# TAMC 2021 MICHIGAN NON-NBI CULVERT STRUCTURE INSPECTION GUIDE

# UPDATES TO THE ROADSOFT CULVERT MODULE

**RUCUS 2021** 

# TAMC CULVERT INITIATIVES

- 2018 TAMC CULVERT PILOT SET STAGE FOR COLLECTION EFFORT
- 2019-2020 PILOT TRAINING CONTINUED AND DATA ANALYSIS
- 2021 MICHIGAN NON-NBI CULVERT STRUCTURE INSPECTION GUIDE
  - SPECIFIC GUIDANCE FOR INVENTORY AND INSPECTION OF CULVERTS WITHIN STATE OF MICHIGAN
  - UPDATES TO ROADSOFT
  - UPDATES TO TRAINING

# **2018 PILOT**

CHARGE CAME FROM GOVERNOR'S OFFICE TO ESTIMATE THE FOLLOWING FOR LOCALLY **OWNED CULVERTS:** 

- Number within the state (196,000)
- **OVERALL CONDITION**
- RANGE OF PHYSICAL CHARACTERISTICS
- BENCHMARK INVENTORY COLLECTION PRODUCTIVITY RATES
- BENCHMARK CONDITION EVALUATION PRODUCTIVITY RATES





The Michigan Transportation Asset Management Council (TAMC), the TAMC Bridge Committee and the Centerfor Technology and Training at Michigan Technological University (CTT) wish to acknowledge the contribution of the transportation professionals who coordinated the culvert data collection at their respective agencies, and for the data, input and suggested best practices for the collection of culvert data for Michigan's local transportation agencies. Their input assisted in the development of this report.

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A full detailed report can be found on the TAMC website at www.michigan.gov/tamc

# 2018 PILOT DATA FIELDS

- Inventory ID
- GPS COORDINATES
- Material Type
- Asset Collection Date (Rating Date)
- SHAPE
- SKEW ANGLE
- PHOTOGRAPHS (OPTIONAL)

- LENGTH (AND UNIT)
- WIDTH (AND UNIT)
- Height/Diameter (and unit)
- DEPTH OF COVER(AND UNIT)
- ROADWAY SURFACE TYPE
- CULVERT RATING

# MATERIAL

- PLASTIC
- STEEL
- TIMBER
- ALUMINUM
- CONCRETE

# SHAPE

- Box
- MULTI-CELL BOX
- 3-SIDED
- SLAB/SUPERSTRUCTURE & ABUTMENT
- CIRCULAR
- ELLIPTICAL
- ARCH

Other Roadsoft types were accepted

# CONDITION ASSESSMENT

- FOLLOWS INTENT OF FHWA CULVERT INSPECTION MANUAL (1986)
- Closely mirrors Ohio DOT Updated FHWA Method (2017)
- RATING SPECIFICS FOR EACH ELEMENT VARY BY MATERIAL AND CULVERT TYPE
- INDIVIDUAL RATING FOR THE FOLLOWING ELEMENTS:
  - STRUCTURAL DETERIORATION
  - NVERT DETERIORATION
  - Section Deformation
  - JOINTS/SEAMS
  - BLOCKAGE
  - SCOUR

# CONDITION ASSESSMENT - CMP EXAMPLE

CMP	Structural Deterioration (Corrosion)	Closed Bottom Invert Deterioration	Open Bottom Invert Deterioration	Section Deformation	Joints/ Seams	Condition
10	New condition. Galvanizing intact. No corrosion.	New condition; galvanizing intact; no corrosion.	New condition			Excellent
9	Discoloration of surface. Galvanizing partially gone. No layers of rust.	Discoloration of surface. Galvanizing partially gone along invert. No layers of rust.	Good with no invert erosion			Very Good
8	Discoloration of surface. Galvanizing gone along invert but no layers of rust. Minor section loss at ends of pipe not located beneath roadway.	Discoloration of surface. Galvanizing gone along invert but no layers of rust. Minor section loss at ends of pipe not located beneath readway.	Good with only minor invert crosion	Table	ple	Good
7	Galvanizing gone with layers of rust. Moderate section loss at ends of pipe not located beneath roadway. Moderate section loss: Less than 6 in <sup>1</sup> /B <sup>2</sup> .	Galvanizing gone along invert with layers of rust. Moderate section loss at ends of pipe not located beneath roadway. Moderate section loss: Less than 4% of invert area.	Minor erosion near footings	mation	Reference CMP Joints / Seams Table	Satisfactory
6	Heavy rust and scale throughout. Heavy section loss with perforations not located under the roadway. Heavy section loss: Up to 15 in <sup>2</sup> /fr <sup>2</sup> .	Heavy rust and scale throughout. Heavy section loss with perforations in invert not located under the roadway. Heavy section loss: Up to 10% of invert area.	Moderate erosion along footing; protective measures may be required	e Defor		Fair
5	Extensive heavy rust and scaling throughout. Perforations throughout with an area less than 30 in Vit <sup>2</sup> . Overall thin metal, which allows for an easy puncture with chipping hammer.	Extensive heavy rust and scaling throughout.  Perforations throughout invert with an area less than 20% of invert area. Overall thin metal, which allows for an easy puncture with chipping hammer.	Erosion along footing with slight undermining, protection required	IP Shap		Poor
4	Extensive heavy rust and scaling throughout. Perforations throughout with an area less than 36 in <sup>1</sup> /th <sup>2</sup> .	Extensive heavy rust and scaling throughout.  Perforations throughout invert with an area less than 25% of invert area.	Severe undermining with slight differential settlement causing minor cracking or spalling in footing and minor distress in walls	Reference CMP Shape Deformation Table	erence (	Serious
3	Perforations throughout with an area greater than 36 $\rm in^{1/}ft^{2}$ .	Perforations throughout invert with an area greater than 25% of invert area.	Severe undermining with significant differential settlement causing severe cracks in footing and distress in walls	Refere	Ref	Critical
2	Pipe partially collapsed.	Pipe partially collapsed.	Structure partially collapsed or collapse is imminent.			Imminent Failure
1	Total failure of pipe.	Total failure of pipe.	Total failure of structure.			Failed



СМР	Blockage	Scour	Condition
10	No blockage. Designed condition.	No evidence of score at either inlet or outlet of culvert.	Excellent
9	Minor amounts of sediment build-up with no appreciable loss of opening.	Minor scour holes developing at inlet or outlet. Scour protection placed.	Very Good
8	Culvert waterway blockage is less than 5% of the cross sectional area of the opening. Bank and channel have minor amounts of drift.	Minor scour holes developing at inlet or outlet. Top of footings is exposed. Probing indicates soft material in scour hole.	Good
7	cubert waterway blockage is less than 10% of the cross sectional area of the opening. Sediment buildup ensing flow through 1 of 2 pipes. Silt and Gravel buildup ensire that of the channel. Tree or both growing in the channel. Fence placed at inlet or outlet. Rock dans in cultver.	Minor scow holes. I foot or less deep, developing at inlet or outlet. Footings along the side are exposed less than 6 inches. Damage to scour counter measures. Probing indicates soft material in scour hole.	Satisfactory
6	Culvert waterway blockage is less than 30% of the cross sectional area of the opening. Tree or bush growing in channel. Fence placed at inlet or outlet. Rock dams in culvert.	Minor scour holes, 2 feet or less deep, developing at inlet or outlet. Footings along the side are exposed less than 12 inches. Damage to scour counter measures. Probing indicates soft material in scour hole.	Fair
5	Culvert waterway blockage is less than 40% of the cross sectional area of the opening. Occasional overtopping of roadway. Large deposits of debris are in the waterway.	Significant scour holes, 3 feet or less deep, developing at inlet or outlet. Does not appear to be undermining cutoff walls or headwalls. Bortom of footing is exposed. Major stream erosion behind headwall that threatens to undermine culvert.	Poor
4	Culvert waterway blockage is less than 80% of the cross sectional area of the opening. Overtopping of roadway with significant traffic delays.	Major scour holes, 3 feet or deeper, at inlet or outlet undermining cutoff walls or headwalls. Footing is undermined.	Serious
3	Culvert waterway blockage is 80% or greater of the cross sectional area of the opening. Frequent overtopping of roadway with significant traffic delays.	Streambed degradation causing severe settlement.	Critical
2	Culvert waterway completely blocked and causing water to pool.  Road closed because of channel failure.	Culvert closed because of channel failure.	Imminent Failure
1	Total failure of pipe.	Total failure of culvert because of channel failure.	Failed



# **CMP SECTION DEFORMATION**

CMP Section Deformation	Round/Vertical/ Elongated Pipes	Pipe Arch	Plate Arch	Box	Low Profile Long Span*	High Profile Long Span*	Pear	Horizontal Ellipse*	Condition
10	New Condition	New Condition	New Condition	New Condition	New Condition	New Condition	New Condition	New Condition	Excellent
9	Good, smooth curvature in barrel. Horizontal diameter (span) dimension within 10% of original design.	Good with smooth curvature in barrel. Horizontal span dimension less than 3% greater than original design.	Good, smooth symmetrical curvature. Rise: within +/- 3 percent of original design.	Good appearance, smooth symmetrical curvature. Top are mid-ordinate within 11 percent of enginal design. Horistontal spate within 5 percent of original design. Sides: smight fee type slightly deflected inward or outward and curvature smooth.	Good appearance, senooth symmetrical curvature. Top are mid-ordinate: within 11 percent of oniginal design. Horizontal space within 5 percent of original design.	Good appearance, smooth symmetrical curvature. Top acc mid-colinate: within 11 percent of original design. Horizontal span: within 5 percent of original design.	Good appearance, senooth symmetrical curvature. Top are said-ordinate varibia 11 percent of original design. Horizontal space varibia 5 percent of original design. Side plates: smooth curvature	Good appearance, smooth symmetrical curvature. Top are mid-ordinate: within 11 percent of original design. Horizontal span: within 5 percent of original design. Bornous are: smooth curvature, mid-ordinate within 50 percent of original design.	Very Good
8	Generally good, top half of pipe smooth but numer flattening of bottom. Horizontal diameter (span) demension within 10% of original design.	Generally good, smooth curvature in top half, flattened but still curved. Horizontal spon within 3 to 5 percent greater than design.	Generally good with smooth curvature, symmetrical; slight flattening of top or sides in one section. Rise within 3 to 4 percent of engrand design.	Generally good; curvature is uncord and symmetrical. Top are mid-enfinate: within 11 percent to 15 percent of original design. Sides, smaight leg slightly deflected inward or modesnelly deflected outward, curvature smooth.	Generally good; curvature is smooth and symmetrical. Top are mid-ordinate: within 11 percent to 15 percent of original design. Horizontal spox within 5 percent of original design.	Generally good; curvature is smooth and symmetrical. Top are mid-ordinate: within 11 percent to 15 percent of original design. Horizontal span: within 5 percent of original design.	Generally good; curvature is smooth and symmetrical. Top are mod-ordinate: within 11 percent to 15 percent of original design. Borizontal spax, within 5 percent of original design. Side planes side flamened, mid-ordinate less than 50 percent of original design.	Generally good; curvature is smooth and symmetrical. Top ace mid-ordinate: within 11 percent to 15 percent of original design. Horizontal span, within 5 percent of original design. Buttom are: bottom flatened, mid-ordinate less than 50 percent of original design.	Good
7	Fair, top half has smooth curvature but bottom half has flatmosed significantly. Horizontal diameter (span) dimension within 20% of original design.	Fair, smooth curvature in top half, bottom flat. Horizontal span 5 percent greater than original design.	Fair, smooth curvature but non-symmetrical; slight flamesing of top and sides throughout Rise: within 4 to 5 percent of original design.	Smooth curvature, shape is non-symmetrical. Top are mid-refinant: within 15 process of oniginal design. Horizontal span: more than "1-5 process of design. Sidex straight leg smolarately deflected invasid or extremely deflected outward, curvature smooth.	Smooth curvature, shape is non- symmetrical. Top are mid- cedinate: within 15 percent of original design. Horizontal spax: more than 4/- 5 percent of design.	Smooth curvature, shape is non- symmetrical. Top ace mid- ordinate: within 15 percent of original design. Horizontal spax- more than */- 5 percent of design.	Smooth curvature, shape is non- symmetrical. Top are mid-refinate: within 15 percent of original design. Horizontal span: more than +/- 5 percent of design. Side plates: side flattened, mid-ordinate less than 35 percent of original design.	Smooth curvature, shape is non- symmetrical. Top are mid-ordinate: within 15 percent of original design. Horizontal span: more than +i-5 percent of design. Bottom are: bottom flatmond and irregular, mid-ordinate last than 50 percent of original design.	Satisfactory
6	Generally fair, significant denotion at isolated locations in top half and extreme flattening of the invest. Hocimontal diameter (span) dimension 10% to 15% greater than original design.	Generally fair, significant distortion in top in our location; betten has slight reverse curvature in one location. Horizontal spax within 5 to 7 percent greater than original design.	Generally fair, significant distortion and deflection in one section, sides beganning to flatters; con- symmetrical. Rine: within 5 to 7 percent of original design.	Generally fair, significant distortion and deflection in one section, half top of sex beginning to flatter, mid-ordanate of half top- berginning to flatter, mid-ordanate of half top- ser. 10 percent less than original designs. Top- are mid-ordanare within 15 to 20 percent of original design, Brainboards upon more than *1-5 percent of original design, Sidne- tingal leg lowed surmed suggislateastly or extremely howed customed for dottaneo of less than 14 mm learth.	Generally fair, significant distortion and deflection is one section, half top of area beginning to flatten, mil- ordinate of half top are 30 percent less than original design. Top are mild-ordinate; within 15 to 20 percent of original design. Horizontal spar: more than 41-5 percent of original design.	Generally thir, significant distortion and deflection is one section; half top of arcs beginning to flatter; such ordinate of half top are 19 process less than explicit and design. Top are mid-ordinate within 15 to 20 percent of original design. Boxicortial spax; more than 4t-5 percent of original design. Boxicortial spax; more than 4t-5 percent of original design.	Generally fair, viguificant distortions and deflection in one section; half by of incre-beginning to flutten; maid-ordinate of half boy are? 39 percent less than exiginal design. Top are maid-ordinate within 15 to 20 percent of enginal design, viguing. Hostiscontal spair: more than *i-5 percent of enginal design, 50 et plates; 50 et plates of enginal design. Self plates; percent of enginal design.	Generally fair, significant discretion and deflection is one section. Italif top of arca beginning to flatters, and codinate of half top not 20 percent less than oniginal design. Top are mid-ordinate within 15 to 20 percent of original design. Horizontal spair: more than +/- 5 percent of original design, Bettien arc than set— thousand spair and setting bettien arc buttons virtually flat over center half of zer.	Fair
5	Marginal significant distortion throughout length of pipe, lewer third may be kinked. Heriannial diameter (spon) dismension 10% to 15% greater than original design.	Marginal, significant distortion all along top of such bostom has reverse curve. Heriannial space more than 7 percent greater than original design	Marginal, significant distortion and deflection throughout, sides flattened with radius 100 percent greater than design. Earn: within 7 so 8 percent of original design.	Mangiaal, significant discertion and deflection throughour, mid-ordinate of half top are less than 50 percent of original 0 to 30 percent of original 10 percent of original 10 percent of original 10 percent of original 10 percent of original. Homozontal upon: more than +1-5 percent of design. Sides: straight leg bowed inswed significantly or extensely bowed outward for distance between 114 and 152 seals insuch, curvature insensity.	Marginal, significant distortion and deflection throughout, mid- ordinate of half top are less than 50 percent of original design. Top are mid-refinate: within 15 to 20 percent of design. Horizontal span: more than +/- 5 percent of design.	Marginal, significant distortion and deflection throughout; mid- ordinate of half top arc less than 50 percent of original design. Top are mid-ordinates within 15 to 20 percent of design. Horizontal spain, more than *!- 5 percent of design.	Margonal, significant distribution and deflection from flowing, und-ordinate of half top are less than 50 percent of original design. Top are raid-ordinate within 15 to 20 percent of design, side popercent of design, side paters of the flattened, and-ordinate less than 20 percent of entirely design.	Marginal, significant discertion and deflection throughout; mid-ordinate of half top are less than 50 percent of original design. Top are end-ordinate within 15 to 20 percent of design. Horisonnal span: more than **-5 percent of design. Botton serv. bottom variantly flat over center half of are and deflected dewn at conserv.	Poor
4	Poor with entreme deflection at stotherd locations, flattening of the coven, coven radius 20 to 30 feet. Hostoothal diameter (spax) dimension in excess of 15% greater than original design.	Prox, extreme deflection in top arch in one section; bostomen has reverse curvature throughout. Hercontal spox more than 7 percent greater than original design.	Proc. extreme distortion and deflection in one section; sides virtually flammed; extremely non- symmetrical. Rose: within 8 to 10 percent of original design.	Proc. extreme distortion and deflections is one section and codusate of half top are 50 to 20 percent less than design. Top are mid- ordinate. 30 to 40 percent less than enginal design. Barricontal spair inner data wi- 6 percent of original design. Sides: straight for extremely bowed invarial fee distance less than 1/2 upon length of leg bowed outward serverely canning bullers in next, and are treated to the straight of the server o	Proc. extreme distortion and deflection in one section and occlosure of half top are 50 to 70 percent less than design. Top are unid-ordinate: 20 to 30 percent less than original design. Horizontal span: more than */- 6 percent of original design.	Poor, extreme desterbins and deflection in one section and oedinase of Infall top are 50 to 70 percent less than design. Top are mid-collaste: 20 to 30 percent less than onegual design. Horizontal span: more than +/- 6 percent of original design.	Pow. extense distortion and deflection in one section and column of half top are 50 to 70 percent less than design. Top are und-ordinate: 20 to 30 percent less than onigonal design. Historican! space more than +/- 9 percent of onigonal design. Side planes: side farmende, mid- codinate less than 12 percent of design.	Peer, extreme detection and deflections in one section and celluste of half top are 50 to 70 percent less than design. Top are und-ordinate: 20 to 30 percent less than original design. Honcontral space more than +/- 5 percent of oniginal design. Bonness are: bottom revenue curved in center.	Serious
3	Coisical, extreme distortion and deflection throughout pape, flattening of the crown, crown radius over 30 feet. Horizontal diameter (span) dissension more than 20% greater than original device.	Critical, extreme deflection along top of pape. Honocortal span: more than 7 percent greater than original design.	Critical, extreme deflection, throughout, sides fatnessed, extremely non-symmetrical. Rise, greater than 10 percent of original design.	Critical, extreme distortion and end deflection forcuplant, and confinate of half top are more than 70 percent less than design. Top are mid-extinate, more than 40 percent of original design. Handsonal space, more than 91-4 percent of design. Sides: smajtal leg extremely bewell sureaf for a distance of 1/2 to 1 space longer, to leg bowed overaid severety canonic below to the providence of 1/2 to 1 space longer, or leg bowed overand severety canonic bulger of histories of the providence of the	Critical, extreme distortion and end deflection throughout, mid-ordinate of half top are more than 70 percent less than design. Top are mid-ordinate more than 50 percent of original design. Horizontal span: more than 44- E percent of design.	Critical, entreme distortion and end deflection throughout, mid- ordinate of flad top are more than 70 percent less than design. Top- arc mid-ordinate: more than 30 percent of original design. Horizontal span: more than 4/- 8 percent of design.	Critical, extreme distortion and end deflection foreignbort, mad crimate of half top are more than 70 percent less than design. Top are mad cediment more than 85 percent of original design. Horizontal span: more than 16 percent of original design. Horizontal span: more than 16 percent of design, Side plates: safe flatment, and ordinate less than 10 percent of design. Side plates: safe flatment.	Critical, extreme distortion and deflection forcuplant, and ordinate of half top ace racer than 70 percent less than design. Top are mid-ordinate, more than 50 percent of original design. Horizontal span: more than 71-8 percent of design. Bottom are: bottom precent of design. Bottom are: bottom proceed carried an occupant and open are some or design.	Critical
2	Partially collapsed with crown in reverse curvature	Structure portially collapsed	Severe due to portial collapse, local reverse curve of crown and sides	Severe due to portial collapse; top arc curvature flat or sevene curved.	Severe due to partial collapse; top are curvature flat or revene curved.	Severe due to portial collapse; top arc curvature flat or severse curved.	Servere due to poetial collapse; top are curvature flat or reverse curved. Side plates: side flat or reversed curved.	Severe due to partial collapse; top are curvature flat or reverse curved.	Imminent Failure
1	Structure collapsed	Structure collapsed	Completely collapsed	Completely collapsed	Completely collapsed	Completely cellapsed	Completely collapsed	Completely collapsed	Failed

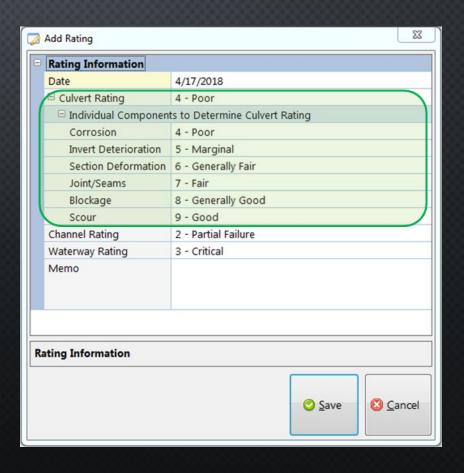
CMP Joints & Seams	Pipe Joints or Seams	Multi-plate Joints or Seams	Condition
10	Straight line between sections.	Minor amounts of efflorescence or staining	Excellent
9	No settlement or misalignment. Tight with no defects apparent.	Light surface rust on bolts due to loss of galvanizing. Efflorescence staining.	Very Good
8	Minor misalignment at joints. Minor settlement. Distress to pipe material adjacent to joint.	Metal has cracking on each side of a bolt hole: Less than 3 in a seam section. Minor seam openings that are less than 5 inch. Potential for backfill infiltration. More than 2 missing bolts in a row. Rust scale around bolts.	Good
7	Misalignment of joints but no infiltration. Settlement. Dislocated end section. Extensive areas of shallow deterioration.	Evidence of backfill infiltration through seams.	Satisfactory
6	Joint open and allowing backfill to infaltrate. Significant cracking or buckling of pipe material. Joint offset less than 3 inches. End sections dislocated and about to drop off from main portion of the structure. Infaltration staining apparent.	Moderate cracking at bolt holes along a seam in one section. Backfull being lost through seam causing slight deflection. Less than 6 missing bolts in a row or 20% along the total seam.	Fair
5	Differential movement and separation of joints. Significant infiltration or exfiltration at joints. Joint offset less than 4 inches. Voids seen in fill through offset joints. End sections dropped off at inlet.	Major cracking of seam near crown. Infiltration of backfill causing major deflection. Partial cocked and cusped seams. 10% section loss to bolt heads along seams.	Poor
4	Significant openings. Dislocated joints at several locations exposing fill material with joint offsets greater than 4 inches. Infiltration or exfiltration causing misalignment of pipe and settlement or depressions in roadway. Large voids seen in fill through offset joints.	Longitudinal cocked and couped seams. Metal has 3 inch crack on each side of the bolt hole run for the entire length of the culvert. Missing or tipping bolts.	Serious
3	Culvert not functioning due to alignment problems throughout. Large voids seen in fill through offset joints.	Seam cracked from bolt to bolt. Significant amounts of backfill infiltration.	Critical
2	Pipe partially collapsed or collapse is imminent.	Pipe partially collapsed or collapse is imminent.	Imminent Failure
1	Total failure of pipe.	Total failure of pipe.	Failed



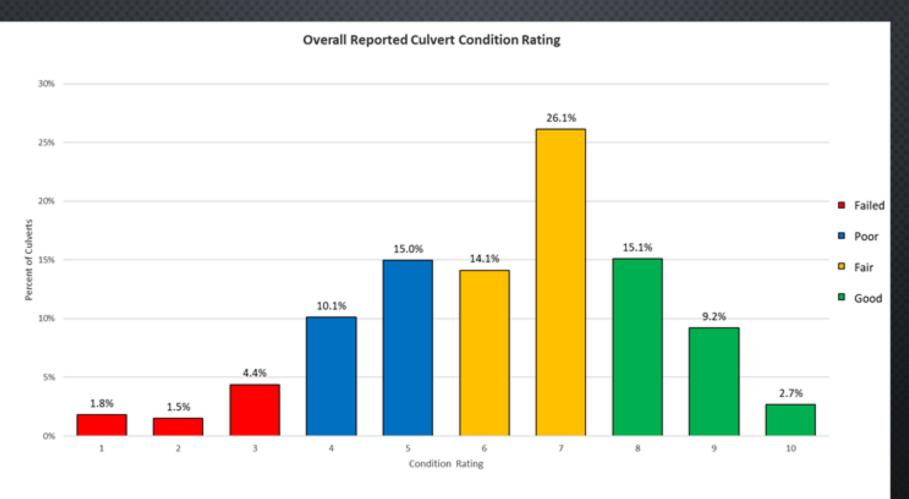
**CMP JOINTS SEAMS** 

# **CULVERT RATINGS**

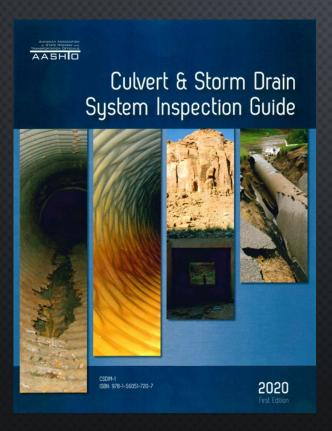
- 10 POINT NUMERIC SCALE
- OVERALL RATING DETERMINED FROM ELEMENT RATING INPUT
  - STRUCTURAL DETERIORATION
  - NVERT DETERIORATION
  - Section Deformation
  - JOINT/SEAMS
  - BLOCKAGE
  - SCOUR
  - SLAB
  - ABUTMENT



# 2018 PILOT FINDINGS – OVERALL CONDITION



# 2019-2020 TRAINING AND DATA ANALYSIS



- CONTINUED TRAINING BASED ON WHAT WAS DEVELOPED FOR THE PILOT
- EVALUATION OF DATA FROM COMBINED SOURCES
- CONDITION ASSESSMENT SYSTEM TRANSLATION
- FOLLOW UP SURVEY OF 2018 PILOT PARTICIPANTS

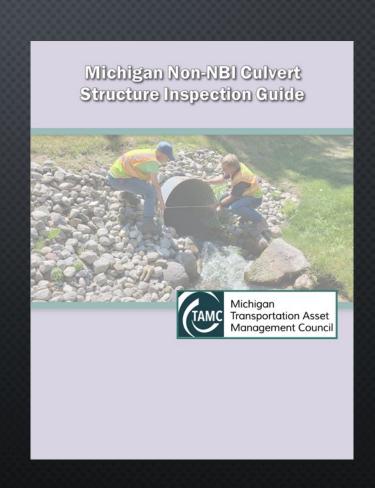
Available August 2020

# 2020 – FOLLOW UP SURVEY

- MOST RESPONDENTS FOUND PILOT DATA USEFUL ONE-YEAR AFTER THE PILOT
  - PREPARING ESTIMATES FOR ROAD REPAIR
  - PRIORITIZING MAINTENANCE SCHEDULES
  - DEVELOPING ASSET MANAGEMENT PLANS
- 67% of agencies continued collection efforts after pilot
- SPLIT PREFERENCE FOR 10 POINT RATING SCALE VS GOOD/FAIR/POOR/SEVERE
- Longer evaluation periods OK if structure is good or smaller in size

# 2021 – MICHIGAN NON-NBI CULVERT STRUCTURE INSPECTION GUIDE

- Guidance for establishing
  - SAFETY
  - FREQUENCY OF INSPECTION
  - EVALUATION DETAIL
- INVENTORY COLLECTION
- CONDITION EVALUATION
  - GOOD/FAIR/POOR/SEVERE
  - Two components or more detailed



# LIMITATIONS OF THE GUIDE

- INTENDED FOR ASSET MANAGEMENT PURPOSES.
- SAFETY ASSESSMENT MAY REQUIRE ADDITIONAL ANALYSIS
- AASHTO MANUAL PROVIDES MORE DETAILED INFORMATION
- CULVERT-LIKE STRUCTURES THAT MEET THE NBIS DEFINITION OF A
  BRIDGE MUST BE INSPECTED PER NBIS AND MISIM
- BRIDGE-LIKE STRUCTURES THAT MEET THE NBIS DEFINITION OF A
  CULVERT MAY BE INSPECTED PER NBIS AND MISIM

# TO BE DETERMINED BY LOCAL AGENCY

- SAFETY PROTOCOL
- INSPECTION INTERVALS
- Level of Detail on Evaluations

## SAFETY

### FOLLOW YOUR AGENCY'S SAFETY PROTOCOL/RULES

### SAFETY RESOURCES:

- AASHTO CULVERT & STORM DRAIN SYSTEMS INSPECTION GUIDE (3.10)
- MICHIGAN STRUCTURE INSPECTION MANUAL (MISIM) (CHAPTER 13)
- Bridge Inspector's Reference Manual (BIRM) (Chapter 2)

# INSPECTION INTERVALS

- TO BE DETERMINED BY LOCAL AGENCY (6 YEAR MAX INTERVAL)
  - RISK BASED
  - TOO SHORT LITTLE TO NO CHANGE BETWEEN INSPECTIONS, INEFFICIENT
  - TOO LONG MISSED OPPORTUNITIES TO PERFORM MAINTENANCE, POTENTIAL RISK OF FAILURE
- RECOMMENDED CONSIDERATIONS
  - CONDITION RATING
  - SIZE
  - MATERIAL
  - AGE
  - Roadway ADT

# GENERAL CONDITION RATINGS, ACTIONS, DESCRIPTIONS

Good	Action Indicated: No Action. Note in inspection report only. Condition: Like New Little to no deterioration Structurally sound Functionally adequate
Fair	Action Indicated: No action (more frequent inspection may be warranted). Inform maintenance personnel.  Condition: Some deterioration Structurally sound Functionally adequate
Poor	Action Indicated: Corrective action based on inspector's evaluation. Recommendations made in inspection report. Condition: Significant deterioration AND/OR Functionally inadequate Requires maintenance/repair
Severe	Action Indicated: Corrective action based on engineering evaluation to specify appropriate repair. Required action is urgent. Condition: Severe deterioration Structurally unsound Functionally inadequate Possible to imminent failure or threat to public safety.
Not Rated	Action Indicated: No Action. Condition:  Not part of the culvert design/structure Functional adequacy not required Not an inspection item at last culvert inspection. Excludes items missing due to vandalism, damage, or deterioration.

#### Overall Rating Submitted to TAMC

Vicinity and Appurtenant Structures

Good Fair Poor Severe

Culvert Barrel

**Good** Fair Poor Severe

#### **Optional Rating Characteristics**

Roadway

Channel Scour and Blockage

End Treatments and Appurtenant Structure

#### Additional Vicinity Characteristics



#### Roadway

Pavement

Shoulders

Guardrail

Slope stability

**Embankment erosion** 

#### Channel Scour and Blockage

Channel alignment

Bank erosion and scour

Existing protection

Blockage

#### **End Treatments and Appurtenant Structures**

Concrete

Surface damage, spalling, delamination

Cracking

Metal

Corrosion

Deformation and damage

Scour and stability

Settlement and rotation

#### **Judgement Rating**

A general rating scale and associated actions to be taken can be used to rate components and conditions where the distress criteria in the condition evaluation tables is not adequate to assign a rating.

#### CMF

Shape

Surface damag

Abrasion

Corrosion

Joint separation, offset, and rotation

Seam alignmer

Seam bolts/fastener

Seam bolt holes

Barrel alignment

Infiltration and exfiltration

#### <u>Plastic</u>

Shape

Surface damage

Local buckling, splits, and cracking

Joint separation, offset, and rotation

Barrel Alignment

Infiltration and exfiltration

#### <u>Concret</u>

Slabbing, spalling, delamination, patches

Cracking

Deterioration

Joint separation, offset, and rotation

Joint cracking

Barrel alignment

Infiltration and exfiltration

#### Masonry

Masonry units and movement

Mortar

Efflorescence

#### Timber

Distortion

Abrasion/impact damage

Structural cracks

Checks and shakes

Delamination

Decay

Connections and missing members

# Choose ONE rating list based on material

# Overall Rating Submitted to TAMC

Vicinity and Appurtenant Structures

Good Fair Poor Severe

Culvert Barrel

**Good** Fair Poor Severe

### **Optional Rating Characteristics**

Roadway Channel Scour and Blockage End Treatments and Appurtenant Structures

#### <u>CMP</u>

Shape

Surface damage

Abrasion

Corrosion

Joint separation, offset, and rotation

Seam alignment

Seam bolts/fasteners

Seam bolt holes

Barrel alignment

Infiltration and exfiltration

#### **Additional Vicinity Characteristics**



#### Roadway

Pavement

Shoulders

Guardrail

Slope stability

**Embankment erosion** 

#### Channel Scour and Blockage

Channel alignment

Bank erosion and scour

**Existing protection** 

Blockage

#### **End Treatments and Appurtenant Structures**

Concrete

Surface damage, spalling, delamination

Cracking

Metal

Corrosion

Deformation and damage

Scour and stability

Settlement and rotation

#### **Judgement Rating**

A general rating scale and associated actions to be taken can be used to rate components and conditions where the distress criteria in the condition evaluation tables is not adequate to assign a rating.

# material 0 based list rating ONE Choose

#### <u>Plastic</u>

Shape

Surface damage

Local buckling, splits, and cracking

Joint separation, offset, and rotation

Barrel Alignment

Infiltration and exfiltration

#### Concrete

Slabbing, spalling, delamination, patches

Cracking

Deterioration

Joint separation, offset, and rotation

Joint cracking

Barrel alignment

Infiltration and exfiltration

#### Masonry

Masonry units and movement

Mortar

Efflorescence

#### Timber

Distortion

Abrasion/impact damage

Structural cracks

Checks and shakes

Delamination

Decay

Connections and missing members

# ROADWAY – WHAT TO LOOK FOR

- Pavements and Shoulders
  - SAGS, HUMPS, TRANSVERSE CRACKS, LOCALIZED RUTTING, PATCHING, LONGITUDINAL CRACKING NEAR PAVEMENT EDGE
- Guardrails
  - POST ALIGNMENT, POST ROTATION, SETTLEMENT, SAGGING
- SLOPE STABILITY
  - SLOUGHING, TENSION CRACKS
- EMBANKMENT EROSION
  - SHEET EROSION, RILLING, GULLYING, PIPING\*

\*BLOCKAGES OF THE CULVERT CAN INCREASE THE LIKELIHOOD OF PIPING

# ROADWAY - PAVEMENT SAMPLE

Condition Rating	Good	Fair	Poor	Severe
Pavement	Potential distress: none for 20-foot minimum length on either side of crossing culvert.	Transverse cracking: low severity (less than 0.25 inches in width)	Transverse cracking: medium severity (up to 0.5 inches in width)	Transverse cracking: high severity (greater than 0.5 inches in width with pavement raveling over culvert)
				Longitudinal cracking: high severity (greater than 0.5 inches in width with pavement raveling over culvert)
		Sags or humps: low severity (less than 2 inches over 10 feet) over culvert barrel	Sags or humps: medium severity (up to 4 inches over 10 feet) over culvert barrel	Sags or humps: high severity with voids beneath pavement
			Rutting in wheel path: localized over culvert/storm drain	
			Patching: evidence of repeated patching	

# CULVERT BARREL - WHAT TO LOOK FOR

- Shape deformation (Only Flexible Culverts)
- SURFACE DETERIORATION
- CORROSION OR DECAY
- STRUCTURAL SOUNDNESS
- JOINT/SEAM CONDITIONS
- BARREL ALIGNMENT
- INFILTRATION/EXFILTRATION

# CULVERT BARRELL - CMP SHAPE SAMPLE

Condition Rating	Good	Fair	Poor	Severe
Shape	Curvature: smooth barrel	Curvature: smooth top half	Curvature: significant distortion or flattening	Curvature: extreme distortion throughout barrel, local areas of reverse curvature
	Rise measurement: within tolerance			
	Span measurement: within tolerance			
		Bulges/kinks: minor bulges or flattening of bottom	Bulges/kinks: lower third may be kinked	Bulges/kinks: local area of kinks
	Deformation: less than 5% of original diameter	Deformation: 5% to 10% of original diameter	Deformation: greater than 10% to 15% of original diameter	Deformation: greater than 15% of original diameter
			Out-of-roundness: visible	Out-of-roundness: significant

# 2021 UPDATES TO ROADSOFT CULVERT MODULE

## REFERENCES

AASHTO. 2020. Culvert & Storm Drain System Inspection Guide, American Association of State Highway Transportation Officials (AASHTO).

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