

2019 Michigan Bridge Conference Workshop

METRIC 18

INSPECTION PROCEDURES – SCOUR

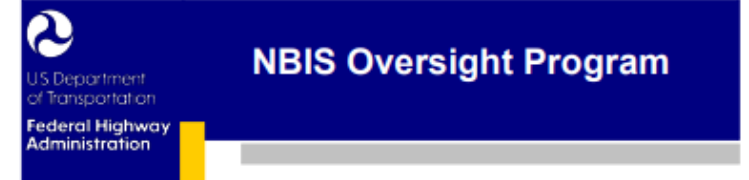
Allie Nadjarian
Bridge Inspection Program Manager

March 19, 2019

National Bridge Inspection Program Review

■ 23 Metrics

- (1) Bridge Inspection Organization
- (2-5) Qualifications



Metric #18: Inspection procedures – Scour

rev 5/1/17

NBIS Reference: 23 CFR 650.313 (e), (e3) Bridges that are scour critical

Criteria

- Bridges over water have a documented evaluation of scour vulnerability.
- Bridges that are scour critical have a scour plan of action (POA) prepared to monitor known and potential deficiencies and to address scour critical findings.
- Bridges that are scour critical are monitored in accordance with the POA.

Population: Bridges for the entire State that are over water and open to traffic.



NBIP Review – Results

■ Substantial Compliance

- Metric 03
- Metric 06
- Metric 07
- Metric 12

■ Conditional Compliance

- Metric 13
- Metric 14
- Metric 18

■ Non – Compliance

- Metric 15

National Bridge Inspection Program

Status and Summary

National Bridge Inspection Program (NBIP) review Final Summary of Metrics (FSM)
Assessment (AL) and Compliance (CL) Levels and review status:

Metric	Prev	AL	Dec 31		Mar 31	
	CL		CL	Complete	CL	Complete
01 - Bridge Inspection Organization	C	Min	C	☒		☐
02 - Qualifications of Personnel - Program Manager	C	Int	C	☒		☐
03 - Qualifications of Personnel - Team Leader(s)	C	Min	SC	☒		☐
04 - Qualifications of Personnel - Load Rating Engineer	C	Min	C	☒		☐
05 - Qualifications of Personnel - UW Bridge Inspection Diver	C	Min	C	☒		☐
06 - Inspection Frequency - Routine - Lower Risk Bridges	SC	Min	SC	☒		☐
07 - Inspection Frequency - Routine - Higher Risk Bridges	SC	Min	SC	☒		☐
08 - Inspection Frequency - Underwater - Lower Risk Bridges	C	Min	C	☒		☐
09 - Inspection Frequency - Underwater - Higher Risk Bridges	C	Min	C	☒		☐
10 - Inspection Frequency - Fracture Critical Member	C	Min	C	☒		☐
11 - Inspection Frequency - Frequency Criteria	C	Min	C	☒		☐
12 - Inspection Procedures - Quality Inspections	C	Min	SC	☒		☐
13 - Inspection Procedures - Load Rating	CC	Min	CC	☒		☐
14 - Inspection Procedures - Post or Restrict	CC	Min	CC	☒		☐
15 - Inspection Procedures - Bridge Files	CC	Int	NC	☒		☐
16 - Inspection Procedures - Fracture Critical Members	C	Min	C	☒		☐
17 - Inspection Procedures - Underwater	C	Int	C	☒		☐
18 - Inspection Procedures - Scour Critical Bridges	CC	Min	CC	☒		☐
19 - Inspection Procedures - Complex Bridges	SC	Int	C	☒		☐
20 - Inspection Procedures - QC/QA	C	Min	C	☒		☐
21 - Inspection Procedures - Critical Findings	C	Min	C	☒		☐
22 - Inventory - Prepare and Maintain	C	Int	C	☒		☐
23 - Inventory - Timely Updating of Data	C	Min	C	☒		☐

Metric 18: Inspection Procedures – Scour

- Metric 18: Inspection Procedures – Scour
 - *Plan of Corrective Action*
 - Local Bridge Owners guide, QA Program, MDOT Policy change, Bridge Advisory



MDOT Michigan Department of Transportation		FY 2018 NBIP Review Plan of Correction Action Metric 18	
PCA No:	PCA_MDOT_2018_M18		
SUBJECT:	METRIC 18 – Inspection Procedures, Scour		
ISSUED BY:			
REVIEWED BY:			
Metric 18:			
As a result of MDOT did not			
Compliance not contain a			
GOAL			
To ensure all critical bridge are monitored			
CORRECTIVE ACTION			
The information Action (PCA submittal data)			
As a result of			
1. MDOT for the			
2. MDOT MiB POA of M all be notified Govt cons			
3. M			

MDOT Michigan Department of Transportation		BRIDGE ADVISORY Bureau of Bridges and Structures	
BRIDGE ADVISORY NUMBER: BA-2018-02		DATE: April 30, 2018	
SUBJECT: Required Documentation and Procedure for Electronic Waterway Data			
ISSUED BY: Brian Zakrzewski, P.E., Bridge Inspection Program Manager			
REVIEWED BY: Andrew Bouvy, P.E., Bridge Inspector			
Contact: Brian Zakrzewski, Bridge Inspection Program Manager, 517-243-9473 or ZakrzewskiB@michigan.gov			
ELECTRONIC WATERWAY DATA			
Michigan Department of Transportation (MDOT) policy now requires waterway data for each bridge to be maintained electronically within the Michigan Bridge Inspection and Management System (MiBRIDGE) . Chapter 4 of the Michigan Structure Inspection Manual (MSIM) specifies the data required to be stored.			
Recent National Bridge Inspection Program (NBIP) reviews conducted by the Federal Highway Administration (FHWA) have identified that the scour assessment and stream bed cross-sections are sometimes missing or misplaced from the bridge file. Since scour is the primary cause of bridge failure nationwide, the value of having accurate and readily available information for each structure spanning water cannot be understated. The National Bridge Inspection Standards (NBIS) requires all bridges over water to have a documented evaluation of scour vulnerability, that all scour critical bridges have a plan of action (POA) to monitor known and potential deficiencies, and that bridges are monitored in accordance with the POA. To ensure this information is accessible during unplanned events MDOT is now requiring waterway data for each bridge to be maintained electronically within the Michigan Bridge Inspection and Management System (MiBRIDGE). This change will improve compliance with the NBIS and assist inspectors when the information is most needed.			
REQUIRED DOCUMENTATION			
ALL STRUCTURES OVER WATERWAYS			
Prior to the next inspection cycle bridge owners shall review their hardcopy or electronic bridge files. Hardcopy documents shall be scanned so they may be stored electronically. The following waterway data for each bridge or culvert crossing water must be uploaded to MiBRIDGE:			
• Scour Evaluation showing Coding of Item 113 (one of the following): ○ Level 1 Scour Assessment ○ Level 2 Scour Assessment ○ Scour Depth Calculations • Stream Bed Cross-Sections			
The above information must be maintained in accordance with the MDOT Guidelines for Bridge Inspection Frequency located at HERE .			



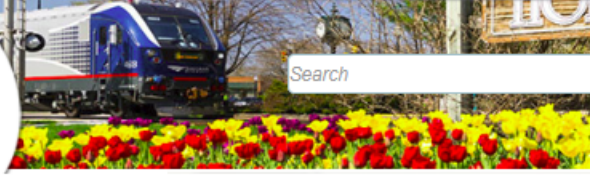
Metric 18: Inspection Procedures – Scour

- MDOT Policy Change – All waterway data must be uploaded to MiBRIDGE
 - *Scour Evaluation showing Item 113 coding*
 - Level I Scour Assessment
 - Level II Scour Assessment
 - Scour Depth Calculations
 - *Stream Bed Cross-Sections*
 - MDOT Frequency Guidelines

MDOT Frequency Guidelines

- www.michigan.gov/bridgeoperations
- Scour Critical Bridges
 - *Active Erosion or Observed Scour*
 - *No Active Erosion/Observed Scour*

[MDOT Home](#) [Contact](#) [Organization](#) [FAQ](#)

[Roads and Travel](#)
[Public Transportation](#)
[Rail](#)
[Bridges, Borders and Ferries](#)
[News and Information](#)
[Projects and Programs](#)
[Maps](#)
[Reports, Publications](#)

[MDOT / DOING BUSINESS / BRIDGE OPERATIONS / SAFETY INSPECTION](#)

Safety Inspection

The safety inspection program is managed within the Office of Structure Preservation and Management of the Bureau of Bridges and Structures. The program ensures compliance with the National Bridge Inspection Standards (NBIS) through comprehensive performance of inspection timeliness verifications, annual FHWA NBIS Metric evaluations, inspection team leader qualification appraisals, and quality assurance reviews. The Office of Structure Preservation and Management also develops inspection procedures, responds directly to the FHWA Michigan Division Bridge Engineer, and serves as the recognized resource for all inspection related inquiries.



COMPONENT OR BRIDGE TYPE		FREQUENCY ⁽¹⁾ (Months)					COMMENTS ⁽²⁾⁽³⁾
		≤ 6	≤ 12	< 24	≤ 36	≤ 48	
ROUTINE / DIVING	STREAM BED CROSS-SECTIONS						
	Scour critical bridges with active erosion or observed scour			X			Minimum every two years or after flood event where the scour POA was reviewed and monitoring occurred (Item 113 = U, 0-3).
	Scour critical bridges with no active erosion or observed scour					X	Minimum every four years or after flood event where the scour POA was reviewed and monitoring occurred (Item 113 = U, 0-3).
	Structures with minor observed scour or erosion						Minimum of one cross section must be in the bridge file. Record additional cross-sections as changes in the channel are observed and every 60 months for locations requiring underwater diving.
	Structures over water with no substructures in the water and no channel erosion						Minimum of one cross section must be in the bridge file for each structure over water. Record additional cross-sections as changes in the channel are observed.

Passenger
Transportation

Inspection Questions

Forms

Stream Cross-Section Report

- www.michigan.gov/bridgeoperations
- All structures over water
 - Compare to previous data
 - Upstream and downstream

MDOT Home

Contact

Organization

FAQ



Michigan Department of Transportation

Search

Roads and Travel

Public Transportation

Rail

Bridges, Borders and Ferries

News and Information

Projects and Programs

Maps

Reports, Publications and Specs

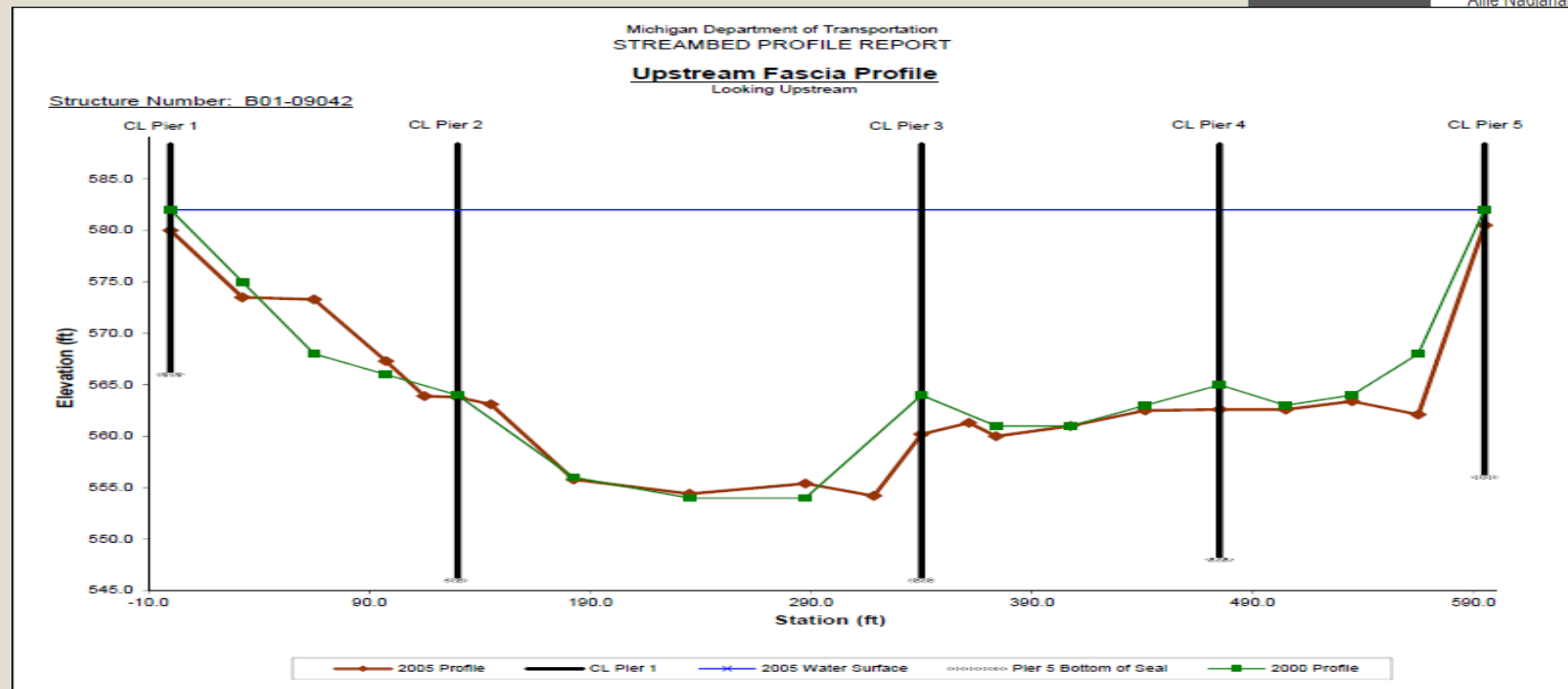
MDOT / DOING BUSINESS / BRIDGE OPERATIONS / SAFETY INSPECTION

Safety Inspection

The safety inspection program is managed within the Office of Structure Preservation and Management of the Bureau of Bridges and Structures. The program ensures compliance with the National Bridge Inspection Standards (NBIS) through comprehensive performance of inspection timeliness verifications, annual FHWA NBIS Metric evaluations, inspection team leader qualification appraisals, and quality assurance reviews. The Office of Structure Preservation and Management also develops inspection procedures, responds directly to the FHWA Michigan Division Bridge Engineer, and serves as the recognized resource for all inspection related inquiries.



Contact:
Allie Nadianian



Michigan.gov

Links

Advisories

Report

Training

Inspection Standards

Publications

Administration

Service Vendors



FHWA Compliance

Manuals

Guides

MiBRIDGE Application Development

Inspection Questions

Forms

Movable Bridge Inspection Checklist

Efficient Element Calculation Worksheet NEW V 2.00.0

Structure Inventory and Appraisal

Fracture Critical Inspection Report

Stream Cross-Section Report

Bridge Diving Inspection Report

Bridge Safety Inspection Report

Other Special Inspection Report

Damage Inspection Report

Scour Action Plan

Fatigue Sensitive Inspection Report

Welcome Allie Nadjarian

Administration

Br

STR 1702



Inventory & Appraisal

Inspect

Document / Photo Data

☒ View Documents ☐ View Photos

Add Document Edit Document De

Select	File Name
☐	
☐	18033 B01 Cross Sec.xl
☐	18033 B01 Cross Sec.xl
☐	Level1 SA.pdf
☐	Level2 SA.pdf

STR 1702

Information Summary and Current Status

B01-18033



Facility
US-127 NB

Feature
S BR TOBACCO RIVER

Location
N LTS OF CLARE

Region / County
Bay(4) / Clare(18)

Latitude / Longitude
43.8312 / -84.7501

Length / Width / Spans
49.9 / 59.7 / 1

Built / Recon. / Paint / Ovly.
1962 / / / 2001

Material / Design
5 Prestressed Concrete / 32 Multi Str Comp

MDOT Structure ID
18118033000B010

Owner
Region: Bay(4)

TSC
Mt. Pleasant(20)

Last NBI Inspection
10/02/2018 / NUBB

Structure Condition
Fair Condition(6)

Operational Status
A Open, no restriction(A)

Scour Evaluation
3 SC - Unstable



Inventory & Appraisal

Inspections / Reports

Load Ratings

Outstanding Work

Work History

Documents

Structure Details

General Info

Physical Characteristics

Route On Info

Route Under Info

Other Features Under

Inspection Data

Other Features Under Structure Information

Edit Print All

Waterway Under Bridge

Waterway Name	Navigation Control (38)	Navigation Vertical Clearance (39)	Navigation Horizontal Clearance (40)	Lift Bridge Navigation Clearance (116)	Pier Protection (111)
0 Permit Not Required	0.0	0.0	0.0	0.0	

Scour Evaluation

Item 113	Scour Criticality	3 SC - Unstable	Source of Item 113	Calculated
Item 71	Waterway Adequacy	8 Equal Desirable		
Level I Assessment		Yes		
Level II Analysis		Yes		
Document Date	Document Name			Document Type
06/05/2018	Level1 SA.pdf			Level I
06/05/2018	Level2 SA.pdf			Level II

Calculated Values

Scour Analysis Frequency	25 Year	50 Year	100 Year	500 Year	Comments
Anticipated Surface Elevation (ft)	0.0	0.0	816.0	0.0	
Distance Below Bottom Chord (ft)	0.0	0.0	0.3	0.0	
Anticipated Flow (cubic ft/sec)	0.0	0.0	2370.0	0.0	
Anticipated Pressure Flow (Y/N)					

Waterway Data Compliance

STR 1702

Information Summary and Current Status

B01-18033



Facility
US-127 NB

Feature
S BR TOBACCO RIVER

Location
N LTS OF CLARE

Region / County
Bay(4) / Clare(18)

Latitude / Longitude
43.8312 / -84.7501

Length / Width / Spans
49.9 / 59.7 / 1

Built / Recon. / Paint / Ovly.
1962 / / / 2001

Material / Design
5 Prestressed Concrete / 32 Multi Str Comp

MDOT Structure ID
18118033000B010

Owner
Region: Bay(4)

TSC
Mt. Pleasant(20)

Last NBI Inspection
10/02/2018 / NUBB

Structure Condition
Fair Condition(6)



Operational Status
A Open, no restriction(A)

Scour Evaluation
3 SC - Unstable

Inventory & Appraisal

Inspections / Reports

Load Ratings

Outstanding Work

Work History

Documents

Document / Photo Data

☒ View Documents ☐ View Photos

Add Document

Edit Document Details

Select	Document Name
☐	18033 B01 Cross Sec.xl
☐	18033 B01 Cross Sec.xl
☐	Level1 SA.pdf
☐	Level2 SA.pdf

SUPPORTING DOCUMENTS

Upload documents

Choose File

No file chosen

File Name : [Example Cross Section.pdf](#)

Report/Group: Waterway

Category :

Cross Section
Level I
Level II

Description

remove

Save

Waterway



[Michigan.gov Home](#)

Welcome Allie Nadjarian

Administration Bridge Management

Jurisdiction MDOT Region Region Bay

Structure Inventory Summary

	Count
Total No. of Structures	1,185
Highway (NBI) Structures greater than 20'	811
Highway Structures less than 20'	354
Rail Road Structures (X)	9
Pedestrian Structures (P)	11
Other Non-Highway Structures (V, Plaza)	0

Additional Bridge Inventory Information

Posted Structures	2
Closed Structures	0
Fracture Critical Structures	2
Scour Critical Structures	91
Scheduled/Under Construction (S, G)	1

Total No. of Structures

Open▼

Select	Struct. Nbr.	Bridge ID	Facility Carried
☐	1688	18118023000S010	US-10 CON TO US-10
☐	1699	18118024000S120	US-10E TO US-127
☐	1700	18118031000B010	US-127 BR
☐	1701	18118031000C010	US-127 BR
☐	1702	18118033000B010	US-127 NB
☐	1703	18118033000B020	US-127 SB
☐	1704	18118033000B030	US-127 SB
☐	1705	18118033000C020	US-127 NB
☐	1706	18118033000S021	US-127 NB
☐	1707	18118033000S022	US-127 SB



Bridge Management and Inspection System

[Michigan.gov Home](#) [MiBRIDGE Home](#) | [Contact MiBRIDGE](#) | [Feedback](#) | [Help](#) [Sign Out](#)

Welcome Allie Nadjarian Jurisdiction: Bridge Operations - C and T

Administration Bridge Management Assignments Dashboards Reports

STR 1702 Information Summary and Current Status B01-18033



Facility
US-127 NB

Feature
S BR TOBACCO RIVER

Location
N LTS OF CLARE

Region / County
Bay(4) / Clare(18)

Latitude / Longitude
43.8312 / -84.7501

Length / Width / Spans
49.9 / 59.7 / 1

Built / Recon. / Paint / Ovly.
1962 / / / 2001

Material / Design
5 Prestressed Concrete / 32 Multi Str Comp

MDOT Structure ID
18118033000B010

Owner
Region: Bay(4)

TSC
Mt. Pleasant(20)

Last NBI Inspection
10/02/2018 / NUBB

Structure Condition
Fair Condition(6)

Operational Status
A Open, no restriction(A)

Scour Evaluation
3 SC - Unstable



Inventory & Appraisal **Inspections / Reports** **Load Ratings** **Outstanding Work** **Work History** **Documents**

Special Inspections Requested ☐ Fracture Critical (92A) ☐ Underwater (92B) ☐ Other Special (92C) ☐ Fatigue Sensitive (92D) ☒ Scour Critical

Inspection Data: (select from folders below)

Routine - BSIR

Element

Request for Action

Fracture Critical

Fatigue Sensitive

Underwater

Other Special

Damage

Scour Action Plan

NBI INSPECTION

Inspector Name	Agency / Company Name	Insp. Freq.	Insp. Date
David Andrews	MDOT Bay Region	24	10/02/2018

GENERAL NOTES

DECK

Item	Rating	Comments
1. Surface (SIA-58A)	6 FAIR CONDITION	Concrete deck with many unsealed tight multi-directional and transverse cracks throughout. Light scaling. 2SFT open spall at SE.
2. Expansion Joints	4 POOR CONDITION	HPR at both reference lines. Minor chips and missing filler at both reference lines. Leakage observed from below > 5%.
3. Other Joints	4 POOR CONDITION	Center construction joint. Leakage observed from below > 5%.
4. Railings	5 FAIR CONDITION	Concrete barrier railings. Several vertical leaching cracks in both rails. Leaching map cracks on outside of west barrier and both sides of east barrier. Scaling at south end of west rail. Spall to steel top SW quad., 6LF of scaling top of west rail mid span.
5. Sidewalks	N NOT APPLICABLE	
6. Deck Bottom Surface (SIA-58B)	6 FAIR CONDITION	Longitudinal leaching cracks in bay 5w near mid span. Construction joint in bay 4w has minor leaching. Plywood form in bay 6w and 8w. Few scattered transverse leaching tight cracks. Less

Bay	N	Y	09/19/2018	N	6	N			N	N	7		100
Bay	Y	Y	01/25/2018	N	N	5	6	5	6	6	N		96.9
Bay	Y	Y	01/30/2018	N	N	5	6	5	6	6	N		96.9



Facility

US-127 NB

Feature

S BR TOBACCO RIVER

Location

N LTS OF CLARE

Region / County

Bay(4) / Clare(18)

Latitude / Longitude

43.8312 / -84.7501

Length / Width / Spans

49.9 / 59.7 / 1

Built / Recon. / Paint / Ovly.

1962 / / / 2001

Material / Design

5 Prestressed Concrete / 32 Multi Str Comp

MDOT Structure ID

18118033000B010

Owner

Region: Bay(4)

TSC

Mt. Pleasant(20)

Last NBI Inspection

10/02/2018 / NUBB

Structure Condition

Fair Condition(6)

Operational Status

A Open, no restriction(A)

Scour Evaluation

3 SC - Unstable



Other Features Under Structure Information

Edit

Print All

Waterway Under Bridge

Waterway Name	Navigation Control (38)	Navigation Vertical Clearance (39)	Navigation Horizontal Clearance (40)	Lift Bridge Navigation Clearance (116)	Pier Protection (111)
0 Permit Not Required	0.0	0.0	0.0	0.0	

Scour Evaluation

Item 113	Scour Criticality	3 SC - Unstable	Source of Item 113	Calculated
Item 71	Waterway Adequacy	8 Equal Desirable		
Level I Assessment		Yes		
Level II Analysis		Yes		

Document Date	Document Name	Document Type
06/05/2018	Level1 SA.pdf	Level I
06/05/2018	Level2 SA.pdf	Level II

Calculated Values

Scour Analysis Frequency	25 Year	50 Year	100 Year	500 Year	Comments
Anticipated Surface Elevation (ft)	0.0	0.0	816.0	0.0	
Distance Below Bottom Chord (ft)	0.0	0.0	0.3	0.0	
Anticipated Flow (cubic ft/sec)	0.0	0.0	2370.0	0.0	
Anticipated Pressure Flow (Y/N)					





Facility

US-127 NB

Feature

S BR TOBACCO RIVER

Location

N LTS OF CLARE

Region / County

Bay(4) / Clare(18)

Latitude / Longitude

43.8312 / -84.7501

Length / Width / Spans

49.9 / 59.7 / 1

Built / Recon. / Paint / Ovly.

1962 / / / 2001

Material / Design

5 Prestressed Concrete / 32 Multi Str Comp

MDOT Structure ID

18118033000B010

Owner

Region: Bay(4)

TSC

Mt. Pleasant(20)

Last NBI Inspection

10/02/2018 / NUBB

Structure Condition

Fair Condition(6)

Operational Status

A Open, no restriction(A)

Scour Evaluation

3 SC - Unstable



Waterway Under Bridge

Waterway Name

Navigation Control (38)

0 Permit Not Required

Navigation Vertical Clearance (39)

0.0

Navigation Horizontal Clearance (40)

0.0

Lift Bridge Navigation Clearance (116)

0.0

Pier Protection (111)

Edit Waterway

Scour Evaluation

Item 113

Scour Criticality

3 SC - Unstable

Source of Item 113

Calculated

Item 71

Waterway Adequacy

8 Equal Desirable

Level I Assessment

☒

Level II Analysis

☒

Upload Level I Worksheet

Choose File

Upload Level II Worksheet

Choose File

Document Date

06/05/2018

Level1 SA.pdf

Document Date

06/05/2018

Level2 SA.pdf

Calculated Values

Scour Analysis Frequency

25 Year

50 Year

100 Year

500 Year

Comments

Anticipated Surface Elevation (ft)

0.0

0.0

816.0

0.0

Distance Below Bottom Chord (ft)

0.0

0.0

0.3

0.0

Anticipated Flow (cubic ft/sec)

0.0

0.0

2370.0

0.0

Anticipated Pressure Flow (Y/N)

☐ Yes ☐ No

☐ Yes ☐ No

☐ Yes ☐ No

☐ Yes ☐ No

Cross Sections

Date Last Taken

Upload Cross Section Worksheet

Choose File

Document Date

05/30/2018

18033 B01 Cross Sec.xlsx

Document Date

06/26/0013

18033 B01 Cross Sec.xlsx

Waterway Data Compliance

- Timeline: Bridge Advisory
 - *After 4/30/2018*
 - 180 days from notification
 - *Before 4/30/2018*
 - With next Routine Inspection



Scour Plan of Action

- Monitor known and potential deficiencies
- Item 113 Coded ≤ 3 or U (Unknown Foundation)
- Item 113 = 7 (Countermeasures have been installed)
 - *MDOT vs. Local Agency*



- Information Summary
- Plan of Action authors
- Scour Vulnerability
- Countermeasures
- Monitoring Program
- Bridge Closure Plan

SCOUR V

Item 113

Item 71

Level I A

Level II A

Flood Monitoring - Initiate monitoring when any of the following occur

☐ NOAA Flood Warning (This includes both Flash Flood and Flood Warnings)

Flood Information

☐ Discharge	cfs
☐ Rainfall	in/hr
☐ WS Elevation	ft Measured from

Contacts Responsible for OPENING Bridge

Agency
Edge Field Services
Es Engineering Group, LLC

Countermeasure Comments

PLAN OF ACTION

BOUVYA
ate
8

Information Summary and Current Status



Inventory & Appraisal Inspections / Reports Load Ratings Outstanding Work Work History Documents

Special Inspections Required:

☐ Fracture Critical (92A) ☐ Underwater (92B) ☐ Other Special (92C) ☐ Fatigue Sensitive (92D) ☒ Scour Critical

Inspection Data: (select from folders below)

Print

Print All

- Routine - BSIR
- Element
- Request for Action
- Fracture Critical
- Fatigue Sensitive
- Underwater
- Other Special
- Damage
- Scour Action Plan
 - Action Plan (Edit)
 - (Add) Scour Insp.
 - (Add) H.F. Event

NBI INSPECTION

CURRIEE9213 - 5TL6

Inspector Name	Agency / Company Name	Insp. Freq.	Insp. Date

GENERAL NOTES

DECK

Item	Rating	Comments
1. Surface (SIA-58A)	4 POOR CONDITION	Concrete surface with HMA patching throughout, percent of deck patched per span as follows: Span 1S 35%, span 2S 35%, span 3S 40%, span 4S 60%. Concrete patch at both north and south ends. Shallow popouts in concrete throughout. Outer 3ft full of gravel.
2. Expansion Joints	6 FAIR CONDITION	Over all piers, strip seal expansion joints are full of debris. Concrete header at pier 1S and 3S has hairline cracks throughout.
3. Other Joints	N NOT APPLICABLE	
4. Railings	6 FAIR CONDITION	R4 railing with thrie beam retrofit. Cracks and popouts in brush blocks.
5. Sidewalks	N NOT APPLICABLE	
6. Deck Bottom Surface (SIA-58B)	6 FAIR CONDITION	Span 4S, 3 hairline cracks with efflorescence. Span 3S efflorescence along longitudinal construction joint and 2 transverse cracks with efflorescence. Span 2S, spalling at 1 deck drain westside and 1 transverse crack. Span 1S has 2 transverse leaching cracks.
7. Deck (SIA-58)	5 FAIR CONDITION	Surface: Concrete surface with HMA patching throughout, percent of deck patched per span as follows: Soan 1S 35%. span 2S 35%. span 3S 40%. span 4S 60%. Concrete patch at both

Scour POA Monitoring

MONITORING PROGRAM

Recommended Monitoring Requirements

Top of SW Pier: 584.0 South Abutment: Top of Footing 565.0, Bottom of Footing 560.0, Bottom of Tremie 547.0 North Abutment: Top of Footing 565.0, Bottom of Footing 560.0, Bottom of Tremie 547.0

(Check all that are recommended)

Type	Frequency/ Amount	Comments
☒ Regular Inspection	15.0	Perform depth soundings during annual routine inspection.
☐ Other Special Inspection		
☒ Underwater Inspection	60.0	Contracted underwater diving inspections.
☒ Stream Bed Cross Sections	48.0	
☐ Monitoring Devices (Fixed, Sonar, etc.)		

Flood Monitoring - Initiate monitoring when any of the following occur

☐ NOAA Flood Warning (This includes both Flash Flood and Flood Warnings)

Flow Information

☐ Discharge	cfs	
☐ Rainfall	in/hr	
☐ WS Elevation	ft	Measured from
☐ Pressure Flow		
☐ Debris Accumulation		

Items to Watch During Monitoring

Perform depth soundings along piers. Monitor structure for signs of settlement.

Foundation	Items to Watch
Abutment A	Perform depth soundings; South Abutment: Top of Footing 565.0, Bottom of Footing 560.0, Bottom of Tremie 547.0
Abutment B	Perform depth soundings; North Abutment: Top of Footing 565.0, Bottom of Footing 560.0, Bottom of Tremie 547.0
Pier 1	
Pier 2	

Inspection Summary

Type	Latest Date Completed	Current Frequency	Inspector	Agency
Routine	04/23/2018	15	Andrew Bouvy	MDOT Bridge Field Services
Underwater	08/06/2015	60	Amy Trahey	Great Lakes Engineering Group, LLC
Cross Section				
Scour Inspection				
High Flow Monitoring				

Special Inspections Required:

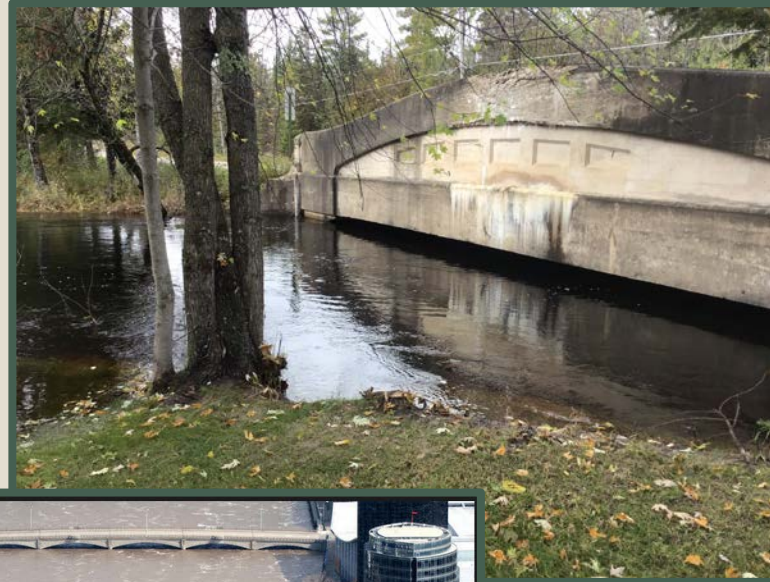
Inspection Data: (select from folders below)

- Folder Routine - BSIR
- Folder Element
- Folder Request for Action
- Folder Fracture Critical
- Folder Fatigue Sensitive
- Folder Underwater
- Folder Other Special
- Folder Damage
- Folder Scour Action Plan

[Action Plan \(Edit\)](#)

[\(Add\) H.F. Event](#)

Scour Action Plan – High Flow



- High Flow Event Field Review
 - *As-Needed until Scour Inspection*
- High Flow Event Report
 - *Storm Duration*
 - *High Water Distance from Chord*
 - *Estimated Total Rainfall*
 - *Estimated Flow Discharge*
 - *Whirlpools*
 - *Debris*
 - *Actions Taken/Closure*

Special Inspections Required:

Inspection Data: (select from folders below)

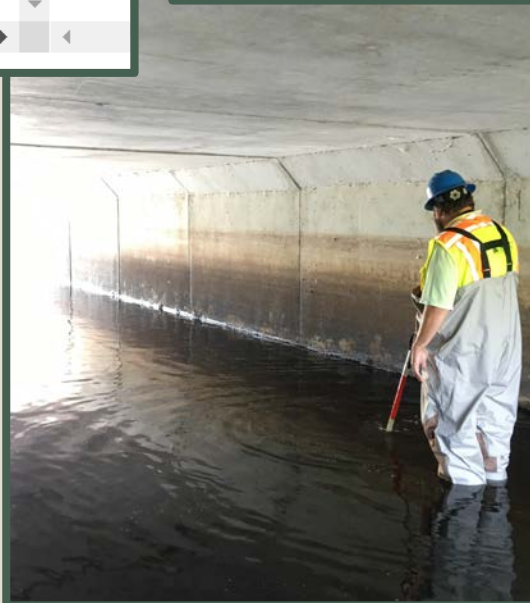
- Folder Routine - BSIR
- Folder Element
- Folder Request for Action
- Folder Fracture Critical
- Folder Fatigue Sensitive
- Folder Underwater
- Folder Other Special
- Folder Damage
- Folder Scour Action Plan

(Add) Scour Insp.

Scour Action Plan – Scour Inspection



- Scour Inspection Field Review
 - Probe substructure units
- Scour Inspection Report
 - Observed Scour
 - Inspection Methods/Location
 - Recommendations
 - Supporting Documents and Photos



MDOT Scour Program

Erik Carlson, PE
MDOT Hydraulic Unit



Beginnings of the Scour Program



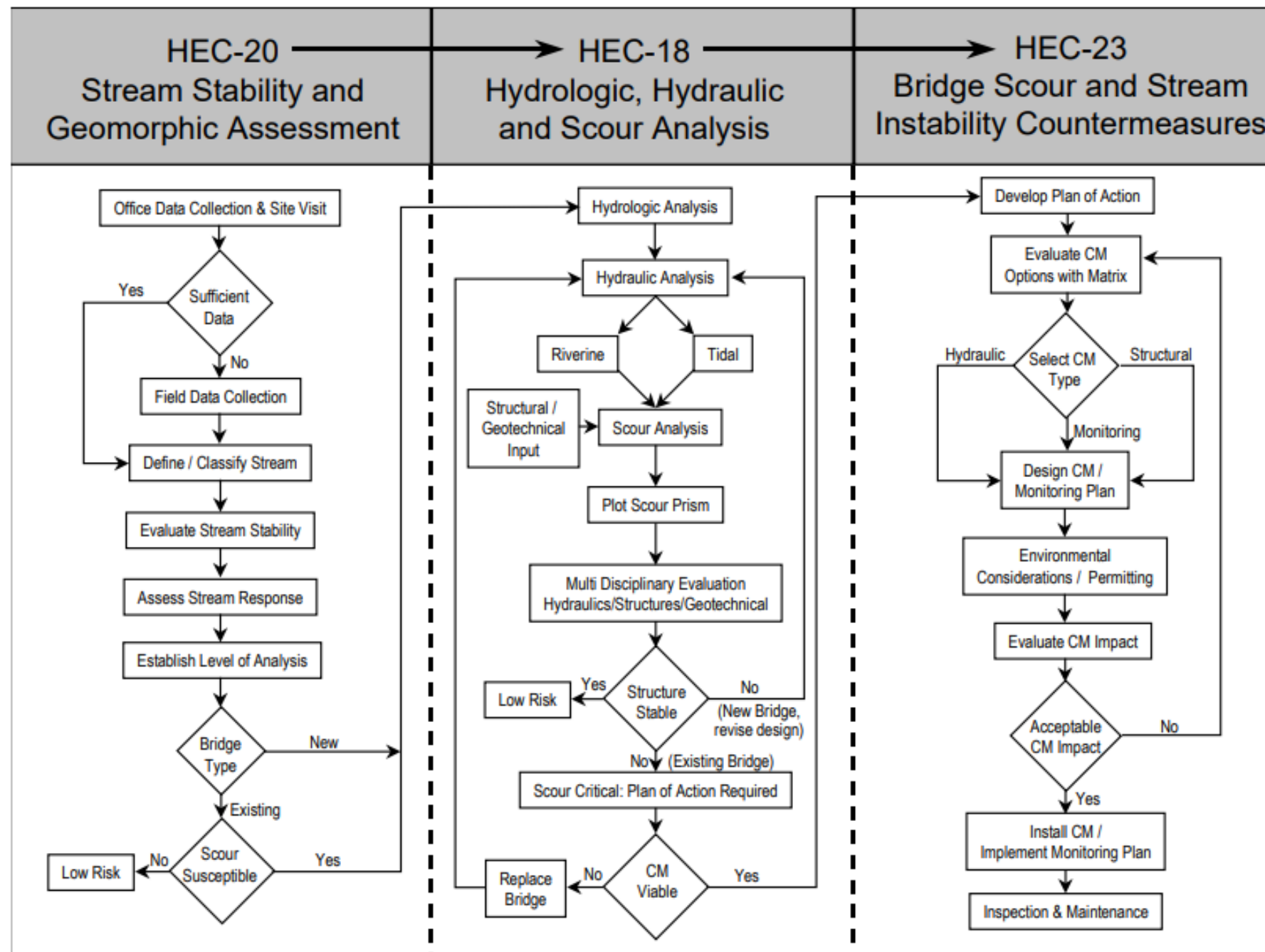
Source: <https://water.usgs.gov/wid/images/NY.figure.id.3.gif>

- On April 5, 1987, the New York State Thruway Bridge over Schoharie Creek collapsed due to scour killing ten people.
- The bridge was built in 1953 on piers with spread footings and no piles.
- National scour evaluation program was established in 1988 by Technical Advisory T 5140.20, which was superseded in 1991 by T 5140.23, "Evaluating Scour at Bridges."

Beginnings of the Scour Program



- In the early 1990's, MDOT formed a multi-disciplinary team for scour.
- Recommendations from the committee led to the development of the Level I, Level II, and Level III evaluations.



MICHIGAN DEPARTMENT OF TRANSPORTATION

GUIDELINES FOR EVALUATION OF SCOUR AT EXISTING STRUCTURES

INTRODUCTION

These guidelines are proposed for the evaluation of scour at existing bridge structures for the Michigan Department of Transportation (MDOT) and local agencies. The guidelines supplement the following Federal Highway Administration (FHWA) publications and directives on scour:

1. "Evaluating Scour at Bridges," HEC -18 (Fifth Edition)
2. Technical Advisory T 5140.23
3. "Stream Stability at Highway Structures," HEC - 20 (Fourth Edition)

Scour is a dynamic sediment transport process. Research on scour is ongoing, and revisions to the methods of scour and stream stability analyses may occur.

These guidelines are organized to discuss the priority of evaluation, the three levels of analysis, the National Bridge Inventory System (NBIS), the plan of action, and design of scour countermeasures for scour critical bridges. It is important that an interdisciplinary team consisting of hydraulic, geotechnical, and structural engineers be involved in all levels of analysis and the evaluation process.

Chapter 10 of FHWA's HEC-18 outlines a scour evaluation process for existing bridges. HEC-18 recommends documentation of each level of analysis. Documentation for Michigan includes updating Item 113 of the NBIS at each level of analysis and action and retaining the Level One and Level Two Worksheets. The Level Two Worksheet should include, if needed, recommended scour countermeasures and a "Plan of Action." The Plan of Action should include a timetable to implement the design and construction of accepted scour countermeasures.

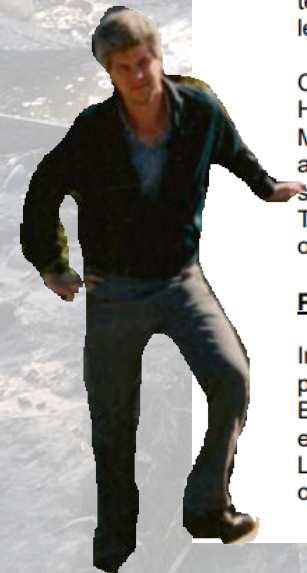
PRIORITY OF EVALUATION

In 1991, MDOT developed a scour screening procedure for development of an initial priority list. This procedure was approved by FHWA and distributed to local agencies. Each agency should now have a "priority list" based on this procedure to start its scour evaluation program. An agency should use this priority list to schedule the proposed Level One analysis given in these guidelines. The Level One analysis must be completed to determine the need for a Level Two analysis.

MDOT Scour Program

- Outline of procedures in the MDOT Drainage Manual in Appendix 6-D
- Level I and Level II forms can also be found in Appendix 6-D.

<https://www.michigan.gov/stormwatermgt/0,4672,7-205--93193--,00.html>



Scour Program - Level I Review

MICHIGAN DEPARTMENT OF TRANSPORTATION LEVEL ONE SCOUR ANALYSIS WORKSHEET

Date: _____ By: _____ Structure No: _____ Control Section: _____

Job No. _____ Route: _____ Watercourse: _____

All references are to HEC-20, 3rd Edition.

Data Collection

- _____ Plans
- _____ Bridge Inspection Reports (Maintenance Division)
- _____ Underwater Inspection Reports (Maintenance Division)
- _____ Review existing items 60, 61, 71, 92, 93, and 113 of the NBIS
- _____ Review available construction, design, and maintenance files for repair and maintenance work done on structure

Field Investigation Date: _____

_____ Channel bottom width approximately one bridge span upstream = _____ feet

_____ Overbank and channel Manning's roughness coefficients

_____ Left _____ Channel _____ Right

_____ Is there sufficient riprap? Abutments _____ Piers _____

_____ Photographs

_____ Cross sections at upstream and downstream faces of bridge

Comments:

Stream Characteristics

_____ Complete the attached Figure 2.6 from HEC-20.

Comments:

Land Use: Identify the existing and past land use of the upstream watershed:

Urban Area	Yes	No	Comments:
Sand and Gravel Mining	Yes	No	Comments:
Undeveloped Land	Yes	No	Comments:

- Level I forms originally developed with guidance from FHWA's HEC-18 and HEC-20 manuals.
- Approved through the MDOT Scour committee in the 1990's.
- Overall scour and stream stability through site visit, aerial photographs, construction records, etc.
- Many single span structures rated 8 off original Level I analysis through engineering judgement, which we often re-review at project level.
- Construction records often required to verify pile length or if piles were even constructed.

Scour Program - Level I Review

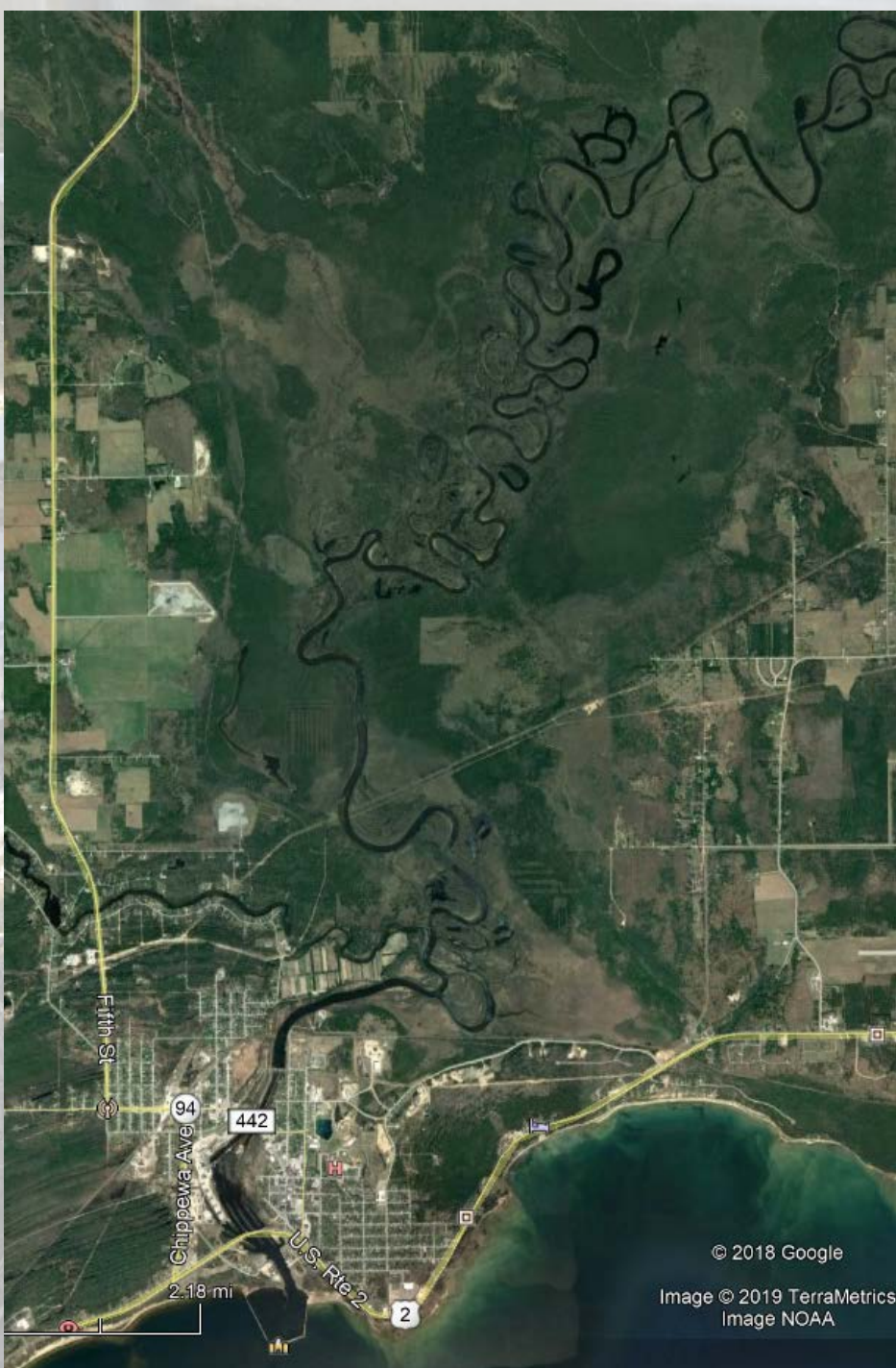
- Stream morphology rating using Figure 2.6 from FHWA's HEC-20 manual.
- MDOT existing structures typically were rated 8 or 6 for Item 113 off a Level I evaluation with the initial screening (some 7 and U's).

STREAM SIZE (Sect 2.3.2)	Small [< 30 m (100 ft.) wide]	Medium [30-150 m (100-500 ft.)]	Wide [> 150 m (500 ft.)]		
FLOW HABIT (Sect 2.3.3)	Ephemeral	(Intermittant)	Perennial but flashy	Perennial	
BED MATERIAL (Sect 2.3.4)	Silt-Clay	Silt	Sand	Gravel	Cobble or Boulder
VALLEY SETTING (Sect 2.3.5)	 No valley; alluvial fan	 Low relief valley [< 30 m (100 ft.) deep]	 Moderate relief [30-300 m (100-1000 ft.) deep]	 High relief [> 300 m (1000 ft.) deep]	
FLOODPLAINS (Sect 2.3.6)	 Little or none (< 2 x channel width)	 Narrow (2-10 x channel width)	 Wide (> 10 x channel width)		
NATURAL LEVEES (Sect 2.3.7)	 Little or none	 Mainly on concave	 Well developed on both banks		
APPARENT INCISION (Sect 2.3.8)	 Not Incised	 Probably Incised			
CHANNEL BOUNDARIES (Sect 2.3.9)	 Alluvial	 Semi-alluvial	 Non-alluvial		
TREE COVER ON BANKS (Sect 2.3.9)	< 50 percent of bankline	50-90 percent of bankline	> 90 percent of bankline		
SINUOSITY (Sect 2.3.10)	 Straight Sinuosity (1-1.05)	 Sinuous (1.06-1.25)	 Meandering (1.25-2.0)	 Highly Meandering (>2.0)	
BRAIDED STREAMS (Sect 2.3.11)	 Not braided (<5 percent)	 Locally braided (5-35 percent)	 Generally braided (> 35 percent)		
ANABRANCHED STREAMS (Sect 2.3.12)	 Not anabranching (<5 percent)	 Locally anabranching (5-35 percent)	 Generally anabranching (> 35 percent)		
VARIABILITY OF WIDTH AND DEVELOPMENT OF BARS (Sect 2.3.13)	 Narrow point bars	 Wide point bars	 Irregular point and lateral bars		

Figure 2.6. Geomorphic factors that affect stream stability (adapted from FHWA 1978a).

Scour Program - Level I Review

Stable or Unstable?



Scour Program - Level I Review

Stable or Unstable?



Scour Program - Level I Review



Stable or Unstable?

Scour Program - Level I Review



- Substructure elements on deep foundations or bedrock?
- Sufficient Riprap?
- Low risk for scour?

Revised: 5/06/02

MICHIGAN DEPARTMENT OF TRANSPORTATION
LEVEL TWO SCOUR ANALYSIS WORKSHEET

Date: _____ By: _____

Structure No: _____ Control Section: _____ Job No. _____

Route: _____ Watercourse: _____

Page numbers refer to HEC-20, 3rd Edition and HEC-18, 4th Edition. Attach water surface profile modeling printouts with pertinent variables highlighted. Scour calculations automatically done by HEC-RAS are not acceptable. All calculations must be attached or on the back of their respective pages.

1. Hydrology:

Method of Analysis: DEQ estimate, SCS, Regression, DAR to gage, other

Drainage Area: _____ square miles

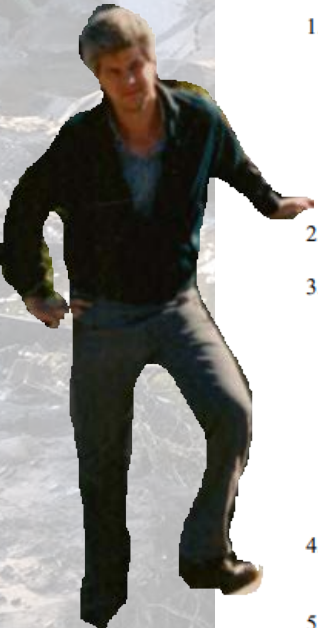
Q₅₀ = _____ cfs Q₁₀₀ = _____ cfs Q₅₀₀ = _____ cfs**2. Hydraulics:** Water surface profiles by: HEC-2 ____ WSPRO ____ HEC-RAS ____**3. Geotechnical:** Bed and overbank material values:D₅₀ ____ D₈₄ ____ (ft) Left OverbankD₅₀ ____ D₈₄ ____ (ft) Right OverbankD₅₀ ____ D₈₄ ____ (ft) Main Channel

Source of information:

4. Incipient motion analysis: For gravel and cobble streams only. Refer to Page 6.14 of HEC-20.**5. Armoring potential:** Refer to Page 6.16 of HEC-20.

Scour Program - Level II Analysis

- Calculations following guidelines in FHWA's HEC-18 Manual.
- Estimating any future stream degradation.
- Calculating contraction and local scour for the substructure elements.
- Requires a hydraulic survey and analysis.
- All new structures require Level II analysis.
- Soil borings and sieve analysis required.



COMPUTE 100 YR SCOUR (1% CHANCE) FOR PROPOSED STRUCTURE:

Compute 100 yr. Contraction Scour:

LIVE BED or CLEAR WATER?

$$V_c = K_u y^{1/6} D^{1/3} \quad (\text{HEC-18, Eq. 6.1})$$

$K_u = 11.17$ (English)
 $y = 4.16$ ft. (Hyd. Depth, Sect. 70)
 $D = D_{50} = 3.28\text{E-}04$ ft.
 $V = 10.87$ ft/s (Avg. Vel., Sect. 70)

$$V_c = 11.17 * 4.16^{(1/6)} * 3.28\text{E-}04^{(1/3)} = 0.98 \text{ ft/s}$$

$$V_c < V \quad \text{TRUE}$$

==> LIVE BED

USE SECTION 90 AS 1st FULL DEVELOPED CROSS-SECTION:

$Q_1 = 636.60$ cfs
 $A_1 = 72.67$ sft.
 $W_1 = 14.42$ ft.
 $y_1 = A_1/W_1 = 5.04$ ft.

BRIDGE SECTION UPSTREAM

$Q_2 = 750.00$ cfs
 $A_2 = 150.73$ sft. (Bridge open area)
 $W_2 = 36.00$ ft. (Bridge width)
 $y_0 = A_2/W_2 = 4.19$ ft.

FIND EXPONENT, K_1 :

$$V^* = (g y_1 S_1)^{1/2} \quad (\text{HEC-18, pg. 6.10})$$

$g = 32.2$ ft/s²
 $y_1 = 5.04$ ft. (Hydraulic Depth, Sect. 90)
 $S_1 = 0.00689$ ft./ft. (Energy Slope, Sect. 90)

$$V^* = (32.2 \text{ ft/s}^2 * 5.04 \text{ ft.} * 0.00689 \text{ ft/ft})^{1/2} = 1.06 \text{ ft/s}$$

Sheet ____ of ____

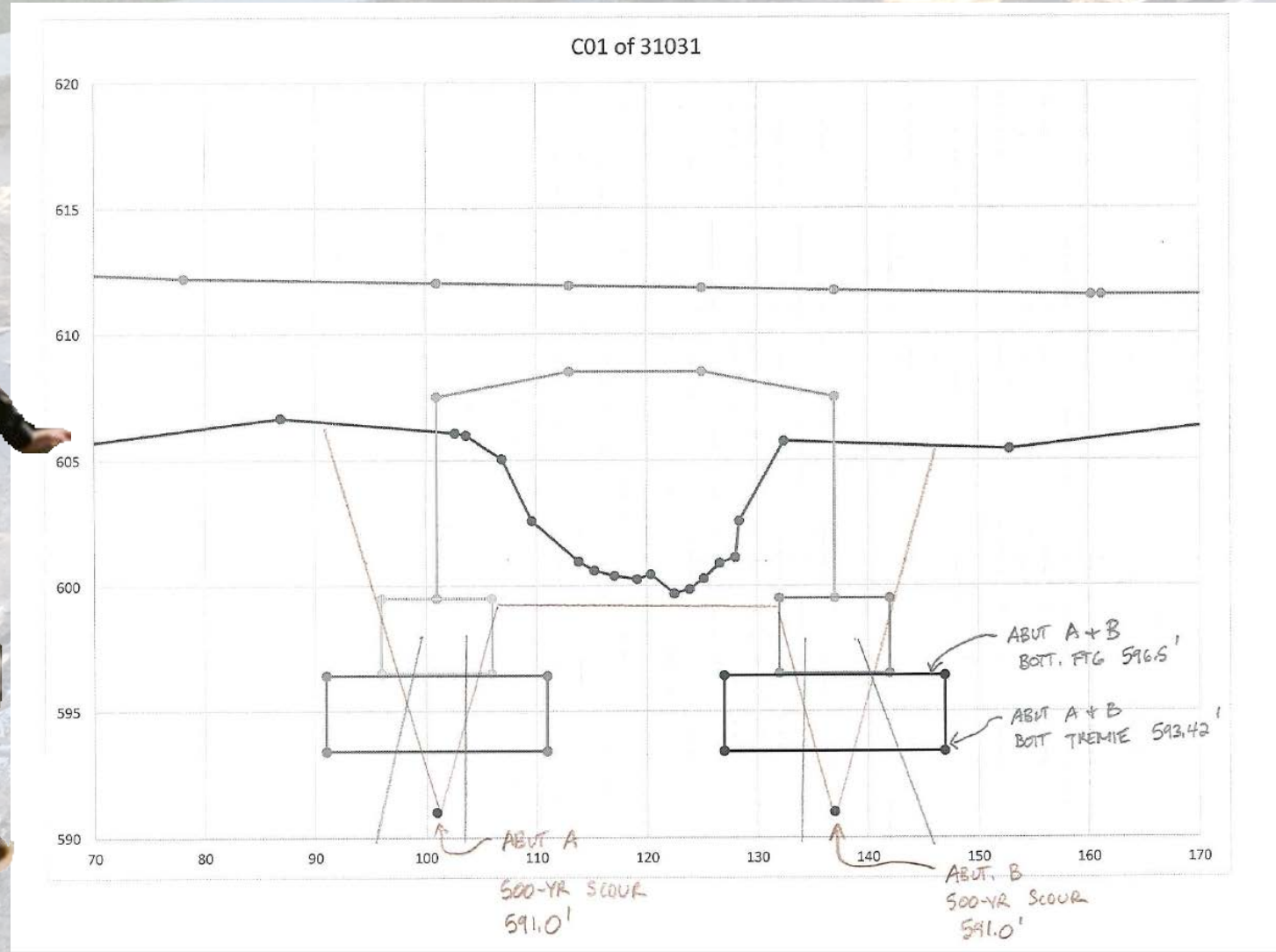
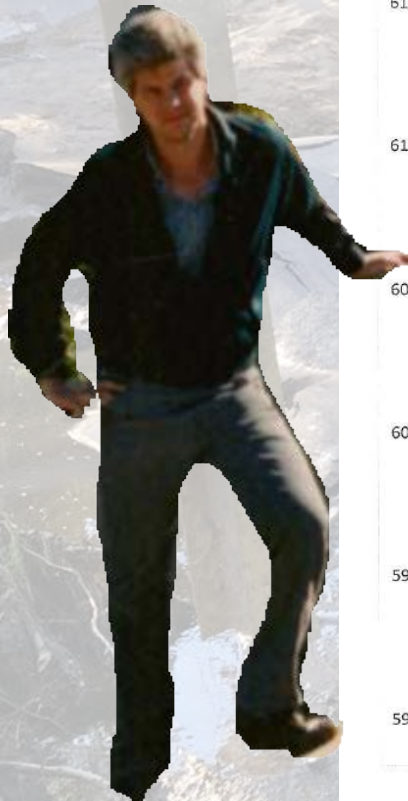
Scour Program - Level II Analysis

- Scour computed for the design scour event (100 year, 1% chance, for MDOT structures) and evaluated for the check flood (500 year, 0.2% chance, for MDOT structures)
- Recommended minimum frequencies found in Table 2.1 in FHWA's HEC-18 manual:

Table 2.1. Hydraulic Design, Scour Design, and Scour Design Check Flood Frequencies.

Hydraulic Design Flood Frequency, Q_D	Scour Design Flood Frequency, Q_S	Scour Design Check Flood Frequency, Q_C
Q_{10}	Q_{25}	Q_{50}
Q_{25}	Q_{50}	Q_{100}
Q_{50}	Q_{100}	Q_{200}
Q_{100}	Q_{200}	Q_{500}

Scour Program - Level II Analysis



Scour Program - Level II Analysis

		PAGE 1 OF 11	
 MDOT Michigan Department of Transportation	GUIDANCE DOCUMENT	IDENTIFIER	EFFECTIVE DATE
		10231	06/04/14
		SUPERSEDES	DATED
		10231	04/30/15
RESPONSIBLE ORGANIZATION:		Bureau of Highway Development – Design- Bridge Development	
SUBJECT:	Coding and Managing Bridges for Scour Vulnerability		

Purpose

The purpose of this policy is to identify MDOT and local agencies' responsibilities for the management of bridges vulnerable to scour. MDOT's goals for management of scour susceptible bridges are:

- Ensure the safety of individual bridges and bridge approaches crossing waterways.
 - Perform Scour Evaluations following procedures listed in HEC -18.
 - Develop and implement Plan of Actions (POA).
 - Address critical findings by initiating follow up actions such as scour monitoring, mitigation, or replacement.
- Reduce the network wide risk of bridge scour and minimize future flood damage to bridges.
 - Utilize data driven, risk-based asset management. See MDOT Scour Risk Assessment, or Local Agency Scour Risk Assessment documents
 - Prioritize scour mitigation and countermeasures given fiscal resources and constraints.
 - Design and place countermeasures to reduce the risk of bridges that are scour critical.
 - Consider bridge replacement as an option for mitigation if one of the following conditions are met:
 - The structure is a replacement candidate due to condition.
 - The structure is ranked both highly critical and highly vulnerable during the risk assessment and countermeasures will not reduce the risk to acceptable levels.
 - Countermeasures are not feasible due to cost, constructability, environmental constraints or backwater concerns.

Information

MDOT seeks to enhance bridge safety and make effective use of resources in managing bridges on a network level while ensuring safety at a bridge level. In order to accomplish these goals, MDOT uses a risk and data driven procedure to classify and manage bridges. In 1988, FHWA initiated the National Scour Evaluation Program. The National Bridge Inspection Standards (NBIS) specifies that all bridges over waterways must be evaluated to assess susceptibility to scour and to determine if protection in the form of countermeasures is required to ensure the stability of the structure. NBIS further specifies that the

- Item 113 coding based on MDOT Guidance Document “Coding and Managing Bridges for Scour Vulnerability.”

https://www.michigan.gov/documents/mdot/10231_489948_7.pdf

Scour Program - Level III Analysis



- Physical modeling in a lab environment.
- Has not been done on any MDOT structures.
- FHWA's J. Sterling Jones Hydraulics Research Lab at Turner-Fairbanks

Source: <https://highways.dot.gov/laboratories/hydraulics-research-laboratory/hydraulics-research-laboratory-overview>