

Presented by:

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Part 5 (Fatigue & Fracture Critical Inspection)- Tony

INDOT BRIDGE INSPECTION MANUAL

PART 5

FATIGUE & FRACTURE CRITICAL INSPECTIONS



Part 5 (Fatigue & Fracture Critical Inspection)- Tony

PRESENTATION DISCUSSION

1. Chapter Organization and Updates
2. Fracture Critical Report Requirements
3. Fracture Critical Member Diagrams
4. Fracture Critical Inspection Notes and Report
5. Fracture Critical Work Plan and Hazard Analysis



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CHAPTER ORGANIZATION AND UPDATES

5-5.01 THE FRACTURE CRITICAL INSPECTION

5-5.01(01) Classification of Fracture Critical Members

5-5.01(02) Inspector Qualification

5-5.01(03) Inspection Interval

5-5.01(04) Inspection Preparation

5-5.01(05) Field Inspection

5-5.01(06) Field Inspection Reporting



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FRACTURE CRITICAL REPORT REQUIREMENTS

- Requirements fully detailed in Subsection 5-5.01(06)
- Most report components can be done through BIAS by selecting appropriate check boxes (Location Map, NBI Data, Element Data, and Photographs)
- BIAS Photographs – Software limits are 120 photographs.
- Additional Photographs need to be uploaded as additional sections.
- Three report requirement **MUST** be uploaded to BIAS as additional sections.
 1. Fracture critical framing plan(s) or diagram(s).
 2. Fracture Critical Inspection Notes and Report.
 3. Fracture Critical Work Plan and Hazard Analysis (*if necessary*).

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Report Sections for 237-62-06512C
Filter Map? Module Maintenance Manager Administration Help

Type Asset Name Here.

Remove Section	Persisted	Order	Section Name	Print	Include in Table of Contents	Insert Cover Page Before Section	Show Page Number	Edit Custom Section
	☒	1	Report Cover	View ☒	☐	☐	☐	
	☒	2	Table of Contents	View ☒	☐	☐	☐	
	☒	3	Location Map	View ☒	☒	☐	☒	
	☒	4	Executive Summary	View ☒	☒	☐	☒	
	☒	5	Fracture Critical Member Diagram	View ☒	☒	☐	☒	View
	☒	6	Fracture Critical Member Inspection Notes and Report	View ☒	☒	☐	☒	View
	☒	7	Fracture Critical Member Inspection Notes (Upper)	View ☒	☒	☐	☒	View
	☒	8	Fracture Critical Work Plan	View ☒	☒	☐	☒	View
	☒	9	National Bridge Inventory	View ☒	☒	☐	☒	
	☒	10	Elements	View ☒	☒	☐	☒	
	☒	11	Picturesh	View ☒	☒	☐	☒	
	☒	12	Additional Pictures I	View ☒	☒	☐	☒	View
	☒	13	Additional Pictures II	View ☒	☒	☐	☒	View
	☒	14	Sketches	View ☐	☐	☐	☐	
	☒	15	Maintenance - Bridge	View ☒	☒	☐	☒	

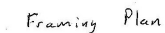
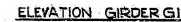


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FRACTURE CRITICAL MEMBER DIAGRAMS

- Must identify all fracture critical members, components, and connections on the bridge and inspected.
- Fracture Critical Members and Connections must be identified through structural analysis.
- Plans should also identify naming and numbering used.

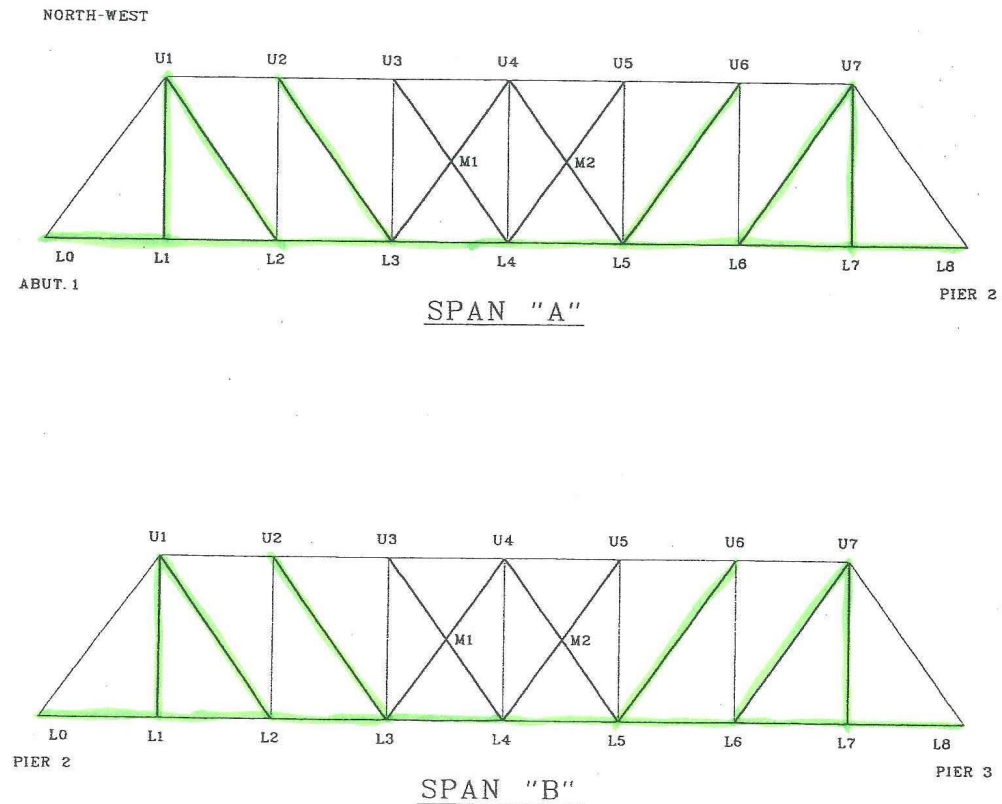
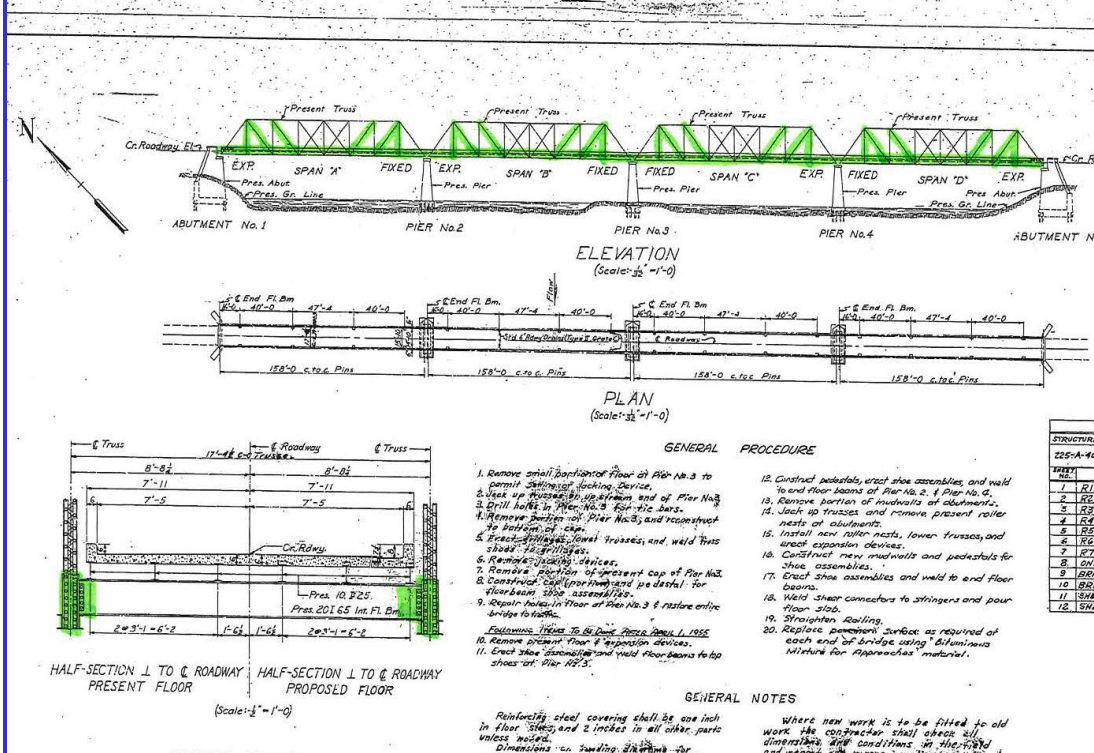
Drawings and Plan Types not standardized; however, this information must be clear to users of these reports.



I74-170-04684 BERL

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Fracture Critical Members





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FRACTURE CRITICAL INSPECTION NOTES AND REPORT REQUIREMENTS

- Required per Subsection 5-5.01(06), Item 2 and BIM Appendix 5B.
- INTRODUCTION narrative.
 - Location and Description.
 - Structure History.
- FIELD INSPECTION OPERATIONS narrative.
 - Members to be Inspected.
 - Inspection Procedures.
 - Equipment Required for Inspection.
 - Bridge Cleaning Requirements.
 - Traffic Maintenance Requirements.
 - Other Items – availability of plans; past inspections; or other items as necessary.
- SUMMARY OF INSPECTION FINDINGS narrative.
- SUMMARY OF RECOMMENDATIONS narrative.
- TABLE(S) OF FRACTURE CRITICAL ELEMENTS INSPECTION FINDINGS.



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TABLE(S) OF FRACTURE CRITICAL ELEMENTS INSPECTION FINDINGS

BRIDGE INSPECTION MANUAL

APPENDICES: BRIDGE INSPECTION

TABLE OF FRACTURE CRITICAL ELEMENTS INSPECTION FINDINGS

SPAN	MEMBER	CONDITION RATING	FATIGUE CATEGORY	INSPECTION NOTES
Span identified	Each member FC and connection shall have an individual row	NBI 58, 59, 60 rating scale	AASHTO fatigue category letter	Describe condition, defects, cracks, section remaining, or other noteworthy issues.

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TABLE(S) OF FRACTURE CRITICAL ELEMENTS INSPECTION FINDINGS

STEEL CONTINUOUS ARCH THROUGH TRUSS WITH TRANSVERSE FLOOR BEAM FRAMING

Truss inspection field notes and condition ratings are tabulated below. Photographs taken during the inspection documenting both typical conditions and locations of deterioration have been uploaded to the BIAS Inspection Report.

U = Denotes Upper Chord Member/Connection Node.

L = Denotes Lower Chord Member/Connection Node.

T = Denotes Span 7 Tie Girder Member/Connection Node.

BELOW DECK FRACTURE CRITICAL MEMBERS – WEST DOWNSTREAM TRUSS

SPAN	MEMBER	CONDITION RATING	FATIGUE CATEGORY	INSPECTION NOTES
6	L0	5	D	All inner surfaces on bottom flange and up 4" from the bottom exhibiting 1/8" to 3/16" nominal pitting; similar deterioration visible on bolt and rivet heads; up to around 5% on the East web.
6	L0-L1	5	D	Inner surfaces of both the East and West webs along the bottommost 2" exhibiting up to 1/8" nominal pitting along most of length; heaviest near the L0 end; similar on diaphragms. Outer surface of West web at L1 end exhibiting approximately 12" L x 3" max H x up to 1/4" nominal depth pitting extending horizontal above the bottom shelf plate.
6	L1	6	D	Two rivets replaced w/bolts on bottom edge and two on the east face. All inner surfaces within 1" to 3" of bottom exhibiting 1/8" to 3/16" nominal pitting. Bottom flange around full perimeter of bottom horizontal shelf plate exhibiting similar depth pitting.
6	L1-L2	5	D	2" hole in bottom flange at access hole (12' from L2) has been retrofitted. Similar section loss as L0-L1 but only 15% of length. Both the East and West webs exhibiting 1/16" to 1/8" nominal pitting along the bottom and up 2" to 3" maximum height extending along approximately 15% of the total chord length.
6	L2	6	D	Previously deteriorated rivets replaced; all inner surfaces within 1" to 2" of bottom exhibiting 1/16" to 1/8" nominal pitting. Outer face of inner gusset plates north and south of the floor beam exhibiting 1/16" to 1/8" horizontal section loss above the full length of the lower horizontal shelf plate.

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FRACTURE CRITICAL WORK PLAN AND HAZARD ANALYSIS

- Template provided in BIM Appendix 5C
- 2019 Fracture Critical Inspection – Bridge 237-62-06512 C (Sample)
 - Emergency Services
 - Inspection Personnel
 - Information regarding roadway safety (speed limits, traffic counts)
 - Safety equipment
 - Anticipated inspection and traffic hazards, with mitigations.

For State Roads and Local/County Roads carried by smaller fracture critical bridges – Work Plan and Hazard Analysis NOT REQUIRED.

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IN SUMMARY

Most of the updates made were general housekeeping, streamlining information, and deleting duplicate information.

Requirements detailed in the Manual **MUST** be included in ALL Fracture Critical Reports (State and LPA); FHWA will hold us accountable if any required item is missing from any Fracture Critical Report.



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Thank you for your time and attention!

Anthony Marino, P.E.

INDOT Bridge Inspection Area Engineer

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Part 6 (Scour)- Tony

INDOT BRIDGE INSPECTION MANUAL

PART 6

SCOUR



Part 6 (Scour)- Tony

PRESENTATION DISCUSSION

1. Chapter Organization and Updates
2. Scour Plans of Actions
3. Scour Inspection Triggers
4. Scour Monitoring
5. Scour Inspection Reports



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CHAPTER ORGANIZATION AND UPDATES

6-1.01 BRIDGE SCOUR EVALUATION PROCEDURES FOR STATE BRIDGES

6-1.02 BRIDGE SCOUR EVALUATION PROCEDURES FOR LPA BRIDGES

6-1.03 SCOUR ASSESSMENT/SCOUR ANALYSIS PROCEDURES

6-1.04 SCOUR RATINGS DURING FIELD REVIEWS

6-1.05 BRIDGE SCOUR PLAN OF ACTION (POA) PROCEDURES



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CHAPTER ORGANIZATION AND UPDATES

6-1.01 BRIDGE SCOUR EVALUATION PROCEDURES FOR STATE BRIDGES

- *Scour vulnerability determined through analysis by INDOT Hydraulics Division.*
- *Initial scour inspections following trigger event.*
- *Establishes approved trigger events.*
- *Scour monitoring.*
- *Final Scour Inspection Report.*



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CHAPTER ORGANIZATION AND UPDATES

6-1.02 BRIDGE SCOUR EVALUATION PROCEDURES FOR LPA BRIDGES

6-1.03 SCOUR ASSESSMENT/SCOUR ANALYSIS PROCEDURES

- *These two sections specified primarily for LPA Bridges.*
- *No major changes were made in this revision – only minor housekeeping.*
- *Initial Scour Screenings and Scour Assessment Procedures are to establish SCOUR CRITICAL EVALUATION RATINGS for NBI Item 113.*
- *Most of this work has already been completed for LPA Bridges.*



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CHAPTER ORGANIZATION AND UPDATES

6-1.04 SCOUR RATINGS DURING FIELD REVIEWS

6-1.05 BRIDGE SCOUR PLAN OF ACTION (POA) PROCEDURES

- *Discusses information required in Scour Plans of Action.*
- *Discusses required actions during scour trigger events at scour critical bridges.*
- *Goal is to encourage actions by bridge owners to mitigate scour risks through properly designed and installed countermeasures.*
- *Scour POA template cited in BIM Appendix 6A – **This template is not correct!***
- ***ALL** State and LPA Bridges identified through NBI Item 113 as Scour Critical shall use the BIAS Scour Plan of Action Template.*



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SCOUR PLANS OF ACTION (POA)

- Required for all State and LPA bridges when NBI Rating = 3 or less
 - NBI = 1 or 0 (LPA Bridges) - ***MUST BE CLOSED TO TRAFFIC***
- Scour POA template in BIAS – ***MUST BE USED FOR ALL BRIDGES***
- Must be written by the Responsible Inspection Team Leader
- Initial Scour POA must be approved by responsible supervisor
- Scour POA must be updated regularly:
 - State Bridges = following each Routine Inspection.
 - LPA Bridges = updated every 24 months, preferably during the Routine Inspection.

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Group: All

052-24-06649



The report sections below are included in the selected group.

Save Order Changes

Add Sections/PDF Attachments

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Remove Section	Order	Section Name	Print	Include in Table of Contents	Insert Cover Page Before Section	Show Page Number
	1	Report Cover	View ☒	☐	☐	☐
	2	Table of Contents	View ☒	☐	☐	☐
	3	Location Map	View ☒	☒	☐	☒
	4	Executive Summary	View ☒	☒	☐	☒
	5	National Bridge Inventory	View ☒	☒	☐	☒
	6	Elements	View ☐	☐	☐	☐
	7	Pictures	View ☒	☒	☐	☒
	8	Sketches	View ☐	☐	☐	☐
	9	Miscellaneous Asset Data	View ☒	☒	☐	☒
	10	Scour Analysis	View ☐	☐	☐	☐
	11	Load Rating - BRADIN	View ☒	☒	☐	☒
	12	Maintenance - Bridge	View ☐	☐	☐	☐
	13	Scour Channel Profile	View ☒	☒	☐	☒

Forms

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Misc Asset Data

Miscellaneous Asset Data

MAD2

Scour Channel Profile

Bridge POA Monitoring Log

Scour Analysis

Scour Analysis

Maintenance

Maintenance - Bridge

Critical Finding

Critical Finding Maintenance

Load Rating - Bradin

Load Rating - Bradin

History



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INDOT BRIDGE INSPECTION DIVISION					
05 DISTRICT					
SCOUR PLAN OF ACTION					
<u>GENERAL INFORMATION</u>					
NBI Number:	019430	Facility Carried :	US 52		
Feature Intersected:	E FORK WHITEWATER RIVER	Location:	00.47 E SR 252		
<u>SCOUR STATUS SUMMARY</u>					
Scour Critical Rating:	8	Substructure Rating:	7	Channel and Channel	7
Culvert Rating:	N	Waterway Adequacy	7	Protection Rating:	
Scour/Flood History:					

Most of this information is populated from the NBI Data.

Comment box provided for scour or flood history narrative (as necessary).



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Initial Scour Inspection And Monitoring Plan

Bridge Scour Critical Components:

Trigger:

Initial Scour Inspection following Trigger(Date/Findings):

Monitoring Required after Initial Scour Inspection (Y/N):

Reason for Bridge Monitoring:

If monitoring is required after initial inspection, the Bridge Scour Monitoring Log shall be used

Person or Agency that will monitor the bridge:

Monitoring Methodology:

Monitoring History/Comments:

Monitoring Termination Criteria:

Bridge Owner Contact Information (Primary):

*Leave blank with
initial POA.*

Most information will not change from Initial POA unless event requires monitoring.



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<u>Countermeasures Information</u>	
Existence/Type of Countermeasures Present:	
Countermeasures Observations:	
Countermeasures Recommendations:	
<u>Emergency Traffic Information</u>	
Closure Plan:	
Suggested Detour Route:	
Re-opening Procedures:	
<u>Recommendations</u>	
<i>Provide recommendations as needed, such as reduced routine inspection frequency, need for future underwater inspections, countermeasure recommendations, and other comments.</i>	
Scour POA Author (Name/Title)	
Scour POA Approved (Name/Title)	
Scour POA Updated (Name/Title)	

Date

Date

Date

Future Update will add a comment box to this form.

Scour POA (continued) – Countermeasures, Closure and Detour, Approvals.



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SCOUR INSPECTION TRIGGERS

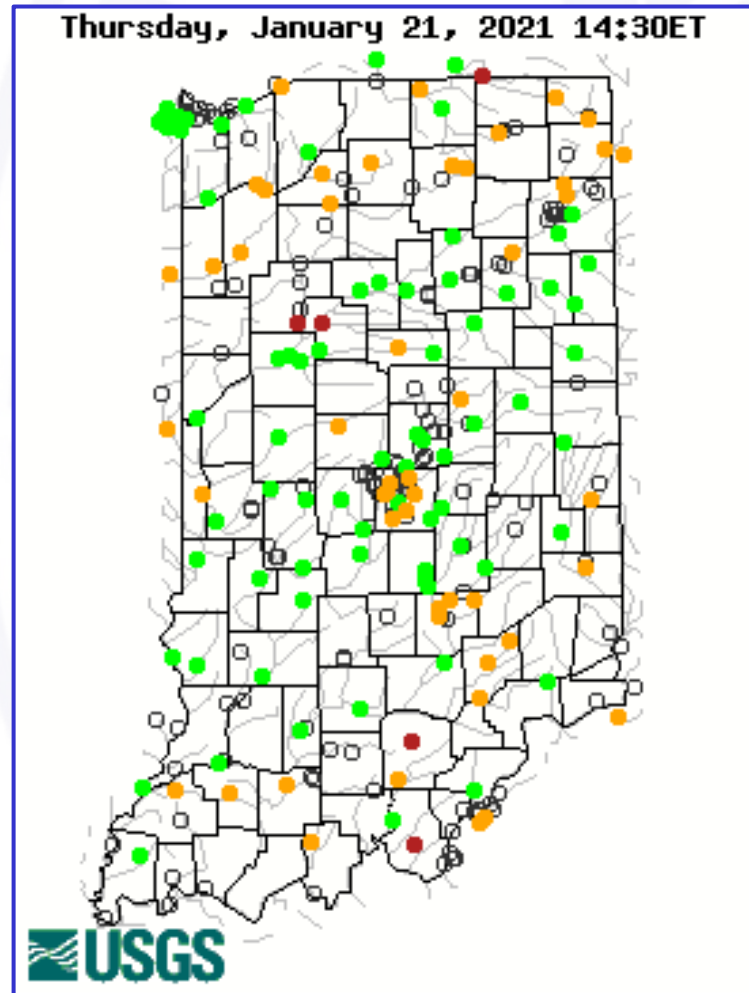
- Subsection 6-1.01(3) defines **THREE** triggers for **STATE** Bridges.
 1. Rainfall event resulting in 2.5 inches or more of rain in a 24-hour period.
 2. Channel exceeds the 50-year flow rate or flood stage (Q_{50})
 3. Notification of significant flood event requiring road served by a scour critical bridge to be closed.

National Water Information System Web Interface – U.S. Geological Survey

<https://waterdata.usgs.gov.nwis/rt>

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SCOUR INSPECTION TRIGGERS



NOTE: USGS Indiana historic, recent, and real-time data will continue to be provided in Eastern Standard Time.

NOTE: During winter months, stage and discharge may be affected by ice. [Click here for more information.](#)

--- Predefined displays ---

Indiana Streamflow Table
Major River Basin

Daily Streamflow Conditions

Select a site to retrieve data and station information.

Thursday, January 21, 2021 14:30ET

Explanation

- High
- > 90th percentile
- 76th - 90th percentile
- 25th - 75th percentile
- 10th - 24th percentile
- < 10th percentile
- Low
- Not ranked

The colored dots on this map depict streamflow conditions as a percentile, which is computed from the period of record for the current day of the year. Only stations with at least 30 years of record are used. The **gray circles** indicate other stations that were not ranked in percentiles either because they have fewer than 30 years of record or because they report parameters other than streamflow. Some stations, for example, measure stage only.

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SCOUR INSPECTION TRIGGERS

Current Conditions for Indiana: Precipitation -- 75 site(s) found

PROVISIONAL DATA SUBJECT TO REVISION

--- Predefined displays ---

Indiana Precipitation Table

Group table by

County

Select sites by number or name

go

show sites on a map

Customize table to display other current-condition parameters

Station Number	Station name	Date/Time	1 hour	4 hours	Precipitation in inches during the previous		12 hours	24 hours	2 days	5 days
● Cook County, Illinois										
413113087342201	RAIN GAGE NEAR CHICAGO HEIGHTS, IL	01/21 14:00 CST	0	0	0	0	0	0	0	0.03
● Wabash County, Illinois										
03377500	WABASH RIVER AT MT. CARMEL, IL	01/21 14:45 EST	0	0	0	0	0	0	0	0.11
● Will County, Illinois										
412657087372001	RAIN GAGE AT CRETE, IL	01/21 14:00 CST	0	0.01	0.01	0.01	0.01	0.03	0.10	
● Adams County										
03322900	WABASH RIVER AT LINN GROVE, IN	01/21 14:45 EST	0	0	0	0	0	0	0	0
● Allen County										
04183038	BLACK CREEK NEAR HARLAN, IN	01/21 14:00 EST	0	0.04	0.04	0.04	0.04	0.04	0.11	
411228084541701	OVERLAND FLOW WEST OF BULL RAPIDS RD NR HARLAN, IN	01/21 14:00 EST	0	0	0	0	0	0	0	0.08
● Bartholomew County										
03363000	DRIFTWOOD RIVER NEAR EDINBURGH, IN	01/21 14:30 EST	0	0	0	0	0	0	0	0
03364000	EAST FORK WHITE RIVER AT COLUMBUS, IN	01/21 15:00 EST	0	0	0	0	0	0	0	0.12
03364500	CLIFTY CREEK AT HARTSVILLE, IN	01/21 15:00 EST	0	0	0	0	0	0	0	0.22
391627085534401	BARTHOLOMEW 4 (BA 4)	01/21 15:15 EST	0	0	0	0	0	0	0	0.10
● Benton County										
402851087213501	BENTON 4 (BE 4)	01/21 15:00 EST	0	0	0	0	0	0.07	0.26	
● Boone County										
03339280	PRAIRIE CREEK NEAR LEBANON, IN	01/21 15:15 EST	0	0	0	0	0	0	0	0.06
03353200	EAGLE CREEK AT ZIONSVILLE, IN	01/21 14:45 EST	0	0	0	0	0	0	0	0.11
● Carroll County										
03332605	TIPPECANOE RIVER BELOW OAKDALE DAM, IN	01/21 15:15 EST	0	0	0	0	0	0	0	0.02
03333050	TIPPECANOE RIVER NEAR DELPHI, IN	01/21 14:45 EST	0	0	0	0	0	0	0	0.03
● Cass County										
403407086175701	CASS 3 (CS 3)	01/21 15:00 EST	0	0.02	0.02	0.05	0.19	0.64		
● Crawford County										
03302849	WHISKEY RUN AT MARENGO, IN	01/21 14:30 EST	0	0	0	0	0	0	0	0.16
● Dearborn County										
03276650	TANNERS CREEK AT LAWRENCEBURG, IN	01/21 15:00 EST	0	0	0	0	0	0.01	0.07	
● Dubois County										
03374500	PATOKA RIVER NEAR CUZCO, IN	01/21 14:45 EST	0	0	0	0	0	0	0	0.27
03375500	PATOKA RIVER AT JASPER, IN	01/21 15:15 EST	0	0	0	0	0	0	0	0.08



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SCOUR INSPECTION TRIGGERS

Section 6-1.05 (LPA Scour Critical Bridges)

“The scour triggering event criteria specified in the Bridge Inspection Manual for State-owned scour critical bridges may be used for LPA Bridges identified as scour critical. Other scour triggering event criteria may be used if they can easily be determined.

SCOUR INSPECTION TRIGGER REQUIREMENTS DETAILED FOR STATE BRIDGES ARE NOT SPECIFIED FOR LPA BRIDGES. THEY MAY BE USED, BUT INTENTION WAS TO ALLOW FLEXIBILITY IN DEFINING THESE TRIGGERS. MAY SELECT A COUNTY-WIDE TRIGGER FOR ALL SCOUR CRITICAL BRIDGES WITHIN A COUNTY.

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SCOUR MONITORING

- Required for all State and LPA bridges when field conditions do not allow scour inspections to terminate with the initial scour inspection.
- Scour Monitoring Template is shown in BIM Appendix 6F and provided directly in BIAS bridge files.
- Scour Monitoring Form to be used for reporting scour conditions for State and LPA bridges for follow up inspections.

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Group: All

The report sections below are included in the selected group.

Save Order Changes

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View PDF

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	13	Scour Channel Profile	View ☒	☒	☐	☒

052-24-06649



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MAD2

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Scour Analysis

Maintenance

Maintenance - Bridge

Critical Finding

Critical Finding Maintenance

Load Rating - Bradin

Load Rating - Bradin

History



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This function in BIAS allows additional data tables to be created for reporting ongoing monitoring.

NBI 008: Structure Number NBI 007: Facility Carried by Structure
NBI 006: Feature Intersected NBI 009: Location

Add New

POA Monitoring Log - 1

Date/Time  Inspectors Name Type of Monitoring

Bridge Condition Due to Scour

Actions Taken

Comments/Conclusions



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BRIDGE INSPECTION MANUAL

APPENDICES: BRIDGE INSPECTION

APPENDIX 6F: POA MONITORING LOG BOOK

Indiana Department of Transportation
BRIDGE SCOUR MONITORING/CLOSING REPORT FORM
POA MONITORING LOG BOOK
Structure Number: XXX-XX-XXXXX [XXXXXX]
Road: XXXXXXXX **Stream Name:** XXXXXXXXXXXX

Date & Time	Type Monitoring	of	Initials	Condition of Bridge Due to Scour	Action



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SCOUR INSPECTION REPORT REQUIREMENTS (STATE BRIDGES)

- Detailed in Subsection 6-1.01(05).
- Must be done in BIAS
- Required after every scour triggering event at a scour critical bridge.
- Required whether monitoring was or was not done.
- BIAS Scour Inspection and Report (Select **SCOUR** inspection type).
 - Location Map.
 - Narrative paragraph(s) in Executive Summary.
 - Updated NBI information and data.
 - Photographs – BIM specifies photos that must be taken.
 - Completed and **UPDATED** Scour Plan of Action.
 - Completed Bridge Scour Monitoring Form (if done).

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SCOUR INSPECTION REPORT REQUIREMENTS (LPA BRIDGES)

Subsection 6-1.05

“An Initial Scour Inspection shall be carried out for each or all LPA Bridge identified as a scour critical bridge when the triggering event criteria is either detected, reported, or measured at each applicable bridge. If the conditions observed during the initial scour inspection determine that no appreciable scour has occurred, or that any scour action that has occurred has not resulted in any adverse [effect] to the bridge or any of its scour critical components, or that any observed effects are not detrimental and can be corrected by the bridge owner’s maintenance forces, then no further monitoring triggered by that event may be necessary.”

INSPECTION REPORT REQUIREMENT DETAILED FOR STATE BRIDGES ARE NOT SPECIFIED FOR LPA BRIDGES, BUT ARE RECOMMENDED.



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Thank you for your time and attention!

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