Staff Report

Feasibility Study and Report
6th Street Bridge Over Squaw Creek

January 12, 2010

BACKGROUND:

The 6th Street Bridge over Squaw Creek is located in the central portion of Ames near the west end of 6th Street between Brookridge Avenue and University Boulevard. The route serves as an important connector between Iowa State University and downtown Ames for motorists, pedestrians and bicyclists. Property to the south of the bridge is owned by Iowa State University (ISU) and property to the north of the bridge, while owned by ISU, is managed by the City of Ames as Brookside Park. The main Union Pacific Railroad east-west line is approximately 160-feet south (downstream) of the bridge. There is also a shared-use path that runs under the bridge on the west side of Squaw Creek.

The bridge on 6th Street over Squaw Creek is a three span steel two-girder bridge with a cast-in-place concrete deck that was built in 1948. A bridge deck overlay with sidewalk repair was completed in 1987, and abutment backwall and approach pavement repairs were completed in 1997. There are 6-ft sidewalks on each side, separated from traffic by one-foot high curbs. Due to the two-girder superstructure arrangement, the bridge is non-redundant and is classified as fracture critical. According to AASHTO, “fracture critical members or member components (FCMs) are steel tension members or steel tension components of members whose failure would be expected to result in collapse of the bridge.” Redundancy refers to the ability of other structural members that could temporarily take the load previously carried by a failed member, thereby potentially avoiding the collapse of the bridge. For this bridge, there are no other structural members that could temporarily take the load in the event of failure of one girder, likely leading to collapse of the span. The bridge is also considered functionally obsolete by the FHWA due to the narrow bridge roadway width in relation to the high volume of traffic on the bridge. This refers to the fact that the bridge no longer serves the function for which it was built in comparison to a new bridge designed to current standards.

Based on the current condition of the bridge, the type of construction, and the projected need for maintenance, City Council determined the need to perform a study of the existing condition and possible repair or replacement options for the existing bridge. This study is shown in the 2009/10 Capital Improvements Plan (CIP). WHKS and Company of Mason City, Iowa, was contracted to perform the evaluation and has prepared the attached report. This feasibility study and report includes several options that were investigated, identifying the advantages, disadvantages, and probable cost for each option.

ALTERNATIVES:

OPTION 1: DO NOTHING

Description
The first option investigated was the "do nothing" option. This option would leave the bridge essentially as-is with no planned repair or replacement. Minor on-going maintenance of the roadway would be required.

At this point, **none of the problems visibly evident in the inspection or noted in the report are serious enough to pose a safety concern** or affect the performance of the bridge. However, the rate of deterioration generally tends to increase over time as the effects of water, deicing chemicals, freeze-thaw, traffic impact, and the formation and growth of rust combine.

The variability of these factors makes it difficult to estimate the remaining life of the bridge. Within **two to five years**, the pack rust and section loss present in the girders could expand to a point which would necessitate posting a lowered load limit on the bridge. Eventually, the section loss could grow to a degree that would make it impossible to accurately predict the strength of the girders and the bridge would have to be closed. **It could be 10 to 15 years before this type of action would be necessary.**

Estimated Costs
There are no direct costs associated with this option since no work would be performed. However, the bridge would still accrue annual maintenance costs estimated at **$5,000 to $10,000 per year**.

OPTION 2: BRIDGE REHABILITATION

Description
The bridge rehabilitation option involves performing an extensive repair of the bridge to correct deficiencies and extend the remaining life of the bridge. The work would include a deck overlay or a deck replacement, joint replacement, abutment repairs and superstructure painting.

Completing the repairs would correct the major deficiencies of the bridge and greatly increase the remaining life of the bridge. Rehabilitation could be completed in two phases with the **superstructure painting occurring first**. It is estimated that this work could extend the service life of this bridge by **5 to 10 years**. Addressing the **deck and other rehabilitation needs** could follow which generally could **add 20 to 30 years** to the life of the bridge. However, **it would not address any concerns inherent to the non-redundant fracture critical girders or narrow bridge roadway width**.

Estimated Costs
Based on the proposed scope of work, the estimated total project cost for a deck overlay is approximately **$605,000** and a deck replacement is approximately **$1,171,000**. These estimates include superstructure painting, which is estimated at $165,000 and proposed in the 2010/11 City of Ames CIP.

OPTION 3: REPLACE WITH PPCB BRIDGE

Description

The third option involves replacing the existing bridge with a pretensioned, prestressed concrete beam (PPCB) bridge with concrete piers and abutments. This option would involve removal of the existing bridge prior to construction of the new bridge. The proposed layout for this option consists of three spans with piers on each side of the channel. A new PPCB bridge could be expected to have a **design life of 75 years**.

Aesthetics could be incorporated into the bridge design, if desired. Potential areas for using aesthetics include decorative lighting, picket rail fencing, aesthetic barrier rails, concrete rustications and colored concrete sealer. Including aesthetic treatments would add to the appeal of the bridge especially considering its close proximity to Brookside Park and the shared-use path running under the bridge. These features would likely increase the overall cost of the bridge by approximately 5-10%.

Estimated Costs

The estimated **base costs for construction** of this bridge option are **$1,794,000**. As noted, including **aesthetic features** are estimated to cost an **additional $179,000**, bringing **total estimated costs to $1,973,400**.

OPTION 4: REPLACE WITH CWPG BRIDGE

Description

The fourth option involves replacing the existing bridge with a continuous welded plate girder (CWPG) bridge with concrete piers and abutments. This option would involve removal of the existing bridge prior to construction of the new bridge. The proposed layout for this option would be similar to Option 3 but would consist of only two spans with one pier at the middle of the bridge. Use of only one pier would likely allow for a slightly shorter bridge than Option 3. Other benefits of using one pier would include reduced relative construction costs and lower on-going maintenance and inspection costs.

Estimated Costs

The estimated **base costs for construction** of this bridge option are **$2,091,000**. As noted with Option 3, **aesthetic features** could be added for approximately an **additional $209,000**, bringing **total estimated construction costs to $2,300,000**.

STAFF COMMENTS:

The 6th Street Bridge over Squaw Creek has provided an important link between downtown Ames and Iowa State University for over 60 years. However, the superstructure and abutments are starting to show significant levels of deterioration that will require attention in the coming years. The non-redundant fracture critical superstructure is a concern that should be included when considering any type of repair or replacement.

To address these varied concerns, **WHKS & Co. has recommended that the City pursue Option 3, the PPCB bridge replacement option**. This option addresses the concerns of bridge deterioration, roadway width, and non-redundancy, but has a lower construction cost than Option 4. A new PPCB bridge could be expected to have a design life of 75 years, which would provide a long-term solution for the bridge. The scenic setting near Brookside Park plays a factor in whether or not to include aesthetics in the project. The aesthetic treatments could be added to the bridge for a relatively low cost.

Superstructure painting, which is estimated at $165,000, is currently proposed in the 2010/11 City of Ames CIP. As noted, this could extend the functional life of the bridge by 5 to 10 years, allowing for further rehabilitation work or bridge replacement to be appropriately programmed in a future year of the CIP.

WHKS No. 7244

CITY OF AMES

Feasibility Study & Report
for the
6th Street Bridge over Squaw Creek

November 2009

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.

SIGNATURE ON ORIGINAL HARD COPY

Fouad K. Daoud, P.E. & S.E. Date

License number_____

My license renewal date is December 31, 2009.

Pages or sheets covered by this seal:

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WHKS & CO.

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INTRODUCTION

STUDY OBJECTIVE

The City of Ames has determined the need to perform a study of the existing condition and possible repair or replacement options for the existing bridge on 6th Street over Squaw Creek. The need for the study is based on the current condition of the bridge, the type of construction, and the projected need for bridge maintenance. The purpose of the this Feasibility Report is to investigate several options, identify the advantages and disadvantages of each option, and develop a probable cost for each option.

LOCATION

The 6th Street Bridge over Squaw Creek is located in the central portion of Ames near the west end of 6th Street where it terminates at University Boulevard. The nearest intersection on the east side of the bridge is with Brookridge Avenue and North Hazel Avenue. The route serves as an important connector between Iowa State University and downtown Ames for motorists, pedestrians and bicyclists. Citizens accessing Brookside Park and the nearby skate park, which are north and west of the bridge, also frequently use the route. Property to the north of the bridge is owned by the City of Ames serving as Brookside Park and property to the south of the bridge is owned by Iowa State University. The main Union Pacific Railroad east-west line is approximately 160-feet south (downstream) of the bridge. There is also a shared-use path that runs under the bridge on the west side of Squaw Creek.

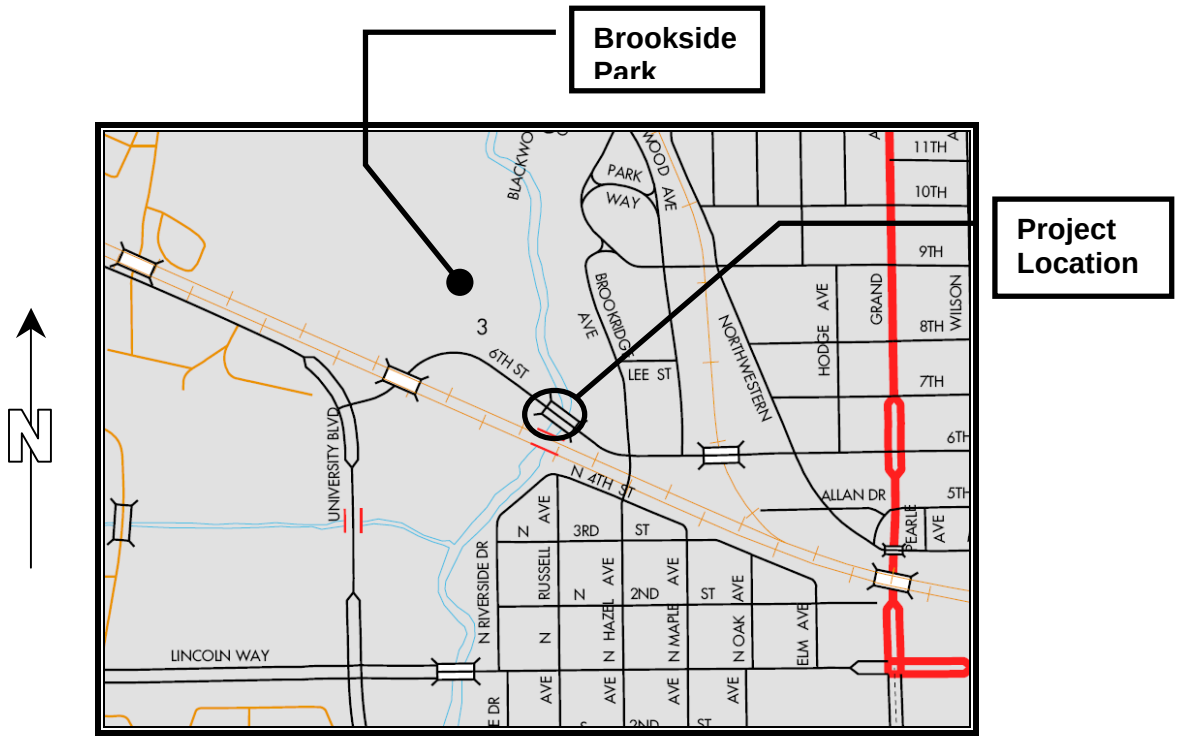

Figure 1. Project Location Map.

BACKGROUND

The bridge on 6th Street over Squaw Creek is a three span steel two-girder bridge with a cast-in-place concrete deck that was built in 1948. A bridge deck overlay with sidewalk repair was completed in 1987, and abutment backwall and approach pavement repairs were completed in 1997. The bridge length is approximately 250'-0 and the roadway width is 25'-8 with 6-ft sidewalks on each side. The sidewalks are separated from traffic by 1'-0 tall curbs. Decorative steel handrails are present at the outside edge of each sidewalk. The roadway configuration is two-lane on the bridge but transitions to four-lane just east of the bridge. Traffic counts from 2007 show that approximately 5900 vehicles per day use the bridge.

Due to the two-girder superstructure arrangement, the bridge is non-redundant and is classified as fracture critical. According to AASHTO, "fracture critical members or member components (FCMs) are steel tension members or steel tension components of members whose failure would be expected to result in collapse of the bridge".[1] Redundancy refers to the ability of other structural members that could temporarily take the load previously carried by a failed member, thereby potentially avoiding the collapse of the bridge. For this bridge, there are no other structural members that could temporarily take the load in the event of failure of one girder. This would likely lead to collapse of the span, which results in the classification of the bridge as non-redundant and fracture critical.

Figure 2. Existing Bridge Profile looking West.

The report from the most recent bridge inspection in 2008 reads as follows:

> *Hairline transverse cracks in top of deck and hairline cracks with leaching on bottom of deck. Edge of south curb is spalled and crumbling. Bottom flange of south girder near west pier is bent at two locations. Ends of girders and bearings are rusty. Pack rust between bottom flange cover plates on both girders. Rockers at both abutments are tipped. Minor erosion in west berm.*

[1] American Association of State Highway and Transportation Officials (AASHTO), Manual for Condition Evaluation of Bridges, 1994 (Washington, DC: AASHTO, 2000)

As can be noted, water and deicing chemicals are starting to leach through the deck as well as cause deterioration of the concrete fascia and to the steel beams and bearings below the joints. Pack rust is also causing a loss of section at the girder bottom flange cover plates. To help minimize the advance of rusting, a recommendation was made in the inspection report to consider repainting the bridge.

Due to the evidence of deterioration beginning to occur on the bridge, the City approved a contract with WHKS & Co. in August 2009 to conduct a feasibility study to investigate the repair and replacement options for the 6th Street Bridge. As a part of this study, WHKS & Co conducted a site visit of the bridge on September 23, 2009, along with City staff to verify the findings of the most recent inspection, gain insights, and discuss alternatives. This report is a summary of the feasibility study and investigation. It is anticipated that the City will use this report as an aid in deciding what type of construction, if any, should be considered at the 6th Street Bridge over Squaw Creek.

SCOPE OF STUDY

The alternatives section of this report includes four different options and each option includes each of the following items:

- Description
- Design features
- Estimated project costs
- Advantages and disadvantages

STUDY LIMITATIONS

This feasibility study is a preliminary report and thus has limitations. The intent of this study is to present in some detail the consequences of selecting each of several options. Since the project is at a conceptual stage and not all of the project details are finalized, the cost estimates are best used to evaluate the relative magnitude of cost between options. The City could choose to modify certain factors that would alter the cost of the project. All cost figures are given in present dollars, and do not include any provision for inflation.

This study included a preliminary hydraulic review that was based on information from the Federal Emergency Management Agency (FEMA) flood insurance studies and FEMA-issued flood maps. Bridge lengths and elevations based on this data would need to be verified by using survey data to perform a final hydraulic analysis in the next phase of the project.

ALTERNATIVES

OPTION 1: DO NOTHING

DESCRIPTION

The first option investigated was the “do nothing” option. This option would leave the bridge essentially as-is with no planned repair or replacement. Minor on-going maintenance of the roadway would be required.

DESIGN FEATURES

There are no specific design features applicable to this option since it is the do-nothing option. However, an important aspect of this option is the estimated remaining life of the bridge and the effect of deferred maintenance on the performance and life of the bridge.

As noted in the Background section, the bridge is experiencing cracks and leaching in the deck, scaling and crumbling of the deck fascia, rust at the girders and bearings, and deterioration of the joints and bridge seats. This kind of wear and deterioration is typical of bridges over 60 years old and subjected to the combined effects of deicing chemicals and freeze-thaw cycles.

Figure 3. Example of Pack Rust at Bottom Flange.

Figure 4. Example of Deck Fascia Spalling.

At this point, none of the problems visibly evident in the inspection or noted in this report are serious enough to pose a safety concern or affect the performance of the bridge. However, in our experience the rate of deterioration generally tends to increase over time as the effects of water, deicing chemicals, freeze-thaw, traffic impact, and the formation and growth of rust combine. For example, as chloride-laden water runs over damaged concrete it gradually causes more scaling of the concrete until it reaches the reinforcing steel. Once the reinforcing is exposed, it rapidly begins to form rust that expands against the concrete and causes more spalling and scaling until there is severe section loss, which continues to exacerbate the problem.

The perceived or inherent safety issues associated with the fracture critical two-girder superstructure are also a consideration. All other issues notwithstanding, a properly designed and maintained fracture critical bridge is not a safety concern. However, if one of the girders begins to deteriorate and develop problems such as rust and section loss, it begins to put the safety of the entire bridge in question. If one girder were to fail, however unlikely that may be, the entire bridge would collapse due to the non-redundant nature of the fracture critical two-girder system.

The variability of these factors makes it difficult to estimate the remaining life of the bridge. Within two to five years, the pack rust and section loss present in the girders could expand to a point which would necessitate de-rating the girders and posting a lowered load limit on the bridge. Eventually, the section loss could grow to a degree that would make it impossible to accurately predict the strength of the girders and the bridge would have to be closed. However, it could be 10-15 years before this type of action would be necessary.

ESTIMATED PROJECT COST
There are no direct costs associated with this option since no work would be performed. However, the bridge would still accrue indirect costs such as on-going roadway maintenance, snow removal, and biennial bridge inspections. Annual maintenance costs for budgeting could be estimated as $5,000 - $10,000 per year.

ADVANTAGES
The primary advantages of the do-nothing option include:

- No initial cost

DISADVANTAGES
The primary disadvantages of the do-nothing option include:

- Continued bridge deterioration
- Highest on-going maintenance costs
- Does not address concerns of non-redundancy
- Possible load limits and bridge closing in future
- Not a viable long-term solution

OPTION 2: BRIDGE REHABILITATION

DESCRIPTION
The bridge rehabilitation option involves performing an extensive repair of the bridge to correct deficiencies and extend the remaining life of the bridge. The work would include either a deck overlay or a deck replacement. It would also include superstructure painting, which is currently included in the City of Ames Capital Improvement Plan (CIP). Repair projects of this nature are fairly common in Iowa on bridges owned by counties and the Department of Transportation (DOT). With this option the City would hire a contractor to perform the work and the road would be closed during the construction period.

DESIGN FEATURES
The intent of the rehabilitation option would be to correct the specific areas of deterioration that were mentioned in the Background section above. The work generally includes a bridge deck overlay or replacement, abutment repairs, joint replacement, concrete patching, and superstructure painting. To determine the need for a deck overlay or replacement, concrete cores of the deck could be taken to determine the extent of deterioration.

Based on the most recent bridge inspection and the site visit conducted by WHKS for this report, the following scope of repair work is proposed:

1. Perform bridge deck rehabilitation
    a. Remove the existing overlay, perform Class A deck repairs as necessary, and overlay the bridge with Portland Cement Concrete (PCC), OR
    b. Remove and replace the concrete bridge deck including sidewalks
2. Perform concrete repair to the scaling and deteriorated areas of the deck fascia and west abutment bridge seat.
3. Replace the existing bridge joints at both abutments with steel extrusion joints with neoprene glands.
4. Replace the entire west abutment backwall and the top of east abutment backwall.
5. Reset the girder bearings at the west abutment.
6. Repaint the entire bridge including the girders, cross frames, and bearings.

7. Replace approaches on both ends of the bridge with 70-foot long, 12-inch P.C.C. approaches. See Iowa DOT standard road plans RK-20 and RK-23.

Traffic control during the repair would involve closure of 6th Street to through traffic due to narrow lane widths if staging were attempted. This will pose an inconvenience to the public, but will save expenses on staging and traffic control and will allow the construction to be completed more quickly.

Completing the repairs would correct the major deficiencies of the bridge and greatly increase the remaining life of the bridge. It would not, however, address any concerns inherent to the non-redundant fracture critical girders. Projects of this nature generally add 20-30 years to the life of the bridge. At that point the bridge would need additional repairs or would be replaced.

ESTIMATED PROJECT COST
Costs associated with the rehabilitation option are based on average awarded bid price data from the Iowa DOT and estimated quantities to complete the proposed scope of work shown above. The cost estimate also contains 10% mobilization and 20% contingency, which includes engineering and construction observation costs. See Appendix A for a breakdown of the estimated costs.

Based on the proposed scope of work, we estimate the total project cost of Option 2a (deck overlay) to be approximately **$605,000** and Option 2b (deck replacement) to be approximately **$1,171,000**. Other costs, which are not included here, would include routine maintenance items such as snow removal and biennial bridge inspections. The City of Ames CIP currently has $165,000 budgeted in 2010/11 for superstructure painting only.

ADVANTAGES
The primary advantages of the repair and overlay option include:

- Prolongs life and maintains use of existing structure
- Shorter construction time than replacement options causing less disruption to traffic
- Lower construction cost than replacement options

DISADVANTAGES
The primary disadvantages of the repair and overlay option include:

- Not a long-term solution; bridge will eventually need to be replaced
- Higher on-going maintenance costs than replacement options
- Does not address concerns of non-redundancy
- Requires closing of roadway during construction

OPTION 3: REPLACE WITH PPCB BRIDGE

DESCRIPTION
The third option involves replacing the existing bridge with a pretensioned prestressed concrete beam (PPCB) bridge with concrete piers and abutments. This option would involve removal of the existing bridge prior to construction of the new bridge. Similar to the present condition, the proposed bridge would carry two lanes of traffic and a sidewalk/path on each side.

DESIGN FEATURES
The proposed layout for this option consists of three spans (80'-90'-80') and piers on each side of the channel. The abutments would be placed either in front of or behind the existing

abutments to minimize interference between the substructures during construction. The total proposed bridge length would remain around 250'-0, which was estimated based on meeting hydraulic requirements.

FEMA will require a no-rise condition of the flood profiles. In effect, the hydraulic performance of the proposed bridge will need to match or exceed the performance of the existing bridge. Thus, the waterway opening width of the bridge will need to be approximately the same as the existing bridge. It is anticipated that using standard 4'-6 deep concrete beams will provide the required 3'-0 freeboard above the Q_{50} (2% annual chance) flood elevation of approximately 898.9 feet. Therefore the basic alignment and profile grade of the existing bridge could remain the same. Riprap should be placed on the east bank to protect against visible erosion just upstream of the bridge.

The proposed roadway width would be 30'-0 with 6'-0 sidewalks on each side. This would allow for two 12'-0 traffic lanes and 3'-0 shoulder areas on the bridge. The sidewalks would be protected from traffic by a 42" high concrete rail and by a pedestrian fence on the outside edge of the sidewalk.

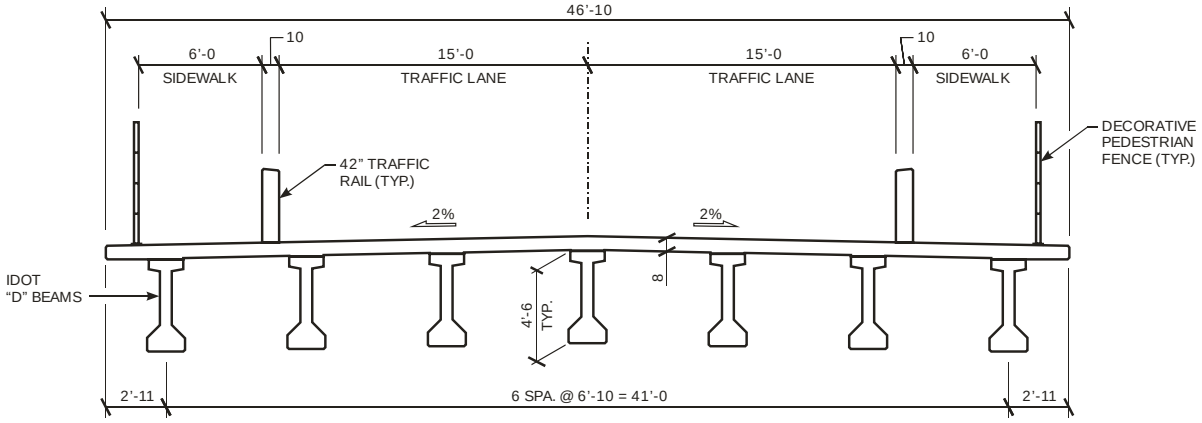

Figure 5. Proposed PPCB Cross Section

Aesthetics could be incorporated into the bridge design if desired by the City. Potential areas for using aesthetics include decorative lighting, picket rail fencing, aesthetic barrier rails, concrete rustications and colored concrete sealer. Including aesthetic treatments would add to the appeal of the bridge especially considering its close proximity to Brookside Park and the shared-use path running under the bridge. However, we feel it would increase the overall cost of the bridge by around 5-10%.

Figure 6. Example of Pier Aesthetics on PPCB Bridge in Algona, IA.

Traffic control on 6th Street would involve road closure during the duration of the construction. Staged construction is not feasible on a fracture critical bridge and therefore was not considered.

ESTIMATED PROJECT COST

Items included in the construction cost for this option include removal of the existing bridge; construction of new piers, abutments, prestressed concrete beams, bridge deck, fence and barrier rails; and placing new bridge approaches at each end. Additional costs for cofferdams for pier construction were included based on a review of the soil borings in the plans for the existing bridge.

Costs associated with the PPCB replacement option are based on average unit cost data compiled by the Iowa DOT and estimated quantities to complete the proposed scope of work shown above. The cost estimate also contains 10% mobilization; 30% contingency which includes potential right-of-way acquisition, engineering, and construction observation; and 10% for optional aesthetic treatments. See Appendix A for a breakdown of the estimated costs.

Based on the proposed scope of work for this option, we estimate the total project cost of Option 3 to be approximately **$1,973,000**, including around **$179,400** for optional aesthetic treatments. Other costs, which are not included here, would include routine maintenance items such as snow removal and biennial bridge inspections.

ADVANTAGES

The primary advantages of the PPCB bridge replacement option include:

- Long-term solution
- Addresses concerns of deterioration and non-redundancy of existing bridge
- Lower on-going maintenance costs
- Can incorporate aesthetics on bridge

DISADVANTAGES

The primary disadvantages of the PPCB bridge replacement option include:

- High initial cost
- Requires closure of roadway during construction

OPTION 4: REPLACE WITH CWPG BRIDGE

DESCRIPTION

The fourth option involves replacing the existing bridge with a continuous welded plate girder (CWPG) bridge with concrete piers and abutments. This option would involve removal of the existing bridge prior to construction of the new bridge. Similar to the present condition, the proposed bridge would carry two lanes of traffic and a sidewalk/path on each side.

DESIGN FEATURES

The proposed layout for this option would be similar to Option 3 but would consist of only two spans (120'-120') with one pier at mid-span of the bridge. Use of only one pier would likely allow for a slightly shorter bridge than Option 3. Other benefits of using one pier would include reduced construction cost and on-going pier maintenance and inspection. The abutments would be placed either in front of or behind the existing abutments to minimize interference between the substructures during construction. The total proposed bridge length is 240'-0, which was estimated based on meeting hydraulic requirements.

FEMA will require a no-rise condition of the flood profiles. In effect, the hydraulic performance of the proposed bridge will need to match or exceed the performance of the existing bridge. Thus, the waterway opening width of the bridge will need to be approximately the same as the existing bridge. It is anticipated that using 4'-4 deep girders will provide the required 3'-0 freeboard above the Q_{50} (2% annual chance) flood elevation of approximately 898.9 feet. Therefore the basic alignment and profile grade of the existing bridge could remain the same. Riprap should be placed on the east bank to protect against visible erosion just upstream of the bridge.

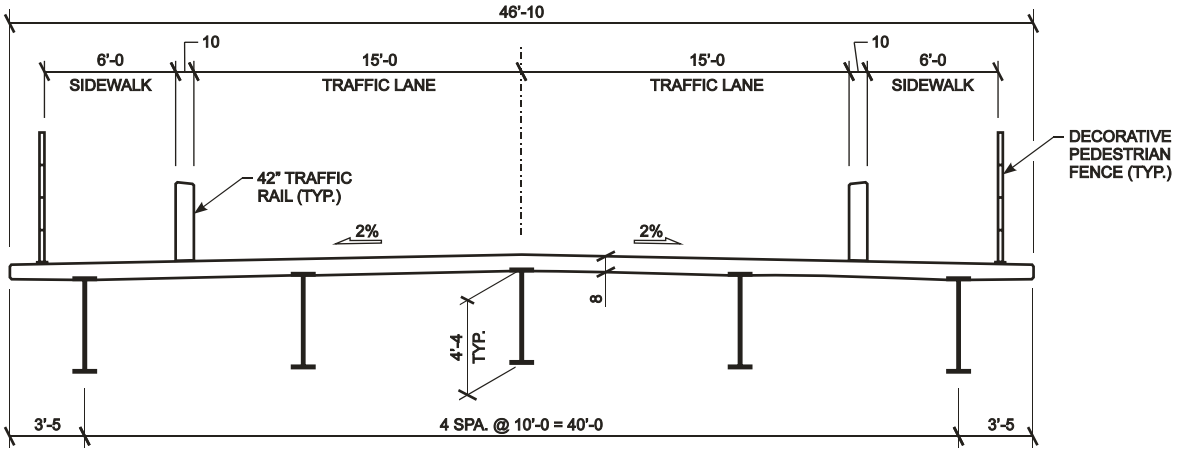

Figure 7. Proposed CWPG Cross Section.

The proposed roadway width would be 30'-0 with 6'-0 sidewalks on each side. This would allow for two 12'-0 traffic lanes and 3'-0 shoulder areas on the bridge. The sidewalks would be protected from traffic by a 42" high concrete rail and by a pedestrian fence on the outside edge of the sidewalk.

Aesthetics could be incorporated into the bridge design if desired by the City. Potential areas for using aesthetics include decorative lighting, picket rail fencing, aesthetic barrier rails, concrete rustications and colored concrete sealer. Including aesthetic treatments would add to the appeal of the bridge especially considering its close proximity to Brookside Park and the shared-use path running under the bridge. However, we feel it would increase the overall cost of the bridge by around 5-10%.

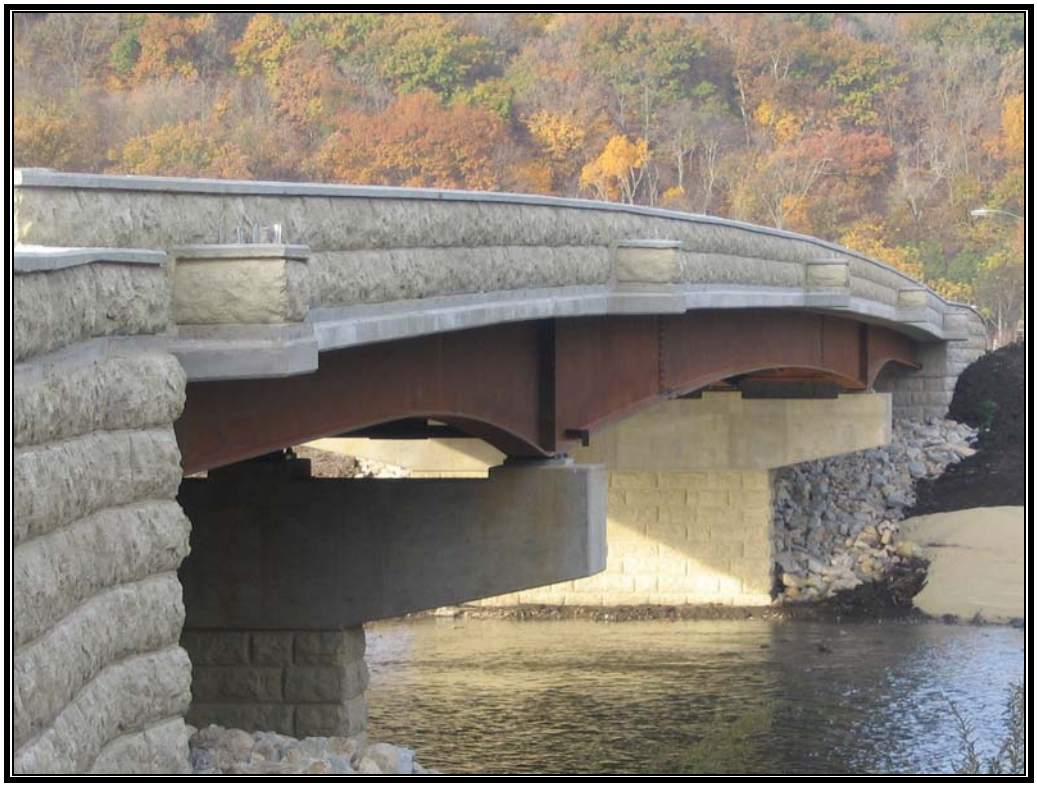

Figure 8. Example of Aesthetics on CWPG Bridge in Decorah, IA.

Traffic control on 6th Street would involve road closure during the duration of the construction. Staged construction is not feasible on a fracture critical bridge and therefore was not considered.

ESTIMATED PROJECT COST

Items included in the construction cost for this option include removal of the existing bridge; construction of a new pier, abutments, steel girders, bridge deck, fence and barrier rails; and placing new bridge approaches at each end. Additional costs for a cofferdam for pier construction were included based on a review of the soil borings in the plans for the existing bridge. Cost saving was realized by reducing the number of spans from three to two and piers from two to one.

Costs associated with the CWPG replacement option are based on average unit cost data compiled by the Iowa DOT and estimated quantities to complete the proposed scope of work shown above. The cost estimate also contains 10% mobilization; 30% contingency which includes potential right-of-way acquisition, engineering, and construction observation; and 10% for optional aesthetic treatments. See Appendix A for a breakdown of the estimated costs.

Based on the proposed scope of work for this option, we estimate the total project cost of Option 4 to be approximately **$2,300,000**, including around **$209,100** for optional aesthetic

treatments. Other costs, which are not included here, would include routine maintenance items such as snow removal and biennial bridge inspections.

ADVANTAGES
The primary advantages of the CWPG bridge replacement option include:

- Long-term solution
- Addresses concerns of deterioration and non-redundancy of existing bridge
- Uses two spans and eliminates one pier
- Lower on-going maintenance costs
- Can incorporate aesthetics on bridge

DISADVANTAGES
The primary disadvantages of the CWPG bridge replacement option include:

- Highest initial cost
- Requires closure of roadway during construction

SUMMARY OF ALTERNATIVES

A table summarizing the estimated construction costs, advantages, and disadvantages for each option is below:

	Estimated Project Cost	Major Advantages	Major Disadvantages
Option 1: Do Nothing	$5,000-10,000 per year	• No initial cost	• Continued bridge deterioration • Highest on-going maintenance costs • Does not address concerns of non-redundancy • Possible load limits and bridge closing in future • Not a viable long-term solution
Option 2: Bridge Rehabilitation	$605,000 for deck overlay $1,171,000 for deck replacement	• Prolongs life and maintains use of existing structure • Shorter construction time than replacement options causing less disruption to traffic • Lower construction cost than replacement options	• Not a long-term solution; bridge will eventually need to be replaced • Higher on-going maintenance costs than replacement options • Does not address concerns of non-redundancy • Requires closing of roadway during construction
Option 3: PPCB Bridge Replacement	$1,973,000 (includes $179,400 for aesthetics)	• Long-term solution • Addresses concerns of deterioration and non-redundancy of existing bridge • Lower on-going maintenance costs • Can incorporate aesthetics on bridge	• High initial cost • Requires closure of roadway during construction

Option 4: CWPG Bridge Replacement	$2,300,000 (includes $209,100 for aesthetics)	• Long-term solution • Addresses concerns of deterioration and non-redundancy of existing bridge • Use two spans and eliminates one pier • Lower on-going maintenance costs • Can incorporate aesthetics on bridge	• Highest initial cost • Requires closure of roadway during construction

RECOMMENDATION

The 6th Street Bridge over Squaw Creek has provided an important link between downtown Ames and Iowa State University for over 60 years. However, the superstructure and abutments are starting to show significant levels of deterioration that will require attention in the coming years. The non-redundant fracture critical superstructure is a concern that should be included when considering any type of repair or replacement.

To address these varied concerns, **WHKS & Co. recommends that the City pursue Option 3, the PPCB bridge replacement option**. This option addresses the concerns of bridge deterioration and non-redundancy, but has a lower construction cost than Option 4. A new PPCB bridge could be expected to have a design life of 75 years, which would provide a long-term solution for the bridge. The bridge's scenic setting near Brookside Park plays a factor in whether or not to include aesthetics in the project. We feel that aesthetic treatments would be a worthy addition to the project and could be added to the bridge for a relatively low cost.

THE NEXT PHASES

Should the City Council decide to pursue one of the bridge construction alternatives the next phase in the design process would be preliminary design. The preliminary design phase would include the following: survey, final hydraulic design, obtaining all required permits from the Iowa Department of Natural Resources (DNR) and the US Army Corps of Engineers (USACE), determination of ROW impacts, preliminary bridge layout, preliminary roadway design, and updated construction cost estimates.

After completion of the preliminary design phase, final design consisting of bridge and roadway design and creation of construction plans and specifications would take place. Without knowing the source of funding for this project, and due to the time required to obtain permits from the Iowa DNR and the USACE, we would anticipate that the earliest possible time for letting and construction for a bridge replacement project would be during the 2011 or 2012 construction season.

Option 2a - Deck Overlay and Repair

Item	Quantity	Unit	Unit Price	Price
Removals, As Per Plan	1	LS	$ 30,000.00	$ 30,000.00
Excavation, Class 20	18.8	CY	$ 80.00	$ 1,504.00
Structural Concrete (Misc.)	23.2	CY	$ 1,500.00	$ 34,800.00
Reinforcing Steel, Epoxy Coated	3480	LB	$ 3.00	$ 10,440.00
Structural Steel	550	LB	$ 7.00	$ 3,850.00
Longitudinal Grooving in Concrete	627	SY	$ 5.00	$ 3,135.00
Bridge Deck Overlay	713	SY	$ 65.00	$ 46,345.00
Bridge Deck Repair, Class A	143	SY	$ 185.00	$ 26,455.00
Steel Extrusion Joint w/ Neoprene	54	LF	$ 130.00	$ 7,020.00
Neoprene Gland Installation	54	LF	$ 30.00	$ 1,620.00
Concrete Repair	208	SF	$ 115.00	$ 23,920.00
Bridge Raising	1	LS	$ 10,000.00	$ 10,000.00
Bridge Cleaning for Painting	1	LS	$ 7,000.00	$ 7,000.00
Blast Cleaning of Structural Steel	1	LS	$ 80,000.00	$ 80,000.00
Containment	1	LS	$ 25,000.00	$ 25,000.00
Paint Waste Transport & Disposal	1	LS	$ 3,500.00	$ 3,500.00
Painting of Structural Steel	1	LS	$ 35,000.00	$ 35,000.00
Removal of Existing P.C. Overlay	713	SY	$ 15.00	$ 10,695.00
Bridge Approach Pavement, RK-20	420	SY	$ 180.00	$ 75,600.00
Removal of Pavement	420	SY	$ 18.00	$ 7,560.00
Traffic Control	1	LS	$ 5,000.00	$ 5,000.00
Other Roadway Items	1	LS	$ 10,000.00	$ 10,000.00
Mobilization (10%)	1	LS	$ 45,844.00	$ 45,844.00
Contingency (20% includes design & observation)				$ 100,858.00
			Total (rounded) =	**$ 605,000.00**

Option 2b - Deck Replacement and Repair

Item	Quantity	Unit	Unit Price	Price
Removals, As Per Plan	1	LS	$ 65,000.00	$ 65,000.00
Excavation, Class 20	18.8	CY	$ 80.00	$ 1,504.00
Structural Concrete (Bridge)	324.5	CY	$ 1,000.00	$ 324,500.00
Reinforcing Steel, Epoxy Coated	97350	LB	$ 2.00	$ 194,700.00
Structural Steel	550	LB	$ 7.00	$ 3,850.00
Longitudinal Grooving in Concrete	627	SY	$ 5.00	$ 3,135.00
Steel Extrusion Joint w/ Neoprene	54	LF	$ 130.00	$ 7,020.00
Neoprene Gland Installation	54	LF	$ 30.00	$ 1,620.00
Remove & Stockpile Exist. Handrail	1	LS	$ 3,500.00	$ 3,500.00
Concrete Repair	208	SF	$ 115.00	$ 23,920.00
Bridge Raising	1	LS	$ 10,000.00	$ 10,000.00
Bridge Cleaning for Painting	1	LS	$ 7,000.00	$ 7,000.00
Blast Cleaning of Structural Steel	1	LS	$ 80,000.00	$ 80,000.00
Containment	1	LS	$ 25,000.00	$ 25,000.00
Paint Waste Transport & Disposal	1	LS	$ 3,500.00	$ 3,500.00
Painting of Structural Steel	1	LS	$ 35,000.00	$ 35,000.00
Bridge Approach Pavement, RK-20	420	SY	$ 180.00	$ 75,600.00
Removal of Pavement	420	SY	$ 18.00	$ 7,560.00
Traffic Control	1	LS	$ 5,000.00	$ 5,000.00
Other Roadway Items	1	LS	$ 10,000.00	$ 10,000.00
Mobilization (10%)	1	LS	$ 88,741.00	$ 88,741.00
Contingency (20% includes design & observation)				$ 195,230.00
			Total (rounded) =	**$ 1,171,000.00**

Option 3 - PPCB Bridge Replacement

Item	Quantity	Unit	Unit Price	Price
Removal of Existing Bridge	10193	SF	$ 8.00	$ 81,544.00
PPCB Bridge (Urban)	11989	SF	$ 85.00	$ 1,019,065.00
Cofferdams for Piers	2	EA	$ 25,000.00	$ 50,000.00
Revetment, Class E	173	TON	$ 35.00	$ 6,055.00
Bridge Approach Pavement, RK-20	420	SY	$ 180.00	$ 75,600.00
Removal of Pavement	420	SY	$ 18.00	$ 7,560.00
Traffic Control	1	LS	$ 5,000.00	$ 5,000.00
Other Roadway Items	1	LS	$ 10,000.00	$ 10,000.00
Mobilization (10%)	1	LS	$ 125,482.00	$ 125,482.00
Contingency (30% includes ROW, design & observation)				$ 414,092.00
			Project Total (rounded) =	**$ 1,794,000.00**
Optional Aesthetics (10%)				$ 179,400.00
			Total w/ Aesthetics =	**$ 1,973,000.00**

Option 4 - CWPG Replacement

Item	Quantity	Unit	Unit Price	Price
Removal of Existing Bridge	10193	SF	$ 8.00	$ 81,544.00
CWPG Bridge (Urban)	11380	SF	$ 110.00	$ 1,251,800.00
Cofferdams for Piers	1	EA	$ 25,000.00	$ 25,000.00
Revetment, Class E	173	TON	$ 35.00	$ 6,055.00
Bridge Approach Pavement, RK-20	420	SY	$ 180.00	$ 75,600.00
Removal of Pavement	420	SY	$ 18.00	$ 7,560.00
Traffic Control	1	LS	$ 5,000.00	$ 5,000.00
Other Roadway Items	1	LS	$ 10,000.00	$ 10,000.00
Mobilization (10%)	1	LS	$ 146,256.00	$ 146,256.00
Contingency (30% includes ROW, design & observation)				$ 482,645.00
			Project Total (rounded) =	**$ 2,091,000.00**
Optional Aesthetics (10%)				$ 209,100.00
			Total w/ Aesthetics =	**$ 2,300,000.00**