ALTERNATIVE 1 - REPAIR AND REHABILITATION OF EXISTING STRUCTURE

This alternative considers repair and rehabilitation of the existing superstructure and substructure to extend the useful service life and maintain the available load capacity. The existing roadway geometry and navigation clearances are assumed to be acceptable.

The existing bridge is a 1,800 foot long two lane crossing of the Cumberland River that was open to traffic in 1931. The bridge has been in service for 82 years, is generally in poor condition and does not meet current standards both in terms of live load carrying capacity and roadway geometry– overall the bridge has an sufficiency rating of 32.7 (out of 100). According to the FHWA standards, a sufficiency rating less than 50 qualifies a bridge for replacement funding.

While the FHWA Structure Inventory and Appraisal Report, which is updated every two years based on a federally mandated inspection, indicates the deck is in generally good condition, much of the structural steel supporting the deck is highly deteriorated and will need to be replaced. As a consequence of this, the deck will need to be replaced as well. The report states that the Deck Geometry is rated 2 (on a scale of 0-9) with the comment "Intolerable – Replace".

With all steel superstructures, extending the bridge service life must consider corrosion protection. The existing coating system has failed with widespread surface corrosion. Painting of the bridge is included in the conceptual rehabilitation estimate. The existing paint system likely contains lead. Hazardous material containment and collection would likely be required as part of preparation to repaint the bridge.

In addition to the superstructure steel repairs, deck replacement and repainting, the existing piers have a history of movement and are currently subject to scour. Thus the project will need to include work to address these deficiencies as well.

A related issue to the steel repairs and deck replacement is the impact on local traffic. The bridge deck has a driving surface of 20 feet between curbs striped to provide two – ten foot lanes. With such narrow lane widths, and the likely need to replace some floorbeams and center stringers, rehabilitation by part-width (staged) construction, maintaining traffic in one lane while working in the second lane, is judged to be neither feasible nor safe. Thus any replacement scheme would require either a temporary detour or nighttime and weekend closures, neither of which are desirable and both of which will significantly increase the cost of the construction.

During the first public meeting on June 20, 2013, stakeholders, including local public officials and industry representatives, expressed the significant negative impact that closure of nearby existing Ledbetter Bridge to all but passenger vehicles has had on the local economy. The Ledbetter Bridge lies on the same route south of the city of Smithland. They further said that closure of the Smithland Bridge would be even more damaging. Given the lack of feasibility for part-width (staged) construction and the high level of interest in maintaining mobility across the Cumberland River, the cost of a temporary structure during rehabilitation is included in the conceptual estimate for this alternative. While ferry service or night and weekend closures with accelerated construction techniques could be considered, a low level of service or interrupted service may not be acceptable to the public and stakeholders.

Based on past experience, repair and rehabilitation of the existing structure would extend the useful service life approximately 20 years beyond the date of the rehabilitation. It would not increase the load carrying capacity of the bridge to current standards nor would it improve roadway safety or geometric deficiencies. This estimate of service life extension does not consider the remaining fatigue life of the structure, which could considerably reduce the remaining life. A fatigue study would be required to assess the remaining fatigue life. An example of a bridge with inadequate geometric clearances is the Skagit Bridge in Washington which, like this bridge, includes a through-truss span. In the case of the Skagit Bridge, one truss span recently collapsed after being damaged by an oversized truck load. Thus rehabilitation would not change its low rating and the bridge would remain functionally obsolete.

The following is a summary of the estimated bridge only conceptual costs:

Repairs and Rehabilitation	$ 2,800,000
Deck Replacement	$ 1,800,000
Painting	$12,500,000
Temporary Detour including temporary bridge	$ 13,500,000
Contingency (30%)	$ 9,200,000
Total	$ 39,800,000

The estimated costs were based on the element level deficiencies reported in the Structure Inventory and Assesment Report, KYTC unit prices for concrete and steel reinforcement, recent bids for bridge painting and judgement on the cost of a temporary structure as compared to new permanent construction.

ALTERNATIVE 2 - NEW AND WIDER SUPERSTRUCTURE ON REINFORCED AND WIDENED SUBSTRUCTURE

This alternative considers replacing the existing superstructure on the existing alignment with selective reuse of the existing substructure units. The existing roadway geometry and navigation clearances are assumed to be acceptable.

Reuse of the existing substructure to expedite construction and reduce cost was considered. Where the bridge's substructure is in good condition or can be rehabilitated this can be a cost effective alternative if the related maintenance of traffic issues can be addressed.

For this site, it is envisioned the new superstructure would be constructed alongside the existing bridge while the existing bridge piers and abutments would be modified and strengthened as needed to accept the new superstructure. Based on current bridge design standards the new superstructure would provide two 12 foot wide travel lanes and 8 foot wide shoulders. During this work the existing bridge would need to remain in service. Since the existing bridge is deficient in load carrying capacity and includes narrow lanes, use of the bridge by the contractor would be impacted.

It is known that the existing piers have a history of movement along the direction of the roadway and are currently subject to scour. Thus the project will need to include work to address these deficiencies. The Structure Inventory and Appraisal Report includes noted moderate to heavy scour and erosion around the approach piers (piers NP1 and SP1) adjacent to the truss piers along the river bank.

In order to construct the new superstructure, temporary falsework bents would need to be constructed, and given the topography of the site, these would be significant structures in and of themselves. Once the new superstructure is completed on the temporary substructure and opened for maintenance of traffic, the existing superstructure would be removed and the existing substructure would be reinforced and rehabilitated. Once that is accomplished, the existing bridge can be closed to traffic and the new span slid into its permanent position. This change out would require a shutdown of 5-10 days. As one can anticipate this would be a complex and costly undertaking.

Typically this type of replacement is not needed when, as discussed below for Alternatives 3 and 4, one can introduce a new alignment. However it has been done before, for example the replacement of the Coleman Bridge across the York River in Virginia. A more recent example of this is the Milton-Madison Bridge over the Ohio River in Trimble County, Kentucky. Unlike the Milton-Madison Bridge, the existing Smithland Bridge does not have piers in the river. As such, the cost savings achieved by the Milton-Madison Bridge project by expediting the construction work in the river is much less significant for the Smithland Bridge. Also, the relative length of the land bridge approaches compared to the river crossing, 1,300 feet of land bridge approaches and 500 feet of river truss for the Smithland Bridge versus 1,000 feet of land bridge approaches and 2,200 feet of river truss for the Milton-Madison Bridge, places a significantly greater portion of the cost for the Smithland Bridge in the land bridge approach structures. At the approach structures, new superstructures with longer spans and fewer substructure units would be more economical than widening the existing piers.

For reasons described for Alternative 1, maintenance of traffic is a key issue for the town of Smithland and Livingston County. Therefore, costs for temporary bents to support the new superstructure during its erection and temporary bents to support the existing superstructures once it is removed are included in the conceptual cost estimate. The conceptual cost estimate also includes the cost of rehabilitating the existing bridge substructure.

The following is a summary of the estimated bridge only conceptual costs:

New Superstructure	$ 13,400,000
Substructure Widening and Rehabilitation	$ 8,600,000
Temporary Approaches and River Bents	$ 8,000,000
Demolition and removal of existing superstructure	$ 2,000,000
Contingency (30%)	$ 9,600,000
Total	$ 41,600,000

The costs were based largely on the costs of construction for the Ledbetter Bridge over the Tennessee River, judgement on the cost of a temporary structure as compared to new permanent construction and judgement on the cost of demolition.

ALTERNATIVES 3 AND 4 - NEW BRIDGE CONSTRUCTION

These alternatives consider construction of a new bridge on an adjacent alignment while traffic is maintained on the existing structure. The existing navigation clearances are assumed to be acceptable.

A conceptual cost estimate for Alternatives 3 and 4 has been prepared. Based on current bridge design standards the new superstructure would provide two 12 foot wide travel lanes and 8 foot wide shoulders. Construction of a new bridge on new alignment will provide for maintenance of traffic on the existing bridge during construction, thereby avoiding the costs of temporary structures. A new structure will also provide the required load carrying capacity, a life span of at least 75 years and roadway geometry that meets current alignment design criteria. Alternative 3 provides for a new bridge east of the existing bridge, while Alternative 4 is on an adjacent alignment west of the existing bridge.

The conceptual costs for these two alternatives have been estimated using the average bids for the new Ledbetter Bridge on this same route south of Smithland over the Tennessee River. Those conceptual costs have been adjusted using 5% annual inflation from 2005 for the river substructure, and from 2010 for the approaches and river superstructure, to 2013.

The following is a summary of the estimated bridge only conceptual costs:

New Bridge 3A and 4 .... $ 27,000,000
Demolition and removal of existing superstructure .... $ 3,000,000
Contingency (30%) .... $ 9,000,000
Total .... $ 39,000,000

New Bridge 3B .... $ 30,100,000
Demolition and removal of existing superstructure .... $ 3,000,000
Contingency (30%) .... $ 9,900,000
Total .... $ 43,000,000

The costs were based largely on the costs of construction for the Ledbetter Bridge over the Tennessee River and judgement on the cost of demolition.