Winona Bridge Work Package #5
Bridge No. 5900 (Existing Bridge) Rehabilitation and Reconstruction
Installment #3
The $30 million Cost Growth

March 9, 2016

The history of the Winona Bridge project spans many years. To fully understand the $30 million projected cost growth, we need to start with the *Planning Phase* and then weave our way through the *Scoping and Preliminary Design Phases,* and then into the *Final Design Phase*. The overall goals, guidance and decisions along the way will provide the chapters to the entire story.

We've shared previously the $142 million budget for construction and engineering was set in the *Planning Phase*. At that time, the overall goal for the project was to provide a structurally sound crossing of the Mississippi River for Winona and the surrounding region. Actual river crossing alignments and bridge scope(s) of work were yet to be determined.

Following the *Planning Phase*, the *Scoping and Preliminary Design Phases* overlapped, which is common for large, complex projects on aggressive delivery timelines. During this time, several key decision areas were evaluated, including:

- Should the existing bridge be repaired or replaced?
- If rehabilitation of the existing bridge is recommended, what should be the major components of the work?
- If the rehabilitation of the existing bridge is recommended, how should traffic be maintained?
- If a new permanent parallel bridge is recommended, on what alignment should it be built?
- If a new permanent parallel bridge is recommended, what bridge type should be built?

These key decision areas, along with the regulatory agency criteria and feedback from the public as well as state and local leaders provided the framework for the project Environmental Assessment (EA). Much more detail is provided in the approved EA for the project at (http://www.dot.state.mn.us/winonabridge/documents.html).

The EA was approved in September 2013 and included extensive public feedback including public hearings, public meetings, and the feedback from state and local leaders, most notably in September 2012 when they recommended the current two-bridge concept with the goal of building a new bridge as quickly as possible and rehabilitation and reconstruction of the existing bridge. This provided a solution that not only addressed the concerns associated with the continued deterioration of the existing bridge, in regards to potential future closings, but also provided a permanent two-bridge, four-lane crossing.

With the Finding of No Significant Impact (FONSI) issued in January 2014, the necessary environmental approvals were granted to move forward with the *Final Design Phase* of the project from the National Environmental Protection Agency (NEPA) process perspective.

The “Build Alternative” (recommended current approach) included:

- Rehabilitation/reconstruction of the existing bridge including:
    - Full deck removal and replacement with a lightweight concrete deck.
    - Removal of the pedestrian cantilevered walkway on the existing bridge.
    - Removal and replacement of the approach spans and analysis of piers.
    - Replacement in kind of the deck truss spans and piers based on detailed study of condition and ability to retain historic integrity.
    - Repair, cleaning and painting of the main through-truss and piers.
    - Construction of a new bridge parallel to the existing bridge on the Winona Street West alignment, with the following features:
        - Girder type.
        - A 12- foot wide pedestrian/bike way on the upstream (west) side.
        - Improvements to the Winona Street-4th Street intersection, including turn lanes, signalization, and pedestrian improvements
        - Reconstruction of portions of 2nd and 3rd Streets
        - Reconstruction of the TH 43-Latsch Island road access intersection including turn lanes and trail connections.

In delivering the Winona Bridge project, numerous factors have contributed to the increased cost. For example, the accelerated nature of building the new bridge was more costly than what could have been accomplished on a typical construction schedule, maintaining traffic movements across the river for the entire project duration, aesthetic enhancements, historical requirements and design standard upgrades all added cost to the project.

However, for now, we will focus on the through-truss of the existing bridge as the predominant (but not sole) source of cost growth for the Work Package #5 existing bridge work.

Bridge No. 5900 Through-truss

The bridge design practices utilized today have many complexities so let's start with a few definitions:

Fracture Critical Member (FCM): The current National Bridge Inspection Standards (NBIS) definition for a FCM is "a steel member in tension, or with a tension element, whose failure would probably cause a portion of or the entire bridge to collapse."

HL-93 Loading: This link provides a short overview of the AASHTO HL-93 loading analysis for bridges (http://www.aboutcivil.org/aashto-hl-93-loading-design.html) with background on the HS-20 design vehicle as well.

Redundancy: The AASHTO LRFD Bridge Design Specifications (LRFD), 7th Edition, defines redundancy as "the quality of a bridge that enables it to perform its design function in a damaged state" and redundant member as "a member whose failure does not cause failure of the bridge."

As was mentioned in Installment #1 – Project Budget History and Performance, the Winona Bridge project appeared to be on budget at the end of the *Preliminary Design Phase.*

During the *Preliminary Design Phase*, the through-truss was analyzed without system redundancy considerations and using AASHTO HL-93 load rating methodologies. (Please read the question and answer section of this website for additional background on this design transition from the *Planning Phase* when the Load Factor Rating and HS-20 loading was the bridge design standard protocol utilized). During this phase external redundancy of the through-truss was viewed as an "Adverse Effect" from a historical perspective and adding internal redundant members was not considered as an option; there were no structural enhancements provided to the through-truss to address the fracture critical members in the structure.

The condition of the through-truss was viewed as being in good condition with some areas of minor corrosion based on field inspections. No specific service design life of the through-truss was prescribed. There were no field investigation efforts to assess the condition of the bridge foundations (timber piling) as this activity was viewed as not feasible. Also note the recommended use of a light weight deck was deemed to provide significant benefits in regards to reducing the extent of structural strengthening of the through-truss members.

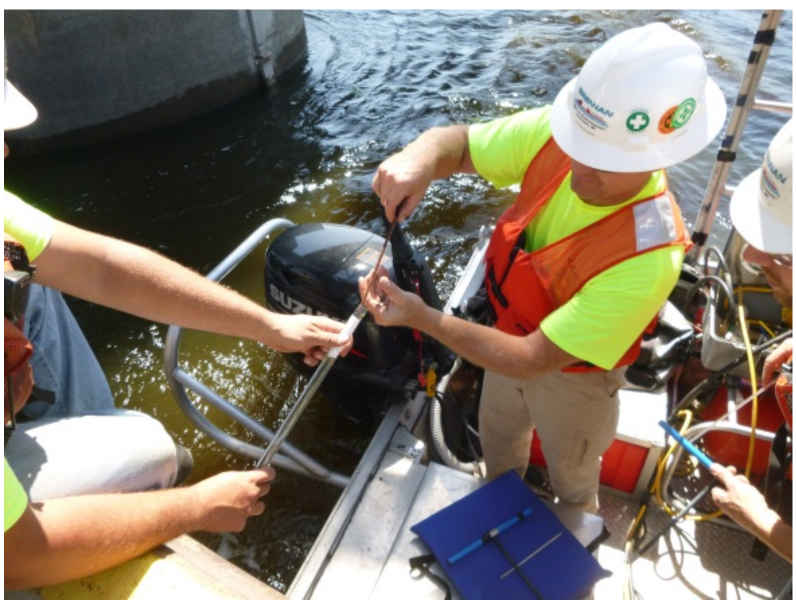
These assumptions resulted in a recommendation of approximately 10% of the members of the through-truss requiring strengthening. The estimated investment in the through-truss *Preliminary Design* scope of work was $13.4 million. The *Final Design* team felt this approach and investment would have resulted in an approximate 10-year Service Design Life for the through-truss, with the potential for permit load restrictions and no accommodations for system redundancy in the through-truss. While this approach is still feasible, the *Final Design* team does not recommend it as the prudent course of action.

During the current *Final Design Phase*, the through-truss was analyzed to identify additional elements to provide internal redundancy, and by utilizing LRFD Design Specifications with MnDOT Modified HL-93 loading, which is a MnDOT Bridge Design

Standard used to ensure the final structural enhancement would accommodate safe passage of special permit vehicles.

The condition of the through-truss was investigated in the field and found to have deteriorated more rapidly from recent inspections. Field investigations were conducted by the CMGC contractor in work package #3 to assess the condition of the timber piling so the *Final Design* team was confident in the structural support and health of the existing foundations. The light weight deck recommended in *Preliminary Design* was evaluated in detail and found to provide a minimal reduction in structural strengthening of through-truss members and also deemed not worth the potential service life reduction and health of the concrete deck that will be subject to a freeze-thaw environment with application of de-icing salt.

As a whole, these *Final Design Phase* efforts resulted in the recommendation of approximately 19% of the through-truss members requiring plating over existing members to add strengthening. With the current approach, a 50 year Design Life of the through-truss is anticipated and all permit restrictions are removed. While the existing bridge will still be classified as a Fractural Critical bridge, internal redundancy will be provided to safely distribute the loads to other elements in case a fracture critical member of the through-truss fails. In addition, a bridge specific vessel impact study was performed and scour countermeasures are included, both enhancements since *Preliminary Design*. The project and design criteria utilized in the *Final Design Phase* do, however, come with increased costs to the project.



Timber Piling Cores from existing Bridge No. 5900

As stated in previous installments, the Winona Bridge project team felt the through-truss rehabilitation plan development was the highest risk aspect of the project, in terms of potential cost growth, and one of the primary reasons CMGC was chosen as the procurement method. This is important to understand as we have detailed pricing from the CMGC contractor, Ames Construction, Inc., much earlier in the project delivery process so project partners can strategically review the current *Final Design Phase* approach along with the “known” costs. This is why we have hit the “pause button” as we have time to perform this strategic review, which would not have been possible using our traditional delivery methodology. If the entire project had been let as a single bid package and the bid pricing came in significantly over budget, it could have delayed the start of construction on the new bridge. Even if the existing bridge work had been let as a single work package by itself using our traditional design-bid-build procurement methodology, the costs could have come in higher than budgeted and at that point, it could have been more challenging to make a strategic review of the scope of work.

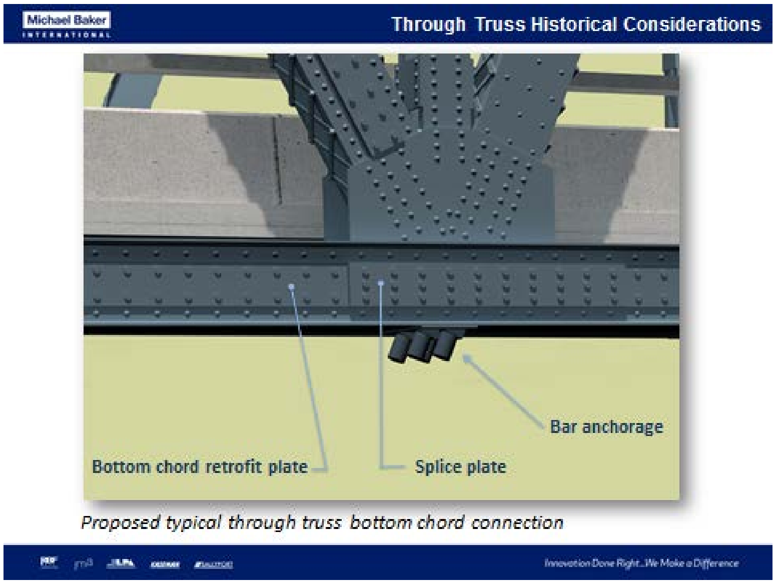
In regards to budget and costs, let's focus on some of the specific areas of cost growth regarding the through-truss rehabilitation from the *Preliminary Design Phase* to where we are currently in the *Final Design Phase*. As previously mentioned, the Winona Bridge Project Management team feels the current approach to the through-truss rehabilitation provides a long-term, low-risk solution for the Winona community and region. There is, however, a higher initial price tag for this solution, but we feel it will provide the overall lowest cost in the long run.

Through-Truss Budget and Cost Estimate: At the conclusion of the *Preliminary Design Phase,* based on the through-truss rehabilitation scope of work at that time, the cost estimate for the existing bridge through-truss rehabilitation was \$13.4 million. In the current *Final Design Phase,* using the CMGC procurement methodology, after the 90% design level pricing effort was recently completed, the cost estimate for the existing bridge through-truss rehabilitation is \$33.9 million. This is a significant added investment in the through-truss of approximately \$20.5 million so let's break down some of the areas of cost growth related to the through-truss (note: the through-truss is not the only area of cost growth):

- **Through-truss Deterioration Rate:** The Winona Bridge Project Management team spent considerable time and effort in reviewing recent bridge inspection reports for Bridge No. 5900. As shown in Appendix A, the rate of deterioration has accelerated in recent years with some very evident changes from 2013 to 2014 in the reports. The "moderate deterioration went from 75% to 0%, the extensive deterioration went from 25% to 85%, and severe deterioration went from 0% to 15%. The photos in Appendix A are from the same location and span several years.

  The estimated cost for the bottom chord repairs is now \$6-7 million. There was very little bottom chord repair work anticipated or estimated in the Preliminary Design Phase cost estimate. The bottom chord is part of the "below deck" structural elements of the existing bridge.

- **Internal Redundancy:** The current through-truss rehabilitation solution includes internal redundancy to provide an added level of protection to the bridge. The added cost for this work is \$1-2 million. This is not required by the Federal Highway Administration but was included as endorsed by MnDOT, because it is an important element that is provided to safely distribute the loads to other elements, in case a fracture critical member of the through truss fails.



Internal Redundancy Bars protruding out truss bottom chord

- **<u>MnDOT Modified HL-93 Loading vs. AASHTO HL-93 Loading with Special Permit Vehicles:</u>** The *Final Design* team estimates that the cost for added structural strengthening plating based on the HL-93 loading criteria utilized in *Final Design* is $3-4 million. This is not a requirement from the FHWA, but another MnDOT endorsed project criteria.

<u>Other Items Budget and Cost Estimate:</u>

- **<u>Structural Steel:</u>** In the CMGC process, the estimating teams and contractor traditionally use "plug prices" at the 30% and 60% design cost estimate level. These prices are based on their recent estimating/bidding experience with similar work. At the 90% design estimate level, the team strives to obtain physical price quotes from subcontractors and suppliers. In regards to the structural steel, primarily related to the deck truss approach spans, there was an increase in the steel pricing of approximately $2.5 million from the initial preliminary cost estimates. This is related to steel material costs, detailing, and high labor costs associated with the intricate fabrication of the historically replicated deck trusses. In addition, the costs for the deck trusses are higher than estimated in preliminary design at an even greater amount.

Bridge No. 5900 – Latsch Island Deck Trusses

- **Winona Approach Beam Span Lengths and Historic Beams:** For the Winona approach spans on the existing bridge, there are short span lengths and non-standard concrete beams that are intended to be replicated to meet the historical character of these elements. There is, however, a premium of approximately $2.2 million to accomplish this.

Bridge No. 5900 – Winona Concrete Beam Spans

- **Aesthetics, City Items, and Environmental Permitting:** Several other aspects of the project are worth mentioning. In regards to aesthetics, there is approximately $3 million worth of bridge and roadway aesthetic elements included in the current plans and specifications, most of which are paid for by MnDOT. In fact, we believe all of the final recommendations of the Winona volunteer Visual Quality Committee (VQC) are included in the project. In addition, the kick-off letter on the work package #5 cost overrun website detailed multiple items added to the project, many of which were not originally planned. In addition, the requirements of the environmental permits have evolved and added expense to the project over the years of the delivery of the project.

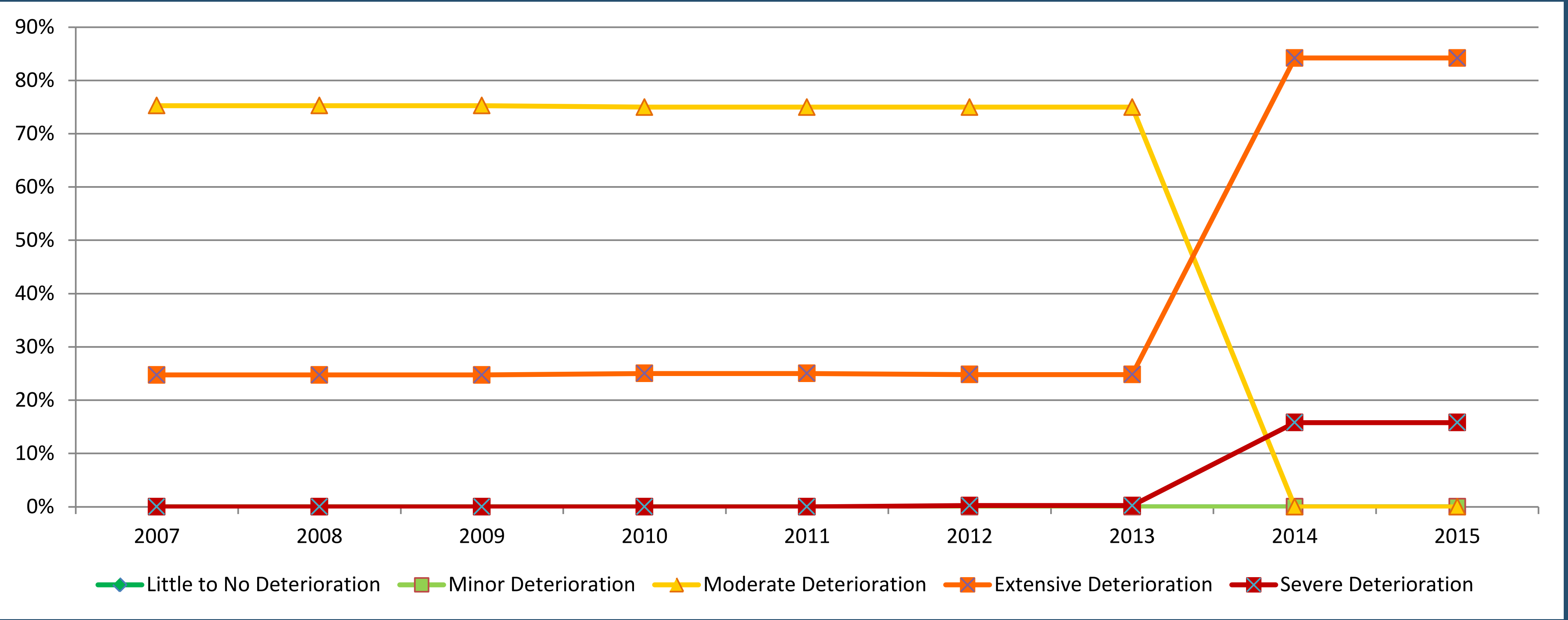
- **Engineering:** It has been stated that the Engineering costs for the project are approximately $10 million over budget. The original budget included $16.5 million for Engineering, or about 13% of the construction budget. Traditionally, our team would expect the Engineering budget to be closer to 22-25%, which is where we are at today.

In closing this installment, we hope you have a greater understanding of the higher standard of care the *Final Design* team has given the work on the existing bridge. We believe the Winona community and region expects and deserves a highly qualified engineering team to work on this highly complex bridge project. We have assembled bridge experts from across the country to help get us to where we are currently with our approach to *Final Design*. Again, there is a premium for our efforts; however, we feel this is worth the initial investment being proposed.

Appendix A

- Existing Bridge No. 5900 Bottom Chord Element Condition Ratings.
- Existing Bridge No. 5900 “Same Location” Photos.

Through Truss - Bottom Chord Element Condition Ratings



Bottom Chord Repairs cost $6-7 Million

Bridge 5900 Inspection Report Conditions

2008

Photo #2: Typical corrosion and pack rust along bottom chord at lacing bar connections

2010

Photo 49 – Span 19 - Bottom Chord Looking East - Typical

2012

Photo 67 - Span 19 L13-L14E Bottom Lacing Corrosion

2014

Photo 15 - Span 19 L17-L18E Looking North