

Muskogee County
Begin MP 290, E 1.0 Mi.

STATE JOB NO.: 34334(04)
PROJECT NO.: J3-4334(004)PM

BRIDGE HYDRAULIC REPORT
VOLUME I OF I
Interstate 40 over Arkansas River



Utley & Associates LLC

for

EST, LLC

November 8, 2023

Muskogee County
Begin MP 290, E 1.0 Mi

STATE JOB NO.: 34334(04)
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Interstate 40 over Arkansas River

PREPARED BY:



Utley & Associates LLC

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CA NO. 4202 EXP. 06/30/2025

for

EST, LLC
615 N. Hudson, Ste. 300
Oklahoma City, Oklahoma 73102

Risk Statement

Overtopping of the roadway occurs at a storm frequency of greater than 500 years. The encroachment associated with the structures is considered “Low Risk”, since there are no hazards to life or property upstream of the structures, and no detrimental effect to beneficial floodplain.

**The proposed design is in compliance with
Federal -Aid Policy Guide 23 CFR 650, Subpart A**



L. Kevin Bishop, P.E. #31051

November 8, 2023

Initials	Date
LKB	11/8/2023

Project No. **Muskogee / Sequoyah County**
J3-4334(004)PM
 JP # **34334(04)**

I-40 over **Arkansas River**
NBIS # 17051

Hydraulic Summary

Total Drainage Area = **86849** sq. mi
 Controlled Drainage Area = **0** sq. mi
 Effective Drainage Area = **86849** sq. mi

Existing Structure:
 C/L Station **3-125' Conc. Grid., 3-PL. Gird.
 (220',330'-200'), 4-125', 3-125' PL.
 Gird, Sk. 0^
 767+08.92**

L = **1970** ft
 $Q_{OT} \approx Y_{r_{freq}} \geq 500$

Low Bm Elev = **507.80** ft
 Low Bm Sta = **777+06.30**
 Rdwy_{OT} Elev = **479.89** ft
 Rdwy_{OT} Sta = **689+50.00**

Proposed Structure:
 C/L Station **3@120',238', 380', 244', 3@125',
 4@120' PCB & Steel I-Bm., Sk. 0^
 767+11.50**

L = **2079** ft
 $Q_{OT} \approx Y_{r_{freq}} \geq 500$

Low Bm Elev = **510.42** ft
 Low Bm Sta = **777+51.00**
 Rdwy_{OT} Elev = **479.89** ft
 Rdwy_{OT} Sta = **689+50.00**

0 ft offset to the NA

Detour Structure:
 C/L Station **NA
 NA**

Slope = **NA** ft/ft
 $Q_{OT} \approx Y_{r_{freq}} \geq 500$

Inlet Elev = **NA** ft
 Detour_{OT} Elev = **NA** ft
 Detour_{OT} Sta = **NA**

0 ft offset to the NA

Freq.	Q (cfs)	CHW (ft)	V (fps)	Contraction Scour (ft)	Pier Scour (ft)	Total Scour (ft)
2	172100	459.15	5.84			
5	271400	467.36	6.65			
10	324600	470.97	7.04			
25	403500	474.74	7.83			
50	462900	477.13	8.44			
100	521200	478.88	9.13	9.26	26.49	35.76
OT or 500 =>500	660500	482.1	10.84	13.90	28.38	42.28
Detour OT = Y_{r_{freq}}						

Notes:

*Hydraulic Design is in compliance with
 "Federal-Aid Policy Guide 23 CFR 650, Subpart A"*



Initials:	Date:
LKB	11/8/2023

County	Muskogee / Sequoyah
JP#	34334(04)
Project #	J3-4334(004)PM
Highway	I-40
Crossing	Arkansas River

		NBIS #	17051		Computed Water Surface Elev. (FT)							Velocity (FPS)			
Discharges (CFS)		Open Channel	Existing 3-125' Conc. Gird., 3-PL. Gird. (220'-330'-200'), 4-125', 3-125' PL. Gird. Spans, SK. 0^		Backwater	Proposed 13 Span(3@120', 238', 380', 244', 3@125', 4@120' PCB and Steel I-Bm. Spans, SK 0^		Backwater			Backwater	Open Channel	Existing 3-125' Conc. Gird., 3-PL. Gird. (220'-330'-200'), 4-125', 3-125' PL. Gird. Spans, SK. 0^	Proposed 13 Span(3@120', 238', 380', 244', 3@125', 4@120' PCB and Steel I-Bm. Spans, SK 0^	
			Low Beam (ft)	507.80		Low Beam (ft)	510.42		Flowline In (ft)						
Q2 =	172100	458.87	459.12	0.25	459.15	0.28			5.75	5.52	5.84				
Q5 =	271400	467.05	467.37	0.32	467.36	0.31			6.46	6.34	6.65				
Q10 =	324600	470.62	470.97	0.35	470.97	0.35			6.77	6.72	7.04				
Q25 =	403500	474.29	474.74	0.45	474.74	0.45			7.24	7.48	7.83				
Q50 =	462900	476.51	477.11	0.60	477.13	0.62			7.52	8.07	8.44				
Q100 =	521200	478.03	478.85	0.82	478.88	0.85			7.81	8.73	9.13				
Q500 =	660500	480.65	482.05	1.40	482.10	1.45			8.53	10.37	10.84				
		Overtopping Elev (ft) =	479.89		Overtopping Elev (ft) =	479.89		Overtopping Elev (ft) =							
		Overtopping Q (cfs) ≈	>=500		Overtopping Q (cfs) ≈	>=500		Overtopping Q (cfs) ≈							
		Overtopping Freq (yr) ≈	>=500		Overtopping Freq (yr) ≈	>=500		Overtopping Freq (yr) ≈							

BRIDGE HYDRAULIC REPORT

Interstate 40 over Arkansas River

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BRIDGE HYDRAULIC REPORT

Interstate 40 over Arkansas River

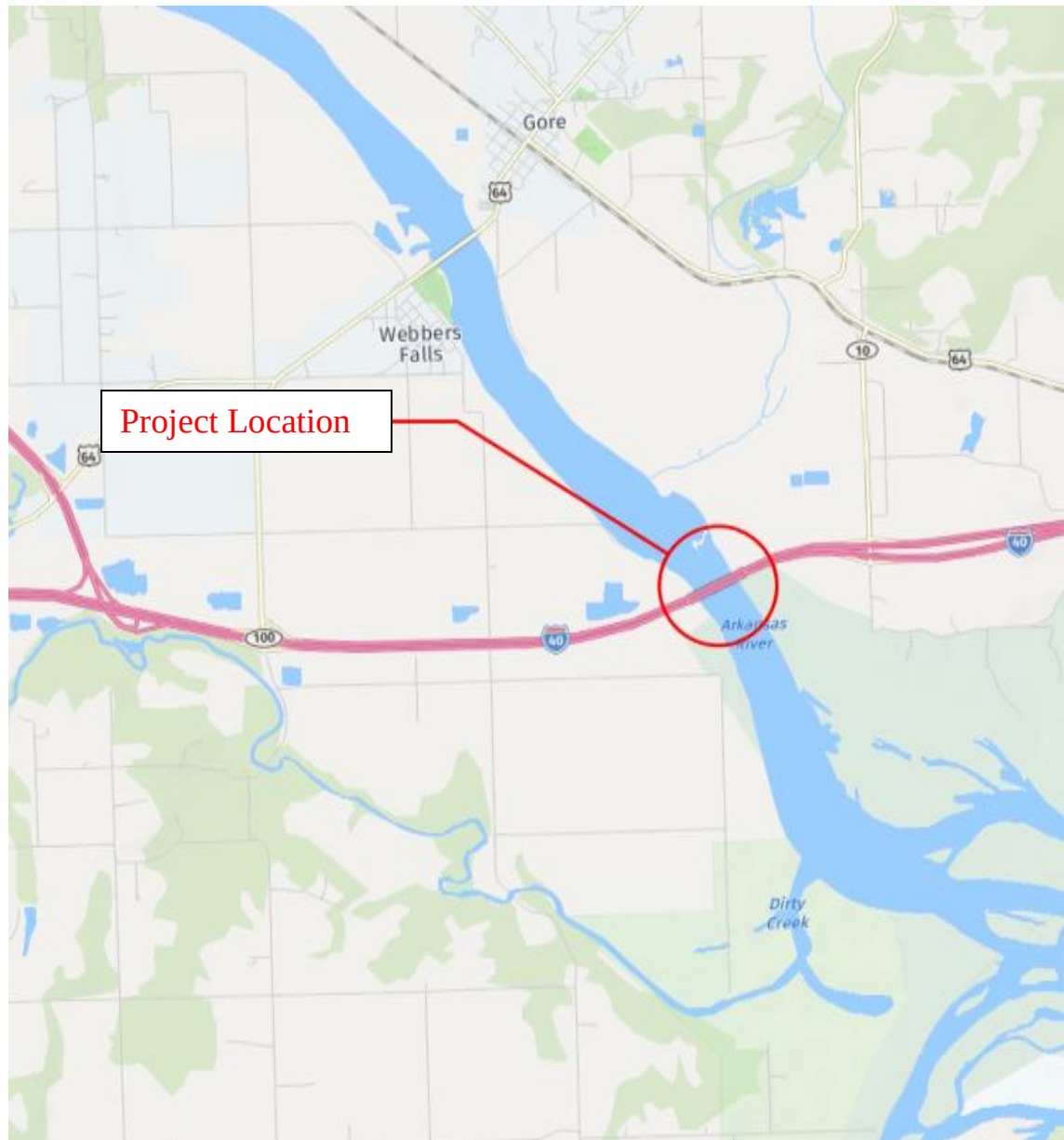
I. INTRODUCTION

This report contains the hydrologic and hydraulic analysis necessary to size the Interstate 40 crossing of a structure over the Arkansas River. The subject structure is located in Sections 28 and 29 of Township 12 North (T-12-N), and Range 21 East (R-21-E). The existing bridge crosses the stream at approximate centerline station 767+08.92 (CRL). The total drainage area of the basin is 86,849 square miles. The structure is located in the FEMA Zone AE and Zone A special flood hazard area associated with the Arkansas River (Lower Reach). The Zone AE cross sections and BFE water surface elevations are upstream of the bridge. The proposed structure will be phased during construction to avoid the need for a detour.

II. GENERAL

The structure is located in Muskogee and Sequoyah County. The watershed is located in parts of Colorado, New Mexico, Kansas, Missouri, Arkansas and Oklahoma. The channel is part of the McClellan-Kerr Navigation System (MKARNS) that serves the Port of Catoosa and Port of Muskogee and is administered by the U.S. Army Corp of Engineers. MKARNS runs southeast through Oklahoma and Arkansas to the Mississippi River. In 2015 the U.S. DOT upgraded the MKARNS from a “Connector” to a “Corridor” on the National Marine Highway. More than 10 million tons of cargo per year is transitioned through the waterway. The channel has an average depth of 9 to 12 feet and an average width of 250 to 300 feet.

Project Location Map



III. DESIGN FLOWS / HYDROLOGY

The design flows were developed by weighting the drainage area at the site location versus the drainage area and frequency flows of the USGS gage located on the Arkansas River near Muskogee (USGS gage station no. 07194500). This method was chosen because the USGS regression methods described in the United States Geologic Survey's Scientific Investigations Report 2010-5137 "Methods for Estimating the Magnitude and Frequency of Peak Stream Flows for Unregulated Streams in Oklahoma" were determined to be outside of the applicable ranges. Additionally, the use of the USGS's Streamstats application returned errors due to one of more parameters being outside of the suggested range. The Streamstats report is included for basin characteristics and information only. A summary of the discharges appear below. The drainage map, hydrology worksheet, and gage information appear in Appendix B.

I-40 over Arkansas River	
Unregulated D.A. = 86,849 sq. mi.	
Mean-Annual Precip. = 46.37 in/yr	
Slope = 2.29 ft/mi	
Storm Frequency (years)	Discharge (cfs)
2	172100
5	271400
10	324600
25	403500
50	462900
100	521200
500	660500

IV. HYDRAULIC ANALYSIS

The hydraulic analysis for this site employs the U.S. Army Corps of Engineers water surface profile program HEC-RAS version 5.0.7. The topographic data used in the model was derived from aerial survey, augmented by publicly available USGS elevation data. Three models have been developed for the site: Natural, Existing, and Proposed. The Manning's 'N' values were determined using an aerial photo of the area. The modeling is sub-critical using the average downstream channel slope as the starting energy grade. The results of the models are summarized in a following section and appear as Appendices C, D, and E.

V. EXISTING STRUCTURE

The existing bridge consists of 3-125' Concrete Girder spans, 3-Steel Plate Girder spans (220'-330'-200'), 4-125' and 3-125' Steel Plate Girder spans, skewed 0 degrees, with a total length of 2000 feet. The structure's piers are protected by sixteen (16) concrete collision barriers upstream and ten (10) barriers downstream. Two (2) of the upstream barriers are 42 feet in diameter (protecting the piers at the main navigation channel) and the remaining fourteen upstream barriers are 12 feet in diameter. All of the downstream barriers are 12 feet in diameter. The centerline station of the existing structure is 767+08.92 (CRL). The low beam elevation is 507.80 located at station 777+06.30 at the northeast abutment. The existing roadway overtopping elevation is 479.89 located at Centerline Survey Station 689+50.00 (CRL). This station was extrapolated from the existing CRL stations because it lies outside of the survey extents. The existing roadway overtops at a storm frequency of greater than 500 years.

VI. PROPOSED STRUCTURE

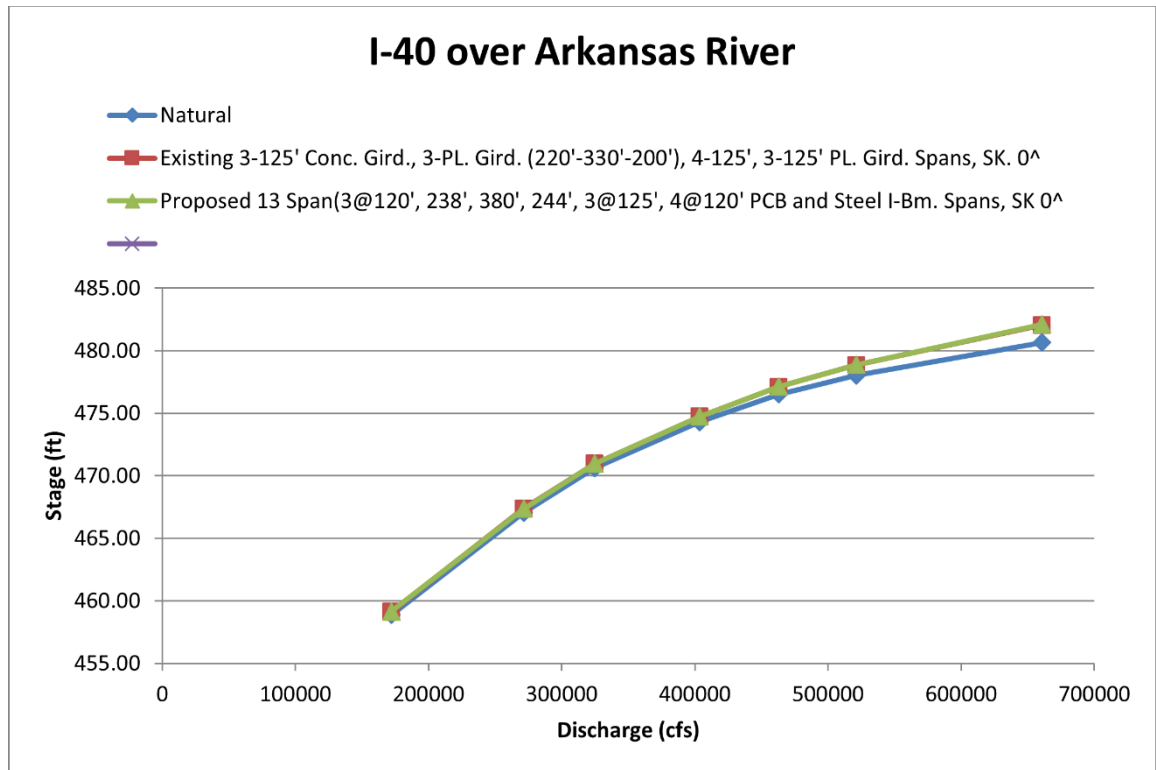
Bridge A

The proposed structure is a 3-120', 238', 380', 244', 3-125', 4-120' P.C. Beam and Steel I-Beam spans, skewed 0 degrees, with a total length of 2079 feet, crossing the proposed roadway at centerline station 767+11.50 (CRL). The proposed low chord elevation is 510.42 at Station 777+51.00 (CRL), located at the northeast abutment. The roadway overtopping elevation is 479.89 located at Station 689+50.00 (CRL). The hydraulic characteristics of the natural channel, existing and proposed structures are shown in the table below.

I-40 over Arkansas River									
Frequency (years)	Q (cfs)	Backwater (Section 520)					Velocity		
		Nat	Exist		Prop		Nat	Exist	Prop
		Elev	Elev	Bwtr	Elev	Bwtr			
2	172100	458.87	459.12	0.25	459.15	0.28	5.75	5.52	5.84
5	271400	467.05	467.37	0.32	467.36	0.31	6.46	6.34	6.65
10	324600	470.62	470.97	0.35	470.97	0.35	6.77	6.72	7.04
25	403500	474.29	474.74	0.45	474.74	0.45	7.24	7.48	7.83
50	462900	476.51	477.11	0.60	477.13	0.62	7.52	8.07	8.44
100	521200	478.03	478.85	0.82	478.88	0.85	7.81	8.73	9.13
500	660500	480.65	482.05	1.40	482.10	1.45	8.53	10.37	10.84

The proposed roadway overtopping frequency is greater than 500 years. The maximum velocity for the 100-year profile (9.13 fps) is greater than the generally accepted maximum allowable (8.00 fps), but is within an acceptable range.

A comparison of natural, existing, and proposed models is shown on the following page in the form of stage discharge curves.



VI. NFIP ANALYSIS

Interstate 40 runs approximately perpendicular to the Arkansas River. The Arkansas River is within a special flood hazard area with an established regulatory floodplain upstream of I-40. The first cross section of the detailed study occurs at approximately the upstream face of the existing and proposed bridges. The current effective model was unable to be located. Therefore, the modeling is based on a best available data model developed for this report. The geometric data for the modeling is a mosaic of on-site survey data and Lidar data from the National Elevation Dataset. The flow for the 1% annual chance storm (100 year) was taken from the effective published FIS data. Since there is no downstream cross section to determine a starting water surface elevation, the boundary condition was set using normal depth. Two models have been developed to determine compliance with the National Flood Insurance Program. The models were developed based on the previously mentioned data. The results of the existing and proposed models are summarized in the table on the following page and appear in Appendix 'F' and 'G'. The modeling indicates no increase in the Base Flood Elevation.

Section		Base Flood Elevation (NAVD88)	
Label	Stream Sta	Existing	Proposed
A	21520	478.45	478.39

The results meet the Oklahoma Water Resources Board Floodplain Regulations of no rise for proposed development within any flood hazard area. A floodway analysis was not performed.

VII. SCOUR ANALYSIS

Scour calculations were performed for contraction scour and pier scour at the 100-year and 500-year rainfall events. The USDA Natural Resource Conservation Service-Web Soil Survey was used to identify the soil types at the site. The soil unit Roxana (60,61) comprises the channel area adjacent overbank areas. Both of these soils have an AASHTO Rating of “A-4” and a USCS rating of “ML” and “CL-ML”. These soils are classified as very fine sandy loam and are only sampled to a maximum depth of approximately 80 inches. The median grain size (D50) for these soils has been determined to be 0.035 mm (from Munoz-Carpena and Parsons 2000). Contraction scour depth in the channel was calculated to be 9.26 feet at the 100-year event and 13.90 feet at the 500-year event. Pier scour was calculated to be 26.49 feet at the 100-year event and 28.38 feet at the 500-year event. The sum of contraction and pier scour should be used for structure design considerations. The maximum combined scour is 42.28 feet which occurs at the 500-year event. Scour calculations can be found in Appendix ‘H’.

VIII. RISK STATEMENT

The proposed structures meets or exceeds all applicable local, state, and federal requirements. Specifically, the structure meets ODOT, FEMA, and FHWA requirements for the hydraulic design of bridge structures.

Overtopping of the proposed roadway occurs at a storm frequency greater than 500 years. The encroachment associated with the proposed structures is considered “Low Risk”, since there are no appreciable hazards to life or property upstream of the structure, and no detrimental effects to the beneficial floodplain.

**This design is in compliance with
Federal-Aid Policy Guide 23, CFR 650, Subpart A**

APPENDIX ‘A’

Scope





Oklahoma Department of Transportation Project Initiation Report

Report Date: 02/17/2021

Job Piece: 3433404

Div / County: 01 / 51 - MUSKOGEE

Project ID: J3-4334(004)PM

Highway: IS040

Project Description: I-40: OVER ARKANSAS RIVER, BEGIN MP 290, E 1.0 MI

PS&E: FY 2027

R/W: FY 2025

Drive-out Date: March 30th, 2020

Programmed Estimate:

\$30,000,000

EXISTING INFORMATION

Reconnaissance Data Available Yes

Location: <http://plansrv1.agency.ok.local/osd/JP3433404/PSEDevelopment/DataReconnaissance>

Functional Classification

Area Type:	☐ Urban	☐ Suburban	☒ Rural	
Terrain Type:	☒ Flat	☐ Rolling	☐ Mountainous	
Access Control:	☒ Full	☐ Partial	☐ None	
Highway Type:	☒ Freeway	☐ Principal Arterial	☐ Minor Arterial	☐ Collector
	☒ NHS	☐ Non-NHS	☐ STRAHNET	☐ Scenic Hwy

Existing Condition

Current ADT: 21,800	% Trucks: 4%	Number of lanes: 4	Lane Width: 12'
Outside Shoulder Width: 10'		Inside Shoulder Width: 4'	
☒ Open Section	☐ Curb & Gutter	☒ Divided	Median Width: 10'
☐ Other (describe)			

Pavement Type: Asphalt Conc.	Pavement Condition: Poor
Shoulder Type: Asphalt Conc.	Shoulder Condition: Poor
Storm Sewer ☒ No ☐ Yes	Storm Sewer Condition:
Sidewalks ☒ No ☐ Yes	Left Width: Right Width:

Bridges within the Project extents: SEE ATTACHED INSPECTION REPORTS

Bridge 1 NBI#: 17051 over ARKANSAS RIVER

CONSIDERATIONS

Environmental

- ☒ **Threatened & Endangered Species, list with seasonal restrictions**
Piping Plover, Red Knot, Whooping Crane, Northern Long-Eared Bat, Indiana Bat, Gray Bat, Ozark Big-Eared Bat, ABB
- ☒ **Wetlands, list**

Alternative Impacts

- ☒ Other agencies / entities
- ☐ Turnpike Involvement
- ☐ Metropolitan Planning Organization
- US Coast Guard

Report Date: 02/17/2021

Job Piece: 3433404

Div / County: 01 / 51 - MUSKOGEE

Project ID: J3-4334(004)PM

Highway: IS040

Project Description: I-40: OVER ARKANSAS RIVER, BEGIN MP 290, E 1.0 MI

Right of Way / Utilities

☒ **Additional Right of Way anticipated, list**

As Needed for Design

☒ **Utility Conflicts, list**

As Needed for Design

Permit Information

Design Exception Anticipated: No

☐ **Maintenance Agreements (Lighting, Signals,...), list**

Permits Required:

☐ FAA

☒ USACE

☐ OWRB

☐ Railroad

☒ Other

US Coast Guard

Additional Permit Comments:

Special Considerations:

The Arkansas River is a Navigable waterway and is listed as Section 10 water. Bridge design will need to be approved by the US Coastguard prior to 30% plans. Navigation lights will need replacement in consultation with the US Coastguard.

PROPOSED IMPROVEMENTS

Project Intent:

Replacement of existing Bridge

Description of Proposed Improvements:

The Project Initiation Team's scope is to replace the single I-40 bridge over the Arkansas River with two new bridges. The new bridges substructure should be evaluated for separate or a single shared substructure. The new structures must be evaluated to meet minimum clearances for a navigable waterway, and include navigational lighting. All coordination for and obtaining the USCG permit will be the responsibility of the designer. The new bridges will evaluate the efficiency of a 4 beam system vs a 5 beam system in this location and be positioned to utilize existing pier protection. Existing pier protection will be evaluated for vessel collisions. Traffic during new bridge construction will be managed via crossovers into a single lane in each direction. Crossovers will be removed after project is complete. Provide new guardrail as required and minimize Roadway work needed to accommodate vertical changes.

New Bridge Info:

Design Speed:

Desired: 70

Minimum:

Report Date: 02/17/2021

Job Piece: 3433404

Div / County: 01 / 51 - MUSKOGEE

Project ID: J3-4334(004)PM

Highway: IS040

Project Description: I-40: OVER ARKANSAS RIVER, BEGIN MP 290, E 1.0 MI

Potential to transfer Steel Beams to County:

☐ Yes

☒ No

☐ N/A

Project Termini

Beginning of Project: Approx. 1800' West of existing Arkansas River bridge

End of Project: Approx. 1800' East of existing Arkansas River bridge

Limits of Survey: 150' LT. & RT. of Centerline. From 4435 Rd. to SH-10

Limits of NEPA: Same Width and Length as Survey extents, include crossovers

Typical Section

☒ Open Section ☐ Curb & Gutter ☒ Divided Median Width: 10' & variable
☐ Other

Number of lanes: 4

Lane Width: 12'

Outside Shoulder Width: 10'

Inside Shoulder Width: 4'

Storm Sewer: ☒ No (only if needed in C&G section) ☐ Yes

Sidewalks: ☒ No ☐ Yes

Overlay: ☐ No ☐ Yes Thickness:

Coldmill: ☐ No ☐ Yes Thickness:

Add Shoulders ☐ No ☐ Yes Width:

Bridge Width: 38' Clear Roadway

Alignment

☒ Existing symmetrical offset from centerline for bridges
☐ New, located ☐ North ☐ South ☐ East ☐ West of existing
☐ Parallel lanes, located ☐ North ☐ South ☐ East ☐ West of existing

Decision comments:

☐ Spot Improvements

☐ Horizontal, Description:

☒ Vertical, Description: As needed for Navigational clearance

Detour

☐ Shoo-fly, located ☐ North ☐ South ☐ East ☐ West of existing
☐ Widening, located ☐ North ☐ South ☐ East ☐ West of existing

☒ Crossovers

☐ Close Road

☐ Signed Detour, Route Desc:

Anticipated Duration of Detour:

☐ Agreement Required for Detour

☒ Phased Construction, Desc: One lane of Traffic in each direction must be maintained at all times.

Aesthetics

☐ Yes ☒ No

Report Date: 02/17/2021

Job Piece: 3433404

Div / County: 01 / 51 - MUSKOGEE

Project ID: J3-4334(004)PM

Highway: IS040

Project Description: I-40: OVER ARKANSAS RIVER, BEGIN MP 290, E 1.0 MI

Traffic Items

Traffic Management Plan	☐ No	☒ Yes		
Median Barrier	☒ No	☐ Yes		
New Guardrail	☐ No	☒ Yes		
End Treatment	☐ No	☒ Yes, Type: GET		
Highway Lighting	☒ No	☐ Yes	☐ Outside	☐ Median
Traffic Signals	☒ No	☐ Yes		

Miscellaneous

Channel Work	☒ No	☐ Relocation	☐ Re-alignment	☐ Cleanup
Public Involvement	☒ No	☐ Road Closure Letters		
		☐ Public Meeting		
		☐ Stakeholder Meeting		

PROGRAMMING INFORMATION

RW Project Needed	☐ No	☒ Yes
Utility Project Needed	☐ No	☒ Yes

Initiation Estimate

Roadway:	\$806,000	Total Construction:	\$33,795,403
Bridge:	\$28,800,000		
Traffic Control:	\$365,000	Right of Way:	\$103,000
Signing and Striping:	\$55,000	Utilities:	\$300,000
Highway Lighting:			
Traffic Signals:			
Mobilization:	\$1,266,040		
Staking:	\$625,841		
E & C:	\$1,877,522	Total Estimate:	\$34,198,403

Comments:

Program Revisions

Estimate:	Letting Date:	/	Project Length:
Work Type:			
Description:			

Attendees

Report Date: 02/17/2021

Job Piece: 3433404 Div / County: 01 / 51 - MUSKOGEE

Project ID: J3-4334(004)PM

Highway: IS040

Project Description: I-40: OVER ARKANSAS RIVER, BEGIN MP 290, E 1.0 MI

Brian Linam, Project Management Division
Chris Wallace, Field District One
Jamie Malmstrom, Field District One
Jon Arps, Field District One
Eduardo Elder, Roadway Design Division
Mohamed Elyazgi, Roadway Design Division
Steven Bowen, Roadway Design Division, Geometrics
Patty Defranco, Bridge Design Division
Siv Sundaram, Environmental Programs Division
Leslie Novotny, Environmental Programs Division
Kathy Koon, Environmental Programs Division
Darin Stratton, Survey Division

Report Author: Brian Linam



Begin Project

End Project

Crossovers

Crossovers

100' Estimated R/W

100' Estimated R/W

ADD 30' TO ESTIMATED R/W
FOR ENVIRONMENTAL STUDIES

OKLAHOMA DEPARTMENT OF TRANSPORTATION
ROADWAY DESIGN DIVISION
SCOPING

I-40
Arkansas River

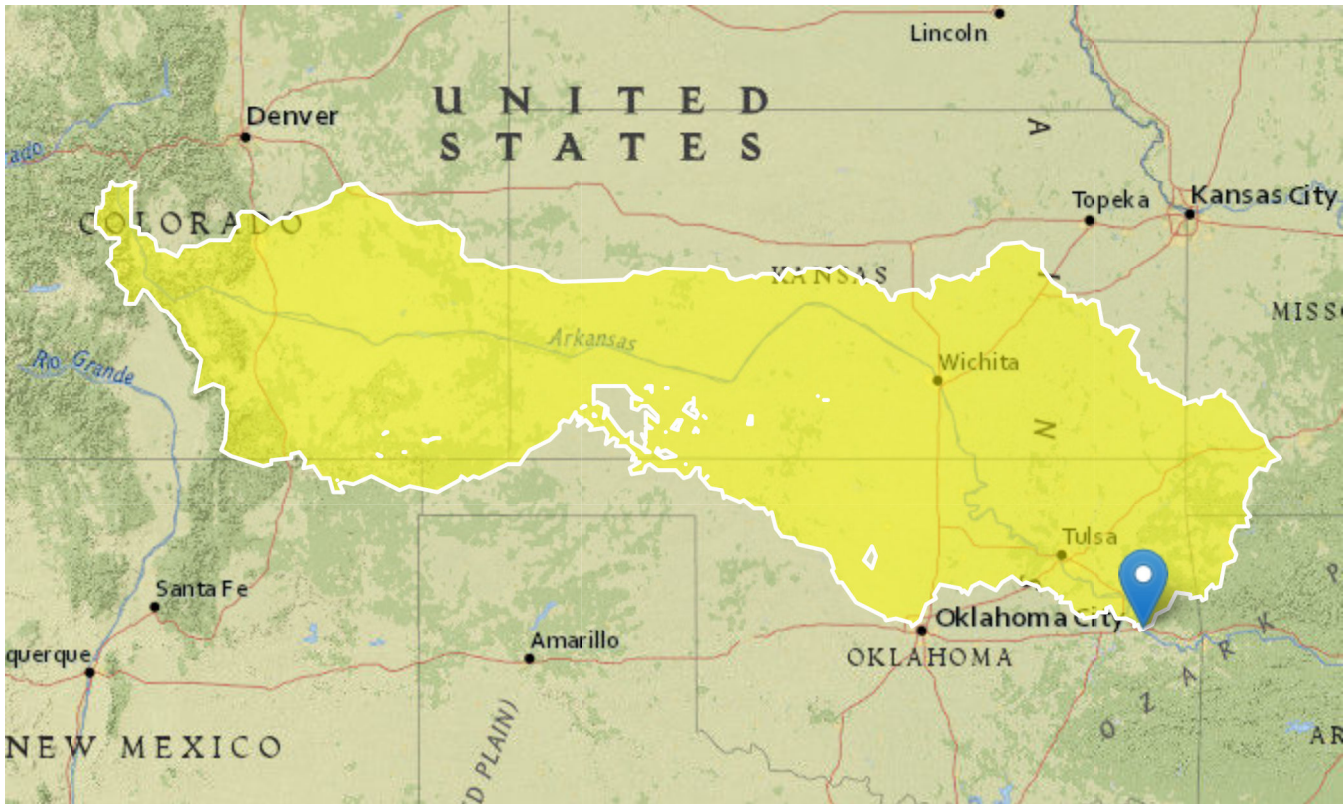
Muskogee Co. J / P 34333(04)

APPENDIX ‘B’

Hydrology / Drainage Map

I-40 over Arkansas River, Muskogee & Sequoyah Co. - J/P 34334(04)

Region ID: OK
Workspace ID: OK20231024152605019000
Clicked Point (Latitude, Longitude): 35.48671, -95.09736
Time: 2023-10-24 10:26:50 -0500



Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
BSLDEM10M	Mean basin slope computed from 10 m DEM	2.29	percent
CONTDA	Area that contributes flow to a point on a stream	86849.27	square miles
CSL10_85fm	Change in elevation between points 10 and 85 percent of length along main channel to basin divide divided by length between points ft per mi	5.19	feet per mi

Parameter Code	Parameter Description	Value	Unit
DAUNREG	Unregulated drainage area used in OK regulated equations	87464.29	square miles
DRNAREA	Area that drains to a point on a stream		square miles
NRCSPCT	Percent of contributing drainage area regulated by NRCS floodwater-retarding structures	1.6	percent
PRECIP	Mean Annual Precipitation	28.59	inches
PRECIPOUT	Mean annual precip at the stream outlet (based on annual PRISM precip data in inches from 1971-2000)	46.37	inches
PREG_06_10	Mean precipitation at gaging station location for June to October summer period	20.1	inches

General Disclaimers

The delineation point is in an exclusion area. ELEVATION-DEPENDENT BASIN CHARACTERISTICS (BSLDEM10M AND CLS10_85) AND FLOW STATISTICS THAT RELY ON THOSE BASIN CHARACTERISTICS ARE NOT VALID.

➤ Peak-Flow Statistics

Peak-Flow Statistics Parameters [7.3 Percent (7050 square miles) Peak Panhandle 2015 5134]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
CONTDA	Contributing Drainage Area	86849.27	square miles	1	2060

Peak-Flow Statistics Parameters [7.3 Percent (7050 square miles) Peak Panhandle NRCS Regulated 2015 5134]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DAUNREG	Unregulated Drainage Area	87464.29	square miles	1	2060

Peak-Flow Statistics Parameters [12.0 Percent (11600 square miles) Peak Region 1 NRCS Regulated 2019 5143]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DAUNREG	Unregulated Drainage Area	87464.29	square miles	0.1	2510
PRECIP	Mean Annual Precipitation	28.59	inches	16.6	62.1

Peak-Flow Statistics Parameters [12.0 Percent (11600 square miles) Peak Region 1 Unregulated 2019 5143]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
CONTDA	Contributing Drainage Area	86849.27	square miles	0.1	2510
PRECIP	Mean Annual Precipitation	28.59	inches	16.6	62.1

Peak-Flow Statistics Parameters [22.2 Percent (21400 square miles) Peak Region 2 Unregulated 2019 5143]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
CONTDA	Contributing Drainage Area	86849.27	square miles	0.1	2510
CSL10_85fm	Stream Slope 10 and 85 Method ft per mi	5.19	feet per mi	1.98	342

Peak-Flow Statistics Parameters [22.2 Percent (21400 square miles) Peak Region 2 NRCS Regulated 2019 5143]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
----------------	----------------	-------	-------	-----------	-----------

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DAUNREG	Unregulated Drainage Area	87464.29	square miles	0.1	2510
CSL10_85fm	Stream Slope 10 and 85 Method ft per mi	5.19	feet per mi	1.98	342

Peak-Flow Statistics Disclaimers [7.3 Percent (7050 square miles) Peak Panhandle 2015 5134]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors. Weighted flows were not calculated. Users should be careful to evaluate the applicability of the provided estimates. Percentage of area falls outside where region is undefined. Whole estimates have been provided using available regional equations.

Peak-Flow Statistics Flow Report [7.3 Percent (7050 square miles) Peak Panhandle 2015 5134]

Statistic	Value	Unit
50-percent AEP flood	3710	ft ³ /s
20-percent AEP flood	11200	ft ³ /s
10-percent AEP flood	20300	ft ³ /s
4-percent AEP flood	33700	ft ³ /s
2-percent AEP flood	51000	ft ³ /s
1-percent AEP flood	75300	ft ³ /s
0.2-percent AEP flood	137000	ft ³ /s

Peak-Flow Statistics Disclaimers [7.3 Percent (7050 square miles) Peak Panhandle NRCS Regulated 2015 5134]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors. Weighted flows were not calculated. Users should be careful to evaluate the applicability of the provided estimates. Percentage of area falls outside where region is undefined. Whole estimates have been provided using available regional equations.

Peak-Flow Statistics Flow Report [7.3 Percent (7050 square miles) Peak Panhandle NRCS Regulated 2015 5134]

Statistic	Value	Unit
-----------	-------	------

Statistic	Value	Unit
Regulated 50-percent AEP flood	3720	ft ³ /s
Regulated 20-percent AEP flood	11200	ft ³ /s
Regulated 10-percent AEP flood	20400	ft ³ /s
Regulated 4-percent AEP flood	33800	ft ³ /s
Regulated 2-percent AEP flood	51100	ft ³ /s
Regulated 1-percent AEP flood	75500	ft ³ /s
Regulated 0.2-percent AEP flood	137000	ft ³ /s

Peak-Flow Statistics Disclaimers [12.0 Percent (11600 square miles) Peak Region 1 NRCS Regulated 2019 5143]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors. Weighted flows were not calculated. Users should be careful to evaluate the applicability of the provided estimates. Percentage of area falls outside where region is undefined. Whole estimates have been provided using available regional equations.

Peak-Flow Statistics Flow Report [12.0 Percent (11600 square miles) Peak Region 1 NRCS Regulated 2019 5143]

Statistic	Value	Unit
Regulated 50-percent AEP flood	69900	ft ³ /s
Regulated 20-percent AEP flood	193000	ft ³ /s
Regulated 10-percent AEP flood	266000	ft ³ /s
Regulated 4-percent AEP flood	383000	ft ³ /s
Regulated 2-percent AEP flood	541000	ft ³ /s
Regulated 1-percent AEP flood	620000	ft ³ /s
Regulated 0.2-percent AEP flood	875000	ft ³ /s

Peak-Flow Statistics Disclaimers [12.0 Percent (11600 square miles) Peak Region 1 Unregulated 2019 5143]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors. Weighted flows were not calculated. Users should be careful to evaluate the applicability of the provided estimates. Percentage of area falls outside where region is undefined. Whole estimates have been provided using available regional equations.

Peak-Flow Statistics Flow Report [12.0 Percent (11600 square miles) Peak Region 1 Unregulated 2019 5143]

Statistic	Value	Unit
50-percent AEP flood	69700	ft ³ /s
20-percent AEP flood	192000	ft ³ /s
10-percent AEP flood	265000	ft ³ /s
4-percent AEP flood	381000	ft ³ /s
2-percent AEP flood	539000	ft ³ /s
1-percent AEP flood	618000	ft ³ /s
0.2-percent AEP flood	872000	ft ³ /s

Peak-Flow Statistics Disclaimers [22.2 Percent (21400 square miles) Peak Region 2 Unregulated 2019 5143]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors. Weighted flows were not calculated. Users should be careful to evaluate the applicability of the provided estimates. Percentage of area falls outside where region is undefined. Whole estimates have been provided using available regional equations.

Peak-Flow Statistics Flow Report [22.2 Percent (21400 square miles) Peak Region 2 Unregulated 2019 5143]

Statistic	Value	Unit
50-percent AEP flood	602000	ft ³ /s
20-percent AEP flood	1280000	ft ³ /s
10-percent AEP flood	1910000	ft ³ /s
4-percent AEP flood	2680000	ft ³ /s
2-percent AEP flood	3710000	ft ³ /s
1-percent AEP flood	4360000	ft ³ /s
0.2-percent AEP flood	7510000	ft ³ /s

Peak-Flow Statistics Disclaimers [22.2 Percent (21400 square miles) Peak Region 2 NRCS Regulated 2019 5143]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors. Weighted flows were not calculated. Users should be careful to evaluate the

applicability of the provided estimates. Percentage of area falls outside where region is undefined. Whole estimates have been provided using available regional equations.

Peak-Flow Statistics Flow Report [22.2 Percent (21400 square miles) Peak Region 2 NRCS Regulated 2019 5143]

Statistic	Value	Unit
Regulated 50-percent AEP flood	605000	ft^3/s
Regulated 20-percent AEP flood	1290000	ft^3/s
Regulated 10-percent AEP flood	1920000	ft^3/s
Regulated 4-percent AEP flood	2700000	ft^3/s
Regulated 2-percent AEP flood	3730000	ft^3/s
Regulated 1-percent AEP flood	4380000	ft^3/s
Regulated 0.2-percent AEP flood	7550000	ft^3/s

Peak-Flow Statistics Citations

Smith, S.J., Lewis, J.M., and Graves, G.M.,2015, Methods for estimating the magnitude and frequency of peak streamflows at ungaged sites in and near the Oklahoma Panhandle: U.S. Geological Survey Scientific Investigations Report 2015–5134, 35 p. (<http://dx.doi.org/10.3133/sir20155134>)

Lewis, J.M., Hunter, S.L., and Labriola, L.G.,2019, Methods for estimating the magnitude and frequency of peak streamflows for unregulated streams in Oklahoma developed by using streamflow data through 2017: U.S. Geological Survey Scientific Investigations Report 2019–5143, 39 p. (<https://doi.org/10.3133/sir20195143>)

➤ General Flow Statistics

General Flow Statistics Parameters [12.0 Percent (11600 square miles) Duration Region 1 2009 5267]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
CONTDA	Contributing Drainage Area	86849.27	square miles	3.65	9056
PREG_06_10	Jun to Oct Gage Precipitation	20.1	inches	13	17.9

General Flow Statistics Parameters [15.9 Percent (15400 square miles) Duration Region 2 2009 5267]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
CONTDA	Contributing Drainage Area	86849.27	square miles	4.02	7159
PREG_06_10	Jun to Oct Gage Precipitation	20.1	inches	15.7	18

General Flow Statistics Parameters [6.3 Percent (6090 square miles) Duration Region 3 2009 5267]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
CONTDA	Contributing Drainage Area	86849.27	square miles	8	2296
PRECIPOUT	Mean Annual Precip at Gage	46.37	inches	38	58

General Flow Statistics Disclaimers [12.0 Percent (11600 square miles) Duration Region 1 2009 5267]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors. Weighted flows were not calculated. Users should be careful to evaluate the applicability of the provided estimates. Percentage of area falls outside where region is undefined. Whole estimates have been provided using available regional equations.

General Flow Statistics Flow Report [12.0 Percent (11600 square miles) Duration Region 1 2009 5267]

Statistic	Value	Unit
Average daily streamflow	44300	ft ³ /s

General Flow Statistics Disclaimers [15.9 Percent (15400 square miles) Duration Region 2 2009 5267]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors. Weighted flows were not calculated. Users should be careful to evaluate the applicability of the provided estimates. Percentage of area falls outside where region is undefined.

Whole estimates have been provided using available regional equations.

General Flow Statistics Flow Report [15.9 Percent (15400 square miles) Duration Region 2 2009 5267]

Statistic	Value	Unit
Average daily streamflow	35900	ft ³ /s

General Flow Statistics Disclaimers [6.3 Percent (6090 square miles) Duration Region 3 2009 5267]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors. Weighted flows were not calculated. Users should be careful to evaluate the applicability of the provided estimates. Percentage of area falls outside where region is undefined. Whole estimates have been provided using available regional equations.

General Flow Statistics Flow Report [6.3 Percent (6090 square miles) Duration Region 3 2009 5267]

Statistic	Value	Unit
Average daily streamflow	85500	ft ³ /s

General Flow Statistics Citations

Esralew, R.A., Smith, S.J., 2009, Methods for estimating flow-duration and annual mean-flow statistics for ungaged streams in Oklahoma: U.S. Geological Survey Scientific Investigations Report 2009-5267, 131 p. (<http://pubs.usgs.gov/sir/2009/5267/>)

➤ Maximum Probable Flood Statistics

Maximum Probable Flood Statistics Parameters [9.6 Percent (9270 square miles) Crippen Bue Region 8]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area		square miles	0.1	10000

Maximum Probable Flood Statistics Parameters [37.0 Percent (35600 square miles) Crippen Bue Region 9]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area		square miles	0.1	10000

Maximum Probable Flood Statistics Parameters [46.5 Percent (44900 square miles) Crippen Bue Region 12]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area		square miles	0.1	7000

Maximum Probable Flood Statistics Parameters [6.9 Percent (6620 square miles) Crippen Bue Region 13]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area		square miles	0.1	10000

Maximum Probable Flood Statistics Flow Report [9.6 Percent (9270 square miles) Crippen Bue Region 8]

Statistic	Value	Unit
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Maximum Probable Flood Statistics Flow Report [37.0 Percent (35600 square miles) Crippen Bue Region 9]

Statistic	Value	Unit
-----------	-------	------

Maximum Probable Flood Statistics Flow Report [46.5 Percent (44900 square miles) Crippen Bue Region 12]

Statistic	Value	Unit
-----------	-------	------

Maximum Probable Flood Statistics Flow Report [6.9 Percent (6620 square miles) Crippen Bue Region 13]

Statistic	Value	Unit
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Maximum Probable Flood Statistics Citations

quality standards relative to the purpose for which the data were collected. Although these data and associated metadata have been reviewed for accuracy and completeness and approved for release by the U.S. Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data for other purposes, nor on all computer systems, nor shall the act of distribution constitute any such warranty.

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Application Version: 4.18.0

StreamStats Services Version: 1.2.22

NSS Services Version: 2.2.1

StreamStats Data-Collection Station Report

Gage Information

Name	Value
USGS Station Number	07194500 (https://waterdata.usgs.gov/monitoring-location/07194500)
Station Name	Arkansas River near Muskogee, OK
Station Type	Gaging Station, continuous record
Latitude	35.76954
Longitude	-95.29719
NWIS Latitude	35.7695432
NWIS Longitude	-95.2971867
Is regulated?	false
Agency	United States Geological Survey
NWIS Discharge Period of Record	07/24/2003 - 11/04/2023

Physical Characteristics

Filter By Statistic Group: 1 Checked ▼ Filter By Citation: Select ▼

Basin Dimensional Characteristics

Characteristic Name	Value	Units	Citation
Contributing Drainage Area	84818	square miles	152
Drainage Area	104603	square miles	193

Streamflow Statistics

Filter By Statistic Group: **Select ▼** Filter By Citation: **Select ▼**Show Only Preferred ☐

Peak-Flow Statistics

Statistic Name	Value	Units	Preferred?	Years of Record	Standard Error, percent	Citation	Comments
50-percent AEP flood	168000	cubic feet per second	✓			155	
20-percent AEP flood	265000	cubic feet per second	✓			155	
10-percent AEP flood	317000	cubic feet per second	✓			155	
4-percent AEP flood	394000	cubic feet per second	✓			155	
2-percent AEP flood	452000	cubic feet per second	✓			155	
1-percent AEP flood	509000	cubic feet per second	✓			155	
0.2-percent AEP flood	645000	cubic feet per second	✓			155	
Equivalent Years of Peak Record	55	dimensionless	✓			3	

Low-Flow Statistics

DA Weighted Discharges

USGS Gage Sta. No. 07194500

Arkansas River at Muskogee

DA= 84818 Sq. Mi.

2-yr	168000
5-yr	265000
10-yr	317000
25-yr	394000
50-yr	452000
100-yr	509000
500-yr	645000

Site

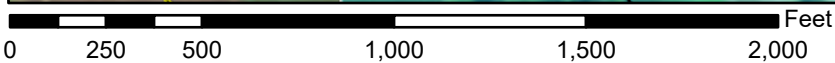
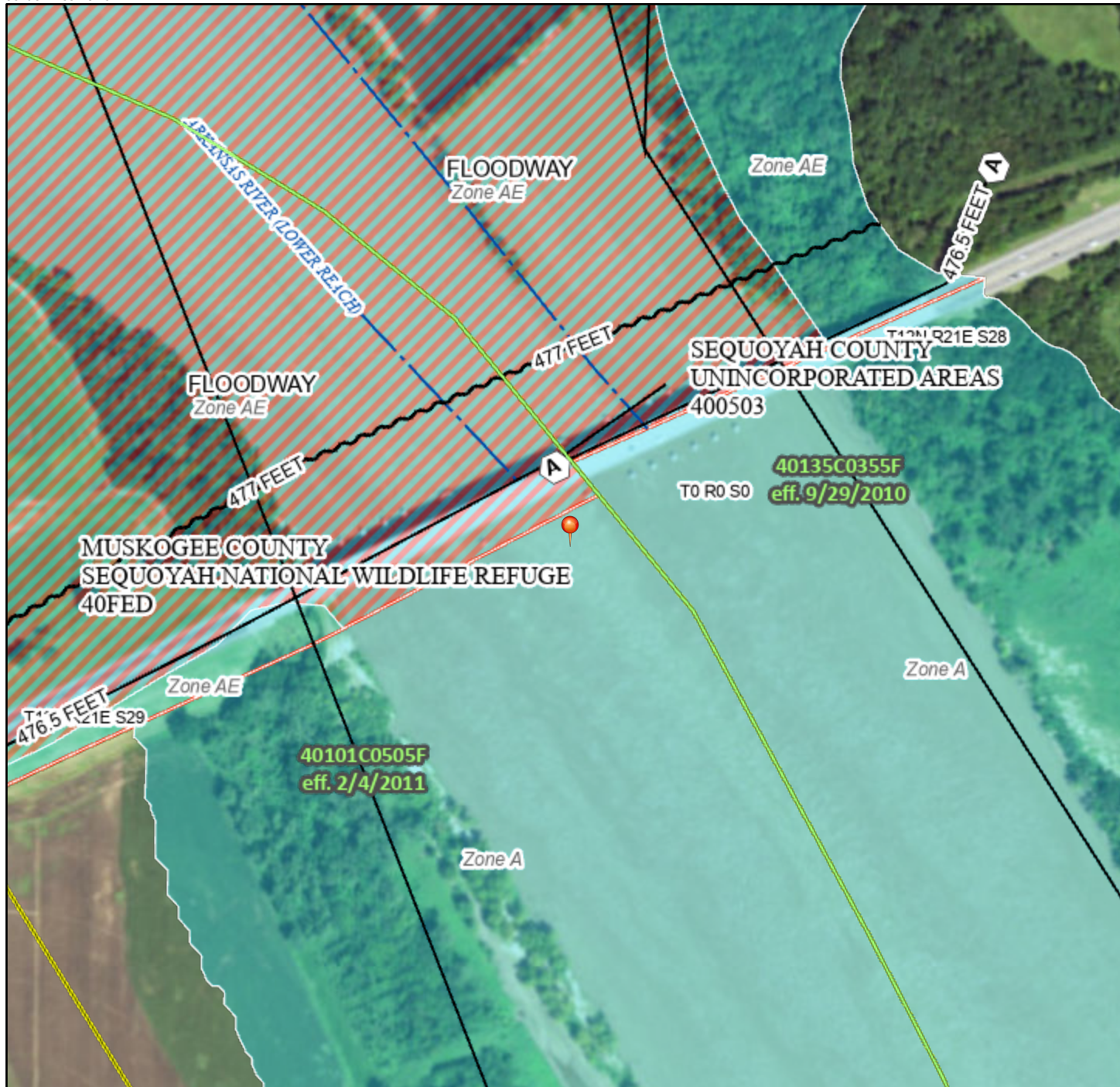
DA= 86849 Sq. Mi.

2-yr	172100
5-yr	271400
10-yr	324600
25-yr	403500
50-yr	462900
100-yr	521200
500-yr	660500

National Flood Hazard Layer FIRMette



95°6'9"W 35°29'25"N



1:6,000

95°5'31"W 35°28'56"N

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard Zone D
		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **10/25/2023 at 12:33 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

APPENDIX ‘C’

HEC-RAS model

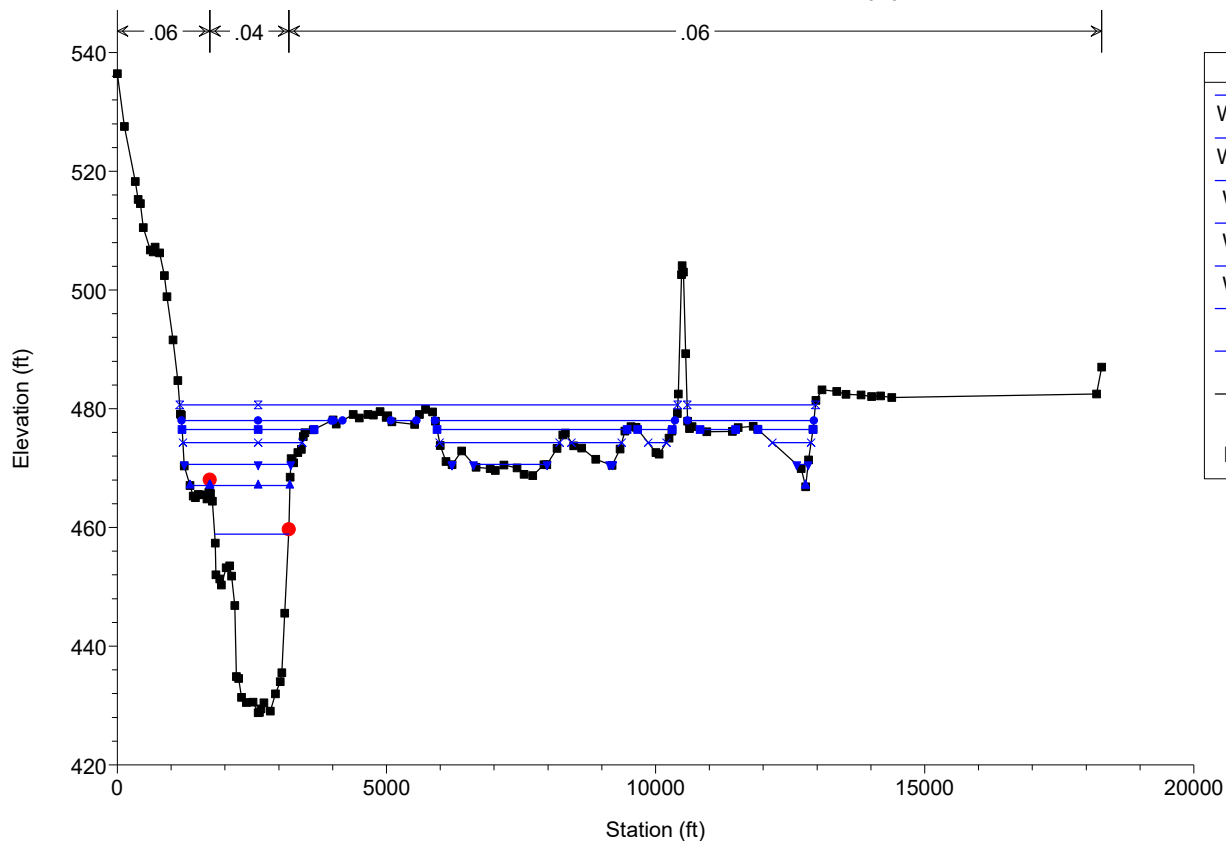
Natural Conditions

HEC-RAS Plan: Natural River: Arkansas River Reach: 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
1	1049	2-yr	172100.00	428.78	458.87		459.45	0.000488	6.12	28142.12	1377.24	0.24
1	1049	5-yr	271400.00	428.78	467.05		467.77	0.000415	6.82	40376.05	1852.33	0.23
1	1049	10-yr	324600.00	428.78	470.62		471.40	0.000388	7.14	48606.09	3632.85	0.23
1	1049	25-yr	403500.00	428.78	474.29		475.14	0.000377	7.59	67527.40	6433.72	0.23
1	1049	50-yr	462900.00	428.78	476.51		477.38	0.000369	7.83	83311.34	8313.07	0.23
1	1049	100-yr	521200.00	428.78	478.03		478.95	0.000381	8.18	97493.36	10242.24	0.23
1	1049	500-yr	660500.00	428.78	480.65		481.68	0.000422	9.00	126725.50	11637.61	0.25
1	872.667*	2-yr	172100.00	428.66	458.80		459.36	0.000463	6.02	28602.27	1380.38	0.23
1	872.667*	5-yr	271400.00	428.66	466.99		467.69	0.000405	6.70	40877.21	1832.89	0.23
1	872.667*	10-yr	324600.00	428.66	470.57		471.33	0.000377	7.01	49173.48	3552.65	0.22
1	872.667*	25-yr	403500.00	428.66	474.24		475.07	0.000369	7.48	67428.49	6375.47	0.23
1	872.667*	50-yr	462900.00	428.66	476.46		477.32	0.000362	7.73	83890.15	9096.42	0.23
1	872.667*	100-yr	521200.00	428.66	477.98		478.87	0.000372	8.06	98842.97	10702.15	0.23
1	872.667*	500-yr	660500.00	428.66	480.61		481.60	0.000407	8.81	128615.00	11590.27	0.24
1	696.333*	2-yr	172100.00	428.55	458.76		459.27	0.000403	5.75	29928.53	1394.54	0.22
1	696.333*	5-yr	271400.00	428.55	466.96		467.61	0.000368	6.46	42285.07	1815.45	0.22
1	696.333*	10-yr	324600.00	428.55	470.54		471.25	0.000347	6.77	50784.85	3265.87	0.22
1	696.333*	25-yr	403500.00	428.55	474.21		474.99	0.000341	7.24	69242.27	6564.64	0.22
1	696.333*	50-yr	462900.00	428.55	476.43		477.24	0.000338	7.52	86631.59	9520.03	0.22
1	696.333*	100-yr	521200.00	428.55	477.95		478.80	0.000346	7.81	102533.50	11177.55	0.22
1	696.333*	500-yr	660500.00	428.55	480.58		481.51	0.000377	8.53	132642.20	11688.52	0.24
1	520	2-yr	172100.00	428.43	458.61	441.83	459.17	0.000661	6.03	28560.57	1295.14	0.23
1	520	5-yr	271400.00	428.43	466.79	445.47	467.51	0.000662	6.82	39967.28	1644.55	0.23
1	520	10-yr	324600.00	428.43	470.37	447.21	471.16	0.000662	7.14	48034.11	2939.83	0.23
1	520	25-yr	403500.00	428.43	474.08	449.65	474.90	0.000662	7.52	66668.02	6671.65	0.23
1	520	50-yr	462900.00	428.43	476.36	451.41	477.15	0.000662	7.58	85299.64	9630.21	0.23
1	520	100-yr	521200.00	428.43	477.91	453.16	478.69	0.000662	7.72	101706.20	11080.40	0.23
1	520	500-yr	660500.00	428.43	480.60	456.37	481.38	0.000662	8.10	132696.20	11860.78	0.23

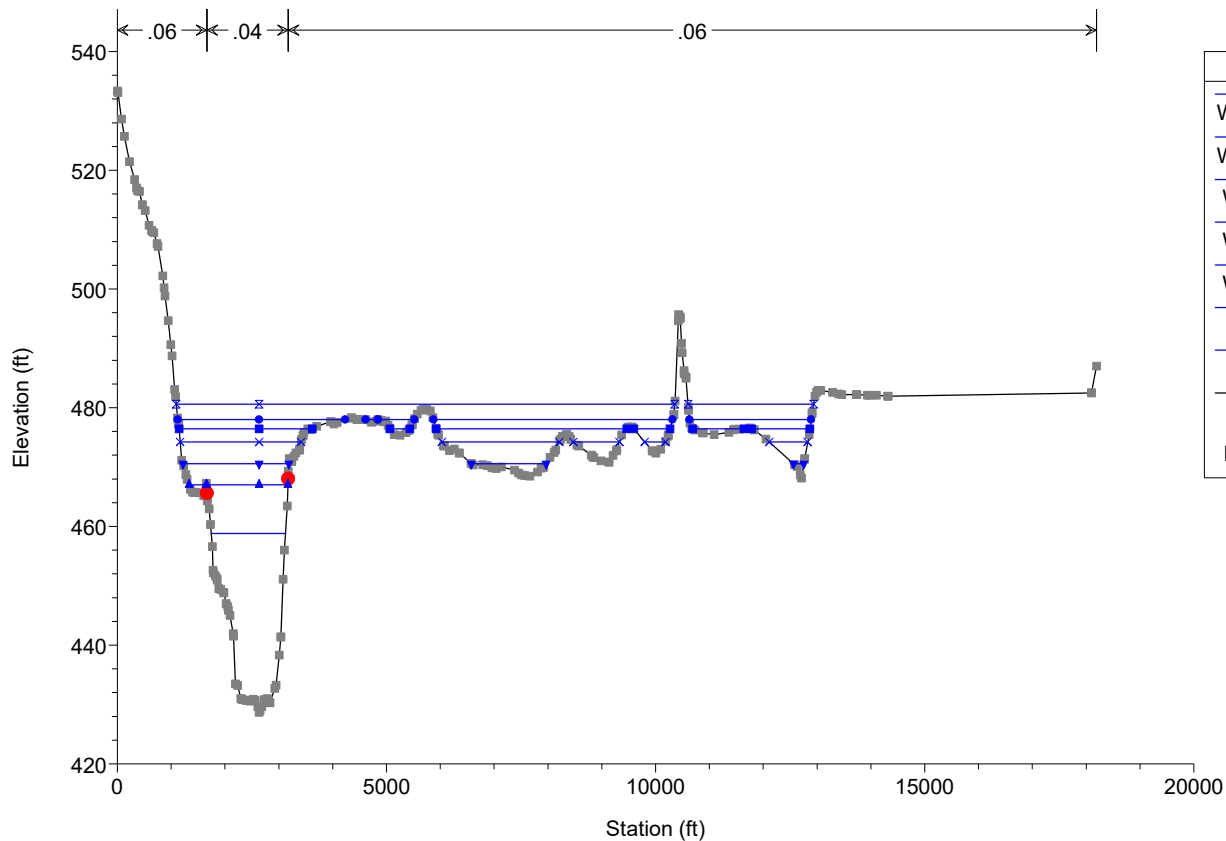
HEC-RAS Model Plan: Natural 11/9/2023

River = Arkansas River Reach = 1 RS = 1049



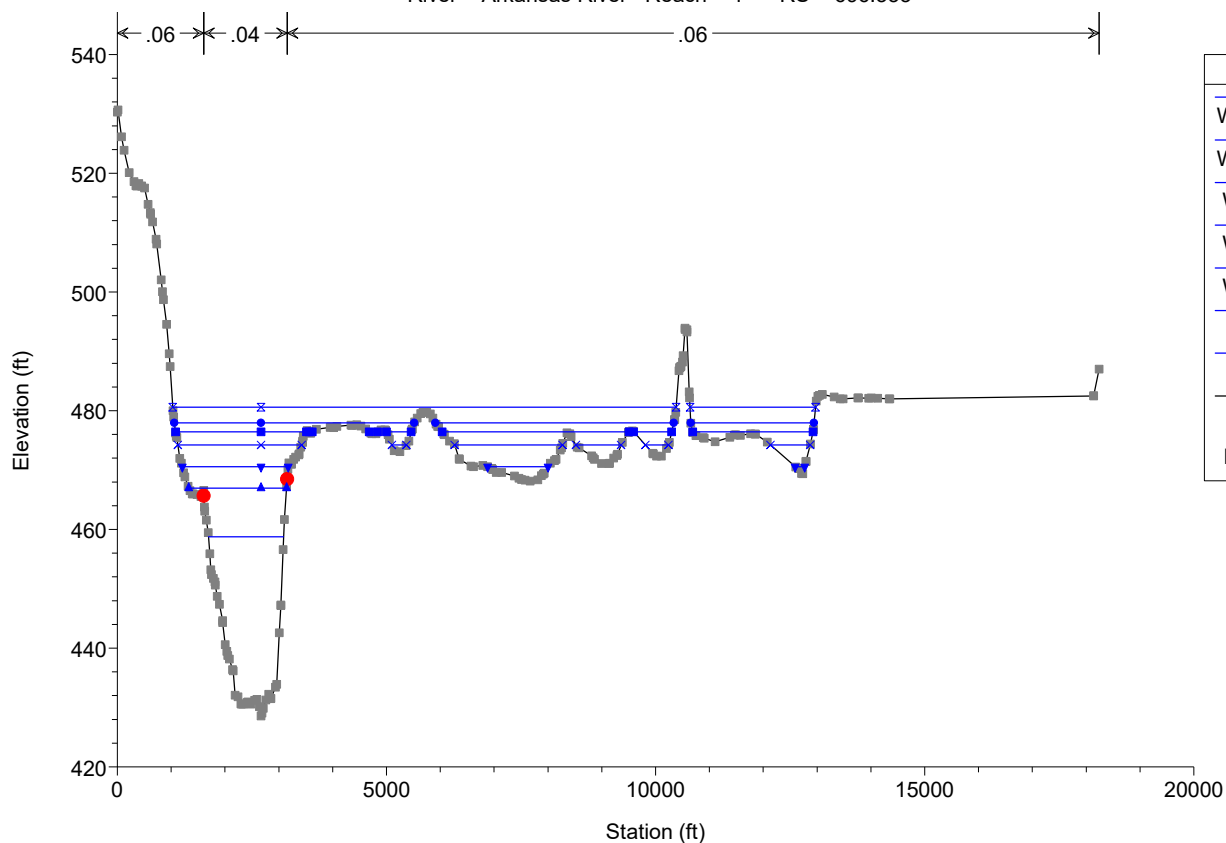
HEC-RAS Model Plan: Natural 11/9/2023

River = Arkansas River Reach = 1 RS = 872.667*



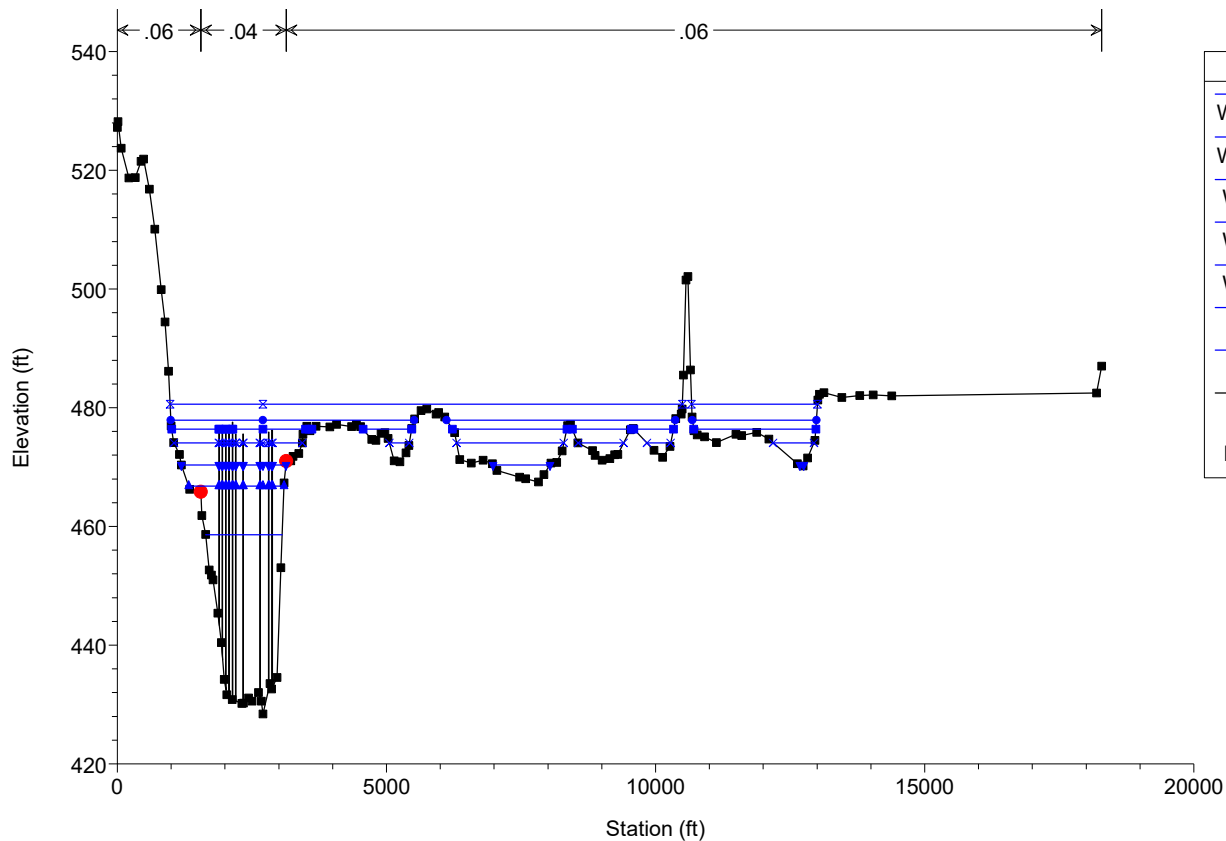
HEC-RAS Model Plan: Natural 11/9/2023

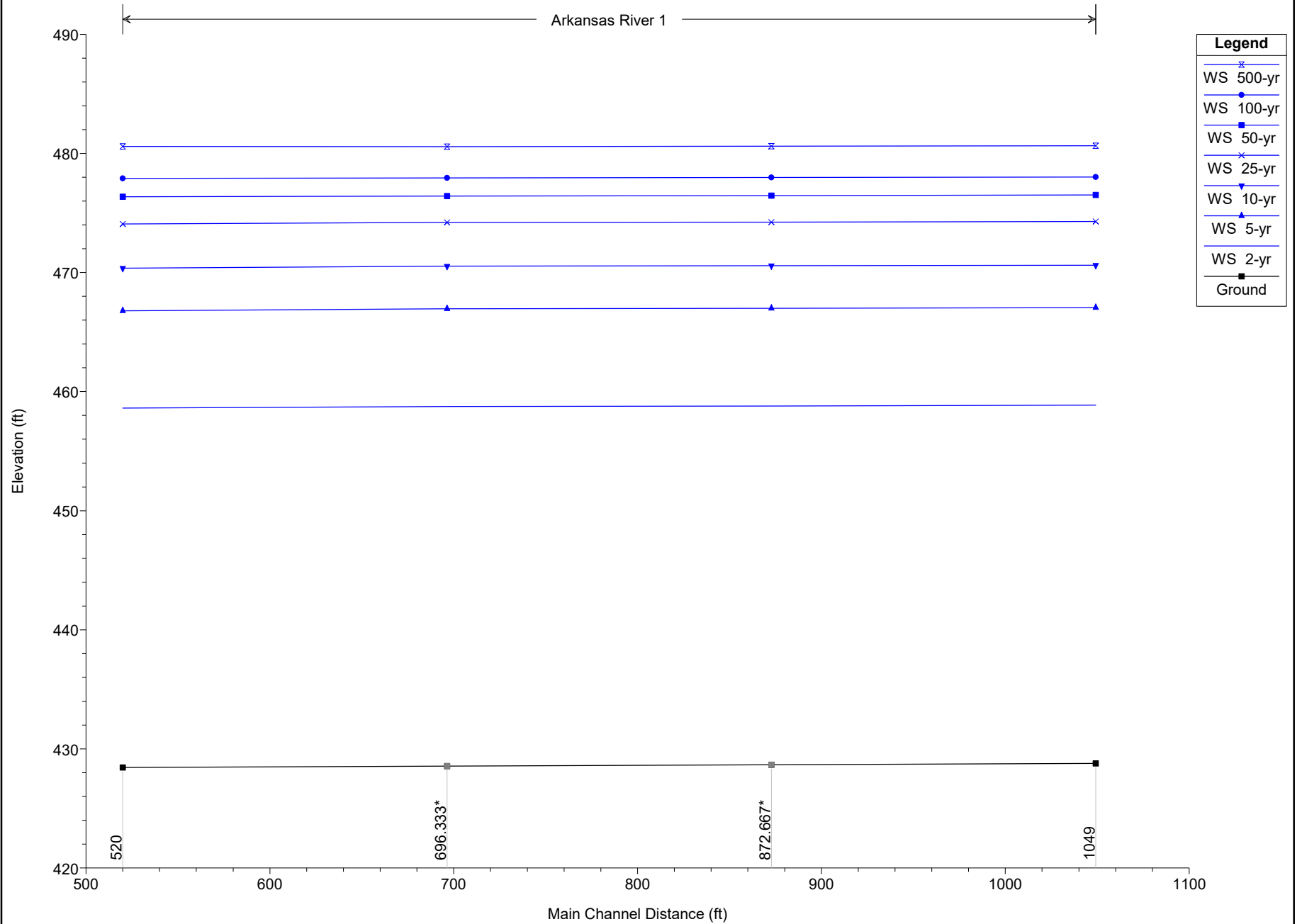
River = Arkansas River Reach = 1 RS = 696.333*



HEC-RAS Model Plan: Natural 11/9/2023

River = Arkansas River Reach = 1 RS = 520





HEC-RAS HEC-RAS 6.3.1 September 2022
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

X	X	XXXXXX	XXXX	XXXX	XX	XXXX
X	X	X	X	X	X	X
X	X	X	X	X	X	X
XXXXXXXX	XXXX	X	XXX	XXXX	XXXXXX	XXXX
X	X	X	X	X	X	X
X	X	X	X	X	X	X
X	X	XXXXXX	XXXX	X	X	XXXXX

PROJECT DATA

Project Title: HEC-RAS Model

Project File : I-40 over Arkansas River_2.prj

Run Date and Time: 11/9/2023 10:58:15 AM

Project in English units

PLAN DATA

Plan Title: Natural

Plan File : I:\EST\34334_Muskogee_Co_I40_Arkansas\geohecras\I-40 over Arkansas River_2.p05

Geometry Title: Natural

Geometry File : I:\EST\34334_Muskogee_Co_I40_Arkansas\geohecras\I-40 over Arkansas River_2.g05

Flow Title : Natural

Flow File : I:\EST\34334_Muskogee_Co_I40_Arkansas\geohecras\I-40 over Arkansas River_2.f05

Plan Summary Information:

Number of: Cross Sections	=	4	Multiple Openings	=	0
Culverts	=	0	Inline Structures	=	0
Bridges	=	0	Lateral Structures	=	0

Computational Information

Water surface calculation tolerance	=	0.01
Critical depth calculation tolerance	=	0.01
Maximum number of iterations	=	20
Maximum difference tolerance	=	0.33
Flow tolerance factor	=	0.001

Computation Options

Critical depth computed only where necessary	
Conveyance Calculation Method:	At breaks in n values only
Friction Slope Method:	Average Conveyance
Computational Flow Regime:	Subcritical Flow

FLOW DATA

Flow Title: Natural

Flow File : I:\EST\34334_Muskogee_Co_I40_Arkansas\geohecras\I-40 over Arkansas River_2.f05

Flow Data (cfs)

```
*****
*****
* River      Reach      RS      *      2-yr      5-yr      10-yr      25-yr
50-yr      100-yr      500-yr *
* Arkansas River 1      1049      *      172100      271400      324600      403500
462900      521200      660500 *
*****
*****
```

Boundary Conditions

```
*****
* River      Reach      Profile      *      Upstream      Downstream      *
*****
* Arkansas River 1      2-yr      *      Normal S = 0.000661      Normal S = 0.000661 *
* Arkansas River 1      5-yr      *      Normal S = 0.000661      Normal S = 0.000661 *
* Arkansas River 1      10-yr     *      Normal S = 0.000661      Normal S = 0.000661 *
* Arkansas River 1      25-yr     *      Normal S = 0.000661      Normal S = 0.000661 *
* Arkansas River 1      50-yr     *      Normal S = 0.000661      Normal S = 0.000661 *
* Arkansas River 1      100-yr    *      Normal S = 0.000661      Normal S = 0.000661 *
* Arkansas River 1      500-yr    *      Normal S = 0.000661      Normal S = 0.000661 *
*****
*****
```

GEOMETRY DATA

Geometry Title: Natural

Geometry File : I:\EST\34334_Muskogee_Co_I40_Arkansas\geohecras\I-40 over Arkansas River_2.g05

CROSS SECTION

RIVER: Arkansas River

REACH: 1

RS: 1049

INPUT

Description:

Station Elevation Data

num= 129

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	536.45	133.43	527.57	333.11	518.25	388.16	515.24	428.99	514.55
484.22	510.5	613.09	506.72	666.15	506.4	704.28	507.22	783.67	506.28
876.69	502.42	921.3	498.89	1033.75	491.6	1125.46	484.77	1172.51	479.06
1187.12	478.93	1241.49	470.36	1347.42	467.06	1408.06	465.28	1451.06	465.03
1505.43	465.57	1590.06	465.49	1665.9	464.81	1700.07	465.92	1720.36	468.02
1732.38	465.69	1764.45	464.41	1819.21	457.37	1830.45	452	1904.71	451.31
1933.41	450.3	2019.16	453.22	2084.31	453.53	2120.25	451.81	2181.06	446.86
2211.61	434.88	2255.05	434.57	2304.47	431.39	2398.74	430.53	2520.14	430.54
2617.6	428.78	2640.61	428.86	2670.61	429.45	2724.14	430.45	2840.65	429.06
2939.32	431.99	3027.33	434.01	3058.43	435.53	3107.16	445.57	3189.48	459.67
3210.62	468.45	3229.32	471.6	3277.14	470.9	3353.03	472.61	3415.7	473.14
3451.98	475.31	3486.8	475.93	3635.7	476.43	4008.84	478.14	4065.13	477.4
4383.77	479.05	4493.32	478.41	4656.2	479.03	4755.03	478.92	4879.86	479.54
4995.76	478.57	5025.8	478.8	5100.19	477.8	5523.7	477.37	5613.94	479.03
5725.49	479.89	5856.86	479.47	5909.01	477.91	5998.83	473.81	6106.85	471.11
6218.3	470.59	6397.83	472.87	6661.88	470.13	6923.9	469.92	7021.74	469.6
7184.2	470.49	7427.01	470.01	7557.81	468.95	7714.05	468.75	7924.89	470.57
7980.01	470.54	8170.51	473.29	8274.18	475.6	8324.01	475.91	8477.05	473.75
8627.04	473.37	8886.19	471.48	9193.78	470.46	9341.85	473.23	9426.72	476.2
9542.21	476.99	9634.92	476.85	10007.99	472.64	10067.41	472.33	10251.76	475.04
10301.25	476.24	10401.92	479.17	10423.13	482.51	10484.04	502.57	10493.48	504.09
10519.15	503.03	10556.37	489.28	10595.9	477.91	10630.65	476.64	10679.19	476.96
10952.66	476.13	11426.07	476.15	11535.6	476.82	11815.77	477.04	11898.51	476.54
12703.92	469.92	12786.55	466.86	12842.72	471.36	12924.58	476.57	12980.59	481.39
13090.62	483.16	13365.92	482.91	13534.87	482.45	13817.74	482.31	14011.29	482.07
14178.38	482.13	14390.12	481.9	18190	482.5	18290	487		

Manning's n Values

num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-----	-------	-----	-------	-----	-------

```
*****
0      .06 1720.36      .04 3189.48      .06
```

```
Bank Sta: Left   Right   Lengths: Left Channel   Right   Coeff Contr.   Expan.
      1720.36 3189.48      176.4   176.4   176.4      .1      .3
```

CROSS SECTION

```
RIVER: Arkansas River
REACH: 1                RS: 872.667*
```

INPUT

Description:

```
Station Elevation Data      num=      252
```

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	533.38	12.73	533.11	78.25	528.6	128.39	525.72	225.62	521.48
320.53	518.41	357.48	517.02	373.5	516.55	412.78	516.42	465.92	514.17
466.7	514.16	519.34	513.2	589.93	510.74	635.17	509.89	640.99	509.75
677.67	509.51	740.03	507.66	754.06	507.17	843.57	502.23	868.31	500.22
886.5	498.81	947.62	494.66	994.7	490.6	1014.41	488.76	1065.49	483.05
1082.95	481.84	1118.13	478.27	1128.22	477.36	1142.27	477.19	1194.59	471.17
1230.42	470.18	1270.37	468.73	1296.52	467.95	1354.87	466.27	1396.24	465.76
1435.69	465.71	1448.56	465.79	1529.99	465.68	1602.97	465.18	1635.84	465.9
1655.37	467.29	1664.06	465.61	1668.47	464.75	1673.09	464.29	1703.43	462.99
1731.04	460.32	1763.13	456.63	1775.38	452.61	1785.87	452.17	1821.57	451.68
1846.76	451.27	1856.34	450.97	1887.62	449.52	1922.15	449.38	1976.78	448.87
1981.09	448.77	2023.75	447.01	2052.11	446.49	2064.67	445.86	2091.29	445
2149.75	441.92	2157.59	441.52	2190.88	433.48	2238.24	433.2	2292.11	431
2300.72	430.94	2326.12	430.82	2394.87	430.68	2407.89	430.73	2459.06	430.55
2527.22	430.88	2560.91	430.66	2608.81	429.65	2633.46	428.66	2654.47	428.95
2681.86	429.64	2730.75	430.85	2787.75	430.98	2829.57	430.32	2837.14	430.29
2927.25	432.72	2951.53	433.25	3007.61	438.31	3035.36	441.34	3036.02	441.41
3080.51	451.09	3106.14	456.02	3155.69	463.45	3172.25	468.05	3176.75	469.3
3195.37	471.41	3242.48	470.95	3242.99	470.95	3282.42	471.79	3318.57	472.4
3380.99	472.85	3386.66	473.09	3417.12	474.6	3449.27	475.28	3451.79	475.39
3464.65	475.83	3536.95	476.43	3596.35	476.32	3600.09	476.34	3703.67	476.9
3958.05	477.63	3971.71	477.69	4027.76	477.26	4082.43	477.52	4345.11	478.31
4360.59	478.24	4450.64	478.02	4454.2	478	4528.68	478.06	4616.42	477.98
4714.84	477.57	4733.77	477.57	4807.7	477.76	4839.16	477.99	4901.85	477.9
4954.59	477.63	4974.71	477.75	4984.51	477.75	5031.48	477.06	5058.59	476.51
5143.56	475.49	5250.03	475.36	5364.92	475.8	5416.65	476.17	5472.44	477.08
5480.38	477.15	5524.98	478.16	5570.25	478.91	5639.77	479.55	5681.34	479.8
5749.73	479.71	5812.18	479.47	5864.11	478.34	5919.08	476.56	5953.56	475.58
5966.75	475.38	6061.14	473.59	6076.07	473.51	6172.14	472.75	6258.75	473.06

6350.93	472.4	6354.77	472.32	6569.4	470.62	6613.9	470.35	6788.24	470.38
6874.85	470.23	6954.34	469.97	6972.3	469.84	7037.01	469.78	7134.09	470.05
7375.91	469.51	7457.05	468.99	7506.17	468.69	7568.8	468.59	7661.77	468.44
7804.4	469.16	7871.76	469.81	7908.87	469.94	7926.65	470.02	8038.52	471.67
8116.37	472.45	8143.17	472.86	8219.61	474.49	8243.09	474.74	8269.24	475.21
8345.8	475.54	8395.96	475.13	8421.66	474.69	8534.93	473.67	8571.04	473.55
8802.23	472.03	8829.12	471.77	8853.27	471.6	8983.79	471.03	9124.51	470.81
9135.45	470.81	9211.74	471.96	9270.4	472.71	9282.92	472.95	9367.45	475.43
9482.46	476.65	9499.1	476.74	9552.13	476.76	9574.8	476.66	9934.46	472.8
9946.34	472.68	10005.52	472.33	10095.26	472.99	10189.11	474.33	10230.23	475.19
10238.41	475.44	10336.8	478.81	10338.66	478.85	10359.79	481.12	10420.44	494.65
10429.85	495.68	10437.47	495.49	10455.42	495.27	10456.34	495.05	10480.99	490.85
10492.48	489.29	10529.23	486.28	10531.85	485.79	10564.92	485.16	10566.45	484.94
10609.35	480.06	10614.8	479.56	10636.55	477.41	10674.31	476.56	10731.89	476.21
10867.89	475.82	10887.15	475.75	11087.61	475.46	11358.63	475.83	11445.58	476.3
11467.7	476.38	11556.78	476.37	11746.73	476.58	11829.14	476.31	11832.86	476.28
12053	474.71	12578.12	470.42	12631.26	470.07	12685.29	468.67	12713.54	468.12
12767.89	471.32	12769.49	471.42	12851.01	475.48	12905.88	479.04	12906.79	479.13
12960.33	481.94	12989.66	482.57	13016.38	482.89	13070.55	482.92	13290.55	482.61
13403.19	482.31	13458.81	482.22	13729.76	482.22	13740.52	482.22	13933.28	482.1
13978.96	482.11	14099.69	482.12	14310.56	481.94	14323.85	481.93	18094.92	482.5
18095.26	482.51	18194.51	487						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.06	1664.06	.04	3172.25	.06

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	1664.06	3172.25		176.4	176.4	176.4	.1 .3

CROSS SECTION

RIVER: Arkansas River

REACH: 1 RS: 696.333*

INPUT

Description:

Station Elevation Data		num= 252							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	530.3	12.32	530.65	75.78	526.17	124.34	523.88	218.49	520.1
310.41	518.58	346.2	517.88	361.7	517.85	399.76	518.29	451.23	517.83
451.96	517.84	502.95	517.54	571.31	514.76	615.12	513.35	620.76	513.09
656.28	511.79	716.67	508.87	730.27	508.07	816.95	502.04	840.91	500.05

858.52	498.72	917.71	494.56	963.31	489.59	982.39	487.45	1031.86	479.98
1048.77	478.92	1082.84	476.21	1092.61	475.67	1106.22	475.46	1156.89	471.98
1191.6	471.17	1230.29	469.55	1255.6	468.83	1312.11	467.27	1352.18	466.5
1390.37	465.98	1402.85	466.01	1481.71	465.87	1552.37	465.55	1584.22	465.88
1603.13	466.55	1607.76	465.66	1617.41	463.8	1622.44	463.05	1655.52	461.57
1685.61	459.48	1720.58	455.89	1733.94	453.21	1745.37	452.42	1784.28	451.75
1811.75	451.14	1822.18	450.64	1856.28	448.74	1893.92	447.38	1953.47	444.66
1958.16	444.32	2004.66	440.61	2035.58	439.45	2049.27	438.74	2078.29	438.19
2142	436.39	2150.54	436.17	2186.84	432.08	2238.45	431.83	2297.17	430.62
2306.56	430.57	2334.25	430.54	2409.19	430.83	2423.38	430.92	2479.16	430.56
2553.44	431.21	2590.17	431.35	2642.38	430.12	2669.24	428.55	2688.42	429.04
2713.43	429.84	2758.05	431.25	2810.08	432.26	2848.26	431.47	2855.17	431.52
2937.41	433.44	2959.58	433.9	3010.77	442.61	3036.1	447.18	3036.7	447.29
3077.32	456.62	3100.71	461.67	3145.94	467.22	3155.03	468.49	3167.06	470.16
3185.76	471.21	3233.04	471	3233.55	471	3273.11	471.8	3309.39	472.19
3372.02	472.57	3377.71	472.7	3408.28	473.88	3440.54	474.68	3443.08	474.86
3455.96	475.69	3528.53	476.65	3588.13	476.23	3591.88	476.25	3695.83	476.89
3951.09	477.19	3964.8	477.24	4021.05	477.12	4075.92	477.35	4339.5	477.57
4355.06	477.53	4445.41	477.61	4448.99	477.59	4523.72	477.43	4611.77	476.94
4710.54	476.22	4729.53	476.12	4803.71	476.14	4835.29	476.45	4898.21	476.78
4951.13	476.7	4971.31	476.77	4981.15	476.69	5028.28	475.96	5055.49	475.22
5140.76	473.27	5247.59	473.12	5362.9	474.1	5414.81	474.9	5470.77	476.77
5478.74	476.93	5523.5	478.13	5568.93	478.78	5638.7	479.53	5680.41	479.71
5749.05	479.75	5811.7	479.46	5863.82	478.76	5918.99	477.73	5953.59	477.34
5966.83	477.29	6061.54	476.07	6076.52	475.98	6172.92	474.9	6259.84	474.43
6352.35	471.94	6356.2	471.8	6571.58	470.65	6616.23	470.56	6791.19	470.76
6878.1	470.54	6957.87	470.27	6975.88	470.09	7040.82	469.61	7138.24	469.61
7380.9	469.01	7462.33	468.64	7511.62	468.43	7574.47	468.3	7667.77	468.13
7810.89	468.33	7878.48	469.04	7915.73	469.32	7933.57	469.5	8045.82	471.17
8123.95	471.61	8150.84	471.83	8227.56	473.38	8251.11	473.74	8277.35	474.51
8354.18	476.26	8404.52	476.14	8430.3	475.64	8543.96	473.87	8580.2	473.72
8812.21	472.39	8839.19	472.06	8863.43	471.79	8994.4	471.09	9135.62	471.12
9146.6	471.16	9223.15	472.03	9282.01	472.43	9294.58	472.66	9379.4	474.67
9494.82	476.32	9511.51	476.51	9564.73	476.63	9587.47	476.47	9948.4	472.82
9960.31	472.72	10019.7	472.32	10109.75	472.32	10203.94	473.63	10245.19	474.33
10253.4	474.64	10352.14	478.5	10354	478.53	10375.2	479.74	10436.08	486.72
10445.51	487.27	10453.17	487.21	10471.17	487.51	10472.09	487.42	10496.84	488.17
10508.36	489.29	10545.24	493.91	10547.87	493.68	10581.06	493.62	10582.59	493.24
10625.64	483.21	10631.11	482.16	10652.93	477.92	10690.82	476.33	10748.6	475.81
10885.08	475.45	10904.41	475.37	11105.57	474.78	11377.54	475.51	11464.8	475.92
11487	475.94	11576.37	475.85	11767	476.13	11849.69	476.06	11853.43	476.06
12074.33	474.71	12601.28	470.49	12654.61	470.22	12708.84	469.42	12737.19	469.38
12791.73	471.42	12793.33	471.48	12875.14	474.41	12930.19	476.77	12931.12	476.87
12984.84	481.62	13014.27	482.41	13041.08	482.61	13095.44	482.74	13316.22	482.3
13429.24	482.01	13485.06	482.13	13756.95	482.13	13767.76	482.13	13961.19	482.12
14007.03	482.14	14128.18	482.12	14339.79	481.97	14353.12	481.97	18137.37	482.5

18137.71 482.5118237.31 487

Manning's n Values num= 3
Sta n Val Sta n Val Sta n Val

0 .06 1607.76 .04 3155.03 .06

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
1607.76 3155.03 176.39 176.39 176.39 .1 .3

CROSS SECTION

RIVER: Arkansas River
REACH: 1 RS: 520

INPUT

Description:

Station Elevation Data num= 126
Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev

0 527.23 11.93 528.19 73.34 523.73 211.45 518.73 335.04 518.75
437.4 521.52 486.74 521.87 595.3 516.81 693.57 510.08 813.81 499.88
888.13 494.45 950.73 486.14 998.6 476.91 1047.94 474.15 1153.19 472.15
1190.63 470.37 1345.56 466.25 1551.46 465.82 1572.39 461.82 1640.83 458.64
1705.58 452.68 1747.75 451.82 1777.5 451.02 1866.54 445.38 1931.06 440.45
1986.53 434.21 2034.87 431.62 2135.35 430.86 2313.65 430.19 2343.65 430.25
2440.23 431.12 2500.67 430.57 2620.95 432.03 2677.52 430.58 2706.63 428.43
2834.02 433.54 2868.55 432.63 2969.24 434.55 3038.45 453.03 3096.89 467.31
3137.8 471 3225.25 471.04 3265.49 471.8 3370.51 472.31 3433.59 474.08
3449.08 475.55 3521.93 476.86 3581.78 476.14 3689.91 476.88 3946.2 476.74
4071.53 477.18 4351.79 476.81 4442.51 477.2 4521.14 476.8 4727.77 474.68
4802.26 474.52 4897.13 475.67 4970.53 475.8 5027.73 474.85 5140.66 471.05
5247.92 470.88 5363.69 472.41 5415.81 473.64 5472.01 476.47 5524.95 478.1
5640.61 479.51 5751.4 479.79 5922.03 478.9 5970.06 479.19 6080.2 478.45
6264.26 475.8 6361 471.29 6577.25 470.68 6797.74 471.15 6965.09 470.58
7048.38 469.44 7471.59 468.28 7584.18 468.02 7821.56 467.5 7926.82 468.71
8057.44 470.68 8162.88 470.8 8263.55 472.73 8367.04 476.98 8417.58 477.15
8557.59 474.08 8826.91 472.75 8878.34 471.99 9009.84 471.15 9151.62 471.43
9239.51 472.1 9298.61 472.15 9529.03 476.28 9582.46 476.5 9967.68 472.85
10129.68 471.6510265.67 473.4810373.05 478.1910474.48 478.9210493.49 479.78
10518.33 485.4810566.93 501.5310602.89 502.0810647.65 486.3410675.05 478.43
10713.1 476.1110771.11 475.4110908.14 475.0811129.52 474.111490.19 475.54
11602.22 475.3311880.39 475.8312102.19 474.7212631.26 470.5512739.25 470.18
12822.47 471.5112961.49 474.513016.36 481.313045.91 482.2413127.41 482.55
13462.55 481.7213791.59 482.0414042.67 482.1714390.16 482 18190 482.5

18290 487

Manning's n Values num= 3
Sta n Val Sta n Val Sta n Val

0 .06 1551.46 .04 3137.8 .06

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
1551.46 3137.8 0 0 0 .1 .3

Blocked Obstructions num= 10
Sta L Sta R Elev Sta L Sta R Elev Sta L Sta R Elev

1881.95 1894.45 476.4 1944.75 1957.25 476.2 2006.75 2019.25 476.4
2070.45 2082.95 476.3 2132.95 2145.45 477.6 2194.75 2207.25 475.6
2330.15 2342.65 475.6 2642.75 2655.25 476.1 2806.15 2818.65 475.9
2868.15 2880.65 476.2

SUMMARY OF MANNING'S N VALUES

River: Arkansas River

* Reach * River Sta. * n1 * n2 * n3 *

*1 * 1049 * .06* .04* .06*
*1 * 872.667* * .06* .04* .06*
*1 * 696.333* * .06* .04* .06*
*1 * 520 * .06* .04* .06*

SUMMARY OF REACH LENGTHS

River: Arkansas River

* Reach * River Sta. * Left * Channel * Right *

*1 * 1049 * 176.4* 176.4* 176.4*
*1 * 872.667* * 176.4* 176.4* 176.4*
*1 * 696.333* * 176.39* 176.39* 176.39*
*1 * 520 * 0* 0* 0*

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS

River: Arkansas River

```
*****
*      Reach      *      River Sta.      * Contr.  * Expan.  *
*****
*1              *      1049      *      .1*      .3*
*1              *      872.667**      .1*      .3*
*1              *      696.333**      .1*      .3*
*1              *      520      *      .1*      .3*
*****
```

APPENDIX ‘D’

HEC-RAS model

Existing Conditions

HEC-RAS Plan: Existing River: Arkansas River Reach: 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
1	1049	2-yr	172100.00	428.78	459.12		459.69	0.000470	6.04	28487.19	1380.65	0.23
1	1049	5-yr	271400.00	428.78	467.37		468.07	0.000400	6.73	40976.98	1880.94	0.23
1	1049	10-yr	324600.00	428.78	470.97		471.73	0.000371	7.04	49945.18	3978.85	0.22
1	1049	25-yr	403500.00	428.78	474.74		475.54	0.000355	7.43	70446.22	6649.36	0.22
1	1049	50-yr	462900.00	428.78	477.11		477.93	0.000344	7.64	88553.96	9303.70	0.22
1	1049	100-yr	521200.00	428.78	478.85		479.67	0.000338	7.81	106109.30	10862.70	0.22
1	1049	500-yr	660500.00	428.78	482.05		482.89	0.000340	8.25	143185.60	12833.42	0.22
1	834	2-yr	172100.00	428.53	458.81	442.64	459.51	0.000914	6.71	25637.75	1177.18	0.25
1	834	5-yr	271400.00	428.53	467.04	446.59	467.90	0.001023	7.43	36508.30	1513.21	0.27
1	834	10-yr	324600.00	428.53	470.63	448.54	471.56	0.000985	7.73	42040.43	1554.42	0.26
1	834	25-yr	403500.00	428.53	474.21	451.58	475.33	0.001075	8.50	47639.26	1573.77	0.27
1	834	50-yr	462900.00	428.53	476.39	453.36	477.67	0.001261	9.06	51267.80	2243.35	0.29
1	834	100-yr	521200.00	428.53	477.89	454.93	479.34	0.001387	9.70	53975.60	2636.21	0.31
1	834	500-yr	660500.00	428.53	480.56	458.39	482.43	0.001623	11.09	66774.92	7400.17	0.34
1	771		Bridge									
1	716	2-yr	172100.00	428.52	458.87	440.48	459.30	0.000304	5.27	32682.23	1405.50	0.19
1	716	5-yr	271400.00	428.52	467.08	443.92	467.64	0.000297	6.05	45509.91	1774.59	0.20
1	716	10-yr	324600.00	428.52	470.65	445.58	471.28	0.000286	6.41	51916.01	1810.97	0.20
1	716	25-yr	403500.00	428.52	474.22	447.83	475.00	0.000309	7.15	58418.39	1831.47	0.21
1	716	50-yr	462900.00	428.52	476.39	449.68	477.30	0.000333	7.71	62412.71	1841.12	0.22
1	716	100-yr	521200.00	428.52	477.87	451.24	478.93	0.000371	8.34	65134.15	1867.90	0.23
1	716	500-yr	660500.00	428.52	480.35	454.35	481.85	0.000483	9.91	69737.52	2725.50	0.27
1	520	2-yr	172100.00	428.43	458.61	441.83	459.17	0.000661	6.03	28560.57	1295.14	0.23
1	520	5-yr	271400.00	428.43	466.79	445.47	467.51	0.000662	6.82	39967.28	1644.55	0.23
1	520	10-yr	324600.00	428.43	470.37	447.21	471.16	0.000662	7.14	48034.11	2939.83	0.23
1	520	25-yr	403500.00	428.43	474.08	449.65	474.90	0.000662	7.52	66668.02	6671.65	0.23
1	520	50-yr	462900.00	428.43	476.36	451.41	477.15	0.000662	7.58	85299.64	9630.21	0.23
1	520	100-yr	521200.00	428.43	477.91	453.16	478.69	0.000662	7.72	101706.20	11080.40	0.23
1	520	500-yr	660500.00	428.43	480.60	456.37	481.38	0.000662	8.10	132696.20	11860.78	0.23

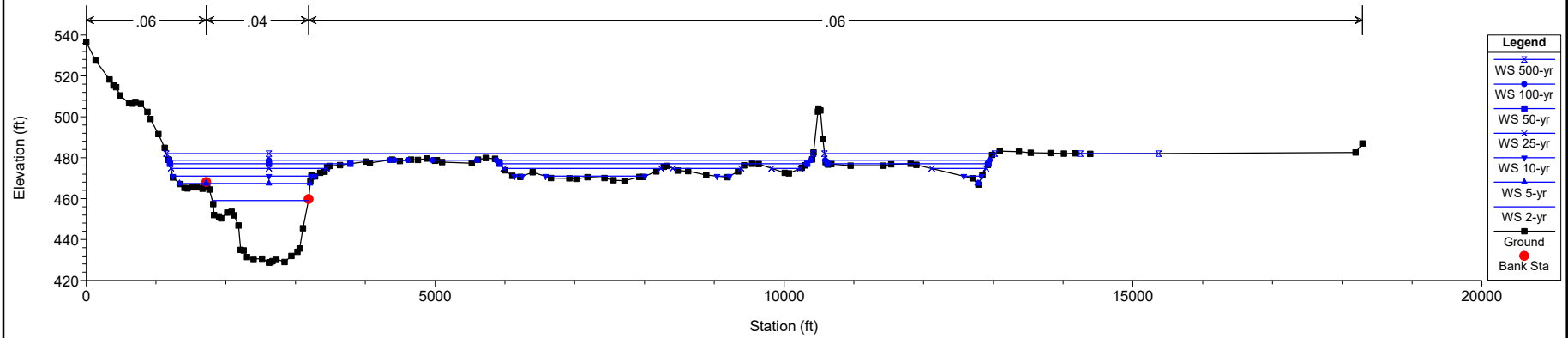
HEC-RAS Plan: Existing River: Arkansas River Reach: 1

Reach	River Sta	Profile	E.G. Elev (ft)	W.S. Elev (ft)	Crit W.S. (ft)	Frctn Loss (ft)	C & E Loss (ft)	Top Width (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Vel Chnl (ft/s)
1	1049	2-yr	459.69	459.12		0.14	0.04	1380.65		172100.00		6.04
1	1049	5-yr	468.07	467.37		0.13	0.05	1880.94	504.45	270812.30	83.29	6.73
1	1049	10-yr	471.73	470.97		0.12	0.05	3978.85	3027.66	320325.90	1246.45	7.04
1	1049	25-yr	475.54	474.74		0.12	0.09	6649.36	7794.78	379333.30	16371.91	7.43
1	1049	50-yr	477.93	477.11		0.13	0.14	9303.70	11584.94	416744.10	34571.00	7.64
1	1049	100-yr	479.67	478.85		0.13	0.19	10862.70	14735.98	445764.80	60699.16	7.81
1	1049	500-yr	482.89	482.05		0.14	0.31	12833.42	21403.72	510025.60	129070.70	8.25
1	834	2-yr	459.51	458.81	442.64	0.00	0.00	1177.18		172100.00		6.71
1	834	5-yr	467.90	467.04	446.59	0.00	0.01	1513.21		271399.70	0.29	7.43
1	834	10-yr	471.56	470.63	448.54	0.00	0.02	1554.42		324487.00	112.96	7.73
1	834	25-yr	475.33	474.21	451.58	0.00	0.03	1573.77		403009.50	490.46	8.50
1	834	50-yr	477.67	476.39	453.36	0.01	0.03	2243.35		461986.80	913.22	9.06
1	834	100-yr	479.34	477.89	454.93	0.01	0.04	2636.21		519907.40	1292.63	9.70
1	834	500-yr	482.43	480.56	458.39	0.01	0.09	7400.17		647769.30	12730.68	11.09
1	771 BR U	2-yr	459.50	458.80	442.61	0.07	0.11	1172.29		172100.00		6.71
1	771 BR U	5-yr	467.88	466.99	446.61	0.07	0.14	1484.47	1218.30	270181.50	0.20	7.61
1	771 BR U	10-yr	471.54	470.55	448.53	0.07	0.15	1520.64	4163.13	320329.10	107.74	8.02
1	771 BR U	25-yr	475.30	474.09	451.58	0.08	0.17	1540.16	8808.88	394204.50	486.63	8.89
1	771 BR U	50-yr	477.63	476.26	453.34	0.10	0.19	1694.16	13003.43	448983.10	913.46	9.53
1	771 BR U	100-yr	479.30	477.72	454.92	0.11	0.21	1748.58	16515.39	503374.50	1310.08	10.23
1	771 BR U	500-yr	482.34	480.16	458.38	0.15	0.27	1969.55	24316.28	633899.00	2284.72	12.03
1	771 BR D	2-yr	459.32	458.85	440.76	0.00	0.02	1344.39		172100.00		5.52
1	771 BR D	5-yr	467.67	467.05	444.28	0.00	0.03	1681.17	813.44	270586.50	0.10	6.34
1	771 BR D	10-yr	471.32	470.62	445.94	0.00	0.03	1722.13	2765.98	321787.20	46.83	6.72
1	771 BR D	25-yr	475.04	474.18	448.28	0.00	0.04	1746.14	5847.95	397377.00	275.04	7.48
1	771 BR D	50-yr	477.35	476.35	450.21	0.00	0.04	1763.62	8378.74	453998.70	522.59	8.07
1	771 BR D	100-yr	478.98	477.82	451.82	0.00	0.05	1775.46	10694.75	509738.80	766.36	8.73
1	771 BR D	500-yr	481.92	480.29	454.99	0.00	0.07	1807.12	16179.26	642925.30	1395.53	10.37
1	716	2-yr	459.30	458.87	440.48	0.08	0.04	1405.50		172100.00		5.27
1	716	5-yr	467.64	467.08	443.92	0.08	0.05	1774.59	687.01	270712.90	0.09	6.05
1	716	10-yr	471.28	470.65	445.58	0.08	0.05	1810.97	2354.33	322209.00	36.67	6.41
1	716	25-yr	475.00	474.22	447.83	0.09	0.01	1831.47	4999.00	398292.60	208.35	7.15
1	716	50-yr	477.30	476.39	449.68	0.09	0.06	1841.12	7186.65	455323.90	389.43	7.71
1	716	100-yr	478.93	477.87	451.24	0.10	0.14	1867.90	9169.94	511464.60	565.48	8.34
1	716	500-yr	481.85	480.35	454.35	0.11	0.36	2725.50	13833.63	645654.90	1011.50	9.91
1	520	2-yr	459.17	458.61	441.83			1295.14		172100.00		6.03

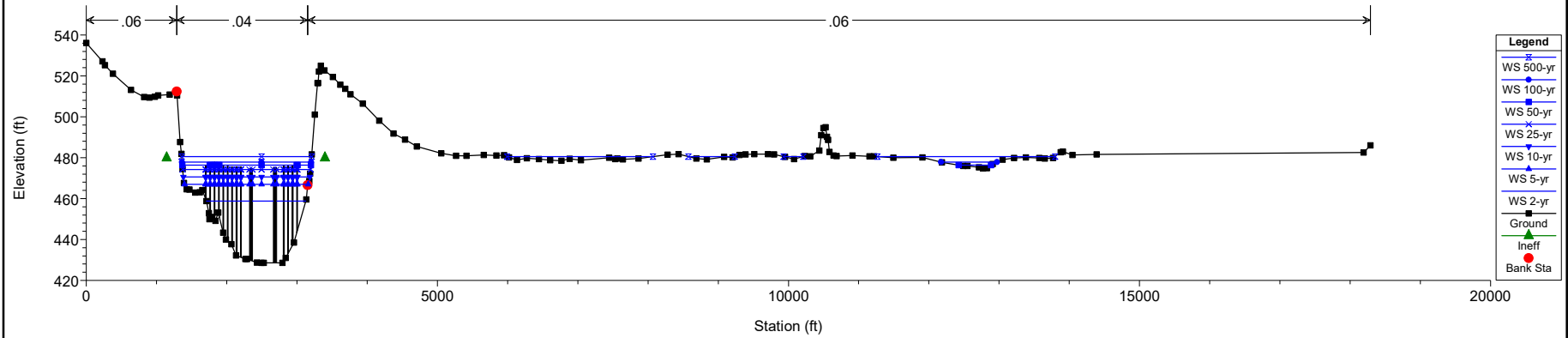
HEC-RAS Plan: Existing River: Arkansas River Reach: 1 (Continued)

Reach	River Sta	Profile	E.G. Elev (ft)	W.S. Elev (ft)	Crit W.S. (ft)	Frctn Loss (ft)	C & E Loss (ft)	Top Width (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Vel Chnl (ft/s)
1	520	5-yr	467.51	466.79	445.47			1644.55	81.91	271318.10		6.82
1	520	10-yr	471.16	470.37	447.21			2939.83	1732.49	321120.90	1746.62	7.14
1	520	25-yr	474.90	474.08	449.65			6671.65	5467.36	378830.30	19202.42	7.52
1	520	50-yr	477.15	476.36	451.41			9630.21	9434.05	407004.00	46462.00	7.58
1	520	100-yr	478.69	477.91	453.16			11080.40	12855.01	433529.50	74815.52	7.72
1	520	500-yr	481.38	480.60	456.37			11860.78	19975.92	489723.10	150801.00	8.10

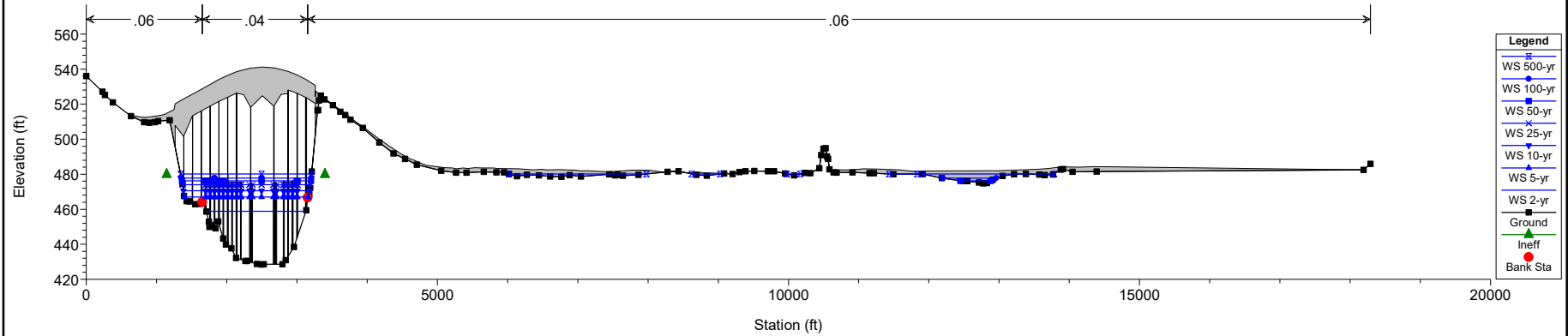
HEC-RAS Model Plan: Existing 11/9/2023
River = Arkansas River Reach = 1 RS = 1049



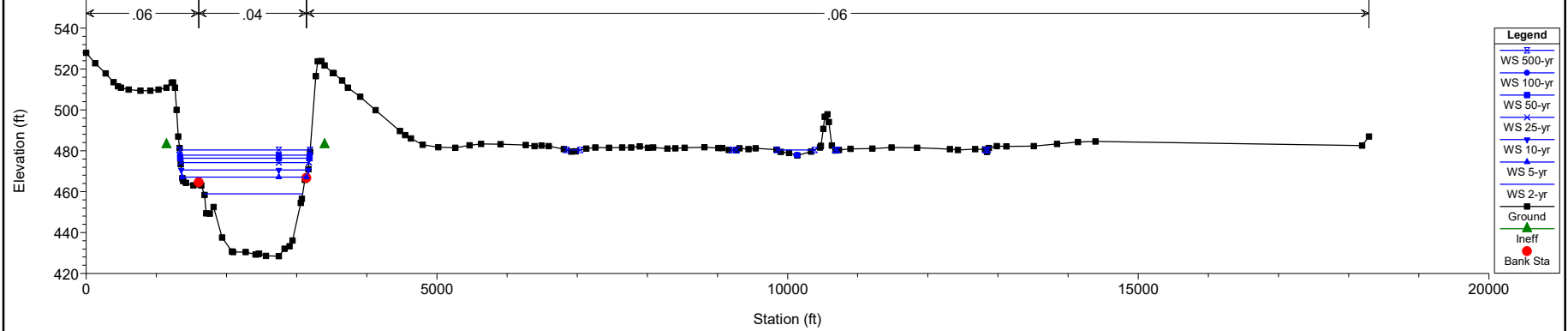
HEC-RAS Model Plan: Existing 11/9/2023
River = Arkansas River Reach = 1 RS = 834



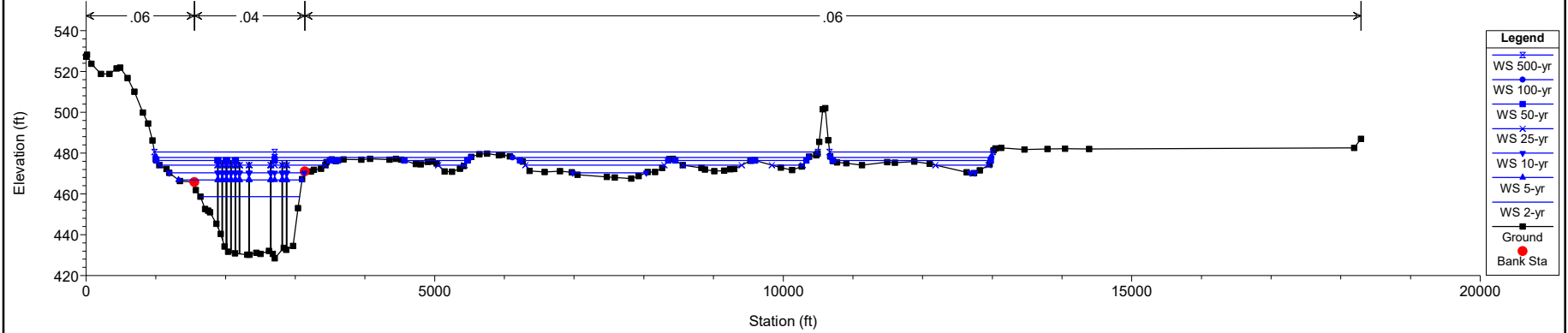
HEC-RAS Model Plan: Existing 11/9/2023
River = Arkansas River Reach = 1 RS = 771 BR



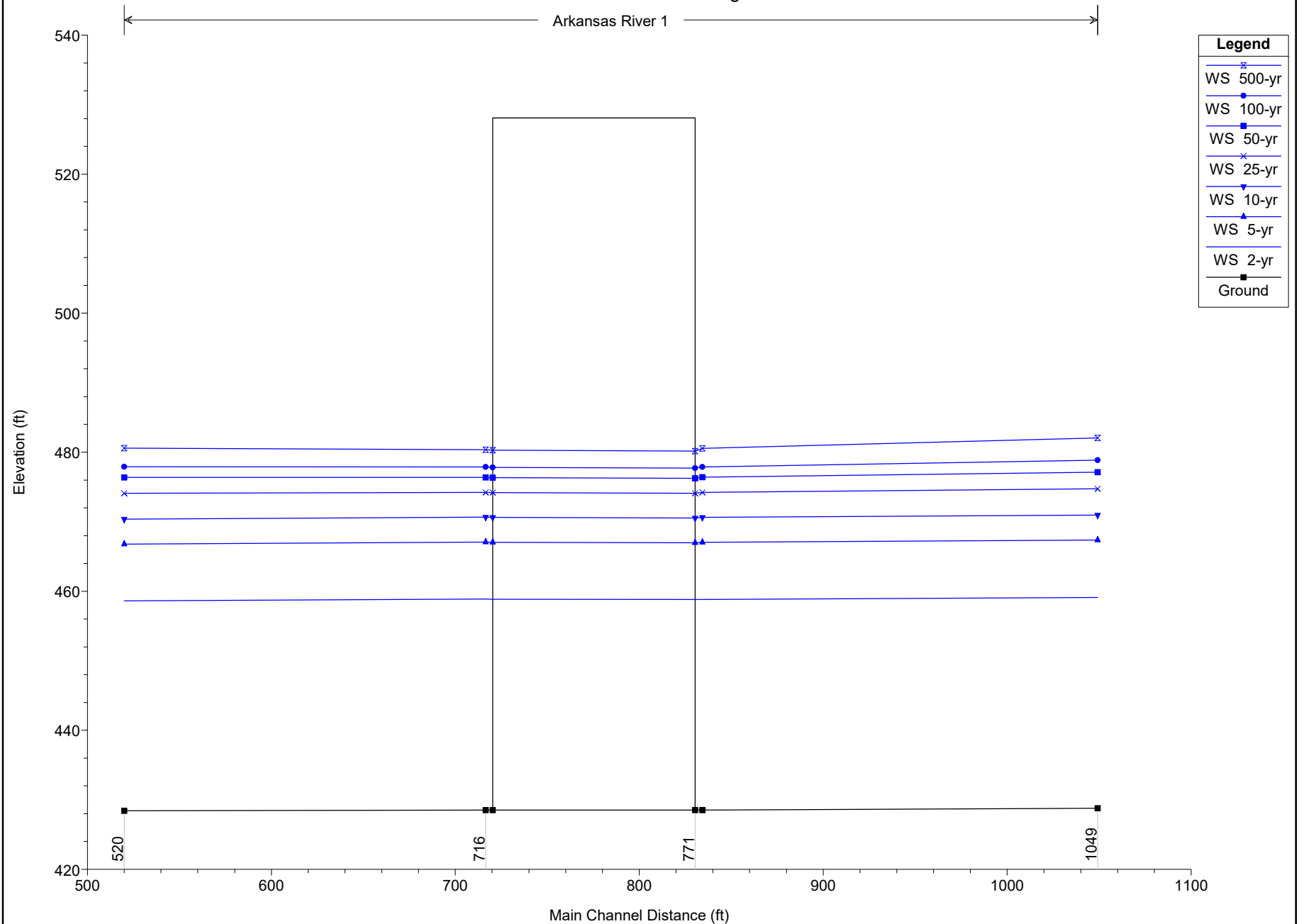
HEC-RAS Model Plan: Existing 11/9/2023
River = Arkansas River Reach = 1 RS = 716



HEC-RAS Model Plan: Existing 11/9/2023
River = Arkansas River Reach = 1 RS = 520



Arkansas River 1



HEC-RAS HEC-RAS 6.3.1 September 2022
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

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X      X  XXXXXX      XXXX      XXXX      XX      XXXX
X      X  X          X      X      X      X      X
X      X  X          X          X      X      X      X
XXXXXXXX XXXX      X          XXX XXXX      XXXXXX      XXXX
X      X  X          X          X      X      X          X
X      X  X          X      X      X      X      X
X      X  XXXXXX      XXXX      X      X      X      X      XXXXX
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PROJECT DATA

Project Title: HEC-RAS Model
Project File : I-40 over Arkansas River_2.prj
Run Date and Time: 11/9/2023 11:49:26 AM

Project in English units

PLAN DATA

Plan Title: Existing

Plan File : I:\EST\34334_Muskogee_Co_I40_Arkansas\geohecras\I-40 over Arkansas River_2.p02

Geometry Title: Existing

Geometry File : I:\EST\34334_Muskogee_Co_I40_Arkansas\geohecras\I-40 over Arkansas River_2.g02

Flow Title : E-OT

Flow File : I:\EST\34334_Muskogee_Co_I40_Arkansas\geohecras\I-40 over Arkansas River_2.f02

Plan Summary Information:

Number of: Cross Sections	=	4	Multiple Openings	=	0
Culverts	=	0	Inline Structures	=	0
Bridges	=	1	Lateral Structures	=	0

Computational Information

Water surface calculation tolerance	=	0.01
Critical depth calculation tolerance	=	0.01
Maximum number of iterations	=	20
Maximum difference tolerance	=	0.33
Flow tolerance factor	=	0.001

Computation Options

Critical depth computed only where necessary	
Conveyance Calculation Method:	At breaks in n values only
Friction Slope Method:	Average Conveyance
Computational Flow Regime:	Subcritical Flow

FLOW DATA

Flow Title: E-OT

Flow File : I:\EST\34334_Muskogee_Co_I40_Arkansas\geohecras\I-40 over Arkansas River_2.f02

Flow Data (cfs)

```
*****
*****
* River      Reach      RS      *      2-yr      5-yr      10-yr      25-yr
50-yr      100-yr      500-yr *
* Arkansas River 1      1049      *      172100      271400      324600      403500
462900      521200      660500 *
*****
*****
```

Boundary Conditions

```
*****
* River      Reach      Profile      *      Upstream      Downstream      *
*****
* Arkansas River 1      2-yr      *      Normal S = 0.000661      Normal S = 0.000661 *
* Arkansas River 1      5-yr      *      Normal S = 0.000661      Normal S = 0.000661 *
* Arkansas River 1      10-yr      *      Normal S = 0.000661      Normal S = 0.000661 *
* Arkansas River 1      25-yr      *      Normal S = 0.000661      Normal S = 0.000661 *
* Arkansas River 1      50-yr      *      Normal S = 0.000661      Normal S = 0.000661 *
* Arkansas River 1      100-yr      *      Normal S = 0.000661      Normal S = 0.000661 *
* Arkansas River 1      500-yr      *      Normal S = 0.000661      Normal S = 0.000661 *
*****
*****
```

GEOMETRY DATA

Geometry Title: Existing

Geometry File : I:\EST\34334_Muskogee_Co_I40_Arkansas\geohecras\I-40 over Arkansas River_2.g02

CROSS SECTION

RIVER: Arkansas River

REACH: 1

RS: 1049

INPUT

Description:

Station Elevation Data num= 129

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	536.45	133.43	527.57	333.11	518.25	388.16	515.24	428.99	514.55
484.22	510.5	613.09	506.72	666.15	506.4	704.28	507.22	783.67	506.28
876.69	502.42	921.3	498.89	1033.75	491.6	1125.46	484.77	1172.51	479.06
1187.12	478.93	1241.49	470.36	1347.42	467.06	1408.06	465.28	1451.06	465.03
1505.43	465.57	1590.06	465.49	1665.9	464.81	1700.07	465.92	1720.36	468.02
1732.38	465.69	1764.45	464.41	1819.21	457.37	1830.45	452	1904.71	451.31
1933.41	450.3	2019.16	453.22	2084.31	453.53	2120.25	451.81	2181.06	446.86
2211.61	434.88	2255.05	434.57	2304.47	431.39	2398.74	430.53	2520.14	430.54
2617.6	428.78	2640.61	428.86	2670.61	429.45	2724.14	430.45	2840.65	429.06
2939.32	431.99	3027.33	434.01	3058.43	435.53	3107.16	445.57	3189.48	459.67
3210.62	468.45	3229.32	471.6	3277.14	470.9	3353.03	472.61	3415.7	473.14
3451.98	475.31	3486.8	475.93	3635.7	476.43	4008.84	478.14	4065.13	477.4
4383.77	479.05	4493.32	478.41	4656.2	479.03	4755.03	478.92	4879.86	479.54
4995.76	478.57	5025.8	478.8	5100.19	477.8	5523.7	477.37	5613.94	479.03
5725.49	479.89	5856.86	479.47	5909.01	477.91	5998.83	473.81	6106.85	471.11
6218.3	470.59	6397.83	472.87	6661.88	470.13	6923.9	469.92	7021.74	469.6
7184.2	470.49	7427.01	470.01	7557.81	468.95	7714.05	468.75	7924.89	470.57
7980.01	470.54	8170.51	473.29	8274.18	475.6	8324.01	475.91	8477.05	473.75
8627.04	473.37	8886.19	471.48	9193.78	470.46	9341.85	473.23	9426.72	476.2
9542.21	476.99	9634.92	476.85	10007.99	472.64	10067.41	472.33	10251.76	475.04
10301.25	476.24	10401.92	479.17	10423.13	482.51	10484.04	502.57	10493.48	504.09

10519.15	503.0310556.37	489.28	10595.9	477.910630.65	476.6410679.19	476.96
10952.66	476.1311426.07	476.15	11535.6	476.8211815.77	477.0411898.51	476.54
12703.92	469.9212786.55	466.8612842.72	471.3612924.58	476.5712980.59	481.39	
13090.62	483.1613365.92	482.9113534.87	482.4513817.74	482.3114011.29	482.07	
14178.38	482.1314390.12	481.9	18190	482.5	18290	487

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.06	1720.36	.04	3189.48	.06

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	1720.36	3189.48		214.88	214.88	214.88	.3 .5

CROSS SECTION

RIVER: Arkansas River

REACH: 1 RS: 834

INPUT

Description:

Station Elevation Data		num= 126							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	536.11	229.86	527.05	267.04	525.3	377.83	521.02	636.12	513.17
822.9	509.68	898.68	509.37	977.02	509.76	1021.96	510.41	1186.81	510.84
1287.68	512.32	1294.58	510.42	1337.74	487.7	1356.97	481.82	1371.36	474.5
1389.3	467.6	1430.38	464.61	1467.29	464.41	1550.31	462.9	1619.41	463.09
1651.14	464.19	1712.8	458.73	1747.17	452.83	1755.87	449.93	1788.19	450.96
1839.44	449.1	1879.11	453.09	1948.15	443.29	1987.33	439.96	2066.75	437.7
2134.93	432.28	2267.93	430.52	2290.72	430.52	2428.56	428.75	2496.04	428.53
2526.04	428.55	2793.26	428.54	2840.25	430.97	2957.56	438.49	3131.65	459.54
3154.3	466.62	3177.97	468.61	3190.06	472.16	3212.34	481.6	3254.17	501.06
3293.58	516.51	3301.38	516.55	3314.75	522.16	3339.51	524.95	3393.14	522.71
3514.12	519.51	3616.71	515.64	3689.53	513.74	3761.56	511.07	3937.62	506.38
4174.6	498.08	4376.5	491.81	4538.68	488.81	4707.89	485.49	5054.42	482.09
5266.14	480.89	5415.07	480.95	5662.49	481.36	5840.09	481.06	5951.29	481.15

6021.65	480.13	6135.81	478.92	6276.23	479.74	6447.26	479.33	6605.58	478.78
6768.18	478.57	6882.88	479.44	7046.21	478.79	7448.16	479.94	7532.57	479.33
7565.78	479.59	7641.29	479.14	7864.8	479.66	8278.79	481.46	8433.62	481.75
8689.18	479.6	8838.59	479.21	9084.77	480.44	9204.83	480.19	9303.12	481.29
9389.03	481.66	9512.15	481.81	9709.01	481.74	9793.56	481.64	9949.5	480.41
10079.1	479.29	10232.14	480.75	10310.17	480.68	10441.21	483.45	10468.69	491
10496.22	494.52	10530.22	494.91	10548.83	490.18	10562.97	488.73	10584.03	482.84
10644.26	481.12	10686.28	480.84	10913.96	481.07	11156.26	480.65	11217.56	480.68
11493.41	480.02	11910.47	480.19	12187.47	477.78	12492.05	476.12	12548.13	476.02
12714.61	475.27	12770.63	474.75	12825.24	474.96	12907.77	476.92	13047.68	479
13213.71	479.92	13381.74	480.11	13574.77	479.89	13652.53	479.58	13768.67	479.8
13877.95	482.64	13907.42	482.98	14045.78	481.32	14390.29	481.62	18190	482.5
18290	486								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.06	1287.68	.04	3154.3	.06

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	1287.68	3154.3		117.83	117.83		.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	1146	479.89	F
3400	18290	479.89	F

Blocked Obstructions num= 15

Sta L	Sta R	Elev	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1695.45	1707.95	476.3	1758.05	1770.55	477	1820.45	1832.95	477.8
1883.55	1896.05	476.7	1945.45	1957.95	476.3	2008.75	2021.25	476.1
2071.05	2083.55	475.6	2134.55	2147.05	475.6	2196.45	2208.95	475.6
2326.1	2368.1	474.6	2666.3	2710.8	475.2	2806.95	2819.45	476
2866.55	2879.05	476	2931.75	2944.25	476.25	2997.35	3009.85	476.5

BRIDGE

RIVER: Arkansas River

REACH: 1

RS: 771

INPUT

Description:

Distance from Upstream XS = 4

Deck/Roadway Width = 110

Weir Coefficient = 2.6

Upstream Deck/Roadway Coordinates

num= 110

Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord

-32.68	529.89				95.67	526.12				259.89	521.01			
367.59	518.17				468.7	515.75				588.54	513.84			
803.95	512.53				869.35	512.5				1062.41	513.67			
1121.13	514.33				1251.48	517.01				1265.8	520.17			
1265.8	520.17	507.8			1388	523.02	501.52			1513	525.77	513.34		
1639	528.54	516.2			1765	531.33	519			1890	534.12	521.71		
2015	536.58	524			2141	538.5	526.3			2241.5	539.72	525.38		
2342	540.61	518.22			2507	541.14	524.81			2672	540.69	518.85		
2773	539.84	525.51			2873	538.64	526.09			2874	538.64	528.08		
3003.6	536.67	526.2			3133.6	534	523.6			3261.3	530.75	520.38		
3261.3	524.41				3262.3	527.26				3264.59	527.5			
3344.5	525.12				3463.28	521.26				3584.37	517.76			
3847.21	509.72				3956.04	506.59				4177.54	499.81			
4346.97	495.14				4492.8	491.45				4620.94	488.58			
4671.34	487.99				4731.04	486.84				4838.33	485.18			
5106.91	483.76				5214.21	483.61				5269.61	483.17			
5373.73	483.52				5431.88	483.25				5536.64	483.78			
5641.05	483.56				5801.24	483.53				5855.35	483.33			
6158.29	483.07				6371.41	482.51				6477.3	482.83			
6581.24	482.47				6740.58	482.68				6962.13	482.27			
7054.92	481.92				7159.46	481.99				7259.72	481.77			
7366.87	481.48				7403.48	481.46				7668.44	482.06			

7777.67	482.37	7923.97	482.33	8037.17	482.14
8182.73	481.33	8291.06	481.18	8387.58	480.37
8543.81	480.91	8597.66	480.71	8647.18	481.05
8751.3	481.06	8855.25	480.49	8901.27	480.82
8963.79	480.57	9105.44	480.65	9155.57	480.26
9205.47	480.99	9460.58	481.23	9724.57	480.57
9765.94	480.55	9867.42	479.98	9906.6	480.17
10022.62	479.89	10138.64	480.08	10272.97	480.68
10323.59	481.3	10436.03	481.35	10546.71	481.75
10675.72	482.43	10918.73	482.45	11063.46	483.05
11262.82	483.03	11588.87	482.49	11762.69	481.7
11891.2	481.65	11977.79	481.83	12976.82	482.05
13115.65	482.12	13420.24	482.69	13533.85	482.76
13698.37	483.26	13894.79	484.15	14148.16	484.1
14355.07	484.32	18190	482.5		

Upstream Bridge Cross Section Data

Station Elevation Data num= 121

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev

0	536.11	229.86	527.05	267.04	525.3	377.83	521.02	636.12	513.17
822.9	509.68	898.68	509.37	977.02	509.76	1021.96	510.41	1186.81	510.84
1371.36	474.5	1389.3	467.6	1430.38	464.61	1467.29	464.41	1550.31	462.9
1619.41	463.09	1651.14	464.19	1712.8	458.73	1747.17	452.83	1755.87	449.93
1788.19	450.96	1839.44	449.1	1879.11	453.09	1948.15	443.29	1987.33	439.96
2066.75	437.7	2134.93	432.28	2267.93	430.52	2290.72	430.52	2428.56	428.75
2496.04	428.53	2526.04	428.55	2793.26	428.54	2840.25	430.97	2957.56	438.49
3131.65	459.54	3154.3	466.62	3177.97	468.61	3190.06	472.16	3212.34	481.6
3293.58	516.51	3301.38	516.55	3314.75	522.16	3339.51	524.95	3393.14	522.71
3514.12	519.51	3616.71	515.64	3689.53	513.74	3761.56	511.07	3937.62	506.38
4174.6	498.08	4376.5	491.81	4538.68	488.81	4707.89	485.49	5054.42	482.09
5266.14	480.89	5415.07	480.95	5662.49	481.36	5840.09	481.06	5951.29	481.15
6021.65	480.13	6135.81	478.92	6276.23	479.74	6447.26	479.33	6605.58	478.78
6768.18	478.57	6882.88	479.44	7046.21	478.79	7448.16	479.94	7532.57	479.33
7565.78	479.59	7641.29	479.14	7864.8	479.66	8278.79	481.46	8433.62	481.75
8689.18	479.6	8838.59	479.21	9084.77	480.44	9204.83	480.19	9303.12	481.29
9389.03	481.66	9512.15	481.81	9709.01	481.74	9793.56	481.64	9949.5	480.41
10079.1	479.29	10232.14	480.75	10310.17	480.68	10441.21	483.45	10468.69	491

10496.22	494.5210530.22	494.910548.83	490.1810562.97	488.7310584.03	482.84
10644.26	481.1210686.28	480.8410913.96	481.0711156.26	480.6511217.56	480.68
11493.41	480.0211910.47	480.1912187.47	477.7812492.05	47612548.13	476.02
12714.61	475.2712770.63	474.7512825.24	474.9612907.77	476.9213047.68	479
13213.71	479.9213381.74	480.1113574.77	479.8913652.53	479.5813768.67	479.8
13877.95	482.6413907.42	482.9814045.78	481.3214390.29	481.62 18190	482.5
18290	486				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.06	1651.14	.04	3154.3	.06

Bank Sta:	Left	Right	Coeff	Contr.	Expan.
	1651.14	3154.3	.3	.5	

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	1146	479.89	F
3400	18290	479.89	F

Blocked Obstructions num= 15

Sta L	Sta R	Elev	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1695.45	1707.95	476.3	1758.05	1770.55	477	1820.45	1832.95	477.8
1883.55	1896.05	476.7	1945.45	1957.95	476.3	2008.75	2021.25	476.1
2071.05	2083.55	475.6	2134.55	2147.05	475.6	2196.45	2208.95	475.6
2326.1	2368.1	474.6	2666.3	2710.8	475.2	2806.95	2819.45	476
2866.55	2879.05	476	2931.75	2944.25	476.25	2997.35	3009.85	476.5

Downstream Deck/Roadway Coordinates

num= 110

Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord
-32.68	529.89		95.67	526.12	259.89	521.01			
367.59	518.17		468.7	515.75	588.54	513.84			
803.95	512.53		869.35	512.5	1062.41	513.67			
1121.13	514.33		1251.48	517.01	1265.8	520.17			
1265.8	520.17	507.8	1388	523.02	501.52	1513	525.77	513.34	
1639	528.54	516.2	1765	531.33	519	1890	534.12	521.71	

2015	536.58	524	2141	538.5	526.3	2241.5	539.72	525.38
2342	540.61	518.22	2507	541.14	524.81	2672	540.69	518.85
2773	539.84	525.51	2873	538.64	526.09	2874	538.64	528.08
3003.6	536.67	526.2	3133.6	534	523.6	3261.3	530.75	520.38
3261.3	524.41		3262.3	527.26		3264.59	527.5	
3344.5	525.12		3463.28	521.26		3584.37	517.76	
3847.21	509.72		3956.04	506.59		4177.54	499.81	
4346.97	495.14		4492.8	491.45		4620.94	488.58	
4671.34	487.99		4731.04	486.84		4838.33	485.18	
5106.91	483.76		5214.21	483.61		5269.61	483.17	
5373.73	483.52		5431.88	483.25		5536.64	483.78	
5641.05	483.56		5801.24	483.53		5855.35	483.33	
6158.29	483.07		6371.41	482.51		6477.3	482.83	
6581.24	482.47		6740.58	482.68		6962.13	482.27	
7054.92	481.92		7159.46	481.99		7259.72	481.77	
7366.87	481.48		7403.48	481.46		7668.44	482.06	
7777.67	482.37		7923.97	482.33		8037.17	482.14	
8182.73	481.33		8291.06	481.18		8387.58	480.37	
8543.81	480.91		8597.66	480.71		8647.18	481.05	
8751.3	481.06		8855.25	480.49		8901.27	480.82	
8963.79	480.57		9105.44	480.65		9155.57	480.26	
9205.47	480.99		9460.58	481.23		9724.57	480.57	
9765.94	480.55		9867.42	479.98		9906.6	480.17	
10022.62	479.89		10138.64	480.08		10272.97	480.68	
10323.59	481.3		10436.03	481.35		10546.71	481.75	
10675.72	482.43		10918.73	482.45		11063.46	483.05	
11262.82	483.03		11588.87	482.49		11762.69	481.7	
11891.2	481.65		11977.79	481.83		12976.82	482.05	
13115.65	482.12		13420.24	482.69		13533.85	482.76	
13698.37	483.26		13894.79	484.15		14148.16	484.1	
14355.07	484.32		18190	482.5				

Downstream Bridge Cross Section Data

Station Elevation Data num= 118

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev

0	527.96	127.75	522.8	279.26	517.79	389.02	513.49	451.68	511.5
496.74	510.82	606.28	509.95	773.84	509.39	915.76	509.36	1030.49	510

1146.18	510.84	1347.83	473.41	1369.53	466.6	1382.24	465.23	1423.33	464.24
1527.22	463.03	1589.18	463.63	1605.22	464.54	1639.25	463.04	1686.32	458.41
1710.22	449.36	1760.66	449.29	1816.32	452.42	1938.85	437.58	2079.88	430.68
2095.74	430.48	2273.77	430.52	2414.36	429.21	2444.36	429.46	2463.63	429.62
2564.6	428.57	2748.01	428.52	2827.2	432.12	2899.03	433.28	2942.33	436.13
3060.3	454.52	3076.04	456.5	3119.32	465.72	3139.7	466.66	3169.63	470.94
3190.81	479.53	3274.37	516.52	3300.87	523.7	3350.28	523.86	3398.75	521.74
3517.54	518.05	3529.42	518.05	3647.64	514.36	3731.24	510.9	3907.26	506.48
4124.32	499.93	4471.77	489.72	4549.63	487.69	4629.88	486.04	4796.41	482.89
5018.69	481.8	5261.3	481.44	5464.81	482.72	5628.61	483.39	5907.35	483.24
6267.98	482.82	6391.93	482.32	6492.55	482.54	6596.25	482.27	6808.85	480.84
6913.6	479.57	6976.7	479.74	7131.17	481.1	7258.27	481.61	7454.4	481.52
7642.2	481.59	7770.22	481.64	7891.49	482.11	8007.51	481.5	8084.55	481.65
8286.4	481.1	8400.66	481.15	8532.54	481.43	8815.11	481.68	9013.9	481.29
9066.42	481.36	9162.99	480.44	9267.72	480.22	9316.17	481.26	9445.09	480.81
9544.92	481.25	9840.07	480.55	9905.35	479.45	10019.66	478.98	10137.25	477.77
10335.61	479.59	10461.71	481.57	10475.35	482.43	10510.68	490.79	10530.49	496.67
10569.71	497.86	10589.33	494.08	10632.19	482.58	10682.47	480.15	10730.76	480.46
10897.14	480.91	11207.52	481.09	11484.5	481.59	11844.97	481.52	12316.03	480.77
12427.04	480.38	12675.91	480.84	12815.11	480.72	12843.11	479.52	12871.11	481.28
12981.91	482.23	13119.86	482.21	13509.8	482.25	13840.8	483.31	14141.33	484.34
14390.2	484.53	18190	482.5	18290	487				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.06	1605.22	.04	3139.7	.06

Bank Sta: Left Right Coeff Contr. Expan.

1605.22	3139.7	.3	.5
---------	--------	----	----

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	1146	483	F
3400	18290	483	F

Upstream Embankment side slope = 0 horiz. to 1.0 vertical

Downstream Embankment side slope = 0 horiz. to 1.0 vertical

Maximum allowable submergence for weir flow = .98

Elevation at which weir flow begins =
 Energy head used in spillway design =
 Spillway height used in design =
 Weir crest shape = Broad Crested

Number of Piers = 13

Pier Data

Pier Station Upstream= 1388 Downstream= 1388
 Upstream num= 4

Width	Elev	Width	Elev	Width	Elev	Width	Elev
6	480	6	480	5	480	5	510.5

 Downstream num= 4

Width	Elev	Width	Elev	Width	Elev	Width	Elev
6	480	6	480	5	480	5	510.5

Pier Data

Pier Station Upstream= 1513 Downstream= 1513
 Upstream num= 4

Width	Elev	Width	Elev	Width	Elev	Width	Elev
6	480	6	480	5	480	5	513.3

 Downstream num= 4

Width	Elev	Width	Elev	Width	Elev	Width	Elev
6	480	6	480	5	480	5	513.3

Pier Data

Pier Station Upstream= 1639 Downstream= 1639
 Upstream num= 4

Width	Elev	Width	Elev	Width	Elev	Width	Elev
6	480	6	480	5	480	5	516.2

 Downstream num= 4

Width	Elev	Width	Elev	Width	Elev	Width	Elev
6	480	6	480	5	480	5	516.2

6 480 6 480 5 480 5 516.2

Pier Data

Pier Station Upstream= 1765 Downstream= 1756

Upstream num= 5

Width	Elev	Width	Elev	Width	Elev	Width	Elev	Width	Elev
-------	------	-------	------	-------	------	-------	------	-------	------

7	450	7	450	6	480	5	480	5	519
---	-----	---	-----	---	-----	---	-----	---	-----

Downstream num= 5

Width	Elev	Width	Elev	Width	Elev	Width	Elev	Width	Elev
-------	------	-------	------	-------	------	-------	------	-------	------

7	450	7	450	6	480	5	480	5	519
---	-----	---	-----	---	-----	---	-----	---	-----

Pier Data

Pier Station Upstream= 1890 Downstream= 1890

Upstream num= 5

Width	Elev	Width	Elev	Width	Elev	Width	Elev	Width	Elev
-------	------	-------	------	-------	------	-------	------	-------	------

7	450	7	450	6	480	5	480	5	521.7
---	-----	---	-----	---	-----	---	-----	---	-------

Downstream num= 5

Width	Elev	Width	Elev	Width	Elev	Width	Elev	Width	Elev
-------	------	-------	------	-------	------	-------	------	-------	------

7	450	7	450	6	480	5	480	5	521.7
---	-----	---	-----	---	-----	---	-----	---	-------

Pier Data

Pier Station Upstream= 2015 Downstream= 2015

Upstream num= 5

Width	Elev	Width	Elev	Width	Elev	Width	Elev	Width	Elev
-------	------	-------	------	-------	------	-------	------	-------	------

7	450	7	450	6	480	5	480	5	524
---	-----	---	-----	---	-----	---	-----	---	-----

Downstream num= 5

Width	Elev	Width	Elev	Width	Elev	Width	Elev	Width	Elev
-------	------	-------	------	-------	------	-------	------	-------	------

7	450	7	450	6	480	5	480	5	524
---	-----	---	-----	---	-----	---	-----	---	-----

Pier Data

Pier Station Upstream= 2141 Downstream= 2141

Upstream num= 5

Width	Elev	Width	Elev	Width	Elev	Width	Elev	Width	Elev
7	450	7	450	6	480	5	480	5	526.3
Downstream		num= 5							
Width	Elev	Width	Elev	Width	Elev	Width	Elev	Width	Elev
7	450	7	450	6	480	5	480	5	526.3

Pier Data

Pier Station	Upstream=	2342	Downstream=	2342					
Upstream	num=	6							
Width	Elev	Width	Elev	Width	Elev	Width	Elev	Width	Elev
10	456	10	456	8	456	8	480	6	480
6	518.2								
Downstream		num= 6							
Width	Elev	Width	Elev	Width	Elev	Width	Elev	Width	Elev
10	456	10	456	8	456	8	480	6	480
6	518.2								

Pier Data

Pier Station	Upstream=	2672	Downstream=	2672					
Upstream	num=	6							
Width	Elev	Width	Elev	Width	Elev	Width	Elev	Width	Elev
10	400	10	456	8	456	8	480	6	480
6	518.8								
Downstream		num= 6							
Width	Elev	Width	Elev	Width	Elev	Width	Elev	Width	Elev
10	400	10	456	8	456	8	480	6	480
6	518.8								

Pier Data

Pier Station	Upstream=	2873.5	Downstream=	2873.5			
Upstream	num=	4					
Width	Elev	Width	Elev	Width	Elev	Width	Elev

```

*****
      9  469.4      9  469.4      7  469.4      7  528
Downstream      num=      4
      Width  Elev      Width  Elev      Width  Elev      Width  Elev
*****
      9  469.4      9  469.4      7  469.4      7  528

```

```

Pier Data
Pier Station      Upstream= 3003.6      Downstream= 3003.6
Upstream      num=      4
      Width  Elev      Width  Elev      Width  Elev      Width  Elev
*****
      9  469.4      9  469.4      7  469.4      7  528
Downstream      num=      4
      Width  Elev      Width  Elev      Width  Elev      Width  Elev
*****
      9  469.4      9  469.4      7  469.4      7  528

```

```

Pier Data
Pier Station      Upstream= 3124.1      Downstream= 3124.1
Upstream      num=      5
      Width  Elev      Width  Elev      Width  Elev      Width  Elev      Width  Elev
*****
      7  450      7  450      6  480      5  480      5  526
Downstream      num=      5
      Width  Elev      Width  Elev      Width  Elev      Width  Elev      Width  Elev
*****
      7  450      7  450      6  480      5  480      5  526

```

Pier Data

Pier Station Upstream= 3133.6 Downstream= 3133.6

Upstream num= 4

Width	Elev	Width	Elev	Width	Elev	Width	Elev
-------	------	-------	------	-------	------	-------	------

9	420	9	470	9	470	7	523.5
---	-----	---	-----	---	-----	---	-------

Downstream num= 4

Width	Elev	Width	Elev	Width	Elev	Width	Elev
-------	------	-------	------	-------	------	-------	------

9	420	9	470	9	470	7	523.5
---	-----	---	-----	---	-----	---	-------

Number of Bridge Coefficient Sets = 1

Low Flow Methods and Data

Energy

Selected Low Flow Methods = Energy

High Flow Method

Pressure and Weir flow

Submerged Inlet Cd =

Submerged Inlet + Outlet Cd = .8

Max Low Cord =

Additional Bridge Parameters

Add Friction component to Momentum

Do not add Weight component to Momentum

Class B flow critical depth computations use critical depth

inside the bridge at the upstream end

Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION

RIVER: Arkansas River

REACH: 1

RS: 716

INPUT

Description:

Station Elevation Data num= 124

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
0	527.96	127.75	522.8	279.26	517.79	389.02	513.49	451.68	511.5
496.74	510.82	606.28	509.95	773.84	509.39	915.76	509.36	1030.49	510
1146.18	510.84	1219.7	513.24	1239.11	513.41	1266.49	510.86	1290.34	499.99
1314.25	487.03	1332.18	481.36	1347.83	473.41	1369.53	466.6	1382.24	465.23
1423.33	464.24	1527.22	463.03	1589.18	463.63	1605.22	464.54	1639.25	463.04
1686.32	458.41	1710.22	449.36	1760.66	449.29	1816.32	452.42	1938.85	437.58
2079.88	430.68	2095.74	430.48	2273.77	430.52	2414.36	429.21	2444.36	429.46
2463.63	429.62	2564.6	428.57	2748.01	428.52	2827.2	432.12	2899.03	433.28
2942.33	436.13	3060.3	454.52	3076.04	456.5	3119.32	465.72	3139.7	466.66
3169.63	470.94	3190.81	479.53	3274.37	516.52	3300.87	523.7	3350.28	523.86
3398.75	521.74	3517.54	518.05	3529.42	518.05	3647.64	514.36	3731.24	510.9
3907.26	506.48	4124.32	499.93	4471.77	489.72	4549.63	487.69	4629.88	486.04
4796.41	482.89	5018.69	481.8	5261.3	481.44	5464.81	482.72	5628.61	483.39
5907.35	483.24	6267.98	482.82	6391.93	482.32	6492.55	482.54	6596.25	482.27
6808.85	480.84	6913.6	479.57	6976.7	479.74	7131.17	481.1	7258.27	481.61
7454.4	481.52	7642.2	481.59	7770.22	481.64	7891.49	482.11	8007.51	481.5
8084.55	481.65	8286.4	481.1	8400.66	481.15	8532.54	481.43	8815.11	481.68
9013.9	481.29	9066.42	481.36	9162.99	480.44	9267.72	480.22	9316.17	481.26
9445.09	480.81	9544.92	481.25	9840.07	480.55	9905.35	479.45	10019.66	478.98
10137.25	477.77	10335.61	479.59	10461.71	481.57	10475.35	482.43	10510.68	490.79
10530.49	496.67	10569.71	497.86	10589.33	494.08	10632.19	482.58	10682.47	480.15
10730.76	480.46	10897.14	480.91	11207.52	481.09	11484.5	481.59	11844.97	481.52
12316.03	480.77	12427.04	480.38	12675.91	480.84	12815.11	480.72	12843.11	479.52
12871.11	481.28	12981.91	482.23	13119.86	482.21	13509.8	482.25	13840.8	483.31
14141.33	484.34	14390.2	484.53	18190	482.5	18290	487		

Manning's n Values num= 3
 Sta n Val Sta n Val Sta n Val

 0 .06 1605.22 .04 3139.7 .06

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 1605.22 3139.7 196.48 196.48 196.48 .3 .5

Ineffective Flow num= 2
 Sta L Sta R Elev Permanent
 0 1146 483 F
 3400 18290 483 F

CROSS SECTION

RIVER: Arkansas River

REACH: 1 RS: 520

INPUT

Description:

Station Elevation Data num= 126
 Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev

 0 527.23 11.93 528.19 73.34 523.73 211.45 518.73 335.04 518.75
 437.4 521.52 486.74 521.87 595.3 516.81 693.57 510.08 813.81 499.88
 888.13 494.45 950.73 486.14 998.6 476.91 1047.94 474.15 1153.19 472.15
 1190.63 470.37 1345.56 466.25 1551.46 465.82 1572.39 461.82 1640.83 458.64
 1705.58 452.68 1747.75 451.82 1777.5 451.02 1866.54 445.38 1931.06 440.45
 1986.53 434.21 2034.87 431.62 2135.35 430.86 2313.65 430.19 2343.65 430.25
 2440.23 431.12 2500.67 430.57 2620.95 432.03 2677.52 430.58 2706.63 428.43
 2834.02 433.54 2868.55 432.63 2969.24 434.55 3038.45 453.03 3096.89 467.31
 3137.8 471 3225.25 471.04 3265.49 471.8 3370.51 472.31 3433.59 474.08
 3449.08 475.55 3521.93 476.86 3581.78 476.14 3689.91 476.88 3946.2 476.74
 4071.53 477.18 4351.79 476.81 4442.51 477.2 4521.14 476.8 4727.77 474.68
 4802.26 474.52 4897.13 475.67 4970.53 475.8 5027.73 474.85 5140.66 471.05
 5247.92 470.88 5363.69 472.41 5415.81 473.64 5472.01 476.47 5524.95 478.1
 5640.61 479.51 5751.4 479.79 5922.03 478.9 5970.06 479.19 6080.2 478.45
 6264.26 475.8 6361 471.29 6577.25 470.68 6797.74 471.15 6965.09 470.58

7048.38	469.44	7471.59	468.28	7584.18	468.02	7821.56	467.5	7926.82	468.71
8057.44	470.68	8162.88	470.8	8263.55	472.73	8367.04	476.98	8417.58	477.15
8557.59	474.08	8826.91	472.75	8878.34	471.99	9009.84	471.15	9151.62	471.43
9239.51	472.1	9298.61	472.15	9529.03	476.28	9582.46	476.5	9967.68	472.85
10129.68	471.65	10265.67	473.48	10373.05	478.19	10474.48	478.92	10493.49	479.78
10518.33	485.48	10566.93	501.53	10602.89	502.08	10647.65	486.34	10675.05	478.43
10713.1	476.11	10771.11	475.41	10908.14	475.08	11129.52	474.11	11490.19	475.54
11602.22	475.33	11880.39	475.83	12102.19	474.72	12631.26	470.55	12739.25	470.18
12822.47	471.51	12961.49	474.51	13016.36	481.31	13045.91	482.24	13127.41	482.55
13462.55	481.72	13791.59	482.04	14042.67	482.17	14390.16	482	18190	482.5
18290	487								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.06	1551.46	.04	3137.8	.06

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	1551.46	3137.8		0	0		.1	.3

Blocked Obstructions num= 10

Sta L	Sta R	Elev	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1881.95	1894.45	476.4	1944.75	1957.25	476.2	2006.75	2019.25	476.4
2070.45	2082.95	476.3	2132.95	2145.45	477.6	2194.75	2207.25	475.6
2330.15	2342.65	475.6	2642.75	2655.25	476.1	2806.15	2818.65	475.9
2868.15	2880.65	476.2						

SUMMARY OF MANNING'S N VALUES

River:Arkansas River

* Reach	* River Sta.	* n1	* n2	* n3	*
*1	* 1049	* .06*	.04*	.06*	
*1	* 834	* .06*	.04*	.06*	
*1	* 771	*Bridge	*	*	*
*1	* 716	* .06*	.04*	.06*	
*1	* 520	* .06*	.04*	.06*	

SUMMARY OF REACH LENGTHS

River: Arkansas River

* Reach	* River Sta.	* Left	* Channel	* Right	*
*1	* 1049	* 214.88*	214.88*	214.88*	
*1	* 834	* 117.83*	117.83*	117.83*	
*1	* 771	*Bridge	*	*	*
*1	* 716	* 196.48*	196.48*	196.48*	
*1	* 520	* 0*	0*	0*	

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS

River: Arkansas River

```
*****
*      Reach      *      River Sta.    *      Contr.   *      Expan.   *
*****
*1              *      1049      *      .3*      .5*
*1              *      834      *      .3*      .5*
*1              *      771      *Bridge *      *
*1              *      716      *      .3*      .5*
*1              *      520      *      .1*      .3*
*****
```

APPENDIX ‘E’

HEC-RAS Model

Proposed Structure

HEC-RAS Plan: Proposed River: Arkansas River Reach: 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
1	1049	2-yr	172100.00	428.78	459.15		459.72	0.000468	6.03	28533.92	1381.11	0.23
1	1049	5-yr	271400.00	428.78	467.36		468.07	0.000400	6.74	40961.77	1860.59	0.23
1	1049	10-yr	324600.00	428.78	470.97		471.73	0.000372	7.04	49661.41	3940.77	0.22
1	1049	25-yr	403500.00	428.78	474.74		475.55	0.000356	7.44	70232.41	6653.58	0.22
1	1049	50-yr	462900.00	428.78	477.13		477.95	0.000344	7.64	88470.70	9310.19	0.22
1	1049	100-yr	521200.00	428.78	478.88		479.69	0.000337	7.80	106132.40	10886.84	0.22
1	1049	500-yr	660500.00	428.78	482.10		482.93	0.000338	8.24	143521.40	13286.76	0.22
1	834	2-yr	172100.00	428.53	458.85	442.60	459.54	0.000903	6.68	25762.21	1180.49	0.25
1	834	5-yr	271400.00	428.53	467.01	446.56	467.89	0.000931	7.55	36557.18	1514.91	0.25
1	834	10-yr	324600.00	428.53	470.58	448.49	471.54	0.000942	7.95	42063.36	1556.60	0.25
1	834	25-yr	403500.00	428.53	474.15	451.52	475.32	0.001065	8.78	47662.94	1575.98	0.26
1	834	50-yr	462900.00	428.53	476.34	453.31	477.67	0.001280	9.37	51292.85	2232.17	0.29
1	834	100-yr	521200.00	428.53	477.83	454.85	479.35	0.001421	10.04	53994.27	2626.28	0.31
1	834	500-yr	660500.00	428.53	480.49	458.31	482.45	0.001685	11.50	66433.41	7325.53	0.34
1	771	Bridge										
1	716	2-yr	172100.00	428.52	458.88	440.48	459.31	0.000304	5.26	32697.28	1405.66	0.19
1	716	5-yr	271400.00	428.52	467.05	443.92	467.62	0.000298	6.05	45464.53	1774.33	0.20
1	716	10-yr	324600.00	428.52	470.62	445.58	471.26	0.000287	6.42	51869.81	1810.71	0.20
1	716	25-yr	403500.00	428.52	474.20	447.83	474.99	0.000310	7.15	58389.39	1831.40	0.21
1	716	50-yr	462900.00	428.52	476.38	449.68	477.29	0.000333	7.71	62394.16	1841.07	0.22
1	716	100-yr	521200.00	428.52	477.86	451.24	478.92	0.000371	8.34	65117.17	1865.97	0.23
1	716	500-yr	660500.00	428.52	480.34	454.37	481.84	0.000484	9.91	69723.58	2717.53	0.27
1	520	2-yr	172100.00	428.43	458.62	441.83	459.19	0.000661	6.02	28586.48	1299.22	0.23
1	520	5-yr	271400.00	428.43	466.77	445.47	467.49	0.000662	6.82	39961.92	1643.89	0.23
1	520	10-yr	324600.00	428.43	470.35	447.21	471.13	0.000662	7.15	47996.21	2926.40	0.23
1	520	25-yr	403500.00	428.43	474.06	449.65	474.89	0.000662	7.53	66593.26	6659.42	0.23
1	520	50-yr	462900.00	428.43	476.35	451.41	477.14	0.000662	7.58	85237.27	9620.56	0.23
1	520	100-yr	521200.00	428.43	477.90	453.16	478.69	0.000662	7.72	101637.60	11078.96	0.23
1	520	500-yr	660500.00	428.43	480.59	456.38	481.37	0.000662	8.11	132640.60	11860.62	0.23

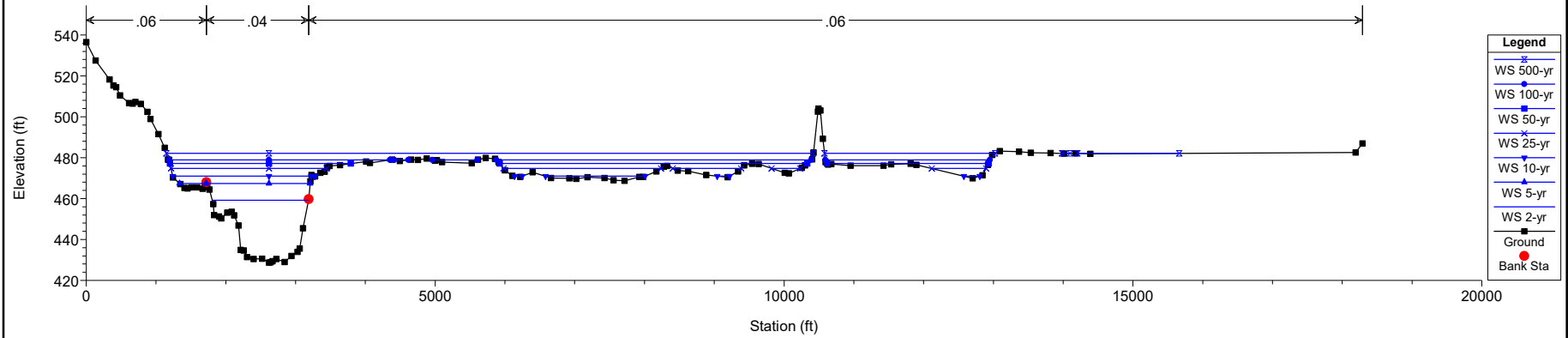
HEC-RAS Plan: Proposed River: Arkansas River Reach: 1

Reach	River Sta	Profile	E.G. Elev (ft)	W.S. Elev (ft)	Crit W.S. (ft)	Frctn Loss (ft)	C & E Loss (ft)	Top Width (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Vel Chnl (ft/s)
1	1049	2-yr	459.72	459.15		0.14	0.04	1381.11		172100.00		6.03
1	1049	5-yr	468.07	467.36		0.13	0.05	1860.59	502.31	270815.60	82.15	6.74
1	1049	10-yr	471.73	470.97		0.12	0.06	3940.77	3025.51	320534.30	1040.14	7.04
1	1049	25-yr	475.55	474.74		0.12	0.11	6653.58	7811.78	379669.50	16018.71	7.44
1	1049	50-yr	477.95	477.13		0.13	0.15	9310.19	11613.12	416833.30	34453.63	7.64
1	1049	100-yr	479.69	478.88		0.13	0.21	10886.84	14774.11	445820.30	60605.59	7.80
1	1049	500-yr	482.93	482.10		0.14	0.34	13286.76	21460.28	509730.50	129309.20	8.24
1	834	2-yr	459.54	458.85	442.60	0.00	0.01	1180.49		172100.00		6.68
1	834	5-yr	467.89	467.01	446.56	0.00	0.01	1514.91	1282.28	270117.50	0.22	7.55
1	834	10-yr	471.54	470.58	448.49	0.00	0.01	1556.60	4565.75	319927.10	107.15	7.95
1	834	25-yr	475.32	474.15	451.52	0.00	0.02	1575.98	9988.01	393031.70	480.35	8.78
1	834	50-yr	477.67	476.34	453.31	0.01	0.02	2232.17	15213.29	446777.00	909.74	9.37
1	834	100-yr	479.35	477.83	454.85	0.01	0.03	2626.28	19426.14	500478.50	1295.42	10.04
1	834	500-yr	482.45	480.49	458.31	0.01	0.08	7325.53	28461.42	619727.00	12311.59	11.50
1	771 BR U	2-yr	459.53	458.81	442.72	0.07	0.10	1154.93		172100.00		6.81
1	771 BR U	5-yr	467.87	466.95	446.72	0.08	0.12	1490.55	1266.62	270133.40		7.72
1	771 BR U	10-yr	471.53	470.51	448.67	0.08	0.13	1505.49	4536.68	320063.30		8.13
1	771 BR U	25-yr	475.30	474.07	451.67	0.09	0.15	1512.47	9768.41	393730.70	0.92	9.01
1	771 BR U	50-yr	477.64	476.23	453.46	0.10	0.16	1659.43	14434.85	448445.90	19.28	9.64
1	771 BR U	100-yr	479.31	477.69	455.06	0.11	0.18	1708.86	18304.93	502839.80	55.33	10.36
1	771 BR U	500-yr	482.36	480.12	458.56	0.15	0.23	1889.96	26836.60	633465.70	197.74	12.19
1	771 BR D	2-yr	459.36	458.83	441.51	0.00	0.05	1330.13		172100.00		5.84
1	771 BR D	5-yr	467.68	466.99	445.19	0.00	0.06	1666.49	920.02	270480.00		6.65
1	771 BR D	10-yr	471.32	470.56	446.95	0.00	0.06	1681.31	3232.20	321367.80		7.04
1	771 BR D	25-yr	475.07	474.13	449.41	0.00	0.08	1688.40	6884.13	396615.10	0.75	7.83
1	771 BR D	50-yr	477.38	476.30	451.42	0.00	0.09	1701.41	9809.78	453076.50	13.69	8.44
1	771 BR D	100-yr	479.03	477.76	452.98	0.00	0.10	1710.21	12437.44	508723.80	38.74	9.13
1	771 BR D	500-yr	481.99	480.20	456.17	0.00	0.14	1724.92	18567.58	641797.10	135.39	10.84
1	716	2-yr	459.31	458.88	440.48	0.08	0.04	1405.66		172100.00		5.26
1	716	5-yr	467.62	467.05	443.92	0.08	0.05	1774.33	678.93	270721.00	0.08	6.05
1	716	10-yr	471.26	470.62	445.58	0.08	0.04	1810.71	2342.62	322221.30	36.10	6.42
1	716	25-yr	474.99	474.20	447.83	0.09	0.01	1831.40	4989.67	398302.90	207.46	7.15
1	716	50-yr	477.29	476.38	449.68	0.09	0.06	1841.07	7180.03	455331.30	388.69	7.71
1	716	100-yr	478.92	477.86	451.24	0.10	0.14	1865.97	9163.32	511472.00	564.66	8.34
1	716	500-yr	481.84	480.34	454.37	0.11	0.36	2717.53	13827.11	645662.30	1010.56	9.91
1	520	2-yr	459.19	458.62	441.83			1299.22		172100.00		6.02

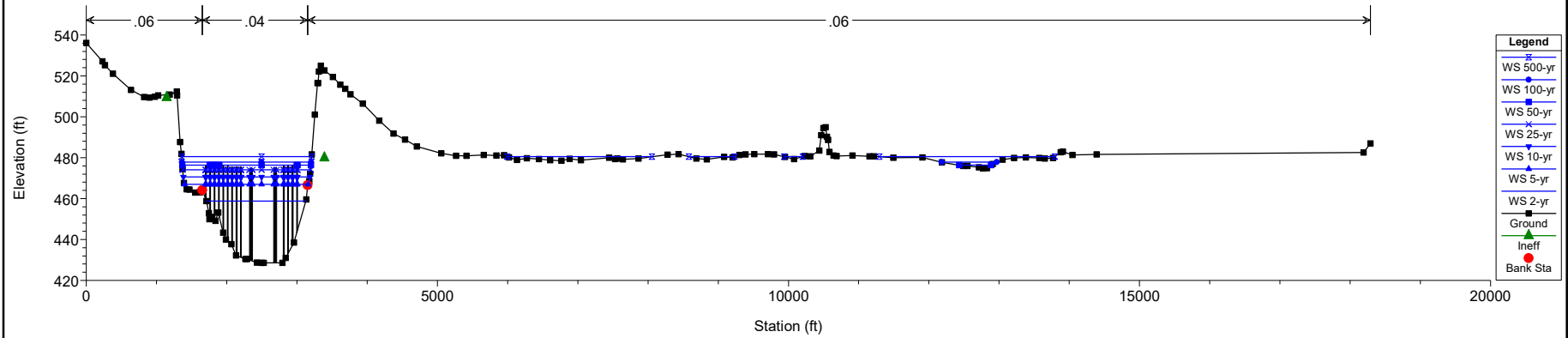
HEC-RAS Plan: Proposed River: Arkansas River Reach: 1 (Continued)

Reach	River Sta	Profile	E.G. Elev (ft)	W.S. Elev (ft)	Crit W.S. (ft)	Frctn Loss (ft)	C & E Loss (ft)	Top Width (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Vel Chnl (ft/s)
1	520	5-yr	467.49	466.77	445.47			1643.89	77.50	271322.50		6.82
1	520	10-yr	471.13	470.35	447.21			2926.40	1714.11	321176.30	1709.58	7.15
1	520	25-yr	474.89	474.06	449.65			6659.42	5446.50	378998.20	19055.28	7.53
1	520	50-yr	477.14	476.35	451.41			9620.56	9413.03	407193.80	46293.20	7.58
1	520	100-yr	478.69	477.90	453.16			11078.96	12832.59	433783.90	74583.59	7.72
1	520	500-yr	481.37	480.59	456.38			11860.62	19953.91	490025.50	150520.60	8.11

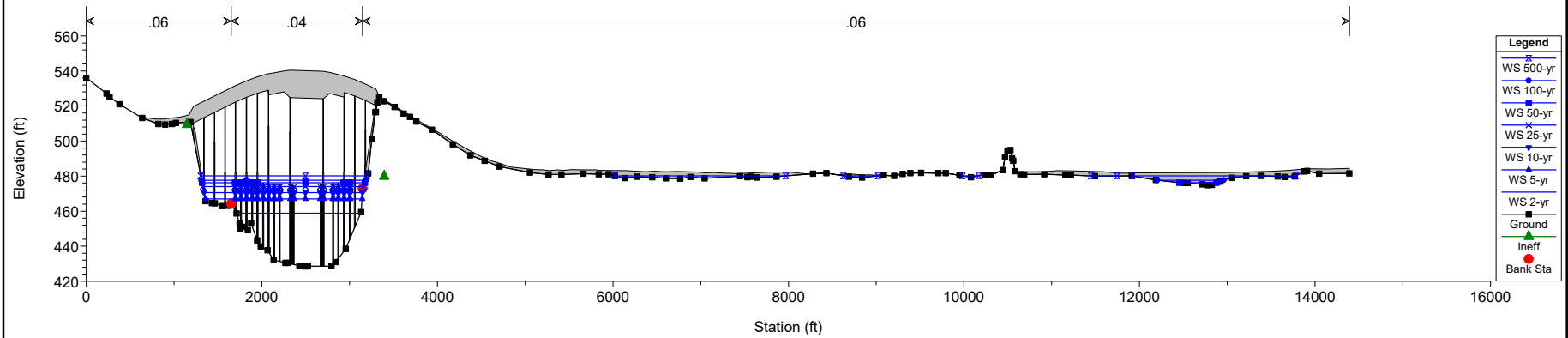
HEC-RAS Model Plan: Proposed 11/9/2023
River = Arkansas River Reach = 1 RS = 1049



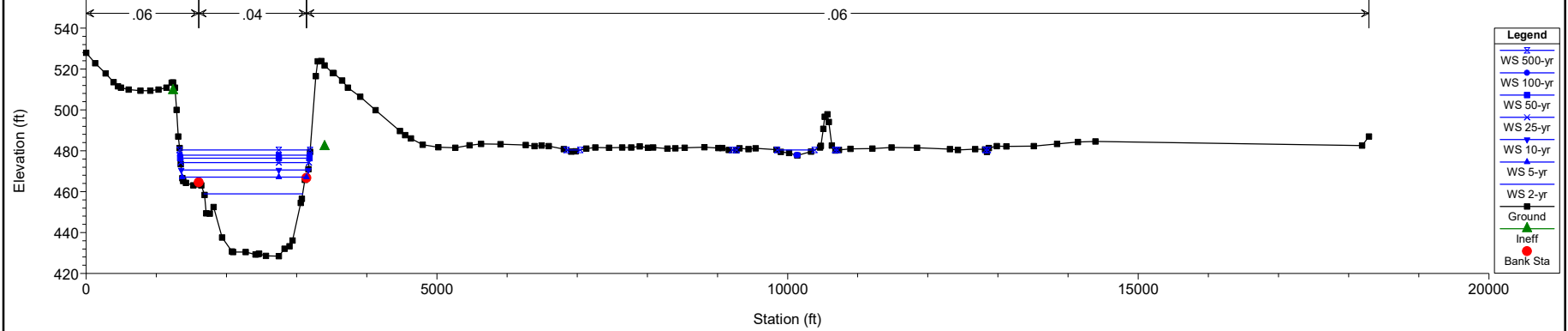
HEC-RAS Model Plan: Proposed 11/9/2023
River = Arkansas River Reach = 1 RS = 834



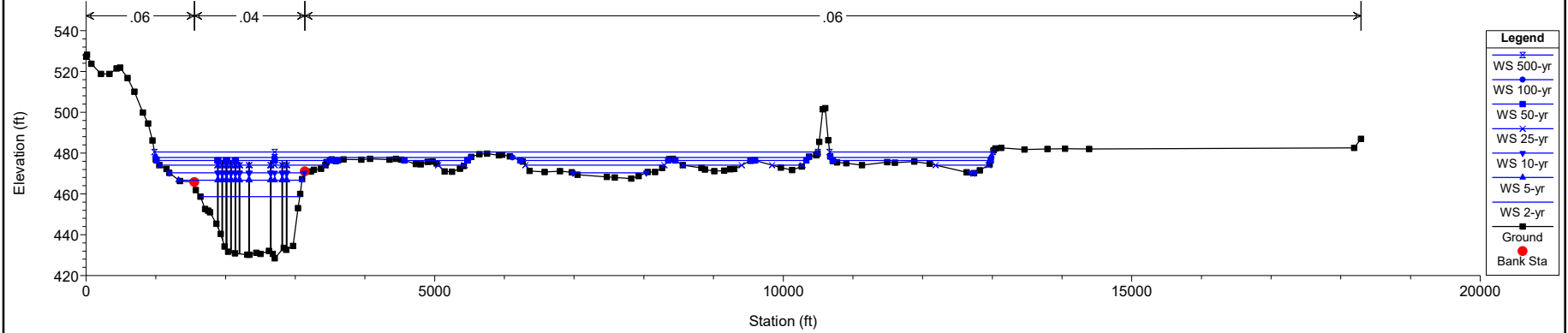
HEC-RAS Model Plan: Proposed 11/9/2023
River = Arkansas River Reach = 1 RS = 771 BR



HEC-RAS Model Plan: Proposed 11/9/2023
River = Arkansas River Reach = 1 RS = 716

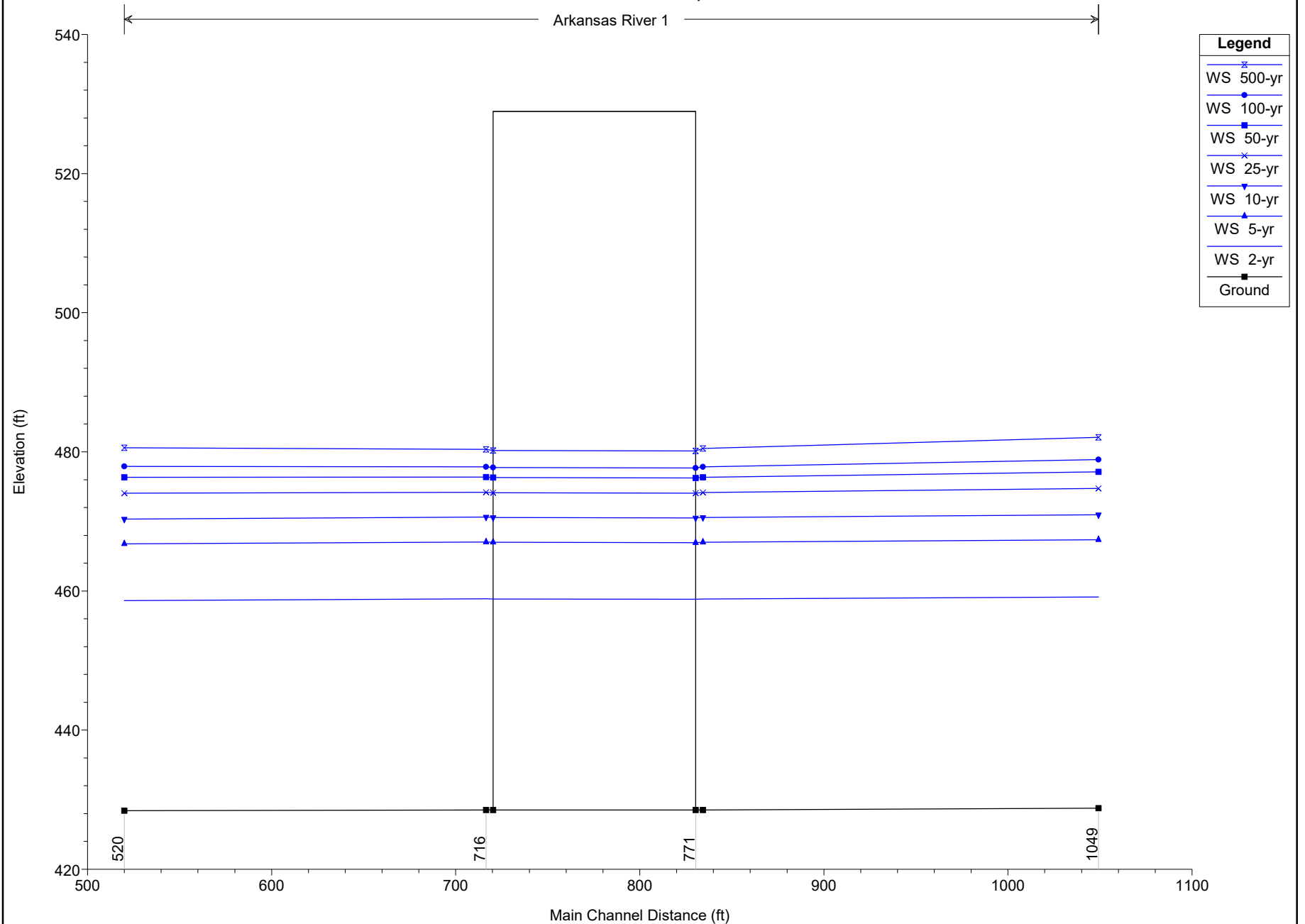


HEC-RAS Model Plan: Proposed 11/9/2023
River = Arkansas River Reach = 1 RS = 520



HEC-RAS Model Plan: Proposed 11/9/2023

Arkansas River 1



HE EC-RAS HEC-RAS 6.3.1 September 2022
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

X	X	XXXXXX	XXXX	XXXX	XX	XXXX
X	X	X	X	X	X	X
X	X	X	X	X	X	X
XXXXXXXX	XXXX	X	XXX	XXXX	XXXXXX	XXXX
X	X	X	X	X	X	X
X	X	X	X	X	X	X
X	X	XXXXXX	XXXX	X	X	XXXXX

PROJECT DATA

Project Title: HEC-RAS Model

Project File : I-40 over Arkansas River_2.prj

Run Date and Time: 11/9/2023 11:49:43 AM

Project in English units

PLAN DATA

Plan Title: Proposed

Plan File : I:\EST\34334_Muskogee_Co_I40_Arkansas\geohecras\I-40 over Arkansas River_2.p03

Geometry Title: Proposed

Geometry File : I:\EST\34334_Muskogee_Co_I40_Arkansas\geohecras\I-40 over Arkansas River_2.g03

Flow Title : P-OT

Flow File : I:\EST\34334_Muskogee_Co_I40_Arkansas\geohecras\I-40 over Arkansas River_2.f03

Plan Summary Information:

Number of: Cross Sections	=	4	Multiple Openings	=	0
Culverts	=	0	Inline Structures	=	0
Bridges	=	1	Lateral Structures	=	0

Computational Information

Water surface calculation tolerance	=	0.01
Critical depth calculation tolerance	=	0.01
Maximum number of iterations	=	20
Maximum difference tolerance	=	0.33
Flow tolerance factor	=	0.001

Computation Options

Critical depth computed only where necessary	
Conveyance Calculation Method:	At breaks in n values only
Friction Slope Method:	Average Conveyance
Computational Flow Regime:	Subcritical Flow

FLOW DATA

Flow Title: P-OT

Flow File : I:\EST\34334_Muskogee_Co_I40_Arkansas\geohecras\I-40 over Arkansas River_2.f03

Flow Data (cfs)

```
*****
*****
* River      Reach      RS      *      2-yr      5-yr      10-yr      25-yr
50-yr      100-yr      500-yr *
* Arkansas River 1      1049      *      172100      271400      324600      403500
462900      521200      660500 *
*****
*****
```

Boundary Conditions

```
*****
* River      Reach      Profile      *      Upstream      Downstream      *
*****
* Arkansas River 1      2-yr      *      Normal S = 0.000661      Normal S = 0.000661 *
* Arkansas River 1      5-yr      *      Normal S = 0.000661      Normal S = 0.000661 *
* Arkansas River 1      10-yr      *      Normal S = 0.000661      Normal S = 0.000661 *
* Arkansas River 1      25-yr      *      Normal S = 0.000661      Normal S = 0.000661 *
* Arkansas River 1      50-yr      *      Normal S = 0.000661      Normal S = 0.000661 *
* Arkansas River 1      100-yr      *      Normal S = 0.000661      Normal S = 0.000661 *
* Arkansas River 1      500-yr      *      Normal S = 0.000661      Normal S = 0.000661 *
*****
```

GEOMETRY DATA

Geometry Title: Proposed

Geometry File : I:\EST\34334_Muskogee_Co_I40_Arkansas\geohecras\I-40 over Arkansas River_2.g03

CROSS SECTION

RIVER: Arkansas River

REACH: 1 RS: 1049

INPUT

Description:

Station Elevation Data num= 128

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	536.45	133.43	527.57	333.11	518.25	388.16	515.24	428.99	514.55
484.22	510.5	613.09	506.72	666.15	506.4	704.28	507.22	783.67	506.28
876.69	502.42	921.3	498.89	1033.75	491.6	1125.46	484.77	1172.51	479.06
1187.12	478.93	1241.49	470.36	1347.42	467.06	1408.06	465.28	1451.06	465.03
1505.43	465.57	1590.06	465.49	1665.9	464.81	1700.07	465.92	1720.36	468.02
1732.38	465.69	1764.45	464.41	1819.21	457.37	1830.45	452	1904.71	451.31
1933.41	450.3	2019.16	453.22	2084.31	453.53	2120.25	451.81	2181.06	446.86
2211.61	434.88	2255.05	434.57	2304.47	431.39	2398.74	430.53	2520.14	430.54
2617.6	428.78	2640.61	428.86	2670.61	429.45	2724.14	430.45	2840.65	429.06
2939.32	431.99	3027.33	434.01	3058.43	435.53	3107.16	445.57	3189.48	459.67
3210.62	468.45	3229.32	471.6	3277.14	470.9	3353.03	472.61	3415.7	473.14
3451.98	475.31	3486.8	475.93	3635.7	476.43	4008.84	478.14	4065.13	477.4
4383.77	479.05	4493.32	478.41	4656.2	479.03	4755.03	478.92	4879.86	479.54
4995.76	478.57	5025.8	478.8	5100.19	477.8	5523.7	477.37	5613.94	479.03
5725.49	479.89	5856.86	479.47	5909.01	477.91	5998.83	473.81	6106.85	471.11
6218.3	470.59	6397.83	472.87	6661.88	470.13	6923.9	469.92	7021.74	469.6
7184.2	470.49	7427.01	470.01	7557.81	468.95	7714.05	468.75	7924.89	470.57
7980.01	470.54	8170.51	473.29	8274.18	475.6	8324.01	475.91	8477.05	473.75
8627.04	473.37	8886.19	471.48	9193.78	470.46	9341.85	473.23	9426.72	476.2
9542.21	476.99	9634.92	476.85	10007.99	472.64	10067.41	472.33	10251.76	475.04
10301.25	476.24	10401.92	479.17	10423.13	482.51	10484.04	502.57	10493.48	504.09
10519.15	503.03	10556.37	489.28	10595.9	477.91	10630.65	476.64	10679.19	476.96

10952.66	476.1311426.07	476.15	11535.6	476.8211815.77	477.0411898.51	476.54
12703.92	469.9212842.72	471.3612924.58	476.5712980.59	481.3913090.62	483.16	
13365.92	482.9113534.87	482.4513817.74	482.3114011.29	482.0714178.38	482.13	
14390.12	481.9 18190	482.5 18290	487			

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.06	1720.36	.04	3189.48	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
1720.36	3189.48	214.88	214.88	214.88	.3	.5

CROSS SECTION

RIVER: Arkansas River

REACH: 1 RS: 834

INPUT

Description:

Station Elevation Data				num= 126					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	536.11	229.86	527.05	267.04	525.3	377.83	521.02	636.12	513.17
822.9	509.68	898.68	509.37	977.02	509.76	1021.96	510.41	1186.81	510.84
1287.68	512.32	1294.58	510.42	1337.74	487.7	1356.97	481.82	1371.36	474.5
1389.3	467.6	1430.38	464.61	1467.29	464.41	1550.31	462.9	1619.41	463.09
1651.14	464.19	1712.8	458.73	1747.17	452.83	1755.87	449.93	1788.19	450.96
1839.44	449.1	1879.11	453.09	1948.15	443.29	1987.33	439.96	2066.75	437.7
2134.93	432.28	2267.93	430.52	2290.72	430.52	2428.56	428.75	2496.04	428.53
2526.04	428.55	2793.26	428.54	2840.25	430.97	2957.56	438.49	3131.65	459.54
3154.3	466.62	3177.97	468.61	3190.06	472.16	3212.34	481.6	3254.17	501.06
3293.58	516.51	3301.38	516.55	3314.75	522.16	3339.51	524.95	3393.14	522.71
3514.12	519.51	3616.71	515.64	3689.53	513.74	3761.56	511.07	3937.62	506.38
4174.6	498.08	4376.5	491.81	4538.68	488.81	4707.89	485.49	5054.42	482.09
5266.14	480.89	5415.07	480.95	5662.49	481.36	5840.09	481.06	5951.29	481.15
6021.65	480.13	6135.81	478.92	6276.23	479.74	6447.26	479.33	6605.58	478.78
6768.18	478.57	6882.88	479.44	7046.21	478.79	7448.16	479.94	7532.57	479.33

7565.78	479.59	7641.29	479.14	7864.8	479.66	8278.79	481.46	8433.62	481.75
8689.18	479.6	8838.59	479.21	9084.77	480.44	9204.83	480.19	9303.12	481.29
9389.03	481.66	9512.15	481.81	9709.01	481.74	9793.56	481.64	9949.5	480.41
10079.1	479.29	10232.14	480.75	10310.17	480.68	10441.21	483.45	10468.69	491
10496.22	494.52	10530.22	494.91	10548.83	490.18	10562.97	488.73	10584.03	482.84
10644.26	481.12	10686.28	480.84	10913.96	481.07	11156.26	480.65	11217.56	480.68
11493.41	480.02	11910.47	480.19	12187.47	477.78	12492.05	476.12	12548.13	476.02
12714.61	475.27	12770.63	474.75	12825.24	474.96	12907.77	476.92	13047.68	479
13213.71	479.92	13381.74	480.11	13574.77	479.89	13652.53	479.58	13768.67	479.8
13877.95	482.64	13907.42	482.98	14045.78	481.32	14390.29	481.62	18190	482.5
18290	487								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.06	1651.14	.04	3154.3	.06

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	1651.14	3154.3		117.83	117.83		.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	1146	509.37	F
3393	18290	479.89	F

Blocked Obstructions num= 15

Sta L	Sta R	Elev	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1695.45	1707.95	476.3	1758.05	1770.55	477	1820.45	1832.95	477.8
1883.55	1896.05	476.7	1945.45	1957.95	476.3	2008.75	2021.25	476.1
2071.05	2083.55	475.6	2134.55	2147.05	475.6	2196.45	2208.95	475.6
2326.1	2368.1	474.6	2667.6	2709.6	475.2	2806.95	2819.45	476
2866.55	2879.05	476	2931.75	2944.25	476.25	2997.35	3009.85	476.5

BRIDGE

RIVER: Arkansas River

REACH: 1

RS: 771

INPUT

Description:

Distance from Upstream XS = 4

Deck/Roadway Width = 110

Weir Coefficient = 2.6

Upstream Deck/Roadway Coordinates

num= 107

Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord

-32.68	529.89				95.67	526.12				259.89	521.01			
367.59	518.17				468.7	515.75				588.54	513.84			
803.95	512.53				869.35	512.5				1062.41	513.67			
1121.13	514.33				1172	515.11				1221	519.8			
1221	519.8	510.42			1341	522.78	513.38			1461	525.73	516.34		
1581	528.69	519.3			1701	531.64	522.23			1826	534.36	524.96		
1951	536.59	527.2			2076.5	538.35	528.94			2077.5	538.35	526.37		
2254	539.99	528			2321	540.35	524.78			2701	539.76	524.2		
2771	539.16	527.18			2938.5	537.1	525.11			2939.5	537.1	527.68		
3060	535.06	525.67			3180	532.6	523.19			3300	529.66	520.28		
3344.5	524.98				3463.28	521.51				3584.37	517.76			
3847.21	509.72				3956.04	506.59				4177.54	499.81			
4346.97	495.14				4492.8	491.45				4620.94	488.58			
4671.34	487.99				4731.04	486.84				4838.33	485.18			
5106.91	483.76				5214.21	483.61				5269.61	483.17			
5373.73	483.52				5431.88	483.25				5536.64	483.78			
5641.05	483.56				5801.24	483.53				5855.35	483.33			
6158.29	483.07				6371.41	482.51				6477.3	482.83			
6581.24	482.47				6740.58	482.68				6962.13	482.27			
7054.92	481.92				7159.46	481.99				7259.72	481.77			
7366.87	481.48				7403.48	481.46				7668.44	482.06			
7777.67	482.37				7923.97	482.33				8037.17	482.14			
8182.73	481.33				8291.06	481.18				8387.58	480.37			

8543.81	480.91	8597.66	480.71	8647.18	481.05
8751.3	481.06	8855.25	480.49	8901.27	480.82
8963.79	480.57	9105.44	480.65	9155.57	480.26
9205.47	480.99	9460.58	481.23	9724.57	480.57
9765.94	480.55	9867.42	479.98	9906.6	480.17
10022.62	479.89	10138.64	480.08	10272.97	480.68
10323.59	481.3	10436.03	481.35	10546.71	481.75
10675.72	482.43	10918.73	482.45	11063.46	483.05
11262.82	483.03	11588.87	482.49	11762.69	481.7
11891.2	481.65	11977.79	481.83	12976.82	482.05
13115.65	482.12	13420.24	482.69	13533.85	482.76
13698.37	483.26	13894.79	484.15	14148.16	484.1
14355.07	484.32	18190	482.5		

Upstream Bridge Cross Section Data

Station Elevation Data num= 117

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev

0	536.11	229.86	527.05	267.04	525.3	377.83	521.02	636.12	513.17
822.9	509.68	898.68	509.37	977.02	509.76	1021.96	510.41	1186.81	510.84
1360	465.8	1430.38	464.61	1467.29	464.41	1550.31	462.9	1619.41	463.09
1651.14	464.19	1712.8	458.73	1747.17	452.83	1755.87	449.93	1788.19	450.96
1839.44	449.1	1879.11	453.09	1948.15	443.29	1987.33	439.96	2066.75	437.7
2134.93	432.28	2267.93	430.52	2290.72	430.52	2428.56	428.75	2496.04	428.53
2526.04	428.55	2793.26	428.54	2840.25	430.97	2957.56	438.49	3131.65	459.54
3152	473	3212.34	481.6	3254.17	501.06	3293.58	516.51	3301.38	516.55
3314.75	522.16	3339.51	524.95	3393.14	522.71	3514.12	519.51	3616.71	515.64
3689.53	513.74	3761.56	511.07	3937.62	506.38	4174.6	498.08	4376.5	491.81
4538.68	488.81	4707.89	485.49	5054.42	482.09	5266.14	480.89	5415.07	480.95
5662.49	481.36	5840.09	481.06	5951.29	481.15	6021.65	480.13	6135.81	478.92
6276.23	479.74	6447.26	479.33	6605.58	478.78	6768.18	478.57	6882.88	479.44
7046.21	478.79	7448.16	479.94	7532.57	479.33	7565.78	479.59	7641.29	479.14
7864.8	479.66	8278.79	481.46	8433.62	481.75	8689.18	479.6	8838.59	479.21
9084.77	480.44	9204.83	480.19	9303.12	481.29	9389.03	481.66	9512.15	481.81
9709.01	481.74	9793.56	481.64	9949.5	480.41	10079.1	479.29	10232.14	480.75
10310.17	480.68	10441.21	483.45	10468.69	491.10	10496.22	494.52	10530.22	494.9
10548.83	490.18	10562.97	488.73	10584.03	482.84	10644.26	481.12	10686.28	480.84
10913.96	481.07	11156.26	480.65	11217.56	480.68	11493.41	480.02	11910.47	480.19
12187.47	477.78	12492.05	476.12	12548.13	476.02	12714.61	475.27	12770.63	474.75

12825.24	474.9612907.77	476.9213047.68	47913213.71	479.9213381.74	480.11
13574.77	479.8913652.53	479.5813768.67	479.813877.95	482.6413907.42	482.98
14045.78	481.3214390.29	481.62			

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.06	1651.14	.04	3152	.06

Bank Sta:	Left	Right	Coeff	Contr.	Expan.
	1651.14	3152	.3	.5	

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	1146	509.37	F
339314390.29	479.89		F

Blocked Obstructions num= 15

Sta L	Sta R	Elev	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1695.45	1707.95	476.3	1758.05	1770.55	477	1820.45	1832.95	477.8
1883.55	1896.05	476.7	1945.45	1957.95	476.3	2008.75	2021.25	476.1
2071.05	2083.55	475.6	2134.55	2147.05	475.6	2196.45	2208.95	475.6
2326.1	2368.1	474.6	2667.6	2709.6	475.2	2806.95	2819.45	476
2866.55	2879.05	476	2931.75	2944.25	476.25	2997.35	3009.85	476.5

Downstream Deck/Roadway Coordinates num= 107

Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord
-32.68	529.89				95.67	526.12				259.89	521.01			
367.59	518.17				468.7	515.75				588.54	513.84			
803.95	512.53				869.35	512.5				1062.41	513.67			
1121.13	514.33				1172	515.11				1221	519.8			
1221	519.8	510.42			1341	522.78	513.38			1461	525.73	516.34		
1581	528.69	519.3			1701	531.64	522.23			1826	534.36	524.96		
1951	536.59	527.2			2076.5	538.35	528.94			2077.5	538.35	526.37		
2254	539.99	528			2321	540.35	524.78			2701	539.76	524.2		
2771	539.16	527.18			2938.5	537.1	525.11			2939.5	537.1	527.68		
3060	535.06	525.67			3180	532.6	523.19			3300	529.66	520.28		
3344.5	524.98				3463.28	521.51				3584.37	517.76			

3847.21	509.72	3956.04	506.59	4177.54	499.81
4346.97	495.14	4492.8	491.45	4620.94	488.58
4671.34	487.99	4731.04	486.84	4838.33	485.18
5106.91	483.76	5214.21	483.61	5269.61	483.17
5373.73	483.52	5431.88	483.25	5536.64	483.78
5641.05	483.56	5801.24	483.53	5855.35	483.33
6158.29	483.07	6371.41	482.51	6477.3	482.83
6581.24	482.47	6740.58	482.68	6962.13	482.27
7054.92	481.92	7159.46	481.99	7259.72	481.77
7366.87	481.48	7403.48	481.46	7668.44	482.06
7777.67	482.37	7923.97	482.33	8037.17	482.14
8182.73	481.33	8291.06	481.18	8387.58	480.37
8543.81	480.91	8597.66	480.71	8647.18	481.05
8751.3	481.06	8855.25	480.49	8901.27	480.82
8963.79	480.57	9105.44	480.65	9155.57	480.26
9205.47	480.99	9460.58	481.23	9724.57	480.57
9765.94	480.55	9867.42	479.98	9906.6	480.17
10022.62	479.89	10138.64	480.08	10272.97	480.68
10323.59	481.3	10436.03	481.35	10546.71	481.75
10675.72	482.43	10918.73	482.45	11063.46	483.05
11262.82	483.03	11588.87	482.49	11762.69	481.7
11891.2	481.65	11977.79	481.83	12976.82	482.05
13115.65	482.12	13420.24	482.69	13533.85	482.76
13698.37	483.26	13894.79	484.15	14148.16	484.1
14355.07	484.32	18190	482.5		

Downstream Bridge Cross Section Data

Station Elevation Data num= 115

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev

0	536.11	229.86	527.05	267.04	525.3	377.83	521.02	636.12	513.17
822.9	509.68	898.68	509.37	977.02	509.76	1021.96	510.41	1186.81	510.84
1360	465.8	1430.38	464.61	1467.29	464.41	1550.31	462.9	1619.41	463.09
1651.14	464.19	1712.8	458.73	1747.17	452.83	1755.87	449.93	1788.19	450.96
1839.44	449.1	1879.11	453.09	1948.15	443.29	1987.33	439.96	2066.75	437.7
2134.93	432.28	2267.93	430.52	2290.72	430.52	2428.56	428.75	2496.04	428.53
2526.04	428.55	2793.26	428.54	2840.25	430.97	2957.56	438.49	3131.65	459.54
3152	473	3212.34	481.6	3300	517.4	3314.75	522.16	3339.51	524.95
3393.14	522.71	3514.12	519.51	3616.71	515.64	3689.53	513.74	3761.56	511.07

3937.62	506.38	4174.6	498.08	4376.5	491.81	4538.68	488.81	4707.89	485.49
5054.42	482.09	5266.14	480.89	5415.07	480.95	5662.49	481.36	5840.09	481.06
5951.29	481.15	6021.65	480.13	6135.81	478.92	6276.23	479.74	6447.26	479.33
6605.58	478.78	6768.18	478.57	6882.88	479.44	7046.21	478.79	7448.16	479.94
7532.57	479.33	7565.78	479.59	7641.29	479.14	7864.8	479.66	8278.79	481.46
8433.62	481.75	8689.18	479.6	8838.59	479.21	9084.77	480.44	9204.83	480.19
9303.12	481.29	9389.03	481.66	9512.15	481.81	9709.01	481.74	9793.56	481.64
9949.5	480.41	10079.1	479.29	10232.14	480.75	10310.17	480.68	10441.21	483.45
10468.69	491.10	10496.22	494.52	10530.22	494.91	10548.83	490.18	10562.97	488.73
10584.03	482.84	10644.26	481.12	10686.28	480.84	10913.96	481.07	11156.26	480.65
11217.56	480.68	11493.41	480.02	11910.47	480.19	12187.47	477.78	12492.05	476
12548.13	476.02	12714.61	475.27	12770.63	474.75	12825.24	474.96	12907.77	476.92
13047.68	479.13	13213.71	479.92	13381.74	480.11	13574.77	479.89	13652.53	479.58
13768.67	479.81	13877.95	482.64	13907.42	482.98	14045.78	481.32	14390.29	481.62

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.06	1651.14	.04	3152	.06

Bank Sta: Left Right Coeff Contr. Expan.

1651.14	3152	.3	.5
---------	------	----	----

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	1239	509.37	F
3399	14390.29	482	F

Upstream Embankment side slope = 0 horiz. to 1.0 vertical

Downstream Embankment side slope = 0 horiz. to 1.0 vertical

Maximum allowable submergence for weir flow = .98

Elevation at which weir flow begins =

Energy head used in spillway design =

Spillway height used in design =

Weir crest shape = Broad Crested

Number of Abutments = 2

Abutment Data

Upstream num= 3

Sta	Elev	Sta	Elev	Sta	Elev
1221	507.5	1235	507.5	1360	465.8

Downstream num= 3

Sta	Elev	Sta	Elev	Sta	Elev
1221	507.5	1235	507.5	1360	465.8

Abutment Data

Upstream num= 3

Sta	Elev	Sta	Elev	Sta	Elev
3152	473	3286	517.4	3300	517.4

Downstream num= 3

Sta	Elev	Sta	Elev	Sta	Elev
3152	473	3286	517.4	3300	517.4

Number of Piers = 12

Pier Data

Pier Station Upstream= 1341 Downstream= 1341

Upstream num= 6

Width	Elev	Width	Elev	Width	Elev	Width	Elev	Width	Elev
12	440	12	482.7	8	482.7	8	499.4	5	499.4
5	525.7								

Downstream num= 6

Width	Elev	Width	Elev	Width	Elev	Width	Elev	Width	Elev
12	440	12	482.7	8	482.7	8	499.4	5	499.4
5	525.7								

Pier Data

Pier Station Upstream= 1461 Downstream= 1461

Upstream num= 6

Width	Elev	Width	Elev	Width	Elev	Width	Elev	Width	Elev
12	440	12	482.7	8	482.7	8	499.4	5	499.4


```

5 525.7
Downstream num= 6
Width Elev Width Elev Width Elev Width Elev Width Elev
*****
12 440 12 482.7 8 482.7 8 499.4 5 499.4
5 525.7

```

```

Pier Data
Pier Station Upstream= 1581 Downstream= 1581
Upstream num= 6
Width Elev Width Elev Width Elev Width Elev Width Elev
*****
12 440 12 482.35 8 482.35 8 499.4 5 502.36
5 528.6
Downstream num= 6
Width Elev Width Elev Width Elev Width Elev Width Elev
*****
12 440 12 482.35 8 482.35 8 499.4 5 502.36
5 528.6

```

```

Pier Data
Pier Station Upstream= 1701 Downstream= 1701
Upstream num= 6
Width Elev Width Elev Width Elev Width Elev Width Elev
*****
12 440 12 482.3 8 482.3 8 505.3 5 531.6
5 550.3
Downstream num= 6
Width Elev Width Elev Width Elev Width Elev Width Elev
*****
12 440 12 482.3 8 482.3 8 505.3 5 531.6
5 550.3

```

```

Pier Data
Pier Station Upstream= 1826 Downstream= 1826
Upstream num= 6
Width Elev Width Elev Width Elev Width Elev Width Elev
*****
12 440 12 482 8 482 8 508 5 508

```

```

5 534.3
Downstream num= 6
Width Elev Width Elev Width Elev Width Elev Width Elev
*****
12 440 12 482 8 482 8 508 5 508
5 534.3

```

```

Pier Data
Pier Station Upstream= 1951 Downstream= 1951
Upstream num= 6
Width Elev Width Elev Width Elev Width Elev Width Elev
*****
12 440 12 482.26 8 482.26 8 510.26 5 510.26
5 536.5
Downstream num= 6
Width Elev Width Elev Width Elev Width Elev Width Elev
*****
12 440 12 482.26 8 482.26 8 510.26 5 510.26
5 536.5

```

```

Pier Data
Pier Station Upstream= 2077 Downstream= 2077
Upstream num= 6
Width Elev Width Elev Width Elev Width Elev Width Elev
*****
12 440 12 482.7 8 482.7 8 508.5 6 508.5
6 538.3
Downstream num= 6
Width Elev Width Elev Width Elev Width Elev Width Elev
*****
12 440 12 482.7 8 482.7 8 508.5 6 508.5
6 538.3

```

```

Pier Data
Pier Station Upstream= 2321 Downstream= 2321
Upstream num= 6
Width Elev Width Elev Width Elev Width Elev Width Elev
*****
12 440 12 482.7 8 482.7 8 505.2 6 505.2

```

```

        6  540.3
Downstream      num=      6
  Width  Elev    Width  Elev    Width  Elev    Width  Elev    Width  Elev
*****
        12    440        12  482.7        8  482.7        8  505.2        6  505.2
        6  540.3

```

Pier Data

Pier Station Upstream= 2701 Downstream= 2701

```

Upstream      num=      6
  Width  Elev    Width  Elev    Width  Elev    Width  Elev    Width  Elev
*****
        12    440        12  482.7        8  482.7        8  504.7        6  504.7
        6  539.7

```

```

Downstream    num=      6
  Width  Elev    Width  Elev    Width  Elev    Width  Elev    Width  Elev
*****
        12    440        12  482.7        8  482.7        8  504.7        6  504.7
        6  539.7

```

Pier Data

Pier Station Upstream= 2939 Downstream= 2939

```

Upstream      num=      6
  Width  Elev    Width  Elev    Width  Elev    Width  Elev    Width  Elev
*****
        12    440        12  482.3        8  482.3        8  507.3        6  507.3
        6  525.7

```

```

Downstream    num=      6
  Width  Elev    Width  Elev    Width  Elev    Width  Elev    Width  Elev
*****
        12    440        12  482.3        8  482.3        8  507.3        6  507.3
        6  525.7

```

Pier Data

Pier Station Upstream= 3060 Downstream= 3060

```

Upstream      num=      6
  Width  Elev    Width  Elev    Width  Elev    Width  Elev    Width  Elev
*****
        12    440        12  482.7        8  482.7        8  508.7        5  508.7

```

5	535									
Downstream	num=	6								
Width	Elev	Width	Elev	Width	Elev	Width	Elev	Width	Elev	

12	440	12	482.7	8	482.7	8	508.7	5	508.7	
5	535									

Pier Data

Pier Station Upstream= 3180 Downstream= 3180

Upstream	num=	6								
Width	Elev	Width	Elev	Width	Elev	Width	Elev	Width	Elev	

12	440	12	486.3	8	486.3	8	506.3	5	506.3	
5	532.6									

Downstream	num=	6								
Width	Elev	Width	Elev	Width	Elev	Width	Elev	Width	Elev	

12	440	12	486.3	8	486.3	8	506.3	5	506.3	
5	532.6									

Number of Bridge Coefficient Sets = 1

Low Flow Methods and Data

Energy

Selected Low Flow Methods = Highest Energy Answer

High Flow Method

Pressure and Weir flow

Submerged Inlet Cd	=	
Submerged Inlet + Outlet Cd	=	.8
Max Low Cord	=	

Additional Bridge Parameters

Add Friction component to Momentum

Do not add Weight component to Momentum

Class B flow critical depth computations use critical depth
inside the bridge at the upstream end

Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION

RIVER: Arkansas River

REACH: 1

RS: 716

INPUT

Description:

Station Elevation Data

num= 124

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	527.96	127.75	522.8	279.26	517.79	389.02	513.49	451.68	511.5
496.74	510.82	606.28	509.95	773.84	509.39	915.76	509.36	1030.49	510
1146.18	510.84	1219.7	513.24	1239.11	513.41	1266.49	510.86	1290.34	499.99
1314.25	487.03	1332.18	481.36	1347.83	473.41	1369.53	466.6	1382.24	465.23
1423.33	464.24	1527.22	463.03	1589.18	463.63	1605.22	464.54	1639.25	463.04
1686.32	458.41	1710.22	449.36	1760.66	449.29	1816.32	452.42	1938.85	437.58
2079.88	430.68	2095.74	430.48	2273.77	430.52	2414.36	429.21	2444.36	429.46
2463.63	429.62	2564.6	428.57	2748.01	428.52	2827.2	432.12	2899.03	433.28
2942.33	436.13	3060.3	454.52	3076.04	456.5	3119.32	465.72	3139.7	466.66
3169.63	470.94	3190.81	479.53	3274.37	516.52	3300.87	523.7	3350.28	523.86
3398.75	521.74	3517.54	518.05	3529.42	518.05	3647.64	514.36	3731.24	510.9
3907.26	506.48	4124.32	499.93	4471.77	489.72	4549.63	487.69	4629.88	486.04
4796.41	482.89	5018.69	481.8	5261.3	481.44	5464.81	482.72	5628.61	483.39
5907.35	483.24	6267.98	482.82	6391.93	482.32	6492.55	482.54	6596.25	482.27
6808.85	480.84	6913.6	479.57	6976.7	479.74	7131.17	481.1	7258.27	481.61
7454.4	481.52	7642.2	481.59	7770.22	481.64	7891.49	482.11	8007.51	481.5
8084.55	481.65	8286.4	481.1	8400.66	481.15	8532.54	481.43	8815.11	481.68
9013.9	481.29	9066.42	481.36	9162.99	480.44	9267.72	480.22	9316.17	481.26
9445.09	480.81	9544.92	481.25	9840.07	480.55	9905.35	479.45	10019.66	478.98
10137.25	477.77	10335.61	479.59	10461.71	481.57	10475.35	482.43	10510.68	490.79
10530.49	496.67	10569.71	497.86	10589.33	494.08	10632.19	482.58	10682.47	480.15
10730.76	480.46	10897.14	480.91	11207.52	481.09	11484.5	481.59	11844.97	481.52
12316.03	480.77	12427.04	480.38	12675.91	480.84	12815.11	480.72	12843.11	479.52
12871.11	481.28	12981.91	482.23	13119.86	482.21	13509.8	482.25	13840.8	483.31
14141.33	484.34	14390.2	484.53	18190	482.5	18290	487		

Manning's n Values

num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-----	-------	-----	-------	-----	-------

0 .06 1605.22 .04 3139.7 .06

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	1605.22	3139.7		196.48	196.48		.3	.5
Ineffective Flow		num=	2					
Sta L	Sta R	Elev	Permanent					
0	1239	509.37	F					
3399	18290	482	F					

CROSS SECTION

RIVER: Arkansas River

REACH: 1 RS: 520

INPUT

Description:

Station Elevation Data num= 127

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
0	527.23	11.93	528.19	73.34	523.73	211.45	518.73	335.04	518.75
437.4	521.52	486.74	521.87	595.3	516.81	693.57	510.08	813.81	499.88
888.13	494.45	950.73	486.14	998.6	476.91	1047.94	474.15	1153.19	472.15
1190.63	470.37	1345.56	466.25	1551.46	465.82	1572.39	461.82	1640.83	458.64
1705.58	452.68	1747.75	451.82	1777.5	451.02	1866.54	445.38	1931.06	440.45
1986.53	434.21	2034.87	431.62	2135.35	430.86	2313.65	430.19	2343.65	430.25
2440.23	431.12	2500.67	430.57	2620.95	432.03	2677.52	430.58	2706.63	428.43
2834.02	433.54	2868.55	432.63	2969.24	434.55	3038.45	453.03	3071.94	460.02
3096.89	467.31	3137.8	471	3225.25	471.04	3265.49	471.8	3370.51	472.31
3433.59	474.08	3449.08	475.55	3521.93	476.86	3581.78	476.14	3689.91	476.88
3946.2	476.74	4071.53	477.18	4351.79	476.81	4442.51	477.2	4521.14	476.8
4727.77	474.68	4802.26	474.52	4897.13	475.67	4970.53	475.8	5027.73	474.85
5140.66	471.05	5247.92	470.88	5363.69	472.41	5415.81	473.64	5472.01	476.47
5524.95	478.1	5640.61	479.51	5751.4	479.79	5922.03	478.9	5970.06	479.19
6080.2	478.45	6264.26	475.8	6361	471.29	6577.25	470.68	6797.74	471.15
6965.09	470.58	7048.38	469.44	7471.59	468.28	7584.18	468.02	7821.56	467.5
7926.82	468.71	8057.44	470.68	8162.88	470.8	8263.55	472.73	8367.04	476.98
8417.58	477.15	8557.59	474.08	8826.91	472.75	8878.34	471.99	9009.84	471.15

9151.62	471.43	9239.51	472.1	9298.61	472.15	9529.03	476.28	9582.46	476.5
9967.68	472.85	10129.68	471.65	10265.67	473.48	10373.05	478.19	10474.48	478.92
10493.49	479.78	10518.33	485.48	10566.93	501.53	10602.89	502.08	10647.65	486.34
10675.05	478.43	10713.1	476.11	10771.11	475.41	10908.14	475.08	11129.52	474.1
11490.19	475.54	11602.22	475.33	11880.39	475.83	12102.19	474.72	12631.26	470.55
12739.25	470.18	12822.47	471.51	12961.49	474.51	13016.36	481.31	13045.91	482.24
13127.41	482.55	13462.55	481.72	13791.59	482.04	14042.67	482.17	14390.16	482
18190	482.5	18290	487						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.06	1551.46	.04	3137.8	.06

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	1551.46	3137.8		0	0		.1	.3

Blocked Obstructions num= 10

Sta L	Sta R	Elev	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1881.95	1894.45	476.4	1944.75	1957.25	476.2	2006.75	2019.25	476.4
2070.45	2082.95	476.3	2132.95	2145.45	477.6	2194.75	2207.25	475.6
2330.15	2342.65	475.6	2642.75	2655.25	476.1	2806.15	2818.65	475.9
2868.15	2880.65	476.2						

SUMMARY OF MANNING'S N VALUES

River:Arkansas River

* Reach	* River Sta.	* n1	* n2	* n3	*
*1	* 1049	* .06*	* .04*	* .06*	
*1	* 834	* .06*	* .04*	* .06*	
*1	* 771	* Bridge	* *	* *	
*1	* 716	* .06*	* .04*	* .06*	
*1	* 520	* .06*	* .04*	* .06*	

SUMMARY OF REACH LENGTHS

River: Arkansas River

```
*****
*      Reach      *      River Sta.    *      Left    *      Channel *      Right    *
*****
*1              *      1049          *      214.88*      214.88*      214.88*
*1              *      834           *      117.83*      117.83*      117.83*
*1              *      771           *      Bridge    *              *
*1              *      716           *      196.48*      196.48*      196.48*
*1              *      520           *              *      0*          0*          0*
*****
```

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS

River: Arkansas River

```
*****
*      Reach      *      River Sta.    *      Contr.   *      Expan.   *
*****
*1              *      1049          *      .3*        .5*
*1              *      834           *      .3*        .5*
*1              *      771           *      Bridge    *              *
*1              *      716           *      .3*        .5*
*1              *      520           *      .1*        .3*
*****
```


APPENDIX ‘F’

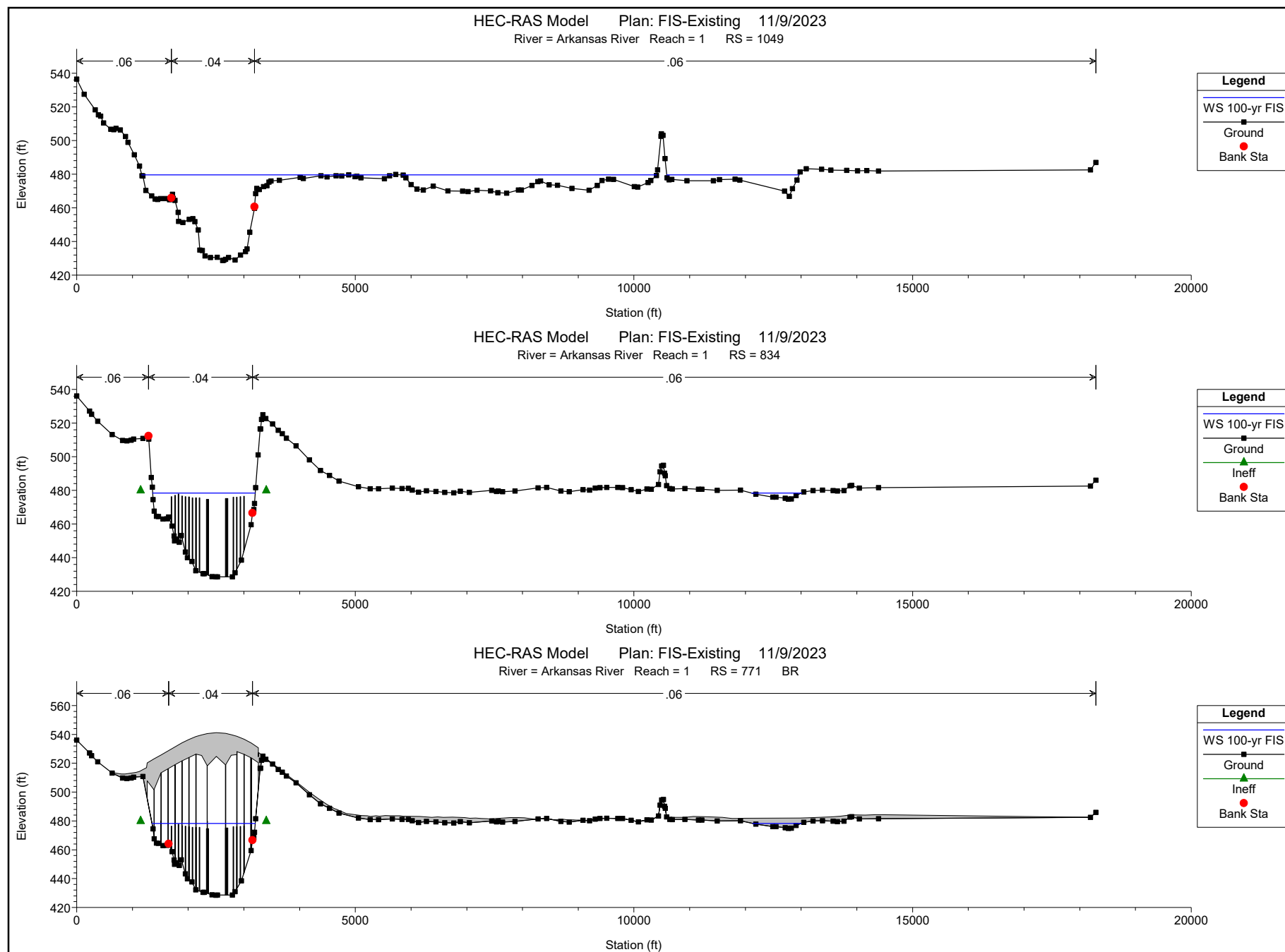
FEMA HEC-RAS BEST AVAILABLE DATA MODEL

HEC-RAS Plan: FIS-Existing River: Arkansas River Reach: 1 Profile: 100-yr FIS

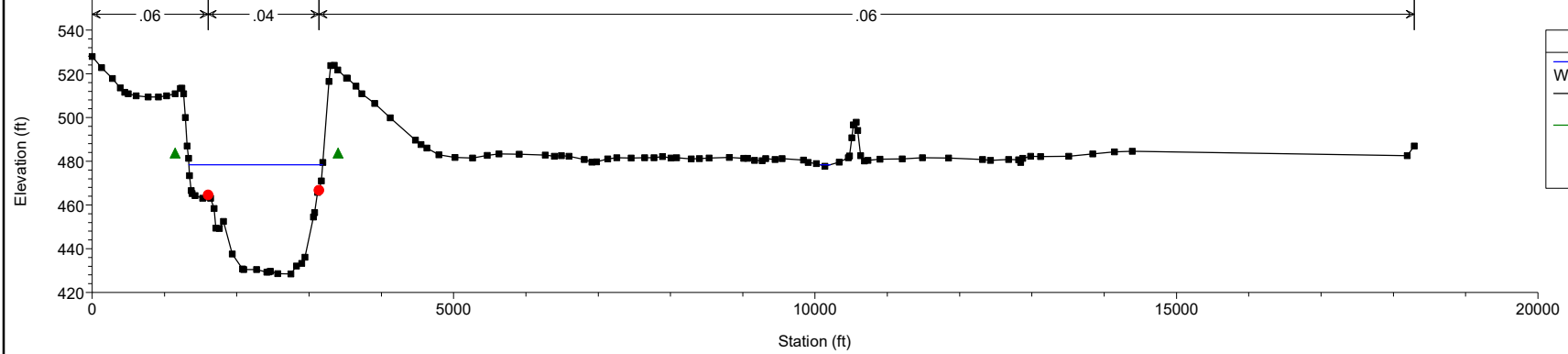
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	1049	100-yr FIS	550000.00	428.78	479.55		480.37	0.000343	7.90	113846.50	11453.43	0.22
1	834	100-yr FIS	550000.00	428.53	478.45	455.66	480.01	0.001452	10.04	55008.86	2740.96	0.32
1	771		Bridge									
1	716	100-yr FIS	550000.00	428.52	478.42	451.97	479.57	0.000394	8.67	66157.55	1984.47	0.24
1	520	100-yr FIS	550000.00	428.43	478.51	453.84	479.29	0.000662	7.81	108313.60	11232.49	0.23

HEC-RAS Plan: FIS-Existing River: Arkansas River Reach: 1 Profile: 100-yr FIS

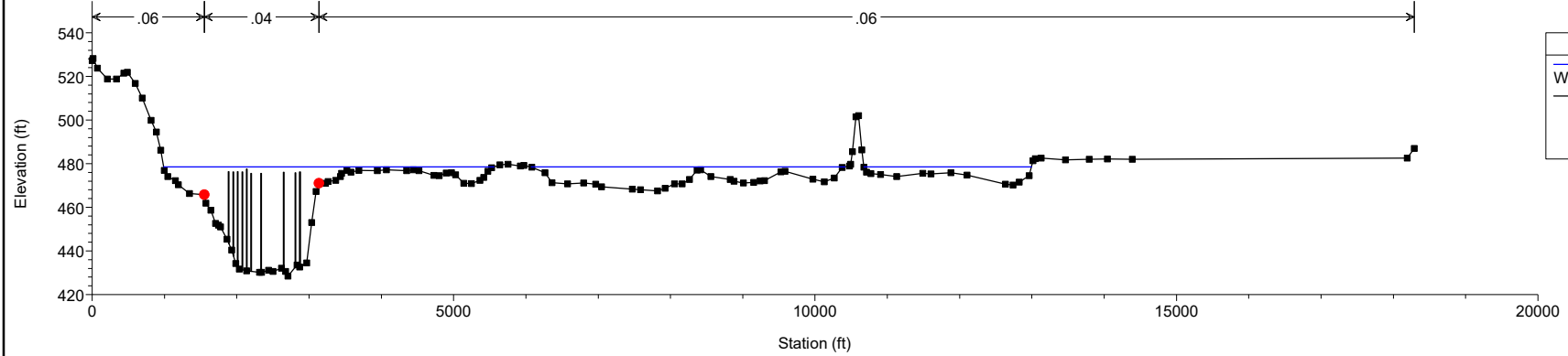
Reach	River Sta	Profile	E.G. Elev (ft)	W.S. Elev (ft)	Crit W.S. (ft)	Frctn Loss (ft)	C & E Loss (ft)	Top Width (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Vel Chnl (ft/s)
1	1049	100-yr FIS	480.37	479.55		0.13	0.22	11453.43	15374.48	460895.50	73730.03	7.90
1	834	100-yr FIS	480.01	478.45	455.66	0.01	0.04	2740.96		548534.80	1465.25	10.04
1	771 BR U	100-yr FIS	479.96	478.26	455.67	0.12	0.22	1765.24	18128.47	530375.20	1496.36	10.61
1	771 BR D	100-yr FIS	479.63	478.37	452.54	0.00	0.05	1779.89	11779.81	537337.30	882.95	9.07
1	716	100-yr FIS	479.57	478.42	451.97	0.10	0.18	1984.47	10095.48	539255.30	649.26	8.67
1	520	100-yr FIS	479.29	478.51	453.84			11232.49	14319.70	445842.60	89837.74	7.81



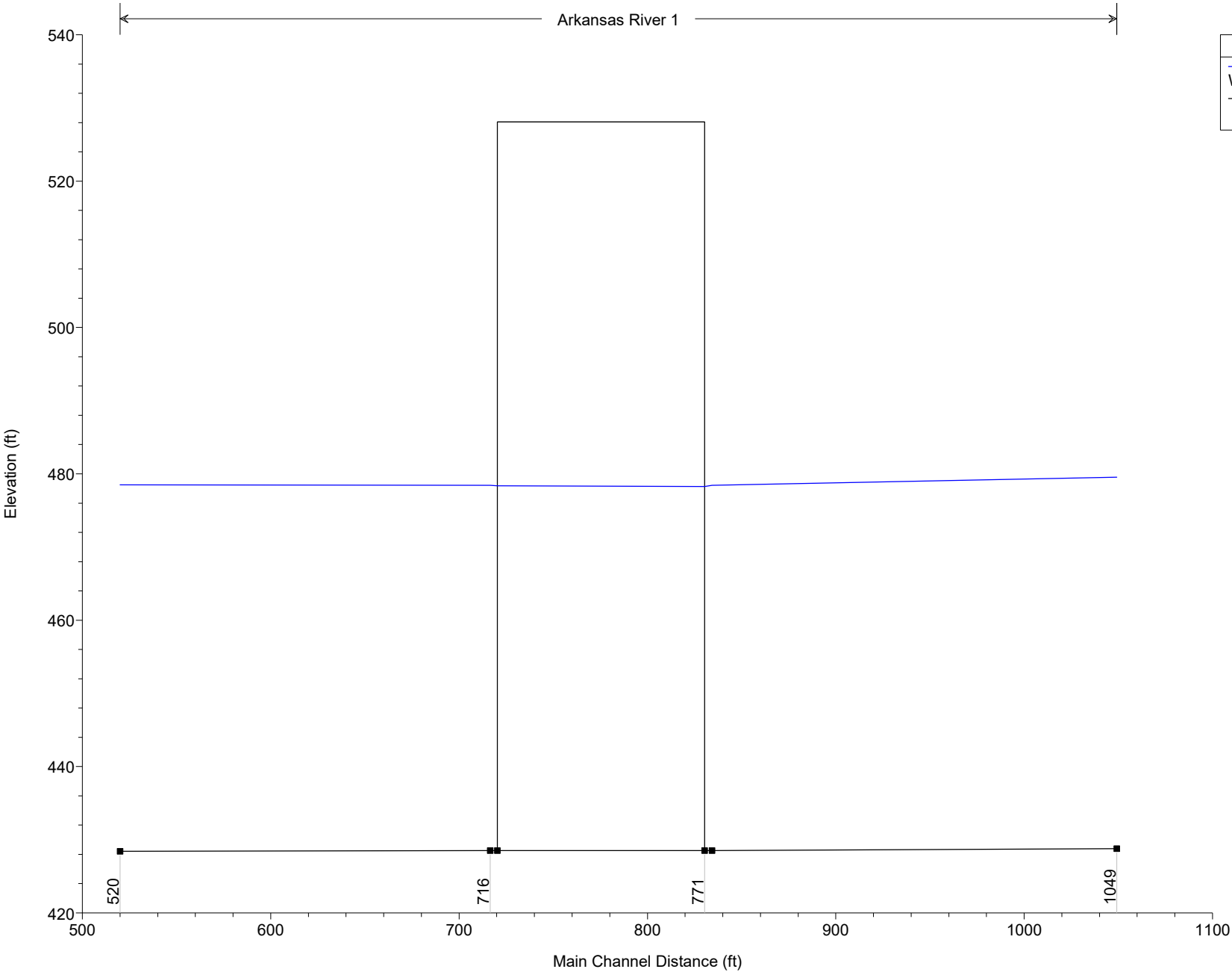
HEC-RAS Model Plan: FIS-Existing 11/9/2023
River = Arkansas River Reach = 1 RS = 716



HEC-RAS Model Plan: FIS-Existing 11/9/2023
River = Arkansas River Reach = 1 RS = 520



Arkansas River 1



Legend

WS 100-yr FIS

Ground

HEC-RAS HEC-RAS 6.3.1 September 2022
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

X	X	XXXXXX	XXXX	XXXX	XX	XXXX
X	X	X	X X	X X	X X	X
X	X	X	X	X X	X X	X
XXXXXXXX	XXXX	X	XXX	XXXX	XXXXXX	XXXX
X	X	X	X	X X	X X	X
X	X	X	X X	X X	X X	X
X	X	XXXXXX	XXXX	X X	X X	XXXXX

PROJECT DATA

Project Title: HEC-RAS Model

Project File : I-40 over Arkansas River_2.prj

Run Date and Time: 11/9/2023 11:49:58 AM

Project in English units

PLAN DATA

Plan Title: FIS-Existing

Plan File : I:\EST\34334_Muskogee_Co_I40_Arkansas\geohecras\I-40 over Arkansas River_2.p06

Geometry Title: FIS-Existing

Geometry File : I:\EST\34334_Muskogee_Co_I40_Arkansas\geohecras\I-40 over Arkansas River_2.g06

Flow Title : FIS-Existing

Flow File : I:\EST\34334_Muskogee_Co_I40_Arkansas\geohecras\I-40 over Arkansas River_2.f06

Plan Summary Information:

Number of: Cross Sections	=	4	Multiple Openings	=	0
Culverts	=	0	Inline Structures	=	0
Bridges	=	1	Lateral Structures	=	0

Computational Information

Water surface calculation tolerance	=	0.01
Critical depth calculation tolerance	=	0.01
Maximum number of iterations	=	20
Maximum difference tolerance	=	0.33
Flow tolerance factor	=	0.001

Computation Options

Critical depth computed only where necessary	
Conveyance Calculation Method:	At breaks in n values only
Friction Slope Method:	Average Conveyance
Computational Flow Regime:	Subcritical Flow

FLOW DATA

Flow Title: FIS-Existing

Flow File : I:\EST\34334_Muskogee_Co_I40_Arkansas\geohecras\I-40 over Arkansas River_2.f06

Flow Data (cfs)

```
*****
* River      Reach      RS      *      100-yr FIS *
* Arkansas River 1      1049    *      550000 *
*****
```

Boundary Conditions

```
*****
* River      Reach      Profile      *      Upstream      Downstream      *
*****
* Arkansas River 1      100-yr FIS      *      Normal S = 0.000661      Normal S = 0.000661 *
*****
```

GEOMETRY DATA

Geometry Title: FIS-Existing

Geometry File : I:\EST\34334_Muskogee_Co_I40_Arkansas\geohecras\I-40 over Arkansas River_2.g06

CROSS SECTION

RIVER: Arkansas River

REACH: 1 RS: 1049

INPUT

Description:

Station Elevation Data num= 129

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	536.45	133.43	527.57	333.11	518.25	388.16	515.24	428.99	514.55
484.22	510.5	613.09	506.72	666.15	506.4	704.28	507.22	783.67	506.28
876.69	502.42	921.3	498.89	1033.75	491.6	1125.46	484.77	1172.51	479.06
1187.12	478.93	1241.49	470.36	1347.42	467.06	1408.06	465.28	1451.06	465.03
1505.43	465.57	1590.06	465.49	1665.9	464.81	1700.07	465.92	1720.36	468.02
1732.38	465.69	1764.45	464.41	1819.21	457.37	1830.45	452	1904.71	451.31
2019.16	453.22	2084.31	453.53	2120.25	451.81	2181.06	446.86	2211.61	434.88
2255.05	434.57	2304.47	431.39	2398.74	430.53	2520.14	430.54	2617.6	428.78
2640.61	428.86	2670.61	429.45	2724.14	430.45	2840.65	429.06	2939.32	431.99
3027.33	434.01	3058.43	435.53	3107.16	445.57	3189.48	459.67	3192.04	460.68
3210.62	468.45	3229.32	471.6	3277.14	470.9	3353.03	472.61	3415.7	473.14
3451.98	475.31	3486.8	475.93	3635.7	476.43	4008.84	478.14	4065.13	477.4
4383.77	479.05	4493.32	478.41	4656.2	479.03	4755.03	478.92	4879.86	479.54
4995.76	478.57	5025.8	478.8	5100.19	477.8	5523.7	477.37	5613.94	479.03
5725.49	479.89	5856.86	479.47	5909.01	477.91	5998.83	473.81	6106.85	471.11
6218.3	470.59	6397.83	472.87	6661.88	470.13	6923.9	469.92	7021.74	469.6
7184.2	470.49	7427.01	470.01	7557.81	468.95	7714.05	468.75	7924.89	470.57
7980.01	470.54	8170.51	473.29	8274.18	475.6	8324.01	475.91	8477.05	473.75
8627.04	473.37	8886.19	471.48	9193.78	470.46	9341.85	473.23	9426.72	476.2
9542.21	476.99	9634.92	476.85	10007.99	472.64	10067.41	472.33	10251.76	475.04
10301.25	476.24	10401.92	479.17	10423.13	482.51	10484.04	502.57	10493.48	504.09
10519.15	503.03	10556.37	489.28	10595.9	477.91	10630.65	476.64	10679.19	476.96

10952.66	476.1311426.07	476.15	11535.6	476.8211815.77	477.0411898.51	476.54
12703.92	469.9212786.55	466.8612842.72	471.3612924.58	476.5712980.59	481.39	
13090.62	483.1613365.92	482.9113534.87	482.4513817.74	482.3114011.29	482.07	
14178.38	482.1314390.12	481.9	18190	482.5	18290	487

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.06	1700.07	.04	3192.04	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
1700.07	3192.04	214.88	214.88	214.88	.3	.5

CROSS SECTION

RIVER: Arkansas River

REACH: 1 RS: 834

INPUT

Description:

Station Elevation Data				num= 126					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	536.11	229.86	527.05	267.04	525.3	377.83	521.02	636.12	513.17
822.9	509.68	898.68	509.37	977.02	509.76	1021.96	510.41	1186.81	510.84
1287.68	512.32	1294.58	510.42	1337.74	487.7	1356.97	481.82	1371.36	474.5
1389.3	467.6	1430.38	464.61	1467.29	464.41	1550.31	462.9	1619.41	463.09
1651.14	464.19	1712.8	458.73	1747.17	452.83	1755.87	449.93	1788.19	450.96
1839.44	449.1	1879.11	453.09	1948.15	443.29	1987.33	439.96	2066.75	437.7
2134.93	432.28	2267.93	430.52	2290.72	430.52	2428.56	428.75	2496.04	428.53
2526.04	428.55	2793.26	428.54	2840.25	430.97	2957.56	438.49	3131.65	459.54
3154.3	466.62	3177.97	468.61	3190.06	472.16	3212.34	481.6	3254.17	501.06
3293.58	516.51	3301.38	516.55	3314.75	522.16	3339.51	524.95	3393.14	522.71
3514.12	519.51	3616.71	515.64	3689.53	513.74	3761.56	511.07	3937.62	506.38
4174.6	498.08	4376.5	491.81	4538.68	488.81	4707.89	485.49	5054.42	482.09
5266.14	480.89	5415.07	480.95	5662.49	481.36	5840.09	481.06	5951.29	481.15
6021.65	480.13	6135.81	478.92	6276.23	479.74	6447.26	479.33	6605.58	478.78
6768.18	478.57	6882.88	479.44	7046.21	478.79	7448.16	479.94	7532.57	479.33

7565.78	479.59	7641.29	479.14	7864.8	479.66	8278.79	481.46	8433.62	481.75
8689.18	479.6	8838.59	479.21	9084.77	480.44	9204.83	480.19	9303.12	481.29
9389.03	481.66	9512.15	481.81	9709.01	481.74	9793.56	481.64	9949.5	480.41
10079.1	479.29	10232.14	480.75	10310.17	480.68	10441.21	483.45	10468.69	491
10496.22	494.52	10530.22	494.91	10548.83	490.18	10562.97	488.73	10584.03	482.84
10644.26	481.12	10686.28	480.84	10913.96	481.07	11156.26	480.65	11217.56	480.68
11493.41	480.02	11910.47	480.19	12187.47	477.78	12492.05	476.12	12548.13	476.02
12714.61	475.27	12770.63	474.75	12825.24	474.96	12907.77	476.92	13047.68	479
13213.71	479.92	13381.74	480.11	13574.77	479.89	13652.53	479.58	13768.67	479.8
13877.95	482.64	13907.42	482.98	14045.78	481.32	14390.29	481.62	18190	482.5
18290	486								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.06	1287.68	.04	3154.3	.06

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	1287.68	3154.3		117.83	117.83		.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	1146	479.89	F
3400	18290	479.89	F

Blocked Obstructions num= 15

Sta L	Sta R	Elev	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1695.45	1707.95	476.3	1758.05	1770.55	477	1820.45	1832.95	477.8
1883.55	1896.05	476.7	1945.45	1957.95	476.3	2008.75	2021.25	476.1
2071.05	2083.55	475.6	2134.55	2147.05	475.6	2196.45	2208.95	475.6
2326.1	2368.1	474.6	2666.3	2710.8	475.2	2806.95	2819.45	476
2866.55	2879.05	476	2931.75	2944.25	476.25	2997.35	3009.85	476.5

BRIDGE

RIVER: Arkansas River

REACH: 1

RS: 771

INPUT

Description:

Distance from Upstream XS = 4

Deck/Roadway Width = 110

Weir Coefficient = 2.6

Upstream Deck/Roadway Coordinates

num= 110

Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
-32.68	529.89				95.67	526.12				259.89	521.01			
367.59	518.17				468.7	515.75				588.54	513.84			
803.95	512.53				869.35	512.5				1062.41	513.67			
1121.13	514.33				1251.48	517.01				1265.8	520.17			
1265.8	520.17	507.8			1388	523.02	501.52			1513	525.77	513.34		
1639	528.54	516.2			1765	531.33	519			1890	534.12	521.71		
2015	536.58	524			2141	538.5	526.3			2241.5	539.72	525.38		
2342	540.61	518.22			2507	541.14	524.81			2672	540.69	518.85		
2773	539.84	525.51			2873	538.64	526.09			2874	538.64	528.08		
3003.6	536.67	526.2			3133.6	534	523.6			3261.3	530.75	520.38		
3261.3	524.41				3262.3	527.26				3264.59	527.5			
3344.5	525.12				3463.28	521.26				3584.37	517.76			
3847.21	509.72				3956.04	506.59				4177.54	499.81			
4346.97	495.14				4492.8	491.45				4620.94	488.58			
4671.34	487.99				4731.04	486.84				4838.33	485.18			
5106.91	483.76				5214.21	483.61				5269.61	483.17			
5373.73	483.52				5431.88	483.25				5536.64	483.78			
5641.05	483.56				5801.24	483.53				5855.35	483.33			
6158.29	483.07				6371.41	482.51				6477.3	482.83			
6581.24	482.47				6740.58	482.68				6962.13	482.27			
7054.92	481.92				7159.46	481.99				7259.72	481.77			
7366.87	481.48				7403.48	481.46				7668.44	482.06			
7777.67	482.37				7923.97	482.33				8037.17	482.14			

8182.73	481.33	8291.06	481.18	8387.58	480.37
8543.81	480.91	8597.66	480.71	8647.18	481.05
8751.3	481.06	8855.25	480.49	8901.27	480.82
8963.79	480.57	9105.44	480.65	9155.57	480.26
9205.47	480.99	9460.58	481.23	9724.57	480.57
9765.94	480.55	9867.42	479.98	9906.6	480.17
10022.62	479.89	10138.64	480.08	10272.97	480.68
10323.59	481.3	10436.03	481.35	10546.71	481.75
10675.72	482.43	10918.73	482.45	11063.46	483.05
11262.82	483.03	11588.87	482.49	11762.69	481.7
11891.2	481.65	11977.79	481.83	12976.82	482.05
13115.65	482.12	13420.24	482.69	13533.85	482.76
13698.37	483.26	13894.79	484.15	14148.16	484.1
14355.07	484.32	18190	482.5		

Upstream Bridge Cross Section Data

Station Elevation Data num= 121

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	536.11	229.86	527.05	267.04	525.3	377.83	521.02	636.12	513.17
822.9	509.68	898.68	509.37	977.02	509.76	1021.96	510.41	1186.81	510.84
1371.36	474.5	1389.3	467.6	1430.38	464.61	1467.29	464.41	1550.31	462.9
1619.41	463.09	1651.14	464.19	1712.8	458.73	1747.17	452.83	1755.87	449.93
1788.19	450.96	1839.44	449.1	1879.11	453.09	1948.15	443.29	1987.33	439.96
2066.75	437.7	2134.93	432.28	2267.93	430.52	2290.72	430.52	2428.56	428.75
2496.04	428.53	2526.04	428.55	2793.26	428.54	2840.25	430.97	2957.56	438.49
3131.65	459.54	3154.3	466.62	3177.97	468.61	3190.06	472.16	3212.34	481.6
3293.58	516.51	3301.38	516.55	3314.75	522.16	3339.51	524.95	3393.14	522.71
3514.12	519.51	3616.71	515.64	3689.53	513.74	3761.56	511.07	3937.62	506.38
4174.6	498.08	4376.5	491.81	4538.68	488.81	4707.89	485.49	5054.42	482.09
5266.14	480.89	5415.07	480.95	5662.49	481.36	5840.09	481.06	5951.29	481.15
6021.65	480.13	6135.81	478.92	6276.23	479.74	6447.26	479.33	6605.58	478.78
6768.18	478.57	6882.88	479.44	7046.21	478.79	7448.16	479.94	7532.57	479.33
7565.78	479.59	7641.29	479.14	7864.8	479.66	8278.79	481.46	8433.62	481.75
8689.18	479.6	8838.59	479.21	9084.77	480.44	9204.83	480.19	9303.12	481.29
9389.03	481.66	9512.15	481.81	9709.01	481.74	9793.56	481.64	9949.5	480.41
10079.1	479.29	10232.14	480.75	10310.17	480.68	10441.21	483.45	10468.69	491
10496.22	494.52	10530.22	494.91	10548.83	490.18	10562.97	488.73	10584.03	482.84
10644.26	481.12	10686.28	480.84	10913.96	481.07	11156.26	480.65	11217.56	480.68

11493.41	480.0211910.47	480.1912187.47	477.7812492.05	47612548.13	476.02
12714.61	475.2712770.63	474.7512825.24	474.9612907.77	476.9213047.68	479
13213.71	479.9213381.74	480.1113574.77	479.8913652.53	479.5813768.67	479.8
13877.95	482.6413907.42	482.9814045.78	481.3214390.29	481.62 18190	482.5
18290	486				

Manning's n Values num= 3

Sta	n	Val	Sta	n	Val	Sta	n	Val

0	.06	1651.14	.04	3154.3	.06			

Bank Sta:	Left	Right	Coeff	Contr.	Expan.
	1651.14	3154.3	.3	.5	

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	1146	479.89	F
3400	18290	479.89	F

Blocked Obstructions num= 15

Sta L	Sta R	Elev	Sta L	Sta R	Elev	Sta L	Sta R	Elev

1695.45	1707.95	476.3	1758.05	1770.55	477	1820.45	1832.95	477.8
1883.55	1896.05	476.7	1945.45	1957.95	476.3	2008.75	2021.25	476.1
2071.05	2083.55	475.6	2134.55	2147.05	475.6	2196.45	2208.95	475.6
2326.1	2368.1	474.6	2666.3	2710.8	475.2	2806.95	2819.45	476
2866.55	2879.05	476	2931.75	2944.25	476.25	2997.35	3009.85	476.5

Downstream Deck/Roadway Coordinates

num= 110

Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord

-32.68	529.89				95.67	526.12				259.89	521.01			
367.59	518.17				468.7	515.75				588.54	513.84			
803.95	512.53				869.35	512.5				1062.41	513.67			
1121.13	514.33				1251.48	517.01				1265.8	520.17			
1265.8	520.17	507.8			1388	523.02	501.52			1513	525.77	513.34		
1639	528.54	516.2			1765	531.33	519			1890	534.12	521.71		
2015	536.58	524			2141	538.5	526.3			2241.5	539.72	525.38		
2342	540.61	518.22			2507	541.14	524.81			2672	540.69	518.85		
2773	539.84	525.51			2873	538.64	526.09			2874	538.64	528.08		

3003.6	536.67	526.2	3133.6	534	523.6	3261.3	530.75	520.38
3261.3	524.41		3262.3	527.26		3264.59	527.5	
3344.5	525.12		3463.28	521.26		3584.37	517.76	
3847.21	509.72		3956.04	506.59		4177.54	499.81	
4346.97	495.14		4492.8	491.45		4620.94	488.58	
4671.34	487.99		4731.04	486.84		4838.33	485.18	
5106.91	483.76		5214.21	483.61		5269.61	483.17	
5373.73	483.52		5431.88	483.25		5536.64	483.78	
5641.05	483.56		5801.24	483.53		5855.35	483.33	
6158.29	483.07		6371.41	482.51		6477.3	482.83	
6581.24	482.47		6740.58	482.68		6962.13	482.27	
7054.92	481.92		7159.46	481.99		7259.72	481.77	
7366.87	481.48		7403.48	481.46		7668.44	482.06	
7777.67	482.37		7923.97	482.33		8037.17	482.14	
8182.73	481.33		8291.06	481.18		8387.58	480.37	
8543.81	480.91		8597.66	480.71		8647.18	481.05	
8751.3	481.06		8855.25	480.49		8901.27	480.82	
8963.79	480.57		9105.44	480.65		9155.57	480.26	
9205.47	480.99		9460.58	481.23		9724.57	480.57	
9765.94	480.55		9867.42	479.98		9906.6	480.17	
10022.62	479.89		10138.64	480.08		10272.97	480.68	
10323.59	481.3		10436.03	481.35		10546.71	481.75	
10675.72	482.43		10918.73	482.45		11063.46	483.05	
11262.82	483.03		11588.87	482.49		11762.69	481.7	
11891.2	481.65		11977.79	481.83		12976.82	482.05	
13115.65	482.12		13420.24	482.69		13533.85	482.76	
13698.37	483.26		13894.79	484.15		14148.16	484.1	
14355.07	484.32		18190	482.5				

Downstream Bridge Cross Section Data

Station Elevation Data num= 118

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev

0	527.96	127.75	522.8	279.26	517.79	389.02	513.49	451.68	511.5
496.74	510.82	606.28	509.95	773.84	509.39	915.76	509.36	1030.49	510
1146.18	510.84	1347.83	473.41	1369.53	466.6	1382.24	465.23	1423.33	464.24
1527.22	463.03	1589.18	463.63	1605.22	464.54	1639.25	463.04	1686.32	458.41
1710.22	449.36	1760.66	449.29	1816.32	452.42	1938.85	437.58	2079.88	430.68
2095.74	430.48	2273.77	430.52	2414.36	429.21	2444.36	429.46	2463.63	429.62

2564.6	428.57	2748.01	428.52	2827.2	432.12	2899.03	433.28	2942.33	436.13
3060.3	454.52	3076.04	456.5	3119.32	465.72	3139.7	466.66	3169.63	470.94
3190.81	479.53	3274.37	516.52	3300.87	523.7	3350.28	523.86	3398.75	521.74
3517.54	518.05	3529.42	518.05	3647.64	514.36	3731.24	510.9	3907.26	506.48
4124.32	499.93	4471.77	489.72	4549.63	487.69	4629.88	486.04	4796.41	482.89
5018.69	481.8	5261.3	481.44	5464.81	482.72	5628.61	483.39	5907.35	483.24
6267.98	482.82	6391.93	482.32	6492.55	482.54	6596.25	482.27	6808.85	480.84
6913.6	479.57	6976.7	479.74	7131.17	481.1	7258.27	481.61	7454.4	481.52
7642.2	481.59	7770.22	481.64	7891.49	482.11	8007.51	481.5	8084.55	481.65
8286.4	481.1	8400.66	481.15	8532.54	481.43	8815.11	481.68	9013.9	481.29
9066.42	481.36	9162.99	480.44	9267.72	480.22	9316.17	481.26	9445.09	480.81
9544.92	481.25	9840.07	480.55	9905.35	479.45	10019.66	478.98	10137.25	477.77
10335.61	479.59	10461.71	481.57	10475.35	482.43	10510.68	490.79	10530.49	496.67
10569.71	497.86	10589.33	494.08	10632.19	482.58	10682.47	480.15	10730.76	480.46
10897.14	480.91	11207.52	481.09	11484.5	481.59	11844.97	481.52	12316.03	480.77
12427.04	480.38	12675.91	480.84	12815.11	480.72	12843.11	479.52	12871.11	481.28
12981.91	482.23	13119.86	482.21	13509.8	482.25	13840.8	483.31	14141.33	484.34
14390.2	484.53	18190	482.5	18290	487				

Manning's n Values num= 3

Sta	n	Val	Sta	n	Val	Sta	n	Val
0	.06	1605.22	.04	3139.7	.06			

Bank Sta:	Left	Right	Coeff	Contr.	Expan.
	1605.22	3139.7	.3	.5	

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	1146	483	F
3400	18290	483	F

Upstream Embankment side slope	=	0 horiz. to 1.0 vertical
Downstream Embankment side slope	=	0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow	=	.98
Elevation at which weir flow begins	=	
Energy head used in spillway design	=	
Spillway height used in design	=	
Weir crest shape	=	Broad Crested

Number of Piers = 13

Pier Data

Pier Station Upstream= 1388 Downstream= 1388

Upstream num= 4

Width	Elev	Width	Elev	Width	Elev	Width	Elev
6	480	6	480	5	480	5	510.5

Downstream num= 4

Width	Elev	Width	Elev	Width	Elev	Width	Elev
6	480	6	480	5	480	5	510.5

Pier Data

Pier Station Upstream= 1513 Downstream= 1513

Upstream num= 4

Width	Elev	Width	Elev	Width	Elev	Width	Elev
6	480	6	480	5	480	5	513.3

Downstream num= 4

Width	Elev	Width	Elev	Width	Elev	Width	Elev
6	480	6	480	5	480	5	513.3

Pier Data

Pier Station Upstream= 1639 Downstream= 1639

Upstream num= 4

Width	Elev	Width	Elev	Width	Elev	Width	Elev
6	480	6	480	5	480	5	516.2

Downstream num= 4

Width	Elev	Width	Elev	Width	Elev	Width	Elev
6	480	6	480	5	480	5	516.2

Pier Data

Pier Station Upstream= 1765 Downstream= 1756

Upstream num= 5

Width	Elev	Width	Elev	Width	Elev	Width	Elev	Width	Elev
-------	------	-------	------	-------	------	-------	------	-------	------

```

*****
      7      450      7      450      6      480      5      480      5      519
Downstream      num=      5
      Width      Elev      Width      Elev      Width      Elev      Width      Elev      Width      Elev
*****
      7      450      7      450      6      480      5      480      5      519

```

```

Pier Data
Pier Station      Upstream=      1890      Downstream=      1890
Upstream      num=      5
      Width      Elev      Width      Elev      Width      Elev      Width      Elev      Width      Elev
*****
      7      450      7      450      6      480      5      480      5      521.7
Downstream      num=      5
      Width      Elev      Width      Elev      Width      Elev      Width      Elev      Width      Elev
*****
      7      450      7      450      6      480      5      480      5      521.7

```

```

Pier Data
Pier Station      Upstream=      2015      Downstream=      2015
Upstream      num=      5
      Width      Elev      Width      Elev      Width      Elev      Width      Elev      Width      Elev
*****
      7      450      7      450      6      480      5      480      5      524
Downstream      num=      5
      Width      Elev      Width      Elev      Width      Elev      Width      Elev      Width      Elev
*****
      7      450      7      450      6      480      5      480      5      524

```

```

Pier Data
Pier Station      Upstream=      2141      Downstream=      2141
Upstream      num=      5
      Width      Elev      Width      Elev      Width      Elev      Width      Elev      Width      Elev
*****
      7      450      7      450      6      480      5      480      5      526.3
Downstream      num=      5
      Width      Elev      Width      Elev      Width      Elev      Width      Elev      Width      Elev
*****
      7      450      7      450      6      480      5      480      5      526.3

```

Pier Data

```

Pier Station      Upstream=    2342    Downstream=    2342
Upstream      num=        6
  Width  Elev    Width  Elev    Width  Elev    Width  Elev    Width  Elev
*****
    10    456     10    456     8    456     8    480     6    480
    6    518.2
Downstream      num=        6
  Width  Elev    Width  Elev    Width  Elev    Width  Elev    Width  Elev
*****
    10    456     10    456     8    456     8    480     6    480
    6    518.2
  
```

Pier Data

```

Pier Station      Upstream=    2672    Downstream=    2672
Upstream      num=        6
  Width  Elev    Width  Elev    Width  Elev    Width  Elev    Width  Elev
*****
    10    400     10    456     8    456     8    480     6    480
    6    518.8
Downstream      num=        6
  Width  Elev    Width  Elev    Width  Elev    Width  Elev    Width  Elev
*****
    10    400     10    456     8    456     8    480     6    480
    6    518.8
  
```

Pier Data

```

Pier Station      Upstream=   2873.5    Downstream=   2873.5
Upstream      num=        4
  Width  Elev    Width  Elev    Width  Elev    Width  Elev
*****
     9   469.4     9   469.4     7   469.4     7   528
Downstream      num=        4
  Width  Elev    Width  Elev    Width  Elev    Width  Elev
*****
     9   469.4     9   469.4     7   469.4     7   528
  
```

Pier Data

Pier Station Upstream= 3003.6 Downstream= 3003.6
Upstream num= 4
Width Elev Width Elev Width Elev Width Elev

9 469.4 9 469.4 7 469.4 7 528
Downstream num= 4
Width Elev Width Elev Width Elev Width Elev

9 469.4 9 469.4 7 469.4 7 528

Pier Data
Pier Station Upstream= 3124.1 Downstream= 3124.1
Upstream num= 5
Width Elev Width Elev Width Elev Width Elev Width Elev

7 450 7 450 6 480 5 480 5 526
Downstream num= 5
Width Elev Width Elev Width Elev Width Elev Width Elev

7 450 7 450 6 480 5 480 5 526

Pier Data
Pier Station Upstream= 3133.6 Downstream= 3133.6
Upstream num= 4
Width Elev Width Elev Width Elev Width Elev

9 420 9 470 9 470 7 523.5
Downstream num= 4
Width Elev Width Elev Width Elev Width Elev

9 420 9 470 9 470 7 523.5

Number of Bridge Coefficient Sets = 1

Low Flow Methods and Data

Energy

Selected Low Flow Methods = Energy

High Flow Method

Pressure and Weir flow
Submerged Inlet Cd =
Submerged Inlet + Outlet Cd = .8
Max Low Cord =

Additional Bridge Parameters

Add Friction component to Momentum
Do not add Weight component to Momentum
Class B flow critical depth computations use critical depth
inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION

RIVER: Arkansas River

REACH: 1

RS: 716

INPUT

Description:

Station Elevation Data

num=

124

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
0	527.96	127.75	522.8	279.26	517.79	389.02	513.49	451.68	511.5
496.74	510.82	606.28	509.95	773.84	509.39	915.76	509.36	1030.49	510
1146.18	510.84	1219.7	513.24	1239.11	513.41	1266.49	510.86	1290.34	499.99
1314.25	487.03	1332.18	481.36	1347.83	473.41	1369.53	466.6	1382.24	465.23
1423.33	464.24	1527.22	463.03	1589.18	463.63	1605.22	464.54	1639.25	463.04
1686.32	458.41	1710.22	449.36	1760.66	449.29	1816.32	452.42	1938.85	437.58
2079.88	430.68	2095.74	430.48	2273.77	430.52	2414.36	429.21	2444.36	429.46
2463.63	429.62	2564.6	428.57	2748.01	428.52	2827.2	432.12	2899.03	433.28
2942.33	436.13	3060.3	454.52	3076.04	456.5	3119.32	465.72	3139.7	466.66
3169.63	470.94	3190.81	479.53	3274.37	516.52	3300.87	523.7	3350.28	523.86
3398.75	521.74	3517.54	518.05	3529.42	518.05	3647.64	514.36	3731.24	510.9
3907.26	506.48	4124.32	499.93	4471.77	489.72	4549.63	487.69	4629.88	486.04
4796.41	482.89	5018.69	481.8	5261.3	481.44	5464.81	482.72	5628.61	483.39
5907.35	483.24	6267.98	482.82	6391.93	482.32	6492.55	482.54	6596.25	482.27
6808.85	480.84	6913.6	479.57	6976.7	479.74	7131.17	481.1	7258.27	481.61
7454.4	481.52	7642.2	481.59	7770.22	481.64	7891.49	482.11	8007.51	481.5
8084.55	481.65	8286.4	481.1	8400.66	481.15	8532.54	481.43	8815.11	481.68
9013.9	481.29	9066.42	481.36	9162.99	480.44	9267.72	480.22	9316.17	481.26
9445.09	480.81	9544.92	481.25	9840.07	480.55	9905.35	479.45	10019.66	478.98
10137.25	477.77	10335.61	479.59	10461.71	481.57	10475.35	482.43	10510.68	490.79
10530.49	496.67	10569.71	497.86	10589.33	494.08	10632.19	482.58	10682.47	480.15
10730.76	480.46	10897.14	480.91	11207.52	481.09	11484.5	481.59	11844.97	481.52
12316.03	480.77	12427.04	480.38	12675.91	480.84	12815.11	480.72	12843.11	479.52
12871.11	481.28	12981.91	482.23	13119.86	482.21	13509.8	482.25	13840.8	483.31
14141.33	484.34	14390.2	484.53	18190	482.5	18290	487		

Manning's n Values

num=

3

Sta	n Val	Sta	n Val	Sta	n Val
0	.06	1605.22	.04	3139.7	.06

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	1605.22	3139.7		196.48	196.48		.3	.5
Ineffective Flow		num=	2					
Sta L	Sta R	Elev	Permanent					
0	1146	483	F					
3400	18290	483	F					

CROSS SECTION

RIVER: Arkansas River

REACH: 1 RS: 520

INPUT

Description:

Station	Elevation	Data	num=	126						
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta
0	527.23	11.93	528.19	73.34	523.73	211.45	518.73	335.04	518.75	
437.4	521.52	486.74	521.87	595.3	516.81	693.57	510.08	813.81	499.88	
888.13	494.45	950.73	486.14	998.6	476.91	1047.94	474.15	1153.19	472.15	
1190.63	470.37	1345.56	466.25	1551.46	465.82	1572.39	461.82	1640.83	458.64	
1705.58	452.68	1747.75	451.82	1777.5	451.02	1866.54	445.38	1931.06	440.45	
1986.53	434.21	2034.87	431.62	2135.35	430.86	2313.65	430.19	2343.65	430.25	
2440.23	431.12	2500.67	430.57	2620.95	432.03	2677.52	430.58	2706.63	428.43	
2834.02	433.54	2868.55	432.63	2969.24	434.55	3038.45	453.03	3096.89	467.31	
3137.8	471	3225.25	471.04	3265.49	471.8	3370.51	472.31	3433.59	474.08	
3449.08	475.55	3521.93	476.86	3581.78	476.14	3689.91	476.88	3946.2	476.74	
4071.53	477.18	4351.79	476.81	4442.51	477.2	4521.14	476.8	4727.77	474.68	
4802.26	474.52	4897.13	475.67	4970.53	475.8	5027.73	474.85	5140.66	471.05	
5247.92	470.88	5363.69	472.41	5415.81	473.64	5472.01	476.47	5524.95	478.1	
5640.61	479.51	5751.4	479.79	5922.03	478.9	5970.06	479.19	6080.2	478.45	
6264.26	475.8	6361	471.29	6577.25	470.68	6797.74	471.15	6965.09	470.58	
7048.38	469.44	7471.59	468.28	7584.18	468.02	7821.56	467.5	7926.82	468.71	
8057.44	470.68	8162.88	470.8	8263.55	472.73	8367.04	476.98	8417.58	477.15	

8557.59	474.08	8826.91	472.75	8878.34	471.99	9009.84	471.15	9151.62	471.43
9239.51	472.1	9298.61	472.15	9529.03	476.28	9582.46	476.5	9967.68	472.85
10129.68	471.65	10265.67	473.48	10373.05	478.19	10474.48	478.92	10493.49	479.78
10518.33	485.48	10566.93	501.53	10602.89	502.08	10647.65	486.34	10675.05	478.43
10713.1	476.11	10771.11	475.41	10908.14	475.08	11129.52	474.11	11490.19	475.54
11602.22	475.33	11880.39	475.83	12102.19	474.72	12631.26	470.55	12739.25	470.18
12822.47	471.51	12961.49	474.51	13016.36	481.31	13045.91	482.24	13127.41	482.55
13462.55	481.72	13791.59	482.04	14042.67	482.17	14390.16	482	18190	482.5
18290	487								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.06	1551.46	.04	3137.8	.06

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	1551.46	3137.8		0	0		.1	.3

Blocked Obstructions num= 10

Sta L	Sta R	Elev	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1881.95	1894.45	476.4	1944.75	1957.25	476.2	2006.75	2019.25	476.4
2070.45	2082.95	476.3	2132.95	2145.45	477.6	2194.75	2207.25	475.6
2330.15	2342.65	475.6	2642.75	2655.25	476.1	2806.15	2818.65	475.9
2868.15	2880.65	476.2						

SUMMARY OF MANNING'S N VALUES

River:Arkansas River

* Reach	* River Sta.	* n1	* n2	* n3	*
*1	* 1049	* .06*	* .04*	* .06*	
*1	* 834	* .06*	* .04*	* .06*	
*1	* 771	* Bridge	* *	* *	
*1	* 716	* .06*	* .04*	* .06*	
*1	* 520	* .06*	* .04*	* .06*	

SUMMARY OF REACH LENGTHS

River: Arkansas River

```
*****
*      Reach      *      River Sta.    *      Left    *      Channel *      Right    *
*****
*1              *      1049          *      214.88*      214.88*      214.88*
*1              *      834           *      117.83*      117.83*      117.83*
*1              *      771           *      Bridge    *              *
*1              *      716           *      196.48*      196.48*      196.48*
*1              *      520           *              *      0*          *      0*          *
*****
```

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS

River: Arkansas River

```
*****
*      Reach      *      River Sta.    *      Contr.  *      Expan.  *
*****
*1              *      1049          *      .3*      .5*
*1              *      834           *      .3*      .5*
*1              *      771           *      Bridge    *              *
*1              *      716           *      .3*      .5*
*1              *      520           *      .1*      .3*
*****
```

APPENDIX ‘G’

FEMA HEC-RAS PROPOSED MODEL

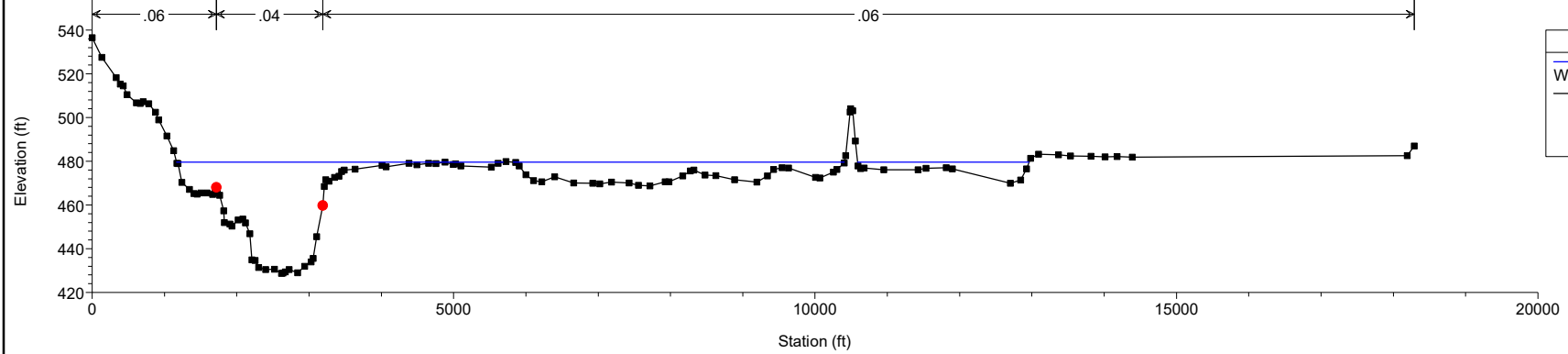
HEC-RAS Plan: FIS-Proposed River: Arkansas River Reach: 1 Profile: 100-yr FIS

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
1	1049	100-yr FIS	550000.00	428.78	479.57		480.40	0.000340	7.93	113920.80	11464.21	0.22
1	834	100-yr FIS	550000.00	428.53	478.39	455.61	480.02	0.001492	10.40	55023.34	2730.61	0.32
1	771	Bridge										
1	716	100-yr FIS	550000.00	428.52	478.41	451.97	479.56	0.000394	8.68	66140.80	1982.56	0.24
1	520	100-yr FIS	550000.00	428.43	478.50	453.84	479.28	0.000662	7.81	108245.00	11228.93	0.23

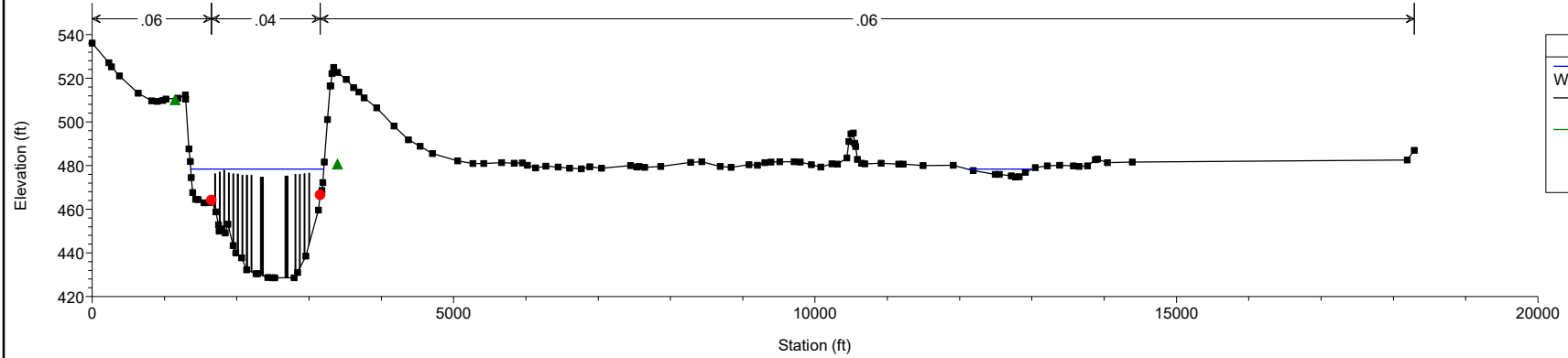
HEC-RAS Plan: FIS-Proposed River: Arkansas River Reach: 1 Profile: 100-yr FIS

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
1	1049	100-yr FIS	480.40	479.57		0.13	0.24	11464.21	15967.50	460783.10	73249.46	7.93
1	834	100-yr FIS	480.02	478.39	455.61	0.01	0.03	2730.61	21278.49	527251.10	1470.50	10.40
1	771 BR U	100-yr FIS	479.98	478.24	455.82	0.12	0.19	1713.08	20022.25	529901.50	76.25	10.75
1	771 BR D	100-yr FIS	479.67	478.30	453.67	0.00	0.11	1713.49	13659.22	536287.30	53.47	9.49
1	716	100-yr FIS	479.56	478.41	451.97	0.10	0.18	1982.56	10088.65	539262.90	648.39	8.68
1	520	100-yr FIS	479.28	478.50	453.84			11228.93	14296.45	446098.80	89604.77	7.81

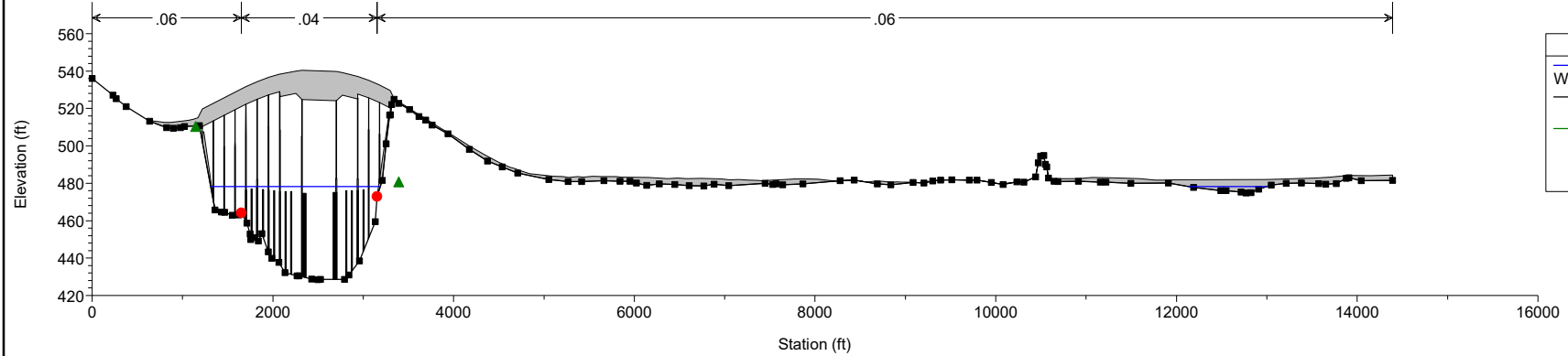
HEC-RAS Model Plan: FIS-Proposed 11/9/2023
River = Arkansas River Reach = 1 RS = 1049



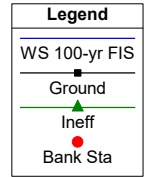
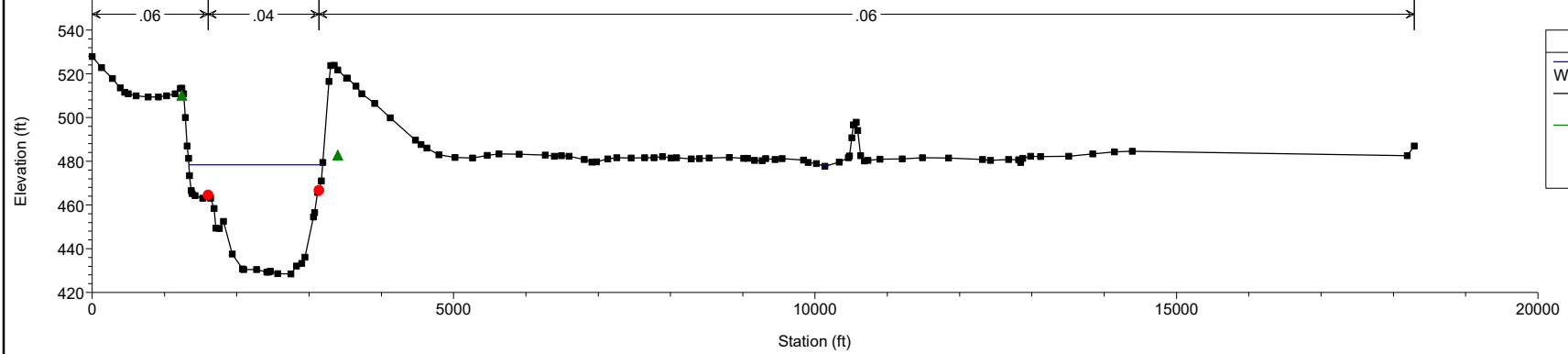
HEC-RAS Model Plan: FIS-Proposed 11/9/2023
River = Arkansas River Reach = 1 RS = 834



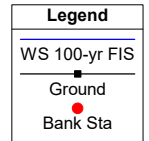
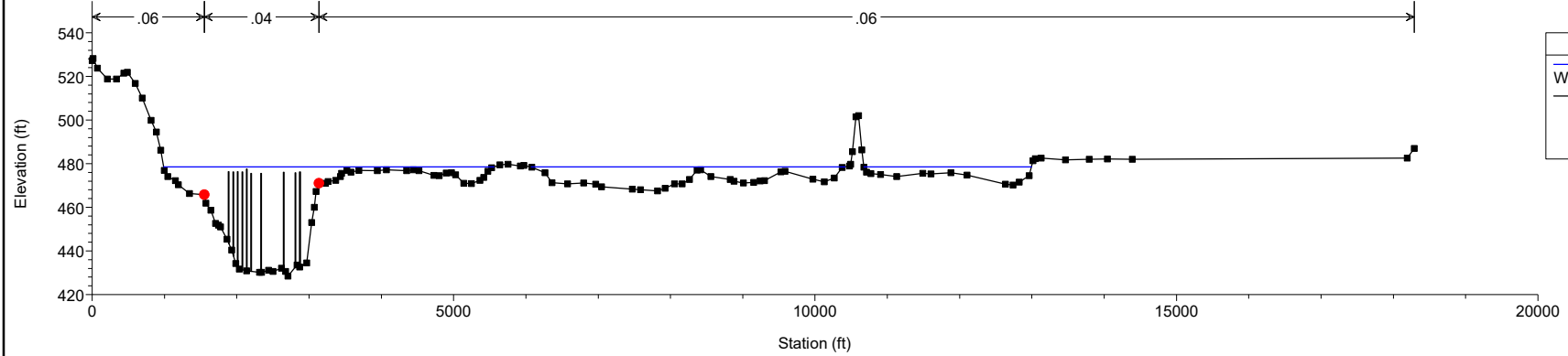
HEC-RAS Model Plan: FIS-Proposed 11/9/2023
River = Arkansas River Reach = 1 RS = 771 BR



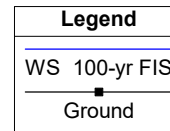
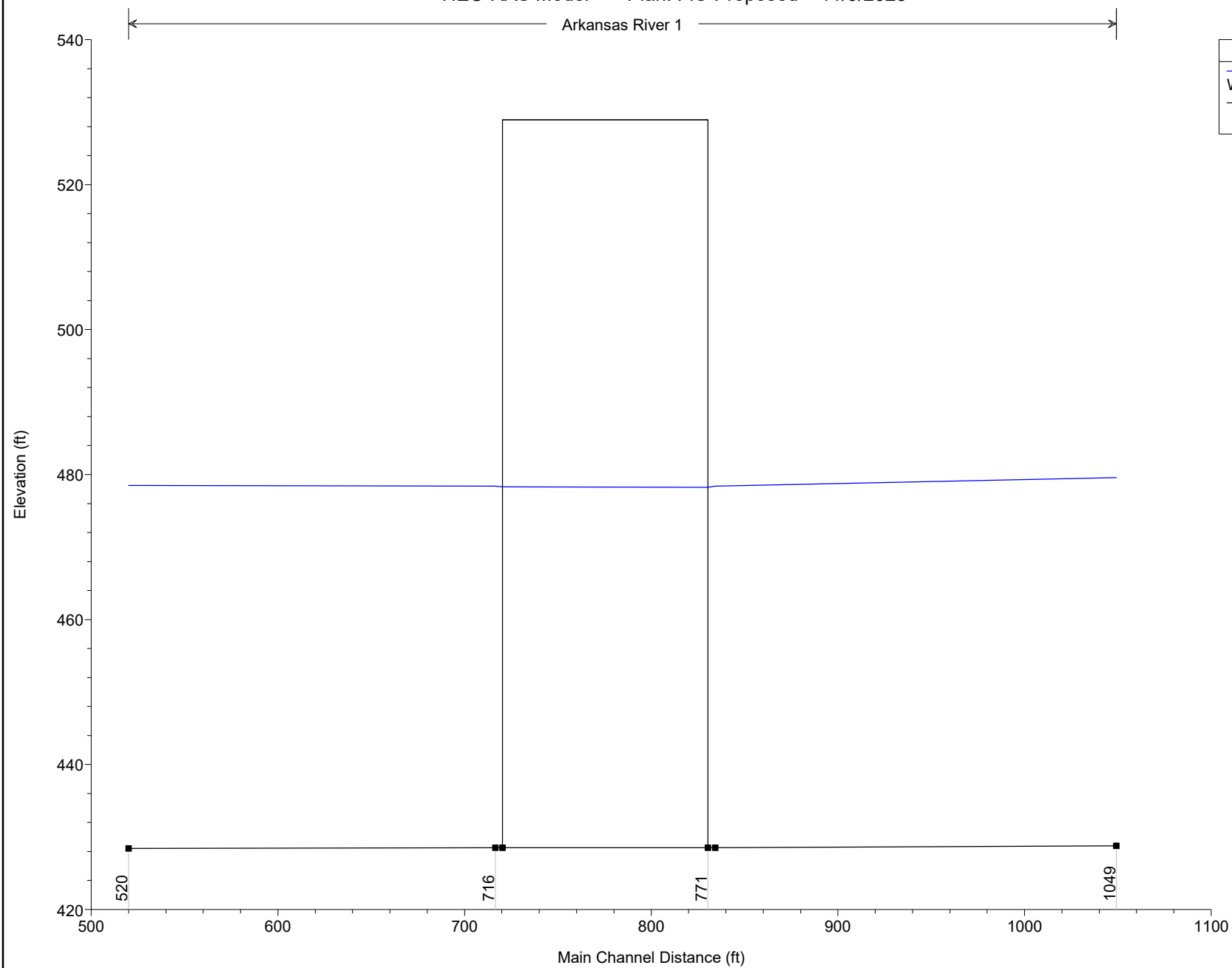
HEC-RAS Model Plan: FIS-Proposed 11/9/2023
River = Arkansas River Reach = 1 RS = 716



HEC-RAS Model Plan: FIS-Proposed 11/9/2023
River = Arkansas River Reach = 1 RS = 520



Arkansas River 1



HEC-RAS HEC-RAS 6.3.1 September 2022
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

X	X	XXXXXX	XXXX	XXXX	XX	XXXX
X	X	X	X	X	X	X
X	X	X	X	X	X	X
XXXXXXXX	XXXX	X	XXX	XXXX	XXXXXX	XXXX
X	X	X	X	X	X	X
X	X	X	X	X	X	X
X	X	XXXXXX	XXXX	X	X	XXXXX

PROJECT DATA

Project Title: HEC-RAS Model

Project File : I-40 over Arkansas River_2.prj

Run Date and Time: 11/9/2023 11:50:13 AM

Project in English units

PLAN DATA

Plan Title: FIS-Proposed

Plan File : I:\EST\34334_Muskogee_Co_I40_Arkansas\geohecras\I-40 over Arkansas River_2.p04

Geometry Title: FIS-Proposed

Geometry File : I:\EST\34334_Muskogee_Co_I40_Arkansas\geohecras\I-40 over Arkansas River_2.g04

Flow Title : FIS-Proposed

Flow File : I:\EST\34334_Muskogee_Co_I40_Arkansas\geohecras\I-40 over Arkansas River_2.f04

Plan Summary Information:

Number of: Cross Sections	=	4	Multiple Openings	=	0
Culverts	=	0	Inline Structures	=	0
Bridges	=	1	Lateral Structures	=	0

Computational Information

Water surface calculation tolerance	=	0.01
Critical depth calculation tolerance	=	0.01
Maximum number of iterations	=	20
Maximum difference tolerance	=	0.33
Flow tolerance factor	=	0.001

Computation Options

Critical depth computed only where necessary	
Conveyance Calculation Method:	At breaks in n values only
Friction Slope Method:	Average Conveyance
Computational Flow Regime:	Subcritical Flow

FLOW DATA

Flow Title: FIS-Proposed

Flow File : I:\EST\34334_Muskogee_Co_I40_Arkansas\geohecras\I-40 over Arkansas River_2.f04

Flow Data (cfs)

```
*****
* River      Reach      RS      *      100-yr FIS *
* Arkansas River 1      1049    *      550000 *
*****
```

Boundary Conditions

```
*****
* River      Reach      Profile      *      Upstream      Downstream      *
*****
* Arkansas River 1      100-yr FIS      *      Normal S = 0.000661      Normal S = 0.000661 *
*****
```

GEOMETRY DATA

Geometry Title: FIS-Proposed

Geometry File : I:\EST\34334_Muskogee_Co_I40_Arkansas\geohecras\I-40 over Arkansas River_2.g04

CROSS SECTION

RIVER: Arkansas River

REACH: 1 RS: 1049

INPUT

Description:

Station Elevation Data num= 128

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	536.45	133.43	527.57	333.11	518.25	388.16	515.24	428.99	514.55
484.22	510.5	613.09	506.72	666.15	506.4	704.28	507.22	783.67	506.28
876.69	502.42	921.3	498.89	1033.75	491.6	1125.46	484.77	1172.51	479.06
1187.12	478.93	1241.49	470.36	1347.42	467.06	1408.06	465.28	1451.06	465.03
1505.43	465.57	1590.06	465.49	1665.9	464.81	1700.07	465.92	1720.36	468.02
1732.38	465.69	1764.45	464.41	1819.21	457.37	1830.45	452	1904.71	451.31
1933.41	450.3	2019.16	453.22	2084.31	453.53	2120.25	451.81	2181.06	446.86
2211.61	434.88	2255.05	434.57	2304.47	431.39	2398.74	430.53	2520.14	430.54
2617.6	428.78	2640.61	428.86	2670.61	429.45	2724.14	430.45	2840.65	429.06
2939.32	431.99	3027.33	434.01	3058.43	435.53	3107.16	445.57	3189.48	459.67
3210.62	468.45	3229.32	471.6	3277.14	470.9	3353.03	472.61	3415.7	473.14
3451.98	475.31	3486.8	475.93	3635.7	476.43	4008.84	478.14	4065.13	477.4
4383.77	479.05	4493.32	478.41	4656.2	479.03	4755.03	478.92	4879.86	479.54
4995.76	478.57	5025.8	478.8	5100.19	477.8	5523.7	477.37	5613.94	479.03
5725.49	479.89	5856.86	479.47	5909.01	477.91	5998.83	473.81	6106.85	471.11
6218.3	470.59	6397.83	472.87	6661.88	470.13	6923.9	469.92	7021.74	469.6
7184.2	470.49	7427.01	470.01	7557.81	468.95	7714.05	468.75	7924.89	470.57
7980.01	470.54	8170.51	473.29	8274.18	475.6	8324.01	475.91	8477.05	473.75
8627.04	473.37	8886.19	471.48	9193.78	470.46	9341.85	473.23	9426.72	476.2
9542.21	476.99	9634.92	476.85	10007.99	472.64	10067.41	472.33	10251.76	475.04
10301.25	476.24	10401.92	479.17	10423.13	482.51	10484.04	502.57	10493.48	504.09
10519.15	503.03	10556.37	489.28	10595.9	477.91	10630.65	476.64	10679.19	476.96

10952.66	476.1311426.07	476.15	11535.6	476.8211815.77	477.0411898.51	476.54
12703.92	469.9212842.72	471.3612924.58	476.5712980.59	481.3913090.62	483.16	
13365.92	482.9113534.87	482.4513817.74	482.3114011.29	482.0714178.38	482.13	
14390.12	481.9	18190	482.5	18290	487	

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.06	1720.36	.04	3189.48	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
1720.36	3189.48	214.88	214.88	214.88	.3	.5

CROSS SECTION

RIVER: Arkansas River

REACH: 1 RS: 834

INPUT

Description:

Station Elevation Data				num= 126					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	536.11	229.86	527.05	267.04	525.3	377.83	521.02	636.12	513.17
822.9	509.68	898.68	509.37	977.02	509.76	1021.96	510.41	1186.81	510.84
1287.68	512.32	1294.58	510.42	1337.74	487.7	1356.97	481.82	1371.36	474.5
1389.3	467.6	1430.38	464.61	1467.29	464.41	1550.31	462.9	1619.41	463.09
1651.14	464.19	1712.8	458.73	1747.17	452.83	1755.87	449.93	1788.19	450.96
1839.44	449.1	1879.11	453.09	1948.15	443.29	1987.33	439.96	2066.75	437.7
2134.93	432.28	2267.93	430.52	2290.72	430.52	2428.56	428.75	2496.04	428.53
2526.04	428.55	2793.26	428.54	2840.25	430.97	2957.56	438.49	3131.65	459.54
3154.3	466.62	3177.97	468.61	3190.06	472.16	3212.34	481.6	3254.17	501.06
3293.58	516.51	3301.38	516.55	3314.75	522.16	3339.51	524.95	3393.14	522.71
3514.12	519.51	3616.71	515.64	3689.53	513.74	3761.56	511.07	3937.62	506.38
4174.6	498.08	4376.5	491.81	4538.68	488.81	4707.89	485.49	5054.42	482.09
5266.14	480.89	5415.07	480.95	5662.49	481.36	5840.09	481.06	5951.29	481.15
6021.65	480.13	6135.81	478.92	6276.23	479.74	6447.26	479.33	6605.58	478.78
6768.18	478.57	6882.88	479.44	7046.21	478.79	7448.16	479.94	7532.57	479.33

7565.78	479.59	7641.29	479.14	7864.8	479.66	8278.79	481.46	8433.62	481.75
8689.18	479.6	8838.59	479.21	9084.77	480.44	9204.83	480.19	9303.12	481.29
9389.03	481.66	9512.15	481.81	9709.01	481.74	9793.56	481.64	9949.5	480.41
10079.1	479.29	10232.14	480.75	10310.17	480.68	10441.21	483.45	10468.69	491
10496.22	494.52	10530.22	494.91	10548.83	490.18	10562.97	488.73	10584.03	482.84
10644.26	481.12	10686.28	480.84	10913.96	481.07	11156.26	480.65	11217.56	480.68
11493.41	480.02	11910.47	480.19	12187.47	477.78	12492.05	476.12	12548.13	476.02
12714.61	475.27	12770.63	474.75	12825.24	474.96	12907.77	476.92	13047.68	479
13213.71	479.92	13381.74	480.11	13574.77	479.89	13652.53	479.58	13768.67	479.8
13877.95	482.64	13907.42	482.98	14045.78	481.32	14390.29	481.62	18190	482.5
18290	487								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.06	1651.14	.04	3154.3	.06

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	1651.14	3154.3		117.83	117.83		.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	1146	509.37	F
3393	18290	479.89	F

Blocked Obstructions num= 15

Sta L	Sta R	Elev	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1695.45	1707.95	476.3	1758.05	1770.55	477	1820.45	1832.95	477.8
1883.55	1896.05	476.7	1945.45	1957.95	476.3	2008.75	2021.25	476.1
2071.05	2083.55	475.6	2134.55	2147.05	475.6	2196.45	2208.95	475.6
2326.1	2368.1	474.6	2667.6	2709.6	475.2	2806.95	2819.45	476
2866.55	2879.05	476	2931.75	2944.25	476.25	2997.35	3009.85	476.5

BRIDGE

RIVER: Arkansas River

REACH: 1

RS: 771

INPUT

Description:

Distance from Upstream XS = 4

Deck/Roadway Width = 110

Weir Coefficient = 2.6

Upstream Deck/Roadway Coordinates

num= 107

Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord

-32.68	529.89				95.67	526.12				259.89	521.01			
367.59	518.17				468.7	515.75				588.54	513.84			
803.95	512.53				869.35	512.5				1062.41	513.67			
1121.13	514.33				1172	515.11				1221	519.8			
1221	519.8	510.42			1341	522.78	513.38			1461	525.73	516.34		
1581	528.69	519.3			1701	531.64	522.23			1826	534.36	524.96		
1951	536.59	527.2			2076.5	538.35	528.94			2077.5	538.35	526.37		
2254	539.99	528			2321	540.35	524.78			2701	539.76	524.2		
2771	539.16	527.18			2938.5	537.1	525.11			2939.5	537.1	527.68		
3060	535.06	525.67			3180	532.6	523.19			3300	529.66	520.28		
3344.5	524.98				3463.28	521.51				3584.37	517.76			
3847.21	509.72				3956.04	506.59				4177.54	499.81			
4346.97	495.14				4492.8	491.45				4620.94	488.58			
4671.34	487.99				4731.04	486.84				4838.33	485.18			
5106.91	483.76				5214.21	483.61				5269.61	483.17			
5373.73	483.52				5431.88	483.25				5536.64	483.78			
5641.05	483.56				5801.24	483.53				5855.35	483.33			
6158.29	483.07				6371.41	482.51				6477.3	482.83			
6581.24	482.47				6740.58	482.68				6962.13	482.27			
7054.92	481.92				7159.46	481.99				7259.72	481.77			
7366.87	481.48				7403.48	481.46				7668.44	482.06			
7777.67	482.37				7923.97	482.33				8037.17	482.14			
8182.73	481.33				8291.06	481.18				8387.58	480.37			

8543.81	480.91	8597.66	480.71	8647.18	481.05
8751.3	481.06	8855.25	480.49	8901.27	480.82
8963.79	480.57	9105.44	480.65	9155.57	480.26
9205.47	480.99	9460.58	481.23	9724.57	480.57
9765.94	480.55	9867.42	479.98	9906.6	480.17
10022.62	479.89	10138.64	480.08	10272.97	480.68
10323.59	481.3	10436.03	481.35	10546.71	481.75
10675.72	482.43	10918.73	482.45	11063.46	483.05
11262.82	483.03	11588.87	482.49	11762.69	481.7
11891.2	481.65	11977.79	481.83	12976.82	482.05
13115.65	482.12	13420.24	482.69	13533.85	482.76
13698.37	483.26	13894.79	484.15	14148.16	484.1
14355.07	484.32	18190	482.5		

Upstream Bridge Cross Section Data

Station Elevation Data num= 117

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev

0	536.11	229.86	527.05	267.04	525.3	377.83	521.02	636.12	513.17
822.9	509.68	898.68	509.37	977.02	509.76	1021.96	510.41	1186.81	510.84
1360	465.8	1430.38	464.61	1467.29	464.41	1550.31	462.9	1619.41	463.09
1651.14	464.19	1712.8	458.73	1747.17	452.83	1755.87	449.93	1788.19	450.96
1839.44	449.1	1879.11	453.09	1948.15	443.29	1987.33	439.96	2066.75	437.7
2134.93	432.28	2267.93	430.52	2290.72	430.52	2428.56	428.75	2496.04	428.53
2526.04	428.55	2793.26	428.54	2840.25	430.97	2957.56	438.49	3131.65	459.54
3152	473	3212.34	481.6	3254.17	501.06	3293.58	516.51	3301.38	516.55
3314.75	522.16	3339.51	524.95	3393.14	522.71	3514.12	519.51	3616.71	515.64
3689.53	513.74	3761.56	511.07	3937.62	506.38	4174.6	498.08	4376.5	491.81
4538.68	488.81	4707.89	485.49	5054.42	482.09	5266.14	480.89	5415.07	480.95
5662.49	481.36	5840.09	481.06	5951.29	481.15	6021.65	480.13	6135.81	478.92
6276.23	479.74	6447.26	479.33	6605.58	478.78	6768.18	478.57	6882.88	479.44
7046.21	478.79	7448.16	479.94	7532.57	479.33	7565.78	479.59	7641.29	479.14
7864.8	479.66	8278.79	481.46	8433.62	481.75	8689.18	479.6	8838.59	479.21
9084.77	480.44	9204.83	480.19	9303.12	481.29	9389.03	481.66	9512.15	481.81
9709.01	481.74	9793.56	481.64	9949.5	480.41	10079.1	479.29	10232.14	480.75
10310.17	480.68	10441.21	483.45	10468.69	491.10	10496.22	494.52	10530.22	494.9
10548.83	490.18	10562.97	488.73	10584.03	482.84	10644.26	481.12	10686.28	480.84
10913.96	481.07	11156.26	480.65	11217.56	480.68	11493.41	480.02	11910.47	480.19
12187.47	477.78	12492.05	476.12	12548.13	476.02	12714.61	475.27	12770.63	474.75

12825.24	474.9612907.77	476.9213047.68	47913213.71	479.9213381.74	480.11
13574.77	479.8913652.53	479.5813768.67	479.813877.95	482.6413907.42	482.98
14045.78	481.3214390.29	481.62			

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.06	1651.14	.04	3152	.06

Bank Sta:	Left	Right	Coeff	Contr.	Expan.
	1651.14	3152	.3	.5	

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	1146	509.37	F
339314390.29	479.89		F

Blocked Obstructions num= 15

Sta L	Sta R	Elev	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1695.45	1707.95	476.3	1758.05	1770.55	477	1820.45	1832.95	477.8
1883.55	1896.05	476.7	1945.45	1957.95	476.3	2008.75	2021.25	476.1
2071.05	2083.55	475.6	2134.55	2147.05	475.6	2196.45	2208.95	475.6
2326.1	2368.1	474.6	2667.6	2709.6	475.2	2806.95	2819.45	476
2866.55	2879.05	476	2931.75	2944.25	476.25	2997.35	3009.85	476.5

Downstream Deck/Roadway Coordinates num= 107

Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord
-32.68	529.89				95.67	526.12				259.89	521.01			
367.59	518.17				468.7	515.75				588.54	513.84			
803.95	512.53				869.35	512.5				1062.41	513.67			
1121.13	514.33				1172	515.11				1221	519.8			
1221	519.8	510.42			1341	522.78	513.38			1461	525.73	516.34		
1581	528.69	519.3			1701	531.64	522.23			1826	534.36	524.96		
1951	536.59	527.2			2076.5	538.35	528.94			2077.5	538.35	526.37		
2254	539.99	528			2321	540.35	524.78			2701	539.76	524.2		
2771	539.16	527.18			2938.5	537.1	525.11			2939.5	537.1	527.68		
3060	535.06	525.67			3180	532.6	523.19			3300	529.66	520.28		
3344.5	524.98				3463.28	521.51				3584.37	517.76			

3847.21	509.72	3956.04	506.59	4177.54	499.81
4346.97	495.14	4492.8	491.45	4620.94	488.58
4671.34	487.99	4731.04	486.84	4838.33	485.18
5106.91	483.76	5214.21	483.61	5269.61	483.17
5373.73	483.52	5431.88	483.25	5536.64	483.78
5641.05	483.56	5801.24	483.53	5855.35	483.33
6158.29	483.07	6371.41	482.51	6477.3	482.83
6581.24	482.47	6740.58	482.68	6962.13	482.27
7054.92	481.92	7159.46	481.99	7259.72	481.77
7366.87	481.48	7403.48	481.46	7668.44	482.06
7777.67	482.37	7923.97	482.33	8037.17	482.14
8182.73	481.33	8291.06	481.18	8387.58	480.37
8543.81	480.91	8597.66	480.71	8647.18	481.05
8751.3	481.06	8855.25	480.49	8901.27	480.82
8963.79	480.57	9105.44	480.65	9155.57	480.26
9205.47	480.99	9460.58	481.23	9724.57	480.57
9765.94	480.55	9867.42	479.98	9906.6	480.17
10022.62	479.89	10138.64	480.08	10272.97	480.68
10323.59	481.3	10436.03	481.35	10546.71	481.75
10675.72	482.43	10918.73	482.45	11063.46	483.05
11262.82	483.03	11588.87	482.49	11762.69	481.7
11891.2	481.65	11977.79	481.83	12976.82	482.05
13115.65	482.12	13420.24	482.69	13533.85	482.76
13698.37	483.26	13894.79	484.15	14148.16	484.1
14355.07	484.32	18190	482.5		

Downstream Bridge Cross Section Data

Station Elevation Data num= 115

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev

0	536.11	229.86	527.05	267.04	525.3	377.83	521.02	636.12	513.17
822.9	509.68	898.68	509.37	977.02	509.76	1021.96	510.41	1186.81	510.84
1360	465.8	1430.38	464.61	1467.29	464.41	1550.31	462.9	1619.41	463.09
1651.14	464.19	1712.8	458.73	1747.17	452.83	1755.87	449.93	1788.19	450.96
1839.44	449.1	1879.11	453.09	1948.15	443.29	1987.33	439.96	2066.75	437.7
2134.93	432.28	2267.93	430.52	2290.72	430.52	2428.56	428.75	2496.04	428.53
2526.04	428.55	2793.26	428.54	2840.25	430.97	2957.56	438.49	3131.65	459.54
3152	473	3212.34	481.6	3300	517.4	3314.75	522.16	3339.51	524.95
3393.14	522.71	3514.12	519.51	3616.71	515.64	3689.53	513.74	3761.56	511.07

3937.62	506.38	4174.6	498.08	4376.5	491.81	4538.68	488.81	4707.89	485.49
5054.42	482.09	5266.14	480.89	5415.07	480.95	5662.49	481.36	5840.09	481.06
5951.29	481.15	6021.65	480.13	6135.81	478.92	6276.23	479.74	6447.26	479.33
6605.58	478.78	6768.18	478.57	6882.88	479.44	7046.21	478.79	7448.16	479.94
7532.57	479.33	7565.78	479.59	7641.29	479.14	7864.8	479.66	8278.79	481.46
8433.62	481.75	8689.18	479.6	8838.59	479.21	9084.77	480.44	9204.83	480.19
9303.12	481.29	9389.03	481.66	9512.15	481.81	9709.01	481.74	9793.56	481.64
9949.5	480.41	10079.1	479.29	10232.14	480.75	10310.17	480.68	10441.21	483.45
10468.69	491.10	10496.22	494.52	10530.22	494.91	10548.83	490.18	10562.97	488.73
10584.03	482.84	10644.26	481.12	10686.28	480.84	10913.96	481.07	11156.26	480.65
11217.56	480.68	11493.41	480.02	11910.47	480.19	12187.47	477.78	12492.05	476
12548.13	476.02	12714.61	475.27	12770.63	474.75	12825.24	474.96	12907.77	476.92
13047.68	479.13	13213.71	479.92	13381.74	480.11	13574.77	479.89	13652.53	479.58
13768.67	479.81	13877.95	482.64	13907.42	482.98	14045.78	481.32	14390.29	481.62

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.06	1651.14	.04	3152	.06

Bank Sta: Left Right Coeff Contr. Expan.

1651.14	3152	.3	.5
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Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	1239	509.37	F
3399	14390.29	482	F

Upstream Embankment side slope = 0 horiz. to 1.0 vertical

Downstream Embankment side slope = 0 horiz. to 1.0 vertical

Maximum allowable submergence for weir flow = .98

Elevation at which weir flow begins =

Energy head used in spillway design =

Spillway height used in design =

Weir crest shape = Broad Crested

Number of Abutments = 2

Abutment Data

Upstream num= 3

Sta	Elev	Sta	Elev	Sta	Elev
1221	507.5	1235	507.5	1360	465.8

Downstream num= 3

Sta	Elev	Sta	Elev	Sta	Elev
1221	507.5	1235	507.5	1360	465.8

Abutment Data

Upstream num= 3

Sta	Elev	Sta	Elev	Sta	Elev
3152	473	3286	517.4	3300	517.4

Downstream num= 3

Sta	Elev	Sta	Elev	Sta	Elev
3152	473	3286	517.4	3300	517.4

Number of Piers = 12

Pier Data

Pier Station Upstream= 1341 Downstream= 1341

Upstream num= 6

Width	Elev	Width	Elev	Width	Elev	Width	Elev	Width	Elev
12	440	12	482.7	8	482.7	8	499.4	5	499.4
5	525.7								

Downstream num= 6

Width	Elev	Width	Elev	Width	Elev	Width	Elev	Width	Elev
12	440	12	482.7	8	482.7	8	499.4	5	499.4
5	525.7								

Pier Data

Pier Station Upstream= 1461 Downstream= 1461

Upstream num= 6

Width	Elev	Width	Elev	Width	Elev	Width	Elev	Width	Elev
12	440	12	482.7	8	482.7	8	499.4	5	499.4

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5 525.7
Downstream num= 6
Width Elev Width Elev Width Elev Width Elev Width Elev
*****
12 440 12 482.7 8 482.7 8 499.4 5 499.4
5 525.7

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Pier Data
Pier Station Upstream= 1581 Downstream= 1581
Upstream num= 6
Width Elev Width Elev Width Elev Width Elev Width Elev
*****
12 440 12 482.35 8 482.35 8 499.4 5 502.36
5 528.6
Downstream num= 6
Width Elev Width Elev Width Elev Width Elev Width Elev
*****
12 440 12 482.35 8 482.35 8 499.4 5 502.36
5 528.6

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Pier Data
Pier Station Upstream= 1701 Downstream= 1701
Upstream num= 6
Width Elev Width Elev Width Elev Width Elev Width Elev
*****
12 440 12 482.3 8 482.3 8 505.3 5 531.6
5 550.3
Downstream num= 6
Width Elev Width Elev Width Elev Width Elev Width Elev
*****
12 440 12 482.3 8 482.3 8 505.3 5 531.6
5 550.3

```

```

Pier Data
Pier Station Upstream= 1826 Downstream= 1826
Upstream num= 6
Width Elev Width Elev Width Elev Width Elev Width Elev
*****
12 440 12 482 8 482 8 508 5 508

```

```

5 534.3
Downstream num= 6
Width Elev Width Elev Width Elev Width Elev Width Elev
*****
12 440 12 482 8 482 8 508 5 508
5 534.3

```

```

Pier Data
Pier Station Upstream= 1951 Downstream= 1951
Upstream num= 6
Width Elev Width Elev Width Elev Width Elev Width Elev
*****
12 440 12 482.26 8 482.26 8 510.26 5 510.26
5 536.5
Downstream num= 6
Width Elev Width Elev Width Elev Width Elev Width Elev
*****
12 440 12 482.26 8 482.26 8 510.26 5 510.26
5 536.5

```

```

Pier Data
Pier Station Upstream= 2077 Downstream= 2077
Upstream num= 6
Width Elev Width Elev Width Elev Width Elev Width Elev
*****
12 440 12 482.7 8 482.7 8 508.5 6 508.5
6 538.3
Downstream num= 6
Width Elev Width Elev Width Elev Width Elev Width Elev
*****
12 440 12 482.7 8 482.7 8 508.5 6 508.5
6 538.3

```

```

Pier Data
Pier Station Upstream= 2321 Downstream= 2321
Upstream num= 6
Width Elev Width Elev Width Elev Width Elev Width Elev
*****
12 440 12 482.7 8 482.7 8 505.2 6 505.2

```

```

        6  540.3
Downstream      num=      6
  Width  Elev    Width  Elev    Width  Elev    Width  Elev    Width  Elev
*****
        12    440        12  482.7        8  482.7        8  505.2        6  505.2
        6  540.3

```

Pier Data

Pier Station Upstream= 2701 Downstream= 2701

```

Upstream      num=      6
  Width  Elev    Width  Elev    Width  Elev    Width  Elev    Width  Elev
*****
        12    440        12  482.7        8  482.7        8  504.7        6  504.7
        6  539.7

```

```

Downstream    num=      6
  Width  Elev    Width  Elev    Width  Elev    Width  Elev    Width  Elev
*****
        12    440        12  482.7        8  482.7        8  504.7        6  504.7
        6  539.7

```

Pier Data

Pier Station Upstream= 2939 Downstream= 2939

```

Upstream      num=      6
  Width  Elev    Width  Elev    Width  Elev    Width  Elev    Width  Elev
*****
        12    440        12  482.3        8  482.3        8  507.3        6  507.3
        6  525.7

```

```

Downstream    num=      6
  Width  Elev    Width  Elev    Width  Elev    Width  Elev    Width  Elev
*****
        12    440        12  482.3        8  482.3        8  507.3        6  507.3
        6  525.7

```

Pier Data

Pier Station Upstream= 3060 Downstream= 3060

```

Upstream      num=      6
  Width  Elev    Width  Elev    Width  Elev    Width  Elev    Width  Elev
*****
        12    440        12  482.7        8  482.7        8  508.7        5  508.7

```

5	535									
Downstream	num=	6								
Width	Elev	Width	Elev	Width	Elev	Width	Elev	Width	Elev	

12	440	12	482.7	8	482.7	8	508.7	5	508.7	
5	535									

Pier Data

Pier Station Upstream= 3180 Downstream= 3180

Upstream	num=	6								
Width	Elev	Width	Elev	Width	Elev	Width	Elev	Width	Elev	

12	440	12	486.3	8	486.3	8	506.3	5	506.3	
5	532.6									

Downstream	num=	6								
Width	Elev	Width	Elev	Width	Elev	Width	Elev	Width	Elev	

12	440	12	486.3	8	486.3	8	506.3	5	506.3	
5	532.6									

Number of Bridge Coefficient Sets = 1

Low Flow Methods and Data

Energy

Selected Low Flow Methods = Highest Energy Answer

High Flow Method

Pressure and Weir flow

Submerged Inlet Cd	=	
Submerged Inlet + Outlet Cd	=	.8
Max Low Cord	=	

Additional Bridge Parameters

Add Friction component to Momentum

Do not add Weight component to Momentum

Class B flow critical depth computations use critical depth

inside the bridge at the upstream end

Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION

RIVER: Arkansas River

REACH: 1

RS: 716

INPUT

Description:

Station Elevation Data

num= 124

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	527.96	127.75	522.8	279.26	517.79	389.02	513.49	451.68	511.5
496.74	510.82	606.28	509.95	773.84	509.39	915.76	509.36	1030.49	510
1146.18	510.84	1219.7	513.24	1239.11	513.41	1266.49	510.86	1290.34	499.99
1314.25	487.03	1332.18	481.36	1347.83	473.41	1369.53	466.6	1382.24	465.23
1423.33	464.24	1527.22	463.03	1589.18	463.63	1605.22	464.54	1639.25	463.04
1686.32	458.41	1710.22	449.36	1760.66	449.29	1816.32	452.42	1938.85	437.58
2079.88	430.68	2095.74	430.48	2273.77	430.52	2414.36	429.21	2444.36	429.46
2463.63	429.62	2564.6	428.57	2748.01	428.52	2827.2	432.12	2899.03	433.28
2942.33	436.13	3060.3	454.52	3076.04	456.5	3119.32	465.72	3139.7	466.66
3169.63	470.94	3190.81	479.53	3274.37	516.52	3300.87	523.7	3350.28	523.86
3398.75	521.74	3517.54	518.05	3529.42	518.05	3647.64	514.36	3731.24	510.9
3907.26	506.48	4124.32	499.93	4471.77	489.72	4549.63	487.69	4629.88	486.04
4796.41	482.89	5018.69	481.8	5261.3	481.44	5464.81	482.72	5628.61	483.39
5907.35	483.24	6267.98	482.82	6391.93	482.32	6492.55	482.54	6596.25	482.27
6808.85	480.84	6913.6	479.57	6976.7	479.74	7131.17	481.1	7258.27	481.61
7454.4	481.52	7642.2	481.59	7770.22	481.64	7891.49	482.11	8007.51	481.5
8084.55	481.65	8286.4	481.1	8400.66	481.15	8532.54	481.43	8815.11	481.68
9013.9	481.29	9066.42	481.36	9162.99	480.44	9267.72	480.22	9316.17	481.26
9445.09	480.81	9544.92	481.25	9840.07	480.55	9905.35	479.45	10019.66	478.98
10137.25	477.77	10335.61	479.59	10461.71	481.57	10475.35	482.43	10510.68	490.79
10530.49	496.67	10569.71	497.86	10589.33	494.08	10632.19	482.58	10682.47	480.15
10730.76	480.46	10897.14	480.91	11207.52	481.09	11484.5	481.59	11844.97	481.52
12316.03	480.77	12427.04	480.38	12675.91	480.84	12815.11	480.72	12843.11	479.52
12871.11	481.28	12981.91	482.23	13119.86	482.21	13509.8	482.25	13840.8	483.31
14141.33	484.34	14390.2	484.53	18190	482.5	18290	487		

Manning's n Values

num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-----	-------	-----	-------	-----	-------

0 .06 1605.22 .04 3139.7 .06

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	1605.22	3139.7		196.48 196.48	196.48		.3	.5
Ineffective Flow	num=		2					
Sta L	Sta R	Elev	Permanent					
0	1239	509.37	F					
3399	18290	482	F					

CROSS SECTION

RIVER: Arkansas River

REACH: 1 RS: 520

INPUT

Description:

Station Elevation Data num= 127

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
0	527.23	11.93	528.19	73.34	523.73	211.45	518.73	335.04	518.75
437.4	521.52	486.74	521.87	595.3	516.81	693.57	510.08	813.81	499.88
888.13	494.45	950.73	486.14	998.6	476.91	1047.94	474.15	1153.19	472.15
1190.63	470.37	1345.56	466.25	1551.46	465.82	1572.39	461.82	1640.83	458.64
1705.58	452.68	1747.75	451.82	1777.5	451.02	1866.54	445.38	1931.06	440.45
1986.53	434.21	2034.87	431.62	2135.35	430.86	2313.65	430.19	2343.65	430.25
2440.23	431.12	2500.67	430.57	2620.95	432.03	2677.52	430.58	2706.63	428.43
2834.02	433.54	2868.55	432.63	2969.24	434.55	3038.45	453.03	3071.94	460.02
3096.89	467.31	3137.8	471	3225.25	471.04	3265.49	471.8	3370.51	472.31
3433.59	474.08	3449.08	475.55	3521.93	476.86	3581.78	476.14	3689.91	476.88
3946.2	476.74	4071.53	477.18	4351.79	476.81	4442.51	477.2	4521.14	476.8
4727.77	474.68	4802.26	474.52	4897.13	475.67	4970.53	475.8	5027.73	474.85
5140.66	471.05	5247.92	470.88	5363.69	472.41	5415.81	473.64	5472.01	476.47
5524.95	478.1	5640.61	479.51	5751.4	479.79	5922.03	478.9	5970.06	479.19
6080.2	478.45	6264.26	475.8	6361	471.29	6577.25	470.68	6797.74	471.15
6965.09	470.58	7048.38	469.44	7471.59	468.28	7584.18	468.02	7821.56	467.5
7926.82	468.71	8057.44	470.68	8162.88	470.8	8263.55	472.73	8367.04	476.98
8417.58	477.15	8557.59	474.08	8826.91	472.75	8878.34	471.99	9009.84	471.15

9151.62	471.43	9239.51	472.1	9298.61	472.15	9529.03	476.28	9582.46	476.5
9967.68	472.85	10129.68	471.65	10265.67	473.48	10373.05	478.19	10474.48	478.92
10493.49	479.78	10518.33	485.48	10566.93	501.53	10602.89	502.08	10647.65	486.34
10675.05	478.43	10713.1	476.11	10771.11	475.41	10908.14	475.08	11129.52	474.1
11490.19	475.54	11602.22	475.33	11880.39	475.83	12102.19	474.72	12631.26	470.55
12739.25	470.18	12822.47	471.51	12961.49	474.51	13016.36	481.31	13045.91	482.24
13127.41	482.55	13462.55	481.72	13791.59	482.04	14042.67	482.17	14390.16	482
18190	482.5	18290	487						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.06	1551.46	.04	3137.8	.06

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	1551.46	3137.8		0	0		.1	.3

Blocked Obstructions num= 10

Sta L	Sta R	Elev	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1881.95	1894.45	476.4	1944.75	1957.25	476.2	2006.75	2019.25	476.4
2070.45	2082.95	476.3	2132.95	2145.45	477.6	2194.75	2207.25	475.6
2330.15	2342.65	475.6	2642.75	2655.25	476.1	2806.15	2818.65	475.9
2868.15	2880.65	476.2						

SUMMARY OF MANNING'S N VALUES

River:Arkansas River

* Reach	* River Sta.	* n1	* n2	* n3	*
*1	* 1049	* .06*	* .04*	* .06*	
*1	* 834	* .06*	* .04*	* .06*	
*1	* 771	* Bridge	* *	* *	
*1	* 716	* .06*	* .04*	* .06*	
*1	* 520	* .06*	* .04*	* .06*	

SUMMARY OF REACH LENGTHS

River: Arkansas River

```
*****
*      Reach      *      River Sta.      *      Left      *      Channel      *      Right      *
*****
*1              *      1049              *      214.88*      214.88*      214.88*
*1              *      834              *      117.83*      117.83*      117.83*
*1              *      771              *      *Bridge      *      *      *
*1              *      716              *      196.48*      196.48*      196.48*
*1              *      520              *      0*      0*      0*
*****
```

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS

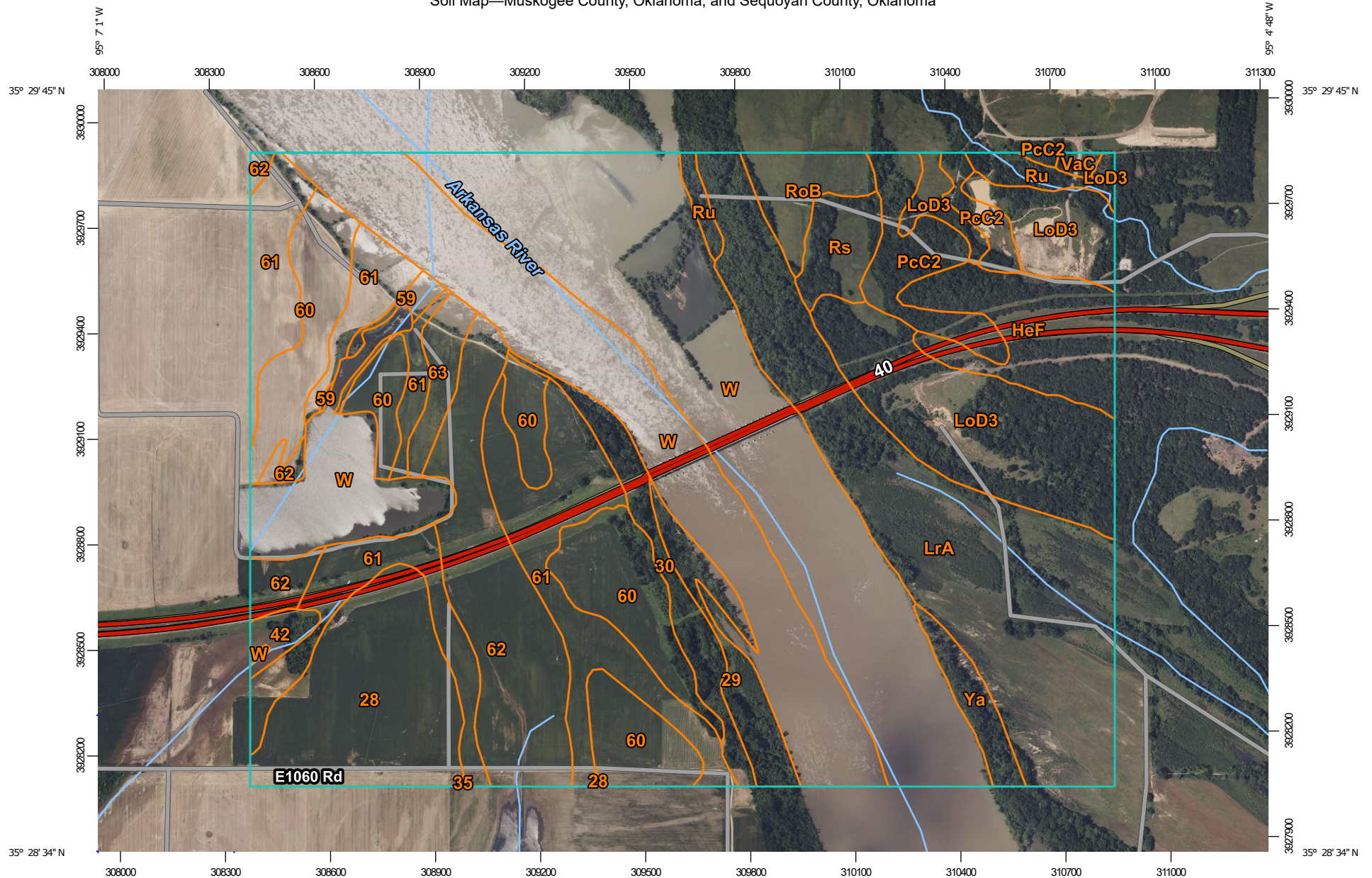
River: Arkansas River

```
*****
*      Reach      *      River Sta.      *      Contr.      *      Expan.      *
*****
*1              *      1049              *      .3*      .5*
*1              *      834              *      .3*      .5*
*1              *      771              *      *Bridge      *      *
*1              *      716              *      .3*      .5*
*1              *      520              *      .1*      .3*
*****
```

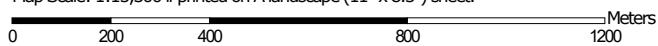
APPENDIX ‘H’

SCOUR DATA

Soil Map—Muskogee County, Oklahoma, and Sequoyah County, Oklahoma



Map Scale: 1:15,300 if printed on A landscape (11" x 8.5") sheet.



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



**Natural Resources
Conservation Service**

Web Soil Survey
National Cooperative Soil Survey

11/7/2023
Page 1 of 4

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features



Blowout



Borrow Pit



Clay Spot



Closed Depression



Gravel Pit



Gravelly Spot



Landfill



Lava Flow



Marsh or swamp



Mine or Quarry



Miscellaneous Water



Perennial Water



Rock Outcrop



Saline Spot



Sandy Spot



Severely Eroded Spot



Sinkhole



Slide or Slip



Sodic Spot



Spoil Area



Stony Spot



Very Stony Spot



Wet Spot



Other



Special Line Features

Water Features



Streams and Canals

Transportation



Rails



Interstate Highways



US Routes



Major Roads



Local Roads

Background



Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL:

Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Muskogee County, Oklahoma

Survey Area Data: Version 19, Sep 1, 2023

Soil Survey Area: Sequoyah County, Oklahoma

Survey Area Data: Version 18, Sep 8, 2023

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: May 12, 2022—Jun 22, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
28	Keo very fine sandy loam, 0 to 1 percent slopes, rarely flooded	65.3	5.9%
29	Kiomatic loamy fine sand, 0 to 1 percent slopes, frequently flooded	19.8	1.8%
30	Kiomatic fine sandy loam, 0 to 2 percent slopes, rarely flooded	21.5	2.0%
35	Latanier silty clay loam, 0 to 1 percent slopes, rarely flooded	0.1	0.0%
42	Norwood silt loam, 0 to 1 percent slopes, rarely flooded	5.3	0.5%
59	Roebuck clay, 0 to 1 percent slopes, frequently flooded	3.6	0.3%
60	Roxana very fine sandy loam, 0 to 1 percent slopes, rarely flooded	90.6	8.2%
61	Roxana very fine sandy loam, 1 to 3 percent slopes, rarely flooded	119.4	10.8%
62	Severn very fine sandy loam, 0 to 1 percent slopes, rarely flooded	74.6	6.8%
63	Severn very fine sandy loam, 2 to 6 percent slopes, rarely flooded	10.8	1.0%
W	Water	157.4	14.3%
Subtotals for Soil Survey Area		568.3	51.5%
Totals for Area of Interest		1,103.4	100.0%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
HeF	Hector-Linker-Enders complex, 5 to 40 percent slopes, extremely stony	38.8	3.5%
LoD3	Linker and Stigler soils, 3 to 8 percent slopes, severely eroded	94.4	8.6%
LrA	Coushatta silt loam, 0 to 1 percent slopes, rarely flooded	143.6	13.0%
PcC2	Shermore loam, 3 to 5 percent slopes, moderately eroded	31.5	2.9%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
RoB	Madill fine sandy loam, 0 to 3 percent slopes, rarely flooded	16.1	1.5%
Rs	Cupco silt loam, 0 to 1 percent slopes, occasionally flooded	14.6	1.3%
Ru	Guyton and Rexor soils, 0 to 1 percent slopes, frequently flooded	10.2	0.9%
VaC	Vian silt loam, 3 to 5 percent slopes	1.8	0.2%
W	Water	172.9	15.7%
Ya	Oklared fine sandy loam, 0 to 3 percent slopes, occasionally flooded	11.0	1.0%
Subtotals for Soil Survey Area		535.1	48.5%
Totals for Area of Interest		1,103.4	100.0%

Engineering Properties

This table gives the engineering classifications and the range of engineering properties for the layers of each soil in the survey area.

Hydrologic soil group is a group of soils having similar runoff potential under similar storm and cover conditions. The criteria for determining Hydrologic soil group is found in the National Engineering Handbook, Chapter 7 issued May 2007(<http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba>). Listing HSGs by soil map unit component and not by soil series is a new concept for the engineers. Past engineering references contained lists of HSGs by soil series. Soil series are continually being defined and redefined, and the list of soil series names changes so frequently as to make the task of maintaining a single national list virtually impossible. Therefore, the criteria is now used to calculate the HSG using the component soil properties and no such national series lists will be maintained. All such references are obsolete and their use should be discontinued. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These properties are depth to a seasonal high water table, saturated hydraulic conductivity after prolonged wetting, and depth to a layer with a very slow water transmission rate. Changes in soil properties caused by land management or climate changes also cause the hydrologic soil group to change. The influence of ground cover is treated independently. There are four hydrologic soil groups, A, B, C, and D, and three dual groups, A/D, B/D, and C/D. In the dual groups, the first letter is for drained areas and the second letter is for undrained areas.

The four hydrologic soil groups are described in the following paragraphs:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Depth to the upper and lower boundaries of each layer is indicated.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."

Classification of the soils is determined according to the Unified soil classification system (ASTM, 2005) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 2004).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of particle-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Percentage of rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Liquid limit and plasticity index (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

References:

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Report—Engineering Properties

Absence of an entry indicates that the data were not estimated. The asterisk "*" denotes the representative texture; other possible textures follow the dash. The criteria for determining the hydrologic soil group for individual soil components is found in the National Engineering Handbook, Chapter 7 issued May 2007(<http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba>). Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).



Engineering Properties—Muskogee County, Oklahoma														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
28—Keo very fine sandy loam, 0 to 1 percent slopes, rarely flooded														
Keo	90	B	0-9	Very fine sandy loam	CL-ML, ML	A-4	0- 0- 0	0- 0- 0	100-100 -100	98-99-1 00	85-90- 95	50-70- 90	0-13 -25	NP-4 -7
			9-71	Silt loam, very fine sandy loam, silty clay loam	ML, CL-ML, CL	A-4, A-6	0- 0- 0	0- 0- 0	100-100 -100	98-99-1 00	85-93-1 00	50-70- 90	0-18 -35	2-8 -13
Choska	5	B	0-14	Silt loam	CL, CL-ML, ML	A-4	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	94-97-1 00	51-74- 97	15-23 -31	NP-5 -10
			14-50	Silt loam, very fine sandy loam	CL, CL-ML, ML	A-4	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	94-97-1 00	51-74- 97	15-23 -31	NP-5 -9
			50-67	Loamy fine sand	SM	A-2	0- 0- 0	0- 0- 0	100-100 -100	98-99-1 00	90-95-1 00	15-25- 35	0-0 -0	NP
Roxana	3	B	0-7	Very fine sandy loam	CL-ML, ML	A-4	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	85-93-1 00	50-63- 75	0-14 -27	NP-4 -7
			7-60	Silt loam, very fine sandy loam, loamy very fine sand	CL-ML, ML	A-4	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	85-93-1 00	50-68- 85	0-14 -27	NP-4 -7
Norwood	2	B	0-10	Silt loam	CL, CL-ML	A-4, A-6	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	95-98-1 00	51-71- 90	20-28 -35	4-10-15
			10-65	Silt loam, very fine sandy loam, silty clay loam	CL, CL-ML, ML	A-4, A-6, A-7	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	90-95-1 00	70-84- 98	20-33 -45	2-14-25

Engineering Properties—Muskogee County, Oklahoma														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
29—Kiomatia loamy fine sand, 0 to 1 percent slopes, frequently flooded														
Kiomatia	90	B	0-10	Loamy fine sand	SM, SC-SM	A-2-4, A-4	0- 0- 0	0- 0- 0	100-100-100	95-98-100	80-90-100	30-38-45	16-21-26	NP-4 -7
			10-62	Stratified fine sand to loam	SM, SC-SM	A-2-4	0- 0- 0	0- 0- 0	100-100-100	95-98-100	80-90-100	13-22-30	16-19-22	NP-3 -5
Choska	5	B	0-14	Silt loam	CL-ML, CL, ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	94-97-100	51-74-97	15-23-31	NP-5 -10
			14-50	Very fine sandy loam, silt loam	CL-ML, CL, ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	94-97-100	51-74-97	15-23-31	NP-5 -9
			50-67	Loamy fine sand	SM	A-2-4	0- 0- 0	0- 0- 0	100-100-100	98-99-100	90-95-100	15-25-35	0-0 -0	NP
Roxana	3	B	0-7	Very fine sandy loam	ML, CL-ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	85-93-100	50-63-75	0-14 -27	NP-4 -7
			7-60	Silt loam, very fine sandy loam, loamy very fine sand	ML, CL-ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	85-93-100	50-68-85	0-14 -27	NP-4 -7
Severn	2	A	0-8	Very fine sandy loam	CL-ML, CL, ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	94-97-100	65-78-90	14-23-31	NP-5 -10
			8-60	Stratified loamy very fine sand to silty clay loam	SM, CL	A-4, A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	94-97-100	36-67-97	0-21 -42	NP-10-19

Engineering Properties--Muskogee County, Oklahoma														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
30—Kiomatia fine sandy loam, 0 to 2 percent slopes, rarely flooded														
Kiomatia	85	B	0-10	Fine sandy loam	SM, SC-SM	A-4, A-2-4	0- 0- 0	0- 0- 0	100-100-100	95-98-100	80-90-100	30-38-45	16-21-26	NP-4 -7
			10-62	Stratified fine sand to loam	SM, SC-SM	A-2-4	0- 0- 0	0- 0- 0	100-100-100	95-98-100	80-90-100	13-22-30	16-19-22	NP-3 -5
Roxana	8	B	0-7	Very fine sandy loam	ML, CL-ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	85-93-100	50-63-75	0-14 -27	NP-4 -7
			7-60	Silt loam, very fine sandy loam, loamy very fine sand	ML, CL-ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	85-93-100	50-68-85	0-14 -27	NP-4 -7
Severn	7	A	0-8	Very fine sandy loam	ML, CL, CL-ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	94-97-100	65-78-90	14-23-31	NP-5 -10
			8-60	Stratified loamy very fine sand to silty clay loam	CL, SM	A-4, A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	94-97-100	36-67-97	0-21 -42	NP-10-19

Engineering Properties—Muskogee County, Oklahoma														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
35—Latanier silty clay loam, 0 to 1 percent slopes, rarely flooded														
Latanier	90	D	0-11	Silty clay loam	CL	A-6, A-7-6	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	100-100 -100	95-98-1 00	33-38 -42	13-17-2 0
			11-35	Clay, silty clay	CH	A-7-6, A-7-5	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	100-100 -100	95-98-1 00	51-63 -75	26-36-4 5
			35-71	Silt loam, silty clay loam, very fine sandy loam	CL, ML	A-4, A-6	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	100-100 -100	80-90-1 00	0-20 -40	NP-9 -17
Roebuck	5	D	0-16	Clay	CH, CL	A-7-6, A-7-5, A-6	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	96-98-1 00	90-95- 99	37-54 -70	15-28-4 0
			16-54	Clay loam, silty clay, clay	CH, CL	A-6, A-7-5, A-7-6	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	96-98-1 00	80-90- 99	37-54 -70	15-28-4 0
			54-80	Clay loam, silty clay, clay	CH, CL	A-7-6, A-7-5, A-6	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	96-98-1 00	80-90- 99	37-54 -70	15-28-4 0
Roxana	3	B	0-7	Very fine sandy loam	ML, CL-ML	A-4	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	85-93-1 00	50-63- 75	0-14 -27	NP-4 -7
			7-60	Silt loam, very fine sandy loam, loamy very fine sand	ML, CL-ML	A-4	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	85-93-1 00	50-68- 85	0-14 -27	NP-4 -7
Severn	2	A	0-8	Very fine sandy loam	ML, CL, CL-ML	A-4	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	94-97-1 00	65-78- 90	14-23 -31	NP-5 -10
			8-60	Stratified loamy very fine sand to silty clay loam	CL, SM	A-4, A-7-6	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	94-97-1 00	36-67- 97	0-21 -42	NP-10-1 9

Engineering Properties--Muskogee County, Oklahoma														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
42--Norwood silt loam, 0 to 1 percent slopes, rarely flooded														
Norwood	90	B	0-10	Silt loam	CL, CL-ML	A-4, A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	95-98-100	51-71-90	20-28-35	4-10-15
			10-65	Silt loam, very fine sandy loam, silty clay loam	CL, ML	A-6, A-7-6, A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	90-95-100	70-84-98	20-33-45	2-14-25
Keo	5	B	0-9	Very fine sandy loam	CL-ML, ML	A-4	0- 0- 0	0- 0- 0	100-100-100	98-99-100	85-90-95	50-70-90	0-13 -25	NP-4 -7
			9-71	Silt loam, very fine sandy loam, silty clay loam	CL, ML	A-4, A-6	0- 0- 0	0- 0- 0	100-100-100	98-99-100	85-93-100	50-70-90	0-18 -35	2-8 -13
Severn	5	A	0-8	Very fine sandy loam	CL-ML, CL, ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	94-97-100	65-78-90	14-23-31	NP-5 -10
			8-60	Stratified loamy very fine sand to silty clay loam	CL, SM	A-7-6, A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	94-97-100	36-67-97	0-21 -42	NP-10-19

Engineering Properties—Muskogee County, Oklahoma														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
59—Roebuck clay, 0 to 1 percent slopes, frequently flooded														
Roebuck	95	D	0-10	Clay	CH	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	82-92-100	67-81-90	52-66-76	33-43-50
			10-45	Clay, silty clay, clay loam	CL, CH	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	80-92-100	64-80-97	48-61-76	29-39-51
			45-72	Clay, silty clay, clay loam	CL, CH	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	80-92-100	64-80-97	45-60-76	25-38-51
Madill	1	B	0-11	Fine sandy loam	CL, SC-SM, SM	A-4, A-2-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	81-93-100	32-43-56	0-21 -26	NP-6 -8
			11-42	Fine sandy loam, loam	CL, SM, SC-SM	A-4, A-2-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	81-93-100	30-40-57	0-19 -28	NP-6 -9
			42-79	Fine sandy loam, loam, loamy fine sand	SM, SC-SM, CL	A-2-4, A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	84-96-100	21-28-52	0-19 -27	NP-6 -9
Severn	1	A	0-8	Very fine sandy loam	SM, CL-ML, CL	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	87-99-100	44-59-73	0-21 -27	NP-6 -8
			8-28	Stratified loamy very fine sand to silty clay loam	CH, CL, ML	A-6, A-4, A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	84-100-100	55-79-98	0-32 -52	NP-18-29
			28-48	Very fine sandy loam	SM, CL, CL-ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	87-99-100	44-59-73	0-21 -27	NP-6 -8

Engineering Properties--Muskogee County, Oklahoma														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
			48-79	Stratified loamy very fine sand to silty clay loam	ML, CL, CH	A-4, A-6, A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	84-100-100	55-79-98	0-32 -52	NP-18-29
Tulahassee	1	A/D	0-13	Fine sandy loam	CL, SC-SM, SC	A-2-4, A-6, A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	79-93-100	31-43-57	22-26 -30	6-9 -12
			13-45	Fine sandy loam, loam	SC-SM, SM, CL	A-2-4, A-6, A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	77-92-100	32-47-62	16-23 -30	2-7 -12
			45-79	Loamy fine sand, fine sandy loam, loam	SC-SM, SC, SM	A-6, A-2-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	83-95-100	19-26-48	16-23 -30	2-7 -12
Verdigris	1	B	0-7	Silt loam	CL-ML, CL, ML	A-6, A-7-6, A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	92-100-100	80-92-100	27-39 -45	7-15-18
			7-28	Silt loam	CL, CL-ML, ML	A-6, A-7-6, A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	92-100-100	80-92-100	27-39 -45	7-15-18
			28-46	Silty clay loam, silt loam	CL, CH	A-7, A-7-6, A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	93-100-100	80-92-100	30-39 -51	12-18-25
			46-79	Silt loam, silty clay loam	CL, CH	A-7-6, A-6, A-7	0- 0- 0	0- 0- 0	100-100-100	100-100-100	93-100-100	80-92-100	30-39 -51	12-18-25
Wynona	1	C/D	0-20	Silt loam	CL	A-4, A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	92-99-100	85-94-100	28-35 -36	9-15-16
			20-32	Silty clay loam, silt loam	CL	A-7-6, A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	91-99-100	84-94-100	30-39 -44	11-18-22
			32-48	Silty clay loam, silty clay	CL, CH	A-7-6, A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	95-100-100	87-96-100	37-46 -50	16-23-27
			48-79	Silty clay loam, silty clay	CH, CL	A-6, A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	95-100-100	87-96-100	37-46 -50	16-23-27

Engineering Properties—Muskogee County, Oklahoma														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
60—Roxana very fine sandy loam, 0 to 1 percent slopes, rarely flooded														
Roxana	90	B	0-7	Very fine sandy loam	ML, CL-ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	85-93-100	50-63-75	0-14 -27	NP-4 -7
			7-60	Silt loam, very fine sandy loam, loamy very fine sand	ML, CL-ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	85-93-100	50-68-85	0-14 -27	NP-4 -7
Verdigris	4	B	0-31	Silt loam	CL, ML	A-4, A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	95-98-100	65-83-100	22-30 -38	2-8 -13
			31-80	Silt loam, silty clay loam	CL	A-6, A-7-6, A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	95-98-100	80-90-100	30-38 -45	8-16-23
Latanier	3	D	0-11	Silty clay loam	CL	A-6, A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	100-100-100	95-98-100	33-38 -42	13-17-20
			11-35	Silty clay, clay	CH	A-7-6, A-7-5	0- 0- 0	0- 0- 0	100-100-100	100-100-100	100-100-100	95-98-100	51-63 -75	26-36-45
			35-71	Silt loam, silty clay loam, very fine sandy loam	CL, ML	A-4, A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	100-100-100	80-90-100	0-20 -40	NP-9 -17
Severn	3	A	0-8	Very fine sandy loam	CL-ML, CL, ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	94-97-100	65-78-90	14-23 -31	NP-5 -10
			8-60	Stratified loamy very fine sand to silty clay loam	CL, SM	A-4, A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	94-97-100	36-67-97	0-21 -42	NP-10-19

Engineering Properties--Muskogee County, Oklahoma														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
61--Roxana very fine sandy loam, 1 to 3 percent slopes, rarely flooded														
Roxana	85	B	0-7	Very fine sandy loam	ML, CL-ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	85-93-100	50-63-75	0-14 -27	NP-4 -7
			7-60	Silt loam, very fine sandy loam, loamy very fine sand	ML, CL-ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	85-93-100	50-68-85	0-14 -27	NP-4 -7
Keo	10	B	0-9	Very fine sandy loam	ML, CL-ML	A-4	0- 0- 0	0- 0- 0	100-100-100	98-99-100	85-90-95	50-70-90	0-13 -25	NP-4 -7
			9-71	Silt loam, very fine sandy loam, silty clay loam	ML, CL	A-4, A-6	0- 0- 0	0- 0- 0	100-100-100	98-99-100	85-93-100	50-70-90	0-18 -35	2-8 -13
Severn	5	A	0-8	Very fine sandy loam	CL-ML, CL, ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	94-97-100	65-78-90	14-23 -31	NP-5 -10
			8-60	Stratified loamy very fine sand to silty clay loam	CL, SM	A-4, A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	94-97-100	36-67-97	0-21 -42	NP-10-19

Engineering Properties--Muskogee County, Oklahoma														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
62--Severn very fine sandy loam, 0 to 1 percent slopes, rarely flooded														
Severn	90	A	0-8	Very fine sandy loam	CL-ML, CL, ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	94-97-100	65-78-90	14-23-31	NP-5-10
			8-60	Stratified loamy very fine sand to silty clay loam	CL, SM	A-4, A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	94-97-100	36-67-97	0-21 -42	NP-10-19
Norwood	5	B	0-10	Silt loam	CL, CL-ML	A-4, A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	95-98-100	51-71-90	20-28-35	4-10-15
			10-65	Silt loam, very fine sandy loam, silty clay loam	CL, ML	A-6, A-7-6, A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	90-95-100	70-84-98	20-33-45	2-14-25
Roxana	5	B	0-7	Very fine sandy loam	ML, CL-ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	85-93-100	50-63-75	0-14 -27	NP-4 -7
			7-60	Loamy very fine sand, very fine sandy loam, silt loam	ML, CL-ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	85-93-100	50-68-85	0-14 -27	NP-4 -7

Engineering Properties--Muskogee County, Oklahoma														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
63--Severn very fine sandy loam, 2 to 6 percent slopes, rarely flooded														
Severn	90	A	0-8	Very fine sandy loam	CL-ML, CL, ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	94-97-100	65-78-90	14-23-31	NP-5-10
			8-60	Stratified loamy very fine sand to silty clay loam	CL, SM	A-4, A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	94-97-100	36-67-97	0-21 -42	NP-10-19
Roxana	10	B	0-7	Very fine sandy loam	ML, CL-ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	85-93-100	50-63-75	0-14 -27	NP-4 -7
			7-60	Silt loam, very fine sandy loam, loamy very fine sand	ML, CL-ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	85-93-100	50-68-85	0-14 -27	NP-4 -7
W--Water														
Water	100		0-80	Water	—	—	—	—	—	—	—	—	—	—

Engineering Properties—Sequoyah County, Oklahoma														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
HeF—Hector-Linker-Enders complex, 5 to 40 percent slopes, extremely stony														
Hector	35	D	0-6	Stony fine sandy loam	CL, SC-SM, SM	A-2-4, A-4, A-6	13-19-32	4-10-17	82-90-98	67-83-95	57-79-95	23-37-58	0-23 -36	NP-4 -13
			6-15	Fine sandy loam, gravelly fine sandy loam, gravelly loam	SC-SM, SM, CL	A-6, A-4, A-2-4	0-2-7	3-4-4	81-81-92	61-63-83	52-59-83	23-27-50	18-23 -34	3-6 -15
			15-25	Bedrock	—	—	—	—	—	—	—	—	—	—
Linker	33	C	0-5	Stony loam	SM, CL	A-4, A-2-4, A-6	13-19-32	4-10-17	82-90-98	67-83-95	55-72-89	35-51-63	19-27 -36	3-8 -13
			5-8	Gravelly loam, gravelly fine sandy loam, loam	SC-SM, SC, CL	A-1-b, A-6	0-1-3	1-2-7	72-80-93	45-61-84	37-54-81	25-38-57	21-29 -38	6-11-17
			8-26	Sandy clay loam, gravelly sandy clay loam, gravelly loam, loam, clay loam, gravelly clay loam	SC, CL	A-2-6, A-6, A-7-6	0-1-3	1-2-7	72-80-93	45-61-84	37-56-83	28-44-65	28-38 -45	12-19-24
			26-39	Bedrock	—	—	—	—	—	—	—	—	—	—
Enders	32	D	0-3	Stony fine sandy loam	SC-SM, ML, SC	A-2-4, A-6	13-19-31	4-11-17	81-90-98	66-82-94	56-76-94	24-38-57	25-34 -38	6-11-13
			3-7	Very stony loam, stony sandy loam, stony silt loam	CL, SC-SM, SC	A-1-b, A-7-6, A-2-6	13-19-31	4-11-17	81-90-98	66-82-94	47-63-84	22-32-53	23-33 -43	6-11-17

Engineering Properties—Sequoyah County, Oklahoma														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
			7-26	Stony silty clay loam, gravelly clay, gravelly silty clay, cobbly clay	SC, CH	A-2-6, A-7-6	0- 1- 4	2- 2- 12	75-80-89	50-60-80	41-55-80	31-45-73	39-51-71	21-29-43
			26-40	Stony silty clay loam, gravelly clay, gravelly silty clay, cobbly clay	CH, SC	A-2-7, A-7-6	0- 1- 4	2- 2- 12	75-80-89	50-60-80	42-55-80	34-48-75	44-56-69	24-34-44
			40-50	Bedrock	—	—	—	—	—	—	—	—	—	—

Engineering Properties—Sequoyah County, Oklahoma														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
LoD3—Linker and Stigler soils, 3 to 8 percent slopes, severely eroded														
Linker, severely eroded	45	C	0-6	Loam	CL, CL-ML	A-4, A-6	0- 0- 0	0- 0- 0	75-88-100	75-88-100	65-80-95	50-63-75	20-28-35	4-10-15
			6-20	Clay loam, gravelly sandy clay loam, gravelly clay loam, sandy clay loam	SC, CL, GC	A-6, A-2-4	0- 0- 0	0- 5- 10	50-88-100	40-70-100	25-60-95	15-48-80	25-33-40	8-14-20
			20-30	Bedrock	—	—	—	—	—	—	—	—	—	—
Stigler, severely eroded	30	D	0-9	Silt loam	CL-ML, CL, ML	A-4, A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	96-98-100	65-81-97	22-26-30	2-7 -11
			9-18	Silt loam, very fine sandy loam, loam	CL, ML	A-4, A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	94-97-100	60-79-97	20-29-37	2-8 -14
			18-24	Silty clay loam, silty clay, clay	CH, CL	A-7-6, A-7-5, A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	96-98-100	80-90-99	37-54-70	15-27-38
			24-67	Silty clay loam, silty clay, clay	CH, CL	A-6, A-7-5, A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	96-98-100	80-90-99	37-54-70	15-27-38
			67-74	Bedrock	—	—	—	—	—	—	—	—	—	—
Shermore, severely eroded	15	D	0-10	Loam	CL, SC	A-6, A-4	0- 0- 0	0- 0- 0	75-88-100	75-88-100	72-86-100	48-67-85	30-33-35	9-11-13
			10-43	Sandy clay loam, clay loam, loam	CL, SC-SM	A-6, A-2-4	0- 0- 0	0- 0- 0	85-93-100	85-93-100	67-84-100	27-59-90	25-33-40	7-13-18

Engineering Properties—Sequoyah County, Oklahoma														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
			43-68	Clay loam, sandy clay loam, loam	CL, SC-SM	A-6, A-2-4	0- 0- 0	0- 0- 0	85-93-100	85-93-100	67-84-100	27-59-90	25-33-40	7-13-18
Vian, severely eroded	5	C	0-10	Silt loam	CL	A-4, A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	96-98-100	80-89-97	30-34-37	8-11-13
			10-18	Silt loam, loam	CL	A-6, A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	96-98-100	65-81-97	30-34-37	8-11-14
			18-26	Silt loam, loam, silty clay loam	CL	A-6, A-7-6, A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	96-98-100	65-82-98	30-37-43	9-15-20
			26-72	Silty clay loam, clay loam	CL	A-6, A-7-6	0- 0- 0	0- 0- 0	85-93-100	85-92-98	80-85-90	70-75-80	33-38-43	12-16-20
Spiro, severely eroded	3	C	0-12	Silt loam	CL, ML	A-4, A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	96-98-100	80-89-97	22-30-37	2-8 -13
			12-24	Silty clay loam, loam, silt loam	CL	A-6, A-7-6, A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	96-98-100	65-82-98	30-37-43	9-15-20
			24-27	Very gravelly silty clay loam, silt loam, silty clay loam	GC, CL, GP-GC	A-2-4, A-7-6, A-6	0- 0- 0	0- 0- 0	15-53-90	10-48-85	10-45-80	6-43- 80	30-37-43	9-15-20
			27-36	Bedrock	—	—	—	—	—	—	—	—	—	—
Mckamie, severely eroded	2	D	0-7	Loam	ML, CL, CL-ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	90-95-100	50-63-75	0-15 -30	3-7 -10
			7-70	Clay, silty clay	CH, CL	A-7-6, A-7-5	0- 0- 0	0- 0- 0	100-100-100	100-100-100	95-98-100	80-90-100	45-58-70	22-31-40

Engineering Properties—Sequoyah County, Oklahoma														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
LrA—Coushatta silt loam, 0 to 1 percent slopes, rarely flooded														
Coushatta	95	B	0-18	Silt loam	CL-ML, CL, ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	100-100-100	70-85-100	0-15 -30	NP-5 -10
			18-24	Silt loam, silty clay loam	CL	A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	100-100-100	90-95-100	28-34 -40	12-16-20
			24-70	Silt loam, silty clay loam, very fine sandy loam	CL, ML	A-6, A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	100-100-100	70-85-100	0-20 -40	NP-10-20
Madill	5	B	0-9	Fine sandy loam	SM, CL-ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	94-97-100	36-48-60	15-21 -26	NP-4 -7
			9-50	Fine sandy loam, loam	ML, CL-ML, SM	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	94-97-100	36-61-85	14-22 -29	NP-4 -7
			50-70	Loamy fine sand, loam, fine sandy loam	ML, CL-ML, SM	A-4, A-2-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	90-95-100	15-50-85	0-15 -29	NP-4 -7
PcC2—Shermore loam, 3 to 5 percent slopes, moderately eroded														
Shermore, moderately eroded	95	D	0-10	Loam	CL, SC	A-6, A-4	0- 0- 0	0- 0- 0	90-90-100	79-79-100	66-70-94	46-51-71	26-32 -38	9-13-17
			10-43	Loam, sandy clay loam, clay loam	CL, SC	A-6, A-7-6	0- 0- 0	0- 0- 0	90-94-100	81-89-100	64-81-99	43-63-81	27-37 -47	12-20-27
			43-68	Loam, sandy clay loam, clay loam	CL, SC	A-6, A-7-6	0- 0- 0	0- 0- 0	91-95-100	82-89-100	65-81-99	44-64-81	27-37 -46	12-20-27
			68-78	Bedrock	—	—	—	—	—	—	—	—	—	—

Engineering Properties—Sequoyah County, Oklahoma														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
RoB—Madill fine sandy loam, 0 to 3 percent slopes, rarely flooded														
Madill	90	B	0-16	Fine sandy loam	SM, CL-ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	94-97-100	36-48-60	15-21-26	NP-4 -7
			16-40	Fine sandy loam, loam	ML, CL-ML, SM	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	94-97-100	36-61-85	14-22-29	NP-4 -7
			40-68	Fine sandy loam, loam, loamy fine sand	SM, CL-ML, ML	A-4, A-2-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	90-95-100	15-50-85	0-15 -29	NP-4 -7
Oklared	5	A	0-19	Fine sandy loam	SM, CL-ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	94-97-100	36-48-60	14-20-26	NP-4 -7
			19-49	Fine sandy loam, very fine sandy loam, loam	CL-ML, CL, SM	A-4	0- 0- 0	0- 0- 0	100-100-100	98-99-100	94-97-100	36-67-97	14-23-31	NP-5 -10
			49-76	Stratified loamy fine sand to silt loam	CL-ML, CL, SM	A-4, A-2-4	0- 0- 0	0- 0- 0	100-100-100	98-99-100	90-95-100	15-56-97	0-16 -31	NP-5 -10
Shermore	5	D	0-10	Loam	CL, SC	A-6, A-4	0- 0- 0	0- 0- 0	75-88-100	75-88-100	72-86-100	48-67-85	30-33-35	9-11-13
			10-43	Sandy clay loam, clay loam, loam	CL, SC-SM	A-6, A-2-4	0- 0- 0	0- 0- 0	85-93-100	85-93-100	67-84-100	27-59-90	25-33-40	7-13-18
			43-68	Sandy clay loam, clay loam, loam	CL, SC-SM	A-6, A-2-4	0- 0- 0	0- 0- 0	85-93-100	85-93-100	67-84-100	27-59-90	25-33-40	7-13-18

Engineering Properties—Sequoyah County, Oklahoma														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
Rs—Cupco silt loam, 0 to 1 percent slopes, occasionally flooded														
Cupco	90	C/D	0-14	Silt loam	CL	A-6	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	93-99-1 00	83-92-1 00	26-33 -39	9-14-18
			14-24	Silt loam, silty clay loam	CL	A-6, A-7-6	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	92-99-1 00	84-94-1 00	26-38 -41	9-19-21
			24-45	Silty clay loam	CL	A-7-6	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	95-99-1 00	89-95-1 00	36-41 -46	19-22-2 5
			45-79	Clay loam, silty clay loam	CL	A-7-6	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	90-99-1 00	82-95-1 00	37-41 -45	19-22-2 5
Neff	5	C/D	0-18	Silt loam	CL	A-6, A-7-6	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	93-99-1 00	83-92- 99	26-34 -41	9-14-18
			18-35	Silty clay loam, silt loam	CL	A-6, A-7-6	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	93-99-1 00	85-95-1 00	34-39 -45	17-21-2 5
			35-79	Silty clay loam, silt loam	CL	A-7-6, A-6	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	91-99-1 00	82-95-1 00	28-38 -45	12-20-2 5
Rexor	5	B	0-12	Loam	CL	A-6, A-7-6	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	90-100- 100	66-79- 86	27-35 -41	9-14-18
			12-48	Clay loam, silty clay loam, silt loam	CL	A-6, A-7-6	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	88-100- 100	75-95-1 00	28-36 -45	12-18-2 5
			48-79	Silt loam, loam	CL	A-6	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	89-100- 100	77-94-1 00	28-33 -38	12-16-1 9

Engineering Properties—Sequoyah County, Oklahoma														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
Ru—Guyton and Rexor soils, 0 to 1 percent slopes, frequently flooded														
Guyton	65	C/D	0-10	Silt loam	ML, CL-ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	95-98-100	65-78-90	0-14 -27	NP-4 -7
			10-18	Silt loam, silty clay loam, clay loam	CL, CL-ML	A-6, A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	94-97-100	75-85-95	22-31 -40	6-12-18
			18-65	Silt loam, silty clay loam, sandy clay loam	CL, ML	A-6, A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	95-98-100	50-73-95	0-20 -40	NP-9 -18
Rexor	35	B	0-11	Silt loam	CL	A-4, A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	96-98-100	80-89-97	30-34 -37	8-11-13
			11-34	Clay loam, silt loam, silty clay loam	CL	A-6, A-7-6, A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	96-98-100	80-89-98	30-37 -43	8-14-20
			34-65	Loam, silt loam	CL	A-6, A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	96-98-100	70-84-97	30-34 -37	8-11-14

Engineering Properties—Sequoyah County, Oklahoma														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
VaC—Vian silt loam, 3 to 5 percent slopes														
Vian	90	C	0-10	Silt loam	CL	A-4, A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	96-98-100	80-89-97	30-34-37	8-11-13
			10-18	Silt loam, loam	CL	A-6, A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	96-98-100	65-81-97	30-34-37	8-11-14
			18-26	Silt loam, loam, silty clay loam	CL	A-6, A-7-6, A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	96-98-100	65-82-98	30-37-43	9-15-20
			26-72	Silty clay loam, clay loam	CL	A-7-6, A-6	0- 0- 0	0- 0- 0	85-93-100	85-92-98	80-85-90	70-75-80	33-38-43	12-16-20
Clebit	5	D	0-7	Very stony fine sandy loam	GM, GC-GM	A-1-b, A-2-4, A-1-a	0- 8- 15	10-18-25	35-43-50	35-43-50	30-40-50	13-22-30	0-13 -26	NP-4 -7
			7-10	Very stony loam, very stony fine sandy loam, bouldery very fine sandy loam	GM, GC, GC-GM	A-2-4, A-6, A-1-a	0- 8- 15	10-18-25	35-50-50	35-43-50	30-40-50	13-29-45	0-18 -35	NP-7 -13
			10-20	Bedrock	—	—	—	—	—	—	—	—	—	—
Spiro	5	C	0-12	Silt loam	CL, ML	A-4, A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	96-98-100	80-89-97	22-30-37	2-8 -13
			12-24	Silt loam, loam, silty clay loam	CL	A-6, A-7-6, A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	96-98-100	65-82-98	30-37-43	9-15-20
			24-27	Very gravelly silty clay loam, silt loam, silty clay loam	GC, CL, GP-GC	A-6, A-7-6, A-2-4	0- 0- 0	0- 0- 0	15-53-90	10-48-85	10-45-80	6-43- 80	30-37-43	9-15-20
			27-36	Bedrock	—	—	—	—	—	—	—	—	—	—

Engineering Properties—Sequoyah County, Oklahoma														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
W—Water														
Water	100		0-80	Water	—	—	—	—	—	—	—	—	—	—
Ya—Okla red fine sandy loam, 0 to 3 percent slopes, occasionally flooded														
Okla red	95	A	0-19	Fine sandy loam	SM, CL-ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	94-97-100	36-48-60	14-20-26	NP-4 -7
			19-49	Fine sandy loam, very fine sandy loam, loam	CL-ML, CL, SM	A-4	0- 0- 0	0- 0- 0	100-100-100	98-99-100	94-97-100	36-67-97	14-23-31	NP-5 -10
			49-76	Stratified loamy fine sand to silt loam	CL-ML, CL, SM	A-4, A-2-4	0- 0- 0	0- 0- 0	100-100-100	98-99-100	90-95-100	15-56-97	0-16 -31	NP-5 -10
Wrightsville	5	D	0-3	Silt loam	CL-ML, CL, ML	A-4	0- 0- 0	0- 0- 0	100-100-100	95-98-100	90-95-100	70-85-100	0-15 -30	3-7 -10
			3-14	Silt loam	CL-ML, CL, ML	A-4	0- 0- 0	0- 0- 0	100-100-100	95-98-100	90-95-100	70-85-100	0-15 -30	3-7 -10
			14-25	Silty clay loam, clay, silty clay	ML, MH, CL	A-7-5, A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	95-98-100	75-85-95	39-50-60	15-20-25
			25-80	Silty clay loam, silty clay, silt loam	CH, CL	A-6, A-7-6, A-4	0- 0- 0	0- 0- 0	100-100-100	95-98-100	90-95-100	70-83-95	25-38-50	8-17-25

Data Source Information

Soil Survey Area: Muskogee County, Oklahoma
 Survey Area Data: Version 19, Sep 1, 2023

Soil Survey Area: Sequoyah County, Oklahoma
 Survey Area Data: Version 18, Sep 8, 2023



Contraction Scour (100-yr)

	Left	Channel	Right
Ys (ft):	8.15	9.26	0.00
Vc (ft/s):	0.82	1.00	0.70
Equation:	Live	Live	Live

Pier Scour (100-yr)

All Piers:	Ys (ft):	26.49
	Froude #:	0.36
	Equation:	CSU equation

Abutment Scour

	Left	Right
Abutment Ys (ft):	33.27	
Ve=	2.10	
Froude #:	0.12	
Equation:	Froehlich	Default

Combined Scour Depths (100-yr)

Pier Scour + Contraction Scour (ft):

Left Bank:	34.65
Channel:	35.76
Right Bank:	26.49

Left abut + contr (ft): 41.42

Contraction Scour (500-yr)

	Left	Channel	Right
Ys (ft):	10.96	13.90	0.00
Vc (ft/s):	0.84	1.01	0.75
Equation:	Live	Live	Live

Pier Scour (500-yr)

All Piers:	Ys (ft):	28.38
	Froude #:	0.41
	Equation:	CSU equation

Abutment Scour

	Left	Right
Abutment Ys (ft):	39.28	
Ve=	2.36	
Froude #:	0.13	
Equation:	Froehlich	Default

Combined Scour Depths (500-yr)

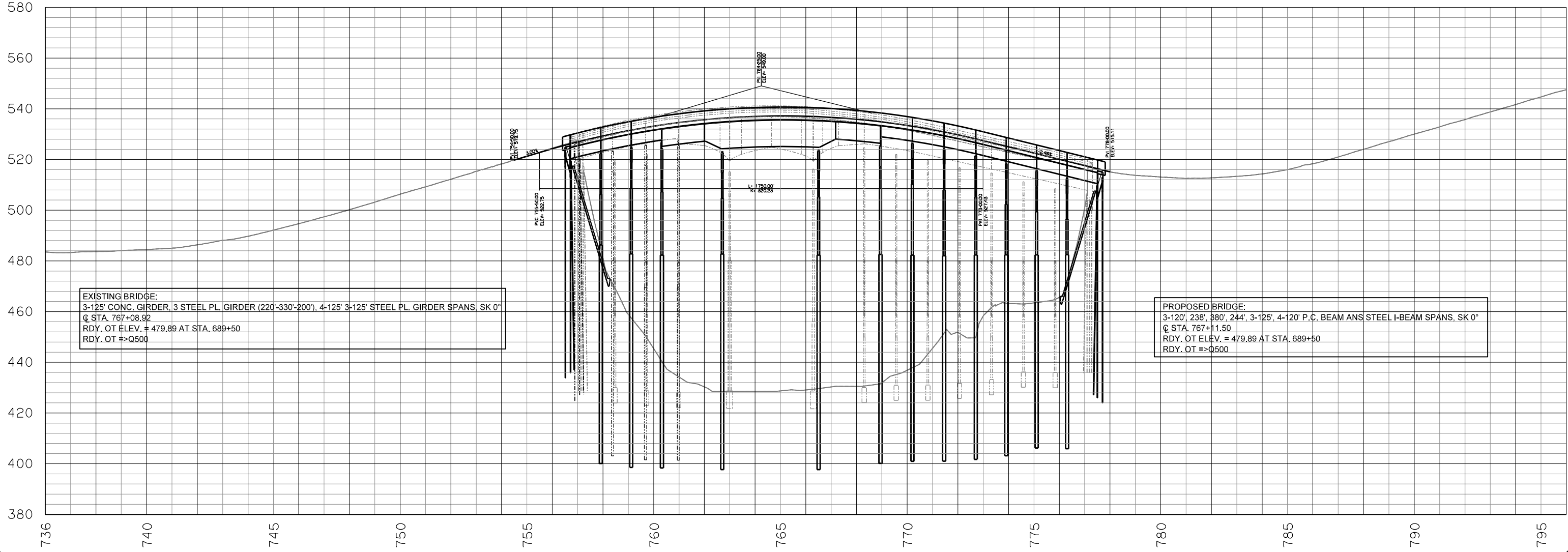
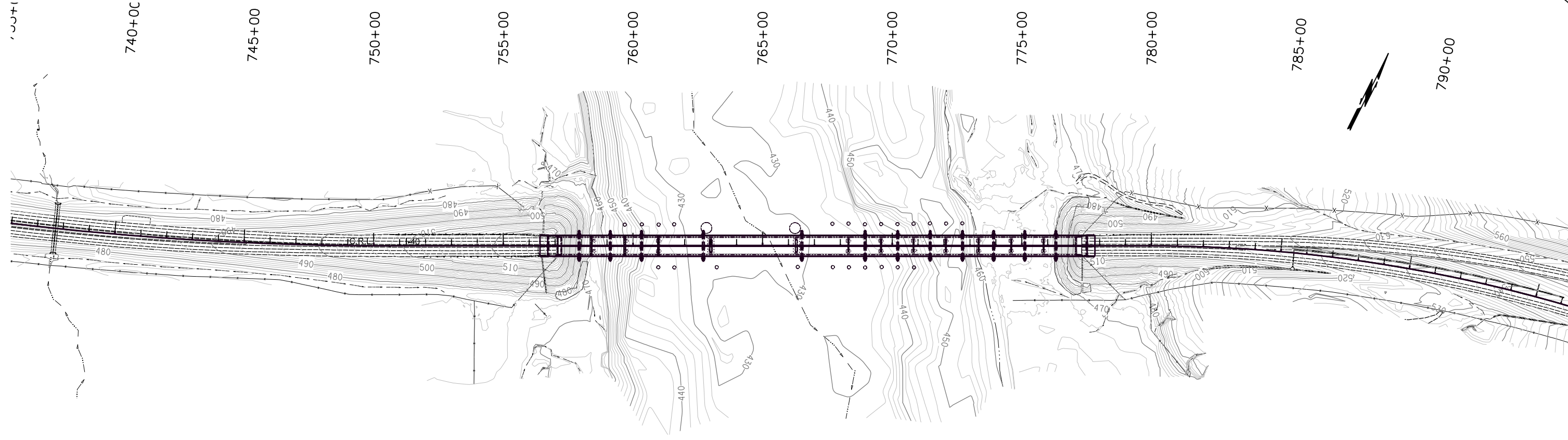
Pier Scour + Contraction Scour (ft):

Left Bank:	39.33
Channel:	42.28
Right Bank:	28.38

Left abut + contr (ft): 50.23

APPENDIX ‘I’

PLAN AND PROFILE

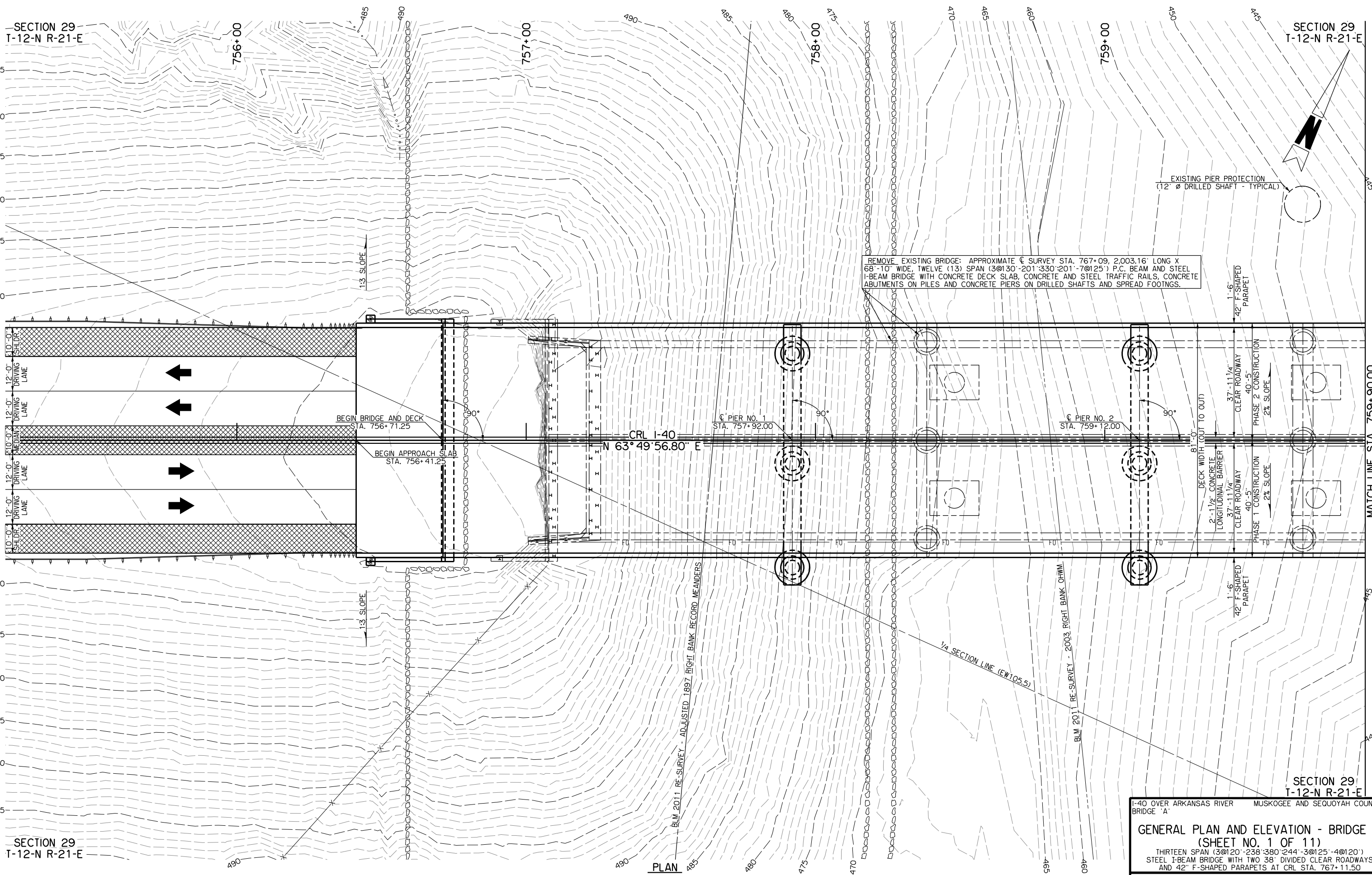


SECTION 29
T-12-N R-21-E

SECTION 29
T-12-N R-21-E

SECTION 29
T-12-N R-21-E

SECTION 29
T-12-N R-21-E



REMOVE EXISTING BRIDGE: APPROXIMATE C SURVEY STA. 767+09, 2,003.16' LONG X 68'-10" WIDE, TWELVE (12) SPAN (3@130'-201'-330'-201'-7@25') P.C. BEAM AND STEEL I-BEAM BRIDGE WITH CONCRETE DECK SLAB, CONCRETE AND STEEL TRAFFIC RAILS, CONCRETE ABUTMENTS ON PILES AND CONCRETE PIERS ON DRILLED SHAFTS AND SPREAD FOOTINGS.

EXISTING PIER PROTECTION
(12" Ø DRILLED SHAFT - TYPICAL)

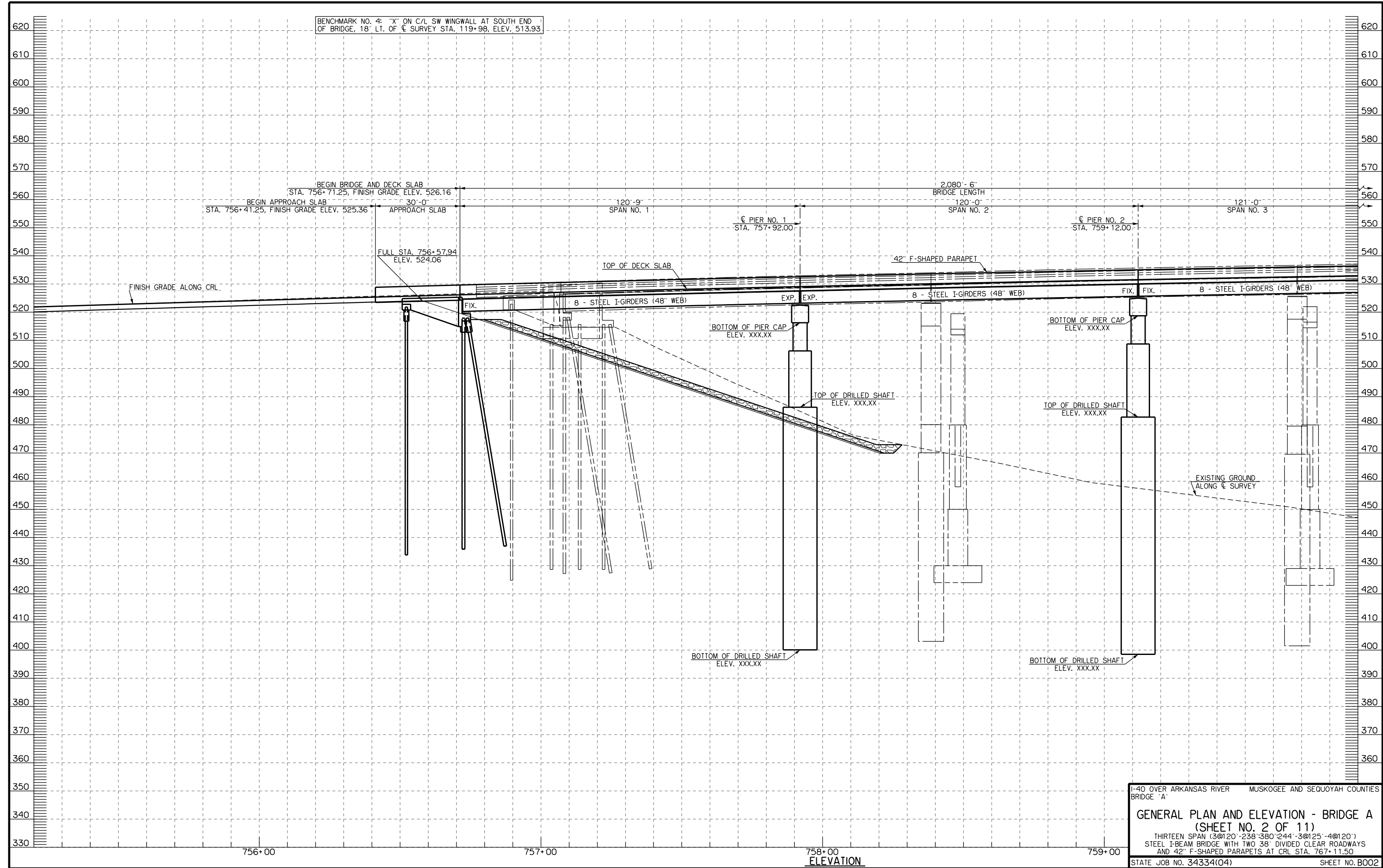
BEGIN BRIDGE AND DECK
STA. 756+71.25

BEGIN APPROACH SLAB
STA. 756+41.25

C PIER NO. 1
STA. 757+92.00

C PIER NO. 2
STA. 759+12.00

I-40 OVER ARKANSAS RIVER MUSKOGEE AND SEQUOYAH COUNTIES
BRIDGE "A"
GENERAL PLAN AND ELEVATION - BRIDGE A
(SHEET NO. 1 OF 11)
THIRTEEN SPAN (3@120'-238'-380'-244'-3@125'-4@120')
STEEL I-BEAM BRIDGE WITH TWO 38' DIVIDED CLEAR ROADWAYS
AND 42" F-SHAPED PARAPETS AT CRL STA. 767+11.50
STATE JOB NO. 34334(04) SHEET NO. B001



SECTION 29
T-12-N R-21-E

SECTION 29
T-12-N R-21-E

MATCH LINE STA. 759+90.00

MATCH LINE STA. 764+60.00

SECTION 29
T-12-N R-21-E

SECTION 29
T-12-N R-21-E

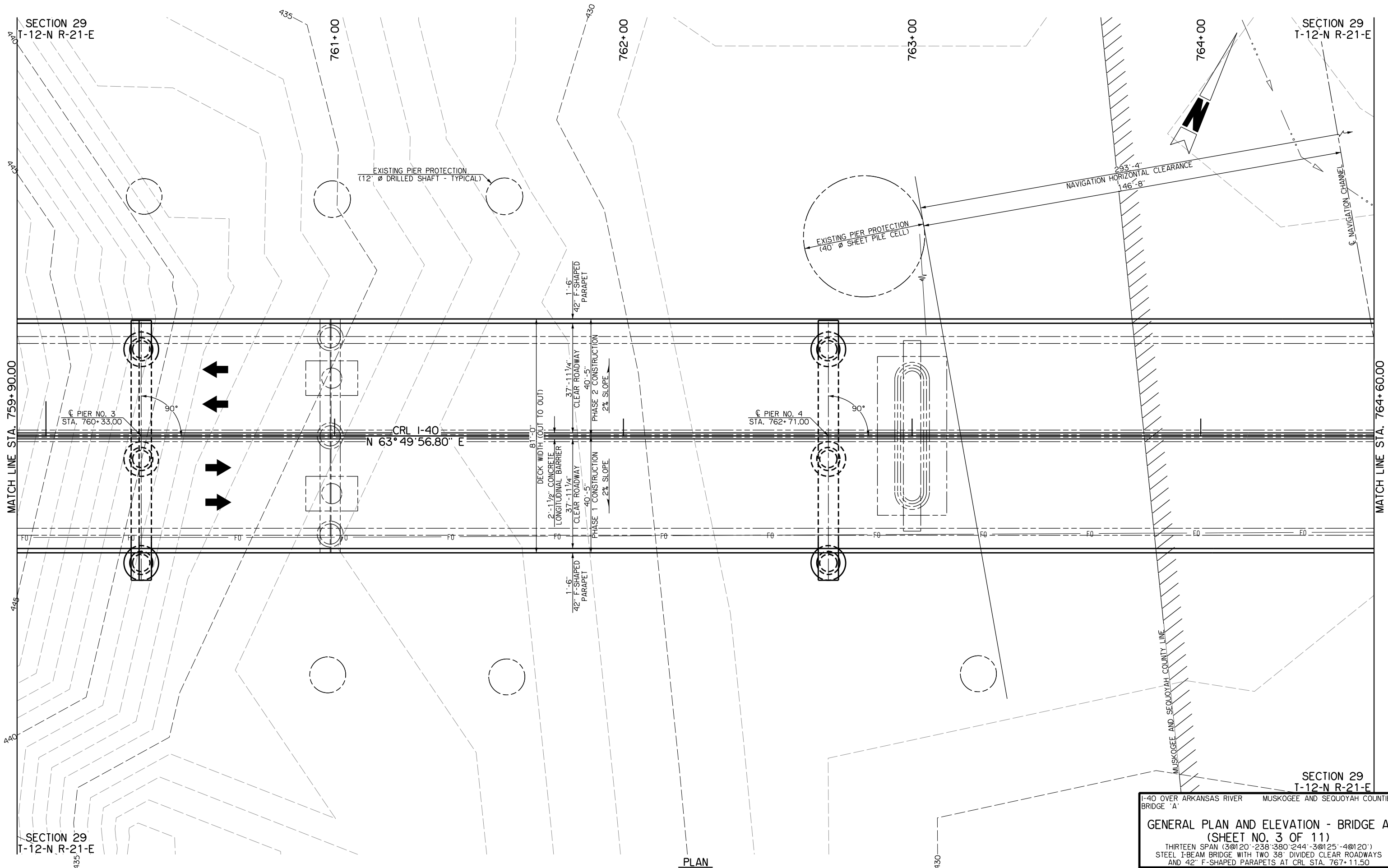
I-40 OVER ARKANSAS RIVER MUSKOGEE AND SEQUOYAH COUNTIES
BRIDGE 'A'

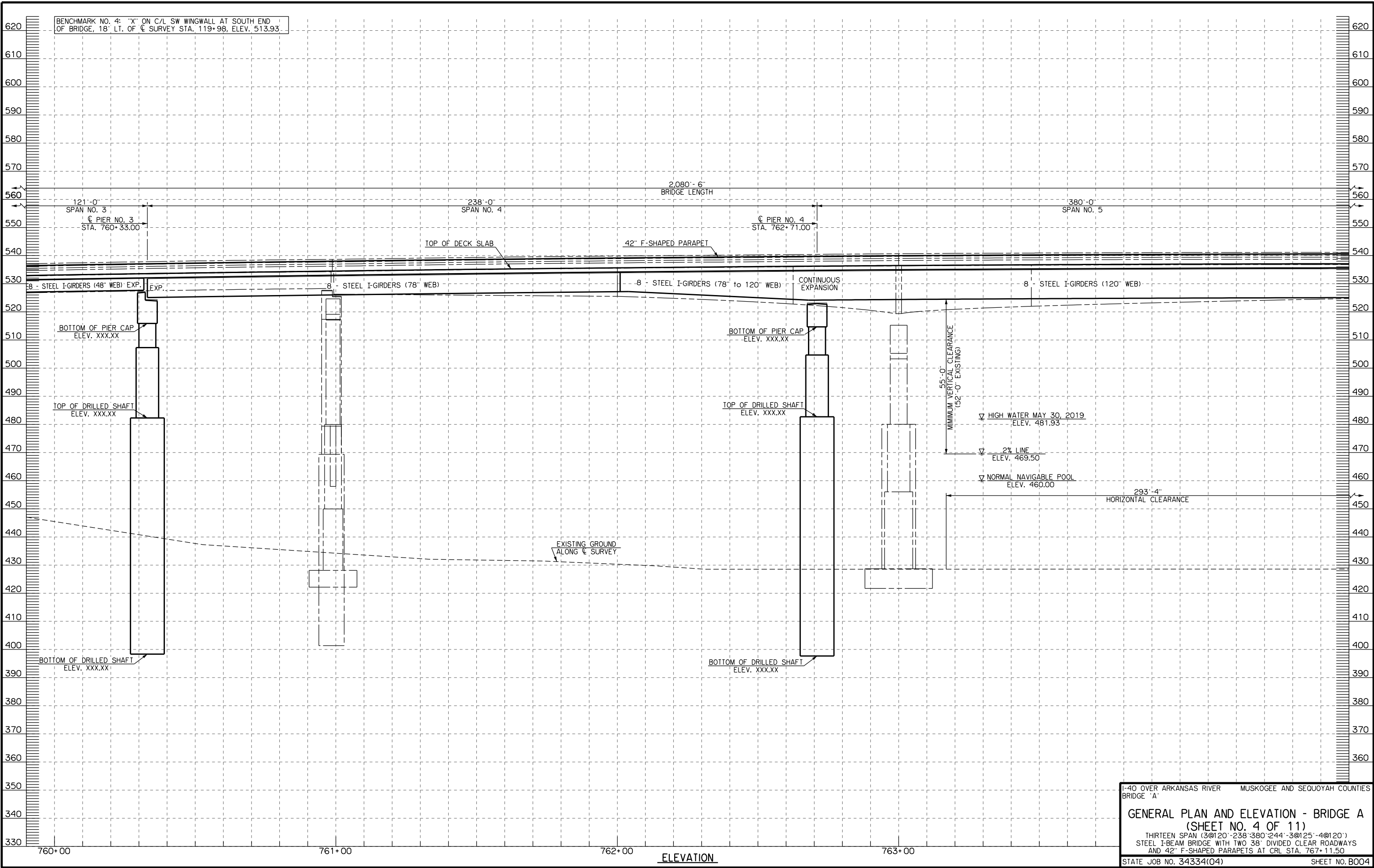
GENERAL PLAN AND ELEVATION - BRIDGE A
(SHEET NO. 3 OF 11)

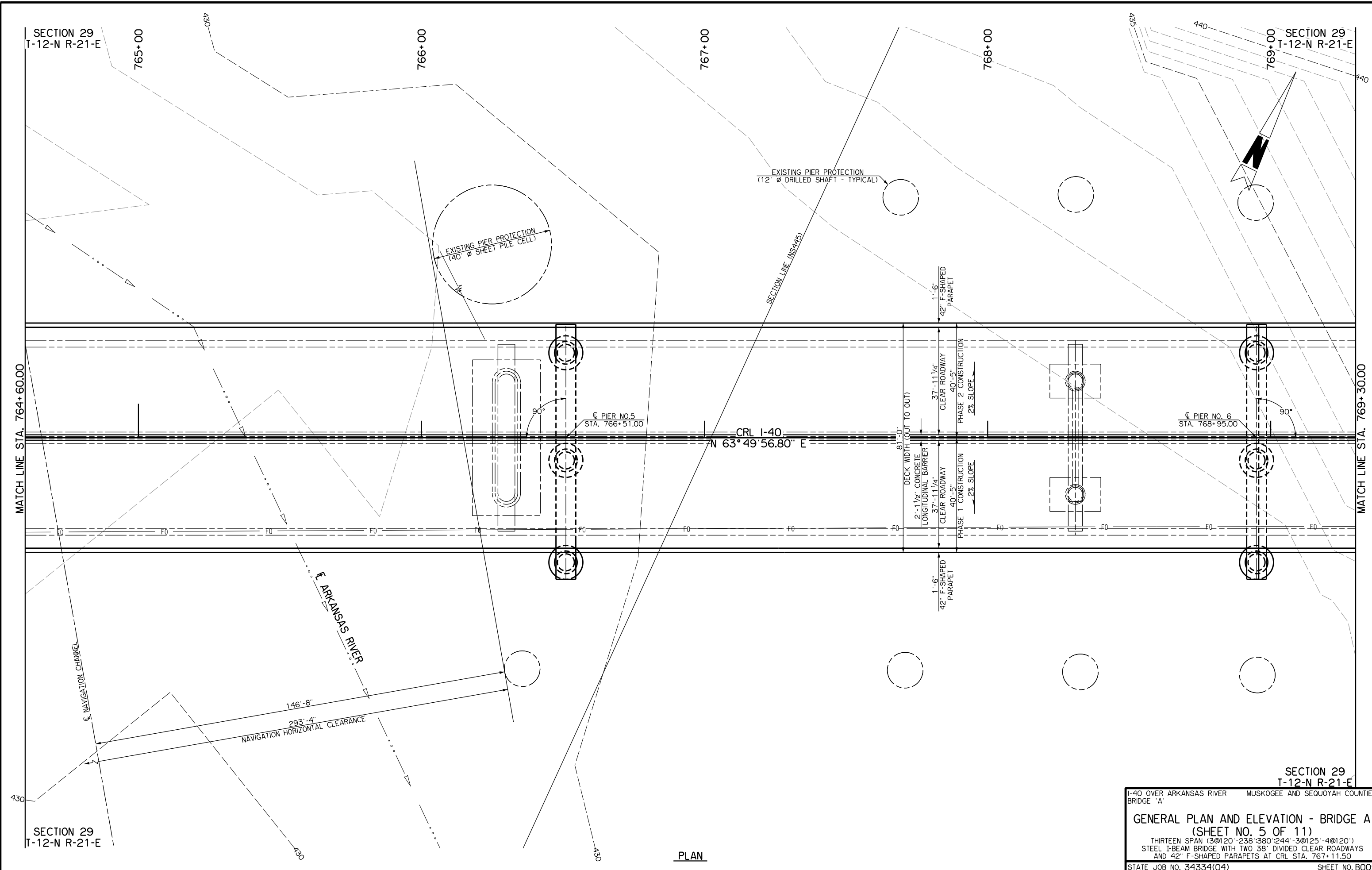
THIRTEEN SPAN (3@120'-238'-380'-244'-3@125'-4@120')
STEEL I-BEAM BRIDGE WITH TWO 38' DIVIDED CLEAR ROADWAYS
AND 42" F-SHAPED PARAPETS AT CRL STA. 767+11.50

STATE JOB NO. 34334(04) SHEET NO. B003

PLAN







PLAN

SECTION 29
T-12-N R-21-E

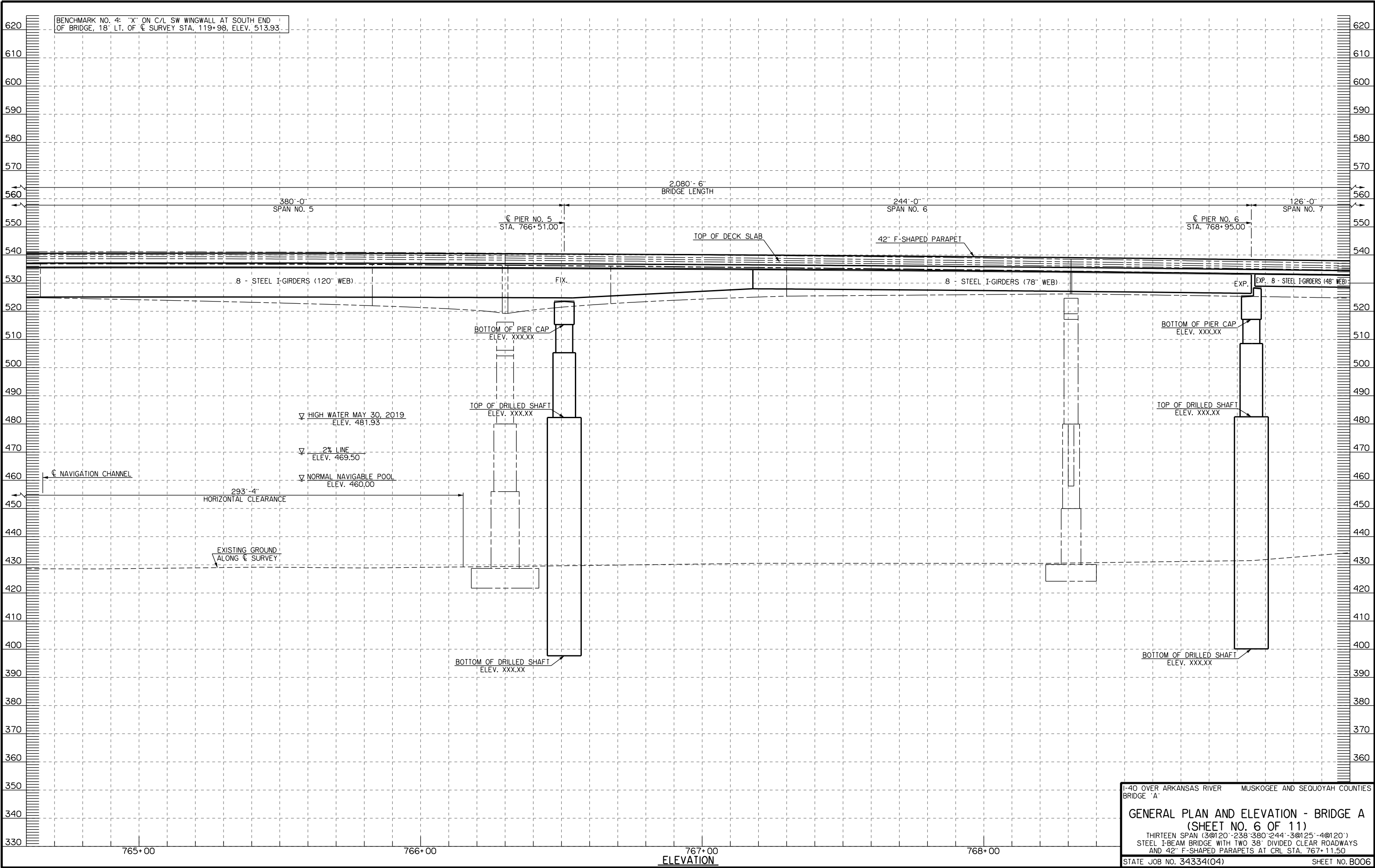
I-40 OVER ARKANSAS RIVER MUSKOGEE AND SEQUOYAH COUNTIES
BRIDGE 'A'

GENERAL PLAN AND ELEVATION - BRIDGE A
(SHEET NO. 5 OF 11)

THIRTEEN SPAN (3@120'-238'-380'-244'-3@125'-4@120')
STEEL I-BEAM BRIDGE WITH TWO 38' DIVIDED CLEAR ROADWAYS
AND 42" F-SHAPED PARAPETS AT CRL STA. 767+11.50

STATE JOB NO. 34334(04)

SHEET NO. 8005



SECTION 29
T-12-N R-21-E

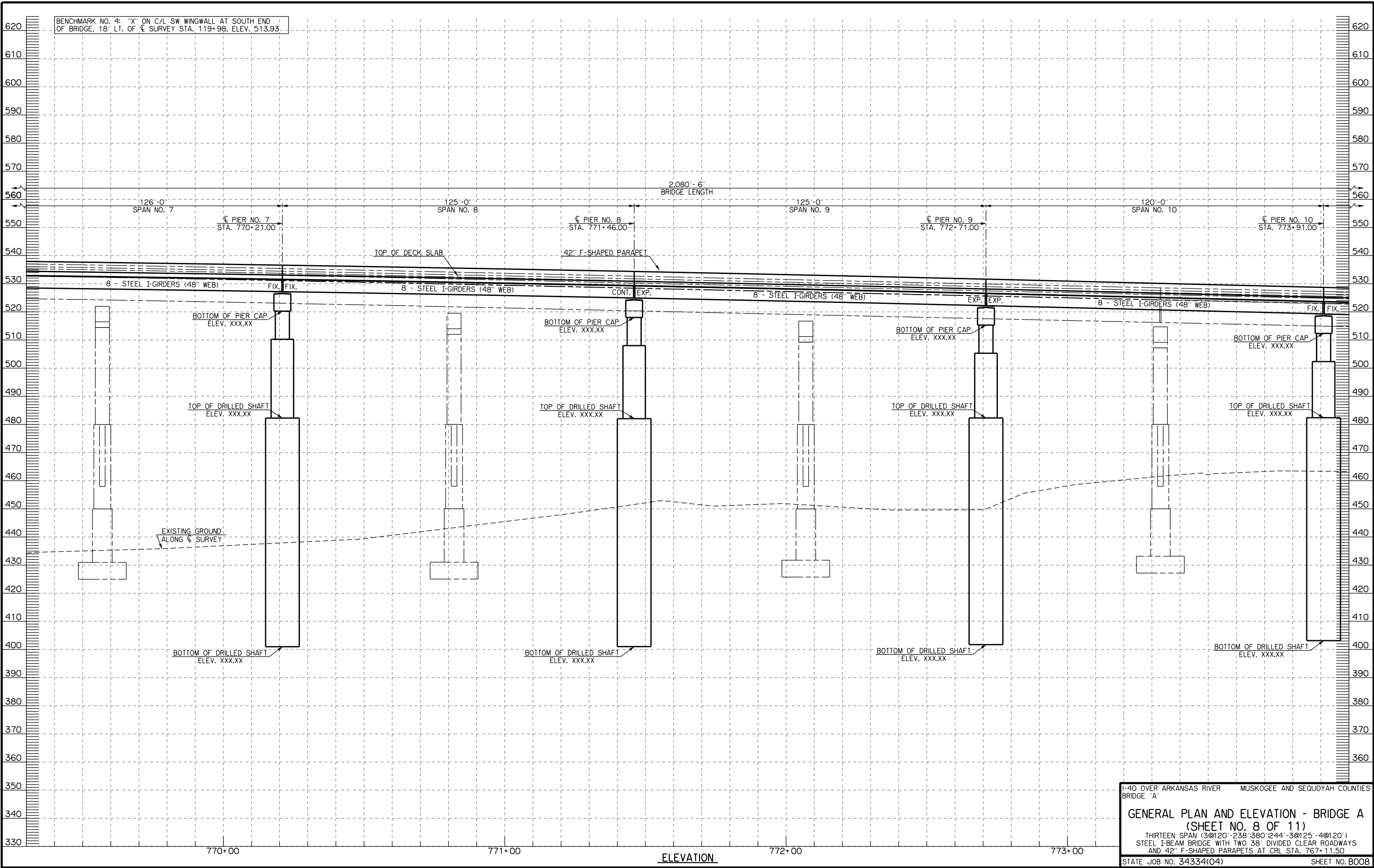
SECTION 29
T-12-N R-21-E

1-40 OVER ARKANSAS RIVER MUSKOGEE AND SEQUOYAH COUNTIES
BRIDGE "A"

GENERAL PLAN AND ELEVATION - BRIDGE A
(SHEET NO. 7 OF 11)

THIRTEEN SPAN (3@120'-238'-380'-244'-3@125'-4@120')
STEEL I-BEAM BRIDGE WITH TWO 38' DIVIDED CLEAR ROADWAYS
AND 42' F-SHAPED PARAPETS AT CRL STA. 767+11.50

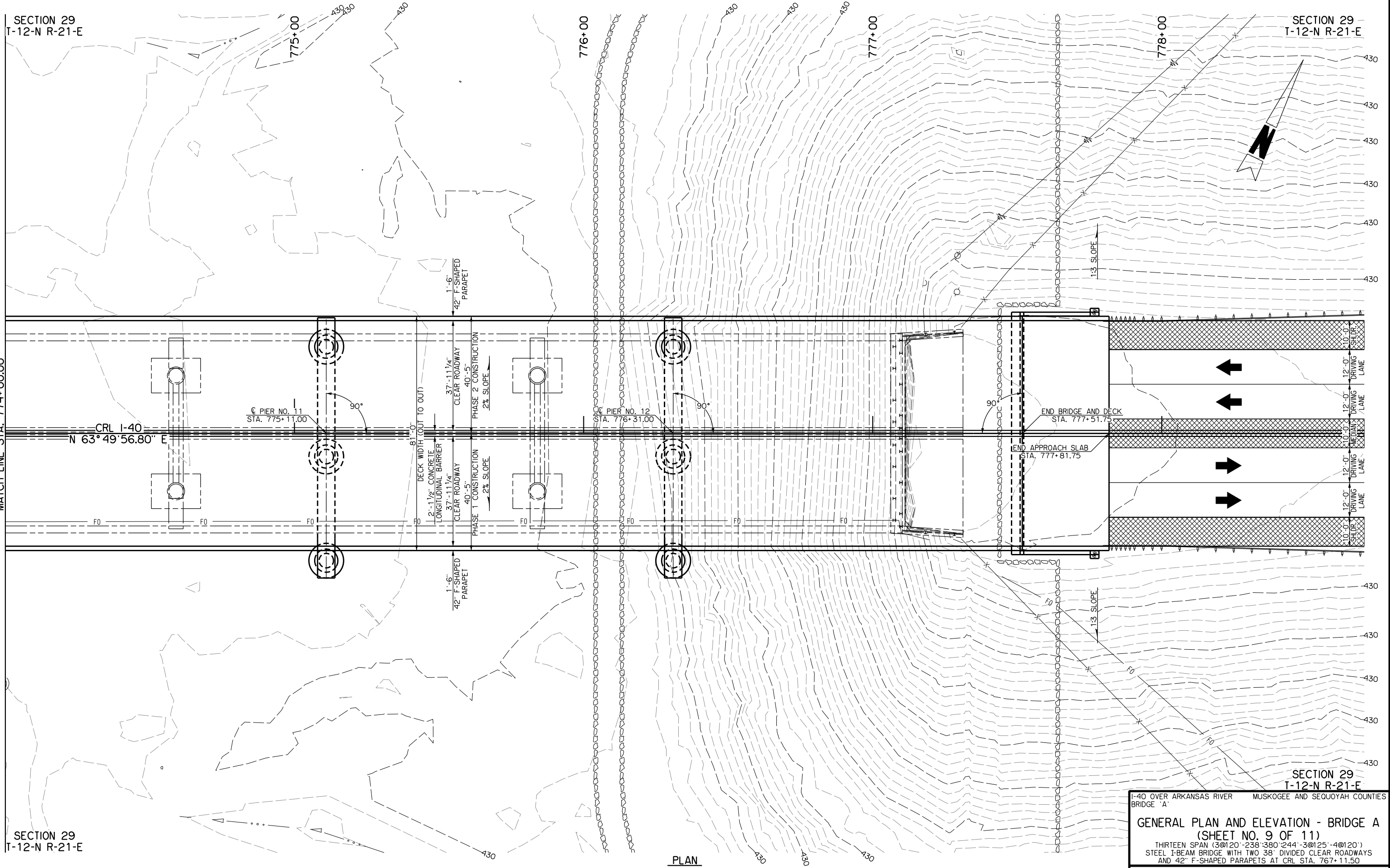
STATE JOB NO. 34334(04) SHEET NO. B007



SECTION 29
T-12-N R-21-E

SECTION 29
T-12-N R-21-E

MATCH LINE STA. 774+00.00



SECTION 29
T-12-N R-21-E

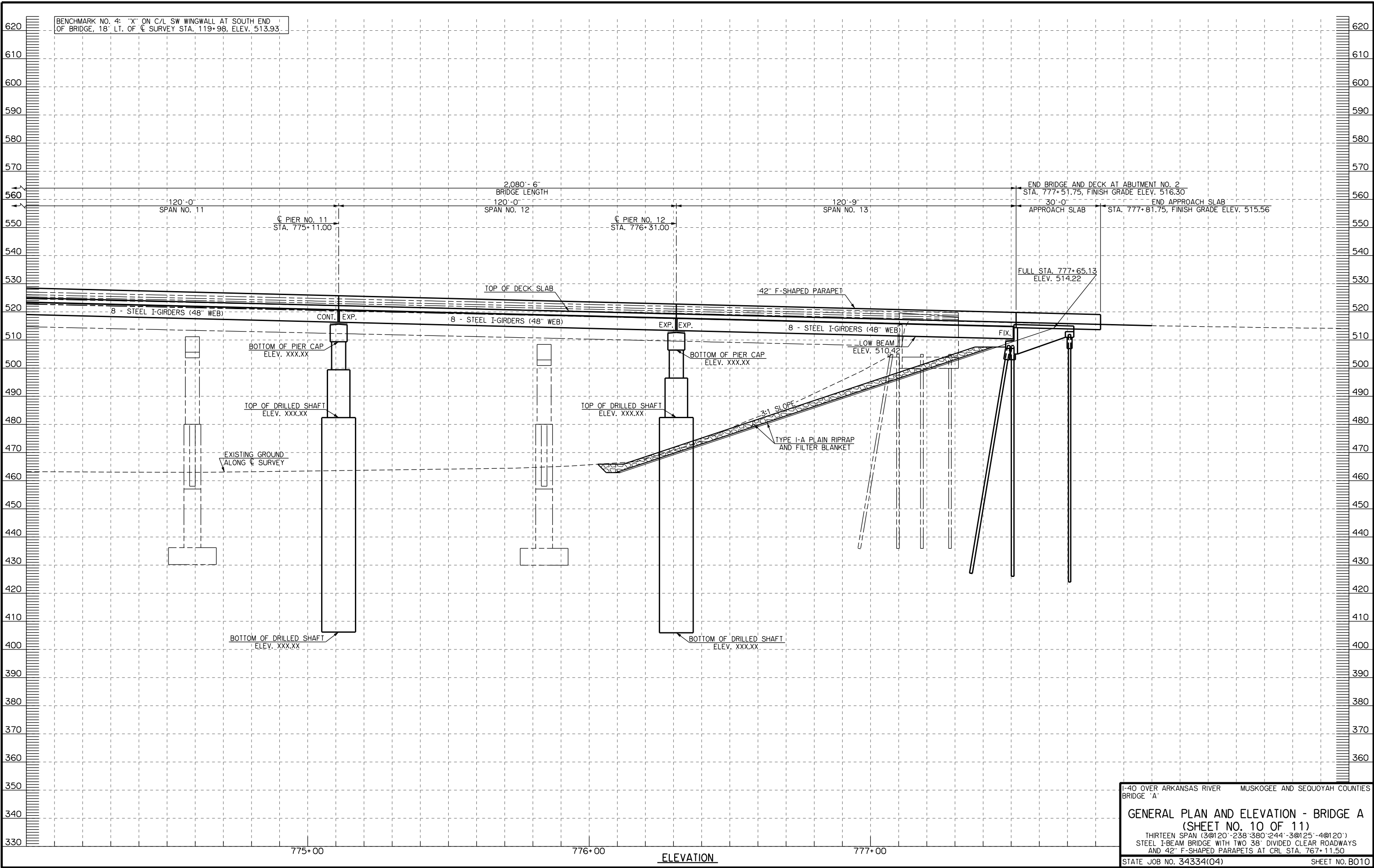
SECTION 29
T-12-N R-21-E

I-40 OVER ARKANSAS RIVER MUSKOGEE AND SEQUOYAH COUNTIES
BRIDGE 'A'

GENERAL PLAN AND ELEVATION - BRIDGE A
(SHEET NO. 9 OF 11)

THIRTEEN SPAN (3@120'-238'-380'-244'-3@125'-4@120')
STEEL I-BEAM BRIDGE WITH TWO 38' DIVIDED CLEAR ROADWAYS
AND 42" F-SHAPED PARAPETS AT CRL STA. 767+11.50

STATE JOB NO. 34334(04) SHEET NO. B009



SUMMARY OF QUANTITIES - BRIDGE 'A'						
ITEM	UNIT	ABUTMENTS	PIERS	SUPERSTRUCTURE	APPROACH SLABS	TOTAL
SUBSTRUCTURE EXCAVATION COMMON	CY	-	-	-	-	-
CLSM BACKFILL	CY	-	-	-	-	-
APPROACH SLAB	SY	-	-	-	-	-
SAW-CUT GROOVING	SY	-	-	-	-	-
42" F-SHAPED PARAPET	LF	-	-	-	-	-
STRUCTURAL STEEL	LB	-	-	-	-	-
STAINLESS STEEL FIXED BEARING ASSEMBLY	EA	-	-	-	-	-
STAINLESS STEEL EXP. BEARING ASSEMBLY	EA	-	-	-	-	-
ELASTOMERIC COATING	SF	-	-	-	-	-
CLASS AA CONCRETE	CY	-	-	-	-	-
CLASS A CONCRETE	CY	-	-	-	-	-
REINFORCING STEEL	LB	-	-	-	-	-
EPOXY COATED REINFORCING STEEL	LB	-	-	-	-	-
PILES, FURNISHED (HP 10X42)	LF	-	-	-	-	-
PILES, FURNISHED (HP 12X53)	LF	-	-	-	-	-
PILES, DRIVEN (HP 10X42)	LF	-	-	-	-	-
PILES, DRIVEN (HP 12X53)	LF	-	-	-	-	-
PILE SPLICE, H-PILE (NON-BIDDABLE)	EA	-	-	-	-	-
WATER REPELLENT (VISUALLY INSPECTED)	SY	-	-	-	-	-
DRILLED SHAFTS 144" DIAMETER	LF	-	-	-	-	-
CROSSHOLE SONIC LOGGING	EA	-	-	-	-	-
SEALED EXPANSION JOINTS	LF	-	-	-	-	-
SEALER CRACK PREPARATION	LF	-	-	-	-	-
SEALER RESIN	GAL	-	-	-	-	-
6" PERFORATED PIPE UNDERDRAIN ROUND	LF	-	-	-	-	-
6" NON-PERF. PIPE UNDERDRAIN RND.	LF	-	-	-	-	-

INDEX OF SHEETS

SHEET NO.	SHEET DESCRIPTION
AB01, AB02	NOTES AND SUMMARY OF PAY QUANTITIES - BRIDGE
BO01-BO11	GENERAL PLAN AND ELEVATION - BRIDGE A
BO12-BO15	BRIDGE CONSTRUCTION SEQUENCING

REQUIRED STANDARD DRAWINGS

2009 ROADWAY	2009 BRIDGE
LECS-5-2	FSHP-42-2-00E
PED-4-1	EJ-SQ-04E
PUD-4-1	EJ-DTL-02E
	HP1-2-01E

UTILITIES

COMMUNICATIONS:
DOBSON FIBER: 855-536-2766
MBO VIDEO/EARLSBORO: 877-777-8941
CROSS TELEPHONE COMPANY: 800-828-6567
CENTURY LINK INTERNET: 833-544-2540

ELECTRIC:
COOKSON HILLS ELECTRIC: 800-328-2368
EAST CENTRAL OKLAHOMA ELEC.: 918-756-0833

PETROLEUM:
ONEOK GAS TRANSPORT: 405-756-2600

STRUCTURAL DESIGN DATA

MATERIAL:
CLASS A CONCRETE, f'c = 3,000 PSI
CLASS AA CONCRETE, f'c = 4,000 PSI
REINFORCING STEEL, fy = 60,000 PSI
STRUCTURAL STEEL M270 (GRADE 50W), Fy = 50,000 PSI
STAINLESS STEEL A240 (TYPE 316), Fy = 30,000 PSI

LOADING:
AASHTO HL-93
OKLAHOMA DOT 9 AXLE OVERLOAD TRUCK (175 KIP)
OKLAHOMA DOT 16 AXLE OVERLOAD TRUCK (315 KIP)
20 PSF FUTURE WEARING SURFACE

DESIGN:
AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, 9TH EDITION
ANSI/AASHTO/AWS D1.5 BRIDGE WELDING CODE
ANSI/AWS D1.6 STRUCTURAL WELDING CODE - STAINLESS STEEL

HL-93 INVENTORY RATING FACTOR: X.XX
HL-93 OPERATING RATING FACTOR: X.XX

FOUNDATION DESIGN DATA - ABUTMENT PILES		
ABUTMENT NO.	1	2
MAXIMUM FACTORED PILE LOAD (TONS/PILE)	XX	XX

ALL ABUTMENT PILING SHALL BE DRIVEN THROUGH THE COMPACTED FILL. PILING SHALL BE DRIVEN TO POINT BEARING ON SOLID FOUNDATION MATERIAL AT THE APPROXIMATE ELEVATION SHOWN IN THE PLANS. IF THE MAXIMUM FACTORED PILE LOAD IS NOT OBTAINED AT THIS ELEVATION, DRIVING SHALL CONTINUE UNTIL THE MAXIMUM FACTORED PILE LOAD IS OBTAINED. THE LENGTH OF STEEL PILING SHOWN IN THE PLANS IS FOR ESTIMATING PURPOSES ONLY.

FOUNDATION DESIGN DATA - DRILLED SHAFTS

FOUNDATION DESIGN DATA - DRILLED SHAFTS												
PIER NO.	1	2	3	4	5	6	7	8	9	10	11	12
DRILLED SHAFT DIAMETER (INCHES)	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
FACTORED REACTION (TONS/SHAFT)	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
UNIT BEARING	UNIT RESISTANCE (TSF)	XX.X	XX.X	XX.X	XX.X	XX.X	XX.X	XX.X	XX.X	XX.X	XX.X	XX.X
	RESISTANCE FACTOR	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
	FACTORED RESISTANCE (TONS/SHAFT)	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
SIDE FRICTION	UNIT RESISTANCE (TSF)	X.XX	X.XX	X.XX	X.XX	X.XX	X.XX	X.XX	X.XX	X.XX	X.XX	X.XX
	RESISTANCE FACTOR	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
	FACTORED RESISTANCE (TONS/SHAFT)	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	DEPTH OF ROCK NEGLECTED (FEET)	X.X	X.X	X.X	X.X	X.X	X.X	X.X	X.X	X.X	X.X	X.X
TOTAL FACTORED RESISTANCE (TONS/SHAFT)												
X,XXX X,XXX X,XXX X,XXX X,XXX X,XXX X,XXX X,XXX X,XXX X,XXX X,XXX X,XXX												

HYDRAULIC DATA

DRAINAGE AREA (SQ. MI.)		86,849	
CONTROLLED DRAINAGE AREA (SQ. MI.)		0.00	
EFFECTIVE DRAINAGE AREA (SQ. MI.)		86,849	
FREQUENCY	Q (CFS)	CHW (FT.)	V (FPS)
2	172,100	459.15	5.84
5	271,400	467.36	6.65
10	324,600	470.97	7.04
25	403,500	474.74	7.83
50	462,900	477.13	8.44
100	521,200	478.88	9.13
0T+500	660,500	482.10	10.84

SCOUR DEPTH (FT.)

FREQUENCY	CONTRACTION	PIER	TOTAL
100	9.26	26.49	35.76
0T+500	13.90	28.38	42.28

I-40 OVER ARKANSAS RIVER MUSKOGEE AND SEQUOYAH COUNTIES
BRIDGE 'A'

GENERAL PLAN AND ELEVATION - BRIDGE A
(SHEET NO. 11 OF 11)

THIRTEEN SPAN (3@120'-238'-380'-244'-3@125'-4@120')
STEEL I-BEAM BRIDGE WITH TWO 38' DIVIDED CLEAR ROADWAYS
AND 42' F-SHAPED PARAPETS AT CRL STA. 767+11.50