HydInfra Inspection Manual

Culvert and Storm Drainage Systems

Condition Rating Codes

Like new	1	Excellent – like new condition
Still okay	2	Fair – some wear, but structurally sound
Fix in project	3	Poor – deteriorated, consider for repair or replacement
Fix it sooner	4	Severe – serious deterioration
Unknown	0	Not able to rate, not visible

Notes:

- This guide is used to rate the condition of storm drainage system assets, including culverts where the pipe (or installations of more than one pipe) is less than 10 feet wide as measured along the centerline of roadway.
- The worst defect found in an asset determines its condition rating. (Refer to inspection criteria on pages 27 to 36).
- Drainage assets are rated on structural integrity and ability to perform their functions. Need for cleaning is NOT part of the Overall Condition rating.
- Phone in unsafe road problems to Maintenance Area Supervisor immediately.

MnDOT HydInfra Phone: 651/366 4474 Send questions to Kellie.Thom@state.mn.us

Internal HydInfra webpage: http://ihub/bridge/hydraulics/hydinfra/index.html

External HydInfra webpage: http://www.dot.state.mn.us/bridge/hydraulics/inspector.html

DEPARTMENT OF TRANSPORTATION

Table of Contents

Get TAMS-HydInfra drainage asset data

HydInfra in Transportation Asset Management System (TAMS)

TAMS-HydInfra is MnDOT's Transportation Asset Management System for Hydraulic Infrastructure. HydInfra began in 1996 as an in-house program used by MnDOT Districts state-wide for inventory and inspection of drainage features -- Pipes, Hydraulic Structures and Special Structures, and later Ponds and water quality devices (SPCDs). HydInfra was converted into Agile Assets TAMS application with an ArcGIS Collector app for field inventory and inspection beginning in 2018. TAMS-HydInfra continues the framework that was developed in 1996 with GPS inspection, GIS mapping, database and reports.

Where to Finds TAMS-HydInfra Feature Records

Drainage asset records and IHUB webpage help sheets are available within MnDOT, for contractors inspecting for MnDOT and externally by request. MnDOT users can get information by four methods:

1. Web-based HydInfra Reports
2. Georilla Map Service
3. TAMS Agile Assets application reports or data exports
4. Collector HydInfra Inspection application

1) TAMS-HydInfra Web-based Crystal Reports

- *Find Reports on the IHUB HydInfra webpage* or direct link http://webreports/hydinfra
- *Last week's Collector Inspections* will show up in web-based reports on Tuesday of the current week. If disconnected Collector inspections are not synced on Fridays they won't show up on Tuesday.
- *Asset Details Reports* – Pipe Details Pond Details and Structure Details – show all TAMS information about each asset of any Status (Inplace, Review Status, Removed, etc.) Export this report to PDF.
- *Project Design and Scoping Reports* show Inventory and latest Inspection data for Inplace Pipes and Structures along a highway or from a list of IDs. Export this report to Excel and don't print it.
- *Instructions for web-based TAMS-HydInfra Reports* are here: How to use web-based HydInfra reports

2) Georilla Map Service

- *Instructions to Use Georilla* map service to find Inplace TAMS assets and many other map layers.
- *Tuesday updates* of HydInfra inspection data in Georilla. Nightly updates for Inventory updates

3) TAMS Application

- *Get TAMS Reports* of current HydInfra data. This week's Collector inspections are uploaded on Friday night. Run Collector Check reports for this week's inspections. Descriptions of reports are here http://ihub/bridge/hydraulics/hydinfra/TAMS-HydInfra%20Agile%20Assets.html
- *You will need a login* with a HydInfra or Maintenance Supervisor role to use TAMS-HydInfra.

4) Collector Application

- *View HydInfra assets* in the field with GPS location.
- *You will need a login* to HydInfra Inspection app and HydInfra Training to get access.

Methods for TAMS-HydInfra Inventory and Inspection

Drainage assets are recorded in TAMS-HydInfra

TAMS-HydInfra is used by MnDOT or consultant inspectors and hydraulic designers. The HydInfra Inspection ArcGIS Collector app is used in the field to record Inventory and Inspections. Agile Assets application is used in the office to update records and run reports. Collector inspections are available in TAMS the week after they are recorded and synced. Collector Inventory updates are in TAMS the next business day. Updates done in TAMS are available immediately in TAMS Reports.

HydInfra asset records include the inventory record and some number of inspections done over the years. The inventory data fields describe that thing that is the asset while each inspection describes its condition and defects on each date it was inspected.

Data input methods

Field Inspection with ArcGIS Collector Apps

ArcGIS Collector apps for HydInfra Inspection are the best option to use in the field.

- TAMS-HydInfra Collector webpage has information for the ArcGIS Collector app for HydInfra Inspection http://ihub/bridge/hydraulics/hydinfra/TAMS-HydInfra-%20Collector.html
- Collector Inspection apps:
  - *HydInfra Inspection* – Production app used for field inspections.
  - *HydInfra Inspection with Flow Arrows* – Production app has arrows showing flow direction.
  - *HydInfra Train* – Practice with the training app. You can create junk here.
  - *HydInfra Train with Flow Arrows* – Learn how to inspect with Collector app that shows flow arrows

Disconnected Editing

When cellular data connection is a problem, disconnected editing can be used in the field with a downloaded data set.

- Find instructions on the IHUB HydInfra Collector webpage

Field Inspection Equipment

- Laptop or tablet with 1 meter accurate GPS that communicates with Collector HydInfra Inspection app are used in the field.

TAMS Agile Assets Application

- This is not the best app to use in the field. Use if you need an immediate update in TAMS.
- TAMS-HydInfra Agile Assets IHUB webpage has information to use the TAMS app http://ihub/bridge/hydraulics/hydinfra/TAMS-HydInfra%20Agile%20Assets.html

Updates to multiple assets

- By request, updates to multiple assets can be uploaded in a batch process. Kellie Thom can help you get the data formatted for upload.

Inventory Terms for all assets

TAMS-HydInfra Asset Classes

1. Pipes and open channels are captured as line features and include sub-tables for end-sections (aprons), components like bends or increaser/reducers, and extensions of a different size or material.
2. Hydraulic Structures are captured as point features including: storm drain Structures like manholes, catchbasins, drop inlets and buried structures; SPCDs (Structural Pollution Control Devices) water quality devices; and Special Features – other, usually free-standing structures, with a purpose.
3. Ponds and Filtration or Infiltration Basins are captured as polygons
4. Stormwater Tunnel Systems are deep stormwater tunnels in Minneapolis and St. Paul. Only Metro Water Resources Engineering (WRE) inventories tunnels.

Inventory Fields Common to All Asset Classes

Asset Inventory records include many data fields in common across HydInfra Asset Classes: Pipes, Structures and Ponds. Several fields describing location, ownership and others pertain to all drainage assets.

Scoping and Design fields

- *Year to Fix* – Input the year that construction or a repair is planned for this asset.
- *Repair Project Type/Org* – Input whether Maintenance or Construction will do the repair.
- *Repair Priority* – Designate the importance of repairing this asset in a project – High, Medium or Low.
- *Repair Notes* – Instructions or consideration about the repair that is needed.
- *Regulatory Notes* – Input information about Watershed District or environmental permitting requirements. Include Permits applied for or received.

Ownership fields

- *Administrative Unit* – District Subarea (auto-filled in TAMS)
- *Maintenance District* – within boundary of the MnDOT Maintenance District (auto-filled in TAMS)
- *Construction District* – within boundary of the MnDOT Construction District (auto-filled in TAMS)
- *Owner Type* – Identifies the unit of government responsible for the asset, usually "MnDOT District"
- *Maintenance Agency* – Entity with responsibility to do maintenance, as defined in a Maintenance Agreement

Location fields

- *Route ID* -- codes from MnDOT's Linear Reference System (LRS) where first two digits identify the road level (01-interstate, 02 – U.S. highway, 03 – MN highway. Looks like 0300000000000079-I, I- is increasing, D- decreasing.
- *Beg. Measure or Carto Mile* – Linear distance calculated along highway alignments flat map measurement, formerly known as Beginning Measure Point (BMP)
- *Local Name* – Text field for location identifier or name
- *Reference Point* – (not available yet) almost matches roadway distance from mile marker signs but not quite
- *Offset* – Distance left or right of the increasing or decreasing Route ID alignment. Negative is left
- *Left/Right of Centerline* – when on road, look in the direction of increasing mile markers choose L or R
- *Latitude* – (Upstream or Downstream for Pipes) north-south or Y- coordinate
- *Longitude* – (Upstream or Downstream for Pipes) east-west or X- coordinate
- *Geometric Length* – (Pipes only) Distance between upstream and downstream end point locations
- *X-Y Source* –Location method might be hand-drawn or GPS Sub-meter (Upstream or Downstream ends for Pipes)

- *Z Source* – Elevation method, Surveyed or As-Built are valid inputs (Upstream or Downstream for Pipe ends)
- *Vertical Accuracy* – (To be developed) value in feet from GPS location (Upstream or Downstream for Pipe ends)
- *Horizontal Accuracy* – (To be developed) value in feet from GPS location (Upstream or Downstream for Pipes)
- *Left/Right of Centerline* – A side culvert is left or right of highway alignment, used for local road pipes
- *Traffic Direction* – Asset is on the northbound, southbound, eastbound or west bound lanes
- *Geometry* – Holds all X, Y and Z locations for the asset

Status

Status identifies active, Inplace, assets from other assets collected in the past but no longer active. HydInfra records are rarely deleted, -- only when a record can't be related to a current or past pipe is the asset deleted.

Active Status

- *Inplace* – Active status, asset is working, in the ground

Not Active

- *Abandoned* – Plugged and abandoned, the asset is filled and left in the ground
- *Removed* – Asset is taken out of the ground
- *Duplicate* – When two TAMS records exist for one asset, if one was not removed then mark one as Duplicate.
- *Review Status* – Use this rarely to mark records that should be discussed before changing Status
- *Turnback* – If a highway is turned back to County or City ownership the assets on it are changed to Turnback
- *Proposed* – Blank asset record created for a planned construction project design.

Roadway Type

Roadway Type describes the Asset's Location

Roadway Type describes the general location and relative importance to highway traffic. For example, a "Centerline" culvert would disrupt traffic flow when replaced while a Field Entrance could be replaced with little impact to highway traffic. Categories of Roadway Types differentiate all culverts under highway traffic from other sets.

Roadway Type Categories:

1. *Highway Culverts* are under state highway lanes of traffic. They include Centerline, Median, Ramp/Loop, Collector/Distributor, Roundabout
2. *Side Culverts* are either local road culverts or are part of state highway but not under traffic
3. *Entrance Culverts* are privately owned (but within the highway right of way they are maintained by MnDOT)
4. *Mainline* applies to storm drain, not culverts

Work Orders and Repair Activity History

Repair Activity History

Repair Activity sub-table holds repair records mostly done before 2018. Culvert Repair Cost repair records are included, but other repairs, primarily done by Metro's Drainage Maintenance crews, were also recorded. Repair Activity records are available in the TAMS Pipe Inventory record or the TAMS-HydInfra web-based Asset Details reports, available from the IHUB HydInfra webpage.

TAMS Work Orders (Maint History)

Maint. History data field in TAMS shows link to Work Orders. Since 2018, drainage repairs are recorded in TAMS as Work Orders. Work Orders should include the TAMS ID for the drainage asset so that the repair is linked to the HydInfra asset record. Work Orders linked to a HydInfra asset can be found in the last column of the TAMS-HydInfra Inventory record, labeled "Maint. History".

Web-based HydInfra Asset Details Reports include summaries of work orders linked to HydInfra assets. Find Asset Details reports from the IHUB HydInfra webpage http://ihub/bridge/hydraulics/hydinfra/index.html

Linking to eDOCs Documents

Documents

(Instructions will be developed for linking documents from eDOCs.)

In TAMS, important documents stored in eDocs can be linked to an asset. For example, Maintenance Agreements for Ponds could be linked directly to Pond record and opened from TAMS. Photos could also be stored in eDocs to be linked in TAMS, but a simpler process needs to be developed for photo collection and linking.

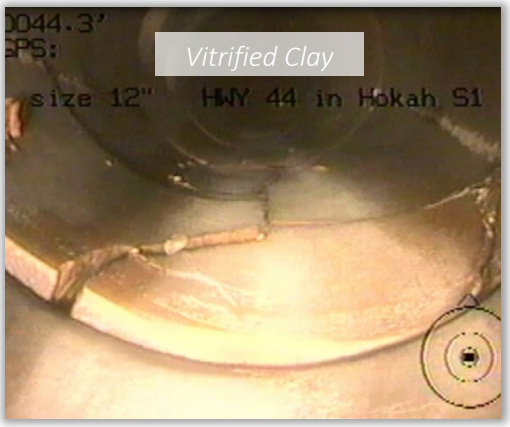
Link or find linked document in TAMs Inventory table on the far right under "Documents".

Materials of Pipes and Structures

Materials shown here are used to describe Pipes or Structures in TAMS. Materials listed in TAMS-HydInfra have been found in one or more MnDOT Districts. Several of these materials are no longer installed. Material pages for steel, plastic and liners follow on the next three pages. This page shows a mixed set.

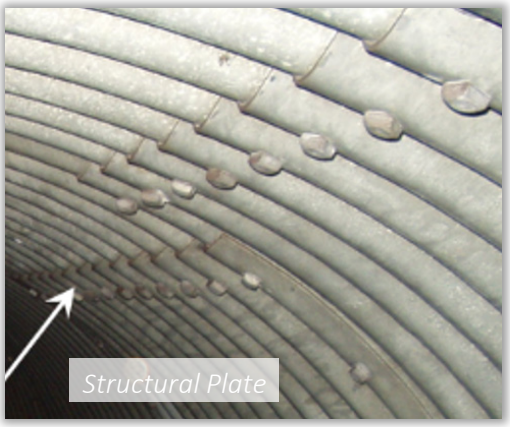
- *Concrete* is most common pipe material. About 90% of HydInfra culvert and storm drain pipes are concrete.
- *Brick/Masonry* might be used in new structures but not pipes. This example brick and stone culvert example lives in Duluth on Highway 61.

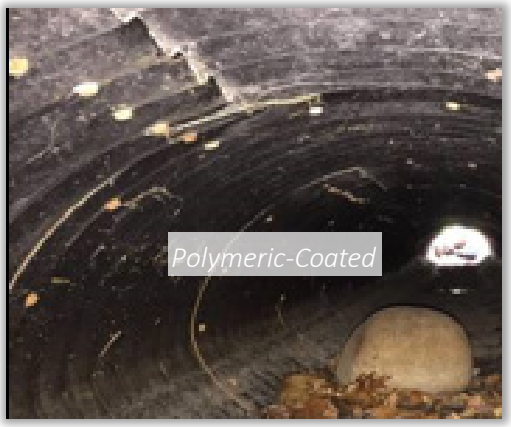
- *Vitrified Clay* pipe exists in some very old systems. Look for red color.
- *Timber* culverts may still exist in small box culverts.
- *Other* is used when no other material on the list applies.



Other

Steel Materials





Liner Materials

If a pipe is lined, use the material name that begins with “Liner”.

These liner materials and possibly others are used in one or more MnDOT Districts.

- *Liner CIPP* (Cured in Place Pipe) is a fabric liner with a resin cured by steam, hot water or UV light, looks like fiberglass.
- *Liner PVC* is no longer used.
- *Liner HDPE* is commonly used for slipliners.
- *Liner Steel* flat-seam pipe has been used for pipe liners.
- *Liner Spray-applied* can be concrete or resin cementitious material.


Liner CIPP


Liner PVC


Liner HDPE


Liner Spray-applied


Liner Spray-applied

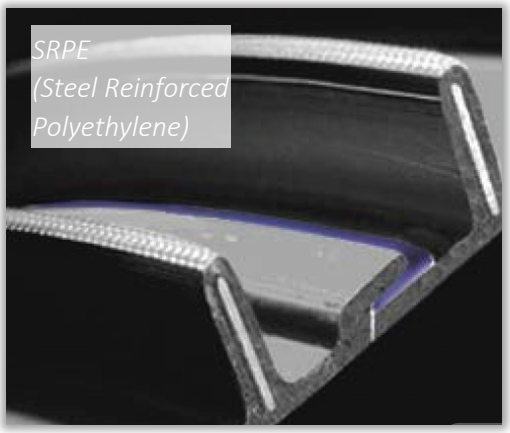
Liner Other


Liner Steel

Plastic Materials

Plastic pipe materials shown here are known to exist in one or more Districts.

- *Corg. Plastic (HDPE)* is always black, and only dual-wall (smooth interior and corrugated exterior) is used for culverts.
- *Steel-reinforced polyethylene (SRPE)* has several varieties, but all will be hard to recognize because the steel is concealed inside the black polyethylene surface. The SRPE shown here will have a spiraling blue line inside pipe.
- *Polypropylene* is grey but otherwise looks like dual-wall Corg. Plastic (HDPE). Polypropylene is somewhat stiffer than HDPE.
- *PVC* pipe is white or green or even light blue. It is more brittle than HDPE. It deteriorates in sunlight and should not be used for culverts.
- *Perforated Pipe* can be ether PVC or HDPE single-wall pipe with holes that allow water to leak out into gravel and surrounding soil.
- *Other* is used for plastic pipe not shown on this page.
- See also Liner Materials and if a pipe has been lined, use the material name that starts with "Liner".



Other

Pipe Inventory

Asset Type: Pipe includes linear assets

Culverts, Stormwater pipes or ditches are collected as lines with 2 or more points. Culverts and Storm Drain pipes are located by upstream and downstream end points. A third point can be added if the pipe includes a Bend component. Ditches are rarely added to TAMS but an offtake ditch could be inventoried in TAMS HydInfra as a multi- point line. Only the upstream and downstream end point locations are shown in TAMS latitude and longitude data fields. Intermediate XY locations are captured in the Geometry data field.

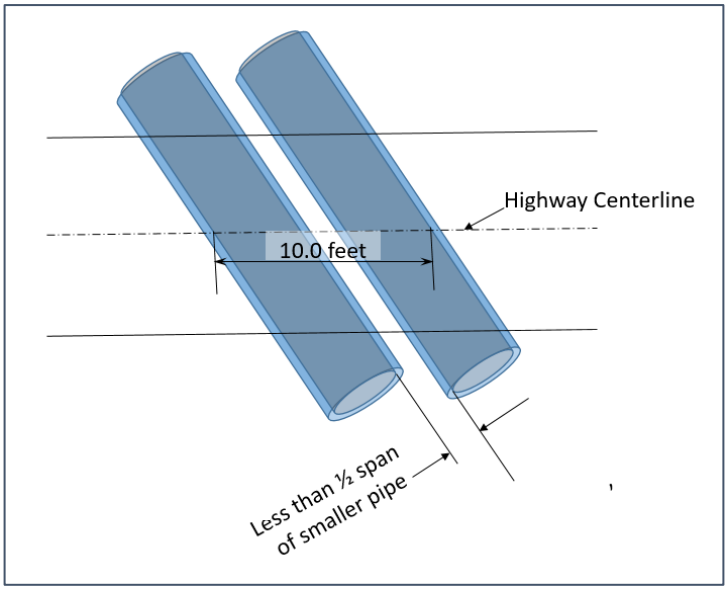
Pipe Class Codes

1. Culvert – tubular conveyance with 2 open ends that carries stormwater under a road or embankment
2. Storm Drain – pipe that is part of a network of structures and pipes that drains the road surface
3. Open Channel – a ditch or channel with an open top
4. Drain Tile – either agricultural field drain tile system that crosses the highway or perforated pipe under filtration basins

Culverts

HydInfra Culverts are less than 10-foot span that are not Bridges. Two or more pipes set close together can be a bridge under Minnesota law. These are not recorded in HydInfra but are recorded in the MnDOT Bridge database.

It is a bridge – and not a HydInfra culvert – if total span is 10 feet or greater and the gap between pipes is less than half the smaller pipe's interior diameter. Span for bridges is measured along the road centerline. This example shows 2 small pipes that together are a Bridge Culvert under Minnesota law.



To identify a Bridge Culvert in the field, look for a sign with the bridge number.

If the culvert qualifies as a bridge but has no bridge number sign, contact the MnDOT District Bridge Engineer with the location and culvert information to add to the MnDOT Bridge database.

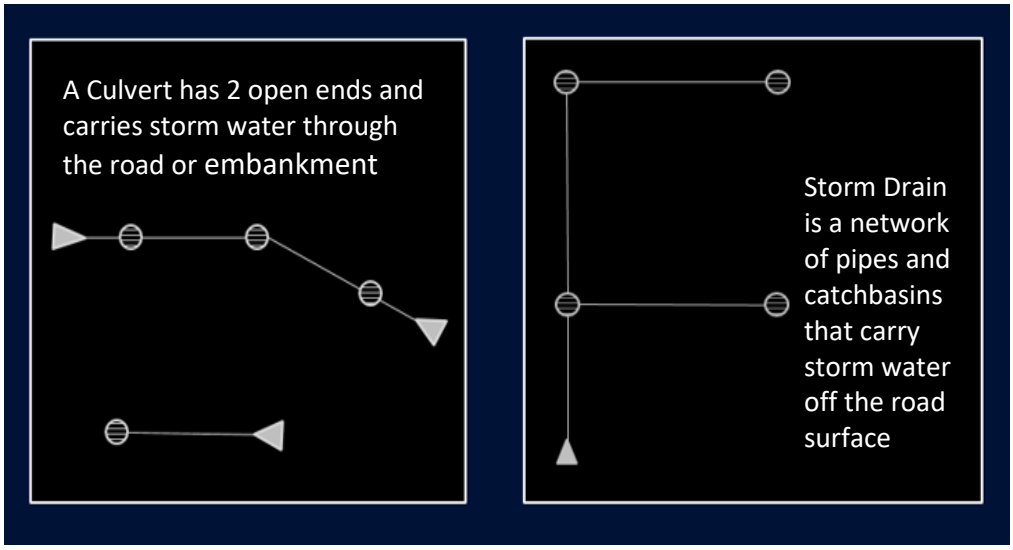
For more about bridge culvert inspection, see FHWA Bridge Inspector's Reference Manual Chapter 14 http://www.dot.state.mn.us/bridge/pdf/insp/birm/birmchapt14-inspofculverts.pdf

Storm Drain Pipes can be any size

Storm Drain pipes larger than 10 foot span would be inventoried in TAMS-HydInfra and are never included in the Bridge Culvert database. Deep stormwater tunnels that exist in Metro District – Minneapolis and St. Paul – are recorded in a separate module in TAMS not in HydInfra.

Choose Culvert or Storm Drain Pipe

Nearly all pipes in TAMS HydInfra are Class Code Culvert or Storm Drain. Culvert pipes have two open ends, usually with aprons (End Sections) and carry water under a road or embankment. Storm Drain pipes and catchbasin or manhole structures are connected in a network that carry water off the road surface. Median drains are culverts whether they have a drop inlet or an apron capturing runoff in the median.

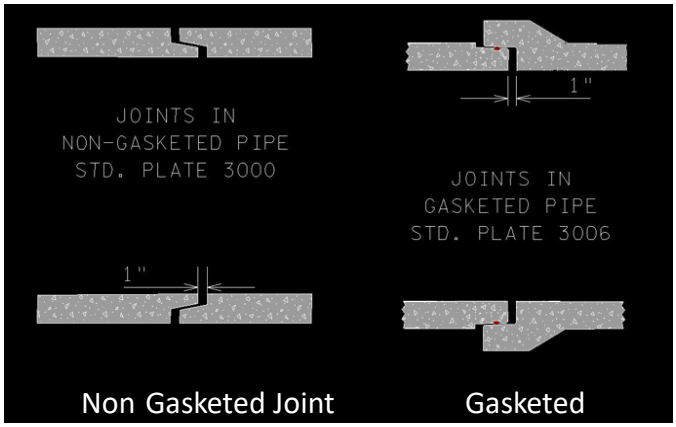


Pipe Descriptors

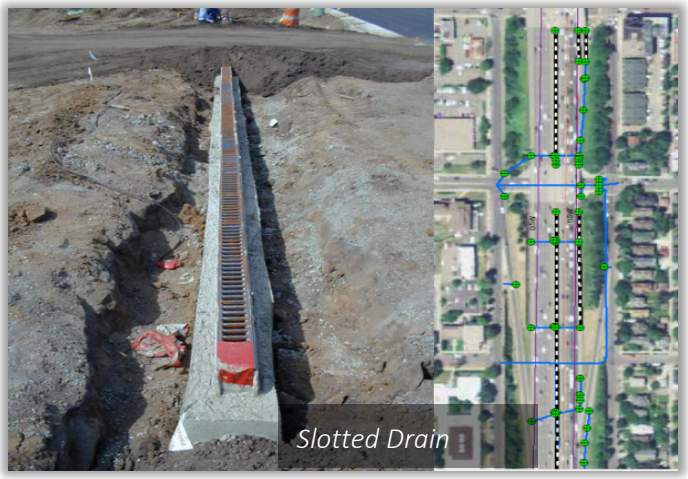
Pipe Type

Pipe Type identifies other description categories, including:

- *Gasketed or Non-gasketed* – different types of pipe joints, also known as 3006 or 3000
- *Open Flume* – hardened open channel
- *Perforated Pipe* – used for pond basin underdrains and has drainage holes
- *Slotted Drain* – linear inlet with grate, usually part of a storm drain network




Pipe Type: Open Flume
Class Code: Open Channel

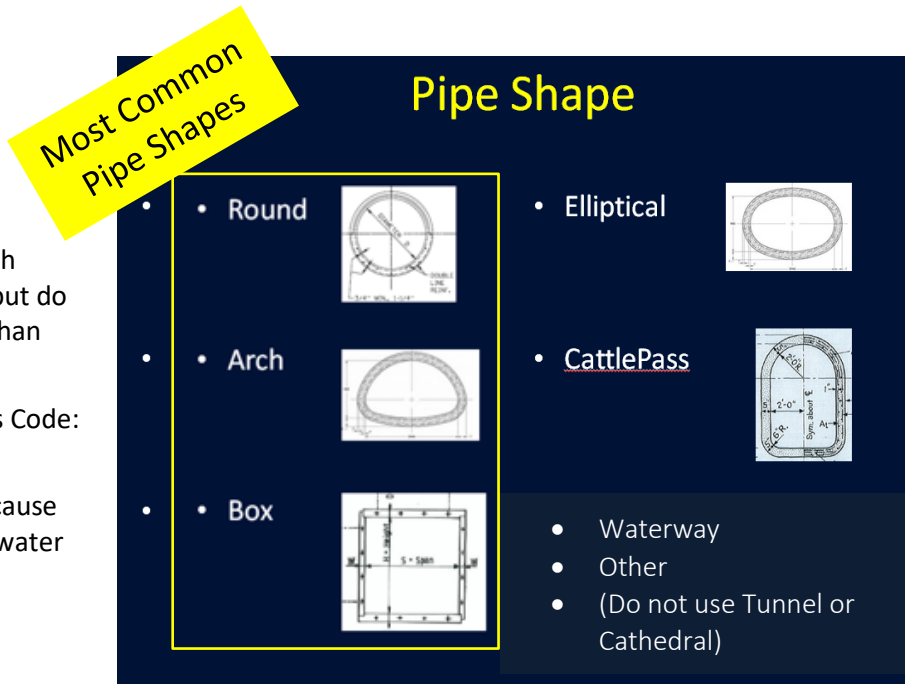

Slotted Drain

Pipe Shape

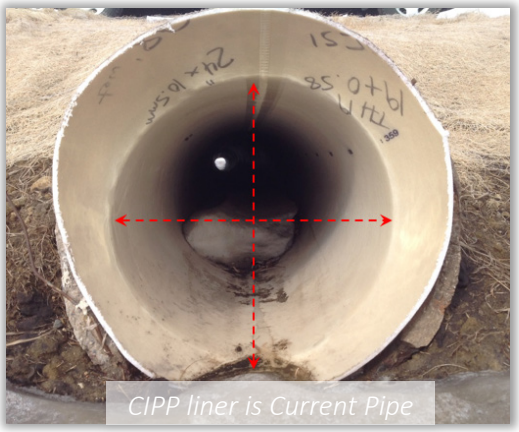
Round, Arch and Box are the most common cross-sectional shapes of pipes. CattlePass shape has a rounded top but other cattle passes are a simple 48 x 72 inch Box shape. Elliptical pipe shapes are rare but do exist. If the shape is wider at the bottom than the top, it's an Arch shape.

Waterway pipe shape is only used for Class Code: Open Channel.

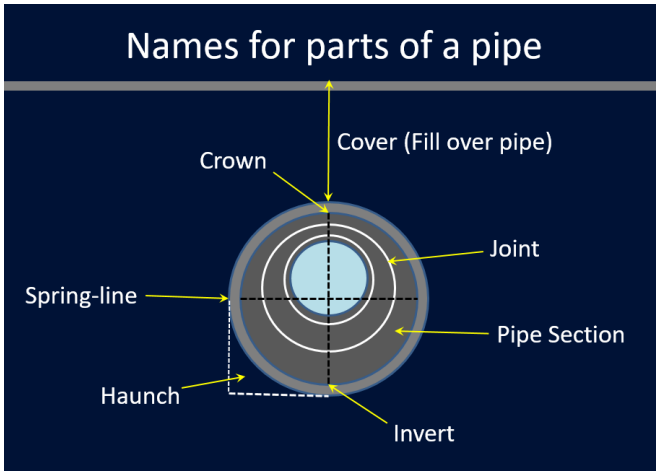
Do not use Tunnel or Cathedral shapes because they are only used to describe deep stormwater tunnels in MnDOT Metro District.

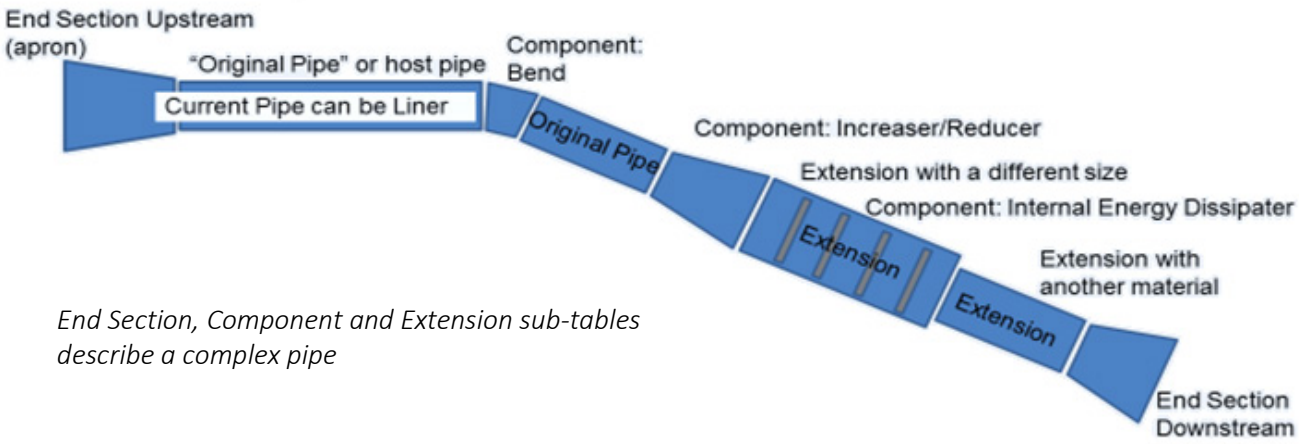


Current Pipe and Original Pipe



- *Original* – pipe **Material, Shape**, **Width** and **Height** describes the installed pipe or the host pipe if lined
- *Current* – pipe **Material, Shape, Width** and **Height** describes the pipe interior now. If lined these will be different from Original
- In this example, Current Material is Liner CIPP (Cured in Place Pipe liner). Arrows show Current Height and Width. Original Material is Concrete, exposed at lower left and right of pipe. Shape is Round for both Current and Original. Original concrete Height and Width are about 1 inch less than the Liner CIPP. For slipliners, the Current and Original Height and Width will differ by several inches.
- *Total Length* – Input the length of pipe
- *Cover at Upstream Road Edge (Ft)* – Estimate height of fill from top of pipe to surface of road at fog line at upstream end of pipe
- *Pipe Class/Gage* – Strength rating or thickness of concrete or steel pipe
- *Pipe Ties* – Long bolts that stretch across concrete pipe joints (Yes/No)
- *Lined* – Pipe has a liner (Yes/No)
- *Year Lined* – Year that pipe was lined
- *Year to Inspect* – Calculated year to do Highway Culvert inspection based on previous inspection date and condition rating





End Section, Component and Extension sub-tables describe a complex pipe

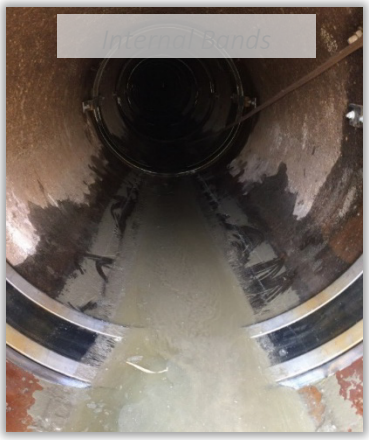
Pipe Inventory sub-tables add information to each asset

- *Components* – Components describe added parts like bends, increasers, AOP design, or dissipater rings
- *Extensions* – Extensions describe additional materials, sizes or shapes of a pipe collected as one asset
- *End Sections* – End Sections are various aprons, box end sections or flapgates attached to end of pipe

Component Types

The Component sub-table holds records about add-ons to a standard pipe. Bends, Energy Dissipater D-Rings, and Increaser/Reducer tapered pipe sections are all components. Aquatic Organism Passage (AOP) also known as Fish Passage details including culverts designed for stream bank-full width or those deliberately embedded in stream bottom are recorded as AOP Components. Knowing where AOP components are can help prevent unintended destruction.

- *AOP - Bankfull width* – Culvert designed as wide as the stream channel to promote AOP
- *AOP - Embedded culvert* – Embedded culvert - culvert invert installed below stream grade, with streambed material placed inside
- *AOP - Other* – Aquatic Organism Passage not in list
- *AOP - Recessed Culvert* – is placed below stream grade with no streambed material placed during construction
- *Bend* – One or more curved concrete pipe sections that change the horizontal direction of a pipe. Can also be used for vertical elbow in steel pipe
- *Increaser/Reducer* – Pipe section that tapers in diameter
- *Internal Bands* – Joint Repair bands
- *Internal Energy Dissipater* - Internal Energy Dissipater
- *None* - There is no component on this pipe
- *Paved Invert* – Paved Invert includes concrete cloth or other materials



End Section Types

- *Flared Aprons* are wider than the pipe
- *Flap Gate* closes to prevented floodwater back flow
- *Safety Aprons* are narrow like pipe diameter, are sloped at 10:1, 6:1 or 4:1 tapers


Flared Apron (Steel)

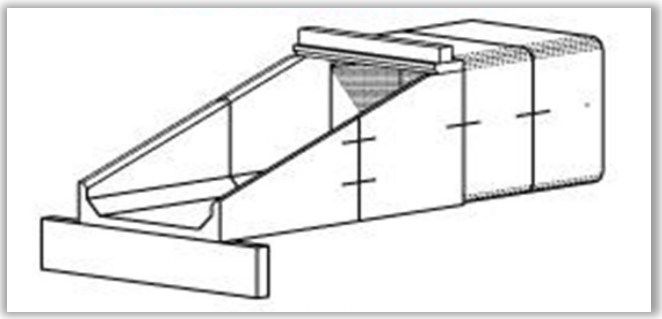

Flared Apron (Concrete) with Safety Grate

- *Box End Sections* are precast tapered box pipe sections
- *Headwall* lays flat against the road inslope
- *Headwall-Wingwall* on box culverts flare out to hold back inslope.


Flap Gate


Safety Apron 6:1 (Concrete)


Safety Apron 10:1 (Steel)

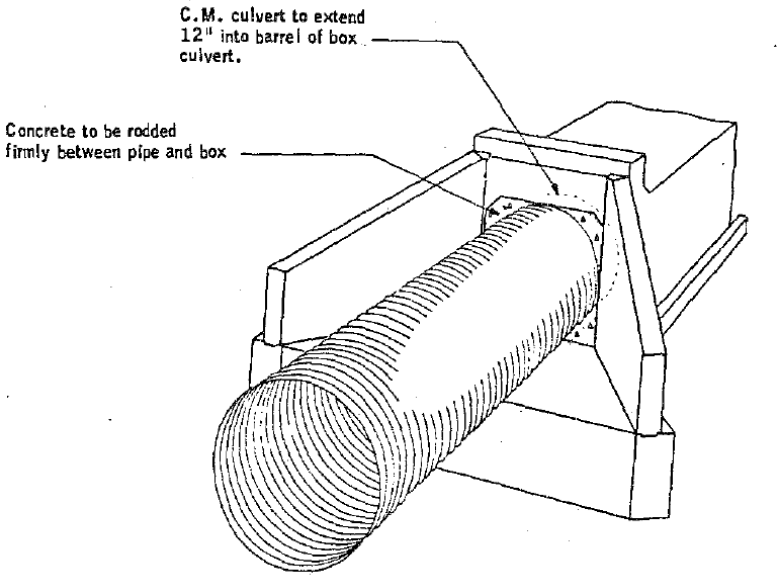



Headwall


Headwall-Wingwall

Extensions

The Extensions sub-table allows a pipe to be described with multiple materials. For example, a concrete box culvert installed under the old highway may have had round corrugated steel pipes inserted on each end when the road was widened. The Extension sub-table would include a separate record for each different pipe size, shape or material.



MnDOT Standard Plate 3066 shows how a corrugated metal pipe was inserted into a concrete box culvert, used when a narrow highway was widened. (Also notice the Headwall Wingwall End Section)

Structure Inventory

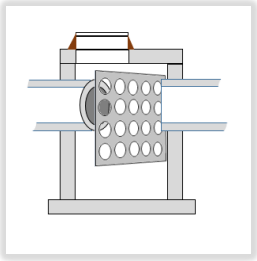
The structures types most commonly found in Storm Drain networks are Catchbasins, Manholes or Drop Inlets, but many other structure types are described in TAMS HydInfra. The three Class Codes have different inspection forms.

Class Codes – Structure, SPCD or Special Feature

Structure – mostly functions as a node on a storm drain system. Structure - Structure Types include:

- *Catch Basin* – CB structure has grate with inflow from pavement
- *Drop Inlet* – DI captures drainage in ditch or swale
- *Control Structure* – Structure regulates water elevation or flow rate
- *Manhole – MH* Structure is a solid-top junction with no inflow
- *Buried Manhole* – Buried MH is hidden beneath ground surface
- *Diverter* – Diverter structure splits or changes flow to two or more paths
- *Deck Drain* – Deck Drain captures flow on a bridge
- *Inspection Tee* – Inspection Tee is opening to ground surface to view or maintain drain tile
- *Other* – Other is some odd type of storm drain structure not listed here, describe in Inventory comment

SPCD – Structural Pollution Control Device, a water quality structure treats storm water by filtering, skimming or separating water from sediment or floatables. Structure - SPCD Types include:



SPCD-Sump MH with Baffle

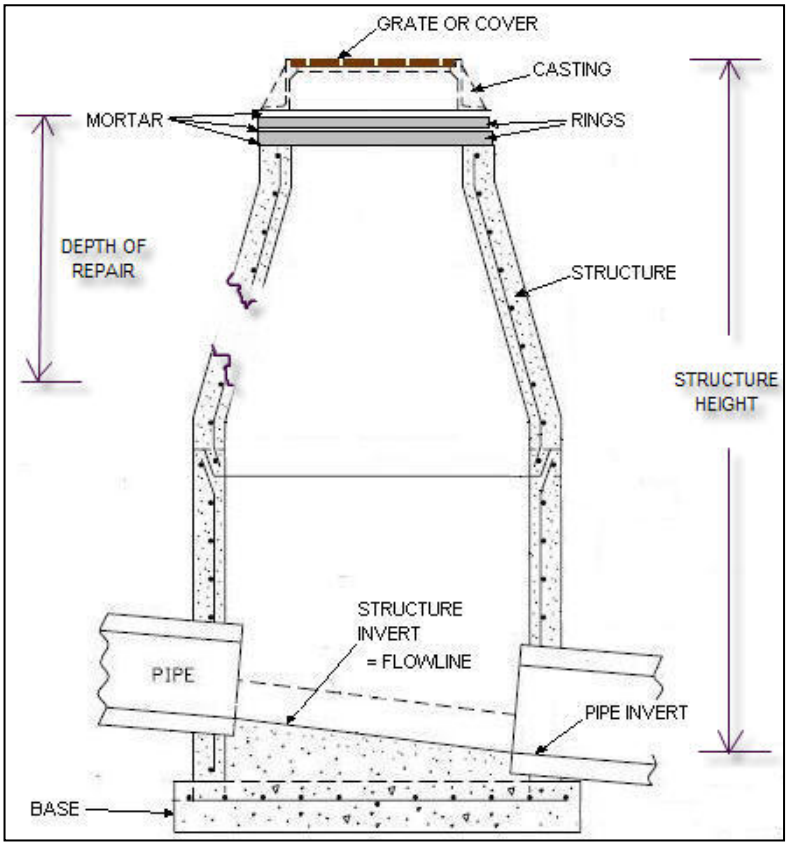
- *SPCD - Filter* – Filter uses sand, gravel or screens to separate sediment
- *SPCD - Grit Chamber* – Grit Chamber has multiple cells to drop out sediment
- *SPCD - Infiltration Device* - Infiltration device distributes water to gravel area below
- *SPCD - Separator* – Separator swirls inflow to spin out cleaner outflow
- *SPCD - Skimmer* – Skimmer holds back floatable debris and oils
- *SPCD - Sump MH* – Sump manhole has pit in bottom to store some sediment
- *SPCD - Sump MH with Baffle* – A large plate with holes suspended vertically in a Sump MH structure allows sediment to drop out and prevents re-suspension
- *Other* ***– SPCD*** type Other is a water quality device not in the list, describe in Inventory comment

Special Feature – is a structure that does not function as a node in a storm drain or a water quality device but has some other purpose. Structure - Special Feature Types include:

- *SpecFeat - Ditch Block* – Ditch Block is a tiny dam to divert water to a pipe
- *SpecFeat - Energy Dissipater* – Energy Dissipater, usually of concrete, tumbles flow
- *SpecFeat - Floodgate* – Floodgate caps downstream pipe end when it floods
- *SpecFeat - Overflow* – Overflow structure handles high water outflows from ponds
- *SpecFeat - Riprap* – Riprap is broken rocks to dissipate flow velocity
- *SpecFeat - Weir* – Weir is a partition designed to overflow at specific level
- *Other* – Special Feature type Other is a water quality device not in the list, describe in Inventory comment

Structure Inventory Terms

Type: Structure



- *Structure Type* – Manhole, Catchbasin, Drop Inlet, Buried Manhole, Control Structure, Deck Drain, Diverter, Inspection Tee
- *Structure Diameter* (inches) – Width of structure (entered from Asbuilt or plans, not measured in field)
- *Structure Height* (Ft.) – Measure from top of grate to bottom of invert
- *Repair Depth* (Ft.) – (Inspection term) Measure from bottom of casting to bottom of the needed repair (gaps, cracks, holes, missing blocks or brick, etc.)
- *Connected Pipes* – Number of pipes attached to the structure
- *Sump Depth* (Ft.) – Measure from lowest pipe invert to structure invert if and record if deeper than 1 foot
- *Grate/Frame Type* – Casting assembly, see standard plates
- *Ring Material* – Concrete or plastic rings under the casting and on top of the pre-cast structure, used as vertical spacers

Type: SPCD

- *SPCD Make* – Manufacturer of the water quality device
- *SPCD Model* – A specific type or manufacturer's name for the device
- *Skimmer* – A device that removes floatables from stormwater
- *# of Cells* – Number of chambers within the water quality device, multiples are usually in a Grit Chamber
- *# of Access Points* – Number of openings available for maintenance, usually with a manhole cover
- *Sediment Capacity Depth (Ft.)* – Device has storage for sediment, find this number in construction documents
- *Expected Maintenance Freq (Mo.)* – SPCDs are assumed to have 12 month frequency unless otherwise noted
- *Special Equipment Needed* – An SPCD might require equipment to open or access the interior, name it

Type: Special Feature

- *Riprap Class* – Identify the type of rock or concrete armoring that protects against erosion or scour

Pond Inventory

Asset Type Pond is a temporary or semi-permanent reservoir of stormwater. Ponds in TAMS HydInfra have a shape – a polygon – to describe the perimeter. The two Pond Class Codes have different inspection forms.

Class Codes – Pond or Basin:

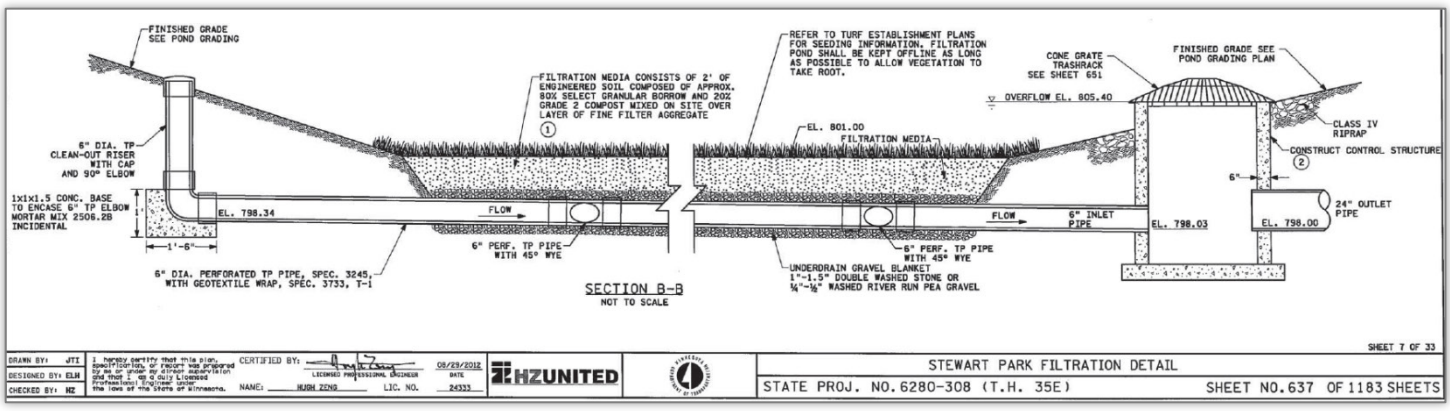
Pond

- *Wet Pond* – Wet pond normally has water up to the level of the outlet structure and maintains a permanent pool of water
- *Dry Pond* – Dry pond has outlet elevation at pond bottom and drains dry
- *Mitigation Wetland* – Mitigation Wetland was built to offset wetland loss on a construction project. Look for NWC (New Wetland Credit) or PVC (Public Value Credit) or other note on plans
- *Natural Wetland* – Natural Wetland identifies a pre-existing wetland protected by Minnesota or Federal law
- *Unknown* – Unknown type is used when the type is unidentified

Basin

- *Filtration Basin* – Filtration Basins have perforated underdrains – Drain Tile – that allows stormwater to drawdown and dry out between rainfalls and maintain vegetation
- *Infiltration Basin* – Infiltration Basins are built with a granular or gravel substrate meant to leak into the ground until dry. They normally have living plants on basin bottom

Filtration Basin plan profile example



Inspection – Rating the Condition of Assets

Inspection Notes, Criteria and Condition Codes

As noted on the front page Conditions Ratings:

- This guide is used to rate the condition of storm drainage system assets, including culverts where the pipe (or installations of more than one pipe) is less than 10 feet wide as measured along the centerline of roadway.
- The worst defect found in an asset determines its condition rating. (Refer to inspection criteria on pages 27 to 36).
- Drainage assets are rated on structural integrity and ability to perform their functions. Need for cleaning is NOT part of the Overall Condition rating.

Inspection fields and criteria for Class Code and Material

TAMS-HydInfra inspections draw from one set of data fields for all asset types. Each Asset Type -- or sometimes Class Code within an Asset Type -- uses a subset of all inspection flags or measures. To see an example, run the web-based Project Design Reports -- they show Pipe and Structure inventory and inspection records together, sorted by highway and carto mile, with similar inspection fields lined up in columns.

Apply the inspection criteria for the asset type and material of the feature. Structure and Pond inspections have different inspection forms for each Class Code. Ponds, with Class Codes Pond or Basin, have separate inspection forms with different sets of inspection data fields for each. Structures have 3 Class Codes – Structures, SPCDs and Special Features – that have three different inspection forms. Choose the inspection form that matches the Class Code of your asset.

Condition Rating Codes

See Page 1. The Condition codes convey whether an asset needs repair. Inspection flags, measures and comments tell the complete story about the condition of the asset.

Condition 1 indicates the asset is like new, with the expectation it will last for many years. An asset can be in Condition 2 for decades – still okay, worn but structurally sound. Pitting/Rusting is a typical inspection flag that indicates a condition 2 metal or concrete pipe. Condition 1 and 2 are in good condition and do not need repair.

Condition 3 assets need repair. When a District is looking for repairs to do, they will look for Condition 3 or 4 assets. If the asset that needs repair is not coded Condition 3 or 4, it may not be found in a report. A separated apron is a common reason that a concrete pipe is rated Condition 3.

Condition 4 pipes may impact the road surface, especially if piping is ongoing and road voids occur. Condition 4 Highway Culverts – culverts under state highway traffic lanes – are inspected every one or 2 years, according the drainage inspection performance measure.

Assets are rated Condition 0 *unless we already know* it's in bad condition. If a previous inspection shows the culvert to be Condition 3 or 4 with defects to match, don't call it Condition 0. Instead, keep the inspection and write a comment to say the culvert is underwater but the previous inspection says it's bad. That way, TAMS pipe reports that show only the most recent inspection will show that the asset needs repair.

In the Collector app, choose iView to re-inspect an asset by updating the previous inspection. Apply the inspection criteria and fill in all the inspection flags and measures so that your inspection tells a story in the data. And inspection comments? – they can remove all doubt.

Inspection Cycle and Performance Measures

1) Highway Culverts Inspection Measure http://ihub/bridge/hydraulics/Measure-HydInfra%20Inspection.html

Recommended Inspection Frequency for Highway Culverts*		
Overall Condition	Inspection Frequency Years	Comments
4 - Very Poor	2	Pipes where problem is not under the road
	1	Pipes where problem requires a repair under the road
3 - Poor	4	Most condition 3 pipes
	2	Condition 3 Pipes with Piping or Road Void **
1 - Like New or 2 - Fair	6	Pipes that do not need repair
0 - Can't be Rated	2	Pipe condition is not visible
Pipes with no inspections		Pipes created in TAMS-HydInfra without an inspection. Goal to inspect Highway Culverts within 6 years of Date Discovered
Overall Target: 80% of Highway Pipes meet Recommended Inspection Frequency		

The Drainage Performance Measure recommended inspection frequency applies to "Highway Culverts" defined as culverts under MnDOT highway traffic lanes.

*Highway Culverts, included in the Drainage Performance Measure, are HydInfra pipes where:

- Status is Inplace
- Class Code is Culvert
- Roadway Type is Centerline, Collector/Distribut, Mainline, Median or Ramp/Loop or Roundabout
- Owner is not City, County or Private

  Pipes that are not under State highway traffic lanes are not included in the performance measure. Pipes not included are "Side Pipes" with Roadway Types of Crossover, County, City, Township, Frontage, Entrance Pipes (Entrance, Field Entrance, Farm Entrance, Commercial Entrance) or others (Trail, Railroad, Bridge, Ditch Block or Other). Pipes that are not culverts are also not included in the Performance Measure. Pipes with Class Codes of Storm Drain or Drain Tile are not counted as culverts.

**Condition 3 pipes with piping or road void have a 2-year inspection cycle because these serious conditions could lead to road problems.

2) Highway Culverts Condition Measure http://ihub/bridge/hydraulics/Measure-Condition.html

3) Highway Culverts Repair Measure http://ihub/bridge/hydraulics/Measure-Maint_Repairs.html

Drainage Maintenance webpages are available on MnDOT IHUB. Email Kellie.Thom@state.mn.us for more information.

Asset Inspection Terms

TAMS-HydInfra captures multiple inspections for each asset inventory record. If assets' installation dates are recorded (Date Built) multiple inspections will show rates of deterioration over time and will help us estimate the expected lifespan of materials.

Fields about the Inspection

- *Inspection for S.P.* – If you are scoping a project, use the upcoming construction's State Project (S.P.) number
- *Inspection Method* – For pipes, use End of Pipe unless you use a HIVE or Pan-Tilt Video or Person Entry
- *Data Org* – Inspector's employer, either MnDOT or Consultant company name if under contract

Inspection Flags and Measures

Inspection flags in HydInfra are Yes/No questions – is it there or not? Measures allow more detailed descriptions from a list of options.

Not in Condition Rating

- *Needs Cleaning* – Does this asset need to be cleaned? Pipe has sediment 30% of the pipe height or more, somewhere within the pipe. Sediment or Debris will impede drainage. (See also Sediment % Full). (Yes/No)
- *Plugged* – Something is in pipe causing water to backup or restrict the water flow. (Yes/No)
- *Sediment % Full* – Estimate the depth of sediment, compared to the interior height of apron or pipe. For SPCDs and Ponds, estimate the percentage of the total volume that is filled by sediment.
- *Water Observed* – Describe the typical water situation in the pipe: Dry, Slow, Fast, Standing, or Full
- *Water % Full* – Describe the water level in the pipe at time of inspection as a percent of pipe height.

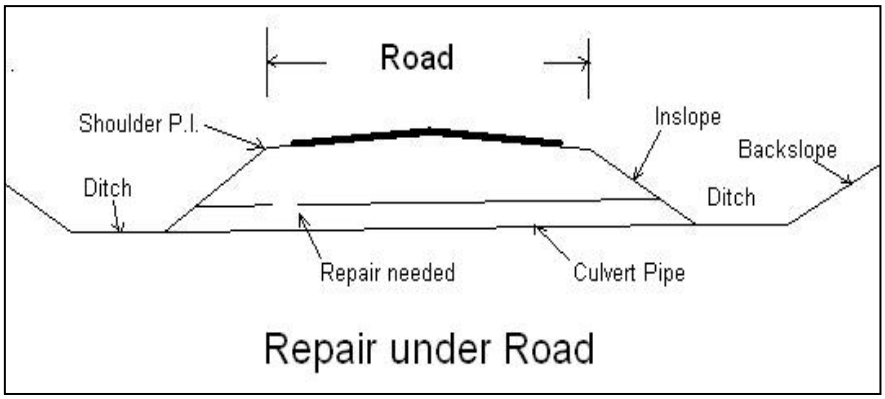
Roadway Indicator Flags (describe problems adjacent to an asset)

- *Inslope Cavity* – A cave-in or hole in the inslope of the roadway above an apron or pipe joint. Usually found in areas where joint separation has occurred. (Yes/No)
- *Road Distress* – Pavement problem – Road Bump, Dip, Pavement Patch or Cracks that are indicators of possible loss of roadbed through poor condition pipe or structure. (Yes/No)
- *Void in Road* – Evidence of a loss of fill from the road around or near the pipe or other asset. Sagging pavement, one or more patches, holes in pavement or braided pavement cracks may be signs of Road Void. Loss of fill seen below a pipe with holes indicates both Piping and Road Void. (Yes/No)
- *Erosion* – Describe where the erosion is: Inlet, Outlet, Both (ends), Other or None. Erosion, scour or channel degradation caused by water flows has occurred, as evidenced by a gully or loss of vegetation.

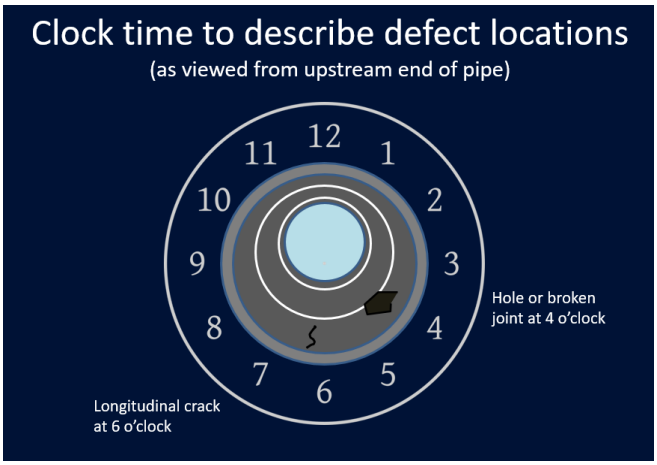
Condition Flags and Measures

- *Needs Repair* – Does this asset need to be repaired? (Yes/No)
- *Repair under Road* –

  If a repair is needed and the needed repair will encroach on the road surface between the two shoulder PI's then Repair under Road is marked Yes. To be valid, Needs Repair must also be "Yes". (P.I. means Point of intersection where the road surface intersects with the inslope).



- *Pitting/Rusting* – Small pits are visible in the surface of the pipe. If metal, rusted but still solid. Concrete has exposed aggregate. (Yes/No)
- *Spalling/Flaking* – Loss of material as chips of concrete are lost from asset's surface, or if metal, flakes of rust are falling away. (Yes/No)
- *Cracks* – Describes crack severity – choose from the list: Not Visible (no crack), Crack (cracked), Fracture (broken), or Displaced (fractured with offset pieces)
- *Holes* – Hole goes completely through the asset's material.
- *Max Joint Separation* – Estimate or measure, in inches, the largest separation between pipe sections visible inside the pipe. < 1 means no separations more than 1 inch are visible.
- *# Joints to Fix* – Count the number of joints that are separated by 1 inch or more, or have evidence of soil infiltrating the joints. <1 means no joints need to be fixed.



- *Separated Apron* – Describe which end(s) of pipe has a separated apron, where the joints between the apron and first pipe section may be allowing soil to filter through to cause an Inslope Cavity.
- *Misalignment* – Estimate, in inches, how far pipe sections are out of alignment. Good alignment is 0 to 1 inch offset and would not interfere with a slipliner.
- *Deformation* – Asset's shape is distorted or flattened. Use inspection comment to describe how deformed it is. (Yes/No)
- *Infiltration* – Evidence that soil or water is seeping into pipe. (Yes/No)
- *Piping* – Water is flowing along the outside of pipe, which causes loss of fill from the roadbed (void in road). Look for gaps between pipe exterior and road fill. (Yes/No)
- *Deteriorated Ties* – Pipe ties are corroded or broken. Pipe ties are bolts between concrete pipe sections that help maintain the alignment. (Yes/No)
- *Inspector Suggested Repair* – Inspector suggests a pipe repair method from a list of repairs. See Repair Made Examples at http://ihub/bridge/hydraulics/Measure-Maint_Repairs.html

Structure, Special Feature and SPCD-specific Flags and Measures

- *Replace Frame* – Iron casting on top of structure needs to be replaced.
- *Replace Grate* – Top cover is broken, needs to be replaced.
- *Replace Rings* – The adjusting rings (= layers below the iron casting assembly) are broken or cracked. Rings may also have missing mortar. (Yes/No)
- *Repair Invert* – Inside bottom of structure concrete is broken up, needs repair (Yes/No)
- *Repair Depth* – Measure from bottom of casting to lowest part of damage to structure (does not include invert repair. (Yes/No)
- *Inflow Functions* – Incoming stormwater flow is not obstructed. (Yes/No)
- *Outflow Functions* – Outgoing stormwater flow is not obstructed. (Yes/No)
- *WQ Controls Function* – Water Quality mechanism is working properly. (Yes/No)
- *Chamber Sediment Depth* – Measure depth in Inlet, Outlet and multiple other chambers.
- *Airvents* – Does the SPCD have Airvents? (Yes/No)
- *Airvents Clear* – Are the Airvents open and functioning? (Yes/No)

Pond and Basin-specific Flags and Measures

- *Inflow Functions* – Incoming stormwater flow is not obstructed. (Yes/No)
- *Outflow Functions* – Outgoing stormwater flow is not obstructed. (Yes/No)
- *WQ Controls Function* – Water Quality mechanism is working properly. (Yes/No)
- *Forebay Depth (Ft.)* – Forebay is the tiny pond before the pond. Measure the available depth.
- *Forebay Sediment % Full* – Estimate or measure the proportion of filled Forebay to the total volume in the Forebay.
- *Forebay Sediment Method* – Choose Measured or Visual (estimated).
- *Pond Depth* – Estimate or measure the available depth.
- *Pond Depth Method* – Choose Measured or Visual (estimated).
- *Sediment above Normal Pool* – Sediment shows above the water surface. (Yes/No)
- *Overflow Usage* – Input the frequency that the Pond overflows.
- *Overflow Obstructed/Compromised* – The area that the pond would overflow is blocked or damaged (Yes/No)
- *Repair Embankment* – The pond slopes or embankment are eroded or need repair. (Yes/No)
- *Embankment Trash/Debris* – Slopes or embankment around the pond has trash or debris that should be removed. (Yes/No)
- *Debris in Pond* – Pond has trash or debris that should be removed. (Floating debris can clog outlet Control Structure grate, causing flow over embankment and potential damage). (Yes/No)
- *Invasive Plants* – Pond has bad weeds that should be removed. See County lists of invasive plants. (Yes/No)
- *Trees in Pond/Basin* – Trees are growing up in pond where they shouldn't be. (Yes/No)
- *High Water Mark Observation* – Waterline evidence of highest recent pond level.
- *Encroachment into R/W* – Adjacent landowners are encroaching in Pond Right of Way. (Yes/No)

Inspection Criteria – Roadway Indicators

Factors: Integrity of road fill material related to drainage assets	Flags
Good or Fair Condition ▪ No road settlement ▪ No pavement patching ▪ Road surface not affected	
Poor Condition ▪ Pavement cracking above pipe ▪ Holes in inslope – inslope cavity	 Road Distress Inslope Cavity
Severe Condition ▪ Indications of voids around pipe or loss of road fill including Piping ▪ Settlement of road surface (Road Void) ▪ Holes in road surface caused by pipe or structure condition ▪ Evidence of repeated pavement patching ▪ Inslope failure, slumping, soil cracks parallel to road, ditch headcut	 Piping Road Void Road Void Road Distress

Notes: The general conditions of the roadway and adjacent area are used as clues to help determine the condition rating for each hydraulic asset that is inspected. These general conditions may be indicators of concealed structural problems. Pipe failures with loss of road fill are often visible on road surface.

Inspection Criteria – Concrete Pipe

Factors: Structural integrity, Integrity of surrounding material	Flags
1 Excellent Condition ▪ Like new ▪ May have minor chipping at joints or minor blemishes ▪ *Crack - Not Visible or hairline crack less than 1/100 inch	Cracks-Not Visible
2 Fair Condition ▪ Maximum Joint Separation less than 1 inch – broken or pulled apart anywhere along a joint ▪ *Exposed aggregate (pitting) or surface abrasion less than ¼ inch deep ▪ *Spalling or scaling to ½ inch depth in a patch less than 6 inch diameter ▪ *Lengthwise Crack less than 1/20 inch wide (thickness of one dime) or around the pipe with no infiltration (not wet, stained or deposition) ▪ Pipe is lined and in good condition	Joint Separation Pitting/Rusting Spalling/Flaking Cracks-Crack
3 Poor Condition ▪ Maximum Joint Separation 1-3 inches – broken or pulled apart anywhere along a joint ▪ *Lengthwise crack with width 1/20 to 1/10 inch (thickness of 1 to 2 dimes) ▪ *Spalling or scaling ½ to ¾ inch depth in patch larger than 6 inch diameter ▪ *Abrasion or Spalling ¼ to ½ inch with deeply exposed aggregate or reinforcement beginning to show ▪ Erosion has undermined apron or pipe section at inslope ▪ Apron is separated from pipe but other joints not separated ▪ Inslope cavity ▪ *Water infiltration through cracks (or with rust staining or efflorescence) ▪ Infiltration of soil into pipe causing soil loss from road inslope ▪ Pipe may be causing soil loss beneath road surface	Joint Separation Cracks-Crack Spalling/Flaking Misaligned Erosion Separated Apron Inslope Cavity Infiltration Infiltration Road Distress
4 Severe Condition ▪ Maximum Joint Separation more than 3" – joint is pulled apart or broken at any point along joint (unless only at apron – see condition 3) ▪ *Lengthwise Fracture – crack greater than 1/10 inch wide (width of 2 dimes) ▪ *Fractured crack with displaced pipe pieces ▪ *Exposed and/or corroded steel reinforcement. Reinforcement fully exposed in places ▪ *Widespread spalling more than ¾ inch depth or invert deterioration and loss of pipe wall thickness ▪ *Holes through concrete or bottom gone ▪ *Slabbing – Pipe deformation with cracks and spalling ▪ Piles of soil at joints inside pipe, or any indication that soil infiltrates into pipe under roadway (piping or soil infiltration) ▪ Piping – Water flowing outside of pipe or other evidence of Road Void under road surface or shoulder	Joint Separation Cracks–Fracture or Displaced Spalling Holes Deformation Road Void & Infiltration Piping

Notes:

*Criteria updated to match the NCHRP 14-26 draft 2016 Culvert and Storm Drain Inspection Manual, 06NOV17

Need for cleaning is NOT part of the Overall Condition rating but is noted by 'Clean? = Y' and "Sediment % Full" = >30%

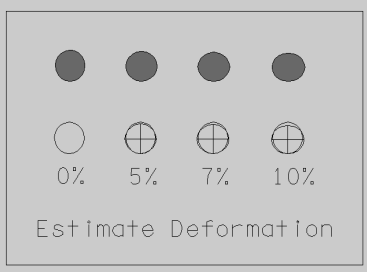
Inspection Criteria – Metal Pipe

Factors: Structural integrity, Integrity of surrounding material	Flags
1 Excellent Condition ▪ Discoloration of surface ▪ Galvanizing intact ▪ No rust or pitting	
2 Fair Condition ▪ Galvanizing gone from invert ▪ Pitting, superficial rust or tight rust flakes ▪ *Deformation less than 10% of original diameter ▪ Pipe is lined and in good condition with no road voids. Grouting has been completed	 Pitting/Rusting Deformation
3 Poor Condition ▪ Flaking rust evident, with some loss of wall thickness ▪ A hole, less than 1 inch in size ▪ *Deformation, deflection or distortion visible, up to 10% 10 to 15% of diameter ▪ *Can poke a hole in pipe with a sharp point or a hammer pick strike ▪ Inslope Cavity – Infiltration of soil into the pipe from road inslope (embankment) ▪ Infiltration of soil into pipe may be causing loss of fill beneath road surface ▪ Erosion has undermined apron or pipe ▪ Apron is separated from pipe or needs replacement	 Spalling/Flaking Holes Deformation Spalling/Flaking Inslope Cavity Road Distress Erosion Separated Apron
4 Severe Condition ▪ Hole 1 inch or greater, or many small holes, or bottom gone ▪ Cracks or tears ▪ *Severe deformation greater than 10% 15% of diameter ▪ Joints separated ▪ Misalignment ▪ Can poke a hole in pipe with a blunt rod ▪ Piping or Road Void – Pipe condition is causing soil loss beneath road surface	 Holes Cracks Deformation Joint Separation Misaligned Spalling/Flaking Piping Road Void

Notes:

*Criteria updated to match the NCHRP 14-26 draft 2016 Culvert and Storm Drain Inspection Manual, 06NOV17Need for cleaning is NOT part of the Overall Condition rating but is noted with a separate “Clean” flag (Clean? = Y) and a “Sediment % Full” value.

Attributes, such as hole-size or deformation %, won’t be measured in most cases – inspectors estimate defects based on what they see from the pipe end.



Inspection Criteria – Dual Wall Plastic Pipe or Liners

Factors: Structural integrity, Integrity of surrounding material (dual-wall HDPE or PP)	**Flags**
1 **Excellent Condition** ▪ Pipe is straight ▪ Joint separation less than 1” ▪ *Deformation less than 5% of original inside diameter	
2 Fair Condition ▪ *Deformation of pipe 5% to 7% of original inside diameter ▪ *Local buckling or rippling in wall. For dual wall HDPE pipe, liner buckling in 2 or fewer areas ▪ *Blistering less than 25% of pipe interior surface ▪ Joint separation less than 3” with no soil infiltration through joints ▪ For dual wall HDPE pipe, circumferential cracking in PE liner only, above flow line and less than 1/4 of circumference, (if crack is below flow line, freeze/thaw may increase damage, use Condition 3) ▪ Minor misalignment and settlement throughout pipe ▪ Pipe is lined and in good condition with no road voids. Grouting has been completed	Deformation Joint Separation Cracks-Crack Misalignment
3 Poor Condition ▪ Significant ponding of water due to sagging or vertical misalignment ▪ *Deformation of pipe 7% to 10% of original inside diameter ▪ For dual wall HDPE pipe, liner buckling in more than 2 areas ▪ *Abrasion more than 10% of wall thickness ▪ *Blistering over more than 25% of pipe interior surface ▪ Joint separation more than 3 inches, but not detached ▪ Evidence of soil infiltration in pipe under inslope ▪ *For dual wall HDPE pipe, circumferential cracking in HDPE liner only, in upper or lower portion of pipe, less than 1/2 of pipe circumference, with no soil infiltration through joints ▪ Erosion has undermined apron or pipe end ▪ Apron is separated from pipe but other joints are not separated ▪ Repair is needed but is not under road	Misalignment Deformation Deformation Joint Separation Infiltration Inslope Cavity Crack-Fracture Separated Apron CIPP delamination
4 Severe Condition ▪ Floated – top of pipe is at or above ground surface ▪ Joint separation allowing soil infiltration under road surface or shoulder ▪ *Deformation greater than 10% of original inside diameter or kinked pipe wall ▪ *For dual wall PE pipe, buckling of liner and exterior shell ▪ Hole through pipe material ▪ *Abrasion more than 25% of wall thickness ▪ *For dual wall PE pipe, circumferential cracking greater than 1/2 of pipe circumference, in the liner only or longitudinal cracks less than 12 inches ▪ *Soil infiltration under road surface or shoulder (including Piping or Road Void) ▪ Burnt – describe in comments	Misaligned Joint Separation Deformation Deformation Holes Cracks Cracks Road Void, Piping Spalling/Flaking

*Criteria updated to match the NCHRP 14-26 draft 2016 Culvert and Storm Drain Inspection Manual, 06NOV17

Inspection Criteria – Single Wall Plastic Pipe or Liners

Factors: Structural integrity, Integrity of surrounding material (PVC or CIPP Liner)	**Flags**
1 Excellent Condition	
▪ Pipe is straight	
▪ Joint separation less than 1”	Max Joint Sep <1
▪ *Deformation less than 5% of original inside diameter	
2 Fair Condition	
▪ *Deformation of pipe 5% to 7% of original inside diameter	Deformation
▪ Joint separation less than 3” with no soil infiltration through joints	Max Joint Separation
▪ Minor misalignment and settlement throughout pipe	Misalignment
▪ Pipe is lined and in good condition with no road voids. Grouting has been completed	
3 Poor Condition	
▪ Significant ponding of water due to sagging or vertical misalignment	Misalignment
▪ *Deformation of pipe 7% to 10% of original inside diameter	Deformation
▪ *Abrasion more than 10% of wall thickness	
▪ Joint separation more than 3 inches, but not detached	Max Joint Separation
▪ CIPP folds or flaps > 1” but not obstructing flow	
▪ CIPP localized delamination	
▪ Pipe condition is causing soil loss of inslope	Inslope Cavity
▪ Any crack in PVC pipe outside of road surface area	Cracks
▪ Erosion has undermined apron or pipe	Erosion
▪ Apron is separated from pipe	Separated Apron
▪ Repair is needed but is not under road	Repair Under Road
4 Severe Condition	
▪ Floated – top of pipe is at or above ground surface	Misalignment
▪ Joint separation allowing soil infiltration under road	Max Joint Sep.
▪ *Deformation greater than 10% of original inside diameter	Deformation
▪ Hole through pipe material	Holes
▪ Any crack in PVC pipe under road surface or shoulder	Cracks
▪ CIPP delamination or gap that allows piping	Piping
▪ *Abrasion more than 25% of wall thickness	
▪ Uncured areas in CIPP walls	Add comments about problems
▪ Incomplete grouting of liner that allows piping	
▪ *Soil infiltration under road surface or shoulder (including Piping or Road Void)	
▪ *Degradation from sunlight – UV caused cracks or broken wall at exposed ends	
▪ Burnt – describe in comments.	

*Criteria updated to match the NCHRP 14-26 draft 2016 Culvert and Storm Drain Inspection Manual, 06NOV17

Inspection Criteria – Open Channel or Ditch

Factors: Vegetation, Erosion (Physical integrity), Flow Capacity or Sediment Deposition	Flags
1 Excellent Condition ▪ Vegetation is well established, without noxious weeds (see county list of Noxious Weeds). ▪ No eroded rills ▪ If it is an Infiltration ditch, ditch is infiltrating water.	
2 Fair Condition ▪ Sediment deposition is visible. ▪ Limited patches of missing vegetation. ▪ Sheet erosion occurring (look for exposed grass roots). ▪ Healed (re-vegetated) rills.	Add comments about problem
3 Poor Condition ▪ Noxious Weeds are present (see county list of Noxious Weeds). ▪ Ditch liner material (geotextile, clay liner, etc.) is damaged. ▪ Ditch grade headcut (ditch bottom is de-grading from downhill to uphill) is occurring – pipe aprons suspended above eroded ditch bottom may be an indicator. ▪ "Infiltration Ditch" (ditch constructed specifically to infiltrate stormwater) has dead vegetation where water ponds. ▪ "Infiltration Ditch" (ditch constructed specifically to infiltrate stormwater) has standing water for more than 3 days in a row.	Add comments about problem
4 Severe Condition ▪ Eroded gully or slope failure presents a hazard to vehicles leaving the roadway or threatens road or embankment integrity. ▪ Sediment <u>in ditch</u> causing water to back up onto upstream or adjacent properties, or onto roadway. (Pipes are most likely the problem – check affected pipes first). ▪ Soil crack in the inslope or shoulder that is parallel to the roadway – indicates a developing slope failure	Add comments about problem

Note:

Need for cleaning is <u>NOT</u> part of the Overall Condition rating but is noted with a separate "Clean" flag (Clean? = Y).

Inspection Criteria – Hydraulic Structure (MH, CB & DI)

Factors: Structural integrity, Integrity of surrounding material	Flags
1 Excellent Condition	
▪ Very minor defects in concrete rings	
▪ None to hairline cracks evident	
▪ None to slight spalling or scaling	
2 Fair Condition	
▪ Pitting or exposed aggregate	Pitting
▪ *Cracks between 0.01" and 0.05"	Crack - Crack
▪ *Evidence of seepage – infiltration of water	Infiltration
3 Poor Condition	Replace Rings
▪ Concrete rings broken, or mortar missing – gaps 1/2" to 1"	Replace Frame or Grate
▪ Grate or Frame is broken	Road Distress
▪ Settlement of pavement or soil adjacent to structure	Spalling/Flaking
▪ *Blocks/bricks flaking/crumbling	Spalling/Flaking
▪ *Spalling or scaling with some exposed reinforcing steel	Spalling/Flaking
▪ *Spalling or scaling ½ to ¾ inch depth in patch larger than 6 inch diameter	Spalling/Flaking
▪ *Abrasion or Spalling ¼ to ½ inch with deeply exposed aggregate or reinforcement shows	Crack-Fracture
▪ *Lengthwise crack with width 1/20 to 1/10 inch (thickness of 1 to 2 dimes)	Crack-Fracture
▪ *Map-cracking	Crack-Infiltration
▪ *Slight gaps in mortar between blocks or bricks of structure	
▪ *Water infiltration through cracks (or rust staining or efflorescence)	
4 Severe Condition	
▪ Voids or depressed pavement adjacent to structure caused by soil infiltration	Road Void
▪ Concrete rings broken or mortar missing with gaps >1"	
▪ *Infiltration of soil	Infiltration
▪ *Holes through structure	Holes
▪ *Blocks/bricks missing	Repair Depth (ft)
▪ *Lengthwise Fracture – crack greater than 1/10 inch wide (width of 2 dimes)	Crack-Fracture
▪ *Fractured crack or Crack with misaligned or displaced sides	Crack-Displaced
▪ *Exposed and/or corroded steel reinforcement (look for rust staining along cracks or holes)	
▪ *Widespread spalling more than ¾ inch depth or crumbling invert	Spalling/Flaking
▪ *Gap at pipe joint	
▪ *Structure settlement that affects structure stability or function (look for out-of-level structures and gaps at pipe connections)	
▪ *Slabbing	Deformed with Crack-Displaced

Notes:
*Criteria updated to match the NCHRP 14-26 draft 2016 Culvert and Storm Drain Inspection Manual, 06NOV17
Attributes such as crack width and spalling depth will not be measured in most cases – inspectors must estimate defects based on what they see from the pipe end. Iron steps are not included in Structure rating. Add inspection comment to describe problems. Need for cleaning is NOT part of the Overall Condition rating but is noted with a separate "Clean" flag (Clean? = Y) and a "Sediment % Full" value.

Inspection Criteria – Other Materials or SPCD

Factors: Structural integrity, Water Quality Functions, Clogging, Integrity of surrounding material	Flags
1 Excellent Condition ▪ Materials are intact.	
2 Fair Condition ▪ Materials have minor defects but the asset is structurally sound. ▪ The asset is functioning properly.	
3 Poor Condition ▪ Materials have defects that may affect function or structural integrity of the asset but can wait for a repair ▪ Repair is needed but is not under road	Repair Under Road = No
4 Severe Condition ▪ Components are broken or not working ▪ Outflow is non-functional ▪ Piles of soil inside asset at the joints, or any indication that soil infiltrates into asset from under roadway (Piping, Road Void) ▪ Materials have severe defects and need repair soon.	Inflow-Outflow-WQ Controls Function = No Piping Road Void

Notes:

SPCD (Structural Pollution Control Device) is an asset built to improve water quality. Examples of SPCDs include Grit Chambers (like a partitioned box), swirling Separators (like Vortech, CDS, Stormceptor, Baysaver, Downstream Defender and other makes) Skimmers and Filters.

When inspecting manufactured SPCDs use inspection criteria from the manufacturer.

"Other Materials" may be any that are not described in Plastic, Metal or Concrete rating criteria. For detailed concrete rating criteria go to Hydraulic Structure – MH, CB & DI criteria.

Need for cleaning is NOT part of the Overall Condition rating but is noted with a separate "Clean" flag (Clean? = Y) and a "Sediment % Full" value.

Factors: Water Quality Functions, Water containment functions – basin integrity/clogging/overtopping, Vegetation	Flags
1 Excellent Condition ▪ Embankment is sound. ▪ Outflow structures are clear of debris and functional ▪ Vegetation is well established, without any noxious weeds (see county list of Noxious Weeds).	
2 Fair Condition ▪ Limited patches of missing vegetation. ▪ Sheet erosion occurring (look for exposed grass roots). ▪ "Healed" (vegetated) rills.	
3 Poor Condition ▪ Evidence of overtopping (flow marks over embankment for example). ▪ Noxious Weeds are present (see county list of Noxious Weeds). ▪ Vegetation missing over 500 sq. ft. or more total area. ▪ Pond or embankment liner material (geotextile, clay liner, etc.) is damaged.	Erosion
4 Severe Condition ▪ Burrows, piping or alternate flow paths through embankment. ▪ Eroded gully or slope failure presents a hazard to vehicles leaving the roadway or threatens road or embankment integrity. ▪ Evidence of pond water backup onto upstream or adjacent properties or onto roadway. ▪ Normal outfall or emergency overflow or is non-functional or is bypassed.	Piping Erosion

Note:

Need for cleaning is NOT part of the Overall Condition rating but is noted with a separate "Clean" flag (Clean? = Y) and a "Sediment % Full" value.

Wet Pond

Factors: Infiltration and Filtration Functions, Water Quality Functions, Water containment functions – basin integrity/clogging/overtopping, Vegetation	Flags
1 Excellent Condition ▪ Embankment is sound. ▪ Outflow structures are clear of debris and functional ▪ Vegetation is well established, without any noxious weeds (see county list of Noxious Weeds).	
2 Fair Condition ▪ Limited patches of missing vegetation. ▪ Sheet erosion occurring (look for exposed grass roots). ▪ "Healed" (vegetated) rills.	
3 Poor Condition ▪ Evidence of overtopping (flow marks over embankment for example). ▪ Noxious Weeds are present (see county list of Noxious Weeds). ▪ Vegetation missing over 500 sq. ft. or more total area. ▪ Pond or embankment liner material (geotextile, clay liner, etc.) is damaged. ▪ Infiltration pond has dead vegetation where water stands. ▪ Infiltration pond has standing water for more than 3 days in a row.	Erosion
4 Severe Condition ▪ Burrows, piping or alternate flow paths through embankment. ▪ Eroded gully or slope failure presents a hazard to vehicles leaving the roadway or threatens road or embankment integrity. ▪ Evidence of pond water backup onto upstream or adjacent properties or onto roadway. ▪ Normal outfall or emergency overflow or is non-functional or is bypassed.	Piping Erosion

Note:

Need for cleaning is NOT part of the Overall Condition rating but is noted with a separate "Clean" flag (Clean? = Y) and a "Sediment % Full" value.

Filtration Basin

MS4-related

MnDOT MS4 information

Information about MnDOT's MS4 program is available at http://www.dot.state.mn.us/environment/ms4/index.html

Outfall identification

An MS4 Outfall is a drainage conveyance where MnDOT stormwater permanently leaves MnDOT right of way or merges with a natural water (lake, stream, wetland, county ditch, etc.) and is located within a MnDOT MS4 boundary.

Outfalls should be inspected for Illicit Discharges so that pollutants can be traced back to the source and eliminated. In TAMS, an MS4 Outfall is designated by checking both "Report MS4" and "Outfall" fields.

Underground Outfalls are any structures or inaccessible pipes where stormwater permanently leaves MnDOT right of way and goes into another municipal storm drain system. Underground Outfalls do not require MS4 inspections. Structures or pipes are designated in TAMS-HydInfra as Underground Outfalls with these data fields:

- Local Name: add "Underground Outfall" to the name
- Outfall flag = Yes
- Inspect for MS4 = No (is unchecked)

MS4 Outfalls are to be inspected once every 5 years if not underground.

MS4 Outfall

MS4 Outfalls do not include diffuse runoff (sheet flow) or natural waters passing through MnDOT Right of Way or municipal storm drains passing through MnDOT Right of Way without MnDOT inputs.

Illicit Discharge reporting

Illicit Discharge is a polluted inflow, or deposit of polluting materials liquid or solid, that can be transported to natural waterways.

Look for:

- Unexpected pipes coming into the highway storm drain system.
- Pipes flowing when storm drains should not be.
- Suspicious odors, floatables, colors or opaque water. (Do not sniff out an odor – your first impression is sufficient. Some substances are damaging to inhale.)
- Deposits of dumped or otherwise deposited polluting materials.

Report suspected Illicit Discharge to your District Contact within 24 hours for follow up.

Report accidental spills from trucks to District Dispatch, who forwards incident to MPCA Duty Officer. Spill is cleaned up by trucking company's contractor and not reported as Illicit Discharge.

References

Get the current HydInfra Inspection Manual from the MnDOT HydInfra webpage http://www.dot.state.mn.us/bridge/hydraulics/hydinfra.html

HydInfra Inspection criteria incorporates criteria from the NCHRP 14-26 research project which produced the draft for the soon-to-be published AASHTO Manual. NCHRP 14-26 drew from HydInfra ideas – compare NCHRP 14-26 Section 4 Condition Rating System to page 1 of this manual and the "Other Materials" criteria. HydInfra differs from the NCHRP14-26 draft manual because we use descriptive inspection flags and measures to describe defects, rather than a numerical rating for each culvert component. Special or Damage Inspections with the 2020 AASHTO manual can be recorded in TAMS-HydInfra.

HydInfra condition ratings compared to the 1986 Culvert Inspection Manual 9 to 0 rating scale is available here: HydInfra ratings compared to NBIS.pdf

Minnesota culverts larger than 10 ft span are bridges inspected in MnDOT SIMS database. See FHWA Bridge Inspector's Reference Manual Chapter 14 http://www.dot.state.mn.us/bridge/pdf/insp/birm/birmchapt14-inspofculverts.pdf

MnDOT Consultant As-Built information is at: http://www.dot.state.mn.us/gisspec/methods/drainage.html

Consultant Pre-Qualification at MnDOT is at: http://www.dot.state.mn.us/consult/prequal.html Look for Work Type 13.0

MnDOT uses TAMS-HydInfra in these initiatives:

- Transportation Asset Management Plan (TAMP) http://www.dot.state.mn.us/assetmanagement/tamp.html
- Project Selection http://www.dot.state.mn.us/projectselection/
- CIMS (Corridor Investment Management Strategy) http://www.dot.state.mn.us/cims/
- Performance Measures https://www.dot.state.mn.us/measures/index.html
- MS4 permit reporting http://www.dot.state.mn.us/environment/ms4/index.html
- GSOC (Gopher State One Call) www.gopherstateonecall.org
- MnDOT Permit Reviews http://www.dot.state.mn.us/utility/
- Scoping for construction project design
- Maintenance repair planning and Drainage Performance Measures http://ihub/bridge/hydraulics/DrainagePerformanceMeasure.html

Learn about culvert hydraulics from these FHWA videos: Hydraulic Engineering: Open Channel Flow and Culvert Hydraulics Demonstration Series (turn on "CC" closed captions)

District Contacts

District	Contact	Phone
Metro District	Metro Dispatch	651-234-7500
District 1	Matt Meyer, Duluth	218-725-2758
District 2	District 2 Hydraulics Engineer, Bemidji	218-755-6500
District 3	Robert Miller, Hydraulics Engr, Baxter	218-828-5700
District 4	District 4 Hydraulics Engr, Detroit Lakes	1-800-657-3984
District 6	District 6 Hydraulics Engineer, Rochester	507-286-7692
District 7	Scott Morgan, Hydraulics Engr, Mankato	507-304-6210
District 8	District 8 Hydraulics Engineer, Willmar	1-800-657-3792