# HydInfra Inspection Manual

## Culvert and Storm Drainage Systems

### Condition Rating Codes:

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Excellent – like new condition</td>
</tr>
<tr>
<td>2</td>
<td>Fair – some wear, but structurally sound</td>
</tr>
<tr>
<td>3</td>
<td>Poor – deteriorated, consider for repair or replacement</td>
</tr>
<tr>
<td>4</td>
<td>Severe – serious deterioration</td>
</tr>
<tr>
<td>0</td>
<td>Not able to rate, not visible</td>
</tr>
</tbody>
</table>

### Notes:

- This guide is used to rate the condition of culverts, where the pipe (or installations of more than one pipe) is less than 10 feet wide as measured along the centerline of roadway, or any storm drainage system features.
- The worst defect found in a feature determines its condition rating. (Refer to condition rating criteria on pages x to x).
- Drainage features 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.

---

*HydInfra* Terms, Flags and Measures

**Illustrated Guide to the HydInfra Manual**

2018 October
Culvert failure under new pavement looks like this:

Photo by HydInfra Inspector Brad Fredin
October 2018, MN55 project
HYDINFRA is Mn/DOT’s Hydraulic Infrastructure Inspection Program
Stipulations:

• This guide is used to rate the condition of culverts less than 10 feet wide or any storm drainage system features.

• The worst defect found in a feature determines its condition rating.

• Drainage features are rated on structural integrity and ability to perform their functions.

• Need for cleaning is NOT part of the Condition rating.

• Phone in unsafe road problems to Maintenance Area Supervisor immediately.
Index to HydInfra Inspection Manual

<table>
<thead>
<tr>
<th>Page</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HydInfra Condition Rating Codes (on cover)</td>
</tr>
<tr>
<td>2</td>
<td>Information about this Manual</td>
</tr>
<tr>
<td>3</td>
<td>Index (this page)</td>
</tr>
<tr>
<td>4</td>
<td>Asset Type: Pipes and Channels</td>
</tr>
<tr>
<td>5</td>
<td>Asset Type: Hydraulic Structures: MH, CB, DJ; SPCD; Special Features</td>
</tr>
<tr>
<td>6</td>
<td>Asset Type: Ponds and Basins</td>
</tr>
<tr>
<td>7</td>
<td>Is it a Bridge or a Culvert?</td>
</tr>
<tr>
<td>8</td>
<td>Is it Storm Drain Pipe or Culvert?</td>
</tr>
<tr>
<td>9</td>
<td>Roadway Types and Highway Culverts defined</td>
</tr>
<tr>
<td>10</td>
<td>Drainage Performance Measures for Highway Culverts</td>
</tr>
<tr>
<td>11</td>
<td>Pipe Shape</td>
</tr>
<tr>
<td>12-13</td>
<td>List of Inspection Flags and Measures</td>
</tr>
<tr>
<td>15-25</td>
<td>Definitions – HydInfra Flags and Measures</td>
</tr>
<tr>
<td>26</td>
<td>Materials Identification</td>
</tr>
<tr>
<td>27</td>
<td>Roadway Indicators</td>
</tr>
<tr>
<td>28</td>
<td>Concrete Pipe Rating Criteria</td>
</tr>
<tr>
<td>29</td>
<td>Metal Pipe Rating Criteria</td>
</tr>
<tr>
<td>30</td>
<td>Plastic Pipe – Dual-Wall Rating Criteria</td>
</tr>
<tr>
<td>31</td>
<td>Plastic Pipe – Liners, PVC or single wall Rating Criteria</td>
</tr>
<tr>
<td>32</td>
<td>Ditch Rating Criteria</td>
</tr>
<tr>
<td>33</td>
<td>Structure Concrete (MH, CB, DJ, SPCD, Special Feature) Rating Criteria</td>
</tr>
<tr>
<td>34</td>
<td>Other Materials, SPCD or Special Feature Rating Criteria</td>
</tr>
<tr>
<td>35</td>
<td>Pond Rating Criteria</td>
</tr>
<tr>
<td>36</td>
<td>Basins – Infiltration or Filtration Rating Criteria</td>
</tr>
</tbody>
</table>

MS4-Related

| 36   | Illicit Discharge Identification |
| 37   | Outfall Identification |

District Contacts

| 36   | District Phone Numbers for Immediate Reporting |
Not HydInfra if there’s a Bridge No.

MN State Law defines Bridges as 10 foot span or greater. If it has no Bridge number, email Lisa.Hartfiel@state.mn.us
It’s a bridge – not a HydInfra Culvert – if two or more culverts’ total Span* is 10 feet or greater and the gap between pipes is less than half the smaller pipe’s interior diameter.

Two 8 ft. wide culverts with a five ft. space between them would not be a “bridge”.

Two 6 ft. wide culverts with a 2 ft. space between them would be a “bridge”.

*Span is measured along road centerline so a skewed culvert’s span is wider than the measured pipe width.
Status

Active Assets

• Inplace: working, in the ground
• Proposed: recorded from plan data
• Review Status: check Status

• Abandoned: plugged and left in ground
• Removed: taken out of ground
• Duplicate: if 2 records for one pipe
Status: **Abandoned**

is plugged and left in the ground

Status: **Removed**

is taken out of the ground
TAMS Work Order Management module does not change HydInfra record

- After repair, Insert a new inspection
- After replacement, change old pipe Inventory record to “Removed” and Insert a new pipe Inventory

Metro District drainage repairs will be updated in TAMS-HydInfra by WRE.
TAMS Asset Types

- **Line features – Pipes**
  - Culverts
  - Storm Drain
  - Open Channels
  - Drain Tile

- **Point features – Structures**
  - Structures MH, CB and Drop Inlet
  - SPCDs (Water Quality Devices)
  - Special Features

- **Polygon features – Ponds**
  - Pond or
  - Basin
TAMS-HydInfra Assets:

- **Pipes** -- Class Codes: Culverts (less than 10 foot span); Storm Drain; Open Channels; Drain Tile

- **Structures** -- Class Codes: Structures (Manholes, Catchbasins, Drop Inlets); SPCDs; or “Special Features” catchall

- **Ponds** (Class Codes: Ponds or Infiltration Basins)
### HydInfra Asset – Pipes and Channels (line features)

<table>
<thead>
<tr>
<th>Class Codes</th>
<th>Descriptive Fields</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culverts</td>
<td>End Sections</td>
<td>End Sections are aprons or safety aprons or box end sections or none</td>
</tr>
<tr>
<td></td>
<td>Extensions</td>
<td>Extensions describe additional materials, sizes or shapes of pipe</td>
</tr>
<tr>
<td></td>
<td>Components</td>
<td>Components describe added parts like fish passage or dissipater rings</td>
</tr>
<tr>
<td></td>
<td>Current pipe</td>
<td>Current pipe describes the inner pipe</td>
</tr>
<tr>
<td></td>
<td>Original pipe</td>
<td>Original pipe describes the outer or host pipe if lined, or same as current</td>
</tr>
<tr>
<td>Storm Drain</td>
<td>End Sections</td>
<td>End Sections are aprons or safety aprons or box end sections or none</td>
</tr>
<tr>
<td></td>
<td>Extensions</td>
<td>Extensions describe additional materials, sizes or shapes of pipe</td>
</tr>
<tr>
<td></td>
<td>Components</td>
<td>Components describe added parts like fish passage or dissipater rings</td>
</tr>
<tr>
<td></td>
<td>Current pipe</td>
<td>Current pipe describes the inner pipe</td>
</tr>
<tr>
<td></td>
<td>Original pipe</td>
<td>Original pipe describes the outer or host pipe if lined, or same as current</td>
</tr>
<tr>
<td></td>
<td>Pipe Type</td>
<td>Pipe Type includes Slotted Drain, Gasketed, Non-gasketed, Open Flume</td>
</tr>
<tr>
<td>Open Channels</td>
<td>Pipe Type</td>
<td>Pipe Type includes Open Flume</td>
</tr>
<tr>
<td>Drain Tile</td>
<td>Material</td>
<td>Material list includes Perforated Plastic</td>
</tr>
</tbody>
</table>
Inventory data fields describe the Pipe

- End Section Upstream (apron)
- "Original Pipe" or host pipe
- Current Pipe can be Liner

Component:
- Bend
- Original Pipe
- Component: Increaser/Reducer
- Extension with a different size
- Component: Internal Energy Dissipater
- Extension
- Extension
- Extension
- End Section Downstream

1. Original material was first pipe
2. Current Pipe is same as original or is Liner
3. End Sections are part of Pipe (aprons)
4. Extensions are different materials or sizes from current pipe
5. Components are Bends, Reducers, Internal Energy Dissipaters

Describe a complex pipe in TAMS
Choose Pipe Class Code

Is it a **Culvert** or Storm Drain Pipe?

A culvert has 2 open ends and carries water across the road

Storm Drain has pipes and catchbasins that carry storm water off of road surface
Pipe Type

includes

- Slotted Drain
- Open Flume
- Gasketed
- Non-gasketed
Pipe Type: **Open Flume**
carries water down a slope in a special channel

Onlookers get a close-up view of construction
Pipe Shape

Most Common Pipe Shapes

- Round
- Arch
- Box

- Elliptical
- CattlePass

- Waterway (ditch or channel)
- Other
- Do not use Tunnel- shapes
Names for parts of a pipe

- Crown
- Joint
- Pipe Section
- Invert
- Spring-line
- Cover (Fill over pipe)
- Haunch
Clock time to describe defect locations

Hole or broken joint at 4 o’clock

Longitudinal crack at 6 o’clock
<table>
<thead>
<tr>
<th>Asset Class</th>
<th>HYD_STRUCTURE_TYPE_NAME</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure</td>
<td>Buried Manhole</td>
<td>Buried MH is hidden beneath surface</td>
</tr>
<tr>
<td></td>
<td>Catch Basin</td>
<td>CB structure has grate with inflow from pavement</td>
</tr>
<tr>
<td></td>
<td>Deck Drain</td>
<td>Deck Drain captures flow on a bridge</td>
</tr>
<tr>
<td></td>
<td>Diverter</td>
<td>Diverter structure splits or changes flow</td>
</tr>
<tr>
<td></td>
<td>Drop Inlet</td>
<td>DI captures drainage in ditch or swale</td>
</tr>
<tr>
<td></td>
<td>Inspection Tee</td>
<td>Inspection Tee is opening to view or maintain structure</td>
</tr>
<tr>
<td></td>
<td>Manhole</td>
<td>MH structure is a solid-top junction with no inflow</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>Other may be an odd type of storm drain structure</td>
</tr>
<tr>
<td>SPCD</td>
<td>SPCD - Filter</td>
<td>Filter uses sand, gravel or screens to separate sediment</td>
</tr>
<tr>
<td></td>
<td>SPCD - Grit Chamber</td>
<td>Grit Chamber has multiple cells to drop out sediment</td>
</tr>
<tr>
<td></td>
<td>SPCD - Infiltration Device</td>
<td>Infiltration device distributes water to gravel area below</td>
</tr>
<tr>
<td></td>
<td>SPCD - Separator</td>
<td>Separator swirls inflow to spin out cleaner outflow</td>
</tr>
<tr>
<td></td>
<td>SPCD - Skimmer</td>
<td>Skimmer holds back floatable debris and oils</td>
</tr>
<tr>
<td></td>
<td>SPCD - Sump MH</td>
<td>Sump manhole has pit in bottom to store some sediment</td>
</tr>
<tr>
<td></td>
<td>SPCD - Sump MH with Baffle</td>
<td>Baffle in Sump MH is a plate with holes to prevent re-suspension of sediment</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>Other may be an odd type of water quality device</td>
</tr>
<tr>
<td>Special Feature</td>
<td>SpecFeat - Ditch Block</td>
<td>Ditch Block is a tiny dam to divert water to a pipe</td>
</tr>
<tr>
<td></td>
<td>SpecFeat - Energy Dissipater</td>
<td>Energy Dissipater, usually of concrete, tumbles flow</td>
</tr>
<tr>
<td></td>
<td>SpecFeat - Floodgate</td>
<td>Floodgate caps downstream pipe end when it floods</td>
</tr>
<tr>
<td></td>
<td>SpecFeat - Overflow</td>
<td>Overflow structure handles highwater outflows</td>
</tr>
<tr>
<td></td>
<td>SpecFeat - Riprap</td>
<td>Riprap is broken rocks to dissipate flow velocity</td>
</tr>
<tr>
<td></td>
<td>SpecFeat - Weir</td>
<td>Weir is a partition designed to overflow at specific level</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>Other is a strange structural asset not specifically listed</td>
</tr>
</tbody>
</table>
Structure Terms
for Types: Catchbasin, Manhole and Drop Inlet

**Structure Height** – Measure from top of grate to bottom of invert

**Repair Depth** – Measure from bottom of casting to bottom of the needed repair

**Connected Pipes** – number of pipes attached to the structure

**Sump** – a basin below the outgoing pipe that is deeper than 1 foot

**Deteriorated Rings** – The adjusting rings (= layers below the iron casting assembly) are broken or cracked. Rings may also have missing mortar.
Inside the structure, **rings** are below steel casting

Manhole (solid cover) with 3 rings
Class Code Structure

- Catchbasin - CB
- Manhole - MH
- Drop Inlet - DI

And less common:
- Buried Manhole
- Control Structure
- Deck Drain
- Diverter
- Inspection Tee
Class Code: Structure
Structure Type: Special Feature

What is the purpose? Special Features are odd structures with a purpose.

Structure Types for Special Feature:
- SpecFeat - Ditch Block
- SpecFeat - Energy dissipater
- SpecFeat - Floodgate
- SpecFeat - Overflow
- SpecFeat - Riprap
- SpecFeat - Weir

Historic photos from S:\Hydraulics\photos\Slide Scanning Photos\Scanned Hydraulics Slides\B22
Structure Class Code: SPCD is a water quality device
## Asset Type Pond

<table>
<thead>
<tr>
<th>HYD_POND (polygon features)</th>
<th>Class Code</th>
<th>Pond/Basin Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pond</td>
<td></td>
<td>Dry Pond</td>
<td>Dry pond has outlet elevation at pond bottom and drains dry</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mitigation Wetland</td>
<td>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</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Natural Wetland</td>
<td>Natural Wetland identifies a pre-existing wetland protected by Minnesota or Federal law</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unknown</td>
<td>Unknown type is used when the type is unidentified.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wet Pond</td>
<td>Wet pond normally has water up to the level of the outlet structure</td>
</tr>
<tr>
<td>Basin</td>
<td></td>
<td>Filtration Basin</td>
<td>Filtration Basins might have draintile that allows drawdown between rainfalls.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Infiltration Basin</td>
<td>Infiltration Basins are built to leak into the ground until dry. They normally have living plants on basin bottom.</td>
</tr>
</tbody>
</table>

**Class Code:** Pond or Basin
Pond or Basin
(Class Code)

Ponds are designed to detain or retain water and slow the outflow.

Basins are designed to filter or infiltrate stormwater.
Accurate identification of pipe material is essential to tracking material performance.
Material: Liner

describes a Lined Pipe

Use Activity “Liner” only when liner is first installed
Roadway Type
(also known as culvert type)

Highway Culverts
Side Culverts
Not Culvert

Mainline (Storm drain)

Centerline
Crossover
Field Entrance
Farm Entrance
County Road
City Road
Township Road
Frontage
Entrance

Ramp/Loop
Median
Roadway Types:
Centerline and Ditch Block
(not Median because it doesn’t cross the lanes of traffic)

Clarification question and Sketch by Katie Westphal WSP_PB
Performance Measures

Highway Culvert
Inspection Cycle and Condition Targets
**Inspection Cycle for Drainage Performance Measure**

<table>
<thead>
<tr>
<th>Recommended Inspection Frequency for Highway Culverts*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overall Condition</strong></td>
</tr>
<tr>
<td>4 - Very Poor</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>3 - Poor</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>1 - Like New or</td>
</tr>
<tr>
<td>2 - Fair</td>
</tr>
<tr>
<td>0 - Can't be Rated</td>
</tr>
<tr>
<td>Pipes with no</td>
</tr>
<tr>
<td>inspections</td>
</tr>
</tbody>
</table>

Overall Target: 80% of Highway Pipes meet Recommended Inspection Frequency

*Highway Culverts included in the Drainage Performance Measure are HydInfra pipes where:
  - Class Code is Culvert;
  - Roadway Type is Centerline, Collector/Distribut, Mainline, Median or Ramp/Loop;
  - Owner is not City, County or Private;
  - Status is Inplace or Proposed
Condition Codes
Condition Code defines the **Structural Integrity** of a feature (is it broken? or not)

<table>
<thead>
<tr>
<th>Condition Rating Codes:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Like new</td>
<td>1</td>
</tr>
<tr>
<td>Still okay</td>
<td>2</td>
</tr>
<tr>
<td>Fix in project</td>
<td>3</td>
</tr>
<tr>
<td>Fix it sooner</td>
<td>4</td>
</tr>
<tr>
<td>Unknown</td>
<td>0</td>
</tr>
</tbody>
</table>
What makes a pipe condition 4?
(See Inspection Criteria, page 27 – 36)

- Pipe condition is causing soil loss, or loss of support, beneath road surface
- Concrete - Joints pulled apart or broken – more than 3”
- Metal – One hole greater than 1”, or many small holes
- Plastic – Deformation > 10% of original inside diameter
- Repairs are needed sooner rather than later
Condition 0: Unknown

Not Accessible
or
Underwater
or
Under Dirt

- But, if you see serious defects from criteria, rate it 3 or 4.
- Don’t overwrite condition 3 or 4 rating with a 0.
- Flags are mostly left blank, except Water, Sediment, etc.
Capture Defects with Inspection

Flags and Measures
### HydInfra Inspection Manual

#### Culvert and Storm Drainage Systems

### Inspection Flags and Measures

<table>
<thead>
<tr>
<th>Condition Indicators</th>
<th>Images</th>
</tr>
</thead>
<tbody>
<tr>
<td>Needs Repair?</td>
<td>Needs Repair</td>
</tr>
<tr>
<td>Repair under Road</td>
<td>Repair Under Road</td>
</tr>
<tr>
<td>Piping</td>
<td>Piping</td>
</tr>
<tr>
<td>Cracks</td>
<td>Cracks</td>
</tr>
<tr>
<td>Holes</td>
<td>Holes</td>
</tr>
<tr>
<td>Deformation</td>
<td>Deformation</td>
</tr>
<tr>
<td>Misalignment</td>
<td>Misalignment</td>
</tr>
<tr>
<td>Spalling/Flaking</td>
<td>Spalling/Flaking</td>
</tr>
<tr>
<td>Pitting/Rusting</td>
<td>Pitting Rusting</td>
</tr>
<tr>
<td>Joints Separated*</td>
<td>Joints Separated</td>
</tr>
<tr>
<td>Maximum Joint Separation</td>
<td>Max Joint Sep</td>
</tr>
<tr>
<td>Number of Separated Joints</td>
<td># Joints to Fix</td>
</tr>
<tr>
<td>Separated Apron</td>
<td>Apron Separated</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Roadway Indicators</th>
<th>Images</th>
</tr>
</thead>
<tbody>
<tr>
<td>Void in Road</td>
<td>Road Void</td>
</tr>
<tr>
<td>Road Distress</td>
<td>Road Distress</td>
</tr>
<tr>
<td>Inslope Cavity</td>
<td>Inslope Cavity</td>
</tr>
<tr>
<td>Erosion/Scour</td>
<td>Erosion</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Not in Condition Rating</th>
<th>Images</th>
</tr>
</thead>
<tbody>
<tr>
<td>Needs Clean?</td>
<td>Needs Clean</td>
</tr>
<tr>
<td>Plugged</td>
<td>Plugged</td>
</tr>
<tr>
<td>Sediment % Full</td>
<td>Silt</td>
</tr>
<tr>
<td>Water % Full</td>
<td>Water</td>
</tr>
<tr>
<td>Typical Water Flow</td>
<td>Typical Water Flow</td>
</tr>
</tbody>
</table>

---

**What’s bad and how bad is it?**

---

**4-6 Definitions**
Choose the Flags that best describe the defects

Not all defects have flags to match.

Use Comments to describe the odd ones.
Needs Repair?
– Does this feature need to be repaired?

- Y or N (what we call a “Flag”)
- Condition 3 or 4 is always Yes
- Condition 1 or 2 pipes are good and don’t need repair
Repair under Road –
If a repair is needed, and the needed repair is located between the two shoulder PI’s

Shoulder P.I. is the point of intersection where the shoulder and inslope meet.
Repair under Road --

No
(not under road)

Yes
(is under road)

Shoulder P.I. is the dividing line.
Pitting/Rusting –
Small pits are visible in the surface of the pipe, or if metal, rusted but still solid.
Spalling/Flaking – Flat chips of concrete are lost from feature’s surface or if metal, flakes of rust are falling away.
Cracks –

- Not Visible
- Crack
- Fracture
- Displaced
- Unknown
- (don’t use Yes)
Holes –
Hole goes completely through the asset’s material.
Separated Joints —
The joints between two pipe sections are separated (lengthwise) and may be allowing soil to filter through.

Max Joint Separation –

# Joints to Fix –

Separated Apron –
Max Joint Separation –
Estimate or measure the largest separation between pipe sections
Max. Joint Separation in Concrete

**JOINTS IN**

**NON-GASKETED PIPE**

STD. PLATE 3000

**JOINTS IN**

**GASKETED PIPE**

STD. PLATE 3006

24” pipe example

**Estimate gap between pipe sections**
# Joints to Fix –
Count the number of joints that are separated by 1 inch or more, or have evidence of soil infiltrating the joints.
Separated Apron –
Describe which end of pipe has a separated apron

- Inlet
- Outlet
- None
- Other
- Both

Inslope cavities caused by apron and joint separations are hazardous for mowers. Most are not obvious like this one is.
Misalignment –
The pipe sections are offset and alignment is bad.

Estimate number of inches pipe is out of alignment
Deformation –
Feature’s shape is distorted, flattened or oval-ed.

Deformed Concrete pipe also has cracks, spalling, slabbing.
Estimate Deformation in HDPE Pipe

- Photo shows about 5% Deformation (rotated)

Then apply Plastic rating criteria (pg. 30 and 31) for Condition Rating.
Sediment Percent Full –
Estimate of sediment inside pipe compared to pipe height
Infiltration –
Evidence that soil or water is seeping into pipe.
Piping – Water is flowing along the outside of pipe (causes loss of soil in roadbed).

TH27 ST309+00 RP196.319. H2O is piping under Apr. and 1st section of pipe and entering thru large holes in pipe bottom.

Gap outside of pipe allows water to carry road fill away.
This is what **piping** looks like – water leaves the pipe at holes or joint separations and flows along the outside.
**Deter. Ties (Deteriorated Ties)** – Pipe ties are rusted or broken, may not hold pipe joints together.

A good tie bolt looks like this:
Deteriorated Rings — The adjusting rings (layers below the iron casting assembly) are broken or cracked or Rings have missing mortar.
Roadway Indicator Flags

- **Inslope Cavity** – A cavity or hole in the inslope of the roadway above an apron or pipe joint. Usually found in areas where joint separation has occurred.

- **Road Distress** – Pavement problem – Road Bump, Dip, Pavement Patch or Cracks (indicators of possible loss of roadbed through a poor condition pipe or structure).

- **Void in Road** – Evidence of a loss of soil from the road around or near the pipe or other feature.

- **Erosion** (or Scour) – Erosion or channel degradation has occurred as evidenced by a gully or loss of vegetation, caused by water flows.
Inslope Cavity –
A cavity or hole in the inslope of the roadway above an apron or pipe joint. Usually found in areas where joint separation has occurred.

Separated aprons affect the inslope, so are rated Condition 3. Condition 3 Highway Culverts only need inspections once every 4 years (that’s not terribly often).

Separated aprons can be the first stage in major problems that can accelerate during a big rainstorm.
Road Distress –
Pavement problem – Road Bump, Dip, Pavement Patch or Cracks (indicators of possible loss of roadbed through a poor condition pipe or structure).
Void in Road – Evidence of a loss of soil from the road around or near the pipe or other feature.
Void in grout between slipliner and host pipe allows continued Piping and Road Void

Photos from Ohio DOT Office of Hydraulic Engineering, Jeffrey E. Syar, P.E., 11AUG17
Erosion (or Scour) – Erosion or channel degradation has occurred as evidenced by a gully or loss of vegetation, caused by water flows.
Condition Code does not include the need for cleaning

Need for cleaning is defined by:

- Clean = Y
- Sediment % Full = “30%” or greater
- Plugged = Y indicates severe problem
- Silt = Y indicates something is covering the pipe invert, not a need for cleaning by itself
Needs Clean? –
Does this feature need to be cleaned?

- Yes, if Pipe is 30% or more full of sediment.
- Sediment or Debris will impede drainage.
- Or Plugged flag = Y
Plugged –
Something is in pipe causing water to backup or restrict the water flow.
Water Observed —
Describe the typical water situation in the pipe:

- Dry (usually has no water)
- Slow
- Fast
- Standing
- Full
- Saturated Soils
Condition Rating Criteria
Roadway Indicators are Clues to Pipe’s Condition

### HydInfra Ratings Guide

#### Roadway Indicators

<table>
<thead>
<tr>
<th>Factors: Integrity of road fill material related to drainage features</th>
<th>Flags and Images</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Good or Fair Condition</strong></td>
<td></td>
</tr>
<tr>
<td>- No road settlement</td>
<td></td>
</tr>
<tr>
<td>- No pavement patching</td>
<td></td>
</tr>
<tr>
<td>- Road surface not affected</td>
<td></td>
</tr>
</tbody>
</table>
| **Poor Condition** | Road Distress  
Inslope Cavity |
| - Pavement cracking above pipe (road distress) |  |
| - Holes in inslope (inslope cavity) |  |
| **Very Poor Condition** | Piping  
Road Void  
Road Distress |
| - Voids around pipe (piping) |  |
| - Settlement of road surface (void in road) |  |
| - Holes in road surface caused by pipe or structure condition (void in road) |  |
| - Evidence of repeated pavement patching |  |

**Notes:**
The general conditions of the roadway and adjacent area are used as clues to help determine the condition rating for each hydraulic feature that is inspected. These general conditions may be indicators of concealed structural problems.
Road surface may indicate condition of pipe

MN 95 near MP 89, near Marine on the St. Croix
Road Surface may indicate pipe condition

6’ x 6’ box in Owatonna
A soil crack parallel to road could give an early indication of slope failure
(US 8 April 2016)

Photos by Oakdale Surveys
If the structure is not made of Concrete use rating criteria for other materials.

<table>
<thead>
<tr>
<th>Structure (MH, CB &amp; DI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factors: Structural integrity, Integrity of surrounding material</td>
</tr>
</tbody>
</table>

1. **Excellent Condition**
   - Very minor defects in concrete rings
   - None to hairline cracks evident
   - None to slight spalling or scaling

2. **Fair Condition**
   - Some mortar missing at concrete rings
   - Pitting of pre-cast concrete
   - Aggregate is visible
   - Spalling or scaling to 1/4 inch depth
   - Cracks less than 1/8 inch
   - Evidence of infiltration of water or soil

3. **Poor Condition**
   - Concrete rings broken, or mortar missing – gaps 1/2” to 1”
   - Settlement of pavement or soil adjacent to structure
   - Reinforcement shows
   - Blocks/bricks flaking/crumbling
   - Cracking evident with widths 1/8 - 1/4 inch
   - Spalling or scaling > 1/4 inch depth

4. **Very Poor Condition**
   - Concrete rings broken or mortar missing – gaps >1”
   - Voids in soil or depressed pavement adjacent to structure, caused by infiltration
   - Structure settlement that affects structure stability or function
   - Extensive exposure of reinforcement
   - Cracks that show movement (misaligned pieces)
   - Blocks/bricks missing
   - Holes through the structure
Plastic criteria includes:
HDPE, PVC, CIPP, SRPE, Polypropylene

### HydInfra Ratings Guide

#### Plastic Pipe or Liners – HDPE or PVC or CIPP

<table>
<thead>
<tr>
<th>Factors: Structural integrity, Integrity of surrounding material</th>
<th>Flags and Images</th>
</tr>
</thead>
</table>

1. **Excellent Condition**
   - Pipe is straight
   - Joint separation less than 1”
   - Deformation less than 5% of original inside diameter

   ![Image of flags and percentage estimates]

2. **Fair Condition**
   - Deformation of pipe 5% to 7% of original inside diameter
   - For dual wall HDPE pipe, liner buckling in 2 or fewer areas
   - 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

<table>
<thead>
<tr>
<th>Deformation</th>
<th>Joint Separation</th>
<th>Cracks</th>
<th>Misalignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Image of flags and images]</td>
<td>![Image of flags and images]</td>
<td>![Image of flags and images]</td>
<td>![Image of flags and images]</td>
</tr>
</tbody>
</table>
### Poor or Very Poor Plastic

#### 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
- Joint separation more than 3 inches, but not detached
- Evidence of soil infiltration in pipe
- Pipe condition is causing soil loss in road shoulder
- Any crack in PVC pipe outside of road surface area
- 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
- Apron is separated from pipe
- Repair is needed but is not under road

<table>
<thead>
<tr>
<th>Misalignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deformation</td>
</tr>
<tr>
<td>Joint Separation</td>
</tr>
<tr>
<td>Infiltration</td>
</tr>
<tr>
<td>Inslope Cavity</td>
</tr>
<tr>
<td>Cracks</td>
</tr>
<tr>
<td>Cracks HDPE</td>
</tr>
<tr>
<td>CIPP delamination</td>
</tr>
<tr>
<td>Separated Apron</td>
</tr>
</tbody>
</table>

#### 4 Very Poor Condition
- Floated – top of pipe is at or above ground surface
- Joint separation allowing major soil infiltration
- Deformation greater than 10% of original inside diameter
- Hole through pipe material
- Pipe condition is causing soil loss beneath road surface
- Any crack in PVC pipe under road surface area
- For dual wall PE pipe, circumferential cracking greater than 1/2 of pipe circumference, in the liner only
- For dual wall PE pipe, buckling of liner and exterior shell
- Burnt (there is no inspection flag for burnt pipe, use spalling/flaking or holes)

<table>
<thead>
<tr>
<th>Misalignment – Float</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joint Separation</td>
</tr>
<tr>
<td>Deformation</td>
</tr>
<tr>
<td>Holes</td>
</tr>
<tr>
<td>Road Void, Piping</td>
</tr>
<tr>
<td>Cracks</td>
</tr>
<tr>
<td>Cracks</td>
</tr>
<tr>
<td>Deformation</td>
</tr>
<tr>
<td>Burnt HDPE</td>
</tr>
</tbody>
</table>
### Estimate Deformation – Round Pipe

<table>
<thead>
<tr>
<th>Deformation Level</th>
<th>Diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td><img src="image1" alt="0% Deformation" /></td>
</tr>
<tr>
<td>5%</td>
<td><img src="image2" alt="5% Deformation" /></td>
</tr>
<tr>
<td>7%</td>
<td><img src="image3" alt="7% Deformation" /></td>
</tr>
<tr>
<td>10%</td>
<td><img src="image4" alt="10% Deformation" /></td>
</tr>
</tbody>
</table>

*Estimate Deformation*
<table>
<thead>
<tr>
<th>Factors: Structural integrity, Integrity of surrounding material</th>
<th>Flags and Images</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1 Excellent Condition</strong></td>
<td></td>
</tr>
<tr>
<td>• Discoloration of surface</td>
<td>Condition 1 Steel</td>
</tr>
<tr>
<td>• Galvanizing intact</td>
<td></td>
</tr>
<tr>
<td>• No rust or pitting</td>
<td></td>
</tr>
<tr>
<td><strong>2 Fair Condition</strong></td>
<td>Pitting/Rusting</td>
</tr>
<tr>
<td>• Galvanizing gone</td>
<td></td>
</tr>
<tr>
<td>• Pitting, superficial rust or tight rust flakes</td>
<td></td>
</tr>
<tr>
<td><strong>3 Poor Condition</strong></td>
<td></td>
</tr>
<tr>
<td>• Flaking rust evident, with some loss of wall thickness</td>
<td>Spalling/Flaking</td>
</tr>
<tr>
<td>• A hole, less than 1 inch in size</td>
<td>Holes</td>
</tr>
<tr>
<td>• Deformation, deflection or distortion visible, up to 10% of</td>
<td>Deformation</td>
</tr>
<tr>
<td>diameter</td>
<td></td>
</tr>
<tr>
<td>• Can poke a hole in pipe with a sharp point</td>
<td>Spalling/Flaking</td>
</tr>
<tr>
<td>• Inslope Cavity – Infiltration of soil into the pipe from</td>
<td>Inslope Cavity</td>
</tr>
<tr>
<td>road shoulder</td>
<td>Road Distress</td>
</tr>
<tr>
<td>• Infiltration of soil into pipe may be causing loss of fill</td>
<td>Erosion</td>
</tr>
<tr>
<td>beneath road surface</td>
<td>Separated Apron</td>
</tr>
<tr>
<td>• Erosion has undermined apron or pipe</td>
<td></td>
</tr>
<tr>
<td>• Apron is separated from pipe</td>
<td></td>
</tr>
<tr>
<td>• Repair is needed but is not under road</td>
<td></td>
</tr>
<tr>
<td><strong>4 Very Poor Condition</strong></td>
<td></td>
</tr>
<tr>
<td>• Hole 1 inch or greater, or many small holes, or bottom</td>
<td>Holes</td>
</tr>
<tr>
<td>gone</td>
<td>Cracks</td>
</tr>
<tr>
<td>• Cracks or tears</td>
<td>Deformation</td>
</tr>
<tr>
<td>• Severe deformation greater than 10% of diameter</td>
<td>Joint Separation</td>
</tr>
<tr>
<td>• Joints separated</td>
<td>Misaligned</td>
</tr>
<tr>
<td>• Misalignment</td>
<td>Spalling/Flaking</td>
</tr>
<tr>
<td>• Can poke a hole in pipe with a blunt rod</td>
<td>Piping or Road Void</td>
</tr>
<tr>
<td>• Piping or Road Void – Pipe condition is causing soil loss</td>
<td></td>
</tr>
<tr>
<td>beneath road surface</td>
<td></td>
</tr>
</tbody>
</table>
Steel Pipe will rust, flake and get holes

1 Excellent Condition
- Discoloration of surface
- Galvanizing intact
- No rust or pitting

1 Like New
Steel Pipe Rusts 2

2 Fair Condition
- Galvanizing gone
- Pitting, superficial rust or tight rust flakes

Still Okay
3 Poor Condition

- Flaking rust evident, with some loss of wall thickness
- A hole, less than 1 inch in size
- Can poke a hole in pipe with a sharp point
Steel Pipe Rusts and gets Holes 4

4 Very Poor Condition
- Hole 1 inch or greater, or many small holes, or bottom gone
- Can poke a hole in pipe with a blunt rod
- Piping or Road Void -- Pipe condition is causing soil loss beneath road surface

Fix it sooner
## Concrete Pipe & Special Structure

### Factors: Structural integrity, Integrity of surrounding material

#### 1. Excellent Condition
- Minor chipping at joints/openings
- Hairline cracks
- Insignificant spalling or scaling

| Condition 1 Concrete
| Hairline cracks |

#### 2. Fair Condition
- Joints broken or pulled apart up to 1” (anywhere along joint)
- Aggregate exposed (pitting)
- Cracks evident with widths up to 1/8 inch
- Spalling or scaling to 1/4 inch depth

| Joint Separation
| Pitting/Rusting
| Cracks
| Spalling/Flaking |

#### 3. Poor Condition
- Joints broken or pulled apart 1”-3” (anywhere along the joint)
- Cracking evident with widths 1/8 - 1/4 inch
- Spalling or scaling > 1/4 inch depth
- Reinforcement beginning to show
- Ends misaligned or shifted
- Infiltration of soil into pipe under inslope causing soil loss in road shoulder
- Pipe may be causing soil loss beneath road surface
- Erosion has undermined apron or pipe
- Apron is separated from pipe
- Repair is needed but is not under road

| Joint Separation
| Cracks
| Spalling/Flaking
| Misaligned
| Infiltration
| Inslope Cavity
| Road Distress
| Erosion
| Separated Apron |

#### 4. Very Poor Condition
- Joints pulled apart or broken more than 3” at any point along joint (unless only at apron – see condition 3)
- Cracking evident with widths > 1/4 inch or cracks showing movement – pipe pieces have shifted
- Reinforcement fully exposed in places
- Holes through concrete or bottom gone
- Deformation – pipe is misshapen (look also for cracks and spalling)
- Piles of soil at joints, or any indication that soil infiltrates into pipe under roadway

| Joint Separation
| Cracks
| Spalling/Flaking
| Holes
| Deformation
| Road Void
| Infiltration & Piping |
Concrete Pipe Joint Separation 1

Concrete Condition 1 Excellent

- Minor chipping at joints/openings
- No Joint Separation
- *Crack - Not Visible or hairline crack less than 1/100 inch
- Insignificant spalling or scaling
Concrete Pipe Joint Separation 2

Concrete Condition 2  Fair

- Joints broken or pulled apart up to 1”
- Exposed aggregate
- *Spalling or scaling to ½ inch depth less than 6 inch diameter patch
- Lengthwise Crack less than 1/20 inch wide (thickness of one dime) or around the pipe with no infiltration (not wet, stained or deposit)
Concrete Condition 3  Poor

- Joints broken or pulled apart 1”-3”
- Infiltration of water
- *Lengthwise crack with width 1/20 to 1/10 inch (thickness of 1 to 2 dimes)
- *Abrasion or Spalling ¼ to ½ inch with deeply exposed aggregate or reinforcement showing
- Apron is separated from pipe
- Pipe may be causing soil loss beneath road surface
Concrete Condition 4 Very Poor

- Joints pulled apart or broken more than 3” at any point along joint
- *Lengthwise Fracture – crack greater than 1/10 inch wide (width of 2 dimes)
- *Fractured crack with displaced pipe pieces
- *Widespread spalling more than ¾ inch depth or invert deterioration
- Piles of soil at joints, or any indication that soil infiltrates into pipe under roadway

Fix it sooner
### SPCD (Structural Pollution Control Device) or Other Materials

<table>
<thead>
<tr>
<th>Factors: Structural integrity, Water Quality Functions, Clogging, Integrity of surrounding material</th>
<th>Flags and Images</th>
</tr>
</thead>
</table>
| **1 Excellent Condition**  
  • Materials are intact. | |
| **2 Fair Condition**  
  • Materials have minor defects but the feature is structurally sound.  
  • The feature is functioning properly. | |
| **3 Poor Condition**  
  • Materials have defects that may affect function or structural integrity of the feature  
  • Feature needs repair but can wait for construction project | |
| **4 Very Poor Condition**  
  • Components are broken or not working  
  • Outflow is non-functional  
  • Materials have severe defects and need repair soon. | |
Features built out of Dirt
# Infiltration Areas or Ponds

**Pond**

<table>
<thead>
<tr>
<th>Factors: Water Quality Functions, Water containment functions – basin integrity/clogging/overtopping, Vegetation</th>
<th>Flags and Images</th>
</tr>
</thead>
</table>
| **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. | |
| **4 Very Poor 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. | |
### Ditch

<table>
<thead>
<tr>
<th>Factors: Vegetation, Erosion (Physical integrity), Flow Capacity or Sediment Deposition</th>
<th>Flags and Images</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1 Excellent Condition</strong>&lt;br&gt;• Vegetation is well established, without noxious weeds (see county list of Noxious Weeds).&lt;br&gt;• No eroded rills&lt;br&gt;• If it is an Infiltration ditch, ditch is infiltrating water.</td>
<td></td>
</tr>
<tr>
<td><strong>2 Fair Condition</strong>&lt;br&gt;• Sediment deposition is visible.&lt;br&gt;• Limited patches of missing vegetation.&lt;br&gt;• Sheet erosion occurring (look for exposed grass roots).&lt;br&gt;• “Healed” (vegetated) rills.</td>
<td></td>
</tr>
<tr>
<td><strong>3 Poor Condition</strong>&lt;br&gt;• Noxious Weeds are present (see county list of Noxious Weeds).&lt;br&gt;• Ditch liner material (geotextile, clay liner, etc.) is damaged.&lt;br&gt;• 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.&lt;br&gt;• “Infiltration Ditch” (ditch constructed specifically to infiltrate stormwater) has dead vegetation where water ponds.&lt;br&gt;• “Infiltration Ditch” (ditch constructed specifically to infiltrate stormwater) has standing water for more than 3 days in a row.</td>
<td>Erosion or Headcut</td>
</tr>
<tr>
<td><strong>4 Very Poor Condition</strong>&lt;br&gt;• Eroded gully or slope failure presents a hazard to vehicles leaving the roadway or threatens road or embankment integrity.&lt;br&gt;• Sediment in ditch causing water to back up onto upstream or adjacent properties, or onto roadway. (Pipes are most likely the problem – check affected pipes first).</td>
<td></td>
</tr>
</tbody>
</table>
Illicit Discharge is a discharge 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 shouldn’t be.
- Suspicious odors, floatables, colors or opaque water. (Don’t sniff out an odor – your first impression is sufficient. Some substances are damaging to inhale.)

HYDINFRA can also be used to record deposits of dumped or otherwise deposited polluting materials.

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

Accidental spills by trucks, that are reported to Dispatch, forwarded to MPCA Duty Officer and cleaned up by trucking company’s contractor are **not** reported as Illicit Discharge, but are logged by Dispatch.

<table>
<thead>
<tr>
<th>District</th>
<th>Contact</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metro District</td>
<td>Metro Dispatch</td>
<td>651-234-7500</td>
</tr>
<tr>
<td>District 1</td>
<td>Shelly Micke, Duluth</td>
<td>218-725-2758</td>
</tr>
<tr>
<td>District 2</td>
<td>District 2 Hydraulics Engineer, Bemidji</td>
<td>218-755-6500</td>
</tr>
<tr>
<td>District 3</td>
<td>Robert Nibbe, Hydraulics Engr, Baxter</td>
<td>218-828-5700</td>
</tr>
<tr>
<td>District 4</td>
<td>District 4 Hydraulics Engr, Detroit Lakes</td>
<td>1-800-657-3984</td>
</tr>
<tr>
<td>District 6</td>
<td>District 6 Hydraulics Engineer, Rochester</td>
<td>507-286-7692</td>
</tr>
<tr>
<td>District 7</td>
<td>Scott Morgan, Hydraulics, Mankato</td>
<td>507-304-6210</td>
</tr>
<tr>
<td>District 8</td>
<td>District 8 Hydraulics Engineer, Willmar</td>
<td>1-800-657-3792</td>
</tr>
</tbody>
</table>
An MS4 Outfall is a separate and identifiable drainage conveyance where stormwater leaves Mn/DOT right of way or merges with a natural water (lake, stream, wetland, county ditch, etc.) and is located within an MS4 boundary.

MS4 Outfall does NOT Include:
- Diffuse runoff (sheet flow)
- Natural waters passing through Mn/DOT Right of Way
- Municipal storm drains passing through Mn/DOT Right of Way without Mn/DOT inputs
(Not in the Manual)

Essential Tools

(and Men and Women)
High-powered Flashlight and Shovel are essential tools
LaMourea’s Inspection Tools

- HydInfra Inspection Manual
- Mega Flashlight
- Shovel
- Measuring tape
- MH cover lifter
- Measuring wheel
- Rods to probe in sludge
- Sledge hammer??
- Weed Wacker

- Special telescoping measuring tool that extends inside the pipe
Essential Inspection Tools

Useful tools to bring for inspections

- Trimble
- DMI
- Paper Hydinfra reports for staying organized/taking notes
- Whiteboard(marker)
- Digital Camera
- Ruler(other measuring tools)
- PPE – life
- Flashlight
- Bug Spray
- Hip boots(waders)
- HIVE vehicle for smaller pipes
  - Spool/Cable
  - Tablet
  - Camera
  - Spare Batteries
  - Portable chargers if available and make sure all batteries are charged

(Tools list from D3 Nate Walton June 2017)
D6 HIVE unit with Pan and Tilt video

HIVE inspects inside pipes more than 55 feet long and climbs over obstacles.

D6 Rob Coughlin, photos and HIVE
Measure it.

Pipes sometimes are ordered for Construction projects based on HydInfra dimensions
Measure **lined** pipes carefully

- Lined pipes will have odd dimensions
- Measure the interior dimensions
Personal Equipment:

- Tick and Mosquito repellant
- Rubber boots
- Safety gear

D8 HydInfra Inspector – photo from Kurt Oelligan
End Goal:

*Lifecycle Cost Analysis in Asset Management*
Culvert Cost WIG on the Road to Drainage Asset Management

End Goal: TAMS-HydInfra

Lifecycle Cost Analysis in Asset Management