Executive Summary

Bridge L5669, or the Yaeger (Kern) Bridge, is located in the southeast corner of South Bend Township in Blue Earth County. The bridge spans the Le Sueur River and is closed to vehicular and pedestrian traffic. Blue Earth County owns the bridge. Bridge L5669 is unusual in that its 189-foot span length exceeds the standard lengths of 50 to 130 feet for bowstring truss spans nationally. Constructed in 1873, the bridge is listed in the National Register of Historic Places (National Register) as the only example of a bowstring through-truss bridge in Minnesota. It holds exceptional significance as the longest bowstring truss in the United States and the second longest in North America.

Bridge L5669 formerly carried Ivywood Lane (Township Road 190) over the Le Sueur River in Blue Earth County. The out-to-out width of the timber deck is 15 feet 10-inches and the clear width is 14 feet 9 inches between the timber curbs. The deck is about 30 feet above the riverbed. The abutments are stone masonry.

Bridge L5669 is in fair condition overall but is currently closed to pedestrian and vehicular traffic. The recommendations contained herein outline a process to stabilize the bridge in the near term and preserve the truss once relocated to a new site.

Any work on Bridge L5669 should proceed according to the Secretary of the Interior’s Standards for the Treatment of Historic Properties (Standards) [36 CFR part 67] and The Secretary’s Standards with Regard to Repair, Rehabilitation, and Replacement Situations, as adapted by the Virginia Transportation Research Council (Guidelines).
Bridge Location: L5669

Bridge Location

Bridge L5669 – T190 over LE SUEUR RIVER

PROJECT LOCATION
BLUE EARTH COUNTY
SEC. 35, TO 107NN, R 27W
UTM ZONE: 15 NAD: 27
USGS QUAD NAME: GOOD THUNDER
EASTING: 1366819 ft.
NORTHING: 16025539 ft.

AUGUST 2014
Bridge Location
Executive Summary

Bridge Location

I. Project Introduction
II. Historic Data
III. Bridge Data
IV. Existing Conditions/Recommendations
V. Projected Costs

Appendices

A. Glossary
B. Guidelines for Bridge Maintenance and Rehabilitation based on the Secretary of the Interior’s Standards
C. Documents
This Bridge Report is a product of a comprehensive study performed for approximately 140 historic bridges owned by county, city, township, private and other state agencies besides MnDOT. The study is the second phase of a multi-phased process developed and executed in partnership with representatives from the Federal Highway Administration (FHWA); State Historic Preservation Office (SHPO); MnDOT State Aid; MnDOT Cultural Resources Unit (CRU); the US Army Corps of Engineers (USACE); local public works and county highway departments; county and township boards and city councils; the preservation community and the general public. To perform the study, MnDOT retained the consultant team of LHB Inc., Mead & Hunt Inc., and The 106 Group.

The general goals of the study include:

- Gathering and compiling the existing historic and bridge condition data and other relevant information on the bridges in the study group into bridge reports.
- National Register nominations for a select number of bridges within the study group which the bridge owner may request a nomination to be prepared.
- Updating MnDOT’s Management Plan for Historic Bridges in Minnesota based on the study’s findings.
- Producing a narrative for the MnDOT Historic Bridge Website to disseminate information regarding locally owned historic bridges in Minnesota.
- Investigating and preparing a summary regarding how other states have funded historic bridge programs and structured Programmatic Agreements when multiple non-state entities are the owners of historic bridges.

The Bridge Reports compile and summarize the historic and engineering information concerning the structures. The reports also document the existing use and condition of the bridges along with assessments of the maintenance, stabilization and preservation needs of each structure, including cost estimates. The maintenance activities, along with regular structural inspections and anticipated bridge component replacement activities are routine practices directed toward continued structure serviceability. Stabilization activities address immediate needs identified as necessary to maintain a bridge’s structural and historic integrity and serviceability. Preservation activities are near term or long term steps that need to be taken to preserve and in some cases restore a bridge’s structural and historic integrity and serviceability. In assessing preservation activities, a design life of 20 years or longer is typically considered. In addition to general restoration activities and dependent on the severity of deterioration, preservation activities may include spot repair, disassembly and reassembly or replacement of specific bridge components.

Recommendations within the Bridge Reports are consistent with the Secretary of the Interior’s Standards for the Treatment of Historic Properties (Standards). The Standards are basic principles created to help preserve the distinct character of a historic property and its site, while allowing for reasonable change to meet new engineering standards and codes. The Standards recommend repairing, rather than replacing deteriorated features whenever possible. The Standards apply to historic properties of all periods, styles, types, materials and sizes and encompass the property’s location and surrounding environment.
The Standards were developed with historic buildings in mind and cannot be easily applied to historic bridges. The Virginia Transportation Research Council (Council) adapted the Standards to address the special requirements of historic bridges. They were published in the Council's 2001 Final Report: A Management Plan for Historic Bridges in Virginia, *The Secretary's Standards with Regard to Repair, Rehabilitation, and Replacement Situations*, provide useful direction for undertaking maintenance, repair, rehabilitation, and replacement of historic bridges and are included in the Appendix to this report.

Existing bridge data sources typically available for Minnesota bridges were gathered for the study. These sources include:

- PONTIS, a bridge management system formerly used by MnDOT to manage its inventory of bridges statewide, and its replacement system, SIMS (Structure Information Management System)
- The current MnDOT Structure Inventory Report and MnDOT Bridge Inspection Report. Reports are available for the majority of the bridges (not available for bridges in private ownership)
- Database and inventory forms resulting from the 2012 Minnesota Local Historic Bridge Study and other prior historic bridge studies as incorporated into the database
- Existing Minnesota historic contexts studies for bridges in Minnesota, including *Reinforced-Concrete Highway Bridges in Minnesota, 1900-1945*, *Minnesota Masonry-Arch Highway Bridges, 1870-1945*, *Iron and Steel Bridges in Minnesota, 1873-1945* and *Minnesota Bridges 1955-1970*
- Field investigations documenting the general structural condition and determining characteristic-defining features

Additional data sources researched and gathered for some of the bridges as available also included:

- Files and records at MnDOT offices
- Original bridge construction plans, rehabilitation plans, and maintenance records of local owners
- Files and documents available at the SHPO office, including previous inventory forms, determinations of eligibility, studies, and compliance documents
- Existing historic and documentary material related to the National Register-eligible bridges

The Appendix contains the following: a Glossary explaining structural and historic preservation terms used in the report, the Guidelines for Bridge Maintenance and Rehabilitation based on the Secretary of the Interior's Standards, a list of engineering and historic documents available for this bridge, and copies of the MnDOT Structure Inventory and Bridge Inspection Reports current at the time of the report preparation.

The Bridge Report will provide the bridge owner and other interested parties with a comprehensive summary of the bridge condition and detailed information related to the historic nature of the bridge. This information will enable historic bridge owners to make informed decisions when planning for their historic properties.
II – Historic Data

This narrative is drawn from previous documents, as available for the subject bridge, which may include determination of eligibility (also known as Phase II evaluation), Minnesota Architecture/History Inventory Form, National Register nomination, Multiple Property Documentation Form, and/or applicable historic contexts. See Sources for details on which documents were used in compiling this Historic Data section.

Contractor
John Mahowald, Wrought Iron Bridge Company

Designer/Engineer
Unknown

Description
Bridge L5669, commonly called the Yaeger Bridge or the Kern Bridge, is located in Blue Earth County in the southeast corner of South Bend Township and spans the Le Sueur River. The bridge is closed to all vehicular and pedestrian traffic. It is in a remote setting surrounded by dense vegetation. The former road over the bridge was abandoned in 1991; the west end of the bridge now terminates on private property.

Constructed in 1873, the bridge is a single-span, wrought-iron, bowstring arch through truss resting on limestone abutments. The main span measures 189 feet long. The top (arched) chord is in a Phoenix column configuration, comprised of six angular iron segments riveted together along their flanges to form a hollow beam. The bottom chord is comprised of paired wide iron bars, connected end-to-end with riveted outside plates and an inside separator plate. The floor system consists of a 20-foot-wide wood deck on rolled I-beam stringers resting on rolled I-beam floorbeams that are carried on the top edge of the bottom chord. The floorbeams are secured to the bottom chord and the verticals with bolted fittings.

Each truss has 13 verticals, consisting of alternating lattice girders and paired back-to-back angles, extending between the top and bottom chords. The verticals are bolted through the top chord. Latticed top lateral bracing extends between the four central latticed verticals, and paired rods are used as laterals between the five central paired-rod verticals. Diagonal bracing is utilized on both the vertical and the lateral members. Two lines of wire cable have been strung across the verticals to serve as railings.

In 1973 Blue Earth County performed maintenance and repair work to the bridge. Modifications to the bridge likely made at this time include concrete repairs to the limestone abutments, replacement of some original bolts with hex-head bolts, and addition of a steel support column. The I beam column, located at the southwest corner of the bridge a few feet in front of the abutment, extends from the bottom chord of the truss to a concrete pad cast upon the bedrock riverbed. It is unclear as to why this support column was constructed.

Significance
In the early 1870s the Blue Earth County Board of Commissioners looked to provide a new crossing over the Le Sueur River to connect two major roads in West Mankato: the Cobb River Road to Beauford and the Indian Lake Road to Good Thunder and Rapidan. The County Board of Commissioners had originally considered multiple sites for the bridge location, finally settling on a crossing on John Kern’s property. The Board of Commissioners designated the bridge site the Red Jacket Crossing, because it was close to the Red Jacket Mill. However the bridge was commonly referred to as the “Kern Bridge” (for the original
property owner, John Kern). In recent years it has also been referred to as the "Yaeger Bridge" after a later property owner.

In the spring of 1873 Blue Earth Board of County Commissioners awarded the contract to construct the superstructure of Bridge L5669 to the Wrought Iron Bridge Company of Canton, Ohio. The contract to construct the masonry abutments was awarded to John Mahowald. The construction of the abutments cost $2,658, and the bridge construction cost $6,000.

Bridge L5669 was closed for repairs in 1973. This may have been when concrete repairs were made to masonry abutment, and a support column was welded to the bottom chord at the southwest corner. The bridge remained open to traffic until 1991. In 1999, at the request of Blue Earth County, the bridge was removed from the MnDOT inventory. The roadway is closed; the east approach is barricaded and a home has been constructed on the west approach roadway.

Bridge L5669 is unique as it is the only bowstring arch in the state. Nationally, according to the *Historic Context for Common Historic Bridge Types*, the bowstring arch truss is one of the most important nineteenth-century bridge forms, dating from the 1870s and 1880s, and examples are highly significant. The bowstring arch truss design was developed in 1840 by Squire Whipple, a surveyor and bridge designer. The first bowstring truss bridge constructed was the 82-foot-long, tied arch over the Erie Canal at Utica, New York. Whipple patented his bowstring design in 1841. The bowstring features arches of cast iron functioning as the primary compression members, and vertical and diagonal rods of wrought iron. Even before Whipple’s patent expired in 1869, bridge builders copied his design, some with slight variation to avoid infringement, and many without any respect of the patent. During the last quarter of the nineteenth century it was one of the most generally adapted truss forms in bridge design. The bowstring bridge type proved very popular over the next 40 years and was used to construct train sheds, other curved vault structures, and short highway and canal spans of 50 to 100 feet, although some bowstring trusses were much longer.

According to historicbridges.org and the HABS/HAER truss diagrams typical lengths for the bowstring truss range from 50 to 130 feet. At 189 feet long, Bridge L5669 exceeds the standard span lengths of bowstrings nationally. In a comparison of bowstrings known nationally and in North America, only the Blackfriars Street Bridge in Ontario, Canada (closed to all traffic in 2013) is longer at 225 feet. Within the United States, the Freeport Bridge (also constructed by the Wrought Iron Bridge Company) near Decorah, Iowa is second longest at 160 feet. As such, Bridge L5669 is the second known longest bowstring truss in North America and the longest in the United States.

Whipple’s patent was adopted by Zenas King, David Hammond, and other builders who secured patents for the configuration of the upper chord and other details. These men established bridge-fabricating companies to manufacture bridges by the thousands to meet the overwhelming demand for economic, short to moderate span bridges for burgeoning farm-to-market road systems. The King Iron Bridge Company of Cleveland and the Wrought Iron Bridge Company of Canton, Ohio, founded by King and Hammond, were two of literally hundreds of bridge fabricating companies established throughout the east and Midwest to meet demands. The companies employed agents who operated out of larger cities, covering territories and selling their bridges to county commissioners through catalogs, hence the name...
"catalog" bridges. Whipple himself operated one of the earliest bridge fabricating companies, building hundreds of iron bridges.

Bridge L5669, constructed by the Wrought Iron Bridge Company, is a variation of Whipple’s patented design. One particular variation is the use of the six-sided riveted top chord. It is uncertain if the columns are Phoenix columns, after designer Samuel Reeves’s fabrication company the Phoenix Iron Co., or Keystone Columns, after the Keystone Bridge Company. Both columns feature four-, six-, or eight-sided segmented beam and were used in many applications, including in bridge, building, and mine construction as structural supports due to their ability to support heavy loads. The iron top chord of Bridge L5669 has no manufacturer’s stamps, so it is uncertain if the Phoenix Iron Co or the Keystone Bridge Company provided the top chord members for Bridge L5669. Other bowstring trusses nationally are known to have used Keystone Columns, such as the Dubuque & Dunleith Bridge in Iowa. However, it is more likely the Wrought Iron Bridge Company simply copied or made a slight variation on the patented column designs. Commonly Phoenix column has come to describe this multi-sided chord design, and is used in this report.

In addition to being the only bowstring arch truss bridge in Minnesota, Bridge L5669 is significant for its wrought-iron construction. The bridge is one of seven extant wrought-iron constructed bridges in the state, and one of four that are trusses. The other six wrought-iron bridge examples include:

- Bridge 27664, 1887, Pratt through truss, Hennepin County
- Bridge 4846, 1875, Pratt through truss, Le Sueur County
- Bridge 92366, 1885, Pratt through truss, Hennepin County
- Bridge 82524, 1877, Parker through truss, Washington County
- Bridge 94246, 1886, deck truss, Hennepin County
- Bridge L1393, 1882, deck girder railroad bridge, Winona County

Despite minor repairs to the structure in the 1970s, the bridge retains its original wrought-iron members and configuration. As such the bridge retains integrity of design, workmanship, and materials. Changes with a minor effect on integrity include concrete repairs to the limestone abutments, replacement of some original connections with hex-heads, and addition of steel support column to the bottom chord at the southwest corner of the bridge. Additionally, the bridge continues to span the Le Sueur River in its original rural, location but no longer serves a transportation function. As such the bridge has lost minor integrity of association and feeling. However, these modifications and changes over time are considered modest and the bridge continues to retain historic integrity. The period of significance for the bridge is 1873, which corresponds to the date of the bridge’s construction.

In 1980 Bridge L5669 was listed in the National Register under Criterion C in the area of Engineering for its significance as the only example of a bowstring through truss bridge in Minnesota. When it was listed in the National Register the bridge was also significant as the oldest known roadway bridge in use in the state; however, since its listing the bridge has been closed to all traffic. The nomination also indicates that the bridge is unusual for its exceptional main span length. At 189 feet long, it is the longest bowstring truss in the United States and the second longest in North America.
### Minnesota Department of Transportation (MnDOT)
### Local Historic Bridge Report

#### Bridge Number: L5669

<table>
<thead>
<tr>
<th>Section</th>
<th>Data</th>
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<tr>
<td><strong>Historic Context</strong></td>
<td>Historic Iron and Steel Highway Bridges in Minnesota, 1873-1945</td>
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<tr>
<td><strong>National Register Status</strong></td>
<td>Listed (Individually)</td>
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<tr>
<td><strong>Criterion A Significance</strong></td>
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<tr>
<td><strong>Criterion C Significance</strong></td>
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<td><strong>Historic District</strong></td>
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<tr>
<td><strong>SHPO inventory number</strong></td>
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#### Sources Used to Compile Section II – Historic Data


- National Register of Historic Places, Kern Bridge, Blue Earth County, Minnesota. National Register #90001950


- Hoth, Nathan. Freeport Bridge and Blackfrairs Street Bridge. Available at historicbridges.org (accessed 30 September 2014).

- Field investigation by LHB, Inc. and Mead & Hunt, Inc., 29 April 2014.
Character-Defining Features
Character-defining features are prominent or distinctive aspects, qualities, or characteristics of a historic property that contribute significantly to its physical character. Features may include materials, engineering design, and structural and decorative details. Often, the character-defining features include important historic fabric. However, historic fabric can also be found on other elements of a bridge that have not been noted as character-defining. For this reason, it is important to consider both character-defining features and the bridge’s historic fabric when planning any work.

Feature 1: Design and construction of an exceptionally long-span bowstring arch truss, the only of its kind in Minnesota and the longest example in the United States. Elements of the bridge include the design of the curved top chord, diagonal bracing, latticed verticals, latticed portal and top chord bracing, and paired bottom chord bars.
Feature 2: Phoenix type six-sided, wrought-iron, riveted top chord.
Feature 3: Wrought-iron materials of structural members.
Minnesota Department of Transportation (MnDOT)
Local Historic Bridge Report

III – Bridge Data

<table>
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<th>Date of Construction (remodel)</th>
<th>1873</th>
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<tbody>
<tr>
<td>Common Name (if any)</td>
<td>Yaeger (Kern) Bridge</td>
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**Location**
- Feature Carried: Pedestrian
- Feature Crossed: LeSueur River
- County: Blue Earth
- Ownership: Blue Earth County

**Structure Data**
- *Data Current (as of): Sep 2013*
- Main Span Type: 903 Iron High Truss
- Main Span detail: Bowstring
- Substructure Type - Foundation Type:
  - Abutment: 4-Masonry – 2-Spread/Rock
  - Piers: N-Not Applicable - N-Not Applicable

**Non-MnDOT Data**

**Approach Roadway Characteristics**
- Lane Widths: Road Closed
- Shoulder Width: Road Closed
- Shoulders Paved or Unpaved: Road Closed
- Roadway Surfacing: Road Closed

**Number of Crashes reported in MnMCAT within 500 feet of Bridge Site**
- N/A (Ped)

**Location of Plans**
- Blue Earth County

**Plans Available**
- Partial Plan (Undated)

* Non-MnDOT data collected during field survey. All other fields of data collected from MnDOT September of 2013. See Appendix C for MnDOT inventory and inspection report data.
** Unless a significant number of crashes are noted on or near a bridge, the accident data is not detailed in this report.
Existing Conditions
Available information, as detailed in the Project Introduction section, concerning Bridge L5669 was reviewed prior to visiting the bridge site. The site visit was conducted to establish the following:

1. General condition of structure
2. Conformation to available extant plans
3. Current use of structure
4. Roadway/pedestrian trail geometry and alignment (as applicable)
5. Bridge geometry, clearances and notable site issues

General Bridge Description
Bridge L5669 is a single-span bridge made up of a 189-foot, through, bowstring arch truss. Bridge L5669 formerly carried Ivywood Lane (Township Road 190) over the Le Sueur River in Blue Earth County. The bridge is currently closed to vehicular and pedestrian traffic. The former east approach roadway is overgrown with brush and tree cover and is impassable by vehicles. The west approach is currently private residential property and no discernable roadway approach exists. The truss members of the bridge vary in composition with the top chord consisting of a built up “Phoenix Column,” while the bottom chord is made up of pairs of wrought iron plates. The verticals are built up of latticed angle members and the diagonals are round bars. The truss members are interconnected with bolts and threaded rods. The overall height of the truss is about 19 feet and the horizontal distance between the two trusses is 18 feet 6 inches. The trusses support I-shaped floorbeams which in turn support sawn timber stringers and timber plank decking with timber running planks. The out-to-out width of the deck is 15 feet 10 inches and the clear width is 14 feet 9 inches between the timber curbs. The deck is about 30 feet above the riverbed. The railings consist of non-historic wire rope affixed to the truss verticals at regular intervals and anchored to the top chord member near the ends of the truss. The abutments are stone masonry and vary in height. The west abutment is rather short at 5 feet (at the maximum exposed height) and the east abutment is up to 14 feet tall.

Bridge L5669 is in fair condition overall. The paint system has failed nearly 100 percent and active corrosion is present on the bottom chord and built-up vertical truss members. Approximately 20 percent of the timber deck planks are in need of replacement due to decay; the timber running planks are almost entirely missing from a combination of decay and wear. The abutments are in poor condition. Significant settlement was noted at the southeast corner and the stone masonry on the east abutment is cracked and displaced near the bearings. Undermining of the west abutment has been halted by underpinning repairs performed in the past.

Serviceability Observations
The bridge is currently closed to vehicle traffic. This closure is the result of the bridge’s deteriorated condition and low load bearing capacity. The east approach is heavily vegetated. An earth berm, together with a plate beam traffic barrier, effectively prevents vehicular use. The west approach has been removed altogether and is now residential private property. A broken-down wooden fence is present at the west approach. Signs of use of the bridge by pedestrians were observed at the time of the site visit and signs prohibiting such use were not evident.
Condition Observations

Superstructure

Wrought Iron Truss-Primary Members
The bottom chord tension members are in fair condition. Impact damage to the bottom chord members was noted in four locations on the south (upstream) truss. The bottom chord splice plates are distorted from minor pack rust. The top chord Phoenix Columns are in good condition with no significant defects noted. The built up vertical members are in fair condition with minor pitting noted, especially near the connection to the lower chord. Some loss of section was noted at these locations, amounting to 5 percent or less of original section. The round stock diagonal members are in good condition.

Wrought Iron Truss-Portals and Secondary Members
Two of the portals on the west end of the truss are damaged from impacts. Bolts are missing from the connections between the bottom chord and bracing members at several locations along the length of the bridge. The upper sway brace connection in the southeast corner of the bridge is broken. The X-bracing in the plane of floor system is mostly disconnected and most of the members are hanging off the bridge and ineffective.

Truss Floorbeams and Timber Stringers
The truss floorbeams appeared to be in good condition, though close examination was only possible at either end of the truss (L1 and L13). The timber stringers that were accessible also appeared to be in good condition.

Bridge Railings
The original bridge railings appear to have been removed, as evidenced by hardware and brackets left behind. The two lines of wire rope that have been installed on each truss to function as railings are in good condition, though the railing geometry and configuration does not meet current standards for either pedestrian/bikeway or vehicular traffic.

Paint System
The paint system has failed 100 percent on all metal portions of the bridge.

Timber Deck, Curbs, and Running Planks
The transverse timber deck planks are in fair condition, with approximately 30 individual planks requiring replacement due to damage and/or decay. The timber cubs are in fair condition with an estimated 30 linear feet of damaged or decayed curb requiring replacement. The longitudinal timber running planks
are in poor condition and require 100 percent replacement. The existing broken and decayed running planks along with exposed nails and hardware present a serious tripping hazard that, coupled with the non-conforming railings, present a serious safety risk.

Bearsings
Truss bearings are non-functioning and mostly buried in earth. Movement of the truss independent of the bearings has caused cracks and dislocation of the stone masonry at the east abutment.

Substructures
Abutments
The stone masonry abutments are in poor condition, especially the east abutment. The masonry at the east abutment is cracked and some of the stones are dislodged from their original position, particularly near the truss supports where non-functioning expansion bearings have transmitted unintended lateral forces to the masonry. In addition, the foundation of the east abutment at the south end has settled, causing vertical translation of the bottom chord at this location. This condition may also be responsible for the broken sway brace connection in the southeast corner discussed in the “Wrought Iron Truss-Portal and Secondary Members” section above. The west abutment has been underpinned in the past to correct undermining.

An independent support of the bottom chord consisting of a steel H-pile section supported on a concrete pad poured on the bedrock is present in the southwest corner. While it is unclear whether or not this rough shoring apparatus is actually supporting the truss, it should be removed prior to subjecting the truss to any significant live or dead loading. The location of the temporary support is at least a couple feet from the bearing location and will introduce loading directions and magnitudes that the truss is not designed to accommodate. Crippling of the bottom chord and collapse of the bridge is a likely scenario if the bridge is subjected to vehicular live loads with this support in place.

Approach/Waterway Observations
The west bridge approach has been removed and the east approach is blocked with an earth berm and a plate beam guard rail. The remnants of the east approach are heavily vegetated. Informal pedestrian pathways lead off each end of the bridge. The waterway appears adequate and scour protection is in place where appropriate.

Date of Engineering Site Visit by LHB
April 29, 2014
Condition 1: South elevation, looking north

Condition 2: East bridge approach, looking west
Minnesota Department of Transportation (MnDOT)
Local Historic Bridge Report

IV – Existing Conditions/Recommendations

Bridge Number: L5669

Condition 3: East approach, looking east

Condition 4: West approach, looking east
IV – Existing Conditions/Recommendations

Condition 5: West approach, looking west

Condition 6: Typical bottom chord configuration
Condition 7: Bottom chord showing distortion of splice plates

Condition 8: Top chord configuration (Phoenix Column)
Condition 9: Typical latticed vertical member

Condition 10: Typical built-up vertical member (note old railing hardware remaining)
Condition 11: End portals and sway braces

Condition 12: Floorbeams and timber stringers (note hanging X-bracing)
Condition 13: Missing bolt at secondary member connection (1 of 2)

Condition 14: Missing bolts at secondary member connection (2 of 2)
Condition 15: Timber deck (note uneven surface, potential tripping hazard)

Condition 16: Bearing at east abutment
Condition 17: East abutment masonry dislocation, southeast corner

Condition 18: East abutment masonry dislocation, northeast corner
Condition 19: West abutment

Condition 20: Truss support in southwest corner
Condition 21: Typical bolted connection, vertical to bottom chord

Condition 22: Typical bolted connection, vertical to top chord
Overall Recommendations
Bridge L5669 is currently closed to vehicular and pedestrian traffic as a result of its condition, deficient geometry and closure of the township road the bridge was located on. The bridge owner has indicated that there are no plans to reopen the bridge to vehicular or pedestrian traffic. The age and original design of the bridge make it unlikely it would possess the capacity to carry modern highway loads without significant alterations to its original character.

The recommendations that follow assume the bridge will be dismantled and reassembled at a different location and used for recreational purposes. These recommendations also include measures to be taken to prevent/discourage pedestrian use until such time as the preservation work can be accomplished, as well as to minimize exposure of the bridge owner to excessive liability. The nature of the original bridge construction, with mainly bolted connections, lends itself well to disassembly and relocation although the sheer size and remote setting/location would make for a difficult task. Should this course of action be considered, the historic impacts (adverse effect of relocation) of such a move would have to be weighed with potential outcomes if the bridge were not to be moved and cannot be preserved or maintained in place.

Recommended Stabilization Activities
The stabilization recommendations which follow should be performed in the near-term to allow the bridge to remain in place for up to 10 years, while a new location is found. These are temporary measures. More permanent solutions to the bridge’s stability, safety and structural integrity are included in the preservation recommendations below.

1. Survey and periodically monitor the settlement at the southeast bearing and erect shoring if settlement is continuing.
2. Replace missing bolts at connections with bottom chord
3. Replace in-plane X-bracing in floor system.
4. Repair connection of upper bracing to truss in southeast corner.
5. Install proper signage and barriers to effectively prevent pedestrian use.

Recommended Preservation Activities
Structure Relocation
The bridge should be dismantled on site and shipped to a steel fabrication/paint shop for straightening, blasting/painting, and reassembly. The nature of the truss construction should permit complete disassembly without having to separate the individual components of the riveted built up members (channels, lacing, batten plates, etc.). Prior to disassembly all truss members must be carefully match marked to ensure reassembly exactly matches the original. For purposes of this report, it is assumed the bridge will be shipped from the shop to its new site and that the new bridge location is within the boundaries of Blue Earth County. Prior to any effort at relocation of this structure, an engineering study should be undertaken to determine if it possesses adequate strength for modern day pedestrian and trail loading. A report by the Minnesota Department of Natural Resources in 2014 questions if the structure is
capable of carrying pedestrian and light vehicular loads. While the bridge was built in an era of much lighter live loads, it was in service and open to vehicular traffic until 1990 and presumably carried vehicles through that time. The design effects of modern loading requirements can be minimized somewhat by restricting deck width to minimize applied loading magnitude, installing bollards to keep vehicles off the bridge etc. Design exceptions can also be sought if necessary. This approach was recently used on the Gateway Trail Iron Bridge and the Como Park Pedestrian Bridge. For both projects, a sign was installed on either side of the bridge stating the maximum number of pedestrians allowed on the bridge at a time.

Truss Primary Members
Perform detailed assessment of degree of section loss to verticals and lower chord members. Perform similar assessment to other truss members, though anticipated degree of section loss is less for those members. Costs for this assessment have been included in the Preliminary Design and Assessment estimate. It is anticipated that four lower chord members will require straightening. If they have stretched they will require replacement to restore their effectiveness as tension members. While it is preferred to rehabilitate vs. replace a historic component, it is possible that select lower chord members will require replacement. If replacement is determined to be necessary, replacement with components of like material and geometry should be considered to the extent possible as they are a visual element of the structure. For purposes of cost estimation, straightening without replacement is assumed.

Truss Secondary Members
Repair/straighten two damaged portals/sway braces. Replace two damaged portals/sway braces. To maintain historic integrity, repair shall always be performed over replacement. Where repair is not possible, original members shall be replaced with members of like shape and material to the original.

Bridge Railings
Remove existing wire ropes and reconstruct original railing. Further research should be performed in an effort to determine the design of the original railing. This research combined with the determined future use, code safety requirements for the future use, and potential variances and design exceptions from current safety code requirements should be assessed. It is likely that complete replacement of the railings to a rail type which is responsive to the historic structure and which also reaches an acceptable safety level will be the end result. It is possible the railing solution will not fully meet current code safety requirements. This is based on solutions reached on other similar structures where a balance between the historic needs and current code requirements were achieved. The preservation scope and estimates includes a replacement railing which is composed of a two-line angle iron railing fastened to the vertical truss members. Consideration of how the bridge will be utilized and what it will cross over at its potential new location should be carefully weighed, since it can affect the height and type of the required railing. For example, it may be best to have the bridge just carry pedestrians and only require a pedestrian-height rail, but not bicycle or horses, which require a higher rail. Also, placement over a roadway or railroad, which may require higher rails and smaller openings to avoid objects being thrown off the bridge, should be avoided if possible.

Deck and Floor System
The deck system will need to be removed in order to dismantle the truss. At that time, the wrought iron floorbeams can be closely assessed and repaired as determined necessary based on the design live load.
requirements determined by the future use. Based on current observations and previous inspection records, it is assumed that required repair to the floorbeams will be minimal.

Replace all timber running planks and timber deck planks. It will be assumed that the existing timber stringers will require replacement as well. Timber curbs should be replaced. All replaced timber elements should utilize timber of like species, size and finish/color as the existing elements.

Paint System
The current paint system on the trusses and remaining bridge superstructure is failed and the system should be replaced. It is recommended the in-place paint system and surface rust be entirely removed to bare metal through abrasive blasting (which through testing is determined will not degrade portions of the wrought iron structure which are to remain). Following removal, the structure should be painted with a zinc-rich primer and a protective overcoat system with color and sheen to be selected based on a study of the historic requirements of the structure. The in-place system will require testing to determine the presence of lead. Due to the toxicity of lead the removal of lead paint system requires approved shop containment methods. For purposes of cost estimating a lead based system has been presumed.

Bearings
The bearings are fairly deteriorated and, in the case of the expansion bearings, they are non-functioning. It is likely replacement will be necessary though this will need to be further determined through more detailed inspection and clean-up. If replacement is determined to be necessary, the components should be replaced with new components of like material and geometry as they are a visual element of the structure. For purposes of the preservation cost estimate, replacement has been assumed.

Substructure
Abutments
New abutments will be required and for the purposes of this report it is assumed that the new abutments will be cast-in-place concrete with a level of architectural treatment to allow them to appropriately exist with the historic structure. Use of a stone veneer element could also be considered though has not been incorporated in the estimate. Final determination of abutment materials and aesthetics will involve a detailed study of the new location setting for the bridge, the bridge's historic features, and compliance with the Secretary's Standards.

Relocation of the structure will require the removal of the existing abutments and sloping back of the approaches to eliminate a fall hazard which would exist if the abutments were left in place. Restoration of the existing site will also include establishment of vegetation on the slopes. At the new site, grading and approach work will be required following construction of the new abutments.

Recommended Annual Maintenance Activities
1. Clear brush and vines from northwest corner and periodically remove earth, vegetation and vines from all bearing areas.
2. Monitor bridge during high flows and remove accumulated debris.
Summarized Maintenance, Stabilization and Preservation Construction Cost Estimates

It is important to recognize that the work scope and cost estimates presented herein are based on a limited level assessment of the existing structure. In moving forward with future project planning, it will be essential to undertake a detailed structure assessment addressing the proposed work for the structure. It is also important that any future preservation work follow applicable preservation standards with emphasis to rehabilitate and repair in-place structure elements in lieu of replacement. This includes elements which are preliminarily estimated for replacement within the work scope of this report. Only through a thorough review of rehabilitation and repair options and comprehensive structural and historic assessment can a definitive conclusion for replacement of historic fabric be formed.

The opinions of probable construction and administrative costs provided below are presented in 2013 dollars. These costs were developed without benefit of a detailed, thorough bridge inspection, bridge survey or completion of preliminary design for the estimated improvements. The estimated costs represent an opinion based on background knowledge of historic unit prices and comparable work performed on other structures. The opinions of cost are intended to provide a programming level of estimated cost. These costs will require refinement and may require significant adjustments as further analysis is completed in determining the course of action for future structure improvements. A 20 percent contingency and 7 percent mobilization allowance has been included in the construction cost estimates.

Administrative and engineering costs are also presented below. Engineering and administrative costs are also to be interpreted as programming level only. Costs can be highly variable and are dependent on structure condition, intended work scope, project size and level of investigative, testing and documentation work necessary. Additional studies, evaluation, and historic consultation costs not exclusively called out may also be incurred on a case-by-case basis.

Maintenance, Stabilization and Preservation Costs (refer to the work item breakdown on the next page)

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opinion of Annual Cost- Maintenance Activities:</td>
<td>$ 2,200</td>
</tr>
<tr>
<td>Opinion of Construction Cost- Stabilization Activities:</td>
<td>$ 98,400</td>
</tr>
<tr>
<td>Opinion of Construction Cost- Preservation Activities:</td>
<td>$ 970,550</td>
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</table>

Estimated Preliminary Design, Final Design, Construction Administration Costs

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preliminary Design and Assessment</td>
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</tr>
<tr>
<td>Final Design and Plans</td>
<td>$ 100,000</td>
</tr>
<tr>
<td>Construction Administration</td>
<td>$ 110,000</td>
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</tbody>
</table>
### Maintenance, Stabilization & Preservation Cost Estimate (2013 Dollars)

#### Bridge No. L5569

**August 14, 2014**

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Unit</th>
<th>Quantity</th>
<th>Unit Cost</th>
<th>Total Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maintenance Costs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Clear earth, brush and vines from bearing areas</td>
<td>Lump Sum</td>
<td>1</td>
<td>$1,000.00</td>
<td>$1,000.00</td>
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<tr>
<td>2. Monitor bridge during high flows/ remove debris</td>
<td>Lump Sum</td>
<td>1</td>
<td>$1,000.00</td>
<td>$1,000.00</td>
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<tr>
<td>20% Contingency</td>
<td>Lump Sum</td>
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<td>$200.00</td>
<td>$200.00</td>
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<tr>
<td><strong>Estimated Maintenance Costs</strong></td>
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<td></td>
<td></td>
<td>$2,200.00</td>
</tr>
<tr>
<td><strong>Stabilization Costs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Survey/monitor east abutment, erect shoring if warranted</td>
<td>Lump Sum</td>
<td>1</td>
<td>$24,000.00</td>
<td>$24,000.00</td>
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<tr>
<td>2. Replace missing bolts at lower connections</td>
<td>Lump Sum</td>
<td>1</td>
<td>$2,500.00</td>
<td>$2,500.00</td>
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<tr>
<td>3. Replace in-place floor X-bracing</td>
<td>Lump Sum</td>
<td>1</td>
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<tr>
<td>4. Repair sway brace/truss connection</td>
<td>Each</td>
<td>1</td>
<td>$7,500.00</td>
<td>$7,500.00</td>
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<tr>
<td>5. Signage and pedestrian barriers</td>
<td>Lump Sum</td>
<td>1</td>
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<tr>
<td>20% Contingency</td>
<td>Lump Sum</td>
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<td>$16,400.00</td>
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<td><strong>Estimated Stabilization Costs</strong></td>
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<td>$98,400.00</td>
</tr>
<tr>
<td><strong>Preservation Costs</strong></td>
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<tr>
<td>Mobilization @ 7%</td>
<td>Lump Sum</td>
<td>1</td>
<td>$47,400.00</td>
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<tr>
<td>1. Disassemble truss and ship to fab shop</td>
<td>Lump Sum</td>
<td>1</td>
<td>$85,000.00</td>
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<tr>
<td>2. Straighten lower chord members</td>
<td>Each</td>
<td>4</td>
<td>$5,000.00</td>
<td>$20,000.00</td>
</tr>
<tr>
<td>3. Straighten sway braces</td>
<td>Each</td>
<td>2</td>
<td>$2,500.00</td>
<td>$5,000.00</td>
</tr>
<tr>
<td>4. Replace sway braces</td>
<td>Each</td>
<td>2</td>
<td>$10,000.00</td>
<td>$20,000.00</td>
</tr>
<tr>
<td>5. Repair floor beams</td>
<td>Lump Sum</td>
<td>1</td>
<td>$8,000.00</td>
<td>$8,000.00</td>
</tr>
<tr>
<td>6. Replace timber running planks</td>
<td>Lin Ft</td>
<td>3400</td>
<td>$8.00</td>
<td>$27,200.00</td>
</tr>
<tr>
<td>7. Replace timber deck planks</td>
<td>Sq Ft</td>
<td>1650</td>
<td>$25.00</td>
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<td>8. Replace timber stringers</td>
<td>Each</td>
<td>140</td>
<td>$500.00</td>
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<td>9. Replace timber curbs</td>
<td>Lin Ft</td>
<td>380</td>
<td>$10.00</td>
<td>$3,800.00</td>
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<tr>
<td>10. Blast &amp; paint (shop)</td>
<td>Sq Ft</td>
<td>7700</td>
<td>$18.00</td>
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<tr>
<td>11. Replace bearings in kind</td>
<td>Each</td>
<td>4</td>
<td>$5,000.00</td>
<td>$20,000.00</td>
</tr>
<tr>
<td>12. New railing at new site</td>
<td>Lin Ft</td>
<td>220</td>
<td>$250.00</td>
<td>$55,000.00</td>
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<tr>
<td>13. New concrete abutments at new site</td>
<td>Each</td>
<td>2</td>
<td>$50,000.00</td>
<td>$100,000.00</td>
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<tr>
<td>14. Trucking of components to new site</td>
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<td>1</td>
<td>$7,500.00</td>
<td>$7,500.00</td>
</tr>
<tr>
<td>15. Reassemble/ erect bridge</td>
<td>Lump Sum</td>
<td>1</td>
<td>$70,000.00</td>
<td>$70,000.00</td>
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<tr>
<td>16. Grading approach work at new site</td>
<td>Lump Sum</td>
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<td>$60,000.00</td>
<td>$60,000.00</td>
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<tr>
<td>17. Site work and restoration at old location</td>
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<tr>
<td>20% Contingency</td>
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<td>$161,800.00</td>
<td>$161,800.00</td>
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<tr>
<td><strong>Estimated Preservation Costs</strong></td>
<td></td>
<td></td>
<td></td>
<td>$970,550.00</td>
</tr>
</tbody>
</table>
Appendix A. Glossary
Glossary

**Abutment** – Component of bridge substructure at either end of bridge that transfers load from superstructure to foundation and provides lateral support for the approach roadway embankment.

**Appraisal ratings** – Five National Bridge Inventory (NBI) appraisal ratings (structural evaluation, deck geometry, under-clearances, waterway adequacy, and approach alignment, as defined below), collectively called appraisal ratings, are used to evaluate a bridge’s overall structural condition and load-carrying capacity. The evaluated bridge is compared with a new bridge built to current design standards. Ratings range from a low of 0 (closed bridge) to a high of 9 (superior). Any appraisal item not applicable to a specific bridge is coded N.

**Approach alignment** – One of five NBI inspection ratings. This rating appraises a bridge’s functionality based on the alignment of its approaches. It incorporates a typical motorist’s speed reduction because of the horizontal or vertical alignment of the approach.

**Character-defining features** – Prominent or distinctive aspects, qualities, or characteristics of a historic property that contribute significantly to its physical character. Features may include structural or decorative details and materials.

**Condition, fair** – A bridge or bridge component of which all primary structural elements are sound, but may have minor deterioration, section loss, cracking, spalling, or scour.

**Condition, good** – A bridge or bridge component which may have some minor deficiencies, but all primary structural elements are sound.

**Condition, poor** – A bridge or bridge component that displays advanced section loss, deterioration, cracking, spalling, or scour.

**Condition rating** – Level of deterioration of bridge components and elements expressed on a numerical scale according to the NBI system. Components include the substructure, superstructure, deck, channel, and culvert. Elements are subsets of components, e.g., piers and abutments are elements of the component substructure. The evaluated bridge is compared with a new bridge built to current design standards. Component ratings range from 0 (failure) to 9 (new) or N for (not applicable); elements are rated on a scale of 1-3, 1-4 or 1-5 (depending on the element type and material). In all cases condition state 1 is the best condition with condition state 3, 4 or 5 being the worst condition. In rating a bridge’s condition, MnDOT pairs the NBI system with the newer and more sophisticated Pontis element inspection information, which quantifies bridge elements in different condition states and is the basis for subsequent economic analysis.

**Corrosion** – The general disintegration of metal through oxidation.

**Cutwater** – The wedge-shaped end of a bridge pier, designed to divide the current and break up ice.
*Decay* – Deterioration of wood as a result of fungi feeding on its cell walls.

*Delamination* – Surface separation of concrete, steel, glue laminated timber plies etc. into layers.

*Deck geometry* – One of five NBI appraisal ratings. This rating appraises the functionality of a bridge’s roadway width and vertical clearance, taking into account the type of roadway, number of lanes, and ADT.

*Deficiency* – The inadequacy of a bridge in terms of structure, serviceability, and/or function. Structural deficiency is determined through periodic inspections and is reflected in the ratings that are assigned to a bridge. Service deficiency is determined by comparing the facilities a bridge provides for vehicular, bicycle, and pedestrian traffic with those that are desired. Functional deficiency is another term for functionally obsolete (see below). Remedial activities may be needed to address any or all of these deficiencies.

*Deficiency rating* – A nonnumeric code indicating a bridge’s status as structurally deficient (SD) or functionally obsolete (FO). See below for the definitions of SD and FO. The deficiency rating status may be used as a basis for establishing a bridge’s eligibility and priority for replacement or rehabilitation.

*Design exception* – A deviation from federal design and geometric standards that takes into account environmental, scenic, aesthetic, historic, and community factors that may have bearing upon a transportation project. A design exception is used for federally funded projects where federal standards are not met. Approval requires appropriate justification and documentation that concerns for safety, durability, and economy of maintenance have been met.

*Design load* – The usable live-load capacity that a bridge was designed to carry, expressed in tons according to the AASHTO allowable stress, load factor, or load resistance factor rating methods. An additional code was recently added to assess design load by a rating factor instead of tons. This code is used to determine if a bridge has sufficient strength to accommodate traffic load demands. A bridge that is posted for load restrictions is not adequate to accommodate present or expected legal truck traffic.

*Deterioration* – Decline in condition of surfaces or structure over a period of time due to chemical or physical degradation.

*Efflorescence* – A deposit on concrete or brick caused by crystallization of carbonates brought to the surface by moisture in the masonry or concrete.

*Extant* – Currently or actually existing.

*Extrados* – The upper or outer surfaces of the voussoirs which compose the arch ring. Often contrasted with intrados.
**Footing** – The enlarged, lower portion of a substructure which distributes the structure load either to the earth or to supporting piles.

**Fracture Critical Members** – Tension members or tension components of bending members (including those subject to reversal of stress) whose failure would be expected to result in collapse of the bridge.

**Functionally obsolete** – The Federal Highway Administration (FHWA) classification of a bridge that does not meet current or projected traffic needs because of inadequate horizontal or vertical clearance, inadequate load-carrying capacity, and/or insufficient opening to accommodate water flow under the bridge. An appraisal rating of 3 or less for deck geometry, underclearance, approach alignment, structural evaluation or waterway adequacy will designate a bridge as functionally obsolete.

**Gusset plate** – A plate that connects the horizontal and vertical members of a truss structure and holds them in correct position at a joint.

**Helicoidal** – Arranged in or having the approximate shape of a flattened coil or spiral.

**Historic fabric** – The material in a bridge that was part of original construction or a subsequent alteration within the historic period of the bridge (i.e., more than 50 years old). Historic fabric is an important part of the character of the historic bridge and the removal, concealment, or alteration of any historic material or distinctive engineering or architectural feature should be avoided if possible. Often, the character-defining features include important historic fabric. However, historic fabric can also be found on other elements of a bridge that have not been noted as character-defining.

**Historic bridge** – A bridge that is listed in, or eligible for listing in, the National Register of Historic Places.

**Historic integrity** – The authenticity of a bridge’s historic identity, evidenced by the survival and/or restoration of physical characteristics that existed during the bridge’s historic period. A bridge may have integrity of location, design, setting, materials, workmanship, feeling, and association.

**Inspections** – Periodic field assessments and subsequent consideration of the fitness of a structure and the associated approaches and amenities to continue to function safely.

**Intrados** – The inner or lower surface of an arch. Often contrasted with extrados.

**Inventory rating** – The load level a bridge can safely carry for an indefinite amount of time expressed in tons or by the rating factor described in design load (see above). Inventory rating values typically correspond to the original design load for a bridge without deterioration.

**Keystone** – Wedge-shaped stone, or voussoir, at the crown of an arch.
**Load Rating** – The determination of the live load carrying capacity of a bridge using bridge plans and supplemented by field inspection.

**Maintenance** – Work of a routine nature to prevent or control the process of deterioration of a bridge.

**Minnesota Historical Property Record** – A documentary record of an important architectural, engineering, or industrial site, maintained by the Minnesota Historical Society as part of the state’s commitment to historic preservation. MHPR typically includes large-format photographs and written history, and may also include historic photographs, drawings, and/or plans. This state-level documentation program is modeled after a federal program known as the Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER).

**National Bridge Inventory** – Bridge inventory and appraisal data collected by the FHWA to fulfill the requirements of the National Bridge Inspection Standards (NBIS). Each state maintains an inventory of its bridges subject to NBIS and sends an annual update to the FHWA.

**National Bridge Inspection Standards** – Federal requirements for procedures and frequency of inspections, qualifications of personnel, inspection reports, and preparation and maintenance of state bridge inventories. NBIS applies to bridges located on public roads.

**National Register of Historic Places** – The official inventory of districts, sites, buildings, structures, and objects significant in American history, architecture, archaeology, and culture, which is maintained by the Secretary of the Interior under the authority of the National Historic Preservation Act of 1966 (as amended).

**Non-vehicular traffic** – Pedestrians, non-motorized recreational vehicles, and small motorized recreational vehicles moving along a transportation route that does not serve automobiles and trucks. Includes bicycles and snowmobiles.

**Operating rating** – Maximum permissible load level to which a bridge may be subjected based on a specific truck type, expressed in tons or by the rating factor described in design load (see above).

**Pack rust** – Rust forming between adjacent steel surfaces in contact which tends to force the surfaces apart due to the increase in steel volume.

**Pier** – A substructure unit that supports the spans of a multi-span superstructure at an intermediate location between its abutments.

**Pointing** – The compaction of mortar into the outermost portion of a joint and the troweling of its exposed surface to secure water tightness and/or desired architectural effect (when replacing deteriorated mortar).
**Pony truss** – A through bridge with parallel chords and having no top lateral bracing over the deck between the top chords.

**Posted load** – Legal live-load capacity for a bridge which is associated with the operating rating. A bridge posted for load restrictions is inadequate for legal truck traffic.

**Pontis** – Computer-based bridge management system to store inventory and inspection data and assist in other bridge data management tasks.

**Preservation** – Preservation, as used in this report, refers to historic preservation that is consistent with the Secretary of the Interior’s *Standards for the Treatment of Historic Properties*. Historic preservation means saving from destruction or deterioration old and historic buildings, sites, structures, and objects, and providing for their continued use by means of restoration, rehabilitation, or adaptive reuse. It is the act or process of applying measures to sustain the existing form, integrity, and material of a historic building or structure, and its site and setting. MnDOT’s *Bridge Preservation, Improvement and Replacement Guidelines* describe preservation differently, focusing on repairing or delaying the deterioration of a bridge without significantly improving its function and without considerations for its historic integrity.

**Preventive maintenance** – The planned strategy of cost-effective treatments that preserve a bridge, slow future deterioration, and maintain or improve its functional condition without increasing structural capacity.

**Reconstruction** – The act or process of depicting, by means of new construction, the form, features, and detailing of a non-surviving site, landscape, building, structure, or object for the purpose of replicating its appearance at a specific period of time and in its historic location. Activities should be consistent with the Secretary of the Interior’s *Standards for the Treatment of Historic Properties*.

**Rehabilitation** – The act or process of returning a historic property to a state of utility through repair or alteration which makes possible an efficient contemporary use, while preserving those portions or features of the property that are significant to its historic, architectural, and cultural values. Historic rehabilitation, as used in this report, refers to implementing activities that are consistent with the Secretary of the Interior’s *Standards for the Treatment of Historic Properties*. As such, rehabilitation retains historic fabric and is different from replacement. MnDOT’s *Bridge Preservation, Improvement and Replacement Guidelines* describe rehabilitation and replacement in similar terms.

**Restoration** – The act or process of accurately depicting the form, features, and character of a property as it appeared at a particular period of time. Activities should be consistent with the Secretary of the Interior’s *Standards for the Treatment of Historic Properties*.

**Ring stone** – One of the separate stones of an arch that shows on the face of the headwall, or end of the arch. Also known as a voussoir.
**Scaling** – The gradual distentegration of a concrete surface due to the failure of the cement surface caused by chemical attack or freeze-thaw cycles or rebar too close to the surface and oxidizing from exposure to chlorides.

**Scour** – Removal of material from a river’s bed or bank by flowing water, compromising the strength, stability, and serviceability of a bridge.

**Scour critical rating** – A measure of a bridge’s vulnerability to scour (see above). MnDOT utilizes letter designations to represent specific descriptions of a bridge’s susceptibility and/ or present condition in regards to scour. Range in condition and scour susceptibility does not necessarily correlate alpha numerically to the MnDOT scour code letters so it is important to understand the specific scour description for each MnDOT scour code. The scour codes and descriptions can be found in the “MNDOT Bridge Inspection Field Manual”.

**Section loss** – Loss of a member’s cross sectional area and resulting strength usually by corrosion or decay.

**Serviceability** – Level of facilities a bridge provides for vehicular, bicycle, and pedestrian traffic, compared with current design standards.

**Smart flag** – Special Pontis inspection element used to report the condition assessment of a deficiency that cannot be modeled, such as cracks, section loss, and steel fatigue.

**Spall** – Depression in concrete caused by a separation of a portion of the surface concrete, revealing a fracture parallel with or slightly inclined to the surface.

**Spring line** – The imaginary horizontal line at which an arch or vault begins to curve. As example, the point of transition from the vertical face of an abutment to the start of arch curvature extending from abutment face.

**Stabilization** – The act or process of stopping or slowing further deterioration of a bridge by means of making minor repairs until a more permanent repair or rehabilitation can be completed.

**Stringcourse** – A horizontal band of masonry, generally narrower than other courses and sometimes projecting, that extends across the structure’s horizontal face as an architectural accent. Also known as belt course.

**Structural evaluation** – Condition rating of a bridge designed to carry vehicular loads, expressed as a numeric value and based on the condition of the superstructure and substructure, the inventory load rating, and the ADT.
**Structurally deficient** – Classification indicating NBI condition rating of 4 or less for any of the following: deck condition, superstructure condition, substructure condition, or culvert condition. A bridge is also classified as structurally deficient if it has an appraisal rating of 2 or less for its structural evaluation or waterway adequacy. A structurally deficient bridge is restricted to lightweight vehicles; requires immediate rehabilitation to remain open to traffic; or requires maintenance, rehabilitation, or replacement.

**Sufficiency rating** – Rating of a bridge’s structural adequacy and safety for public use, and its serviceability and function, expressed on a numeric scale ranging from a low of 0 to a high of 100. It is a relative measure of a bridge’s deterioration, load capacity deficiency, or functional obsolescence. MnDOT may use the rating as a basis for establishing eligibility and priority for replacement or rehabilitation. Typically, bridges which are structurally deficient and have sufficiency ratings between 50 and 80 are eligible for federal rehabilitation funds and those which are structurally deficient with sufficiency ratings of 50 and below are eligible for replacement.

**Through truss** – A bridge with parallel top and bottom chords and top lateral bracing with the deck generally near the bottom chord.

**Under-clearances** – One of five NBI appraisal ratings. This rating appraises the suitability of the horizontal and vertical clearances of a grade-separation structure, taking into account whether traffic beneath the structure is one- or two-way.

**Variance** – A deviation from State Aid Operations Statute Rules that takes into account environmental, scenic, aesthetic, historic, and community factors that may have bearing upon a transportation project. A design variance is used for projects using state aid funds. Approval requires appropriate justification and documentation that concerns for safety, durability and economy of maintenance have been met.

**Vehicular traffic** – The passage of automobiles and trucks along a transportation route.

**Voussoir** – One of the separate stones forming an arch ring; also known as a ring stone.

**Waterway adequacy** – One of five NBI appraisal ratings. This rating appraises a bridge’s waterway opening and passage of flow under or through the bridge, frequency of roadway overtopping, and typical duration of an overtopping event.
Appendix B. Guidelines for Bridge Maintenance and Rehabilitation based on the Secretary of the Interior’s Standards
**The Secretary’s Standards with Regard to Repair, Rehabilitation, and Replacement Situations**

Adapted from:

The Secretary of the Interior’s Standards for the Treatment of Historic Properties, first codified in 1979 and revised in 1992, have been interpreted and applied largely to buildings rather than engineering structures. In this document, the differences between buildings and structures are recognized and the language of the Standards has been adapted to the special requirements of historic bridges.

1. Every reasonable effort shall be made to continue an historic bridge in useful transportation service. Primary consideration shall be given to rehabilitation of the bridge on site. Only when this option has been fully exhausted shall other alternatives be explored.

2. The original character-defining qualities or elements of a bridge, its site, and its environment should be respected. The removal, concealment, or alteration of any historic material or distinctive engineering or architectural feature should be avoided.

3. All bridges shall be recognized as products of their own time. Alterations that have no historic basis and that seek to create a false historic appearance shall not be undertaken.

4. Most properties change over time; those changes that have acquired historic significance in their own right shall be retained and preserved.

5. Distinctive engineering and stylistic features, finishes, and construction techniques or examples of craftsmanship that characterize an historic property shall be preserved.

6. Deteriorated structural members and architectural features shall be retained and repaired, rather than replaced. Where the severity of deterioration requires replacement of a distinctive element, the new element should match the old in design, texture, and other visual qualities and where possible, materials. Replacement of missing features shall be substantiated by documentary, physical, or pictorial evidence.

7. Chemical and physical treatments that cause damage to historic materials shall not be used. The surface cleaning of structures, if appropriate, shall be undertaken using the most environmentally sensitive means possible.
8. Significant archaeological and cultural resources affected by a project shall be protected and preserved. If such resources must be disturbed, mitigation measures shall be undertaken.

9. New additions, exterior alterations, structural reinforcements, or related new construction shall not destroy historic materials that characterize the property. The new work shall be differentiated from the old and shall be compatible with the massing, size, scale, and architectural features to protect the historic integrity of the property and its environment.

10. New additions and adjacent or related new construction shall be undertaken in such a manner that if removed in the future, the essential form and integrity of the historic property and its environment would be unimpaired.
Appendix C. Documents
Additional Electronic Data
Bridge L5669

Historic Data
- Research

Local Data
- 071014 MNDNR KernBridgeReport
- Historic bridges.xls

MnDOT Reports
- Maps
  - L5669 Survey.doc
  - L5669_Condition Sheet_2010

Photos
- 2002 Photos
- 2005
- Historic Photos
  - L5669 LHB 04-30-14
  - L5669_M&H Photos_4-29-14
- Report Photos

Plans
- L5669 Partial Plans 1-6