- No. 200 %	% Recovery	% RQD
Very soft to soft brown clayey silt w/occasional rootlets	4	90		
Stiff to very stiff reddish brown silty clay w/numerous chert and limestone fragments	32			
Stiff to very stiff reddish brown fine sandy clay w/numerous chert and limestone fragments	45			
- with chert seams below 6 ft	50/6"			
	25/0"			
- auger refusal at 10 ft				
Moderately hard to hard gray cherty limestone, styolitic joints				
q_u= 5610 psi, TUW= 159 pcf			100	83
			100	92
			100	94
			87	85

COMPLETION DEPTH: 27.5 ft
DATE: 4-8-22

DEPTH TO WATER
IN BORING: Dry to 10 ft

DATE: 4/5/2022

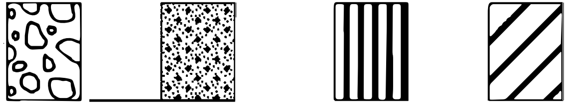
RECRQDN200-2 19-118_LITTLE OSAGE CREEK.GPJ 9-21-23

Grubbs, Hoskyn,
Barton & Wyatt, Inc.
Consulting Engineers

SYMBOLS AND TERMS USED ON BORING LOGS

SOIL TYPES

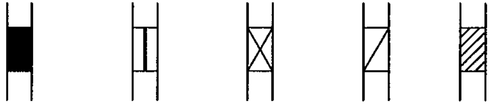
(SHOWN IN SYMBOLS COLUMN)



Predominant type shown heavy

SAMPLER TYPES

(SHOWN ON SAMPLES COLUMN)



TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on No. 200 sieve): Includes (I) Clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as determined by laboratory tests.

DESCRIPTIVE TERM	N-VALUE	RELATIVE DENSITY
VERY LOOSE	0-4	0-15%
LOOSE	4-10	15-35%
MEDIUM DENSE	10-30	35-65%
DENSE	30-50	65-85%
VERY DENSE	50 and above	85-100%

FINE GRAINED SOILS (major portion passing No. 200 sieve): Includes (1) Inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests.

DESCRIPTIVE TERM	UNCONFINED COMPRESSIVE STRENGTH TON/SQ. FT.
VERY SOFT	Less than 0.25
SOFT	0.25-0.50
FIRM	0.50-1.00
STIFF	1.00-2.00
VERY STIFF	2.00-4.00
HARD	4.00 and higher

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

TERMS CHARACTERIZING SOIL STRUCTURE

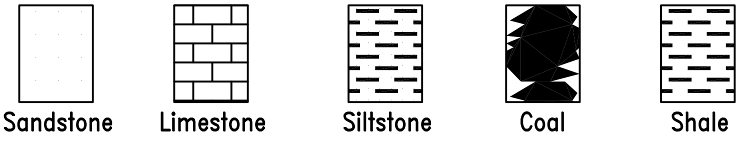
SLICKENSIDED - having inclined planes of weakness that are slick and glossy in appearance.
FISSURED - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
LAMINATED - composed of thin layers of varying color and texture.
INTERBEDDED - composed of alternate layers of different soil types.
CALCAREOUS - containing appreciable quantities of calcium carbonate.
WELL GRADED - having a wide range in grain sizes and substantial amounts of all intermediate particle sizes.
POORLY GRADED - predominantly of one grain size, or having a range of sizes with some intermediate sizes missing.

Terms used on this report for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No.3-357, Waterways Experiment Station, March 1953

Grubbs, Hoskyn,
Barton & Wyatt, Inc.
Consulting Engineers

BORING LOG TERMS – ROCK

ROCK TYPES
(SHOWN IN SYMBOLS COLUMN)



	Spacing	
Joint Characteristics –	Very Close	0.75 to 2.5 in.
	Close	2.5 to 8 in.
	Moderately Close	8 to 24 in.
	Wide	2 to 6 ft
	Very Wide	More than 6 ft
Bedding Characteristics –	Very Thin	0.75 to 2.5 in.
	Thin	2.5 to 8 in.
	Medium	8 to 24 in.
	Thick	2 to 6 ft
	Massive	More than 6 ft

Lithologic Characteristics –
- Clayey
- Shaly
- Calcareous (limy)
- Siliceous
- Sandy (Arenaceous)
- Silty
- Plastic Seams

Parting –	Less than 1/16 inch
Seam –	1/16 to 1/2 inch
Layer –	1/2 to 12 inches
Stratum –	Greater than 12 inches

Hardness–

Soft (S) – Reserved for plastic material alone.

Friable (F) – Easily crumbled by hand, pulverized or reduced to powder and is too soft to be cut with a pocket knife.

Low Hardness (LH) – Can be gouged deeply or carved with a pocket knife.

Moderately Hard (MH) – Can be readily scratched by a knife blade; scratch leaves a heavy trace of dust and scratch is readily visible after the powder has been blown away.

Hard (H) – Can be scratched with difficulty; scratch produces little powder and is often faintly visible; traces of the knife steel may be visible.

Very hard (VH) – Cannot be scratched with a pocket knife. Knife steel marks left on surface.

Texture –
- Fine – Barely seen with naked eye
- Medium – Barely seen up to 1/8 in.
- Coarse – 1/8 in. to 1/4 in.

Structure –
- Bedding
  - Flat – 0° – 5°
  - Gently Dipping – 5° – 35°
  - Moderately Dipping – 55° – 85°
  - Steeply Dipping – 55° – 85°
- Fractures, scattered
  - Open
  - Cemented or Tight
- Fractures, closely spaced
  - Open
  - Cemented or Tight
- Brecciated (Sheared and Fragmented)
  - Open
  - Cemented or Tight
- Joints
  - Faulted
  - Slickensides

Degree of Weathering –

Fresh – No visible signs of decomposition or discoloration. Rings under hammer impact.

Slighty Weathered – Slight discoloration inwards from open fractures, otherwise similar to fresh.

Moderately Weathered – Discoloration throughout. Weaker minerals such as feldspar decomposed. Strength somewhat less than fresh rock, but cores cannot be broken by hand or scraped by knife. Texture preserved.

Highly Weathered – Most minerals somewhat decomposed. Specimens can be broken by hand with effort or shaved with knife. Core stones present in rock mass. Texture becoming indistinct but fabric

Completely Weathered – Minerals decomposed to soil but fabric and structure preserved (Saprolite). Specimens easily crumbled or penetrated.

Residual Soil – Advanced state of decomposition resulting in plastic soils. Rock fabric and structure completely destroyed. Large volume change.

Solution and Void Conditions –
- Solid, contains no voids
- Vuggy (pitted)
- Vesicular (igneous)
- Porous
- Cavities
- Cavernous

Swelling Properties –
- Nonswelling
- Swelling

Slaking Properties –
- Nonslaking
- Slakes slowly on exposure
- Slakes readily on exposure

Rock Quality Designation (RQD) –

RQD (Percent)	Diagnostic Description
Greater than 90	Excellent
75 – 90	Good
50 – 75	Fair
25 – 50	Poor
Less than 25	Very Poor

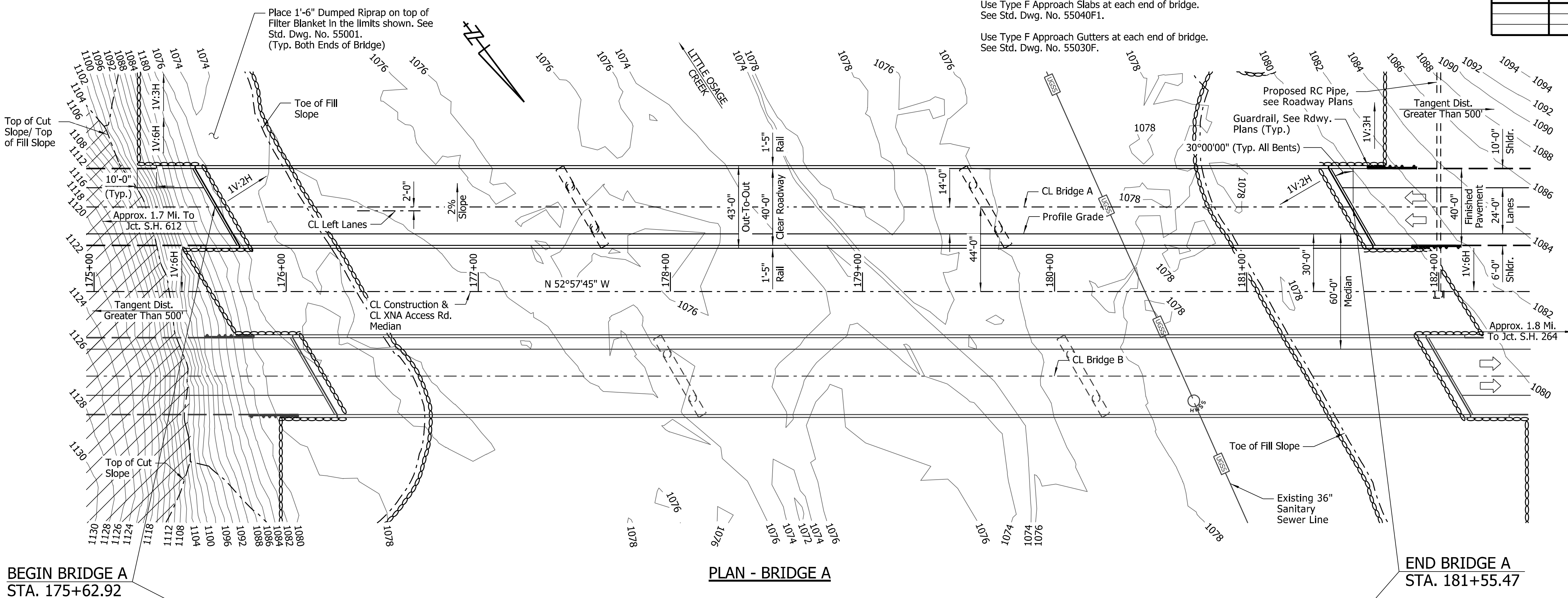
KEYROCK FHWA 3-2-12

APPENDIX A

DATE REVISED	DATE REVISED	FED. ROAD DIST. NO.	STATE	JOB NO.	SHEET NO.	TOTAL SHEETS
		6	ARK.	090069	$SN5101$	ST
		$BN05A$		LAYOUT		$DN5101$

NOTES:
Use Type F Approach Slabs at each end of bridge. See Std. Dwg. No. 55040F1.

Use Type F Approach Gutters at each end of bridge. See Std. Dwg. No. 55030F.



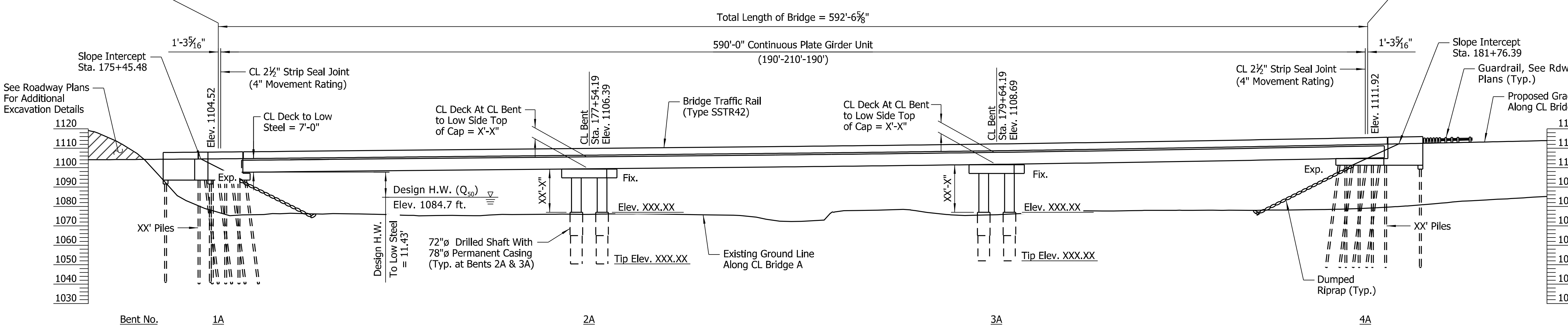
PLAN - BRIDGE A

EXISTING UTILITIES LEGEND

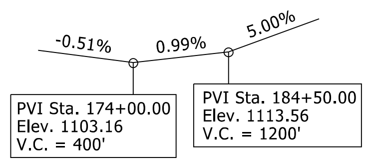
UGSS = Underground Sanitary Sewer

NOTE:
Utilities shown are based on locations at time of survey and do not reflect any potential utility relocations prior to construction.

SOIL BORINGS NOT AVAILABLE AT TIME OF PRINTING



ELEVATION - BRIDGE A



VERTICAL CURVE DATA

XNA Access Rd.
(Profile Grade 14' Right of CL Bridge A)

NOTES:
Stations shown are along CL Construction. Elevations shown are actual top of deck elevations at CL Bridge A. Any vertical dimension referenced to CL Deck is based on actual top of deck elevation at CL Bridge A.

For "PROJECT GENERAL NOTES", see Dwg. No. $DN0201$.

For "ELEVATION OF SOIL BORINGS - BRIDGE A", "GENERAL NOTES", and "HYDRAULIC DATA" see Dwg. No. $DN5103$.

For "LOCATION SKETCH", see Dwg. No. $DN5104$.

For "BORING LEGEND" and "N-VALUES", see Dwg. No. $DN5105$.

FOR R/W DATA, SEE ROADWAY PLANS

175+00 176+00 177+00 178+00 179+00 180+00 181+00 182+00

JESkinner 6/29/2023 1:42:31 PM
WORKSPACE: ARDOT Bridge (2019)
L:\2017\17017600 - XNA Access - NEPA\Drawings\b090069x5_S101_LO.dgn
REVISED DATE:

SHEET 1 OF 5
LAYOUT OF BRIDGES
XNA ACCESS RD. OVER LITTLE OSAGE CREEK
NORTHWEST ARKANSAS
NATIONAL AIRPORT ACCESS (F)
BENTON COUNTY

ROUTE RTSEC. SC

ARKANSAS STATE HIGHWAY COMMISSION

LITTLE ROCK, ARK.

PRELIMINARY
NOT FOR
CONSTRUCTION

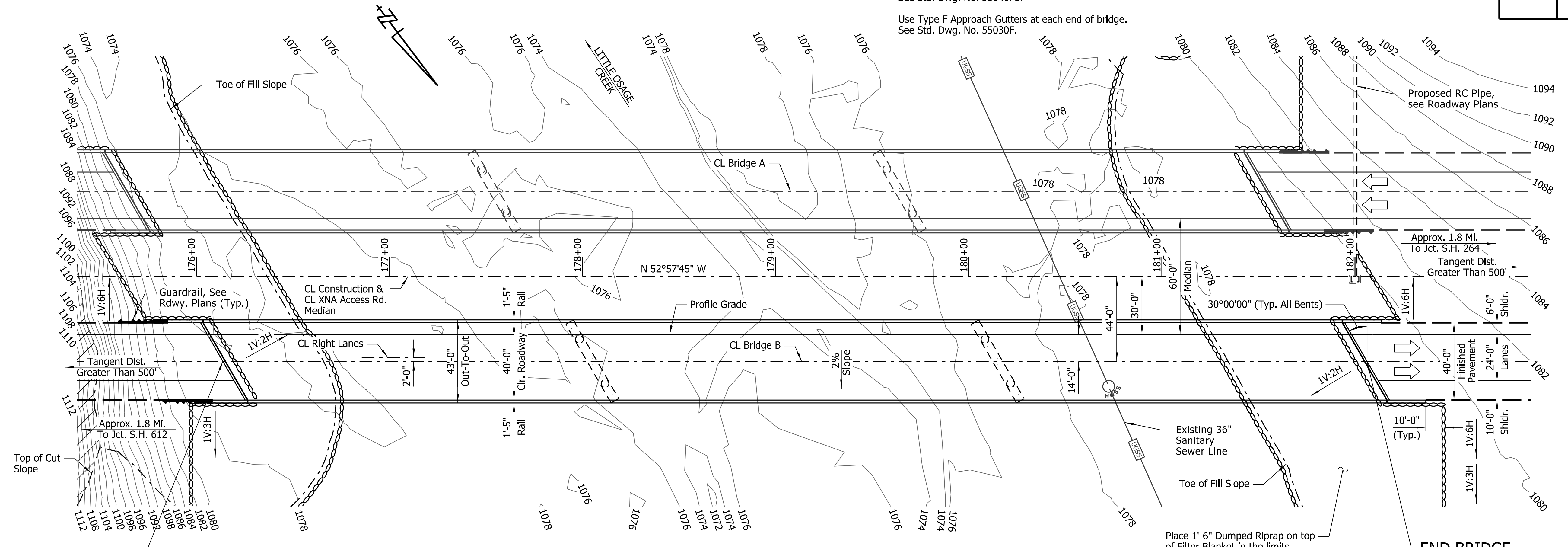
BRIDGE ENGINEER

DRAWN BY: CSW DATE: MAR. 2022 FILENAME: b090069x5_L1.dgn
CHECKED BY: JES DATE: AUG. 2022 SCALE: 1" = 30'-0"
DESIGNED BY: CSW DATE: MAR. 2022
BRIDGE NO. $BN05A$ DRAWING NO. $DN5101$

DATE REVISED	DATE REVISED	FED. ROAD DIST. NO.	STATE	JOB NO.	SHEET NO.	TOTAL SHEETS
		6	ARK.	090069	$SN5102$	ST
		$BN05B$		LAYOUT		$DN5102$

NOTES:
Use Type F Approach Slabs at each end of bridge. See Std. Dwg. No. 55040F1.

Use Type F Approach Gutters at each end of bridge. See Std. Dwg. No. 55030F.



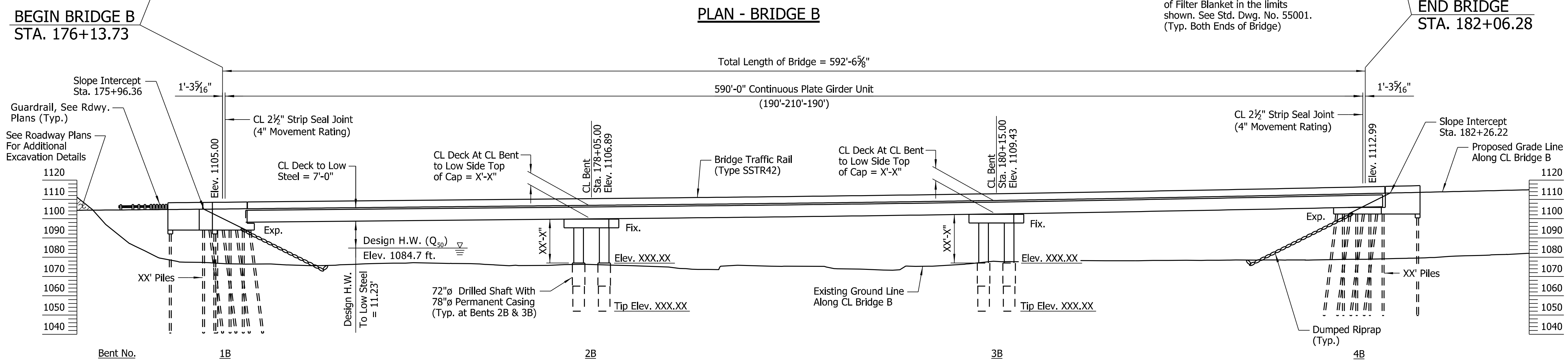
EXISTING UTILITIES LEGEND

UGSS = Underground Sanitary Sewer

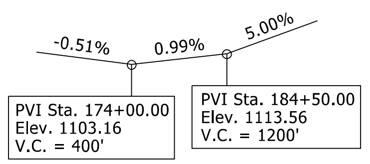
NOTE:
Utilities shown are based on locations at time of survey and do not reflect any potential utility relocations prior to construction.

SOIL BORINGS NOT AVAILABLE AT TIME OF PRINTING

PLAN - BRIDGE B



ELEVATION - BRIDGE B



VERTICAL CURVE DATA

XNA Access Rd.
(Profile Grade 14' Left of CL Bridge B)

182+00

NOTES:
Stations shown are along CL Construction. Elevations shown are actual top of deck elevations at CL Bridge B. Any vertical dimension referenced to CL Deck is based on actual top of deck elevation at CL Bridge B.

For "PROJECT GENERAL NOTES", see Dwg. No. $DN0201$.

For "ELEVATION OF SOIL BORINGS - BRIDGE B", "GENERAL NOTES", and "HYDRAULIC DATA" see Dwg. No. $DN5103$.

For "LOCATION SKETCH", see Dwg. No. $DN5104$.

For "BORING LEGEND" and "N-VALUES", see Dwg. No. $DN5105$.

FOR R/W DATA, SEE ROADWAY PLANS

176+00 177+00 178+00 179+00 180+00 181+00

JESkinner 6/29/2023 1:42:31 PM
WORKSPACE-ARDOT Bridge (2019)
L:\2017\1701 7600 - XNA Access - NEPA\Drawings\b090069x5_S102_LO.dgn
REVISED DATE:

PRELIMINARY
NOT FOR
CONSTRUCTION

BRIDGE ENGINEER

SHEET 2 OF 5
LAYOUT OF BRIDGES
XNA ACCESS RD. OVER LITTLE OSAGE CREEK
NORTHWEST ARKANSAS
NATIONAL AIRPORT ACCESS (F)
BENTON COUNTY

ROUTE RTSEC. SC

ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

DRAWN BY:	CWT	DATE:	AUG. 2022	FILENAME:	b090069x5_L2.dgn
CHECKED BY:	JES	DATE:	AUG. 2022	SCALE:	1" = 30'-0"
DESIGNED BY:	CSW	DATE:	JULY 2022		

BRIDGE NO. $BN05B$ DRAWING NO. $DN5102$

APPENDIX B

B-S27: Run 1 (10-15 ft)

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A UES Company

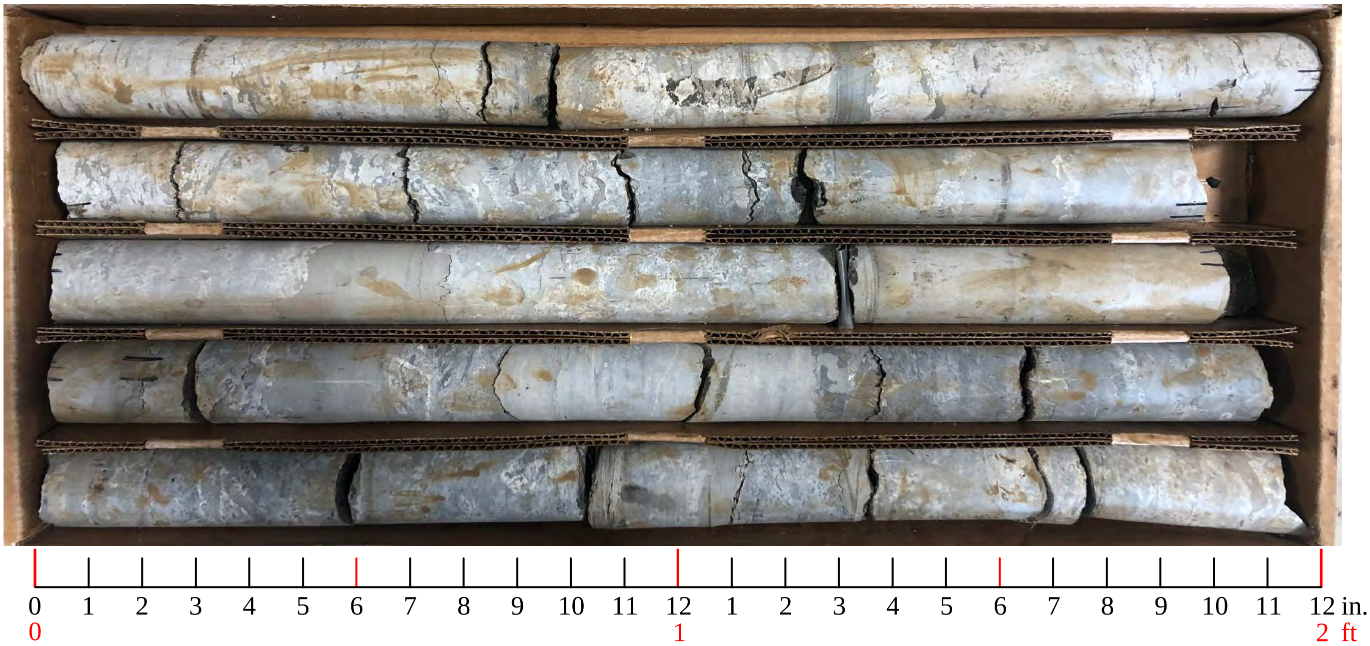
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S28: Run 1 (10-15 ft), Run 2 (15-20 ft)

B-S28: Run 3 (20-25 ft), Run 4 (25-29.5 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC
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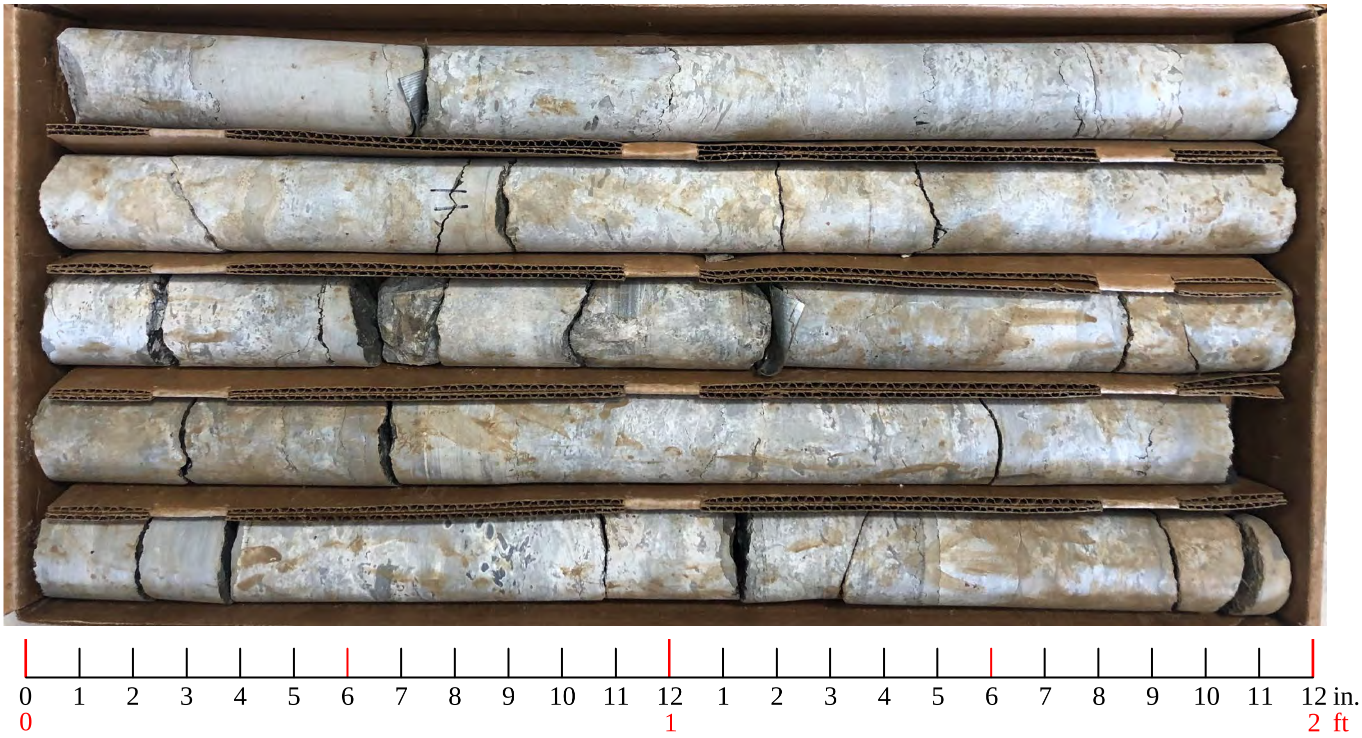
090069 XNA Access Road
Benton County, Arkansas

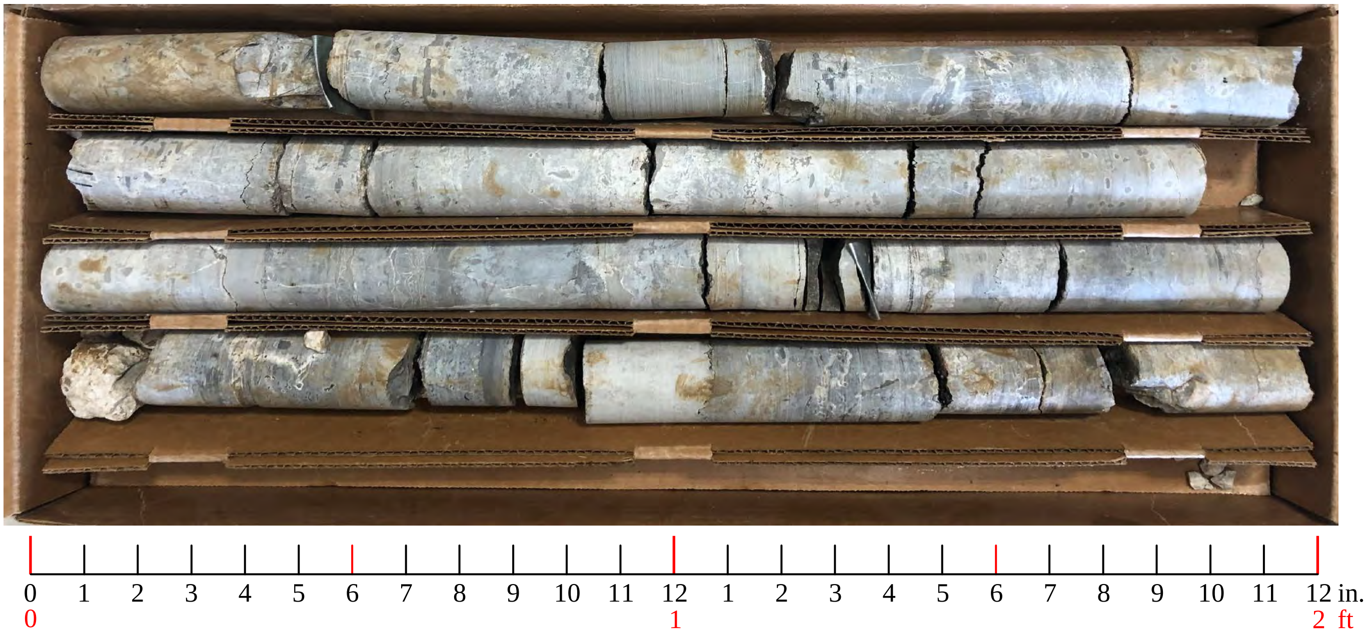
Job No. 19-118

Plate

B-S28: Run 5 (30-35 ft), Run 6 (35-40 ft)



B-S28: Run 7 (40-45 ft), Run 8 (45-50 ft)



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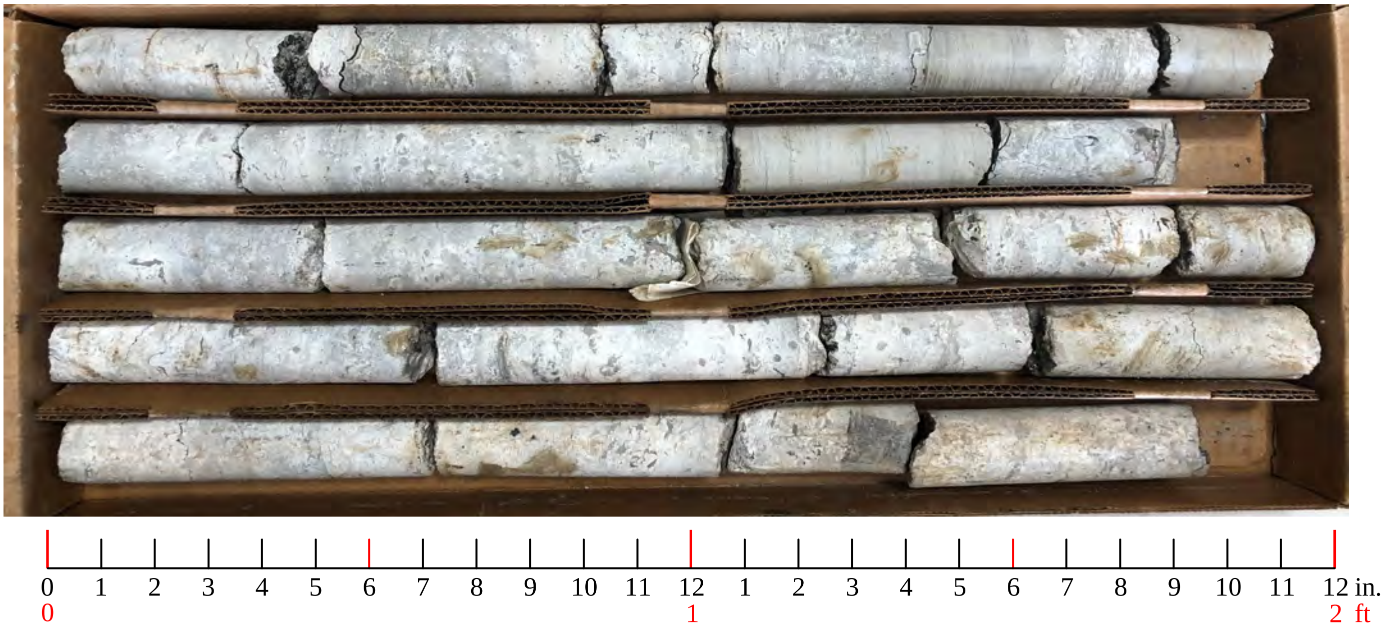
Benton County, Arkansas

Job No. 19-118

Plate

B-S29: Run 1 (12-17 ft), Run 2 (17-22 ft)

B-S29: Run 3 (22-27 ft), Run 4 (27-32 ft)



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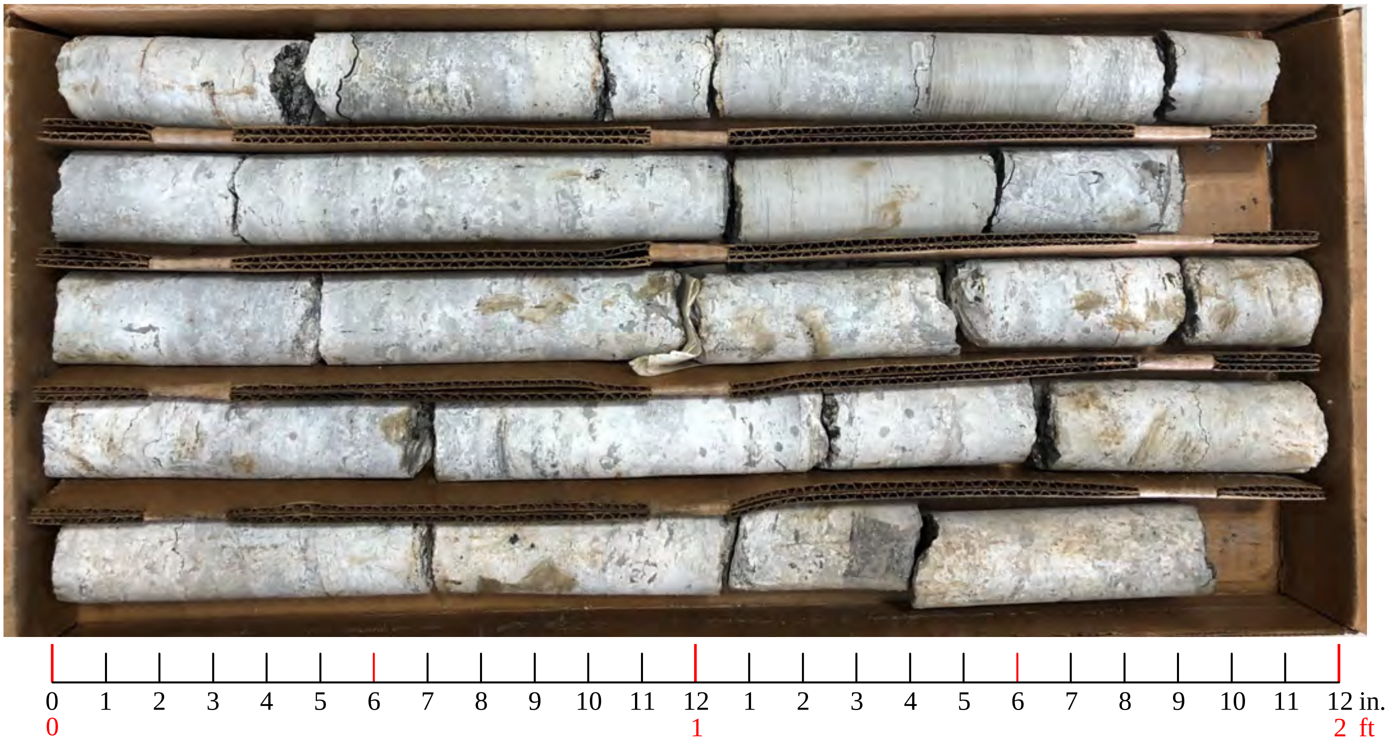
090069 XNA Access Road
Benton County, Arkansas

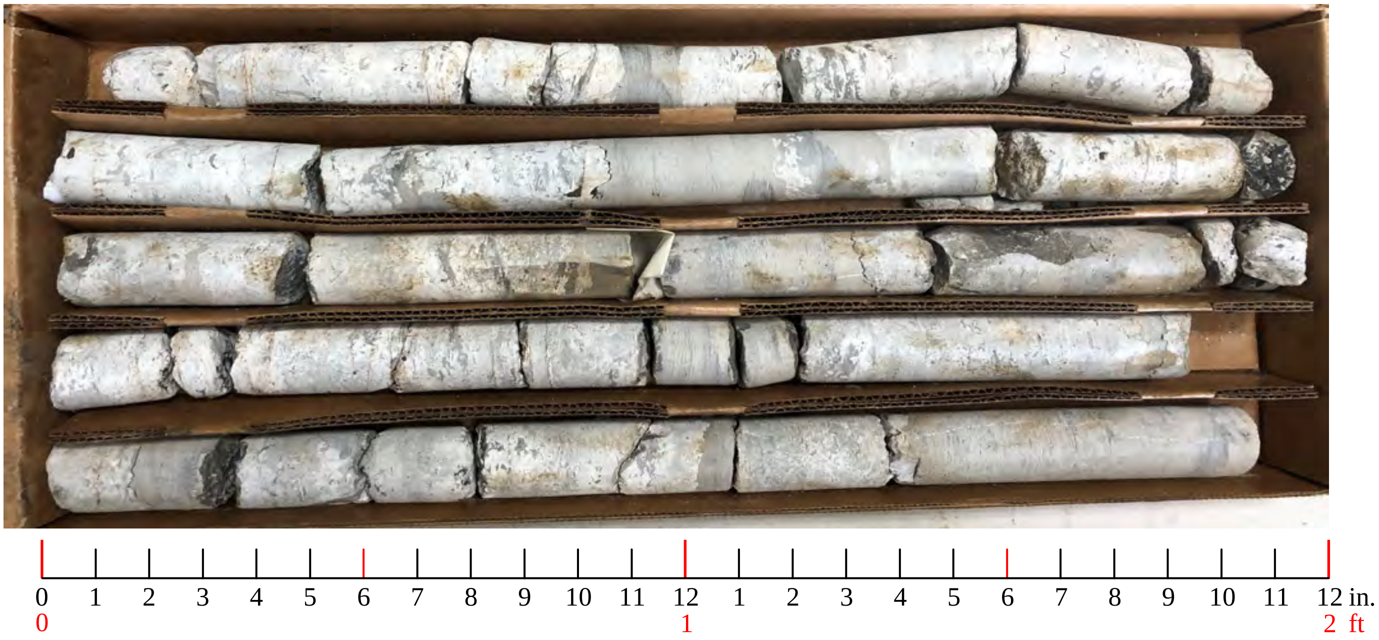
Job No. 19-118

Plate

B-S29: Run 3 (22-27 ft), Run 4 (27-32 ft)



B-S29: Run 5 (32-37 ft), Run 6 (37-42 ft)



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ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S29: Run 7 (42-47 ft), Run 8 (47-52 ft)

B-S29: Run 9 (52-57 ft)

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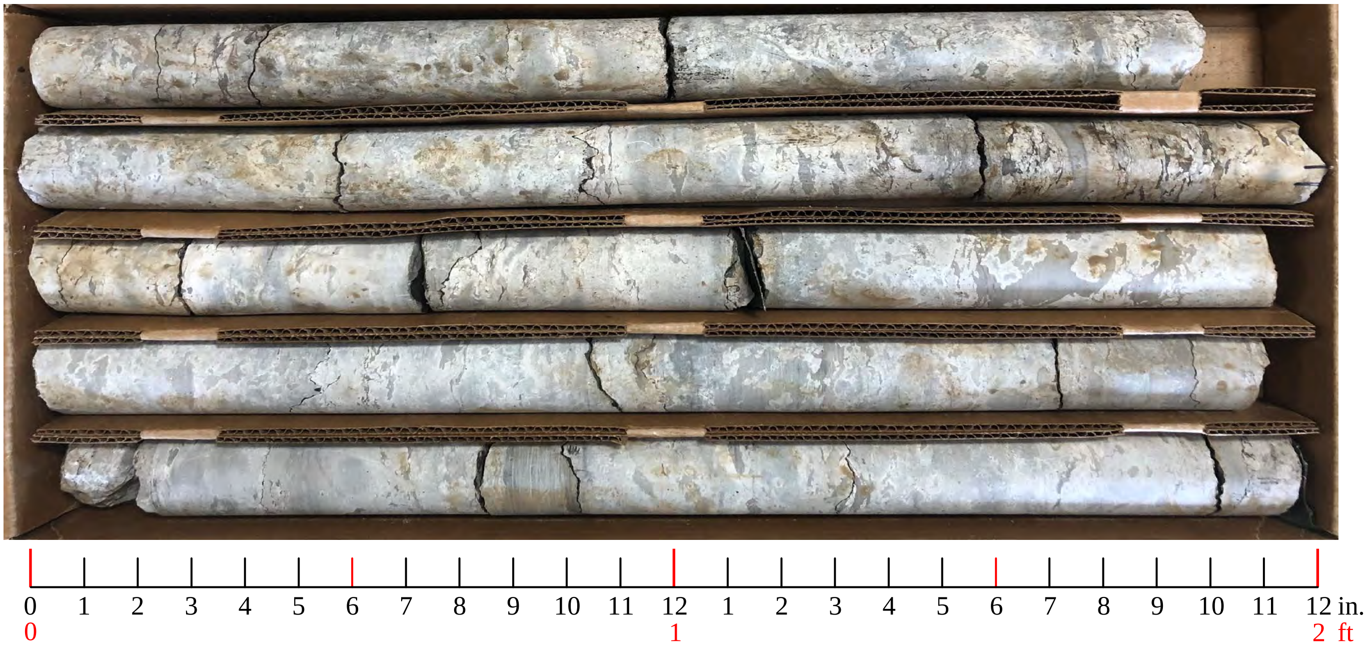
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S30: Run 1 (8-10 ft), Run 2 (10-15 ft), Run 3 (15-20 ft)

B-S30: Run 4 (20-25 ft), Run 5 (25-30 ft)



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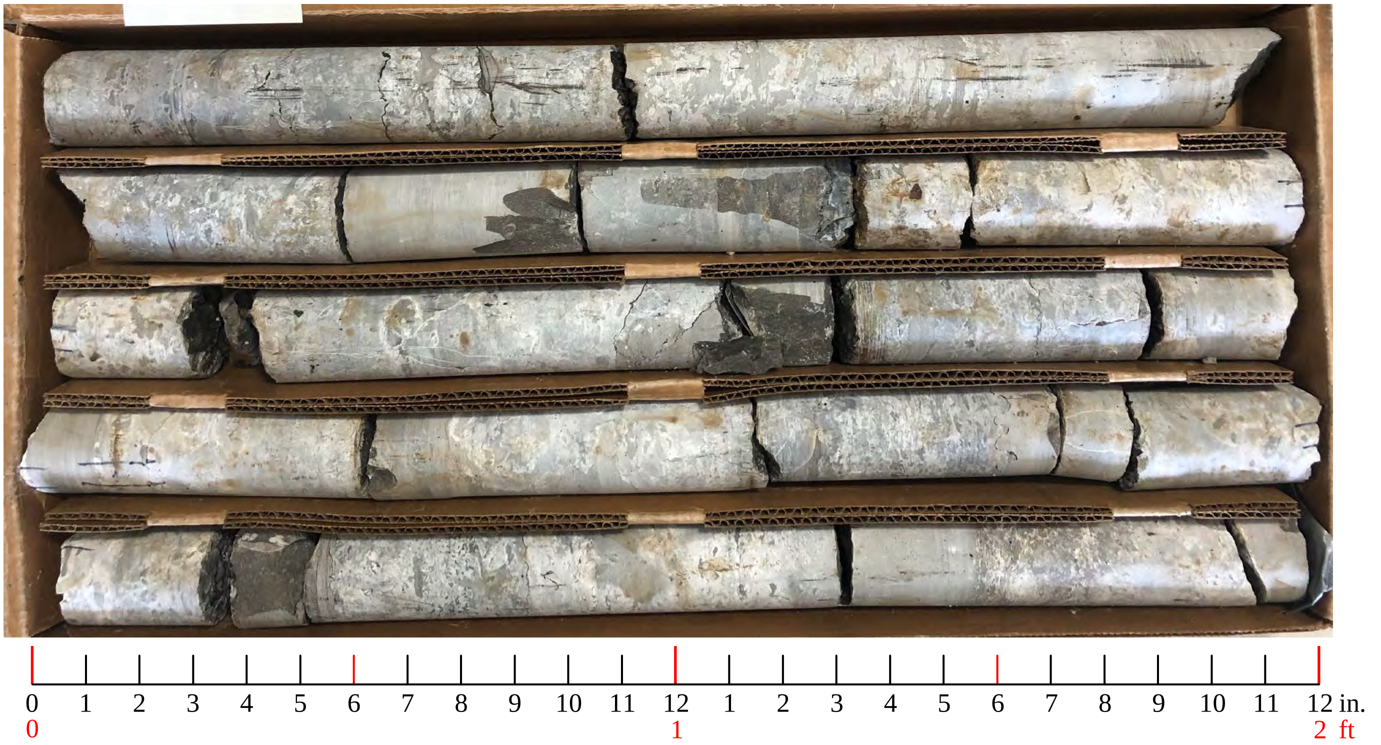
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

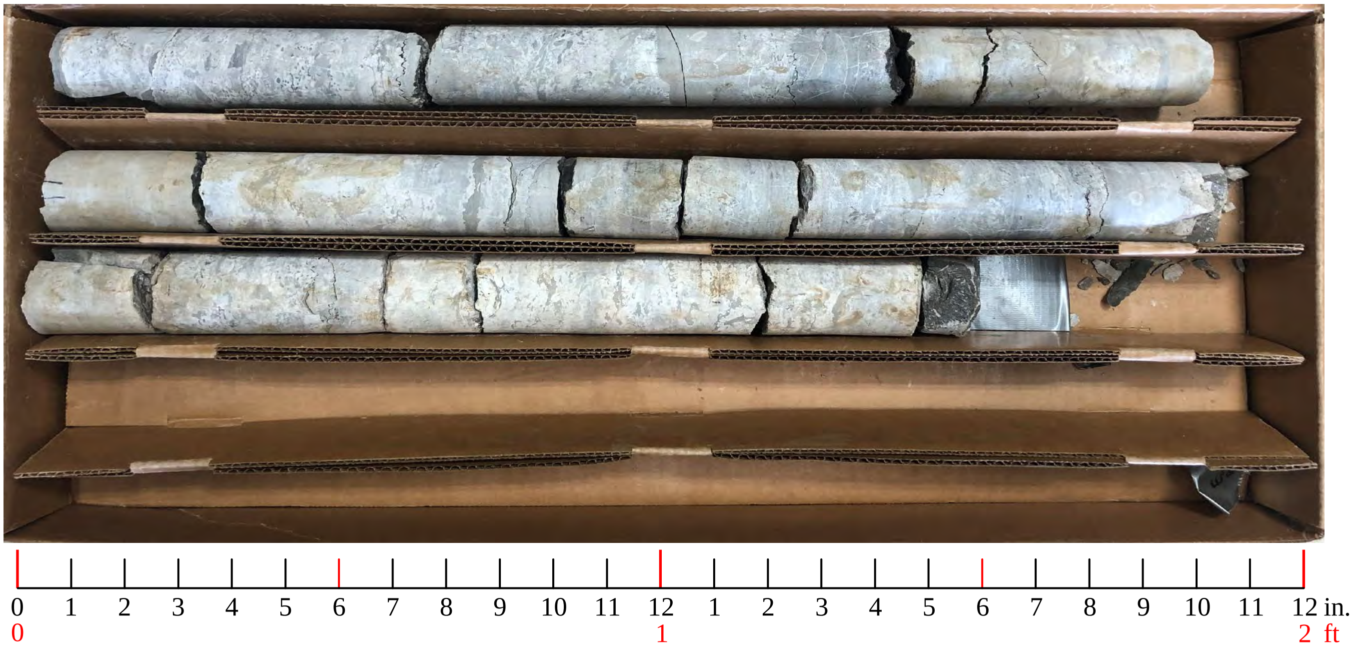
Job No. 19-118

Plate

B-S30: Run 6 (30-35 ft), Run 7 (35-40 ft)



B-S30: Run 8 (40-45 ft)



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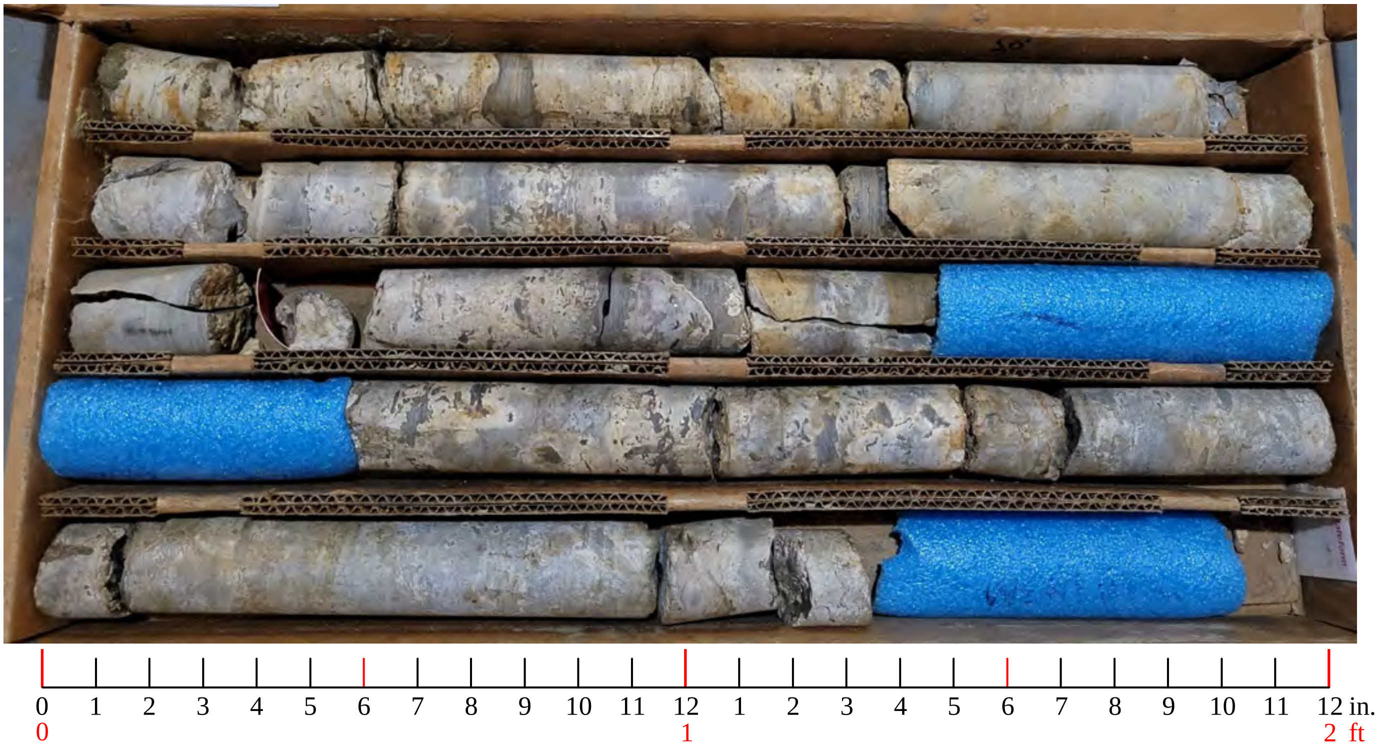
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

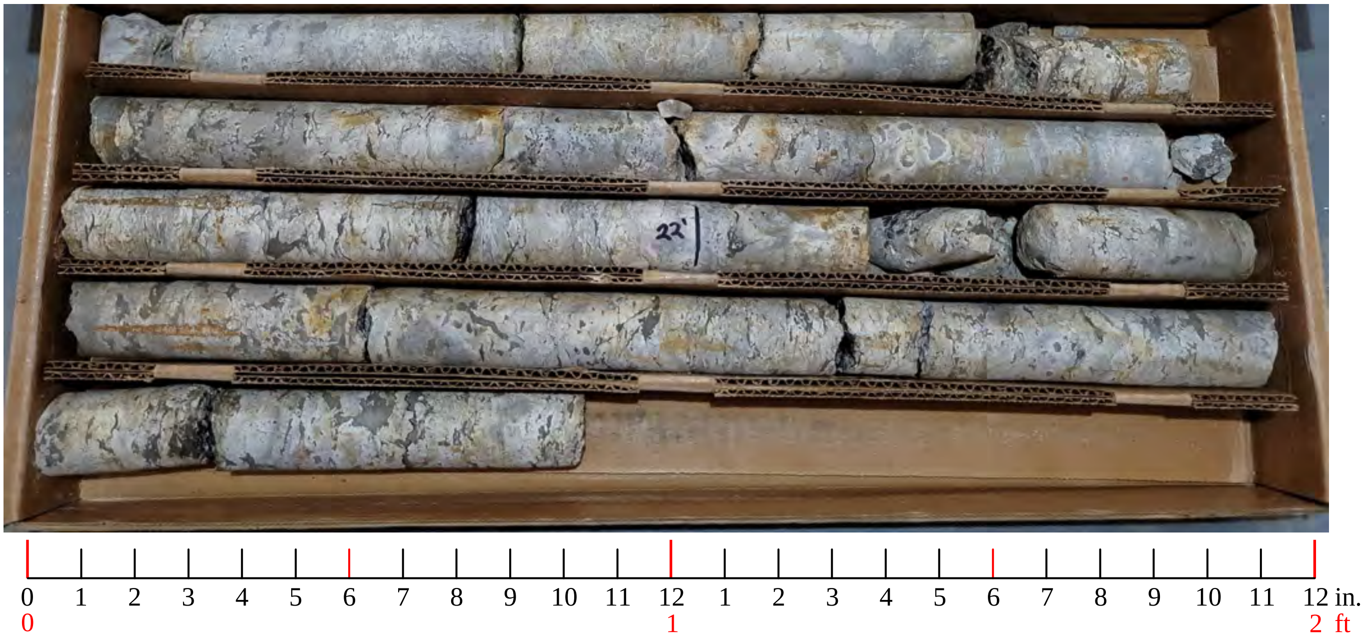
Job No. 19-118

Plate

B-S31: Run 1 (7-12 ft), Run 2 (12-17 ft)



B-S31: Run 3 (17-22 ft), Run 4 (22-27 ft)



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A UES Company

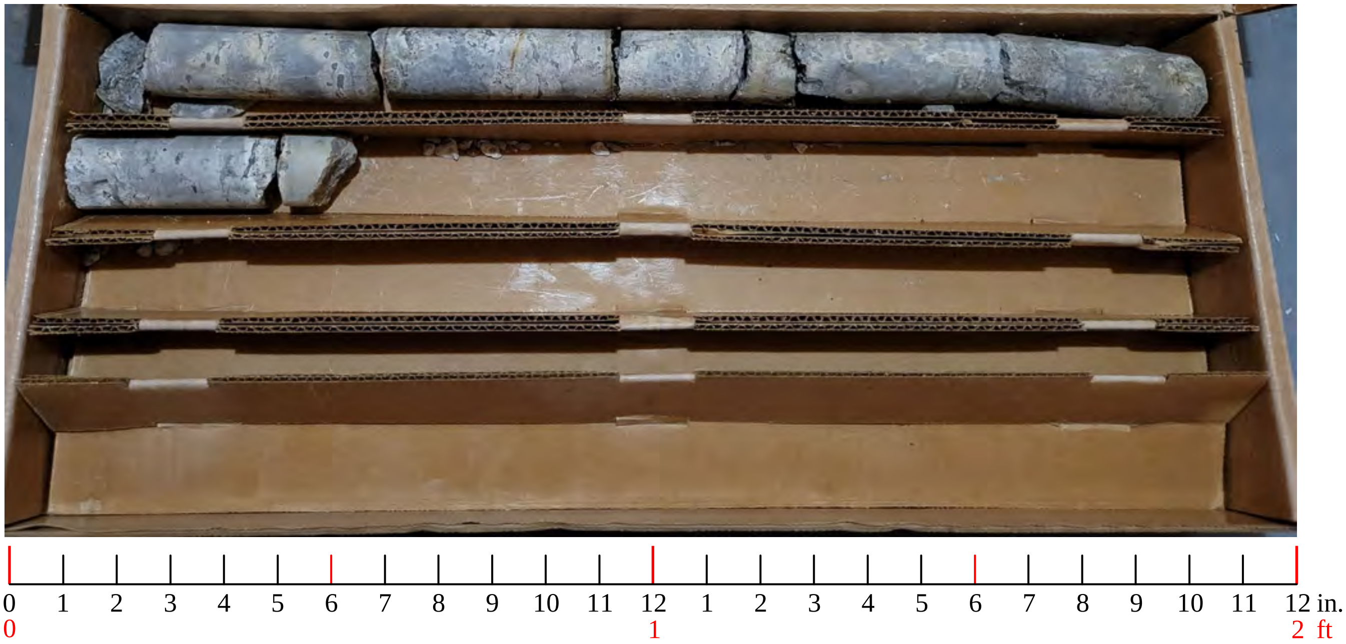
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S31: Run 5 (27-32 ft), Run 6 (32-37 ft)

B-S31: Run 7 (37-39.5 ft)



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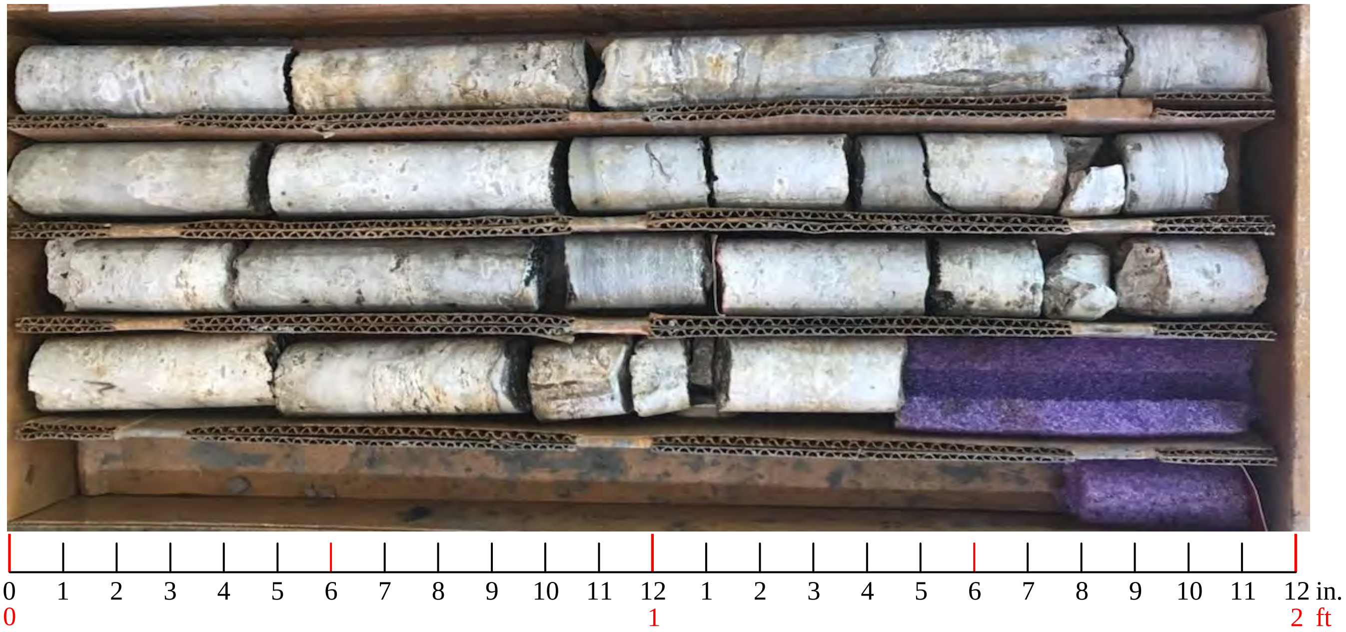
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S31: Run 8 (39-44 ft), Run 9 (44-49 ft)

B-S31: Run 10 (49-54 ft), Run 11 (54-56.5 ft)



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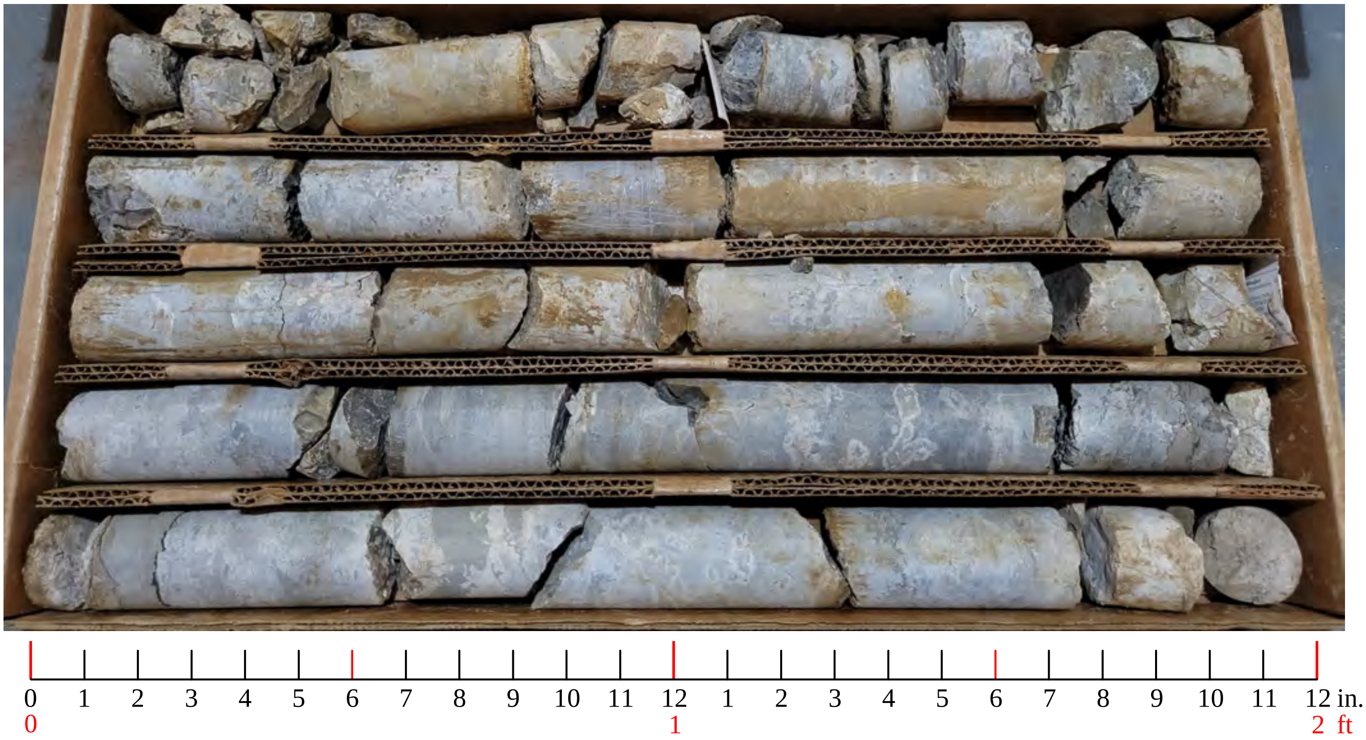
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

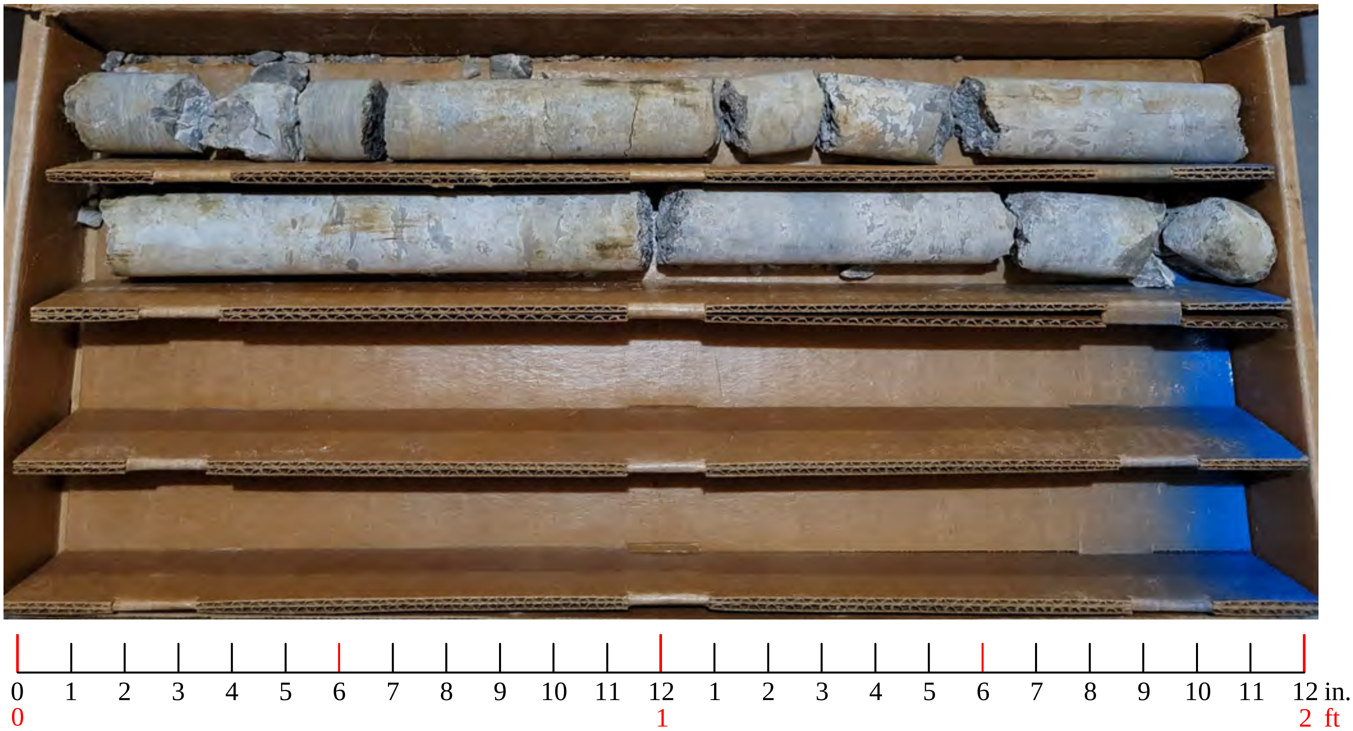
Job No. 19-118

Plate

B-S32: Run 1 (13-14 ft), Run 2 (14-18 ft), Run 3 (18-23 ft)



B-S32: Run 4 (23-27 ft)



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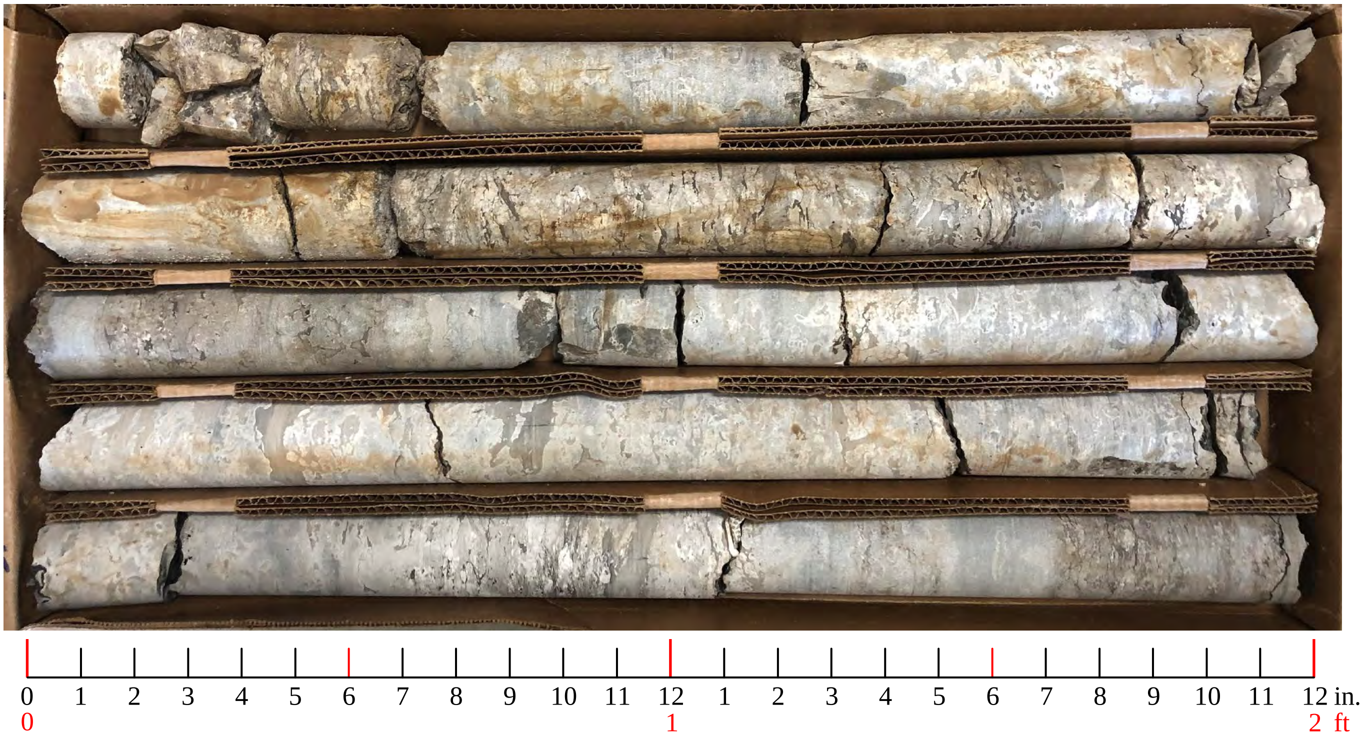
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S33: Run 1 (11-15 ft), Run 2 (15-20 ft), Run 3 (20-21 ft)



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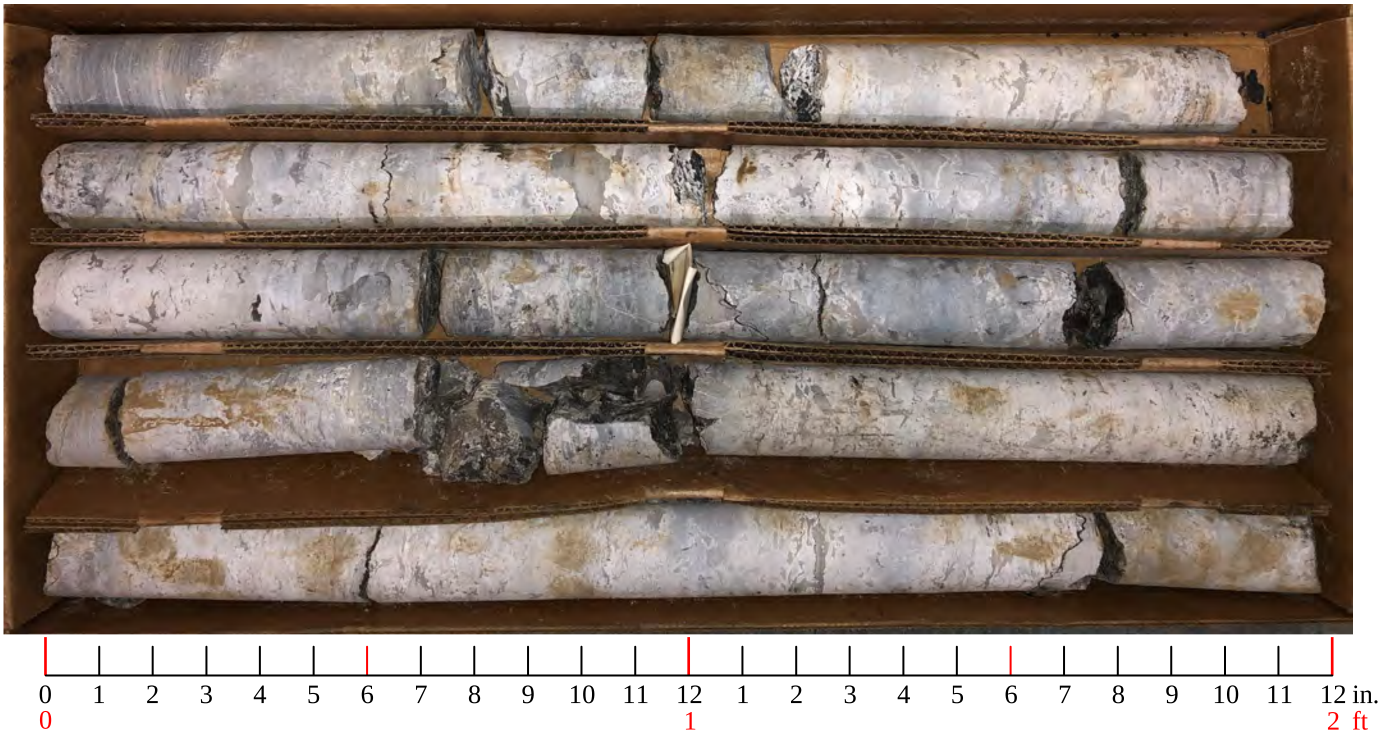
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S34: Run 1 (15-20 ft), Run 2 (20-25 ft)

B-S34: Run 3 (25-30 ft), Run 4 (30-35 ft)



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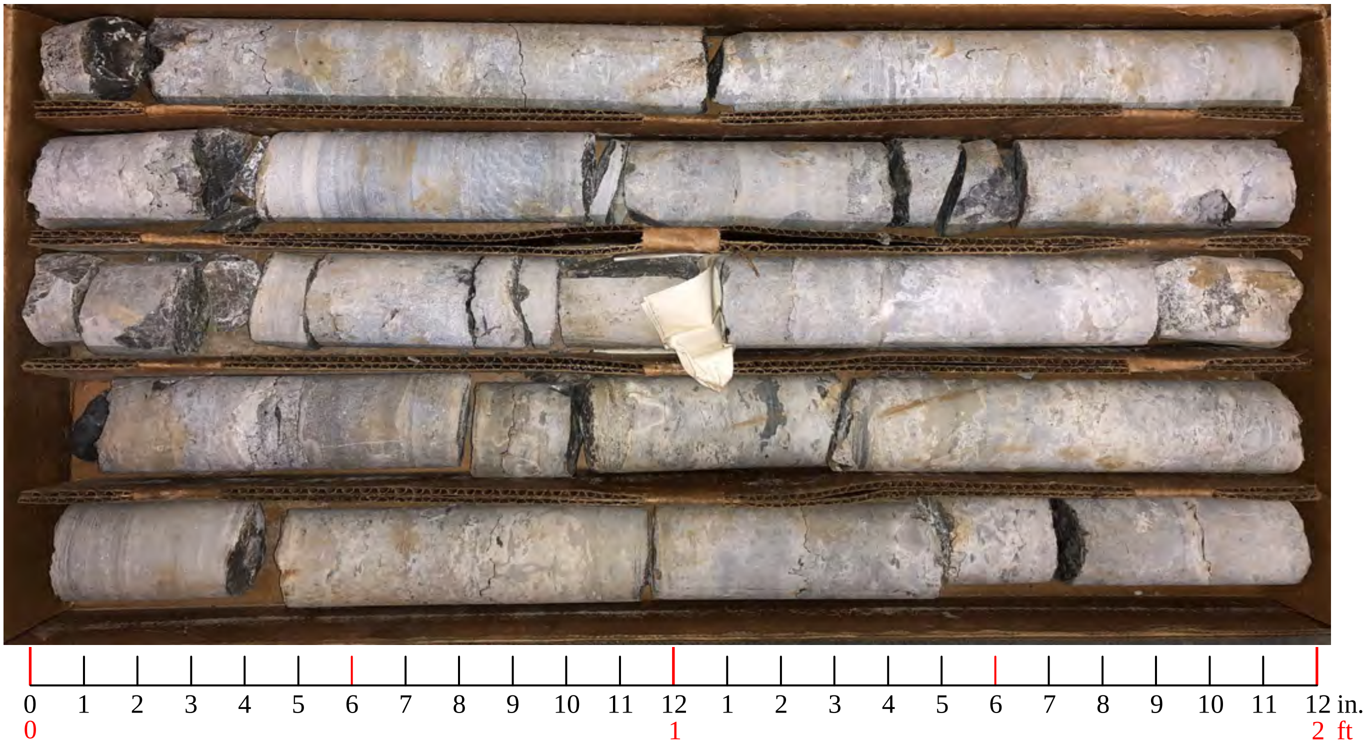
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

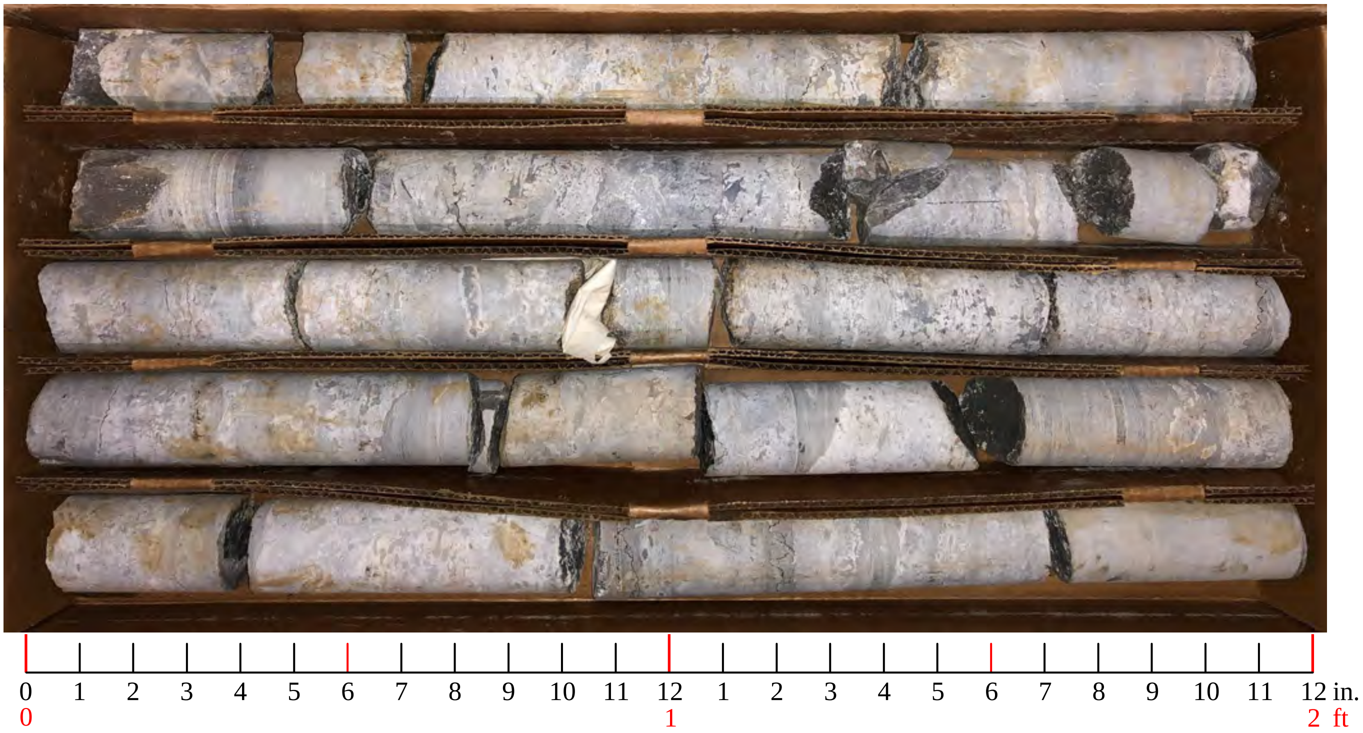
Job No. 19-118

Plate

B-S34: Run 5 (35-40 ft), Run 6 (40-45 ft)

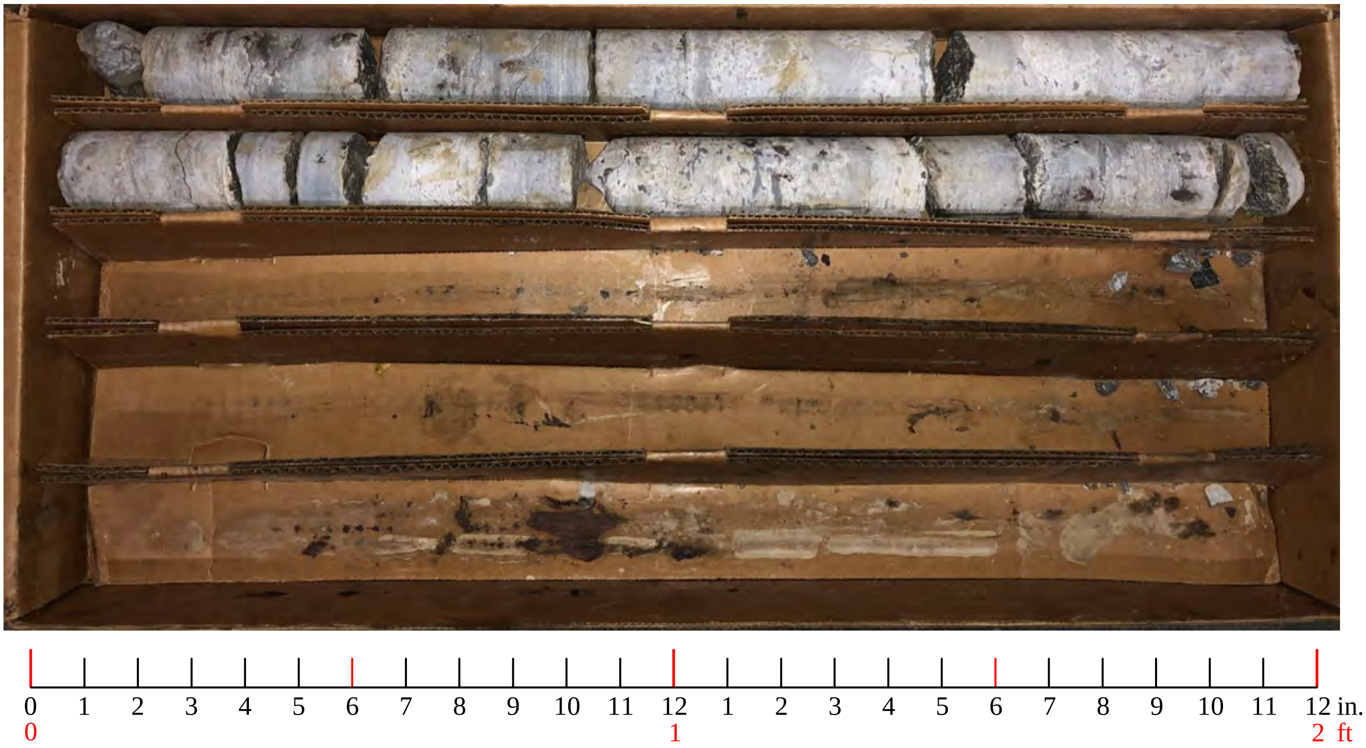


B-S34: Run 7 (45-50 ft), Run 8 (50-55 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**<u>ROCK CORE PHOTOS</u>** **090069 XNA Access Road** **Benton County, Arkansas**	**Job No. 19-118** **Plate**

B-S34: Run 9 (55-59 ft)



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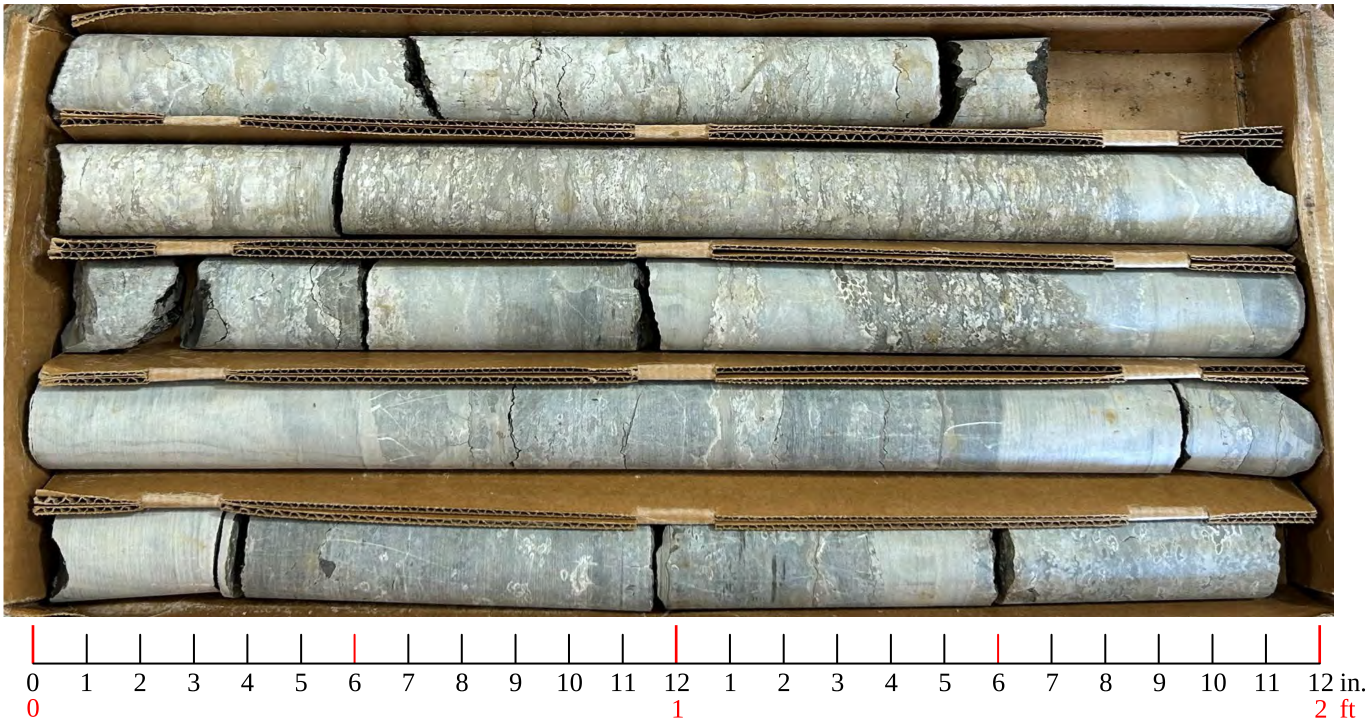
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S35: Run 1 (11-15 ft), Run 2 (15-20 ft)

B-S35: Run 3 (20-25 ft), Run 4 (25-30 ft)



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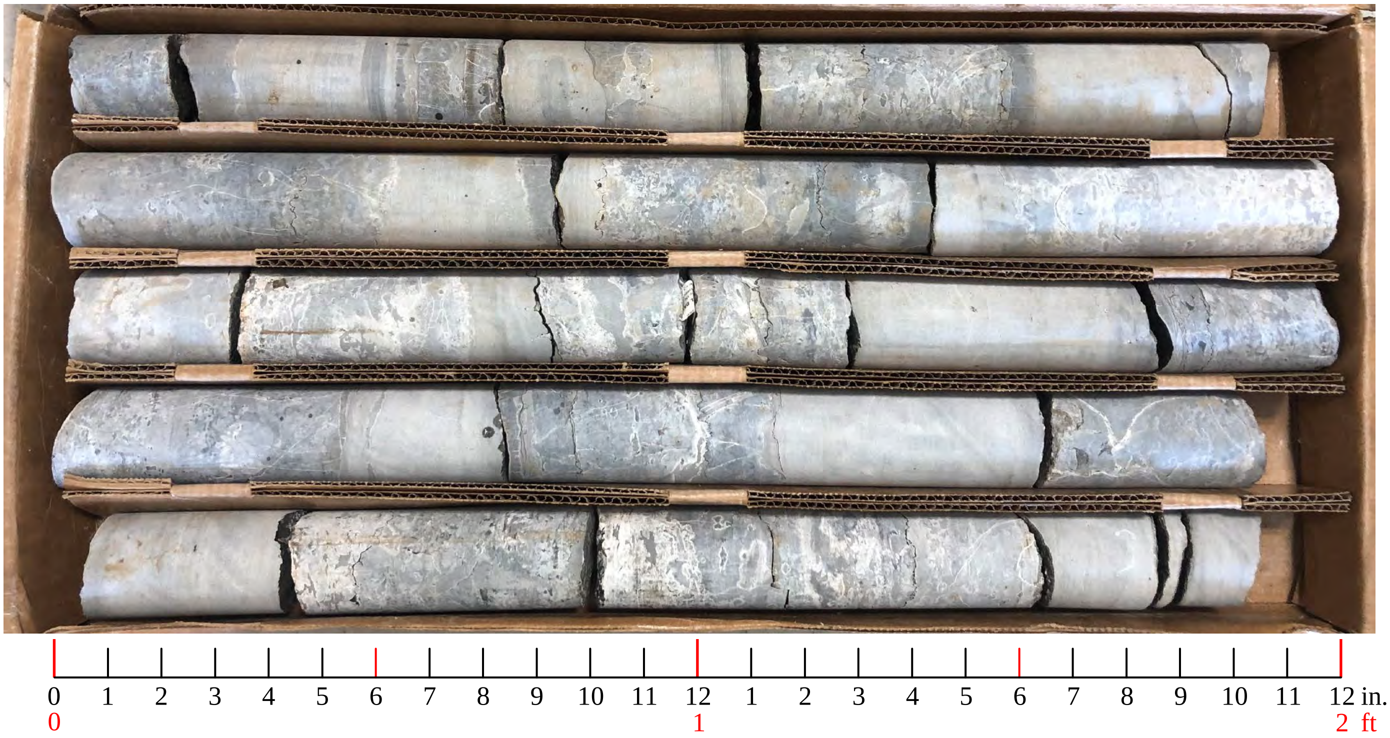
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

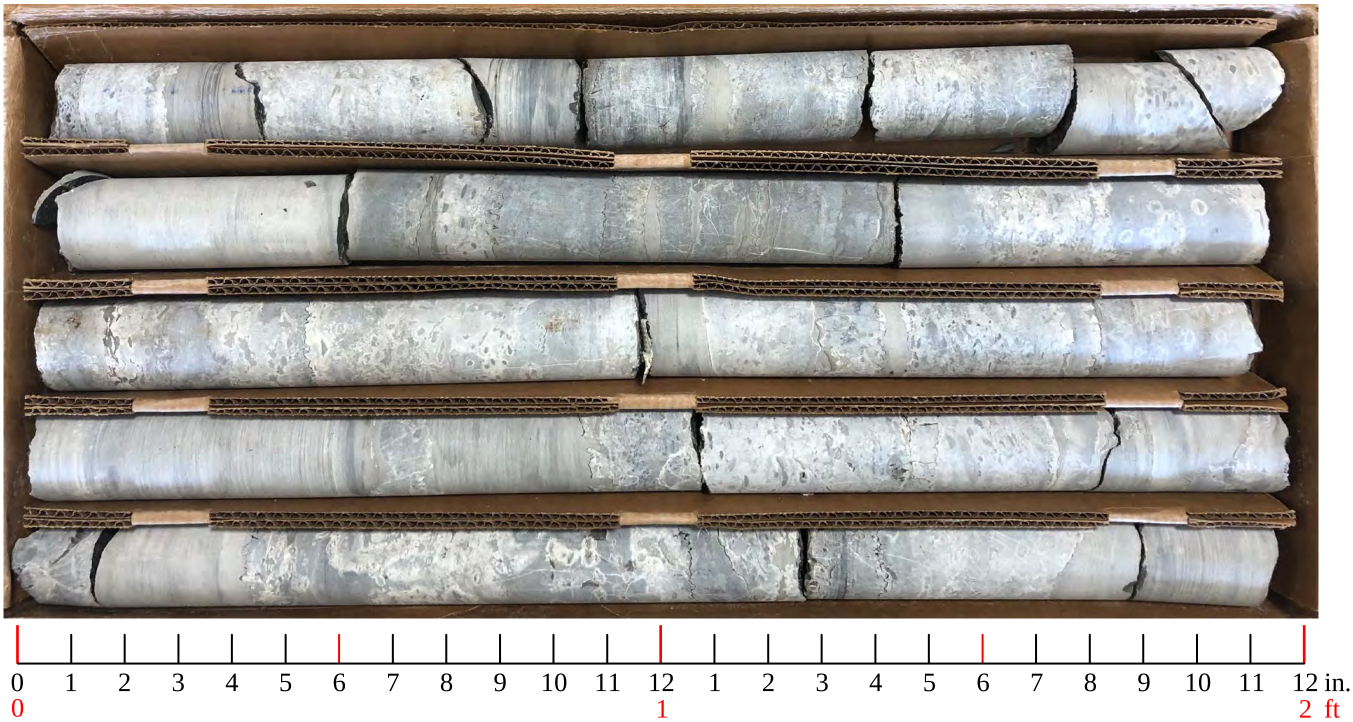
Job No. 19-118

Plate

B-S35: Run 5 (30-35 ft), Run 6 (35-40 ft)



B-S35: Run 7 (40-45 ft), Run 8 (45-50 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC
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ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S35: Run 9 (50-51 ft)

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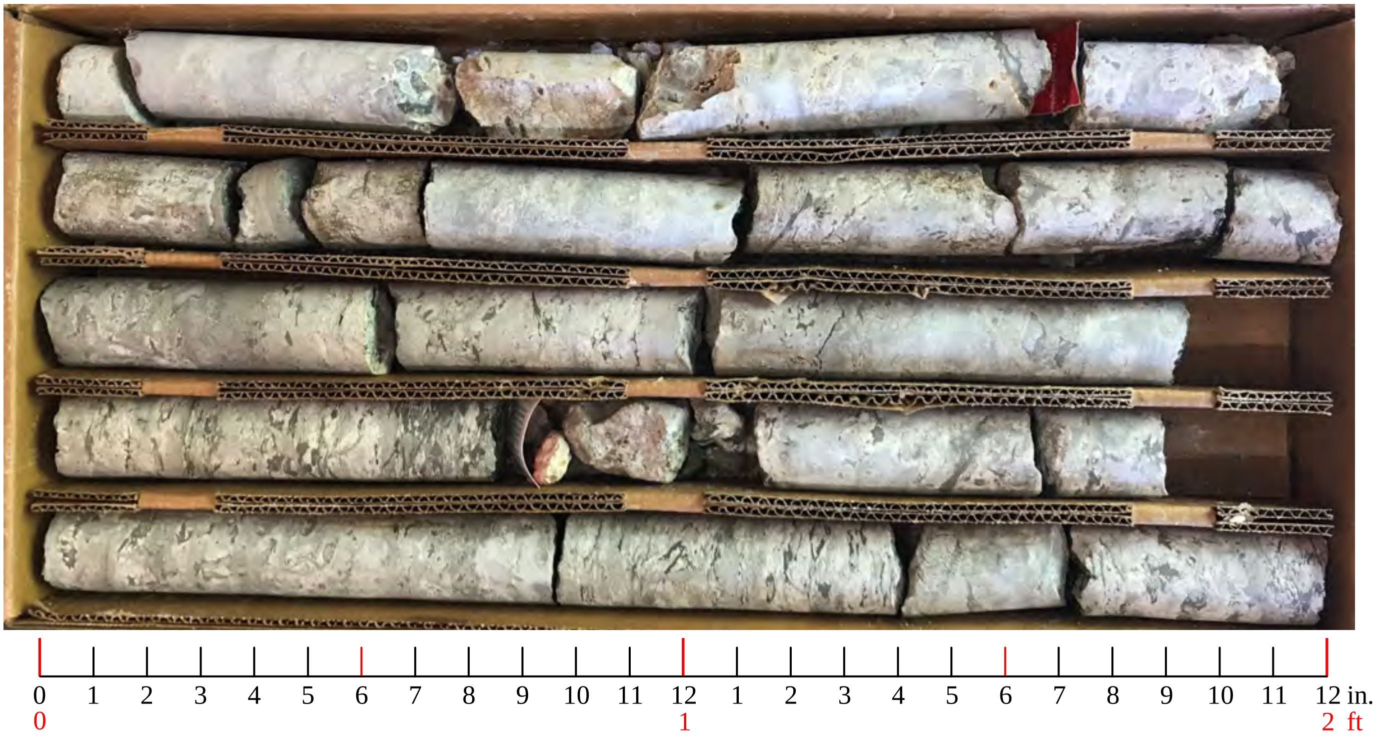
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S36: Run 1 (8-10 ft), Run 2 (10-15 ft), Run 3 (15-18 ft)

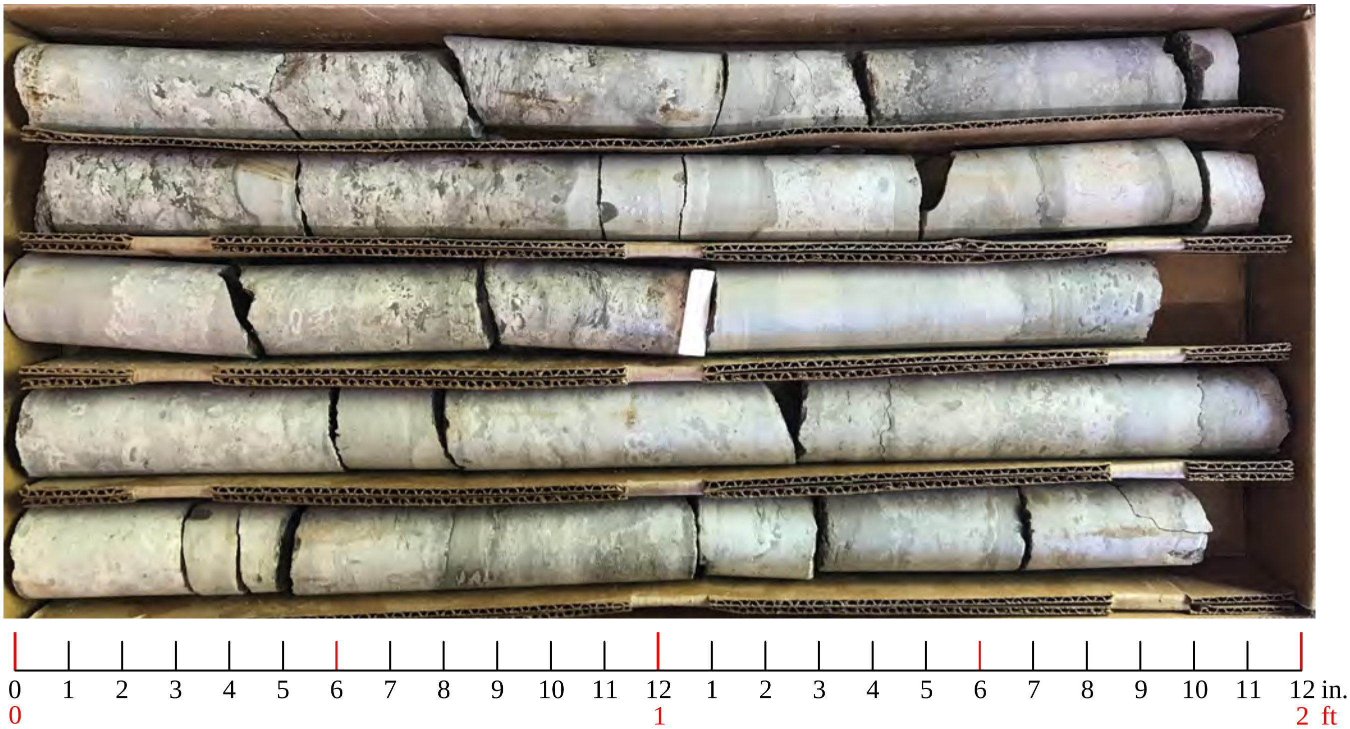


B-S36: Run 4 (18-23 ft), Run 5 (23-28 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **090069 XNA Access Road** **Benton County, Arkansas**	**Job No. 19-118** **Plate**

B-S36: Run 6 (28-33 ft), Run 7 (33-38 ft)

B-S36: Run 8 (38-45 ft), Run 9 (45-48 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
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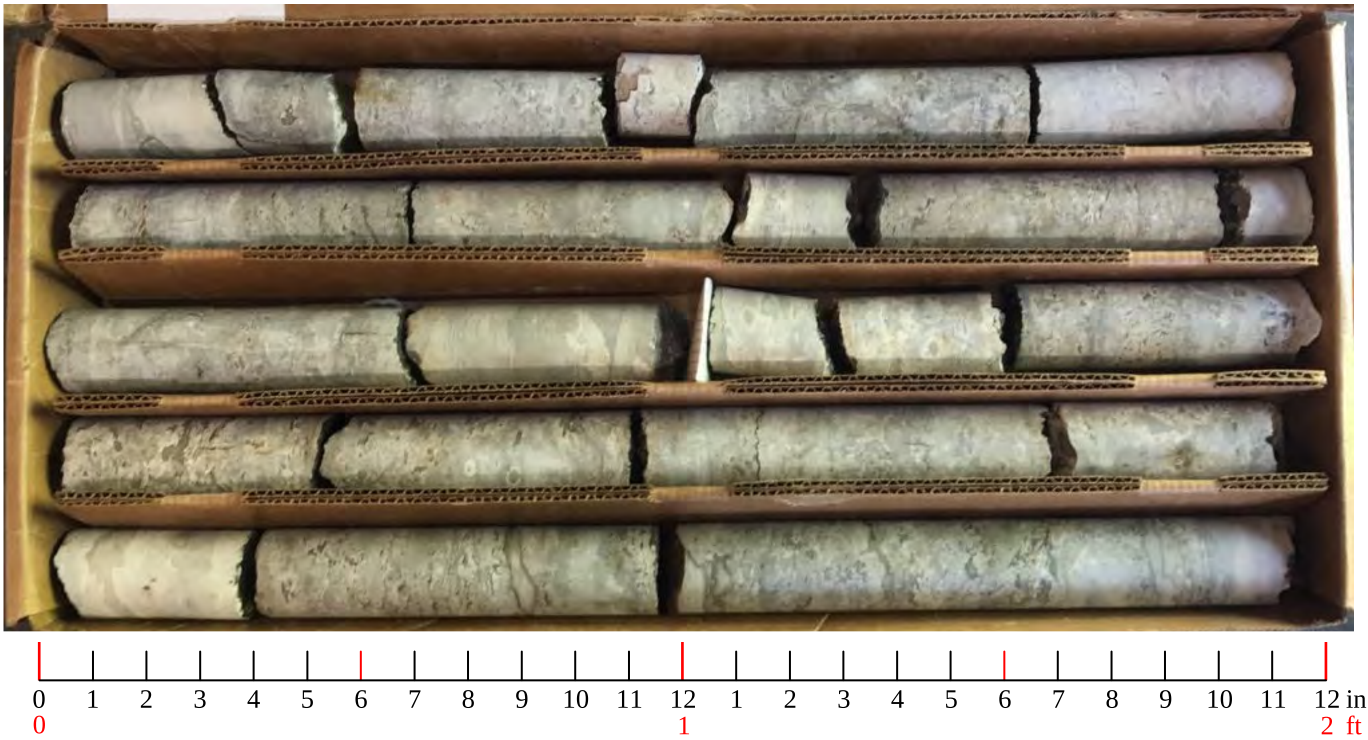
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S36: Run 10 (48-53 ft), Run 11 (53-58 ft)



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ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S37: Run 1 (8-13 ft), Run 2 (13-14 ft), Run 3 (14-18 ft)

B-S37: Run 4 (18-23 ft), Run 5 (23-28 ft)

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A UES Company

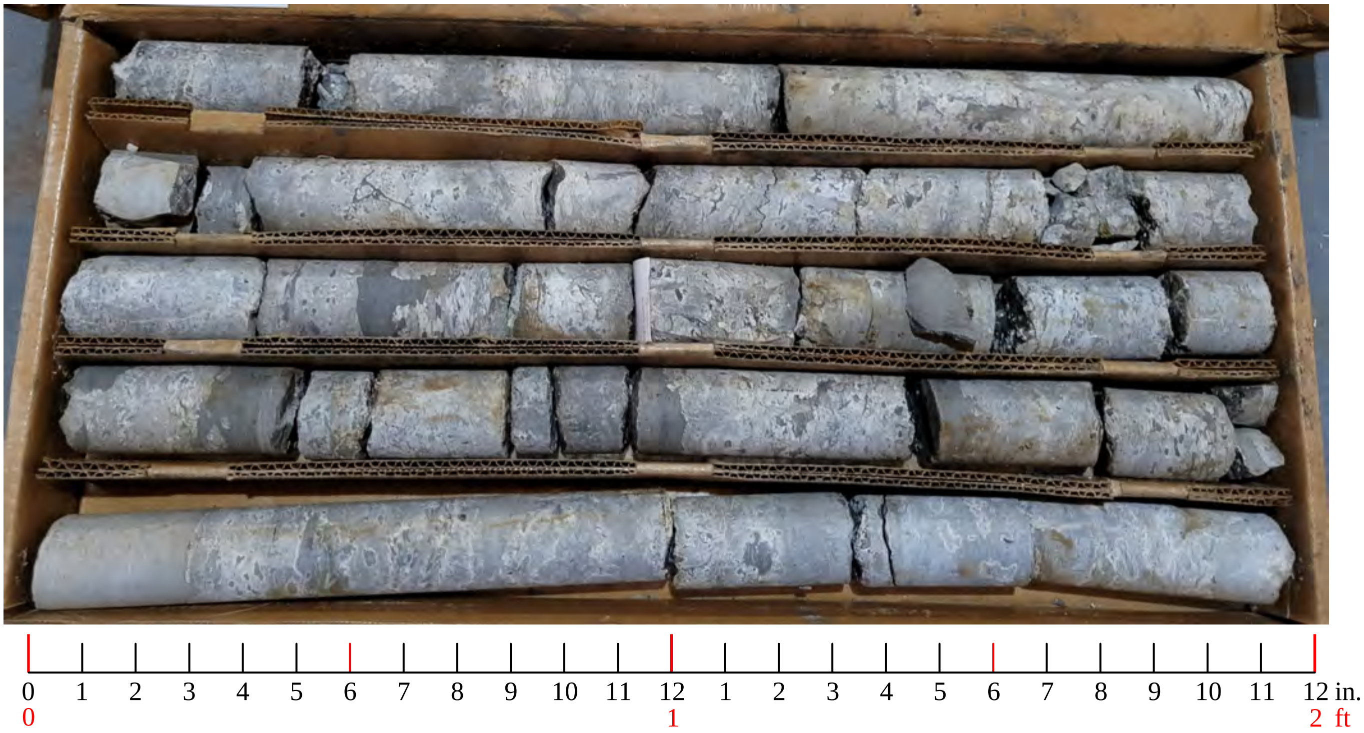
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S37: Run 6 (28-33 ft), Run 7 (33-38 ft)

B-S37: Run 8 (38-43 ft), Run 9 (43-48 ft)



Grubbs, Hoskyn,
Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S37: Run 10 (48-53 ft), Run 11 (53-58 ft)

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ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S38: Run 1 (12-17 ft), Run 2 (17-20 ft)

B-S38: Run 3 (20-23 ft)

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A UES Company

ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S38: Run 4 (23-27.5 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

APPENDIX C

SUMMARY of CLASSIFICATION TEST RESULTS

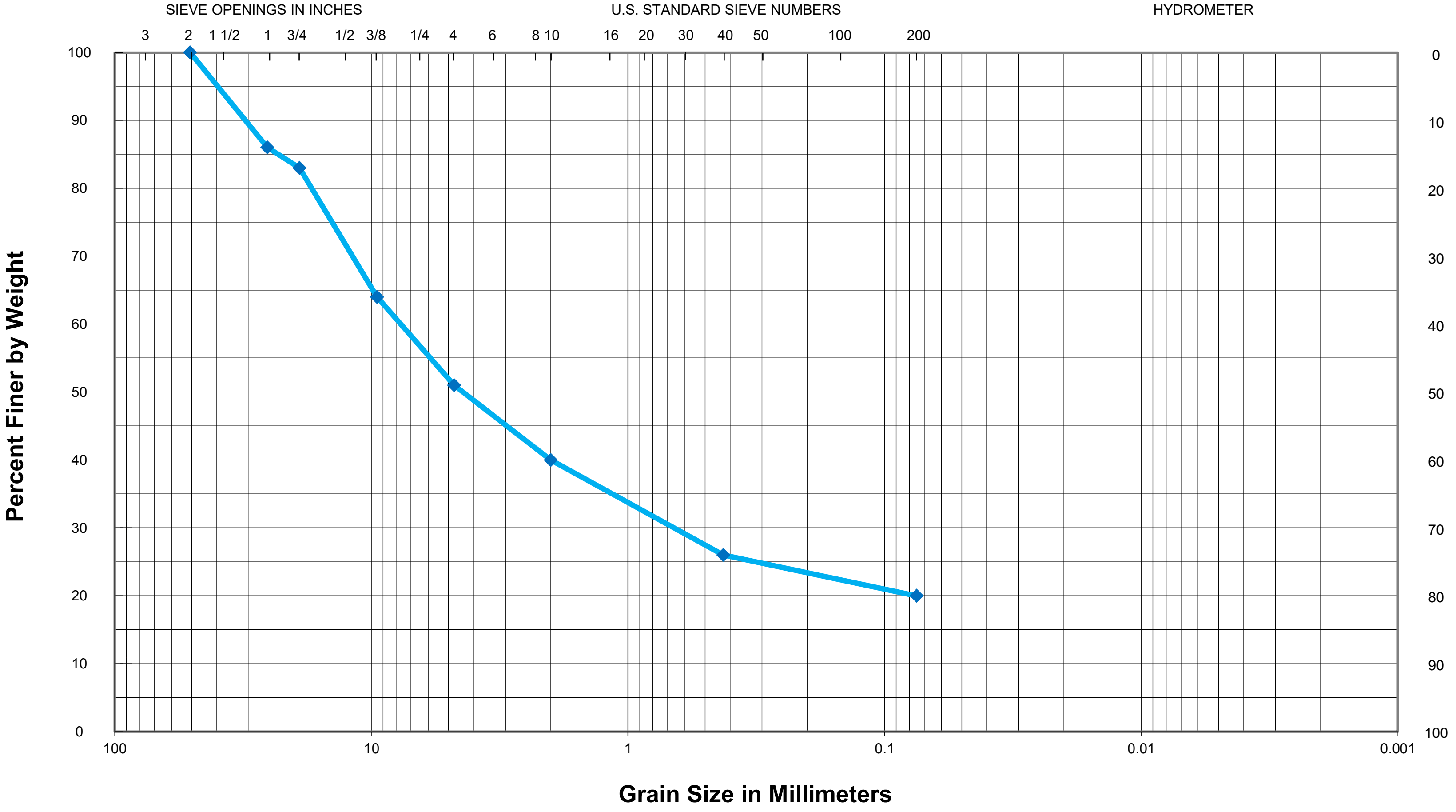
PROJECT: 090069 XNA Access Road
LOCATION: Benton County, Arkansas
GHBW JOB NUMBER: 19-118

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING								USCS CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
S27	4.5-5.5	50	38	32	6	---	---	---	---	100	---	---	63	ML	A-4
S28	4.5-5.5	24	35	22	13	---	---	---	---	63	---	---	35	SC	A-2-6
S30	2.5-3.5	11	34	21	13	---	---	---	---	91	---	---	81	CL	A-6
S31	2.5-3.5	13	28	23	5	---	---	---	---	51	---	---	18	GM	A-1-b
S32	0.5-1.5	17	27	20	7	---	---	---	---	64	---	---	48	GM-GC	A-4
S32	4.5-5.5	13	25	21	4	---	---	---	---	58	---	---	22	GM-GC	A-1-b
S33	6.5-7.5	20	37	21	16	---	---	---	---	50	---	---	28	GC	A-2-6
S34	4.5-5.5	24	43	21	22	100	86	83	64	51	40	26	20	GC	A-2-7
S35	6.5-7.5	12	--	--	--	100	100	80	63	48	32	17	12	GP-GM	A-1-b
S36	4.5-5.5	30	34	24	10	---	---	---	---	58	---	---	24	GM	A-2-4
S37	0.5-1.5	13	29	25	4	---	---	---	---	43	---	---	15	GM	A-1-a
S38	0.5-1.5	25	37	26	11	---	---	---	---	98	---	---	90	ML	A-6

19-118

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

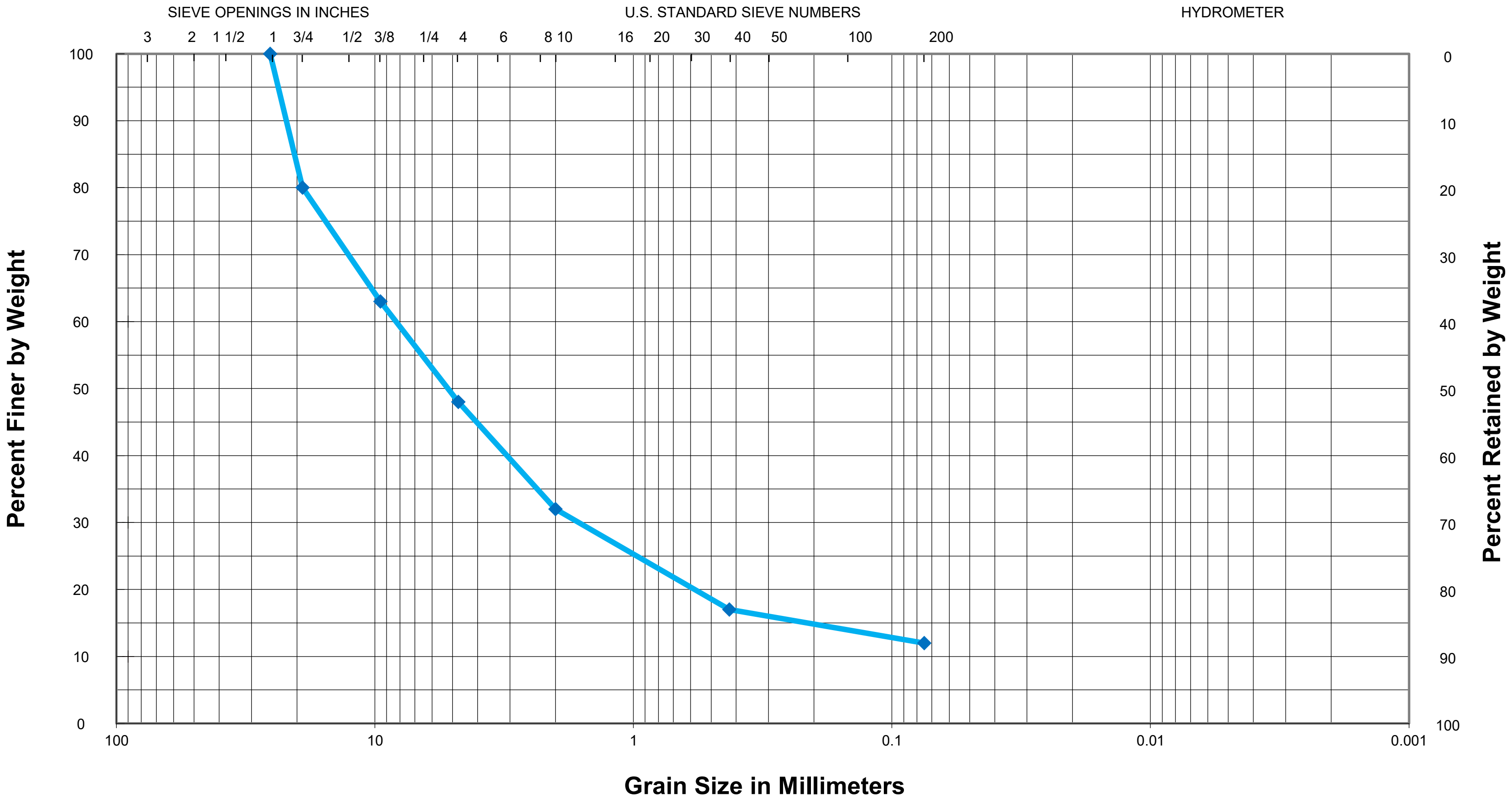
Sample: Boring S34, 4.5-5.5 ft; LL = 43, PL = 21, PI = 22
Description: Brown silty CLAY w/ numerous chert fragments

USCS Classification = GC
AASHTO Classification = A-2-7

19-118

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

Sample: Boring S35, 6.5-7.6 ft
Description: Medium dense brown and tan fine to coarse gravel w/ cobbles, slightly silty with a little sand

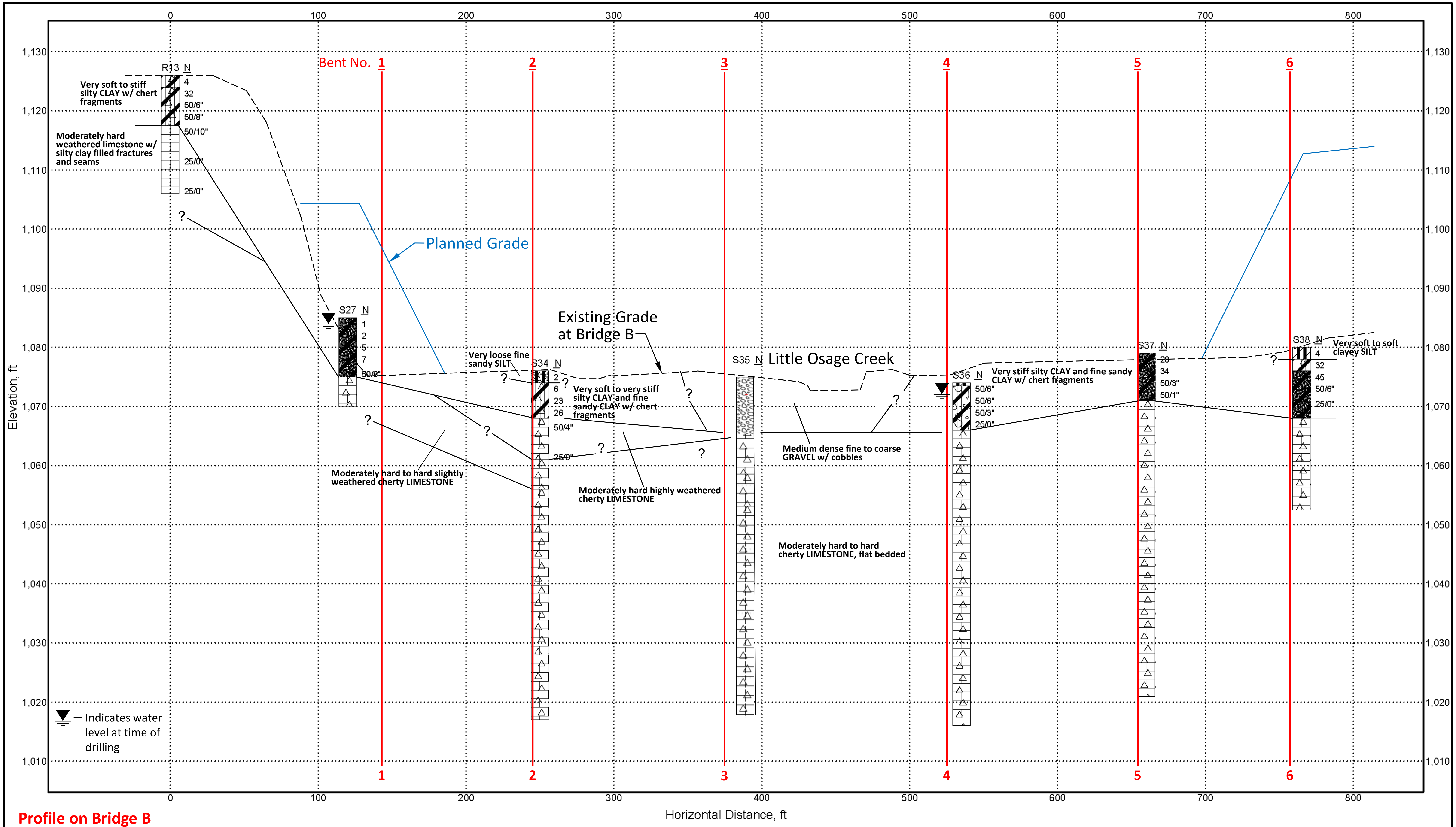
USCS Classification = GP-GM
AASHTO Classification = A-1-b

SUMMARY of COMPRESSION TEST RESULTS

PROJECT: 090069 XNA Access Road
LOCATION: Benton County, Arkansas
GHBW JOB NUMBER: 19-118

BORING No.	SAMPLE DEPTH (ft)	TOTAL UNIT WEIGHT (pcf)	COMPRESSIVE STRENGTH (psi)	DESCRIPTION
S29	15.5-16	----	7,420	Light gray cherty LIMESTONE
S29	24.5-25	147	10,740	Light gray cherty LIMESTONE
S29	30-30.5	152	3,040	Light gray cherty LIMESTONE
S29	39.5-40	152	10,630	Light gray cherty LIMESTONE
S29	45.5-46	155	7,170	Light gray cherty LIMESTONE
S31	21-21.5	155	10,940	Gray and tan cherty LIMESTONE
S31	29.5-30	152	7,320	Gray and tan cherty LIMESTONE
S31	40-40.5	150	9,010	Gray and tan cherty LIMESTONE
S32	15.5-16	161	9,240	Gray cherty LIMESTONE
S34	21-21.5	156	8,200	Gray cherty LIMESTONE
S34	21.5-22	154	4,810	Gray cherty LIMESTONE
S34	42.5-43	156	6,970	Gray cherty LIMESTONE
S34	51-51.5	160	6,220	Gray cherty LIMESTONE
S36	28-28.5	154	8,090	Light gray w/ gray cherty LIMESTONE
S36	33.5-34	151	7,190	Light gray w/ gray cherty LIMESTONE
S36	39.5-40	147	3,310	Light gray w/ gray cherty LIMESTONE
S36	44.5-45	157	8,120	Light gray w/ gray cherty LIMESTONE
S36	50.5-51	149	7,710	Light gray w/ gray cherty LIMESTONE
S37	22-22.5	150	10,930	Gray and tan cherty LIMESTONE
S37	25.5-26	149	14,180	Gray and tan cherty LIMESTONE
S37	40.3-40.8	----	8,990	Gray and tan cherty LIMESTONE
S37	45-45.5	141	4,760	Gray and tan cherty LIMESTONE
S37	50.5-51	167	4,160	Gray and tan cherty LIMESTONE
S38	13-13.5	159	5,610	Gray cherty LIMESTONE

APPENDIX D



Profile on Bridge B

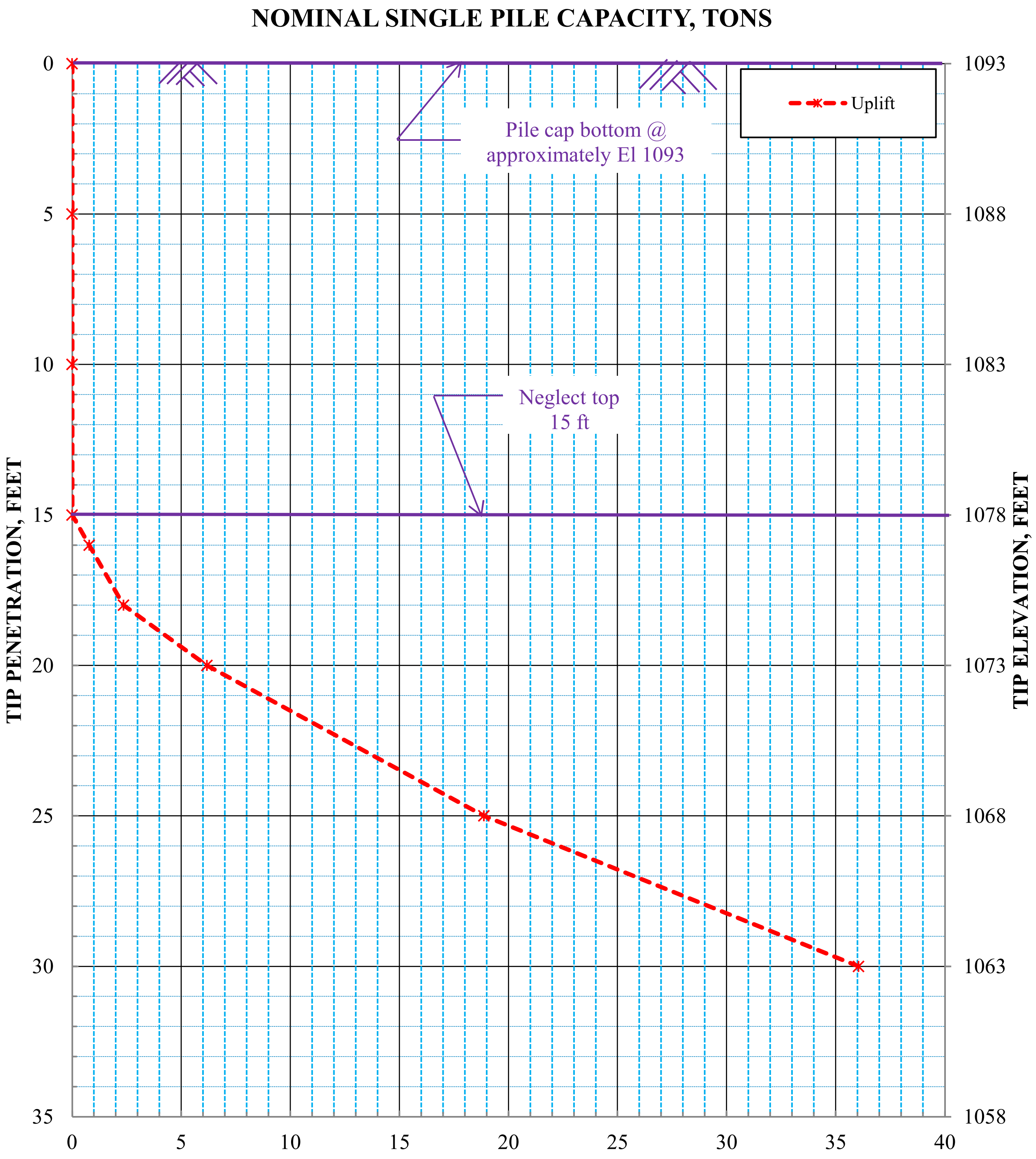
Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

NOTES:
1. Subsurface conditions have been inferred between discrete boring locations. Actual conditions may vary.
2. Ground surface approximate.

SCALE:
1" = 60' Horizontal
1" = 15' Vertical

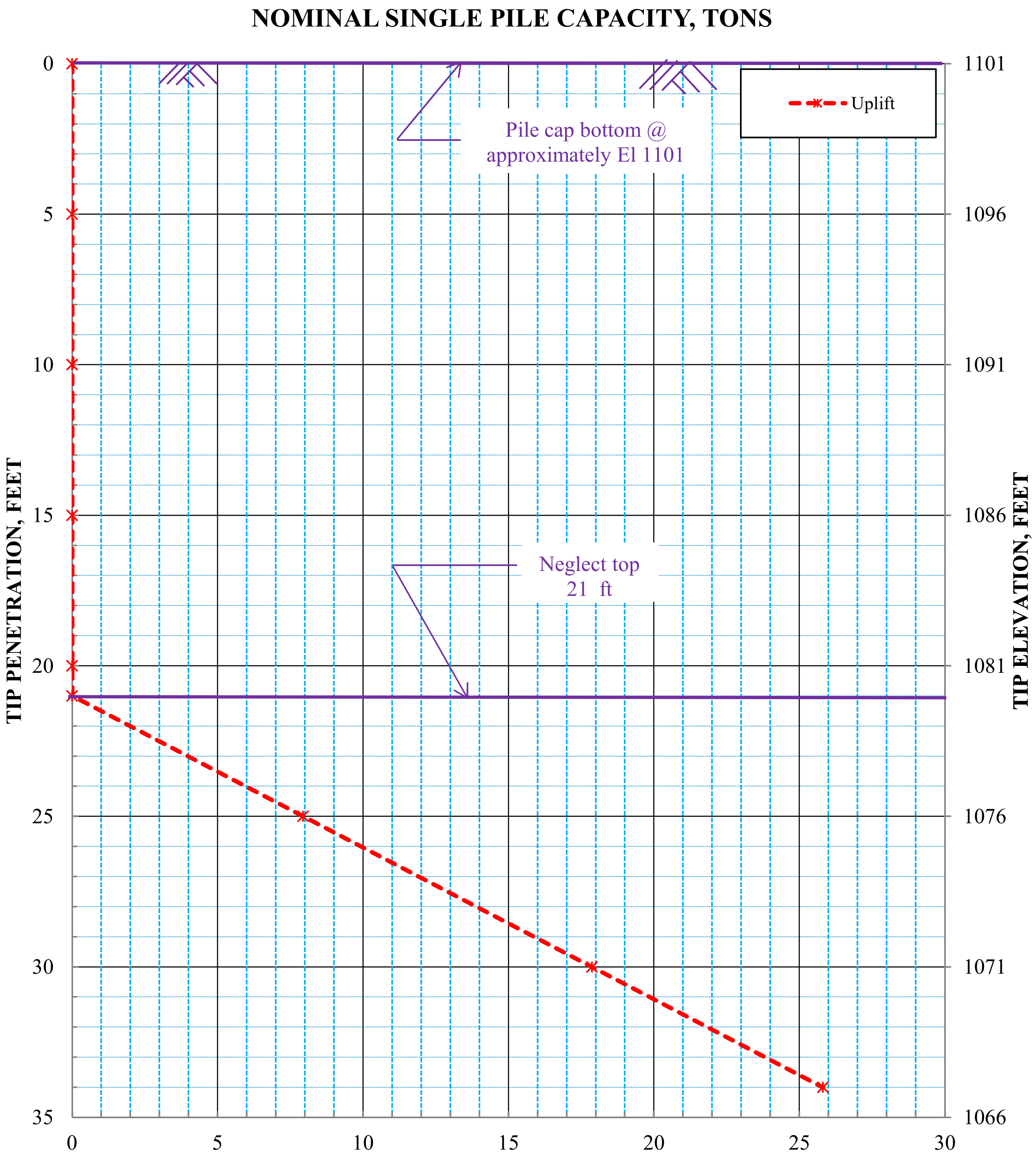
Generalized Subsurface Profile
090069 XNA Access Road over Little Osage Ck
Benton Co., Arkansas
Project Number: 19-118

APPENDIX E



NOMINAL SINGLE PILE CAPACITY, TONS
Grouted HP12x53 Steel Piles - Uplift
090069 XNA Access Road over Little Osage Creek
Bent 1A (South Bent)
Benton County, Arkansas

Note: 1. Piles driven from cap bottom elevation
2. Preboring and grouting required in moderately hard cherty limestone below El 1075±

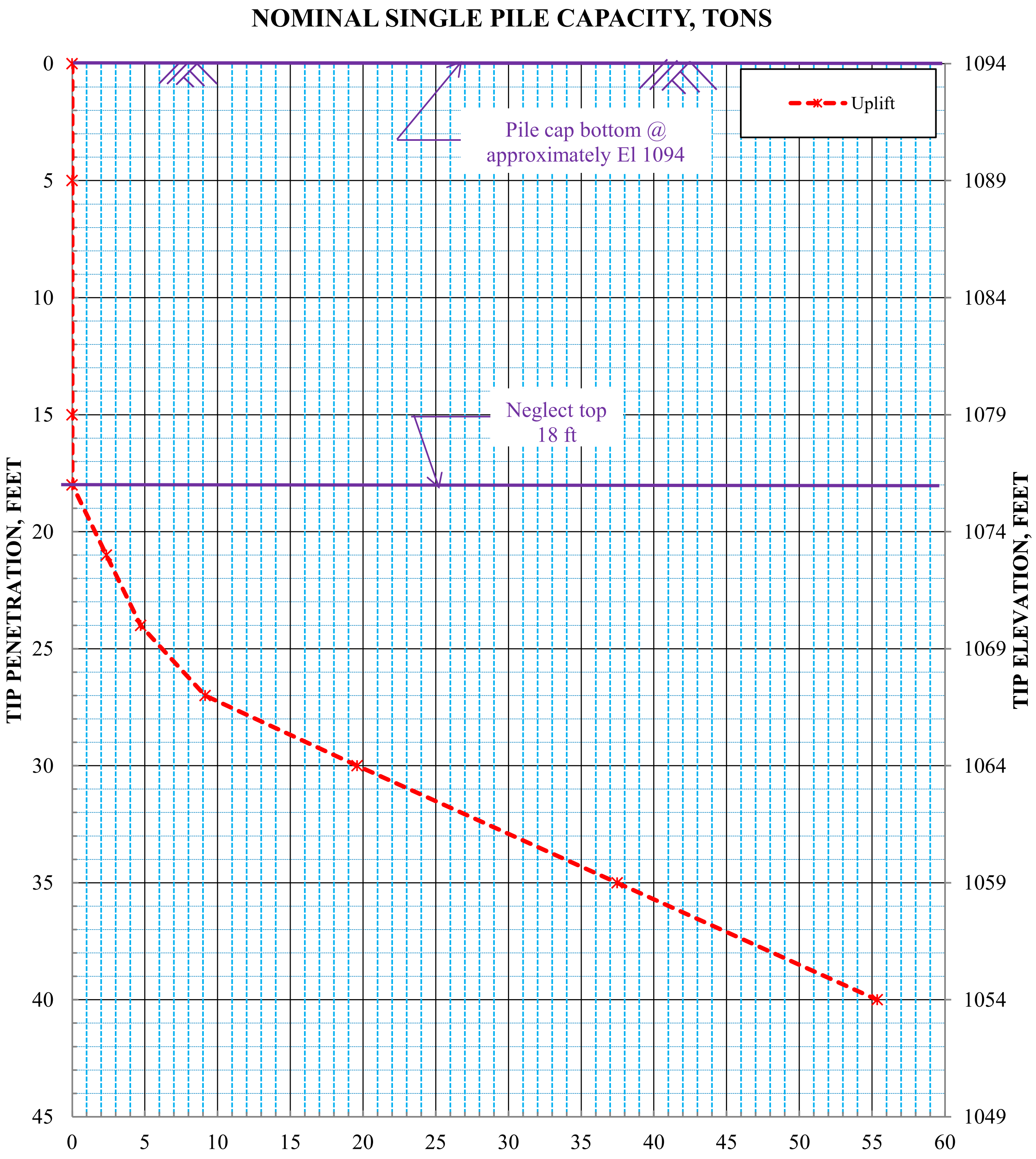


NOMINAL SINGLE PILE CAPACITY, TONS

HP12x53 Steel Piles - Uplift
090069 XNA Access Road over Little Osage Creek
Bent 4A (North Bent)
Benton County, Arkansas

Note: 1. Piles driven from cap bottom elevation
2. Preboring and grouting required in moderately hard cherty limestone below El 1067±

Grubbs, Hoskyn, Barton & Wyatt, LLC
Consulting Engineers



NOMINAL SINGLE PILE CAPACITY, TONS

Grouted HP12x53 Steel Piles - Uplift

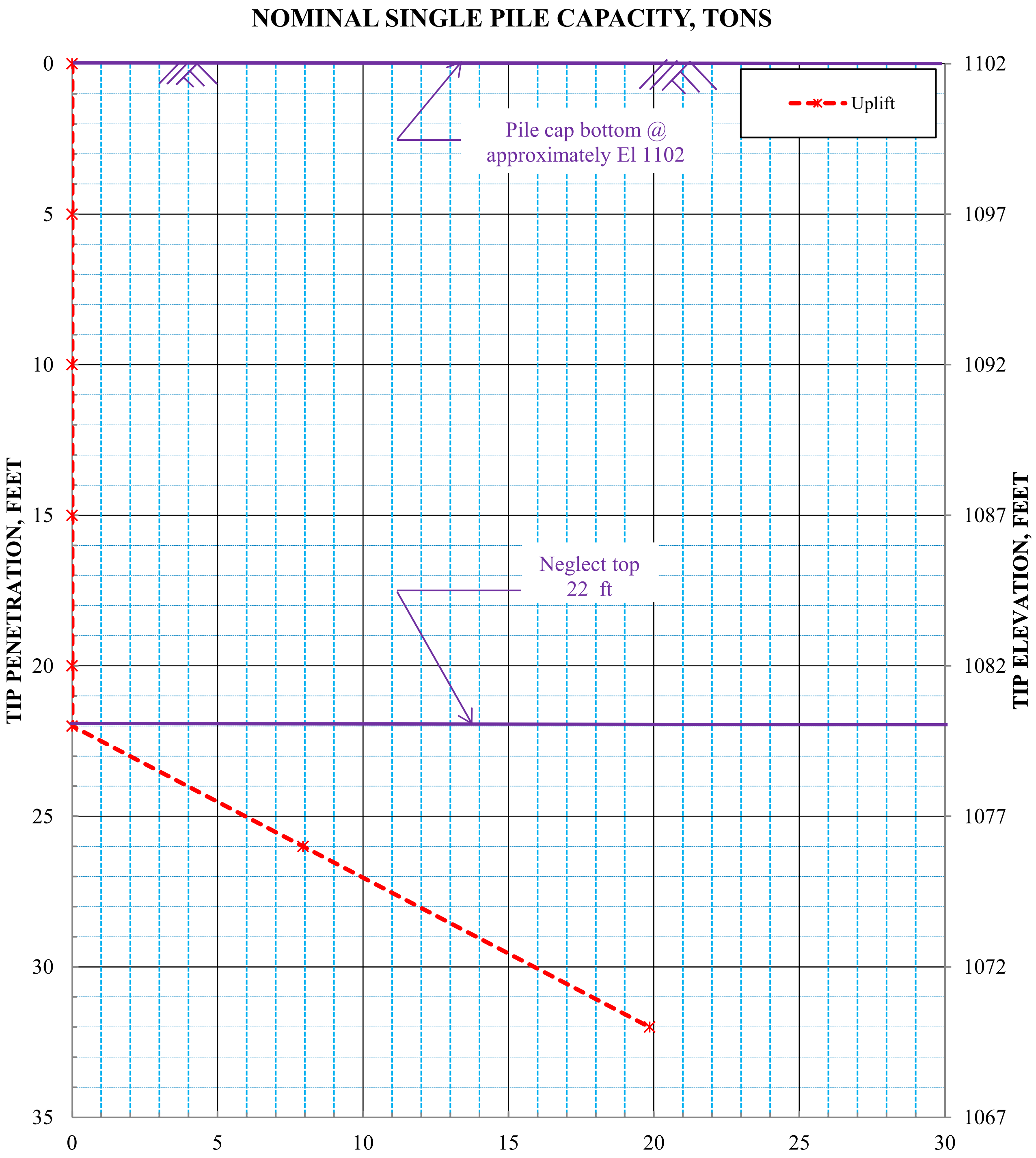
090069 XNA Access Road over Little Osage Creek

Bent 1B (North Bent)

Benton County, Arkansas

Note: 1. Piles driven from cap bottom elevation

2. Preboring and grouting required in moderately hard cherty limestone below El 1067±



NOMINAL SINGLE PILE CAPACITY, TONS

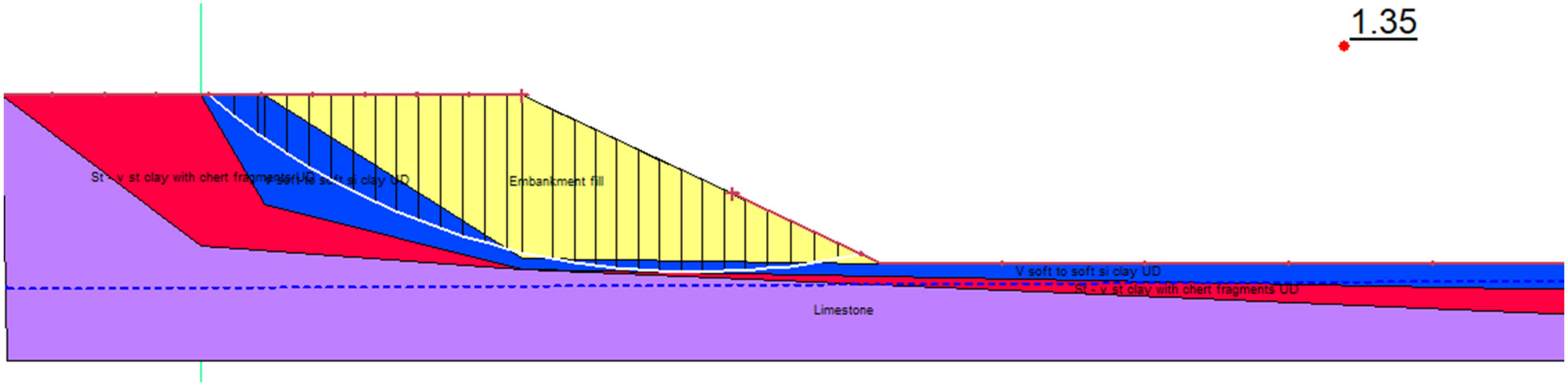
HP12x53 Steel Piles - Uplift
090069 XNA Access Road over Little Osage Creek
Bent 4B (North Bent)
Benton County, Arkansas

Note: 1. Piles driven from cap bottom elevation
2. Preboring and grouting required in moderately hard cherty limestone below El 1070±

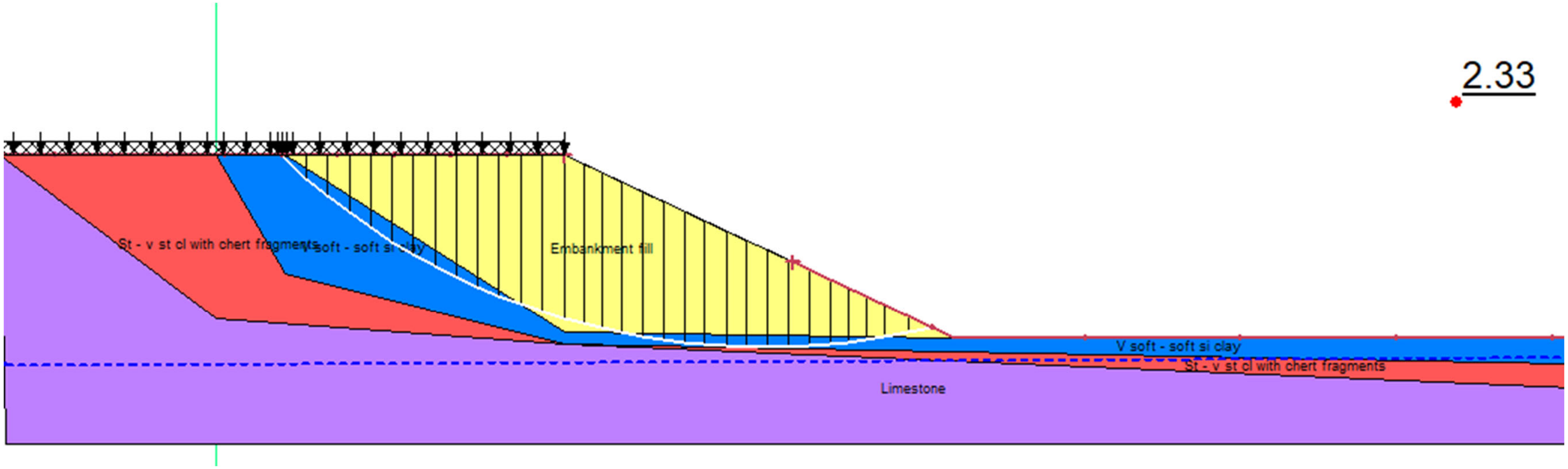
APPENDIX F

Summary of Stability Analysis Results
ARDOT 090069 XNA Access Road over Little Osage Creek
GHBW Job No. 19-118
Benton County, Arkansas

	Design Loading Condition	**Calculated Minimum Factor of Safety**
South End Slope (Bent 1) (2H:1V)	End of Construction	1.35
	Long Term	2.33
	Rapid Drawdown from El 1085 to El 1074	2.17
	Seismic ($k_h = A_S/2 = 0.0245$)	1.24
South Side Slope (Bent 1) (3H:1V)	End of Construction	3.55
	Long Term	3.22
	Rapid Drawdown from El 1085 to Existing Grade	3.01
	Seismic ($k_h = A_S/2 = 0.\ 0245$)	2.80
North End Slope (Bent 4) (2H:1V)	End of Construction	2.70
	Long Term	2.39
	Rapid Drawdown from El 1085 to El 1074	2.16
	Seismic ($k_h = A_S/2 = 0.\ 0245$)	2.39
North Side Slope (Bent 4) (3H:1V)	End of Construction	3.17
	Long Term	2.96
	Rapid Drawdown from El 1085 to Existing Grade	2.62
	Seismic ($k_h = A_S/2 = 0.\ 0245$)	2.90

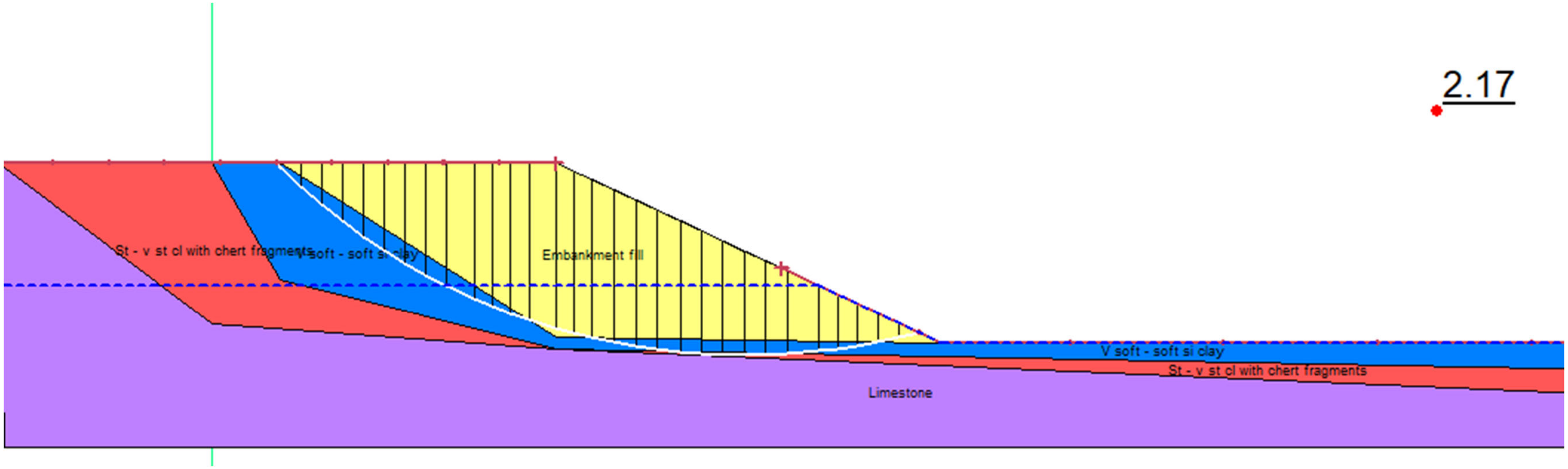


Results of Stability Analyses – End of Construction
Bent 1 End Slope
2H:1V Slope, H=28 ft ±
19-118 – ArDOT 090069 XNA Access Road over Little Osage Creek



Results of Stability Analyses – Long Term Condition
Bent 1 End Slope
2H:1V Slope, H=28 ft ±
19-118 – ARDOT 090069 XNA Access Road over Little Osage Creek

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



Results of Stability Analyses – Rapid Drawdown Condition from El 1085 to El 1074
Bent 1 End Slope
2H:1V Slope, H=28 ft ±
19-118 – ARDOT 090069 XNA Access Road over Little Osage Creek

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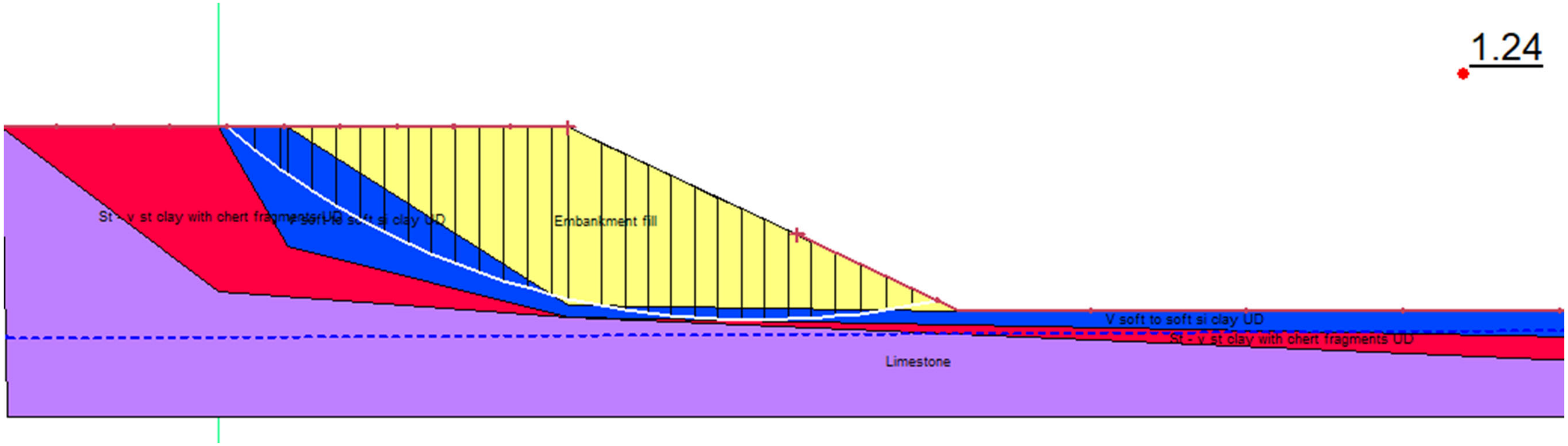
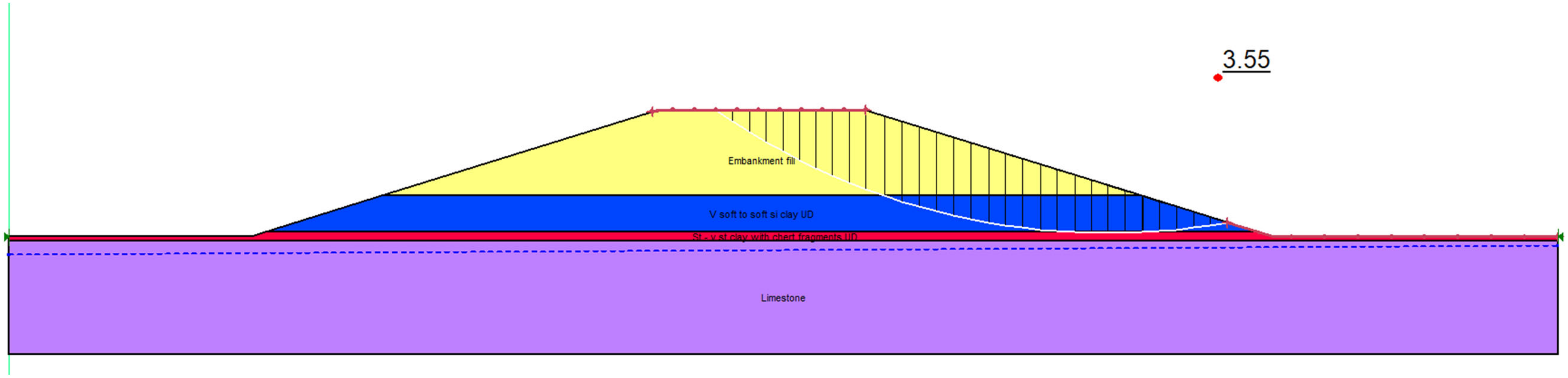
CONSULTING ENGINEERS
A UES Company

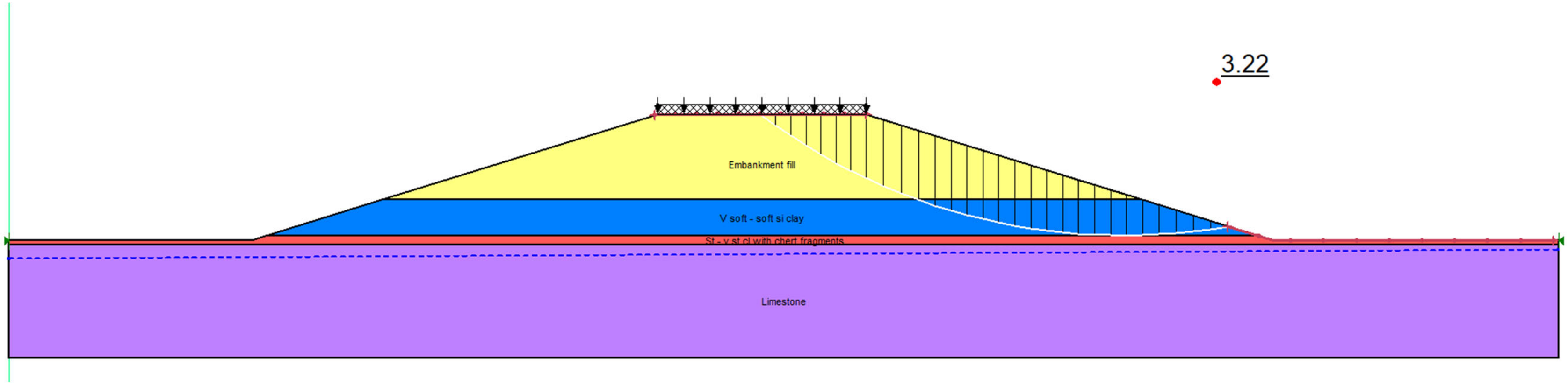


Results of Stability Analyses – Seismic Condition ($k_h = A_S /2= 0.0245$)
Bent 1 End Slope
2H:1V Slope, H=28 ft ±
19-118 – ARDOT 090069 XNA Access Road over Little Osage Creek

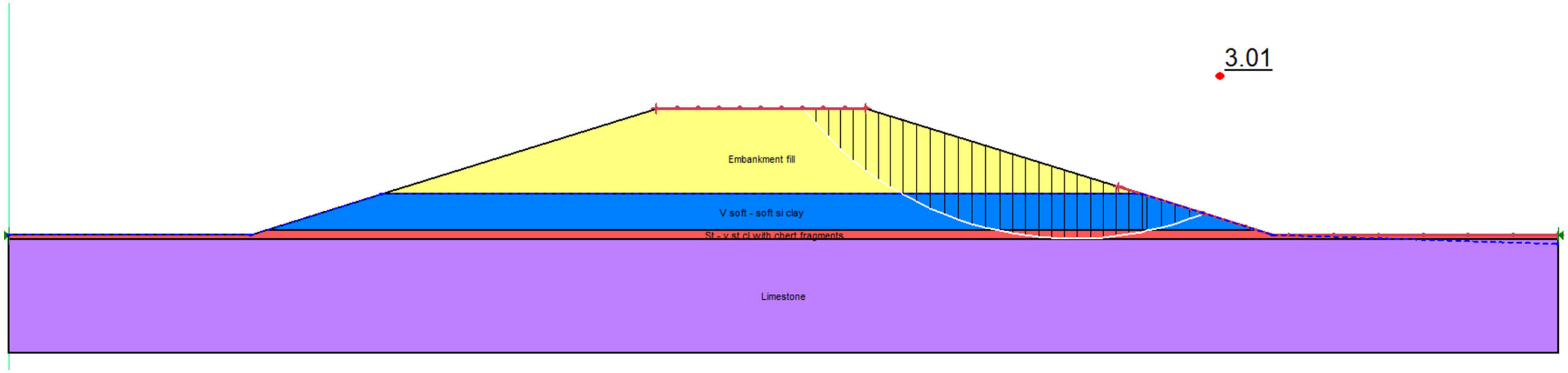
**Grubbs, Hoskyn,
Barton & Wyatt, LLC**
CONSULTING ENGINEERS
A UES Company



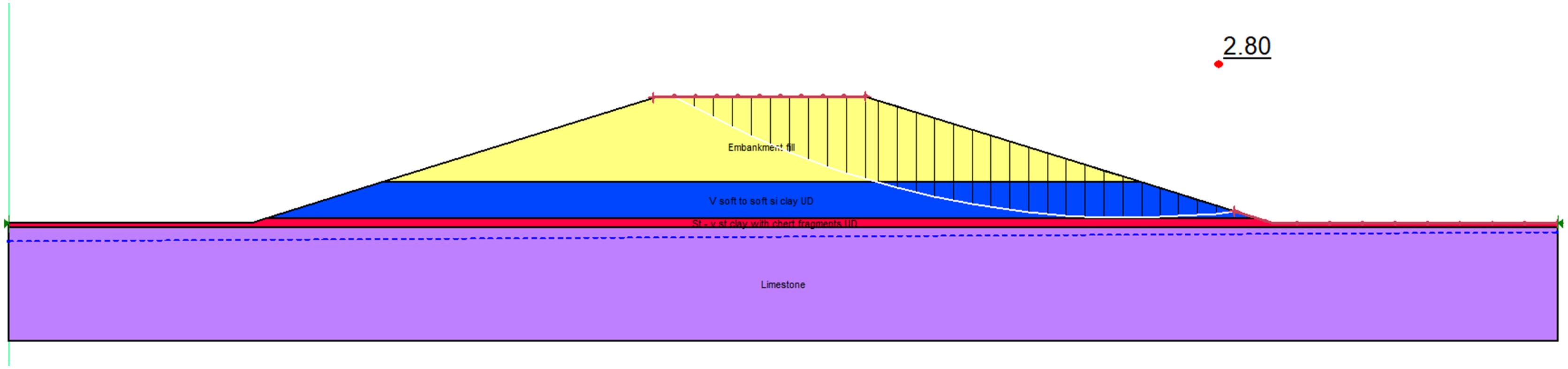
Results of Stability Analyses – End of Construction
Bent 1 Side Slope
3H:1V Slope, H=28 ft ±
19-118 – ARDOT 090069 XNA Access Road over Little Osage Creek



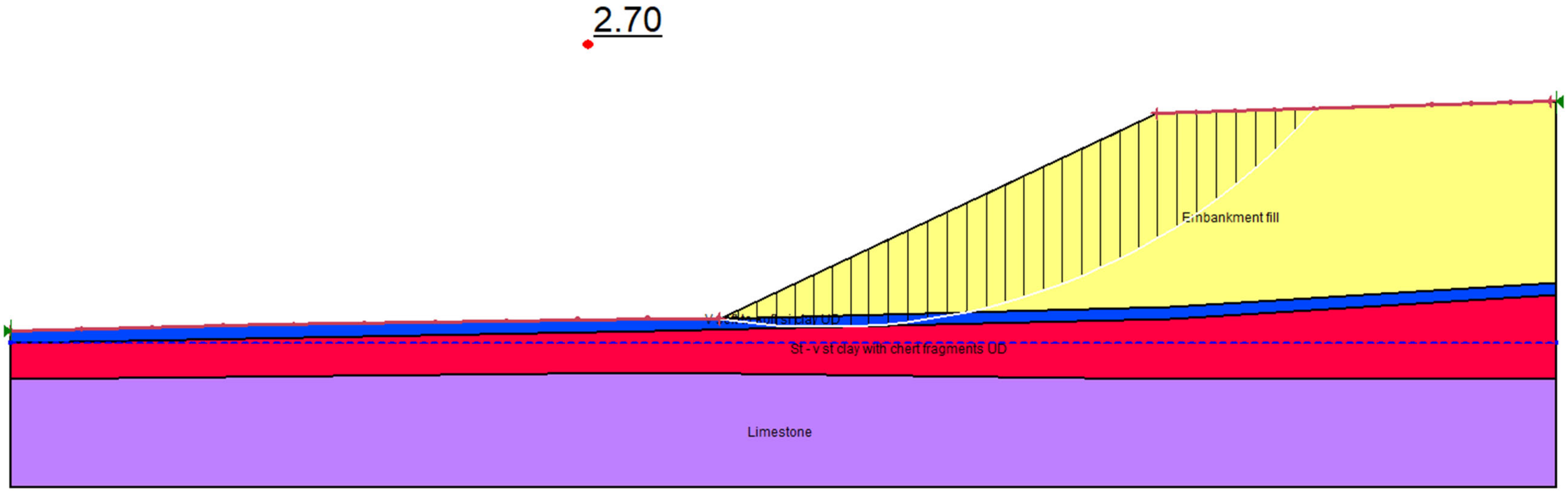
Results of Stability Analyses – Long Term Condition
Bent 1 Side Slope
3H:1V Slope, H=28 ft ±
19-118 – ArDOT 090069 XNA Access Road over Little Osage Creek



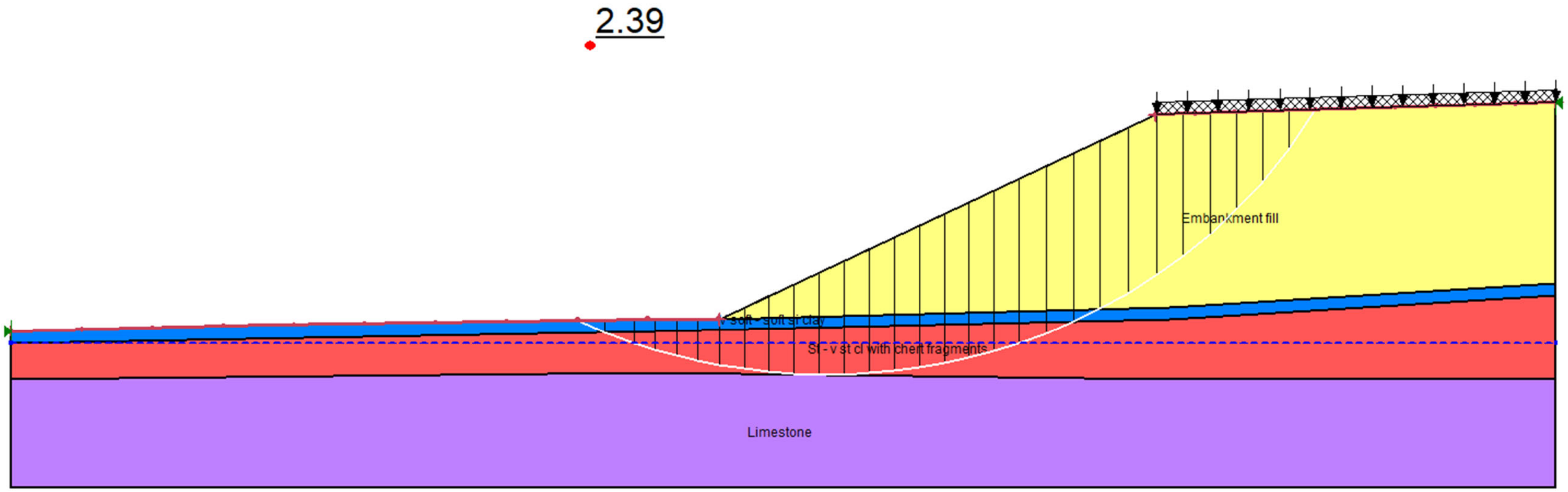
Results of Stability Analyses – Rapid Drawdown El 1085 to Existing Grade
Bent 1 Side Slope
3H:1V Slope, H=28 ft ±
19-118 – ArDOT 090069 XNA Access Road over Little Osage Creek



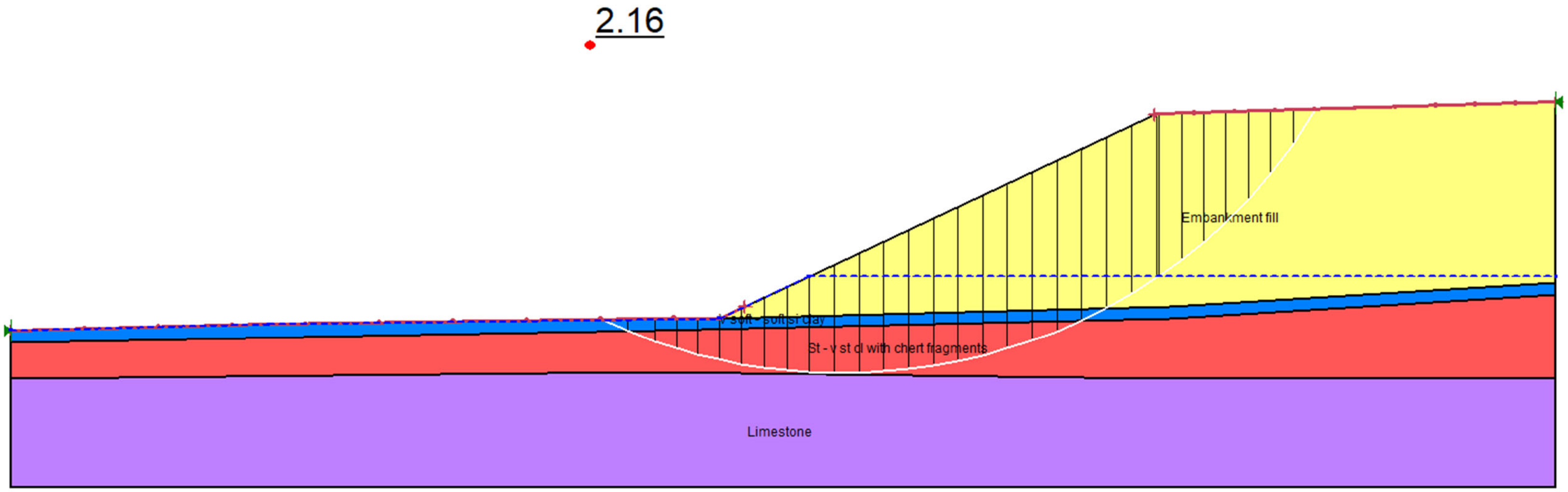
Results of Stability Analyses – Seismic Condition ($k_h = A_S /2= 0.0245$)
Bent 1 Side Slope
3H:1V Slope, H=28 ft ±
19-118 – ARDOT 090069 XNA Access Road over Little Osage Creek



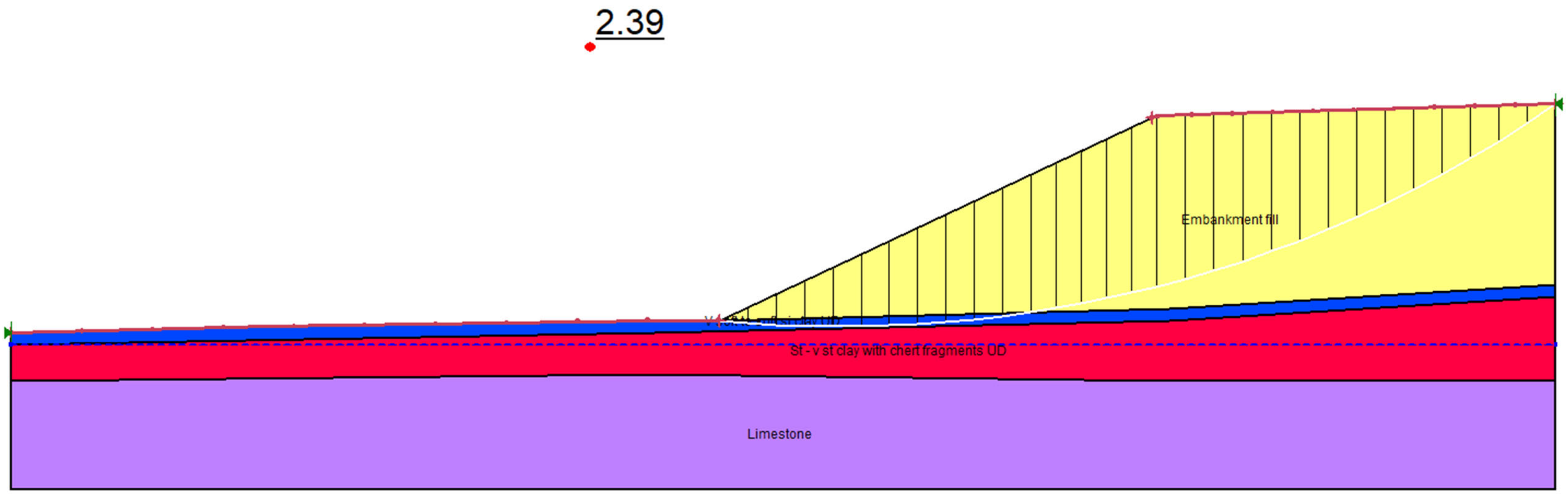
Results of Stability Analyses – End of Construction
Bent 4 End Slope
2H:1V Slope, H=34 ft ±
19-118 – ArDOT 090069 XNA Access Road over Little Osage Creek



Results of Stability Analyses – Long Term Condition
Bent 4 End Slope
2H:1V Slope, H=34 ft ±
19-118 – ARDOT 090069 XNA Access Road over Little Osage Creek
r



Results of Stability Analyses – Rapid Drawdown Condition, El 1085 to El 1074
Bent 4 End Slope
2H:1V Slope, H=34 ft ±
19-118 – ArDOT 090069 XNA Access Road over Little Osage Creek



Results of Stability Analyses – Seismic Condition ($k_h = A_S /2 = 0.0245$)
Bent 4 End Slope
2H:1V Slope, H=34 ft ±
19-118 – ARDOT 090069 XNA Access Road over Little Osage Creek

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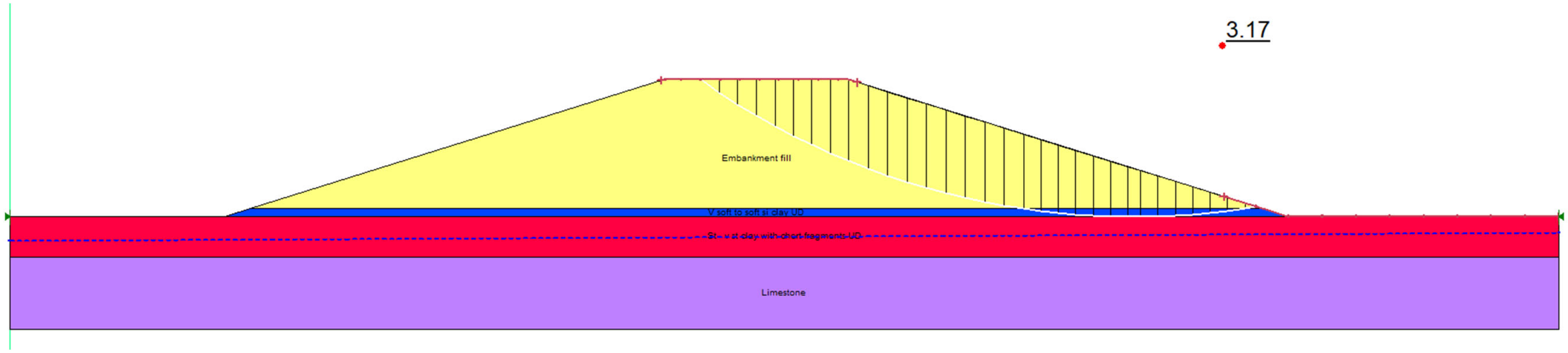
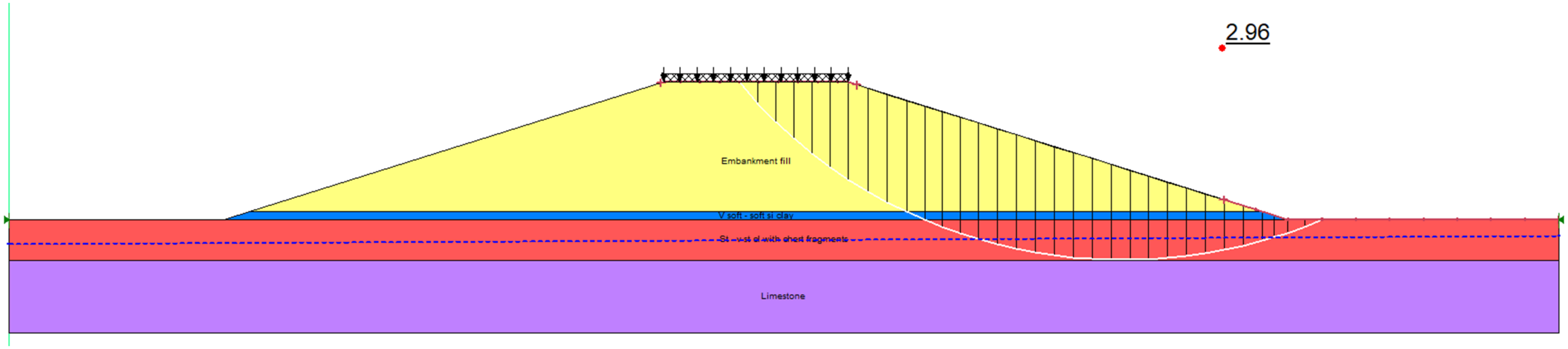
A UES Company

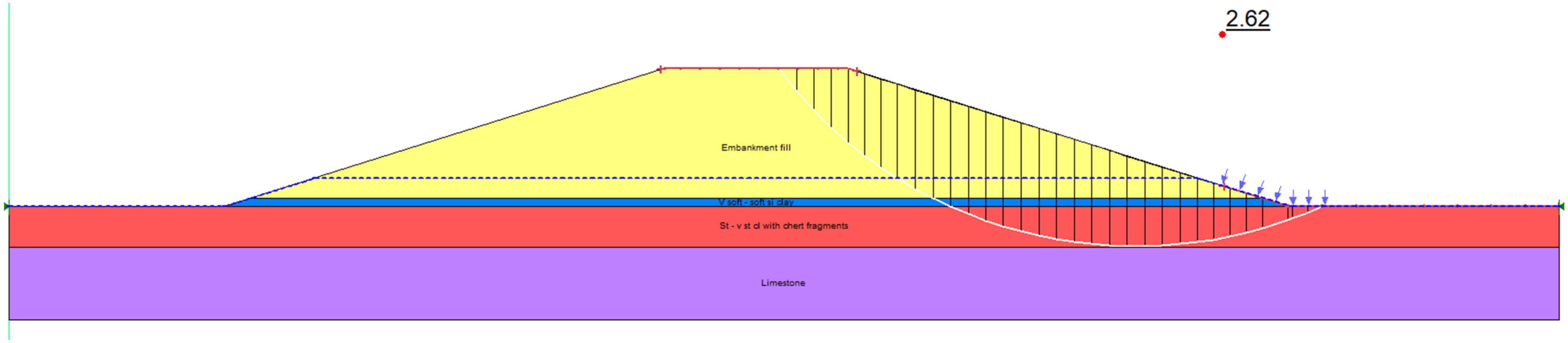


Results of Stability Analyses – End of Construction
Bent 4 Side Slope
3H:1V Slope, H=34 ft ±
19-118 – ARDOT 090069 XNA Access Road over Little Osage Creek



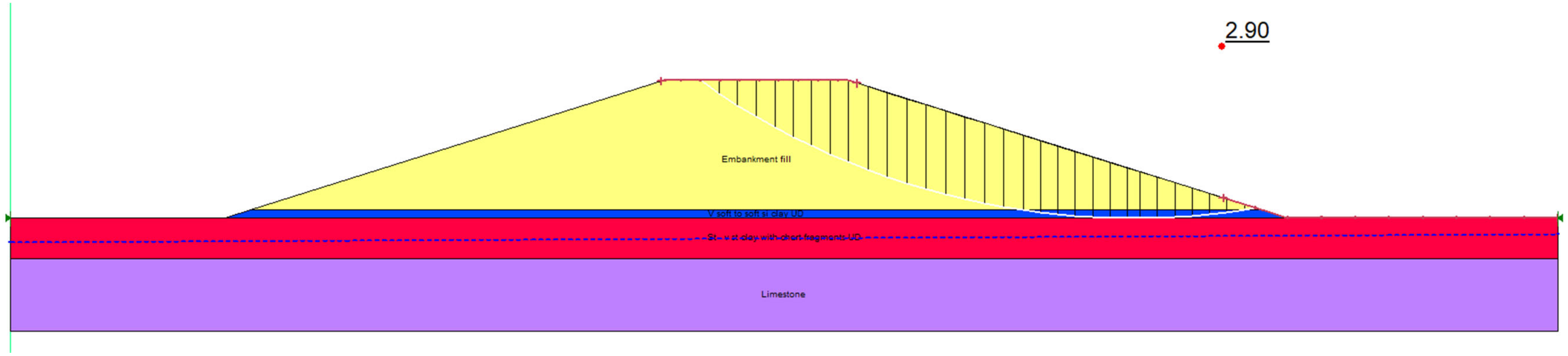
Results of Stability Analyses – Long Term Condition
Bent 4 Side Slope
3H:1V Slope, H=34 ft ±
19-118 – ARDOT 090069 XNA Access Road over Little Osage Creek

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



Results of Stability Analyses – Rapid Drawdown Condition, El 1085 to Existing Grade
Bent 4 Side Slope
3H:1V Slope, H=34 ft ±
19-118 – ArDOT 090069 XNA Access Road over Little Osage Creek

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



Results of Stability Analyses – Seismic Condition ($k_h = A_S /2 = 0.0245$)
Bent 4 Side Slope
3H:1V Slope, H=34 ft ±
19-118 – ARDOT 090069 XNA Access Road over Little Osage Creek

APPENDIX G

EXAMPLE SPECIAL PROVISION
SHOT ROCK FILL
JOB 090069

SHOT ROCK FILL

Description: Shot rock shall be highly durable and sound stone such as limestone, dolostone, sandstone, or other inorganic material acceptable to the Engineer. Shale and soft weathered rock shall not be used. All rocks shall be of an angular shape having dimensions similar to that which exists after final blasting at the quarry site and prior to crushing. Typically, neither the width nor thickness of any piece of stone shall be less than one-third (⅓) of the length.

The shot rock shall consist of a well-graded mixture of nominal 3 in. to 18 in. top size durable stone with less than 5 percent by weight passing the No. 200 size sieve. Use of particles finer than about 3 in. should be limited to what is required to fill voids in coarser materials. In general, rock fill borrow should have a maximum percent of wear not greater than 45 based on the Los Angeles Test (AASHTO T 96), a loss not greater than 12 percent when subjected to five (5) cycles of the Sodium Sulfate Soundness Test (AASHTO T 104), and an absorption rate less than 3 percent (AASHTO T 85) unless otherwise modified or accepted by the Engineer.

Construction Methods: If widely variable, the shot rock should be graded from coarse in the lower and outer embankment zones to fine in the inner zones and the top of the fill. In general, the lift thickness for rock fills should be limited to about 24 inches. Shot rock fill should be densified using a smooth steel-wheel vibratory roller or other suitable equipment. Shot rock fill must be continuously wetted as required to facilitate compaction/densification. If the surface of the shot rock fill at the subgrade elevation is irregular with exposed voids it should be sealed with a minimum 6 in. of crushed stone aggregate base (ARDOT Standard Specifications Section 303, Class 7) or approved alternate.

In order to evaluate rock fill density and placement methods, including determination of the number of roller passes required to adequately densify the shot rock fill, a test fill section should be utilized. The initial lift of shot rock may be constructed as a test fill. Typically a minimum 50-ft by 100-ft area will be adequate for a test fill, but this can be adjusted based on field conditions. Construction of the test fill should be monitored by the Engineer. Lift thickness must be accurately measured. In-place density of the compacted material can be assessed by observing settlement of the densified fill. Continuous passes of the vibratory roller must continue until no additional settlement of the fill is indicated.

The number of passes by the vibratory roller and lift settlement should be monitored during construction in order to confirm density of the rock fill. If the quality or gradation of the excavated rock fill (i.e., durable limestone, dolostone, or sandstone) changes during construction, additional test fills should be constructed and monitored to evaluate gradation and densification criteria of the variable material.

Acceptance shall be by visual inspection; a written explanation of the manufacturing process shall be provided if requested by the Engineer.

Basis of Payment: per ton of approved shot rock

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

Materials Testing
Geotechnical Engineering
Environmental
Building Sciences & Safety
Inspections & Code Compliance
Virtual Design Consulting

June 2, 2023
Job No. 19-118

Garver LLC
4701 Northshore Dr
North Little Rock, Arkansas 72118

Attn: Mr. Joel Skinner, P.E.

RESULTS of GEOTECHNICAL INVESTIGATION
ARDOT JOB 090069
XNA ACCESS ROAD BRIDGES A and B OVER HADEN ROAD
BENTON COUNTY, ARKANSAS

INTRODUCTION

This report provides the results of the geotechnical investigation performed for the XNA Access Road over Haden Road Bridges A and B in Benton County, Arkansas. This project is one facet of the Job 090069 Northwest Arkansas Regional Airport Access (Benton Co) (F). This geotechnical investigation was authorized by the Garver, LCC Subconsultant Agreement for Task Order No. 061 on August 27, 2019. Notice to proceed with the field studies was received on August 30, 2019. Preliminary boring logs were submitted on May 7, 2022.

We understand the new bridges at Haden Road will be continuous W-beam structures with four (4) bents, three (3) spans, and total lengths of approximately 228.5 feet each. We also understand that a foundation system consisting of steel H-piles is planned. Foundation loads of the new bridges are anticipated to be moderate. Simple slopes will be utilized at the bridge ends with end slopes at approximate 2-horizontal to 1-vertical (2H:1V) configurations and side slopes at 3-horizontal to 1-vertical (3H:1V) configurations. Preliminary bridge layouts are provided in Appendix A.

The purposes of this study were to explore subsurface conditions in the alignment of the twin bridges and to develop recommendations to guide design and construction of foundations. These purposes have been achieved by a multi-phased study that included the following.

- Drilling sample and core borings to evaluate subsurface conditions at the planned bridge locations and obtain samples of the subgrade and foundation soil and rock.
- Performing laboratory tests to evaluate pertinent engineering properties of the foundation and subgrade strata.
- Analyzing field and laboratory data to develop recommendations for seismic site class, seismic performance zone/seismic design category, foundation and subgrade support, slope stability, and construction considerations.

The relationship of these factors to design and construction of the new bridges has been considered in developing the recommendations and considerations discussed in the following report sections.

SUBSURFACE EXPLORATION

Subsurface conditions at the Haden Road bridge location were investigated by drilling eight (8) sample and core borings to depths of 27 to 45 feet. The site vicinity is shown on Plate 1. The approximate boring locations are shown on the bridge layout drawing on Plate 2. The subsurface exploration program is summarized in Table 1 below.

Table 1: Summary of Exploration Program

Boring No.	Approx Sta	Approx Offset, ft	Approx Surf El, ft	Completion Depth, ft
S39	190+90	60 Lt	1106	33
S40	191+60	60 Lt	1109	32
S41	192+35	60 Lt	1114	27
S42	193+20	60 Lt	1126	45
S43	191+60	60 Rt	1106	30
S44	192+35	60 Rt	1110	33
S45	193+05	60 Rt	1117	43
S46	193+90	60 Rt	1134	33

The boring logs, presenting descriptions of the soil and rock strata encountered in the borings and the results of the field and laboratory tests, are included as Plates 3 through 12. The centerline station and offset of the boring locations and approximate ground surface elevation, as inferred from the topographic information provided by the Engineer (Garver, LLC) or as inferred from available topographic information, are also shown on the logs. It must be recognized that the surface elevations shown are approximate and actual elevations may vary. Keys to the terms and symbols used on the logs are presented as Plates 13 and 14.

The borings were drilled with a track-mounted CME 850X rotary-drilling rig using a combination of dry-auger and rotary-wash drilling methods. Samples were typically obtained at 2-ft intervals to 10-ft depth and at 5-ft intervals thereafter. Samples were recovered using a 2-in.-diameter split-barrel sampler driven into the strata by blows of a 140-lb automatic hammer with 30-in. drop in accordance with Standard Penetration Test (SPT) procedures. The number of blows required to drive the standard split-barrel sampler the final 12 in. of an 18-in. total drive, or a portion thereof, is defined as the Standard Penetration Number (N). Recorded N-values are shown on the boring logs in the "Blows Per Ft" column.

Representative samples of the cherty limestone bedrock were obtained using a 5-ft-long NQWL-size double-tube core barrel with a diamond bit. For each core run, the percent recovery was determined as the ratio of recovery to total length of core run. Rock Quality Designation (RQD) was also determined for the core run as the sum of intact, sound rock core greater than 4-in. length divided by the total length of the run and expressed in percent. Both these values are presented in the right-hand columns of the log forms, opposite the corresponding core run. Photographs of the recovered rock cores are provided in Appendix B.

All samples were removed from sampling tools in the field, examined and visually classified by the field geologist. Samples were then placed in appropriate containers to prevent moisture loss and/or change in condition during transfer to our laboratory for further examination and testing.

The borings were advanced using dry-auger procedures to the extent possible to facilitate evaluation of shallow groundwater conditions. Observations regarding groundwater levels are noted in the lower-right portion of each log and are discussed in subsequent sections of this report. All boreholes were backfilled after obtaining the final water level readings.

LABORATORY TESTING

Laboratory testing was performed to evaluate subgrade and foundation plasticity and to confirm visual classification. The testing program included natural water content determinations (AASHTO T 265), liquid and plastic (Atterberg) limit determinations (AASHTO T 89 and T 90), and sieve analyses through the No. 200 sieve (AASHTO T 88). Soil shear strength was estimated in the field using SPT results.

A total of 54 natural water content determinations were performed to develop information on *in-situ* soil water content for each boring. Water content results are plotted on the boring log forms in accordance with the scale and symbols shown in the legend located in the upper-right corner of the logs.

To verify field classification and to evaluate soil plasticity, 14 liquid and plastic limit (Atterberg limits) determinations and 14 sieve analyses were performed on selected representative samples. The Atterberg limits are plotted on the logs as pluses inter-connected with a dashed line using the water content scale. The percentage of soil passing through the No. 200 Sieve is noted in the "- No. 200 %" column on the appropriate log forms. Classification test results, along with soil classification by the Unified Soil Classification System and AASHTO designations, are summarized in Appendix C. Grain-size distribution curves are also included in Appendix C.

Unconfined compressive strength of representative core samples of the cherty limestone bedrock was evaluated by compression tests. Results of the laboratory compression tests are shown in lbs per sq in. at the appropriate depth on the boring logs. The total unit weight of intact cores was also measured and these data are also shown on the logs.

GENERAL SITE and SUBSURFACE CONDITIONS

Site Conditions

The alignment of the XNA Access Road extends northwest to southeast. The Haden Road bridges will cross the existing Haden Road alignment approximately 2100 ft southeast of the intersection of Haden Road and Holmes Road. The site locale is a mixture of open agricultural land and occasional trees. Woodlands are present to the northwest. Some scattered houses are present near the bridge location. The site terrain rises steeply to the west of Haden Road. South of Haden Road, the slopes flattens but continues to slope gently to the southeast. Surface drainage is considered good.

Site Geology

The project alignment is located in the mapped exposure of the Boone Formation. The early and middle Mississippian Period Boone consists of fine- to coarse-grained limestone interbedded with chert. The chert content can vary widely, both horizontally and vertically, and limestone or chert may be predominant. The Boone Formation is known for dissolutional features such as sinkholes, caves, and enlarged fissures. Typically, the limestone/cherty limestone units of the Boone decompose (weather) to erratic blends of chert fragments and clay/silty clay. The residual soil mantle may extend to significant depths on higher terrain and may contain hard chert seams and/or layers. The thickness of the Boone Formation is reported to be 300 to 350 ft in northern Arkansas. The Boone is generally disconformable to the underlying Chattanooga Shale and St. Joe Limestone member, with some areas having a conformable contact.

Seismic Conditions

In light of the results of the borings, a Seismic Site Class C (very dense soil and soft rock profile) is considered applicable for the site with respect to the criteria of the AASHTO LRFD Bridge Design Specifications Seventh Edition 2014[1].

Given the location and AASHTO code-based values, the 1.0-sec period spectral acceleration coefficient for Site Class C (S_1) is 0.051 and the 1.0-sec period spectral acceleration coefficient (S_{D1}) value for Site Class C is 0.086. Utilizing these parameters, Table 3.10.6-1[2] indicates that a Seismic Performance Zone 1 is fitting for the Haden Road bridge site. In reference to the 2011 edition of the AASHTO Guide Specifications, the Peak Ground Acceleration (PGA) having a 7 percent chance of exceedance in 75 years (or mean return period of approximately 1000 years) is predicted to be 0.049 for a Seismic Site Class C for the bridge location. The liquefaction potential is considered low for the predominantly cohesive overburden soils and underlying rock units encountered in the borings drilled for this study.

Subsurface Conditions

The results of the borings indicate that the subgrade soils in the new bridge alignments typically consist of natural very soft to very stiff brown, reddish brown, tan, reddish tan, and gray clay, silty clay and fine sandy clay with variable, but generally numerous chert fragments to 18- to 27-ft. The subgrade soils typically classify as A-2-4, A-4, A-6, and A-7-6 by the AASHTO classification system. A surficial layer of very soft to soft brown clayey silt is locally present to 2 feet. In general, the natural surface and near-surface soils are relatively strong and will provide fair to good subgrade support for pavement structures. However, some areas will warrant localized undercut for subgrade preparation.

The overburden soils are underlain by moderately hard to very hard light gray cherty limestone. The limestone is flat-bedded with healed fractures. The core sample recovery ranges from 77 to 100 percent and the core sample RQD ranges from 28 to 95 percent in this stratum. The cherty limestone exhibits high strength with laboratory compressive strength values ranging from 3230 to 17,250 lbs per sq inch.

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[1] AASHTO LRFD Bridge Design Specifications, 7th Edition; AASHTO; 2014

[2] AASHTO LRFD Bridge Design Specification, AASHTO; 2012

To aid in visualizing subsurface conditions in the bridge alignment, generalized subsurface profiles are provided in Appendix D. It should be recognized that the stratigraphy illustrated by the profiles has been inferred between discrete boring locations. In view of the natural variations in stratigraphy and subsurface conditions, variations from the stratigraphy illustrated by the profiles should be anticipated. Additionally, the natural transition between strata is generally gradual, and the stratigraphy shown on the profile may vary.

Groundwater Conditions

Groundwater was encountered at variable depths ranging from 13.8 ft to 27 ft in April 2022. It has been our experience in the area that localized shallow perched groundwater can be present in the silty overburden soils and fractured zones of the cherty limestone. Groundwater levels will vary, depending on seasonal precipitation, surface runoff and infiltration, and water levels in nearby drainage features.

ANALYSES and RECOMMENDATIONS

Foundation Design

Foundations for the new bridges must satisfy two (2) basic and independent design criteria: a) foundations must have an acceptable factor of safety against bearing failure under maximum design loads, and b) foundation movement due to consolidation or swelling of the underlying strata should not exceed tolerable limits for the structures. Construction factors, such as installation of foundations, excavation procedures and surface and groundwater conditions, must also be considered.

Based on the results of the borings performed at the Haden Road bridge site and our understanding of the project, we recommend that foundation loads at the abutments and interior bents be supported on steel piling. Alternatively, the interior bents could be supported on drilled shaft foundations. Recommendations for steel piles are discussed in the following report sections. Recommendations for drilled shafts can be provided upon request.

Piling Foundations

We recommend that the foundation loads of the bridges be supported on steel HP 12x53 or HP 14x73 piles. Other pile sizes or types may be evaluated if desired. Point-bearing steel piles driven to refusal should extend through any new embankment fill, the natural overburden soils, and any zones of highly weathered cherty limestone to develop safe bearing capacity in the competent moderately hard to hard limestone. End-bearing piles should be driven to practical refusal in the moderately hard to hard limestone. We recommend that all steel piles be fitted with rock points.

Steel piles driven to refusal should be designed for the structural capacity of the pile, as per applicable AASHTO Load and Resistance Factor Design (LRFD) procedures[3]. An effective resistance factor (φ_c) of 0.50 is recommended for structural determination of factored bearing capacities. This effective resistance factor for steel piles has been based on the assumption of severe driving conditions.

For determination of bearing capacities of steel piles driven to refusal we recommend that nominal (ultimate) resistance (P_n) of HP piles be determined based on the yield strength of steel H piles (f_y) and the net end area (A_{net}) of the section. It has been our experience that allowable pile capacities of 96 tons for HP12x53 piles and 133 tons for HP14x73 piles are typical for f_y = 50 ksi steel pile sections. These capacities are based on allowable stress design (ASD). However, the appropriate factored bearing capacity should be confirmed by the Engineer. Post-construction settlement of piles driven to refusal will be negligible.

The nominal axial capacities are based on single, isolated foundations. Piles spaced closer than three (3) pile widths may develop lower individual capacity due to group effects. The potential for group capacity reductions should be evaluated for pile spacing closer than three (3) widths (center to center).

Estimated pile tip elevations are summarized below in Table 2.

Estimated Tip Elevations of Steel Piles Driven to Refusal

Bridge	Bent No.	Estimated Pile Tip Elevation, ft	Comments
A	1 (South Bridge End)	1084	Refusal in moderately hard to hard cherty limestone
	2 (Approx Sta 191+61)	1087	Refusal in moderately hard to hard cherty limestone
	3 (Approx Sta 192+43)	1087	Refusal in moderately hard to hard cherty limestone
	4 (North Bridge End)	1096	Refusal in moderately hard to hard cherty limestone
B	1 (South Bridge End)	1088	Refusal in moderately hard to hard cherty limestone
	2 (Approx Sta 192+16)	1087	Refusal in moderately hard to hard cherty limestone

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[3] Load and Resistance Factor Design (LRFD) for Highway Bridge Substructures, Publication No. FHWA HI-98-032, National Highway Institute, May 2001.

Bridge	Bent No.	Estimated Pile Tip Elevation, ft	Comments
B	3 (Approx Sta 192+98)	1089	Refusal in moderately hard to hard cherty limestone
	4 (North Bridge End)	1111	Refusal in moderately hard to hard cherty limestone

It should be noted that the tip elevations shown in the table above are estimates only based on the results of the relevant borings and the inferred surface elevations at the particular locations. Pile refusal and final depth must be field verified.

Nominal single pile uplift capacity curves for steel HP 14x73 piles are provided in Appendix E. Nominal axial pile capacities for uplift have been developed using static pile capacity formulae, the results of the borings, and the plan pile cap bottom elevations shown on the preliminary bridge layout drawings. We recommend that compression loads be designed for end-bearing alone based on piling driven to refusal, as recommended above.

Based on AASHTO LRFD geotechnical design procedures, a resistance factor (φ_{up}) of 0.25 is recommended for evaluation of factored uplift capacity. This resistance factor is based on Strength Limit States. For Extreme Events Limit States such as earthquake loading and collision, a resistance factors of 0.8 for uplift is recommended.

Given the anticipated site grading including up to 43 ft of fill, downdrag loads from embankment settlement are anticipated. We recommend a minimum period of 45 days after completion of fill placement before pile driving. Alternatively, piling may be installed prior to the recommended 45 days if piles are pre-bored to the cherty limestone bearing stratum. Downdrag loads on piles constructed as recommended are expected to be negligible. Pre-boring is not expected to be required for pile installation other than installing pile casing.

We recommend a minimum pile penetration of 10 ft below natural grade unless practical refusal is encountered in the moderately hard limestone at shallower depth. We also recommend a minimum pile length of 10 feet.

Piles should be installed in compliance with Standard Specifications for Highway Construction, 2014 Edition, Section 805. However, we recommend a hammer delivering a minimum energy of 22,000 ft-lbs per blow. A specific review and analysis of the pile-hammer system proposed by the Contractor should be performed by the Engineer prior to hammer acceptance and start of driving. We recommend that all piles be fitted with rock points.

As a minimum, safe bearing capacity of piles should be determined by ARDOT Standard Specifications Section 805.09, Method A. Driving records should be available for review by the Engineer during pile installation. Blow counts on steel piles should be limited to about 20 blows per inch. Practical pile refusal may be defined as a penetration of 0.5 in. or less for the final 10 blows. Driving records should be available for review by the Engineer during pile installation.

Embankment Slopes

The replacement bridges will include new slope configurations. Plan bridge end embankment configurations are 2-horizontal to 1-vertical (2H:1V) with 3-horizontal to 1-vertical (3H:1V) side slope configurations. The bridge end embankments will have maximum heights of about 42 feet.

To evaluate suitability of the end and side slope plan configurations, slope stability analyses have been performed. A 250 lbs per sq ft uniform surcharge from vehicles was included for the purposes of stability analyses. Stability analyses were performed using the computer program SLOPE/W 2020[4] and utilizing a Morgenstern-Price analysis. For the embankment slopes, three (3) general loading conditions were evaluated, i.e., End of Construction, Long Term, and Seismic Conditions For analysis of the seismic condition, a horizontal seismic acceleration coefficient (k_h) of one-half the peak acceleration (A_s) was used, a value of 0.0245.

Stability analyses results are summarized and presented graphically in Appendix F. The results of the stability analyses indicate that plan configurations of the embankment end and side slopes are acceptable with respect to stability of all loading conditions evaluated.

Subgrade Support

The results of the borings indicate the on-site subgrade soils are somewhat variable, but generally consist of clay and silty clay with chert fragments (AASHTO A-2-4, A-4, A-6, and A-7-6). Given the anticipated new embankment, the approach roadway subgrade is likely to consist of embankment fill. Locally-available borrow, which is likely to be used as unclassified embankment fill, is expected to have similar classification.

We recommend that any soils classifying as A-7-6 and soils with a plasticity index (PI) in excess of 18, if encountered during the work, be excluded from use as subgrade within 18 in. of the plan subgrade elevation. The top 18 in. of subgrade soils should have a maximum plasticity index (PI) of 18. The as-built pavement subgrade should be evaluated by the Engineer. Areas of

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[4] Slope/W 2020; GEO-SLOPE International; 2020.

unstable or otherwise unsuitable subgrade should be improved by undercut and replacement or treatment with additives approved by the Engineer.

Based on the results of previous laboratory CBR tests on the silty clay with chert fragments subgrade and correlation with the AASHTO classification, we recommend the following parameters for use in design of pavements.

- CBR value:	8.3
- Resilient Modulus (M_R):	3260 lbs per sq in.
- R value:	13
- Modulus of Subgrade Reaction (k):	100 lbs per cu in.

Site Grading and Subgrade Preparation

Site grading and site preparation twin bridge location should include necessary clearing and grubbing of trees and underbrush and stripping the organic-containing surface soils in work areas. Where fill depths in excess of 3 ft are planned, stumps may be left after close cutting trees to grade, as per ARDOT criteria. Otherwise, tree stumps must be completely excavated and stumpholes properly backfilled. The zone of organic surface soils should be completely stripped in the embankment footprint areas and at least 5 ft beyond the projected embankment toes. Particular care must be taken to muck out all saturated and/or organic-laden soils in the existing pond or existing drainage features.

Following stripping and grubbing, and prior to fill placement, the extent of weak and unsuitable soils should be determined. Thorough proof-rolling should be performed to verify subgrade stability. Proof-rolling should be performed with a loaded tandem-wheel dump truck or similar equipment. Unstable soils exhibiting a tendency to rut and/or pump should be undercut and replaced with suitable fill. Care should be taken that undercuts, stump holes, and other excavations or low areas resulting from subgrade preparation are properly backfilled with compacted fill.

Based on the results of the borings, the zone of weak surface soils is localized and extends to a depth of about 2 to 4 ft below existing grades, more or less, with some weak zones at depth. Undercuts may be backfilled with unclassified borrow used for embankment fill. Where the weak zone extends in excess of about 3 ft below existing grades, the undercut depth can typically be limited to 3 ft and undercuts backfilled with stone backfill (ARDOT Standard Specifications Section 207).

In lieu of undercutting and replacing unsuitable soils in roadway areas, consideration may be given to using additives to improve soil workability and to stabilize weak areas. Hydrated lime, quick lime, Portland cement, fly ash, or suitable alternate materials may be used as verified by appropriate testing and approved by the Engineer. Additives can be effective where the depth of unstable soils is relatively shallow. Treatment will be less effective in areas where the zone of unstable soils is deep. The optimum application rate of stabilization additive must be determined by specific laboratory tests performed on the alignment subgrade soils. We recommend a minimum treatment depth of 8 inches.

Subgrade preparation and mass undercuts should extend at least 5 ft beyond the embankment toes to the extent possible. Subgrade preparation in roadway areas should extend at least 3 ft outside pavement shoulder edges to the extent possible.

Fill and backfill may consist of unclassified borrow free of organics and other deleterious materials as per ARDOT Standard Specifications Subsection 210.06. The top 18 in. of subgrade soils should have a maximum plasticity index (PI) of 18. Where A-7-5 or A-7-6 soils are encountered at the subgrade elevation, we recommend that these soils be undercut as required to provide at least 18 in. of low-plasticity subgrade soils, i.e., with a maximum PI of 18. Alternatively, stabilization additives may be utilized to develop a stable subgrade with a PI of 18 or less. Granular soils must be protected from erosion with a minimum 18-in.-thick armor of clayey soil.

Subgrade preparation should comply with ARDOT Standard Specifications Section 212. Embankments should be constructed in accordance with ARDOT criteria (ARDOT Standard Specifications Section 210). Fill and backfill should be placed in nominal 6- to 10-in.-thick loose lifts. All fill and backfill must be placed in horizontal lifts. Where fill is placed against existing slopes, short vertical cuts should be "notched" in the existing slope face to facilitate bonding of horizontal fill lifts. The in-place density and water content should be determined for each lift and should be tested to verify compliance with the specified density and water content prior to placement of subsequent lifts.

CONSTRUCTION CONSIDERATIONS

Groundwater and Seepage Control

Positive surface drainage should be established at the start of the work, be maintained during construction and following completion of the work to prevent surface water ponding and subsequent saturation of subgrade soils. Density and water content of all earthwork should be maintained until embankments, bridge work, and pavements are completed.

Groundwater was encountered between 13.8 to 27 ft in April 2022. Shallow perched groundwater may be encountered in the near-surface soils, particularly at lower elevations and during times of high seepage flow. In addition, seasonal surface seeps or springs could develop as infiltrated surface water from areas of higher terrain migrate downgradient.

Seepage into excavations and cuts can typically be controlled by ditching or sump-and-pump methods. If seepage infiltration cannot be controlled, construction of drains and/or the use of Select Granular Backfill (AASHTO M 43 No. 57), stone backfill (ARDOT Standard Specifications Section 207), or approved alternates to an elevation above the inflow of seepage will be warranted. In areas of seepage infiltration, the granular fill should be encapsulated with a filter fabric complying with ARDOT Standard Specifications Subsection 625.02, Type 2 and vented to positive discharge. Where surface seeps or springs are encountered during site grading, we recommend the seepage be directed via French drains or blanket drains to positive discharge at daylight or to storm drainage lines.

Piling

Piles should be installed in compliance with ARDOT Standard Specifications, Section 805. Piles should be carefully examined prior to driving and piles with structural defects should be rejected. Any splices in steel piles should develop the full cross-sectional capacity of un-spliced piles. Pile installation should be monitored by qualified personnel to maintain specific and complete driving records and observe pile installation procedures. Safe bearing capacity of production piles should be determined by ARDOT Standard Specifications Section 805.09, Method A. Driving records should be available for review by the Engineer during pile installation. For driving steel piles on this project, we recommend a minimum hammer energy of 22,000 ft-lbs per blow. Blow counts on steel piles should be limited to about 20 blows per inch. Practical pile refusal may be defined as a penetration of 0.5 in. or less for the final 10 blows.

CLOSURE

The Engineer or a designated representative thereof should monitor site preparation, grading work and foundation and pavement construction. Subsurface conditions significantly at variance with those encountered in the borings should be brought to the attention of the Geotechnical Engineer. The conclusions and recommendations of this report should then be reviewed in light of the new information.

The following illustrations are attached and complete this final report.

Plate 1	Site Vicinity
Plate 2	Plan of Borings
Plates 3 through 12	Boring Logs
Plates 13 and 14	Keys to Terms and Symbols
Appendix A	Preliminary Bridge Layouts
Appendix B	Rock Core Photographs
Appendix C	Laboratory Test Results
Appendix D	Generalized Subsurface Profiles
Appendix E	Nominal HP 14x73 Pile Uplift Capacity Curves
Appendix F	Stability Analyses Results

* * * * *

We appreciate the opportunity to be of service to you on this project. Should you have any questions regarding this report, or if we may be of additional assistance, please call on us.

Sincerely,

GRUBBS, HOSKYN,
BARTON &WYATT, LLC

Velleta M. Scott, P.E.
Sr. Project Engineer

Mark E. Wyatt, P.E.
President

STATE OF ARKANSAS
REGISTERED PROFESSIONAL ENGINEER
No. 7791
MARK E. WYATT

VMS/MEW:jw

Copies Submitted: Garver LLC

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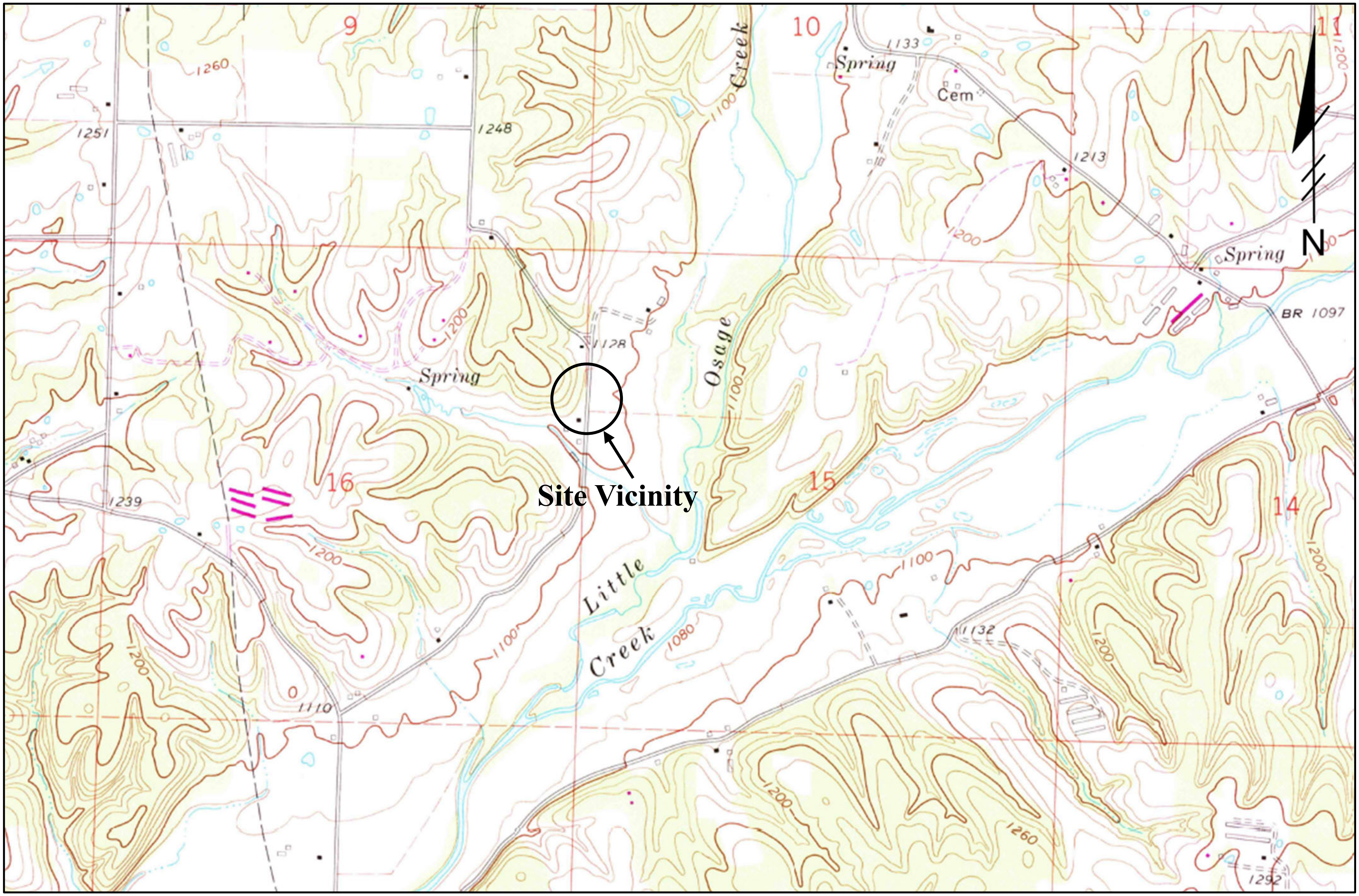
Attn:	Mr. John H. Ruddell, P.E., S.E.	(1-email)
Attn:	Mr. Adam Wierciak, P.E.	(1-email)



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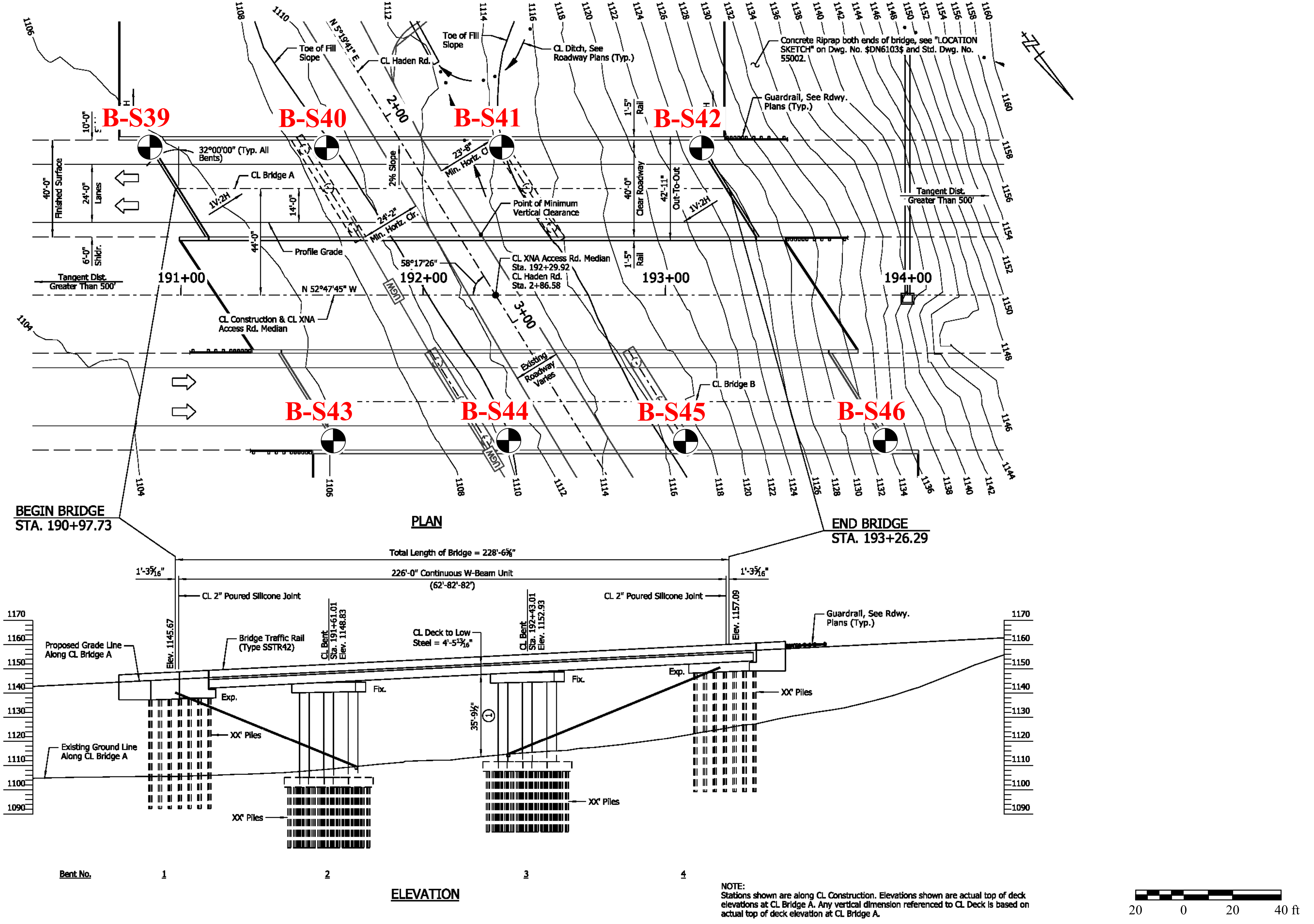
CONSULTING ENGINEERS
A UES Company

SITE VICINITY MAP
090069 XNA Access Road over Haden Road
Benton County, Arkansas

Job No. 19-118

Plate 1



NOTE:
Stations shown are along CL Construction. Elevations shown are actual top of deck elevations at CL Bridge A. Any vertical dimension referenced to CL Deck is based on actual top of deck elevation at CL Bridge A.

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CONSULTING ENGINEERS
A UES Company

PLAN of BORINGS
090069 XNA Access Road over Haden Road
Benton County, Arkansas

Scale: As shown

Job No. 19-118

PLATE 2

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LOG OF BORING NO. S39

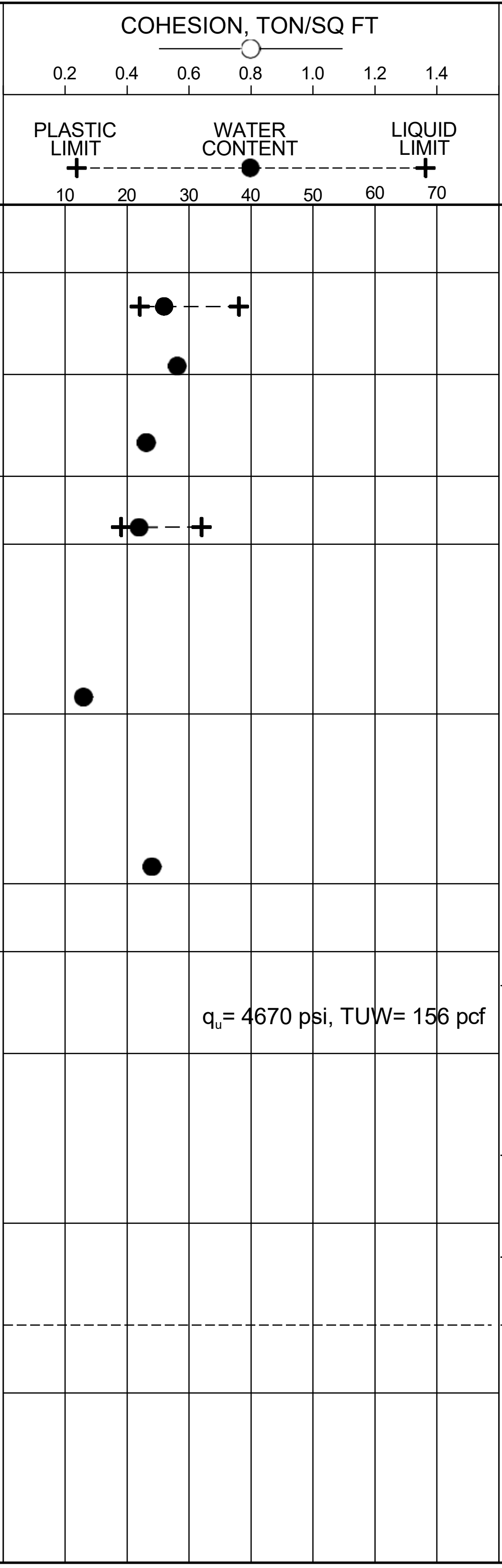
090069 XNA Access Road over Haden Rd.
Benton Co., Arkansas

TYPE: HSA to 22 ft /Wash to 23 ft /Core

LOCATION: Approx Sta 190+90, 60 ft Lt

SURF. EL: 1106±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Very soft to soft brown and reddish brown clay w/rootlets	4				
	Soft brown, reddish brown and gray silty clay w/chert fragments and nodules and ferrous stains	5		77		
5	- stiff to very stiff below 4 ft	11				
	- with more chert fragments below 6 ft	27				
10	Firm to stiff tan and brown silty clay w/some chert fragments and nodules	10		90		
15	- stiff to very stiff below 13 ft - with numerous chert fragments at 13 to 18 ft	41				
20	- with more clay and fewer chert fragments below 18 ft	13				
	- HSA refusal at 22 ft					
	Moderately hard to hard light gray cherty limestone, stylolitic joints - chert seam at 24 ft					
25					97	87
30					89	78
					96	83
35						



q_u= 4670 psi, TUW= 156 pcf

COMPLETION DEPTH: 33.0 ft
DATE: 4-26-22

DEPTH TO WATER
IN BORING: 19.5 ft

DATE: 4/26/2022

RECRQDN200-2 19-118_HADEN RD.GPJ 9-13-22

19-118

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

L O G O F B O R I N G N O. S40

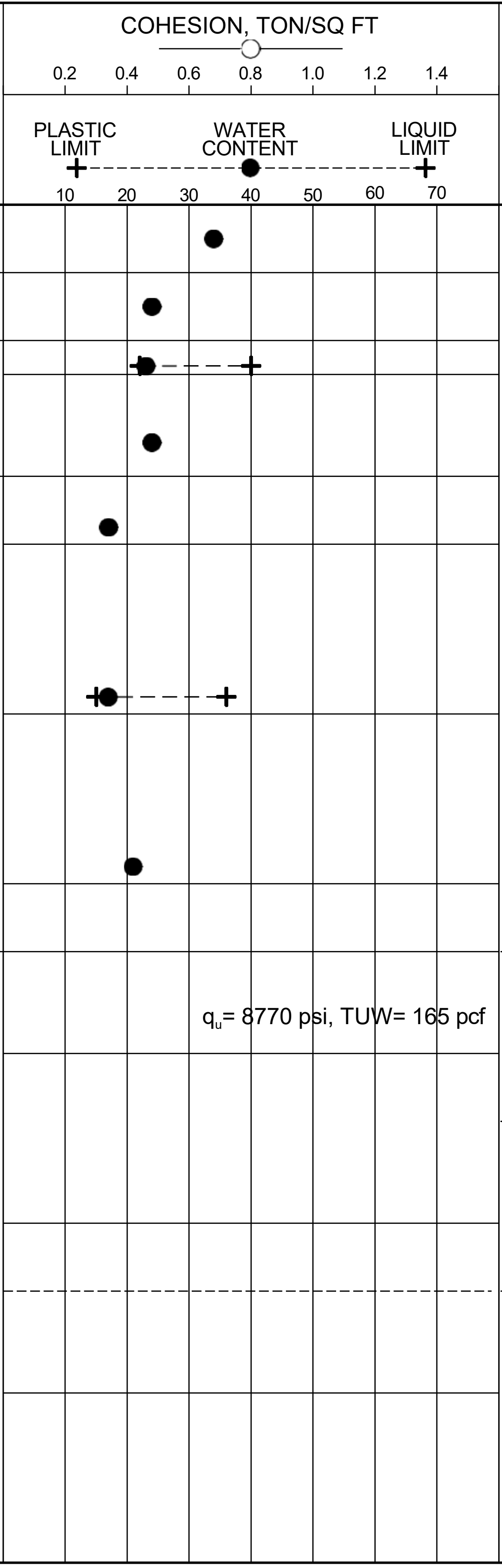
090069 XNA Access Road over Haden Rd.
Benton Co., Arkansas

TYPE: HSA to 22 ft /Core

LOCATION: Approx Sta 191+60, 60 ft Lt

SURF. EL: 1109±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Very soft brown clayey silt w/rootlets and occasional limestone fragments	3				
	Very soft to soft tan and reddish tan clay w/trace fine gravel	4				
5	Firm tan, gray and reddish tan silty clay w/fine sand, silt pockets, and chert fragments	8		36		
		8				
10	Stiff reddish brown silty clay w/chert fragments and nodules	20				
15		21		46		
20	- stiff to very stiff, less silty below 18 ft	50/6"				
	- HSA refusal at 22 ft					
25	Moderately hard to hard gray cherty limestone, flat bedded, stylolitic joints				98	83
30					98	95
35						



COMPLETION DEPTH: 32.0 ft
DATE: 4-27-22

DEPTH TO WATER
IN BORING: Dry to 22 ft

DATE: 4/27/2022

RECRQDN200-2 19-118_HADEN RD.GPJ 9-13-22

Grubbs, Hoskyn,
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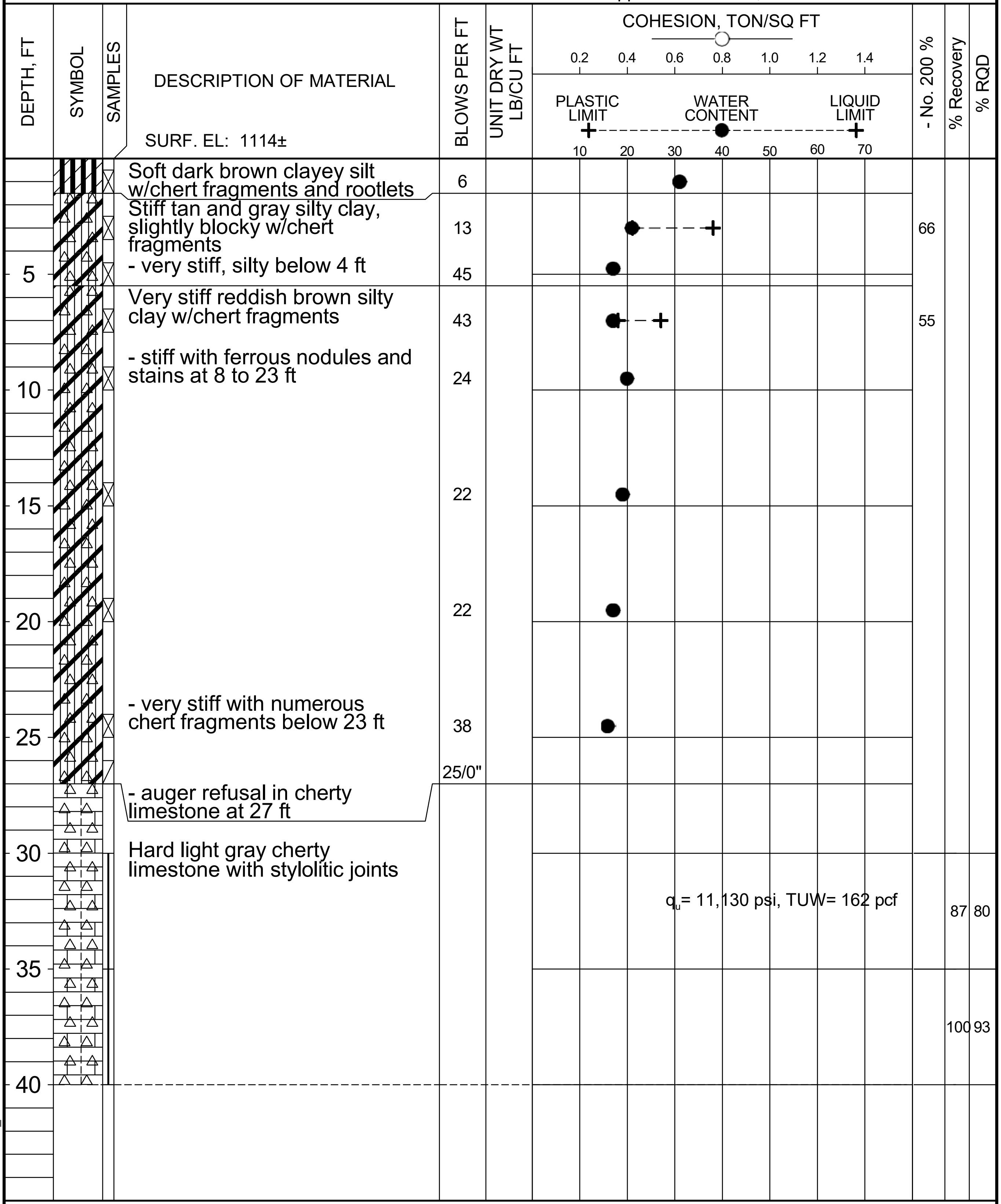
Consulting Engineers

LOG OF BORING NO. S41

090069 XNA Access Road over Haden Rd.
Benton Co., Arkansas

TYPE: Auger to 27 ft /Wash to 30 ft /Core

LOCATION: Approx Sta 192+35, 60 ft Lt



DESCRIPTION OF MATERIAL	BLOWS PER FT	- No. 200 %	% Recovery	% RQD
Soft dark brown clayey silt w/chert fragments and rootlets	6			
Stiff tan and gray silty clay, slightly blocky w/chert fragments	13	66		
- very stiff, silty below 4 ft	45			
Very stiff reddish brown silty clay w/chert fragments	43	55		
- stiff with ferrous nodules and stains at 8 to 23 ft	24			
	22			
	22			
- very stiff with numerous chert fragments below 23 ft	38			
	25/0"			
- auger refusal in cherty limestone at 27 ft				
Hard light gray cherty limestone with stylolitic joints				
q_u= 11,130 psi, TUW= 162 pcf			87	80
			100	93

COMPLETION DEPTH: 40.0 ft
DATE: 4-22-22

DEPTH TO WATER
IN BORING: 27 ft

DATE: 3/16/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

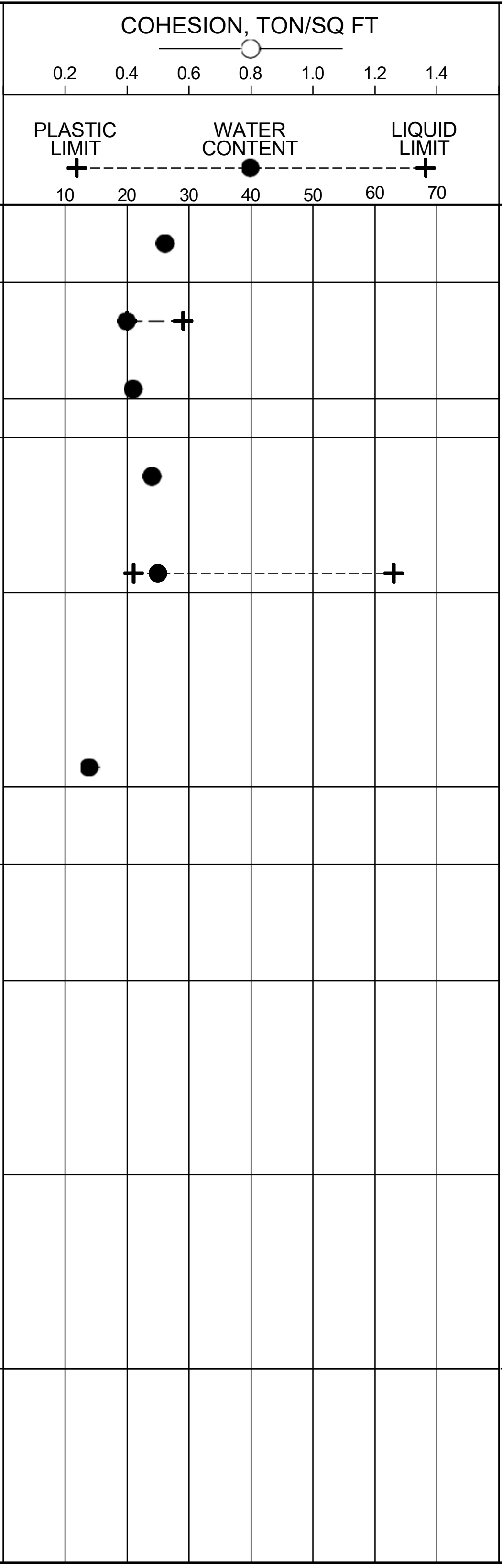
LOG OF BORING NO. S42

090069 XNA Access Road over Haden Rd.
Benton Co., Arkansas

TYPE: HSA to 30 ft /Core

LOCATION: Approx Sta 193+20, 60 ft Lt

SURF. EL: 1126±



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
Stiff brown silty clay w/rootlets and cherty limestone fragments	14				
Stiff light brown silty clay w/numerous chert and limestone fragments	21		36		
- very stiff, reddish tan below 4 ft	27				
Stiff reddish brown clay w/numerous chert and limestone fragments	23				
	21		52		
- with discontinuous chert seams below 13 ft	50/4"				
Stiff to very stiff tan and light gray silty clay w/numerous chert and limestone fragments and chert seams and layers (completely weathered limestone)	27				
- soft to firm below 22 ft	5				
- with discontinuous chert seams below 28.5 ft	25/0"				
Moderately hard to hard light gray w/gray cherty limestone, stylolitic joints				85	28

DEPTH, FT: 5, 10, 15, 20, 25, 30

COMPLETION DEPTH: 45.0 ft
DATE: 4-20-22

DEPTH TO WATER
IN BORING: Dry to 30 ft

DATE: 4/20/2022

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Consulting Engineers

LOG OF BORING NO. S42

090069 XNA Access Road over Haden Rd.
Benton Co., Arkansas

TYPE: HSA to 30 ft /Core

LOCATION: Approx Sta 193+20, 60 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT ○ 0.2 0.4 0.6 0.8 1.0 1.2 1.4 PLASTIC LIMIT + WATER CONTENT ● LIQUID LIMIT + 10 20 30 40 50 60 70	- No. 200 %	% Recovery	% RQD
			- moderately hard to hard light gray w/gray cherty limestone, stylolitic joints					98	88
40								100	77
45									
50									
55									
60									
65									

COMPLETION DEPTH: 45.0 ft
DATE: 4-20-22

DEPTH TO WATER
IN BORING: Dry to 30 ft

DATE: 4/20/2022

RECRQDN200-2 19-118_HADEN RD.GPJ 9-13-22

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S43

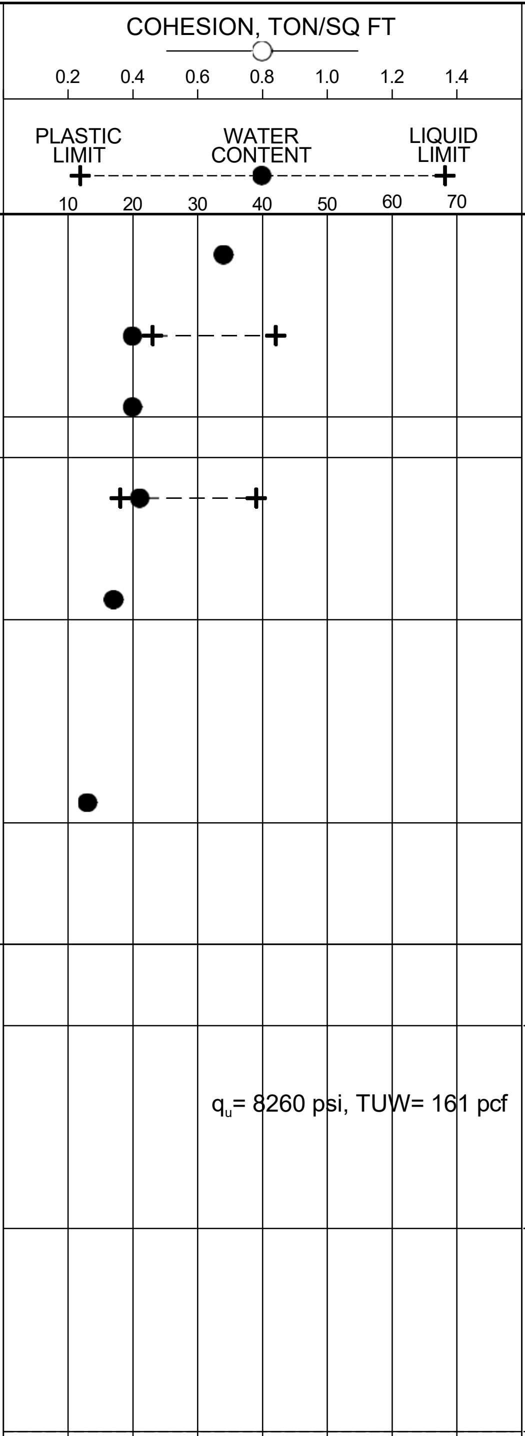
090069 XNA Access Road over Haden Rd.
Benton Co., Arkansas

TYPE: HSA to 20 ft /Core

LOCATION: Approx Sta 191+60, 60 ft Rt

SURF. EL: 1106±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Stiff gray, reddish tan and red silty clay w/trace fine gravel and ferrous stains	13				
	- very stiff to firm at 2 to 4 ft	26		58		
5	- stiff, silty below 4 ft	17				
	Stiff brown, tan and reddish brown silty clay w/silt pockets and ferrous stains	16		82		
10	- with chert and limestone fragments below 8 ft	23				
15	- with discontinuous chert seams and inclusions below 13 ft	50/7"				
20	Moderately hard to hard light gray cherty limestone, stylolitic joints	50/1"				
	- with rehealed high-angle shear at 21 ft - with vertical shear and calcite-filled vugs at 22.5 to 22.7 ft				98	82
25					100	93
30						



q_u= 8260 psi, TUW= 161 pcf

COMPLETION DEPTH: 30.0 ft
DATE: 4-29-22

DEPTH TO WATER
IN BORING: 13.8 ft

DATE: 4/29/2022

19-118

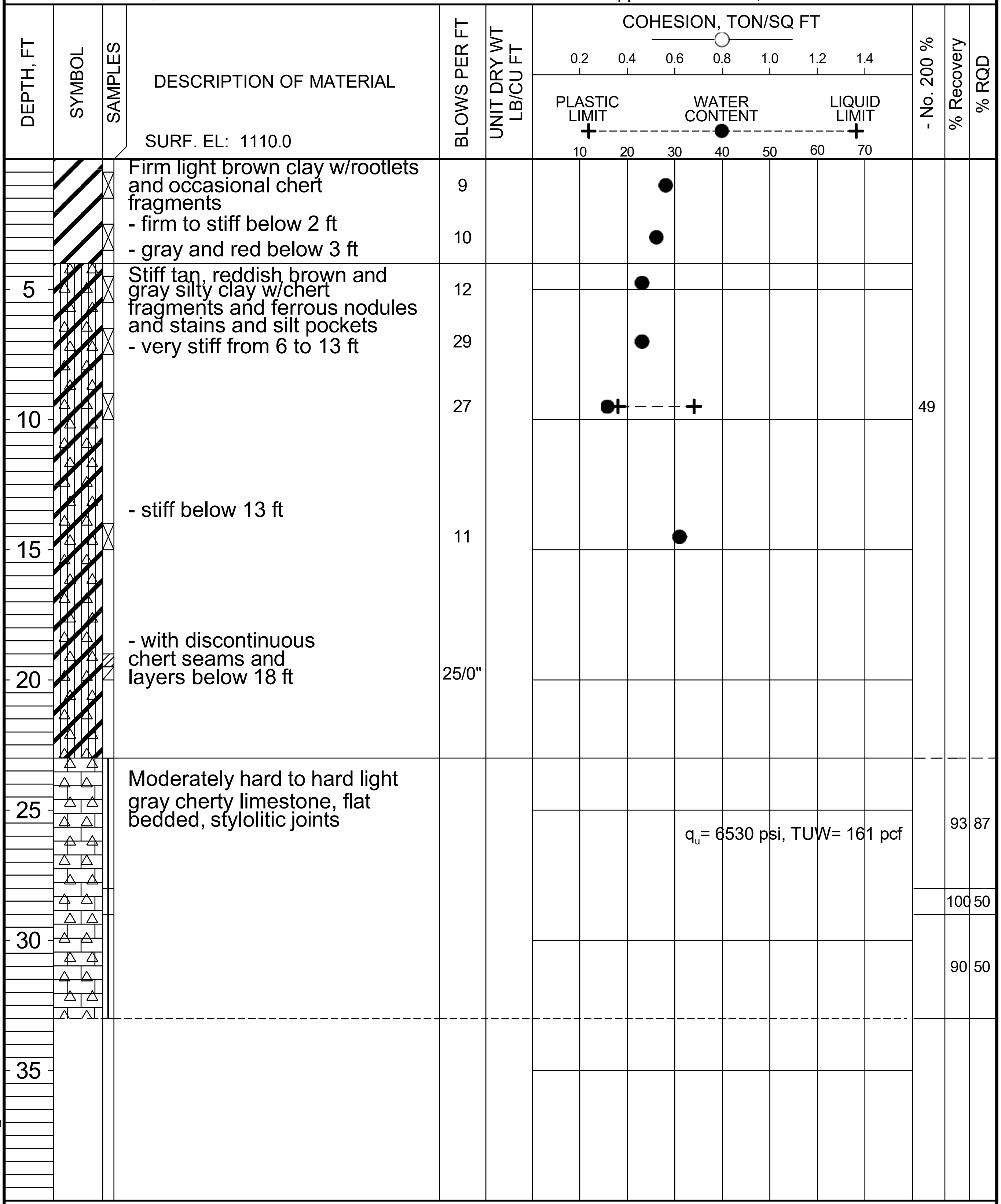
Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S44

090069 XNA Access Road over Haden Rd.
Benton Co., Arkansas

TYPE: Auger to 20 ft /Wash to 23 ft /Core

LOCATION: Approx Sta 192+35, 60 ft Rt



SURF. EL: 1110.0

DESCRIPTION OF MATERIAL	BLOWS PER FT	- No. 200 %	% Recovery	% RQD
Firm light brown clay w/rootlets and occasional chert fragments	9			
- firm to stiff below 2 ft - gray and red below 3 ft	10			
Stiff tan, reddish brown and gray silty clay w/chert fragments and ferrous nodules and stains and silt pockets	12			
- very stiff from 6 to 13 ft	29			
	27	49		
- stiff below 13 ft	11			
- with discontinuous chert seams and layers below 18 ft	25/0"			
Moderately hard to hard light gray cherty limestone, flat bedded, stylolitic joints			93	87
q_u= 6530 psi, TUW= 161 pcf				
			100	50
			90	50

COMPLETION DEPTH: 33.0 ft
DATE: 5-10-22

DEPTH TO WATER
IN BORING: 14.8 ft

DATE: 4/29/2022

Grubbs, Hoskyn,
Barton & Wyatt, Inc.
Consulting Engineers

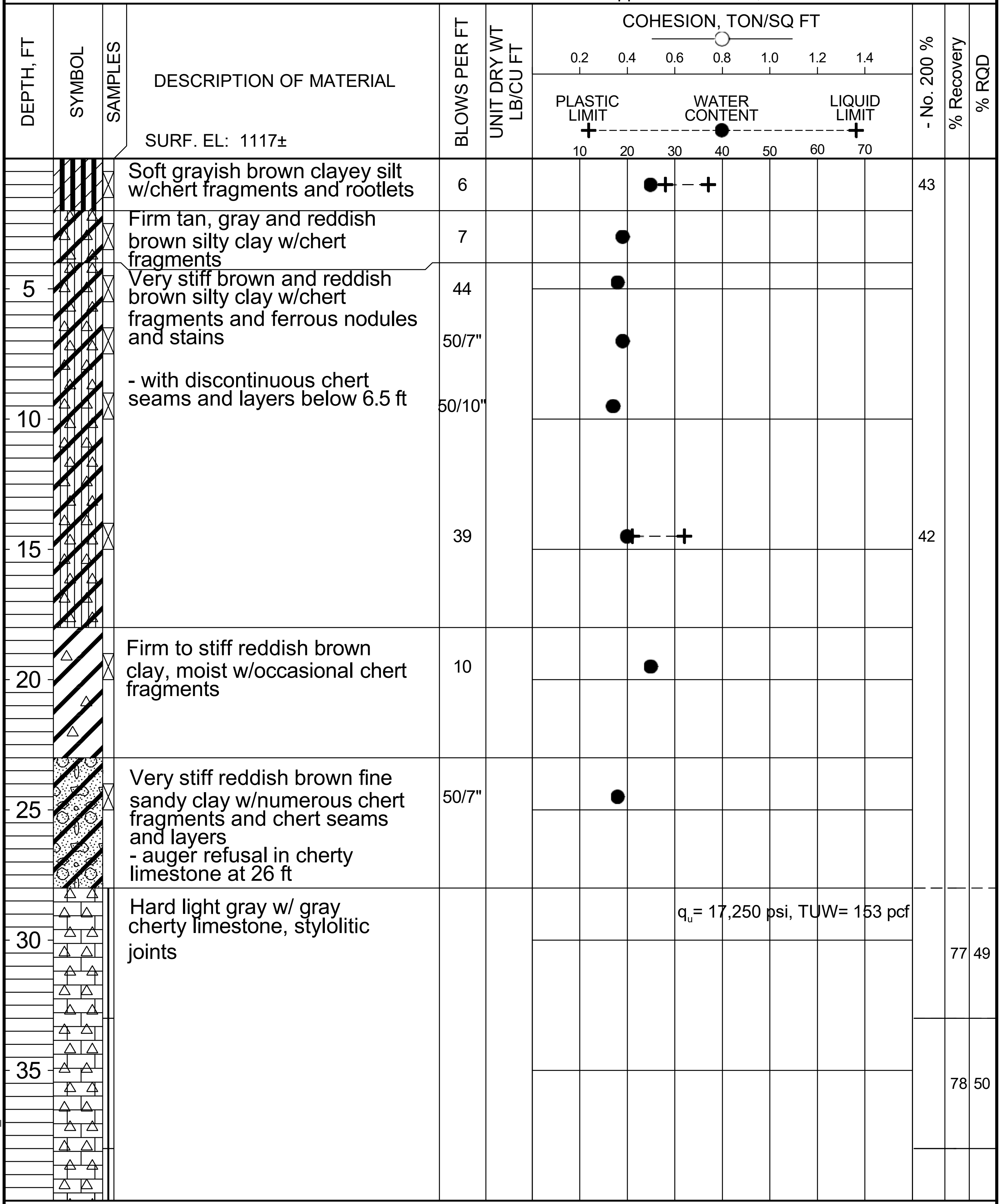
LOG OF BORING NO. S45

090069 XNA Access Road over Haden Rd.
Benton Co., Arkansas

TYPE: Auger to 28 ft /Core

LOCATION: Approx Sta 193+05, 60 ft Rt

SURF. EL: 1117±



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
Soft grayish brown clayey silt w/chert fragments and rootlets	6		43		
Firm tan, gray and reddish brown silty clay w/chert fragments	7				
Very stiff brown and reddish brown silty clay w/chert fragments and ferrous nodules and stains - with discontinuous chert seams and layers below 6.5 ft	44				
	50/7"				
	50/10"				
	39		42		
Firm to stiff reddish brown clay, moist w/occasional chert fragments	10				
Very stiff reddish brown fine sandy clay w/numerous chert fragments and chert seams and layers - auger refusal in cherty limestone at 26 ft	50/7"				
Hard light gray w/ gray cherty limestone, stylolitic joints					
q_u= 17,250 psi, TUW= 153 pcf					
				77	49
				78	50

COMPLETION DEPTH: 43.0 ft
DATE: 4-22-22

DEPTH TO WATER
IN BORING: 20 ft

DATE: 3/16/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S45

090069 XNA Access Road over Haden Rd.
Benton Co., Arkansas

TYPE: Auger to 28 ft /Core

LOCATION: Approx Sta 193+05, 60 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT ○ 0.2 0.4 0.6 0.8 1.0 1.2 1.4 PLASTIC LIMIT + WATER CONTENT ● LIQUID LIMIT + 10 20 30 40 50 60 70	- No. 200 %	% Recovery	% RQD
			- hard light gray w/ gray cherty limestone					93	82
45									
50									
55									
60									
65									
70									
75									

COMPLETION DEPTH: 43.0 ft
DATE: 4-22-22

DEPTH TO WATER
IN BORING: 20 ft

DATE: 3/16/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S46

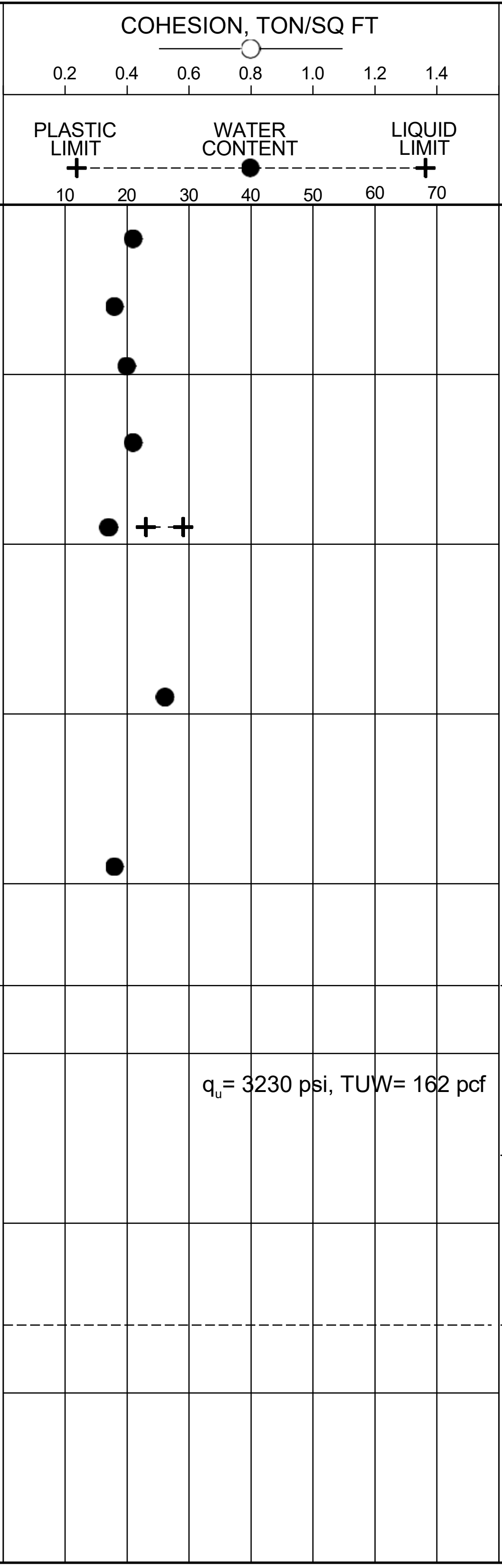
090069 XNA Access Road over Haden Rd.
Benton Co., Arkansas

TYPE: HSA to 23 ft /Core

LOCATION: Approx Sta 193+90, 60 ft Rt

SURF. EL: 1134±

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	- No. 200 %	% Recovery	% RQD
Stiff reddish brown and brown fine sandy clay w/numerous chert and limestone fragments - very stiff at 2 to 8 ft	21					
	29					
	50/6"					
	50/6"					
- firm from 8 to 13 ft	8			27		
- very stiff from 13 to 18 ft	50/5"					
- soft below 18 ft	5					
	50/3"					
Moderately hard to hard gray w/tan cherty limestone, stylolitic joints - with close rehealed fractures below 24.5 ft - with high-angle shears at 26.5 to 26.7 ft and 27.7 and 28 ft			q_u= 3230 psi, TUW= 162 pcf		100	68
					100	73



DEPTH, FT: 5, 10, 15, 20, 25, 30, 35

COMPLETION DEPTH: 33.0 ft
DATE: 4-28-22

DEPTH TO WATER
IN BORING: Dry to 23 ft

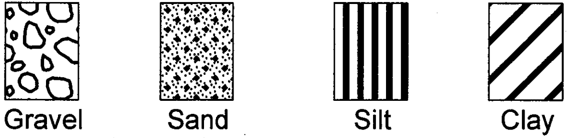
DATE: 4/28/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

SYMBOLS AND TERMS USED ON BORING LOGS

SOIL TYPES

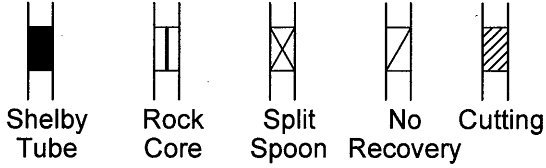
(SHOWN IN SYMBOLS COLUMN)



Predominant type shown heavy

SAMPLER TYPES

(SHOWN ON SAMPLES COLUMN)



TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on No. 200 sieve): Includes (I) Clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as determined by laboratory tests.

DESCRIPTIVE TERM	N-VALUE	RELATIVE DENSITY
VERY LOOSE	0-4	0-15%
LOOSE	4-10	15-35%
MEDIUM DENSE	10-30	35-65%
DENSE	30-50	65-85%
VERY DENSE	50 and above	85-100%

FINE GRAINED SOILS (major portion passing No. 200 sieve): Includes (1) Inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests.

DESCRIPTIVE TERM	UNCONFINED COMPRESSIVE STRENGTH TON/SQ. FT.
VERY SOFT	Less than 0.25
SOFT	0.25-0.50
FIRM	0.50-1.00
STIFF	1.00-2.00
VERY STIFF	2.00-4.00
HARD	4.00 and higher

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

TERMS CHARACTERIZING SOIL STRUCTURE

SLICKENSIDED - having inclined planes of weakness that are slick and glossy in appearance.
FISSURED - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
LAMINATED - composed of thin layers of varying color and texture.
INTERBEDDED - composed of alternate layers of different soil types.
CALCAREOUS - containing appreciable quantities of calcium carbonate.
WELL GRADED - having a wide range in grain sizes and substantial amounts of all intermediate particle sizes.
POORLY GRADED - predominantly of one grain size, or having a range of sizes with some intermediate sizes missing.

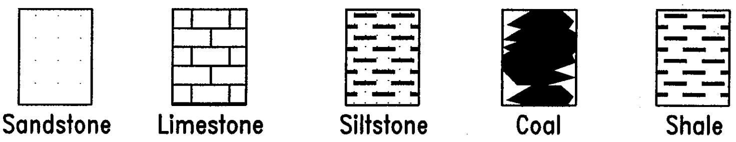
Terms used on this report for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No.3-357, Waterways Experiment Station, March 1953

KEY 7-28-11

Grubbs, Hoskyn,
Barton & Wyatt, Inc.
Consulting Engineers

BORING LOG TERMS - ROCK

ROCK TYPES
(SHOWN IN SYMBOLS COLUMN)



Joint Characteristics - Spacing
- Very Wide
- Wide
- Moderately Close
- Close
- Very Close

Bedding Characteristics -
- Very Thin
- Thin
- Medium
- Thick
- Massive

Lithologic Characteristics -
- Clayey
- Shaly
- Calcareous (limy)
- Siliceous
- Sandy
- Silty
- Plastic Seams

Seam - 1/6 to 1/2 inch
Layer - 1/2 to 12 inches
Stratum - Greater than 12 inches

Hardness and Degree of Cementation -

	Approximate Range of Uniaxial Compressive Strength (psi)
Very Soft - Can be peeled with a knife	140 - 3500
Soft - Can just be scraped with knife	3500 - 6900
Hard - Can be broken with single moderate blow with pick	6900 - 13,900
Very hard - Hand held specimen breaks with hammer end of pick under more than one blow	13,900 - 28,000
Extremely Hard - Many blows with hammer required to break intact specimen	More than 28,000

Poorly Cemented

Cemented

Texture -
- Dense
- Fine
- Medium
- Coarse

Structure -
- Bedding
  - Flat
  - Gently Dipping
  - Steeply Dipping
- Fractures, scattered
  - Open
  - Cemented or Tight
- Fractures, closely spaced
  - Open
  - Cemented or Tight
- Brecciated (Sheared and Fragmented)
  - Open
  - Cemented or Tight
- Joints
- Faulted
- Slickensides

Degree of Weathering -

Fresh - No visible signs of decomposition or discoloration. Rings under hammer impact.

Slighty Weathered - Slight discoloration inwards from open fractures, otherwise similar to fresh.

Moderately Weathered - Discoloration throughout. Weaker minerals such as feldspar decomposed. Strength somewhat less than fresh rock, but cores cannot be broken by hand or scraped by knife. Texture preserved.

Highly Weathered - Most minerals somewhat decomposed. Specimens can be broken by hand with effort or shaved with knife. Core stones present in rock mass. Texture becoming indistinct but fabric preserved.

Completely Weathered - Minerals decomposed to soil but fabric and structure preserved (Saprolite). Specimens easily crumbled or penetrated.

Residual Soil - Advanced state of decomposition resulting in plastic soils. Rock fabric and structure completely destroyed. Large volume change.

Solution and Void Conditions -
- Solid, contains no voids
- Vuggy (pitted)
- Vesicular (igneous)
- Porous
- Cavities
- Cavernous

Swelling Properties -
- Nonswelling
- Swelling

Slaking Properties -
- Nonslaking
- Slakes slowly on exposure
- Slakes readily on exposure

Rock Quality Designation (RQD) -

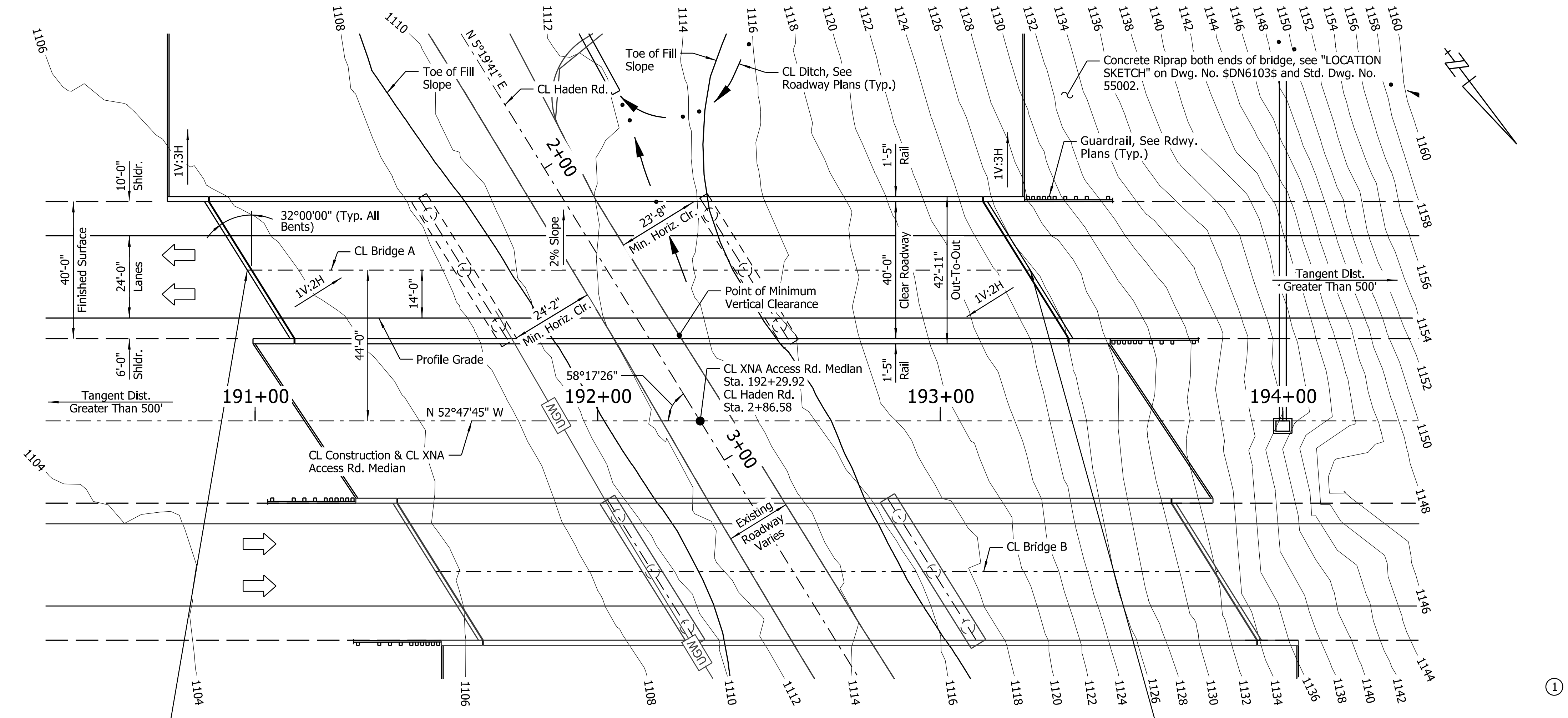
RQD (Percent)	Diagnostic Description
Greater than 90	Excellent
75 - 90	Good
50 - 75	Fair
25 - 50	Poor
Less than 25	Very Poor

KEYROCK 5-22-07

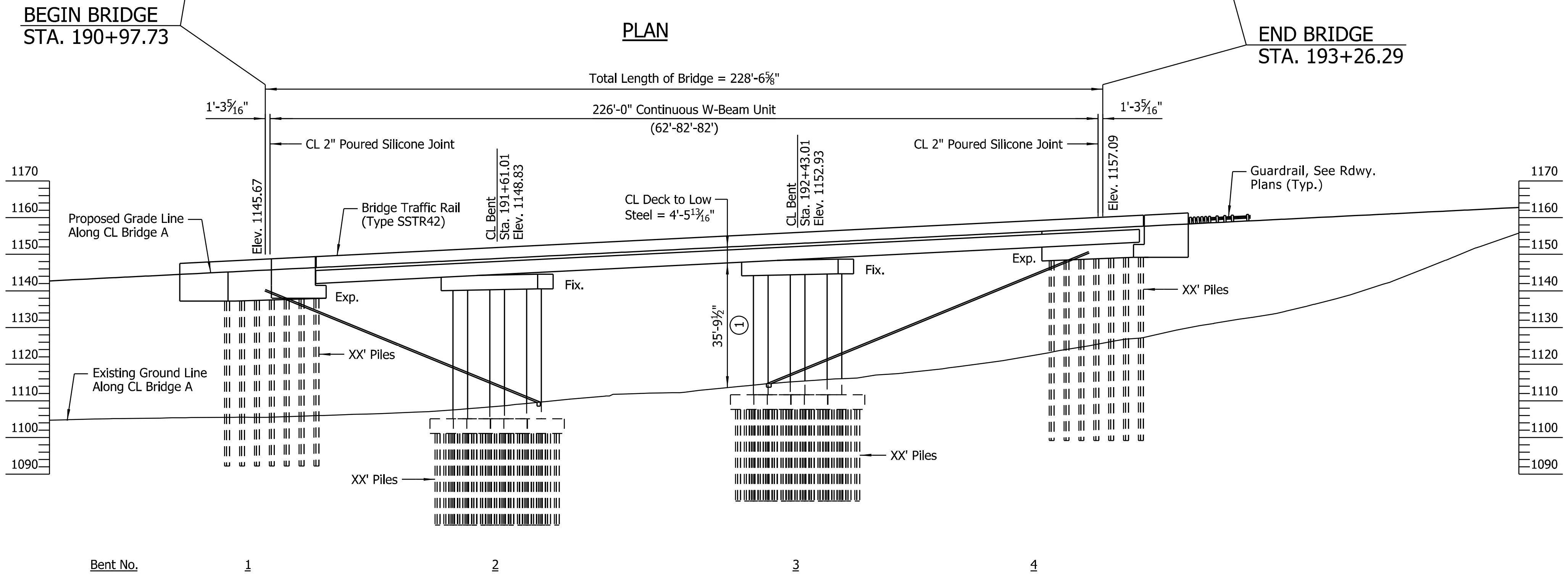
APPENDIX A

DATE REVISED	DATE FILMED	DATE REVISED	DATE FILMED	FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
				6	ARK.			
				JOB NO.		090069	$SN6101$	ST

① $BN06A$ LAYOUT $DN6101$

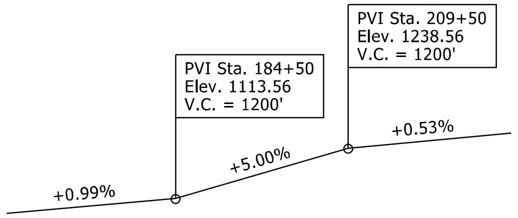


① Point of Minimum Vertical Clearance



PLAN

ELEVATION



VERTICAL CURVE DATA

XNA Access Rd.
(Profile Grade 14' Right of CL Bridge A)

NOTE:
Stations shown are along CL Construction. Elevations shown are actual top of deck elevations at CL Bridge A. Any vertical dimension referenced to CL Deck is based on actual top of deck elevation at CL Bridge A.

FOR R/W DATA, SEE
ROADWAY PLANS

191+00
192+00
193+00
194+00

PRELIMINARY
NOT FOR
CONSTRUCTION

BRIDGE ENGINEER

LAYOUT OF BRIDGE A
XNA ACCESS RD. OVER HADEN RD.
NORTHWEST ARKANSAS
NATIONAL AIRPORT ACCESS (F)
BENTON COUNTY

ROUTE RT SEC. SC

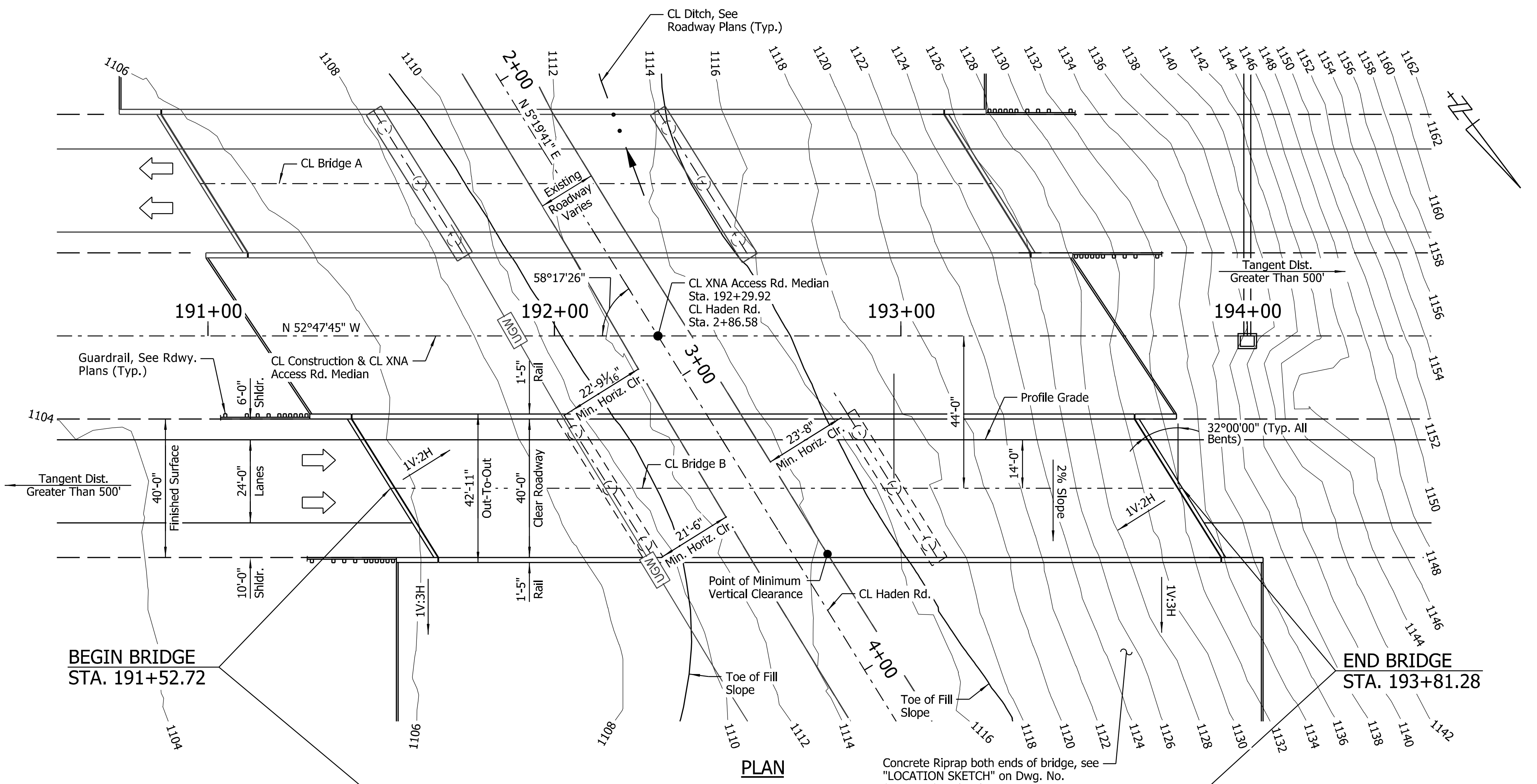
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

DRAWN BY: CWT DATE: AUG. 2021 FILENAME: b090069a6_L1.dgn
CHECKED BY: JES DATE: SEPT. 2021 SCALE: 1" = 20'-0"
DESIGNED BY: CSW DATE: AUG. 2021
BRIDGE NO. $BN06A$ DRAWING NO. $DN6101$

JESkinner 9/30/2021 4:14:45 PM
WORKSPACE: ARDOT Bridge (2019)
L:\2017\17017600 - XNA Access - NEPA\Drawings\b090069a6_S101_LO.dgn
REVISED DATE:

DATE REVISED	DATE FILMED	DATE REVISED	DATE FILMED	FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
				6	ARK.			
				JOB NO.		090069	$SN6102$	ST

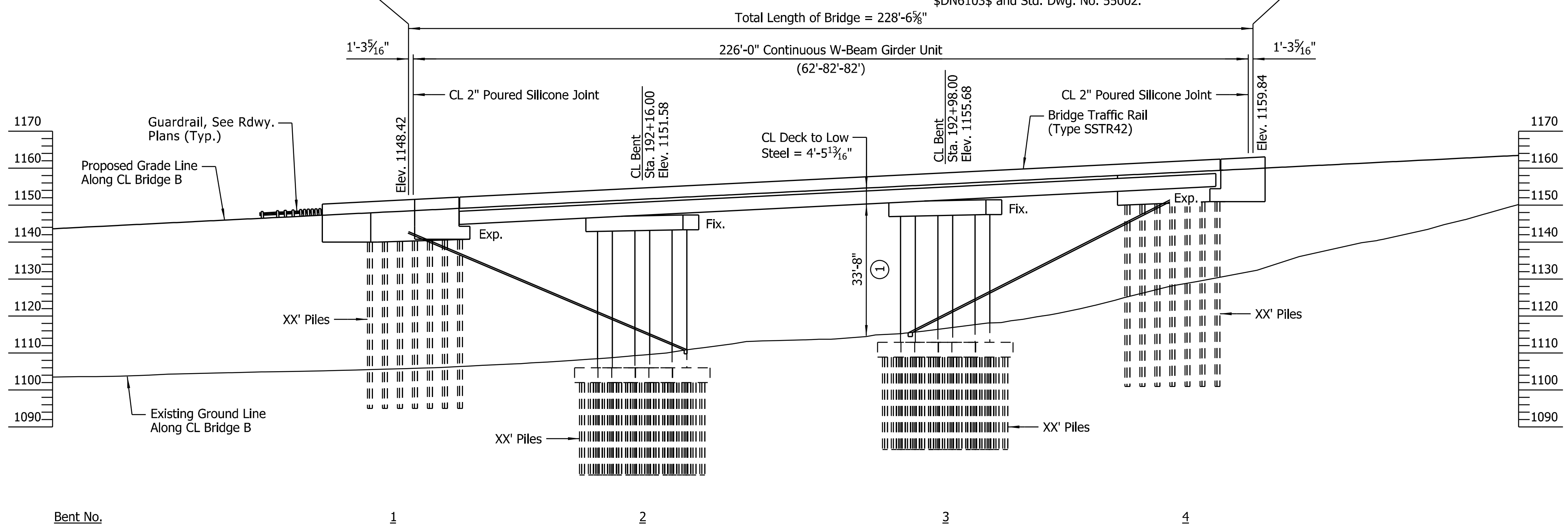
① $BN06B$ LAYOUT $DN6102$



Concrete Riprap both ends of bridge, see "LOCATION SKETCH" on Dwg. No. $DN6103$ and Std. Dwg. No. 55002.

PLAN

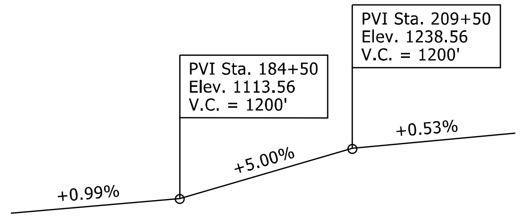
① Point of Minimum Vertical Clearance



ELEVATION

NOTE:
Stations shown are along CL Construction. Elevations shown are actual top of deck elevations at CL Bridge B. Any vertical dimension referenced to CL Deck is based on actual top of deck elevation at CL Bridge B.

FOR R/W DATA, SEE ROADWAY PLANS



VERTICAL CURVE DATA

XNA Access Rd.
(Profile Grade 14' Left of CL Bridge B)

PRELIMINARY
NOT FOR
CONSTRUCTION

BRIDGE ENGINEER

LAYOUT OF BRIDGE B
XNA ACCESS RD. OVER HADEN RD.
NORTHWEST ARKANSAS
NATIONAL AIRPORT ACCESS (F)
BENTON COUNTY

ROUTE RT SEC. SC

ARKANSAS STATE HIGHWAY COMMISSION

LITTLE ROCK, ARK.

DRAWN BY: CWT DATE: AUG. 2021 FILENAME: b090069b6_L1.dgn
CHECKED BY: JES DATE: SEPT. 2021 SCALE: 1" = 20'-0"
DESIGNED BY: CSW DATE: AUG. 2021
BRIDGE NO. $BN06B$ DRAWING NO. $DN6102$

JESkinner 9/30/2021 4:14:47 PM
WORKSPACE: ARDOT Bridge (2019)
L:\2017\17017600 - XNA Access - NEPA\Drawings\b090069b6_S101_LO.dgn
REVISED DATE:

APPENDIX B

Boring S39
23 – 33 ft
19-118 090069 XNA Access Road over Haden Road

Boring S40
22 – 32 ft
19-118 090069 XNA Access Road over Haden Road

Boring S41
30 – 40 ft
19-118 090069 XNA Access Road over Haden Road

Boring S42
30 – 40 ft
19-118 090069 XNA Access Road over Haden Road

Boring S42
40 – 45 ft
19-118 090069 XNA Access Road over Haden Road

Boring S43
20 – 30 ft
19-118 090069 XNA Access Road over Haden Road

Boring S44
23 – 29 ft
19-118 090069 XNA Access Road over Haden Road

Boring S44
29 – 33 ft
19-118 090069 XNA Access Road over Haden Road

Boring S45
28 – 38 ft
19-118 090069 XNA Access Road over Haden Road

Boring S45
38 – 43 ft
19-118 090069 XNA Access Road over Haden Road

Boring S46
23 – 33 ft
19-118 090069 XNA Access Road over Haden Road

APPENDIX C

SUMMARY of CLASSIFICATION TEST RESULTS

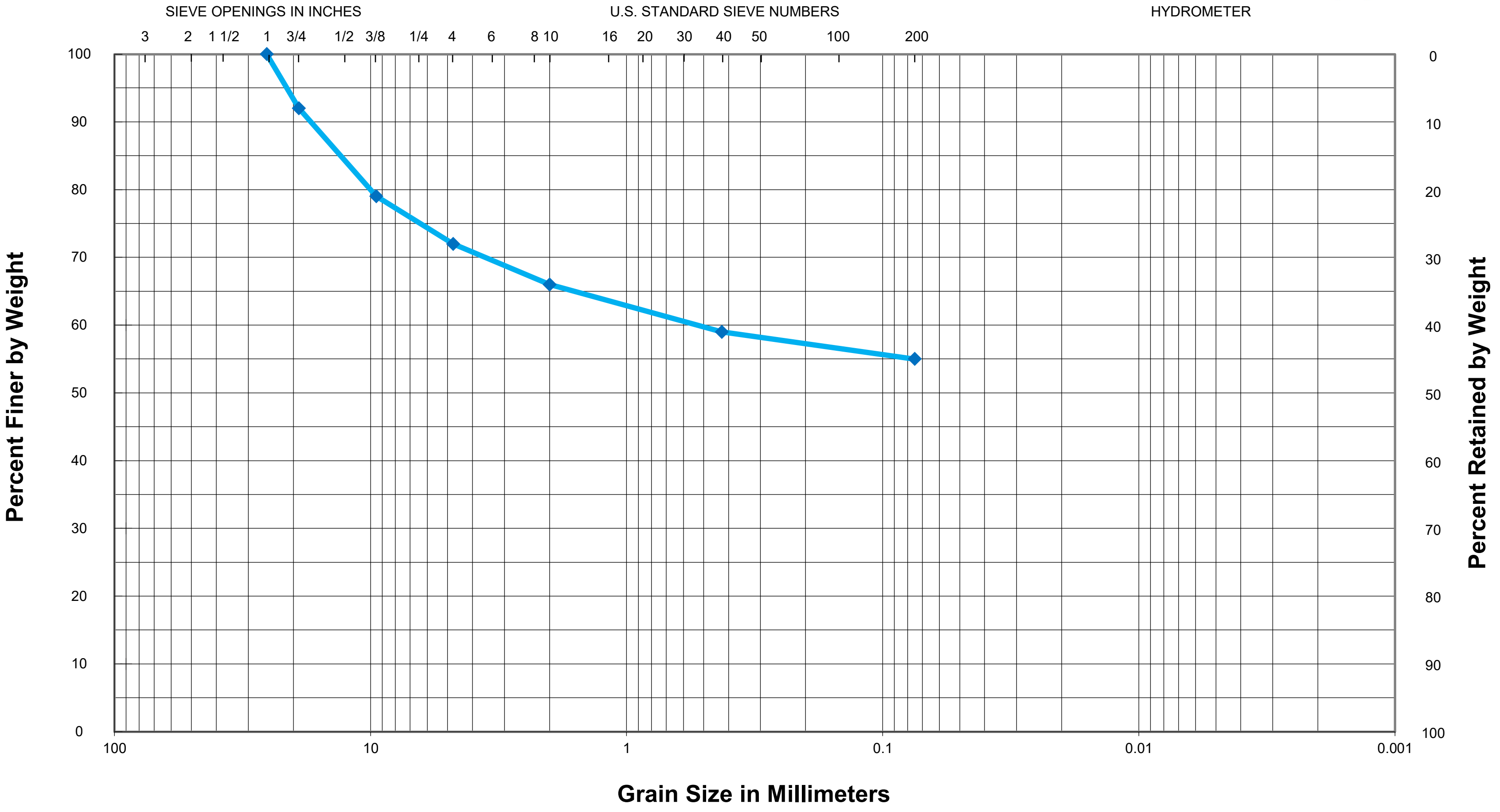
PROJECT: 090069 XNA Access Road Bridge over Haden Road
LOCATION: Benton County, Arkansas
GHBW JOB NUMBER: 19-118

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING								USCS CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
S39	2.5-3.5	26	38	22	16					100			77	CL	A-6
S39	9-10	22	32	19	13					98			90	CL	A-6
S40	4.5-5.5	23	40	22	18					92			36	SC	A-6
S40	14-15	17	36	15	21					62			46	GC	A-6
S41	2.5-3.5	21	38	21	17					78			66	CL	A-6
S41	6.5-7.5	17	27	18	9	100	100	92	79	72	66	59	55	CL	A-4
S42	2.5-3.5	20	29	20	9					60			36	GC	A-4
S42	9-10	25	63	21	42					72			52	CH	A-7-6
S43	2.5-3.5	20	42	23	19					94			58	CL	A-7-6
S43	6.5-7.5	21	39	18	21					97			82	CL	A-6
S44	9-10	16	34	18	16					79			49	SC	A-6
S45	0.5-1.5	25	37	28	9					54			43	GM	A-4
S45	14-15	20	32	21	11					63			42	GC	A-6
S46	9-10	17	29	23	6					58			27	GM	A-2-4

19-118

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

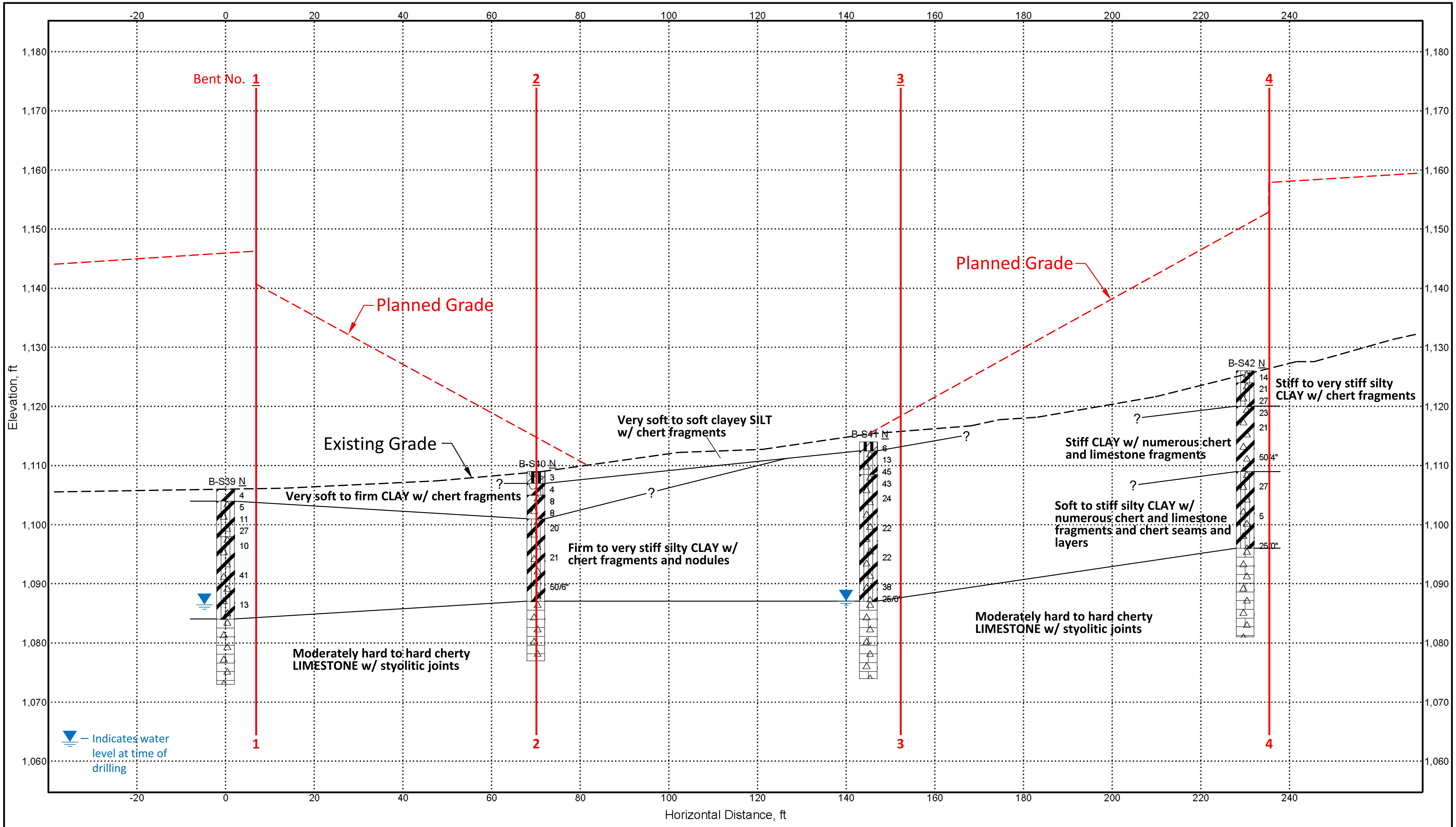


GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

Sample: Boring S41, 6.5-7.5 ft; LL = 27, PL = 18, PI = 9
Description: Reddish brown silty CLAY w/ chert fragments

USCS Classification = CL
AASHTO Classification = A-4

APPENDIX D



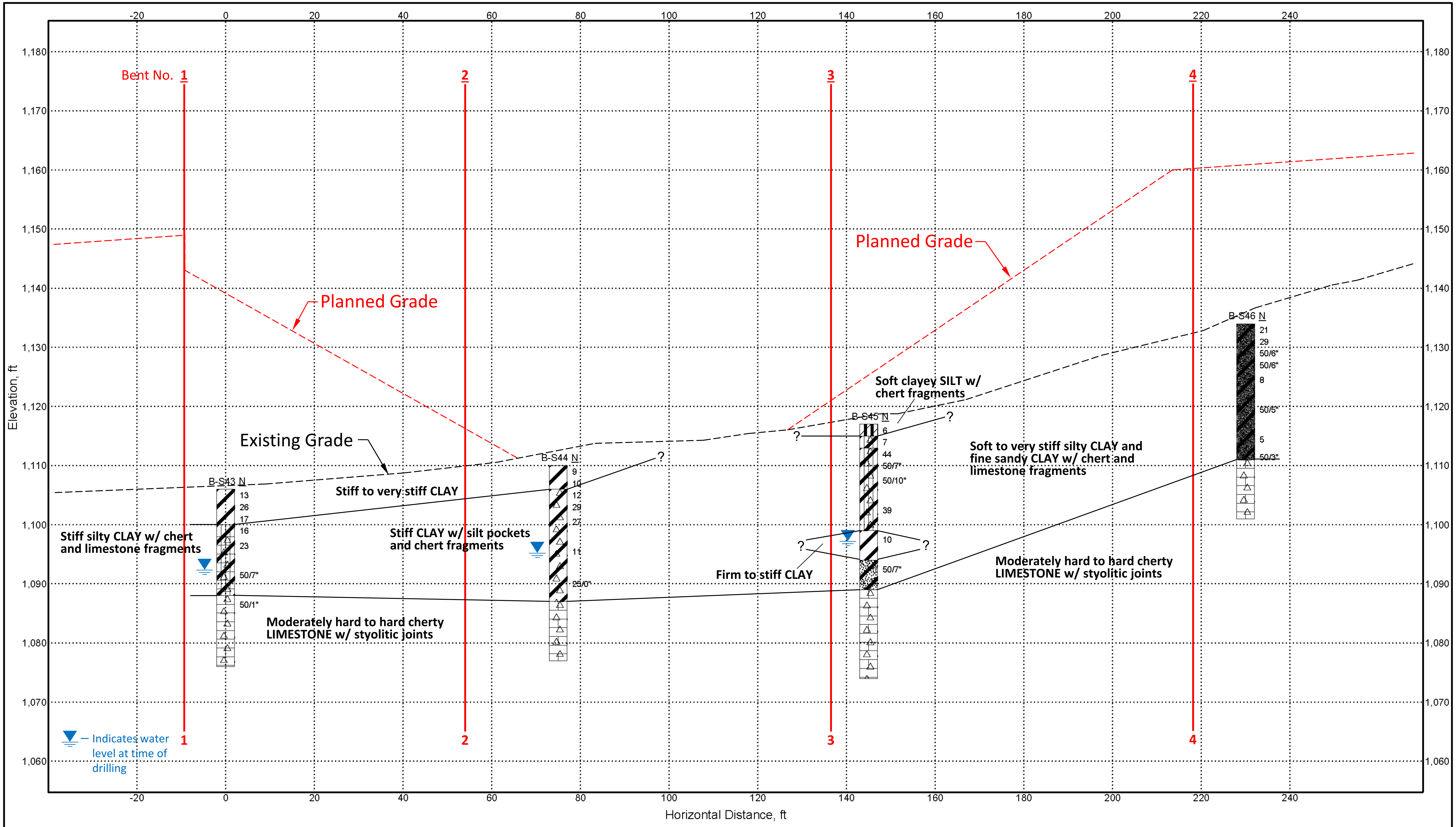
Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

NOTES:
1. Subsurface conditions have been inferred between discrete boring locations. Actual conditions may vary.
2. Ground surface approximate.

SCALE:
1" = 20' Horizontal
1" = 15' Vertical

Generalized Subsurface Profile - Bridge A
090069 XNA Access Road over Haden Rd.
Benton Co., Arkansas

Project Number: 19-118



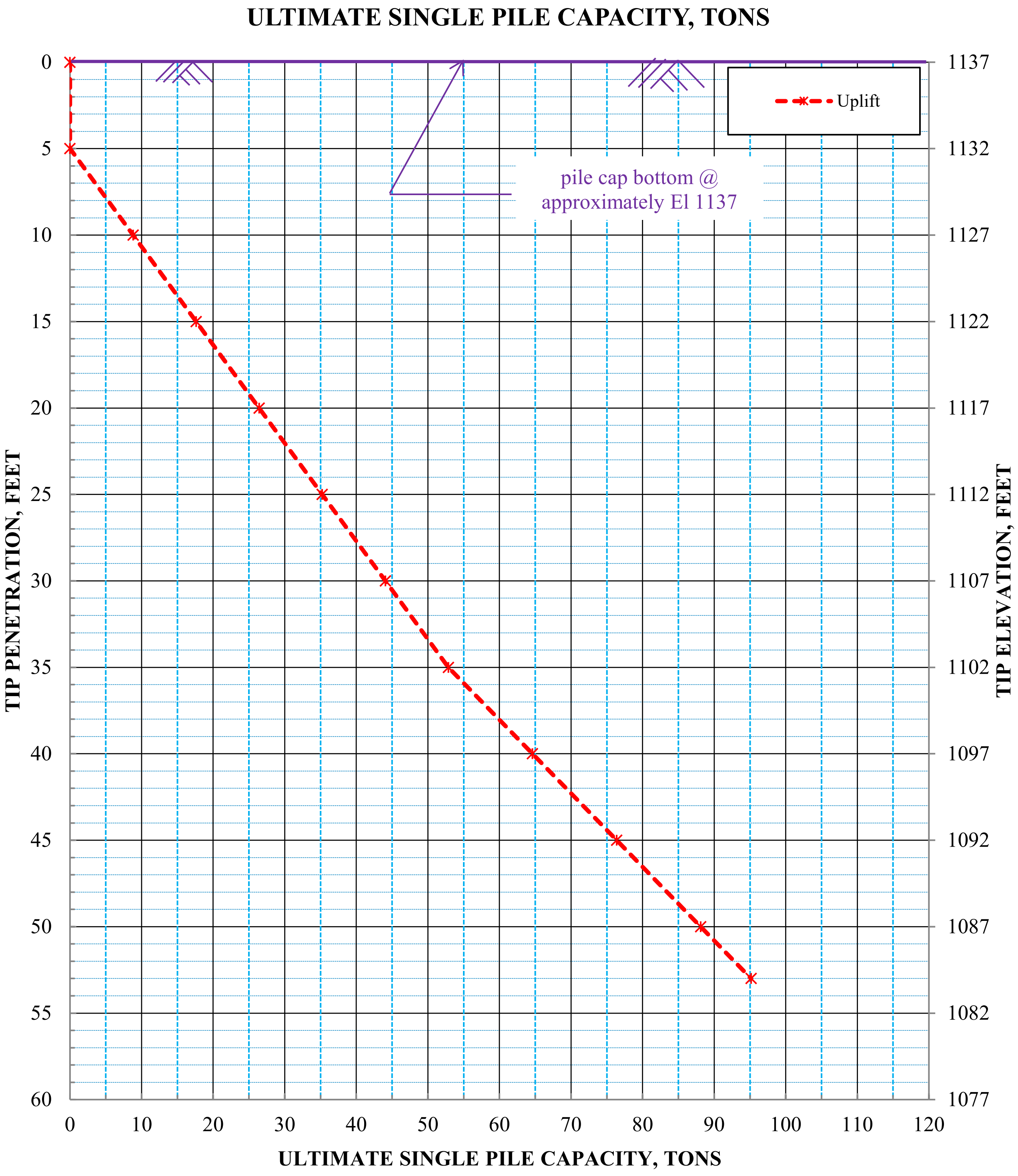
Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

NOTES:
1. Subsurface conditions have been inferred between discrete boring locations. Actual conditions may vary.
2. Ground surface approximate.

SCALE:
1" = 20' Horizontal
1" = 15' Vertical

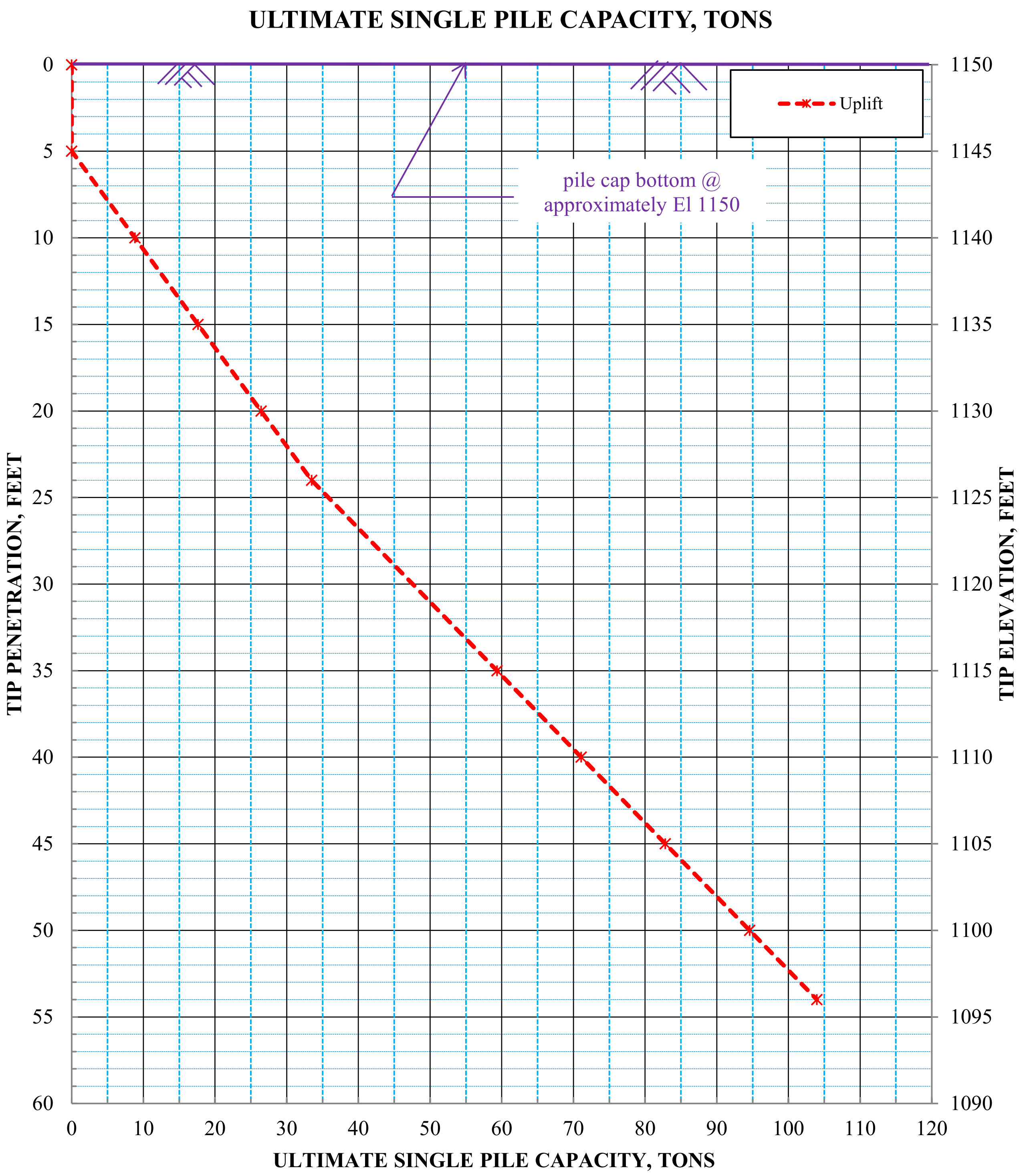
Generalized Subsurface Profile - Bridge B
090069 XNA Access Road over Haden Rd.
Benton Co., Arkansas
Project Number: 19-118

APPENDIX E



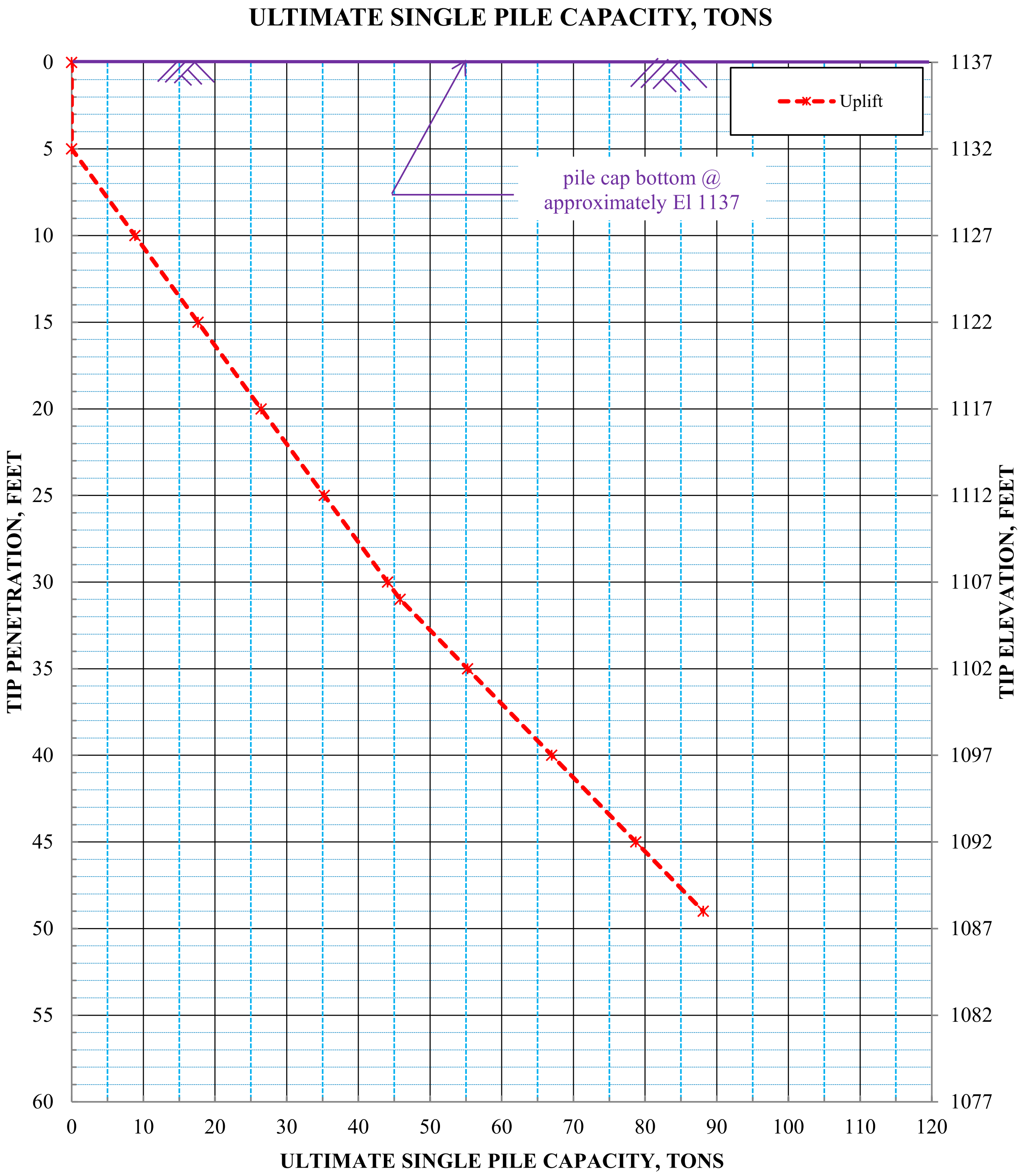
HP14x73 Steel Piles - Uplift
Bridge A - Bent 1
090069 XNA Access Road - Haden Road
Benton County, Arkansas

Note: 1. Cap bottom at ±El 1137
2. Pile penetration limited in moderately hard weathered limestone below El. 1084±



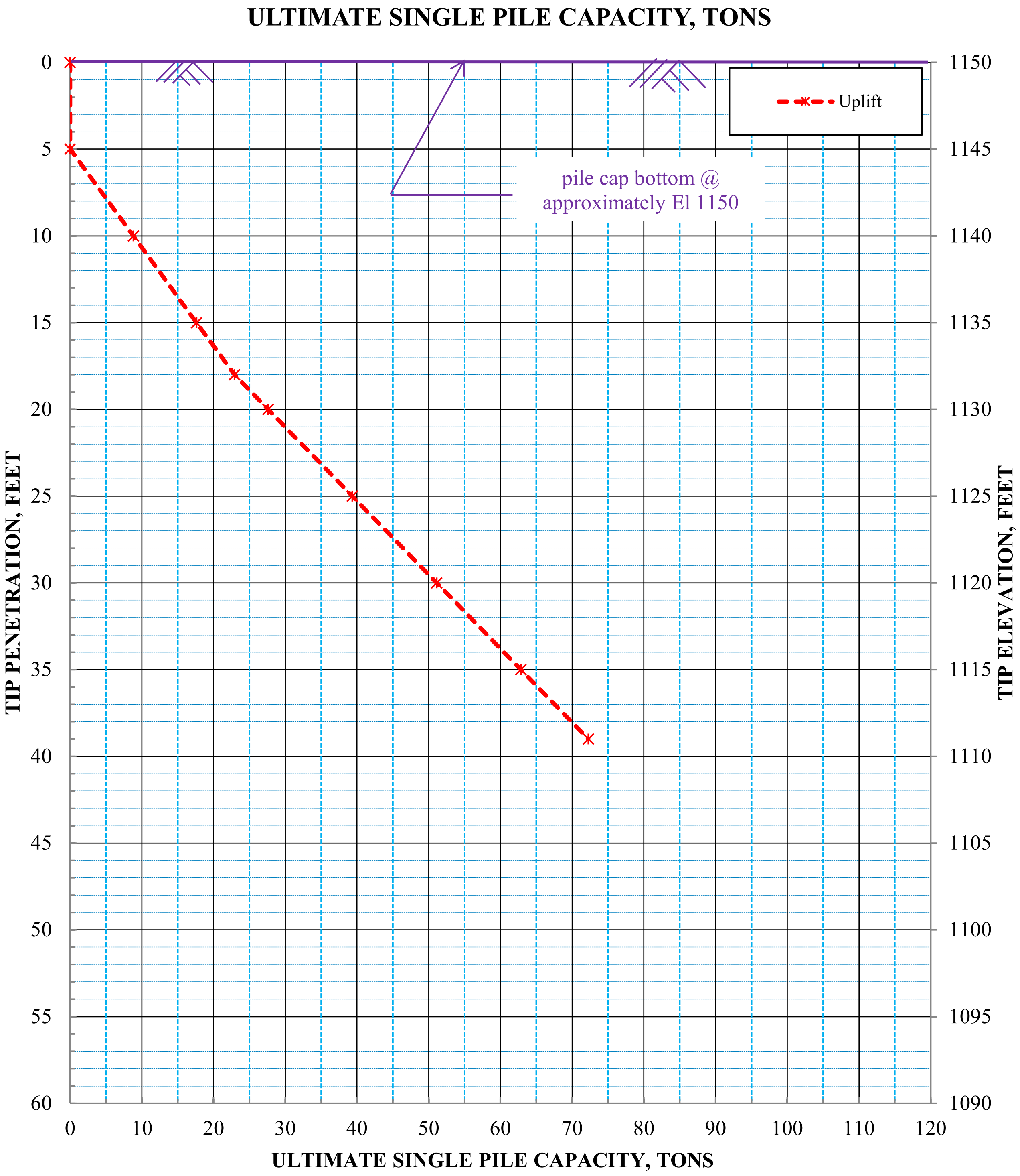
HP14x73 Steel Piles - Uplift
Bridge A - Bent 4
090069 XNA Access Road - Haden Road
Benton County, Arkansas

Notes: 1. Cap bottom at ±El 1150
2. Pile penetration limited in moderately hard weathered limestone below El. 1096±



HP14x73 Steel Piles - Uplift
Bridge B - Bent 1
090069 XNA Access Road - Haden Road
Benton County, Arkansas

Note: 1. Cap bottom at ±El 1137
2. Pile penetration limited in moderately hard weathered limestone below El. 1088±



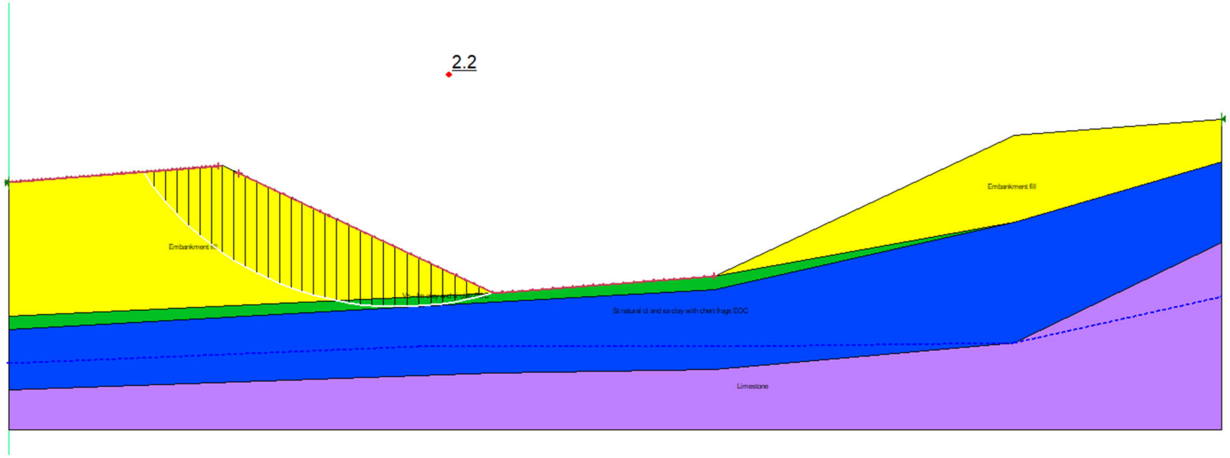
HP14x73 Steel Piles - Uplift
Bridge B - Bent 4
090069 XNA Access Road - Haden Road
Benton County, Arkansas

Notes: 1. Cap bottom at ±El 1150
2. Pile penetration limited in moderately hard weathered limestone below El. 1111±

APPENDIX F

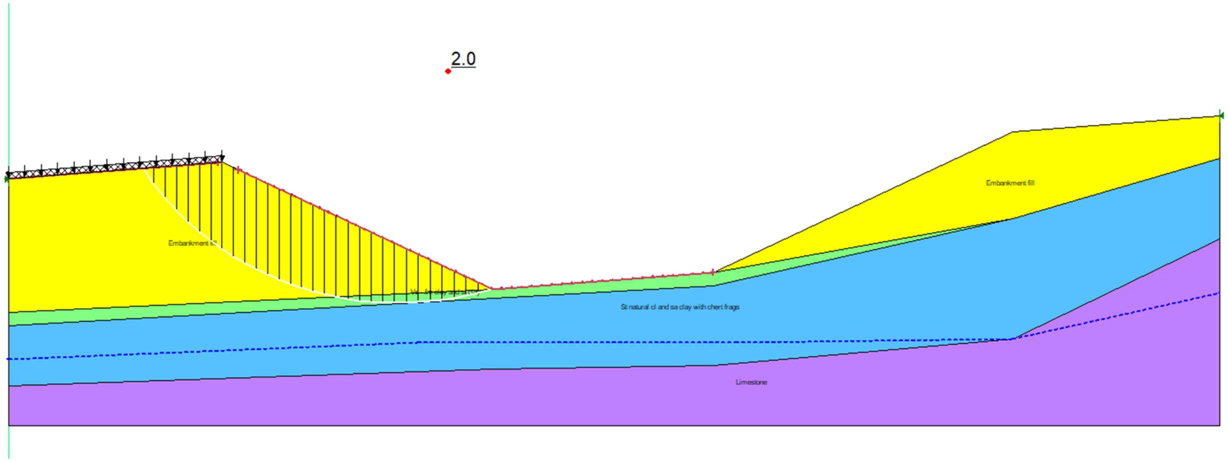
Summary of Stability Analysis Results
090069 XNA Access Road over Haden Road
GHBW Job No. 19-118
Benton County, Arkansas

	Design Loading Condition	Calculated Minimum Factor of Safety
South End Slope Bent 1 (2H:1V)	End of Construction	2.2
	Long Term	2.0
	Seismic ($k_h = A_S/2 = 0.0245$)	2.0
South Side Slope Bent 1 (3H:1V)	End of Construction	2.4
	Long Term	2.3
	Seismic ($k_h = A_S/2 = 0.0245$)	2.2
North End Slope Bent 4 (2H:1V)	End of Construction	2.6
	Long Term	2.1
	Seismic ($k_h = A_S/2 = 0.0245$)	2.1
North End Side Slope Bent 4 (3H:1V)	End of Construction	4.9
	Long Term	3.3
	Seismic ($k_h = A_S/2 = 0.0245$)	3.2

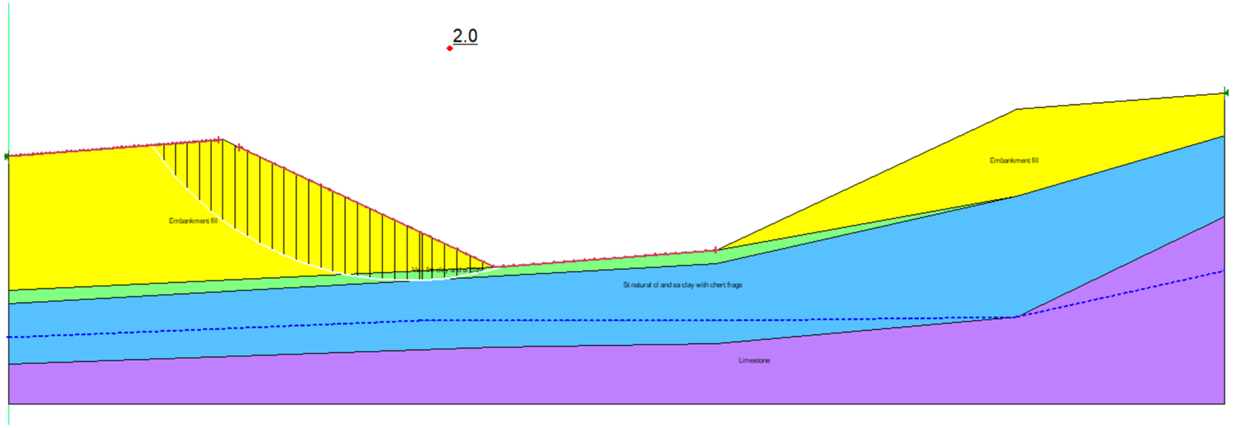


Results of Stability Analyses – End of Construction
Bent 1 South End Slope
2H:1V Slope, H=38 ft ±
19-118 - 090069 XNA Access Road over Haden Road

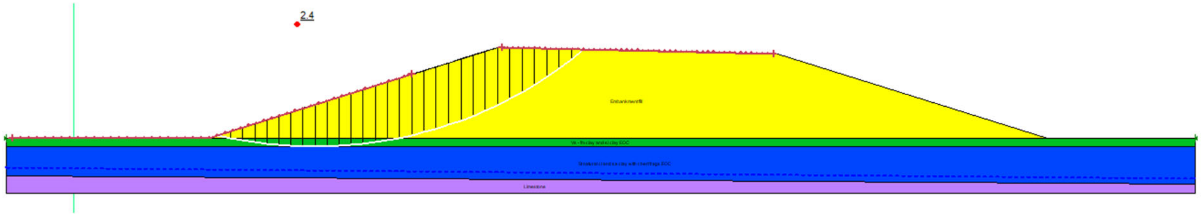
Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



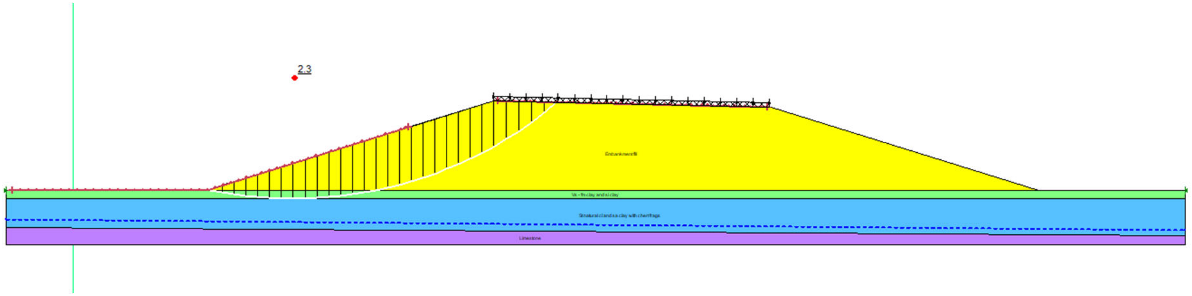
Results of Stability Analyses – Long Term Condition
Bent 1 South End Slope
2H:1V Slope, H=38 ft ±
19-118 - 090069 XNA Access Road over Haden Road



Results of Stability Analyses – Seismic Condition ($k_h = A_S /2= 0.0245$)
Bent 1 South End Slope
2H:1V Slope, H=38 ft ±
19-118 - 090069 XNA Access Road over Haden Road

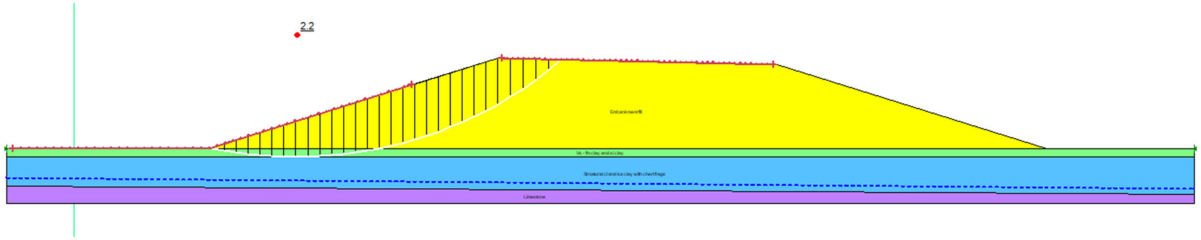


Results of Stability Analyses – End of Construction
Bent 1 South Side Slope
3H:1V Slope, H=43 ft ±
19-118 - 090069 XNA Access Road over Haden Road



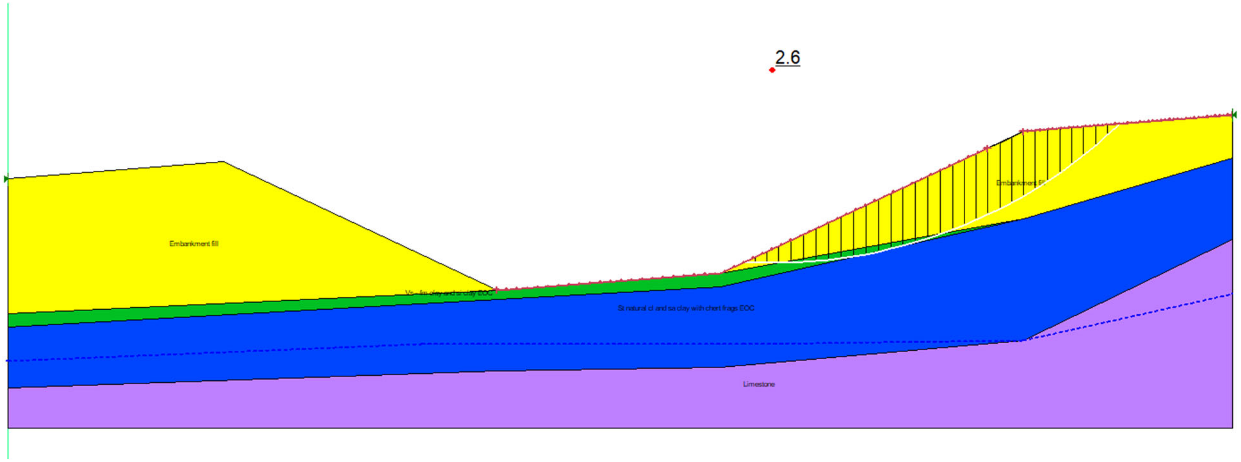
Results of Stability Analyses – Long Term Condition
Bent 1 South Side Slope
3H:1V Slope, H=43 ft ±
19-118 - 090069 XNA Access Road over Haden Road

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

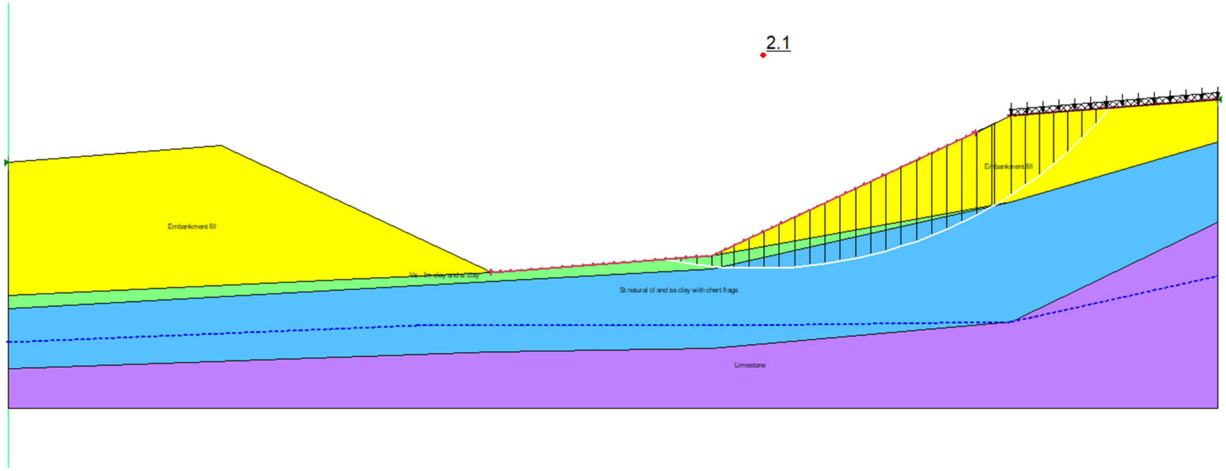


Results of Stability Analyses – Seismic Condition ($k_h = A_S /2= 0.0245$)
Bent 1 South Side Slope
3H:1V Slope, H=43 ft ±
19-118 - 090069 XNA Access Road over Haden Road

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

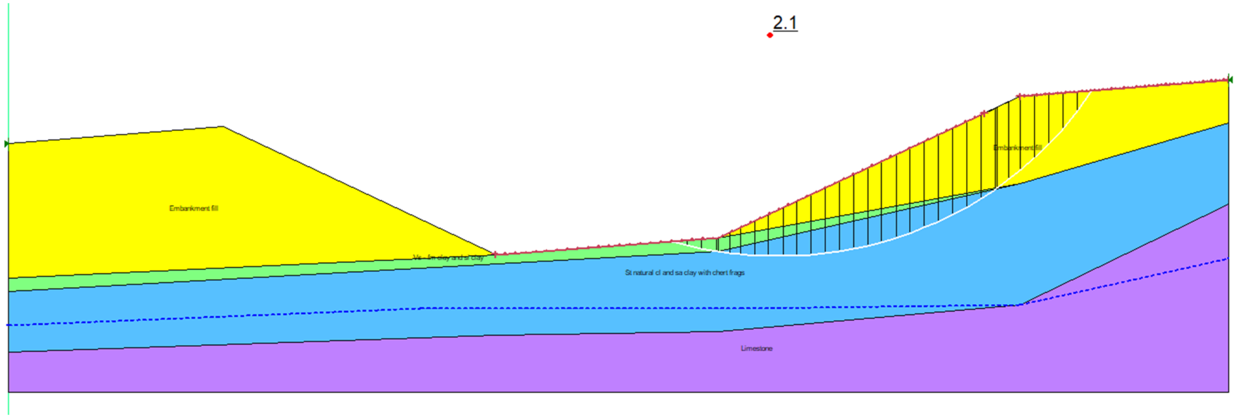


Results of Stability Analyses – End of Construction
Bent 4 North End Slope
2H:1V Slope, H=42 ft ±
19-118 - 090069 XNA Access Road over Haden Road



Results of Stability Analyses – Long Term Condition
Bent 4 North End Slope
2H:1V Slope, H=42 ft ±
19-118 - 090069 XNA Access Road over Haden Road

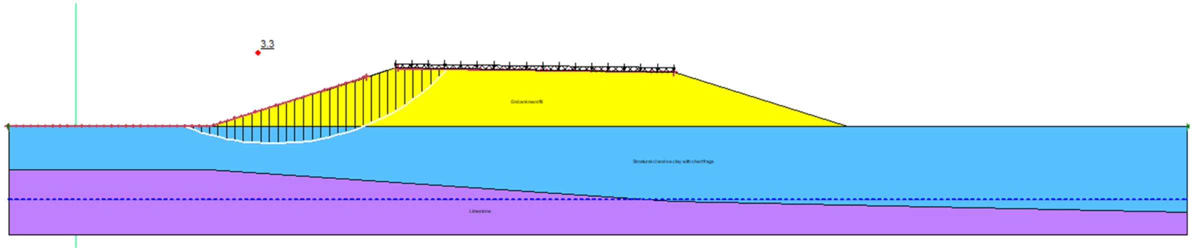
Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



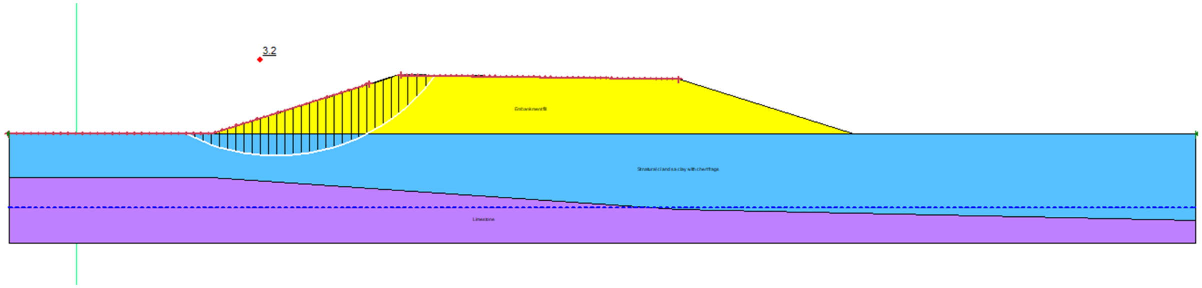
Results of Stability Analyses – Seismic Condition (k_h = A_S /2= 0.0245)
Bent 4 North End Slope
2H:1V Slope, H=42 ft ±
19-118 - 090069 XNA Access Road over Haden Road

Results of Stability Analyses – End of Construction
Bent 4 North Side Slope
3H:1V Slope, H=28 ft ±
19-118 - 090069 XNA Access Road over Haden Road

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



Results of Stability Analyses – Long Term Condition
Bent 4 North Side Slope
3H:1V Slope, H=28 ft ±
19-118 - 090069 XNA Access Road over Haden Road



Results of Stability Analyses – Seismic Condition ($k_h = A_S /2= 0.0245$)
Bent 4 North Side Slope
3H:1V Slope, H=28 ft ±
19-118 - 090069 XNA Access Road over Haden Road

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

Materials Testing
Geotechnical Engineering
Environmental
Building Sciences & Safety
Inspections & Code Compliance
Virtual Design Consulting

September 26, 2023
Job No. 19-118

Garver LLC
4701 Northshore Drive
North Little Rock, Arkansas 72118

Attn: Mr. Joel Skinner, P.E.

RESULTS of GEOTECHNICAL INVESTIGATION
ARDOT JOB 090069
XNA ACCESS ROAD OVER HOLMES ROAD
BENTON COUNTY, ARKANSAS

INTRODUCTION

This report provides the final results of the geotechnical investigation performed for the XNA Access Road over Holmes Road Bridges A and B in Benton County, Arkansas are provided in this report. The Holmes Road overpass is one facet of ARDOT Job 090069 Northwest Arkansas Regional Airport Access (Benton Co) (F). This geotechnical investigation was authorized by the Garver, LCC Subconsultant Agreement for Task Order No. 061 on August 27, 2019. Notice to proceed with the field studies was received on August 30, 2019. Results and recommendations have been provided throughout the course of this study. An interim report for the bridge was submitted on August 9, 2023, and a preliminary report for the MSE wall planned at the Holmes Road site was submitted on August 12, 2023.

We understand the new Holmes Road bridge will be a continuous plate girder structure with five (5) bents, four (4) spans, and a total length of approximately 323 feet. We also understand that a foundation system consisting of steel piles is planned for all bents. Foundation loads of the new bridge are anticipated to be moderate. The new Holmes Road bridges will include simple slopes with 2-horizontal to 1-vertical (2H:1V) and 3-horizontal to 1-vertical (3H:1V) configurations for the embankment ends and sides, respectively. A MSE retaining wall (Retaining Wall No. 1) is planned northwest of the proposed bridge alignment. Site grading is expected to include up to 60 ft of fill. Preliminary bridge and MSE wall layouts are provided in Appendix A.

The purposes of this study were to explore subsurface conditions in the bridge alignment and to develop recommendations to guide design and construction of foundations. These purposes have been achieved by a multi-phased study that included the following.

- Drilling sample and core borings at the planned bridge location to evaluate subsurface conditions and obtain samples of the subgrade and foundation soil and rock for laboratory testing.
- Performing laboratory tests to evaluate pertinent engineering properties of the foundation and subgrade strata.
- Analyzing field and laboratory data to develop recommendations for seismic site class, seismic performance zone/seismic design category, foundation and subgrade support, MSE walls, slope stability, site grading, and construction considerations.

The relationship of these factors to design and construction of the new bridge has been considered in developing the recommendations and considerations discussed in the following report sections.

SUBSURFACE EXPLORATION

Subsurface conditions at the Holmes Road bridge location were investigated by drilling 13 sample and core borings to depths of 2.5 to 61 feet. The site vicinity is shown on Plate 1. The approximate bridge boring locations are shown on Plate 2 and MSE wall boring locations are shown on Plate 3. The subsurface exploration program is summarized in Table 1 below.

Table 1: Summary of Exploration Program

Boring No.	Approx Sta	Approx Offset, ft	Approx Surf El, ft	Completion Depth, ft
S47A	211+40	45 Lt	1219	2.5*
S47	211+40	40 Lt	1220	61
S48	212+35	55 Lt	1206	51.8
S49	213+50	50 Lt	1191	37
S51	214+80	55 Lt	1182	38.7
S52A	210+55	45 Rt	1229	9*
S52	210+55	50 Rt	1229	10*
S53	211+30	45 Rt	1223	30
S54	212+15	55 Rt	1210	47.4
S56	213+65	55 Rt	1208	42.5
W1	214+90	155 Lt	1182	32
W2	215+90	140 Lt	1201	25
W3	217+10	161 Lt	1214	25

*Note: Boring terminated at practical refusal in hard chert bed or cherty limestone.

The boring logs, presenting descriptions of the soil and rock strata encountered in the borings and the results of the field and laboratory tests, are included as Plates 4 through 17. The centerline station and offset of the boring locations and approximate ground surface elevation, as inferred from the topographic information provided by the Engineer (Garver, LLC) or as inferred from available topographic information, are also shown on the logs. It must be recognized that the surface elevations shown are approximate and actual elevations may vary. Keys to the terms and symbols used on the logs are presented as Plates 18 and 19.

The borings were drilled with a track-mounted CME 55 rotary-drilling rig and a truck-mounted CME-55 rotary-drilling rig using a combination of dry-auger and rotary-wash drilling methods. Samples were typically obtained at 2-ft intervals to 10-ft depth and at 5-ft intervals thereafter. Samples were recovered using a 2-in.-diameter split-barrel sampler driven into the strata by blows of a 140-lb automatic hammer with 30-in. drop in accordance with Standard Penetration Test (SPT) procedures. The number of blows required to drive the standard split-barrel sampler the final 12 in. of an 18-in. total drive, or a portion thereof, is defined as the Standard Penetration Number (N). Recorded N-values are shown on the boring logs in the "Blows Per Ft" column.

Representative samples of the cherty limestone/limestone bedrock were obtained using a 5-ft-long NQWL- or NQ2-size double-tube core barrel with a diamond bit. For each core run, the percent recovery was determined as the ratio of recovery to total length of core run. Rock Quality Designation (RQD) was also determined for the core run as the sum of intact, sound rock core greater than 4-in. length divided by the total length of the run and expressed in percent. Both these values are presented in the right-hand columns of the log forms, opposite the corresponding core run. Photographs of recovered rock cores are provided in Appendix B.

All samples were removed from sampling tools in the field, examined and visually classified by the field geologist. Samples were then placed in appropriate containers to prevent moisture loss and/or change in condition during transfer to our laboratory for further examination and testing.

The borings were advanced using dry-auger procedures to the extent possible to facilitate evaluation of shallow groundwater conditions. Observations regarding groundwater levels are noted in the lower-right portion of each log and are discussed in subsequent sections of this report. All boreholes were backfilled after obtaining the final water level readings.

LABORATORY TESTING

Laboratory testing was performed to evaluate subgrade and foundation plasticity and to confirm visual classification. The testing program included natural water content determinations (AASHTO T 265), liquid and plastic (Atterberg) limit determinations (AASHTO T 89 and T 90), and sieve analyses through the No. 200 sieve (AASHTO T 88). Soil shear strength was estimated in the field using SPT results.

Natural water content determinations were performed to develop information on *in-situ* soil water content for the borings. Water content results are plotted on the boring log forms in accordance with the scale and symbols shown in the legend located in the upper-right corner of the logs.

To verify field classification and to evaluate soil plasticity, liquid and plastic limit (Atterberg limits) determinations and sieve analyses were performed on selected representative samples. The Atterberg limits are plotted on the logs as pluses inter-connected with a dashed line using the water content scale. The percentage of soil passing through the No. 200 Sieve is noted in the "- No. 200 %" column on the appropriate log forms.

A summary of classification test results and classification by the Unified Soil Classification System and AASHTO Classification System is presented in Appendix C. Grain-size distribution curves are also included in Appendix C.

GENERAL SITE and SUBSURFACE CONDITIONS

Site Conditions

The overall alignment of the XNA Access Road extends from the Northwest Arkansas Regional Airport (XNA) about 4 miles southeast to the planned terminus at Highways 70 and 71. The Holmes bridge site crosses Holmes Road approximately 700 ft south of the intersection of Holmes Road and Haden Road. The site locale is presently open pasture land with some mature trees. A drainage ditch with thick underbrush is present in the center of the alignment. Agricultural buildings are located just south of the bridge alignment. The site terrain slopes moderately from the southeast to the northwest and steeply from the northeast to the northwest. Surface drainage is considered good overall, but poor in the area of the drainage feature.

Site Geology

The project alignment is located in the mapped exposure of the Boone Formation. The early and middle Mississippian Period Boone consists of fine- to coarse-grained limestone interbedded with chert. The chert content can vary widely, both horizontally and vertically, and limestone or chert may be predominant. The Boone Formation is known for dissolutional features such as sinkholes, caves, and enlarged fissures. Typically, the limestone/cherty limestone units of the Boone decompose (weather) to erratic blends of chert fragments and clay/silty clay. The residual soil mantle may extend to significant depths on higher terrain and may contain hard chert seams and/or layers. The thickness of the Boone Formation is reported to be 300 to 350 ft in northern Arkansas. The Boone is generally disconformable to the underlying Chattanooga Shale and St. Joe Limestone member, with some areas having a conformable contact.

Seismic Conditions

In light of the results of the borings performed for the Holmes Road bridge, a Seismic Site Class C (very dense soil and soft rock) is considered applicable for the site with respect to the criteria of the AASHTO LRFD Bridge Design Specifications Eighth Edition 2017[1].

Given the location and AASHTO code-based values, the 1.0-sec period spectral acceleration coefficient for Site Class C (S_1) is 0.049 and the 1.0-sec period spectral acceleration coefficient (S_{D1}) value for Site Class C is 0.051. Utilizing these parameters, Table 3.10.6-1[2] indicates that a Seismic Performance Zone 1 is fitting for the Holmes Road bridge site. In reference to the 2012 edition of the AASHTO Guide Specifications, the Peak Ground Acceleration (PGA) having a 7 percent chance of exceedance in 75 years (or mean return period of approximately 1000 years) is predicted to be 0.049 for a Seismic Site Class C for the bridge location. The liquefaction potential is considered low for the predominantly cohesive overburden soils and underlying rock units encountered in the borings drilled for this study.

Subsurface Conditions

Based on the results of the borings, the subsurface stratigraphy may be generalized into four (4) primary strata as follows.

Stratum I: The Stratum I soils typically consist of firm to very stiff brown, dark brown, tan, and yellowish tan clayey silt and silty clay and loose to medium dense brown silt and fine sandy silt extending to 1 to 4 feet. This stratum has variable, but generally numerous chert fragments and organics. The silt/fine sandy silt, clayey silt, and silty clay exhibit low plasticity, moderate to high compressibility, and low shear strength. The low-plasticity and silty soils are moisture-sensitive and will lose considerable strength when saturated.

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[1] AASHTO LRFD Bridge Design Specifications, 8th Edition; AASHTO; 2017

[2] AASHTO LRFD Bridge Design Specification, AASHTO; 2012

Stratum II: Below the surficial silty soils is very soft to very stiff red, yellowish red, reddish brown, tan, and light gray clay, silty clay, and fine to coarse sandy clay with variable, but generally numerous chert fragments and low hardness tan, yellowish red, grayish brown, and light gray highly weathered chert and cherty limestone with silty clay seams to 9- to 51-ft depth. This stratum also contains variable amounts of limestone fragments and increasing chert seams and layers with depth. Medium dense brown, gray, and reddish brown fine to coarse clayey sand layers are locally present in this stratum. The subgrade soils typically classify as A-2-6, A-2-7, and A-6 by the AASHTO classification system. In general, the natural surface and near-surface soils are relatively strong and will provide fair to good subgrade support for pavement structures. However, some areas will warrant localized undercut for subgrade preparation.

Stratum III: The overburden soils are underlain by low hardness to moderately hard gray and light gray highly weathered to fresh cherty limestone. The competence of the limestone increases with depth. The limestone is flat-bedded with healed fractures and some weathered chert seams. The core sample recovery ranges from 13 to 100 percent and the core sample RQD ranges from 0 to 92 percent in this stratum. These RQD values are indicative of variable poor to fair rock quality. Rock quality generally increases with depth.

To aid in visualizing subsurface conditions, generalized subsurface profiles are presented in Appendix D. It should be recognized that the stratigraphy illustrated by the profiles has been inferred between discrete boring locations. In view of the natural variations in stratigraphy and conditions, variations from the stratigraphy illustrated by the profiles should be anticipated. Additionally, the natural transition between strata is generally gradual, and the stratigraphy described in the sections above may vary.

Groundwater Conditions

Groundwater was not encountered within the exploration range of the borings in March 2022 and January 2023. Perched water may be encountered in the fractured zones of the cherty limestone. Groundwater levels will vary, depending on seasonal precipitation, surface runoff and infiltration, and water levels in nearby drainage features.

ANALYSES and RECOMMENDATIONS

Foundation Design

Foundations for the new bridge must satisfy two (2) basic and independent design criteria: a) foundations must have an acceptable factor of safety against bearing failure under maximum design loads, and b) foundation movement due to consolidation or swelling of the underlying strata should not exceed tolerable limits for the structures. Construction factors, such as installation of foundations, excavation procedures and surface and groundwater conditions, must also be considered.

Based on the results of the borings performed at the Holmes Road bridge site and our understanding of the project, we recommend that foundation loads at the abutments and interior bents be supported on steel piling. Recommendations for steel piles are discussed in the following report sections.

Pile Foundations

We recommend that the foundation loads of the twin bridges be supported on steel HP12x53 or HP14x73 piles. Other pile sizes or types may be evaluated if desired. Point-bearing steel piles driven to refusal should extend through any new embankment fill, the natural overburden soils, and any zones of highly weathered chert or cherty limestone to develop safe bearing capacity in the competent moderately hard limestone. End-bearing piles should be driven to practical refusal in the moderately hard cherty limestone. We recommend that all steel piles be fitted with rock points.

Steel piles driven to refusal should be designed for the structural capacity of the pile, as per applicable AASHTO Load and Resistance Factor Design (LRFD) procedures[3]. An effective resistance factor (φ_c) of 0.50 is recommended for structural determination of factored bearing capacities. This effective resistance factor for steel piles has been based on the assumption of severe driving conditions.

For determination of bearing capacities of steel piles driven to refusal we recommend that nominal (ultimate) resistance (P_n) of HP piles be determined based on the yield strength of steel H piles (f_y) and the net end area (A_{net}) of the section. It has been our experience that allowable pile capacities of 96 tons for HP12x53 piles and 133 tons for HP14x73 piles are typical for f_y = 50 ksi steel pile sections. These capacities are based on allowable stress design (ASD). However, the appropriate factored bearing capacity should be confirmed by the Engineer. Post-construction settlement of piles driven to refusal will be negligible.

The nominal axial capacities are based on single, isolated foundations. Piles spaced closer than three (3) pile widths may develop lower individual capacity due to group effects. The potential

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[3] Load and Resistance Factor Design (LRFD) for Highway Bridge Substructures, Publication No. FHWA HI-98-032, National Highway Institute, May 2001.

for group capacity reductions should be evaluated for pile spacing closer than three (3) widths (center to center).

Estimated pile tip elevations are summarized in Table 1 below.

Table 1: Estimated Tip Elevations of Steel Piles Driven to Refusal

Bridge	**Bent No.**	**Estimated Pile Tip Elevation, ft**	**Comments**
A	1A (South Bridge End)	1169	Refusal in moderately hard cherty limestone
	2A	1167	Refusal in moderately hard weathered cherty limestone
	3A	1168	Refusal in moderately hard slightly weathered cherty limestone
	4A	1162	Refusal in moderately hard slightly weathered cherty limestone
	5A (North Bridge End)	1154	Refusal in moderately hard slightly weathered cherty limestone
B	1B (South Bridge End)	1219	Refusal in hard cherty limestone or chert
	2B	1212	Refusal in moderately hard weathered cherty limestone
	3B	1174	Refusal in moderately hard cherty limestone
	4B	1175	Refusal in moderately hard cherty limestone
	5B (North Bridge End)	1177	Refusal in moderately hard to hard cherty limestone

It should be noted that the tip elevations shown in the table above are estimates only based on the results of the relevant borings and the inferred surface elevations at the particular locations. Pile refusal and final depth must be field verified. Given the variable topography and depth to competent limestone, variation from these estimated tip elevations should be anticipated.

Some steel piles may be subjected to uplift loads. Nominal single pile uplift capacity curves for steel HP piles are provided in Appendix E. Where preboring is expected for pile installation, calculated uplift capacities are based upon a prebored section. Nominal axial pile uplift capacities have been developed using static pile capacity formulae, the results of the borings, and the plan pile cap elevations shown on the preliminary bridge layout drawings.

Based on AASHTO LRFD geotechnical design procedures, a resistance factor (φ_{up}) of 0.25 is recommended for evaluation of factored uplift capacity. This resistance factor is based on

Strength Limit States. For Extreme Events Limit States such as earthquake loading and collision, a resistance factors of 0.8 for uplift is recommended.

Given the anticipated site grading on the north embankment, including up to 60 ft of fill, downdrag loads from settlement of embankment soils and the embankment foundation soils could occur. We recommend deferring pile driving for a minimum period of 45 days after completion of embankment fill placement. Alternatively, piling may be installed prior to the recommended waiting period if piles are pre-bored to the cherty limestone bearing stratum. Downdrag loads on piles constructed utilizing prebores are expected to be negligible.

We understand that the 45-day waiting period for embankment and foundation settlement may not be possible at Bent 4A due to the planned construction sequence. If fill is placed after pile installation at Bent 4A, downdrag loads of 26 tons have been calculated for an HP14x73 steel pile. Due to the lesser amount of fill at the southern embankment, with maximum fill heights of about 12 ft at Bent 1, a waiting period is not considered to be needed after embankment construction and before pile installation.

Pre-boring through more resistant chert layers may be required for pile installation. Following pile acceptance, the annulus around the installed piles in prebores should be expeditiously backfilled with grout as per ARDOT Standard Specifications Section 805. The grout should have a minimum compressive strength pf 4000 psi, as per ARDOT Section 501 or an alternate approved by the Engineer.

We recommend a minimum pile penetration of 10 ft below natural grade unless practical refusal is encountered in the moderately hard to hard cherty limestone at shallower depth. We also recommend a minimum pile length of 10 feet. Pre-boring is anticipated to develop minimum pile lengths of 10 ft for Bents 1B and 2B.

Piles should be installed in compliance with Standard Specifications for Highway Construction, 2014 Edition, Section 805. However, we recommend a hammer delivering a minimum energy of 22,000 ft-lbs per blow. A specific review and analysis of the pile-hammer system proposed by the Contractor should be performed by the Engineer prior to hammer acceptance and start of driving. We recommend that all piles be fitted with rock points.

As a minimum, safe bearing capacity of piles should be determined by ARDOT Standard Specifications Section 805.09, Method A. Driving records should be available for review by the Engineer during pile installation. Blow counts on steel piles should be limited to about 20 blows per inch. Practical pile refusal may be defined as a penetration of 0.5 in. or less for the final 10 blows. Driving records should be available for review by the Engineer during pile installation.

MSE Walls

The project includes a mechanically stabilized earth (MSE) retaining wall to the northwest of the proposed bridge. Wall height varies from a nominal 5 ft to 18 ft, with the maximum height of the walls at the eastern section of the wall alignment (approximately Sta 1+70) and the height tapering out away on both ends. Design of MSE walls must include consideration of both internal and external stability. Design with respect to internal stability must be performed by the specific wall designer based on final plans and configurations. Analyses have been performed to verify external (global) stability and bearing capacity.

MSE Wall Bearing

The natural subgrade and foundation soils in the wall alignment generally consist of medium dense fine sandy silt with chert fragments, very soft to very stiff silty clay with numerous chert fragments, and low hardness highly weathered cherty limestone. These soils and weathered rock exhibit variable low to moderate shear strength and moderate to low compressibility. Depending on final grading plans, some undercut and replacement will be required to improve bearing capacity and to limit settlement. The wall north of approximately Sta 0+85 will be supported in embankment fill. Subgrade preparation, including undercut of unstable or otherwise unsuitable soils, should include the complete wall alignment, including areas where the wall is supported in embankment fill. All subgrade improvements should extend at least 5 ft outside wall face and reinforced zone limits.

MSE wall subgrade/foundation preparation and bearing recommendations are summarized below.

1. The leveling pad and reinforced zone should be embedded at least 2 ft below final grade. The embedded depth must be such that the embedment grade is equal to or below the elevation of the foreslope at a distance from the wall face which is equal to the width of the reinforced zone.
2. The wall subgrade/bearing stratum should be observed by the Engineer and thoroughly proof-rolled to verify stability and suitable bearing.
3. The results of the borings indicate that mass undercuts on the order of 2 ft, more or less, will likely be required to develop a stable subgrade. Depending on seasonal site conditions, deeper undercuts could be required in some areas. Undercuts should extend to the stiff to very stiff reddish brown silty clay or the low hardness pale red highly weathered limestone.

4. All undercuts should be backfilled with ARDOT Standard Specifications Section 303, Class 7 crushed stone aggregate base, or Select Granular Backfill (AASHTO M43 No. 57).
5. Nominal bearing on compacted undercut backfill over stiff to very stiff silty clay: 10.0 kips per sq ft
6. Resistance factor (φ_b) for bearing resistance: 0.65
7. Nominal resistance to sliding: 0.35
8. Resistance factor for sliding resistance (φ_τ): 1.0

The MSE wall leveling pad and reinforced zones should bear as recommended above and at a minimum depth of 2 ft below lowest adjacent grade. A minimum wall reinforcement length of 0.7H or 8 ft, whichever is greater, is recommended. Subgrade and foundation preparation in the wall locations and under all embankments must include stripping all organics and thorough proof-rolling.

The suitability of the MSE wall bearing stratum must be field verified by the Engineer or Department at the time of construction. Where undercuts are warranted, these should extend a minimum horizontal distance determined by a 1-horizontal to 1 -vertical (1H:1V) projection or at least 5 ft, whichever is greater, beyond the reinforced zone to the undercut bottom.

Where seepage into undercuts is apparent or positive drainage cannot be assured, Select Granular Backfill should be used for backfill. The crushed stone should be fully encapsulated in a filter fabric geotextile complying with ARDOT Standard Specifications Subsection 625.02, Type 2. Granular backfill should be vented to positive discharge for the relief of infiltrated surface water and/or groundwater.

MSE Wall Global Stability

Stability analyses were performed to verify global stability of the MSE wall. A 250 lbs per sq ft uniform surcharge from vehicles was included for the purposes of stability analyses. Stability analyses were performed using the computer program SLOPE/W 2021[4] and a Morgenstern-Price analysis. Three (3) general loading conditions were evaluated, i.e., End of Construction, Long Term, and Seismic Conditions. For analysis of the seismic condition, a horizontal seismic acceleration coefficient (k_h) of one-half the peak acceleration (A_s) was used, a value of 0.0245.

For the purposes of the stability analyses, unclassified embankment as per Standard Specifications for Highway Construction, 2014 Edition, Subsection 210.06 was assumed for

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[4] Slope/W 2021; GEOSLOPE Ltd.

embankment fill. Accordingly, an undrained shear strength value of 1500 lbs per sq ft has been assumed for the embankment fill. Depending on the specific borrow utilized for embankments, verification of stability could be warranted.

Stability analyses results for the MSE wall are summarized and presented graphically in Appendix F. The results of the stability analyses indicate that global stability of plan configurations of the MSE wall is acceptable with respect to stability of all loading conditions evaluated.

Embankment Slopes

The project scope includes new embankments at each bridge end. Plan bridge end embankment configurations are 2-horizontal to 1-vertical (2H:1V) with 3-horizontal to 1-vertical (3H:1V) side slope configurations. The embankment heights are expected to be a maximum of 60 feet.

To evaluate suitability of the plan configurations, slope stability analyses have been performed. A 250 lbs per sq ft uniform surcharge from vehicles was included for the stability analyses. Stability analyses were performed using the computer program SLOPE/W 2021[5] and a Morgenstern-Price analysis. For the embankment slopes, three (3) general loading conditions were evaluated, i.e., End of Construction, Long Term, and Seismic. For analysis of the seismic condition, a horizontal seismic acceleration coefficient (k_h) of one-half the peak acceleration (A_s) was used, a value of 0.0245.

Stability analyses results are summarized and presented graphically in Appendix F. The results of the stability analyses indicate that plan configurations of the embankment end and side slopes are acceptable with respect to stability of all loading conditions evaluated.

Subgrade Support

The results of the borings indicate the on-site subgrade soils generally consist of silt, clay and silty clay with chert fragments (AASHTO A-2-6 and A-2-7). Given the anticipated new embankment, the approach roadway subgrade is likely to consist of embankment fill. Locally-available borrow, which is likely to be used as unclassified embankment fill, is expected to have similar classification.

We recommend that any soils classifying as A-7-5 or A-7-6 soils be excluded from use as subgrade within 18 in. of the plan subgrade elevation. The top 18 in. of subgrade soils should have a maximum plasticity index (PI) of 18. The as-built pavement subgrade should be evaluated by the

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[5] Slope/W 2021; GEOSLOPE Ltd.

Engineer. Areas of unstable or otherwise unsuitable subgrade should be improved by undercut and replacement or treatment with additives approved by the Engineer.

Based on the results of previous laboratory CBR tests on the silty clay with chert fragments subgrade and correlation with the AASHTO classification, we recommend the following parameters for use in design of pavements.

- CBR: 8.3
- Resilient Modulus (MR): 3260 lbs per sq in.
- R value: 13
- Modulus of Subgrade Reaction (k): 100 lbs per cu in.

Site Grading and Subgrade Preparation

As noted, the silty surface soils are moisture-sensitive. Though presently stable, at elevated water contents the silt and clayey silt subgrade is likely to be soft and unstable. Consequently, site grading operations will be significantly easier to perform during dry seasons of the year.

Site preparation will require localized clearing and grubbing and stripping the zone of organic-containing soils. The depth of stripping will be variable, with deeper stripping depths in wooded areas, and less stripping required in open land. In general, the stripping depth is estimated to be about 6 to 9 inches in clear areas but may be 18 to 24 in. or more where trees and thick underbrush are present. The zone of organic surface soils should be completely stripped in the embankment footprint areas and at least 5 ft beyond the projected embankment toes and outside the reinforced zone of MSE walls. Particular care must be taken to muck out all saturated and/or organic-laden soils in the existing drainage feature.

Following stripping and prior to fill placement, the extent of weak and unsuitable soils should be determined. Thorough proof-rolling should be performed to verify subgrade stability. Proof-rolling should be performed with a loaded tandem-wheel dump truck or similar equipment. Unstable soils exhibiting a tendency to rut and/or pump should be undercut and replaced with suitable fill. Care should be taken that undercuts, stump holes, and other excavations or low areas resulting from subgrade preparation are properly backfilled with compacted fill.

Depending on seasonal conditions, undercuts of about 2 to 4 ft below existing grades, more or less, could be required. Deeper undercuts may be required in wet seasons. General undercuts for site grading may be backfilled with unclassified borrow used for embankment fill. Undercuts under MSE wall foundations should be backfilled with ARDOT Standard Specifications Section 303, Class 7 crushed stone aggregate base or Select Granular Backfill (AASHTO M43 No. 57).

In lieu of undercutting and replacing unsuitable soils in approach road alignments, consideration may be given to using additives to improve soil workability and to stabilize weak areas. Hydrated lime, quick lime, Portland cement, fly ash, or suitable alternate materials may be used as verified by appropriate testing and approved by the Engineer. Additives can be effective where the depth of unstable soils is relatively shallow. Treatment will be less effective in areas where the zone of unstable soils is deep. The optimum application rate of stabilization additive must be determined by specific laboratory tests performed on the alignment subgrade soils. We recommend a minimum treatment depth of 8 inches.

Subgrade preparation and mass undercuts should extend at least 5 ft beyond the embankment toes and outside the reinforced zone of MSE walls to the extent possible. Subgrade preparation for the approach roads should extend at least 3 ft outside pavement shoulder edges to the extent possible.

Fill and backfill may consist of unclassified borrow free of organics and other deleterious materials as per ARDOT Standard Specifications Subsection 210.06. Where A-7-5 or A-7-6 soils are encountered at the subgrade elevation, we recommend that these soils be undercut as required to provide at least 18 in. of suitable low-plasticity subgrade soils, i.e., with a maximum PI of 18, or approved "hillside" cherty clay with a maximum of 35 percent passing the No. 200 sieve. Alternatively, stabilization additives may be utilized to develop a stable subgrade with a PI of 18 or less. Granular soils must be protected from erosion with a minimum 18-in.-thick armor of clayey soil.

Subgrade preparation should comply with ARDOT Standard Specifications Section 212. Embankments should be constructed in accordance with ARDOT criteria (ARDOT Standard Specifications Section 210). Fill and backfill should be placed in nominal 6- to 10-in.-thick loose lifts. All fill and backfill must be placed in horizontal lifts. The in-place density and water content should be determined for each lift and should be tested to verify compliance with the specified density and water content prior to placement of subsequent lifts.

CONSTRUCTION CONSIDERATIONS

Groundwater and Seepage Control

Positive surface drainage should be established at the start of the work, be maintained during construction and following completion of the work to prevent surface water ponding and subsequent saturation of subgrade soils. Density and water content of all earthwork should be maintained until embankments, bridge work, and pavements are completed.

Shallow groundwater was not encountered in the borings in March 2022 and January 2023. Shallow perched groundwater may be encountered in the near-surface soils, particularly during wet seasons. Seepage into excavations and cuts can typically be controlled by ditching or sump-and-pump methods. If seepage infiltration cannot be controlled, construction of drains and/or the use of Select Granular Backfill (AASHTO M 43 No. 57), stone backfill (ARDOT Standard Specifications Section 207), or approved alternates to an elevation above the inflow of seepage will be warranted. In areas of seepage infiltration, the granular fill should be encapsulated with a filter fabric complying with ARDOT Standard Specifications Subsection 625.02, Type 2 and vented to positive discharge. Where surface seeps or springs are encountered during site grading, we recommend the seepage be directed via French drains or blanket drains to positive discharge at daylight or to storm drainage lines.

Site preparation should also include construction of blanket drains in all existing drainage features which will be covered by fill. All loose and/or organic materials should be excavated from drainage features prior to drain construction. Blanket drains should consist of at least 8 to 12 in. of select granular backfill (AASHTO M 43 No. 57) fully encapsulated by a filter fabric. A fabric complying with ARDOT Standard Specifications Subsection 625.02, Type 2 is recommended. Drains should direct water to positive discharge at daylight or into storm drain lines.

Piling

Piles should be installed in compliance with ARDOT Standard Specifications, Section 805. Piles should be carefully examined prior to driving and piles with structural defects should be rejected. Any splices in steel piles should develop the full cross-sectional capacity of un-spliced piles. Preboring should be anticipated for pile installation. Some rock drilling could be required for prebores. Where piles are prebored to develop uplift resistance, the annulus between the steel piles and the prebore should be expeditiously backfilled with approved grout or concrete.

Pile installation should be monitored by qualified personnel to maintain specific and complete driving records and observe pile installation procedures. Safe bearing capacity of production piles should be determined by ARDOT Standard Specifications Section 805.09, Method A. Driving records should be available for review by the Engineer during pile installation. For driving steel piles on this project, we recommend a minimum hammer energy of 34,000 ft-lbs per blow. Blow counts on steel piles should be limited to about 20 blows per inch. Practical pile refusal may be defined as a penetration of 0.5 in. or less for the final 10 blows.

CLOSURE

The Engineer or Department or a designated representative thereof should monitor site preparation, grading work and foundation and pavement construction. Subsurface conditions significantly at variance with those encountered in the borings should be brought to the attention of the Geotechnical Engineer. The conclusions and recommendations of this report should then be reviewed in light of the new information.

The following illustrations are attached and complete this final report.

Plate 1	Site Vicinity
Plates 2 and 3	Plans of Borings
Plates 4 through 17	Boring Logs
Plates 18 and 19	Keys to Terms and Symbols
Appendix A	Preliminary Bridge and MSE Wall Layouts
Appendix B	Selected Rock Core Photographs
Appendix C	Classification Test Results
Appendix D	Generalized Subsurface Profiles
Appendix E	Nominal Uplift Pile Capacity Curves
Appendix F	Stability Analyses Results

* * * * *

We appreciate the opportunity to be of service to you on this project. Should you have any questions regarding this report, or if we may be of additional assistance, please call on us.

Sincerely,

GRUBBS, HOSKYN,
BARTON &WYATT, LLC

Velleta M. Scott

Velleta M. Scott, P.E.
Sr. Project Engineer

STATE OF ARKANSAS
REGISTERED PROFESSIONAL ENGINEER
No. 7791
MARK E. WYATT

Mark E. Wyatt, P.E.
President

VMS/MEW:jw

Copies Submitted: Garver LLC
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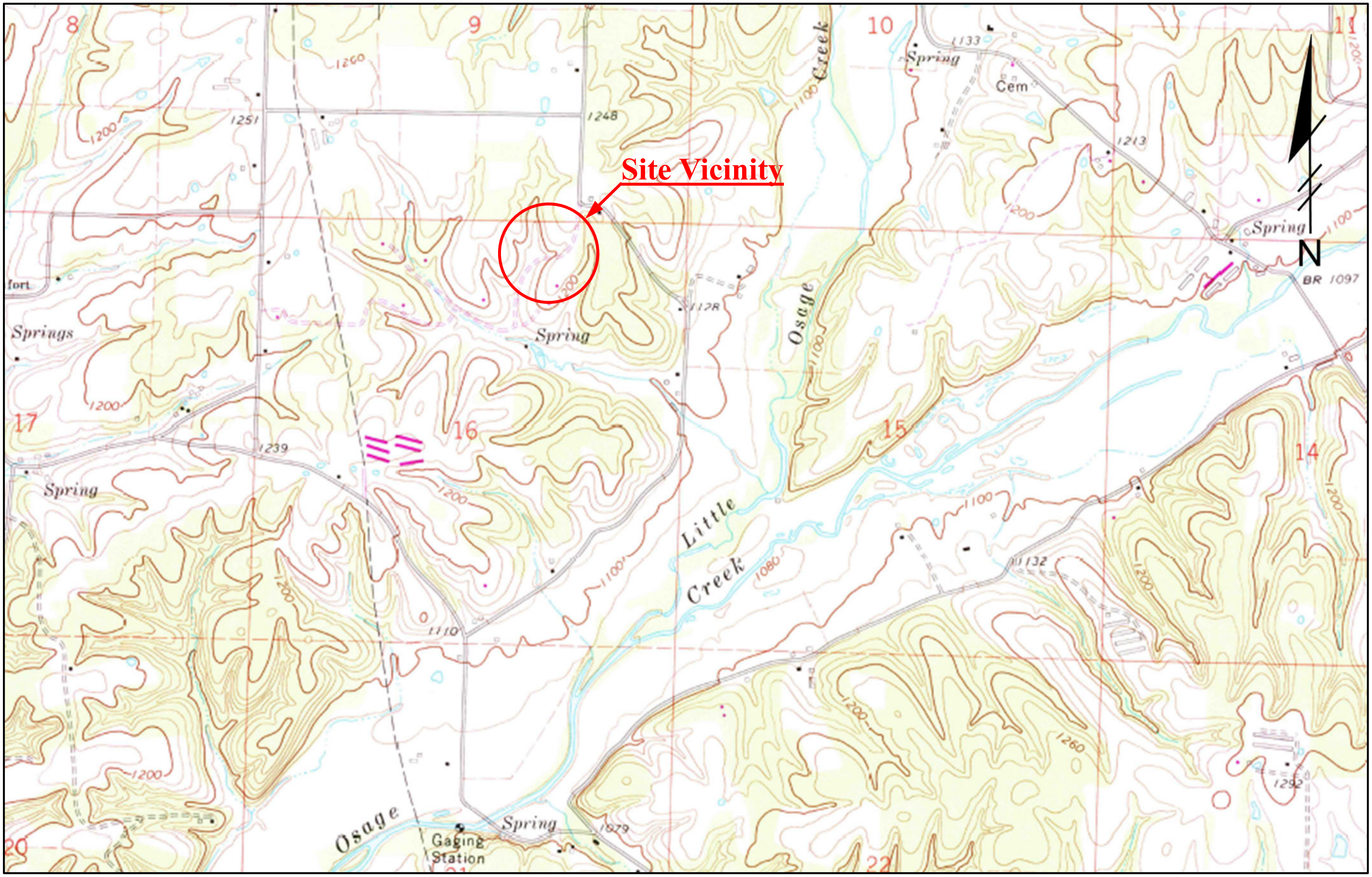
Attn: Mr. Lawren Wilcox, P.E. (1-email)
Attn: Mr. Adam Wierciak, P.E. (1-email)



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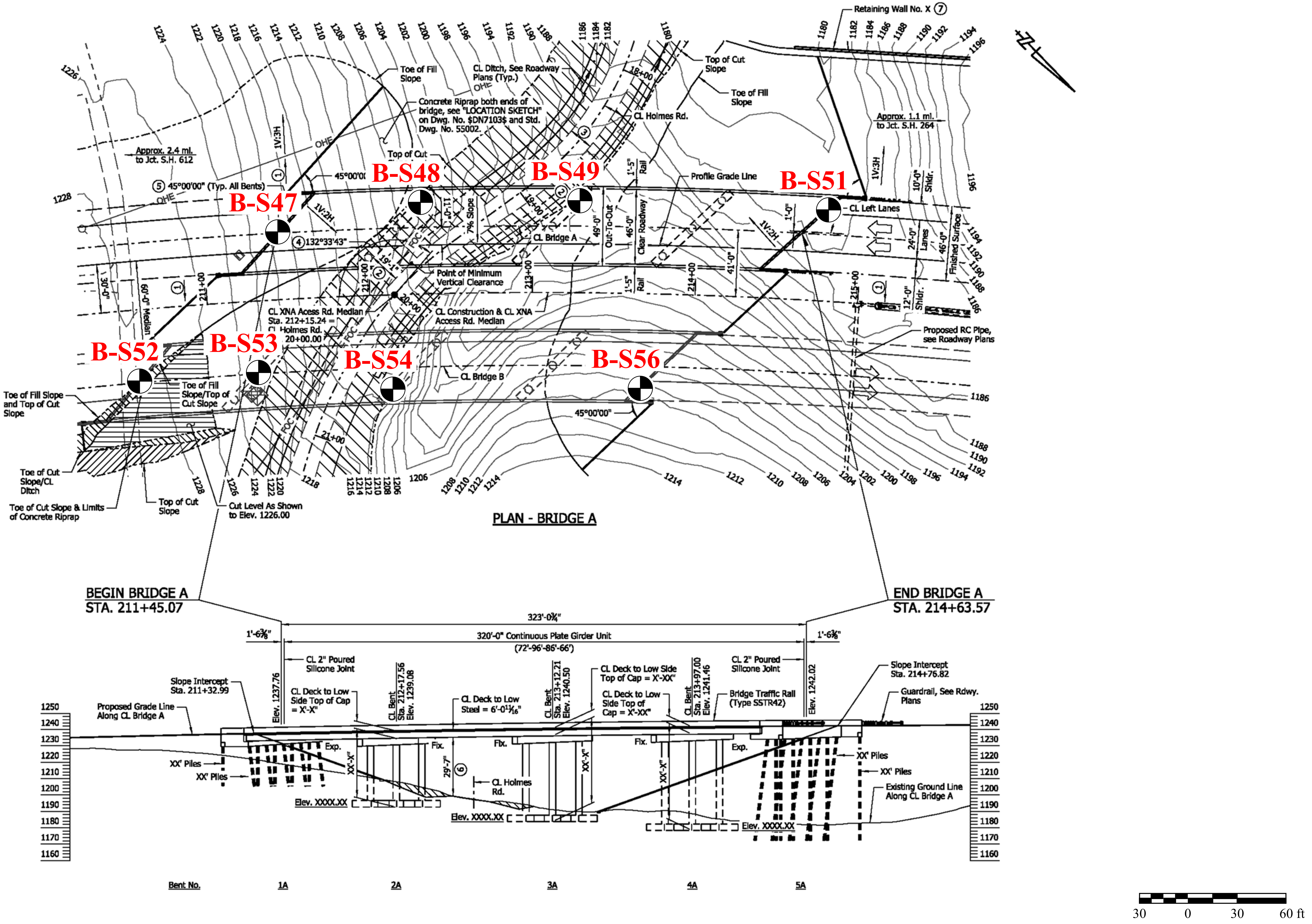
A UES Company

SITE VICINITY MAP
090069 XNA Access Road over Holmes Road
Benton County, Arkansas

Job No. 19-118

Plate 1



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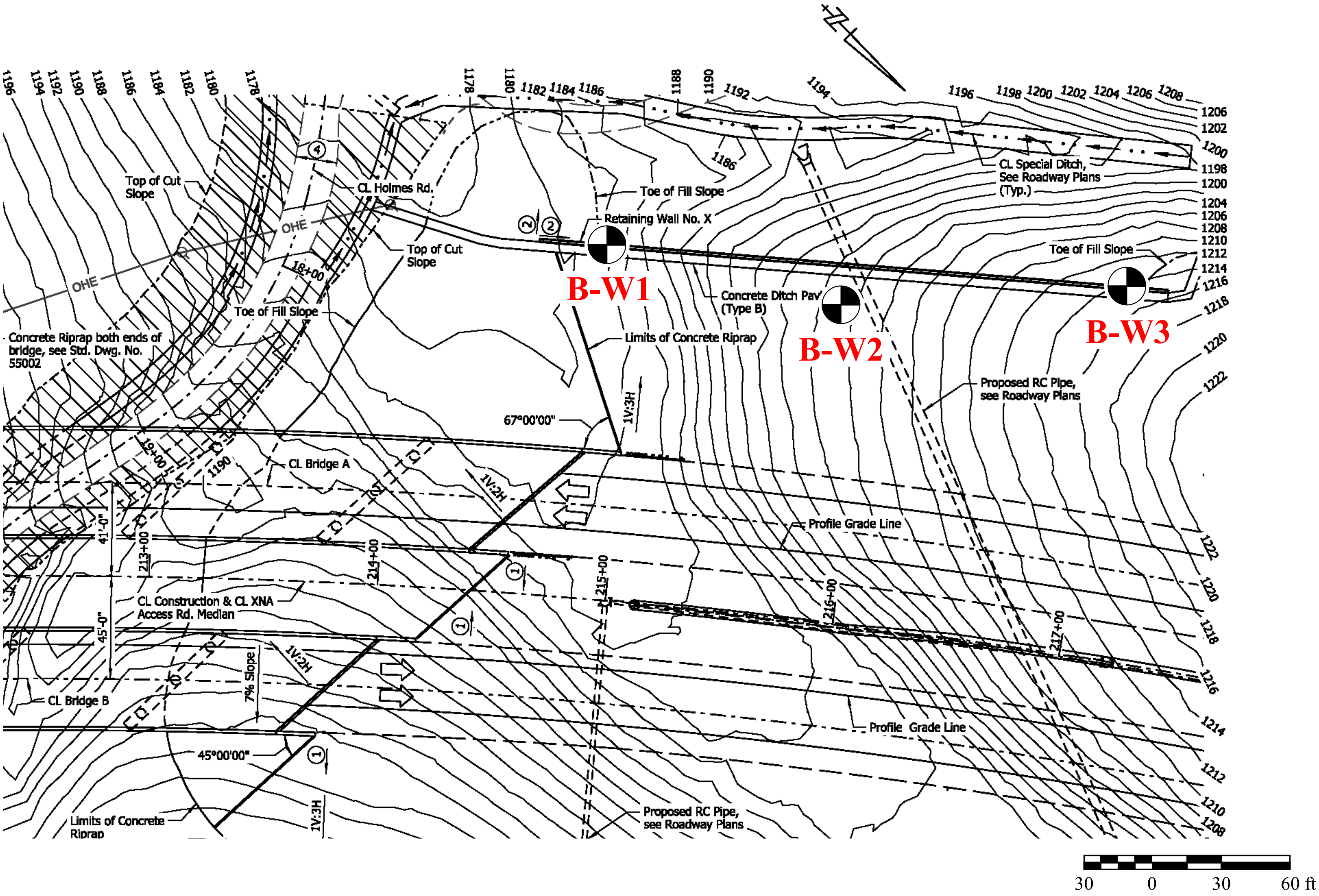
A UES Company

PLAN of BORINGS
090069 XNA Access Road over Holmes Road
Benton County, Arkansas

Scale: As shown

Job No. 19-118

PLATE 2



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A UES Company

PLAN of BORINGS

090069 XNA Access Road over Holmes Road – Retaining Wall
Benton County, Arkansas

Scale: As Shown

Job No. 19-118

Plate 3

19-118

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LOG OF BORING NO. S47A

090069 XNA Access Road over Holmes Rd.
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 211+40, 45 ft Lt

SURF. EL: 1219±

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT 0.2 0.4 0.6 0.8 1.0 1.2 1.4 / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT 10 20 30 40 50 60 70	- No. 200 %
0	△ △		Low hardness gray and tan weathered cherty limestone and interbedded chert seams and layers w/ferrous stains in fractures				
1	△ △	☒		36			
2	△ △	▨		25/0"			
2.5			- auger refusal in chert / cherty limestone at 2.5 ft				

NOTE: Boring abandoned in extremely hard rock.

COMPLETION DEPTH: 2.5 ft
DATE: 3-15-22

DEPTH TO WATER
IN BORING: Dry

DATE: 3/15/2022

LGBNEW 19-118_HOLMES RD.GPJ 8-2-23

PLATE

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Consulting Engineers

LOG OF BORING NO. S47

090069 XNA Access Road over Holmes Rd.
Benton Co., Arkansas

TYPE: HSA to 51 ft /Wash

LOCATION: Approx Sta 211+40, 40 ft Lt

SURF. EL: 1220±

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT + ---- WATER CONTENT ● ---- LIQUID LIMIT +: 10 20 30 40 50 60 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Very stiff light brown clayey silt w/chert nodules and fragments, dry	32				
	Very stiff red silty clay w/numerous chert nodules and fragments	66				
5		50/2"				
	- with discontinuous chert seams and layers below 4 ft	50/6"				
10		80				
15		43				
	Low hardness light yellowish red and very light gray highly weathered cherty limestone w/red silty clay seams					
20		64				
	Stiff to very stiff red silty clay w/chert nodules and fragments					
25		28				
30		19				
35		19				
	Very soft light gray and light yellowish red highly weathered cherty limestone, fractured w/red silty clay seams					
40		9				
	- with grayish brown below 42 ft	11				

COMPLETION DEPTH: 61.0 ft
DATE: 7-28-23

DEPTH TO WATER
IN BORING: Dry to 51 ft

DATE: 7/28/2023

PLATE

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S47

090069 XNA Access Road over Holmes Rd.
Benton Co., Arkansas

TYPE: HSA to 51 ft /Wash

LOCATION: Approx Sta 211+40, 40 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT 0.2 0.4 0.6 0.8 1.0 1.2 1.4 / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT 10 20 30 40 50 60 70	- No. 200 %	% Recovery	% RQD
50			- auger refusal at 51 ft	11					
			Moderately hard to hard gray cherty limestone					100	92
55								92	62
			- chert layers at 58.2 to 58.5 ft and 59.2 to 59.4 ft					100	55
60									
65									
70									
75									
80									
85									

COMPLETION DEPTH: 61.0 ft
DATE: 7-28-23

DEPTH TO WATER
IN BORING: Dry to 51 ft

DATE: 7/28/2023

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LOG OF BORING NO. S48

090069 XNA Access Road over Holmes Rd.
Benton Co., Arkansas

TYPE: HSA to 37.5 ft /Wash

LOCATION: Approx Sta 212+35, 55 ft Lt

SURF. EL: 1206±

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT + - - - WATER CONTENT ● - - - LIQUID LIMIT +: 10 20 30 40 50 60 70

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
			Stiff brown and yellowish tan clayey silt w/numerous chert nodules and fragments	18				
			Firm reddish brown and light gray silty clay w/numerous chert nodules and fragments - stiff to very stiff below 4 ft	9 50 27 27				
			Stiff reddish brown and light gray fine to medium sandy clay w/numerous chert fragments and nodules	21 16				
			Stiff light gray and yellowish red fine to coarse sandy clay w/weathered limestone seams and layers - stiff to very stiff below 33 ft - auger refusal at 37.5 ft	12 14 34				
			Moderately hard gray weathered cherty limestone				23	12
			Moderately hard to hard light gray and gray cherty limestone				82 91	57 87

COMPLETION DEPTH: 51.8 ft
DATE: 7-28-23

DEPTH TO WATER
IN BORING: Dry to 37.5 ft

DATE: 7/28/2023

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LOG OF BORING NO. S49

090069 XNA Access Road over Holmes Rd.
Benton Co., Arkansas

TYPE: HSA to 22 ft /Wash

LOCATION: Approx Sta 213+30, 50 ft Lt

SURF. EL: 1191±

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Very stiff yellowish red silty clay w/numerous chert nodules and fragments	67				
		69				
5		46				
		34				
10		39				
	Low hardness yellowish red highly weathered chert w/silty clay pockets and seams	47				
15						
	- with red clay seams and layers below 18 ft	37				
20						
	- auger refusal at 22 ft					
	Moderately hard light gray weathered cherty limestone					
25					20	1
	Hard light gray cherty limestone					
30					91	58
	- with styolites below 32 ft					
35					100	95
40						

COMPLETION DEPTH: 37.0 ft
DATE: 7-30-23

DEPTH TO WATER
IN BORING: Dry to 22 ft

DATE: 7/30/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S51

090069 XNA Access Road over Holmes Rd.
Benton Co., Arkansas

TYPE: HSA to 28 ft /Wash

LOCATION: Approx Sta 214+80, 55 ft Lt

COHESION, TON/SQ FT ○: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT + WATER CONTENT ● LIQUID LIMIT +: 10 20 30 40 50 60 70

SURF. EL: 1182±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Stiff brown and tan clayey silt w/organics and numerous chert nodules and fragments - fewer organics below 2 ft	13 11				
5	Medium dense brown fine to medium sand w/fine limestone gravel and numerous chert nodules and fragments	14				
10	Medium dense reddish brown sandy fine to coarse chert fragments w/red silty clay seams	23 17				
15 20 25	Stiff to very stiff yellowish red fine to coarse sandy clay w/numerous chert nodules and fragments - moist at 18 to 20 ft - very soft to soft below 23 ft - auger refusal at 28 ft	32 17 4				
30 35	Moderately hard gray slightly weathered cherty limestone - chert layer at 37.3 ft				89 97 100	89 90 50
40						

COMPLETION DEPTH: 38.7 ft
DATE: 7-26-23

DEPTH TO WATER
IN BORING: Dry to 28 ft

DATE: 7/26/2023

PLATE

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

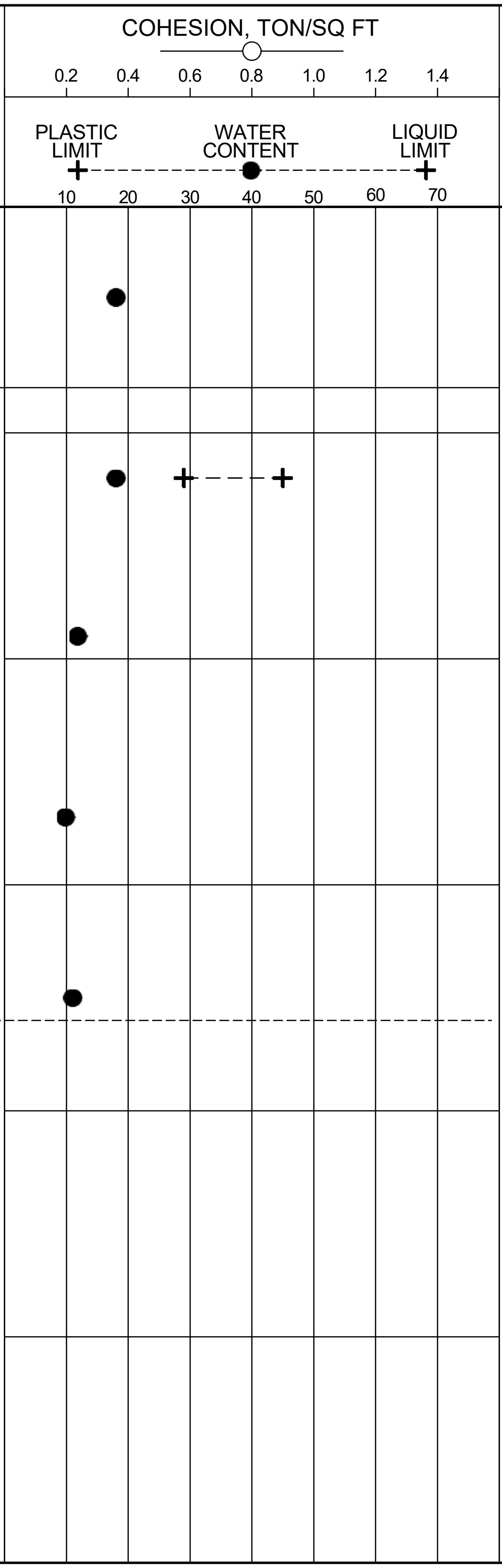
LOG OF BORING NO. S52A

090069 XNA Access Road over Holmes Rd.
Benton Co., Arkansas

TYPE: Auger
LOCATION: Approx Sta 210+55, 45 ft Rt

SURF. EL: 1229±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
	Firm to stiff light brown clayey silt w/chert nodules and fragments and occasional organics	10		
	Stiff to very stiff red and brownish gray silty clay w/chert fragments and discontinuous chert seams and layers	50/5"		31
	- red and reddish brown with very close chert inclusions, seams, and layers below 4 ft	25/0"		
5				
		25/0"		
		25/0"		
	- auger refusal in cherty limestone at 9 ft			
10	NOTE: Boring abandoned in extremely hard rock			
15				



COMPLETION DEPTH: 9.0 ft
DATE: 3-15-22

DEPTH TO WATER
IN BORING: Dry

DATE: 3/15/2022

LGBNEW 19-118_HOLMES RD.GPJ 8-2-23

19-118

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S52

090069 XNA Access Road over Holmes Rd.
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 210+55, 50 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 1229±	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT 0.2 0.4 0.6 0.8 1.0 1.2 1.4 PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT 10 20 30 40 50 60 70	- No. 200 %
			Stiff to very stiff light brown clayey silt w/chert nodules and fragments and occasional organics	27			
			Very stiff yellowish red and red silty clay w/numerous chert nodules and fragments	48			
			- with discontinuous chert seams and layers below 4 ft				
5				50/3"			
				50/1"			
				50/4"			
10			- auger refusal at 10 ft				
			NOTE: Boring abandoned in extremely hard rock				
15							

COMPLETION DEPTH: 10.0 ft
DATE: 7-27-23

DEPTH TO WATER
IN BORING: Dry

DATE: 7/27/2023

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Consulting Engineers

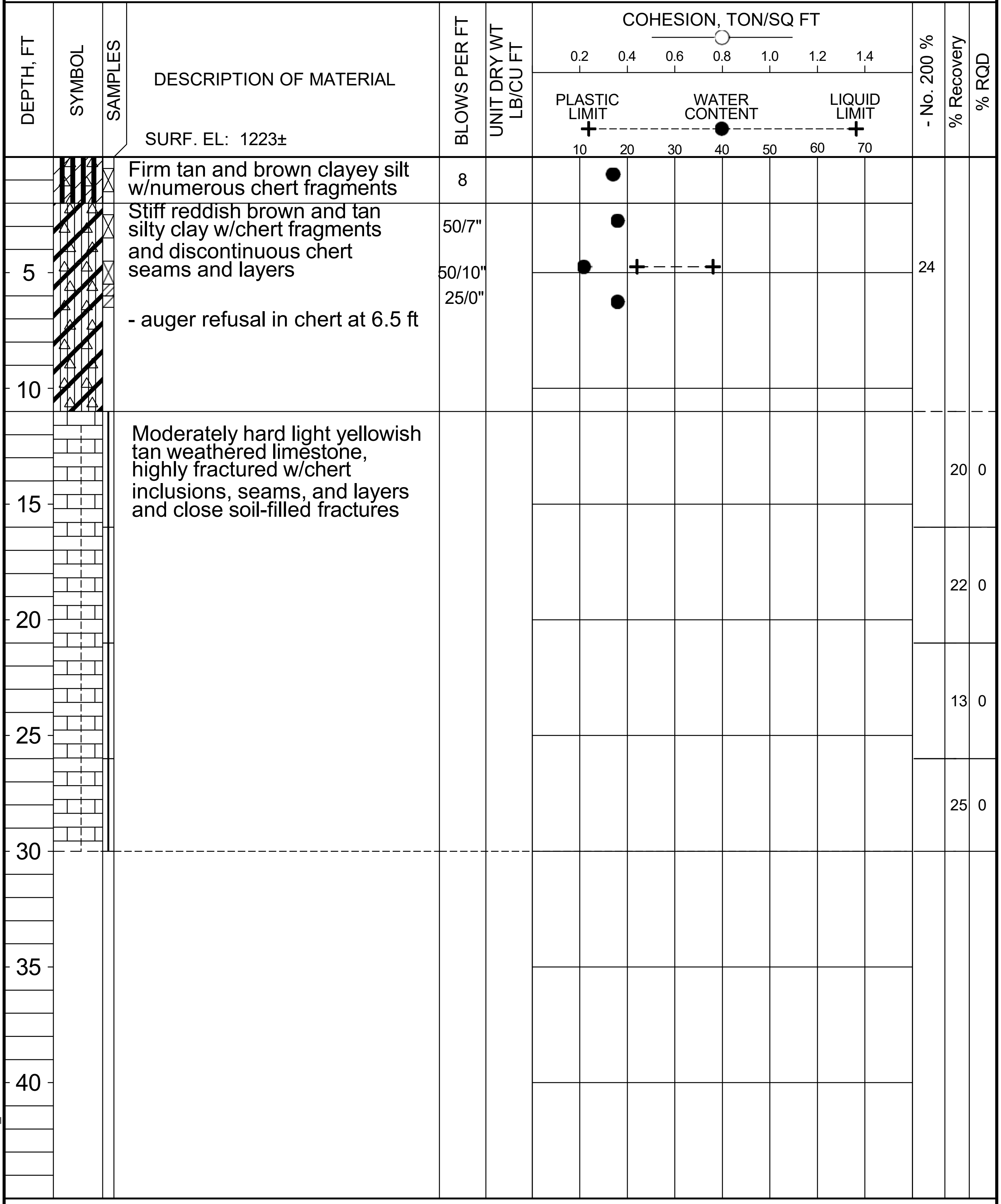
LOG OF BORING NO. S53

090069 XNA Access Road over Holmes Rd.
Benton Co., Arkansas

TYPE: Auger to 6.5 ft /Wash to 11 ft /Core

LOCATION: Approx Sta 211+30, 45 ft Rt

SURF. EL: 1223±



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
Firm tan and brown clayey silt w/numerous chert fragments	8				
Stiff reddish brown and tan silty clay w/chert fragments and discontinuous chert seams and layers - auger refusal in chert at 6.5 ft	50/7" 50/10" 25/0"		24		
Moderately hard light yellowish tan weathered limestone, highly fractured w/chert inclusions, seams, and layers and close soil-filled fractures				20 22 13 25	0 0 0 0

COMPLETION DEPTH: 30.0 ft
DATE: 3-15-22

DEPTH TO WATER
IN BORING: Dry to 11 ft

DATE: 3/15/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

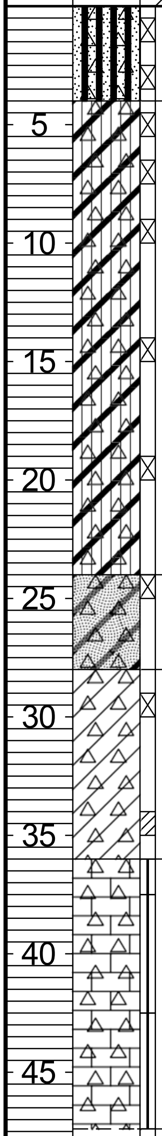
LOG OF BORING NO. S54

090069 XNA Access Road over Holmes Rd.
Benton Co., Arkansas

TYPE: HSA to 36 ft /Wash

LOCATION: Aprrox Sta 212+15, 55 ft Rt

SURF. EL: 1210±



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
Medium dense brown fine sandy silt w/organics and numerous chert and limestone fragments (topsoil) - loose to medium dense below 2 ft	13 10 10					
Firm to stiff red silty clay w/numerous chert nodules and fragments - stiff to very stiff below 6 ft - chert layer at 8 ft - more red clay below 18 ft	41 50/5" 31 31					
Stiff yellowish red fine to coarse sandy clay w/numerous chert nodules and fragments (completely weathered cherty limestone)	17					
Low hardness very light tan and reddish tan highly weathered chert w/limestone fragments and silty clay pockets and seams - auger refusal at 36 ft	51					
Moderately hard to hard gray cherty limestone, fractured					58 20 45	0 0 0

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT + – – – WATER CONTENT ● – – – LIQUID LIMIT +: 10 20 30 40 50 60 70

COMPLETION DEPTH: 47.4 ft
DATE: 7-29-23

DEPTH TO WATER
IN BORING: Dry to 36 ft

DATE: 7/29/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S56

090069 XNA Access Road over Holmes Rd.
Benton Co., Arkansas

TYPE: HSA to 31.5 ft /Wash

LOCATION: Approx Sta 213+65, 55 ft Rt

SURF. EL: 1208±

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT + - - - WATER CONTENT ● - - - LIQUID LIMIT +: 10 20 30 40 50 60 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	- No. 200 %	% Recovery	% RQD
0 - 1	Stiff dark brown silty clay w/chert nodules and fragments	20					
1 - 6	Stiff to very stiff red clay w/numerous chert nodules and fragments	28 60					
6 - 13	Medium dense to dense reddish brown and light gray clayey fine to coarse sand w/numerous chert nodules and fragments	35 16					
13 - 31.5	Stiff to very stiff reddish brown and light gray fine to medium sandy clay w/numerous chert nodules and fragments	50 19					
	- with highly weathered cherty limestone seams and layers below 23 ft - moist below 26 ft	17					
	- chert layer at 28 ft - auger refusal at 31.5 ft	50/5"					
31.5 - 42.5	Moderately hard to hard gray cherty limestone			q_u= 5930 psi, TUW= 166 pcf		73	65
						100	100
						91	67

COMPLETION DEPTH: 42.5 ft
DATE: 7-31-23

DEPTH TO WATER
IN BORING: Dry to 31.5 ft

DATE: 7/31/2023

RECRQDN200-2 19-118_HOLMES RD.GPJ 8-9-23

**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**
Consulting Engineers

LOG OF BORING NO. W1

090069 XNA Access Road over Holmes Rd.
Benton Co., Arkansas

TYPE: HSA to 25.5 ft /Wash

LOCATION: Approx Sta 214+90, 155 ft Lt

SURF. EL: 1182±

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT 0.2 0.4 0.6 0.8 1.0 1.2 1.4 PLASTIC LIMIT + WATER CONTENT ● LIQUID LIMIT + 10 20 30 40 50 60 70	- No. 200 %	% Recovery	% RQD
			Medium dense brown fine sandy silt w/chert nodules and fragments	14					
			Stiff reddish brown silty clay w/numerous chert fragments and nodules	15					
5				50/5"					
				45					
10				19					
15				24					
			- very soft,red below 17.5 ft						
20				4					
25			Very soft reddish tan and yellowish brown silty clay, calcareous w/chert nodules (completely weathered chert limestone	3					
30			Moderately hard gray and light gray cherty limestone					71	69
35									

COMPLETION DEPTH: 32.0 ft
DATE: 7-25-23

DEPTH TO WATER
IN BORING: Dry to 27.5 ft

DATE: 3/25/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. W2

090069 XNA Access Road over Holmes Rd.
Benton Co., Arkansas

TYPE: HSA

LOCATION: Approx Sta 215+90, 140 ft Lt

SURF. EL: 1201±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4); PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
0	Loose to medium dense brown fine sandy silt w/chert nodules and fragments and trace organics	10			
2	Stiff to very stiff reddish brown silty clay w/numerous chert nodules and fragments	12			
5		33			
	- with discontinuous chert seams below 6 ft	50/4"			
10		33			
15		21			
20		50/5"			
	- with more chert below 22.5 ft				
25		10			

COMPLETION DEPTH: 25.0 ft
DATE: 7-26-23

DEPTH TO WATER
IN BORING: Dry

DATE: 7/26/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. W3

090069 XNA Access Road over Holmes Rd.
Benton Co., Arkansas

TYPE: HSA

LOCATION: Approx Sta 217+10, 161 ft Lt

SURF. EL: 1214±

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
Medium dense light brown silt w/chert and limestone fragments	14		
Low hardness pale red highly weathered limestone w/chert nodules and fragments and discontinuous chert seams	25		
	50/3"		
	50/4"		
- with red cherty clay seams and layers below 8 ft	46		
	50/2"		
	30		
Very stiff reddish brown silty clay w/numerous chert nodules and fragments	25		

DEPTH, FT: 5, 10, 15, 20, 25

COMPLETION DEPTH: 25.0 ft
DATE: 7-25-23

DEPTH TO WATER
IN BORING: Dry

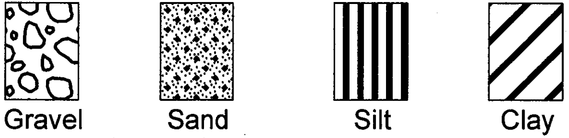
DATE: 7/25/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

SYMBOLS AND TERMS USED ON BORING LOGS

SOIL TYPES

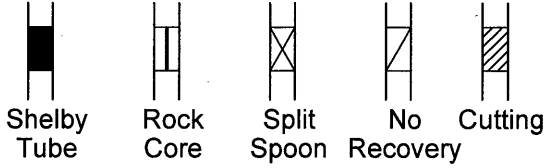
(SHOWN IN SYMBOLS COLUMN)



Predominant type shown heavy

SAMPLER TYPES

(SHOWN ON SAMPLES COLUMN)



TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on No. 200 sieve): Includes (I) Clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as determined by laboratory tests.

DESCRIPTIVE TERM	N-VALUE	RELATIVE DENSITY
VERY LOOSE	0-4	0-15%
LOOSE	4-10	15-35%
MEDIUM DENSE	10-30	35-65%
DENSE	30-50	65-85%
VERY DENSE	50 and above	85-100%

FINE GRAINED SOILS (major portion passing No. 200 sieve): Includes (1) Inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests.

DESCRIPTIVE TERM	UNCONFINED COMPRESSIVE STRENGTH TON/SQ. FT.
VERY SOFT	Less than 0.25
SOFT	0.25-0.50
FIRM	0.50-1.00
STIFF	1.00-2.00
VERY STIFF	2.00-4.00
HARD	4.00 and higher

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

TERMS CHARACTERIZING SOIL STRUCTURE

SLICKENSIDED - having inclined planes of weakness that are slick and glossy in appearance.
FISSURED - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
LAMINATED - composed of thin layers of varying color and texture.
INTERBEDDED - composed of alternate layers of different soil types.
CALCAREOUS - containing appreciable quantities of calcium carbonate.
WELL GRADED - having a wide range in grain sizes and substantial amounts of all intermediate particle sizes.
POORLY GRADED - predominantly of one grain size, or having a range of sizes with some intermediate sizes missing.

Terms used on this report for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No.3-357, Waterways Experiment Station, March 1953

Grubbs, Hoskyn,
Barton & Wyatt, Inc.
Consulting Engineers

BORING LOG TERMS – ROCK

ROCK TYPES
(SHOWN IN SYMBOLS COLUMN)

Joint Characteristics –

Spacing	
Very Close	0.75 to 2.5 in.
Close	2.5 to 8 in.
Moderately Close	8 to 24 in.
Wide	2 to 6 ft
Very Wide	More than 6 ft

Bedding Characteristics –

Very Thin	0.75 to 2.5 in.
Thin	2.5 to 8 in.
Medium	8 to 24 in.
Thick	2 to 6 ft
Massive	More than 6 ft

Lithologic Characteristics –

Clayey
Shaly
Calcareous (limy)
Siliceous
Sandy (Arenaceous)
Silty
Plastic Seams

Parting –	Less than 1/1 6inch
Seam –	1/1 6to 1/2inch
Layer –	1/2 to 1 2inches
Stratum –	Greater than 1 2inches

Hardness–

Soft (S) – Reserved for plastic material alone.

Friable (F) – Easily crumbled by hand, pulverized or reduced to powder and is too soft to be cut with a pocket knife.

Low Hardness (LH) – Can be gouged deeply or carved with a pocket knife.

Moderately Hard (MH) – Can be readily scratched by a knife blade; scratch leaves a heavy trace of dust and scratch is readily visible after the powder has been blown away.

Hard (H) – Can be scratched with difficulty; scratch produces little powder and is often faintly visible; traces of the knife steel may be visible.

Very hard (VH) – Cannot be scratched with a pocket knife. Knife steel marks left on surface.

Texture –

Fine – Barely seen with naked eye
Medium – Barely seen up to 1/8 in.
Coarse – 1/8 in. to 1/4 in.

Structure –

- Bedding
  - Flat – 0° – 5°
  - Gently Dipping – 5° – 35°
  - Moderately Dipping – 55° – 85°
  - Steeply Dipping – 55° – 85°
- Fractures, scattered
  - Open
  - Cemented or Tight
- Fractures, closely spaced
  - Open
  - Cemented or Tight
- Brecciated (Sheared and Fragmented)
  - Open
  - Cemented or Tight
- Joints
  - Faulted
  - Slickensides

Degree of Weathering –

Fresh – No visible signs of decomposition or discoloration. Rings under hammer impact.

Slighty Weathered – Slight discoloration inwards from open fractures, otherwise similar to fresh.

Moderately Weathered – Discoloration throughout. Weaker minerals such as feldspar decomposed. Strength somewhat less than fresh rock, but cores cannot be broken by hand or scraped by knife. Texture preserved.

Highly Weathered – Most minerals somewhat decomposed. Specimens can be broken by hand with effort or shaved with knife. Core stones present in rock mass. Texture becoming indistinct but fabric

Completely Weathered – Minerals decomposed to soil but fabric and structure preserved (Saprolite). Specimens easily crumbled or penetrated.

Residual Soil – Advanced state of decomposition resulting in plastic soils. Rock fabric and structure completely destroyed. Large volume change.

Solution and Void Conditions –

Solid, contains no voids
Vuggy (pitted)
Vesicular (igneous)
Porous
Cavities
Cavernous

Swelling Properties –

Nonswelling
Swelling

Slaking Properties –

Nonslaking
Slakes slowly on exposure
Slakes readily on exposure

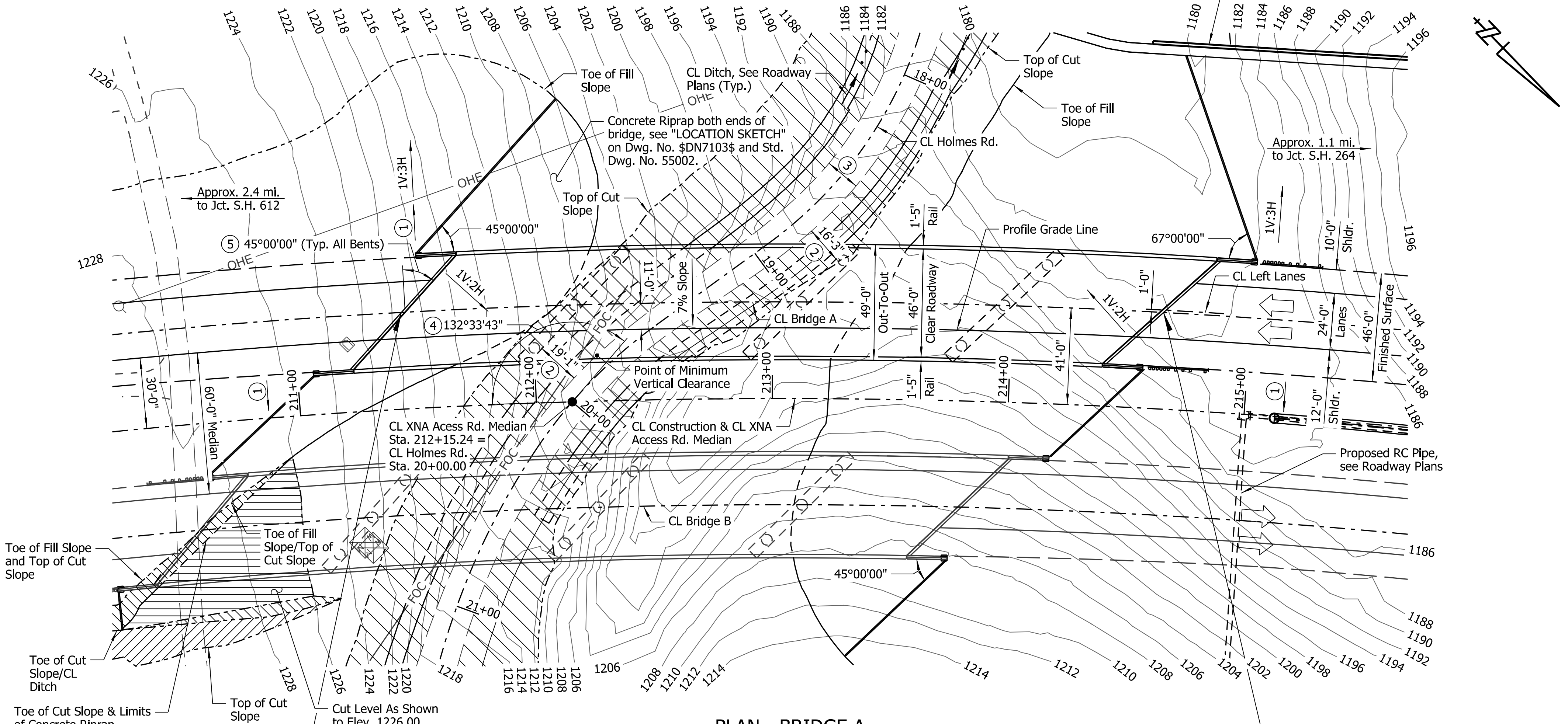
Rock Quality Designation (RQD) –

RQD (Percent)	Diagnostic Description
Greater than 90	Excellent
75 – 90	Good
50 – 75	Fair
25 – 50	Poor
Less than 25	Very Poor

KEYROCK FHWA 3-2-12

APPENDIX A

DATE REVISED	DATE REVISED	FED. ROAD DIST. NO.	STATE	JOB NO.	SHEET NO.	TOTAL SHEETS
		6	ARK.	090069	$SN7101$	ST
		$BN07A$		LAYOUT		$DN7101$



PLAN - BRIDGE A

NOTES:
Use Type F Approach Slab at each end of bridge. See Std. Dwg. No. 55040F1.

Use Type F Approach Gutters at each end of bridge. See Std. Dwg. No. 55030F.

EXISTING UTILITIES LEGEND

FOC = Fiber Optic Cable
OHE = Overhead Electric

NOTE:
Utilities shown are based on locations at time of survey and do not reflect any potential utility relocations prior to construction.

HORIZONTAL CURVE DATA

XNA Access Rd. Median
PI = 224+12.04
Δ = 55°35'22" Rt.
D = 2°00'00"
T = 1510.09'
L = 2779.47'
e = 0.07 Ft./Ft.
R = 2864.79'

NOTES:
For "PROJECT GENERAL NOTES", see Dwg. No. $DN0201$.

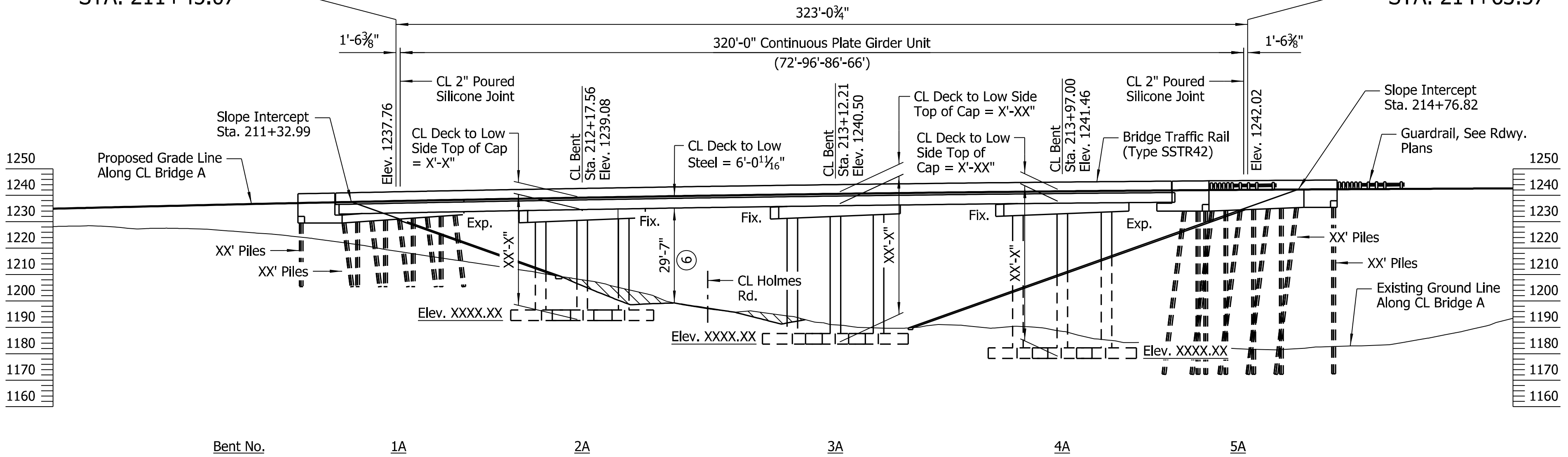
For "LOCATION SKETCH" and "GENERAL NOTES", see Dwg. No. $DN7103$.

For "ELEVATION OF SOIL BORINGS - BRIDGE A", "BORING LEGEND" and "N-VALUES", see Dwg. No. $DN7104$.

CL Construction is on a 2°00'00" curve right. CL Girders and the longitudinal lines of the bridge and approach slabs and gutters shall be constructed on curves concentric with CL Construction.

BEGIN BRIDGE A
STA. 211+45.07

END BRIDGE A
STA. 214+63.57



NOTE:
Stations shown are along CL Construction. Elevations shown are actual top of deck elevations at CL Bridge A. Any vertical dimension referenced to CL Deck is based on actual top of deck elevation at CL Bridge A.

ELEVATION - BRIDGE A

SOIL BORINGS NOT
AVAILABLE AT TIME
OF PRINTING

211+00
212+00
213+00
214+00
215+00

① 1V:6H

② Minimum Horizontal Clearance

③ Existing gravel roadway width varies

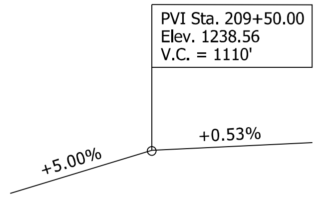
④ Angle measured at point of intersection between line tangent to CL XNA Access Rd. Median and line tangent to CL Holmes Rd.

⑤ For Bents 1A & 5A:
Measured from CL Joint to a line radial to CL Bridge A at CL Joint.

For Bents 2A-4A:
Measured from CL Bent to a line radial to CL Bridge A at CL Bent.

⑥ Point of Minimum Vertical Clearance

⑦ For Retaining Wall Details, see Dwg. Nos. $DNXXXX$-$DNXXXX$.



VERTICAL CURVE DATA

XNA Access Rd.
(Profile Grade 11' Right of CL Bridge A)

07-20-2023

SHEET 1 OF 4
LAYOUT OF BRIDGES
XNA ACCESS RD. OVER HOLMES RD.
NORTHWEST ARKANSAS
NATIONAL AIRPORT ACCESS (F)
BENTON COUNTY

ROUTE RTSEC. SC

ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

PRELIMINARY
NOT FOR
CONSTRUCTION

BRIDGE ENGINEER

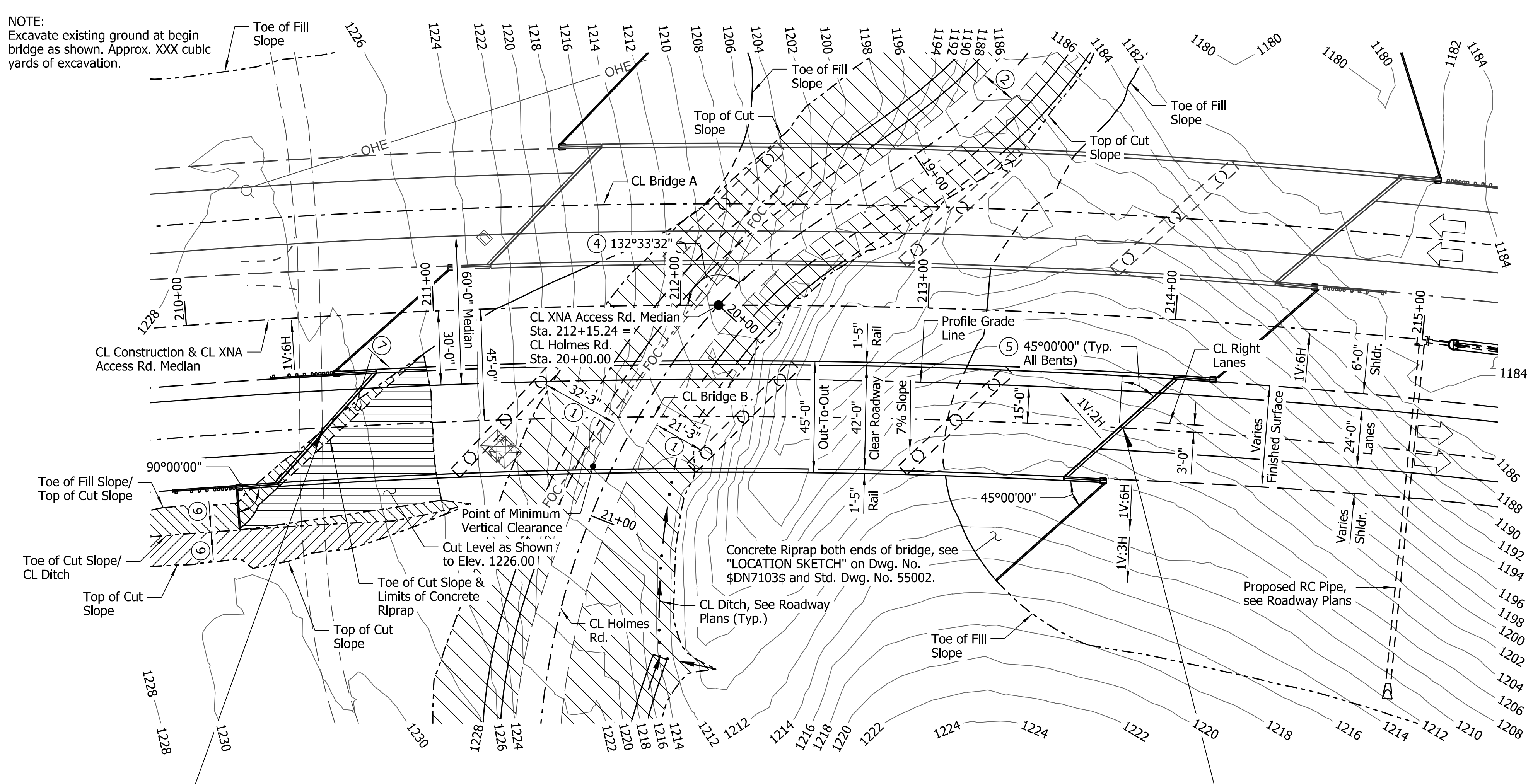
DRAWN BY: CSW DATE: AUG. 2021 FILENAME: b090069x7_L1.dgn
CHECKED BY: ABH DATE: AUG. 2022 SCALE: 1" = 30'-0"
DESIGNED BY: CSW DATE: AUG. 2021
BRIDGE NO. $BN07A$ DRAWING NO. $DN7101$

FOR R/W DATA, SEE
ROADWAY PLANS

JESkinner 8/3/2023 9:30:14 AM
WORKSPACEBRDOT Bridge (2019)
L:\2017\17017600 - XNA Access - NEPA\Drawings\b090069x7_S101_LO.dgn
REVISED DATE:

DATE REVISED	DATE REVISED	FED. ROAD DIST. NO.	STATE	JOB NO.	SHEET NO.	TOTAL SHEETS
		6	ARK.	090069	$SN7102$	ST
		$BN07B$		LAYOUT		$DN7102$

NOTE:
Excavate existing ground at begin bridge as shown. Approx. XXX cubic yards of excavation.



PLAN - BRIDGE B

NOTES:
Use Type F Approach Slab at each end of bridge. See Std. Dwg. No. 55040F1.

Use Type F Approach Gutters at each end of bridge. See Std. Dwg. No. 55030F.

EXISTING UTILITIES LEGEND

FOC = Fiber Optic Cable
OHE = Overhead Electric

HORIZONTAL CURVE DATA

XNA Access Rd. Median
PI = 224+12.04
Δ = 55°35'22" Rt.
D = 2°00'00"
T = 1510.09'
L = 2779.47'
e = 0.07 Ft./Ft.
R = 2864.79'

NOTES:
For "PROJECT GENERAL NOTES", see Dwg. No. $DN0201$.

For "LOCATION SKETCH" and "GENERAL NOTES", see Dwg. No. $DN7103$.

For "ELEVATION OF SOIL BORINGS", "BORING LEGEND" and "N-VALUES", see Dwg. No. $DN7104$.

CL Construction is on a 2°00'00" curve right. CL Girders and the longitudinal lines of both the bridge and approach slabs and gutters shall be constructed on curves concentric with CL Construction. CL Joints of Bents 1 & 5 and CL Bents of Bents 2 thru 4 shall be constructed on radial lines to CL Construction.

① Minimum Horizontal Clearance

② Existing gravel roadway width varies

③ Point of Minimum Vertical Clearance

④ Angle measured at point of intersection between lines tangent to CL XNA Access Rd. Median and CL Holmes Rd.

⑤ For Bents 1B & 5B:
Measured from CL Joint to a line radial to CL Bridge B at CL Joint.

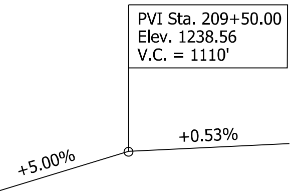
For Bents 2B-4B:
Measured from CL Bent to a line radial to CL Bridge B at CL Bent

⑥ 1V:3H

⑦ 1V:2H

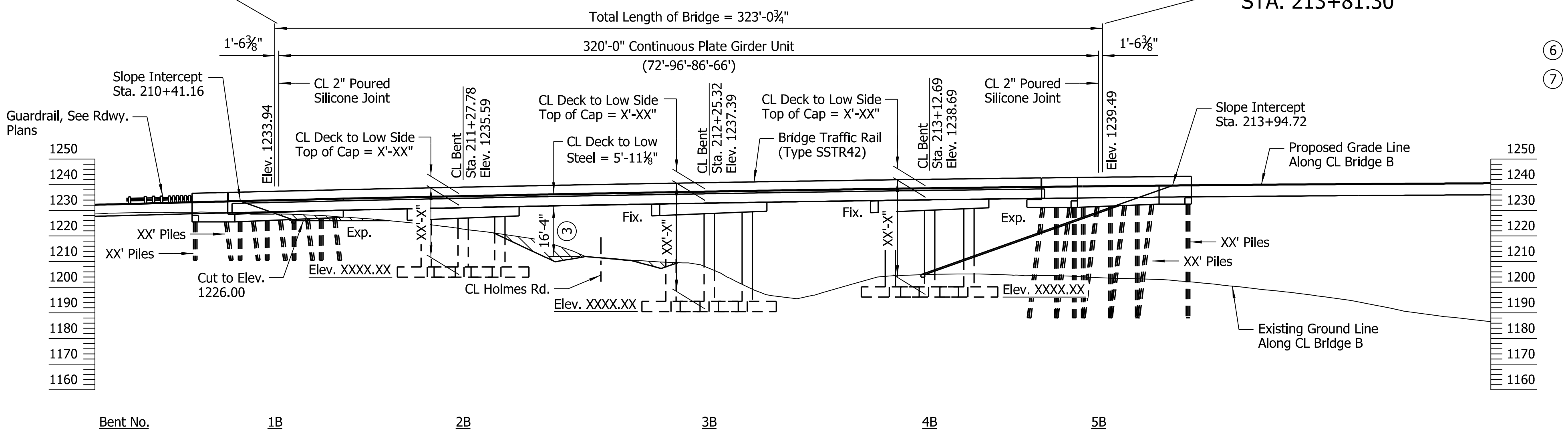
BEGIN BRIDGE B
STA. 210+53.08

END BRIDGE B
STA. 213+81.30



VERTICAL CURVE DATA

XNA Access Rd.
(Profile Grade 15' Left of CL Bridge B)



07-20-2023

SHEET 2 OF 4
LAYOUT OF BRIDGES
XNA ACCESS RD. OVER HOLMES RD.
NORTHWEST ARKANSAS
NATIONAL AIRPORT ACCESS (F)
BENTON COUNTY
ROUTE RTSEC. SC

ELEVATION - BRIDGE B

NOTE:
Stations shown are along CL Construction. Elevations shown are actual top of deck elevations at CL Bridge B. Any vertical dimension referenced to CL Deck is based on actual top of deck elevation at CL Bridge B.

SOIL BORINGS NOT AVAILABLE AT TIME OF PRINTING

FOR R/W DATA, SEE ROADWAY PLANS

210+00 211+00 212+00 213+00 214+00 215+00

PRELIMINARY NOT FOR CONSTRUCTION

BRIDGE ENGINEER

ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

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CHECKED BY: ABH DATE: AUG. 2022 SCALE: 1" = 30'-0"
DESIGNED BY: CSW DATE: AUG. 2021
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REVISED DATE:

DATE REVISED	DATE REVISED	FED. ROAD DIST. NO.	STATE	JOB NO.	SHEET NO.	TOTAL SHEETS
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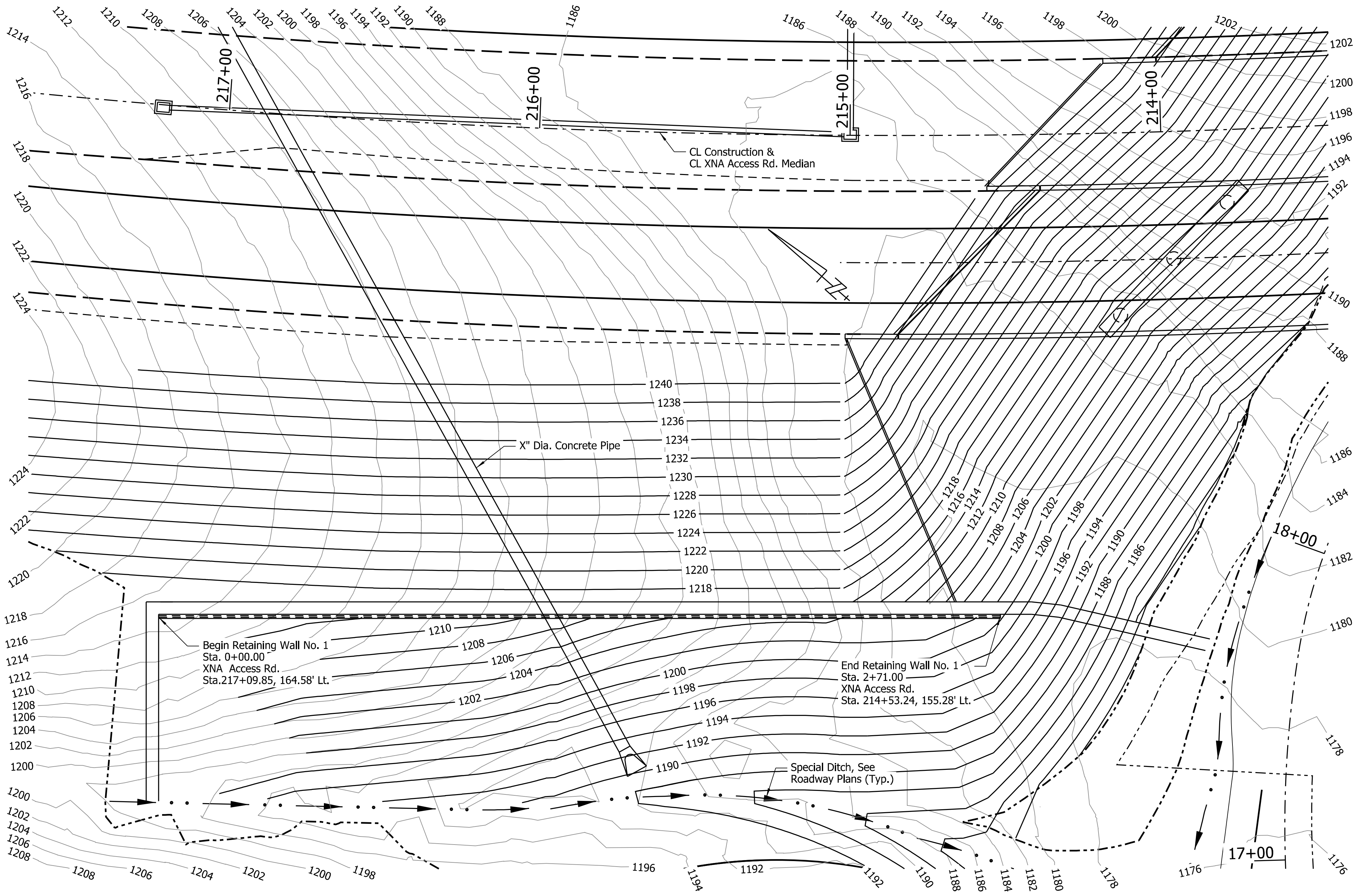
		$BN0XX$		RETAINING WALLS		$DN9101$



PLAN

Scale: 1" = 20'-0"

LEGEND

—— = Proposed Contour

—— = Existing Contour

07-20-2023

SHEET 1 OF X

RETAINING WALL DETAILS

ROUTE SEC.

ARKANSAS STATE HIGHWAY COMMISSION

LITTLE ROCK, ARK.

PRELIMINARY
NOT FOR
CONSTRUCTION

BRIDGE ENGINEER

DRAWN BY: HEW DATE: MAY 2023 FILENAME: b090069_rw1.dgn

CHECKED BY: $CHKBY$ DATE: $DTCHK$ SCALE: As Shown

DESIGNED BY: CSW DATE: MAY 2023

BRIDGE NO. $BNXX$ DRAWING NO. $DN9101$

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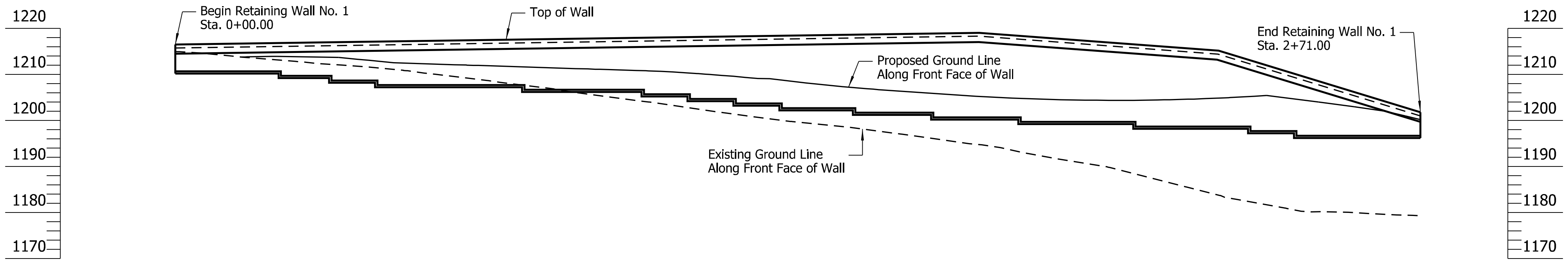
WORKSPACE:ARDOT Bridge (2019)
L:\2017\17017600 - XNA Access - NEPA\Drawings\b090069x9_S101_RW.dgn
REVISED DATE:

DATE REVISED	DATE REVISED	FED. ROAD DIST. NO.	STATE	JOB NO.	SHEET NO.	TOTAL SHEETS
		6	ARK.	090069	$SNXXX$	ST
		$BN0XX$		RETAINING WALLS		$DNXXX$



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REVISED DATE:

07-20-2023

PRELIMINARY
NOT FOR
CONSTRUCTION

BRIDGE ENGINEER

SHEET 1 OF X
RETAINING WALL DETAILS

ROUTE SEC.

ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

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CHECKED BY: $CHKBY$ DATE: $DTCHK$ SCALE: As Shown
DESIGNED BY: CSW DATE: MAY 2023
BRIDGE NO. $BNXX$ DRAWING NO. $DNXXX$

APPENDIX B

B-S47: Run 1 (51-52 ft), Run 2 (52-57 ft)

B-S47: Run 3 (57-61 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **090069 XNA Access Road** **Benton County, Arkansas**	**Job No. 19-118** **Plate**

B-S48: Run 1 (37.5-39.5 ft), Run 2 (39.5-42.7 ft), Run 3 (42.7-47.7 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

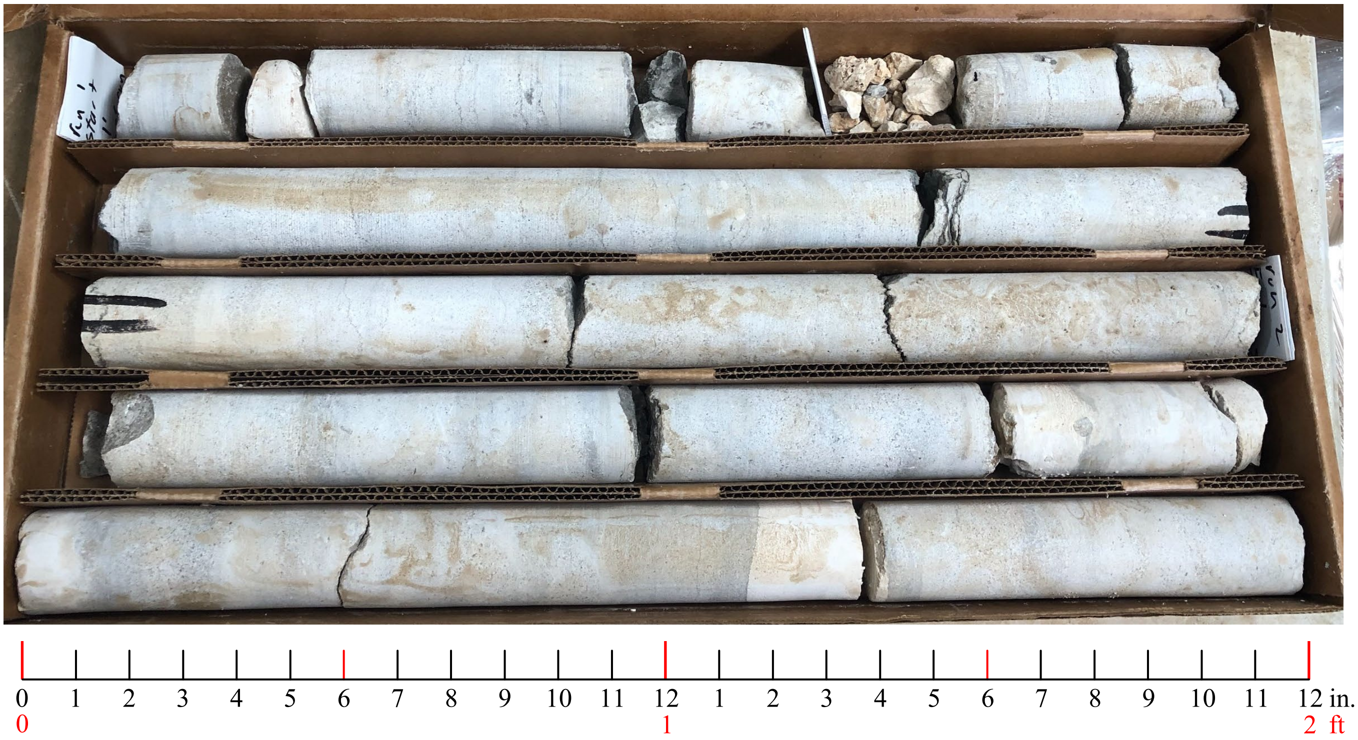
Plate

B-S49: Run 1 (22-27 ft), Run (27-32 ft)

B-S49: Run 3 (32-37 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **090069 XNA Access Road** **Benton County, Arkansas**	**Job No. 19-118** **Plate**

B-S50: Run 1 (21-22.25 ft), Run 2 (22.25-27.25 ft), Run 3 (27.25-31 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

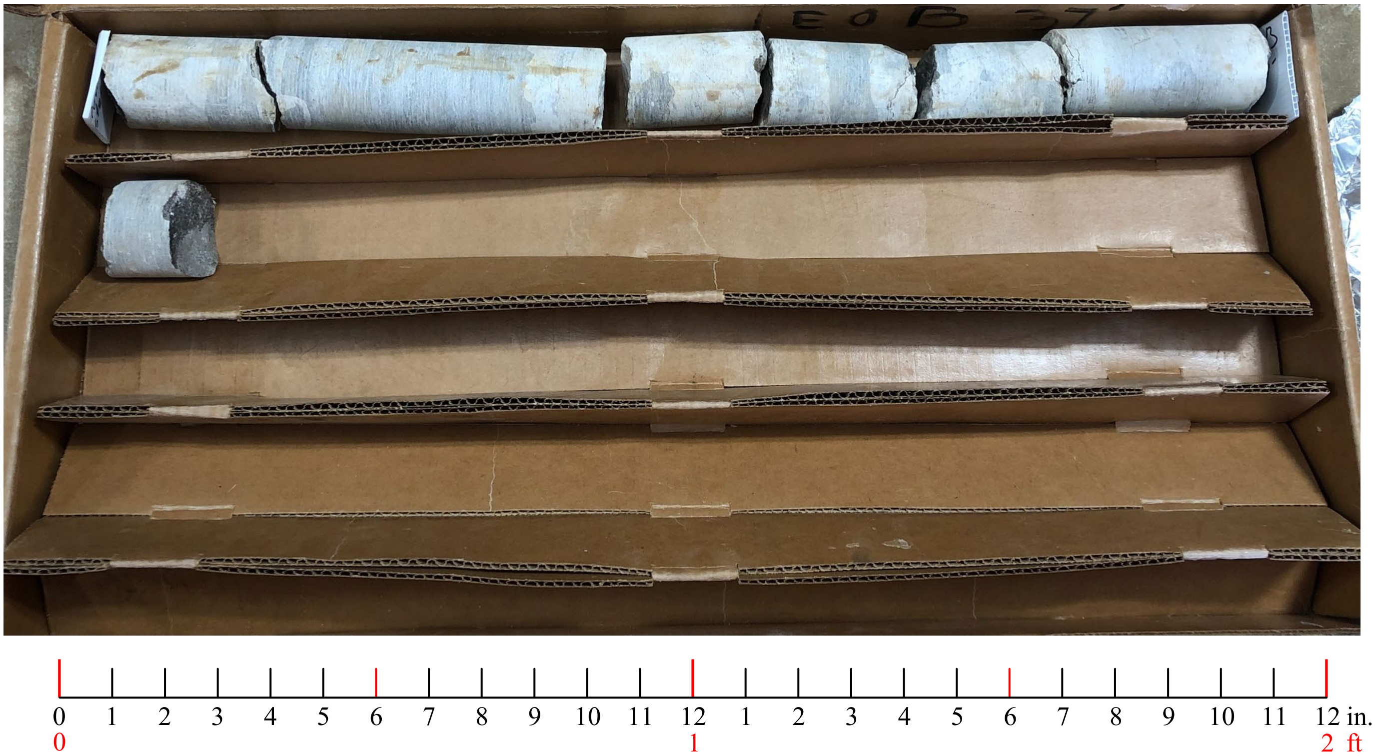
ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S51: Run 1 (28-31.7 ft), Run 2 (31.7-36.7 ft)

B-S51: Run 3 (36.7-38.7 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S53: Run 1 (11-16 ft), Run 2 (16-21 ft)

B-S53: Run 3 (21-26 ft), Run 4 (26-30 ft)

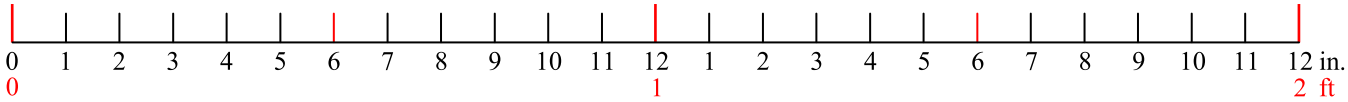
Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S54: Run 1 (36-37.5 ft), Run 2 (37.5-42.5 ft), Run 3 (42.5-47.5 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S55: Run 1 (34-37.25 ft), Run 2 (37.25-39.25 ft), Run 3 (39.42–41.92 ft)

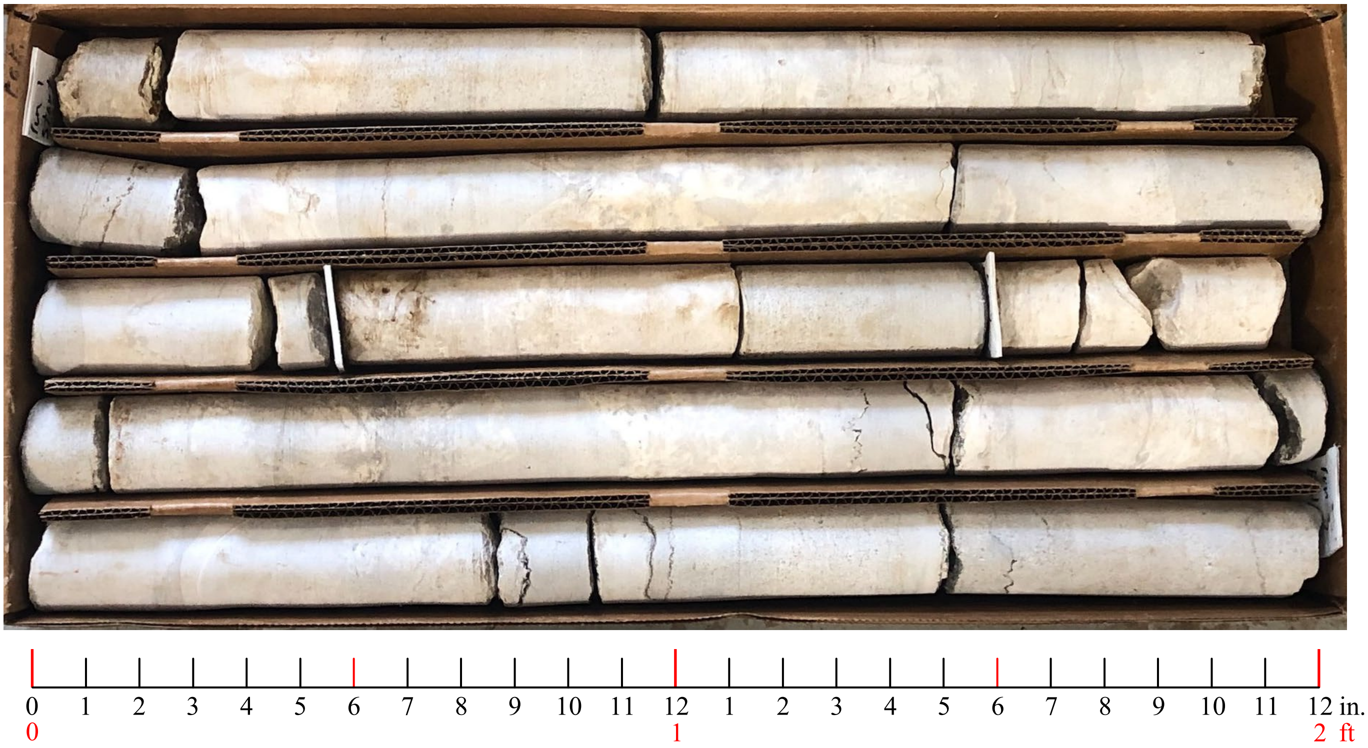
Grubbs, Hoskyn,
Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

B-S56: Run 1 (31.5-36.5 ft), Run 2 (36.5-37.5 ft), Run 3 (37.5-42.5 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

ROCK CORE PHOTOS
090069 XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate

APPENDIX C

SUMMARY of CLASSIFICATION TEST RESULTS

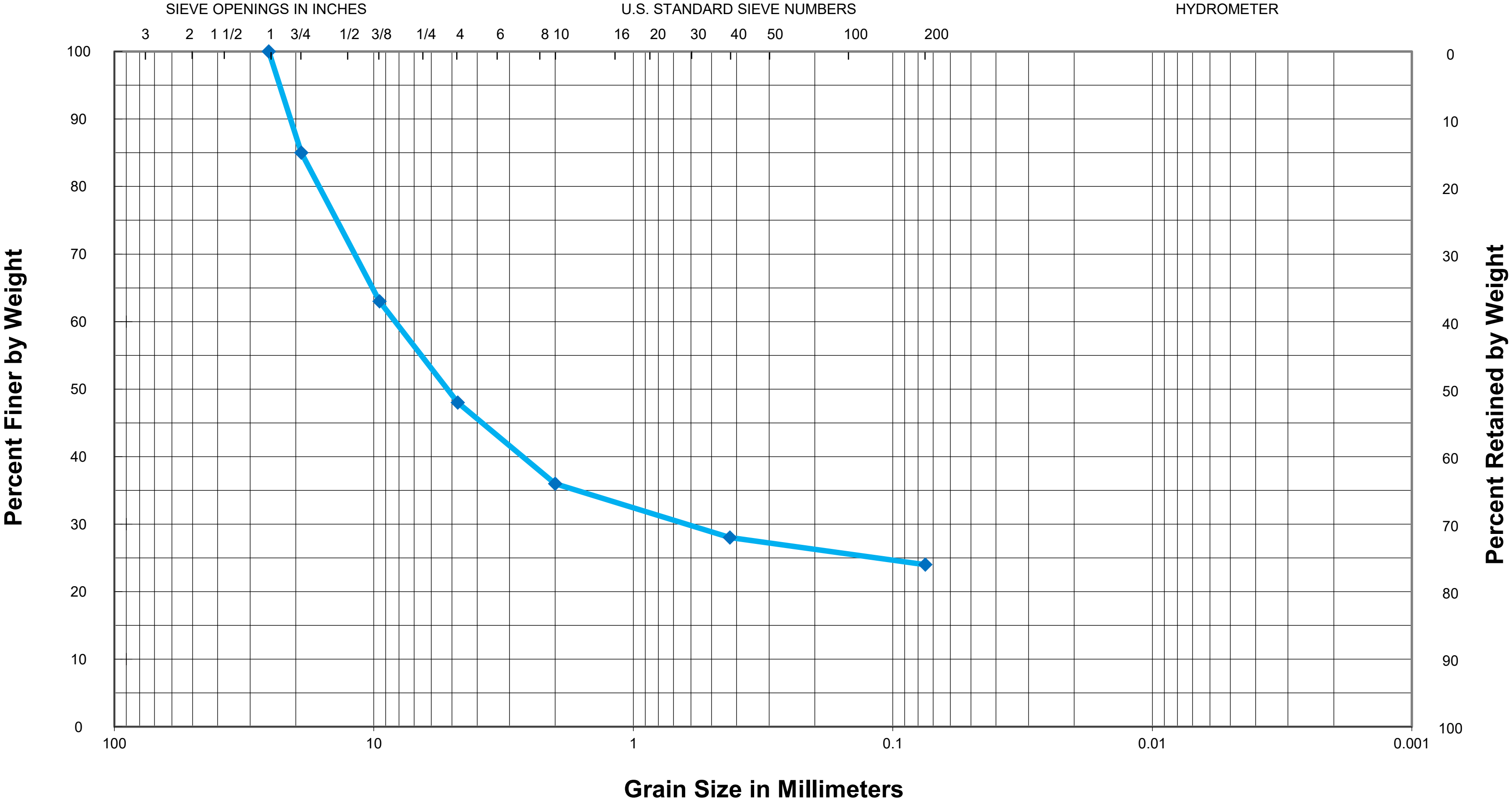
PROJECT: 090069 XNA Access Road
LOCATION: Benton County, Arkansas
GHBW JOB NUMBER: 19-118

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING								USCS CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
S52A	2.5-3.5	18	45	29	16	---	---	---	---	52	---	---	31	GM	A-2-7
S53	4.5-5.5	11	38	22	16	100	100	85	63	48	36	28	24	GC	A-2-6

19-118

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

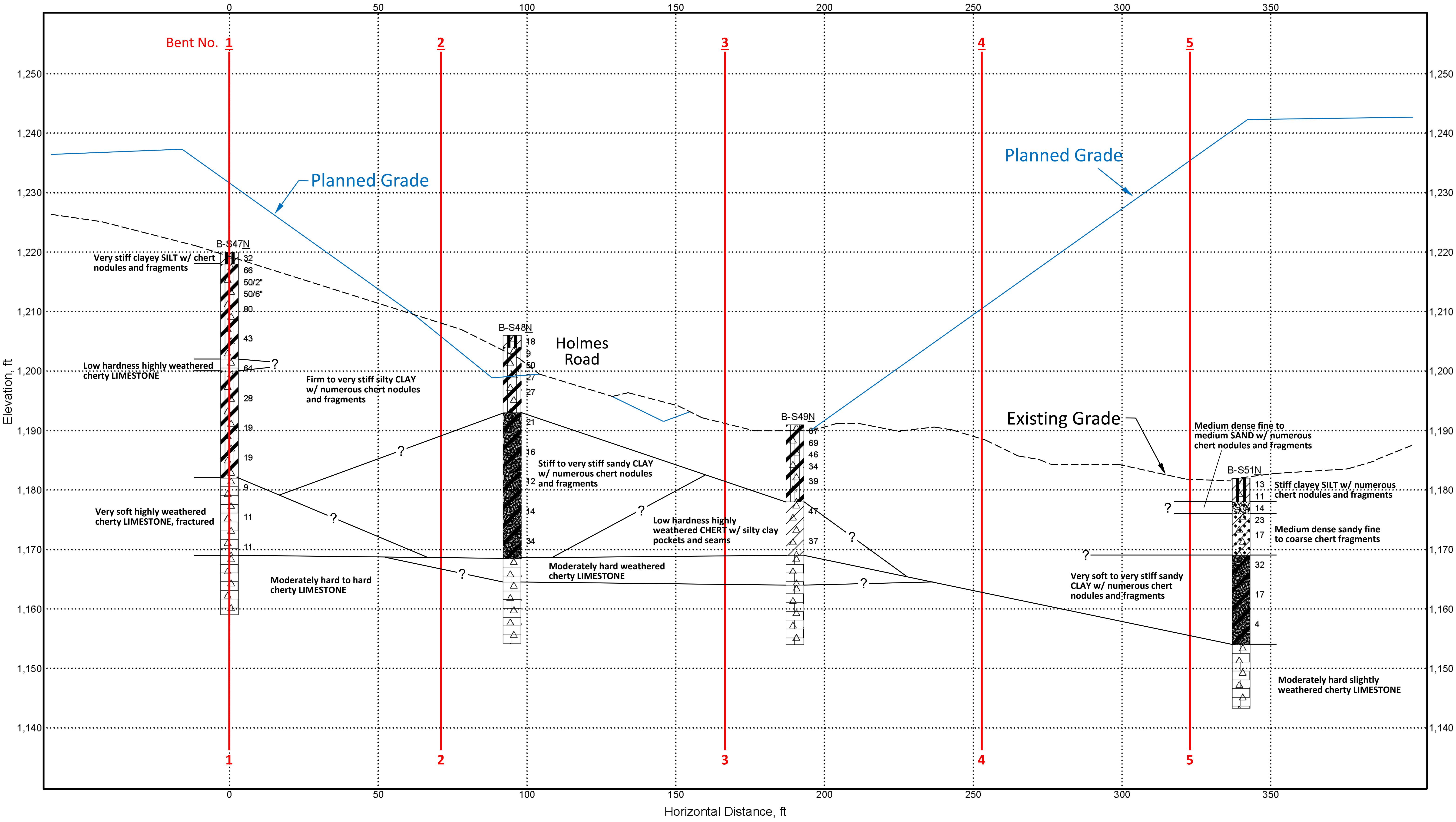


GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

Sample: Boring S53, 4.5-5.5 ft; LL = 38, PL = 22, PI = 16
Description: Reddish brown and tan silty CLAY w/ numerous chert fragments and chert seams and layers

USCS Classification = GC
AASHTO Classification = A-2-6

APPENDIX D



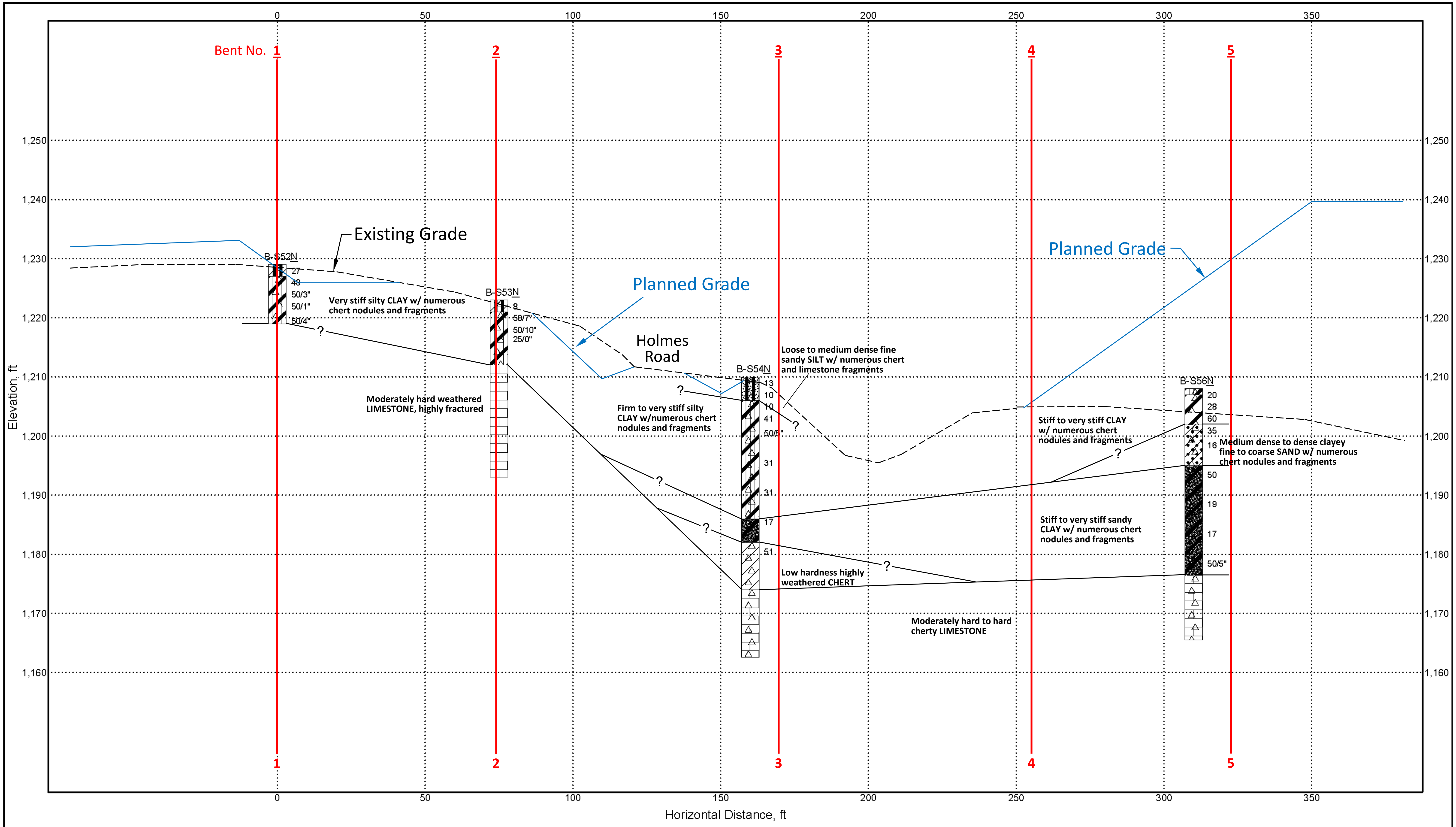
Grubbs, Hoskyn,
Barton & Wyatt, LLC

NOTES:
1. Subsurface conditions have been inferred between discrete boring locations. Actual conditions may vary.
2. Ground surface approximate.

SCALE:
1" = 30' Horizontal
1" = 15' Vertical

Generalized Subsurface Profile - Bridge A
090069 XNA Access Road over Holmes Rd.
Benton Co., Arkansas

Project Number: 19-118



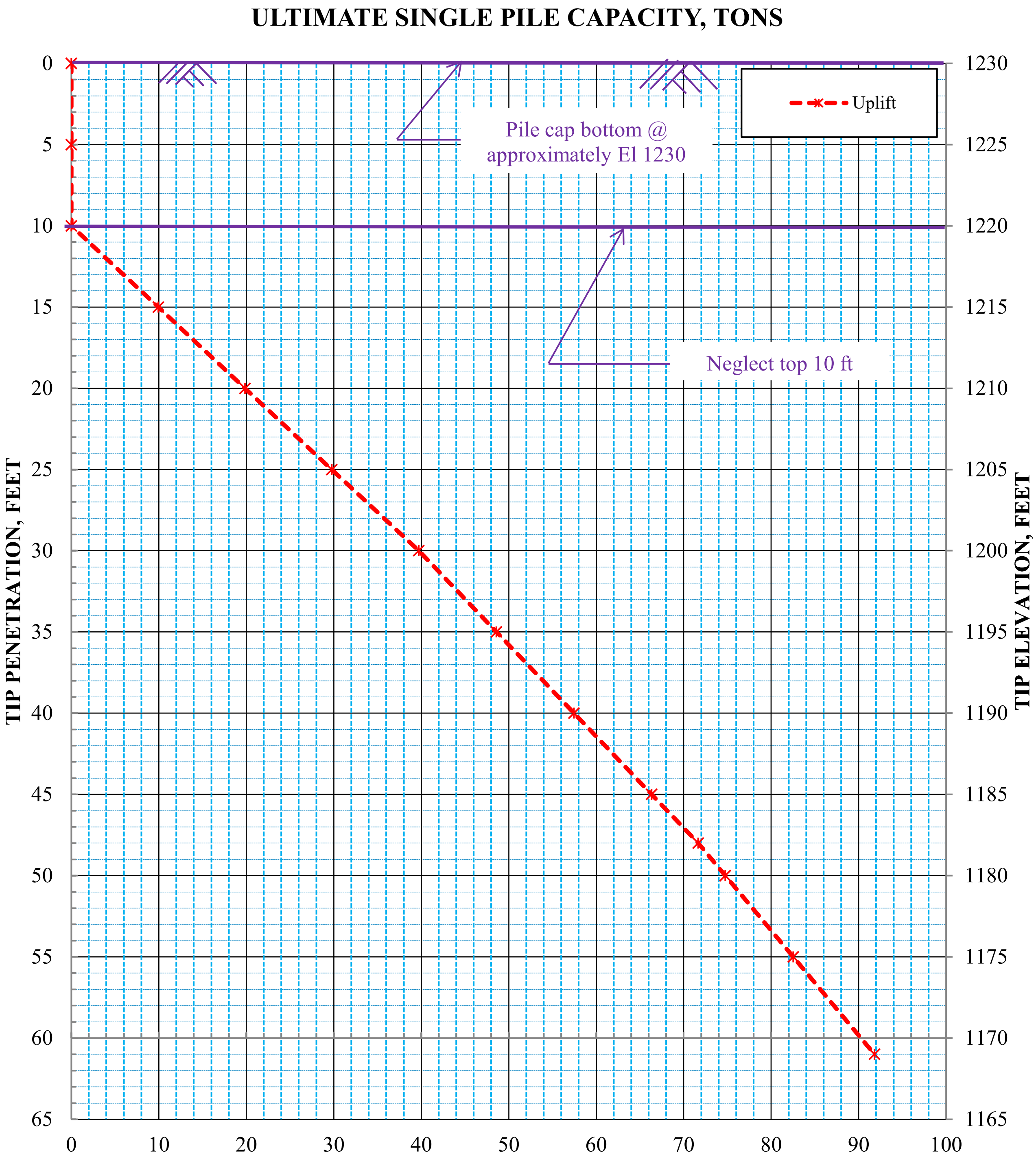
Grubbs, Hoskyn,
Barton & Wyatt, LLC

NOTES:
1. Subsurface conditions have been inferred between discrete boring locations. Actual conditions may vary.
2. Ground surface approximate.

SCALE:
1" = 30' Horizontal
1" = 15' Vertical

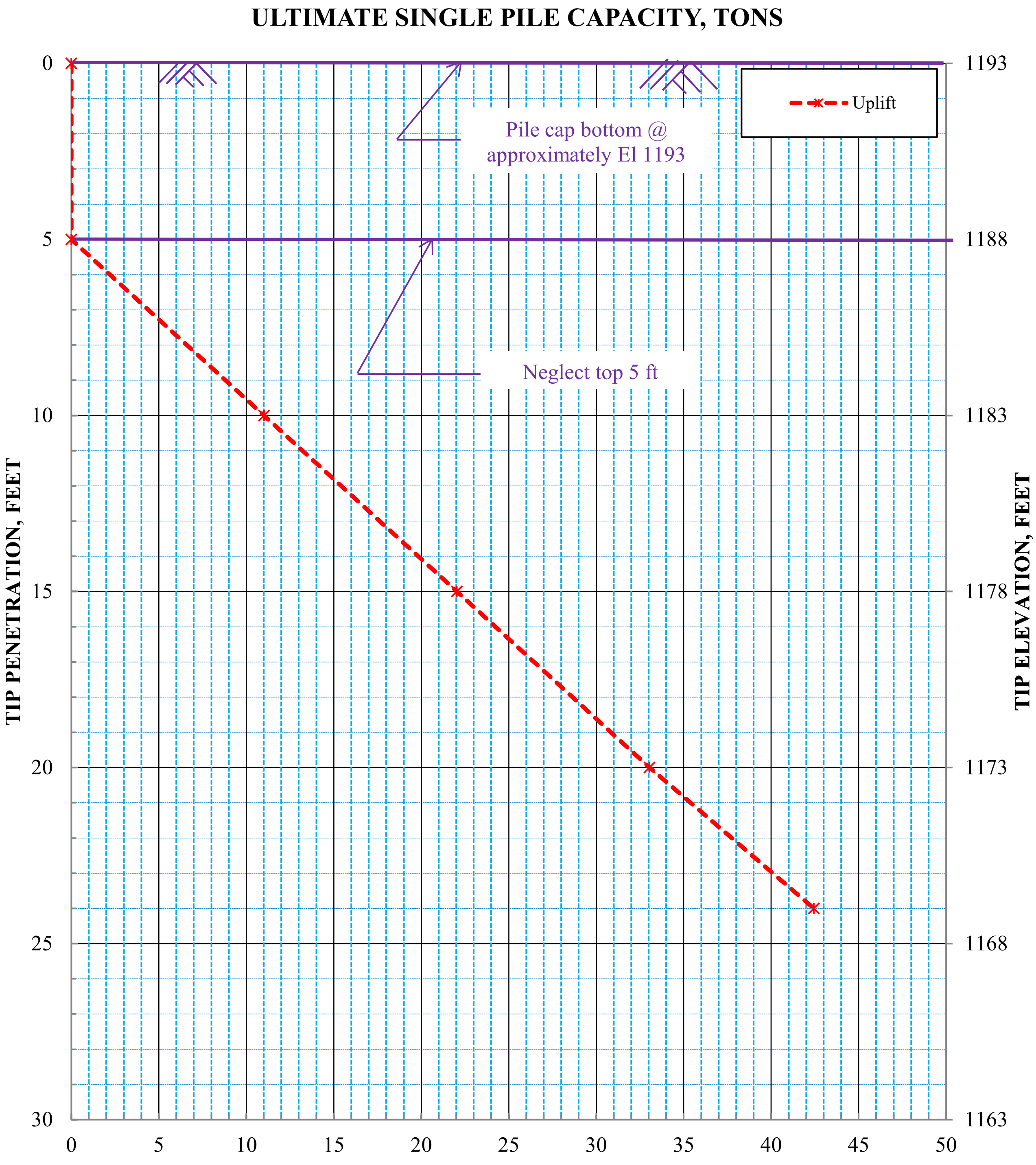
Generalized Subsurface Profile - Bridge B
090069 XNA Access Road over Holmes Rd.
Benton Co., Arkansas
Project Number: 19-118

APPENDIX E



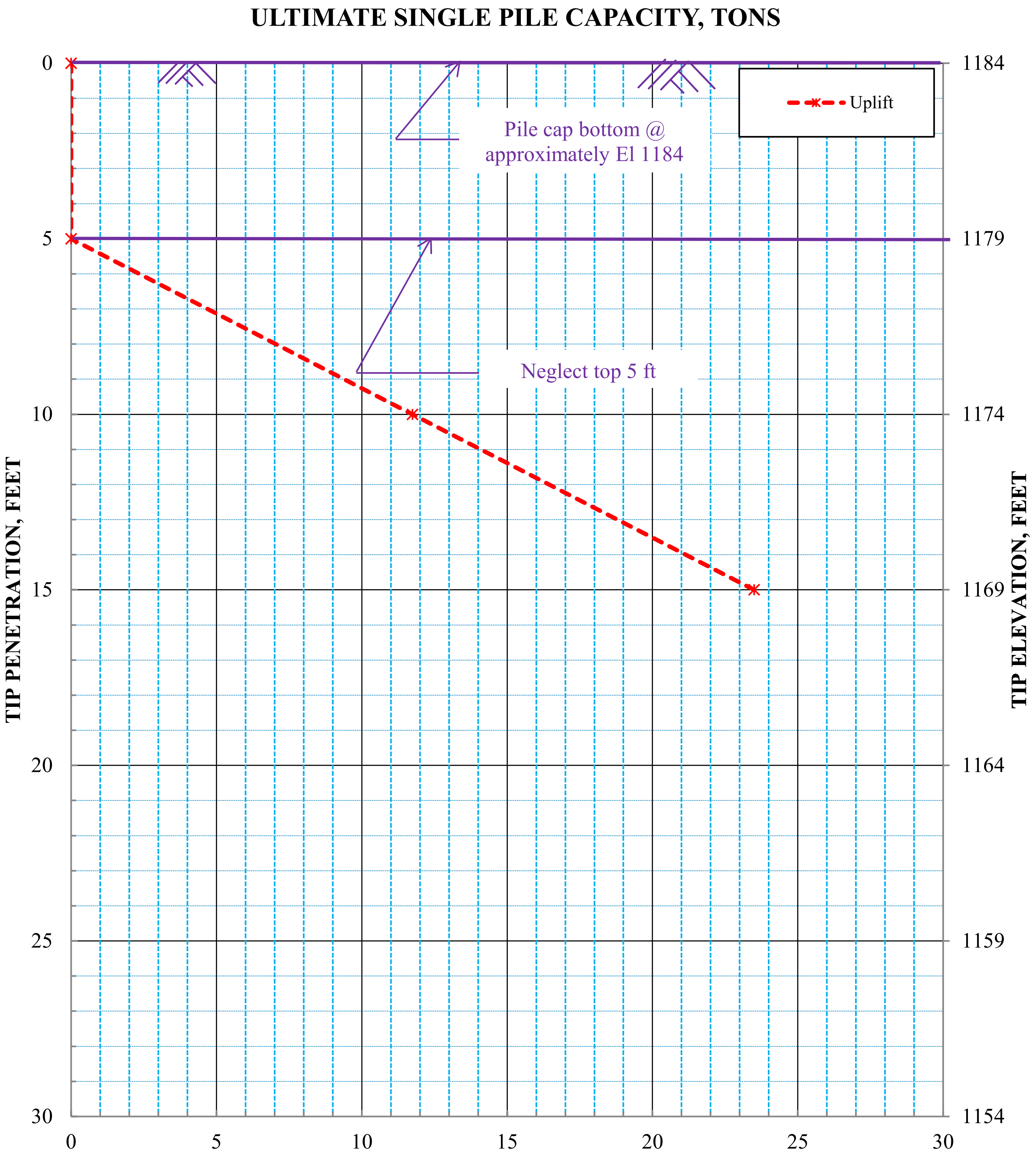
ULTIMATE SINGLE PILE CAPACITY, TONS
HP12x53 Steel Piles - Uplift
090069 XNA Access Road over Holmes Road
Bent 1A (South Bent)
Benton County, Arkansas

Note: 1. Piles driven from cap bottom elevation
2. Pile penetration limited in moderately hard weathered limestone below El. 1169±



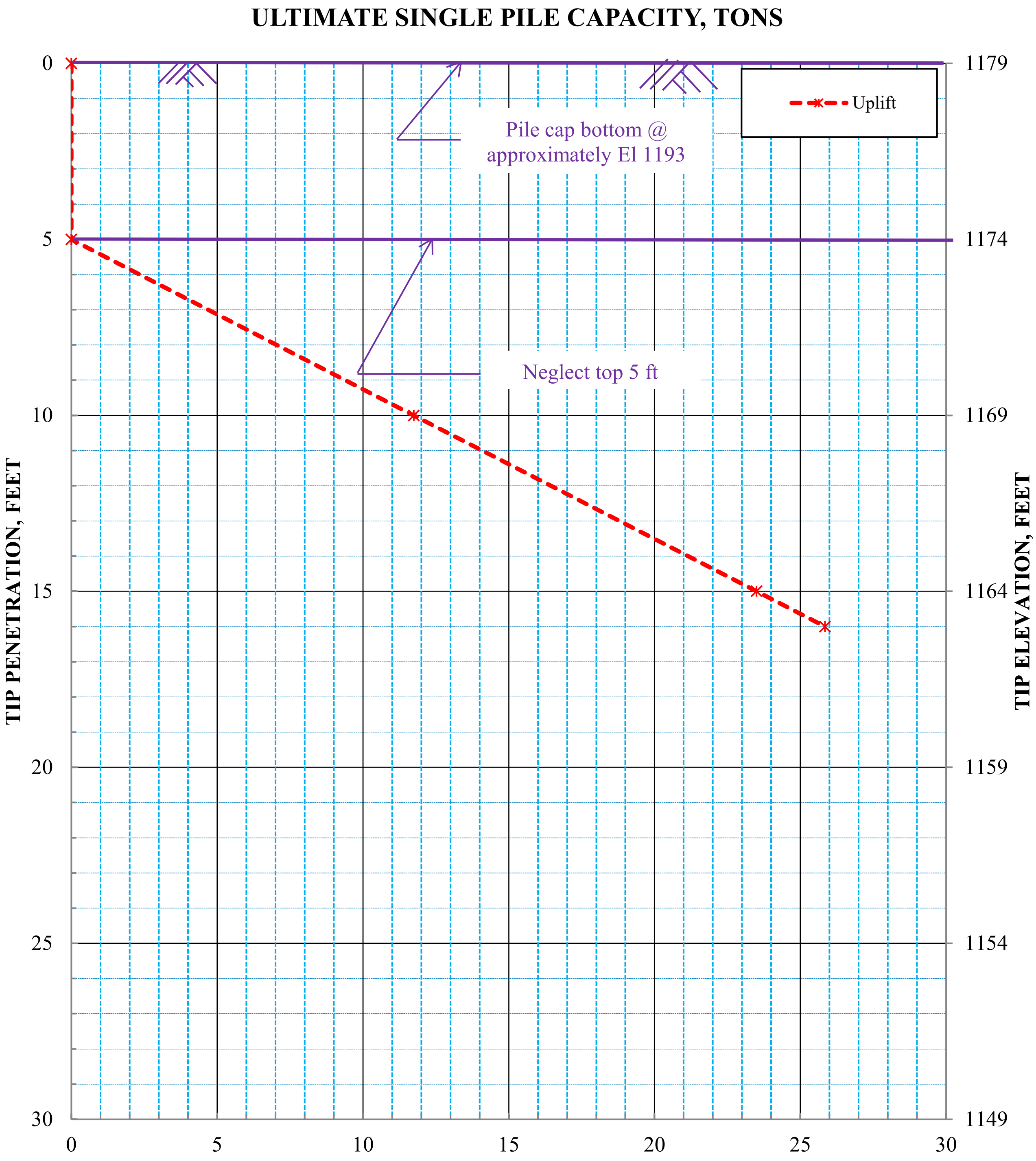
ULTIMATE SINGLE PILE CAPACITY, TONS
HP14x73 Steel Piles - Uplift
090069 XNA Access Road over Holmes Road
Bent 2A (Interior Bent)
Benton County, Arkansas

Note: 1. Piles driven from cap bottom elevation
2. Pile penetration limited in moderately hard weathered limestone below El. 1169±



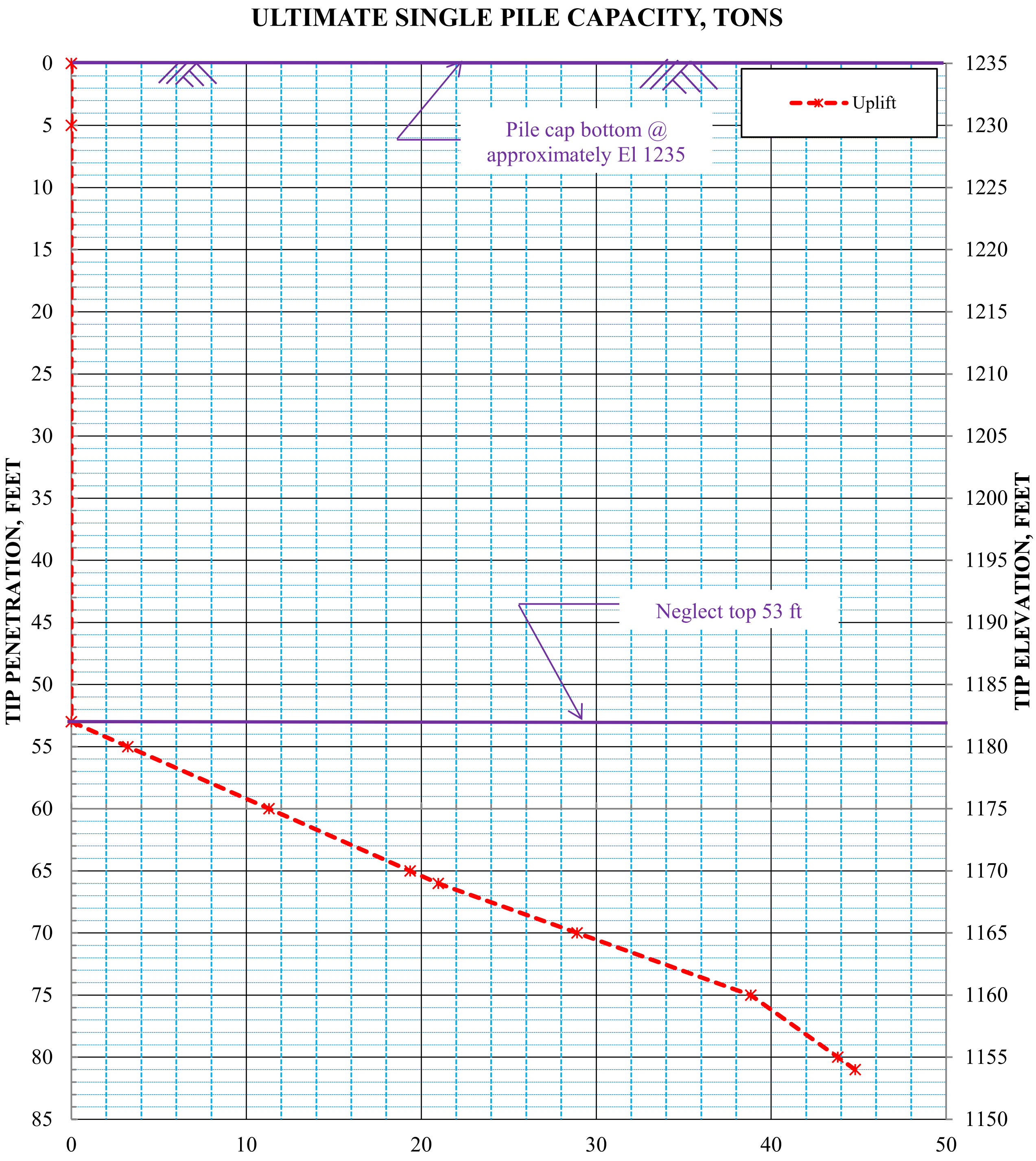
ULTIMATE SINGLE PILE CAPACITY, TONS
HP14x73 Steel Piles - Uplift
090069 XNA Access Road over Holmes Road
Bent 3A (Interior Bent)
Benton County, Arkansas

Note: 1. Piles driven from cap bottom elevation
2. Pile penetration limited in moderately hard weathered limestone below El. 1169±



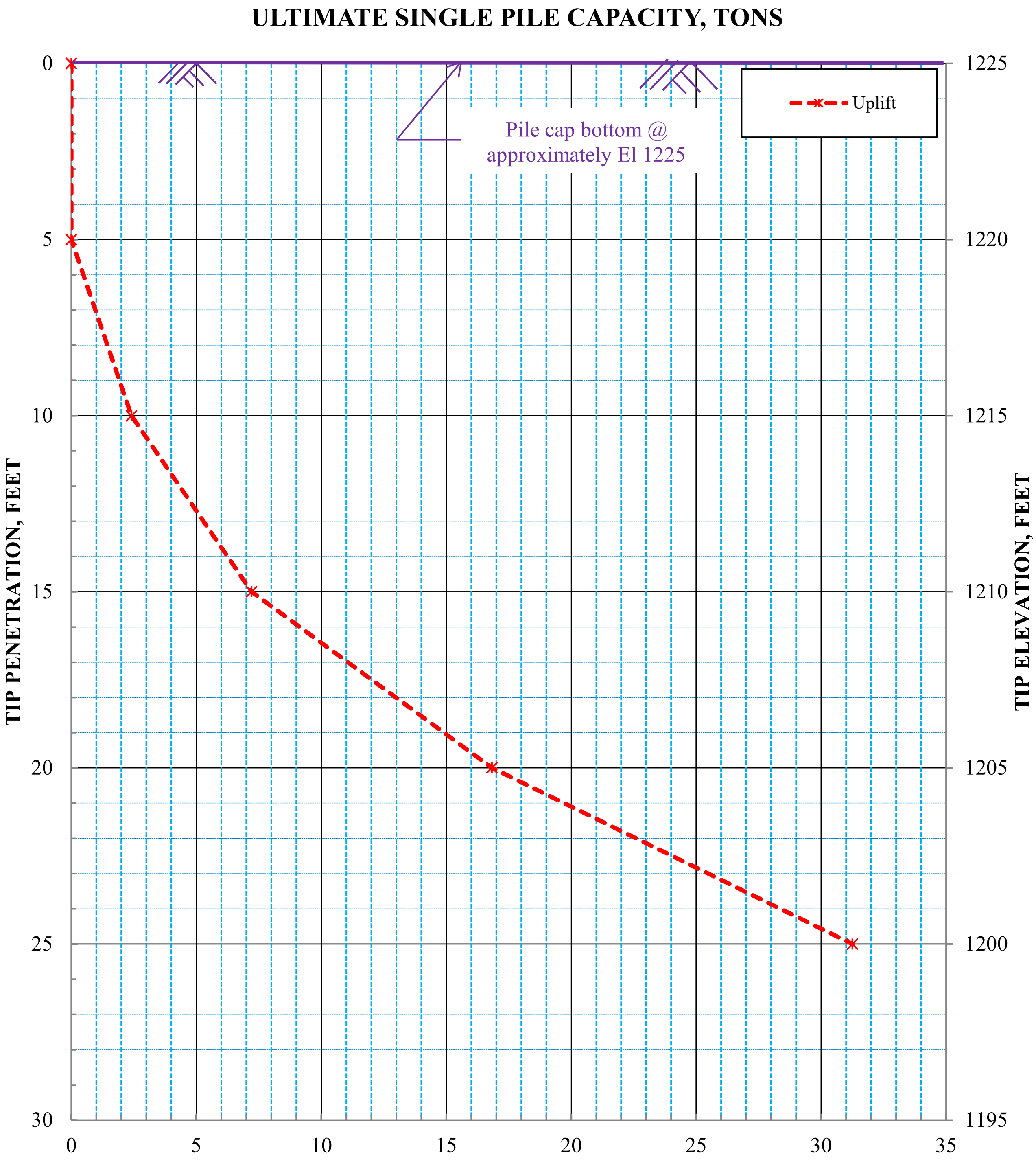
ULTIMATE SINGLE PILE CAPACITY, TONS
HP14x73 Steel Piles - Uplift
090069 XNA Access Road over Holmes Road
Bent 4A (Interior Bent)
Benton County, Arkansas

Note: 1. Piles driven from cap bottom elevation
2. Pile penetration limited in moderately hard weathered limestone below El. 1163±



ULTIMATE SINGLE PILE CAPACITY, TONS
HP12x53 Steel Piles - Uplift
090069 XNA Access Road over Holmes Road
Bent 5A (North Bent)
Benton County, Arkansas

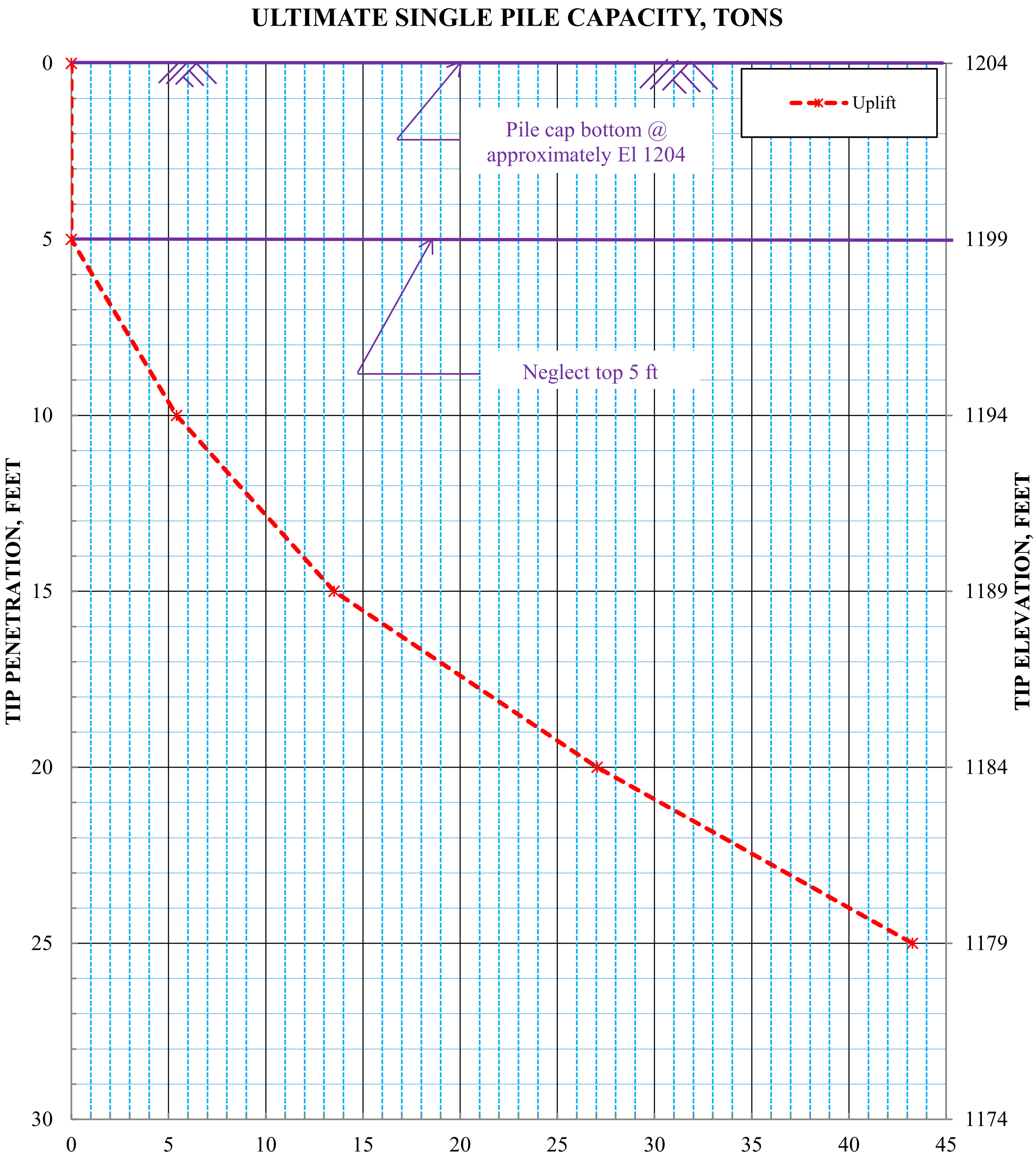
Note: 1. Piles driven from cap bottom elevation
2. Pile penetration limited in moderately hard weathered limestone below El. 1154±



ULTIMATE SINGLE PILE CAPACITY, TONS

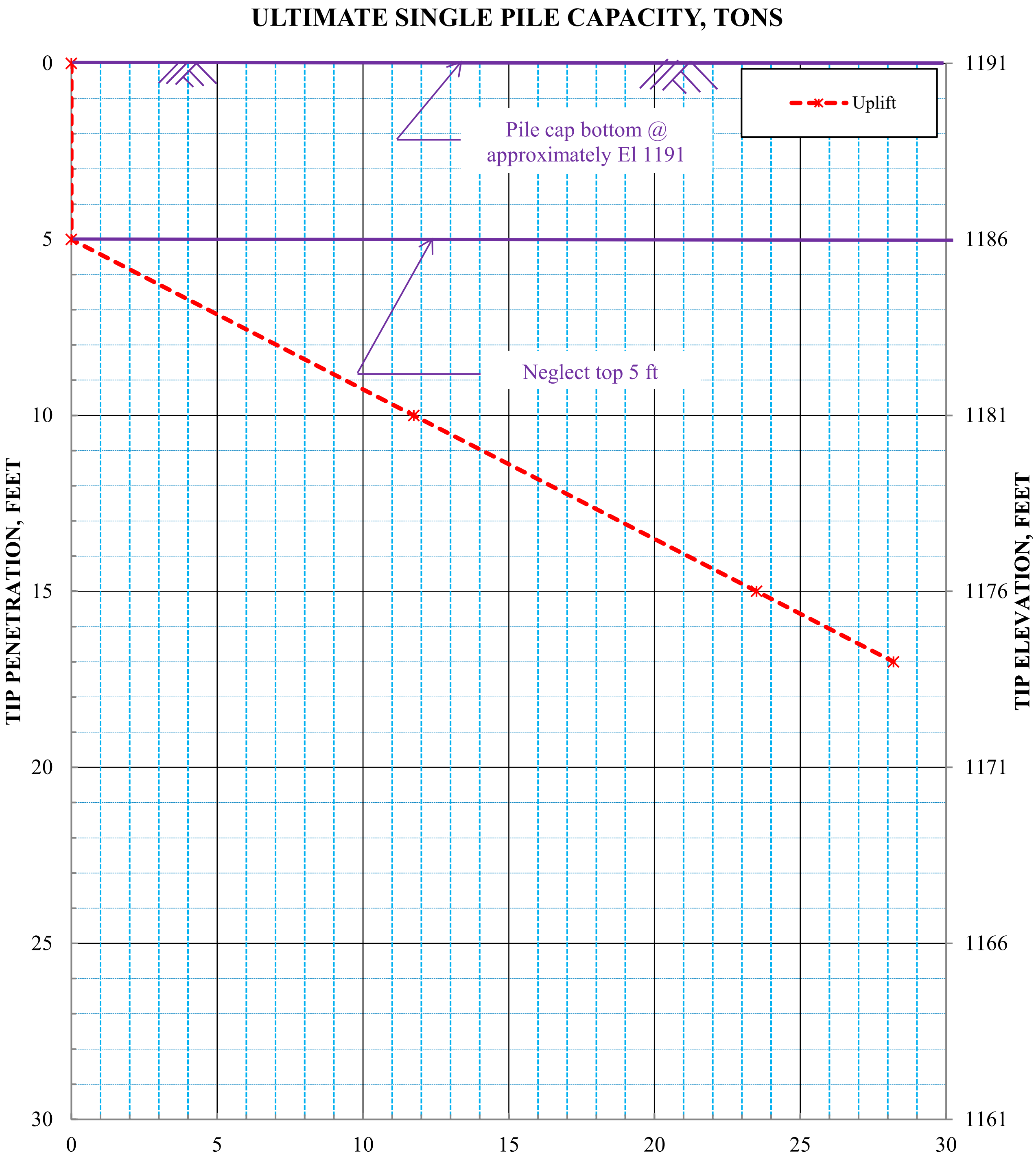
Grouted HP12x53 Steel Piles - Uplift
090069 XNA Access Road over Holmes Road
Bent 1B (South Bent)
Benton County, Arkansas

Note: 1. Piles driven from cap bottom elevation
2. Preboring and grouting required in moderately hard weathered limestone below El. 1220±



ULTIMATE SINGLE PILE CAPACITY, TONS
Grouted HP14x73 Steel Piles - Uplift
090069 XNA Access Road over Holmes Road
Bent 2B (Interior Bent)
Benton County, Arkansas

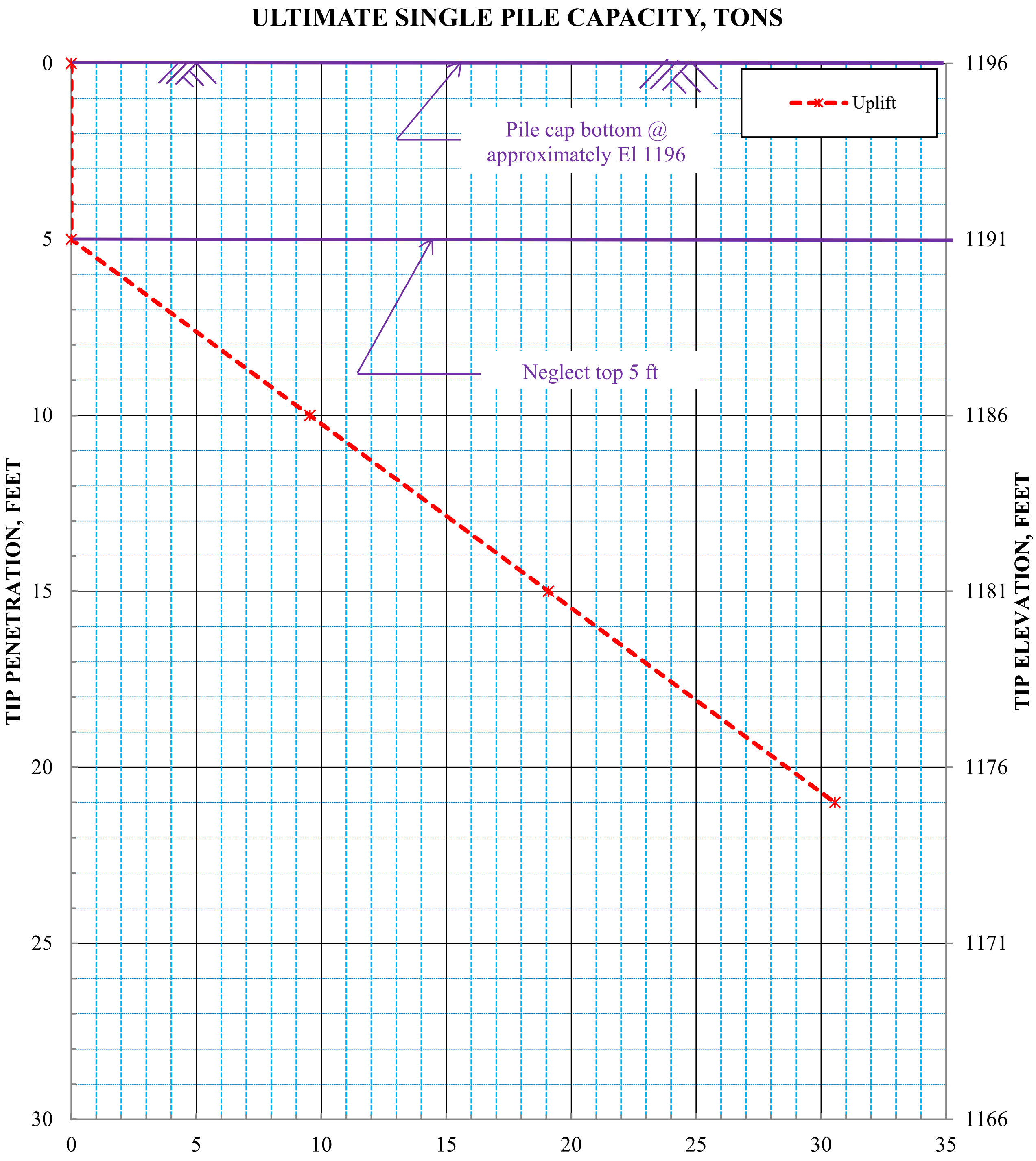
Note: 1. Piles driven from cap bottom elevation
2. Preboring and grouting required in moderately hard weathered limestone below El. 1212±



ULTIMATE SINGLE PILE CAPACITY, TONS

HP14x73 Steel Piles - Uplift
090069 XNA Access Road over Holmes Road
Bent 3B (Interior Bent)
Benton County, Arkansas

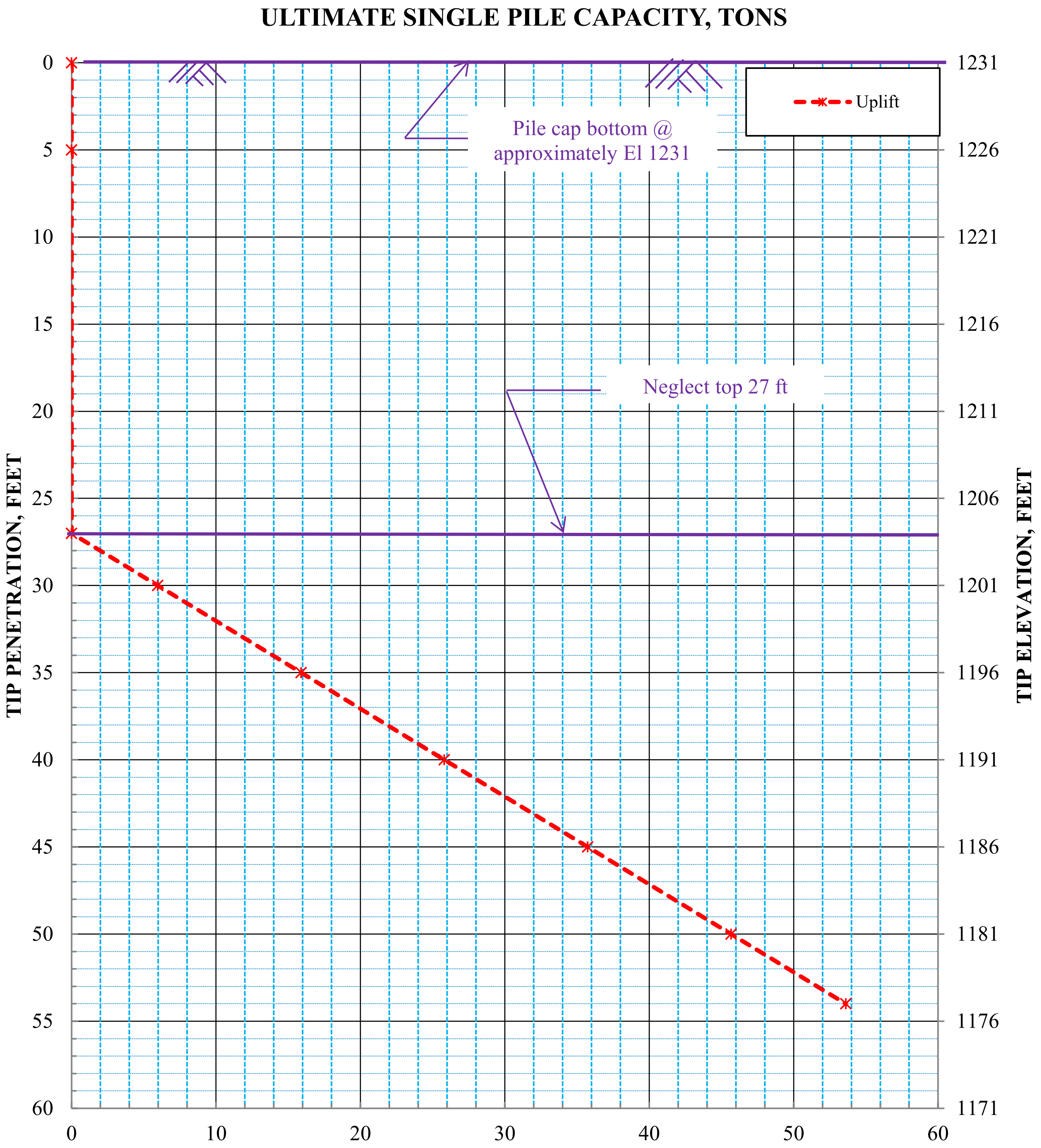
Note: 1. Piles driven from cap bottom elevation
2. Pile penetration limited in moderately hard weathered limestone below El. 1174±



ULTIMATE SINGLE PILE CAPACITY, TONS
HP14x73 Steel Piles - Uplift
090069 XNA Access Road over Holmes Road
Bent 4B (Interior Bent)
Benton County, Arkansas

Note: 1. Piles driven from cap bottom elevation
2. Pile penetration limited in moderately hard weathered limestone below El. 1175±

Grubbs, Hoskyn, Barton & Wyatt, LLC
Consulting Engineers



ULTIMATE SINGLE PILE CAPACITY, TONS
HP12x53 Steel Piles - Uplift
090069 XNA Access Road over Holmes Road
Bent 5B (North Bent)
Benton County, Arkansas

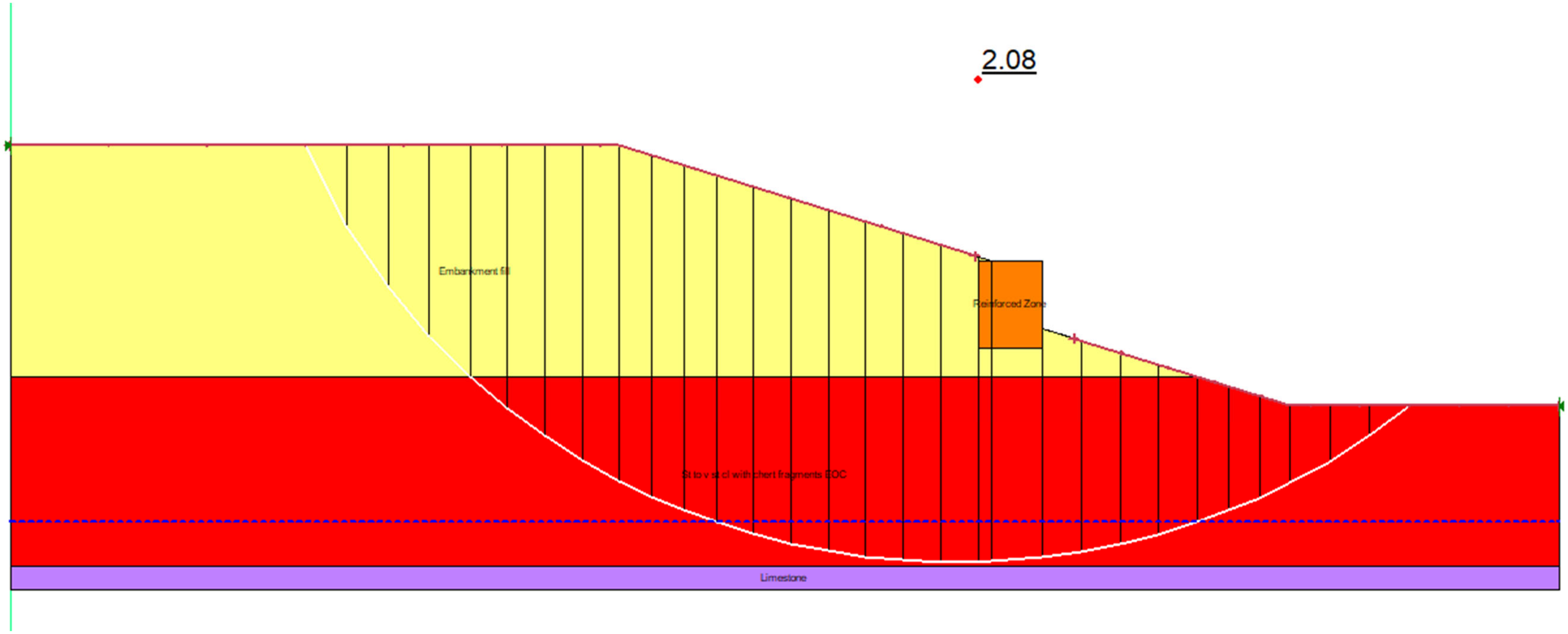
Note: 1. Piles driven from cap bottom elevation
2. Pile penetration limited in moderately hard weathered limestone below El. 1177±

Grubbs, Hoskyn, Barton & Wyatt, LLC
Consulting Engineers

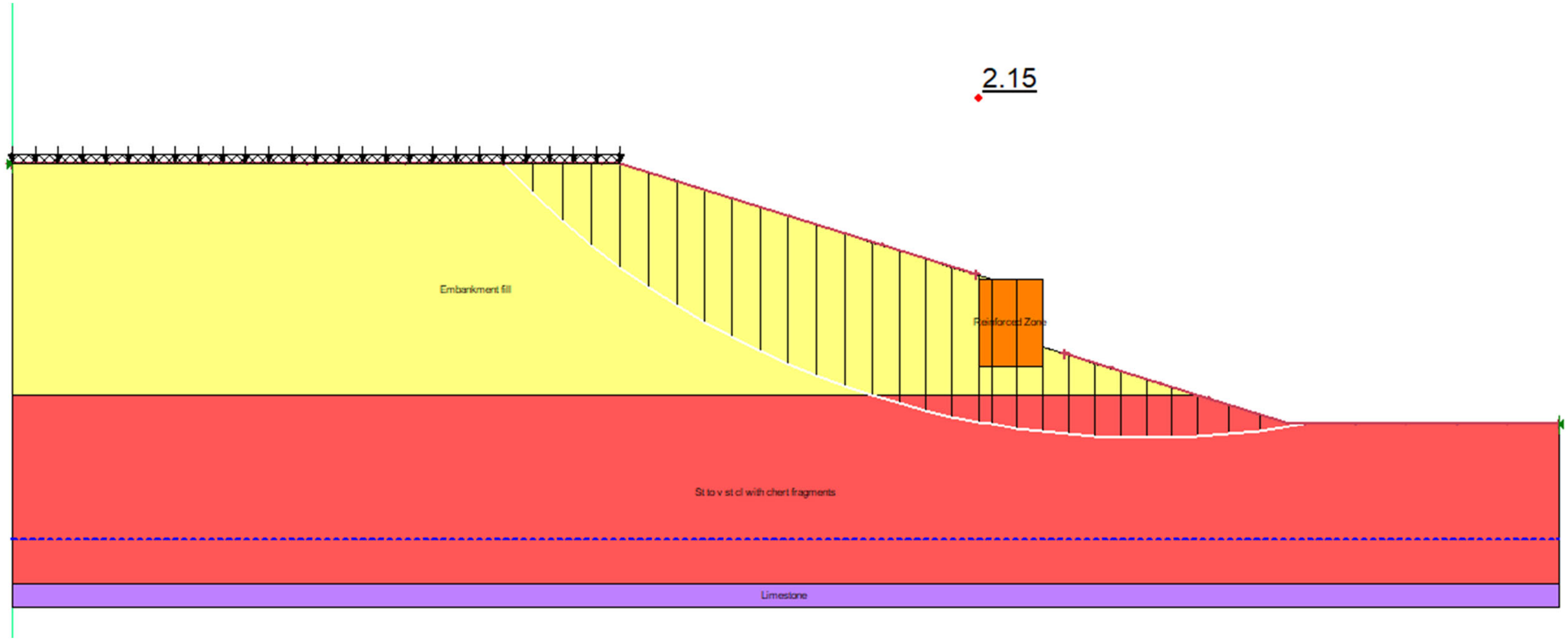
APPENDIX F

Summary of Stability Analysis Results
ARDOT 090069 XNA Access Road over Holmes Road
GHBW Job No. 19-118
Benton County, Arkansas

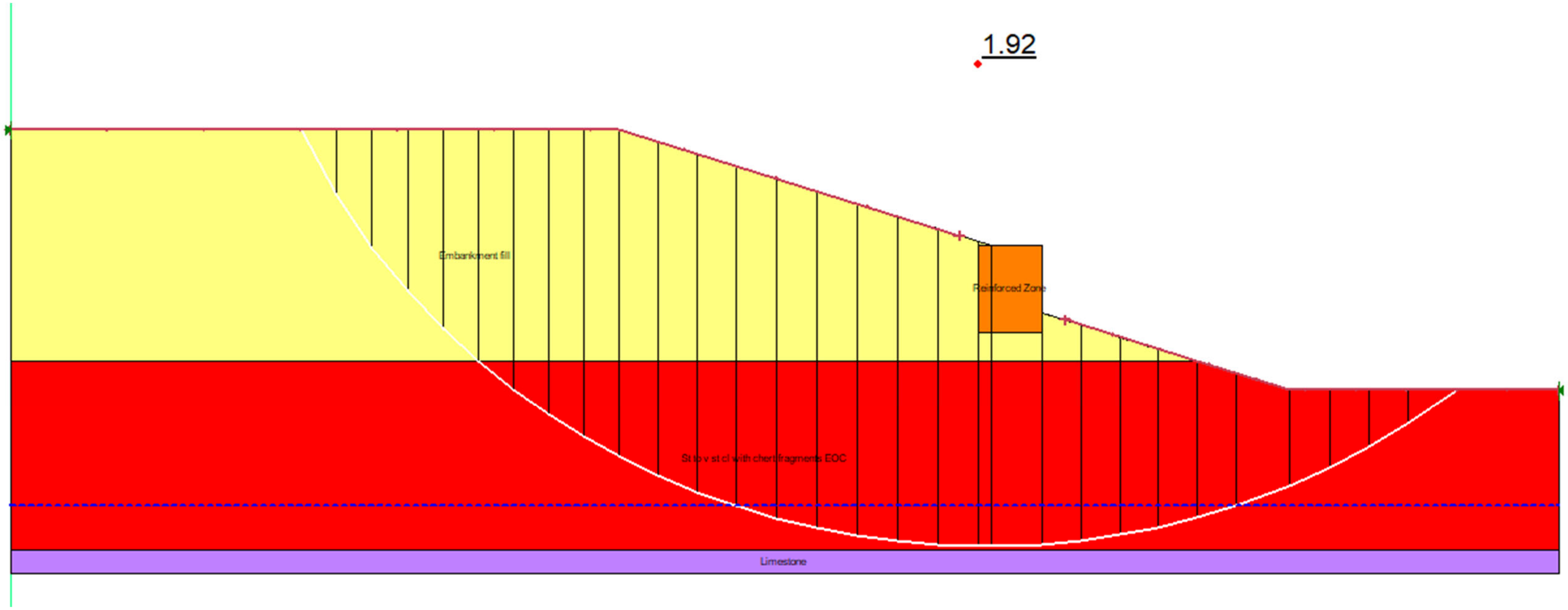
	Design Loading Condition	Calculated Minimum Factor of Safety
MSE Wall No. 1 (H=18 ft)	End of Construction	2.08
	Long Term	2.15
	Seismic ($k_h = A_S/2 = 0.0245$)	1.82



Results of Stability Analyses – End of Construction
MSE Wall No. 1
3H:1V Slope, Wall Height=18 ft ±
19-118 – ARDOT Job No.090069 – XNA Access Road over Holmes Road



Results of Stability Analyses – Long Term Condition
MSE Wall No. 1
3H:1V Slope, Wall Height=18 ft ±
19-118 – ArDOT Job No.090069 – XNA Access Road over Holmes Road



Results of Stability Analyses – Seismic Condition ($k_h = A_S /2 = 0.0245$)
MSE Wall No. 1
3H:1V Slope, Wall Height=18 ft ±
19-118 – ArDOT Job No.090069 – XNA Access Road over Holmes Road

Summary of Stability Analysis Results
ARDOT 090069 XNA Access Road over Holmes Road
GHBW Job No. 19-118
Benton County, Arkansas

	Design Loading Condition	**Calculated Minimum Factor of Safety**
South End Slope (Bent 1) (2H:1V)	End of Construction	2.69
	Long Term	2.26
	Seismic (k_h =A_S/2 = 0.0245)	2.53
South Side Slope (Bent 1) (3H:1V)	End of Construction	3.71
	Long Term	3.19
	Seismic (k_h =A_S/2 = 0.0245)	3.37
North End Slope (Bent 5) (2H:1V)	End of Construction	2.13
	Long Term	1.87
	Seismic (k_h =A_S/2 = 0.0245)	1.98
North Side Slope (Bent 5) (3H:1V)	End of Construction	2.11
	Long Term	2.32
	Seismic (k_h =A_S/2 = 0.0245)	1.93

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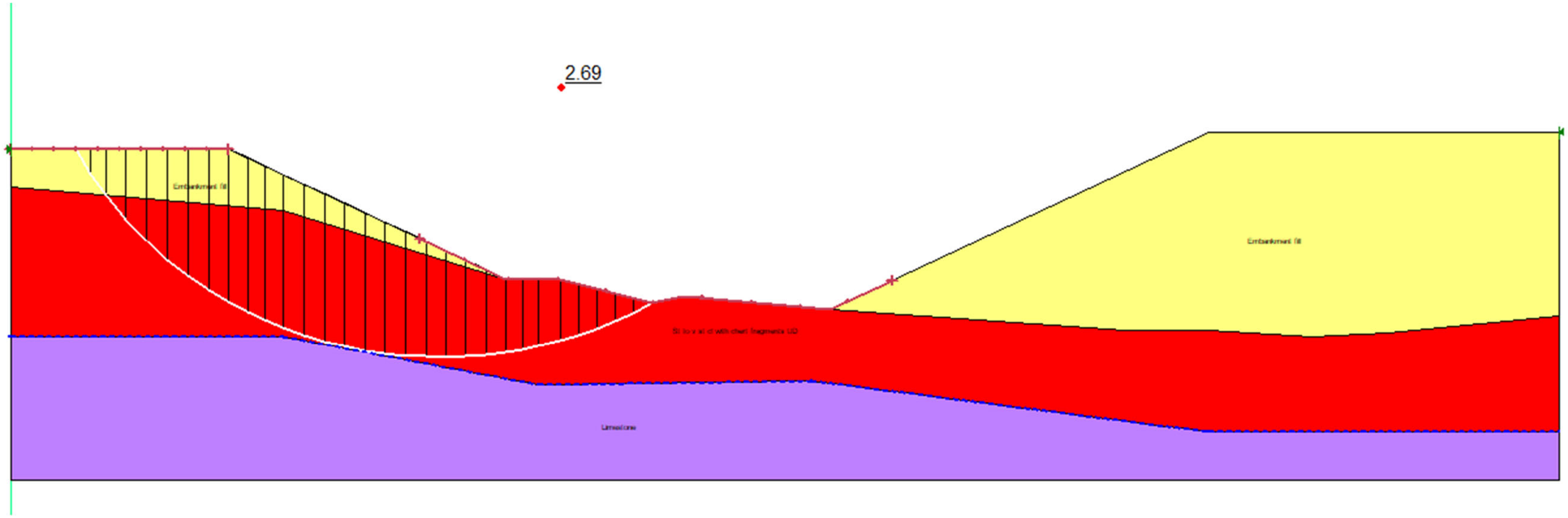
Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



Results of Stability Analyses – End of Construction
Bent 1 End Slope
2H:1V Slope, H=47 ft ±
19-118 – ARDOT Job No.090069 – XNA Access Road over Holmes Road

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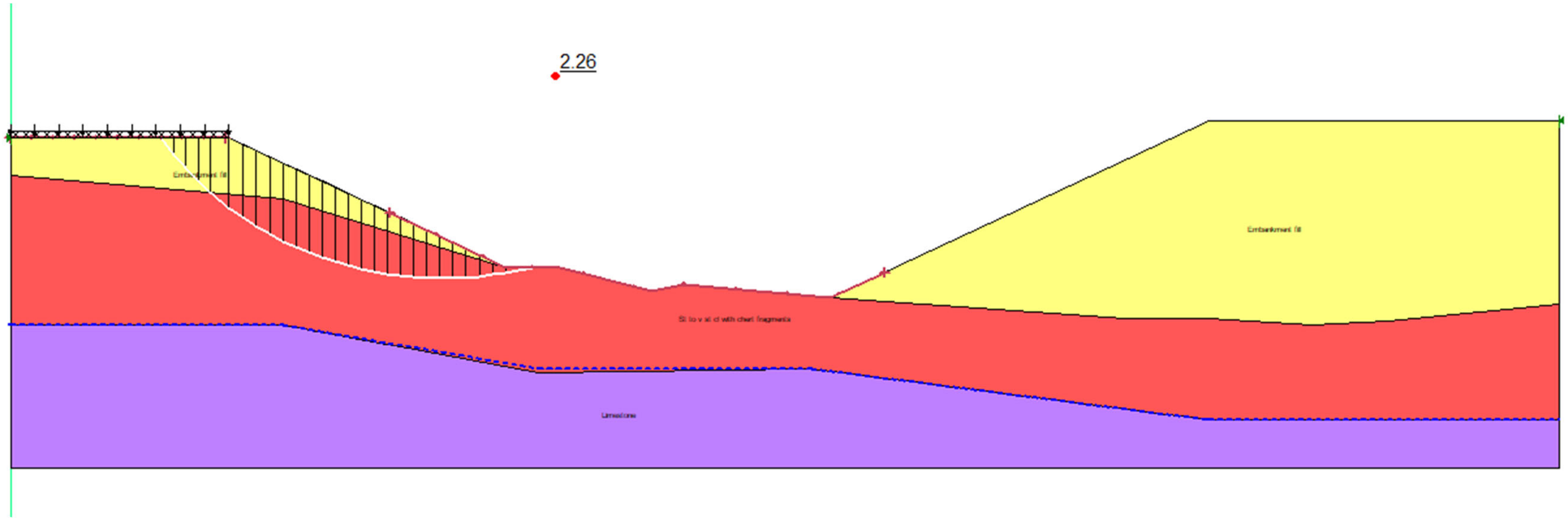
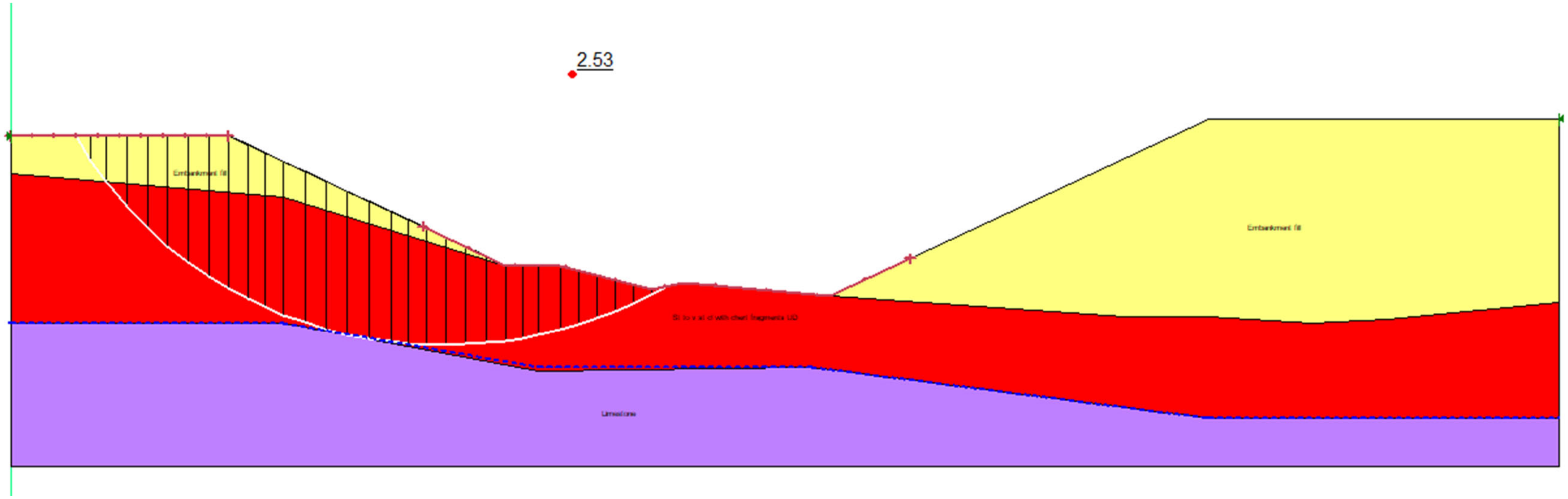
A UES Company



Results of Stability Analyses – Long Term Condition
Bent 1 End Slope
2H:1V Slope, H=47 ft ±
19-118 – ArDOT Job No.090069 – XNA Access Road over Holmes Road



Results of Stability Analyses – Seismic Condition ($k_h = A_S$ /2= 0.0245)
Bent 1 End Slope
2H:1V Slope, H=47 ft ±
19-118 – ARDOT Job No.090069 – XNA Access Road over Holmes Road

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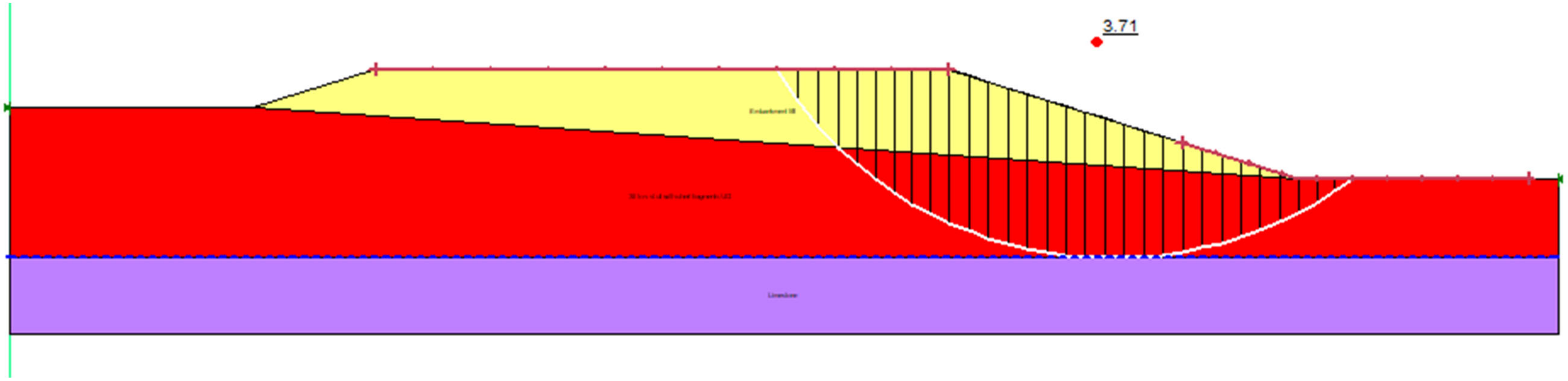
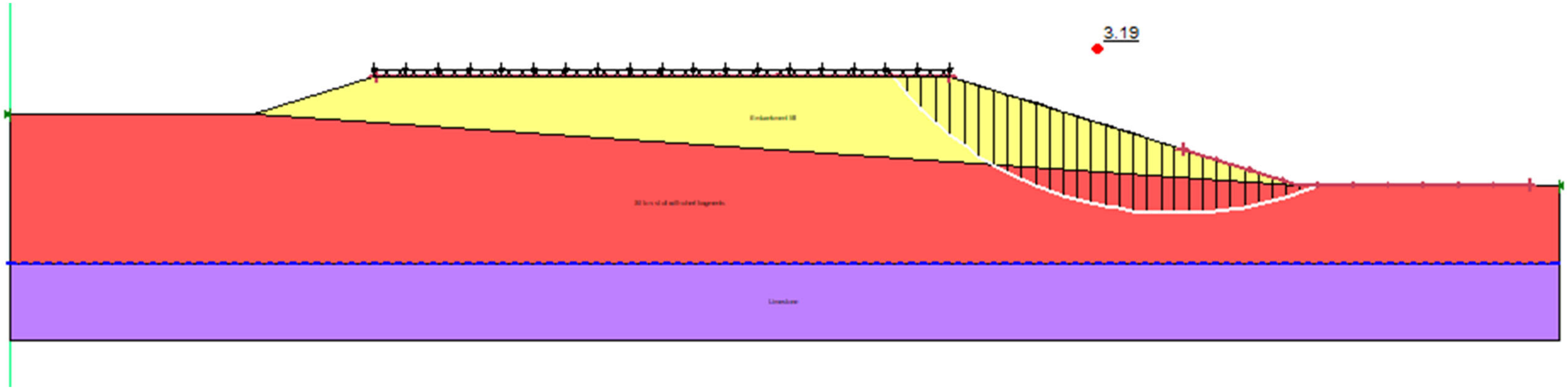
CONSULTING ENGINEERS
A UES Company



Results of Stability Analyses – End of Construction
Bent 1 Side Slope
3H:1V Slope, H=47 ft ±
19-118 – ARDOT Job No.090069 – XNA Access Road over Holmes Road



Results of Stability Analyses – Long Term Condition
Bent 1 Side Slope
3H:1V Slope, H=47 ft ±
19-118 – ARDOT Job No.090069 – XNA Access Road over Holmes Road
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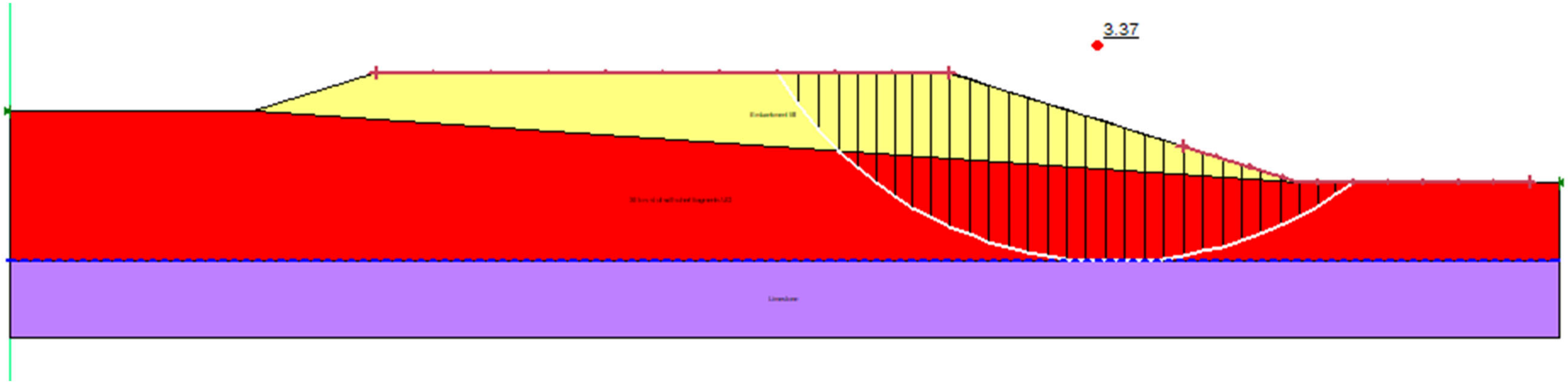
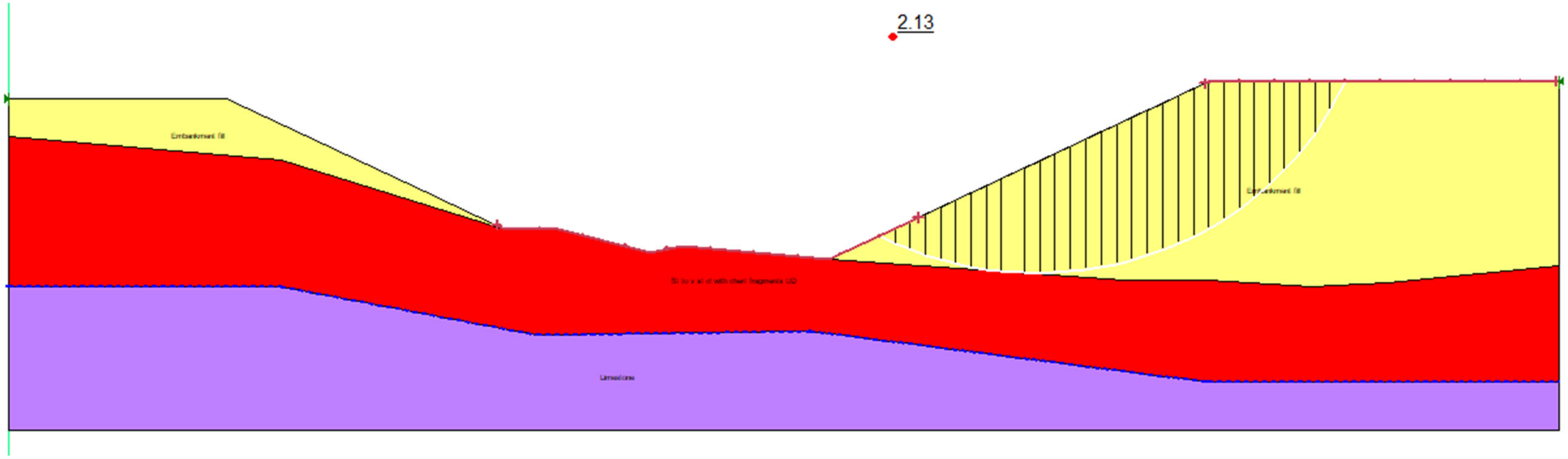
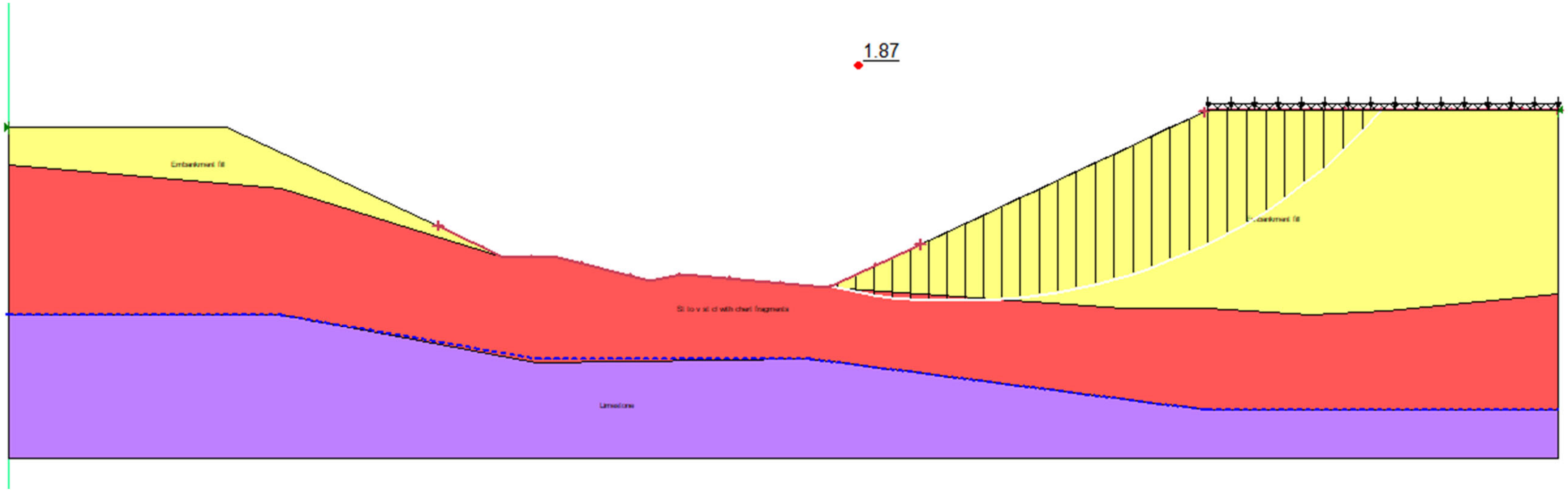


Results of Stability Analyses – Seismic Condition ($k_h = A_S /2= 0.0245$)
Bent 1 Side Slope
3H:1V Slope, H=47 ft ±
19-118 – ARDOT Job No.090069 – XNA Access Road over Holmes Road

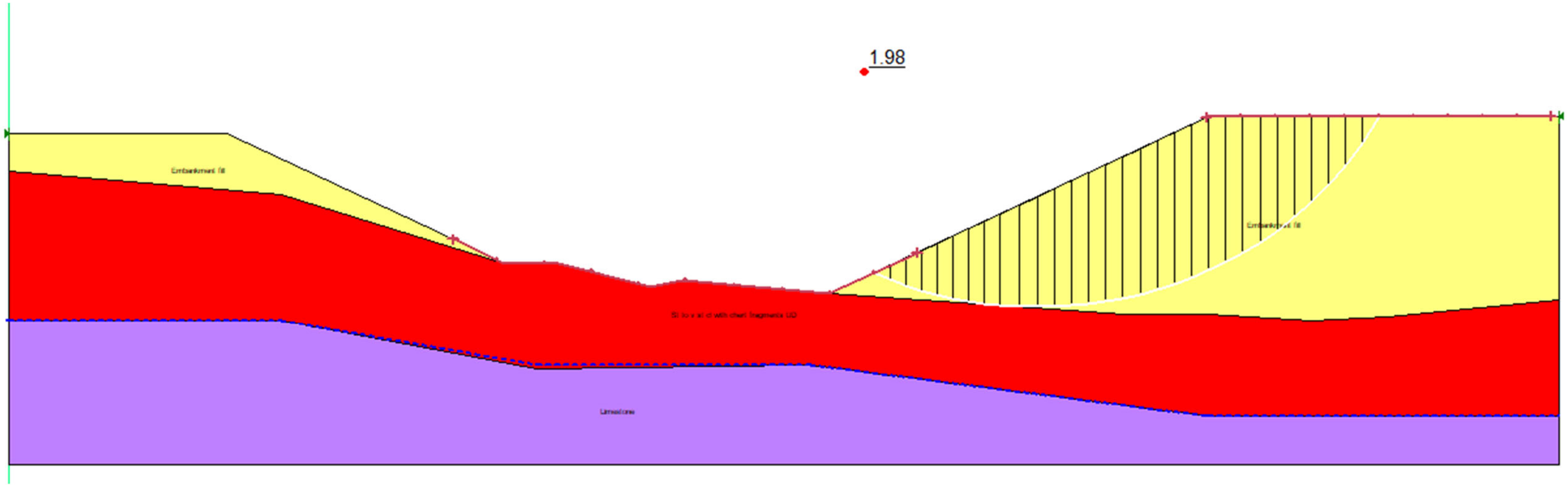


Results of Stability Analyses – End of Construction
Bent 5 End Slope
2H:1V Slope, H=60 ft ±
19-118 – ARDOT Job No.090069 – XNA Access Road over Holmes Road

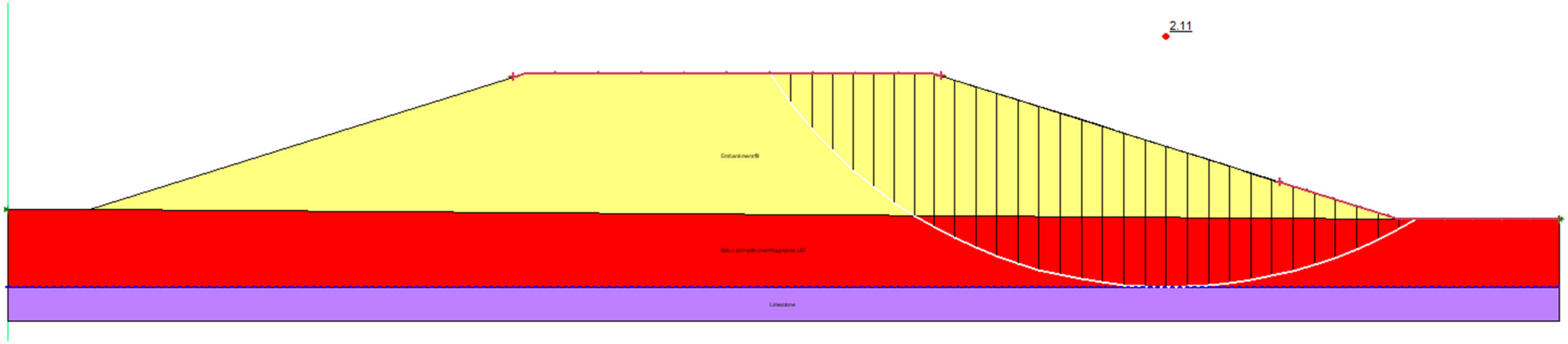
Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



Results of Stability Analyses – Long Term Condition
Bent 5 End Slope
2H:1V Slope, H=60 ft ±
19-118 – ARDOT Job No.090069 – XNA Access Road over Holmes Road



Results of Stability Analyses – Seismic Condition ($k_h = A_S /2 = 0.0245$)
Bent 5 End Slope
2H:1V Slope, H=60 ft ±
19-118 – ARDOT Job No.090069 – XNA Access Road over Holmes Road



Results of Stability Analyses – End of Construction
Bent 5 Side Slope
3H:1V Slope, H=60 ft ±
19-118 – ARDOT Job No.090069 – XNA Access Road over Holmes Road

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Barton & Wyatt, LLC
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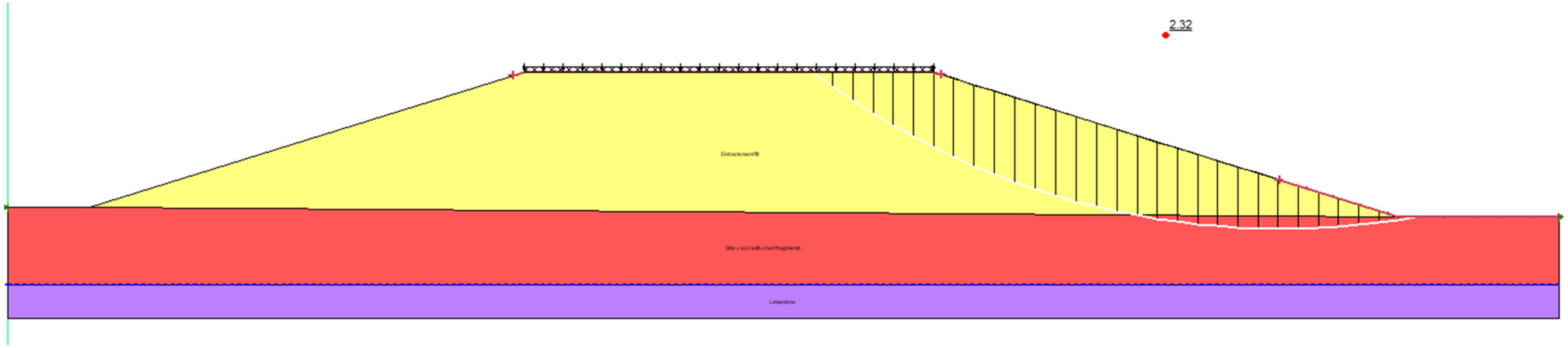
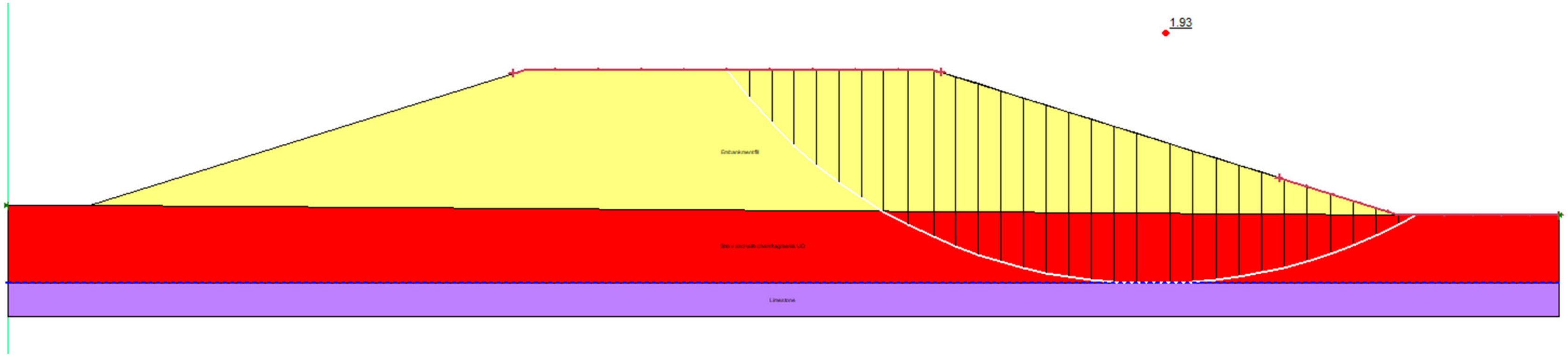


Results of Stability Analyses – Long Term Condition
Bent 5 Side Slope
3H:1V Slope, H=60 ft ±
19-118 – ARDOT Job No.090069 – XNA Access Road over Holmes Road



Results of Stability Analyses – Seismic Condition ($k_h = A_S /2= 0.0245$)
Bent 5 Side Slope
3H:1V Slope, H=60 ft ±
19-118 – ARDOT Job No.090069 – XNA Access Road over Holmes Road

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A UES Company

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A UES Company

Materials Testing
Geotechnical Engineering
Environmental
Building Sciences & Safety
Inspections & Code Compliance
Virtual Design Consulting

September 28, 2023
Job No. 19-118

Garver LLC
4701 Northshore Drive
North Little Rock, Arkansas 72118

Attn: Mr. Joel Skinner, P.E.

FINAL RESULTS of GEOTECHNICAL INVESTIGATION
ARDOT JOB 090069
MALONE LANE BRIDGE OVER XNA ACCESS ROAD
BENTON COUNTY, ARKANSAS

INTRODUCTION

This report provides the final results of the geotechnical investigation performed for the Malone Lane over the XNA Access Road in Benton County, Arkansas are provided in this report. The Malone Lane overpass is one facet of ARDOT Job 090069 Northwest Arkansas Regional Airport Access (Benton Co) (F). This geotechnical investigation was authorized by the Garver, LCC Subconsultant Agreement for Task Order No. 061 on August 27, 2019. Notice to proceed with the field studies was received on August 30, 2019. This final report includes additional recommendations for pile foundation uplift resistance and supersedes the submittal of June 3, 2023.

We understand the new Malone Lane bridge will be a continuous plate girder structure with three (3) bents, two (2) spans, and a total length of approximately 218 feet. We also understand that a foundation system consisting of steel piles is planned for all bents. Foundation loads of the new bridge are anticipated to be moderate. The bridge end embankments will utilize MSE walls at bridge abutments and simple slopes at 3-horizontal to 1-vertical (3H:1V) configurations at the embankment sides. Site grading is expected to include up to 29 ft of embankment fill. A preliminary bridge layout is provided in Appendix A.

The purposes of this study were to explore subsurface conditions in the bridge alignment and to develop recommendations to guide design and construction of foundations. These purposes have been achieved by a multi-phased study that included the following.

- Drilling sample and core borings at the planned bridge location to evaluate subsurface conditions and obtain samples of the subgrade and foundation soil and rock for laboratory testing.
- Performing laboratory tests to evaluate pertinent engineering properties of the foundation and subgrade strata.
- Analyzing field and laboratory data to develop recommendations for seismic site class, seismic performance zone/seismic design category, foundation and subgrade support, MSE walls, slope stability, site grading, and construction considerations.

The relationship of these factors to design and construction of the new bridge has been considered in developing the recommendations and considerations discussed in the following report sections.

SUBSURFACE EXPLORATION

Subsurface conditions at the Malone Lane bridge location were investigated by drilling 11 sample and core borings to depths of 9.5 to 68 feet. The site vicinity is shown on Plate 1. The approximate boring locations are shown on the bridge layout drawing on Plate 2. The subsurface exploration program is summarized in Table 1 below.

Table 1: Summary of Exploration Program

Boring No.	Approx Sta	Approx Offset, ft	Approx Surf El, ft	Completion Depth, ft
S57	22+36	CL	1241	62
S58	23+50	CL	1242	68
S59	24+57	CL	1243	55
S60	22+04	74 L	1240	15*
S61	22+35	40 L	1240	25
S62	22+44	34 Rt	1242	14.5*
S63	22+09	67 Rt	1242	14.5*
S64	24+78	60 L	1244	10*
S65	22+10	67 R	1244	9.5*
S66	24+58	38 Rt	1242	10*
S67	24+90	78 Rt	1242	11.5*

*Note: Boring terminated at practical refusal in hard chert bed or cherty limestone.

The boring logs, presenting descriptions of the soil and rock strata encountered in the borings and the results of the field and laboratory tests, are included as Plates 3 through 16. The centerline station and offset of the boring locations and approximate ground surface elevation, as inferred from the topographic information provided by the Engineer (Garver, LLC) or as inferred from available topographic information, are also shown on the logs. It must be recognized that the surface elevations shown are approximate and actual elevations may vary. Keys to the terms and symbols used on the logs are presented as Plates 17 and 18.

The borings were drilled with a track-mounted CME 55 rotary-drilling rig using a combination of dry-auger and rotary-wash drilling methods. Samples were typically obtained at 2-ft intervals to 10-ft depth and at 5-ft intervals thereafter. Samples were recovered using a 2-in.-diameter split-barrel sampler driven into the strata by blows of a 140-lb automatic hammer with 30-in. drop in accordance with Standard Penetration Test (SPT) procedures. The number of blows required to drive the standard split-barrel sampler the final 12 in. of an 18-in. total drive, or a portion thereof, is defined as the Standard Penetration Number (N). Recorded N-values are shown on the boring logs in the "Blows Per Ft" column.

Representative samples of the limestone bedrock were obtained using a 5-ft-long NQWL-size double-tube core barrel with a diamond bit. For each core run, the percent recovery was determined as the ratio of recovery to total length of core run. Rock Quality Designation (RQD) was also determined for the core run as the sum of intact, sound rock core greater than 4-in. length divided by the total length of the run and expressed in percent. Both these values are presented in the right-hand columns of the log forms, opposite the corresponding core run. Selected photographs of the recovered rock cores are provided in Appendix B.

All samples were removed from sampling tools in the field, examined and visually classified by the field geologist. Samples were then placed in appropriate containers to prevent moisture loss and/or change in condition during transfer to our laboratory for further examination and testing.

The borings were advanced using dry-auger procedures to the extent possible to facilitate evaluation of shallow groundwater conditions. Observations regarding groundwater levels are noted in the lower-right portion of each log and are discussed in subsequent sections of this report. All boreholes were backfilled after obtaining the final water level readings.

LABORATORY TESTING

Laboratory testing was performed to evaluate subgrade and foundation plasticity and to confirm visual classification. The testing program included natural water content determinations (AASHTO T 265), liquid and plastic (Atterberg) limit determinations (AASHTO T 89 and T 90), and sieve analyses through the No. 200 sieve (AASHTO T 88). Soil shear strength was estimated in the field using SPT results.

A total of 44 natural water content determinations were performed to develop information on *in-situ* soil water content for each boring. Water content results are plotted on the boring log forms in accordance with the scale and symbols shown in the legend located in the upper-right corner of the logs.

To verify field classification and to evaluate soil plasticity, 10 liquid and plastic limit (Atterberg limits) determinations and 12 sieve analyses were performed on selected representative samples. The Atterberg limits are plotted on the logs as pluses inter-connected with a dashed line using the water content scale. The percentage of soil passing through the No. 200 Sieve is noted in the "- No. 200 %" column on the appropriate log forms. Classification test results, along with soil classification by the Unified Soil Classification System and AASHTO designations, are summarized in Appendix C.

GENERAL SITE and SUBSURFACE CONDITIONS

Site Conditions

The overall alignment of the XNA Access Road extends from the Northwest Arkansas Airport (XNA) about 4 miles southeast to the planned terminus at Highways 70 and 71. The Malone bridge site crosses Malone Lane approximately 1250 ft west of the intersection of Malone Lane and Haden Road. The site locale is presently open agricultural/pasture land with scattered mature trees. A drainage area with shallow standing water and thick underbrush is present in the center of the alignment near the plan Bent 2 location. The site terrain slopes gently from the south to the north. Surface drainage is considered fair overall, but poor in the area of the drainage feature and localized low areas.

Site Geology

The project alignment is located in the mapped exposure of the Boone Formation. The early and middle Mississippian Period Boone consists of fine- to coarse-grained limestone interbedded with chert. The chert content can vary widely, both horizontally and vertically, and limestone or chert may be predominant. The Boone Formation is known for dissolutional features such as sinkholes, caves, and enlarged fissures. Typically, the limestone/cherty limestone units of the Boone decompose (weather) to erratic blends of chert fragments and clay/silty clay. The residual soil mantle may extend to significant depths on higher terrain and may contain hard chert seams and/or layers. The thickness of the Boone Formation is reported to be 300 to 350 ft in northern Arkansas. The Boone is generally disconformable to the underlying Chattanooga Shale and St. Joe Limestone member, with some areas having a conformable contact.

Seismic Conditions

In light of the results of the borings, a Seismic Site Class C (very dense soil and soft rock profile) is considered applicable for the site with respect to the criteria of the AASHTO LRFD Bridge Design Specifications Seventh Edition 2014[1].

Given the location and AASHTO code-based values, the 1.0-sec period spectral acceleration coefficient for Site Class C (S_1) is 0.051 and the 1.0-sec period spectral acceleration coefficient (S_{D1}) value for Site Class C is 0.086. Utilizing these parameters, Table 3.10.6-1[2] indicates that a Seismic Performance Zone 1 is fitting for the Malone Lane bridge site. In reference to the 2011 edition of the AASHTO Guide Specifications, the Peak Ground Acceleration (PGA) having a 7 percent chance of exceedance in 75 years (or mean return period of approximately 1000 years) is predicted to be 0.049 for a Seismic Site Class C for the bridge location. The liquefaction potential is considered low for the predominantly cohesive overburden soils and underlying rock units encountered in the borings drilled for this study.

Subsurface Conditions

Based on the results of the borings, the subsurface stratigraphy may be generalized into four (4) primary strata as follows.

Stratum I: The Stratum I soils extend to depths of 2 to 4 ft and are comprised of loose to medium dense brown, reddish brown, and tan silt and fine sandy silt with subordinate units of soft to stiff brown, reddish brown, and reddish tan clayey silt and silty clay. These surface and near-surface soils contain a variable content of chert fragments and nodules. The silt/fine sandy silt, clayey silt, and silty clay exhibit low plasticity, moderate to high compressibility, and low shear strength. The low-plasticity and silty soils are moisture-sensitive and will lose considerable strength when saturated.

Stratum II: Below the predominantly weak surface and near-surface soils of Stratum I and extending to 6- to 15-ft depth are stiff to very stiff red, reddish brown, tan, and gray clay and silty clay with numerous chert fragments and discontinuous chert seams and layers. The clay and silty clay are residual in origin and have weathered from the underlying cherty limestone bedrock. The Stratum II clay and silty clay have low to moderate plasticity, low to moderate shear strength, and low compressibility. The potential for volume change with

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[1] AASHTO LRFD Bridge Design Specifications, 7th Edition; AASHTO; 2014

[2] AASHTO LRFD Bridge Design Specification, AASHTO; 2012

changes in water content is considered low due to the relatively high content of limestone and chert fragments.

Stratum III: The overburden soils are underlain to 50- to 63-ft depth by low hardness to moderately hard gray and light gray weathered cherty limestone with numerous reddish brown cherty clay seams and layers. The weathered cherty limestone exhibits differential weathering with frequent reddish brown clay seams, laminations, and layers, which represent zones of completely weathered limestone. SPT refusal in the frequent The weathered limestone has very poor rock quality.

Stratum IV: The basal stratum encountered in the borings is moderately hard gray and light gray cherty limestone. The cherty limestone is flat bedded. Rock core recovery values range from 33 to 100 percent and rock quality designation (RQD) values range from 0 to 100 percent. These RQD values are indicative of variable poor to fair rock quality. Rock quality generally increases with depth.

To aid in visualizing subsurface conditions, a generalized subsurface profile is presented in Appendix D. It should be recognized that the stratigraphy illustrated by the profile has been inferred between discrete boring locations. In view of the natural variations in stratigraphy and conditions, variations from the stratigraphy illustrated by the profile should be anticipated. Additionally, the natural transition between strata is generally gradual, and the stratigraphy described in the sections above may vary.

Groundwater Conditions

Groundwater was locally encountered at 12 ft in January 2023. This represents perched water over the fractured zones of the cherty limestone. Groundwater levels will vary, depending on seasonal precipitation, surface runoff and infiltration, and water levels in nearby drainage features.

ANALYSES and RECOMMENDATIONS

Foundation Design

Foundations for the new bridge must satisfy two (2) basic and independent design criteria: a) foundations must have an acceptable factor of safety against bearing failure under maximum design loads, and b) foundation movement due to consolidation or swelling of the underlying strata should not exceed tolerable limits for the structures. Construction factors, such as installation of foundations, excavation procedures and surface and groundwater conditions, must also be considered.

Based on the results of the borings performed at the Malone Lane bridge site and our understanding of the project, we recommend that foundation loads at the abutments and interior bents be supported on steel piling. Recommendations for steel piles are discussed in the following report sections.

Piling Foundations

We recommend that the foundation loads of the bridge be supported on steel piles. Steel piles should be driven to refusal in the moderately hard cherty limestone. Highly variable chert beds, seams and layers extend to depths of 45 to 63 ft below existing grades at the Malone bridge site. Preboring will likely be required for pile installation through the interbedded chert zones. Prebores must extend to competent moderately hard cherty limestone and steel piles driven to refusal to mobilize the structural capacity of the pile section.

Steel piles driven to refusal should be designed for the structural capacity of the pile, as per applicable AASHTO Load and Resistance Factor Design (LRFD) procedures[3]. An effective resistance factor (φ_c) of 0.50 is recommended for structural determination of factored bearing capacities. This effective resistance factor for steel piles has been based on the assumption of severe driving conditions.

For determination of bearing capacities of steel piles driven to refusal, we recommend that nominal (ultimate) resistance (P_n) of HP piles be determined based on the yield strength of steel H piles (f_y) and the net end area (A_{net}) of the section. It has been our experience that allowable pile capacities of 133 tons for HP14x73 piles are typical for f_y = 50 ksi steel pile sections. These capacities are based on allowable stress design (ASD). However, the appropriate factored bearing capacity should be confirmed by the Engineer. Post-construction settlement of piles driven to refusal will be negligible.

The nominal axial capacities are based on single, isolated foundations. Piles spaced closer than three (3) pile widths may develop lower individual capacity due to group effects. The potential for group capacity reductions should be evaluated for pile spacing closer than three (3) widths (center to center).

Consideration may be given to driving a heavy HP14x73 or greater pile through the interbedded chert zones. If the Contractor elects to forgo preboring and drive through the interbedded chert zones to the recommended limestone bearing stratum, it is opined that the heavier pile sections, i.e., HP14x73 or heavier, will be required along with a high energy hammer

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[3] Load and Resistance Factor Design (LRFD) for Highway Bridge Substructures, Publication No. FHWA HI-98-032, National Highway Institute, May 2001.

to achieve the anticipated depth. There will be a risk that the required pile bearing elevation cannot be attained without unacceptable damage to piles. Where piles are prebored to the competent moderately hard cherty limestone, as shown in Table 2 below, HP12x53 steel piles will be suitable.

End-bearing piles must be driven to practical refusal. All steel piles should be fitted with rock points. Hard driving or deep preboring should be anticipated.

Estimated prebore depths and pile tip elevations are summarized below in Table 2.

Table 2: Estimated Tip Elevations of Steel Piles Driven to Refusal

Bent No.	**Estimated Prebore depth, ft (below existing grade)**	**Estimated Pile Tip Elevation, ft**	**Comments**
1 (West Bridge End)	48	1194	Refusal in moderately hard cherty limestone (Stratum IV)
2 (Approx Sta 23+53)	63	1179	Refusal in moderately hard cherty limestone (Stratum IV)
3 (East Bridge End)	45	1198	Refusal in moderately hard cherty limestone (Stratum IV)

It should be noted that the prebore depths and tip elevations shown in the table above are estimates only based on the results of the relevant borings and the inferred surface elevations at the particular locations. Pile refusal and final depth must be field verified.

Steel piles at the end bents (Bents 1, 2, and 3) may be subjected to uplift loads. Nominal single pile uplift capacity curves for steel HP14x73 piles are provided in Appendix E. Nominal axial pile capacities have been developed using static pile capacity formulae, the results of the borings, and the plan MSE wall subgrade elevations shown on the preliminary bridge layout drawings. Prebored and grouted piles have been assumed for calculation of the uplift resistance.

Based on AASHTO LRFD geotechnical design procedures, a resistance factor (φ_{up}) of 0.25 is recommended for evaluation of factored uplift capacity. This resistance factor is based on Strength Limit States. For Extreme Events Limit States such as earthquake loading and collision, a resistance factor of 0.8 for uplift is recommended.

Piles should be installed in compliance with Standard Specifications for Highway Construction, 2014 Edition, Section 805. We recommend a hammer delivering a minimum energy of 34,000 ft-lbs per blow. A higher energy hammer may be required where the Contractor plans to drive a heavier steel pile section through the interbedded chert zones. A specific review and analysis of the pile-hammer system proposed by the Contractor should be performed by the

Engineer prior to hammer acceptance and start of driving. We recommend that all piles be fitted with rock points.

A minimum pile length of 10 ft is recommended. As noted, preboring is expected for pile installation to facilitate installation through the more resistant chert seams, layers, and beds. encountered at shallow depth. Rock drilling methods could be required for prebores extending through thicker intervals of chert or weathered limestone. Following pile acceptance, the annulus around installed piles in prebores should be expeditiously backfilled as per ARDOT Standard Specifications Section 805. The grout should have a minimum compressive strength of 4000 lbs per sq in., as per ARDOT Section 501 or an alternate approved by the Engineer.

As a minimum, safe bearing capacity of piles should be determined by ARDOT Standard Specifications Section 805.09, Method A. Driving records should be available for review by the Engineer during pile installation. Blow counts on steel piles should be limited to about 20 blows per inch. Practical pile refusal may be defined as a penetration of 0.5 in. or less for the final 10 blows. Driving records should be available for review by the Engineer during pile installation.

MSE Walls

The project includes mechanically stabilized earth (MSE) retaining walls on both bridge ends. Wall height varies from a nominal 2 ft to 27 ft, with the maximum height of the walls near the center of the wall alignment and the height tapering out away from the bridge ends and parallel to the roadway. Design of MSE walls must include consideration of both internal and external stability. Design with respect to internal stability must be performed by the specific wall designer based on final plans and configurations. Analyses have been performed to verify external (global) stability and bearing capacity. Conclusions and recommendations regarding wall bearing and global stability are discussed in the following report sections.

MSE Wall Bearing

The subgrade and foundation soils in the wall alignment generally consist of stiff to very stiff clay and silty clay with numerous chert fragments. These soils exhibit moderate shear strength and low compressibility. Depending on final grading plans, some undercut and replacement may be required to improve bearing capacity and to limit settlement. MSE wall bearing recommendations are summarized below.

1. Bent 1 – West bridge end
    a. Undercut the leveling pad and reinforced zone subgrade as needed to encounter the very stiff clay and silty clay with chert fragments (Stratum II). The undercut should extend at least 5 ft beyond the reinforced zone limits to the extent possible.
        i. Mass undercut on the order of 4 ft, more or less, could be required to develop suitable bearing.
        ii. Backfill any undercut with ARDOT Standard Specifications Section 303, Class 7 crushed stone aggregate base or Select Granular Backfill (AASHTO M43 No. 57).
        iii. Nominal bearing on very stiff clay: 16,000 lbs per sq ft
2. Bent 3 – East bridge end
    a. Undercut the leveling pad and reinforced zone subgrade as needed to encounter the very stiff clay and silty clay with chert fragments (Stratum II). The undercut should extend at least 5 ft beyond the reinforced zone limits to the extent possible.
        i. Mass undercut on the order of 2 ft, more or less, should be anticipated to develop suitable bearing.
        ii. Backfill all undercuts with ARDOT Standard Specifications Section 303, Class 7 crushed stone aggregate base or Select Granular Backfill (AASHTO M43 No. 57).
        iii. Nominal bearing on very stiff clay: 16,000 lbs per sq ft
3. Resistance factor (φ_b) for bearing resistance: 0.65
4. Nominal resistance to sliding: 0.35
5. Resistance factor for sliding resistance (φ_τ): 1.0

The MSE wall leveling pads and reinforced zones should bear as recommended above and at a minimum depth of 2 ft below lowest adjacent grade. A minimum wall embedment of 2 ft and a minimum reinforcement length of 0.7H or 8 ft, whichever is greater, is recommended. Subgrade and foundation preparation in the wall locations and under all embankments must include stripping all organics and thorough proof-rolling.

The suitability of the MSE wall bearing stratum must be field verified by the Engineer or Department at the time of construction. Where undercuts are warranted, these should extend a minimum horizontal distance determined by a 1-horizontal to 1 -vertical (1H:1V) projection or at least 5 ft, whichever is greater, beyond the reinforced zone to the undercut bottom.

Where seepage into undercuts is apparent or positive drainage cannot be assured, Select Granular Backfill should be used for backfill. The crushed stone should be fully encapsulated in a filter fabric geotextile complying with ARDOT Standard Specifications Subsection 625.02, Type 2. Granular backfill should be vented to positive discharge for the relief of infiltrated surface water and/or groundwater.

MSE Wall Global Stability

Stability analyses were performed to verify global stability of the MSE walls at both the bridge abutments. A 250 lbs per sq ft uniform surcharge from vehicles was included for the purposes of stability analyses. Stability analyses were performed using the computer program SLOPE/W 2020[4] and a Morgenstern-Price analysis. Three (3) general loading conditions were evaluated, i.e., End of Construction, Long Term, and Seismic Conditions. For analysis of the seismic condition, a horizontal seismic acceleration coefficient (k_h) of one-half the peak acceleration (A_s) was used, a value of 0.0245.

Stability analyses results for the MSE walls are summarized and presented graphically in Appendix F. The results of the stability analyses indicate that global stability of plan configurations of the MSE walls is acceptable with respect to stability of all loading conditions evaluated.

Embankment Slopes

The bridge end embankments will utilize MSE walls at the bridge abutments and simple slopes at 3-horizontal to 1-vertical (3H:1V) configurations on the embankment sides. The bridge embankments will have maximum heights of about 28 feet.

To evaluate suitability of the side slope plan configurations, slope stability analyses were performed using the computer program SLOPE/W 2020[5] and utilizing a Morgenstern-Price analysis. A 250 lbs per sq ft uniform surcharge from vehicles was included for the purposes of stability analyses. Stability analyses For the embankment slopes, End of Construction, Long Term, and Seismic Conditions were evaluated. For analysis of the seismic condition, a horizontal seismic acceleration coefficient (k_h) of one-half the peak acceleration (A_s) was used, a value of 0.0245.

The stability analyses results summarized in Appendix F include the results of evaluation of side slopes. The results of the stability analyses indicate that plan configurations of the side slopes are acceptable with respect to stability of all loading conditions evaluated.

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[4] Slope/W 2020; GEO-SLOPE International; 2020.

[5] *ibid*

Subgrade Support

The results of the borings indicate the on-site subgrade soils generally consist of silt, clay and silty clay with chert fragments (AASHTO A-2-6, A-4, A-6, and A-7-5). Given the anticipated new embankment, the approach roadway subgrade is likely to consist of embankment fill. Locally-available borrow, which is likely to be used as unclassified embankment fill, is expected to have similar classification.

We recommend that any soils classifying as A-7-5 or A-7-6 soils be excluded from use as subgrade within 18 in. of the plan subgrade elevation. The top 18 in. of subgrade soils should have a maximum plasticity index (PI) of 18. The as-built pavement subgrade should be evaluated by the Engineer. Areas of unstable or otherwise unsuitable subgrade should be improved by undercut and replacement or treatment with additives approved by the Engineer.

Based on the results of previous laboratory CBR tests on the silty clay with chert fragments subgrade and correlation with the AASHTO classification, we recommend the following parameters for use in design of pavements.

• CBR:	8.3
• Resilient Modulus (MR):	3260 lbs per sq in.
• R value:	13
• Modulus of Subgrade Reaction (k):	100 lbs per cu in.

Site Grading and Subgrade Preparation

As noted, the surface soils are silty, poorly graded, and moisture-sensitive. Though presently stable, at elevated water contents the silt and clayey silt subgrade is likely to be soft and unstable. Consequently, site grading operations will be significantly easier to perform during dry seasons of the year.

Site preparation will require localized clearing and grubbing and stripping the zone of organic-containing soils. The depth of stripping will be variable, with deeper stripping depths in wooded areas, and less stripping required in open land. In general, the stripping depth is estimated to be about 6 to 9 inches in clear areas but may be 18 to 24 in. or more in the localized areas where trees and thick underbrush are present. The zone of organic surface soils should be completely stripped in the embankment footprint areas and at least 5 ft beyond the projected embankment toes and outside the reinforced zone of MSE walls. Particular care must be taken to muck out all saturated and/or organic-laden soils in the existing drainage features.

Following stripping and prior to fill placement, the extent of weak and unsuitable soils should be determined. Thorough proof-rolling should be performed to verify subgrade stability.

Proof-rolling should be performed with a loaded tandem-wheel dump truck or similar equipment. Unstable soils exhibiting a tendency to rut and/or pump should be undercut and replaced with suitable fill. Care should be taken that undercuts, stump holes, and other excavations or low areas resulting from subgrade preparation are properly backfilled with compacted fill.

Depending on seasonal conditions, undercuts of about 2 to 4 ft below existing grades, more or less, could be required. Deeper undercuts may be required in wet seasons. General undercuts for site grading may be backfilled with unclassified borrow used for embankment fill. Undercuts under MSE wall foundations should be backfilled with ARDOT Standard Specifications Section 303, Class 7 crushed stone aggregate base or Select Granular Backfill (AASHTO M43 No. 57).

In lieu of undercutting and replacing unsuitable soils in approach road alignments, consideration may be given to using additives to improve soil workability and to stabilize weak areas. Hydrated lime, quick lime, Portland cement, fly ash, or suitable alternate materials may be used as verified by appropriate testing and approved by the Engineer. Additives can be effective where the depth of unstable soils is relatively shallow. Treatment will be less effective in areas where the zone of unstable soils is deep. The optimum application rate of stabilization additive must be determined by specific laboratory tests performed on the alignment subgrade soils. We recommend a minimum treatment depth of 8 inches.

Subgrade preparation and mass undercuts should extend at least 5 ft beyond the embankment toes and outside the reinforced zone of MSE walls to the extent possible. Subgrade preparation for the approach roads should extend at least 3 ft outside pavement shoulder edges to the extent possible.

Fill and backfill may consist of unclassified borrow free of organics and other deleterious materials as per ARDOT Standard Specifications Subsection 210.06. Where A-7-5 or A-7-6 soils are encountered at the subgrade elevation, we recommend that these soils be undercut as required to provide at least 18 in. of suitable low-plasticity subgrade soils, i.e., with a maximum PI of 18, or approved "hillside" cherty clay with a maximum of 35 percent passing the No. 200 sieve. Alternatively, stabilization additives may be utilized to develop a stable subgrade with a PI of 18 or less. Granular soils must be protected from erosion with a minimum 18-in.-thick armor of clayey soil.

Subgrade preparation should comply with ARDOT Standard Specifications Section 212. Embankments should be constructed in accordance with ARDOT criteria (ARDOT Standard Specifications Section 210). Fill and backfill should be placed in nominal 6- to 10-in.-thick loose lifts. All fill and backfill must be placed in horizontal lifts. The in-place density and water content should be determined for each lift and should be tested to verify compliance with the specified density and water content prior to placement of subsequent lifts.

CONSTRUCTION CONSIDERATIONS

Groundwater and Seepage Control

Positive surface drainage should be established at the start of the work, be maintained during construction and following completion of the work to prevent surface water ponding and subsequent saturation of subgrade soils. Density and water content of all earthwork should be maintained until embankments, bridge work, and pavements are completed.

Localized perched groundwater was encountered in the borings in January 2023. Shallow perched groundwater may be encountered in the near-surface soils, particularly during wet seasons. Seepage into excavations and cuts can typically be controlled by ditching or sump-and-pump methods. If seepage infiltration cannot be controlled, construction of drains and/or the use of Select Granular Backfill (AASHTO M 43 No. 57), stone backfill (ARDOT Standard Specifications Section 207), or approved alternates to an elevation above the inflow of seepage will be warranted. In areas of seepage infiltration, the granular fill should be encapsulated with a filter fabric complying with ARDOT Standard Specifications Subsection 625.02, Type 2 and vented to positive discharge. Where surface seeps or springs are encountered during site grading, we recommend the seepage be directed via French drains or blanket drains to positive discharge at daylight or to storm drainage lines.

Piling

Piles should be installed in compliance with ARDOT Standard Specifications, Section 805. Piles should be carefully examined prior to driving and piles with structural defects should be rejected. Any splices in steel piles should develop the full cross-sectional capacity of un-spliced piles. Preboring should be anticipated for pile installation. Some rock drilling could be required for prebores. Where piles are prebored to develop uplift resistance, the annulus between the steel piles and the prebore should be expeditiously backfilled with approved grout or concrete.

Pile installation should be monitored by qualified personnel to maintain specific and complete driving records and observe pile installation procedures. Safe bearing capacity of production piles should be determined by ARDOT Standard Specifications Section 805.09, Method A. Driving records should be available for review by the Engineer during pile installation. For driving steel piles on this project, we recommend a minimum hammer energy of 34,000 ft-lbs per blow. Blow counts on steel piles should be limited to about 20 blows per inch. Practical pile refusal may be defined as a penetration of 0.5 in. or less for the final 10 blows.

CLOSURE

The Engineer or Department or a designated representative thereof should monitor site preparation, grading work and foundation and pavement construction. Subsurface conditions significantly at variance with those encountered in the borings should be brought to the attention of the Geotechnical Engineer. The conclusions and recommendations of this report should then be reviewed in light of the new information.

The following illustrations are attached and complete this final report.

Plate 1	Site Vicinity
Plate 2	Plan of Borings
Plates 3 through 16	Boring Logs
Plates 17 and 18	Keys to Terms and Symbols
Appendix A	Preliminary Bridge Layout
Appendix B	Selected Rock Core Photographs
Appendix C	Classification Test Results
Appendix D	Generalized Subsurface Profile
Appendix E	Nominal HP14x73 Uplift Pile Capacity Curves
Appendix F	Stability Analyses Results

We appreciate the opportunity to be of service to you on this project. Should you have any questions regarding this report, or if we may be of additional assistance, please call on us.

Sincerely,

GRUBBS, HOSKYN,
BARTON &WYATT, LLC

Velleta M. Scott

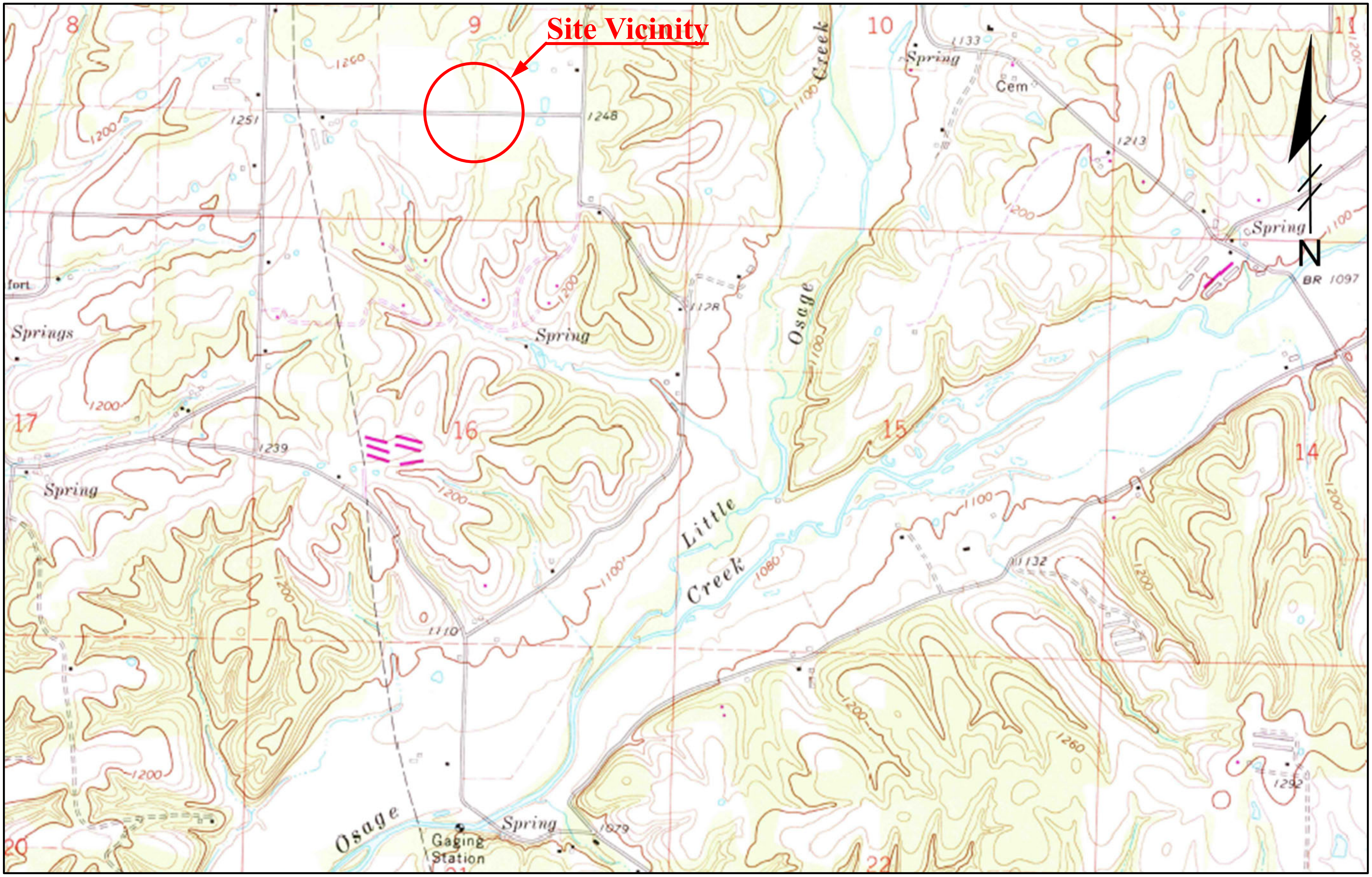
Velleta M. Scott, P.E.
Sr. Project Engineer

STATE OF ARKANSAS
REGISTERED PROFESSIONAL ENGINEER
No. 7791
MARK E. WYATT

Mark E. Wyatt, P.E.
President

VMS/MEW:jw

Copies Submitted: Garver LLC
Attn: Mr. Joel Skinner, P.E. (1-email)
Attn: Mr. Lawren Wilcox, P.E. (1-email)
Attn: Mr. Adam Wierciak, P.E. (1-email)

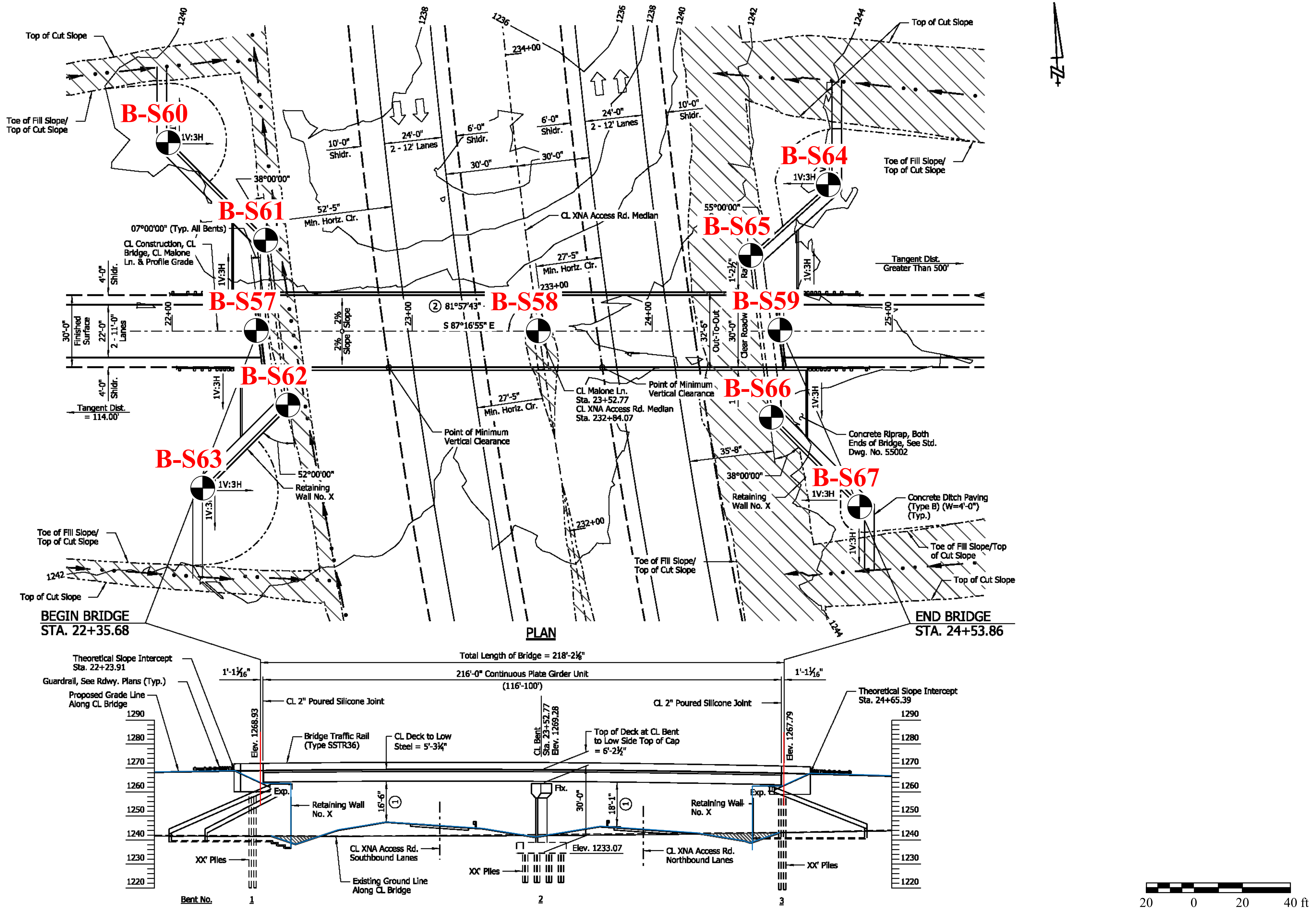


Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

SITE VICINITY MAP
090069 Malone Lane over XNA Access Road
Benton County, Arkansas

Job No. 19-118

Plate 1



Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

PLAN of BORINGS
090069 Malone Lane over XNA Access Road
Benton County, Arkansas

Scale: As shown

Job No. 19-118

PLATE 2

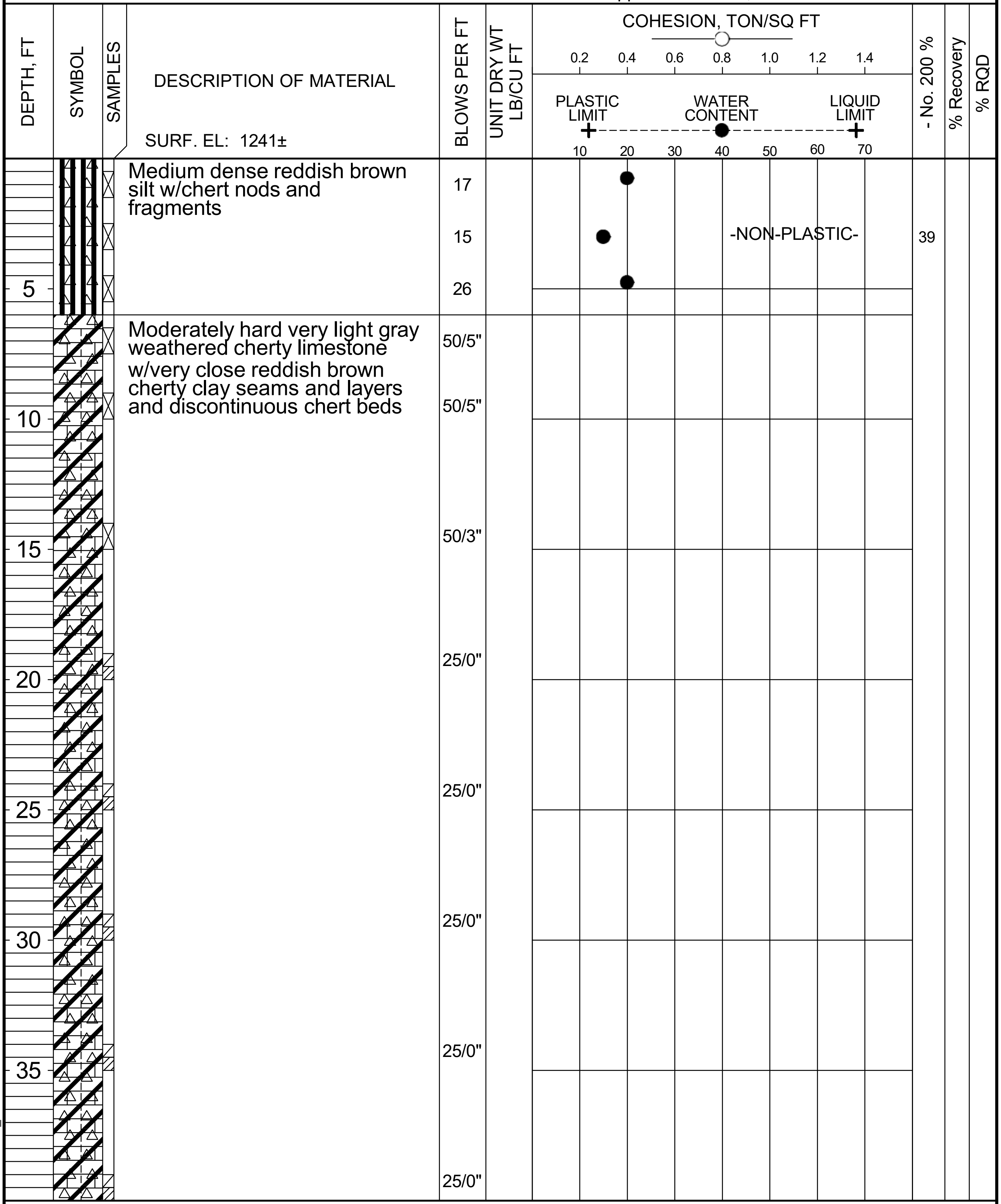
Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S57

090069 Malone Lane over XNA Access Road
Benton Co., Arkansas

TYPE: Auger to 15 ft /Wash

LOCATION: Approx Sta 22+36, CL



SURF. EL: 1241±

DESCRIPTION OF MATERIAL	BLOWS PER FT		- No. 200 %
Medium dense reddish brown silt w/chert nods and fragments	17		
	15	-NON-PLASTIC-	39
	26		
Moderately hard very light gray weathered cherty limestone w/very close reddish brown cherty clay seams and layers and discontinuous chert beds	50/5"		
	50/5"		
	50/3"		
	25/0"		
	25/0"		
	25/0"		
	25/0"		
	25/0"		

COMPLETION DEPTH: 62.0 ft
DATE: 2-15-23

DEPTH TO WATER
IN BORING: Dry to 15 ft

DATE: 2/15/2023

**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**
Consulting Engineers

LOG OF BORING NO. S57

090069 Malone Lane over XNA Access Road
Benton Co., Arkansas

TYPE: Auger to 15 ft /Wash

LOCATION: Approx Sta 22+36, CL

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT 0.2 0.4 0.6 0.8 1.0 1.2 1.4 PLASTIC LIMIT + WATER CONTENT ● LIQUID LIMIT + 10 20 30 40 50 60 70	- No. 200 %	% Recovery	% RQD
45				25/0"					
			Moderately hard gray and tan weathered cherty limestone w/ clay seams and pockets	25/0"					
50			Moderately hard gray cherty limestone, flat bedded - highly fractured w/ clay laminations and seams to 55 ft					33	0
55						q_u= 5840 psi, TUW= 153 pcf		100	100
60								99	85
65									
70									
75									

COMPLETION DEPTH: 62.0 ft
DATE: 2-15-23

DEPTH TO WATER
IN BORING: Dry to 15 ft

DATE: 2/15/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S58

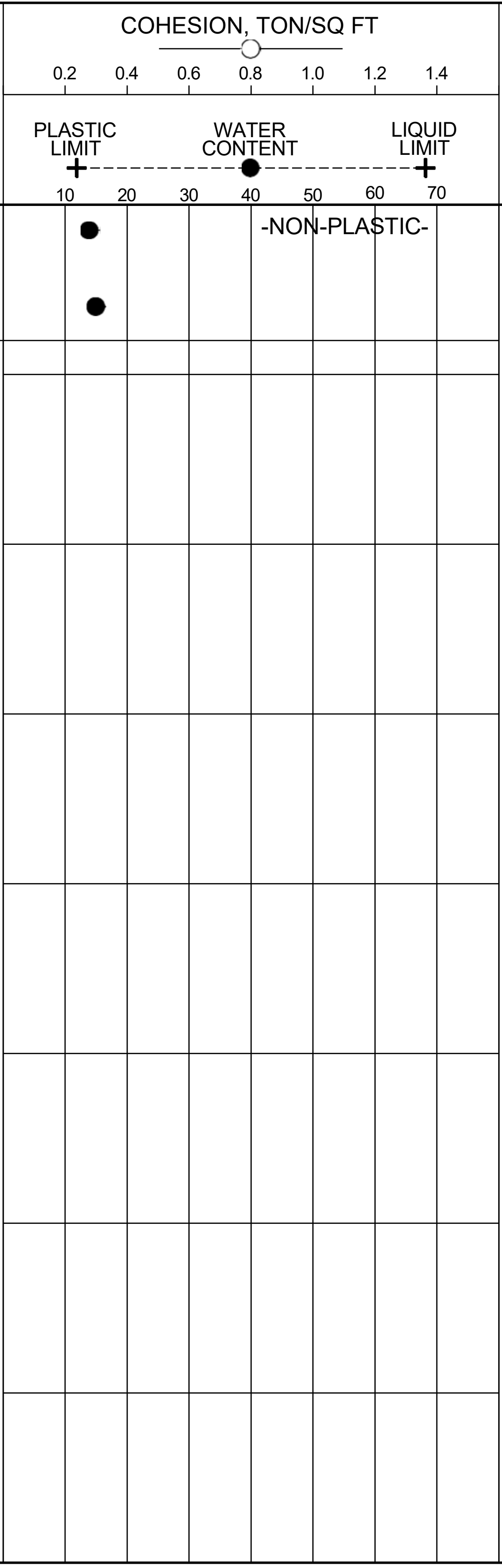
090069 Malone Lane over XNA Access Road
Benton Co., Arkansas

TYPE: Auger to 20 ft /Wash

LOCATION: Approx Sta 23+50, CL

SURF. EL: 1242±

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
			Medium dense brown silt w/chert fragments and nodules	23		-NON-PLASTIC-	41		
				24					
5			Low hardness very light gray weathered cherty limestone w/very close reddish brown cherty clay seams and layers - moderately hard w/ discontinuous chert beds below 6.5 ft	45					
				50/8"					
10				50/3"					
15				25/0"					
20				25/0"					
25				25/0"					
30				25/0"					
35				25/0"					
				25/0"					



COMPLETION DEPTH: 68.0 ft
DATE: 2-6-23

DEPTH TO WATER
IN BORING: Dry to 20 ft

DATE: 2/6/2023

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Consulting Engineers

LOG OF BORING NO. S58

090069 Malone Lane over XNA Access Road
Benton Co., Arkansas

TYPE: Auger to 20 ft /Wash

LOCATION: Approx Sta 23+50, CL

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT + - - - WATER CONTENT ● - - - LIQUID LIMIT +: 10 20 30 40 50 60 70

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION / WATER CONTENT	- No. 200 %	% Recovery	% RQD
		25/0"					
45							
		25/0"					
50							
		25/0"					
55							
		25/0"					
60							
	Moderately hard gray cherty limestone, flat bedded			q_u= 2830 psi, TUW= 147 pcf			
65						100	67
70							
75							

COMPLETION DEPTH: 68.0 ft
DATE: 2-6-23

DEPTH TO WATER
IN BORING: Dry to 20 ft

DATE: 2/6/2023

RECRQDN200-2 19-118_MALONE RD.GPJ 6-1-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

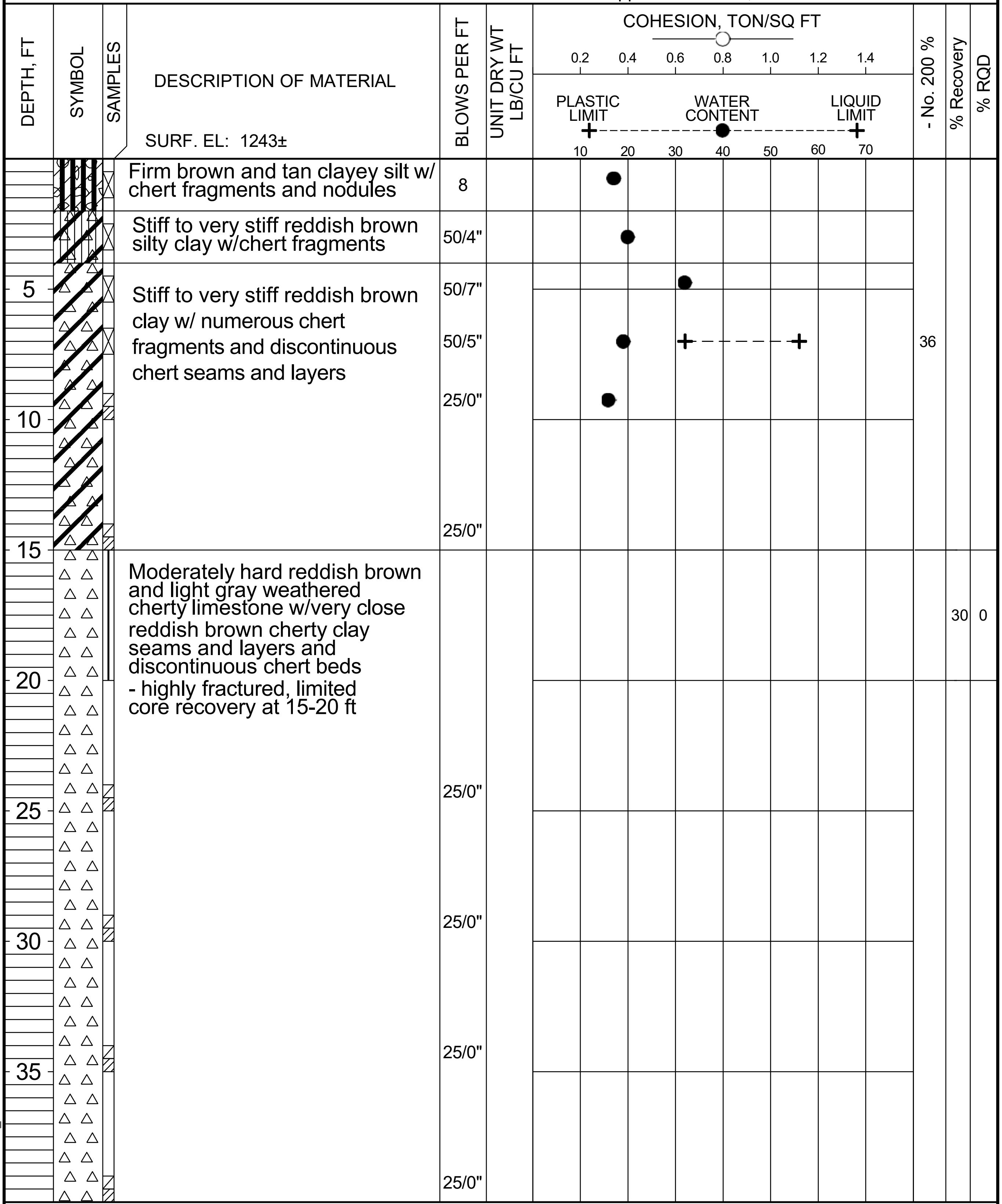
LOG OF BORING NO. S59

090069 Malone Lane over XNA Access Road
Benton Co., Arkansas

TYPE: Auger to 15 ft /Wash

LOCATION: Approx Sta 24+57, CL

SURF. EL: 1243±



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
Firm brown and tan clayey silt w/ chert fragments and nodules	8				
Stiff to very stiff reddish brown silty clay w/chert fragments	50/4"				
Stiff to very stiff reddish brown clay w/ numerous chert fragments and discontinuous chert seams and layers	50/7" 50/5" 25/0" 25/0"		 36		
Moderately hard reddish brown and light gray weathered cherty limestone w/very close reddish brown cherty clay seams and layers and discontinuous chert beds - highly fractured, limited core recovery at 15-20 ft	25/0" 25/0" 25/0" 25/0"			30	0

COMPLETION DEPTH: 55.0 ft
DATE: 1-25-23

DEPTH TO WATER
IN BORING: Dry to 15 ft

DATE: 1/25/2023

RECRQDN200-2 19-118_MALONE RD.GPJ 4-17-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S59

090069 Malone Lane over XNA Access Road
Benton Co., Arkansas

TYPE: Auger to 15 ft /Wash

LOCATION: Approx Sta 24+57, CL

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT 0.2 0.4 0.6 0.8 1.0 1.2 1.4 / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT 10 20 30 40 50 60 70	- No. 200 %	% Recovery	% RQD
				25/0"					
45			Moderately hard light gray and gray slightly weathered cherty limestone, flat bedded					87	70
50								97	55
55									
60									
65									
70									
75									

COMPLETION DEPTH: 55.0 ft
DATE: 1-25-23

DEPTH TO WATER
IN BORING: Dry to 15 ft

DATE: 1/25/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S60

090069 Malone Lane over XNA Access Road
Benton Co., Arkansas

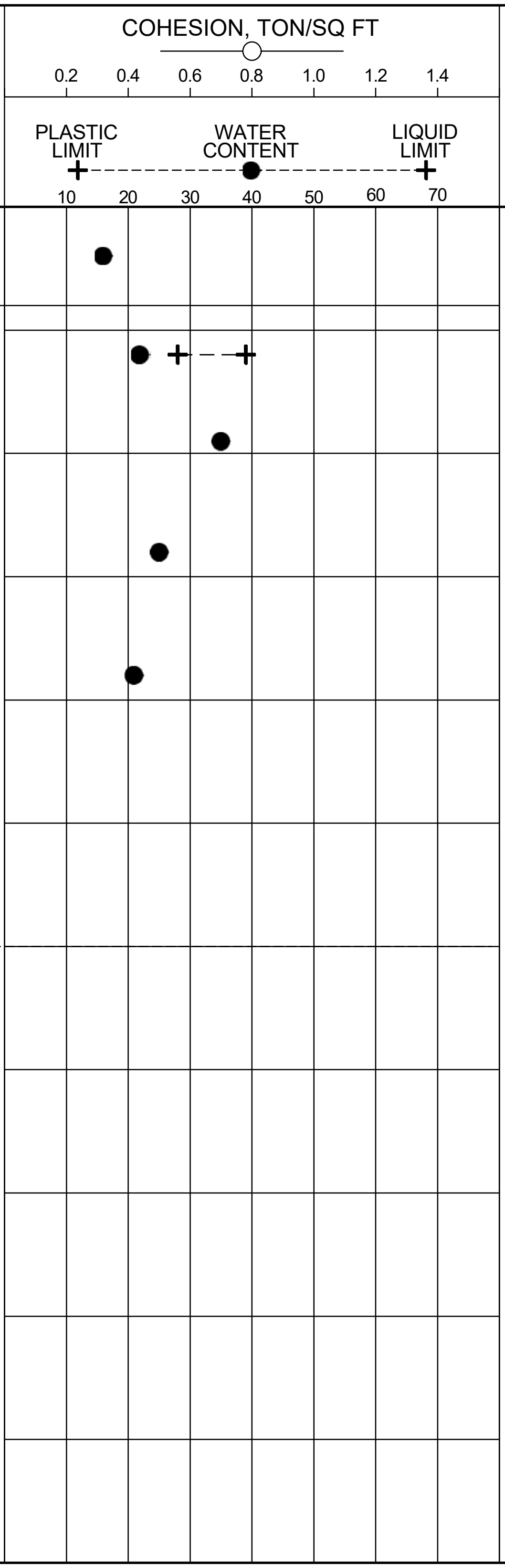
TYPE: Auger

LOCATION: Approx Sta 22+04, 74 ft Lt

SURF. EL: 1240±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
	Loose brown and tan fine sandy silt, slightly clayey	4		
	Stiff to very stiff reddish brown clay w/chert nodules and fragments	32		23
5	- with discontinuous chert seams and layers below 4 ft	50/7"		
		50/3"		
		50/4"		
10				
15	- with more chert fragments below 14 ft	25/0"		
20				
25				

Note: Practical refusal in hard chert bed or cherty limestone



COMPLETION DEPTH: 15.0 ft
DATE: 1-19-23

DEPTH TO WATER
IN BORING: Dry

DATE: 1/19/2023

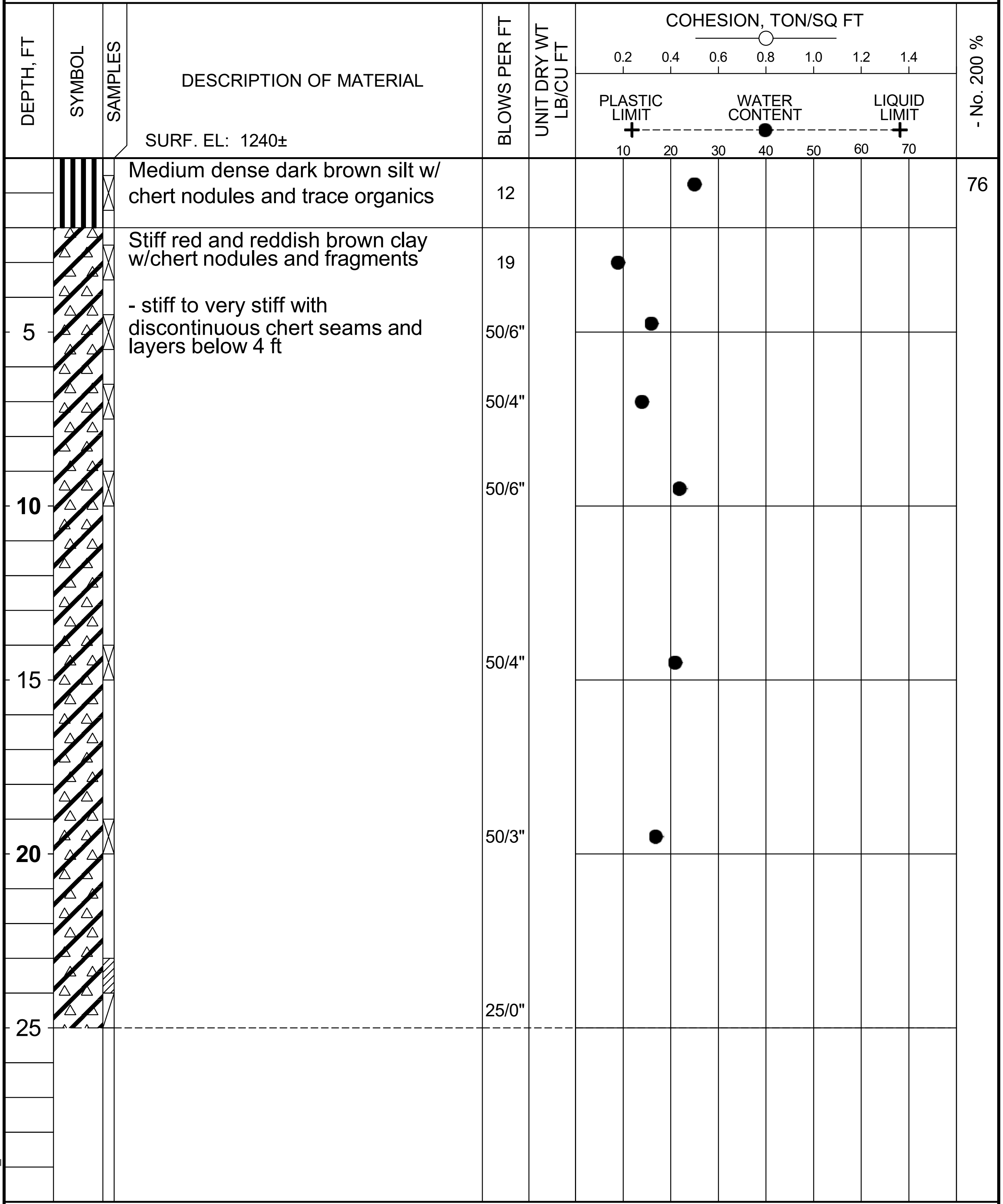
Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S61

090069 Malone Lane over XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 22+35, 40 ft Lt



DESCRIPTION OF MATERIAL	BLOWS PER FT	- No. 200 %
Medium dense dark brown silt w/ chert nodules and trace organics	12	76
Stiff red and reddish brown clay w/chert nodules and fragments	19	
- stiff to very stiff with discontinuous chert seams and layers below 4 ft	50/6"	
	50/4"	
	50/6"	
	50/4"	
	50/3"	
	25/0"	

COMPLETION DEPTH: 25.0 ft
DATE: 1-19-23

DEPTH TO WATER
IN BORING: Dry

DATE: 1/19/2023

LGBNEW 19-118_MALONE RD.GPJ 3-1-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

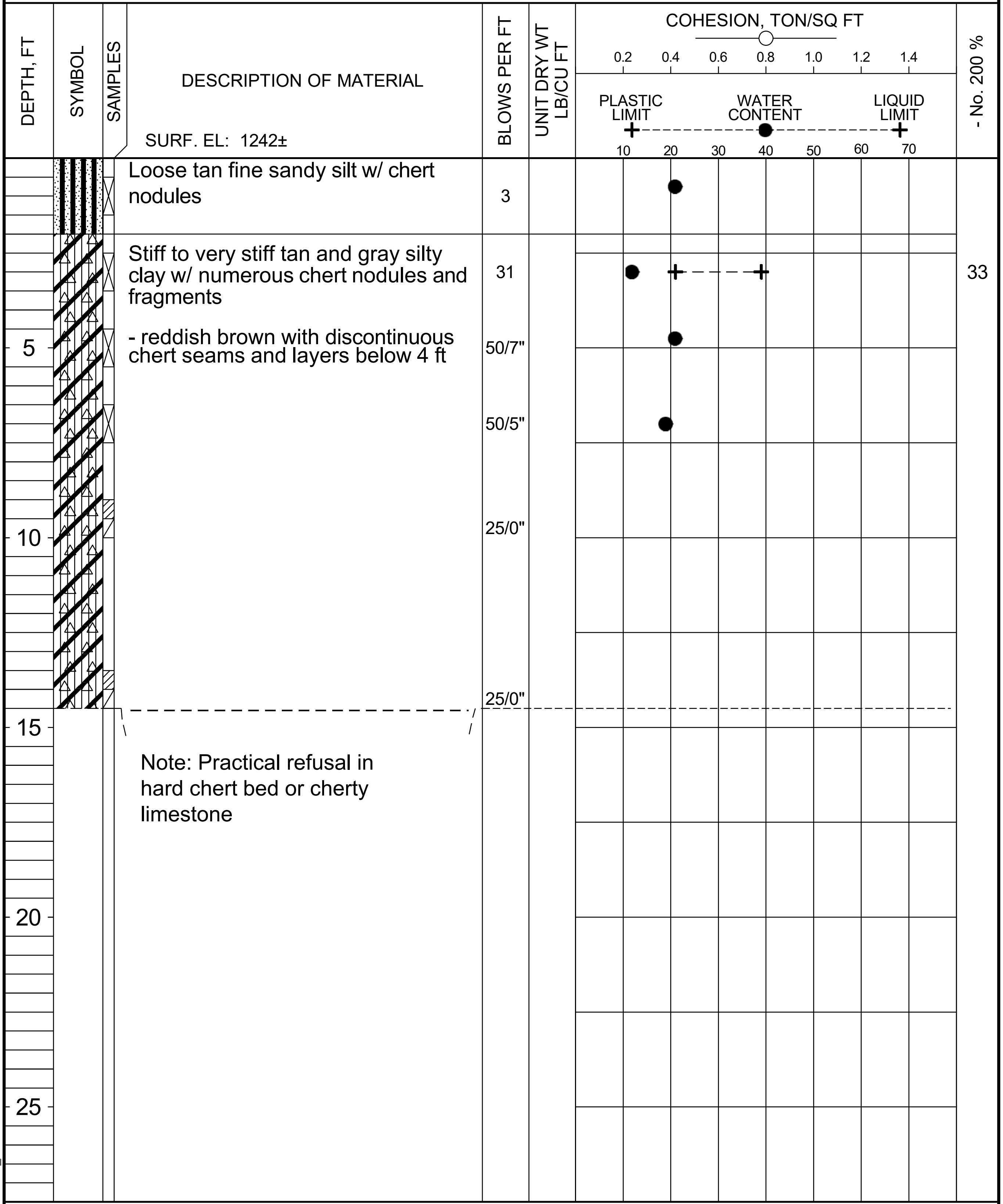
LOG OF BORING NO. S62

090069 Malone Lane over XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 22+44, 34 ft Rt

SURF. EL: 1242±



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
Loose tan fine sandy silt w/ chert nodules	3		
Stiff to very stiff tan and gray silty clay w/ numerous chert nodules and fragments	31		33
- reddish brown with discontinuous chert seams and layers below 4 ft	50/7"		
	50/5"		
	25/0"		
	25/0"		

Note: Practical refusal in hard chert bed or cherty limestone

COMPLETION DEPTH: 14.5 ft
DATE: 1-20-23

DEPTH TO WATER
IN BORING: Dry

DATE: 1/20/2023

19-118

Grubbs, Hoskyn,
Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S63

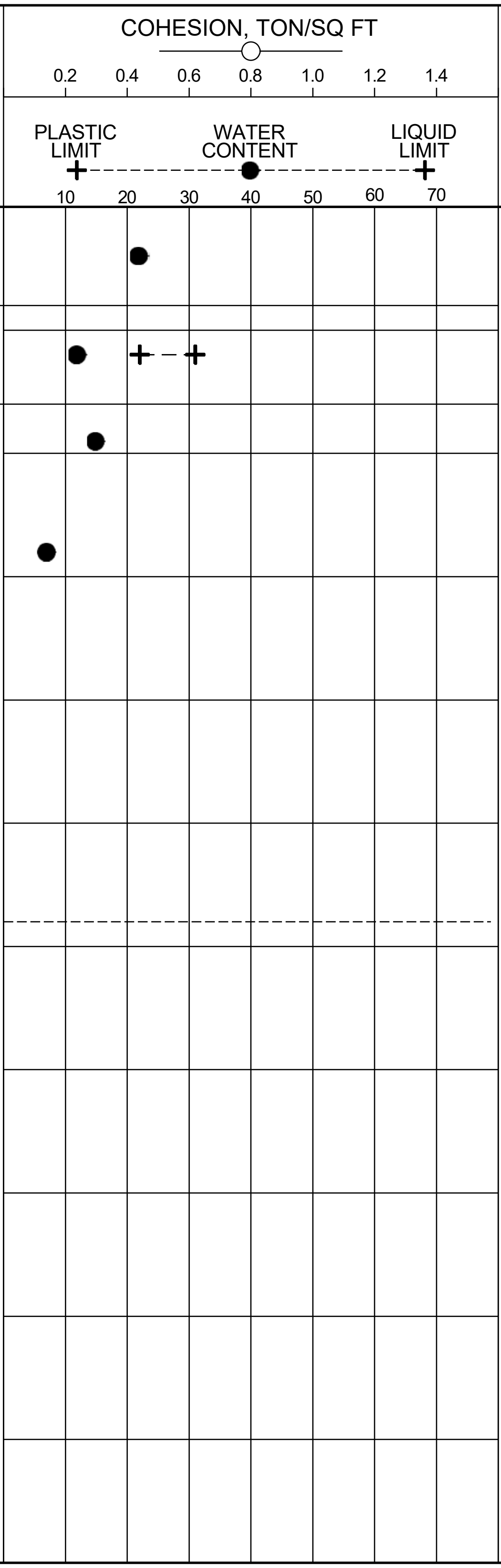
090069 Malone Lane over XNA Access Road
Benton Co., Arkansas

TYPE: Auger LOCATION: Approx Sta 22+09, 67 ft Rt

SURF. EL: 1242±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
0	Loose tan fine sandy silt w/ chert nodules	4		87
2	Very stiff tan and gray clayey silt w/chert nodules and fragments	50		36
4	Stiff to very stiff reddish brown and gray clay w/chert nodules and fragments and discontinuous chert seams and layers	50/9"		
		50/4"		
		50/6"		
		25/0"		

Note: Practical refusal in hard chert bed or cherty limestone



COMPLETION DEPTH: 14.5 ft
DATE: 1-20-23

DEPTH TO WATER
IN BORING: Dry

DATE: 1/20/2023

LGBNEW 19-118_MALONE RD.GPJ 3-1-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S64

090069 Malone Lane over XNA Access Road
Benton Co., Arkansas

TYPE: Auger

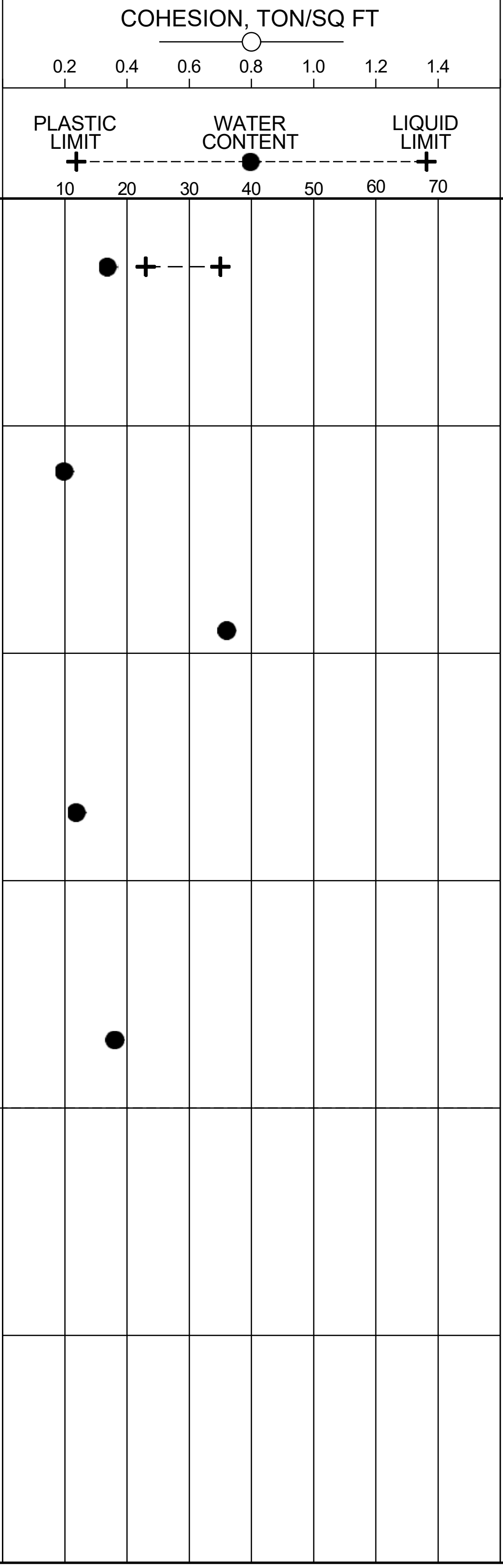
LOCATION: Approx Sta 24+78, 60 ft Lt

SURF. EL: 1244±

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
Stiff to very stiff reddish brown and clay w/chert nodules and fragments			37
	31		
- with discontinueous chert seams and layers below 2.5 ft			
	50/7"		
	50/6"		
	50/3"		
	25/0"		

DEPTH, FT: 5, 10, 15

Note: Practical refusal in hard chert bed or cherty limestone



COMPLETION DEPTH: 10.0 ft
DATE: 1-19-23

DEPTH TO WATER
IN BORING: Dry

DATE: 1/19/2023

19-118

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

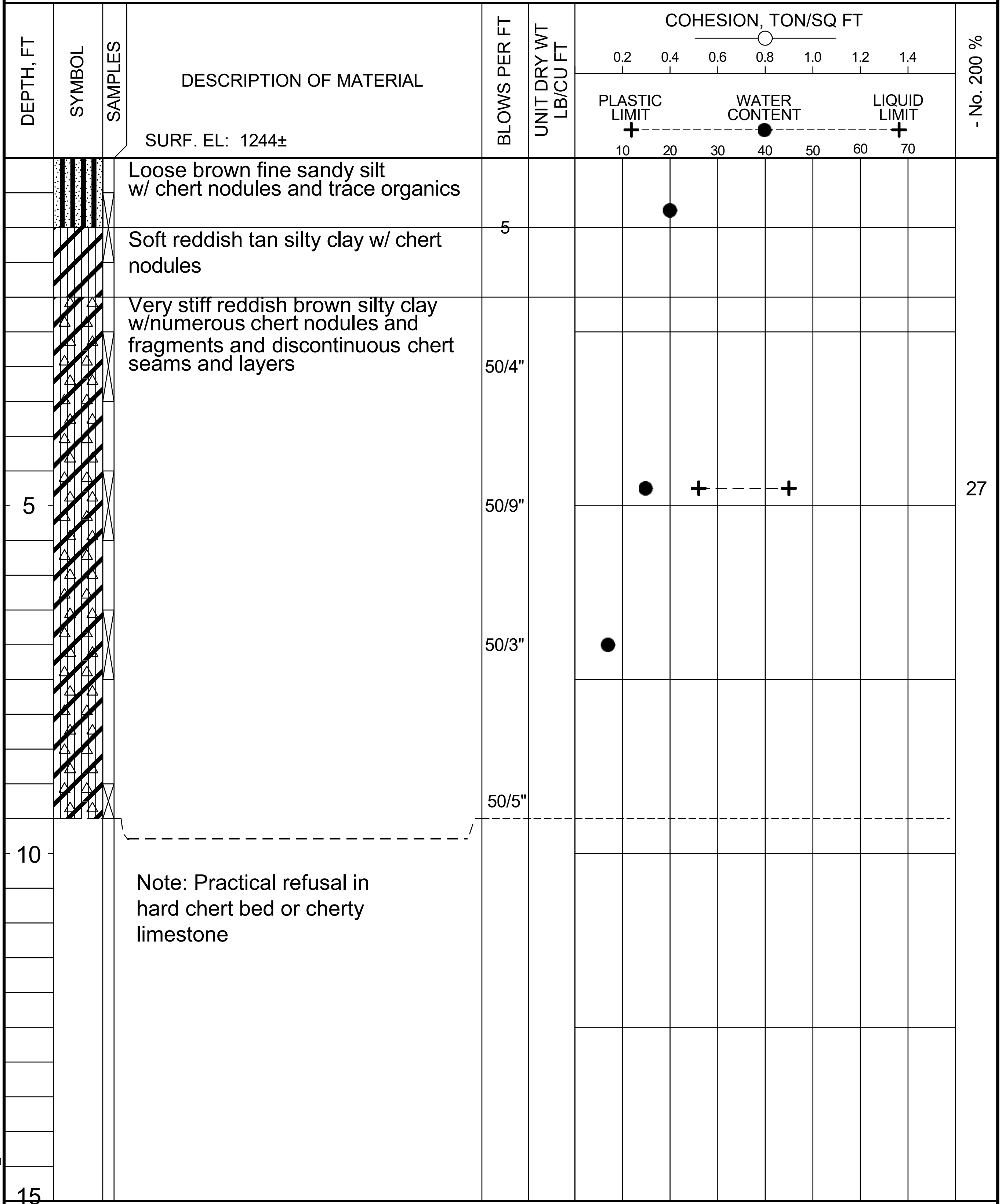
LOG OF BORING NO. S65

090069 Malone Lane over XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 22+10, 67 ft Rt

SURF. EL: 1244±



Loose brown fine sandy silt w/ chert nodules and trace organics

Soft reddish tan silty clay w/ chert nodules

Very stiff reddish brown silty clay w/numerous chert nodules and fragments and discontinuous chert seams and layers

Note: Practical refusal in hard chert bed or cherty limestone

COMPLETION DEPTH: 9.5 ft
DATE: 1-19-23

DEPTH TO WATER
IN BORING: Dry

DATE: 1/19/2023

LGBNEW 19-118_MALONE RD.GPJ 5-23-23

19-118

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S66

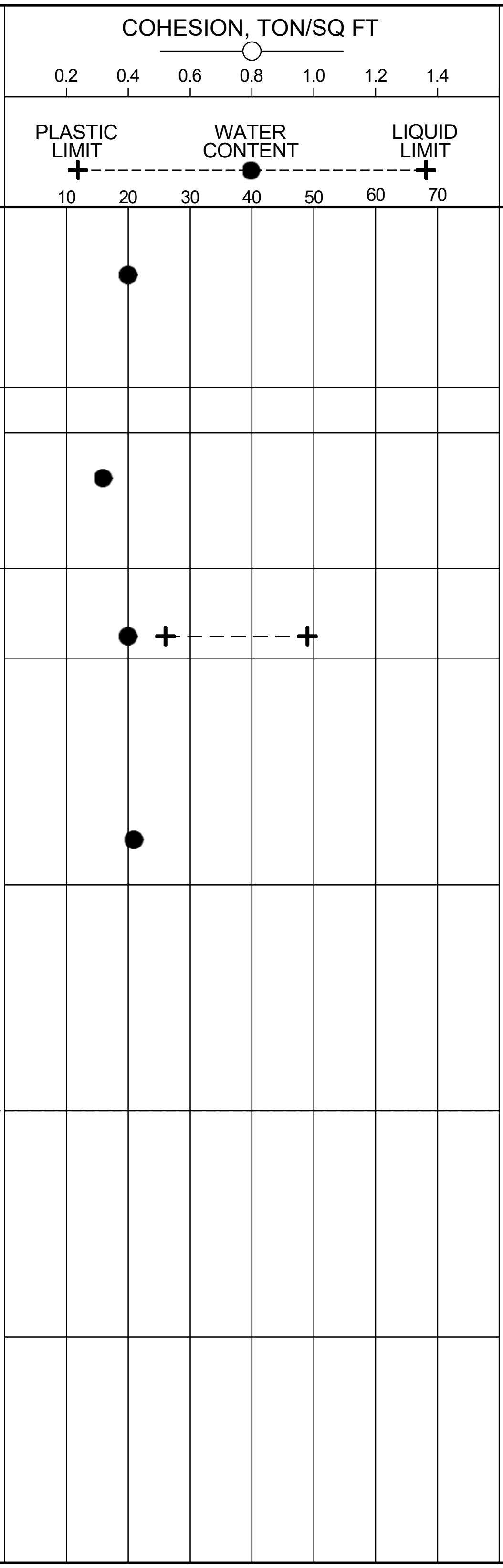
090069 Malone Lane over XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 24+58, 38 ft Rt

SURF. EL: 1242±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
	Loose tan fine sandy silt, slightly clayey w/ chert nodules	5		
	Stiff to very stiff tan silty clay w/chert nodules and fragments	27		
5	Very stiff reddish brown and tan silty clay w/numerous chert nodules and fragments and discontinuous chert seams and layers	50/11"		29
		50/7"		
		50/4"		
		25/0"		
10	Note: Practical refusal in hard chert bed or cherty limestone			
15				



COMPLETION DEPTH: 10.0 ft
DATE: 1-20-23

DEPTH TO WATER
IN BORING: Dry

DATE: 1/20/2023

LGBNEW 19-118_MALONE RD.GPJ 5-23-23

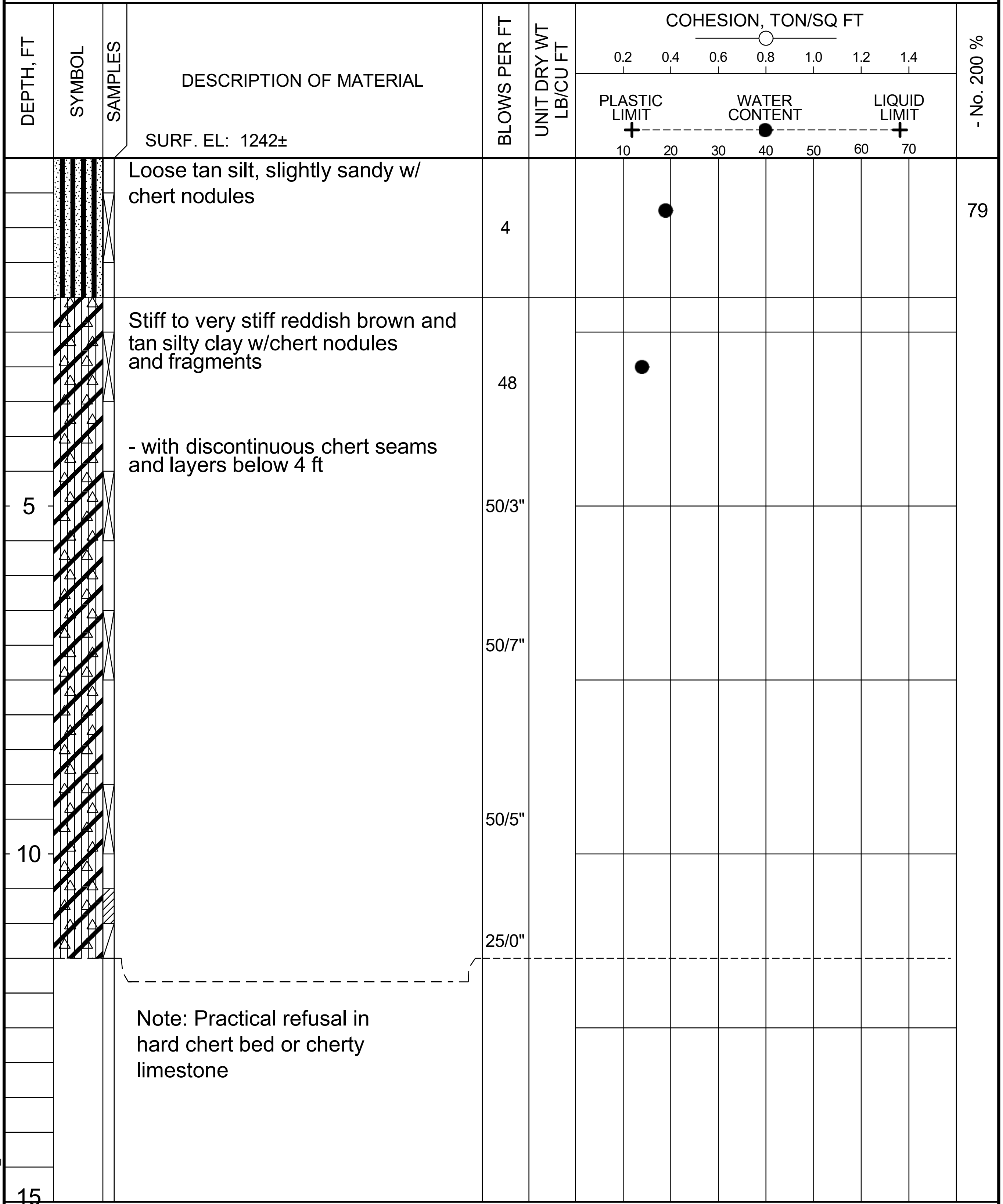
Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. S67

090069 Malone Lane over XNA Access Road
Benton Co., Arkansas

TYPE: Auger

LOCATION: Approx Sta 24+90, 78 ft Rt



SURF. EL: 1242±

DESCRIPTION OF MATERIAL	BLOWS PER FT	- No. 200 %
Loose tan silt, slightly sandy w/ chert nodules	4	79
Stiff to very stiff reddish brown and tan silty clay w/chert nodules and fragments	48	
- with discontinuous chert seams and layers below 4 ft	50/3"	
	50/7"	
	50/5"	
	25/0"	

Note: Practical refusal in hard chert bed or cherty limestone

COMPLETION DEPTH: 11.5 ft
DATE: 1-20-23

DEPTH TO WATER
IN BORING: 12 ft

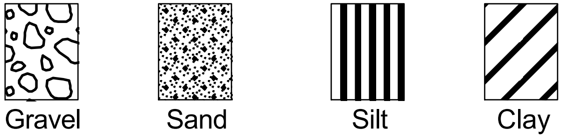
DATE: 1/20/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

SYMBOLS AND TERMS USED ON BORING LOGS

SOIL TYPES

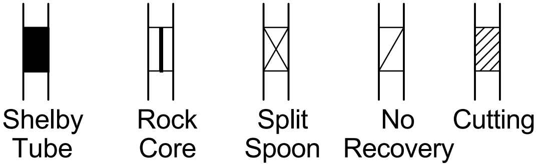
(SHOWN IN SYMBOLS COLUMN)



Predominant type shown heavy

SAMPLER TYPES

(SHOWN ON SAMPLES COLUMN)



TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on No. 200 sieve): Includes (I) Clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as determined by laboratory tests.

DESCRIPTIVE TERM	N-VALUE	RELATIVE DENSITY
VERY LOOSE	0-4	0-15%
LOOSE	4-10	15-35%
MEDIUM DENSE	10-30	35-65%
DENSE	30-50	65-85%
VERY DENSE	50 and above	85-100%

FINE GRAINED SOILS (major portion passing No. 200 sieve): Includes (1) Inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests.

DESCRIPTIVE TERM	UNCONFINED COMPRESSIVE STRENGTH TON/SQ. FT.
VERY SOFT	Less than 0.25
SOFT	0.25-0.50
FIRM	0.50-1.00
STIFF	1.00-2.00
VERY STIFF	2.00-4.00
HARD	4.00 and higher

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

TERMS CHARACTERIZING SOIL STRUCTURE

SLICKENSIDED - having inclined planes of weakness that are slick and glossy in appearance.
FISSURED - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
LAMINATED - composed of thin layers of varying color and texture.
INTERBEDDED - composed of alternate layers of different soil types.
CALCAREOUS - containing appreciable quantities of calcium carbonate.
WELL GRADED - having a wide range in grain sizes and substantial amounts of all intermediate particle sizes.
POORLY GRADED - predominantly of one grain size, or having a range of sizes with some intermediate sizes missing.

Terms used on this report for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No.3-357, Waterways Experiment Station, March 1953

KEY 3-14-12

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Consulting Engineers

BORING LOG TERMS – ROCK

ROCK TYPES
(SHOWN IN SYMBOLS COLUMN)

Joint Characteristics –

	Spacing	
	Very Close	0.75 to 2.5 in.
	Close	2.5 to 8 in.
	Moderately Close	8 to 24 in.
	Wide	2 to 6 ft
	Very Wide	More than 6 ft

Bedding Characteristics –

Very Thin	0.75 to 2.5 in.
Thin	2.5 to 8 in.
Medium	8 to 24 in.
Thick	2 to 6 ft
Massive	More than 6 ft

Lithologic Characteristics –

Clayey
Shaly
Calcareous (limy)
Siliceous
Sandy (Arenaceous)
Silty
Plastic Seams

Parting –	Less than 1/1 6inch
Seam –	1 /1 6to 1 /2inch
Layer –	1 /2to 1 2inches
Stratum –	Greater than 1 2inches

Hardness–

Soft (S) – Reserved for plastic material alone.

Friable (F) – Easily crumbled by hand, pulverized or reduced to powder and is too soft to be cut with a pocket knife.

Low Hardness (LH) – Can be gouged deeply or carved with a pocket knife.

Moderately Hard (MH) – Can be readily scratched by a knife blade; scratch leaves a heavy trace of dust and scratch is readily visible after the powder has been blown away.

Hard (H) – Can be scratched with difficulty; scratch produces little powder and is often faintly visible; traces of the knife steel may be visible.

Very hard (VH) – Cannot be scratched with a pocket knife. Knife steel marks left on surface.

Texture –

Fine – Barely seen with naked eye
Medium – Barely seen up to 1/8 in.
Coarse – 1 /8in. to 1 /4 in.

Structure –

- Bedding
  - Flat – 0° – 5°
  - Gently Dipping – 5° – 35°
  - Moderately Dipping – 55° – 85°
  - Steeply Dipping – 55° – 85°
- Fractures, scattered
  - Open
  - Cemented or Tight
- Fractures, closely spaced
  - Open
  - Cemented or Tight
- Brecciated (Sheared and Fragmented)
  - Open
  - Cemented or Tight
- Joints
  - Faulted
  - Slickensides

Degree of Weathering –

Fresh – No visible signs of decomposition or discoloration. Rings under hammer impact.

Slighty Weathered – Slight discoloration inwards from open fractures, otherwise similar to fresh.

Moderately Weathered – Discoloration throughout. Weaker minerals such as feldspar decomposed. Strength somewhat less than fresh rock, but cores cannot be broken by hand or scraped by knife. Texture preserved.

Highly Weathered – Most minerals somewhat decomposed. Specimens can be broken by hand with effort or shaved with knife. Core stones present in rock mass. Texture becoming indistinct but fabric

Completely Weathered – Minerals decomposed to soil but fabric and structure preserved (Saprolite). Specimens easily crumbled or penetrated.

Residual Soil – Advanced state of decomposition resulting in plastic soils. Rock fabric and structure completely destroyed. Large volume change.

Solution and Void Conditions –

Solid, contains no voids
Vuggy (pitted)
Vesicular (igneous)
Porous
Cavities
Cavernous

Swelling Properties –

Nonswelling
Swelling

Slaking Properties –

Nonslaking
Slakes slowly on exposure
Slakes readily on exposure

Rock Quality Designation (RQD) –

RQD (Percent)	Diagnostic Description
Greater than 90	Excellent
75 – 90	Good
50 – 75	Fair
25 – 50	Poor
Less than 25	Very Poor

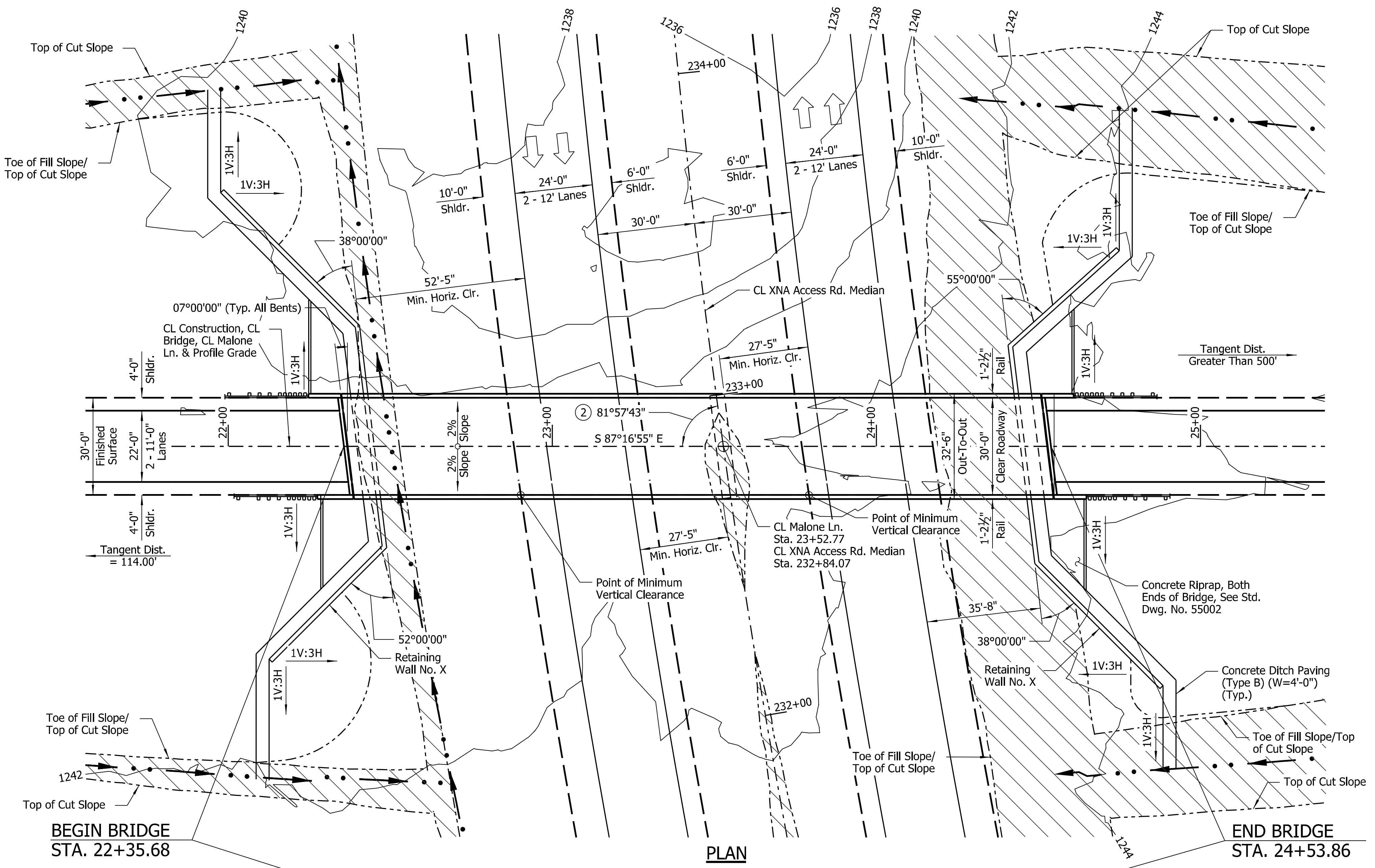
KEYROCK FHWA 3-2-12

PLATE 18

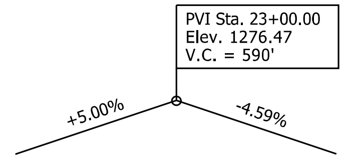
APPENDIX A

DATE REVISED	DATE FILMED	DATE REVISED	DATE FILMED	FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
				6	ARK.			
				JOB NO.		090069	$SN8101$	ST

① $BN08$ LAYOUT $DN8101$



PLAN



VERTICAL CURVE DATA

Malone Ln.
(Theoretical Grade Along CL Construction)

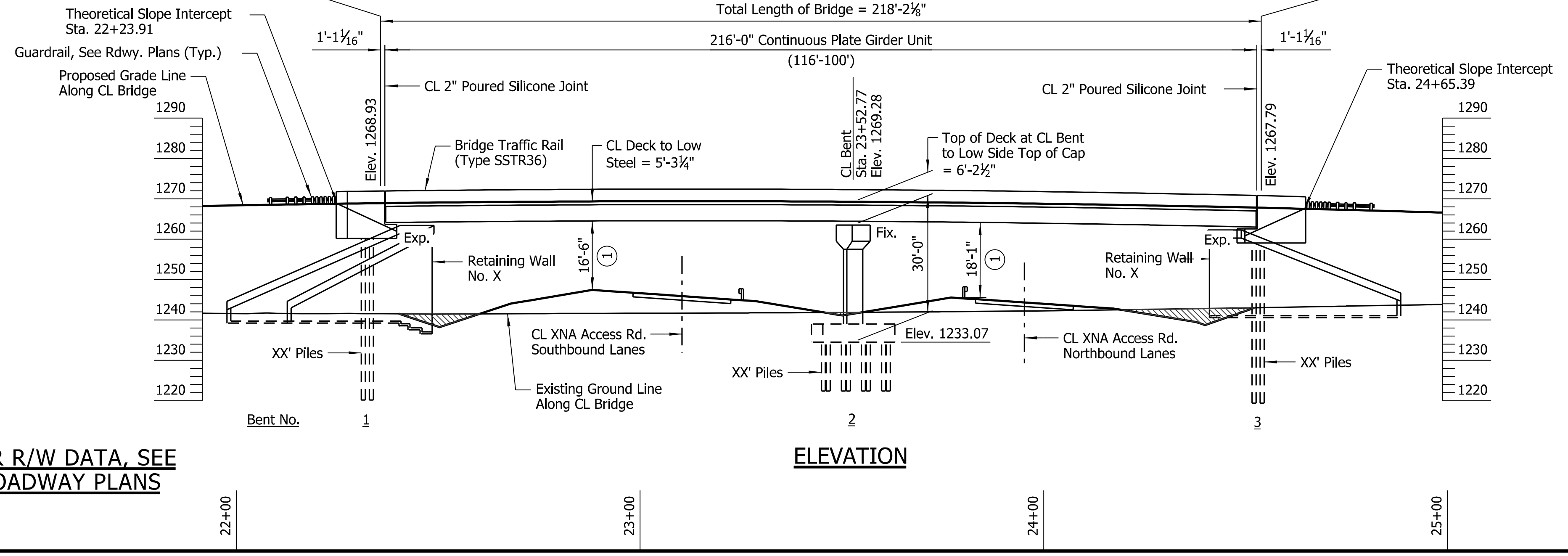
NOTES:
For "PROJECT GENERAL NOTES", see Dwg. No. $DN0201$.

For "ELEVATION OF SOIL BORINGS", "N-VALUES", "BORING LEGEND", and "GENERAL NOTES", see Dwg. No. $DN8102$.

Use Type F Approach Gutters at each end of bridge. See Std. Dwg. No. 55030F.

Stations shown are along CL Construction. Elevations shown are theoretical working point elevations at CL Bridge. Any vertical dimension referenced to CL Deck is based on theoretical working point elevation at CL Bridge. See "Rounding Detail" on Standard Drawing No. 55007 for additional information.

SOIL BORINGS NOT AVAILABLE AT TIME OF PRINTING



ELEVATION

① Point of Minimum Vertical Clearance

② Angle measured between a line tangent to CL XNA Access Rd. Median at Sta. 232+84.07 and CL Malone Ln.

FOR R/W DATA, SEE ROADWAY PLANS

SHEET 1 OF 2
LAYOUT OF BRIDGE
MALONE LN. OVER XNA ACCESS RD.
NORTHWEST ARKANSAS
NATIONAL AIRPORT ACCESS (F)
BENTON COUNTY

ROUTE RT SEC. SC

ARKANSAS STATE HIGHWAY COMMISSION

LITTLE ROCK, ARK.

PRELIMINARY
NOT FOR
CONSTRUCTION

BRIDGE ENGINEER

DRAWN BY: HEW DATE: JULY 2022 FILENAME: b090069x8_L1.dgn
CHECKED BY: JES DATE: SEPT. 2022 SCALE: 1" = 20'-0"
DESIGNED BY: MAS DATE: JULY 2022
BRIDGE NO. $BN08$ DRAWING NO. $DN8101$

JESkinner 11/1/2022 10:13:37 AM
WORKSPACE: ARDOT Bridge (2019)
L:\2017\17017600 - XNA Access - NEPA\Drawings\b090069x8_S101_LO.dgn
REVISED DATE:

APPENDIX B


19-118 S-58
Run 1: 63'-68'
P.O. Box 30970
e Rock, Arkansas
72260-0970
Grubbs, Hoskyn, Barton & Wyatt, INC.
CONSULTING ENGINEERS


19-118
859
15-20'
Grubbs, Hoskyn, Barton & Wyatt, INC.
CONSULTING ENGINEERS
Grubbs, Hoskyn, Barton & Wyatt, INC.
CONSULTING ENGINEERS
19-118
341 W. County Line Rd.
Springdale, Arkansas
72764
Run-1 15'-20'
S-89


19-118
S59
45-55'
Grubbs, Hoskyn, Barton & Wyatt, INC.
CONSULTING ENGINEERS
RUN1 45-50'
RUN2. 50-55'
County Line Rd.
ingdale, Arkansas
72764
-59
TE

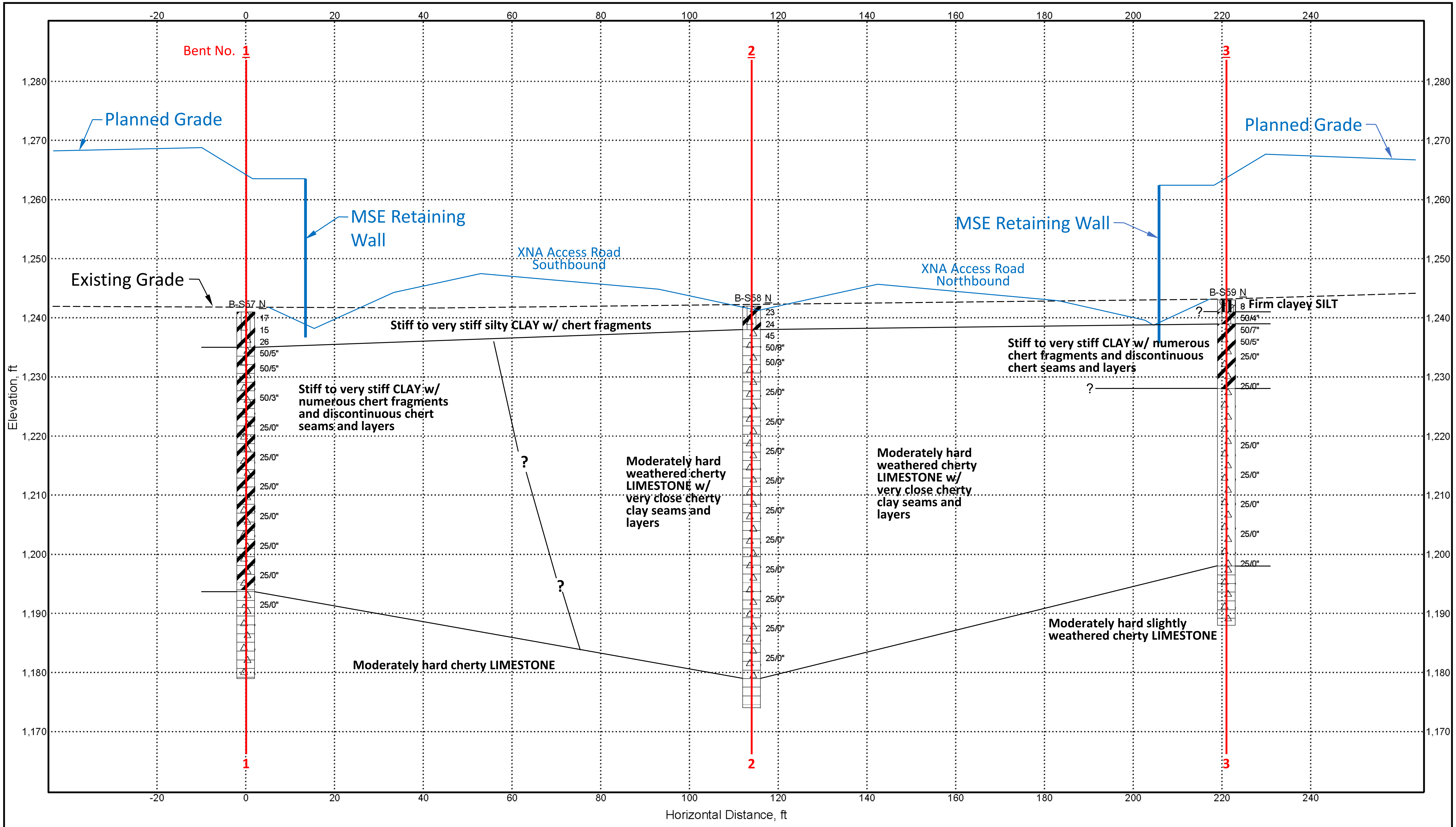
APPENDIX C

SUMMARY of CLASSIFICATION TEST RESULTS

PROJECT: 090069 XNA Access Road over Malone Lane
LOCATION: Benton County, Arkansas
GHBW JOB NUMBER: 19-118

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING								USCS CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
S57	2.5-3.5	15	---NON-PLASTIC---			---	---	---	---	---	---	---	39	GM	A-4
S58	0.5-1.5	13	---NON-PLASTIC---			---	---	---	---	---	---	---	41	GM	A-4
S59	6.5-7.5	19	56	32	24	---	---	---	---	---	---	---	36	GC	A-7-5
S60	2.5-3.5	22	39	28	11	---	---	---	---	77	---	---	23	SC	A-2-6
S61	0.5-1.5	25	---NON-PLASTIC---			---	---	---	---	97	---	---	76	ML	A-4
S63	0.5-1.5	22	---	---	---	---	---	---	---	96	---	---	87	ML	A-4
S63	2.5-3.5	12	31	22	9	---	---	---	---	80	---	---	36	SC	A-4
S64	0.5-1.5	17	35	23	12	---	---	---	---	63	---	---	37	SC	A-6
S65	4.5-5.5	15	45	26	19	---	---	---	---	47	---	---	27	GC	A-2-7
S66	4.5-5.5	20	49	26	23	---	---	---	---	73	---	---	29	SC	A-2-7
S67	0.5-1.5	19	---	---	---	---	---	---	---	89	---	---	79	ML	A-4

APPENDIX D



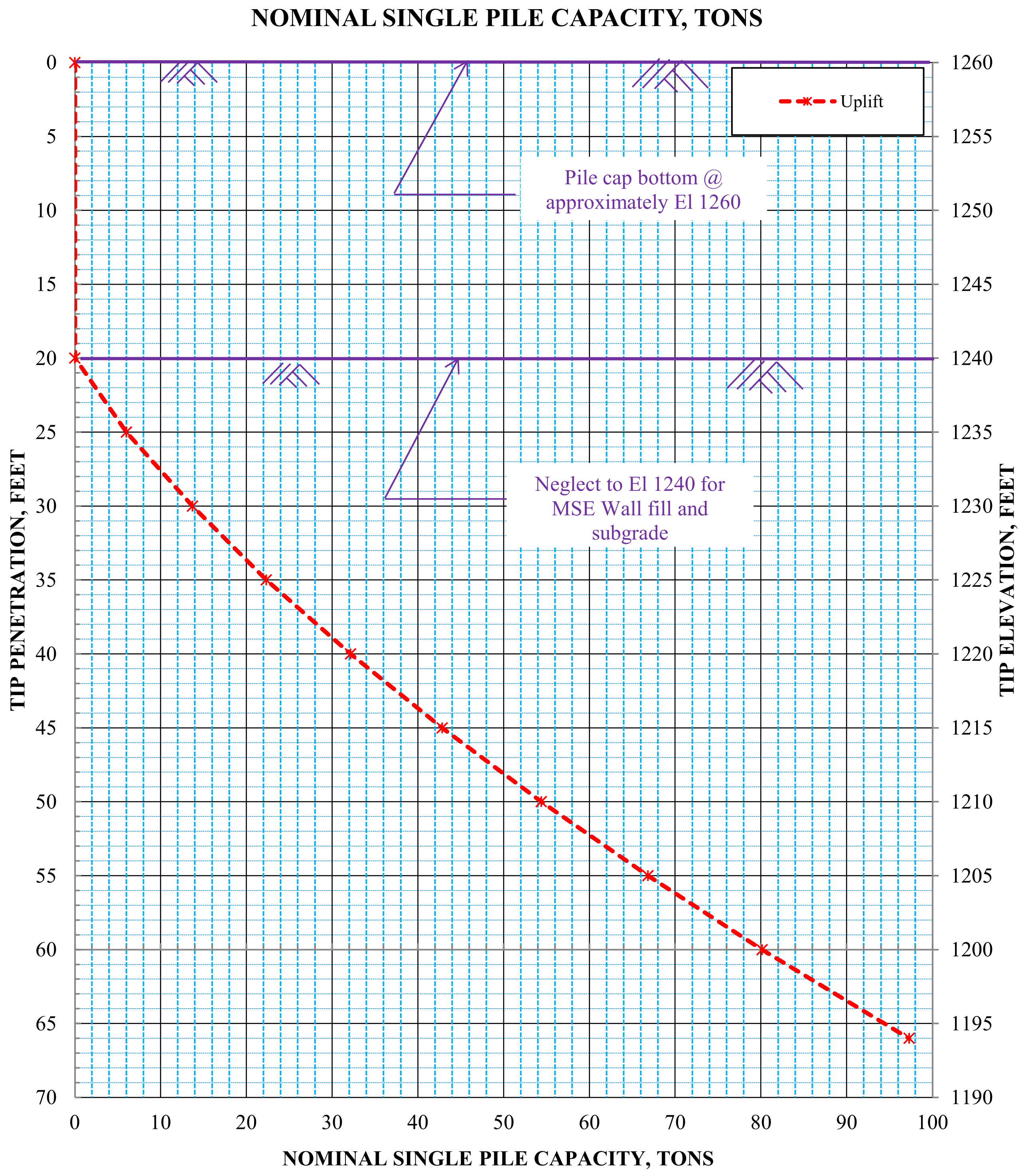
Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

NOTES:
1. Subsurface conditions have been inferred between discrete boring locations. Actual conditions may vary.
2. Ground surface approximate.

SCALE:
1" = 20' Horizontal
1" = 15' Vertical

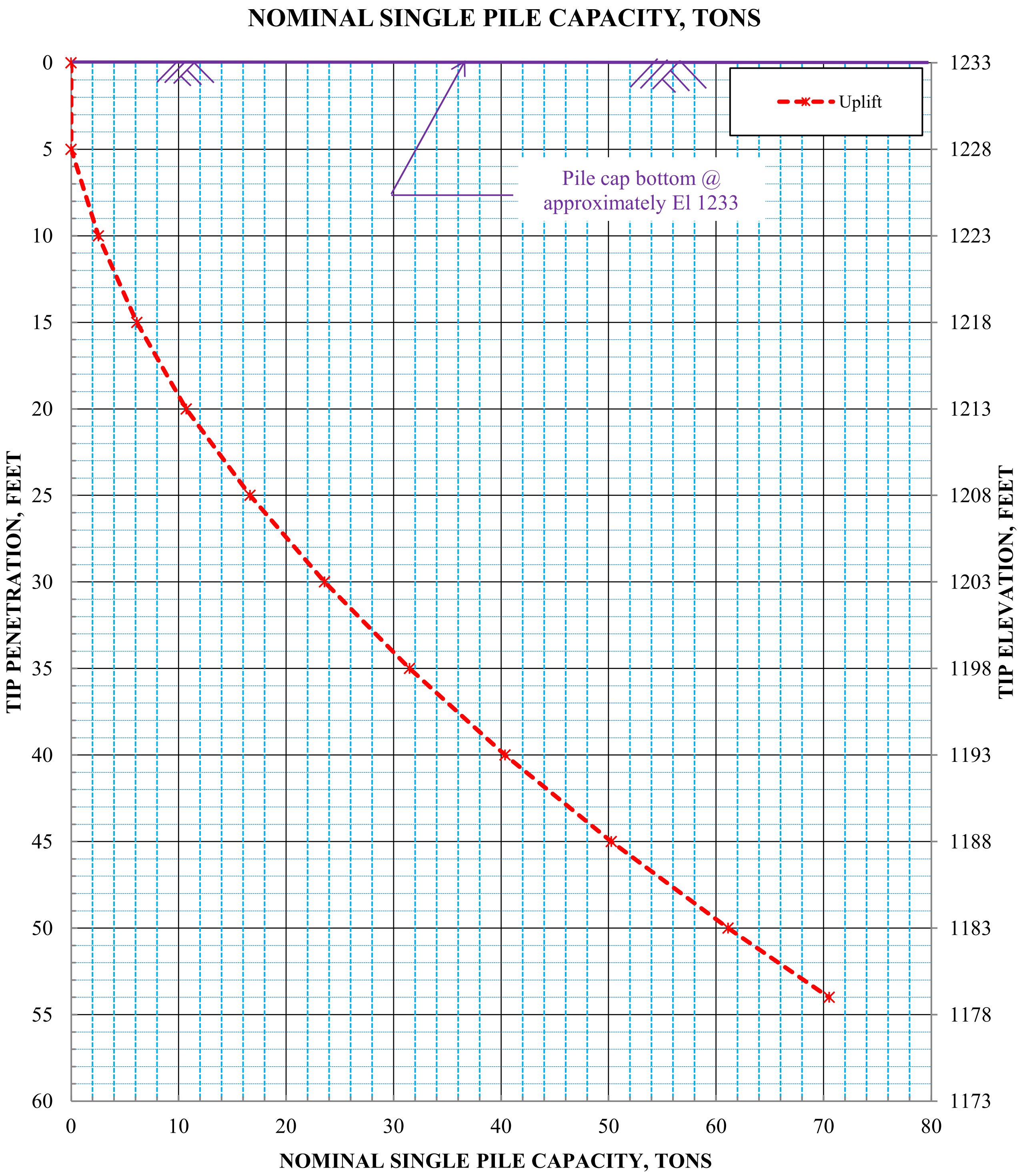
Generalized Subsurface Profile
090069 Malone Lane over XNA Access Road
Benton Co., Arkansas
Project Number: 19-118

APPENDIX E



Grouted HP12x53 Steel Piles - Uplift
090069 XNA Access Road - Malone Lane - Bent 1
Benton County, Arkansas

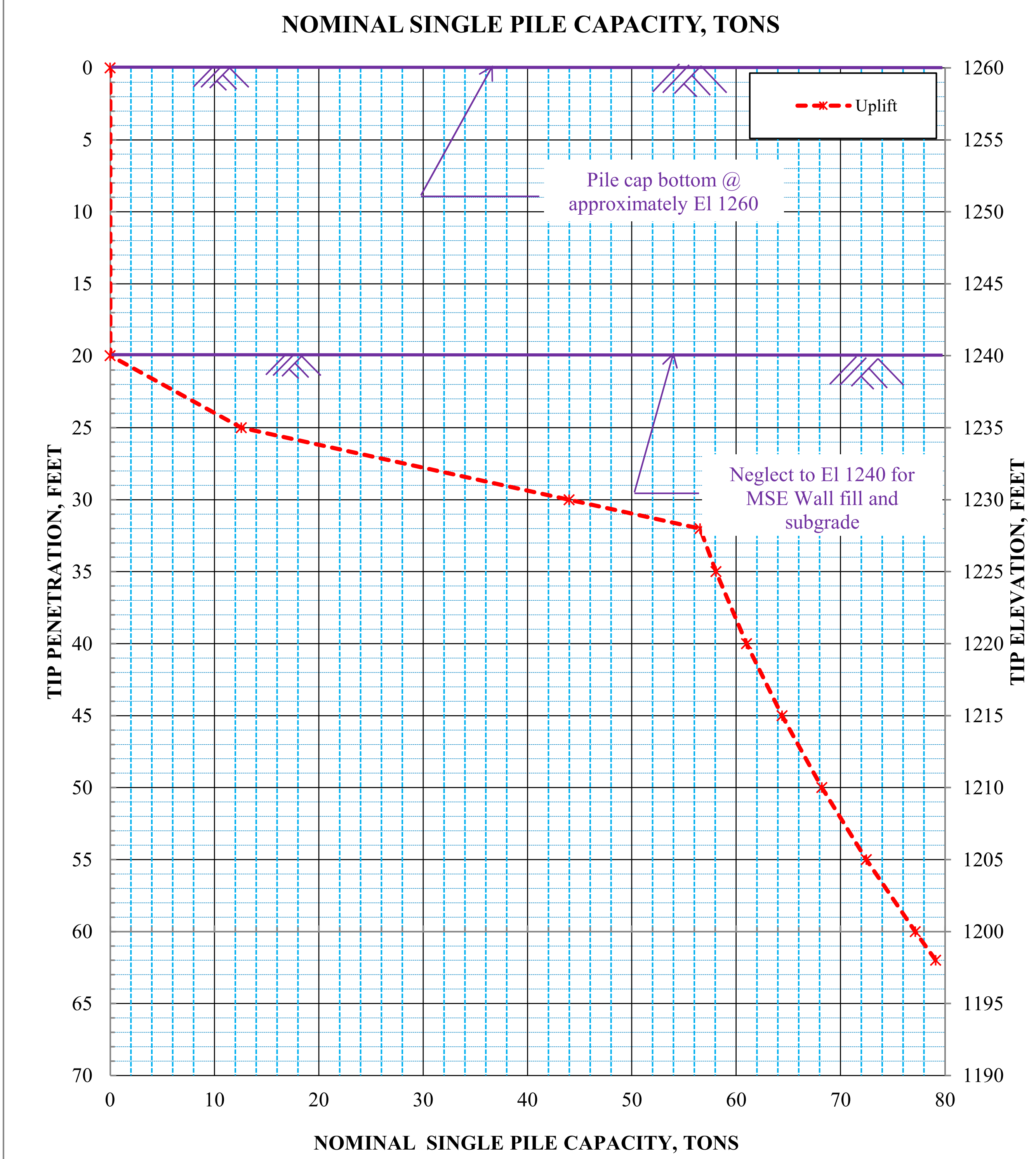
Note: 1. Piles driven from MSE wall subgrade
2. Pile penetration limited in moderately hard weathered cherty limestone below El 1194±



Grouted HP14x73 Steel Piles - Uplift
090069 XNA Access Road - Malone Lane - Bent 2
Benton County, Arkansas

Note: 1. Piles driven cap bottom elevation
2. Pile penetration limited in moderately hard weathered cherty limestone below El 1179±

Grubbs, Hoskyn,
Barton & Wyatt, LLC
Consulting Engineers



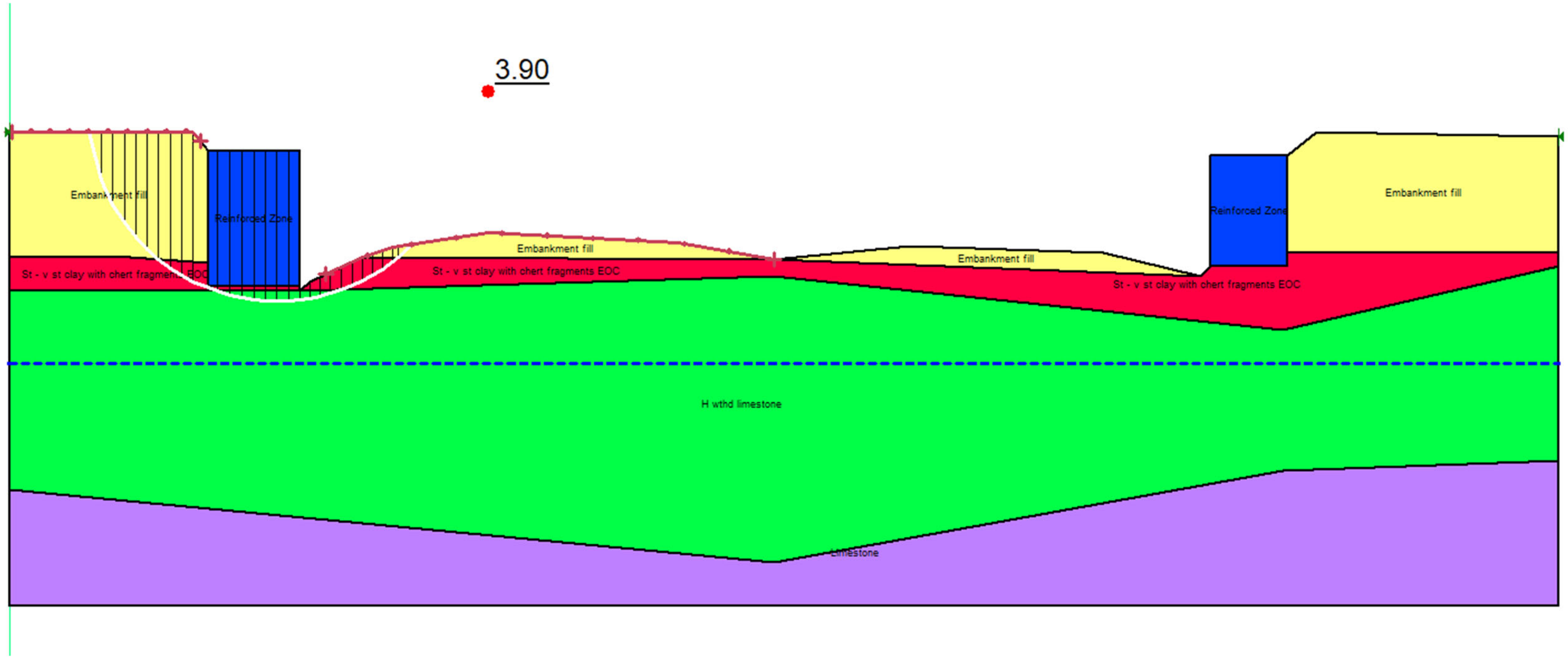
Grouted HP12x53 Steel Piles - Uplift
090069 XNA Access Road - Malone Lane - Bent 3
Benton County, Arkansas

Note: 1. Piles driven from MSE wall subgrade
2. Pile penetration limited in moderately hard weathered cherty limestone below El. 1198±

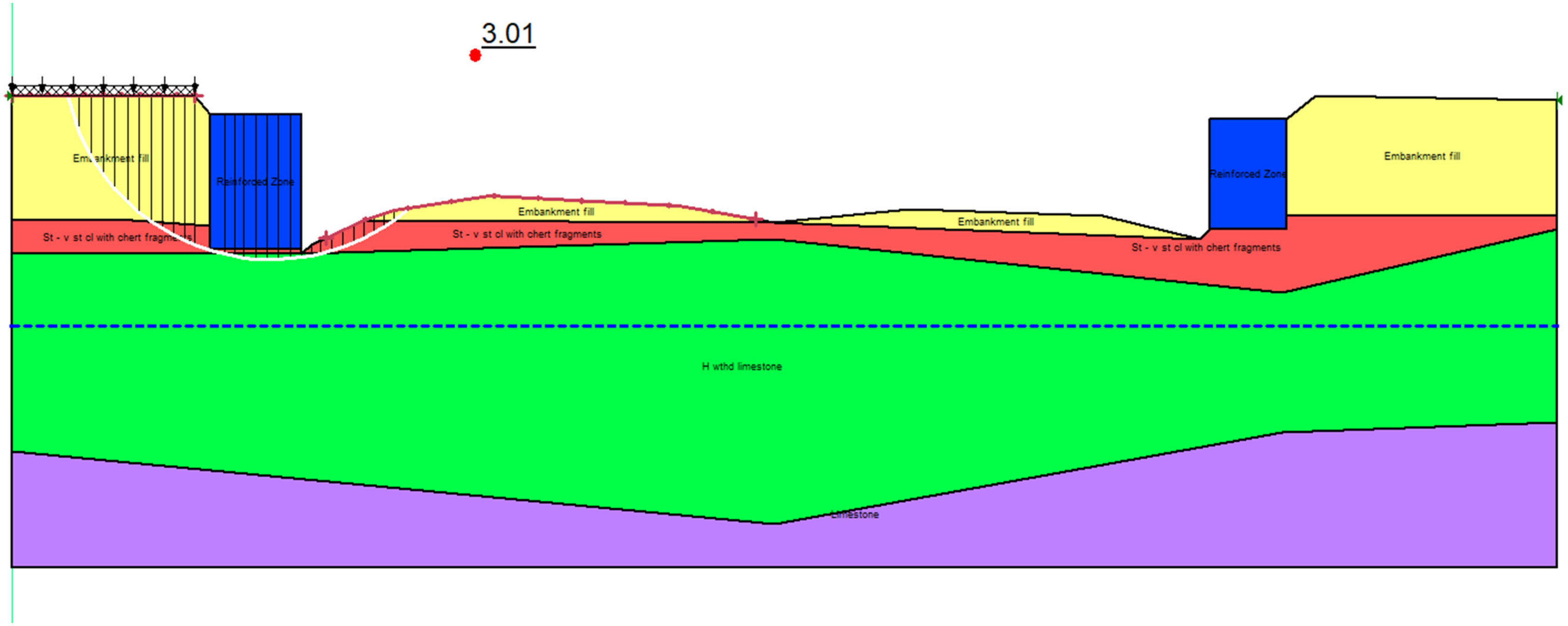
APPENDIX F

Summary of Stability Analysis Results
090069 XNA Access Road – Malone Lane over XNA Access Road
GHBW Job No. 19-118
Benton County, Arkansas

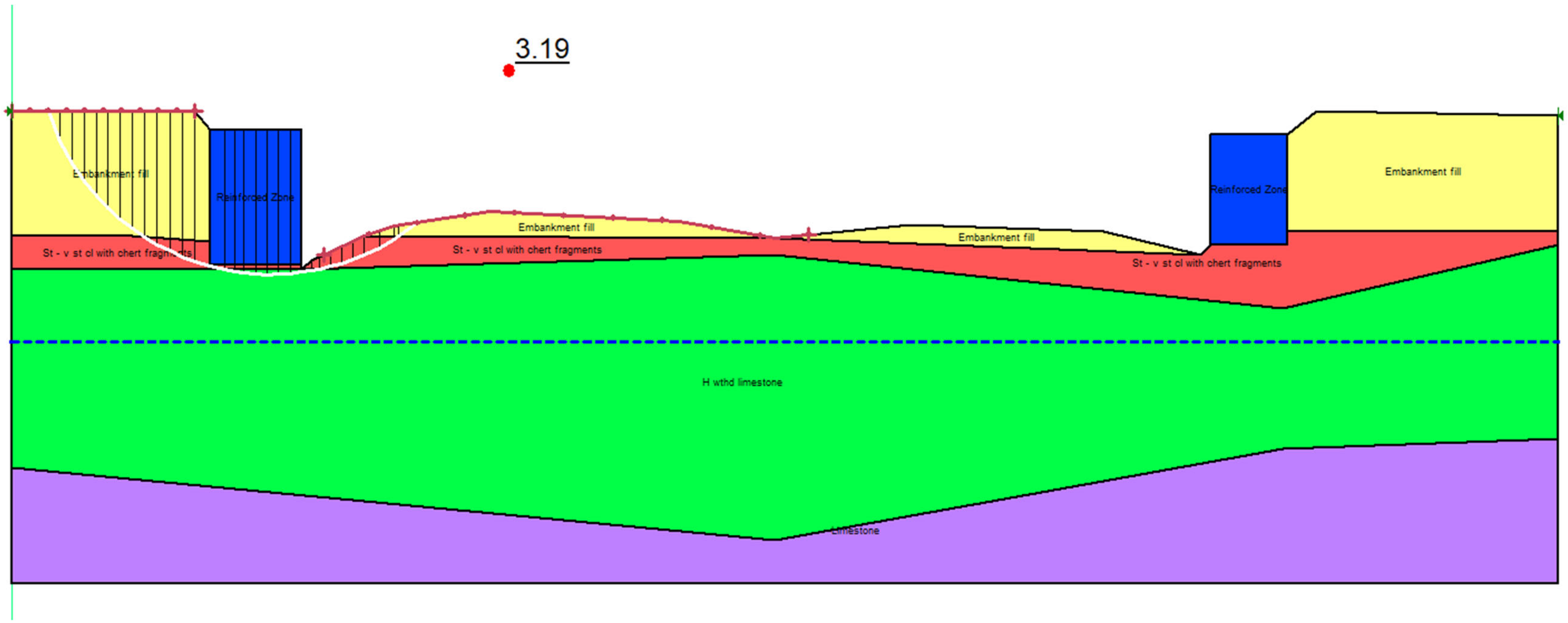
	Design Loading Condition	**Calculated Minimum Factor of Safety**
West MSE Wall Bent 1	End of Construction	3.90
	Long Term	3.01
	Seismic ($k_h = A_S/2 = 0.0245$)	3.19
West Side Slope Bent 1 (3H:1V)	End of Construction	3.98
	Long Term	3.26
	Seismic ($k_h = A_S/2 = 0.0245$)	3.67
East MSE Wall Bent 3	End of Construction	2.98
	Long Term	2.41
	Seismic ($k_h = A_S/2 = 0.0245$)	2.72
East Side Slope Bent 3 (3H:1V)	End of Construction	4.35
	Long Term	3.21
	Seismic ($k_h = A_S/2 = 0.0245$)	4.01



Results of Stability Analyses – End of Construction
Bent 1 - West MSE Wall
H=27 ft ±
19-118 - 090069 Malone Lane over XNA Access Road

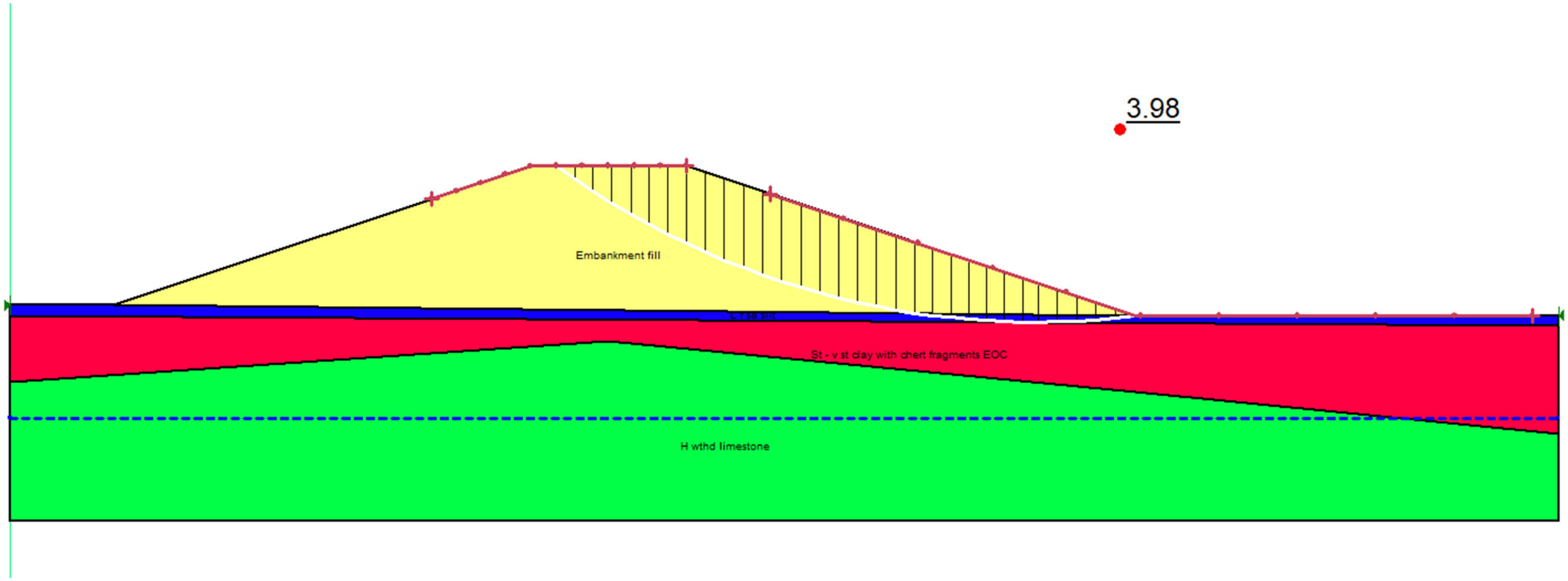


Results of Stability Analyses – Long Term Condition
Bent 1 -West MSE Wall
H=27 ft ±
19-118 - 090069 Malone Lane over XNA Access Road

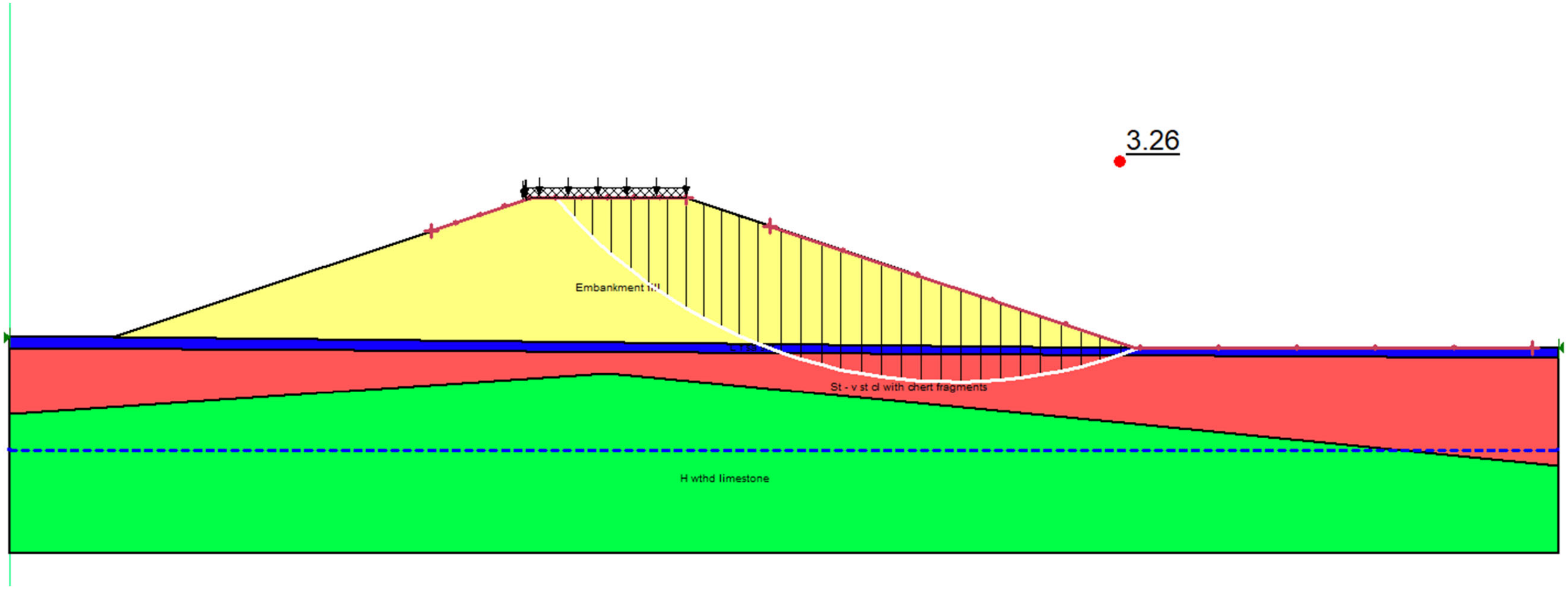


Results of Stability Analyses – Seismic Condition ($k_h = A_S /2= 0.0245$)
Bent 1 – West MSE Wall
H=27 ft ±
19-118 - 090069 Malone Lane over XNA Access Road

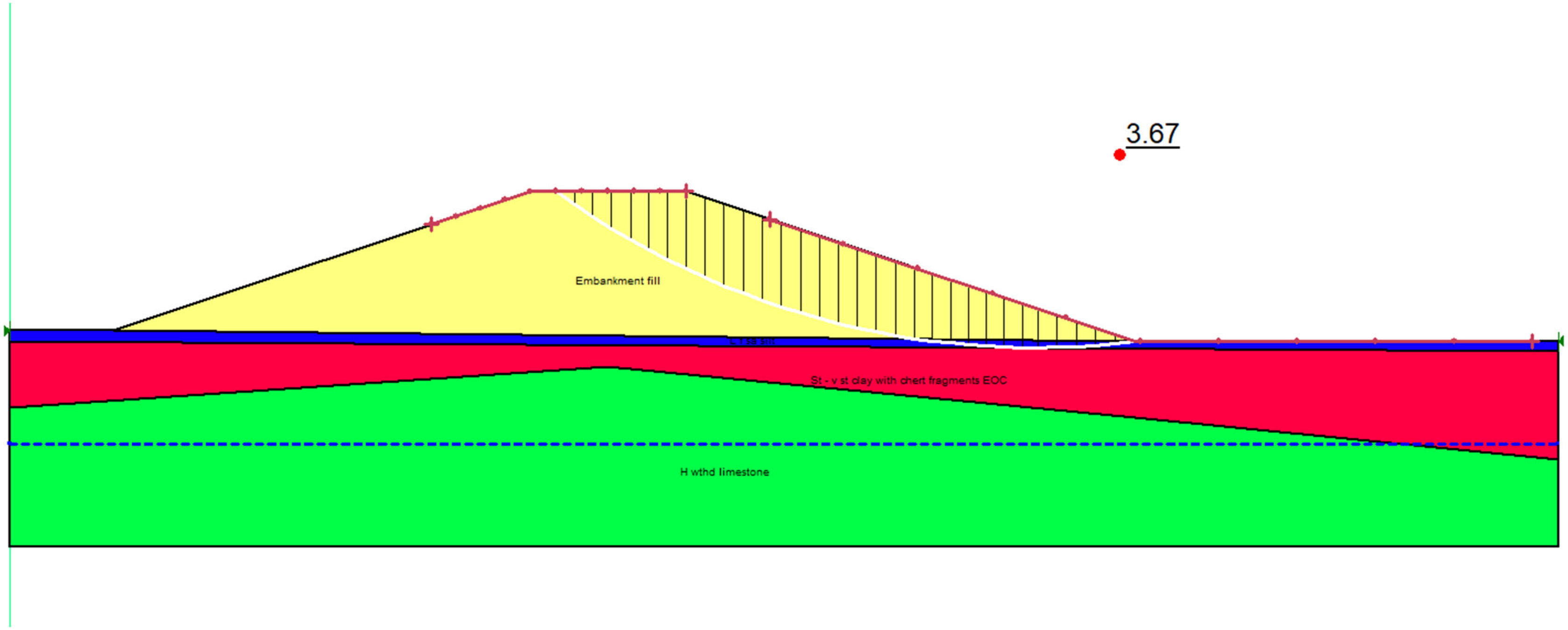
**Grubbs, Hoskyn,
Barton & Wyatt, LLC**
CONSULTING ENGINEERS
A UES Company



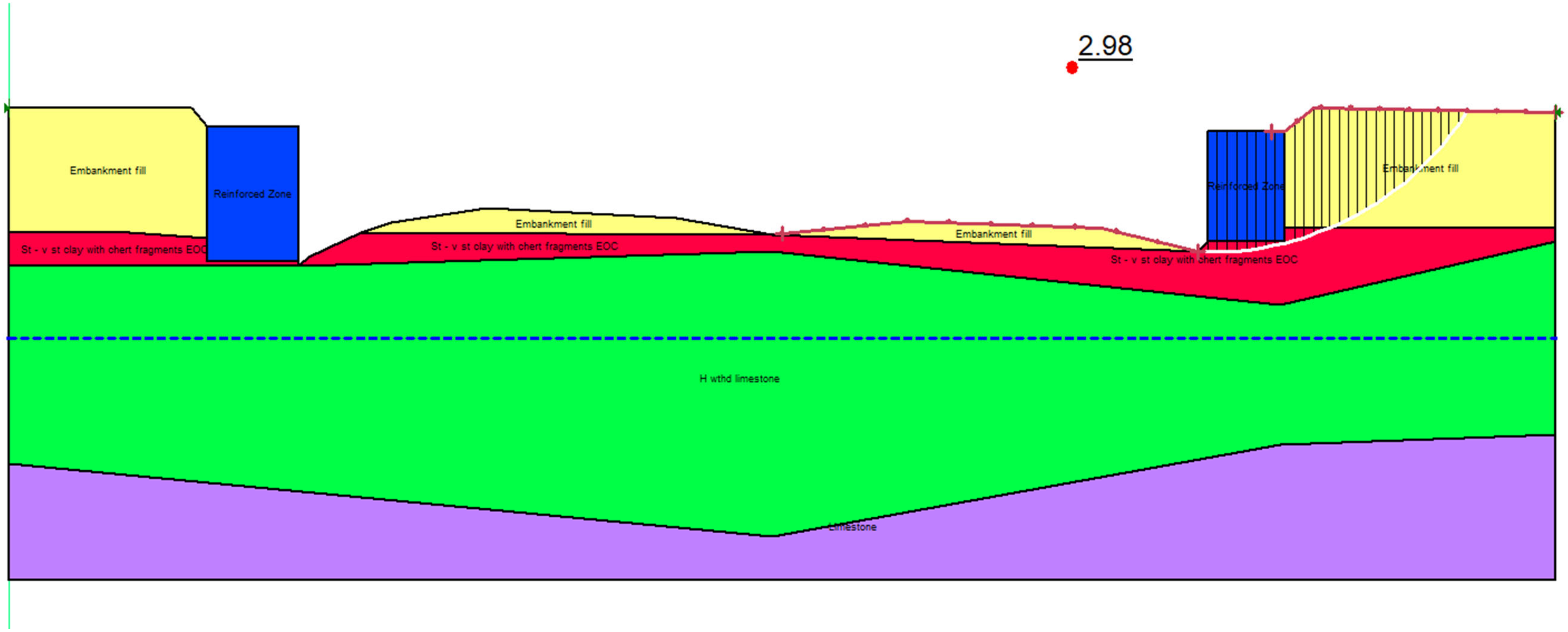
Results of Stability Analyses – End of Construction
Bent 1 - West Side Slope
3H:1V Slope, H=29 ft ±
19-118 - 090069 Malone Lane over XNA Access Road



Results of Stability Analyses – Long Term Condition
Bent 1 - West Side Slope
3H:1V Slope, H=29 ft ±
1919-118 - 090069 Malone Lane over XNA Access Road



Results of Stability Analyses – Seismic Condition ($k_h = A_S /2= 0.0245$)
Bent 1 - West Side Slope
3H:1V Slope, H=28 ft ±
19-118 - 090069 Malone Lane over XNA Access Road



Results of Stability Analyses – End of Construction
Bent 3 – East MSE Wall
H=23 ft ±
19-118 - 090069 Malone Lane over XNA Access Road

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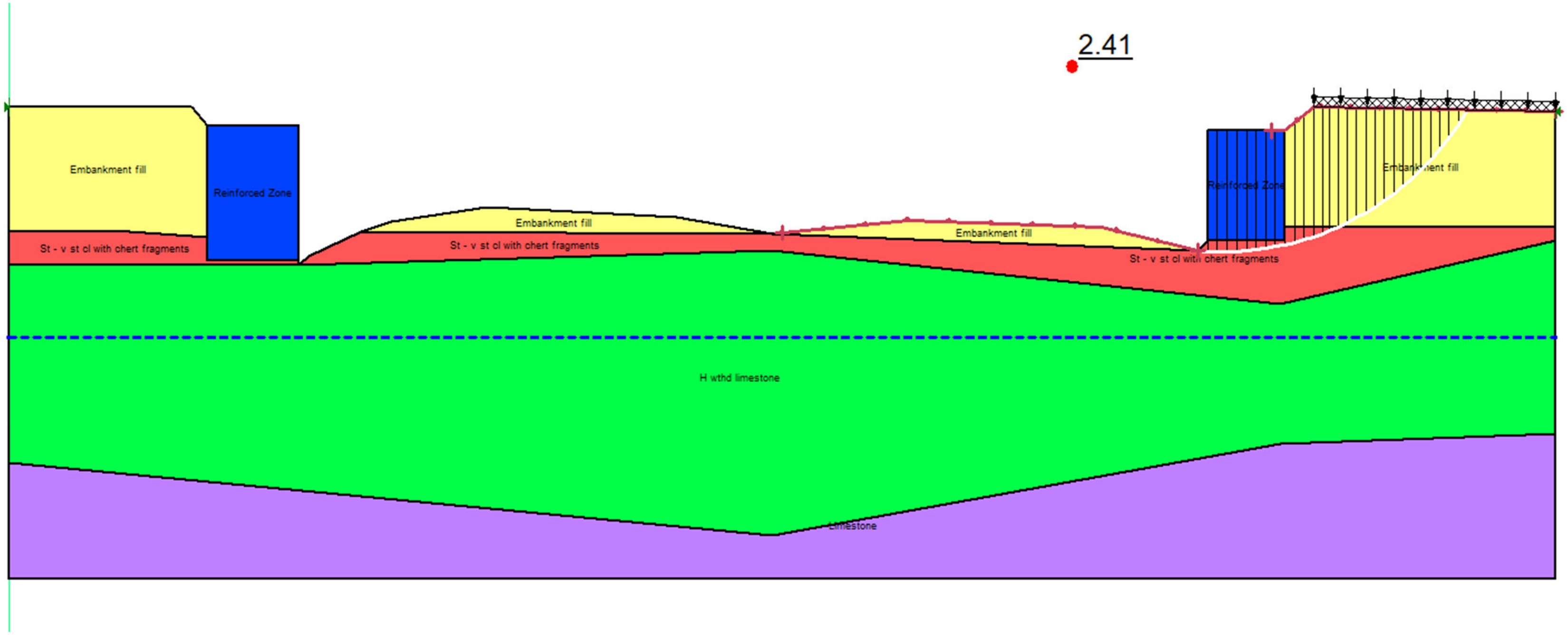

Results of Stability Analyses – Long Term Condition
Bent 3 – East MSE Wall
H=23 ft ±
19-118 - 090069 Malone Lane over XNA Access Road

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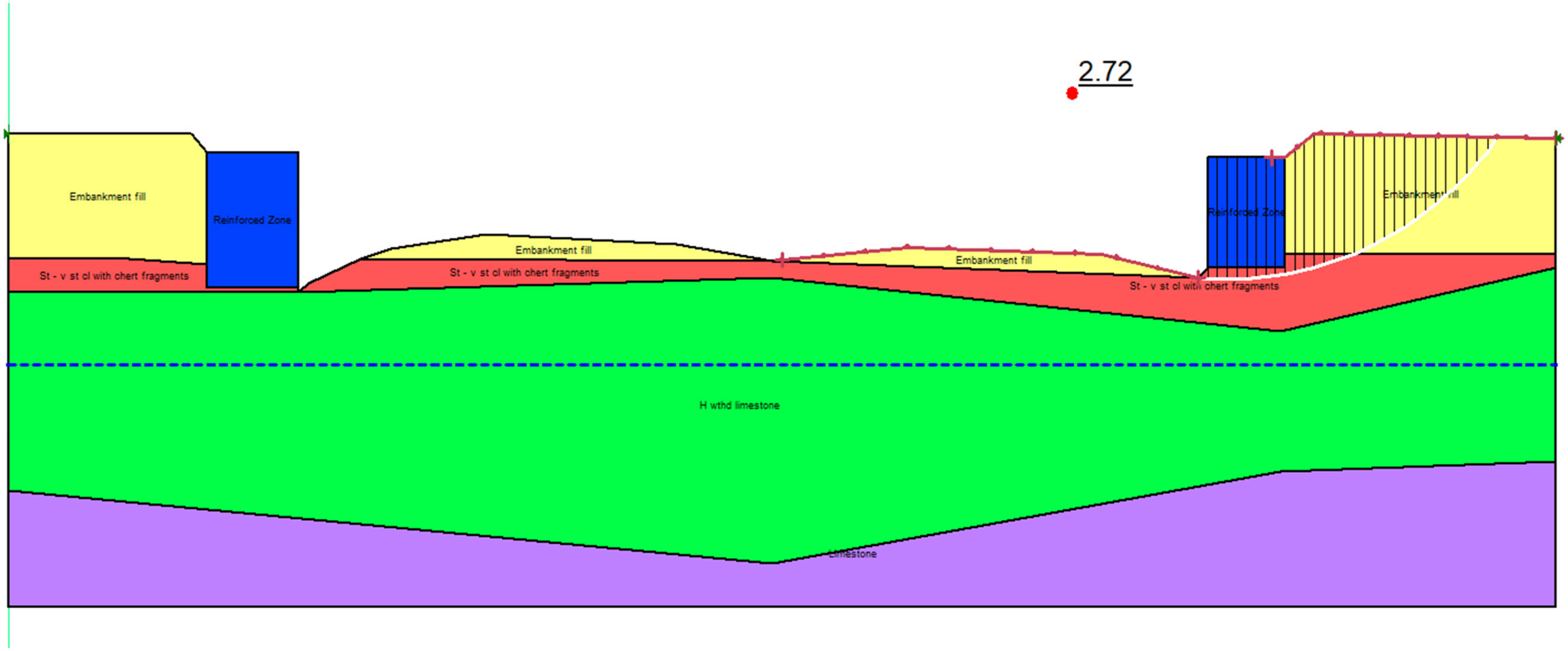

Results of Stability Analyses – Seismic Condition ($k_h = A_S /2= 0.0245$)
Bent 3 – East MSE Wall
H=23 ft ±
19-118 - 090069 Malone Lane over XNA Access Road

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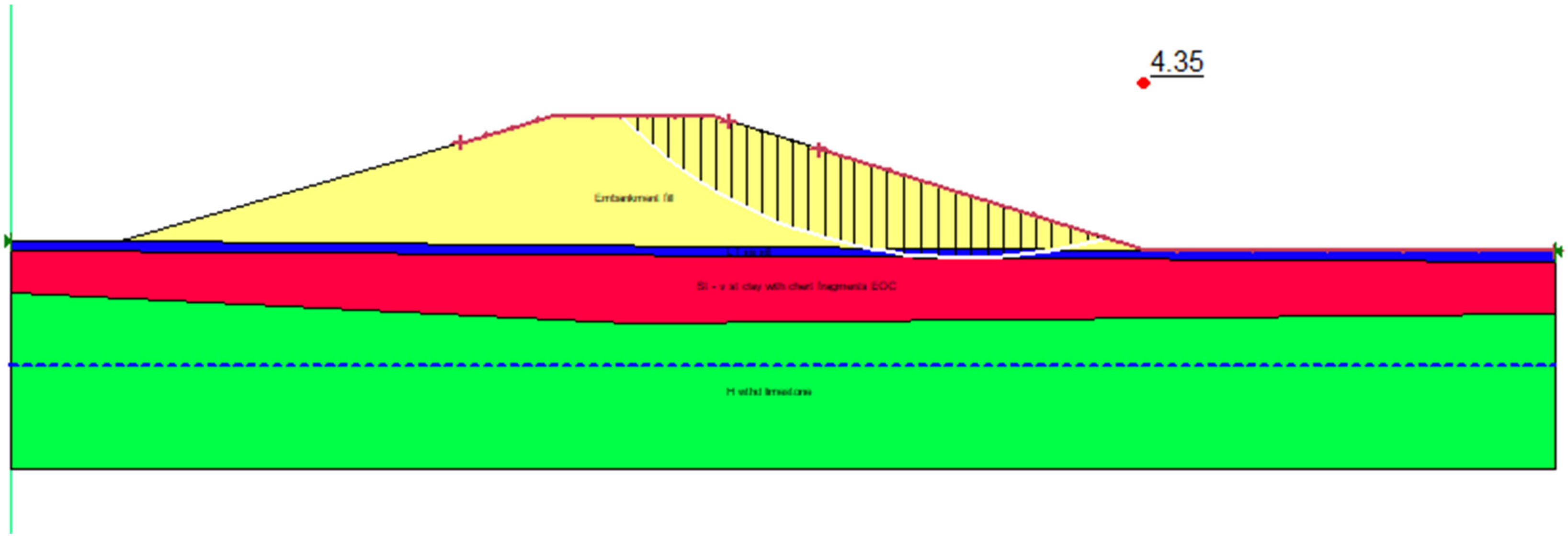
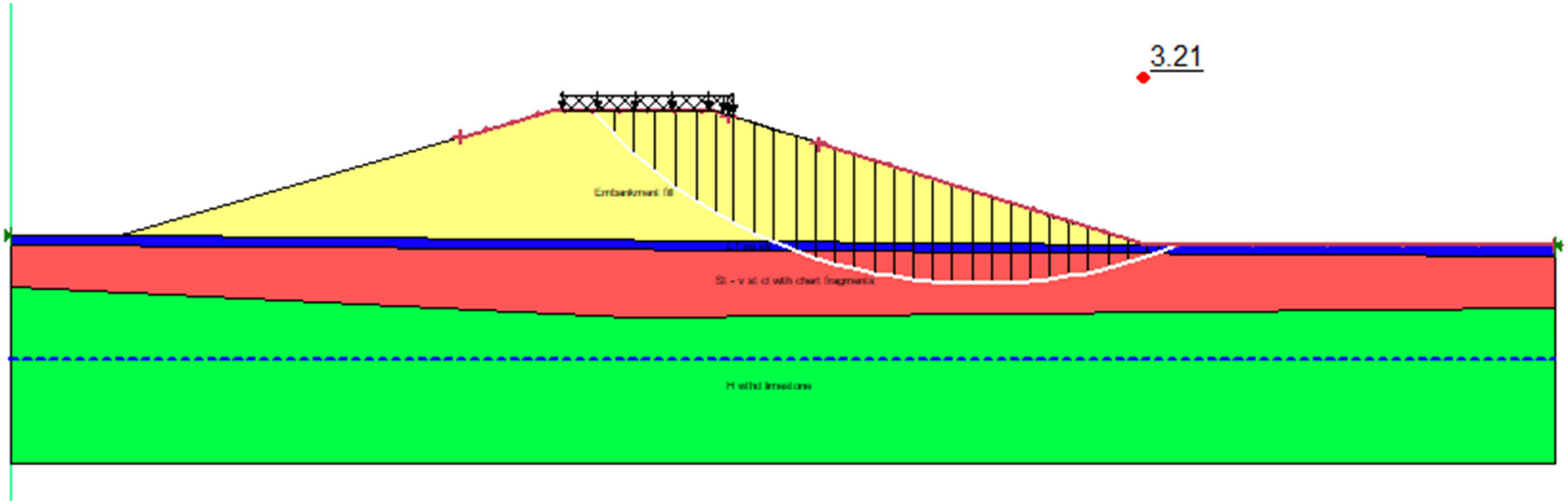
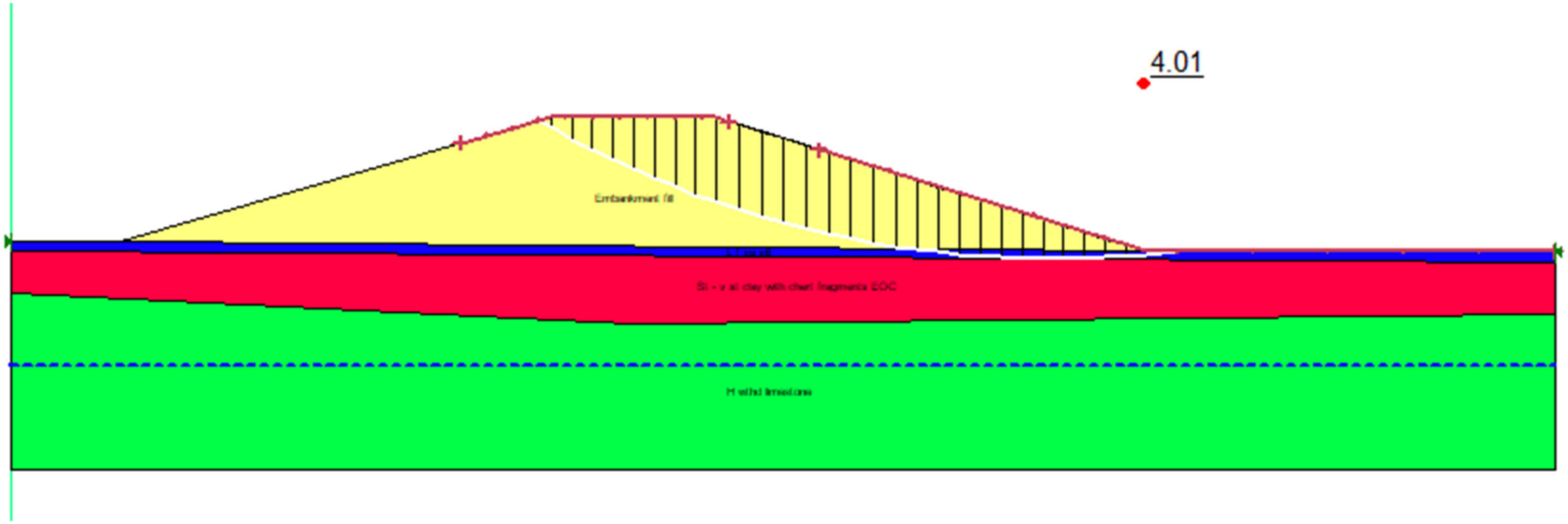


Results of Stability Analyses – End of Construction
Bent 3 – East Side Slope
3H:1V Slope, H=26 ft ±
19-118 - 090069 Malone Lane over XNA Access Road



Results of Stability Analyses – Long Term Condition
Bent 3 - East Side Slope
3H:1V Slope, H=26 ft ±
19-118 - 090069 Malone Lane over XNA Access Road



Results of Stability Analyses – Seismic Condition ($k_h = A_S /2= 0.0245$)
Bent 3 - East Side Slope
3H:1V Slope, H=26 ft ±
19-118 - 090069 Malone Lane over XNA Access Road

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