APPENDIX D

Appendix/Attachment Title

Critical Findings and Repair Recommendations

Appendix/Attachment Revision and Year:

Version 1.0, 2026

Appendix/Attachment Introduction and Discussion

Critical Findings and Repair Recommendations shall be reported as required.

Appendix/Attachment Description

Appendix D includes common examples both for Critical Findings and Repair Recommendations (Priority A, Priority B and Priority C) for bridges in South Carolina. The lists are not all-inclusive; final evaluation as to how to determine status of the deficiency is the responsibility of the BITL. The BITL may consult with the DBIS and DBE for specific repair recommendations that may be needed for the bridge. Appendix D also outlines the process for the BITL to submit repair recommendations to the appropriate parties.

Critical Finding Examples - General

Examples of a Critical Finding are listed below. Material specific Critical Findings are included on the following page. Detailed examples of what may be discovered in the field and what may warrant a Critical Finding are included below. FHWA has set 3 tons as the absolute minimum gross live load capacity for a bridge and a bridge closure is required for load ratings that result in less capacity. If any bridge needs a posting less than 3 tons, the bridge needs to be closed. Any of the situations listed may result in closure of a bridge.

The list below provides an example of what shall be considered a Critical Finding:

- Bridges which are given a condition evaluation rating code of 3 or less; this includes:
    - Item B.C.01 (Deck Condition Rating)
    - Item B.C.02 (Superstructure Condition Rating)
    - Item B.C.03 (Substructure Condition Rating)
    - Item B.C.04 (Culvert Condition Rating)
    - Item B.C.14 (NSTM Inspection Condition Rating)
    - Item B.C.15 (Underwater Inspection Condition Rating)
- Bridges which are given any waterway rating of 3 or less; this includes:
    - Item B.C.09 (Channel Condition Rating)
    - Item B.C.10 (Scour Condition Rating)
- Bridges with a controlling legal load (Item B.LR.07) of 6 tons or less, unless the bridge is already posted for 17 tons or less,
    - Note: FHWA has set 3 tons as the absolute minimum gross live load capacity for a bridge. Bridge closure is required for load ratings that result in less than 3 tons gross. A Critical Finding shall be issued, and the district shall close the bridge.
    - Note: If immediate work is needed on a bridge to prevent a substantial reduction in safe load capacity, especially on bridges carrying primary routes, a Critical Finding may be issued.
- Missing or illegible at-bridge or approach posting signs,
    - Note: There may be deviations in posting sign type on the Posting Form.
- Incorrect at-bridge or approach posting values if the posted weight is higher than the approved value (refer to load posting flowchart, Figure D.1),
- Immediate work needed to prevent substantial reduction in safe load capacity,
- Measured vertical clearance of 14.5’ or less and missing or illegible at-bridge or advance vertical clearance sign or either sign has value over 14.5’ (refer to measured vertical clearance flowchart, Figure D.2),
- Bridge railing or approach guardrail is missing, damaged, deteriorated, or no longer can contain and/or redirect vehicles for bridges designed for loads higher than H-15 and bridges designed for H-10 or H-15 loads which are part of the NHS,
    - Note: Some H-10/H-15 bridges off the NHS, a railing may not be required – see References),
- Storage of flammable, explosive, or hazardous materials stored in the right-of-way adjacent to a bridge or under a bridge,
- Any quantity of a non-redundant steel element (including NSTMs) placed in Condition State 4,
- Loose, deteriorated, damaged, or spalling deck material (such as joints, concrete or timber) in imminent danger of falling onto traffic or pedestrians which could cause extensive damage or injury,
- Pedestrian railing is missing or detached, potentially allowing a pedestrian to fall off the structure,

- Sidewalk walking surface with damage or deterioration presenting a hazardous condition to pedestrians,
- Serious mechanical, electrical, or hydraulic problems which have stopped or may stop the operation of a movable span or safety equipment,
- Hole in the deck,
- Navigational lighting systems on the structure with failure, or
- Any situation that would pose the risk of partial or complete collapse of a bridge, or may pose imminent danger to public safety, including the following:
    - Severe loss of bearing;
    - Severe scouring of a foundation;
    - Significant scour damage, bank erosion, or slope erosion which endanger the stability of substructure elements;
    - Excessive drift causing excess pressure/scour on bridge substructure;
    - Bridges which are or may be prone to severe scour before, during, or after a scour or hydraulic event;
    - Critical damage or a defect to main structural members;
    - Bridges which are damaged either by collision, natural event, fire, or chemicals;
    - Damage to bridge fenders where there is a danger to the channel or the traveling public;
    - Drastic/excessive movement or vertical/horizontal displacement (e.g. sliding or deflection) in major structural component or to the structure, including unstable foundations.

Critical Finding Examples – Steel

- Significant damage, failure, unmitigated cracks, or significant section loss of an NSTM or a fatigue-prone detail,
- Members with deteriorated areas that have failed in buckling, crippling, etc., or make imminent failure likely,
- Rocker bearings that are excessively tilted or bearing on the outer 1/4 width of the rocker.
- Primary structural member with completely fractured tension element due to fatigue, or
- Bottom flange cover plates with cracked welds at the end of a partial length welded cover plate for a steel girder or steel floorbeam.

Critical Finding Examples – Concrete

- Prestressed girder with broken strands at high tension areas or 100 percent section loss at high tension area,
- Severely sheared or spalled concrete tee-beam ends,
- Non-composite prestressed adjacent box beams with cracking and rust-staining, strand loss, loss of camber, or torsional cracking,
- Severe loss of girder bearing area, where remaining area may no longer have capacity to support the girder under legal loads,
- Reinforced concrete girder with damaged or deteriorated primary rebar with 100 percent section loss, with more bars affected at the same location,
- Reinforced concrete bent cap with damaged or deteriorated primary rebar with 100 percent section loss, with more bars affected at the same location, or
- Concrete column or cap with significant structural cracking that is supporting a span with a NSTM.

Critical Finding Examples - Timber Piles

- Critical Findings related to decay on a timber pile are included in Figures D.3 to D.6.

Critical Finding Examples – Timber Piles Unbraced Length

Inspectors will note the pile diameters and unbraced lengths on timber piles. The combination of either of these factors could warrant a Critical Finding as determined by the BITL. The tables below indicate the maximum allowable unbraced lengths on timber piles for two common bridge configurations.

Table D.1 – Unbraced Pile Length Recommendations (15' Span Precast Panel Bridge)

15' Span Precast Panel Bridge			
Timber Pile Diameter	10"	11"	12" +
Maximum Recommended Unbraced Pile Length	13 feet	15 feet	18 feet

Note: Recommendations are based on an average asphalt thickness of 2.5". Unbraced pile lengths should be reduced by one (1) foot if asphalt thickness exceeds 5".

Table D.2 – Unbraced Pile Length Recommendations (30' Span Channel Beam Bridge)

30' Span Prestressed Concrete Channel Beam Bridge			
Timber Pile Diameter	10"	11"	12" +
Maximum Recommended Unbraced Pile Length	10 feet	12 feet	15 feet

Note: Recommendations are based on an average asphalt thickness of 2.5". Unbraced pile length should be reduced by one (1) foot if asphalt thickness exceeds 5".

Critical Finding Examples – Timber (Non-Piles)

- Deck boards with hole completely through, broken deck boards in traffic areas, or deck planks in danger of breaking through,
- Primary structural member with multiple open cracks (splits) in high stress region, or crushing/decay leading to superstructure settlement, or
- Bents which have a loss of bearing capacity or soil retention with crushing, decay, or insect damage which may lead to failure.

Repair Recommendation Examples - General

The following are examples of repair recommendations. Flag categorization is up to the discretion of the BITL and will be based on the severity and need for repair. See Table D.3 for the summary of repair recommendation classification. Note that Priority A – "A Flags" must be corrected within 30 days so they are considered urgent. Items on the Priority A – "A Flags" will be considered Critical Findings only if there is an immediate safety concern.

Table D.3 – Time Frame for Repair Recommendations

Flag Type	Timeline for Work Completion [T]
Priority A	30 Calendar Days [CF]
Priority B	90 Calendar Days
Priority C	366 Calendar Days

T = These timelines are a guideline.
CF = A "Priority A" flag alone shall not be used for any fi ndings that are classified as Critical Findings. The Critical Findings must be reported per FHWA policy.

See Table D.4 for the work activity code that needs to be reported for each repair recommendation. Unless there was a Critical Finding, there needs to be a bridge d ata change, or an urgent maintenance inspection was r equested, a maintenance inspection is not required following every repair. The inspection may ta ke place at the convenience of a BITL or at the next scheduled inspection.

Table D.4 – Work Activity Codes

Work Activity Code	Type of Deficiency	Work Activity Code	Type of Deficiency
102	Settlement Repair/Repair Asphalt	801	Any Curb/Sidewalk Repair on Bridge
202	Erosion/Washout Under the Caps	802	Any Concrete Parapet Repair
203	Erosion/Washout Around the Four Corners/Repair Flumes	803	Repair Any Beams and Truss Members / Reinforced Concrete Diaphragms
401	Mowing, Hand Trimming & Remove Vegetation from Bridge	805	Clean/Repair Expansion Joints
407	Remove Trash on or around Bridge	806	Clean, Paint or Repair Bearings / Repair Saddles
407	Remove Trash from Channel	807	Repair Headwalls
408	Tree Removal from Bridge or Channel	807	Fender Repair
408	Remove Vegetation from Channel	807	Install Temporary Bridge
409	**STORM USE ONLY**	807	Maintain Temporary Bridge
504	R.C. Medians, Curbs, Sidewalks Not on Bridge	807	Remove Temporary Bridge
603	Signs, Temporary	807	Clean/Clear Scuppers
603	Bridge End Markers/Load Restriction	807	Repair Guardrail/Bridge Rail/Post on Bridge only*
603	Any Sign Repair or Replacement	807	Clean and Paint Steel Beams
610	Any Approach Rail Repair/Installation*	807	Scour/Build-up at Culvert and Bridge Piles
613	Crash Attenuator Repair/Replacement	809	Repair Spalls in Piles/Caps/Paint Clean Steel H-Pile
801	Any Deck Repair and Clean/Paint Exposed Rebar		

* Work Activity Code 610 shall be used for approach guardrail away from the bridge, under the bridge or guardrail in general. Work Activity Code 807 shall be used for the approach guardrail from the bridge including the end treatment or from the bridge to a length 75 feet from the bridge.

Repair Recommendation – Priority A – "A Flags"

- Bridge railing or approach guardrail is missing, damaged, deteriorated, or no longer can contain and/or redirect vehicles for bridges designed for loads of H-15 or less and bridges which are not part of the NHS,
    - Note: Some H-10/H-15 bridges off the NHS, a railing may not be required – see References).
- Guardrail connections to bridge railing, concrete barrier rebar, or guardrail that is detached but there is no current risk to the traveling public,
- Incorrect at-bridge or approach posting values if the posted weight is lower than the approved value (refer to load posting flowchart, Figure D.1),
- Measured vertical clearance over 14.5' and up to 17.0' and any of the following (refer to measured vertical clearance flowchart, Figure D.2),
    - Missing or illegible at-bridge vertical clearance sign,
    - At-bridge vertical clearance sign has value of 14.5' or less, or
    - At-bridge vertical clearance sign has value of over 17.0'.
- Severe loss of bearing (generally greater than 50% of bearing area with no immediate safety concern),
- Scouring of a foundation (generally greater than 30% of bearing area with no immediate safety concern),
- Channel maintenance urgently required before significant scour will occur,
- Lighting fixtures, signs, traffic signals, or utility poles with damaged, split, or buckled sections, missing connections, cracked welds at connections, or base plate connections with loose nuts,
- Significant scour damage, bank erosion, or slope erosion which do not endanger the stability of substructure elements, or
- Hole in the deck (no immediate safety concern).

Repair Recommendation – Priority B – "B Flags"

- Measured vertical clearance over 17.0' any of the following (the repair recommendation is to remove the sign, refer to measured vertical clearance flowchart, Figure D.2),
    - At-bridge vertical clearance sign has value under 17.0', or
    - At-bridge vertical clearance sign has value over 17.0' and the value on the sign is higher than measured.
- Impacted approach guardrail or end terminal/treatment,
- Loss of bearing (between 0% and 50% of bearing area with no safety issue),
- Scouring of a foundation (generally less than 30% of bearing area with no safety issue),
- Channel maintenance required before significant scour may occur,
- Large spalls with exposed rebar,
- Frozen or rusted bearings,
- Leaking or damaged expansion joints,
- Heavy dirt and debris around bridge bearings,
- Clogged deck drains,
- Extensive dirt and debris on bridge deck,
- Excess vegetation around bridge area limiting bridge inspection access,

- Heavy debris on caps, bridge seats, or bents,
- Drift causing excess substructure pressure/scour,
- Wearing surface failures which cannot wait for general maintenance, i.e. large potholes,
- Settlement of approach slabs or approach roadway resulting drivers needed to reduce speed,
- Mechanical, electrical, or hydraulic problems which will affect the operation of a movable span or safety equipment if allowed to continue to deteriorate,
- Regulatory or warning signs which are missing or worn, including end markers and pier markers (see References).

Repair Recommendation – Priority C – "C Flags"

- Measured vertical clearance over 17.0' and at-bridge vertical clearance sign has value over 17.0' and the value on the sign is lower than measured (the repair recommendation is to remove the sign, refer to measured vertical clearance flowchart, Figure D.2),
- Minor damage to guardrail,
- Decayed or damaged wheel guard not presenting danger to vehicles,
- Loose or missing connection shoe,
- Missing, incorrect, or illegible Asset ID placards (see Page D-16 for additional Asset ID placard guidance),
- Other missing or worn signs (which are not regulatory or warning) such as informational signs,
- Damage to handrail, guardrail, attenuators, or parapets,
- Slight substructure settlement,
- Exposed coarse aggregate and/or exposed rebar due to abrasion in concrete deck,
- Highway lighting systems on the structure with lighting outages,
- Primary masonry members out of alignment, or
- Primary masonry members with unsound patching.

Repair Recommendation Examples - Steel

Steel Repair Recommendation – Priority A – "A Flags"

- Redundant beams, girders, or piles with deteriorated areas which are likely to cause localized failure, or have localized failure in buckling, crippling, etc.,
- Redundant structures with impact damage to steel members which are likely to cause failure, or have failed in buckling, crippling, etc.,
- Active measurable section loss in the tension zone on NSTMs, or
- Redundant primary structural members (beams/girders/steel piles) with active corrosion and over 75% section loss (generally localized defects (i.e. beam ends)).

Steel Repair Recommendation – Priority B – "B Flags"

- Secondary members (diaphragms, bracing, etc.) with between 25% to 75% section loss to a widespread amount of members,
- Bolted Field Splice: Missing bolts, active corrosion and with between 25% to 75% section loss to a widespread amount of splices,
- Redundant primary structural members (beams/girders/steel piles) with active corrosion and between 25% to 75% section loss, or

Steel Repair Recommendation – Priority C – "C Flags"

- Cracks or deterioration in secondary steel members,
- Need for spot painting primary structural steel members (25% or more of surface area of steel on bridge),
- Primary structural members (beams/girders/steel piles) with active corrosion and under 25% section loss,
- Dormant measurable section loss in the tension zone on NSTMs,
- Unmitigated crack in a secondary steel member, or
- Cracked welds on steel grid deck.

Repair Recommendation Examples - Concrete

Concrete Repair Recommendation – Priority A – "A Flags"

- Deep and wide cracks (greater than ½" wide) in areas which compromise the structural integrity of the member (no immediate safety concern),
- Severely deteriorated, sheared (cracked), or spalled concrete sections (especially spalled concrete caps at girder bearing area) which may be compromising the structural integrity (no immediate safety concern), or
- Deck spalls below the top mat of reinforcing steel, which do not pose a hazard to traffic, or in danger of punching through.

Concrete Repair Recommendation – Priority B – "B Flags"

- Deep and wide cracks (up to ½" wide) in areas which may lead to a condition that could compromise the structural integrity of the member (no immediate safety concern),
- Spalled prestressed girder with exposed/deteriorating strands which may lead to a condition that could compromise the structural integrity of the member (no immediate safety concern),
- Spalled reinforced concrete girder with exposed/deteriorating main rebar with section loss and more than one bar affected at same location on girder, or
- Spalled/cracked columns with extensive spalls and areas of exposed rebar.

Concrete Repair Recommendation – Priority C – "C Flags"

- Cracks (½" wide or less) which required repair,
- Unsound patches with rust staining in prestressed concrete members,
- Previous unsatisfactory repairs (i.e. mortar or patches) of delaminated, spalled, or cracked concrete to prevent additional deterioration especially in the bearing areas, or
- Slightly sheared beam ends.

Repair Recommendation Examples - Timber Piles

Any piles that have a repair recommendation shall be field marked.

Timber Pile Repair Recommendation – Priority A – "A Flags"

- Pile defects in CS 4 including severe splits, scour, checking/shaking, misalignment, settlement, damage, or cracking (no immediate safety concern).
- Priority A – "A Flags" related to decay on a timber pile are included in Figures D.3 to D.6.

Timber Pile Repair Recommendation – Priority B – "B Flags"

- Pile defects in CS 3 including significant splits, scour, checking/shaking, misalignment, settlement, damage, or cracking, or

- Replacement of timber pile cross-bracing.
- Priority B – "B Flags" related to decay on a timber pile are included in Figures D.3 to D.6.

Timber Pile Repair Recommendation – Priority C – "C Flags"

- Pile defects in CS 3 including slight splits, scour, checking/shaking, misalignment, settlement, damage, or cracking.
- Priority C – "C Flags" related to decay on a timber pile are included in Figures D.3 to D.6.

Repair Recommendation Examples - Timber (Non-Piles)

Timber Repair Recommendation – Priority A – "A Flags"

- Bearing loss/undermining due to scour on timber mud-sill footing (≥30% loss of footing bearing area),
- Deck boards with a hole completely through or broken deck boards in traffic areas (no immediate safety concern),
- Cracked or broken timber stringers,
- Extensively decayed and crushed caps, crown strips or sills, or
- Broken or severely decayed timber joists.

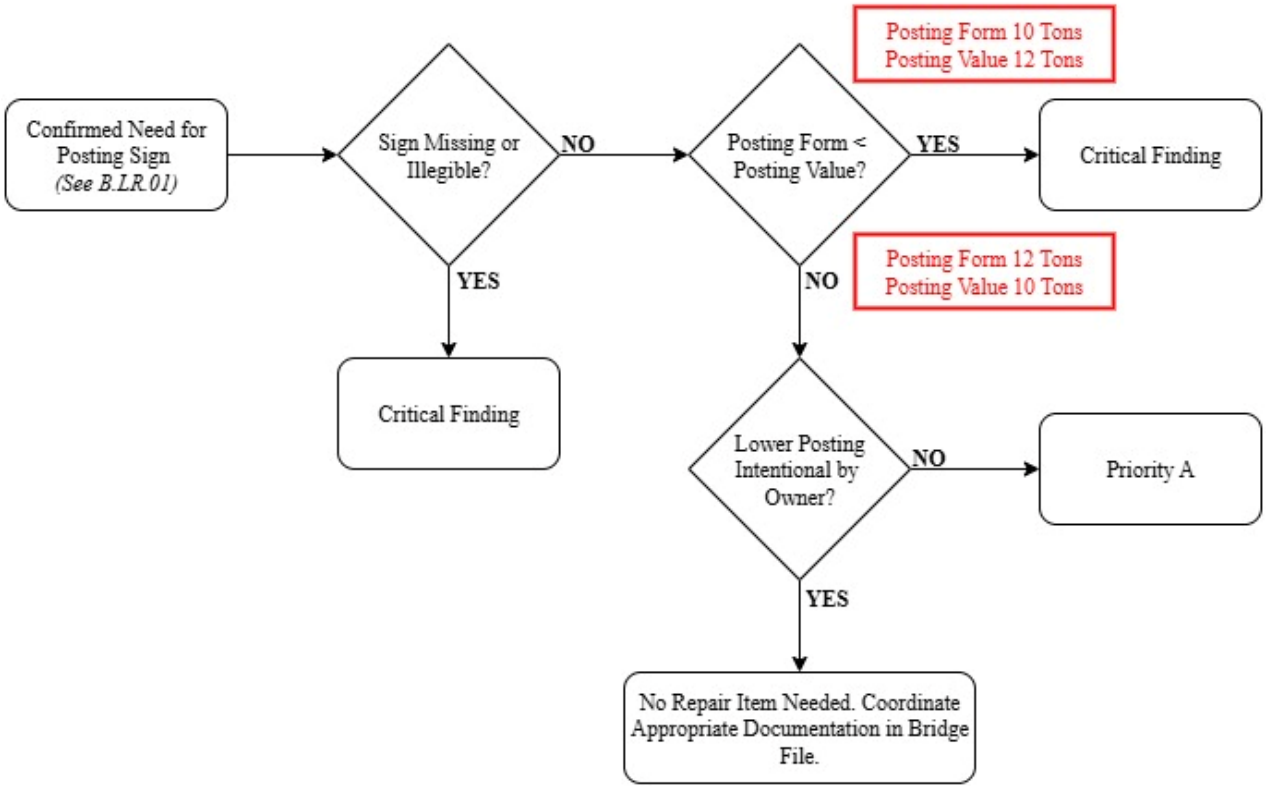
Timber Repair Recommendation – Priority B – "B Flags"

- Bearing loss/undermining due to scour on timber mud-sill footing (<30% loss of footing bearing area),
- Partially failed deck plank boards,
- Decayed or missing bulkhead boards with loss of fill,
- Excessive drift causing excess pressure/scour on bridge substructure (if there is no immediate safety concern),
- Missing/broken/damaged/loose/badly decayed rail posts, rail boards, and blockouts, or
- Loose deck boards.

Timber Repair Recommendation – Priority C – "C Flags"

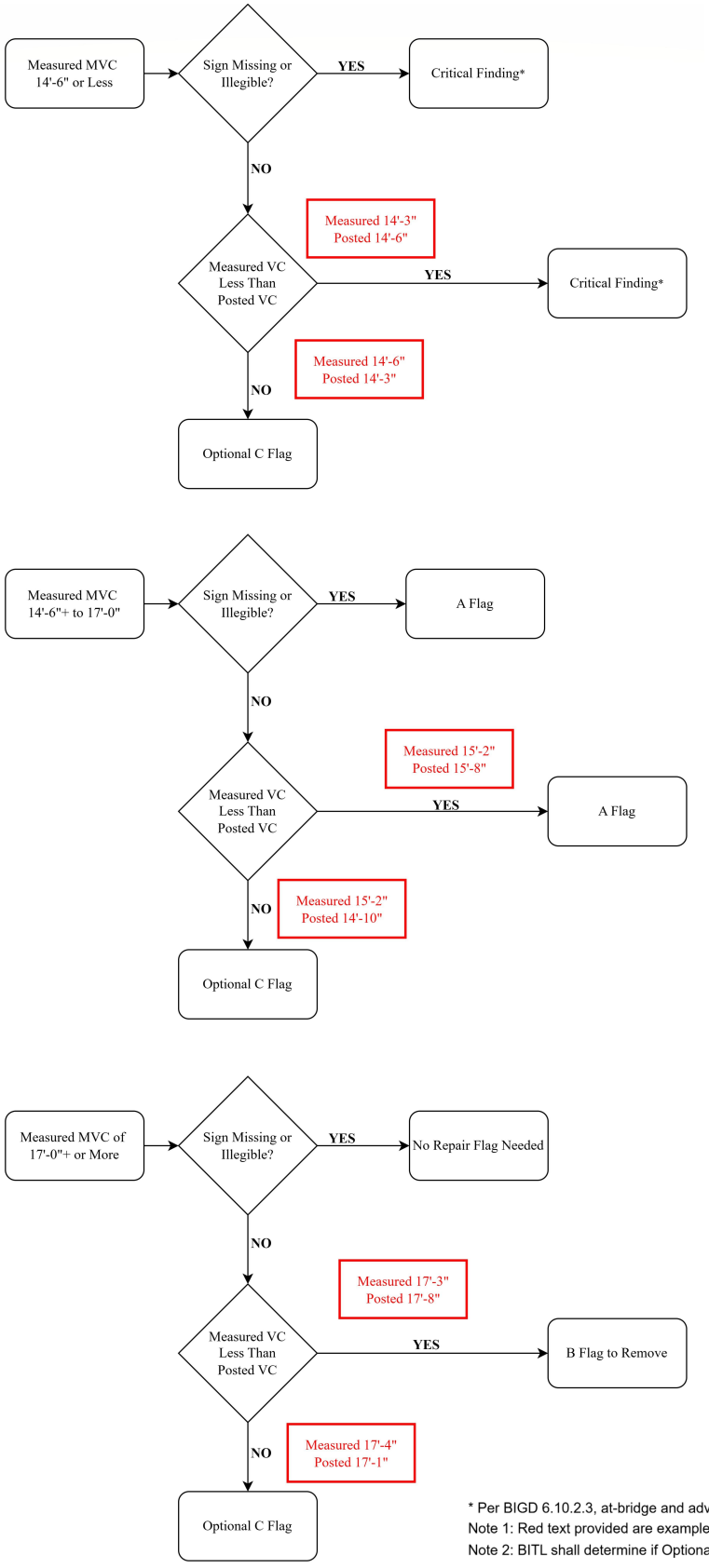
- Split/decayed nailers,
- Decayed or unusual/excessive splits in timber joists,
- Decayed or unusual/excessive splits in caps and sills, but still intact and not subject to extensive crushing,
- Decayed timber wingwall system, or

Figure D.1: Load Posting Sign Flowchart



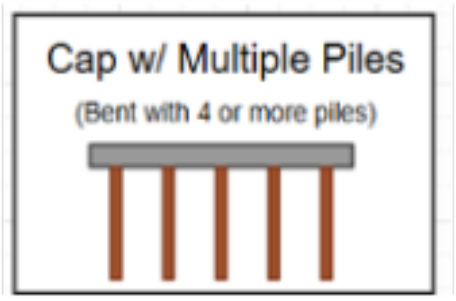
Note 1: Red text provided are examples of Load Posting values.

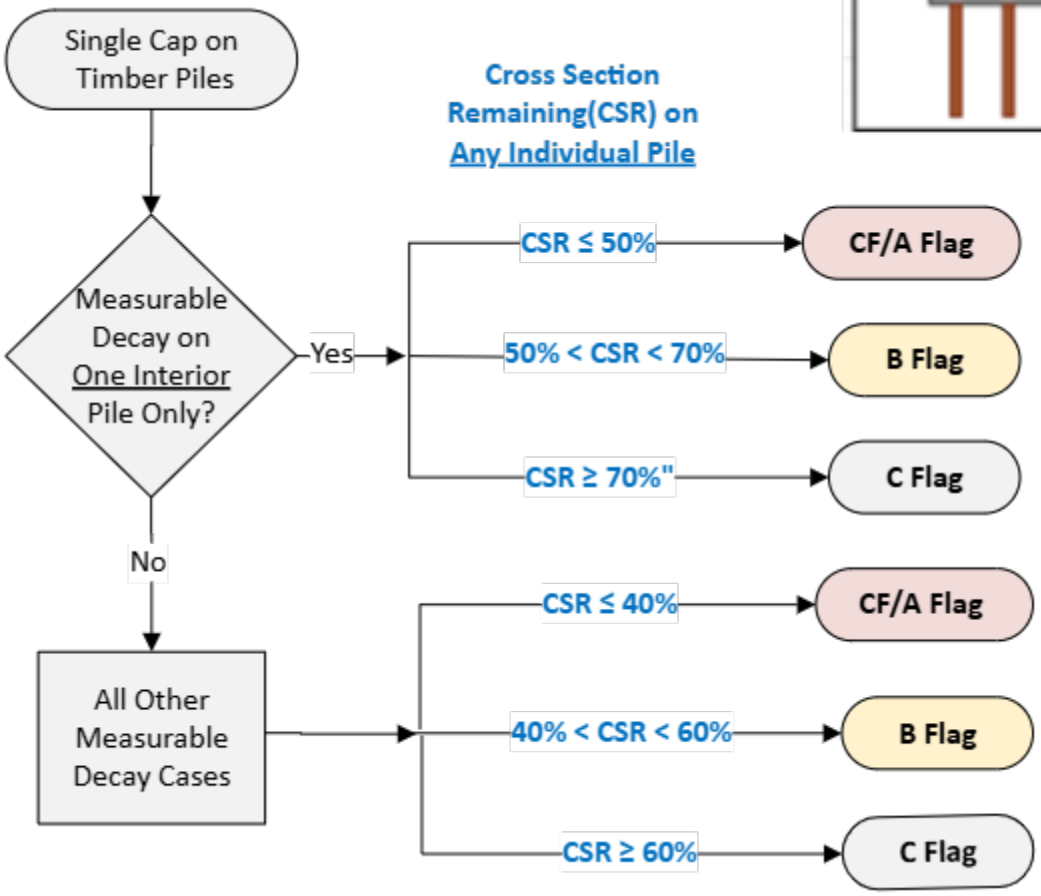
Figure D.2: Measured Vertical Clearance (MVC) and Clearance Sign Flowchart



* Per BIGD 6.10.2.3, at-bridge and advance vertical clearance signs are required for measured VC of 14'-6" or less.
Note 1: Red text provided are examples of MVC values.
Note 2: BITL shall determine if Optional C Flag is needed. They may choose to discuss need with the DBE.

Figure D.3: Single Cap on Timber Piles Flowchart





Note 1: This flowchart is applicable to timber piles with an exposed pile height > 4 feet.

Note 2: The BITL shall determine if a CF or "A Flag" is required. If there is a risk of bridge collapse or partial collapse of the bridge, a CF shall be reported. If bridge closure or lane closure is recommended due to the condition of the pile, a CF shall be reported. Generally, once a pile reaches any of the following decay levels, a CF should be considered: 40% or less section remaining on a single pile with other defects on the piles in that bent, 30% or less section remaining on interior pile with defects isolated to that pile, 25% or less section remaining on an exterior pile

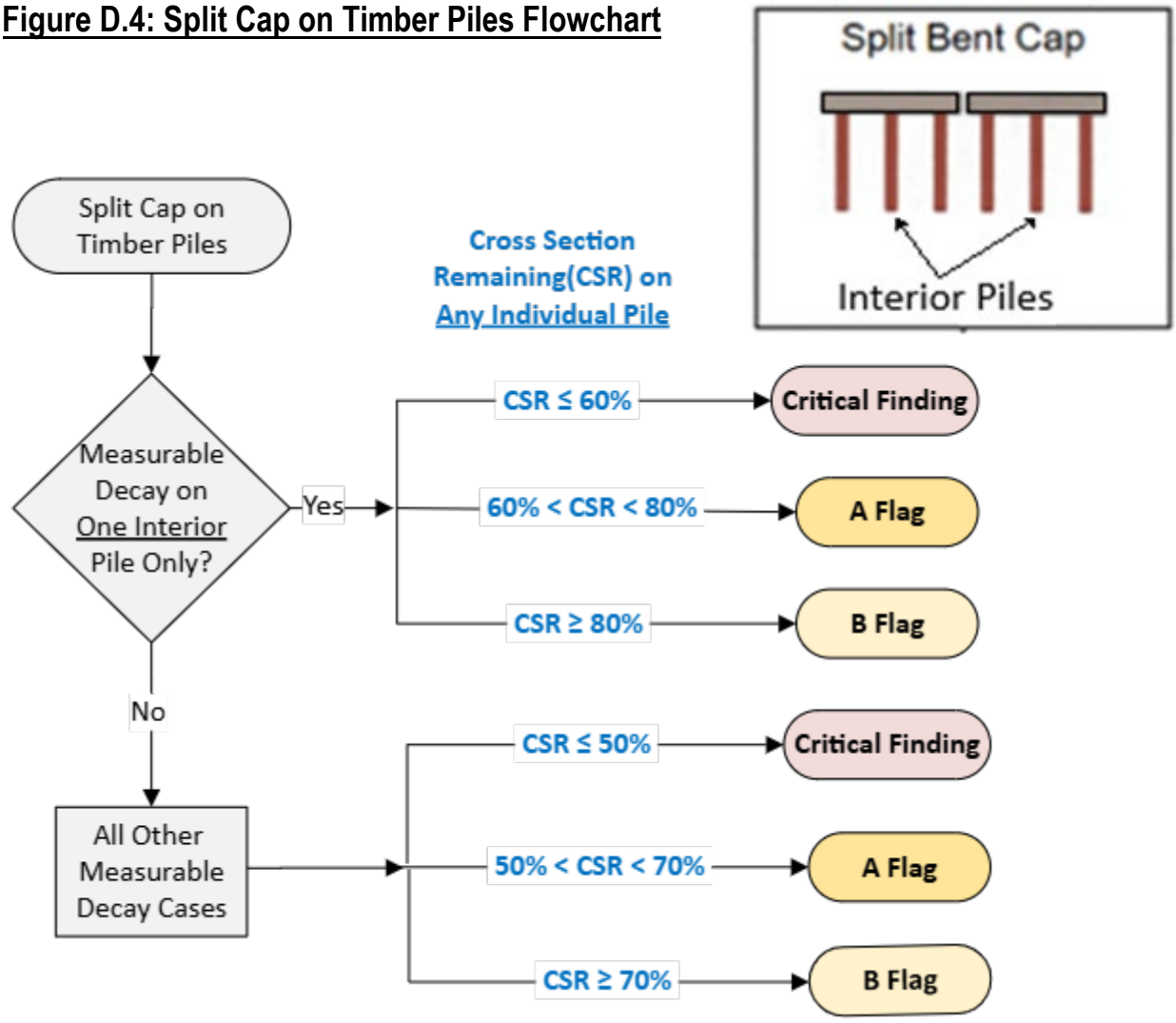
Note 3: If more than one pile on a single bent reaches the "CF/A Flag" level, a CF shall be reported.

Note 4: Insignificant defects (CS1) on piles should not be considered in determining if multiple piles in a bent have defects.

Note 5: Section loss on 10" (or smaller) piles is more critical than larger piles. The presence of decay/section loss on smaller diameter piles could warrant a CF.

Note 6: The recommendations in this flowchart are not requirement, the BITL may consult the DBE and DBIS for additional clarification when preparing pile repair recommendations.

Figure D.4: Split Cap on Timber Piles Flowchart



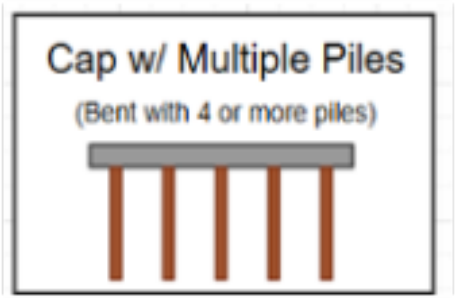
Note 1: This flowchart is applicable to timber piles with an exposed pile height > 4 feet.

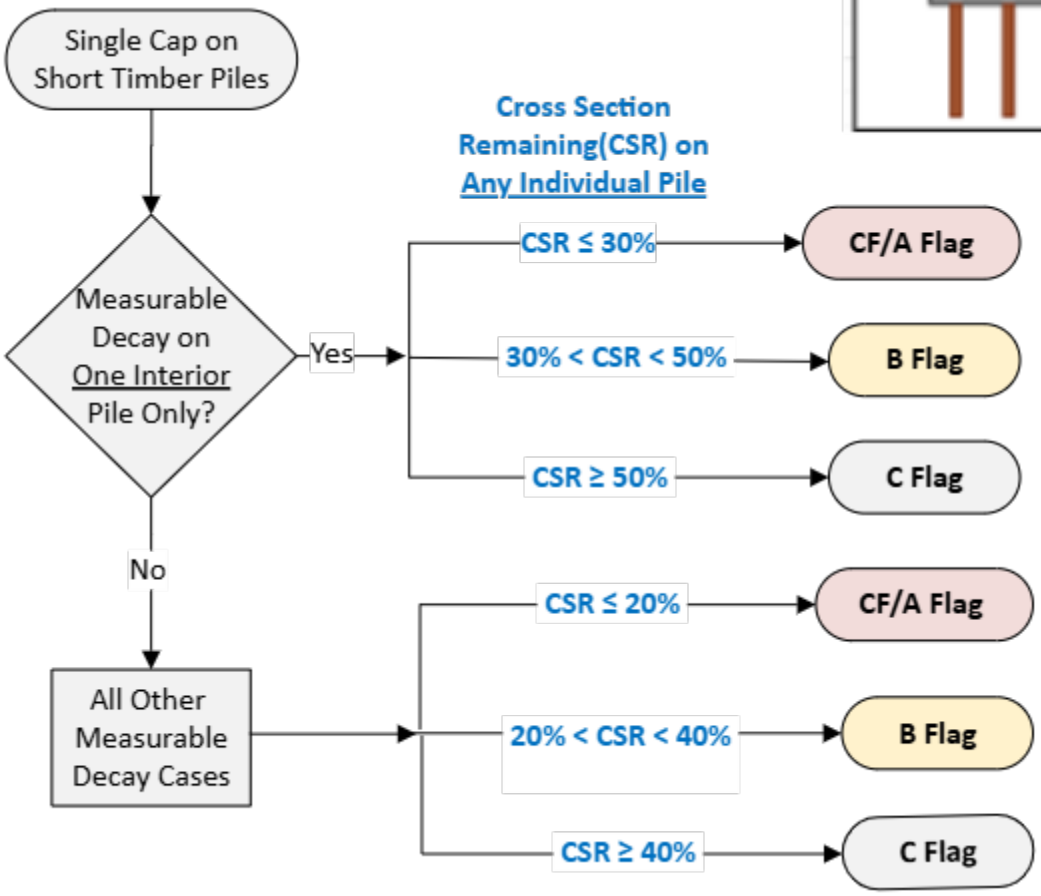
Note 2: Insignificant defects (CS1) on piles should not be considered in determining if multiple piles in a bent have defects.

Note 3: Section loss on 10" (or smaller) piles is more critical than larger piles. The presence of decay/section loss on smaller diameter piles could warrant a CF.

Note 4: The recommendations in this flowchart are not requirement, the BITL may consult the DBE and DBIS for additional clarification when preparing pile repair recommendations.

Figure D.5: Single Cap on Short Timber Piles Flowchart





Note 1: This flowchart is applicable to timber piles with an exposed pile height ≤ 4 feet.

Note 2: The BITL shall determine if a CF or "A Flag" is required. If there is a risk of bridge collapse or partial collapse of the bridge, a CF shall be reported. If bridge closure or lane closure is recommended due to the condition of the pile, a CF shall be reported. Generally, once a pile reaches any of the following decay levels, a CF should be considered: 40% or less section remaining on a single pile with other defects on the piles in that bent, 30% or less section remaining on interior pile with defects isolated to that pile, 25% or less section remaining on an exterior pile

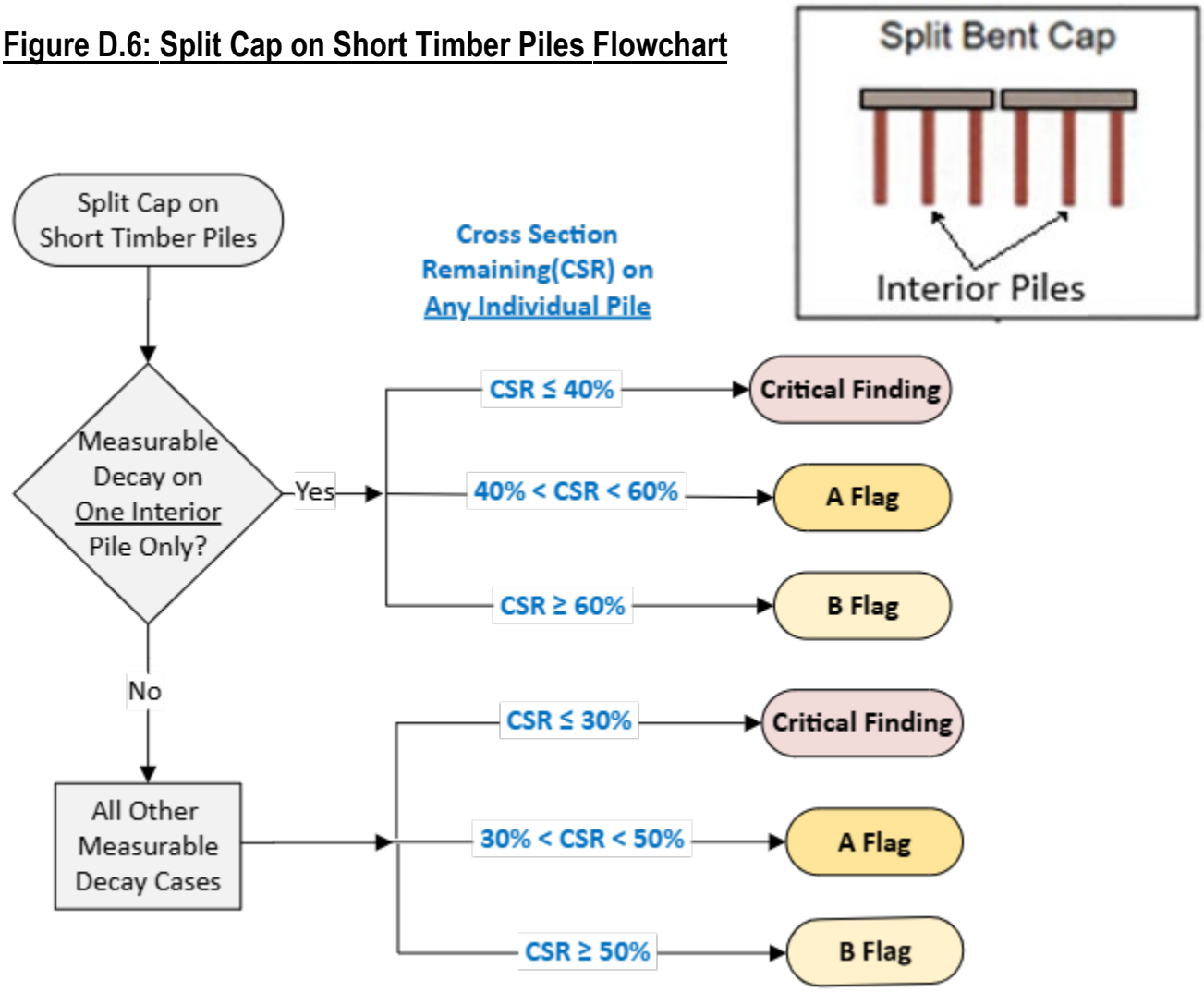
Note 3: If more than one pile on a single bent reaches the "CF/A Flag" level, a CF shall be reported.

Note 4: Insignificant defects (CS1) on piles should not be considered in determining if multiple piles in a bent have defects.

Note 5: Section loss on 10" (or smaller) piles is more critical than larger piles. The presence of decay/section loss on smaller diameter piles could warrant a CF.

Note 6: The recommendations in this flowchart are not requirement, the BITL may consult the DBE and DBIS for additional clarification when preparing pile repair recommendations.

Figure D.6: Split Cap on Short Timber Piles Flowchart



Note 1: This flowchart is applicable to timber piles with an exposed pile height ≤ 4 feet.

Note 2: Insignificant defects (CS1) on piles should not be considered in determining if multiple piles in a bent have defects.

Note 3: Section loss on 10" (or smaller) piles is more critical than larger piles. The presence of decay/section loss on smaller diameter piles could warrant a CF.

Note 4: The recommendations in this flowchart are not requirement, the BITL may consult the DBE and DBIS for additional clarification when preparing pile repair recommendations.

Asset ID Placement on Bridges

An Asset ID Number placard shall appear on all bridges. To promote uniformity, the BMO has directed the Asset ID Number placards to be placed adjacent to Bent 1 or Barrel 1, preferably on the right side when looking upstation. Placards shall be located at the Bent 1 end (for bridges) or at Barrel 1 (for culverts) per the labeling diagram.

If a bridge does not have an Asset ID Number posted or if it has an incorrect number posted, it shall be replaced. If consultants discover an Asset ID Number placard missing on a bridge and they are unable to install one, the consultant shall recommend the placard be installed as a Priority C (or "C Flag") Repair Recommendation.

The DBIS and Consultant PM shall discuss the importance of the placement of the Asset ID Number placard on the bridge. Any member of maintenance or consultant inspectors may place or move an Asset ID Number placard on bridges. If the placard was incorrectly placed, the Asset ID Number placard shall be moved by the inspectors. If inspectors move or install an Asset ID Number placard, the BITL shall add a note stating what was done in the Inspection Note (B.IE.11) field. If the consultant is unable to safety place or relocate the placard due to traffic or other conditions, they should recommend the district take action with a Priority C (or "C Flag") Repair Recommendation.

Structures with Multiple or Incorrect Asset ID Numbers

Inspectors or load raters may come across structures which have multiple or incorrect Asset ID Numbers. This may occur if two bridges are replaced with a single bridge and a new number was not assigned. This may also occur if more than one Asset ID was requested while a bridge was being replaced. This practice is not acceptable, and a single number should have been assigned as Asset ID Number. The inspector or load rater shall inform the BMO of the errors and request corrections with Road Data Services (RDS) as needed.