NEW LPA SCOUR ASSESSMENT PROCEDURE

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PURPOSE

- Apply risk-based approach to scour evaluations and the development of Plans of Action
- Ensure consistency in scour ratings
- Ensure those efforts are properly documented in each bridge file

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DEVELOPMENT OF THE POLICY

- Combined effort between FHWA, INDOT, and ACEC
- Final draft sent to FHWA for review and approval
- Next step: a spreadsheet will be developed to ensure consistency throughout the state

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SCOUR ASSESSMENT SHALL:

- Utilize existing documents, field conditions, and engineering judgement
- Utilize Office and Field reviews
- Be performed by a “Scour Evaluator” who is:
  - A Professional Engineer who is an NBIS Certified Team Leader in Indiana
  - Preferably utilizes a multi-disciplinary team

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SCOUR ASSESSMENT SHALL:

- Have clear documentation
- Be uploaded to INDOT's Electronic Bridge File
- Be based on the worst-case foundation – if the bridge has multiple foundation types

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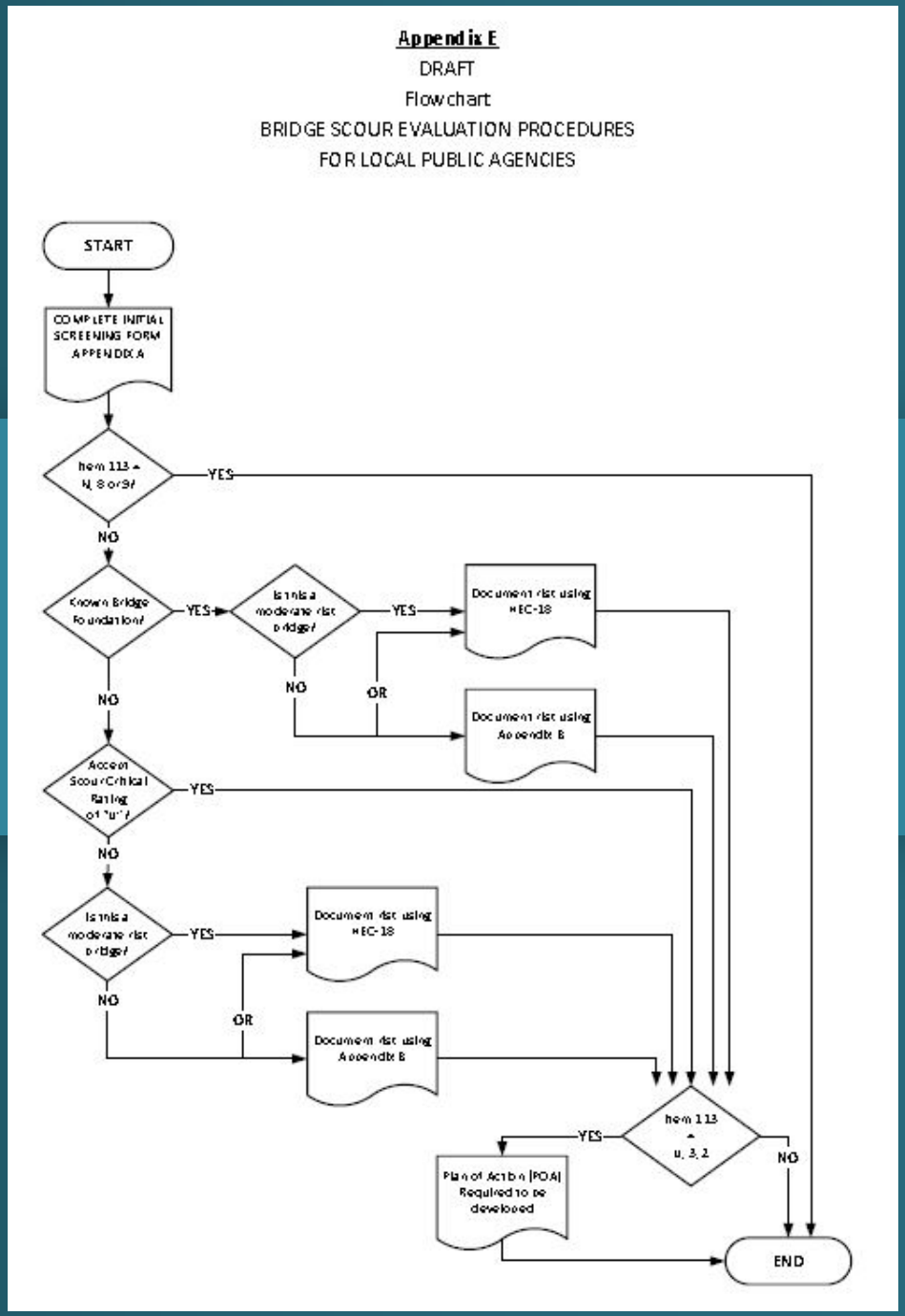
FLOW CHART (APPENDIX E)



DEFINITIONS

- “No signs or history of scour”
- “Significant scour on spread footings”
- “Significant scour on piles”
- “Appropriately sized scour countermeasures”
- “Stream banks unstable”

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STEP 1
INITIAL SCREENING PROCESS

- Purpose is to quickly screen out structures not over waterways or easily identified as low risk for scour
- Required for every bridge
- Shall be signed and dated by the Scour Evaluator and uploaded to INDOT's Electronic Bridge File
- If the Initial Screening value is "NA", the bridge must be evaluated using the Scour Assessment/Scour Analysis Procedures

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STEP 1
INITIAL SCREENING PROCESS

1. Is the bridge over a waterway?
2. Are all of the foundations on dry land well above flood water elevations or floodway?
3. Was the bridge designed and constructed to resist scour?
4. Are the spread footings on erosion resistant rock or pile foundations of sufficient depth below scour with no signs or history of scour?

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STEP 1
INITIAL SCREENING PROCESS

5. Is the bridge a single span bridge and meets certain criteria?
6. Is the bridge a 4-sided box culvert or a pipe culvert with no signs or history of scour?
7. Is the bridge a single span concrete arch bridge with no signs or history of scour?

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STEP 2
DETERMINE IF A SCOUR ASSESSMENT OR SCOUR ANALYSIS IS REQUIRED

- Assess Risk
  - Bridges over the waterways shown on the map in Appendix D should be considered "Moderate Risk".

Appendix D

DRAFT

Indiana Department of Transportation

MAP OF MODERATE RISK BRIDGES FOR USE WITH SCOUR EVALUATION PROCESS FOR LOCAL PUBLIC AGENCIES

STEP 2A
ASSESS RISK

- Or risk can be identified by the Inspection Team Leader
  - Higher risk bridges might:
    - Show signs of active migration near the bridge
    - Have many bends in the channel near the bridge
- All other bridges can be considered “Low Risk”

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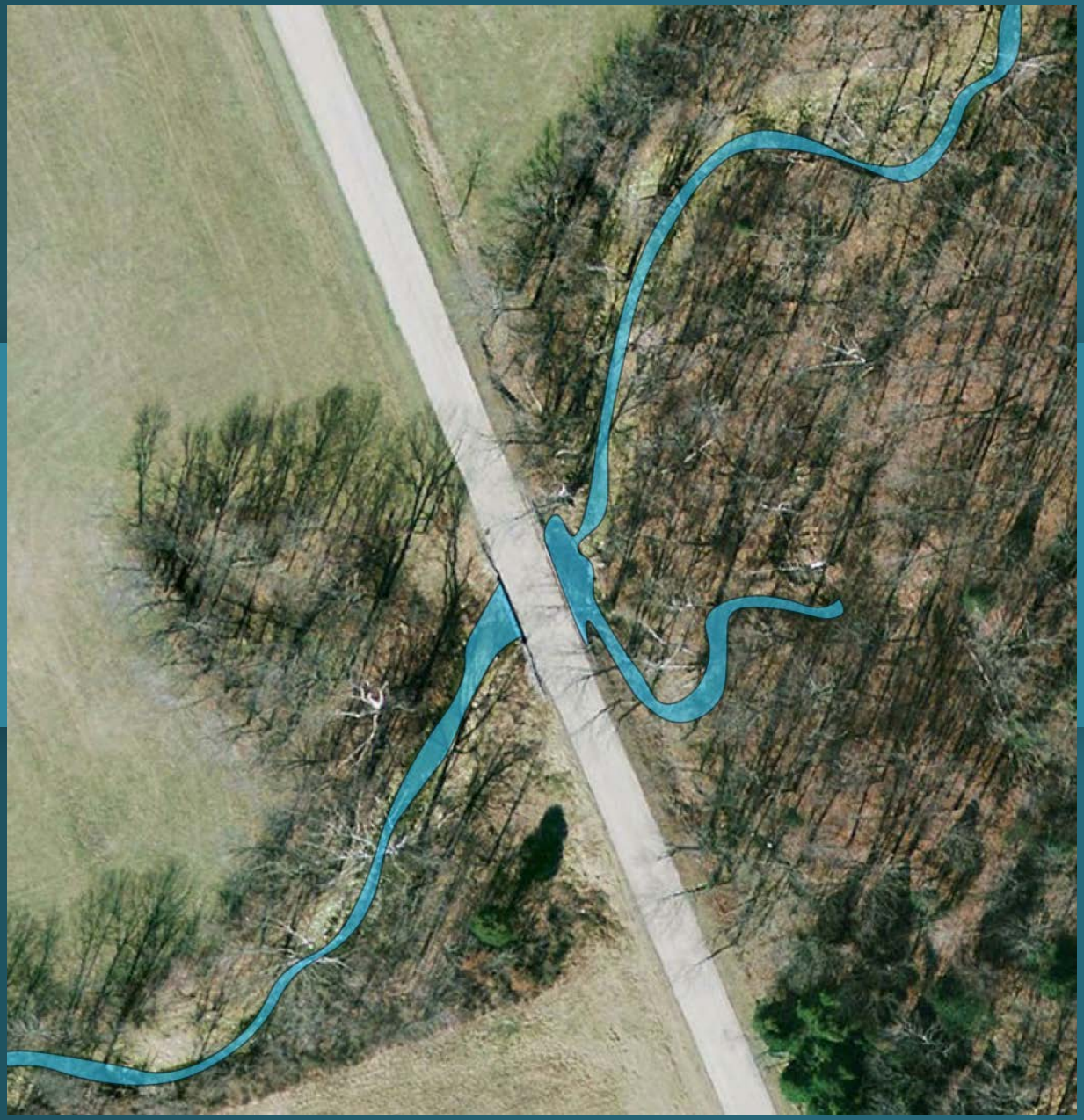
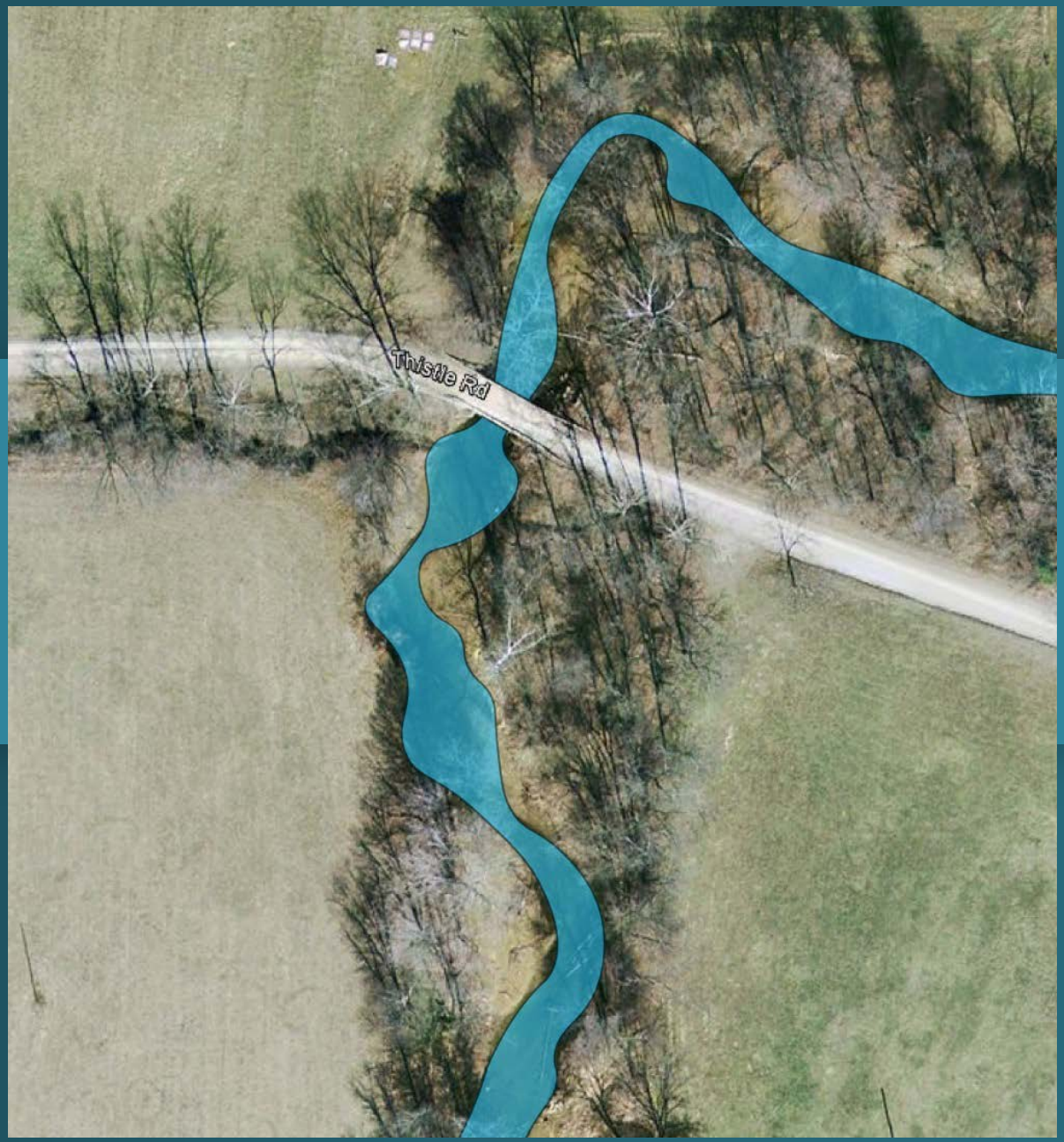
STEP 2A
ASSESS RISK



STEP 2A
ASSESS RISK

STEP 2A
ASSESS RISK



STEP 2A
ASSESS RISK

STEP 2B
ASSESS FOUNDATION

- Known Foundations – have bridge plans or other documents on file
- Unknown Foundations
  - Inference based on similar bridges built in similar timeframe
  - In lieu of inference:
    - If rock is near surface; assume spread footings
    - If footings can be located, assume bottom of footing is 3’ below top of footing
    - If foundation is unknown, and pile lengths cannot be reasonably determined, treat the bridge as if it were on spread footings

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STEP 2

DETERMINE IF A SCOUR ASSESSMENT OR SCOUR ANALYSIS IS REQUIRED

- Known or Unknown Foundation
  - Moderate Risk – Analyze bridge using HEC-18
  - Low Risk – Use Scour Assessment Procedures (Appendix B) OR analysis using HEC-18

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STEP 3
SCOUR ANALYSIS USING HEC-18

- Scour Analyses shall follow the procedures in the Hydraulics Section of the Indiana Design Manual
- The Scour Analysis Summary and supporting scour report shall be uploaded to the INDOT Electronic Bridge File
- Counties may elect to use a Plan of Action for bridges that would otherwise require an analysis using HEC-18

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STEP 3

SCOUR ASSESSMENT PROCEDURE FOR LOCAL PUBLIC AGENCIES

- Purpose is to help the Scour Evaluator quickly assess the scour risk of a structure to determine the scour rating
- The Scour Assessment shall be signed and dated by the Scour Evaluator and uploaded to INDOT's Electronic Bridge File

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STEP 3

SCOUR ASSESSMENT PROCEDURE FOR LOCAL PUBLIC AGENCIES

1. Culverts
   - If it is a 4-sided box culvert or a pipe culvert, you will use assessment created for this type of structure
2. Historical Scour Performance
   - Has the bridge experienced the 100 year storm with no problems? Is it over 50 years old with no problems?

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STEP 3

SCOUR ASSESSMENT PROCEDURE FOR LOCAL PUBLIC AGENCIES

3. Scour Countermeasures
   - Are countermeasure in place? How are they functioning? Why were the installed?
4. Geomorphic Conditions Affecting Scour Resistance
   - Is the channel showing signs that might indicate higher risk for scour?

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STEP 3

SCOUR ASSESSMENT PROCEDURE FOR LOCAL PUBLIC AGENCIES

5. Single Span Bridge Considerations
   - Is the waterway adequate? Is the foundation type low risk for scour?
6. Reduced Risk Bridges
   - Is the bridge programmed for rehab or replacement within 5 years? Or for scour countermeasure within the next 2 years? Does the roadway have low ADT and low functional classification?

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STEP 3

SCOUR ASSESSMENT PROCEDURE FOR LOCAL PUBLIC AGENCIES

7. Foundation Scour Resistance Assessment
   - Soil types may be based on known geotechnical information, historical records, or professional judgement.
   - Foundation type is based on known or inferred foundations.
   - If the scour evaluator feels that the rating is not reasonable, an alternate rating may be assigned using sound engineering judgement. **This rating must be clearly documented and approved by the Bridge Program Manager.** Documentation shall be included with the INDOT electronic bridge file.

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STEP 3

SCOUR ASSESSMENT PROCEDURE FOR LOCAL PUBLIC AGENCIES

8. Culverts
   - Initial screening would have eliminated need for further assessment of culverts if there were no signs or history of scour.
   - Is the channel showing signs that might indicate higher risk for scour? Is any scour present at the culvert or wingwalls?

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SCOUR RATINGS

- Bridges with Scour Ratings of 0, 1, 2, or 3 are considered “Scour Critical”. Plans of Action are required for Scour Critical Bridges and for bridges with a Scour Rating of “U”
- Bridges that are not Scour Critical will be monitored for scour during routine inspections.

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EXAMPLE #1

- Single Span Bridge
- Built in 1955 (Age of structure ~61 years)
- Foundation type: Concrete abutment on unknown
- No plans available
- No signs or history of scour

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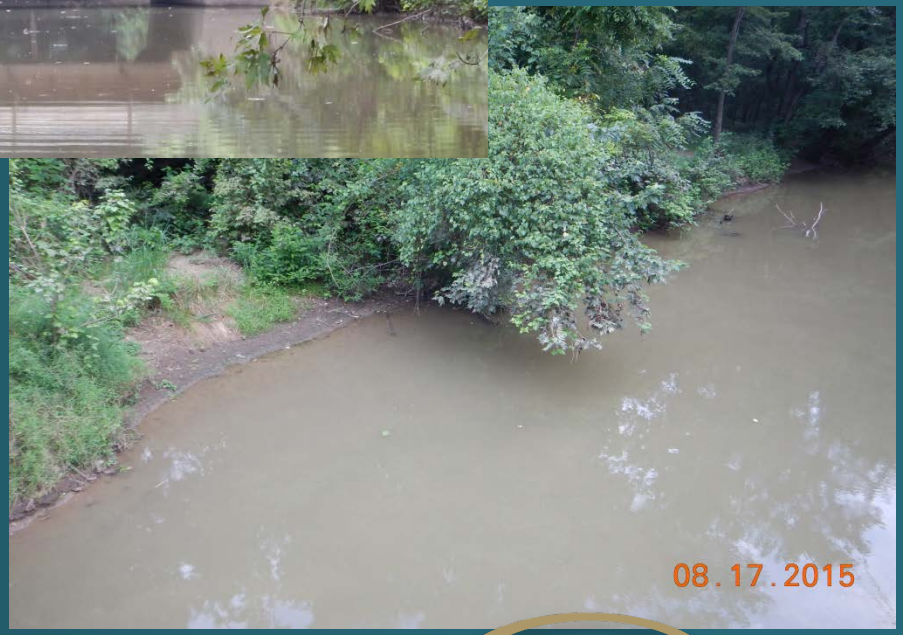
EXAMPLE #1



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EXAMPLE #1

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EXAMPLE #1

- Initial Scour Screening (Appendix A):
  1. Is the bridge over a waterway?

     YES (Go to 2)
  2. Are all of the foundations on dry land well above floodwater elevations or floodway?

     NO (Go to 3)
  3. Was the bridge designed to resist scour?

     UNKNOWN (Go to 4)
  4. Are spread footings on erosion resistant rock?

     UNKNOWN (Go to 5)

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EXAMPLE #1

5. Is the bridge single span and:
   i. Appropriate sized scour countermeasures in place?

      NO

   ii. Elevation of stream bottom above bottom of footing?

      YES

   iii. Does not have any signs or history of scour?

      YES (No signs or history of scour)
      Go to 6

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EXAMPLE #1

6. Is the bridge a 4-sided box culvert or pipe culvert?

   NO (Go to 7)

7. Is the bridge a single span concrete arch bridge?

   NO – CODE 'NA' on Initial Screening Form and Go to Scour Assessment Procedures (Appendix B)

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EXAMPLE #1

Scour Assessment Procedure (Appendix B):

1. Culverts
   a. Is the bridge a 4-sided box culvert or pipe culvert?
      NO (Go to 2)
2. Historical Scour Performance
   a. Has the bridge experienced a documented 100 year flood?
      UNKNOWN
   b. Is the bridge >50 years old with no signs or history of scour and not on granular or soft soil?
      YES
      Code Item 113 as "8"

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EXAMPLE #2

- Three Span Bridge
- Built in 1996 (Age of structure ~20 years)
- Foundation type:
  - End Bents - Concrete caps on piles; protected by riprapped spill slopes
  - Piers – Concrete caps on concrete encased piles, piles driven to refusal in bedrock
- Plans available
- Riprap washed away below high water elevation

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EXAMPLE #2

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EXAMPLE #2

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EXAMPLE #2

Initial Scour Screening (Appendix A):

1. Is the bridge over a waterway?

   YES (Go to 2)

2. Are all of the foundations on dry land well above floodwater elevations or floodway?

   NO (Go to 3)

3. Was the bridge designed to resist scour?

   UNKNOWN – Plans do not indicate scour elevations (Go to 4)

4. Are pile foundations 20’ below scour elevation with no history of scour?

   UNKNOWN – Plans do not indicate scour elevations (Go to 5)

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EXAMPLE #2

5. Is the bridge single span?

   NO (Go to 6)

6. Is the bridge a 4-sided box culvert or pipe culvert?

   NO (Go to 7)

7. Is the bridge a single span concrete arch bridge?

   NO - CODE 'NA' on Initial Screening Form and Go to Scour Assessment Procedures (Appendix B)

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EXAMPLE #2

- Scour Assessment Procedure (Appendix B):
  1. Culverts
     a. Is the bridge a 4-sided box culvert or pipe culvert?
     NO (Go to 2)
  2. Historical Scour Performance
     a. Has the bridge experienced a documented 100 year flood?
     UNKNOWN
     b. Is the bridge >50 years old with no signs or history of scour and not on granular or soft soil?
     NO (Go to 3)

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EXAMPLE #2

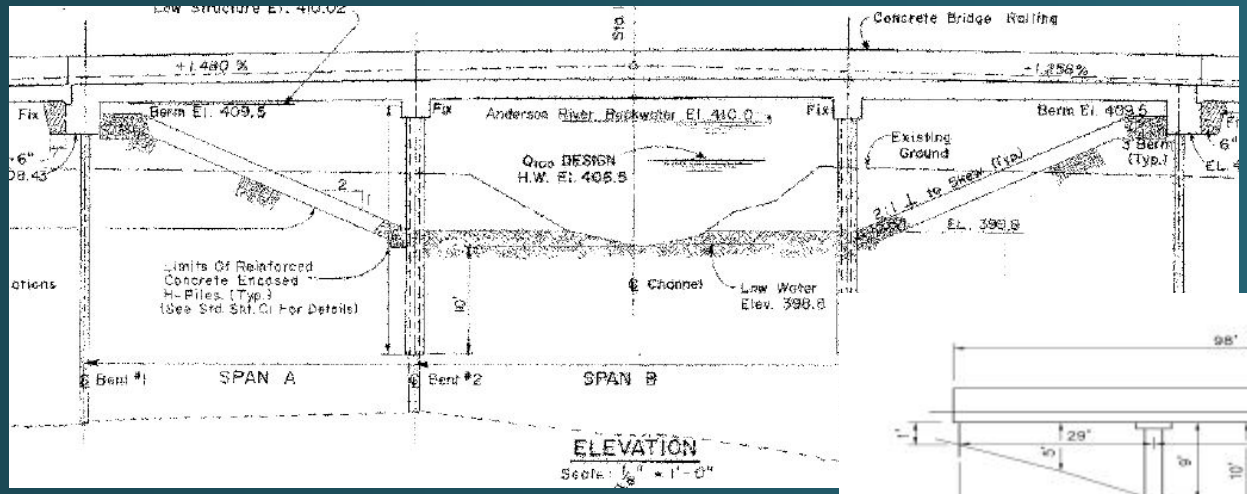
3. Scour Countermeasures
   a. Are scour countermeasures in place, functioning properly, and have minor to no damage?

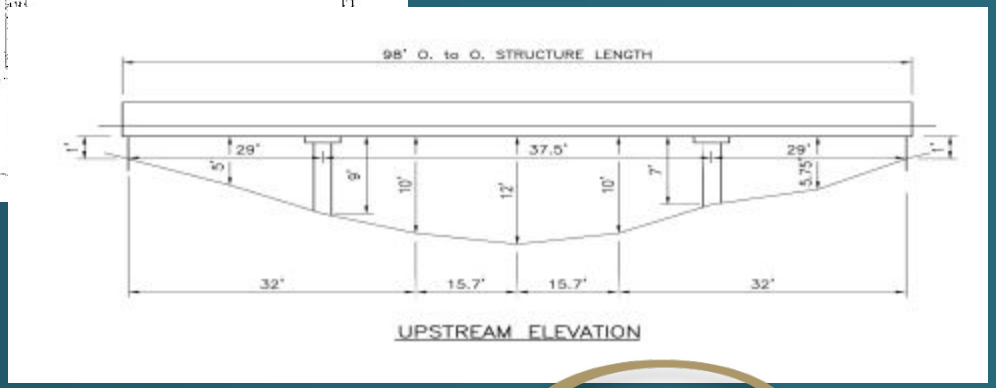
      NO – Plans show revetment riprap to toe of slope. Riprap has washed away. (Go to 4)

EXAMPLE #2

4. Geomorphic Conditions Affecting Scour Resistance
   a. Is the stream bed degrading?

      NO – Compare existing elevation view to current upstream elevation sketch





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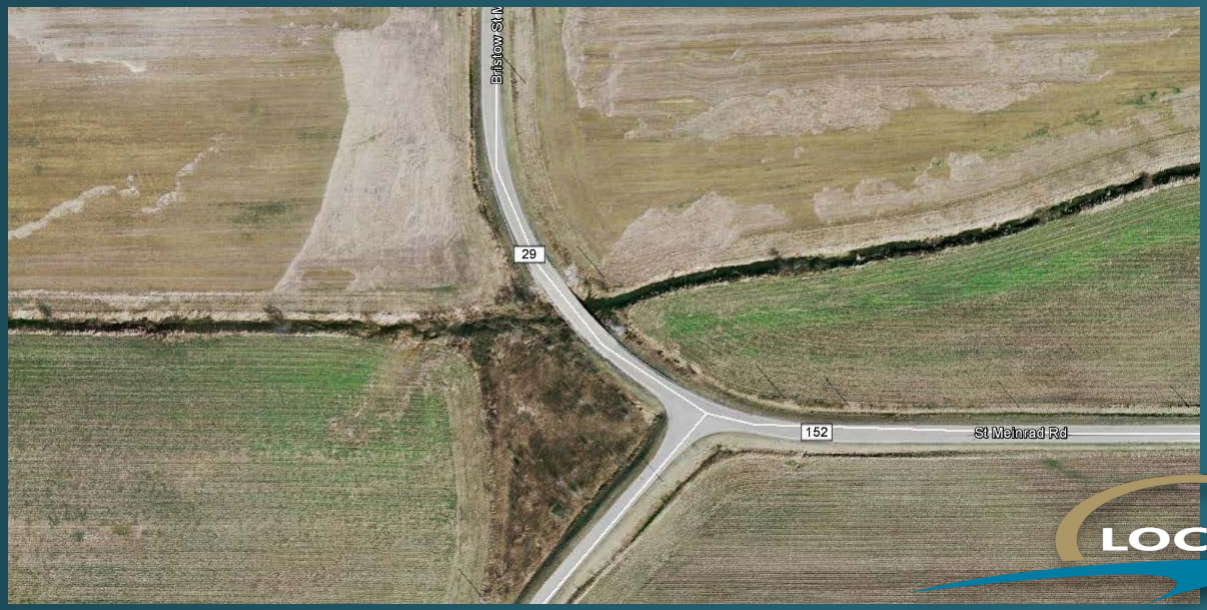
EXAMPLE #2

4. Geomorphic Conditions Affecting Scour Resistance
   b. Is the channel meandering?

      NO

   c. For natural streams, are there channel bends of greater than 30 degrees within 100’ upstream of the bridge?

      NO



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EXAMPLE #2

4. Geomorphic Conditions Affecting Scour Resistance
   d. Are the stream banks unstable?

      NO

   e. Are the substructure units skewed from the direction of flow?

      NO – Plans show substructure skewed to match stream alignment

   f. Do ice jams or debris block more than 10% of the flow cross section?

      NO (Go to 5)

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EXAMPLE #2

5. Single Span Bridge Considerations

   The bridge is multiple-span, Go to 6

6. Reduced Risk Bridges

   a. Is the bridge programmed for replacement or rehabilitation within 5 years OR scour countermeasure installation within 2 years?

      NO

   b. Is the road classified as a “Rural Minor Collector” or “Local Road” AND is the estimated ADT over the bridge <200 vpd?

      NO – Rural Major Collector; current ADT = 325 vpd. (Go to 7)

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EXAMPLE #2

7. Foundation Scour Resistance Assessment
   a. Is the bridge supported on spread footings?

      NO

   b. Is the bridge supported on pile foundations?

      Yes – piles driven to refusal on bedrock, estimated length below ground – 30-37 ft.

      3) Pile tips on rock but not socketed or driven into rock:
         a) Minor to no existing scour is present or has occurred previously?

            No scour evident

            1. A 3' minimum thickness of cohesive soil in upper ½ of embedded pile length?

               Yes, borings show soil type is mainly clay.

               Code Item 113 as "8"

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EXAMPLE #3

- Three Span Bridge
- Built in 1965 (Age of structure ~51 years)
- No plans
- Scour evident at NE corner where the roadside ditch comes in to the stream

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EXAMPLE #3

- Foundation type: Unknown
  - End Bents – Assume – Concrete caps on piles; protected by riprapped spill slopes
  - Piers – Assume – Concrete caps on concrete encased piles

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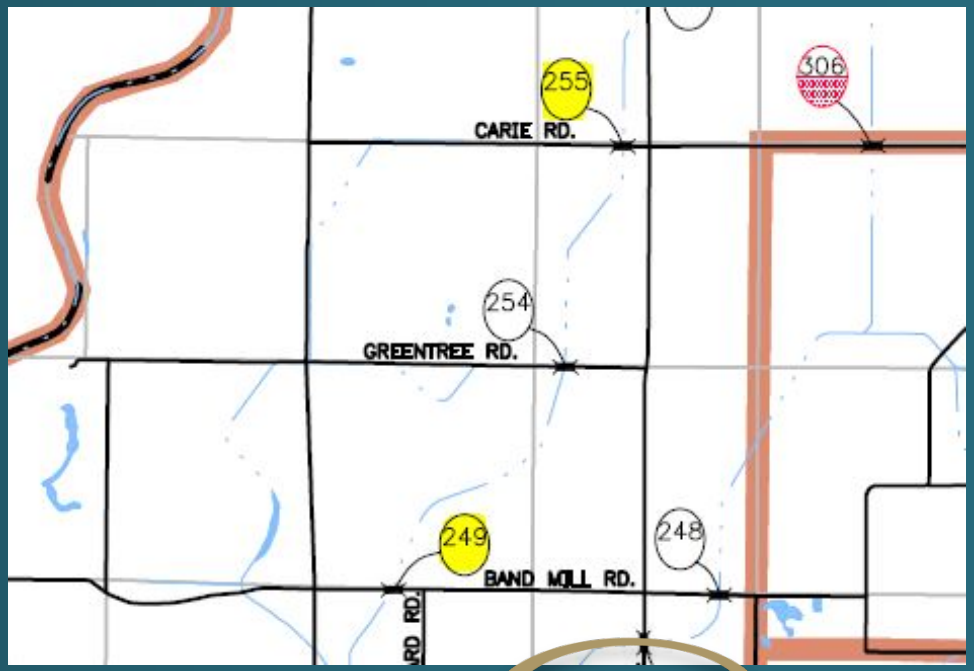
EXAMPLE #3

Nearby structure (#249) is only 2.25 miles downstream of the example structure (#255). It was built within 5 years of the example structure and the piers consist of a concrete cap on piles.



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EXAMPLE #3

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EXAMPLE #3

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EXAMPLE #3

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EXAMPLE #3

- Initial Scour Screening (Appendix A):
  1. Is the bridge over a waterway?

     YES (Go to 2)
  2. Are all of the foundations on dry land well above floodwater elevations or floodway?

     NO (Go to 3)
  3. Was the bridge designed to resist scour?

     UNKNOWN (Go to 4)
  4. Are pile foundations 20’ below scour with no history of scour?

     UNKNOWN (Go to 5)

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EXAMPLE #3

5. Is the bridge single span?

   NO (Go to 6)

6. Is the bridge a 4-sided box culvert or pipe culvert?

   NO (Go to 7)

7. Is the bridge a single span concrete arch bridge?

   NO - CODE 'NA' on Initial Screening Form and Go to Scour Assessment Procedures (Appendix B)

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EXAMPLE #3

- Scour Assessment Procedure (Appendix B):
  1. Culverts
     a. Is the bridge a 4-sided box culvert or pipe culvert?

        NO (Go to 2)
  2. Historical Scour Performance
     a. Has the bridge experienced a documented 100 year flood?

        UNKNOWN

     b. Is the bridge >50 years old with no signs or history of scour and not on granular or soft soil?

        NO – Bridge is over 50 years old, but there are signs of scour. (Go to 3)

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EXAMPLE #3

3. Scour Countermeasures
   a. Are scour countermeasures in place, functioning properly, and have minor to no damage?

      NO – Concrete slopewalls were used for scour protection. Slopewalls are undercut and pulling away from the end bents. (Go to 4)

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EXAMPLE #3

4. Geomorphic Conditions Affecting Scour Resistance
   a. Is the stream bed degrading?
      Yes. Inspection Report states that the stream is slumping and undercutting scour countermeasures.
   b. Is the channel meandering?
      No.
   c. Are there channel bends greater than 30 degrees within 100’ upstream of the bridge?
      No.

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EXAMPLE #3

4. Geomorphic Conditions Affecting Scour Resistance
   d. Are the stream banks unstable?

      Yes. Banks are slumping in roadside ditch that is coming into the stream near the NE wingwall.

   e. Are bridge substructure units skewed from the direction of flow?

      No. Substructure skewed to match stream alignment.

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EXAMPLE #3

4. Geomorphic Conditions Affecting Scour Resistance
   f. Do ice jams or debris block more than 10% of the flow cross section?

      NO (Go to 5)
5. Single Span Bridge Considerations

   The bridge is multiple-span (Go to 6)

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EXAMPLE #3

6. Reduced Risk Bridges
   a. Is the bridge programmed for replacement or rehabilitation within 5 years OR scour countermeasure installation within 2 years?

      NO

   b. Is the road classified as a “Rural Minor Collector” or “Local Road” AND is the estimated ADT over the bridge <200 vpd?

      YES – Rural Local Road; current ADT = 130 vpd.
      Since the bridge has had history of scour, Go to 7

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EXAMPLE #3

7. Foundation Scour Resistance Assessment
   a. Is the bridge supported on spread footings?

      NO

   b. Is the bridge supported on pile foundations?

      Inferred to be on piles, Yes. Length is unknown. Soil conditions are unknown.

      6) If the foundation is unknown and the pile length cannot be reasonably assured, then treat the bridge as if it is supported on spread footings.

         Go back to "7.a"

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EXAMPLE #3

7. Foundation Scour Resistance Assessment
   a. Assume the bridge is supported by spread footings. Worst case substructure unit is the west end bent. Wingwall is undermined, end bent is not undermined at this time.
      1) The end bents are not on rock.

         (Go to 2)
      2) Soils at the end bents appears to be stiff clay.

         (Go to 2a)
         a) No scour observed?

            NO. Scour is present
         b) Scour present, footing not exposed?

            YES. Scour is present, but the piles are not exposed. The structure appears to be structurally stable.

            Code Item 113 as "5"

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NEW LPA SCOUR ASSESSMENT PROCEDURE

QUESTIONS???

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