

US-169/I-70 North Loop
Planning & Environmental Linkages Study



Refined Strategies Impact and Evaluation Report

Draft – April 20, 2018

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List of Acronyms and Abbreviations

Abbreviation	Term/Phrase/Name
ADA	Americans with Disabilities Act
A.M.	Morning
APE	Area of Potential Effect
AST	Aboveground Storage Tank
ASTM	American Society for Testing and Materials
BGPA	Bald and Golden Eagle Protection Act
BMcD	Burns & McDonnell
BMPs	Best Management Practices
C-D	Collector-Distributor
CBD	Central Business District
CMT	Congestion Management Toolbox
CMP	Congestion Management Process
CWA	Clean Water Act
dBa	A-Weighted Decibels
EDR	Environmental Data Resources, Inc.
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	US Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
GDAP	Greater Downtown Area Plan
GIS	Geographic information system

HCM	Highway Capacity Manual
HCS	Highway Capacity Software
I-29	Interstate 29
I-35	Interstate 35
I-70	Interstate 70
Hg	Hg Consult, Inc.
KCATA	Kansas City Area Transportation Authority
KC EDC	Kansas City Economic Development Council
KCK	Kansas City, Kansas
KCMO	Kansas City, Missouri
KDOT	Kansas Department of Transportation
LCV	Lewis & Clark Viaduct
Leq	Equivalent Sound Level
LOS	Level of Service
LUST	Leaking Underground Storage Tank
MARC	Mid America Regional Council
MBTA	Migratory Bird Treaty Act
MDC	Missouri Department of Conservation
MDNR	Missouri Department of Natural Resources
MO	Missouri
Route 9	Missouri Route 9
MoDOT	Missouri Department of Transportation
MP	Milepost
Mph	Miles Per Hour
MPO	Metropolitan Planning Organization
NAC	Noise Abatement Criteria
NCHRP	National Cooperative Highway Research Program

NEPA	National Environmental Policy Act
NRHP	National Register of Historic Places
PEL	Planning and Environmental Linkages
P.M.	Evening
RCBC	Reinforced Concrete Box Culvert
ROW	Right-of-Way
TAZ	Transportation Analysis Zone
TNM	Traffic Noise Model
TOD	Transit-Oriented Development
UG	Unified Government of Wyandotte County/Kansas City, KS
US-169	US Highway 169
USACE	US Army Corps of Engineers
USCG	US Coast Guard
USDOT	US Department of Transportation
USGS	US Geological Survey
USFWS	US Department of Interior Fish and Wildlife Service
UST	Underground Storage Tank
VMS	Variable Message Sign
Vpd	Vehicles Per Day
Vph	Vehicles Per Hour
Wheeler Airport	
WOUS	Waters of the United States

1. Introduction and Overview

This technical memorandum documents the evaluation, findings, and the selection of the final set of reasonable strategies carried forth through the US-169/I-70 North Loop Planning and Environmental Linkages (PEL) Study.

The study is led by the Mid America Regional Council (MARC), the metropolitan planning organization for the Kansas City metropolitan region, in cooperation with Federal Highway Administration (FHWA), the Missouri Department of Transportation, (MoDOT), and Kansas City, Missouri (KCMO).

The PEL Study focuses on development of a strategic plan that identifies and evaluates a set of reasonable strategies for the US-169 corridor, including access connections to the Downtown Airport, replacement or rehabilitation of the US-169 Buck O'Neil Bridge over the Missouri River, and its connections into downtown Kansas City and the surrounding freeway system. In addition, the Study focuses on the I-70 corridor which traverses the north edge of the KCMO Central Business District (CBD), improvement of traffic flow and better connection of the street grid between the River Market and Downtown KCMO. Additional issues to be considered will include access to the Port of Kansas City, airspace around the Downtown Airport, Missouri River navigation, bicycle and pedestrian accommodations on major bridges, impacts to existing transit and railroads, and opportunities to expand transit. As identified in the Study's Statement of Purpose and Need, the improvement strategies were developed and assessed in relation to their respective abilities to serve future access needs, mobility, safety, system preservation, and economic development/redevelopment opportunities.

The US-169/I-70 North Loop PEL Study covers the general area of the downtown Kansas City area bounded by the shaded limits depicted in Figure 1-1. Predominant highways addressed in the study include I-70 to the east, north, and west of the Kansas City, MO CBD, US 169 extending north from I-70 to approximately Route 9, and Route 9 to the east of US 169, extending north from the CBD to the Heart of America Bridge crossing of the Missouri River. While these routes comprise the primary focus of transportation related strategies in the Study Area, potential operational impacts to other proximate facilities in the region are included as part of the overall evaluation of the possible strategies considered in the Study.

The perimeter of the KCMO CBD is bounded by the circumferential interstate system consisting of I-70 to the east, I-70/I-35 to the north, I-35 to the west, and I-670 to the south (Figure 1-2). This system of highways is commonly referred to in the region as the Loop. I-70 connections to the Loop are at the southeast and northwest corners. I-35 connections to the Loop are at the northeast and southwest corners. For the purposes of discussion in this study, the area of I-70 comprising the north edge is referred to as the North Loop, and the segment of I-670 along the south edge is referred to as the South Loop.

BEYOND THE LOOP
STUDY AREA

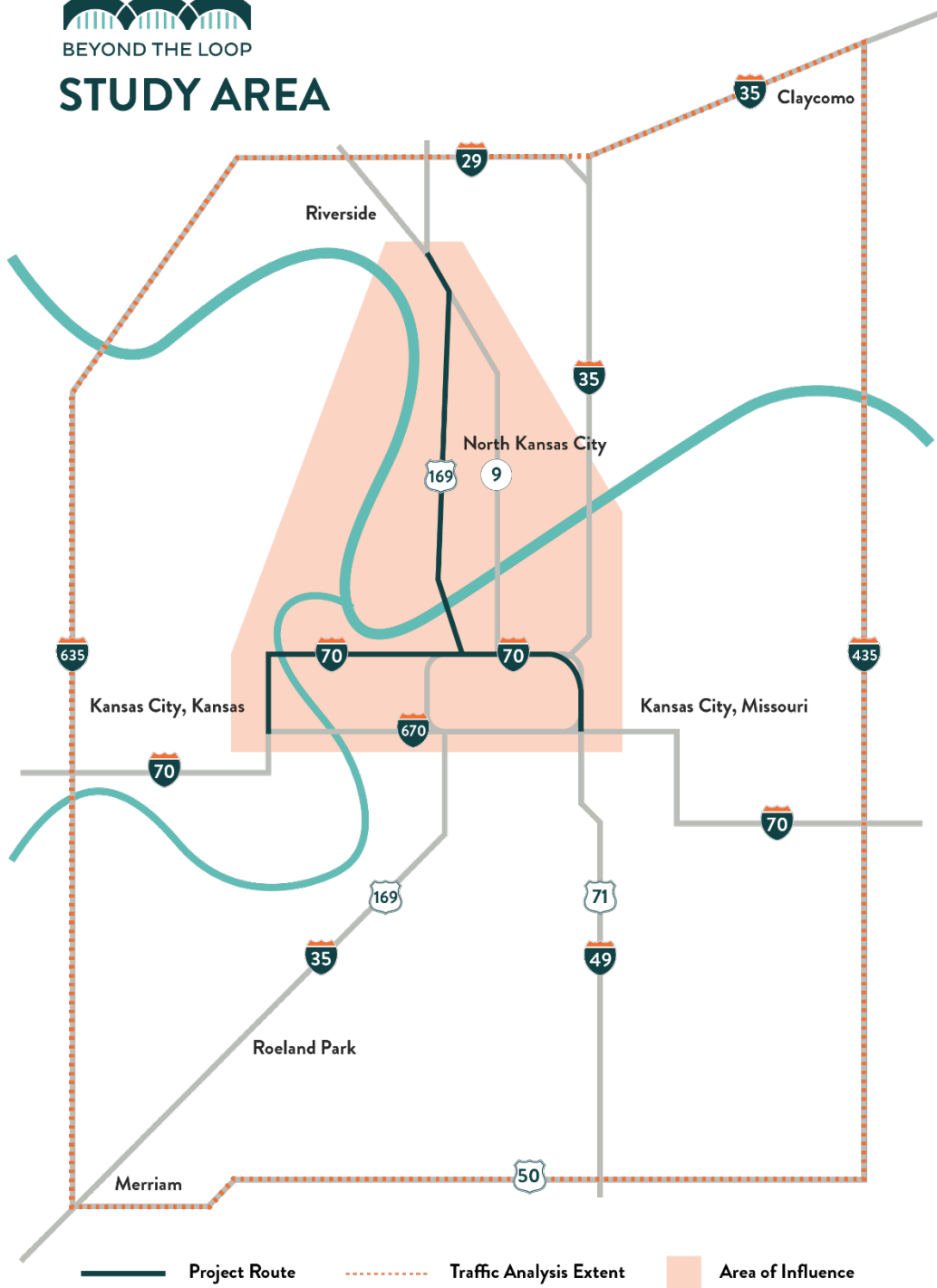


Figure 1-1: US-169/I-70 North Loop Planning and Environmental Linkages (PEL) Study Area Map

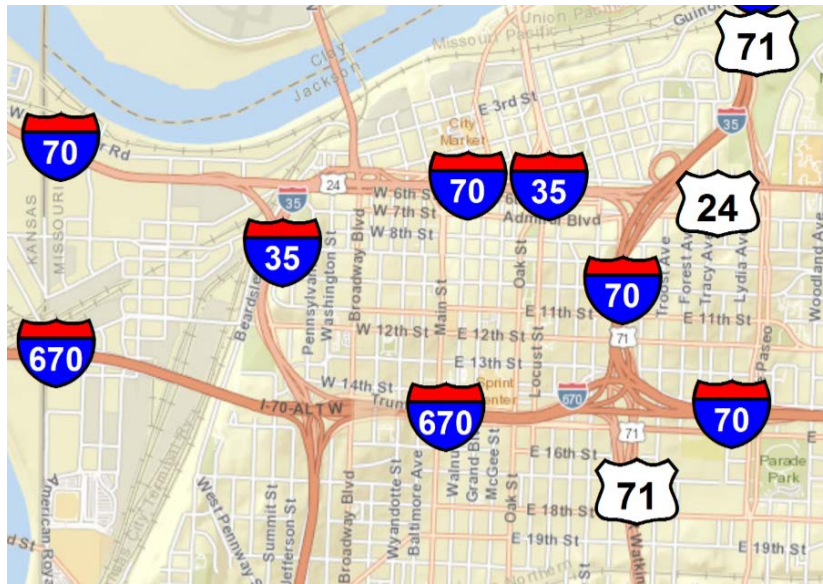


Figure 1-2: US-169/I-70 Loop

After conducting a Level 1 screening of a broad range of alternatives and strategies, those that were advanced have been refined. This report presents the Refined Strategies and their Level 2 evaluation to determine how well they meet the identified purpose and need. It considers features along the US-169 corridor including northward access connections to the Charles B. Wheeler Downtown Airport (Wheeler Airport), replacement or rehabilitation of the US-169 Buck O’Neil Bridge, and southward connections to I-35 and Downtown and River Market areas. Features along the I-70 corridor include the western connections to I-70, I-35 and US-169, eastern connections to I-70 and I-35, connections to Downtown areas, traffic flow, and connection of the street grid between the River Market and Downtown. Additional geographic areas evaluated include Route 9 connections between River Market and Columbus Park and West Bottoms connections. Additional features considered include access to the Port of Kansas City, airspace around the Downtown Airport, Missouri River navigation, bicycle and pedestrian accommodations on major bridges, impacts to transit and railroads, recommendations and plans relating to the KDOT Lewis and Clark Viaduct study and design, and potential downtown interstate access and routing. Improvement strategies will address future access needs, mobility, safety, system preservation, and redevelopment.

This Refined Strategies Impacts and Evaluation Report summarizes the range of refined conceptual strategies identified to respond to the project’s stated needs and objectives defined in the Study’s Statement of Purpose and Need. This analysis considered and applied data obtained from a variety of sources, including MoDOT traffic and safety evaluations, MARC and KCMO traffic models, and information obtained from other federal, state and local agencies. The full spectrum of data sources is identified and documented in the companion Data Sources Technical Memorandum. Information gathering has benefited from a comprehensive agency and stakeholder coordination effort. The findings of the baseline information are documented in the detailed Study Area Condition Assessment Report which is referenced in support of the Purpose and Need statement. It is anticipated that the findings and recommendations of this report will be used to inform future project-level National Environmental Policy Act (NEPA) studies.

The identification and development of the strategies was supported by reference to the MARC Congestion Management Toolbox (CMT), updated in 2013 as a component to MARC’s current Congestion Management Process (CMP) adopted in 2011 to meet the needs of the Kansas City metropolitan area. The

CMP is intended to formulate a systematic approach to monitor, measure, and diagnose causes of current and projected future congestion on the region’s multi-modal transportation system. The Process formulates the framework for evaluating and recommending alternative strategies to manage congestion, and to ultimately monitor the performance of implemented strategies. The CMP is integrated into the regional metropolitan process and conforms with the requirements promulgated by federal transportation legislation (23 CFR 450.320).

The CMT was developed as a companion component to the CMP to provide a reference of alternative strategies to consider in corridor studies and subsequent NEPA documents. In 2013, the Toolbox was updated to expand the number of strategy categories, include additional contemporary strategies, and additional supporting information. In addition to supporting the identification and development of strategy concepts, the Toolbox also provides a general framework for establishing criteria for analyzing and evaluating the strategies as outlined in the Strategy Evaluation and Screening Methodology Technical Memorandum for this PEL Study.

On August 22, 2017, a public meeting was conducted to present the conceptual strategies that were selected to be advanced to a higher level of detail, refinement, and analysis. Graphics and other information presented to the public are provided in the separate Initial Strategies Report. Results of public input and response to the strategies are documented separately, with additional information provided at the project website – beyondtheloopkc.com. The PEL process will culminate with the screening of the refined strategies to a final set of reasonable strategies which will be carried through the subsequent NEPA process which will formulate the basis for the selection of the preferred strategies upon reconciliation of any future project commitments.

1.1 Consistency with Purpose and Need

The Purpose and Need Statement sets the stage for consideration of the strategies for the Study Area. The Purpose defines the transportation problem to be solved, and the Need provides the data to support the problem statement (Purpose). The Purpose and Need Statement captures what is to be accomplished and why is it necessary. This statement is then used to guide the development of strategies, so that only those strategies that meet the Purpose and Need are carried forward.

STUDY PURPOSE:

The study purpose is to seek the most effective approach to improving the transportation facilities in the Study Area identified in Figure 1-1, including the development of alternative strategies, which, when implemented, will meet the identified current and future needs while balancing the interests of the various stakeholders.

For this Study, the interests of the stakeholders can be grouped into three distinct groups:

- **Federal/State** – The federal interest includes maintaining the viability of the interstate highway system for long-distance travel. The state interest includes improving the condition of the transportation assets on the state highway network in both Missouri and Kansas, providing opportunities for improved goods movement, and improving the travel conditions for long-distance travel.
- **Regional** – The regional interest includes improving the ability of the traveling public to access the Central Business District (CBD), River Market, Charles B. Wheeler Downtown Airport and other

regional destinations for work, services, recreation, or commerce, as well as maintaining access to critical infrastructure and industry.

- **Local** – The local interest includes improving the economic viability of the KCMO Downtown core, including adjacent neighborhoods and economic centers, through improved accessibility, modal options, and environmental sustainability.

STUDY NEEDS:

The strategies were presented and discussed with the members of a Study Management Team (SMT) consisting of staff from MARC, KCMO, MoDOT, the Kansas Department of Transportation (KDOT), and the Unified Government of Wyandotte, County/Kansas City, Kansas (UG). The review included a qualitative assessment of the strategies in relation to how they perform in satisfying the project needs, goals, and objectives summarized as follows:

- **NEED 1: Improve Physical Conditions** – Ensure that existing and new transportation assets in the Study Area better serve the region and are maintained in a state of good repair.
- **NEED 2: Optimize System Performance** – Manage the operations of the existing transportation facilities to achieve reliable and efficient performance.
- **NEED 3: Improve Safety & Security** – Identify reasonable improvements to ensure the safety and security of the affected area.

STUDY GOALS:

The following goals and objectives are considered in the comparative evaluation of strategies developed to address the stated needs:

- **GOAL 1: Improve Transportation Choices** – Provide viable, accessible, multimodal transportation.
- **GOAL 2: Improve Economic Vitality and Placemaking** – Improve transportation and land-use linkages in the Study Area.
- **GOAL 3: Improve Sustainability** – Protect and enhance the region’s natural, cultural, and social resources. Explore ways to mitigate the adverse impacts of the existing system and proposed alternatives.

1.2 Geographical Segments

The Study Area contains several different physical and operational characteristics. To facilitate the evaluation, screening, and refinement of the potential strategies, the Study Area has been divided into five geographical segments which include the four geographical segments. These segments were presented in the Initial Strategies Report, and the separate breakout of Route 9 from the I-70 North Loop segment that was added during project development process. As strategy development and evaluation activities proceeded with subsequent studies, certain refinements necessary to address how these different segments interrelated, and potentially how they would be phased and constructed as segments of independent utility.

Area A - Missouri River Bridge and Interchange: This segment includes US-169 from landward of the floodwall near the north bank of the Missouri River to I-35/I-70 at the northwest corner of the KCMO CBD. This set of strategies includes connections linking US-169 with I-70, I-35, and directly with the downtown KCMO local roadway network. See Section 2 of this report for detailed information on the definition, evaluation, and screening of Missouri River Bridge and Interchange strategies.

Area B - I-70 North Loop: This segment includes the 3/4-mile section of I-70 from the northeast corner of the CBD to the northwest corner of the CBD. This segment is currently co-designated as I-35 and I-70. Strategies in this area include alternative modifications to access and the overall transportation system serving the various land uses in the Study Area. See Section 3 of this report for detailed information on the definition, evaluation, and screening of I-70 North Loop strategies.

Area C – Charles B. Wheeler Downtown Airport: This segment includes US-169 from just north of the Wheeler Airport (NW Lou Holland Drive), to landward of the floodwall near the north bank of the Missouri River. This set of strategies includes maintaining and improving access to the Wheeler Airport to the west, and the Harlem area of Kansas City to the east. It also includes alternatives to improve access between the airport and US-169 that are independent of the alternative interchange strategies. See Section 4 of this report for detailed information on the definition, evaluation, and screening of Wheeler Airport strategies.

Area D - West Bottoms: This segment includes I-70 from US-169 to the Kansas River. These strategies are focused on connections to the West Bottoms from KCMO, which are potentially affected by alternatives along the Missouri River Bridge and I-70 North Loop segments. See Section 5 of this report for detailed information on the definition, evaluation, and screening of West Bottoms strategies.

Area E - Route 9: This segment includes the 0.5-mile section of Route 9 from the Heart of America Bridge to Admiral Boulevard. These strategies were previously included in the I-70 North Loop segment and focus on bringing all or part of Route 9 back down to grade to reconnect the River Market and Columbus Park neighborhoods on either side. See Section 6 of this report for detailed information on the definition, evaluation, and screening of Route 9 strategies.

A set of Transportation System Management (TSM) strategies that aim to improve efficiencies by reducing congestion, primarily by improving transportation system capacity and efficiency are incorporated into each of the individual geographical segment strategies where feasible.

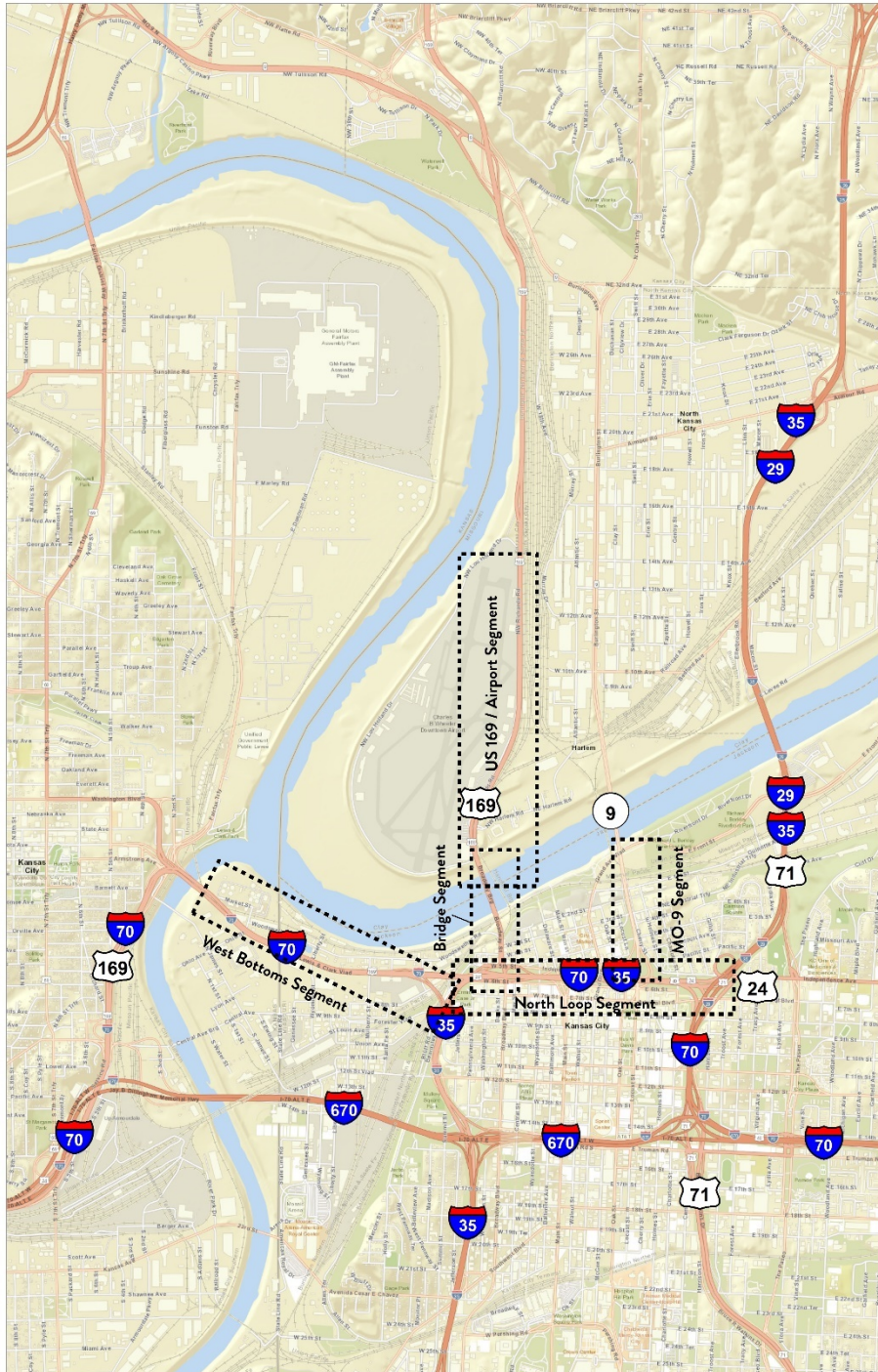


Figure 1-3: Geographic Segments Key Map

1.3 Initial Strategies Evaluation Summary

At the Level 1 - Initial Strategies stage of the PEL Study, a set of potential strategies were developed for each of the four initially identified geographical segments. The strategies were developed at a concept level of limited detail to provide a general location and notion of traffic operations for mainline and access movements.

The Level 1 screening was performed within each geographical segment based on two primary components. A detailed matrix was developed based on a comprehensive list of quantitative and qualitative measurable items developed to provide the best relative assessment of alternatives possible based on current available data. Other elements where information could not be obtained, was not available, or was prohibitively cumbersome to calculate, such as detailed traffic operational analysis, were given a qualitative measure based on expert opinion and relative performance.

The results of the Level 1 screening are shown below:

Table 1-1: Initial Level 1 Strategy – Area A: Missouri River Bridge

Area A: Missouri River Bridge	Strategy	Description	Status
Rehabilitate the Existing O’Neil Bridge (No-Build Condition)	A1	Rehabilitation of the existing bridge as currently programmed would consist of a \$52 million project and would restore the structure to satisfactory physical condition, and would extend the expected service life of the bridge an additional 35 years	Advanced
Western Alignment	A2	Approximate 28-degree skew from perpendicular to the navigation channel. Most direct connection to I-35.	Advanced
Central Alignment	A3	Approximate 21-degree skew from perpendicular to the navigation channel. Approximately halfway between the existing bridge at Broadway and I-35 at the west side of the loop.	Advanced
Eastern Alignment	A4	Approximate 10-degree skew from perpendicular to the navigation channel. Location adjacent to existing bridge. Requires reconfiguration of existing Broadway interchange	Advanced
New Bridge with Rehabilitation and Re-purposed O'Neil Bridge	A5	Construction of a new bridge at either the previously described A2 or A3 alternative locations, combined with the rehabilitation of the existing bridge.	Screened Out
Combination New Bridge with New Railroad Bridge	A6	Construction of a structure that combines a new highway bridge with a replacement of the existing Hannibal Bridge that carries the BNSF railway.	Screened Out

Table 1-2: Initial Level 1 Strategy – Area B: I-70 North Loop

Area B: I-70 North Loop	Strategy	Description	Status
Re-Use I-70 Mainline and Consolidation of Ramps and Access Points	B1	Replicates the design concept that was developed in 2005 to support the original I-29/I-35 corridor EIS.	Advanced
New Collector Distributor (CD) System	B2	Removes short sections of auxiliary lanes from the existing I-70 mainline and constructs a new CD System within the I-70 right-of-way to consolidate and distribute access into the River Market and CBD	Screened Out
<i>Compressed Footprint Strategies</i>			
Compressed Footprint South Strategy	B3-6a	Compressed I-70 Along South Side of Corridor with Access at Independence Ave. Independence Avenue converted to an arterial roadway with connections across MO-9 and 6th Street two-way between Broadway and Charlotte with connections at MO-9. Possible Roundabout and MO-9	Advanced
Compressed Footprint North Strategy	B3-6b	Compressed I-70 Along North Side of Corridor with Access at Broadway and MO-9. Compressed I-70 Along South Side of Corridor with Access at Independence Ave. Independence Avenue converted to an arterial roadway with connections across MO-9 and 6th Street two-way between Broadway and Charlotte with connections at MO-9.	Advanced
Compressed Footprint on Centered Strategy	B3-7	Compressed I-70 Along Centerline of existing I-70. Compressed I-70 Along South Side of Corridor with Access at Independence Ave. Independence Avenue converted to an arterial roadway with connections across MO-9 and 6th Street two-way between Broadway and Charlotte with connections at MO-9.	Advanced
<i>One-way Circulation Strategies</i>			
Reconfiguration of the Downtown Loop to One-Way Directional	B4	Reconfigures the entire loop system to carry traffic one-way in the counter clockwise direction.	Screened Out
Reconfiguration of the Downtown Loop to One-Way Directional with CD System	B5	Mimics Strategy B4 and includes a CD system in the opposing direction to mitigate the major missing directional connections on the east and west legs of the loop.	Screened Out
Reconfiguration of the Downtown Loop to Partial One-Way Directional	B6	Reconfigures the downtown loop to partial one-way counter clockwise circulating interstate system.	Screened Out
<i>Remove and Reclassify North Loop</i>			

Reclassify North Loop to Local Street Network	B7-1	Develop local roadways to support primary east-west traffic connections including Independence Avenue converted to an arterial roadway with connections across MO-9 and 6th Street two-way between Broadway and Charlotte with connections at MO-9.	Advanced
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Table 1-3: Initial Level 1 Strategy – Area C: Wheeler Airport

Area C: Wheeler Airport	Strategy	Description	Status
Interchange Improvements			
Half Diamond Interchange with Existing Harlem Road Access	C1	A half diamond interchange, with the exit and entrance ramps on the east side.	Advanced
Half Diamond Interchange with Direct Connection to Northbound Richards Road	C2	Similar to strategy C1 except US-169 NB exit ramps connects to Richards Road.	Screened Out
Half Diamond Interchange with Relocated Harlem Railroad Crossing and Improved Direct Connection to Northbound Richards Road	C3	Similar to strategy C1 except the Harlem Road railroad crossing is relocated.	Screened Out
Half Diamond Interchange with Split Lou Holland Undercrossing	C4	Similar to strategy C1 except Northbound Lou Holland drive splits near the floodwall and provides direct connection to Northbound US-169 and Richards Road via a weaving movement.	Advanced
Half Diamond Interchange with New Single Harlem Road Railroad Crossing	C5	A half diamond interchange, with the exit and entrance ramps on the east side. Harlem Eastbound and Westbound traffic is brought together for a single railroad undercrossing.	Advanced
Button-Hook Interchange with Relocated Harlem Railroad Crossing	C6	A half diamond interchange with button-hook style ramps, along with the exit and entrance ramps on the east side. The Harlem Road railroad undercrossing is relocated either to the north or south.	Screened Out
Auxiliary Improvements			
Right-In/Right-Out at Grade Improvements	C7	Improve existing RIRO by providing separated accel/decel lanes	Advanced
Interchange Improvements at Richards Road (North)	C8	New folded diamond interchange with SB on and exit ramp connections and NB entrance ramp Connections	Advanced

Table 1-4: Initial Level 1 Strategy – Area D: West Bottoms

Area D: West Bottoms	Strategy	Description	Status
<i>New Interchange Strategies on I-70 to mitigate possible closure of Woodswether Viaduct and connection to Broadway</i>			
Half Diamond Interchange at Wyoming Street	D1	Provides partial interchange access into and out of the West Bottoms from I-70. Reduces impacts to the existing Kansas City Missouri Waste Water Treatment Facility.	Screened Out
Full Diamond Interchange at Wyoming Street	D2	Provides all traffic movements between I-70 and Wyoming Street.	Screened Out
Folded Diamond Interchange at Wyoming Street	D3	Eliminates impacts to the existing Kansas City Missouri Wastewater Treatment Facility in the NW quadrant of I-70 and Wyoming Street. Provides all movements to and from I-70 at Wyoming Street. Provides additional separation distance from future Phase 2 construction of the LCV.	Screened Out
Partial Folded Diamond Interchange at Wyoming Street	D4	Eliminates impacts to the existing Kansas City Missouri wastewater treatment facility in the NW quadrant of I-70 and Wyoming Street. Eliminates tight radius (20 mph) loop ramp for EB I-70.	Screened Out
Madison Ave to Santa Fe Street	D5	New connection between Woodswether and Forrester	Screened Out
Mulberry St to Forrester Road	D6	Utilize existing Mulberry Street between Woodswether and Forrester	Advanced
Wyoming St to Forrester Road	D7	Utilize existing Wyoming Street between Woodswether and Forrester	Advanced
4 th Street Connection	D8	Construct an extension of 4 th Street over the railroad with connection to Woodswether Road	Advanced

1.4 Refined Strategies Evaluation

A Level 2 evaluation was performed within each geographical segment on each of the strategies advanced from the Level 1 screening to evaluate their ability to serve the identified needs and goals. While many of the measures are directly quantified, some of the criteria and objectives were comparatively rated qualitatively. The rating of these measures was completed with input from the Technical Advisory Group (TAG) and the public through the stakeholder engagement process.

A detailed discussion of the evaluation methodology is provided in the Screening Evaluation and Screening Methodology Technical Memorandum.

A discussion of the results of the evaluation can be found in this report as follows:

Section 2	Area A – Missouri River Bridge and Interchange
Section 3	Area B – I-70 North Loop
Section 4	Area C –Wheeler Airport
Section 5	Area D – West Bottoms
Section 6	Area E – Route 9

The Evaluation Matrices are available in Appendix F.

2. Area A: Missouri River Bridge and Interchange

2.1 Constraints and Conditions

The existing US-169 Buck O'Neil Bridge over the Missouri River is nearing the end of its service life and has been reviewed for replacement or rehabilitation by MoDOT. Three alternate alignments are being considered for a new bridge. Figure 2-1 illustrates the extent of the geographic area covering the Missouri River bridge and interchange strategy development.

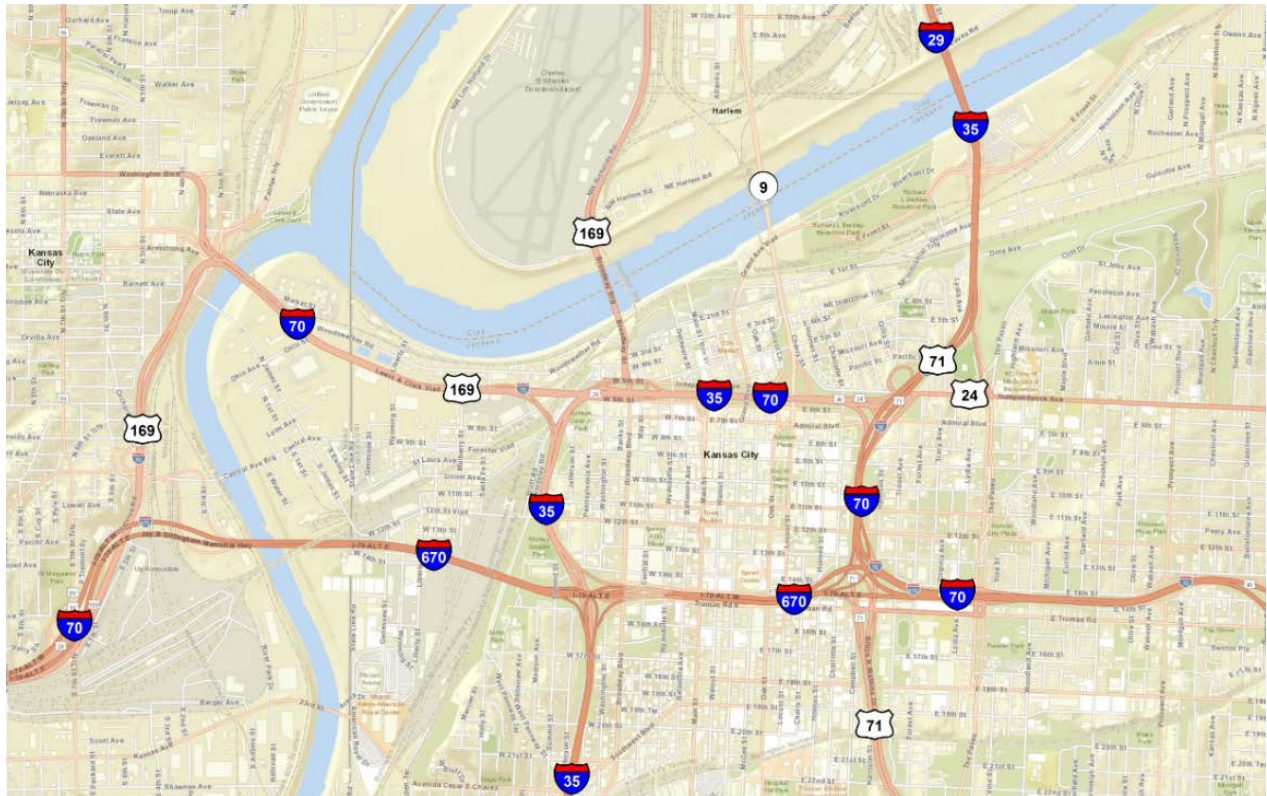


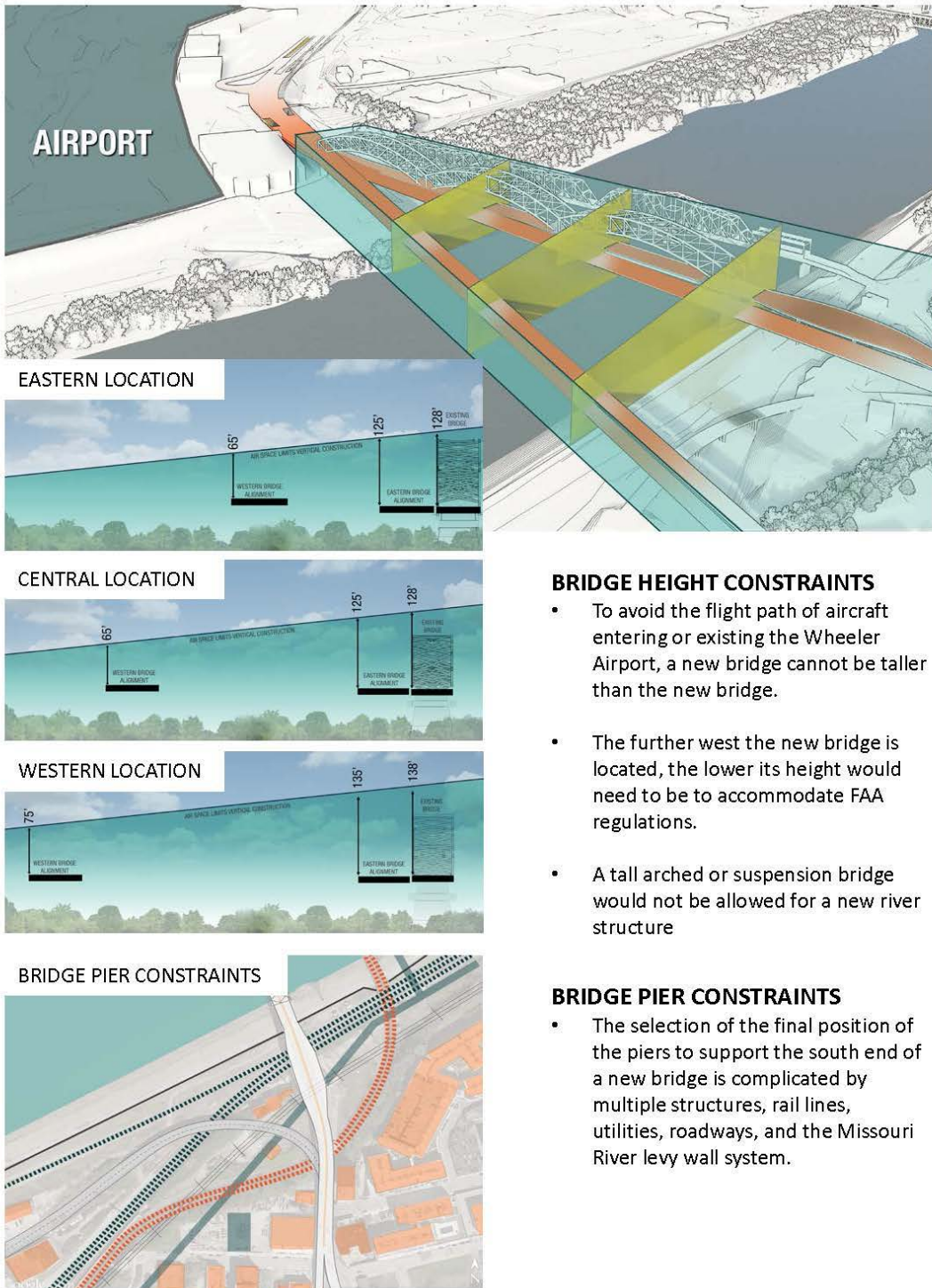
Figure 2-1: Missouri River Bridge and Interchange Geographic Area

In addition, given its current condition and status of potential inclusion in the Missouri five-year State Transportation Improvement Program (STIP), a major rehabilitation of the existing bridge will constitute the No-Build alternate. The bridge strategies are defined by their relative position to the existing bridge and the river. On the north side of the river and landward of the floodwall, all new bridge alignments are immediately adjacent to the existing US-169 alignment and are constrained by the BNSF railroad to the east and the existing airport building to the west. Because the bridge alignment directly influences the type and location of the interchange for connections with I-35, I-70, and the CBD, four interchange strategies are also considered for connecting the bridge into highways and local roads south of the Missouri River.

Figure 2-2 depicts some of the physical and environmental constraints that limited the potential options for a bridge crossing location, particularly on the south side of the river. These constraints include

proximity of bridge piers to multiple railroad tracks, vertical height clearance for the Wheeler Airport approach surface, and a multitude of significant utilities and pump stations on both banks of the river.

These strategies were developed and screened based on their ability to meet the purpose and need, and since the purpose and need does not specifically address bridge type, then bridge type is not a singular separate consideration. Each bridge strategy is, however, considered only if it is structurally feasible (i.e. that there is no fatal flaw in the alignment, number of lanes, or traffic conditions).



BRIDGE HEIGHT CONSTRAINTS

- To avoid the flight path of aircraft entering or existing the Wheeler Airport, a new bridge cannot be taller than the new bridge.
- The further west the new bridge is located, the lower its height would need to be to accommodate FAA regulations.
- A tall arched or suspension bridge would not be allowed for a new river structure

BRIDGE PIER CONSTRAINTS

- The selection of the final position of the piers to support the south end of a new bridge is complicated by multiple structures, rail lines, utilities, roadways, and the Missouri River levy wall system.

Figure 2-2: Bridge Crossing Constraints

2.2 Conceptual Strategies

Four strategies were carried forward from the initial screening that address the need of crossing the Missouri River by either using or replacing the US-169 Buck O'Neil Bridge along with four interchange strategies for connecting the bridge with I-70, I-35, and the CBD. Various combinations of bridge and interchange strategies are possible depending on which bridge alignment is ultimately chosen. Detailed graphics of these strategies can be found in Appendix A.

A new Missouri River bridge would consist of a four-lane structure with four 12-foot lanes, 8-foot outside shoulders and 4-foot inside shoulders. Northbound and southbound traffic would be separated by a concrete median barrier. A 10-foot clear width shared use path has been assumed on the east side of the northbound roadway, protected from traffic by a concrete barrier. The bridge may widen to three lanes in one or both directions near the south end to accommodate the divergence or convergence of ramps connecting US-169 to I-35 and the CBD and to support traffic operations. An underdeck steel plate girder structure can be used to minimize encroachment into the airspace for the Wheeler Airport. Bridge span length and pier placement will be dictated by Missouri River navigation requirements and the need to minimize impacts to the levee systems, railroads, and local roads.

A concept-level discussion was conducted with the US Coast Guard (USCG) regarding navigation requirements at this reach of the river. The existing Hannibal Railroad Swing Bridge, located just downstream of the existing Buck O'Neil Bridge, is oriented perpendicular to the USCG sailing line of the navigation channel. That bridge provides only 200 feet of horizontal clearance for navigation and is the smallest bridge opening along this reach of the river.

The existing Buck O'Neil Bridge is oriented approximately 10 degrees from perpendicular to the navigation channel. This bridge provides 500 feet of horizontal clearance when measured perpendicular to the navigation channel. According to the USCG, barge vessels typically sail next to the right descending bank when passing beneath the Buck O'Neil Bridge, with the stern of the tow maneuvered as close to the bank as possible to line up with the 200-foot clearance at the Hannibal Bridge just downstream. The USCG has indicated that a reduced 400-foot horizontal clearance is a reasonable requirement for a new bridge at this location, when measured perpendicular to the navigation channel from the right descending bank.

The Adjacent, Central and West Bridge Alignments are located at 10, 21 and 28 degrees from perpendicular to the navigation channel, respectively. The clear span required for navigation along the skew increases to 407 feet, 429 feet and 453 feet when moving from east to west. A longer navigation span is required for the larger skews but can still be accomplished with a conventional steel plate girder bridge configuration.

Each strategy has its own inherent set of underlying trade-offs as they relate to costs, local and regional mobility during and after construction, and how well each strategy addresses the project needs and accomplishes the desired goals. This section briefly describes the strategies and includes an assessment of each strategy based on a set of performance measures derived to understand the ability of a strategy to achieve the desired outcomes. The Bridge Strategies evaluated include the following:

Strategy A1 – Existing Alignment (No-Build)

The rehabilitation of the existing bridge as currently programmed would consist of a \$52 million project that restores the structure to satisfactory physical condition and extends the expected life of the bridge for an additional 35 years. This is considered the No-Build condition as it constitutes the future condition of

the bridge without the construction of a replacement structure. Connections with Broadway and I-35 could be improved under this strategy by a total reconstruction of the existing interchange with a high capacity type interchange, but these improvements are not included in the rehabilitation scope or cost. A new six-foot sidewalk was included in this structural rehabilitation scheme for the bridge although connections to existing facilities have not yet been established.

Strategy A2 – West Alignment

Strategy A2, illustrated in Figure 2-3 below, consists of a new bridge that is oriented in the westernmost alignment. It is the straightest connection between US-169 north of the river to I-35 south of the river.

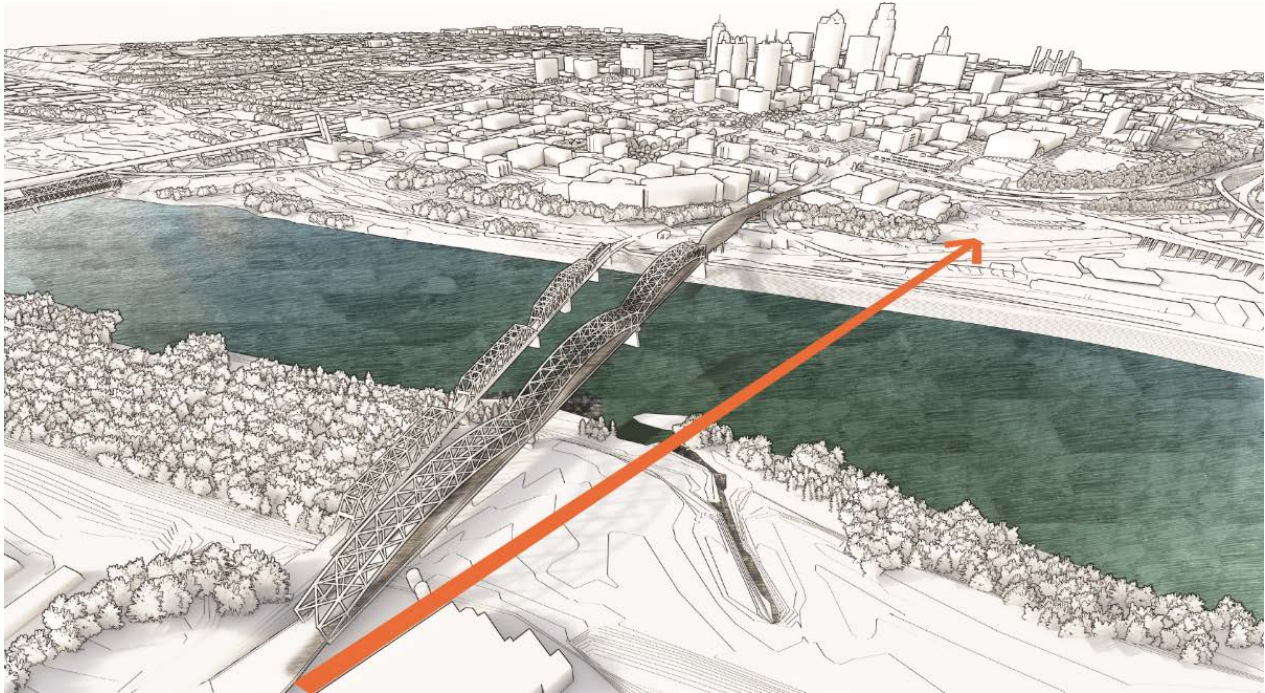


Figure 2-3: West Alignment Strategy

Strategy A3 – Central Alignment

Strategy A3, illustrated in Figure 2-4 below, consists of a new bridge that is oriented between the westernmost alignment and the existing bridge.



Figure 2-4: Central Alignment Strategy

Strategy A4 – Adjacent Alignment

Strategy A4, illustrated in Figure 2-5 below, consists of a new bridge that is parallel and adjacent to the existing bridge.



Figure 2-5: Adjacent Alignment Strategy

To connect a new Buck O’Neil Bridge to I-70, I-35, and local roads, the following four Interchange Strategies have been developed that can be used with one or more of the Bridge Strategies. The Interchange Strategies are as follows:

Interchange Strategies - Depending on which Bridge Strategy is selected, several possible concepts for Interchange Strategies have been defined for connecting the new bridge to I-35 and the CBD. Since almost half of the traffic on the bridge connects with I-35 on the west side of the Loop, one of the key elements to improving traffic operations is the separation of the two distinct travel markets. Each interchange accommodates a direct connection with the freeway system and local connection into the CBD in the vicinity of Broadway. Depending on which North Loop strategy is paired with the new bridge and interchange, the distribution of traffic is expected to shift more towards the direct freeway connection. All the strategies entail a braided split and convergence near the south end of the river structure to accomplish this, and either a left-side or right-side exit northbound from the freeway system. The final determination of the northbound exit configuration will depend on which bridge and interchange strategy is recommended and determined in subsequent environmental studies.

Interchange Strategy AB1 – Broadway Direct Connection

Interchange Strategy AB1, illustrated in Figure 2-6, provides for direct connections of both northbound and southbound US-169 to I-35 on the west side of the loop and to Broadway north of the 5th Street/Independence Avenue intersection for connection to the CBD. Portions of the existing

Woodswether Viaduct that connects the West Bottoms to River Market and Broadway would likely be removed due to anticipated bridge pier conflicts. Strategies to provide access from West Bottoms to downtown KCMO areas are addressed in Section 5 of this report.

This strategy is compatible with Bridge Strategies A2, A3, or A4 and with all North Loop Strategies.

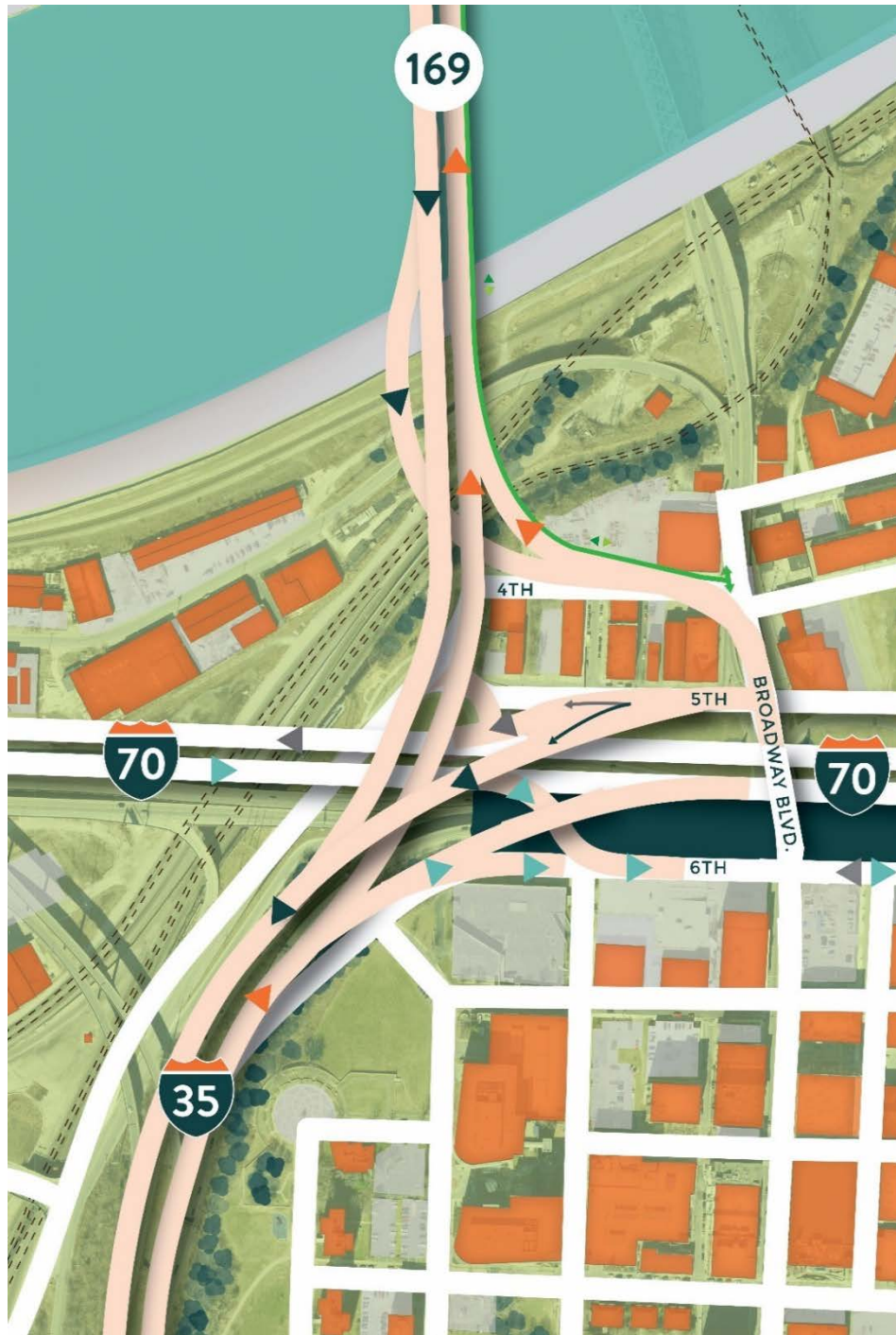


Figure 2-6: Broadway Direct Connection Strategy

Interchange Strategy AB2 – Hybrid Interchange

Interchange Strategy AB2 is paired with US-169 either on its current alignment or immediately adjacent to the existing bridge, connecting with Broadway north of the 5th Street/Independence Avenue intersection. To connect to I-35, southbound US-169 will pass over 5th Street and turn to the west where it will tie into the existing I-35 entrance ramp from 5th Street. Northbound I-35 traffic destined to US-169 will exit at 6th Street to a dedicated elevated left-turn ramp that crosses I-70 and 5th Street to connect with northbound US-169. This removes and separates northbound I-35 traffic from the Broadway intersections at 6th Street and 5th Street. The Woodswether Viaduct will remain in place under the new bridge and interchange connecting the West Bottoms to both 3rd Street and 4th Street in River Market similarly to current conditions.

This strategy is compatible with Bridge Strategies A1 and A4 and with all North Loop Strategies.



Figure 2-7: Hybrid Interchange Strategy

Interchange Strategy AB3 – I-35 Direct / 4th Street Interchange

Interchange Strategy AB3 connects US-169 to I-35 on the west side of the Loop using an elevated roadway crossing over 4th Street, 5th Street, I-70 and 6th Street. Ramps from the bridge provide connections along 4th Street to Broadway. Connections to the River Market at 3rd and 4th Streets will be modified to support traffic operations to and from US-169.

This strategy is compatible with Bridge Strategies A2 and A3 and with all North Loop Strategies

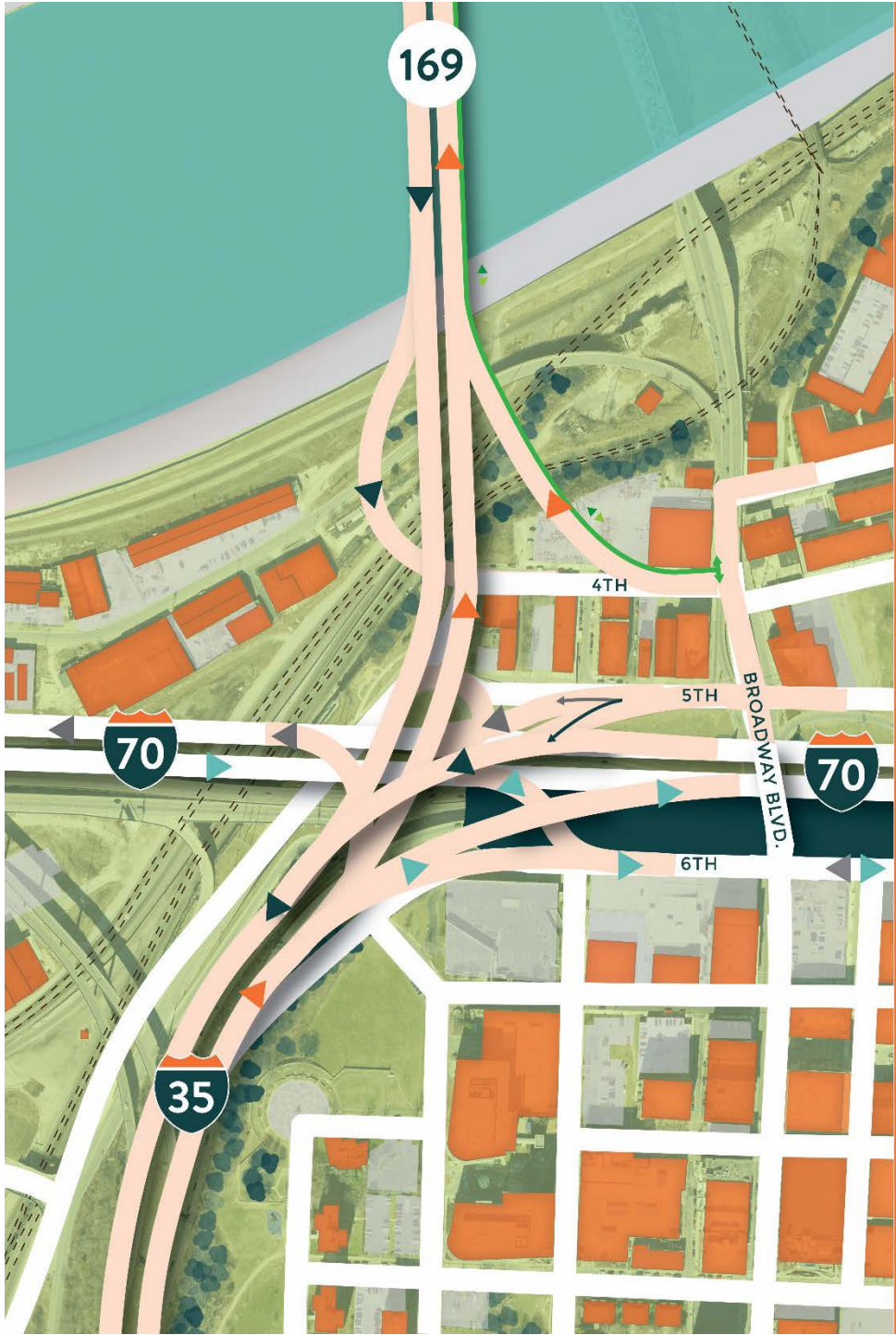


Figure 2-8: I-35 Direct /4th and 5th Street Interchange Strategy

Interchange Strategy AB4 – I-35 Direct / 5th and 6th Street Interchange

This strategy connects US-169 to I-35 on the west side of the Loop using an elevated roadway crossing over 4th Street, 5th Street, I-70, and 6th Street. Access to the CBD and I-70 for southbound US-169 traffic is provided by an exit ramp that connects traffic onto Beardsley Road at 4th Street. Access to the CBD requires motorist to proceed south on Beardsley Road and turn east onto 6th Street. Traffic destined to westbound I-70 must take the same route but turn north on Broadway and then west on 5th Street to access the entrance ramp in the proximity to its current location. The entrance ramp for CBD motorists to northbound US-169 is accessed via 5th Street just west of Broadway. Access into and out of River Market is maintained via Broadway at 3rd Street and 4th Street.

This strategy is compatible with Bridge Strategies A2 and A3 and with all North Loop Strategies.

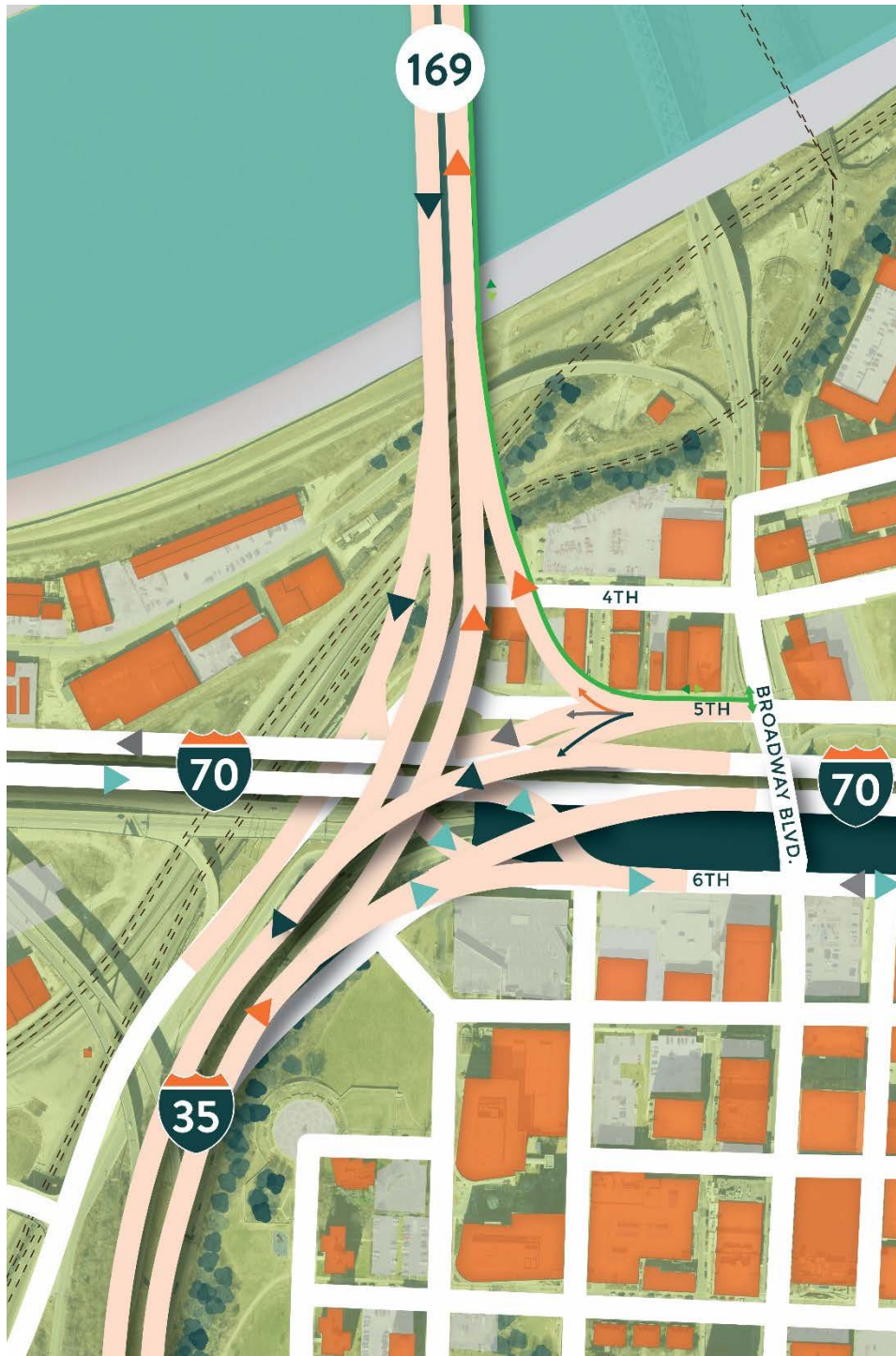


Figure 2-9: I-35 Direct / 5th and 6th Street Interchange Strategy

Table 2-1: Summary of Missouri River Bridge and Interchange Strategies

Missouri River Bridge and Interchange	Strategy	Description
Rehabilitate the Existing O’Neil Bridge (No-Build Condition)	A1	Rehabilitation of the existing bridge as currently programmed would consist of a \$50 million project and would restore the structure to satisfactory physical condition, and would extend the expected life of the bridge an additional 35 years
Western Alignment	A2	Approximate 28-degree skew to perpendicular with river. Most direct connection to I-35.
Central Alignment	A3	Approximate 21-degree skew to perpendicular with river. Centrally located between the existing bridge and I-35 at the west side of the loop.
Adjacent Alignment	A4	Approximate 10-degree skew to perpendicular with river. Location just upstream of existing bridge. Requires reconfiguration of existing Broadway interchange.
Broadway Direct Connection	AB1	US-169 uses its existing alignment, tying US-169 into the Broadway intersection at 5th Street/Independence Avenue.
Hybrid Interchange	AB2	US-169 uses its existing alignment, tying US-169 into the Broadway intersection at 5th Street/Independence Avenue plus a direct flyover ramp to and from I-35.
I-35 Direct / 4th Street Interchange	AB3	US-169 connects to I-35 on the west side of the loop using an elevated roadway crossing over 4th Street, 5th Street and I-70 with local access connections at 4 th Street.
I-35 Direct / 5th and 6th Street Interchange	AB4	US-169 connects to I-35 on the west side of the loop using an elevated roadway crossing over 4 th Street, 5 th Street and I-70 with local access via 5 th and 6 th Streets.

2.3 Level 2 Evaluation

The Missouri River Bridge and Interchange strategies were evaluated based on 54 separate measures related to the Project Needs and Project Goals. A generalized comparison of the strategies in terms of the three basic Needs and Goals is provided at the end of this section, with the matrix listing the detailed results of the evaluation provided in Appendix F.

Strategy A1 (Rehabilitation of the existing O’Neil Bridge) constitutes the No-Build alternative and will be advanced for further evaluation for comparison to the other strategies and alternates.

Project Need: Improve Physical Conditions

Rehabilitation of the existing Buck O’Neill Bridge would provide only 35 years of additional life to the bridge at which point reconstruction or additional rehabilitation would be required. Strategies A2, A3, and A4 all remove the existing bridge and replace it with a new structure that would provide a 100-year service life with appropriate maintenance.

Strategies A2 and A3, in combination with Interchange Strategies AB2, AB3 or AB4, provide the greatest opportunity to improve substandard roadway geometry due to the reconfiguration of the connections to and from US-169 from the CBD.

Project Need: Optimize System Performance

All improvement Strategies provide substantial reduction in traffic congestion along US-169 and the Broadway Boulevard interchange area as compared to A1. The improvements resulted in a 50% decrease in peak hour delay across the bridge. The Strategies linked to new bridge alignment (A2, A3 and A4) all perform comparably in system performance. But when combined with the related Interchange Strategies there is a dramatic difference in performance. AB1 combined with A4 has very similar movements to the existing configuration and therefore provides no system performance benefit. AB1 combined with A2 or A3 provide the best performance with the lowest expected travel times. At the study level, both AB3 & AB4 combined with A2 or A3 perform nearly identical with only small impacts to local movements differing between them. AB4 combined with A4 has slightly higher travel times associated with travel distance for some movements.

Project Need: Improve Safety and Security

Conflict points increase under Interchange Strategies AB3 and AB4 due to the greater extent of the improvements they provide. AB1 and AB2, with connections similar to the existing facility, provide a similar number of conflict points.

All the strategies except for A1 provide for reducing delays from an incident on the bridge due to shoulder improvements, improving Bike/Ped safety, and improving emergency responder access to the bridge and ramps.

Project Goals: Improve Transportation Choices

All the strategies allow for the expansion of Bike/Ped facilities in the segment. Strategy A1, with only a 6-foot-wide sidewalk added onto the existing bridge, is only a slight improvement. A 12-foot shared use path inclusive with Strategies A2, A3 and A4 and the ability to make changes to the connections with downtown bike facilities provides better opportunities for improvement.

Project Goals: Improve Economic Vitality and Placemaking

All the Bridge/Interchange strategy combinations except for the A4/AB2 (Adjacent Bridge/Hybrid Interchange) strategy could adversely affect the commercial and residential properties in the approximately 4-acre tract west of Broadway between 4th and 5th Street. Depending on the combination of interchange type and bridge location, the extent of the impacts in the area vary between direct takings, access to remnant tracts, and viewshed interference.

The connection from the Wheeler Airport to the highway system is enhanced by any of the strategy combinations. There is no improvement over the existing condition relative to access to the Fairfax area. Access to the Port of KC and West Bottoms from/to the River Market area is marginally reduced due to impacts to the Woodswether Viaduct.

Project Goals: Improve Sustainability

The A3/AB1 strategy combination has the largest commercial right of way impact with 3.6 acres affected. The A2/AB1, A3/AB3 and A4/AB1 combinations have 3.1, 2.9 and 2.9 acres impacted respectively. Other strategy combinations range from 0.7 to 1.4 acres of impacts.

The A3/AB3 strategy combination has a residential right of way impact of 0.4 acres and could displace up to approximately 20 apartment units. There are no impacts to EJ/LEP populations for any of the proposed strategy combinations.

Relative to cultural resources, all the bridge/interchange strategies have either one or two impacts to NHRP or NHRP eligible resources. The existing bridge and historic district are the potential elements that will be impacted. There is also one hazardous materials site, and no documented archeological sites impacted by any of the strategies.

Impacts to natural resources include one or two parks or trails, depending on the strategy. In addition, 2.0 to 2.2 acres of wetlands could be disturbed, and 1,500 to 1,650 linear feet of floodplain could be impacted.

Project Goals: General Feasibility

Each of the strategies crosses railroad facilities on the south side of the Missouri River and will have varying degrees of impact from construction and access for construction. Other than the No-Build strategy, the A4/AB2 strategy combination has the least impact since the bridge is on an adjacent alignment crossing the railroad close to the same location as it currently crosses. The further to the west the bridge/interchange strategies are shifted, the more complex the railroad crossing becomes and the more difficult it will be to acquire easements and perform bridge construction.

Likewise, the further to the west a proposed strategy is oriented, the greater the impacts to the aviation approach path boundaries. Height restrictions for the Western A2 alignments are lower than those for the Central A3 and Adjacent A4 alignments. These restrictions will complicate the required heavy crane construction in the river and south towards I-35 and I-70.

Due to the skew of the bridges to the Missouri River, the A2 alignment requires the longest river bridge for the costliest bridge crossing. The A4 alignment requires the shortest river bridge for the least costly bridge crossing.

2.4 Level 2 Screening

Strategies A2, A3 and A4 all address the needs to improve Physical Condition with the construction of a new bridge with a 100-year service life. All address the need to Optimize System Performance and Improve Safety and Security, albeit at different levels of effectiveness depending on how connections with I-70, I-35, and the CDB are configured. Goals to Improve Transportation Choices and Improve Economic Vitality and Placemaking can all be potentially satisfied with the incorporation of facilities that link new and potentially expanded land uses with alternative transportation modes. The extent to achieve the goal to Improve Sustainability will vary between the three location alternates with tradeoffs to be considered relating to impacts to right-of-way, potential commercial relocations, environmental features, and cultural and natural resources.

The Western Alignment (Strategy A2) is oriented to minimize impacts to residential and commercial right-of-way on the south side of the river along 4th and 5th Streets. This alignment is perched on the westernmost corner of the bluff and crosses directly above the convergence of multiple UP and BNSF railroad tracks. The skew of the tracks to this alignment and the area of convergence will be a challenge to coordinate with the railroad companies. This will likely result in very long spans which are skewed and curved. This complex geometry and proximity to the tracks has the most challenging constructability of Strategies A2, A3 and A4, and will most likely result in a higher construction cost.

The Central Alignment (Strategy A3) is aligned between the Western and Adjacent Alignments and has the greatest impact to right-of-way. This alignment may result in a negative net result relating to the goals of improving Economic Vitality and Placemaking, and Environmental Sustainability due to the potential impacts to businesses and potentially historic district in the area between 4th and 5th Streets lying west of Broadway. However, the alignment crosses at a much more favorable orientation to the railroad tracks below. The connections to both I-35 and downtown are reasonably direct with a more straightforward structural solution.

The Adjacent Alignment (Strategy A4) is parallel and adjacent to the existing bridge. Like the Western Alignment, the orientation was selected to minimize impacts to right-of-way. A direct connection to I-35 is unfavorable at this location, because of difficulties with both the horizontal alignment and the vertical profile but can be accomplished.

Bridge Strategy Alternates A2, A3, and A4 were all perceived to collectively and positively address the needs and were determined to be strategies worthy of advancing to a higher level of detail and evaluation. Figures 2-10 and 2-11 depicts a generalized comparative summary of the bridge and interchange strategies as they relate to meeting the stated study's needs and objectives. A more detailed evaluation matrix which comparatively scores the strategies as discussed in Section 2.3 is provided in Appendix F.

River Bridge Crossing Location Alternatives					
		Rehab Existing (No-Build)	A2 Western Alignment	A3 Central Alignment	A4 Adjacent Alignment
Needs	Improve Physical Conditions				
	Optimize System Performance				
	Improve Safety & Security				
Goals	Improve Transportation Choices				
	Improve Economic Vitality & Placemaking				
	Improve Sustainability - Right of Way Impacts				
	Feasibility				
	Affordability	\$	\$\$\$	\$\$\$	\$\$\$

Figure 2-10 Generalized Evaluation Summary of Bridge Strategies

River Bridge Interchange Alternatives							
		Rehab Existing (No-Build)	AB1 Broadway Direct		AB2 Hybrid Connection	AB3 4th Street Direct	AB4 5th & 6th Direct
			West/Central	Adjacent	Adjacent	West/Central	
Needs	Improve Physical Conditions						
	Optimize System Performance						
	Improve Safety & Security						
Goals	Improve Transportation Choices						
	Improve Economic Vitality & Placemaking						
	Improve Sustainability - Right of Way Impacts						
	Affordability	\$	\$\$\$		\$\$	\$\$\$	\$\$\$\$

Figure 2-11 Generalized Evaluation Summary of Bridge Interchange Strategies

3. Area B: I-70 North Loop

3.1 Constraints and Conditions

The north side of the Downtown Loop consists of the three-lane I-70 interstate facility contained within an approximately 300-foot wide right-of-way. Ramps and interchanges currently provide access at Broadway, Delaware Street and Route 9. Additional grade separation structures are located at Wyandotte Street, Walnut Street, Grand Boulevard and Charlotte Street. Figure 3-1 illustrates the I-70 North Loop geographic area. Given the short distance across the north loop, the existing configuration does not meet current requirements for ramp geometrics, ramp spacing, and weave distances resulting in slower speeds and congestion.

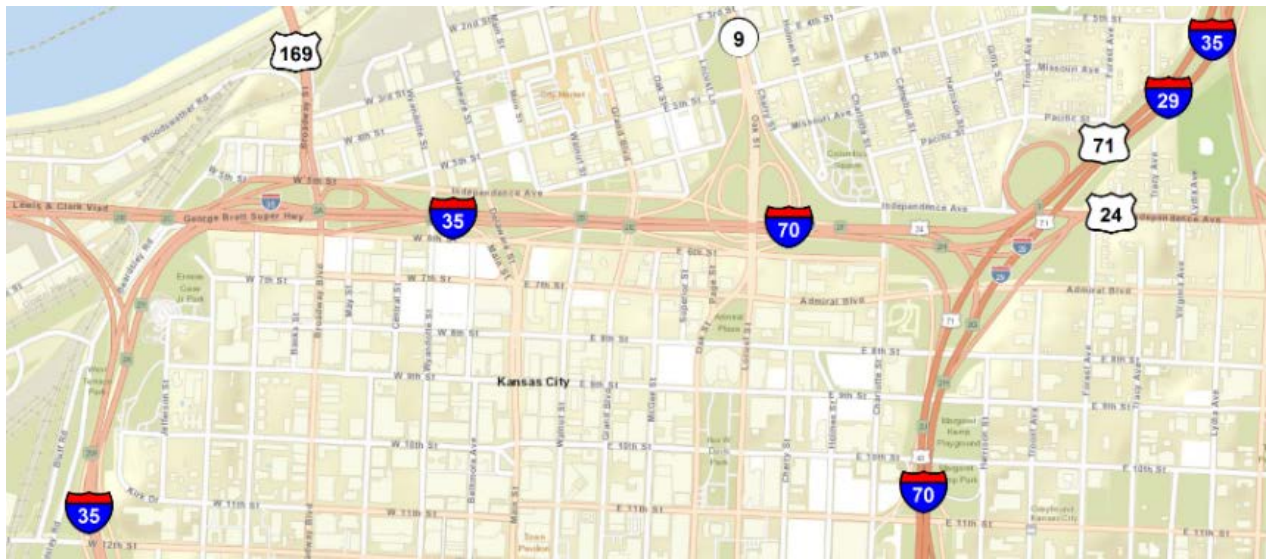


Figure 3-1: I-70 North Loop Geographic Area

Conceptual strategies were developed that would modify or reconfigure the North Loop with the objective of advancing those that collectively best serve the identified long-term needs in the Study Area.

The North Loop strategies include highway, local road, and interchange modifications along I-70 North Loop which can be built independently of a new river bridge and interchange concept. The refined concepts were developed so they could ultimately be incorporated into subsequent phased deployment of other long-term strategies. The North Loop strategies include:

- Access Consolidation
- Compressed Footprint (Three Strategies)
- Remove and Reclassify

All strategies reconfigure the highway system in the North Loop area to the extent that the current highway infrastructure footprint is reduced, providing new space for redevelopment to serve a variety of

potential expanded land uses. The quantity of the reclaimed land will vary between the strategies and is valued in the evaluation in relative comparison with each other. An independent review by a national Technical Advisory Group, convened by the Urban Land Institute in September 2017, suggested that the redevelopment of the incremental additional space resulting from the strategies would not be economically feasible until about the year 2028, following infill of existing undeveloped vacant space.

3.2 Conceptual Strategies

Five strategies were defined for improving the I-70 North Loop as described below. Detailed graphics of these strategies can be found in Appendix B.

Strategy B1 – Access Consolidation

Strategy B1, illustrated in Figure 3-2 below, consists of consolidating ramp and access points along the North Loop, removing the connections with Route 9, Delaware Street, and the northbound Broadway to the westbound I-70 loop entrance ramp.



Figure 3-2: North Loop Strategy B1-Access Consolidation

At the west end of the I-70 North Loop, all the existing I-70/I-35 connections will be maintained along with the following local access connections:

- Northbound I-35 exit ramp to 6th Street
- Eastbound I-70 exit ramp to 6th Street
- 5th Street entrance ramp to southbound I-35
- 5th Street entrance ramp to westbound I-70
- Eastbound I-70 exit ramp to southbound Beardsley Road

The exact configuration of interchange connections to US-169 at this location will depend on the final selection of a Bridge and Interchange Strategy defined in Section 2 of this report.

At the east end of the I-70 North Loop, modifications to access and geometry will be made including the following:

- The Independence Avenue/Troost Avenue loop entrance ramp to westbound I-70 is eliminated.
- An Independence Avenue to northbound I-35/I-29 entrance ramp is added.
- The southbound I-29/I-35 to westbound I-70 connection is braided with I-70 to prevent I-70 motorist from weaving across two lanes of mainline traffic to take the westbound Independence Avenue exit ramp.
- Eastbound I-70 is braided with the southbound I-29/I-35 connector to eastbound I-70 which will eliminate the ability of eastbound I-70 traffic from exiting to 11th Street.

At Route 9 there will be no direct connections to I-70. Route 9 will connect to Independence Avenue and 6th Street using at-grade signalized intersections. Route 9 improvements are coordinated with North Loop strategies but are independent of North Loop strategies. See Section 6 of this report for strategies related to Route 9.

Independence Avenue will continue to be a two-way arterial roadway east of Charlotte Street. West of Charlotte Street it will be a one-way westbound roadway. Sixth Street will continue to be a one-way eastbound roadway.

Broadway, Wyandotte Street, Delaware Street, Walnut Street, Grand Boulevard, Charlotte Street, Admiral Boulevard, and 8th Street will continue to cross I-70 in the same locations. Independence Avenue will continue to cross I-29/I-35 in the same location.

Strategy B3-6a – Compressed Footprint (South)

Strategy B3-6a, illustrated in Figure 3-3 below, reduces the footprint of I-35/I-70 through the North loop and shifts the highway to the south side of the existing right of way to allow opening the north side of the existing highway right of way along Independence Avenue for development. Retaining walls will be constructed at the outer edges of the interstate shoulders to accommodate widening of Independence Avenue and 6th Street, and to maximize the space available for redevelopment recaptured from the narrowed interstate right-of-way.

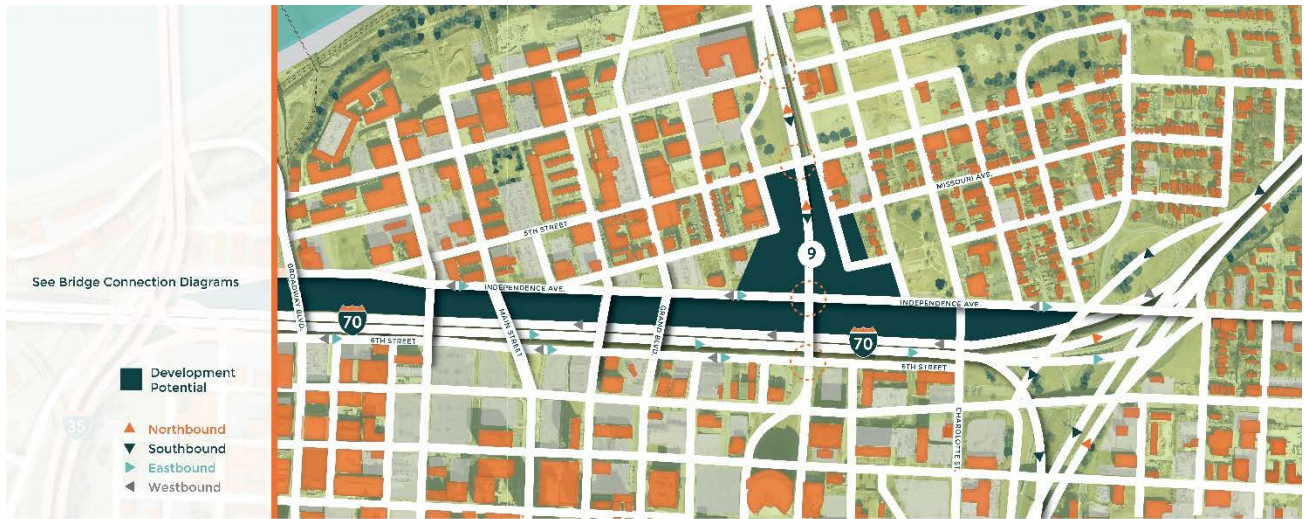


Figure 3-3: Strategy B3-6a – Compressed Footprint (South)

At the west end of the I-70 North Loop, all the existing I-70/I-35 connections will be maintained along with the following local access connections:

- Northbound I-35 exit ramp to 6th Street
- Eastbound I-70 exit ramp to 6th Street
- 5th Street entrance ramp to southbound I-35
- 5th Street entrance ramp to westbound I-70
- Northbound Beardsley Road entrance ramp to westbound I-70
- Eastbound I-70 exit ramp to southbound Beardsley Road

The exact configuration of interchange connections at this location will depend on the final selection of a Bridge and Interchange Strategy defined in Section 2 of this report.

At the east end of the I-70 North Loop, modifications to access and geometry will be made including the following:

- The Independence Avenue/Troost Avenue loop entrance ramp to westbound I-70 is eliminated
- An Independence Avenue to northbound I-35/I-29 entrance ramp is added
- A southbound I-29/I-35 to Independence Avenue exit ramp is added
- A connector from the southbound I-29/I-35 exit ramp terminal at Independence Avenue to the eastbound I-70 entrance ramp terminal on Admiral is provided

At Route 9 there will be no connections to I-70. Route 9 will connect to Independence Avenue and 6th Street at at-grade signalized intersections. North Loop strategies are coordinated with Route 9 strategies, each set of strategies being independent. See Section 6 of this report for strategies related to Route 9.

Independence Avenue will become a two-way arterial roadway with a cycle track from Broadway to east of Harrison Street. Sixth Street will become a 4-lane two-way roadway from Broadway to Charlotte Street.

Broadway, Wyandotte Street, Delaware Street, Walnut Street, Grand Boulevard, Charlotte Street, Admiral Boulevard, and 8th Street will all continue to cross I-70 in their current locations on new structures of shorter lengths than the existing bridges. Independence Avenue will continue to cross I-29/I-35 at the current location.

Strategy B3-6b – Compressed Footprint (North)

This strategy, illustrated in Figure 3-4 below, is similar to Strategy B3-6a, except I-70 is shifted to the north adjacent to Independence Avenue, opening the area between I-70 and 6th Street for development.



Figure 3-4: Strategy B3-6b – Compressed Footprint (North)

Strategy B3-7 – Compressed Footprint (Center)

Operationally and geometrically, this strategy is similar to the other two Compressed Footprint strategies, with the exception that the I-70 location will be centered on the existing highway centerline. Narrower areas on both sides of the right-of-way would be available for redevelopment in comparison with strategies that shift the highway to the north or south. Implementation of this strategy could be phased with the initial reconfiguration of the North Loop under the Access Consolidation strategy.

Strategy B7-1 – Remove and Reclassify

This strategy, illustrated in Figure 3-5 below, eliminates the North Loop I-70 portion of the Interstate highway system. All the area between Independence Avenue and 6th Street will be leveled and made available for a variety of potential redevelopment land uses.



Figure 3-5: Strategy B7-1 –Remove and Reclassify

I-35 will be rerouted from the north and west sides of the Downtown Loop to the east and south legs. I-70 will be rerouted from the north and east sides of the Downtown Loop to the south side to the segment of freeway currently designated as I-670. The portion of I-70 west of the Loop (Lewis and Clark Viaduct) and between the Viaduct and the connecting interchange with I-670 in Kansas City, Kansas, could be redesignated as I-670 to maintain that interstate designation and route continuity.

Independence Avenue and 6th Street will be converted to two-way roadways. Broadway, Wyandotte Street, Delaware Street, Walnut Street, Grand Boulevard, Route 9 (Oak Trafficway) and Charlotte Street will continue to connect between Independence Avenue and 6th Street.

At the northeast corner of the Downtown Loop, the existing Troost Avenue Loop entrance ramp to westbound I-70 is removed, along with all the freeway connections to and from the existing North Loop portion of I-70. A split diamond interchange is created for I-29/I-35 with ramps on the north side of Independence Avenue and the south side of Admiral Boulevard. A new connector from Independence Avenue to Admiral Boulevard is added as part of the split diamond construction.

Under this strategy, the re-routing of I-70 and I-35 will divert a significant amount of throughput traffic to what is currently designated as I-670 along the south side of the Loop. Approximately 40% of the current traffic on the North Loop (I-70) is comprised of trips destined to or originating from the CBD area and can be served efficiently from the improved two-way arterial system (Independence Avenue and 6th Street). The reassignment of traffic is projected to result in significant speed reductions and delays along the South Loop freeway segment. The detailed traffic analysis of the South Loop segment suggests that the source of congestion is not from a lack of general mainline capacity along I-670, but instead is the result of weaves and merges at critical locations. Local widening and reconfiguration of lane assignments was shown to provide relief to existing congestion at the following locations:

- Eastbound I-670 at the I-35 merge at the southwest quadrant of the Loop
- Eastbound I-670 at the I-70 and I-35 diverge at the southeast quadrant of the Loop

Eastbound I-670 at the I-35 merge at the Southwest Quadrant of the Loop

As three-lane I-670 approaches the Loop from Kansas City, Kansas from the west, the inside lane is committed as a drop or trap-lane to the Central Avenue exit into Downtown Kansas City, Missouri. The second lane is committed to eastbound I-670 under the Bartle Hall convention center and comprises the inside lane of the three -lane segment of I-670 along the south side of the Loop. The third lane is designated to the southbound I-35 exit. A fourth lane is developed at the Wyoming Street on-ramp which merges with the mainline only about 1,800 feet from the Central Avenue exit split and is also committed to southbound I-35. See Figure 3-6. This configuration results in repeated congestion during peak periods, from vehicles occupying the inside lane trap-lane and from the Wyoming on-ramp traffic merging and weaving to eastbound I-670.

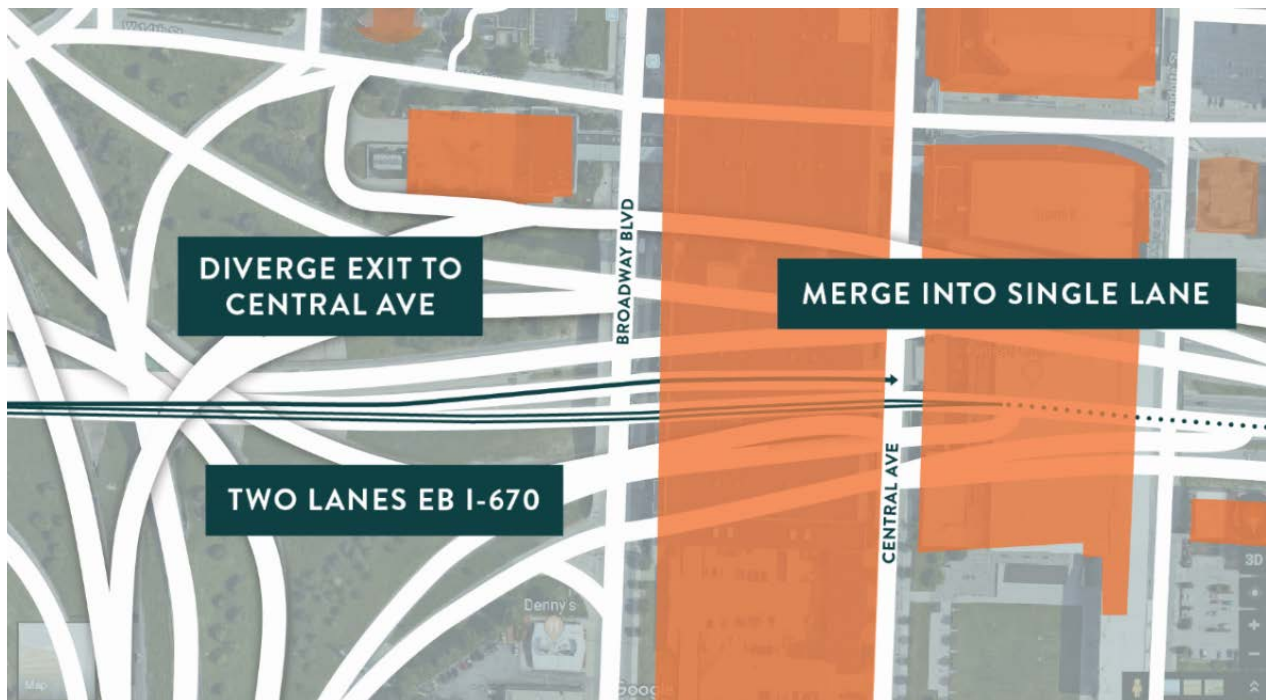


Figure 3-6: Existing Eastbound I-670 Lane Configuration at Southwest Quadrant of the Loop

The single I-670 lane approach to the Loop includes paved shoulders on both sides that could provide adequate space to restripe and continue two lanes under the convention center, which will still merge further to the east into the single inside I-670 lane. Under this concept, the exit to Central Avenue is converted to a diverge from the inside lane and the merge of the two mainline lanes is shifted to the east, downstream from the Wyoming Street entrance and I-35 exit weaving activities (Figure 3-7). Modeling of

traffic operations under this configuration demonstrated improvements to the extent that congestion is mitigated under the Remove and Reclassify Strategy to equal or better than under the No-Build condition.



Figure 3-7: Reconfiguration of I-670 Lane Configuration at Southwest Quadrant of the Loop

Construction of this concept would entail overlay and restriping of the pavement through reconfigured section, modifications to pull through signs on two overhead sign structures, and possibly one additional overhead sign structure. Order of magnitude costs for this would be less than \$1 million.

Eastbound I-670 at the I-70 and I-35 Diverge at the Southeast Quadrant of the Loop

As eastbound three-lane I-670 approaches the east end of the Loop, an eastbound entrance from Grand Boulevard comprises the fourth lane of the approach. The current lane designation from inside to outside is as follows (Figure 3-8):

- Lane 1 – Shared lane I-70 Eastbound/ ramp to I-35 Northbound
- Lane 2 – Eastbound I-70
- Lane 3 – Eastbound I-70
- Lane 4 (from Grand Entrance Ramp) – Southbound US 71

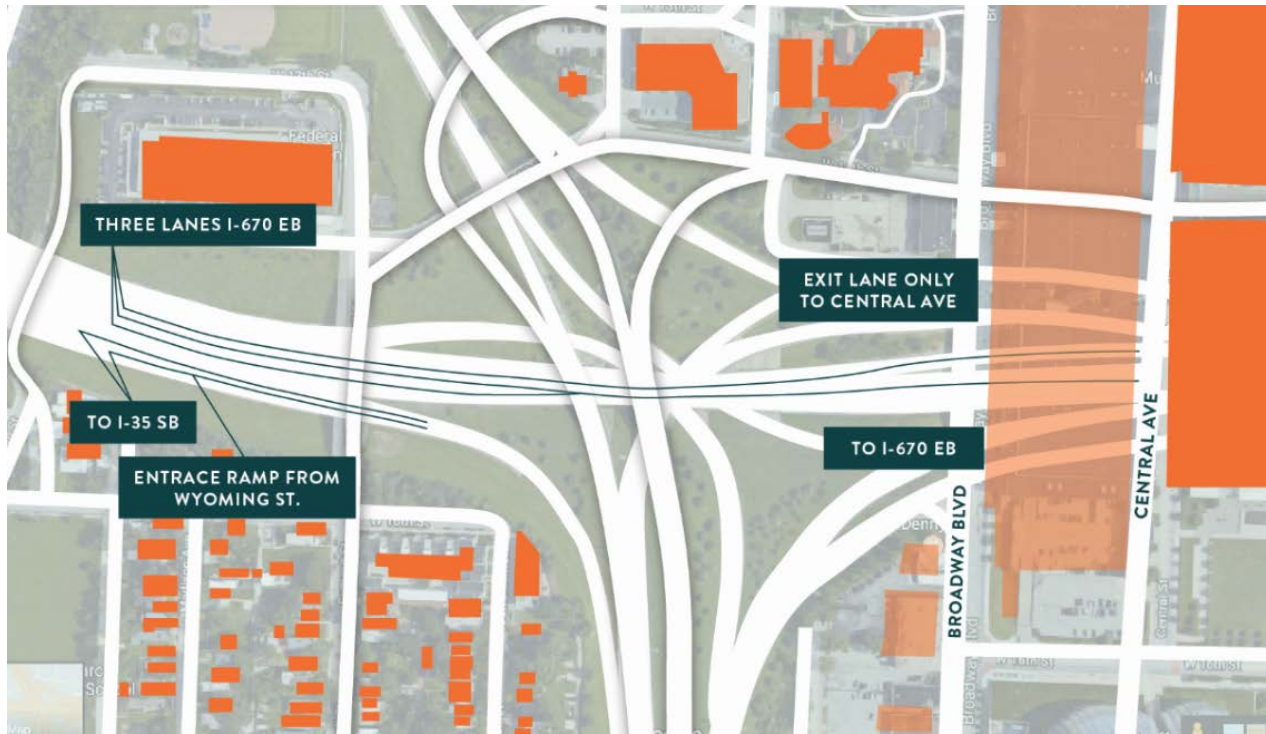


Figure 3-8: Existing Eastbound I-670 Lane Configuration at Southeast Quadrant of the Loop

Lane shifts required to connect with I-35 northbound, I-70 eastbound, and US 71 southbound at this location results in regularly occurring congestion, particularly in the evening peak period as traffic departs the CBD. This condition is further exacerbated under the Remove and Reclassify Strategy resulting from additional traffic diverted from the North Loop and the designation of the South Loop segment as both I-70 and I-35. Route continuity along I-35 northbound would require two lane shifts along the 3/4-mile stretch. Congestion and delay is projected to increase significantly under this strategy in comparison with that modeled under the existing and future No-Build scenarios.

Conceptually, the approach was evaluated for traffic operations under the following revised lane configuration which reduces lane shifts, and provides additional capacity for the I-35 northbound movement (Figure 3-9):

- Lane 1 – I-35 northbound only
- Lane 2 – Shared lane I-70 eastbound/ ramp to I-35 northbound
- Lane 3 – Eastbound I-70
- Lane 4 (from Grand Entrance Ramp) – Shared lane I-70 eastbound/southbound US 71



Figure 3-9: Reconfiguration of I-670 Lane Configuration at Southeast Quadrant of the Loop

Modeling of traffic operations under this configuration demonstrated significant improvements to the extent that congestion is mitigated under the Remove and Reclassify Strategy to that or better than under the No-Build condition.

Furthermore, additional relief could be provided with the elimination of the Grand Boulevard entrance ramp. The ramp serves as one of the predominant access points to I-35 northbound, I-70 eastbound, and US 71 southbound from the Kansas City CBD and the Crossroads District to the south. Connections to these routes could be accommodated by Truman Road to Paseo Boulevard to the east or 22nd Street to US 71 to the south. Additional traffic studies would be required to evaluate the impacts of diverting traffic from the existing ramp to the local arterial network and alternative interchange points with the freeway system.

Actions to Remove and Redesignate a Portion of the Interstate System

The decommissioning or removal of an interstate designation from an existing route on the National Highway System (NHS) is not explicitly accounted for in U.S. codes or regulations. As in, there is not a formal set of procedures to decommission an interstate. The most applicable code is 23 U.S.C. 103(b)(3) which covers modifications to the NHS. This section allows states to propose modifications to the NHS and authorizes the Secretary of Transportation to approve such a request given that the modification meets the criteria established for the NHS and enhances the characteristics of the NHS. Difficulties arise when forming an argument that the removal of an interstate can enhance the characteristics of the NHS. Careful research and planning must go into the proposal, in order to convince the Secretary to the merits of the modification. Explicitly, 23 CFR 470 Subpart A, Appendix D states that any proposal of adding or deleting a route to the NHS should include information on the possible effects modifications will have to other

existing NHS routes that are in close proximity. Additionally, it states that any proposal that may impact adjoining states should be developed in cooperation with that state.

23 U.S.C. 103(b)(3)(B) also establishes an expectation of cooperation. It asserts that a state shall cooperate with local and regional officials when proposing a modification to the NHS. Specifically, for urban areas officials shall act through the area's metropolitan planning organization (MPO) designated under 23 U.S.C 134.

The study team has spoken to individuals who are championing the attempt to remove freeway segments in other metropolitan areas. The consensus for the process confirms the procedures outlined above. The critical step is the political alignment and support from the cities, counties, MPOs, and states impacted by the NHS modification. A collaborative process with AASHTO and the FHWA will be required that will require a vote for approval by AASHTO members. MoDOT and the FHWA Missouri Division Office will initiate the process if it is later determined that decommissioning a portion of I-70 in the North Loop is a viable option. Once each party has signed off, the proposal can be submitted to the U.S. Department of Transportation to be approved by the Secretary.

Table 3-1: Summary of North Loop Strategies

I-70 North Loop	Strategy	Description
Access Consolidation	B1	Removes ramps and eliminates the direct connection between Route 9 and I-70. Entrance and exit ramps at Broadway maintained. Route 9 returned to arterial connecting with Independence Avenue connected between Grand and Charlotte (See Route 9 Strategy Segments).
Compressed Footprint South Strategy	B3-6a	Compressed I-70 along South Side of Corridor, returns existing ROW to commercial/recreational use, Independence Avenue converted to an arterial roadway, consolidate interstate highway access
Compressed Footprint North Strategy	B3-6b	Compressed I-70 along North Side of Corridor, returns existing ROW to commercial/recreational use, Independence Avenue converted to an arterial roadway, consolidate interstate highway access
Compressed Footprint Centered on Existing Alignment Strategy	B3-7	Compressed I-70 along existing location, returns existing ROW to commercial/recreational use, Independence Avenue converted to an arterial roadway, consolidate interstate highway access
Remove and Reclassify	B7-1	North Loop I-70/I-35 removed and relinquished space used for redevelopment. Independence Avenue converted to a divided Parkway and 6th Street converted to two-way arterial, both between Broadway and Charlotte.

3.3 Level 2 Evaluation

The North Loop strategies were evaluated based on 68 separate measures related to the Project Needs and Project Goals. The matrix showing the detailed results of the Level 2 evaluation can be found in Appendix F.

Project Need: Improve Physical Conditions

Strategies were compared on the potential to improve the useful life of the highway facility by comparing the areas of bridges being removed, built, or needing maintenance and/or major repairs along with the area of existing pavement to being removed and replaced.

Each of the strategies, except the No-Build strategy, does something to improve the useful life of the facility by removing and replacing existing bridges and pavement within the area.

- The Access Consolidation Strategy (B1) improves useful life through the removal of I-70 access ramps and bridges and the replacement of some bridge structures. This strategy could include pavement replacement or rehabilitation with the project or as a separate project depending on the conditions of the roadway at the time of the project. Independence Avenue and 6th Streets may be reconstructed or used in place continuing as one-way streets for this strategy.
- The Compressed Footprint strategies (B3-6a, B3-6b, and B3-7) improve useful life through the complete reconstruction of the highway through the North Loop area. These strategies build newer pavement and bridges than the other strategies. Strategy B3-7 may provide a strategy to

re-use existing I-70 in place to control the initial cost of the proposed project and can be coordinated during future phases. Independence Avenue and 6th Street will be fully reconstructed as two-way streets.

- The Remove and Reclassify strategy (B7) eliminates the interstate highway from the transportation system managed by MoDOT. Independence Avenue and 6th Street will be fully reconstructed as two-way streets.

All the strategies, except the No-Build strategy, improve substandard geometric features with between 35 and 48 substandard geometric features being removed or replaced.

Project Need: Optimize System Performance

In comparison with the other geographic segments addressed in this study, the North Loop strategies result in the most significant impacts to traffic relating to volume, speeds, and delay. System-wide and link-level metrics were evaluated for the network covered within the limits of the DTA regional model and more locally, within the limits of the defined Study Area. The detailed results of the traffic analysis are addressed and stated in the Traffic and Transportation Report supporting technical memorandum. Key metrics and performance criteria that differentiate the strategies are tabulated in the detailed evaluation matrix provided in the Appendix to this report. These criteria are referenced and considered in the overall general relative comparative evaluation of the strategies.

No-Build System Performance

In the year 2040, system-wide delay on the arterial and freeway system within the limits of the DTA model network under the No-Build condition is projected to increase by 47 percent and 42 percent in the morning and evening peak period, respectively in comparison with current delay for the same time periods. Comparative performance measures relating to traffic service under the strategies is stated relative to the No-Build condition. Within the study limits itself, the increase in delay is more pronounced, and is projected to increase by 109 percent and 224 percent in the morning and evening peak periods, respectively.

System Performance Under Strategies

In comparison with the No-Build condition, the year 2040 morning delay across the DTA network varied between approximately 4 percent for the Access Consolidation strategy to 17 percent for the Remove and Reclassify Strategy. In the evening, the range of impacts ranged from an actual slight reduction under the Access Consolidation to an increase of 15 percent under the Remove and Reclassify Strategy. At the Study Area level, the impacts are more apparent. In the morning, the range of delay increase varies between 40% for the Access Consolidation, 49 percent for the Compressed Footprint, and 71 percent for the Remove and Reclassify Strategy.

Another key metric for comparing the strategies directly affecting delay is travel speed along critical links within the Study Area. One of the most affected link in the Study Area is the I-670 segment of the South Loop under the Compressed and Removal Strategies. Elimination of access under the Compressed Footprint Strategy, and total removal under the Remove and Reclassify Strategy will tend to divert traffic at various magnitudes to I-670 with resulting increases in congestion and reduced speeds. This is particularly the case for the evening peak period, where speeds are projected to decrease to ranges between 11 and 25 mph, which is well below the posted speed limit of 45 mph.

Effects of Autonomous and Connected Vehicles (AV/CV)

The immediate effects of emerging technologies in the field of autonomous and connected vehicles are beginning to be realized with increased deployment into the overall vehicle fleet. The potential future effects on this technology on speed and congestion was evaluated by conservatively assuming a 20 percent increase in free-flow saturation rate.

Project Need: Improve Safety and Security

Driver Safety can be measured by many criteria. Ramp Density is one of those, and on I-70 the Ramp Density is currently 16 ramps per mile. This number does not provide sufficient spacing for adequate acceleration lanes, deceleration lanes and weaving. The Access Consolidation strategy reduces this number to 6 and the Compressed Footprint strategies reduce it to only 4. The Remove and Reclassify strategy eliminates ramps in the I-70 North Loop area and therefore has 0 ramps per mile.

Driver Safety can also be measured by the number of conflict points or points where a pair of vehicles on separate paths might cross. The lower the number of conflict points, the less opportunity for crashes-- which leads to fewer crashes. The existing system has 201 conflict points. By eliminating the ramps, the Access Consolidation strategy reduces that by almost 20 percent to 166 conflict points. The other strategies increase the number of conflict points by almost double to 396 conflict points for the Compressed Footprint strategies and 418 conflict points for the Remove and Reclassify strategy. This occurs primarily because Independence Avenue/5th Street are widened to three lanes in each direction resulting in many additional conflict points at each of the crossroad intersections.

Another item to consider is the potential for severe/fatal crash reductions, where evaluated subjectively and with FHWA Crash Modification factors for Interstate and local roads. The potential for a reduction in these crashes is best with the Remove and Reclassify Strategy since there is no interstate highway. The Access Consolidation and Compressed Footprint Strategies also have reductions compared with the No-Build Strategy, with the Access Consolidation Strategy scoring slightly better.

On the local roads, the Access Consolidation Strategy scores best because of the reduction of conflict points with ramps. The Remove and Reclassify Strategy scored the worst because the elimination of the interstate highway pushes all traffic traveling across the I-70 North Loop area to utilize local roads.

Due to the reconstruction of Independence Avenue/5th Street and 6th Street that would occur with either the Compressed Footprint or Remove and Reclassify Strategies, bicycle and pedestrian safety would be most improved with these strategies. The Ramp Consolidation Strategy could be improved somewhat over the No-Build scenario through improvements to the existing local roads and sidewalks.

Project Goals: Improve Transportation Choices

The Remove and Reclassify Strategy (B7-1) provides the best opportunities to improve transportation choices in the I-70 North Loop area due to the complete removal of the interstate highway and the reconstruction of Independence Avenue/5th Street and 6th Street. Bike/Ped, Independence BRT integration, and Streetcar integration can all be easily done under this strategy.

While the Compressed Footprint strategies also have excellent potential for the integration of Independence Avenue BRT and Streetcar, the compressed highway footprint still creates an obstacle that must be spanned making expansion of Bike/Ped facilities a little more difficult.

The Access Consolidation strategy has the least potential to improve transportation choices since it involves mainly the removal of existing highway ramps. The reconnection of Independence Avenue across Route 9 would provide some improvement in that immediate area.

Project Goals: Improve Economic Vitality and Placemaking

Both the Compressed Footprint and Remove and Reclassify Strategies open up existing highway right of way that could be converted to commercial or recreational uses with the latter providing the most opportunity due to the complete removal of the interstate highway. The Access Consolidation Strategy provides only minor opportunities for revitalization.

Another criterion evaluated was the ability of the strategies to enhance regional freight hubs including the Port of Kansas City/West Bottoms, Fairfax, and the Downtown Airport. Both the Access Consolidation and Compressed Footprint Strategies provide good opportunities to reduce average truck travel times. The Remove and Reclassify Strategy requires trucks that currently use the I-70 North Loop interstate highway to either utilize city streets to get across this area or to divert around the south and west sides of the Downtown Loop resulting in longer travel times.

When it comes to the visual character and aesthetics of the strategies, the Remove and Reclassify Strategy provides the most opportunity to improve the look of the area since it has no interstate highway. By compressing the footprint of the interstate and opening up land on one or both sides of the interstate highway, the Compressed Footprint strategies also have good opportunities to enhance the character and aesthetics of this corridor. These strategies would also allow for the construction of a “lid” over a portion of the depressed interstate highway allowing for creation of an open park area in the densely built urban environment.

Project Goals: Improve Sustainability

Because all the North Loop strategies fit within the existing right-of-way footprint there are no impacts to right-of-way, natural resources or cultural resources. The two measures that vary between strategies are Opportunities for Water Quality and Stormwater and Air Quality. The Water Quality measure is directly related to the area of right-of-way made available by a given strategy and therefore aligns strongly with Economic and Vitality Goal. The Air Quality measure is a byproduct of the delay and travel distance and, therefore, aligns strongly with the Optimize System Performance need. Overall, each of the strategies perform comparably toward the goal of improving sustainability.

Project Goals: General Feasibility

All strategies are confined within existing right-of-way and have no direct impact to adjacent properties. For this reason, beyond the projected cost of each strategy, there is no difference in the feasibility to construct any strategy.

3.4 Level 2 Screening

Strategy B1 addresses the needs to Improve the Physical Conditions, Optimize System Performance, and Improve Safety and Security. However, this strategy has limited potential to address the goals relating Transportation Choices, Economic Vitality, and Environmental Sustainability.

Strategy B1 incrementally Optimizes System Performance and Improves Safety and Security by improving traffic operations along the mainline through consolidation of closely spaced interchanges. The possible reconfiguration of Route 9 to an at-grade arterial would support the goal to Improve Economic Vitality and Placemaking, with limited opportunity to address the other goals to Improve Transportation Choices and Improve Sustainability. Nonetheless, this strategy is recommended to be advanced for further evaluation due to its potential to be phased with other long-term strategies under consideration.

Strategies B3-6a, B3-6b, and B3-7 address the need to improve the Physical Conditions of the freeway network, and positively addresses the other identified needs. The relocation of I-70 to either to the south (B3-6a) or north (B3-6b) edges of the existing right-of-way affords opportunities for increased and enhanced land use development, while providing additional benefits to the environment by fostering possible development of more highly sustainable land uses, increased multi-modal opportunities, and potential quality of life improvements. These three strategies are recommended to be advanced for further evaluation.

Strategy B7-1, which removes the interstate status from the North Loop, redesignates the other three legs of the system, and best reconnects the existing grid system and adjacent land-use demographics. As a result, this strategy meets the stated Goals to Improve Transportation Choices, Improve Economic Vitality and Placemaking, and Sustainability. This strategy has negative impacts to travel times, mainline traffic speeds, and total peak hour delay due to the traffic operational impacts related to the removal of I-70 from the North Loop. These impacts can be mitigated locally with additional capacity improvements. Furthermore, the long-term time frame in which this strategy would be contemplated for implementation would entail the consideration of emerging vehicle fleet technology, and its potential effects on capacity and travel demand relating to transportation infrastructure planning and design. For these reasons, this strategy will be advanced for further evaluation.

Figure 3-10 depicts a generalized comparative summary of the strategies as they relate to meeting the stated study's needs and objectives. A more detailed evaluation matrix which comparatively scores the strategies as discussed in Section 3.3 is provided in Appendix F.

		I-70 North Loop Alternatives					
		No-Build	B1 Access Consolidation	B3-6a Compressed (South)	B3-6b Compressed (North)	B3-7 Compressed (Existing)	B7-1 Reclassify I-70
Needs	Improve Physical Conditions						
	Optimize System Performance						
	Improve Safety & Security						
Goals	Improve Transportation Choices						
	Improve Economic Vitality & Placemaking						
	Improve Sustainability - Right of Way Impacts						
	Affordability	\$	\$\$	\$\$\$\$	\$\$\$\$	\$\$\$\$	\$\$

Figure 3-10: Generalized Evaluation Summary of North Loop Strategies

A more detailed evaluation matrix which comparatively scores the strategies as discussed in Section 3.3 is provided in Appendix F.

4. [Area C: Wheeler Airport](#)

4.1 Constraints and Conditions

US-169 runs north from the existing Buck O’Neill Bridge between Wheeler Airport on the west and the BNSF Railway on the east in a highly confined corridor. There are three interchange areas providing Wheeler Airport access to US-169. The southernmost interchange to Richards Road and Harlem Road provides a southbound entrance to US-169 and northbound entrance and exit ramps from US-169. A second interchange provides southbound right-in/right-out entrance and exit ramps to Richards Road. The third interchange at the north end of the of the Wheeler Airport provides a northbound entrance and a southbound exit ramp to Richards Road.

The existing south US-169 interchange with Harlem Road features left-side entrance and exit ramps, no acceleration lane for the southbound or northbound US 169 entrance ramp movements, and a complex nine-legged roundabout that serves the interchange, Richards Road, Lou Holland Drive, and Harlem Road. The left-side entrance ramp to US-169 in the southbound direction is of concern due to confusion related to signing and lack of an acceleration lane.

At a minimum, redundant access provisions to US-169 for airport patrons and on-site business will be maintained at current levels which include one northbound exit ramp, two northbound entrance ramps,

two southbound exit ramps, and two southbound entrance ramps. One southbound entrance ramp is moved from the south interchange to the north interchange for all strategies.

Conceptual improvements address safety concerns and mobility at the north and south interchanges and the southbound right-in / right-out located on the east side of the airport.

All the strategies for this area will work with any of the Missouri River Bridge Strategies listed in Section 2.2.

4.2 Conceptual Strategies

Three strategies and two auxiliary improvements have been defined to improve the Downtown Wheeler Airport area. To maintain the same number of access points as the existing condition, the north interchange auxiliary improvements must be completed with all three south interchange strategies. Detailed graphics of these strategies and auxiliary improvements can be found in Appendix C.

Strategy C1 – Half Diamond Interchange with Existing NW Harlem Road Access

This strategy, illustrated in Figure 4-1 below, eliminates the southbound entrance ramp to US-169 and moves the northbound US-169 exit ramp and entrance ramp to the outside to eliminate the confusing left, or inside, ramps. Local traffic wishing to enter southbound US-169 will travel north on Richards Road and access southbound US-169 at the right-in/right-out intersection 1,900 feet north of the NW Harlem Road interchange.

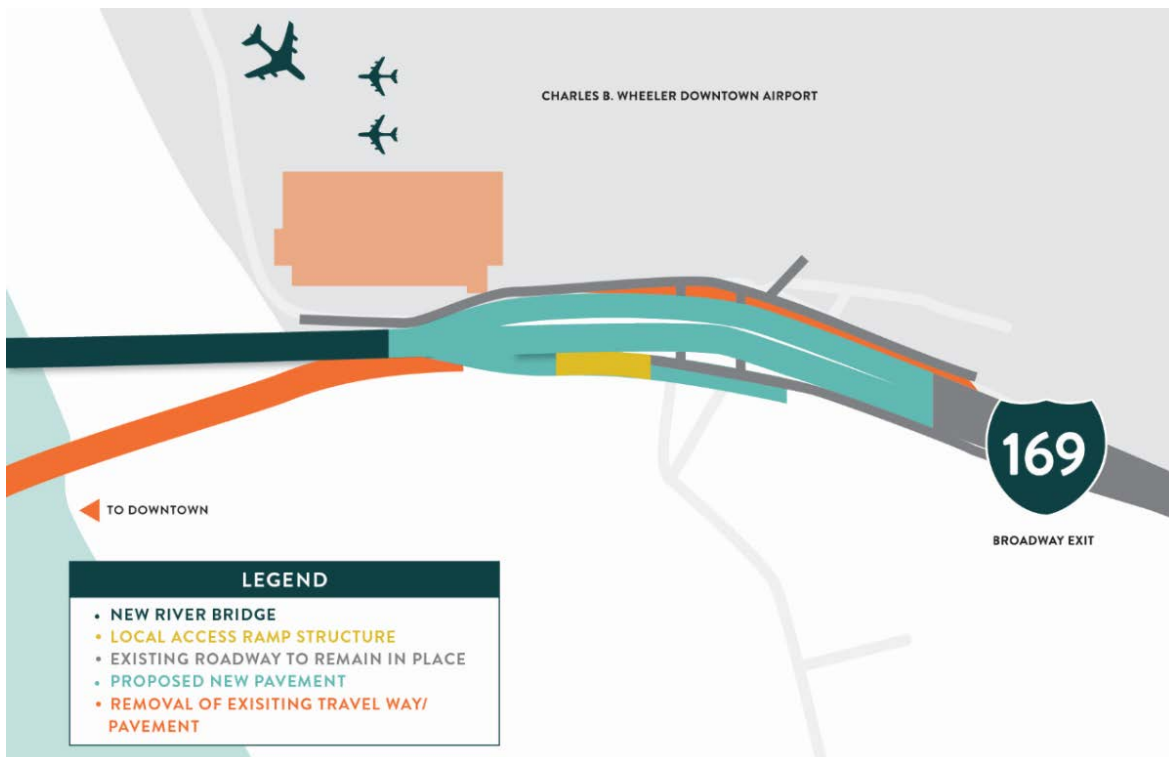


Figure 4-1: Strategy C1 – Half Diamond Interchange with Existing NW Harlem Road Access

NW Harlem Road continues to connect to Richards Road on the west side of the interchange utilizing the existing structures taking the road under the railroad. The multi-leg traffic circle interchange connecting NW Harlem Road, Richards Road, interchange ramps, and airport parking access is eliminated in favor of a gridded intersection configuration.

US-169 is realigned to bring the elevated northbound and southbound lanes together. US-169 is anticipated to be on structure from the north end of the river bridge to the northbound entrance ramp gore area due to the required grade separations and railroad constraints.

Richards Road will be realigned to no longer run underneath of southbound US-169. This may allow southbound US-169 to be built on retained fill, eliminating the construction and long-term maintenance of approximately 400 feet of bridge structure.

A shared use path will be added to the east side of the new river bridge, following down the northbound US-169 exit ramp to NW Harlem Road, where it will cross under US-169 and connect to an existing sidewalk along Richards Road.

The right-in/right-out and north interchange auxiliary improvements described later in this section are included with this strategy.

Strategy C4 – Half Diamond Interchange with Split Lou Holland Undercrossing

This strategy, illustrated in Figure 4.2 below, provides similar US-169 ramp conditions as Strategy C1.

Richards Road will be modified to form a one-way loop between NW Harlem Road/Richards Road on the north and the Missouri River levee on the south. A portion of the southbound portion of the Loop will fall underneath southbound US-169. The northbound portion of the Loop will be braided with the northbound US-169 exit ramp. The Loop road merges with northbound exiting traffic as it approaches Harlem Road.

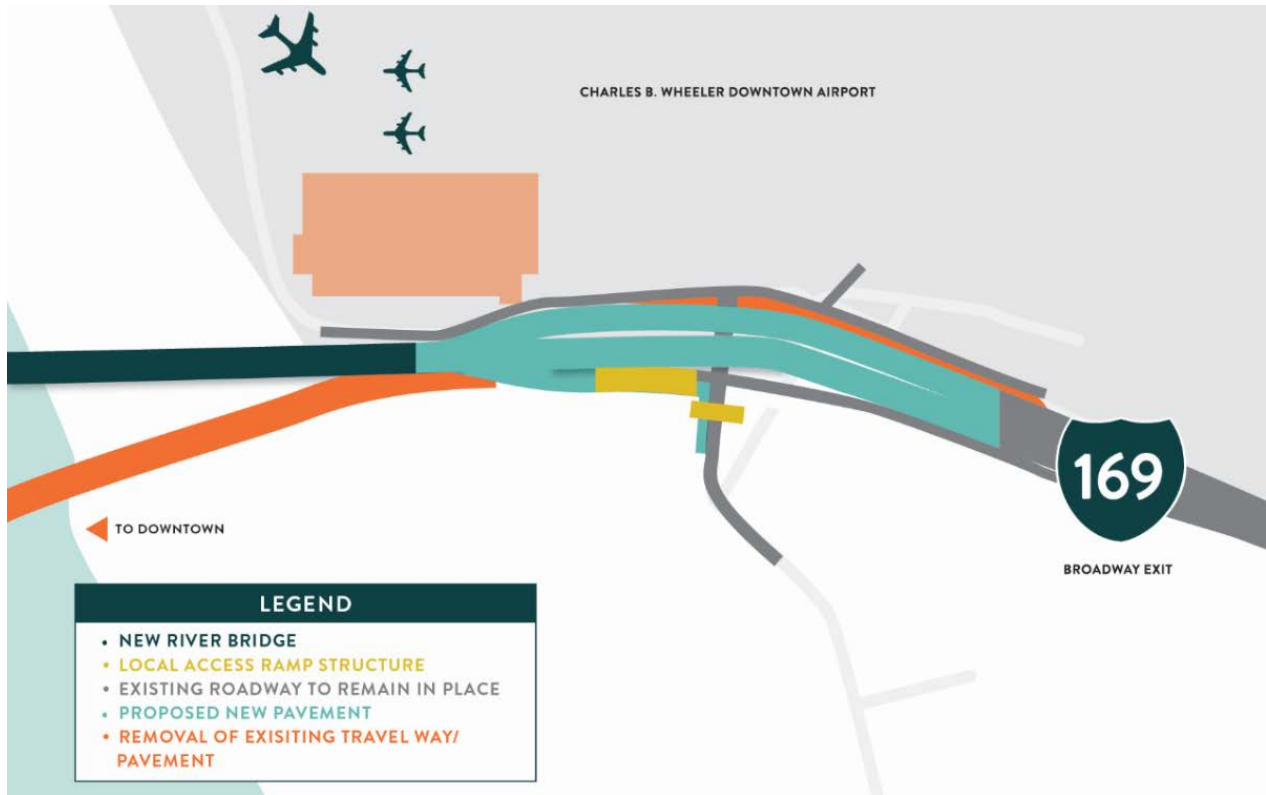


Figure 4-2: Strategy C4 – Half Diamond Interchange with Split Lou Holland Undercrossing

NW Harlem Road will continue to pass underneath the railroad using existing structures and will be tied into the Richards Road Loop.

US-169 is realigned to bring the elevated northbound and southbound lanes together. US-169 is anticipated to be on structure from the north end of the river bridge to the northbound US-169 entrance ramp gore due to the required grade separation and railroad constraints.

A shared use path will be added to the east side of the new river bridge, following down the northbound US-169 exit ramp to NW Harlem Road where it will cross under US-169 and connect to an existing sidewalk on Richards Road.

The right-in/right-out and north Interchange auxiliary improvements described later in this section are included with this strategy.

Strategy C5 – Half Diamond Interchange with New Single Harlem Road Railroad Crossing

This strategy, illustrated in Figure 4-3 below, is similar to Strategy C1, with the following differences:

- The eastbound and westbound directions of NW Harlem Road would be brought together and pass under a new railroad bridge structure allowing for two lanes of roadway traffic and better vertical clearance.

- The shared use path would be extended to the east under the railroad as far as the entrance to the Holiday Apartments.



Figure 4-3: Strategy C4 – Half Diamond Interchange with Split Lou Holland Undercrossing

Strategy C5 provides the simplest intersecting road network between US-169 ramps, Harlem Road and Richards Road. Coordination with the railroad is more complicated for both the permanent construction and temporary shoofly bridge phasing to maintain railroad connections during construction.

Auxiliary Improvement C-RIRO - Right-In/Right-Out

This strategy, illustrated in Figure 4-4 below, improves the geometry of the existing right-in/right-out access to Richards Road on southbound US-169 to provide sufficient acceleration and deceleration lengths and to separate the acceleration and deceleration lanes from mainline US-169. This improvement may be included with each of the three strategies.

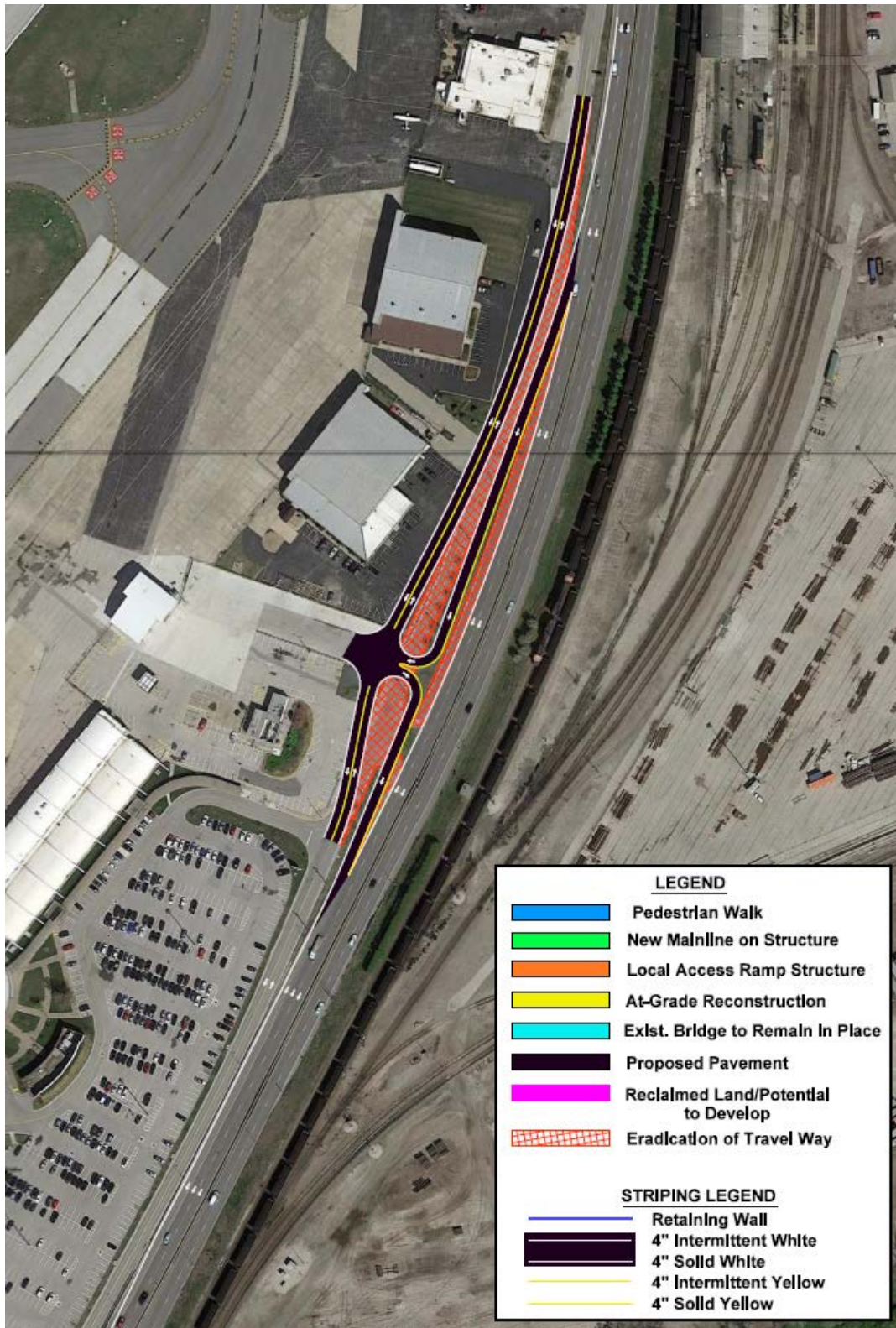


Figure 4-4: Auxiliary Improvement C-RIRO - Right-In/Right-Out

Auxiliary Improvement C-NI - North Interchange Improvements

This strategy, illustrated in Figure 4-5, moves the southbound US-169 exit ramp at the north airport interchange to exit US-169 north of the existing grade separation with the northbound entrance ramp from Richards Road. This results in a single intersection at Richards Road to improve safety by reducing the possibility of a northbound motorist entering southbound US-169. This revision also allows for construction of a Loop ramp that will provide access to southbound US-169 to replace the on-ramp removed from the existing interchange at the US 169 bridge approach. This improvement is included with each of the three strategies to maintain the same number of US-169 entrance and exit ramps as the existing condition.

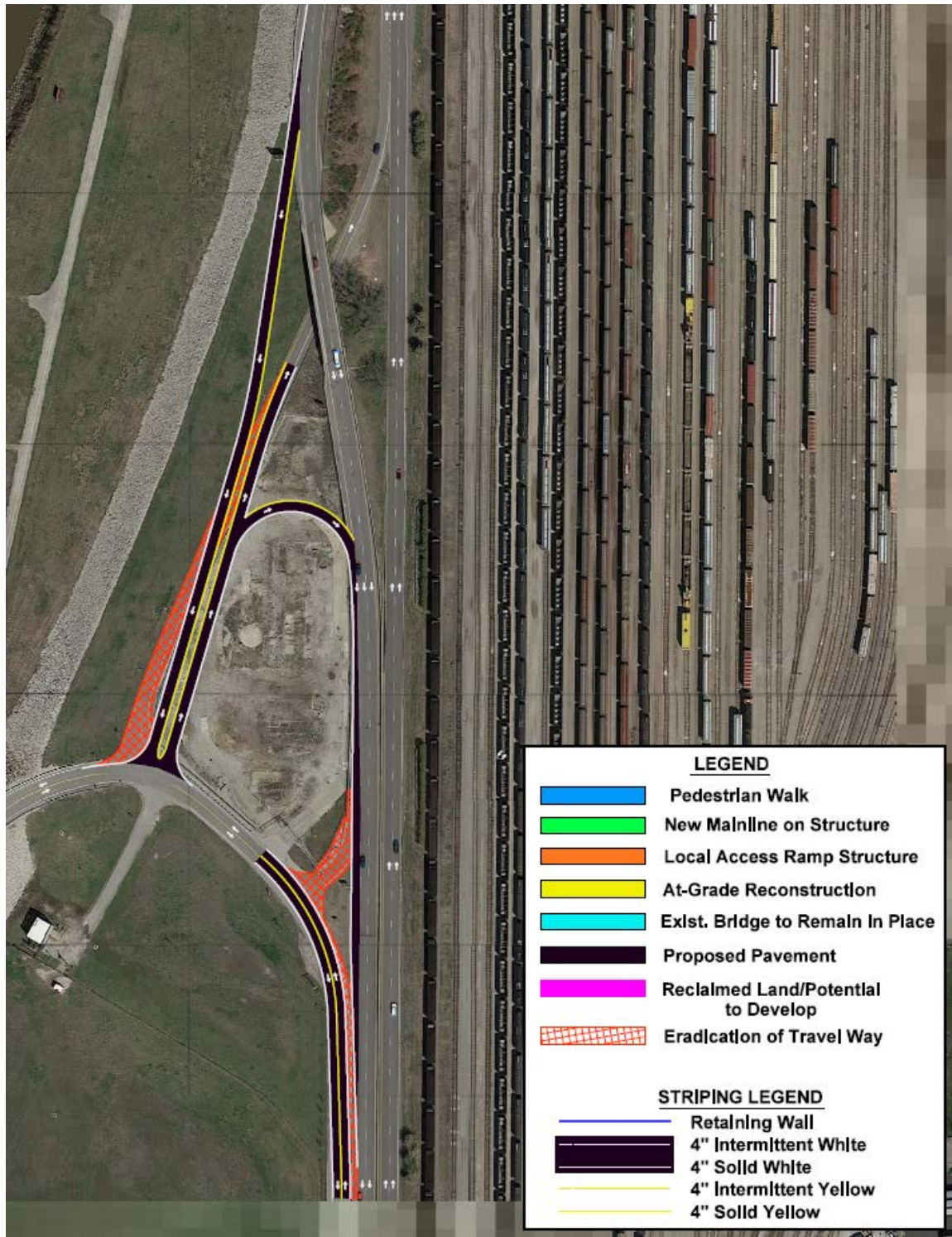


Figure 4-5: Auxiliary Improvement C-NI - North Interchange Improvements

Table 4-1: Summary of Wheeler Airport Strategies

Wheeler Airport	Strategy	Description
Half Diamond Interchange with Existing Harlem Road Access	C1	A half diamond interchange, with the exit and entrance ramps on the right-hand side.
Half Diamond Interchange with Split Lou Holland Undercrossing	C4	Similar to strategy C1 except Northbound Lou Holland Drive splits near the floodwall and provided direct connection to Northbound US-169 and Richards Road via a weaving movement.
Half Diamond Interchange with New Single Harlem Road Railroad Crossing	C5	A half diamond interchange, with the exit and entrance ramps on the right-hand side. Harlem Eastbound and Westbound traffic is brought together for a Single railroad undercrossing.
Auxiliary Improvements		
Right-In/Right-Out At-Grade Improvements	C-RIRO	Improve existing RIRO by providing additional length to existing accel/decel lanes and separated accel/decel lanes
Interchange Improvements at Richards Road (North)	C-NI	SB entrance and exit ramp connections and NB Entrance ramp connections

4.3 Level 2 Evaluation

The Wheeler Airport strategies were evaluated based on 42 separate measures related to the Project Needs and Project Goals. The matrix showing the detailed results of the Level 2 evaluation can be found in Appendix F.

Project Need: Improve Physical Conditions

Each of the strategies will remove and replace a similar amount of existing, deteriorated, bridge structure with new bridge structure. Likewise, the various strategies will remove between 126,000 and 142,000 square feet of existing pavement and replace it with new pavement.

Project Need: Optimize System Performance

Each of the strategies will improve system performance in the same way and to the same extent.

Project Need: Improve Safety and Security

Each of the strategies will provide high potential for safety improvements to bike/ped facilities and improve Kansas City Fire Department access between Downtown Airport and Harlem. Driver safety is improved with a reduction in the number of conflict points from the existing 25 conflict points to between 13 and 20 conflict points.

Project Goals: Improve Transportation Choices

The addition of a shared use path to a new bridge that would connect on the north side of the Missouri River helps to improve transportation choices for each of the three strategies. While there is some opportunity for integration and enhancement of bus services due to improved geometrics, the improvements do not anticipate the integration of streetcars.

Project Goals: Improve Economic Vitality and Placemaking

The improvement of the geometrics associated with the strategies serves to enhance the connectivity of the Downtown Airport with the highway system making it a more attractive location to conduct business. There are only small (<0.6 acres) right of way impacts to commercial properties to implement the strategies. Each of the strategies would impact two NRHP Districts. No other ROW, displaced populations, cultural resources, or natural resources, are impacted by the three strategies.

Project Goals: General Feasibility

All main strategies will include railroad coordination for the removal and construction of new retaining walls along the railroad right of way to support the shift in the mainline and ramp grade changes. Strategy C4 will also include road construction along levee areas along the north bank of the Missouri River. Strategy C5 is the least feasible and most costly of the strategies due to the difficulty of obtaining new railroad easement and constructing a new underpass of the railroad.

4.4 Level 2 Screening

In comparison with the existing interchange and its inherent physical condition and geometric characteristics that do not conform to current design and traffic standards, all the proposed strategies meet the needs to Improve the Physical Conditions, Optimize System Performance, and Improve Safety and Security.

All three strategies meet the need of improving the geometry and physical condition of the interchange and improve drive safety. They also meet the goals of improving connectivity to the highway system, but at various degrees for certain movements. Strategy C4 provides a more direct access to Richards Road for northbound US-169 traffic exiting at the interchange, in comparison with the C1 and C5 conventional diamond interchanges. It provides less direct access to the northbound US-169 entrance ramp due to the need to loop south under the end of the Missouri River Bridge to gain access to the ramp. The configuration of Richards Road and the shared use path circulation will require additional refinement and assessment to minimize conflict points as this strategy is advanced for additional study.

Auxiliary Improvements C-RIRO and C-NI both meet the needs to Optimize System Performance and Improve Safety and Security. Both Auxiliary Improvements are advanced for further evaluation.

All three interchange strategies were perceived to collectively and positively address the needs and were determined to be worthy of advancing to a higher level of detail and evaluation. Figure 4-6 depicts a generalized comparative summary of the strategies as they relate to meeting the stated study's needs and objectives. A more detailed evaluation matrix which comparatively scores the strategies as discussed in Section 4.3 is provided in Appendix F.

Wheeler Airport Interchange Alternatives					
		No-Build	C1 Half Diamond w/ Existing Harlem Access	C4 Half Diamond w/ Split at Lou Holland	C5 Half Diamond w/ new Harlem Access
Needs	Improve Physical Conditions				
	Optimize System Performance				
	Improve Safety & Security				
Goals	Improve Transportation Choices				
	Improve Economic Vitality & Placemaking				
	Improve Sustainability - Right of Way Impacts				
	Affordability	\$	\$\$	\$\$	\$\$\$

Note: All strategies include north area folded diamond with improved SB off, existing NB on, and new SB on

Figure 4-6 Generalized Evaluation Summary of Wheeler Airport Interchange Strategies

5. Area D: West Bottoms

5.1 Constraints and Conditions

The Lewis and Clark Viaduct extends approximately 1.3 miles between I-35 at the west end of the North Loop, across the Kansas River, to an interchange serving local access into Downtown Kansas City, Kansas and the Fairfax Industrial District. Local access to and from this portion of the West Bottoms is served from the Woodswether Viaduct, which connects with Broadway and 3rd Street at the east end beneath the US-169/O'Neil Bridge approach span, and Woodswether Road at the west end. Woodswether Road and Viaduct also carry a KCATA transit route that serves the northern region of the Bottoms, connecting the River Market to the east with James Street and Kansas City, Kansas to the west.

The current configuration of the Broadway intersection at 5th Street prohibits the Woodswether traffic from connecting directly with I-35 southbound or I-70 westbound. Truck traffic destined for these routes often traverse through the River Market residential and commercial areas on 3rd Street to Wyandotte or other streets that provide connections to the freeway system. In addition to vehicular traffic, Woodswether Road is signed as a bike route as an integral part of the Greater Kansas City Regional Trails and Bikeway system, connecting Downtown and the River Market area with the Riverfront Heritage Trail that runs beneath the Lewis and Clark Viaduct and across the Kansas River to the west.

Due to its declining condition, in 2011 a Woodswether Viaduct Alternatives Study was commissioned by and completed for the City of Kansas City, which reported on the evaluation of a range of alignment and bridge configurations. Alternates evaluated ranged from replacing on existing alignment, to multiple new alignments which required property acquisitions. The original study ultimately recommended that the existing bridge be rehabilitated on the existing alignment. The strategy of constructing a new Woodswether Viaduct, in addition to the cost differential between a new structure in comparison with a full rehabilitation of the existing, was not advanced as a viable concept for the following reasons:

- Requirements for significant bridge and retaining walls over and on railroad right-of-way
- Acquisition of multiple properties
- Continued routing of truck traffic through the River Market area
- Potential conflicts with the construction of a new US-169 Missouri River Bridge
- Continued operations and safety concerns with maintaining commercial truck traffic through the Broadway and 5th & 6th Street I-70 Interchange

The Woodswether Viaduct repairs including re-decking and other structural repairs were completed in 2017. As a result of the previous study recommendations, and the current commitment to repair the bridge, strategies that entailed reconstruction of the bridge on a new alignment were not advanced for further evaluation under this study.

Daily traffic on the Woodswether Viaduct is approximately 2,800 vehicles per day, of which approximately 10 percent is comprised of trucks and heavy vehicles. Of the six predominant access streets and highways serving the area, historical traffic data suggests that approximately 7 percent of the traffic generated in the area is carried on the Viaduct. The conceptual strategies in this portion of the Study Area focused on providing an alternate means of vehicular and non-motorized access into the area to mitigate the possible removal of the Viaduct to accommodate construction of a new river bridge on an alignment west of the existing bridge.

In addition to Woodswether Road and the Viaduct, West Bottoms access is provided from five other locations serving the estimated volume distribution between the hours of 9:00 a.m. and 3:00 p.m. as follows:

- Forrester Road connection to Beardsley Road to I-70 and I-35 (14%)
- 12th Street connection to I-35 on the west side of the loop (10%)
- I-670 at Wyoming Street and Genesee Street (26%)
- Central Avenue Viaduct to I-70 and from I-670 (22%)
- James Street to I -70 (21%)



Figure 5-1: West Bottoms Service Area

Generally, the alternative West Bottoms access strategies involve local roadway improvements to carry traffic on Forrester Road and the Forrester Viaduct.

5.2 Conceptual Strategies

A series of conceptual strategies to provide access to the West Bottoms using the local street system were developed for consideration. In addition to determining feasible access alternatives for vehicular traffic into and out of the West Bottoms, the strategies also considered accommodations for non-motorized modes to maintain bike/pedestrian connectivity. These strategies include a possible re-use of a portion of the existing Woodswether Viaduct, with a segment of new structure possibly incorporated into the new river bridge substructure, to maintain bicycle and pedestrian connectivity.

Three strategies were developed to carry the traffic that would typically rely on Woodswether Road and the Viaduct, with the objective of routing the traffic to the Forrester Viaduct and Beardsley Road. Forrester Road and the Viaduct carry approximately 3,000 vehicles per day with adequate spare capacity to serve the traffic needs at the northeast region of the Bottoms that currently relies on Woodswether. These strategies augment the existing roadway network to better define the preferred routing of traffic

although other means to connect with Forrester Road or alternate general access to the region would still be available. Local intersection improvements, pavement rehabilitation, and widening at the Beardsley Road Loop ramp connections to westbound I-70 are included to accommodate the additional traffic and roadway geometric needs.

Strategy D6: Mulberry Street to Forrester Road

This strategy utilizes an improved Mulberry Street to St Louis Avenue, Hickory Street, and Forester Road. Mulberry is approximately 32 feet wide with sidewalk on the east side. Local intersection improvements may be required along the new route to provide adequate turning geometrics for heavy vehicles.

The Woodswether Viaduct would be closed to vehicular traffic, but a portion would remain in place to provide continuity of bike/ped routes.



Figure 5-2: Strategy D6: Mulberry Street to Forrester Road

Strategy D7: Wyoming Street to Forrester Road

This strategy utilizes an improved Wyoming Street for the connection between Woodswether and 9th Street, which becomes Forrester Road to the east. Wyoming is approximately 32 feet wide with some improved segments that include curbing and sidewalk. Local intersection improvements at the 9th Street intersection may be required to provide adequate turning geometrics for heavy vehicles.

The Woodswether Viaduct would be closed to vehicular traffic, but a portion would remain in place to provide continuity of bike/ped routes.



Figure 5-3: Strategy D7: Wyoming Street to Forrester Road

Strategy D8: 4th Street Connector

This strategy would extend 4th Street west across the railroad from Beardsley Road to connect with Woodswether Road. This new connection would also provide bike/ped facilities. The existing Woodswether Viaduct would be removed.



Figure 5-4: Strategy D8: 4th Street Connector

Table 5-1: Summary of West Bottom Strategies

West Bottoms	Strategy	Description
Mulberry St to Forrester Rd	D6	Utilize existing Mulberry St between Woodswether and Forrester
Wyoming St to Forrester Rd	D7	Utilize existing Wyoming St between Woodswether and Forrester
4 th St to Woodswether Viaduct	D8	Extend 4 th Street west across the railroad on a new bridge to into Woodswether Road.

5.3 Level 2 Evaluation

The West Bottoms strategies were evaluated based on 33 separate measures related to the Project Needs and Project Goals. The matrix showing the detailed results of the Level 2 evaluation can be found in Appendix F.

Project Need: Improve Physical Conditions

Each of the strategies removes all or part of the existing Woodswether Viaduct bridge eliminating the need to maintain and rehabilitate the existing structure as a structure carrying motorized traffic. Portions of the existing bridge may be left in place where there are no conflicts with the US-169 proposed bridge

improvements. Remaining sections of the existing bridge may be reconnected to provide bicycle and pedestrian access. Up to 197,000 square feet of existing pavement would also be removed or repaired.

Project Need: Optimize System Performance

Local access under the D6 and D7 strategies are negatively impacted by the elimination of the Woodswether Viaduct requiring use of different access location to access the West Bottoms area north of I-70. The proposed improvements do provide marginal opportunities to improve access management, active transportation, and geometric improvements where roadway improvements are being made.

Project Need: Improve Safety and Security

Driver safety is best improved by the D8 strategy with a reduction of conflict points from 116 down to 40. Strategies D6 and D7 do little or nothing to reduce the number of conflict points. Strategy D8 also has the most opportunity to improve bike/ped safety, though D6 and D7 also provide some improvement over the No-Build strategy by removing vehicular traffic conflicts for bicycles and pedestrians from the bridge.

Due to the removal of the Woodswether Road bridge in strategies D6 and D7, emergency response times from Kansas City Fire Department Station 25 at 401 East Missouri Avenue is increased. Strategy D8 response times are similar to those of the No-Build scenario.

Project Goals: Improve Transportation Choice

All the strategies provide some opportunities to improve bike/ped facilities in the locations where roadways are being improved. Strategy D8, with a new 4th Street connection to Woodswether Road, provides the potential for improving bus service in the area.

Project Goals: Improve Economic Vitality and Placemaking

Reconnection of the Woodswether Viaduct to maintain bicycle and pedestrian connections may provide opportunities for placemaking by creating Missouri River overlook viewing areas on the structure. Furthermore, this connection maintains a key bicycle connection between Downtown, the River Market, Kansas City, Kansas, and the Kaw Point recreational area.

Project Goals: Improve Sustainability

The only community impacts would be the need to acquire less than 2 acres of commercial property for ROW under Strategy D8.

In the area of cultural resources, all 3 strategies would impact 2 NRHP districts. For natural resources, Strategy D8 would impact one acre of parks due to the extension of 4th Street through River Bluff Park.

Project Goals: General Feasibility

Strategy D8 scores lowest in general feasibility as it would require the acquisition of a new railroad easement and construction of a new bridge over the railroad. Because of the bridge and retaining walls required D8 would also be the most expensive strategy. Connections to parking lots and utility and railroad access roads from the elevated 4th Street connection will be a challenge.

5.4 Level 2 Screening

Strategies D6 and D7 generally provide the same traffic operations level of connection to Forrester Road in terms of convenience and travel distance from Woodswether Road. Depending on the specific origin or destination in the region, some alternatives require more or less travel distance than others. Transit service can be maintained via Beardsley Road and Forrester Road, which are both currently used for other KCATA routes. Existing bike connectivity along Woodswether could be maintained by repurposing the existing viaduct, supplemented with new structure dedicated to non-motorized modes to link the segment of the bridge removed to accommodate the new river bridge.

All three strategies were perceived to collectively and positively address the needs and were determined to be strategies worthy of advancing to a higher level of detail and evaluation. Figure 5-5 depicts a generalized comparative summary of the strategies as they relate to meeting the stated study’s needs and objectives. A more detailed evaluation matrix which comparatively scores the strategies as discussed in Section 5.3 is provided in Appendix F.

West Bottoms Local Street Improvement Alternatives					
		No-Build	D6 Mulberry St. to Forrester	D7 Wyoming St. to Forrester	D8 4th St. to Woodswether
Needs	Improve Physical Conditions				
	Optimize System Performance				
	Improve Safety & Security				
Goals	Improve Transportation Choices				
	Improve Economic Vitality & Placemaking				
	Improve Sustainability - Right of Way Impacts				
	Affordability	\$	\$\$	\$\$	\$\$\$

Figure 5-5: Generalized Evaluation Summary of West Bottoms Access Strategies

6. Area E: Route 9

6.1 Constraints and Conditions

Route 9 connects I-70 and Downtown Kansas City to North Kansas City along a half mile stretch of freeway connecting Locust Street and Oak Street, Downtown to the Heart of America Bridge over the Missouri

River. At I-70 there is an interchange providing some, but not all, movements between I-70 and Route 9. Independence Avenue is not connected across Route 9.

Route 9 runs north and south, just west of Cherry Street, dividing the River Market area and Columbus Square neighborhoods. There are grade separations at 3rd Street and 5th Street, but the only connections to Route 9 are an entrance ramp from 3rd Street to northbound Route 9 and an exit ramp from southbound Route 9 to 3rd Street.

Bike/Ped facilities consist of a dedicated bicycle lane and sidewalk along the east side of Cherry Street from Independence Avenue to 3rd Street. North of 3rd Street a shared use bike/ped path runs up the entrance ramp to Route 9 and crosses into North Kansas City on the east side of the Heart of America Bridge. This shared use path is separated from roadway traffic by a concrete barrier.

The open area bounded by 3rd Street, Locust Street, 5th Street, and Route 9 is utilized as the River Market Dog Park.

6.2 Conceptual Strategies

Four strategies have been defined for improving the Route 9 area as described below. Detailed graphics of these strategies can be found in Appendix E.

Strategy E2a – All At-Grade Connections, Existing MO-9 Alignment

This strategy brings Route 9 down to grade between I-70 and the Heart of America Bridge with new at-grade intersections at 3rd Street, 5th Street, Independence Avenue, and 6th Street. Route 9 would consist of two lanes northbound and 3 lanes southbound to 5th Street, then two lanes southbound to the south of 5th Street. The existing Route 9 southbound exit ramp to 3rd Street, along with the 4th Street connector between 3rd Street and Locust Street would be removed. The existing northbound entrance ramp from 3rd Street provides bicycle and pedestrian connectivity to the Heart of America Bridge. If this ramp is removed, alternative connections will be necessary. All existing ramps connecting Route 9 to I-70 would also be removed. Cherry Street between Missouri Avenue and Charlotte Street is shown to be removed.

A new bike/ped lane will be constructed on the east side of Route 9 starting at Independence Avenue at the south and continuing north, connecting with the existing barrier separated trail on the Heart of America Bridge crossing of the Missouri River.



Figure 6-1: Strategy E2a – All At-Grade Connections, Existing Route 9 Alignment

Strategy E2b – All At-Grade Connections, Western Offset of MO-9 Alignment

This strategy is similar to Strategy E2 except that Route 9 is shifted west to allow for additional development or future street car expansion on the east side of Route 9.



Figure 6-2: Strategy E2b – All At-Grade Connections, Western Offset of MO-9 Alignment

Strategy E3 – South At-Grade Connections

This strategy includes new at-grade grade intersections of Route 9 with 3rd Street, 5th Street, Independence Avenue, and 6th Street. Route 9 would consist of two lanes northbound and three lanes southbound to Independence Avenue, and two lanes southbound to the south of Independence Avenue. The existing 4th Street connector between 3rd Street and Locust Street, along with all the ramps at I-70, would be removed. Cherry Street between Independence Avenue and Missouri Avenue would also be removed.

A new bike/ped lane will be constructed on the east side of Route 9, starting at Independence Avenue at the south, and continuing north across the Heart of America Bridge.

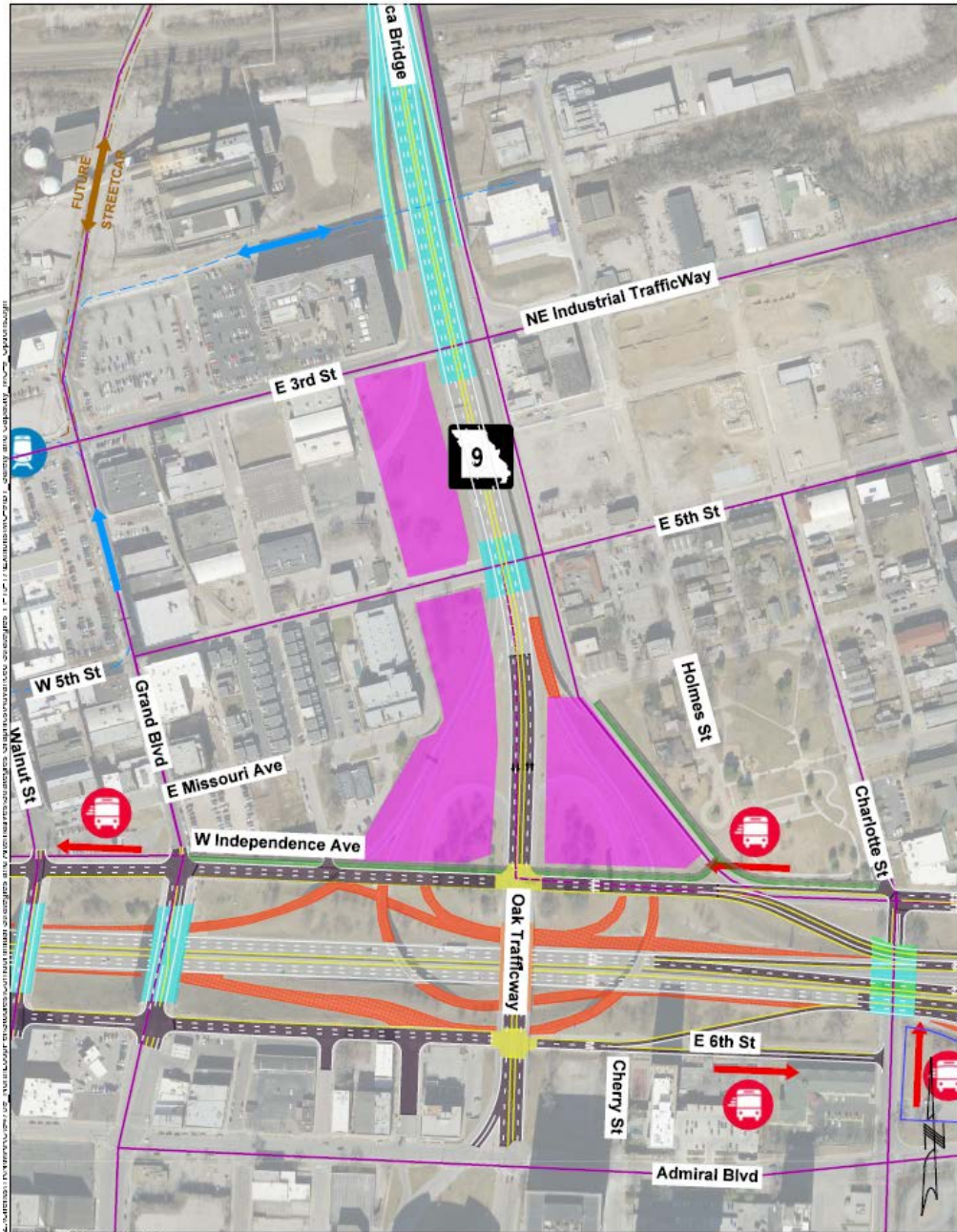


Figure 6-3: Strategy E3 – South At-Grade Connections

Strategy E4 – South At-Grade Connections with Split Lanes

This strategy is like Strategy E4 except that southbound Route 9 would split away from northbound Route 9, south of 5th Street. This results in separate intersections for northbound and southbound traffic with 6th Street and Independence Avenue. South of I-70, southbound Oak Street between 6th Street and 8th Street would be removed, and Page Street between 6th Street and 8th Street improved to accommodate southbound traffic.

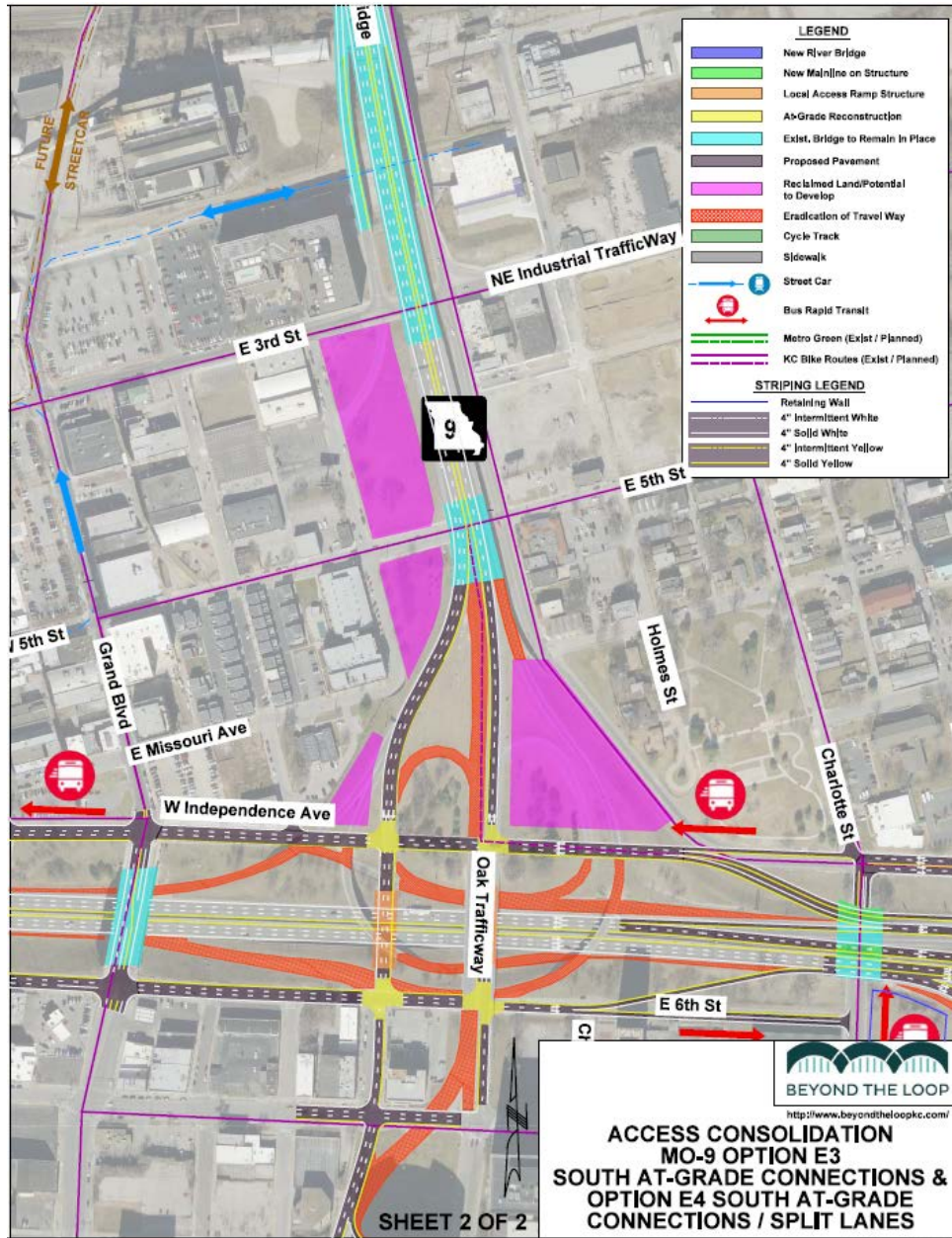


Figure 6-4: Strategy E4 – South At-Grade Connections with Split Lanes

Table 6-1: Summary of Route 9 Strategies

Missouri Route 9	Strategy	Description
All At-grade Crossings on Existing Alignment	E2a	MO- 9 brought back to grade with at-grade crossings at 3 rd Street, 5 th Street, Independence Avenue, and 6 th Street. No shift in MO-9 alignment
All at-grade Crossings on Western Alignment	E2b	MO-9 brought back to grade with at-grade crossings at 3 rd Street, 5 th Street, Independence Avenue, and 6 th Street. Route 9 alignment shifted west.
South At-Grade Connections	E3	I-70/MO-9 interchange removed and replace with at-grade intersections at Independence Avenue and 6 th Street
South At-Grade Connections / Split Lanes	E4	I-70/MO-9 interchange removed. Northbound and southbound MO-9 split with each having at-grade intersections at Independence Avenue and 6 th Street

6.3 Level 2 Evaluation

The Route 9 strategies were evaluated based on 38 separate measures related to the Project Needs and Project Goals. The matrix showing the detailed results of the Level 2 evaluation can be found in Appendix F.

Project Need: Improve Physical Conditions

Strategies E2a and E2b bring Route 9 back down to the level of the adjoining neighborhoods. This complete reconstruction of the roadway provides a new facility with better physical conditions and a longer useful life than the existing facility. Strategies E3 and E4 improve only the portion of Route 9 south of 5th Street.

All the strategies improve 21 existing substandard geometric features.

Project Need: Optimize System Performance

The most significant difference in the performance of the strategies toward this goal relates travel time along Route 9. For the Level 2 evaluation, this was measured as travel time for southbound Route 9 vehicles to traverse from the Heart of America Bridge to either westbound I-70 or southbound US-71. The No-Build or existing condition provides free flow freeway operations, so it performs the fastest. E2a and E2b provide all at-grade crossings and therefore have the highest travel time. E3 and E4 maintain the bridge crossings at 3rd and 5th Streets, and therefore provide travel times higher than E1, but less E2a and E2b. Relative travel times for Route 9 southbound from the Heart of America Bridge to westbound I-70 at Broadway were projected as (from 1-longest to 5-shortest): Existing - 1, E2a – 4, E2b – 5, E3 – 3, E4 – 2.

Access to and from Columbus Park and River Market are best improved by Strategies E2a and E2b which add new at-grade intersections with 3rd Street and 5th Street and a reconnected Independence Avenue. Strategies E3 and E4 provide only the improvement at the reconnected Independence Avenue.

There are multiple congestion mitigation strategies that can be applied to the each of these strategies. Active Transportation and Transit strategies appear most applicable across all four Route 9 strategies. There is also some potential for application of Highway and Transportation Operations and Management strategies.

Project Need: Improve Safety and Security

Driver safety as measured by the number of conflict points would decrease from the No-Build condition. Strategies E2a and E2b create four new at grade intersections at 3rd Street, 5th Street, Independence Avenue, and 6th Street create approximately three times as many conflict points as currently exist. Strategies E3 and E4 only add a net four conflict points with the removal of the interchange with I-70 and the addition of at-grade intersections at Independence Avenue and 6th Street.

Strategy E2b, which has Route 9 shifted to the west, provides the most opportunity to improve bike/ped safety, due to its ability to better separate bike/ped traffic from the roadway. Strategies E2A and E3 provides somewhat less opportunity than Strategy E2b, but reconstruction of all of part of the roadway provides opportunity to implement safety improvements. Strategy E4 includes 2 separate intersections at Independence Avenue and 6th Street, and therefore, has even less opportunity to improve bike/ped safety.

Access to the Route 9 from KCFD Station 25 at 401 East Missouri Avenue is improved by strategies E3 and E4, due to the ability to gain access using Independence Avenue. Strategies E2a and E2b are even better, as access is also available at 3rd Street and 5th Street.

Project Goals: Improve Transportation Choices

The potential to expand bike/ped facilities is best found in Strategy E2b. With the western shift in the alignment, this strategy allows additional room to create a separate bike/ped facility between Route 9 and Cherry Street. The other strategies also provide opportunities for expansion, but to a slightly lesser degree.

The potential to expand bus or streetcar services is best with Strategies E2a and E2b since they bring the entire roadway down to the same level as the surrounding neighborhood. Strategies E3 and E4 only provide opportunities for improvement south of 5th Street where reconstruction would occur.

Project Goals: Improve Economic Vitality and Placemaking

Each of the strategies would make space available for commercial or recreational development in areas of right of way not required to construction improvements. The area runs from a low of six acres in Strategy E4 to a high of nine acres in Strategy E2b.

Visual character and aesthetics is best improved by Strategies E2a and E2b because they eliminate the raised highway dividing the neighborhoods. These two strategies at-grade intersections at 3rd Street and 5th Street also provide the best access to River Market.

Strategies E3 and E4 have a more limited ability to improve visual character and aesthetics since improvements would only be made south of 5th Street. They also provide no benefit in providing access to River Market.

Project Goals: Improve Sustainability

Because all of the Route 9 strategies fit within the existing right-of-way footprint of the existing interchange, there are no impacts to right-of-way, natural resources or cultural resources. The two measures that vary between Strategies are Opportunities for Water Quality and Stormwater and Air Quality. The Water Quality measure is directly related to the area of right-of-way made available by a given Strategy and therefore aligns strongly with Economic and Vitality Goal.

Project Goals: General Feasibility

Reconstruction of the south end of the Heart of America Bridge would be required in Strategies E2a and E2b to bring Route 9 down to grade at 3rd Street. Strategies E3 and E4 would have no impacts to the bridge.

With construction limited to work south of 5th Street, Strategies E3 and E4 would be the least costly to construct. Strategies E2a and E2b are costlier because of the required modification of the Heart of America Bridge and the removal of the embankment, walls, and bridges from 3rd Street to 5th Street in addition to the work done in Strategies E3 and E4.

6.4 Level 2 Screening

Each of the Route 9 strategies were perceived to collectively and positively address the needs and were determined to be worthy of advancing to a higher level of detail and evaluation. Figure 6-5 depicts a generalized comparative summary of the strategies as they relate to meeting the stated study's needs and objectives. A more detailed evaluation matrix which comparatively scores the strategies as discussed in Section 6.3 is provided in Appendix F.

Missouri Route 9 Improvement Alternatives						
		No-Build	All At-Grade		South Only At-Grade	
			E2a Eastern Alignment	E2b Western Alignment	E3 Existing Alignment	E4 Split Lanes
Needs	Improve Physical Conditions					
	Optimize System Performance					
	Improve Safety & Security					
Goals	Improve Transportation Choices					
	Improve Economic Vitality & Placemaking					
	Improve Sustainability - Right of Way Impacts					
	Affordability	\$	\$\$\$\$	\$\$\$\$	\$\$	\$\$

Figure 6-5 Generalized Evaluation Summary of Route 9 Strategies

A more detailed evaluation matrix which comparatively scores the strategies as discussed in Section 6.3 is provided in Appendix F.

7. Transportation System Management

Transportation System Management (TSM) is an approach in planning and engineering aimed at increased efficiencies, capacity and safety of existing infrastructure through low cost improvements. This section provides an overview of TSM categories and initiatives as well as their suitability in potential alternatives in the Broadway PEL extents and surrounding facilities. Strategies with applicability to one of the five specific geographic areas are included in the evaluation matrices found in Appendix F.

7.1 Strategy Definitions

System Management

System-wide TSM improvements that increase access, mobility, capacity and communications across the entire TSM platform.

Table 7-1: TSM – System Management

Category	TSM	Definition	Suitability Rating		
			Low	Medium	High
System Management	<i>Freeway & Arterial Bottleneck Removal</i>	Minor roadway geometric or traffic control improvements			
	<i>Ramp Metering</i>	Traffic signals on ramps control vehicles entering freeways.			
	<i>Access Management</i>	Careful planning of access points along roadways			
	<i>ITS Technology</i>	ITS applications that address travel mobility			
	<i>Traffic Incident Management</i>	Planned process to detect and respond to traffic incidents.			
	<i>Travel Information</i>	Provides information to drivers regarding traffic conditions.			
	<i>Parking Management</i>	Providing information regarding parking			

Travel Demand

Travel Demand TSM strategies seek to lower the demand for single passenger vehicles and to increase the multimodality of existing road facilities through innovative methods that give travelers multiple options for commuting and routing.

Table 7-2: TSM – Travel Demand

Category	TSM	Definition	Suitability Rating		
			Low	Medium	High
Travel Demand	<i>Ridesharing</i>	Includes both carpooling and vanpooling.			
	<i>Public Transportation</i>	Includes fixed route bus service, streetcar and paratransit service.			
	<i>Bicycle and Pedestrian Travel</i>	Bicycle and pedestrian facilities.			
	<i>Land Use Management</i>	Guide development to lessen traffic impacts.			
	<i>Goods Movement Management</i>	It can reduce congestion from city streets in peak hours by regulating pickups and delivery times for freights delivery			
	<i>Telework</i>	Promoting telework to reduce number of commuters			

Increasing Capacity

Capacity focused TSM seek to increase the capacity of existing infrastructure while modifying lanes, signage and interchanges to prioritize travel and develop system-wide efficiencies.

Table 7-3: TSM – Increasing Capacity

Category	TSM	Definition	Suitability Rating		
			Low	Medium	High
Increasing Capacity					
	<i>Add Travel Lanes</i>	Widening existing roadways to add travel lanes.			
	<i>Modify or Add Interchange</i>	Adding capacity to existing interchanges or adding new interchanges to system.			
	<i>Intersection Improvements</i>	An intersection can be improved by installing traffic control devices for the smooth and safe passage of both pedestrians and vehicles. The devices used could be stop signs, yield signs, traffic signs, turning lanes, traffic islands, channelization, and improved design. Includes adding turn lanes, and roundabouts.			
	<i>Geometric Design</i>	Appropriate geometric design helps in reducing congestion and improves safety and freedom of driving. Replacement of continuous left turn lanes with a raised median and adding lanes increases capacity			
	<i>Transit Capacity</i>	Includes added transit service and facilities.			
	<i>HOV and Managed Lanes</i>	A set of lanes where operational strategies respond to changing conditions. Includes high occupancy vehicle lanes.			
	<i>Bicycle and Pedestrian Facilities</i>	Construct bicycle and pedestrian facilities.			

Pedestrian

Pedestrian focused TSM seek to assist and enhance pedestrian safety and mobility at intersections. These TSM support a modal shift by enhancing the pedestrian crossing timing as well as advancing pedestrian phasing for special events.

Table 7-4: TSM – Pedestrian

Category	TSM	Definition	Suitability Rating		
			Low	Medium	High
Pedestrian					
	<i>Pedestrian Countdown Timers (ADA)</i>	Equip all signalized intersections with Pedestrian Countdown Timers			
	<i>Audible Pedestrian Signals(ADA)</i>	Equip all signalized intersections with Audible devices			
	<i>Pedestrian Operations</i>	"Advance" pedestrian phasing, detection, timing for special events			

Cycling

Cycling focused TSM seek to assist and enhance cyclist’s safety and mobility at intersections. These TSM support a modal shift by enhancing and prioritizing cyclists comfort and safety when traveling through intersections.

Table 7-5: TSM – Cycling

Category	TSM	Definition	Suitability Rating		
			Low	Medium	High
Cycling					
	<i>Bike Signal</i>	Equip intersection with Bike Signal displays containing bicycle silhouette			
	<i>Bike Route</i>	Provide marked and signed routes for enhanced corridor use definition.			
	<i>Bicycle Detection</i>	Evaluate new bicycle detection technologies			

Transit

Transit focused initiatives assist in enhancing transit safety, mobility and overall performance of the system. These TSM strategies support a modal shift towards transit by improving the reliability and through prioritizing transit vehicles.

Table 7-6: TSM – Transit

Category	TSM	Definition	Suitability Rating		
			Low	Medium	High
Transit					
	<i>Transit Priority</i>	Continue to implement transit priority features at signalized including: signal priority, queue jumps, queue relocation, etc.			
	<i>Transit Detection</i>	Evaluate new bus detection technologies			
	<i>Access to Transit</i>	Enhance transit stop accessibility and information for transit passengers at transit stops.			
	<i>Bus Schedule Adherence</i>	Incorporate bus schedule with central traffic system and incident detection and management systems			

Traffic Control

Strategies which maintain and operate traffic signal infrastructure in the safest and most cost-effective manner possible.

Table 7-7: TSM – Traffic Control

Category	TSM	Definition	Suitability Rating		
			Low	Medium	High
Traffic Control Signals					
	<i>Traffic Signal Re-Lamping</i>	City forces currently replace all incandescent signal bulbs, clean signal lens, and inspect signal hardware on an annual basis.			
	<i>Inspect, Test and Maintain Conflict Monitors</i>	Conflict monitors are installed in all traffic signal controller cabinets and continually check for conflicting signal indications and respond to a conflict by emitting a signal			
	<i>Traffic Signal Improvements</i>	Several studies revealed that change in signals' physical equipment and timing optimization has helped intensively in congestion mitigation. Traffic flow could be improved by equipment update, timing plan improvement, interconnected signals, traffic signal removal, or traffic signal maintenance as needed.			
	<i>LED Replacement</i>	Replacement of LED signal displays			

Traffic Signs

Strategies which help manage and schedule traffic sign maintenance and consistency.

Table 7-8: TSM – Traffic Signs

Category	TSM	Definition	Suitability Rating		
			Low	Medium	High
Traffic Signs					
	<i>Traffic Signs Inspection Program</i>	Create a traffic sign inspection program. Inspection options include the use of a reflectometer or visual inspections by trained personnel			
	<i>Wayfinding Signage</i>	Provide direction information for key destinations, streetcar and freeway/highway access.			
	<i>Traffic Sign Inventory</i>	Create a data management system for traffic signs			

Pavement Markings

These strategies help to maintain existing pavement markings on roads and at intersections to enable a safe environment for motorists, cyclists and pedestrians.

Table 7-9: TSM – Pavement Markings

Category	TSM	Definition	Suitability Rating		
			Low	Medium	High
Pavement Markings					
	<i>Roadway Markings (Longitudinal and Transverse)</i>	All roadway markings are applied once per year. This includes yellow dividing lines, white lane lines, edge lines, bike lanes, and cross hatching			
	<i>Intersection Markings</i>	Intersections, signalized and unsignalized, are painted twice per year.			

Traffic Management Center

Kansas City’s Scout Traffic Management Center coordinates and manages transportation resources and ITS technologies. These TSM seek to evolve and expand the Center to better manage transportation systems and incidents.

Table 7-10: TSM – Traffic Management Center

Category	TSM	Definition	Suitability Rating		
			Low	Medium	High
Traffic Management Center					
	<i>Expanded Monitoring/ Hours of Operation</i>	Incremental increase in hours of operation to enhance traffic management capabilities resulting from increasing traffic volumes, special events, and emergency road closures and operational needs of the streetcar.			
	<i>Outreach & Education</i>	Provide tours of the TCM to interested groups/members of public/other agencies. Information sessions to schools as to operation of pedestrian signals			
	<i>Informing Public on Real-Time Traffic Conditions</i>	Provide public with real time traveler information by updating traveler information website, changing messages on permanent variable message signs, providing update to media on changing traffic conditions as a result of collisions, construction, unplanned events, etc.			
	<i>Active Traffic and Demand Management</i>	Builds on Integrated Corridor Management (ICM) to dynamically monitor, control, and influence travel demand, traffic demand, and traffic flow of key highway corridors. Active Traffic and Demand Management (ATDM) facilitates the use of transportation alternatives through various approaches, including dynamic ridesharing, dynamic speed limits, dynamically priced parking, and predictive traveler information to improve overall highway efficiency and to maximize investment in ICM.			

Traffic Signal and Camera Infrastructure

These TSM strategies seek to improve the communication and technological capacity of the camera and signal infrastructure to increase the safety of travelers and to gather real-time data for analysis.

Table 7-11: TSM – Traffic Signal and Camera Infrastructure

Category	TSM	Definition	Suitability Rating		
			Low	Medium	High
Traffic Signal and Camera Infrastructure					
	<i>Communication</i>	Continue to enhance traffic signal and camera communications network (fiber optic, copper) Research and deploy new reliable and cost effective wireless technologies where feasible.			
	<i>Traffic Cameras</i>	Continue installation of traffic cameras at critical intersections in order to monitor operations and make timing changes due to incidents. Explore opportunities to use traffic cameras to support traveler information systems.			
	<i>Local Traffic Control Equipment (Hardware and Software)</i>	Continue replacement of aging traffic signal control equipment with new state of the art microprocessor based equipment. Continue development of City designed advanced traffic controller. Features to be developed/enhanced include: Accessible features, Transit Priority, IP communications, Streetcar, Emergency vehicle pre-emption. Equip critical and remote signalized intersections with Uninterrupted Power Supplies (back-up battery).			
	<i>Traffic Signal Timing</i>	Update signal timing at every signalized intersection on a five year basis			
	<i>Permanent Traffic Count Locations</i>	Establish network of traffic sensors along critical arterial roadways to feed central traffic system. Will allow for more adaptable signal timing			

Central Traffic Control System

A centralized traffic control system allows for traffic signals to communicate with a central computer so that traffic signals can be synchronized, monitored and adjusted. These TSM strategies continue to develop upon the current system with annual updates.

Table 7-12: TSM – Traffic Control System

Category	TSM	Definition	Suitability Rating		
			Low	Medium	High
Central Traffic Control System					
	<i>Adaptive and Demand Responsive Signal Control Systems</i>	Explore traffic signal algorithms that automatically and continuously update traffic signal timing and offsets (synchronization) based on real time demand supplied by traffic sensors			
	<i>Emergency Vehicle (Fire) Pre-emption</i>	Expand GPS based emergency vehicle pre-emption network			
	<i>Traffic System Monitoring</i>	Continue to identify opportunities to improve system monitoring capabilities.			
	<i>Street Car Transit Compatibility</i>	Plan and engineer traffic system computability to support "at-grade" Streetcar applications			

Enhanced Traffic Incident Management

Traffic Incident Management is the systematic coordinated use of automated and human and technical resources to reduce the severity and amount of traffic incidents as well as to improve the response to incidents. The TSM strategies decrease congestion caused by incidents and improve emergency response to incidents for other travelers and medical professionals.

Table 7-13: TSM – Enhanced Traffic Incident Management

Category	TSM	Definition	Suitability Rating		
			Low	Medium	High
Enhanced Traffic Incident Management					
	<i>Incident Detection</i>	Implement real-time incident detection system			
	<i>Incident Response</i>	Enhance incident response and activation of a planned strategy for the safe and rapid development of the most appropriate personnel and resources to the scene			
	<i>Traveler Information</i>	Provide timely, accurate information to roadway users about roadway conditions and alternate routes through the use of Traveler Information Services (TIS)			
	<i>Incident Clearance</i>	Enhance incident clearance in a safe and timely manner			
	<i>Emergency Detour Routes</i>	Enhance and implement EDR's for major bridge crossings in the city, as well as major railroad level crossings			
	<i>Incident Data Software</i>	Procure incident logging CADD			
	<i>Cost Sharing</i>	Establish cost sharing formulas and agreements between MPO agencies			
	<i>Permanent Variable Message Signs</i>	Installation of signs at strategic locations throughout the city that will allow motorists to make informed decisions on route selection based on current conditions			

Innovative TSM Technologies and Services

New innovations in TSM that help increase safety and mobility overall as well as to guide future technological growth in transportation jobs.

Table 7-14: TSM – Innovative Technologies and Services

Category	TSM	Definition	Suitability Rating		
			Low	Medium	High
Innovative TSM Technologies and Services					
	<i>Traffic Data Gathering Equipment</i>	Collection of pedestrian, cycling, transit and vehicle data using technologies such as wireless, video, gps, etc.			
	<i>Incident Detection Systems</i>	Explore systems that will be able to detect incidents automatically and to predict when incidents may occur in the future			
	<i>Highway Advisory Radio Systems</i>	Explore feasibility of using radio systems to provide traveler information and to provide real time updates on traffic conditions			
	<i>TIS Information for Pedestrians/Cyclists</i>	Explore GPS technology to help guide pedestrians of cyclists through the City's recreational pathways			
	<i>Wireless Data Collection Technology</i>	Explore wireless technologies to collect travel times along arterial corridors			
	<i>Intelligent Vehicle Technologies</i>	Explore opportunities to leverage advancement in intelligent Vehicle technologies (i.e.. Vehicle to infrastructure and vehicle to vehicle)			
	<i>Data Sharing with External Third Party Applications</i>	Sharing data to third party developers to enhance their applications so that travelers of the City have the most up-to-date information			
	<i>Mobility Hubs</i>	Transportation centers located in smart growth opportunity areas served by high frequency transit service. They provide an integrated suite of transportation services, amenities, and urban design enhancements that bridge the distance between transit and an individual's origin or destination. Mobility hubs are places of connectivity, where different modes of travel—walking, biking, ridesharing, streetcar services—come together seamlessly, and where there is a concentration of employment, housing, shopping, and/or recreation. Mobility hubs feature a range of transportation choices including: bikeshare, carshare, neighborhood electric vehicles, bike parking, dynamic parking management strategies, real-time traveler information, real-time ridesharing, demand-based Bridj shuttle, bicycle and pedestrian improvements, wayfinding, urban design enhancements, and supporting systems like mobile applications, electric vehicle charging, smart intersections, and a universal payment system to make it easy to access a wide range of travel choices			
	<i>Freeway Incident Management System</i>	Prompt removal of a disabled vehicle from travel lanes improves traffic flow			

7.2 Consistency with Purpose and Need

Although TSM strategies can be effective in managing traffic, the strategies contained in this section are not stand-alone strategies and do not meet purpose and need alone. However, the strategies do help overall traffic operations and system mobility by augmenting the viable build strategies outlined in the previous sections. As such, the inclusion of TSM strategies are outlined with the final build alternatives identified as reasonable and feasible.