Final Report
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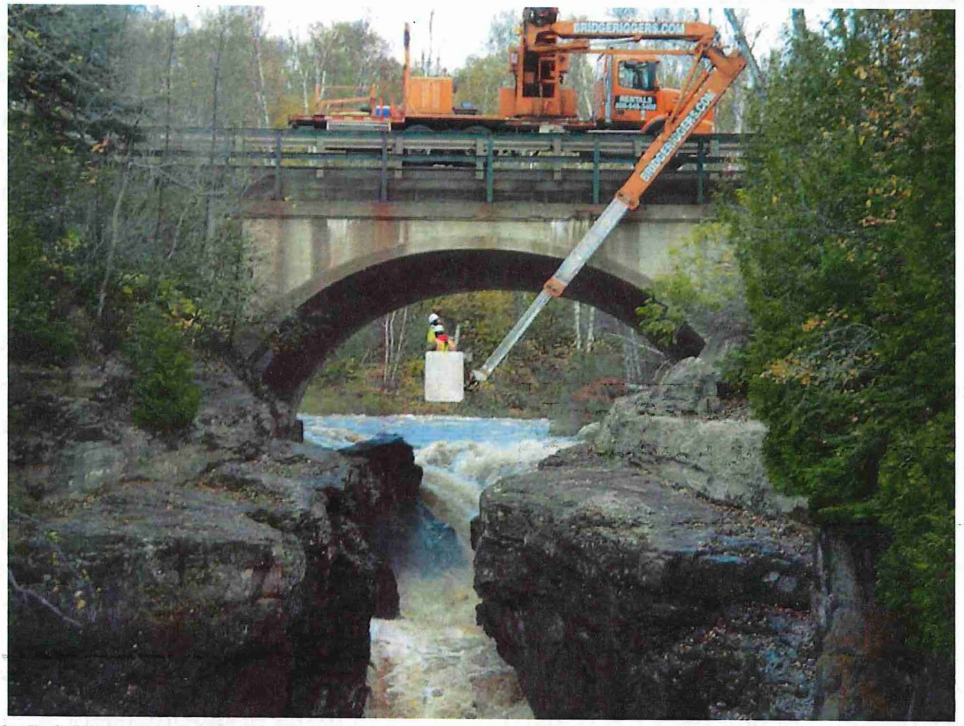
NATIONAL BRIDGE INSPECTION STANDARDS COMPLIANCE REVIEW REPORT



Mn/DOT CONTRACT NO. 91600

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Consultant's Report

NBIS Bridge Inspection Compliance Review

For the

Minnesota Department of Transportation

Executive Summary:

Immediately following the I-35W Bridge collapse in Minneapolis, the Governor of Minnesota requested a "stem to stern review" of the Minnesota Department of Transportation bridge inspection policies and procedures. Responding to Governor Pawlenty's request, the Minnesota Department of Transportation (Mn/DOT) entered into an agreement with PB Americas (PB) to review the Mn/DOT bridge inspection program and determine its compliance with the National Bridge Inspection Standards.

Peer Review:

The goal of any Agency's bridge inspection program is to ensure that the inspections are consistent and accurate. The Agency's bridge inspection manual is the primary reference for the bridge inspector and inspection teams so it is important that this inspection manual is clear and concise and in concurrence with national condition rating guidelines.

The Mn/DOT Bridge Inspection Manual was reviewed and compared to the FHWA Structure Inventory and Appraisal Coding Guide (Coding Guide), and the Texas and Missouri DOT's Bridge Inspection Manuals. The Coding Guide establishes the numeric condition rating guide for all of the inspection manuals reviewed. The Mn/DOT Bridge Inspection Manual used the Coding Guide basic condition rating definitions and expanded those condition rating descriptions to describe the conditions of the bridge components that a bridge inspector would encounter on Minnesota bridges. Those descriptions assist the inspectors in assigning the proper condition rating and promote consistency and accuracy. The Mn/DOT Bridge Inspection Manual is clear and concise and assists the inspection staff in being accurate and consistent.

Among the first tasks of the compliance review was to compare the consultant teams' inspection findings for 301 fracture critical and routine bridge inspections in the Metro District to the Mn/DOT inspection reports for those same bridges. With the goal of a bridge inspection program to be consistent and accurate, being able to compare the consultant and Mn/DOT bridge inspection findings for the same bridges presented a reliable assessment of the consistency and accuracy of the Mn/DOT reports.

When comparing bridge inspection findings the desired outcome is that the NBIS condition ratings, and the bridge condition comments would be identical or very similar. A variance in the numerical condition rating of 1 is certainly acceptable and since there was some time lapse between inspections, some continued condition degradation of the structure would be expected. A variance in the numerical condition rating greater than 1 suggests a lack of consistency or accuracy between the consultant team and Mn/DOT inspections.

The comparison of the routine inspections revealed that the inspection findings were generally similar and within the acceptable variance in the numerical condition rating. Therefore, the Mn/DOT routine bridge inspections are consistent and accurate.

The comparison of the fracture critical inspection findings revealed that there was a larger variance in numerical condition ratings and condition comments. Those variances were investigated and details are presented further in this report.

The overall evaluation of the inspection findings was that Mn/DOT inspection findings were consistent and accurate but there are opportunities for improvement related to fracture critical bridges.

Compliance with the Code of Federal Regulations:

Following the comparison of the bridge inspection findings, the next task within the compliance review was to compare the Mn/DOT inspection program to the NBIS regulations. The Mn/DOT inspection program was compared to the primary sections of the NBIS regulations contained in the CFR Section 23, Highways, part 650, subpart C.

Bridge Inspection Organization:

Each state is mandated to have a bridge inspection organization that administers the inspection of the bridges on the public roadways in the state. The Mn/DOT Bridge Office has that responsibility for the state inspection program including establishing inspection policies and procedures, maintaining the statewide database, certifying inspectors, monitoring load rating and conducting special inspections. The Bridge Office maintains the inventory of all of the bridges in the state. Mn/DOT is in compliance with this section.

Qualifications of Personnel:

Each Program Manager and Team Leader is required to meet minimum qualifications to be certified at these positions. Mn/DOT's required training, experience and testing requirements exceed the NBIS requirements in this regard and Mn/DOT is in compliance with this section.

Inspection Frequencies:

All of the routine, fracture critical and underwater inspections meet the NBIS required inspection frequencies.

The routine inspections are the responsibility of the bridge owners and the inspection ratings and findings are entered into the state database. The non-state bridge owner inspection programs were not part of this review.

Except for two Districts in a few cases, all of the fracture critical inspections are performed by the Mn/DOT Bridge Office.

Underwater inspections are performed by certified and qualified consultant inspectors.

Mn/DOT is in compliance with this section.

Inspection Procedures:

Each bridge is inspected in accordance with the AASHTO Manual. The Mn/DOT policy is that a Team Leader has to be present at all inspections. The Bridge Office is responsible for load rating the state system structures and monitors the load rating on the rest of the bridges.

Each bridge owner is required to prepare and maintain a bridge file for each structure. The bridge file should maintain inspection findings, maintenance recommendations and inspection procedures. Mn/DOT requires each owner to maintain a bridge file so they are in compliance with this section. There are opportunities to improve the bridge files by developing a process to document and track maintenance needs identified as inspection findings.

Fracture critical structures have been identified with some of the fracture critical members (FCM) identified as required. Identifying the FCMs and the fatigue prone details and the inspection procedures would complete the inspection files.

Structures that are scour critical and/or those that need underwater inspection have been identified and the underwater inspection intervals, inspection details and inspection procedures have been developed. Scour critical structures have been identified and scour action plans have been developed and are part of the bridge file maintained by the bridge owners.

The Mn/DOT quality control and assurance program is robust and can be considered a positive example of a QC/QA program for the industry.

Critical inspection findings have been addressed by Technical Memorandums.

Mn/DOT is in compliance with this section.

Inventory:

The statewide bridge inventory information is updated after each inspection. The inspection findings are used to revise the inventory data and provide the most current information about the condition of the bridge. The NBIS directs that the inspection findings are to be entered into the inventory within a regulated interval. Because of the harsh winter weather, inspections are very difficult or impossible to perform during that timeframe making inspection opportunities very limited during the year. Most of the inspectors interviewed indicated that they perform the inspections during the good weather periods and then enter the inspection data later during the winter weather periods. The compliance review team found that the required inspection frequencies are being met but the inspection data may be entered at a later date. The compliance review team found that most of the inspection information is entered within the required intervals but there is evidence that some bridges may be out of compliance.

Mn/DOT is in substantial compliance with this section.

Conclusion and Findings:

Overall the Mn/DOT bridge inspection policies and procedures are in compliance with the NBIS regulations.

There are some opportunities for improvement and they are:

(1) Clarify the responsibilities among the fracture critical and routine inspection teams

(2) Encourage program administrators to receive the same training as the Team Leaders

(3) Increase the number of qualified fracture critical inspectors, consider adding more engineers in the inspection program

(4) Identify complex structures and develop the inspection procedures

(5) Develop a process to ensure the inspection findings are entered into the bridge database within the required interval

(6) Develop a follow up process that documents inspection findings, maintenance recommendations, and completion of maintenance work.

(7) Develop a standardize bridge inspection report, especially the fracture critical narrative report.

Introduction:

The independent review of the Mn/DOT bridge inspection policies and procedures began with the consultant team's first bridge inspection assignment of the Blatnik Bridge on August 6th, 2007 where the teams used the previous Mn/DOT bridge inspection report for reference and comparison. The consultant teams continued to utilize the previous Mn/DOT reports for reference throughout the entire project while performing over 300 fracture critical and routine bridge inspections. These inspections included a diverse statewide group of structures on the trunk highway system that was selected as a peer sample for the compliance review. The intent of the peer sample was to compare the consultant's inspection findings with Mn/DOT's previous findings.

The Project Manager for the compliance review was Ms. Laura Amundson, P.E., Senior Project Manager for PB who assembled the compliance review team. Ms. Amundson brings 30 years of bridge related experience to this effort. She is a MnDOT compliant Team Leader and has performed and managed bridge inspection projects. Mr. Carlis J. Callahan, P.E., Project Manager, Volkert & Assoc., was selected as the Compliance Review Task Manager. Prior to his retirement, Mr. Callahan was the State Bridge Maintenance Engineer for the Missouri Department of Transportation (MoDOT). He retired in 2007 with 30 years of bridge inspection and maintenance experience. As MoDOT State Bridge Maintenance Engineer he was responsible for the routine, fracture critical, and underwater inspection program for the MoDOT state system structures. His MoDOT experience and bridge inspection knowledge qualified him to evaluate the Mn/DOT bridge inspection policies and procedures.

The elements of a bridge inspection program are established primarily in federal laws and regulations and are usually supplemented by state law, rule, and policy. The National Bridge Inspection Standards (NBIS) establishes the minimum requirements for the bridge inspection program. The sections mentioned in the NBIS that were used to evaluate the Mn/DOT inspection program were:

- Bridge Inspection Organization
- Qualifications of Personnel
- Inspection Frequency
- Inspection Procedures
- Inventory

To better evaluate the Mn/DOT bridge inspection policies, procedures and culture, representatives of the Mn/DOT bridge inspection staff were interviewed. The interviews allowed the compliance review team to understand Mn/DOT's internal bridge inspection policies, procedures and their unwritten standard procedures. Bridge inspection staff interviewed ranged across the entire program from the Program Manager to District Team Leader inspectors.

Compliance Review:

Project Directives

As outlined in the project's "Description of Work" the compliance review was conducted using the following national standards and regulations:

- National Bridge Inspection Standards (NBIS), Code of Federal Regulations Section 23, Highways, Part 650, subpart C – National Bridge Inspection Standards 2007
- American Association of State Highway and Transportation Officials (AASHTO) "Manual for Condition Evaluation for Bridges", 2nd Edition dated 2000 with Interims through 2003.
- Bridge inspector's Reference Manual (BIRM) dated December 2006 FHWA NHI 03-003
- Federal Highway Administration (FHWA) Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges (Coding Guide) dated December 1995.

The compliance review was conducted as outlined in the project documents by evaluating the Mn/DOT bridge inspection policies and procedures in accordance with the following NBIS components:

- Bridge inspection organization
- Qualifications of personnel
- Inspection frequency
- Inspection procedures
- Inventory and reporting

As directed the following tasks were completed:

- Obtained and reviewed two inspection cycles of the previous Mn/DOT inspection reports, inventory sheets and documentation for the peer review sample of bridges.
- Reviewed the Mn/DOT Bridge Inspection Manual
- Reviewed the Mn/DOT Technical Memorandums listed in the contract documents. The two recently issued Technical Memorandums Nos. 08-01-B-01 and 08-02-B-02 were also reviewed.
- Mn/DOT Personnel involved with all facets of the bridge inspection program were interviewed, from the inspectors to the program manager.
- Reviewed the Mn/DOT NBI bridge database.

The interviews with Mn/DOT personnel constituted the primary source of information for this compliance review. Other than the reports reviewed as part of the peer review, no audit of Mn/DOT records or files was performed.

Peer Review

The peer review consisted of comparing the consultant inspection reports with the most recent Mn/DOT inspection reports with an emphasis on confirming consistency in findings of the four NBI condition ratings. The four NBI components, the Deck, Superstructure, Substructure, and Culvert are rated on a 0 to 9 scale with 9 being excellent/new and 0 failed/closed.

All of the consultant and Mn/DOT inspectors have attended the NHI Bridge Inspection Courses. One of the most important goals of this training is to relate the bridge condition to the condition descriptions in the Mn/DOT inspection manual and the FHWA Coding Guide. Another important feature of the training is to promote consistency in the rating of the bridge elements with a goal of a maximum variance of one condition rating between evaluations of different inspectors.

The NBI condition ratings were compared for differences between the previous Mn/DOT inspection and the consultant inspection. A change of +/- 1 for any element is an acceptable variance between inspectors. It is also within reasonable expectations of condition degradation over the period between inspections. Therefore, our review and evaluation concentrated on rating changes that are greater than 1.

Three distinct groups of bridge inspections were peer reviewed: statewide routine inspections, Metro Area routine inspections and fracture critical inspections.

Routine Inspections

There were 97 routine bridge inspections performed state-wide by consultant inspectors. The resultant consultant inspection reports were compared to the previous Mn/DOT inspection reports. Of the 97 bridges in Phase lll, 63 (65%) did not have any condition rating changes, 32 (33%) of those bridges had a condition rating change of one level, and 2 (2%) had a rating change of greater than one level. See Table 1 below.

The review of the 34 reports with a change in condition ratings found that the consultant inspection teams adjusted ratings on 24 bridges without changing the previous Mn/DOT condition notation. This suggests that the consultant found the same condition as the previous Mn/DOT inspection but correlated that condition to a different condition rating.

Our review of the PONTIS reports also found that in some instances the Mn/DOT inspectors did not correlate the PONTIS condition state ratings to the NBIS condition ratings. For example, the consultant inspectors lowered the condition ratings from a new condition (9) to a good condition (8) on a structure several years old and with PONTIS condition state quantities and comments that would be expected with age.

Our review of the condition ratings between the consultant routine inspections and previous Mn/DOT routine inspections found general and substantial agreement between condition ratings. The majority of rating changes made by the consultants were within one condition

level which is within Mn/DOT consistency goals and represents reasonably expected condition degradation between inspections.

Table 1 Comparison of NBI ratings by District

District	No Rating Changes	Rating Change=1	Rating Changes>1
1	10	3	0
2	6	2	0
3	9	3	0
4	3	9	1
Metro	8	8	1
6	8	3	0
7	8	3	0
8	11	1	0
Total	63	32	2

Metro Area Routine Inspections

There were 150 routine inspections performed in the Metro Area by consultant inspectors. Of those 150 structures, 111 (74%) did not have any condition rating changes, 34 (23%) had a rating change of one condition level, and 5 (3%) had a rating change of greater than one condition level. Based on the small percentage of rating changes greater than one condition level, we generally found the Metro Area routine inspection findings to be consistent between Mn/DOT and consultant inspections.

Fracture Critical Inspections

There were 54 fracture critical bridge inspections performed state-wide by consultant inspectors. Of those 54 structures, 20 (37%) did not have any condition rating changes, 22 (41%) had a condition rating change of one condition level, and 12 (22%) structures had a condition rating change of greater than one condition level.

The fracture critical structures with a rating change of greater than one condition level were reviewed and the consultant reports was compared to the Mn/DOT reports to determine where the changes in condition rating were occurring. In one instance, it appears that a timber pier cap had substantially worsened in condition from one inspection to the other. It is not uncommon for timber in already relatively poor condition to continue to degrade quickly and this was considered an appropriate change in condition rating.

The compliance review team found that when reviewing the inspection comments for the FCM's in both the consultant and Mn/DOT inspection reports revealed that the comments were very similar and consistent with each other.

The Mn/DOT fracture critical bridge inspection team's primary focus is on the FCMs of the bridge and may not include other structural members. The Mn/DOT teams report the inspection findings to the bridge owners, they do not make condition rating recommendations.

It should be noted that the routine inspection for many of the FCM bridges have been performed in the past by County inspectors. Entering the inspection data into the database is the bridge owner's responsibility and the condition ratings are assigned by the local bridge owners.

NBIS Compliance Review:

Following are the results of the review of Mn/DOT bridge inspection policies and procedures in accordance with the National Bridge Inspection Standards as stated in the CFR Section 23, Part 650.

Bridge Inspection Organization 650.307:

Paraphrasing this section of the CFR, "..each state must inspect or cause to have inspected all of the highway bridges on public roads in that state. Each state shall have a bridge inspection organization that is responsible for the statewide bridge inspection policies and procedures, quality assurance and control, and an inventory of the structures. The bridge organization is responsible for the bridge reports, load ratings and any other requirements. These tasks may be delegated but the state still has the responsibility. "

Like most surrounding states Mn/DOT's bridge inspection organization has been assigned to the Bridge Office. The Bridge Office has overall responsibility for the state inspection program, including establishing inspection policies and procedures, maintaining the statewide Bridge Management System (BMS) database, certifying inspectors and conducting special inspections. The Bridge Office also maintains the inventory of all bridges within the state. This inventory identifies who is the "bridge owner". The owners will be the Mn/DOT District, County or City responsible for the bridge. The bridge inventory also defines who has "report jurisdiction" which is usually the bridge owner.

The bridge inspections are split into three different categories; routine inspections, fracture critical inspections and underwater inspections. This report will discuss each type of inspection seperatly for each CFR section.

Routine Inspections

Each of Mn/DOT's eight District offices performs the inspections on state owned bridges where they are assigned report jurisdiction. The inspections are performed with the oversight of the respective District Bridge Engineer who reviews and approves all PONTIS inspection reports.

The PONTIS reports are then sent to the Bridge Office which enters the information into the state database. A Team Leader must be on site during the entire inspection.

The Counties, Cities and Townships have been delegated responsibility for inspection of the bridges that they own. Each local entity maintains their own inspection program and enters the inspection ratings into Mn/DOT's BMS database. The County, City, and Township inspection programs were not part of this evaluation.

Inspection of DOT bridges and non-DOT bridges varies from state to state. In general if the Cities and Counties have an engineer on staff then they are responsible for inspection. For example in Missouri, most Counties and Cities do not have any engineers on staff so MoDOT is requested to perform the inspections for those jurisdictions.

Fracture Critical Bridge Inspection

The inspections on all State, County and local fracture critical bridges are performed by the Mn/DOT Bridge Office except in a few cases for Mn/DOT bridges in District 6 and the Metro District. This is due to the special training required for FCM inspectors.

The list of FCM bridges received in August 2007 included 238 bridges of which 150 were locally owned (Counties, Cities and Townships) and 88 were owned by Mn/DOT. The current number is likely lower as several of these bridges were slated for replacement in 2007.

Of the 238 bridges, 23 are border bridges. There are 8 on the border with Wisconsin, 14 on the North Dakota border and 1 bridge shared with the Canadian Province of Ontario.

Mn/DOT staff performs the FCM inspections on all wholly owned Mn/DOT and local bridges as well as North Dakota border bridges. With the Wisconsin border bridges, the inspection alternates between the states. The one Canadian border bridge was inspected jointly in its most recent cycle.

By performing the inspection of the FCM's, Mn/DOT offers the Cities and Counties a great benefit of highly skilled and consistent inspection. In most states the inspections of the non-state fracture critical structures are the responsibility of the owners and they are required to perform those inspections with their own staff or to contract with a consultant.

Underwater Inspection

The Bridge Office is responsible for the underwater inspection program. Mn/DOT has an inventory of all of the bridges that require underwater inspection and a consultant is retained for that inspection. Mn/DOT also performs underwater inspections for County, City and Township bridges.

Load Rating

The Bridge Office also monitors and administers the load rating evaluations of the bridges in the state. The Trunk Highway System bridges are evaluated within a section of the Bridge Office. The load rating of the other structures is the responsibility of the owner with assistance, if requested, from the Bridge Office through its QA program, manual, website and guidance.

The bridge inspection organization has a program manager that meets or exceeds the requirements as noted in the NBIS and has responsibility for all of the functions listed under **Bridge Inspection Organization 650.307.**

Mn/DOT is in substantial compliance with Section 650.307.

Qualifications of Personnel 650.309:

The CFR Section 650.309 establishes the qualifications of the bridge inspection program manager and the bridge inspectors. A Program Manager must be a Professional Engineer or have 10 years of bridge inspection experience and have successfully completed the Federal Highway Administration (FHWA) comprehensive bridge inspection training. The current program manager Mr. Gary Peterson exceeds the minimum requirements.

This section also establishes the minimum requirements for a bridge inspection Team Leader. A Bridge Inspector in Minnesota can be certified at one of two levels – inspection team leader or assistant inspector. Team Leaders conduct all of the bridge inspections. To be certified as a Team Leader, candidates must

(1) either be a registered professional engineer in the state of Minnesota; or have five years of bridge inspection experience;

(2) successfully complete the two-week FHWA comprehensive bridge inspection training course;

(3) pass a field proficiency test administered by the Mn/DOT Bridge Office.

Assistant Inspectors can only assist in bridge inspections; a Team Leader must be present. Assistant Inspector certification is assigned to those who successfully complete the one-week FHWA training course ("Engineering Concepts for Bridge Inspectors"). The Bridge Office maintains rosters of qualified inspectors.

In general, the States surrounding Minnesota do use technicians and non-engineers for all types of bridge inspections. Each state has developed its own process and procedure for certifying bridge inspectors. Minnesota's bridge inspector certification requirements exceed the federal standards as well as those standards of many of the surrounding States.

Routine Inspections

The routine inspections are performed at the District level. Each District has a roster of Bridge Workers who have completed the training for Assistant Inspector and Team Leader. Team

Leaders must be at the bridge and perform the inspection. This is a very good program that ensures that the inspection personnel are qualified to perform those inspections.

Because inspection is seasonal, the bridge inspectors are not full time inspectors and the amount of time devoted to bridge inspection is influenced by the work load for that person and District. The bridge inspection staff interviewed by PB emphasized that conducting bridge inspections is a top priority but is done roughly 3-5 months per year. None of the District routine inspectors are engineers.

Fracture Critical Member Inspection

MN/DOT has four dedicated FCM inspectors in their Central Office. Additionally, there is a FCM inspector in both the Metro District and District 6. All of the FCM inspectors are required to have completed the two week FHWA inspection training course and the three day class on the inspection of FCMs. At this time two of the inspectors are Professional Engineers.

Practices vary among the States on fracture critical inspections but the major difference in Minnesota is that Mn/DOT does perform the FCM inspections for the non-state bridges. This is a great benefit to those bridge owners; one common thread among other states that perform fracture critical inspections of the non-state bridges is that they inspect all of the bridges not just the fracture critical bridges. Therefore, their inspection resources are larger than those States that do not perform those functions.

Underwater Inspection

This section of the CFR also notes that inspectors conducting underwater inspections have to have successfully completed the FHWA bridge inspection and underwater inspection training. Mn/DOT does require the consultants that are retained to perform these inspections supply the necessary documentation to ensure that the inspectors are qualified.

Load Rating

Mn/DOT has a supervisor for the Bridge Load Ratings who is professional engineer.

Mn/DOT is in substantial compliance with Section 650.309.

Inspection Frequency 650.311

Routine inspections

The CFR states that routine inspections are to be performed at regular intervals not to exceed 24 months. By Minnesota Statute, each bridge in the state must be inspected annually unless the bridge can meet some established criteria that allows the inspection frequency to be extended to a 24 month interval. This section does allow extension of the inspection interval with FHWA approval if the structure meets certain criteria but due to the State Statute Mn/DOT cannot extend any of the inspection intervals.

The "State Highways and Bridges Evaluation Report" authored by the Office of the Legislative Auditor notes that the inspection dates for Minnesota bridges on the trunk highway system 2002 -2006 were analyzed and between 83 and 86 percent were inspected in compliance with the 24 month inspection intervals. If a 90 day grace period is allowed then 96 to 97 percent of the inspections were in compliance. This section of the NBIS does not mention any grace period but because of the effects of equipment, staff and weather on inspection schedules, most states have difficulty from time to time to meet the inspection interval. The Bridge Office monitors the inspection frequencies and deadlines and they inform the bridge owners when they are out of compliance.

Underwater inspections

Bridges with elements in water that cannot be adequately inspected by wading and probing are required to be inspected on regular intervals not to exceed sixty months. The Bridge Office is responsible for the underwater inspection program. Every bridge on the trunk highway system that requires an underwater inspection is inspected every forty-eight months. The city and county structures requiring an underwater inspection are inspected every sixty months.

The bridge owners send a list of bridges requiring an underwater inspection to the Bridge Office and the inspections are performed by consultants who have the required training and experience to qualify for the project. All of the bridges by system are combined for the contracting effort so that every 48 months a contract is awarded for the underwater inspection of the trunk highway system bridges and every 60 months a contract is awarded for the rest of the structures. All of the inspections are conducted in the summer months so there is not a large variance in the inspection dates.

The benefits of this program are that once the bridge is on the list requiring an underwater inspection, there has to be a very good reason to remove it from that list. Therefore the entire list is inspected on the established frequency and the frequency requirement is consistently met.

Missouri performs about 20% of their underwater inspections each year but if a bridge is inspected when water levels are low and the substructure units are visible, that bridge does not get an underwater inspection for the next five years. As a result, that system is very difficult to monitor and the work load can vary from year to year. Mn/DOT's underwater inspection program maintains compliance frequencies and avoids missing structures that require underwater inspections.

Fracture Critical Member Inspections

Mn/DOT had established a 60 month cycle for FCM inspections with TM 02-22-B-01 in 2002. In May 2004 TM 04-08-B-01 was issued stating that Fracture Critical bridges must be inspected on a one year basis. This annual requirement refers to the routine inspection of FCM bridges and not the hands-on inspection requirement. The current requirement in effect is the CFR 650 issued in December of 2004 requires that fracture critical inspections are to be conducted on regular intervals not to exceed twenty four months.

Due to State and Federal directives on FCM inspections since the I-35W collapse in Minneapolis all bridges with FCMs were inspected before the end of 2007. MN/DOT has indicated that they will inspect one half of the FCM bridges in 2008 and the remainder of them in 2009. This will establish a 24 month inspection cycle for all FCM bridges and will be in compliance with the new FHWA guidelines. The Technical Memorandum 08-01-B-01 issued in 2008 establishes the maximum inspection frequency of 24 months.

With the change in the NBIS, several states have revised their fracture critical inspection schedules or scope of program. Texas, like Minnesota previously performed all of the fracture critical inspections in the state with their own staff. With the change in this section they have reduced their program and the other bridge owners in the State must perform the fracture critical inspections on their bridges. Mn/DOT will need to monitor their program and make sure the necessary resources are available to meet the mandated frequency.

Special Inspections

All bridges with pin and hanger connections are inspected by special methods on a frequency not to exceed 60 months.

Damage, in-depth and special inspections are performed as they are required by trained staff with a Team Leader on site.

Mn/DOT is in substantial compliance with Section 650.311.

Inspection Procedures 650.313

Load Ratings

Each Mn/DOT bridge is load rated for its safe load carrying capacity. The Bridge Office is responsible for the load rating of the structures on the Trunk Highway System. The Bridge Office does monitor the load ratings of the other structures and has delegated the load rating to the bridge owners. The Bridge Office sends out load rating reminders and this is a topic usually discussed in the annual Bridge Inspector refresher courses sponsored by the Bridge Office.

Bridge Files

This section requires each bridge to have a file that maintains inspection reports, findings, relevant maintenance information, assessment of current bridge conditions and any as-built drawings for the bridge. The Mn/DOT Districts have the responsibility for maintaining the bridge files. The BMS PONTIS inspection statewide database is maintained by the Bridge Office.

The fracture critical, in-depth, special, and underwater inspection reports that are performed by Mn/DOT staff or consultants are submitted to the Bridge Office for review and then copies

are sent to the bridge owners. If the bridge owners perform the inspections, the inspection reports are kept in the file for that bridge.

Routine Inspection

The bridge inventory identifies who has report jurisdiction for each bridge. Mn/DOT's eight District offices perform the routine inspections within their jurisdiction. All of the routine inspections are performed according to the PONTIS element rating system. PONTIS is a condition rating system developed by AASHTO which divides the bridge into separate elements which are then rated individually. Mn/DOT's Bridge Inspection Manual defines the elements and the ratings used. These are based on the AASHTO Guide for Commonly Recognized Structural Elements. The PONTIS inspection consists of placing a numerical "condition state" rating on each element and an accompanying written comment for each element explaining any findings.

Additionally all bridges are rated according to the NBI rating system which numerically rates the deck, superstructure, substructure as well as the channel and culvert as needed. There is no written portion of NBI rating.

Mn/DOT requires a Team Leader to be on site for any type of bridge inspection. The Team Leader prepares the PONTIS inspection report and NBI ratings. All PONTIS and NBI inspection ratings and comments are approved by the District Bridge Engineer. The information is then entered in the statewide BMS database by Mn/DOT Bridge Management Unit.

Fracture Critical Bridge Inspection

Mn/DOT has identified all bridges containing FCMs. A hands-on inspection is required of FCMs which is defined as visually inspected from a distance not to exceed 24 inches. A narrative report and photographic report is prepared along with the PONTIS and NBIS inspection report.

Mn/DOT Technical Memorandums require that the bridge files include the location and description of the FCMs. The compliance review team found that the reports for truss bridges had a sketch of the truss identifying the fracture critical tension members of the truss but they generally did not call out whether or not the floorbeams were FCM.

For structures that contain two girder systems or cross girder pier caps, these elements should be called out as FCMs and the tension zones of these members should be identified, especially if they have negative moment areas over supports.

Fatigue prone details have generally not been identified and located in the files for structures that contain those details. Providing information regarding FCM's and fatigue prone details assists the inspection staff and enhances the inspection by providing focus on and understanding of areas that require special attention. Mn/DOT is currently pursuing adding this information to the bridge inspection report.

A narrative report is prepared for each FCM inspection as well as the Pontis element inspection that is performed for all bridges. Mn/DOT previously did not have a standard format for the FCM narrative inspection report, consequently the reports varied in the way the inspection findings were presented and how much background information about the bridge was included. A report format is currently under development and will be used in subsequent FCM inspections.

Underwater Bridge Inspection

Bridges requiring underwater inspections must have the underwater elements identified, described, and located. The inspection frequency should be noted and the inspection procedures should be included as part of the bridge file. The inspection should follow the procedures as they are described in the file. Mn/DOT has an inventory of all of the bridges that require underwater inspection and a consultant is retained for that inspection.

Scour critical bridges have been identified and a plan of action has been prepared for each structure. The plan identifies the known deficiencies and the actions required in the case of a critical finding. The scour action plans are part of the bridge file being maintained by the bridge owners. The bridges should be monitored in accordance to the action plan and in times of flooding, the owner should refer to the scour action plan and act accordingly.

Complex Bridges

Complex structures are defined in the CFR. Although there are bridges in Minnesota that meet the definition of a complex bridge, Mn/DOT has not used this definition to identify any of the structures in the state. Currently all of the complex bridges in Minnesota are being inspected on regular intervals as either a fracture critical structure or a bridge that needs an in-depth inspection so they are inspected at the required frequency. Although this approach provides compliance with the intent of the complex structure subsection, Mn/DOT should identify complex bridges and provide inspection procedures and inspector training and experience requirements that may be appropriate for these structures.

Inspection Findings

Inspection findings that require maintenance of the structure are documented differently by each district. Since most of the routine inspections are performed by maintenance staff, each District has developed a method to inventory and communicate bridge maintenance needs. The notes on the PONTIS inspection report are the primary way of recording and transmitting the findings from the inspection staff to the District Bridge Engineer who approves all the reports. One district Maintenance Supervisor keeps a personal database of all findings generated by the inspection. Other districts are less formal in their record keeping and just issue work orders as priorities allow.

There is no state-wide established procedure for follow-up action on FCM inspection findings that do not rise to the level of critical findings. The inspectors can, and do, contact the District

Bridge Engineer if something serious is found but this is infrequent and not done for every finding. Without this notification, it is up to the District Bridge Engineer to review the report to determine the findings that need action. For the locally owned bridges, the report is sent to the local authority with no follow up.

Mn/DOT has previously not developed a standard FCM report format; therefore, the findings are recorded in different ways. In some reports the findings are summarized at the beginning. Others are noted in the narrative of the report, often combined in sections of description and history of the bridge. There is also no standardized classification for findings such as Maintenance, Structural or Follow up Inspection Needed.

The new Technical Memorandum TM 08-01-B-02 requires that "Findings that may affect the posted load capacity of the bridge shall be reported to the Bridge Inspection Engineer...". This should facilitate the monitoring and tracking of structural deficiencies that do not rise to the level of critical findings.

The findings for bridges shared with Wisconsin are reviewed annually in a meeting with WisDOT. On the shared bridges with North Dakota, Mn/Dot performs maintenance and makes repairs and there is a cost sharing agreement.

QA/QC

A systematic quality control and quality assurance (QC/QA) program is a part of the inspection procedures. The bridge inspection QC/QA program is used to keep the inspections accurate and consistent. The QC/QA should include field review of inspection teams, bridge inspection refresher training for Team Leaders and Program Managers, and an independent review of the inspection reports and computations.

Minnesota uses four primary strategies to ensure inspection consistency and quality;

(1) Inspector training and certification,

(2) Annual mandatory bridge inspection refresher courses,

(3) Inspection program reviews at Mn/DOT local offices and local owners,

(4) Review and approval of the inspection reports by an engineer.

The review and approval of the inspection reports is conducted by an engineer who supervises the inspection staff and who is a professional engineer. The District Bridge Engineer reviews the reports generated at the District level. The engineers in these positions possess varied bridge experience. Establishing a required experience level for these positions within Mn/DOT would enhance the current QC program and assure that compliance with these requirements is maintained in the future.

The FCM bridges reports are reviewed by the Structures Metals and Bridge Inspection Engineer who supervises the Central Bridge Office bridge inspection group.

The Bridge Division does conduct quality reviews of 20 percent of state and local jurisdictions each year. The process begins with an office audit of the selected owners. The Bridge Office does send a questionnaire to the owner requiring verification of the inspector training records, descriptions of inspection compliance, and confirmation of the accuracy of the inspection findings. The Bridge Office does field reviews of the inspections of the selected structures in the jurisdiction being reviewed. The Bridge Office informs the bridge owners of the results of the audit and the evaluation of their compliance.

Critical Findings

Critical findings follow-up is a requirement of the CFR regulations and Mn/DOT has issued a Technical Memorandum 08-02-B-02 establishing a procedure for critical findings. The Memorandum includes an action and communication plan along with specific responsibilities for the Bridge Inspector, the Engineer and the Bridge Office. The owners of non-Mn/DOT bridges are required to keep Mn/DOT informed of the actions taken along with documentation. A critical findings log is kept by the Bridge Office of actions taken by the owner and documentation is required for repairs, closings, reposting etc.

Mn/DOT is in substantial compliance with Section 650.313.

Inventory 650.315

As noted earlier in this report, the Mn/DOT Bridge Office is responsible for the statewide bridge inspection program and data management. The inspection information is entered into the statewide database and the information is then used as needed for bridge condition information.

The Mn/DOT Bridge Management group maintains the PONTIS database and the Structure Inventory Reports which equates to the CFR's Structural Inventory and Appraisal (SI&A) form. The inspection reports are stored by the Bridge Management group as well as in the Bridge File at the Districts.

This section of the CFR states that the bridge inspection findings concerning the SI&A information must be entered into the statewide database within 90 days for the state system bridges and 120 days for the other bridges. The Office of the Legislative Auditors reviewed the inspection dates and found them in compliance with the required frequencies for inspection; however, the date of the data entry was not investigated. Tracking the data entry date could be an enhancement to the Mn/DOT inspection program ensuring that data is entered in a timely manner. This helps ensure that any clarifications required for entry can be resolved easily by the inspectors based on better recall of more recent field work.

It should be recognized that weather does have an effect on the inspection program. Bridge inspections must be performed in weather that is suitable for staff to work outside and when all

of the bridge elements are visible. In general, Mn/DOT bridge inspections are performed during warm weather months and times of inclement weather are utilized to perform office work such as entering data into the statewide database.

Mn/DOT is in substantial compliance with Section 650.315.

Report Summary and Recommendations

The review of the Minnesota Department of Transportation bridge inspection policies and procedures find that Mn/DOT is substantially in compliance with the National Bridge Inspection Standards and the other manuals and articles referenced by the NBIS. The Mn/DOT bridge inspection program excels in their quality control and assurance program and the inspector certification is very good. While reviewing the policies and procedures it was noted that there are opportunities to improve the bridge inspection policies and processes.

Improvement Opportunities:

Organization and Personnel

1. Clarify the roles and responsibilities for the routine and fracture critical inspection teams on the fracture critical structures.

2. Encourage the program administrators to receive the same training as the Team Leaders.

3. Increase the number of qualified fracture critical inspectors. Consider adding more graduate engineers in the rotation program to conduct bridge inspections. Those engineers would gain valuable bridge knowledge and the inspection program would gain from the knowledge of these engineers.

Inspection Procedures

4. Identify the complex structure and develop the special inspection procedures needed for those structures.

Reporting/Documentation

5. Ensure that the inspection findings are entered into the bridge database within the required interval.

6. Develop a follow up process to document, prioritize and track bridge inspection findings, maintenance recommendations, completion of the recommended maintenance work

7. Standardize bridge inspection reports including the narrative, findings, identification of FCMs, fatigue prone details, and framing plan numbering.