



Scour Evaluation Guide & Updates

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Scour Evaluation Guide Revision

July 2023



Change 1 – Add Overview Chapter Chapter 1

Scour Evaluation Guide Revision (Change 1 – Add One Chapter)



- Change 1 – Added an overview Chapter 1 in the Guide.
- This Chapter summarizes the history of scour revisions since 2020.
- All previous Chapters offset one chapter.



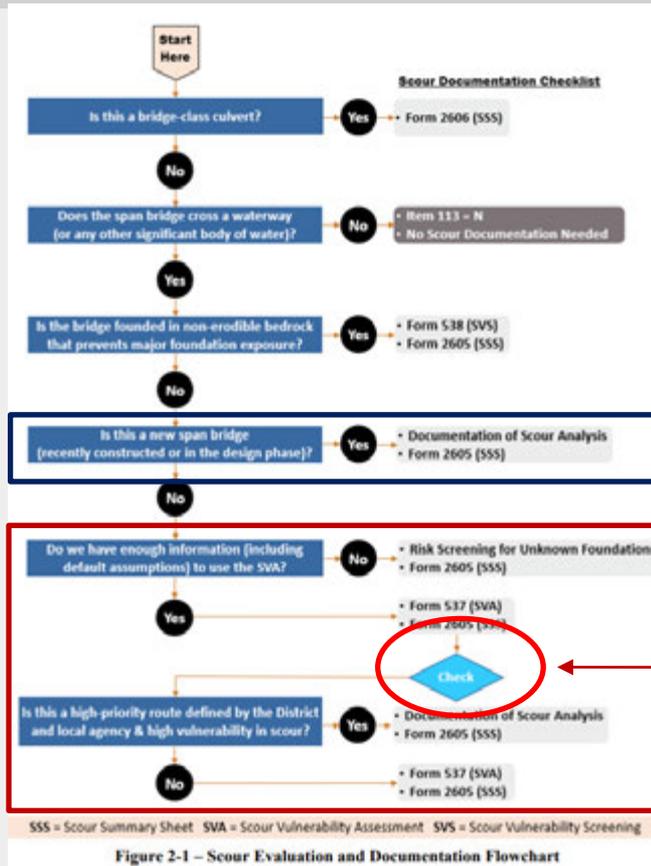


Change 2 – Scour Documentations Chapter 2

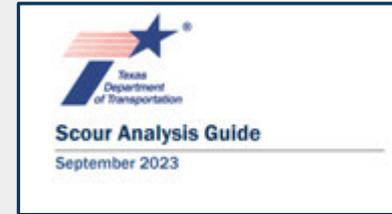
Scour Evaluation Guide Revision (Change 2 – Scour Documentation)



Figure 2-1



Refer to the TxDOT Scour Analysis Guide
<https://ftp.txdot.gov/pub/txdot-info/des/guides/scour-guide.pdf>



New Bridges: Scour Analysis

Existing Bridges: Focus on using Risk Screening and Scour Vulnerability to prioritize bridges that may need in-depth scour analysis.

***Does NOT mean scour analysis is not necessary.**

Figure 2-1 – Scour Evaluation and Documentation Flowchart

An illustration featuring a central white rounded rectangle with a black border and a dotted pattern on its left side. The text 'FREQUENTLY ASKED QUESTIONS' is written in bold black capital letters inside the box. Surrounding the box are several stylized hands of various colors (red, blue, green, purple) and sleeve patterns (solid, wavy, dotted), some pointing towards the box. Dotted lines connect the hands to the box, and there are also some solid lines radiating from the top of the box.

FREQUENTLY ASKED QUESTIONS

Why a new bridge needs scour analysis (e.g. HEC18, SRICOS, Annandale's Erodibility Index Method)?

Or

Why a Scour Vulnerability Assessment (i.e. SVA – Form 537) is not suitable to evaluate scour for a new bridge?



SVA requires enough channel history to evaluate the vulnerability of a stream crossing.

Table 8-3 – SVA Scoring Criteria for **Scour History**

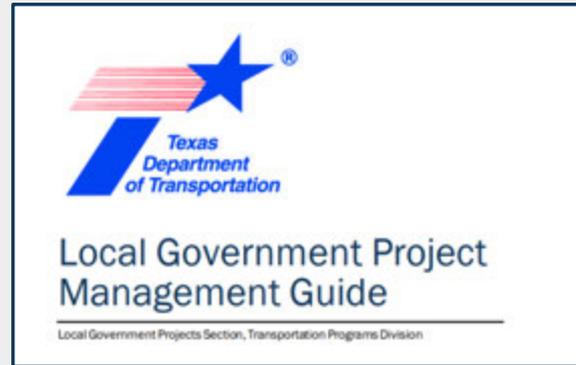
Foundation Exposure from y_{sh}	Score
Minimal	-2
Moderate	1
Major	4

Table 8-4 – SVA Scoring Criteria for **Channel Migration History**

Foundation Exposure from y_{max}	Score
No History of Channel Migration	0
Channel migration has occurred, but the shift has not impacted adjacent bents or abutments.	1
Channel migration has occurred, and the shift has impacted adjacent bents or abutments.	2



- Comply with FHWA and TxDOT requirements (also listed the TxDOT Bridge Design Manual, Hydraulic Design Manual, Geotechnical Manual, etc).
- Bridges built by **Local Agencies MUST comply** too (Refer to Chp 7.4.6 of the Local Government Project Management Guide).





Change 3 – Foundation Exposure Graphs Chapters 3 and 8



Figure 3-1(b), Figure 8-1. This figure applies to both the interior bent and abutment footings

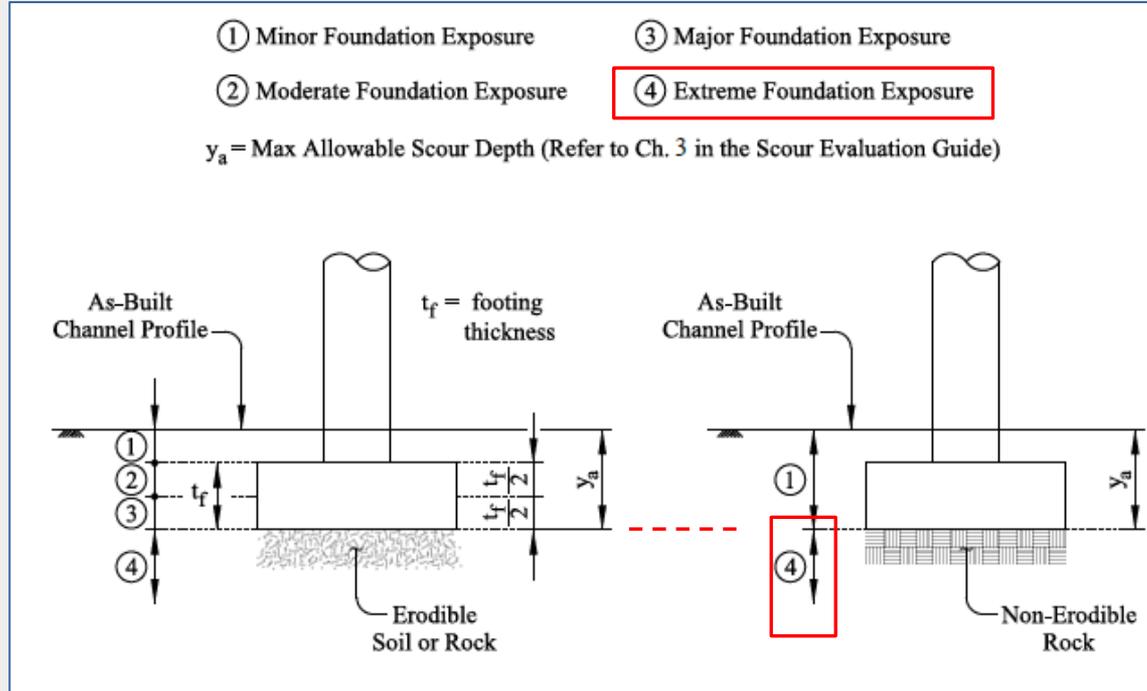




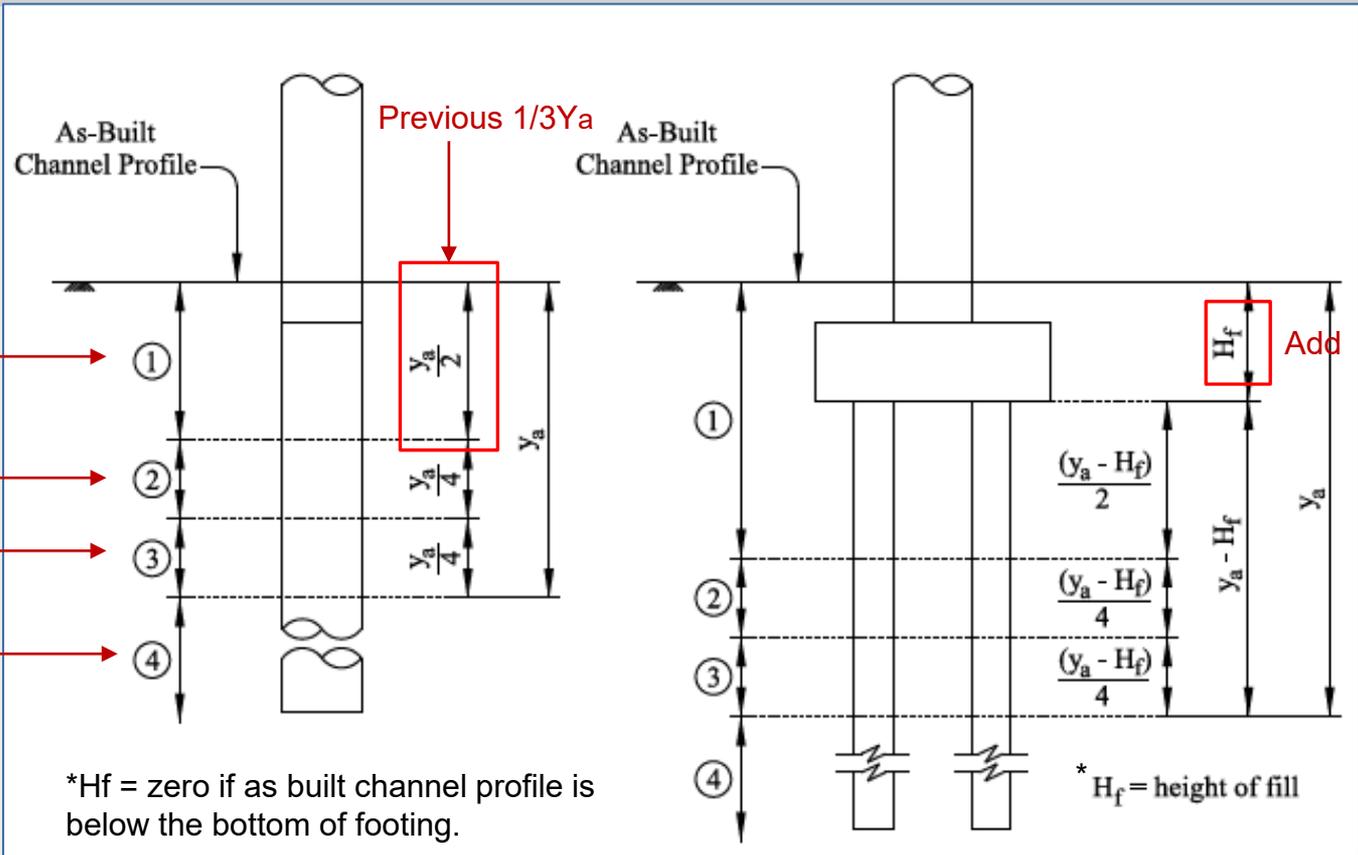
Figure 8-1

Item 113,
Rating
8

5, 4, 3

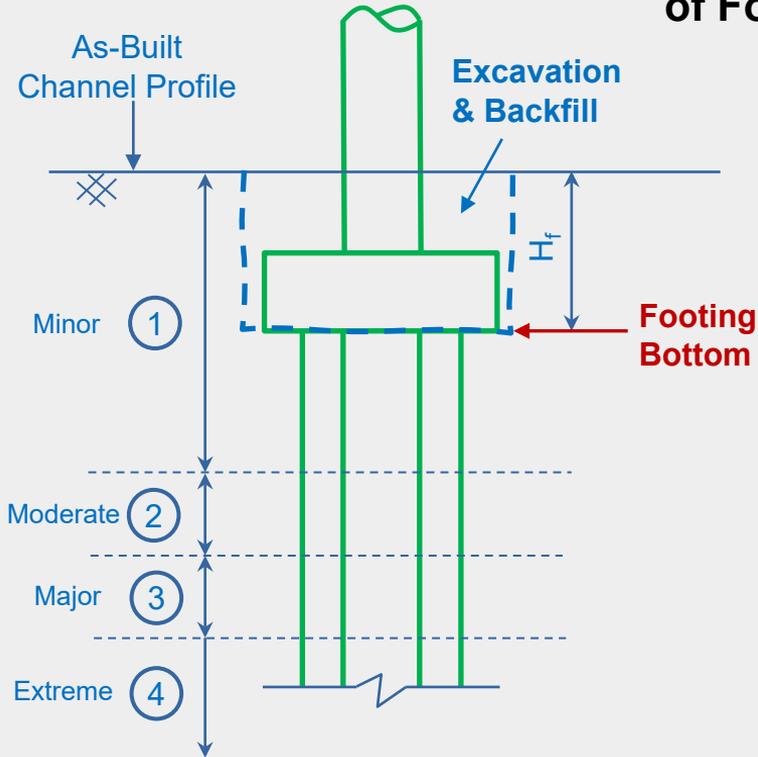
4, 3, 2

3, 2, 1

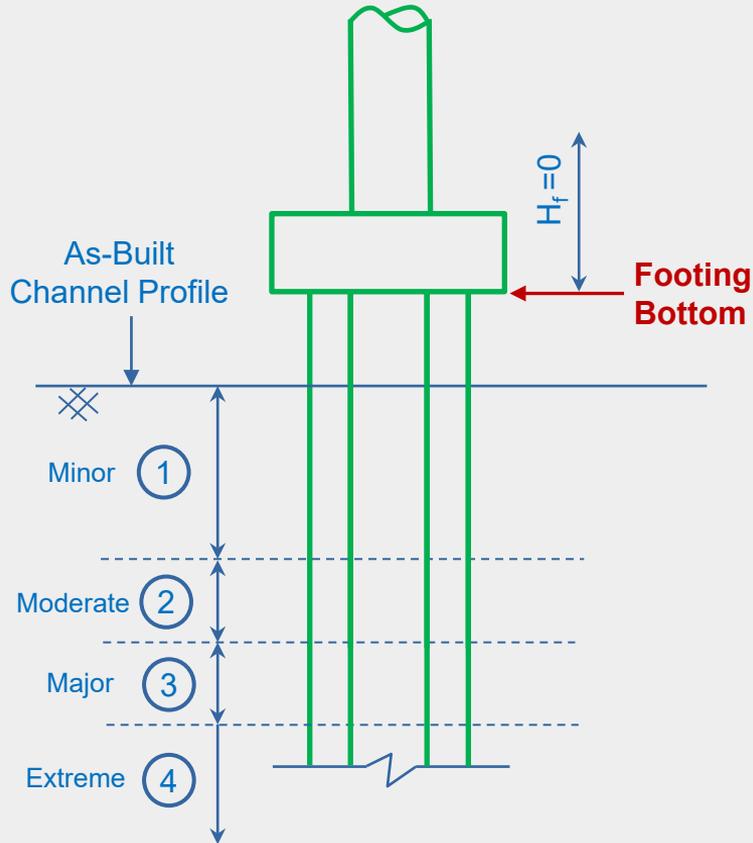




CASE I – As Built Channel Profile At or Above the Bottom of Footing.

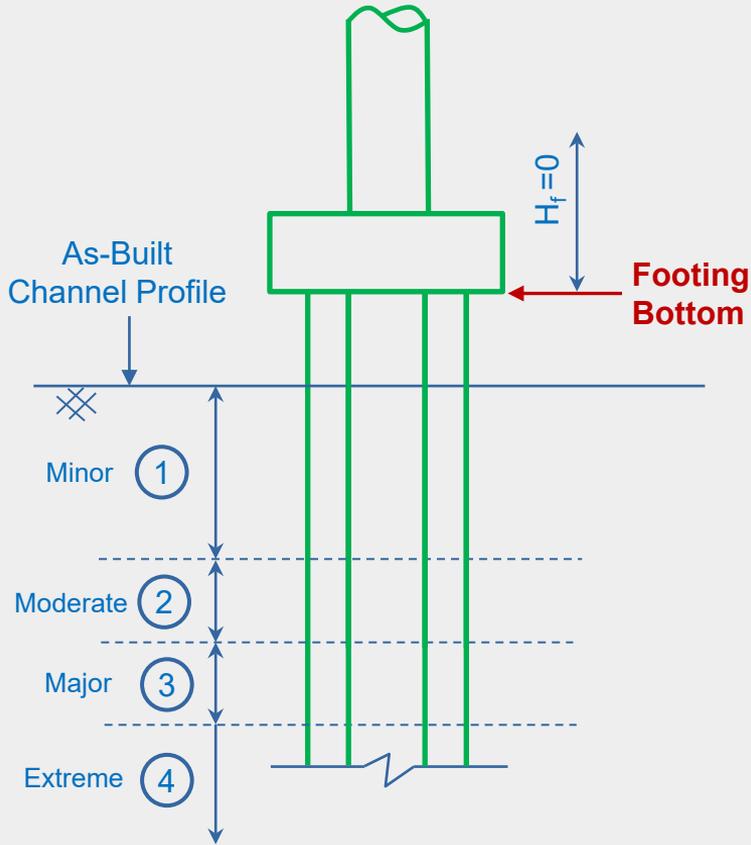


- Scour above bottom of footing is considered minor exposure.
- Original Embedment (E_0) of foundation or Y_a (Both Y_{a1} and Y_{ab}) should count from the bottom of footing to the tip of piling/DS.

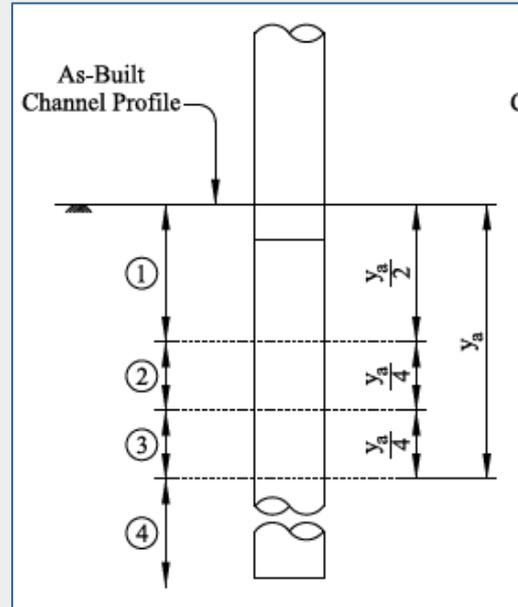


CASE II – As Built Channel Profile Below the Bottom of Footing.

- $H_f = 0$
- The grade separation between the bottom of footing and as-built channel profile is NOT scour.
- Embedment of foundation (E_0) and Y_{ab} should count from as-built Channel Profile to the tip of piling/DS.
- Y_{al} should count from the bottom of footing.



CASE II – As Built Channel Profile Below the Bottom of Footing.



Essentially the same as this situation



When calculating the maximum allowable scour depth for a pile/DS, do we need to account the neglected depth from the scour analysis?



Do we consider the neglected depth from scour analysis for allowable scour depth?

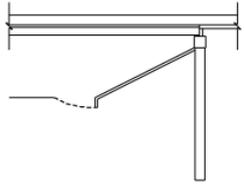
- Only when we have confirmation from the foundation design EOR that the calculated scour depth is included in foundation design as a part of the neglected depth.
- A documented sample calculation of foundation design is recommended to attach to the Scour Summary Sheet for inclusion in AssetWise.
- Reach out to BRG-GEO for more guidance.



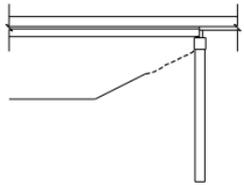
Figure 8-2

Foundation Exposure Categories for Spill-Through Abutments

Minor

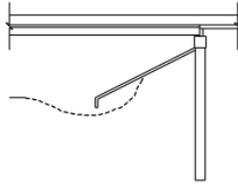


- No significant undermining of riprap

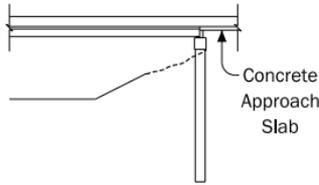


- No significant undermining of cap

Moderate

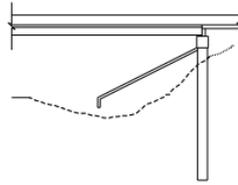


- Significant undermining of riprap
- Embankment not affected

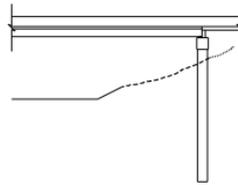


- Significant undermining of cap
- Embankment not affected
- Bridge has concrete approach slab

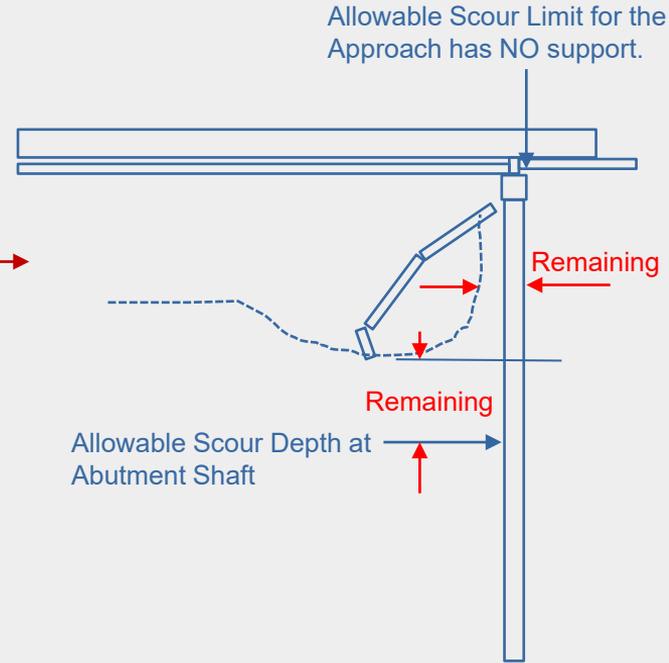
Major



- Significant undermining of riprap
- Undermining extends to embankment



- Significant undermining of cap
- Undermining extends to embankment





Do NOT ignore scour at Abutment

It can be a sign of:

- Contraction scour
- Lateral Channel Migration
- Slope Stability Issue (Geotechnical) at the approach.





Change 4 – Clarity on Coding Guide Chapters 5

Scour Evaluation Guide Revision (Change 4)



The TxDOT Coding Guide includes detailed coding instructions for all three scour items. The same guidance is also provided in Appendix A of this document for ease of reference. **With properly designed and functioning scour countermeasures, Item 113 is assigned an 8.**

Added consideration for Countermeasures

Table 5-1, is the basis of Item 113 coding for span bridges without designed and functioning scour countermeasures.

Table 5-1 – Basis of Item 113 Coding for Span Bridges Without Designed and Functioning Scour Countermeasures

Foundation Exposure	Calculated or Assessed Scour Depth (From Scour Analysis)	Observed Scour Depth (From Inspection Record)
Minor	8	8
Moderate	5	4
Major	4	2 ⁽¹⁾
Extreme	3 ⁽²⁾	1 ⁽¹⁾

Adjusted exposure category coding correlations

Notes: (1) If Major or Extreme foundation exposure is observed, verify the coding with scour assessment (see Section 3.4). Consult Geotechnical Branch at scour@txdot.gov regarding structural scour assessment, recommending repairs and countermeasures, and scour documentation.

(2) When observed scour depths are not consistent with calculated scour depths, this indicates a need to re-evaluate scour vulnerability (e.g., Forms 537 or 538) and /or methods of scour analyses.

Reminder that Scour Evaluation should be reviewed.



The TxDOT Coding Guide includes detailed coding instructions for all three scour items. The same guidance is also provided in Appendix A of this document for ease of reference. **With properly designed and functioning scour countermeasures, Item 113 is assigned an 8.**



Have to fulfill both Properly Designed and Functioning to get a coding of “8”



Designed Countermeasure:

- Countermeasures should be designed based on HEC23 or equivalent methods
- BRG Stone Sizing Spreadsheet for use

CROSS ROADS

[Divisions](#) / [Bridge Division](#) / [Sections](#) / [Field Operations section](#)

Scour forms and guidance

Stone riprap sizing

- [Stone Riprap Sizing Spreadsheet](#)

Scour forms

- [Form 537 - Scour Vulnerability Assessment](#) | [Guide](#)
- [Form 538 - Scour Vulnerability Screening](#) | [Guide](#)
- [Form 2605 - Scour Summary Sheet for Span Bridges](#) | [Guide](#)
- [Form 2606 - Scour Summary Sheet for Bridge-Class Culverts](#) | [Guide](#)
- [Form 2609 - Bridge Scour Plan of Action \(Item 113 = 1\)](#) | [Guide](#)
- [Form 2624 - Bridge Scour Plan of Action \(Item 113 = 2\)](#) | [Guide](#)

<https://crossroads/divisions/brg/sections/field-operations-section/scour-forms-and-guidance.html>



Properly Functioning Scour Countermeasure

- Like other structural or geotechnical elements, we should evaluate the performance of a countermeasure system.
- Item 61 “Channel and Channel Protection” should be a good indicator.
- A few inspection cycles (not single) should be considered.



Properly Functioning Scour Countermeasure



NOT Properly Functioning Scour Countermeasure



NOTE: 1. North channel bank is steep and has moderate scour due to channel bank and run-off erosion. Rock rubble riprap has been previously placed to provide protection and control scour but due to steep north channel bank some rock rubble has partially settled in the channel bed.

Is countermeasure stable?



Change 5 – A New Scour Analysis Guide

Scour Evaluation Guide Revision (Change 5)



Chapter 9 – Detailed Scour Evaluations Based on Analyses

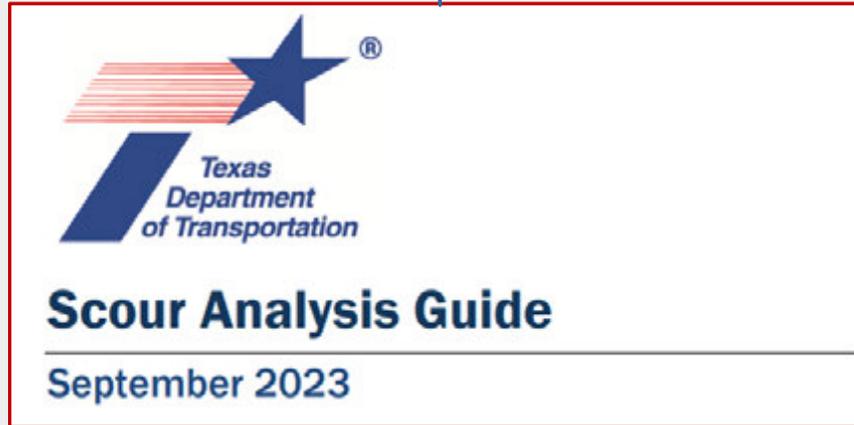
Chapter 9 DETAILED SCOUR EVALUATIONS BASED ON ANALYSES

See the TxDOT Scour Analysis Guide in the Hydrology & Hydraulics Section.

Appendix B – SRICOS Method for Contraction & Pier Scour

Appendix B SRICOS METHOD FOR CONTRACTION & PIER SCOUR

See the TxDOT Scour Analysis Guide in the Hydrology & Hydraulics Section.



Bridge Scour TxDOT resources

- [Scour Analysis Guide](#)
- [Scour Evaluation Guide](#)
- [Scour Forms & Guidance](#)

FHWA resources

- [Bridge Scour](#)
- [TA 5140.23: Evaluating Scour at Bridges \(1991\)](#)
- [HEC-18: Evaluating Scour at Bridges \(2012\)](#)
- [Countermeasures](#)
- [HEC-23: Bridge Scour and Stream Instability Countermeasures](#)

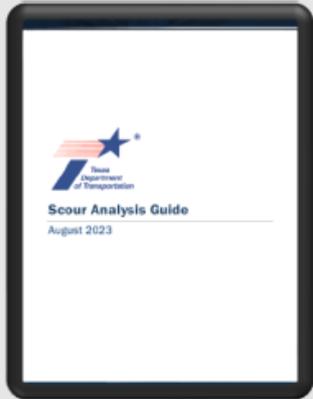
<https://ftp.txdot.gov/pub/txdot-info/des/guides/scour-guide.pdf>



Design Division

► Hydrology & Hydraulics Section

- Scour Analysis Guide

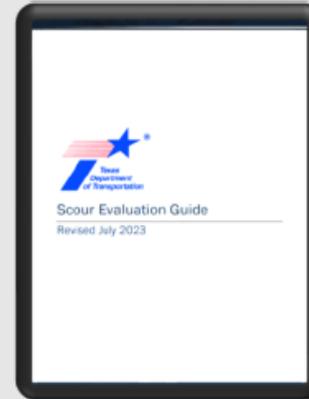


site investigation
hydraulic modeling for scour
scour design flood
scour analysis methods
scour analysis reporting

Bridge Division

► Geotechnical Branch

- Scour Evaluation Guide



regulatory compliance
scour documentation
scour assessment methods
scour condition ratings
stone protection riprap



Scour Analysis Guide

September 2023

- **Revised and Expanded Chp 9 and Appendix B for Scour Analysis**
- **Scour Evaluation Guide and Scour Analysis Guide are companion documents**
- **Design H&H Section maintains Scour Analysis Guide**
- **Bridge Geotechnical Branch maintains Scour Evaluation Guide**



Additional TxDOT Bridge Scour Guidance

- **Hydraulic Design Manual**
 - Hydraulic Design Flood
- **Geotechnical Manual**
 - Erodibility criteria and foundation design
- **Bridge Project Development Manual**
 - Preliminary bridge layout review (PBLR)
- **Local Government Projects Policy Manual**
 - Applicable laws and regulations for local governments developing transportation projects under the oversight of TxDOT



Scour Coding Guidance SNBI

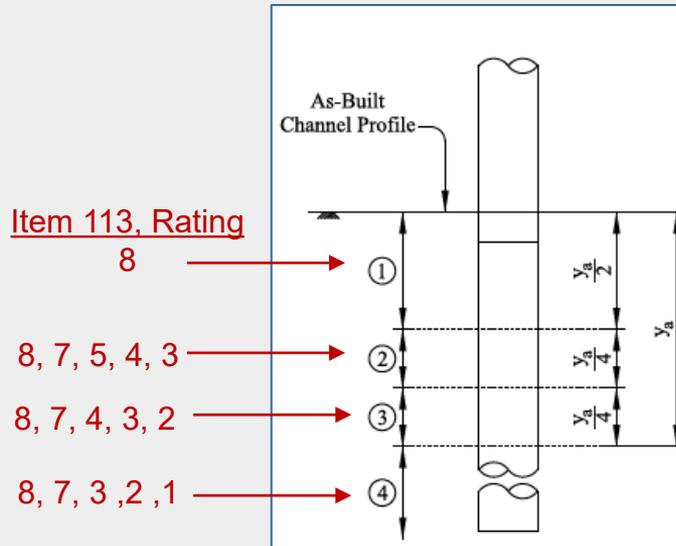
July 2023



■ Current Federal/TxDOT Guidance

– Item 113 (Scour Critical Bridges)

Bundles Observed Scour and Calculated or Assessed Scour, as well as the account for countermeasures.





■ **SNBI Coding**

– **Item B.C.11 (Scour Condition Rating)**

- Accounts for Observed Scour ONLY (Not Calculated Scour)
- Accounts spatial extent for Minor and Moderate scour.

– **Item B.AP.03 (Scour Vulnerability)**

- Accounts for Calculated or Assessed Scour
- Countermeasures
- Documentations

– **Item B.AP.04 (Scour Plan of Action)**

- More clarity for documentation

Scour Coding Guide Revision (Scour Condition Rating, Item ID = B.C.11)



7.1 – COMPONENT CONDITION RATINGS

Scour Condition Rating		
Format	Frequency	Item ID
AN (1)	EI	B.C.11
Specification		
Report the scour condition that represents the observed or measured scour using one of the following codes. The entire code description must be satisfied for the code to apply.		
Code	Condition Description	
N	Bridge does not cross over water.	
9	No scour.	
8	Insignificant scour.	
7	Some minor scour.	
6	Widespread minor or isolated moderate scour.	
5	Moderate scour; strength and stability of the bridge are not affected.	
4	Widespread moderate or isolated major scour; strength and/or stability of the bridge is affected.	
3	Major scour; strength and/or stability of the bridge is seriously affected. Condition typically necessitates more frequent monitoring, load restrictions, and/or corrective actions.	
2	Major scour; strength and/or stability of the bridge is severely compromised. Condition typically necessitates frequent monitoring, significant load restrictions, and/or corrective actions to keep the bridge open.	
1	Bridge is closed to traffic due to scour condition. Channel rehabilitation may return the bridge to service.	
0	Bridge is closed due to scour condition, and is beyond corrective action. Bridge replacement is needed to restore service.	
Commentary		
Refer to Item B.AP.03 (<i>Scour Vulnerability</i>) to verify if the bridge has been determined to be stable or unstable for appraised scour conditions.		
Consider design scour depth and critical scour depth, commonly found in hydraulic designs, scour evaluations, and POAs, when determining the scour condition ratings.		
When observed conditions are not consistent with the scour design or the assumptions used in the scour appraisal, this indicates a need to reevaluate Item B.AP.03 (<i>Scour Vulnerability</i>).		

- Only observed or measured scour.
- Account for **spatial** extent for minor and moderate scour. (e.g. 4, 6, & 7)

Scour Coding Guide Revision (Scour Vulnerability, Item ID = B.AP.03)



7.4 – APPRAISAL

Scour Vulnerability	
Format AN (1)	Frequency EI
Specification	Item ID B.AP.03
<p>Report the scour vulnerability of the bridge using one of the following codes.</p> <p>Code Description</p> <p>D Scour appraisal has not been completed.</p> <p>A Scour appraisal completed. Bridge determined to be stable for scour.</p> <p>B Scour appraisal completed. Bridge determined to be stable for scour, dependent upon designed, and functioning countermeasures.</p> <p>C Scour appraisal completed. Bridge could become unstable for scour. Temporary (not designed) countermeasure installed to mitigate scour. Bridge is scour critical.</p> <p>D Scour appraisal completed. Bridge is, or may become, unstable for scour. Bridge is scour critical.</p> <p>E Scour appraisal has not been completed. Temporary (not designed) countermeasure installed to mitigate scour.</p> <p>U Scour appraisal has not been completed due to unknown foundations.</p> <p>Do not report this item if the bridge does not cross over a waterway as indicated in Item B.F.01 (Feature Type).</p>	<p>The intent of this item is to report the status and vulnerability determination from scour appraisals required by the NBIS.</p> <p>The codes for this item are based on the appraised scour vulnerability as described in HEC-18, Evaluating Scour at Bridges; HEC-23, Bridge Scour and Stream Instability Countermeasures; and HEC-20, Stream Stability at Highway Structures.</p> <p>Scour appraisals are typically performed by a multidisciplinary team of hydraulic, geotechnical, and structural engineers (Scour Appraisal Team).</p> <p>FHWA Hydraulic Technical Advisories, manuals, and software can be found at: https://www.fhwa.dot.gov/engineering/hydraulics/index.cfm.</p> <p>Refer to Item B.C.11 (Scour Condition Rating) in the Component Condition Ratings subsection to address field observed scour conditions and the effect on bridge components.</p> <p>Use code B when designed, installed, and functioning countermeasures are used to address potential scour and to maintain bridge stability for new or existing bridges, or bridges with unknown foundations.</p> <p>Use code B when the Scour Appraisal Team determines that the in-place, non-designed countermeasures are fully functioning and are appropriate to mitigate the risk of scour.</p> <p>Use code C for bridges that could become unstable for the potential scour, and temporary countermeasures are installed that were not designed.</p>

- Account for the scour evaluation/document not in place (e.g. 0 & E)
- Account for countermeasure installed and its brief performance (e.g. B, C, & E)
- Account for unknown foundation (i.e. U).
- Account for calculated scour (e.g. A,B,C,D, and E)
- We will have a separate item for Channel Protection Condition Rating (i.e. Item ID = B.C.10).

7.1 – COMPONENT CONDITION RATINGS

Channel Protection Condition Rating		
Format AN (1)	Frequency EI	Item ID B.C.10
Specification		
<p>Report the condition of the channel protection device(s) using one of the following codes. The entire code description must be satisfied for the code to apply.</p>		



7.4 – APPRAISAL

Scour Plan of Action									
Format AN (1)	Frequency I								
Item ID B.AP.04									
Specification	Commentary								
<p>Report whether the bridge has a scour plan of action (POA) implemented using one of the following codes.</p> <table border="0"> <tr> <td style="padding-right: 10px;"><u>Code</u></td> <td><u>Description</u></td> </tr> <tr> <td>0</td> <td>A scour POA is not required.</td> </tr> <tr> <td>N</td> <td>A scour POA is required, but not implemented.</td> </tr> <tr> <td>Y</td> <td>A scour POA is required and implemented.</td> </tr> </table> <p>Do not report this item if the bridge does not cross over a waterway as indicated in Item B.F.01 (<i>Feature Type</i>).</p>	<u>Code</u>	<u>Description</u>	0	A scour POA is not required.	N	A scour POA is required, but not implemented.	Y	A scour POA is required and implemented.	<p>The NBIS requires a scour POA for bridges over water that are determined to be scour critical or have unknown foundations.</p> <p>More information on scour POA can be found at the FHWA Hydraulics Engineering website: http://www.fhwa.dot.gov/engineering/hydraulics/bridgehyd/poa.cfm.</p> <p>Use code 0 if a bridge was considered scour critical, but now has designed, installed, and fully functional scour countermeasures.</p> <p>A scour POA is a document that addresses, based on risk, a schedule for repair or installation of scour countermeasures, and/or the monitoring, inspection, closing, and opening a bridge to traffic during and after flood events to protect the traveling public.</p> <p>A scour POA is implemented when those responsible for actions under the plan are aware of their responsibilities, and are exercising them when called for during or after a triggering event.</p> <p>A bridge should have a scour POA when it could become unstable for scour, and temporary countermeasures are installed that were not designed.</p>
<u>Code</u>	<u>Description</u>								
0	A scour POA is not required.								
N	A scour POA is required, but not implemented.								
Y	A scour POA is required and implemented.								

Current Item 113.1

P - POA on File

Blank - a) POA is not required.

b) POA is required but not on file



Appendix A

A recommended mapping from current TxDOT coding to the SNBI is presented in Table A-1.

Table A-1 Recommended Mapping for TxDOT Coding to SNBI Coding

TxDOT Coding Guide			New SNBI Coding		
Item 113 Coding	Item 113.1	Item 113.2	Item B.C.11	Item B.AP.03	Item B.AP.04
Scour Critical Bridges	Scour POA	Unknown Foundation	Scour Condition Rating	Scour Vulnerability	Scour POA
N			N		
U		Blank or U		U	
T					
9			9	A	0
8			6, 7, 8, or 9	A or B	0
7			5, 6, 7, 8, or 9	B, C, or E	0, N, or Y
6				0, E	
5			5, 6, 7, 8, or 9	A or B	0
4			4 or 5	A or B	0
3	Blank or P		4, 5, 6, 7, 8, or 9	C or D	N or Y
2	Blank or P		2 or 3	C or D	N or Y
1	Blank or P		1	C or D	N or Y
0			0	C or D	

Code Mapping Website:

<https://www.fhwa.dot.gov/bridge/snbi/codemapping.cfm#bc11>



Conclusions

- **Scour Guide Revision**
 - Clarification for the Scour Documentation Requirements
 - Exposure Figure modifications may result in higher coding
 - Scour Countermeasure Approach and Coding
 - A smooth transition to SNBI coding system
- **SNBI Coding**
 - Less confusion due to more granularity of option



QUESTIONS?

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