BRENT SPENCE BRIDGE CORRIDOR PROJECT

DESIGN SUMMARY REPORT

AUGUST 23, 2022

KENTUCKY TRANSPORTATION CABINET

HNTB

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1. INTRODUCTION

1.1 Project History

On October 14, 2004, The Kentucky Transportation Cabinet (KYTC) and the Ohio Department of Transportation (ODOT) recognized the need to improve the Brent Spence Bridge (BSB) corridor and formally entered into an agreement to jointly develop and deliver a project to replace the existing BSB over the Ohio River. The BSB project goals are to improve the operational characteristics in the BSB corridor for both local and through traffic by improving traffic flow and level of service, improving safety, correcting geometric deficiencies, and maintaining connections to key regional and national transportation corridors.

In August 2012, the Federal Highway Administration (FHWA) issued a Finding of No Significant Impact (FONSI) identifying the selected alternative for the BSB project, referred to as Alternative I. This preferred Alternative I was further evaluated:

- In October 2012, a Value Engineering Workshop was held to generate technical ideas to improve the design and constructability.
- In 2015, a modification to travel on the existing and companion bridges in Alternative I was developed to separate interstate traffic from local ramp connections, referred to as the Whiz Bang Concept.
- In 2019, a Performance-Based Design Workshop was held to review the project using practical design principles, updated design standards, updated traffic counts, and traffic analysis to determine potential cost savings. Two value engineering concepts were developed with different lane configurations for the existing and companion bridges – Concept I-W (Whiz Bang) and Concept I-M.

In May 2020, the development of these two concepts was documented in the *Analysis of Design Concepts* report with recommendations for moving forward based on operation, design, and cost. Concept I-W and Concept I-M were both considered viable options for the BSB corridor and recommended for further study.

1.2 2021-2022 Project Tasks

KYTC and ODOT recognized the need to move the BSB project forward from these previous studies and approved the following tasks in October 2021:

1. Project Summary Report
2. Project Governing Structure Review
3. Project Financial Update
4. Traffic Analysis and Modeling
5. Design Concept Development and Refinement
6. Project Outreach and Communication

This report is a summary of Task 5 – Design Concept Development and Refinement which is influenced by the work performed in Task 4 – Traffic Analysis and Modeling. It includes a design refinement and evaluation of Alternative I, Concept I-W, and Concept I-M. This analysis and design refinement allowed for the comparison of characteristics specific to Alternative I, Concept I-W, and Concept I-M, such as operations, local connectivity, design exceptions, work limits, and cost estimates.

1.3 Purpose of Report

The purpose of this Brent Spence Bridge Project - Design Summary Report is to summarize recent work efforts related to the review of the 2012 Value Engineering Workshop, refinement and analysis of two value engineering concepts (Concept I-W and Concept I-M) from the 2019 Performance Based Design Workshop, and an updated analysis and evaluation of Alternative I. This report includes the following items:

- Summary of operational analysis based on updated traffic modelling
- Comparison of connectivity
- Refinement of design and scope of work
  - Physical work limits and impacts
  - Potential design exceptions
  - Updated cost estimates
  - Constructability
- Comparison of design characteristics
- Recommendations

2. VALUE ENGINEERING

2.1 Value Engineering Workshop

Since the approval of the FONSI and selection of the preferred Alternative I, additional design reviews and studies have been conducted by KYTC and ODOT, including the Value Engineering Workshop held in 2012. The purpose of the Workshop was to generate technical ideas for delivering the BSB project quickly, economically, and safely. Nearly 100 ideas were identified for improvements to Alternative I.

Prior to a final report for the 2012 Workshop, the project was put on hold and no final decisions were made relative to the developed value engineering concepts and ideas. On June 2, 2022, a meeting was held with ODOT, KYTC and FHWA from both states to discuss these value engineering ideas and those developed during the 2019 performance-based design workshop to determine which items would be recommended for further consideration. These recommendations are summarized in the **Brent Spence Bridge Value Engineering Matrix** in **Appendix A**.

2.2 Performance-Based Design Workshop

In December 2019, a Performance-Based Design Workshop was held with members of ODOT, KYTC, and FHWA from both states. Alternative I was further evaluated to apply practical design principles which included an update to design standards, updated traffic counts, and traffic analysis to determine potential cost savings. As a result of this effort, two value engineering concepts were developed with different lane configurations for the existing and companion bridges across the Ohio River. Concept I-W (the Whiz Bang option from 2015) and Concept I-M were both considered viable options for the BSB corridor that could provide cost savings with respect to Alternative I:

- Concept I-W – This design has a similar mainline and ramp layout through the corridor as Alternative I. However, all interstate traffic for I-71 and I-75 is carried on the companion bridge, and all local connectivity is accommodated on the existing BSB.
- Concept I-M - This design keeps many of the same traffic movements and local connections on the existing BSB as they are today, including both directions of I-71. The companion bridge carries only I-75 and connections to and from the local street system along the west side of downtown Cincinnati.

These concepts did not change the access points provided in Alternative I nor did they change the concept of creating a collector-distributor system that separates the interstate through traffic from the local street connections. Initial evaluation of both concepts showed that they remain within the footprint of the original NEPA document.

2.3 Description of Designs

A description of each of the three designs are provided below:

2.3.1 Alternative I

Alternative I, which was identified as the preferred alternative in the Preferred Alternative Verification Report (March 2011), utilizes the existing I-71/I-75 alignment from the southern project limits at the Dixie Highway Interchange north to the Kyles Lane Interchange. The Dixie Highway and Kyles Lane interchanges will be modified slightly to accommodate a C-D roadway, which will be constructed along both sides of I-71/I-75 between the two interchanges. North of the Kyles Lane Interchange, the alignment shifts to the west to accommodate additional I-71/I-75 travel lanes. Between Kyles Lane and KY 12th Street, six lanes will be provided in each direction for a total of 12 travel lanes. Near KY 12th Street, the alignment separates into three routes for I-71, I-75, and a local C-D roadway in the NB direction.

A companion bridge (with a width of 172 feet) will be built just west of the existing BSB to carry NB and SB I-75 traffic with three lanes in each direction. Two additional lanes will be provided for SB I-71 traffic and three other lanes will carry SB local traffic as part of the C-D roadway system. The existing BSB will be rehabilitated to carry two lanes for NB I-71 traffic and three lanes for NB local traffic as part of the C-D roadway system.

Alternative I reconfigures I-75 through the I-71/I-75/US 50 Interchange and eliminates access to and from I-75 NB between KY 12th Street and the US 50/ OH 6th Street overpass in the NB direction. Alternative I also eliminates access to and from I-75 SB between the Freeman Avenue exit and KY 12th Street exit.

2.3.2 Concept I-W

Concept I-W uses the Alternative I design for the I-71/I-75 alignment from the Dixie Highway Interchange north to KY 12th Street; north of Freeman Avenue in Ohio; and includes the local C-D along both sides of I-75 in Ohio.

In Concept I-W, a companion bridge (with a width of 107 feet) will be built just west of the existing BSB with all I-71 and I-75 traffic on the new bridge and all C-D local traffic on the existing BSB. The new bridge will carry five lanes of SB I-71 and I-75 traffic on the lower deck and five lanes of NB I-71 and I-75 traffic on the upper deck. The existing BSB will be rehabilitated to carry three lanes for NB local traffic on the lower deck and three lanes for SB local traffic on the upper deck, as part of the C-D roadway system. See **Appendix B** for the **BSB Concept I-W Plan.**

2.3.3 Concept I-M

Concept I-M uses the Alternative I design for the I-71/I-75 alignment from the Dixie Highway Interchange north to KY 12th Street; north of Freeman Avenue in Ohio; and includes the local C-D along both sides of I-75 in Ohio.

In Concept I-M, a companion bridge (with a width of 133 feet) will be built just west of the existing BSB with all I-71 traffic on the existing BSB (as it is today), and all I-75 traffic on the new bridge. Local traffic connectivity will be distributed to both bridges, with many connections to the existing bridge remaining.

The new bridge will carry three lanes of SB I-75 traffic on the lower deck and three lanes of NB I-75 traffic on the upper deck. Two additional lanes will be provided on each deck of the new bridge to carry local traffic as part of the C-D roadway system. The existing BSB will be rehabilitated to carry two lanes for NB I-71 traffic on the lower deck and two lanes for SB I-71 traffic on the upper deck. One additional lane will be provided on each deck to carry local traffic as part of the C-D roadway system, specifically existing connections at 4th and 5th Streets in Covington and 2nd and 3rd Streets in Cincinnati. See **Appendix C** for the **BSB Concept I-M Plan.**

3. EVALUATION OF ALTERNATIVE I, VE CONCEPT I-W AND VE CONCEPT I-M

3.1 Traffic Operations

The traffic analysis effort was built upon previous work completed by the Brent Spence Bridge Corridor project (2013-2022), Brent Spence Strategic Corridor Study (2017), and the ODOT Connected Autonomous Vehicle study (2020-2021). This latest analysis developed refined alternative traffic forecasts and operational analysis

using TransModeler for two value engineering concepts (Concept I-W and Concept I-M) with a comparison to the preferred Alternative I from the Environmental Assessment (EA) in 2012.

This traffic study, ***Traffic Operations Report*** dated June 2022, includes the review of available traffic counts, OKI travel demand modeling, existing (2019) TransModeler validation, development of refined alternative traffic forecasts, and TransModeler scenario analysis of 2050 build concepts.

TransModeler was used to refine Concept I-W and I-M designs to optimize the traffic performance in the corridor. The models include freeway mainline, ramps, ramp terminals, and adjacent intersections. The future modeling assumptions removed external capacity constraints from the corridor and conserved the existing traffic temporal distributions. These inputs maximized traffic demand on the concept design elements, which provided valuable insight into areas of concern for each concept. Design enhancements were made for each Concept based on the traffic analysis.

The TransModeler analysis showed that Concept I-W has acceptable traffic operations. There are segments of the I-71/I-75 corridor that have periods of poor traffic operations, but all segments fully recover within the model period. This was not the case with Concept I-M, which experiences severe queuing on I-71/I-75 NB in the AM period. Below is a summary of traffic operations results for each design option.

3.1.1 Alternative I

The TransModeler analysis was completed using the 2050 Base forecasts. Overall, Alternative I has acceptable traffic operations. The two areas of mainline freeway delays occur in the peak direction of travel: NB I-71/I-75 in the AM peak and SB I-71/I-75 in the PM peak. The travel delays are comparable to travel delays also identified for the value engineering concepts.

SB I-71/I-75 has a +5% grade between 12th Street and Kyles Lane. The steep grade along with high PM period traffic volumes result in travel delays on the roadway section between 9th Street and Kyles Lane in Kentucky. All three concepts experience similar travel delays in this section, but they are contained between Kyles Lane and 9th Street and do not impact the companion bridge.

3.1.2 Concept I-W

Overall, Concept I-W has acceptable traffic operations, very similar to Alternative I. The off-peak directions continue to operate acceptably as they do in the other concepts. The AM period has a travel delay for NB I-71 similar to Alternative I. In the PM period, SB I-71/I-75 has travel delays similar to other build scenarios.

Concept I-W was refined during the design modification phase of the project to address some operational concerns. The design changes include:

1. Modification of the lane alignment for the NB I-75 CD road from the existing Brent Spence Bridge through the US-50 exit.
2. The addition of an eastbound through lane at the 5th Street intersection with Central Avenue in Ohio.

3. Right-sizing of the Kentucky frontage road system to have acceptable operations and minimize right-of-way acquisition
4. Extension of the merge area between NB I-71 and the NB I-71/I-75 CD prior to entering Fort Washington Way.

3.1.3 Concept I-M

Concept I-M has acceptable operations for the off-peak directions, but experiences major operational concerns for NB I-71 in the AM period and minor operational concerns for SB I-71/I-75 in the PM period. The major operational issues for NB I-71 in the AM period make Concept I-M an unacceptable value engineering concept.

Concept I-M was refined during the design modification phase of the project to address some operational concerns. The design changes include:

1. The addition of an eastbound through lane at the 5th Street intersection with Central Avenue in Ohio.
2. Right-sizing of the Kentucky frontage road system to have acceptable operations and minimize right-of-way acquisition.
3. A new NB ramp between 12th Street and I-71 to provide interstate access consistent with the existing conditions and the other build scenarios.

3.2 Connectivity

Maintaining or improving local connections to the interstate and improving regional mobility are the goals of the Brent Spence Project. The value engineering concepts provide access as provided in Alternative I and use a collector-distributor (C-D) system to separate the interstate through traffic from the local street connections as in Alternative I. However, the local connectivity for Alternative I, Concept I-W and Concept I-M varies slightly due to the differences in the proposed use of the two bridges for local and interstate traffic. Each option was reviewed to evaluate specific items relative to travel:

- Local access to the Interstate
- Access to Covington from the Interstate
- Access to Downtown Cincinnati from the Interstate
- Separation of Local and Regional Traffic

A chart showing the results for each design option is included in **Appendix D** titled **Brent Spence Bridge Local Connectivity**.

3.3 Design Exceptions

The potential design exceptions for Concepts I-W and I-M have been summarized in tables and referenced to corresponding graphics that show the locations. The tables for each of these concepts also list the deficiencies from Alternative I for comparison. Overall, Concept I-W has fewer potential design exceptions than Alternative I

and Concept I-M. See **Appendix E** for the **BSB Potential Design Exceptions** with a separate map (E-1) and a table (E-2) for Concept I-W and two maps (Kentucky E-3 and Ohio E-4) and a table (E-5) for Concept I-M.

3.4 Work Limits

Work limits were approved for Alternative I as part of the Environmental Documentation in 2012. These limits were used as part of the development of the value engineering concepts with the requirement that any proposal would not expand beyond those approved for Alternative I. These requirements were met.

3.4.1 Concept I-W

The changes in Concept I-W with respect to Alternative I are between the 12th Street interchange in Kentucky to Linn Street in Ohio. In Covington, the northbound work limits between 12th and 9th Streets were reduced by the narrowing of lanes on Simon Kenton Way (formerly Jillian's Way) and narrowing the interstate corridor. The northbound work limits between 9th and 5th Streets match Alternative I along Goebel Park, which does require new right-of-way. The southbound work limits in Kentucky decrease by 60 feet from the Ohio River to 3rd Street and continue to decrease up to 106 feet between 3rd and 4th Streets. Concept I-W avoids work limits through the River Center Collision property that are needed in Alternative I. Additional design updates were made along Bullock Street/SB CD exit to 9th Street to reduce impacts to Crescent Avenue.

The work limits across the Ohio River on the west side of the project decrease by 60 feet. In Ohio, the work limits are consistent with Alternative I except on the west side of the segment between the Ohio River and the railroad track just south of 3rd Street. The work limits for Concept I-W decrease in this section by 60 feet including along Longworth Hall. The northbound ramp to 2nd Street from the existing BSB was revised to allow more horizontal distance between the Duke Gas utility and the ramp.

3.4.2 Concept I-M

The changes in Concept I-M with respect to Alternative I are between the 12th Street interchange in Kentucky to Linn Street in Ohio. In Covington, the northbound work limits between 12th and 9th Streets were reduced by the narrowing of lanes on Simon Kenton Way (formerly Jillian's Way) and the need for a narrower interstate corridor. The northbound work limits between 9th and 5th Street match Alternative I along Goebel Park, which does require new right-of-way. Design updates were made along Bullock St/SB CD exit to 9th Street to reduce impacts to Crescent Avenue.

In Ohio, the work limits are consistent with Alternative I except on the west side of the segment between the Ohio River and the railroad track just south of 3rd Street. The work limits for Concept I-M decrease in this section by 30 feet including along Longworth Hall. The northbound ramp to 2nd Street from the existing BSB was revised to allow more horizontal distance between the Duke Gas utility and the ramp.

3.5 Construction Cost Estimate

The updated Alternative I, Concept I-W and Concept I-M cost estimates are based on the Alternative I original 2010 cost estimate and project segments, with assumptions developed by KYTC and ODOT:

- Quantities
    - Used quantities from the Alternative I original 2010 estimate
    - Used quantities for the entire BSB corridor from Dixie to north of the WHV to generate unit prices
    - Changed quantities for I-W and I-M based on differences with Alternative I only if there was a significant cost difference:
        - Retaining walls, Bridge structures and Pavement for I-W
        - Retaining walls, Bridge structures and Structure removal for I-M
- Inflation, Unit Prices
    - Design Contingency – 25% of construction cost
    - Refreshed all unit prices based on updated estimator guidelines
    - Revised inflation rate to 6.2% based on guidelines
    - CY22-26 Business Plan Inflation Calculator – Revision dated 01-26-2022 was used
    - Inflation calculator start date updated to January 2022
    - Reviewed recent bid history and updated unit prices
    - Updated material and inflation costs for steel for various structures
    - Used ODOT unit prices from January 2022.
- Construction Dates
    - Dixie to Linn – start date 10/2023 – 5 years construction
    - Linn to Findlay – start date Q3 of 2023 – 4 years construction
    - Findlay to north of the WHV – start date 4/2028 - 4 years construction

ROW costs were provided by ODOT and KYTC. Some utilities have already been relocated. ODOT provided the utility and actual cost for relocation. The estimate continues to utilize the 2012 estimated utility costs in Kentucky and has applied an inflation factor. Since the project is moving forward with Concept I-W, future updates for the cost will only be done for Concept I-W.

3.5.1 Alternative I

The construction cost estimate for Alternative I was last updated on April 22, 2022 to $3,218,584,751 ($3.22B)

3.5.2 Concept I-W

The construction cost estimate for Concept I-W was last updated on April 22, 2022 to $2,961,113,906 ($2.96B)

Concept I-W is $257M or 8.0 percent less than Alternative I.

3.5.3 Concept I-M

The construction cost estimate for Concept I-M was last updated on April 22, 2022 to $2,933,980,214 ($2.93B)

Concept I-M is $284M *or 8.9 percent* less than Alternative I

3.6 Constructability

A high level review was performed for constructability. The Alternative I construction staging plan was utilized as a base to evaluate the constructability of Concept I-W and the associated changes. This review revealed no fatal flaws in constructing Concept I-W. The conceptual construction staging for Concept I-W is being submitted under a separate document. The detailed construction staging and TMP plans will be developed by the Design Build Team once they are selected.

3.7 Concept I-W Conceptual Signing Plan

The 2012 Alternative I signing plan was reviewed to determine if there were any fatal flaws in the conceptual signing plan in transitioning from Alternative I to Concept I-W and to reflect the changes (if any) required on the Alternative I signing plan to accommodate Concept I-W. No fatal flaws were found for signing of Concept I-W. However, while considering the Concept I-W signing, it was recognized that potential revisions could be made to the Alternative I signing plan to simplify and clarify the layout and configuration to improve driver understanding and operation. To keep the review focused on updates to accommodate Concept I-W, a high-level overview was provided without detailed redesign of the signing. Comments received from both states are addressed on plan sheets included in **Appendix F**.

The next phase of design will include additional traffic analysis to verify any new design ideas but will also evaluate the C-D and associated signalized intersection operation. The verification of lane assignments for the highway lane use seems reasonable to include so that the appropriate pavement marking and signing needs for Concept I-W can be determined. This will also coordinate well with the design of the freeway management/ITS and destination signing.

4. COMPARISON OF DESIGNS

The following Matrix graphically summarizes the different topics of evaluation discussed above.

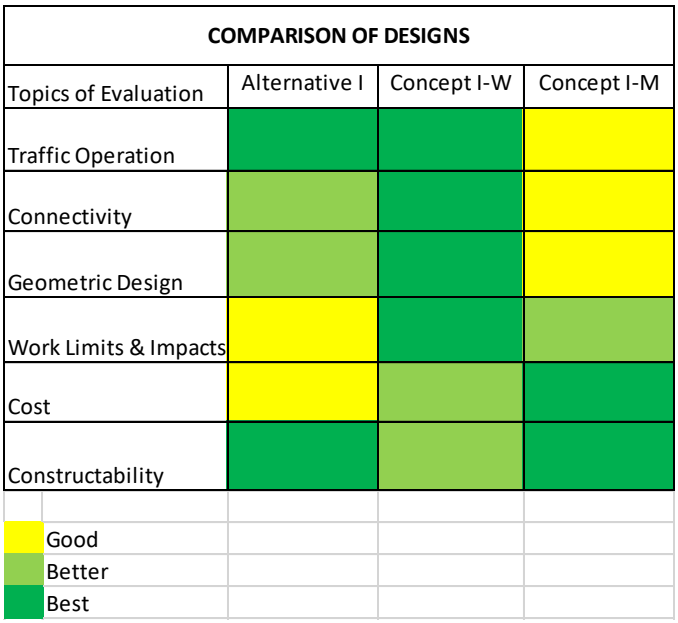

Figure 1

5. RECOMMENDATIONS

Various design factors and traffic operational analyses were refined for Alternative I, Concept I-W and Concept I-M for the BSB project. The purpose of this effort was to gain an understanding of the differences in each factor and to compare these for the three design options.

Traffic operations analysis using TransModeler and refined alternative traffic forecasts developed from the OKI travel demand model were completed for the BSB corridor representing a 2050 condition. The modeling indicates operational deficiencies for the preferred Alternative I, especially for NB I-71/I-75 in the AM peak period and SB I-71/I-75 in the PM peak period. The two value engineering concepts were evaluated and compared to Alternative I. The operations analysis indicates Concept I-W has acceptable traffic operations with similar deficiencies to Alternative I, while Concept I-M experiences excessive traffic queues for NB I-71/I-75 in the AM peak period.

Other design factors were evaluated including connectivity, geometric design, work limits, cost estimates and constructability. Based on the comparison of these factors and the traffic operations, as shown in the Design Comparison Matrix in Figure 1 above, the majority of the evaluation factors favor concept I-W. Therefore, it is recommended that Concept I-W be carried forward as a value engineering concept to Alternative I, and Concept I-M should be excluded from further consideration.

The project is currently planned to be delivered as a Progressive Design Build procurement. The two northern projects (PID # 113361 and PID # 114161) are being procured as a Design-Bid-Build. The value engineering concepts shown as accepted in Appendix A will be included in the design build RFP. Those shown as pending will not be excluded from consideration if recommended by a design build team. The results of these recommendations do not preclude or eliminate consideration of additional concepts and ideas if developed by a design build team as part of the RFI/Alternative Technical Concept process. Value Engineering Concept I-W will be included as the base concept in the design build RFP. This concept separates local and interstate traffic and provides significantly better traffic flow than Concept I-M.

Appendix A:
BSB Value Engineering Matrix

APPENDICES AVAILABLE *UPON REQUEST*

Appendix B:
BSB Concept I-W Plan

APPENDICES AVAILABLE *UPON REQUEST*

Appendix C:
BSB Concept I-M Plan

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Appendix D:
BSB Local Connectivity

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Appendix E:
BSB Potential Design Exceptions

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Appendix F:
Concept I-W Conceptual Signing Plan

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