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## **CHAPTER 3**

# **QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) FOR IOWA DOT PERSONNEL**

### **3.1 SCOPE OF IOWA DOT BRIDGE INSPECTION QUALITY ASSURANCE/QUALITY CONTROL PROGRAM**

The Iowa portion of the NBI is more than 25,000 bridges. Iowa DOT owns, inspects, and maintains more than 4,000 of these bridges (those on State or Interstate routes) in compliance with the NBIS. This chapter covers the Quality Assurance and Quality Control definitions, policies, and procedures for these 4,000 plus bridges. The role of SIIMS in collecting, verifying, and flagging input data and dates is also reviewed. Criteria for when an inspection report is to be sent for Engineering, Hydraulic or Load Rating review is provided. NBIS Training requirements for Program Managers and Team Leaders is provided. Finally, Iowa DOT’s Independent Oversight Model (IOM) used by Supervisors to perform a prescribed Quality Assurance process is outlined. This includes quantity, frequency and selection of QA bridges, items to be compared to the inspection report, acceptable tolerances for coding and scoring those items and Close Out review of findings with the inspection teams.

Note that QA/QC for the 19,000-plus Local Public Agency (LPA) owned bridges is provided in Chapter 5. Private bridge owners are subject to the NBIS and do fall under Iowa DOT oversight when there is a public route on both ends of the bridge.

### **3.2 NBIS DEFINITION OF TERMS**

The NBIS definitions of Quality Control and Quality Assurance are provided in the following sections.

#### **3.2.1 Quality Control**

Quality Control is defined as procedures intended to maintain the quality of a bridge inspection and load rating at or above a specified level.

#### **3.2.2 Quality Assurance**

Quality Assurance is defined as the use of sampling and other measures to assure the adequacy of quality control procedures in order to verify or measure the quality level of the entire bridge inspection and load rating program.

### **3.3 ROLE OF SIIMS**

Iowa DOT implemented SIIMS in May 2010. SIIMS is a software package used to update the bridge records of Iowa’s portion of the NBI. The user interface is a password-protected website allowing Iowa DOT and LPA bridge inspectors to manage inspections and document findings in a standardized reporting format.

SIIMS is the foundation of the Iowa DOT quality control program. The software presents standard collection screens for data entry, schedules inspections, and performs integrity checks at each stage of the approval process. These quality control measures are in place to obtain consistent inspection data from multiple inspectors, which is necessary if proper resource planning is to occur across the State.

## 3.4 QUALITY CONTROL

### 3.4.1 Inspection Scheduling

Inspection dates and inspection frequencies are entered in SIIMS for all NBI structures. Multiple inspection types, such as NSTM or Underwater Inspections, may be entered and scheduled for separate dates, years, and frequencies.

SIIMS can forecast upcoming inspections and provide maps of bridge locations.

When the date of an inspection passes without the creation of an inspection report, SIIMS will automatically notify the bridge owner and Program Manager via e-mail if a report is not created by the time the inspection is 1 month, 3 months, and 6 months past due.

If an inspection report was created but remains unapproved, SIIMS will automatically notify the bridge owner and Program Manager via e-mail when the inspection report is 3 months and 6 months past the inspection date.

If an inspection report is not created or the report remains unapproved 6 months after the inspection date, SIIMS will automatically notify the bridge owner and Program Manager via e-mail and request an aggressive, short-term plan to correct this deficiency.

### 3.4.2 Data Collection

When an inspection report is created in SIIMS, a series of web pages are populated with the SNBI information available for the structure. SIIMS promotes consistent SNBI data collection by standardizing the data entry based on the following:

1. The inspector reviews each SNBI and Element Level item data and updates the data to reflect their inspection findings.
2. Each report includes a Load Rating Evaluation Form the inspector must complete before SIIMS will allow the inspection report to be approved.

Each report has an Error Check page to alert the inspector to entries missing or varying from an expected format.

### 3.4.3 Quality Control Processing

The last step in the data entry process for an inspection report is requesting approval. When an inspector submits a report for approval, the error check software in SIIMS will review the report fields. If data entry errors are found, such as Item B.IR.01 (NSTM Inspection Required) is coded “Y” but no condition rating is provided for Item B.C.14 (NSTM Inspection Condition), an Error Check page will appear, and the report will not be approved until the errors are resolved.

When the error check software finds entries that do not match the data stored in the SIIMS database, the inspector will be asked if the new data should overwrite the existing data or if the existing data should remain. The inspector must choose whether to use the report values or central database values before SIIMS will allow the report to be approved. Some data may be uneditable because it is data maintained by the Iowa DOT. If the data is uneditable and appears to be incorrect or in question, contact the Research and Analytics Bureau to correct or clarify the data discrepancy.

Iowa DOT inspectors submit each report to the Quality Control team for content review and approval. A member of the Quality Control team reads each report to check the following:

1. The SNBI fields used for data entry and NBE/MBE/ADE usage and coding are appropriate for the type of structure, condition, and components being inspected.

2. The written descriptions convey mental images of field conditions consistent with the photographs and sketches of deterioration.
3. The descriptions, photographs, and sketches provide sufficient information for a person not able to physically visit the bridge to make judgments about maintenance activities or structural repairs.
4. Critical Findings have been identified, documented sufficiently, and the appropriate authority has been notified.

If the member of the Quality Control team finds the report fails these checks, the Quality Control team member may either make the necessary corrections or return the report to the inspector for completion. If the Quality Control team member decides the report is complete, they must then decide to take one of three actions based on the findings in the report:

1. Approve the report without making maintenance and/or program recommendations
2. Approve the report with maintenance recommendations and/or program recommendations
3. Forward the report for further review to:
  - a. Engineering Review
  - b. Hydraulic Review
  - c. Load Rating Review

The following criteria must be used to determine when to forward the inspection report to Engineering Review:

1. A condition rating decreased to a 4 or below.
2. An NBE has a combined total of more than 10% in condition state 3 and/or 4.
3. A BME has a combined total of more than 15% in condition state 3 and/or 4.
4. Any issue the Quality Control team finds questionable.
5. A Critical Finding has been identified.

The following criteria must be used to determine when to forward the inspection report to Preliminary Bridge Design for Hydraulic Review:

1. The structure is scour-critical, per SNBI Item B.AP.03 (Scour Vulnerability) coding.
2. Scour is found during the current inspection.
3. Severe channel movement is present that is threatening a bridge substructure element.
4. Any condition the Quality Control team finds questionable.

The Preliminary Design Section will perform the Hydraulic Review, following their own procedures, not documented in this bridge inspection manual.

The following criteria must be used to determine when to forward the inspection report to Load Rating Review:

1. There is collision damage to primary members since the last inspection with:
  - a. exposed strand(s) in prestressed beams,
  - b. gouges, tears, cracks, or bends in steel beams, or
  - c. unrepaired previous collision damage.
2. There is more than 1/16 inch new section loss in steel primary members and any additional section loss at an old area.
3. There is new or additional bearing area loss.
4. There is a new deck, new deck overlay, new barrier rails, bridge widening, or any impactful dead loads added to the bridge since the last inspection.

5. There are damaged sign trusses attached to bridges (attachments with exposed anchor bolts, cracks in truss members, truss members with significant section loss).
6. Strengthening of load carrying members has been performed since the last inspection.
7. The bridge requires a special inspection, is posted, or is being considered for a detour route.
8. There are wood piling problems (hollow or rotten areas, major splits).
9. The structure is a new bridge.
10. There is movement of substructure units.
11. There is significant concrete deterioration of prestressed beam ends, pier caps and columns, if not previously reported.
12. There is post tensioned retrofit of steel and concrete bridges.

Engineer review or Load Rating Review includes reviewing the entire inspection report, verifying existing repair recommendations, and making additional recommendations for repair. Recommendations for program work, when needed, must also be completed during an engineer's review. When the review is complete, the engineer will approve the final report.

A Hydraulic Review will only review the need for repair of the waterway. When the Hydraulic Review is complete, the report will be sent back to the Quality Control team for finalization or further engineer review.

### 3.4.4 Training

The NBIS requires periodic bridge inspection refresher training for Program Managers and Team Leaders in Part 650.309. Iowa DOT has defined periodic as being every 5 years in accordance with the NBIS. All State and LPA bridge inspection Program Managers and Team Leaders are required to complete the Bridge Inspection Refresher Training Course every 5 years following the completion of initial comprehensive bridge inspection training.

The SIIMS system contains an individual's qualifications as a team leader. When an individual's refresher training or professional license is within 6 months of expiring, a notice will appear each time the user logs into SIIMS. This notice will show the date(s) of expiration.

## 3.5 QUALITY ASSURANCE

The terms quality control and quality assurance are not interchangeable. The NBIS defines quality control as a tool and quality assurance as an evaluation of that tool. SIIMS has built-in quality controls guiding inspectors through data collection and standardize data entry in order to obtain consistent inspection data from multiple inspectors.

Quality assurance is a review of the inspection data to provide the following:

1. An evaluation of how well the quality control tools in SIIMS are delivering consistent inspection data
2. Identification of where the data is not consistent so the quality control tools can be corrected or modified

Iowa DOT employs six inspection teams to perform SNBI inspections complying with the NBIS. The supervisor of the inspection teams performs a formal quality assurance review of two teams annually using the criteria described in the following sections.

### 3.5.1 Team Selection

Two inspection teams are reviewed annually. The six teams are selected in the following 3-year cycle:

Year 1 = Teams 1 and 4

Year 2 = Teams 2 and 5

Year 3 = Teams 3 and 6

### 3.5.2 Bridge Selection

Four bridges assigned to a team are selected for review, but the bridges must not be selected at random. The bridges must be scheduled for inspection during the calendar year of the review. The age and bridge condition must be considered to avoid selecting bridges that are too new to have notable deterioration. The type of the four structures selected must include the following:

1. Steel Continuous Multi-Beam
2. Prestressed Concrete Multi-Beam
3. Concrete Continuous Slab
4. Concrete Continuous Culvert

The size and complexity of the structures must be similar to a number of other bridges of the same type the team inspects.

### 3.5.3 Quality Assurance Inspections

The supervisor will inspect the selected bridges using an Independent Oversight Model (IOM), which is a quality assurance review generating a bridge inspection independent and without the knowledge of the team under review. The supervisor must review previous inspection reports and plans, prepare sketches, take digital photographs, rate SNBI items, complete Bridge Element condition states, and describe deterioration as if they were performing the biennial NBIS inspection.

### 3.5.4 Tolerance Thresholds

The supervisor will compare the IOM inspections to the inspection reports the team submits and prepare a summary of any differences between the reports. Specifically, the supervisor must look for consistency in coding, ratings, Bridge Element condition states, sketches, and photographs using the following thresholds established to define if data is in-tolerance or out-of-tolerance:

Inspection Report Data Tolerances:

1. Condition/appraisal ratings are within +/- 1 of the IOM ratings.
2. Subjective SNBI item lengths (field measurements that may be difficult to exactly duplicate, such as vertical clearances) are within +/- 0.2 feet or +/- 3 inches.
3. Non-subjective SNBI item lengths (obtained from bridge plans that must not vary, such as the longest span) are within +/- 0.1 feet or +/- 2 inches.
4. Non-subjective SNBI item quantities (obtained from bridge plans that must not vary, such as the number of spans) are within +/- 0 quantity.
5. Non-subjective SNBI item descriptive codes (obtained from bridge plans that must not vary, such as the type of wearing surface) are within +/- 0.

AASHTO Bridge Elements:

1. Each Bridge Element included in the inspection team's report that does not apply to the bridge must be counted as out-of-tolerance.
2. Each failure to include a Bridge Element in the inspection team's report that does apply to the bridge must be counted as out-of-tolerance.

Condition States for AASHTO Bridge Elements:

1. Bridge Elements where condition state quantities are reported in feet: +/- 10 feet
2. Bridge Elements where condition state quantities are reported in square feet: +/- 25 square feet
3. Bridge Elements where condition state quantities are reported in each: +/- 1

### 3.5.5 Scoring

Each report will receive a score of up to 100 points. The report score is the sum of points awarded in the following four categories:

1. Condition/Appraisal Ratings = 25 points
2. SNBI Data Items = 25 points
3. AASHTO Bridge Elements = 25 points
4. Supporting Documentation = 25 points

#### 3.5.5.1 Condition/Appraisal Ratings

The supervisor will compare the inspection team's SNBI ratings for Items B.C.01 – B.C.11, B.C.14-B.C.15, & B.AP.01-B.AP.02 to the IOM inspection. The fifteen items will be counted as either in-tolerance or out-of-tolerance. A score will be calculated as follows:

N = number of out-of-tolerance items

$$\text{Score} = (1 - N / 6) * 25 \text{ pts.}$$

#### 3.5.5.2 SNBI Data Items

The supervisor will compare the inspection team's values for SNBI items B.H.12, B.W.01, B.W.02, B.W.03, B.H.08, B.G.09, B.G.10, B.G.11, B.G.15, B.RH.01, B.RH.02, B.PS.01, B.F.01, B.F.02, B.SP.01, B.SP.02, B.SP.04, B.SP.05, B.SP.06, B.H.16, B.G.01, B.G.02, B.G.03, B.G.05, B.G.06, B.G.07, B.G.08, B.H.13, B.H.14, B.H.15, B.SP.09, B.SP.10, B.SP.11 & B.SP.12 to the IOM inspection. The 34 values for these items will be counted as either in-tolerance or out-of-tolerance. A score will be calculated as follows:

N = number of out-of-tolerance items

$$\text{Score} = (1 - N / 15) * 25 \text{ pts}$$

#### 3.5.5.3 AASHTO Bridge Elements

The supervisor will count the number of Bridge Elements that are either in-tolerance or out-of-tolerance. A score will be calculated as follows:

N = number of out-of-tolerance elements

T = total number of elements in the IOM inspection

$$\text{Score} = (1 - N / T) * 25 \text{ pts.}$$

#### 3.5.5.4 Supporting Documentation

The supervisor will score the inspection team's photographs, photo descriptions, sketches, Bridge Element text descriptions, and proper use of grammar, capitalization, and sentence structure. Each criterion is worth up to 5 points. An overall score for Supporting Documentation will be calculated by summing the scores for the five aforementioned criteria. Each criterion score shall be based on the following model:

5 = Excellent documentation

4

**3** = Minimum acceptable effort

**2**

**1** = Completely unacceptable effort

Points 4 and 2 are to be used where the documentation is judged to fall between the 5, 3, and 1 point scores.

The example provided in Figure 3.5.5-1 is intended to provide a scoring guide for Supporting Documentation, but the reviewer must use judgment to decide if the inspection team’s documentation more closely aligns with the excellent or unacceptable end of the rating scale. Figure 3.5.5-2 is a summary scoring sheet for the entire Quality Assurance Review.



Bridge ID: \_\_\_\_\_ SNBI B.IE.02 Date: \_\_\_\_\_ FHWA Number: \_\_\_\_\_

Quality Score	Description of Quality
<b>Photographs</b>	
5	Photo or series of photos tells story of deterioration without explanation.
4	
3	All photos are in focus and well lit.
2	
1	Two or more photos are out of focus, blurry, or poorly lit.
<b>Photo Descriptions</b>	
5	Descriptions identify location, orientation of viewer, and/or purpose of photo.
4	
3	Descriptions identify location and/or subject.
2	
1	Two or more photos are not labeled, or label is inaccurate.
<b>Sketches</b>	
5	Sketches show deterioration with quantitative information such as dates, dimensions, and numbers.
4	
3	Sketches are legible, initialed, and dated.
2	
1	Two or more sketches are not dated, not initialed, have illegible writing, or are too faint to read.
<b>Bridge Element Text Descriptions</b>	
5	Text descriptions provide context or history of deterioration.
4	
3	Text descriptions are consistent and support the reported condition states.
2	
1	One or more elements have quantities in condition states 3, or 4 without a written description explaining why the condition state is not 1 or 2.
<b>Grammar, Capitalization, and Sentence Structure</b>	
5	Text descriptions include concise descriptive sentences that convey a mental image consistent with the photographs and sketches and provide a context.
4	
3	Text descriptions include descriptive sentences that convey a mental image consistent with the photographs and sketches and may have extra words or wordy descriptions.
2	
1	Text descriptions include run-on sentences, misspellings, or missing punctuation.

Figure 3.5.5-1 Supporting Document Review Scoring Guide

Maint. Number: \_\_\_\_\_  
 FHWA Number: \_\_\_\_\_

SNBI B.IE.02 Date: \_\_\_\_\_  
 Total: \_\_\_\_\_

<p><u>Condition/Appraisal Ratings</u></p> <p>The supervisor will compare the inspection team’s SNBI ratings for Items B.C.01 – B.C.04, B.C.09 72 &amp; B.AP.02 to the IOM inspection. The six items will be counted as either in-tolerance or out-of-tolerance. A score will be calculated as follows:</p> <p>N = number of out-of-tolerance items</p> <p>Score = (1 - N / 6) * 25 pts.</p>	N	
	Score	
<p><u>SNBI Data Items</u></p> <p>The supervisor will compare the inspection team’s values for SNBI items B.H.12, B.W.01, B.W.02, B.W.03, B.H.08, B.G.09, B.G.10, B.G.11, B.G.15, B.RH.01, B.RH.02, B.PS.01, B.F.01, B.F.02, B.SP.01, B.SP.02, B.SP.04, B.SP.05, B.SP.06, B.H.16, B.G.01, B.G.02, B.G.03, B.G.05, B.G.06, B.G.07, B.G.08, B.H.13, B.H.14, B.H.15, B.SP.09, B.SP.10, B.SP.11 &amp; B.SP.12 to the IOM inspection. The 34 values for these items will be counted as either in-tolerance or out-of-tolerance. A score will be calculated as follows:</p> <p>N = number of out-of-tolerance items</p> <p>Score = (1 - N / 34) * 25 pts.</p>	N	
	Score	
<p><u>AASHTO Bridge Elements</u></p> <p>The supervisor will count the number of Bridge Elements that are either in-tolerance or out-of-tolerance. A score will be calculated as follows:</p> <p>N = number of out-of-tolerance elements</p> <p>T = total number of elements in the IOM inspection</p> <p>Score = (1 - N / T) * 25 pts.</p>	N	
	T	
	Score	
<p><u>Supporting Documentation</u></p> <p>The supervisor will score the inspection team’s photographs; photo descriptions; sketches; Bridge Element text descriptions; and proper use of grammar, capitalization, and sentence structure using the five scoring criteria tables in Figure 3.5.5-1. Each criterion is worth up to 5 points. An overall score will be calculated by summing the scores for the five criteria.</p>	Photographs	
	Photo Descriptions	
	Sketches	
	Bridge Element Text Descriptions	
	Grammar, Capitalization, and Sentence Structure	
	Score	

Figure 3.5.5-2 Summary Score for Quality Assurance Review

### **3.5.6 Close-Out Meeting**

The supervisor will schedule a meeting with the inspection teams to review the findings from the IOM inspections and the scores of the team inspections. The meeting must be a constructive discussion to identify gaps in training, training topics that must be repeated or emphasized, expectations that must be revised or clarified, and possible changes to SIIMS.