

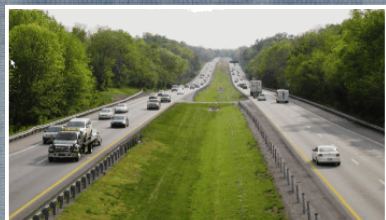
Alternatives Study for I-71 / I-265

Jefferson County, Kentucky

KYTC Item Number: 5-68.00

Final Report

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Prepared for :



**Kentucky Transportation Cabinet
District 5**

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1.0 EXECUTIVE SUMMARY

The Kentucky Transportation Cabinet (KYTC) is considering improvements to the existing interchange of Interstate 71 and Interstate 265. This interchange is directly connected to the I-265 and KY 22 interchange. Based on the need to improve the interchange at this location, KYTC initiated an Alternatives Study with the following purpose:

1. Examine improvement alternatives for the existing interchange at I-71 and I-265;
2. Develop conceptual alternatives and analyze them for effectiveness; and
3. Recommend a short list of three conceptual alternatives that will be advanced for continual study in the next phase of the project process (Phase I Design).

Existing and future traffic data was analyzed to evaluate the existing Level of Service (LOS) and future level of service. The analysis indicated Ramp 8 from I-265 NB to I-71 SB has an existing rating of E during AM peak conditions. This location creates congestion on mainline I-71 SB from north of Chamberlain Lane and I-265 NB from south of KY 22. In addition, the volume of traffic on KY 22 trying to enter I-265 NB creates congestion on KY 22. In the PM peak period a large volume of traffic exits I-71 NB to I-265 SB. The congestion in the AM and PM period contribute to a large number of rear end accidents. Based on future traffic projections in the “no build” scenario the existing interchange will have a LOS of F or E in a variety of locations.

RECOMMENDATIONS

Short-term (Quick-fix):

- Implement improvements of Alternative 1 from I-71 NB to I-265 SB. This ramp modification will add capacity to address current congestion issues in the PM and will be fully compatible with all other future alternatives recommended for advancement. Alternative 1 was included in the 2010 Recommended Highway Plan as Item 5-48.30 with design scheduled for Fiscal Year 2013.
- The second recommendation is to enhance the existing warning signage for the I-71 southbound exit ramp (ramp 8). Supplemental signs in advance of the bridge are recommended to alert motorists, especially truck drivers, to the tight curvature on ramp 8. It is recommended that a panel sign be mounted overhead, with flashers, on the I-265 bridge.



Long Range:

To address the existing deficiencies of the interchange(s) practical solutions, mid-term, and long term alternatives were developed and evaluated. Based on the Highway Capacity Analysis and VISSIM simulations, three alternatives were recommended for further development: Alternatives 5A, 8A, and 10A. These alternatives all met the project study purpose and should proceed to Phase I design.

The following is a summary of the recommended alternative improvement benefits:

Alternative 5A (See Figure 27, Page 39)

- Improves capacity on I-71
- Eliminates AM and PM congestion
- Improves weaving from KY 22 and/or I-265 to I-71 and increases free flow speed
- Improved geometrics with flyover ramp to I-71 southbound
- Safety

Alternative 8A (See Figure 32, Page 44)

- Improves capacity on I-71 and I-265
- Eliminates AM and PM congestion
- Improves weaving from KY 22 and/or I-265 to I-71 and increases free flow speed
- Improved geometrics with flyover ramp to I-71 southbound and I-71 northbound
- Safety

Alternative 10A (See Figure 34, Page 47)

- Improves capacity on I-71
- Eliminates AM and PM congestion
- Improves weaving from KY 22 and/or I-265 to I-71 during AM and PM peak period
- Minimal right of way and utilities affected
- Cost when compared to other ultimate build alternates

2.0 INTRODUCTION

2.1 Project Study Area

The project is located in northeastern Jefferson County, near Oldham County, as shown in **Figure 1**. This is one of the fastest growing areas in the county and has undergone intense land use changes since 2000. Jefferson County has the highest population in any county of Kentucky, with an estimated population of 721,594 in 2009.

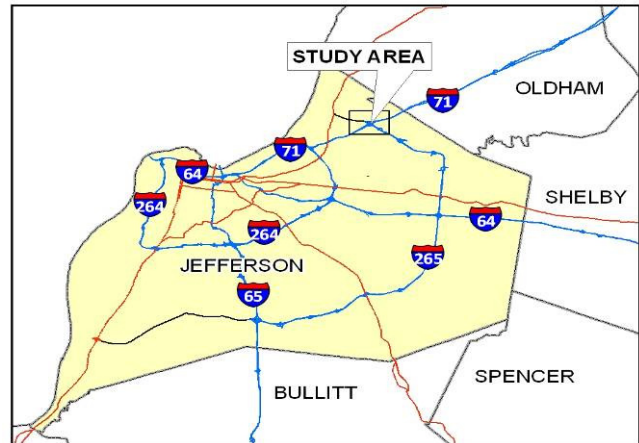


Figure 1. Location Map

The study area extends about 4 miles (north-south) along Interstate 71 and about 4 miles (east-west) along Interstate 265. The study area boundary used for the project is depicted in **Figure 2** which also shows a 1,000 foot buffer along existing I-71 and I-265.

Oldham County is located approximately 2 miles to the northeast of the project. Oldham County has an estimated population of 58,095 (2009), which is the 15th largest in Kentucky. Similar to Jefferson County, western Oldham County has experienced growth in residential development



Figure 2. Project Area

over the past decade as a bedroom community of Louisville. I-71 serves as a commuter corridor connecting Oldham County and northern Jefferson County to downtown Louisville. Major origins/destinations for traffic in this area include the bridges over the Ohio River, I-264, Louisville airports, several large retail centers, businesses, schools, medical centers and residential areas.

2.2 Purpose of the Study

The purpose of the Alternatives Study was to address the current safety and capacity deficiencies with short-term projects and plan for an ultimate future interchange.

1. Examine improvement alternatives for the existing interchange at I-71 and I-265;
2. Develop conceptual alternatives and analyze them for effectiveness; and
3. Recommend a short list of three conceptual alternatives that will be advanced for continual study in the next phase of the project process (Phase I Design).

Tasks undertaken as part of this effort included:

- Identifying project goals and issues;
- Defining the need for the project;
- Determining project termini and potential alternatives;
- Describing the conditions along the existing roadway;
- Performing an environmental overview to document potential impacts;
- Estimating the project costs; and
- Identifying priority segments for future phase activities.

One of the early steps in this process was the collection of technical and resource agency input concerning the project. This was accomplished by:

- Compiling information from existing data and reports;
- Establishing a project team to provide direction and review for the study; and
- Coordinating with resource agencies and local officials.

After an initial review of the data decisions were made to:

- Develop a project description;
- Define logical termini;
- Address the geometrics, level of service, CRASH history, and other influencing issues;
- Establish general design criteria;
- Document known environmental concerns; and
- Develop a draft statement of project issues and goals.

2.3 Planning Process



Transportation planning projects begin with identifying, collecting, and analyzing a wide range of data regarding the project study area. This data typically includes land use, environmental constraints, the overall roadway network, daily and peak period traffic volumes, existing safety data, researching other area plans or projects, and identifying public issues.



Shortly after the data gathering process was completed, a kickoff meeting was held with members of the KYTC and FHWA to present the early findings and define project goals and objectives. These were used as a key evaluation metric for the alternatives.

Coordination and review meetings were held with the KYTC and FHWA to update the project status, seek input and discuss resolution of various project issues, and evaluate the project alternatives.

At this stage of the overall project process, a public involvement component was not implemented. A full Public Involvement Plan will be implemented during the next phase of the project process (Phase I Design).

2.4 History of the Project

In the early 1990's the Kentucky Transportation Cabinet (KYTC) recognized the need to improve the existing interstate system in northeastern Jefferson County. As a result, in 1993 KYTC began work on the I-71 Corridor Improvement Study. This project evaluated multiple capacity adding improvements to I-71 from I-64 (Spaghetti Junction) to I-265 (Gene Snyder Freeway) and included an intensive public involvement process. During the latter course on this project (2005), KYTC and FHWA held a Peer-to-Peer meeting to review the project purpose and need. It was decided afterward that the most effective use of funds was to focus on the elimination of the bottlenecks/chokepoints caused at the interchanges during peak hour congestion instead of doing a wholesale corridor widening. This shift in focus lead to the following breakout projects in the Six Year Plan:

- **Item No. 5-48.10:** Improvements to the I-71 and Zorn Avenue interchange;
- **Item No. 5-48.20:** Improvements to the I-71 and I-264 interchange; and
- **Item No. 5-48.30:** Reconstruction of the I-71 and I-265 interchange.

The interchanges were constructed nearly 40 years ago using older design criteria and have exceeded their design life. This section of I-71 has an average daily traffic (ADT) as high as 77,000 vehicles per day and congestion and crashes are almost a daily occurrence, particularly during peak periods of the day.

The desire to improve the I-71 and I-265 interchange led KYTC to include an additional project in the 2006 Six Year Plan (**Item No. 5-68.00**) which is this project. URS Corporation was selected to complete the study to evaluate both short and long term improvements to I-71 and I-265 interchange.



3.0 PROJECT GOALS AND ISSUES

Based on meetings with the KYTC District 5 Project Team, goals for the project were developed. They are listed below:

- Simplify the traffic flow on ramps;
- Improve access between the two major interstate routes;
- Improve geometrics;
- Improve safety;
- Evaluate the safety and capacity of the existing interchange;
- Determine the future adequacy of the interchange; and
- Consideration of interim and ultimate-build scenarios.

The need for the project is defined by:

- Poor traffic flow;
- Closely spaced ramps;
- Insufficient acceleration, deceleration, merging and weaving distances; and
- Safety problems, including a high number of incidents and crashes.

4.0 EXISTING CONDITIONS

The process of developing future roadway alternatives began with a complete assessment of current conditions. This included roadway characteristics such as number of lanes, lane widths, right-of-way limits, topography, current traffic information, identification of bottlenecks or choke points, environmental constraints, condition of structures, and researching other planned projects in the vicinity of the study area.

4.1 Roadway Characteristics

The current cloverleaf interchange fits into a relatively compact area. Each loop ramp was designed with compound curves and minimum curve radii to conserve space, but maintain a 30 mph design speed. Both interstates are four-lane facilities with the exception of the northwestern leg of the Gene Snyder Freeway (KY 841). This segment of the Gene Snyder Freeway tapers into a two lane segment (KY 841) just beyond the interchange area and ends at US 42. Eventually, this segment will be widened and connect to the proposed East End Ohio River bridge. The speed limits on both interstates in the study area are 65 mph, with the exception of the two-lane section of the Gene Snyder Freeway which is 55 mph. The southeastern segment of the Gene Snyder Freeway (I-265) intersects with KY 22 in very close proximity to the interchange with I-71 (approximately 3,400 feet between centerlines). The interchanges of I-71 and KY 22 with I-265 are so close that they share auxiliary lanes between the ramps which are inadequate for proper weaving.



Figure 3. I-265 Northbound to I-71 Southbound
AM Peak – Existing Merge/Weave

Currently, this system interchange experiences peak hour congestion due to capacity bottlenecks or chokepoints. During the morning peak hour (7 AM – 9 AM), the heavy demand from I-265 northbound to I-71 southbound exceeds the capacity of the weaving section between the two loop ramps on I-71 (ramp 2 and 8). **Figure 3** at the left depicts the existing merge/weave from I-265 NB to I-71 SB and the resulting mainline congestion.

Note in Figure 3, the vehicles on top of the I-265 bridge are in the queue for the loop ramp from I-265 northbound to I-71 southbound. The weaving area between the loop ramps on I-71 is limited to 850 feet. The inbound commuting traffic volume from Oldham County places I-71 near

capacity. The addition of the Gene Snyder Freeway traffic tips the scales over capacity at the point where these two volumes merge together. Resulting congestion causes unsafe driving conditions such as high speed differential between entering/exiting and through vehicles.



Figure 4. I-71 Northbound Approaching I-265

During the afternoon peak hour, I-71 northbound travels very slowly between the Watterson Expressway and the Gene Snyder Freeway. **Figure 4** shows the difference between the northbound and southbound traffic volumes. On the left is the northbound volume heading toward I-265 during the PM peak hour. This is due to the high exit demand from I-71

northbound to I-265 southbound and/or KY 22. Over 50 percent of the PM northbound volume exits at KY 22 (ramp 5). Once traffic reaches the I-265 southbound off-ramp choke point; speeds on both ramp 5 and I-71 northbound increase.

Identification of these root causes of peak hour congestion was the key element in developing solutions for short and mid-range projects as well as ultimate solutions for the interchange. The chokepoints described above are shown on the next page in **Figure 5**.

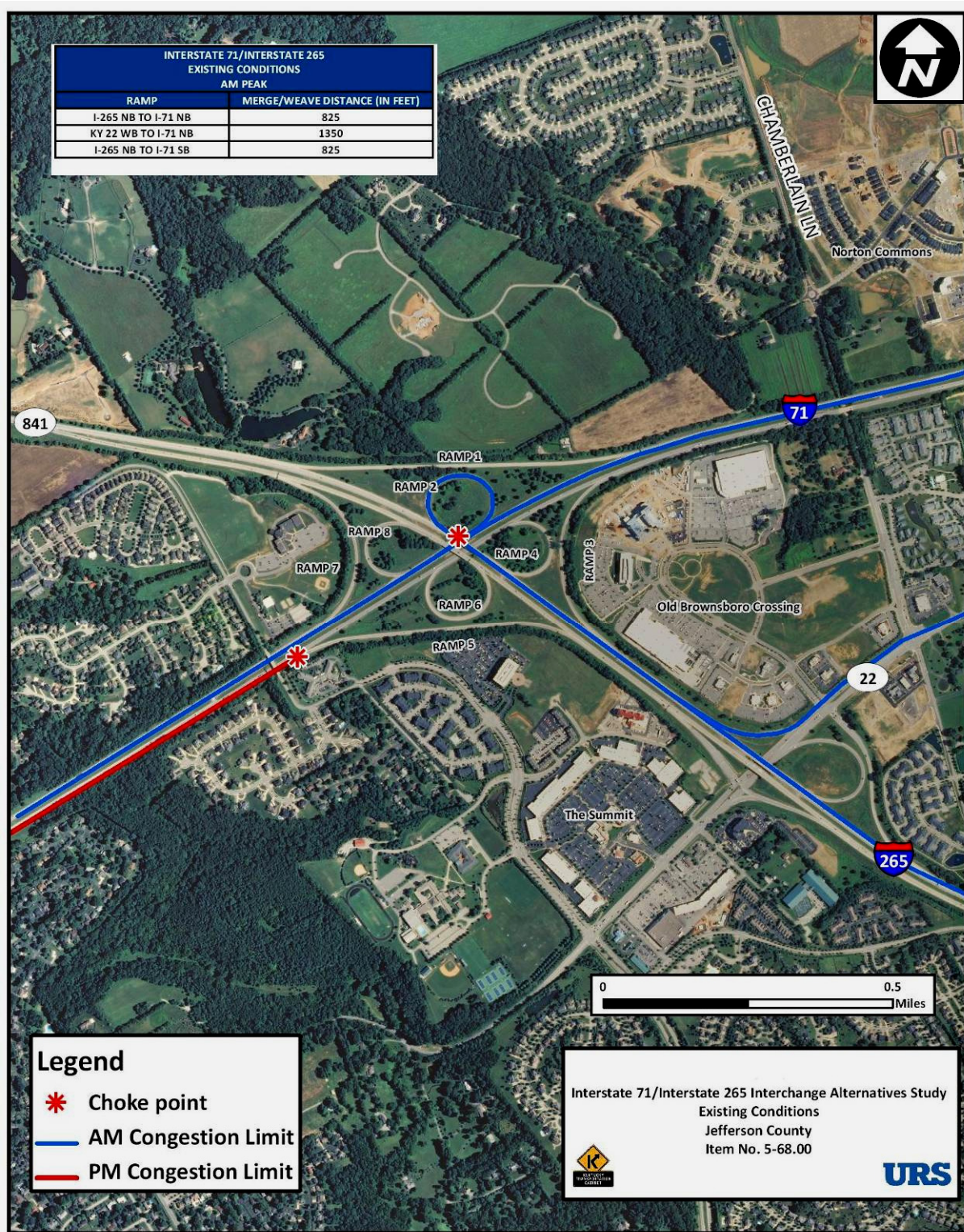


Figure 5. Project Area Chokepoints



4.2 Traffic Volumes

Traffic volumes for the existing interchange were collected by the consultant team. Average daily traffic volumes (ADT) were collected on all freeway segments and ramps in the study area. In addition, vehicle classification data was collected for all interstate traffic counts. Peak period turning movement counts were also collected on KY 22 at the signalized ramp intersections. Weaving counts were also collected in both directions on I-265 between KY 22 and I-71. This data was very beneficial in identifying travel patterns between the interchanges for the purposes of developing new ramp configurations for the future alternatives. This data was collected in February and March 2009. Existing and future “no build” traffic volumes are shown in **Table A** on the next page.

The Kentuckiana Regional Planning and Development Agency (KIPDA) was instrumental in developing the future traffic forecasts for the project. KIPDA used their regional travel demand model to examine multiple future scenarios that accounted for the Ohio River Bridges project, with or without a potential future interchange on I-71 near the Oldham County line. The volumes were provided in the form of average daily traffic (ADT) and the consultant team used this information to develop morning and afternoon peak hour movements. KIPDA’s future traffic data supplied for this project can be found in **Appendix A**.

Travel demand models are used to predict changes in travel patterns and the utilization of the transportation system in response to changes in regional development, demographics, and the transportation network. They can be used in a small area, but are typically used on a countywide or regional basis for the purpose of developing long-range transportation plans. For example, the KIPDA model covers the entire metropolitan region and was well suited for use on this project due to the regional impact anticipated by the Louisville Bridges project.

KIPDA provided 2030 base year, also known as a “no-build” forecast. The future No-Build analysis is a theoretical baseline that is used to evaluate the improvements of the proposed alternatives. It considers all projects that are currently programmed in the current Transportation Improvement Plan. Additional future projects were also considered such as a new interchange on I-71 at the Jefferson/Oldham county line on Haunz Lane and an “unconstrained” model. The purpose of the unconstrained model was to determine the future demand on I-71 assuming capacity were no obstacle. It was determined that some latent demand, trips that are taken on alternative routes to avoid congestion on I-71, does exist; however, the focus of this project was to address the current and future deficiencies of the system interchange and not the I-71 corridor.



The travel demand model determined a minor difference in future volumes if the current cloverleaf remains intact or if a two-lane flyover ramp is constructed. Because the travel demand model assigns traffic volumes according to a travel time estimate, higher capacity ramps will draw more traffic since that can handle higher traffic volumes. The different future volume data sets were used to analyze the appropriate alternatives based upon geometry.

TABLE A.

INTERSTATE 71 / INTERSTATE 265 EXISTING AND FUTURE NO BUILD TRAFFIC VOLUMES		
ROADWAY SEGMENT	EXISTING/NO-BUILD	
	ADT	
	2009	2030
Interstate 71		
I-264 to I-265	73,700	80,500
I-265 to Oldham Co. Line	56,800	87,000
Interstate 71 Ramps		
I-71 NB to KY 841 NB	1,100	3,400
KY 841 SB to I-71 SB	1,300	1,800
I-71 NB to I-265 SB	17,100	16,400
I-265 NB to I-71 SB	15,700	14,300
I-71 SB to KY 841 NB	600	8,500
KY 841 SB to I-71 NB	800	10,300
I-71 SB to I-265 SB	9,000	5,100
I-265 NB to I-71 NB	9,800	7,000
Interstate 265/KY 841		
I-71 to US 42	9,200	36,100
I-71 to KY 22	74,800	106,700
KY 22 to Westport Road	53,500	87,800
Interstate 265 Ramps		
NB off ramp at KY 22	6,100	12,700
SB on-ramp at KY 22	6,000	14,700
SB off-ramp at KY 22	12,900	19,000
NB on-ramp at KY 22 from east	7,300	13,000
NB on-ramp at KY 22 from west	5,400	5,500
KY 22		
West of Hurstbourne (KY 1747)	14,100	16,600
West of I-265	23,100	38,300
East of I-265	21,200	51,700
West of KY 1694	21,200	49,300
East of KY 1694	12,100	38,300
West of Haunz Lane	7,000	37,000
East of Haunz Lane	7,000	36,200
West of KY 329	9,000	32,000



4.3 Levels of Service

Level of Service (LOS) is a qualitative measure used to describe the operational performance of a transportation facility. There are several types of transportation facilities that serve different functions: freeways and interstates, multilane highways, urban and rural streets, and rural two-lane highways. The performance measures upon which LOS is based varies depending upon the type of facility.

The methodologies for calculating LOS are in the Highway Capacity Manual (HCM). The HCM is published by the Transportation Research Board. The current edition is the HCM 2000 and its analytical methodologies have been incorporated into a computer software package called the Highway Capacity Software (HCS).

The Level of Service (LOS) in the HCM is measured on a graduated scale from “A” to “F.” One confusing aspect of LOS is that its quantified differently for different types of facilities. For example, at signalized and unsignalized intersections, LOS is determined by average vehicle delay. For freeway or interstate facilities, LOS is determined by density of vehicles in the area of analysis. In the case of rural highways and urban arterial streets, LOS is based upon a calculated travel speed compared to “Free Flow Speed.”

This report uses a variety of technical terms related to transportation analysis. The following definitions are provided to help understand these terms.

- **Freeway** (interstate type facility) is defined as a divided highway with full control of access and two or more lanes for the exclusive use of traffic in each direction. This definition assumes that:
 1. There is no interaction with adjacent facilities (streets, other freeways)
 2. Free-flow conditions exist on either side of study area
 3. Basic freeway segments are outside the influence of ramps and weaving areas
- **Freeway capacity** is the maximum sustained 15-min flow rate, expressed in passenger cars per hour per lane (pc/hr/ln), that can be accommodated by a uniform freeway segment under prevailing traffic and roadway conditions in one direction of flow.
- **Free-Flow Speed (FFS)** is the mean speed of passenger cars that can be accommodated under low to moderate flow rates on a uniform freeway segment under prevailing roadway and traffic conditions. Some of the roadway conditions that affect FFS are lane width, lateral distance to roadside objects (guardrail, barriers, etc.), number of lanes, interchange frequency, hills and curves.
- **Undersaturated conditions** refers to traffic flow that is unaffected by upstream or downstream conditions.
- **Queue discharge** is where traffic flow that has just passed through a bottleneck and is accelerating back to the FFS of the freeway.
- **Congested Conditions** are achieved when a facility is at or exceeds its capacity. This usually occurs or is caused by a bottleneck at certain times of the day.
- A **Bottleneck/Chokepoint** is a point where capacity is restricted or reduced from a change in roadway geometry or a ramp within an interchange where the interaction of high volumes of vehicles exceeds the capacity.

It's important to know that freeway analysis is broken into many segments. A freeway is broken down into the following components for analysis.

- Basic Freeway Segments
- Ramps (both on and off-ramps)
- Weaving Areas

Figures 6, 7, and 8 are from the HCM and illustrate the various freeway facilities.

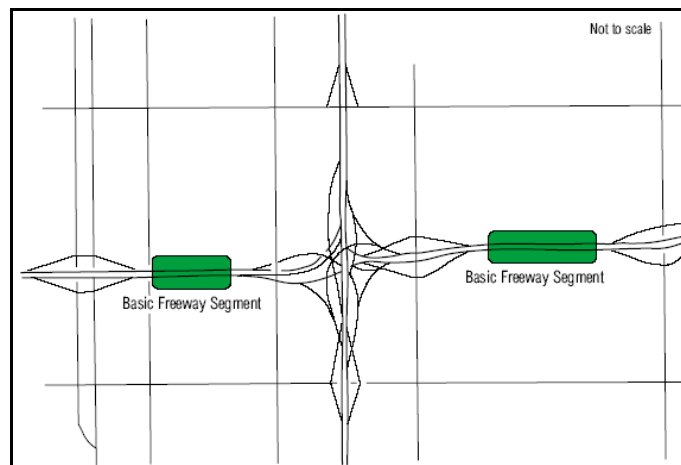


Figure 6. Illustration of an HCM Basic Freeway Segment

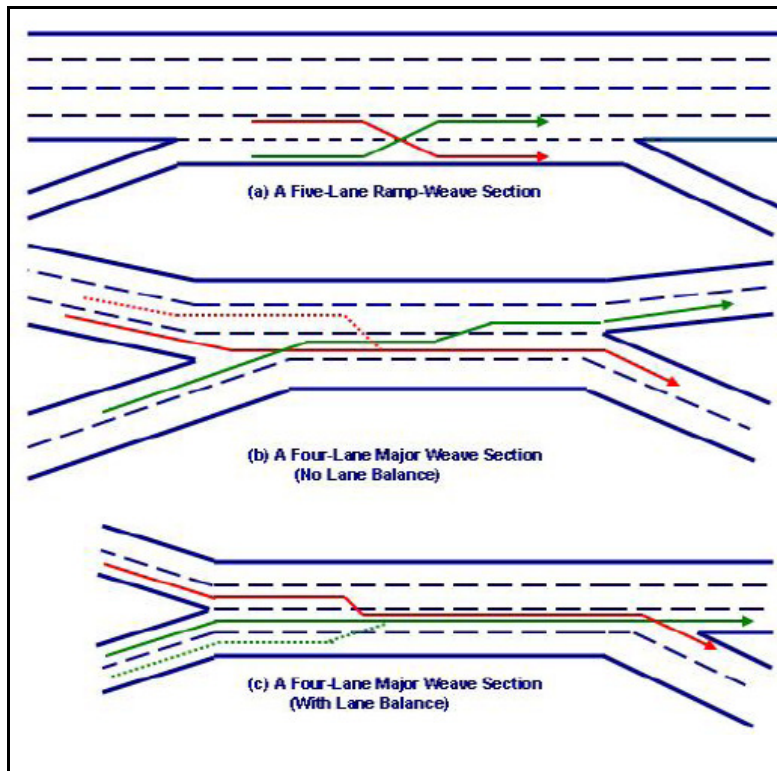


Figure 7. Illustration of HCM Weaving Areas

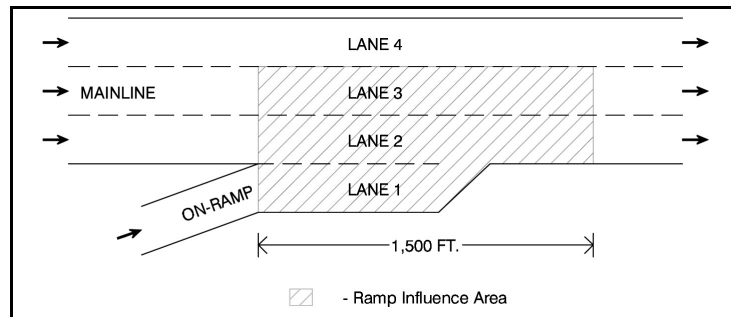


Figure 8. Illustration of an HCM On-Ramp Segment

As previously mentioned, the performance measure for freeway facilities is density of vehicles. This is measured in terms of passenger cars per mile per lane. In other words, envision an aerial photograph that covers a one mile segment of freeway. By averaging the vehicles in each lane in one direction over that one mile segment, you have measured the density for that direction.

The LOS criteria for freeway facilities are shown in **Table B**.

TABLE B	
LOS CRITERIA FOR FREEWAY SEGMENTS	
A	LESS THAN OR EQUAL TO 11 PC/MI/LN*
B	11 TO 18 PC/MI/LN*
C	18 TO 26 PC/MI/LN*
D	26 TO 35 PC/MI/LN*
E	35 TO 45 PC/MI/LN*
F	GREATER THAN 45 PC/MI/LN*
* pc/mi/ln = passenger cars per mile per lane	

Capacity analysis is traditionally performed using morning and afternoon peak hour traffic data from an average weekday. Occasionally weekend or seasonal analysis is performed. For this project, an average weekday was defined as typical weekday while schools are in session. It is important to note that by analyzing the peak hour conditions, the calculated LOS therefore represents the worst conditions of the day (also called design hour) and is not indicative of all hours of the day. In fact, this study area experiences all levels of service, from A through F, over a 24-hour period.

The following descriptions of each LOS is from the *Highway Capacity Manual 2000* :

LOS A describes free-flow operations. Traffic flows with very little delay and free-flow speeds prevail. Vehicles are almost completely unimpeded in their ability to maneuver the traffic stream. The effects of incidents or chokepoints are easily absorbed at this level. A picture from the HCM illustrating observed LOS A is shown in **Figure 9** at the right.



Figure 9. Photo Representing LOS A

LOS B also represents good traffic flow with very little delay, and free-flow speeds are maintained. The ability to maneuver within the traffic stream is only slightly restricted, and the general level of motorist comfort is still high. The effects of minor incidents and point breakdowns are still easily absorbed. A picture from the HCM illustrating observed LOS B is shown in **Figure 10** at the right.



Figure 10. Photo Representing LOS B

LOS C provides for flow with speeds at or near the free-flow speeds. Maneuvering within the traffic stream performing lane changes requires more care and vigilance on the part of the motorist. Minor incidents may still be absorbed, but the localized congestion around the incident could be substantial. Queues may be expected to form behind any significant blockage. A LOS of C is the typical design goal of rural areas. A picture from the HCM illustrating observed LOS C is shown in **Figure 11** at the right.



Figure 11. Photo Representing LOS C

LOS D is where speeds begin to decline slightly with increasing flows and density begins to increase somewhat more quickly. Freedom to maneuver within the traffic stream is noticeably more limited, and the driver experiences reduced physical and psychological comfort levels. Minor incidents at this level will create queuing, because the traffic stream has little space to absorb disruptions. A LOS of D is the typical design goal of an urban area. A picture from the HCM illustrating observed LOS D is shown in **Figure 12** at the right.

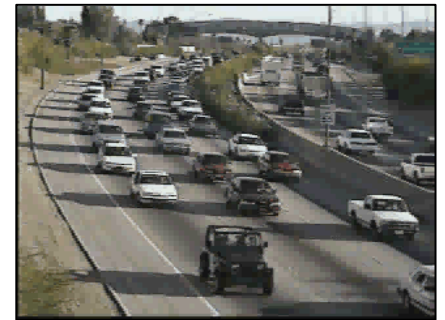


Figure 12. Photo Representing LOS D

LOS E, at its highest density value, describes operation at capacity. Operations at this level are volatile, because there are virtually no usable gaps in the traffic stream. Vehicles are closely spaced, leaving little room to maneuver within the traffic stream at speeds that still exceed 49 mi/h. Any disruption of the traffic stream, such as vehicles entering from a ramp or a vehicle changing lanes, can send a shockwave that propagates throughout the upstream traffic flow. At capacity, the traffic stream has no ability to dissipate even the most minor disruption, and any incident can be expected to produce a serious breakdown with extensive queuing. Maneuverability within the traffic stream is extremely limited. A picture from the HCM illustrating observed LOS E is shown at the right.

LOS F describes breakdowns in vehicular flow. These conditions generally exist within queues forming behind breakdown points forming “stop and go” traffic. Breakdowns in traffic flow occur for a number of reasons: Some of the more common situations found for this study include:

1. Points of recurring congestion, such as merge or weaving segments and lane drops, experience very high demand in which the number of vehicles arriving is greater than the number of vehicles discharged.
2. Traffic incidents causing temporary reductions in the capacity of a short segment, so that the number of vehicles arriving at the point is greater than the number of vehicles that can move through it. This is referred to as non-reoccurring congestion because the incident does not reoccur at the same point on a regular basis.

In forecasting situations, the projected peak-hour (or other) flow rate can exceed the estimated capacity of the location. Note that in all cases, breakdown occurs when the ratio of vehicular demand to actual capacity exceeds 1.00. Operations immediately downstream are generally at or near capacity, and gradually improve as discharging vehicles move away from the bottleneck. Whenever LOS F conditions exist, they have the potential to extend upstream for significant distances.

Figure 13 displays simplistic scale noting the levels of service and their meaning.

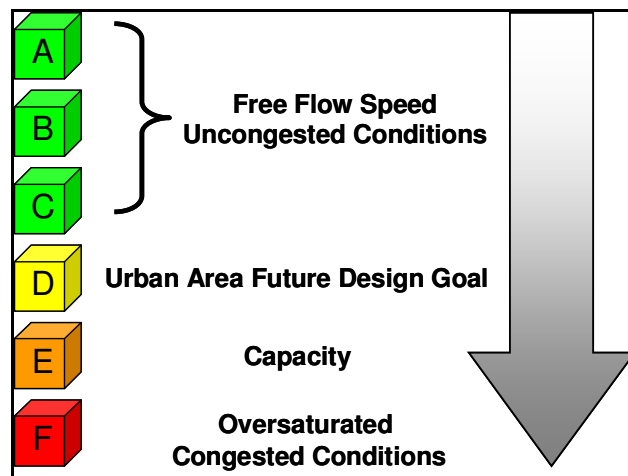


Figure 13. Simplistic LOS Descriptions

The question is frequently asked, “Why design only for LOS D in urban areas? Why not LOS A, B, or C?” The question is simply answered by cost. The cost of right-of-way and construction are very high. It’s important to remember that transportation projects are expected to have a 20-year design life and the reported Level of Service is what is projected for the design year. Furthermore, LOS D roughly equates to 80 percent of capacity; therefore, in theory, a transportation facility will have the ability to absorb more traffic growth beyond the design year.

As with most analytical methods, there are a variety of conditions that cannot be analyzed by HCS or other limitations such as:



-
- Special lanes reserved for a particular type of vehicle (High Occupancy Vehicles, truck climbing lanes, etc.)
 - Extended bridge and tunnel segments and their impacts to flow
 - Segments near a toll plaza
 - Influence of downstream blockages or queuing
 - Extent of police enforcement
 - Intelligent transportation system features
 - Capacity-enhancing effects of ramp metering
 - Demand in excess of capacity (Oversaturated Conditions)

The last item is one of the more significant items and requires further explanation for this study

Focusing on the chokepoints, the current traffic volumes reveal why daily peak hour congestion occurs. **Table C** summarizes the existing and future “no build” AM and PM Peak Volumes and resulting Level of Service. The cells highlighted in the 2030 design year no-build scenario highlight the capacity deficiencies that are expected if nothing is done.



TABLE C

INTERSTATE 71/INTERSTATE 265 EXISTING AND FUTURE AM/PM PEAK HOUR VOLUMES & LEVEL OF SERVICE								
ROADWAY SEGMENT	EXISTING/NO-BUILD							
	AM PEAK				PM PEAK			
	2009 DHV	2009 LOS	2030 DHV	2030 LOS	2009 DHV	2009 LOS	2030 DHV	2030 LOS
Interstate 71 NB								
I-264 to I-265 NB	1,918	B	2,093	B	3,622	D	3,948	D
Ramp 5 - Off Ramp (I-71 NB to I-265 SB)	944	C	944	C	1,638	D	1,574	E
I-71 (Ramp 5 to Ramp 4)	974	A	1,1149	A	1,984	B	2,374	C
Ramp 4 (I-71 NB to I-265 NB Weave)	55	A	170	B	118	B	364	E
I-71 (Ramp 4 to Ramp 3)	959	A	1,504	B	2,005	B	3,802	D
Ramp 3 On-Ramp (I-265 NB to I-71 NB)	460	B	329	B	998	C	714	E
I-265 to KY 329 NB	1,419	B	1,833	B	3,003	C	4,516	E
Interstate 71 SB								
KY 329 to I-265 SB	3,000	C	4,009	C	1,905	B	2,904	B
Ramp 1 Off Ramp (I-71 SB to KY -841 NB)	74	D	1,046	E	55	C	782	D
I-71 (Ramp 1 to Ramp 8)	2,926	C	2,963	C	1,850	B	2,122	B
Ramp 8 (I-71 SB to I-265 SB Weave)	748	E	423	E	721	D	408	C
I-71 (Ramp 8 to Ramp 7)	3,510	D	3,756	D	2,280	C	2,758	C
Ramp 7 On Ramp (I-265 SB to I-71 SB)	253	D	351	F	81	C	112	D
I-71 SB to I-264	3,763	D	4,107	F	2,361	C	2,870	C
Interstate 265 NB								
Westport Road to I-265 NB	1,689	B	1,894	C	2,344	C	2,645	D
I-265 (KY 22 on ramp to I-265 Weave)	2,407	B	3,465	C	2,842	C	4,041	D
I-265 NB (Ramp 3 to Ramp 2)	1,947	B	3,136	D	1,844	B	3,327	D
Ramp 2 (I-265 NB to I-71 SB Weave)	1,332	D	1,216	E	1,151	C	1,044	E
I-265 NB (Ramp 2 to Ramp 1)	670	A	2,090	C	811	A	2,647	C
Ramp 1 On Ramp (I-71 SB to I-265 NB)	74	A	1,046	C	55	B	782	E
I-265 NB to KY 841 NB	744	A	3,136	D	866	A	3,429	D
Interstate 265 SB								
KY 841 SB to I-265 SB	928	A	2,813	D	947	A	4,310	D
Ramp 7 Off Ramp (I-265 SB to I-71 SB)	253	B	351	E	81	B	112	E
I-265 SB (Ramp 8 to Ramp 6)	675	A	2,462	D	866	A	4,198	D
Ramp 6 (I-265 SB to I-71 NB Weave)	40	B	525	D	139	B	1,792	E
I-265 SB (Ramp 6 to Ramp 5)	1,383	B	2,360	D	1,448	B	2,814	C
I-265 SB (Ramp 5 to KY 22 exit Weave)	2,327	B	3,306	E	3,086	C	4,388	D
I-265 SB to KY 22 Exit Ramp	1,013	B	1,501	C	1,554	B	1,748	B
I-265 SB to KY 22 On-Ramp	301	B	1,000	E	334	B	1,354	C
I-265 SB to Westport Road	1,314	B	1,803	D	1,532	B	2,640	D

4.4 Microsimulation Modeling

The use of microscopic traffic simulation models, such as VISSIM, has become more prevalent on complex transportation design projects. These models allow transportation professionals to analyze the detailed movement of vehicles in a computer environment. This level of analysis ultimately provides for better roadway designs. Traffic simulation models have the ability to provide multiple types of output. Operational performance is gauged through measures such as average vehicle speed, vehicle stops, delays, vehicle-hours and vehicle-miles of travel, queue length and duration, fuel consumption and vehicular emissions. However, model output cannot be directly translated into LOS. The models have the ability to provide animated simulations of the design alternatives; providing the design team, decision-makers, and the public an opportunity to visualize any future improvements.

Microsimulation modeling was performed for this study to compensate for the limitations of the highway capacity methodology; primarily for the HCS's inability to model queues that spill back through successive freeway segments. The current version of the HCS performs only a "spot" analysis of freeway segments. One of the most striking examples of this in the existing conditions analysis is the level of service for the weaving area between KY 22 and I-71 during the morning peak period.

Anyone who frequents this segment of I-265 traveling towards I-71 knows that the queue of traffic begins at the base of the loop ramp (Ramp 2), where I-265 northbound merges with I-71 southbound, and extends backward as far as the I-265 bridge over KY 22. The extent of the morning congestion is highlighted by the arrow in **Figure 14**. Due to the congestion every morning in this weaving area, it seems counterintuitive that the LOS for the weaving section is "B," as shown in Table B. In order to understand the HCS output, the root cause of the congestion must be determined.

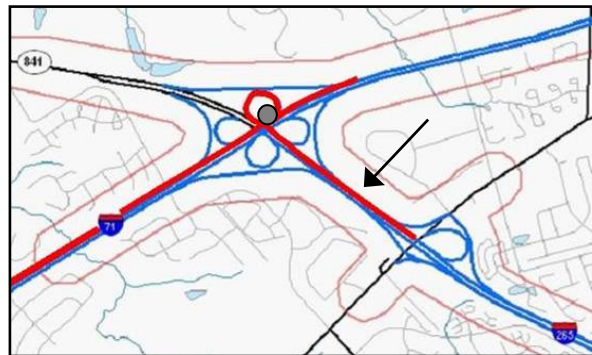


Figure 14. AM Peak Extent of Congestion

The root cause is the weaving maneuver at the base of the loop ramp (Ramp 2) on I-71 where the LOS was calculated as "E" (shown as the grey dot in the figure above). The result of this movement from I-265 northbound to I-71 southbound is that a queue develops and extends back to the KY 22 interchange. If the LOS at this chokepoint could be improved to where this condition no longer exists, then the weaving area from KY 22 to I-71 would indeed operate with

a LOS of B. The HCM methodologies assume there are no downstream chokepoints. This is a commonly misunderstood issue when using the HCM or its software counterpart.

Currently, TRB is finalizing a 2010 update to the HCM that provides many enhancements to the freeway facilities analysis methodologies. One of the major enhancements is to overcome the limitation just discussed. By the time the project process moves into the Interchange Justification Study phase, a new version of the HCS will likely be available.

The microsimulation models allow for a holistic analysis instead of a series of spot analyses. Therefore the interactions between freeway sections and impacts of chokepoints upon the rest of the study area can be better quantified.

The microsimulation model chosen for this study was VISSIM. VISSIM has the ability to analyze all modes of transportation. This includes urban streets and freeways, including pedestrians, cyclists, and mass transit (buses and rail). It also has the capability to simulate any type of traffic control from stop signs to traffic signals, and ramp meters.

4.5 Crash Data

KYTC provided crash data for three (3) years (January 1, 2006 to December 31, 2008) collected from the Kentucky State Police Accident Data System. Three routes within the interchange area (I-71, I-265, and KY 841) were combined to make one overall picture of reported vehicle crashes. Total crashes on all routes for the three-year period is 598. **Figure 15** presents a bar chart summary of the different crash types and their frequency over the three-year period.

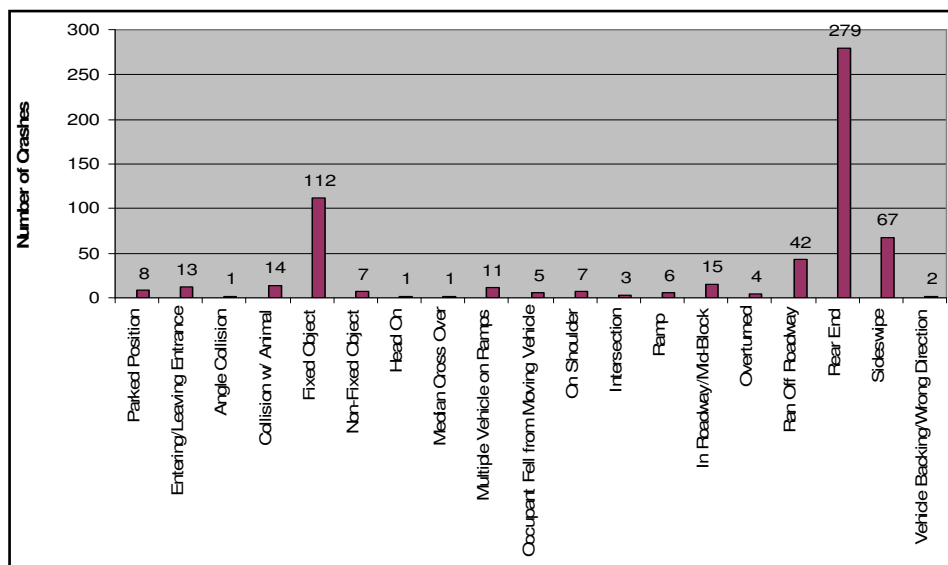


Figure 15. Summary of Crash Data



The bar chart points out the largest number of crashes is the rear-end type, which is most common under congested conditions with high speed differentials. Slowed or stopped traffic on the mainline and interchange ramps is the root cause for this type of crash. The number of fixed object/run off road crashes is also significant. This type of crash is usually a single-vehicle collision, occurring when the vehicle leaves the road. The horizontal alignment of the loop ramps combined with interstate speeds contributes to motorists leaving the roadway. There are also several sideswipe crashes which is an indicator of problems with lane changing, and insufficient merge/diverge lengths at the ramp areas.

Crashes are more prevalent when the congestion increases. Nearly 600 crashes averaged over a three-year period (1095 days), equates to having one crash every 1.8 days. **Figure 16**, on the next page, illustrates the concentration of the crash locations in the study area. Please note that each dot may represent more than one crash.

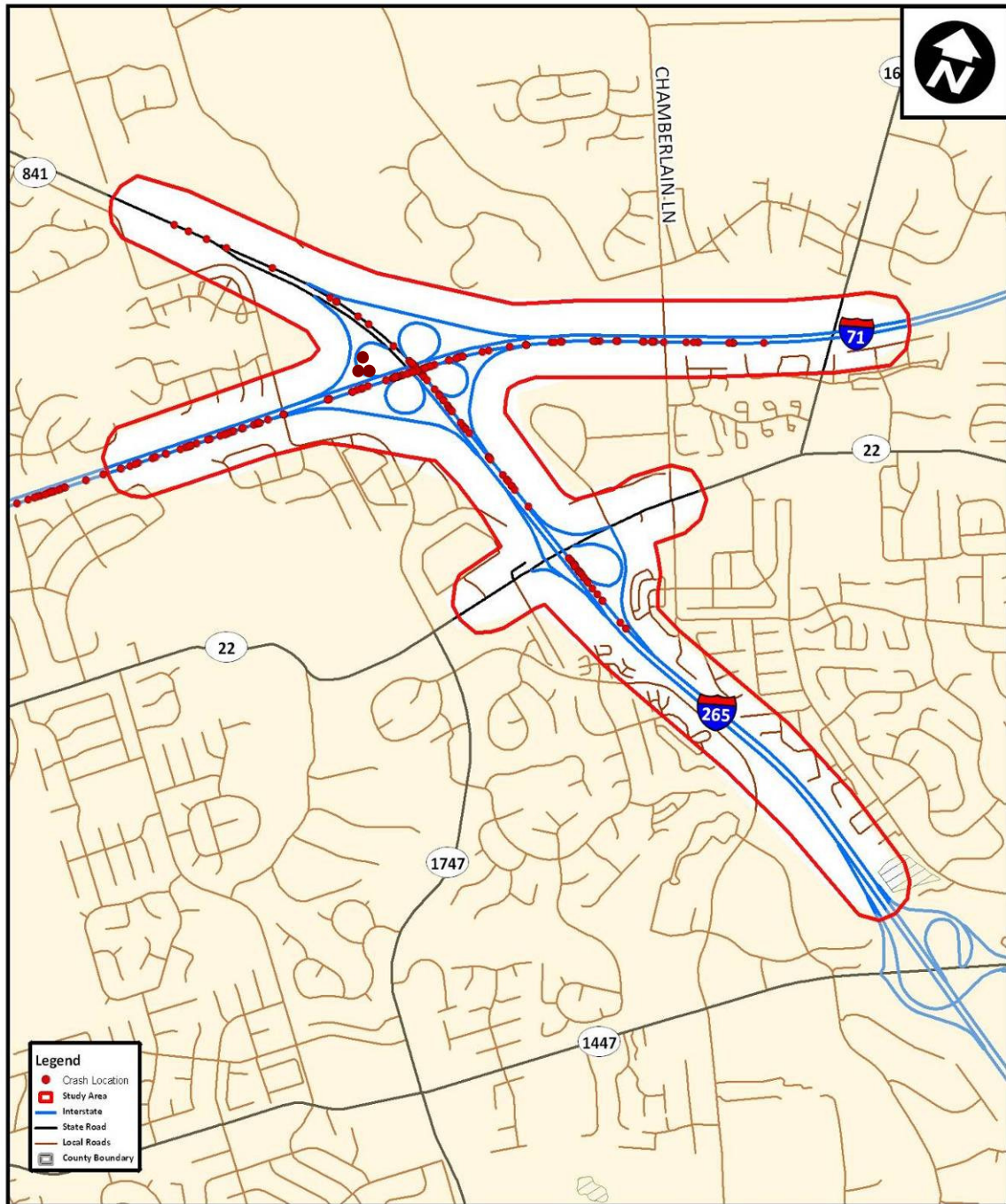


Figure 16. Map of Crash Locations

Crashes have a significant impact upon a roadway's capacity. Studies have shown that even a disabled vehicle on the shoulder can reduce through capacity by as much as 20 percent from rubbernecking. Improving capacity will reduce not only delays in the study area, but it will also reduce the number of rear end collisions that occur, especially during congested conditions. A

reduction in the number of crashes will have the compounding positive effect of increasing the reliability of the interstate system in this area.

Some areas of note where crashes routinely occur are:

1. The weaving area between the loop ramps on I-71 southbound
2. The I-71 southbound (loop) off-ramp to I-265 southbound.
3. I-265 northbound approaching the KY 22 overpass

The loop ramp from I-71 southbound to I-265 southbound has a combination of a high volume of exiting traffic, a compound curve and an uphill grade. There have been many truck accidents (turnovers) on this ramp due to excessive exiting speed.

In 2006, the cable barrier system was installed in the I-71 median during a rehabilitation project as a safety countermeasure. The barrier is shown in the photo to the right, in **Figure 17**. Since its installation, the KYTC District 5 office reports that the barrier has been struck over 160 times preventing wayward vehicles from crossing the median. In maintaining the barrier, the District has replaced over 950 structural posts. The barrier has proven itself very effective; there have been no fatal crashes on I-71 since installation.



Figure 17. I-71 Cable Barrier

4.6 Existing Sign Inventory Analysis



Figure 18. Existing Signage

As part of the existing conditions analysis for the study, a sign inventory was collected. The purpose of the inventory was to assess the adequacy of the existing signage and consider opportunities for improvements. The photo depicted in **Figure 18** at the left is the existing posted ramp speed for I-71 SB to I-265 SB. This area has been the location of many truck roll-overs or runoffs. Information regarding the inventory is included in **Appendix D**.

The exit advisory speed sign shown above could be enhanced as a short-term safety improvement. It is recommended that addition warning signs be installed in advance of the I-265 overpasses on I-71 southbound. The sign shown above is not very noticeable until motorists emerge from the shadows of the I-265 bridges.



4.7 Environmental Considerations

Issues identified as particular concern in subsequent project development phases can be found in the environmental overview document (a stand alone report) Issues covered in that report include:

- Land use – Undeveloped land continues to change from residential to commercial properties in the study area. Areas directly adjacent to the interchange and interstate continue are of particular concern as they limit the viability of purchasing future right of way due to high property impact and cost.
- Noise – Highway noise continues to be an important issue to residential properties directly adjacent to the interstate and interchange. Should capacity adding projects be pursued in the future, noise mitigation options may be considered pending completion of a noise analysis.
- Cultural Resources - Although historic resources are present within proximity to the study area, future improvements are not likely to have impacts.
- Threatened and Endangered Species - Little Goose Creek is crossed by I-71 and it has documented mist netting for Indiana Bat. Habitat assessment and possible coordination with US Fish and Wildlife Service will be required for any culvert extensions.
- Air Quality – PM 2.5 Interagency Coordination will be required for any proposed improvements. In addition, EPA has proposed new Ozone standards which may affect Jefferson County.

The Environmental Overview document is included in **Appendix F**.

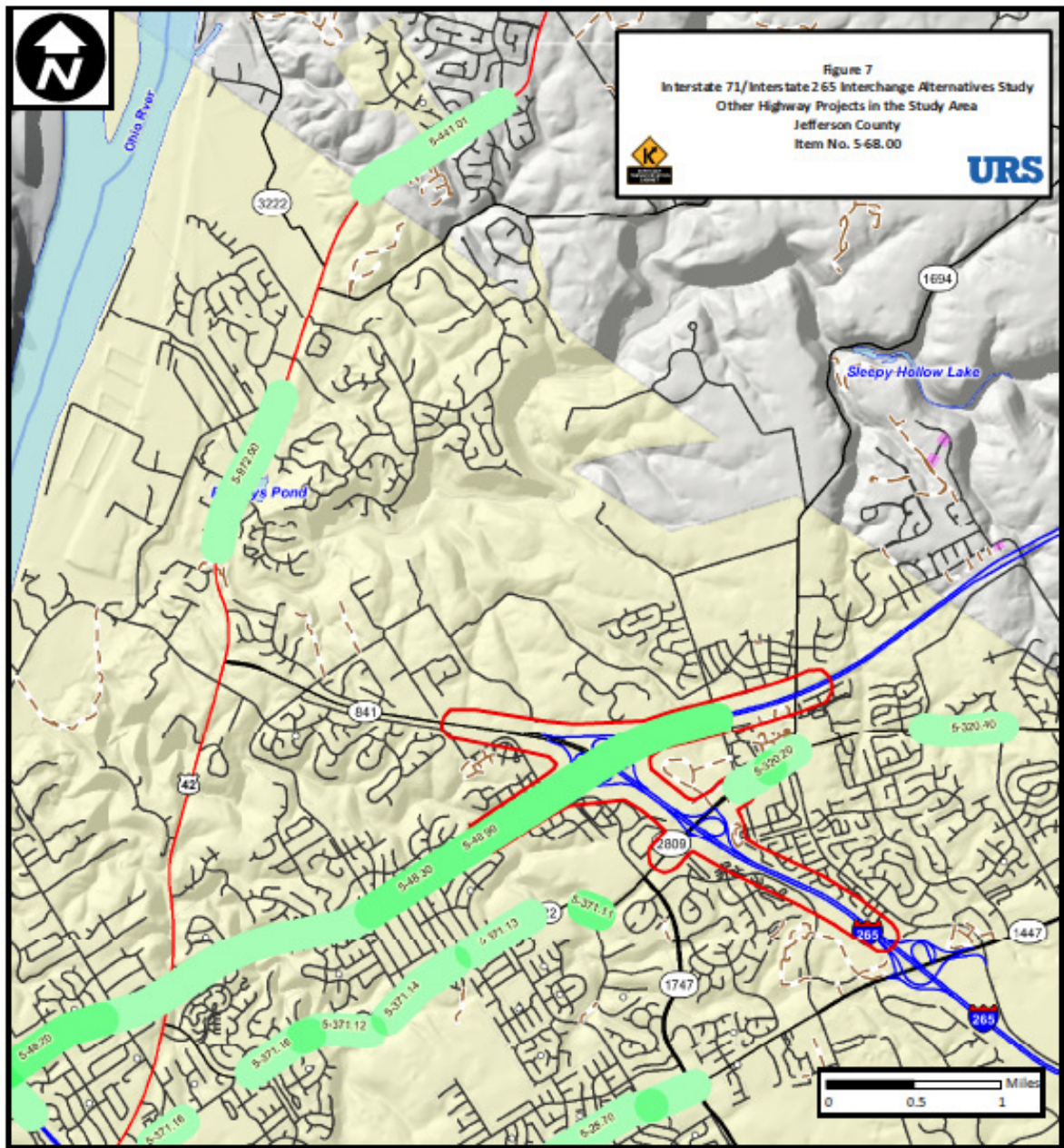
4.8 Other Highway Projects in the Study Area

There are a variety of other projects planned in the vicinity of this interchange. The list below summarizes these projects, as of the date of this report, noting the KYTC project item number and a brief description of the planned work. **Figure 19** on the next page highlights the location of each project and identifies it by Six Year Plan item number.

- **5-48.2** - I-71/I-264 Interchange improvements.
- **5-320.2** - KY 22 Widening from Chamberlain to KY 1694 to 5 lanes;
- **5- 320.4** - Widening to 3 lanes from Hitt Road to Murphy Lane;
- **5-371.01** - KY 22 intersection improvement projects at various locations;
- **5-441.01** - US 42 widening from the Oldham County Line to Ridgemoor Drive;
- **5-48.3** – I-71/I-265 Phase II Design, R/W, Utilities, Construction phases
- **5-972.00** - US 42 improvements;

The following projects, while not listed in the 2010 Recommended Highway Plan, are still under development by KYTC:

- **5-320.3** - KY 22 Widening to 3 lanes Silver Wing to Hitt Road;
- **5-745.000** – Louisville Bridges Section 5, East End Ohio River Bridge





5.0 PROJECT COORDINATION

5.1 KYTC Project Team

The Project Design Team was composed of representatives from various Divisions within the KYTC and FHWA. These included Traffic, Environmental Analysis, Planning and Project Development. Project team meetings were held at the District 5 office on June 2, 2009, September 18, 2009, November 3, 2009 and January 5, 2010. The four project team meetings were held to discuss project progress and present alternatives. Meeting minutes from all project team and stakeholder coordination meetings can be found in **Appendix E**.

5.2 Resource Agency Coordination

Other resource agencies were very helpful in either assembling and/or providing information for the study. The consultant team met with Community Transportation Solutions (CTS), the Ohio River Bridges program management consultant, to discuss this interchange as it relates to the proposed east end Ohio River Bridge. This meeting occurred on June 16, 2009 at the District 5 office. The consultant team was very interested in obtaining future traffic forecasts for this interchange that included the proposed east end Ohio River Bridge to provide a coordinated plan with past projects. Unfortunately, the I-71/I-265 interchange was not part of the bridges study and no traffic related information was provided.

The Kentuckiana Regional Planning and Development Agency (KIPDA) was instrumental in developing the future traffic forecasts for the project. KIPDA used their regional travel demand model to examine multiple future scenarios that accounted for the Ohio River Bridges project, with or without a potential future interchange on I-71 near the Oldham County line. The volumes were provided in the form of average daily traffic (ADT) and the consultant team used this information to develop morning and afternoon peak hour movements. As mentioned earlier, KIPDA's future traffic data supplied for this project can be found in Appendix A.

A coordination meeting at the TRIMARC office was held on October 1, 2009. TRIMARC is the incident management agency for the Louisville Metro area and was consulted to gain their perspective on the root causes of the daily congestion experienced at the interchange. The existing condition simulation models were shown to the TRIMARC staff to determine if they felt they reflected the daily conditions. They agreed with our model's presentation of the current conditions and the critical areas of need as shown in Figure 5.



6.0 STUDY ALTERNATIVES

6.1 Do-Nothing Alternative

The No-Build Alternative will not improve the operational and safety issues documented at the interchange. Continued development (commercial and residential) will increase traffic volumes and demand on the interstates and interchanges. Therefore, this alternative does not meet the study goals.

6.2 Interstate/Interchange Build Alternatives

Our approach began with identifying the root causes of the daily congestion and developing targeted solutions for current day deficiencies in capacity and safety using the Cabinet's "practical solutions" project development model. We began to build upon these smaller projects to develop our larger scale (longer term) projects for the future. During this process all interim projects were preserved by building upon them to develop the larger future alternatives.

Brief descriptions of each alternative are given below and schematic drawings for each alternative can be found in **Appendix B**.

6.3 Range of Alternatives

It was apparent at the onset of this project that the current transportation funding issues will persist for many years to come. It is extremely unlikely that an ultimate alternative would be built as a single construction project. In order to develop financially feasible and constructable alternatives, an incremental or phase construction approach was used. The project examined small-scale improvement projects that could be quickly constructed and provide immediate benefits. Later, five to ten years in the future, it was assumed that the funding salutation would improve and some larger components of the larger, ultimate interchange would be constructed. Finally, in ten to 15 years, the ultimate interchange would be completed.

While it may seem undesirable on the part of motorists for a heavily traveled section of freeway to be perpetually under construction, constructing the ultimate interchange as one project is not feasible given the many demands for capital improvement dollars across the Commonwealth.



SHORT-TERM ALTERNATIVES

The short-term projects focused directly on the chokepoints of the interchange. A series of improvements were investigated for both the AM and PM peak problems. Some projects fell short of solving the problem because larger scale improvements were necessary in addition to the proposed spot improvements. However, one project (Alternative 1) was found to have a substantial impact and met the requirements of a project that could be quickly implemented through the KYTC Six Year Plan.

MID-TERM ALTERNATIVES

The mid-term alternatives are billed as the next level of projects that build toward the ultimate interchange. As the project team continued with its bottom up approach, analyses using a 10 year traffic forecast were performed to predict where congestion and bottlenecks will exist in the relatively near future.

The mid-term alternatives were developed looking for future compatibility with the long-term ultimate build alternatives.

LONG-TERM (ULTIMATE) ALTERNATIVES

As the analysis progressed over the 20-year design year, the ultimate design options came into focus. Just as before the consultant team began building upon the mid-term alternatives to meet the future traffic demands. By the design year 2030, it is presumed that the east end Ohio River Bridge is completed and open to traffic.



7.0 EVALUATION OF ALTERNATIVES

Detailed traffic analysis was performed using traditional Highway Capacity Manual methodologies and the microsimulation traffic software VISSIM to analyze the alternatives. The Highway Capacity Software (HCS) was used to analyze the current conditions, and proposed future improvements. The level of service summaries for each alternative can be found in **Appendix C**.

Both the HCS and VISSIM software packages were used to serve different purposes. The HCS software provides Level of Service (LOS) which is a qualitative measure of a transportation facility's performance. The HCS LOS is a widely known and understood performance measure for transportation analysis among planners, designers, decision-makers, and laypersons. The HCS provides a higher level, macroscopic view of the transportation network.

Finally, the HCS analysis is required by the FHWA on interstate facilities. By performing this work now it can also be used later in the project design process (Phase I Design) when a Interchange Justification Study (IJS) is required.

7.1 Capacity Analysis & Simulation Modeling

As mentioned before, the critical points in the system are; 1) at the I-265 northbound to I-71 southbound loop ramp and I-71 southbound to I-265 southbound in the morning and 2) at the I-71 northbound to I-265 southbound ramp diverge in the afternoon (see Figure 5). The effects of the congestion at these points spill backward into other ramps, weave and mainline sections of the freeway over extended lengths that create substantial delay while creating many safety issues.

The following are descriptions for each alternatives analysis. Because each alternative was targeted to address a certain condition or set of conditions, the analysis commentary in this report focuses on current congestion hot spots and future areas of concern.

Alternative 0 - Summary of Project Benefits:

This alternative assumes a six-lane I-71, with no modifications to the existing interchange. This corresponds to the original study performed in the 1990's. This alternative is shown in **Appendix B-1** and includes one new lane in each direction on I-71. The additional lanes are added in the median. No modifications are made to the existing interchange.

Alternative 0 examines the capacity issues that currently exist along I-71 from the interchange of I-71 and I-265 to I-264 by adding an additional lane on I-71 from Chamberlain Lane to I-264. There is no modification or addition to any existing ramp with this alternative.

AM (2030): Alternative simulation shows that existing loop ramp from I-265 northbound to I-71 southbound and I-71 southbound to I-265 southbound continues to be congested while the standing queues are reduced.

PM (2030): Alternative simulation shows heavy congestion on I-71 northbound to I-265 northbound as well as from I-265 southbound to I-71 northbound due to the increased traffic from the construction of the east end bridge. The congestion is primarily caused by the lack of weaving distance between the two loops.

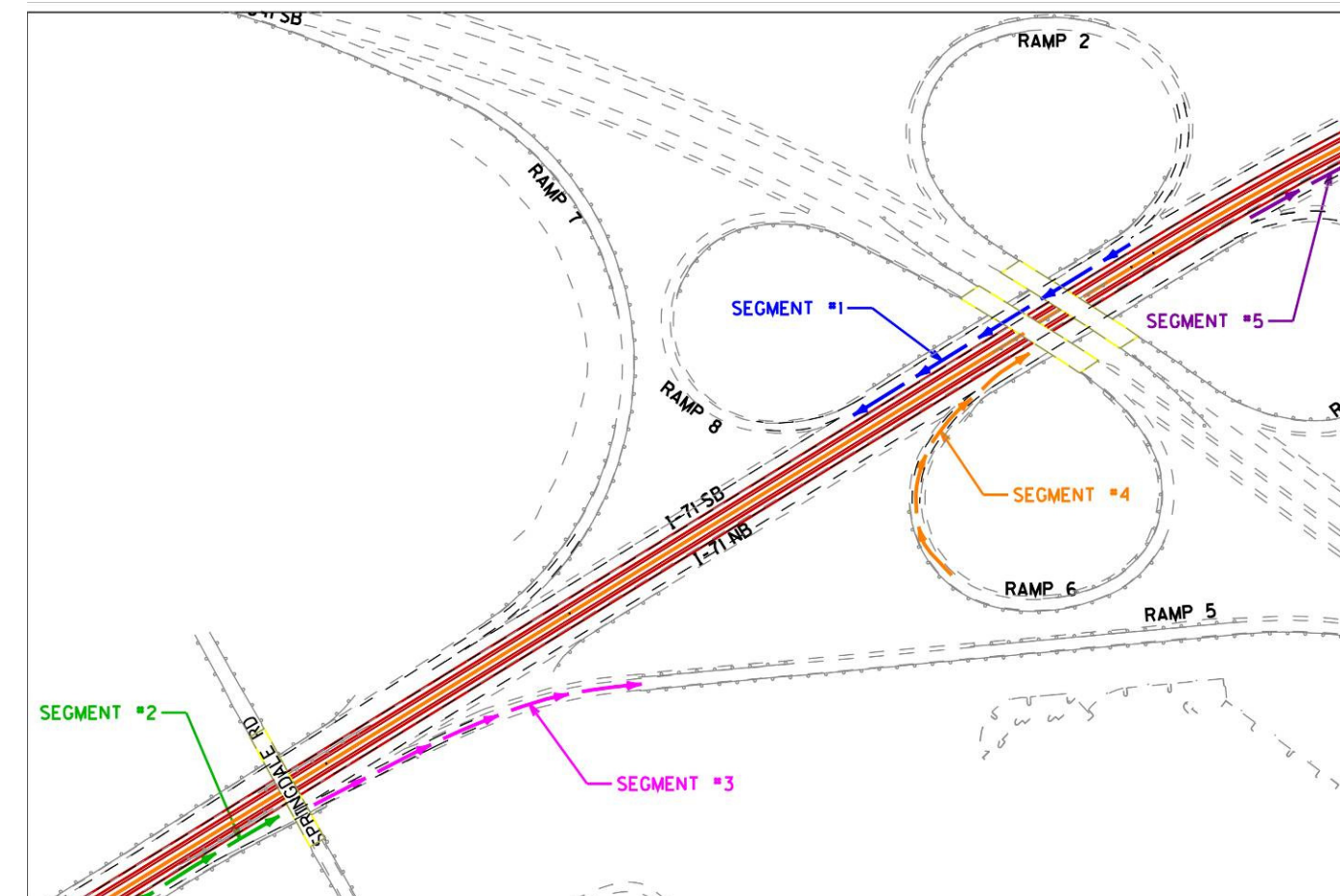
Pros:

- Improves capacity on I-71 with addition of six lanes to I-264
- Reduces right of way impacts with widening to the median as presented
- Safety

Cons:

- Environmental impacts with increased noise due to added lanes
- Does not resolve weaving issues with I-71 and I-265 ramps and KY 22
- Significant right of way impacts if I-71 is widened to the outside
- Poor geometrics with existing loop ramps

Cost: **\$40 million**



Segment Number	Segment	2009 Existing (AM/PM)	2030 No-Build LOS (AM/PM)	2030 Build (AM/PM)
1	Ramp 2 (I-265 NB to I-71 SB Weave)	E/D	F/C	D/C
2	I-71 NB (From Southern Limit to Ramp 5)	B/D	B/D	A/C
3	Ramp 5 (I-71 NB to I-265 SB Off-Ramp)	C/D	C/E	B/C
4	Ramp 6 (I-265 SB to I-71 NB Weave)	A/B	B/F	A/D
5	I-71 NB (Between Ramp 4 and Ramp 3)	A/B	B/D	A/C

Figure 20. Alternate 0 Critical Segment Analysis

Alternate 0 does not specifically address current congestion issues throughout the limits of the study area. Therefore, this project does not meet the project goals. This alternative was eliminated from advancing further in the process as a stand alone option. However, as will be discussed later, this alternative can be a break out project before constructing the ultimate alternative for the interchange.

Alternative 1 - Summary of Project Benefits:

This alternative, shown in **Appendix B-2** adds an auxiliary lane to I-71 northbound and continues up Ramp 5, creating a two-lane exit ramp to KY 22. The auxiliary lane, highlighted as “segment 1” in the analysis, is proposed to be 2,500 feet long. It will not be a continuous lane that extends back to the Watterson Expressway interchange. The second lane on the I-265 southbound off-ramp will carry forward through the weave area between I-71 and KY 22, and exit directly onto the KY 22 off-ramp.

Alternative 1 analyzes a solution that can be incorporated with any ultimate solution for the interchange as a potential break out project. Alternative 1 adds an auxiliary lane on I-71 northbound and widens Ramp 5 to two lanes to I-265 southbound at KY 22.

AM (2020): None. The ramp improvement for Alternative 1 addresses the PM peak period.

PM (2020): This alternative simulation shows a significant reduction in delay and congestion on I-71 northbound in the PM peak. The creation of the 2,500 foot auxiliary lane allows vehicles to segregate themselves into the proper lanes and provides two lanes of capacity for both northbound I-71 and Ramp 5 to I-265 southbound and KY 22. This improvement eliminates the current congestions issues and improves the LOS for this ramp in 2020 as well as 2030 which will be depicted later in a longer term alternative solution.

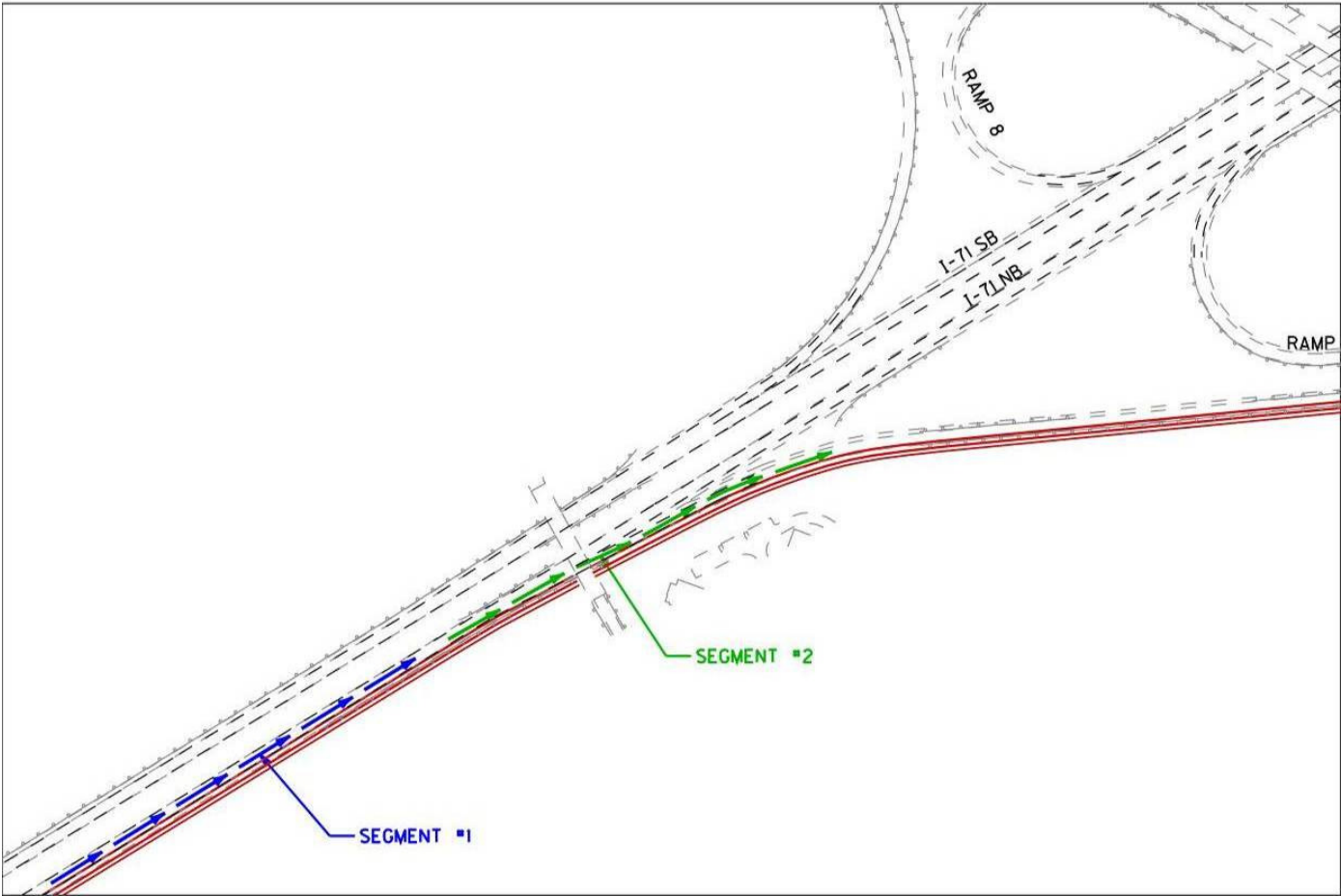
Pros:

- Eliminates PM congestion at Ramp 5

Cons:

- Does not address AM Conditions and improve capacity on I-71
- Effects Springdale Road Bridge
- Widening to the outside may affect right of way and/or utilities

Cost: **\$7.5 million**



Segment Number	Segment	2009 Existing (AM/PM)	2030 No-Build LOS (AM/PM)	2020 Build (AM/PM)
1	I-71 NB (From Southern Limit to Ramp 5)	B/D	B/D	A/C
2	Ramp 5 (I-71 NB to I-265 SB Off-Ramp)	C/D	C/E	A/B

Figure 21. Alternate 1 Critical Segment Analysis

Alternate 1 was developed as a stand alone project and is incorporated into all other proposed future alternatives. It is cost effective, has significant benefits and can be quickly implemented. The KYTC District 5 office has recommended this project for inclusion into the 2010 Highway Plan.



Alternative 2

Due to lane diverging and converging issues creating significant delay, congestions, and safety issues, Alternative 2 was eliminated from further advancement and analysis. Therefore, it does not meet the project goals.

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Alternative 3

This alternative's primary purpose is to improve the congested AM conditions on I-71 southbound at I-265 as a potential break out project coordinated with the ultimate solution for the interchange. I-71 will be widened to the inside on the southbound side only creating three lanes from Chamberlain Lane and taper back to two lanes on I-71 just past Springdale Road. Also, due to the close proximity of the interchange with I-265/KY 22 and I-71/I-265, KY 22 is reconfigured at I-265 to increase the weaving distance between I-265 and I-71. Please refer to **Appendix B-4** for a detailed drawing of this alternative.

AM (2020): The simulation showed that the added lane on I-71 southbound helps mainline flow but the weaving from I-265 northbound to I-71 southbound remains heavily congested where I-71 tapers back to two lanes southbound. The addition of a third lane on I-71 southbound has effectively moved the point of highest congestion from the weaving area at the base of the loop ramp to the point where I-71 tapers back to two lanes. Also, with the reconfiguring of KY 22 creates tremendous delay and congestion on KY 22. This is illustrated in the screen images below.

PM (2020): This alternative has no affect to the PM since its primary purpose is to improve the AM only.

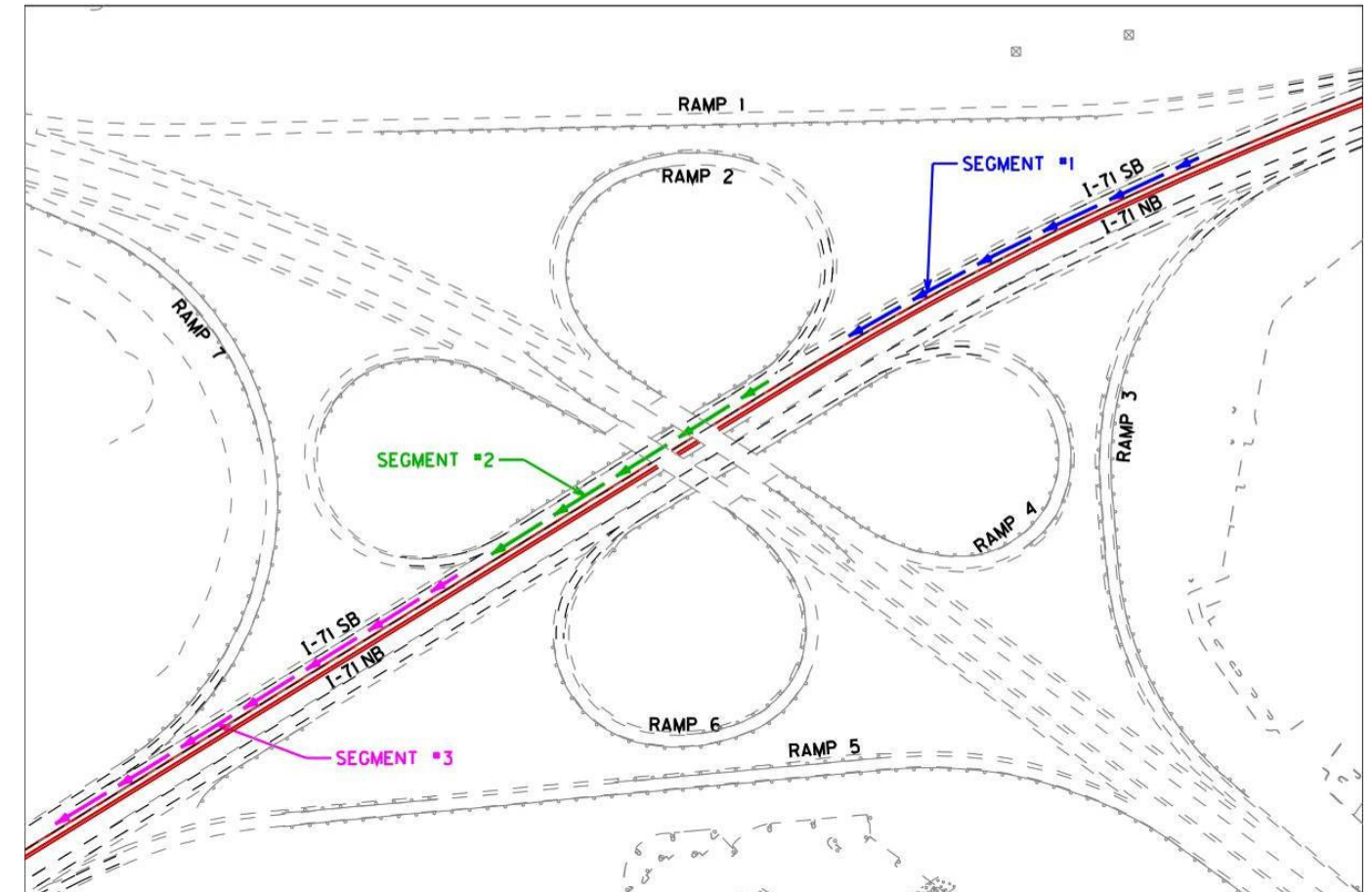
Pros:

- Increased weaving distance from KY 22 to I-265 with reconfiguration of KY 22 on ramp

Cons:

- Does not improve capacity on I-71
- Does not address PM Conditions
- Does not improve weaving from I-265 northbound to I-71 southbound
- Creates significant delay and backup on KY 22 due to the reconfiguration of the on ramp at KY 22
- Moves congestion point downstream on I-71 southbound

Cost: **\$10 million**



Segment Number	Segment	2009 Existing (AM/PM)	2030 No-Build LOS (AM/PM)	2020 Build (AM/PM)
1	I-71 SB (Between Ramp 1 and Ramp 2)	C/B	C/B	B/A
2	Ramp 2 (I-265 NB to I-71 SB Weave)	E/D	F/C	D/B
3	I-71 SB (Between Ramp 8 and Ramp 7)	D/C	D/C	C/B

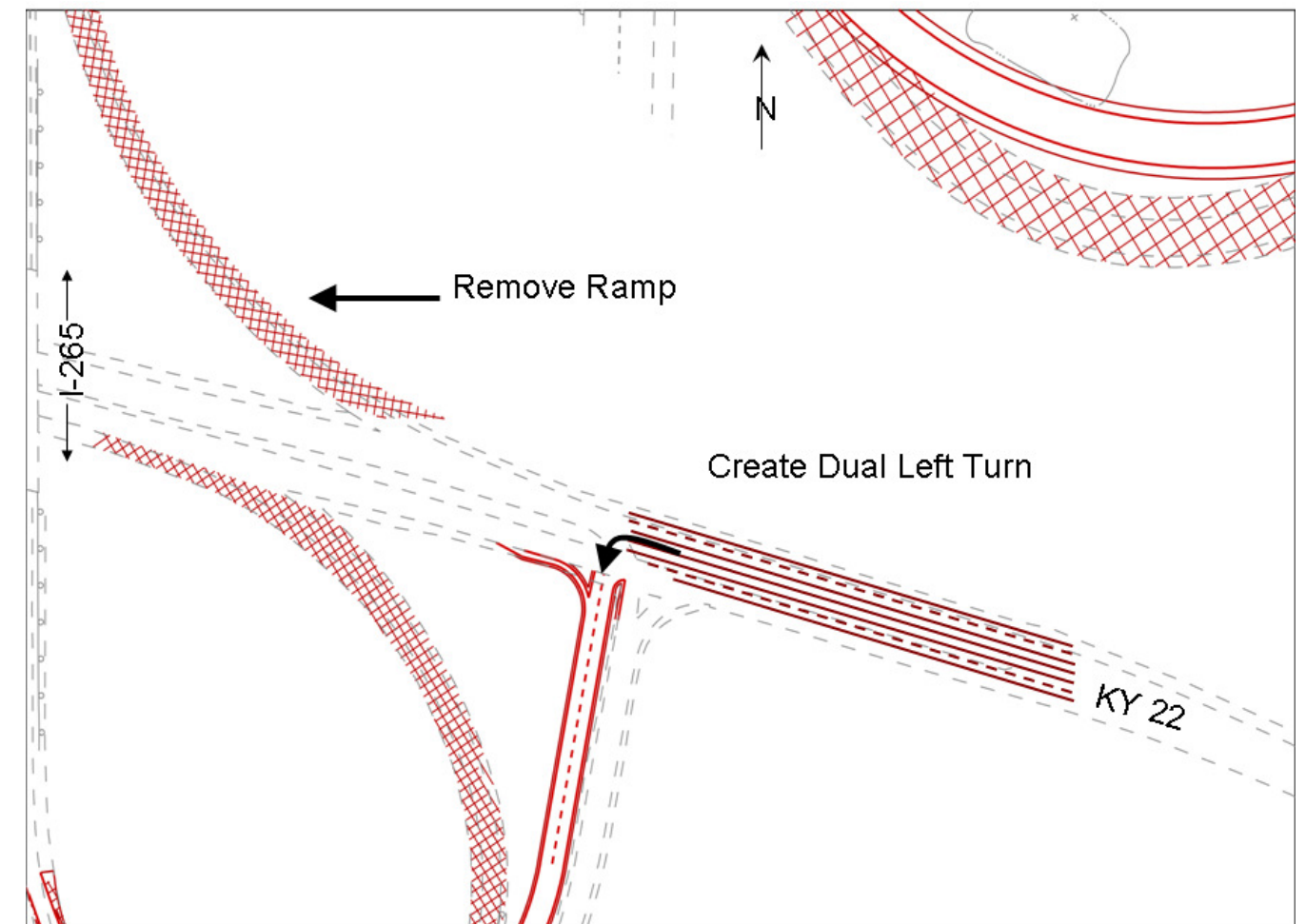
Figure 22. Alternate 3 Critical Segment Analysis

Continued on next page

Alternative 3 Continued

This alternative's primary purpose is to improve the congested AM conditions on I-71 southbound at I-265 as a potential break out project. This option has multiple issues:

- It takes a free flowing right turn onto I-265 northbound and creates the need for a dual left turn.
- It adds a phase to the traffic signal at this intersection which increases delay
- The loop ramp must be widened for two receiving lanes, however must quickly taper back to one lane
- Existing right turn onto loop ramp is shortened to a right turn lane creating additional congestion on KY 22 eastbound.



Intersection	2009 Existing	2030 No- Build LOS	2030 Build (AM/PM)
KY 22 at I-265 NB off-ramp	C/D	F/F	F/F

Figure 23. Alternate 3 KY 22 Analysis

This alternative was eliminated from further consideration primarily because it does not solve the morning congestion problem and does not address the evening congestion issue. Therefore, this concept does not meet the project goals.

Alternative 4

This alternative shifts I-71 southbound to the median creating a third lane through the interchange, eliminates the KY 22 ramp to I-265 northbound, and aligns the new I-265 northbound ramps with the I-265 southbound ramp at KY 22. It also adds an auxiliary lane to I-71 northbound and continues up Ramp 5 to make a two-lane exit ramp to KY 22. Please see **Appendix B-5** for an illustration of this concept.

Because this alternative is a combination of Alternates 1 and 3, a detailed simulation was not developed; only the Highway Capacity analysis was performed. As a standalone project, only Alternative 1 was successful at solving the PM I-71 northbound congestion problem at Ramp 5. Alternate 4 was an attempt to develop an improvement package of multiple small improvements into one larger project.

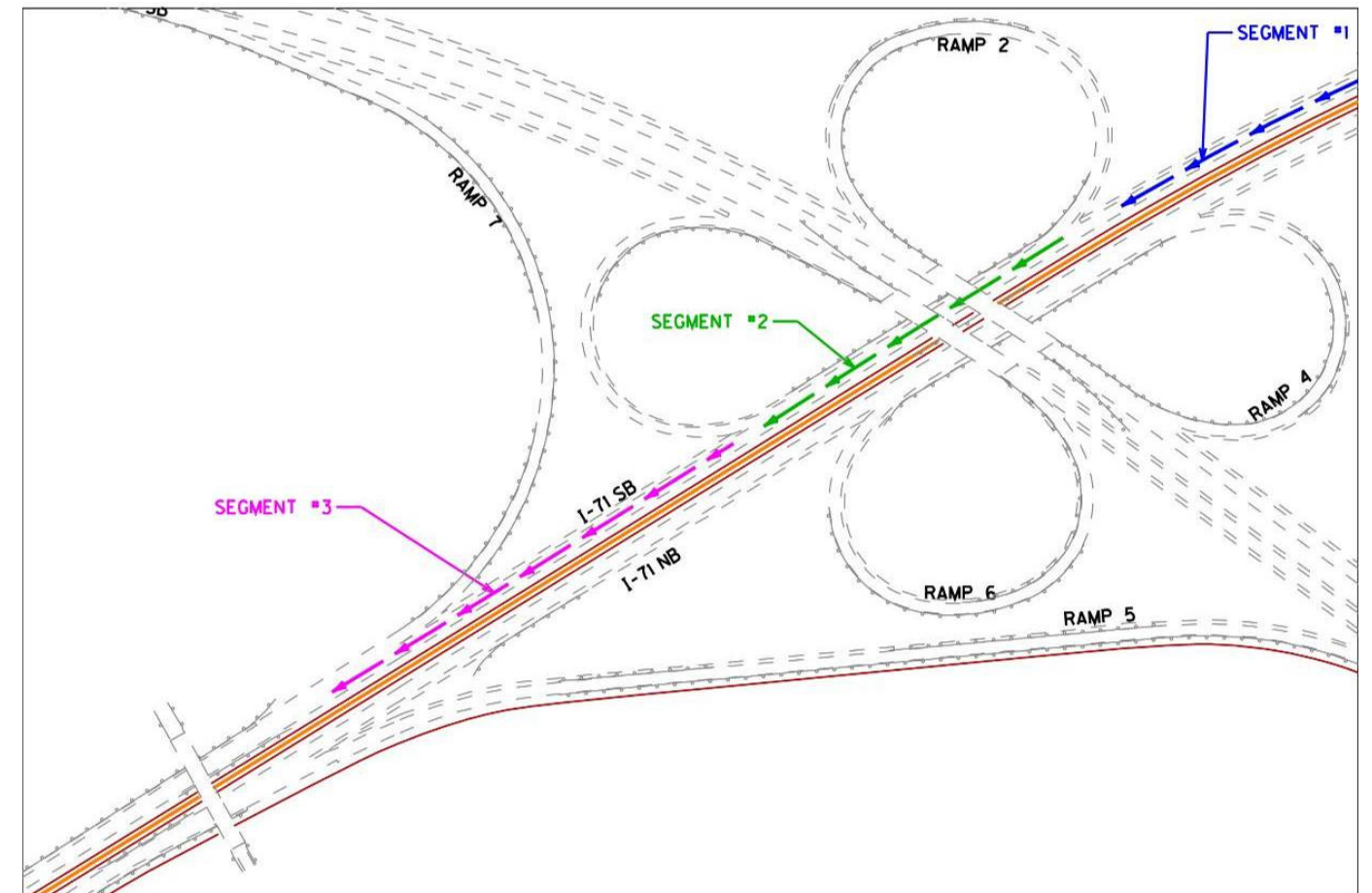
Pros:

- Increased weaving distance from KY 22 to I-265 with reconfiguration of KY 22 on ramp
- Eliminates PM congestion at Ramp 5
- Safety improvement for PM peak period

Cons:

- Does not improve capacity on I-71
- Does not improve weaving from I-265 northbound to I-71 southbound
- Creates significant delay and backup on KY 22 due to the reconfiguration of the on ramp at KY 22
- Moves congestion point downstream on I-71 southbound
- Effects Springdale Road Bridge
- Widening to the outside may affect right of way and/or utilities

Cost: **\$25 million**



Segment Number	Segment	2009 Existing (AM/PM)	2030 No-Build LOS (AM/PM)	2030 Build (AM/PM)
1	I-71 SB (Between Ramp 1 and Ramp 2)	C/B	C/B	B/B
2	Ramp 2 (I-265 NB to I-71 SB Weave)	E/D	F/C	D/C
3	I-71 SB (Between Ramp 8 and Ramp 7)	D/C	D/C	C/C

Figure 24. Alternate 4 Critical Segment Analysis

This alternative was eliminated from further consideration because it does not meet the project goals.

Alternative 4A

Alternate 4A is identical to Alternate 4 except that the KY 22 interchange is not reconfigured. Again, because this alternative is similar to Alternative 4, a detailed simulation model was not developed. Even without the negative impacts to the KY 22 interchange, this alternate does not provide any significant benefits for I-71 southbound during the AM peak period.

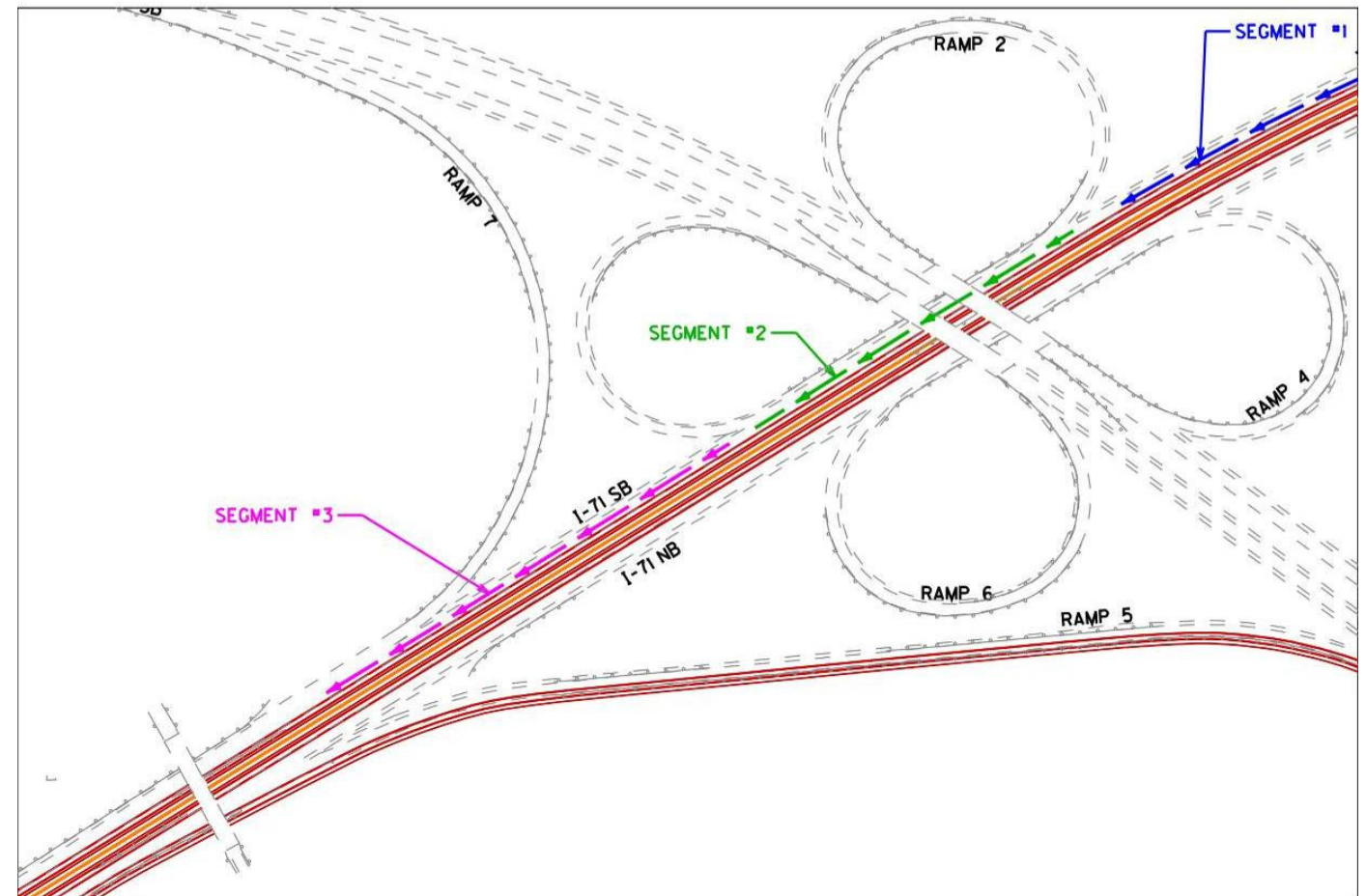
Pros:

- Eliminates PM congestion at Ramp 5
- Safety improvement for PM peak period

Cons:

- Does not improve capacity on I-71
- Does not improve weaving from I-265 northbound to I-71 southbound
- Moves congestion point downstream on I-71 southbound
- Effects Springdale Road Bridge
- Widening to the outside may affect right of way and/or utilities

Cost: **\$22.5 million**



Segment Number	Segment	2009 Existing (AM/PM)	2030 No-Build LOS (AM/PM)	2030 Build (AM/PM)
1	I-71 SB (Between Ramp 1 and Ramp 2)	C/B	C/B	B/B
2	Ramp 2 (I-265 NB to I-71 SB Weave)	E/D	F/C	D/C
3	I-71 SB (Between Ramp 3 and Ramp 4)	D/C	D/C	C/C

Figure 25. Alternate 4A Critical Segment Analysis

This alternative was eliminated from further consideration because it does not meet the project goals.

Alternative 5

This is the first of the 2030 design year alternatives that attempted to address the AM and PM peak period congestion issues. As such, it is the first alternative that proposes a significant change to the existing interchange geometry. This alternative constructs a two-lane flyover ramp from I-265 northbound to I-71 southbound, and includes the Alternate 1 concept for the off-ramp from I-71 northbound to I-265 southbound. Other features of this alternative include:

- Extending the Ramp 3 auxiliary lane (I-71 Northbound merge lane) to the Chamberlain Lane bridge
- Reconfiguring the KY 22 interchange as described in Alternate 4; and
- Reconstructing the Springdale Road bridge, which needs to be widened for the two-lane flyover ramp.

The existing AM problematic merging point between I-265 and I-71 has been moved further downstream on I-71 with the proposed flyover to I-71 southbound. Also, KY 22 is reconfigured at I-265 to increase the weaving distance between I-265 and I-71. Please refer to **Appendix B-7** for a schematic view of all this alternative.

AM (2030): Due to the inadequate capacity on I-71 southbound (two lanes) at the merging point with the flyover from I-265 northbound, the two-lane flyover ramp basically stores traffic on it until traffic can merge onto I-71 southbound. The screen image from the simulation below shows the morning rush hour queuing on the proposed flyover ramp as well as significant back up and delay on KY 22. Conversely, Ramp 5 is widened as presented in Alternate 1 which still accommodates the 2030 traffic.

PM (2030): Alternative simulation shows improved performance of I-71 northbound to I-265 southbound and KY 22 because the improvements to Ramp 5 as illustrated in Alternative 1 decreases the delay and congestion in the 2030 PM Peak Period.

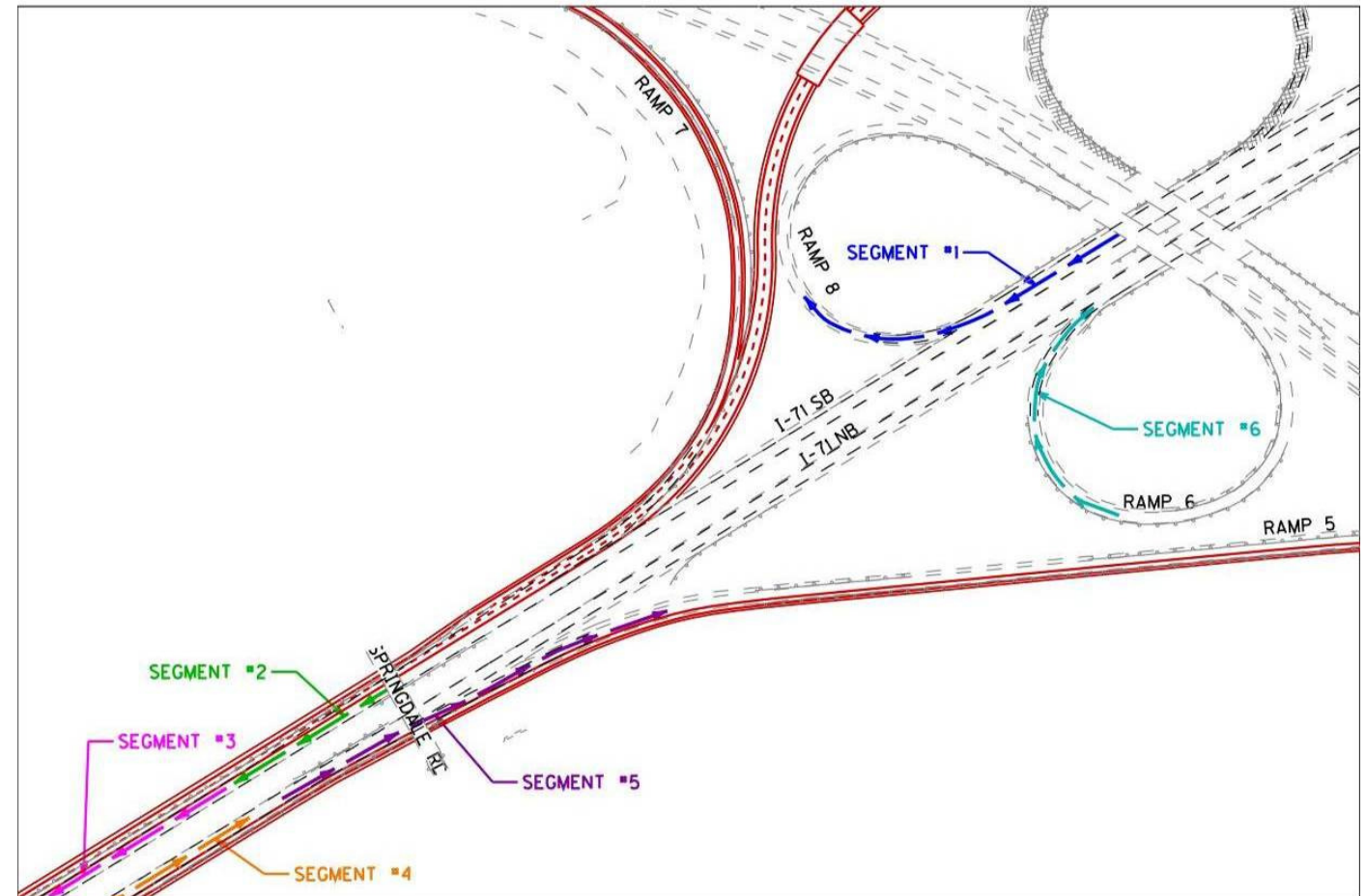
Pros:

- Eliminates AM congestion at KY 22 and I-265
- Eliminates PM congestion at Ramp 5
- Improved geometrics with flyover ramp to I-71 southbound
- Safety improvement for PM peak period

Cons:

- Does not improve capacity on I-71
- Moves congestion point downstream on I-71 southbound
- Effects Springdale Road Bridge
- Creates significant delay and backup on KY 22 due to the reconfiguration of the on ramp at KY 22
- Widening may affect right of way and/or utilities

Cost: **\$30 million**



Segment Number	Segment	2009 Existing (AM/PM)	2030 No-Build LOS (AM/PM)	2030 Build (AM/PM)
1	I-71 SB Ramp 8-No longer Weave	E/D	F/C	E/B
2	I-71 SB Ramp 7 and New Flyover Entrance	D/C	D/D	B/D
3	I-71 SB South of Ramp 7	D/C	F/C	B/A
4	I-71 NB (From Southern Limit to Ramp 5)	B/D	B/D	A/C
5	Ramp 5 (I-71 NB to I-265 SB Off-Ramp)	C/D	C/E	A/B
6	Ramp 6 (I-265 SB to I-71 NB Weave)	A/B	B/F	B/E

Figure 26. Alternate 5 Critical Segment Analysis

This alternative was eliminated from further consideration because it does not meet the project goals.

Alternative 5A

Due to the lack of capacity on I-71 with the increased traffic from I-265 and other contributing factors, it became apparent to the consultant team that in order to increase capacity at the interchange, capacity to I-71 would also have to be increased. Alternate 5A is identical to Alternate 5 with the exception that I-71 will be six lanes between I-264 and I-265. Also, KY 22 will not be reconfigured at I-265. **Appendix B-8** presents Alternate 5A which is identical to Alternative 5 without changes to the KY 22 interchange.

AM (2030): The simulation showed the AM significantly improved operations of the interchange and I-71 downstream while significantly decreasing congestion, delay, and weaving. Both the flyover ramp and southbound I-71 are estimated to have free-flowing conditions during the AM and PM peak (in the design year) with this alternative. Compare the previous simulation screen image of Alternative 5 with the one posted below.

PM (2030): Alternative simulation shows improved performance of I-71 northbound to I-265 southbound and KY 22 because the improvements to Ramp 5 as illustrated in Alternative 1 decreases the delay and congestion in the 2030 PM Peak Period as well as the additional lane to I-71 northbound tremendously decreases delay and improves capacity.

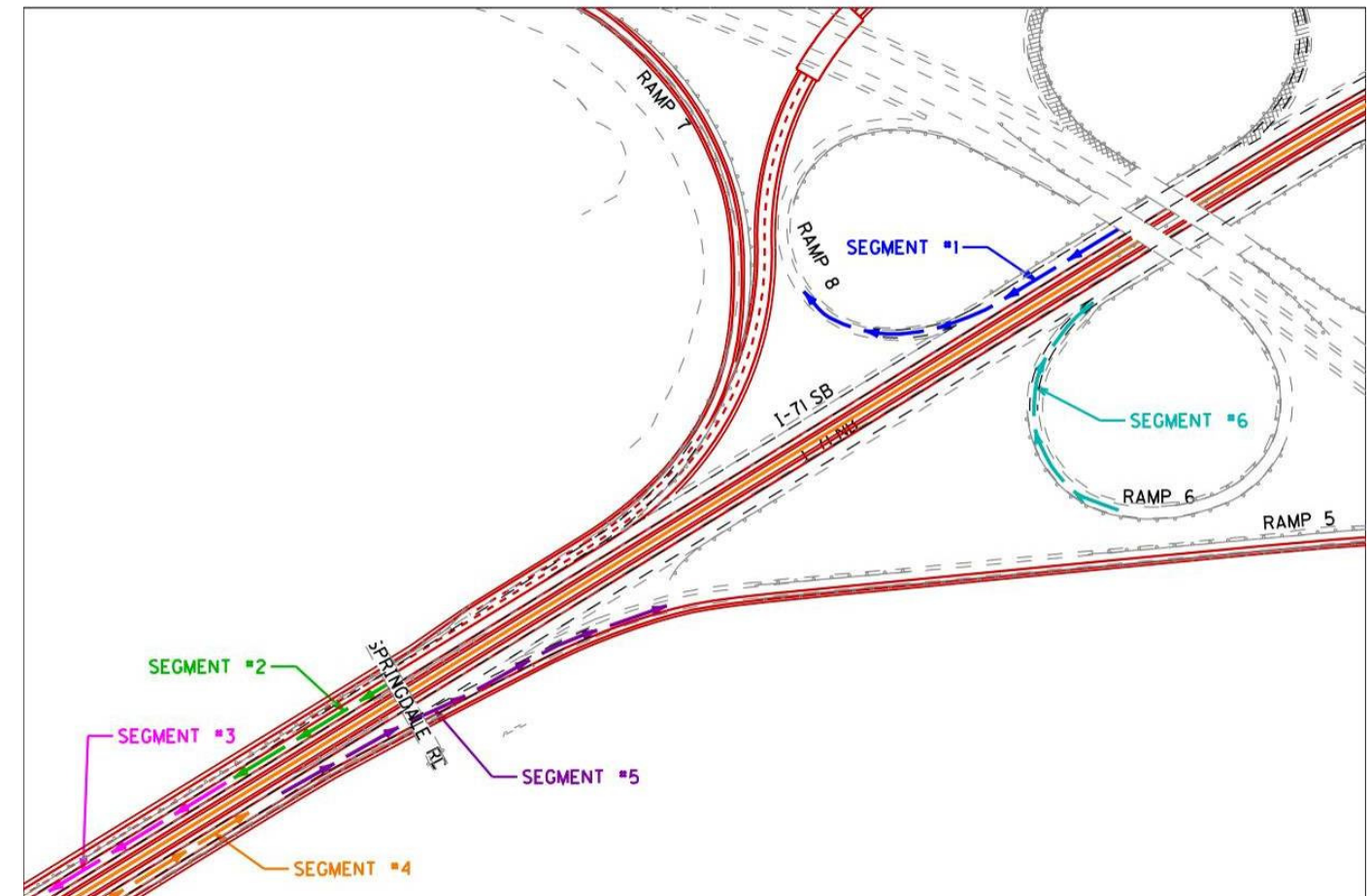
Pros:

- Improves capacity on I-71
- Eliminates AM and PM congestion
- Improves weaving from KY 22 and/or I-265 to I-71 and increases free flow speed
- Improved geometrics with flyover ramp to I-71 southbound
- Safety

Cons:

- Effects underpasses and overpasses with the widening on I-71 to I-264
- Widening may affect right of way and/or utilities
- Environmental impacts with increased noise due to added lane
- Relatively High cost

Cost: **\$70 million**



Segment Number	Segment	2009 Existing (AM/PM)	2030 No-Build LOS (AM/PM)	2030 Build (AM/PM)
1	I-71 SB Ramp 8-No longer Weave	E/D	F/C	C/B
2	I-71 SB Ramp 7 and New Flyover Entrance	D/C	D/D	B/B
3	I-71 SB South of Ramp 7	D/C	F/C	B/A
4	I-71 NB (From Southern Limit to Ramp 5)	B/D	B/D	A/C
5	Ramp 5 (I-71 NB to I265 SB Off-Ramp)	C/D	C/E	B/C
6	Ramp 6 (I-265 SB to I-71 NB Weave)	A/B	B/F	A/D

Figure 27. Alternate 5A Critical Segment Analysis

This alternative shows significant improvements over the current conditions up to the design year. This alternative meets the project goals and is recommended to advance further in the project development process.

Alternative 6

Alternate 6 expands upon Alternate 5 by adding a CD for I-265 northbound between KY 22 and I-71 and creating a slip ramp at the end of the CD back to I-265. I-71 is also widened to six lanes to I-264.

AM and PM (2030): All future movements performed well after simulation and analysis.

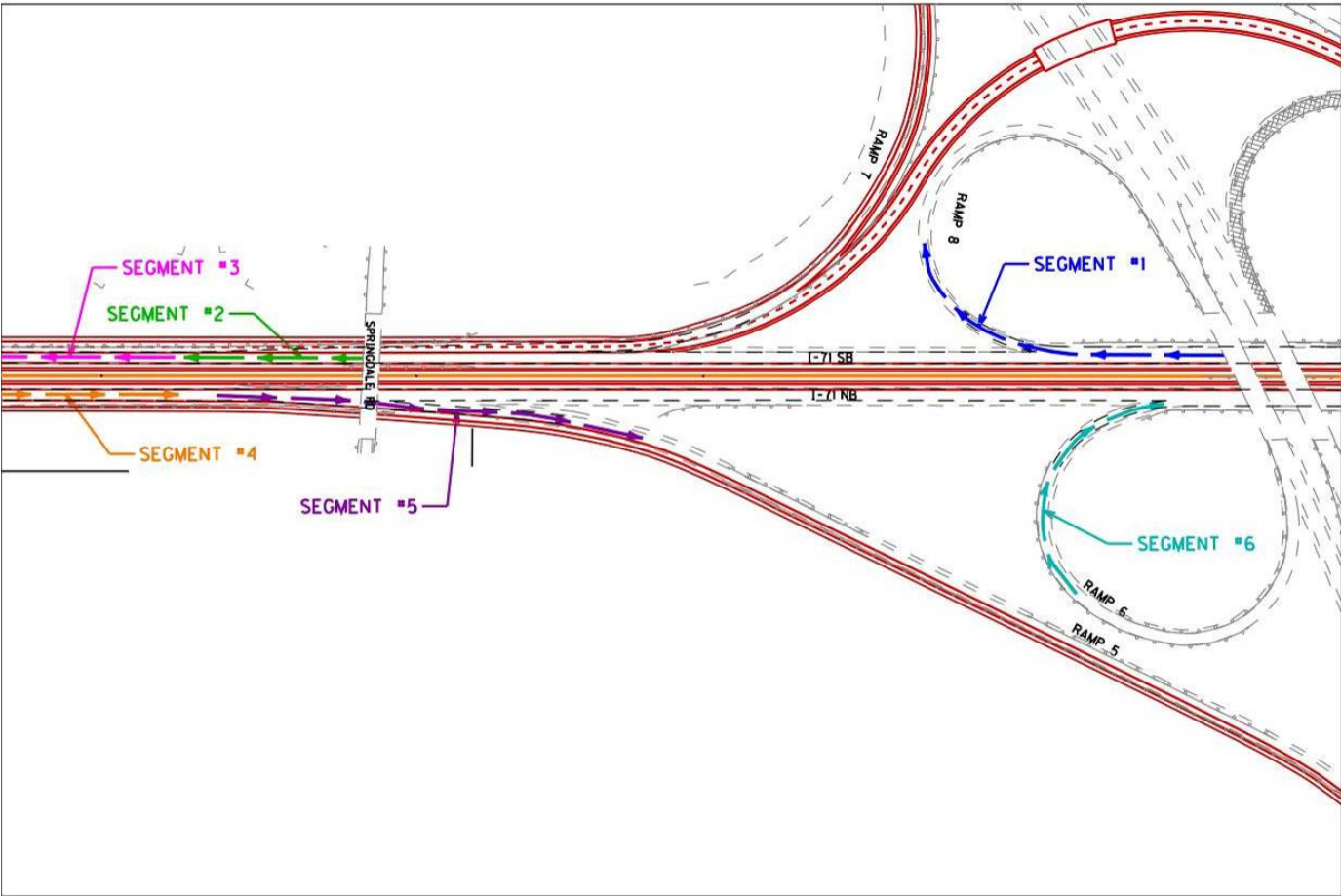
Pros:

- Improves capacity on I-71
- Eliminates AM and PM congestion
- Improves weaving from KY 22 and/or I-265 to I-71 and increases free flow speed
- Improved geometrics with flyover ramp to I-71 southbound
- Safety

Cons:

- Effects underpasses and overpasses with the widening on I-71 to I-264
- Widening may affect right of way and/or utilities
- Environmental impacts with increased noise due to added lane
- Slip ramp from KY 22 to I-265 northbound is located in close proximity to I-71/I-265
- Cost

Cost: \$75 million



Segment Number	Segment	2009 Existing (AM/PM)	2030 No-Build LOS (AM/PM)	2030 Build (AM/PM)
1	I-71 SB Ramp 8-No longer Weave	E/D	F/C	C/B
2	I-71 SB Ramp 7 and New Flyover Entrance	D/C	D/D	C/B
3	I-71 SB South of Ramp 7	D/C	F/C	B/A
4	I-71 NB (From Southern Limit to Ramp 5)	B/D	B/D	A/C
5	Ramp 5 (I-71 NB to I265 SB Off-Ramp)	C/D	C/E	B/C
6	Ramp 6 (I-265 SB to I-71 NB Weave)	A/B	B/F	A/D

Figure 28. Alternate 6 Critical Segment Analysis

This alternative was eliminated from further consideration because the modeling shows the CD system does not perform significantly better than Alternative 5A, has a higher cost and has undesirable ramp spacing from the end of the CD to the loop ramp from I-71 northbound to I-265 northbound (traveling toward the new Ohio River bridge).



Alternative 6A

Alternate 6A is the same as Alternative 6 with the exception that I-71 remains as four lanes to I-264.

AM (2030): Due to the inadequate capacity on I-71 southbound (two lanes) at the merging point with the flyover from I-265 northbound, the two-lane flyover ramp basically stores traffic on it until traffic can merge onto I-71 southbound as can be seen in the simulation image below.

PM (2030): Alternate 1 is incorporated into this plan and shows improved performance of I-71 northbound and significantly reduces delay and congestion.

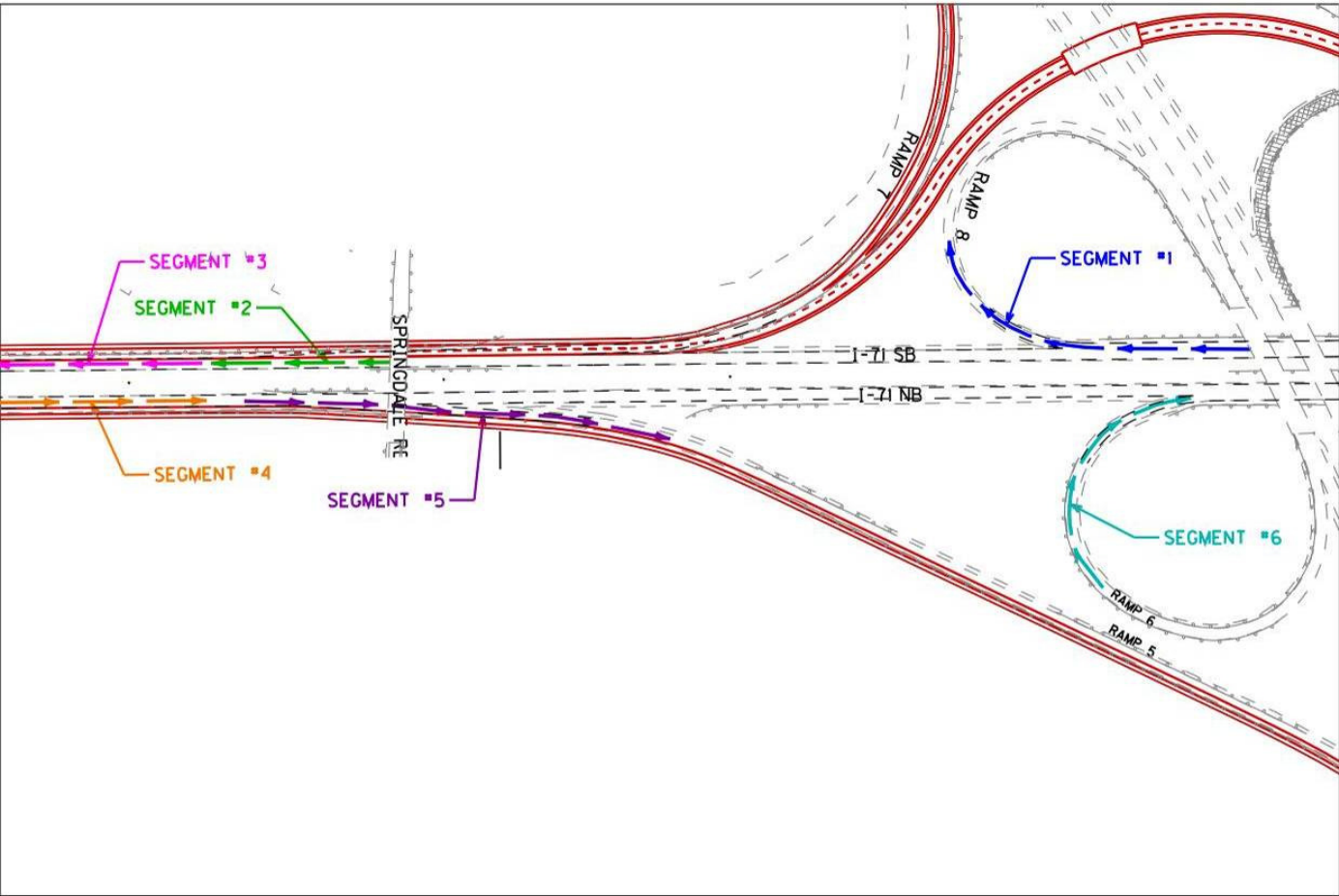
Pros:

- Eliminates AM congestion at KY 22 and I-265
- Eliminates PM congestion at Ramp 5
- Improved geometrics with flyover ramp to I-71 southbound
- Safety improvement for PM peak period

Cons:

- Does not improve capacity on I-71
- Moves congestion point downstream on I-71 southbound
- Effects Springdale Road Bridge
- Widening may affect right of way and/or utilities

Cost: \$35 million



Segment Number	Segment	2009 Existing (AM/PM)	2030 No-Build LOS (AM/PM)	2030 Build (AM/PM)
1	I-71 SB Ramp 8-No longer Weave	E/D	F/C	E/B
2	I-71 SB Ramp 7 and New Flyover Entrance	D/C	D/D	D/B
3	I-71 SB South of Ramp 7	D/C	F/C	B/A
4	I-71 NB (From Southern Limit to Ramp 5)	B/D	B/D	A/C
5	Ramp 5 (I-71 NB to I265 SB Off-Ramp)	C/D	C/E	B/C
6	Ramp 6 (I-265 SB to I-71 NB Weave)	A/B	B/F	A/E

Figure 29. Alternate 6A Critical Segment Analysis

This alternative was eliminated from further consideration because it does not meet the project goals.

Alternative 7

Alternate 7 was developed to determine if moving the flyover to the intersection of I-71 and I-265 would be feasible and cost effective when compared to Alternative 5. The proposed traffic characteristics were very comparable to Alternate 5. Therefore, this scenario was dropped from further consideration and not recommended for advancement primarily due to structural logistics with the flyover from I-265 northbound to I-71 southbound being relocated to the intersection of existing I-71 and I-265 as well as the reconfiguration of KY 22 at I-265.

AM (2030): Due to the inadequate capacity on I-71 southbound (two lanes) at the merging point with the flyover from I-265 northbound, the two-lane flyover ramp basically stores traffic on it until traffic can merge onto I-71 southbound similar to Alternate 5 as well as creating significant back up and delay on KY 22.

PM (2030): Alternative shows improved performance of I-71 northbound to I-265 southbound and KY 22 because the improvements to Ramp 5 as illustrated in Alternative 1 decreases the delay and congestion in the PM Peak Period.

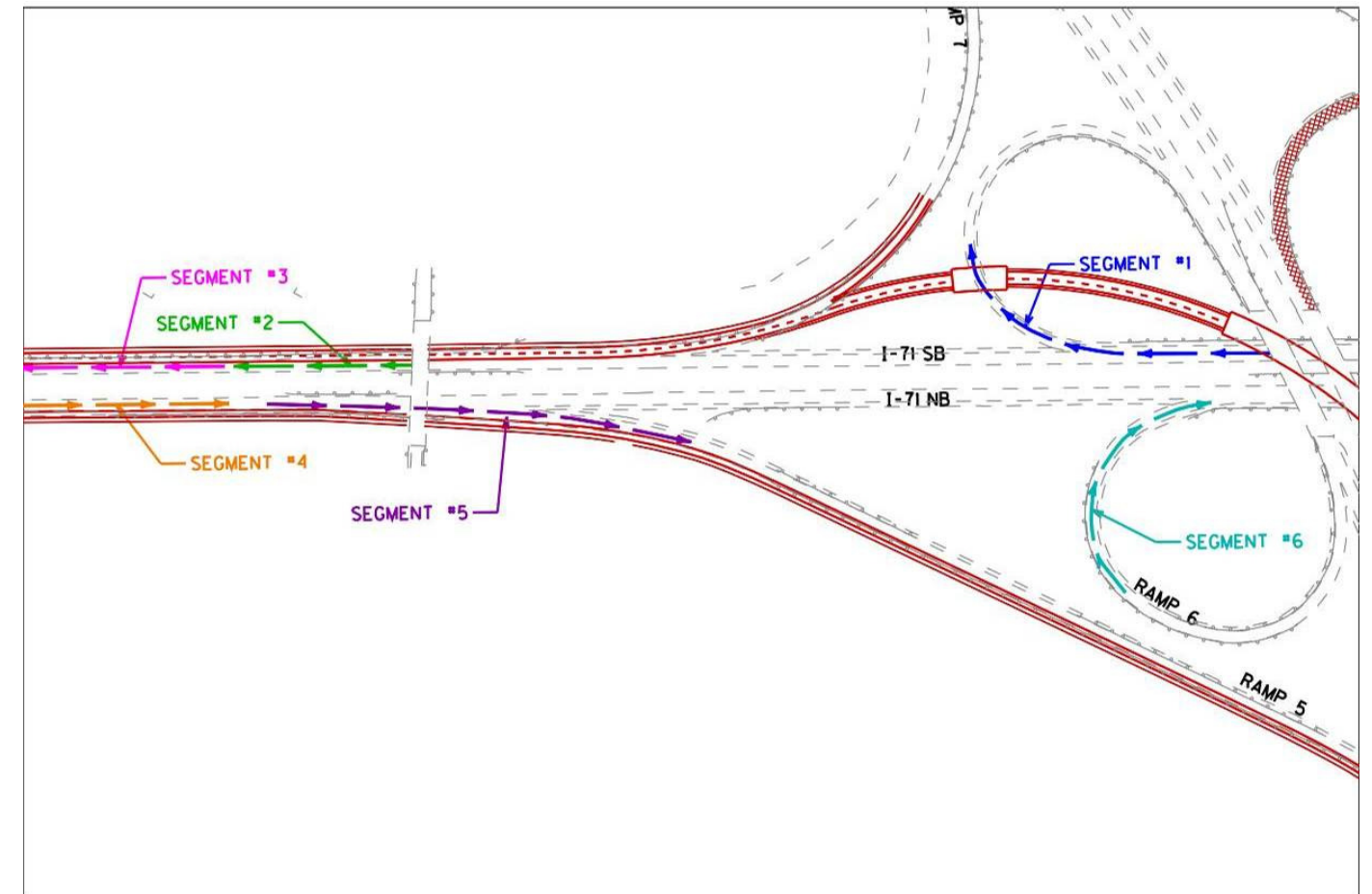
Pros:

- Eliminates AM congestion at KY 22 and I-265
- Eliminates PM congestion at Ramp 5
- Improved geometrics with flyover ramp to I-71 southbound
- Safety improvement for PM peak period

Cons:

- Does not improve capacity on I-71
- Moves congestion point downstream on I-71 southbound
- Creates significant delay and backup on KY 22 due to the reconfiguration of the on ramp at KY 22
- Effects Springdale Road Bridge
- Widening may affect right of way and/or utilities

Cost: **\$40 million**



Segment Number	Segment	2009 Existing (AM/PM)	2030 No-Build LOS (AM/PM)	2030 Build (AM/PM)
1	I-71 SB Ramp 8-No longer Weave	E/D	F/C	E/B
2	I-71 SB Ramp 7 and New Flyover Entrance	D/C	D/D	D/B
3	I-71 SB South of Ramp 7	D/C	F/C	B/A
4	I-71 NB (From Southern Limit to Ramp 5)	B/D	B/D	A/C
5	Ramp 5 (I-71 NB to I265 SB Off-Ramp)	C/D	C/E	B/C
6	Ramp 6 (I-265 SB to I-71 NB Weave)	A/B	B/F	A/E

Figure 30. Alternate 7 Critical Segment Analysis

This alternative was eliminated from further consideration because it does not meet the project goals.

Alternative 8

Alternate 8 widens both I-71 and I-265 to six lanes. This alternative constructs a second flyover ramp from I-265 southbound to I-71 northbound to complement the flyover ramp that accommodates the morning peak traffic presented in previous alternates. To help compensate for the short distance between I-71 and KY 22, as well as reduce the number of weaving vehicles between interchanges, Alternate 8 has braided ramps near the KY 22 exit off of I-265. With this option the braided ramps are also part of a large and complex CD system proposed at Ramp 5 and I-265 southbound to KY 22.

AM and PM (2030): All future movements performed well after simulation and analysis.

Pros:

- Improves capacity on I-71 and I-265
- Eliminates AM and PM congestion
- Improves weaving from KY 22 and/or I-265 to I-71 and increases free flow speed
- Improved geometrics with flyover ramp to I-71 southbound and I-71 northbound
- Safety

Cons:

- Effects underpasses and overpasses with the widening on I-71 to I-264 and effects overpasses on I-265
- Widening will affect right of way and/or utilities (braided weave near businesses will require significant right of way and utility relocations)
- Environmental impacts with increased noise due to added lanes
- Cost

Cost: **\$105 million**

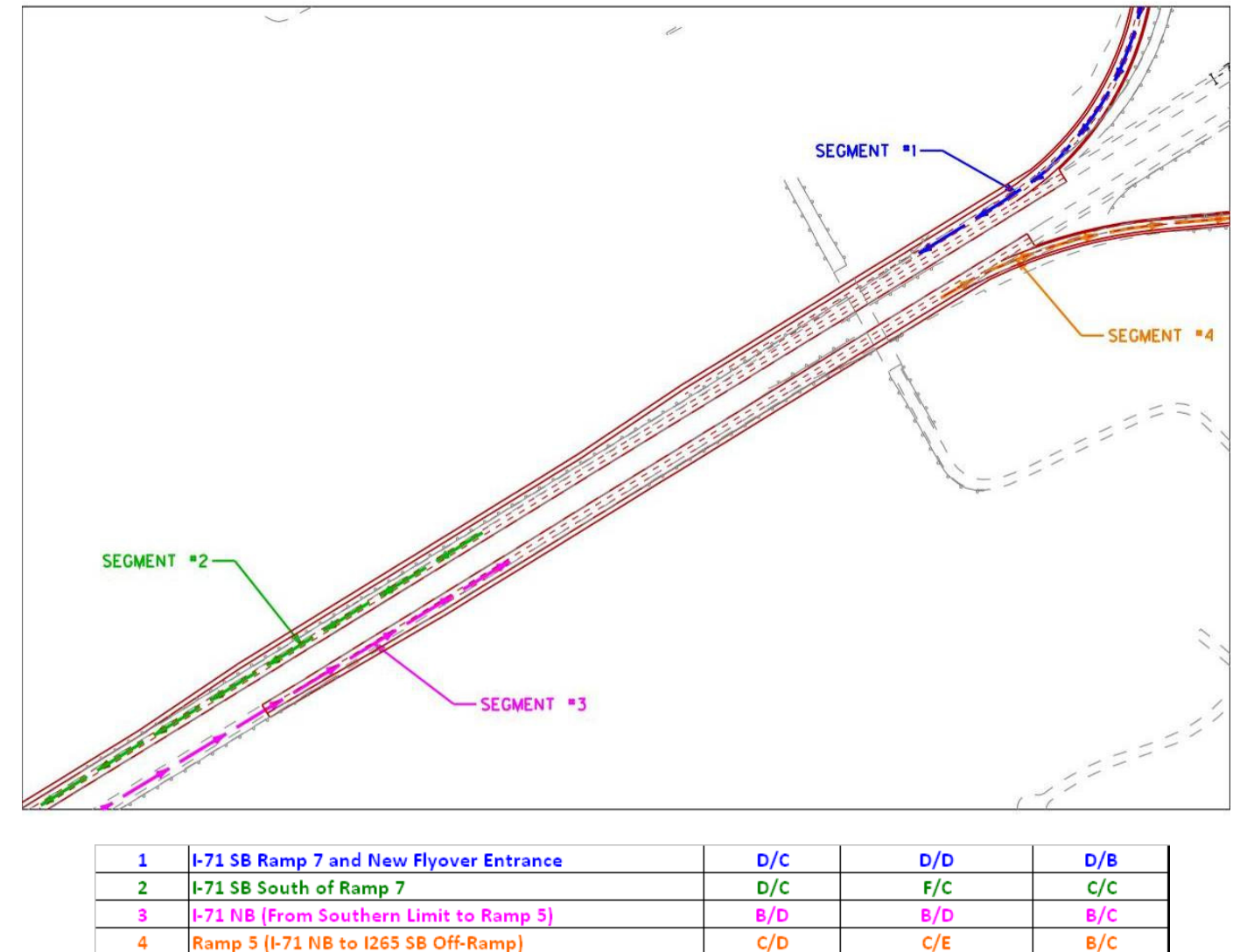


Figure 31. Alternate 8 Critical Segment Analysis

This alternative was eliminated from further consideration due to significant right of way and utility impacts primarily located at the braided weave to KY 22.



Alternative 8A

Alternate 8A is similar to Alternate 8 with the removal of the braided weave at KY 22 while I-71 and I-265 are six lanes each, respectively.

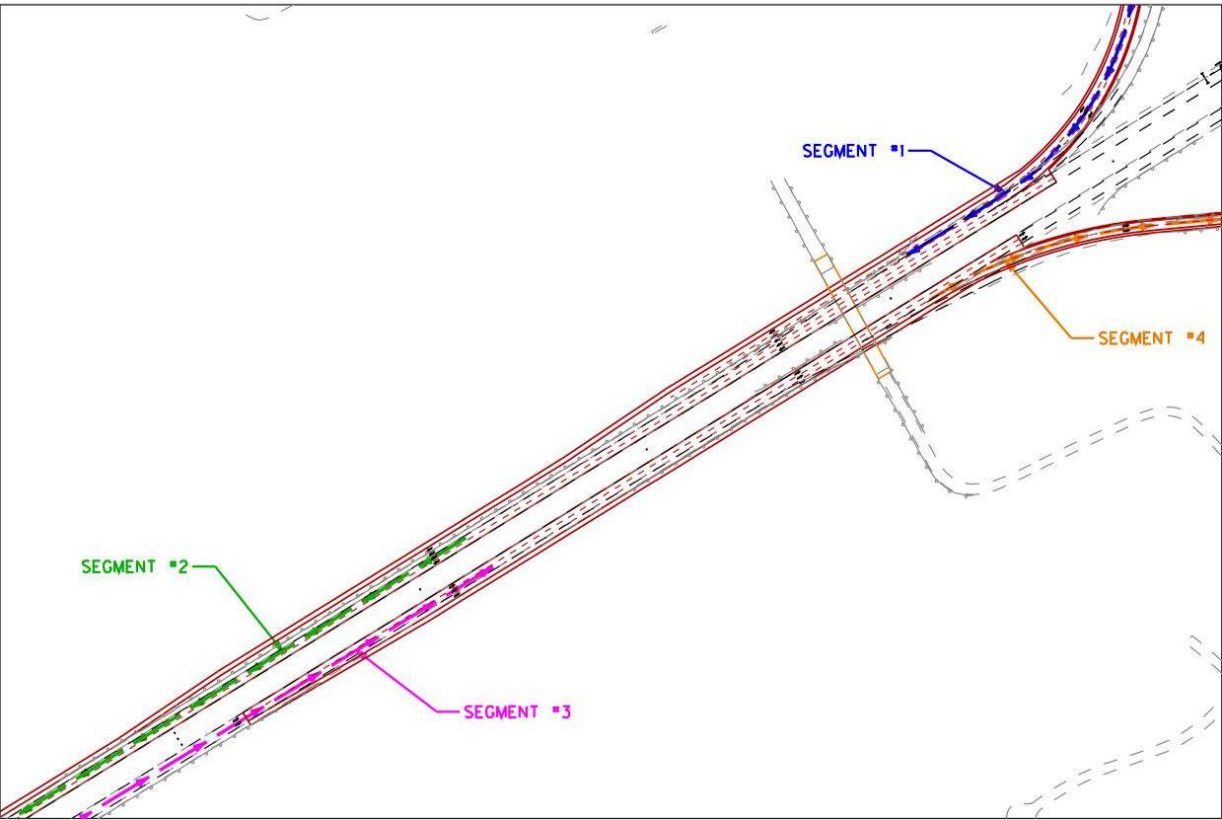
Pros:

- Improves capacity on I-71 and I-265
- Eliminates AM and PM congestion
- Improves weaving from KY 22 and/or I-265 to I-71 and increases free flow speed
- Improved geometrics with flyover ramp to I-71 southbound and I-71 northbound
- Safety

Cons:

- Effects underpasses and overpasses with the widening on I-71 to I-264 and effects overpasses on I-265
- Widening may affect right of way and/or utilities
- Environmental impacts with increased noise due to added lanes
- Cost

Cost: \$100 million



1	I-71 SB Ramp 7 and New Flyover Entrance	D/C	D/D	D/B
2	I-71 SB South of Ramp 7	D/C	F/C	C/C
3	I-71 NB (From Southern Limit to Ramp 5)	B/D	B/D	B/C
4	Ramp 5 (I-71 NB to I265 SB Off-Ramp)	C/D	C/E	B/C

Figure 32. Alternate 8A Critical Segment Analysis

This alternative meets the project goals and is recommended to proceed in the project development process into Phase I design as part of the ultimate solution for the interchange.

Alternative 9

Alternate 9 is similar to Alternate 8A with the removal of the flyover from I-265 southbound to I-71 northbound while I-71 and I-265 are six lanes each, respectively.

AM (2030): The future movements performed well with good levels of services and with little to no delay in the simulation model.

PM (2030): The future movements performed without delay with the exception of the loop ramp from I-265 southbound to I-71 northbound (ramp 6). With the increased traffic volume from the construction of the east end bridge for the design year, this area showed extreme congestion and delay as well as weaving issues. Ramp 6 is the only movement that may need additional improvements in the future (ie. flyover ramp shown in 8A). Additional coordination with KIPDA and the Louisville Bridges project is recommended for the next phase of the design process.

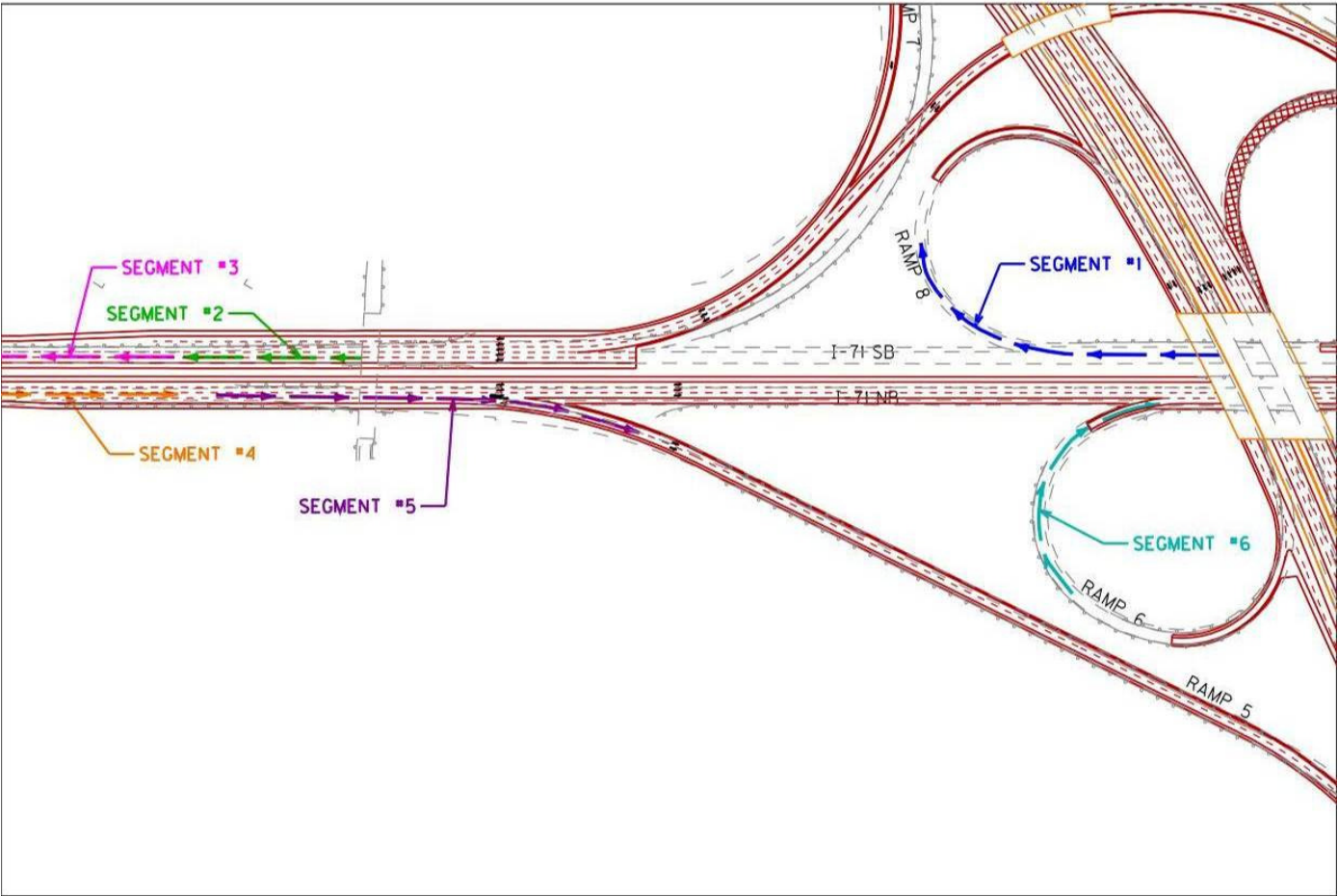
Pros:

- Improves capacity on I-71 and I-265
- Eliminates AM and PM congestion
- Improves weaving from KY 22 and/or I-265 to I-71 and increases free flow speed
- Improved geometrics with flyover ramp to I-71 southbound
- Safety

Cons:

- Effects underpasses and overpasses with the widening on I-71 to I-264 and effects overpasses on I-265
- Widening may affect right of way and/or utilities
- Environmental impacts with increased noise due to added lanes
- Relatively high cost

Estimated Cost- **\$85 Million**



Segment Number	Segment	2009 Existing (AM/PM)	2030 No-Build LOS (AM/PM)	2030 Build (AM/PM)
1	I-71 SB Ramp 8-No longer Weave	E/D	F/C	D/C
2	I-71 SB Ramp 7 and New Flyover Entrance	D/C	D/D	C/B
3	I-71 SB South of Ramp 7	D/C	F/C	C/C
4	I-71 NB (From Southern Limit to Ramp 5)	B/D	B/D	B/C
5	Ramp 5 (I-71 NB to I-265 SB Off-Ramp)	C/D	C/E	B/C
6	Ramp 6 (I-265 SB to I-71 NB Weave)	A/B	B/F	A/C

Figure 33. Alternate 9 Critical Segment Analysis

Because this alternative is similar to Alternative 8A and after further engineering investigation and analysis, it was determined that due to the heavy movement in the 2030 design year, the existing loop ramp from I-265 southbound to I-71 northbound would not adequately handle the increased traffic. Therefore, this alternative was eliminated from further consideration.

Alternative 10

Alternative 10 examines a CD system through the I-265 interchange creating the C/D on I-71 north and southbound. The CD is created by constructing the CD through the abutment on I-71 (spill through abutment). With this scenario the existing cloverleaf interchange is maintained and I-71 is four lanes beyond the C/D merge points.

AM (2030): New merge/weave point from I-265 southbound to I-71 northbound is heavily congested with traffic moving at low speeds on I-71 according to the simulation.

PM (2030): Ramp congestion will exist from I-265 southbound to I-71 northbound (ramp 6) and I-265 northbound to I-71 northbound.

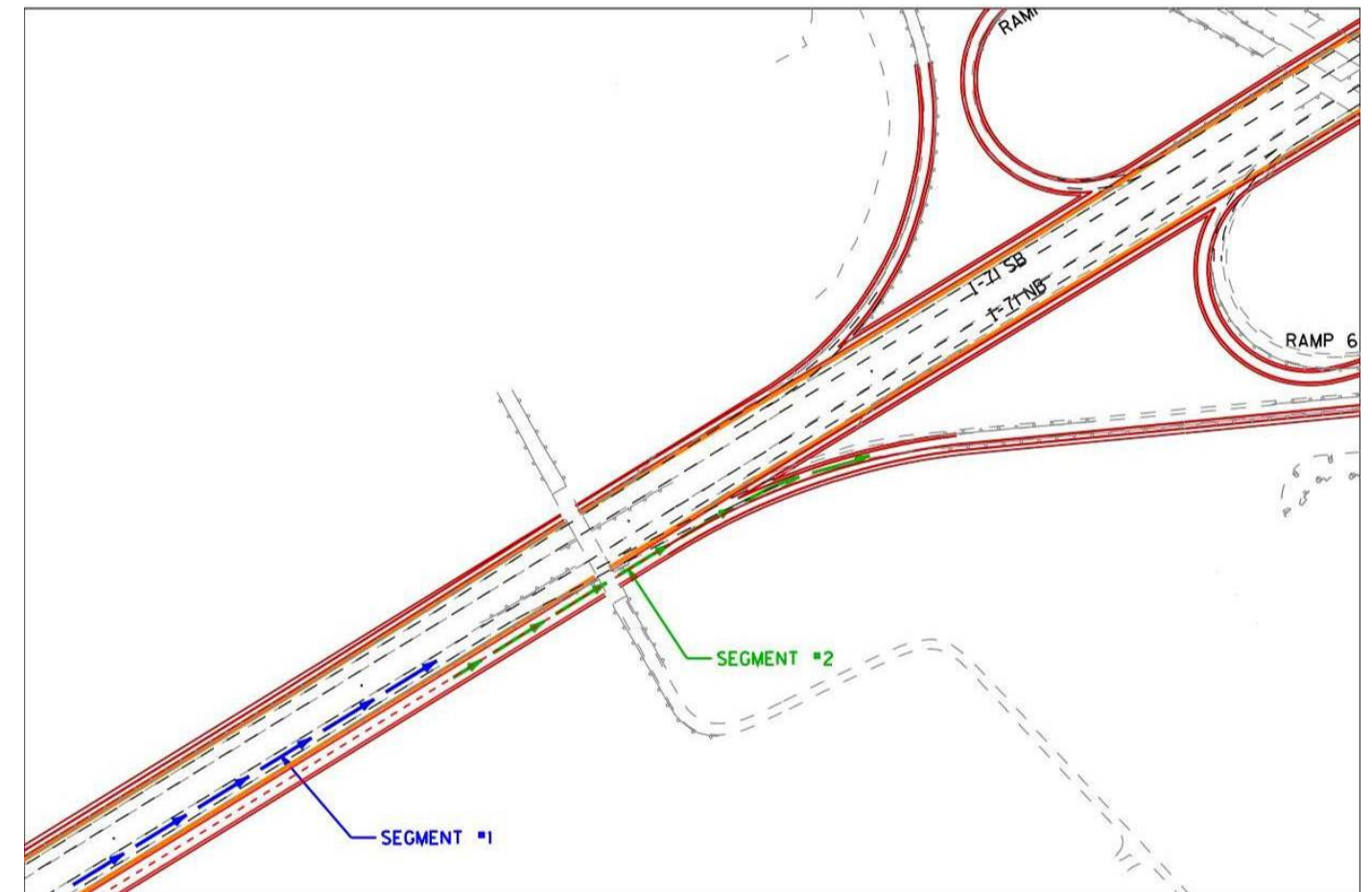
Pros:

- Eliminates PM congestion as presented in Alternate 1
- Improves weaving from KY 22 and/or I-265 to I-71 during PM peak period as presented in Alternate 1
- Minimal right of way and utilities affected

Cons:

- Does not improve capacity on I-71 and stores merging traffic on the CD due to inadequate capacity on I-71
- Moves congestion point downstream on I-71 southbound
- Effects Springdale Road Bridge
- Effects I-265 overpass with the construction of the CD on I-71
- Ramp congestion from I-265 southbound to I-71 northbound and I-265 northbound to I-71 northbound
- Does not improve geometrics of interchange

Estimated Cost- **\$25 Million**



Segment Number	Segment	2009 Existing (AM/PM)	2030 No-Build LOS (AM/PM)	2030 Build (AM/PM)
1	I-71 NB Southern Limit Mainline	B/D	B/D	B/C
2	I-71 NB C/D Ramp 5	C/D	C/E	B/C

Figure 34. Alternate 10 Critical Segment Analysis

This alternative was eliminated from further consideration because it does not meet the project goals.



Alternative 10A:

Alternative 10A is similar to Alternative 10 with the exception that I-71 is widened to six lanes to I-264.

AM (2030): CD system and mainline show traffic free flowing in the simulation.

PM (2030): CD system and mainline show traffic free flowing in the simulation.

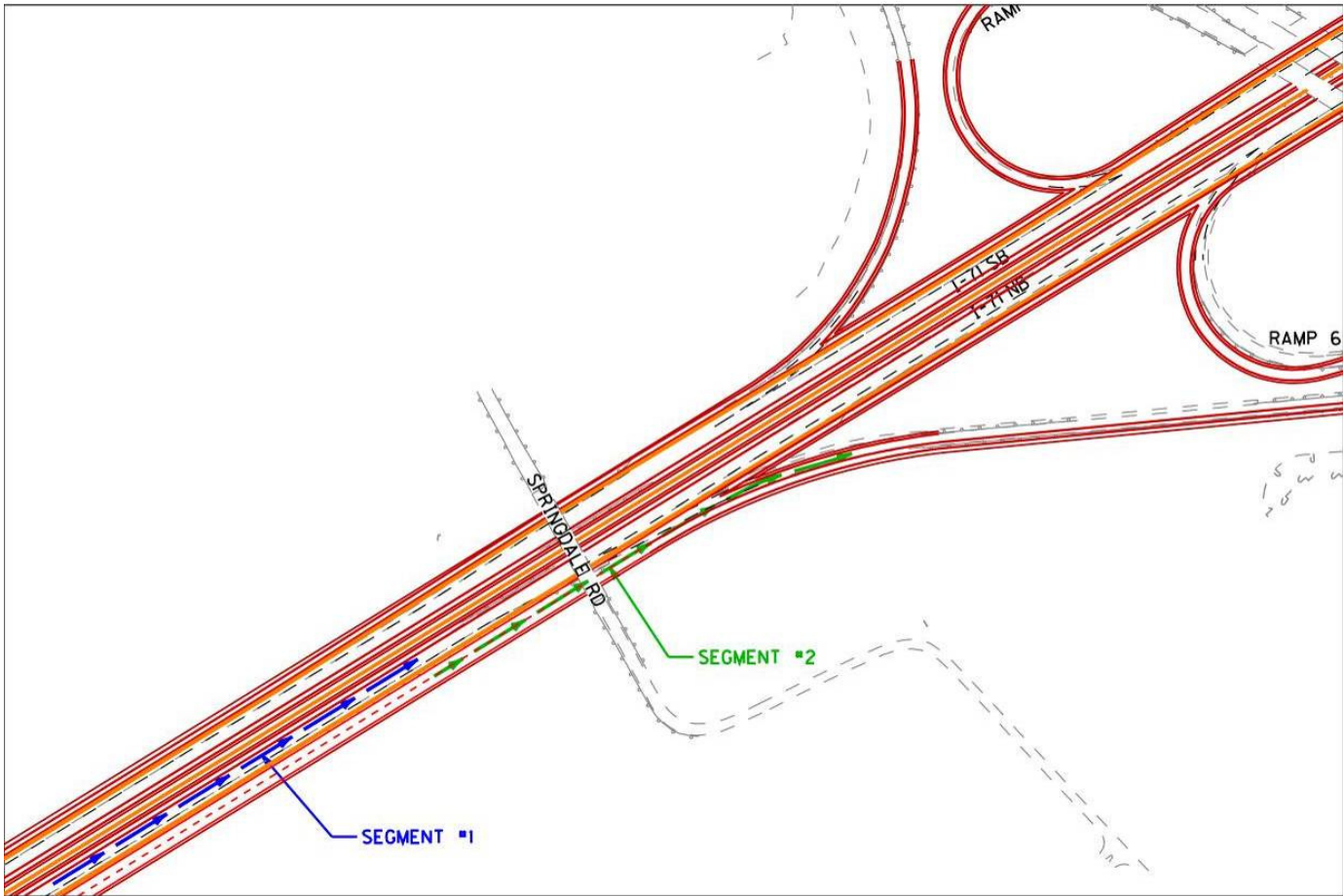
Pros:

- Improves capacity on I-71
- Eliminates AM and PM congestion
- Improves weaving from KY 22 and/or I-265 to I-71 during AM and PM peak period
- Minimal right of way and utilities affected
- Cost when compared to other ultimate build alternates

Cons:

- Effects underpasses and overpasses with the widening on I-71 to I-264
- Effects I-265 overpass with the construction of the CD on I-71
- Does not improve geometrics of interchange

Estimated Cost - \$65 Million



Segment Number	Segment	2009 Existing (AM/PM)	2030 No-Build LOS (AM/PM)	2030 Build (AM/PM)
1	I-71 NB Southern Limit Mainline	B/D	B/D	B/C
2	I-71 NB C/D Ramp 5	C/D	C/E	B/C

Figure 35. Alternate 10A Critical Segment Analysis

This alternative meets the project goals and is recommended to proceed in the project development process into Phase I design as part of the ultimate solution for the interchange.

8.0 RECOMMENDATIONS

Due to the current transportation funding situation, it is not feasible to construct an ultimate interchange design with one large project. Instead, a phased construction approach is recommended to address current needs with cost effective, small-scale improvement projects and construct additional pieces of the ultimate interchange for the next 5 to 15 years.

There are two recommendations as a result of this study. Alternative 1 was presented to the State Highway Engineer's office and was recommended for advancement as its own standalone project. This ramp modification will add capacity to address current congestion issues in the PM and will be fully compatible with all other future alternatives recommended for advancement. Alternative 1 was included in the 2010 Recommended Highway Plan as Item 5-48.30 with design scheduled for Fiscal Year 2013.

The second recommendation is to enhance the existing warning signage for the I-71 southbound exit ramp (ramp 8). As shown in Figure 18, in the Existing Signing section on page 23, the advance warning signage for the loop ramp is limited to one advanced warning sign. While this is compliant with the Manual on Uniform Traffic Control Devices, supplemental signs in advance of the bridge are recommended to alert motorists, especially truck drivers, to the tight curvature on ramp 8. By nature, loop off-ramps have more crash problems than loop on-ramps because of the speed differential between mainline speeds and the design speed of the ramp.

It is recommended that a panel sign be mounted overhead, with flashers, on the I-265 bridge. An example of this sign is shown in Figure 35 below. This sign presents the rollover risk to trucks for safely exiting via ramp 8.



Figure 36. Recommended Supplemental Warning Signage for Ramp 8

Regarding the longer-term solutions for this interchange, the project team is recommending that Alternatives 5A, 8A, and 10A should be advanced for Phase I analysis and design.