Culvert Inspection and Rating

Introduction

- Many different types of culverts – refer to Table 1.1 in Manual

- Vast majority are CSP or SPCSP in various shapes - round, arch pipe, horizontal ellipse

- Three culvert forms (Cul1, CulE, CulM)

- Same forms used for all types of culverts

- Timber pipe (TP) culverts exception
  - Use TT form

Form Types

- **CUL1**
  - Single culvert or single culvert extended with same material and size

- **CULM**
  - Two or more culverts (MP, SP or BP etc.)
  - Includes 1 Upstream & 1 Downstream End section for each Barrel section
  - Exception is Concrete Boxes (BP) where single U/S and single D/S sections for all barrel sections
  - Includes 2 cell box extended with single steel

- **CULE**
  - Single culvert extended with different material and/or size
  - One Upstream & Downstream section, Barrel sections for all cells and/or pipes
Inventory Information

- Extracted from BIS
- Span/rise is original design shape
- If round then only rise is recorded
- Span types – refer to Table 1.1 and Sec. 13.2.3
- Corrugation Profile and Plate Thickness selected from Table 13.1 and 13.2 (p.13.5 in manual)
- Specific information is provided for all pipes
  - a culvert extended with same material and size is considered to be one culvert (Cul1)

Numbering and Identification

- Where the culvert does not carry flow determine “upstream” and “downstream”
  - Look in direction of increasing chainage
    - (to north or east)
  - Left is “upstream” (end 1)
  - Right is “downstream” (end 2)
  - Keep same choice for each subsequent inspection
Culvert Inspection and Ratings

Numbering and Identification

- Primary span is the largest span at the site
- Secondary span is the smaller span
- Multiple culverts of same dimension are numbered in order of increasing chainage (from south to north or west to east)
- Multiple culverts also have same Ring numbering system (R1, R2, R3, etc.)

Ends - General

- Individual rating sections for the Upstream and Downstream ends
- Single upstream and downstream end sections for the CUL1, CULE forms
- Separate Upstream and Downstream ends for each Barrel section on CULM forms - except Concrete Boxes
- Upstream and Downstream sections are identical
- Items are inspected and rated the same way for both ends

Ends - General

Ends - End Treatment

- Purpose:
  - Improve aesthetics
  - Improve hydraulic performance
  - Prevent undermining due to scour
  - Prevent scour of the embankment
  - Reduce piping along or under the culvert
  - Resist uplift due to buoyancy forces
  - Shorten the culvert
  - Stiffen the ends
Culvert Inspection and Ratings

End Treatment -Types

- Steel:
  - Most common
  - Bevel end with no concrete treatment

- Concrete
  - Presence of any or all of: Headwall, Collar, Wingwall, Cutoff Wall

- Other
  - Timber Culvert with Timber End Treatment

- None
  - Square end – no Bevel present

Bevel Ends – End Treatment Type is “Steel”

Bevel Ends with Full Concrete End Treatment - Type is “Concrete”

Bevel End with Full Concrete End Treatment - Type is “Concrete”
End Treatment - Headwall

- Located over the crown
- Usually attached to the barrel
- Purpose:
  - Aesthetics
  - Strengthen end
  - Resist buoyancy force
  - Retaining walls

End Treatment - Headwall

- Look for:
  - Signs of movement or tilting
  - Loose connections
- Rate according to condition of material and functionality of component
- Condition affecting functionality rate 4 or less

End Treatment - Collar / Slope Protection

- Located along the beveled slopes of flexible culverts between headwall and cutoff wall
- Usually constructed from concrete
- Usually used with and connected to headwall and cutoff walls
  - May be used alone

End Treatment - Collar / Slope Protection

- Purpose:
  - Aesthetics
  - Stiffen the bevel
  - Resist buoyancy force
  - Improve hydraulic efficiency of end
  - Concrete slope protection
    - protect against scour / erosion
    - reduces piping potential
Culvert Inspection and Ratings

End Treatment - Collar / Slope Protection

- Look for:
  - Evidence of piping or scour / erosion
  - Loose connections
  - Voids underneath or settlement
- Rate according to condition of material and functionality of component
- If piping, rate 4 or less:
  - Also rated under bevel end and barrel

End Treatment - Wingwalls

- Generally found at culverts that do not have bevels
- Shape is either Parallel or Flared to culvert axis
- Main difference from Bevel is Wingwall is not attached to the barrel
- Usually constructed from concrete or steel
- Purpose
  - Improve hydraulic efficiency
  - Retain embankment fill

End Treatment - Wingwalls

- Record Shape as “Parallel”, “Flare”, or “Perpendicular” (to culvert axis)
  - Parallel wingwall
    - Req’ less scour protection between walls
  - Flared wingwalls
    - more hydraulic efficient
- May have a reinforced concrete slab between
  - Prevents undermining of wingwalls due to scour
  - Act as struts for greater stability
  - If present rate with wingwalls

End Treatment - Wingwalls

- Look for:
  - Evidence of movement
  - Loose connections (gap at barrel)
  - Scour / erosion at toe or behind wingwall
- If wingwall is unstable rate 4 or less
- Separation losing fill rate 4 or less
- Includes rating of wingwall floor slab
End Treatment – Flared Wingwalls

End Treatment - Cutoff Wall

- Located at the end of the culvert
- Vertical wall extending down below the bottom of the culvert
- Depth exceeds the depth of the riprap or concrete apron
- Usually constructed from concrete or steel
- Purpose:
  - Reduce potential for undermining of end of culvert
  - Minimize possibility of piping
  - Resist buoyancy force

End Treatment - Cutoff Wall

- Look for evidence of:
  - Undermining
  - Piping
  - Uplift
  - Loose connections

- Usually not possible to inspect since they are submerged or covered with ice or debris
  - If not visible rate “N”
  - If certain not present rate “X”

- If piping, rate 4 or less
  - May also affect Bevel End and Barrel Rating
Culvert Inspection and Ratings

Ends - Bevel End

<table>
<thead>
<tr>
<th>Culvert Component</th>
<th>Land</th>
<th>New</th>
<th>Explanation of Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bevel End</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insert Above/Below Stream Bed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Above/Below (mm)</td>
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<td></td>
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</tr>
</tbody>
</table>

• Sloped section at the end of the culvert
• Permanently attached to the barrel
• Generally parallel to the culvert axis
• Bevel types
  – Full bevel
  – Step bevel

If possible, measure or estimate height above or depth below streambed and record amount in mm. (may not be able to measure or confirm measurements in high water or winter).

• Normally “Below” as designed to be buried ¼ diameter below streambed.

• If invert is “at streambed” record Above/Below as 0mm.

• Find a representative natural streambed location
  – Discount presence of localized scour hole or deposits (aggrading) at end of culvert

Ends - Bevel End

• Compared to projecting ends, bevel ends are more:
  – Aesthetic
  – Economical
  – Hydraulically efficient

• Compared to projecting ends, bevel ends on corrugated steel culverts are more flexible and susceptible to:
  – Deform due to lateral earth pressure
  – Uplift due to buoyancy
  – Heave due to frost action

Ends - Bevel End

• Measure or estimate heaving of bevel and record amount

• Often best place to estimate is from inside barrel looking back to Bevel
• Use waterline as level
• Some heave is tolerable as long as water is entering Bevel
### Ends - Bevel End

- Look for:
  - Piping
  - Deformation
  - Impact damage
  - Corrosion that affect strength
  - Abrasion
- If piping, rate 4 or less
  - Also rated under End Treatment if present
- Defects/deformations not affecting function rate 6 or less (un-supported bevel - no heave)
- Severe corrosion affecting strength (perforations) rate 4 or less – otherwise corruptions should not affect rating
- If no bevel, rate “X”
  - Underpasses often have square ends

### Ends - Scour Protection

- Usually heavy rock riprap
- The current version of Std. Drawing S-1418-03 shows the minimum requirements for riprap
  - Coverage
  - Size
  - Minimum thickness
  - Gradation

[http://www.transportation.alberta.ca/4860.htm](http://www.transportation.alberta.ca/4860.htm)
Ends - Scour Protection

- Purpose is to prevent scour and erosion at culvert ends which may:
  - Undermine the culvert
  - Undermine the sideslopes
  - Cause the formation of sand bars

Ratings

- No scour/erosion or displacement rate 7 or more
- If none exists and none is required record type as "NATURAL" and rate 7 or more
- If none exists but is required record type as "NONE" and rate 4 or less (also make recommendation)
- Generally not rated higher than Scour rating – especially when Scour is 4 or less
- Protected area is smaller than required or rock gradation or quality is inadequate rate 4 or less
- Concrete protection with excessive settlement or undermining rate 4 or less
- Cattlepasses that handle drainage rate – otherwise X

Ends - Scour Protection

- Record the type of Scour Protection
  - If none exists and none is required, record type as "NATURAL"
  - If none exists and some is required, record type as "NONE"

- Estimate and record the average size (rock only)
- Look for:
  - Durability of riprap - e.g. sandstone is not acceptable
  - Shape – flat rocks not desirable
  - Displacement or movement
  - Scour
  - Current standards on S- 1418

Ends - Scour / Erosion

- Removal of material from the streambed, banks or sideslopes by the action of flowing water and/or constrictions or obstructions (refer to Section 16.2 in manual).
- Effects:
  - Undermine the culvert
  - Undermine the sideslopes
  - Impede fish passage
  - Alter culvert hydraulics
Ends - Scour / Erosion

- Two types:
  - General – uniform lowering of original stream
  - Local – occurring at specific locations

- Look for:
  - Scour holes, especially at downstream ends
  - Undermining of culvert end or sideslopes
  - Slumping of sideslope or banks
  - Areas where flow impinges on banks, sideslopes or protection systems
  - Areas susceptible to high velocities and undermining
    - culvert footings
    - ends or bottoms of wingwalls and cutoff walls
    - sides of collars
    - ends or bottoms of ends of protection systems

Rate the presence and extent of scour and adverse effects on culvert, embankment, streambed and banks

- If culvert and embankment are not affected, rate 5 or more
- Scour/erosion affecting culvert, rate 4 or less
**Culvert Inspection and Ratings**

### Ends - Beaver Activity

- Beavers frequently construct dams at inlet or inside culverts
- Effects:
  - reduced flow capacity
  - Flooding upstream
  - Scour
  - Ponding of water inside culverts preventing inspection

### Ends - General Rating

- Governing elements: (Refer to 1.10.7 & 13.5.10)
  - Headwall
  - Collar
  - Wingwall
  - Cutoff Wall
  - Bevel end
  - Scour protection
- If all are rated “X” then provide rating based on general condition of culvert end

### Barrel - Rigid Types

- Made from concrete or timber
- Designed to carry loads without deflection (Rise and Span measurements normally not necessary).
- Culvert carries entire load with no reliance on surrounding fill for support.
- Generally more expensive but more durable, last longer and require less structural maintenance.
Barrel - Flexible Types

- Made from corrugated steel
- Low strength
- Dependent on surrounding backfill for support
- Culvert deflects under load until the backfill picks up the stress
- Entire load carrying system cannot be inspected directly (i.e. can inspect culvert but not backfill)
- Flexible culverts more susceptible to failure by:
  - Change in shape due to excessive deflection
  - Defective joints - cracks, open joints, cusped seams, etc.
  - Severe corrosion
  - Uplift of ends due to buoyancy forces

Barrel - General

- If barrel is accessible provide current date
- Not accessible explain why & retain previous date
- Rate elements N if not visible
- Previous comments are retained and dated
- If more than one barrel indicate location (west) or span number

Barrel - Special Features

- Cannot be rated under another component
- May be temporary or permanent
- Must be visible to inspect
  - Special design features not usually inspectable (ribs, thrust blocks, etc.)
Barrel - Special Features

- Examples
  - Struts
  - Shotcrete beams
  - Abrasion plates
  - Concrete Floor
  - Storm Drains
- Record type
- Provide additional information in Explanation of Condition
  - Description
  - Location
  - Dimensions
  - Inspection procedures
- Provide rating based on condition /functionality

Barrel - Special Features
Shotcrete Beam

Barrel - Special Features
Struts – Rated 3

Barrel - Deformation
Barrel - Ring

- Different elements make up a complete ring:
  - Roof
  - Sidewall
  - Floor
  - Bolted or riveted seams
  - Circumferential seams (bolted (SPCSP) or external coupler (CSP))

- Purpose:
  - Carry water flow or traffic
  - Carry loads and transmit to surrounding soil
  - Prevent infiltration of fill

Barrel – Ring Defects

- Flexible Steel culverts look for:
  - Deformation (measure crest to crest)
  - Localized crimping or buckling
  - Longitudinal seam problems
  - Corrosion
  - Abrasion on floor

- Rigid Timber culverts look for:
  - Material defects – rot decay

- Rigid Concrete culverts look for:
  - Structural problems - cracking
  - Material defects - corrosion, scaling, freeze-thaw damage

Barrel - Roof

Flexible Culverts:
- Record lowest measured Rise in mm (crest-crest). Mark in culvert for future reference.
- Record Ring number measurements taken.
- If floor bulge occurs at same location add bulge to measured rise and explain in comments.
- Calculate and record Sag in mm (design – measured rise).
- Calculate and record % Sag.
- Rate Roof based on % Sag (Table 13.3) or other visual defects.
- If not able to measure Rise due to ice, silt, concrete floor, etc. a Roof rating is still required based on visual evidence and estimated sag.
**Barrel – Roof Ratings**

Flexible culverts - continued
- Presence of temporary repairs has no influence.
- Sag within 5%, no corrosion - rate 7
- Sag within 7%, no pitting - rate 5
- Sag within 10%, corrosion pitting - rate 4
- Sag 11-15%, isolated perforations – rate 3
- Sag >15%, roof flattening, reverse curvature, extensive perforations – rate 2.
- Reverse curvature in flat HE or round under low cover, severe perforations – rate 1.
- Consider Longitudinal Seam rating if in Roof.

Rigid Culverts:
- Rate Roof based on visual evidence, defects
- Measurements not required

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**Barrel – Sidewall Ratings**

Flexible Culverts:
- Record greatest measured Span in mm. (crest-crest). Mark in culvert for future reference.
- Record Ring number measurements taken.
- Calculate and record Deflection in mm (measured rise - design).
- Calculate and record % Deflection.
- Rate Sidewall based on % Deflection (Table 13.3) or other visual defects.
- If not able to measure Span due to size, ice, etc. a Sidewall rating is still required based on visual evidence and estimated deflection.

Rigid Culverts:
- Rate Sidewall based on visual evidence, defects
- Measurements are not required
Barrel – Sidewall Inward Movement – Rated 2

Barrel – Sidewall Buckling – Rated 3 or less

Barrel - Floor

- Note and record substrate type and %.
- Check timber floors for rot, missing sections.
- Check concrete floors for cracking, spalling, missing sections.
- Check steel floors for cracks, crimping/buckling, defective seams, corrosion, abrasion.
- Measure or estimate floor bulge and record ring number.
- For flexible culverts - If greatest floor bulge is occurring in same ring as worst roof deflection add bulge to measured Rise
- Indicate abrasion on floor by Yes or No. If yes provide comment.

Barrel - Floor

- Rate flexible culvert floors as per Table 13.3:
  - Isolated perforations rate 4
  - Extensive perforations rate 3
  - Severe perforations rate 2
  - <5% bulging, minor abrasion and corrosion, no buckling or seam defects rate 6 or more
  - Seam rating may govern if located in floor
Barrel - Ring

A = Roof Sag
B1 + B2 = Sidewall Deflection
c = Floor Bulge

Barrel - Circumferential Seams

- Refers to seams joining individual rings or sections of culvert
- Found on most types of culverts
  – Bolted seams on SPCSP
  – Couplers on CSP or Riveted pipes
  – Joints in precast concrete
  – Construction joints in cast-in-place concrete

Barrel - Circumferential Seams

- Purpose
  – Join rings
  – Prevent infiltration of backfill
- Most common problems are separation caused by settlement or corrosion of couplers
  – Especially CSP and precast concrete (settlement)
- Potential for safety problem if void develops in fill
- Look for:
  – Separation
  – Loose or missing couplers (corrosion)
  – Bent or broken edges on the rings
  – Misalignment of rings
  – Infiltration of backfill
  – Voids in surrounding fill

Barrel - Circumferential Seams

- Record width of worst separation.
- Gap but no soil infiltration - rate 4.
- Gap with minor soil infiltration - rate 3.
- Void from loss of material due to soil infiltration - rate 2.
- Severe loss of material due to soil infiltration - rate 1.
- Cracking from over torqueing of bolts but no growth or problems – rate 5.
- Cracking due to roof sag rate 4 or less.
- May affect Roof, Sidewall or Floor rating if severe (2 or less).
Barrel - Circumferential Seam Void Rated 2

Barrel - Circumferential Seam – Material Loss and Voids Rated 2

Barrel - Longitudinal Seams

- Applies to SPCSP and CSP riveted culverts
- All others, Rate “X”

Barrel - Longitudinal Seams

- Purpose
  - Join individual plates in ring
  - Transmit loads between plates
  - Approx. 75% bending strength of plates
- Indicate if all seams properly lapped by Yes or No
  - If No, provide comment
- Indicate if seams staggered by Yes or No
  - Within same arc only
  - At change of arc should not be staggered
  - If No provide comment
  - Most common problem is cracking
  - Especially on improperly lapped seams
**Barrel - Longitudinal Seams**

- Typical longitudinal seams

![Correct Lap](image)

![Incorrect Lap](image)

**Typical longitudinal seams**

- Cracked Seam

**Other Problems**

- Poorly nested plates
  - Improper fabrication and/or poor assembly
  - Cusping
  - Sharp break or discontinuity in curvature
  - Occurs most often at longitudinal seams
  - Improper fabrication, poor assembly/plate rotation during torqueing
  - Improper backfill
  - Bolt tipping
  - High ring compression causing plate slippage and/or hole elongation
- Plate distortion
  - High ring compression, improper assembly and backfill
- Corrosion

- Record and comment on number of rings with cracked seams
- Record and comment on number of rings with 2 or more cracked seams (may cause catastrophic failure)
- Record least remaining steel between cracks and record location in comments (“At R9”)
- Mark and date ends of worst cracks – pencil is best
- Properly lapped seam has bolt in valley nearest visible edge of plate
**Culvert Inspection and Ratings**

**Barrel - Longitudinal Seams**

Rating

- Rate as per Table 13.3
- All seams properly lapped and no defects rate 9
- If seams are not properly lapped but in otherwise excellent condition - rate 7
- >100mm remaining steel between cracks rate 4
- 50 – 100mm remaining steel between cracks - rate 3
- <50mm remaining steel between cracks rate 2
- Two cracked seams in same Ring – rate 2
- Rating for longitudinal seams may also affect Roof, Sidewall and Floor ratings
- Rate riveted longitudinal seams in CSP

**Barrel – Wrong Lap - Cracked Longitudinal Seam - <50mm Remaining Steel-Rated 2**

**Barrel – Cracked Longitudinal Seam and Wrong Lap**

**Barrel - Coating**

- Applicable to steel culverts only
- Applies mainly to zinc or aluminized coating
  - Can include other types - bituminous
- Purpose is to protect the steel from corrosion
  - Zinc & aluminum protect by sacrificial action
Barrel - Coating

- Corrosion can occur on soil or water side of culvert
- Soil side corrosion is generally visible above waterline and most common at seams
  - Can lead to perforations
  - Difference in backfill resistivity
  - Corrosive chemicals in backfill or water in fill
- Water side corrosion usually occurs in lower areas
  - Abrasion can remove protective coating
  - Water may have low pH or contain corrosive chemicals
  - Anaerobic bacteria may live in stagnant water

Barrel - Coating

- Look for:
  - Fabrication or installation defects or damage
  - Loss of coating - Corrosion
  - Rust stains from bolt holes or seams
  - Perforations
- Record if corrosion is on SOIL and/or WATER side – provide comment if Yes
- Rate according to Table 13.3
  - Superficial corrosion no pitting – rate 5 or 6
  - Corrosion with pitting in roof or sidewall rate 4
  - Isolated perforations in roof or sidewall, extensive perforations in floor - rate 3
  - Extensive perforations in roof or sidewall, severe perforations in floor - rate 2
  - Severe perforations in roof or sidewall - rate 1
- Rating of Coating may affect other elements ratings

Barrel Coating – Sidewall Perforations and Separation

Barrel Coating – Floor Severe Perforations
### Culvert Inspection and Ratings

#### Barrel - Camber

<table>
<thead>
<tr>
<th>Component</th>
<th>Camber POSITIVE/NEGATIVE</th>
</tr>
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<tbody>
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<td>Camber POSITIVE/NEGATIVE</td>
<td></td>
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</tbody>
</table>

- Refers to longitudinal gradeline of invert
- No rating is required
- If water line is level, can be used to determine camber
- Record whether camber is **POSITIVE**, Zero (0), or **NEGATIVE**
- If significantly **POSITIVE** or **NEGATIVE** provide explanation

#### Culvert Inspection and Ratings

#### Barrel – Fish Passage Adequacy

<table>
<thead>
<tr>
<th>Component</th>
<th>Fish Passage Adequacy</th>
</tr>
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<tbody>
<tr>
<td>Camber POSITIVE/NEGATIVE</td>
<td></td>
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</table>

- Refer to BIM Bulletin #5
- Inspector should assume ALL culverts are fish bearing even when dry, and rate accordingly
- Refers to ability of culvert to accommodate fish passage U/S and D/S
- May have fish baffles to:
  - provide rest areas
  - reduce velocities
  - provide minimum water levels
Barrel - Fish Passage Adequacy

- Types of baffles
  - Spoilers
    - Concrete or steel projections
  - Large boulders
  - Weirs
    - Extend fully across floor
    - May have notches
  - Bolted to floor to prevent displacement

Record type of baffle or NONE

Condition and functionality of baffles including anchorages

- Look for:
  - Excessive velocities
    - Scour
  - Silt deposition downstream
  - Steep gradient in culvert
  - Drops at ends of culvert
  - Anything which could block flow or affect water levels
    - Dirt
    - Beaver dams
Fish Passage Adequacy-Bulletin #5

- Additional information is recorded for Fish Passage Adequacy for all W/C culvert sites.
- Multiple culvert sites - record for primary culvert only, or for the worst case culvert (from a fish passage perspective) when no obvious primary exists.
- Note if fish are observed in stream or in culvert
- Record information under the following:
  - Debris Blockage:
    - If obstructed by debris record % of culvert diameter and the cause of obstruction.
  - Substrate in Culvert:
    - Note if present and dominate type (sand, gravel, cobble, boulder, silt, other).
    - Est. and note % of length that contains substrate.

Backwater in Culvert:
- U/S extension of standing water outlet pool into the culvert (Flowing water is not backwater).
- Estimate and record how far up into the culvert (% of culvert length from the outlet).

Outlet Pool Depth:
- Record depth of the pool to the nearest cm at the outlet.
- Take measurement within one culvert diameter of the end of the culvert.
- If outlet pool depth is highly variable, take several measurements and record the average.

Barrel - Fish Passage Adequacy

- Fish Passage Adequacy rated according to Section 13.6.12 of the BIM Inspection Manual.
- Culverts used as Cattlepass, Ped. Underpass or Grade Separation Rate X unless also designed to handle flows
- Rate whether flowing or dry
- If in line with or below streambed rate 5 or more
- U/S or D/S ends above streambed rate 4 or less

Barrel - Waterway Adequacy

- Refers to the ability of the culvert to safely pass the design flow
  - Maintain Freeboard
  - Pass drift without damage
  - No damage from backwater created
Culvert Inspection and Ratings

Barrel - Waterway Adequacy

- Adequately sized culvert may be affected by:
  - Ice build up
  - Silt deposition
  - Drift accumulation
  - Beaver dams
  - Ponding
  - Repair or rehabilitation work
    - Shotcrete beams
    - Struts
  - Adequately sized culvert may be affected by:
    - Ice build up
    - Silt deposition
    - Drift accumulation
    - Beaver dams
    - Ponding
    - Repair or rehabilitation work
      - Shotcrete beams
      - Struts

Barrel - Waterway Adequacy

- Indicate presence of ice build up (icing) by Yes or No if Yes explain
  - Not normal freezing of ponded water
  - Results from active springs which freeze and causes layers of ice to build up
  - If previously Yes - leave and retain comments adding date of previous inspection
  - Indicate presence of silt build up (Silting) by Yes or No, if Yes explain
    - Invert normally below streambed
    - Minor accumulation of silt expected
  - Indicate presence of drift in Barrel by Yes or No
    - If “yes”, explain

Barrel - Waterway Adequacy

- Rate “X” if not a drainage culvert
  - Adequate opening rate 5
  - HWM above crown, 4 or less
  - Culvert blockage 50% or more rate 3 or less
Culvert Inspection and Ratings

Barrel - Waterway Adequacy - 100% Blockage

Barrel - Waterway Adequacy - 50% Blockage

Barrel - General Rating

- Governed by the following element ratings:
  - Roof
  - Sidewalls
  - Longitudinal seams
  - Circumferential seam rating of 2 or less
  - Corrosion rating of 2 or less

- Barrel not accessible - rate barrel elements “N”

- If previous Barrel General Rating was 4 or less then carry over previous General Rating rating and provide Explanation of Condition (“carried forward”)

- If previous Barrel General Rating was 5 or more rate current General Rating “N”

Effects of Struts on Barrel General Rating

- Inspector may increase General Rating by 1 or 2 points but not exceed rating of 4.

- Rating Conditions
  - struts in place more than 2 years
  - struts rated 5 or more
  - 1 permanent reference for monitoring
  - struts inspected after any significant event
  - consider culvert size and depth of cover (failure of large diameter culvert under high fill may not be as serious as under low fill)
  - does not apply when deflections >30% or cracked seams with less than 25mm remaining steel
  - applied to general rating only, element ratings remain unchanged
Questions??