

## Bridge 06415 Inspection Report



Latitude:34.06785, Longitude:-93.96717

Route:278 Section:03 Log:6.49

Arnold Road ID:31x278x3xA, Arnold Log mile:6.492

District 03, 61 - Howard County

Owner: 1 - State Highway Agency

Inspection Direction: 1 - N to S

**Bridge Posting Information**

41 - Structure Open/Posted/Closed: A - Open, no restriction

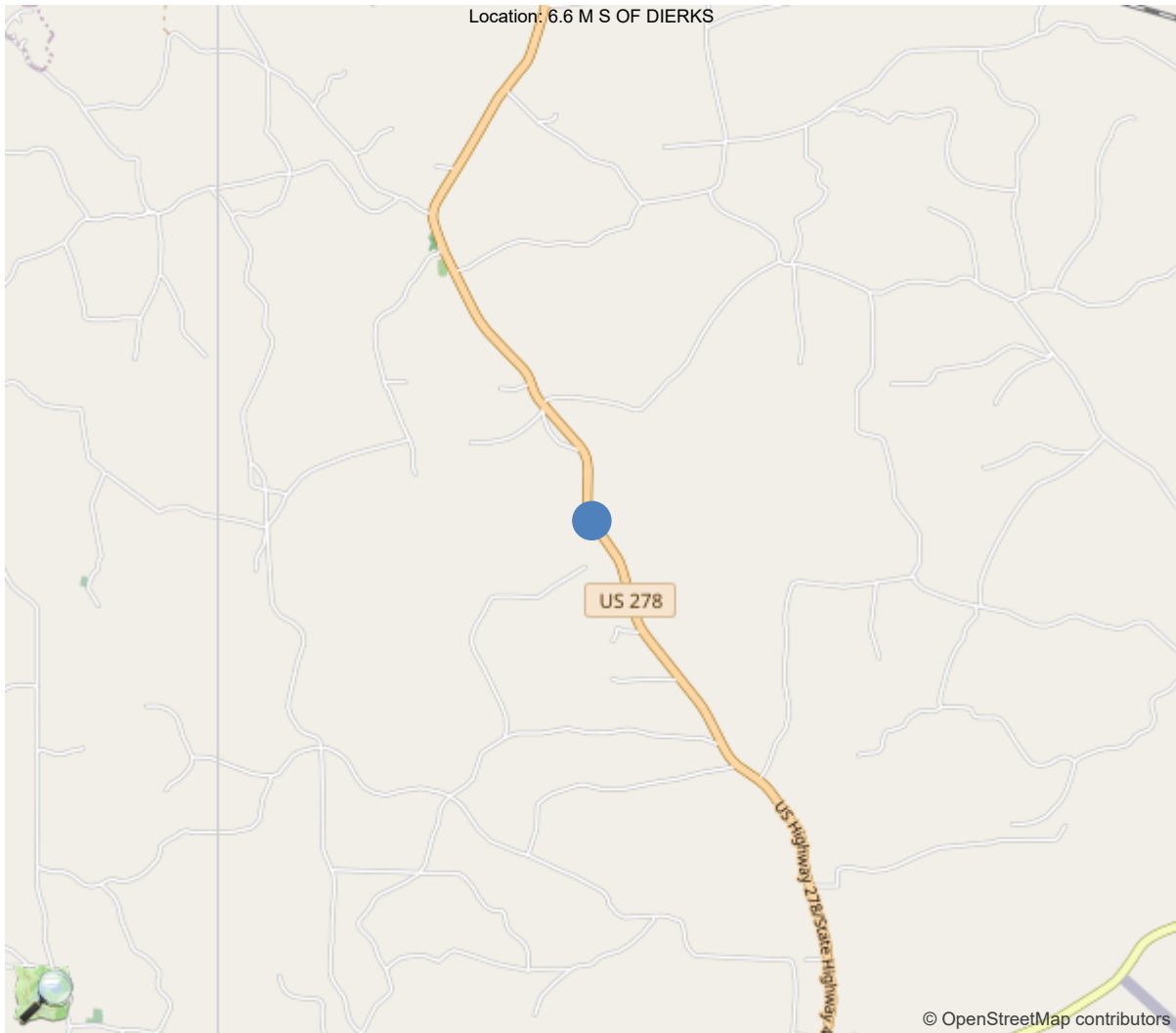
70 - Bridge Posting: 5 - Equal to or above legal loads

Legal Load	Calculated Capacity	Beginning of Bridge Sign Current Value	End of Bridge Sign Current Value
Code 4 (22 Tons)	40		
Code 9 (31 Tons)	50		
Code 5 (40 Tons)	60		

If calculated capacity is less than the Legal Load Listed, the Bridge Legally Requires Posting Signs to be installed by the Bridge Owner.



30"x36" AR



34.06785, -93.96717





Asset #06415(POA Scour Assessment Evaluation)

US 278- 03- 6.63 over MESSER CREEK

Location: 6.6 M S OF DIERKS

Team Lead: Anahi Mendez Inspection Date: 01/06/2025

## National Bridge Inventory Data Sheet

IDENTIFICATION	
(1) State Names	5 - Arkansas
(8) Structure Number	06415
(5) Inventory Route	1
(2) Highway Agency District	03 - District 03
(3) County Code	61 - Howard County
(4) Place Code	0
(6) Features Intersected	MESSER CREEK
(7) Facility Carried	US 278- 03- 6.63
(9) Location	6.6 M S OF DIERKS
(11) Mile Point	6.49 mi
(12) Base Highway Network	No
(13) LRS Inventory Rte & Subrte	0000000000
(16) Latitude	34.067848
(17) Longitude	-93.967171
(98) Border Bridge State Code	
(99) Border Bridge Structure No.	
STRUCTURE TYPE AND MATERIAL	
(43) Main Structure Type	14
Material	1 - Concrete
Type	4 - Tee beam
(44) Approach Structure Type	00
Material	0 - Other
Type	0 - Other
(45) No. of Spans in Main Unit	4
(46) No. of Approach Spans	0
(107) Deck Structure Type	1 - Concrete Cast-in-Place
(108) Wearing Surface/Protective System	
Type of Wearing Surface	1 - Monolithic Concrete (concurrently pl
Type of Membrane	0 - None
Type of Deck Protection	0 - None
AGE AND SERVICE	
(27) Year Built	1993
(106) Year Reconstructed	0
(42) Type of Service	15
On	1 - Highway
Under	5 - Waterway
(28) Lane	
On	2
Under	0
(29) Average Daily Traffic	1600
(30) Year of ADT	2018
(109) Truck ADT	1 %
(19) Bypass, Detour Length	32 mi
GEOMETRIC DATA	
(48) Length of Maximum Span	35 ft
(49) Structure Length	140 ft
(50) Curb or Sidewalk Width	
Left	0 ft
Right	0 ft
(51) Bridge Roadway Width Curb to Curb	32.2 ft
(52) Deck Width Out to Out	34.8 ft
(32) Approach Roadway Width (W/Shoulders)	40 ft
(33) Bridge Median	0 - No median
(34) Skew	28 Deg
(35) Structure Flared	0 - No flare
(10) Inventory Route Min Vert Clear	99.99 ft
(47) Inventory Route Total Horiz Clear	32.2 ft
(53) Min Vert Clear Over Bridge Rdwy	99.99 ft
(54) Min Vert Underclear	0 ft
Ref:	
(55) Min Lat Underclear RT	99.9 ft
Ref:	
(56) Min Lat Underclear LT	0 ft
NAVIGATION DATA	
(38) Navigation Control	0 - No navigation control on w
(111) Pier Protection	1 - Navigation protection not
(39) Navigation Vertical Clearance	0 ft
(116) Vert-Lift Bridge Nav Min Vert Clear	0 ft
(40) Navigation Horizontal Clearance	0 ft

CLASSIFICATION	
(112) NBIS Bridge Length	Y
(104) Highway System	0
(26) Functional Class	7 - Rural Major Collector
(100) Defense Highway	0 - The inventory route is not
(101) Parallel Structure	N - No parallel structure exists
(102) Direction of Traffic	2 - way traffic
(103) Temporary Structure	
(105) Federal Lands Highways	0 - N/A
(110) Designated National Network	0 - The inventory route is not
(20) Toll	3 - On free road. The structure
(21) Maintain	1 - State Highway Agency
(22) Owner	1 - State Highway Agency
(37) Historical Significance	5 - Bridge is not eligible for
CONDITION	
(58) Deck	6
(59) Superstructure	7
(60) Substructure	7
(61) Channel & Channel Protection	6
(62) Culverts	N
LOAD RATING AND POSTING	
(31) Design Load	5 - MS 18 / HS 20
(63) Operating Rating Method	1
(64) Operating Rating	
Type	1 - Load Factor(LF)
Rating	60
(65) Inventory Rating Method	1 - Load Factor(LF)
(66) Inventory Rating	
Type	
Rating	36
(70) Bridge Posting	5 - Equal to or above legal loads
(41) Structure Open/Posted/Closed	A - Open, no restriction
APPRAISAL	
(67) Structural Evaluation	
(68) Deck Geometry	5
(69) Clearances, Vertical/Horizontal	N
(71) Waterway Adequacy	8
(72) Approach Roadway Alignment	8
(36A) Bridge Railings	1 - Inspected feature meets current
(36B) Transitions	1 - Inspected feature meets current
(36C) Approach Guardrail	1 - Inspected feature meets current
(36D) Approach Guardrail Ends	1 - Inspected feature meets current
(113) Scour Critical Bridges	3 - Bridge is scour critical; bridge
PROPOSED IMPROVEMENTS	
(75) Type of Work	
(76) Length of Structure Improvement	0 ft
(94) Bridge Improvement Cost	\$ 0
(95) Roadway Improvement Cost	\$ 0
(96) Total Project Cost	\$ 0
(97) Year of Improvement Cost Estimate	0
(114) Future ADT	1809
(115) Year of Future ADT	2028

INSPECTIONS *			
(90) Inspection Date			04/15/2024
(91) Frequency			24
(92) Critical Feature Inspection	Done	Freq. (Mon)	Date
A: Fracture Critical Detail	No		
B: Underwater Inspection	No		
C: Other Special Inspection	No		
* The inspection date and frequency information in this box contains the current NBI date and frequency information. Please refer to the report header for the date this inspection was conducted.			





Team Lead: Anahi Mendez, Inspection Date: 01/06/2025

## Specifications for National Bridge Inventory Sheets

IDENTIFICATION	
B.ID.01 Bridge Number	06415
B.ID.02 Bridge Name	
B.ID.03 Previous Bridge No.	01870
B.W.01 Year Built	1993

LOCATION	
B.L.01 State Code	5 - Arkansas
B.L.02 County Code	61 - Howard County
B.L.03 Place Code	00000 - N/A
B.L.04 Highway Agency District	03 - District 03
B.L.05 Latitude	34.067848
B.L.06 Longitude	-93.967171
B.L.07 Border Bridge Number	
B.L.08 Border Bridge State or Country Code	
B.L.09 Border Bridge Insp. Resp.	
B.L.10 Border Bridge Designated Lead State	
B.L.11 Bridge Location	6.6 M S OF DIERKS
B.L.12 Metropolitan Planning Organization	

CLASSIFICATION	
B.CL.01 Owner	S01 - State transportation departme
B.CL.02 Maint. Responsibility	S01 - State transportation departme
B.CL.03 Federal or Tribal Land Access	N - Not Applicable
B.CL.04 Historic Significance	N - Bridge is not eligible for the
B.CL.05 Toll	N - Bridge does not carry a toll ro
B.CL.06 Emergency Evacuation Designation	

ROADSIDE HARDWARE	
B.RH.01A Bridge Railing Type	
B.RH.01B Bridge Railing Year (YY)	
B.RH.01C Bridge Railing Test Level	
B.RH.02A Transition Type	
B.RH.02B Transition Year (YY)	
B.RH.02C Transition Test Level	

BRIDGE GEOMETRY	
B.G.01 NBIS Bridge Length	140
B.G.02 Total Bridge Length	140.1
B.G.03 Max Span Length	35.1
B.G.04 Min Span Length	35
B.G.05 Bridge Width Out-to-Out	34.8
B.G.06 Bridge Width Curb-to-Curb	32.2
B.G.07 Left Curb or Sidewalk Width	0
B.G.08 Right Curb or Sidewalk Width	0
B.G.09 Approach Roadway Width	40

B.G.10 Bridge Median	0 - No median
B.G.11 Skew	28
B.G.12 Curved Bridge	CP - Piecewise straight girders
B.G.13 Max Bridge Height	18
B.G.14 Sidehill Bridge	N - Not a sidehill bridge
B.G.15 Irregular Deck Area	
B.G.16 Calculated Deck Area	4872

LOADS AND LOAD RATING	
B.LR.01 Design Load	HS20 - HS-20
B.LR.02 Design Method	
B.LR.03 Load Rating Date	
B.LR.04 Load Rating Method	LFR - Load Factor Rating
B.LR.05 Inventory Load Rating Factor	1
B.LR.06 Operating Load Rating Factor	1.67
B.LR.07 Controlling Legal Load Rating Factor	
B.LR.08 Routine Permit Loads	

INSPECTION REQUIREMENTS	
B.IR.01 NSTM Inspection Required	N - NSTM inspection not required.
B.IR.02 Fatigue Details	
B.IR.03 UW Inspection Required	N - Underwater inspection not requi
B.IR.04 Complex Feature	N - Bridge does not have complex fe

COMPONENT CONDITION RATINGS	
B.C.01 Deck Condition Rating	6 - SATISFACTORY - Widespread
B.C.02 Superstructure Condition	7 - GOOD - Some minor defects.
B.C.03 Substructure Condition	7 - GOOD - Some minor defects.
B.C.04 Culvert Condition	N - NOT APPLICABLE - Component
B.C.05 Bridge Railing Condition	7 - GOOD - Some minor defects.
B.C.06 Bridge Railing Transitions Condition	7 - GOOD - Some minor defects.
B.C.07 Bridge Bearings Cond.	N - NOT APPLICABLE - Component
B.C.08 Bridge Joints Condition	7 - GOOD - Some minor defects.
B.C.09 Channel Condition Rating	6 - SATISFACTORY - Widespread
B.C.10 Channel Protection Condition	N - NOT APPLICABLE - Bridge do
B.C.11 Scour Condition Rating	6 - Widespread minor or isolat
B.C.12 Bridge Condition Classification	F - Fair
B.C.13 Lowest Condition Rating	6 - SATISFACTORY - Widespread
B.C.14 NSTM Insp. Condition	
B.C.15 UW Inspection Condition	

APPRAISAL	
B.AP.01 Approach Roadway Alignment	G - Good
B.AP.02 Overtopping Likelihood	1 - Remote - once every 100 years o
B.AP.03 Scour Vulnerability	D - Scour appraisal completed. Brid
B.AP.04 Scour Plan of Action	Y - A scour POA is required and imp
B.AP.05 Seismic Vulnerability	A - Seismic evaluation completed. B

SPAN SETS			
<b>M1</b>			
B.SP.02 # of Spans	4	B.SP.08 Deck Interaction	IM - Integral or monolithic
B.SP.03 # of Beam Lines	4	B.SP.09 Deck Material and Type	CR-T - TEMP - concrete cast-in
B.SP.04 Span Material	C01 - Reinforced concrete - ca	B.SP.10 Wearing Surface	C01 - Concrete - monolithic
B.SP.05 Span Continuity	1 - Simple or single span	B.SP.11 Deck Protective System	CX - Coating - other
B.SP.06 Span Type	G03 - Girder/beam - tee-beam	B.SP.12 Deck Reinforcing Protective System	0 - None
B.SP.07 Span Protective System	0 - None	B.SP.13 Deck Stay-In-Place Forms	0 - None

SUBSTRUCTURE SETS			
<b>A1</b>			
B.SB.02 No. of Substructure Units	2	B.SB.05 Substructure Protective System	0 - None
B.SB.03 Substructure Material	C01 - Reinforced concrete - ca	B.SB.06 Foundation Type	P01 - Pile - steel H-shape
B.SB.04 Substructure Type	A02 - Abutment - stub	B.SB.07 Foundation Protective System	0 - None
<b>P1</b>			
B.SB.02 No. of Substructure Units	3	B.SB.05 Substructure Protective System	0 - None
B.SB.03 Substructure Material	C01 - Reinforced concrete - ca	B.SB.06 Foundation Type	F01 - Footing - not on rock
B.SB.04 Substructure Type	B01 - Bent - column or open	B.SB.07 Foundation Protective System	0 - None

HIGHWAY FEATURES			
<b>H1</b>			
B.F.02 Feature Location	C - Carried on bridge	B.H.09 Annual ADT	1600
B.F.03 Feature Name	US 278- 03- 6.63	B.H.10 Annual ADTT	16
B.H.01 Functional Classification	5 - Major Collector	B.H.11 Year of Annual ADT	2018
B.H.02 Urban Code	99999	B.H.12 Highway Max Usable Vertical Clearance	99.9
B.H.03 NHS Designation	N - Non-NHS	B.H.13 Highway Min Vertical Clearance	99.9
B.H.04 National Highway Freight Network	N - Not on the NHFN	B.H.14 Highway Min Horizontal Clearance, Left	
B.H.05 STRAHNET Designation	N - Not a STRAHNET route	B.H.15 Highway Min Horizontal Clearance, Right	
B.H.06 LRS Route ID		B.H.16 Highway Max Usable Surface Width	32.1
B.H.07 LRS Mile Point	6.49	B.H.17 Bypass Detour Length	32
B.H.08 Lanes On Highway	2	B.H.18 Crossing Bridge Number	

HIGHWAY ROUTES					
Highway Parent	B.RT.01 Route Designation	B.RT.02 Route Number	B.RT.03 Route Direction	B.RT.04 Route Type	B.RT.05 Service Type
H1	1	278	2-T - TEMP - Two-way traffic - NS or EW	2 - U.S. route	1 - Mainline



Team Lead: Anahi Mendez, Inspection Date: 01/06/2025

## WATERWAY FEATURES

W1

B.F.02 Feature Location	B - Below bridge	B.N.03 Movable Bridge Max Navigation Vertical Clearance	
B.F.03 Feature Name	Messer Creek	B.N.04 Navigation Channel Width	
B.N.01 Navigable Waterway	N - Not navigable waters	B.N.05 Navigation Channel Min Horizontal Clearance	
B.N.02 Navigation Min Vertical Clearance		B.N.06 Substructure Navigation Protection	

## POSTING STATUS DATA

B.PS.01 Load Posting Status	B.PS.02 Posting Status Change Date
PO - Permanent and Open	

## LOAD EVALUATION AND POSTING

B.EP.01 Legal Load Configuration	B.EP.02 Legal Load Rating Factor	B.EP.03 Posting Type	B.EP.04 Posting Value
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### Inspection Notes

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**58 - Deck** (6 - SATISFACTORY CONDITION - structural elements show some minor deterioration.)

Deck rating is a 6 this inspection due to deck cracking throughout all spans. The undersurface of the concrete bridge deck has various locations of cracking with efflorescence throughout all spans.

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**59 - Superstructure** (7 - GOOD CONDITION - some minor problems.)

Superstructure rating is a 7 this inspection due to minor defects to the concrete tee beams. The concrete diaphragms above all end bents and intermediate bents have cracking with efflorescence throughout various locations.

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**60 - Substructure** (7 - GOOD CONDITION - some minor problems.)

Substructure rating is a 7 this inspection due to a minor spall that is located to the left side of the bent 2 concrete cap.

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**61 - Channel/Channel Protection** (6 - Bank is beginning to slump. River control devices and embankment protection have widespread minor damage. There is minor stream bed movement evident. Debris is restricting the channel slightly.)  
Channel rating is a 6 this inspection due to evident streambank movement as well as a large log jam that is restricting the channel flow at intermediate bents 2 & 3. Soundings taken this inspection and linked to asset and report files. Channel profile of bent 2 RT side is showing that the top of the footing is now exposed.

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**A-119 - Scour Assessment Request** (No)

Scour assessment is being requested do to recent findings during the latest channel profile is showing the top of the footing at bent 2 RT side is now exposed.

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**A-B.C.11 - B.C.11 Scour Condition Rating (New NBIS)** (6 - Widespread minor or isolated moderate scour.)

Scour rating is a 6 this inspection due to isolated moderate scour being found around intermediate bents 2 and 3.

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Asset #06415(POA Scour Assessment Evaluation)

US 278- 03- 6.63 over MESSER CREEK

Location: 6.6 M S OF DIERKS

Team Lead: Anahi Mendez Inspection Date: 01/06/2025

### National Bridge Element Quantities and Notes

ELEMENTS	DESCRIPTION	UNITS	TOTAL	CS1	CS2	CS3	CS4
16	Reinforced Concrete Top Flange	SF	4480	4420	60	0	0
1120	Efflorescence/Rust Staining	SF	30	0	30	0	0
1130	Cracking (RC and Other)	SF	30	0	30	0	0
(16) Deck cracking is found in various locations throughout all spans, CS2. Cracking with efflorescence is located throughout all spans on the undersurface and overhangs of the concrete bridge deck, CS2.							
110	Reinforced Concrete Open Girder/Beam	LF	560	560	0	0	0
205	Reinforced Concrete Column	EA	6	6	0	0	0
215	Reinforced Concrete Abutment	LF	135	135	0	0	0
234	Reinforced Concrete Pier Cap	LF	205	204	1	0	0
1080	Delamination/Spall/Patched Area	LF	1	0	1	0	0
(234) Bent 2, Looking back, Spalling to left side of cap, CS2							
301	Pourable Joint Seal	LF	160	90	50	20	0
2320	Seal Adhesion	LF	70	0	50	20	0
(301) Bent 2, Left side, Loss of seal adhesion, CS3. Bent 3, Right side, Loss of seal adhesion, CS2.							
331	Reinforced Concrete Bridge Railing	LF	280	280	0	0	0

## Inspection Photos and Notes



Elevation



Undersurface photo



Deck photo



Cracking with efflorescence to concrete diaphragm at all bents





Cracking with efflorescence to concrete diaphragm at all bents



Typical concrete tee beam photo



Typical abutment photo



Typical bent photo





Log jam is located on the upstream side of intermediate bents 2 & 3.



Upstream channel



Downstream channel



Inventory





Concrete Bridge railing



Metal Bridge railing transition



Joint photo



Bent 3, Column 1 scour from log jam.





Bent 2 scour.



Span 3, Bay 1, cracking with efflorescence to undersurface, CS2.



Span 2, Bay 1, cracking with efflorescence to undersurface, CS2.



Span 2, Bay 3, cracking with efflorescence to undersurface, CS2.





Span 3, Right side, Deck cracking, CS2.



Bent 2, Looking back, Spalling to left side of cap, CS2



Bent 2, Left side, Loss of seal adhesion, CS3



Bent 2, Left side, Loss of seal adhesion, CS2





Bent 3, Right side, Loss of seal adhesion, CS2



### Maintenance Needs

Date Reported: 04/24/2020

Priority: C - Important

Type of Work: Repair (General)

Status: Assigned

Component: Approach

### Deficiency Description

Erosion under LT shoulder at Bent 1 bridge end, approx. 3 ft wide X 1 ft deep

### Remarks

04/11/2022 - Erosion is still under LT shoulder at bent 1 bridge end, reopened maintenance need.

04/16/2024 - Reopened MN for review to assign or monitor.



04/15/2024

2024. Updated photo of the erosion under the left side of the beginning of bridge.



04/15/2024

2024. Updated photo of the erosion under the left side of the beginning of bridge.



04/11/2022

04/2022... erosion LT side bent 1



04/11/2022

04/2022... erosion LT side bent 1





Bent 1 LT side



Bent 1 LT side



Bent 1 LT side



### Maintenance Needs

Date Reported: 04/15/2024

Priority: C - Important

Type of Work: Miscellaneous

Status: Assigned

Component: Bridge

### Deficiency Description

Trees and vegetation are growing over the bridge railing in various locations of bridge.

### Remarks



End of bridge, Right side, Trees and vegetation growing over bridge railing.



End of bridge, Left side, Trees and vegetation growing over bridge railing.



Beginning of bridge, Left side, Trees and vegetation growing over bridge railing.



Beginning of bridge, Right side, Trees and vegetation growing over bridge railing.





Beginning of bridge, Right side, Trees and vegetation growing over bridge railing.



Beginning of bridge, Right side, Trees and vegetation growing over bridge railing.



Beginning of bridge, Right side, Trees and vegetation growing over bridge railing.



### Maintenance Needs

**Date Reported:** 04/16/2024

**Priority:** C - Important

**Type of Work:** Substructure Repair

**Status:** Assigned

**Component:** Substructure

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### Deficiency Description

Channel profile of bent 2 RT side is showing that the top of the footing is now exposed and within 1'-10" of undermining, footing is 2'-6" thick.

### Remarks

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Scour area around bent 3, column 1.

### Maintenance Needs

**Date Reported:** 04/12/2022

**Priority:** D- Routine

**Type of Work:** Miscellaneous

**Status:** Assigned

**Component:** Channel

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### Deficiency Description

Large tree at Bent 2 needs removed from channel.

### Remarks

4/16/2024 - Reopened MN for review to assign or monitor.

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4/15/2024. Updated photo of log jam





## Routine Maintenance

### Check Box Maintenance Items

Type of Maintenance	Is Recommended?
A-54 - Sealable Deck Cracks	No
A-55 - Deck Washing Needed	No
A-56 - Joint Cleaning/Flushing Needed	No
A-57 - Beam End and Bearing Paint Needed	No
A-58 - Cap Cleaning/Flushing Needed	No
A-59 - Joint Repair Needed	No
A-60 - Full Beam Painting Needed	No
A-61 - Polymer Overlay Advised	No
A-62 - Hydro and LMC Advised	No
A-63 - Missing/Incorrect Log Mile Signage	No
A-64 - Vegetation Removal Requested	No
A-65 - Clogged deck drains?	
A-66 - Approach minor pothole/leveling needed	

**A-54 - Sealable Deck Cracks (No)**

**A-55 - Deck Washing Needed (No)**

**A-56 - Joint Cleaning/Flushing Needed (No)**



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**A-57 - Girder End and Bearing Painting Needed (No)**

**A-58 - Cap Cleaning/Flushing Needed (No)**

**A-59 - Joint Repair Needed (No)**

**A-60 - Full Girder Painting Needed (No)**

**A-61 - Polymer Overlay Advised (No)**

**A-62 - Hydro and LMC Advised (No)**

**A-63 - Missing/Incorrect Log Mile Signage (No)**

**A-64 - Vegetation Removal Requested (No)**

**A-65 - Clogged deck drains?**





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**A-66 - Approach minor pothole/leveling needed**



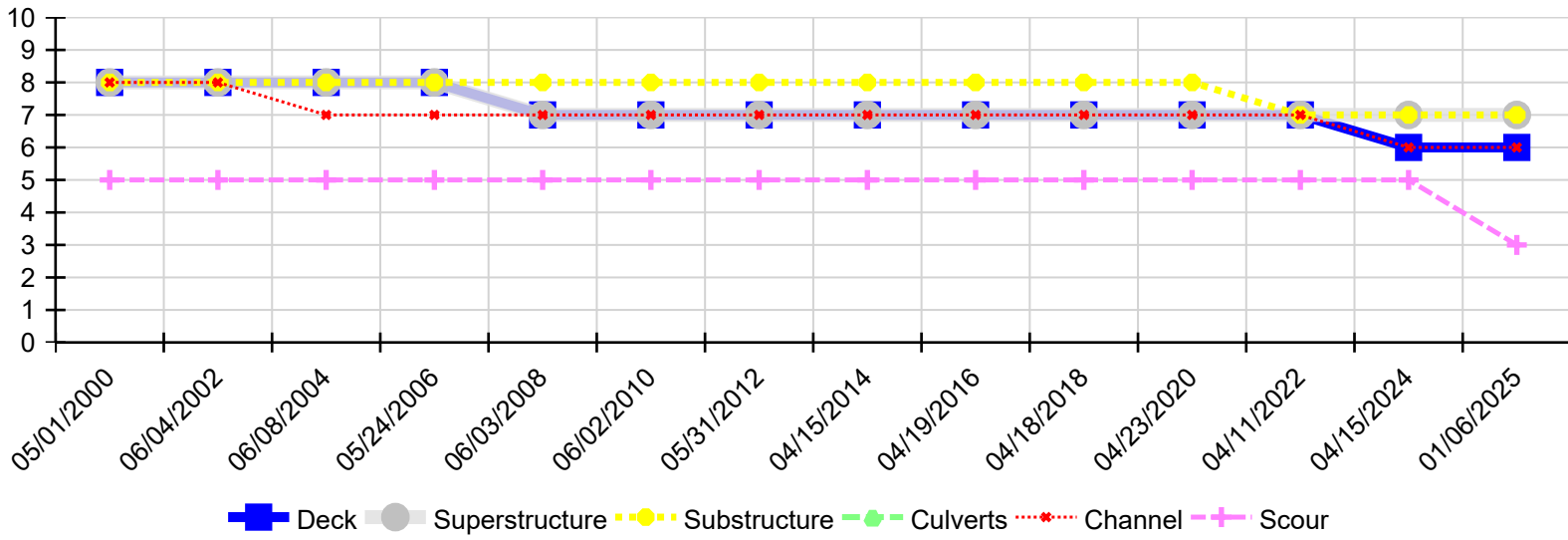
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Condition History



Inspection Date	Deck	Superstructure	Substructure	Culverts	Channel	Scour
01/06/2025	6	7	7	N	6	3
04/15/2024	6	7	7	N	6	5
04/11/2022	7	7	7	N	7	5
04/23/2020	7	7	8	N	7	5
04/18/2018	7	7	8	N	7	5
04/19/2016	7	7	8	N	7	5
04/15/2014	7	7	8	N	7	5
05/31/2012	7	7	8	N	7	5
06/02/2010	7	7	8	N	7	5
06/03/2008	7	7	8	N	7	5
05/24/2006	8	8	8	N	7	5
06/08/2004	8	8	8	N	7	5
06/04/2002	8	8	8	N	8	5
05/01/2000	8	8	8	N	8	5





BR 426

Qal

Highway 278 N

Weyco Rd

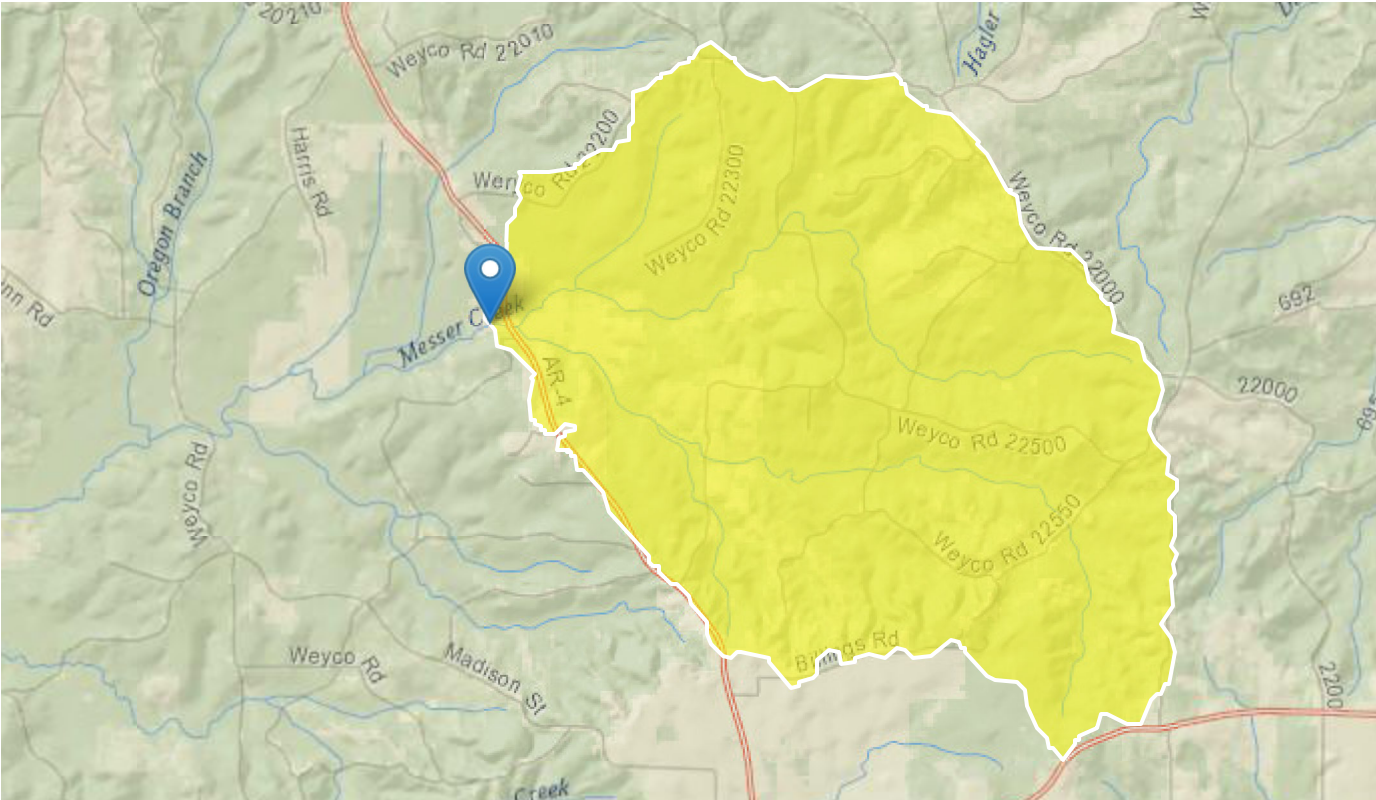
**Qal**

**Alluvium—Alluvial deposits of present streams**



# StreamStats Report

Region ID: AR  
Workspace ID: AR20250106160342575000  
Clicked Point (Latitude, Longitude): 34.06766, -93.96877  
Time: 2025-01-06 10:04:11 -0600



 Collapse All

## ➤ Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
ALVM	Percentage of the basin covered by Quaternary alluvial deposits from Reed & Bush (2005)	0	percent
BFI	Proportion of mean annual flow that is from ground water (base flow)	0.21	dimensionless
BSHAPELFP	Basin Shape Factor computed as the square of the longest flow path divided by drainage area	4.544	dimensionless
CSL1085ADJ	Adjusted 10-85 slope in feet per mile	41.441	feet per mi

<b>Parameter Code</b>	<b>Parameter Description</b>	<b>Value</b>	<b>Unit</b>
CSL1085LFP	Change in elevation divided by length between points 10 and 85 percent of distance along the longest flow path to the basin divide, LFP from 2D grid	39.8	feet per mi
CSL1085RAW	Unadjusted 10-85 stream slope method in feet per mile.	39.8	feet per mi
CSLBlue	Change in elevation of the longest blue-line stream (not extended to the boundary) divided by stream length	48.6	feet per mi
DRNAREA	Area that drains to a point on a stream	7.59	square miles
ELEV	Mean Basin Elevation	538	feet
HIGHREG	HIGHREG	1717	dimensionless
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	4.88	percent
LC11DVOPN	Percentage of developed open area from NLCD 2011 class 21	4.32	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	0.38	percent
LC11PAST	Percentage of area of pasture area from NLCD 2011 class 81	0.74	percent
LFPLENGTH	Length of longest flow path	5.874	miles
LOWREG	Low Flow Region Number	1440	dimensionless
MARAVPRE	Mean March Precipitation	5.51	inches
NOVAVPRE	Mean November Precipitation	5.01	inches
ORDOMISS	Percent Surficial Geology as Ordovician and Mississippian Rocks	63.1	percent
PRECIP	Mean Annual Precipitation	55.6	inches
PREMARAPR	Precipitation March-April basin average, mean monthly as defined in SIR 2008-5065	10.2	inches
PRENOVDEC	Precipitation November-December basin average, mean monthly as defined in SIR 2008-5065	9.8	inches
PRNOVAPR00	Precipitation November-April basin average, mean seasonal from PRISM 1971-2000	28.7	inches
PRNOVAPR90	Precipitation November-April basin average, mean seasonal from PRISM 1961-1990	27.2	inches

Parameter Code	Parameter Description	Value	Unit
PZNSSREGNO	Zeroflow Region Number	1447	dimensionless
SOILINDEX	Mean STATSGO Hydrologic Soils Index (from PL. 2 WRIR 03-4107 for WY)	2.98	dimensionless
TAU_ANN_G	Tau, Average annual base-flow recession time constant as defined in SIR 2008-5065	10	days
TAU_SPR_G	Tau, Average base-flow recession time constant for March through April as defined in SIR 2008-5065, estimated from a grid	8	days
TAU_WIN_G	Tau, Average base-flow recession time constant for November through December as defined in SIR 2008-5065, estimated from a grid	10	days
TRUN0711	Mean annual dry season total runoff, July through November	5.71	inches
UPZ	Percentage of the basin covered by upper Paleozoic strata from Reed & Bush (2005)	0	percent

## ➤ Peak-Flow Statistics

### Peak-Flow Statistics Parameters [Peak Region B2 2016 5081]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
ALVM	Percent_Quaternary_Alluvium	0	percent	0	100
DRNAREA	Drainage Area	7.59	square miles	0.04	2090
LC11DVOPN	Percent_Open_Developed_from_NLCD2011	4.32	percent	0	10.89
PRECIP	Mean Annual Precipitation	55.6	inches	49.3	56.6
SOILINDEX	Mean Basin Hydrologic Soils Index	2.98	dimensionless	2.2	3.8

### Peak-Flow Statistics Flow Report [Peak Region B2 2016 5081]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error, PC: Percent Correct, RMSE: Root Mean Squared Error, PseudoR^2: Pseudo R Squared (other -- see report)

Statistic	Value	Unit	PIL	PIU	ASEp
50-percent AEP flood	781	ft^3/s	432	1410	42



Statistic	Value	Unit	PIL	PIU	ASEp
20-percent AEP flood	1490	ft <sup>3</sup> /s	895	2480	39
10-percent AEP flood	2050	ft <sup>3</sup> /s	1220	3430	38
4-percent AEP flood	2830	ft <sup>3</sup> /s	1680	4770	38
2-percent AEP flood	3480	ft <sup>3</sup> /s	1990	6080	39
1-percent AEP flood	4170	ft <sup>3</sup> /s	2410	7220	40
0.2-percent AEP flood	5960	ft <sup>3</sup> /s	3100	11500	43

#### *Peak-Flow Statistics Citations*

**Wagner, D.M., Krieger, J.D., and Veilleux, A.G., 2016, Methods for estimating annual exceedance probability discharges for streams in Arkansas, based on data through water year 2013: U.S. Geological Survey Scientific Investigations Report 2016–5081, 136 p. (<http://dx.doi.org/10.3133/sir20165081>)**

## ➤ Low-Flow Statistics

### Low-Flow Statistics Parameters [Low Flow Region 3 2008 5065]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	7.59	square miles	4.7	932
LOWREG	Low Flow Region Number	1440	dimensionless		
PREMARAPR	Basin Ave Rainfall Mar Apr	10.2	inches	10	12.3
TAU_ANN_G	Tau Annual from Grid	10	days	6.2	12.1

### Low-Flow Statistics Flow Report [Low Flow Region 3 2008 5065]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error, PC: Percent Correct, RMSE: Root Mean Squared Error, PseudoR<sup>2</sup>: Pseudo R Squared (other -- see report)

Statistic	Value	Unit	ASEp
7 Day 2 Year Low Flow	0.258	ft <sup>3</sup> /s	116
7 Day 10 Year Low Flow	0.0134	ft <sup>3</sup> /s	139

#### *Low-Flow Statistics Citations*

**Funkhouser, J.E., Eng, Ken, and Moix, M.W., 2008, Low-Flow Characteristics and Regionalization of Low Flow Characteristics for Selected Streams in Arkansas: U. S.**

## ➤ Monthly Flow Statistics

### Monthly Flow Statistics Parameters [Low Flow Region 3 2008 5065]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	7.59	square miles	4.7	932
LOWREG	Low Flow Region Number	1440	dimensionless		
ORDOMISS	Percent SurficialGeology Ordo and Miss	63.1	percent	0	100
PRNOVAPR90	Basin Ave Rainfall Nov Apr PRISM 1990	27.2	inches	25.8	32.8
TAU_ANN_G	Tau Annual from Grid	10	days	6.2	12.1

### Monthly Flow Statistics Parameters [Dry Season Mean Monthly Flow 2015 5031]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	7.59	square miles	4.1	7350
TRUN0711	Dry Season Total Runoff	5.71	inches	3.6	5.6

### Monthly Flow Statistics Disclaimers [Dry Season Mean Monthly Flow 2015 5031]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

### Monthly Flow Statistics Flow Report [Dry Season Mean Monthly Flow 2015 5031]

Statistic	Value	Unit
July Mean Flow	5.84	ft <sup>3</sup> /s
August Mean Flow	2.94	ft <sup>3</sup> /s
September Mean Flow	7.36	ft <sup>3</sup> /s
October Mean Flow	8.11	ft <sup>3</sup> /s
November Mean Flow	21.8	ft <sup>3</sup> /s

## Monthly Flow Statistics Flow Report [Low Flow Region 3 2008 5065]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error, PC: Percent Correct, RMSE: Root Mean Squared Error, PseudoR^2: Pseudo R Squared (other -- see report)

Statistic	Value	Unit	ASEp
Nov 7 Day 10 Year Low Flow	0.371	ft^3/s	113
Dec 7 Day 10 Year Low Flow	0.408	ft^3/s	76.8
Jan 7 Day 10 Year Low Flow	0.738	ft^3/s	54.6
Feb 7 Day 10 Year Low Flow	0.93	ft^3/s	52.4
Mar 7 Day 10 Year Low Flow	1.17	ft^3/s	64.9
Apr 7 Day 10 Year Low Flow	0.93	ft^3/s	72.8

## Monthly Flow Statistics Flow Report [Area-Averaged]

Statistic	Value	Unit	
July Mean Flow	5.84	ft^3/s	
August Mean Flow	2.94	ft^3/s	
September Mean Flow	7.36	ft^3/s	
October Mean Flow	8.11	ft^3/s	
November Mean Flow	21.8	ft^3/s	
Nov 7 Day 10 Year Low Flow	0.371	ft^3/s	113
Dec 7 Day 10 Year Low Flow	0.408	ft^3/s	76.8
Jan 7 Day 10 Year Low Flow	0.738	ft^3/s	54.6
Feb 7 Day 10 Year Low Flow	0.93	ft^3/s	52.4
Mar 7 Day 10 Year Low Flow	1.17	ft^3/s	64.9
Apr 7 Day 10 Year Low Flow	0.93	ft^3/s	72.8

### *Monthly Flow Statistics Citations*

**Funkhouser, J.E., Eng, Ken, and Moix, M.W.,2008, Low-Flow Characteristics and Regionalization of Low Flow Characteristics for Selected Streams in Arkansas: U. S. Geological Survey Scientific Investigations Report 2008-5065, 161 p.**

(<http://pubs.usgs.gov/sir/2008/5065/pdf/SIR2008-5065.pdf>)

**Breaker, B.K.,2015, Dry season mean monthly flow and harmonic mean flow regression equations for selected ungaged basins in Arkansas: U.S. Geological Survey Scientific Investigations Report 2015-5031, 25 p. (<http://pubs.usgs.gov/sir/2015/5031/>)**



## ➤ Seasonal Flow Statistics

### Seasonal Flow Statistics Parameters [Low Flow Region 3 2008 5065]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	7.59	square miles	4.7	932
LOWREG	Low Flow Region Number	1440	dimensionless		
PREMARAPR	Basin Ave Rainfall Mar Apr	10.2	inches	10	12.3
PRNOVAPR90	Basin Ave Rainfall Nov Apr PRISM 1990	27.2	inches	25.8	32.8
TAU_ANN_G	Tau Annual from Grid	10	days	6.2	12.1

### Seasonal Flow Statistics Flow Report [Low Flow Region 3 2008 5065]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error, PC: Percent Correct, RMSE: Root Mean Squared Error, PseudoR<sup>2</sup>: Pseudo R Squared (other -- see report)

Statistic	Value	Unit	ASEp
Nov to Apr 7 Day 10 Year Low Flow	0.472	ft <sup>3</sup> /s	99.1
Nov to Dec 7 day 10 Year Low Flow	0.398	ft <sup>3</sup> /s	109
Jan to Feb 7 Day 10 Year Low Flow	0.738	ft <sup>3</sup> /s	48.1
Mar to Apr 7 Day 10 Year Low Flow	0.463	ft <sup>3</sup> /s	39.3

#### *Seasonal Flow Statistics Citations*

**Funkhouser, J.E., Eng, Ken, and Moix, M.W.,2008, Low-Flow Characteristics and Regionalization of Low Flow Characteristics for Selected Streams in Arkansas: U. S. Geological Survey Scientific Investigations Report 2008-5065, 161 p.**  
(<http://pubs.usgs.gov/sir/2008/5065/pdf/SIR2008-5065.pdf>)

## ➤ General Flow Statistics

### General Flow Statistics Parameters [Harmonic Mean Flow Region 2 2015 5031]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
BFI	Base Flow Index	0.21	dimensionless	0.1	0.4
DRNAREA	Drainage Area	7.59	square miles	4.1	2090
ORDOMISS	Percent SurficialGeology Ordo and Miss	63.1	percent	0	100

### General Flow Statistics Flow Report [Harmonic Mean Flow Region 2 2015 5031]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error, PC: Percent Correct, RMSE: Root Mean Squared Error, PseudoR<sup>2</sup>: Pseudo R Squared (other -- see report)

Statistic	Value	Unit	PIL	PIU	ASEp
Harmonic Mean Streamflow	0.4	ft <sup>3</sup> /s	0.237	0.675	76.6

#### *General Flow Statistics Citations*

**Breaker, B.K.,2015, Dry season mean monthly flow and harmonic mean flow regression equations for selected ungaged basins in Arkansas: U.S. Geological Survey Scientific Investigations Report 2015–5031, 25 p. (<http://pubs.usgs.gov/sir/2015/5031/>)**

## ➤ Bankfull Statistics

### Bankfull Statistics Parameters [Atlantic Plain D Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	7.59	square miles	0.30888	1086.8715

### Bankfull Statistics Parameters [USA Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	7.59	square miles	0.07722	59927.7393

## Bankfull Statistics Flow Report [Atlantic Plain D Bieger 2015]

Statistic	Value	Unit
Bieger_D_channel_width	21.5	ft
Bieger_D_channel_depth	2.06	ft
Bieger_D_channel_cross_sectional_area	42.4	ft <sup>2</sup>

## Bankfull Statistics Flow Report [USA Bieger 2015]

Statistic	Value	Unit
Bieger_USA_channel_width	25.3	ft
Bieger_USA_channel_depth	1.86	ft
Bieger_USA_channel_cross_sectional_area	51.1	ft <sup>2</sup>

## Bankfull Statistics Flow Report [Area-Averaged]

Statistic	Value	Unit
Bieger_D_channel_width	21.5	ft
Bieger_D_channel_depth	2.06	ft
Bieger_D_channel_cross_sectional_area	42.4	ft <sup>2</sup>
Bieger_USA_channel_width	25.3	ft
Bieger_USA_channel_depth	1.86	ft
Bieger_USA_channel_cross_sectional_area	51.1	ft <sup>2</sup>

### *Bankfull Statistics Citations*

**Bieger, Katrin; Rathjens, Hendrik; Allen, Peter M.; and Arnold, Jeffrey G.,2015, Development and Evaluation of Bankfull Hydraulic Geometry Relationships for the Physiographic Regions of the United States, Publications from USDA-ARS / UNL Faculty, 17p. ([https://digitalcommons.unl.edu/usdaarsfacpub/1515?utm\\_source=digitalcommons.unl.edu%2Fusdaarsfacpub%2F1515&utm\\_medium=PDF&utm\\_campaign=](https://digitalcommons.unl.edu/usdaarsfacpub/1515?utm_source=digitalcommons.unl.edu%2Fusdaarsfacpub%2F1515&utm_medium=PDF&utm_campaign=)**



## ➤ Probability Statistics

### Probability Statistics Parameters [Pzero Flow Region 3 2008 5065]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	7.59	square miles	4.7	932
ORDOMISS	Percent SurficialGeology Ordo and Miss	63.1	percent	0	100
PZNSSREGNO	Prob zero flow region number	1447	dimensionless		
TAU_ANN_G	Tau Annual from Grid	10	days	6.2	12.1

### Probability Statistics Flow Report [Pzero Flow Region 3 2008 5065]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error, PC: Percent Correct, RMSE: Root Mean Squared Error, PseudoR<sup>2</sup>: Pseudo R Squared (other -- see report)

Statistic	Value	Unit	PC
Probability zero flow 7Day	0.00353	dim	77.6
Probability zero flow 7 day Nov to Apr	0.0276	dim	96.9
Probability zero flow 7 day Nov to Dec	0.0288	dim	96.9
Probability zero flow 7 day Nov	0.0293	dim	96.9

#### *Probability Statistics Citations*

**Funkhouser, J.E., Eng, Ken, and Moix, M.W.,2008, Low-Flow Characteristics and Regionalization of Low Flow Characteristics for Selected Streams in Arkansas: U. S. Geological Survey Scientific Investigations Report 2008-5065, 161 p.**  
(<http://pubs.usgs.gov/sir/2008/5065/pdf/SIR2008-5065.pdf>)

## ➤ Maximum Probable Flood Statistics

### Maximum Probable Flood Statistics Parameters [Crippen Bue Region 10]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	7.59	square miles	0.1	1000

## Maximum Probable Flood Statistics Flow Report [Crippen Bue Region 10]

Statistic	Value	Unit
Maximum Flood Crippen Bue Regional	36200	ft <sup>3</sup> /s

### *Maximum Probable Flood Statistics Citations*

**Crippen, J.R. and Bue, Conrad D.1977, Maximum Floodflows in the Conterminous United States, Geological Survey Water-Supply Paper 1887, 52p.  
(<https://pubs.usgs.gov/wsp/1887/report.pdf>)**

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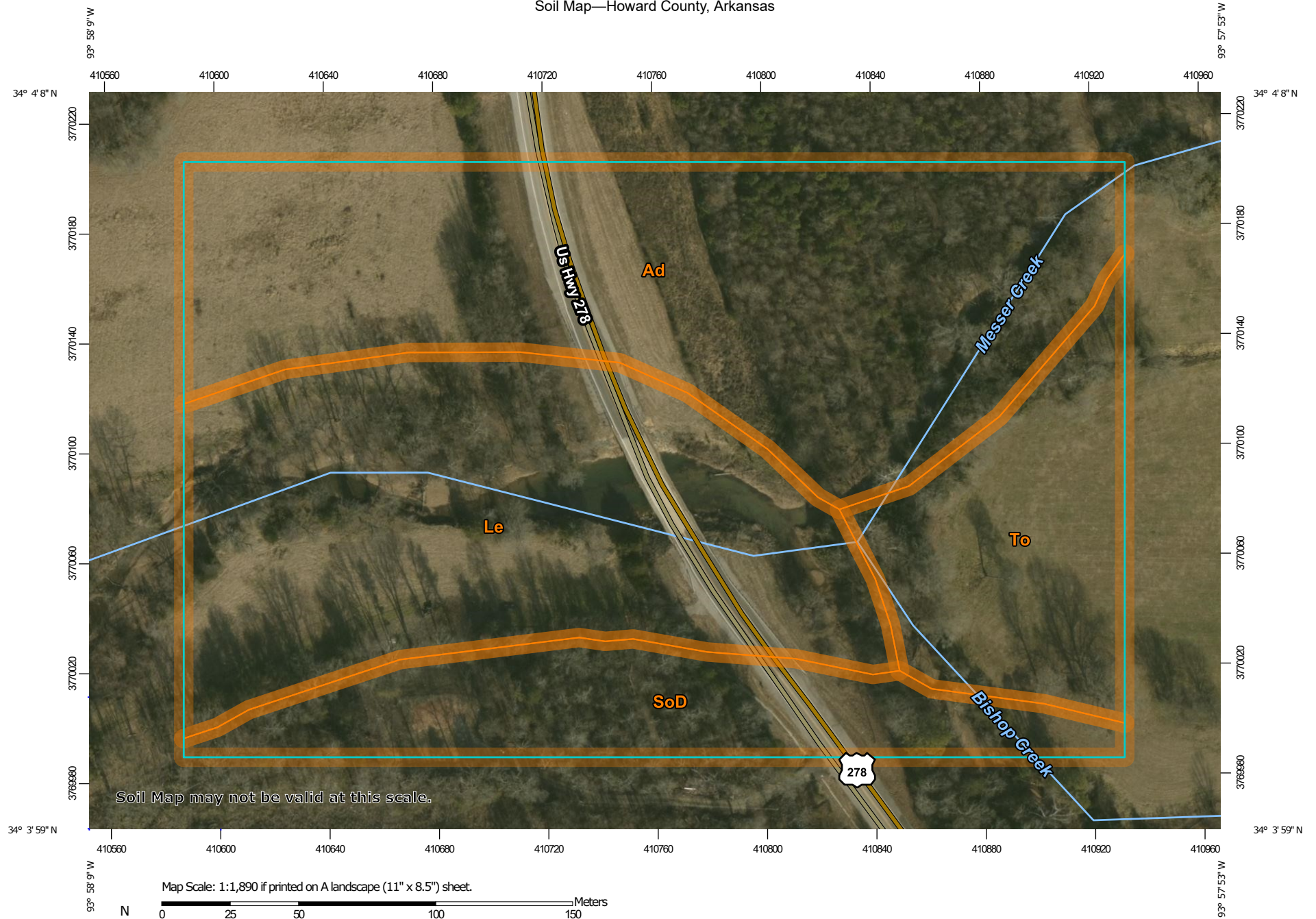
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Application Version: 4.25.0

StreamStats Services Version: 1.2.22

NSS Services Version: 2.2.1

# Soil Map—Howard County, Arkansas





## MAP LEGEND

### Area of Interest (AOI)

 Area of Interest (AOI)

### Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

### Special Point Features



Blowout



Borrow Pit



Clay Spot



Closed Depression



Gravel Pit



Gravelly Spot



Landfill



Lava Flow



Marsh or swamp



Mine or Quarry



Miscellaneous Water



Perennial Water



Rock Outcrop



Saline Spot



Sandy Spot



Severely Eroded Spot



Sinkhole



Slide or Slip



Sodic Spot



Spoil Area



Stony Spot



Very Stony Spot



Wet Spot



Other



Special Line Features

### Water Features



Streams and Canals

### Transportation



Rails



Interstate Highways



US Routes



Major Roads



Local Roads

### Background



Aerial Photography

## MAP INFORMATION

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

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL:

Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Howard County, Arkansas

Survey Area Data: Version 22, Sep 9, 2024

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

Date(s) aerial images were photographed: Dec 23, 2019—Jan 27, 2020

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
Ad	Adaton silt loam	7.2	39.0%
Le	Leeper silty clay	6.3	33.8%
SoD	Sumter-Oktibbeha association, rolling	2.6	14.0%
To	Toine loam	2.4	13.2%
<b>Totals for Area of Interest</b>		<b>18.5</b>	<b>100.0%</b>

Table 2.1 STREAM INSTABILITY AND BRIDGE SCOUR COUNTERMEASURES MATRIX

Countermeasure Group	Countermeasure Characteristics																	
	FUNCTIONAL APPLICATIONS						SUITABLE RIVER ENVIRONMENT								MAINTENANCE		INSTALLATION EXPERIENCE BY STATE	DESIGN GUIDELINE REFERENCE*
	Local Scour		Contraction Scour	Stream Instability		Overtopping Flow	River Type	Stream Size	Bend Radius	Velocity	Bed Material	Ice/Debris Load	Bank Slope	Floodplain	Estimated Allocation of Resources			
	Abutments	Piers <sup>4</sup>	Floodplain and Channel	Vertical	Lateral	Approach Embankments	B = braided M = meandering S = straight	W = wide M = moderate S = small	L = long M = moderate S = short	F = fast M = moderate S = slow	C = coarse bed S = sand bed F = fine bed	H = high M = moderate L = low	V = very steep S = steep M = mild	W = wide M = moderate N = narrow/none	H = high M = moderate L = low			
GROUP 1. HYDRAULIC COUNTERMEASURES																		
GROUP 1.A. RIVER TRAINING STRUCTURES																		
TRANSVERSE STRUCTURES																		
Impermeable spurs (jetties, groins, wing dams)	►	►	○	○	●	○	B, M	W, M	L, M	✓	✓	✓	✓	✓	M - L	Widely Used	DG 2	
Permeable spurs (fences, netting)	►	►	○	○	●	○	B, M	W, M	L, M	M, S	S, F	L	✓	✓	H - M	Widely Used	DG 2	
Transverse dikes	○	○	○	○	●	○	B, M	W, M	✓	✓	✓	✓	✓	✓	M - L	NE		
Bendway weirs/Stream barbs <sup>1</sup>	►	►	○	○	●	○	M	✓	M, S	✓	✓	✓	✓	✓	L	CO, ID, IL, MO, MT, OR, WA	DG 1	
Hardpoints	○	○	○	○	●	○	✓	✓	✓	✓	✓	✓	✓	✓	L	CA, ND, NE, SD	CH 8	
Drop structures (check dams, grade control)	►	►	►	●	○	○	✓	✓	✓	✓	✓	✓	✓	✓	M	Widely Used	DG 3	
Embankment Spurs	►	○	►	○	○	○	✓	✓	✓	✓	✓	✓	✓	W	L	AK, OK		
LONGITUDINAL STRUCTURES																		
Longitudinal dikes (crib/rock toe/embankments)	►	○	○	○	●	►	✓	✓	L, M	✓	✓	M, L	✓	✓	M - L	AK, AZ, CA, OK, OR, MS	CH 8	
Retards	►	○	○	○	●	○	✓	✓	L, M	✓	S, F	L	✓	✓	H - M	Widely Used	CH 8	
Bulkheads	●	○	○	○	●	○	✓	✓	✓	✓	✓	✓	V, S	✓	M	Widely Used	CH 8	
Guide banks	●	►	►	○	►	►	✓	W, M	✓	✓	✓	✓	✓	W, M	M - L	Widely Used	DG 15	
AREAL STRUCTURES/TREATMENTS																		
Jacks/tetrahedron jetty fields	○	○	○	○	●	○	B, M	W, M	L	M, S	S, F	M, L	✓	W, M	M	Widely Used	CH 8	
Vanes	○	►	○	○	●	○	B, M	W, M	L, M	M, S	S, F	L	✓	✓	H - M	IA		
Channelization	►	►	○	○	●	○	B, M	✓	✓	✓	✓	✓	✓	✓	M	MS, MO, MT, TX	CH 8	
Flow relief (overflow, relief bridge)	►	►	●	○	○	●	✓	✓	✓	✓	✓	✓	✓	W	M	Widely Used		
Sediment detention basin	○	○	○	●	○	○	✓	✓	✓	✓	C, S	✓	✓	✓	H - M	Widely Used		
GROUP 1.B. ARMORING COUNTERMEASURES																		
REVTMENTS AND BED ARMOR																		
Rigid																		
Soil cement	●	●	►	►	●	●	✓	✓	✓	✓	S, F	✓	✓	✓	L	AZ, CO, NM	DG 7	
Roller compacted concrete	●	►	●	●	●	●	✓	✓	✓	✓	S, F	✓	✓	✓	L	Widely Used		
Concrete pavement	►	○	●	►	●	►	✓	✓	✓	✓	✓	✓	S, M	✓	M	Widely Used		
Rigid grout filled mattress/concrete fabric mat	►	○	►	►	●	►	✓	✓	✓	✓	✓	✓	S, M	✓	M	GA, MA, MD, ME, SD, WA		
Fully grouted riprap	○	○	○	○	►	○	✓	✓	✓	✓	✓	✓	S, M	✓	M	AZ, CA, CT, ME, MI, TN	CH 5	
Flexible/articulating																		
Riprap	●	●	►	►	●	►	✓	✓	✓	✓	✓	✓	S, M	✓	M	Widely Used	DG 4	
Self launching riprap (windrow)	○	○	○	○	►	○	✓	✓	✓	✓	C,S	✓	V, S	✓	H - M	GA, CA, IL, PA	DG 4	
Riprap fill-trench	►	○	○	○	●	○	✓	✓	✓	✓	✓	✓	✓	✓	M	Widely Used	DG 4	
Gabions/gabion mattress <sup>2</sup>	●	●	►	►	●	►	✓	✓	✓	✓	S, F	M, L	✓	✓	M	Widely Used	DG 11	
Wire enclosed riprap mattress (rail bank/sausage)	●	○	○	○	●	○	✓	✓	✓	M, S	S, F	M, L	S, M	✓	M	AZ, CO, NM	DG 6	
Articulated blocks (interlocking and/or cable tied)	●	●	●	►	●	●	✓	✓	✓	✓	✓	✓	S, M	✓	M - L	Widely Used	DG 9	
Concrete/grout mattress (fabric-formed)	●	►	●	►	●	►	✓	✓	✓	M, S	✓	✓	S, M	✓	M - L	OR, CA, IA, IL, AZ	DG 10	
Partially grouted riprap	●	●	►	►	●	○	✓	✓	✓	✓	✓	✓	S, M	✓	L	European practice	DG 12	
LOCAL SCOUR ARMORING																		
Riprap (fill/apron)	●	●	N/A	N/A	N/A	N/A	✓	✓	✓	✓	✓	✓	S, M	✓	H - M	Widely Used	DG 8, DG 14	
Fully grouted riprap	►	○	N/A	N/A	N/A	N/A	✓	✓	✓	✓	✓	✓	S, M	✓	H - M	Widely Used	CH 5	
Concrete armor units (Toskanes, tetrapods, etc.) <sup>3</sup>	►	►	N/A	N/A	N/A	N/A	✓	✓	✓	✓	✓	✓	M	✓	M - L	AZ, PA, NY, VA	CH 5	
Grout filled bags/sand cement bags	●	►	N/A	N/A	N/A	N/A	✓	✓	✓	✓	✓	M, L	M	✓	H - M	Widely Used	DG 13	
Gabions/gabion mattress <sup>2</sup>	●	●	N/A	N/A	N/A	N/A	✓	✓	✓	✓	S, F	M, L	S, M	✓	M	FL, VA, TN, OR	DG 11	
Articulated blocks (interlocking and/or cable tied)	●	●	N/A	N/A	N/A	N/A	✓	✓	✓	✓	✓	✓	S, M	✓	M - L	Widely Used	DG 9	
Sheet pile/cofferdam	►	►	N/A	N/A	N/A	N/A	✓	✓	✓	✓	✓	✓	✓	✓	M - L	CA, CT, FL, NH, WA		
Partially grouted riprap	●	●	N/A	N/A	N/A	N/A	✓	✓	✓	✓	✓	✓	S, M	✓	L	European practice	DG 12	

- well suited/primary use
- possible application/secondary use
- unsuitable/rarely used
- N/A

not applicable

✓

suitable for the full range of the characteristic

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Table 2.1 STREAM INSTABILITY AND BRIDGE SCOUR COUNTERMEASURES MATRIX (continued).

Countermeasure Group	Countermeasure Characteristics																
	FUNCTIONAL APPLICATIONS						SUITABLE RIVER ENVIRONMENT								MAINTENANCE	INSTALLATION EXPERIENCE BY STATE	DESIGN GUIDELINE REFERENCE*
	Local Scour		Contraction Scour	Stream Instability		Overtopping Flow	River Type	Stream Size	Bend Radius	Velocity	Bed Material <sup>5</sup>	Ice/Debris Load	Bank Slope	Floodplain	Estimated Allocation of Resources		
	Abutments	Piers <sup>4</sup>	Floodplain and Channel	Vertical	Lateral	Approach Embankments	B = braided M = meandering S = straight	W = wide M = moderate S = small	L = long M = moderate S = short	F = fast M = moderate S = slow	C = coarse bed S = sand bed F = fine bed	H = high M = moderate L = low	V = very steep S = steep M = mild	W = wide M = moderate N = narrow/none	H = high M = moderate L = low		
GROUP 2. STRUCTURAL COUNTERMEASURES																	
FOUNDATION STRENGTHENING																	
Crutch bents/Underpinning	○	●	●	●	▮	N/A	✓	✓	✓	✓	✓	✓	✓	✓	L	FL, NC, OR, TX	
Cross bracing	○	●	●	●	○	N/A	✓	✓	✓	✓	✓	✓	✓	✓	L	NC, FL, LA	
Continuous spans	○	●	●	●	○	N/A	✓	✓	✓	✓	✓	✓	✓	✓	L	NC	
Pumped concrete/grout under footing	●	●	▮	▮	▮	N/A	✓	✓	✓	✓	✓	✓	✓	✓	M	Widely Used	DG 13
Lower foundation	●	●	●	●	●	N/A	✓	✓	✓	✓	✓	✓	✓	✓	L	CA, OR, TX	
PIER GEOMETRY MODIFICATION																	
Extended footings	N/A	●	N/A	N/A	N/A	N/A	✓	✓	✓	✓	✓	✓	✓	✓	L	Widely Used	
Pier shape modifications	N/A	●	N/A	N/A	N/A	N/A	✓	✓	✓	✓	✓	✓	✓	✓	M	FL	
Debris deflectors	N/A	●	N/A	N/A	N/A	N/A	✓	✓	✓	✓	✓	✓	✓	✓	H - M	CA, FL, NM, OR	
Sacrificial piles/dolphins	N/A	●	N/A	N/A	N/A	N/A	✓	✓	✓	✓	✓	✓	✓	✓	H - M		
GROUP 3. BIOTECHNICAL COUNTERMEASURES <sup>5</sup>																	
Vegetated geosynthetic products	○	○	○	○	●	▮	M, S	M, S	✓	M, S	✓	M, L	M, S	✓	H - M	Widely Used	CH 6
Fascines/woody mats	○	○	○	○	●	○	✓	M, S	✓	M, S	✓	L	M, S	✓	H - M	Widely Used	CH 6
Vegetated riprap	○	○	○	○	●	▮	✓	✓	✓	✓	✓	✓	M, S	✓	M - L	Widely Used	CH 6
Root wads	○	○	○	○	●	○	✓	M, S	✓	M, S	✓	L	M	✓	H - M	Widely Used	CH 6
Live staking	○	○	○	○	●	○	✓	M, S	✓	M, S	✓	M, L	M, S	✓	H - M	Widely Used	CH 6
GROUP 4. MONITORING																	
FIXED INSTRUMENTATION																	
Sonar scour monitor	▮	●	●	●	▮	○	✓	✓	✓	✓	✓	L	✓	✓	M	CO, FL, IN, NY, VA, TX	CH 9
Magnetic sliding collar	●	●	●	●	▮	○	✓	✓	✓	✓	S, F	✓	✓	✓	M	Widely Used	CH 9
Float out device	●	●	●	●	●	●	✓	✓	✓	✓	S, F	✓	✓	✓	L	AZ, CA, NV	CH 9
Sounding rods	▮	●	●	●	▮	○	✓	✓	✓	M, S	C	M, L	✓	✓	H	AR, IA, NY	CH 9
PORTABLE INSTRUMENTATION																	
Physical probes	●	●	●	●	●	○	✓	✓	✓	M, S	✓	M, L	✓	✓	L	Widely Used	CH 9
Sonar probes	●	●	●	●	●	○	✓	✓	✓	M, S	✓	L	✓	✓	L	Widely Used	CH 9
VISUAL MONITORING																	
Periodic Inspection	●	●	●	●	●	●	✓	✓	✓	✓	✓	M, L	✓	✓	H	Widely Used	CH 2
Flood watch	●	●	●	●	●	●	✓	✓	✓	✓	✓	M, L	✓	✓	H	Widely Used	CH 2

- well suited/primary use
- ▮ possible application/secondary use
- unsuitable/rarely used
- N/A not applicable

✓ suitable for the full range of the characteristic

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NOTES:

1. There is limited but successful field experience using bendway weirs/stream barbs as stream instability countermeasures.

2. Performance of welded vs. twisted wire, and PVC coated vs. uncoated wire gabions is not distinguished in the matrix.

3. There is limited but successful field experience using concrete armor units for scour protection at bridge piers.

4. Piers at new bridges cannot rely on countermeasures to reduce the design depths of foundation elements (Federal guidance).

5. Biotechnical countermeasures are only intended for stream banks, not stream beds. This matrix assumes that any biotechnical treatments are fully grown, with well-established root systems. The toe of any streambank treatment should be reinforced with rock riprap or other armor material, as discussed in Chapter 6 of this document.

6. See Chapter 3 for discussion of selection criteria for countermeasures.

7. See Chapter 6 for discussion of biotechnical engineering countermeasures.

8. See Chapter 8 for discussion of other countermeasures and case histories of performance.

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