

A decorative banner at the top of the page features a collage of images related to architecture and construction. On the left, there's a view through a window of a modern building with large glass panels. In the center, a construction site is visible with scaffolding and structural elements. On the right, there's a close-up of a metal truss structure. Below the banner, there are three small square images: a wooden fence, a close-up of a green pipe or structure, and a road leading towards a building.

## Part 2 Treatment & Work Recommendations

Historic Preservation Goals & Objectives  
Alternatives  
Work Plan  
Financial Analysis  
Funding Opportunities  
Public Education & Input

## Historic Preservation Goals and Objectives

The historic preservation goals and objectives for this report are intended to guide preservation activities for the Meramec River U.S. 66 Bridge. The objectives include encouraging wide appreciation of the State of Missouri's cultural resources with an overriding mission of achieving supportive public policy and sustainable funding for the historic preservation of this bridge. To meet these needs, greater public awareness and understanding about historic preservation and the connection between economic development and historic preservation must be acknowledged. The following goals and objectives have been established to guide the preservation effort on the Meramec River U.S. 66 Bridge:

**Goal 1:** Encourage appropriate treatment of historic and cultural bridge resources specifically to ensure the integrity and preservation of the Meramec River U.S. 66 Bridge

Objectives: Promote the use of The Secretary of the Interior's Standards for the Treatment of Historic Properties, paying particular regard to The Secretary of the Interior's Standards for Rehabilitation (Appendix A), and the Guidelines for Bridge Maintenance and Rehabilitation based on those standards (Appendix B). Make

available technical information and assistance on caring for historic bridges.

**Goal 2:** Maintain access and a complete transportation network. The existing access and transportation network should be maintained. Because resources are limited, it becomes necessary to prioritize transportation options. Closing part of the network instead of maintaining what already exists will cause decreased mobility in established areas.

Objectives: To promote a protocol that considers preservation before replacement/demolition. Follow a national transportation project selection criterion that recognizes bridge preservation activities.

**Goal 3:** Promote improved safety. Transportation projects should be aimed at increasing safety for all users, including bicyclists, pedestrians and motorists. Safety should focus on continuing to further the multi-modal network making it as complete as possible and continuing to provide access to all users.

Objectives: To emphasize safety in all elements of transportation planning and incorporate the consideration of the context of the bridge for safety enhancements for all funding programs. Enact recommendations

of the Meramec River Greenway Concept Plan for the River Ring that addresses safety concerns. Coordinate regional actions with the AASHTO's Route 66 United States numbered bicycle route. Maintain the interconnected pedestrian network to create a more comfortable, less intimidating pedestrian environment.

**Goal 4:** Increase public awareness of the value and importance of the Meramec River U.S. 66 Bridge as one of Missouri's significant historic resources.

Objectives: Outline a viable, coordinated, preservation education outreach program. Increase the visibility of historic bridge preservation through historic preservation organizations. Encourage interpretation of this historic site to educate the public on a broader approach. Support the development of elementary, secondary, and post-secondary programs that teach about Missouri's historic bridges as important resources. Improve awareness of and access to historic preservation information. Encourage accuracy of information about local historic bridges, places and sites.

**Goal 5:** Provide incentives to encourage historic preservation as an economic driver.

Objectives: Promote historic preservation as a successful economic development tool to maintain, enhance, and revitalize communities and to promote tourism. Seek funding from state and national sources to assist with preservation of historic properties. Support efforts to establish tax

incentives at local and national levels for preservation of historic properties. Encourage establishment of incentive programs in the private and non-profit communities. Endorse special initiatives of agencies at local, state, and national levels for historic resources.

**Goal 6:** Enhance economic development. Transportation should be used to spur economic development, specifically taking advantage of tourism opportunities related to U.S. Route 66. Efficient transportation systems that are aesthetically pleasing can help spur economic development.

Objectives: To consider impacts on and opportunities for economic development in plans and projects. Create a "tool box" of economic enhancement techniques for transportation facilities.

**Goal 7:** Encourage consideration of historic bridges in the planning and decision making processes of the public and private sectors. Transportation facilities should not diminish neighborhood character and safety; bridges should be viewed as places, part of the neighborhood, not a separate entity.

Objectives: Review development projects to assure all reasonable steps are taken to protect cultural resources. Review emergency response laws and plans so that bridges receive maximum protection in the event of a disaster. Promote local preservation program efforts to maintain and enhance the community's character. Promote the incorporation of preservation issues in

plans. Review Regional Transportation Plans for multi-modal connectivity that is conscious of “smart growth” philosophies.

**Goal 8:** Develop awareness of impacts to the region’s natural environment and historic bridge heritage resulting from transportation planning processes, projects and programs.

Objectives: To review regional planning processes, projects and programs for positive and negative impacts on the natural environment and historic heritage. Address the transportation component of current planning initiatives with regard to the Meramec Bridge’s environment, such as watershed management, recreation planning, and historic preservation.

**Goal 9:** Form new partnerships to expand and strengthen the historic preservation community.

Objectives: Support and strengthen local historic preservation efforts. Encourage historic groups to identify concerns and develop strategies to protect the bridge as a cultural resource. Encourage nonprofit statewide organizations, to promote historic preservation. Foster stewardship of cultural resources by land owners, private individuals, groups, and public agencies. Use emerging technologies to improve communication among organizations and individuals interested in historic preservation.

## Alternatives

### Transfer of Ownership

In order for the Meramec Bridge to remain standing, a transfer of ownership must occur. Because this is fundamental to any discussion of the future use of the bridge, it is presented here as a reference for potential interim or permanent owners to consider in conjunction with the alternatives that follow. The information contained below may act as a guide to the challenges and questions that arise during a transfer of ownership transaction.

#### Transfer Agreement

In accordance with applicable laws, rules, and regulations, it may be possible to transfer a historic bridge from Missouri Department of Transportation (MoDOT) to a new owner. A transfer agreement should specify the parties involved in the transfer and should transfer the responsibility for maintenance and operation to the new owner. Although specific items to include in the agreement should be considered on an individual bridge basis, it may be appropriate to consider the following for the Meramec River U.S. 66 Bridge:

- Special requirements for the reuse of the bridge (e.g., pedestrian railing geometry and capacity restrictions).
- Scope of work to be performed on the bridge, including modifications, restoration, and/or preservation, and the party responsible for such work.
- Description of any new construction needed to accommodate the Bridge at its current location or at a new site, and the party responsible for such work.
- Any environmental clearances or permits required.
- Details of funding provisions, if any.
- Schedule for completing the bridge relocation and rehabilitation.
- Provisions relating to the transfer of any real property associated with the bridge in its current or new location.
- Disclosure of hazardous material, and/or implementation of a survey to determine if the bridge includes products such as lead-based paint or asbestos.
- Transfer of existing records including design, construction, and maintenance records.

### Right-of-Way Issues

Right-of-way issues are relevant for the Meramec River U.S. 66 Bridge because access to the Bridge is currently provided by a public road on public right of way. Any transfer of bridge ownership should bear in mind access to the structure for the new owner as well as intended users. This access is essential for use and for maintenance of the structure. For situations in which the transfer of on-site ownership is the preferred disposition of the structure, the successful transfer of the structure is dependent on the ability to ensure that the new owner of the bridge has access to it and that access is controlled by the disposition of the right-of-way approaches.

The statutory basis for highway right of way is described in the Missouri State Statues,

Section 226. Highway right of way in Missouri is owned by MoDOT through fee simple ownership or a prescriptive easement. Primary routes are generally held in fee simple (absolute ownership, without limitation or condition). Most secondary roads are on prescriptive easement (the right, acquired through long-continued use, to use or control property owned, usually in fee simple, by another).

The majority of Missouri's secondary roads began as county roads, a system that dated from the days of earliest settlement and remained in place until the creation of the

## ROAD RIGHT OF WAY



state roadway system. In Missouri, the prescriptive easement for secondary roads is usually a right of way of 30 feet, which was the statutory width for county roads constructed prior to the creation of the state secondary system.

According to the Code, highway right of way is disposed through either abandonment or discontinuance, actions that have different results depending upon how the right of way is held.

Abandonment not only “extinguishes” the public right of way, it also returns the underlying property to the full control or ownership by the private sector. If the right of way is a prescriptive easement, the property automatically reverts to the “owner of the fee,” usually the adjacent property owners, upon abandonment. Abandonment of right of way owned in fee simple, however, results in the formal transfer of ownership by deed. In contrast, discontinuance extinguishes the use of the property as a highway but the land remains a public right of way regardless of how it is owned. Procedures for abandonment and discontinuance of right of way are defined in the Missouri State Statutes.

The transfer of ownership or responsibility for an historic bridge on its original location is influenced by the manner by which the approach right of way is held and the method by which it is disposed. If the approaches to the bridge are owned in fee simple, the approach right of way can be transferred to a private owner by deed. For situations in which the access of other private property owners must be maintained

along a fee-simple right of way, the approach could be retained by and access to the bridge could be ensured by an agreement or land-use permit. Approach right of way used by prescriptive easement, however, could make transfer of bridge ownership difficult. Abandonment of prescriptive right of way would return use of the property to the “owner(s) of the fee,” and access to the bridge would be extinguished. Discontinuance of an approach used by prescriptive easement would ensure that the successor owner of the bridge has access to it. That access, however, could not be controlled or limited since the approach would remain a public way.

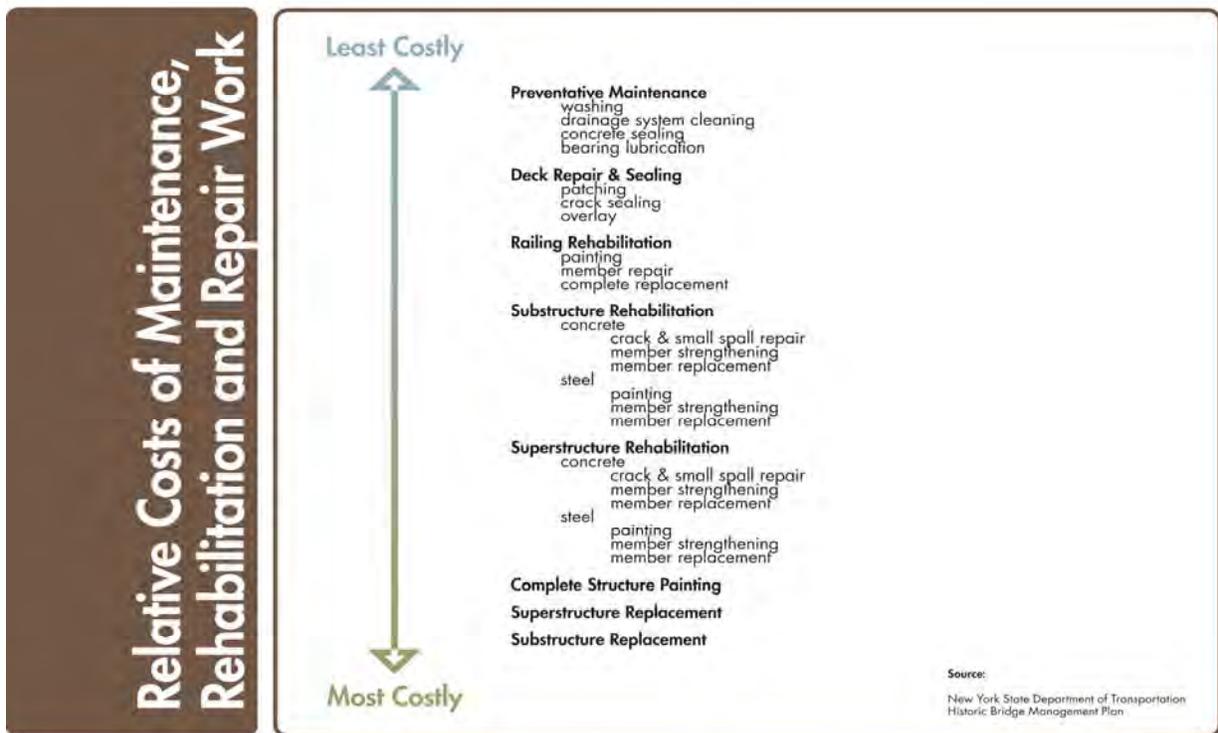
## Rehabilitation

The Meramec River U.S. 66 Bridge is a good candidate for rehabilitation because it not only satisfies a transportation need, but it completes the transportation network, making a critical connection across the Meramec River. The connection completes the vehicular travel network by providing a link that enhances the viability of the Route 66 Park and adds to the Route 66 experience in Missouri. This is important for this bridge because of the significance of its connection with Historic U.S. Route 66, and the automobile. The bridge also completes the multi-modal transportation network connecting hundreds of miles of trail with the river crossing.

## Considerations for Maintenance and Maintaining Historic Integrity

For the Meramec River U.S. 66 Bridge, as with many historic bridges, the focus of maintenance and rehabilitation work should be on maintaining the historic integrity of the bridge. To meet this objective, maintenance and rehabilitation work should be conducted using the Secretary of the Interior’s Standards for Rehabilitation in Appendix A. The figure shows relative costs of maintenance, rehabilitation, and repair work that contribute to the preservation of historic bridges.

With rehabilitation, the Meramec River U.S. 66 Bridge can fulfill a transportation need.



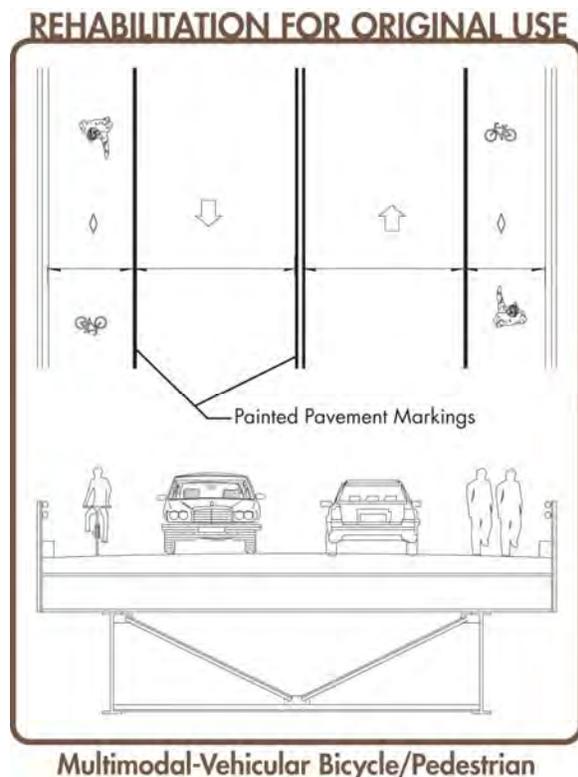
Because many historic bridges were designed with narrower roadway widths and lower load limits, they often have difficulty meeting current design standards. Federal and state policies recognize that existing bridges with less than desirable geometric criteria (width, horizontal and vertical alignments) can be retained. The Meramec River U.S. 66 Bridge is unique in the fact that the approach alignment, bridge width and vertical clearance are adequate to meet the current design standard criteria.

### Rehabilitation of Structural Components

From the findings and analysis of the Meramec River U.S. 66 Bridge, the major items of work that are needed to maintain vehicular and pedestrian use include:

#### Superstructure

The superstructure may be repaired, but cannot be replaced without detrimental effects on the historic bridge. The superstructure of the Meramec River U.S. 66 Bridge is one of the character-defining elements of the historic bridge. The elements of the bridge that are deteriorated may be repaired or replaced as needed. The repair or replacement of these elements should be performed in a manner that preserves the original appearance of the element. Some of the options available are present in Appendix C – Examples of Superstructure Work – offers suggestions for work that may be done to rehabilitate or repair the Meramec River U.S. 66 Bridge.



For this Bridge the primary concerns are the deterioration and section loss which has occurred in the bottom chords of the trusses near the ends. The figure below shows how this issue can be addressed by strengthening the member with angles. The angles act provide additional steel area to the location where rusting has caused section loss. This approach could also be used on the vertical members at the ends of the truss as well. No other rehabilitation is anticipated for other truss members. Some repairs to bracing and other miscellaneous members may also be necessary.

## BOTTOM CHORD REPAIR



The other superstructure component to be replaced is a number of the floor beams have experienced severe deterioration and some form of buckling or cracking. These floor beams would be replaced with new floor beams. It is anticipated that approximately 25% of the floor beams would be replaced.

## Bearings

While rehabilitating the bridge, it is important to service the bearings. No major repairs are expected. This work would consist of replacing missing nuts, cleaning any pack rust that has collected and cleaning any debris which has accumulated in these locations.

## Substructure

The deficient substructure for this bridge can be repaired and/or rebuilt without detrimental effects on the historic bridge. For this bridge, the substructure is not a character-defining feature of the historic bridge. This is typically the case for types with a substructure that is not integral with the Superstructure.

The substructure repairs would consist of removing unsound concrete on the columns and the caps to sound material, cleaning, replacing reinforcing steel and forming the area to receive new concrete. This work would be consistence with work which has been done on the bridge in the past.

## Traffic Railing

There are some portions of the railing system that are in need of repair and/or replacement. For this bridge, the railing is attached to the floor beams, thus it is integral with the superstructure. Special consideration must be given toward



maintaining the bridge's historic integrity under these circumstances.

The railing would be reused to the maximum extent possible and where necessary replaced with similar material.

#### Deck

The deck of the bridge is in very poor condition and is in need of replacement. It has been accepted that a deficient deck can often be replaced without detrimental effects on the historic bridge. To reduce a bridge's dead load, it may be possible to replace the deck with a deck of lighter weight.

The rehabilitation of the bridge would include full removal of the bridge deck. This would allow for the replacement of the floor beams. Then, a new deck could



be poured. It is recommended that use of lightweight decking material, such as carbon fiber composite material, or various light-weight concrete systems for deck replacement be considered. As previously discussed, the deck uses a lot of the capacity of the bridge which is replaced with a light-weight deck could provide additional capacity for live load (vehicular loads).

#### Other Alternative Uses

When a historic bridge cannot meet a vehicular transportation need, other uses for the bridge should be considered. Other uses of the historic bridge at the existing site or at a new site may be considered preservation

options if a viable alternate use for the bridge can be found. Most important to the bridge is prioritizing alternatives that first preserve the location and historic integrity of the bridge to the greatest degree possible.

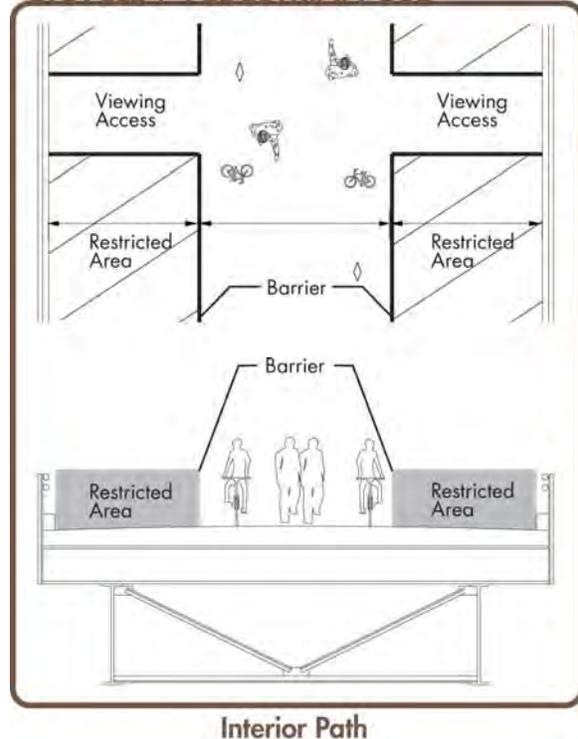
It is recognized that the reuse of a bridge at the existing location is preferred if it does not have an adverse effect or if there is no longer a transportation need at the site. However, this is not the case for the Meramec River U.S. 66 Bridge.

If the bridge cannot be rehabilitated, the bridge could remain in place, but no longer carry traffic. Another option is to reuse the bridge at a new location. This may be possible if an appropriate location and willing new owner can be found. It has been discussed that the bridge or portions of the bridge could be placed in the Route 66 State Park, providing visitors the opportunity to experience the structure as a monument. Analysis of the feasibility of reuse options should be done on an individual project asis. However, some considerations for reuse options are provided below.

### Bicycle/pedestrian traffic

Since the bridge is on an established bicycle/pedestrian route, it may be possible to carry non-vehicular traffic across the historic bridge. In considering this option, much of the same work as recommended for both vehicular and pedestrian/bicycle traffic

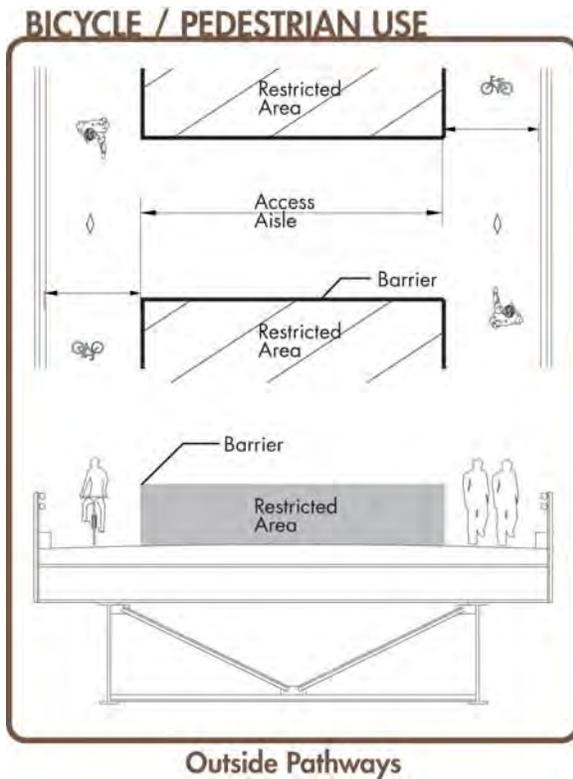
### BICYCLE / PEDESTRIAN USE



would still be required. There could be some advantages realized with this alternative if the pedestrian traffic is restricted to a 12-foot pathway. The figures below show two alternative layouts which could provide this type of configuration.

See the Structural Evaluation section of this HSR for more information on the loading restrictions for this alternative.

With the interior path, light maintenance and emergency vehicle access could also be provided.



### Recreational viewing platform

Another unique opportunity with this bridge would be to provide a viewing point for adjacent natural or man-made features that exist along this stretch of the Meramec River and are of interest to the local population and tourists.

### Fishing pier

Under certain circumstances a bridge may be reused for a fishing pier. This would be difficult at this location, primarily due to the height of the structure above the Meramec

River. However, provisions could be made to incorporate access from the bridge via a ramp or stairway to a lower elevation closer to the river.

### Adapt as building

In some cases, a bridge may be adapted to serve a new role. Portions of the bridge could be converted to a building, such as a store or museum. This type of adaptive reuse may be eligible for Transportation Enhancement (TE) funds for museum development, for instance, if the museum is tied to a transportation theme.

### Superstructure Replacement

Although the Secretary of the Interior's Standards for Rehabilitation (Appendix A) calls for the continued use of historic bridges, in cases where this is not feasible, selection of a new superstructure of the same basic type may be appropriate. For example, a historic truss could be replaced with a newly constructed truss. It is recommended that the new bridge be similar in scale and type to the one it replaces.

### Build a New Bridge from Salvaged Pieces

In select cases, it may be possible to reuse elements of a historic bridge on a newly constructed bridge, allowing some of these components to be preserved by use on the new structure. This could occur with a new bridge at this location or an alternate location.

## Stabilize and Close

Another consideration for evaluation is that if the bridge does not fulfill a transportation need at the site and it is not feasible to relocate the bridge to a new site due to structural limitations, lack of funding, inability to identify a viable new owner, it may be possible to close the bridge to traffic, stabilize the bridge, and leave it standing. In this situation, certain measures would need to be adopted to reduce liability and to monitor the condition of the bridge. Minimal maintenance (washing and spot painting) and periodic inspections should continue. The bridge closure should be clearly posted and a vehicle barrier should be installed to limit pedestrian and vehicle access to the bridge. In addition to prolonging its life, removal of the bridge deck may also be appropriate as a means of limiting access to the structure.

## Monument

All or part of a bridge may be relocated to a public access location to serve as a monument to engineering and/or cultural heritage. Some bridges have been converted into historical exhibits in public parks.

## Move to private property

Occasionally, new owners are interested in moving a bridge to their private property. Bridges can be used on a private road or driveway to span a creek, or as a commercial draw for economic benefit.

## Work Plan

The Meramec River U.S. 66 Bridge is a unique community resource. It is historically significant at the local, state and national levels and retains a very high degree of integrity. The bridge derives this historical significance from its place within the rich history of U.S. Route 66 and its contribution to American society. The Meramec Bridge's age has not lessened its value in that it remains an exceptional artistic and community accomplishment. However, as indicated in the structural evaluation, the bridge must be repaired to address the deferred maintenance issues and be placed back into service.

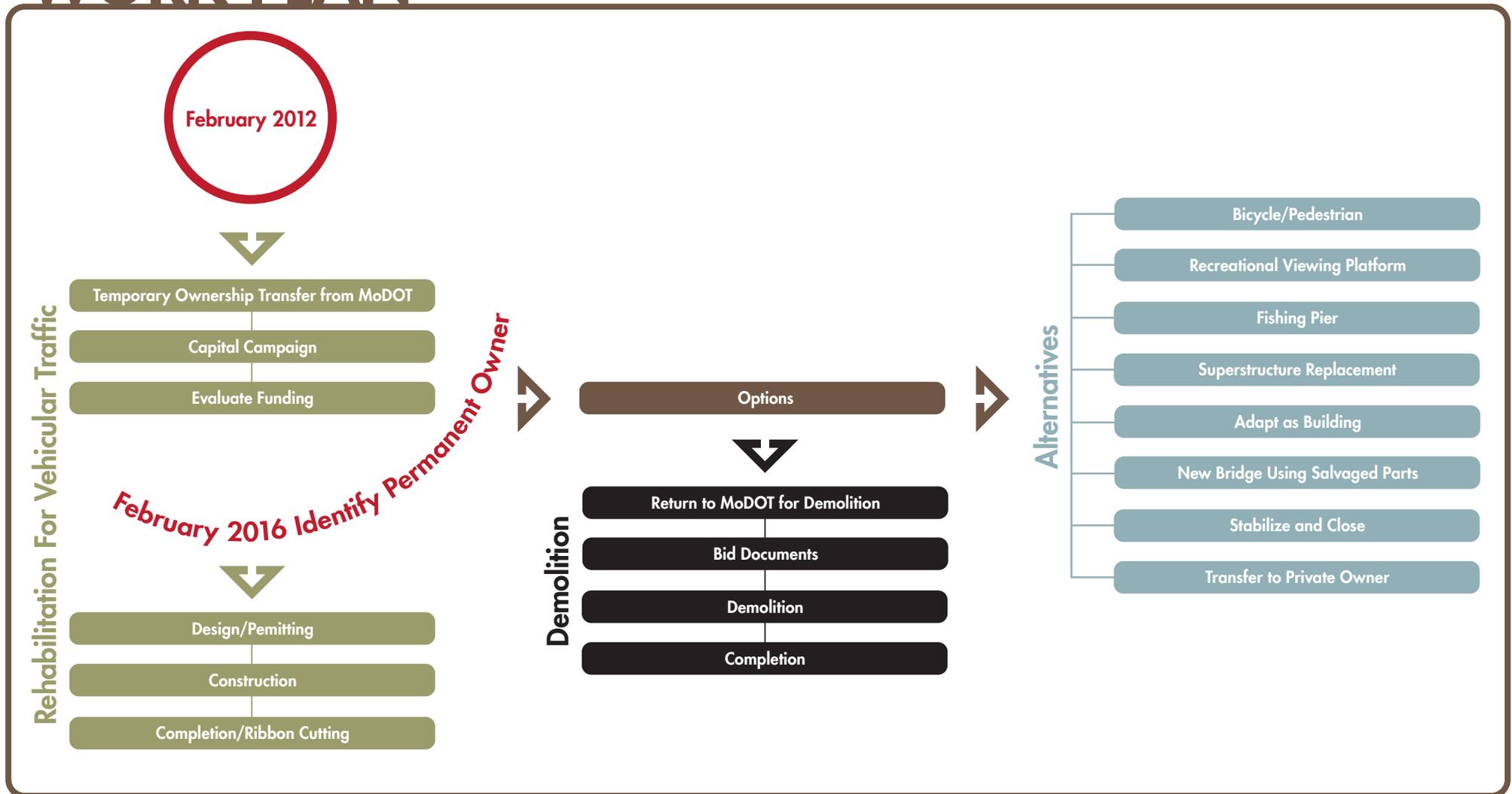
The work plan presented here is intended to outline the timeline with regard to the transfer of ownership that must occur in order to preserve the bridge for future generations. In summary, ownership, temporary or permanent, of the Meramec River U.S. 66 Bridge must be transferred from Missouri Department of Transportation (MoDOT) by February 2012. A temporary owner can hold the bridge for a maximum of four years, until February 2016, at which time either the bridge must be transferred to a permanent owner, or returned back to MoDOT for demolition.

According to MoDOT, from February 2012, a temporary owner would have four years to

raise funds through capital campaign, donations or grant applications, etc. Additionally, MoDOT has set aside \$600,000 in funds they have earmarked for the bridge. The agency has indicated that these funds can be used by the new interim or permanent owner on the rehabilitation of the bridge, or if a new owner is not found, the funds will be used to tear the bridge down.

If a new owner raises funds, the money raised would go toward the rehabilitation of the bridge or toward the pursuit of an option for one of the other alternatives shown on the graphic work plan following this page. The alternatives are also described in the section of this Report entitled *Alternatives*. All of the alternatives listed in the work plan will require repairs that can be accomplished in such a way so as to retain some of the integrity of the Meramec Bridge and all will take varying amounts of time to accomplish.

# WORK PLAN



## Financial Analysis

### Qualifier Statement

The opinions of probable costs provided below have been prepared in 2011 dollars. The costs were developed without benefit of preliminary construction plans and are based on the findings included in this report. Using engineering judgment and/or gross estimates of quantities and historic unit prices from past project bid tabulations and are intended to provide a programming level of probable costs.

Refinement of the probable costs is recommended once more detail from preliminary plans has been developed. The estimated preservation costs include a 20% contingency and 7% mobilization allowance for the preservation activities, excluding soft costs. Actual costs may vary from the opinion of cost provided herein.

### SUMMARIZED COSTS

#### Annualized Routine Cost:

Maintenance Cost:	\$	10,000
Trim/Remove Vegetation:	\$	2,000
\$10,000 every 5 years		
Fracture Critical Inspection:	\$	10,000
Load Rating Analysis	\$	2,000
\$10,000 every 5 years		
Insurance:	\$	10,000
Administration:	\$	5,000
<b>Total Annualized Cost</b>	<b>\$</b>	<b>39,000</b>

#### Rehabilitation Activities (Not Annualized):

• Superstructure:	\$	5,516,410
• Substructure:	\$	280,000
• Deck:	\$	1,199,520
• Mobilization:	\$	623,000
• Other:	\$	415,000
• Design/Construction Service	\$	1,523,000
• Contingency	\$	1,482,000

**Rehabilitation Cost: \$ 11,038,930**

**OPINION OF PROBABLE CONSTRUCTION COST**

ENGINEER: GRA                      DATE: 11/14/2011  
 LOCATION: Meramec River Bridge - Route 66  
 PRIMARY REPAIR STRATEGY: Rehabilitation

BRIDGE LENGTH: 1,008.0 FT  
 DECK DIM: 31.5 FT

STRUCTURE ID: J0421

STR. TYPE: Deck Truss and Steel Beams

WORK ITEM	QUANTITY	DIMENSION	UNIT COST	TOTAL
<b>NEW DECK</b>				
Removal of Existing Bridge Deck	31,752.0	SF	\$10.00 /SF	\$317,520.00
New Deck	3,528.0	SY	\$250.00 /SF	\$882,000.00
<b>SUPERSTRUCTURE REPAIR</b>				
Removal of Expansion Joints	504.0	LF	\$250.00 /LF	\$126,000.00
Replace Expansion Joints	504.0	LF	\$420.00 /LF	\$211,680.00
6" Pavement Markings	120,960.0	LF	\$0.50 /LF	\$60,480.00
Rehabilitating Bearings	8.0	EA	\$7,500.00 /EA	\$60,000.00
Replace Floor Beams (25 beams)	58,400.0	LBS	\$15.00 /LBS	\$876,000.00
Replace/ Repair Truss Lateral Bracing	100.0	LBS	\$100.00 /LBS	\$10,000.00
Repair Gusset Plates	28.0	EA	\$25,000.00 /EA	\$700,000.00
Plate Web of Verticals	1,000.0	LBS	\$15.00 /LBS	\$15,000.00
Repair Bridge Railing	350.0	LF	\$75.00 /LF	\$26,250.00
Surface Preparation for Recoating Structural Steel	94,000.0	SF	\$25.00 /SF	\$2,350,000.00
Field Applied Inorganic Zinc Primer	94,000.0	SF	\$5.00 /SF	\$470,000.00
Intermediate Field Coat (System G)	94,000.0	SF	\$3.00 /SF	\$282,000.00
Finish Field Coat (System G)	94,000.0	SF	\$3.50 /SF	\$329,000.00
<b>SUBSTRUCTURE REPAIR</b>				
Substructure Repair	2,000.0	SF	\$140.00	\$280,000.00
<b>MISCELLANEOUS</b>				
Trim and Remove Vegetation	1.0	LS	\$15,000.00 LS	\$15,000.00
Scour Countermeasures	1.0	LS	\$100,000.00 LS	\$100,000.00
Enhancement	1.0	LS	\$250,000.00 LS	\$250,000.00
<b>TRAFFIC CONTROL</b>				
Traffic Control	1.0	LS	\$50,000.00 LS	\$50,000.00
CONTINGENCY (20%)	20.0	%	\$7,411,000.00	\$1,482,000.00
MOBILIZATION (7%)	7.0	%	\$8,893,000.00	\$623,000.00
DESIGN & CONSTRUCTION PHASE SERVICES (16%)	16.0	%	\$9,516,000.00	\$1,523,000.00
<b>CONSTRUCTION TOTAL</b>				<b>\$11,039,000.00</b>

## Funding Opportunities

The majority of funding for the rehabilitation and reuse of historic bridges is available through Federal Highway Administration (FHWA) federal funding programs. The legislation authorizing the various federal funding programs is named the Safe, Accountable, Flexible, and Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). The SAFETEA-LU available funding programs and the applicability of those different funding programs are discussed below.

The current status of Federal Highway Program funding is given below. This information is important to understand, because without having a well defined Federal Highway Program and funding, it becomes difficult to establish a clear path of potential funding and opportunities for Federal and State participation.

Since the current highway law (SAFETEA-LU) expired on Sept. 30, 2009, the highway program has been operating under a series of eight short-term extensions. The uncertainty surrounding reauthorization has hit the transportation system hard. Without a clear sense of what resources will be available for future investment, states have not been able to plan major new projects.

In December 2009, as a part of the much larger FY2010 Defense appropriations bill, President Obama signed into law another short-term extension of SAFETEA-LU programs and funding. Unless the White House, the Senate and the House give priority to this matter, a long-term highway bill authorization will be put off until 2012 or beyond.

Recent highway program extension expiring on March 31, 2012, the House and Senate have yet to introduce highway reauthorization legislation.

It has been discussed that a multiyear surface transportation reauthorization bill will be introduced "in the coming weeks" and "hope to move the legislation through the House before the end of the year". The bill is expected to provide funding levels to be at or above current levels.

Numerous proposals have been discussed publically. House Transportation and Infrastructure Committee Chairman John Mica, R-Florida, had been under instruction from House leadership to limit a six-year reauthorization bill to funding levels that could be supported by existing revenue into the Highway Trust Fund. That would result in a cut of roughly one-third in federal highway and transit spending compared to

the current annual level. Mica has since discussed keeping the prior six-year funding level.

While the Senate Environment and Public Works Committee has to mark up a two-year surface transportation reauthorization measure. The legislation would authorize highway and transit spending of \$109 billion for the two-year period.

### **National Highway System Funds**

These funds are available for work on the National Highway System (NHS). NHS funds may be obligated for any of the following projects:

- Bridges undergoing a rehabilitation that includes improvements for bicycle and pedestrian use.
- Construction, reconstruction, resurfacing, restoration, and rehabilitation of segments of the NHS.
- Operational improvements for segments of the NHS.
- Construction of, and operational improvements for, a federal-aid highway not on the NHS.

### **Highway Bridge Replacement and Rehabilitation Program Funds (HBRRP)**

HBRRP funds are available to replace or rehabilitate deficient or functionally obsolete

bridges if certain criteria are met. FHWA also allows HBRRP funds to be used for preventive maintenance.

HBRRP funding typically provides an 80% federal contribution to a bridge project, with the additional 20% matched by the state and/or local government. If the project is not state sponsored, the additional 20% is the local government's responsibility. HBRRP funds may be used to rehabilitate a historic bridge either for continued vehicular use or for non-vehicular use. If a bridge is not being retained for vehicular use, certain limitations apply.

#### **1. Rehabilitation for Vehicular Use**

If a historic bridge can still meet a transportation need, HBRRP funds may be applied when planning a rehabilitation project.

According to FHWA guidance, preventive maintenance on federal-aid highway bridges is eligible for funding under the HBRRP if the state demonstrates to the satisfaction of the Secretary of Transportation that the activity is a cost-effective means of extending the bridge's useful life.

#### **2. Rehabilitation for Non-Vehicular Use**

HBRRP funds for non-vehicular use are not to exceed costs of demolition as per Title 23 Section 144(o) of U.S. Code, "Historic Bridge Program." Federal funds are available pursuant to Title 23, Section

144(o) for the rehabilitation of historic bridges for non-vehicular use. If the bridge is no longer carrying motorized traffic, money is available up to the cost of demolition of the bridge. It is important to note that use of these funds precludes future use of Transportation Enhancement (TE) funds for work on the bridge. On reuse projects, SAFETEA-LU (and successor funding) funds can and should be used prior to the use of HBRRP funds. The use of TE funds and Successor Funds is discussed below:

#### **Use of Transportation Enhancement (TE) Funds (and Successor Funding)**

The Federal Government has historically set aside 10% of a state's federal transportation dollars for transportation enhancement projects. Funds are available through the TE program for historic preservation activities, including bridge rehabilitation.

TE funds can be used to rehabilitate historic bridges for both vehicular and non-vehicular uses. Unlike HBRRP funding, the use of TE funds does not preclude the use of other federal funding. For project planning purposes, use of these funds prior to an application for HBRRP funds will maximize the federal assistance for rehabilitation of a historic bridge.

The SAFETEA-LU program, like HBRRP, includes 80% federal funding with the remaining 20% a mixture of state and local funds. Local governments have the option of contributing their match in local dollars,

otherwise referred to as a "hard" match. A "soft" match option allows local governments to provide their portion of funding through three alternate methods:

- They can choose to provide their portion of the match by applying other federal funds, such as Housing and Urban Development or Environmental Protection Agency money.
- They can use a non-FHWA-funded transportation-related expenditure, such as a storm sewer upgrade, as the match.
- The value of local and state government services, materials, and land utilized for the project and the costs of preliminary engineering prior to project approval may be credited to the state and local match.

#### **Capital Campaigns, Deferred Gifts and Endowments**

Other options to gaining funds for the Meramec River U.S. 66 Bridge include conducting a capital campaign to raise funds for the Bridge.

A capital campaign raises money that will be spent to acquire or improve a physical asset, in this case the Meramec River U.S. 66 Bridge. The purpose of a capital campaign for the Bridge would be to raise funds to be spent on the one-time expenditure of rehabilitation.

The capital campaign should set a goal to raise the amount of money projected for the construction costs as well as to cover some of the expenses incurred to conduct the campaign. The capital campaign should be targeted as a large-donor campaign. In that regard, the following rule of thumb applies: Plan on raising at least one-third of the goal from 10 to 15 donors, a second third from an additional 75 to 100 donors, and the final third from the rest.

Because they rely heavily on large gifts to raise a substantial amount of money, capital campaigns draw their volunteer leadership and solicitors from the upper end of a community's business and civic leadership. The high visibility of a capital campaign raises the stakes considerably. Few situations are more damaging to the image of an organization than announcing the planned construction of a project and then failing to raise the money to get it done.

Though a capital campaign will likely run longer than an organization's annual campaign, it should usually be wrapped up within a year, eliminating the risk of carrying over into successive annual campaigns. Ideally, the money to pay for the bridge rehabilitation should be in hand before the ground-breaking for the project. On the other hand, a ground-breaking is often an effective fund-raising event, and taking prospective donors to a construction site or showing them the Bridge may be particularly compelling.

Capital campaigns often offer naming opportunities. In the case of the Meramec River U.S. 66 Bridge, some creativity would need to be applied if naming rights were considered. Typically, a donor need not necessarily cover the entire expense of a capital project in order to be offered a naming opportunity. When a potential donor is considering making a gift that is far and away the largest donation to a capital campaign and when that gift is truly a substantial portion of the total expense of construction, then offering naming rights may be both appropriate and persuasive.

Another kind of gift that could be solicited during a capital campaign is in-kind goods and services. Although organizations would generally rather have cash than any other kind of gift, capital campaigns are one of the few instances where there is no difference between cash and in-kind gifts. It is important to give public credit for the cash value of an in-kind gift. The IRS won't let the donor deduct that amount, but public acknowledgement of what the gift was worth to the organization, what it would have cost "retail" should be cited.

During a capital campaign for the Meramec River U.S. 66 Bridge, cash gifts should be encouraged over deferred giving since the money being raised is money that needs to be spent on improvements in the near future. While the offer of a deferred gift poses no problem other than timing to those seeking to build an organization's endowment fund, fund-raisers seeking cash for the capital

project should be ready with a plan for accepting deferred gifts.

There may be a way to turn a deferred gift into endowment funds to help with the future expense of maintaining the Bridge. The primary difference between capital and endowment funds is that capital funds are not retained and invested to yield income like endowment funds. Endowment funds can be raised, held and invested to cover ongoing, operational and maintenance expenses, or to fund special projects for the Bridge. Building an endowment for the Meramec River U.S. 66 Bridge reduces the pressure on future annual campaigns to raise the additional operating and maintenance money that will be needed to maintain the Bridge.

An organization which undertakes an endowment campaign does so in order to lessen its need either to raise money each year to cover any operational deficit, or to raise money for occasional extraordinary expenses. Income earned on money placed in an endowment fund is restricted to the purpose of that fund, and the fund is not easily invaded. Usually, an organization's bylaws make it hard, if not impossible, for the organization to spend endowment.

Since the money being raised in an endowment campaign is to be invested for future income, the goal should never be small. The effort required for an endowment campaign is too great to justify a result that

when invested will yield only a few thousand dollars of yearly income.

The base for any successful fund-raising campaign is an attainable goal, a plan for getting to that goal, and the tools to execute that plan. But in the end, the success or failure of a fund-raising campaign hinges on leadership, and that leadership starts with a plan of action.

Raising funds to rehabilitate the Meramec River U.S. 66 Bridge is about more than money. It is about preserving history, protecting American heritage, maintaining the transportation network, serving people and many other worthy causes. It is easy to understand that the concern to raise the funds to get the project accomplished often becomes the front and center issue and discussions center on dollars. But, we must never let the need for money obscure, or put too far into the background, the reasons the project should be accomplished.

## Public Interest and Benefit and Educational Opportunities

### PUBLIC INTEREST AND BENEFIT

The June 2011 Federal Highway Administration (FHWA) monthly newsletter, *Successes in Stewardship* states, “Historic bridges enhance a community’s character and are an important part of the United States’ transportation infrastructure. Historic bridges can provide particular benefits to communities. Planners and transportation officials note that historic bridges often have unique and context-sensitive designs, fostering a sense of place as a monument to a community’s history. Additionally, historic bridges are typically narrower than newer bridges and therefore can function as traffic-calming devices, as drivers tend to reduce speeds in narrower lanes. Residents and business owners often express appreciation for how historic bridges reduce traffic speed, especially when bridges serve as gateways to community centers. Preserving historic bridges can also provide environmental and economic benefits; agencies can reduce waste and yield significant cost savings by rehabilitating instead of replacing historic bridges.”

The FHWA clearly recognizes the importance of historic preservation of bridges like the historic Meramec River U.S. 66 Bridge. The benefits stated in the excerpt from the article above are only a few of the

benefits to the public. In the case of the Meramec River Bridge, the impact reaches much further than the immediate surrounds. Because the bridge is an intrinsic resource for U.S. Route 66, the impact of this bridge is international in nature. The bridge is irreplaceable to the 250,000 annual visitors to the Route 66 State Park, and though there is an understanding by those most familiar with the bridge, broader public education and input is necessary to continue to spread the word.

A primary goal of an ongoing public education and input process is for it to serve as a central component of the planning, priority-setting, development, and dissemination system for the Meramec River U.S. 66 Bridge. These public processes allow for understanding and responding to complex problems and situations. By harnessing the collective wisdom of people who are stakeholders in the situation, critical needs can be identified and priorities can be developed.

A grant from the National Trust for Historic Preservation helped to fund the development of a public education campaign. The Meramec River U.S. 66 Bridge was identified as a preservation project through a program launched as “Show the Love” for

the Meramec River Route 66 Bridge. This campaign is promoted through a website developed during the course of the project: <http://meramecriverrt66bridge.greatriv.com/> provides a historical overview, educational talking points, and a connection to stakeholders, the public, and all interested parties. Additionally, the website promotes fund-raising and marketing materials. In great part the public education campaign heightened awareness and laid the groundwork for this Historic Structure Report for the Bridge funded in part by the National Park Service's Route 66 Preservation Program.

The "Show the Love" Campaign educates and engages the public in historic preservation efforts in an effort to raise community, regional and national awareness



of the importance of the Meramec River U.S. 66 Bridge as well as providing an outlet for donations for funds to save the bridge from demolition. In addition to education, the website provides a mechanism for collecting ongoing public input. Both public and private stakeholders have an opportunity to log opinions and ideas for the preservation of this historic resource. The website stimulates community interest to

take action and serves as an educational conduit to demonstrate the importance of preservation of our historical community and national resources.

While the Meramec River U.S. 66 Bridge is the subject of this report, there are many other historic bridges in Missouri that can benefit from public education and input strategies. As part of the effort to ensure that Missouri's historic bridges have the best possible chance of survival, outreach programs can be established to encourage maintenance, rehabilitation, and reuse of historic bridges. Education and outreach for bridge owners, design professionals and other decision-makers (e.g., local government officials) will help to raise awareness for the options available for retaining these bridges. The maintenance, rehabilitation, and reuse of historic bridges should be promoted at different venues in order to reach bridge engineers, design professionals, decision-makers, and contractors. The following programs and concepts highlight some of the most viable opportunities for educating the public and gathering input and insight on historic preservation of bridges.

### Local Roads Program

The Local Roads Program is a center established by FHWA's Local Technical Assistance Program. The program provides training, technical assistance, and information to municipal officials and employees responsible for the maintenance,

construction, and management of local roads and bridges in Missouri. Services provided by the Local Roads Program include:

#### Training programs

The primary service offered by the Local Roads Program is training targeted to all highway and public works agencies in Missouri by direct mailings. Training courses on a variety of technical and management topics are offered to accommodate the needs of highway personnel and other municipal officials. Currently, the Program does not offer a course focusing on historic bridge issues.

#### School for Highway Superintendents

The School is offered annually and features short sessions of general interest as well as specialized workshops.

#### Technical Assistance Program

The program's Technical Assistance Administrator can provide technical assistance relating to pavement maintenance, drainage, road rehabilitation, and administrative topics. Referrals to someone qualified to address specific issues can also be provided.

#### Library Resources

The information library is composed of publications, videotapes, computer

software, and CD-ROMS from a variety of sources on numerous topics. Materials are available to local highway and public works officials and municipal employees, either free of charge or by loan.

#### Conferences

Conferences provide an opportunity for owners, design professionals, and other decision-makers (e.g., local government officials) to exchange ideas on successes, failures, and emerging technologies available for bridge maintenance and rehabilitation projects. The most relevant conference sessions presentations should highlight maintaining and rehabilitating historic bridges in the state and should offer guidance to local governments as they pursue options to retain their historic bridges.

In Missouri some of the most significant conferences providing opportunities for relevant information include:

Transportation Engineers Association of Missouri (TEAM) Conference promotes the advancement of knowledge in transportation design, construction, maintenance and operations, along with the promotion of all matters and interest pertaining to the welfare of public transportation in Missouri.

Missouri Municipal League (MML) The League's basic goal is to strengthen cities through unity and cooperation. Missouri Association of Counties (MAC) provides assistance to its member counties in matters pertaining to local, state, and federal government activities. Most pertinent to bridge preservation:

- conducting research and studies useful to county government;
- by providing a forum for the interchange of ideas among county officials;
- by providing training and educational resources during annual conferences;

Missouri Association of County Transportation Officials (MACTO) focuses on County and other local government employees involved with construction or maintenance of roads and bridges in the state of Missouri

### **Design Professional Training Programs**

Training programs also provide an opportunity to disseminate available information on historic bridge preservation issues and emerging technologies. Design Professionals and contractors should be encouraged to attend training programs on historic bridge maintenance and rehabilitation.

### **New Training Programs**

Additional training programs could be developed through available federal grants. Grants of up to \$25,000 are awarded annually by the National Center for Preservation Technology and Training (for additional information see <http://www.ncptt.nps.gov>). These funds could be used to develop a training program to promote the maintenance and rehabilitation of Missouri historic bridges. The training could be given in several locations across the state to encourage attendance by local bridge owners and design professionals. The training program should include a brief overview of historic bridges and an explanation of why it is important to preserve them. The focus of the training should be on the "nuts and bolts" of bridge preservation, providing specifications for how to maintain and rehabilitate bridges while retaining their historic integrity.

### **Publications**

Another possible use of grant money is for the production of a publication on historic bridge maintenance and rehabilitation. This type of manual could provide additional specific guidance on maintaining and rehabilitating different types of historic bridges. The publication could be used as a reference guide for design professionals and local governments who own historic bridges.

## EDUCATIONAL OPPORTUNITIES

### Creating Public Support and Raising Awareness with the General Public

Support for saving bridges should be cultivated in the public realm with the general citizenry, as well as among design professionals and government officials. Too often the public does not become involved in the maintenance and preservation decisions for their bridges until a bridge is slated for replacement. Raising awareness of the importance of historic bridges in communities may increase local support for bridge maintenance and rehabilitation, and increase the chances of historic bridge survival.

Assistance for creating additional public support for saving historic bridges can be obtained from public agencies that have specialized knowledge in historic preservation. Agencies and organizations, such as the State Historic Preservation Office (SHPO) can help develop and/or sponsor public programs. Outreach efforts conducted by the SHPO could provide the public with a greater understanding of the importance of maintaining and rehabilitating their population of historic bridges and the available grants to accomplish preservation goals. Some potential public programs are listed below:

### Develop School Programs

Discussions of historic bridges could be incorporated into the curriculum of school programs. School children could learn about the history of bridge engineering during Engineers Week, an event designed to introduce students to the importance of engineering. Engineers' Week is sponsored primarily by the American Society of Civil Engineers, which chairs the National Engineers' Week Committee of sponsors. Other supporting sponsors include Federal Highway Administration (FHWA), Missouri Department of Transportation (MoDOT), American Public Works Association (APWA), Local Contractors Associations, American Society of Landscape Architects (ASLA), and American Planning Association (APA).

### Produce Informational Pamphlets

Informational pamphlets could be created for distribution at public meetings, museums, libraries, and highway rest stops. The pamphlets could include information about the results of the Historic Bridge Inventory. The benefits of preservation to communities, with examples, could also be discussed.

### Publicize Bridge Rehabilitation Success Stories

Success stories about successful rehabilitation projects could be publicized through the SHPO, Local Historical

Societies, and MoDOT websites; newsletters and in local newspapers.

Presentations and Public Programs can be presented to local Historical Societies and Preservation Groups as well as Chambers of Commerce and other local business groups. Public programs could be used by local historical societies to mount bridge exhibits, highlighting a community's or county's bridges. Additional programs, including public talks, forums and open houses could also be coordinated through these groups.

Public education and input is an essential and integral part of any historic preservation plan development process, but with regard to historic bridges in Missouri, where the public is less familiar with bridge preservation, it is critical. Done well, it can improve the knowledge base for decisions, clarify the nature and extent of agreements and disagreements (e.g., among participants and between participants and agencies), and yield more widely accepted decisions (National Research Council, 1989, 1996). In the case of the Meramec River U.S. 66 Bridge, public education and input can help leaders better understand the public's view of preservation and rehabilitation issues and help stakeholders better understand critical action plan items.

Clearly, the public is intensely interested in the Meramec River U.S. 66 Bridge. There is broad agreement among the public, not-for-profit agencies, preservation organizations, historical societies, the National Trust for

Historical Preservation, and the National Park Service that investing in the preservation of this bridge is the right thing to do. Based on the record, Americans hold high expectations for the future economic development of the Route 66 corridor, where the Bridge resides. That economic development will ultimately provide the return on investments made in public lands and infrastructure such as bicycle and walking paths, hiking trails, water recreation, roads, and bridges.

A decorative banner at the top of the page features a collage of images related to architecture and construction. On the left, there's a view of a modern building's interior with large glass windows. In the center, a construction site is visible with scaffolding and structural elements. On the right, there's a view of a bridge or walkway with a metal railing. Below the banner, there are three small square images: a fence, a close-up of a structural beam, and a road leading towards a building.

# References & Appendices

Sources of Information for Report Summary  
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List of Appendices

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A decorative banner at the top of the page features a collage of images. On the left, there's a view through a window with a wooden frame. In the center, a large, light-colored architectural structure is visible. On the right, there's a view of a green metal truss bridge structure. Below the banner, there are three small square images: a wooden fence, a close-up of a green metal structure, and a paved road leading towards a building.

# Appendices

List of Appendices

## Appendix A

### Secretary of the Interior's Standards for Rehabilitation

The Secretary of the Interior's Standards for Rehabilitation are basic principles created to help preserve the distinctive character of an historic building and its site, while allowing reasonable change to meet new needs. The Guidelines for Bridge Maintenance and Rehabilitation based on the Secretary of the Interior's Standards is included in Appendix B. These guidelines illustrate how the Secretary's Standards have been adapted to the needs of maintaining and rehabilitating historic bridges and may provide additional information for owners pursuing such projects.

1. A property shall be used for its historic purpose or be placed in a new use that requires minimal change to the defining characteristics of the building and its site and environment.
2. The historic character of a property shall be retained and preserved. The removal of historic materials or alteration of features and spaces that characterize a property shall be avoided.
3. Each property shall be recognized as a physical record of its time, place, and use. Changes that create a false sense of historical development, such as adding conjectural features or architectural elements from other buildings, 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 features, finishes, and construction techniques or examples of craftsmanship that characterize a property shall be preserved.
6. Deteriorated historic features shall be repaired rather than replaced. Where the severity of deterioration requires replacement of a distinctive feature, the new feature shall match the old in design, color, texture, and other visual qualities and, where possible, materials. Replacement of missing features shall be substantiated by documentary, physical, or pictorial evidence.
7. Chemical or physical treatments, such as sandblasting, that cause damage to historic materials shall not

be used. The surface cleaning of structures, if appropriate, shall be undertaken using the gentlest means possible.

8. Significant archaeological 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, 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 B

### Guidelines for Bridge Maintenance and Rehabilitation Based on the Secretary of the Interior's Standards

Secretary of the Interior's Standards to address the special requirements of historic bridges and to identify specific applications of the standards to historic bridges. These guidelines may provide useful guidance to anyone involved in a bridge maintenance and/or rehabilitation project.

1. 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 features should be avoided.
2. All bridges shall be recognized as products of their own time. Alterations that have no historical basis and that seek to create a false historical appearance shall not be undertaken.
3. Most properties change over time; those changes that have acquired historic significance in their own right shall be retained and preserved.
4. Distinctive engineering and stylistic features, finishes, and construction techniques or examples of craftsmanship that characterize an historic property shall be preserved.
5. 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.
6. 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.
7. 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.

8. 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.
9. 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

### Superstructure Work by Bridge Type

#### Beams/Girders

Beam or girder bridges have become a prevalent bridge type in the United States in the twentieth century. The terms beam and girder are interchangeable as girder simply refers to a large beam of metal or concrete. Based on the post and lintel structural system, the earliest simple beam bridges were constructed of timber and often consisted of a plank stretched over a waterway supported by a basic pier or block system. Using the same structural form as the simple beam structures, multi-girders are structures consisting of a series of steel or concrete beams placed parallel to traffic, supporting the roadway directly on their top flanges. Beam and girder bridges are supported by abutments at the ends of the bridge. The placement of intermediate piers allowed for an almost unlimited total overall bridge length. Limits on shipping, splicing, and girder depths dictated the maximum unsupported distance for this type of construction. As material technology advanced, the favored materials for beam and girder bridges became steel and concrete.

#### Steel/Pre-Stressed Concrete Girders

Steel or pre-stressed concrete structures may be strengthened by adding intermediate girders. The deck would need to be replaced for this option. Steel girder structures may also be strengthened by augmentation, such as through adding cover plates. Pre-stressed concrete girders could be strengthened by post-tensioning.

#### Trusses

A truss uses diagonal, vertical and horizontal members to support the deck loads. The members are joined with plates and fasteners (rivets or bolts) to create several rigid triangular shapes. This configuration allows relatively light units to be created for large spans.

There are three basic arrangements of trusses – pony, through, and deck – and a wide variety of types. The arrangement is called a pony truss (or, less commonly, a low truss) when the structural system lies alongside the deck. A through truss may also be referred to as an overhead truss. In the case of a deck truss, the entire truss is below the roadway. The roadway itself is usually supported by a system of longitudinal and transverse beams supported by the truss.

Various truss configurations are found in Missouri, with different types selected based on the span length that was needed. The continuous and cantilevered design approach also produced changes in the range of spans for trusses.

Truss bridges generally need to be temporarily supported to replace any deficient or deteriorated members. In cases where the members are left in place and are being augmented or strengthened by post-tensioning the truss could be rehabilitated without having to provide temporary supports. The following presents discussion on strengthening or replacing the primary elements of truss bridges. The discussion applies to both steel and timber truss bridges.

#### Lower Chord

This normally tension member is fracture critical. If it fails, it tends to fail catastrophically. The failure of this member could cause the entire bridge to collapse. These members can be replaced with a new member or they can be strengthened by augmentation, including post-tensioning. Post-tensioning uses steel or non-metallic cables or rods to provide additional load-carrying capabilities. It may or may not be fastened to a chord member. Strengthening the lower chord is generally expensive and must be done carefully to avoid causing the collapse of the structure.

#### Upper Chord

This normally compressive member tends to buckle. Upper chords are usually conservatively designed. Strengthening the upper chord can be accomplished by augmentation. Complete replacement is expensive and would require that the structure be temporarily supported.

#### Stringers

These are longitudinal members, connected to transverse floor beams. They carry the deck and live loads to the floor beams. These members can be replaced with new members or they can be strengthened with augmentation. It is relatively inexpensive to replace the stringers compared to the major truss elements.

These are usually larger transverse members connecting to the main trusses at the panel points. At these panel points, the deck and live loading are transferred to the truss. These members can be replaced or they can be strengthened by adding cover plates.

#### Web Members (Diagonals, Verticals and Bracing)

The diagonals are generally tension members and the verticals can be tension or compression members. The rehabilitation of these members would be similar to the bottom chord and top chord, respectively.

## Appendix D

### Alternate Design Standards – Sources and Examples

#### Sources

1. Guidelines for Geometric Design Policy of Very Low-Volume Local Roads (ADT # 400)
2. Adopted by AASHTO in 2001, these guidelines apply to the many two-lane highways in the U.S. that have very low traffic volume. Of two-lane highways in the U.S., approximately 80 percent have an average daily traffic (ADT) volume of less than 400 vehicles per day. This study demonstrates that minimum roadway widths for such highways can be used to economically and safely address operational needs. The recommended standards for low-volume highways are expected to produce meaningful savings in construction costs.
3. Policy on the Geometric Design of Highways and Streets (Green Book)
4. A Policy on the Geometric Design of Highways and Streets (known as the Green Book), published by the American Association of State Highway and Transportation Officials (AASHTO), contains the basic geometric design criteria that establish the physical features of a roadway. State standards for roadway and bridge design are typically based on the Green Book. As noted in Flexibility in Highway Design, discussed below, a project that is sensitive to an historic bridge may be achieved within the parameters established by the Green Book.
5. FHWA's Flexibility in Highway Design (on-line at [www.fhwa.dot.gov/environment/flex/](http://www.fhwa.dot.gov/environment/flex/)) offers highway engineers and project managers guidance about the flexibility available to them when designing roads and illustrates successful approaches used in other highway projects. Starting with the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991, Congress made a commitment to preserving and protecting the environmental and cultural values affected by transportation facilities. This guide is intended to provoke innovative thinking for fully considering the scenic, historic, aesthetic, and other cultural values, along with the safety and mobility

needs, in developing highway projects. It does not establish any new or different geometric design standards or criteria for highways and streets in scenic, historic, or otherwise environmentally or culturally sensitive areas, nor does it imply that safety and mobility are less important design considerations.

Flexibility in Highway Design is correlated to a large extent to the Green Book because that is the primary geometric design tool used by the highway design community. Projects highlighted in this guide were achieved working within the parameters of the Green Book to obtain safety and mobility and to preserve environmental and cultural resources. These projects used the alternatives that are available within the criteria of the Green Book. Flexibility in Highway Design encourages highway designers to expand their consideration in applying the Green Book criteria by showing possible approaches that fully consider aesthetic, historic, and scenic values, along with safety and mobility.

Options available to state and local highway agency officials to aid in achieving a balanced road design and to resolve design issues include:

- Use the flexibility within the standards adopted for each state.
- Recognize that design exceptions may be appropriate where

environmental consequences are great.

- Be prepared to reevaluate decisions made in the planning phase.
- Consider developing alternative standards for different types of local roadways.
- Recognize the safety and operational impact of various design features and modifications.

