MEMORANDUM

TO: Chad Hanson, MnDOT

FROM: Chris Hiniker, AICP

DATE: June 18, 2013

RE: Red Wing Bridge Project
DRAFT - River Bridge Options – Screening Considerations
SEH No. MNT06 119112 14.00

The purpose of this memorandum is to document the consideration of purpose and need, environmental factors, and cost in the assessment and eventual screening of the range of river crossing options being considered in the Red Wing Bridge Project study process. The river crossing options being evaluated include:

- Rehabilitate Bridge 9040 including the Wisconsin approach structure. This option assumes no cantilevered sidewalks will be added to the river structure.
- Replace Bridge 9040, including the Wisconsin approach structure, with a new structure immediately upstream (assume 10 feet separation between the existing and new structure). The seven new bridge types under consideration include:
  - Tied-arch
  - Simple span truss
  - Three-span truss
  - Extradosed
  - Cable-stayed
  - Concrete segmental box girder
  - Steel box girder

The first objective of this assessment is to provide a recommendation as to whether to proceed with either rehabilitation or replacement of Bridge 9040. If the recommendation is to replace Bridge 9040, the second objective will be to screen the bridge type options from seven to two or three for more detailed consideration.

The new bridge types are described in detail in the Bridge 9040 New Structure Alternatives memorandum dated March 4, 2013. Other memoranda that contain pertinent information related to the river bridge options include:

- Draft Comparison of Two-Lane River Bridge Rehabilitation and Replacement Options, April 23, 2013
- Draft River Crossing Options Risk Summary, May 24, 2013

The study process has not yet transitioned to the formal environmental impact assessment phase that will be conducted in compliance with the National Environmental Policy Act (NEPA). At this point it is assumed that an Environmental Assessment (EA) will be prepared to address the NEPA requirements. It is assumed this process will begin once the range of options has been screened to a single preferred alternative. To facilitate screening the options and assure compliance with NEPA, the alternatives evaluation process includes consideration of the Project's purpose and need, the social, economic, and environmental (SEE) subject areas, and cost. Table 1 identifies the range of purpose and need, SEE, and cost factors and highlights those where there are differences that facilitate screening the options at this study phase.

Table 1
Differentiating Purpose and Need, SEE, and Cost Factors
Associated with the River Crossing Options

P&N/SEE Factor	Potential for Substantive Differences Among the Options
Primary Need: Structurally sound crossing of the Mississippi River (P)	No
Primary Need: Structurally sound crossing of TH 61 (P)	N/A
Secondary Need: Continuity of Highway 63 (S)	No
Secondary Need: Highway 63 connection to Highways 58 and 61 (S)	No
Secondary Need: Adequate capacity, acceptable operations, safe design (S)	No
Secondary Need: Maximize maintenance of traffic (S)	Yes
Secondary Need: Access to Trenton Island (S)	No
Secondary Need: Pedestrian/Bicyclist Facilities (S)	Yes
Structural Redundancy (O)	Yes
Geometrics (O)	No
Economic Development (O)	No
Parking (O)	No
Regulatory Requirements (O)	No
Property Impacts (O)	No
Land Use	Yes
Farmland	No – no farmland in study area
Social and Community	Yes
Right-of-Way and Relocation	No – no permanent right-of-way or relocation required
Economic	Yes
Joint Development	No - no differentiating impacts associated with river crossing options
Pedestrian and Bicyclists	Yes
Air Quality	No - no differentiating impacts associated with river crossing options
Noise	Yes
Water Quality	Yes
Permits	No - no differentiating issues associated with river crossing options
Wetlands	Yes
Wildlife	Yes
Floodplains/Water Body Modification	Yes
Wild and Scenic Rivers	No – not a wild and scenic river
Coastal Barriers	No – not a coastal barrier
Coastal Zones	No – study area not in a coastal zone
Threatened and Endangered Species	Yes - potential mussel impacts pending results of investigation
Section 106 – Direct Impacts	To be determined following completion of additional studies
Section 106 – Indirect Impacts	Yes
Section 4(f)	No
Hazardous Waste	No - no differentiating impacts associated with river crossing options
Visual	Yes
Construction	Yes – see P&N maximize maintenance of traffic factor
Construction Cost	Yes
Service Life	Yes

(P) – Primary Need
(S) – Secondary Need
(O) – Other Consideration

Screening

This section documents the assessment of each factor identified as having the potential to call out substantive differences amongst the river crossing options. Because the new bridge types would be constructed in the same location and the new bridge is proposed immediately upstream from the existing bridge, the differences in physical impacts, such as wetlands, are primarily associated with the number and location of piers. The overall assessment is presented in Table 2. The table indicates that the primary differences in impacts are associated with structurally sound crossing, maintenance of traffic, pedestrian/bicyclists, water quality, wildlife, visual, construction cost and service life. The differentiators are described below:

Bridge 9040 Rehabilitation

- Retains fracture critical structure
- Avoids adverse impacts to natural environmental resources
- Very substantial maintenance of traffic impacts (detours, delays, emergency services, economic activity)
- No separated sidewalk/trail facility and not ADA compliant
- Avoids impact to historic resources if Bridge 9103 is retained. No visual impact
- Construction cost is approximately $67-$74 million
- The estimated service life for the rehabilitation is 40 years

Bridge 9040 Replacement Options

Compared to the rehabilitation option, each of the replacement options:

- Potentially impact land use and operations at the Harbor Marina
- Include a 10 foot separated sidewalk/trail and are ADA compliant
- Pretreat storm water prior to discharging into the Mississippi River
- Result in a slight net decrease in wetland impacts due to removal of the existing bridge piers.
- Have very minor maintenance of traffic issues
- Construction cost ranges from $72 to $144 million.
- Each of the new bridge types have an estimated service life of 100 years.

Comparing between the seven bridge type options:

- The tied-arch, extra-dosed, cable-stayed, concrete segmental box, and steel box girder options provide a structurally redundant crossing.
- The cable-stayed introduces the greatest wildlife impact (waterfowl migration) concerns given the 300 foot tower and associated cable stays.
- The tied-arch, simple span truss, three-span truss, cable-stayed, and steel box girder options have a slight reduction in floodplain impact. The concrete segmental box girder has no net change in floodplain impact and the extra-dosed has a slight net increase in floodplain impact.
- The tied arch introduces the greatest potential for adverse impacts to the historic river view-shed
- The steel box girder, concrete segmental, and extra-dosed introduce the lowest potential for adverse impacts to the historic river view-shed
- The tied arch, simple span truss, three-span truss, extra dosed, and cable-stayed retain the over deck structure design
- The steel box girder has the lowest estimated construction cost at $72-$82 million. The cable-stayed bridge has the highest cost estimate at $132-$144 million.
- The extradosed, concrete segmental box girder, and steel box girder have noticeably thicker structure depths. The structure depth is the depth from the top of the roadway down to the bottom of the girder
- The cable-stayed introduces the greatest visual change with respect to height
- The concrete segmental box provides the greatest potential for decreased noise from traffic

Conclusions

Based on consideration of the range of differentiating purpose and need, environmental, and cost factors the following technical recommendations have been developed:

- Replacing rather than rehabilitating Bridge 9040 is the recommended approach. This recommendation is based on the following key elements:
  - the replacement options have substantially less construction period impacts, especially related to maintenance of traffic;
  - the replacement approach provides options that are structurally redundant;
  - the replacement options provide a separate pedestrian trail and will be design to be fully ADA compliant;
  - the replacement options will be designed to pretreat water runoff prior to being discharged into the Mississippi River;
  - there are replacement options that are approximately the same cost as the rehabilitation option.

Assuming the preferred approach includes replacing Bridge 9040 upstream and immediately adjacent to the existing bridge, the next step is to reduce the number of potential new bridge types from the original list of seven. Based on the information included in Table 2, the following bridge types are recommended to carry forward for more detailed evaluation in the next analysis phase:

- Tied-Arch
  - Shallower bridge deck limits increases in the approach roadway grades;
  - It is the only overdeck truss structure that has been designed with structural redundancy;

- Concrete Segmental Box Girder
  - Lower cost
  - Structurally redundant
  - Lower potential for adverse impacts to historic river viewshed

- Steel Box Girder
  - Lower cost
  - Structurally redundant
  - Lower potential for adverse impacts to historic river viewshed

Table 2
Purpose and Need and SEE Screening Considerations

P&N/SEE Factors	Rehab 9040	Tied Arch	Simple Span Truss	Three-Span Truss	Extradosed	Cable-Stayed	Concrete Segmental Box Girder	Steel Box Girder
Maximum Maintenance of Traffic	Substantial maintenance of traffic impacts (detours, delays, emergency services, economic activity)	Minor maintenance of traffic impacts given close proximity to construction activities	Minor maintenance of traffic impacts given close proximity to construction activities	Minor maintenance of traffic impacts given close proximity to construction activities	Minor maintenance of traffic impacts given close proximity to construction activities	Minor maintenance of traffic impacts given close proximity to construction activities	Minor maintenance of traffic impacts given close proximity to construction activities	Minor maintenance of traffic impacts given close proximity to construction activities
Pedestrian and Bicyclists	- Six foot shoulders, no separate sidewalk/trail - Wisconsin approach needs to be widened to accommodate six foot shoulders - Not ADA compliant	- Six foot shoulders and a separate ten foot walk/trail - ADA compliant	- Six foot shoulders and a separate ten foot walk/trail - ADA compliant	- Six foot shoulders and a separate ten foot walk/trail - ADA compliant	- Six foot shoulders and a separate ten foot walk/trail - ADA compliant	- Six foot shoulders and a separate ten foot walk/trail - ADA compliant	- Six foot shoulders and a separate ten foot walk/trail - ADA compliant	- Six foot shoulders and a separate ten foot walk/trail - ADA compliant
Structural Redundancy	Retains existing fracture critical river crossing structure	Provides a new river crossing structure with redundancy	Provides a new fracture critical river crossing structure	Provides a new river crossing design that may not be able to be constructed with redundancy	Provides a new river crossing structure with redundancy	Provides a new river crossing structure with redundancy	Provides a new river crossing structure with redundancy	Provides a new river crossing structure with redundancy
Land Use	No change over existing	Potential change to existing land use at the Harbor Marina boat launch and docks	Potential change to existing land use at the Harbor Marina boat launch and dock	Potential change to existing land use at the Harbor Marina boat launch and dock	Potential change to existing land use at the Harbor Marina boat launch and dock	Potential change to existing land use at the Harbor Marina boat launch and dock	Potential change to existing land use at the Harbor Marina boat launch and dock	Potential change to existing land use at the Harbor Marina boat launch and dock
Social/ Community and Economic	Significant travel delays, emergency service response impacts, and loss of economic activity during construction	Minor impacts associated with construction phase	Minor impacts associated with construction phase	Minor impacts associated with construction phase	Minor impacts associated with construction phase	Minor impacts associated with construction phase	Minor impacts associated with construction phase	Minor impacts associated with construction phase

P&N/SEE Factors	Rehab 9040	Tied Arch	Simple Span Truss	Three-Span Truss	Extradosed	Cable-Stayed	Concrete Segmental Box Girder	Steel Box Girder
Noise	No change over existing which has greater potential noise issues compared to the concrete segmental box girder	Greater potential noise issues relative to concrete segmental box girder	Greater potential noise issues relative to concrete segmental box girder	Greater potential noise issues relative to concrete segmental box girder	Greater potential noise issues relative to concrete segmental box girder	Greater potential noise issues relative to concrete segmental box girder	All concrete construction reduces noise and vibration issues	Greater potential noise issues relative to concrete segmental box girder
Water Quality	No treatment; direct discharge into river	All drainage pretreated before discharged	All drainage pretreated before discharged	All drainage pretreated before discharged	All drainage pretreated before discharged	All drainage pretreated before discharged	All drainage pretreated before discharged	All drainage pretreated before discharged
Wetlands	No change over existing	- 0.1 acres of new impact - 0.2 acres restored	- 0.1 acres of new impact - 0.2 acres restored	- 0.1 acres of new impact - 0.2 acres restored	- 0.1 acres of new impact - 0.2 acres restored	- 0.1 acres of new impact - 0.2 acres restored	- 0.1 acres of new impact - 0.2 acres restored	- 0.1 acres of new impact - 0.2 acres restored
Wildlife	-No change over existing	-No differentiating change over existing	-No differentiating change over existing	-No differentiating change over existing	-No differentiating change over existing	- 300 foot tower and cable stays could impact migratory birds	Minor improvement relative to migratory bird traffic given no over deck structure	Minor improvement relative to migratory bird traffic given no over deck structure
Floodplains/ Water Body Modification	No change over existing	- 0.2 acres of new impact - 0.2 acres restored	- 0.2acres of new impact - 0.2 acres restored	- 0.2 acres of new impact - 0.2 acres restored	- 0.2 acres of new impact - 0.2 acres restored	- 0.2 acres of new impact - 0.2 acres restored	- 0.2 acres of new impact - 0.2 acres restored	- 0.2 acres of new impact - 0.2 acres restored
Threatened and Endangered Species	No change over existing	potential mussel impacts pending results of investigation	potential mussel impacts pending results of investigation	potential mussel impacts pending results of investigation	potential mussel impacts pending results of investigation	potential mussel impacts pending results of investigation	potential mussel impacts pending results of investigation	potential mussel impacts pending results of investigation
Section 106 – Indirect Impacts	No change over existing	Competes with and pulls attention away from the river corridor landforms including Barn Bluff	Visually somewhat transparent	Visually somewhat transparent and harmonizes better than the other truss and cable-type structures	Visually compatible with the shape of the river valley and opens up the river view; has a nautical reference	- At 300 feet tall the main tower and cable stays would dominate the setting and view shed - Potential direct impact to Barn Bluff (to be determined)	Lack of structure above the deck therefore doesn't compete as strongly with the setting	Lack of structure above the deck therefore doesn't compete as strongly with the setting; more shallow deck then the concrete segmental box girder; steel could be painted dark to visually slim the deck

P&N/SEE Factors	Rehab 9040	Tied Arch	Simple Span Truss	Three-Span Truss	Extradosed	Cable-Stayed	Concrete Segmental Box Girder	Steel Box Girder
Visual (Non-Section 106 Considerations)	No change over existing	- Retains an over deck structure type - arch is 75 foot at peak compared to existing truss at 50 feet	- Retains an over deck structure type - truss is 70 foot at peak compared to existing truss at 50 feet	- most similar to existing bridge	- substantially different look compared to existing - noticeably thicker structure depth - towers are approximately same height as existing truss	- substantially different look compared to existing - main tower is 240 feet above deck compared to 50 feet for the existing truss	- no over deck structure - noticeably thicker structure depth	- no over deck structure - noticeably thicker structure depth
Construction Cost (2018$)	$67M - $74M	$84M - $97M	$86M - $98M	$106M - $123M	$117M - $128M	$132M - $144M	$78M - $85M	$72M - $82M
Service Life	40 years	100 years	100 years	100 years	100 years	100 years	100 years	100 years