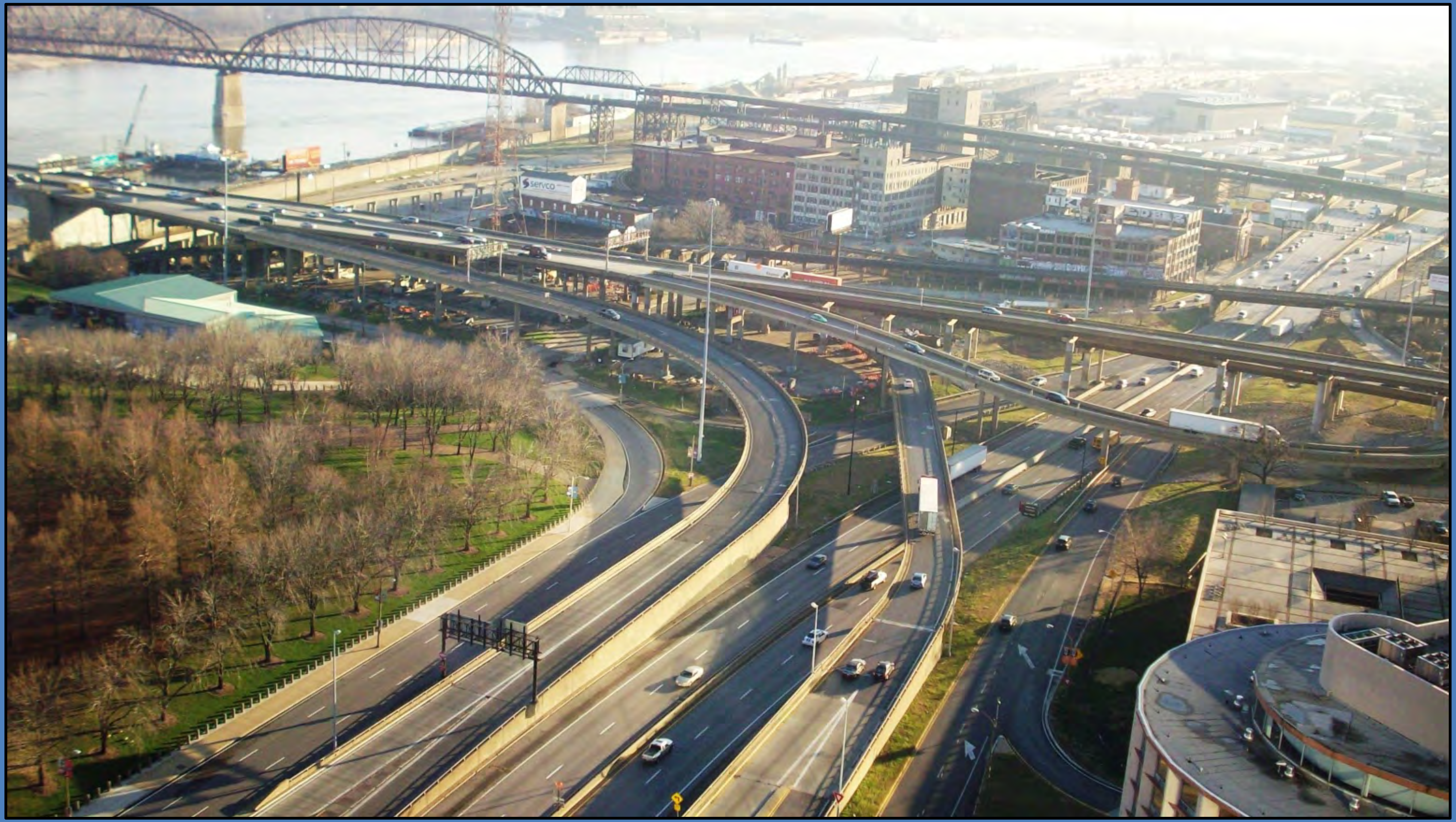
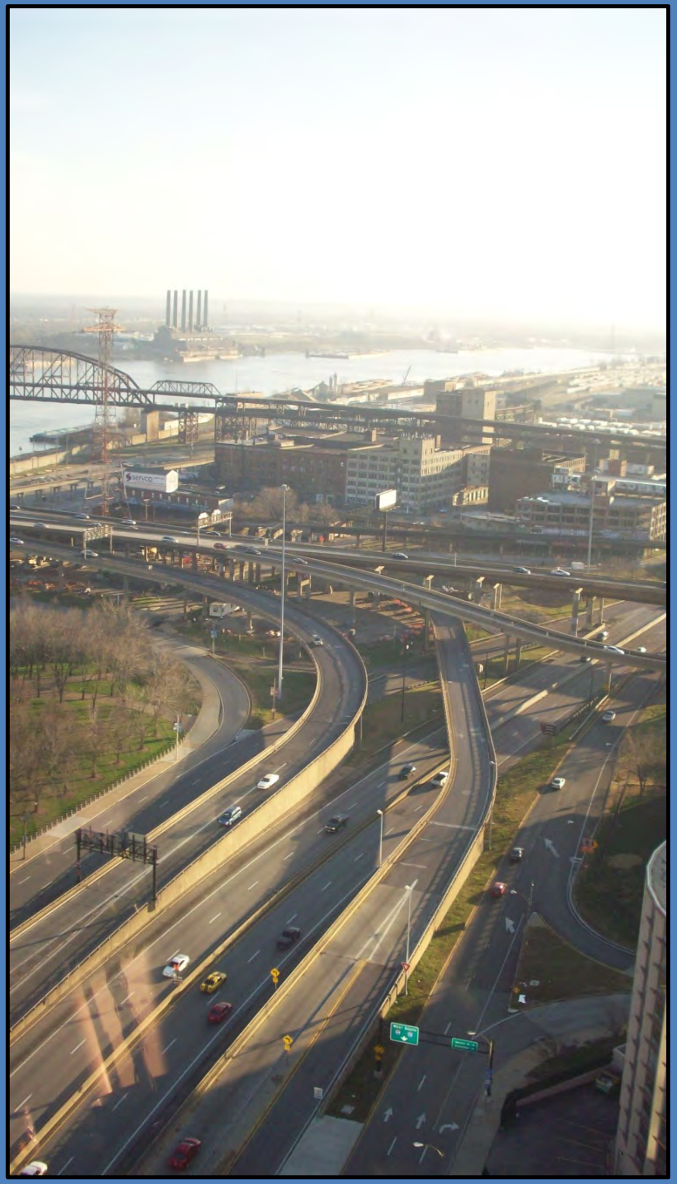
Poplar Street Bridge Interchange Project

Final Access Justification Report





May 2013

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Final Access Justification Report

Missouri Department of Transportation

May 2013

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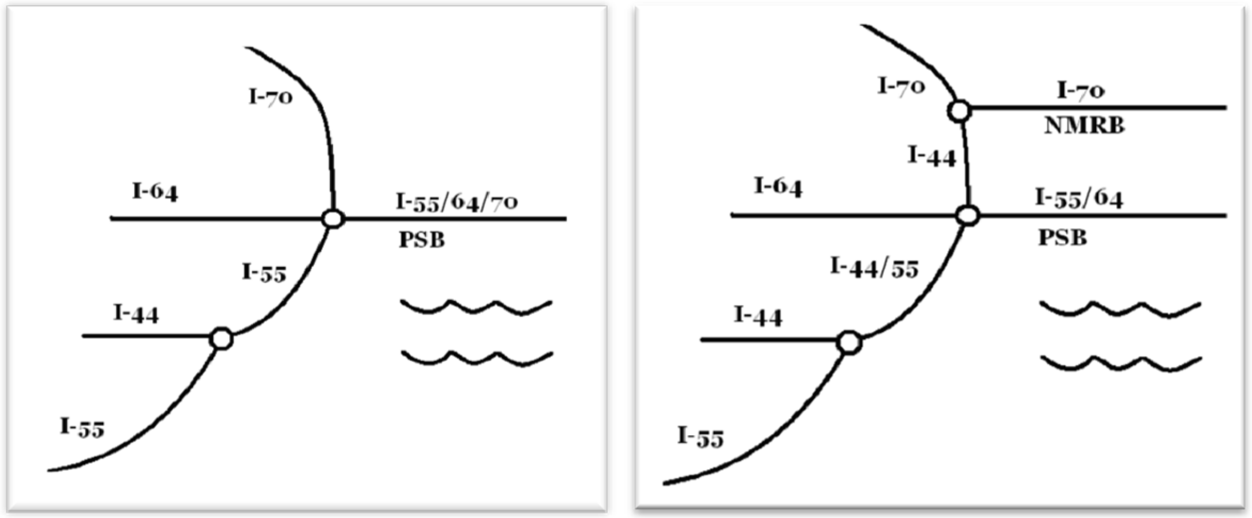
1 Executive Summary

This Access Justification Report (AJR) was generated by the Missouri Department of Transportation (MoDOT) for submission to the U.S. Department of Transportation, Federal Highway Administration (FHWA) and addresses freeway access modifications proposed for Interstate 55 (I-55), Interstate 64 (I-64), Interstate 44 (I-44), and existing Interstate 70 (I-70), in downtown St. Louis, Missouri. The proposed access changes affect the junction of these interstate facilities at the west end of the Poplar Street Bridge (PSB). The existing west PSB Interchange is shown in Exhibit 1.1.

Exhibit 1.1: Existing Poplar Street Bridge (PSB) Interchange

The PSB is a major Mississippi river bridge currently carrying three interstates (I-55, I-64, and I-70) between Missouri and Illinois. As the only core-area interstate crossing of the Mississippi River, the eight-lane Poplar Street Bridge is severely overburdened. Its capacity is inadequate to meet the needs of the through and local motorists travelling on and between I-55, I-44, I-64, and I-70, as well as in and out of downtown St. Louis. Its 40-year-old design is now substandard. Too many decision points are placed in too close proximity at both approaches to the bridge so that motorists do not have adequate distance to weave or merge into and diverge out of the traffic flow. The substandard design of the approach ramps compounds the resulting congestion problems and leads to traffic crashes. In addition to inadequate capacity on the bridge itself, the interstate connections on both sides (and their geometries) contribute to queuing and congestion on the bridge and its approaches. The west PSB Interchange (Missouri side) is especially problematic. However, at the time of this project's construction, the New Mississippi River Bridge (NMRB) will have opened and I-70 will be re-routed over this bridge. The current and future networks are shown in Exhibit 1.2.



Existing

2015

Exhibit 1.2: Downtown St. Louis Interstate Network

Improvements to the PSB Interchange were a component of the original NMRB project approved in 2001. The goal of the NMRB project was to relieve traffic congestion and improve safety on downtown St. Louis Mississippi River crossings, especially the Poplar Street Bridge (PSB). Due to funding constraints, a portion of the original NMRB project, including improvements to the PSB Interchange, were delayed to an indefinite second Phase of the project. Now with the NMRB nearing completion, daily congestion at the interchange, and escalating maintenance costs for the ramps, MoDOT has proposed the PSB Interchange reconstruction to coincide with network modifications being designed as part of the recently approved City Arch River | 2015 (CAR 2015) project.

It is MoDOT's recommendation to pursue a design which can be constructed within the available right-of-way and will accommodate both I-70 (Future I-44) and I-55 traffic from time of construction through the Design Year of 2035, while improving the operations of I-64 as much as possible. The preferred alternative provides an acceptable LOS for both the freeway system ramp connections and local street network by replacing existing Ramps A and D (to and from I-55) with dual-lane ramps. However, due to numerous design and right-of-way restrictions, widening these ramps will require the removal of existing Ramp B. Although the elimination of Ramp B is less than desirable, it would allow MoDOT to increase the capacity of Ramps A and D, improve safety, and minimize design exceptions. Through cooperative study efforts with the Illinois Department of Transportation (IDOT), MoDOT has confirmed that Ramp B cannot be reasonably reconstructed and has identified network improvements that will replace the connectivity of existing Ramp B. IDOT plans to construct a new connection from the Martin Luther King Bridge (MLK Bridge) to IL Route 3 (IL 3); this project is being studied and submitted for approvals separately by IDOT. The preferred alternative also identifies future phases that would add capacity to I-64, thereby reducing congestion to I-64 and improving a problematic location for the region.

The recommended phases are as follows:

- *Phase 1: MLK Connector, Ramp C, Ramp D – Estimated cost: $42.7 million*
    - Construct a ramp connection between the eastbound MLK Bridge and southbound I-64 (duplicating the function of Ramp B). The current schedule is that the MLK Connector and the project that removes Ramp B will be occurring simultaneously. During the construction period when Ramp B is removed and prior to the MLK Ramp being complete, eastbound I-70 traffic will be able to access southbound IL 3 by using the NMRB to St. Clair Avenue to southbound I-55 to southbound IL 3. (See Appendix B, Figure 19). Reconstruct Ramp D to dual-lane ramp
    - Reconstruct Ramp C to a single-lane ramp to share the mainline exit with Ramp D
- *Phase 2: PSB Slide, Ramp A, 64 Split Initial – Estimated cost: $37.3 million*
    - "Slide" the PSB to add an additional eastbound lane (resulting in five eastbound lanes)
    - Widen Ramp A (westbound PSB to southbound I-55) to two lanes
    - Extend the 6th Street on-ramp to become the fifth lane of the PSB
- *(Future) Phase 3: 64 Split Final – Estimated cost: $31 million*
    - Construct a "C-D road" type connection for I-64 at the 6th Street exit and entrance, effectively maintaining three lanes on I-64 eastbound

MoDOT strongly feels that the preferred alternative will be the greatest benefit to taxpayers and the driving public. The preferred alternative will greatly improve the functionality of the interchange for many years to come.

2 Introduction

This Access Justification Report (AJR) was generated by the Missouri Department of Transportation (MoDOT) for submission to the U.S. Department of Transportation, Federal Highway Administration (FHWA) and addresses freeway access modifications proposed for Interstate 55 (I-55), Interstate 64 (I-64), Interstate 44 (I-44), and existing Interstate 70 (I-70), in downtown St. Louis, Missouri. The proposed access changes affect the junction of these interstate facilities at the west end (Missouri side) of the Poplar Street Bridge (PSB).

This AJR seeks approval to reconstruct and reconfigure the interstate ramp connections at the west end of the PSB. Specifically, these changes include:

- Removing and reconstructing the single-lane ramp connections between I-55 and the PSB as dual-lane ramps in both directions
- Reconstructing the westbound (WB) PSB to existing WB I-70 (future NB I-44) ramp
- Removing the existing EB I-70 (future SB I-44) to EB PSB ramp, with construction of the new MLK Connector from EB MLK to WB I-64 in Illinois
- Widening the EB (south) side of the PSB to add one lane between the existing 6th Street entrance ramp (currently a merge situation) and the existing IL 3 ramp (currently an add-lane)
- Future Phase – Add capacity enhancements to EB I-64 by constructing a connector between the 6th Street exit (currently a drop lane) and the 6th Street entrance, creating a continuous third lane

These proposed freeway modifications aim to improve Interstate highway network performance and regional access to and from downtown St. Louis. They are a response to several critical needs and concerns:

- The existing ramps are structurally deficient, costly to maintain, and in need of replacement
- Pending system changes with the opening of the New Mississippi River Bridge (expected Spring, 2014)
- Existing safety concerns
- Existing capacity constraints

2.1 Project Description and Background

2.1.1 Project Location

The Poplar Street Bridge (PSB) was constructed in the late 1960's and currently provides the only Interstate crossing of the Mississippi River in downtown St. Louis. The bridge is located adjacent to the Jefferson National Expansion Memorial (JNEM, or the "Arch") grounds, **Exhibit 2.1**, below. As seen in this image, there are three other river crossings within the City; however none of them are designated as Interstate and most of their connections are to the local network. This project impacts the Missouri-side (west) interchange for the PSB where four interstates converge at the southeast corner of the central business district (CBD) of the City, a very dense urban location. The City of St. Louis has a population of over 300,000 and is, therefore, considered a Transportation Management Area (TMA) as designated by the Secretary of Transportation. The St. Louis region is also currently designated as a non-attainment area for the eight-hour standard for ozone pollution levels. The new eight-hour designation came in April 2004, just months after the region was declared to be in attainment of the one-hour standard.

Exhibit 2.1: Poplar Street Bridge Location Downtown St. Louis, MO (Image: CAR 2015 Final AJR Document, July 2012)

The PSB currently serves as the Missouri-Illinois interstate link for Interstates: 55, 64, and 70 (I-44 currently terminates at its junction with I-55), as shown in **Exhibit 2.2**. The PSB interchange is located at the following milepost locations:

- MP 251 – Interstate 70
- MP 209 – Interstate 55
- MP – 40 – Interstate 64

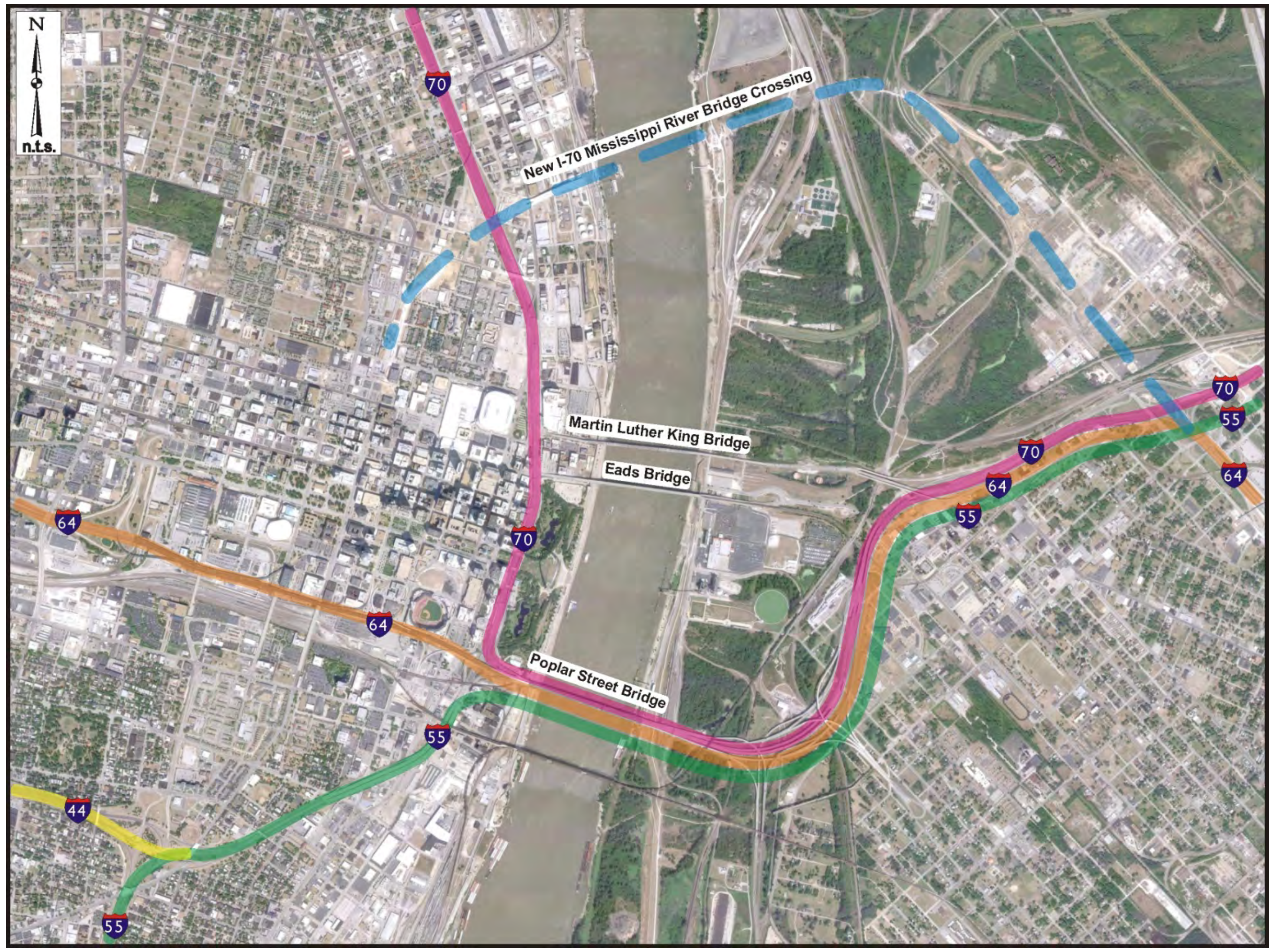


Exhibit 2.2: Poplar Street Bridge Interstate Connections

The exhibit also indicates the complexity and connectivity of the interstate network adjacent to the PSB. Interstates 44 and 55 converge roughly two miles southwest of the PSB interchange. Interstate 64 converges with I-55/I-70 approximately four miles east of the PSB interchange. In addition, a New Mississippi River Crossing is currently being constructed north of the PSB. This new crossing and its approaches will be designated as I-70 and will connect from the system interchange east of the bridge, to a new interchange roughly two miles north of the PSB interchange. The study area therefore incorporated this entire network.

2.1.2 Project History

2.1.2.1 The New Mississippi River Bridge

Planning for PSB Interchange improvements formally began with the planning for the New Mississippi River Bridge (NMRB, Section 2.1.4.1). This project was included in a Final Environmental Impact Statement (FEIS) approved by the Federal Highway Administration (FHWA) on March 26, 2001, with a Record of Decision (ROD) approved on June 13, 2001 and a subsequent re-evaluation on November 5, 2008. The preferred alternative included alterations to the ramps at the west side of the existing PSB (referred to as the Missouri South Interchange) among other downtown St. Louis interstate access improvements.

The New Mississippi River Bridge (NMRB) is the first bridge connecting downtown St. Louis and southwest Illinois to be built in more than 40 years. The project is currently under construction and expected to be complete in early 2014. The NMRB will create a new gateway between Illinois and Missouri that provides better connections to and through St. Louis. The project includes a new landmark bridge structure and the realignment and reconstruction of I-70 and numerous local roads on both sides of the state line. The new facility will include four traffic lanes, two eastbound and two westbound, with direct ramp connections to and from downtown St. Louis as well as to and from I-70 to the west (from I-70 eastbound and to I-70 westbound). The project aims to provide enhanced transportation system reliability, sustainability, linkages, and community access and to reduce traffic congestion and incident potential on the existing downtown St. Louis area Mississippi River crossings as shown in Exhibit 2.4. When complete, the NMRB will be designated as I-70, as shown in Exhibit 2.5, relocating that east-west movement from the existing PSB and Martin Luther King (MLK) bridges and reducing overall traffic volumes in the downtown area. The segment of existing I-70 between the PSB and the future NMRB Missouri North I-70 Interchange, currently designated as I-70, will be re-designated as I-44.

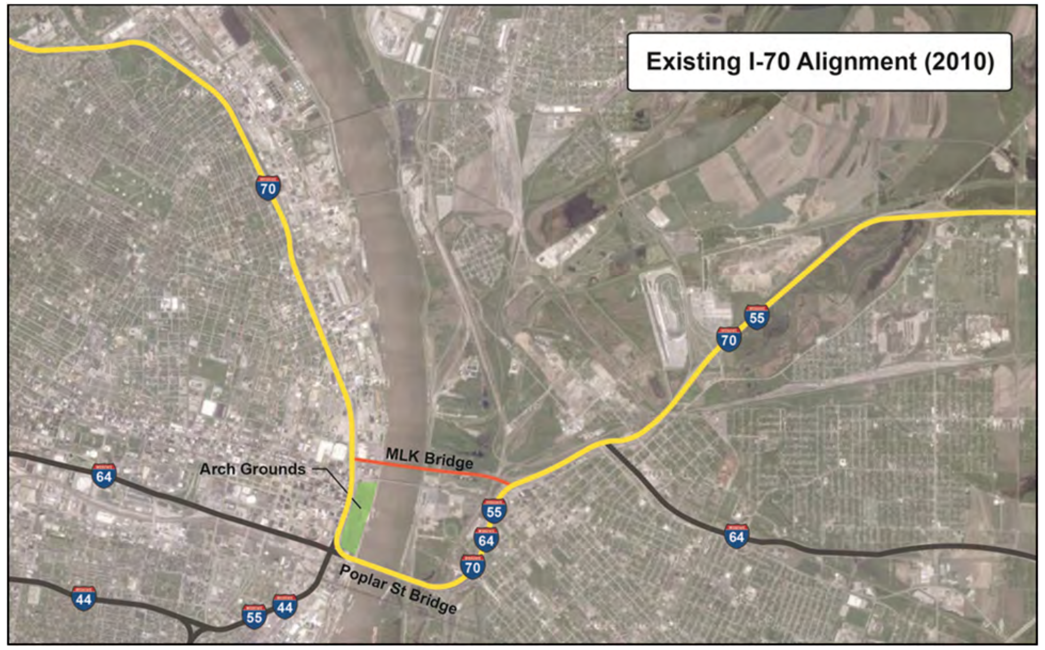


Exhibit 2.3: Existing Interstate I-70 Alignment through downtown St. Louis
(Image: CAR 2015 Final AJR Document, July 2012)

In the approved NMRB FEIS document, the Preferred Alternative included the following components to relieve increasingly severe traffic congestion and reduce traffic crashes on downtown St. Louis area Mississippi River crossings, especially at the Poplar Street Bridge (PSB):

- Relocated I-70 in Illinois, north of its current location (Illinois I-70 roadways) including an interchange with Relocated IL Route 3
- A new, eight-lane, I-70 Mississippi River Bridge (New Mississippi River Bridge)
- An interchange in Missouri with existing I-70 (Missouri North I-70 Interchange)
- An improved Tri-Level Interchange (I-55/64/70) in East St. Louis (Tri-Level Interchange)
- A connection between existing I-55/64/70 (Tri-Level Interchange) and the relocated I-70 (I-64 Connector)
- Improvements to ramps at the west side of the existing I-55/64/70 Poplar Street Bridge including the removal of the existing I-70 ramps (Missouri South Interchange)

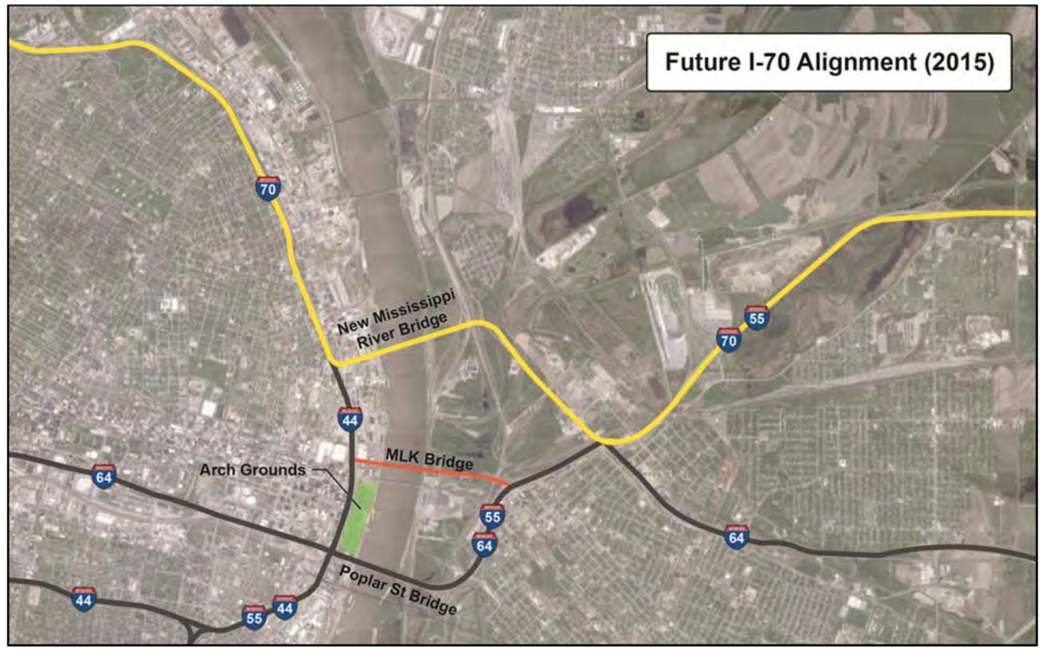


Exhibit 2.4: Future Interstate I-70 Alignment through downtown St. Louis
(Image: CAR 2015 Final AJR Document, July 2012)

In 2004, it was determined that funding for the entire project could not be secured to satisfy the financial plan requirements for a major project. In May 2005, Illinois and Missouri initiated numerous efforts to reduce the cost of the project:

- Following relocated I-70 in Illinois, north of its current location but avoiding the Cahokia Canal Relocation
- A new, eight-lane, I-70 Mississippi River Bridge with the main span reduced in length from 2,000 feet to 1,500 feet;
- Reducing the scale of the Missouri North I-70 Interchange
- Delaying to a later phase the reconstruction of the Tri-Level Interchange (I-55/64/70) in East St. Louis
- Delaying to a later phase the connection between the existing Tri-Level Interchange and the I-64 Connector
- Delaying to a later phase the proposed improvements to ramps at the Missouri South Interchange

In January 2007, the Federal Highway Administration issued a Major Project Guidance which amended Title 23 United States Code Subchapter 106 and made several significant changes to the requirements for Major Projects. One of the changes allows the scope of work described in the ROD to be divided into multiple projects that will independently conform to Major Project requirements. The multiple projects would be operationally independent phases of work which can be built and function as a viable transportation facility even if the rest of the work described in the ROD is never built.

Based on the Title 23 amendment, the Illinois Department of Transportation (IDOT) submitted an October 2008 Memorandum that re-evaluated the 2001 FEIS. The Memorandum describes an operationally independent initial phase of the New Mississippi River Bridge Project that allows the states to satisfy the Major Projects requirements while providing components essential to meeting the main elements of the project's purpose and need. The proposed improvements are referred to as the New Mississippi River Bridge (NMRB) crossing, shown in Exhibit 2.5, and include:

- A new two-way four-lane I-70 Mississippi River Bridge and approaches in Illinois and Missouri
- A four-lane roadway (Relocated I-70), primarily following the original I-64 connector alignment, connecting the new bridge to the I-55/64/70 Tri-Level Interchange
- Various ramp improvements and local street improvements at the I-55/64/70 Tri-Level Interchange
- A new Missouri North I-70 Interchange connecting the new bridge to I-70
- A new local street connection from the new bridge to Cass Avenue in St. Louis.

It was anticipated that a future project (referred to as NMRB Phase II) would include the following key components carried over from the original plans:

- A companion four-lane Mississippi River Bridge
- A relocated I-70 alignment from the east end of the NMRB to east of the I-55/I-64/I-70 Tri-Level Interchange
- Connections to and from I-44 south of the Missouri North I-70 Interchange
- Additional local street connections at the Missouri North I-70 Interchange near Cass Avenue
- Improvements to ramps at the west side of the existing I-55/64/70 Poplar Street Bridge including the removal of the existing I-70 ramps (Missouri South Interchange)

At this time only the PSB Ramp improvements (Missouri South Interchange) is being proposed for implementation. Additional projects are not approved or funded and there is no timeline for construction.

Subsequent to the delay of the PSB Interchange portion of the NMRB project, MoDOT discovered a miscalculation error that was instrumental in shaping the preferred design for that project. A metric conversion error led to the belief that existing Ramp C could not be reconstructed in place within current design standards. Therefore the plans instead proposed constructing both a loop ramp to connect the PSB with Spruce Street and a bridge over I-70 to connect to Memorial Drive. That discovery allowed MoDOT to investigate more practical design options. It has since been confirmed that existing Ramp C can be reconstructed in place to meet design standards, and the loop ramp/bridge concept was determined to be less preferable.

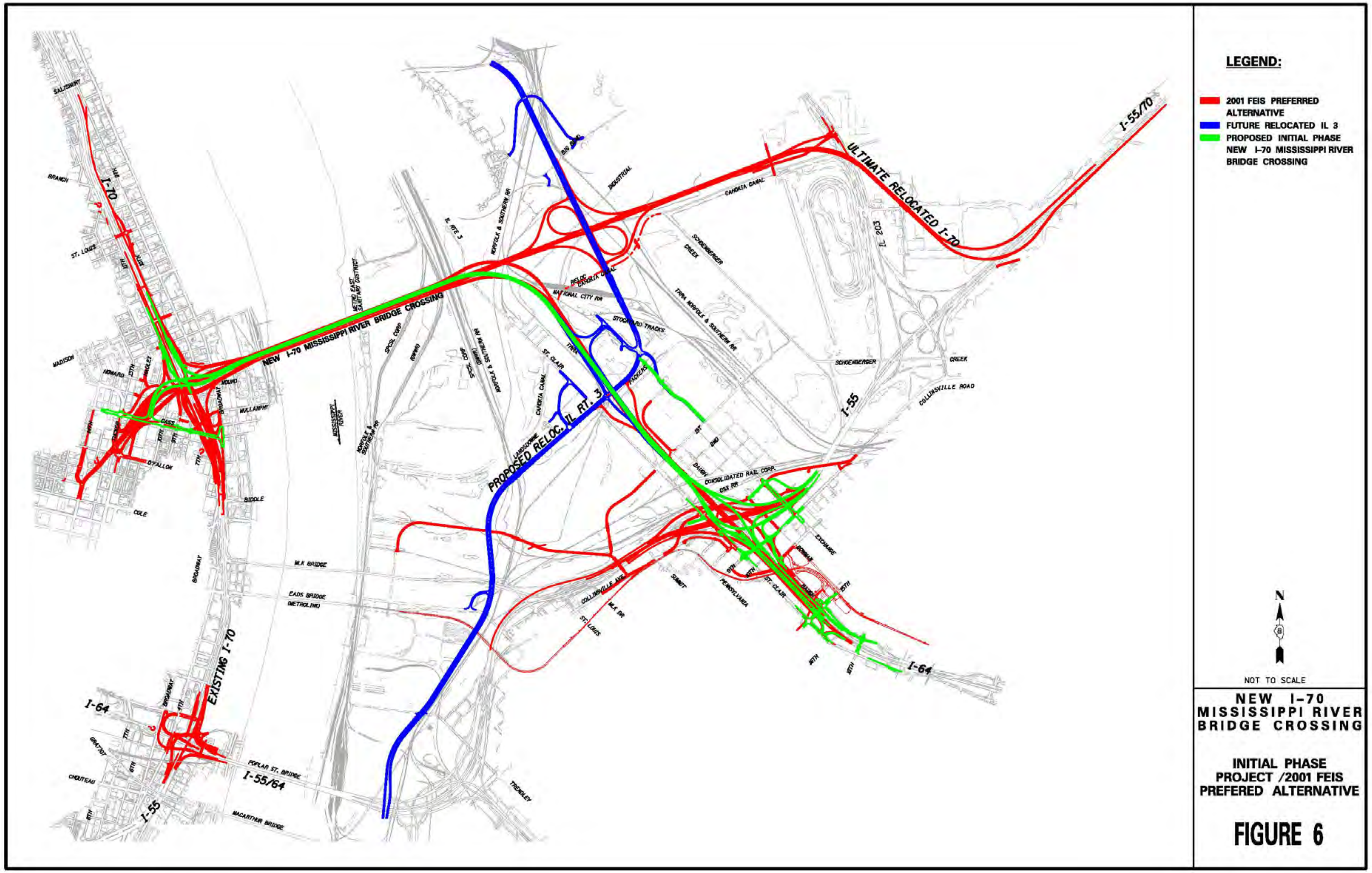


Exhibit 2.5: New Mississippi River Bridge Initial Phase Project and 2001 FEIS Preferred Alternative

Please Note: Proposed Relocated IL Route 3 is not part of the NMRB project. The interchange between Relocated IL Route 3 and the new I-70 alignment is included in the Initial Phase NMRB Project.

2.1.2.2 Poplar Street Bridge Independent Review

Although delayed to an indeterminate later Phase of the NMRB project, the PSB Interchange project remained part of the plan for the downtown St. Louis network. The PSB Modifications were in the EWGCOG Transportation Improvement Program (TIP) as Bridge Improvements to 21st St. to Poplar St. Bridge under project #4414K-12-02, and are in the MoDOT Statewide Transportation Improvement Program (STIP) as Rehab and Reconstruction under projects #6I2377B and #6I2377C. All plans included in the STIP were also addressed in the MoDOT Long Range Transportation Plan (LRTP).

When planning for the City+Arch+River | Project began in 2010, MoDOT saw an opportunity for concurrent design and reconstruction of the PSB Interchange. Performing these projects simultaneously would allow both design teams to integrate their projects, would minimize any impacts to the new Arch project by later PSB Interchange construction, and would spare the public multiple construction periods.

Due to the regional significance of the PSB and its approaches, MoDOT and the IDOT cooperated to investigate design alternatives for the PSB Interchange, with the knowledge that the preferred design associated with the NMRB project was not practical. The bi-state effort concluded that the existing and projected traffic warranted dual-lanes to and from I-55 south of the PSB (existing Ramps A and D). In addition, constructing these ramps to meet design standards and improve safety within the interchange would require removal of Ramp B (eastbound I-70 to eastbound PSB). A preferred alternative was defined in a Draft PSB Interchange AJR document dated July, 2012.

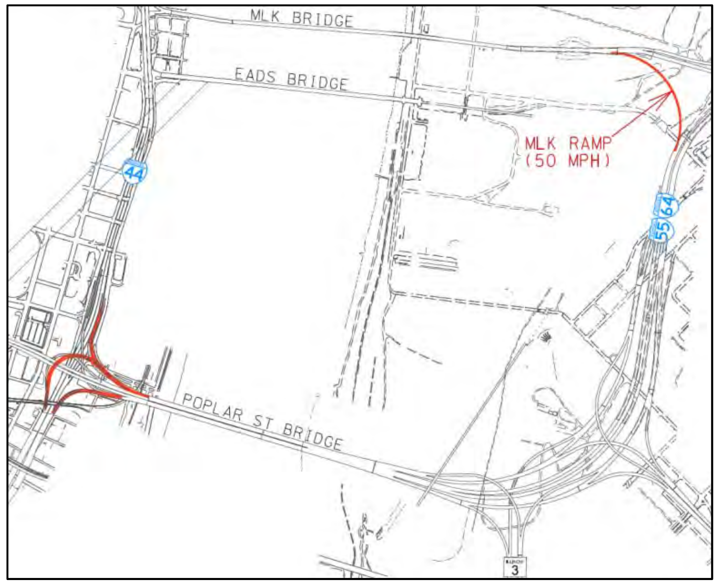
Concerns expressed by local stakeholders regarding the impacts to Illinois drivers led to the removal of the project from the TIP. Subsequently, the local MPO (East West Gateway Council of Governments, or EWGCOG) engaged a local consultant to perform an independent review of design options for the PSB Interchange and to identify any additional alternatives. The consultant was asked to evaluate six different alternatives that could preserve the function of existing Ramp B. All five options incorporated two-lane ramps to and from I-55 and preservation of existing Ramp C (the westbound PSB to westbound I-70 movement). These design alternatives were evaluated for the 2035 projected PM peak hour traffic volumes using MoDOT's design criteria and an operational analysis using VISSIM microsimulation software. The final report for the EWGCOG investigation is attached to this AJR as Appendix A.

The following points from the EWGCOG study are relevant to the analysis supporting this AJR documentation:

- Regarding Ramp B –
    - An operationally acceptable option to maintain Ramp B could not be identified. See Exhibit 2.6.
    - If additional capacity (lanes) is added to the EB PSB, greater improvements can be made to the system by utilizing that lane for I-64 vs. Ramp B. See Exhibit 2.7
- Regarding Ramp A –
    - "A design principle gleaned…is that two unimpeded lanes are needed on Ramp A if the northbound I-55 mainline is to function acceptably"
    - "…and analysis of previous options demonstrated clearly that Ramp A (northbound-to-eastbound PSB) must carry two unimpeded lanes."
- Regarding the PSB
    - The PSB structure type and design affords a unique opportunity to widen the structure at a reasonable cost
- Regarding I-64 –
    - Any design alternative that does not address I-64 perpetuates the failing operations (LOS F) of the eastbound I-64 approach. See Exhibits 2.6 and 2.7
    - The capacity constraint of four eastbound lanes on the PSB is a fundamental problem in the interchange.
    - "Without a doubt, the 6th Street exit-only lane (that reduces I-64 through lanes from three to two) is "the bottleneck that contributes most significantly to existing and future congestion on I-64 during the PM peak hour.

Based on their findings, the independent consultant's recommended "a program of phased improvements that would ultimately have a substantial, positive regional impact on commute traffic."[1] The recommended phases were as follows:

- *Phase 1: MLK Connector, Ramp C, Ramp D – Estimated cost: $42.7 million*
    - Construct a ramp connection between the eastbound MLK Bridge and westbound I-64 (duplicating the function of Ramp B). The current schedule is that the MLK Connector and the project that removes Ramp B will be occurring simultaneously. During the construction period when Ramp B is removed and prior to the MLK Ramp being complete, eastbound I-70 traffic will be able to access southbound IL 3 by using the NMRB to St. Clair Avenue to southbound I-55 to southbound IL 3. (See Appendix B, Figure 19).Reconstruct Ramp D to dual-lane ramp
    - Reconstruct Ramp C to a single-lane ramp to share the mainline exit with Ramp D



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[1] *Poplar Street Bridge: Independent Review*, East-West Gateway Council of Governments; September 12, 2012

- *Phase 2: PSB Slide, Ramp A, 64 Split Initial – Estimated cost: $37.3 million*
    - "Slide" the PSB to add an additional eastbound lane (resulting in five eastbound lanes)
    - Widen Ramp A (westbound PSB to southbound I-55) to two lanes
    - Extend the 6th Street on-ramp to become the fifth lane of the PSB
- *Phase 3: 64 Split Final – Estimated cost: $31 million*
    - Construct a "C-D road" type connection for I-64 at the 6th Street exit and entrance, effectively maintaining three lanes on I-64 eastbound

Upon review of EWGCOG's recommendations, Illinois and Missouri agreed to jointly implement the recommended course of action. MoDOT and IDOT have drafted an agreement that is expected to be finalized by summer, 2013. With the MPO and State DOT approvals and agreements, the project was restored to the TIP.

2.1.2.3 MLK Connector

Subsequent to EWGCOG's Poplar Street Bridge Independent Review (Section 2.1.2.2) and the regional agreements to the Poplar Street Bridge related projects, IDOT began planning for the proposed MLK Connector. As described in the previous section, the MLK Connector project will construct a one-lane ramp from existing EB MLK Bridge to the existing WB I-64/55/70 (future WB I-64/55). This proposed freeway modification, allows for continued access from downtown St. Louis to the Sauget area in St. Clair County, which will be eliminated by the removal of existing Ramp B. The MLK Connector will allow eastbound MLK Drive access to westbound I-64/55/70, which will then provide access to southbound IL 3 and Piggott/Tudor Avenue. Plans for this new connection are shown in Exhibits 2.8 and 2.9. A Preliminary AJR for the MLK Connector project has been prepared (May, 2013) and is attached to this document as Appendix B.

MLK Drive is the extension of the MLK Bridge, in the City of East Louis, Illinois, and connects I-64/55/70, in Illinois, with I-70 (future I-44) and the downtown street network in St. Louis, Missouri. The bridge was built in 1951 as the Veterans' Memorial Bridge to relieve congestion on the MacArthur Bridge to the south and was owned by the City of East St. Louis. In 1968, the ownership was transferred dually to the Missouri (MoDOT) and Illinois (IDOT) Departments of Transportation and the bridge was renamed after Martin Luther King, Jr.

This new link will duplicate the function of existing PSB Interchange Ramp B, thereby allowing for its removal. The operational and safety analyses for this PSB Interchange AJR reflect the incorporation of an operational MLK Connector and, as presented in Section 6 Alternatives Analysis (Model Results and Outputs), clearly indicate that the MLK corridor (including the MLK Bridge, the local street network on the Missouri side, and the proposed interstate connections on the Illinois side) can accommodate the projected additional traffic diversions from existing Ramp B.

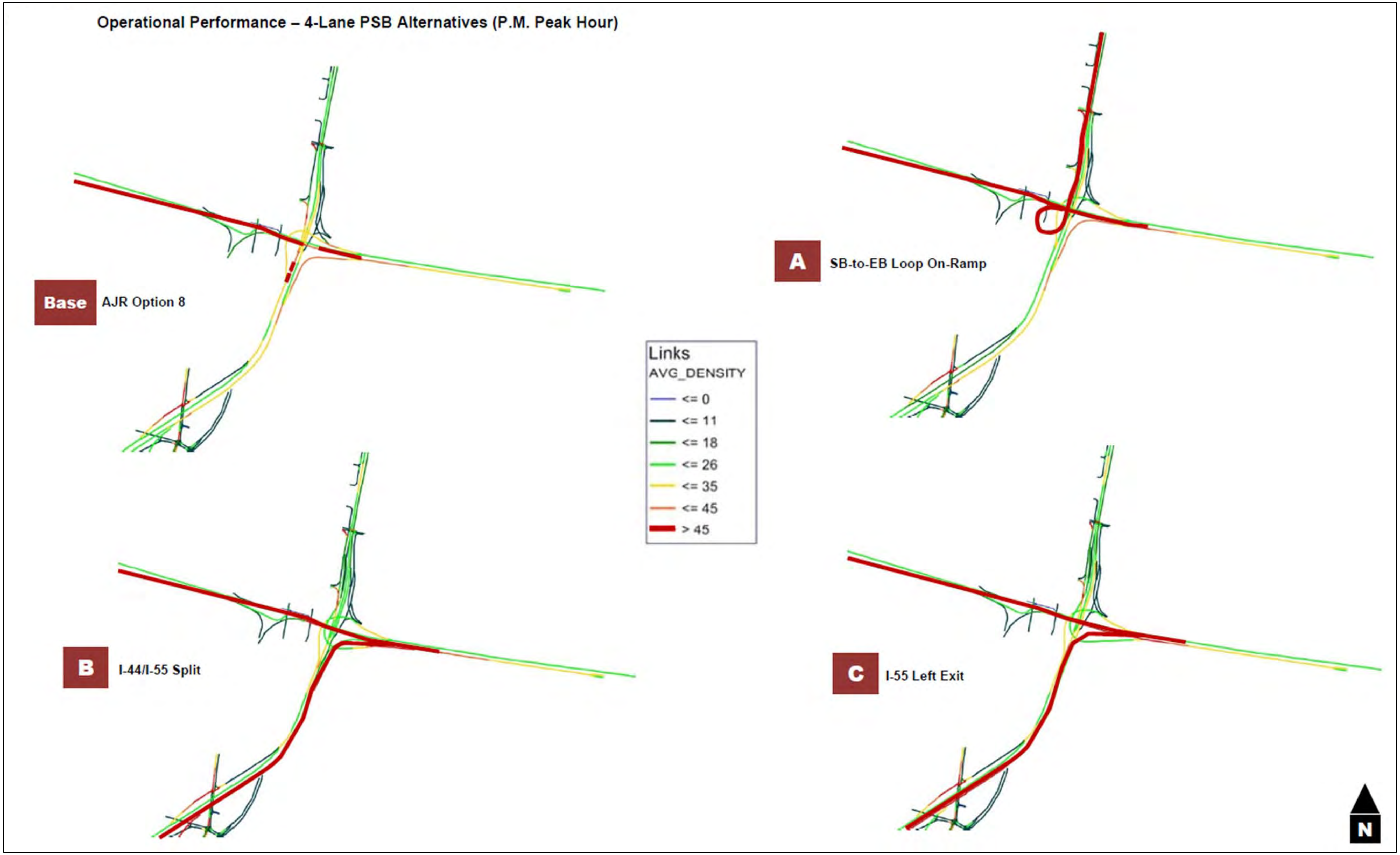


Exhibit 2.6: Projected Operational Performance of PSB Interchange Options to Maintain Existing Ramp B (Image: Poplar Street Bridge: Independent Review, September 2012)

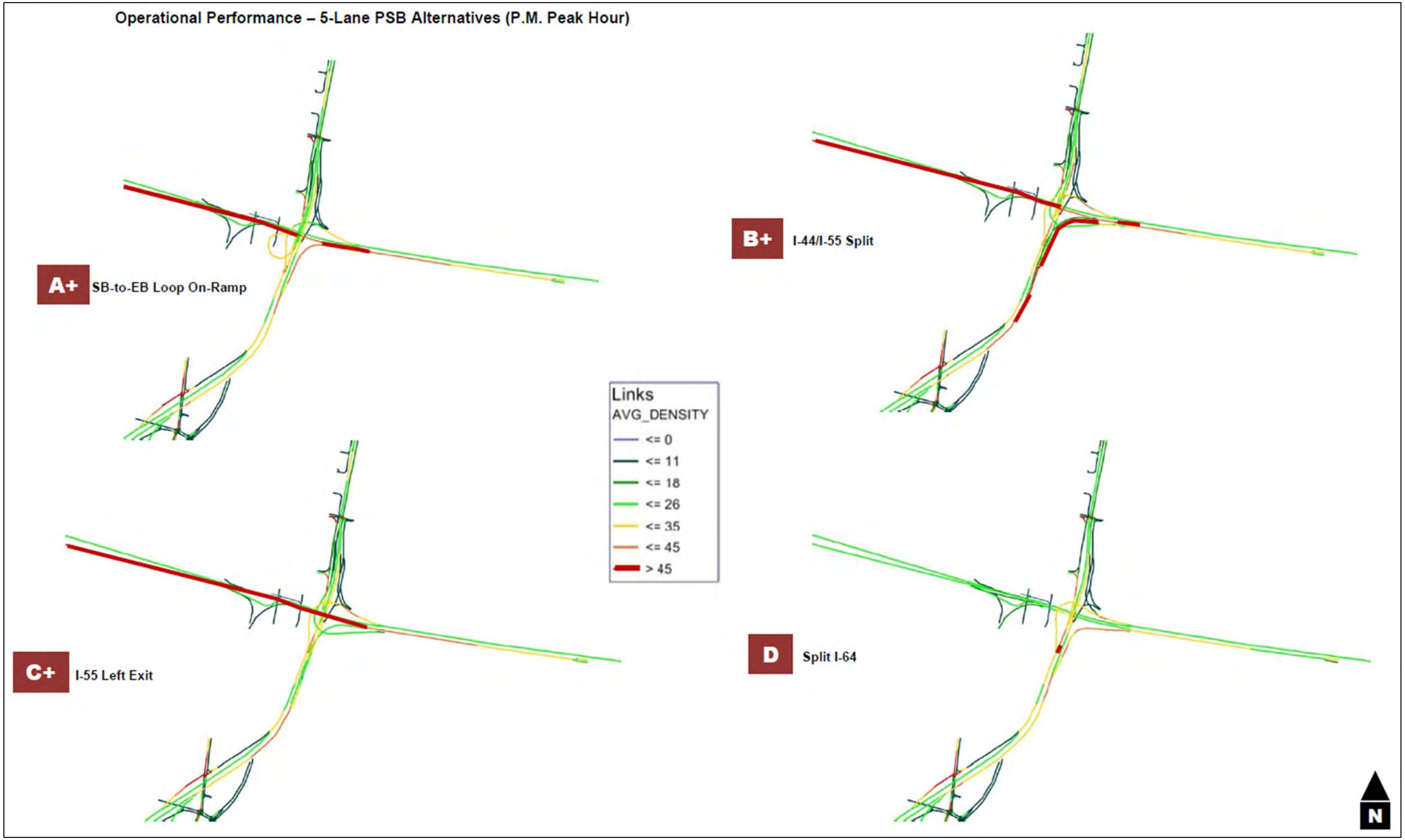


Exhibit 2.7: Projected Operational Performance of PSB Interchange Options to Maintain Existing Ramp B (Image: Poplar Street Bridge: Independent Review, September 2012)

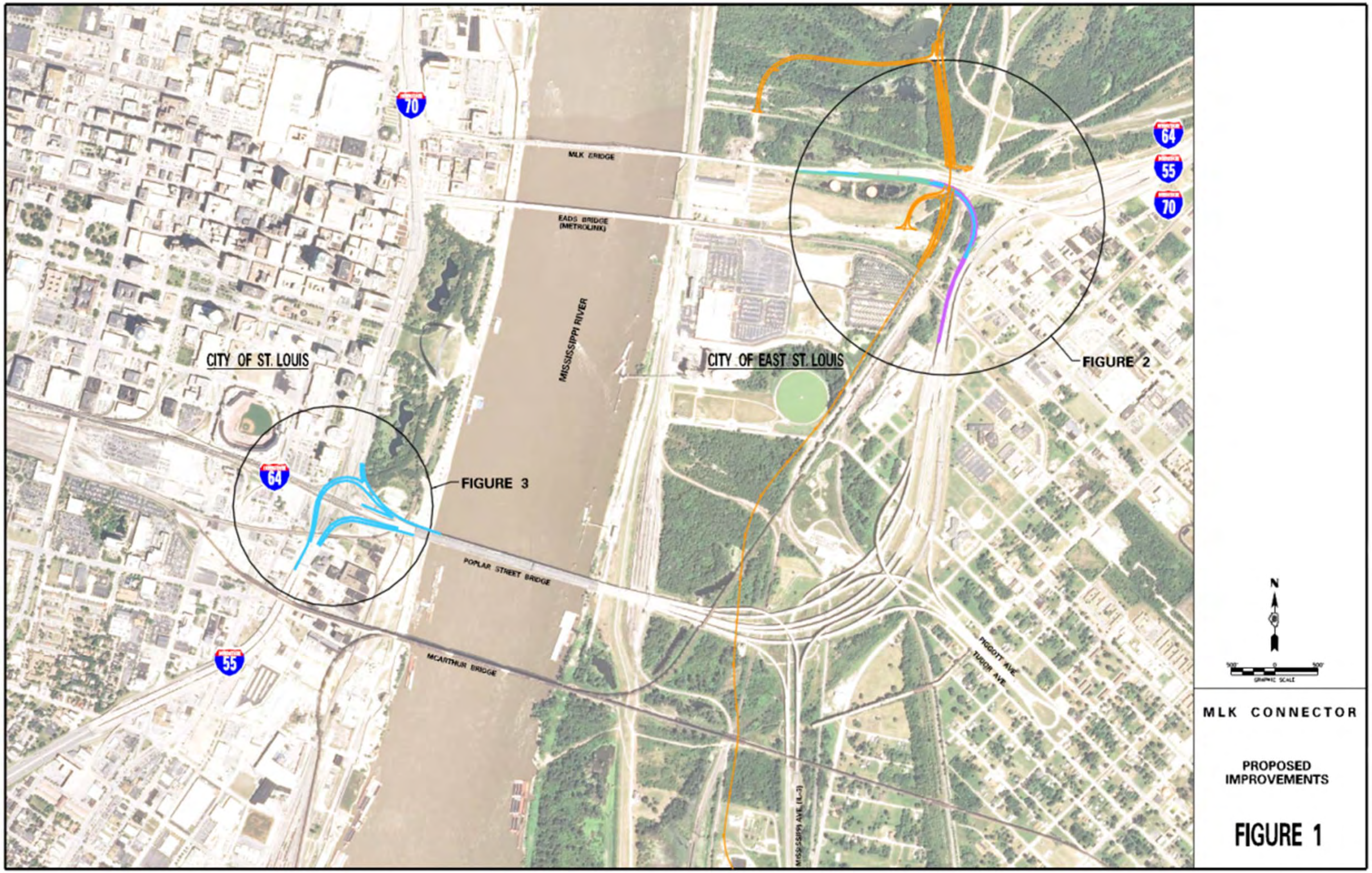


Exhibit 2.8: Proposed MLK Connector, Figure 1 (Image: MLK Connector Preliminary AJR, May2013)

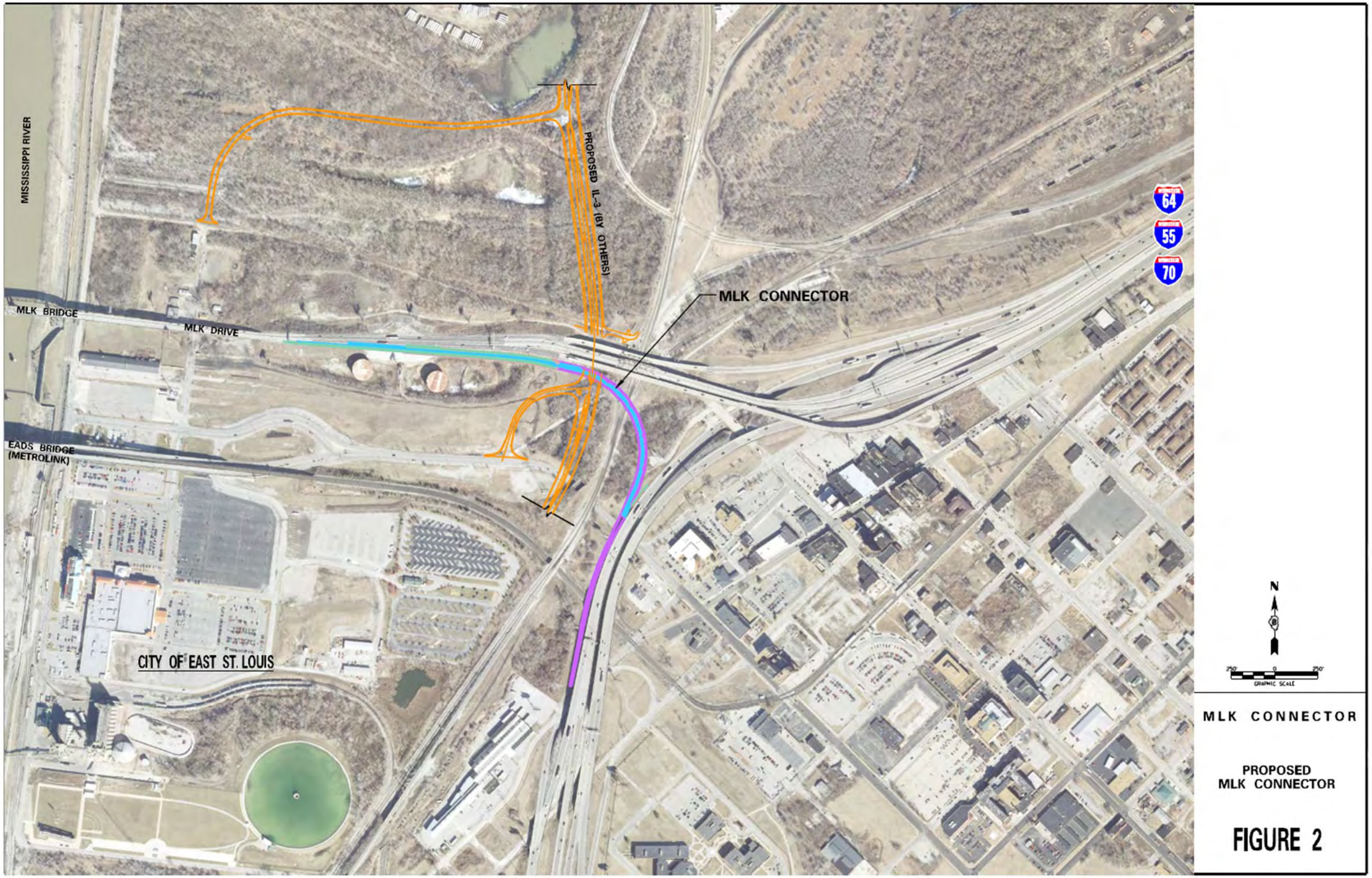


Exhibit 2.9: Proposed MLK Connector, Figure 2 (Image: MLK Connector Preliminary AJR, May2013)

2.1.3 Existing Conditions and Geometries

The existing PSB Interchange is a 40-year old substandard design with substandard curves and clearances, tapered merges, short weaving distances, and multiple decision points within short distances. These geometric and traffic conditions create safety concerns, and the interchange has 3 times the average crash rate. In addition, all four of the I-70 and I-55 ramp bridges are currently rated as structurally deficient, and their condition has deteriorated to the point where rehabilitation is no longer a feasible option for MoDOT. One purpose of this project is to replace the structurally deficient bridge ramps.

The interchange is also operating over-capacity: 100,000 vehicles per day currently utilize the interchange, and this volume is expected to increase to 150,000 by year 2030. I-64 approaching the PSB is heavily congested and causes congestion and queues over a half-mile long in the PM peak period. Most of the congestion on the ramps, both commuter and non-commuter traffic, occurs on the I-55 ramps to and from the PSB. Traffic patterns have shifted in this area over time; when the PSB first opened, traffic on the west interchange ramps was heavier to and from the north on I-70. Since then, travel demand has shifted to the south. The traffic demand has greatly oversaturated both the mainline approach and the single-lane ramps; adding capacity is the only viable option to reducing congestion at this interchange.

The PSB Interchange ramp network, shown in Exhibit 2.10, currently includes four ramps:

- Ramp A: from northbound (NB) I-55/I-44 to PSB eastbound (EB).
- Ramp B: two ramps that combine to become one connection to EB PSB – one from southbound (SB) Memorial Drive and one from EB I-70
- Ramp C: one ramp that divides to two ramps connecting westbound (WB) PSB with NB Memorial Drive and the depressed section of WB I-70
- Ramp D: WB PSB to SB I-55/I-44

The daily and peak hour ramp traffic volumes, also shown on Exhibit 2.3, are an indication of the congestion caused by the west PSB Interchange. All four ramps approach or exceed the capacity of a single-lane ramp. In addition, three of the four ramps (B, C, and D) have substandard geometric features which require or create reduced ramp travel speeds, compounding the congestion. These geometric features additionally contribute to a number of roadway crashes causing recurrent travel interruptions and delays.

As seen in Exhibit 2.3, there are currently two lanes on EB I-64 approaching the PSB. Two additional lanes from Ramp A (NB I-55) and Ramp B (EB I-70) join the EB I-64 lanes on their right; resulting in four eastbound lanes on the PSB crossing the Mississippi River.

2.1.3.1 Ramp A – Northbound I:55/44 to Eastbound PSB

Ramp A, shortly after exiting mainline NB I-55, goes under a railroad overpass as shown in Photo 2.1. This bridge is a limiting factor in both the vertical and horizontal alignment for this ramp. Currently, Ramp A has a vertical clearance of 14’-10”, which is less than the preferred clearance of 16’-6” for interstates according to MODOT standards. The sag vertical curve beneath the railroad bridge is acceptable for only 20 MPH, and the horizontal curve is acceptable for 30 MPH. This ramp is signed with an advisory speed of 20 MPH via an overhead guide sign with flashers. The curve itself is signed with chevrons and an arrow board, as shown in Photo 2.2.

Photo 2.1: Existing Ramp A Under the Railroad Bridge


Photo 2.2: Sharp Horizontal Curve on Ramp A

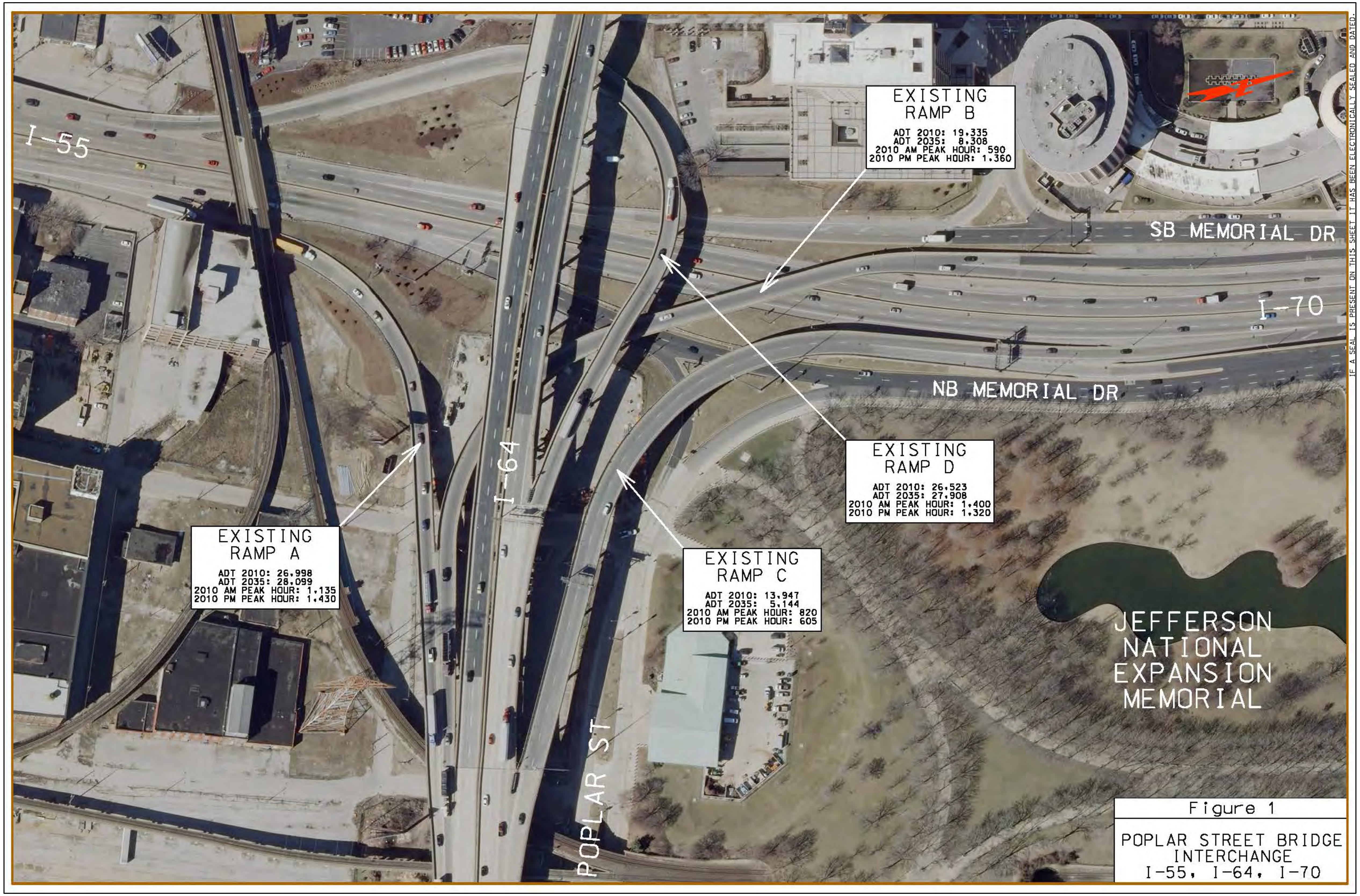


Exhibit 2.10: Existing Poplar Street Bridge Interchange

2.1.3.2 Ramp B – Eastbound I-70 to Eastbound PSB

Ramp B is elevated over both I-70 and NB Memorial Drive, and runs under both Ramp D and I-64. Ramp B has a vertical clearance of 15'-0" over I-70 instead of the preferred clearance of 16'-6" over an interstate, see Photo 2.3. There are also low vertical clearances of 14'-11" over NB Memorial Drive, and 15'-2" under I-64. This ramp has a sag vertical curve beneath I-64 which is only acceptable for 25 MPH. Increasing the vertical clearances over I-70 or under I-64 would only make this sag vertical curve worse, and improving the vertical curve would reduce the clearances.

Photo 2.3: Facing south toward Ramp B over I-70

Due to a sharp horizontal curve, as well as the sub-standard vertical alignment, Ramp B has a posted advisory speed of only 20 MPH. There are also warning chevron signs installed along the sharp curve, as shown in Photo 2.4. Ramp B is tightly threaded between the columns of both the EB and WB spans of the I-64 bridges and around one of the columns of Ramp D. There is no available space to improve the horizontal alignment of this ramp in its current location due to the existing bridge columns.

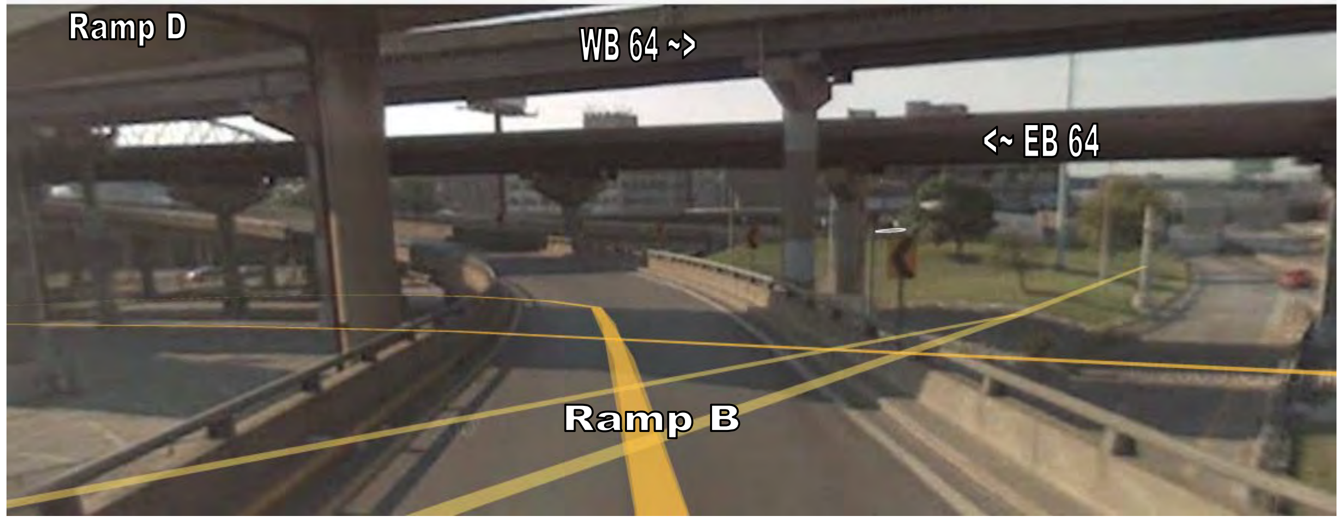


Photo 2.4: Sharp curve along Ramp B between columns of I-64 bridges

2.1.3.3 Ramp C – Westbound PSB to Westbound I-70

Due to the relocation of I-70 to the NMRB, removal of the connection from WB PSB to WB I-70 (Ramp C) was considered. The existing entrance ramp has a sub-standard tapered acceleration lane, Photo 2.5, however a new auxiliary lane is proposed between the entrance of Ramp C and the new "Washington Exit" ramp to be built as part of the CAR-2015 project. During planning for that project, MoDOT designers found a practical solution for providing that auxiliary lane without impacting the existing retaining walls between EB I-44 (existing WB I-70) and Memorial Drive. Adding a 12-foot wide auxiliary lane will involve restriping the mainline lanes from 12 feet to 11 feet, and reducing the outside shoulder from 12 feet to 2 feet, which will require design exceptions (The 6I2413 design exception was approved contingent on further discussion concerning these lane widths). The same concept will be used for the WB I-44 lanes (existing EB I-70) to add an acceleration lane from the new "Washington Entrance" ramp from Memorial Drive, also part of the CAR-2015 project.

Photo 2.5: Depressed lanes of I-70 south of Walnut St at Ramp C acceleration lane

2.1.3.4 Ramp D – Westbound PSB to Southbound I-55/44

Ramp D currently has a very sharp horizontal curve, with a posted advisory speed of only 20 MPH. In addition, the ramp crosses under the Terminal Railroad Association Bridge with vertical 20 MPH sag curve and sub-standard vertical clearance of 14'-6".

For the new dual-lane Ramp 2, the horizontal alignment improves from a design speed of 30 MPH to 35 MPH. The sag vertical curve improves from 20 MPH to 30 MPH, and the crest vertical curve improves from 35 MPH to 45 MPH. Eliminating the WB I-44 (existing EB I-70) traffic using Ramp B will greatly improve the operations of Ramp 2 by affording that ramp dedicated lanes on the PSB.

2.1.4 Related Projects

2.1.4.1 City+Arch+River | 2015

CityArchRiver 2015 (CAR 2015) is a foundation-led project to reconnect downtown St. Louis, the Jefferson National Expansion Memorial (JNEM) grounds (home to the Gateway Arch) and the Mississippi River through improvements to St. Louis City interstates, streets, sidewalks, bridges, and landscaping. The CAR 2015 project aims to create this connection, in part, with a Park over the depressed section of I-70, between Market and Chestnut Streets in downtown St. Louis as shown in **Exhibit** 2.11.

Exhibit 2.11: Rendering of CAR 2015 Park over the Highway (Image: CAR 2015 Final AJR Document, July 2012)

These plans will necessitate modifications to three Interstate ramps in addition to various surface street modifications as shown in **Exhibit** 2.12 and including:

- Closure of NB and SB Memorial Drives
- 'Flipping' the ramps at Memorial Drive [i.e. the entrance to WB I-70 from NB Memorial Drive will become an exit from (future) EB I-44 to Washington Avenue and the exit from EB I-70 to SB Memorial Drive will become an entrance from Washington Avenue to (future) WB I-44]
- Adding a new connection between NMRB ramps at N. Tucker Boulevard to replace the EB/SB off-ramp movement lost at Memorial
- Adding a new street network connection to create new access to an existing on-ramp at the Martin Luther King Jr. Bridge (MLK), which replaces the WB/NB on-ramp movement lost at Memorial.
- An extension of North 3rd Street to connect with an existing on-ramp to I-70 westbound near the western terminus of the Martin Luther King Jr. Bridge

The CAR 2015 project AJR received approval for engineering and operational acceptability from FHWA in July, 2012. The environmental documentation was approved in May, 2013. Construction is expected to begin in August, 2013 with completion by October 28, 2015 (the fiftieth anniversary of the completion of the Arch monument and the scheduled dedication for all CAR 2015 improvements).

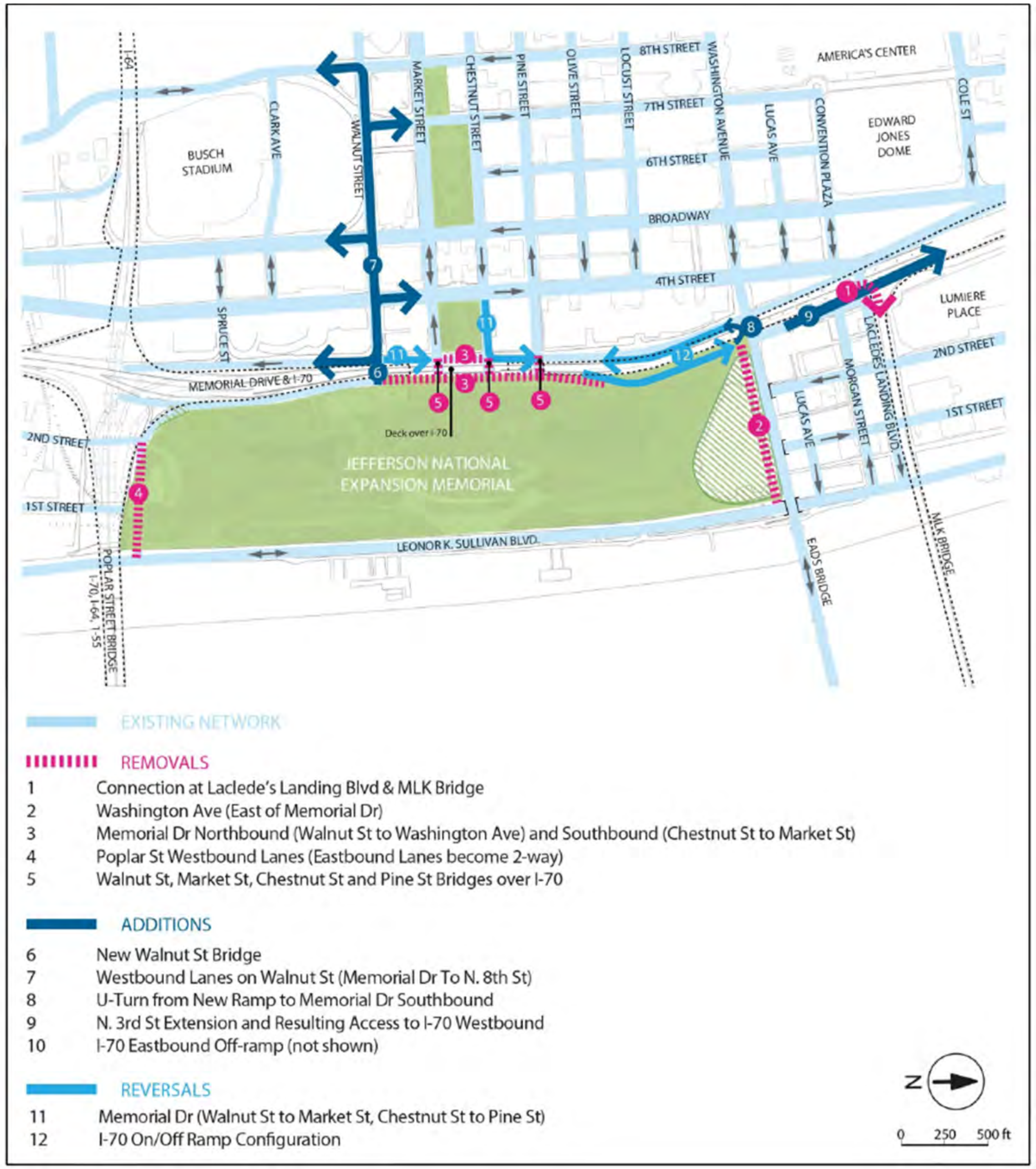


Exhibit 2.12: CAR 2015 Proposed Network Changes (Image: CAR 2015 Final AJR Document, July 2012)

2.1.5 Related Transportation Studies

2.1.5.1 2009 Memorial Drive Closure Traffic Study

In 2009, EDAW/AECOM in collaboration with AECOM Transportation performed a Traffic Impact Study as part of the General Management Plan/EIS for the JNEM in Downtown St. Louis. The purpose of the study was to determine the traffic impacts of closing a portion of Memorial Drive, adjacent to the Jefferson National Expansion Memorial (JNEM), to vehicular traffic. The study identified the traffic impacts on adjacent streets, intersections, and ramps in the vicinity of the Memorial in Downtown St. Louis.

The following three scenarios were tested on Memorial Drive as a part of this study:

- Scenario A: One-block closure of northbound and southbound Memorial Drive between Market Street and Chestnut Streets;
- Scenario B: Two-block Closure of northbound and southbound Memorial Drive between Walnut and Chestnut Streets; and
- Scenario C: Three block closure of northbound and southbound Memorial Drive between Walnut and Pine Streets.

The results of this study indicated that Scenario A (one-block closure) created the least traffic impacts. Scenario B (two-block closure) would have greater impacts than Scenario A, and Scenario C would present the most significant traffic operations impacts of all three Scenarios. All three scenarios were expected to favour pedestrian circulation and access by eliminating the roadway barrier adjacent to the Arch grounds. Additional analysis results included:

- Scenario A: all intersections near the Arch Grounds operated at LOS D or better.
- Scenario B: LOS E during the AM peak period at the 4th Street/ Walnut Street intersection due to increased traffic through this intersection. LOS D at the Broadway Avenue/ Walnut Street intersection was due to a major increase in the southbound left turn volumes as under Scenario A.
- Scenario C: the SYNCHRO model displayed congested conditions with LOS E during the AM peak periods at the 4th Street/ Walnut Street and 4th Street/Pine Street intersections. For the 4th Street/Walnut Street intersection, LOS E was projected due to increased traffic through the intersection in both directions while at the 4th Street/Pine Street intersection a LOS E was anticipated due to increased traffic volumes on the westbound approach.

2.1.5.2 2009 Martin Luther King (MLK) Bridge Alternatives Analysis

Crawford, Bunte, Brammeier (CBB) performed an alternative analysis in 2009 summarizing alternative lane configurations on the Martin Luther King (MLK) Bridge. The Martin Luther King Bridge connects Interstates 55/70/64 and Martin Luther King Drive in East St. Louis, Illinois, with Interstate 70 and the downtown street network in St. Louis, Missouri. The 2009 IDOT internet ADT maps showed that the bridge carried about 37,500 vehicles per day.

The purpose of the Martin Luther King Bridge Alternatives Analysis was to evaluate alternative lane configurations that would improve safety along the bridge. MLK Bridge traffic flows are influenced by both the systematic interaction of the downtown bridge system and the MLK Bridge's geometrics. The MLK Bridge had four narrow travel lanes (approximately 10 feet in width) and no median barrier separating opposing traffic. It was common for motorists to avoid side-by-side travel with other vehicles, presumably because of discomfort with the narrow lane configuration. Likewise, the sharp right-turn movement at the Missouri end of the bridge required westbound vehicles to slow to approximately 30 mph, resulting in minor traffic backups and/or "moving queues" under heavy volumes.

This configuration coupled with vehicles routinely travelling in excess of the 45 miles per hour (mph) speed limit were contributing factors to safety issues, specifically head-on collisions. Reducing the potential for these crashes was IDOT's primary focus in developing various alternative lane configurations on the MLK Bridge. However, the narrow width of the bridge (~40 feet) eliminated the feasibility of installing a median barrier and also maintaining four travel lanes. Therefore, all the alternatives evaluated were designed to carry a maximum of three travel lanes on the bridge.

Analysis results indicated that alternative lane configurations with one westbound lane impacted the merge area on the approach from Interstates 55/70/64 in Illinois causing potential queue spillbacks on to the freeways in the morning peak period. Alternative lane configurations with one eastbound lane impacted signalized intersections on the Missouri side, creating the potential for queue spillbacks in Downtown St. Louis and I-70. Reversible lane configurations that provide two westbound lanes in the morning peak period and two eastbound lanes in the evening peak period operate similar to existing conditions. However, this configuration would create an unwelcome effect of having barriers on both sides on all travel lanes on the bridge. A reversible three-lane bridge operating westbound in the morning peak and eastbound in the evening peak was additionally investigated. Preliminary analysis indicated that this concept was feasible and could improve traffic operations on the Mississippi River Bridges.

Based on a number of factors, the bridge was reconfigured with one westbound lane and two eastbound lanes. This configuration provides the additional capacity in the eastbound direction necessary to accommodate the diverted Ramp B trips. Although capacity issues will exist on the city of St. Louis street network leading to the bridge, analysis indicates that the bridge itself as well as its connections on the Illinois side will continue to operate efficiently with the additional traffic volumes.

2.1.5.3 The Danforth Foundation Arch Study

In 2005, the Danforth Foundation, established by Former U.S. Sen. John C. Danforth, began studying ways to make the Arch riverfront livelier and better connected to Downtown St. Louis. It spent $2 million on that work, leading two years later to Danforth's suggestion — with support from the Mayor of the City of St. Louis — that local interests purchase a portion of the 91-acre Jefferson National Expansion Memorial for development purposes.

The goal of this concept was to entice visitors to remain in the area after visiting the popular Gateway Arch. The Danforth Foundation was prepared to spend $50 million and help raise an additional $100 million to invest in a new museum, cafes, an amphitheatre and other attractions. The study estimated it would cost $90 million to solve a longstanding local frustration — how to get people safely across Memorial Drive and peacefully over the noise of Interstate 70's depressed lanes.

The Danforth Foundation and the National Park Service never came to agreement on the land transfer. In November 2008, the Danforth Foundation withdrew. Danforth's efforts were the catalyst for the Arch design competition held in December 2008.

Following Danforth’s withdrawal from the Arch project, The City + Arch + River | 2015 (CAR 2015) Foundation, a non-profit organization, was established to oversee the redesign. Michael Van Valkenburgh and Associates (MVVA) of New York released their specific design proposal in 2009 following their victory in the international design competition.

The Danforth Foundation announced a $1 million grant to the CAR 2015 Foundation in early 2011 in an effort to push the redesign of the Arch grounds and improve its connections to Downtown St. Louis, the Mississippi River, and the Illinois riverfront.

2.1.6 Preferred Alternative

MoDOT’s preferred alternative, shown in Exhibit 2.13, proposes dual lane ramps between the PSB and I-55, but would remove the WB I-44 (Existing EB I-70) to EB PSB connection. This AJR document demonstrates the preferred alternative is necessary to better serve the motorists using the Poplar Street Bridge.

There are seven components that comprise the proposed changes to PSB access ramps, as listed in Table 2.1. These include eliminating the connection between Memorial Drive and existing I-70 eastbound to the PSB (Ramp B), and doubling the capacity of the connection between the PSB and I-55/I-44. The removal of access to and from the north is made practicable by two new links between St. Louis and East St. Louis via the NMRB and a new MLK Connector.

Removing Ramp B from the north would enable MoDOT to rebuild the ramps to and from the south as dual-lane ramps. Traffic modeling analysis indicates that doubling the capacity to and from the south would potentially remove the congestion and queuing on northbound I-55/I-44 during peak commuter periods. In addition, the improved geometric design would remove the reduced speed restrictions and minimize the potential for overturning vehicles on the ramps.

Table 2.1: PSB Interchange Project.Preferred Alternative Access Modifications

Proposed Modifications for PSB Interchange
Remove existing Ramp B (Exit 251A) – EB I-70 /SB Memorial Drive to EB PSB
Construction of MLK Connector – EB MLK Bridge to WB I-64
Reconstruct existing Ramp D (exit 40C) – WB PSB to SB I-55/I-44 as a two-lane “Ramp 1”
Reconstruct existing Ramp A (exit 209A) – NB I-55/I-44 to EB PSB as a two lane “Ramp 2”
Reconstruct existing Ramp C (exit 40C) – WB PSB to WB I-70/NB Memorial Drive, moving the diverge gore from the PSB to the new Ramp 1.
Widen the PSB structure to add one EB lane connected to I-64 6th Street entrance (existing merge)
Future Phase – Convert I-64 6th Street exit (existing drop lane) to entrance ramp to create continuous through lane (third lane) on EB I-64

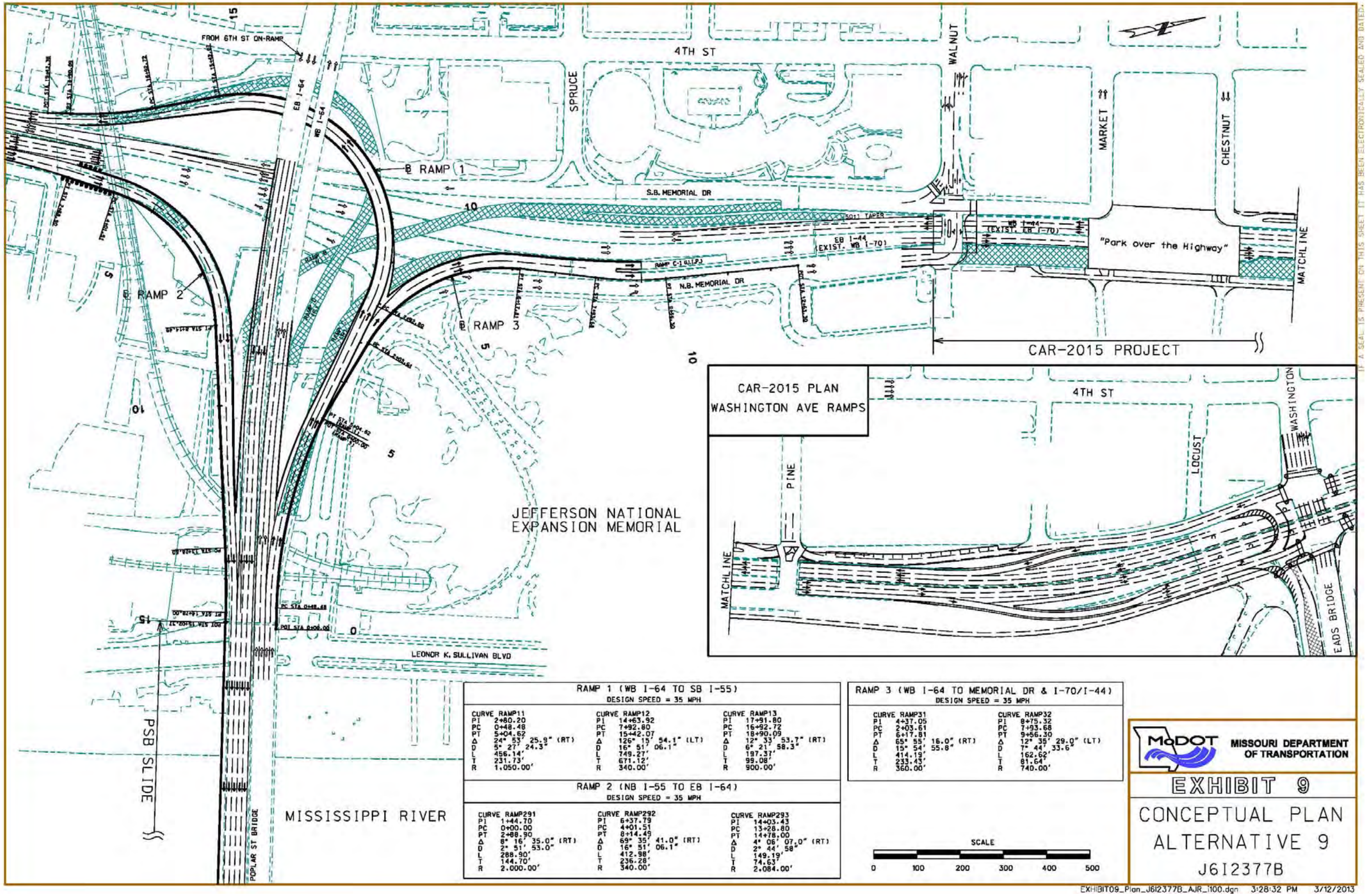
Ramp D currently has a very sharp curve, with a posted advisory speed of only 20 MPH. The horizontal alignment of proposed Ramp 1 is an improvement of the existing radius and is designed for 35 MPH. The proposed profile of Ramp 1 improves the existing sag curve beneath the Terminal Railroad Association Bridge from 20 MPH to 30 MPH; however, a design exception for shoulder width will be needed in order to fit the two-lane ramp between the piers of this bridge. In addition, the existing ramp has sub-standard vertical clearance beneath the railroad bridge (14’-6”), and the new ramp does not substantially improve this clearance.

For the new dual-lane Ramp 2, the horizontal alignment improves from a design speed of 30 MPH to 35 MPH. The sag vertical curve improves from 20 MPH to 30 MPH, and the crest vertical curve improves from 35 MPH to 45 MPH. Eliminating the WB I-44 (existing EB I-70) traffic using Ramp B will greatly improve the operations of Ramp 2 by affording that ramp dedicated lanes on the PSB in the eastbound direction.

Removal of Ramp B would not be completed until after the after the opening of the New Mississippi River Bridge (NMRB, Section 2.1.4.1), which is expected to occur in early 2014. The NMRB will be designated as I-70 and is expected to capture nearly all of the existing EB I-70 trips currently utilizing the PSB. In fact, in the future motorists on EB I-70 would pass the NMRB/I-70 connection, continuing on WB I-44, prior to arriving at the existing Ramp B exit – a counter-intuitive route. In addition, as part of the City Arch River 2015 (CAR 2015) project (Section 2.1.4.2) a link will also be constructed between the NMRB and Tucker Boulevard, a major north-south arterial in the heart of the St. Louis CBD. This link is expected to be complete in summer of 2013. Therefore, it is expected that the Ramp B volume currently arriving via SB Memorial Drive will decrease significantly as well. Traffic that does not shift to Tucker Boulevard and the NMRB will have increased connectivity to the Martin Luther King Bridge (due to the CAR 2015) project and to the new Ramp 2.

Reconstruction of existing Ramp C allows for movement from Illinois (via the PSB) to the St. Louis CBD and future NB I-44. Although the 2001 Preferred Alternative called for removal of the ramp; the phase of the NMRB currently being constructed will have indirect connections to IL Route 3. Because the reconstruction of Ramp C will not interfere with the reconstruction of Ramp D to dual-lane Ramp 1, MoDOT is proposing to reconstruct this ramp.

Additional design details, including profiles and typical sections can be found in MoDOT’s Design Report, attached as Appendix C. The proposed signing plan is attached as Appendix D.



RAMP 1 (WB I-64 TO SB I-55)
DESIGN SPEED = 35 MPH

CURVE	RAMP11	CURVE	RAMP12	CURVE	RAMP13
PI	2+80.20	PI	14+63.92	PI	17+91.80
PC	0+48.48	PC	7+92.80	PC	16+92.72
PT	5+04.62	PT	15+42.07	PT	18+90.09
Δ	24° 53′ 25.9″ (RT)	Δ	126° 15′ 54.1″ (LT)	Δ	12° 33′ 53.7″ (RT)
D	5° 27′ 24.3″	D	16° 51′ 06.1″	D	6° 21′ 58.3″
L	456.14′	L	749.27′	L	197.37′
T	231.73′	T	671.12′	T	99.08′
R	1,050.00′	R	340.00′	R	900.00′

RAMP 2 (NB I-55 TO EB I-64)
DESIGN SPEED = 35 MPH

CURVE	RAMP291	CURVE	RAMP292	CURVE	RAMP293
PI	1+44.70	PI	6+37.79	PI	14+03.43
PC	0+00.00	PC	4+01.51	PC	13+28.80
PT	2+88.90	PT	8+14.49	PT	14+78.00
Δ	8° 16′ 35.0″ (RT)	Δ	69° 35′ 41.0″ (RT)	Δ	4° 06′ 07.0″ (RT)
D	2° 51′ 53.0″	D	16° 51′ 06.1″	D	2° 44′ 58″
L	288.90′	L	412.98′	L	149.19′
T	144.70′	T	236.28′	T	74.63′
R	2,000.00′	R	340.00′	R	2,084.00′

RAMP 3 (WB I-64 TO MEMORIAL DR & I-70/I-44)
DESIGN SPEED = 35 MPH

CURVE	RAMP31	CURVE	RAMP32
PI	4+37.05	PI	8+75.32
PC	2+03.61	PC	7+93.68
PT	6+17.81	PT	9+56.30
Δ	65° 55′ 16.0″ (RT)	Δ	12° 35′ 29.0″ (LT)
D	15° 54′ 55.8″	D	7° 44′ 33.6″
L	414.19′	L	162.62′
T	233.43′	T	81.64′
R	360.00′	R	740.00′

Exhibit 2.13: PSB Interchange Reconstruction Preferred Alternative (Alternative 9)

2.2 Purpose & Need

From the NMRB 2001 FEIS, the purpose of the proposed action is to relieve increasingly severe traffic congestion and reduce traffic crashes on the Poplar Street Bridge (I-55/70/64), thereby helping to avoid economic stagnation at the core of the region.

The PSB Interchange project has four significant goals:

1. Replace aged and failing ramp structures
2. Improve the geometric design of the ramps and their connections
3. Improve the level of service (LOS) on the facility to D or better for all movements
4. Accommodate future traffic volumes through the design year of 2035

The PSB is severely overburdened and its 40-year old design does not meet today's standards. This congestion can be attributed both to the volume of traffic crossing the PSB and to the weaving movements that occur on the bridge, due to the interconnection of highways and interstates at either end, evident in Exhibit 2.14.

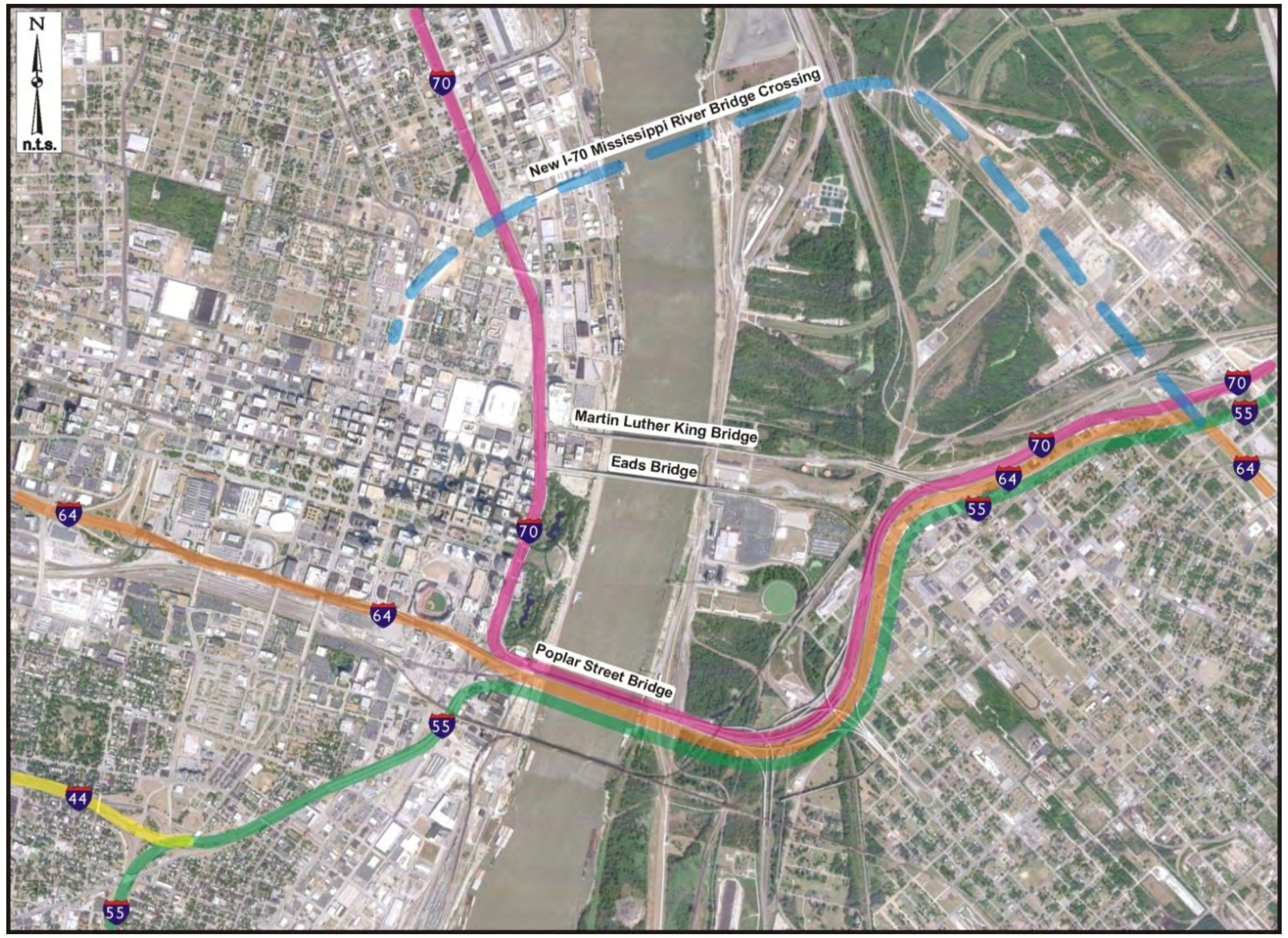


Exhibit 2.14: Poplar Street Bridge Interstate Connections

In the westbound direction, traffic is split coming from Illinois to Missouri. Therefore, motorists seek lane changes on the bridge to position themselves in the appropriate Missouri destination lane before the ramps at the west end of the bridge (i.e. I-64, I-55/44, or I-70). The weaving maneuvers slow traffic, particularly in the center lanes. The weaving issues are exacerbated by the geometry of the ramp to southbound I-55. The 20 mph design speed of that ramp results in slow-moving traffic queues that extend the length of the PSB. This very dense and slow moving queue severely impacts weaving traffic on the PSB. During the AM peak hour, westbound traffic on the PSB experiences operations of LOS F. The average traffic density is approximately 1 car per 50 feet of lane length, and average travel speeds are about 13 mph. As a result, queues extend nearly 9,000 feet from Missouri to just beyond the westbound on-ramp from Main Street in East St. Louis, adding about five minutes to travel times.

In the eastbound direction, both EB I-64 and Ramp A currently operate at volumes over capacity in the PM peak hour. Like the westbound direction, the congestion is exacerbated by the configuration of the PSB approaches and the substandard geometry of the ramps. The low design speeds slow traffic on the ramps, so traffic enters the PSB at lower than optimum speeds. In addition, motorists entering the bridge from the west interchange immediately seek lane changes just downstream of the ramp junctions because the EB I-64 lanes divide on the Illinois side of the PSB. These weaving maneuvers further slow traffic in slow all eastbound lanes, compounding the congestion on EB I-64 and Ramp A and generating congestion on Ramp B. During the PM peak hour congestion on Ramp B regularly impacts EB I-70 as well as SB Memorial Drive. Traffic queues from Ramp A extend to NB I-55/44 south of the entrance ramp at 8th and Marion Street. Finally, congestion on I-64 regularly extends roughly two miles west to Jefferson Avenue.

All of the ramp bridges in the PSB Interchange are classified as being "Structurally Deficient". On a scale of 1 to 9, with 1 being the worst condition, three of the bridges have an overall bridge rating of 3, and one has an overall rating of 4. Because of this, MoDOT will need to either rehab the existing structures or replace them in the very near future. The cost to rehab them has become uneconomical. Given the age of the structures, the most cost effective option at this time would be to replace them. Rather than replace these ramps in their current locations, MoDOT hopes to redesign these connections to improve safety and better serve current and future traffic demands.

The proposed action will provide needed traffic capacity and travel efficiency, improve system linkages and community access, reduce traffic crashes, increase user benefits, including reducing travel times, and help prevent economic stagnation. Without a new connection, NMRB demand will result in increasing abandonment of the core and reinforcement of the region's propensity to sprawl.

2.3 Consistency with FHWA Policy

2.3.1 FHWA Project Planning Involvement

The PSB Interchange project was initially proposed to be constructed concurrently with the CAR 2015 project. With this thought in mind, and due to their proximity and shared users, FHWA initially directed MoDOT to submit a combined AJR for the two projects. Their history of FHWA involvement is, therefore, intertwined.

1. The CAR 2015 transportation initiatives began to take shape in November, 2010. In an effort to solicit early feedback from FHWA on proposed network changes, the MoDOT and CAR 2015 Teams reached out to FHWA as soon as initial alternatives were defined.

In December, 2010, CAR 2015 submitted a memorandum as an initial project description document:

- JNEM Expansion – Transportation Plan Technical Memorandum.

A meeting with FHWA representatives at MoDOT's District office on December 16th, 2010 gave the project team an opportunity to elaborate on the initial Technical Memorandum as well as answer any questions. This meeting initiated regular dialogue between FHWA, MoDOT, and the CAR 2015 Design Team in an effort to streamline the federal review process. This exchange of information was formalized as the PSB-JNEM Core Team Meetings, facilitated by MoDOT every two weeks. These meetings began as an extension of the regular project meetings held by the NMRB project staff (including MoDOT and FHWA) in March, 2011 and are anticipated to continue throughout implementation of the CAR 2015 and PSB projects. FHWA representatives are in attendance at these meetings, where all aspects of both projects are discussed. In addition, the implications of other projects and potential projects in the region are discussed, including for example, IL Route 3 and the Tri- Level Interchange in East St. Louis.

The Design Team expanded beyond the regularly scheduled Core Team meetings in their efforts to coordinate with FHWA. In May, 2011, the team met with FHWA to exhibit and discuss the Traffic Analysis Models. This meeting was followed by documentation aimed at detailing the methodology and results of the traffic analysis (laying the groundwork for AJR documentation).

- Pre-AJR Briefing Memo 1: Project Overview – June, 2011
- Pre-AJR Briefing Memo 2: Traffic Modeling Approach and Assumptions – July, 2011

Subsequent to these Memos, MoDOT and the Design Team met with FHWA representatives on September 21st at the NMRB project office to present the two projects and to solicit feedback regarding information that should be included in the AJR for projects of this scale and complexity. These comments led to the development of the FHWA Technical Memorandum.

- Pre-AJR Briefing Memo 3: FHWA Technical Memorandum – October, 2011

In addition to the Technical Memorandum produced by the CAR 2015 design team, MoDOT issued a similarly styled memo to FHWA for review.

- PSB Interchange J6I2377B Pre AJR Design Memo – October, 2011

In mid-November, FHWA responded to the two October Memos with a set of comments for consideration by MoDOT and the CAR 2015 design team. The Core Team subsequently hosted a telephone call with FHWA on November 22nd, 2011 to review and discuss FHWA's comments prior to the release of the Initial Draft AJR. The outcome of this process, including FHWA's comments and subsequent discussion with the Design Team, are summarized as follows:

- FHWA supports the selection of the PSB Interchange and CAR 2015 projects' opening year of 2015 and the design year, established as 20 years beyond the opening year (2035) per MoDOT project design requirements.
- FHWA confirmed operational and modeling scenarios to be studied;
- FHWA confirmed that the peak hour is appropriate for the modeling period;
- FHWA confirmed the modeled area is appropriate:
  - equivalent full interchange on I-64 at the west extents (including westbound off and on, eastbound off and on) across the PSB to the beginning of the Tri- Level bridge in Illinois at the east extents,
  - I-70/44/55 at 10th Street off-ramp at the north extents to one service interchange south of the I-44/55 interchange at the south extents,
  - I-70 NMRB from Missouri North interchange to NMRB crossing, and
  - MLK from I-44 to MLK crossing.

In terms of design controls, criteria and operational goals, MoDOT follows its own Engineering Policy Guide (EPG) for facility design criteria and operations. When guidance is not provided in the EPG, *A Policy on Geometric Design of Highways and Streets* (2004 Green Book) is consulted. Additionally, the Green Book is sometimes uses as justification for design exceptions when the MoDOT standard can't be reasonably met.

Subsequent to this feedback, the CAR 2015 and MoDOT teams submitted their combined Draft AJR.

- CAR 2015 and PSB Interchange Initial Draft AJR – December, 2011

In early 2012, political issues stalled the PSB Interchange project when it was removed from East West Gateway Council of Government's (the local Metropolitan Planning Organization) Transportation Improvement Plan (TIP). At that time FHWA in agreement with MoDOT and CAR 2015 agreed to submit the CAR 2015 project and the PSB Interchange project as two separate AJR documents. The CAR 2015 project AJR was subsequently finalized and approved, and the PSB Draft AJR was submitted for preliminary approval.

- CAR 2015 Draft AJR – April, 2012
- CAR 2015 Final AJR and FHWA Conceptual Approval – June and July, 2012
- PSB Interchange Project Initial Draft AJR – July 2012

After an independent review of the PSB Interchange design alternatives (facilitated by the EWGCOG), MoDOT revised and finalized their preferred alternative and submitted a Second Draft PSB Interchange AJR. Comments to the second draft were incorporated and a Final PSB Interchange AJR was submitted for approval.

- PSB Interchange Project Second Draft AJR – April, 2013
- PSB Interchange Final AJR – May 2013

FHWA feedback throughout this process was instrumental in refining the project planning and sculpting both Draft AJR documents. FHWA's comments and recommendations to previous documentation been incorporated into this Final PSB Interchange AJR.

2.3.2 FHWA Policy Points

The interchange ramp modifications described in this document require approval by FHWA. The FHWA policy on access to the Interstate system was developed to ensure that proposed modifications are properly reviewed to ensure that the highest level of service in terms of safety and mobility can be maintained.

Approval from the FHWA is a two-step process consisting of conceptual approval and final approval. Conceptual approval is requested by MoDOT via this AJR. After conceptual approval has been obtained, the final approval is automatic after the National Environmental Policy Act (NEPA) requirements have been fulfilled assuming no significant changes have been made to the original concept. This AJR addresses the changes to Interstate Freeway Access as part of the PSB Interchange Project.

As directed by FHWA, the AJR should contain a clear description of the proposed access along with any background information that would explain and/or support the proposal. In addition, new or revised access points to the existing (or future) Interstate System should meet the requirements outlined in the following eight categories:

1. Existing Facilities
2. Transportation System Management
3. Safety and Operational Analysis
4. Access, Connections and Design
5. Consistency with Local Transportation Land Use Plans
6. Consistency with Comprehensive Interstate Network Study
7. Coordination with Transportation System Improvements
8. Consideration for NEPA Environmental Processes

The following table presents the applicable policy statement listed for each element and followed by the conclusions with regards to each proposed project concepts and designs.

Table 2.2: FHWA Policy Point 1 and Responses

Policy Point 1: Existing Facilities	
The need being addressed by the request cannot be adequately satisfied by existing interchanges to the Interstate, and/or local roads and streets in the corridor can neither provide the desired access, nor can they be reasonably improved (such as access control along surface streets, improving traffic control, modifying ramp terminals and intersections, adding turn bays or lengthening storage) to satisfactorily accommodate the design-year traffic demands.	
Questions	PSB Response
Q1. Does the access request clearly describe the need and purpose of the proposal and identify project goals and objectives that are specific and measurable?	Section 2.2 – Purpose and Need
Q2: Is the proposal in the best interest of the travelling public, or does it merely serve a narrow interest?	Sections 2.1.3 – Existing Conditions and Geometries Section 2.2 – Purpose and Need
Q3: Is the proposal serving a regional transportation need, or is it merely compensating for deficiencies in the local network of arterials and collectors?	Sections 2.1.3 – Existing Conditions and Geometries Section 2.2 – Purpose and Need
Q4: In lieu of granting new access, is there any reasonable alternative consisting of improvements to the existing roadway(s) or adjacent access points that could serve the need and purpose.	Sections 2.1 – Project Description and Background Section 2.2 – Purpose and Need
Q5: Has the evaluation of existing interchanges and the local road network taken into account all proposed improvements currently identified in the State and/or Regional Long Range Plan?	Sections 2.1.3 – Existing Conditions and Geometries Section 4 - Methodology
Q6: Will the proposed change in access result in needed upgrades or improvements to the cross road for a significant distance away from the interchange?	Section 2.1.6 – Preferred Alternative

Table 2.3: FHWA Policy Point 2 and Responses

Policy Point 2: Transportation System Management	
The need being addressed by the request cannot be adequately satisfied by reasonable transportation system management (such as ramp metering, mass transit, and HOV facilities), geometric design, and alternative improvements to the Interstate without the proposed change(s) in access.	
Questions	PSB Response
Q1: Was FHWA actively involved in preliminary studies and decisions? If not, then more detailed information may be required in support of proposed action.	Section 2.3.1 – FHWA Project Planning Involvement
Q2: Did the study area cover sufficient area to allow for an evaluation of all reasonable alternatives?	Section 4.2 – Area of Influence
Q3: Was a No-Build Alternative evaluated?	Section 5.1 – No-Build Network
Q4: Considering the context of the proposal, is this the best location for the proposed new interchange?	N/A – the project includes the reconstruction of an existing interchange in its current location
Q5: Were different interchange configurations (Tight diamond, SPDI, Parclo) considered?	Section 5.0 - Alternatives
Q6: Were pedestrians and bicyclists considered in the alternative evaluation?	N/A – this is an interstate system interchange, therefore pedestrians and bicyclists are not users of this facility
Q7: Was there an evaluation of different intersection configurations (stop control, signal, roundabout, free right turns, etc.)	N/A – this is an existing interstate to interstate connection, therefore other configurations are not possible
Q8: Have Transportation Systems Management (i.e. HOV, ITS, Ramp Metering, Transit, etc.) options been evaluated as an alternative to new or modification to an existing interchange?	Section 5.2 – TSM Alternatives
Q9: Did the report discuss how TSM alternatives were evaluated and eliminated from consideration?	Section 5.2 – TSM Alternatives
Q10: Does the proposal consider any future planned TSM strategies and is the design consistent with the ability to implement the future TSM strategies?	N/A – See Section 5.2 – TSM Alternatives

Table 2.4: FHWA Policy Point 3 and Responses

Policy Point 3: Safety and Operational Analysis	
An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which included mainline lanes, existing, new, or modified ramps, ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis shall, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access. The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, shall be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network. Requests for proposed change in access must include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute, and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network. Each request must also include a conceptual plan of the type and location of the signs proposed to support each design alternative.	
Questions	PSB Response
Q1: Does the report demonstrate that a proper traffic operational analysis was conducted? The analysis should include the applicable basic freeway segments, freeway weaving segments, freeway ramp segments, ramp junctions, and crossroad intersections related to the proposed access point and at least the two adjacent interchanges.	Section 4.3 – Operational Analysis Procedures
Q2: Does the report include a safety analysis of the mainline, ramps and intersections of the proposed access point and the nearest adjacent interchange (provided they are near enough that it is reasonable to assume there may be impacts)?	Section 4.4 – Safety Analysis Methodology Section 6.1 – Safety Analysis Results
Q3: Has the design traffic volume been validated?	Section 4.1 – Traffic Projections Appendix E – Project Projected Peak Hour Volumes
Q4: Has a conceptual signing plan been provided?	Appendix D – Proposed Signing Plan
Q5: Is guidance signing (i.e., way-finding or trail blazing signs) clear and simple?	Appendix D – Proposed Signing Plan
Q6: Do the results of the operational analysis result in a significant adverse impact to existing or future conditions?	Section 6.2 – Operational Performance
Q7: Will the proposed change in access result in needed upgrades or improvements to the cross road for a significant distance away from the interchange? If so, have impacts to the local network been disclosed and fully evaluated?	Section 6.2 – Operational Performance

Policy Point 3: Safety and Operational Analysis

An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which included mainline lanes, existing, new, or modified ramps, ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis shall, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access. The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, shall be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network. Requests for proposed change in access must include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute, and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network. Each request must also include a conceptual plan of the type and location of the signs proposed to support each design alternative.

Questions	PSB Response
Q8: Are the cross roads or adjacent surface level roads and intersections affected by the proposed access point analyzed to the extent (length) where impacts caused or affecting the new proposed access point are disclosed to the appropriate managing jurisdiction?	Section 2.3.1 – FHWA Project Planning Involvement Section 4.3 – Operational Analysis Procedures
Q9: Are pedestrian and/or bicycle facilities included (as appropriate) and do these facilities provide for reasonable accommodation?	Section 3.1.4 – Bicycle/Pedestrian Connections
Q10: Does the proposed access secure sufficient Limits of Access adjacent to the Interchange ramps?	N/A – this is an interstate system interchange
Q11: Does the proximity of the nearest crossroad intersections to the ramps contribute to safety or operational problems? Can they be mitigated?	The proximity of the nearest arterial intersections will not change and, therefore, do not contribute to safety or operational concerns.
Q12: In addition to HCS, what analysis tools were employed and were they appropriate?	Section 4.3 – Operational Analysis Procedures
Q13: Has the proposal distinguished between nominal safety (i.e. adherence to design policies and standards) and substantive safety (actual and expected safety performance)?	Section 6.1 – Safety Performance
Q14: Will any individual elements within the recommended alternative be degraded operationally as a result of this action? If yes, are reasons provided to accept them?	Section 6.2 – Operational Performance
Q15: In evaluating whether the proposal has a "significant adverse impact" on safety, has the State Strategic Highway Safety Plan been used as a benchmark?	Section 4.4 – Safety Analysis Procedures Section 6.1 – Safety Performance
Q16: Are the proposed interchange design configurations able to satisfactorily accommodate the design year traffic volumes?	Section 6.2 – Operational Performance
Q17: If the project is to be built in stages, has the traffic operational and safety analyses considered the interim stages of the proposal?	Section 6.2 – Operational Performance Section 6.1 – Safety Performance

Table 2.5: FHWA Policy Point 4 and Responses

Policy Point 4: Access Connections and Design	
The proposed access connects to a public road only and will provide for all traffic movements. Less than "full interchanges" may be considered on a case-by-case basis for applications requiring special access for managed lanes (e.g., transit, HOVs, HOT lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards.	
Questions	PSB Response
Q1: Does the proposed access connect to a public road?	N/A – this is an interstate system interchange, there are no local road connections
Q2: Are all traffic movements for full interchange access provided?	Section 6.3.2 – Interchange Access Considerations Section 5.0 – Alternatives
Q3: If a partial interchange is proposed, is there sufficient justification for providing only a partial interchange?	Sections 2.1.6, 2.2., 5.0, 6.0, and 8.0
Q4: If a partial interchange is proposed; was a full interchange evaluated as an alternative and is there sufficient justification to eliminate or discard it?	Section 5.3 - Build Alternatives with No Access Modification Section 5.4 – Build Alternatives with Modified Access Section 6.3.2 – Interchange Access Considerations
Q5: Is sufficient ROW available (or being acquired) to provide a full interchange at a future date (staged construction)?	Section 6.3.2 – Interchange Access Considerations
Q6: Are you comfortable with how the missing movements will be accommodated on the surface streets and adjacent interchanges?	Section 2.1.6 – Preferred Alternative
Q7: If not, is the proposed access for special purposes such as transit vehicles, HOV's, and/or a park and ride lot?	N/A – this is an existing interstate system interchange
Q8: Does FHWA support the selection of design controls/criteria and desired operational goals?	Section 2.3.1 – FHWA Project Planning Involvement
Q9: Does the proposed access meet or exceed current design standards for the Interstate System?	There are proposed design exceptions for lane and shoulder width and minimal clearance at selected locations.
Q10: If not, have anticipated design exceptions been identified and reviewed (at least conceptually)?	Yes, design exceptions have been identified and reviewed.
Q11: If expected design exceptions could have significant operational impacts on the Interstate and/or Crossroad system, are mitigation measures described?	Proposed design exceptions do not pose significant operational impacts.
Q12: If expected design exceptions could have significant safety impacts on the Interstate and/or Crossroad system, are mitigation measures described?	Proposed design exceptions do not pose significant safety impacts.
Q13: Will the length of access control along the crossroad provide for acceptable operations and safety? (100-300' is a minimum. Additional access control is strongly encouraged when needed for safety and operational enhancement)	N/A – this is an interstate system interchange, there are no crossroad connections
Q14: Does FHWA support selection of opening and design years?	Section 2.3.1 – FHWA Project Planning Involvement
Q15: Have all design criteria (including but not limited to the following) been adequately addressed?	
a. Sight distance at ramp terminals (Don't overlook signal heads obscured by structures.)	N/A – this is an interstate system interchange, ramps terminals are not controlled intersections; ramp merges and diverges meet design standards
b. Sufficient storage on ramp to prevent queues from spilling on to the Interstate (based on current and/or future projected traffic demand)	N/A – this is an interstate system interchange, ramps are not designed to store queues
c. Vertical clearance	Section 2.1.6 – Preferred Alternative
d. Pedestrian access through the interchange	N/A – this is an interstate system interchange, there are no pedestrian accommodations
e. Length of accel/decel lanes	Section 2.1.6 – Preferred Alternative Appendix C
f. Length of tapers	Section 2.1.6 – Preferred Alternative Appendix C

Policy Point 4: Access Connections and Design	
The proposed access connects to a public road only and will provide for all traffic movements. Less than "full interchanges" may be considered on a case-by-case basis for applications requiring special access for managed lanes (e.g., transit, HOVs, HOT lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards.	
Questions	PSB Response
g. Spacing between ramps	Section 2.1.6 – Preferred Alternative Appendix C
h. Lane continuity	Section 2.1.6 – Preferred Alternative Appendix C
i. Lane balance	Section 2.1.6 – Preferred Alternative Appendix C
j. Uniformity in interchange design and operational patterns (i.e. right-side ramps, exit design consistent w/adjacent interchanges)	Section 2.1.6 – Preferred Alternative
Q16: Has each movement of the proposal been "tested" for ease of operation?	Section 4.3 - Analysis Methodology Section 6.2.- Operational Analysis

Table 2.6: FHWA Policy Point 5 and Responses

Policy Point 5: Transportation Land Use Plans	
"The proposal considers and is consistent with local and regional land use and transportation plans. Prior to receiving final approval, all requests for new or revised access must be included in an adopted Metropolitan Transportation Plan, in the adopted Statewide or Metropolitan Transportation Improvement Program (STIP or TIP), and the Congestion Management Process within transportation management areas, as appropriate, and as specified in 23 CFR part 450, and the transportation conformity requirements of 40 CFR parts 51 and 93."	
Questions	PSB Response
Q1: Does the IJR discuss or include (as appropriate) other project(s), studies or planned actions that may have an effect on the report analysis results?	Section 2.1.4 – Related Projects Section 2.1.5 – Related Transportation Studies
Q2: Does the project conform to the local planning, MPO or other related plans?	Section 2.1 – Project Description and Background Section 6.4 – Conformance with Transportation Plans
Q3: Is the access request located within a Transportation Management Areas? (TMA's are metropolitan areas of 200,000 or more in population)	Section 2.1.1 – Project Location.
Q4: Is the access request located within a non-attainment area for air quality? (requests for access in a non-attainment or maintenance areas for air quality must be a part of a conforming transportation plan)	Section 2.1.1 – Project Location
Q5: Is the project included in the TIP/STIP and LRTP?	Section 6.4 – Conformance with Transportation Plans
Q6: Is the access point covered as a part of an Interstate corridor study or plan? (especially important for areas where the potential exists for construction of future adjacent interchanges)	Section 6.4 – Conformance with Transportation Plans Section 2.1.2 – Project History Section 2.1.4 – Related Projects
Q7: If the project is to be built in stages, are follow-on stages included in the STIP? (may demonstrate a commitment on the part of the requestor)	Section 6.4 – Conformance with Transportation Plans
Q8: If the project is to be built in stages, are the funding commitments consistent with state and local government transportation plans?	Section 6.4 – Conformance with Transportation Plans Section 7.1 – Project Funding

Table 2.7: FHWA Policy Point 6 and Responses

Policy Point 6: Comprehensive Interstate Network Study	
"In corridors where the potential exists for future multiple interchange additions, a comprehensive corridor or network study must accompany all requests for new or revised access with recommendations that address all of the proposed and desired access changes within the context of a longer-range system or network plan (23 U.S.C. 109(d), 23 CFR 625.2(a), 655.603(d), and 771.111)."	
Questions	PSB Response
Q1: Is it possible that new interchange(s) not addressed in the IJR could be added within an area of influence to the proposed access point? (If so, could the proposal preclude or otherwise be affected by any future access points?)	N/A – this is an interstate system interchange in a dense urban area, no additional access points are feasible at this time
Q2: Does the IJR report include the traffic volumes generated by any future additional interchanges within a vicinity of influence that are proposed?	Section 4.1- Future Year Traffic Forecasts
Q3: Does the IJR report fail to include any other proposed interstate access points within a vicinity of influence that are being proposed or are in the current long range construction program?	Section 2.1.4 – Related Projects Section 2.1.2.1 – The New Mississippi River Bridge

Table 2.8: FHWA Policy Point 7 and Responses

Policy Point 7: Coordination with Transportation System Improvements	
"When a new or revised access point is due to a new, expanded, or substantial change in current or planned future development or land use, requests must demonstrate appropriate coordination has occurred between the development and any proposed transportation system improvements (23 CFR 625.2(a) and 655.603(d)). The request must describe the commitments agreed upon to assure adequate collection and dispersion of the traffic resulting from the development with the adjoining local street network and Interstate access point (23 CFR 625.2(a) and 655.603(d))."	
Questions	PSB Response
Q1: Does the access request adequately demonstrate that an appropriate effort of coordination has been made with appropriate proposed developments?	Section 4.1- Future Year Traffic Forecasts
Q2: Are the proposed improvements compatible with the existing street network or are other improvements needed?	Section 6.2.2 - SYNCHRO Modeling Analysis Results/Measures of Effectiveness (MOEs)
Q3: Are there any pre-condition contingencies required in regards to the timing of other improvements?	N/A – no contingencies are required
Q4: If pre-condition contingencies are required, are pertinent parties in agreement with these contingencies and is this documented?	N/A – no contingencies are required
Q5: If the proposed improvements are founded on the need for providing access to new development, are appropriate commitments in place to ensure that the development will likely occur as planned?	N/A – this is an interstate system interchange
Q6: If project is privately funded, are appropriate measures in place to ensure improvements will be completed if the developer is unable to meet financial obligations?	N/A – the project is not privately funded
Q7: If the purpose and need to accommodate new development/traffic demands that aren't fully known, is a worst case scenario used for future traffic?	Section 4.1- Future Year Traffic Forecasts
Q8: Does the project require financial or infrastructure commitments from other agencies, organizations or private entities?	Section 7.1 – Project Funding

Table 2.9: FHWA Policy Point 8 and Responses

Policy Point8: Consideration and coordination with environmental process	
"The proposal can be expected to be included as an alternative in the required environmental evaluation, review and processing. The proposal should include supporting information and current status of the environmental processing (23 CFR 771.111)."	
Questions	PSB Response
Q1: Are there any known social or environmental issues that could affect the proposal?	Section 6.3. – Stakeholder and Environmental Concerns
Q2: Is the project consistent with the current TIP/STIP and LRTP and/or proposed amendments to the plan?	Section 6.4 – Conformance with Transportation Plans
Q3: Although NEPA is a separate action, is an environmental overview for the proposed improvements included?	Section 6.3.1 – Environmental Documentation
Q4: Is it appropriate to emphasize to the project stakeholders that the access approval will be handled as a two-step process? (i.e. Step 1: Engineering and Operational Acceptability and Step 2: Environmental Approvals)	Section 6.3.1 – Environmental Documentation (being completed in conjunction with the AJR review and submittal)

3 Existing Conditions

3.1 Existing Facility and Transportation Network

3.1.1 Metropolitan St. Louis Interstate System

St. Louis is home to many large national transportation routes that serve local, regional, and national traffic demands. The interstate highways that traverse downtown St. Louis are:

- **Interstate 44 (I-44)** begins in Wichita Falls, Texas, and runs about 634 miles (including about 290 miles in Missouri) in a generally northeasterly direction to I-55 in St. Louis. Upon completion of the NMRB and related connector roadway and interchange projects, the interstate freeway segment between the PSB and the Missouri North I-70 Interchange, currently designated as I-70, would be re-designated as I-44.
- **Interstate 55 (I-55)** begins in LaPlace, Louisiana, and runs about 964 miles (including about 210 miles in Missouri) in a generally northerly direction to Chicago, Illinois. From Memphis, Tennessee, to St. Louis, I-55 roughly parallels the Mississippi River. I-55 crosses the Mississippi River on the PSB.
- **Interstate 64 (I-64)** begins in Wentzville, Missouri, about 40 miles west of St. Louis, and runs about 954 miles in a generally easterly direction to Chesapeake, Virginia. I-64 crosses the Mississippi River on the PSB.
- **Interstate 70 (I-70)** begins in Cove Fort, Utah, and runs about 2,153 miles (including about 252 miles in Missouri) in a generally easterly direction to Baltimore, Maryland. I-70 currently crosses the Mississippi River on the PSB. Upon completion of the NMRB and related connector roadway and interchange projects, the new interstate freeway segment from the Missouri North I-70 Interchange across the NMRB to the Tri-Level Interchange in Illinois would be designated as I-70. The interstate freeway segment between the west end of the PSB and the Tri-Level Interchange would cease to be designated as I-70, but would remain as I-55 and I-64. The interstate freeway segment between the PSB and the Missouri North I-70 Interchange, currently designated as I-70, would be re-designated as I-44.
- **Interstate 255 (I-255)** begins in Mehlville, Missouri, about 3.8 miles west of the Mississippi River, and runs about 30.8 miles in a generally northeasterly direction to Pontoon Beach, Illinois. I-255 composes the eastern third of the belt system around metropolitan St. Louis. I-255 crosses the Mississippi River on the Jefferson Barracks Bridge.
- **Interstate 270 (I-270)** begins in Mehlville, Missouri, about 3.8 miles west of the Mississippi River, and runs about 50.6 miles in a generally northerly and then easterly direction to Troy, Illinois. I-270 composes the western two-thirds of the belt system around metropolitan St. Louis. I-270 crosses the Mississippi River on the Chain of the Rocks Bridge.

The metropolitan St. Louis interstate system is displayed in **Exhibit 3.1**.

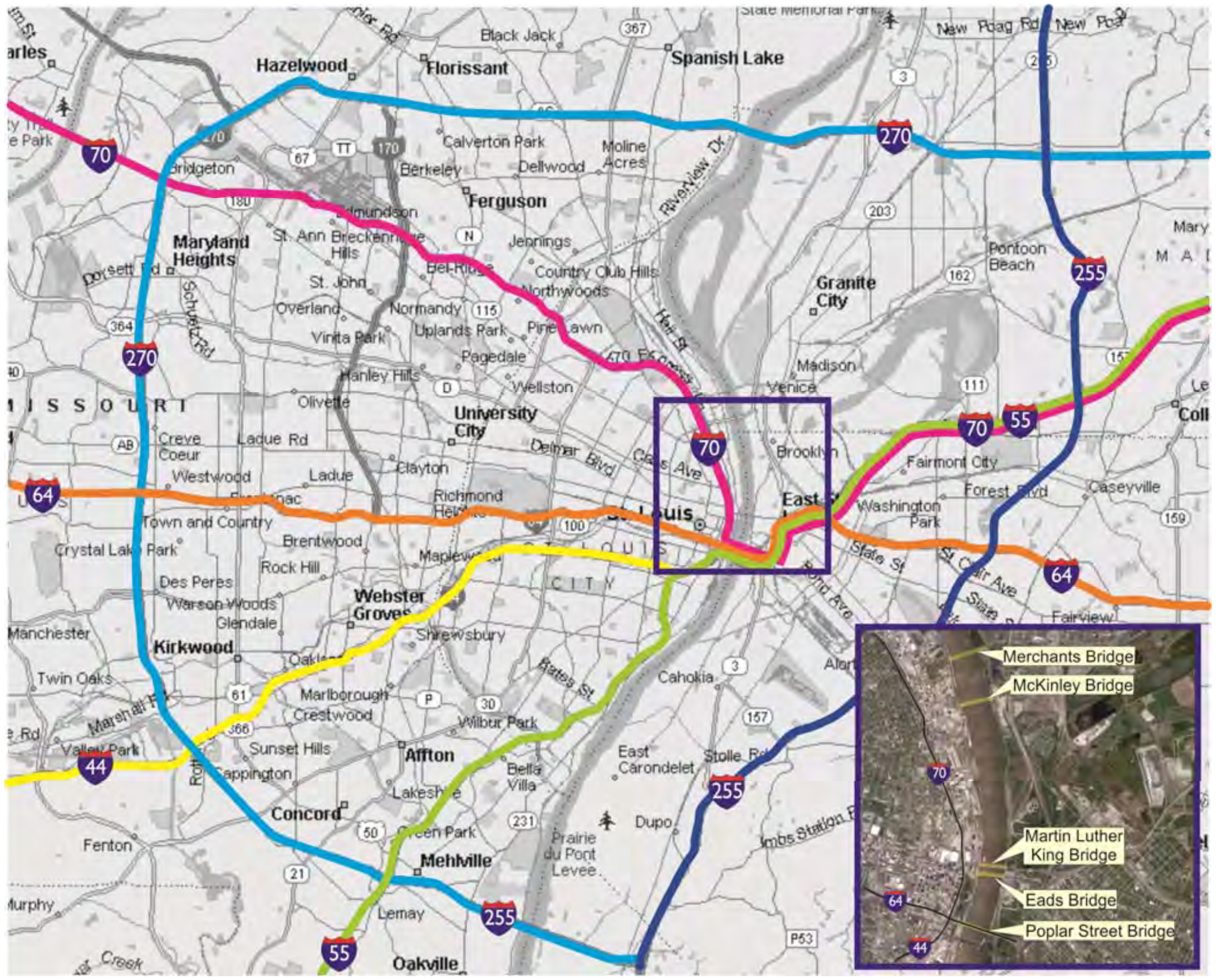


Exhibit 3.1: Metropolitan St. Louis Existing Interstate System

3.1.2 Metropolitan St. Louis Bridge System

Also displayed in **Exhibit 3.1** are the vehicular crossings of the Mississippi River available to metropolitan St. Louis motorists. These include:

- **Eads Bridge.** Completed in 1874, the Eads Bridge was the first major bridge to use steel and was, at the time, the longest supported-deck arch bridge. Today, the Eads Bridge is the oldest bridge crossing of the Mississippi River, and is owned and operated by the City of St. Louis. It has undergone several periods of rehabilitation and serves as an iconic structure within the downtown landscape. The Eads Bridge accommodates four lanes of traffic and a pedestrian/bicycle path on its upper deck and MetroLink rail on the lower deck; however the upper deck is occasionally closed to vehicles for special events. The Eads Bridge connects Washington Avenue in St. Louis, between the Jefferson National Expansion Memorial and Laclede's Landing, with Broadway Avenue in East St. Louis, Illinois.
- **Poplar Street Bridge (PSB)**, located about 4,100 feet south of the Eads Bridge, carries eight lanes of traffic and about 100,000 vehicles per day. The PSB is designated as I-55, I-64, I-70, and US 40 across its entire length.
- **MacArthur Bridge** is located about one mile south of the Eads Bridge and carries rail traffic only.
- **Jefferson Barracks Bridge (J.B. Bridge)**, located about 11 miles south of the Eads Bridge, is a pair of bridges carrying three lanes of traffic each. The J.B. Bridge is designated as I-255 and US-50.
- **Martin Luther King Bridge (MLK Bridge)**, located about 740 feet north of the Eads Bridge, provides an alternate, direct connection between I-70 in downtown St. Louis and I-55/I-64/I-70 in East St. Louis. A five-foot pedestrian walkway is located on the south side of the bridge.
- **McKinley Bridge**, located 2.5 miles north of the Eads Bridge, was originally built in 1910 as a railroad bridge. One lane in each direction for automobile traffic was added in the 1930s. A major refurbishment in 2004 resulted in its current configuration with two automobile travel lanes on the inside, an exclusive service lane on the north side of the bridge, and an exclusive pedestrian sidewalk/bike path on the south side of the bridge. McKinley Bridge connects northern downtown St. Louis with Venice, Illinois.
- **Merchants Bridge** is located about three miles north of the Eads Bridge and carries rail traffic only.
- **New Chain of Rocks Bridge**, located about nine miles north of the Eads Bridge, is a pair of bridges carrying two lanes of traffic each. The New Chain of Rocks Bridge is designated as I-270. The original Chain of Rocks Bridge, located about 1,700 feet south of the New Chain of Rocks Bridge, is a narrow bridge with a 22° bend that currently carries pedestrians and bicyclists only.
- **Clark Bridge**, located about 17 miles north of the Eads Bridge, connects Missouri with Alton, Illinois. Clark Bridge carries four lanes of traffic and is designated as U.S. Highway 67.

3.1.3 Metro Transit

Metro Transit is the Regional Transit Authority (RTA). It provides public transportation for The City of St. Louis and St. Louis County in Missouri and St. Clair County in Illinois. Metro Transit is a bi-state agency that transports nearly 150,000 passengers daily. The system can accommodate 25,000 additional passengers during peak hours and up to 100,000 additional boardings daily. Metro Transit operates:

- **MetroBus**: 75 MetroBus routes, servicing four counties in Missouri and Illinois, including the City of St. Louis. These include 43 local/regional and 6 commuter/express routes in Missouri and 13 local and 4 commuter/express routes in St. Clair County, Illinois.
- **MetroLink**: the region's light-rail system consists of two lines (Red Line and Blue Line) connecting Lambert-St. Louis International Airport and Shrewsbury, MO with Scott Air Force Base near Shiloh, Illinois through Downtown St. Louis as shown in **Exhibit 3.2**. The system features 37 stations, carries an average of 61,573 people each weekday, and uses a shared fare system with MetroBus.
- **Metro Call-A-Ride**: (Curb-to-Curb van service for A.D.A. eligible riders) in Missouri

Madison County Transit is a Metro Transit partner providing additional bus service to downtown St. Louis from nearby Madison County, Illinois.

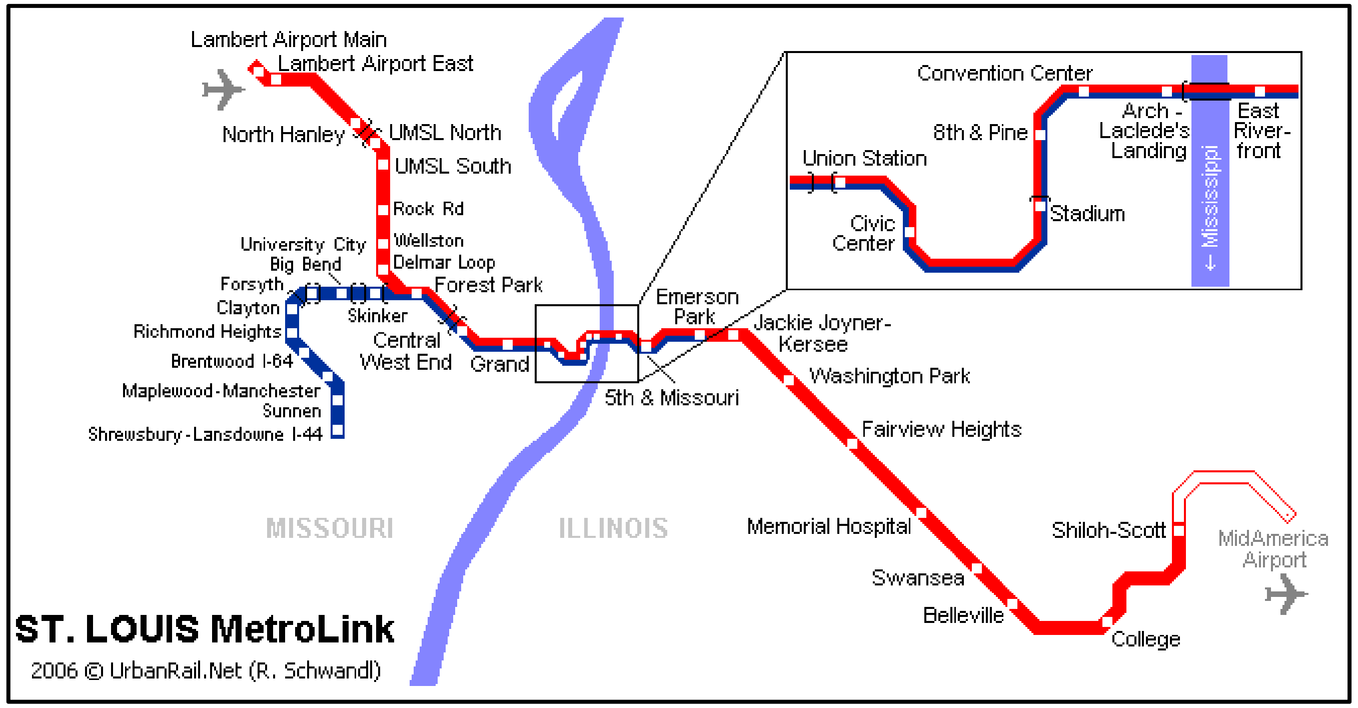


Exhibit 3.2: St. Louis MetroLink System (Image: UrbanRail.net)

3.1.4 Bicycle/Pedestrian Connections

There are no bicycle and/or pedestrian facilities or connections to the PSB or its interchanges. The centerpiece of the Missouri-Illinois Bicycle/Pedestrian system is the Old Route 66/Chain of Rocks Bridge across the Mississippi River which runs parallel to the new Chain of Rocks Bridge and I-270. This bridge is the only true bicycle/pedestrian crossing for cross-country touring cyclists for several hundred miles connecting the St. Louis Riverfront Trail in Missouri and the Madison County Transit Confluence Trail in Illinois. From North Riverfront Park at the west approach to this crossing, the ten-mile St. Louis Riverfront Trail follows the Mississippi River's west bank south to the Gateway Arch in Downtown St. Louis, passing through several of St. Louis' oldest neighborhoods. The Eads Bridge from Downtown St. Louis to East St. Louis also has bike lanes, and is often closed to accommodate bicycle and pedestrian events. The newly-renovated McKinley Bridge offers bike lanes as well, connecting to the St. Louis Riverfront Trail on its west end and to green space at the base of the bridge's east end in Venice, Illinois.

3.2 Existing Land Use and Demographics

This project impacts the Missouri-side (west) interchange for the PSB where four interstates converge at the southeast corner of the CBD of the City of St. Louis. The aerial photo to the right, **Exhibit 3.3**, shows the surrounding area (the PSB is in the lower left). The Jefferson National Expansion Memorial (JNEM, or the "Arch") grounds are located immediately north of the interchange. To its south is an area known as Choteau's Landing. This area of historic buildings is currently in disrepair, but momentum has been building to redevelop this area as an art and entertainment district, and it is anticipated that the CAR 2015 project will spur additional investment. East of the interchange is the PSB and the Mississippi River. I-64 continues west of the interchange and acts as the southern boundary of the St. Louis CBD. As seen in this image, right-of-way for the Interstates in this area is limited and development is dense. A great example is Busch Stadium (baseball) and its proximity to I-64, roughly in the center of the image.

The City of St. Louis has a population of over 300,000 and is, therefore, considered a Transportation Management Area (TMA) as designated by the Secretary of Transportation. It is important to note that both population and traffic growth within the City have been relatively flat for the past twenty to thirty years.

3.3 Environmental Constraints

Although, the project is proposed to be located within existing right-of-way, due to its proximity to and impacts upon the Jefferson National Expansion Memorial, there are "4f" issues associated with the PSB Interchange project. These issues were addressed in a Memorandum of Agreement between the FHWA and the National Park Service in the NMRB FEIS. MoDOT anticipates the environmental study will include a re-evaluation of the NMRB FEIS (2001) which included modifications to the PSB Interchange ramps.

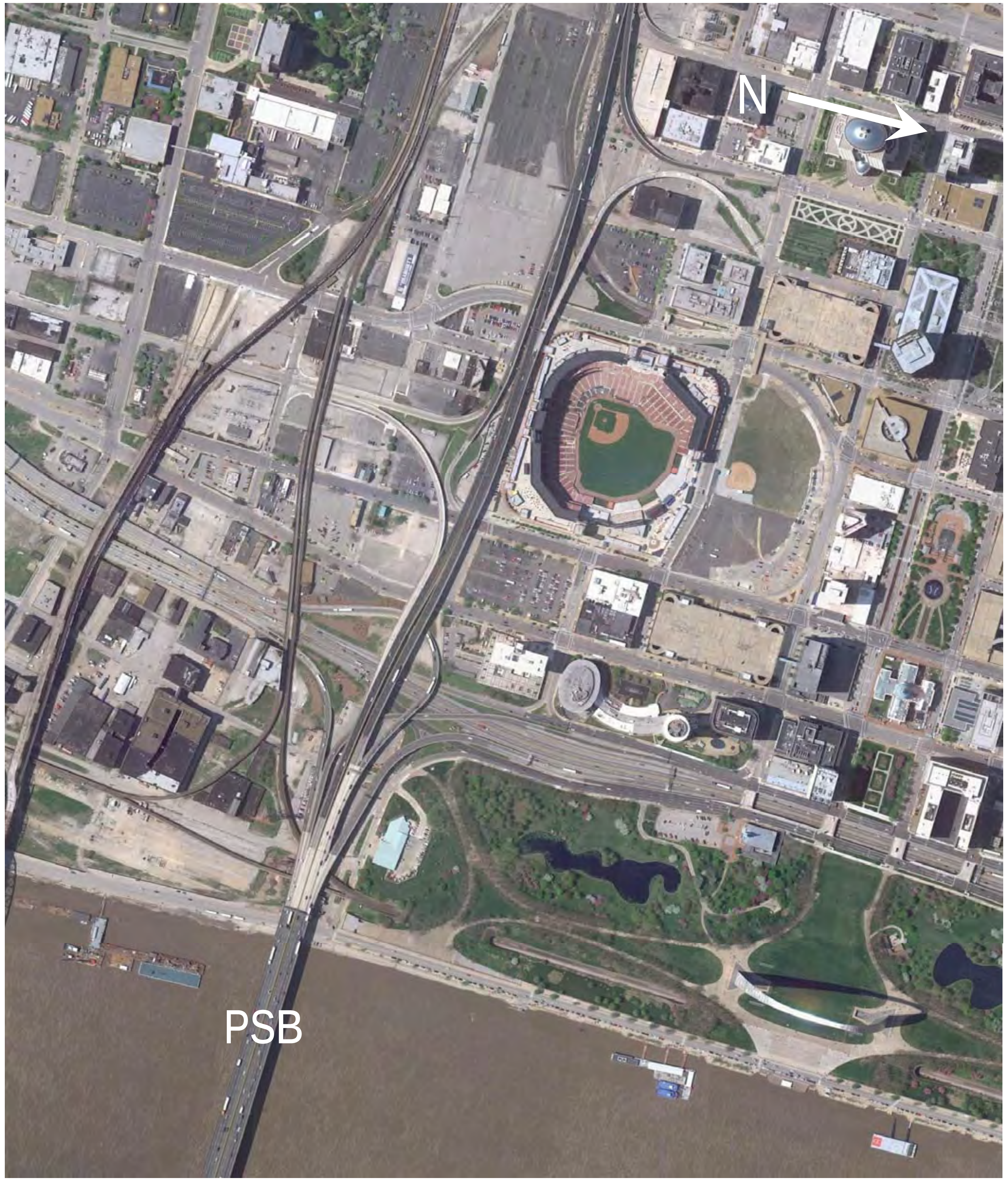


Exhibit 3.3: PSB Interchange Surrounding Land Uses

4 Methodology

4.1 Future Year Traffic Forecasts

Future year traffic forecasts were developed in consultation with MoDOT and the East-West Gateway Council of Government's (EWCOG's) local travel demand model, which has recently been updated to incorporate the future changes to the regional network described in Section 2.1.3. Therefore, traffic projections for the PSB Interchange Project reflect the future St. Louis network after completion of the NMRB and CAR 2015 projects.

Therefore, in order to generate the PSB Interchange Project traffic projections, the team had to first project the future year traffic patterns and volumes of current and proposed network changes. Then, traffic forecasts from 2010 to 2015 consider an increase in background traffic as well as additional traffic generated by local developments. Forecasts from 2015 to 2035 consider an overall background growth of 4%. These assumptions are described in more detail in the following sections.

4.1.1 Impacts of Related Projects

The impacts of the various network changes due to both the NMRB and CAR 2015 projects are described in detail in the following sub-sections as presented in the CityArchRiver 2015 Project Final Access Justification Report (July, 2012).

The New Mississippi River Bridge (NMRB)

The NMRB is scheduled to open in 2014. This new facility will be designated as I-70 and include four traffic lanes, two eastbound and two westbound, with direct ramp connections to and from downtown St. Louis as well as the remaining interstates, as displayed in Exhibit 4.1. The new I-70 alignment is expected to remove a significant amount of interstate traffic from existing I-70 (future I-44) south of the NMRB, as well as the existing Mississippi River crossings (PSB and MLK Bridges). All of the forecasting performed as part of this project reflects the assumptions put forth in the *Missouri River Crossing Access Justification Report, October 2003*, and the *CityArchRiver 2015 Access Justification Report, July 2012*.

The major shifts assumed in relation to the NMRB are:

- Poplar Street Bridge: 10% vehicle reduction, both directions;
- Martin Luther King Bridge: 50% vehicle reduction, both directions; and
- Eads Bridge: 0% reduction (Eads is assumed to serve local trips and connections only)

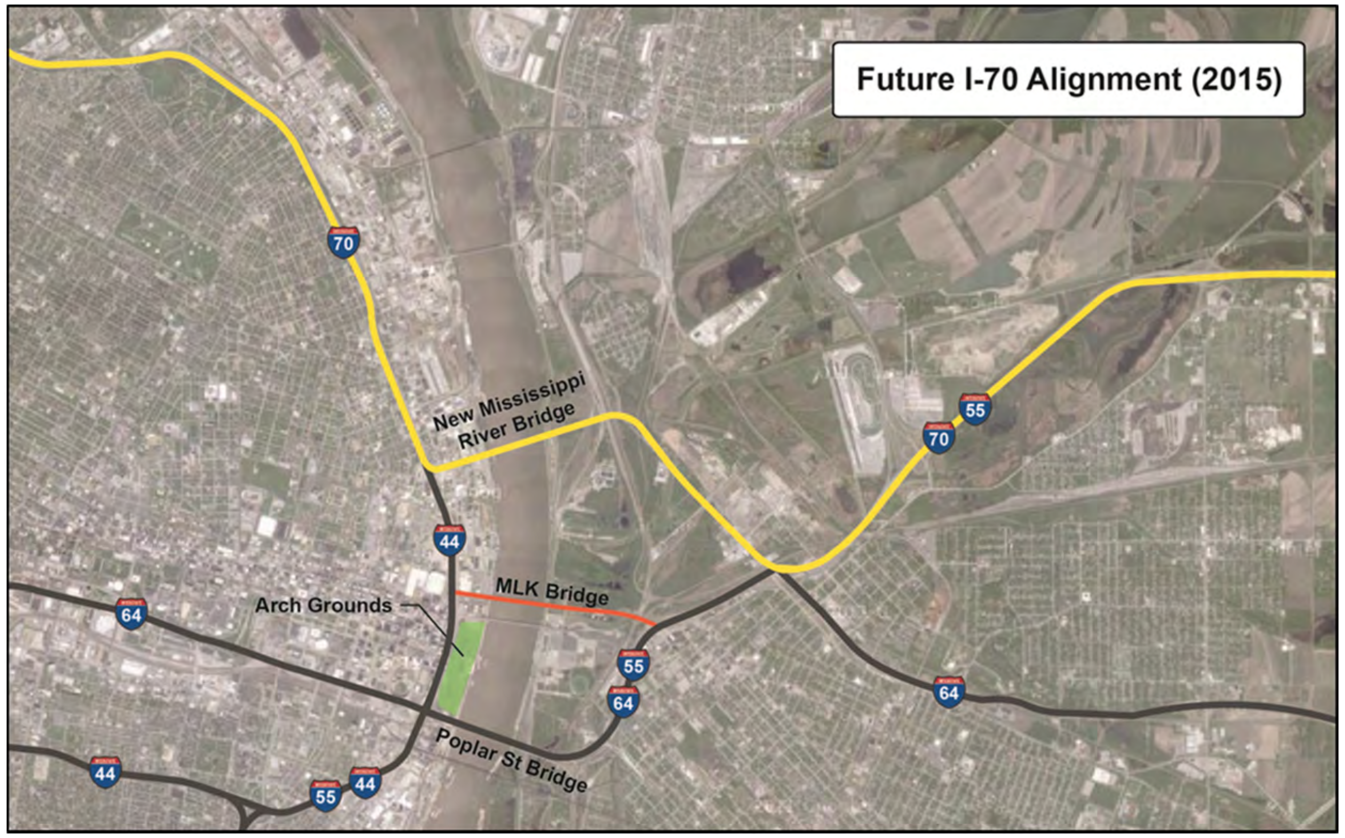


Exhibit 4.1: Future Interstate I-70 Alignment through downtown St. Louis (Image: CAR 2015 Final AJR Document, July 2012)

These shifts generally assume the major traffic movements between I-70 west of St. Louis or the north end of the St. Louis CBD and I-70 or I-64 in IL will relocate their river crossing from the crowded PSB to the more direct NMRB. In addition, there will be non-interstate traffic shifts that connect to the PSB from IL Route 3 and East St. Louis. All of these movements will obtain a direct connection to the NMRB, via the expanded "Tri Level Interchange" (I-64/70/55) east of the MLK bridge connection. However, all traffic with an origin/destination in the south study area is expected to utilize the PSB.

City+Arch+River | 2015 (CAR 2015)

The CAR 2015 project obtained conceptual approval from FHWA in June, 2012, and completed the NEPA (National Environmental Policy Act) process in May, 2013. The project incorporates several Transportation initiatives that will impact I-70 (Future I-44) as well as the St. Louis City arterial street network. The transportation projects are presently being designed and are scheduled to begin construction in summer, 2013.

4.1.1.1 From the North and from the West to Downtown St. Louis

Access and Movements

As shown in **Exhibit 4.2A**, existing movements coming from North and Northwest of St. Louis, eastbound on I-70, previously had access into downtown via the following four exits:

- Movement A: Exit 249A to North 10th Street
- Movement B: Exit 249C to Broadway
- Movement C: Exit 249D I-70 express lane exit to Broadway
- Movement E: Exit 250B to Memorial Drive

Movement A was closed and removed in October, 2011, as part of the NMRB Project. The CAR 2015 project proposes to remove the Memorial Drive exit (Movement E) and construct an entrance ramp in its place.

The CAR 2015 project will construct a new exit to the St. Louis CBD from the future I-70 to NMRB eastbound ramp. This new exit ramp would connect to Tucker Boulevard at Cass Avenue (Movement H), providing a new, direct connection to the western portion of the St. Louis CBD. Tucker Boulevard is an eight-lane roadway that currently operates well under capacity.

Modeling Assumptions

The 2015 movement shifts are shown in **Exhibit 4.2B**. For traffic modeling and analysis purposes, it was assumed that 100% of the existing volume utilizing the 10th Street exit (Movement A) will shift to the proposed Tucker Ramp (Movement H). The vehicles currently exiting to downtown via Memorial Drive (Movement E) will shift to exit via Movement B (50% of existing) and Movement C (50% of existing).

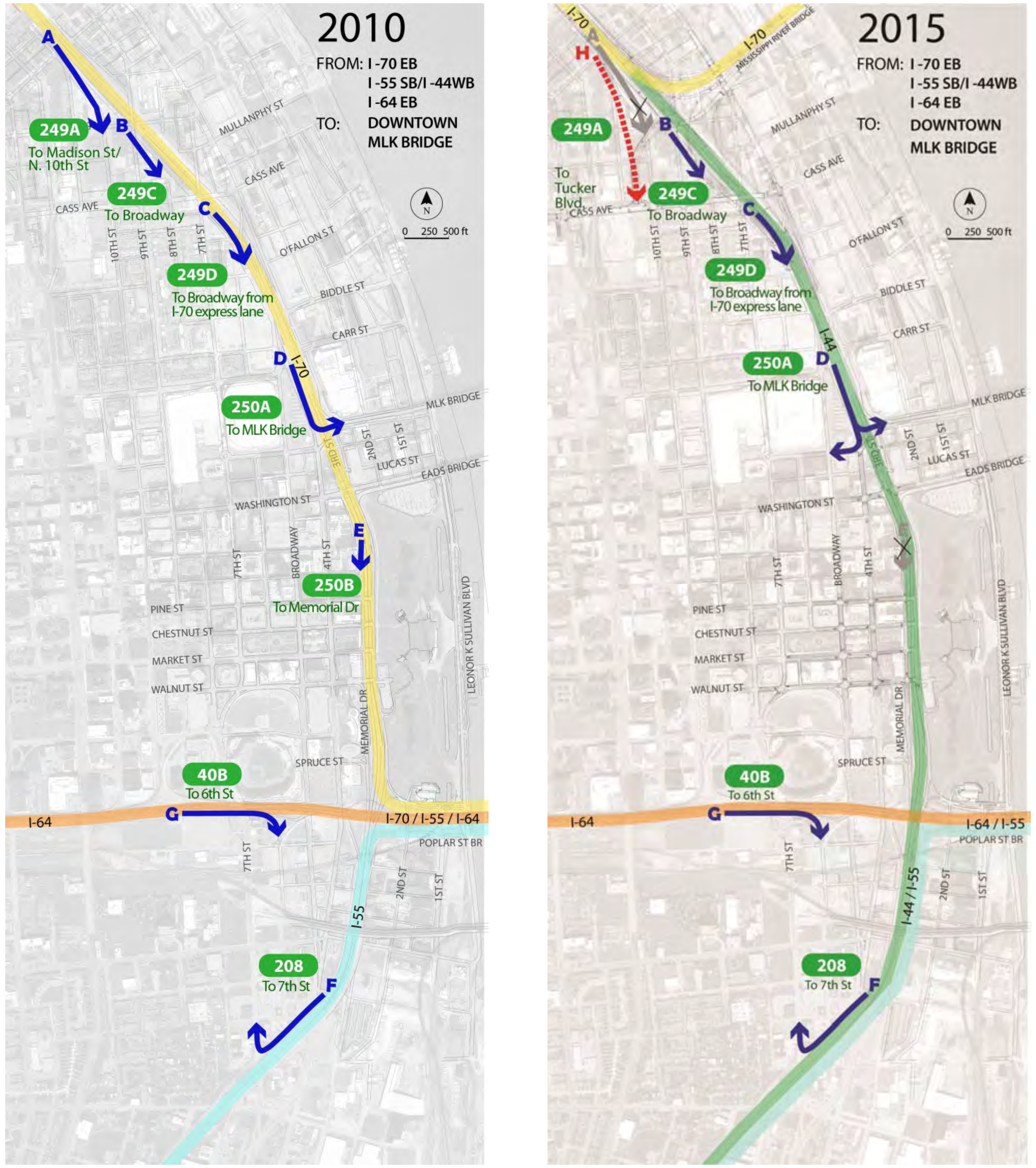


Exhibit 4.2A and 4.2B: Southbound and Eastbound Interstate access to Downtown St. Louis , 2010 and 2015 (Images: CAR 2015 Project Final AJR Document, July 2012)

4.1.1.2 From the South and from the East to Downtown St. Louis

Access and Movements

Existing movements into St. Louis from the South (I-70 westbound, I-44 eastbound, and I-55 northbound) access downtown via five main exits, as shown in **Exhibit 4.3A**:

- Movement A: Exit 209A from I-44/I-55 to NB Memorial Drive *
- Movement B: PSB westbound to Memorial Drive northbound* (and I-70 westbound)
- Movement C: Exit 249A to Madison Street
- Movement D: Exit 40A to 9th Street
- Movement E: Exit 208 to Park Avenue / 7th Street

*Memorial Drive currently provides access to downtown via Market and Pine Streets and also to the northern business district via Washington Avenue.

The CAR 2015 project will to remove Memorial Drive northbound between Walnut and Washington Streets and replace access to the north end of downtown with a new exit ramp to Memorial Drive northbound at Washington Street (Movement F), as shown in **Exhibit 4.3B**. Vehicles can continue to access downtown via Movements A and B as Walnut Street will be converted to a two-way street between Memorial Drive and 8th Street, creating a new gateway entrance to the downtown CBD. Travelers destined for the north end of the CBD and Laclede's Landing will be able to use Movement F from the depressed section of the Interstate.

Modeling Assumptions

Within the future traffic models, it is assumed that movements currently using Memorial Drive to access downtown would shift in the 2015 network as follows:

- 40% of vehicles currently using Movement A will shift to Movement F to access the north end of the CBD. This assumption is based on existing left turn movements from Memorial Drive with some adjustment for expected new developments at the north end of downtown
- 15% of vehicles that currently utilize the Pine Street access from Memorial Drive northbound will take Movement F and the proposed U-turn connection to approach Pine from Memorial Drive southbound
- 100% of vehicles that use Market Street to enter downtown will instead use Walnut Street, based on left turn movement counts on Memorial Drive northbound
- 75% of vehicles that use Movement B will continue that access via Walnut Street. The other 25% will utilize the connection provided by Movement G
- 100% of vehicles currently using Movement C and Movement E will continue to utilize those exits

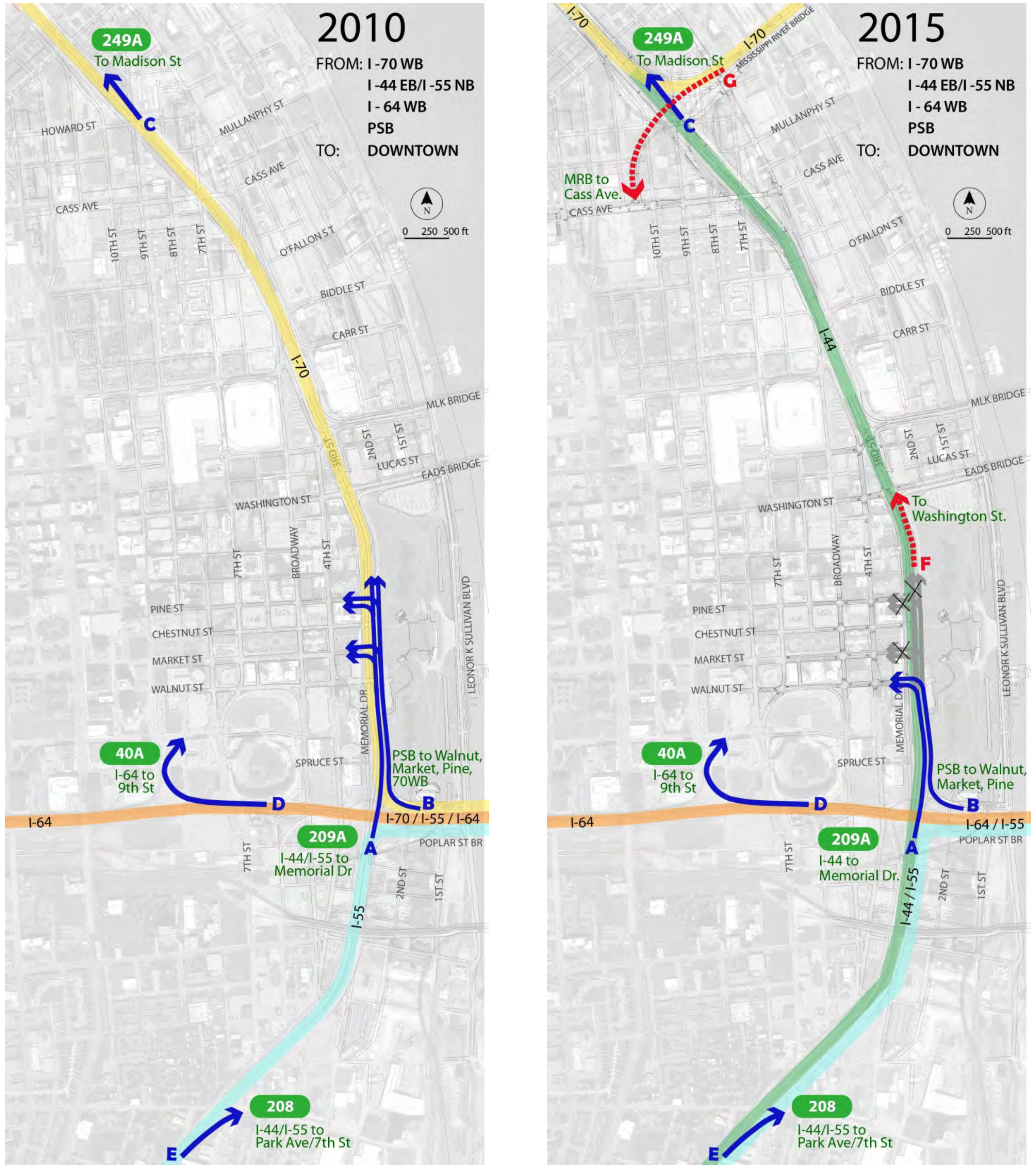


Exhibit 4.3A and 4.3B: Northbound and Westbound Interstate access to Downtown St. Louis, 2010 and 2015 (Images: CAR 2015 Final AJR Document, July 2012)

4.1.1.3 From Downtown St. Louis to the North and to the West

Access and Movements

Existing movements departing downtown St. Louis destined for the North and Northwest can currently access the interstate at four points, as shown in **Exhibit** 4.4A:

- Movement A: Memorial Drive northbound onto I-70 westbound
- Movement B: Biddle Street on-ramp to I-70 westbound
- Movement D: 10th Street on-ramp to I-64 westbound
- Movement E: Marion Street / 8th Street on-ramp to I-70 westbound

As shown in **Exhibit** 4.4B, the CAR 2015 project will remove the entrance from Memorial Drive (Movement A) and replace it with an exit ramp. In addition, the project will modify North 3rd Street to create a new City street connection across the west end of the MLK Bridge (Movement F). This link creates new access from the CBD to the existing MLK/North 3rd on-ramp to westbound I-70. The extension enables access from the northeast corner of downtown, Washington Street, and Convention Plaza to I-70 westbound.

Modeling Assumptions

For traffic modeling and analysis purposes, it is assumed that the new North 3rd extension (Movement F) will serve 55% of the existing Memorial Drive entrance traffic volume, with the remaining 45% utilizing the existing Biddle Street on-ramp (Movement B).

The expectation is that F would be a more attractive option for the relocated movements than B. However, the new intersection of 3rd Street, Convention Plaza and the MLK Bridge ramp is not expected to accommodate all of the existing volume. Therefore, this projected split was achieved by an iterative process that balanced the impacts of the relocated traffic on that intersection and its neighbors (e.g. the intersections of 4th Street with Convention, 4th Street with Biddle/Carr, 3rd with Carr Street, and 3rd with Biddle). The balancing effort also took into consideration the weaving effect to Movement C and the existing capacity constraints for Movement B (the signalized intersection, and merging movement with I-70).

No traffic shifts were anticipated for Movements D and E.

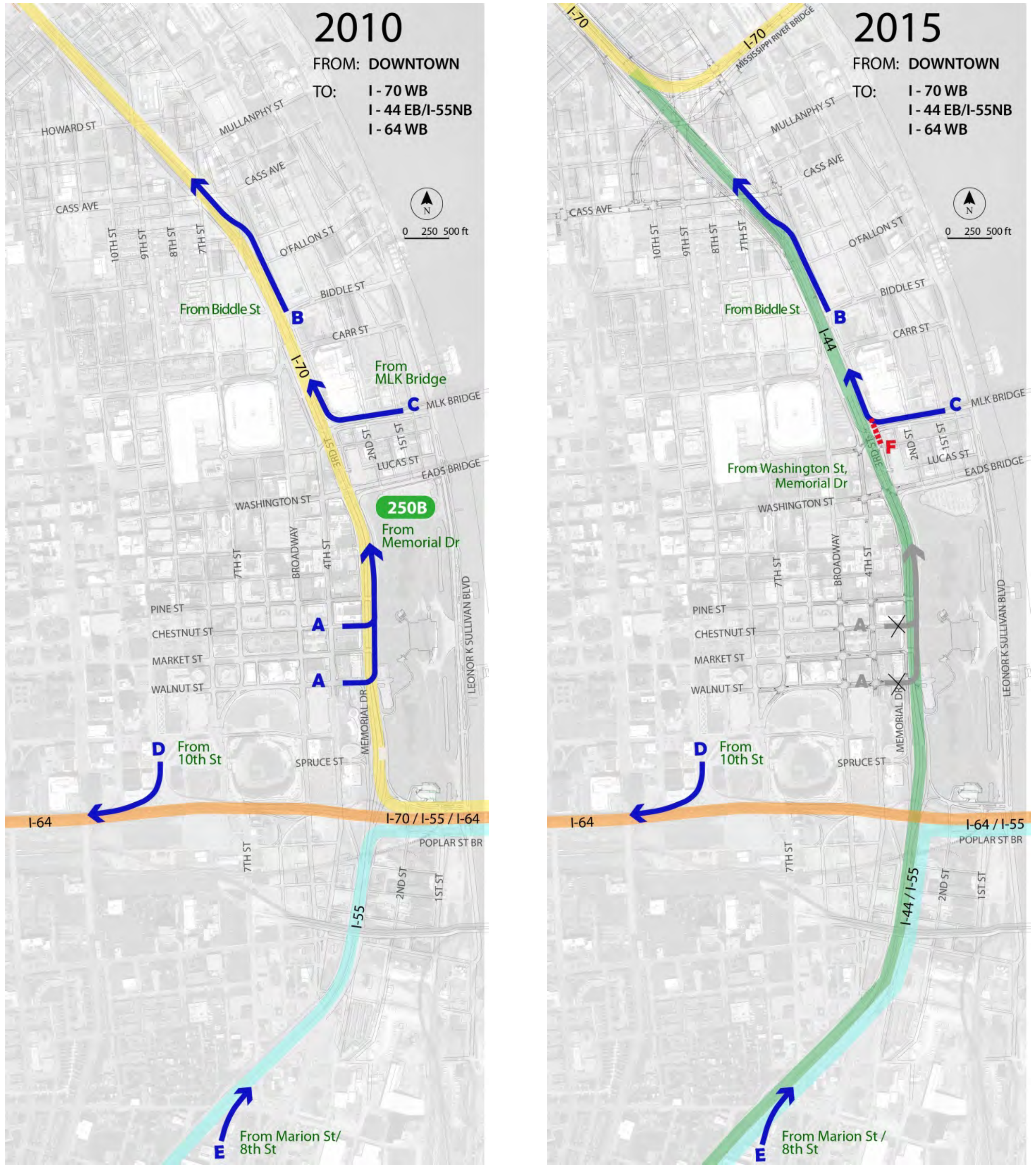


Exhibit 4.4A and 4.4B: Downtown interstate access to the north and west, 2010 and 2015 (Images: CAR 2015 Final AJR Document, July 2012)

4.1.1.4 From Downtown St. Louis to the South and to the East

Access and Movements

Existing movements leaving downtown headed to the south or eastbound to Illinois currently have several access options, as shown in **Exhibit 4.5A**:

- Movement A: From Memorial Drive southbound to I-44/55
- Movement B: From Memorial Drive southbound east across the PSB
- Movement C: From 6th Street to I-64 eastbound across the PSB
- Movement D: From 7th Street to the south via I-44/55
- Movement E: From Marion Street / 8th Street to I-44/55 linking to the PSB

As shown in **Exhibit 4.5B**, the NMRB project will provide a new connection from Cass Avenue to I-70 eastbound via the new bridge (Movement I). Utilizing that new capacity, the proposed PSB Project would remove the ramp that links Memorial Drive southbound to PSB eastbound (Movement B) in order to facilitate the widening of the ramps between the PSB and I-55/I-44.

Access from downtown to I-55/I-44 via southbound Memorial will be maintained, though the connection to Chestnut Street is proposed to be closed due to the park over the highway between Chestnut and Market. However, the CAR 2015 project proposes to create a new on-ramp into the depressed section from Washington Street via southbound Memorial (Movement H).

Modeling Assumptions

Within the future traffic models, it is assumed that:

- 25% of the traffic utilizing Movement A would shift to Movement H, based on the assumed volumes originating from parking garages along Olive and Washington and destined south to I-44/55. The remainder will continue to use Movement A.
- Upon opening of the NMRB, the existing traffic from the southbound portion of the depressed highway section (I-70 eastbound) to the PSB eastbound (existing Ramp B) is expected to shift to Movement I via the new Tucker Boulevard connection;
- Upon completion of the proposed PSB Interchange project, 100% of volume from Movement B to the PSB would shift to the MLK Bridge (movement F). Movements C and E currently operate at or near capacity due to constraints on the PSB approach ramps. However, the PSB project would help to alleviate the approach ramps as bottlenecks, thereby allowing Movements C & E to become an attractive alternative for eastbound PSB access (especially after construction of Phase II adds capacity to Movement C). For analysis purposes, only Movement F was utilized in order to analyze a "worst-case" scenario.

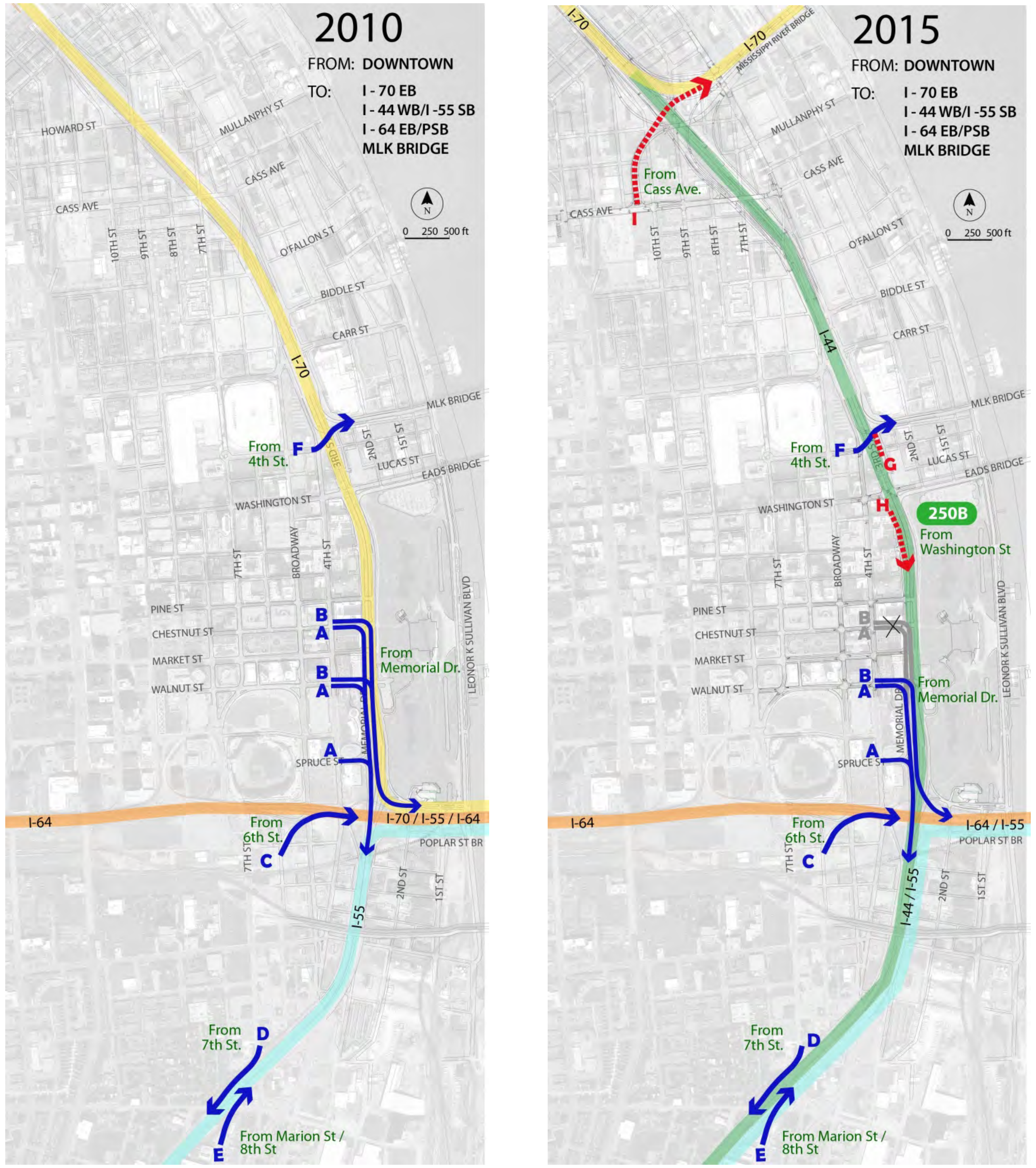


Exhibit 4.5A and 4.5B: Downtown Interstate Access to the south and east, 2010 and 2015 (Images: CAR 2015 Final AJR Document, July 2012)

4.1.2 Development Growth

Traffic forecasts from 2010 to 2015 assume 50% occupancy for the proposed Mercantile, Laurel and Ball Park Village developments (except the Laurel Hotel, assumed to reach 100% occupancy by 2015), as listed in **Table 4.1**.

Table 4.1: Development Projects Anticipated within Project Analysis Timeframe

Development	Element	2015 Build-out	2035 Build-out
Mercantile Exchange	Retail	175,000 s.f.	350,000 s.f.
	Office	262,500 s.f.	525,000 s.f.
Laurel Development	Hi-Rise Apartments	60 units	120 units
	Hi-Rise Condominiums	88 units	175 units
	Hotel	216 rooms	216 rooms
Ball Park Village	Office	112,500 s.f.	225,000 s.f.
	Retail	50,000 s.f.	100,000 s.f.
Bottle District	Office	-	45,000 s.f.
	Apartments	-	235 units
	Restaurant	-	175,000 s.f.
	Hotel	-	150 rooms
Lumière Casino Phase II	Condominiums	-	375 units
	Retail	-	220,810 s.f.

Institute of Traffic Engineers (ITE) Trip Generation Manual, 8th Edition, rates were utilized to forecast the anticipated traffic resulting from these developments. However, the overall plan for the St. Louis CBD is to create a more balanced environment that is pedestrian, bicycle, and transit friendly. In other words, the CBD is planned to become a more dynamic and active place with more round-the-clock activity where people work, live, visit and stay. These developments are based on the philosophy that they will allow residents and visitors to travel to and from the developments by means other than vehicles and will not generate the AM inbound and PM outbound vehicle trips typical of CBD commercial and office space.

Reductions from ITE trip generation rates were taken as follows in **Table 4.2**:

Table 4.2: Project-specific Reduction for ITE Trip Generation Rates

	Reduction from ITE Rates (%)			
2015 Development	Retail	Office	Condo/Apt.	Hotel
Mercantile Exchange	60	20	30	20
Laurel Development	60	20	30	20
Ball Park Village Phase I	60	20	-	-

After reductions, origin/destination assumptions were made for the forecasted trips. Then, the resulting traffic volumes were manually layered on top of the background growth to project area turning movement volumes in the SYNCHRO models and the path volumes in the VISSIM models.

4.1.3 Background Traffic Growth

The traffic growth in the St. Louis CBD has been generally flat or declining for the last several decades. In fact, the standard practice locally has been to use a 0.0% growth rate for downtown projects; this assumption has been supported by both MoDOT and East West Gateway Council of Governments on recent projects.

For reference, **Table 4.3** describes the population of St. Louis City, St. Louis County and the State of Missouri at ten-year intervals. While population is only one of many variables that affects traffic volumes, the negative trend in downtown population and relatively flat growth in St. Louis County over the last several decades is evident.

The annual growth rate was assumed to be 0.2% per annum for the period from 2015 to 2035, in an effort to maintain some level of conservative background growth. This growth rate was determined in consultation with MoDOT.

For the 2035 model the team, in consultation with MoDOT and the East-West Gateway Council of Government's (EWCOG's) local travel demand model, determined that the 0.2% per annum growth rate remained reasonable for the period from 2015 to 2035. At this time, it was also determined that EWCOG's travel demand model incorporates proposed development into the land use projections that form a basis for its future traffic projections. Therefore, a flat 4% growth rate was added to each 2015 model in order to create the 2035 model scenarios, and no additional traffic growth due to development was layered in. The traffic volumes resulting from the traffic forecasting process, and utilized for analyses, are displayed in **Appendix E**.

Table 4.3: St. Louis and Missouri Population History

Year	St. Louis City	10-year Growth	St. Louis County	10-year Growth	Missouri State	10-year Growth
1950	856,796	5.0%	406,349	48.2%	3,954,653	4.5%
1960	750,026	-12.5%	703,532	73.1%	4,319,813	9.2%
1970	622,236	-17.0%	951,353	35.2%	4,676,501	8.3%
1980	453,085	-27.2%	973,896	2.4%	4,916,686	5.1%
1990	396,685	-12.4%	993,529	2.0%	5,117,073	4.1%
2000	348,189	-12.2%	1,016,301	2.3%	5,596,684	9.3%
2010	319,294	-8.3%	998,954	-1.7%	5,988,927	7.0%

4.2 Area of Influence

The base data and existing geometries were used in concert with the selected analysis tools to develop a base set of operational models as described below. The area of influence was defined by the needs of the microsimulation models utilized for operational analyses. Microsimulation models generally have three primary components. The *physical network* is a graphical representation of the study area transportation facilities and consists of elements that do not change throughout the day. The *traffic control* element consists primarily of traffic signal timing plans, which are largely available from the agencies owning the study traffic signals. Finally, *traffic volumes* are typically derived from field counts and/or traffic forecasts at the onset of most projects. In this project all the three components were developed and integrated using both the VISSIM and SYNCHRO software platform.

The SYNCHRO models focus on the City's arterial network including:

- Tucker Boulevard to the west
- Cass Avenue to the north
- Leonor K Sullivan Boulevard to the east
- Spruce Street to the south.

In general, the limits of the VISSIM models extend at least one service interchange beyond the PSB Interchange Project boundary. To comply with FHWA policy[2], the VISSIM models include:

- I-55/I-44 between the I-55/I-44 interchange and Poplar Street Bridge (I-55/I-44/I-70) Interchange
- I-70 between the Poplar Street Bridge Interchange and 11th Street Ramps. 2015 and 2035 VISSIM models will also include the Missouri New Mississippi River Bridge Interchange
- Memorial Drive, 4th Street and Broadway within the above extents of I-70 (including intersections with Spruce Street, Clark Avenue, Walnut Street, Market Street, Chestnut Street, Pine Street, Olive Street, Locust Street, St. Charles Street, Washington Avenue, Lucas Avenue and Convention Plaza, Cole Street and Biddle Street).

The Area of Influence extends one system interchange North and South of the project to capture the NMRB and the full operations of the I-55/I-44 interchange. **Exhibit 4.6** shows the general coverage of both the VISSIM and SYNCHRO models and the area of influence for traffic forecasts.

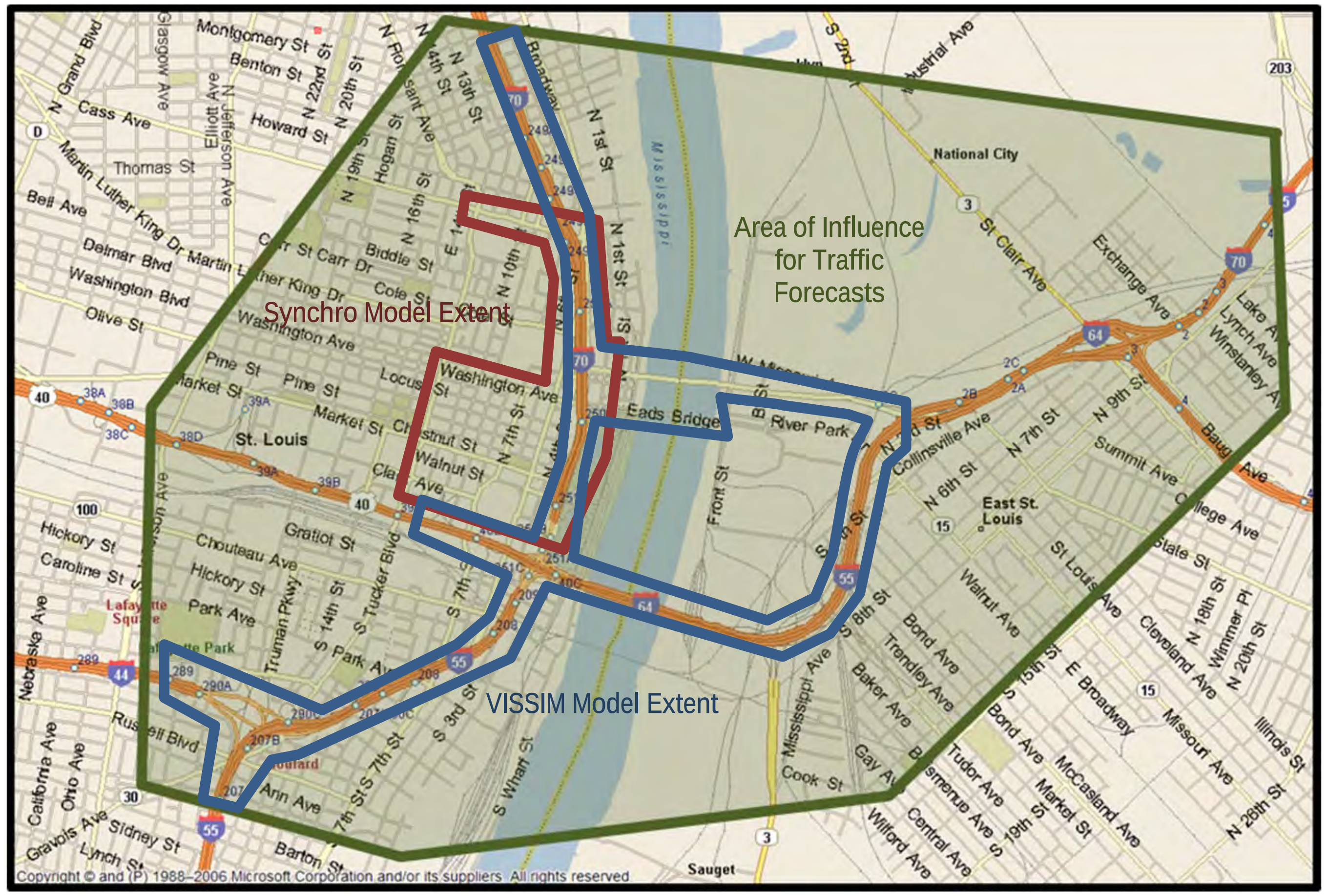


Exhibit 4.6: General Extents of VISSIM and SYNCHRO Models

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[2] Comprehensive Interstate Network Study: In areas where the potential exists for future multiple interchange additions or modifications, all requests for new or revised access are supported by a comprehensive Interstate network study with recommendations that address all proposed desired access (related or otherwise required transportation system improvements) within the context of a long-term plan.

4.3 Operational Analysis Procedures

4.3.1 Software Tools

In light of the significant functional modifications proposed by the PSB Interchange Project, and their wider area of influence, a combination of analysis tools are necessary to adequately investigate and determine how these modifications will impact the existing network, and to describe whether proposed changes will meet the project's objectives. The definition of each type of analytical tool, as well as the platform selected for this project, is described as follows.

Microscopic Simulation Models

Microscopic models evaluate the network as a system rather than as connected parts. The platform utilized is VISSIM, version 5.30, developed by PTV. These stochastic models simulate the movement of individual vehicles based on car-following and lane-changing theories. They reflect the traffic conditions expected to occur within a network given certain volumetric and physical characteristics.

A set of VISSIM models was built to investigate freeway movements, ramps and arterials which incorporate the PSB Interchange ramp modifications and the future system changes connected with the NMRB and CAR 2015 projects.

Traffic Signal Optimization Tools

This project uses SYNCHRO version 7, developed by Trafficware. This tool is primarily designed to develop and evaluate signal phasing and timing plans.

A set of SYNCHRO models was constructed to investigate signal timings, intersection and link level of service for impacts stemming from modifications to freeway access and resulting highway-related traffic shifts to the St. Louis signalized network.

4.3.2 Tool Integration

This project used a "turnkey model" approach to integrate the various tools and analysis methodologies. Turnkey modeling combines the independent modeling needs required by large-scale operational analysis into an integrated modeling system. This process allows analysis of the demand and supply components in relation to each other, as opposed to separate analyses. Turnkey models can better represent capacity improvements and impacts on demand and how those improvements affect operations. Such iterative analysis is difficult to do with traditional modeling techniques. Within these models, the functional scope included modeling a range of facility types, including:

- **Arterials**: signalized streets that primarily serve through traffic and secondarily provide access to abutting properties;
- **Intersections**: single crossing points between two or more roadway facilities;
- **Basic Freeway Segments**: multilane, divided highways with a minimum of two lanes for the exclusive use of traffic in each direction and full access control without traffic interruptions;
- **Auxiliary Lanes**: additional weaving lanes on freeways to connect on and off-ramps; and
- **Freeway Ramps**: short segments of roadway connecting two roadway facilities.

In order to serve these multiple purposes, a set of VISSIM models were built to investigate freeway movements, ramps and arterials; and a set of SYNCHRO models were constructed to investigate signal timings, intersection and link level of service.

4.3.3 Model Inputs

Travel demand forecasting and traffic microsimulation models require a comprehensive set of traffic data and a detailed inventory of the physical and operational attributes to describe and replicate the existing system. This section describes the procedures undertaken to collect, format, and present the data and physical attributes used to generate the models for the project.

4.3.3.1 Traffic Volumes

Freeway Mainline volumes within the study network

MoDOT provided through-volume vehicle counts for the mainline freeways. These counts were typically 48-hour counts collected between May 2009, and January 2011, and were provided in hourly increments. These counts were all collected outside of MoDOT's freeway closures pertaining to the I-64 project, meaning that construction activities and detours did not influence those traffic counts. Traffic.com data was also utilized to validate and/or adjust MoDOT's counts. Count data from previous projects within the study area was also referenced to evaluate the count volumes.

Freeway ramp volumes for all interchanges within the study network

MoDOT provided vehicle counts collected between May 2009 and January 2011. These were typically 24- or 48-hour counts and results were given in hourly increments. Again, count data from previous projects within the study area was additionally referenced to evaluate the count volumes.

Arterial intersection volumes

Count data from the National Park Service's *Memorial Drive Closure Traffic Study* (AECOM, September 2009) was utilized. CBB collected additional counts outside and within that study area for comparison with and expansion of those volumes. Manual turning movement counts (TMCs) were collected for the AM and PM peak hours (7:30 – 8:30 am and 4:30-5:30 pm, respectively), at 26 locations in November 2010, 3 locations in January 2011 and 6 locations in April 2011. The 2011 counts were performed to collect data at locations closed or impacted by construction during November, 2010.

Review and Reconciliation

Careful examination of all traffic volumes was performed to assure the adequacy and consistency of data for use in modeling. Upstream counts were compared to downstream counts to detect any unexplained variations in the data. Where discrepancies were found, the counts were reconciled by normalizing or averaging counts from different time periods, or by assigning midblock sources and sinks where a particular land use warrants a large influx or egress of traffic volumes (e.g. parking garages in the St. Louis CBD). Engineering judgment was used based on local knowledge and field observations.

Traffic data (i.e. arterial and intersection volumes) was compiled taking into account average traffic conditions, free of incidents or poor weather, during multiple time periods. Where counts were needed at locations in close proximity, the counts were performed during the same day in an effort to capture related deficiencies. The final "balanced" peak period traffic volumes are shown in Appendix E.

4.3.3.2 Queue Pattern Observations (Length and Duration)

Observations of vehicle queues were made at several key points within the study corridor in order to support validation during model development. Observations were performed at arterial intersections, mainline freeway segments, and freeway ramps during formal data collection as well as during field visits throughout the project.

As with other field observations, care was taken to compile information during what were deemed as average conditions. However, the complete range of queue lengths was noted in order to capture operational variations. This helped to define "average" queuing patterns as well as determine typical ranges of queuing fluctuations. These queuing patterns were used to validate VISSIM models and to study the effect of external capacity constraints.

4.3.3.3 Geometric conditions and Signal Operations

The modeling team consulted high-resolution aerial photography and supplemented that information with site visits and consultations with MoDOT and the City of St. Louis to compile the geometric characteristics of the facilities. Signal operations were initially acquired from the City of St. Louis traffic controller system then verified by field observations of signal function as well as intersection geometry.

4.3.4 Base year Model Development

4.3.4.1 SYNCHRO Model Development

Year 2010 AM and PM Peak Hour SYNCHRO models were created for the study area, as exhibited in Exhibit 4.7.

The project team utilized a base SYNCHRO model that was updated multiple times for the City of St. Louis' recent CMAQ timing optimization projects. Current turning movement traffic counts, intersection geometries and turn bay lengths, and traffic signal plans were all inputs for the models. The SYNCHRO models were used to analyze arterial operations and were also constructed in such a way as to facilitate exportation of the SYNCHRO traffic signal timing plans directly into the VISSIM models to streamline the modeling process.

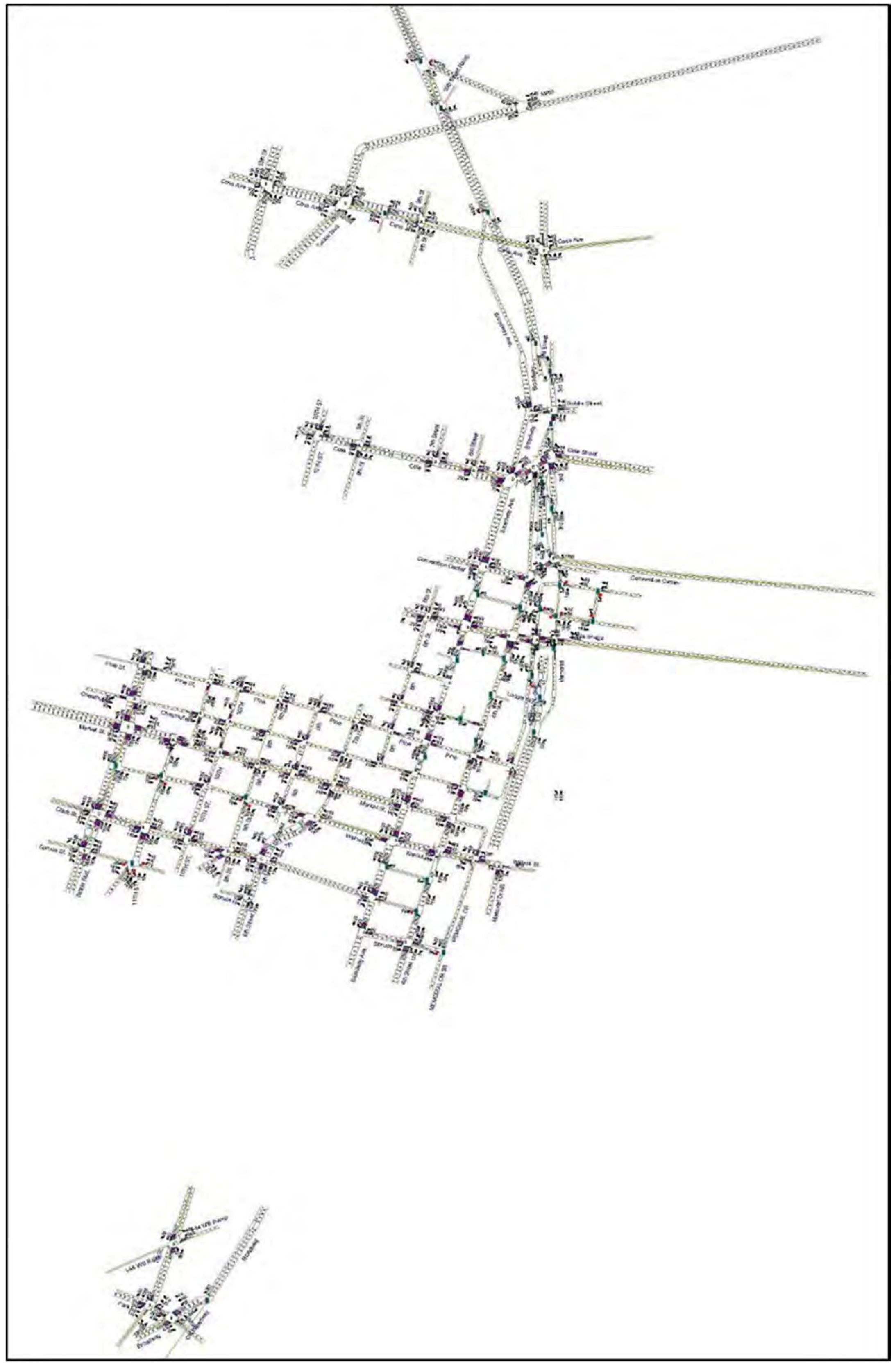

Exhibit 4.7: Synchro Model Network Extents

Zones were set up along specific corridors to coordinate and optimize the signal timing of closely spaced signals within each corridor. These zones reflect the parameter used within the City of St. Louis' signal timing system and were set up within the following three areas:

1. Central Business District (24 intersections);
2. Washington Avenue (two intersections); and
3. Convention Plaza, Cole Street, and Biddle Street (eight intersections).

Additionally there are several signal pairs within this area, which are spaced so closely that they operate as one. These were counted separately for the number of signals in zones. The locations of these groups are:

- Park Avenue with Broadway Avenue and 7th Street;
- Convention Plaza with 4th Street and 3rd Street;
- Cole Street with Broadway Avenue and 4th Street; and
- Biddle Street with Broadway Avenue and 3rd Street.

4.3.4.2 VISSIM Model Development

Physical Network

The physical geometric network was developed in VISSIM based on aerial photography, as built plans, and field observations. Some elements, such as reduced speed areas and desired speed decision points were coded based on a range of observed speeds in the study area. Our model used VISSIM's default vehicle classes, which is desirable to provide efficiencies in the merging or reprocessing of this model in future efforts.

Traffic Control

Traffic signal timing plans were imported from SYNCHRO into VISSIM, creating a true representation of the City of St. Louis' downtown signal system. Another result of this import is that VISSIM incorporates the intersection node numbers defined in SYNCHRO. Allowing continuing symmetry between the two models as signal operations are fine-tuned in the SYNCHRO scenario models.

Traffic Volumes

Traffic can be input in VISSIM using two basic types of routing procedures: 1) origin to destination paths or 2) intersection turning movement volumes. Even though these two methodologies produce the same traffic volumes, it is recommended to use the origin – destination path procedure to more accurately reflect traffic patterns throughout the study area. Moreover, this method is usually more efficient to use in larger models. The origin – destination matrix required for this method should be calculated based on intersection turning movement counts. For this project a matrix was manually created using the balanced turning movement volumes from the SYNCHRO models.

The VISSIM models were developed for one-hour peak periods for both the AM and PM conditions. Although VISSIM microsimulation software does accommodate greater time periods than a single hour, the volumes in the study area are largely constrained by the capacity of the river crossings. Both AM and PM peak periods were identified and examined, as described in the "Data Collection" section, and it was determined that these peak periods have a relatively flat bell curve. Therefore, only the peak hour was utilized for modeling, as the Measures of Effectiveness (MOEs) used for evaluation are based on a peak hour (e.g. density = passenger cars/hour/lane). The VISSIM model networks were thoroughly seeded (filled with representative traffic volumes) to reflect a congested network before the analysis is performed within VISSIM and the MOE data is obtained the peak hour accurately reflects the highest congestion of the peak period. The VISSIM model extents are exhibited in Exhibit 4.8.

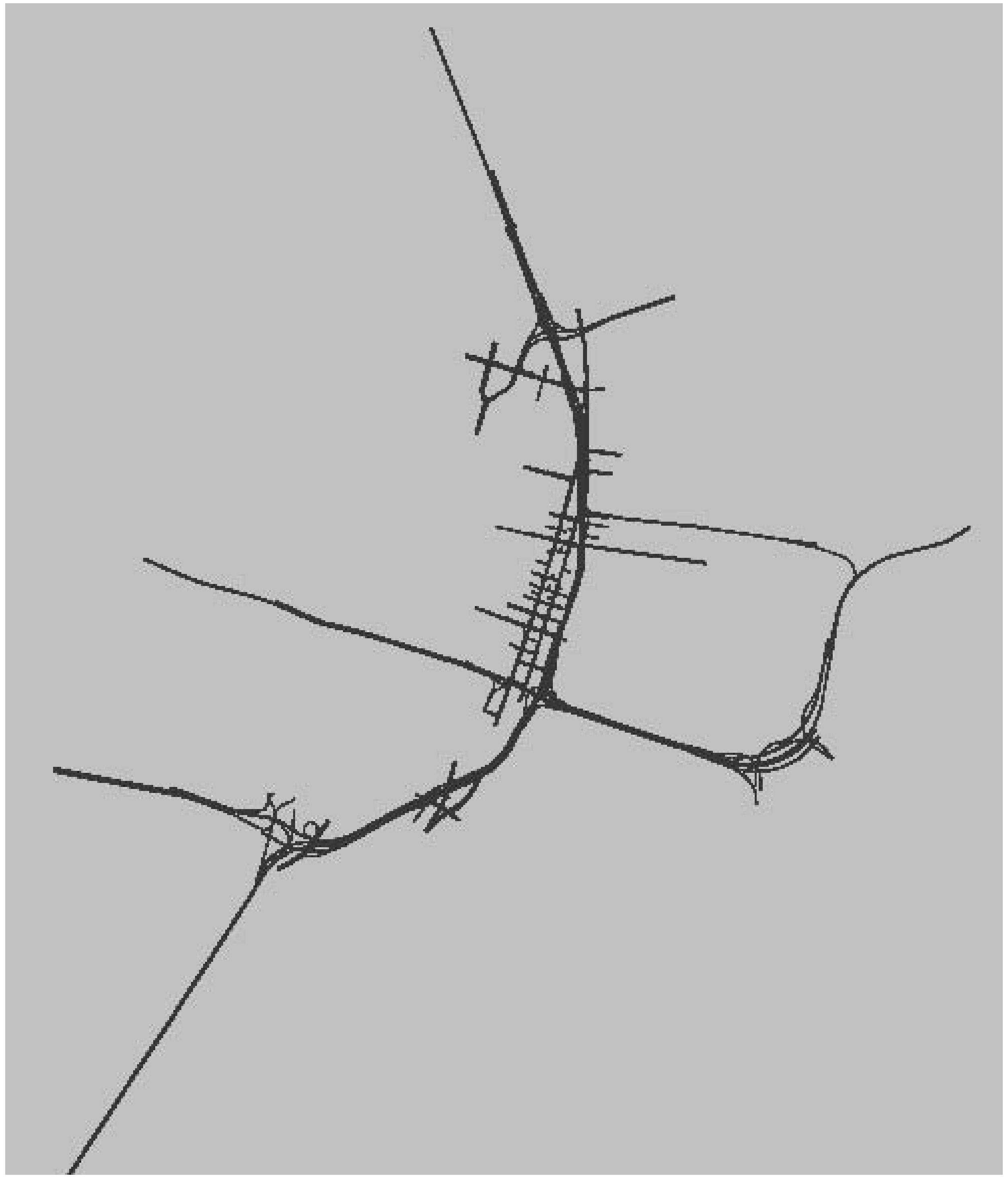

Exhibit 4.8: VISSIM Model Network Extents

4.3.5 Calibration and Validation

Calibration is the adjustment of model parameters to improve the model's ability to reproduce local driver behaviour and traffic performance characteristics. Extensive efforts were made to calibrate model parameters so that the link performance in the models matched field conditions (e.g., traffic volumes, queuing characteristics, lane choice behaviour, and travel speeds). In addition, after calibrating models within the consultant team, both the SYNCHRO and VISSIM models were evaluated side-by-side with MoDOT and City of St. Louis traffic specialists. These experts were able to further define any areas that needed special attention to more-closely reflect existing field conditions. For example, MoDOT requested the modellers to fine tune volume inputs to the eastbound PSB links to more closely reflect travel speeds of 30-40 mph in the AM peak. After these reviews, both MoDOT and City of St. Louis traffic staff agreed that the existing peak hour SYNCHRO and VISSIM models were an accurate representation of year 2011 field conditions.

SYNCHRO

The SYNCHRO model was calibrated previously for use on the City of St. Louis' CMAQ timing projects. These models have been calibrated numerous times in the past and were updated with both the current signal timings and current turning-movement count data. A thorough review showed that projected queuing and operations very closely reflected existing field conditions.

VISSIM

As part of the validation process, the project team coordinated with MoDOT to describe locations within the network where the model required user-generated treatments to reflect unique field conditions that the basic VISSIM driving patterns were unable to replicate. These modifications were applied on both eastbound and westbound I-70 near the Broadway overpass where MoDOT traffic staff agreed that current conditions are a reflection of the horizontal curvature of the road, combined with roadside and overhead barriers. Drivers have a tendency to slow down and space out in reaction to the perceived constriction. Therefore a unique VISSIM driver behaviour was utilized to reduce the saturation flow rate of the freeway section to 1800 vphpl. As with SYNCHRO, the congestion and queuing patterns observed in the field were compared to the VISSIM simulations. This comparison shows a strong correlation between the model results and field conditions and suggests a good calibration of the model parameters.

Comparison of SYNCHRO and VISSIM Results

As a final measure SYNCHRO and VISSIM results were compared to highlight any discrepancies between the modeling platforms. The various software platforms all calculate measures differently, so their results will differ compared to one-another. However, a comparison of their results can "flag" errors in the analysis if the differences cannot be resolved through an understanding of modeling assumptions or methods. A check of these measures concluded that all analysis platforms provided generally reasonable and consistent results. It should be noted that SYNCHRO is a deterministic model and results can be obtained directly from the software user interface. However, VISSIM is a stochastic model; therefore numerous model runs need to be performed and the output averaged to find the projected measures of effectiveness. The VISSIM results for each model are an average of ten model runs.

4.3.6 Model Outputs: Performance Metrics

4.3.6.1 SYNCHRO Models – Signals and City Streets

SYNCHRO uses procedures largely based on the methods outlined in the HCM to calculate delay and level of service estimates. As defined by the HCM, the Level of Service (LOS) for intersections is based on vehicle delay, as shown in **Table 4.4**. Furthermore, given the modelled conditions, a determination was made regarding which critical movement(s) was expected to generate the longest queue.

Table 4.4: Intersection Level of Service Criteria (HCM)

Level of Service	Delay per Vehicle (seconds/vehicle)
A	< 10
B	> 10-20
C	> 20-35
D	> 35-55
E	> 55-80
F	> 80

4.3.6.2 VISSIM Models – Freeway Operations and Network Simulation

Freeway operations analyses for the base year (2010) conditions were performed with VISSIM using HCM methodologies. AM and PM peak periods were analysed for basic freeway segments, weaving areas, and merge/diverge segments.

Basic Freeway Segments

Basic freeway segments were evaluated with the VISSIM software, utilizing the methodologies outlined in the HCM. The HCM defines basic freeway segments as sections of freeway that are outside of the influence area of ramps or weaving areas of the freeway. The primary measure for LOS is freeway density. Speed, freedom to maneuver and proximity to other vehicles are major indicators of service quality to drivers. Density is the parameter used to define LOS for the freeway and ramp sections in the HCM. The ranges of density used to define levels of service are shown in Table 4.5.

Table 4.5: Basic Freeway Segment Level of Service Criteria (HCM)

Level of Service	Freeway Density (passenger cars/mile/lane)
A	0 – 11
B	> 11 – 18
C	> 18 – 26
D	> 26 – 35
E	> 35 – 45
F	> 45.0

Freeway Weaving

The HCM defines a weaving segment as, "the crossing of two or more traffic streams travelling in the same general direction along a significant length of highway without the aid of traffic control devices. Weaving segments are formed when a merge area is closely followed by a diverge area, or when an on-ramp is closely followed by an off-ramp, and the two are joined by an auxiliary lane."[3] The manual goes on to say that its methodologies apply only to weaving segments with a distance that is less than or equal to 2500 feet. LOS for weaving segments is also based on density, as shown in Table 4.6.

Table 4.6: Freeway Weaving Segment Level of Service Criteria (HCM)

Level of Service	Freeway Density (passenger cars/mile/lane)
A	0 – 10
B	> 10 – 20
C	> 20 – 28
D	> 28 – 35
E	> 35 – 43
F	> 43.0

Merge and Diverge (Ramps)

The HCM 2000 defines ramp merge and diverge areas as ramp-freeway junction typically designed to permit high-speed merging or diverging with minimum disruption to the adjacent freeway traffic. Some of the ramp junctions in our study corridor are considered major merges or diverges. HCM methodologies have not yet been developed to properly analyze these situations; therefore, these areas must be analysed by microsimulation.[4] For example the I-44/I-55 merge at the south end of the project area would be a major merge. As with freeway facilities, merge and diverge LOS are based on density, as shown in Table 4.7.

Table 4.7: Freeway Ramp Merge/Diverge Level of Service Criteria (HCM)

Level of Service	Freeway Density (passenger cars/mile/lane)
A	0 – 10
B	> 10 – 20
C	> 20 – 28
D	> 28 – 35
E	> 35
F	Demand > Capacity

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[3] Highway Capacity Manual 2000,Chapter13 – Freeway Concepts Basic Freeway Segments, page 13

[4] Highway Capacity Manual 2000, Chapter 25 – Ramps and Ramp Junctions, page 10

4.4 Safety Analysis Procedures

Safety and security in travel is achieved by decreasing the risk of personal injury and property damage on and near transportation facilities. Missouri's Highway Safety Plan has a goal of reducing the number and severity of crashes occurring in Missouri. There is also a more specific goal – to reduce traffic fatalities to 850 or fewer by the year 2012 as identified in the state's strategic highway safety plan, Missouri's Blueprint to ARRIVE ALIVE.

4.4.1 Historical Data

A review of historical crash data was undertaken to identify any existing crash patterns. Crash summaries were provided by MoDOT for the years 2006 through 2010 on I-70, I-64, and I-55 within the area covered by the VISSIM model extents (shown in Exhibit 4.8). This area included I-55 from I-44 to I-64, I-64 from Broadway to the Illinois state line, and I-70 from the south end of the reversible lanes to I-64. These summaries were analyzed to identify the crash trends and problem areas, defining a baseline for safety performance.

It is generally accepted that geometries of the existing PSB Interchange ramps do not meet current design standards. Incidents, especially involving trucks, occur frequently. A recent event involving an overturned truck is shown in Photo 4.1. In an effort to quantify the rate of occurrence, individual crash reports were reviewed. The team discovered thirteen incidents during the five-year crash study period that can be classified as overturning trucks.

This investigation also found that a significant number of ramp crash reports were not classified by vehicle (e.g. trucks), were not tied to the ramps themselves, or did not include details that would indicate overturning or that geometric features contributed to the incident. The project team feels strongly that geometric and congestion-related incidents associated with the PSB Interchange are underreported. A summary of the results uncovered to date are presented in the following subsections. The background crash data can be found in Appendix F.

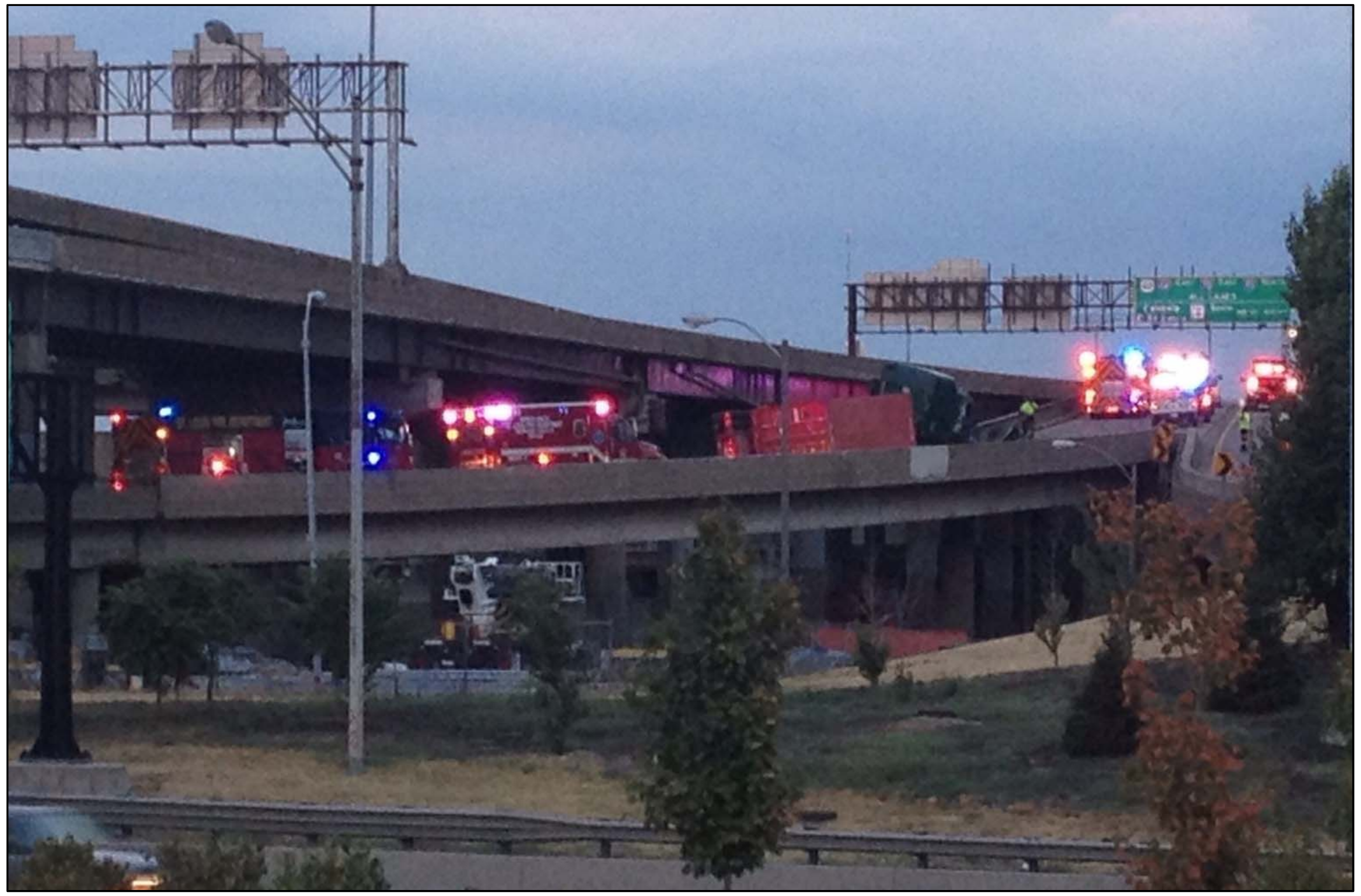


Photo 4.1: Incident Involving Overturned Truck on Ramp B (July, 2012)

4.4.1.1 I-64 Corridor Crash History

The I-64 data is summarized in **Table** 4.8 and **Exhibits** 4.9 and 4.10, below. The majority of all crash types were classified as “Rear End”. In addition, 45.0 percent of the crashes had “Congestion Present” noted on the crash report, although many other entries read “Congestion unknown” and may have been related to those conditions as well. The Road Surface Conditions were “Dry” for 81.9 percent of the crashes and the Lighting Conditions were “Dark” for 28.7 percent.

Table 4.8: I-64 Crash Data Summary (2006-2010)

	Crash Severity				
Collision Class	Fatal	Disabling Injury	Minor Injury	PDO	Total Crashes
Backing	0	0	0	3	3
Changing Lane	0	0	3	24	27
Dual Lefts Collide	0	0	0	1	1
Fixed Object	0	1	3	4	8
Left Turn	0	0	0	1	1
Other	0	0	0	9	9
Out of Control	0	1	15	46	62
Parking or Parked Car	0	0	0	2	2
Passing	0	0	11	95	106
Pedacycle	0	1	0	0	1
Rear End	0	3	57	160	220
Sideswipe	0	0	1	0	1
Right angle	0	0	0	1	1
Total	0	6	90	346	442

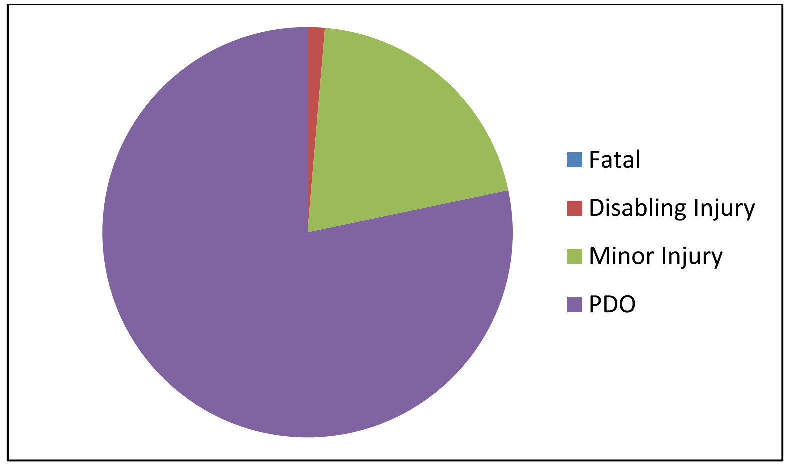


Exhibit 4.9: I-64 Crashes by Type (2006-2010)

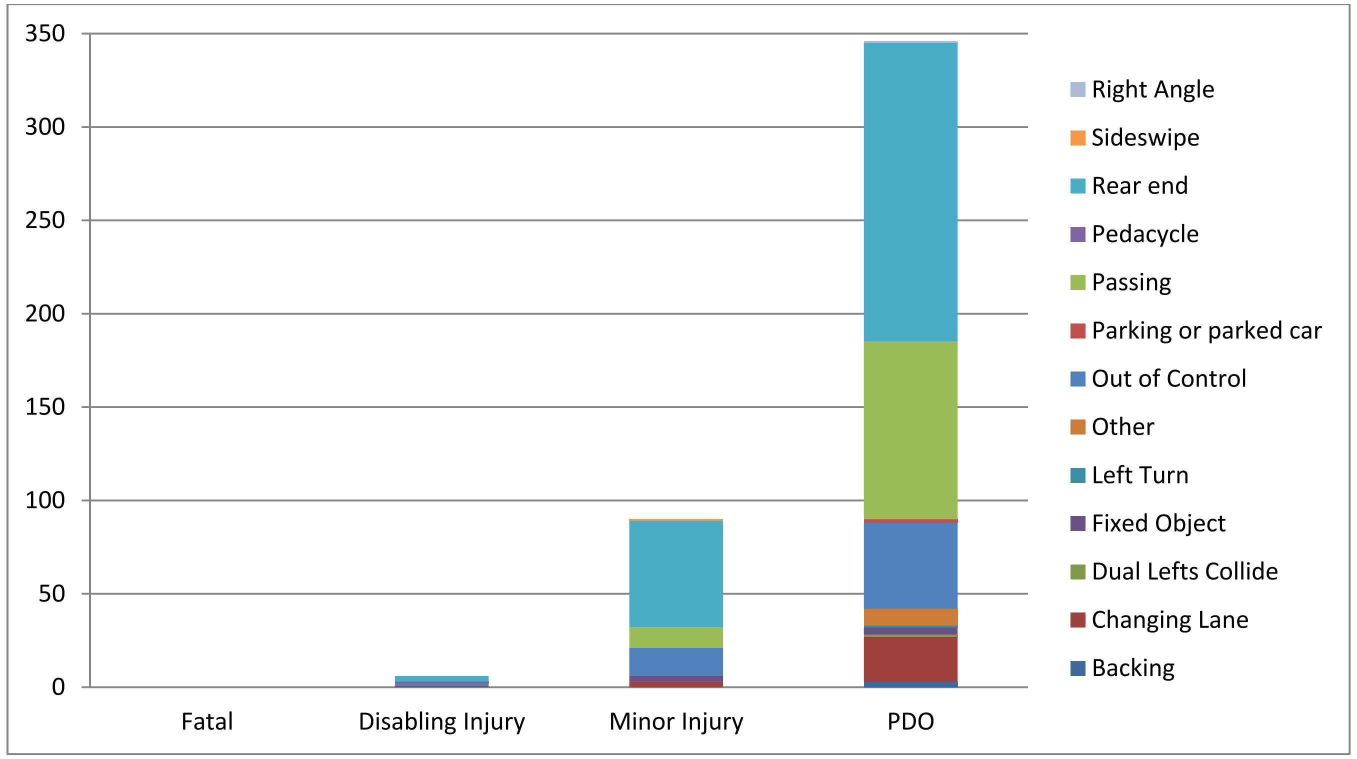


Exhibit 4.10: I-64 Crash Statistics (2006-2010)

4.4.1.2 I-55 Corridor Crash History

The I-55 data is summarized in **Table 4.9** and **Exhibits 4.11** and **4.12**, below. The majority of all crash types were classified as “Rear End” followed by “Out of Control”, which represented the majority of the Fatal and Disabling Injury crashes. The following relevant conditions were noted on the reports:

- “Congestion Present”: 34.0 percent
- Pavement = “Dry”: 81.9 percent
- Lighting Conditions = “Dark”: 29.0 percent

Table 4.9: I-55 Crash Data Summary (2006-2010)

	Crash Severity				
Collision Class	Fatal	Disabling Injury	Minor Injury	PDO	Total Crashes
Avoiding	0	1	2	2	5
Backing	0	0	0	5	5
Changing Lane	0	0	10	31	41
Dual Lefts Collide	0	0	0	1	1
Fixed Object	1	0	8	10	19
Head On	0	0	2	2	4
Turn Right Angle Collision	0	0	0	1	1
Other	0	1	1	22	24
Out of Control	3	8	69	142	222
Parking or Parked Car	0	0	1	5	6
Passing	0	1	22	112	135
Pedestrian	0	0	1	0	1
Rear End	1	2	83	214	300
Right Angle	0	0	0	3	3
Right Turn	0	0	0	1	1
Sideswipe	0	0	1	5	6
Total	5	13	200	556	774

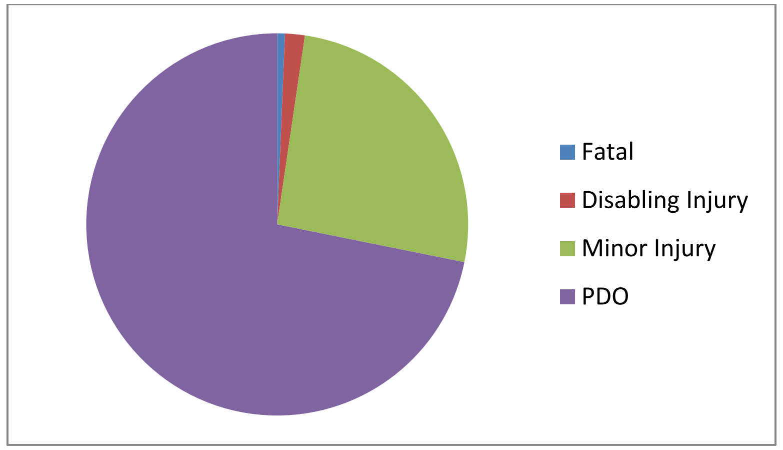


Exhibit 4.11: I-55 Crashes by Type (2006-2010)

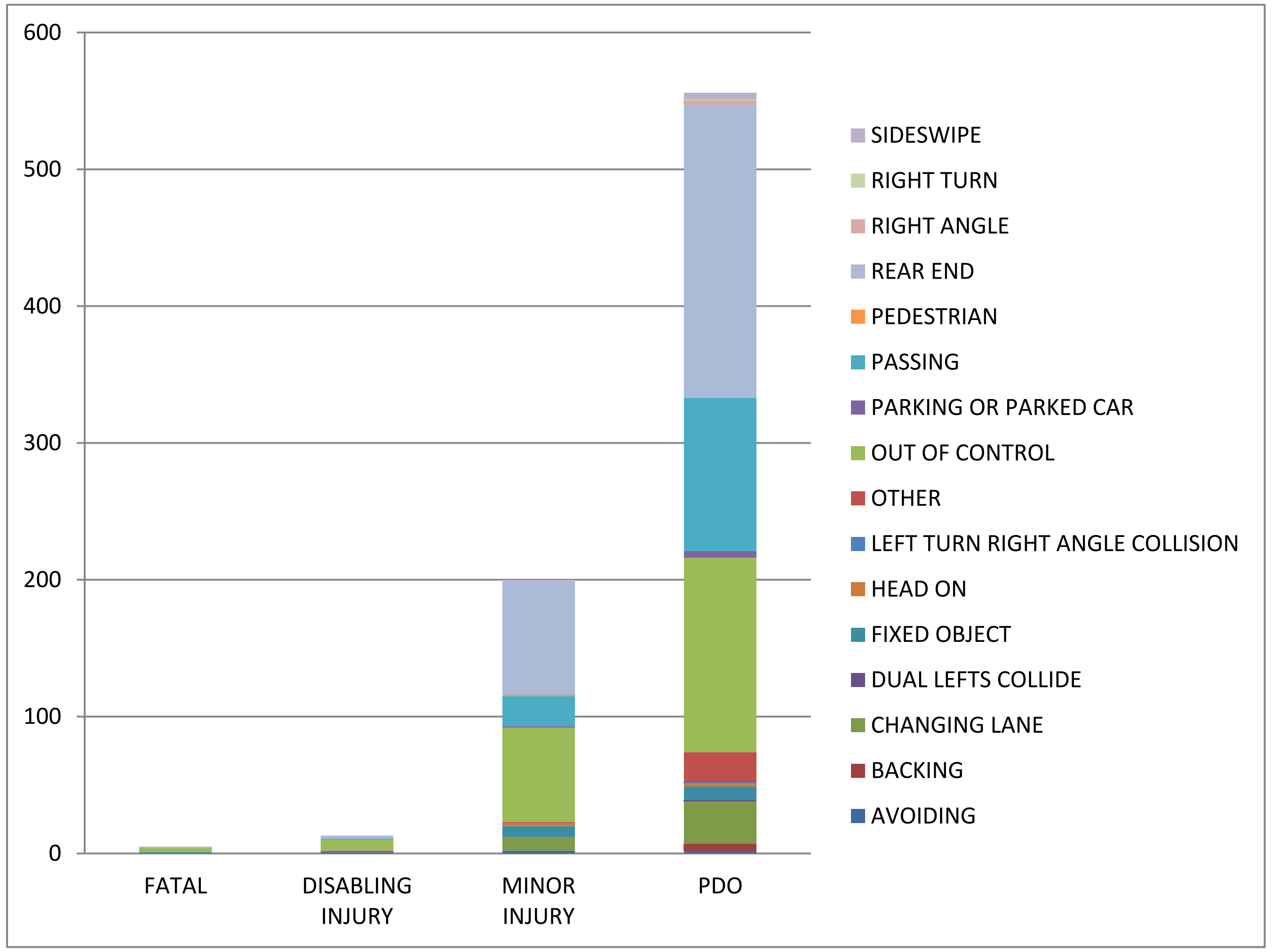


Exhibit 4.12: I-55 Crash Statistics (2006-2010)

4.4.1.3 I-70 Corridor Crash History

The I-70 crash data is summarized in **Table** 4.10, **Figure** 4.13 and **Figure** 4.14 below. The limits of the crash investigation through the I-70 corridor were St. Louis Avenue to the north and I-64 to the south. The majority of all crash types were classified as "Rear End" followed very closely by "Out of Control", which represented the majority of the Fatal and Disabling Injury crashes. Together these two categories represent nearly 70 percent of all the collisions. The following relevant conditions were noted on the reports as well:

- "Congestion Present": 28.2 percent
- Pavement = "Dry": 62.8 percent
- Lighting Conditions = "Dark": 41.9 percent

Table 4.10: I-70 Crash Data Summary (2006-2010)

	Crash Severity				
Collision Class	Fatal	Disabling Injury	Minor Injury	PDO	Total Crashes
Avoiding	0	0	5	4	9
Changing Lane	1	0	6	22	29
Fixed Object	0	0	8	11	19
Head On	0	0	1	0	1
Other	0	0	4	17	21
Out of Control	4	3	71	168	246
Parking or Parked Car	0	0	2	3	5
Passing	0	0	25	122	147
Pedestrian	1	1	1	0	3
Rear End	2	0	90	188	280
Right Angle	0	0	0	1	1
Right Turn	0	0	1	2	3
Sideswipe	1	0	0	3	4
U-Turn	0	0	0	1	1
Total	9	4	214	542	769

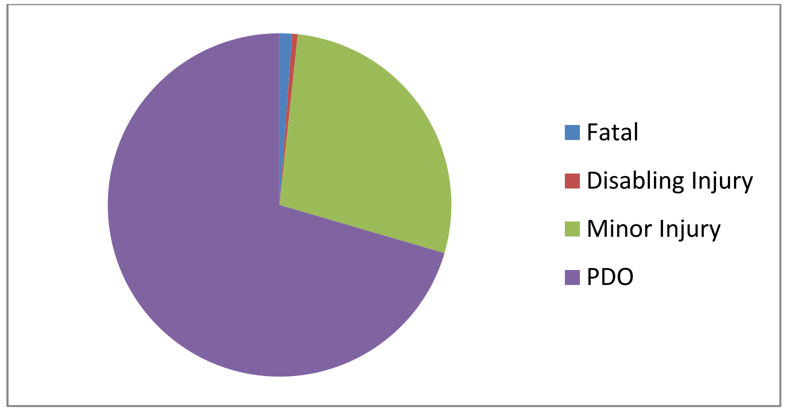


Exhibit 4.13: I-70 Crashes by Type (2006-2010)

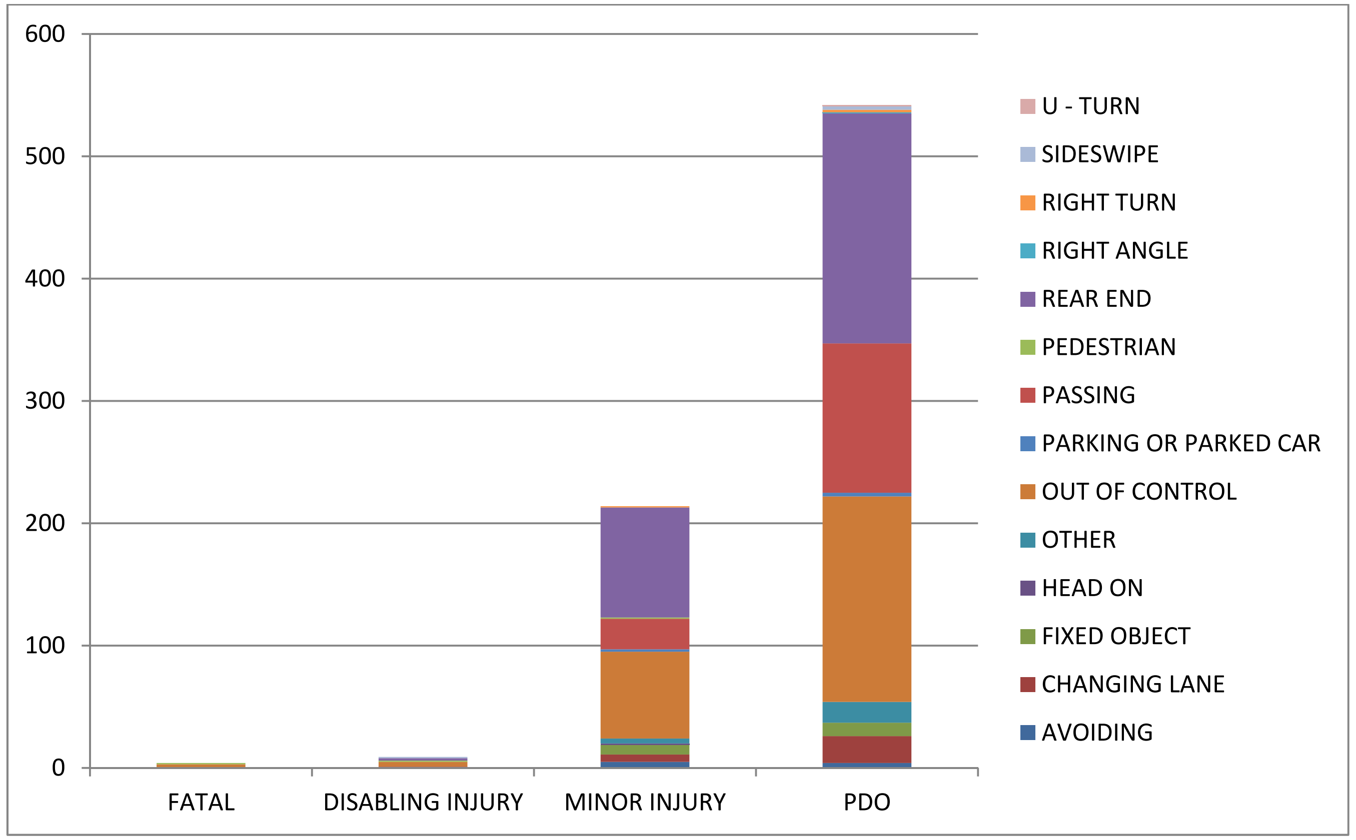


Exhibit 4.14: I-70 Crash Statistics (2006-2010)

4.4.1.4 Historical Crash Data Summary

A review of the crash classification distribution revealed three dominant types of crashes as shown in Table 4.11. As shown in the table, over 90 percent of all the crashes are in these three categories.

Table 4.11: Crash Type Summary (2006-2010)

Route	Rear End		Out of Control		Passing/Changing Lanes		All Others		Total Crashes
	Number	Percent of Total Crashes	Number	Percent of Total Crashes	Number	Percent of Total Crashes	Number	Percent of Total Crashes	
I-55	300	38.8%	222	28.7%	176	22.7%	76	9.8%	774
I-64	220	49.8%	62	14.0%	133	30.1%	27	6.1%	442
I-70	280	36.4%	246	32.0%	176	22.9%	67	8.7%	769
Total	800	40.3%	530	26.7%	485	24.4%	170	8.6%	1985

Geometric features in the study area include closely spaced ramps, less than desirable horizontal and vertical alignments, and a constricted roadside with retaining walls and bridge abutments in the clear zone. These issues, along with heavy traffic volumes and recurring traffic congestion, create an environment where a lot of vehicular weaving takes place in constricted conditions. This is reflected in the crash rates for the interstates in the project area, as shown below in Table 4.12. These rates are reported directionally for each facility on an annual basis. In only three instances is the rate lower than the Statewide Average (and all are on Interstate 64); in many cases the rate is three to four times the Statewide Average.

Table 4.12: Crash Rates for Study Area Interstates

		Year (crashes per hundred million vehicle miles traveled)				
Interstate	Direction	2006	2007	2008	2009	2010
I-70	Eastbound	396	444	381	356	257
	Westbound	361	392	349	335	297
I-55	Northbound	493	365	403	487	429
	Southbound	246	222	297	346	269
I-64	Eastbound	128	185	66	96	174
	Westbound	151	122	109	68	140
Statewide Average For Interstates		108	109	106	103	104

Missouri's Highway Safety Plan has a goal of reducing the number and severity of crashes occurring in Missouri. There is also a more specific goal – to reduce traffic fatalities to 850 or fewer by the year 2012 as identified in the state's strategic highway safety plan, *Missouri's Blueprint to ARRIVE ALIVE.* In line with the strategic plan, the incidence of fatal and disabling injuries was investigated. Table 4.13 portrays a summary of their occurrence in the study area.

Table 4.13: Fatal and Disabling Injury Crash Summary

Year	Fatal		Disabling Injury		Total Fatal/Disabling Injury		Total Crashes
	Number	Percent of Total Crashes	Number	Percent of Total Crashes	Number	Percent of Total Crashes	
2006	1	0.2%	6	1.4%	7	1.6%	430
2007	1	0.2%	1	0.2%	2	0.5%	419
2008	2	0.5%	10	2.6%	12	3.1%	388
2009	2	0.5%	4	1.0%	6	1.6%	381
2010	3	0.8%	7	1.9%	10	2.5%	367
Total	9	0.5%	28	1.4%	37	1.9%	1985

As noted in the table, there were nine fatal crashes, which is 0.5 percent of the total number of crashes. There were 28 disabling injury crashes, which is 1.4 percent of the total number of crashes. Statistics from the Missouri Statewide Traffic Accident Records System (STARS) for St. Louis City and County were reviewed for year 2010 to establish a baseline for comparison to the study area data. The percentages for the City-County area, which includes all roadway systems for 2010, are 0.2 percent for fatal crashes and 2.0 percent for disabling crashes. The combined percentage for the project area is 1.9 percent compared to the 2.2 percent for the city-county area. Thus, while crash rates are high, crash severity compares favorably to the severe crash experience of the St. Louis area.

4.4.3 Safety Analysis Methodology

The AASHTO Highway Safety Manual (HSM; 1st Edition, 2010) methodologies are the preferred method of safety analysis. The HSM provides guidance for quantifying effects on crash rates resulting from design decisions through methodologies for estimating the expected number of crashes on a future facility. Crash frequency is defined as the number of crashes occurring on a particular facility in a one-year period.

The HSM methodology begins with comparison of past safety performance to statistical estimates using available Safety Performance Functions (SPFs). Unfortunately, the current HSM Manual is light on SPFs for Interstate facilities, especially those in an urban area. Therefore, the safety review of these areas does not explicitly follow the traditional Highway Safety Manual approach because their layouts and locations do not comply with guideline examples.

Volume 3 of the HSM defines a number of Crash Modification Factors (CMFs) that represent the relative change to crash frequency resulting from a change in a specific condition. The PSB Interchange project proposes the following changes to existing conditions:

- Widening a one-lane exit, ramp, and entrance to two lanes
- Moving an exit gore from the interstate to another ramp
- Removing/closing a one-lane exit, ramp, and entrance
- Modifying a ramp entrance from a dedicated on-ramp to a merge conditions

Section 6.1 of this document will investigate the applicable CMFs and their projected impact to safety at the PSB Interchange.

5 Alternatives

MoDOT investigated a number of alternatives for ramp reconstruction in an effort to address the geometric and capacity constraints of the PSB Interchange while replacing the deficient ramps. A summary of these alternatives and their design components are presented in the following sections, as listed in Table 5.1. Microstation and Geopak were used to conceptually design each alternative and quantify the design component, unless otherwise noted. And the design components were evaluated for each alternative using MoDOT's Engineering Policy Guide (EPG) and AASHTO's Green Book: A Policy on Geometric Design of Highways and Streets, 5th Edition.

Table 5.1: PSB Interchange Alternatives

Preserve Ramp B	Remove Ramp B	Widened PSB	Employ Junction Control	Design Alternative	Description	Section
X				1	Replace Ramp A with Dual-Lane Ramp, Rebuild Ramp B by Lowering I-44 Mainline	5.4.1
X				2 / 2A	Replace Ramp A with Dual-Lane Ramp, Rebuild Ramp B as Left-Side Exit by Splitting I-44 mainline	54.2
X				3	Replace Ramp A with Dual-Lane Ramp and Rebuild Ramp B as a Flyover Ramp	5.4.3
X				4	Rebuild Ramp A and B as Single Lane Ramps in Place	5.3.1.1
X				5	Replace Ramp A with Dual-Lane Ramp, Rebuild Ramp B by Realigning SB Memorial entrance ramp	5.4.4
X			X	6	Replace Ramp A with Dual-Lane Ramp, Rebuild Ramp B and utilize Junction Control	5.4.5
X				7	Replace Ramp A with Dual-Lane Ramp, Rebuild Ramp B as a U-Turn Flyover ramp, and Remove SB I-55 Exit to 7th Street	5.4.6
	X			8	Replace Ramp A with Dual Lane Ramp and Remove Ramp B (Previously Preferred)	5.4.7
	X	X		9	Replace Ramp A with Dual-Lane Ramp, Widen PSB and Add 5th Lane to EB I-64/PSB from 6th Street Ramp and Remove Ramp B **(Preferred)**	5.4.8
	X			9A	Rebuild Ramp A as Single Lane Ramp, Remove Ramp B, and add 6th Street Connection to PSB	5.4.8
X		X		10	Replace Ramp A with Dual-Lane Ramp, Widen PSB, Rebuild Ramp B	5.4.9
X		X	X	11	Replace Ramp A with Dual-Lane Ramp, Widen PSB, Add 6th Street Ramp Connection, Rebuild Ramp B and Utilize Junction Control	5.4.10

It should be noted that all of the alternatives include reconstructing Ramp C as a single-lane ramp and Ramp D as a dual-lane ramp. In addition at those locations where vertical clearance was an issue, FHWA requested a minimum vertical clearance of 14 feet be used for the design alternatives to investigate the possibility of retaining Ramp B. Due to the legal vehicle height being 15'-0" in this area, MoDOT would not have supported using clearances this low for the ultimate design. However, designing the ramps to this extremely low vertical clearance did demonstrate the difficulty in retaining Ramp B.

In addition, these alternatives are discussed on their own merits and not within the context of the agreements that were made between MoDOT and IDOT following the EWGCOG independent study. However, many of these alternatives could be rejected due to the findings and recommendations of that investigation and their adoption as the (bi-state) preferred project.

The full final Design Memorandum for this project is attached as Appendix C. The design memo includes additional information such as profile drawings for all alternatives.

**Please note that between the time of this AJR documentation and the time of construction, the segment of I-70 north of the PSB will be redesignated as I-44 due to the completion of the NMRB (discussed in Section 5.5.1). An effort has been made to utilize correct terminology for the future conditions.*

5.1 No-Build Transportation Network

The No-Build Alternative provides for a baseline comparison and describes the expected future operating conditions for the transportation network. The No-Build network should include the existing transportation network plus any funded or programmed improvements that are scheduled to be open to traffic in the analysis year. Level-of-Service analyses for the No-Build Network should be performed and used as a baseline for comparison.

An Existing (2010) network was evaluated as was a Future No-Build network. The future No-Build network included the network changes currently being constructed as part of the NMRB project and those proposed as part of the CAR 2015 project. There are no other future projects currently programmed within the area of influence on the west side of the Mississippi River. .

5.2 Transportation Systems Management (TSM) Alternatives

Transportation Systems Management refers to the practice of providing additional capacity on a facility or network by improving the operations through means other than construction. For example, improved signal timing coordination or additional transit options can increase the capacity of an arterial.

As discussed previously, the PSB Interchange is a system interchange with a significant function within the St. Louis regional interstate network. In addition, due to the deteriorated condition of the PSB Interchange ramps, reconstruction is a necessity. Therefore, TSM alternatives are not a viable option to this project situation.

5.3 Build Alternatives with No Access Modification

Only one alternative won't require access modification: replacing the ramps in their current configuration. All of the existing ramp bridges in the PSB Interchange are structurally deficient, and their condition has deteriorated to the point where rehabilitation is no longer a feasible option for MoDOT. Because the current configuration does not operate at an acceptable level of service (LOS) for I-55 and the recurring congestion raises safety concerns, MoDOT recommends improving the interchange to better serve current and future traffic demands given the resources available today, instead of replacing them in their current location.

5.3.1.1 Alternative 4 – Rebuild Ramp A and B as Single Lane Ramps in Place

Alternative 4 evaluates the impacts of rebuilding Ramp A and Ramp B in their current locations. Ramp A would become "Ramp 2" and Ramp B named "Ramp 4", as shown in Exhibit 5.1. In this configuration, the horizontal alignment for Ramp 2 would improve from a design speed from 30 MPH to 35 MPH, while Ramp 4's horizontal alignment would remain acceptable for 30 MPH due to the previously mentioned design constraints which make it difficult to improve the radius.

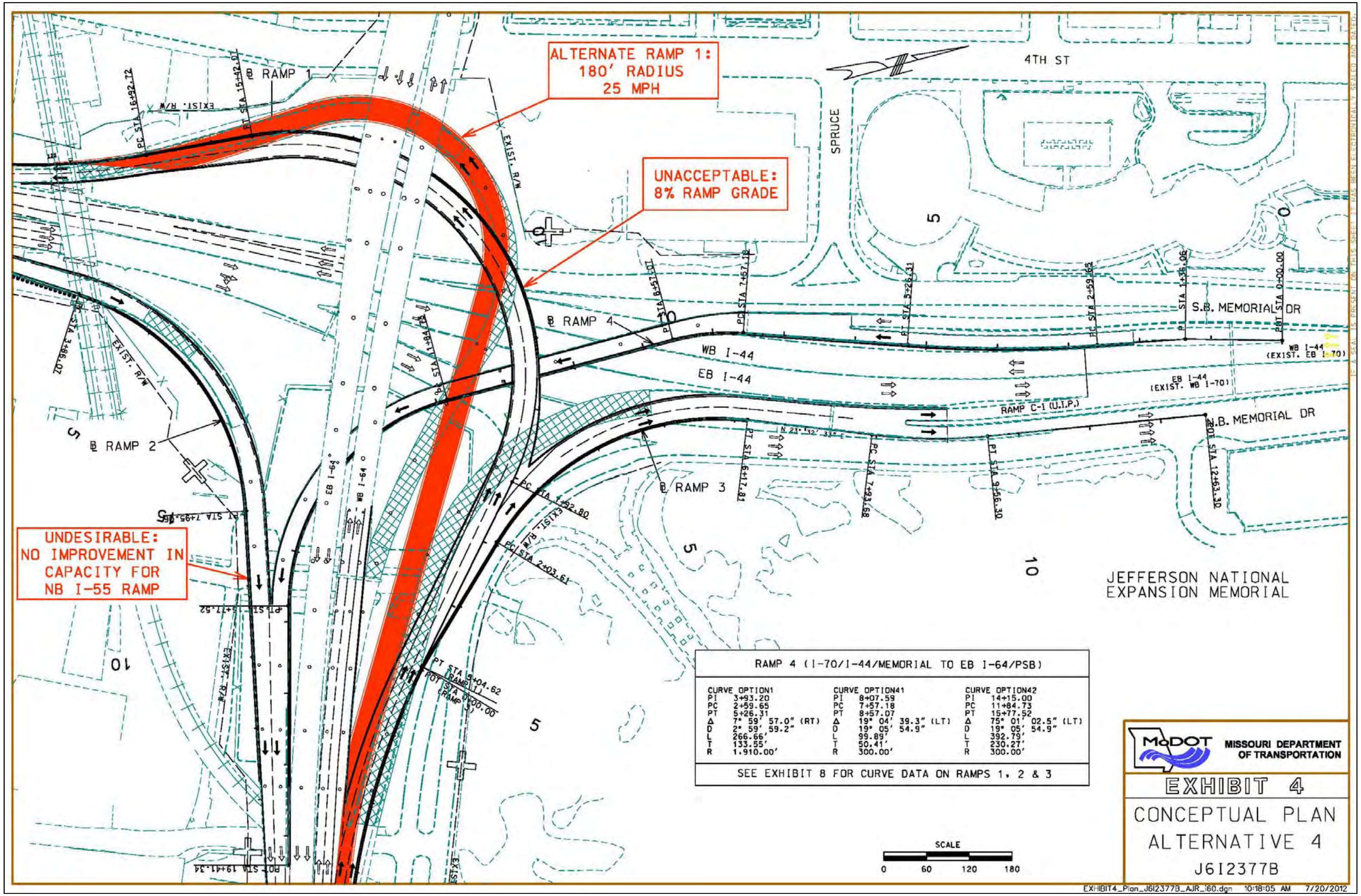
<u>Reconstructing these ramps in their current configuration would offer minimal improvement over their current geometries and no improvement to safety or traffic operations. For this reason, as well as the excessive grade required to construct Ramp 1 in the current location of Ramp B, this is MoDOT's least preferred alternative.</u>

Ramp 4 will restrict the location of one of the bridge columns of future "Ramp 1" (existing Ramp D). There is only five feet between the edge of shoulder on EB I-44 (existing WB I-70) and Ramp 4. This would not leave enough room for the column, guardrail, and proper clearances. The bent would have to be shifted further east and increase the bridge's span length and bridge depth. Although detailed bridge design would have to be done to further investigate this impact, the profile of Ramp 1 was checked using a bridge depth range of 6.5 feet to 4.5 feet.

Ramp 1 would be in full superelevation as it passes over Ramp 4, and two feet of superelevation was used to check the clearance. With a bridge depth of 6.5 feet, the grade on Ramp 1 for the section that spans over I-70 and goes under I-64 would be 8.1 percent in order to provide a minimum allowable vertical clearance of 14 feet over Ramp 4, based on a profile for Ramp 4 similar to existing conditions. This grade exceeds the absolute maximum ramp grade of 7 percent. Profile drawings for this alternative can be seen in Appendix C.

If the profile of Ramp 4 was lowered to provide a minimum clearance of 14 feet over I-44 instead of the existing 15 feet clearance, and using a shallower bridge depth of 4.5 feet, then the grade of Ramp 1 would be 7.5 percent. The grade on Ramp 1 as proposed in Alternative 8 without Ramp B is 4.9 percent.

In order to avoid an excessive grade on Ramp 1, it would need to cross over Ramp 4 at the location where existing Ramps D and Ramp B cross. A dual-lane ramp using a minimum 30 MPH radius of 231 feet will not fit between the I-64 columns if Ramp 1 is shifted in this way. The alternate alignment for Ramp 1, as shown in Exhibit 5.1, has a 25 MPH radius of 180 feet, which is less than the existing radius of 225 feet for Ramp D. Although mainline excavation as discussed under Alternative 1 could be avoided if this alternate for Ramp 1 was used, this alignment is not preferred because it does not improve the existing sub-standard radius of Ramp D.



RAMP 4 (I-70/I-44/MEMORIAL TO EB I-64/PSB)

CURVE OPTION1		CURVE OPTION41		CURVE OPTION42	
PI	3+93.20	PI	8+07.59	PI	14+15.00
PC	2+59.65	PC	7+57.18	PC	11+84.73
PT	5+26.31	PT	8+57.07	PT	15+77.52
Δ	7° 59′ 57.0″ (RT)	Δ	19° 04′ 39.3″ (LT)	Δ	75° 01′ 02.5″ (LT)
D	2° 59′ 59.2″	D	19° 05′ 54.9″	D	19° 05′ 54.9″
L	266.66′	L	99.89′	L	392.79′
T	133.55′	T	50.41′	T	230.27′
R	1,910.00′	R	300.00′	R	300.00′

SEE EXHIBIT 8 FOR CURVE DATA ON RAMPS 1, 2 & 3

Exhibit 5.1: PSB Interchange Reconstruction Alternative 4

5.4 Build Alternatives with Modified Access

As discussed in Section 5.2, there are problems with keeping Ramp B in its existing location, and traffic congestion on Northbound I-55 to Illinois has created a need to increase the capacity of Ramp A. The following is a list of alternatives considered in an effort to maintain all existing access while improving the traffic and safety operations of Ramp A.

5.4.1 Alternative 1: Replace Ramp A with Dual-Lane Ramp, Rebuild Ramp B by Lowering I-44 Mainline

The first reconstruction alternative considered is shown in **Exhibit 5.2**, and annotated with design remarks. In Alternative 1, Ramp A would be rebuilt as a dual-lane ramp (designated as "Ramp 2"). Ramp B would be rebuilt as single-lane ramp ("Ramp 4"). The intent is to lower the I-44 (existing I-70) mainline to provide vertical clearance for improving the ramp grades. Due to the substandard design and the conflicts with the footings on Bridge A1501, this is not MoDOT's preferred alternative.

The profile of Ramp 4 for this alternative is similar to existing, with Ramp 4 going over mainline I-44 (existing I-70) and under both Ramp 1 and I-64. Because of the improved alignment and profile of Ramp 1, the profile for Ramp 4 would have to be lower than that of existing Ramp B. To maintain a minimum clearance of 14 feet over I-44, the mainline would need to be lowered by ten feet. This amount of excavation causes unacceptable conflicts with the I-64 bridge footings (Bridge A1501, Bents 7 & 8). Profile drawings for this alternative can be seen in Appendix C.

Therefore, an alternate profile for Ramp 4 was developed in order to avoid excavation along mainline I-44; testing the potential for Ramp 4 to go over Ramp 1. Unfortunately this profile was deemed unacceptable due to the excessive grade (16.4 percent) necessary to transition under the existing eastbound I-64 bridge. An alternate design for Ramp 1 was considered to avoid mainline excavation, but was ruled out as described under Alternative 4.

The horizontal alignment of Ramp 4 developed for this alternative is similar to existing conditions, except the curve approaching Ramp 2 is slightly sharper in order to maximize the space available to merge into Ramp 2. The horizontal alignment of Ramp B is acceptable for 30 MPH, but due to the sharper curve, the alignment of Ramp 4 is acceptable for only 25 MPH. This is less than AASHTO's recommended minimum operating speed of 30 MPH for ramps. However, the substandard sag curve discussed previously for Ramp B is improved for this alternative, so the vertical curve design speed is improved from 25 MPH to 35 MPH.

The horizontal alignment for Ramp 2 improves from a design speed of 30 MPH to 35 MPH. The sag vertical curve on this ramp improves from 20 MPH to 30 MPH, and the crest vertical curve near the point where Ramp 4 merges with Ramp 2 improves from 35 MPH to 45 MPH. Ramp 4 merges with Ramp 2 on the left as a tapered style on-ramp. Assuming speeds of 40 MPH for Ramp 2 and 25 MPH for Ramp 4 in the merge area, and using an adjustment factor of 1.5 for the 5 percent grade, the required acceleration length would be 315 feet according to Exhibits 10-70 & 10-71 in AASHTO's Green Book. However, this alternate allows for an acceleration length of only 190 feet, which is unacceptable and would be a safety concern.

Per MoDOT's Engineering Policy Guide, left-side entrances are undesirable in a directional interchange. An alternate to the left-side tapered entrance would be to widen the PSB in order to provide an additional lane.

5.4.2 Alternative 2 – Replace Ramp A with Dual Lane Ramp, Rebuild Ramp B as Left-Side Exit by Splitting I-70 mainline

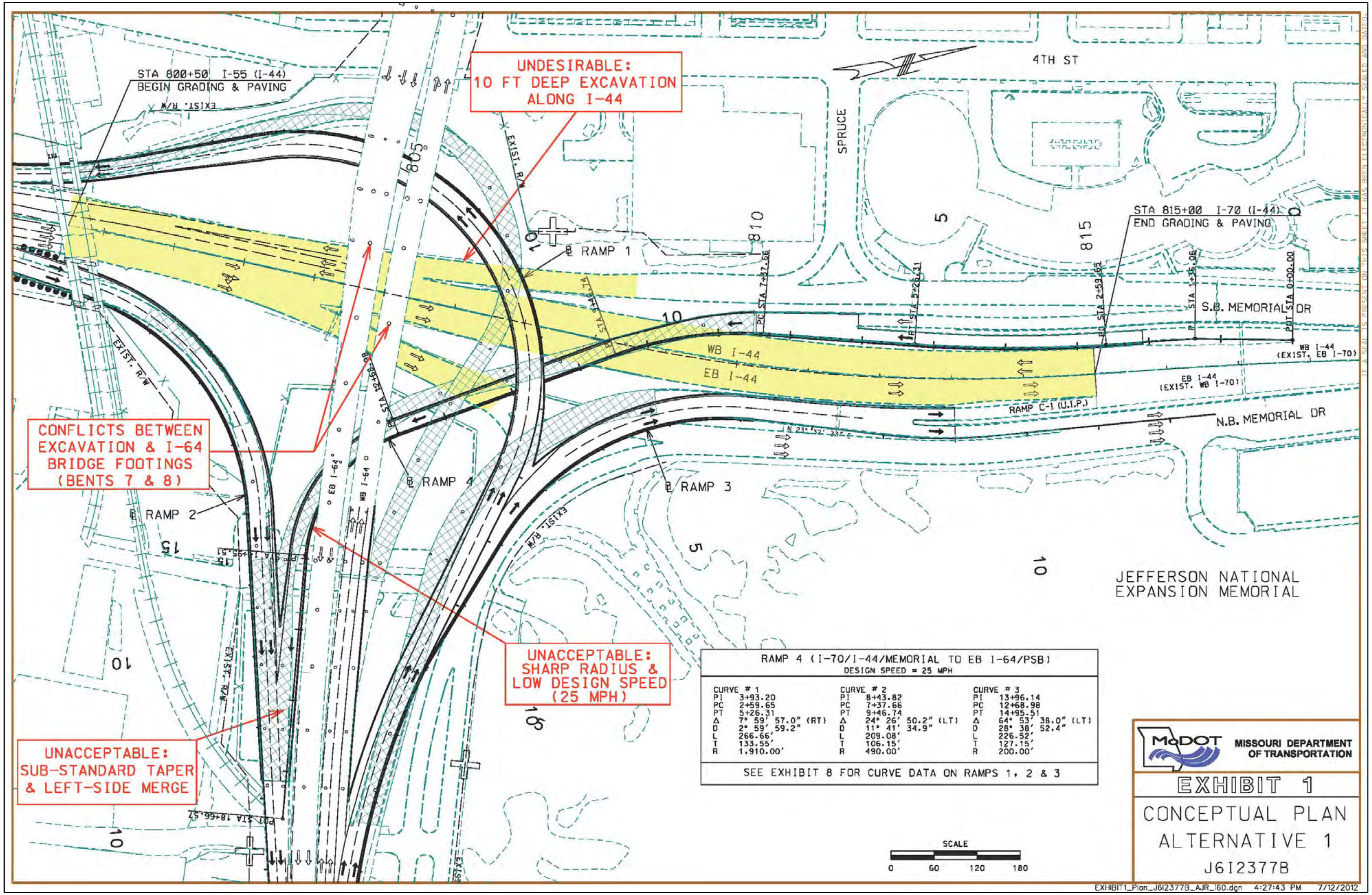
The second reconstruction alternative is shown in **Exhibit 5.3A**, annotated with design comments. For Alternative 2, Ramp A would be rebuilt as dual-lane "Ramp 2". The design of Ramp 2 would an improvement over existing Ramp A, similar to Alternative 1. Ramp B would be rebuilt as single-lane "Ramp 4", exiting from the left side of WB I-44 (existing EB I-70) in an effort to improve the vertical grades. Please note that while this alternative provides access for EB I-44 to Illinois, it does not provide the same access from SB Memorial Drive. Due to the substandard design and the undesirable left-side exit ramp, this is not MoDOT's preferred alternative.

In this alternative WB I-44 (existing EB I-70) would be shifted to the west as it transitions to SB I-55 under I-64, and EB I-44 (existing WB I-70) would be shifted to the east under I-64. Ramp 4 would exit mainline from the left as a tapered exit ramp. The exit gore location is approximately 700 feet south of the existing Ramp B exit. A tapered exit is more acceptable than a tapered entrance; however it is still not a preferred MoDOT ramp type. Regardless of its type, a left-side exit is undesirable in an interchange.

Shifting mainline for this design was proposed to enable Ramp 4 to pass under I-64 without having to also clear mainline below. This design allows Ramp 4 to merge with Ramp 2 on its right side as a parallel entrance ramp – a preferable design. However, Ramp 4 still would have to curve sharply to the left with an unacceptably low design speed of 25 MPH. In addition, the profile of relocated I-44 would have a deep excavation requirement, which causes conflicts with I-64 bridge footings on bents 6, 7, and 8. This excavation is necessary in order to improve a sub-standard sag vertical curve along existing mainline beneath the TRRA railroad bridge.

The vertical alignment for Ramp 4 contains a sag curve near the gore with Relocated WB I-44 that is below the minimum acceptable speed of 30 MPH, and a grade of 6.8 percent that is just under the absolute maximum allowable ramp grade. Profile drawings for this alternative can be seen in Appendix C

A variation for Alternative 2 was developed that considered shifting WB I-44 to the east instead of the west. Alternative 2A, shown in **Exhibit 5.3B** with design comments, is an improvement over Alternative 2 because it does not have a left-side exit and the radius on Ramp 4 improves from 150 feet to 235 feet. However, this alignment would also require a steep grade greater than the desirable 5% for ramps and would not provide enough space for an acceptable entrance ramp for SB Memorial Drive traffic to SB I-55. As a result, access to SB I-55 from SB Memorial Drive would have to be removed. Removal of this entrance ramp would negatively impact traffic patterns in the downtown grid. The City of St. Louis does not support removing this access; therefore Alternative 2 A is not a preferred alternative.



RAMP 4 (I-70/I-44/MEMORIAL TO EB I-64/PSB)
DESIGN SPEED = 25 MPH

	CURVE # 1	CURVE # 2	CURVE # 3
PI	3+93.20	8+43.82	13+96.14
PC	2+59.65	7+37.66	12+68.98
PT	5+26.31	9+46.74	14+95.51
Δ	7° 59' 57.0" (RT)	24° 26' 50.2" (LT)	64° 53' 38.0" (LT)
D	2° 59' 59.2"	11° 41' 34.9"	28° 38' 52.4"
L	266.66'	209.08'	226.52'
T	133.55'	106.15'	127.15'
R	1,910.00'	490.00'	200.00'

SEE EXHIBIT 8 FOR CURVE DATA ON RAMPS 1, 2 & 3

EXHIBIT 1

CONCEPTUAL PLAN
ALTERNATIVE 1
J6I2377B

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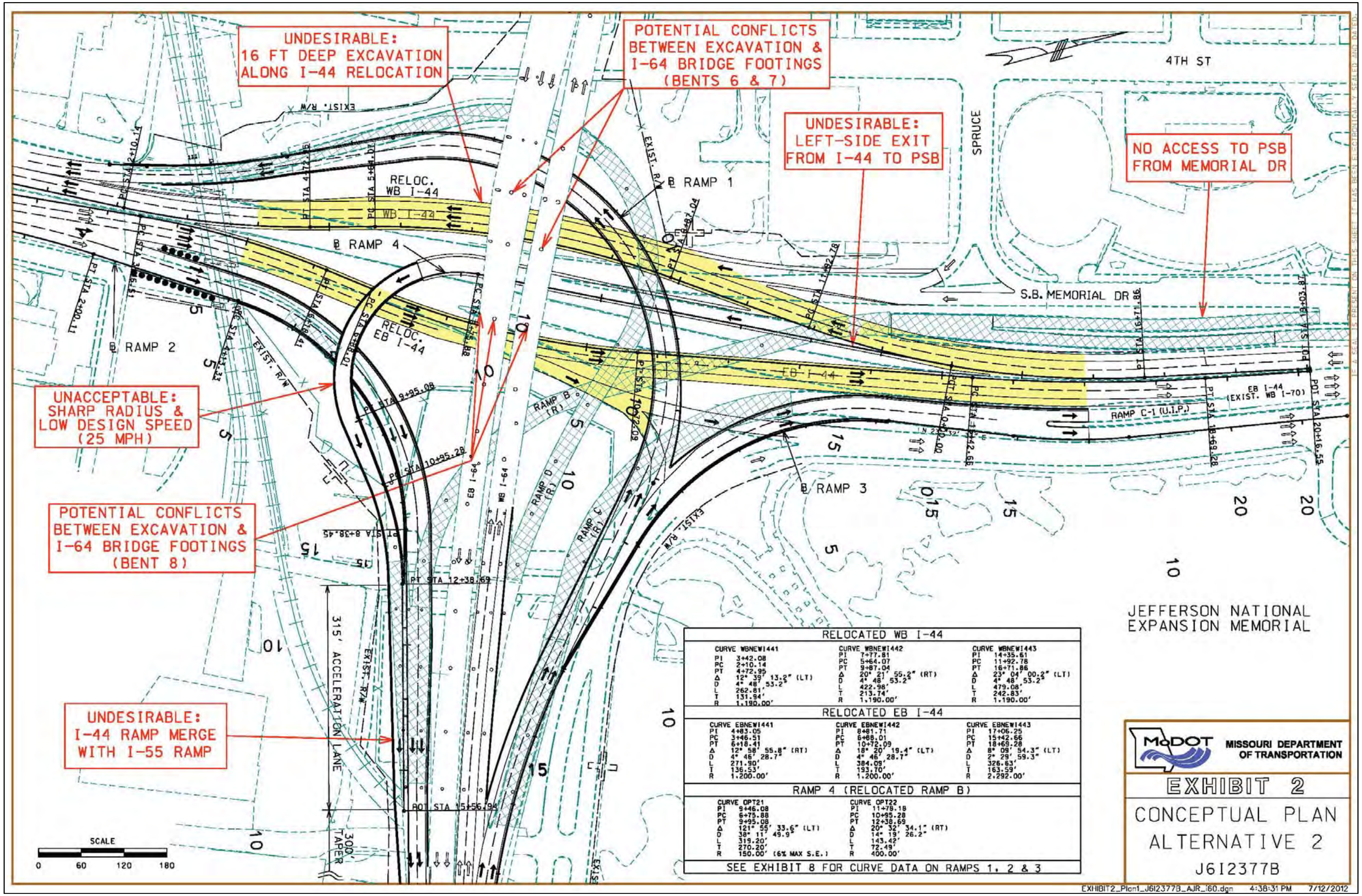
Exhibit 5.2: PSB Interchange Reconstruction Alternative 1



RELOCATED WB I-44

	CURVE WBNEWI441	CURVE WBNEWI442	CURVE WBNEWI443
PI	3+42.08	7+77.81	14+35.61
PC	2+10.14	5+64.07	11+92.78
PT	4+72.95	9+87.04	16+71.86
Δ	12° 39′ 13.2″ (LT)	20° 21′ 55.2″ (RT)	23° 04′ 00.2″ (LT)
D	4° 48′ 53.2″	4° 48′ 53.2″	4° 48′ 53.2″
L	262.81′	422.98′	479.08′
T	131.94′	213.74′	242.83′
R	1,190.00′	1,190.00′	1,190.00′

RELOCATED EB I-44

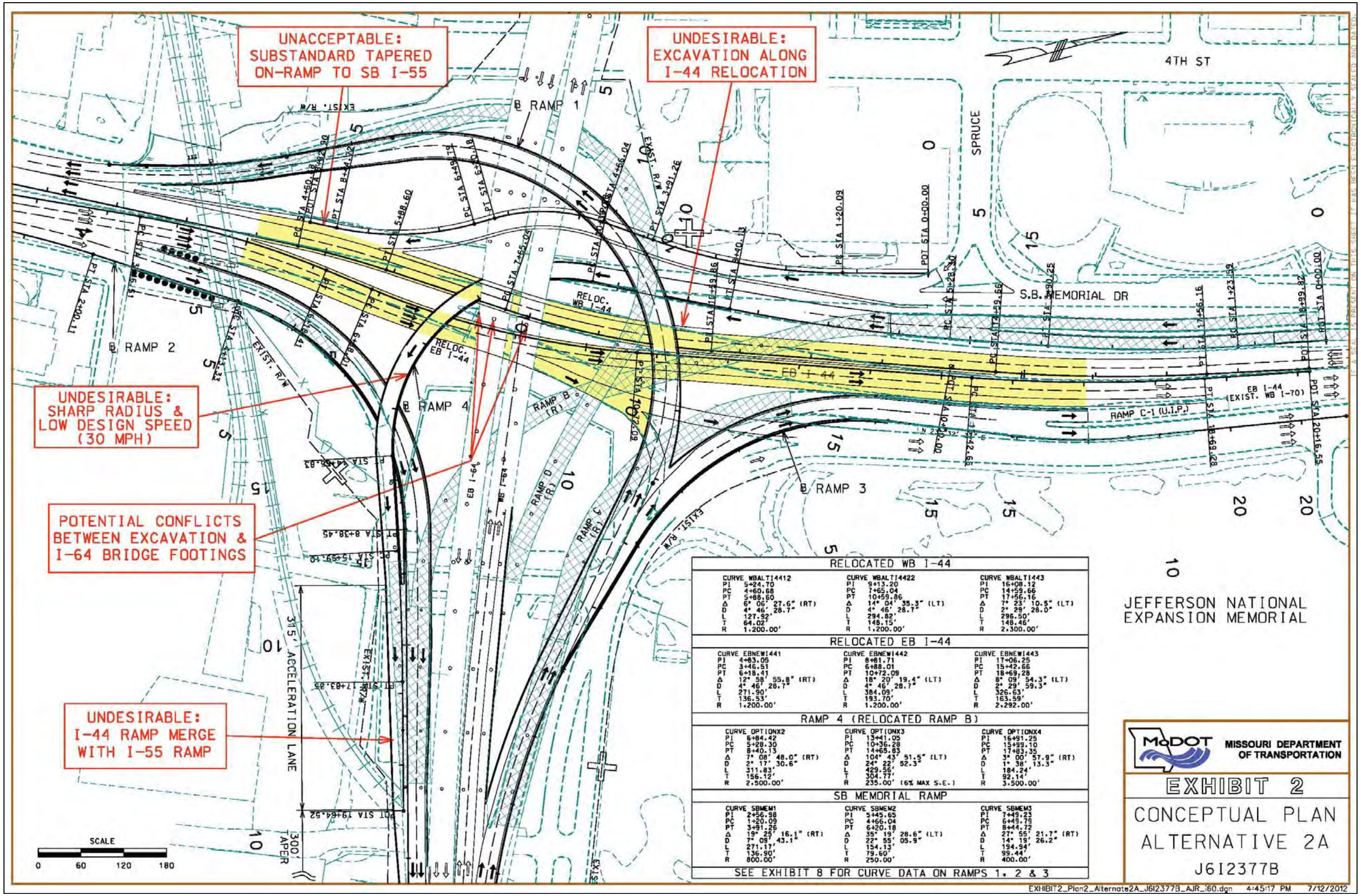
	CURVE EBNEWI441	CURVE EBNEWI442	CURVE EBNEWI443
PI	4+83.05	8+81.71	17+06.25
PC	3+46.51	6+88.01	15+42.66
PT	6+18.41	10+72.09	18+69.28
Δ	12° 58′ 55.8″ (RT)	18° 20′ 19.4″ (LT)	8° 09′ 54.3″ (LT)
D	4° 46′ 28.7″	4° 46′ 28.7″	2° 29′ 59.3″
L	271.90′	384.09′	326.63′
T	136.53′	193.70′	163.59′
R	1,200.00′	1,200.00′	2,292.00′

RAMP 4 (RELOCATED RAMP B)

	CURVE OPT21	CURVE OPT22
PI	9+46.08	11+78.18
PC	6+75.88	10+95.28
PT	9+95.08	12+38.69
Δ	121° 55′ 33.6″ (LT)	20° 32′ 34.1″ (RT)
D	38° 11′ 49.9″	14° 19′ 26.2″
L	319.20′	143.42′
T	270.20′	72.49′
R	150.00′ (6% MAX S.E.)	400.00′

SEE EXHIBIT 8 FOR CURVE DATA ON RAMPS 1, 2 & 3

Exhibit 5.3A: PSB Interchange Reconstruction Alternative 2



UNACCEPTABLE: SUBSTANDARD TAPERED ON-RAMP TO SB I-55

UNDESIRABLE: EXCAVATION ALONG I-44 RELOCATION

UNDESIRABLE: SHARP RADIUS & LOW DESIGN SPEED (30 MPH)

POTENTIAL CONFLICTS BETWEEN EXCAVATION & I-64 BRIDGE FOOTINGS

UNDESIRABLE: I-44 RAMP MERGE WITH I-55 RAMP

RELOCATED WB I-44

CURVE	WBALTI4412	CURVE	WBALTI4422	CURVE	WBALTI443
PI	5+24.70	PI	9+13.20	PI	16+08.12
PC	4+60.68	PC	7+65.04	PC	14+59.66
PT	5+88.60	PT	10+59.86	PT	17+56.16
Δ	6° 06' 27.6" (RT)	Δ	14° 04' 35.3" (LT)	Δ	7° 23' 10.5" (LT)
D	4° 46' 28.7"	D	4° 46' 28.7"	D	2° 29' 26.0"
L	127.92'	L	294.82'	L	296.50'
T	64.02'	T	148.15'	T	148.46'
R	1,200.00'	R	1,200.00'	R	2,300.00'

RELOCATED EB I-44

CURVE	EBNEWI441	CURVE	EBNEWI442	CURVE	EBNEWI443
PI	4+83.05	PI	8+81.71	PI	17+06.25
PC	3+46.51	PC	6+88.01	PC	15+42.66
PT	6+18.41	PT	10+72.09	PT	18+69,28
Δ	12° 58' 55.8" (RT)	Δ	18° 20' 19.4" (LT)	Δ	8° 09' 54.3" (LT)
D	4° 46' 28.7"	D	4° 46' 28.7"	D	2° 29' 59.3"
L	271.90'	L	384.09'	L	326.63'
T	136.53'	T	193.70'	T	163.59'
R	1,200.00'	R	1,200.00'	R	2,292.00'

RAMP 4 (RELOCATED RAMP B)

CURVE	OPTIONX2	CURVE	OPTIONX3	CURVE	OPTIONX4
PI	6+84.42	PI	13+41.05	PI	16+91.25
PC	5+28.30	PC	10+36.28	PC	15+99.10
PT	8+40.13	PT	14+65.83	PT	17+83,35
Δ	7° 08' 48.0" (RT)	Δ	104° 43' 51.5" (LT)	Δ	3° 00' 57.9" (RT)
D	2° 17' 30.6"	D	24° 22' 52.3"	D	1° 38' 13.3"
L	311.83'	L	429.56'	L	184.24'
T	156.12'	T	304.77'	T	92.14'
R	2,500.00'	R	235.00' (6% MAX S.E.)	R	3,500.00'

SB MEMORIAL RAMP

CURVE	SBMEM1	CURVE	SBMEM2	CURVE	SBMEM3
PI	2+56.98	PI	5+45.65	PI	7+49.23
PC	1+20.09	PC	4+66.04	PC	6+49.79
PT	3+91.26	PT	6+20.18	PT	8+44.72
Δ	19° 25' 16.1" (RT)	Δ	35° 19' 28.6" (LT)	Δ	27° 55' 21.7" (RT)
D	7° 09' 43.1"	D	22° 55' 05.9"	D	14° 19' 26.2"
L	271.17'	L	154.13'	L	194.94'
T	136.90'	T	79.60'	T	99.44'
R	800.00'	R	250.00'	R	400.00'

SEE EXHIBIT 8 FOR CURVE DATA ON RAMPS 1, 2 & 3

MoDOT MISSOURI DEPARTMENT OF TRANSPORTATION

EXHIBIT 2

CONCEPTUAL PLAN
ALTERNATIVE 2A
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Exhibit 5.3B: PSB Interchange Reconstruction Alternative 2A

5.4.3 Alternative 3 – Replace Ramp A with Dual Lane Ramp and Rebuild Ramp B as a Flyover Ramp

Similar the previous Alternatives, Alternative 3 proposed to rebuild Ramp A as a dual-lane "Ramp 2", with a radius that would be improved to a design speed of 35 MPH. Ramp B would be rebuilt as single-lane "Ramp 4" flyover ramp. However, due to the limitations of right-of-way, the design speed of Ramp 4 can only be improved to 30 MPH, which is still undesirable but an improvement compared to the first two alternatives. Due to the substandard design, and the fact that this alternate requires widening the PSB over the Mississippi River, this is not MoDOT's preferred alternative.

Ramp 4 would exit WB I-44 (existing EB I-70), as shown in **Exhibit 5.4**, between the existing gore and Walnut overpass and immediately rise in order to go over the I-64 bridges and Ramp 2. Using an absolute minimum clearance of 14 feet over I-64 and a clearance of 15.5 feet under Walnut Street, Ramp 4 would have an undesirable 6.7 percent uphill grade, which exceeds the preferred maximum ramp grade of 5 percent, and is approaching the absolute maximum ramp grade of 7 percent. The physical limitation of the Walnut Street overpass to the north of I-64 makes it difficult to improve this grade to less than 5 percent. Ramp 4 would then merge into Ramp 2 as a parallel style ramp on the right side. MODOT considers fourteen feet of vertical clearance in a commercial zone to be undesirable.

The profile was designed to keep the grade on the downhill section of the ramp less than 5 percent and the sag vertical curve that ties into the PSB acceptable for a speed of 45 MPH, which places the beginning of the acceleration lane for this ramp close to where Ramp 2 ties into mainline I-64 on the PSB. This requires a section of the PSB to be widened over the Mississippi River in order to provide a sufficient acceleration length and taper for Ramp 4. Due to the limitations of right-of-way, the design speed of Ramp 4 can only be improved to 30 MPH, which is still undesirable but an improvement compared to the first two alternatives.

As a worst case scenario, the vertical alignment of the ramp was checked with vertical clearances of 14 feet under the Walnut Street Bridge and over I-64. Even with these absolute minimum clearances, the grade is still 6.1 percent. This option is not realistic to build because it would require widening I-70 (Future I-44) in order to have enough width for a gore point for the exit. A large portion of the wall of the depressed section would need to be rebuilt to widen the roadway in addition to rebuilding the Walnut Street Bridge.

Moving the exit point farther north introduces additional safety issues. The off-ramp to Memorial Drive at Pine Street (Exit 250B) will be converted to an on-ramp as part of the City Arch River 2015 (CAR-2015) project. The acceleration lane from that ramp will be extended to Ramp B. There will be approximately 1450 feet available for an auxiliary lane from the new on-ramp to the location of the current exit point for Ramp B. According to the AASHTO Green Book, the minimum weave distance between an entrance ramp and exit ramp from a collector distributor road should be 1600 feet. With the absolute minimum 14 feet of clearance under Walnut Street and over I-64, the gore point would be moved north shortening the weaving length between the ramps to an unacceptable 1040 feet. The weaving length based on the profile with 15.5 feet of clearance under Walnut Street and 6.7 percent grade would be 1300 feet.

Although this alternative offers an improved horizontal alignment compared to other options, its substandard grades, weaving lengths, and vertical clearances make this an undesirable alternative.

5.4.4 Alternative 5 – Replace Ramp A with Dual Lane Ramp, Rebuild Ramp B by Realigning SB Memorial entrance ramp

Similar to Alternatives 1 through 3, Alternative 5 investigated rebuilding Ramp A as a dual-lane "Ramp 2", with a radius that would be improved to a design speed of 35 MPH, and Ramp B as a single-lane "Ramp 4" realigned to the south to improve the required grades. Due to the substandard design, and the lack of proper access from Memorial Drive to SB I-55, this is not MoDOT's preferred alternative.

In this Alternative, Ramp 4 would exit mainline south of Ramp B's current location, go under I-64 and over both I-44 (existing I-70) and Ramp 2. A sharp radius and low design speed (25 MPH) is needed to fit the ramp within existing right-of-way. This ramp would merge with Ramp 2 from the right in a parallel ramp style. The acceleration length of 315 feet meets AASHTO standards. Profile drawings for this alternative can be seen in Appendix C.

In this configuration, SB Memorial's access to SB I-55 would either need to be relocated or removed. **Exhibit 5.5** shows a plan relocating SB Memorial it to the west of Ramp 1 and merging it into Ramp 1 between I-64 and the Railroad overpass. In this situation, the SB Memorial ramp requires a sharp reverse curve to stay within right-of-way with an undesirable 7 percent grade. It then tapers into Ramp 1 with a short merge, which is a safety concern due to high peak hour volumes and the lack of a recovery zone at the end of the ramp (because of the railroad bridge abutment wall and and narrow shoulder).

The alternative to relocating SB Memorial is closure of this connection. As previously discussed under Alternative 2A, removal of this entrance ramp to I-55 would impact traffic patterns of the downtown grid and is not supported by the City of St. Louis.

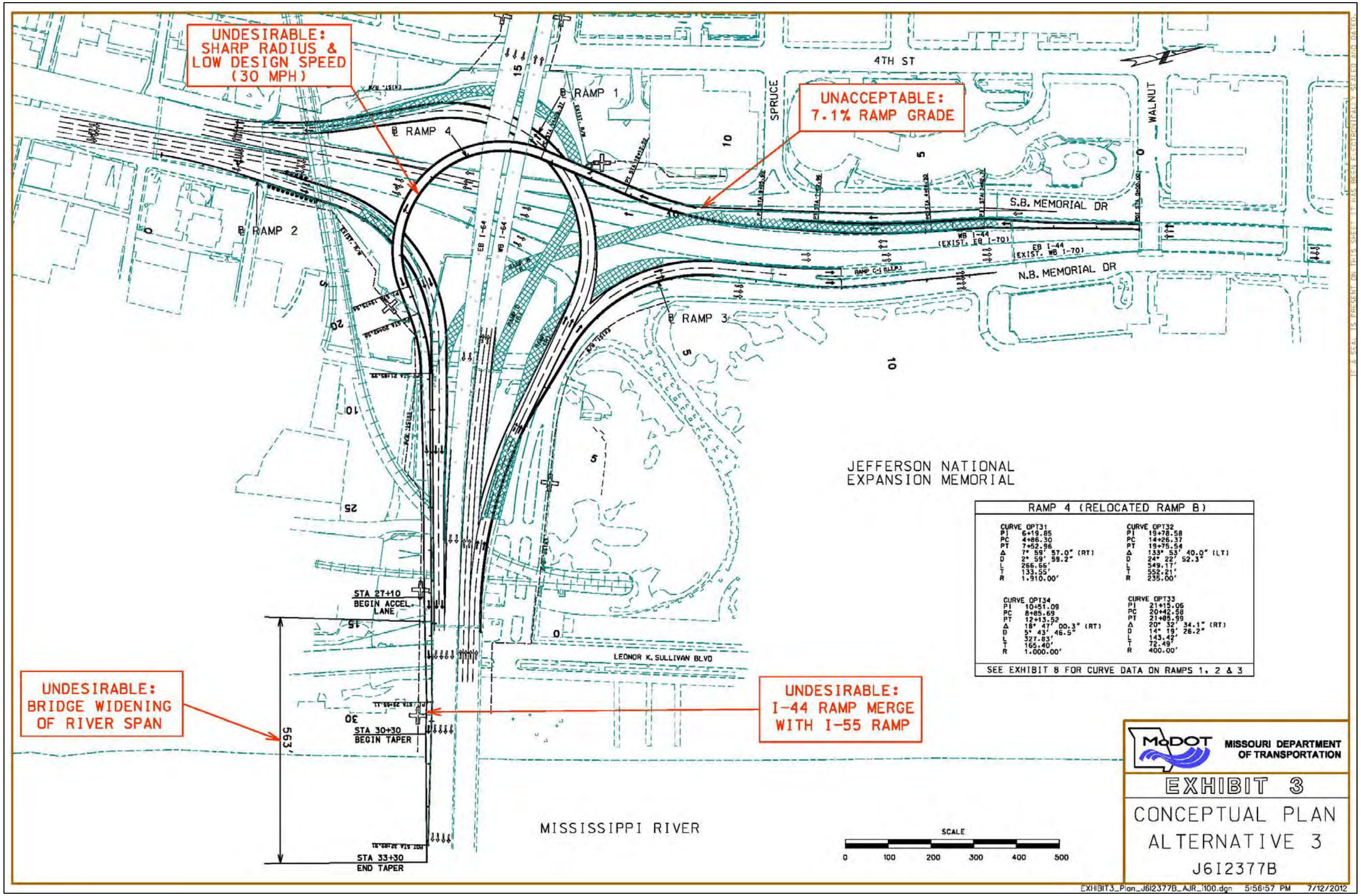
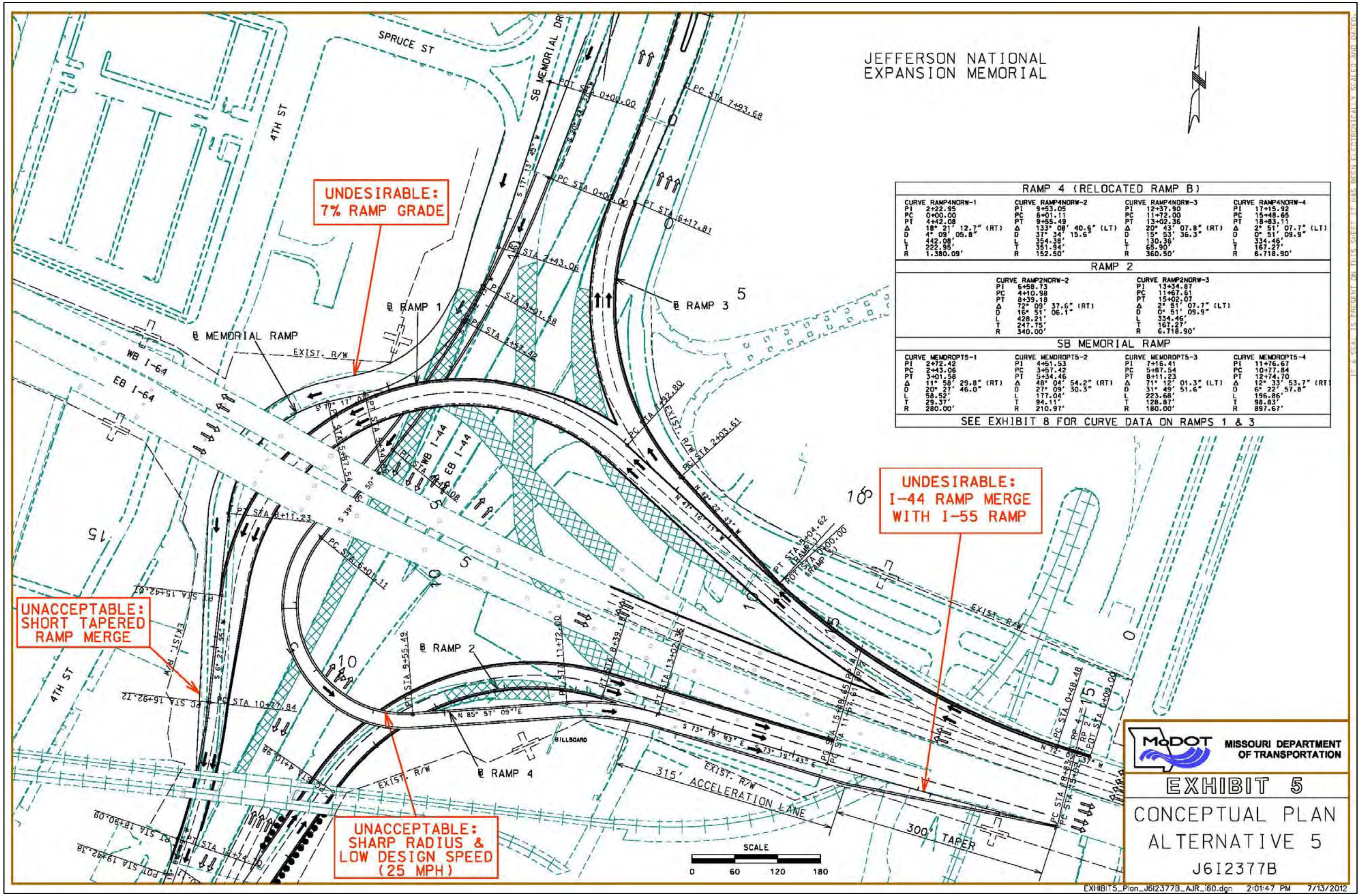


Exhibit 5.4: PSB Interchange Reconstruction Alternative 3



RAMP 4 (RELOCATED RAMP B)							
CURVE	RAMP4NORW-1	CURVE	RAMP4NORW-2	CURVE	RAMP4NORW-3	CURVE	RAMP4NORW-4
PI	2+22.95	PI	9+53.05	PI	12+37.90	PI	17+15.92
PC	0+00.00	PC	6+01.11	PC	11+72.00	PC	15+48.65
PT	4+42.08	PT	9+55.49	PT	13+02.36	PT	18+83.11
Δ	18° 21' 12.7" (RT)	Δ	133° 08' 40.6" (LT)	Δ	20° 43' 07.8" (RT)	Δ	2° 51' 07.7" (LT)
D	4° 09' 05.8"	D	37° 34' 15.6"	D	15° 53' 36.3"	D	0° 51' 09.9"
L	442.08'	L	354.38'	L	130.36'	L	334.46'
T	222.95'	T	351.94'	T	65.90'	T	167.27'
R	1,380.09'	R	152.50'	R	360.50'	R	6,718.90'

RAMP 2			
CURVE	RAMP2NORW-2	CURVE	RAMP2NORW-3
PI	6+58.73	PI	13+34.87
PC	4+10.98	PC	11+67.61
PT	8+39.18	PT	15+02.07
Δ	72° 09' 37.6" (RT)	Δ	2° 51' 07.7" (LT)
D	16° 51' 06.1"	D	0° 51' 09.9"
L	428.21'	L	334.46'
T	247.75'	T	167.27'
R	340.00'	R	6,718.90'

SB MEMORIAL RAMP							
CURVE	MEMDROPT5-1	CURVE	MEMDROPT5-2	CURVE	MEMDROPT5-3	CURVE	MEMDROPT5-4
PI	2+72.42	PI	4+51.53	PI	7+16.41	PI	11+76.67
PC	2+43.06	PC	3+57.42	PC	5+87.54	PC	10+77.84
PT	3+01.58	PT	5+34.46	PT	8+11.23	PT	12+74.70
Δ	11° 58' 29.8" (RT)	Δ	48° 04' 54.2" (RT)	Δ	71° 12' 01.3" (LT)	Δ	12° 33' 53.7" (RT)
D	20° 27' 46.0"	D	27° 09' 30.3"	D	31° 49' 51.6"	D	6° 22' 57.8"
L	58.52'	L	177.04'	L	223.68'	L	196.86'
T	29.37'	T	94.11'	T	128.87'	T	98.83'
R	280.00'	R	210.97'	R	180.00'	R	897.67'

SEE EXHIBIT 8 FOR CURVE DATA ON RAMPS 1 & 3

MoDOT MISSOURI DEPARTMENT OF TRANSPORTATION

EXHIBIT 5

CONCEPTUAL PLAN ALTERNATIVE 5

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Exhibit 5.5: PSB Interchange Reconstruction Alternative 5

5.4.5 Alternative 6 – Build Ramp A (Dual-Lane) and Ramp B (Single-Lane) with Junction Control

Alternative 6 proposes to rebuild Ramp A as a dual-lane "Ramp 2" and improve its design speed of 35 MPH. Ramp B would be rebuilt as single-lane "Ramp 4", in its current location. I-64 would be widened to three lanes east of the 6th Street on-ramp. Junction control would be used to maximize capacity between the two ramps and allow for only two lanes to merge with I-64, maintaining the proposed five-lane EB PSB configuration.

Junction control is defined as "using lane use control, variable traffic signs, and dynamic pavement markings to direct traffic to specific lanes (mainline or ramp) within an interchange area based on varying traffic demand, to effectively utilize available roadway capacity to reduce congestion"[5]; in other words, employing dynamic lane allocation to transfer capacity from one movement to another. According to FHWA documentation[6]:

> *"The rationale for use is that in some traffic conditions or at certain times of day, it may be more effective to use existing downstream or upstream lanes for one type of movement or for traffic coming from the main lanes while at other times of day it may be more effective to use the through lanes for the ramp movement. For example, when ramp volumes are relatively light or mainline volumes are very heavy, it might be most effective to have an entrance ramp merge into the right lane. However, there may be times that the volume on the ramp is extremely high while the mainline volumes are low. In this case, traffic merging from the on-ramp will have to find gaps in the mainline traffic, despite the mainline traffic being relatively light. The delay caused by hesitation and time required to find a gap may be disruptive to ramp capacities and flows and thus, create a situation with higher rear-end collision potential on the ramp. Junction control is used to "close" the right lane of the mainline upstream of the ramp through the use of lane control signs in order to give ramp traffic a near free-flow onto the mainline. Junction control provides priority to the facility with the higher volume and gives a lane drop to the lesser volume roadway."…*
>
> *"Junction control can also be used at off-ramps, especially when hard shoulder running is used, to dynamically create a two lane off-ramp with a freeway drop lane and an option lane. Junction Control is only advantageous at on-ramps when the mainline has spare capacity (giving priority to a higher merge volume).Similarly, junction control at an off-ramp is only desirable if an exit ramp has available width to accommodate an additional exit lane (giving priority to a higher exiting volume and/or downstream merging volume)."*

An investigation could not identify any current applications of Junction Control in the United States, although it "has been applied in Germany, typically at merge points or entrance ramps where there are a lower number of travel lanes downstream of the merge point. This requires the installation of lane control signals over the upstream and merging travel lanes, dynamically providing priority to the facility with the higher volume." A junction control entrance schematic is shown in Exhibit 5.6.

The PSB junction control scenario does not follow this geometric example. In the proposed network, there would be a single-lane ramp and a dual-lane ramp, merging with a three-lane mainline (six upstream lanes) merging into a five-lane section (five downstream lanes).

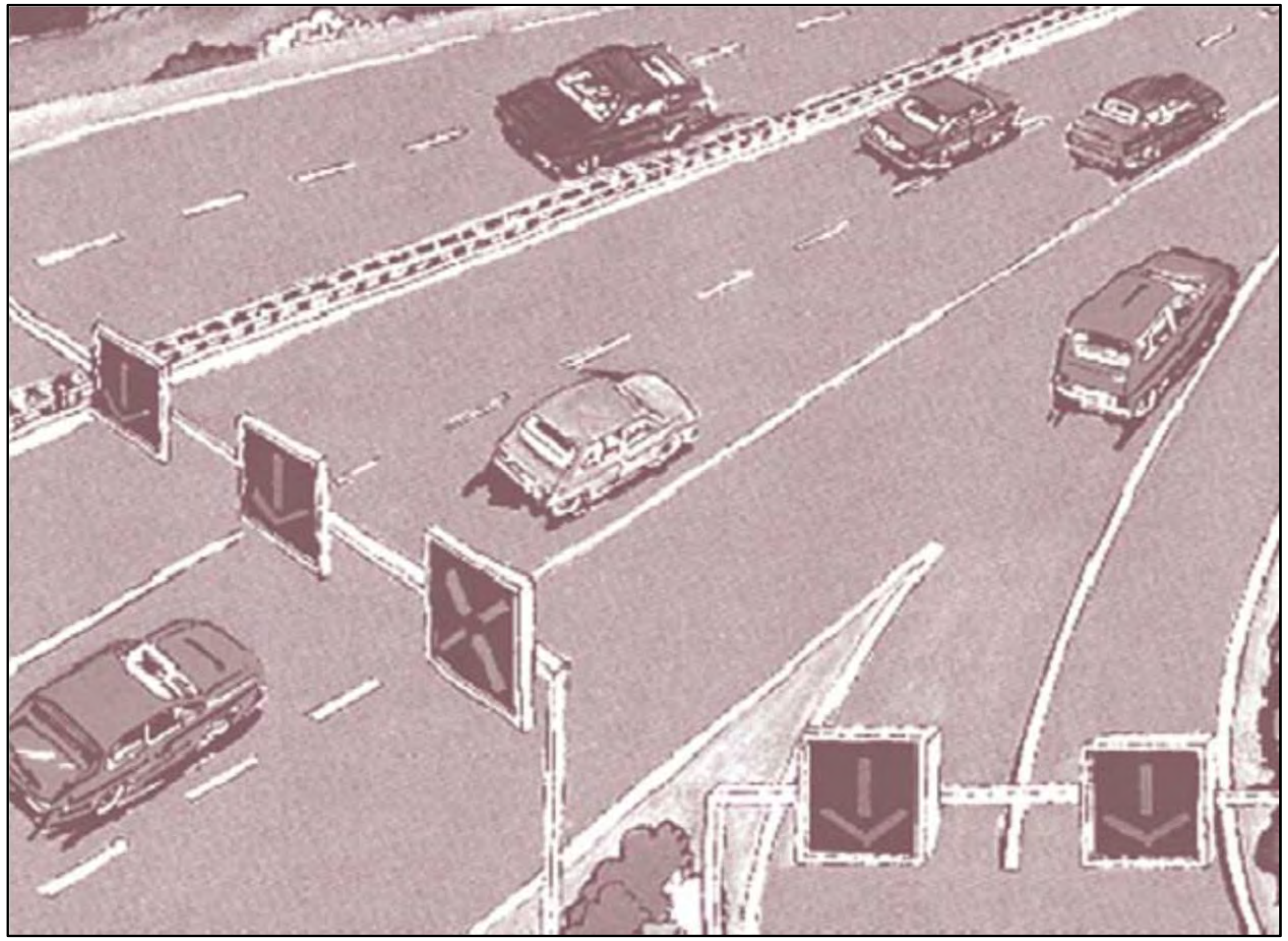

Exhibit 5.6: Junction Control On-Ramp Schematic (FHWA: Synthesis of Active Traffic Management Experiences in Europe and the United States, March 2010)

At FHWA's urging, MoDOT considered a number of alternatives for placing junction control at this location in an effort to maintain the existing Ramp B connection. However, it should be noted that the opportunities for transferring available capacity are limited in this situation. The peak traffic period for both Ramp 2 and Ramp 4 is in the afternoon, as shown in Exhibit 5.7. Because both ramps have the same peak period, it would be difficult to decide which movement would be limited during that period. Due to the large amount of congestion on northbound I-55 during the pm peak this movement would be given priority during that time period. MoDOT feels that, due to potential safety issues with merging, Ramp 4 would need to be closed or metered to minimize traffic and safety impacts during peak periods. Ramp 4 would have its own lane during off-peak hours, with Ramp 2 limited to one lane either using a gate system to close the lane or overhead dynamic lane control signs as shown in Exhibit 5.6.

There are a number of concerns with the use of junction control in the St. Louis Area, the primary one being compliance with the dynamic signing. There is no location for law enforcement to view violators and there are issues with traffic crossing the State line shortly after making this movement. MoDOT officials have voiced their concerns with this option because similar to lane closures on a roadway, people will drive in the traffic lane until physically forced out of the lane with traffic control devices. Because of that concern, MoDOT would not support

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[5] Synthesis of Active Traffic Management Experiences in Europe and the United States, March 2010, FHWA – page 3

[6] Synthesis of Active Traffic Management Experiences in Europe and the United States, March 2010, FHWA – page 15-16

the installation of Junction Control without a physical barrier to force that lane closed. Most likely this would take the form of retractable gates similar to what has been used on the reversible lanes on Interstate 70 into downtown St. Louis.

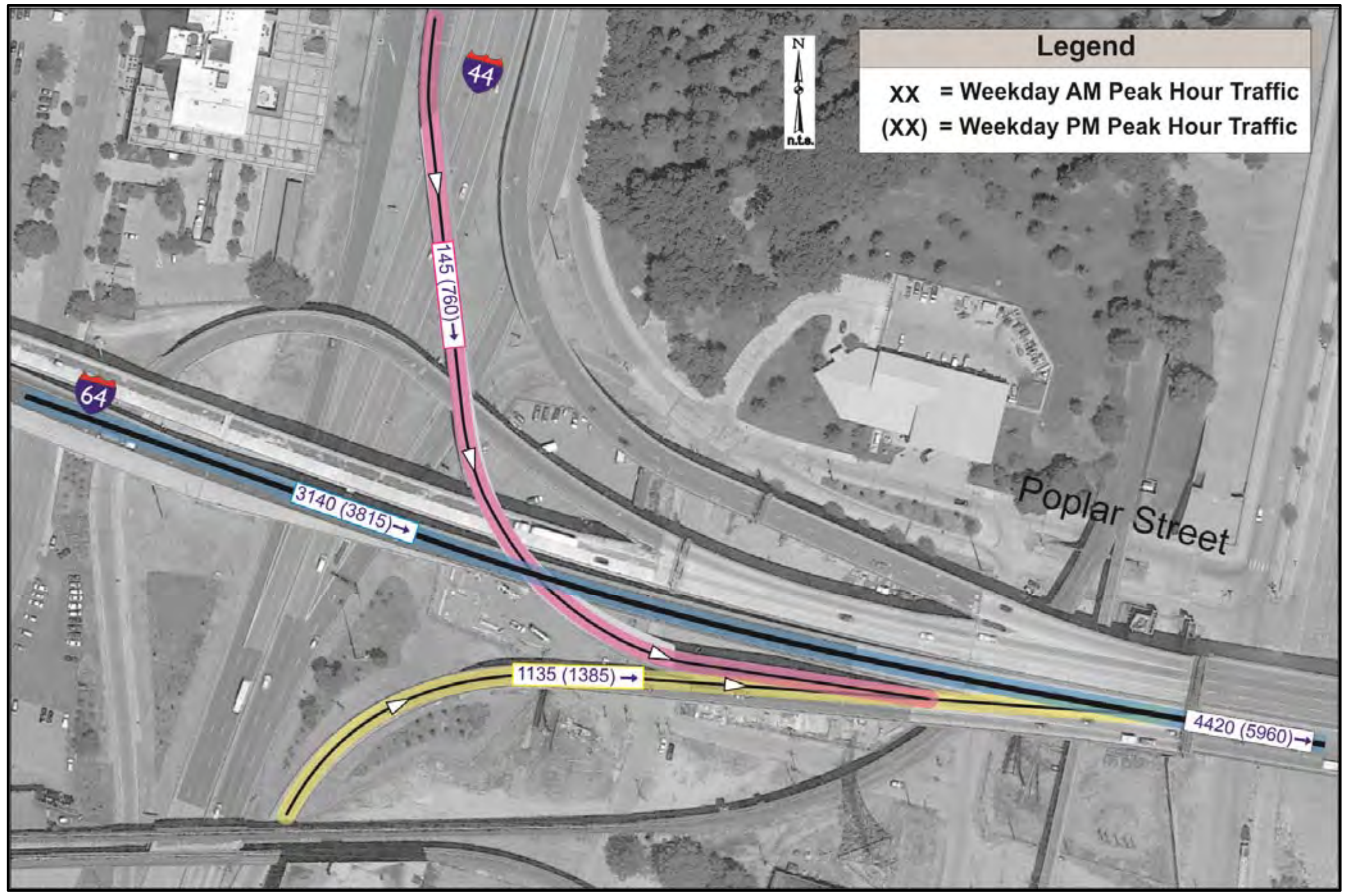


Exhibit 5.7: Peak Hour Ramp Volumes for Proposed Junction Control Location

At a minimum, the length of the gate system would be the same as a standard lane closure taper of 660 feet for the 55 MPH speed limit. The length of this system would preclude it from being a viable method of closing Ramp 4 because the new CAR-2015 on-ramp and auxiliary lane does not leave enough room for a gate system. Although there is enough room to install the gates on I-55 as a method to close one lane on Ramp 2 during off-peak hours, the gate system would need to extend south on I-55 over the viaduct bridge structure, which would cause additional loading to this structure. Therefore, although MODOT has reservations about using overhead dynamic lane control, it would be the most practical method to close a lane on Ramp 2 due to the structural concerns about installing gates on the bridge.

Junction control and ramp metering could be used on several of the alternatives previously discussed, but Alternatives 2A and 3 were considered the best due to the 30 MPH radius on Ramp 4. The addition of ramp metering on Ramp 4 could potentially cause backups onto the Interstate. As discussed in Alternative 3, the weaving distance between the new Washington entrance ramp (near Pine Street) is already sub-standard. If the ramp metering were to cause traffic to back up onto the Interstate, it would further reduce the merge distance and cause a reduction in safety. Ramp metering with Alternative 3 could be problematic due to the steep grade for the flyover option and the distance it would take for trucks or even cars to get up to speed after stopping. This also creates major safety concerns with low speed vehicles merging into a smoothly flowing ramp and backups onto eastbound I-44. Therefore, the preferred alternative on which to investigate ramp metering is Alternative 2A.

Exhibit 5.8A shows the proposed alternative layout using a modifed version of Alternative 2A with a combination of junction control and ramp metering. Exhibits 5.8B and 5.8C indicate the proposed operations during peak and off-peak hours. Ramp 4 would be metered during peak periods, and Ramp 2 would be reduced to one lane using overhead dynamic signs during off-peak periods. The modified version of Alternative 2A improves the undesirable merge, but necessitates the removal of the SB I-55 entrance ramp from Memorial Drive. As previously mentioned, the City of St. Louis does not support removing this access. It should also be noted, that five lanes were assumed for NB I-55 in order to eliminate the shared lane between Ramp 2 and the exit to Memorial Drive, which also simplifies the overhead signing.

Although the idea for junction control combined with ramp metering is compelling, the same safety and geometric design concerns on either modified Alternative 2A or Alternative 3 would remain. In addition, the public perception of spending millions of dollars on rebuilding a ramp only to see it closed is a concern for MoDOT. <u>Therefore, the costs greatly outweigh the benefits of this alternative and it is not preferred by MoDOT</u>.

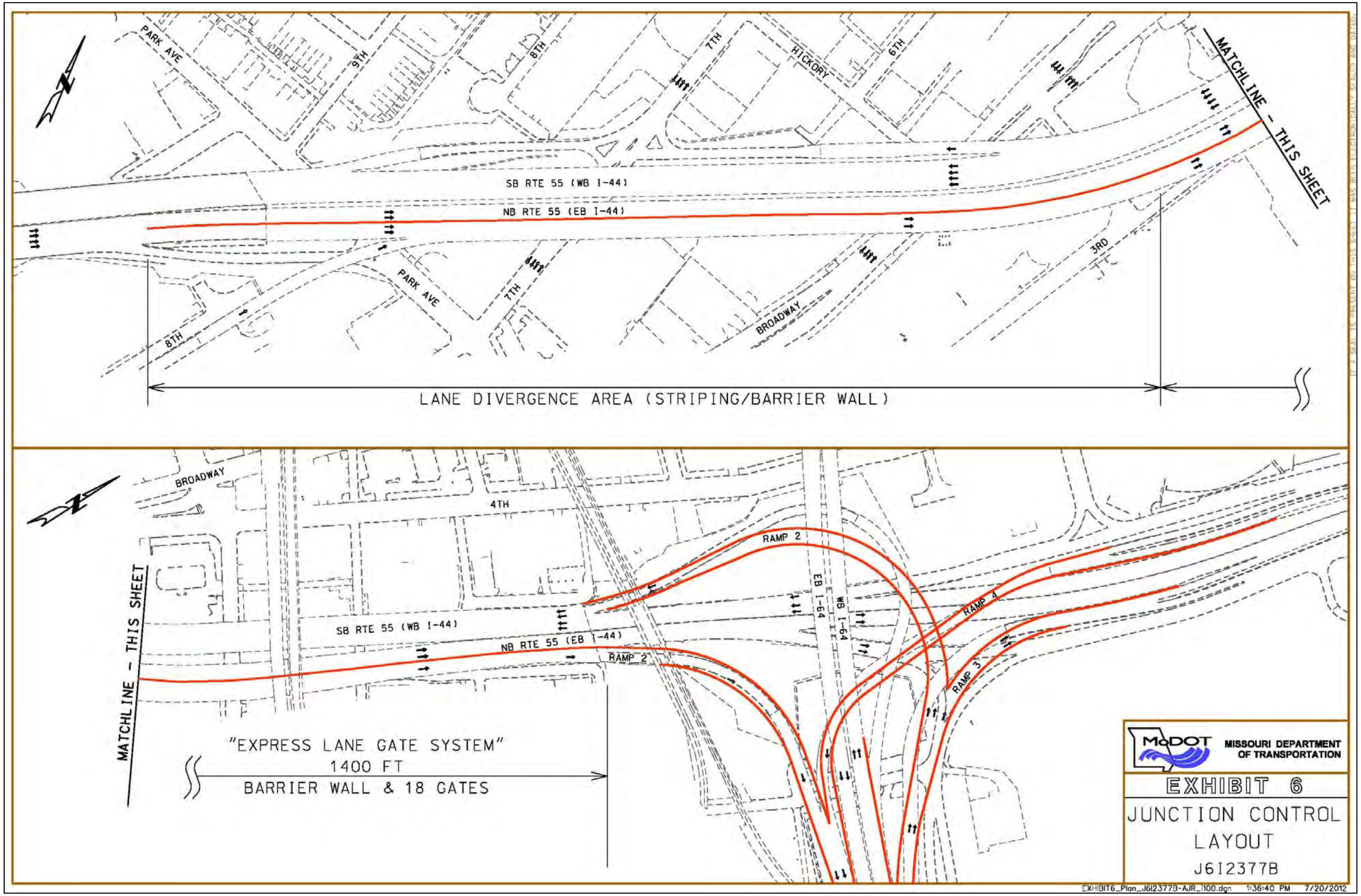


Exhibit 5.8A: PSB Interchange Reconstruction Alternative 6

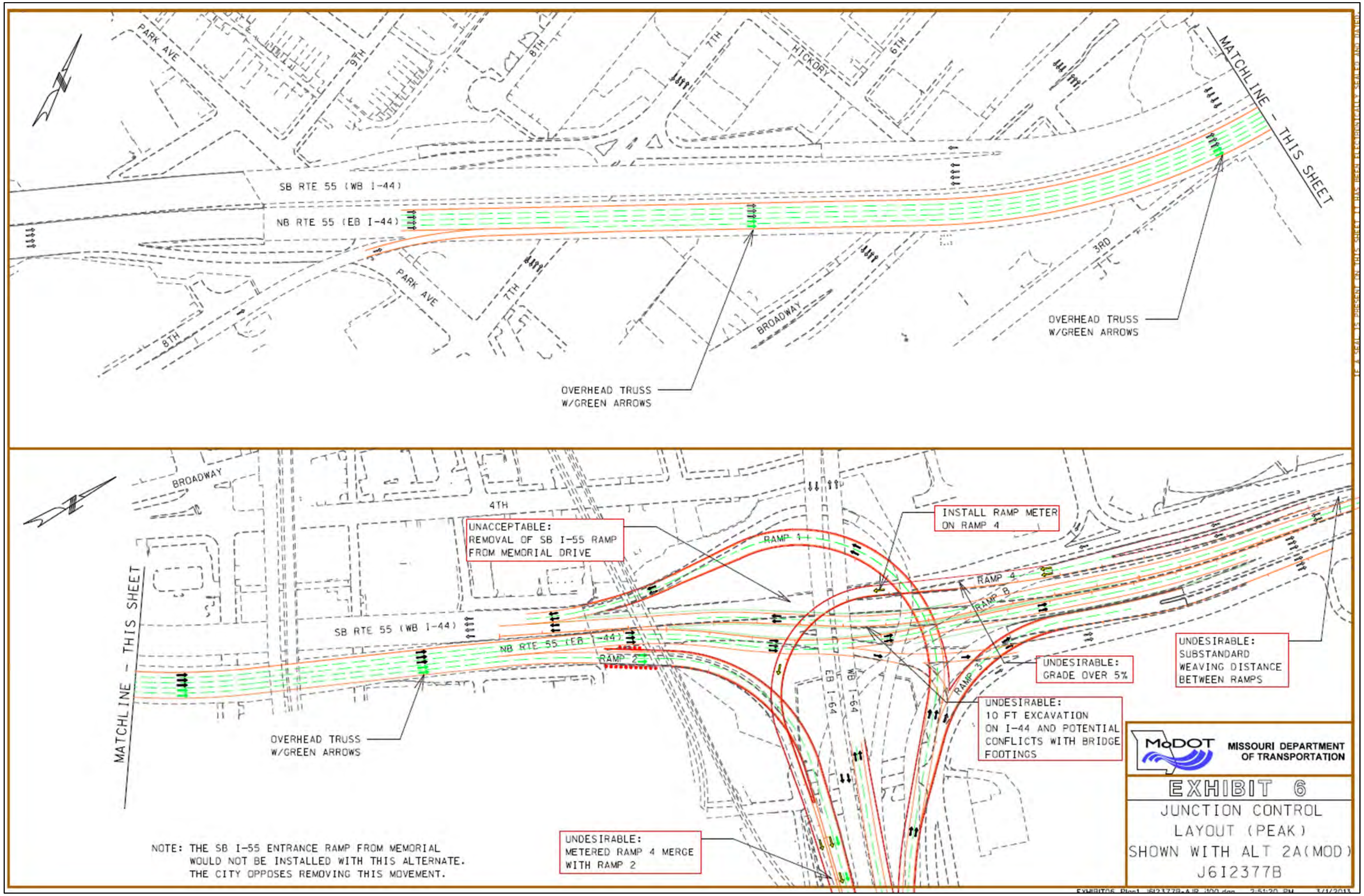


Exhibit 5.8B: PSB Interchange Reconstruction Alternative 6, Peak Period Operations

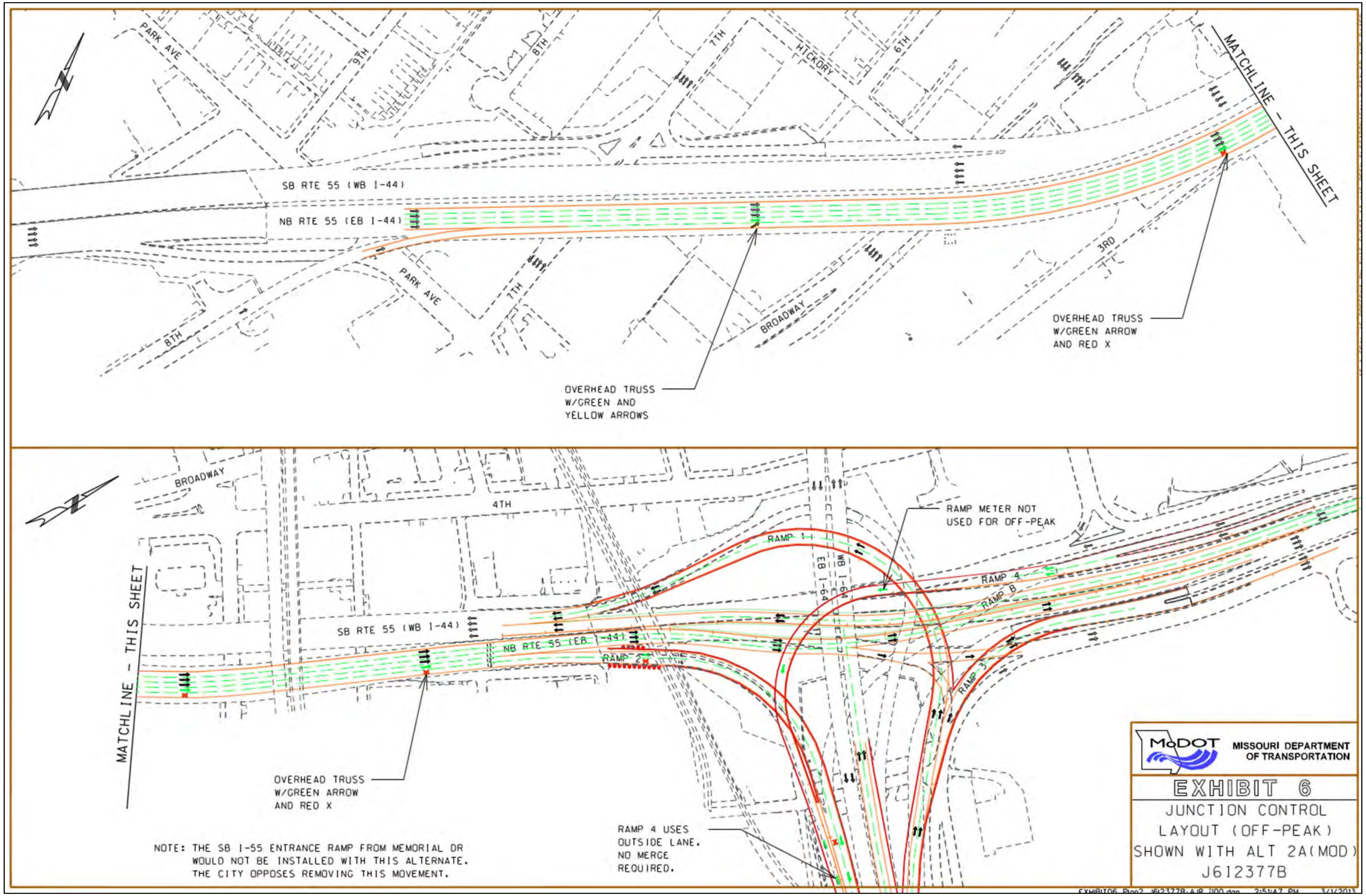


Exhibit 5.8C: PSB Interchange Reconstruction Alternative 6, Off-Peak Period Operations

5.4.6 Alternative 7 – Replace Ramp A with Dual Lane Ramp, Rebuild Ramp B as a U-Turn Flyover ramp, and Remove SB I-55 Exit to 7th Street

Alternative 7 investigated rebuilding Ramp B in a new location, as shown in **Exhibit 5.9**. Instead of exiting near Walnut and Memorial, WB I-44 (existing EB I-70) and SB Memorial traffic would continue onto SB I-55 and past the entrance of Ramp D (future dual-lane "Ramp 1"), to an exit near the existing 7th Street exit ramp. After exiting SB I-55, the ramp would rise over mainline I-55 and curve sharply to the left to perform a U-turn maneuver. The ramp would enter NB I-55 between the Marion/8th Street on-ramp and the Railroad overpass, merge with NB 55 traffic and continue over the Poplar Street Bridge into Illinois, giving drivers the ability to utilize Ramp 1 to complete the movement to the PSB. Unfortunately, this alternative required the removal of the exit from SB I-55 to 7th Street. As discussed previously, the City of St. Louis is opposed to such measures. <u>Due to negative design impacts, including the required closure of the 7th Street exit, this alternative is not preferred by MoDOT.</u>

The conceptual layout indicates the ramp would have to be built beyond the existing I-55 footprint, which impacts both residential and commercial properties. Both the off-ramp and on-ramp would need to be a tapered design and the design speed of the curve would be 30 MPH. With a 14-foot minimum clearance over I-55, the ramp grades were between 2.5 and 3 percent.

Removing SB I-55's access to 7th Street is highly unfavorable both politically and operationally. 7th Street is a major access to the CBD, sporting venues, and the commercial and historic districts along Broadway and 7th Street. Other existing exits could not replace this accessibility. The next SB I-55 exit is 1.93 miles south of 7th Street at Arsenal Street (south of the I-44 interchange). The nearest exit on WB I-44 is Gravois Avenue, which is 0.92 miles from 7th Street, but only allows for westbound access to Gravois. Exits to downtown north of 7th Street are from EB I-70. The nearest exit to the north is 1.45 miles from 7th Street and sends drivers east to Laclede's Landing or over the MLK Bridge to Illinois. The second exit to the north is the N. Broadway exit, 1.83 miles from 7th street and serves the northern portion of the CBD; utilizing this exit for traffic destined to the southern portion of the CBD would increase volumes on Broadway, the main southbound arterial.

This ramp configuration was unfavorable for other reasons as well. The right-of-way requirements for building this ramp did not meet the original intention of this project. Because right-of-way in this area is costly, in both monetary and environmental/historical preservation realms, MoDOT scoped the project to remain within current right-of-way limits. In addition, the design would not meet driver's expectations. Motorists would be required to pass the interchange and perform a U-turn to continue into Illinois. In an already congested area, with a great deal of first-time users, this condition could have had a significant negative impact to the safety performance of the interchange.

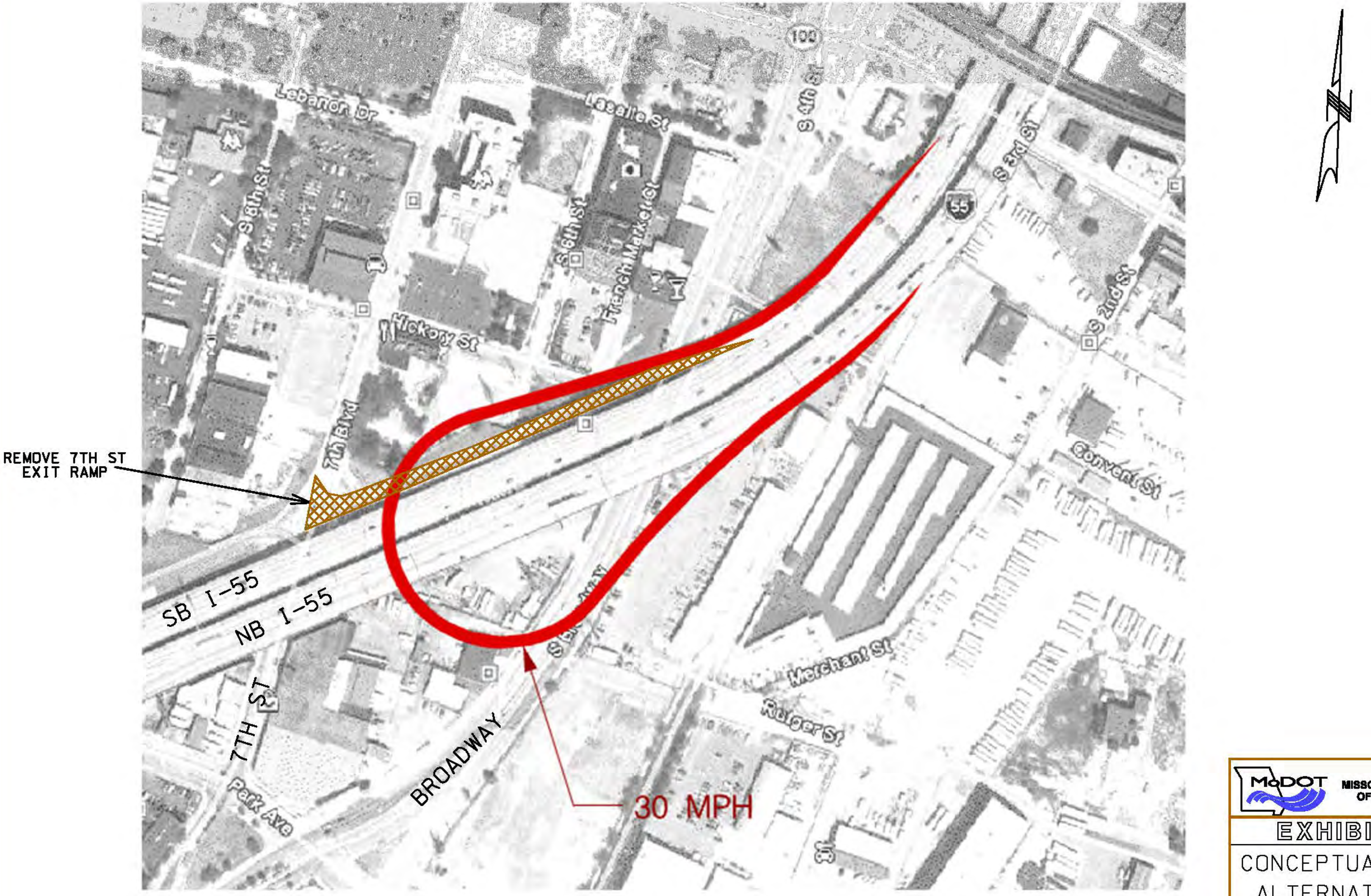
5.4.7 Alternative 8 – Remove Ramp B and Replace Ramp A with Dual Lane Ramp (Previously Preferred)

Alternative 8 investigated a scenario that would not replace Ramp B, but replace Ramp A (single lane ramp) with Ramp 2 (dual-lane ramp) in its current location to accommodate the NB I-55 traffic heading to Illinois. Plans for Alternative 8 are shown in **Exhibits 5.10A, 5.10B, and 5.10C**, typical sections and profiles for this alternative can be found in Appendix C. For the new dual-lane Ramp 2, the horizontal alignment improves from a design speed of 30 MPH to 35 MPH. The sag vertical curve improves from 20 MPH to 30 MPH, and the crest vertical curve improves from 35 MPH to 45 MPH. Eliminating the WB I-44 (existing EB I-70) traffic using Ramp B will greatly improve the operations of Ramp 2 by affording that ramp dedicated lanes on the PSB.

Ramp D currently has a very sharp curve, with a posted advisory speed of only 20 mph. The horizontal alignment of proposed Ramp 1 is an improvement of the existing radius and is designed for 35 mph. A design exception for shoulder width will be needed for Ramp 1 in order to fit the two-lane ramp between the piers on the Terminal Railroad Association Bridge. The proposed profile of Ramp 1 improves the existing sag curve beneath this bridge from 20 MPH to 30 MPH. The existing ramp has sub-standard vertical clearance beneath the railroad bridge (14'-6"), and the new ramp does not substantially improve this clearance. An alternate alignment for Ramp 1 was considered, but was ruled out as described under Alternative 4.

Removal of Ramp B would not be completed until after the after the opening of the New Mississippi River Bridge (NMRB), which is expected to occur in early 2014. The NMRB will be designated as I-70 and is expected to capture nearly all of the existing EB I-70 trips currently utilizing the PSB. In fact, in the future motorists on EB I-70 would pass the NMRB/I-70 connection, continuing on WB I-44, prior to arriving at the existing Ramp B exit – a counter-intuitive route.

As part of the City Arch River | 2015 (CAR 2015) project (Section 2.1.4.1), a link will also be constructed between the NMRB and Tucker Boulevard, a major north-south arterial in the heart of the St. Louis CBD. This link is expected to be complete in year 2014 as well. Therefore, it is expected that the Ramp B volume currently arriving via SB Memorial Drive will decrease significantly as well. Traffic that does not shift to Tucker Boulevard and the NMRB will have increased connectivity to the Martin Luther King Bridge (due to the CAR 2015) project and to the new Ramp 2.



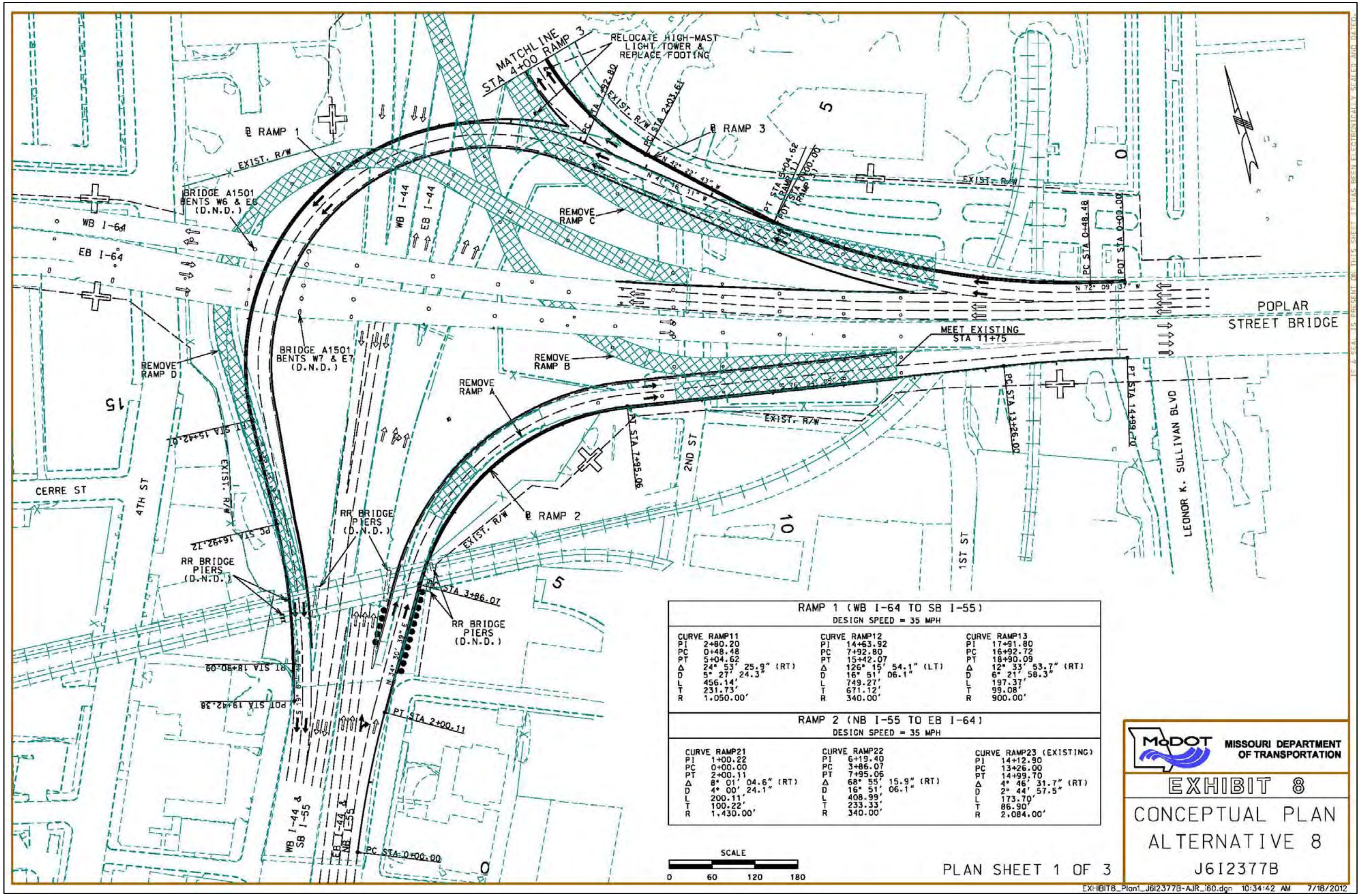
MoDOT MISSOURI DEPARTMENT OF TRANSPORTATION

EXHIBIT 7

CONCEPTUAL PLAN
ALTERNATIVE 7
J6I2377B

EXHIBIT7_Plan_AJR_J612377B_i100.dgn 7/12/2012

Exhibit 5.9: PSB Interchange Reconstruction Alternative 7



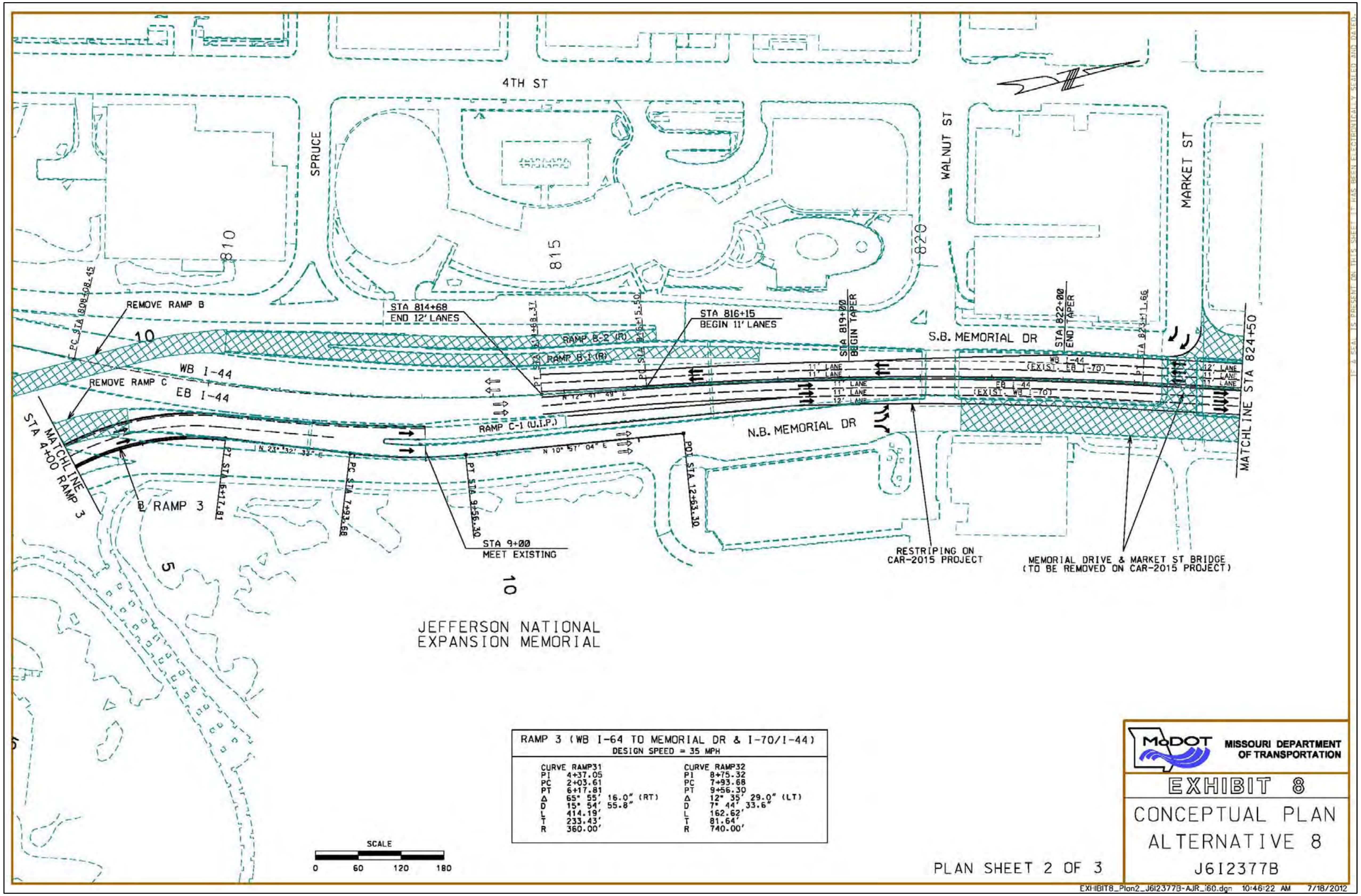
RAMP 1 (WB I-64 TO SB I-55)
DESIGN SPEED = 35 MPH

CURVE	RAMP11	CURVE	RAMP12	CURVE	RAMP13
PI	2+80.20	PI	14+63.92	PI	17+91.80
PC	0+48.48	PC	7+92.80	PC	16+92.72
PT	5+04.62	PT	15+42.07	PT	18+90.09
Δ	24° 53′ 25.9″ (RT)	Δ	126° 15′ 54.1″ (LT)	Δ	12° 33′ 53.7″ (RT)
D	5° 27′ 24.3″	D	16° 51′ 06.1″	D	6° 21′ 58.3″
L	456.14′	L	749.27′	L	197.37′
T	231.73′	T	671.12′	T	99.08′
R	1.050.00′	R	340.00′	R	900.00′

RAMP 2 (NB I-55 TO EB I-64)
DESIGN SPEED = 35 MPH

CURVE	RAMP21	CURVE	RAMP22	CURVE	RAMP23 (EXISTING)
PI	1+00.22	PI	6+19.40	PI	14+12.90
PC	0+00.00	PC	3+86.07	PC	13+26.00
PT	2+00.11	PT	7+95.06	PT	14+99.70
Δ	8° 01′ 04.6″ (RT)	Δ	68° 55′ 15.9″ (RT)	Δ	4° 46′ 31.7″ (RT)
D	4° 00′ 24.1″	D	16° 51′ 06.1″	D	2° 44′ 57.5″
L	200.11′	L	408.99′	L	173.70′
T	100.22′	T	233.33′	T	86.90′
R	1.430.00′	R	340.00′	R	2.084.00′

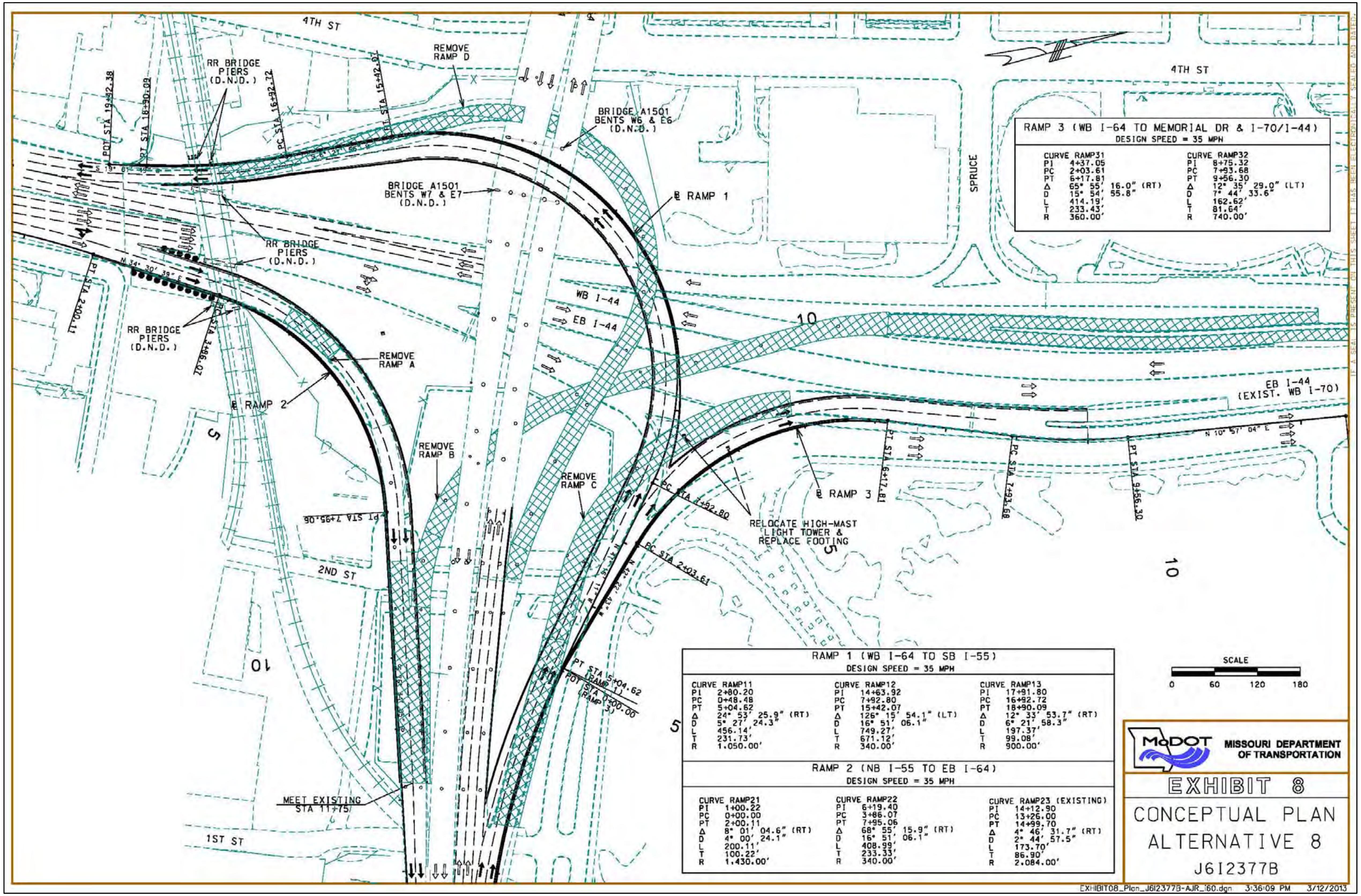
Exhibit 5.10A: PSB Interchange Reconstruction Alternative 8, Sheet 1



RAMP 3 (WB I-64 TO MEMORIAL DR & I-70/I-44)
DESIGN SPEED = 35 MPH

CURVE	RAMP31	CURVE	RAMP32
PI	4+37.05	PI	8+75.32
PC	2+03.61	PC	7+93.68
PT	6+17.81	PT	9+56.30
Δ	65° 55' 16.0" (RT)	Δ	12° 35' 29.0" (LT)
D	15° 54' 55.8"	D	7° 44' 33.6"
L	414.19'	L	162.62'
T	233.43'	T	81.64'
R	360.00'	R	740.00'

Exhibit 5.10B: PSB Interchange Reconstruction Alternative 8, Sheet 2



RAMP 3 (WB I-64 TO MEMORIAL DR & I-70/I-44)
DESIGN SPEED = 35 MPH

CURVE	RAMP31	CURVE	RAMP32
PI	4+37.05	PI	8+75.32
PC	2+03.61	PC	7+93.68
PT	6+17.81	PT	9+56.30
Δ	65° 55' 16.0" (RT)	Δ	12° 35' 29.0" (LT)
D	15° 54' 55.8"	D	7° 44' 33.6"
L	414.19'	L	162.62'
T	233.43'	T	81.64'
R	360.00'	R	740.00'

RAMP 1 (WB I-64 TO SB I-55)
DESIGN SPEED = 35 MPH

CURVE	RAMP11	CURVE	RAMP12	CURVE	RAMP13
PI	2+80.20	PI	14+63.92	PI	17+91.80
PC	0+48.48	PC	7+92.80	PC	16+92.72
PT	5+04.62	PT	15+42.07	PT	18+90.09
Δ	24° 53' 25.9" (RT)	Δ	126° 15' 54.1" (LT)	Δ	12° 33' 53.7" (RT)
D	5° 27' 24.3"	D	16° 51' 06.1"	D	6° 21' 58.3"
L	456.14'	L	749.27'	L	197.37'
T	231.73'	T	671.12'	T	99.08'
R	1,050.00'	R	340.00'	R	900.00'

RAMP 2 (NB I-55 TO EB I-64)
DESIGN SPEED = 35 MPH

CURVE	RAMP21	CURVE	RAMP22	CURVE	RAMP23 (EXISTING)
PI	1+00.22	PI	6+19.40	PI	14+12.90
PC	0+00.00	PC	3+86.07	PC	13+26.00
PT	2+00.11	PT	7+95.06	PT	14+99.70
Δ	8° 01' 04.6" (RT)	Δ	68° 55' 15.9" (RT)	Δ	4° 46' 31.7" (RT)
D	4° 00' 24.1"	D	16° 51' 06.1"	D	2° 44' 57.5"
L	200.11'	L	408.99'	L	173.70'
T	100.22'	T	233.33'	T	86.90'
R	1,430.00'	R	340.00'	R	2,084.00'

Exhibit 5.10C: PSB Interchange Reconstruction Alternative 8, Sheet 3

5.4.8 Alternative 9 – Widen PSB, Replace Ramp A with Dual Lane Ramp, Add Lane to PSB from 6th Street Ramp, and Remove Ramp B (Preferred)

As discussed in Section 2.1.2.2, after concerns over findings of the initial redesign investigation, EWGCOG contracted an independent consultant to investigate existing and potential alternatives. The independent review generally agreed with the conclusions regarding the alternatives identified previously (Alternatives 1 through 8) and the potential barriers to retaining Ramp B. (The documentation of this investigation can be found in Appendix C.)

Subsequent to that investigation, recommendations were made for MoDOT (in partnership with IDOT) to pursue a project to widen the PSB to provide for five lanes of eastbound traffic. This would potentially be accomplished by widening the bridge piers to the south, sliding the bridge, and filling in the space between the bridges creating room for an additional eastbound lane. In addition, IDOT will construct a new “MLK Connector” link from EB MLK bridge to WB I-64. This new link will replace the direct connectivity from EB I-70/I-64/I-55 to SB Route 3.

As shown in **Exhibit 5.11**, Alternative 9 proposes to incorporate the suggestion to widen the PSB to 5 lanes, extend the 6th Street entrance ramp across the PSB, and build Ramp 2 as a dual lane ramp. The additional lane would become an exit-only lane to Illinois Route 3 (currently a diverge exit). The addition of another lane has the potential to reduce congestion on both EB I-64 and NB I-55. It should be noted that this project is the same as Phases 1 and 2 of the preferred alternative in the EWGCOG independent review. As in Alternative 6, this alternative specifies five lanes on northbound I-55.

This alternative not only addresses the congestion on northbound I-55 by adding a dual ramp, it also tackles congestion on eastbound I-64 by adding capacity and weaving distance on the bridge, and enhances access to Route 3 in Illinois. Although the improvements proposed on this alternative are greater than the scope of the original project to replace the ramps at the PSB, it is felt that the proposed design’s benefits are much greater than the previous alternatives that have been explored.

<u>Due to the improved traffic flow to two of downtown St. Louis’ most congested areas, this is MoDOT’s preferred alternative</u>. It should also be noted that this alternative also has the support of IDOT and has been approved by East West Gateway.

A four lane variation of this alternate has also been considered as Alternative 9A. If for some reason the PSB bridge widening were not able to take place, MoDOT considered whether extending the 6th Street ramp would have a greater improvement to traffic conditions than providing a dual lane Ramp 2. In this alternate, the 6th Street Ramp and Ramp 2 would each be given one lane on the bridge. Ramp 2 could potentially be built as dual-lane, but would merge to one lane before the bridge. However, one of the significant findings of the EWGCOG independent review is that “…analysis of previous options demonstrated clearly that Ramp A (northbound-to-eastbound PSB) must carry two unimpeded lanes.”[7] Therefore, Alternative 9A was deemed inferior to Alternative 8 in a future scenario with a four-lane PSB.

5.4.9 Alternative 10 – Widen PSB, Replace Ramp A with Dual Lane Ramp, and Retain Ramp B as 5th Lane

The potential for a five-lane PSB creates the possibility to not only build Ramp 2 as a dual lane ramp, but to rebuild Ramp B (as Ramp 4) at the same time. The addition of the lane would eliminate the issues with short merging distances from Ramp 4.

Any of the previous Alternatives could be combined with the wider PSB to give Ramp 4 an exclusive lane. Although each of these Alternatives as a five-lane section is superior to its four lane counterpart, the alternatives deemed to have the most potential are Alternatives 2A and 3 due to their higher design speeds. Alternative 10-2A has a right side exit and 30 MPH turning radius, but would require the removal of access to SB I-55 from Memorial Drive. This is not supported by the City of St. Louis (as discussed in Section 5.4.2). Alternative 10-3 includes a flyover ramp which also has a 30 MPH design speed. See **Exhibit 5.12** for a plan layout of Alternative 10-3. As mentioned in the discussion on Alternative 3 (Section 5.4.3), there are some serious grade issues that will not improve with the five-lane option. Due to the great height and length of the bridge necessary to construct a ramp over I-64, this is also the costliest of the ramp options investigated.

Although this option for retaining Ramp B is geometrically feasible, it has a very undesirable grade for Ramp 4 and does not create any potential improvements to traffic congestion on EB I-64. .Specifically, constructing Ramp 4 instead of a 6th Street connection and third lane for EB I-64 would preclude the plans for Phase III of the PSB Interchange project proposed by EWGCOG. In that phase, a C-D road connection would be constructed between the 6th Street exit (currently a dropped lane) and the 6th Street entrance (proposed to be an add-lane) that would effectively create a continuous third lane for EB I-64. <u>Because this would change the full PSB Interchange project agreed upon by MoDOT, IDOT, and EWGCOG for the region, Alternative 10 is not preferred.</u>

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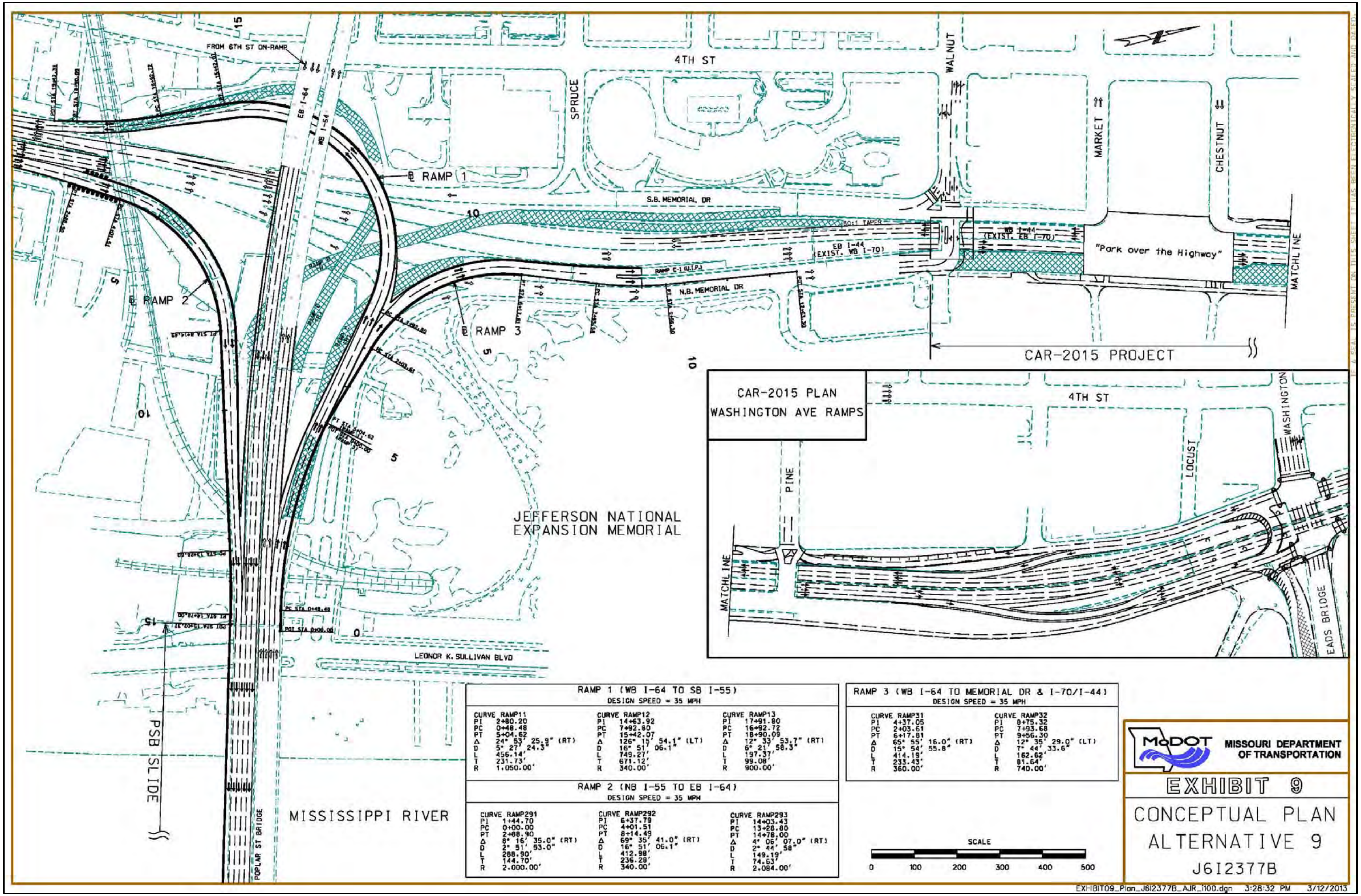
[7] *Poplar Street Bridge: Independent Review*, East-West Gateway Council of Governments; September 12, 2012



RAMP 1 (WB I-64 TO SB I-55)
DESIGN SPEED = 35 MPH

CURVE	RAMP11	CURVE	RAMP12	CURVE	RAMP13
PI	2+80.20	PI	14+63.92	PI	17+91.80
PC	0+48.48	PC	7+92.80	PC	16+92.72
PT	5+04.62	PT	15+42.07	PT	18+90.09
Δ	24° 53′ 25.9″ (RT)	Δ	126° 15′ 54.1″ (LT)	Δ	12° 33′ 53.7″ (RT)
D	5° 27′ 24.3″	D	16° 51′ 06.1″	D	6° 21′ 58.3″
L	456.14′	L	749.27′	L	197.37′
T	231.73′	T	671.12′	T	99.08′
R	1,050.00′	R	340.00′	R	900.00′

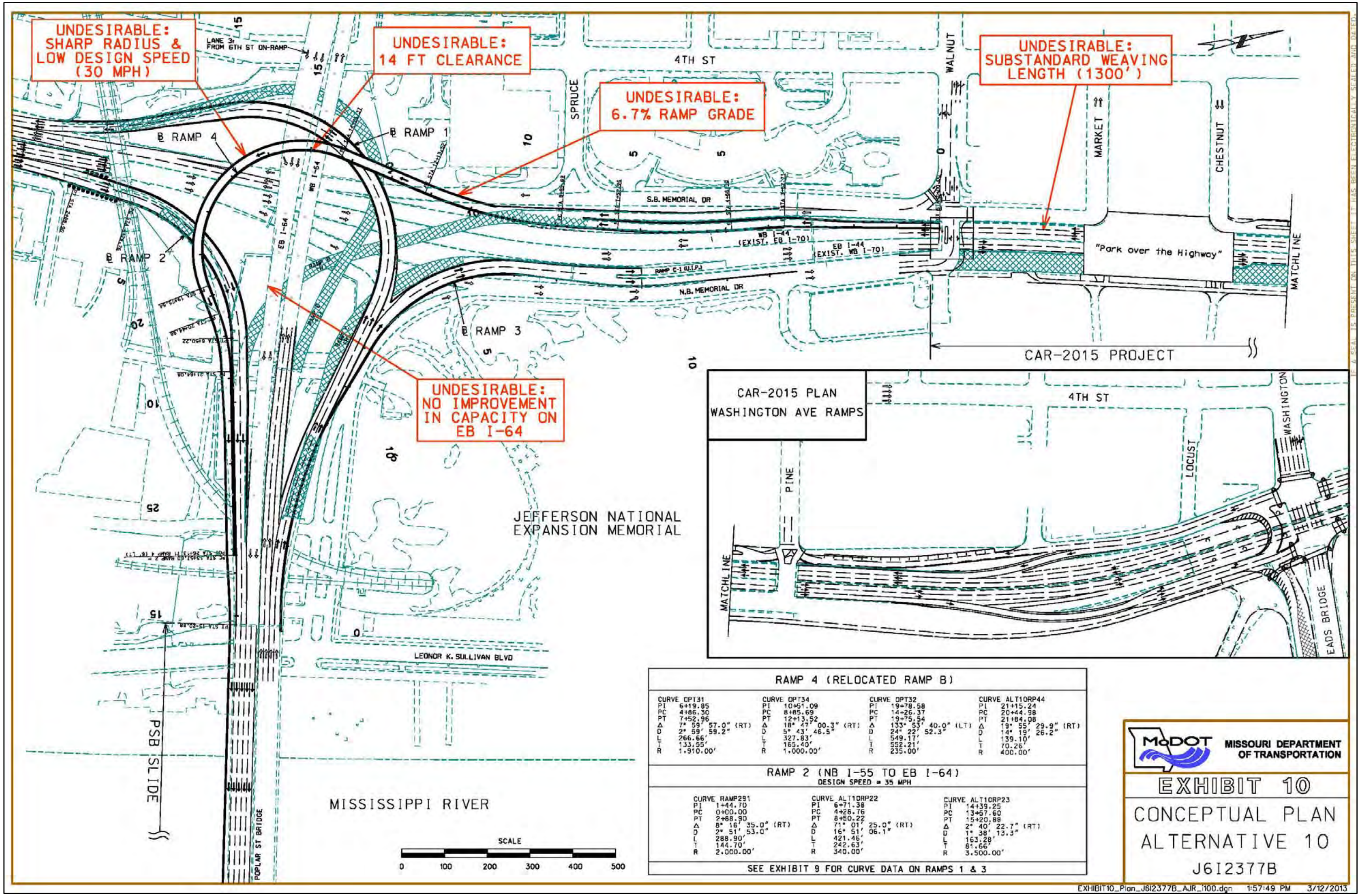
RAMP 2 (NB I-55 TO EB I-64)
DESIGN SPEED = 35 MPH

CURVE	RAMP291	CURVE	RAMP292	CURVE	RAMP293
PI	1+44.70	PI	6+37.79	PI	14+03.43
PC	0+00.00	PC	4+01.51	PC	13+28.80
PT	2+88.90	PT	8+14.49	PT	14+78.00
Δ	8° 16′ 35.0″ (RT)	Δ	69° 35′ 41.0″ (RT)	Δ	4° 06′ 07.0″ (RT)
D	2° 51′ 53.0″	D	16° 51′ 06.1″	D	2° 44′ 58″
L	288.90′	L	412.98′	L	149.19′
T	144.70′	T	236.28′	T	74.63′
R	2,000.00′	R	340.00′	R	2,084.00′

RAMP 3 (WB I-64 TO MEMORIAL DR & I-70/I-44)
DESIGN SPEED = 35 MPH

CURVE	RAMP31	CURVE	RAMP32
PI	4+37.05	PI	8+75.32
PC	2+03.61	PC	7+93.68
PT	6+17.81	PT	9+56.30
Δ	65° 55′ 16.0″ (RT)	Δ	12° 35′ 29.0″ (LT)
D	15° 54′ 55.8″	D	7° 44′ 33.6″
L	414.19′	L	162.62′
T	233.43′	T	81.64′
R	360.00′	R	740.00′

Exhibit 5.11: PSB Interchange Reconstruction Alternative 9



RAMP 4 (RELOCATED RAMP B)

	CURVE OPT31	CURVE OPT34	CURVE OPT32	CURVE ALT1ORP44
PI	6+19.85	10+51.09	19+78.58	21+15.24
PC	4+86.30	8+85.69	14+26.37	20+44.98
PT	7+52.96	12+13.52	19+75.54	21+84.08
Δ	7° 59' 57.0" (RT)	18° 47' 00.3" (RT)	133° 53' 40.0" (LT)	19° 55' 29.9" (RT)
D	2° 59' 59.2"	5° 43' 46.5"	24° 22' 52.3"	14° 19' 26.2"
L	266.66'	327.83'	549.17'	139.10'
T	133.55'	165.40'	552.21'	70.26'
R	1,910.00'	1,000.00'	235.00'	400.00'

RAMP 2 (NB I-55 TO EB I-64)
DESIGN SPEED = 35 MPH

	CURVE RAMP291	CURVE ALT1ORP22	CURVE ALT1ORP23
PI	1+44.70	6+71.38	14+39.25
PC	0+00.00	4+28.76	13+57.60
PT	2+68.90	8+50.22	15+20.88
Δ	8° 16' 35.0" (RT)	71° 01' 25.0" (RT)	2° 40' 22.7" (RT)
D	2° 51' 53.0"	16° 51' 06.1"	1° 38' 13.3"
L	288.90'	421.46'	163.28'
T	144.70'	242.63'	81.66'
R	2,000.00'	340.00'	3,500.00'

SEE EXHIBIT 9 FOR CURVE DATA ON RAMPS 1 & 3

MoDOT MISSOURI DEPARTMENT OF TRANSPORTATION

EXHIBIT 10

CONCEPTUAL PLAN
ALTERNATIVE 10

J6I2377B

EXHIBIT10_Plan_J6I2377B_AJR_100.dgn 1:57:49 PM 3/12/2013

Exhibit 5.12: PSB Interchange Reconstruction Alternative 10

5.4.10 Alternative 11 – Widen PSB, Retain Ramp B, and Extend 6th Street Ramp with Junction Control

This alternative explores the possibility of retaining Ramp B in combination with extending the 6th Street Ramp to the PSB. Junction Control would be used to reduce six lanes to five lanes on the bridge. The PSB will be widened to 5 lanes with Ramp B being rebuilt as Ramp 4. This could be done with any of the alternatives, but has been shown using a similar alignment to alternative 2A. With this alignment, the southbound entrance ramp to I-55 from Memorial Drive would have to be removed. The approach to the PSB would be widened to extend the 6th Street entrance ramp to the bridge.

There are two viable options for junction control on a 5-lane PSB. The first, Alternative 11A, is the five lane equivalent of Alternative 6 with Ramp 4 merging with a dual lane NB I-55 entrance ramp, Ramp 2 during the peak hour. This alternative is able to retain Ramp B using a combination of junction control and ramp metering. For more information on this alternative, see Alternative 6 (Section 5.4.5). A large concern with this option is that ramp metering on Ramp 4 could potentially create a queue in traffic that backs onto eastbound I-70. That concern in combination with the short merge distance between Ramp 4 and the new entrance ramp from Memorial Drive near Washington Avenue is a large safety concern.

The second option for junction control on a 5-lane PSB, Alternative 11B, uses junction control to merge the extended 6th Street Ramp, Ramp 5, into a dual-lane northbound I-55 Ramp 2. Exhibits 5.13A and 5.13B show the proposed plan layout and operations for peak-period and non-peak period operations, respectively. Like Alternative 6, the peak hour for both movements is during the afternoon rush. During that peak period, two lanes would remain open on Ramp 2. Ramp 5 would be forced to merge with eastbound I-64 similar to what it does today. During the off-peak time period, the inside lane of Ramp 2 would be closed using dynamic overhead signing.

When employing junction control, separate lanes come to occupy the same single lane. Therefore, it is important that vehicles can see the lane of traffic with which they would be merging - especially in the event that a vehicle violates the lane use control signals. Due to the difference in grades between I-64 (-0.6 percent) and Ramp 2 (+5.0 percent), the point at which a vehicle in either junction controlled lane can be seen in the other is only 198'. This is close to the stopping sight distance for the ramp (200'); however it is far below the required stopping sight distance for I-64 (425'). Therefore, the geometrics create an unacceptable safety issue at the merge.

The advantage with this alternative over Alternative 11A is that there is more space for the 6th Street Ramp to merge and it would not necessarily require ramp metering. This also eliminates the possibility of Ramp 4 backing up onto eastbound I-70 (Future I-44). The disadvantage of this alternative is that it would not likely have much improvement to the backups on eastbound I-64 due to the required merge.

All of the alternatives with Junction Control still have huge design issues. Even the alternatives with a reasonable horizontal alignment have problems with steep grade, substandard weaving distance, removal of access, or deep excavation. Due to the removal of the southbound I-55 entrance ramp from Memorial Drive, undesirable grades, and Junction Control being untested in the United States, this is not a preferred alternative.

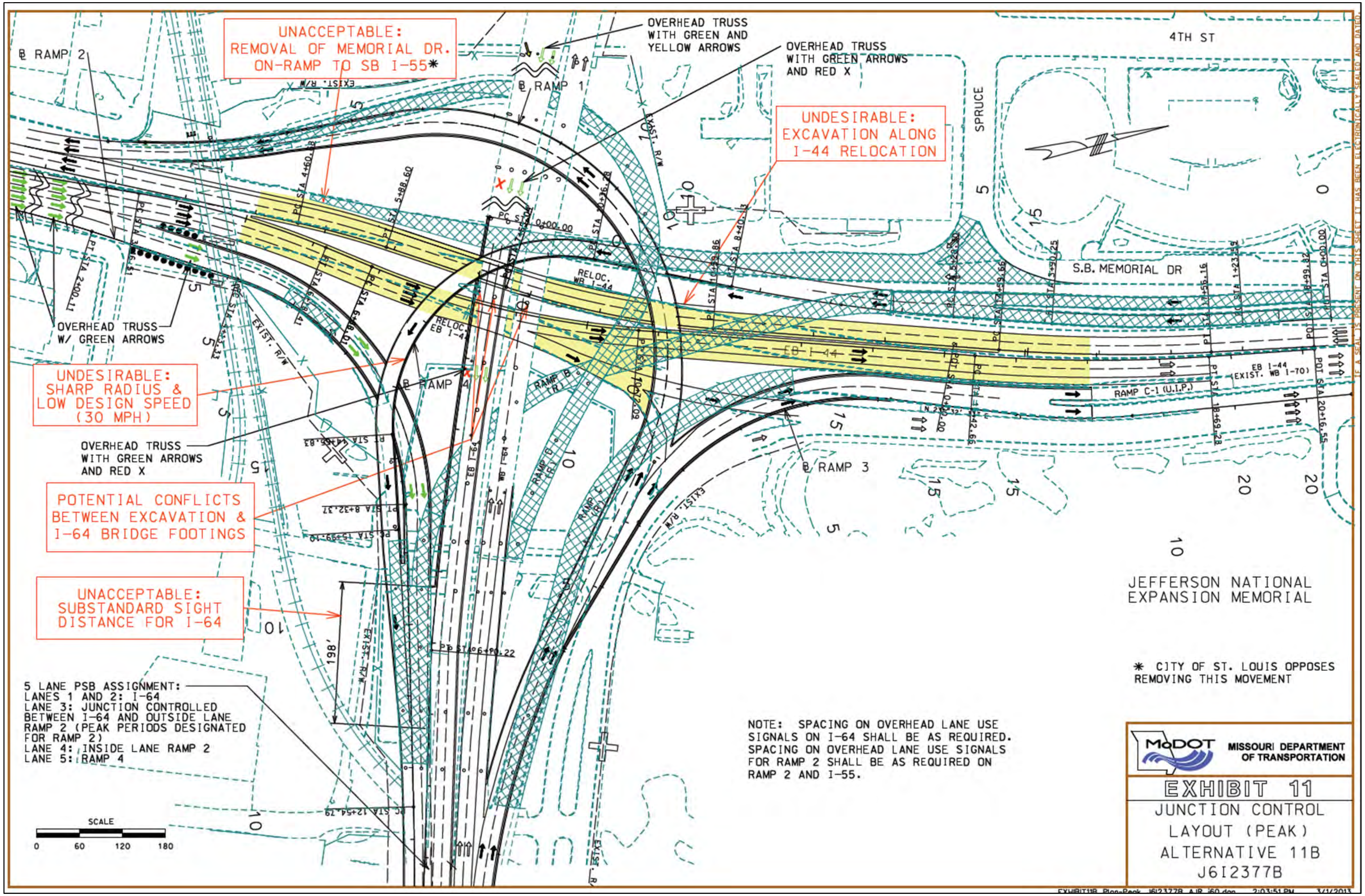


Exhibit 5.13A: PSB Interchange Reconstruction Alternative 11, Peak Period Operations

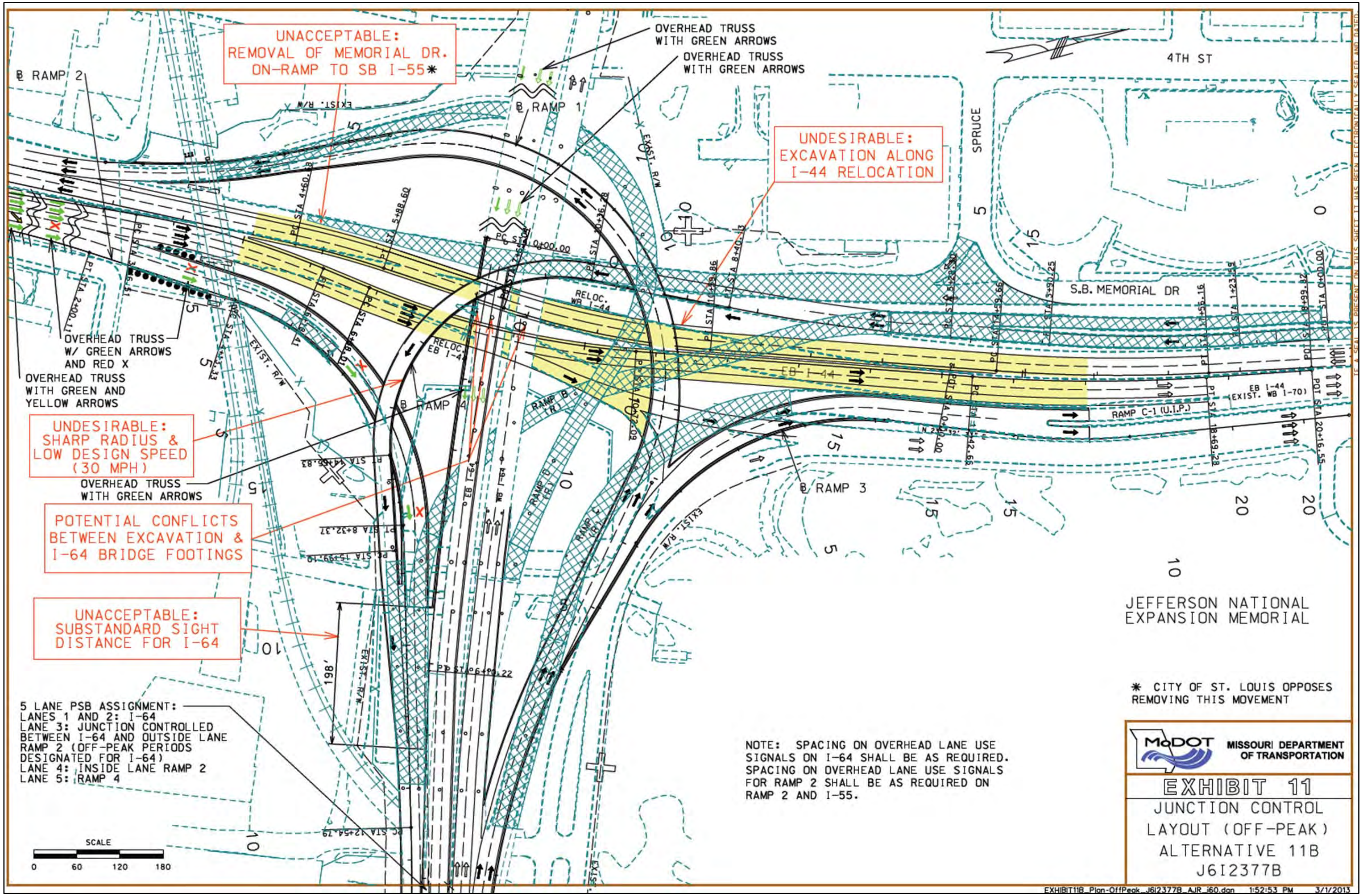


Exhibit 5.13B: PSB Interchange Reconstruction Alternative 11,Off- Peak Period Operations

6 Alternatives Analysis (Model Results and Outputs)

6.1 Safety Performance

Safety and security in travel is achieved by decreasing the risk of personal injury and property damage on and near transportation facilities. Missouri's Highway Safety Plan has a goal of reducing the number and severity of crashes occurring in Missouri. There is also a more specific goal – to reduce traffic fatalities to 850 or fewer by the year 2012 as identified in the state's strategic highway safety plan, Missouri's Blueprint to ARRIVE ALIVE. In line with the strategic plan, the proposed PSB Interchange improvements are expected to have a positive impact on safety in the project area. In fact, the incidence of fatal and disabling injuries for the study area was investigated, and the results compared favourably to the average for the St. Louis City-County area.

6.1.1 Nominal Assessment (Qualitative)

The PSB and its approaches are a significant cause of congestion in St. Louis' downtown freeway network. This congestion can be attributed both to their need for additional capacity and to the sub-standard design of the ramps. Traffic volumes and congestion in this area are anticipated to decrease with the opening of the NMRB and resulting traffic shifts. This reduction in area traffic can be expected to alleviate some of the crash potential in the vicinity of the PSB Interchange.

It can be expected that any improvements to the PSB Interchange that increase capacity and/or improve the geometry will further reduce the potential for crashes. Considering the preferred Alternative 9 includes doubling the capacity and improving the geometry of two currently saturated ramps and removing a substandard ramp and associated diverge/merge movements, it is anticipated that the PSB Interchange project will vastly improve the safety performance of the interchange. **Table 6.1** is a comparison of the alternatives in terms of design criteria and geometry decisions.

Table 6.1: Geometry Comparison of Alternatives

Design Factors	Alt 1	Alt 2	Alt 2A	Alt 3	Alt 4	Alt 5	Alt 6	Alt 8	Alt 9	Alt 9A	Alt 10	Alt 11A	Alt 11B
Ramp 4 Design Speed	25	25	30	30	30	25	30	n/a	n/a	n/a	30	30	30
Ramp 4 Grade Undesirable (5-7%)	5.2%	6.8%	6.5%	6.7%	5.7%	5.5%	6.5% Same as Alt 2A				6.7%	6.5% Same as Alt 2A	6.5% Same as Alt 2A
Ramp Grade Unacceptable (Over 7%)					8.1% Ramp 4								
Substandard Sight Distance													X
Left Side Entrance	X												
Tapered Entrance to PSB	X		X				X						
Substandard Tapered Entrance to SB I-55 or Remove Ramp Access		X	X			X	X					X	X
Left Side Exit		X											
Potential Conflicts w/ Bridge Footings	X	X	X									X	X
Remove Ramp B								X	X	X			
Added Lane to PSB									X		X	X	X
Future Potential for 3-lane I-64									X	X			X

Note: All alternatives to retain Ramp B have an undesirable vertical clearance of 14 feet in one or more locations.

6.1.2 Substantive Assessment (Quantitative)

The AASHTO Highway Safety Manual (HSM; 1st Edition, 2010) methodologies are the preferred method of safety analysis. The HSM provides guidance for quantifying effects on crash rates resulting from design decisions through methodologies for estimating the expected number of crashes on a future facility. Crash frequency is defined as the number of crashes occurring on a particular facility in a one-year period.

The HSM methodology begins with comparison of past safety performance to statistical estimates using available Safety Performance Functions (SPFs). Unfortunately, the current HSM Manual is light on SPFs for Interstate facilities, especially those in an urban area. Therefore, the safety review of these areas does not explicitly follow the traditional Highway Safety Manual approach because their layouts and locations do not comply with guideline examples.

Volume 3 of the HSM defines a number of Crash Modification Factors (CMFs) that represent the relative change to crash frequency resulting from a change in a specific condition. The PSB Interchange project proposes the following changes to existing conditions:

- Widening a one-lane exit, ramp, and entrance to two lanes (Ramps A and D)
- Moving an exit gore from the interstate to another ramp (Ramp C)
- Removing/closing a one-lane exit, ramp, and entrance (Ramp B)
- Modifying a ramp entrance from a dedicated on-ramp to a merge condition (SB Memorial ramp to SB I-55)
- Modifying a ramp entrance from a merge condition to an add-lane (6th Street Ramp)

Only the fourth item on the list above has a related CMF in the HSM. "Modify two-lane to one-lane merge/diverge area" is a CMF listed for interchange design applications and may be applicable to the proposed change. This countermeasure has a CMF of 0.68, indicating a predicted 32-percent reduction in crashes. Therefore, this proposed modification could reduce crash potential at the SB Memorial merge with SB I-55 by 32-percent.

A search of the internet "CMF Clearinghouse" (http://www.cmfclearinghouse.org/) found the following factors which may the applicable to the first list item above. "Change number of lanes on freeway exit ramp from X to Y" has two entries in the database (the reliability ratings are not as strong as those typically included in the HSM, however the factor is presented here for consideration). The entries have CMFs of 0.58 and 0.72, indicating estimates of 42-percent and 28-percent, respectively. Thus, the widening of the NB I-55 ramp to the EB PSB could reduce the crash potential of that diverge area by up to 42-percent, according to research.

Unfortunately there were no other CMFs listed relating to the proposed PSB Interchange modifications. However, the two that were related do indicate a potential reduction in crashes. In addition, it can be assumed that removing Ramp B will also eliminate the queuing and congestion related to that ramp as well as the crash potential created by its substandard geometry, thereby further reducing crash rates in the interchange.

6.2 Operational Performance

The operational analysis evaluated conditions in the ExistingYear (2010), Construction Year (2015) and Design Year (2035). These timeframes were selected by MoDOT based on the anticipated project schedule and confirmed with FHWA during project coordination (Section 2.3.1).

Section 4.1, Future Year Traffic Forecasts, presents the methodology utilized to generate the traffic projections used for analysis. As noted there, the existing and forecasted traffic volumes used for operational analyses, are displayed in Appendix E.

As presented in Section 4.3, the existing network and proposed network modifications were evaluated with dual traffic analysis tools. VISSIM microsimulation software was used to assess the performance of the freeway network and any impacts to MoDOT's system. SYNCHRO software was utilized to analyze the local arterial network and associated traffic signal operations – facilities that are typically owned and operated by the City of St. Louis. Within both software platforms, models were constructed for the peak periods of a typical weekday; determined through traffic data collection to be 7:30 – 8:30 am and 4:30 – 5:30 pm.

6.2.1 VISSIM Modeling Analysis Results/Measures of Effectiveness (MOEs)

Although a large number of design alternatives were considered, the number of scenarios that warranted operational modelling was significantly less. This was primarily due to the ability to reference the operational modelling performed with the EWGCOG independent study (Section 2.1.2.2). For example, this study clearly indicated that an Alternative constructing a dual-lane Ramp A was necessary for acceptable operations. In addition, the study summarized that if additional capacity is added to the EB PSB, it would be preferable to assign that capacity to EB I-64 versus another connection. The results of the EWGCOG study were reviewed and accepted by the local transportation jurisdictions prior to the final traffic analysis for this AJR. In addition, a number of alternatives had geometric components that were considered undesirable and, therefore, could be considered inferior to other Alternatives that were modelled. The various VISSIM model Scenarios discussed in this AJR are described below in Table 6.2. It should be noted that for each design Scenario, an AM- and a PM- peak hour model was constructed and evaluated. However, for the PSB Interchange project, the PM peak hour is the critical period.

A number of measures of effectiveness (MOEs) can be quantified during analysis. Level of Service (LOS) was selected as a MOE for comparison across all alternatives. The LOS for the freeway system is based on the density per lane of a freeway segment (Section 4.3.6.2). The freeway system was divided into operational segments: basic freeway (mainline), weaving, and merging or diverging (ramp).

Table 6.2: VISSIM Model Scenarios and Descriptions

Remove Ramp B	Widened PSB	Design Alternative	Description	Section	Traffic Model
		4	Rebuild Ramp A and B as Single Lane Ramps in Place	5.3.1.1	No Build Models
		1	Replace Ramp A with Dual-Lane Ramp, Rebuild Ramp B by Lowering I-44 Mainline	5.4.1	N/A These options are Inferior to 6th Street connection, per EWGCOG Study
		2 / 2A	Replace Ramp A with Dual-Lane Ramp, Rebuild Ramp B as Left-Side Exit by Splitting I-44 mainline	5.4.2	
		3	Replace Ramp A with Dual-Lane Ramp and Rebuild Ramp B as a Flyover Ramp	5.4.3	
		5	Replace Ramp A with Dual-Lane Ramp, Rebuild Ramp B by Realigning SB Memorial entrance ramp	5.4.4	
		7	Replace Ramp A with Dual-Lane Ramp, Rebuild Ramp B as a U-Turn Flyover ramp, and Remove SB I-55 Exit to 7th Street	5.4.6	
	X	10	Replace Ramp A with Dual-Lane Ramp, Widen PSB, Rebuild Ramp B	5.4.9	
		6	Replace Ramp A with Dual-Lane Ramp, Rebuild Ramp B and utilize Junction Control	5.4.5	N/A Not Geometrically Desirable
	X	11	Replace Ramp A with Dual-Lane Ramp, Widen PSB, Add 6th Street Ramp Connection, Rebuild Ramp B and Utilize Junction Control	5.4.10	
X		8	Replace Ramp A with Dual Lane Ramp and Remove Ramp B (Previously Preferred)	5.4.7	Alt 8 Models (Reference EWGCOG Results)
X	X	9	Replace Ramp A with Dual-Lane Ramp, Widen PSB and Add 5th Lane to EB I-64/PSB from 6th Street Ramp and Remove Ramp B (Preferred)	5.4.8	Alt 9 Models (Reference EWGCOG Results)
X		9A	Rebuild Ramp A as Single Lane Ramp, Remove Ramp B, and add 6th Street Connection to PSB	5.4.8	N/A 2 lanes needed on Ramp 2, per EWGCOG Study

In summary, the traffic modeling indicated that, by eliminating Ramp B and replacing the existing single lane Ramp A with a dual lane ramp, the NB I-55 congestion in the PM Peak Period is virtually eliminated for both the construction year and design year traffic. Likewise, incorporating the MLK Connector and adding a fifth lane to the EB PSB dramatically improves the LOS on the bridge; and reduces congestion and queuing related to EB I-64 traffic.

These results are displayed below in **Exhibits 6.1 and 6.2** for comparison with the results of the operational modelling performed for the EWGCOG independent study (Exhibits 2.6 and 2.7). The link shading represents the average lane density of each link. As discussed previously in Section 4.3.6.2, link density is the basis for defining a LOS for freeway and ramp sections.

Exhibit 6.1: Operational Performance – Alternative 8 2035 PM Link Densities

The primary MOE differences between the modeled Scenarios are shown in **Table 6.3**. The analysis predicts that only the section at the Memorial Drive southbound on ramp to I-55/I-44 (row 45) will be negatively impacted by the interchange modifications. This is because the SB Memorial Drive on ramp will be modified from an add lane to a merge condition, decreasing the capacity of the ramp connection. It is necessary to merge this on-ramp north of the new westbound PSB to southbound I-55 ramp connection, as that ramp will now use two lanes of the existing I-55/I-44 mainline. Merging the SB Memorial ramp will allow the new westbound PSB to southbound I-55 ramp to operate as two add-lanes, maintaining lane balance on the interstate. All of the LOS results for the freeway segments are reported in **Tables 6.4 and 6.5**. A series of figures graphically representing the freeway LOS by Scenario are **Appendix G**. These LOS figures are identified with segment (row) numbers that correspond to the MOE results in Tables 6.3-6.5.

Exhibit 6.2: Operational Performance – Alternative 9 2035 PM Link Densities

Table 6.3: VISSIM MOE Differences Between Scenarios

				2015				2035				2015				2035			
	FREEWAY SEGMENT			NO BUILD		8	9	NO BUILD		8	9	NO BUILD		8	9	NO BUILD		8	9
				AM PEAK HOUR				AM PEAK HOUR				PM PEAK HOUR				PM PEAK HOUR			
	Route	Direction	Location	Type	LOS	LOS	LOS	Type	LOS	LOS	LOS	Type	LOS	LOS	LOS	Type	LOS	LOS	LOS
12	I-44/I-55	EB	Between Marion St. ramp and PSB EB ramp	Freeway	C	C	C	Freeway	D	D	D	Freeway	D	C	C	Freeway	E	D	D
13	I-44/I-55	EB	PSB EB off ramp	Diverge	C	C	C	Diverge	D	D	D	Diverge	E	C	C	Diverge	E	D	D
45	I-55	SB	Memorial Drive SB on ramp	Add Lane	B	B	B	Add Lane	B	B	B	Add Lane	C	D	D	Add Lane	C	E	E
56	I-64/55	WB	West of Main Street					Freeway	D	A	A					Freeway	C	A	A
58	I-64/55	WB	Diverge with CD Road					Diverge	D	A	A					Diverge	C	A	A
59	I-64/55	WB	Mainline					Freeway	D	B	B					Freeway	C	B	B
67	I-64/55	WB	CD Road merge with Route 3					Merge	B	A	A					Merge	B	A	A
68	I-64/55	WB	Mainline merge with CD Road					Merge	C	B	B					Merge	B	A	A
70	PSB	WB	Between Merge and I-55 off ramp	Weave	D	D	D	Weave	D	D	D	Weave	C	B	B	Weave	C	C	C
75	I-64	EB	2 to .5 mille from Broadway off ramp	Freeway	C	C	C	Freeway	C	C	C	Freeway	D	D	B	Freeway	F	F	C
76	I-64	EB	Broadway off Ramp	Diverge	B	C	C	Diverge	C	C	C	Diverge	F	F	B	Diverge	F	F	B
77	I-64	EB	Between Broadway and Gratiot ramps	Freeway	D	D	D	Freeway	D	D	D	Freeway	F	F	D	Freeway	F	F	D
78	I-64	EB	Gratiot on Ramp	Merge	C	C	C	Merge	C	C	C	Merge	F	F	D	Merge	F	F	C
79	I-64	EB	Between Gratiot and PSB	Freeway	D	D	C	Freeway	D	D	C	Freeway	F	F	D	Freeway	F	F	C
80	PSB	EB	Between I-70 and I-55 on ramps and Diverge	Weave	C	C	B	Weave	C	C	B	Weave	F	E	C	Weave	F	D	C
83	MLK	WB	Bridge	Freeway	B	B	B	Freeway	B	B	B	Freeway	A	A	A	Freeway	A	A	A
84	MLK	EB	Bridge	Freeway	A	A	A	Freeway	A	A	A	Freeway	C	D	D	Freeway	C	D	D

Table 6.4: VISSIM Analysis Results (Freeway Segments), AM & PMPeak Hour– WB/NB Direction

				2015				2035				2015				2035			
	FREEWAY SEGMENT			NO BUILD		**8**	**9**	NO BUILD		**8**	**9**	NO BUILD		**8**	**9**	NO BUILD		**8**	**9**
				AM PEAK HOUR				AM PEAK HOUR				PM PEAK HOUR				PM PEAK HOUR			
	Route	Direction	Location	Type	LOS	LOS	LOS	Type	LOS	LOS	LOS	Type	LOS	LOS	LOS	Type	LOS	LOS	LOS
1	I-55	NB	South of I-44 WB	Freeway	D	D	D	Freeway	F	F	F	Freeway	B	B	B	Freeway	B	B	B
2	I-55	NB	South of I-44 WB	Diverge	E	E	E	Diverge	E	E	E	Diverge	B	B	B	Diverge	B	B	B
3	I-55	NB	to I-44 WB and Truman Pkwy	Diverge	B	B	B	Diverge	C	C	C	Diverge	B	B	B	Diverge	C	C	C
4	I-44	WB	Ramp from I-55 NB to I-44	Freeway	D	D	D	Freeway	D	D	D	Freeway	D	D	D	Freeway	E	E	E
5	Truman	NB	At I-44	Freeway	B	B	B	Freeway	B	B	B	Freeway	D	A	A	Freeway	A	A	A
6	I-55	NB	South of I-44 EB Merge	Freeway	C	C	D	Freeway	D	D	D	Freeway	B	B	B	Freeway	B	B	B
7	I-44	EB	west of Gravois on ramp	Freeway	C	C	C	Freeway	D	D	C	Freeway	B	B	B	Freeway	B	B	B
8	I-44	EB	Gravois on ramp	Merge	B	B	B	Merge	C	C	C	Merge	B	B	B	Merge	B	B	B
9	I-44/I-55	EB	Merge to 7th St. off ramp	Weave	C	C	C	Weave	D	D	C	Weave	B	B	B	Weave	B	B	B
10	I-44/I-55	EB	Between 7th St. and Marion St. ramps	Freeway	C	C	C	Freeway	D	D	D	Freeway	C	C	C	Freeway	C	C	C
11	I-44/I-55	EB	Marion St. on ramp	Merge	C	C	C	Merge	C	C	C	Merge	C	B	B	Merge	C	C	C
12	I-44/I-55	EB	Between Marion St. ramp and PSB EB ramp	Freeway	C	C	C	Freeway	D	D	D	Freeway	D	C	C	Freeway	E	D	D
13	I-44/I-55	EB	PSB EB off ramp	Diverge	C	C	C	Diverge	D	D	D	Diverge	E	C	C	Diverge	E	D	D
14	I-44/I-55	NB	I-70 and NB Memorial Drive Diverge	Diverge	D	D	D	Diverge	E	E	E	Diverge	C	C	C	Diverge	C	C	C
15	I-70	NB	South of on ramp from PSB	Freeway	D	D	D	Freeway	D	D	D	Freeway	D	D	D	Freeway	D	D	D
16	I-70	WB	PSB on ramp	Add Lane	C	C	C	Add Lane	B	C	C	Add Lane	B	B	B	Add Lane	B	B	B
17	I-70	WB	Washington Avenue off ramp	Weave	C	C	C	Weave	C	C	C	Weave	B	B	B	Weave	B	C	B
18	I-70	WB	Between Memorial Drive/Washington Ave and MLK on ramps	Freeway	D	D	D	Freeway	D	D	D	Freeway	C	C	C	Freeway	C	C	C
19	I-70	WB	MLK on ramp	Add Lane	C	C	C	Add Lane	C	C	C	Add Lane	C	C	C	Add Lane	C	C	C
20	I-70	WB	Between MLK and Biddle on ramps	Freeway	C	C	C	Freeway	C	C	C	Freeway				Freeway			
21	I-70	WB	Reversible off ramp (left exit)	Diverge				Diverge				Diverge	B	B	B	Diverge	B	C	B
22	I-70	WB	Between reversible off ramp and Biddle on ramp	Freeway				Freeway				Freeway	B	B	B	Freeway	B	B	B
23	I-70	WB	Biddle on ramp	Merge	B	B	B	Merge	B	B	B	Merge	B	B	B	Merge	B	B	B
24	I-70	WB	Between Biddle on ramp and 10th St. off ramp	Freeway	C	C	C	Freeway	C	C	C	Freeway	C	C	C	Freeway	C	C	C
25	I-70	WB	10th St. off ramp	Drop Lane	C	C	C	Drop Lane	C	C	C	Drop Lane	C	C	C	Drop Lane	C	D	D
26	I-70	WB	Between 10th St. off and MRB on ramps	Freeway	D	D	D	Freeway	D	D	D	Freeway	D	D	D	Freeway	D	D	D
27	I-70	WB	MRB on Ramp	Merge	C	C	C	Merge	C	C	C	Merge	B	B	B	Merge	B	C	C
28	I-70	WB	Between MRB on Ramp and 10th on ramp	Freeway	D	D	D	Freeway	D	D	D	Freeway	C	C	C	Freeway	C	D	D
29	I-70	WB	10th St. on ramp	Weave	C	C	C	Weave	C	C	C	Weave	C	C	C	Weave	C	C	C

Table 6.5: VISSIM Analysis Results (Freeway Segments), AM & PM Peak Hour – EB/SB Direction

30	I-70	EB	West of 11th St. on ramp		Freeway	C	C	C	Freeway	C	C	C		Freeway	D	D	D	Freeway	D	D	D
31	I-70	EB	11th St. on ramp		Add Lane	B	B	B	Add Lane	B	B	B		Add Lane	C	C	C	Add Lane	C	C	C
32	I-70	EB	Between 11th St. on ramp and MRB off ramp		Weave	B	B	B	Weave	B	B	B		Weave	C	C	C	Weave	C	C	C
33	I-70	EB	MRB off Ramp		Diverge	B	B	B	Diverge	B	B	B		Diverge	C	C	C	Diverge	C	C	C
34	I-70	EB	Between MRB off ramp and Broadway off ramp		Freeway	A	A	A	Freeway	B	B	B		Freeway	B	B	B	Freeway	B	B	B
35	I-70	EB	Broadway off ramp		Diverge	B	B	B	Diverge	B	B	B		Diverge	B	B	B	Diverge	B	B	B
36	I-70	EB	Between Broadway off and reversibles		Freeway	A	A	A	Freeway	A	A	A		Freeway	C	C	C	Freeway	C	C	C
37	I-70	EB	East of reversibles - includes MLK diverge		Weave	B	B	B	Weave	B	B	B		Weave	B	B	B	Weave	B	B	B
38	I-70	EB	East of MLK off ramp		Freeway	B	B	B	Freeway	B	B	B		Freeway	B	A	A	Freeway	B	B	B
39	I-70	EB	West of SB Memorial on ramp to lane drop		Merge	B	B	B	Merge	B	B	B		Merge	B	B	B	Merge	B	B	B
40	I-70	EB	West of SB Memorial on ramp past lane drop		Freeway	B	B	B	Freeway	C	B	B		Freeway	C	B	B	Freeway	C	B	B
41	I-70	EB	SB Memorial on ramp		Merge	B	B	B	Merge	B	B	B		Merge	B	B	B	Merge	B	B	B
42	I-70	EB	Depressed Section		Freeway	C	B	B	Freeway	C	B	B		Freeway	C	C	C	Freeway	C	C	C
43	I-70	EB	PSB off ramp		Diverge	B			Diverge	B				Diverge	D			Diverge	D		
44	I-70	SB	TO I-55 and I-44 SB		Freeway	B	B	B	Freeway	C	C	C		Freeway	C	C	C	Freeway	C	C	C
45	I-55	SB	Memorial Drive SB on ramp		Add Lane	B	B	B	Add Lane	B	B	B		Add Lane	C	D	D	Add Lane	C	E	E
46	I-55	SB	PSB on ramp		Add Lane	B	C	C	Add Lane	B	C	C		Add Lane	C	D	D	Add Lane	C	D	D
47	I-55	SB	7th St. off ramp		Diverge	B	C	B	Diverge	B	C	C		Diverge	C	C	C	Diverge	D	D	D
48	I-55	SB	Between 7th St. ramps		Freeway	B	B	B	Freeway	B	B	B		Freeway	C	C	C	Freeway	C	C	C
49	I-55	SB	7th St. on ramp to 44 and 55 Diverge		Weave	A	B	B	Weave	A	B	B		Weave	C	C	C	Weave	C	C	C
50	I-55	SB	South of Diverge		Freeway	A	A	A	Freeway	A	B	B		Freeway	C	D	D	Freeway	D	D	D
51	I-44	WB	Gravois off Ramp		Diverge	A	B	B	Diverge	A	B	B		Diverge	B	B	B	Diverge	B	B	B
52	I-44	WB	Between Gravois off and I-55 NB on ramps		Freeway	A	A	A	Freeway	A	A	A		Freeway	C	C	C	Freeway	C	D	D
53	I-44	WB	I-55 NB on ramp		Add Lane	B	B	B	Add Lane	B	B	B		Add Lane	C	C	C	Add Lane	D	D	D
54	I-44	WB	Truman Pkwy on ramp to Jefferson off Ramp		Weave	B	B	B	Weave	B	B	B		Weave	B	B	B	Weave	B	C	C
55	I-44	WB	Between Jefferson Ramps		Freeway	A	A	A	Freeway	A	A	A		Freeway	C	C	C	Freeway	C	C	C
56	I-64/55	WB	West of Main Street						Freeway	D	A	A						Freeway	C	A	A
57	I-64/55	WB	Merge with MLK Connector						Weave		A	A						Weave		A	A
58	I-64/55	WB	Diverge with CD Road						Diverge	D	A	A						Diverge	C	A	A
59	I-64/55	WB	Mainline						Freeway	D	B	B						Freeway	C	B	B
60	I-64/55	WB	CD Road						Freeway	A	A	A						Freeway	B	A	A
61	I-64/55	WB	CD Road merge with Main Street						Merge	A	A	A						Merge	B	A	A
62	I-64/55	WB	CD Road weave between Main Street & Tudor/Piggot						Weave	A	A	A						Weave	B	A	A
63	I-64/55	WB	CD Road diverge to Tudor/Piggot						Diverge	A	A	A						Diverge	B	A	A
64	I-64/55	WB	CD Road diverge to Route 3						Diverge	A	A	A						Diverge	A	A	A
65	I-64/55	WB	CD Road merge with Tudor/Piggot						Merge	A	A	A						Merge	A	A	A
66	I-64/55	WB	CD Road east of Route 3 merge						Freeway	A	A	A						Freeway	A	A	A
67	I-64/55	WB	CD Road merge with Route 3						Merge	B	A	A						Merge	B	A	A
68	I-64/55	WB	Mainline merge with CD Road						Merge	C	B	B						Merge	B	A	A
70	PSB	WB	Between Merge and I-55 off ramp		Weave	D	D	D	Weave	D	D	D		Weave	C	B	B	Weave	C	C	C
71	I-64	WB	West of off ramps		Freeway	D	D	D	Freeway	D	D	D		Freeway	C	C	C	Freeway	C	C	C
72	I-64	WB	Stadium off ramp		Diverge	C	B	C	Diverge	C	B	B		Diverge	B	B	B	Diverge	B	B	B
73	I-64	WB	Between Stadium and Broadway Ramps		Freeway	D	D	D	Freeway	D	D	D		Freeway	C	C	C	Freeway	C	C	C
74	I-64	WB	Broadway on Ramp		Add Lane	C	C	C	Add Lane	C	C	C		Add Lane	C	C	C	Add Lane	C	C	C
75	I-64	EB	2 to .5 mille from Broadway off ramp		Freeway	C	C	C	Freeway	C	C	C		Freeway	D	D	B	Freeway	F	F	C
76	I-64	EB	Broadway off Ramp		Diverge	B	C	C	Diverge	C	C	C		Diverge	F	F	B	Diverge	F	F	B
77	I-64	EB	Between Broadway and Gratiot ramps		Freeway	D	D	D	Freeway	D	D	D		Freeway	F	F	D	Freeway	F	F	D
78	I-64	EB	Gratiot on Ramp		Merge	C	C	C	Merge	C	C	C		Merge	F	F	D	Merge	F	F	C
79	I-64	EB	Between Gratiot and PSB		Freeway	D	D	C	Freeway	D	D	C		Freeway	F	F	D	Freeway	F	F	C
80	PSB	EB	Between I-70 and I-55 on ramps and Diverge		Weave	C	C	B	Weave	C	C	B		Weave	F	E	C	Weave	F	D	C
81	Eads	WB	Bridge		Freeway	B	B	B	Freeway	B	B	B		Freeway	A	A	A	Freeway	A	A	A
82	Eads	EB	Bridge		Freeway	A	A	A	Freeway	A	A	A		Freeway	C	C	C	Freeway	C	D	D
83	MLK	WB	Bridge		Freeway	B	B	B	Freeway	B	B	B		Freeway	A	A	A	Freeway	A	A	A
84	MLK	EB	Bridge		Freeway	A	A	A	Freeway	A	A	A		Freeway	C	D	D	Freeway	C	D	D
85	MRB	WB	Bridge		Freeway	C	C	C	Freeway	C	C	C		Freeway	B	B	B	Freeway	B	B	B
86	MRB	WB	At ramps to I-70 and Tucker		Diverge	B	B	B	Diverge	B	B	B		Diverge	B	B	B	Diverge	B	B	A
87	MRB	EB	East of ramps from I-70 and Tucker		Merge	A	A	A	Merge	A	A	A		Merge	B	B	B	Merge	B	B	B
88	MRB	EB	Bridge		Freeway	A	A	A	Freeway	A	A	A		Freeway	B	B	B	Freeway	C	C	B

6.2.2 SYNCHRO Modeling Analysis Results/Measures of Effectiveness (MOEs)

The LOS for arterials is based on average driver delay induced by the intersection control (Section 4.3.6.1). The arterial LOS results for all Scenarios are presented in Tables 6.6 and 6.7.

Table 6.6: SYNCHRO Analysis Results (Arterial Intersections), AM Peak Hour

	AM PEAK HOUR LOS (DELAY in sec.)			
Intersection	2015		2035	
	No Build	Scenarios 8&9	No Build	Scenarios 8&9
Memorial Drive NB/Walnut St	A (8.2)	A (8.2)	A (8.6)	A (8.6)
Memorial Drive NB/Market St				
Memorial Drive NB/Chestnut St				
Memorial Drive NB/Pine St				
Memorial Drive NB/Washington Ave				
Memorial Drive NB/Eads Bridge	D (40.5)	D (40.5)	D (42.4)	D (42.4)
Memorial Drive SB/Spruce St	A (1.4)	A (1.4)	A (1.5)	A (1.5)
Memorial Drive SB/Walnut Ave	A (2.0)	A (2.1)	A (2.2)	A (2.4)
Memorial Drive SB/Market St				
Memorial Drive SB/Chestnut St				
Memorial Drive SB/Pine St	A (0.2)	A (0.2)	A (0.2)	A (0.2)
Memorial Drive SB/Washington Ave	A (9.1)	A (9.1)	A (9.4)	A (9.3)
3rd St/Convention Center	A (9.5)	A (8.2)	A (9.7)	A (8.5)
3rd St/Cole St	D (53.7)	D (53.7)	D (53.4)	D (53.4)
3rd St/Biddle St	B (13.0)	B (13.0)	B (13.1)	B (13.1)
3rd St/Cass Ave	A (6.5)	A (6.5)	A (6.6)	A (6.6)
4th St/Spruce St	B (10.9)	B (10.9)	B (11.0)	B (11.0)
4th St/Walnut St	C (24.7)	C (30.1)	C (27.6)	C (30.1)
4th St/Market St	C (19.7)	C (25.3)	C (21.7)	C (25.3)
4th St/Chestnut St	A (10.7)	B (10.4)	B (11.1)	B (11.0)
4th St/Pine St	B (17.8)	B (18.3)	B (18.6)	B (19.6)
4th St/Olive St	A (1.5)	A (1.5)	A (1.5)	A (1.5)
4th St/Washington Ave	B (17.2)	B (18.4)	B (19.4)	B (18.6)
4th St/Convention Center	B (20.0)	B (12.4)	B (17.3)	B (12.3)
4th St/Cole St	D (42.9)	D (42.9)	D (44.7)	D (44.7)
Broadway Ave/Spruce St	A (1.4)	A (1.9)	A (1.4)	A (1.9)
Broadway Ave/Clark St	A (4.3)	A (4.4)	A (4.4)	A (4.3)
Broadway Ave/Walnut St	C (21.7)	B (16.8)	B (15.4)	B (18.0)
Broadway Ave/Market St	B (17.8)	B (17.7)	C (22.0)	B (18.3)
Broadway Ave/Chestnut St	A (6.8)	A (2.9)	A (3.0)	A (3.0)
Broadway Ave/Pine St	B (19.6)	B (19.3)	C (31.4)	B (19.5)
Broadway Ave/Olive St	A (4.3)	A (4.5)	A (5.9)	A (4.5)
Broadway Ave/Locust St	A (2.0)	A (1.6)	A (1.4)	A (1.6)
Broadway Ave/St Charles St	A (5.3)	A (5.5)	A (8.4)	A (5.6)
Broadway Ave/Washington Ave	C (20.6)	B (12.6)	B (18.4)	B (12.9)
Broadway Ave/Convention Center	B (16.9)	B (16.9)	B (17.2)	B (17.2)
Broadway Ave/Cole St	C (32.4)	C (32.4)	C (33.8)	C (33.8)
Broadway Ave/Biddle St	A (4.5)	A (4.5)	A (4.6)	A (4.6)

Significantly, these results indicate that the arterials will not be negatively impacted by the new traffic patterns necessitated by the closure of Ramp B. These results have been shared and discussed with City of St. Louis Traffic Department personnel. They are in agreement with the preferred alternative for the PSB Interchange project.

Table 6.7: SYNCHRO Analysis Results (Arterial Intersections), PM Peak Hour

	PM PEAK HOUR LOS (DELAY in sec.)			
Intersection	2015		2035	
	No Build	Scenarios 8&9	No Build	Scenarios 8&9
Memorial Drive NB/Walnut St	A (6.6)	A (6.6)	A (6.6)	A (6.6)
Memorial Drive NB/Market St				
Memorial Drive NB/Chestnut St				
Memorial Drive NB/Pine St				
Memorial Drive NB/Washington Ave				
Memorial Drive NB/Eads Bridge	B (17.1)	B (17.1)	B (17.7)	B (17.7)
Memorial Drive SB/Spruce St	A (9.6)	A (8.9)	B (12.0)	B (10.8)
Memorial Drive SB/Walnut Ave	A (6.7)	A (5.6)	A (7.3)	A (5.7)
Memorial Drive SB/Market St				
Memorial Drive SB/Chestnut St				
Memorial Drive SB/Pine St	A (0.0)	A (0.0)	A (0.0)	A (0.0)
Memorial Drive SB/Washington Ave	B (17.7)	B (17.6)	B (18.2)	B (18.2)
3rd St/Convention Center	D (51.9)	D (53.0)	E (58.3)	E (64.5)
3rd St/Cole St	C (32.1)	C (32.1)	C (32.1)	C (32.1)
3rd St/Biddle St	A (8.5)	A (8.5)	A (9.1)	A (9.1)
3rd St/Cass Ave	A (9.0)	A (9.0)	A (9.4)	A (9.4)
4th St/Spruce St	C (29.0)	C (30.2)	C (28.9)	C (30.9)
4th St/Walnut St	D (47.0)	C (29.5)	D (51.5)	C (29.9)
4th St/Market St	C (32.9)	D (38.4)	C (33.4)	D (41.1)
4th St/Chestnut St	B (19.0)	C (22.0)	B (19.4)	C (22.7)
4th St/Pine St	B (10.1)	B (10.6)	B (10.1)	B (10.8)
4th St/Olive St	C (27.9)	C (28.8)	C (29.0)	C (30.1)
4th St/Washington Ave	C (28.9)	D (33.0)	C (30.1)	D (36.0)
4th St/Convention Center	F (83.8)	F (188.3)	F (94.0)	F (203.9)
4th St/Cole St	D (53.4)	D (53.4)	E (59.7)	E (59.7)
Broadway Ave/Spruce St	A (1.2)	A (1.3)	A (1.2)	A (1.3)
Broadway Ave/Clark St	A (6.4)	A (6.6)	A (6.4)	A (6.6)
Broadway Ave/Walnut St	C (25.0)	C (20.5)	C (28.9)	C (21.3)
Broadway Ave/Market St	B (19.6)	B (16.2)	C (20.3)	B (16.7)
Broadway Ave/Chestnut St	B (13.1)	B (13.7)	B (13.6)	B (14.6)
Broadway Ave/Pine St	B (15.8)	B (14.1)	B (16.1)	B (14.5)
Broadway Ave/Olive St	A (8.2)	A (7.7)	A (8.7)	A (7.8)
Broadway Ave/Locust St	A (5.2)	A (4.7)	A (5.2)	A (4.8)
Broadway Ave/St Charles St	A (2.4)	A (2.1)	A (2.5)	A (2.2)
Broadway Ave/Washington Ave	B (19.7)	C (22.4)	C (20.1)	C (23.6)
Broadway Ave/Convention Center	B (14.2)	B (14.2)	B (14.3)	B (14.4)
Broadway Ave/Cole St	C (28.0)	C (28.0)	C (28.4)	C (28.4)
Broadway Ave/Biddle St	A (6.7)	A (6.7)	A (6.4)	A (6.4)

6.2.3 Stakeholder and Environmental Concerns

For over a year, representatives from agencies including FHWA, MoDOT, IDOT, St. Louis City, and CAR 2015 have participated in "Core Team" meetings to coordinate PSB, CAR 2015, and NMRB project planning, approvals, and issues.

6.2.4 Environmental Documentation

As discussed in Section 2.1.4.1, the PSB Interchange project was originally a portion of the proposed New Mississippi River Bridge (NMRB) project and approved in the initial EIS documentation. Therefore, FHWA has determined that a re-evaluation of the NMRB EIS will be sufficient for environmental clearance. This effort is currently in progress and coordination with FHWA will be consistent throughout.

6.2.5 PSB Interchange Access Considerations

When access is modified for a facility, it is prudent to consider whether there are additional opportunities to improve access at that location. The PSB interchange has never been a full-access interchange. Its historical function provided access between Missouri and Illinois on I-55, I-64, and I-70. The East-West Gateway Council of Governments (the Metropolitan Planning Organization for the Bi-State Area) has not identified a need to change this function. Regional traffic uses I-270 and I-170 as connections between I-55, I-44, I-64, and I-70. Local traffic is well-served by arterial streets in the City of St. Louis.

However, the project team did investigate the potential for incorporating additional access in conjunction with the PSB Interchange ramp modifications. Upgrading the PSB Interchange to provide full access would require the construction of four additional ramps. Alternative alignments for these facilities are shown in **Exhibit 6.4**:

- Ramp E: NB I-55 to WB I-64
- Ramp F: EB I-70 to WB I-64
- Ramp G: EB I-64 to SB I-55
- Ramp H: EB I-64 to WB I-70

A second alternative for Ramp E is shown in green, however, that alignment would conflict with existing Ramp A (also highlighted in red). The yellow shading in Exhibit 2.2 indicates the existing ramps that would need to be removed to construct Ramps E, F, G, and H.

There are numerous design constraints in place that make it very difficult to provide a practical solution for building these direct connections that are not currently in place between I-64, I-55 and I-70 at the Poplar Street Bridge interchange. The demand for these movements and feasibility of providing these movements is summarized below.

MoDOT feels it is not feasible to add additional movements to the PSB Interchange connecting I-64 to I-70 to or I-55. This is due to: impacts to historic properties, construction costs, and multiple design constraints at the existing interchange that may impair interchange function.

6.2.6 Demand for Full-Access Ramps

A full-access interchange at the west end of the PSB is not a necessity. Regional and local drivers have been completing their trips without these direct connections for over forty years. The East-West Gateway Council of Governments (EWGCOG) does not have these movements listed as a need within the long-range Regional Transportation Improvement Plan (TIP) nor the short-range Statewide Transportation Improvement Program (STIP). However, EWGCOG does recognize the need to reconstruct the structurally deficient bridge ramps from I-55 and I-70 to the Poplar Street Bridge.

The latent demand for Ramps E through H is served regionally by Interstates 270 and 170 and locally by St. Louis City's arterial network. **Exhibit 6.3** shows how the region's four interstates are interconnected by I-270 and I-170 and how there are interstate to interstate connections provided for any destination from a regional stand point. For example, a motorist destined for Forest Park from NB I-55 at I-255 would travel NB I-255/270 to EB I-64.

Adding a connection between I-55 and I-64 would be a higher need than between I-70 and I-64, since I-64 runs parallel to I-70 and they intersect in St. Charles County forty miles west of downtown. Currently I-44 and I-55 are only connected to I-64 via freeway to freeway movements at I-270. However, providing that freeway to freeway connection at the riverfront would likely require many motorists to drive out of their way to reach their destinations. For these reasons, MoDOT does not recommend providing these movements until the alternate routes become undesirable to the public and would pursue an alternate location to provide these movements, such as a southern extension of I-170.

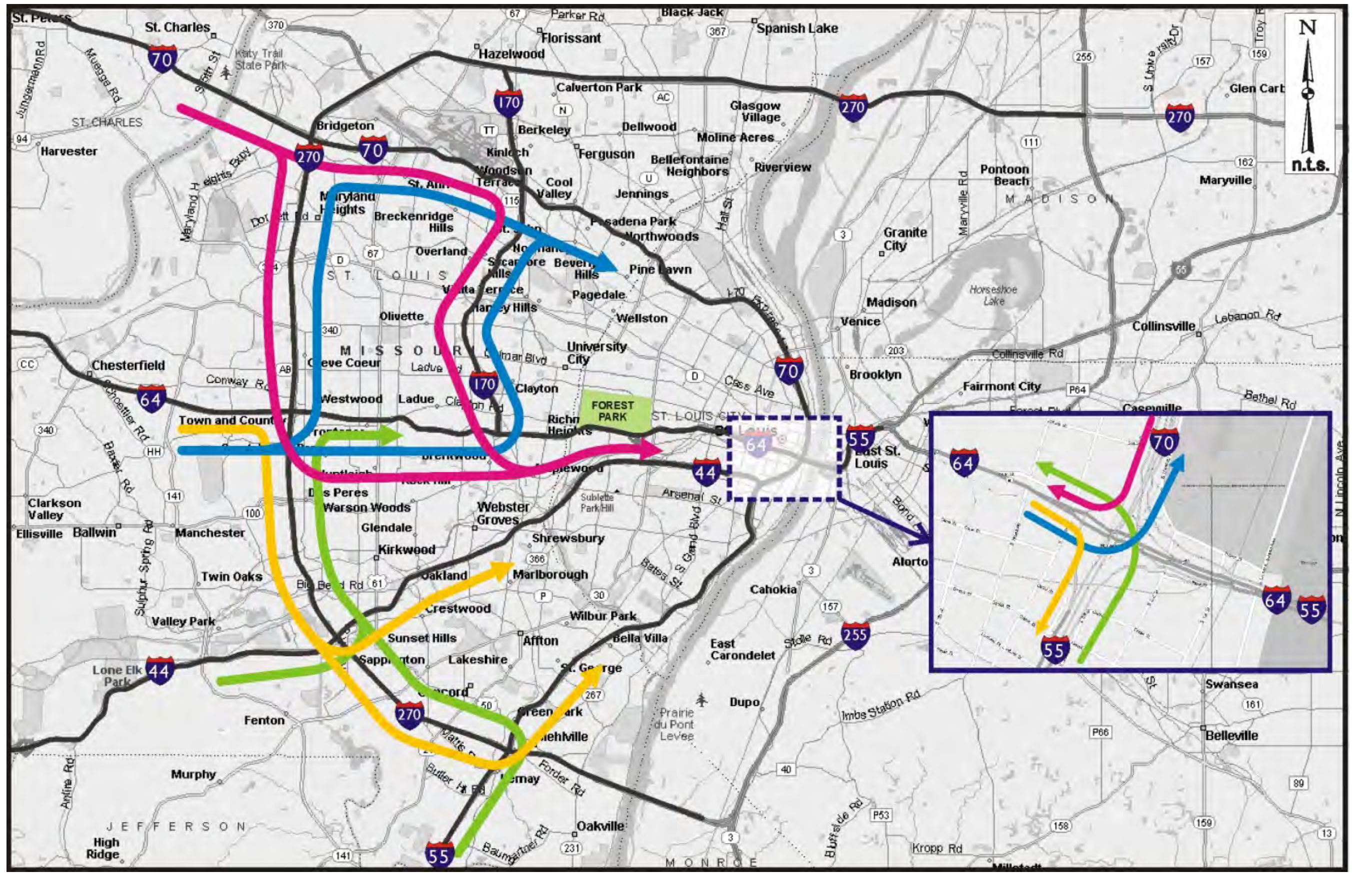


Exhibit 6.3: Regional Interstate Connectivity

Figure2_AJR_PSB_RampsEFGH_J6I2377B_i250.dgn 1:04:20 PM 12/16/2011

Exhibit 6.4: Poplar Street Bridge Interchange Full-Access Ramp Requirements

The local demand for the missing movements is also currently serviced well by the existing road network. The local connections within St. Louis City utilize the downtown arterial grid, as displayed in Exhibits 3.3 through 3.6.

Exhibit 6.5 shows the two examples of alternate routes for Ramp E, utilizing the Truman Parkway exit from NB I-55 and the 7th and Park exit from NB I-55/I-44. From both of these exits travelers can access the south, west, and central parts of downtown St. Louis. In addition, these motorists can also currently exit at NB Memorial Drive within the St. Louis CBD.

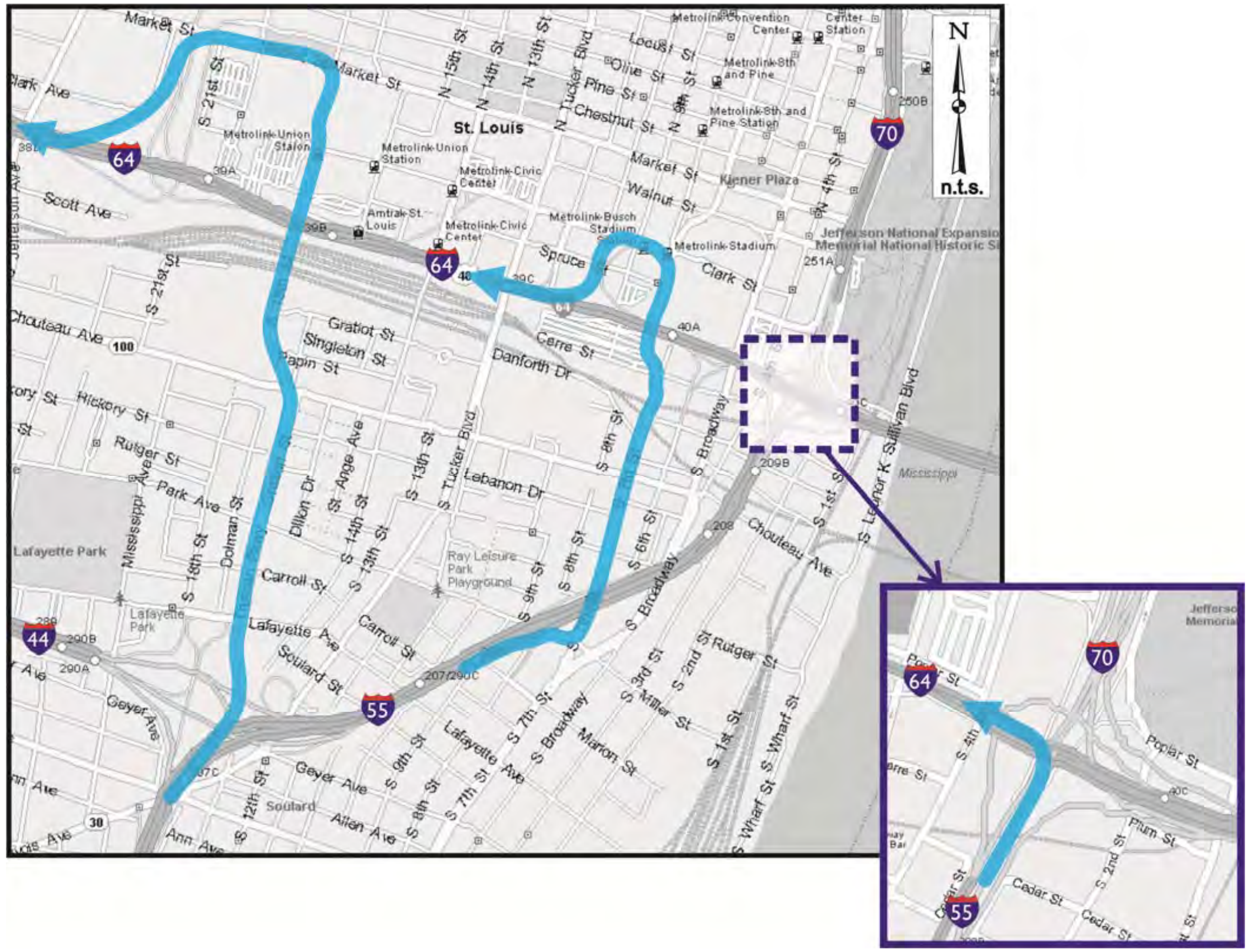
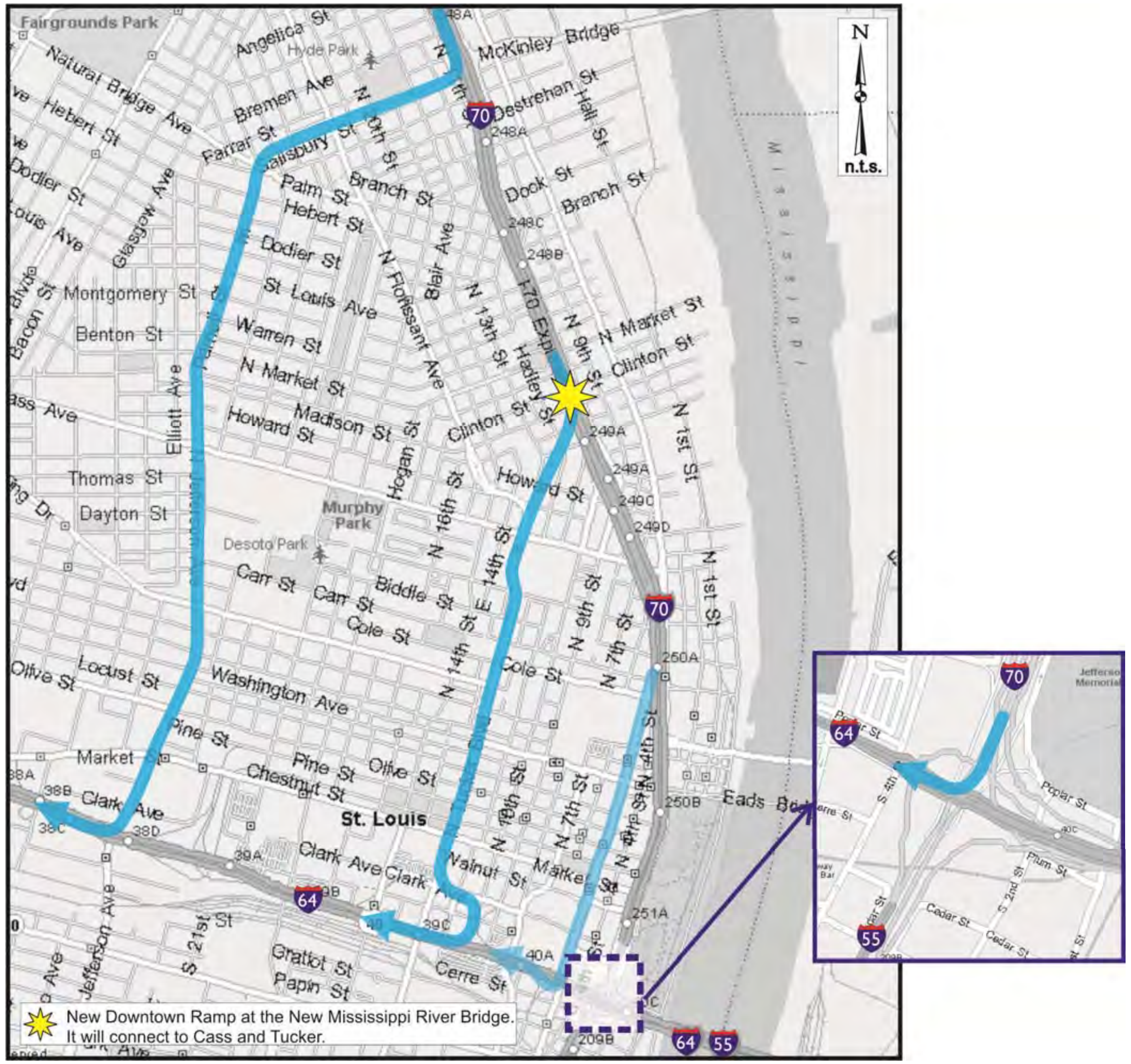


Exhibit 6.5: Local Arterial Alternatives for Ramp E

Exhibit 6.6 shows two alternate routes for Ramp F. As part of the City Arch River | 2015 project (discussed in Section 5.5.2 of this document), a new ramp connection will be constructed between EB I-70 and Tucker Avenue, a major downtown north-south arterial. This connection is expected to serve as the main access point from EB I-70 to the St. Louis CBD. In addition, travelers will still be able to utilize the Salisbury exit (as shown in blue) and the 7th Street exit south of the CBD (shown in Exhibit 3.4).



New Downtown Ramp at the New Mississippi River Bridge. It will connect to Cass and Tucker.

Exhibit 6.6: Local Arterial Alternatives for Ramp F

Exhibit 6.7 shows two alternate routes for Ramp G. EB I-64 drivers are able to utilize the 14th Street and 6th Street exits. In addition there is an EB I-64 exit at 11th Street (shown in Exhibit 3.7); although that exit leads north into the St. Louis CBD, motorists can easily turn south again within the arterial grid.

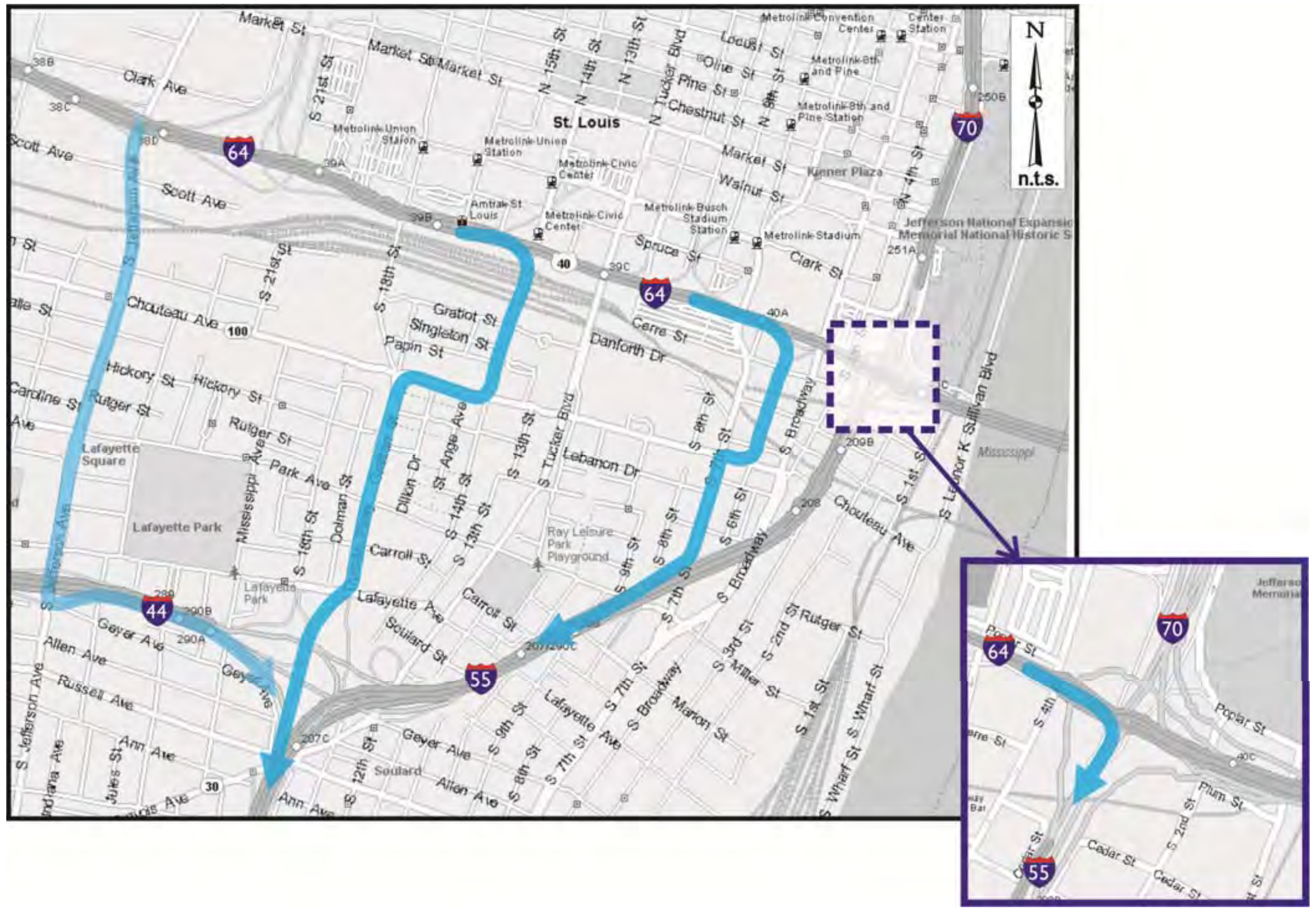
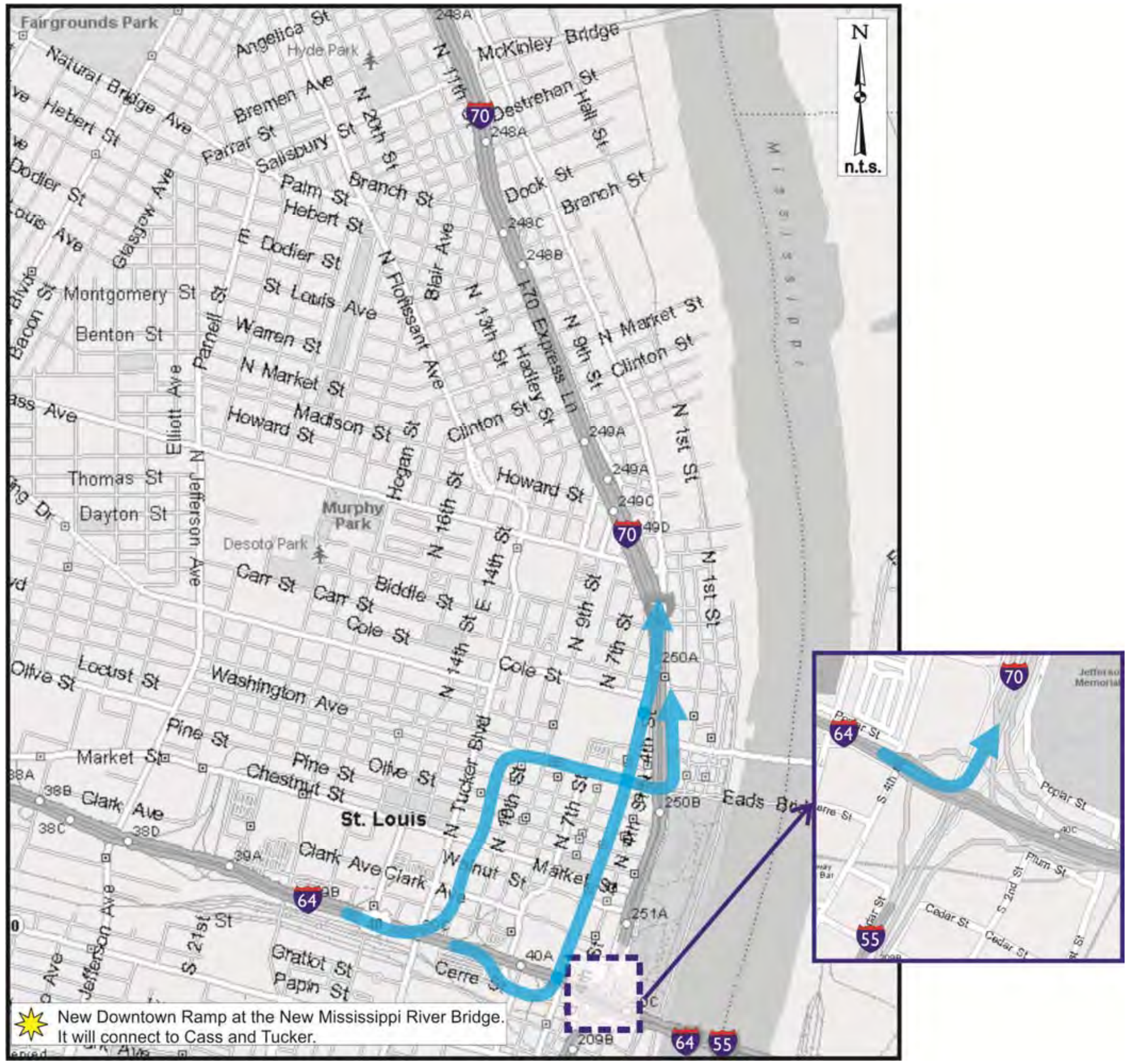


Exhibit 6.7: Local Arterial Alternatives for Ramp G

Exhibit 6.8 shows two alternate routes for Ramp H utilizing the 11th Street and 6th Street exits. Motorists additionally have options to utilize exits further west at 14th Street and 21st Street.



New Downtown Ramp at the New Mississippi River Bridge. It will connect to Cass and Tucker.

Exhibit 6.8: Local Arterial Alternatives for Ramp H

6.2.7 Design Constraints for Full-Access Ramps

Incorporating four additional ramps in the PSB Interchange would be incredibly challenging due to the dense development in the vicinity. Not only are there a number of roadway facilities, but the majority of them are elevated on structure. In addition, right-of-way is minimal due to adjacent urban development. This environment would establish multiple design constraints. These constraints would ultimately result in the closure of the WB I-64 exit to 9th Street to construct Ramps E and F and the closure of the SB I-55 exit to 7th Street to construct Ramp G. Both exits are vital to providing direct access to Downtown St. Louis.

6.2.7.1 Design Constraints: Ramp E and Ramp F Entrances to Westbound I-64

I-64 between 4th Street and 14th Street is a double-deck bridge structure, with two lanes of WB traffic on the upper deck and two lanes of EB traffic on the lower deck. In this segment, WB I-64 incorporates an exit to 9th Street, and an entrance from 10th Street, as shown in Exhibit 3.2. These ramp connections are approximately 1400 feet apart.

As can be seen in **Photo 6.1** and **Exhibit 6.9**, I-64 between 8th Street and Broadway is adjacent to Busch Stadium. Ramps E and F would enter WB I-64 within this two-lane segment. For proper lane balance, there would need to be at least three westbound lanes maintained beyond the merge point. Widening of this double-deck structure could incur a cost of approximately $13.8 million.

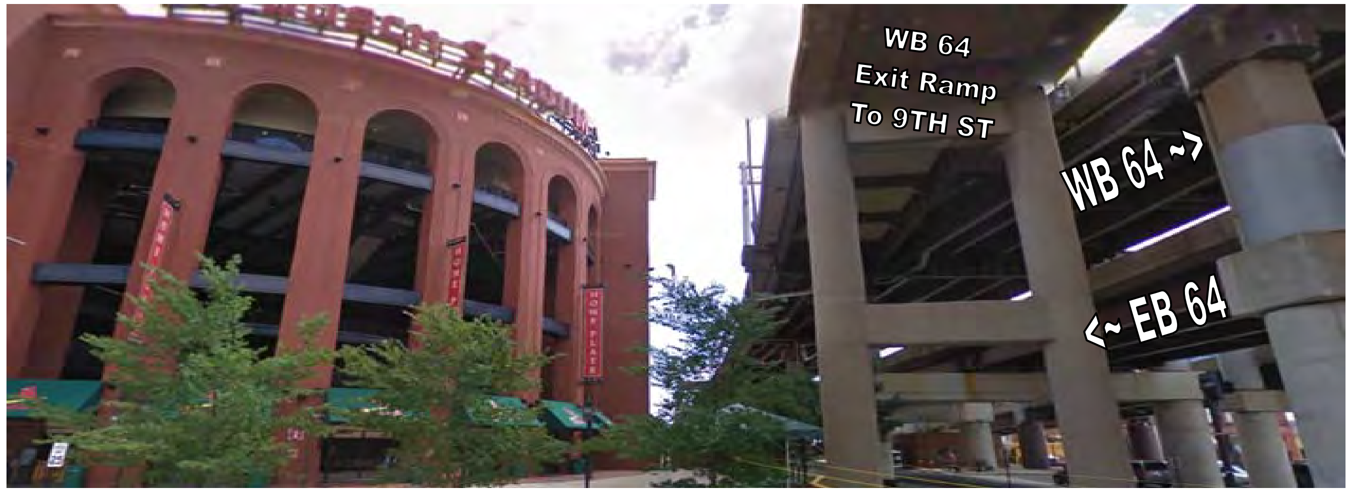


Photo 6.1: I-64 west of the PSB Interchange

In addition, there is not enough distance between the potential entry point and the existing exit to 9th Street to provide adequate weaving length. There would only be approximately 600 feet of weaving length, far below the required minimum ramp spacing of 2000 feet. Relocating the existing exit to increase the weaving length would not be a practical option since at most the length would increase by a few hundred feet, due to the existing entrance ramp at 10th Street.

Removing the existing exit ramp to provide room for either Ramp E or F would eliminate a major access point from WB I-64 to downtown St. Louis. The 9th Street ramp carries an ADT of 2275 and provides access to the south-central portion of the CBD. The 9th Street exit is centrally located between the first westbound I-64 Missouri exit to Memorial Drive and the next exit at 21st//Market Street, 1.4 miles away. Therefore, removal of the 9th Street exit could also be detrimental to the level of service (LOS) of Memorial Drive.

Exhibit 6.9: Detail of I-64 from Exhibit 6.1

6.2.7.2 Design Constraints: Ramp E Exit from NB I-55

There are also design constraints for constructing another exit from NB I-55 for Ramp E. Two options were considered for this connection. The first option would be to create a shared exit with the existing NB I-55 Ramp to the EB PSB, as shown by the red arrow in **Photo 6.2**. However, this type of exit is not feasible because there would not be sufficient distance to develop an acceptable grades or clearances over both I-55 and I-64 (or between I-55 and I-64) from this point. Also, this option has limited locations for placing the bridge bents on this ramp. This option is also represented by the dashed green line in Exhibits 6.1 and 6.7.

Photo 6.2: NB I-55 Exit Location for Ramp E (Option 1)

Incorporating a separate exit ramp for this movement would require it to begin approximately 1000 south of the existing exit ramp to the EB PSB; as marked by the red arrow in **Photo 6.3**. The ramp would then need to be threaded between the trestles on the Union Pacific Railroad bridge, **Photo 6.4**. Ultimately Ramp E would require complete acquisition of several properties just north of the UPRR bridge as well as damages to St. Mary of Victories Church on South 3rd Street, **Photo 6.5**, which is on both the National Register of Historic Places and the St. Louis City Landmarks Registry. In addition, there would only be 1400 feet of weaving length between the Marion/8th Street entrance ramp to NB I-55 and the Ramp E exit, again below the required minimum of 2000 feet.

Photo 6.3: NB I-55 Exit Location for Ramp E (Option 2)

Photo 6.4: Union Pacific Railroad bridge over I-55

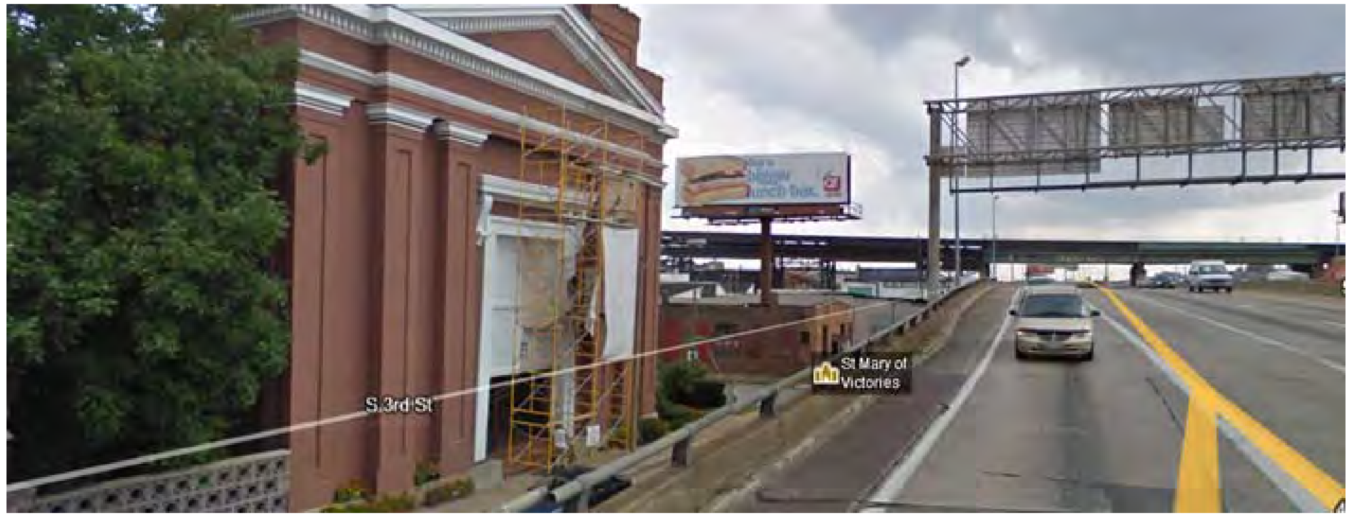


Photo 6.5: St. Mary of Victories Church adjacent to North I-55

6.2.7.3 Design Constraints: Ramp G and Ramp H Exit from EB I-64

As also shown in Exhibits 3.2 and 3.2A, Existing Ramp 7 (6th Street exit) and Ramp 8 (6th Street entrance) are located in the segment of EB I-64 just west of the PSB Interchange. Accommodating full-access ramps would require a connection for Ramps G and H between these two existing ramps that would split into two ramps downstream. Using the minimum required spacing between exit ramps, from Exhibit 10-68 of AASHTO's "Green Book", the new ramp would need to be spaced a minimum of 1000 feet from Ramp 7, as marked by the red arrow in Photo 6.6. This would result in a gore location only 250 feet from Ramp 8, and less than the 500 feet required between an exit and entrance ramp. Additionally, this short distance would require a grade approaching 13 percent to provide a minimum clearance of 14'-0" over existing Ramp 8, exceeding the allowable maximum grade of 7 percent for an interstate ramp. Going under Ramp 8 is not feasible either because there would not be enough clearance over Broadway, which runs beneath that ramp. The addition of a deceleration lane for this exit would also require reconstruction of the bridge bents on the double deck structure. Therefore, constructing an exit between existing Ramp 7 and Ramp 8 does not appear to be feasible.

Photo 6.6: EB I-64 Exit Location for Ramps G & H (Option #1)

Another option for a Ramp G/H exit would be to split the new ramp off from existing Ramp 7 at the location shown by the red arrow in Photo 6.7. Existing Ramp 7 departs from the bottom portion of a double-deck structure and is overlapped by an entrance ramp from Broadway to WB I-64 which connects to the upper deck, Photo 6.8. However, because of the existing bridge columns and the Broadway ramp, the new ramp would not be able to taper off on the tangent section of the ramp, which would be preferred, but would have to split off along a curve in full super-elevation.

Photo 6.7: EB I-64 Exit Location for Ramps G & H (Option #2)

From that point of departure, a grade of approximately 15 percent would be necessary to provide enough clearance over Ramp 8. Going under the entrance ramp would require a grade of 10 percent to clear Broadway and would require lowering this four-lane city arterial, negatively impacting the Eugene Field House & St. Louis Toy Museum at the northeast corner of Broadway and Cerre Street, Photo 6.9. This building is on the National Register of Historic Places and is a City of St. Louis Landmark.

Photo 6.8: Facing West from Broadway toward Ramp 7 & Ramp 8

Photo 6.9: Eugene Field House at Northeast corner of Broadway & Cerre Street

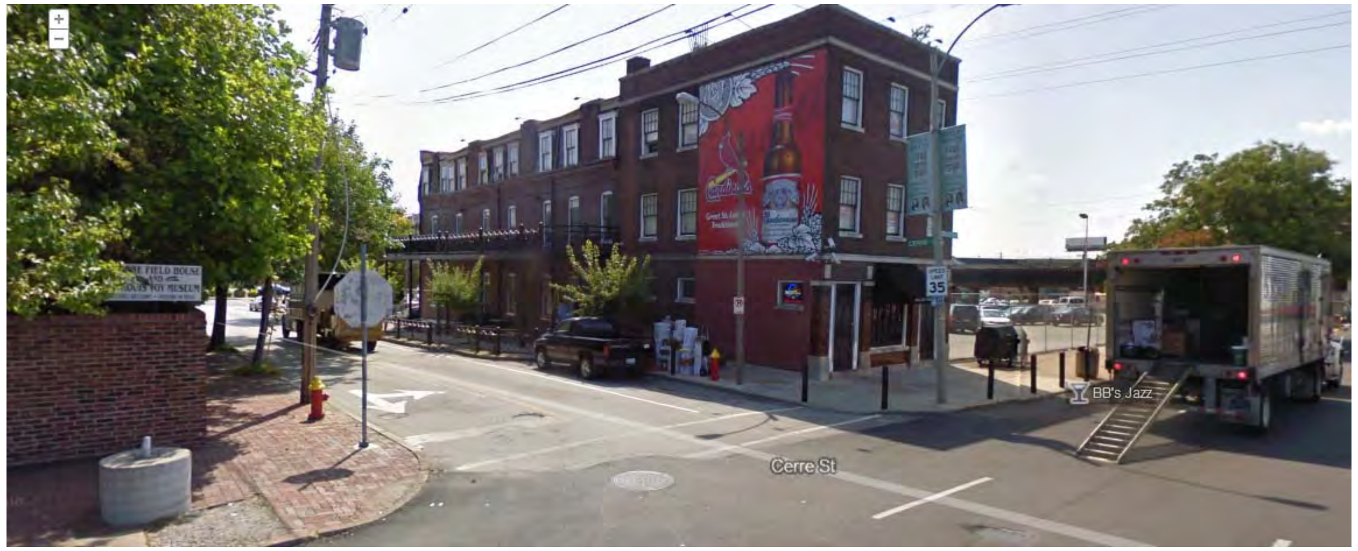


Photo 6.10: Location of Ramps G and H Facing East from Broadway & Cerre Street Intersection

Photo 6.9 and **Photo 6.10** show two views of the intersection of Broadway and Cerre Street. Photo 3.9 is on Broadway facing north with Eugene Field House on the right. I-64's double-deck structure can be seen in the distance to the left. Photo 3.10 is on Broadway facing southeast with Eugene Field House on the left. Proposed Ramp G and H would fly over this intersection and require Cerre Street and the business in the photo to be removed.

6.2.7.4 Design Constraints: Ramp G Entrance to SB I-55

Ramps H and G would diverge east of the overpass of the Broadway and Cerre intersection. Ramp G would remain elevated to pass over 4th Street. However, just south of 4th Street, a downhill grade exceeding 18 percent would be needed to take Ramp G under the Terminal Railroad Association (TRRA) bridge, shown in **Photo 6.11** below. Due to this excessive grade, going under this railroad bridge is not feasible.

Photo 6.11: TRRA Bridge over Ramp D onto Southbound I-55

An elevated section of I-55 begins just south of the TRRA railroad bridge. This viaduct structure originates near Gratiot Street and extends for approximately 0.60 miles. Building Ramp G over the TRRA Bridge would result in a lengthy transition in order to tie back into I-55, and would also require widening of the I-55 viaduct structure. Assuming a 6 percent grade, the point at which Ramp G approaches the grade of SB I-55 is near the Union Pacific railroad (UPRR) bridge, shown in **Photo 6.12**. Ramp G would then have to run parallel to SB I-55 beneath the UPRR bridge in order to clear the supports for this structure. Ramp G would enter SB I-55 somewhere between this bridge and the existing 7th Street exit.

There is less than 300 feet between the UPRR bridge and the beginning of the deceleration lane on SB I-55 for the 7th Street exit. Constructing Ramp G would require removal of this exit ramp in order to provide sufficient room to tie back into SB I-55. The 7th Street exit carries an ADT of 6900 vehicles and provides vital access to the southern portion of the St. Louis CBD and an industrial/trucking corridor to the south. The removal of the 7th Street ramp would increase the exit spacing on EB I-70/SB I-55 to approximately five miles and neglect to the meet the City's needs for access.

Photo 6.12: SB I-55 at Union Pacific Railroad Bridge

6.2.7.5 Design Constraints: Ramp H Entrance to WB I-70

Downstream of its divergence with Ramp G, Ramp H would need to cross the following facilities (in order) before tying into NB I-70:

- Existing Ramp D
- SB and NB I-55
- EB and WB I-64 (in roughly the same location that Ramp E would cross)
- Existing Ramp D again (at this point elevated over existing Ramp B)
- Existing Ramp C.

I-64 is approximately 40 feet above I-55 near the point where Ramp E crosses both interstates. Ramp H would need to also clear Ramp E, which would place Ramp H about 82 feet above I-55. This would require a lengthy transition of approximately 1500 feet in order to tie back into I-70. In addition, there would be very few feasible locations for placing bridge bents along this ramp, due to the multitude of interstate and ramp structures in this area.

Ramp H would join existing WB I-70 near the beginning of a two-lane depressed section, where there are retaining walls between I-70 and adjacent NB Memorial Drive. Adding this movement while also keeping the movement from existing Ramp C, would require reconstruction of these retaining walls, which are 28 feet high. Also, Memorial Drive would need to be relocated to the east, impacting the Jefferson National Expansion Memorial ("St. Louis Arch") grounds.

6.2.8 Sensitivity Analysis

During FHWA‟s review of the pre-AJR briefing memos (when the PSB Interchange and CAR 2015 projects were proceeding with a combined AJR), FHWA noted that the CAR 2015 and PSB Ramp Modification projects might adversely impact existing river bridge crossings, City Streets and other highway infrastructure. This section represents a series of more detailed analyses that respond to the issues raised by FHWA. *Please note that this Section 6.3.5 was first presented in the CAR 2015 Final AJR document, and is repeated here for the reader's convenience.*

6.2.8.1 Findings

Trip behaviors, anticipated to change in response to the roadway network modifications proposed through the CAR 2015, PSB, and NMRB projects, were studied in numerous combinations with a particular focus on trip origins and destinations. For example, trips to and from Illinois were analyzed in 2015 when the NMRB is scheduled to open. Once built, the new bridge and interstate alignment are anticipated to divert traffic from existing river crossings. Furthermore, trips between downtown St. Louis and all cardinal directions were studied to predict changes in travel behaviors and the resulting traffic impacts to alternative routes. The major changes in trip behaviors are summarized below and described in greater detail on the following pages.

The improvements proposed as part of the CAR 2015 and PSB projects would not negatively impact City Streets, existing river crossings or highway infrastructure. Regional travellers would still have route options for traveling between Missouri and Illinois.

6.2.8.2 Origins, Destinations, and Trip Change Behaviors

FHWA noted that the PSB and CAR 2015 projects might adversely impact Illinois traffic or increase traffic on the existing river bridge crossings. This section addresses this issue and demonstrates that origins and destinations and related shifts in travel patterns have been studied and evaluated, and there are no shifts which would create impacts in Illinois beyond the existing travel patterns and volumes.

6.2.8.3 Impacts due to the NMRB

The NMRB and resulting realignment of I-70 will shift the greatest number of trips into and around St. Louis, many more than would shift as a result of the CAR 2015 or PSB projects. When complete, the NMRB will provide an additional crossing alternative that will free up capacity on the PSB and the MLK Bridge. It will ultimately reroute a considerable portion of regional east/west traffic from the existing crossings and the depressed section of I-70 to the new alignment, reducing overall highway traffic through downtown St. Louis. When NMRB Phase I is complete, regional east/west trips between Illinois and Missouri will shift north from the PSB and MLK Bridge. This shift will have the greatest impact on the interstate infrastructure east of the Mississippi.

- MLK Bridge: 50% of east/west traffic (1,195 am, 1,600 pm) will shift to the MRB,
- PSB: 10% of east/west traffic (1,053 am, 1,078 pm) would shift to the MRB,
- Eads Bridge: No anticipated change in demand since the Eads serves mainly local trips

Relocating I-70 across the New MRB will actually reduce its path by approximately 2 miles. However there is concern that local traffic using EB I-70 from St. Louis to East St. Louis or Sauget Illinois will have less direct route.

Currently, EB 70 after crossing the PSB has exits to IL-3 at 8th Street in Sauget and 4th Street at Broadway in East St. Louis. The relocated EB I-70 still has access to Sauget and East St. Louis. It will have an exit to IL-3 near Packers Ave on the north side of East Louis, 2.5 miles from Exit to IL-3 and 1.8 miles from Exit to 4th Street. Below is a list of paths:

To Sauget from EB I-70 near Cass Ave

Via NMRB - 5 miles

Via PSB (Ramp B) - 2.74 miles

Via Eads – 3.39 miles

Via MLK – 6.34 miles

To East St. Louis Business District from EB I-70 near Cass Ave

Via NMRB – 4.1 miles

Via PSB (Ramp B) – 3.58 miles

Via EADS – 2.43 miles

Via MLK – 5.22 miles

6.2.8.4 From the North and West to Downtown

The primary change for trips on this route involves the CAR 2015 project which will modify the current off-ramp from I-70 eastbound to Memorial Drive southbound to an on- ramp from Washington Avenue to I-44 westbound. The vehicles currently using this exit would divert 50/50 (258 am, 30 pm) to the existing local and express Broadway exits, located to the north of downtown near Cass Avenue. The CAR 2015 project will also construct a new ramp at Tucker Boulevard. This ramp will serve as a replacement to the 10th Street off ramp, which was removed as part of NMRB Phase I. Neither of these access changes will affect river crossings or travellers to/from Illinois.

6.2.8.5 From the South and East to Downtown

When Memorial Drive closes between Walnut and Pine Streets as a result of the extension of the Arch Grounds over I-70, the following changes in trip behaviours are expected:

- 40% of vehicles (752 am, 186 pm) currently accessing downtown via Memorial Drive northbound would shift to the new off-ramp from the depressed section of the interstate to Washington Avenue.
- 100% of vehicles (650 am, 205 pm) that currently use Market Street to enter downtown from Memorial would use Walnut Street which would remain open in the CAR 2015 build scenario
- 15% of vehicles (116 am, 17 pm) that currently use Pine Street to enter downtown from Memorial would shift to the new Washington Avenue off-ramp
- 25% of vehicles (205 am, 151 pm) that currently access downtown via the PSB westbound to Memorial would shift to the MRB westbound and enter downtown from the north

Frequent users of I-70 often divert to the MLK Bridge as a bypass to the PSB when travelling between Illinois and Missouri, especially when traffic is heavy on the PSB. This behaviour is likely to decrease due to reduced traffic volume on the PSB and increased opportunities for crossing the Mississippi.

Vehicles currently using the PSB, Eads and MLK bridges will continue to have the same choices and opportunities to cross the Mississippi River.

6.2.8.6 From Downtown to the North and West

An extension of North 3rd Street would connect Memorial Drive northbound by the northwest corner of the Arch Grounds to the existing segment of North 3rd by Lumière Place. This would provide an opportunity for vehicles to get from downtown to I-70 westbound. 45% of vehicles (101 am, 466 pm) currently using the existing Memorial Drive northbound on-ramp to I-70 would shift to this new North 3rd Street extension, while the remaining vehicles (124 am, 569 pm) would access the interstate via the existing Biddle Street on-ramp.

6.2.8.7 From Downtown to the South and East

With the removal of the ramp from I-70 eastbound/Memorial Drive southbound to the PSB eastbound and construction of the MLK Connector, 100 percent of the vehicles originating from I-70 (10 am, 375 pm) and 100 percent of the vehicles originating from Memorial (135 am, 385 pm) would shift to the MLK Bridge.

Overall, the proposed traffic shifts, street closures, and ramp modifications detailed herein would not have significant spillover effects onto other projects and would be absorbed by the existing and future street network.

6.3 Conformance with Transportation Plans

The proposed PSB Interchange modifications do not fall within any recent corridor studies or plans. However, the project location is within both a Transportation Management Area (TMA) and a non-attainment area. The City of St. Louis has a population of over 300,000 and is, therefore, considered a Transportation Management Area (TMA) as designated by the Secretary of Transportation. The St. Louis region is also currently designated as a non-attainment area for the eight-hour standard for ozone pollution levels. The new eight-hour designation came in April 2004, just months after the region was declared to be in attainment of the one-hour standard.

Planning for PSB Interchange improvements formally began with the planning for the New Mississippi River Bridge (NMRB, Section 2.1.4.1). This project initially received a Record of Decision (ROD), Final Environmental Impact Statement (FEIS) Approval and Design Approval in 2001. The preferred alternative included alterations to the ramps at the west side of the existing PSB (referred to as the Missouri South Interchange) among other downtown St. Louis interstate access improvements. In 2004, it was determined that funding for the entire project could not be secured to satisfy the Financial Plan requirements for a Major Project. In May 2005, Illinois and Missouri initiated numerous efforts to reduce the cost of the project, including delayed phasing of the PSB ramp modifications.

Although not constructed with the NMRB, the PSB Interchange project has been part of the plan for downtown St. Louis network since plans for that facility began. The PSB Modifications were in the EWGCOG Transportation Improvement Program (TIP) as Bridge Improvements to 21st St. to Poplar St. Bridge under project #4414K-12-02, and are in the MoDOT Statewide Transportation Improvement Program (STIP) as Rehab and Reconstruction under project #6I2020 and #6I1996. All plans included in the STIP were also addressed in the MoDOT Long Range Transportation Plan (LRTP).

When planning for the City+Arch+River | Project began in 2010, MoDOT saw an opportunity for concurrent design and reconstruction of the PSB Interchange. Performing these projects simultaneously would allow both design teams to integrate their projects, would minimize any impacts to the new Arch project by later PSB Interchange construction, and would spare the public multiple construction periods.

Due to the regional significance of the PSB and its approaches, MoDOT and the IDOT cooperated to investigate design alternatives for the PSB Interchange, with the knowledge that the preferred design associated with the NMRB project was not practical. The bi-state effort concluded that the existing and projected traffic warranted dual-lanes to and from I-55 south of the PSB (existing Ramps A and D). In addition, constructing these ramps to meet design standards and improve safety within the interchange would require removal of Ramp B (eastbound I-70 to eastbound PSB). A preferred alternative was defined in a Draft PSB Interchange AJR document dated July, 2012.

Concerns expressed by local stakeholders regarding the impacts to Illinois drivers led to the removal of the project from the TIP. Subsequently, the local MPO (EWGCOG) engaged a local consultant to perform an independent review of MoDOT's plans for the PSB Interchange. This review recommended "a program of phased improvements that would ultimately have a substantial, positive regional impact on commute traffic."[8] Upon review of EWGCOG's recommendations, Illinois and Missouri agreed to jointly implement the recommended course of action. MoDOT and IDOT currently have a draft agreement to construct Phase I and II of this project; the agreement is expected to be complete by summer, 2013. With the MPO and State DOT approvals and agreements, the project was restored to the TIP.

The portion of the PSB Interchange project to construct the WB ramps from the PSB is currently in both the TIP and the STIP as project #6I2377B. However, the funding for that project is expected to change with the project amendment in March, 2013. With that amendment, project #6I2377C will be added to include construction of the PSB widening, the EB Ramp connections, and the 6th Street Extension.

7 Funding and Schedule

This section should identify the projected funding sources (including any private sources or toll revenues) needed to implement the improvements proposed. The project schedules should also be discussed (anticipated ROW acquisition, construction, etc.).

7.1 Project Funding

The PSB Interchange project Phase I (the interchange ramp connections) will be completely funded by MoDOT. The PSB widening (Phase II) will be jointly funded MoDOT and IDOT. Funding is already in place for design and construction. The MLK Connector, proposed to restore connectivity changes in the existing PSB Interchange, will be independently studied, designed, and constructed by IDOT.

7.2 Project Schedule

MoDOT recently selected a design consultant for Phases I and II of the PSB Interchange project (the interchange ramp connections and bridge widening, respectively). Because no right-of-way acquisition is required, the project will go to contractor bid as soon as the design process allows. However, MoDOT will not close or remove any ramps at the PSB Interchange until the NMRB project is opened to traffic. MoDOT's intent is to complete construction of the WB ramp connections by October, 2015 to coincide with the grand opening of the CAR 2015 improvements. Construction of the EB ramp connections may be timed to coordinate with Phase II construction. It is anticipated that Phase II will be programmed for a February 2016 award.

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[8] *Poplar Street Bridge: Independent Review*, East-West Gateway Council of Governments; September 12, 2012

8 Summary and Recommendations

This AJR seeks FHWA approval for Interstate highway ramp modifications proposed by MoDOT to improve operations and safety at the PSB Interchange located at the west end of the Poplar Street Bridge (PSB) in St. Louis, Missouri. The existing ramps are structurally deficient and, due to escalating maintenance costs, the best course of action is replacement. MoDOT aims to utilize this reconstruction opportunity to redesign the interchange; optimizing the existing right-of-way and connections to improve the capacity and safety of the interchange to serve existing and future travel demands.

Specifically, MoDOT requests approval to:

- Widen the two ramps serving I-55 from one lane to two-lanes (existing Ramps A and D)
- Adjust the connection of the WB PSB ramp to future I-44 (existing I-70); relocating the gore from the PSB to existing Ramp C
- Remove and not replace the existing EB I-70 (future SB I-44) to EB PSB ramp (Existing Ramp B), with IDOT's construction of the MLK Connector from EB MLK to WB I-64 in Illinois
- Widen the EB (south) side of the PSB to add one lane between the existing 6th Street entrance ramp (currently a merge situation) and the existing IL 3 ramp (currently an add-lane)
- Future Phase – Add capacity enhancements to EB I-64 by constructing a connector between the 6th Street exit (currently a drop lane) and the 6th Street entrance, creating a continuous third lane

These changes are supported by existing travel patterns and future changes to the network already being constructed. The I-55 ramps are currently serving demands over their capacity. The New Mississippi River Bridge (NMRB), currently under construction and scheduled to open in Spring 2014, will relocate I-70 from the PSB to the new facility and is expected to greatly diminish the demand for the ramp connections to and from the north (existing I-70, future I-44).

Although the elimination of Ramp B is less than desirable, it would allow MoDOT to increase the capacity of Ramps A and D, improve safety, and minimize design exceptions. After concerns over impacts to Illinois drivers of removing the existing Ramp B, the local MPO engaged a consultant to perform an independent review of MoDOT's proposed design for the PSB Interchange. Recommendations from this review resulted in a bi-state agreement with the MPO on a plan to implement MoDOT's preferred design which includes the construction of a new "MLK Connector" by IDOT to duplicate some of the direct connectivity of Ramp B.

MoDOT strongly feels that the preferred alternative will be the greatest benefit to taxpayers and the driving public. The preferred alternative will greatly improve the functionality of the interchange for many years to come.

8.1 Next Steps

MoDOT's effort moving forward is two-fold. The re-evaluation of the NMRB EIS for environmental clearance is in progress and will be completed in the near future. Concurrently, the design phase has begun and the project will move forward through design and construction.

Appendix A

Poplar Street Bridge: Independent Review

East West Gateway Council of Governments

September, 2012

Appendix B

MLK Connector Preliminary Access Justification Report for Concept Approval

AMEC Environment and Infrastructure, Inc.

May, 2013

Appendix C

Design Report

Appendix D

Proposed Signing Plan

Appendix E

Forecasted Peak Hour Volumes

Appendix F

Crash Data

Appendix G

Interstate Level of Service (LOS) Figures

Appendix A

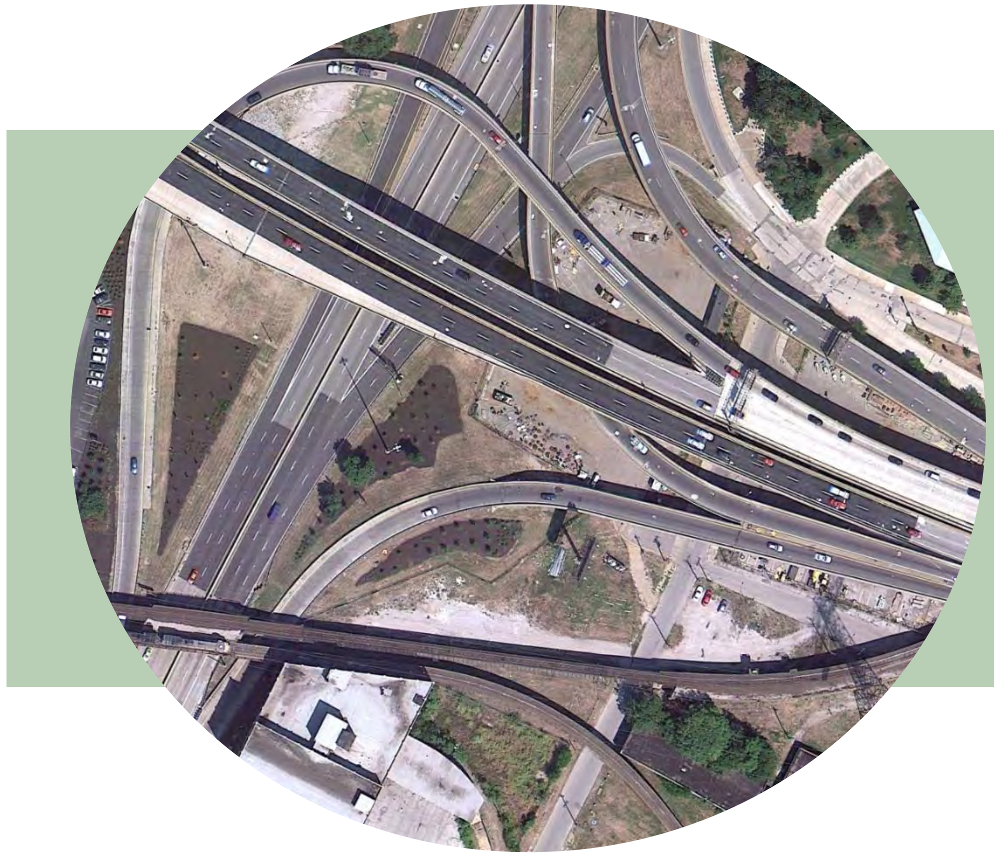
Poplar Street Bridge: Independent Review

East West Gateway Council of Governments

September, 2012

Poplar Street Bridge

Independent Review



Conducted for **East-West Gateway Council of Governments**

By **HDR Engineering, Inc.**

September 12, 2012

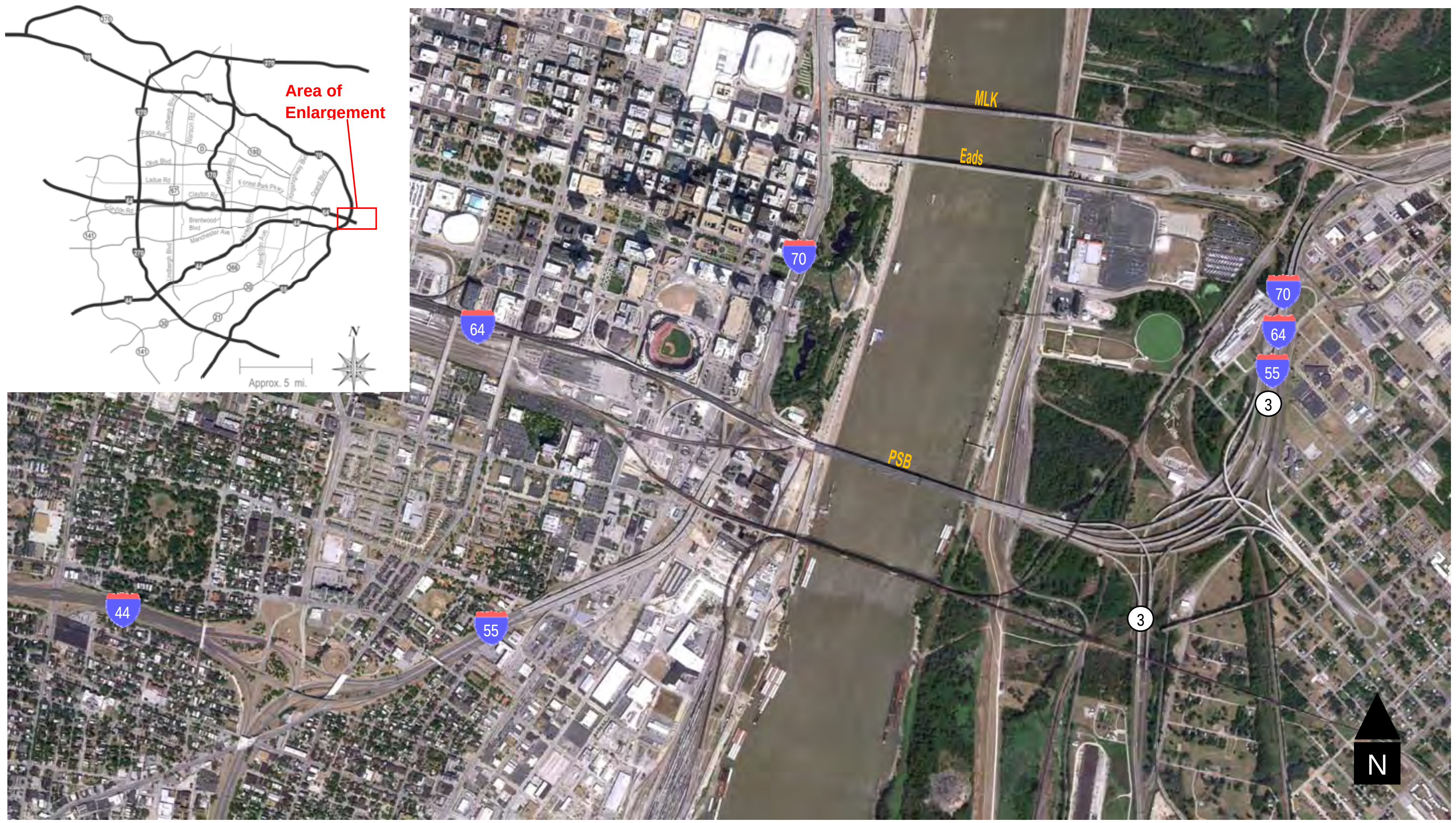
(note: designed to be printed on 11x17" paper using color ink)

Table of Contents

1. Introduction and Scope of Review

HDR Engineering and sub-consultant Civil Design Inc (this team is hereinafter referred to as "HDR") were contracted by East-West Gateway Council of Governments to provide an independent review of the Poplar Street Bridge ("PSB")/I-55/I-70 Interchange project (MoDOT Job# J6I2377B). **Figure 1-1** illustrates the study area.

Figure 1-1: PSB Study Area



The project is one of several projects associated with the larger Mississippi River Bridge project and, as currently scoped, involves: removal of the eastbound I-70 ramp, removal and replacement of the westbound I-70 ramp, removal and replacement of the Memorial Drive ramp, and removal of the northbound and southbound single lane I-55 ramps and replacement of those ramps with dual lane ramps.

HDR was asked, within the context of the overall Mississippi River Bridge project, to review the design options for the PSB/I-55/I-70 Interchange project under consideration by MoDOT and IDOT. Additionally, HDR was asked to assess possibilities for other design alternatives not considered by the state DOTs, develop recommendations on a preferred design alternative, prepare technical documentation of the review, develop a draft and final report, and present the findings to the Council's Board of Directors.

Background

In 1991, the Missouri Department of Transportation (MoDOT) and Illinois Department of Transportation (IDOT) initiated an Environmental Impact Statement (EIS) to examine issues related to traffic congestion and safety issues on the PSB. Some of the improvements the study identified included the construction of a new Mississippi River Bridge, relocation of I-70 off the PSB to the new bridge, then removal of the I-70 ramps and construction of dual northbound-to-eastbound I-55 ramps at the PSB. A Record of Decision (ROD) was issued in 2001, and was re-issued in 2008 after a re-evaluation of the ROD for the new Mississippi River Bridge (MRB) and its associated improvements.

Recent concerns over the removal of the southbound-to-eastbound ramp at the I-70/I-55/I-64 interchange (just west of the PSB) prompted MoDOT to consider alternative configurations of the interchange that would address traffic and safety issues related to the PSB, and still allow the ramp to remain. MoDOT, with the assistance of IDOT, considered several alternative concepts; however, each of the alternative concepts caused MoDOT concern with regards to traffic congestion, safety issues, or project budget. However, IDOT has continued concerns with the loss of access represented by the removal of the ramp. In order to resolve this conflict between access needs and operational concerns, EWGCOG commissioned this independent study.

This study was conducted against a background of three related documents:

- *Poplar Street Bridge Project, Draft Access Justification Report (July, 2012)*: The study that included alternatives to address the southbound-to-eastbound ramp, commented on by MoDOT. Referred to as the "PSB AJR" in this study.
- *Mississippi River Crossing, New I-70 Mississippi River Bridge Crossing – Initial Phase, Access Justification Report (January, 2009)*: This document examined the new crossing, and will be referred to as the "MRB AJR".
- *CityArchRiver 2015, Initial Draft Access Justification request for Concept Approval (March, 2012):* This document examined highway and roadway improvements in the vicinity of the Arch Grounds, and will be referred to as the "CAR AJR".

2. Previously Studied Alternatives

HDR was asked to evaluate six different alternatives that could preserve the southbound-to-eastbound movement at the PSB/I-55/I-70 interchange. **Figure 2-1** illustrates the six alternatives (as commented on by MoDOT), which have also been addressed as part of the PSB AJR. Five of these alternatives are at the interchange itself, while one is located further south on I-55.

The five interchange modification options have two features in common:

- Provision of a realigned two-lane westbound off-ramp just west of the PSB, splitting to a two-lane westbound-to-southbound direct-connector ramp (Ramp D) and a single-lane westbound-to-northbound direct-connector ramp (Ramp C, immediately widening to two lanes after the diverge). See **Figure 2-2** for ramp labeling convention.
- Provision of a two-lane northbound-to-eastbound ramp (Ramp A).

Design Criteria/Evaluation

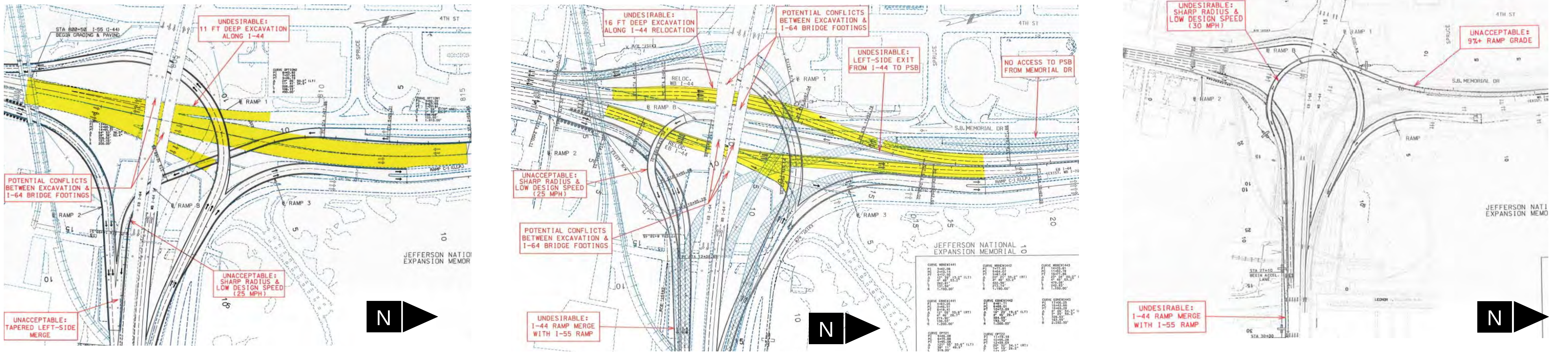
Table 2-1 summarizes the design criteria used by MoDOT to evaluate alternatives, and these are the criteria adopted for HDR's evaluation. MoDOT's review essentially consigned issues to one of three categories: Unacceptable (meaning an element did not meet standards), Undesirable (meaning an element might meet minimum standards but did not meet typical standards), and a third category containing issues that were worth noting.

The study team examined MoDOT's concerns with each of the options in light of the design criteria to verify concerns and begin to build an understanding from which to develop additional alternatives. **Table 2-2** summarizes MoDOT's concerns and the study team's response. The remainder of this chapter describes the review of each alternative.

Table 2-1: Design Criteria for Evaluation

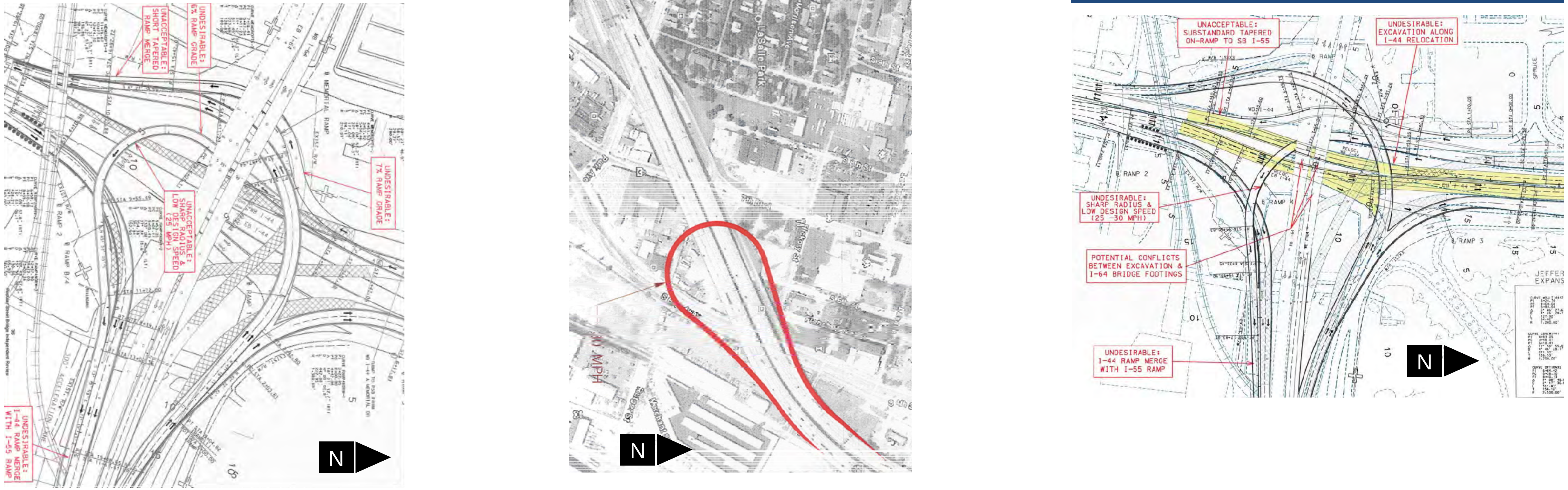
	Mainline	Ramps
Roadway Type		
Functional Classification	Interstate	-
Level of Service	C (D min)	C
Design Year	2035	2035
Design Speed (mph)	50	30
Access Control	Full	Full
Cross-Section		
Lane Widths (ft)	12	12
Paved Shoulders (ft)		
left	10' (6' for 4-lane)	4' (6' for 2-lane)
right	10'	8' (10' for 2-lane) (2' for directional)
Superelevation (max)	4%	6%
SE Transition Length (ft)	180	80 @ 6%
Geometrics		
Horizontal Curvature (min radius)	755	231' @ 30 mph
Grades (max)		
ascending	6%	5% (7% abs max)
descending	3% (4% abs max)	5% (7% abs max)
min for drainage	0.5%	0.5%
Minimum Stopping Sight Distance (ft)	395	200 @ 30 mph
Vertical Curves (min K)		
Crest	84	19 – 30 mph
Sag	96	37 – 30 mph
Minimum Vertical Clearance (ft)		
over Interstate and State Routes	16.5 *	16.5 *
over local roads	15.0 *	15.0 *
over Railroads	23.0	23.0
	* 14 ft (abs min)	* 14 ft (abs min)

Figure 2-1: MoDOT Concerns with Proposed PSB Options


Option 1: Ramp B under I-64 (right exit), inside merge

Option 2: Ramp B under I-64 (left exit), outside merge; I-44 realign

Option 3: Ramp B over I-64 (right exit), outside merge


Option 5: Ramp B under I-64 (right exit), outside merge; Memorial realign

7th Street U-Turn

Alternative 2A: Ramp B under I-64 (right exit), outside merge; I-44 slight realign; Memorial realign

Table 2-2: Review of MoDOT Concerns with Proposed PSB Options

	Issue	Response	Mitigation possible?	Standard	Ref
Option 1: Ramp B under I-64 (right exit), inside merge					
UA	Sharp radius & low design speed (25 mph)	Agree: R = 200'	Pier arrangement prohibits increasing radius	30 mph Design Speed: R=231' (6% super)	AASHTO Table 3-9
UA	Sub-Standard taper	Agree: L = 190'	None. Longer taper will result in widening of PSB structure.	800' (50:1)	AASHTO Fig 10-69
UA	Left-side merge (linked to taper)	Not clearly unacceptable per AASHTO. Considered to be undesirable.	Right-side merges are explored in other options.	Right-side merge	AASHTO Sec 10.9.6
UD	10-foot deep excavation along I-44	Agree. Required for I-44 to cross under Ramp 4, which crosses under Ramp 1	1) Ramp 4 over Ramp 1 results in unacceptable grades 2) Ramp 4 under ex. I-44 results in unacceptable 9+% grade	7% max, 25-30 mph; 6% max, 40 mph	AASHTO Sec 10.9.6
	Potential conflicts between excavation & I-64 bridge footings (Bent 8)	Agree. Excavations are unacceptably close to I-64 pier foundations.	None with this option. I-44 excavation is required for Ramp 4 to pass under Ramp 1 and over I-44 at the location shown.	N/A	N/A
Option 2: Ramp B under I-64 (left exit), outside merge; I-44 realign					
UA	Sharp radius & low design speed (25 mph)	Agree: R=150'	Increasing radius to 231' (30 mph) may fit between piers, but would substantially increase skew angle over Ramp 2 and require additional I-44 excavation	30 mph Design Speed: R=231' (6% super)	AASHTO Table 3-9
UD	Left-side exit from I-44 to PSB	Agree. Left-side ramps should be avoided.	None. This option explores a left-side exit of a realigned SB I-44.	Right-side exit	AASHTO Sec 10.9.6
UD	16-foot deep excavation along I-44	Agree. Caused by bringing I-44 vertical curve under TRRA bridge to current standards for 50 mph design speed	Design sag curve for comfort criteria, AASHTO eq 3-51; reduces excavation to about 9 ft; still undesirable	K=96; 50mph sag	AASHTO Table 3-36
UD	I-44 ramp merge with I-55 ramp	Agree. It is undesirable to merge a ramp into a directional interchange ramp movement.	None. Merge would have to occur on main span of PSB structure to avoid this situation	N/A	N/A
	No access to PSB from Memorial Drive	Agree. Memorial Drive is cut off from Ramp 4 due to the left lane exit of Ramp 4 from SB I-44.	None with this option. Not enough room for Memorial Drive traffic to weave across I-44 traffic and reach Ramp 4.	N/A	N/A
	Potential conflicts between excavation & I-64 bridge footings (SB thru)	Agree. Excavations are unacceptably close to I-64 pier foundations.	None with this option. Substantial I-44 excavation is required for Ramp 4 to pass under I-64 and over I-44 at location shown.	N/A	N/A
	Potential conflicts between excavation & I-64 bridge footings (NB thru)	Agree. Excavations are unacceptably close to I-64 pier foundations.	None with this option. Substantial I-44 excavation is required for Ramp 4 to pass under I-64 and over I-44 at location shown.	N/A	N/A

Abbreviations for MoDOT Ratings:
UA = Unacceptable
UD = Undesirable

	Issue	Response	Mitigation possible?	Standard	Ref
Option 3: Ramp B over I-64 (right exit), outside merge					
UA	7.1% ramp grade	Agree. Caused by req'd 14'6" clearance over WB I-64 + 6' structure depth	(1) Move VPI to Sta 15+00, EL 512.90; results in 6.7% grade in, 4.61% grade out; hold K=20, L=230' (2) Reduce structure depth so grade can be reduced	7% max, 25-30 mph	AASHTO Sec 10.9.6
UD	Sharp radius & low design speed (30 mph)	R=235'	Increasing to R=340' (35 mph) is not possible because curve would overlap upstream curve.	30 mph Design Speed: R=231' (6% super)	AASHTO Table 3-9
UD	I-44 ramp merge with I-55 ramp	Agree. It is undesirable to merge a ramp into a directional interchange ramp movement.	None. Merge would have to occur on main span of PSB structure to avoid this situation	N/A	N/A
Option 5: Ramp B under I-64 (right exit), outside merge; Memorial realign					
UA	Sharp radius & low design speed (25 mph) - SB-to-EB	Agree. R=152.50'	Increasing radius to 231 ft (30 mph) would not fit between piers and would substantially increase skew angle over Ramp 2	30 mph Design Speed: R=231' (6% super)	AASHTO Table 3-9
UA	Short tapered ramp merge (SB)	Agree. L=240'. Taper is also located on outside of curve for Ramp 1, an undesirable location.	Longer taper will result in wider pavement section under RR bridge. May not have enough span length under RR bridge for wider pavement.	800' (50:1)	AASHTO Fig 10-69
UD	7% ramp grade (SB-to-EB)	Result of minimizing earthwork impacts for relocated Memorial Ramp	Grade might be reduced to 5% by moving VPIs to Sta 3+50.42 & Sta 6+76.31. May cause more ROW issues at Sta 4+80	7% max, 25-30 mph; 6% max, 40 mph	AASHTO Sec 10.9.6
UD	I-44 ramp merge with I-55 ramp	Agree. It is undesirable to merge a ramp into a directional interchange ramp movement.	None. Merge would have to occur on main span of PSB structure to avoid this situation	N/A	N/A
7th Street U-turn					
	30-mph curve	Agree. R=231'	Increasing to R=340' (35 mph) is not possible because the curve would interfere with several existing buildings.	30 mph Design Speed: R=231' (6% super)	AASHTO Table 3-9
Alternative 2A: Ramp B under I-64 (right exit), outside merge; I-44 slight realign; Memorial realign					
UA	Substandard tapered on-ramp to SB I-55	Agree. L=250'	Longer taper would interfere with Ramp 1 merge downstream.	800' (50:1)	AASHTO Fig 10-69
UD	Excavation along I-44 relocation - SB	Agree. Caused by bringing I-44 vert curve under TRRA bridge to current standards for 50 mph design speed	Design sag curve for comfort criteria, AASHTO eq 3-51; reduces excavation depth, still undesirable	K=96; 50mph sag	AASHTO Table 3-36
UD	Sharp radius & low design speed (30 mph) - SB-to-EB	R=235'	Increasing to R=340' (35 mph) is not possible because curve would overlap upstream curve.	30 mph Design Speed: R=231' (6% super)	AASHTO Table 3-9
UD	I-44 ramp merge with I-55 ramp	Agree. It is undesirable to merge a ramp into a directional interchange ramp movement.	None. Merge would have to occur on main span of PSB structure to avoid this situation	N/A	N/A
	Potential conflicts between excavation & I-64 bridge footings (SB thru)	Agree. Excavations are unacceptably close to I-64 pier foundations.	None with this option. Substantial I-44 excavation is required for Ramp 4 to pass under I-64 and over I-44 at the location shown.	N/A	N/A

The discussion of each option below makes use of a ramp-labeling convention used in previous analyses, as shown in **Figure 2-2**.

Option 1

Ramp B under I-64 (right exit), inside merge

Option 1 generally attempts to preserve Ramp B on its existing alignment, joining Ramp A from the left side. With Option 1, the grade of I-44 through the interchange would need to be lowered significantly in order to provide necessary vertical clearances to accommodate both Ramp B and a widened, realigned Ramp D (westbound-to-southbound) under the I-64 mainline. Excavation for this lowering would potentially conflict with the I-64 bridge piers. In addition, the Ramp B curvature would provide an undesirable design speed of 30 mph and the left-side taper would be unacceptably short (due to proximity to the PSB abutment). The study team generally agreed with MoDOT's assessment, and could not identify modifications to improve the concept.

Option 2

Ramp B under I-64 (left exit), outside merge; I-44 realign

Option 2 would bend I-44 out to allow provision of a left-exit for Ramp B, which would still travel under Ramp D and the I-64 mainline, but would rise above Ramp A to join it from the right side. As with Option 1, the grade of I-44 through the interchange would need to be lowered significantly in order to provide necessary vertical clearances to accommodate the ramp changes. The excavation for this lowering would conflict with the I-64 bridge piers. In addition, the Ramp B curvature would provide an undesirable design speed of 30 mph and the merge with Ramp A would be undesirable. Also, this option would cut off access to PSB from Memorial Drive. The study team generally agreed with MoDOT's assessment and could not identify modifications to improve the concept.

Option 3

Ramp B over I-64 (right exit), outside merge

Option 3 would elevate Ramp B to the highest vertical level at the interchange, above I-64 mainline and Ramp A. Ramp B would merge with Ramp A from the right. The problems of undesirable ramp curvature and an undesirable merge would remain with this alternative and MoDOT indicated that Ramp B would provide an unacceptable grade. The study team generally agreed with MoDOT's assessment, although it was felt that the ramp grade could be reduced with one of two techniques identified in **Table 2-2**.

Option 5

Ramp B under I-64 (right exit), outside merge; Memorial realign

Option 5 bears many similarities to Option 2, except instead of realigning I-44, it would curve the Memorial Drive Ramp westward to allow development of a right-exit for Ramp B. Ramp B would travel under Ramp D and I-64 mainline, but over I-44 mainline and Ramp A. The problems of undesirable ramp curvature and an undesriable merge would remain with this alternative, and MoDOT indicated that Ramp B and the realigned Memorial Drive Ramp would provide unacceptable grades. The study team generally agreed with MoDOT's assessment, although it was felt that the Ramp B grade could be possibly reduced with one of two techniques identified in **Table 2-2**.

7th Street U-Turn

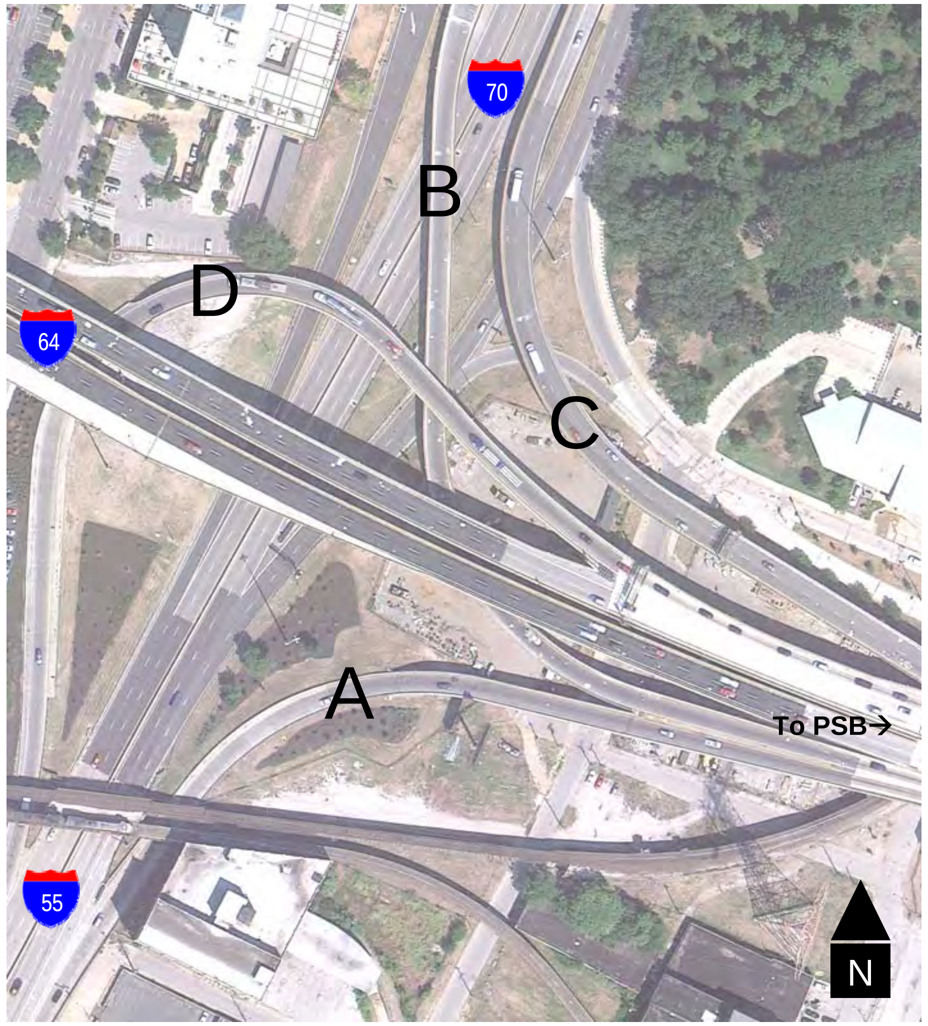
This option would eliminate Ramp B and move the southbound-to-eastbound movement about a half-mile south of the interchange, creating a U-turn ramp in the vicinity of Seventh Street. MoDOT's primary stated concern with this option was the design speed of the ramp, which would be difficult to increase. The study team agreed with this assessment. In addition, it would be desirable to avoid the out-of-direction travel required by this option, if possible.

Alternative 2A

Ramp B under I-64 (right exit), outside merge; I-44 slight realign; Memorial realign

Alternative 2A is essentially a combination of Options 2 and 5, slightly realigning both I-44 mainline and the Memorial Drive ramp to allow a right-exit from southbound I-44 onto southbound Memorial Drive, and a subsequent left-exit to a realigned Ramp B, which would merge with Ramp A from the right. The problems of undesirable ramp curvature and an undesirable merge would remain with this alternative, along with undesirable excavation along I-44 (including potential conflicts with I-64 bridge footings). In addition, the Memorial Drive on-ramp to I-55 would exhibit a substandard taper. The study team generally agreed with MoDOT's assessment and could not identify modifications to improve the concept.

Figure 2-2: Previously Used Ramp-Labeling Convention, Adopted for This Analysis



3. Enhancements & New Alternatives

The study team explored potential additional options that could address concerns about the removal of Ramp B while meeting local and regional mobility needs. **Figure 3-2,** later in this chapter, illustrates these options. The discussion below summarizes the study team's evaluation of the options. All Options are compared against a Base Option, also known as AJR Option 8. This option was the preferred option resulting from the PSB AJR. Relevant features of the Base Option include removal of Ramp B (southbound-to-eastbound), and conversion of Ramp A (northbound-to-eastbound) to a two-lane ramp. It should be noted that the study team examined the cost estimate previously produced for this option, and (using the methodology described below) was able to find ways to reduce the cost estimate by nearly $16 million (from $49.5 million to $33.9 million).

Methodology

Operational Analysis

The alternatives were compared from a traffic operational perspective, using the VISSIM microsimulation software. The analysis was conducted for the p.m. peak hour, the period during which Ramp B sees the heaviest traffic flow as commuters return home from downtown St. Louis to destinations east of the Mississippi River. The horizon year for the analysis was 2035, consistent with recent studies. The analysis was based on traffic density, measured in terms of passenger cars per mile per lane. **Table 3-1** summarizes density ranges from the *Highway Capacity Manual* that are typically used to characterize freeway operations on an A-to-F scale known as level of service (LOS). LOS F indicates over-capacity conditions. **Figures 3-1 and 3-3**, later in this chapter, illustrate the comparative results of the operational analyses; results for individual options are discussed further in the text with each option.

Table 3-1: LOS Values

LOS	Density
A	0-11
B	11-18
C	18-26
D	26-35
E	35-45
F	>45

Cost Estimation

The study team evaluated the cost estimates that were developed for each of the options described in Chapter 2. These project scoping estimates are based on preliminary plan quantities and historical unit cost data from previous projects. The total project cost estimates include removal of improvements, mobilization, surveying, engineering, construction administration, utility relocations, right of way, and a contingency to account for unknown factors.

Based on the original project estimate, the overall total project cost of the Base Option, also known as AJR Option 8, was approximately $49.5 million. The study team utilized the project costs from the Base Option and compared the historical unit bid prices against more recent bid tabulations. The historical bid prices seem to be conservative as compared to recent project awards. This may be a function of an extremely robust "transportation economy" at the time the original planning level cost estimating was undertaken. The overall economy has been in decline, which has helped to make bids more competitive and less costly. The use of an inflated historical base unit bid price is compounded when other project costs are developed as a percentage of those pay items and then an overall project contingency is added on at the end of the cost estimate. Bridge construction is the largest cost component.

The study team used a unit price of $225 per square foot of deck area instead of $300 per square foot used by MoDOT. This base unit price differential and other similarly modified unit prices, combined with the multiple layers of compounding in the estimating methodology, results in large variations in project cost estimates. The study team believes the estimates performed as part of this study reflect reasonable expectations for the cost of these projects. The adjustment of the historical bid prices to more recent unit bid prices resulted in a reduction in the overall project cost for the Base Option from $49.5 million to $33.9 million. The overall project costs for any additional design options that were developed by the design team were developed using these updated unit bid prices. **Table 3-3,** presented at the end of this chapter, is a summary cost estimate comparison for all options studied.

Ramp B Preservation Options

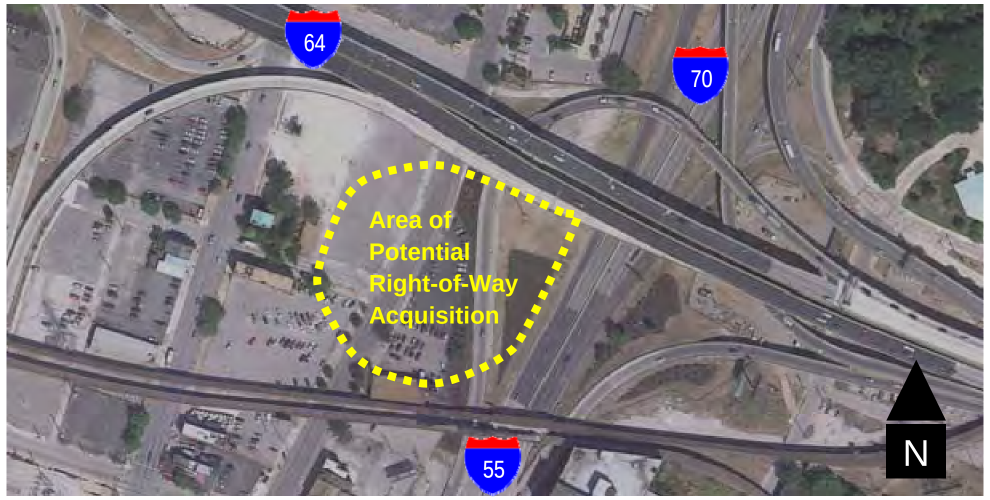
The three options described below attempted to preserve the southbound-to-eastbound movement at the PSB/I-55/I-70 interchange. One of the primary geometric/safety/operational issues identified by MoDOT with all concepts to date that have attempted to preserve this movement, is the merge movement required where Ramp B (southbound-to-eastbound) joins with Ramp A (northbound-to-eastbound) and the I-64 eastbound through movement. In all concepts studied to date, this equates to five lanes (two on mainline I-64, two on Ramp A, and one on Ramp B) approaching the four-lane PSB – requiring a lane-drop and merge. The existing bridge abutment location and bridge width constrain this merge to a short, undesirable distance. Each of the three alternatives below attempts to improve the merge situation by separating the locations at which the on-ramps join I-64.

Option A

SB-to-EB Loop On-Ramp | Cost: $61M

Option A would convert Ramp B from a direct connector to a single-lane loop ramp with a design speed of 25 mph. Constructing a loop would allow Ramp B to join I-64 550 feet west of the PSB bridge abutment, separating the Ramp B merge from Ramp A, allowing both lanes unimpeded flow onto PSB. This option would require new right-of-way to construct. As the graphic on this page illustrates, Option A would potentially impact a building and several parking lots.

Potential Right-of-Way Needs with Option A



As **Figure 3-1** illustrates, Option A would operate fairly similar to the Base Option south and west of the interchange. However, there are some significant differences:

- While Option A continues to indicate a forecasted LOS F on eastbound I-64 west of the interchange, the projected density values would be as much as 20 percent higher than those of the base case, meaning that delays and queues would be much heavier with this option than with the Base Option.
- The loop ramp would operate at unacceptable levels of service, with queues and delay spilling back to southbound Memorial Drive and the southbound I-44 (previously I-70) mainline.

Therefore, from an operational perspective, Option A is considered inferior to the Base Option.

Option B

I-44/I-55 Split | Cost: $90M

Option B would retain Ramp B as a single-lane direct-connector ramp, but would take advantage of the geometry of the major I-44/I-55 merge approximately one mile southwest of the PSB/I-55/I-70 interchange to attempt to separate merge points.

At the I-44/I-55 merge point, northbound I-55 traffic is currently placed into the two left lanes, while eastbound-to-northbound I-44 traffic is placed into the two right lanes. (See the graphic at bottom of this page. Note that there is also an auxiliary lane present between Gravois Road and Park Avenue.) Therefore, I-55 traffic bound for the PSB is required to weave two lanes to the right to access Ramp A. The study team contemplated a solution that would eliminate this weave by creating a single-lane left-exit for I-55 traffic to the PSB, while retaining a single-lane right-exit for I-44 traffic to the PSB. An existing extra-wide shoulder on I-55 appears to provide some of the width to allow this to happen (see the graphic in the lower right corner).

This option would place the merge for the I-55 left-exit 600 feet west of the PSB abutment, and would create a separation distance of 500 feet between the successive on-ramps. Ramp B would be included as a single-lane direct connector with a 235-foot radius (30-mph design speed), merging into Ramp A from the right.

The I-55 left-exit would need to cross above the elevated St. Louis Terminal Railroad Association tracks, and would potentially conflict with an east-west power transmission line that runs just north of the tracks. This potential conflict would be an important design and cost consideration.

Operationally, as **Figure 3-1** illustrates, Option B would be generally similar to the Base Option on the north, east and west legs of the interchange. Of the three ramps accessing eastbound PSB, two would operate acceptably (the northbound-to-eastbound left-exit from I-55 and Ramp B), but the northbound-to-eastbound right-exit ramp from I-44 would operate with significantly worse densities than under the Base Option. Both the basic ramp capacity and the capacity of the merge itself contribute to this congestion. The ramp problem is projected to spill back onto northbound I-55 mainline at least as far south as the Park Avenue interchange,

Because this option would degrade 2035 operations on the northbound I-44/I-55 mainline well below those of the Base Option, it is considered inferior to the Base Option.

Option C

I-55 Left Exit | Cost: $86M

Option C would also retain Ramp B as a single-lane direct-connector 30-mph ramp, but would convert Ramp A (northbound-to-eastbound) to a two-lane left-exit, better respecting route continuity by not forcing northbound I-55 traffic to weave across several lanes to "stay on" I-55 after the I-44 merge in order to cross the PSB. Northbound I-44 traffic, however, would have to weave to exit to PSB.

Ramp B (single lane) would approach Ramp A (two lanes) from the right side, and there are two methods by which these three lanes could be merged to two: (1) by dropping one of the Ramp A lanes in advance of the Ramp A/Ramp B merge, thus narrowing Ramp A to one lane and allowing Ramp B to become an unimpeded "add lane" to cross the PSB ; or (2) by merging Ramp B into Ramp A prior to PSB, thus allowing both Ramp B lanes to continue on PSB. For this analysis, the first method was chosen, allowing a test of the effects of narrowing Ramp A to one lane – in contrast to Option A, which would preserve Ramp A's two lanes approaching PSB.

As with Option B, the potential conflict between the left-exit and the power transmission line would be an important design and cost consideration.

Operationally, as **Figure 3-1** illustrates, Option C would perform nearly identically to Option B, although traffic congestion on I-64 eastbound approaching PSB (while still LOS F) would be much worse (densities 50 to 100 percent higher).

Because this option would degrade 2035 operations on the northbound I-44/I-55 mainline (as well as the eastbound I-64 mainline) well below the Base Option, it is considered inferior to the Base Option.

A design principle gleaned from Option C is that two unimpeded lanes are needed on Ramp A if the northbound I-55/I-44 mainline is to function acceptably.

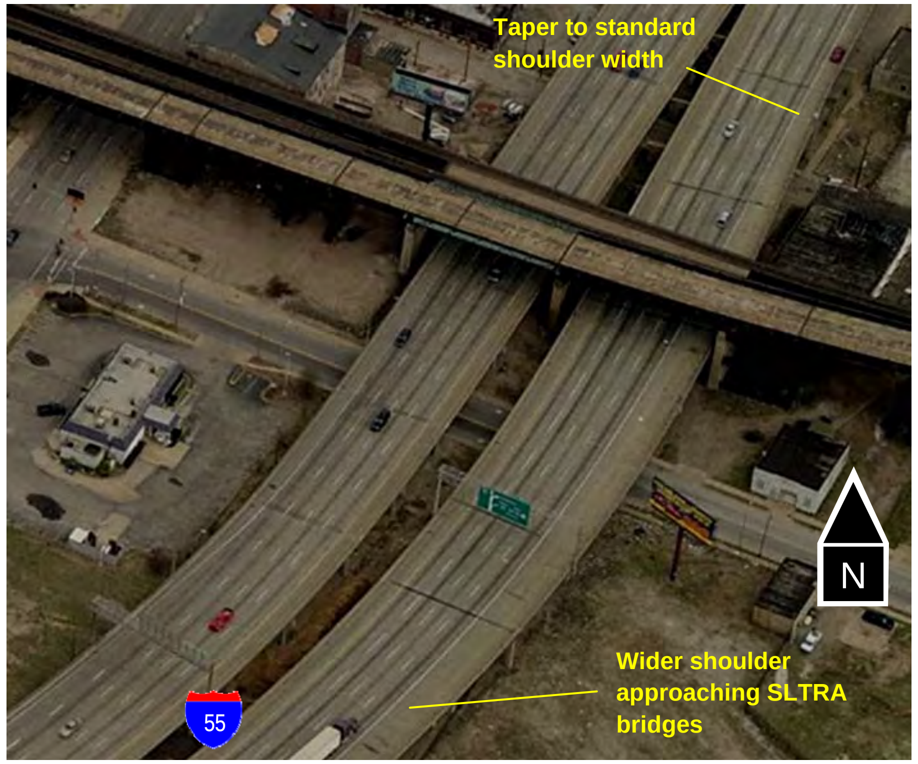
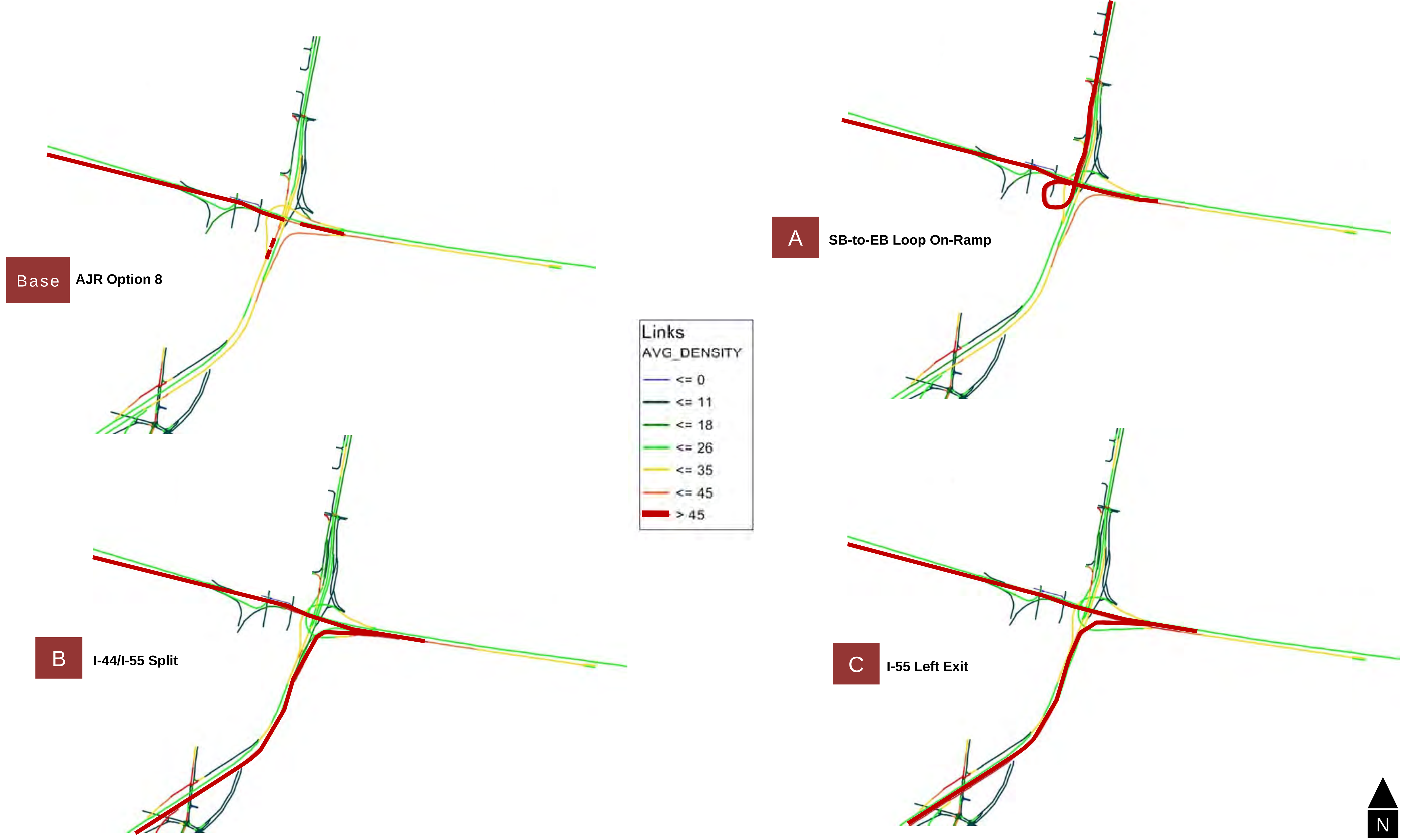


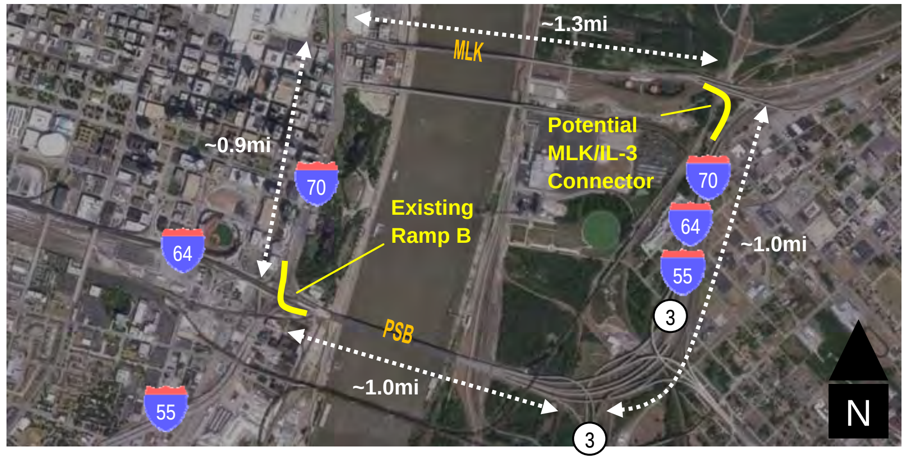
Figure 3-1: Operational Performance – 4-Lane PSB Alternatives (P.M. Peak Hour)



MLK Bridge/IL-3 Connection | *Cost: $17M*

With the Ramp B preservation options not showing operational promise, the study team looked for options that would eliminate Ramp B but still provide the desired regional access (most notably from downtown to the Sauget area immediately south of PSB on the Illinois side).

In exploring possibilities, the study team examined the Martin Luther King (MLK) Bridge (less than a mile north of the PSB). On the Illinois side of the Mississippi River, MLK currently connects to I-70/I-64, but only provides connections to and from the east. IL-3 continues south from this location, but direct connections between it and MLK do not currently exist. The study team examined an option involving the creation of an eastbound-to-southbound ramp from MLK merging with I-64 and subsequently exiting to IL-3. The graphic below illustrates the location of this connection in relation to Ramp B.



The new connector would replace the function of Ramp B, serving movements from downtown across the Mississippi River. Depending on the origin point in downtown, many trips could get shorter using this new route. The graphic above includes some reference distances.

The operational analysis for this study (see **Figure 3-1**) focused on peak-hour traffic conditions at the I-70/I-64/I-55 interchange, and from that perspective, the MLK Option would have the same operations as the Base Option, because both options remove Ramp B from the interchange. Further investigation of this option would need to include detailed looks at the I-70/MLK ramps, and the IL-3/MLK ramps, to make sure capacity is optimized.

The MLK bridge itself has adequate capacity to accommodate this re-routed traffic, especially given that MLK eastbound p.m. peak-hour traffic is expected to significantly decrease (by approximately half) once MRB is constructed. In addition, after traffic bound for IL-3 exited MLK onto southbound I-70, it would stay in the right lane of traffic and no weaves across mainline traffic would be necessary. The fact that this movement is in the reverse commute direction indicates that capacity should be sufficient.

IDOT, in cooperation with MoDOT, has been developing a rehabilitation project (already programmed on the STIP) for the MLK Bridge to address known structural deficiencies in the truss spans. Construction costs for this project are currently shown in MoDOT's STIP as Project J6P2386 for Fiscal Year 2015. The total cost of this project including funding from both DOT's is estimated at $8M. Following completion of this project, the MLK Bridge is anticipated to remain a safe and functional connection across the Mississippi River for the foreseeable future and an adequate alternative for making the connection to southbound Illinois Route 3.

Based on the fact that the operations of the MLK Option would be similar to those of the Base Option, coupled with the fact that the MLK Option would preserve direct and safe access between downtown and areas south of I-64 on the east side of the Mississippi River, adding the MLK Option to the Base Option is considered preferable to the Base Option alone.

PSB Widening | *Cost: $21M*

The study team's exploration of options to retain Ramp B underlined the fundamental problem at the east abutment of the PSB: the capacity constraint represented by the four eastbound lanes on the bridge. Any option that attempts to approach PSB with five lanes will ultimately suffer operational difficulties associated with merging heavy traffic streams. The obvious "flip side" answer to reducing to four approach lanes would be to widen PSB to provide five eastbound lanes. Typically, bridge widening would be a very costly endeavor, well outside the scope of the improvements currently being considered at the I-55/I-64/I-70 interchange. However, as the study team investigated the PSB structure type and design, it was clear that a unique opportunity may exist to widen the structure at a reasonable cost, while enhancing the overall performance of this important river crossing.

The proposed approach to widen PSB is not to add girders and substructure as would be expected for a typical widening, but to slide the southern (eastbound) bridge to the south approximately 9 feet.

The step-by-step process for this widening is:

1) Infill the space between columns with an extension of reinforced concrete essentially creating a wall pier;
2) Extend the southern nose of the pier to support a cap widening to the south;
3) Place the southern cap widening;
4) Remove the shear keys and struts from previous seismic retrofits;
5) Prepare the cap and girders for sliding;
6) Time the slide with the removal and reconstruction of the I-55 ramps when only two lanes of I-64 need to be maintained;
7) Close access to eastbound PSB and slide the bridge 9 feet to the south;
8) Reopen to two lanes of eastbound I-64 only;
9) Drop the left lane of westbound I-64 on PSB;
10) Remove a portion of the inside overhangs from both the eastbound and westbound bridges;
11) Drop in and attach new crossframes between the inside girders of the eastbound and westbound bridges;

12) Infill the orthotropic deck between the two bridges;
13) Construct new median barrier;
14) Reconstruct shear keys and struts as required from previous seismic retrofits;
15) Reopen to all lanes of traffic including a fifth lane of traffic on eastbound PSB.
16) Widen Illinois approach to PSB, in order connect the fifth eastbound lane to the existing add lane on the off-ramp to southbound IL-3.

This process will result in a single four girder, redundant, structure that carries four lanes of westbound traffic and five lanes of eastbound traffic. There is also an opportunity to implement a reversible lane with this modified structure.

The modified structural system can more efficiently carry traffic by taking advantage of the increased torsional stiffness of the superstructure. The live load distribution benefits of this new system are illustrated in **Table 3-2**.

Table 3-2: Live Load Distribution Comparisons

No. Of Lanes Loaded			Multiple Presence	# Wheel Lines To Exterior Girder	No. Of Girders In System
Total	EBD	WBD			
Two Girder System					
1	1	-	1.2	2.75	2
2	2	-	1	3.84	2
3	3	-	0.85	3.96	2
4	4	-	0.65	3.08	2
Four Girder System					
1	1	-	1.2	1.78	4
2	2	-	1	2.75	4
3	3	-	0.85	3.23	4
4	4	-	0.65	3	4
5	5	-	0.65	3.4	4
6	5	1	0.65	3.65	4
7	5	2	0.65	3.78	4
8	5	3	0.65	3.72	4
9	5	4	0.65	3.54	4

- Distribution Factors For 2 Girder System Calculated Using Lever Rule
- Distribution Factors For 4 Girder System Calculated Using Rigid Rotation Analogy

The potential for PSB widening allowed the study team to re-examine Options A, B, and C with five receiving lanes on the bridge rather than four. The results are described below. Operational outputs are shown in **Figure 3-3**.

Option A+

SB-to-EB Loop On-Ramp + Widened PSB | Cost: $83M

If PSB carried five eastbound lanes, the Ramp B loop-ramp and the two-lane Ramp A would not need to merge, and the current two lanes on I-64 could continue to carry through as the two left lanes on PSB. Operationally, Option A+ would operate almost identically to the Base Option, and the loop-ramp would also operate acceptably. Although eastbound I-64 traffic west of the interchange would continue to operate at LOS F, densities would decrease (improve) by as much as 20 percent.

Thus, Option A+ is considered an improvement over the Base Option.

Option B+

I-44/I-55 Split + Widened PSB | Cost: $111M

If PSB carried five lanes, all three Option B ramps connecting to eastbound PSB – Ramp A, the I-55 left-exit, and the I-44 right-exit – could carry onto the PSB without dropping or merging. Operationally, the single-lane I-44-to-PSB right-exit would continue to suffer, but with shorter back-ups than standard Option B (not all the way back to the Park Avenue interchange). To function acceptably, the I-44 right-exit would need two unimpeded lanes, which would require six lanes approaching the five-lane PSB under this scenario. Thus, the I-55 left-exit does not "buy" the needed capacity.

Because of the poor ramp operations, Option B+ is considered inferior to the Base Option.

Option C+

I-55 Left Exit + Widened PSB | Cost: $107M

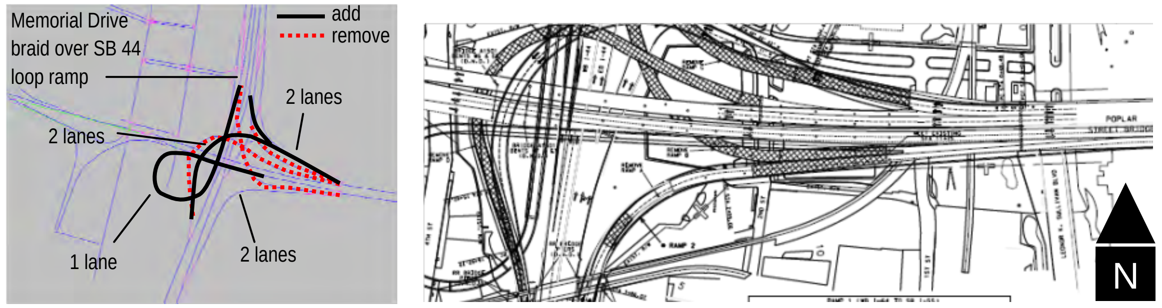
If PSB carried five eastbound lanes, the Ramp B direct connector and the two-lane Ramp A exit would not need to merge, and the current two lanes on I-64 could continue to carry through as the two left lanes on PSB. Operationally, Option C+ functions better than any of the other Options described up to this point, including the Base Option.

Figure 3-2: Additional PSB Options Studied

Alt	Descr	Include MLK/SB 3?	Lanes on PSB	Scenario	Include MRB?	Include CAR 2015?	Peak Hour
Base	AJR Option 8 + MLK	Y	4	2035	Y	Y	PM
Option A	SB-to-EB Loop On-Ramp	N	4	2035	Y	Y	PM
Option A+		N	5	2035	Y	Y	PM
Option B	I-44/I-55 split	N	4	2035	Y	Y	PM
Option B+		N	5	2035	Y	Y	PM
Option C	I-55 Left Exit	N	4	2035	Y	Y	PM
Option C+		N	5	2035	Y	Y	PM
Option D	Split I-64 (3rd Lane)	Y	5	2035	Y	Y	PM

Option A:

SB-to-EB Loop On-Ramp

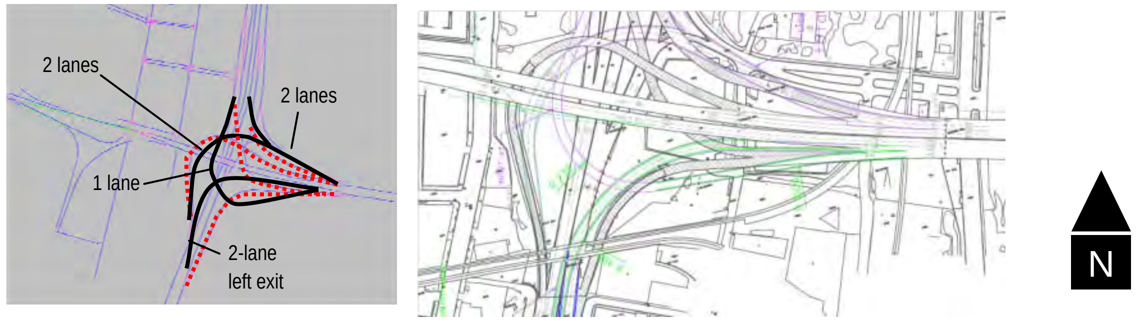


Option B:

I-44/I-55 Split

Option C:

I-55 Left Exit

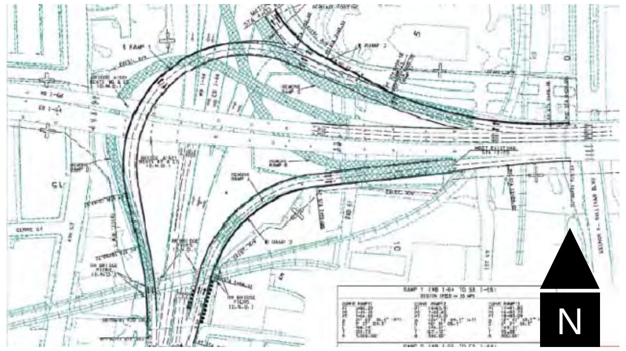


Option D:

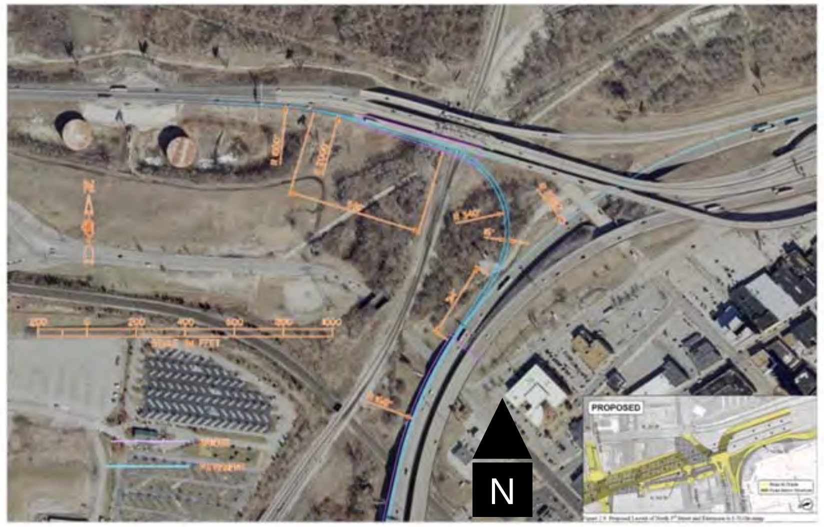
Split I-64

Base:

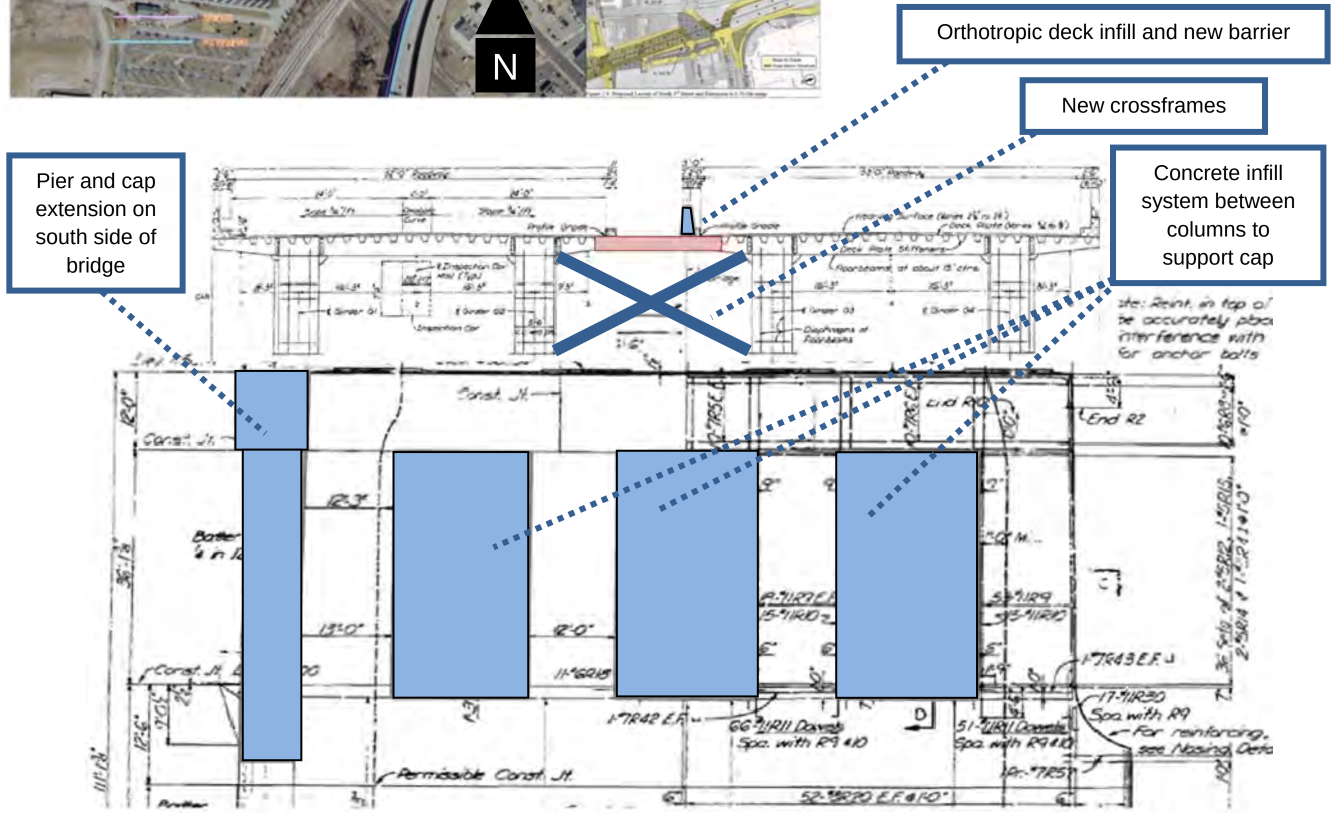
AJR Option 8 + MLK



MLK/IL-3 Connection



PSB Slide to Provide 5 Lanes



Pier and cap extension on south side of bridge

Orthotropic deck infill and new barrier

New crossframes

Concrete infill system between columns to support cap

I-64 Capacity Enhancement (Option D) |

Cost: $111M

Of the eight options examined up to this point (Base, Base + MLK, A/A+, B/B+, C/C+), none would be able to address a fundamental problem in the vicinity of the interchange: the constrained two-lane capacity of eastbound I-64 west of the interchange. Because this issue is left unaddressed, all of the alternatives would operate at LOS F on this portion of I-64 during the p.m. peak hour (albeit some with "better" F's than others).

This problem is not one the study team was necessarily tasked with solving. However, once a five-lane eastbound PSB became a consideration, a further question arose: What is the best use of five eastbound lanes? Is it to accommodate three lanes of ramp traffic and two lanes of I-64 mainline traffic? Or is there an alternative that could allow three lanes of I-64 traffic to access PSB?

The study team noted that at the current Sixth Street off-ramp from eastbound I-64, the freeway reduces from three lanes to two (the exit is a "trap" lane). Without a doubt, this is the bottleneck that contributes most significantly to existing and future congestion on I-64 during the p.m. peak hour. Because I-64 is a double-deck structure at this location, widening the eastbound mainline (the lower deck) would be a very expensive proposition.

The study team considered a potential solution that would not involve widening the double-deck structure. Under this option, dubbed the "Split 64 Option", a third lane of capacity would be gained using the existing Sixth Street exit, and creating (in essence) a collector-distributor (C-D) roadway that would extend parallel to the I-64 structure on its south side, connecting back where the Sixth Street on-ramp ties back in to I-64 (See graphic below). The exit could be marked "Sixth Street/IL-3", but regular p.m. commuters would come to realize that it could be used by any traffic desiring to cross PSB. In this way, three lanes of the eastbound I-64 mainline could be carried onto PSB.

The MLK/IL-3 connector would be a necessary complement to this configuration, because PSB would only be able to accept two additional lanes, and analysis of previous options demonstrated clearly that Ramp A (northbound-to-eastbound) must carry two unimpeded lanes. Therefore, Ramp B would need to be eliminated to ensure optimum functionality of the Split 64 Option, and the MLK/IL-3 connector is the best substitute for Ramp B.

There are also a number of ramp changes to and from 6th Street and Broadway that would be implemented as part of this enhancement.

These changes include:

1) The current access from Broadway to westbound I-64 would be reconfigured to carry eastbound I-64 to southbound Broadway;
2) The off-ramp from eastbound I-64 to 6th Street would be reconfigured to become the 6th Street to westbound I-64 on ramp;
3) The existing 6th Street ramp to eastbound I-64 will be adjusted and merged into I-64 in advance of the two lane ramp from I-55.

These ramp improvements would enhance access to and from I-64 and PSB and should be completed with the addition of the 3rd lane of capacity on eastbound I-64. See the sketch included with **Figure 3-1** for conceptual layout of these ramp modifications.

Figure 3-3 illustrates the operational results for the Split 64 Option (including the MLK/IL-3 connector). I-64 west of PSB would improve from LOS F to LOS C with this option. It must be noted that northbound I-55/I-44 mainline south of the interchange would operate at LOS D/E, but no portion is forecasted to operate at LOS F.

Figure 3-3: Operational Performance – 5-Lane PSB Alternatives (P.M. Peak Hour)

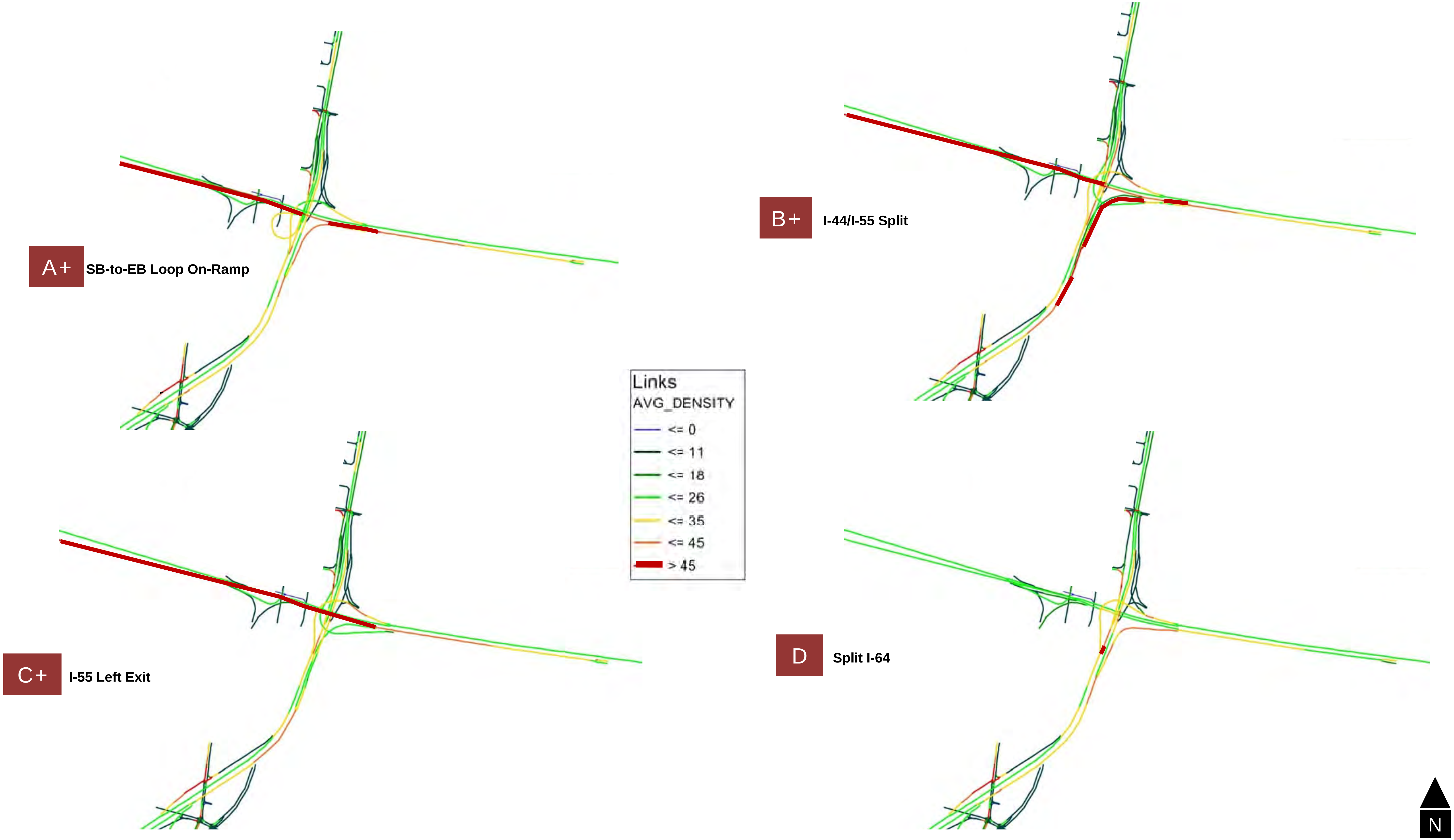


Table 3-3: Cost Estimates, PSB Alternatives

		Option	Estimated By	Subtotal	Removal Of Improvements (10%)	Mobilization (6%)	Surveying (0.91%)	Design Engineering (10%)	Construction Admin (5%)	Contingency (20%)	Misc	Grand Total
Components of Alternatives		Base - AJR Alt. 8	*MoDOT*	*$32,593,633*	*$3,259,363*	*$1,955,618*	*$296,602*	*$3,259,363*	*$1,629,682*	*$6,518,727*	*$0*	*$49,512,988*
			HDR	$22,339,768	$2,233,977	$1,340,386	$203,292	$2,233,977	$1,116,988	$4,467,954	$0	$33,936,342
		Option 3	*MoDOT*	*$31,027,492*	*$3,102,749*	*$1,861,650*	*$282,350*	*$3,102,749*	*$1,551,375*	*$6,205,498*	*$0*	*$47,133,863*
			HDR	$19,391,969	$1,939,197	$1,163,518	$176,467	$1,939,197	$969,598	$3,878,394	$0	$29,458,340
		Split 64 - Initial	HDR	$5,101,551	$510,155	$306,093	$46,424	$510,155	$255,078	$1,020,310	$0	$7,749,766
		Split 64 - Final	HDR	$20,723,395	$2,072,340	$1,243,404	$188,583	$2,072,340	$1,036,170	$4,144,679	$0	$31,480,909
		Option A (Loop Ramp)	HDR	$18,019,023	$1,801,902	$1,081,141	$163,973	$1,801,902	$900,951	$3,603,805	$0	$27,372,698
		PSB Slide	HDR	$14,056,831	$1,405,683	$843,410	$127,917	$1,405,683	$702,842	$2,811,366	$0	$21,353,732
		Option B (I-44/I-55 Split)	HDR	$36,687,393	$3,668,739	$2,201,244	$333,855	$3,668,739	$1,834,370	$7,337,479	$0	$55,731,819
		Option C (I-55 Left Exit)	HDR	$34,323,300	$3,432,330	$2,059,398	$312,342	$3,432,330	$1,716,165	$6,864,660	$0	$52,140,525
		MLK/IL-3 Connector	HDR	$10,784,663	$1,078,466	$647,080	$98,140	$1,078,466	$539,233	$2,156,933	$500,000	$16,882,982
Alternatives	Option 3	Base + Option 3	*MoDOT*	*$63,621,125*	*$6,362,113*	*$3,817,268*	*$578,952*	*$6,362,113*	*$3,181,056*	*$12,724,225*	*$0*	*$96,646,851*
			HDR	$41,731,737	$4,173,174	$2,503,904	$379,759	$4,173,174	$2,086,587	$8,346,347	$0	$63,394,682
	Base, MLK	**Base + MLK Connector**	**HDR**	**$33,124,431**	**$3,312,443**	**$1,987,466**	**$301,432**	**$3,312,443**	**$1,656,222**	**$6,624,886**	**$500,000**	**$50,819,323**
	Alt D, init	**Base + MLK + PSB Slide + Split 64 - Initial**	**HDR**	**$52,282,813**	**$5,228,281**	**$3,136,969**	**$475,774**	**$5,228,281**	**$2,614,141**	**$10,456,563**	**$500,000**	**$79,922,821**
	Alt D, final	**Base + MLK + PSB Slide + Split - 64 Initial + Split 64 - Final**	**HDR**	**$73,006,208**	**$7,300,621**	**$4,380,372**	**$664,356**	**$7,300,621**	**$3,650,310**	**$14,601,242**	**$500,000**	**$111,403,731**
	Option A	Base + Option A	HDR	$40,358,791	$4,035,879	$2,421,527	$367,265	$4,035,879	$2,017,940	$8,071,758	$0	$61,309,039
	Option A+	Base + Option A + PSB Slide	HDR	$54,415,622	$5,441,562	$3,264,937	$495,182	$5,441,562	$2,720,781	$10,883,124	$0	$82,662,771
	Option B	Base + Option B	HDR	$59,027,161	$5,902,716	$3,541,630	$537,147	$5,902,716	$2,951,358	$11,805,432	$0	$89,668,160
	Option B+	Base + Option B + PSB Slide	HDR	$73,083,992	$7,308,399	$4,385,040	$665,064	$7,308,399	$3,654,200	$14,616,798	$0	$111,021,892
	Option C	Base + Option C	HDR	$56,663,068	$5,666,307	$3,399,784	$515,634	$5,666,307	$2,833,153	$11,332,614	$0	$86,076,867
	Option C+	Base + Option C + PSB Slide	HDR	$70,719,899	$7,071,990	$4,243,194	$643,551	$7,071,990	$3,535,995	$14,143,980	$0	$107,430,599

4. Recommendations

Based on the findings of this analysis, the study team recommends a program of phased improvements that would ultimately have a substantial, positive regional impact on commute traffic. The reason to take this long-term view is that, if these recommendations are adopted, short-term construction would need to be designed to anticipate long-term construction (as described below). Recommended phases are as follows (illustrated in **Figure 3-4**):

Phase 1: MLK Connector, Ramp C, Ramp D

Construction Timeline: 2015 (bundled with CAR 2015)
Estimated Cost: $42.7 million – Total
$17.0 million – MLK Connector
$25.7 million – Ramps C & D, Remove Ramp B

The MLK connector could be constructed immediately (and could even be a stand-alone IDOT project). In conjunction with the MLK connector, Ramp B could be removed if its condition necessitates such action. In addition, Ramps C and D would be reconstructed to their ultimate configurations to integrate with the CAR 2015 project, and to time well with the MRB opening in 2015. Users would immediately see some initial incremental operational benefits, as capacity at the interchange would be improved.

Phase 2: PSB Slide, Ramp A, 64 Split Initial

Construction Timeline: 2016 (after MRB Opening)
Estimated Cost: $37.3 million – Total
$21.3 million – PSB Slide
$8.3 million – Ramp A
$7.7 million – 64 Split Initial

It is important to slide PSB after MRB is open to traffic, to allow for an alternative route across the Mississippi River during construction. The study team envisions that the Slide could be accomplished in a long (3-day) weekend, during which a complete closure of eastbound PSB would be necessary. Subsequently, while the infill and ramp work were underway, the two eastbound I-64 lanes could be maintained across PSB, but it is envisioned that northbound I-55 traffic would be diverted to the Jefferson Barracks Bridge, and westbound I-70 traffic would be diverted to the MRB.

During this phase, it is envisioned that Ramp A (northbound-to-eastbound) would be reconstructed to its ultimate two-lane configuration (furthering the need for diversion to the Jefferson Barracks Bridge). An initial component of the 64 Split could also be constructed – extending the Sixth Street on-ramp as an unimpeded “add lane” using the third lane of the PSB, positioning this connection in its correct ultimate location.

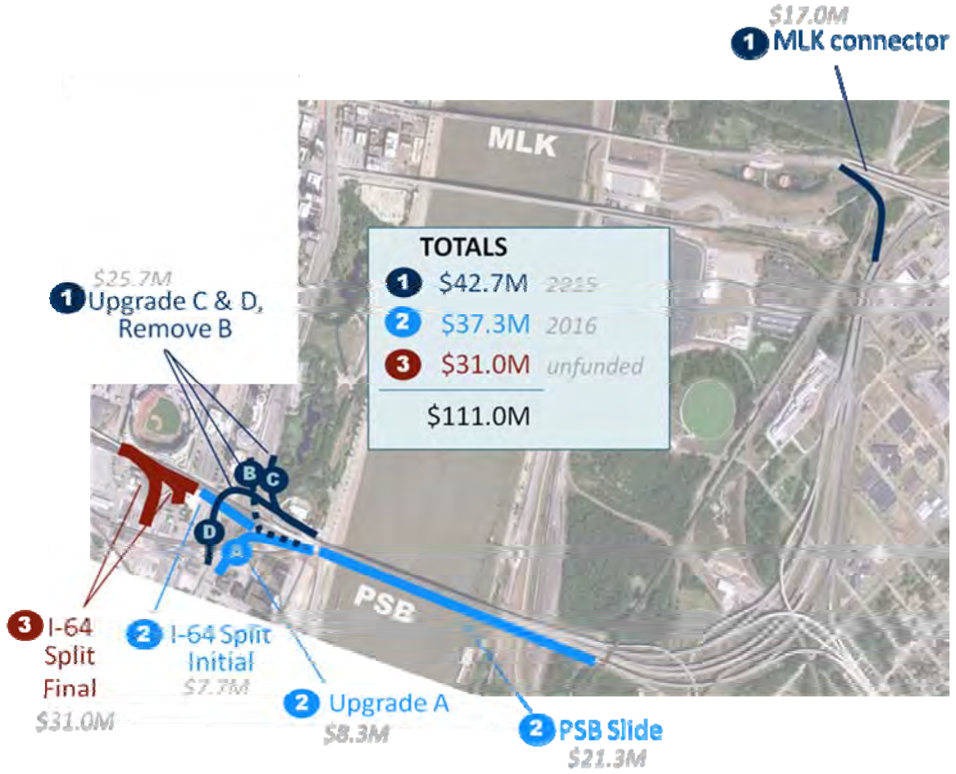
Users would continue to see incremental benefits from this phase, as capacity would increase on PSB and Ramp A, while the elimination of the Sixth Street on-ramp’s need to merge would smooth eastbound flow in advance of PSB.

Phase 3: 64 Split Final

Construction Timeline: As soon as funding is available
Estimated Cost: $31 million

Phase 3 would complete the “C-D” connection between the Sixth Street off-ramp and on-ramp, effectively creating a third lane of capacity for eastbound I-64. Also included in this phase is reconfiguring the on- and off-ramps to 6th Street and Broadway. It would be ideal to bundle this work with Phase 2 if funding were available, but it can be broken out as a separate phase if funding conditions dictate.

Figure 3-4:
Recommended Three-Phase Improvement Strategy



Concluding Remarks

The total estimated cost for all three recommended phases is $111 million. This recommendation offers the following benefits:

- It would maintain convenient access to IL-3 southbound from I-70 and downtown St. Louis (via MLK Bridge), fulfilling the function of existing Ramp B. In the longer term, when I-70 also has a direct connection to IL-3, the MLK Bridge would become part of a strong, redundant system of connections to communities on the east side of the Mississippi River (also including the I-64/Sixth Street ramps).
- It would provide safety and capacity at the I-70/I-64/I-55 interchange equivalent to the PSB AJR recommendations, PLUS it would address a long-term, previously intractable issue that has been a top priority for the public: eliminating the significant eastbound p.m. peak-hour congestion on I-64 approaching the PSB. It would increase eastbound capacity of the PSB by 25 percent.
- It would be expected to improve the PSB structurally by converting it from two two-girder systems to a single four-girder system.
- The recommendations allow the overall project to be phases in modules as funding becomes available. Each phase would improve operations and safety over the next, could operate independently of the next, and could be designed to easily anticipate the next. Each phase was also developed with the intent of integrating and complementing improvements that are planned and underway - namely CAR 2015 and MRB.

While the study team is confident in our findings, we do recommend that this set of recommendations be subjected to more detailed analysis to further understand the operational, safety, and cost implications for the region.

Appendix B

MLK Connector Preliminary Access Justification Report for Concept Approval

AMEC Environment and Infrastructure, Inc.

May, 2013

Appendix B

MLK Connector Preliminary Access Justification Report for Concept Approval

AMEC Environment and Infrastructure, Inc.

May, 2013

MLK Connector

Preliminary Access Justification Report

Concept Approval

Prepared for:
Illinois Department of Transportation

May 2013

Prepared by:
AMEC Environment and Infrastructure, Inc.

Access Justification Report

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Appendix A

Appendix B

Executive Summary

The purpose of this Access Justification Report (AJR) is to present to FHWA an evaluation of the proposed change to the existing interstate system on the Illinois side across the Mississippi River from downtown St. Louis, Missouri. This proposed change represents one of several projects associated with the New Mississippi River Bridge (NMRB) project and involves a new ramp from eastbound Martin Luther King (MLK) Drive to the existing westbound I-64/55/70 bridge structure (see Figure 1). This change is in conjunction with the removal of the existing southbound I-70 to eastbound I-64/55/70 ramp at the west end of the Poplar Street Bridge (PSB), which will be addressed as part of a separate AJR. This proposed freeway modification, the MLK Connector, allows for continued access from downtown St. Louis to the Sauget area in St. Clair County, which will be eliminated by the removal of the existing ramp at the west end of the PSB. The MLK Connector will allow eastbound MLK Drive access to westbound I-64/55/70, which will then provide access to southbound IL 3 and Piggott/Tudor Avenue.

MLK Drive is the extension of the MLK Bridge, in the City of East Louis, Illinois, and connects I-64/55/70, in Illinois, with I-70 (to be re-designated as I-44) and the downtown street network in St. Louis, Missouri. The bridge was built in 1951 as the Veterans' Memorial Bridge to relieve congestion on the MacArthur Bridge to the south and was owned by the City of East St. Louis. In 1968, the ownership was transferred dually to the Missouri (MoDOT) and Illinois (IDOT) Departments of Transportation and the bridge was renamed after Martin Luther King, Jr.

Three separate related AJRs were previously submitted:

- *Poplar Street Bridge Project, Draft Access Justification Report (July 2012).*
  The study that included alternatives to address ramp modifications at the PSB Interchange.

- *Mississippi River Crossing, New I-70 Mississippi River Bridge Crossing – Initial Phase, Access Justification Report (January, 2009).*
  This document examined the new crossing and construction of Relocated I-70.

- *CityArchRiver 2015, Access Justification Request for Concept Approval (June, 2012).*
  The document examined highway and roadway improvements in the vicinity of the Gateway Arch on the grounds of the Jefferson National Expansion Memorial (JNEM).

The AJR needs to address the appropriate issues and to provide the information necessary to allow the FHWA to make an informed decision considering the potential consequences of a change in access. Specifically, the following eight policy requirements should be addressed:

- Existing Facilities;
- Transportation System Management;
- Access Connections and Design;
- Transportation Land Use Plans;
- Comprehensive Interstate Network Study;
- Coordination with Transportation System Improvements;
- Status of Planning and NEPA; and
- Operational Analysis.

1. Description

The Preferred Alternative, shown in Figures 1 and 2, proposes a one-lane ramp from the existing eastbound MLK Drive to the existing southbound I-64/55/70. A detailed description of the new ramp is available under Section 13.2.

This AJR has evaluated the change in access and demonstrates that the Preferred Alternative is necessary to better serve the stated Purpose and Need.

2. Purpose and Need

In the early 1990's the St. Louis regional leaders were concerned about the traffic issues in downtown St. Louis. In 1992, MoDOT and IDOT started an EIS to look at and address these issues. The resulting Final EIS very clearly spelled out that the problem was the PSB. The PSB is one of only two locations in the nation that carry three interstates (I-64, I-55, I-70) over the same pavement. The PSB was built in the 1960's and was never meant to carry the amount of traffic it does today. It was designed to 1960 standards and for today's traffic, the ramp radii are too small, and there is not enough room between the exits and entrances thus causing major weaving issues. This is the reason the accident rate at this location is three times greater than a normal interchange and why trucks periodically overturn on the ramps. The study recommended building a new river bridge to the north and making substantial safety changes to the PSB.

In 2001, after many years of study, public meetings, regional discussion, and East-West Gateway Council of Governments (EWGCOG) approval, the DOTs received a ROD from FHWA to move forward with the NMRB project. This ROD proposes to build a new bridge to carry I-70 over the Mississippi River about one mile north of the PSB. This results in the PSB only carrying I-55 and I-64 traffic. As a part of that approved plan, the west PSB interchange is to be rebuilt to eliminate the I-70 connection and to build dual I-55 ramps in its place.

In 2008 the FEIS was revised to document how the project could be constructed in functional phases. The initial phase, which is a new 4-lane Mississippi River Bridge, is currently under construction and is expected to be complete in early 2014. MoDOT has placed the second phase of the project, the reconstruction of the ramps at the west end of the PSB, on EWGCOG's regional Transportation Improvement Program (TIP) with an anticipated summer 2013 letting. The concept is to have the project on the TIP, funding in place, and plans prepared so that as soon as the NMRB is open to traffic in early 2014, the construction of the PSB ramp project could start.

On June 29, 2011 at the EWGCOG Board Meeting, the EWGCOG removed a TIP project involving the removal of I-70 ramp access at the west end of the PSB from the 2012-2015 TIP. It was determined that the reason for the removal of the project was a belief that removing the I-70 ramp access from the west end of the PSB would negatively affect the Sauget area in St. Clair County by making the access less direct to that area.

In the "Poplar Street Bridge Independent Review" (the Review) dated September 12, 2012, a special review of the southbound-to-eastbound ramp (Ramp B) was made. The Review concluded that the options to preserve Ramp B do not show operational promise. The Review then looked for options that would eliminate the I-70 ramps yet still provided the desired regional access, particularly from downtown St. Louis to the Sauget area immediately south of the PSB on the Illinois side.

The Review examined the MLK Bridge located less than a mile north of the PSB. On the Illinois side, the MLK Bridge currently connects to I-64/55/70 and IL Route 3, but only provides connections to and from the east. IL Route 3 continues south from this location, but direct connections between eastbound MLK and southbound IL Route 3 do not exist. The Review suggested an option involving the creation of an EB-to-SB ramp from MLK to I-64/55/70 and to IL Route 3. Traffic destined to southbound IL Route 3 can then subsequently exit I-64/55/70 to IL Route 3 (Mississippi Avenue) and Tudor/Piggott Avenue in the Sauget area (Figure 1).

The new ramp, the MLK Connector, would replace the function of Ramp B at the west end of the PSB, which would serve movements from downtown St. Louis across the Mississippi River to the Sauget area. Once, when existing I-70 (future I-44) has a direct connection to IL Route 3, the new ramp and the MLK Bridge would become part of strong system of connections to communities on the Illinois side of the Mississippi River.

3. Cost

The MLK Connector construction is scheduled for spring 2015. Surface Transportation Urban Program (STP-U), a federal aid program, and State Funds will be used for the project funding. The cost estimate included pavement construction, the new bridge and widening of the existing structure, embankment and the retaining wall construction, drainage system and various appurtenances as well. Currently, the cost does not include a detention pond. The anticipated construction cost for the MLK Connector is approximately $21,625,000 which includes cost for an acre the new Right-of-Way ($100,000).

4. Background Information

In 1991 The Missouri Department of Transportation (MoDOT) and Illinois Department of Transportation (IDOT) initiated an Environmental Impact Statement (EIS) to examine issues related to traffic congestion and safety on the PSB. Some of the improvements the study indentified included the construction of the New Mississippi River Bridge (NMRB), relocation of I-70 off the PSB to the NMRB, then removal of the I-70 ramps and construction of dual northbound to eastbound I-55 ramps at the PSB. A Record of Decision (ROD) was issued in 2001, and was re-issued in 2008 after a re-evaluation of the ROD for the NMRB and associated improvements.

With the NMRB scheduled to be completed in early 2014, MoDOT revives plans to reroute all I-70 eastbound traffic to the new bridge and modified the west PSB Interchange (aka the Missouri South Interchange) which would ease congestion on the PSB. The interchange modifications are described in Section 4.1.3. The part of the plans is to remove the existing southbound I-70 to eastbound I-64/55/70 ramp. This ramp removal met opposition from Illinois leaders because it will eliminate the shortest connection between downtown St. Louis and the Sauget area. Also, it would be a major hit to the economic engine of the St. Clair County as the ramp is essential artery for the business located in the area.

In response to the public reaction, East-West Gateway Council of Governments (EWGCOG) commissioned an independent review of the PSB Interchange modification plans resulting in the "Poplar Street Bridge Independent Review" (the Review), dated September 12, 2012. The

Review concluded that preserving the southbound to eastbound ramp is not a viable option and suggested a ramp connection (the MLK Connector) between existing eastbound MLK Drive and westbound I-64/55/70 that would provide access to southbound IL 3. The Review has been presented to the EWGCOG Board of Directors and it was unanimously approved on September 26, 2012.

4.1 Related Projects

4.1.1 The New Mississippi River Bridge

The New Mississippi River Bridge (NMRB) is the first bridge connecting downtown St. Louis and southeast Illinois to be built in 40 years. The project is currently under construction and expected to be complete in early 2014.

The NMRB will provide better connections to and through St. Louis. The project includes a new bridge structure and the realignment of I-70 and numerous local roads on both side of the state line. The new facility will include four traffic lanes, two eastbound and two westbound, with direct ramp connections to and from downtown St. Louis. The project should provide transportation system reliability, sustainability, linkages and community access while reducing traffic congestion and increasing safety. When complete, the NMRB will be designated as I-70 and will relocate the east-west I-70 movement from the existing PSB as well as traffic from the MLK Bridge and will reduce overall traffic volumes on the bridges in the downtown area. The segment of existing I-70 from the PSB to the NMRB in downtown St. Louis will be re-designated as I-44 and the PSB will be redesignated I-55/64.

The NMRB project received a signed Record of Decision (ROD) and Final Environmental Statement (FEIS) and Design Approval in 2001. In the FEIS, the Preferred Alternative includes the following:

- Relocated I-70 includes an interchange with Relocated IL 3 (Illinois);
- A new, eight lane, I-70 Mississippi River Bridge (NMRB);
- An interchange with existing I-70 (Missouri);
- An improved Tri-level Interchange (I-64/55/70) in East St. Louis (Illinois);
- A connection between existing I-64/55/70 and the Relocated I-70 (Illinois); and
- Ramp improvements at the PSB Interchange (Missouri).

In the mid 2000's, when both states realized that neither state could afford the nearly $2 billion dollar NMRB project. In May 2005, the following revisions were proposed to reduce the cost of the project:

- Realign relocated I-70 to avoid The Cahokia canal Relocation;
- Reduce the NMRB main span from 2,000 ft to 1,500 ft;
- Eliminate The PSB interchange ramp improvements;
- Reduce the scale of the interchange with existing I-70; and
- Eliminate Tri-Level Interchange (I-64/55/70) improvements including its connection with the I-64 Connector.

In 2008 the FEIS was revised to document how the project could be constructed in functional phases. The independent initial phase of the project allows states to satisfy the major project requirements while providing elements to meet the main elements of the project's propose and need. The initial phase includes:

- A new two-way four- lane I-70 Mississippi River Bridge and approaches in Illinois and Missouri;
- A four-lane roadway (Relocated I-70) connecting the new bridge and Tri-Level interchange;
- Tri-Level Interchange improvements including local street improvements;
- A new interchange connecting the new bridge with the existing I-70 in Missouri; and
- A new local street connection from the new bridge to Cass Avenue in St. Louis.

The future project phase (NMRB Phase II) will include the following elements from the original plans:

- A companion four-lane Mississippi River Bridge;
- A relocated I-70 alignment from the east end of the NMRB to east of the I-64/55/70 Tri-Level Interchange;
- Connections to and from I-44 south of the NMRB; and
- Additional local street connections near Cass Avenue.

Additional projects, at this time, are not approved or funded and without a timeline for construction.

4.1.2 CityArchRiver 2015

CityArchRiver 2015 (CAR 2015) is a foundation-led project to revitalize downtown St. Louis. It connects the JNEM grounds (home of the Gateway Arch) to the Mississippi River by improving roadways, including interstates and streets, bridges and landscaping.

Besides modifications to three Interstate ramps and other surface street improvements, these plans include:

- Adding a new connection to create a new local street access to the existing on-ramp at the MLK Bridge. This will replace the westbound to northbound on-ramp movement lost at the Memorial Drive (existing I-70)
- An extension of North 3rd Street to connect with an existing on-ramp to westbound I-70 (future I-44) near the west terminus of the MLK Bridge.

The project AJR received conceptual FHWA approval in July, 2012. Pending environmental documentation and approval, construction is expected to begin in 2013 with completion by October 28, 2015.

4.1.3 Poplar Street Bridge Ramp Modifications

The PSB currently provides the only Interstate crossing of the Mississippi River into and out of downtown St. Louis. Currently carrying I-64, I-55, and I-70, as well as U.S. Highways 40 and 66 across its entire length, the PSB has a total of eight travel lanes (four in each direction) and no shoulders. The combination of all downtown St. Louis Interstate connections onto a single bridge contributes to severe peak-period congestion.

Most of the congestion on the bridge, both commuter and non-commuter traffic, is caused by the I-55 ramps to and from the west end of the PSB. The traffic demand has greatly oversaturated the capacity of these single-lane ramps. Increasing these ramps to two lanes is the only viable option for improving operations of the bridge.

There are currently four ramp connections at the west end of the PSB:

- “Ramp A” from PSB westbound that splits to connect to Memorial Drive northbound and to the depressed section of I-70 westbound, north of the PSB;
- One-lane ramp from westbound PSB to I-55 to the south;
- Two ramps from eastbound I-70 and Memorial Drive southbound that merge to become a one-lane connection (“Ramp B”) to the eastbound PSB; and
- One-lane ramp from I-55 in the south to PSB eastbound.

I-70 is currently undergoing a major realignment to divert the mainline highway to the north of downtown St. Louis. The first phase of the NMRB project is roughly two miles north of the PSB (discussed in Section 4.1.1 of this document), is currently under construction and scheduled to open in 2014. This project initially received a signed ROD and FEIS and Design Approval in 2001. The preferred NMRB alternative included alterations to the PSB ramps at the west side of the existing I-64/55/70 PSB (aka the Missouri South Interchange) among other downtown St. Louis Interstate access improvements. In 2004, it was determined that funding for the entire project could not be secured to satisfy the financial requirements. In May 2005, Illinois and Missouri initiated numerous efforts among them the elimination of the PSB ramp modifications to reduce the cost of the project.

The NMRB is expected to reduce the traffic on the existing PSB, especially the regional I-70 movements that currently pass through downtown St. Louis. In response to these shifts, MoDOT is again proposing to reconstruct the ramps at the west end of the PSB to alleviate the congestion on the bridge while working in conjunction with the roadway network changes proposed by the CAR 2015 project.

PSB Preferred Build Alternative includes (Figure 3):

- Reconstruct Ramp A from PSB westbound to connect with Memorial Drive northbound and the depressed section of I-70 westbound, north of the PSB;
- Replace the one-lane ramp from PSB westbound to I-55 to the south with a dual-lane ramp;
- Remove Ramp B from Memorial Drive southbound and I-70 eastbound to PSB eastbound;
- Replace the one-lane ramp from I-55 northbound to PSB eastbound with a dual-lane ramp.

4.1.4 Poplar Street Bridge Widening

In summer 2012 East-West Gateway commissioned an independent review of the I-70 PSB Ramp project resulting in the “Poplar Street Bridge Independent Review” (the Review) dated September 12, 2012. The Review concluded that PSB Preferred Build Alternative does not address capacity constraint represented by the four eastbound lanes on the bridge and merging heavy traffic streams. The Review investigated the PSB structure type and design and recommended bridge widening to enhance the overall performance of this river crossing. The proposed action presents unique approach in the bridge widening and includes slide of the southern (eastbound) bridge to the south for approximately nine feet (PSB Slide). It also includes extending the Sixth Street on-ramp (64 Split Initial) and adding “C-D” connection between the Sixth Street off-ramp and on-ramp, creating a third lane for the eastbound I-64 (64 Split Final). The Review recommended phased implementation of the proposed improvements and coordination with construction of the NMRB, the CAR 2015 project and the PSB Interchange modification project.

The Review recommendations are under further consideration and they will be addressed through the current re-evaluation of the FEIS, expected to be finalized in spring 2013.

4.1.5 2009 Martin Luther King Bridge Alternatives Analysis

A Road Safety Assessment (RSA) was completed for IDOT, MoDOT and City of St. Louis during the spring of 2009. The objective of the RSA was to conduct an assessment of two bridges in the St. Louis area (MLK Bridge and McKinley Bridge) to identify opportunities for safety enhancements on and around the general vicinity of the bridges and the impacted highway network, record observations, and suggest potential countermeasures for identified hazards. The RSA team conducted four days of field work observing the project location during various conditions and reviewed extensive information provided by IDOT and MoDOT. The findings were summarized in the final report.

As the response to the RSA report, IDOT prepared a study for the MLK Bridge. The purpose of this study was to evaluate alternative lane configurations that would improve safety along the bridge. MLK Bridge traffic is influenced by the downtown roadway network and the bridge geometrics. The bridge had four narrow travel lanes (approximately 10 ft wide) without a median to separate opposing traffic. Also, the sharp right-turn movement at the Missouri end of the bridge required westbound vehicles to slow to approximately 30 mph, resulting in minor backups and/or “moving queues” under heavy volumes. 2009 IDOT ADT maps showed that the bridge carried about 37,500 vehicles per day.

The existing geometrics in conjunction with vehicle speeds in excess of the 45 mph speed limit caused safety issues, specifically head-on collisions. Reducing the potential for these crashes was the primary focus in developing alternative lane configurations on the bridge. The narrow bridge eliminated the option of installing a median and maintaining four travel lanes, so focus shifted to studying alternatives that are designed to carry a maximum of the three lanes over the bridge. The alternatives are:

1. One eastbound lane and one westbound lane;
2. One westbound lane and two eastbound lanes;
3. Two westbound lanes and one eastbound lane;
4. Three divided lanes center reversible (manually operated);
5. Reversible three-lane operating westbound in the morning peak and the eastbound in the evening peak;
6. Movable barrier wall with reversible lane; and
7. Flush median variant of Alternative 4.

All alternatives were evaluated against traffic operation, safety and cost. Alternative 2, one westbound and two eastbound lanes, was selected as the preferred alternative and was implemented in 2010.

4.2 Transit Facilities

Metro Transit is the operator of the public transportation system for the St. Louis metropolitan region, with MetroLink, MetroBus and Metro Call-A-Ride. It was established as the Bi-State Development Agency (BSDA) in 1949 through an interstate compact between Missouri and Illinois, ratified by the U.S. Congress and signed by President Harry S. Truman. (The BSDA adopted the name Metro in 2003.) The BSDA was created to serve the region on both sides of the Mississippi - to have a regional outlook not tied to any one municipality, county or state. As such, it was given broad powers that enable it to cross local, county and state boundaries to enhance the development of the region.

Currently Metro Transit operates five bus routes across the MLK Bridge into and out of downtown St. Louis. MetroLink red line tracks, a passenger rail operates from Lambert Airport to Shiloh-Scott station, are located under the existing I-64/55/70 bridge structure.

5. Concerns

5.1 Traffic Safety

A crash analysis was performed for the five year period of 2007 through 2011on MLK Drive from the Illinois/Missouri State Line (mile station 0.00) to Missouri Avenue in Illinois (approximate mile station 0.81) and on I-64/55/70 from mile station 1.39 to mile station 1.75 in Illinois. In addition, the analysis included the ramps leading from I-70 CD Road #34 to southbound Tudor Avenue and to southbound IL-3. The analysis was confined to data obtained for eastbound traffic on MLK Drive, westbound traffic on I-64/55/70 and westbound traffic on the affiliated ramps only. The crash analysis was performed in these areas in an attempt to most precisely reflect the anticipated crash data that may occur at the new connection point between the proposed ramp from eastbound MLK Drive and westbound I-64/55/70 and that may occur at the exit points and merge points for the ramps leading from westbound I-70 CD Road #34 to southbound Tudor Avenue and to southbound IL-3.

Eastbound MLK Drive

In the beginning of 2010 the lane configuration of MLK Drive was altered, the number of lanes was reduced and a concrete barrier was installed between eastbound and westbound traffic. A more detailed description of the changes is presented in Section 4.1.5 of this Report. The eastbound historical data gathered for the MLK Drive analysis from 2007 through 2009 included crashes influenced by westbound traffic. To better reflect present road conditions, crashes involving a west bound vehicle were eliminated from the 2007 through 2009 eastbound analysis.

Within the designated eastbound MLK Drive analysis area, a total of 39 crashes occurred. None of the crashes resulted in a fatality, however 8 crashes (20.5% of the total crashes) resulted in a total of 15 injuries. The injuries included 4 Type-A (incapacitating), 8 Type B (non-incapacitating) and 3 Type C (injury reported, not evident).

The most common type of accident was the rear end collision which occurred 13 times (33.3%) during the analysis period. There were 12 same direction sideswipes (30.8%), 8 fixed object crashes (20.5%), 3 “other object” crashes (7.7%) and 3 various other types of crashes.

30 of the crashes (76.9%) occurred on clear days, 8 crashes (20.5%) took place during rain, snow or sleet events and 1 crash (2.6%) occurred in the fog. Pavement condition was recorded

as dry during 26 crashes (74.4%), wet for 7 crashes (17.9%) and icy in 6 crashes (15.4%). 22 of the crashes (56.4%) occurred during daylight, 12 (30.8%) within lighted conditions and 5 (12.8%) in darkness.

A summary of the eastbound MLK Drive crash data is included in Table 1.

Table 1: Summary of Eastbound MLK Drive Crash Data (2007-2011)

Crash Type	Number	Percentage	Type A Injury	Type B Injury	Type C Injury	Fatality
Rear End	13	33.3	2	5	1	0
Sideswipe	12	30.8	1	1	0	0
Fixed Object	8	20.5	1	1	0	0
Other Object	3	7.7	0	0	0	0
Turning	2	5.1	0	1	2	0
Angle	1	2.6	0	0	0	0
Total	39	100	4	8	3	0

A Crash Analysis Diagram for eastbound MLK Drive may be found on Figures 6-8.

The lane reconfiguration and installation of a concrete traffic barrier on MLK Drive in early 2010 has had a significant impact on the number of crashes within the crash analysis study area of MLK Drive. During the 3 years prior to the lane improvements, there was an average of 10 crashes per year for eastbound traffic alone. Since improvements have been put in place, the eastbound number of crashes for the subsequent two years has been reduced to an average of 5 per year.

51% of the accidents on eastbound MLK Drive are same direction sideswipes and fixed object collisions. The probable cause of these types of collisions is the confined maneuvering space on the extended bridge and the relatively short distance between the end of the bridge and the first exit ramp.

33% of eastbound MLK Drive crashes were rear end collisions and 11 of these 13 crashes occurred during daylight hours. The probable cause for the frequency of rear end collisions primarily during daylight hours is the heavy traffic on eastbound MLK Drive during morning and evening rush hours. 5 of the crashes took place between 7:00am and 9:00am and 4 took place between 4:00pm and 6:00pm which is 82% of the daylight rear end collisions.

More detailed crash analysis data may be found in Figure 4.

Westbound I-64/55/70

Within the designated westbound I-64/55/70 analysis area, a total of 36 crashes occurred. None of the crashes resulted in a fatality, however 4 crashes (11.1% of the total crashes) resulted in a total of 7 injuries. The injuries included 3 Type-A (incapacitating) and 4 Type B (non-incapacitating).

The most common type of accident was the same direction sideswipe which occurred 14 times (38.9%) during the analysis period. There were 11 rear end collisions (30.6%), 5 fixed object crashes (13.9%), 2 “other object” crashes (5.6%) and 4 various other types of crashes.

32 of the crashes (88.9%) occurred on clear days and 4 crashes (11.1%) took place during rain, snow or sleet events. Pavement condition was recorded as dry during 30 crashes (83.3%), wet for 3 crashes (8.3%) and icy or snowy in 3 crashes (8.3%). 25 of the crashes (69.4%) occurred during daylight, 8 (22.2%) within lighted conditions and 3 (8.3%) in darkness.

A summary of the westbound I-64/55/70 crash data is included in Table 2.

Table 2: Summary of Westbound I-64/55/70 Crash Data (2007-2011)

Crash Type	Number	Percentage	Type A Injury	Type B Injury	Type C Injury	Fatality
Sideswipe	14	38.9	1	0	0	0
Rear End	11	30.5	0	4	0	0
Fixed Object	5	13.9	0	0	0	0
Other Object	2	5.6	0	0	0	0
Other Non-Collision	3	8.3	0	0	0	0
Head On	1	2.8	2	0	0	0
Total	36	100	3	4	0	0

A Crash Analysis Diagram for westbound I-64/55/70 may be found on Figures 9 and 10.

Approximately 53% of the accidents on westbound I-64/55/70 are same direction sideswipes and fixed object collisions. The probable cause of these types of collisions is the curved road alignment and the number of crossovers and merges in the analysis area.

31% of westbound I-64/55/70 crashes were rear end collisions and all of these 11 crashes occurred during daylight hours. The probable cause for the frequency of rear end collisions during daylight hours is the heavy traffic on I-64/55/70 during morning and evening rush hours. 6 of the crashes took place between 6:30am and 9:00am and 3 took place between 4:00pm and 6:00pm which is 82% of all the rear end collisions.

More detailed crash analysis data may be found in Figure 4.

Ramps

The crash analysis included exit ramps leading from westbound I-64/55/70 to southbound Tudor Avenue and to southbound IL-3. Information was provided for an area one quarter mile prior to an exit or merge and one tenth mile beyond the exit or merge. Four areas were evaluated. The 13th St./Tudor Ave. (FAU 9179) exit from westbound I-70 CD Road #34, the southbound IL-3 exit from westbound I-70 CD Road #34, the 13th St./Tudor Ave. (FAU 9179) merge with eastbound I-70 CD Road #35 and the southbound IL-3 ramp merge with eastbound I-70 CD Road #35.

13th St./Tudor Ave. (FAU 9179) Exit from Westbound I-70 CD Road #34

Within the designated analysis area, a total of 14 crashes occurred. None of the crashes resulted in a fatality, however 3 crashes (21.4% of the total crashes) resulted in a total of 3 injuries. The injuries included 1 Type-A (incapacitating), 1 Type B (non-incapacitating) and 1 Type-C (injury reported, not apparent).

The most common type of accident was the rear end collision which occurred 7 times (50.0%) during the analysis period. There were 2 same direction side swipes (14.3%), 4 fixed object crashes (28.6%) and 1 overturn accident (7.1%).

11 of the crashes (78.6%) occurred on clear days and 3 crashes (21.4%) took place during rain events. Pavement condition was recorded as dry during 8 crashes (57.1%), wet for 3 crashes (21.4%) and icy in 3 crashes (21.4%). 8 of the crashes (57.1%) occurred during daylight, 3 (21.4%) within lighted conditions and 3 (21.4%) in darkness.

A summary of the 13th St./Tudor Ave. (FAU 9179) Exit from Westbound I-70 CD Road #34 crash data is included in Table 3.

Table 3: Summary of 13th St./Tudor Ave. (FAU 9179) Exit from Westbound I-70 CD Road #34 Crash Data (2007-2011)

Crash Type	Number	Percentage	Type A Injury	Type B Injury	Type C Injury	Fatality
Sideswipe	2	14.3	0	0	0	0
Rear End	7	50.0	0	1	0	0
Fixed Object	4	28.6	1	0	1	0
Overturned	1	7.1	0	0	0	0
Total	14	100	1	1	1	0

A Crash Analysis Diagram for the 13th St./Tudor Ave. (FAU 9179) Exit from Westbound I-70 CD Road #34 may be found on Figure 11.

50% of crashes in the exit area were rear end collisions and all of these 7 crashes occurred during daylight hours. Approximately 47% of the accidents in the exit area are same direction sideswipes and fixed object collisions and 5 of these occurred during nighttime hours. The probable cause of these various types of collisions throughout all hours of the day is the close proximity of the Main Street entrance ramp merge and the 13th St./Tudor Ave. exit.

More detailed crash analysis data may be found in Figure 4.

The area of the 13th St./Tudor Ave. exit from westbound I-70 CD Road #34 averages approximately 3 crashes per year. Completion of the MLK Connector and the NMRB is not expected to increase traffic in a significant way if at all and should have little impact on the number of crashes in this area.

Southbound IL-3 Exit from Westbound I-70 CD Road #34

Within the designated analysis area, a total of 2 crashes occurred. None of the crashes resulted in a fatality or injury. Both crashes were rear end collisions and occurred on clear days. Both crashes took place on dry pavement with one during daylight hours and one during darkness.

A summary of the Southbound IL-3 exit from Westbound I-70 CD Road #34 crash data is included in Table 4.

Table 4: Summary of Southbound IL-3 Exit from Westbound I-70 CD Road #34 Crash Data (2007-2011)

Crash Type	Number	Percentage	Type A Injury	Type B Injury	Type C Injury	Fatality
Rear End	2	100.0	0	0	0	0
Total	2	100	0	0	0	0

A Crash Analysis Diagram for the Southbound IL-3 Exit from Westbound I-70 CD Road #34 may be found on Figure 12.

More detailed crash analysis data may be found in Figure 4.

13th St./Tudor Ave. (FAU 9179) Merge with Eastbound I-70 CD Road #35 Exit Ramp

Within the designated analysis area, one crash occurred. The crash did not result in a fatality nor an injury. The crash was an "other object" collision and occurred on a clear day during darkness on dry pavement.

A summary of the 13th St./Tudor Ave. (FAU 9179) merge with eastbound I-70 CD Road #35 crash data is included in Table 5.

Table 5: Summary of 13th St./Tudor Ave. (FAU 9179) Merge with Eastbound I-70 CD Road #35 Exit Ramp Crash Data (2007-2011)

Crash Type	Number	Percentage	Type A Injury	Type B Injury	Type C Injury	Fatality
Other Object	1	100.0	0	0	0	0
Total	1	100	0	0	0	0

A Crash Analysis Diagram for the13th St/Tudor Ave (FAU 9179) Merge with Eastbound I-70 CD Road #35 Exit Ramp may be found on Figure 13.

More detailed crash analysis data may be found in Figure 4.

Southbound IL-3 Ramp Merge with Eastbound I-70 CD Road #35 Exit Ramp

Within the designated analysis area, one crash occurred. The crash did not result in a fatality nor an injury. The crash was a "fixed object" collision and occurred on a clear day in a lighted area on dry pavement.

A summary of the Southbound IL-3 exit from Westbound I-70 CD Road #34 crash data is included in Table 6.

Table 6: Summary of Southbound IL-3 Ramp Merge with Eastbound I-70 CD Road #35 Exit Ramp Crash Data (2007-2011)

Crash Type	Number	Percentage	Type A Injury	Type B Injury	Type C Injury	Fatality
Fixed Object	1	100.0	0	0	0	0
Total	1	100	0	0	0	0

A Crash Analysis Diagram for the Southbound IL-3 Ramp Merge with Eastbound I-70 CD Road #35 Exit Ramp may be found on Figure 14.

More detailed crash analysis data may be found in Figure 4.

The three areas of the southbound IL-3 exit from westbound I-70 CD Road #34, the 13th St./Tudor Ave. merge with the eastbound I-70 CD Road #35 exit ramp and the southbound IL-3 ramp merge with eastbound I-70 CD Road #35 exit ramp experienced a total of 4 crashes over a five year period. Completion of the MLK Connector and the NMRB is not expected to increase traffic in a significant way if at all and should have little impact on the number of crashes in this area.

Five Percent Report Review

As part of the Highway Safety Improvement Program, states are required to submit an annual report to FHWA describing not less than five percent of the highway locations exhibiting the state’s most pressing safety needs. These locations are where severe crashes, specifically fatalities, are clearly overrepresented (Five Percent Locations).The 2012 FHWA Highway Safety Improvement Program Five Percent Report for the State of Illinois includes MLK Drive between mile station 0.0 and mile station 0.53 and I-64/55/70 between mile station 0.0 and mile station 0.62. The proposed ramp from eastbound MLK Drive to westbound I-64/55/70 will begin at mile station 0.43 and therefore is partially within a designated Five Percent Location. The proposed ramp will merge with I-64/55/70 in the area between mile station 1.42 and mile station 1.62 which is outside of the designated Five Percent Location along I-64/55/70. The affiliated CD Roads and exit ramps in this area are not included in the 2012 Five Percent Report.

Assurances must be made to FHWA that minimal adverse impact on safety and operation of MLK Drive will occur. The proposed ramp will be constructed to modern freeway standards. Current FHWA and IDOT standards will be utilized with respect to design speed, cross section elements, horizontal and vertical geometry, barrier warrants and safety warning devices. It is anticipated that construction of the NMRB will reduce traffic on MLK Drive which will only enhance safety and operation. It is expected that the improvements described in Section 4.1.5 and implemented in 2010 along with the reduced traffic will eliminate MLK Drive as a Five Percent Location in the FHWA Safety Improvement Program.

Conclusions

Once construction of the New Mississippi River Bridge is completed, it is projected that the number of vehicles travelling on the MLK Bridge will be greatly reduced. Through traffic will continue on I-70 while, in most cases, only local traffic will use the MLK Bridge. Most of the traffic exiting onto the new ramp from eastbound MLK Drive will not weave onto westbound I-64/55 but will remain to the right and exit onto local streets. Construction of the new bridge will also reduce the number of vehicles travelling on westbound I-64/55 which will contribute to diminishing the encounters between vehicles at the merge point of the new ramp and I-64/55. Because of the NMRB, it is expected that the number of crashes in this area will be reduced and safety will be enhanced.

5.2 Environmental Concerns

A wetland survey was conducted during the fall of 2012 in the MLK Connector vicinity. All potential wetlands within the specified area were examined using criteria established in the *Corps of Engineers Wetland Delineation Manuel* (Environment Laboratory 1987) and the *Regional Supplement to the Corps of Engineers Wetland delineation Manuel: Midwest Region (Version 2.0)* [U/S Army Corps of Engineers (USACE) 2010]. Three sites met these criteria and were, therefore, determined to be wetlands. Summary information regarding these wetlands is presented in the Wetland Delineation Report, dated November 2012. All three delineated wetlands are located south of the MLK Drive, at the MLK Connector departure point from the existing roadway.

A PESA dated 2006 for a previous project within the project area lists APEX Petroleum Fuel and Terminal Company as owning the property on the south side of the Martin Luther King approach. This area contains two large above ground storage tanks. These tanks were installed between 1955 and 1962 and have documented cases of leaking in the past. The Illinois State Geological Survey in 2006 determined that this area contained volatile organic compounds significantly above background levels in soil gas and the headspace of soil samples taken from boreholes at APEX Petroleum Fuel and Terminal Company. In addition, soil samples taken in 2006 by the ISGS in this area contained the heavy metals antimony, arsenic, and lead and exceeded the ingestion values for the Illinois Environmental Protection Agency (IEPA). The heavy metals antimony, arsenic, and lead exceeded both the ingestion and inhalation values for the IEPA Tier 1 residential Tiered Approach to Cleanup Objectives (TACO). In addition, lead exceeded the ingestion value to the IEPA Tier 1 residential TACO objectives.

A few isolated depressional areas that are mapped as regulatory flood plain (Zone AH) in the vicinity of the project. These areas have a Base Flood Elevation (BFE) of 408 (NAVD88) according to data provided in the Flood Insurance Study (FIS) and associated mapping dated November 5, 2003 (panels 20 and 160 of 555 and marked “preliminary”). This BFE assumes that no riverine flooding occurs within the area and the flooding is solely due to local runoff entering the local depressional storage areas. The compensatory storage will be required for fill associated with fill within the isolated AH areas.

6. Communities

The project lies in the Mississippi River floodplain in the township of East. St. Louis, Illinois immediately across the river from downtown St. Louis, Missouri (Figure 1). The terrain in the immediate vicinity of the project study area can be described as flat. The area is protected by a system of levees and floodwalls from floodwater of the Mississippi River.

The portion of East St. Louis where the MLK Connector project is located, has seen intensive human settlement and varied land use for more than 100 years with a broad range of uses and activities normally associated with urbanized areas. Within a 0.5-mile radius of the project, the land uses are a mix of industrial, commercial and residential development as well as some undeveloped area. To the south and west of the project, the land use is commercial and consists primarily of parking and facilities associated with the Casino Queen. There is also a commercial warehouse along South Main Street. Immediately to the south and east of the project lies I-64/55/70. East of the interstate is a mix of mostly commercial and some residential uses within the city of East St. Louis. The commercial uses lie in the downtown business district of East St. Louis and consist of: the East St. Louis government center; part of Southern Illinois University's East St. Louis campus; convenience stores; banks; office buildings and clubs. Immediately north of the project lies the approach to the Martin Luther King Bridge and north of that is area that is primarily undeveloped. These commercial land uses lie between 0.2 and 0.3 miles east of the MLK Connector.

Approximately 2.1 miles south of the MLK Connector is the Village of Sauget, Illinois. Sauget is comprised of a mix of mostly industrial and some retail commercial land uses. The industrial land uses focus on manufacturing and chemical processing. Like East St. Louis, this area has seen intensive human settlement for more than 100 years.

Other features within 0.5 mile of the project include the Gateway Geyser (part of the JNEM), and Malcolm W. Martin Park. Also, various railroad tracks are in the project vicinity including: Norfolk and Southern Railroad, located just west of I-64/55/70, runs in the south-north direction; MetroLink red line, located south of MLK Drive, runs in the east-west direction and passes under I-64/55/70.

Approximately 1.1 miles west of the proposed MLK Connector across the Mississippi River is the city of St. Louis, Missouri. Land uses at the west end of the MLK Bridge are a mix of commercial (office and retail) and high-density residential. Immediately north of the MLK Bridge on the Missouri side of the Mississippi River lies Lumiere Place Casino and Hotel. To the south lies the historic commercial district of Laclede's Landing. The JNEM and the grounds of the Gateway Arch lie 0.2 miles south of the MLK Bridge. This area has seen intensive human settlement for over 200 years.

The 2010 population of East St. Louis Township is 27,006 (Source: U.S. Census Bureau, 2010 Census). Of the total population, 26,454 (or 98.0%) is African American and 241 (or 0.9%) is White. The remaining population (1.1%) is made up of a mix of several races. There are 10,119 households in the township; however, there are only approximately six housing units within 0.5 mile of the project.

The Village of Sauget lies in Centreville Township. The 2010 population of the Village of Sauget was 159 (Source: US Census Bureau, 2010 Census). Of this population, 148 is White and 9 is African American. There are 76 households in the village.
The City of St. Louis is an independent city. The 2010 population of St. Louis was 319,294 (Source: US Census Bureau, 2010 Census). Approximately 44% of this population is White, and 49% is African American. The remaining percentage is a mix of ethnicities. There are two census tracts in the immediate vicinity of the MLK Bridge, Tract 1256 and 1257. In 2010, the total population of Census Tract 1256 was 4,113 (2,012 White, 1,729 African American, the remainder a mix of other ethnicities). The total population of Census tract 1257 was 3,329 (3,210 African American, 59 White, the remainder a mix of other ethnicities).

7. Connections

Two existing interchanges are located near the project location:

- Approximately 1.2 miles east of the MLK Connector tying point to the existing I-65/55/70, these three interstates converge into the one and continue further west toward the PSB.

This interchange, the Tri-Level Interchange, is currently under reconstruction to provide access to the future I-70 (Figure 18).

- Approximately 2.0 miles southwest of the MLK Connector tying point to the existing I-64/55/70, immediately west of the PSB Bridge, three existing interstates diverge into the separate interstates, I-64, I-55 and I-70. This diverge point is also known as the Missouri South Interchange as is subject to the future improvements as shown on Figure 3.

As the distance to the both adjacent interchanges is over a mile, it is anticipated that MLK Connector would not negatively affect traffic operations of the adjacent interchanges. Additionally, the completion of the NMRB will significantly reduce the traffic travelling on the MLK Bridge and entering onto I-64/55 from MLK Drive and will also reduce the number of vehicles on westbound I-64/55.

8. Design Exceptions

Selected features of the project will not comply with IDOT policies. Permanent waivers will need to be granted for these conditions listed below in Table 7.

Table 7: Anticipated Design Exceptions

Description	IDOT "Action Item"	Conditional FHWA Approval
The Stopping sight distance for the ramp meets for 35 mph. (Policy is 40 mph)	Submit for Approval	Yes
The K-value for the sag vertical curve tying in the I-55/64 mainline meets for 35 mph. (Policy is 40 mph)	Submit for Approval	Yes
Section D-D of the MLK Bridge exit terminal has a ramp elevation above the mainline edge of pavement. (Policy is for it to be below the mainline EOP)	Submit for Approval	Yes

9. Traffic Signals/Signing

The MLK Connector is not expected to alter the existing signage plan on the Missouri side of the river. The existing signs on the MLK Drive will be relocated/changed due to the MLK Connector location and appropriate exit signage for the MLK Connector will be added as well. The I-64/44 existing signs, at the MLK Connector tying point, will be relocated due to the proposed bridge widening. See Figures 15 and 16 for the preliminary signage plans. These plans will be further developed during the Design Phase in accordance with applicable policy and design standards.

10. Lane Balance

Important element in the design is lane balance, which presents a set of principles that apply at freeway exits and entrances. At entrances, the number of lanes beyond the merging of two traffic flows should be not less than the sum of approaching lanes minus one. Exceptions to these roles and more detailed explanations are shown in Bureau of Design and Environment Manuel (BDE), Section 37-2.03. The lane balance principles are satisfied at the MLK Connector tying point to the I-64/55/70 (entrance ramp).

11. Existing Facilities

11.1 Existing Interstate System

St. Louis, Missouri is home to many large national transportation routes that serve local, regional, and national traffic demands. The Interstate highways that traverse St. Louis are:

- **Interstate 44 (I-44)** begins in Wichita Falls, Texas and runs about 634 miles in a generally northeasterly direction to a junction with I-55, southeast of the PSB. Upon completion of the NMRB and related connector roadway and interchange projects, the Interstate freeway segment between the west end of the PSB and the Missouri North I-70 Interchange (at the west end of the NMRB), currently designated as I-70, will be re-designated as I-44.
- **Interstate 55 (I-55)** begins in LaPlace, Louisiana, and runs about 964 miles in a generally northerly direction to Chicago, Illinois. From LaPlace to St. Louis, I-55 roughly parallels the Mississippi River. I-55 crosses the Mississippi River at Memphis and again on the PSB.
- **Interstate 64 (I-64)** begins in Wentzville, Missouri, about 40 miles west of St. Louis, and runs about 954 miles in a generally easterly direction to Chesapeake, Virginia. I-64 crosses the Mississippi River on the PSB.
- **Interstate 70 (I-70)** begins in Cove Fort, Utah, and runs about 2,153 miles in a generally easterly direction to Baltimore, Maryland. I-70 currently crosses the Mississippi River on the PSB. Upon completion of the NMRB and related connector roadway and interchange projects, the new Interstate freeway segment from the Missouri North I-70 Interchange across the NMRB to the Tri-Level Interchange (at the east end of the NMRB project) in Illinois would be designated as I-70. The Interstate freeway segment between the west end of the PSB and the Tri-Level Interchange would be re-designated as I-55/I-64. The Interstate freeway segment between the west end of the PSB and the Missouri North I-70 Interchange, currently designated as I-70, would be re-designated as I-44.
- **Interstate 255 (I-255)** begins in Mehlville, Missouri, about 3.8 miles west of the Mississippi River, and runs about 30.8 miles in a generally northeasterly direction to Pontoon Beach, Illinois. I-255 composes the eastern third of the circumferential highway system around metropolitan St. Louis. I-255 crosses the Mississippi River on the Jefferson Barracks Bridge.
- **Interstate 270 (I-270)** begins in Mehlville, Missouri, about 3.8 miles west of the Mississippi River, and runs about 50.6 miles in a generally northerly and then easterly direction to Troy, Illinois. I-270 composes the western two-thirds of the circumferential highway system around metropolitan St. Louis. I-270 crosses the Mississippi River on the Chain of the Rocks Bridge.

The existing St. Louis Interstate system is displayed in Figure 17. The future Interstate system designation in the St. Louis downtown area is shown in Figure 18.

11.2 Existing Bridge System

Figure 17 shows the crossings of the Mississippi River, available to motorists, in the St. Louis area. These include:

- **Eads Bridge,** completed in 1874, was the first major bridge to use steel and was, at the time, the longest supported-deck arch bridge. Today, the Eads Bridge is the oldest bridge crossing of the Mississippi River, and is owned and operated by the City of St. Louis. It has undergone several periods of rehabilitation and serves as an iconic structure within the downtown landscape. The Eads Bridge accommodates four lanes of traffic and a pedestrian/bicycle path on its upper deck and MetroLink rail on the lower deck. The Eads Bridge connects Washington Avenue in St. Louis, between the Jefferson National Expansion Memorial (JNEM) and Laclede's Landing, with Broadway Avenue in East St. Louis, Illinois.

- **Poplar Street Bridge (PSB),** located about 4,100 feet south of the Eads Bridge, carries eight lanes of traffic and about 100,000 vehicles per day. The PSB is designated as I-64, I- 55, I-70, and U.S. Highways 40 and 66 across its entire length.
- **Jefferson Barracks Bridge (J.B. Bridge),** located about 11 miles south of the Eads Bridge, is a pair of bridges carrying three lanes of traffic each. The J.B. Bridge is designated as I-255 and US-50.
- **Martin Luther King Bridge,** located about 740 feet north of the Eads Bridge, provides an alternate, direct connection between existing I-70 (future I-44) in downtown St. Louis and I-64/I-55/I-70 (future I-64/55) in East St. Louis.
- **McKinley Bridge,** located 2.5 miles north of the Eads Bridge, was originally built in 1910 as a railroad bridge. One lane in each direction for automobile traffic was added in the 1930s. A major refurbishment in 2004 resulted in its current configuration with two automobile travel lanes on the inside, an exclusive service lane on the north side of the bridge, and an exclusive pedestrian sidewalk/bike path on the south side of the bridge. McKinley Bridge connects northern downtown St. Louis with Venice, Illinois.
- **New Chain of Rocks Bridge,** located about nine miles north of the Eads Bridge, is a pair of bridges carrying two lanes of traffic each. The New Chain of Rocks Bridge is designated as I-270. The original Chain of Rocks Bridge, located about 1,700 feet south of the New Chain of Rocks Bridge, is a narrow bridge with a 22° bend that currently carries pedestrians and bicyclists only and is part of the St. Louis region’s greenway network.

11.3 No-Build Alternative

The removal of the existing southbound I-70 (future I-44) to eastbound I-64/55/70 ramp eliminates the closest westbound-eastbound connection between downtown St. Louis and the Sauget area. The shift of Illinois eastbound traffic to other existing facilities (Figure 19) would continue and likely increase over time. Those other facilities include:

1. The Marion Ramp accessing northbound I-55 and 6th Street Ramp accessing eastbound I-64. Once on the PSB, vehicles would utilize routes as they currently do.
2. Eastbound Eads Bridge and River Park Drive to westbound Main Street and to southbound IL Route 3.

3. Eastbound MLK Bridge and MLK Drive to eastbound I-64/55/70 (future I-64/55) utilizing St. Clair Avenue to the entrance ramp to westbound I-64/55/70. Another option for the vehicles crossing the MLK Bridge would be to continue eastbound on MLK Drive to westbound Collinsville Road which becomes Main Street and has a ramp connection to southbound IL Route 3.
4. Eastbound NMRB and relocated I-70 to St. Clair Connector and southbound St. Clair Avenue. Further south vehicles would utilize St. Clair Avenue ramp to southbound IL Route 3.

Although the no-build alternative provides access from downtown St. Louis to the Sauget area it would introduce adverse travel for the commuters. It requires complex signage along the routes due to numerous decision points. Also, it presents less safe option as it would partly utilize local street network with uncontrolled access roadways. Improving existing roadways would not reduce the travel time, improve safety or remove complexity of the routes.

The no-build alternative is not a viable option for the location.

12. Transportation System Management

Traffic System Management consists of tools, techniques, and policies aimed to provide additional capacity on a facility or network without involving construction. Some of the tools are freeway and incident management systems, traveler information, and integrated traffic signal systems. TSM also includes ramp metering, mass transit, and HOV facilities.

As the proposed modification involved construction of the new ramp to replace vehicular movement being eliminated by removal of the existing ramp at the PSB Interchange, TSM alternatives are not viable options for this project situation.

13. Access Connections and Design

13.1 Access Connections

The MLK Bridge was built in 1951 to relieve congestion on other bridges over the Mississippi River. Its extension is MLK Drive, classified as an Other Principal Arterial. On its eastern end the MLK Drive is connected to I-64/55/70 creating a partial interchange. The I-64/55/70 was built in 1965 as part of the interstate system.

The existing interchange provides the following movements (Figure 2):

- eastbound MLK Drive to eastbound/northbound I-64/55/70
- westbound/southbound I-64/55/70 to westbound MLK Drive

The proposed improvement would provide access from eastbound MLK Drive to westbound I-64/55/70. No other movements will be provided within this project (Figure 2).

13.2 Design

The MLK Connector provides a connection between existing eastbound MLK Drive and existing I-64/55/70 bridge structure. The design speed of MLK Drive is 50 mph, 45 mph posted. MLK Drive at the MLK Connector departure point, is a tangent roadway with the profile at a sag vertical curve (L=420 ft). Further east, the existing profile rises at 4.0% to overpass a railroad. The existing I-64/55/70 bridge structure is curved to the left (R=1,551.03 ft) and superelevated at 8.0% maximum. The existing bridge profile, at the MLK Connector tying point, is a vertical curve (L=560 ft, crest) connecting +3.494% and -2.675% slopes. Design speed of this interstate section is 55 mph, 50 mph posted.

Five different alternatives, based on different design speeds, have been analyzed for the proposed MLK Connector. The Analysis included: available weaving distance at the tying point to the I-64/55/70; additional acceleration distance required at the I-64/55/70 tying point; impact to the existing billboards; proposed ramp grades; widening of the existing bridge structure; and posted speed.

The 50 mph alternative would provide no weaving area on I-64/55/70, may have sight distance issues, impacts hazardous waste and existing billboards and has a high cost. The 45 mph and 42.5 mph alternatives would provide a deficient weaving area and would impact existing billboards but would avoid hazardous waste. The 40 mph alternative would provide a deficient weaving area and would avoid hazardous waste and existing billboards. The 35 mph alternative would require an auxiliary lane for acceleration and may have operational and safety issues. FHWA and BDE concurred that the 40 mph alternative is preferred as the weaving area provided by this alternative would provide redundancy in system movement. Summary of the analysis is shown as Figure 20.

The MLK Connector has been designed in accordance with current standards and criteria established by IDOT as well as the American Association of State Highway and Transportation Officials (AASHTO). The specific documents utilized include:

- Bureau of Design and Environmental Manual (BDE), 2012
- Policy of Geometric Design of Highways and Streets, 2011
- Highway Capacity Manual, 2010.

A set of ramp criteria was developed and is shown in Table 8. The MLK Connector preliminary typical sections are shown on Figure 21. Preliminary roadway plans and profiles are shown as Figures 22-27.

The MLK Bridge itself has adequate capacity to accommodate rerouted traffic, especially given that MLK EB p.m. peak-hour traffic is expected to significantly decrease (by approximately half) once the NMRB is constructed. In addition after traffic bound for IL Route 3 exits MLK onto westbound I-64/55/70, it would stay in the right lane of traffic and no weaves across mainline traffic would be necessary. The fact that this movement is in the reverse commute direction indicates that capacity should be sufficient.

IDOT, in cooperation with MoDOT, has been developing a rehabilitation project (already programmed on the STIP) for the MLK Bridge to address known structural deficiencies in the truss spans. Following completion of this project the MLK Bridge is anticipated to remain safe and functional connection across the Mississippi River and adequate alternative for making the connection to southbound IL 3 and the Sauget area.

Table 8: MLK Connector Design Criteria

	Criteria	Reference	Remarks
Operation	loop: 25 mph outer ramp: 50 mph	IDOT BDE Figure 37-4.E	V_D= 40 mph used
Design Speed			
Expected Regulatory Speed	35 mph	N/A	
Level of Service (LOS)	C	HCM	
Clear Zone		IDOT BDE Figure 38-3.A	V_D= 40 mph
Front Slopes	1:6 or flatter: 12-14 ft; 1:5 to 1:4: 14-16 ft		
Backslopes	1:3: 12-14 ft; 1:5 to 1:4: 12-14 ft; 1:6 or flatter: 12-14 ft	IDOT BDE Figure 38-3.A	V_D= 40 mph
Clear Zone Adjustment Factors for Horizontal Curves	Varies 1.1 to 1.5	IDOT BDE Figure 38-3.D	Based on radius
Horizontal Alignment	6%	IDOT BDE Figure 37-4.F	
Maximum Superelevation (e_{max})			
Minimum Radius	40 mph: 485 ft	IDOT BDE Figure 37-4.F	
Minimum Length of Compound Curve	Varies Based on Radius	IDOT BDE Figure 37-4.H	
Minimum Superelevation Length	40 mph: 165 ft	IDOT BDE Figure 37-4.F	
Vertical Alignment	+4% and -6%	IDOT BDE Figure 37-4.F	
Maximum Grade			
Minimum Length of Crest Vertical Curve	40 mph: L=3V=3(40)=120ft	IDOT BDE Section 33-4.01(a)	
Minimum Rate of Crest Vertical Curve, K	40 mph=52	IDOT BDE Figure 33-4.D	Adjusted for 6% downgrades
Minimum Length of Sag Vertical Curve	40 mph: L=3V=3(40)=120ft	IDOT BDE Section 33-4.02(a)	
Minimum Rate of Sag Vertical Curve, K	40 mph=72	IDOT BDE Figure 33-4.F	Adjusted for 6% downgrades
Minimum Vertical Clearance	16'-9"	IDOT BDE Figure 44-5.A	
Mainline Structure Over New and Replaced Ramp			

	Criteria	Reference	Remarks
Ramp Structure Over Railroad	23 ft	IDOT BDE Figure 44-5.A	
Ramp Structure Over Interstate and State Routes	16'-9"	IDOT BDE Figure 44-5.A	
Ramp Structure Over Local Roads and Streets	14'-9"	IDOT DBE Figure 48-6.A	
1-Lane Ramp	16 ft	IDOT BDE Figure 37-4.G	
Cross Section			
Lane Width			
Left Shoulder Width	6 ft total, 4 ft paved	IDOT BDE Figure 37-4.G	
Right Shoulder Width	8 ft total, 6 ft paved	IDOT BDE Figure 37-4.G	
Cross Slope Traveled Way	1.50%	IDOT BDE Figure 37-4.G	2% used
Exit Ramp Diverge Taper	3° 7' 15"	IDOT BDE Figure 37-6.A	
Standard Ramp			
Entrance Ramp Merge Taper	1:50	IDOT BDE Figure 37-6.K, 37-6.L	
Side Slopes	1:4 (V:H) or flatter	IDOT BDE Section 37-4.06 #6	1:3 used to minimize impact
Foreslope			
Backslope	1:3 (V:H)	IDOT BDE Figure 34-4.C	
Sight Distance	40 mph: 335 ft	IDOT BDE Figure 31-3.B	Adjusted for 6% downgrades
Stopping			
Decision	40 mph: 825 ft	IDOT BDE Figure 31-3.C	
Clear Recovery Area beyond gore nose	>100 ft	IDOT BDE Section 37-6.01(e)	

14. Transportation Land Use Plans

The proposed improvements are not expected to alter the pattern of the land use and zoning in St. Clair County. The improvements will reinforce the existing industrial/commercial land uses in East St. Louis. The new construction will occur in an established urban context and will improve existing transportation linkage.

The MLK Connector will maintain easier access to southbound IL 3 than the no-build alternative. This is important as the IL 3 is a vital economic artery for the Sauget area and the metro-east.

The project is supported by the cities of St. Louis and East St. Louis, as well as the local MPO, EWGCG, as it is consistent with published plans, land use and policies.

It is expected that the MLK Connector project will be included in *Regional Transportation Plan 2040* and *2013-2016 TIP* as the connected project, the PSB Interchange improvement project, was part of these plans. Anticipated date is spring 2013.

15. Comprehensive Interstate Network Study

The MLK Connector project is located in the area which was under intensive studies in the past. It started in the early 1990's as an effort to address traffic issues in downtown St. Louis. In 1992, MoDOT and IDOT started an EIS to address these issues. The Final EIS was clearly pointed that the PSB as an outdated structure with the traffic greatly exceeding bridge capacity. In 2001, the DOT's received a ROD from FHWA to move forward with the new bridge project. Later in 2008 the FEIS was revised to build the project in functional phases. The Initial Phase, the new four-lane NMRB, is currently under construction including reconfiguration of the Tri-Level Interchange located in close proximity of the MLK Connector. The access change for the Initial Phase project is addressed in Mississippi River Crossing, New I-70 Mississippi River Bridge Crossing – Initial Phase, Access Justification Report (January, 2009). It is anticipated that the NMRB and related roadways will be completed in early 2014.

Part of a downtown St. Louis revitalization is the CityArchRiver 2015 (CAR 2015) project to reconnect the Jefferson National Expansion Memorial and the Mississippi River through improvements to the street network, bridges, landscaping, sidewalks and highway ramp modifications. This project includes ramp modifications addressed in the CityArchRiver 2015, Access Justification Request for Concept Approval (June 15, 2012).

The second phase of the NMRB project includes reconfiguration of the PSB Interchange ramps. MoDOT addressed these ramp modifications through the Poplar Street Bridge Project, Draft Access Justification Report (July 2012). This document is currently under revision to incorporate recommendations of the "Poplar Street Bridge Independent Review", excluding the MLK Connector. Recommendations are grouped in three phases:

Phase 1 – MLK Connector, Ramp C, Ramp D.
Phase 2 – PSB Slide, unique widening of the PSB Bridge by sliding the southern (eastbound) bridge to the south approximately nine feet; Ramp A; I-64 Split Initial, extension of the 6th Street on-ramp.
Phase 3 – I-64 Split Final, "C-D" connection between 6th Street off-ramp and on-ramp, adding a third lane to eastbound I-64.

The MLK Connector project is consistent with all three projects and will have no adverse effect on the interstate network access points. The project, as part of the NMRB project, is also consistent with St. Louis action plans including previous DowntownNow! and current DowntownNext, 2020 Vision for downtown St. Louis.

16. Coordination with Transportation System Improvements

The MLK Connector is a new project introduced in summer 2012 as a result of the review of the PSB Interchange project, described in “Poplar Street Bridge Independent Review”, September 12 2012. Although part of the Phase 1 PSB Interchange improvements, the MLK Connector could be constructed immediately and independent of other PSB improvements. In conjunction with MLK Bridge rehabilitation project element of 2013-2016 TIP the MLK Connector would provide a viable alternative to the PSB Interchange Ramp B. The MLK Connector would not have negative effects on other projects in the area including:

- CAR 2015, downtown St. Louis street network improvements including existing I-70 (future I-44) ramp reconfigurations, scheduled to be completed in 2015.
- The NMRB, the new Mississippi River crossing scheduled to be completed in 2014.
- WB PSB Bridge concrete overlay, programmed for 2016. (Coordination between MLK Connector and this project would be needed if projects go in construction simultaneously.)

17. Status of Planning and NEPA

The PSB Interchange project was included in FEIS approved by FHWA on March 26, 2001 and a subsequent re-evaluation on November 5, 2008. Recent changes proposed for the PSB Interchange, including the MLK Connector, deviate from the Preferred Alternative approved in the FEIS and create a need for another evaluation of the environmental impact including: archeology; historic architecture; wetland; hazardous waste; fish and wildlife; floodplain; farmland and public land; community impacts; noise and air; and construction impact. At a recent IDOT/MoDOT coordination meeting, held on November 19 2012, it was agreed that the MLK Connector impact should be evaluated through a separate document that follows all NEPA procedures. It is expected the documents will be finalized during the first quarter of 2013.

It is anticipated that FEIS re-evaluation will be completed by spring 2013. MoDOT will submit documents for approval.

The following is a status of the current environmental impact evaluation:

Farmland Impacts: There is no farmland within the project area in Illinois.

Wetland Impacts: The National Wetland Inventory Map depicts wetlands within the project area. Wetland delineations were conducted by the Illinois Natural History Survey in November 2012. It was determined that three wetlands were within the project area. The wetlands were described in the wetland delineation report as site 2 – a marsh 0.16 acres within the project area, site 3 – a marsh 0.09 acres within the project area, and site 4 – wet forbland 0.03 acres within the project area.

It is expected that the MLK Connector construction will have minimal, if any, impact to this wetlands. In accordance with IDOT BDE Manual Section 26-8, wetland impacts are to be avoided, minimized and then mitigated. Any wetland impacts will be mitigated at Fairmont City Wetland Mitigation Site, an IDOT District 8 wetland bank.

Historic Preservation: The Martin Luther King Bridge (MLK) is listed as eligible for the National Register of Historic Places, a program of the National Park Service, on the Illinois Historic Preservation Historic Architectural Resources Geographic Information System (HARGIS). Since all work for this project will be on the MLK approach and not the bridge, the MLK Bridge will not be impacted by this project. No other historic structures are within the project area.

If it is determined by the Illinois State Archaeological Survey that there is a potential for archaeological sites within the project area, archaeological excavations will be conducted and the findings will be coordinated with the State Historic Preservation Officer.

Parkland and Public Lands Section 4(f)/6(f) Involvement: There are no Section 4(f) or 6(f) properties in the project area in Illinois.

Threatened and Endangered Species: A records review was conducted for the project area in Illinois using the Illinois Department of Natural Resources Detailed Impact Review Tool. No records of threatened or endangered species were found within the project area. In addition, no state or federally threatened or endangered species were found by the Illinois Natural History Survey when conducting the wetland delineations for the project.

Natural Areas and Nature Preserves: There are no natural areas or nature preserves within the project area in Illinois as per a records view using the Illinois Department of Natural Resources Detailed Impact Review Tool.

Class III Groundwater Area: There is no Class III groundwater within the project area as per a records view in Illinois using the Illinois Department of Natural Resources Detailed Impact Review Tool.

Floodplain Impacts: The project area is located along the Mississippi River within an area that is protected by an existing levee system. The levee system is currently being rehabilitated, therefore the flood zone designation is AR. The AR designation is defined by FEMA as follows: “Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.” The levee reconstruction in the vicinity of the project area is anticipated to be completed in 2014. It is unknown when the flood plain maps will be updated, but an initial submittal to FEMA is anticipated in 2015. Because the revisions to the levee system are going to be completed in the near future, we have assumed that compensatory storage for riverine flooding (i.e., flooding of the Mississippi River) will not be required.

In addition to riverine flooding, there are a few isolated depressional areas that are mapped as regulatory flood plain (Zone AH) in the vicinity of the project. These areas have a Base Flood Elevation (BFE) of 408 (NAVD88) according to data provided in the Flood Insurance Study (FIS) and associated mapping dated November 5, 2003 (panels 20 and 160 of 555 and marked “preliminary”). This BFE assumes that no riverine flooding occurs within the area and the flooding is solely due to local runoff entering the local depressional storage areas. The compensatory storage will be required for fill associated with fill within the isolated AH areas. An analysis will be performed to determine storage requirements for the new MLK Connector and to minimize impact to the isolated depressional storage areas.

Special/Hazardous Waste: The project area is located in and surrounded by commercial and industrial properties within East St. Louis. A PESA dated 2006 for a previous project within the project area lists APEX Petroleum Fuel and Terminal Company as owning the property on the south side of the Martin Luther King approach. This area contains two large above ground storage tanks. These tanks were installed between 1955 and 1962 and have documented cases of leaking in the past. The Illinois State Geological Survey in 2006 determined that this area contained volatile organic compounds significantly above background levels in soil gas and the headspace of soil samples taken from boreholes at APEX Petroleum Fuel and Terminal Company. In addition, soil samples taken in 2006 by the ISGS in this area contained the heavy metals antimony, arsenic, and lead and exceeded the ingestion values for the Illinois Environmental Protection Agency (IEPA). The heavy metals antimony, arsenic, and lead exceeded both the ingestion and inhalation values for the IEPA Tier 1 residential Tiered Approach to Cleanup Objectives (TACO). In addition, lead exceeded the ingestion value to the IEPA Tier 1 residential TACO objectives.

A Preliminary Environmental Site Assessment (PESA), dated March 6, 2013, was conducted by the Illinois State Geological Survey (ISGS) to determine if the project area contains recognized environmental conditions (RECs). It concluded that a Preliminary Site Investigation (PSI) will need to be conducted by the IDOT BDE statewide consultant if any site identified as a REC in the PESA report involves new right-of-way or easement, railroad right-of-way other than single rail rural with no maintenance facilities, or building demolition/modification. A PSI is also required to be conducted on any site identified as a REC within the project area that involves linear excavation or subsurface utility relocation or on existing right-of-way adjacent to a site identified as a REC in the PESA report. Any special/hazardous waste impacts will be mitigated as per the Special Provision from IDOT BDE.

Noise Analysis: A noise analysis was performed during the spring 2013. There are no receptors in the project study area and for the purposes of this noise analysis, a field recording of existing noise levels was not conducted. The existing noise levels were modeled in TNM based on vehicle traffic volumes on the MLK Bridge and I-55/64. The 2035 design-year projected traffic volumes were used to determine the approximate noise levels for the no-build alternative and the proposed alternative. The impacts were assessed based on a change in the noise levels on three locations and their offset distances.

Based on this analysis the noise impact resulting from the proposed MLK Ramp can be considered insignificant and none of these locations warrant a noise abatement wall. Noise generated by the proposed MLK Ramp attenuates to the ambient noise level without affecting any noise receptors located further away. Ambient noise levels can be expected to be slightly higher than the modeled noise levels due to the presence of other noise generating sources such as trains, aircraft and mechanical equipment associated with commercial and industrial development.

18. Operational Analysis

This section of the MLK Connector AJR summarizes the traffic operational analysis completed to evaluate the impacts of the addition of the proposed MLK Connector.

18.1 Traffic Forecasts

Traffic forecasts for this analysis were generated utilizing work that has been completed to date in the PSB AJR, anticipated shifts in travel patterns, and available data from the East-West Gateway Regional Travel Demand Model. It should be emphasized that this analysis recognizes the interlinked nature of this AJR and the PSB AJR; and as such, effort has been made to preserve consistent volumes across the PSB, as documented in the PSB AJR.

Two scenarios were considered for this analysis – 2035 No-Build condition and 2035 MLK Connector alternative. Both scenarios assume the NMRB is constructed and that the Ramp B is removed from the PSB west interchange.

18.2 2035 No-Build Scenario

Under 2035 No-Build scenario, with the opening of the NMRB and the removal of Ramp B, drivers with destinations along IL Route 3 and Tudor Avenue/Piggott Avenue (the Sauget area) from existing I-70 (future I-44) and downtown St. Louis would need to utilize alternative travel routes, as shown in Figure 19. This analysis assumes that the primary travel route for these drivers would be via a shift onto the eastbound MLK Bridge and back to westbound I-64/55 via Collinsville Avenue or St. Clair Avenue, as shown by the red lines in Figure 19. It has to be acknowledges that this alternative access is potentially circuitous and confusing.

18.3 2035 MLK Connector Alternative

For the MLK Connector alternative, it is assumed that that total system-wide volume would be consistent with the 2035 No-Build scenario. However, instead of accessing IL Route 3 and Tudor Avenue/Piggott Avenue via Collinsville Avenue or St. Clair Avenue as in the no-build condition, new and improved access to the affected ramps would be provided via the MLK Connector. Essentially, the same drivers utilizing the MLK Bridge and Collinsville Avenue or St. Clair Avenue under no-build condition, would now utilize the MLK Bridge and the proposed MLK Connector. Traffic forecasts generated for this analysis show that the proposed MLK Connector would cater to 100 vehicles per hour during the morning peak hour and 500 vehicles per hour during the evening peak hour for 2035 analysis year. It is important to note that the peak volume on the MLK Connector is during the evening peak hour while the peak volume along westbound I-64/55 occurs during the morning rush hour. Moreover, it is anticipated that there would be no weaving interaction between vehicles on the MLK Connector and mainline westbound I-64/55 traffic – entire MLK Connector traffic would be destined to IL Route 3 or Tudor Avenue/Piggott Avenue and not the PSB.

Figure 28 and 29 show 2035 traffic forecasts for the two above scenarios.

18.4 Summary of Traffic Operational Analysis

A detailed capacity analysis was undertaken to determine the anticipated roadway operating conditions for the 2035 No-Build and MLK Connector alternative utilizing the methodologies set forth in the Highway Capacity Manual 2010, Highway Capacity Software (HCS2010), and VISSIM microsimulation models.

Highway Capacity Software (HCS2010) analysis procedures are based upon the methodologies outlined in the 2010 edition of the “Highway Capacity Manual” (HCM). The HCM, used universally by highway and traffic engineers to measure roadway capacity, establishes criteria for six Levels of Service (LOS): LOS A (“Free Flow”) through LOS F (“Breakdown Conditions”). HCS2010 was utilized to evaluate the operating conditions along the freeway segments. Highway Capacity Software (HCS2010) outputs are included in Appendix B.

VISSIM is used to evaluate the overall network performance and test system wide measures of effectiveness. VISSIM is a micro-simulation model used to analyze complex transportation systems. It allows the user to observe simulated traffic conditions. Output from VISSIM models was used to evaluate freeway operations. Locally calibrated driving behavior parameters for version 5.40 were used in this analysis. Calibrated driving behavior parameters provide for reasonable capacities and saturation flow rates for Illinois freeways and urban roadways.

The mainline I-64/55 traffic operating conditions analysis was performed using HCM methodology, which uses density as an MOE to determine LOS along a freeway. Although drivers perceive speed to be a major indicator of service quality, freedom to maneuver within the traffic stream and proximity to other vehicles, as measured by the density of the traffic stream, is also a concern to drivers and an important measure of the facility’s operations. Density increases as flow increases up to capacity, resulting in an MOE that is sensitive to a broad range of flows. For these reasons, density is the parameter used to define LOS for the freeway and ramp sections, as shown in Table 9.

Table 9: Freeway Level of Service Criteria

Level of Service	Freeway Weaving Segment Density (pc/mi/ln)*	Merging and Diverging Segment Density (pc/mi/ln)*	Basic Freeway Segment Density (pc/mi/ln)*
A	0 – 10	0 – 10	0 – 11
B	> 10 – 20	> 10 – 20	> 11 – 18
C	> 20 – 28	> 20 – 28	> 18 – 26
D	> 28 – 35	> 28 – 35	> 26 – 35
E	> 35 – 43	> 35	> 35 – 45
F	> 43	Demand exceeds capacity	> 45

* pc/mi/ln = passenger cars per mile per lane

Tables 10, 11, 12, and 13 show summarized evaluations of the 2035 No-Build scenario and the MLK Connector alternative.

Table 10: HCS2010 Summary – 2035 No-Build

Segment	Abbreviation**	Type	LOS	Density pc/mi/ln
WB I-64/55 east of CD Split	F1	Freeway	D (C)	28.7 (24.5)
WB I-64/55 Mainline Left Lanes	F2	Freeway	D (C)	34.1 (24.4)
WB CD Road weave between Main Street and Tudor Avenue	W1	Weave	A (B)	9.9 (12.1)
WB CD Road diverge to IL Route 3	D2	Diverge	B (B)	13.0 (12.7)
WB CD Road merge with Tudor Avenue	M1	Merge	B (B)	13.9 (11.3)
WB CD Road merge with IL Route 3	M2	Merge	C (B)	23.8 (18.8)
WB I-64/55 on PSB	F3	Freeway	D (C)	28.8 (21.0)
EB MLK Bridge	F4	Freeway	A (C)	3.8 (19.0)

* AM(PM) shown, CD Road refers to the right side WB I-64/55 split travel lanes
**Abbreviation for Segment as shown in Figure 28

Table 11: VISSIM Summary – 2035 No-Build

Segment	Abbreviation**	Type	LOS	Density pc/mi/ln
WB I-64/55 east of CD Split	F1	Freeway	D (C)	28.0 (23.7)
Diverge to CD Road	D1	Diverge	D (C)	33.4 (25.6)
WB I-64/55 Mainline Left Lanes	F2	Freeway	D (C)	32.5 (24.1)
WB CD Road weave between Main Street and Tudor Avenue	W1	Weave	A (B)	8.1 (10.2)
WB CD Road diverge to IL Route 3	D2	Diverge	A (A)	8.0 (6.8)
WB CD Road merge with Tudor Avenue	M1	Merge	A (A)	6.3 (4.5)
WB CD Road merge with IL Route 3	M2	Merge	B (B)	16.6 (11.4)
WB 64 Mainline Merge with CD Road	M3	Merge	C (B)	22.2 (15.6)
WB I-64/55 on PSB	F3	Freeway	D (C)	27.3 (19.7)

* AM(PM) shown, CD Road refers to the right side WB I-64/55 split travel lanes
**Abbreviation for Segment as shown in Figure 28

Table 12: HCS2010 Summary – 2035 MLK Connector

Segment	**Abbreviation****	**Type**	**LOS**	**Density pc/mi/ln**
WB I-64/55 east of CD Split	F1	Freeway	D (C)	28.2 (21.7)
WB 64 Merge with MLK Connector***	M4	Merge	C (B)	23.4 (20.0)
WB I-64/55 Mainline Left Lanes	F2	Freeway	D (C)	34.1 (24.4)
WB CD Road weave between Main Street and Tudor Avenue	W1	Weave	A (B)	9.8 (11.8)
WB CD Road diverge to IL Route 3	D2	Diverge	B (B)	13.0 (12.7)
WB CD Road merge with Tudor Avenue	M1	Merge	B (B)	13.9 (11.3)
WB CD Road merge with IL Route 3	M2	Merge	C (B)	23.8 (18.8)
WB I-64/55 on PSB	F3	Freeway	D (C)	28.8 (21.0)
EB MLK Diverge to MLK Connector	D3	Diverge	A (C)	7.8 (22.2)

* AM(PM) shown, CD Road refers to the right side WB I-64/55 split travel lanes
**Abbreviation for Segment as shown in Figure 29
*** Merge type not defined by HCS2010 methodologies; 1500 ft acceleration distance used

Table 13: VISSIM Summary – 2035 MLK Connector

Segment	Abbreviation**	Type	LOS	Density pc/mi/ln
WB I-64/55 east of CD Split	F1	Freeway	D (C)	27.5 (20.9)
WB 64 Merge with MLK Connector***	M4	Merge	C (B)	21.1 (18.1)
WB 64 Diverge to CD Road	D1	Diverge	C (B)#	21.7 (17.4)
WB I-64/55 Mainline Left Lanes	F2	Freeway	D (C)	34.0 (24.1)
WB CD Road weave between Main Street and Tudor Avenue	W1	Weave	A (A)#	8.1 (9.8)
WB CD Road diverge to IL Route 3	D2	Diverge	A (A)	8.0 (5.6)
WB CD Road merge with Tudor Avenue	M1	Merge	A (A)	6.3 (4.5)
WB CD Road merge with IL Route 3	M2	Merge	B (B)	16.5 (11.4)
WB I-64/55 Mainline Merge with CD Road	M3	Merge	C (B)	22.1 (15.7)
WB I-64/55 on PSB	F3	Freeway	D (C)	27.3 (19.7)
EB MLK Diverge to MLK Connector	D3	Diverge	A (B)	3.6 (18.3)

* AM(PM) shown, CD Road refers to the right side WB I-64/55 split travel lanes
**Abbreviation for Segment as shown in Figure 29
*** Merge type not defined by HCS2010 methodologies; 1500 ft acceleration distance used
# Improvement over No-build alternative

As can be seen from the tables above, the MLK Connector alternative would provide acceptable traffic operations (LOS D or better) along westbound I-64/55. In fact, the traffic operations for the MLK Connector alternative are considerably similar to that of the No-Build scenario (within the study area included for this analysis). Moreover, given the fact that the MLK Connector alternative lowers the overall travel distance and the circuitous travel patterns, it is reasonable to assume that the MLK Connector alternative provides better overall traffic operations and significantly improves access for drivers accessing IL Route 3 and Tudor Avenue/Piggott Avenue (the Sauget area) from existing I-70 in Missouri compared to the No-Build condition.

Summary and Recommendations

This AJR seeks FHWA approval for the new interstate ramp proposed by IDOT to improve operations and connectivity in East St. Louis. The proposed ramp is in conjunction with the removal of the existing southbound I-70 to eastbound I-64/55/70 ramp at the west end of the PSB. This proposed ramp, the MLK Connector, allows access from downtown St. Louis to the Sauget area, which will be eliminated by removal of the existing ramp at the PSB.

The analysis described in this report confirms that the proposed actions will:

- Support the goals of overall transportation improvements in the St. Louis area;
- Support the planned future layout and operations of the PSB Ramp Modification Project;
- Maintain access and connectivity for local businesses, residents and workers;

- Not negatively impact safety for motorists who travel on MLK Drive or I-64/55/70;
- Not negatively impact traffic operations along MLK Drive and I-64/55/70;
- Have minimal adverse impact to the surroundings.

This document recommends approval of the proposed ramp, the MLK Connector.

Appendix A

Figures 1-29

MLK CONNECTOR

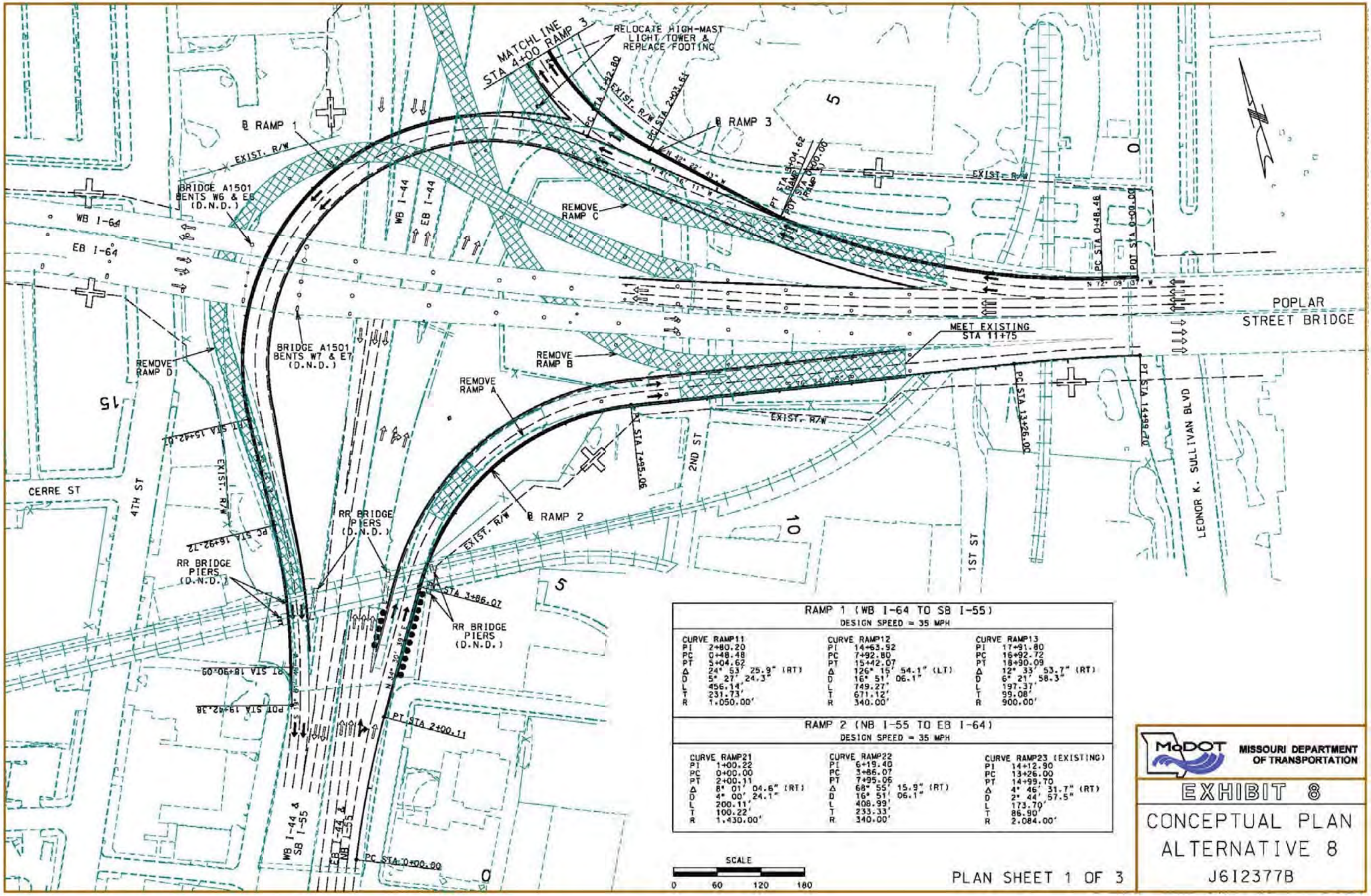
PROPOSED
IMPROVEMENTS

FIGURE 1

MLK CONNECTOR

PROPOSED
MLK CONNECTOR

FIGURE 2



RAMP 1 (WB I-64 TO SB I-55)

DESIGN SPEED = 35 MPH

CURVE	RAMP11	CURVE	RAMP12	CURVE	RAMP13
PI	2+80.20	PI	14+63.92	PI	17+91.80
PC	0+48.48	PC	7+92.80	PC	16+92.72
PT	5+04.62	PT	15+42.07	PT	18+90.09
Δ	24° 53′ 25.9″ (RT)	Δ	126° 15′ 54.1″ (LT)	Δ	12° 33′ 53.7″ (RT)
D	5° 27′ 24.3″	D	16° 51′ 06.1″	D	6° 21′ 58.3″
L	456.14′	L	749.27′	L	197.37′
T	231.73′	T	671.12′	T	99.08′
R	1,050.00′	R	340.00′	R	900.00′

RAMP 2 (NB I-55 TO EB I-64)

DESIGN SPEED = 35 MPH

CURVE	RAMP21	CURVE	RAMP22	CURVE	RAMP23 (EXISTING)
PI	1+00.22	PI	6+19.40	PI	14+12.90
PC	0+00.00	PC	3+86.07	PC	13+26.00
PT	2+00.11	PT	7+95.06	PT	14+99.70
Δ	8° 01′ 04.6″ (RT)	Δ	68° 55′ 15.9″ (RT)	Δ	4° 46′ 31.7″ (RT)
D	4° 00′ 24.1″	D	16° 51′ 06.1″	D	2° 44′ 57.5″
L	200.11′	L	408.99′	L	173.70′
T	100.22′	T	233.33′	T	86.90′
R	1,430.00′	R	340.00′	R	2,084.00′

SCALE
0 60 120 180

PLAN SHEET 1 OF 3

MoDOT MISSOURI DEPARTMENT OF TRANSPORTATION

EXHIBIT 8

CONCEPTUAL PLAN
ALTERNATIVE 8
J6I2377B

IMAGE: POPLAR STREET BRIDGE PROJECT, DRAFT ACCESS JUSTIFICATION REPORT, JULY 2012)

N

GRAPHIC SCALE

MLK CONNECTOR

PROPOSED PSB INTERCHANGE IMPROVEMENTS

FIGURE 3

Eastbound MLK Drive: Illinois/Missouri State Line (mile station 0.00) to Missouri Avenue (mile station 0.81) Crash Data Summary

Location		Year					TOTAL	Type						Surface Condition			Weather Condition				Lighting Condition			Total Injuries	Fatalities	A	B	C
LANDMARK	Mile	2007	2008	2009	2010	2011		Angle	Turning	Fixed Object	Sideswipe	Rear End	Other Object	Wet	Ice	Dry	Clear	Rain	Fog	Sleet/Hail	Darkness	Lighted	Daylight					
	NR					4	4			1	1	1	1	2		2	2	2				3	1					
E. of State Line	0.01	1	1				2				1	1			1	1	1			1		1	1					
E. of State Line	0.02		1				1				1				1					1			1					
E. of State Line	0.09		2				2					2			1	1	2					1	1	2		2		
E. of State Line	0.10		1				1				1				1		1						1					
E. of State Line	0.13		1				1					1			1		1						1	1			1	
E. of State Line	0.17				1		1					1				1	1					1						
Bridge End	0.19		1				1				1				1					1			1					
E. of Bridge End	0.20	1		1	1		3					2	1			3	3				1		2					
E. of Bridge End	0.21		2				2			1	1					2	2				1	1						
E. of Bridge End	0.23		1				1			1						1	1				1							
E. of Bridge End	0.24				1		1						1	1				1					1					
E. of Bridge End	0.25			1			1			1						1	1					1						
E. of Bridge End	0.36				1		1				1			1				1				1		2		1	1	
E. of Bridge End	0.39		1				1					1		1			1						1					
E. of Bridge End	0.40	1		1			2				1	1				2	2					1	1					
E. of Bridge End	0.42	1					1				1					1	1						1					
E. of Bridge End	0.44	1	1		1		3		2			1				3	3						3	6			3	3
E. of Bridge End	0.47	1					1	1								1	1					1						
E. of Bridge End	0.52			1			1			1				1					1		1							
Proposed Exit Area	0.55		2				2				1	1				2	2						2	1			1	
Proposed Exit Area	0.56			1			1				1					1	1						1					
Proposed Exit Area	0.57		1				1			1						1	1					1		1		1		
Proposed Exit Area	0.66			1			1			1						1	1						1					
Proposed Exit Area	0.69			1			1			1				1				1					1	1			1	
RR Bridge Overpass	0.80				1		1					1				1	1						1	1			1	
RR Bridge Overpass	0.81		1				1				1					1	1				1							
TOTAL		6	16	7	6	4	39	1	2	8	12	13	3	7	6	26	30	5	1	3	5	12	22	15	0	4	8	3
Percentages		15	41	18	15	10		3	5	21	31	33	8	18	15	67	77	13	3	8	13	31	56	38	0	10	21	8

NR = Not Reported

Westbound I-64/55/70: Mile Station 1.39 to Mile Station 1.75 St. Clair County, Illinois Crash Data Summary

Location		Year					TOTAL	Type						Surface Condition				Weather Condition			Lighting Condition			Total Injuries	Fatalities	A	B	C
LANDMARK	Mile	2007	2008	2009	2010	2011		Other Non-collision	Fixed Object	Head On	Sideswipe	Rear End	Other Object	Wet	Snow/Slush	Ice	Dry	Clear	Rain	Snow	Darkness	Lighted	Daylight					
WB I-70 CD Road #34 Exit	1.42			1			1					1					1	1					1					
WB I-70 CD Road #34 Exit	1.44		1				1					1					1	1					1					
WB I-70 CD Road #34 Exit	1.45	2	1	2			5			1	1	3					5	5				2	3	5		2	3	
WB I-70 CD Road #34 Exit	1.46	2					2		1			1				1	1	1		1			2	1			1	
WB I-70 CD Road #34 Exit	1.47	2	1	3		1	7		3		1	2	1	1			6	7			2	2	3					
WB I-70 CD Road #34 Exit	1.48	1					1						1				1	1					1					
WB I-70 CD Road #34 Exit	1.50	1			1	1	3				1	2		1			2	2	1		1		2	1		1		
Proposed Merge Point	1.51	1	1			1	3		1		2					1	2	3					3					
Proposed Merge Point	1.54	1					1				1						1	1					1					
Proposed Merge Point	1.59			1	1		2	1				1					2	2				1	1					
Proposed Merge Point	1.60		1				1				1				1					1		1						
Proposed Merge Point	1.62	1					1	1									1	1					1					
S. of Missouri Ave. Overpass	1.66		1		1		2				2			1			1	1	1			1	1					
S. of Missouri Ave. Overpass	1.68	1			1		2	1			1						2	2					2					
S. of Missouri Ave. Overpass	1.69	1					1				1						1	1				1						
S. of Missouri Ave. Overpass	1.72	1					1				1						1	1					1					
S. of Missouri Ave. Overpass	1.73		1				1				1						1	1					1					
S. of Missouri Ave. Overpass	1.74					1	1				1						1	1					1					
TOTAL		14	7	7	4	4	36	3	5	1	14	11	2	3	1	2	30	32	2	2	3	8	25	7	0	3	4	0
Percentages		39	19	19	11	11		8	14	3	39	31	6	8	3	6	83	89	6	6	8	22	69	19	0	8	11	0

13th St./Tudor Ave. (FAU 9179) Exit from Westbound I-70 CD Road #34

Location		Year					TOTAL	Type						Surface				Weather			Lighting			Total Injuries	Fatalities	A	B	C
STATION	Mile	2007	2008	2009	2010	2011		Overturned	Fixed Object	Head On	Sideswipe	Rear End	Other Object	Wet	Snow/Slush	Ice	Dry	Clear	Rain	Snow	Darkness	Lighted	Daylight					
	0.23	1					1	1									1	1			1							
Main St. Merge	0.25			1	1		2				1	1					2	2			1		1					
Main St. Merge	0.26					1	1		1							1		1					1					
S. of Merge	0.29	1					1					1		1					1		1							
S. of Merge	0.30	2					2					2					2	2				1	1	1			1	
Tudor Ave. Exit	0.32		1				1				1						1	1					1					
Tudor Ave. Exit	0.33	1	1			2	4		1			3		1		2	1	3	1				4	1				1
Tudor Ave. Exit	0.34				1		1		1					1					1			1		1		1		
Tudor Ave. Exit	0.35				1		1		1								1	1				1						
TOTAL		5	2	1	3	3	14	1	4	0	2	7	0	3	0	3	8	11	3	0	3	3	8	3	0	1	1	1
Percentages		36	14	7	21	21		7	29	0	14	50	0	21	0	21	57	79	21	0	21	21	57		0	33	33	33

Southbound IL-3 Exit from Westbound I-70 CD Road #34

Location		Year					TOTAL	Type						Surface				Weather			Lighting			Total Injuries	Fatalities	A	B	C
ROAD	Mile	2007	2008	2009	2010	2011		Overturned	Fixed Object	Head On	Sideswipe	Rear End	Other Object	Wet	Snow/Slush	Ice	Dry	Clear	Rain	Snow	Darkness	Lighted	Daylight					
SB IL-3 Exit	0.49		1				1					1					1	1					1					
SB IL-3 Ramp	0.05					1	1					1					1	1			1							
TOTAL		0	1	0	0	1	2	0	0	0	0	2	0	0	0	0	2	2	0	0	1	0	1	0	0	0	0	0
Percentages		0	50	0	0	50		0	0	0	0	100	0	0	0	0	100	100	0	0	50	0	50		0	0	0	0

13th St./Tudor Ave. (FAU 9179) Merge with Eastbound I-70 CD Road #35 Exit Ramp

Location		Year					TOTAL	Type						Surface				Weather			Lighting			Total Injuries	Fatalities	A	B	C
ROAD	Mile	2007	2008	2009	2010	2011		Overturned	Fixed Object	Head On	Sideswipe	Rear End	Other Object	Wet	Snow/Slush	Ice	Dry	Clear	Rain	Snow	Darkness	Lighted	Daylight					
Merge Point	0.13					1	1						1				1	1			1							
TOTAL		0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0
Percentages		0	0	0	0	100		0	0	0	0	0	100	0	0	0	100	100	0	0	100	0	0		0	0	0	0

Southbound IL-3 Ramp Merge with Eastbound I-70 CD Road #35 Exit Ramp

Location		Year					TOTAL	Type						Surface				Weather			Lighting			Total Injuries	Fatalities	A	B	C
ROAD	Mile	2007	2008	2009	2010	2011		Overturned	Fixed Object	Head On	Sideswipe	Rear End	Other Object	Wet	Snow/Slush	Ice	Dry	Clear	Rain	Snow	Darkness	Lighted	Daylight					
Merge Point	0.18					1	1		1								1	1			1							
TOTAL		0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	1	1	0	0	1	0	0	1	0	1	0	0
Percentages		0	0	0	0	100		0	100	0	0	0	0	0	0	0	100	100	0	0	100	0	0		0	100	0	0

MLK CONNECTOR

CRASH ANALYSIS
SUMMARY TABLES

FIGURE 4

FIGURE 5

FILE NAME =	USER NAME = gustavo.pallares	DESIGNED -	REVISED -
D876G09-FIGURE-05.dgn		DRAWN -	REVISED -
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Default	PLOT DATE = 5/9/2013	DATE -	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

CRASH ANALYSIS KEY MAP

SCALE: SHEET OF SHEETS STA. TO STA.

F.A.P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		ST. CLAIR		

CONTRACT NO. 76G09

ILLINOIS FED. AID PROJECT

FIGURE 6

FILE NAME =
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PLOT SCALE = 100.000 '/ in.
PLOT DATE = 5/9/2013

DESIGNED -
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DATE -

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REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

EASTBOUND MLK DRIVE
CRASH ANALYSIS DIAGRAM

SCALE: SHEET OF SHEETS STA. TO STA.

F.A.P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		ST. CLAIR		

CONTRACT NO. 76G09
ILLINOIS FED. AID PROJECT

FIGURE 7

FILE NAME =
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PLOT SCALE = 100.000 ' / in.
PLOT DATE = 5/9/2013

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DATE -

REVISED -
REVISED -
REVISED -
REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

EASTBOUND MLK DRIVE
CRASH ANALYSIS DIAGRAM

SCALE: SHEET OF SHEETS STA. TO STA.

F.A.P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		ST. CLAIR		

CONTRACT NO. 76G09

ILLINOIS FED. AID PROJECT

FIGURE 8

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PLOT SCALE = 100.000 ' / in.
PLOT DATE = 5/9/2013

DESIGNED -
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DATE -

REVISED -
REVISED -
REVISED -
REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

EASTBOUND MLK DRIVE
CRASH ANALYSIS DIAGRAM

SCALE: SHEET OF SHEETS STA. TO STA.

F.A.P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		ST. CLAIR		
		CONTRACT NO. 76G09		

ILLINOIS FED. AID PROJECT

FIGURE 9

FILE NAME =
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PLOT DATE = 5/9/2013

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DATE -

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REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

WESTBOUND I-64/55/70
CRASH ANALYSIS DIAGRAM

SCALE: SHEET OF SHEETS STA. TO STA.

F.A.P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		ST. CLAIR		
		CONTRACT NO. 76G09		

ILLINOIS FED. AID PROJECT

FIGURE 10

FILE NAME =
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USER NAME = gustavo.pallares
PLOT SCALE = 100.000 '/ in.
PLOT DATE = 5/9/2013

DESIGNED -
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DATE -

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REVISED -
REVISED -
REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

WESTBOUND I-64/55/70
CRASH ANALYSIS DIAGRAM

SCALE: SHEET OF SHEETS STA. TO STA.

F.A.P RTE. SECTION COUNTY TOTAL SHEETS SHEET NO.
ST. CLAIR
CONTRACT NO. 76G09
ILLINOIS FED. AID PROJECT

CRASH TYPE LEGEND

- FIXED OBJECT
- TURNING
- SIDESWIPE SAME DIRECTION
- TYPE | YEAR
- ONC OTHER NONCOLLISION
- REAR END
- OTH OTHER OBJECT
- ANGLE
- HEAD ON

FIGURE 11

FILE NAME = D876G09-FIGURE-11.dgn	USER NAME = gustavo.pallares	DESIGNED -	REVISED -
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Default	PLOT DATE = 5/9/2013	DATE -	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

13th ST/TUDOR AVE (FAU 9179) EXIT
FROM WESTBOUND I-70 CD ROAD #34
CRASH ANALYSIS DIAGRAM

SCALE: SHEET OF SHEETS STA. TO STA.

F.A.P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		ST. CLAIR		
		CONTRACT NO. 76G09		
		ILLINOIS FED. AID PROJECT		

FIGURE 12

FILE NAME =	USER NAME = gustavo.pallares	DESIGNED -	REVISED -
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Default	PLOT DATE = 5/9/2013	DATE -	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SOUTHBOUND IL–3 EXIT FROM WESTBOUND I–70 CD ROAD # 34
CRASH ANALYSIS DIAGRAM

SCALE: SHEET OF SHEETS STA. TO STA.

F.A.P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		ST. CLAIR		
		CONTRACT NO. 76G09		

ILLINOIS FED. AID PROJECT

FIGURE 13

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PLOT SCALE = 100.000 ' / in.
PLOT DATE = 5/9/2013

DESIGNED -
DRAWN -
CHECKED -
DATE -

REVISED -
REVISED -
REVISED -
REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

13th ST/TUDOR AVE (FAU 9179) MERGE
WITH EASTBOUND I-70 CD ROAD #35 EXIT RAMP
CRASH ANALYSIS DIAGRAM

SCALE:
SHEET OF SHEETS
STA. TO STA.

F.A.P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		ST. CLAIR		

CONTRACT NO. 76G09

ILLINOIS FED. AID PROJECT

FIGURE 14

FILE NAME = D876G09-FIGURE-14.dgn	USER NAME = gustavo.pallares	DESIGNED -	REVISED -	**STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION**	**SOUTHBOUND IL-3 RAMP MERGE WITH EASTBOUND I-70 CD ROAD # 35 EXIT RAMP CRASH ANALYSIS DIAGRAM**	F.A.P RTE.	SECTION	COUNTY
		DRAWN -	REVISED -					ST. CLAIR
	PLOT SCALE = 100.000 ' / in.	CHECKED -	REVISED -					CONTRACT NO. 76G09
Default	PLOT DATE = 5/9/2013	DATE -	REVISED -		SCALE: SHEET OF SHEETS STA. TO STA.		ILLINOIS FED. AID PROJECT	

TOTAL SHEETS | SHEET NO.

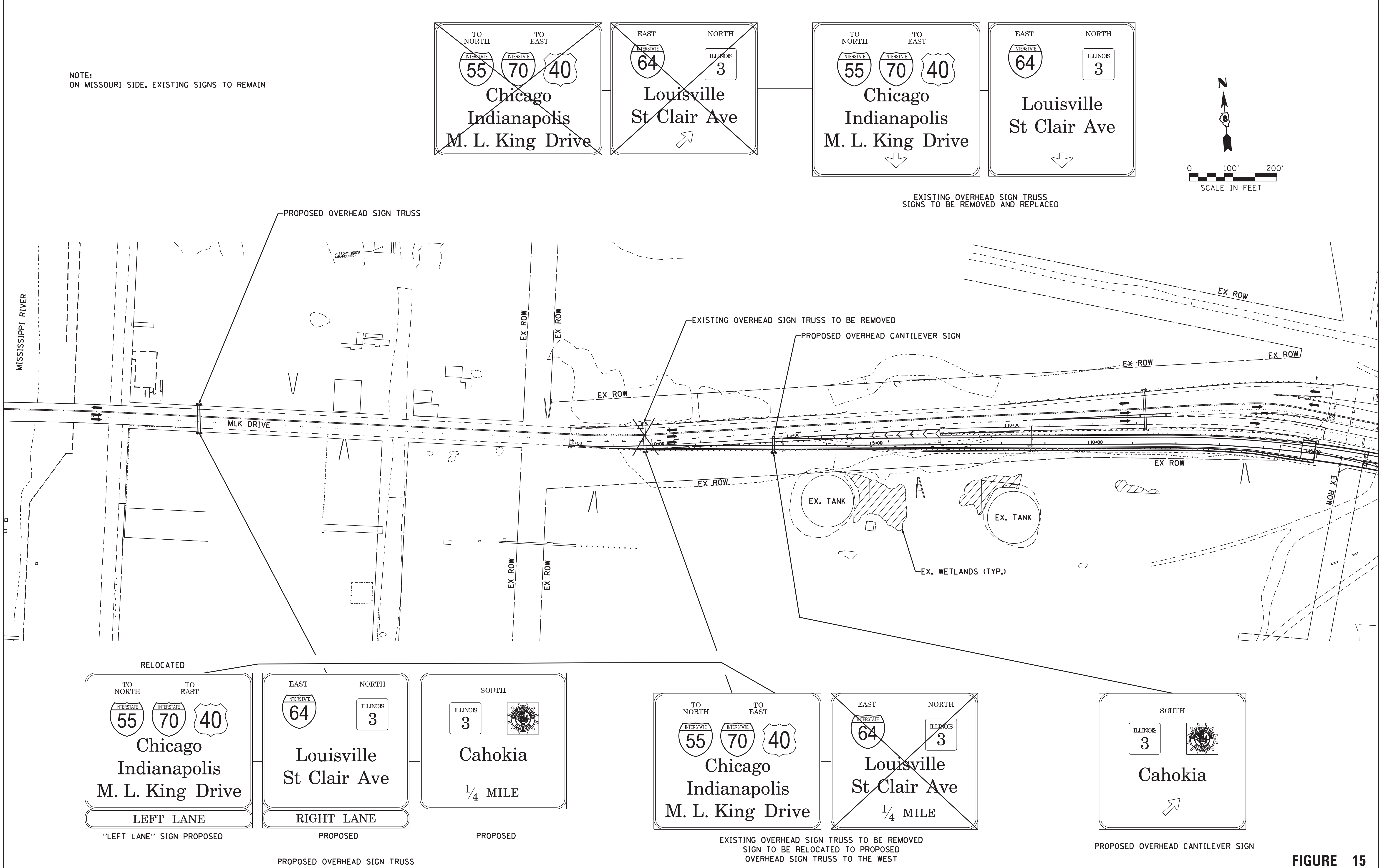

FIGURE 15

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PLOT DATE = 5/9/2013

DESIGNED -
DRAWN -
CHECKED -
DATE -

REVISED -
REVISED -
REVISED -
REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

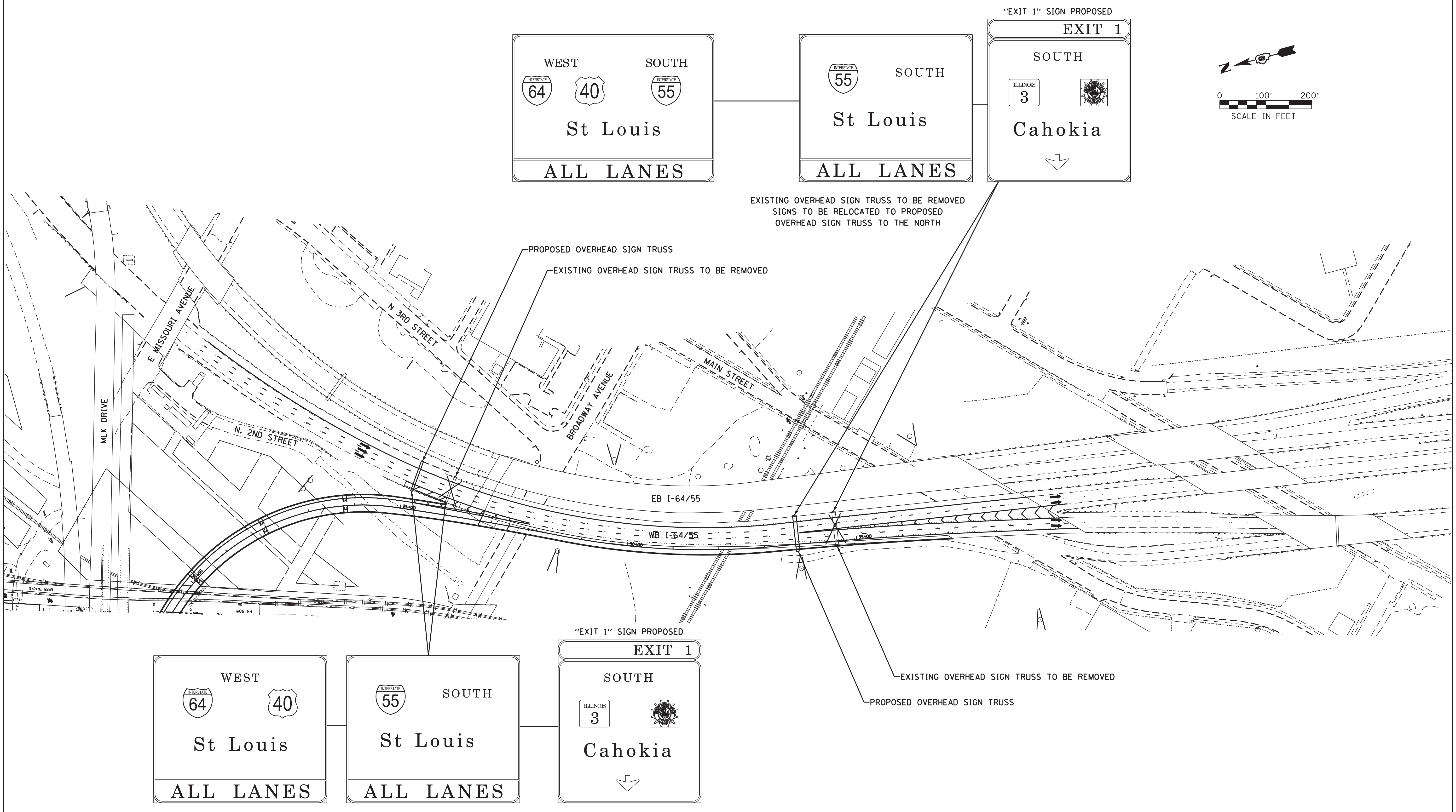
SIGNAGE PLAN
MLK CONNECTOR

SCALE: SHEET OF SHEETS STA. TO STA.

F.A.P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		ST. CLAIR	-	-

CONTRACT NO. 76G09

ILLINOIS FED. AID PROJECT



"EXIT 1" SIGN PROPOSED

EXISTING OVERHEAD SIGN TRUSS TO BE REMOVED
SIGNS TO BE RELOCATED TO PROPOSED
OVERHEAD SIGN TRUSS TO THE NORTH

PROPOSED OVERHEAD SIGN TRUSS

EXISTING OVERHEAD SIGN TRUSS TO BE REMOVED

EXISTING OVERHEAD SIGN TRUSS TO BE REMOVED

PROPOSED OVERHEAD SIGN TRUSS

"EXIT 1" SIGN PROPOSED

EXISTING OVERHEAD SIGN TRUSS TO BE REMOVED
SIGNS TO BE RELOCATED TO PROPOSED
OVERHEAD SIGN TRUSS TO THE NORTH

FIGURE 16

FILE NAME =
D876G09-FIGURE-16.dgn
Default

USER NAME = gustavo.pallares
PLOT SCALE = 200.0000 ' / in.
PLOT DATE = 5/9/2013

DESIGNED -
DRAWN -
CHECKED -
DATE -

REVISED -
REVISED -
REVISED -
REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

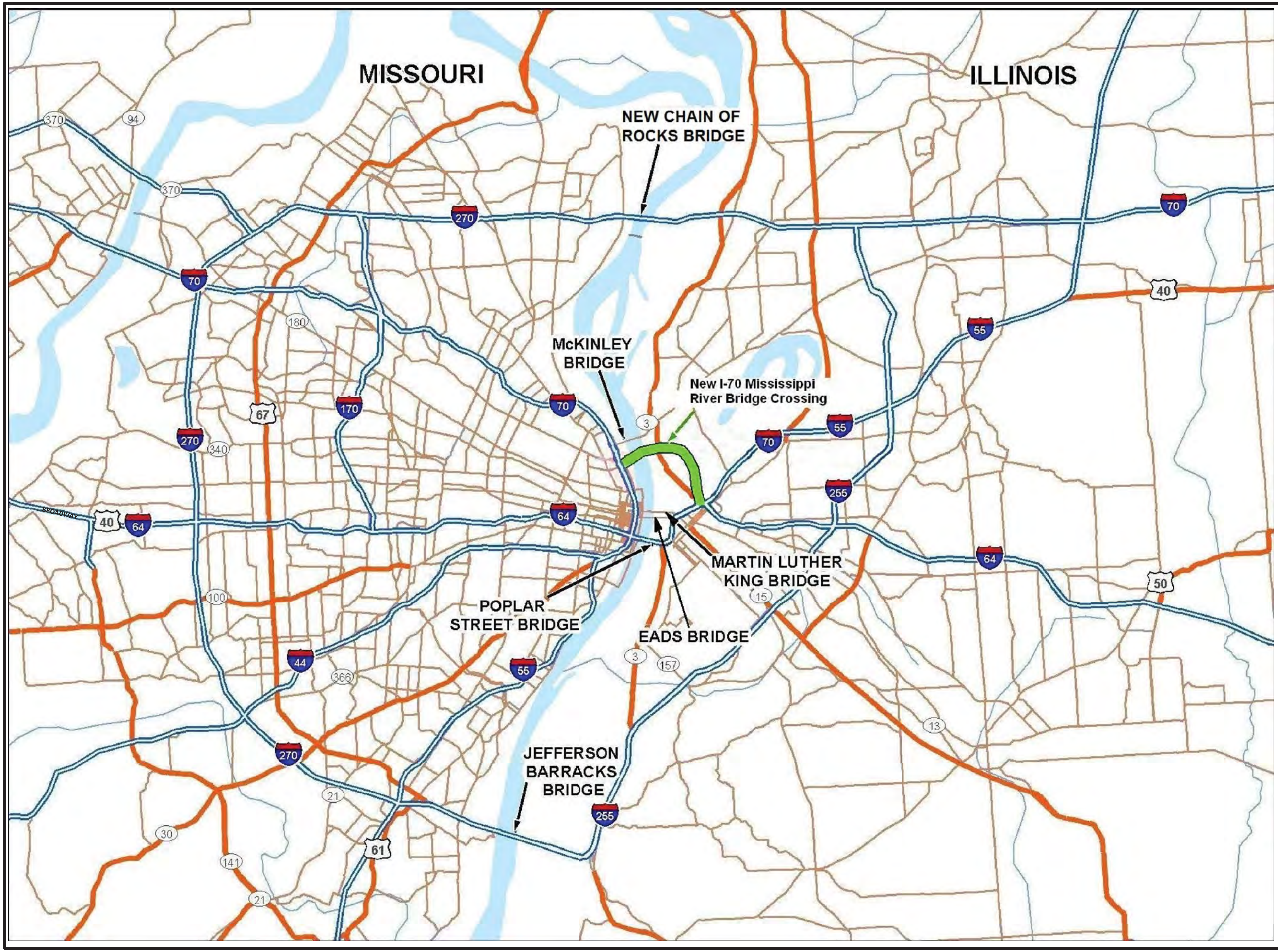
SIGNAGE PLAN
MLK CONNECTOR

SCALE: SHEET OF SHEETS STA. TO STA.

F.A.P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		ST. CLAIR	-	-

CONTRACT NO. 76G09

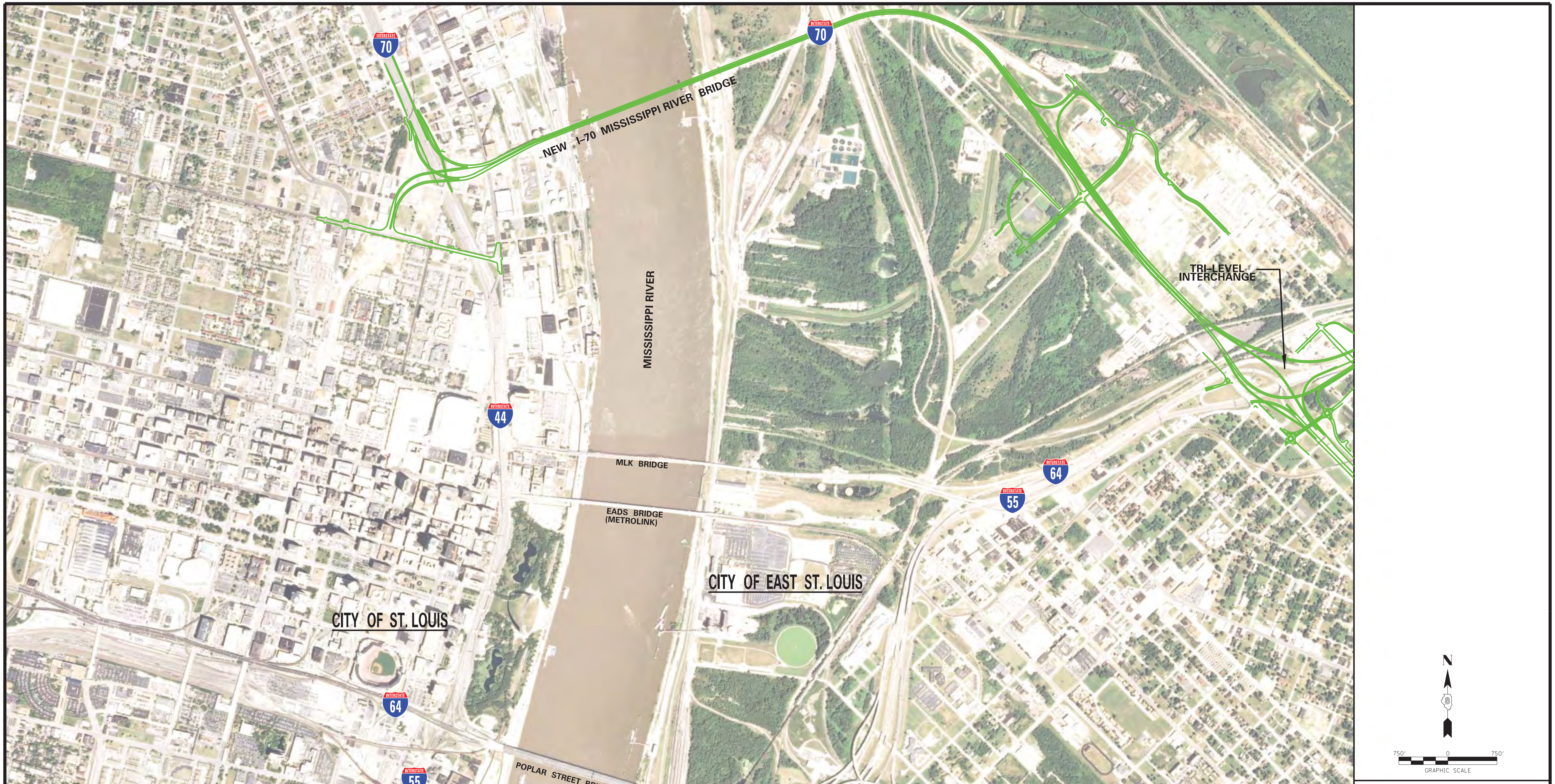
ILLINOIS FED. AID PROJECT



MLK CONNECTOR

EXISTING INTERSTATE SYSTEM

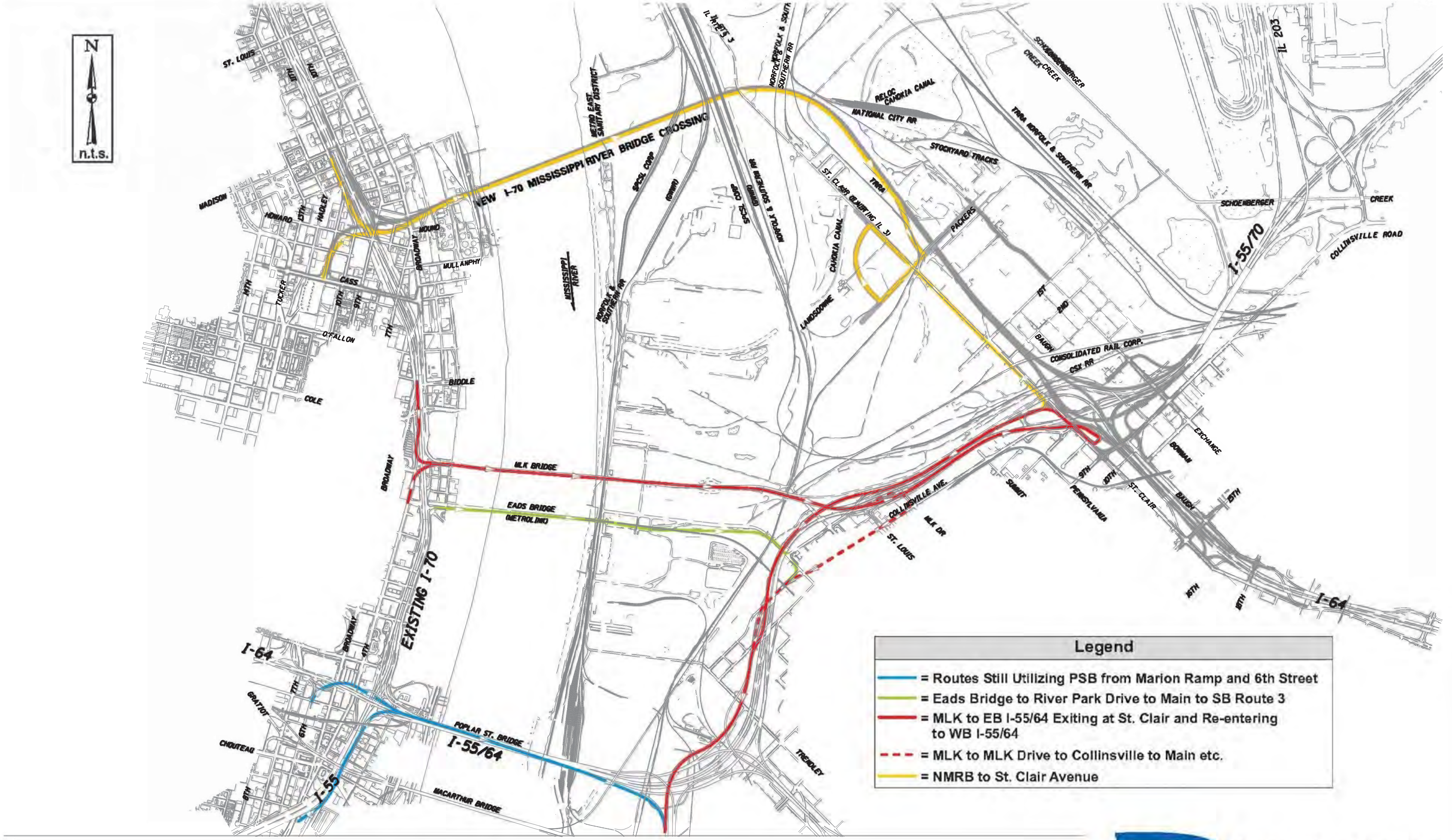
FIGURE 17



MLK CONNECTOR

FUTURE INTERSTATE SYSTEM DESIGNATION

FIGURE 18



Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

N

1000' 0 1000'
GRAPHIC SCALE

MLK CONNECTOR

NO–BUILD ALTERNATIVE ROUTES

FIGURE 19

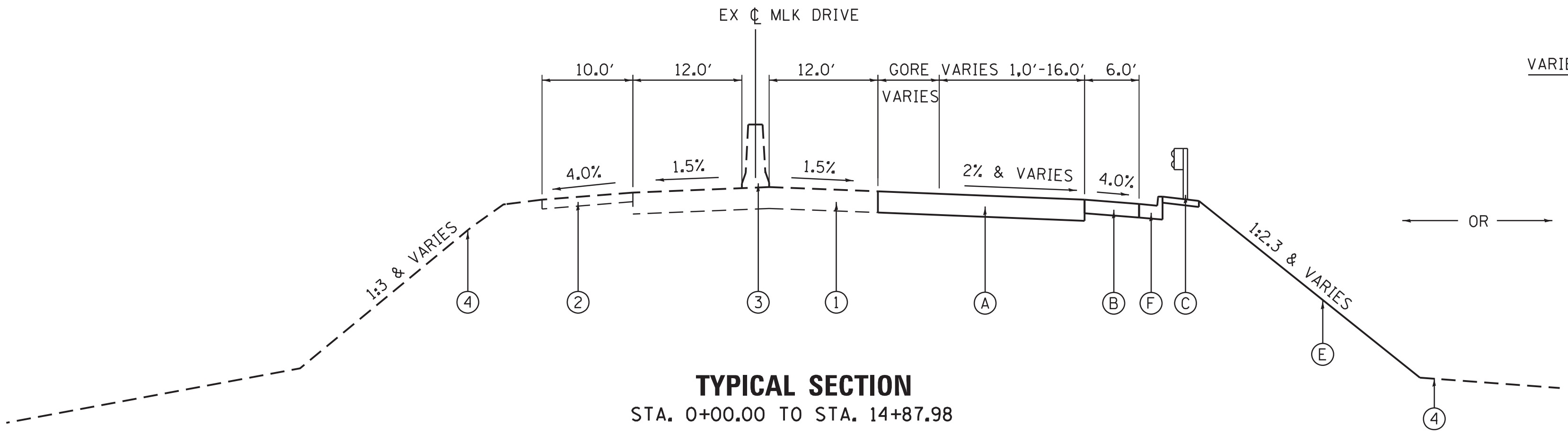
Summary of MLK Connector Alternatives Analysis

Design Speed (mph)	Horizontal Curvature -Radius (ft)	Weaving Distance Available (ft)	Additional Acceleration Distance Required (ft)	Billboards Impacted	Estimated Ramp Grades (%)	K-Values	Ramp Posted Speed (mph)	Pros & Cons	
35	340	1250	350	0	+4 and -6	Crest: 35 mph	25	Pros:	No widening to I-64/55/70 structure; longest weave distance; Auxiliary lane provided; No billboard impacts
						Sag: 25 mph		Cons:	Reduced shoulder widths on structure (6' Rt/6' Lt); Ramp posted speed 25 mph
40	485	900	130	0	+4 and -6	Crest: 40 mph	35	Pros:	Most of merge is on ascending grade of I-64/55/70; No billboards impacts
						Sag: 35 mph		Cons:	Less than 1000' preferred weaving distance
42.5	565	850	65	1	+4 and -6	Crest: 40 mph	35	Pros:	Improved design speed
						Sag: 35 mph		Cons:	Reduced weaving distance; Impacts Billboard; Merging point on I-64/55/70 crest curve
45	645	625	None	2	+4 and -6	Crest: 40 mph	35	Pros:	Improved design speed
						Sag: 35 mph		Cons:	Reduced weaving distance; Impacts Billboard; Merging point on I-64/55/70 crest curve
50	835	None	None	3	+3.5 and -3.5	Crest: 50 mph	50	Pros:	Weaving onto I-64/55/70 mainline prohibited
						Sag: N/A		Cons:	Increased ROW impacts; Hazardous waste; Impacts Billboards; Merge point on descending grade of I-64/55/70 structure

MLK CONNECTOR

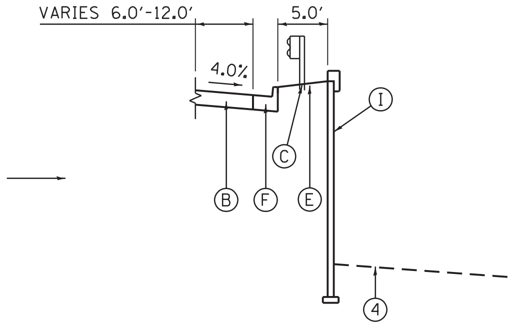
SUMMARY OF MLK CONNECTOR ALTERNATIVES ANALYSIS

FIGURE 20

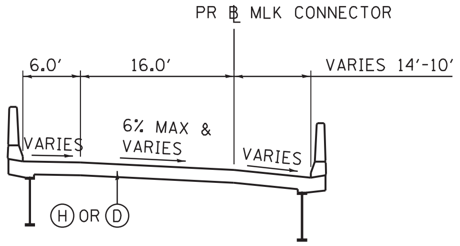


TYPICAL SECTION

STA. 0+00.00 TO STA. 14+87.98

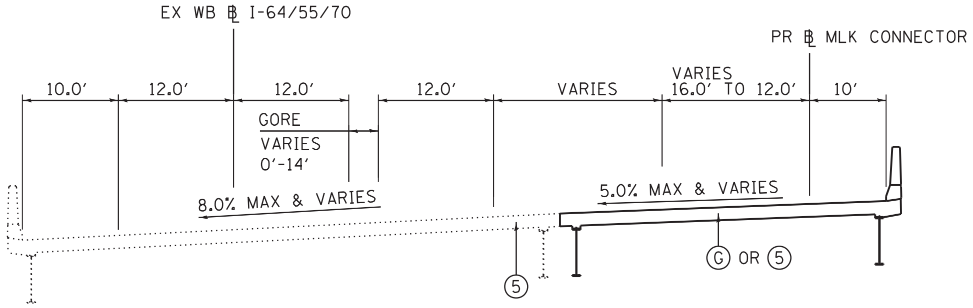


STA. 6+20.00 TO STA. 14+87.98



TYPICAL SECTION

STA. 14+87.98 TO STA. 26+72.92



TYPICAL SECTION

STA. 26+72.92 TO STA. 37+09.61

EXISTING LEGEND

① EXISTING PAVEMENT
② EXISTING HMA SHOULDER
③ EXISTING CONCRETE BARRIER
④ EXISTING GROUND
⑤ EXISTING BRIDGE

PROPOSED LEGEND

Ⓐ PROPOSED PAVEMENT
Ⓑ PROPOSED SHOULDER
Ⓒ PROPOSED GUARDRAIL
Ⓓ PROPOSED BRIDGE
Ⓔ PROPOSED GROUND
Ⓕ PROPOSED COMBINATION CONCRETE CURB & GUTTER
Ⓖ PROPOSED BRIDGE WIDENING
Ⓗ PROPOSED BRIDGE APPROACH PAVEMENT
Ⓘ PROPOSED RETAINING WALL

FIGURE 21

FILE NAME =
D876G09-FIGURE-21.dgn
Default

USER NAME = gustavo.pallares
PLOT SCALE = 20.0000 ' / in.
PLOT DATE = 5/9/2013

DESIGNED -
DRAWN -
CHECKED -
DATE -

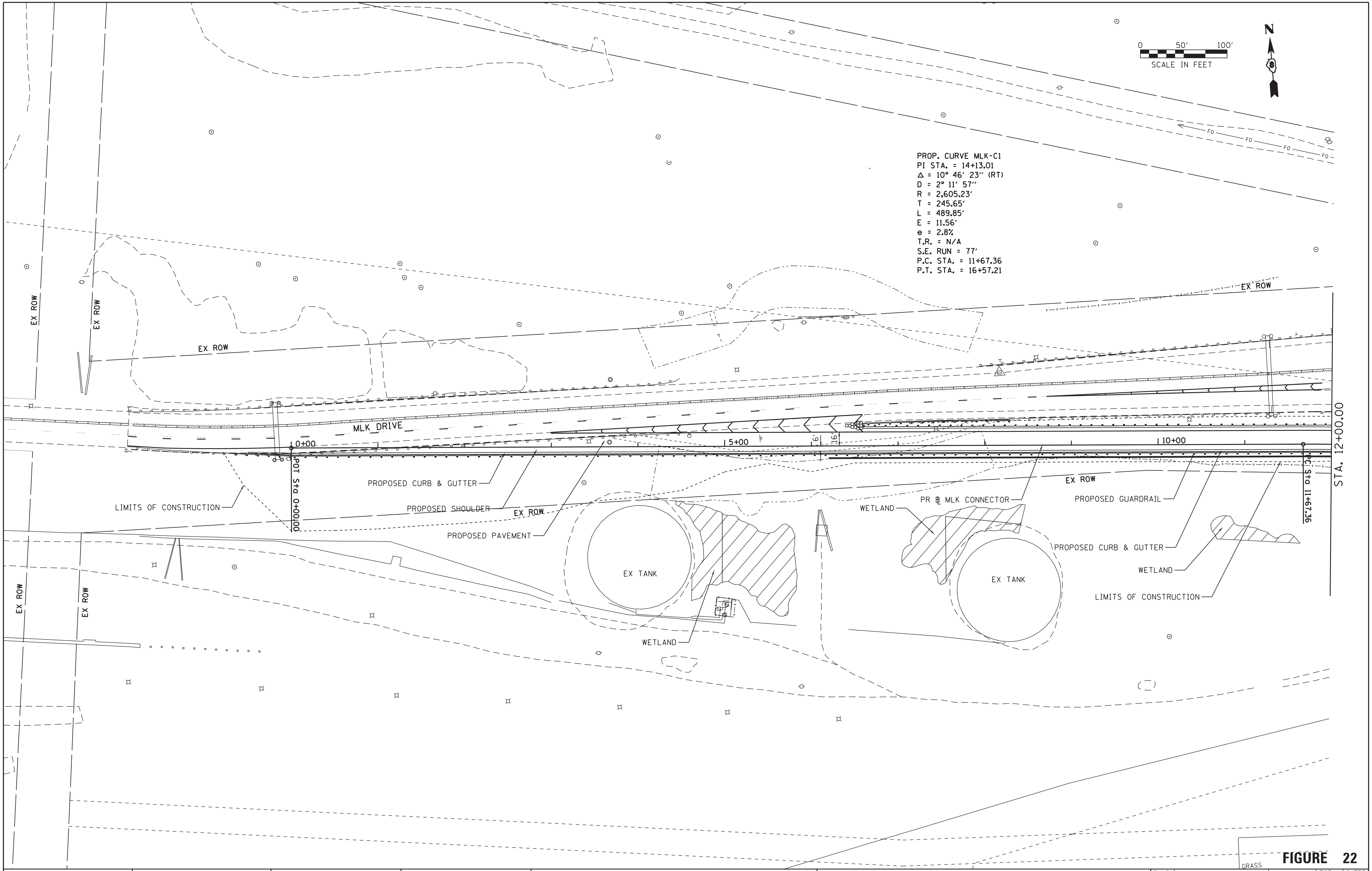
REVISED -
REVISED -
REVISED -
REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

TYPICAL SECTIONS
MLK CONNECTOR

SCALE: SHEET OF SHEETS STA. TO STA.

F.A.P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		ST. CLAIR		
		CONTRACT NO. 76G09		
	ILLINOIS FED. AID PROJECT			



PROP. CURVE MLK-C1
PI STA. = 14+13.01
Δ = 10° 46' 23'' (RT)
D = 2° 11' 57''
R = 2,605.23'
T = 245.65'
L = 489.85'
E = 11.56'
e = 2.8%
T.R. = N/A
S.E. RUN = 77'
P.C. STA. = 11+67.36
P.T. STA. = 16+57.21

FIGURE 22

FILE NAME =
D876G09-FIGURE-22.dgn
Default

USER NAME = gustavo.pallares
PLOT SCALE = 100.0000 ' / in.
PLOT DATE = 5/9/2013

DESIGNED -
DRAWN -
CHECKED -
DATE -

REVISED -
REVISED -
REVISED -
REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

PLAN
MLK CONNECTOR

SCALE: SHEET OF SHEETS STA. TO STA.

F.A.P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		ST. CLAIR		
CONTRACT NO. 76G09				

ILLINOIS FED. AID PROJECT

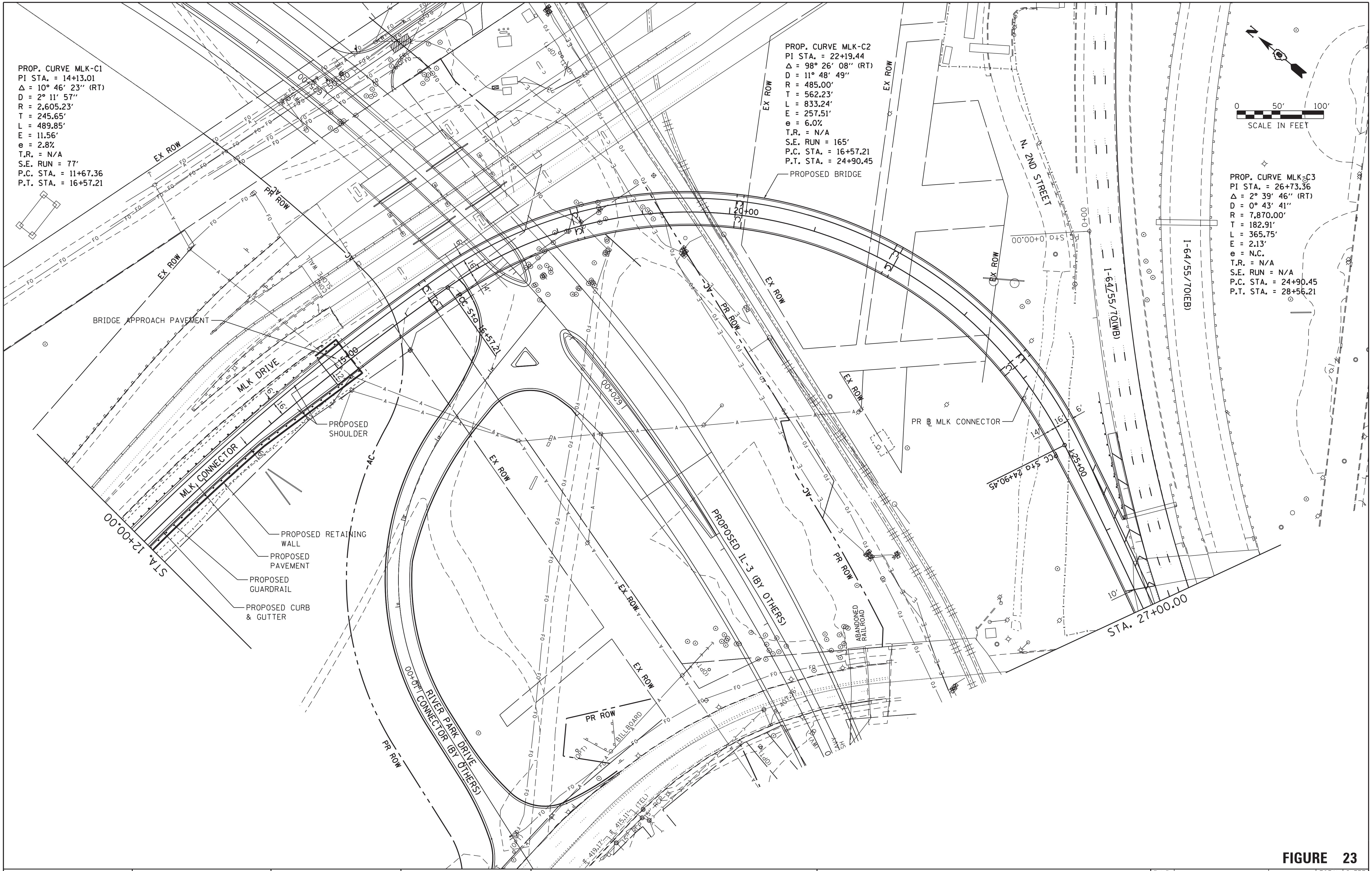


FIGURE 23

FILE NAME =	USER NAME = gustavo.pallares	DESIGNED -	REVISED -
D876G09-FIGURE-23.dgn		DRAWN -	REVISED -
	PLOT SCALE = 100.0000 ′ / in.	CHECKED -	REVISED -
Default	PLOT DATE = 5/9/2013	DATE -	REVISED -

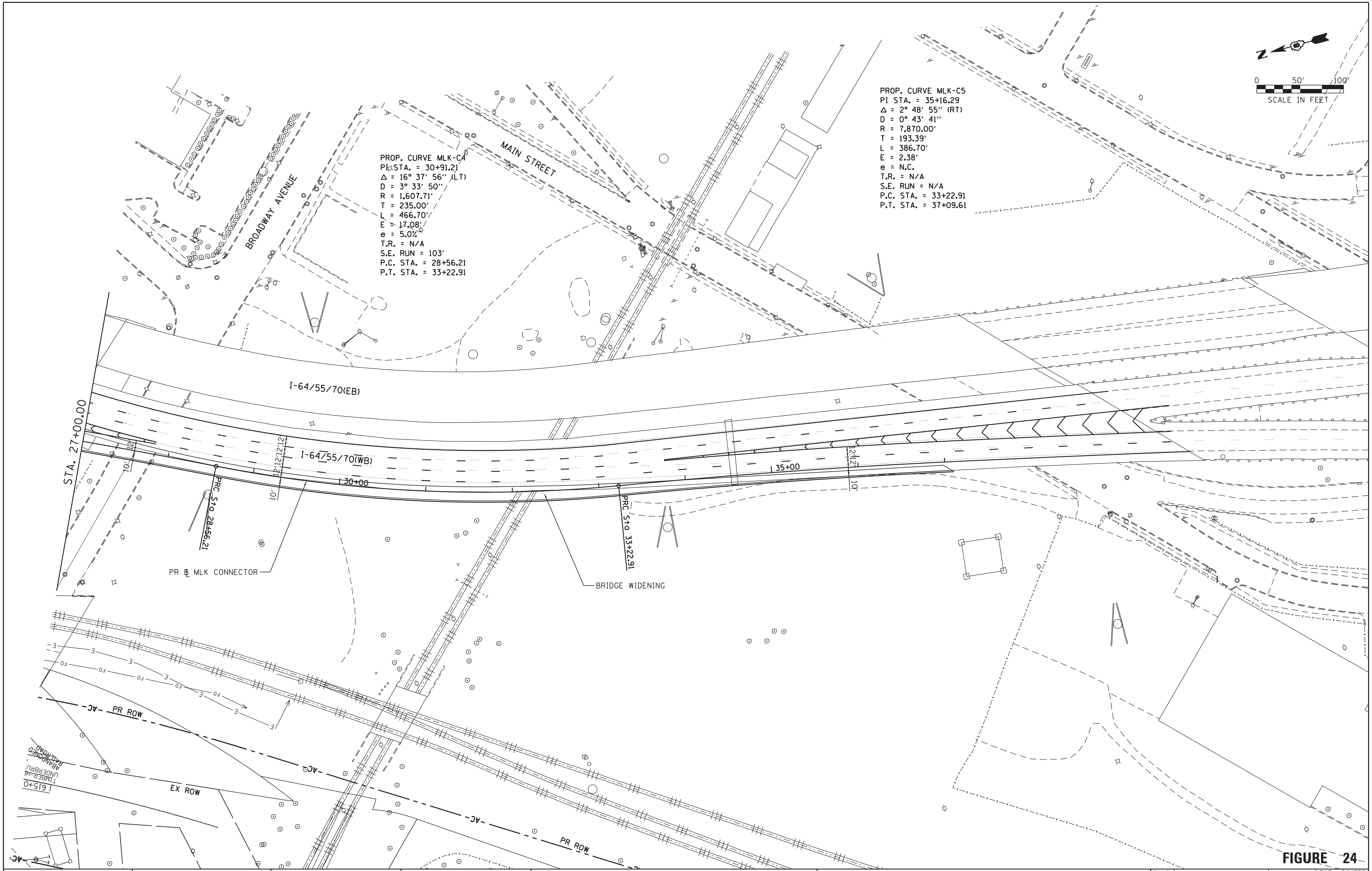
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

PLAN
MLK CONNECTOR

SCALE: SHEET OF SHEETS STA. TO STA.

F.A.P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		ST. CLAIR		
		CONTRACT NO. 76G09		

ILLINOIS FED. AID PROJECT



PROP. CURVE MLK-C4
PI STA. = 30+91.21
Δ = 16° 37′ 56″ (LT)
D = 3° 33′ 50″
R = 1,607.71′
T = 235.00′
L = 466.70′
E = 17.08′
e = 5.0%
T.R. = N/A
S.E. RUN = 103′
P.C. STA. = 28+56.21
P.T. STA. = 33+22.91

PROP. CURVE MLK-C5
PI STA. = 35+16.29
Δ = 2° 48′ 55″ (RT)
D = 0° 43′ 41″
R = 7,870.00′
T = 193.39′
L = 386.70′
E = 2.38′
e = N.C.
T.R. = N/A
S.E. RUN = N/A
P.C. STA. = 33+22.91
P.T. STA. = 37+09.61

FIGURE 24

FILE NAME =
D876G09-FIGURE-24.dgn
Default

USER NAME = gustavo.pallares
PLOT SCALE = 100.0000 ′ / in.
PLOT DATE = 5/9/2013

DESIGNED -
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DATE -

REVISED -
REVISED -
REVISED -
REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

PLAN
MLK CONNECTOR

SCALE: SHEET OF SHEETS STA. TO STA.

F.A.P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		ST. CLAIR		
		CONTRACT NO. 76G09		

ILLINOIS FED. AID PROJECT

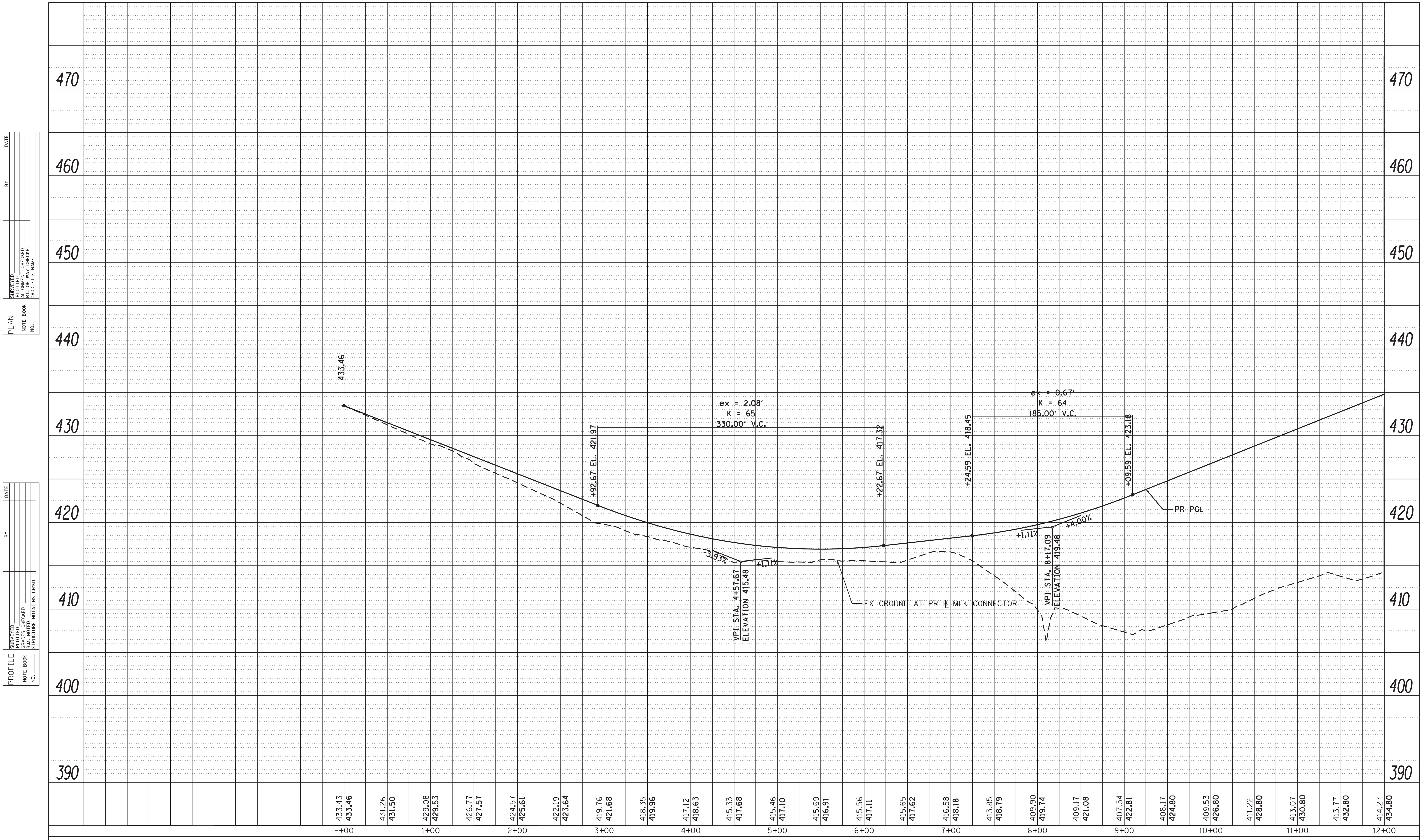

FIGURE 25

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D876G09-FIGURE-25.dgn
Default

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PLOT SCALE = 100.0000 ' / in.
PLOT DATE = 5/9/2013

DESIGNED -
DRAWN -
CHECKED -
DATE -

REVISED -
REVISED -
REVISED -
REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

PROFILE
MLK CONNECTOR

SCALE: SHEET OF SHEETS STA. TO STA.

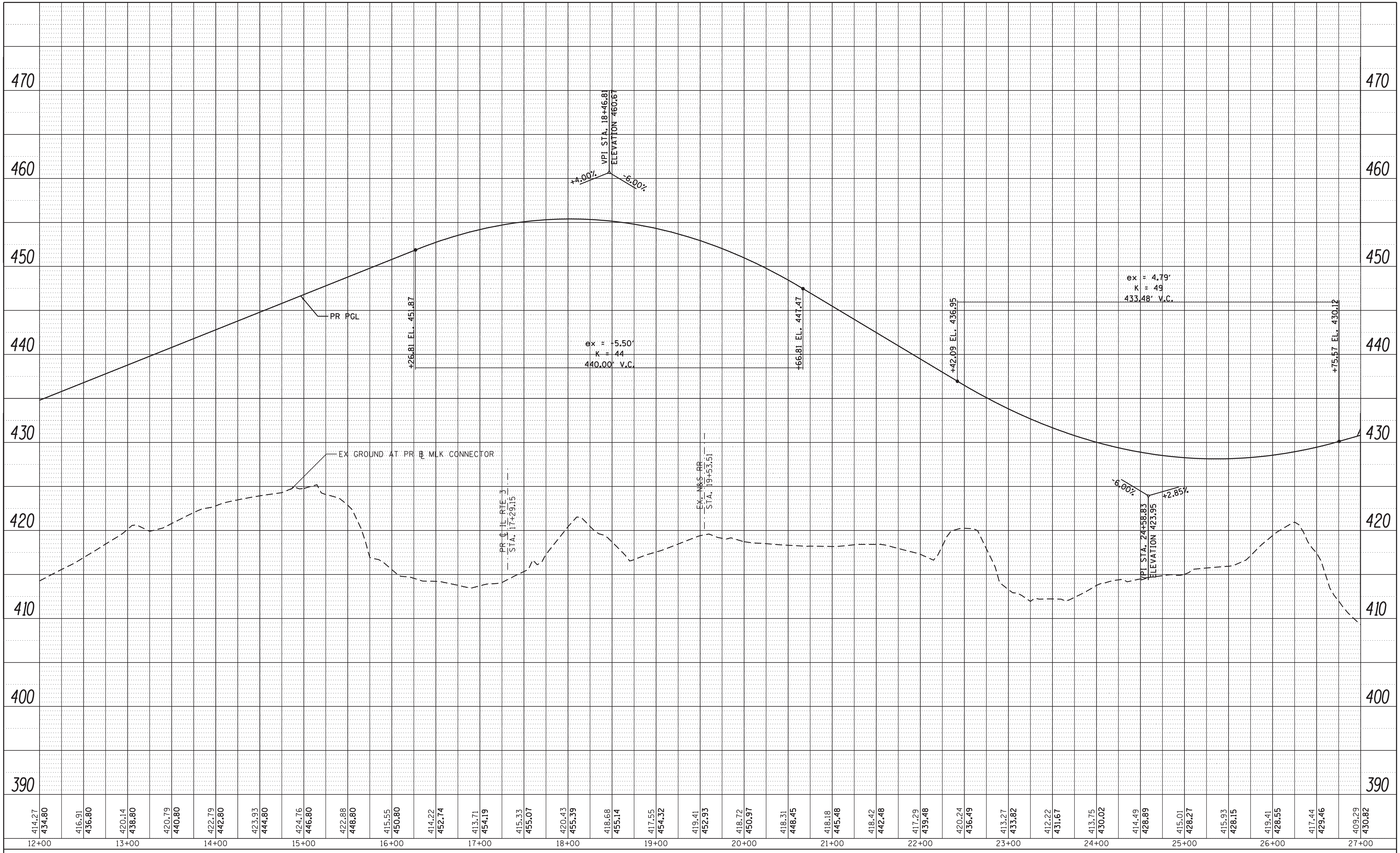
F.A.P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		ST. CLAIR		

CONTRACT NO. 76G09

ILLINOIS FED. AID PROJECT

PLAN
NOTE BOOK
NO.____
SURVEYED ____
PLOTTED ____
ALIGNMENT CHECKED ____
RT. OF WAY CHECKED ____
CADD FILE NAME ____
BY
DATE

PROFILE
NOTE BOOK
NO.____
SURVEYED ____
PLOTTED ____
GRADES CHECKED ____
B.M. NOTED ____
STRUCTURE NOTAT'NS CH'KD
BY
DATE



12+00	414.27	434.80
	416.91	436.80
13+00	420.14	438.80
	420.79	440.80
14+00	422.79	442.80
	423.93	444.80
15+00	424.76	446.80
	422.88	448.80
16+00	415.55	450.80
	414.22	452.74
17+00	413.71	454.19
	415.33	455.07
18+00	420.43	455.39
	418.68	455.14
19+00	417.55	454.32
	419.41	452.93
20+00	418.72	450.97
	418.31	448.45
21+00	418.18	445.48
	418.42	442.48
22+00	417.29	439.48
	420.24	436.49
23+00	413.27	433.82
	412.22	431.67
24+00	413.75	430.02
	414.49	428.89
25+00	415.01	428.27
	415.93	428.15
26+00	419.41	428.55
	417.44	429.46
27+00	409.29	430.82

FIGURE 26

FILE NAME =	USER NAME = gustavo.pallares	DESIGNED -	REVISED -	**STATE OF ILLINOIS** **DEPARTMENT OF TRANSPORTATION**	**PROFILE** **MLK CONNECTOR**
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Default	PLOT DATE = 5/9/2013	DATE -	REVISED -		SCALE: SHEET OF SHEETS STA. TO STA.

F.A.P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		ST. CLAIR		
		CONTRACT NO. 76G09		
		ILLINOIS FED. AID PROJECT		

PLAN
NOTE BOOK
NO. ____
SURVEYED
PLOTTED
ALIGNMENT CHECKED
RT. OF WAY CHECKED
CADD FILE NAME
BY
DATE

PROFILE
NOTE BOOK
NO. ____
SURVEYED
PLOTTED
GRADES CHECKED
B.M. NOTED
STRUCTURE NOTAT'NS CH'KD
BY
DATE

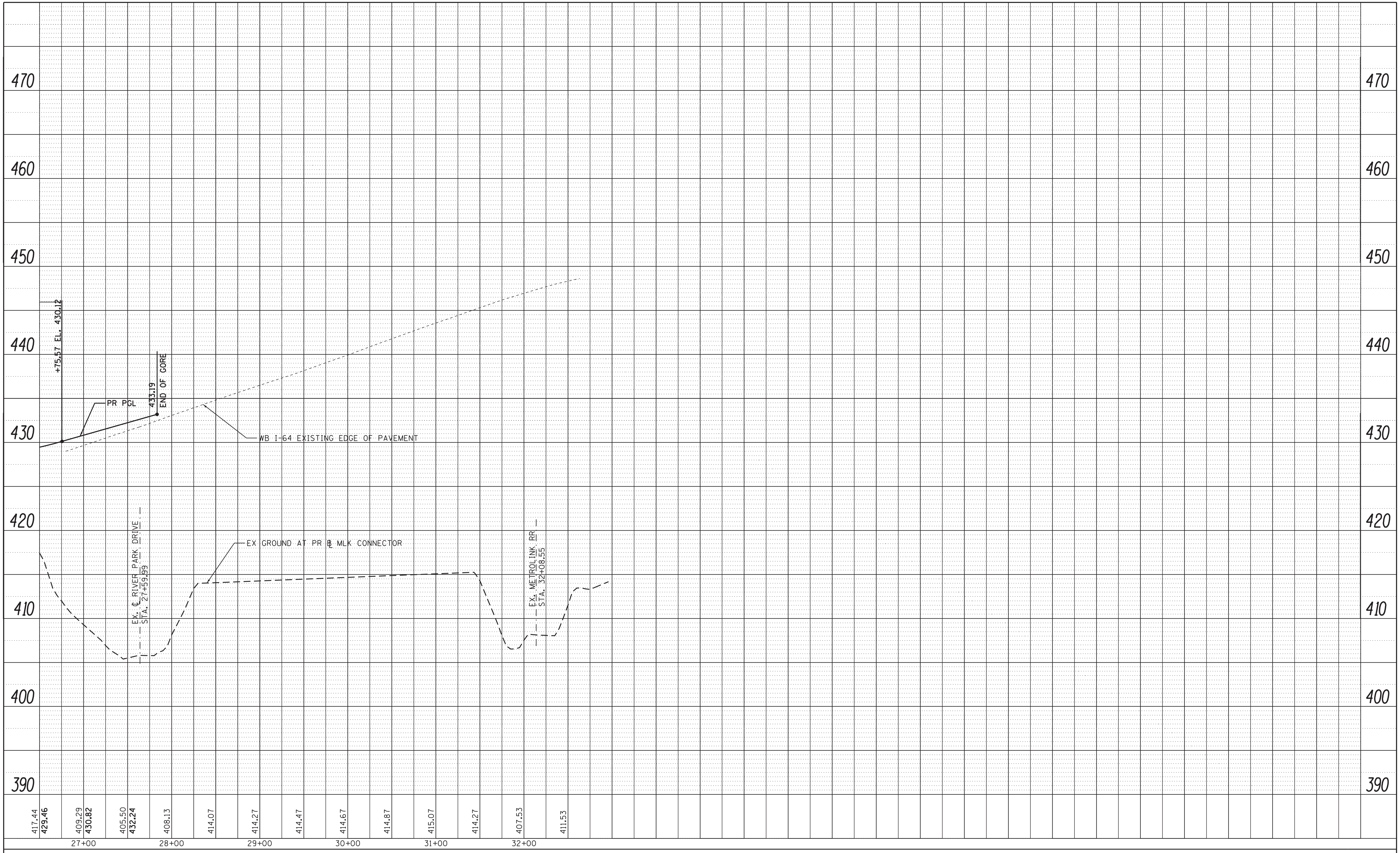

FIGURE 27

FILE NAME = D876G09-FIGURE-27.dgn Default	USER NAME = gustavo.pallares	DESIGNED -	REVISED -
		DRAWN -	REVISED -
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	PLOT DATE = 5/9/2013	DATE -	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

PROFILE
MLK CONNECTOR

SCALE: SHEET OF SHEETS STA. TO STA.

F.A.P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		ST. CLAIR		

CONTRACT NO. 76G09

ILLINOIS FED. AID PROJECT

Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

MLK CONNECTOR

2035 NO-BUILD TRAFFIC FORECAST

FIGURE 28

CBB Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

MLK CONNECTOR

2035 MLK CONNECTOR
TRAFFIC FORECAST

FIGURE 29

Appendix B

HCS2010 Output Files

BASIC FREEWAY SEGMENTS WORKSHEET

General Information / Site Information

Analyst	*JJP*	Highway/Direction of Travel	*WB 64*
Agency or Company	*CBB*	From/To	*E/O Missuri Ave*
Date Performed	*4/15/2013*	Jurisdiction	*IDOT*
Analysis Time Period	*AM*	Analysis Year	*2035 No Build*

Project Description *Operations of WB 64 with volume shift and no MLK connector*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4055*	veh/h	Peak-Hour Factor, PHF	*0.92*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs / Calc Speed Adj and FFS

Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1579*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*28.7*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

Glossary

N - Number of lanes

V - Hourly volume

v_p - Flow rate

LOS - Level of service

DDHV - Directional design hour volume

S - Speed

D - Density

FFS - Free-flow speed

BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12

E_T - Exhibits 11-10, 11-11, 11-13

f_p - Page 11-18

LOS, S, FFS, v_p - Exhibits 11-2, 11-3

f_{LW} - Exhibit 11-8

f_{LC} - Exhibit 11-9

TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information / Site Information

Analyst	*JJP*	Highway/Direction of Travel	*WB 64*
Agency or Company	*CBB*	From/To	*mainline*
Date Performed	*4/15/2013*	Jurisdiction	*IDOT*
Analysis Time Period	*AM*	Analysis Year	*2035 No Build*

Project Description *Operations of WB 64 with volume shift and no MLK connector*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3200*	veh/h	Peak-Hour Factor, PHF	*0.92*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]	*0.930*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1870*	pc/h/ln
S	*54.9*	mph
D = v_p / S	*34.1*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes

V - Hourly volume

v_p - Flow rate

LOS - Level of service

DDHV - Directional design hour volume

S - Speed

D - Density

FFS - Free-flow speed

BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12

E_T - Exhibits 11-10, 11-11, 11-13

f_p - Page 11-18

LOS, S, FFS, v_p - Exhibits 11-2, 11-3

f_{LW} - Exhibit 11-8

f_{LC} - Exhibit 11-9

TRD - Page 11-11

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Operations of WB 64 with volume shift and no MLK connector

FREEWAY WEAVING WORKSHEET

General Information

Analyst	JJP
Agency/Company	CBB
Date Performed	4/15/2013
Analysis Time Period	AM

Site Information

Freeway/Dir of Travel	WB 64 CD Road
Weaving Segment Location	between Main Street and Tudor
Analysis Year	2035 No Build

Project Description *Operations of WB 64 with volume shift and no MLK connector*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	380ft
Freeway free-flow speed, FFS	55 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	705	0.92	15	0	1.5	1.2	0.930	1.00	824
V_{RF}	340	0.92	15	0	1.5	1.2	0.930	1.00	397
V_{FR}	150	0.92	15	0	1.5	1.2	0.930	1.00	175
V_{RR}	0	0.92	15	0	1.5	1.2	0.930	1.00	0
V_{NW}	824							V =	1396
V_W	572								
VR	0.410								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	0.5 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc

Minimum weaving lane changes, LC_{MIN}	572 lc/h
Weaving lane changes, LC_W	615 lc/h
Non-weaving lane changes, LC_{NW}	0 lc/h
Total lane changes, LC_{ALL}	615 lc/h
Non-weaving vehicle index, I_{NW}	16

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	1396 pc/h
Weaving segment capacity, c_w	4912 veh/h
Weaving segment v/c ratio	0.264
Weaving segment density, D	9.9 pc/mi/ln
Level of Service, LOS	A

Weaving intensity factor, W	0.330
Weaving segment speed, S	47.1 mph
Average weaving speed, S_W	45.1 mph
Average non-weaving speed, S_{NW}	48.6 mph
Maximum weaving length, L_{MAX}	6791 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JJP	Freeway/Dir of Travel	WB 64 CD Road
Agency or Company	CBB	Junction	Route 3
Date Performed	4/15/2013	Jurisdiction	IDOT
Analysis Time Period	AM	Analysis Year	2035 No Build

Project Description Operations of WB 64 with volume shift and no MLK connector

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 1200 ft

V_u = 150 veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	190
Freeway Volume, V_F	1045
Ramp Volume, V_R	460
Freeway Free-Flow Speed, S_{FF}	55.0
Ramp Free-Flow Speed, S_{FR}	40.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1045	0.92	Level	15	0	0.930	1.00	1221
Ramp	460	0.92	Level	15	0	0.930	1.00	537
UpStream	150	0.92	Level	15	0	0.930	1.00	175
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 1221 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1221	Exhibit 13-8	4500	No
$V_{FO} = V_F - V_R$	684	Exhibit 13-8	4500	No
V_R	537	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1221	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$$

D_R = 13.0 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.411 (Exhibit 13-12)

S_R= 49.7 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 49.7 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / *Site Information*

Analyst	JJP	Freeway/Dir of Travel	WB CD Road
Agency or Company	CBB	Junction	Tudor on-ramp
Date Performed	4/15/2013	Jurisdiction	IDOT
Analysis Time Period	AM	Analysis Year	2035 No Build

Project Description Operations of WB 64 with volume shift and no MLK connector

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	0
Deceleration Lane Length L_D	
Freeway Volume, V_F	585
Ramp Volume, V_R	365
Freeway Free-Flow Speed, S_{FF}	55.0
Ramp Free-Flow Speed, S_{FR}	40.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	585	0.92	Level	15	0	0.930	1.00	684
Ramp	365	0.92	Level	15	0	0.930	1.00	426
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 684 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1110	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1110	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 13.9 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.333 (Exibit 13-11)

S_R= 50.7 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 50.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JJP	Freeway/Dir of Travel	WB CD Road
Agency or Company	CBB	Junction	Route 3 on-ramp
Date Performed	4/15/2013	Jurisdiction	IDOT
Analysis Time Period	AM	Analysis Year	2035 No Build

Project Description Operations of WB 64 with volume shift and no MLK connector

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	200
Deceleration Lane Length L_D	
Freeway Volume, V_F	950
Ramp Volume, V_R	1275
Freeway Free-Flow Speed, S_{FF}	55.0
Ramp Free-Flow Speed, S_{FR}	40.0

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 0 ft

V_D = 3200 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	950	0.92	Level	15	0	0.930	1.00	1110
Ramp	1275	0.92	Level	15	0	0.930	1.00	1490
UpStream								
DownStream	3200	0.92	Level	15	0	0.930	1.00	3739

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1110 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2600	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2600	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$$

D_R = 23.8 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.358 (Exibit 13-11)

S_R= 50.4 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 50.4 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JJP*	Highway/Direction of Travel	*WB 64*
Agency or Company	*CBB*	From/To	*PSB*
Date Performed	*4/15/2013*	Jurisdiction	*IDOT*
Analysis Time Period	*AM*	Analysis Year	

Project Description *Operations of WB 64 with volume shift and no MLK connector*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*5425*	veh/h	Peak-Hour Factor, PHF	*0.92*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*4*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1585*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*28.8*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JJP*	Highway/Direction of Travel	*EB MLK*
Agency or Company	*CBB*	From/To	*MLK*
Date Performed	*4/15/2013*	Jurisdiction	*IDOT*
Analysis Time Period	*AM*	Analysis Year	*No Build*

Project Description *operations of WB 64 with volume shift and no MLK connector*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*355*	veh/h	Peak-Hour Factor, PHF	*0.92*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*207*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*3.8*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*JJP*
Agency or Company	*CBB*
Date Performed	*4/15/2013*
Analysis Time Period	

Site Information

Highway/Direction of Travel	*WB 64*
From/To	*E/O Missuri Ave*
Jurisdiction	*IDOT*
Analysis Year	*2035 No Build*

Project Description *Operations of WB 64 with volume shift and no MLK connector*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3460*	veh/h	Peak-Hour Factor, PHF	*0.92*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1348*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*24.5*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		*Site Information*	
Analyst	*JJP*	Highway/Direction of Travel	*WB 64*
Agency or Company	*CBB*	From/To	*mainline*
Date Performed	*4/15/2013*	Jurisdiction	*IDOT*
Analysis Time Period	*PM*	Analysis Year	*2035 No Build*

Project Description *Operations of WB 64 with volume shift and no MLK connector*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2300*	veh/h	Peak-Hour Factor, PHF	*0.92*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1344*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*24.4*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

Glossary		**Factor Location**	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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Operations of WB 64 with volume shift and no MLK connector

FREEWAY WEAVING WORKSHEET

General Information

Analyst	JJP	Freeway/Dir of Travel	WB 64 CD Road
Agency/Company	CBB	Weaving Segment Location	between Main Street and Tudor
Date Performed	4/15/2013	Analysis Year	2035 No Build
Analysis Time Period	PM		

Site Information

Project Description *Operations of WB 64 with volume shift and no MLK connector*

Inputs

Weaving configuration	One-Sided	Segment type	Freeway
Weaving number of lanes, N	3	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	380ft	Freeway maximum capacity, C_{IFL}	2250
Freeway free-flow speed, FFS	55 mph	Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	760	0.92	15	0	1.5	1.2	0.930	1.00	888
V_{RF}	250	0.92	15	0	1.5	1.2	0.930	1.00	292
V_{FR}	400	0.92	15	0	1.5	1.2	0.930	1.00	467
V_{RR}	0	0.92	15	0	1.5	1.2	0.930	1.00	0
V_{NW}	888							V =	1647
V_W	759								
VR	0.461								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	759 lc/h
Interchange density, ID	0.5 int/mi	Weaving lane changes, LC_W	802 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	0 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	802 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	17

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	1647 pc/h	Weaving intensity factor, W	0.407
Weaving segment capacity, c_w	4786 veh/h	Weaving segment speed, S	45.2 mph
Weaving segment v/c ratio	0.320	Average weaving speed, S_W	43.4 mph
Weaving segment density, D	12.1 pc/mi/ln	Average non-weaving speed, S_{NW}	46.9 mph
Level of Service, LOS	B	Maximum weaving length, L_{MAX}	7372 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JJP	Freeway/Dir of Travel	WB 64 CD Road
Agency or Company	CBB	Junction	Route 3
Date Performed	4/15/2013	Jurisdiction	IDOT
Analysis Time Period	PM	Analysis Year	2035 No Build

Project Description Operations of WB 64 with volume shift and no MLK connector

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 1200 ft

V_u = 400 veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	190
Freeway Volume, V_F	1010
Ramp Volume, V_R	700
Freeway Free-Flow Speed, S_{FF}	55.0
Ramp Free-Flow Speed, S_{FR}	40.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1010	0.92	Level	15	0	0.930	1.00	1180
Ramp	700	0.92	Level	15	0	0.930	1.00	818
UpStream	400	0.92	Level	15	0	0.930	1.00	467
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F\,(P_{FM})$$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 1180 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1180	Exhibit 13-8	4500	No
$V_{FO} = V_F - V_R$	362	Exhibit 13-8	4500	No
V_R	818	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1180	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$$

D_R = 12.7 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.437 (Exhibit 13-12)

S_R= 49.3 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 49.3 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JJP	Freeway/Dir of Travel	WB CD Road
Agency or Company	CBB	Junction	Tudor on-ramp
Date Performed	4/15/2013	Jurisdiction	IDOT
Analysis Time Period	PM	Analysis Year	2035 No Build

Project Description Operations of WB 64 with volume shift and no MLK connector

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	0
Deceleration Lane Length L_D	
Freeway Volume, V_F	310
Ramp Volume, V_R	350
Freeway Free-Flow Speed, S_{FF}	55.0
Ramp Free-Flow Speed, S_{FR}	40.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	310	0.92	Level	15	0	0.930	1.00	362
Ramp	350	0.92	Level	15	0	0.930	1.00	409
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 362 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	771	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	771	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 11.3 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.329 (Exibit 13-11)

S_R= 50.7 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 50.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JJP	Freeway/Dir of Travel	WB CD Road
Agency or Company	CBB	Junction	Route 3 on-ramp
Date Performed	4/15/2013	Jurisdiction	IDOT
Analysis Time Period	PM	Analysis Year	2035 No Build

Project Description Operations of WB 64 with volume shift and no MLK connector

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N 2

Ramp Number of Lanes, N 1

Acceleration Lane Length, L_A 200

Deceleration Lane Length L_D

Freeway Volume, V_F 660

Ramp Volume, V_R 1000

Freeway Free-Flow Speed, S_{FF} 55.0

Ramp Free-Flow Speed, S_{FR} 40.0

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 0 ft

V_D = 2300 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	660	0.92	Level	15	0	0.930	1.00	771
Ramp	1000	0.92	Level	15	0	0.930	1.00	1168
UpStream								
DownStream	2300	0.92	Level	15	0	0.930	1.00	2687

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 771 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1939	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1939	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 18.8 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.332 (Exibit 13-11)

S_R= 50.7 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 50.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information / Site Information

Analyst	*JJP*	Highway/Direction of Travel	*WB 64*
Agency or Company	*CBB*	From/To	*PSB*
Date Performed	*4/15/2013*	Jurisdiction	*IDOT*
Analysis Time Period	*PM*	Analysis Year	

Project Description *Operations of WB 64 with volume shift and no MLK connector*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3960*	veh/h	Peak-Hour Factor, PHF	*0.92*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*4*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1157*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*21.0*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		***Site Information***	
Analyst	*JJP*	Highway/Direction of Travel	*EB MLK*
Agency or Company	*CBB*	From/To	*MLK*
Date Performed	*4/15/2013*	Jurisdiction	*IDOT*
Analysis Time Period	*PM*	Analysis Year	*No Build*

Project Description *operations of WB 64 with volume shift and no MLK connector*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1785*	veh/h	Peak-Hour Factor, PHF	*0.92*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			**Design (N)**		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
			Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1043*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*55.0*	mph	S		mph
D = v_p / S	*19.0*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*C*		Required Number of Lanes, N		

Glossary	**Factor Location**
N - Number of lanes V - Hourly volume v_p - Flow rate LOS - Level of service DDHV - Directional design hour volume S - Speed D - Density FFS - Free-flow speed BFFS - Base free-flow speed	E_R - Exhibits 11-10, 11-12 E_T - Exhibits 11-10, 11-11, 11-13 f_p - Page 11-18 LOS, S, FFS, v_p - Exhibits 11-2, 11-3 f_{LW} - Exhibit 11-8 f_{LC} - Exhibit 11-9 TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*JJP*
Agency or Company	*CBB*
Date Performed	*4/15/2013*
Analysis Time Period	*AM*

Site Information

Highway/Direction of Travel	*WB 64*
From/To	*E/O Missouri Ave*
Jurisdiction	*IDOT*
Analysis Year	*2035 Build*

Project Description *operations with new MLK connection to WB 64*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3980*	veh/h	Peak-Hour Factor, PHF	*0.92*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1550*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*28.2*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JJP	Freeway/Dir of Travel	WB 64
Agency or Company	CBB	Junction	MLK Connector
Date Performed	4/15/2013	Jurisdiction	IDOT
Analysis Time Period	AM	Analysis Year	2035 Build

Project Description operations with new MLK connection to WB 64

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N 3

Ramp Number of Lanes, N 1

Acceleration Lane Length, L_A 1500

Deceleration Lane Length L_D

Freeway Volume, V_F 3980

Ramp Volume, V_R 100

Freeway Free-Flow Speed, S_{FF} 55.0

Ramp Free-Flow Speed, S_{FR} 40.0

Downstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{down} = 1500 ft

V_D = 880 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	3980	0.92	Level	15	0	0.930	1.00	4651
Ramp	100	0.92	Level	15	0	0.930	1.00	117
UpStream								
DownStream	880	0.92	Level	15	0	0.930	1.00	1028

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = 3806.00 (Equation 13-6 or 13-7)

P_{FM} = 0.729 using Equation (Exhibit 13-6)

V_{12} = 3390 pc/h

V_3 or V_{av34} 1261 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4768	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3507	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 23.4 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.331 (Exibit 13-11)

S_R= 50.7 mph (Exhibit 13-11)

S_0= 52.3 mph (Exhibit 13-11)

S = 51.1 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*JJP*
Agency or Company	*CBB*
Date Performed	*4/15/2013*
Analysis Time Period	*AM*

Site Information

Highway/Direction of Travel	*WB 64*
From/To	*mainline*
Jurisdiction	*IDOT*
Analysis Year	*2035 Build*

Project Description *operations with new MLK connection to WB 64*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3200*	veh/h	Peak-Hour Factor, PHF	*0.92*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]	*0.930*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1870*	pc/h/ln
S	*54.9*	mph
D = v_p / S	*34.1*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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operations with new MLK connection to WB 64

FREEWAY WEAVING WORKSHEET

General Information

Analyst	JJP
Agency/Company	CBB
Date Performed	4/15/2013
Analysis Time Period	AM

Site Information

Freeway/Dir of Travel	WB 64 CD Road
Weaving Segment Location	between Main Street and Tudor
Analysis Year	2035 Build

Project Description *operations with new MLK connection to WB 64*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	380ft
Freeway free-flow speed, FFS	55 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	730	0.92	15	0	1.5	1.2	0.930	1.00	853
V_{RF}	315	0.92	15	0	1.5	1.2	0.930	1.00	368
V_{FR}	150	0.92	15	0	1.5	1.2	0.930	1.00	175
V_{RR}	0	0.92	15	0	1.5	1.2	0.930	1.00	0
V_{NW}	853							V =	1396
V_W	543								
VR	0.389								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	0.5 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc

Minimum weaving lane changes, LC_{MIN}	543 lc/h
Weaving lane changes, LC_W	586 lc/h
Non-weaving lane changes, LC_{NW}	0 lc/h
Total lane changes, LC_{ALL}	586 lc/h
Non-weaving vehicle index, I_{NW}	16

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	1396 pc/h
Weaving segment capacity, c_w	4959 veh/h
Weaving segment v/c ratio	0.262
Weaving segment density, D	9.8 pc/mi/ln
Level of Service, LOS	A

Weaving intensity factor, W	0.318
Weaving segment speed, S	47.4 mph
Average weaving speed, S_W	45.3 mph
Average non-weaving speed, S_{NW}	48.9 mph
Maximum weaving length, L_{MAX}	6558 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JJP	Freeway/Dir of Travel	WB 64 CD Road
Agency or Company	CBB	Junction	Route 3
Date Performed	4/15/2013	Jurisdiction	IDOT
Analysis Time Period	AM	Analysis Year	2035 Build

Project Description operations with new MLK connection to WB 64

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 1200 ft

V_u = 150 veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	190
Freeway Volume, V_F	1045
Ramp Volume, V_R	460
Freeway Free-Flow Speed, S_{FF}	55.0
Ramp Free-Flow Speed, S_{FR}	40.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1045	0.92	Level	15	0	0.930	1.00	1221
Ramp	460	0.92	Level	15	0	0.930	1.00	537
UpStream	150	0.92	Level	15	0	0.930	1.00	175
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 1221 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1221	Exhibit 13-8	4500	No
$V_{FO} = V_F - V_R$	684	Exhibit 13-8	4500	No
V_R	537	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1221	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = 13.0 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.411 (Exhibit 13-12)

S_R= 49.7 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 49.7 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JJP	Freeway/Dir of Travel	WB CD Road
Agency or Company	CBB	Junction	Tudor on-ramp
Date Performed	4/15/2013	Jurisdiction	IDOT
Analysis Time Period	AM	Analysis Year	2035 Build

Project Description operations with new MLK connection to WB 64

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	0
Deceleration Lane Length L_D	
Freeway Volume, V_F	585
Ramp Volume, V_R	365
Freeway Free-Flow Speed, S_{FF}	55.0
Ramp Free-Flow Speed, S_{FR}	40.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	585	0.92	Level	15	0	0.930	1.00	684
Ramp	365	0.92	Level	15	0	0.930	1.00	426
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F \ (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 684 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1110	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1110	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 \ v_R + 0.0078 \ V_{12} - 0.00627 \ L_A$

D_R = 13.9 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.333 (Exibit 13-11)

S_R= 50.7 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 50.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 \ V_{12} - 0.009 \ L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JJP	Freeway/Dir of Travel	WB CD Road
Agency or Company	CBB	Junction	Route 3 on-ramp
Date Performed	4/15/2013	Jurisdiction	IDOT
Analysis Time Period	AM	Analysis Year	2035 Build

Project Description operations with new MLK connection to WB 64

Inputs

Upstream Adj Ramp			Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N	2	☑ Yes ☑ On
☑ No ☐ Off	Ramp Number of Lanes, N	1	☐ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A	200	L_{down} = 0 ft
V_u = veh/h	Deceleration Lane Length L_D		V_D = 3200 veh/h
	Freeway Volume, V_F	950	
	Ramp Volume, V_R	1275	
	Freeway Free-Flow Speed, S_{FF}	55.0	
	Ramp Free-Flow Speed, S_{FR}	40.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	950	0.92	Level	15	0	0.930	1.00	1110
Ramp	1275	0.92	Level	15	0	0.930	1.00	1490
UpStream								
DownStream	3200	0.92	Level	15	0	0.930	1.00	3739

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1110 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2600	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2600	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$$

D_R = 23.8 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.358 (Exibit 13-11)

S_R= 50.4 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 50.4 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*JJP*
Agency or Company	*CBB*
Date Performed	*4/15/2013*
Analysis Time Period	*AM*

Site Information

Highway/Direction of Travel	*WB 64*
From/To	*PSB*
Jurisdiction	*IDOT*
Analysis Year	

Project Description *operations with new MLK connection to WB 64*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*5425*	veh/h	Peak-Hour Factor, PHF	*0.92*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*4*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1585*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*28.8*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		***Site Information***	
Analyst	*JJP*	Highway/Direction of Travel	*EB MLK*
Agency or Company	*CBB*	From/To	*MLK*
Date Performed	*4/15/2013*	Jurisdiction	*IDOT*
Analysis Time Period	*AM*	Analysis Year	*No Build*

Project Description

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*355*	veh/h	Peak-Hour Factor, PHF	*0.92*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			**Design (N)**		
			Design (N)		
Operational (LOS)			Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*207*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*55.0*	mph	S		mph
D = v_p / S	*3.8*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*A*		Required Number of Lanes, N		

Glossary		**Factor Location**	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JJP	Freeway/Dir of Travel	EB MLK
Agency or Company	CBB	Junction	MLK Connector
Date Performed	4/15/2013	Jurisdiction	IDOT
Analysis Time Period	AM	Analysis Year	2035 Build

Project Description operations with new MLK connection to WB 64

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	0
Freeway Volume, V_F	355
Ramp Volume, V_R	100
Freeway Free-Flow Speed, S_{FF}	55.0
Ramp Free-Flow Speed, S_{FR}	40.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	355	0.92	Level	15	0	0.930	1.00	415
Ramp	100	0.92	Level	15	0	0.930	1.00	117
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 415 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	415	Exhibit 13-8	4500	No
$V_{FO} = V_F - V_R$	298	Exhibit 13-8	4500	No
V_R	117	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	415	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = 7.8 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

D_s = 0.374 (Exhibit 13-12)

S_R= 50.1 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 50.1 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		***Site Information***	
Analyst	*JJP*	Highway/Direction of Travel	*WB 64*
Agency or Company	*CBB*	From/To	*E/O Missuri Ave*
Date Performed	*4/15/2013*	Jurisdiction	*IDOT*
Analysis Time Period	*PM*	Analysis Year	*2035 Build*

Project Description *operations with new MLK connection to WB 64*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3060*	veh/h	Peak-Hour Factor, PHF	*0.92*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			**Design (N)**		
Operational (LOS)			Design (N)		
			Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1192*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*55.0*	mph	S		mph
D = v_p / S	*21.7*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*C*		Required Number of Lanes, N		

Glossary		**Factor Location**	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JJP	Freeway/Dir of Travel	WB 64
Agency or Company	CBB	Junction	Main Street on-ramp
Date Performed	4/15/2013	Jurisdiction	IDOT
Analysis Time Period	PM	Analysis Year	2035 Build

Project Description operations with new MLK connection to WB 64

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	1500
Deceleration Lane Length L_D	
Freeway Volume, V_F	3060
Ramp Volume, V_R	500
Freeway Free-Flow Speed, S_{FF}	55.0
Ramp Free-Flow Speed, S_{FR}	40.0

Downstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{down} = 1500 ft

V_D = 760 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3060	0.92	Level	15	0	0.930	1.00	3576
Ramp	500	0.92	Level	15	0	0.930	1.00	584
UpStream								
DownStream	760	0.92	Level	15	0	0.930	1.00	888

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = 3287.67 (Equation 13-6 or 13-7)

P_{FM} = 0.704 using Equation (Exhibit 13-6)

V_{12} = 2518 pc/h

V_3 or V_{av34} 1058 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4160	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3102	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$$

D_R = 20.0 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.288 (Exibit 13-11)

S_R= 51.3 mph (Exhibit 13-11)

S_0= 53.0 mph (Exhibit 13-11)

S = 51.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JJP*	Highway/Direction of Travel	*WB 64*
Agency or Company	*CBB*	From/To	*mainline*
Date Performed	*4/15/2013*	Jurisdiction	*IDOT*
Analysis Time Period	*PM*	Analysis Year	*2035 Build*

Project Description *operations with new MLK connection to WB 64*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2300*	veh/h	Peak-Hour Factor, PHF	*0.92*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft	f_{LW}		mph
Rt-Side Lat. Clearance		ft	f_{LC}		mph
Number of Lanes, N	*2*		TRD Adjustment		mph
Total Ramp Density, TRD		ramps/mi	FFS	*55.0*	mph
FFS (measured)	*55.0*	mph			
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1344*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*24.4*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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operations with new MLK connection to WB 64

FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	CBB
Date Performed	4/15/2013
Analysis Time Period	PM

Site Information

Freeway/Dir of Travel	WB 64 CD Road
Weaving Segment Location	between Main Street and Tudor
Analysis Year	2035 Build

Project Description *operations with new MLK connection to WB 64*

Inputs

Weaving configuration	One-Sided	Segment type	Freeway
Weaving number of lanes, N	3	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	380ft	Freeway maximum capacity, C_{IFL}	2250
Freeway free-flow speed, FFS	55 mph	Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	860	0.92	15	0	1.5	1.2	0.930	1.00	1005
V_{RF}	150	0.92	15	0	1.5	1.2	0.930	1.00	175
V_{FR}	400	0.92	15	0	1.5	1.2	0.930	1.00	467
V_{RR}	0	0.92	15	0	1.5	1.2	0.930	1.00	0
V_{NW}	1005							V =	1647
V_W	642								
VR	0.390								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	642 lc/h
Interchange density, ID	0.5 int/mi	Weaving lane changes, LC_W	685 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	0 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	685 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	19

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	1647 pc/h	Weaving intensity factor, W	0.360
Weaving segment capacity, c_w	4959 veh/h	Weaving segment speed, S	46.4 mph
Weaving segment v/c ratio	0.309	Average weaving speed, S_W	44.4 mph
Weaving segment density, D	11.8 pc/mi/ln	Average non-weaving speed, S_{NW}	47.7 mph
Level of Service, LOS	B	Maximum weaving length, L_{MAX}	6567 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Site Information

Analyst	JJP	Freeway/Dir of Travel	WB 64 CD Road
Agency or Company	CBB	Junction	Route 3
Date Performed	4/15/2013	Jurisdiction	IDOT
Analysis Time Period	PM	Analysis Year	2035 Build

Project Description operations with new MLK connection to WB 64

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 1200 ft

V_u = 400 veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	190
Freeway Volume, V_F	1010
Ramp Volume, V_R	700
Freeway Free-Flow Speed, S_{FF}	55.0
Ramp Free-Flow Speed, S_{FR}	40.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1010	0.92	Level	15	0	0.930	1.00	1180
Ramp	700	0.92	Level	15	0	0.930	1.00	818
UpStream	400	0.92	Level	15	0	0.930	1.00	467
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 1180 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1180	Exhibit 13-8	4500	No
$V_{FO} = V_F - V_R$	362	Exhibit 13-8	4500	No
V_R	818	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1180	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = 12.7 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.437 (Exhibit 13-12)

S_R= 49.3 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 49.3 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JJP	Freeway/Dir of Travel	WB CD Road
Agency or Company	CBB	Junction	Tudor on-ramp
Date Performed	4/15/2013	Jurisdiction	IDOT
Analysis Time Period	PM	Analysis Year	Build 2035

Project Description operations with new MLK connection to WB 64

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	0
Deceleration Lane Length L_D	
Freeway Volume, V_F	310
Ramp Volume, V_R	350
Freeway Free-Flow Speed, S_{FF}	55.0
Ramp Free-Flow Speed, S_{FR}	40.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	310	0.92	Level	15	0	0.930	1.00	362
Ramp	350	0.92	Level	15	0	0.930	1.00	409
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 362 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	771	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	771	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 11.3 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.329 (Exibit 13-11)

S_R= 50.7 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 50.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	JJP	Freeway/Dir of Travel	WB CD Road
Agency or Company	CBB	Junction	Route 3 on-ramp
Date Performed	4/15/2013	Jurisdiction	IDOT
Analysis Time Period	PM	Analysis Year	2035 Build

Project Description operations with new MLK connection to WB 64

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N 2

Ramp Number of Lanes, N 1

Acceleration Lane Length, L_A 200

Deceleration Lane Length L_D

Freeway Volume, V_F 660

Ramp Volume, V_R 1000

Freeway Free-Flow Speed, S_{FF} 55.0

Ramp Free-Flow Speed, S_{FR} 40.0

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 0 ft

V_D = 2300 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	660	0.92	Level	15	0	0.930	1.00	771
Ramp	1000	0.92	Level	15	0	0.930	1.00	1168
UpStream								
DownStream	2300	0.92	Level	15	0	0.930	1.00	2687

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 771 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1939	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1939	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 18.8 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.332 (Exibit 13-11)

S_R= 50.7 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 50.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		**Site Information**	
Analyst	*JJP*	Highway/Direction of Travel	*WB 64*
Agency or Company	*CBB*	From/To	*PSB*
Date Performed	*4/15/2013*	Jurisdiction	*IDOT*
Analysis Time Period	*PM*	Analysis Year	

Project Description *operations with new MLK connection to WB 64*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3960*	veh/h	Peak-Hour Factor, PHF	*0.92*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*4*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1157*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*21.0*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*JJP*
Agency or Company	*CBB*
Date Performed	*4/15/2013*
Analysis Time Period	*PM*

Site Information

Highway/Direction of Travel	*EB MLK*
From/To	*MLK*
Jurisdiction	*IDOT*
Analysis Year	

Project Description *operations with new MLK connection to WB 64*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1785*	veh/h	Peak-Hour Factor, PHF	*0.92*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1043*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*19.0*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	mph
D = v_p / S	pc/mi/ln
Required Number of Lanes, N	

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JJP	Freeway/Dir of Travel	EB MLK
Agency or Company	CBB	Junction	MLK Connector
Date Performed	4/15/2013	Jurisdiction	IDOT
Analysis Time Period	PM	Analysis Year	2035 Build

Project Description operations with new MLK connection to WB 64

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	0
Freeway Volume, V_F	1785
Ramp Volume, V_R	500
Freeway Free-Flow Speed, S_{FF}	55.0
Ramp Free-Flow Speed, S_{FR}	40.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1785	0.92	Level	15	0	0.930	1.00	2086
Ramp	500	0.92	Level	15	0	0.930	1.00	584
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 2086 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2086	Exhibit 13-8	4500	No
$V_{FO} = V_F - V_R$	1502	Exhibit 13-8	4500	No
V_R	584	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2086	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = 22.2 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.416 (Exhibit 13-12)

S_R= 49.6 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 49.6 mph (Exhibit 13-13)

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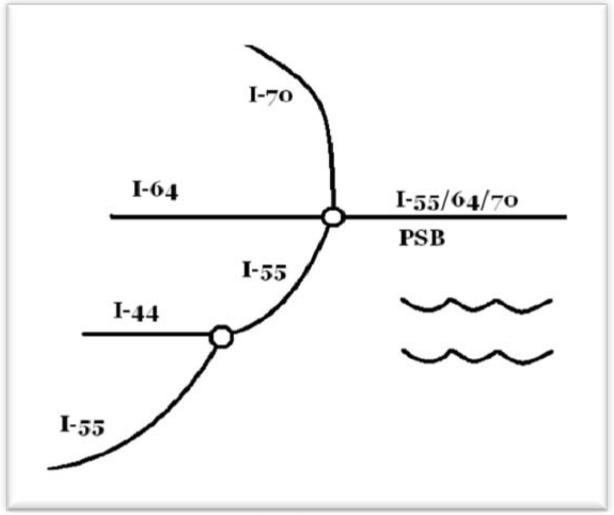
Appendix C

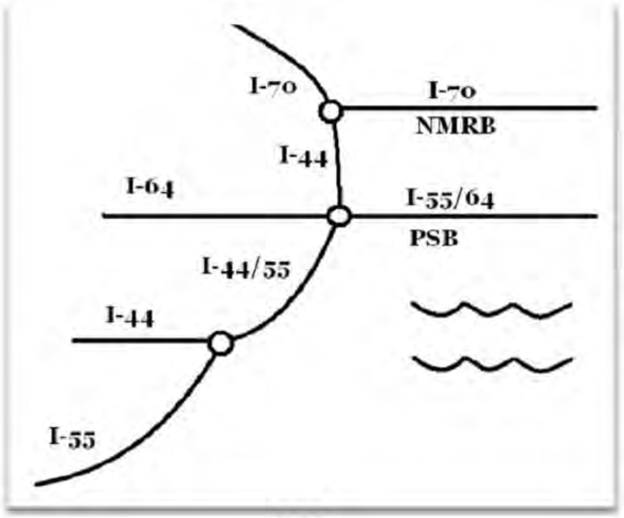
Design Report

1.0 EXECUTIVE SUMMARY

The Missouri Department of Transportation (MoDOT) has completed the conceptual design for I-55 and I-70 ramp connections to the Poplar Street Bridge (PSB) interchange. The PSB is a major Mississippi river bridge currently carrying three interstates (I-55, I-64, and I-70) between Missouri and Illinois. I-64 connects to PSB's two left lanes in both directions. I-55 connects to the third lane on Westbound PSB and the fourth on Eastbound PSB. I-70 connects to the fourth lane on Westbound PSB and third lane on Eastbound PSB. Today I-44 terminates south of PSB into I-55. However, at the time of this project's construction, the New Mississippi River Bridge (NMRB) will have opened and I-70 will be re-routed over this bridge. I-44's designation will be extended and terminated at the NMRB interchange. The roadway section between PSB and NMRB's interchanges currently known as I-70 will then be I-44.



Today



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As described in the operational analysis of PSB's Access Justification Report, the traffic patterns have changed on the PSB since its opening. When the PSB first opened, traffic was heavier to and from the north on I-70. Since then, traffic has shifted more to the south. Most of the congestion, both commuter and non-commuter traffic, occurs on the I-55 ramps to and from the PSB. The traffic demand has greatly oversaturated the capacity of these single lane ramps. Increasing the capacity of these ramps is the only viable option to reducing congestion at this interchange.

All four of the I-70 and I-55 ramp bridges are structurally deficient, and their condition has deteriorated to the point where rehabilitation is no longer a feasible option for MoDOT. One purpose of this project is to replace the structurally deficient bridge ramps. Because the current ramp configuration does not operate at an acceptable level of service (LOS) for I-55 and the recurring congestion raises safety concerns, MoDOT has evaluated several alternatives that also investigate improving the congestion in the area.

The PSB interchange today is not a full access interchange. Its historical function provided access between Missouri and Illinois on I-55, I-64 and I-70. East-West Gateway Council of Governments has not identified a need to change this function. Regional traffic uses I-270 and I-170 as connections between I-70, I-64, I-44, and I-55. The north-south arterials in the City of St. Louis accommodate local traffic. Therefore, MoDOT does not recommend pursuing the costly means, due to limited right of way, historic properties, and high interchange density, of adding the missing movements.

It is our recommendation to pursue a design which will best accommodate traffic at the bridge and Interstates I-55, I-64, and I-70 (Future 44) from the time of construction to Design Year 2035. Our preferred alternative provides an acceptable LOS for both the freeway system and local street network.

2.0 INTRODUCTION

The Poplar Street Bridge (PSB) Interchange was constructed in the late 1960's connecting I-64 (Route 40) to the PSB. The interchange contains four ramps, as shown in **Figure 1**. Two ramps connect the PSB to I-55 to the south and two ramps connect the PSB to I-70 to the north. These four ramps are in poor condition, too costly to maintain, and in need of replacement. The PSB is currently a partial access interchange. In order to provide full access at the PSB interchange, four more ramps needed to be evaluated for their need and constructability.

Below in Section 3, MoDOT presents how the region and local community live without the missing movements. The cost and design constraints are also presented for each ramp. Since the EWGCOG does not consider this a need, MoDOT does not believe the benefits of adding any of these ramps outweighs the costs, both operational and monetarily.

Section 4 explores many alternatives for reconstructing the existing movements to the PSB interchange. MoDOT's preferred alternative, as shown in **Exhibit 8**, creates dual lane ramps for I-55, but removes I-70's (Future I-44) EB connection to EB PSB. This document and the AJR will prove that the preferred alternative is the necessary to better serve the motorists using the Poplar Street Bridge.

3.0 HISTORICALLY MISSING RAMP MOVEMENTS: PSB INTERCHANGE

There are currently four movements missing from the PSB interchange. Alternative alignments for the following ramps are shown in attached **Figure 2** in red:

- Ramp E: from Northbound I-55 to Westbound I-64
- Ramp F: from Eastbound I-70 to Westbound I-64
- Ramp G: from Eastbound I-64 to Southbound I-55
- Ramp H: from Eastbound I-64 to Westbound I-70

Existing Ramp A (NB 55 Ramp to EB 64) proposed alignment is also shown in red to show how Ramp E's 2nd Alternative (in green) shares the same gore location. The yellow shading shows the existing ramps which would need to be removed to provide these missing movements.

There are numerous design constraints in place that make it very difficult to provide a practical solution for building the direct connections that are not currently in place between I-64, I-55 and I-70 at the Poplar Street Bridge interchange. The demand for these movements and feasibility of providing these movements is summarized below.

3.1 DEMAND FOR MISSING MOVEMENTS

Traffic in and around St. Louis has been driving without the movements listed above over forty years. East-West Gateway Council of Governments (EWGCOG), the Metropolitan Planning Organization for the Bi-State Area, does not have these movements listed as a need either under the long-range Regional Transportation Plan (RTP) or under the short-range Statewide Transportation Improvement Program (STIP). However, EWGCOG does recognize the need to reconstruct the structurally deficient bridge ramps from I-55 and I-70 to the Poplar Street Bridge.

The latent demand for Ramps E through H is served regionally by Interstates 270 and 170 and locally by the St. Louis City's street grid. **Figure 3** shows regionally how St. Louis' four interstates are interconnected by I-270 and I-64 and I-70 are connected by I-170. When a motorist is driving, for example NB I-55 at I-255, and their destination is the Forest Park, they would need to travel North on I-255/270 to I-64 East. This map illustrated how there are interstate to interstate connections provided for any destination from a regional stand point.

The local demand for the missing movements has also been considered. Motorists on I-70 East and I-55 North with destinations near the I-64 Westbound exits at 9th/Clark and 21st /Market, already use alternate routes to their destinations. **Figure 4** shows the alternate routes for Ramp E, which would connect Northbound I-55 to Westbound I-64. I-44 Eastbound currently exits at Lafayette and I-55 Northbound at Truman Parkway and continue north to access western edge of Downtown. I-55 exit to 7th and Park provides access to the south side of Downtown. Direct access would be provided and improved with existing Memorial Drive exit and new Washington/3rd Street exit. **Figure 5** shows the alternate routes for Ramp F, which would connect Eastbound I-70 to Westbound I-64. The new ramp located at Cass and Tucker will be I-70's main access into Downtown. Please note that I-70 motorist needing direct access to the south side of Downtown still have the option to continue on WB 44/SB55 and exit at 7th Street. Motorists on I-64 Eastbound with destinations along I-55 to the south and I-70 to the north also already use alternate routes to their destinations. **Figure 6** shows the alternate routes for Ramp G, which would connect Eastbound I-64 to Southbound I-55. **Figure 7** shows the alternate routes for Ramp H, which would connect Eastbound I-64 to Westbound I-70 (future Eastbound I-44). For all the missing ramp connections, the existing 'alternate routes' provide a shorter path for motorists than having a direct freeway to freeway connection.

As described in Section 3.2 and 3.3, alternatives for providing Ramps E, F, and G would require the removal of I-64 Westbound Exit to 9th Street and I-55 Southbound Exit to 7th Street. Both exits are vital to providing direct access to Downtown St. Louis.

Adding a connection between I-55 and I-64 would be a higher need than between I-70 and I-64, since I-64 runs parallel to I-70 and they intersect in St. Charles County forty miles west of downtown. As shown in **Figure 3**, they are currently connected by I-270 and I-170 in St. Louis County. US Route 40/61 has also recently been upgraded to I-64 between I-270 in St. Louis County and I-70 in St. Charles County adding another regional interstate connection. Currently I-44 and I-55 are only connected to I-64 via freeway to freeway movements at I-270. However to provide that freeway to freeway connection at the riverfront would require most motorists to driver further out of their way and back-track to reach most destinations. For the reasons stated above, MoDOT does not recommend providing these movements until the alternate routes become undesirable to the public and would pursue an alternate location to provide these movements, such as a southern extension of I-170.

3.2 DESIGN CONSTRAINTS: ACCESS TO WESTBOUND I-64

Between 14th Street and just west of 4th Street, I-64 is carried on a double-deck bridge structure, with westbound traffic on the upper deck and eastbound traffic on the lower deck. Building the following ramps along this section of I-64 would require widening of this double-deck structure at a cost of approximately $13.8 million.

- Ramp E: from Northbound I-55 to Westbound I-64
- Ramp F: from Eastbound I-70 to Westbound I-64

Photo 1:

The view from ***Photo 1,*** as shown above, is from 8th Street facing east towards Broadway. Between 8th Street and Broadway, I-64 runs adjacent to Busch Stadium. Just east of 8th Street is an exit ramp from westbound I-64 to 9th Street, and approximately 1400 feet west of that is a westbound entrance ramp from 10th Street. There are two westbound lanes on I-64 at the point where Ramps E and F (from NB 55 and EB 70) would enter. For proper lane balance, there would need to be three westbound lanes maintained beyond the merge point. If Ramp F is merged in, there is not an exit available for dropping Ramp E, so both lanes would have to merge into the two existing westbound lanes. This would result in improper lane balance and likely traffic congestion. Proper lane balance could be achieved by only building one of these ramps. However, there is not enough distance between the entry point and the existing exit to 9th Street to provide adequate weaving length. There would only be 600 feet of weaving length, far below the minimum of 2000 feet required between an entrance ramp and an exit ramp. Relocating the existing exit to increase the weaving length would not be a practical option since at most the length would increase by a few hundred feet, still far less than the 2000 feet required. Removing the existing ramp to provide room for either Ramp E or F would eliminate a major westbound exit from Illinois into downtown St. Louis. The 9th Street ramp carries an ADT of 2275 and provides access to the south-central portion of the Central Business District. The 9th St exit ramp is centrally located between the first westbound Missouri exit to Memorial Drive and the next exit to 21st Street/Market Street. The removal of the 9th Street ramp would be detrimental to the level of service of Memorial Drive as the next available I-64 westbound ramp is located at 1.4 miles away at 21st /Market.

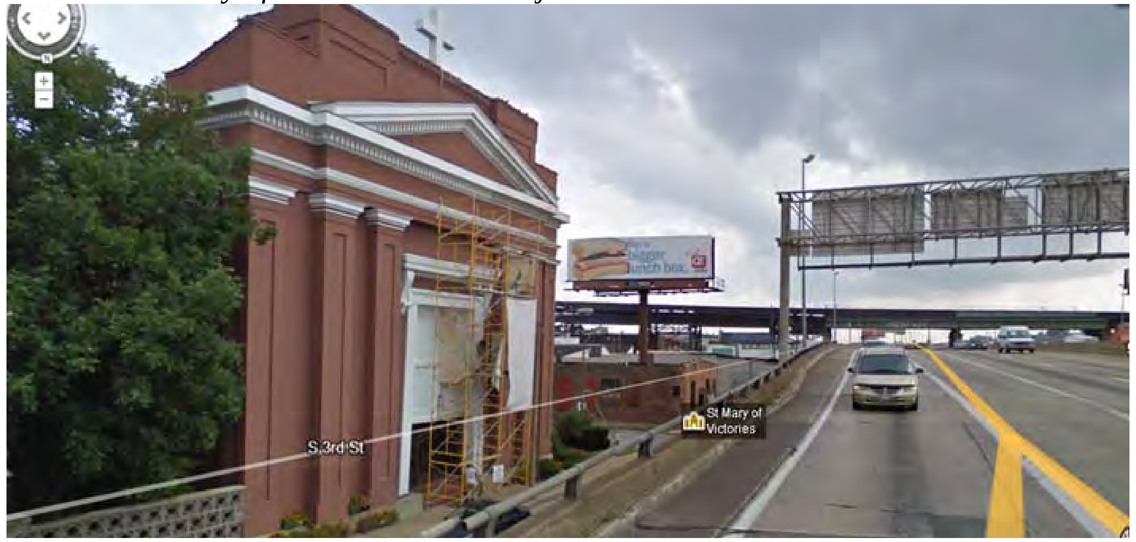
There are also cost-prohibitive issues and other design constraints with building the Ramp E exit from Northbound I-55 to Westbound I-64. Creating a separate exit ramp for this movement would require beginning it approximately 1000 feet south of the existing ramp into Illinois; this exit location is marked in ***Photo 2*** below. The ramp would need to be threaded between the trestles on the Union Pacific Railroad bridge (see ***Photo 3***), and would require complete acquisition of several properties just north of this point, as well as damages to St. Mary of Victories Church on South Third Street (see ***Photo 4****)*, which is on both the National Register of Historic Places and the St. Louis City Landmarks Registry. Also, there would only be 1400 feet of weaving length between the Marion/8th St entrance ramp to I-55 and Ramp E, again below the minimum of 2000 feet required between an entrance ramp and an exit ramp.

The cost to construct ramps E and F, including right of way costs, would be approximately $45 million, which includes the cost to widen the I-55 bridge.

Photo 2: *Exit Location for Ramp E (Option #1)*

Photo 3: *Union Pacific Railroad bridge over I-55*

Photo 4: *St. Mary of Victories Church adjacent to North I-55:*



A second option for this movement would be to create a shared exit with the existing ramp into Illinois, shown below in ***Photo 5***. This type of exit is not feasible because there would not be sufficient distance to develop an acceptable grade or clearance over both I-55 and I-64 (or between I-55 and I-64) from this point. Also, this option has limited locations for placing the bridge bents on this ramp. This option is represented by the dashed green line in attached **Figure 2**.

Photo 5: *Exit Location for Ramp E (Option #2)*

3.3 DESIGN CONSTRAINTS: ACCESS TO SOUTHBOUND I-55 & WESTBOUND I-70

- Ramp G: from Eastbound I-64 to Southbound I-55
- Ramp H: from Eastbound I-64 to Westbound I-70 (Future EB I-44)

Along eastbound I-64, there is an existing exit (Exit 40, to 6th Street) west of 8th Street, followed by an existing entrance ramp from 6th Street (Ramp 8). One option to provide direct access between these interstates would be to build an exit ramp between these two existing ramps. This exit location is marked in ***Photo 6*** below.

This new ramp would then split into two ramps, with one for South I-55 (Ramp G) and the other for West I-70/Future East I-44 (Ramp H). Using the minimum spacing between exit ramps from Exhibit 10-68 of AASHTO's "Green Book", the new ramp would need to be spaced a minimum of 1000 feet from Exit 40, which would result in the gore being only 250 feet from the existing entrance ramp from 6th Street (see ***Photo 6*** below). This would be less than the 500 feet required between an exit and entrance ramp, and this short distance would result in a grade approaching 13% in order to provide a minimum clearance of 14'-0" over the entrance ramp from 6th St to EB I-64. This grade exceeds the allowable maximum grade of 7% for an interstate ramp.

Going under the 6th St entrance ramp is not feasible either because there would not be enough clearance above Broadway, which runs beneath the existing entrance ramp. Also, the addition of a deceleration lane needed for this exit would require reconstruction of the bridge bents on the double deck structure. Since there isn't enough room between the existing ramps to provide an acceptable exit ramp, building a ramp at this location is not a feasible option.

Photo 6: *Exit Location – for Ramps G & H (Option #1)*

A second option for this exit would be to split the new ramp off from existing Exit 40 at the location shown in ***Photo 7*** below.

Photo 7: *Exit Location –for Ramps G & H (Option #2)*

The existing exit ramp departs from the bottom portion of a double-deck structure and is overlapped with an entrance ramp from Broadway to westbound I-64 which connects to the upper deck ***(Photo 8)***. Because of the existing bridge columns and the westbound ramp, the new ramp would not be able to taper off on the tangent section of the ramp, which would be preferred, but would have to split off along a curve in full super-elevation. From this point, a grade of approximately 15% would be needed to provide enough clearance over the entrance ramp from 6th St to EB I-64. Going under the entrance ramp would require a grade of 10% to get over Broadway. Providing an acceptable grade over Broadway would require lowering this four-lane city street, which would impact the Eugene Field House & St. Louis Toy Museum ***(Photo 10)*** at the northeast corner of Broadway and Cerre Street. This building is on the National Register of Historic Places and is a City of St. Louis Landmark.

Photo 8: *Looking west from Broadway toward Ramp 7 & Ramp 8*

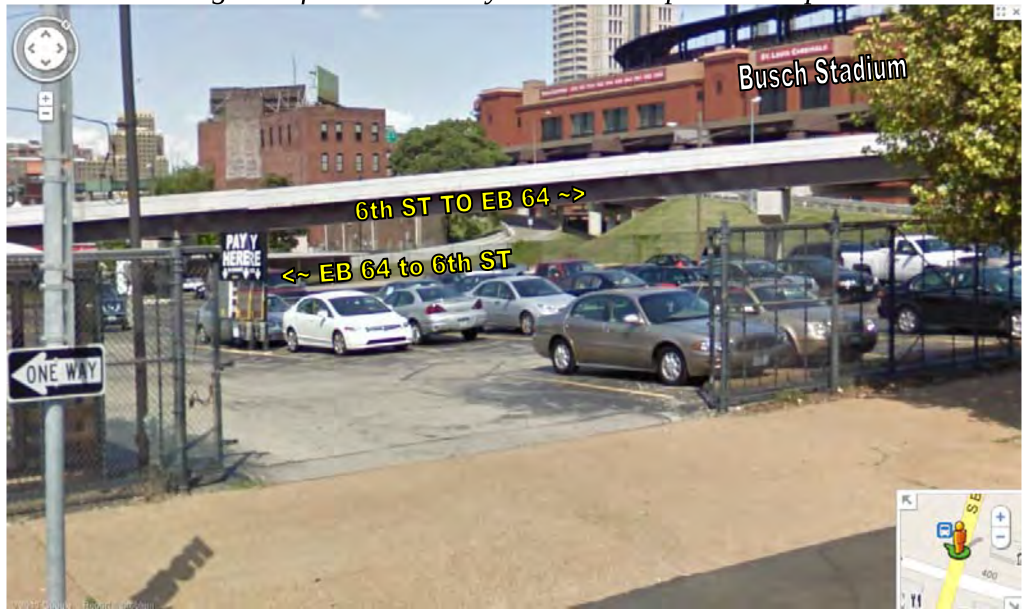


Photo 9: *Location of Ramps G and H looking east from Broadway & Cerre St*

Photo 9 above and **Photo 10** below show two views from the same intersection, Broadway and Cerre. **Photo 9** is shot standing on Broadway facing southeast with Eugene Field House on the left. Proposed Ramp G and H would fly over this intersection and require Cerre Street and business in the photo to be removed. **Photo 10** below faces north on Broadway with Eugene Field House on the right. I-64's Double Deck structure can be seen in the distance to the left.

Photo 10: *Eugene Field House at Northeast corner of Broadway & Cerre St:*

Ramp G: To provide this ramp, it would need to be elevated over 4th Street, and from this point a grade exceeding 18% would be needed to take this ramp under the Terminal Railroad (TRRA) bridge, shown in ***Photo 11*** below. Due to this excessive grade, going under this railroad bridge is not feasible.

Photo 11: *TRRA Bridge over Ramp D onto Southbound I-55:*

An elevated section of I-55 begins just south of the TRRA railroad bridge. This viaduct structure begins near Gratiot Street and extends for approximately 0.60 miles. Building Ramp G over the TRRA Bridge would result in a lengthy transition in order to tie back into I-55, and would also require widening of the I-55 viaduct structure. Assuming a 6% grade, the point at which Ramp G approaches grade on I-55 is near the Union Pacific railroad bridge, shown in ***Photo 12*** below. The ramp would then have to run parallel to I-55 beneath the railroad bridge in order to clear the supports on this structure. The point at which the ramp could tie back into I-55 would be between the railroad bridge and Exit 208 to 7th Street.

There is less than 300 feet between the Union Pacific Railroad Bridge and the beginning of the deceleration lane on southbound I-55 for Exit 208 to 7th Street. Adding Ramp G would require removal of this exit ramp in order to provide sufficient room to tie back into I-55. Exit 208 to 7th Street carries an ADT of 6902 and provides vital access to important aspects of the City; the southern portion of the Central Business District to the north and the industrial/trucking corridor to the south. The removal of the 7th Street ramp would put the exit spacing approximately five miles apart and would neglect to the meet the City's needs for access.

Photo 12: *South I-55 at Union Pacific Railroad bridge, prior to 7th Street exit*

Ramp H:
I-64 is approximately 40 feet above I-55 near the point where Ramp E crosses these interstates. Ramp H would need to also clear Ramp E (from North I-55 to West I-64), which would place Ramp H about 82 feet above I-55. This would require a lengthy transition of approximately 1500 feet in order to tie back into I-70.

For the spans from I-64 to the north, there would be very few feasible locations for placing bridge bents along this ramp, as the following ramps would have to be avoided: Ramp B (from East I-70 to East I-64), Ramp D/1 (from West I-64 to South I-55) and Exit 291 (from North I-55 to Memorial Drive/Poplar Street). Retaining walls would be needed at the tail end of this ramp adjacent to the existing lanes on I-70.

This ramp would join existing West I-70 near the beginning of a two-lane depressed section, with retaining walls between the interstate and the outer roadway (Memorial Drive). Adding this movement while also keeping the movement from existing Ramp C (to both West I-70 and Memorial Drive), would require reconstruction of these retaining walls, which are 28 feet high. Also, Memorial Drive would need to be relocated to the east, which would involve impacts to the Jefferson National Expansion Memorial ("St. Louis Gateway Arch") grounds.

An option to add an auxiliary lane for Ramp C without impacting these high retaining walls is described in Section 4.2, but the addition of Ramp H eliminates this option.

The cost to construct ramps G and H, including right of way costs, would be approximately $70 million. A summary of the missing ramp costs is shown in the table below. If MoDOT were to purchase the sensitive and expensive R/W in that area, it would not make sense to build a single ramp. For that reason, the costs for Ramps E and F and for G and H have been grouped together.

Missing Movements Cost Summary

Movement	Ramp	Total Cost
NB I-55 to WB I-64	E	$45 M
EB I-70 to WB I-64	F	
EB I-64 to SB I-55	G	$70 M
EB I-64 to WB I-70	H	

4.0 MODOT'S PLAN FOR IMPROVING THE PSB INTERCHANGE

All of the ramp bridges in the PSB Interchange are classified as being "Structurally Deficient". On a scale of 1 to 9, with 1 being the worst condition, three of the bridges have an overall bridge rating of 3, and one has an overall rating of 4. Because of this, MoDOT will need to either rehab the existing structures or replace them in the very near future. The cost to rehab them has become uneconomical and, given the age of the structures, the most cost effective option at this time is to replace them. Rather than replacing the ramps in their current configuration, MoDOT recommends improving the interchange at this time to better serve the current and future traffic demands of the area.

As discussed in the *Poplar Street Bridge Access Justification Report*, traffic patterns have changed since construction of the PSB Interchange. Originally most of the traffic using the interchange went to or came from I-70 to the north, but that has changed over time. Most of the traffic today using the interchange comes from or goes to I-55 to the south. Morning commuters heading westbound on the PSB routinely back up across the PSB to Illinois Route 3, a distance of approximately one mile, as they try to cross the bridge. Most of the back-ups can be attributed to motorists trying to access the I-55 ramp to the south which is a single lane, geometrically challenged, low speed ramp. The same can be said for the afternoon commuters heading back across the river. Traffic routinely backs up on NB I-55 past the 8th Street entrance ramp as well as on EB I-70 to the north. Eastbound 70/Future Westbound 44 (Ramp B) will not queue onto the interstate in the afternoon, once the New Mississippi River Bridge (NMRB) is open, as most of these commuters will use the new bridge to cross the Mississippi River into Illinois. Congestion on the bridge also affects EB I-64 approaching the bridge at times queuing back 1.75 miles to Jefferson Avenue.

In Sections 4.1 and 4.2, MoDOT summarizes alternatives considered and design components for each. Microstation and Geopak were used, unless otherwise noted, to conceptually design each alternative and quantify the design component. Each alternative's design components were evaluated using MoDOT's Engineering Policy Guide (EPG) and AASHTO's Green Book: A Policy on Geometric Design of Highways and Streets, 5th Edition. At those locations where vertical clearance was an issue, 14 feet was used as the absolute minimum clearance, which is allowable on urban interstate routes according to AASHTO standards.

4.1 ACCESS TO EASTBOUND I-64 FROM NORTHBOUND I-55 & EASTBOUND I-70

From Northbound I-55 to Illinois
Existing: Ramp A
2010 ADT – Existing Conditions: 26,998
2015 ADT – NMRB & CAR BUILD / PSB NO-BUILD: 26,998

From Eastbound I-70/Southbound Memorial to Illinois
Existing: Ramp B
2010 ADT – Existing Conditions: 19,335 (EB I-70 to PSB: 11,608, SB Memorial to PSB: 7,727)
2015 ADT – NMRB & CAR BUILD / PSB NO-BUILD: 7,982

Currently, there are two eastbound lanes on I-64 approaching the Poplar Street Bridge (PSB) with an additional lane from Ramp A (NB I-55) and another from Ramp B (EB I-70). Four eastbound lanes are carried across the Mississippi River into Illinois.

Photo 13: *Ramp A under the Railroad bridge*

Ramp A, shortly after exiting mainline, goes under the railroad overpass shown in **Photo 13**. This bridge is a limiting factor in both the vertical and horizontal alignment for this ramp. Currently Ramp A has a vertical clearance of 14'-10", which is less than the preferred clearance of 16'-6" for interstates according to MODOT standards, but above the minimum AASHTO standard of 14 feet. The sag veritcal curve beneath the railroad bridge is acceptable for only 20 MPH, and the horizontal curve is acceptable for 30 MPH. This ramp is signed with an advisory speed of 20 MPH. Further south, the approach has an overhead guide sign with flashers warning drivers of the advisory speed on this ramp. The curve itself is signed with chevrons and arrow board, as shown in **Photo 14**.

Photo 14: *Sharp horizontal curve on Ramp A*

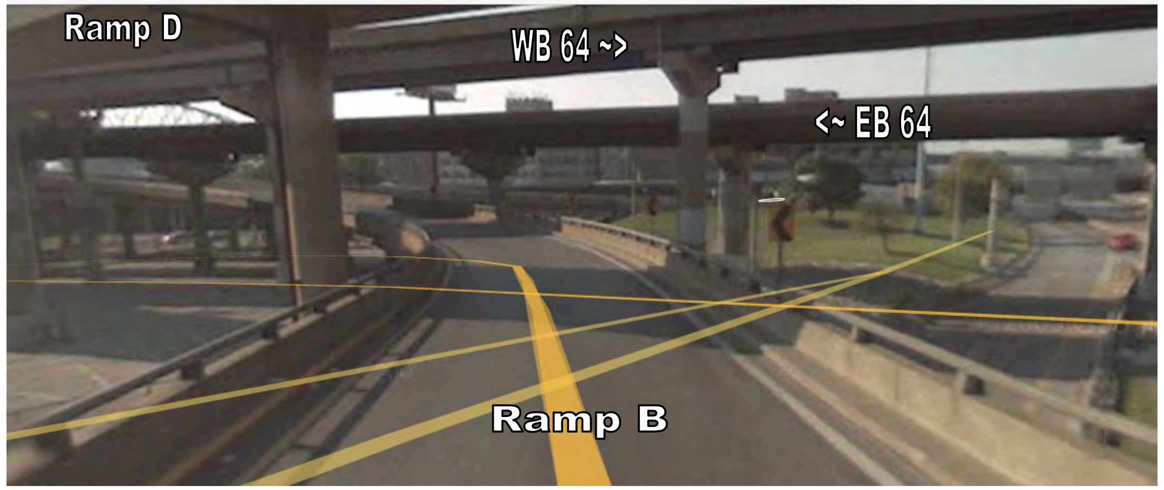
Ramp B is elevated over both I-70 and Exit 291 from northbound I-55, and runs under both Ramp D (from the PSB to South I-55) and I-64. Ramp B has a vertical clearance of 15’-0” over I-70 instead of the preferred clearance of 16’-6” over an interstate (see ***Photo 15***). There are also low vertical clearances of 14’-11” over Exit 291, and 15’-2” under I-64. This ramp has a sag vertical curve beneath I-64 which is only acceptable for 25 mph. Increasing the vertical clearances over I-70 (Future I-44) or under I-64 would only make this sag vertical curve worse, and improving the vertical curve would reduce the clearances**.**

Due to a sharp horizontal curve, as well as the sub-standard vertical alignment, Ramp B has a posted advisory speed of only 20 MPH. There are also warning chevron signs installed along the sharp curve (see ***Photo 16***). Ramp B is tightly threaded between the columns of both the eastbound and westbound spans of the I-64 bridges and around one of the columns of Ramp D. There is no available space to improve the horizontal alignment of this ramp in its current location due to the existing bridge columns.

Ramp B in its current location is in conflict with the proposed profile for Ramp 1, which will replace Ramp D as discussed in Section 4.2. If Ramp B is used-in-place, then the grade on Ramp 1 for the section that spans over I-70 and goes under I-64 would have to increase from 4.9% to 8.1% in order to provide a minimum clearance of 14 feet over Ramp B. Another problem with keeping Ramp B in its current location is that it makes it difficult to increase the capacity of Ramp A while keeping the current lane configuration on the PSB.

Photo 15: *Facing south toward Ramp B over I-70*

Photo 16: *Sharp curve along Ramp B between columns of I-64 bridges*



4.2 <u>ACCESS FROM PSB TO SOUTHBOUND I-55 & WESTBOUND I-70 (Future 44)</u>

From Illinois to West I-70 & Memorial Drive
Existing: Ramp C (to Memorial Dr) & Ramp C1 (to West I-70)
2010 ADT – Existing Conditions: 10,746
2015 ADT – NMRB & CAR BUILD / PSB NO-Build: 3808
Proposed: Remove Existing Ramps & Replace with Ramp 3 (to Memorial Drive and West I-70)

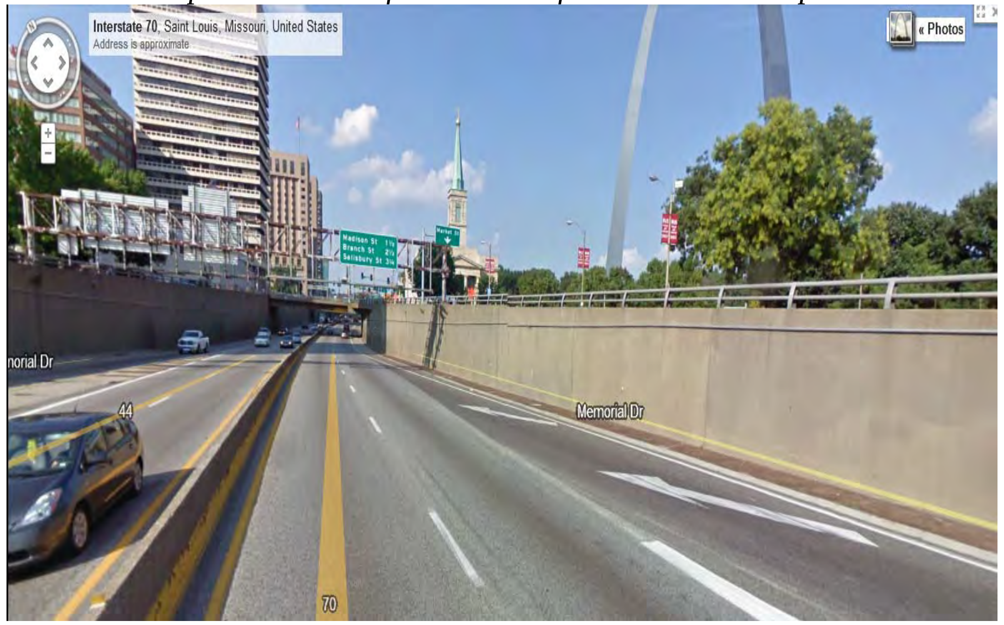
From Illinois to South I-55
Existing: Ramp D
2010 ADT – Existing Conditions: 26,523
2015 ADT – NMRB & CAR BUILD / PSB NO-Build: 26,815
Proposed: Remove Ramp D & Replace with Ramp 1 (dual-lane)

Ramp D currently has a very sharp curve, with a posted advisory speed of only 20 mph. The horizontal alignment of Ramp 1 is an improvement of the existing radius and is designed for 35 MPH. A design exception for shoulder width will be needed for Ramp 1 in order to fit the two-lane ramp between the piers on the Terminal Railroad Association Bridge. The proposed profile of Ramp 1 improves the existing sag curve beneath this bridge from 20 MPH to 30 MPH. The existing ramp has sub-standard vertical clearance beneath the railroad bridge (14’-6”), and the new ramp does not substantially improve this clearance. An alternate alignment for Ramp 1 was considered, but was ruled out as described under Alternative 4. Due to the large volume of vehicles making the westbound to southbound movement, it is absolutely necessary to replace this ramp as a dual lane ramp. The importance of this improvement is reflected in nearly all of the alternatives explored in section 4.3.

Ramp C currently exits I-64 approximately 450’ west of Ramp D. The proposed configuration replaces Ramp C with Ramp 3. Ramps 1 and 3 will share an exit point from I-64 and then split. Ramp 1 going to southbound I-55 and Ramp 3 splitting to provide access to westbound I-70 (Future 44) and Memorial Drive.

Removal of the connection from the PSB to westbound I-70 (Future I-44) was recommended on the NMRB AJR due to I-70 being re-routed to the new Mississippi River Bridge. The existing entrance ramp has a sub-standard tapered acceleration lane (see ***Photo 18***). Improving this entrance would involve building a new auxiliary lane between this entrance ramp and the new exit ramp to be built on a separate project (CAR-2015). It was initially thought that building the auxiliary lane would require replacement of 2000 feet of the retaining walls between I-70 and Memorial Drive. After further investigation, a practical solution was found for keeping the entrance ramp and also providing an auxiliary lane without impacting the existing retaining walls, so this entrance will be kept. As shown in **Exhibit 8**, adding a 12-foot wide auxiliary lane will involve restriping the mainline lanes from 12 feet to 11 feet, and reducing the outside shoulder from 12 feet to 2 feet, which will require design exceptions. The same concept will be used for the “southbound” lanes (WB I-44) to add an acceleration lane from the new entrance ramp from Memorial Drive to be built on the CAR-2015 project.

Photo 18: *Depressed lanes of I-70 south of Walnut St at Ramp C acceleration lane*



4.3 DESIGN ALTERNATIVES FOR THE PSB INTERCHANGE AND 4-LANE PSB

As discussed in Section 4.1, there are problems with keeping Ramp B in its existing location, and traffic congestion on northbound I-55 to Illinois has created a need to increase the capacity of Ramp A. The following is a list of alternatives considered in an effort to maintain all existing access while improving the traffic and safety operations of Ramp A.

Alternative 1 – Rebuild Ramp B; Lower I-70/I-44 Mainline; and Replace Ramp A with Dual Lane Ramp

MoDOT has considered the following alternative, as shown in **Exhibit 1**, for the PSB ramp connections to Illinois. Ramp A (NB I-55 to Illinois) would be rebuilt as dual-lane Ramp 2. Ramp B (EB I-70/SB Memorial to Illinois) would be rebuilt as single-lane Ramp 4.

The profile of Ramp 4 for this alternative is similar to existing, with Ramp 4 going over mainline I-70 (Future I-44) and under both Ramp 1 and I-64. Because of the improved alignment and profile of Ramp 1 (existing Ramp D), Ramp 4’s profile would have to be lower than existing Ramp B’s. To maintain a clearance of 14 feet over Future I-44, the mainline would need to be lowered by ten feet. This amount of excavation causes conflicts with I-64’s bridge footings (Bridge A1501, Bents 7 & 8) which are unacceptable. An alternate profile for Ramp 4 was developed in order to avoid excavation along mainline, with Ramp 4 going over Ramp 1, but this profile was unacceptable due to the excessive grade (16.4%) needed to transition under the existing eastbound I-64 bridge. An alternate design for Ramp 1 was considered to avoid mainline excavation, but was ruled out as described under Alternative 4.

The horizontal alignment of Ramp 4 developed for this alternate is similar to existing conditions, except the curve approaching Ramp 2 is slightly sharper in order to maximize the space available to merge into Ramp 2. The horizontal alignment of Ramp B is acceptable for 30 MPH, but due to the sharper curve, the alignment of Ramp 4 is acceptable for only 25 MPH. This is less than AASHTO’s recommended minimum operating speed of 30 MPH for ramps. However, the substandard sag curve discussed previously for Ramp B is improved for this alternate, so the vertical curve design speed is improved from 25 MPH to 35 MPH.

The horizontal alignment for Ramp 2 improves from a design speed of 30 MPH to 35 MPH. The sag vertical curve on this ramp improves from 20 MPH to 30 MPH, and the crest vertical curve near the point where Ramp 4 merges with Ramp 2 improves from 35 MPH to 45 MPH. Ramp 4 merges with Ramp 2 on the left as a tapered style on-ramp. Assuming speeds of 40 MPH for Ramp 2 and 25 MPH for Ramp 4 in the merge area, and using an adjustment factor of 1.5 for 5% grade, the required acceleration length would be 315 feet according to Exhibits 10-70 & 10-71 in AASHTO’s Green Book. This alternate allows for an acceleration length of only 190 feet, which is unacceptable and would be a safety concern.

Per MoDOT’s Engineering Policy Guide, left-side entrances are undesirable in a directional interchange. Due to the substandard design and the conflicts with the footings on Bridge A1501, this is not MoDOT’s preferred alternative.

Alternative 2 – Rebuild Ramp B as Left-Side Exit; Split I-44 mainline; and Replace Ramp A with Dual Lane Ramp

MoDOT has considered the following alternative for the PSB ramp connections to Illinois. Ramp A (NB I-55 to Illinois) would be rebuilt as dual-lane Ramp 2, and its design would be an improvement over existing Ramp A, same as described under Alternate 1. Ramp B (EB I-70/SB Memorial to Illinois) would be rebuilt as single-lane Ramp 4.

In this alternative, as shown in **Exhibit 2**, Future WB I-44 (Southbound) would be shifted to the west as it transitions to SB I-55 under I-64, and Future EB I-44 (Northbound) would be shifted to the east under I-64. Ramp 4 would exit mainline from the left as a tapered exit ramp. The exit gore location is approximately 700 feet south of the existing I-70 EB exit to Illinois. A tapered exit is more acceptable than a tapered entrance; however it is still not a preferred MoDOT ramp type. Regardless of its type, a left-side exit is undesirable in an interchange.

Shifting mainline for this design was proposed to enable Ramp 4 to pass under I-64 without having to also clear mainline below. This design allows Ramp 4 to merge with Ramp 2 on its right side as a parallel entrance ramp – a preferable design. However, Ramp 4 still would have to curve sharply to the left with an unacceptably low design speed of 25 MPH. In addition, the profile of relocated I-44 would have a deep exavation requirement, which causes conflicts with I-64 bridge footings on bents 6, 7 and 8. This excavation is necessary in order to improve a sub-standard sag vertical curve along existing mainline beneath the TRRA railroad bridge.

The vertical alignment for Ramp 4 contains a sag curve near the gore with Relocated WB I-44 that is below the minimum acceptable speed of 30 MPH, and a grade of 6.8% that is just under the absolute maximum allowable ramp grade.

Please note that while this alternative provides access for EB I-70 (Future EB I-44) to Illinois, it does NOT provide the same access from SB Memorial Drive. Due to the substandard design and the undesirable left-side exit ramp, this is not MoDOT's preferred alternative.

A variation on this alternative that also involved shifting mainline was developed, shown in Exhibit 2 as **Alternative 2A**, with WB I-44 shifted to the east instead of the west. This plan was an improvement over Alternative 2 because it does not have a left-side exit, and the radius on Ramp 4 improves from 150 feet to 235 feet. However, this alignment would also require a steep grade greater than the desirable 5% for ramps. This plan does not provide enough space for an acceptable entrance ramp for SB Memorial Drive traffic to SB I-55. As a result, access to I-55 from Memorial Drive would have to be removed. Removal of this entrance ramp to I-55 would impact traffic patterns of the downtown grid and impact the CAR 2015 project. The City of St. Louis does not support removing this access, therefore this is not a preferred alternative.

Alternative 3 – Rebuild Ramp B as a Flyover Ramp and Replace Ramp A with Dual Lane Ramp

MoDOT has considered the following alternative for the PSB ramp connections to Illinois. Like Alternatives 1 and 2, Ramp A (NB I-55 to Illinois) would be rebuilt as dual-lane Ramp 2, with a radius that would be improved to a design speed of 35 MPH. Ramp B (EB I-70/SB Memorial to Illinois) would be rebuilt as single-lane Ramp 4. Ramp 4 would exit Future I-44 mainline, as shown on the plan sheet of **Exhibit 3**, between the existing gore and Walnut overpass and immediately rise in order to go over the I-64 bridges and Ramp 2. Using an absolute minimum clearance of 14 feet over I-64 and a clearance of 15.5 feet under Walnut Street, Ramp 4 would have an undesirable 6.7 percent uphill grade, which exceeds the preferred maximum ramp grade of 5 percent, and is approaching the absolute maximum ramp grade of 7 percent. The physical limitation of the Walnut Street overpass to the north of I-64 makes it difficult to improve this grade to less than 5 percent. Ramp 4 would then merge into Ramp 2 as a parallel style ramp on the right side. MODOT considers fourteen feet of vertical clearance in a commercial zone to be undesirable.

The profile was designed to keep the grade on the downhill section of the ramp less than 5% and the sag vertical curve that ties into the PSB acceptable for a speed of 45 mph, which places the beginning of the acceleration lane for this ramp close to where Ramp 2 ties into mainline I-64 on the PSB. This requires a section of the PSB to be widened over the Mississippi River in order to provide a sufficient acceleration length and taper for Ramp 4. Due to the limitations of right-of-way, the design speed of Ramp 4 can only be improved to 30 MPH, which is still undesirable but an improvement compared to the first two alternatives.

As a worst case scenario, the vertical alignment of the ramp was checked with vertical clearances of 14 feet under the Walnut Street Bridge and over I-64. Even with these absolute minimum clearances, the grade is still 6.1 percent. This option is not realistic to build because it would require widening I-70 (Future I-44) in order to have enough width for a gore point for the exit. A large portion of the wall of the depressed section would need to be rebuilt to widen the roadway in addition to rebuilding the Walnut Street Bridge.

Moving the exit point farther north introduces additional safety issues. The off-ramp to Memorial Drive at Pine Street (Exit 250B) will be converted to an on-ramp as part of the City Arch River 2015 (CAR-2015) project. The acceleration lane from that ramp will be extended to Ramp B. There will be approximately 1450 feet available for an auxiliary lane from the new on-ramp to the location of the current exit point for Ramp B. According to A Policy on Geometric Design of Highways and Streets (Green Book), the minimum weave distance between an entrance ramp and exit ramp from a collector distributor road should be 1600 feet. With the absolute minimum 14 feet of clearance under Walnut Street and over I-64, the gore point would be moved north shortening the weaving length between the ramps to an unacceptable 1040 feet. The weaving length based on the profile with 15.5 feet of clearance under Walnut Street and 6.7% grade would be 1300 feet.

Although this alternative offers an improved horizontal alignment compared to other options, its substandard grades, weaving lengths, and vertical clearances make this an undesirable alternative.

Alternative 4 – Rebuild Ramp A and B as Single Lane Ramps

MoDOT has considered the following alternative for the PSB ramp connections to Illinois in which Ramp A and Ramp B would be rebuilt as single lane ramps in their current location (Ramp 2 and Ramp 4 respectively), as shown on the plan sheet of **Exhibit 4**. In this configuration, the horizontal alignment for Ramp 2 would improve from a design speed of 30 mph to 35 mph, while Ramp 4's horizontal alignment would remain acceptable for 30 mph due to the previously mentioned design constraints which make it difficult to improve the radius.

Ramp 4 will restrict the location of one of the bridge columns of Ramp 1. There is only five feet between the edge of shoulder on WB I-70 (Future EB I-44) and Ramp 4. This would not leave enough room for the column, guardrail and proper clearances. The bent would have to be shifted further east and increase the bridge's span length and bridge depth. Although detailed bridge design would have to be done to further investigate this impact, the profile of Ramp 1 was checked using a bridge depth range of 6.5 feet to 4.5 feet.

Ramp 1 would be in full superelevation as it passes over Ramp 4, and two feet of superelevation was used to check the clearance. With a bridge depth of 6.5 feet, the grade on Ramp 1 for the section that spans over I-70 and goes under I-64 would be 8.1 percent in order to provide a minimum allowable vertical clearance of 14 feet over Ramp 4, based on a profile for Ramp 4 similar to existing conditions. This grade exceeds the absolute maximum ramp grade of 7 percent. This profile is shown in **Exhibit 4.**

If the profile of Ramp 4 was lowered to provide a minimum clearance of 14 feet over I-70 instead of the existing 15 feet clearance, and using a shallower bridge depth of 4.5 feet, then the grade of Ramp 1 would be 7.5 percent. The grade on Ramp 1 as proposed in Alternative 8 without Ramp B is 4.9 percent.
In order to avoid an excessive grade on Ramp 1, then this ramp would need to cross over Ramp 4 at the location where Ramp D and Ramp B crisscross. A dual-lane ramp using a minimum 30 MPH radius of 231 feet will not fit between the I-64 columns if Ramp 1 is shifted in this way. The alternate alignment for Ramp 1, as shown in **Exhibit 4,** has a 25 MPH radius of 180 feet, which is less than the existing radius of 225 feet for Ramp D. Although mainline excavation as discussed under Alternative 1 could be avoided if this alternate for Ramp 1 was used, this alignment is not preferred because it does not improve the existing sub-standard radius of Ramp D.

While it is feasible to replace these ramps in-kind, MoDOT does NOT recommend doing so especially because of the operational analysis and safety analysis performed for the Poplar Street Bridge Access Justification Report. Today, NB I-55 ramp to Illinois (Ramp A) does not function at an acceptable level of service (LOS). Ramp B also currently operates at undesirable LOS's for both peak periods, though its traffic demand will significantly decrease due to the NMRB in 2015. Replacing Ramp B in its current configuration will only guarantee the same congestion for the next twenty to fifty years. That same congestion creates a safety concern for this area, since some of the crashes for NB I-55 approaching the PSB are associated with reoccurring traffic congestion. For further details, please reference the *Poplar Street Bridge Access Justification Report*.

Although it is possible to reconstruct the ramps, there would be minimal improvement over their current configuration and no improvement to safety or traffic operations. For this reason, as well as the excessive grade on Ramp 1 if Ramp B is replaced in its current location, this is MoDOT's least preferred alternative.

Alternative 5 – Rebuild Ramp B; Realign SB Memorial entrance ramp; and Replace Ramp A with Dual Lane Ramp

MoDOT has considered the following alternative for the PSB ramp connections to Illinois. Like Alternatives 1, 2 and 3, Ramp A (NB I-55 to Illinois) would be rebuilt as dual-lane Ramp 2, with a radius that would be improved to a design speed of 35 MPH. Ramp B (EB I-70/SB Memorial to Illinois) would be rebuilt as single-lane Ramp 4.

As shown in **Exhibit 5**, Ramp 4 would exit mainline further south of Ramp B's current location near the SB Memorial's entrance ramp to SB I-55. Ramp 4 would go under I-64 and over both mainline I-44 and Ramp 2. A sharp radius and low design speed (25 MPH) is needed to fit the ramp within existing right-of-way. This ramp would merge with Ramp 2 from the right in a parallel ramp style. The acceleration length of 315 feet meets AASHTO standards.

Due to this configuration, SB Memorial's access to SB I-55 would either need to be relocated or removed. **Exhibit 5** shows an alternative which relocates it to the west of Ramp 1 and merges into Ramp 1 between I-64 and the Railroad overpass. The ramp performs a sharp reverse curve to stay within right-of-way with an undesirable 7% grade. Then it tapers into Ramp 1 with a short merge, which is a safety concern because when Ramp 1 has a high volume of traffic and if a motorist from Memorial either fails to force a merge or stop before the end of the ramp, the motorist would have no recovery zone because of the railroad bridge abutment wall and and narrow shoulder. Due to the potential safety issue with merging these ramps, then access from SB Memorial Drive to SB I-55 would have to be removed. As previously mentioned under Alternative 2A, removal of this entrance ramp to I-55 would impact traffic patterns of the downtown grid and impact the CAR 2015 project. The City of St. Louis does not support removing this access.

Due to the substandard design, and the lack of proper access from Memorial Drive to SB I-55, this is not MoDOT's preferred alternative.

Alternative 6 – Build Ramp A (Dual-Lane) and Ramp B (Single-Lane) with Junction Control and Ramp Metering

MoDOT has considered the following alternative for the PSB ramp connections to Illinois. Ramp A (NB I-55 to Illinois) would be rebuilt as dual-lane Ramp 2. Its radius would be improved to a design speed of 35 MPH. Ramp B (EB I-70/SB Memorial to Illinois) would be rebuilt as single-lane Ramp 4. Junction Control would be used to maximize capacity between the two ramps.

Junction Control is a traffic management method which allows a dynamic change in lane allocation at interchanges. According to the FHWA document Synthesis of Active Traffic Management Experiences in Europe and the United States, "The rationale for use is that in some traffic conditions or at certain times of day, it may be more effective to use existing downstream or upstream lanes for one type of movement or for traffic coming from the main lanes while at other times of day it may be more effective to use the through lanes for the ramp movement. For example, when ramp volumes are relatively light or mainline volumes are very heavy, it might be most effective to have an entrance ramp merge into the right lane. However, there may be times that the volume on the ramp is extremely high while the mainline volumes are low. In this case, traffic merging from the on-ramp will have to find gaps in the mainline traffic, despite the mainline traffic being relatively light. The delay caused by hesitation and time required to find a gap may be disruptive to ramp capacities and flows and thus, create a situation with higher rear-end collision potential on the ramp. Junction control is used to "close" the right lane of the mainline upstream of the ramp through the use of lane control signs in order to give ramp traffic a near free-flow onto the mainline. Junction control provides priority to the facility with the higher volume and gives a lane drop to the lesser volume roadway."

No examples of Junction Control use could be found in the United States at this time. The typical use for junction control in Europe is in combination with another active traffic management technique, hard shoulder running on the mainline. This allows for the shoulder to be used as a through lane and single exits can be converted to dual-lane during the peak period as shown below. This is not the situation with the PSB where the junction is between two ramps. Since I-64 is only two lanes in this area, reducing it further is not an option.

Junction Control at an Exit with Hard Shoulder Running:

Source: The Netherlands via ops.fhwa.dot.gov

The Poplar Street Bridge ramps are a poor place to install a Junction Control system because the rationale for junction control stated above does not exist. The peak traffic period for both Ramp 2 and Ramp 4 is in the afternoon. Because both ramps have the same peak period, it would be difficult to decide which movement would be limited during that period. Due to the large amount of congestion on northbound I-55 during the afternoon rush, this movement would be given the priority during that time period. Because of safety issues with merging, Ramp 4 would need to be closed or metered to minimize traffic and safety impacts during peak periods. Ramp 4 would have its own lane during off-peak hours, with Ramp 2 limited to one lane either using a gate system to close the lane or overhead dynamic lane control signs as shown below.

There are a number of concerns with the use of junction control in the St. Louis Area, the primary one being compliance with the dynamic signing. There is no location for law enforcement to view violators and there are issues with traffic crossing the State line shortly after making this movement. Traffic engineers and the area engineer for St. Louis City have voiced their concerns with this option because similar to lane closures on a roadway, people will drive in the traffic lane until physically forced out of the lane with traffic control devices. Because of that concern, MoDOT would not support the installation of Junction Control without a physical barrier to force that lane closed. Most likely this would take the form of retractable gates similar to what has been used on the reversible lanes on Interstate 70 into downtown St. Louis.

At a minimum, the length of the gate system would be the same as a standard lane closure taper of 660 feet for the 55 mph speed limit. The length of this system would preclude it from being a viable method of closing Ramp 4 because the new CAR-2015 on-ramp and auxiliary lane mentioned in Alternative 3 does not leave enough room for a gate system. Although there is enough room to install the gates on I-55 as a method to close one lane on Ramp 2 during off-peak hours, the gate system would need to extend south on I-55 over the viaduct bridge structure, which would cause additional loading to this structure. Although MODOT has reservations about using overhead dynamic lane control, it remains the most practical method to close a lane on Ramp 2 due to the structural concerns about installing gates on the bridge.

Junction Control with Dynamic Signing:

Source: ops.fhwa.dot.gov

Junction control and ramp metering could be used on several of the alternatives previously discussed, but Altenatives 2A and 3 were considered the best due to the 30 mph radius on Ramp 4. The addition of ramp metering on ramp 4 could potentially cause backups onto the interstate. As mentioned in Alternative 3, the weaving distance between the new on-ramp near Pine Street is already sub-standard. If the ramp metering were to cause traffic to back up onto the interstate, it would further reduce the merge distance and cause a reduction in safety. Due to the steep grade for the flyover option, ramp metering with Alternative 3 could be problematic due to the distance it would take for trucks or even cars to get up to speed after stopping. This also creates major safety concerns with low speed vehicles merging into a smoothly flowing ramp and backups onto eastbound I-70 (Future 44). Therefore, the preferred alternative for ramp metering is Alternative 2A.

Exhibit 6 shows layouts during peak and off-peak hours using a modifed version of Alternative 2A with a combination of junction control and ramp metering. Ramp 4 would be metered during peak periods, and Ramp 2 would be reduced to one lane using overhead dynamic signs during off-peak periods. The modified version of Alternative 2A improves the undesirable merge, but it also doesn’t contain the soutbound I-55 entrance ramp from Memorial Drive, which was removed to make this alternative feasible. As previously mentioned, the City of St. Louis does not support removing this access. For this alternative, five lanes was used on northbound I-55 in order to eliminate the shared lane between Ramp 2 and the exit to Memorial Drive, which also simplifies the overhead signing.

Although the idea for junction control combined with ramp metering is compelling, the same safety and geometric design concerns on either modified Alternative 2A or Alternative 3 would remain, so this is not MODOT's preferred alternative.

Alternative 7 – Rebuild Ramp B s/o interchange as a U-Turn Flyover ramp; Remove SB 55 Exit to 7th Street Replace Ramp A with Dual Lane Ramp

MoDOT considered rebuilding EB I-70 (Future WB I-44) access to Illinois via the Poplar Street Bridge at a new location. Instead of exiting near Walnut and Memorial, EB I-70 and SB Memorial traffic would continue onto SB I-55, past the entrance of Ramp D (Future dual-lane Ramp 1), to exit near the existing 7th Street exit ramp. After exiting SB I-55, the ramp would rise over mainline I-55 and curve sharply to the left to perform a u-turn maneuver. The ramp would enter NB I-55 between the Marion/8th Street on-ramp and the Railroad overpass, merge with NB 55 traffic and continue over the Poplar Street Bridge into Illinois.

The conceptual layout, as depicted in **Exhibit 7,** shows that the ramp would have to be built beyond the existing I-55 footprint, which impacts both residential and commercial properties. Both the off-ramp and on-ramp would be tapered, and the design speed of the curve is 30 MPH. With a 14 ft min clearance over I-55, the ramp grades were between 2.5 to 3 percent. Please note that this design required the removal of the exit ramp from SB I-55 to 7th Street.

This ramp configuration was unfavorable for several reasons. First of all, it did not meet driver's expectations. A driver would have to pass the interchange and perform a u-turn to continue into Illinois. In an already congested area, with a great deal of first-time users, this could have had a significant negative impact to the safety performance of the interchange. Secondly, right-of-way requirements for building this ramp did not meet the original intention of this project. Because right-of-way in this area is costly, in both monetary and environmental/historical preservation realms, MoDOT scoped the project to remain within current right-of-way limits. Thirdly, removing SB I-55's access to 7th Street was highly unfavorable both politically and operationally. 7th Street is a major access to downtown, major sporting venues, and the commercial and historic districts along Broadway/7th Street. Other exits could not replace the accessibility 7th Street gives to downtown. The next SB I-55 exit is 1.93 miles south of 7th Street at Arsenal Street (south of the I-44 interchange). WB I-44's first exit, after splitting from I-55, is Gravois - - only 0.92 miles from 7th Street, but only allows drivers westbound access on Gravois Ave. Access to downtown north of 7th Street is off of EB 70. The first exit to the north is the MLK exit ramp, which sends drivers into Illinois or into Laclede's Landing and is 1.45 miles from 7th Street. The second exit to the north is the N. Broadway exit on the north side of downtown and is 1.83 miles from 7th street. It would be highly unlikely that the City of St. Louis would support an alternative that removes this access.

Beyond the challenges listed above, this alternative was rejected due to the preliminary traffic analysis which revealed a failing level of service in the weaving section of SB I-55 between Ramp 1 and Relocated Ramp B during the PM period.

MoDOT has investigated the seven alternatives above in the attempt to maintain access, but also improve safety and traffic operations. HOWEVER, no alternative to date has been found that improves traffic operations and safety for NB I-55 ramp to Illinois WHILE maintaining a safe and operationally efficient access for EB I-70 (Future I-44) and SB Memorial Drive to Illinois. The following alternative investigates removing Ramp B.

Alternative 8 – Remove Ramp B and Replace Ramp A with Dual Lane Ramp

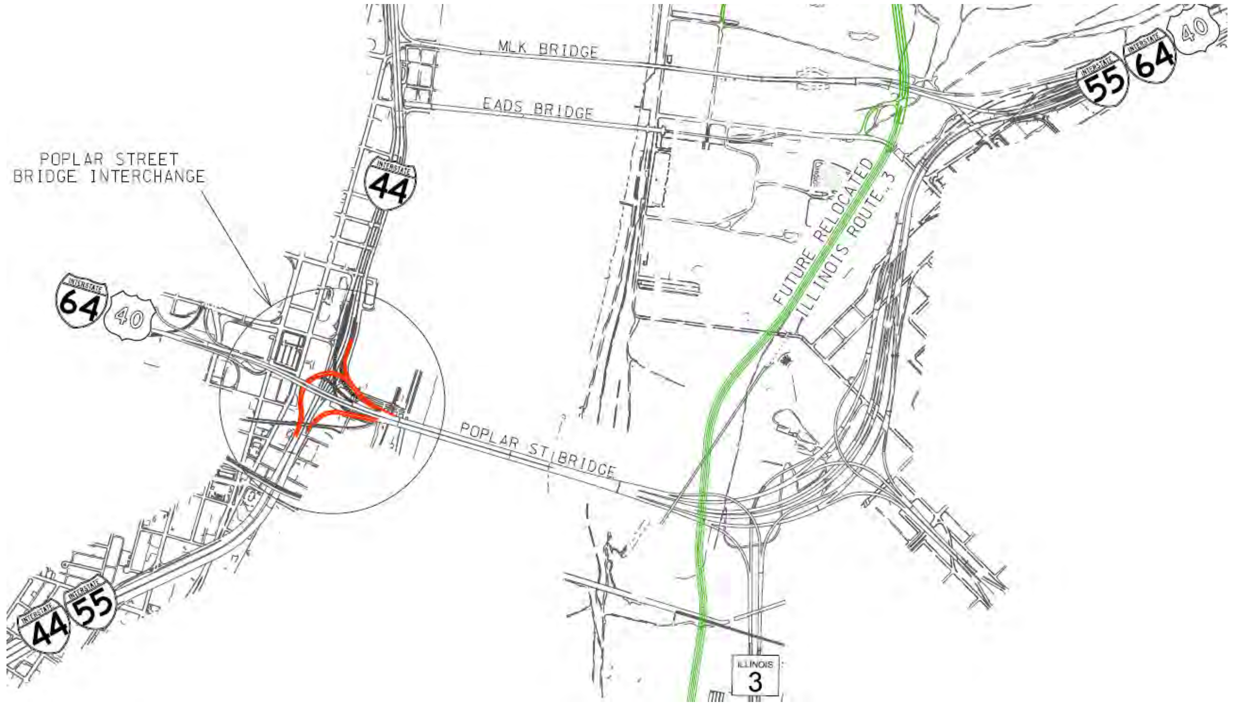
MoDOT has investigated an alternative to not replace Ramp B, and replace Ramp A (single lane ramp) with Ramp 2 (dual-lane ramp) in its current location to accommodate the NB I-55 traffic heading to Illinois. Typcial sections, plan and profile sheets for this alternative are shown in **Exhibit 8**. For the new dual-lane NB I-55 ramp, the horizontal alignment improves from a design speed of 30 MPH to 35 MPH. The sag vertical curve improves from 20 MPH to 30 MPH, and the crest vertical curve improves from 35 MPH to 45 MPH. Eliminating the EB I-70 traffic using Ramp B will greatly improve this operation of this ramp as the I-55 traffic will have its own designated lanes to use on the PSB.   Traffic modeling has shown that, by eliminating Ramp B and replacing the existing single lane Ramp A with a dual lane ramp, the evening back-ups on this ramp are virtually eliminated for both the construction year and design year traffic. Please reference the *Poplar Street Bridge Access Justification Report* to see the improvements to safety and traffic operations this alternative makes to NB I-55.

Ramp B would be removed, but only after the opening of the NMRB. EB I-70 traffic would be accommodated by the new river bridge into Illinois to the Tri-Level interchange. SB Memorial Drive traffic which uses Ramp B today will not be the same traffic that uses it when NMRB and CAR 2015 are opened to traffic. However, the downtown traffic would still have viable options to access I-70/64/I-55 into Illinois. The *Poplar Street Bridge Access Justification Report – Operational Analysis* evaluated the dispersion of traffic due to Ramp B's closure. Please reference that document for the results.

Relocating I-70 across the New MRB will actually reduce its path by approximately 2 miles. However there is concern that local traffic using EB I-70 from St. Louis to East St. Louis or Sauget Illinois will have a less direct route. Currently, EB 70 after crossing the PSB has exits to IL-3 at 8th Street in Sauget and 4th Street at Broadway in East St. Louis. The relocated EB I-70 still has access to Sauget and East St. Louis. It will have an exit to IL-3 near Packers Ave on the north side of East Louis. 2.5 miles from Exit to IL-3 and 1.8 miles from Exit to 4th Street. The Martin Luther King (MLK) and EADS bridges are shown in the diagram on the next page. Below is a list of paths:

<u>To Sauget from EB I-70 near Cass Ave</u>
Via NMRB - 5 miles
Via PSB (Ramp B) - 2.74 miles
Via Eads – 3.39 miles
Via MLK – 6.34 miles

<u>To East St. Louis Business District from EB I-70 near Cass Ave</u>
Via NMRB – 4.1 miles
Via PSB (Ramp B) – 3.58 miles
Via EADS – 2.43 miles
Via MLK – 5.22 miles



4.4 ADDITIONAL ALTERNATIVES WITH PSB BRIDGE WIDENING

The Metropolitan Planning Organization for the St. Louis Area, East West Gateway, contracted an independent consultant to investigate the alternatives considered for the PSB. HDR was chosen as the consultant and investigated the above alternatives and was asked to investigate other possible alternatives not yet considered. The independent review generally agreed with the conclusions regarding the alternatives investigated in this document and difficulty in retaining Ramp B. The Poplar Street Bridge Independent Review has been provided with the AJR documents.

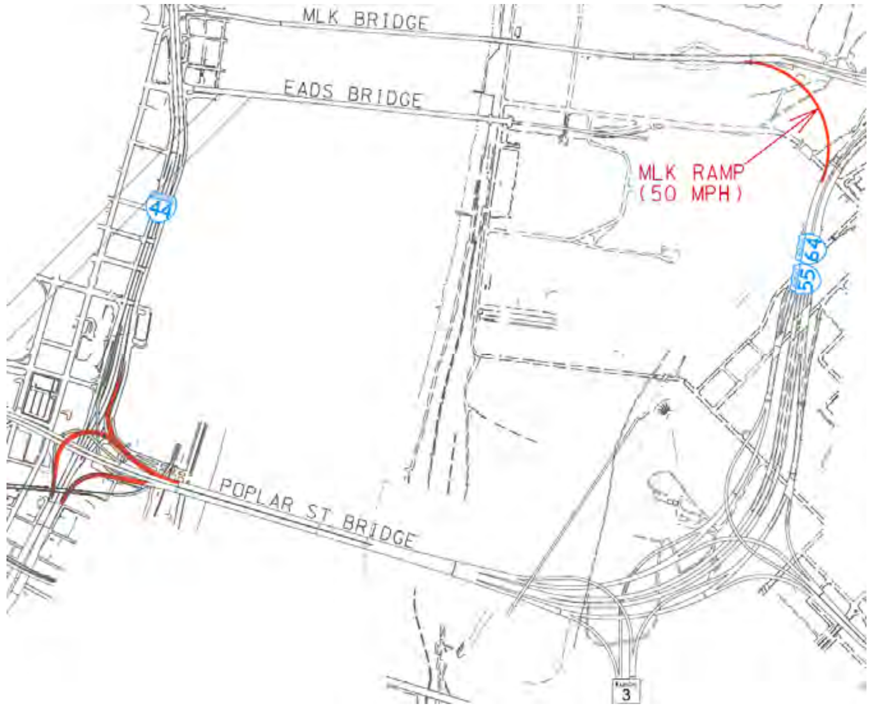
As part of their investigation, HDR determined that the cost of widening the PSB to provide an additional lane was much less than previously thought. They proposed widening the PSB to provide for five lanes of eastbound traffic. This would be accomplished by widening the bridge piers to the south, sliding the bridge, and filling in the space between the bridges creating room for an additional eastbound lane.

Alternative 9 – Slide PSB, Remove Ramp B, and Add Lane to PSB from 6th Street Ramp (Preferred)

Eastbound I-64 currently is reduced from three lanes to two at the 6th Street Exit ramp. Not only is the interstate reduced to two lanes at that location, approximately 1600’ downstream, the 6th Street entrance ramp merges with the two lanes. The reduction in lanes and merge with the ramp cause a drop in capacity that causes congestion issues in the afternoon. As shown in **Exhibit 9**, this option proposes widening the PSB to 5 lanes, extending the 6th Street entrance ramp across the PSB, and building Ramp 2 as a dual lane ramp. The additional lane would be terminated at Illinois Route 3. The addition of another lane would have the added benefit of reducing congestion on eastbound I-64 as well as northbound I-55. It should be noted that this project is the same as Phases 1 and 2 of the preferred alternative in HDR’s independent review. As in Alternative 6, this alternative has five lanes on northbound I-55.

Phase 1 would replace the westbound ramps from the PSB, Ramps 1 and 3. Ramp 1 and Ramp 3 would share an exit before splitting as proposed in earlier alternatives. Both would be dual lane ramps with Ramp 3 splitting to an exit ramp to Memorial Drive and an entrance ramp to westbound I-70 (Future I-44). Phase 2 would install ramp 2 and widen the PSB and bridges approaching the PSB from the 6th Street entrance ramp to the Route 3 exit ramp in Illinois. It would also add a connector from the Martin Luther King Bridge directly to westbound I-64, which could exit to Route 3. This improves access to East St. Louis and Sauget Illinois compared to the other alternatives that do not replace Ramp B. As proposed by HDR, Phase 3 would add a split lane on eastbound I-64 from the 6th Street exit ramp to the 6th Street entrance ramp. The additional lane would further improve the flow to Eastbound I-64 by extending the additional lane from the PSB back to the 6th Street Exit Ramp.

MLK Connector to SB I-55/WB I-64:



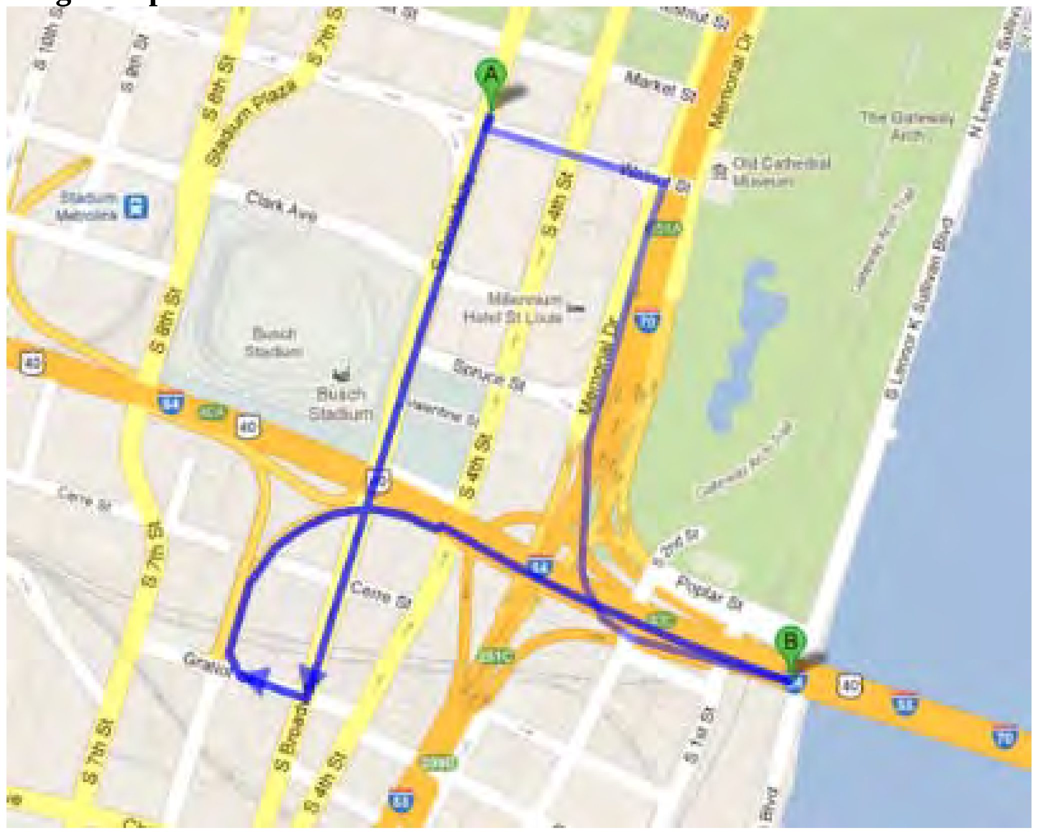
Currently Memorial Drive functions as outer roads for both directions of Interstate 70 and includes access to Ramp B. As mentioned above, the CAR-2015 project will realign the ramps north of the PSB. The project will also permanently remove Memorial Drive for several blocks for the construction of a land bridge over I-70 to connect downtown St. Louis to the Jefferson National Expansion Memorial (Gateway Arch). Whereas the current configuration of Memorial Drive serves to collect traffic from the north side of downtown St. Louis to go to Ramp B, it will no longer do so after 2015. Traffic will be forced to use Broadway to travel south. If ramp B is retained, traffic will have to take a left turn at Walnut, travel 2 blocks and then turn right onto Memorial Drive to enter Ramp B. To get to the 6th Street ramp, traffic will travel approximately ½ mile farther south on Broadway and then take two right turns to enter I-64 traffic.

According to Google Maps driving directions, the 6th Street Ramp movement to the PSB is expected to take 2 minutes vs. 3 minutes via Walnut to Ramp B. Therefore for the majority of the traffic currently using Memorial Drive to access Ramp B, the 6th Street ramp will be more efficient upon completion of CAR2015.

This alternative not only improves the congestion issue on northbound I-55 by adding a dual ramp, it also improves congestion on eastbound I-64 by adding capacity and weaving distance on the bridge, and addresses the access issue to Route 3 in Illinois. Although the improvements proposed on this alternative are greater than the scope of the original project to replace the ramps at the PSB, it is felt that the proposed design's benefits are much greater than the previous alternatives that have been explored.

Due to the improved traffic flow to two of downtown St. Louis' most congested areas, this is MoDOT's preferred alternative. It should also be noted that this alternative also has the support of IDOT and has been approved by East West Gateway. MoDOT would first build Phases 1 and 2 of the project. Phase 3 will be reevaluated after the completion of the NMRB, CAR2015, and first two Phases of this project to determine the final impacts of those projects on traffic patterns in the area.

Google Map of Alternate Routes to PSB:



A four lane variation of this alternate has also been considered as Alternate 9A. If for some reason the PSB bridge widening were not able to take place, MoDOT wanted to consider whether extending the 6th Street ramp would have a greater improvement to traffic conditions than providing a dual lane Ramp 2. In this alternate, the 6th Street Ramp and Ramp 2 would each be given one lane on the bridge. Ramp 2 could potentially be built as dual-lane, but would merge to one lane before the bridge.

Although this alternative could potentially improve congestion on I-64, the area with the most crashes due to congestion is northbound I-55. The fast moving northbound traffic next to backed up lanes queued to enter the PSB is a dangerous situation that would be better alleviated by keeping the dual lane Ramp 2.

Alternative 10 –Widen PSB and Retain Ramp B as 5th Lane

The possibility of widening the bridge also brought about the ability to not only build Ramp 2 as a dual lane ramp, but also build Ramp 4 and with its own lane across the bridge. Each of the alternatives investigated in this memo could be upgraded to give the ramp an exclusive lane. The addition of the lane would eliminate the issues with short merging distances from Ramp 4.

Although each of the five lane alternatives is superior to its four lane counterpart, the alternatives with the most potential are Alternatives 2A and 3 due to their higher design speeds. Alternative 10-2A has a right side exit and 30 mph turning radius, but would require the removal of access to southbound I-55 from Memorial Drive. This is not supported by the City of St. Louis. Alternative 10-3 includes a flyover ramp which also has a 30 mph design speed. See **Exhibit 10** for a plan layout of Alternative 10-3. As mentioned in the discussion on Alternative 3, there are some serious grade issues that will not improve with the 5 lane option. Due to the great height and length of the bridge to construct a ramp over I-64, this is also the costliest of the ramp options investigated

Although this is a buildable option for retaining Ramp B, this alternative has a very undesirable grade for Ramp 4 and does not directly address the traffic congestion on eastbound I-64. The addition of Ramp 4 would make it very difficult and costly to add a third lane to eastbound I-64 in the future. MoDOT feels that the addition of the NMRB in combination with the MLK connector will provide good access to both eastbound I-64 and IL Route 3.

The decision between installing Ramp 4 vs. extending the 6th Street Ramp comes down to a decision between added capacity and added accessibility to eastbound I-64. MoDOT prefers Alternative 9 to add capacity due to the following reasons:

- NMRB will serve the great majority of the current traffic using Ramp B from I-70.
- The MLK connector will serve the remaining traffic currently using Ramp B from I-70.
- CAR 2015 will make it more efficient to access EB I-64 from 6th Street Ramp than from Ramp B via Memorial Drive.
- Relieved congestion on I-64 will better serve drivers than the repetition of a ramp movement.

Alternative 11 - Widen PSB, Retain Ramp B, and Extend 6th Street Ramp with Junction Control

This alternative explores the possibility of retaining Ramp B in combination with extending the 6th Street Ramp to the PSB. Junction Control would be used to reduce six lanes to five lanes on the bridge. The PSB will be widened to 5 lanes with Ramp B being rebuilt as Ramp 4. This could be done with any of the alternatives, but has been shown using a similar alignment to alternative 2A. With this alignment, the southbound entrance ramp to I-55 from Memorial Drive would have to be removed. The approach to the PSB would be widened to extend the 6th Street entrance ramp to the bridge.

There are two viable options for junction control on a 5-lane PSB. The first, Alternative 11A, is the five lane equivalent of Alternative 6 with Ramp 4 merging with a dual lane NB I-55 entrance ramp, Ramp 2 during the peak hour. This alternative is able to retain Ramp B using a combination of junction control and ramp metering. For more information on this alternate, see Alternative 6. A large concern with this option is that ramp metering on Ramp 4 could potentially create a queue in traffic that backs onto eastbound I-70. That concern in combination with the short merge distance between Ramp 4 and the new entrance ramp from Memorial Drive near Washington Avenue is a large safety concern.

The second option for junction control on a 5-lane PSB, Alternative 11B, uses junction control to merge the extended 6th Street Ramp, Ramp 5, into a dual-lane northbound I-55 Ramp 2. See **Exhibit 11** for a plan layout of Alternative 11B. Like Alternative 6, the peak hour for both movements is during the afternoon rush. During that peak period, two lanes would remain open on Ramp 2. Ramp 5 would be forced to merge with eastbound I-64 similar to what it does today. During the off-peak time period, the inside lane of Ramp 2 would be closed using dynamic overhead signing.

Since in junction control separate lanes come to occupy the same single lane, it is important that vehicles can see the lane of traffic with which they would be merging in the event that a vehicle violates the lane use control signals. Due to the difference in grades between I-64 (-0.6%) and Ramp 2 (+5.0%) , the point at which a vehicle in either junction controlled lane can be seen in the other is only 198’. This is close to the stopping sight distance for the ramp (200’), however it is far below the required stopping sight distance for I-64 (425’). Therefore, the geometrics create an unacceptable safety issue at the merge.

The advantage with this alternative over Alternative 11A is that there is more space for the 6th Street Ramp to merge and it would not necessarily require ramp metering. This also eliminates the possibility of Ramp 4 backing up onto westbound I-70 (Future I-44). The disadvantage of this alternative is that it would not likely have much improvement to the backups on eastbound I-64 due to the required merge.

All of the alternatives with Junction Control still have huge design issues. Even the alternatives with a reasonable horizontal alignment have problems with steep grade, substandard weaving distance, removal of access, or deep excavation. Due to the removal of the southbound I-55 entrance ramp from Memorial Drive, undesirable grades, and Junction Control being untested in the United States, this is not the preferred alternative.

5.0 CONCLUSION

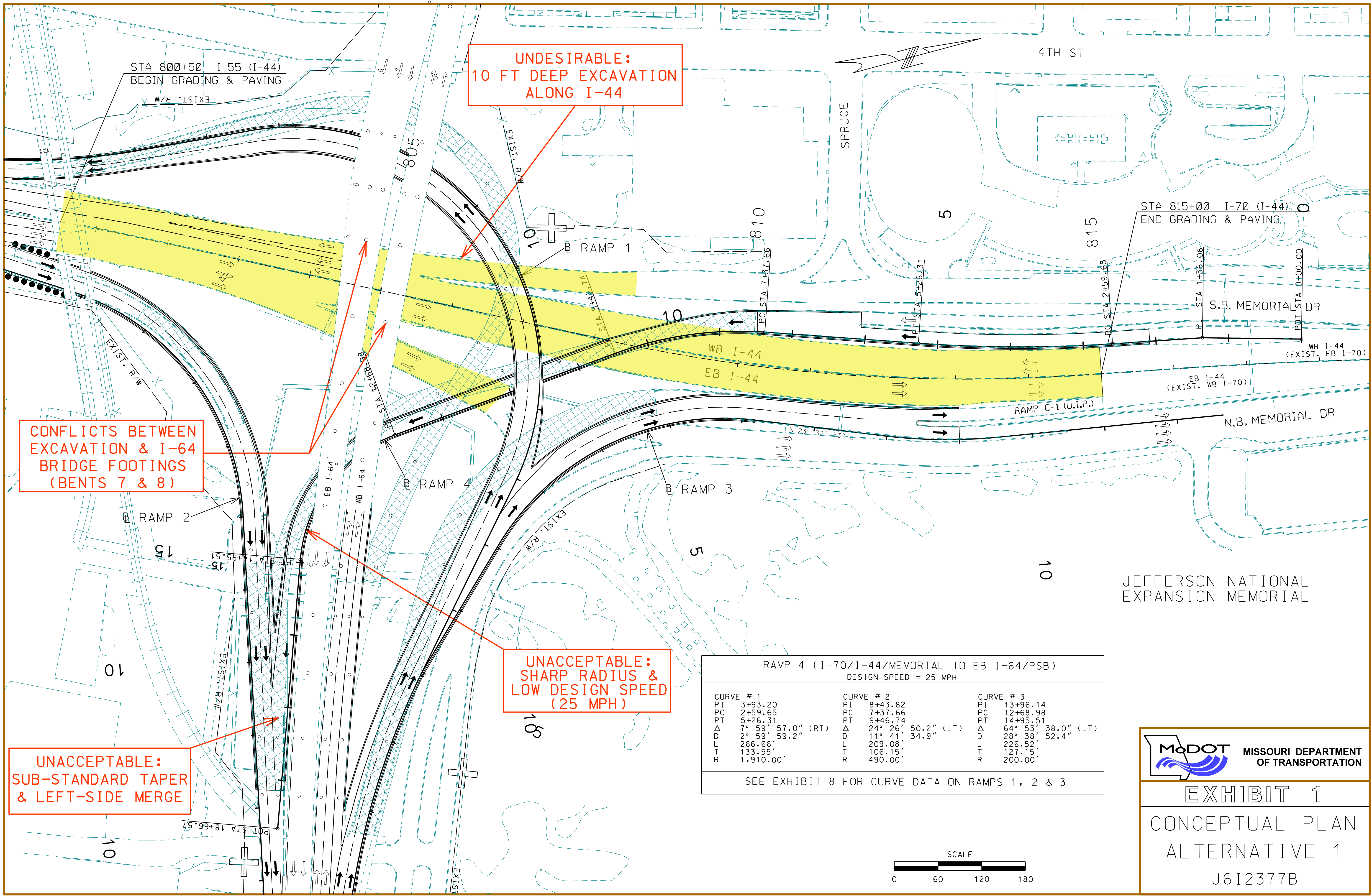
It is the opinion of the Missouri Department of Transportation that it is not feasible to add the missing movements to the PSB Interchange connecting I-64 to I-70 to and from the north or I-55 to and from the south due to the design constraints at the existing interchange and the costs both for construction and to the community in the effects on historic properties. Even if money were no object, there would still be some serious design issues that we would need to overcome in order to make the interchange function properly.

Doing nothing at the interchange is not a viable option either given the condition of the ramp bridges. The bridges have become too costly to maintain and need to be replaced. Although it is possible to replace the bridges in their current locations, this configuration leaves much to be desired. The preferred alternative not only addresses the issue of replacing deficient bridges, but improves traffic flow in the area by providing two lane ramps for the two heaviest movements in the interchange and adding capacity to the bridge. Although the elimination of Ramp B is less than desirable, the demand for that ramp will greatly diminish with the completion of the New Mississippi River Bridge, and there are underutilized alternate routes to reach the Eastbound Poplar Street Bridge. The addition of the MLK Connector will also increase connectivity between I-70 and the cities of East St. Louis and Sauget. The Missouri Department of Transportation strongly feels that the preferred alternative will be the greatest benefit to taxpayers and the driving public. The addition of a fifth lane to the PSB in addition to improving the I-55 ramps to the south by building dual lane ramps and removing the existing EB I-70 ramp will greatly improve the functionality of the interchange for many years to come.

TABLE 1: Summary of Alternatives

	Alt 1	Alt 2	Alt 2A	Alt 3	Alt 4	Alt 5	Alt 6	Alt 8	Alt 9	Alt 9A	Alt 10	Alt 11A	Alt 11B
Ramp 4 Design Speed	**25**	**25**	**30**	**30**	**30**	**25**	**30**	**n/a**	**n/a**	**n/a**	**30**	**30**	**30**
Ramp 4 Grade Undesirable (5-7%)	**5.2%**	**6.8%**	**6.5%**	**6.7%**	**5.7%**	**5.5%**	**6.5% Same as Alt 2A**				**6.7%**	**6.5% Same as Alt 2A**	**6.5% Same as Alt 2A**
Ramp Grade Unacceptable (Over 7%)					**8.1% (Ramp 1)**								
Substandard Sight Distance													**X**
Left Side Entrance	**X**												
Tapered Entrance to PSB	**X**		**X**				**X**						
Substandard Tapered Entrance to SB I-55 or Remove Ramp Access		**X**	**X**			**X**	**X**					**X**	**X**
Left Side Exit		**X**											
Potential Conflicts w/ Bridge Footings	**X**	**X**	**X**									**X**	**X**
Remove Ramp B								**X**	**X**	**X**			
Added Lane to PSB									**X**		**X**	**X**	**X**
Future Potential for 3 lane I-64									**X**	**X**			**X**

Note:
All alternatives to retain Ramp B have an undesirable vertical clearance of 14 feet in one or more locations.



UNDESIRABLE:
10 FT DEEP EXCAVATION
ALONG I-44

CONFLICTS BETWEEN
EXCAVATION & I-64
BRIDGE FOOTINGS
(BENTS 7 & 8)

UNACCEPTABLE:
SHARP RADIUS &
LOW DESIGN SPEED
(25 MPH)

UNACCEPTABLE:
SUB-STANDARD TAPER
& LEFT-SIDE MERGE

RAMP 4 (I-70/I-44/MEMORIAL TO EB I-64/PSB)
DESIGN SPEED = 25 MPH

CURVE # 1		CURVE # 2		CURVE # 3	
PI	3+93.20	PI	8+43.82	PI	13+96.14
PC	2+59.65	PC	7+37.66	PC	12+68.98
PT	5+26.31	PT	9+46.74	PT	14+95.51
Δ	7° 59′ 57.0″ (RT)	Δ	24° 26′ 50.2″ (LT)	Δ	64° 53′ 38.0″ (LT)
D	2° 59′ 59.2″	D	11° 41′ 34.9″	D	28° 38′ 52.4″
L	266.66′	L	209.08′	L	226.52′
T	133.55′	T	106.15′	T	127.15′
R	1,910.00′	R	490.00′	R	200.00′

SEE EXHIBIT 8 FOR CURVE DATA ON RAMPS 1, 2 & 3

MoDOT
MISSOURI DEPARTMENT
OF TRANSPORTATION

EXHIBIT 1

CONCEPTUAL PLAN
ALTERNATIVE 1

J6I2377B

RAMP 4
(RELOCATED RAMP B)

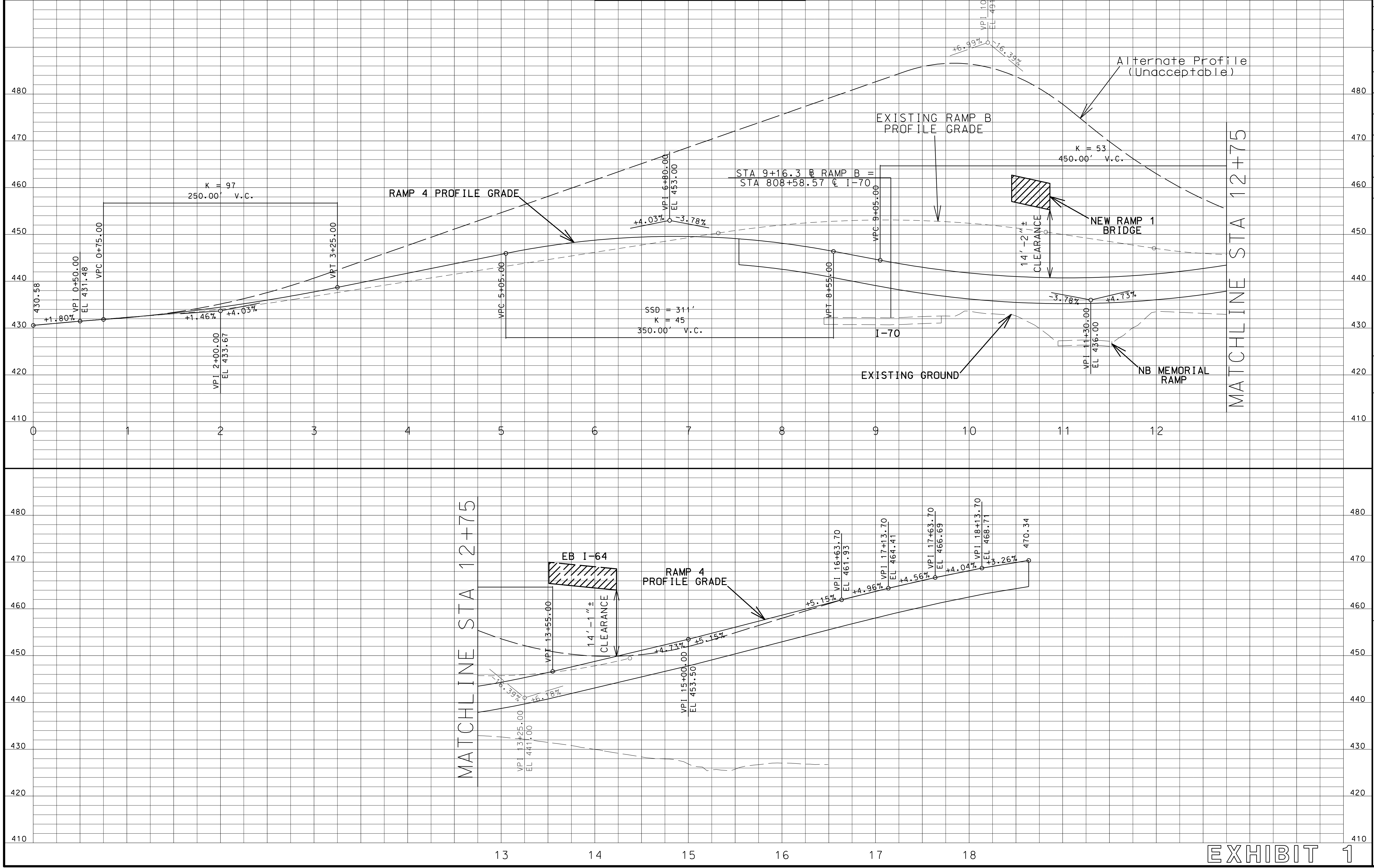


EXHIBIT 1

"THIS MEDIA SHOULD
NOT BE CONSIDERED
A CERTIFIED
DOCUMENT."

DATE

DATE PREPARED
7/5/2012

ROUTE	STATE
I-70	MO
DISTRICT	SHEET NO.
SL	

COUNTY
ST. LOUIS CITY

JOB NO.
J6I2377B

CONTRACT ID.

PROJECT NO.

BRIDGE NO.

DESCRIPTION

DATE

MISSOURI HIGHWAYS AND TRANSPORTATION
COMMISSION

105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

CONCEPTUAL ALTERNATIVE 1

RAMP 4 PROFILE

IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

I-70

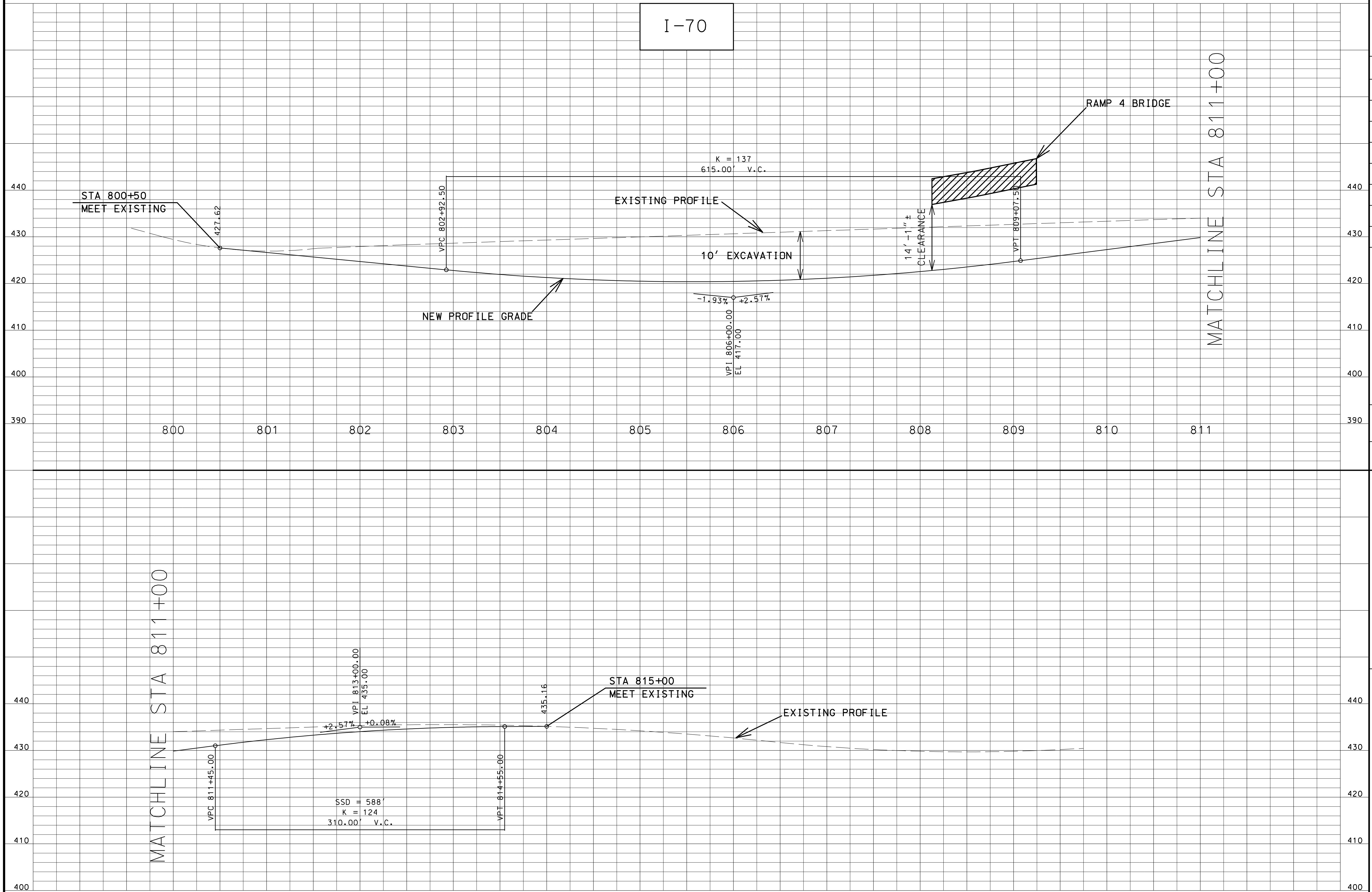


EXHIBIT 1

DATE

DATE PREPARED
7/5/2012

ROUTE	STATE
I-70	MO
DISTRICT	SHEET NO.
SL	

COUNTY
ST. LOUIS CITY
JOB NO.
J6I2377B
CONTRACT ID.

PROJECT NO.

BRIDGE NO.

DESCRIPTION

DATE

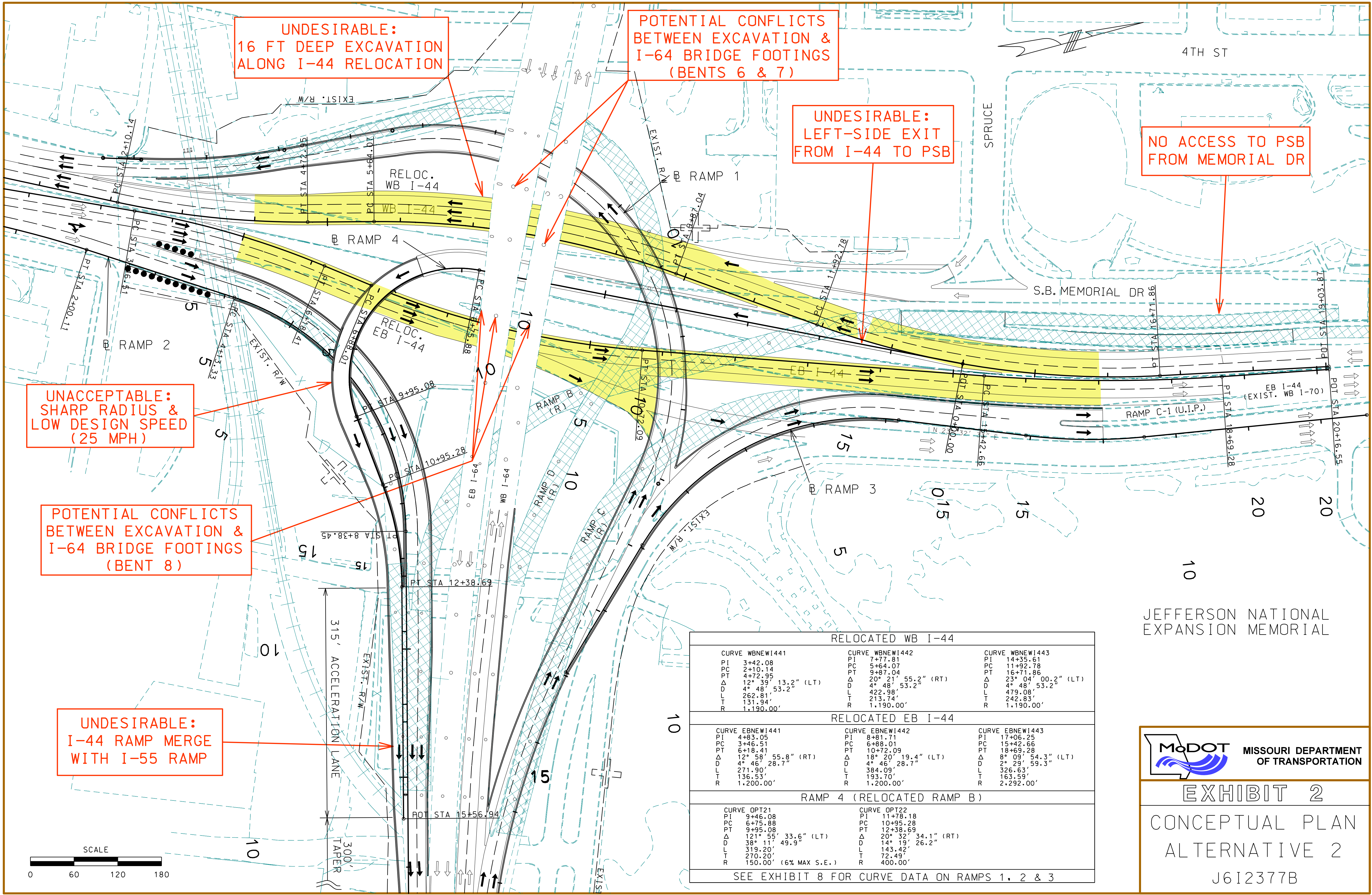
MISSOURI HIGHWAYS AND TRANSPORTATION
COMMISSION

105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

CONCEPTUAL ALTERNATIVE 1

I-70 PROFILE

IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.



UNDESIRABLE:
16 FT DEEP EXCAVATION
ALONG I-44 RELOCATION

POTENTIAL CONFLICTS
BETWEEN EXCAVATION &
I-64 BRIDGE FOOTINGS
(BENTS 6 & 7)

UNDESIRABLE:
LEFT-SIDE EXIT
FROM I-44 TO PSB

NO ACCESS TO PSB
FROM MEMORIAL DR

UNACCEPTABLE:
SHARP RADIUS &
LOW DESIGN SPEED
(25 MPH)

POTENTIAL CONFLICTS
BETWEEN EXCAVATION &
I-64 BRIDGE FOOTINGS
(BENT 8)

UNDESIRABLE:
I-44 RAMP MERGE
WITH I-55 RAMP

RELOCATED WB I-44

	CURVE WBNEWI441	CURVE WBNEWI442	CURVE WBNEWI443
PI	3+42.08	7+77.81	14+35.61
PC	2+10.14	5+64.07	11+92.78
PT	4+72.95	9+87.04	16+71.86
Δ	12° 39′ 13.2″ (LT)	20° 21′ 55.2″ (RT)	23° 04′ 00.2″ (LT)
D	4° 48′ 53.2″	4° 48′ 53.2″	4° 48′ 53.2″
L	262.81′	422.98′	479.08′
T	131.94′	213.74′	242.83′
R	1,190.00′	1,190.00′	1,190.00′

RELOCATED EB I-44

	CURVE EBNEWI441	CURVE EBNEWI442	CURVE EBNEWI443
PI	4+83.05	8+81.71	17+06.25
PC	3+46.51	6+88.01	15+42.66
PT	6+18.41	10+72.09	18+69.28
Δ	12° 58′ 55.8″ (RT)	18° 20′ 19.4″ (LT)	8° 09′ 54.3″ (LT)
D	4° 46′ 28.7″	4° 46′ 28.7″	2° 29′ 59.3″
L	271.90′	384.09′	326.63′
T	136.53′	193.70′	163.59′
R	1,200.00′	1,200.00′	2,292.00′

RAMP 4 (RELOCATED RAMP B)

	CURVE OPT21	CURVE OPT22
PI	9+46.08	11+78.18
PC	6+75.88	10+95.28
PT	9+95.08	12+38.69
Δ	121° 55′ 33.6″ (LT)	20° 32′ 34.1″ (RT)
D	38° 11′ 49.9″	14° 19′ 26.2″
L	319.20′	143.42′
T	270.20′	72.49′
R	150.00′ (6% MAX S.E.)	400.00′

SEE EXHIBIT 8 FOR CURVE DATA ON RAMPS 1, 2 & 3

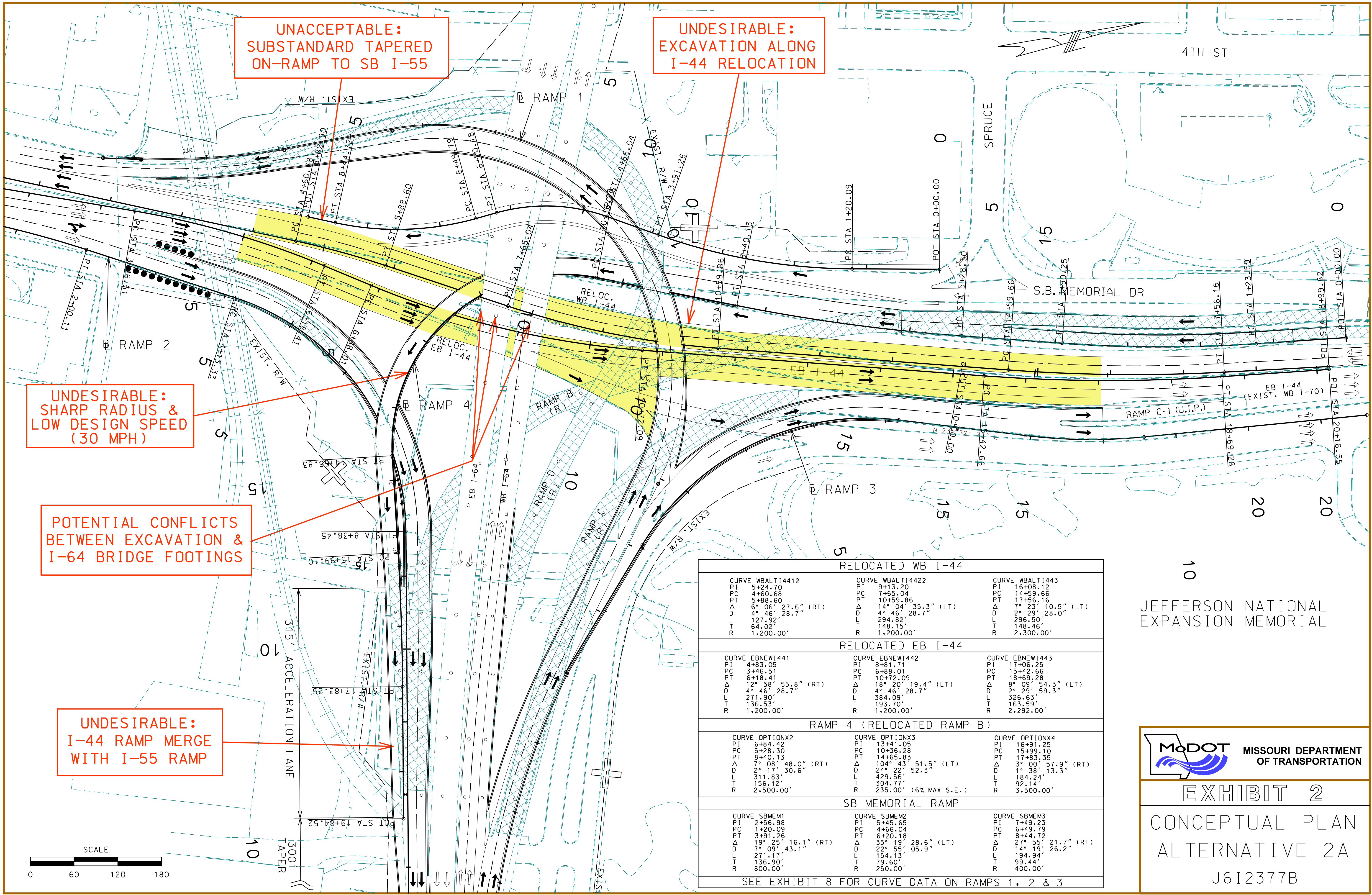
MoDOT
MISSOURI DEPARTMENT
OF TRANSPORTATION

EXHIBIT 2

CONCEPTUAL PLAN
ALTERNATIVE 2

J6I2377B

IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED



UNACCEPTABLE:
SUBSTANDARD TAPERED
ON-RAMP TO SB I-55

UNDESIRABLE:
EXCAVATION ALONG
I-44 RELOCATION

UNDESIRABLE:
SHARP RADIUS &
LOW DESIGN SPEED
(30 MPH)

POTENTIAL CONFLICTS
BETWEEN EXCAVATION &
I-64 BRIDGE FOOTINGS

UNDESIRABLE:
I-44 RAMP MERGE
WITH I-55 RAMP

RELOCATED WB I-44

CURVE	WBALTI4412	CURVE	WBALTI4422	CURVE	WBALTI443
PI	5+24.70	PI	9+13.20	PI	16+08.12
PC	4+60.68	PC	7+65.04	PC	14+59.66
PT	5+88.60	PT	10+59.86	PT	17+56.16
Δ	6° 06′ 27.6″ (RT)	Δ	14° 04′ 35.3″ (LT)	Δ	7° 23′ 10.5″ (LT)
D	4° 46′ 28.7″	D	4° 46′ 28.7″	D	2° 29′ 28.0″
L	127.92′	L	294.82′	L	296.50′
T	64.02′	T	148.15′	T	148.46′
R	1,200.00′	R	1,200.00′	R	2,300.00′

RELOCATED EB I-44

CURVE	EBNEWI441	CURVE	EBNEWI442	CURVE	EBNEWI443
PI	4+83.05	PI	8+81.71	PI	17+06.25
PC	3+46.51	PC	6+88.01	PC	15+42.66
PT	6+18.41	PT	10+72.09	PT	18+69.28
Δ	12° 58′ 55.8″ (RT)	Δ	18° 20′ 19.4″ (LT)	Δ	8° 09′ 54.3″ (LT)
D	4° 46′ 28.7″	D	4° 46′ 28.7″	D	2° 29′ 59.3″
L	271.90′	L	384.09′	L	326.63′
T	136.53′	T	193.70′	T	163.59′
R	1,200.00′	R	1,200.00′	R	2,292.00′

RAMP 4 (RELOCATED RAMP B)

CURVE	OPTIONX2	CURVE	OPTIONX3	CURVE	OPTIONX4
PI	6+84.42	PI	13+41.05	PI	16+91.25
PC	5+28.30	PC	10+36.28	PC	15+99.10
PT	8+40.13	PT	14+65.83	PT	17+83.35
Δ	7° 08′ 48.0″ (RT)	Δ	104° 43′ 51.5″ (LT)	Δ	3° 00′ 57.9″ (RT)
D	2° 17′ 30.6″	D	24° 22′ 52.3″	D	1° 38′ 13.3″
L	311.83′	L	429.56′	L	184.24′
T	156.12′	T	304.77′	T	92.14′
R	2,500.00′	R	235.00′ (6% MAX S.E.)	R	3,500.00′

SB MEMORIAL RAMP

CURVE	SBMEM1	CURVE	SBMEM2	CURVE	SBMEM3
PI	2+56.98	PI	5+45.65	PI	7+49.23
PC	1+20.09	PC	4+66.04	PC	6+49.79
PT	3+91.26	PT	6+20.18	PT	8+44.72
Δ	19° 25′ 16.1″ (RT)	Δ	35° 19′ 28.6″ (LT)	Δ	27° 55′ 21.7″ (RT)
D	7° 09′ 43.1″	D	22° 55′ 05.9″	D	14° 19′ 26.2″
L	271.17′	L	154.13′	L	194.94′
T	136.90′	T	79.60′	T	99.44′
R	800.00′	R	250.00′	R	400.00′

SEE EXHIBIT 8 FOR CURVE DATA ON RAMPS 1, 2 & 3

MoDOT MISSOURI DEPARTMENT OF TRANSPORTATION

EXHIBIT 2

CONCEPTUAL PLAN
ALTERNATIVE 2A
J6I2377B

RAMP 4
(RELOCATED RAMP B)

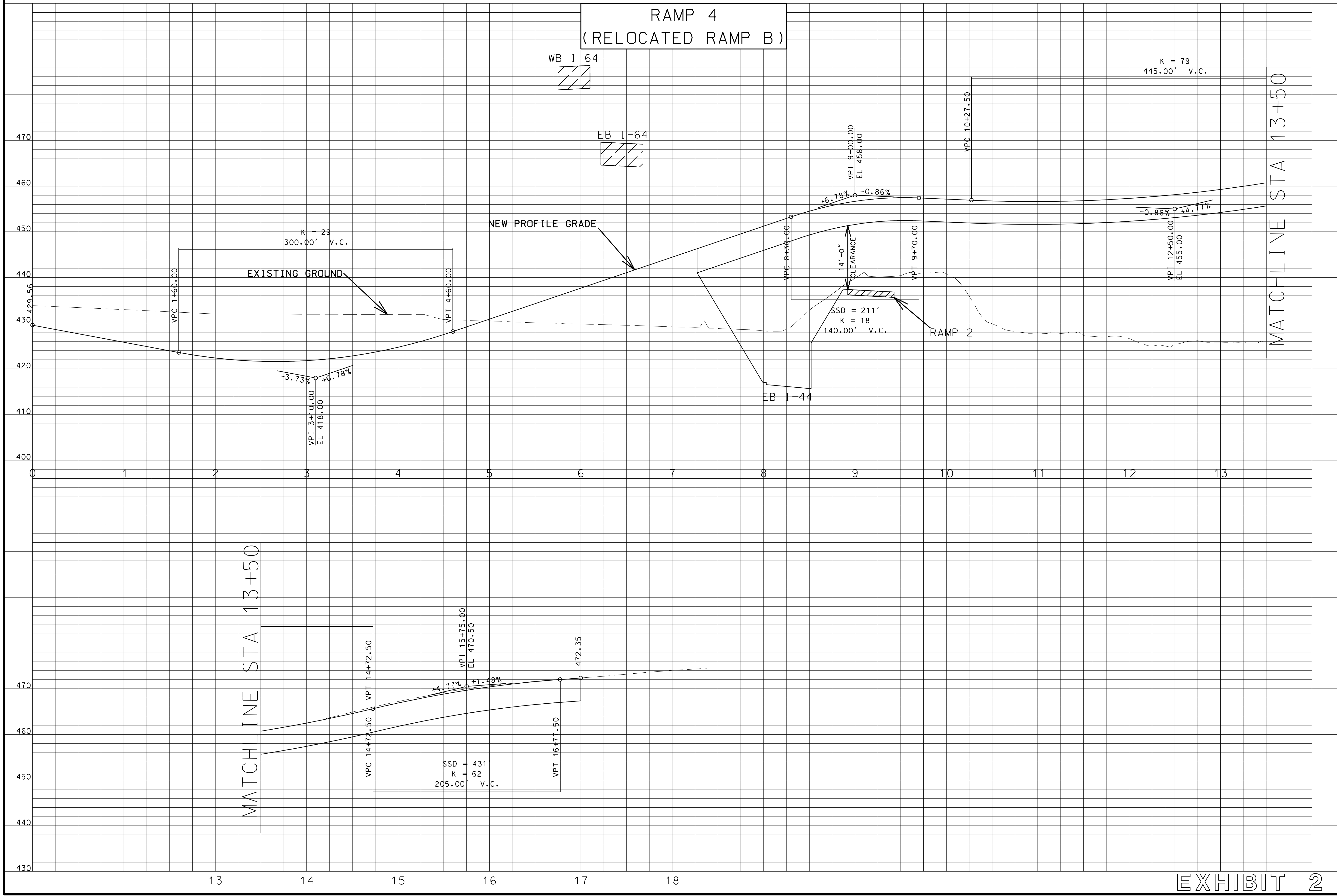


EXHIBIT 2

DATE

DATE PREPARED

ROUTE I-70
STATE MO
DISTRICT SL
SHEET NO.
COUNTY ST. LOUIS CITY
JOB NO. J6I2377B
CONTRACT ID.
PROJECT NO.
BRIDGE NO.

DESCRIPTION

DATE

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

CONCEPTUAL ALTERNATIVE 2

RAMP 4 PROFILE

IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

EXHIBIT2_Profile1_RAMP4-B_i50.dgn 1:07:51 PM 7/6/2012

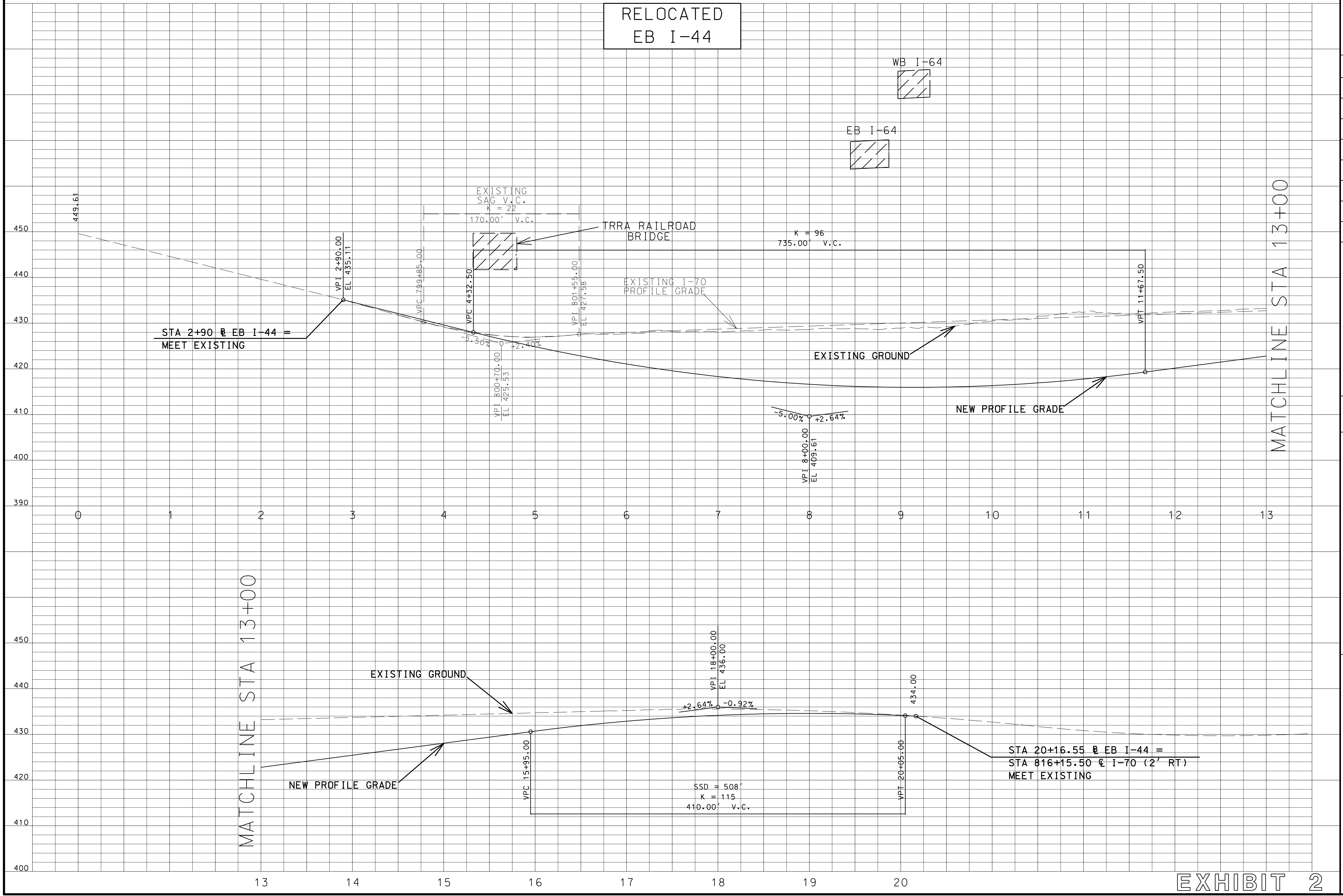


EXHIBIT 2

DATE

DATE PREPARED

ROUTE	STATE
I-70	MO
DISTRICT	SHEET NO.
SL	

COUNTY
ST. LOUIS CITY

JOB NO.
J6I2377B

CONTRACT ID.

PROJECT NO.

BRIDGE NO.

DATE | DESCRIPTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

CONCEPTUAL ALTERNATIVE 2

RELOCATED
EB I-44 PROFILE

IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

EXHIBIT2_Profile2_EBI44_i50.dgn 11:18:42 AM 7/9/2012

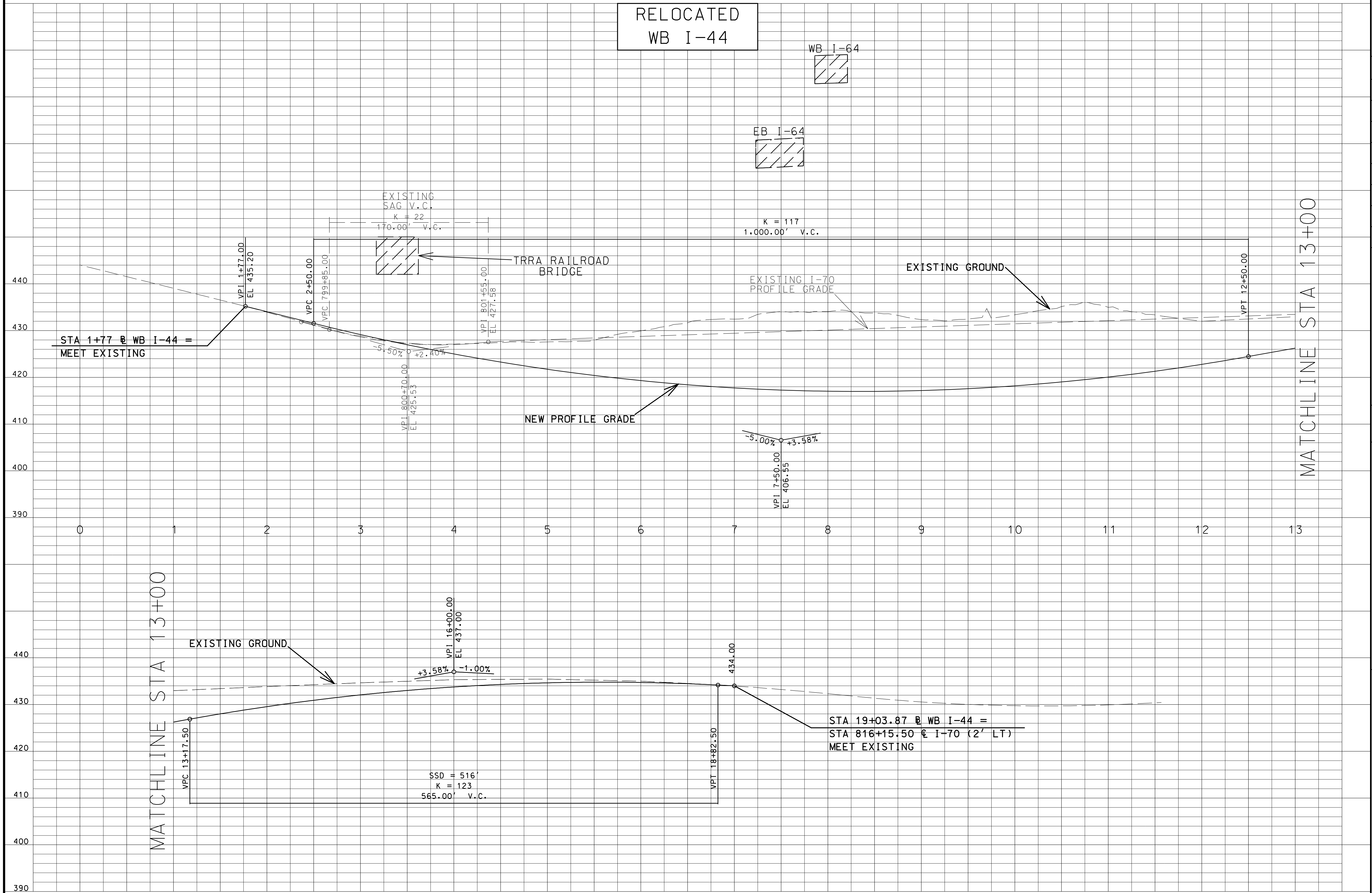


EXHIBIT 2

IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

DATE	
DATE PREPARED	
ROUTE I-70	STATE MO
DISTRICT SL	SHEET NO.
COUNTY ST. LOUIS CITY	
JOB NO. J6I2377B	
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.	

DESCRIPTION

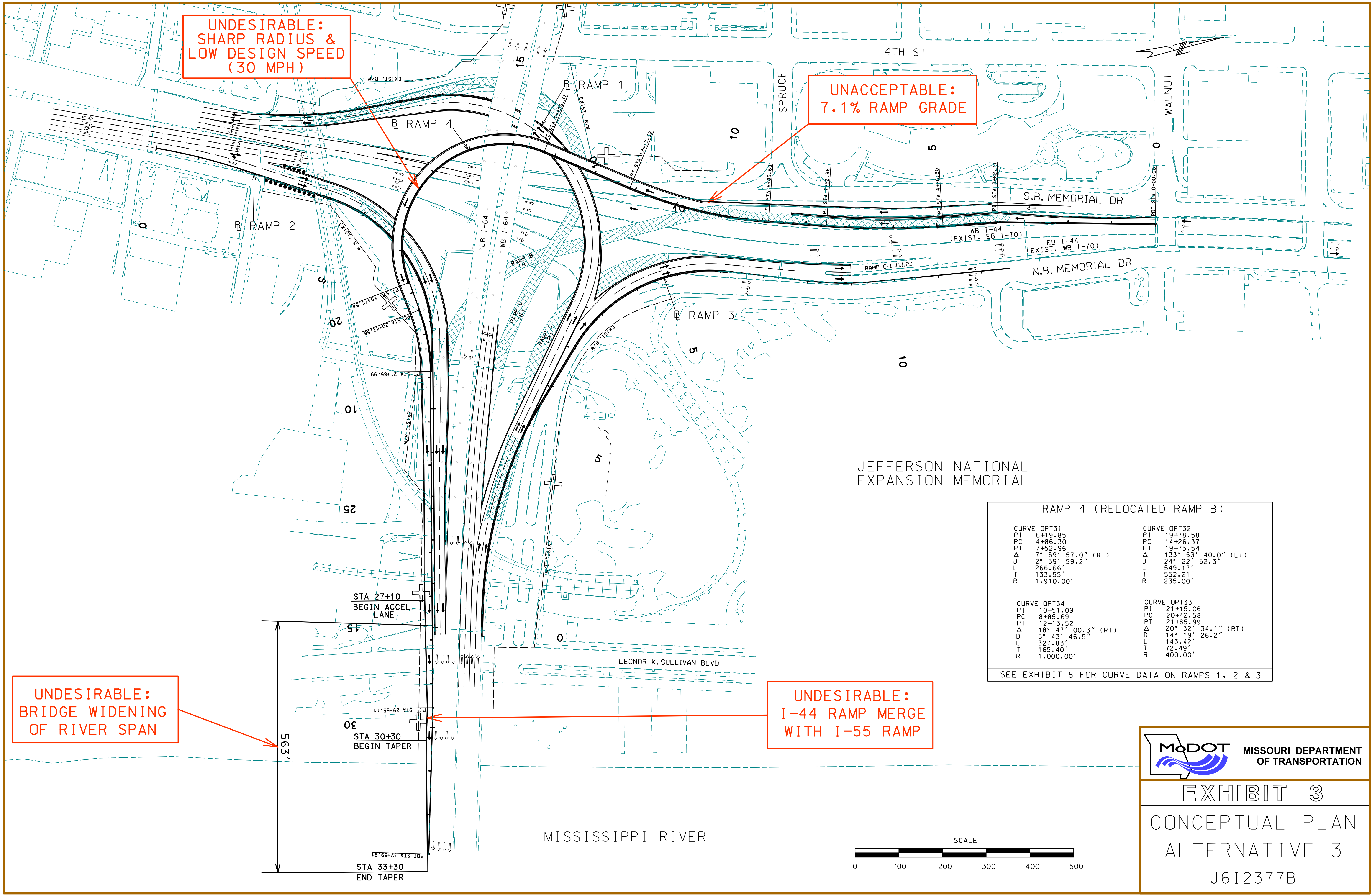
DATE

MISSOURI HIGHWAYS AND TRANSPORTATION
COMMISSION

105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

CONCEPTUAL ALTERNATIVE 2

RELOCATED
WB I-44 PROFILE



RAMP 4 (RELOCATED RAMP B)

CURVE	OPT31	CURVE	OPT32
PI	6+19.85	PI	19+78.58
PC	4+86.30	PC	14+26.37
PT	7+52.96	PT	19+75.54
Δ	7° 59′ 57.0″ (RT)	Δ	133° 53′ 40.0″ (LT)
D	2° 59′ 59.2″	D	24° 22′ 52.3″
L	266.66′	L	549.17′
T	133.55′	T	552.21′
R	1,910.00′	R	235.00′
CURVE	OPT34	CURVE	OPT33
PI	10+51.09	PI	21+15.06
PC	8+85.69	PC	20+42.58
PT	12+13.52	PT	21+85.99
Δ	18° 47′ 00.3″ (RT)	Δ	20° 32′ 34.1″ (RT)
D	5° 43′ 46.5″	D	14° 19′ 26.2″
L	327.83′	L	143.42′
T	165.40′	T	72.49′
R	1,000.00′	R	400.00′

SEE EXHIBIT 8 FOR CURVE DATA ON RAMPS 1, 2 & 3

MoDOT
MISSOURI DEPARTMENT
OF TRANSPORTATION

EXHIBIT 3

CONCEPTUAL PLAN
ALTERNATIVE 3

J6I2377B

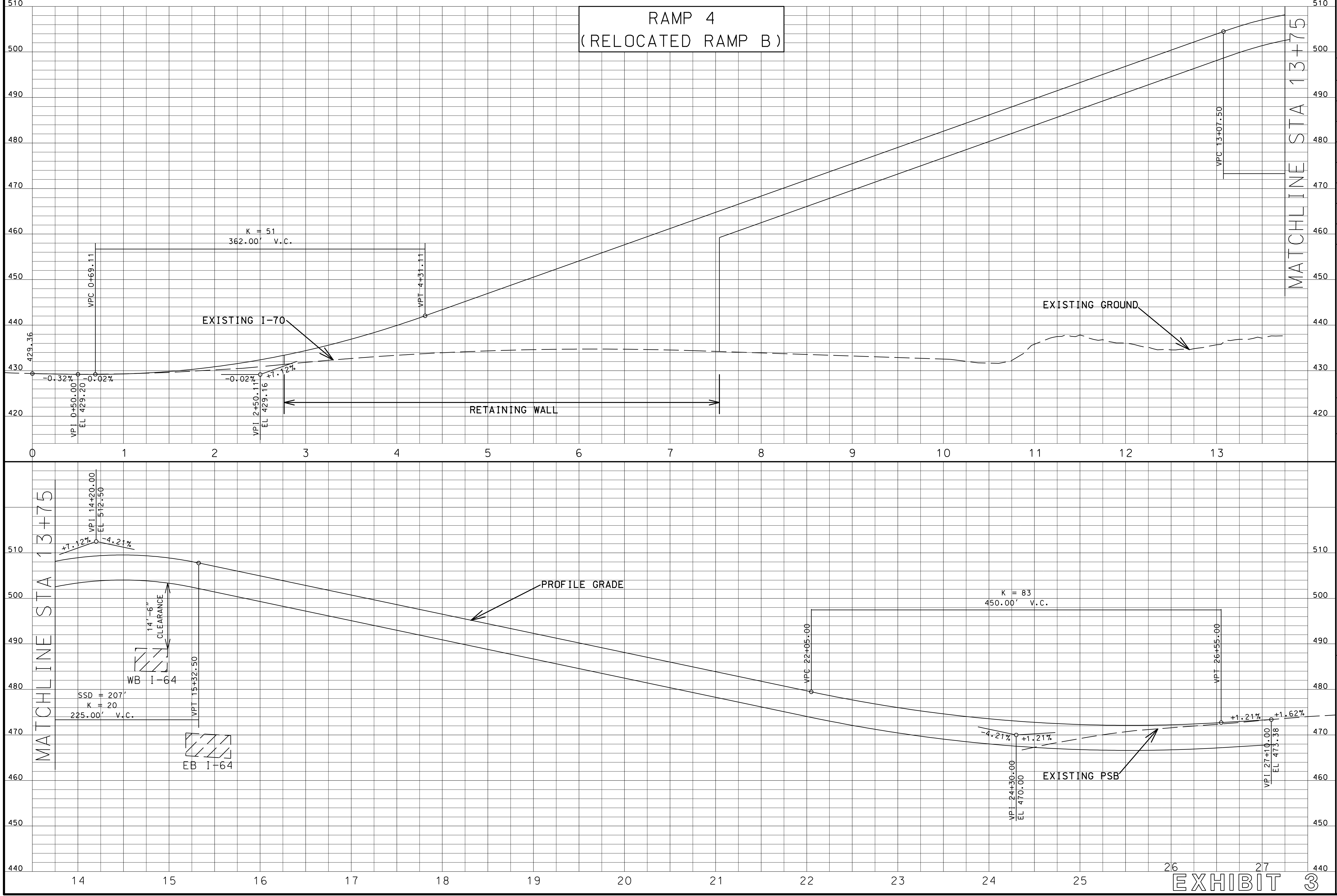


EXHIBIT 3

DATE

DATE PREPARED

ROUTE	STATE
I-70	MO
DISTRICT	SHEET NO.
SL	

COUNTY
ST. LOUIS CITY

JOB NO.
J6I2377B

CONTRACT ID.

PROJECT NO.

BRIDGE NO.

DATE

DESCRIPTION

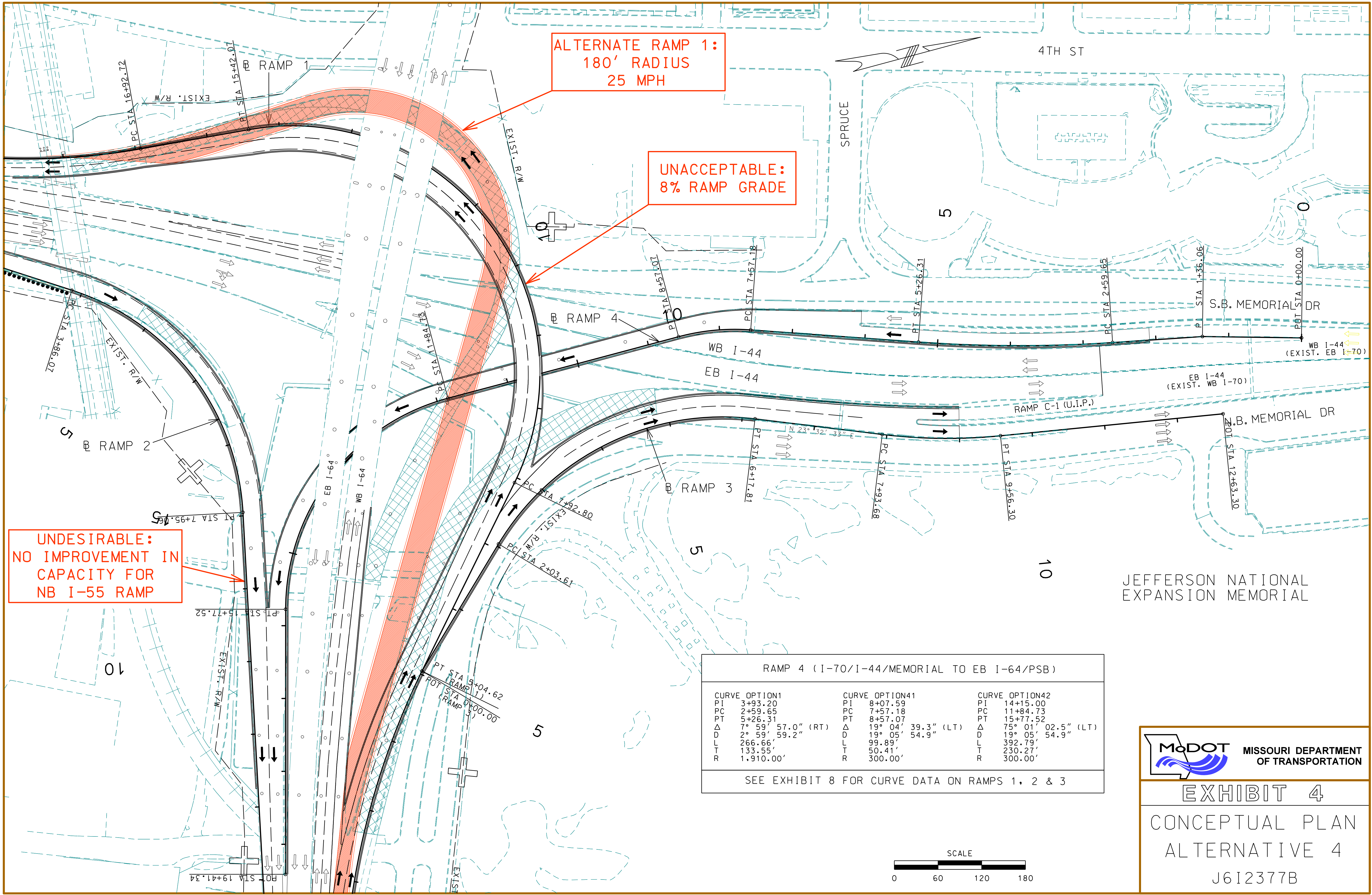
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

CONCEPTUAL ALTERNATIVE 3

RAMP 4 PROFILE

IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.



RAMP 4 (I-70/I-44/MEMORIAL TO EB I-64/PSB)

CURVE	OPTION1	CURVE	OPTION41	CURVE	OPTION42
PI	3+93.20	PI	8+07.59	PI	14+15.00
PC	2+59.65	PC	7+57.18	PC	11+84.73
PT	5+26.31	PT	8+57.07	PT	15+77.52
Δ	7° 59′ 57.0″ (RT)	Δ	19° 04′ 39.3″ (LT)	Δ	75° 01′ 02.5″ (LT)
D	2° 59′ 59.2″	D	19° 05′ 54.9″	D	19° 05′ 54.9″
L	266.66′	L	99.89′	L	392.79′
T	133.55′	T	50.41′	T	230.27′
R	1,910.00′	R	300.00′	R	300.00′

SEE EXHIBIT 8 FOR CURVE DATA ON RAMPS 1, 2 & 3

MoDOT
MISSOURI DEPARTMENT
OF TRANSPORTATION

EXHIBIT 4

CONCEPTUAL PLAN
ALTERNATIVE 4
J6I2377B

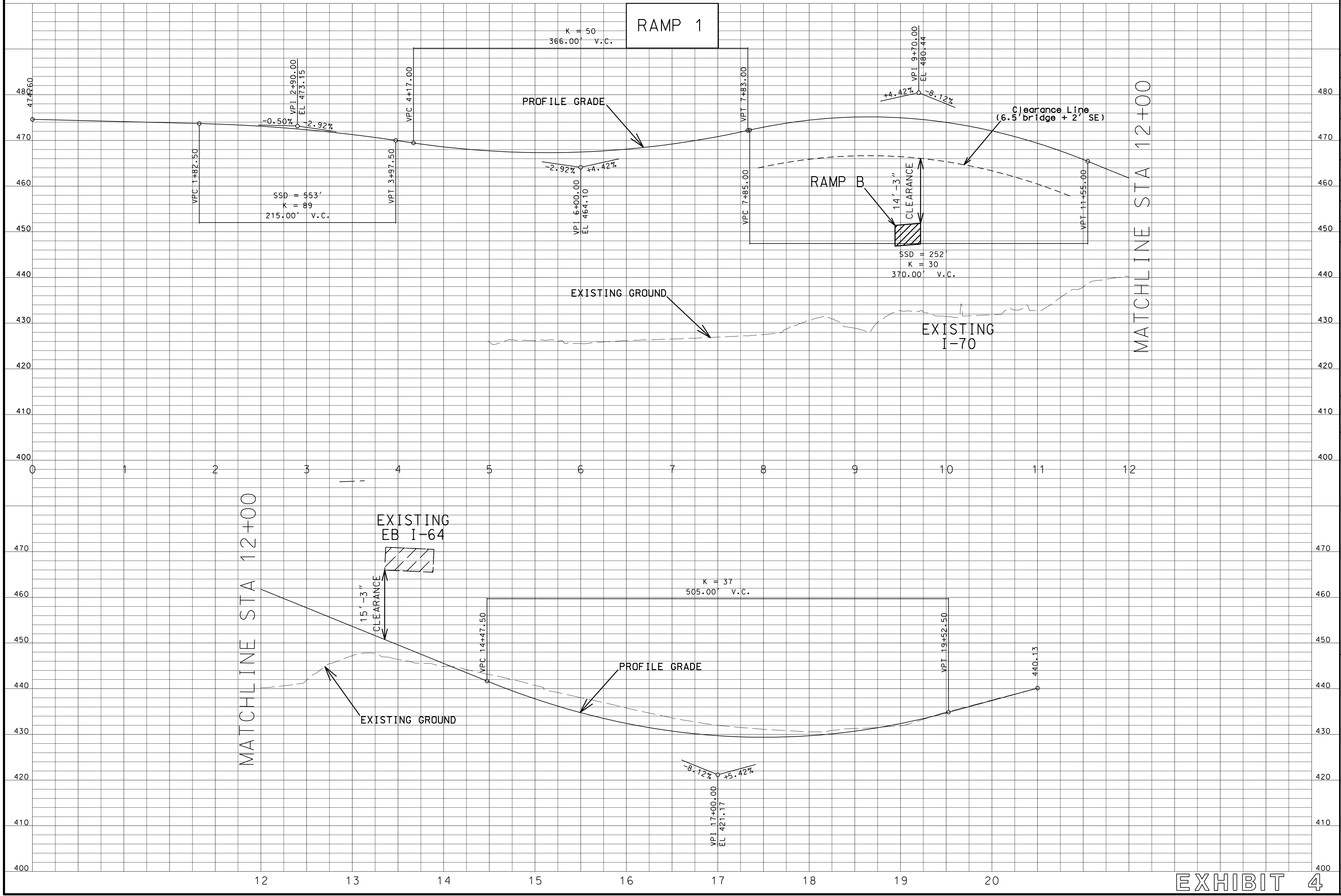


EXHIBIT 4

"THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT."

DATE

DATE PREPARED
7/13/2012

ROUTE	STATE
I-70	MO
DISTRICT	SHEET NO.
SL	

COUNTY
ST. LOUIS CITY

JOB NO.
J6I2377B

CONTRACT ID.

PROJECT NO.

BRIDGE NO.

DESCRIPTION

DATE

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

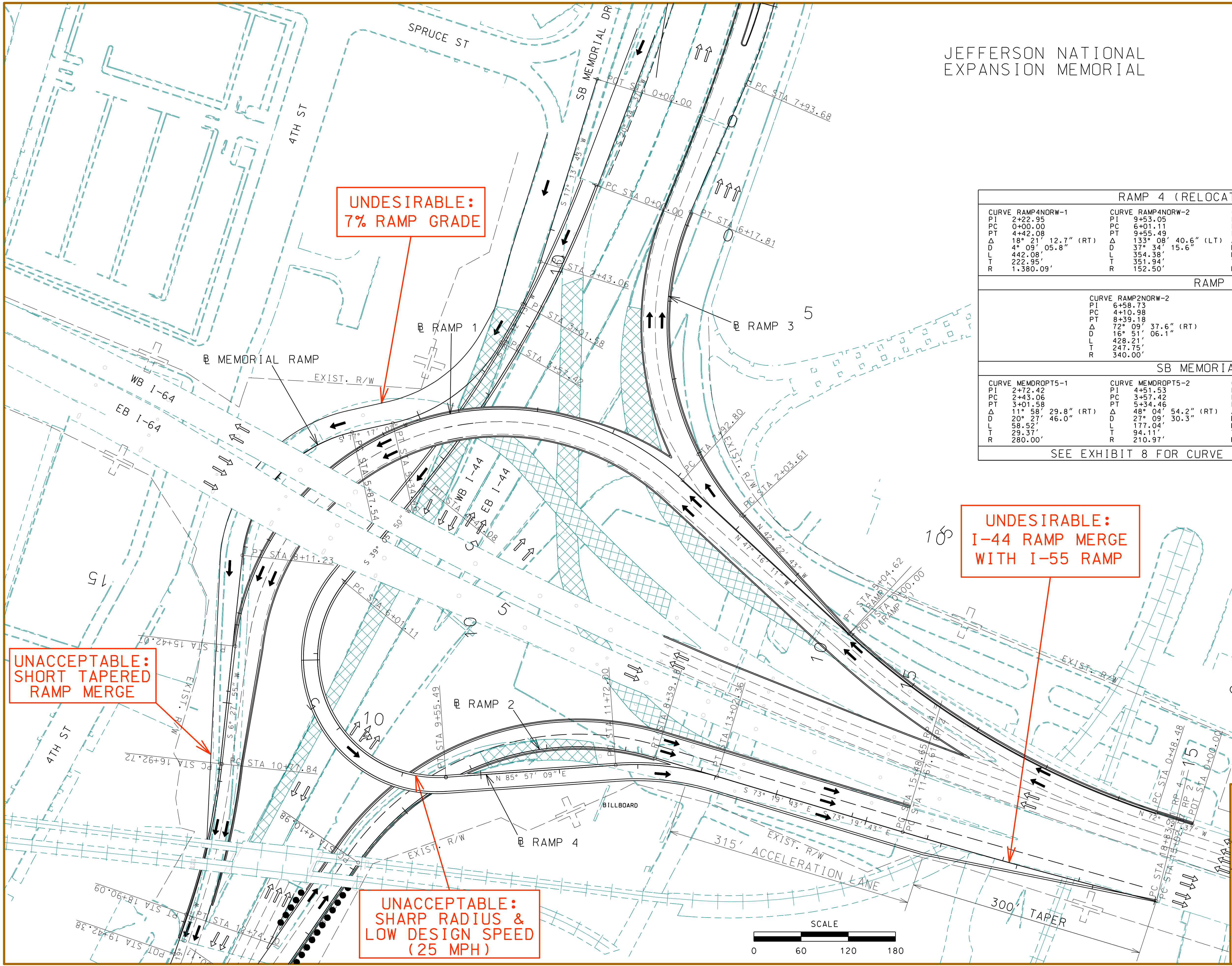
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

CONCEPTUAL ALTERNATIVE 4

RAMP 1 PROFILE WITH RAMP B

IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

EXHIBIT4_PROFILE_Ramp1_J6I2377B_i50.dgn 2:07:19 PM 7/13/2012



UNDESIRABLE:
7% RAMP GRADE

UNDESIRABLE:
I-44 RAMP MERGE
WITH I-55 RAMP

UNACCEPTABLE:
SHORT TAPERED
RAMP MERGE

UNACCEPTABLE:
SHARP RADIUS &
LOW DESIGN SPEED
(25 MPH)

RAMP 4 (RELOCATED RAMP B)

CURVE	RAMP4NORW-1	CURVE	RAMP4NORW-2	CURVE	RAMP4NORW-3	CURVE	RAMP4NORW-4
PI	2+22.95	PI	9+53.05	PI	12+37.90	PI	17+15.92
PC	0+00.00	PC	6+01.11	PC	11+72.00	PC	15+48.65
PT	4+42.08	PT	9+55.49	PT	13+02.36	PT	18+83.11
Δ	18° 21′ 12.7″ (RT)	Δ	133° 08′ 40.6″ (LT)	Δ	20° 43′ 07.8″ (RT)	Δ	2° 51′ 07.7″ (LT)
D	4° 09′ 05.8″	D	37° 34′ 15.6″	D	15° 53′ 36.3″	D	0° 51′ 09.9″
L	442.08′	L	354.38′	L	130.36′	L	334.46′
T	222.95′	T	351.94′	T	65.90′	T	167.27′
R	1,380.09′	R	152.50′	R	360.50′	R	6,718.90′

RAMP 2

CURVE	RAMP2NORW-2	CURVE	RAMP2NORW-3
PI	6+58.73	PI	13+34.87
PC	4+10.98	PC	11+67.61
PT	8+39.18	PT	15+02.07
Δ	72° 09′ 37.6″ (RT)	Δ	2° 51′ 07.7″ (LT)
D	16° 51′ 06.1″	D	0° 51′ 09.9″
L	428.21′	L	334.46′
T	247.75′	T	167.27′
R	340.00′	R	6,718.90′

SB MEMORIAL RAMP

CURVE	MEMDROPT5-1	CURVE	MEMDROPT5-2	CURVE	MEMDROPT5-3	CURVE	MEMDROPT5-4
PI	2+72.42	PI	4+51.53	PI	7+16.41	PI	11+76.67
PC	2+43.06	PC	3+57.42	PC	5+87.54	PC	10+77.84
PT	3+01.58	PT	5+34.46	PT	8+11.23	PT	12+74.70
Δ	11° 58′ 29.8″ (RT)	Δ	48° 04′ 54.2″ (RT)	Δ	71° 12′ 01.3″ (LT)	Δ	12° 33′ 53.7″ (RT)
D	20° 27′ 46.0″	D	27° 09′ 30.3″	D	31° 49′ 51.6″	D	6° 22′ 57.8″
L	58.52′	L	177.04′	L	223.68′	L	196.86′
T	29.37′	T	94.11′	T	128.87′	T	98.83′
R	280.00′	R	210.97′	R	180.00′	R	897.67′

SEE EXHIBIT 8 FOR CURVE DATA ON RAMPS 1 & 3

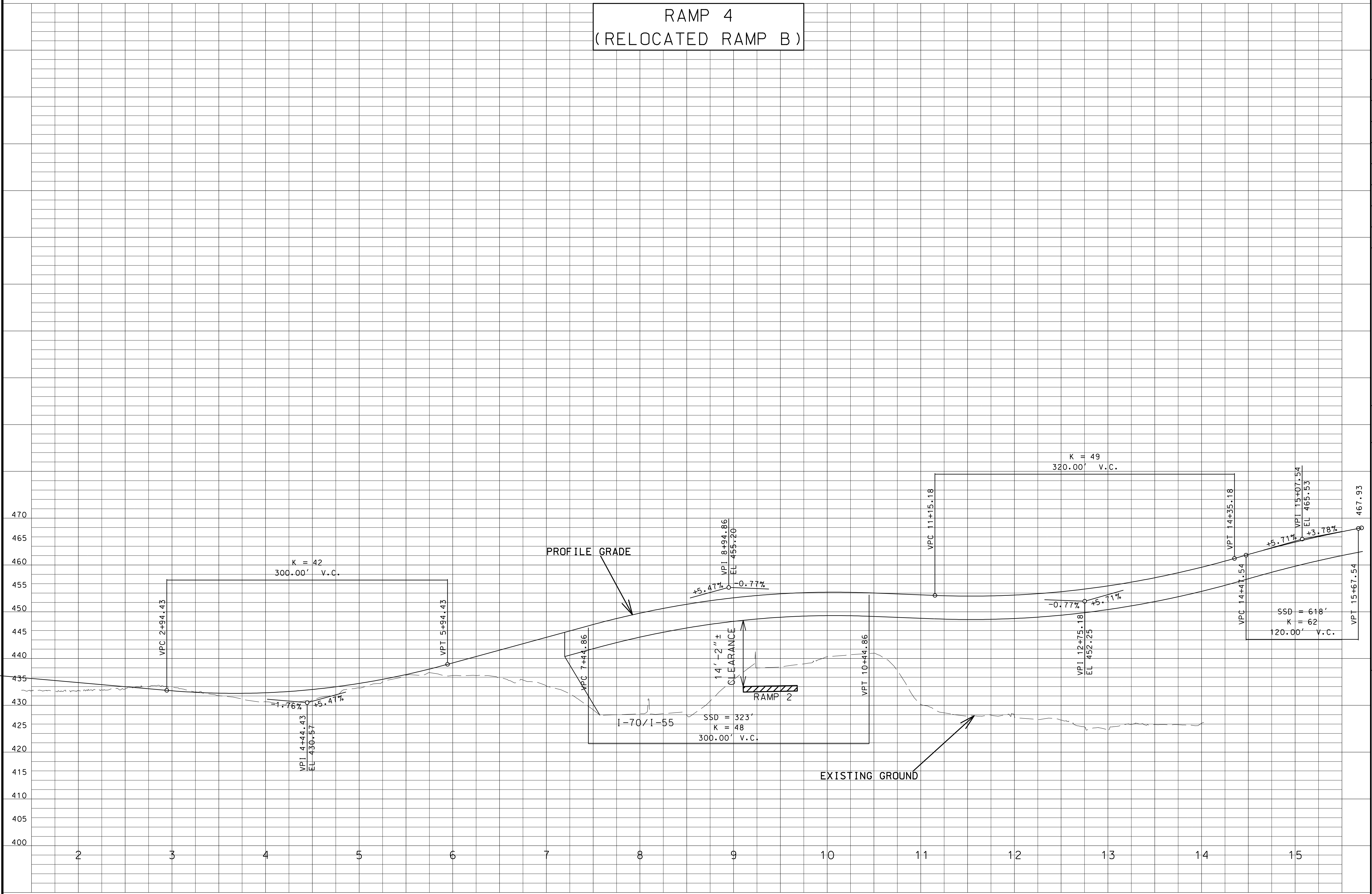
MISSOURI DEPARTMENT
OF TRANSPORTATION

EXHIBIT 5

CONCEPTUAL PLAN
ALTERNATIVE 5

J6I2377B

RAMP 4
(RELOCATED RAMP B)



"THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT."

DATE PREPARED
7/13/2012

ROUTE	STATE
I-70	MO
DISTRICT	SHEET NO.
SL	

COUNTY
ST LOUIS CITY

JOB NO.

CONTRACT ID.

PROJECT NO.

BRIDGE NO.

DATE	DESCRIPTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

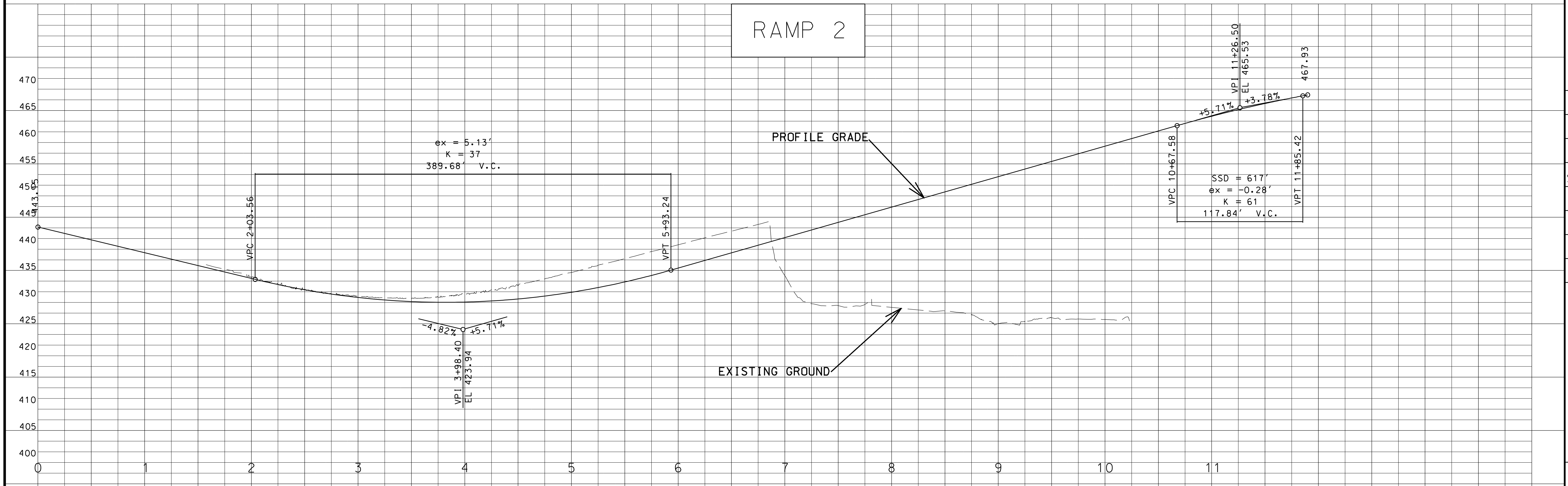
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT

CONCEPTUAL ALTERNATIVE 5

RAMP 4 PROFILE

EXHIBIT 5



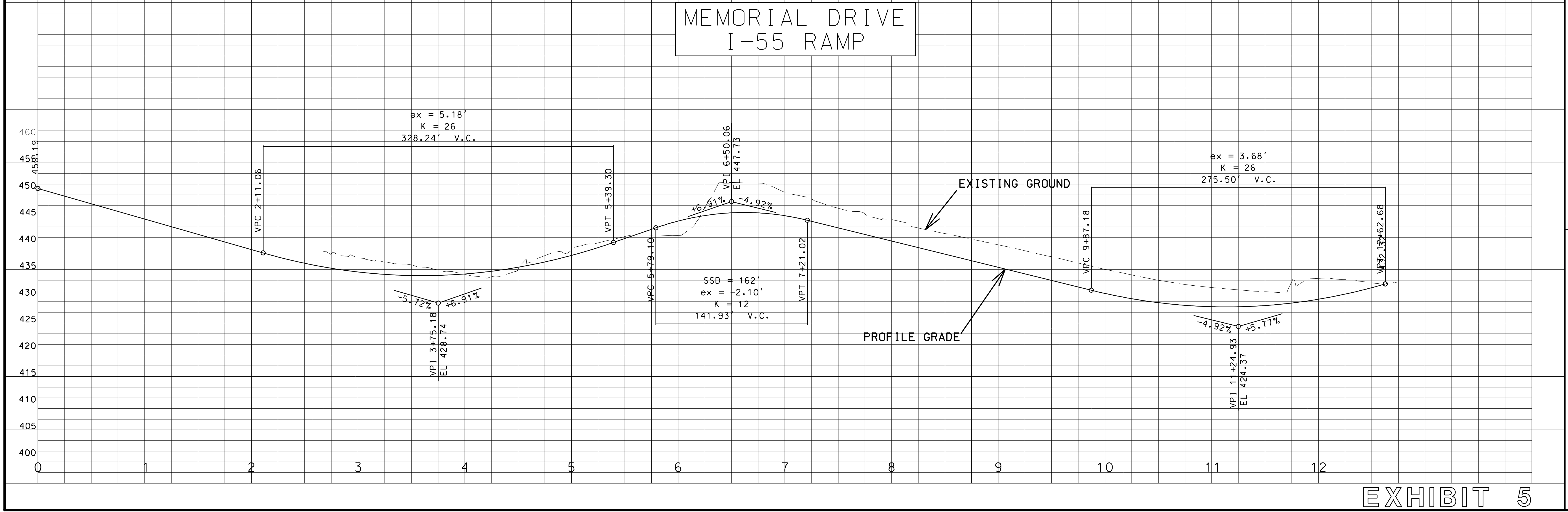


EXHIBIT 5

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A CERTIFIED
DOCUMENT."

IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

DATE PREPARED	
7/13/2012	
ROUTE	STATE
I-70	MO
DISTRICT	SHEET NO.
SL	
COUNTY	
ST LOUIS CITY	
JOB NO.	
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.	

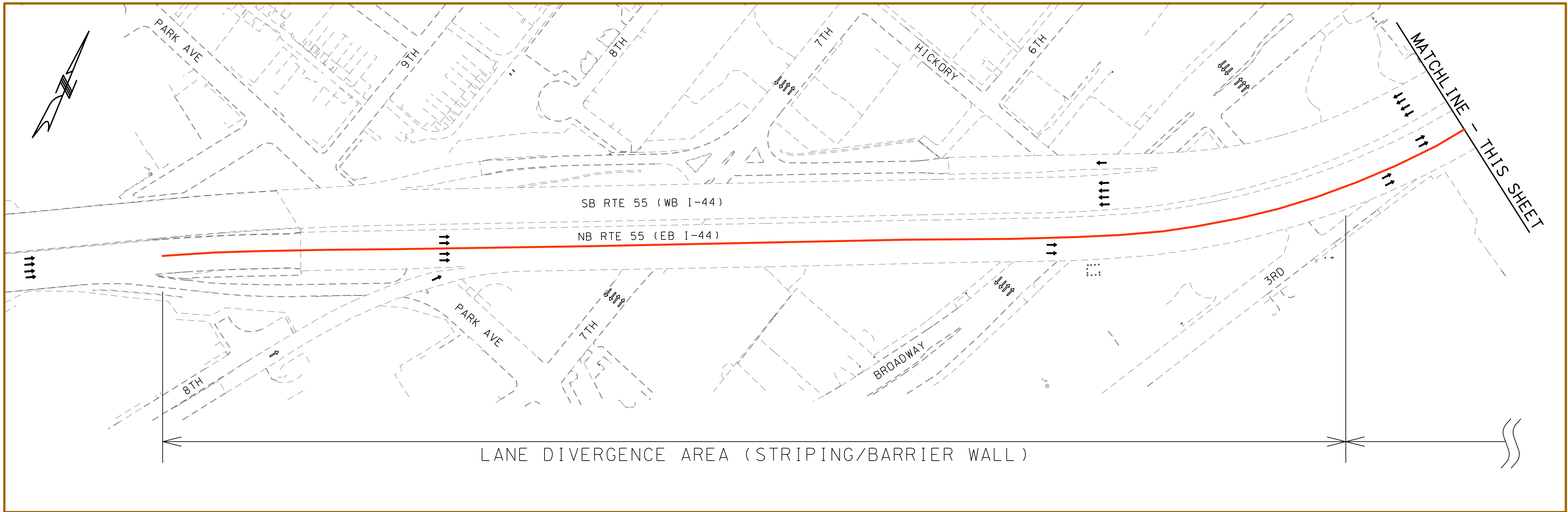
DESCRIPTION

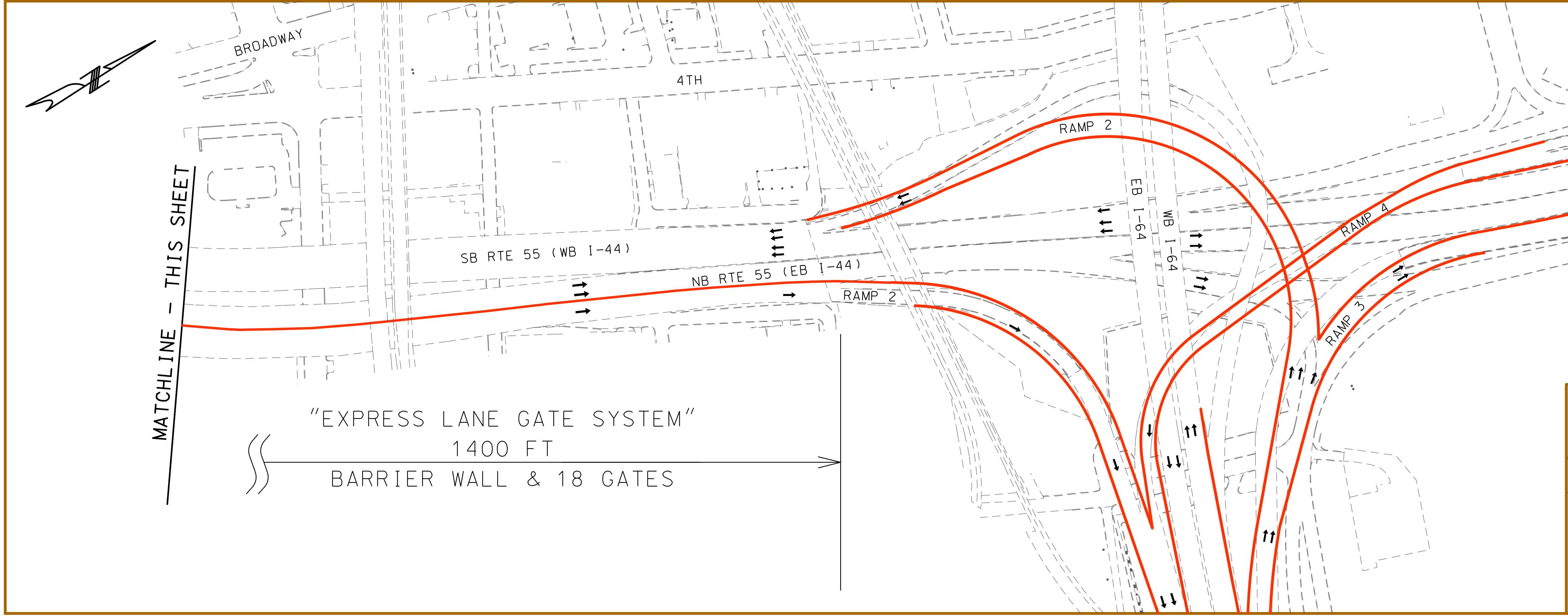
DATE

MISSOURI HIGHWAYS AND TRANSPORTATION
COMMISSION

105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

CONCEPTUAL ALTERNATIVE 5
RAMP 4 &
MEMORIAL RAMP
PROFILES





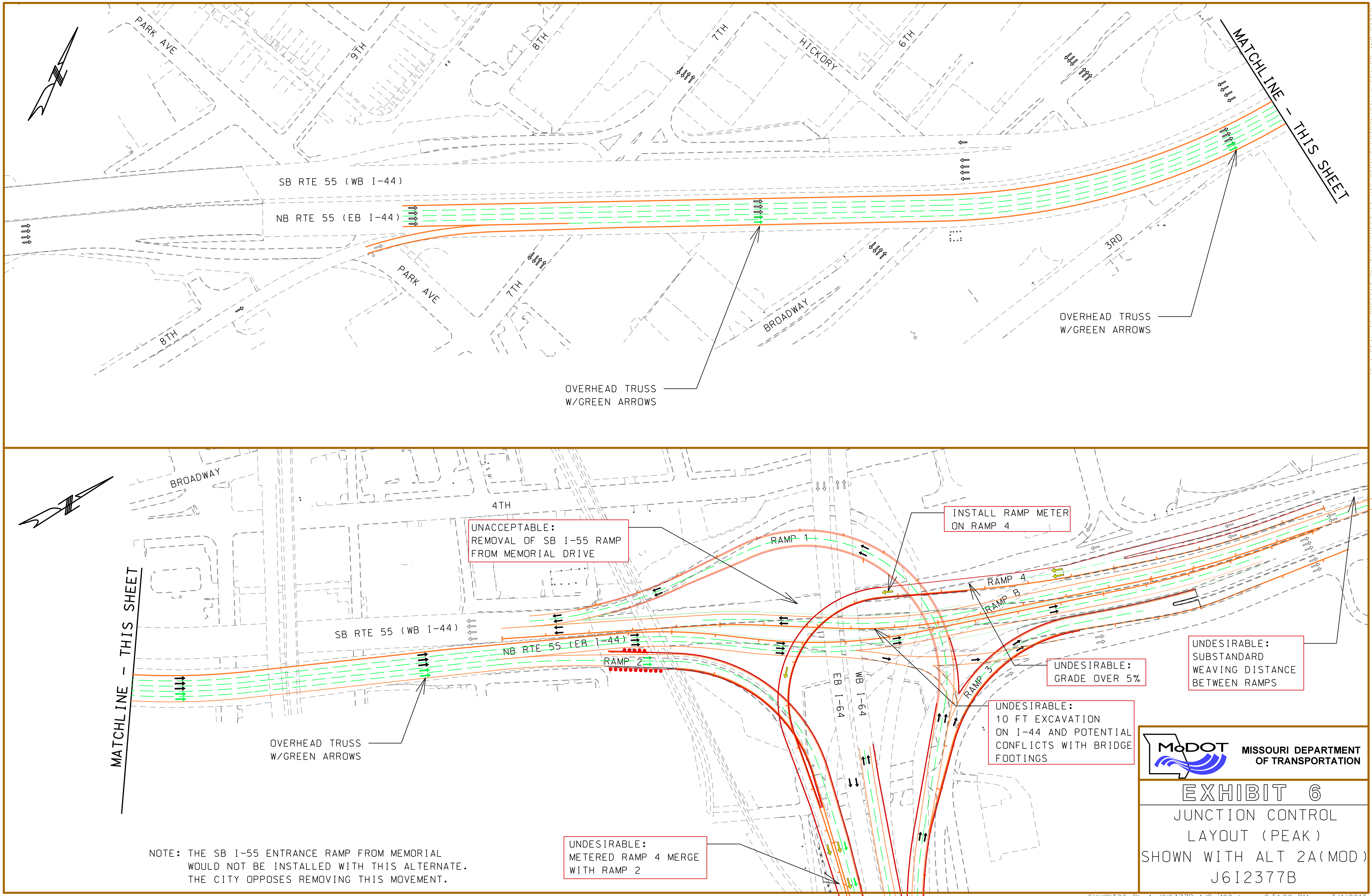
MoDOT

MISSOURI DEPARTMENT OF TRANSPORTATION

EXHIBIT 6

JUNCTION CONTROL LAYOUT

J6I2377B



OVERHEAD TRUSS
W/GREEN ARROWS

OVERHEAD TRUSS
W/GREEN ARROWS

OVERHEAD TRUSS
W/GREEN ARROWS

UNACCEPTABLE:
REMOVAL OF SB I-55 RAMP
FROM MEMORIAL DRIVE

INSTALL RAMP METER
ON RAMP 4

UNDESIRABLE:
GRADE OVER 5%

UNDESIRABLE:
SUBSTANDARD
WEAVING DISTANCE
BETWEEN RAMPS

UNDESIRABLE:
10 FT EXCAVATION
ON I-44 AND POTENTIAL
CONFLICTS WITH BRIDGE
FOOTINGS

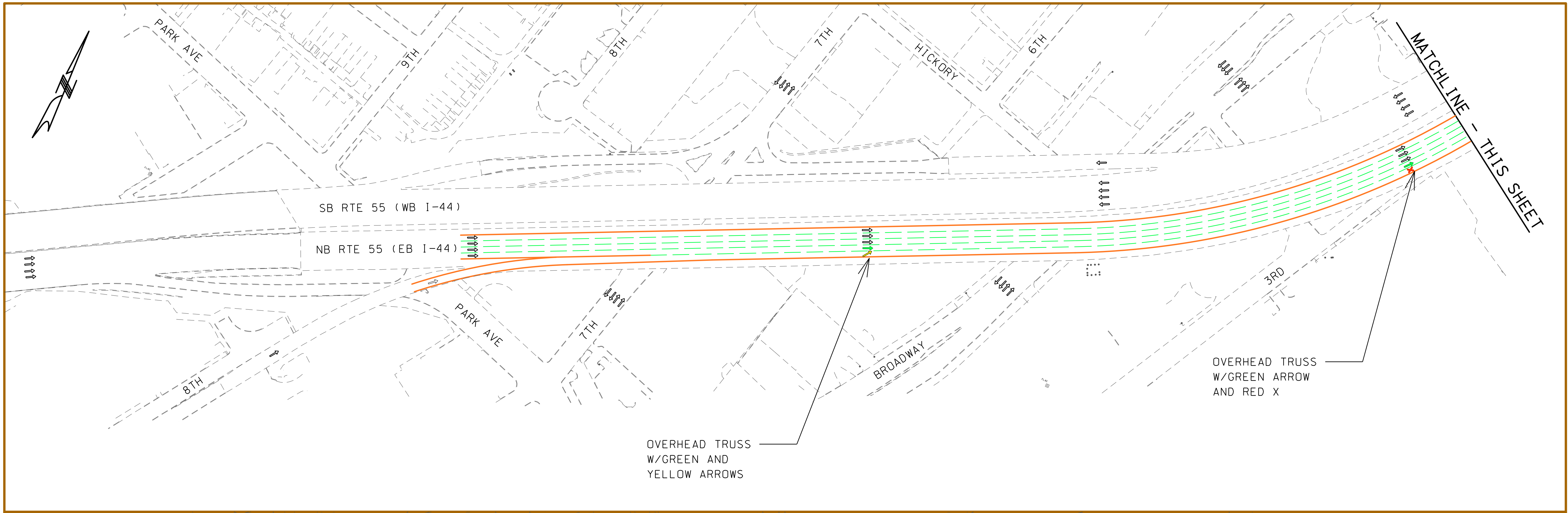
UNDESIRABLE:
METERED RAMP 4 MERGE
WITH RAMP 2

NOTE: THE SB I-55 ENTRANCE RAMP FROM MEMORIAL
WOULD NOT BE INSTALLED WITH THIS ALTERNATE.
THE CITY OPPOSES REMOVING THIS MOVEMENT.

MoDOT MISSOURI DEPARTMENT
OF TRANSPORTATION

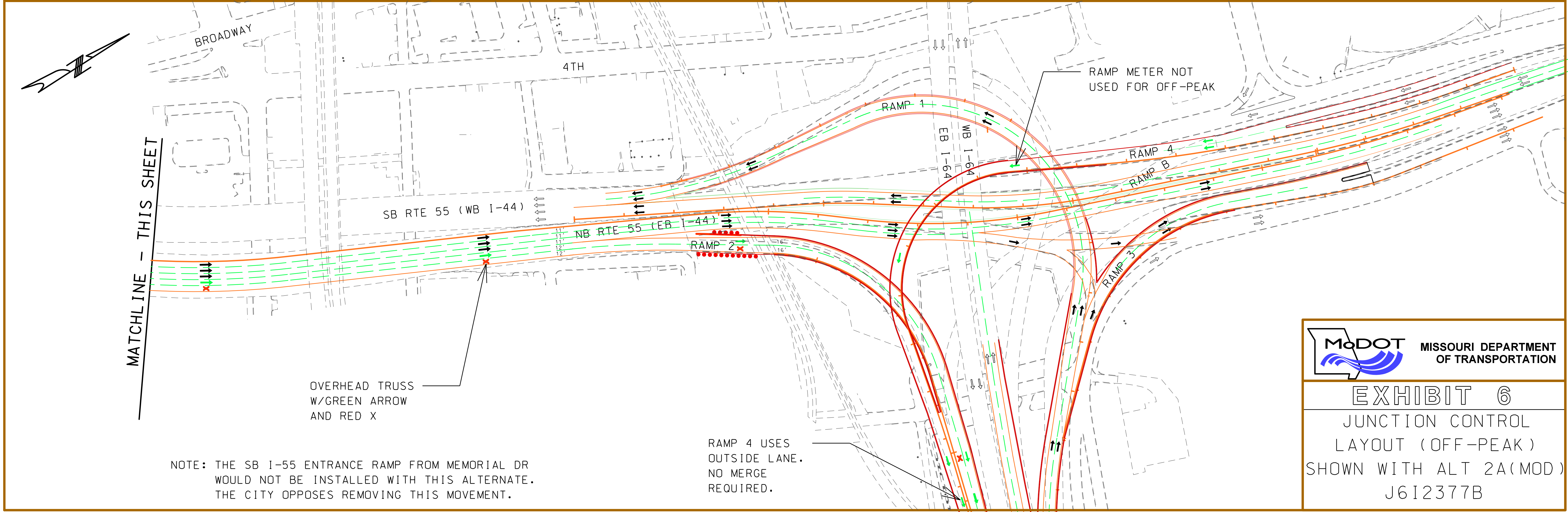
EXHIBIT 6

JUNCTION CONTROL
LAYOUT (PEAK)
SHOWN WITH ALT 2A(MOD)
J6I2377B



OVERHEAD TRUSS
W/GREEN ARROW
AND RED X

OVERHEAD TRUSS
W/GREEN AND
YELLOW ARROWS



RAMP METER NOT
USED FOR OFF-PEAK

OVERHEAD TRUSS
W/GREEN ARROW
AND RED X

RAMP 4 USES
OUTSIDE LANE.
NO MERGE
REQUIRED.

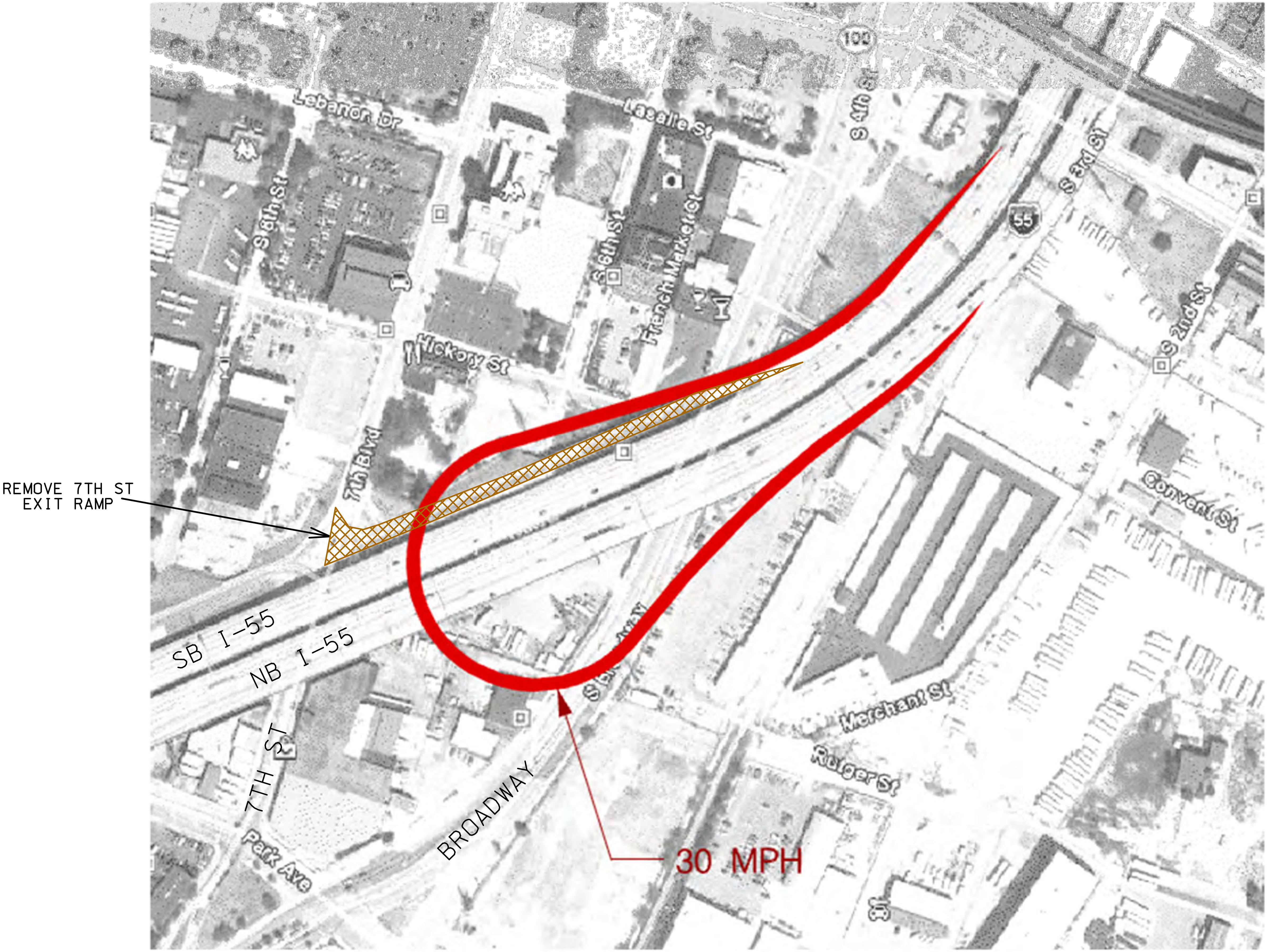
NOTE: THE SB I-55 ENTRANCE RAMP FROM MEMORIAL DR
WOULD NOT BE INSTALLED WITH THIS ALTERNATE.
THE CITY OPPOSES REMOVING THIS MOVEMENT.

MoDOT **MISSOURI DEPARTMENT OF TRANSPORTATION**

EXHIBIT 6

JUNCTION CONTROL
LAYOUT (OFF-PEAK)
SHOWN WITH ALT 2A(MOD)
J6I2377B

IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

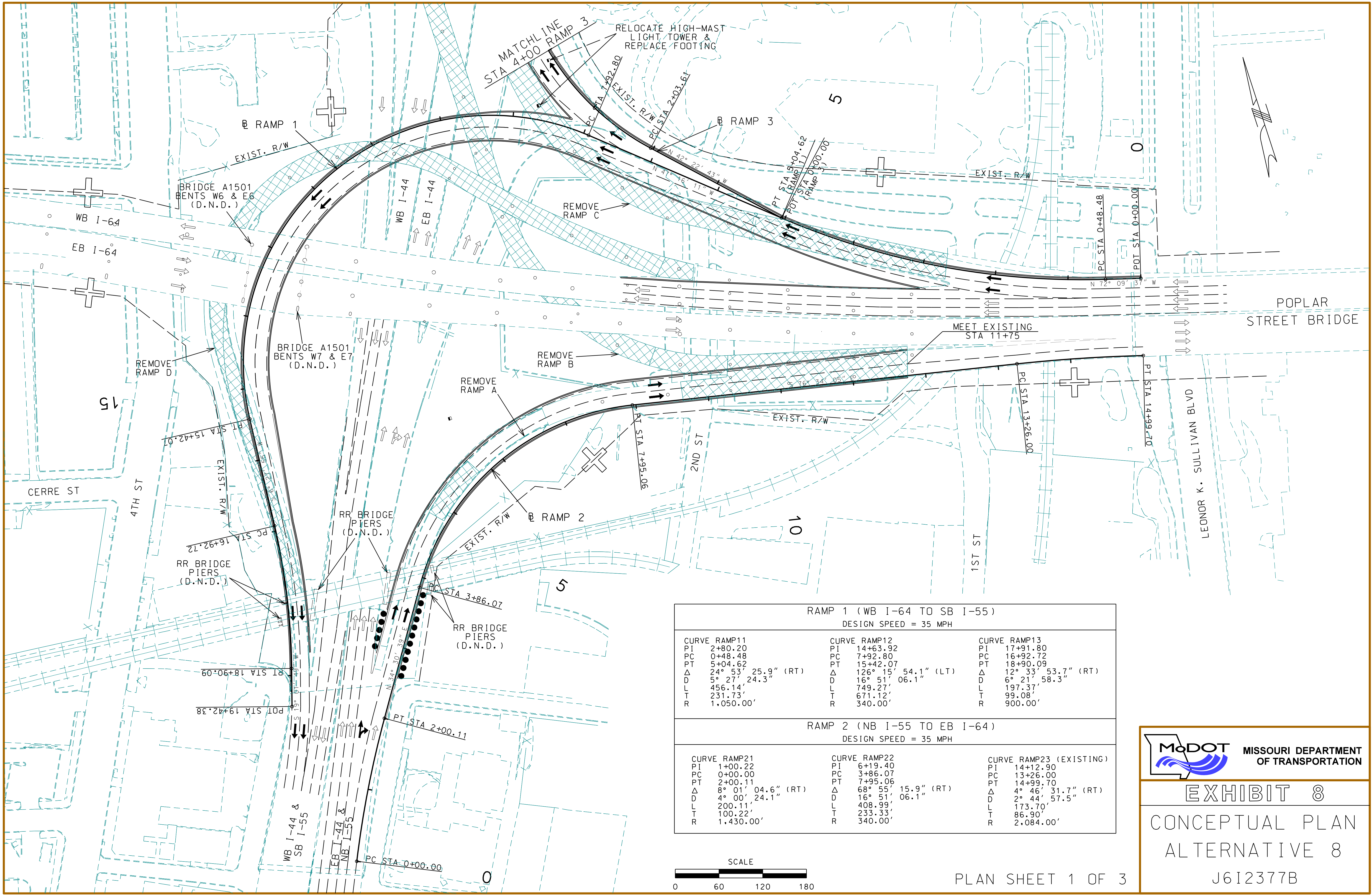


MoDOT MISSOURI DEPARTMENT OF TRANSPORTATION

EXHIBIT 7

CONCEPTUAL PLAN ALTERNATIVE 7

J6I2377B



RAMP 1 (WB I-64 TO SB I-55)

DESIGN SPEED = 35 MPH

CURVE	RAMP11	CURVE	RAMP12	CURVE	RAMP13
PI	2+80.20	PI	14+63.92	PI	17+91.80
PC	0+48.48	PC	7+92.80	PC	16+92.72
PT	5+04.62	PT	15+42.07	PT	18+90.09
Δ	24° 53′ 25.9″ (RT)	Δ	126° 15′ 54.1″ (LT)	Δ	12° 33′ 53.7″ (RT)
D	5° 27′ 24.3″	D	16° 51′ 06.1″	D	6° 21′ 58.3″
L	456.14′	L	749.27′	L	197.37′
T	231.73′	T	671.12′	T	99.08′
R	1,050.00′	R	340.00′	R	900.00′

RAMP 2 (NB I-55 TO EB I-64)

DESIGN SPEED = 35 MPH

CURVE	RAMP21	CURVE	RAMP22	CURVE	RAMP23 (EXISTING)
PI	1+00.22	PI	6+19.40	PI	14+12.90
PC	0+00.00	PC	3+86.07	PC	13+26.00
PT	2+00.11	PT	7+95.06	PT	14+99.70
Δ	8° 01′ 04.6″ (RT)	Δ	68° 55′ 15.9″ (RT)	Δ	4° 46′ 31.7″ (RT)
D	4° 00′ 24.1″	D	16° 51′ 06.1″	D	2° 44′ 57.5″
L	200.11′	L	408.99′	L	173.70′
T	100.22′	T	233.33′	T	86.90′
R	1,430.00′	R	340.00′	R	2,084.00′

SCALE
0 60 120 180

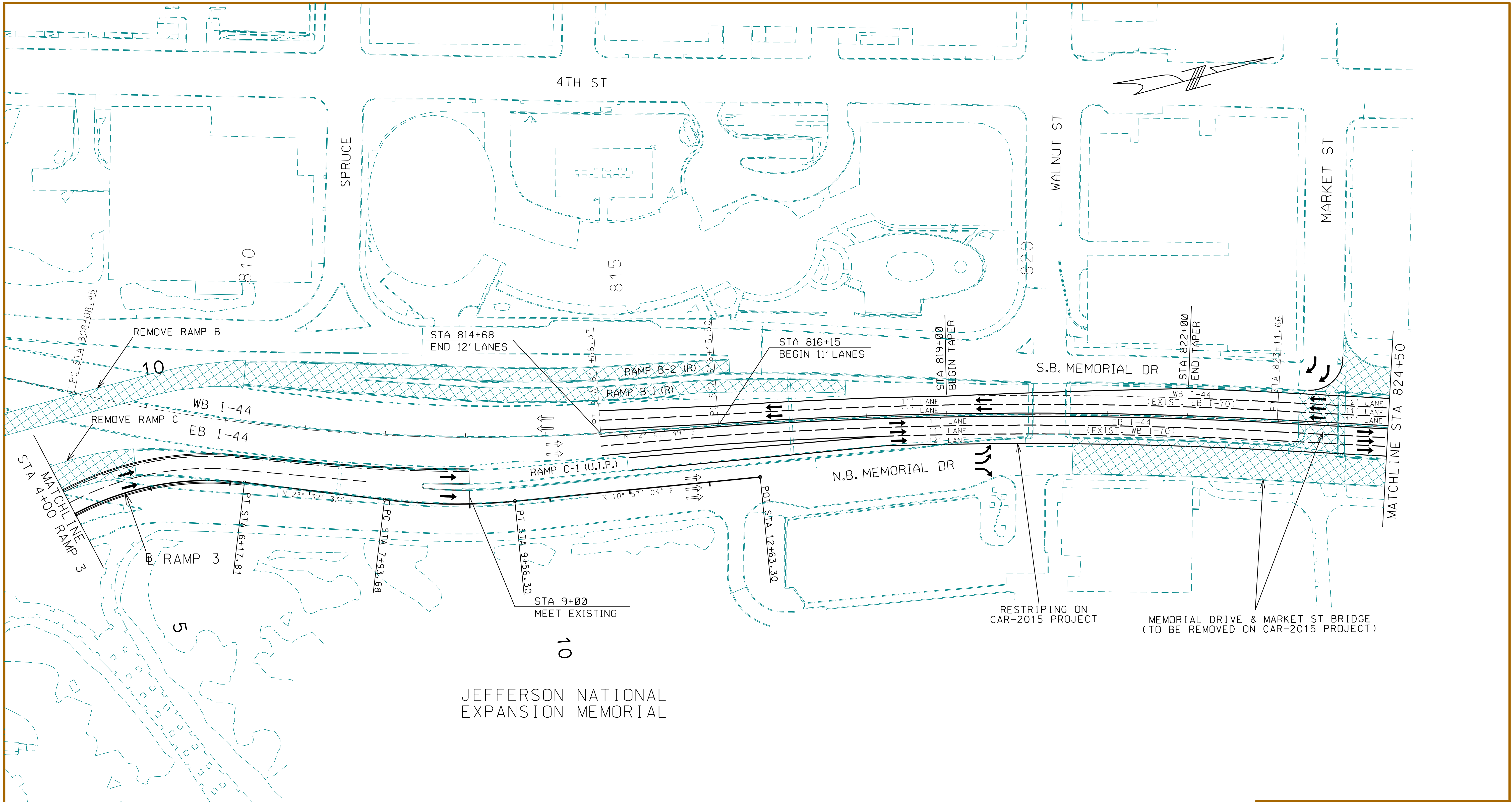
PLAN SHEET 1 OF 3

MoDOT
MISSOURI DEPARTMENT
OF TRANSPORTATION

EXHIBIT 8

CONCEPTUAL PLAN
ALTERNATIVE 8

J6I2377B



RAMP 3 (WB I-64 TO MEMORIAL DR & I-70/I-44)
DESIGN SPEED = 35 MPH

CURVE RAMP31		CURVE RAMP32	
PI	4+37.05	PI	8+75.32
PC	2+03.61	PC	7+93.68
PT	6+17.81	PT	9+56.30
Δ	65° 55' 16.0" (RT)	Δ	12° 35' 29.0" (LT)
D	15° 54' 55.8"	D	7° 44' 33.6"
L	414.19'	L	162.62'
T	233.43'	T	81.64'
R	360.00'	R	740.00'

SCALE

0 60 120 180

PLAN SHEET 2 OF 3

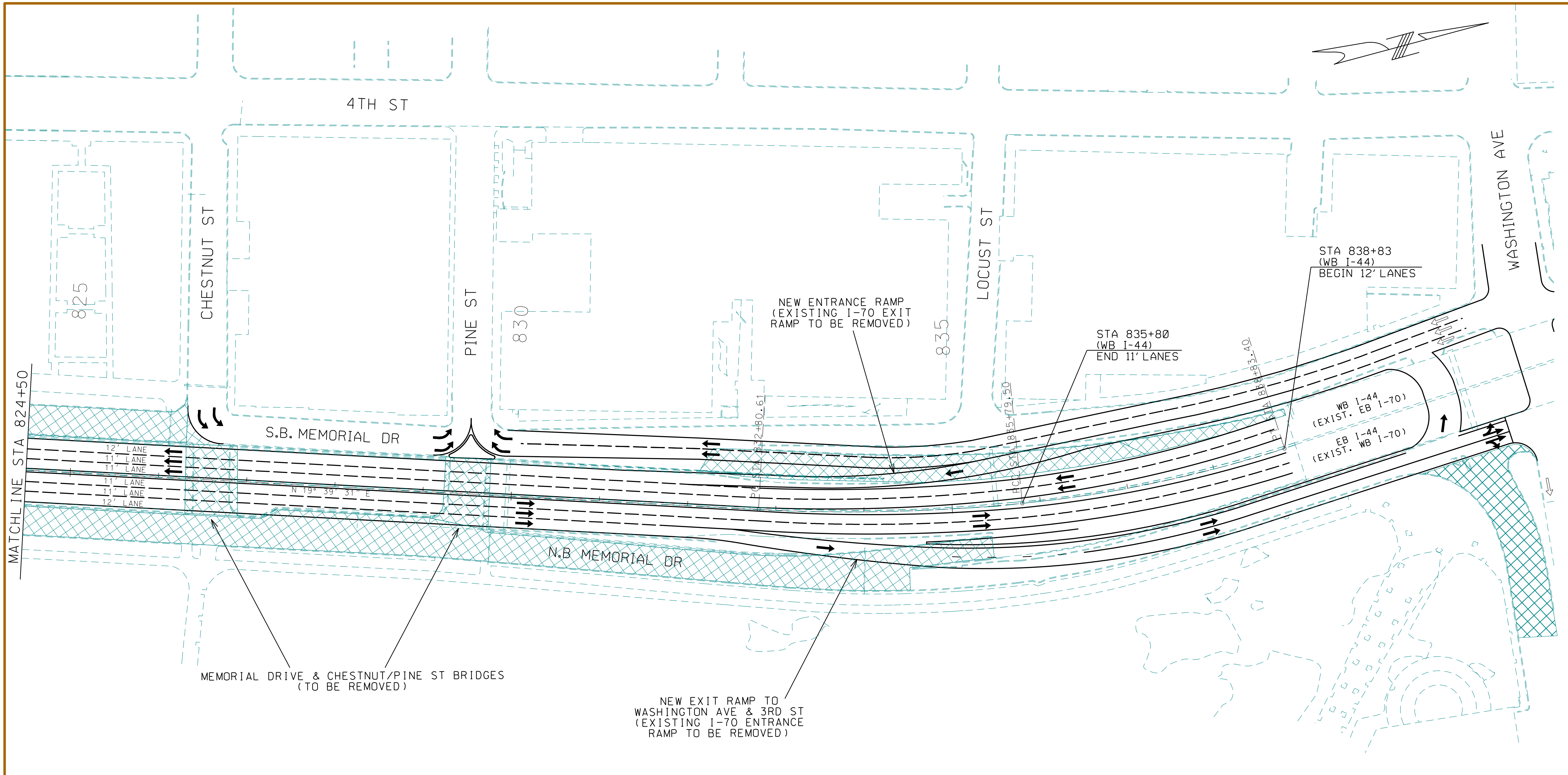
MoDOT
MISSOURI DEPARTMENT
OF TRANSPORTATION

EXHIBIT 8

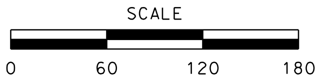
CONCEPTUAL PLAN
ALTERNATIVE 8

J6I2377B

IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED



NOTE: WORK SHOWN IS PART OF CAR-2015 PROJECT



PLAN SHEET 3 OF 3

MISSOURI DEPARTMENT
OF TRANSPORTATION

EXHIBIT 8

CONCEPTUAL PLAN
ALTERNATIVE 8

J6I2377B

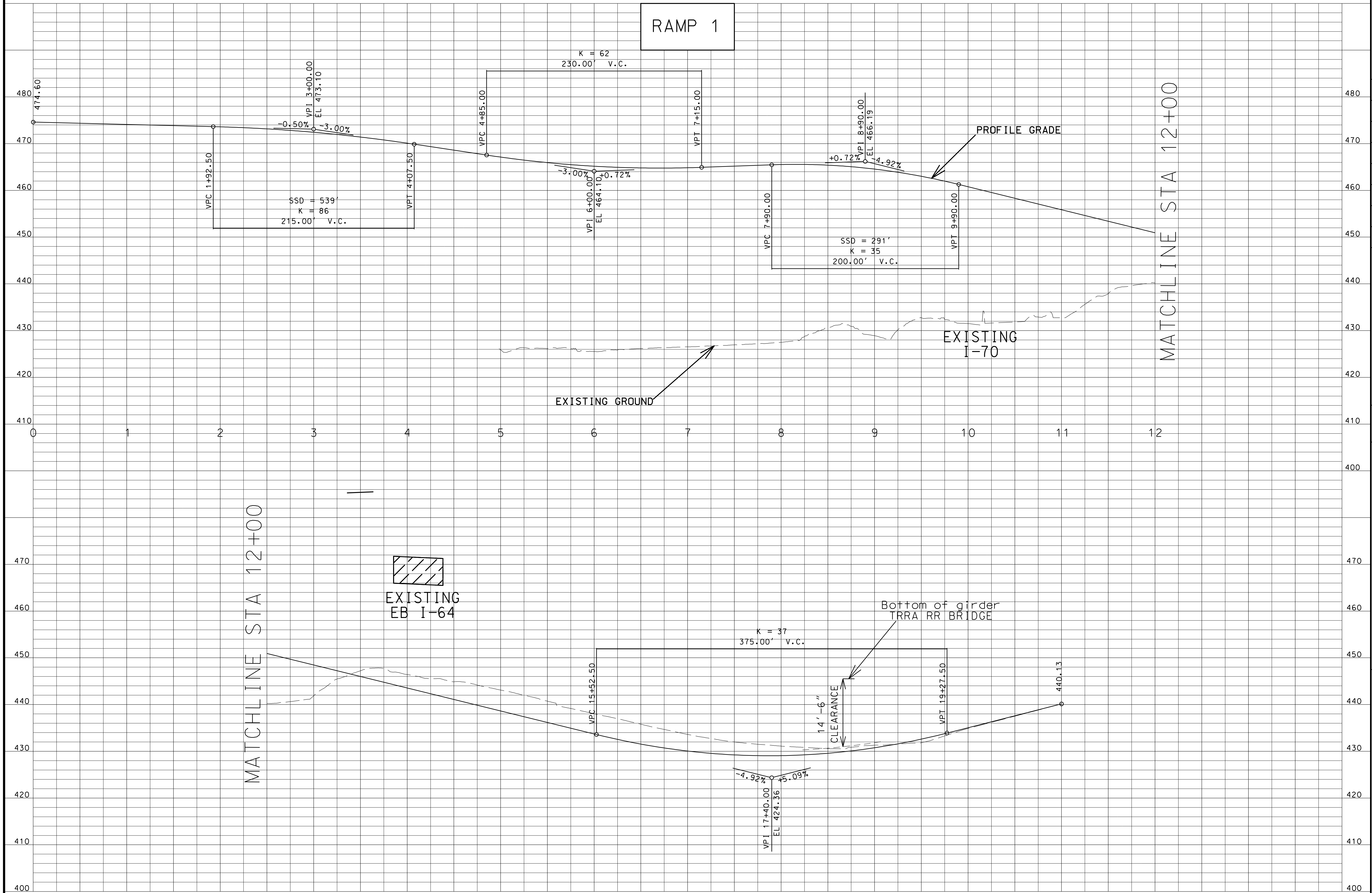


EXHIBIT 8

"THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT."

DATE PREPARED 7/18/2012
ROUTE I-70
STATE MO
DISTRICT SL
SHEET NO.
COUNTY ST. LOUIS CITY
JOB NO. J6I2377B
CONTRACT ID.
PROJECT NO.
BRIDGE NO.

DATE	DESCRIPTION

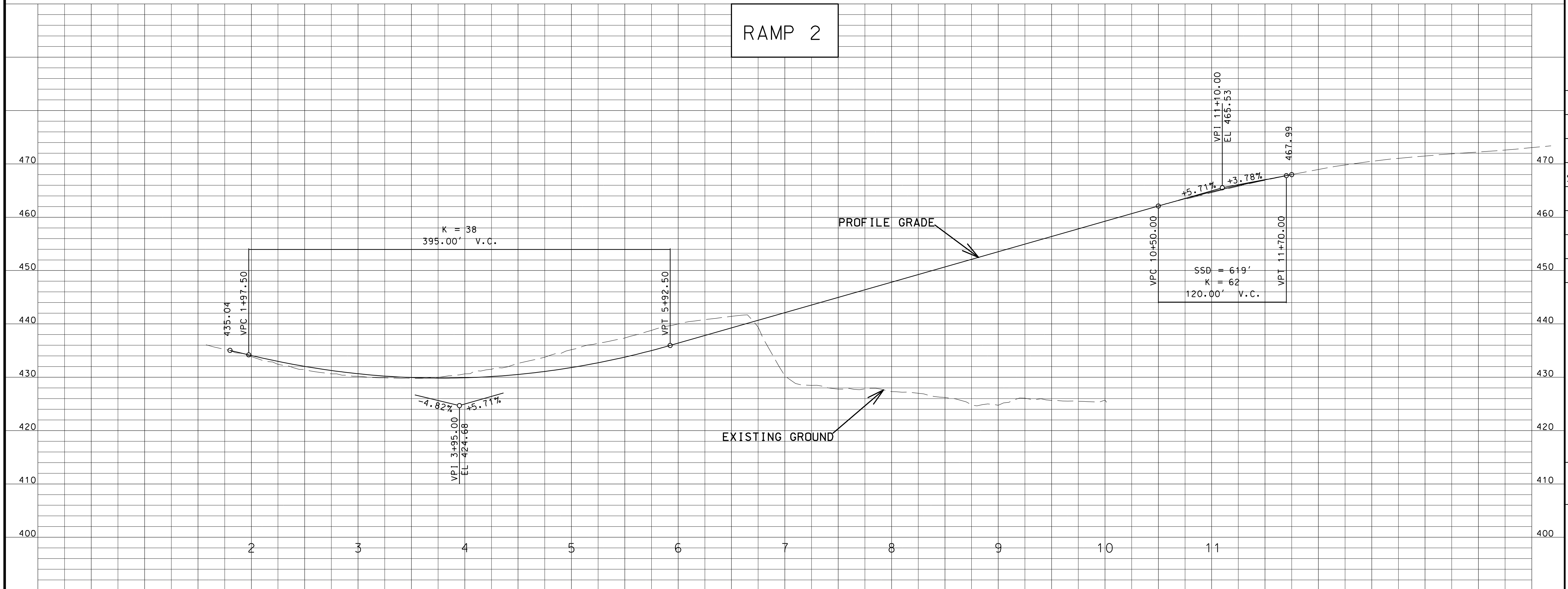
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

CONCEPTUAL ALTERNATIVE 8

RAMP 1 PROFILE

IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.



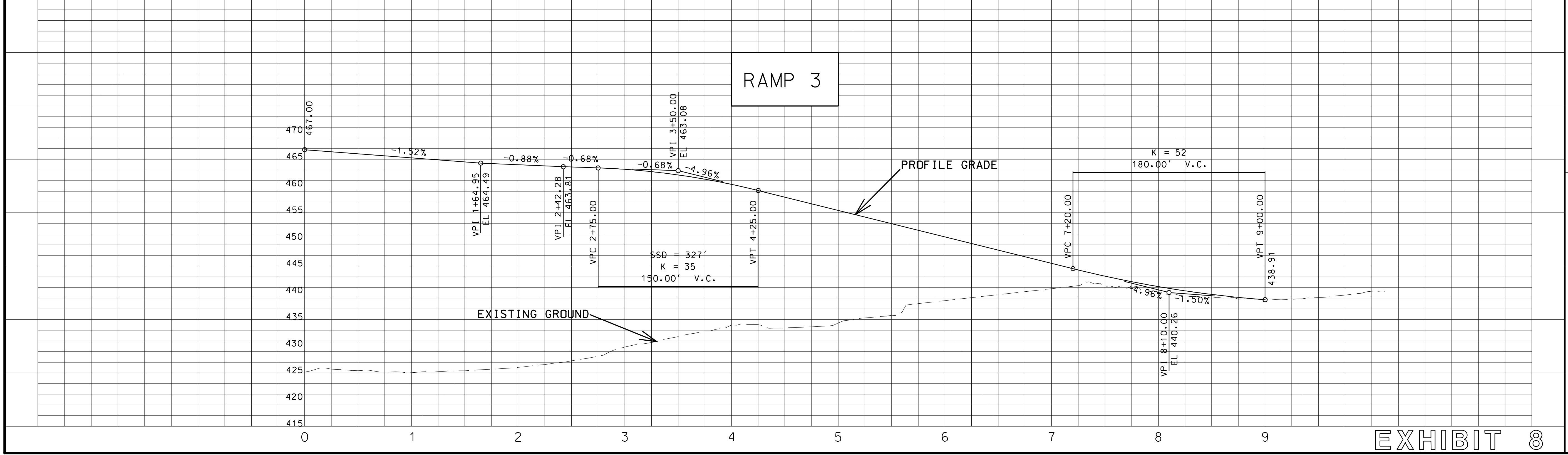


EXHIBIT 8

"THIS MEDIA SHOULD
NOT BE CONSIDERED
A CERTIFIED
DOCUMENT."

DATE PREPARED
7/18/2012

ROUTE	STATE
I-70	MO
DISTRICT	SHEET NO.
SL	

COUNTY
ST. LOUIS CITY
JOB NO.
J6I2377B
CONTRACT ID.

PROJECT NO.

BRIDGE NO.

DESCRIPTION

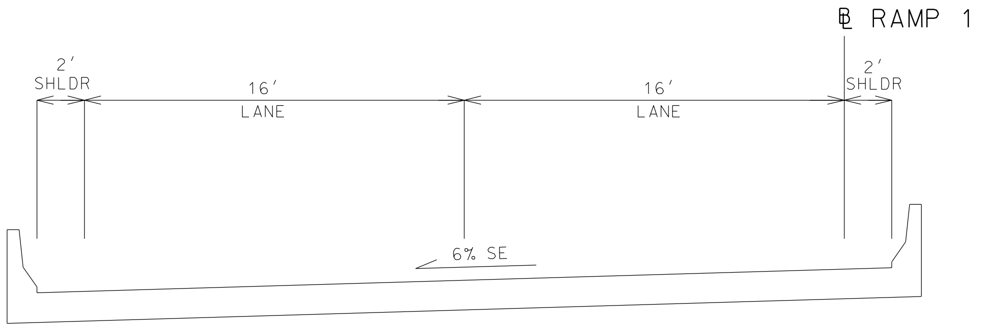
DATE

MISSOURI HIGHWAYS AND TRANSPORTATION
COMMISSION

105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

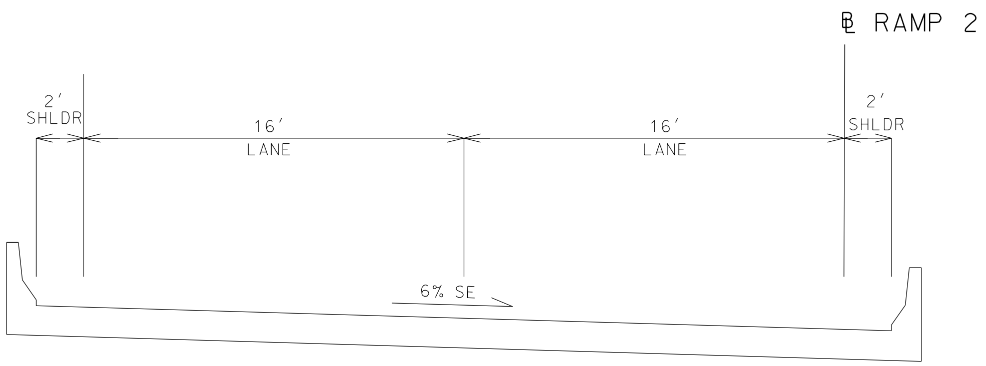
CONCEPTUAL ALTERNATIVE 8
RAMPS 2 & 3
PROFILES

IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.



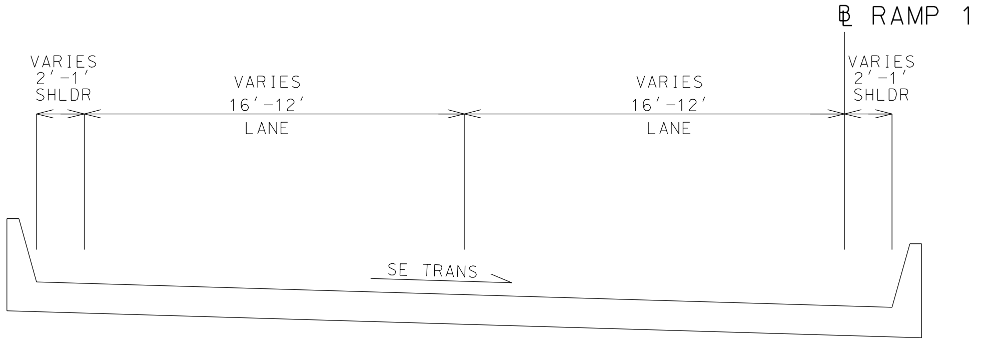
TYPICAL SECTION ON BRIDGE

RAMP 1 (WB I-64 TO SB I-55)



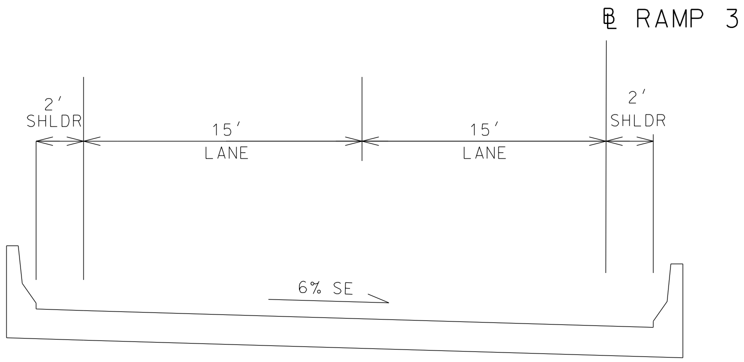
TYPICAL SECTION ON BRIDGE

RAMP 2 (NB I-55 TO EB I-64)



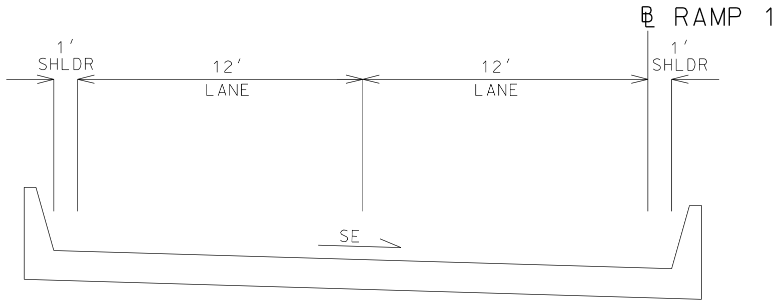
TYPICAL ROADWAY SECTION

RAMP 1 (WB I-64 TO SB I-55)
STA 15+42 TO STA 16+93



TYPICAL SECTION ON BRIDGE

RAMP 3 (WB I-64 TO MEMORIAL DR & I-70/I-44)



TYPICAL ROADWAY SECTION

RAMP 1 (WB I-64 TO SB I-55)
STA 16+93 TO STA 18+50±

NOT TO SCALE

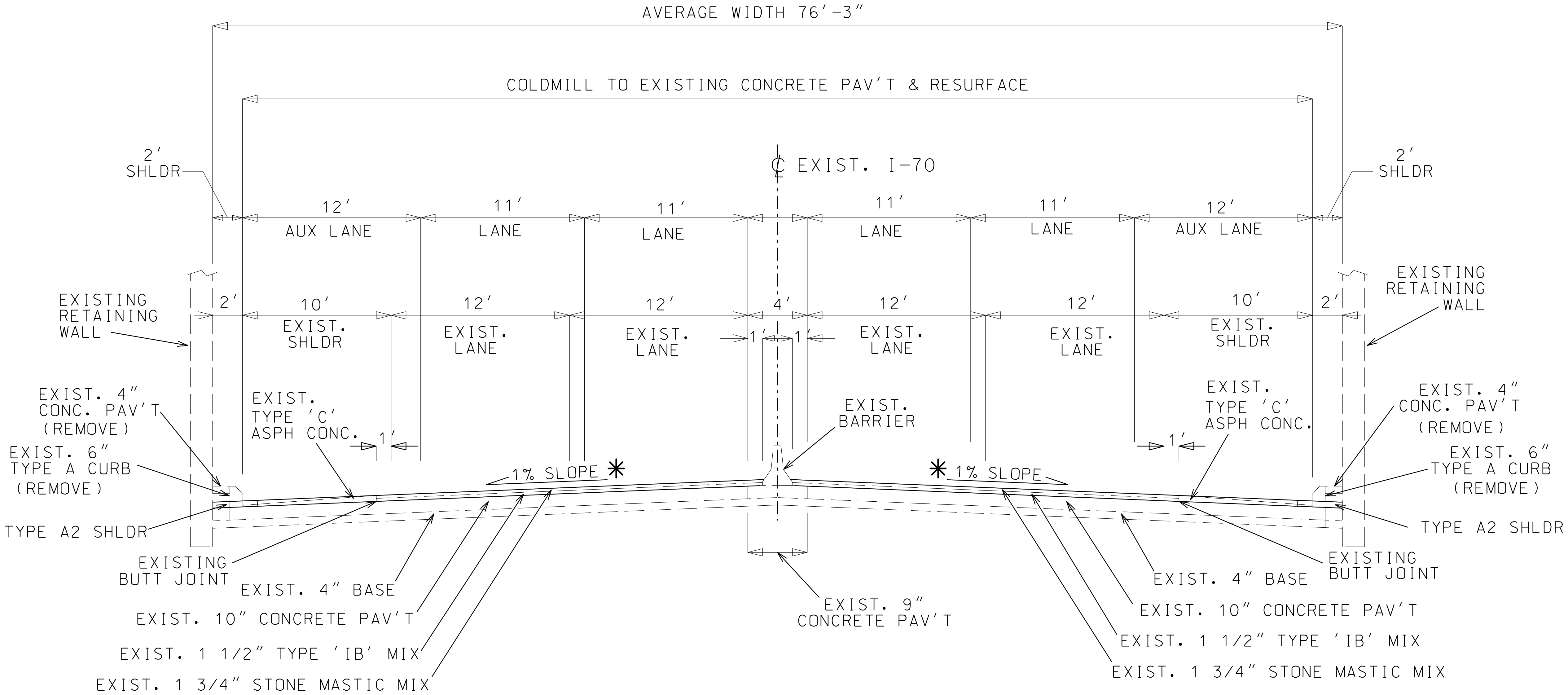
EXHIBIT 8

DATE
DATE PREPARED
ROUTE I-70
STATE MO
DISTRICT 6
SHEET NO.
COUNTY ST.LOUIS CITY
JOB NO. J6I2377B
CONTRACT ID.
PROJECT NO.
BRIDGE NO.

DATE
DESCRIPTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

TYPICAL SECTIONS
SHEET 1 OF 2



SECTION ON TANGENT - DEPRESSED SECTION

EXISTING I-70 (FUTURE I-44)

(TO BE DONE ON CAR-2015 PROJECT)

✳ MATCH EXISTING X-SLOPE

NOT TO SCALE

EXHIBIT 8

DATE

DATE PREPARED

ROUTE I-70
STATE MO
DISTRICT 6
SHEET NO.
COUNTY ST.LOUIS CITY
JOB NO. J6I2377B
CONTRACT ID.
PROJECT NO.
BRIDGE NO.

DESCRIPTION

DATE

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

TYPICAL SECTIONS

SHEET 2 OF 2

REV.

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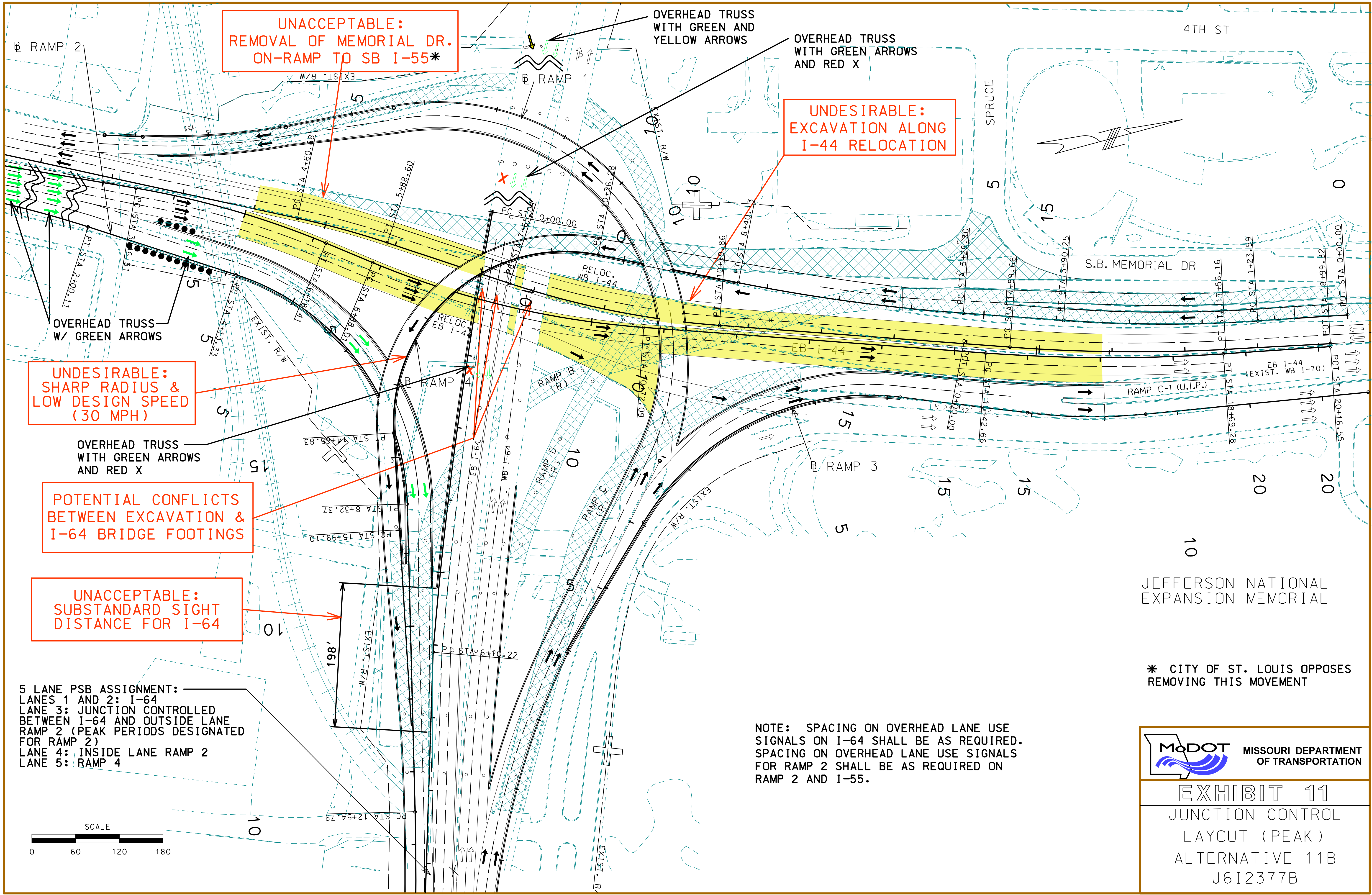


UNACCEPTABLE: REMOVAL OF MEMORIAL DR. ON-RAMP TO SB I-55*

OVERHEAD TRUSS WITH GREEN AND YELLOW ARROWS

OVERHEAD TRUSS WITH GREEN ARROWS AND RED X

UNDESIRABLE: EXCAVATION ALONG I-44 RELOCATION

OVERHEAD TRUSS W/ GREEN ARROWS

UNDESIRABLE: SHARP RADIUS & LOW DESIGN SPEED (30 MPH)

OVERHEAD TRUSS WITH GREEN ARROWS AND RED X

POTENTIAL CONFLICTS BETWEEN EXCAVATION & I-64 BRIDGE FOOTINGS

UNACCEPTABLE: SUBSTANDARD SIGHT DISTANCE FOR I-64

5 LANE PSB ASSIGNMENT:
LANES 1 AND 2: I-64
LANE 3: JUNCTION CONTROLLED BETWEEN I-64 AND OUTSIDE LANE RAMP 2 (PEAK PERIODS DESIGNATED FOR RAMP 2)
LANE 4: INSIDE LANE RAMP 2
LANE 5: RAMP 4

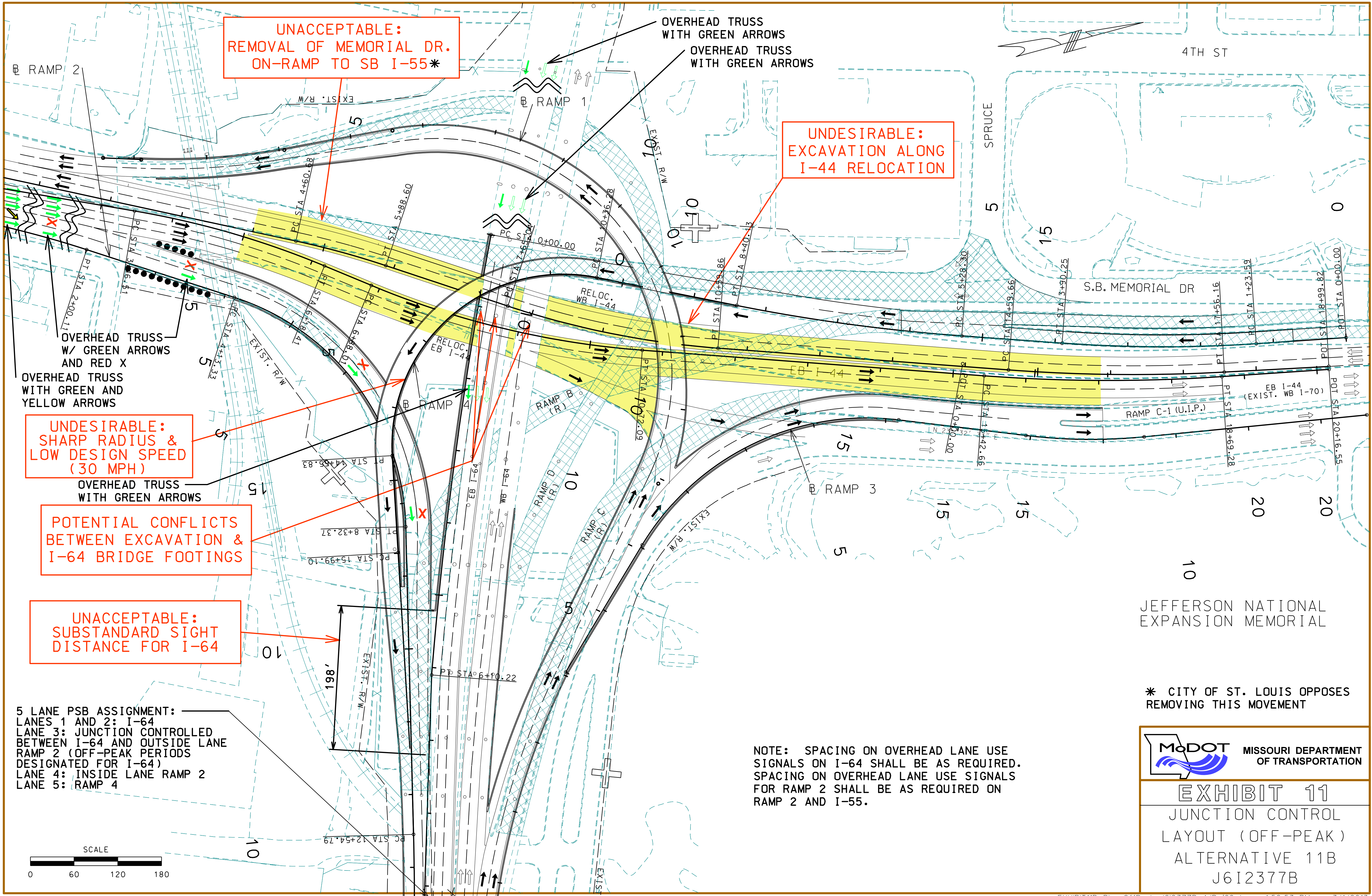
NOTE: SPACING ON OVERHEAD LANE USE SIGNALS ON I-64 SHALL BE AS REQUIRED. SPACING ON OVERHEAD LANE USE SIGNALS FOR RAMP 2 SHALL BE AS REQUIRED ON RAMP 2 AND I-55.

* CITY OF ST. LOUIS OPPOSES REMOVING THIS MOVEMENT

MoDOT MISSOURI DEPARTMENT OF TRANSPORTATION

EXHIBIT 11

JUNCTION CONTROL
LAYOUT (PEAK)
ALTERNATIVE 11B
J6I2377B



UNACCEPTABLE: REMOVAL OF MEMORIAL DR. ON-RAMP TO SB I-55✳

UNDESIRABLE: EXCAVATION ALONG I-44 RELOCATION

UNDESIRABLE: SHARP RADIUS & LOW DESIGN SPEED (30 MPH)

POTENTIAL CONFLICTS BETWEEN EXCAVATION & I-64 BRIDGE FOOTINGS

UNACCEPTABLE: SUBSTANDARD SIGHT DISTANCE FOR I-64

5 LANE PSB ASSIGNMENT:
LANES 1 AND 2: I-64
LANE 3: JUNCTION CONTROLLED BETWEEN I-64 AND OUTSIDE LANE RAMP 2 (OFF-PEAK PERIODS DESIGNATED FOR I-64)
LANE 4: INSIDE LANE RAMP 2
LANE 5: RAMP 4

NOTE: SPACING ON OVERHEAD LANE USE SIGNALS ON I-64 SHALL BE AS REQUIRED. SPACING ON OVERHEAD LANE USE SIGNALS FOR RAMP 2 SHALL BE AS REQUIRED ON RAMP 2 AND I-55.

✳ CITY OF ST. LOUIS OPPOSES REMOVING THIS MOVEMENT

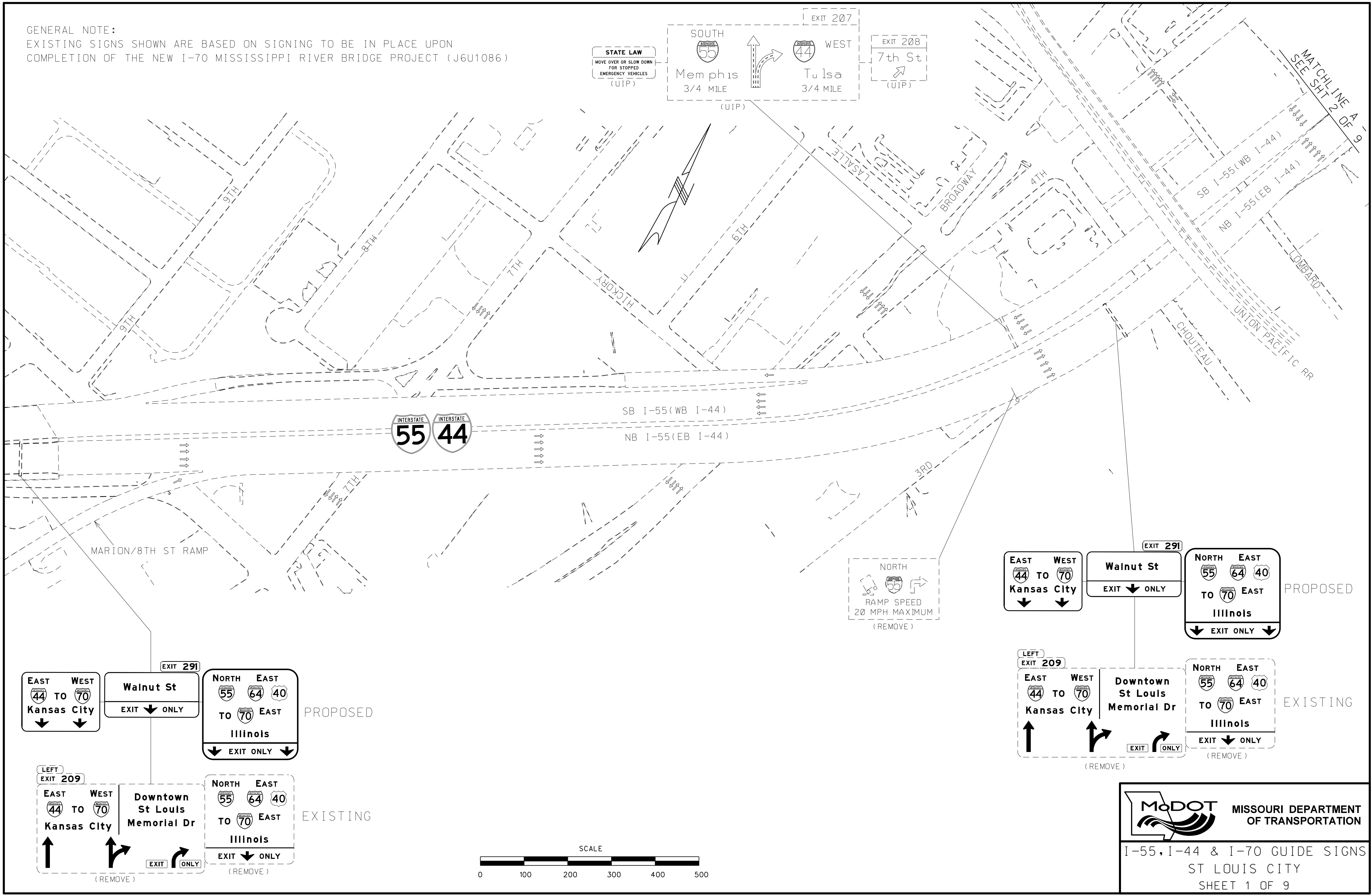
MoDOT MISSOURI DEPARTMENT OF TRANSPORTATION

EXHIBIT 11
JUNCTION CONTROL
LAYOUT (OFF-PEAK)
ALTERNATIVE 11B
J6I2377B

Appendix D

Proposed Signing Plan

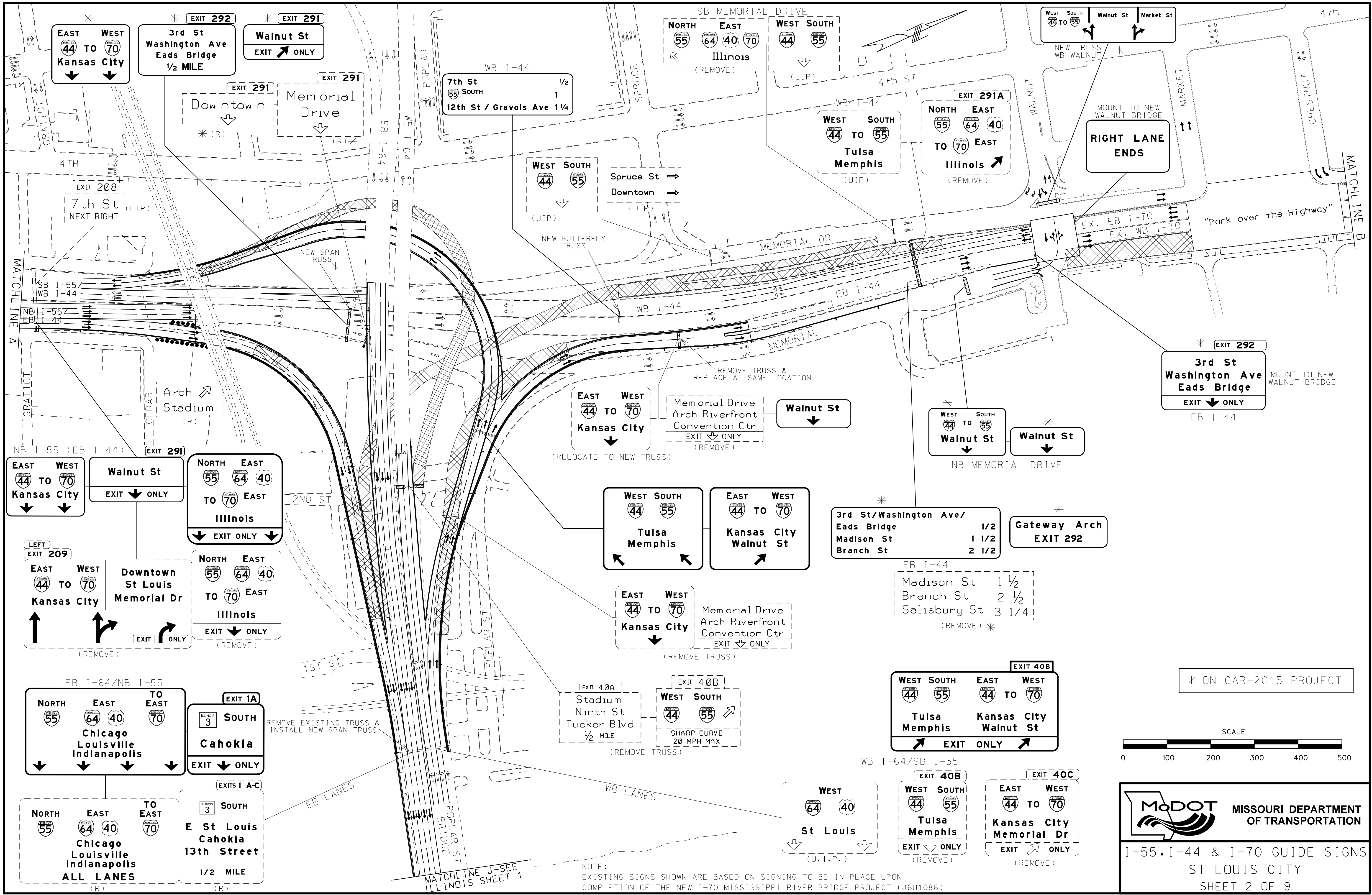
GENERAL NOTE:
EXISTING SIGNS SHOWN ARE BASED ON SIGNING TO BE IN PLACE UPON
COMPLETION OF THE NEW I-70 MISSISSIPPI RIVER BRIDGE PROJECT (J6U1086)



MoDOT
MISSOURI DEPARTMENT OF TRANSPORTATION

I-55, I-44 & I-70 GUIDE SIGNS
ST LOUIS CITY
SHEET 1 OF 9

IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

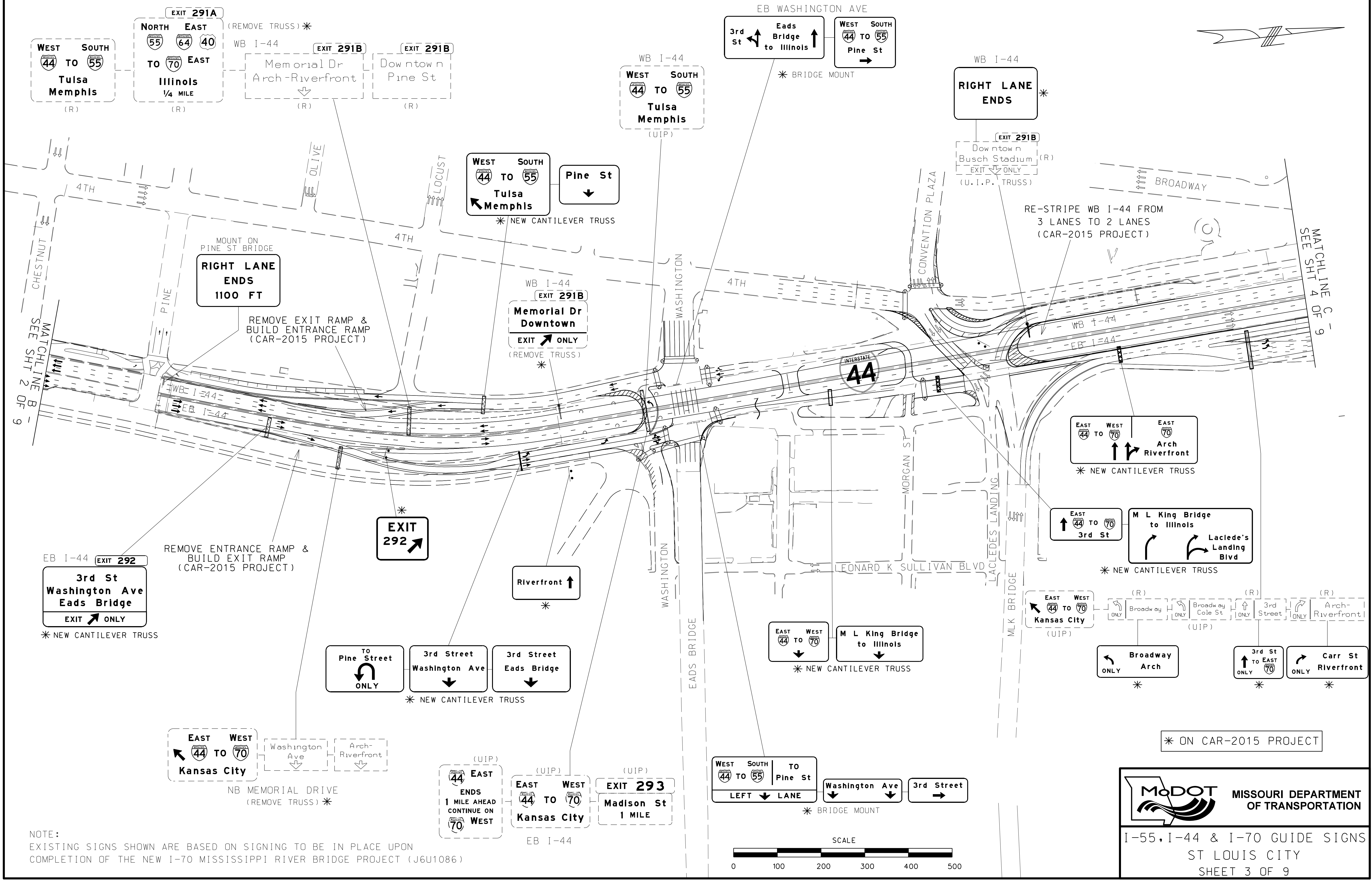


NOTE:
EXISTING SIGNS SHOWN ARE BASED ON SIGNING TO BE IN PLACE UPON COMPLETION OF THE NEW I-70 MISSISSIPPI RIVER BRIDGE PROJECT (J6U1086)

MISSOURI DEPARTMENT OF TRANSPORTATION

I-55, I-44 & I-70 GUIDE SIGNS
ST LOUIS CITY
SHEET 2 OF 9

AJR_Signing02_MISSOURI_J6I2377B_i100_Rev-March2013.dgn 12:22:13 PM 3/14/2013



NOTE:
EXISTING SIGNS SHOWN ARE BASED ON SIGNING TO BE IN PLACE UPON COMPLETION OF THE NEW I-70 MISSISSIPPI RIVER BRIDGE PROJECT (J6U1086)

MoDOT

MISSOURI DEPARTMENT OF TRANSPORTATION

I-55, I-44 & I-70 GUIDE SIGNS
ST LOUIS CITY
SHEET 3 OF 9

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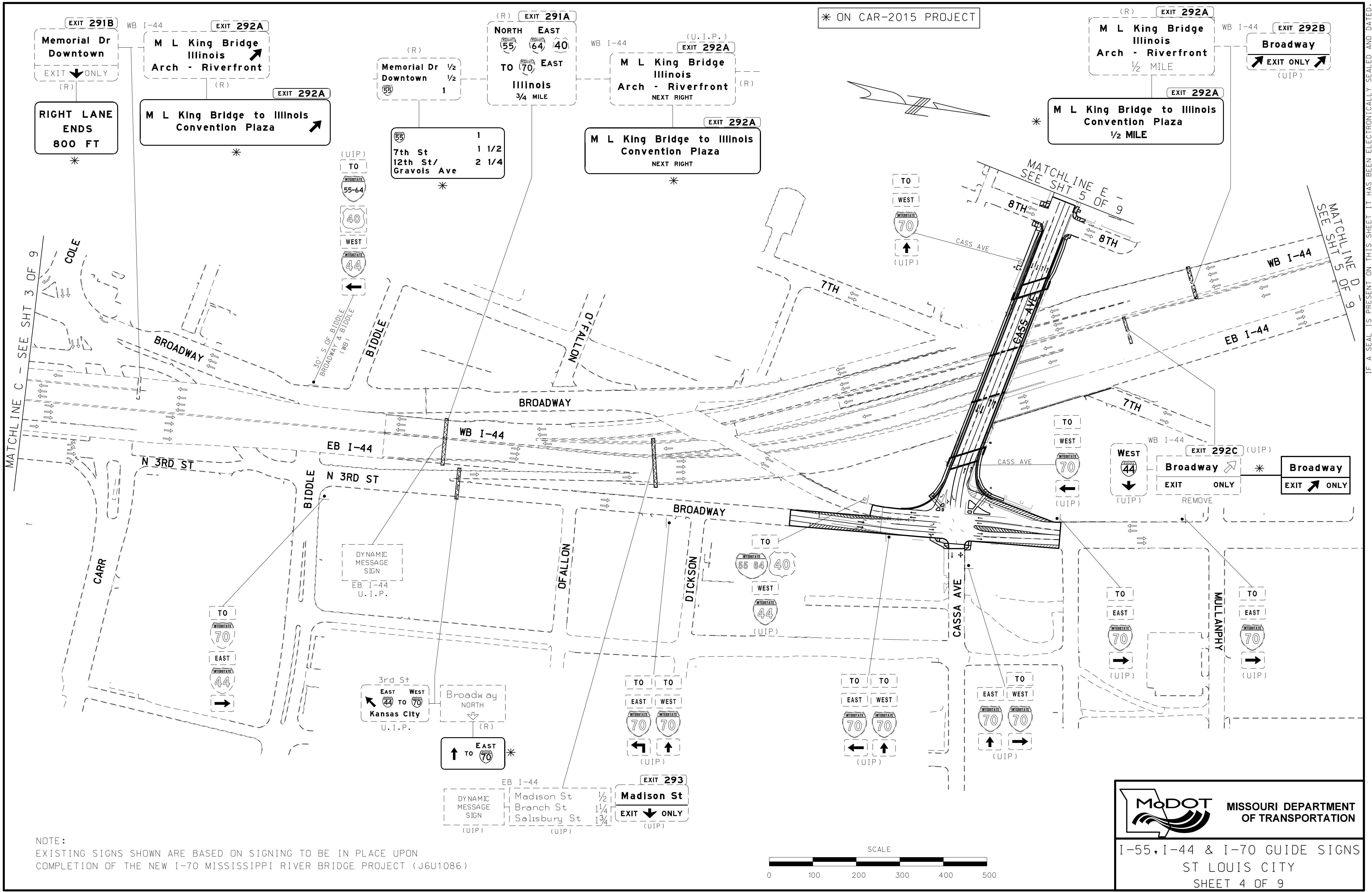

NOTE:
EXISTING SIGNS SHOWN ARE BASED ON SIGNING TO BE IN PLACE UPON COMPLETION OF THE NEW I-70 MISSISSIPPI RIVER BRIDGE PROJECT (J6U1086)

MoDOT
MISSOURI DEPARTMENT OF TRANSPORTATION

I-55, I-44 & I-70 GUIDE SIGNS
ST LOUIS CITY
SHEET 4 OF 9

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NOTE:
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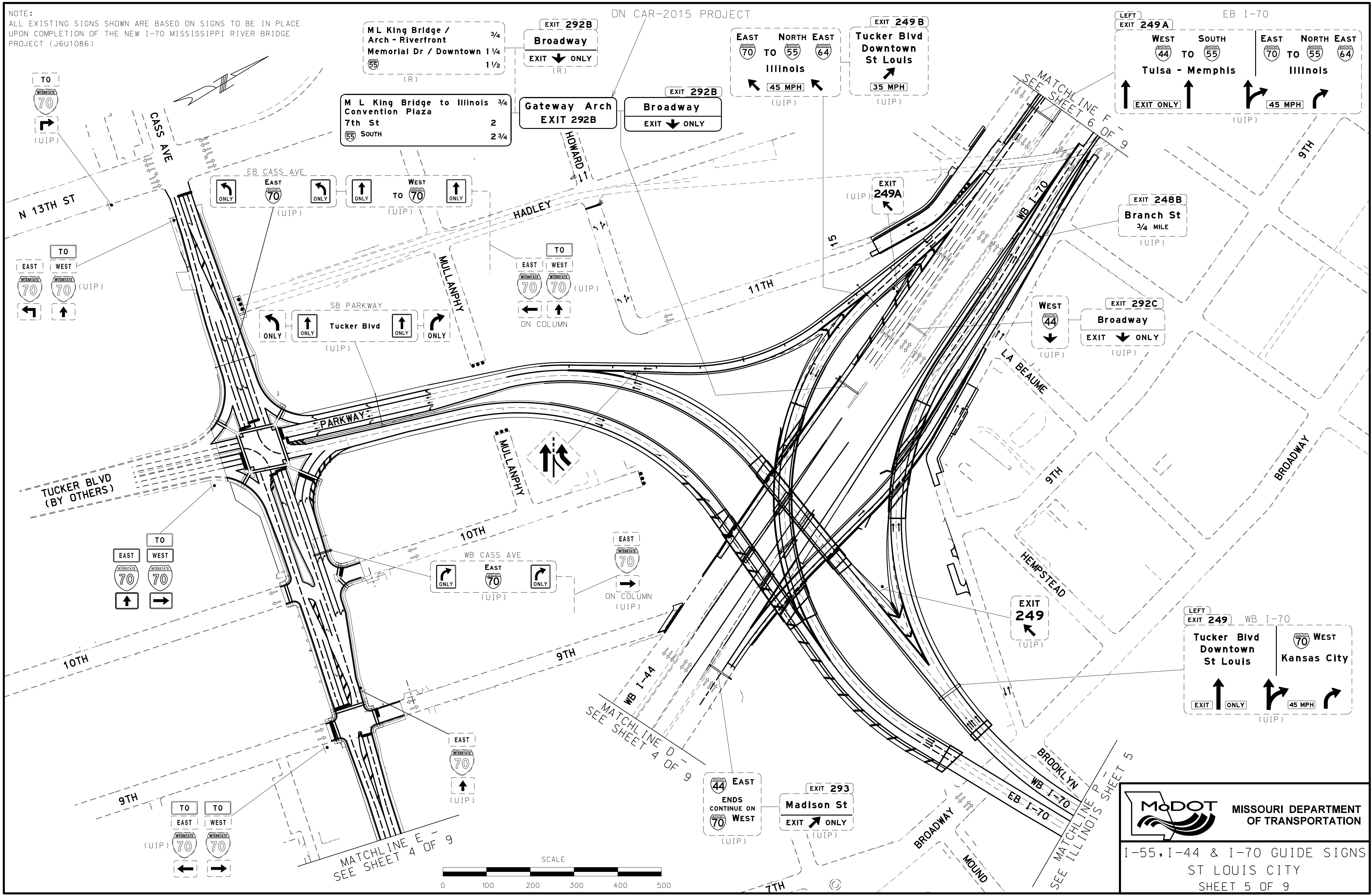

MoDOT
MISSOURI DEPARTMENT OF TRANSPORTATION

I-55, I-44 & I-70 GUIDE SIGNS
ST LOUIS CITY
SHEET 5 OF 9

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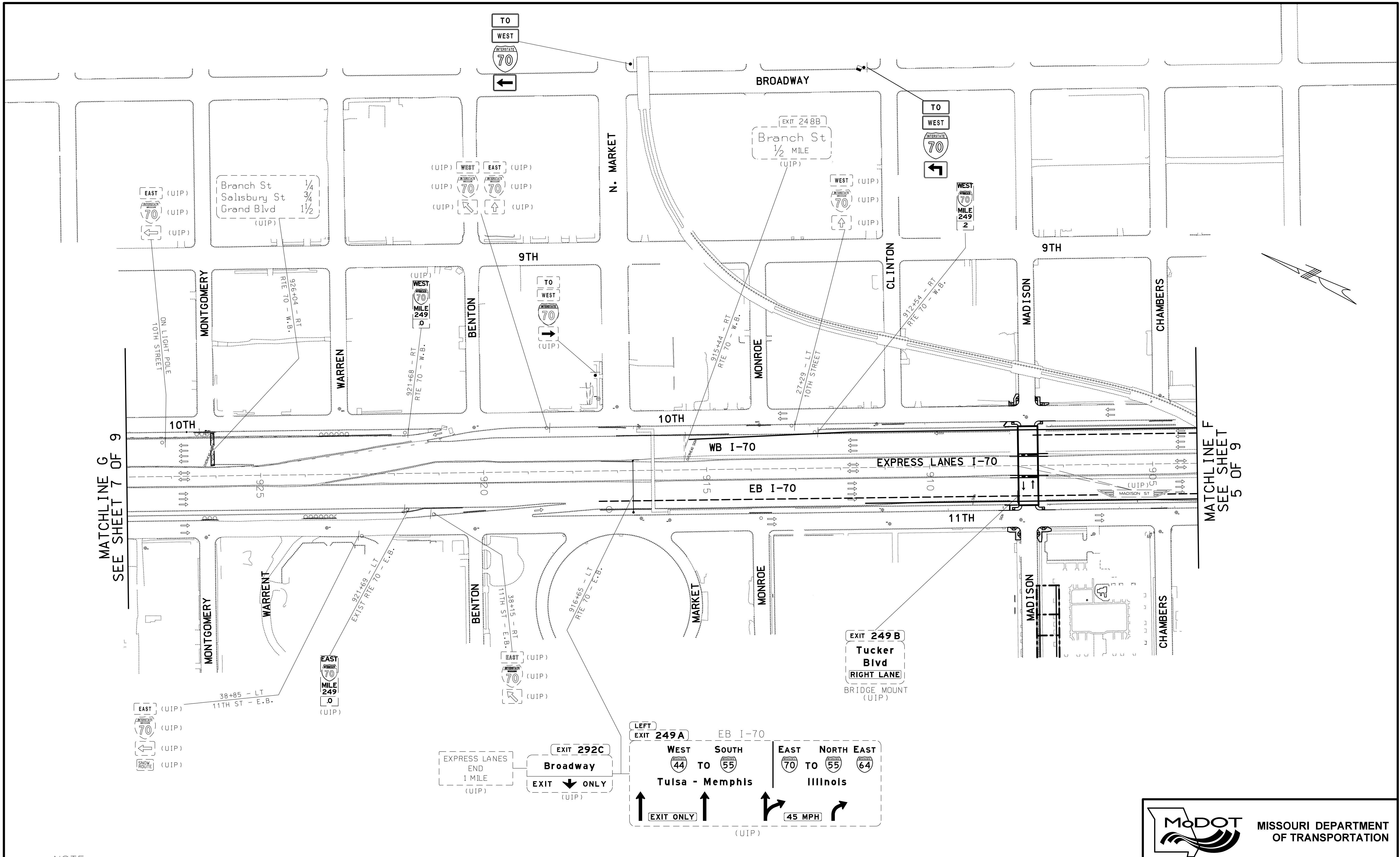
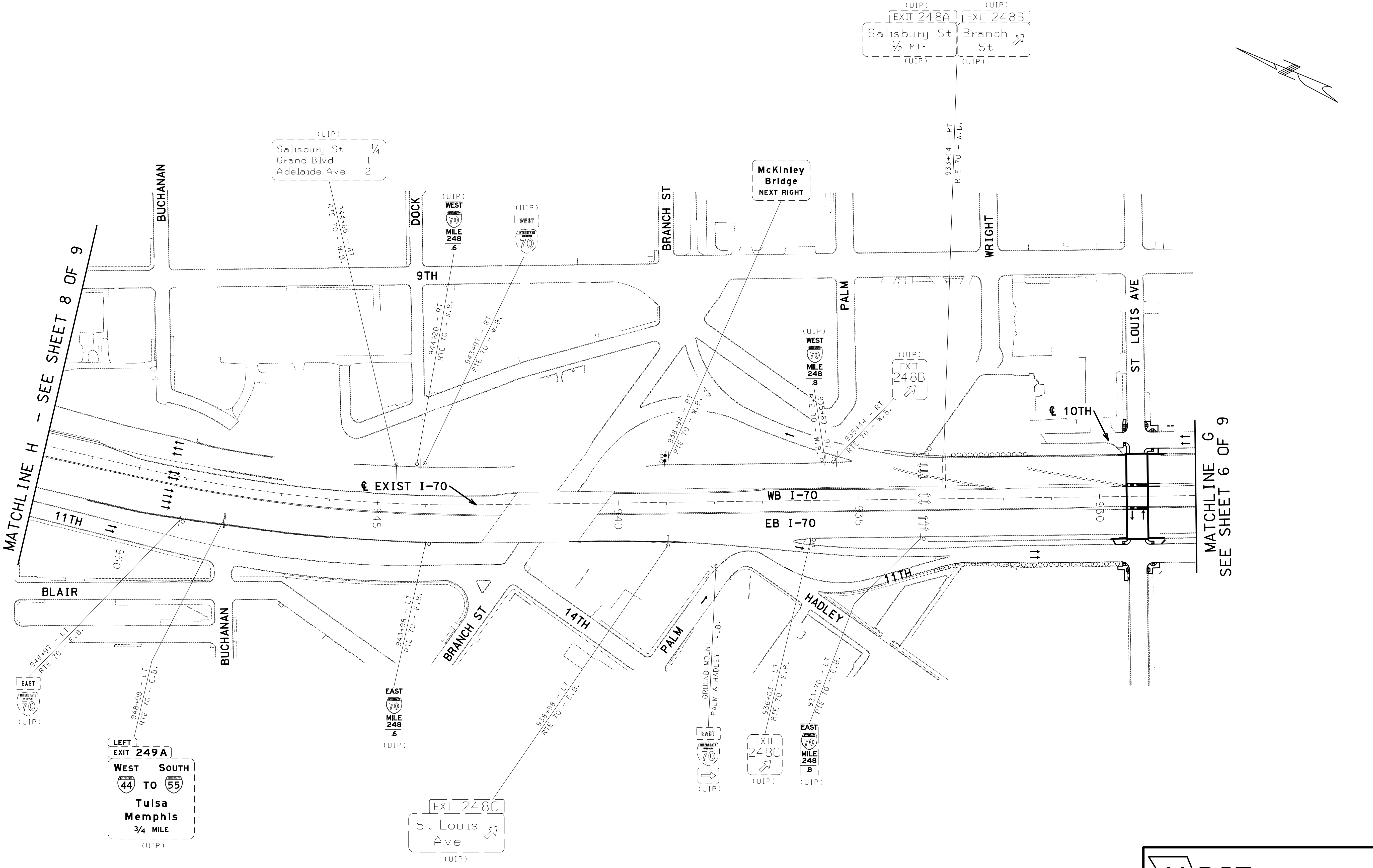


NOTE:
ALL EXISTING SIGNS SHOWN ARE BASED ON SIGNS TO BE IN PLACE UPON
COMPLETION OF THE NEW I-70 MISSISSIPPI RIVER BRIDGE PROJECT (J6U1086)

SCALE
0 100 200 300 400 500

MoDOT
MISSOURI DEPARTMENT
OF TRANSPORTATION

I-55, I-44 & I-70 GUIDE SIGNS
ST LOUIS CITY
SHEET 6 OF 9



NOTE:
ALL EXISTING SIGNS SHOWN ARE BASED ON SIGNS TO BE IN PLACE UPON COMPLETION OF THE NEW I-70 MISSISSIPPI RIVER BRIDGE PROJECT (J6U1086)

SCALE
0 100 200 300 400 500

MoDOT
MISSOURI DEPARTMENT OF TRANSPORTATION

I-55, I-44 & I-70 GUIDE SIGNS
ST LOUIS CITY
SHEET 7 OF 9

AJR_Signing07_MISSOURI_J6I2377B_i100.dgn 10:00:14 AM 7/19/2012

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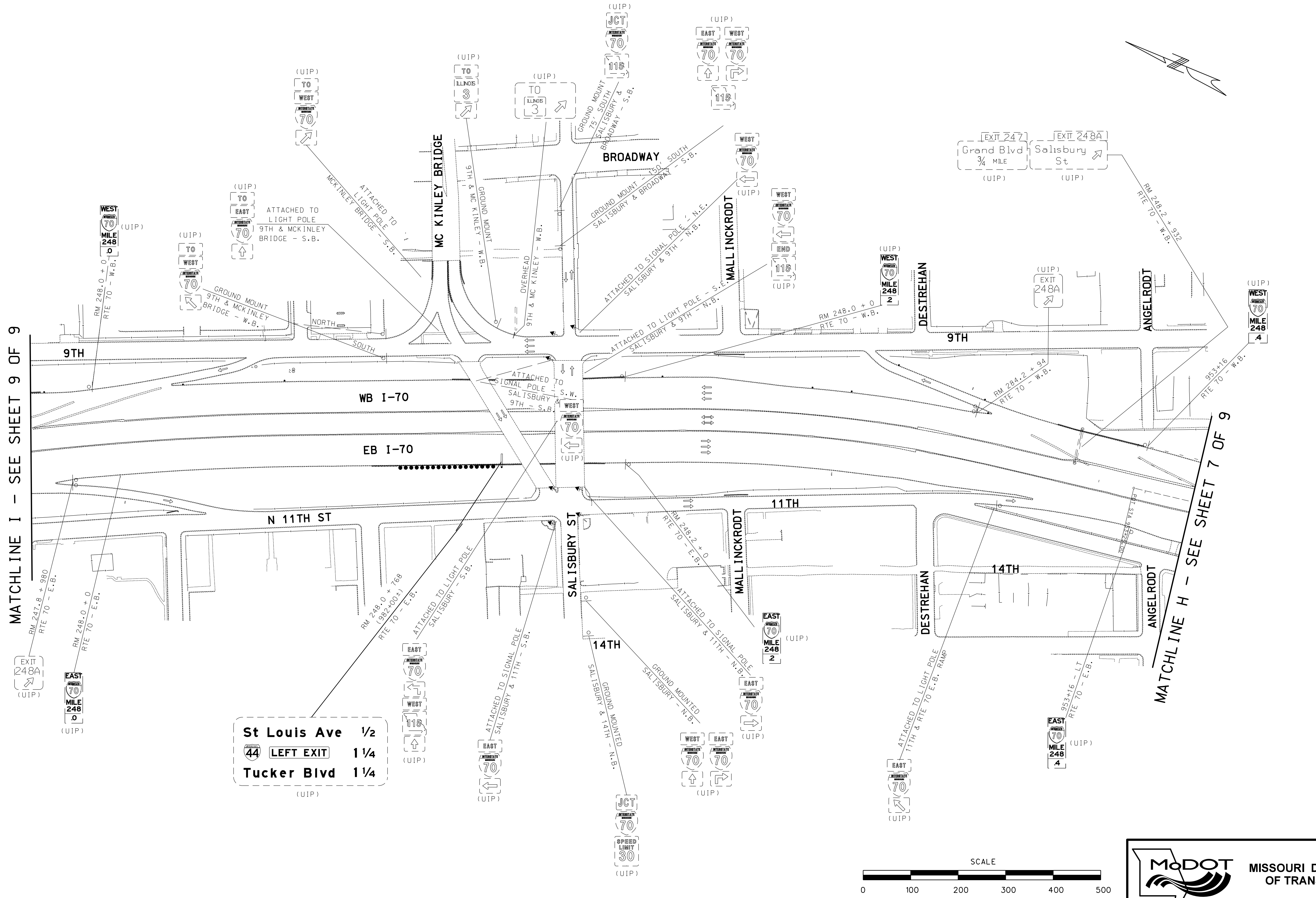

NOTE:
ALL EXISTING SIGNS SHOWN ARE BASED ON SIGNS TO BE IN PLACE UPON COMPLETION OF THE NEW I-70 MISSISSIPPI RIVER BRIDGE PROJECT (J6U1086)

MoDOT
MISSOURI DEPARTMENT OF TRANSPORTATION

I-55, I-44 & I-70 GUIDE SIGNS
ST LOUIS CITY
SHEET 8 OF 9

IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

NOTE:
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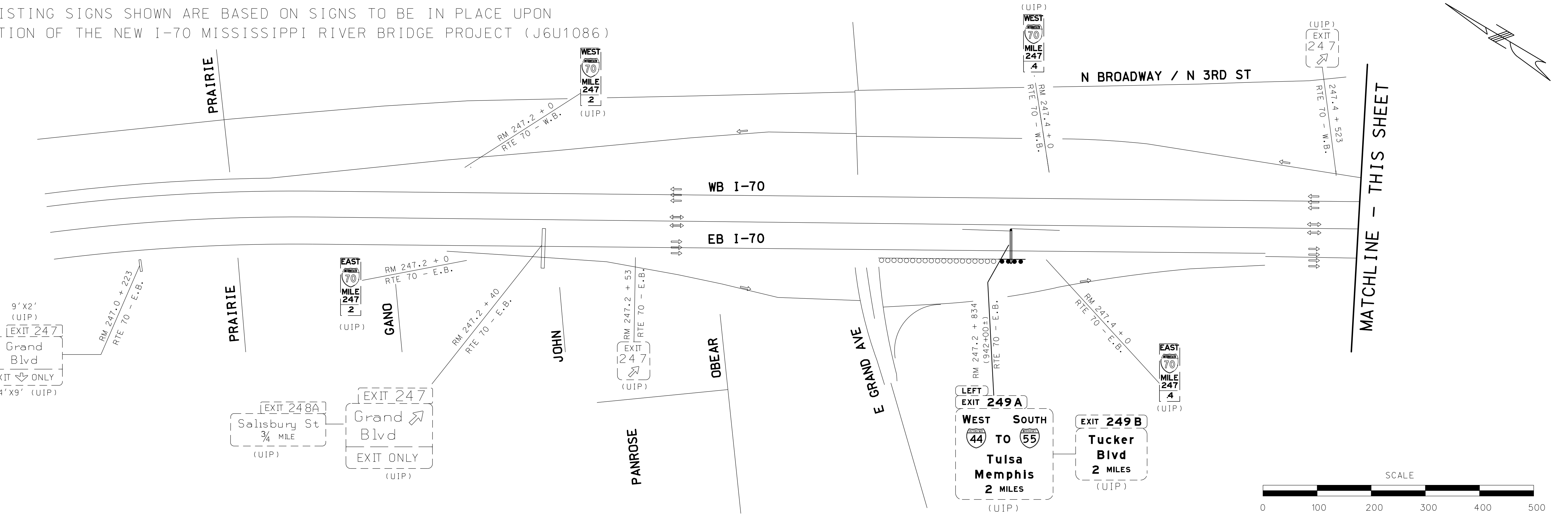
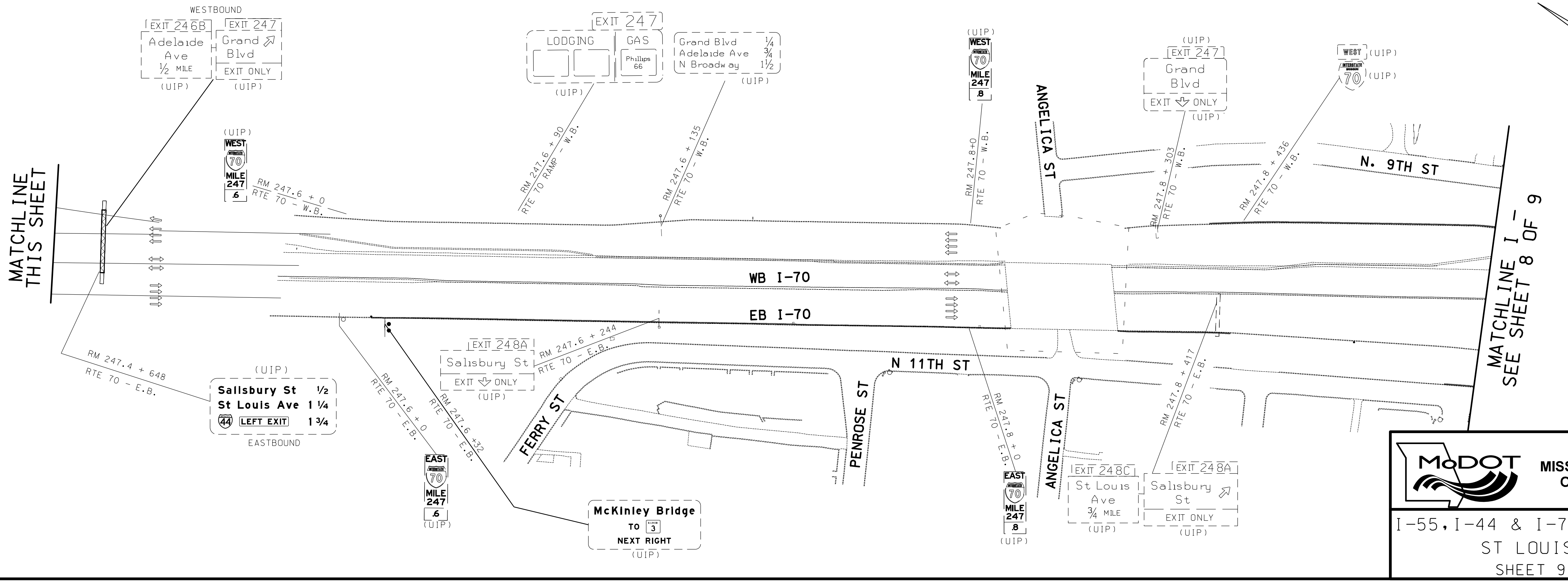
COMPLETION OF THE NEW I-70 MISSISSIPPI RIVER BRIDGE PROJECT (J6U1086)

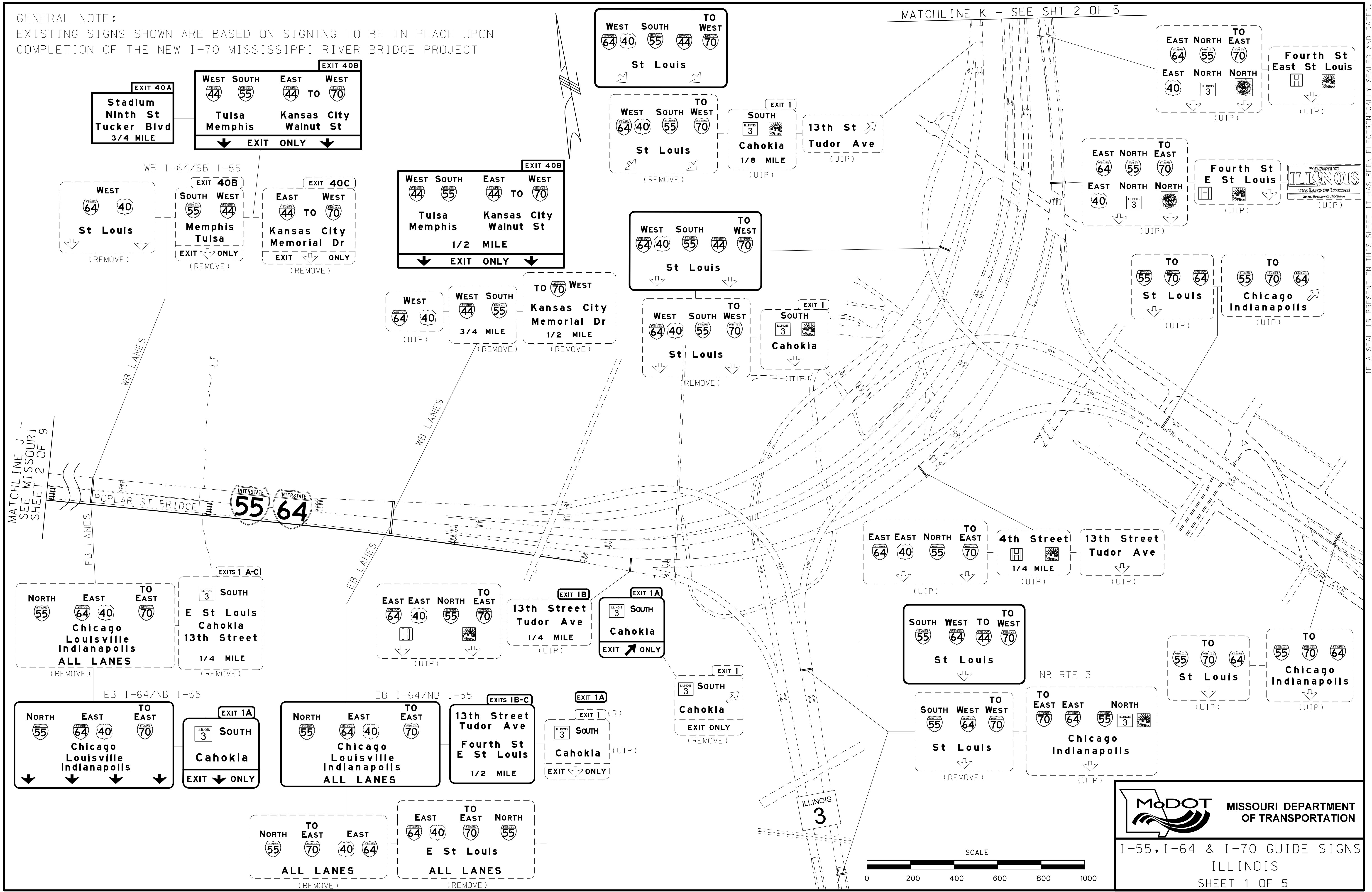




MoDOT
MISSOURI DEPARTMENT
OF TRANSPORTATION

I-55, I-44 & I-70 GUIDE SIGNS
ST LOUIS CITY
SHEET 9 OF 9

GENERAL NOTE:
EXISTING SIGNS SHOWN ARE BASED ON SIGNING TO BE IN PLACE UPON COMPLETION OF THE NEW I-70 MISSISSIPPI RIVER BRIDGE PROJECT



MoDOT MISSOURI DEPARTMENT OF TRANSPORTATION

I-55, I-64 & I-70 GUIDE SIGNS
ILLINOIS
SHEET 1 OF 5

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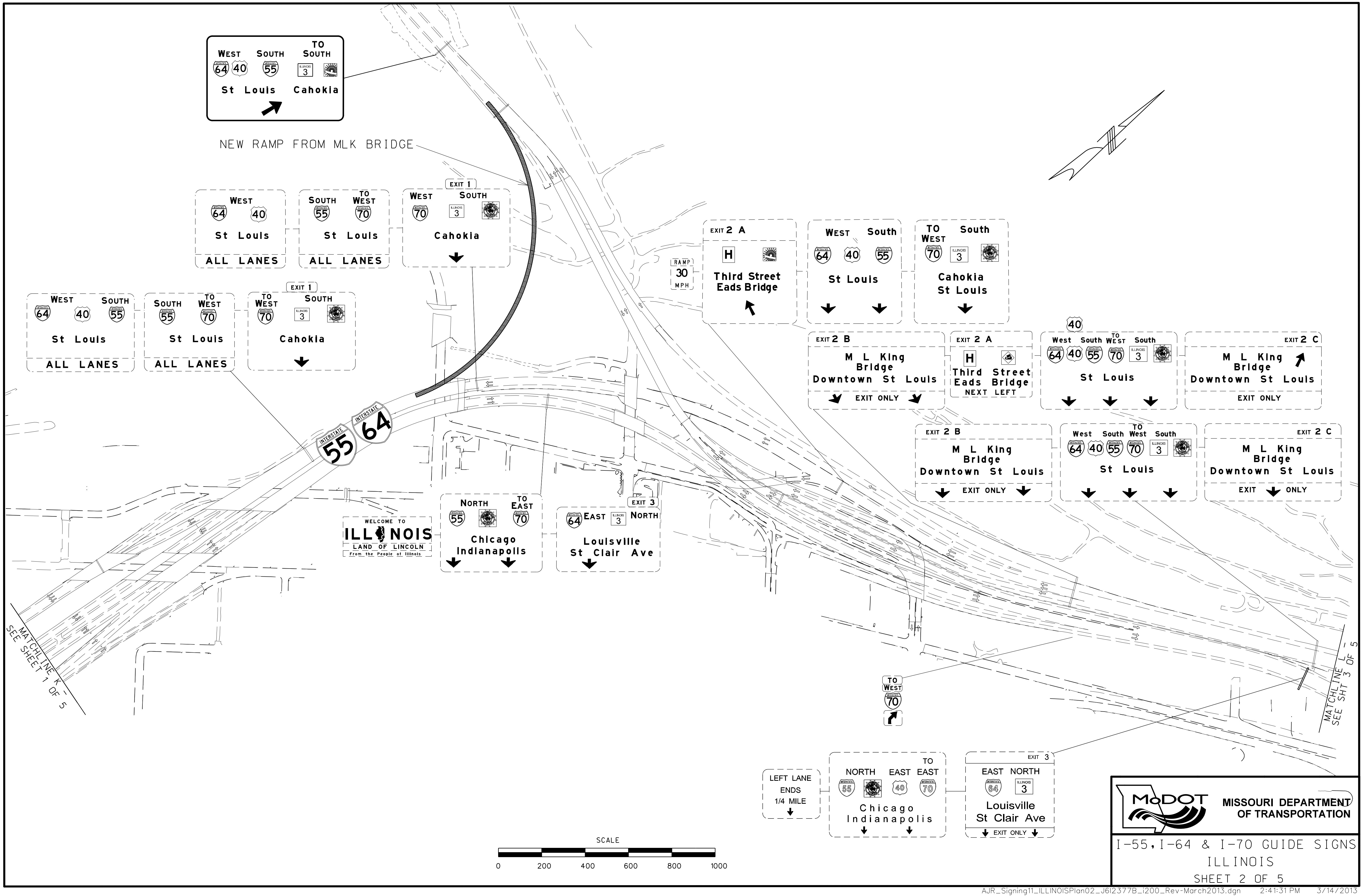


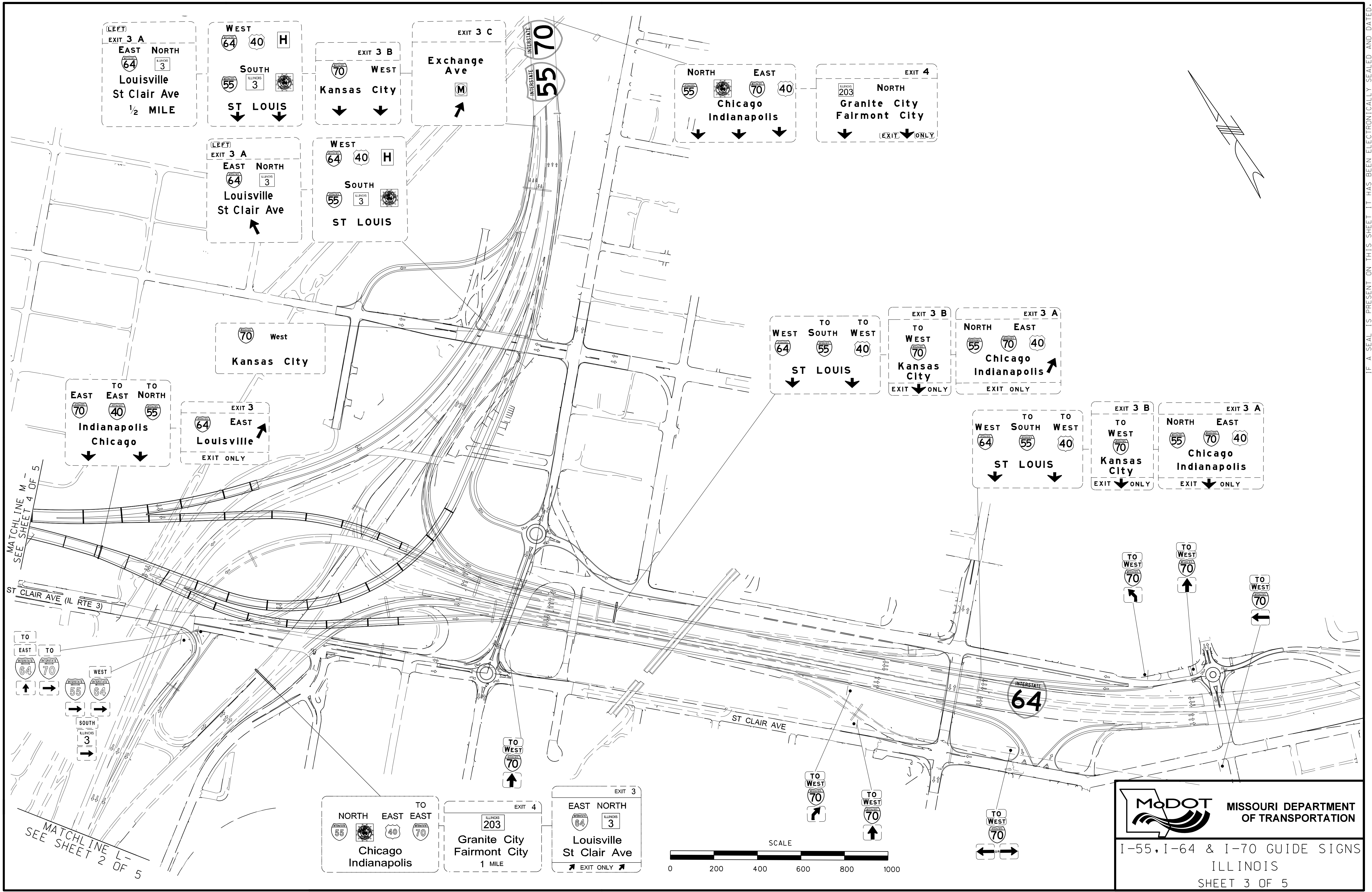
MoDOT

MISSOURI DEPARTMENT OF TRANSPORTATION

I-55, I-64 & I-70 GUIDE SIGNS
ILLINOIS
SHEET 2 OF 5

REV.

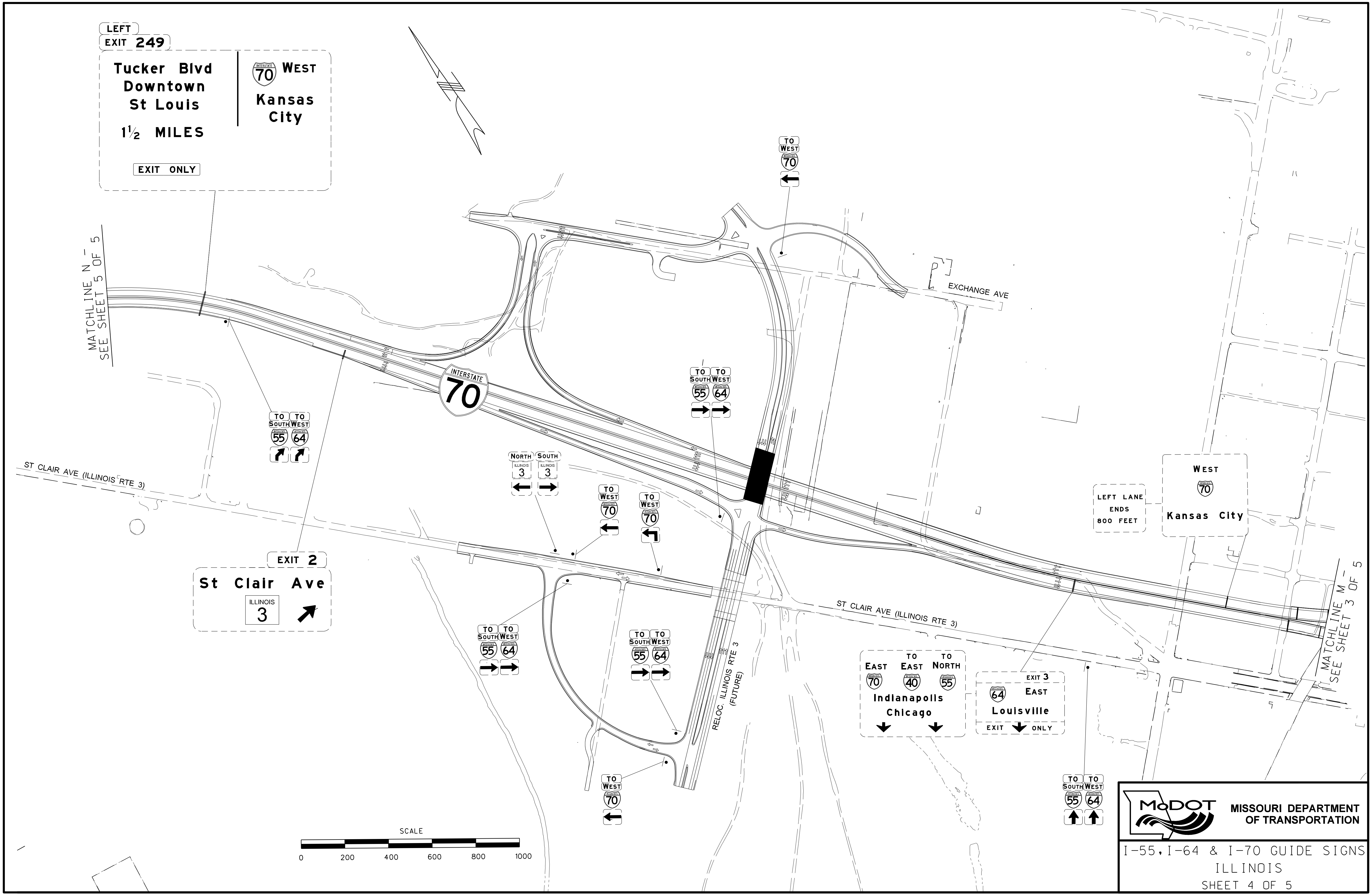
IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.



MoDOT
MISSOURI DEPARTMENT OF TRANSPORTATION

I-55, I-64 & I-70 GUIDE SIGNS
ILLINOIS
SHEET 3 OF 5

IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.



MISSOURI DEPARTMENT OF TRANSPORTATION

I-55, I-64 & I-70 GUIDE SIGNS
ILLINOIS
SHEET 4 OF 5

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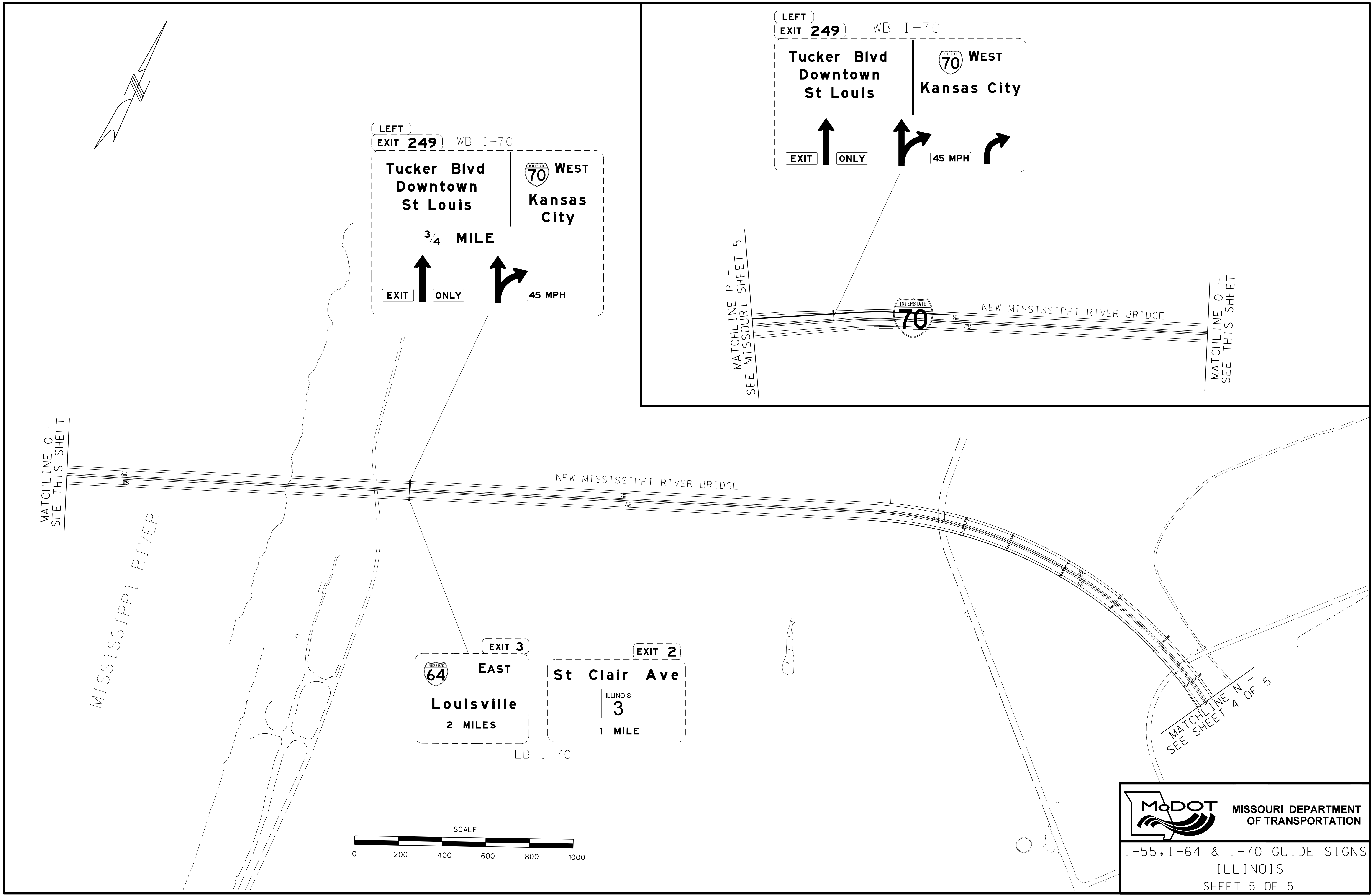


MISSOURI DEPARTMENT OF TRANSPORTATION

I-55, I-64 & I-70 GUIDE SIGNS
ILLINOIS
SHEET 5 OF 5

REV.

AJR_Signing14_ILLINOISPlan05_J6I2377B_i200.dgn 2:11:38 PM 7/19/2012

Appendix E

Forecasted Peak Hour Volumes

No Build 2015 - Sheet 1

* 2035 Volumes are 4%
higher at all locations

PSB AJR
St. Louis, Missouri
Job# 020-13
03/26/13

CBB Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

No Build 2015 - Sheet 2

* 2035 Volumes are 4%
higher at all locations

PSB AJR
St. Louis, Missouri
Job# 020-13
03/26/13

CBB Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

Legend

XX = Weekday AM Peak Hour Traffic

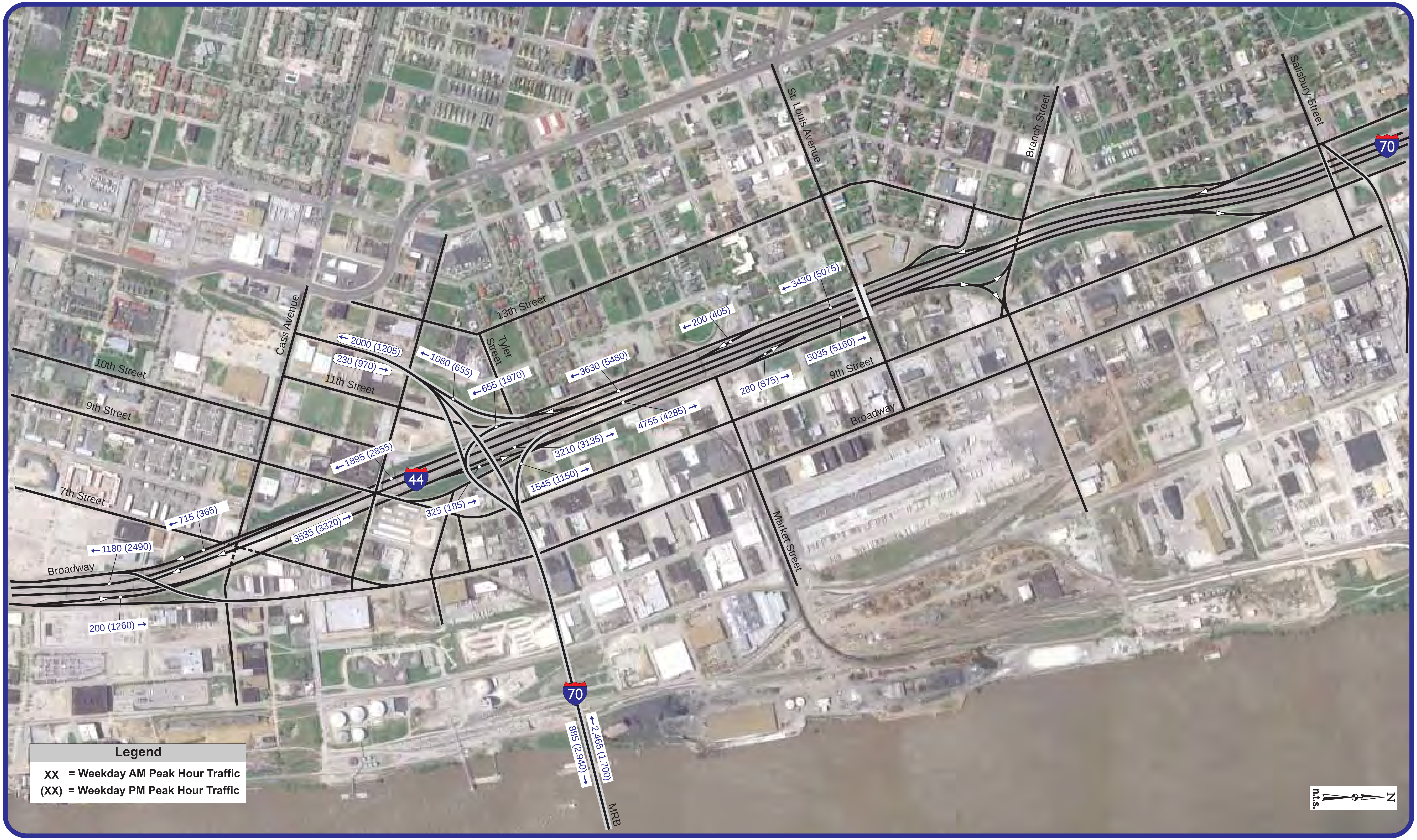
(XX) = Weekday PM Peak Hour Traffic

No Build 2015 - Sheet 3

* 2035 Volumes are 4%
higher at all locations

PSB AJR
St. Louis, Missouri
Job# 020-13
03/26/13

CBB Crawford, Bunte, Brammeier
Traffic and Transportation Engineers



No Build 2015 - Sheet 4

* 2035 Volumes are 4%
higher at all locations

PSB AJR
St. Louis, Missouri
Job# 020-13
03/26/13

CBB Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

No Build 2015 - Sheet 5

* 2035 Volumes are 4%
higher at all locations

PSB AJR
St. Louis, Missouri
Job# 020-13
03/26/13

Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

2015 Build Alternatives 8, 9 - Sheet 1

* 2035 Volumes are 4%
higher at all locations

PSB AJR
St. Louis, Missouri
Job# 020-13
03/26/13

CBB
Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

2015 Build Alternatives 8, 9 - Sheet 2

* 2035 Volumes are 4%
higher at all locations

PSB AJR
St. Louis, Missouri
Job# 020-13
03/26/13

CBB Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

Legend

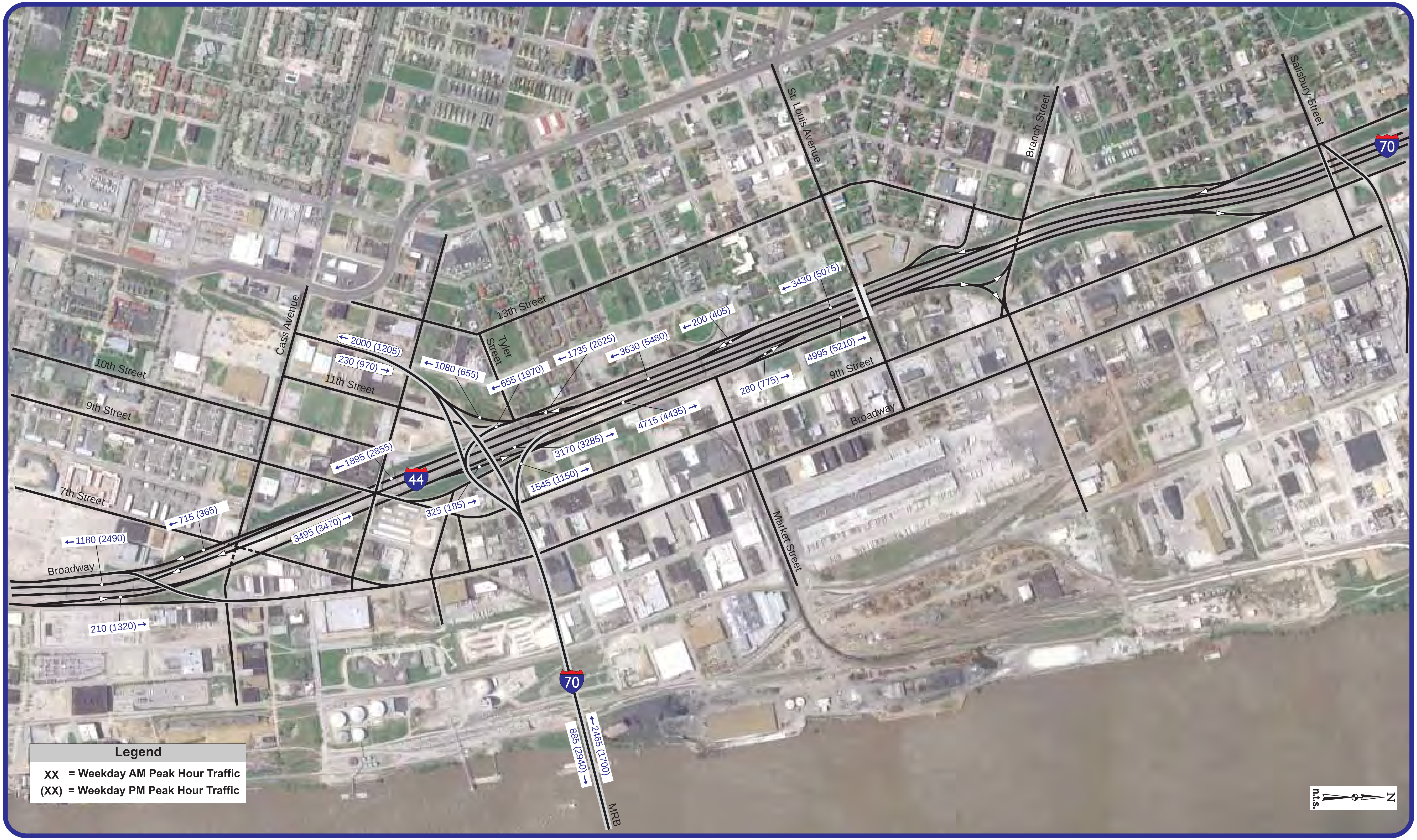
XX = Weekday AM Peak Hour Traffic
(XX) = Weekday PM Peak Hour Traffic

2015 Build Alternatives 8, 9 - Sheet 3

* 2035 Volumes are 4%
higher at all locations

PSB AJR
St. Louis, Missouri
Job# 020-13
03/26/13

CBB
Crawford, Bunte, Brammeier
Traffic and Transportation Engineers



Legend	
XX	= Weekday AM Peak Hour Traffic
(XX)	= Weekday PM Peak Hour Traffic

2015 Build Alternatives 8, 9 - Sheet 4

* 2035 Volumes are 4%
higher at all locations

PSB AJR
St. Louis, Missouri
Job# 020-13
03/26/13

CBB Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

2015 Build Alternatives 8, 9 - Sheet 5

* 2035 Volumes are 4%
higher at all locations

PSB AJR
St. Louis, Missouri
Job# 020-13
03/26/13

CBB Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

Appendix F

Crash Data

Summary	**2006**	**2007**	**2008**	**2009**	**2010**	**Total**
Fatal	0	0	0	0	0	**0**
Disabling Injury	0	1	0	0	1	**2**
Minor Injury	7	9	2	5	9	**32**
PDO	26	38	15	20	35	**134**
Total	33	48	17	25	45	**168**
AADT	**43785**	**44223**	**43948**	**44401**	**43957**	
1 Year Statewide Rate						
Accident Rate	128.41	184.93	65.91	95.93	174.42	
STATE RATE-IS	107.82	108.97	105.5	102.54	104.31	Route Desg
STATE RATE-FREEWAY	106.3	107.87	102.36	100.53	104.51	Rdway_Type
Accident Class						
ANIMAL OTHER THAN DEER	0	0	0	0	0	**0**
AVOIDING	0	1	0	0	0	**1**
BACKING	0	0	0	0	0	**0**
CHANGING LANE	1	2	2	0	5	**10**
CROSS MEDIAN	0	0	0	0	0	**0**
DEER	0	0	0	0	0	**0**
DUAL LEFTS COLLIDE	0	0	0	0	0	**0**
DUAL RIGHTS COLLIDE	0	0	0	0	0	**0**
FIXED OBJECT	2	1	0	0	0	**3**
HEAD ON	0	0	0	0	0	**0**
JACKKNIFE	0	0	0	0	0	**0**
LEFT TURN	0	0	0	0	1	**1**
LEFT TURN RIGHT ANGLE COLLISION	0	0	0	0	0	**0**
OTHER	3	4	0	1	1	**9**
OUT OF CONTROL	5	13	7	5	8	**38**
PARKING OR PARKED CAR	1	2	0	0	0	**3**
PASSING	5	6	2	7	6	**26**
PEDALCYCLE	0	1	0	0	0	**1**
PEDESTRIAN	0	0	0	0	1	**1**
REAR END	16	18	6	12	23	**75**
RIGHT ANGLE	0	0	0	0	0	**0**
RIGHT TURN	0	0	0	0	0	**0**
RIGHT TURN RIGHT ANGLE COLLISION	0	0	0	0	0	**0**
SIDESWIPE	0	0	0	0	0	**0**
TOWED UNIT DISCONNECTS	0	0	0	0	0	**0**
U - TURN	0	0	0	0	0	**0**
WRONG WAY ON DIVIDED HIGHWAY	0	0	0	0	0	**0**
	33	**48**	**17**	**25**	**45**	**168**
Selected Travelway	Offset	Designation	Travelway	Direction	Selected City	
		IS	64	E	NONE SPECIFIED	

From	District	County	County Log	Continuous Log		
	5	ST. LOUIS CITY	5.153	38.79		
To	District	County	County Log	Continuous Log		
	5	ST. LOUIS CITY	7.154	40.791		
Intersecting Travelways						
	Designation	Travelway	Direction			
From						
To	US	40	E			

$$\text{Crash rates for ranges} = \frac{\text{No. of Accidents x 100,000,000}}{\text{No. of Years x AADT x Range Length x 365 days/year}}$$

Summary	**2006**	**2007**	**2008**	**2009**	**2010**	**Total**
Fatal	0	0	0	0	0	**0**
Disabling Injury	2	0	2	0	0	**4**
Minor Injury	10	12	9	3	12	**46**
PDO	32	24	21	17	29	**123**
Total	44	36	32	20	41	**173**
AADT	**46494**	**46959**	**46668**	**47149**	**46677**	
1 Year Statewide Rate						
Accident Rate	151.01	122.33	109.41	67.69	140.16	
STATE RATE-IS	107.82	108.97	105.5	102.54	104.31	Route Desg
STATE RATE-FREEWAY	106.3	107.87	102.36	100.53	104.51	Rdway_Type
Accident Class						
ANIMAL OTHER THAN DEER	0	0	0	0	0	**0**
AVOIDING	0	0	0	0	0	**0**
BACKING	0	0	0	1	1	**2**
CHANGING LANE	2	0	1	2	1	**6**
CROSS MEDIAN	1	0	0	0	0	**1**
DEER	0	0	0	0	0	**0**
DUAL LEFTS COLLIDE	0	0	0	0	0	**0**
DUAL RIGHTS COLLIDE	0	0	0	0	0	**0**
FIXED OBJECT	1	0	1	0	1	**3**
HEAD ON	0	0	0	0	0	**0**
JACKKNIFE	0	0	0	0	0	**0**
LEFT TURN	0	0	0	1	0	**1**
LEFT TURN RIGHT ANGLE COLLISION	0	0	0	0	0	**0**
OTHER	2	1	1	0	1	**5**
OUT OF CONTROL	6	13	14	7	10	**50**
PARKING OR PARKED CAR	1	0	0	0	0	**1**
PASSING	12	3	6	3	7	**31**
PEDALCYCLE	0	0	0	0	0	**0**
PEDESTRIAN	0	1	0	0	0	**1**
REAR END	19	18	9	6	19	**71**
RIGHT ANGLE	0	0	0	0	0	**0**
RIGHT TURN	0	0	0	0	0	**0**
RIGHT TURN RIGHT ANGLE COLLISION	0	0	0	0	0	**0**
SIDESWIPE	0	0	0	0	1	**1**
TOWED UNIT DISCONNECTS	0	0	0	0	0	**0**
U - TURN	0	0	0	0	0	**0**
WRONG WAY ON DIVIDED HIGHWAY	0	0	0	0	0	**0**
	44	**36**	**32**	**20**	**41**	**173**
Selected Travelway	Offset	Designation	Travelway	Direction		
		IS	64	W		

From	District	County	County Log	Continuous Log		
	5	ST. LOUIS CITY	0	0		
To	District	County	County Log	Continuous Log		
	5	ST. LOUIS CITY	1.998	1.998		
Intersecting Travelways						
	Designation	Travelway	Direction			
From	IS	70	W			
To						

Summary	2006	2007	2008	2009	2010	Total
Fatal	1	0	0	2	1	**4**
Disabling Injury	1	0	3	0	2	**6**
Minor Injury	33	17	27	32	34	**143**
PDO	88	75	71	83	65	**382**
Total	**123**	**92**	**101**	**117**	**102**	**535**
AADT	49990	50490	50177	48143	47662	
1 Year Statewide Rate						
Accident Rate	493.13	365.19	403.42	487.07	428.91	
STATE RATE-IS						
STATE RATE-FREEWAY						
Accident Class						
ANIMAL OTHER THAN DEER	0	0	0	0	0	**0**
AVOIDING	0	0	2	0	0	**2**
BACKING	2	1	1	0	0	**4**
CHANGING LANE	6	5	7	11	5	**34**
CROSS MEDIAN	0	0	0	0	0	**0**
DEER	0	0	0	0	0	**0**
DUAL LEFTS COLLIDE	0	1	0	0	0	**1**
DUAL RIGHTS COLLIDE	0	0	0	0	0	**0**
FIXED OBJECT	6	2	0	0	1	**9**
HEAD ON	0	2	0	0	1	**3**
JACKKNIFE	0	0	0	0	0	**0**
LEFT TURN	0	0	0	0	0	**0**
LEFT TURN RIGHT ANGLE COLLISION	0	0	0	0	0	**0**
OTHER	2	0	4	2	4	**12**
OUT OF CONTROL	9	20	24	29	23	**105**
PARKING OR PARKED CAR	0	0	0	2	0	**2**
PASSING	28	18	19	19	11	**95**
PEDALCYCLE	0	0	0	0	0	**0**
PEDESTRIAN	0	1	0	0	0	**1**
REAR END	69	40	44	51	54	**258**
RIGHT ANGLE	0	2	0	0	0	**2**
RIGHT TURN	0	0	0	0	1	**1**
RIGHT TURN RIGHT ANGLE COLLISION	0	0	0	0	0	**0**
SIDESWIPE	1	0	0	3	2	**6**
TOWED UNIT DISCONNECTS	0	0	0	0	0	**0**
U - TURN	0	0	0	0	0	**0**
WRONG WAY ON DIVIDED HIGHWAY	0	0	0	0	0	**0**
Total	**123**	**92**	**101**	**117**	**102**	**535**
Selected Travelway	Offset	Designation	Travelway	Direction	Selected City	
		IS	70	E	NONE SPECIFIED	

From	District	County	County Log	Continuous Log		
	5	ST. LOUIS CITY	6.561	208.324		
To	District	County	County Log	Continuous Log		
	5	ST. LOUIS CITY	7.928	209.691		
Intersecting Travelways						
	Designation	Travelway	Direction			
From	CST	AFAYETTE AVE	E			
To	US	40	E			

Summary	**2006**	**2007**	**2008**	**2009**	**2010**	**Total**
Fatal	0	0	1	0	0	**1**
Disabling Injury	1	0	2	2	4	**9**
Minor Injury	17	17	18	22	15	**89**
PDO	52	47	64	76	58	**297**
Total	**70**	**64**	**85**	**100**	**77**	**396**
AADT	52285	52808	52481	53021	52491	
1 Year Statewide Rate						
Accident Rate	245.51	222.25	297.01	345.87	269.01	
STATE RATE-IS						
STATE RATE-FREEWAY						
Accident Class						
ANIMAL OTHER THAN DEER	0	0	0	0	0	**0**
AVOIDING	0	1	2	0	0	**3**
BACKING	0	1	0	0	0	**1**
CHANGING LANE	0	2	6	11	4	**23**
CROSS MEDIAN	0	0	0	0	0	**0**
DEER	0	0	0	0	0	**0**
DUAL LEFTS COLLIDE	0	0	0	0	0	**0**
DUAL RIGHTS COLLIDE	0	0	0	0	0	**0**
FIXED OBJECT	9	1	2	0	1	**13**
HEAD ON	0	0	0	0	1	**1**
JACKKNIFE	0	0	0	0	0	**0**
LEFT TURN	0	0	0	0	0	**0**
LEFT TURN RIGHT ANGLE COLLISION	1	0	0	0	0	**1**
OTHER	4	4	3	3	1	**15**
OUT OF CONTROL	17	12	31	42	32	**134**
PARKING OR PARKED CAR	1	0	0	3	0	**4**
PASSING	19	21	14	11	15	**80**
PEDALCYCLE	0	0	0	0	0	**0**
PEDESTRIAN	0	0	0	0	0	**0**
REAR END	18	22	26	30	23	**119**
RIGHT ANGLE	0	0	1	0	0	**1**
RIGHT TURN	0	0	0	0	0	**0**
RIGHT TURN RIGHT ANGLE COLLISION	0	0	0	0	0	**0**
SIDESWIPE	0	0	0	0	0	**0**
TOWED UNIT DISCONNECTS	0	0	0	0	0	**0**
U - TURN	1	0	0	0	0	**1**
WRONG WAY ON DIVIDED HIGHWAY	0	0	0	0	0	**0**
Total	**70**	**64**	**85**	**100**	**77**	**396**
Selected Travelway	Offset	Designation	Travelway	Direction	Selected City	
		IS	70	E	NONE SPECIFIED	

From	District	County	County Log	Continuous Log		
	5	ST. LOUIS CITY	0	0		
To	District	County	County Log	Continuous Log		
	5	ST. LOUIS CITY	1.494	1.494		
Intersecting Travelways						
	Designation	Travelway	Direction			
From	IS	70	W			
To	CST	AFAYETTE AVE	W			

Summary	2006	2007	2008	2009	2010	Total
Fatal	1	1	0	0	2	**4**
Disabling Injury	4	1	3	2	2	**12**
Minor Injury	51	51	51	42	33	**228**
PDO	110	135	106	107	71	**529**
Total	**166**	**188**	**160**	**151**	**108**	**773**
AADT	41940	42359	42096	42530	42105	
1 Year Statewide Rate						
Accident Rate	396.34	444.43	380.60	355.53	256.85	
STATE RATE-IS	106.65	107.86	103.4	100.77	0	Route Desg
STATE RATE-FREEWAY	107.93	110.14	104.78	101.53	0	Rdway_Type
Accident Class						
ANIMAL OTHER THAN DEER	0	0	0	0	0	**0**
AVOIDING	0	0	0	2	1	**3**
BACKING	1	1	0	1	0	**3**
CHANGING LANE	1	7	7	9	2	**26**
CROSS MEDIAN	0	0	0	0	0	**0**
DEER	0	0	0	0	0	**0**
DUAL LEFTS COLLIDE	0	0	0	0	0	**0**
DUAL RIGHTS COLLIDE	0	0	0	0	0	**0**
FIXED OBJECT	7	1	3	1	1	**13**
HEAD ON	0	0	1	0	1	**2**
JACKKNIFE	0	0	0	0	0	**0**
LEFT TURN	0	0	0	1	0	**1**
LEFT TURN RIGHT ANGLE COLLISION	0	0	0	0	0	**0**
OTHER	8	7	7	1	7	**30**
OUT OF CONTROL	35	54	67	50	36	**242**
PARKING OR PARKED CAR	0	3	1	0	0	**4**
PASSING	42	45	27	21	15	**150**
PEDALCYCLE	0	0	0	0	0	**0**
PEDESTRIAN	1	0	0	0	0	**1**
REAR END	71	68	46	63	45	**293**
RIGHT ANGLE	0	0	0	1	0	**1**
RIGHT TURN	0	2	0	0	0	**2**
RIGHT TURN RIGHT ANGLE COLLISION	0	0	0	0	0	**0**
SIDESWIPE	0	0	0	0	0	**0**
TOWED UNIT DISCONNECTS	0	0	0	0	0	**0**
U - TURN	0	0	1	1	0	**2**
WRONG WAY ON DIVIDED HIGHWAY	0	0	0	0	0	**0**
Total	**166**	**188**	**160**	**151**	**108**	**773**
Selected Travelway	Offset	Designation	Travelway	Direction	Selected City	
		IS	70	E	NONE SPECIFIED	

From	District	County	County Log	Continuous Log		
	5	ST. LOUIS CITY	5.761	248.766		
To	District	County	County Log	Continuous Log		
	5	ST. LOUIS CITY	8.497	251.502		
Intersecting Travelways						
	Designation	Travelway	Direction			
From	CST	ST LOUIS AVE	E			
To	US	40	E			

Summary	2006	2007	2008	2009	2010	Total
Fatal	0	1	1	0	1	**3**
Disabling Injury	3	0	4	4	1	**12**
Minor Injury	42	53	40	45	33	**213**
PDO	0	0	0	0	0	**0**
Total	**45**	**54**	**45**	**49**	**35**	**228**
AADT	46545	47010	46719	47200	46728	
1 Year Statewide Rate						
Accident Rate	97.96	116.39	97.59	105.19	75.89	
STATE RATE-IS						
STATE RATE-FREEWAY						
Accident Class						
ANIMAL OTHER THAN DEER	0	0	1	0	0	**1**
AVOIDING	0	2	2	1	2	**7**
BACKING	0	0	1	0	0	**1**
CHANGING LANE	4	7	7	12	11	**41**
CROSS MEDIAN	0	0	0	0	0	**0**
DEER	0	0	0	0	0	**0**
DUAL LEFTS COLLIDE	0	1	0	0	0	**1**
DUAL RIGHTS COLLIDE	0	0	0	0	0	**0**
FIXED OBJECT	10	5	4	1	1	**21**
HEAD ON	1	0	0	0	0	**1**
JACKKNIFE	0	0	0	0	0	**0**
LEFT TURN	0	0	0	0	0	**0**
LEFT TURN RIGHT ANGLE COLLISION	0	0	0	0	0	**0**
OTHER	2	5	2	4	5	**18**
OUT OF CONTROL	39	41	50	51	40	**221**
PARKING OR PARKED CAR	3	1	3	1	0	**8**
PASSING	39	47	23	24	23	**156**
PEDALCYCLE	0	0	0	0	0	**0**
PEDESTRIAN	0	1	1	0	0	**2**
REAR END	67	72	64	61	51	**315**
RIGHT ANGLE	0	0	0	0	1	**1**
RIGHT TURN	1	0	0	0	0	**1**
RIGHT TURN RIGHT ANGLE COLLISION	0	0	0	0	0	**0**
SIDESWIPE	0	0	3	1	3	**7**
TOWED UNIT DISCONNECTS	0	0	0	0	0	**0**
U - TURN	0	0	0	0	0	**0**
WRONG WAY ON DIVIDED HIGHWAY	0	0	0	0	0	**0**
Total	**166**	**182**	**161**	**156**	**137**	**802**
Selected Travelway	Offset	Designation	Travelway	Direction	Selected City	
		IS	70	E	NONE SPECIFIED	

From	District	County	County Log	Continuous Log		
	5	ST. LOUIS CITY	0	0		
To	District	County	County Log	Continuous Log		
	5	ST. LOUIS CITY	2.704	2.704		
Intersecting Travelways						
	Designation	Travelway	Direction			
From	US	40	W			
To	CST	ST LOUIS AVE	W			

Appendix G

Interstate Level of Service (LOS) Figures

2015 AM Levels of Service (LOS), Sheet 1

PSB AJR
St. Louis, Missouri
Job# 020-13
03/26/13

CBB Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

2015 AM Levels of Service (LOS), Sheet 2

PSB AJR
St. Louis, Missouri
Job# 020-13
03/26/13

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2015 AM Levels of Service (LOS), Sheet 3

PSB AJR
St. Louis, Missouri
Job# 020-13
03/26/13

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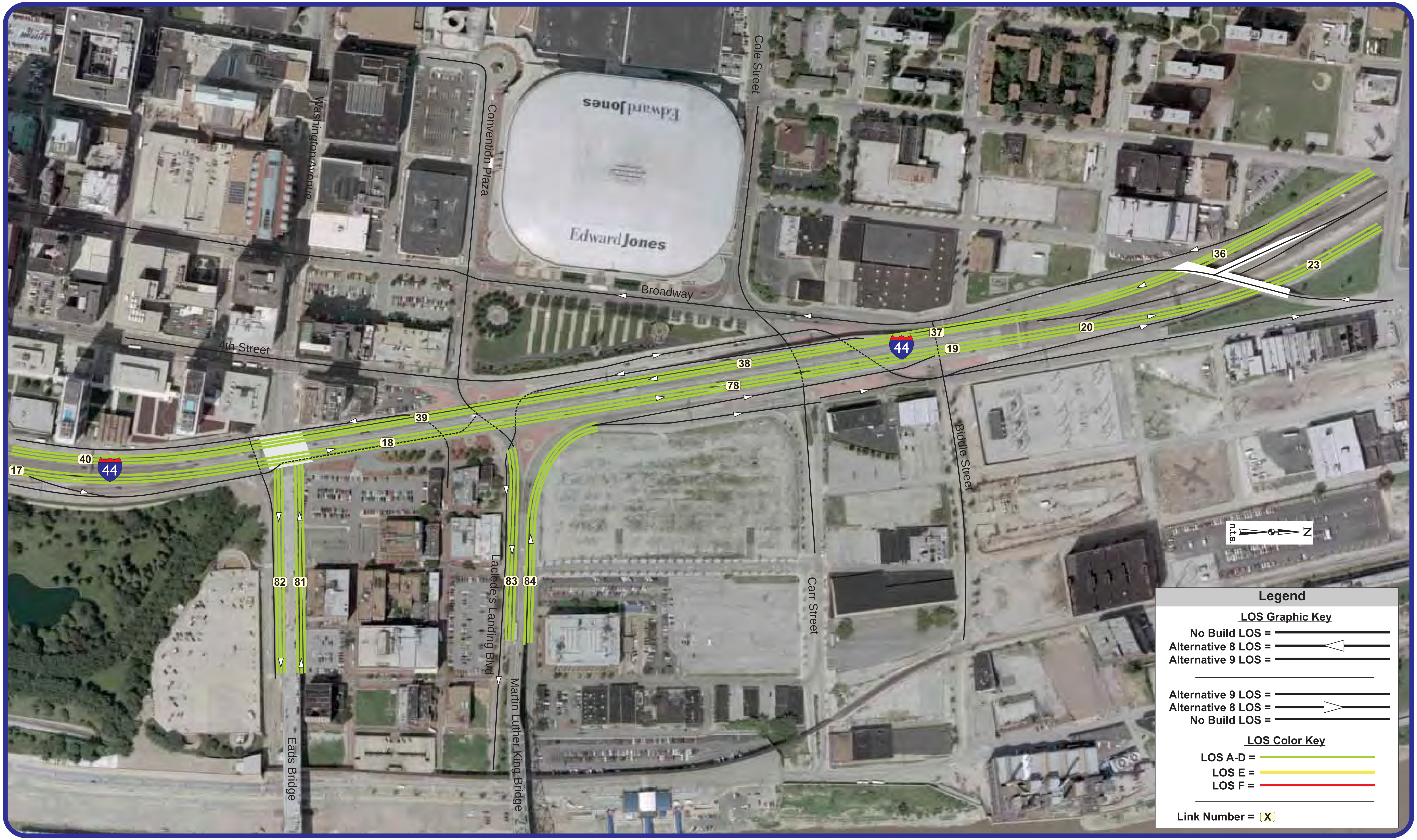

2015 AM Levels of Service (LOS), Sheet 4

PSB AJR
St. Louis, Missouri
Job# 020-13
03/26/13

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2015 AM Levels of Service (LOS), Sheet 5

PSB AJR
St. Louis, Missouri
Job# 020-13
03/26/13

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2035 AM Levels of Service (LOS), Sheet 1

PSB AJR
St. Louis, Missouri
Job# 020-13
03/26/13

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2035 AM Levels of Service (LOS), Sheet 2

PSB AJR
St. Louis, Missouri
Job# 020-13
03/26/13

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2035 AM Levels of Service (LOS), Sheet 3

PSB AJR
St. Louis, Missouri
Job# 020-13
03/26/13

CBB Crawford, Bunte, Brammeier
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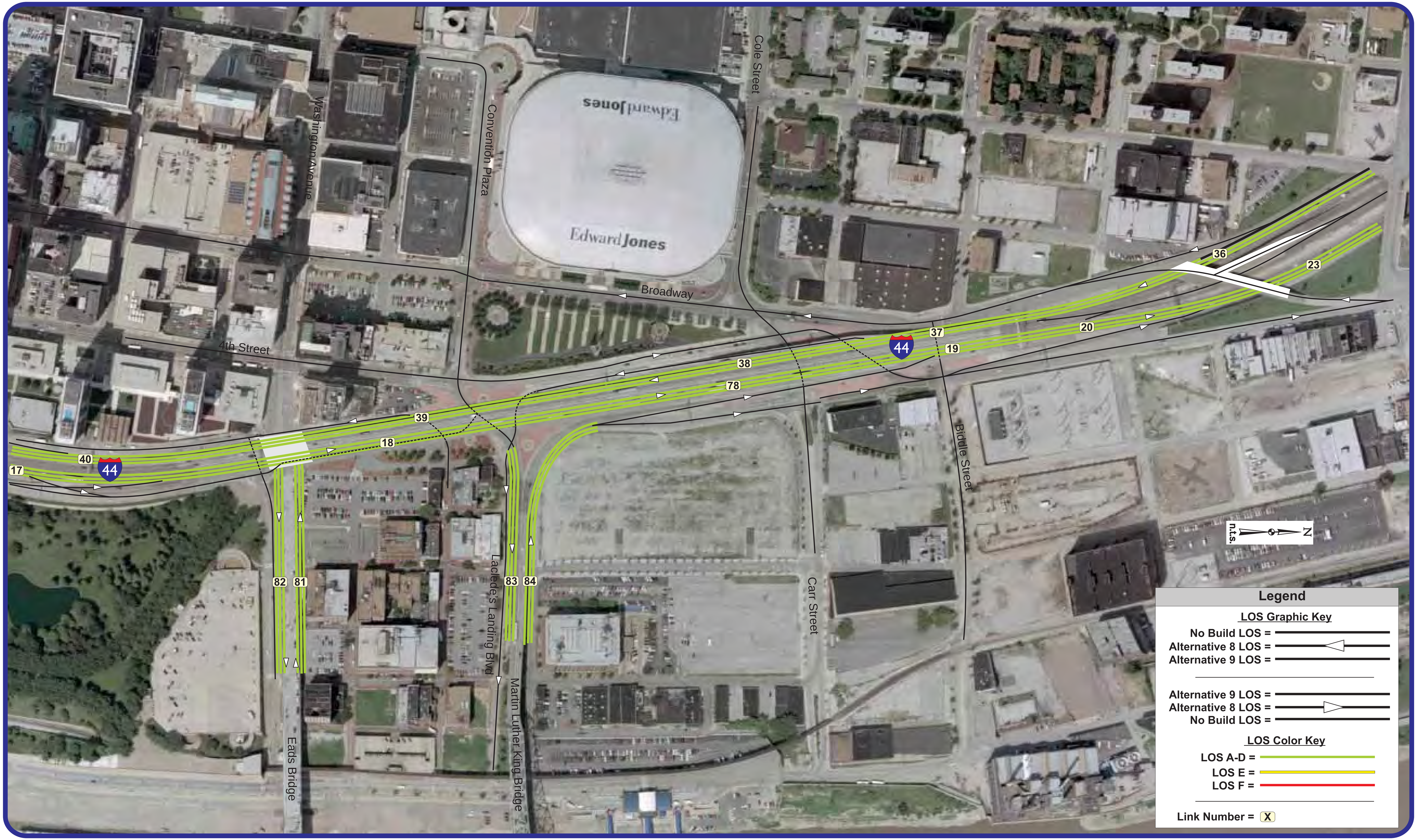

2035 AM Levels of Service (LOS), Sheet 4

PSB AJR
St. Louis, Missouri
Job# 020-13
03/26/13

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2035 AM Levels of Service (LOS), Sheet 5

PSB AJR
St. Louis, Missouri
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03/26/13

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2015 PM Levels of Service (LOS), Sheet 1

PSB AJR
St. Louis, Missouri
Job# 020-13
03/26/13

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2015 PM Levels of Service (LOS), Sheet 2

PSB AJR
St. Louis, Missouri
Job# 020-13
03/26/13

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2015 PM Levels of Service (LOS), Sheet 3

PSB AJR
St. Louis, Missouri
Job# 020-13
03/26/13

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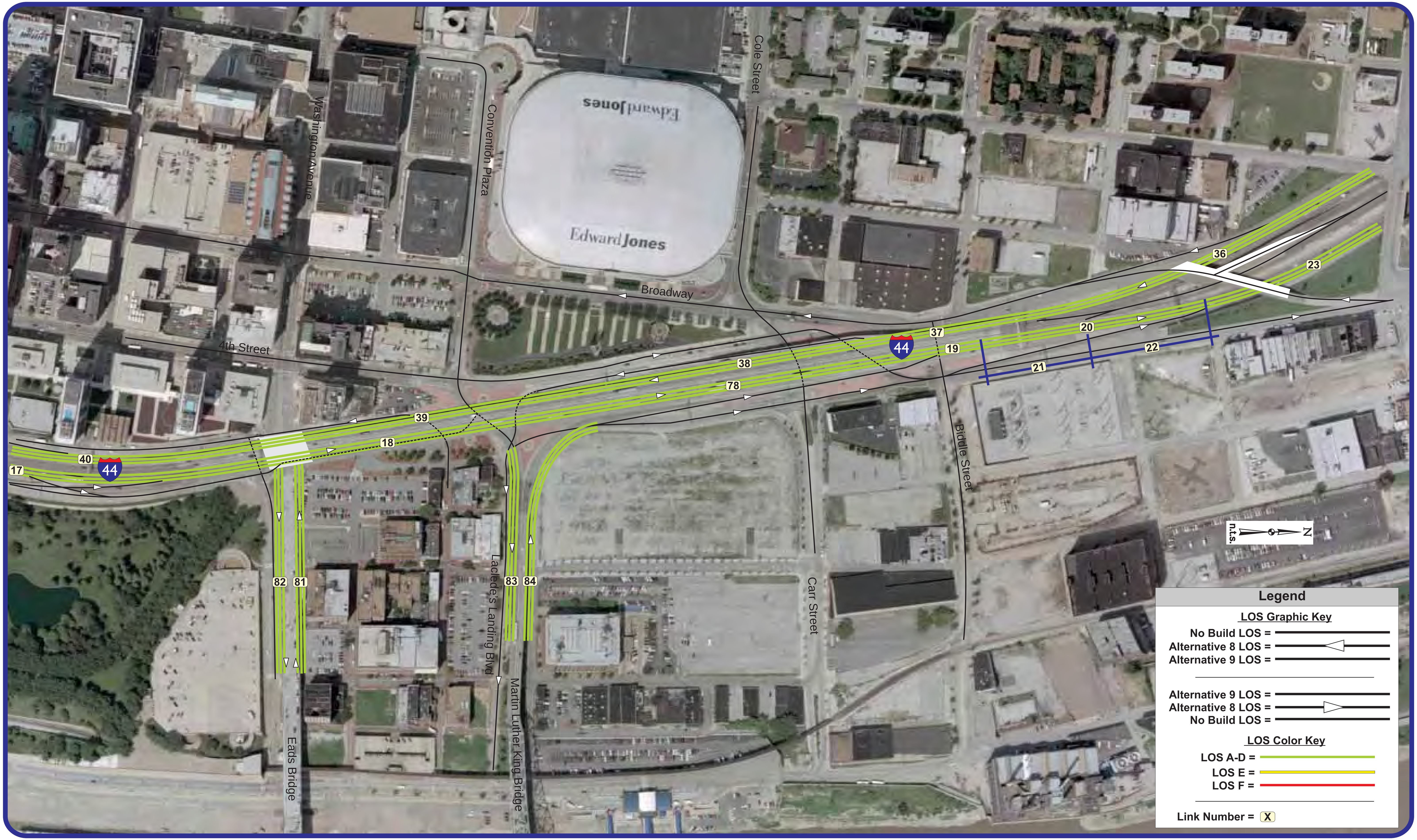

2015 PM Levels of Service (LOS), Sheet 4

PSB AJR
St. Louis, Missouri
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03/26/13

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2015 PM Levels of Service (LOS), Sheet 5

PSB AJR
St. Louis, Missouri
Job# 020-13
03/26/13

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2035 PM Levels of Service (LOS), Sheet 1

PSB AJR
St. Louis, Missouri
Job# 020-13
03/26/13

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2035 PM Levels of Service (LOS), Sheet 2

PSB AJR
St. Louis, Missouri
Job# 020-13
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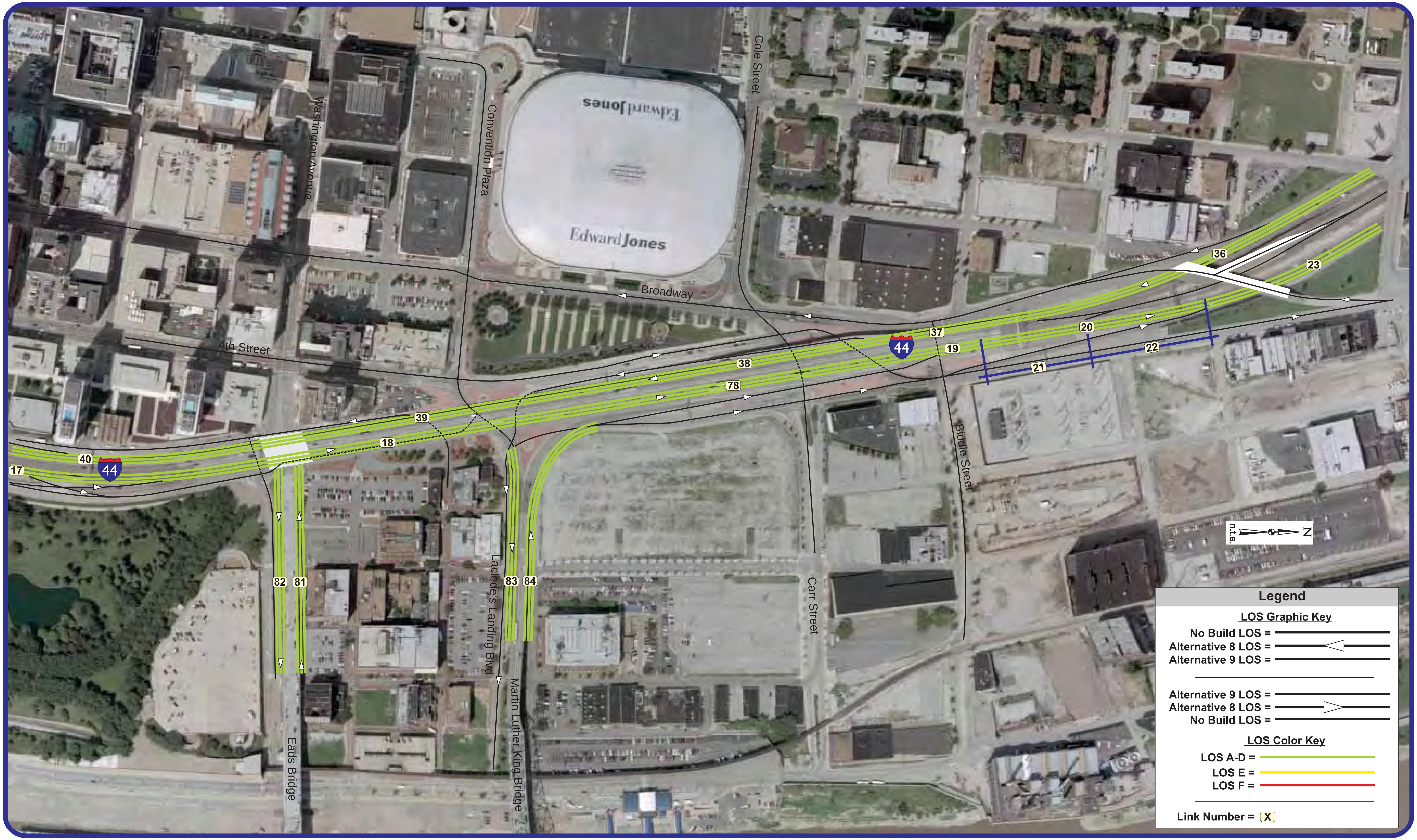
2035 PM Levels of Service (LOS), Sheet 3

PSB AJR
St. Louis, Missouri
Job# 020-13
03/26/13

CBB Crawford, Bunte, Brammeier
Traffic and Transportation Engineers



2035 PM Levels of Service (LOS), Sheet 4

PSB AJR
St. Louis, Missouri
Job# 020-13
03/26/13

CBB Crawford, Bunte, Brammeier
Traffic and Transportation Engineers

2035 PM Levels of Service (LOS), Sheet 5

PSB AJR
St. Louis, Missouri
Job# 020-13
03/26/13

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