ASSET COLLECTION & CONDITION ASSESSMENT GUIDE FOR 1’- <10’ SPAN CULVERTS

September, 2016

Revised:

XX.XX.XX

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INTRODUCTION

In 2015 the Michigan Department of Transportation (MDOT) initiated TAMS (Transportation Asset Management System). MDOT's TAMS takes a GIS centric approach to asset management requiring spatial data collection by asset type. The asset information is used to drive maintenance management and decision making.

Prior to the initiation of TAMS, only culverts with a span of 10 and larger were inventoried and regularly inspected. These culverts are inventoried as part of the NBIS (National Bridge Information System) and have inspections set up according to NBIS standards.

The TAMS process inventories and establishes a monitoring protocol for smaller culverts than those inventoried in the NBIS. Culverts with spans between 1' and less than 10' will fall under the guidelines of the TAMS process for inspection, rating, and asset inventory. This manual provides the various asset attributes to be collected for culverts, proper coding of the various attributes, and how to rate a culverts condition at the time of installation or inspection. This information will then be used to plan maintenance activities at individual culverts and along road corridors.

Attribute collection guidance is provided in this manual. The guidance covers how specific asset attributes are to be recorded for type, size, and location of culvert assets. A second guide in this manual will assist with developing an overall condition rating for the asset. The coding guide was taken from FHWA's Culvert Inspection Manual and is intended to provide a systematic review of the asset attributes so that a consistent approach to culvert condition rating will be applied statewide.

GENERAL COLLECTION INFORMATION

APPROACH

To initially populate the TAMS system, asset and attribute collection will normally be done in a two-stage process. The first stage requires the location of the asset (culvert) geospatially using approved data collector. Each region will train at least one Region collection crew to register the location information of the culverts in their area of responsibility. Data collected by the initial survey crew will include geo-locating each end of the culvert and include type, size, location, and site attributes.

The second stage of the process involves a crew (can be 1 person) to collect the required condition attribute information of the culvert. These attributes include information on deterioration, deformation, joint stability, scour protection, and other attributes. These attributes will be collected using the Vueworks software following methods promoted by the TAMS collection methods team. The crew must be trained in the use, operation, and data collection requirements prior to any field data collection. Once the condition attributes have been collected, Vueworks will calculate an overall condition rating for the asset.

Culverts that are replaced or modified as part of a construction project will have the geo-location and condition attribute information collected by the same crews once final acceptance of the project occurs.

In the event that a culvert is discovered that is not included in the TAMS system, the region collection crew should be contacted to collect the geospatial and attribute information into the system. Once the culvert type, size, and location information has been collected, it should be scheduled for a condition assessment.

LIMITS

Culvert assets that convey water through or along the MDOT ROW with a span between 1' and less than 10' will be collected as part of the TAMS process. Culverts 10' and larger are collected and inspected based on FHWA NBIS criteria and are not part of this effort. Storm sewer outfalls are not collected under the culvert asset collection criteria.

Culverts with spans outside of the recommendations above can still be collected and included in each regions data collection process. If a particular region chooses to collect data on culverts outside of the TAMS requirements (or collect data on any other feature not included in the initial TAMS asset collection), data collection and attribute information should follow the guidelines listed in this document. It should be noted that culverts 10' and larger will fall under the inspection requirements of the NBI system and not the schedule recommended in this document

It should be noted that ratings generated for culverts are based on specific TAMS asset attributes. There are other attributes that are not part of the TAMS data collection that could lead to further work at a given location. Inspection crews that identify potential issues that are not covered by TAMS data collection should notify the Region Engineer. The Region Engineer should then determine what work needs to be done, choose an appropriate schedule for the work, and notify any specialty areas (i.e. Hydraulics, Geotechnical, etc.) of the upcoming work.

During the condition assessment data collection, sites may be identified where the fix would be considered more than just maintenance. These cases should be directed to the Region Engineer so that a project can be programmed for the required work.

RECOMMENDED FREQUENCY OF COLLECTION

It is recommended that asset data be collected after initial construction or during any reconstruction or maintenance to the asset. Culverts that meet the TAMS data collection criteria will be inspected according to the following recommendations as a result of the inspection.

Condition rating 8 - 9, continue with a 5 year inspection cycle.

Condition rating 6-7, inspect on a 2 year cycle if not in current year maintenance program.

Condition rating 5, inspect on annual cycle if not in current year maintenance program.

Condition rating 1 through 4, road closure imminent, repairs must be scheduled.

RESOURCE REQUIREMENTS

PERSONNEL

A properly outfitted crew of 1 or 2 people, depending on experience, is needed to perform field data collection. Staff should be familiar with this document before attempting to collect asset attribute information. Each region can determine who will be doing data collection, however, students are discouraged from being the primary field collection resource and Civil Service rules prohibit the use of Co-Ops for data collection

INSPECTION EQUIPMENT

The following equipment is required:

- Measuring tools, hand tools
- Approved data collection device
- Flashlight
- Safety equipment, including PPE
- Properly sized waders
- Stability pole

SAFETY PRECAUTIONS

GENERAL SAFETY PRECAUTIONS

- Ensure safe practices are utilized while performing all inventory collection and condition assessment field activities. All work must comply with MDOT, OSHA and MiOSHA procedures and regulations.
- Ensure that proper personal protective equipment (PPE) is used in accordance with MDOT's Personal Protective Equipment Policy – Guidance Document 10118. http://mdotcfintra.state.mi.us/interchange/guidocs/files/10118.pdf
- Ensure that safe practices are followed according to Michigan Manual of Uniform Traffic Control Devices http://mdotcf.state.mi.us/public/tands/plans.cfm and the Work Zone Safety and Mobility Manual http://www.michigan.gov/documents/mdot/MDOT_WorkZoneSafetyAndMobilityManual_233891_7.pdf

ADDITIONAL SAFETY CONSIDERATIONS

Culverts can be considered confined spaces and should not be entered unless the individual or individuals collecting the asset data on the culvert have completed confined space entry training.

Asset collection and rating should not be performed during times of high flows. High flows can easily sweep an individual off of their feet or contain debris, both seen and unseen, that can create a very dangerous situation for anyone collecting asset information.

Asset collection requires information to be collected at each end of a culvert. The crew performing this task may have to deal with live traffic situations with no traffic control. Great care must be exercised every time the crew exposes themselves to live traffic.

FIELD ATTRIBUTE COLLECTION PROCEDURE

Field collection must be done in an orderly process. Staff collecting attributes should collect all pertinent data at one end of the culvert before proceeding to the opposite end of the culvert or a different culvert along the route. Collecting attribute data requires close inspection of the exterior of the culvert, road embankment and road itself. Staff collecting data should also look into the culvert to see if there are any issues with separation, sedimentation, and material and/or shape changes.

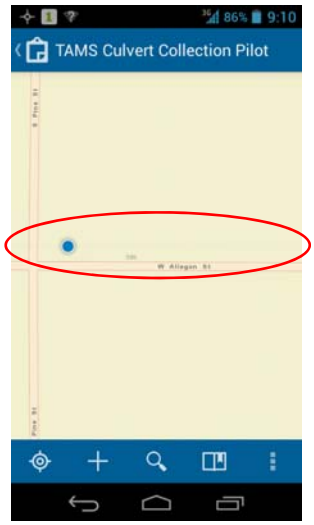
Attribute data should be collected at installation, during routine inspections, and after any maintenance has been completed.

GEOSPATIALLY LOCATING DATA IN THE FIELD

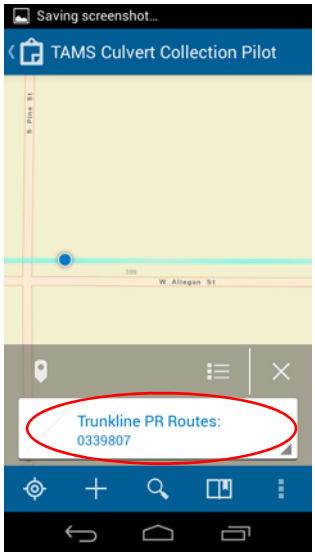
COLLECTING NEW CULVERT LINE AND CULVERT END ATTRIBUTES

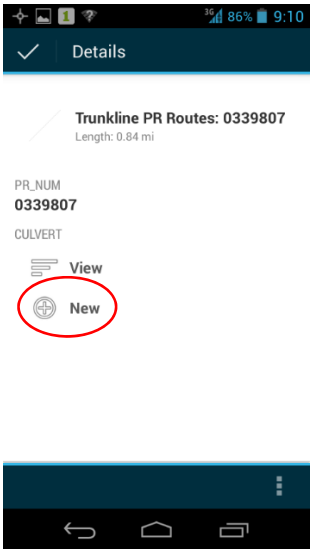
**Images and steps listed below are in reference to Collector for ArcGIS using a Leica Zeno 20 running Android mobile operating system. <u>The use of "streaming" is not permitted for geospatial location of culvert lines</u>- the field crew must shoot an individual point at each culvert end.*

Select your PR based on your location and the road your culvert is located on. It will become a cyan color when selected.

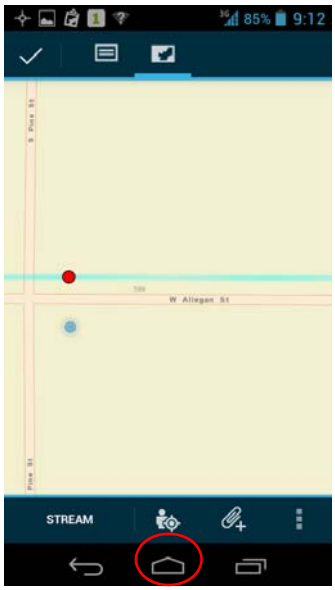


- Click on the white box at the bottom of your screen then select new

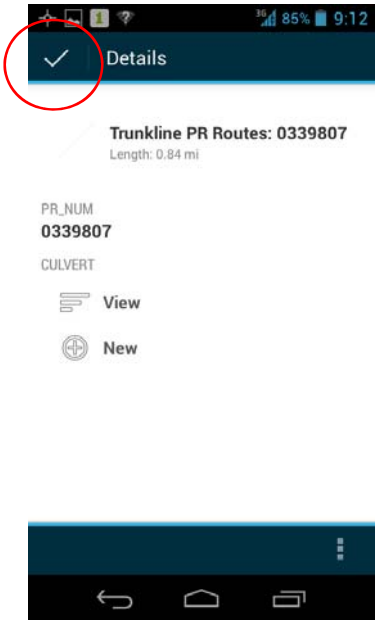


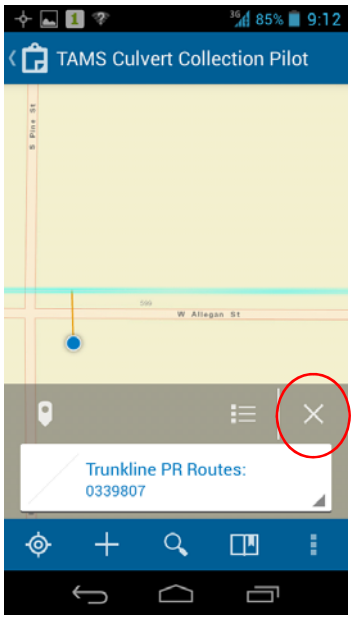


- Populate the attribute data using drop downs. The “PR number” is an auto generated number and will already have a value. Once all fields are filled hit the GPS button on the bottom of your screen to take a shot while standing over the culvert end. The shot will be instant and will not count down or make a noise when it is stored. You can also click on the map icon at the top of your screen to change to a map view (optional).

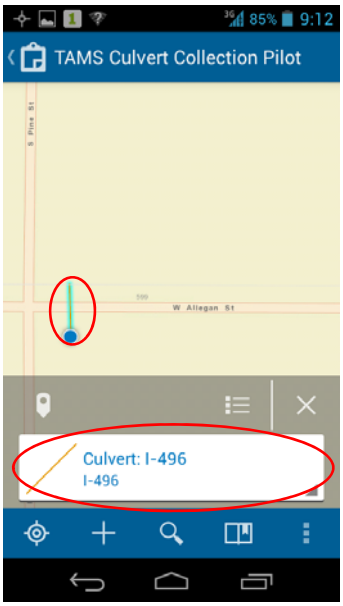


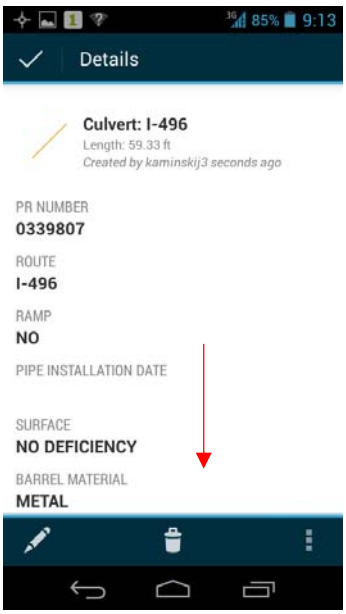
- Walk to the other culvert end and while standing over it click the GPS button again. Click the check mark icon at the top left corner of your screen to save your points and create a line. To save your line you must have two points. If you receive an error check your map to verify both shots were stored. Re-shoot points if needed to store the culvert line. After clicking the check mark click the “X” to de-select the current PR route.

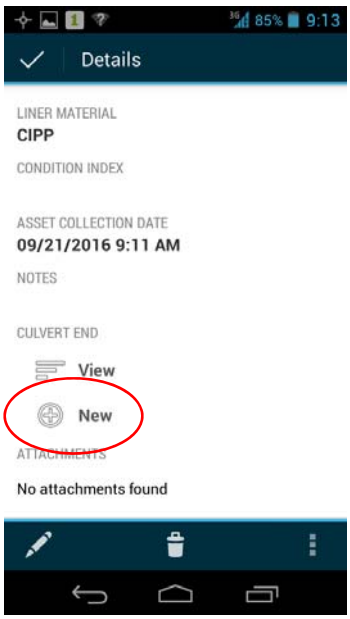




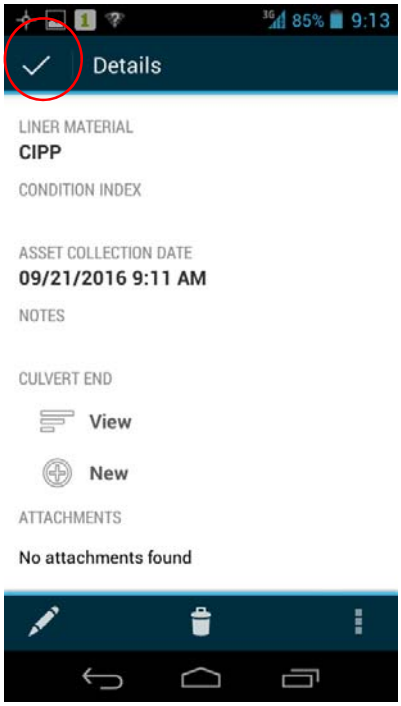
- To record attribute information for each culvert end select the culvert line you created in the previous steps. Click on the white box at the bottom of your screen then scroll to the bottom of the page and select new for culvert ends







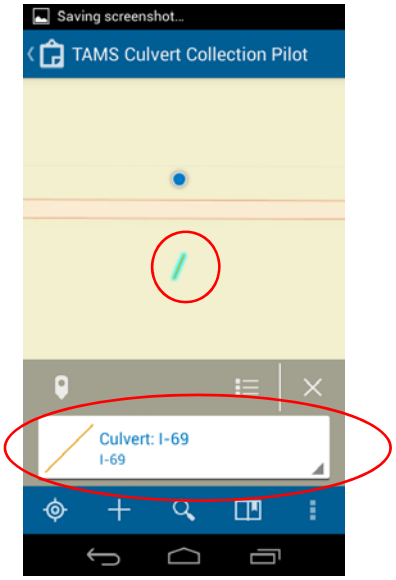
- Populate attribute data for each end. To save the data when finished click the check mark in the top left corner of the screen



EDITING AN EXISTING CULVERT LINE AND CULVERT END ATTRIBUTES

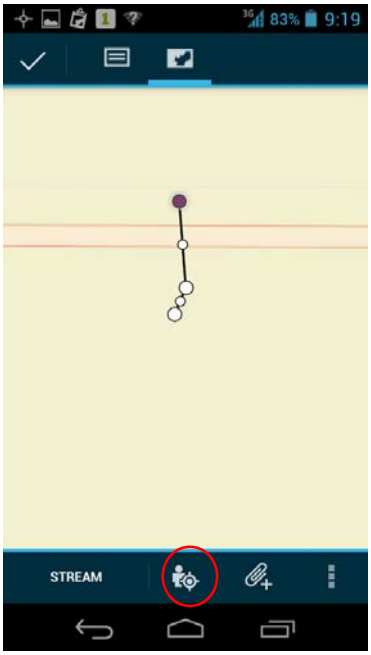
Some instances with heavy traffic do not allow the field crew to safely collect each end of the culvert at the same time. In these situations it is recommended to collect one end of the culvert then walk approximately on line with the culvert to the edge of shoulder and take a GPS shot here to create a temporary line. A line cannot be left "open" in Collector for ArcGIS so a temporary line is used and edited later to correct its end point. After creating your temporary line create a new culvert end and populate its attributes for the correct end you are at. The steps listed below are to edit an existing temporary line.

- Select the line you want to edit then click on the white box at the bottom of the screen

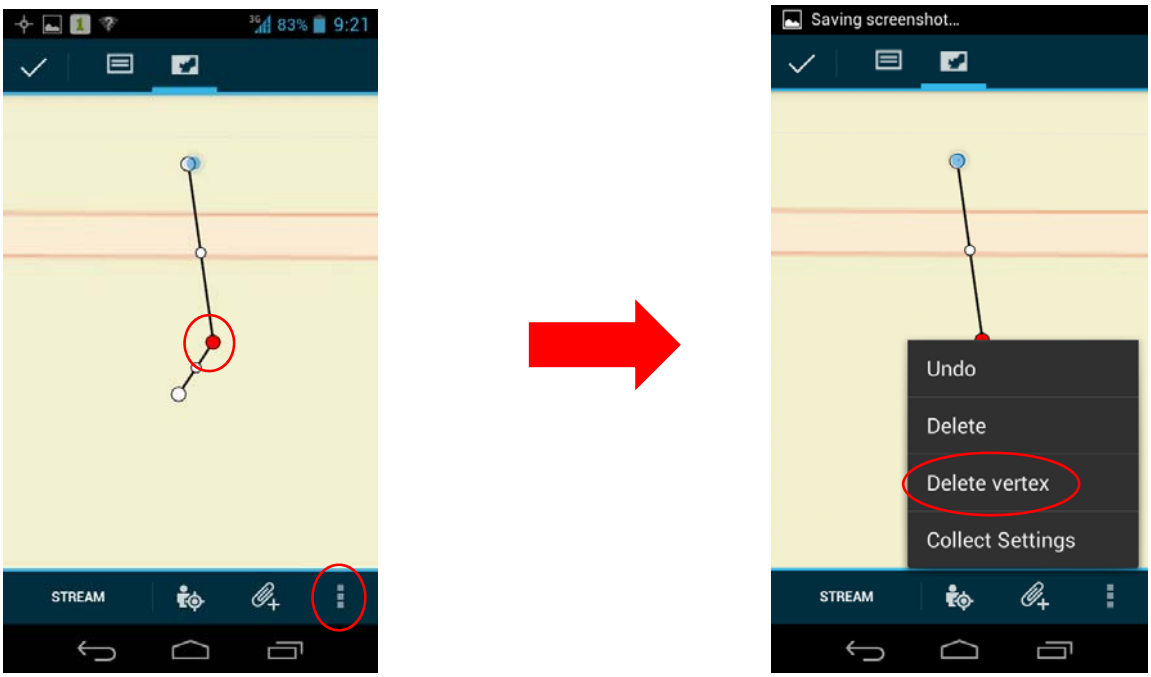


- Click on the edit button in the lower left corner of the screen then switch to the map view by clicking the map icon at the top of your screen.

- Standing over the remaining needed culvert end click the GPS button to extend the existing temporary culvert line. Although you do not need to be in the map view to perform this operation, it helps to visually see the line is drawn.



- With the extended line still active for editing click on vertex needing to be removed which will allow for a straight line then click the 3 vertical dots in the bottom right corner of the screen and select delete vertex



- You will still need to add the new culvert end and populate the attribute data. Click the check box in the top left corner of your screen to save your changes

OFFICE

QA/QC USING ARCGIS ONLINE

To ensure proper QA/QC, utilize ArcGIS Online (AGO) to review the geospatially located features. Although it is not expected to review each culvert collected in the office spot, checking and scanning will prevent mistakes and return visits for missing information. All actions available to the user in the office on AGO are also available to the user in the field inside the Collector for ArcGIS application. Items to pay attention to in AGO include but are not limited to:

- Line completeness
- Were any edits missed in the field for deleting vertices?
- Is there missing attribute information for culvert lines or culvert ends?

Office procedures to upload and review data, along with quality control and quality assurance should follow best practices as outlined by collection methods team.

DATA COLLECTION REQUIREMENTS

DATA ORGANIZATION

Data organization for all MDOT asset data will adhere to the following high level organization and order (Location, Asset, and Condition – LAC): Location and Asset information for culverts will be collected using prescribed data collection tools. Condition of the culvert will be collected using the Vueworks software.

Unique Identifier	**Location**	**Asset**	**Condition**

Culvert data will be split into two primary layers: Barrel Attributes and End Attributes. Barrel attributes will be a line layer and will be the primary layer. Barrel End Attributes will be stored in a table as records and are linked to the Barrel Line feature.

The unique identifiers for the Barrel Line and Barrel Ends will be an auto-generated GUID's created at the time of collection by the GIS tools.

Unique ID's for the Barrel Group ID field will not be auto-generated and must be inputted by the data collector where applicable. The methodology for creating this ID is described below.

Barrel Attributes					
General	**Field**	**Field Description**	**Format**	**Field Options**	**Notes**
Unique ID					
	GlobalID	This ID will be created for each barrel	GUID (Auto gen)	GUID	Alias will be Barrel ID
	CulvertGroupId	Smart-Key 2 digit county (Appendix B) 3 digit route 2 digit sequential.	Concatenated Smart-Key		Example: 3rd culvert group location in Ingham county on I-96 would be 3309603.
Location					
	Route	M (state route), I (interstate), US (United States), SL (state lands), RA (rest area) or FL (federal lands).	Pick from list	This list will have all I, M and US routes	
	Beneath		Pick from List	Mainline, Ramp, Service Drive, Driveway	

Barrel Attributes (Continued)					
General	**Field**	**Field Description**	**Format**	**Field Options**	**Notes**
Asset					
	CulvertInstallationDate		Date		If installation date is unknown, enter 1900.
	AssetCollectionDate	Automatically populated through GIS	Date		
	CulvertMaterial		Pick from list	Metal, Concrete, Plastic	
	CulvertShape		Pick from list	Circular, Horizontal Elliptical, Vertical Elliptical, Arch, 3-sided (footings), 4-sided	
	CulvertHeight (in)		Numeric		
	CulvertWidth (in)		Numeric		
	Liner		Y/N		
	DepthOfCover	Amount of fill above top of barrel.	Y/N		
	LinerMaterial		Pick from list	Plastic (smooth), Plastic (Corrugated), CIPP	
	LinerDiameter (in)		Numeric		
	SpatialQualityIndex		Pick from List	*A, B, C, D, E.*	*See Appendix A for index definitions*
Condition					
	OverallCondition		Condition Rating 9-1		Calculated and pushed from Vueworks

End Attributes					
	Field	**Field Description**	**Format**	**Field Options**	**Notes**
Unique ID					
	CulvertId	This will auto populate from the related Feature Class	GUID	GUID	Field Related to Barrel GlobalID
	GlobalID	Each barrel will have two ends to record information.	GUID	GUID	Alias EndID
Asset					
	EndSection		Pick from List	None Headwall HW w wing Beveled Sloped Flared Mitered	
	EndSectionMaterial		Pick from List	Metal Concrete Clay Plastic	
	InvertAboveChannel Bottom		Y/N		
	Riprap		Y/N		
	SafetyGrate		Y/N		Default No
	EndExtension		Y/N		Default No
	ExtensionMaterialSameAs OriginalCulvert		Y/N	Yes, No, NA	
	ExtensionShapeSameAs OriginalCulvert		Y/N	Yes, No, NA	
	ExtensionDimensionsSame AsOriginalCulvert		Y/N	Yes, No, NA	

ATTRIBUTE COLLECTION GUIDANCE

Each Culvert Barrel, Box, or Pipe should be collected as a single culvert with corresponding culvert ends.

Data is to be collected at each end of a culvert. Cardinal directions shall be used to define how to choose culvert end 1 and culvert end 2. Culvert end 1 shall be the end on the south or west side of the road. End 2 shall be on the north or east side of the road. At locations that do not follow true cardinal directions, the signed direction of the road shall be the basis of determining north, south, east, and west.

- *GlobalId* - A unique auto-generated GUID for each barrel.

- *CulvertGroupId – Enter the* site identification of a culvert group location (for multiple culvert locations only). See appendix B for county code index to use along with route id and group number. Culverts that are separated by less than 10' of earthen fill, even if they share a common headwall, would be considered multiple culverts. - Pay close attention that a twin opening culvert could be considered a single culvert with 2 barrels. If a structural member splits the culvert, then it would be considered a single culvert with multiple barrels.

Example of a single culvert with 2 barrels (collect each barrel separately)

Examples of multiple culverts

- *Route - Pick route name from field list*.

- *Beneath* – Pick what the culvert is beneath from the pick list.

- *CulvertInstallationDate* – Year culvert was installed. Culvert installation dates should be entered into the system upon acceptance of work by the project manager. During initial data collection, installation dates should be taken from design plans. If no plans are available or if the culvert in the field does not match what's detailed on the plans, an installation year of 1900 shall be used.

- *AssetCollectionDate* – Actual date of collection (MM, DD, YYYY)

- *CulvertMaterial* – Culvert material selections include metal, concrete, plastic, and clay (rarely)

Example of metal culvert

Example of concrete culvert

Example of plastic culverts

- *CulvertShape* – Culverts can come in a variety of shapes including circular, horizontal elliptical, vertical elliptical, arch, 3-sided (footings), 4-sided. The culvert shape attribute should describe the main culvert under the road and not an extension (if any).

Circular culvert

Horizontal ellipse (vertical ellipse would have axis rotated 90 degrees)

Arch culvert

Box culvert (has poured bottom)

3-sided (no floor in culvert)

- *CulvertHeight* – The vertical measurement (top of the pipe to the bottom of the pipe or natural bottom if in a 3-sided culvert) in inches. Measurement should reflect the interior dimension of the culvert. Height and width are the same for circular culverts.

- *CulvertWidth* – The horizontal measurement of the culvert in inches. Measurement should reflect the interior dimension of the culvert. Height and width are the same for circular culverts.

- *Liner – Has culvert been lined in the past?* If so, choose "yes". Typically, pipes are lined using a smaller plastic pipe inserted into a larger pipe or a cured in place liner is used.

- *LinerMaterial* – If Culvert Liner attribute is "yes", choose liner material. Materials are typically plastic or a cured in place liner. Plastic liners inserted in a pipe should be listed as smooth or corrugated based on their interior.

Concrete culvert with plastic liner

Cured in place (CIPP) liner

- *LinerDiameter* –Measurement should reflect the interior dimension of the culvert. Height and width are the same for circular culverts.

- *DepthOfCover* – This attribute relates to the amount of fill over a culvert. If distance from the road surface to the top of culvert is 5' or more, choose "Yes" for this attribute.

Depth of cover <5'

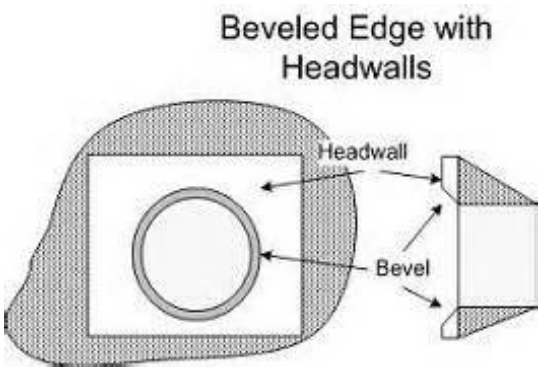
- *End ID (Alias)* – GlobalID GUID linked to barrel

- *EndSection* – None, Headwall, Headwall w/ wingwalls, Beveled, sloped, flared, or mitered

None

Headwall

Headwall with wingwalls



Beveled (Concrete only) – hand formed 45 degree angle between culvert and headwall

Flared end section

Mitered end

- *EndSectionMaterial* - List end section material. Choices include Metal, Concrete, Clay, Plastic, None

Metal end section *Concrete end section*

Plastic end section *No end section*

- *InvertAboveChannelBottom* – is invert of end above the channel bottom, yes or no

- *SafetyGrate* – Is there a safety grate on either end of the culvert. If so, choose “yes”.

Examples of safety grates on culverts

- *EndExtended* – Has the original culvert been extended, yes or no

Example of culvert that has been extended multiple times (note different material and shape of current outlet when compared to the existing culvert).

- *ExtensionMaterialSameAsOriginalCulvert* – If culvert has been extended, does the extension material match the original culvert material?

- *ExtensionDimensionsSameAsOriginalCulvert* – If the culvert has been extended, do the interior dimensions of the extension match those of the original culvert?

- *ExtensionShapeSameAsOriginalCulvert* – See “End 1 Extension shape same as original culvert” attribute above.

- *SpatialQualityIndex* – A, B, C, D, E. Refer to Appendix A for values.

LOCATION INFORMATION REQUIREMENTS & GUIDANCE

The default linear referencing for business viewing is control section milepoint. It is understood that TAMS will also reference PR and route milepoints, and users should have the ability to view those milepoints as well.

ELEVATION

Elevation Data is not required for business purposes and is not part of the field collection process. When defined by business area, the elevation value of the asset, expressed in units of international feet to the decimal value appropriate to the capable precision of the collection method utilized. The values are relative to the North American Vertical Datum of 1988 (NAVD 88).

Format: XXX.XX Example: 743.14

COLLECTION METHOD

Collection methods shall be at the direction of the TAMS collection methods team, in order to collect required information. This manual serves as a guide for noting the attributes to be collected but it will be up to each collection team to determine the most effective way of collecting asset attributes.

SPATIAL QUALITY INDEX

Mapping grade (Level C) is sufficient for culvert business purposes. This entails sub-meter accuracy levels for XY elements, typically achieved with corrected mapping graded (handheld) GPS collection procedures. Levels A and B are also acceptable.

CULVERT CONDITION ASSESSMENT GUIDANCE

The following scale will be used to rate the overall operational status of a culvert as well as indicate actions needed for repair. The overall asset rating will be generated by the Vueworks software and is based on the individual condition attribute ratings. The rating will be stored both in Vueworks and in the GIS spatial data tables.

Culvert Condition Rating

9 – No repairs needed
8 – No repairs needed, list specific items for special inspection during next regular inspection
7 – No immediate plan for repair; examine possibility of increased level of inspection
6 – By end of next season; add to work schedule
5 – Place in current schedule/current season/first reasonable opportunity
4 – Priority, current season; review work plan for relative priority, adjust schedule if possible
3 – High priority; current season as soon as can be scheduled
2 – Highest Priority; discontinue other work if required, emergency basis
1 – Emergency action required; re-route traffic and close

CONDITION ASSESSMENT - FIELD ATTRIBUTE COLLECTION PROCEDURE

Field collection must be done in an orderly process. Staff collecting attributes should collect all pertinent data at one end of the culvert before proceeding to the opposite end of the culvert or a different culvert along the route. Collecting condition attribute data requires close inspection of the interior and exterior of the culvert, road embankment and road itself.

CULVERT CONDITION RATINGS

Vueworks will create an overall condition rating for each culvert based on the appropriate condition attributes in Table 1. Some attributes are specific to a particular culvert material or installation and may not be included in the overall rating calculation.

Any condition assessment that has a value of 3 or less will automatically cause the overall condition rating to default to that minimum rating.

Table 1: Condition Attributes and Rating Scale				
Attribute	**Good** **9-8**	**Fair** **7-6**	**Poor** **5-4**	**Critical** **3-1**
Invert Deterioration (Metal)	Little or no surface rust or coating loss	General corrosion, scaling, or pitting but significant remaining metal section.	Perforations visible or easily made by hammer test strike.	Significant section loss in invert beyond perforations resulting in voids beneath invert and/or roadway/embankment damage.
Invert Deterioration (Concrete)	Little or no abrasion with aggregate exposed.	Moderate abrasion and scaling with minor aggregate loss. No exposure of reinforcement.	Heavy abrasion and scaling with exposed reinforcement.	Holes or section loss with voids beneath and roadway/embankment damage.
Joints	No gaps	Open with minor infil/exfil of water and/or soil	Open or displaced with significant infil/exfil of soil and water. Voids visible	Open or displaced with significant infiltration of soil with accompanying roadway damage.
Section Deformation	None	Slight, perceptible deformation or local bulging	Deformation with longitudinal cracking or crushing in crown, invert, or spring lines.	Excessive deformation resulting in extensive infiltration of soil with roadway/embankment damage.
Corrosion (Metal)	Little or no surface rust or coating loss	Minor surface rust and limited pitting	Perforations visible or easily made, connection hardware failing	Significant section loss resulting in extensive infiltration of soil with roadway/embankment damage.
Corrosion (Concrete)	Little to no efflorescence	Minor cracking and spalling.	Exposed reinforcement	Significant section loss of steel reinforcement that causes pipe deformation, holes, and embankment/roadway damage.
Road over	Same condition as initial placement	Minor cracking along culvert all or part of culvert length.	Multiple patches applied to area over culvert.	Significant damage to road surface where failure is imminent or has occurred.

Table 1: Condition Attributes and Rating Scale (Continued)				
Attribute	**Good** **9-8**	**Fair** **7-6**	**Poor** **5-4**	**Critical** **3-1**
End Section	No undermining	Minor undermining	Broken, Crushed or separated from barrel.	Deterioration is affecting performance or causing roadway/embankment damage.
Apron	No cracking or undermining.	Minor cracking but no undermining.	Significant cracking over >50% of apron or significant undermining.	Partially or totally collapsed causing roadway/embankment damage.
Scour Present	Stream width consistent with culvert inlet/outlet.	Stream has minor widening at culvert inlet/outlet	Stream significantly wider at culvert inlet/outlet. Minor local erosion of streambanks.	Stream significantly wider at culvert inlet/outlet. Stream banks showing significant erosion.
Scour Protection *	Same condition as initial placement	Some material has moved off site but no damage to structure or embankment.	Material section loss is evident. Minor damage to structure or embankment.	Material has deteriorated or moved off site. Significant damage to road embankment or structure.
Sediment **	Same condition as initial placement	Additional material has moved into culvert but does not exceed 20% of rise.	Sediment exceeds 20% but is less than 50% of rise.	Sediment significantly impacting the capacity of the culvert.
Invert Location	Same location as initial placement.	Culvert inlet/outlet is above channel invert by less than 4".	Culvert inlet/outlet is above the channel invert by 6" with water dropping into pool below. Blocks some organism passage.	Culvert significantly above channel invert with water freefalling into pool below. Blocks most organism passage and significant damage to road or embankment occurring.

Table 1: Condition Attributes and Rating Scale (Continued)				
Attribute	**Good** **9-8**	**Fair** **7-6**	**Poor** **5-4**	**Critical** **3-1**
Embankment	Same as initial construction	Minor depressions in embankment but not under road.	Notable depressions in or active erosion of the embankment. Road is being threatened.	Failure of embankment has occurred or is imminent.
Footing Exposed?	Footing not visible.			Footing exposed. Undermining possible.

* This rating is specific to riprap. If other scour protection material is used, new criteria need to be developed.
** Some culverts are intentionally recessed. Check plans to verify culvert invert and stream flowlines.

ATTRIBUTE FIELDS

The following condition attributes determine the overall condition rating for the asset. Not all attributes apply to every culvert. Most attributes have a selection criteria based on a scale from 9-1 with 9 being good condition to 1 being at or near failure. However, the "Footing Exposed" attribute is limited in its condition ratings and essentially act as pass/fail rating.

If there are any questions on how to rate a particular structure condition attribute, contact the Hydraulics Unit for further assistance.

Culvert Condition Assessment Attributes (Vueworks)				
Field	**Field Description**	**Format**	**Field Options**	**Notes**
(Metal) Invert Deterioration		Condition Rating 9-1	Selection 9-1	
(Conc) Invert Deterioration		Condition Rating 9-1	Selection 9-1	
Joints		Condition Rating 9-1	Selection 9-1	
Section Deformation		Condition Rating 9-1	Selection 9-1	
(Metal) Corrosion		Condition Rating 9-1	Selection 9-1	
(Conc) Corrosion		Condition Rating 9-1	Selection 9-1	
Road Condition Above		Condition Rating 9-1	Selection 9-1	
End Section 1		Condition Rating 9-1	Selection 9-1	
End Section 2		Condition Rating 9-1	Selection 9-1	
Apron 1		Condition Rating 9-1	Selection 9-1	
Apron 2		Condition Rating 9-1	Selection 9-1	
Scour		Condition Rating 9-1	Selection 9-1	
Scour Protection		Condition Rating 9-1	Selection 9-1	
Sediment		Condition Rating 9-1	Selection 9-1	
Invert Location		Condition Rating 9-1	Selection 9-1	
Embankment		Condition Rating 9-1	Selection 9-1	
FootingExposed		Condition Rating 9 or 3	Selection 9 or 3	*only for 3-sided culverts*

CONDITION DESCRIPTION & EXAMPLES

The following pictures illustrate how to code many of the condition attributes. More will be added as pictures become available.

- *Invert Deterioration (Metal)* – Examples

Condition rating 7 or less

Condition rating 2 or less

- *Invert Deterioration (Concrete)* – Images pending.

- *Joints* – Condition of joints throughout culvert.

Joint separation in culvert- condition rating of 3

- *Section Deformation* - Examples

Condition rating 6 or less

Slab culvert with failed wall
Condition rating 3 or less

- *Corrosion (Metal)* - Examples

Significant rust with section loss
Condition rating 3 or less

- *Corrosion (Concrete)* – Images pending

- *Road Over* - Condition of surface directly above culvert asset.

Condition rating: 9 *Condition rating: 6 or 7*

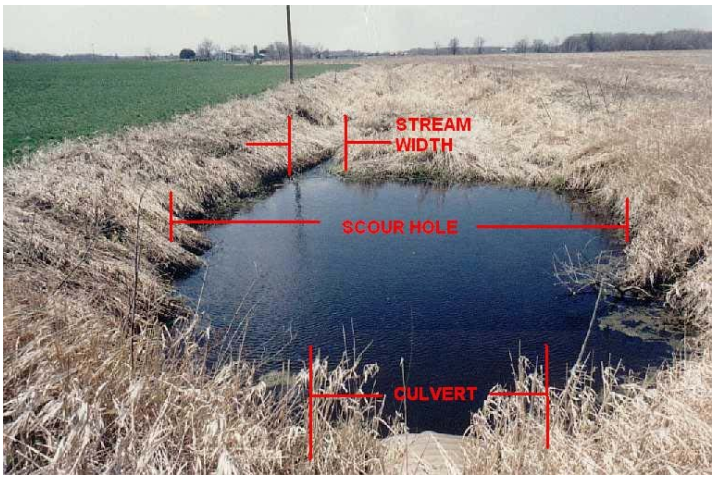
Condition rating: 1

- *End Section (1 or 2)* – Is the end section detached from the culvert? A Yes" value defaults the condition rating to 3.

Detached end section- condition rating of 3.

- *Apron (1 or 2)* –Images pending

- *Scour* – Scour results in perched culverts (culvert invert above the channel bottom) and plunge pools downstream of the culvert. Both are caused by erosive velocities. If scour is present at either end of the culvert, choose condition rating for worst side.



Plunge pool at culvert outlet. Note the channel width immediately downstream of the culvert compared to the actual stream width – condition rating of 5 or less

- *Scour Protection* - Use condition rating guide and rate 1-9. Example ratings are as follows:

Riprap condition rating of 9.
Riprap in same condition as initial placement

Riprap condition rating of 5 or less (poor material, non-interlocking, only 1 layer remaining).

Riprap condition rating of 3 or less
(Material has failed, significant loss of embankment).

- *Sediment* - % Blockage is based on total height of culvert and depth of sediment (excluding any designed recess).

Sediment blocking more than 50% of culvert depth –condition rating of 3 or less

- *Invert Location* – This attribute indicates whether a culvert is perched or not. Perched culvert inverts are above the elevation of the channel invert. This condition is usually more prevalent at the outlet end of the culvert.

Perched culvert (culvert invert above channel invert) – condition rating of 3 or less

- *Footing Exposed* - This field only applies to 3-sided culverts. If the footings are not visible, rate as a 9. If the footing can be seen, rate as a 3.

Footings significantly exposed – condition rating 3.

- *Embankment Condition* – Examine condition of embankment from top of culvert(s) to the road surface.

Embankment in same condition as design - condition rating of 8 or higher.

Depressions forming above twin culverts - condition rating of 6 or less.

Embankment has failed is affecting traffic - condition rating of 2 or less.

DEFINITIONS

Cover – The amount of earthen fill above the culvert. Measured from top of road surface to top of culvert.

Culvert Extensions – adding additional length to a previously placed culvert. Extensions may or may not be the same material or shape as the originally constructed culvert.

Invert – The lowest interior point of a culvert, excluding any sediment.

Flow Line – The lowest point at which water flows through a culvert. It can be located at the culvert invert (if not recessed) or at the top of the sediment elevation.

Perch – When the culvert invert is above the natural channel bottom elevation.

Recess – The amount of depth the culvert invert is below the natural channel.

Sediment – Soil that has naturally accumulated within a culvert. Some culverts on natural streams are designed to retain a small amount of sediment to provide a natural channel bottom for aquatic organisms.

Streaming – A method of collecting points at a pre-determined time interval or distance between observations.

Wingwall / End Section / Headwall - The structures at the inlet and/or outlet of a culvert. Usually placed to retain road embankment and provide hydraulic efficiency to a culvert.

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FAQS

APPENDICIES

APPENDIX A: SPATIAL QUALITY INDEX – OPTIONS

Index	Equivalent	Definition
A	Survey Grade – 3D	**Sub centimeter accuracy levels for XYZ elements**, typically achieved by utilizing field Survey grade collection procedures or "1A" LiDAR. Also applies to assets harvested from CAD engineering drawings. Data acceptable for engineering uses provided it is validated before use.
B	Survey Grade – 2D	**Sub-centimeter accuracy levels for XY elements**, typically achieved by utilizing field GPS – Survey Grade collection procedures or "2B" trajectory processed LiDAR without control.
C	Mapping Grade	**Sub-meter accuracy levels for XY elements**, typically achieved with corrected mapping graded (handheld) GPS collection procedures *(generally acceptable for maintenance operations)*.
D	Informational	**Decimeter** accuracy levels typically achieved by digitizing from orthophotos or other rectified imagery.
E	Unknown	

MDOT County Code List

(8-16-2016)

COUNTY	NO.	COUNTY	NO.	COUNTY	NO.
Alcona	01	Gratiot	29	Missaukee	57
Alger	02	Hillsdale	30	Monroe	58
Allegan	03	Houghton	31	Montcalm	59
Alpena	04	Huron	32	Montmorency	60
Antrim	05	Ingham	33	Muskegon	61
Arenac	06	Ionia	34	Newaygo	62
Baraga	07	Iosco	35	Oakland	63
Barry	08	Iron	36	Oceana	64
Bay	09	Isabella	37	Ogemaw	65
Benzie	10	Jackson	38	Ontonagon	66
Berrien	11	Kalamazoo	39	Osceola	67
Branch	12	Kalkaska	40	Oscoda	68
Calhoun	13	Kent	41	Otsego	69
Cass	14	Keweenaw	42	Ottawa	70
Charlevoix	15	Lake	43	Presque Isle	71
Cheboygan	16	Lapeer	44	Roscommon	72
Chippewa	17	Leelanau	45	Saginaw	73
Clare	18	Lenawee	46	Sanilac	74
Clinton	19	Livingston	47	Schoolcraft	75
Crawford	20	Luce	48	Shiawassee	76
Delta	21	Mackinac	49	St. Clair	77
Dickinson	22	Macomb	50	St. Joseph	78
Eaton	23	Manistee	51	Tuscola	79
Emmet	24	Marquette	52	Van Buren	80
Genesee	25	Mason	53	Washtenaw	81
Gladwin	26	Mecosta	54	Wayne	82
Gogebic	27	Menominee	55	Wexford	83
Grand Traverse	28	Midland	56		