

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

2018 Michigan Local Agency Culvert Inventory Pilot Evaluation Report



The Michigan Transportation Asset Management Council (TAMC), the TAMC Bridge Committee and the Center for 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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Michigan
Transportation Asset
Management Council



Michigan Technological University
**Civil and Environmental
Engineering**

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
 - INVERT DETERIORATION
 - SECTION DEFORMATION
 - JOINTS/SEAMS
 - BLOCKAGE
 - SCOUR

CONDITION ASSESSMENT—CMP EXAMPLE

CMP

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 roadway.	Good with only minor invert erosion			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 ² /ft ² .	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			Satisfactory
6	Heavy rust and scale throughout. Heavy section loss with perforations not located under the roadway. Heavy section loss. Up to 10% of invert area.	Extensive heavy rust and scaling throughout. Perforations throughout invert with an area less than 20% of invert area. Overall this rust, which allows for an easy practice with chipping hammer.	Moderate erosion along footing; protective measures may be required			Fair
5	Extensive heavy rust and scaling throughout. Perforations throughout invert with an area less than 30 in ² /ft ² . Overall this rust, which allows for an easy practice with chipping hammer.	Extensive heavy rust and scaling throughout. Perforations throughout invert with an area less than 25% of invert area.	Erosion along footing with slight undermining. Protection required			Poor
4	Extensive heavy rust and scaling throughout. Perforations throughout invert with an area less than 36 in ² /ft ² .	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			Serious
3	Perforations throughout with an area greater than 36 in ² /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			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

Reference CMP Shape Deformation Table

CMP

CMP	Blockage	Scour	Condition
10	No blockage. Designed condition.	No evidence of scour 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. Score protection placed.	Very Good
8	Culvert watertight 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	Culvert watertight blockage is less than 10% of the cross sectional area of the opening. Sediment building causing flow through 1 of 2 pipes. Silt and gravel building across half of the channel. Tree or bush growing in the channel. Fence placed at inlet or outlet. Rock dams in culvert.	Minor scour holes, 3 feet or less deep, developing at inlet or outlet. Footings along the side are exposed less than 12 inches. Damage to score concrete measures. Probing indicates soft material in scour hole.	Satisfactory
6	Culvert watertight 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, 3 feet or less deep, developing at inlet or outlet. Footings along the side are exposed less than 12 inches. Damage to score concrete measures. Probing indicates soft material in scour hole.	Fair
5	Culvert watertight 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 culvert walls or headwalls. Bottom of footing is exposed. Major stream erosion behind headwall that threatens to undermine culvert.	Poor
4	Culvert watertight blockage is less than 60% of the cross sectional area of the opening. Frequent overtopping of roadway with significant traffic delays.	Major scour holes, 3 feet or deeper, at inlet or outlet undermining culvert walls or headwalls. Footing is undermined.	Serious
3	Culvert watertight 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 watertight completely blocked and coming 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 Span*	Pipe Arch	Plate Arch	Box	Low Profile Long Span*	High Profile Long Span*	Pipe*	Horizontal Ellipse*	Condition
10	New Condition. Good overall condition. No corrosion. Galvanizing intact. No corrosion.	New Condition. Good overall condition. No corrosion. Galvanizing intact. No corrosion.	New Condition. Good overall condition. No corrosion. Galvanizing intact. No corrosion.	New Condition. Good overall condition. No corrosion. Galvanizing intact. No corrosion.	New Condition. Good overall condition. No corrosion. Galvanizing intact. No corrosion.	New Condition. Good overall condition. No corrosion. Galvanizing intact. No corrosion.	New Condition. Good overall condition. No corrosion. Galvanizing intact. No corrosion.	New Condition. Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Excellent
9	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Very Good
8	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good
7	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Satisfactory
6	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Fair
5	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Poor
4	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Serious
3	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Critical
2	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Imminent Failure
1	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Good overall condition. No corrosion. Galvanizing intact. No corrosion.	Failed

* These percentages are maximums for spans under 20 feet.

CMP JOINTS & SEAMS

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 both 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 span section. Minor seam openings that are less than 1/8 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 and stained. Extensive areas of dislodge deterioration.	Evidence of backfill infiltration through seams.	Satisfactory
6	Joint open and allowing backfill to infiltrate. Significant cracking or buckling of pipe material. Joint offset less than 3 inches. Distress to backfill and about 10% of the joint area.	Moderate cracking at bolt holes along a seam in one section. Backfill has been lost through seams causing slight deflection. Less than 6 missing bolts in a row or 20% along the joint seam.	Fair
5	Distorted movement and separation of joints. Significant infiltration or exfiltration at joints. Joint offset less than 3 inches. Voids seen in fill through offset joints. End sections dropped off at inlet.	Major cracking of seams near crown. Infiltration of backfill causing major deflection. Partial cracked and collapsed seams. 10% sections lost to both ends along seams.	Poor
4	Significant opening. 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 depression in roadway. Large voids seen in fill through offset joints.	Longitudinal cracked and exposed seams. Metal has 3 inch crack on each side of the bolt hole run for the entire length of the culvert. Missing or toppling bolts.	Serious
3	Culvert not functioning due to alignment problems throughout. Large voids seen in fill through offset joints.	Seam cracked from both to both. 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

* For spans between structures, site footing conditions. If concrete invert present, site invert based upon Concrete Structural Deterioration.

CULVERT RATINGS

- 10 POINT NUMERIC SCALE
- OVERALL RATING DETERMINED FROM ELEMENT RATING INPUT
 - STRUCTURAL DETERIORATION
 - INVERT DETERIORATION
 - SECTION DEFORMATION
 - JOINT/SEAMS
 - BLOCKAGE
 - SCOUR
 - SLAB
 - ABUTMENT

Add Rating

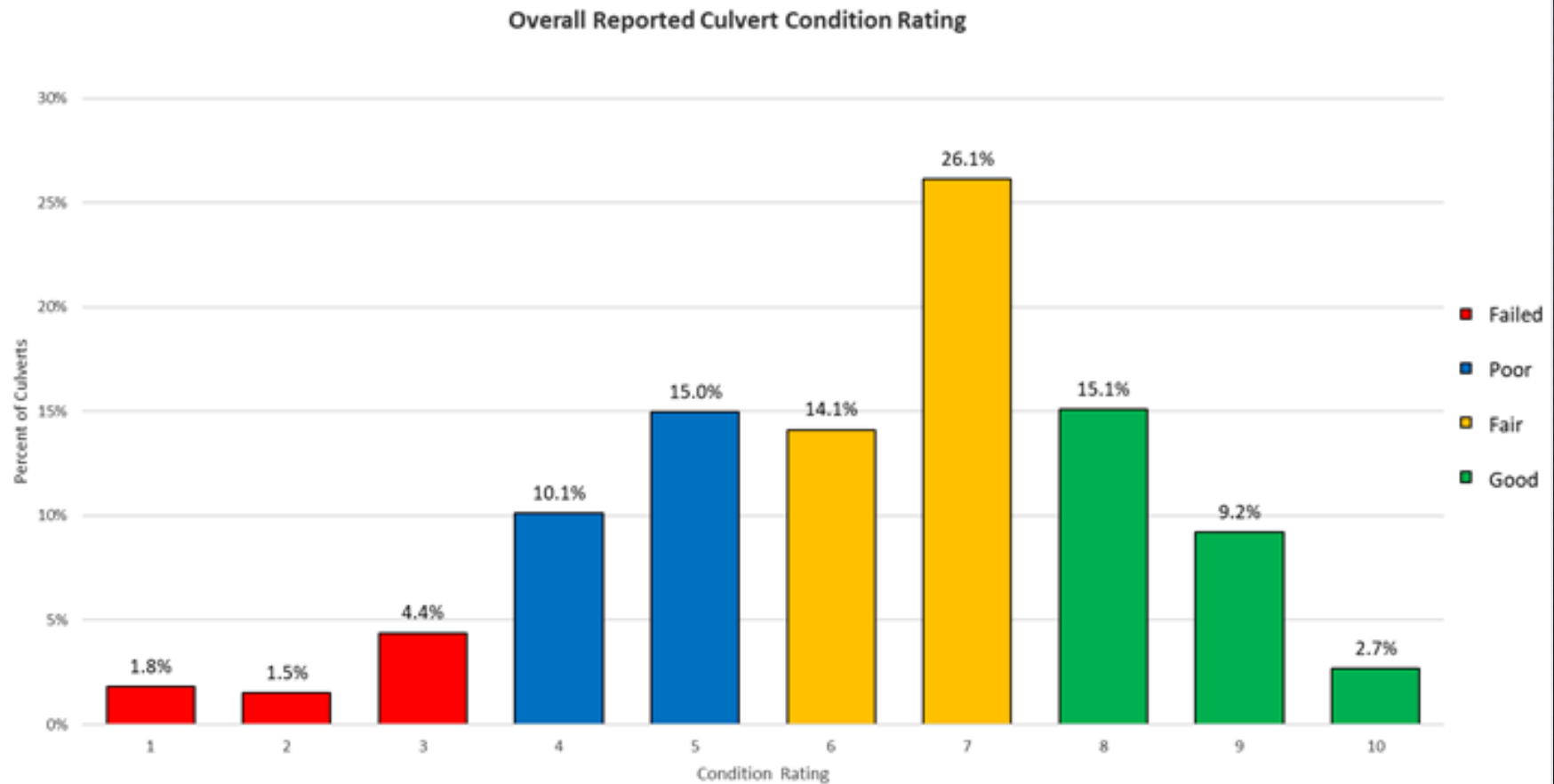
Rating Information

Date	4/17/2018
<input checked="" type="checkbox"/> Culvert Rating	4 - Poor
<input type="checkbox"/> Individual Components to Determine Culvert Rating	
Corrosion	4 - Poor
Invert Deterioration	5 - Marginal
Section Deformation	6 - Generally Fair
Joint/Seams	7 - Fair
Blockage	8 - Generally Good
Scour	9 - Good
Channel Rating	2 - Partial Failure
Waterway Rating	3 - Critical
Memo	

Rating Information

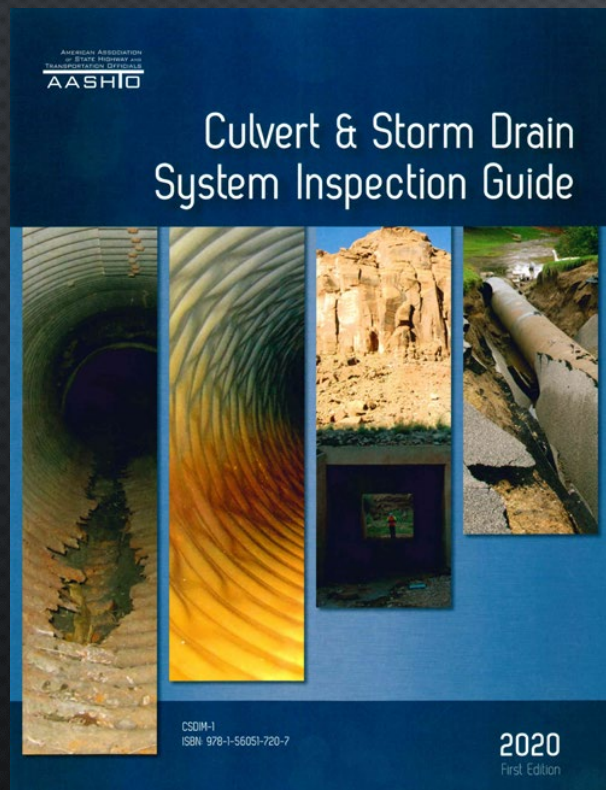
☒ Save ☐ Cancel

2018 PILOT FINDINGS – OVERALL CONDITION



49,664 culverts inventoried, 34,354 recorded condition ratings

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

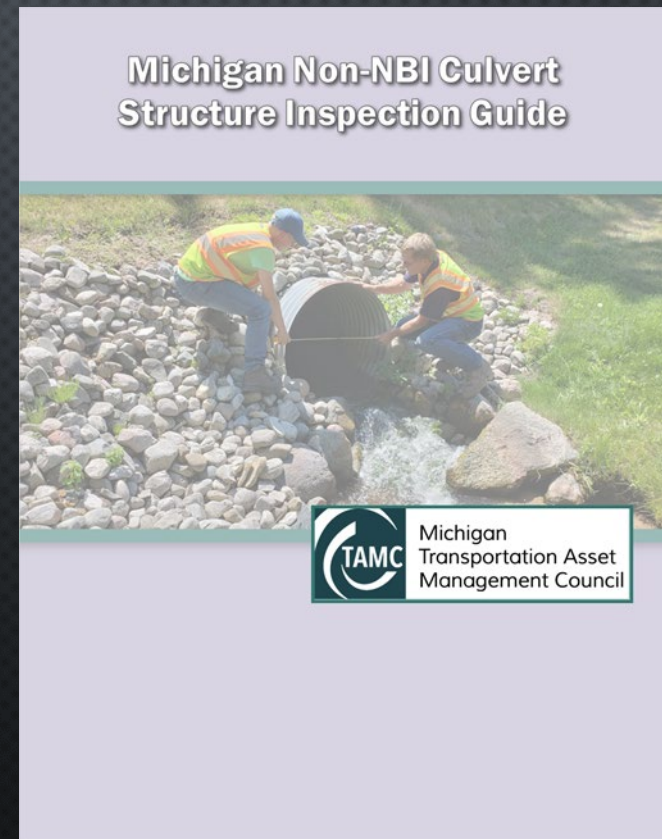
Available August 2020

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	<p><u>Action Indicated:</u> No Action. Note in inspection report only.</p> <p><u>Condition:</u></p> <ul style="list-style-type: none"> • Like New • Little to no deterioration • Structurally sound • Functionally adequate
Fair	<p><u>Action Indicated:</u> No action (more frequent inspection may be warranted). Inform maintenance personnel.</p> <p><u>Condition:</u></p> <ul style="list-style-type: none"> • Some deterioration • Structurally sound • Functionally adequate
Poor	<p><u>Action Indicated:</u> Corrective action based on inspector's evaluation. Recommendations made in inspection report.</p> <p><u>Condition:</u></p> <ul style="list-style-type: none"> • Significant deterioration • AND/OR • Functionally inadequate • Requires maintenance/repair
Severe	<p><u>Action Indicated:</u> Corrective action based on engineering evaluation to specify appropriate repair. Required action is urgent.</p> <p><u>Condition:</u></p> <ul style="list-style-type: none"> • Severe deterioration • Structurally unsound • Functionally inadequate • Possible to imminent failure or threat to public safety.
Not Rated	<p><u>Action Indicated:</u> No Action.</p> <p><u>Condition:</u></p> <ul style="list-style-type: none"> • 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 Structures

CMP

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

Plastic

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

Choose **ONE** rating list based on material

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.

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

CMP

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.



Choose **ONE** rating list based on material

Plastic

- 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.	<p>Transverse cracking: low severity (less than 0.25 inches in width)</p> <p>Sags or humps: low severity (less than 2 inches over 10 feet) over culvert barrel</p>	<p>Transverse cracking: medium severity (up to 0.5 inches in width)</p> <p>Sags or humps: medium severity (up to 4 inches over 10 feet) over culvert barrel</p> <p>Rutting in wheel path: localized over culvert/storm drain</p> <p>Patching: evidence of repeated patching</p>	<p>Transverse cracking: high severity (greater than 0.5 inches in width with pavement raveling over culvert)</p> <p>Longitudinal cracking: high severity (greater than 0.5 inches in width with pavement raveling over culvert)</p> <p>Sags or humps: high severity with voids beneath pavement</p>

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

2021 UPDATES TO ROADSOFT CULVERT MODULE

REFERENCES

AASHTO. 2020. *CULVERT & STORM DRAIN SYSTEM INSPECTION GUIDE*, AMERICAN ASSOCIATION OF STATE HIGHWAY TRANSPORTATION OFFICIALS (AASHTO).

AVAILABLE FOR PURCHASE:

[HTTPS://STORE.TRANSPORTATION.ORG/ITEM/COLLECTIONDETAIL?ID=213](https://store.transportation.org/item/collectiondetail?id=213)

MDOT. 2017. *MICHIGAN STRUCTURE INSPECTION MANUAL (MISIM)*. MICHIGAN DEPARTMENT OF TRANSPORTATION (MDOT). [AVAILABLE FROM:

[HTTPS://WWW.MICHIGAN.GOV/MDOT/0,4616,7-151-9625_24768_24773-326737-,00.HTML](https://www.michigan.gov/mdot/0,4616,7-151-9625_24768_24773-326737-,00.html)]