FINAL

KIPDA Interchange

Bicycle/Pedestrian Safety Study

Summary of

Findings and Recommendations

Prepared for:

Kentuckiana Regional Planning and Development Agency (KIPDA)

Kentucky Transportation Cabinet (KYTC) - District 5

Louisville Metro

Oldham County

Prepared by:

PB Americas, Inc.

In Association with:

HDDS, Inc.

December 2007

KIPDA INTERCHANGE – BICYCLE / PEDESTRIAN SAFETY STUDY
JEFFERSON, BULLITT, AND OLDHAM COUNTIES

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TABLE OF CONTENTS

APPENDICES

APPENDIX A: BICYCLE/PEDESTRIAN INTERCHANGE TOOLBOX

APPENDIX B: PROJECT TEAM MEETING MINUTES

APPENDIX C: STAKEHOLDER MEETING MINUTES

APPENDIX D: LITERATURE REVIEW BIBLIOGRAPHY

APPENDIX E: BICYCLE AND PEDESTRIAN SIGNS

APPENDIX F: DETAILED CASE STUDY COST ESTIMATES

APPENDIX G: EXCERPTS FROM ILLINOIS BUREAU OF DESIGN AND ENVIRONMENTAL MANUAL

TABLE OF TABLES

TABLE OF FIGURES

Preparation of this report has been financed through KIPDA, the U.S. Department of Transportation, and the Kentucky Transportation Cabinet. This financial assistance notwithstanding, the contents of this report do not necessarily reflect the official views or policies of the funding agencies. Accuracy of the information presented herein is the responsibility of PB Americas, Inc.

Executive Summary: KIPDA Interchange – Bicycle / Pedestrian Safety Study

The Kentuckiana Regional Planning and Development Agency (KIPDA) in conjunction with the Kentucky Transportation Cabinet (KYTC) District 5, charged PB Americas, Inc. (PB) with the task of developing a guide of best practices for improving bicycle and pedestrian safety through high speed, high volume freeway interchanges. There is currently no guidance in Louisville Metro, the KIPDA region, or Kentucky for accommodating bicyclists and pedestrians through these types of interchanges. The study has five primary objectives that are listed below:

1. Perform a literature search of policies and guidelines of bicycle and pedestrian safety at interchanges to determine what others are doing to accommodate bicyclists and pedestrians through interchanges,
2. Conduct interviews with local stakeholders regarding bicycle and pedestrian safety at interchanges, and in general in the region,
3. Develop conceptual plans for case studies of five representative interchanges in the KIPDA region,
4. Develop a toolbox for accommodating bicyclists and pedestrians through multiple interchange types, and
5. Document and compile the study finding in a final report.

The first step of this project was to perform a literature review to determine best practices across the United States as well as international sources for improving bicycle and pedestrian safety through interchanges. Guidelines from ten state departments of transportation (DOTs), eight cities and metropolitan planning organizations (MPOs), as well as five other agencies (national and international) were reviewed.

From this review it is clear that there is not one universal source, nor are their sufficient guidelines or best practices with regard to bicycle and pedestrian safety, especially at these types of interchanges. Rather, there are various guidelines for bicycle or pedestrian facilities, including some that generally refer to high-speed, high-volume interchanges, and other general guidance for intersections and other locations. California, Oregon and Florida, as well as regional and local agencies in those states provided the most guidance. Most of the leading edge or best practices are in these three states, and many other agencies had similar guidelines built on or citing these sources.

Common themes include:

- Moving pedestrians and bicyclists through the interchange on the same cycle as through traffic when possible.
- Bicycle and pedestrian facilities should be carried all the way through the interchange, rather than being dropped on either end. If facilities already exist on either side of the interchange, then there is a need for them to be carried through.
- Free flow ramps pose the greatest threat to bicyclists and pedestrians because of high vehicle speeds and poor angles for sight distance.

- Most guidance suggests reducing vehicle speeds and potential conflict points, changing approach or departure angles, and placing crossings at 90 degree angles to improve visibility of bicyclists and pedestrians, and using refuge areas for long crossing distances.

The literature does provide guidance for accommodating bicyclists and pedestrians through interchanges; however the interchange type and field conditions will be the most important factors in determining which specific treatments will be most appropriate to increase bicycle and pedestrian safety at a particular interchange.

The second task was to conduct interviews with local stakeholders regarding bicycle and pedestrian safety at interchanges, and in general in the region. Various stakeholders were contacted, from bicycle and pedestrian activists, to average citizens, and all were asked what could be done to improve safety for bicyclists and pedestrians, as well as to encourage more bicycle and pedestrian activity. From the responses it is clear that there is interest in improving bicycle and pedestrian safety, and that most people involved felt that the project was worthwhile and needed. Many people believe that safer accommodations for bicyclists and pedestrians would encourage more people to walk and bike.

The third task of developing conceptual plans for case studies of the five representative interchanges in the region was completed based on information gathered in the literature review and stakeholder interview processes. The five case study interchanges included:

- Jefferson County: I-264 (Watterson Expressway) at KY 155 (Taylorsville Road) [Skewed Partial Cloverleaf with heavy free-flow movements]
- Jefferson County: I-264 (Watterson Expressway) at US 31E (Bardstown Road) [Single Point Urban Interchange]
- Jefferson County: I-265 (Gene Snyder Freeway) at KY 155 (Taylorsville Road) [Diamond Interchange with arterial road going under interstate]
- Bullitt County: I-65 at KY 1526 (Brooks Road) [Diamond Interchange with arterial road going over interstate]
- Oldham County: I-71 at KY 146 (Buckner) [Partial Cloverleaf]

These represent five types of interchanges commonly found in the region. The recommendations made for each are shown in **Table ES 1**.

Table ES 1: Summary of Recommendations for Case Study Interchanges

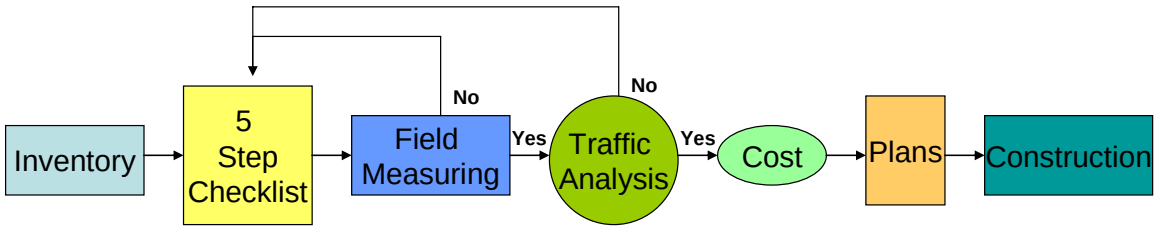
Location	Recommended Alternative	Description	Cost
I-264 & TAYLORSVILLE ROAD (KY 155) [Skewed Partial Cloverleaf]	0	Tree Trimming / Sweeping / Maintenance	Minimal
	1	Right Turn Yield to Bikes	$600
	2	Bike / Pedestrian Warning Signs	$1,200
	3	Pedestrian Warning System	$75,000
	4	Lighting	$38,000
	7A	Zebra Crossing / Sidewalk / Countdown Pedestrian Signal (with Earthwork)	$261,000
	Total		$375,800
I-264 & BARDSTOWN ROAD (US 31E) [Single Point Urban Interchange]	0	Sweep Curbs / Gore Areas	Minimal
	1	Right Turn Yield to Bikes	$600
	2	Stop Here on Red / Staggered Stop Bars	$900
	3	Zebra Stripe Existing Crosswalks	$7,000
	4	Pedestrian Countdown Signals, Double-Sided (8 Heads)	$16,000
	5	Lighting	$38,000
	6	Reconfigure Sidewalk and Crossing at I-264 Right Turn Off Ramps to Provide 90° Crossings	$15,000
	7	Shift Sidewalk / Make Wide Curb Lane for Bikes	$310,000
	Total		$387,500
I-265 & TAYLORSVILLE ROAD (KY 155) [Diamond Interchange with Arterial Under the Interstate]	0	Sweep Curbs / Maintenance	Minimal
	1	Right Turn Yield to Bikes	$600
	2	Extend Pavement Through Interchange for Wide Curb Lane (10' Width) Either Asphalt or Concrete (No Drainage)	$240,000
	3	Lighting	$19,000
	4	Multiuse Path on One Side and Sidewalk on the Other	$210,000
	Total		$469,600
I-65 & BROOKS ROAD (KY 1526) [Diamond Interchange with Arterial Over the Interstate]	0	Sweep Curbs / Maintenance	Minimal
	1	Right Turn Yield to Bikes	$800
	2	Bike / Pedestrian Warning Signs	$1,200
	3	High Mast Lighting	$39,000
	4	Remove Curb Lane Rumble Strips	$50,000
	Total		$91,000
I-71 & KY 146 (BUCKNER) [Partial Cloverleaf]	0	Continue to Maintain Shoulder	Minimal
	1	Right Turn Yield to Bikes	$800
	2	Bike / Pedestrian Warning Signs	$1,200
	4	Create Separate New Bridge for Greenway Facility	$470,000
	Total		$472,000
	Grand Total		$1,795,900

Notes:

- *The alternatives are shown color-coded with blue generally indicating lower cost improvement alternatives, green is medium cost alternatives, and red is generally higher cost alternatives.*
- *Cost is a planning level cost estimate in 2007 dollars for construction costs only.*

The five interchange concepts, stakeholder interviews and literature review, were all used to develop a general guide, or toolbox, for retrofitting bicycle and pedestrian facilities for high speed, high volume interchanges. A graphic showing the process is provided below (**Figure ES 1**).

Figure ES 1: Toolbox Evaluation Process



The toolbox begins with an inventory of existing conditions at the interchange to determine any deficiencies or known problems. This is followed by a five-step checklist that suggests possible treatments with respect to maintenance and signage, sidewalks and pedestrian facilities, bicycle facilities, reduction of conflict points, and grade separation. Next there are interchange sheets for ten different interchange types that discuss possible treatments for each of the five steps on the checklist. The interchange sheets are followed by a field measuring step, then a traffic analysis step, which ensure that any treatments selected are feasible and will not adversely impact traffic. The toolbox evaluation process will enable any user to develop appropriate treatments to enhance bicycle and pedestrian safety at a high speed, high volume interchanges.

1.0 INTRODUCTION

The Kentuckiana Regional Planning and Development Agency (KIDPA), as the Louisville Area Metropolitan Planning Organization (MPO), in coordination with the Kentucky Transportation Cabinet (KYTC), is conducting this planning study to improve bicycle and pedestrian safety in the vicinity of high speed, high volume interchanges. The consulting firm of PB Americas, Inc. (PB) was selected to lead the study effort. Other members of the project team included: HDDS Inc., KIPDA, KYTC District 5, the Federal Highway Administration (FHWA), Louisville Metro Government, and the governments of Oldham and Bullitt counties.

Ultimately, this study is expected to serve as a reference for use in the KIPDA region and beyond to provide ideas and resources for eventual project that would seek to improve the safety of bicyclists and pedestrians at interchanges.

1.1 Study Process

Based on the initial direction provided by KIPDA and the KYTC, five primary study objectives were developed as summarized below.

1. Perform a literature search of policies and guidelines of bicycle and pedestrian safety at interchanges to determine what others (nationally and internationally) are doing to accommodate bicyclists and pedestrians through interchanges;
2. Conduct interviews with local stakeholders regarding bicycle and pedestrian safety at interchanges, and in general in the region;
3. Develop conceptual plans for case studies of five representative interchanges in the KIPDA region;
4. Develop a toolbox for accommodating bicyclists and pedestrians through multiple interchanges types; and
5. Document and compile the study findings in a final report.

The literature review, stakeholder interviews, and case studies are discussed in more detail in this report as subsequent chapters. The toolbox along with meeting documentation is included at the end of the report as appendices (**Appendices A, B** and **C** respectively). Additional documentation is included in subsequent appendices including the literature review bibliography (**Appendix D**), bicycle and pedestrian signs (**Appendix E**), case study cost estimates (**Appendix F**), and supplementary pages that are pertinent to this study from the Illinois Bureau of Design and Environmental Manual (**Appendix G**).

2.0 LITERATURE, POLICIES AND GUIDELINES REVIEW

Executive Summary

The first step of the KIPDA Interchange – Bicycle/Pedestrian Safety Study project was to perform a literature review to determine best practices across the United States as well as international sources for improving bicycle and pedestrian safety through interchanges. Guidelines from ten state departments of transportation (DOTs), eight cities and metropolitan planning organizations (MPOs), as well as five other agencies (national and international) were reviewed.

From this review it is clear that there is not one universal source, nor are their sufficient guidelines or best practices with regard to bicycle and pedestrian safety, especially at these types of interchanges. Rather, there are various guidelines for bicycle or pedestrian facilities, including some that generally refer to high-speed, high-volume interchanges, and other general guidance for intersections and other locations. California, Oregon and Florida, as well as regional and local agencies in those states provided the most guidance. Most of the leading edge or best practices are in these three states, and many other agencies had similar guidelines built on or citing these sources.

Common themes include:

- Moving pedestrians and bicyclists through the interchange on the same cycle as through traffic when possible.
- Bicycle and pedestrian facilities should be carried all the way through the interchange, rather than being dropped on either end. If facilities already exist on either side of the interchange, then there is a need for them to be carried through.
- Free flow ramps pose the greatest threat to bicyclists and pedestrians because of high vehicle speeds and poor angles for sight distance.
- Most guidance suggests reducing vehicle speeds and potential conflict points, changing approach or departure angles, and placing crossings at 90 degree angles to improve visibility of bicyclists and pedestrians, and using refuge areas for long crossing distances.

The literature does provide guidance for accommodating bicyclists and pedestrians through interchanges; however the interchange type and field conditions will be the most important factors in determining which specific treatments will be most appropriate to increase bicycle and pedestrian safety at a particular interchange.

Report

A literature review of policies and guidelines was conducted to determine guidelines and best practices for bicycle and pedestrian facilities through interchanges. Guidelines and best practices from various state departments of transportation (DOTs), cities, metropolitan planning organizations (MPOs) and other government and transportation agencies throughout the world were researched, and a summary of the findings from each of the agencies is given below.

A bibliography documenting the different sources used for this review is provided in **Appendix D**.

2.1 State Departments of Transportation

Oregon

The Oregon DOT has a bicycle and pedestrian plan for the entire state that gives guidelines for the design and implementation of bicycle and pedestrian facilities. One chapter of this document is devoted to facilities at intersections, and a section of that chapter discusses facilities at interchanges.

The guide states that in rural areas, high pedestrian volumes are unlikely, and that bicyclists in this setting usually have enough experience to negotiate the intersection as long as wide shoulders are provided. Urban interchanges, however, may experience high pedestrian volumes and bicyclists of all skill levels, requiring action to be taken to accommodate them. Basic principles include discouraging free flow traffic, forcing vehicles to slow down or stop, as well as providing safe and convenient crossings. Bicycle lanes and sidewalks will usually be the most appropriate facilities, and general urban standards for design of these facilities should be used.

Specific design guidelines include the use of interchange ramps that connect with local streets at right angles, as shown in **Figure 1**. Such design reduces crossing distances for pedestrians and bicyclists and enhances their visibility. **Figures 2 and 3** show how bicycles can be accommodated across an exit or entrance ramp. It should be noted that **Figures 2 and 3** are intended to depict bicycle lanes along a freeway. However, the same concept could be used for bicycles along a road. Therefore, in **Figure 2**, the ramp labeled “entrance ramp” would actually be an exit ramp, and the travel lanes would be the lanes of the local road rather than the freeway. Again, in **Figure 3**, it is assumed that the through movement is along the local road and that the ramp is an entrance ramp for a freeway.

Figure 1: **Example of Interchange Ramps that Connect with Local Roads at Right Angles**

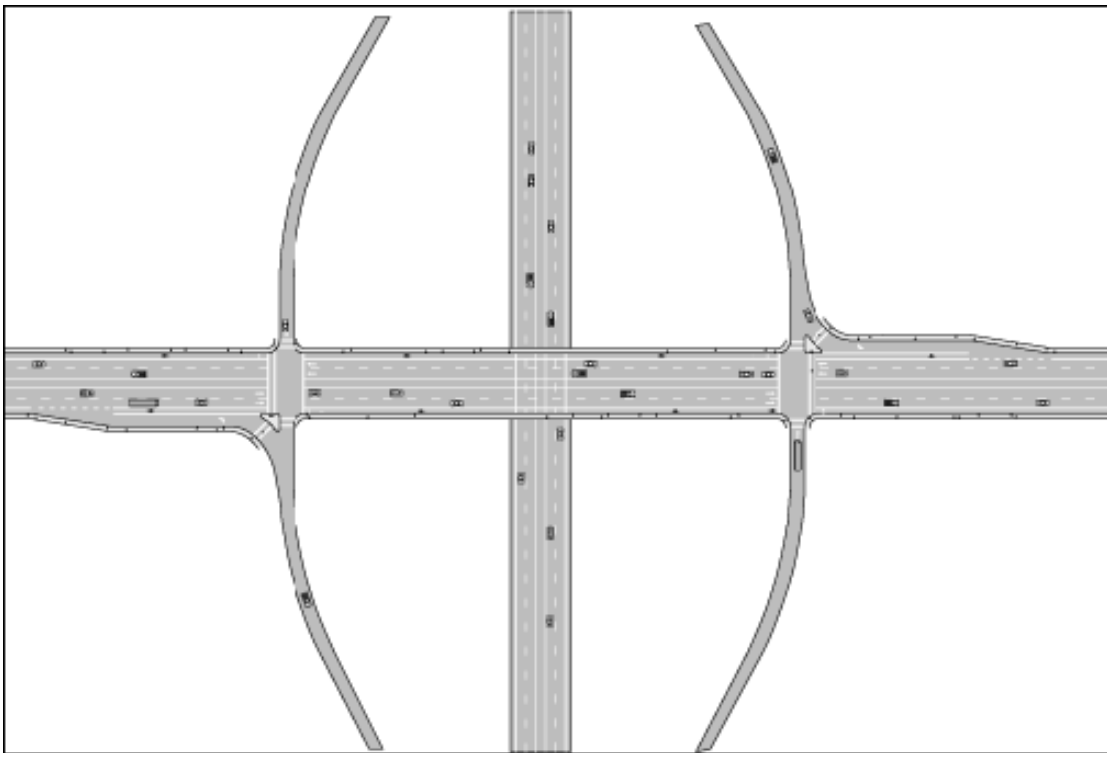


Figure 2: Bicycle Lane Crossing an Entrance Ramp

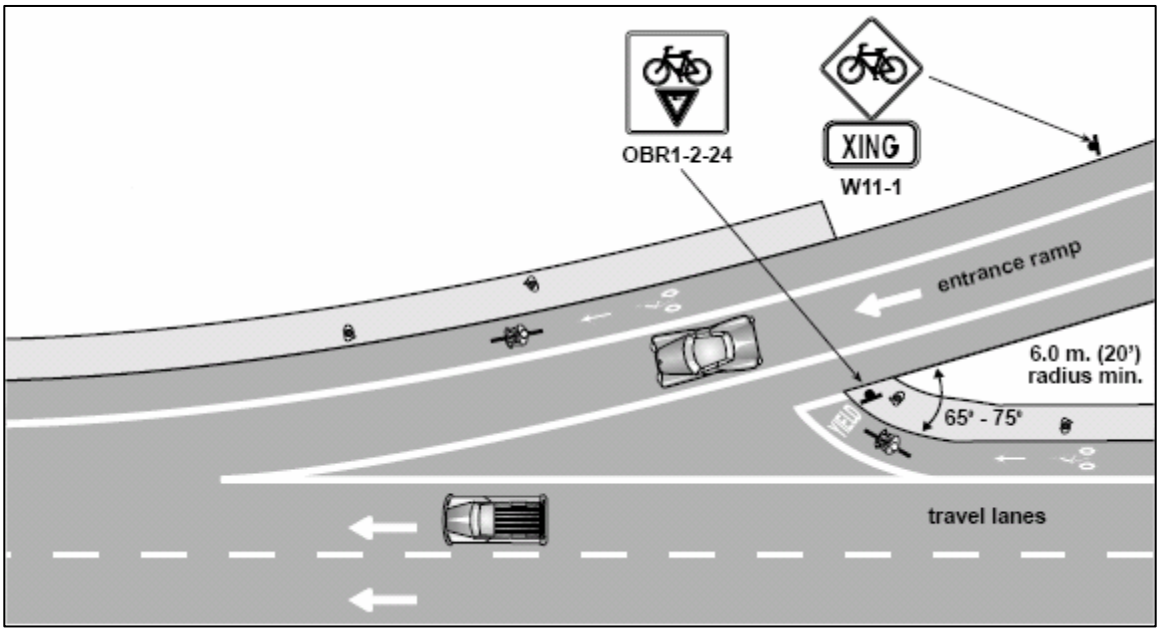
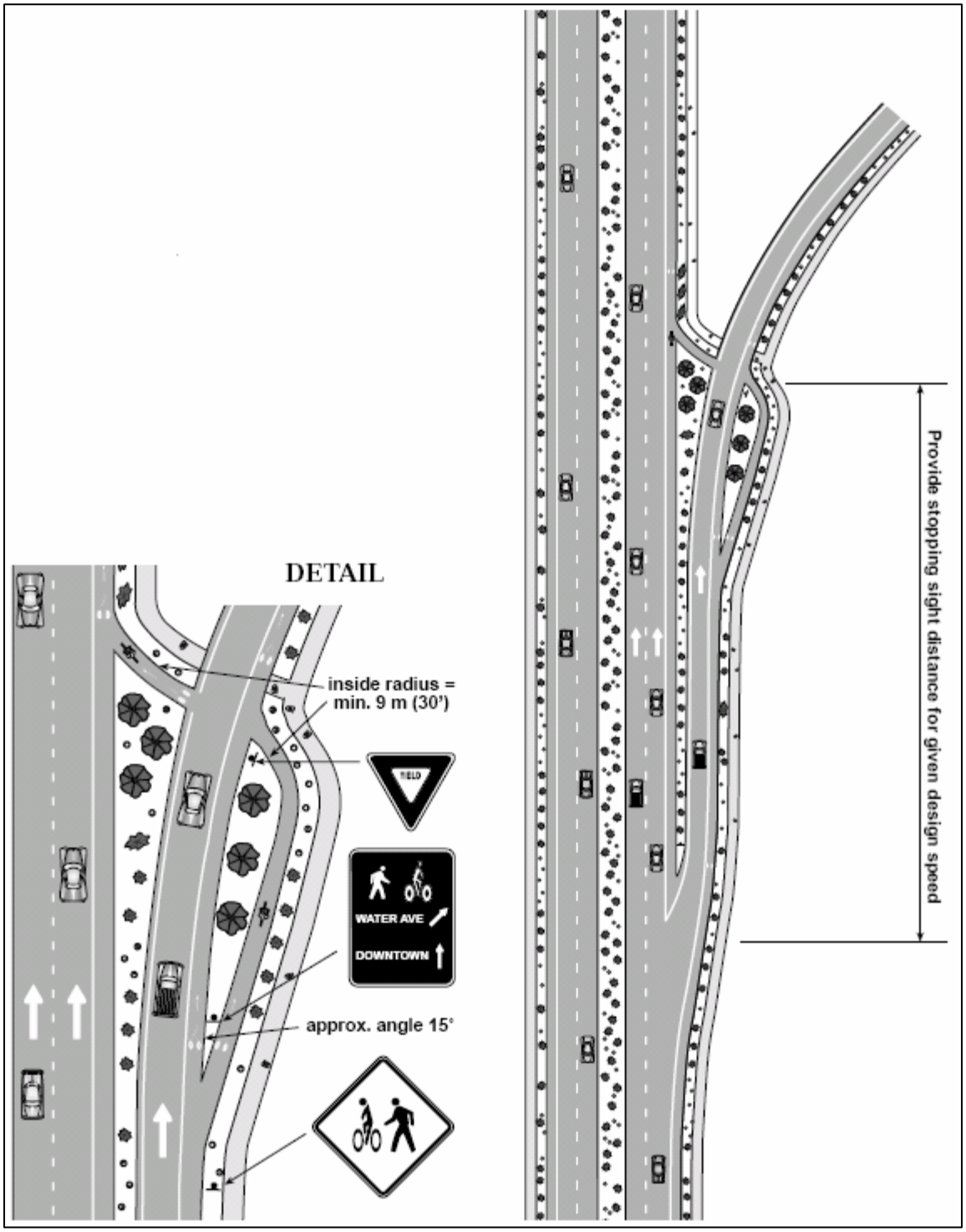


Figure 3: Bicycle Lanes across Exit or Entrance Ramps



California

The California Department of Transportation (Caltrans) has developed a set of guidelines for pedestrian and bicycle facilities in California. While this guidebook does not specifically address the issue of interchange pedestrian facilities, it does have some guidelines for intersections that could apply to interchanges, as well as several guidelines for bicycle facilities at intersections and interchanges.

Caltrans provides guidelines for the safe installation and use of marked crosswalks at uncontrolled intersections. **Figure 4** shows a table that helps determine appropriate pedestrian facilities for an intersection. Depending on the number of lanes, vehicle average daily traffic (ADT), and speed limit, the table will determine:

- If an intersection is a candidate site for marked crosswalks, denoted with a "C";
- If a crosswalk is added without other facility enhancements, denoted with a "P"; or
- If a marked crosswalk alone is not sufficient and other pedestrian facility enhancements are needed, denoted with an "N".

Caltrans provides guidance for bicycle facilities through interchanges as shown in **Figure 5**. As a bicycle lane approaches the first ramp of the interchange, the striping should be discontinued 100 feet prior to the ramp, and continued after the ramp. The shoulder width should not be decreased through the interchange. The striping should end at the next ramp and continue after it, as shown in the figure.

If the intersection of the ramps and the local roads meet at 90 degrees, the guide shows how bicycles should negotiate exclusive right turn lanes, based on American Association of State Highway and Transportation Officials (AASHTO) standards. **Figure 6** shows four examples of different right turn configurations. The situation where the parking area becomes a right-turn-only-lane is likely not applicable to interchanges; however, the other three right turn lane examples could exist at an interchange. If there is a right-turn-only lane that is added at an interchange, then there should be a break in the bicycle lane for cars to move to the right, and the bicycle lane should continue to the left of the right-turn-only lane. In the example where the right lane turns into a shared right turn and through lane, and an additional right-turn-only lane is added, then the bicycle lane should discontinue where the right-turn-only lane begins, and bicycles should share the shared right-through lane with cars. In the final example where the right travel lane turns into a right-turn-only lane, then the bicycle lane should shift to the left of the right-turn-only lane, and there should be a break in the striping for cars and bicycles to negotiate the shift.

Figure 4: Evaluation Table of Pedestrians Facilities at Uncontrolled Intersections

Roadway Type (Number of Travel Lanes and Median Type)	Vehicle ADT ≤ 9,000			Vehicle ADT >9000 to 12,000			Vehicle ADT >12,000 - 15,000			Vehicle ADT > 15,000		
	Speed Limit**											
	≤ 30 mi/h	35 mi/h	40 mi/h	≤ 30 mi/h	35 mi/h	40 mi/h	≤ 30 mi/h	35 mi/h	40 mi/h	≤ 30 mi/h	35 mi/h	40 mi/h
2 Lanes	C	C	P	C	C	P	C	C	N	C	P	N
3 Lanes	C	C	P	C	P	P	P	P	N	P	N	N
Multi-Lane (4 or More Lanes) With Raised Median***	C	C	P	C	P	N	P	P	N	N	N	N
Multi-Lane (4 or More Lanes) Without Raised Median	C	P	N	P	P	N	N	N	N	N	N	N

* These guidelines include intersection and midblock locations with no traffic signals or stop signs on the approach to the crossing. They do not apply to school crossings. A two-way center turn lane is not considered a median. Crosswalks should not be installed at locations that could present an increased safety risk to pedestrians, such as where there is poor sight distance, complex or confusing designs, a substantial volume of heavy trucks, or other dangers, without first providing adequate design features and/or traffic control devices. Adding crosswalks alone **will** not make crossings safer, nor will they necessarily result in more vehicles stopping for pedestrians. Whether or not marked crosswalks are installed, it is important to consider other pedestrian facility enhancements (e.g., raised median, traffic signal, roadway narrowing, enhanced overhead lighting, traffic-calming measures, curb extensions), as needed, to improve the safety of the crossing. **These are general recommendations; good engineering judgment should be used in individual cases for deciding where to install crosswalks.**

** Where the speed limit exceeds 40 mi/h (64.4 km/h) marked crosswalks alone should not be used at unsignalized locations.

C = **Candidate sites for marked crosswalks.** Marked crosswalks must be installed carefully and selectively. Before installing new marked crosswalks, an engineering study is needed to determine whether the location is suitable for a marked crosswalk. For an engineering study, a site review may be sufficient at some locations, while a more in-depth study of pedestrian volume, vehicle speed, sight distance, vehicle mix, etc. may be needed at other sites. It is recommended that a minimum of 20 pedestrian crossings per peak hour (or 15 or more elderly and/or child pedestrians) exist at a location before placing a high priority on the installation of a marked crosswalk alone.

P = **Possible increase in pedestrian crash risk may occur if crosswalks are added without other pedestrian facility enhancements.** These locations should be closely monitored and enhanced with other pedestrian crossing improvements, if necessary, before adding a marked crosswalk.

N = **Marked crosswalks alone are insufficient, since pedestrian crash risk may be increased due to providing marked crosswalks alone. Consider using other treatments, such as traffic-calming treatments, traffic signals with pedestrian signals where warranted, or other substantial crossing improvement to improve crossing safety for pedestrians.**

*** The raised median or crossing island must be at least 4 ft (1.2 m) wide and 6 ft (1.8 m) long to adequately serve as a refuge area for pedestrians in accordance with MUTCD and American Association of State Highway and Transportation Officials (AASHTO) guidelines.

Figure 5: How to Stripe a Bicycle Lane through an Interchange

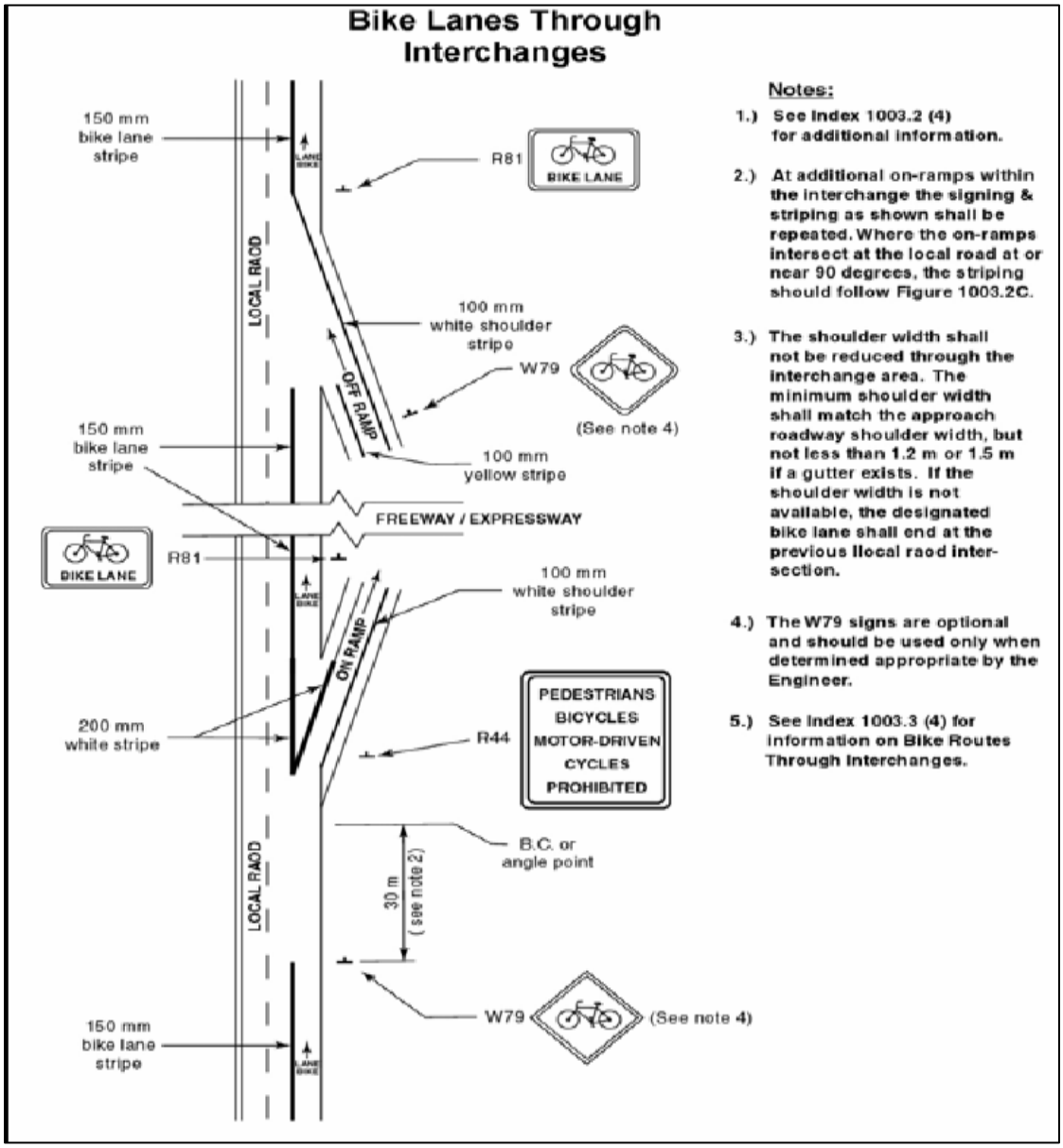
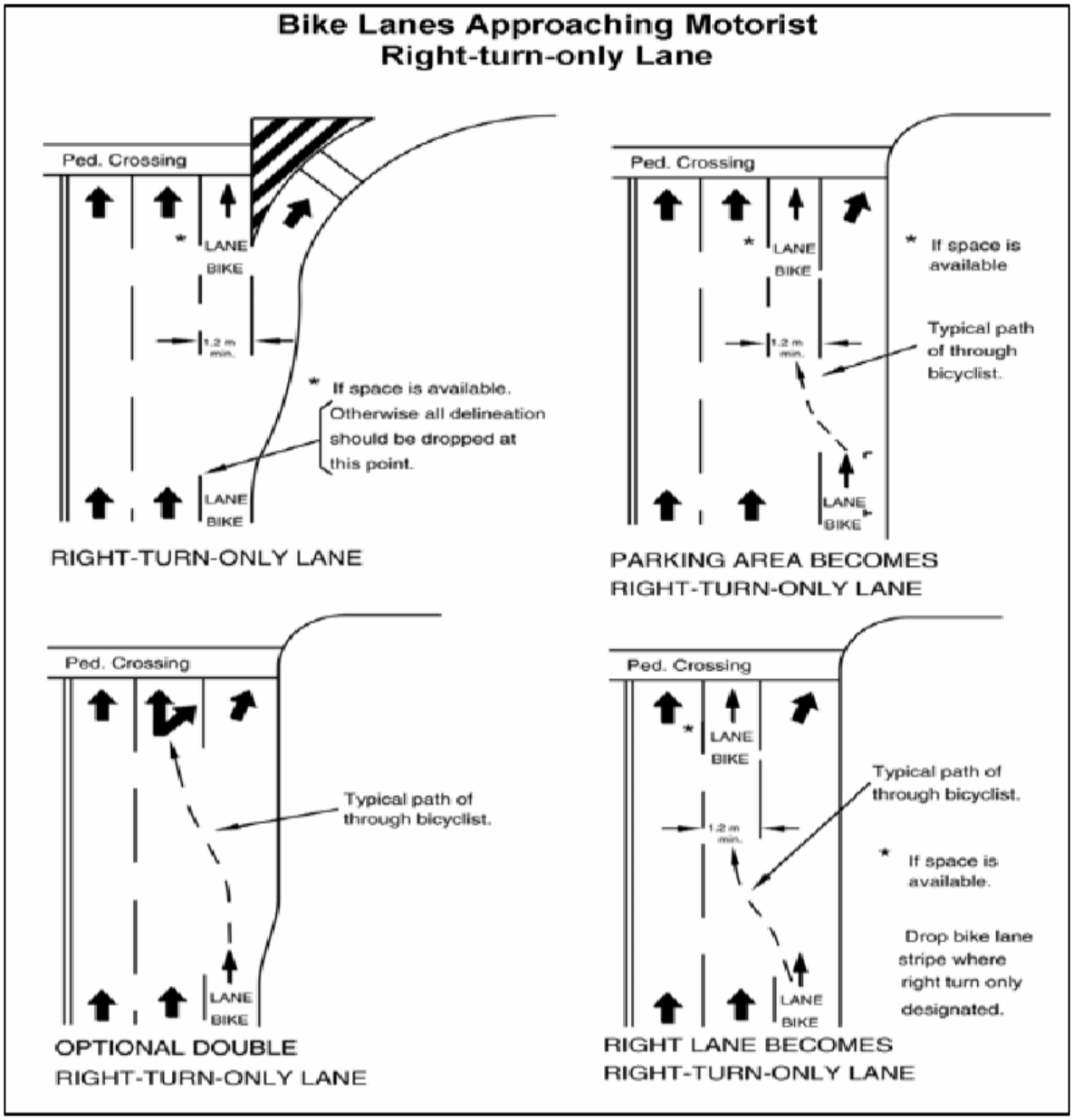
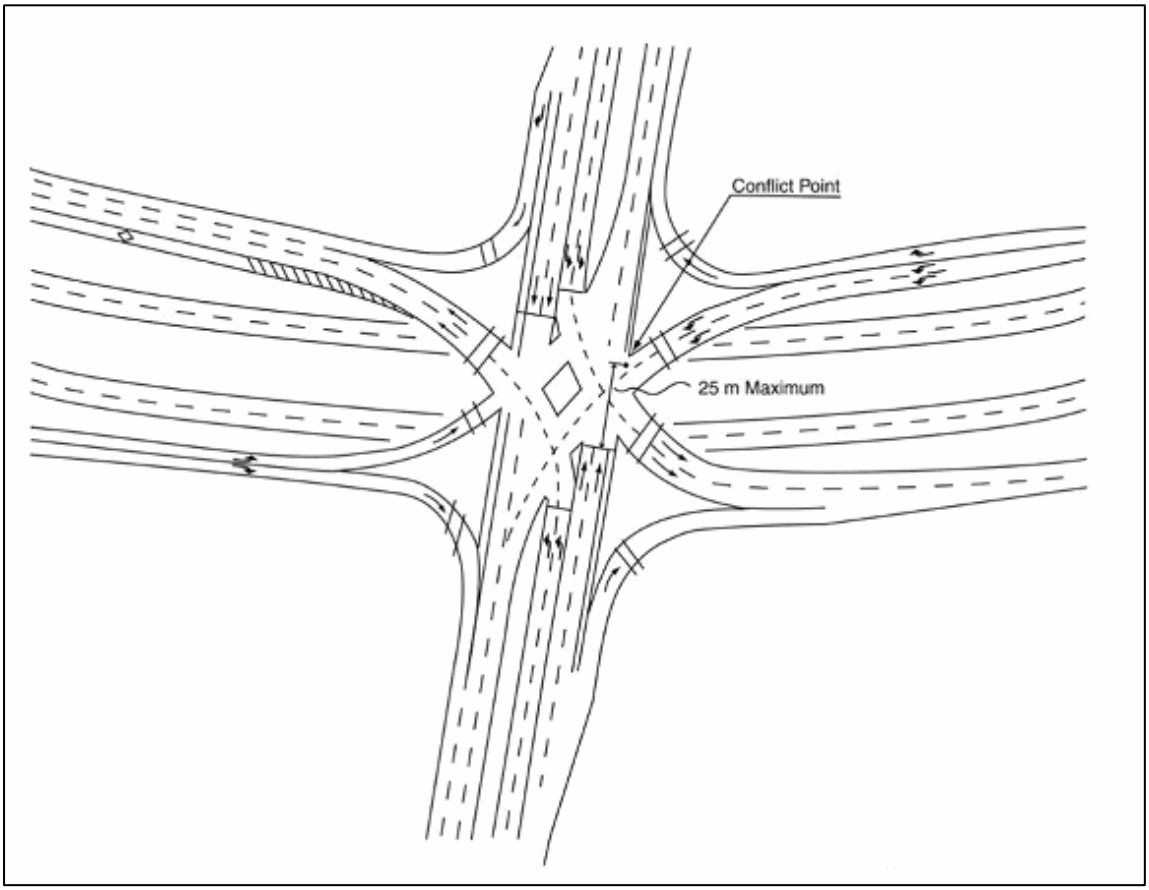


Figure 6: Accommodating Bicyclists at Right Turn Lanes



Caltrans also has a memorandum regarding single point interchange (SPI) planning, design and operation guidelines that discusses how to accommodate pedestrians and bicyclists at these interchanges. These guidelines recommend that a compact SPI be used where pedestrian and bicycle traffic occurs. A compact SPI is defined by this memo as, "An SPI with 25 m maximum distance from the stop bar to the conflict point….the conflict point is defined as the middle of the far lane for turning vehicles that bicyclists must cross under a single phase" (Caltrans Memo: Single Point Interchange Planning, Design, and Operations Guidelines). Implementing a compact SPI reduces crossing distances and merge areas, making the SPI easier and safer for bicyclists and pedestrians to cross. **Figure 7** shows a drawing of a compact SPI.

Figure 7: Compact Single Point Interchange Recommended for Use Where Bicycle and Pedestrian Traffic Occurs



Florida

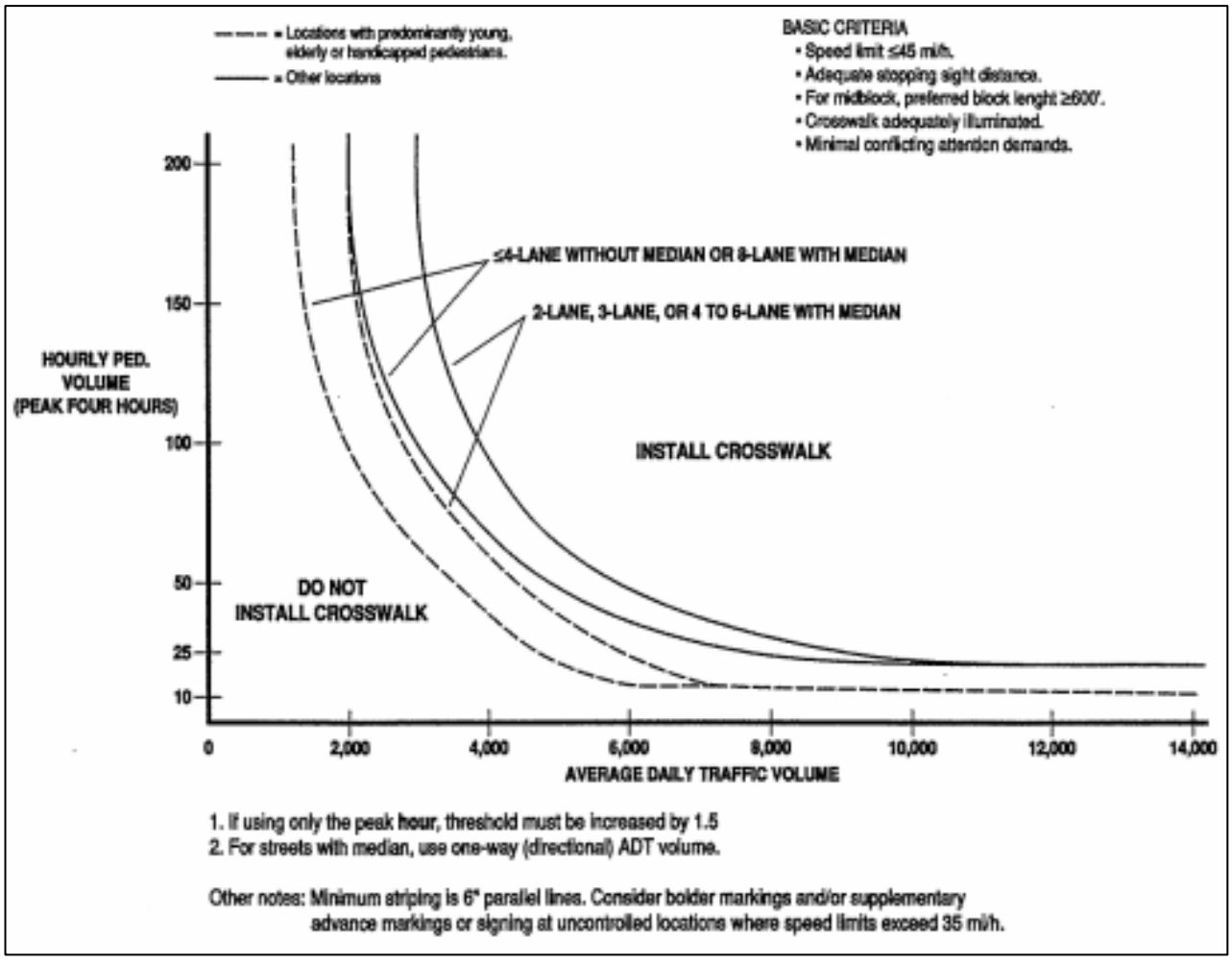
The Florida Department of Transportation has the Florida Bicycle Facilities Planning and Design Handbook as well as the Florida Pedestrian Facilities Planning and Design Handbook. The bicycle handbook has a section regarding bicycle lane treatments at intersections as well as guidelines for limited access crossings. The pedestrian handbook has a chapter on the placement and design of crosswalks, curb ramps and

refuge islands, as well as grade separated crossings. Some of these guidelines can be applied to interchanges.

Florida's documents offer five guidelines for bicyclists at interchanges or other limited access crossings. The first is that bicycle lanes should be changed to paths on wide roadways. The second is that acceleration lanes should be avoided. Thirdly, in rural areas with low volumes of both cars and bicyclists, there is no special treatment needed. The fourth guideline recommends a design for high volume crossings similar to **Figure 2**. Finally, bicycle crossings should be placed at a location where drivers are not searching for other vehicle traffic. Crossing should generally be upstream of any merge areas.

While the pedestrian handbook does not directly address pedestrian facilities at interchanges, the chapter discussing crosswalks, curb ramps and refuge islands does provide guidance for when some of these treatments should be used. Similar to California, Florida provides guidance on when crosswalks are appropriate to install at unsignalized locations. **Figure 8** shows the graph used to determine if crosswalk installation is appropriate. Unlike California, this graph does not determine if additional pedestrian facilities would be needed; however, it could be used at an unsignalized interchange to determine whether a crosswalk is warranted.

Figure 8: Florida's Guidelines for Appropriate use of Crosswalks



Another chapter of this guide discusses grade separated crossings, which may be warranted at some interchanges. This guide helps determine whether or not a grade separated crossing is needed. Interchanges where this may be applicable will have high volumes of both vehicles and pedestrians.

- Pedestrian volumes should exceed 300 people in the four highest continuous hours if speeds are greater than 40 mph in an urban area.
- Otherwise the threshold is 100 people in the four highest continuous hours.
- During the same period vehicular volume should exceed 10,000 and have an ADT of 35,000 provided speeds are greater than 40 mph and it is an urban area.
- If this is not the case, vehicular volume during the four continuous hours should be 7,500 and the ADT should be 25,000.

Design and other guidance for grade separated crossings are included in the chapter.

Vermont

Vermont has a Pedestrian and Bicycle Facility Planning and Design Manual that addresses bicycle and pedestrian facilities at interchanges. The manual recommends specific bicycle lane designs for on and off ramps, as shown in **Figure 9** and **Figure 10**.

From these figures, it is recommended that entrance ramps either continue the bicycle lane through the ramp and replace solid striping with dashed striping to indicate an area where bicyclists need to watch for motorists, or to continue the bicycle lane off the road and provide a right angle crossing at the ramp where there is better visibility and a shorter distance to cross. At an exit ramp, it is recommended to provide a bicycle lane crossing at a right angle with the ramp before vehicles have to begin merging onto the local road. This also provides good visibility of the bicyclists and a short distance to cross. Other bicycle considerations include coloring the bicycle lane pavement to alert drivers and bicyclists to the potential conflict.

With regards to pedestrians, Vermont offers guidance on the use of slip lanes. A slip lane can be an alternative to a free right turning movement, and can be designed to be pedestrian friendly. **Figure 11** shows a slip lane that would make pedestrian crossing of an interchange safer. One important element of the slip lane is a pedestrian refuge island between the right turn and the through and / or left turn movements. This allows pedestrians to cross the free right turn movement when there is an acceptable gap, without worrying about their ability to cross the remainder of the interchange. This also is advantageous to vehicular traffic because the crossing distance is shortened and therefore the pedestrian crossing time will not impact the signal timing as greatly.

Another important element is the placement of the crosswalk to the refuge island. This should be placed in the turn so that pedestrians cross where drivers are looking ahead, and not back to the left for a gap in traffic to merge. Finally, the right turn lane should be a compound curve with a larger radius entering the curve and a sharper radius leaving it. This will still allow for buses and trucks, but will also slow traffic providing a safer crossing for pedestrians.

Figure 9: Vermont DOT's Design Guidance for Bicycle Lanes through On-Ramps

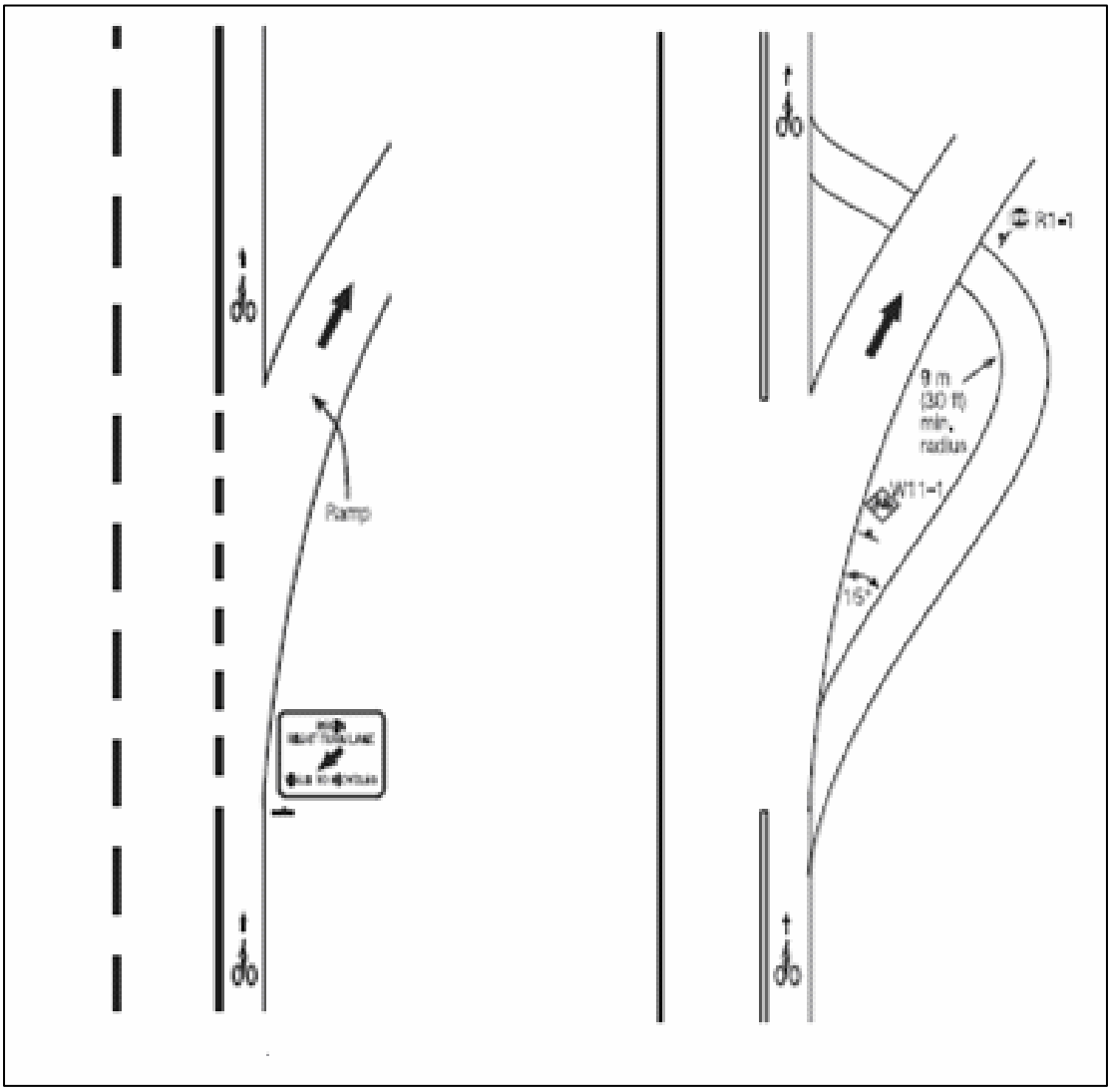


Figure 10: Vermont DOT's Design Guidance for Bicycle Lanes through Off-Ramps

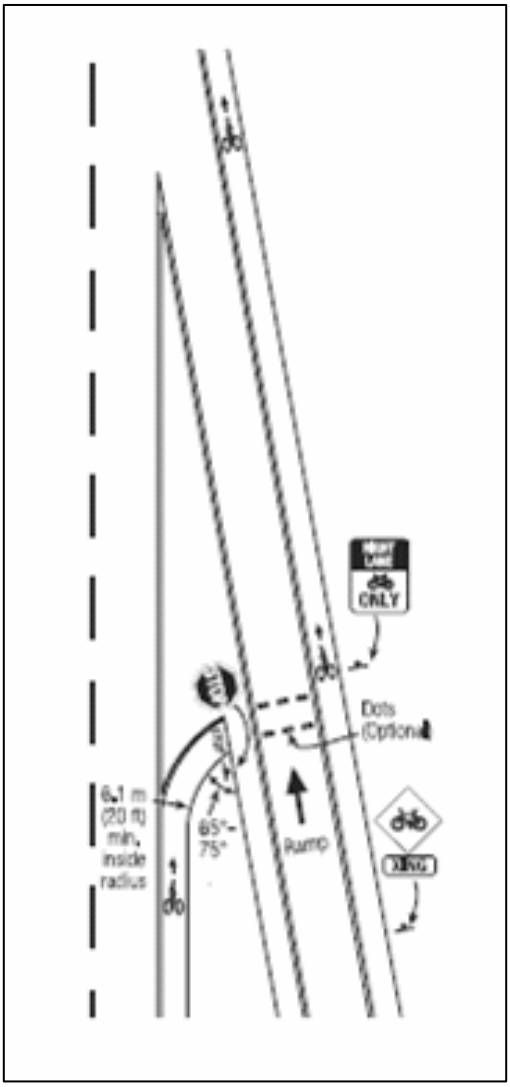


Figure 11: An Appropriately Designed Slip Lane for Safe Pedestrian Crossing

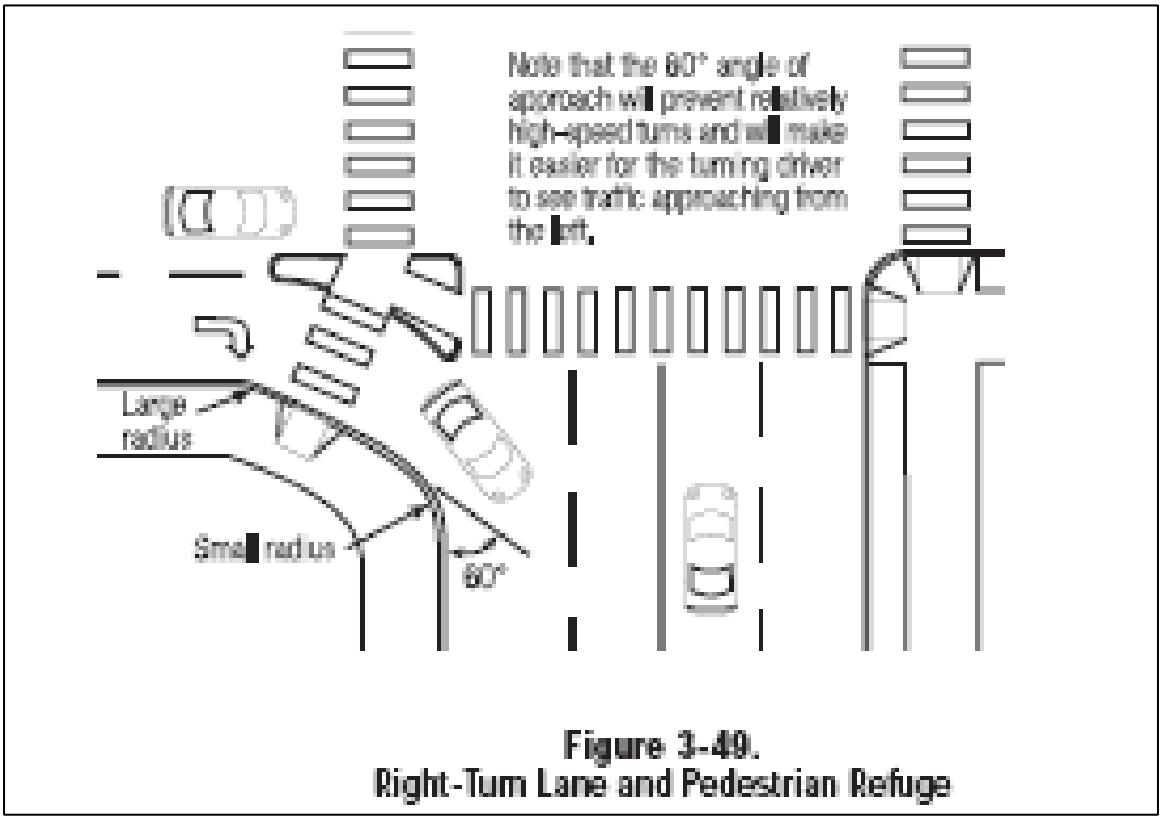


Figure 3-49.
Right-Turn Lane and Pedestrian Refuge

Illinois

A chapter of the Illinois DOT's Bureau of Design and Environmental Manual discusses bicycle and pedestrian accommodations. While it does not provide any guidelines, the manual does provide a figure to guide the design of bicycle facilities through interchanges as shown in **Figure 12**. The design uses many of the guidelines from the other states researched, such as placing bicycle crossings at right angles to the ramps to improve visibility and shorten crossing distance. The bicycle lanes are carried throughout the interchange, and the markings make it simple for bicyclists to maneuver through the interchange.

The manual also provides guidance on continuing bicycle facilities over a narrow bridge or overpass. **Figure 13** shows that through a narrowing of the travel lanes across the bridge, both motorists and cyclist need to use the same "narrowed" space in the travel way. Through pavement markings and signs, this new "narrowed" condition can be properly pointed out. Because local roads and freeways are often grade separated at interchanges, this is a likely scenario for a bicyclist to encounter. **Appendix G** contains several pages from this manual that provide specific design guidance on bicycle lanes across or underneath a bridge structure. This information can also be found on the following website: http://www.dot.il.gov/desenv/BDE%20Manual/BDE/pdf/chap17.pdf, beginning on page 17-2(10). Please note that this is not Kentucky State policy but is one example of another state's approach to bicycle design through an interchange.

Figure 12: Illinois' Guidance on Accommodating Bicycle Lanes through Interchanges

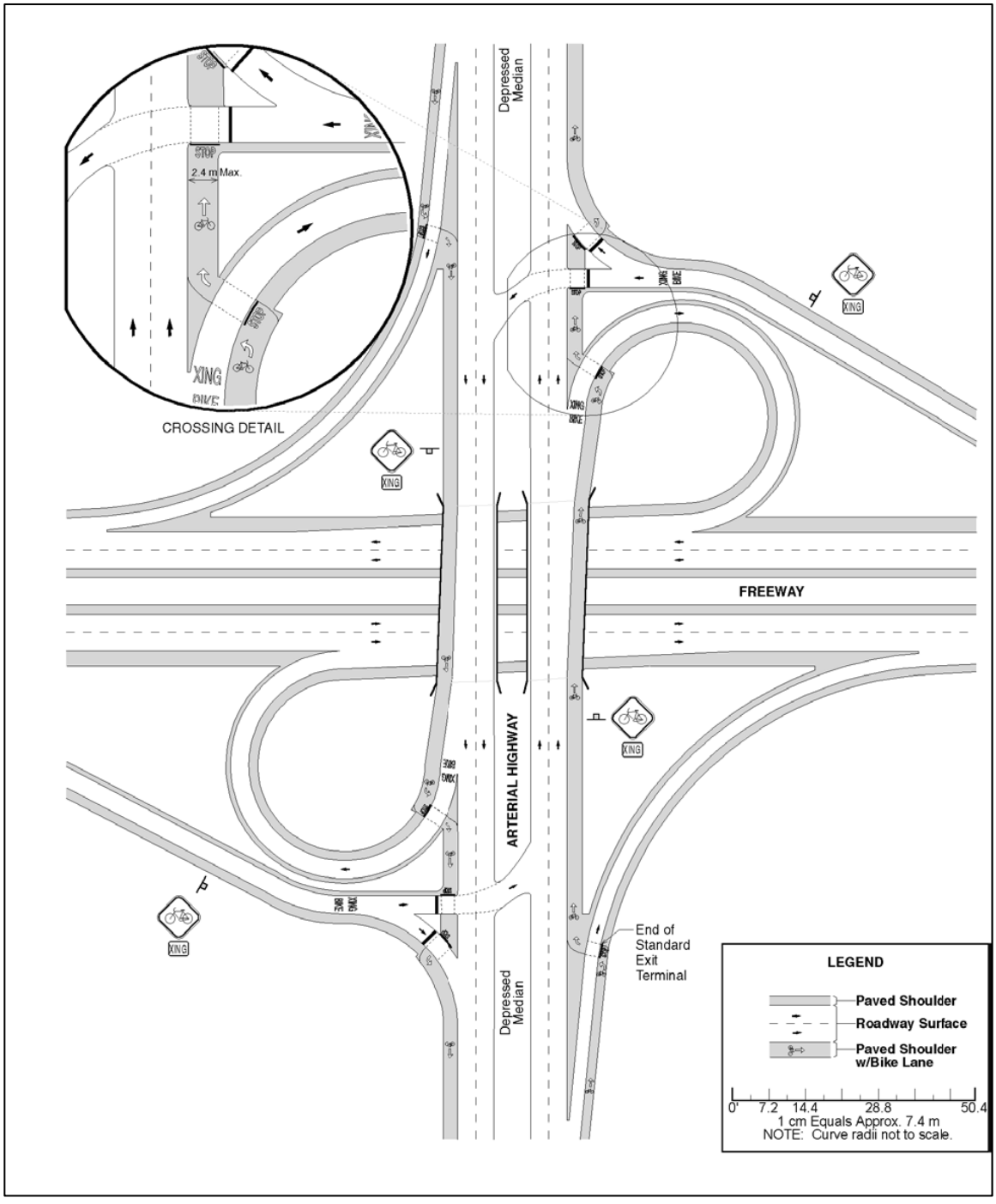
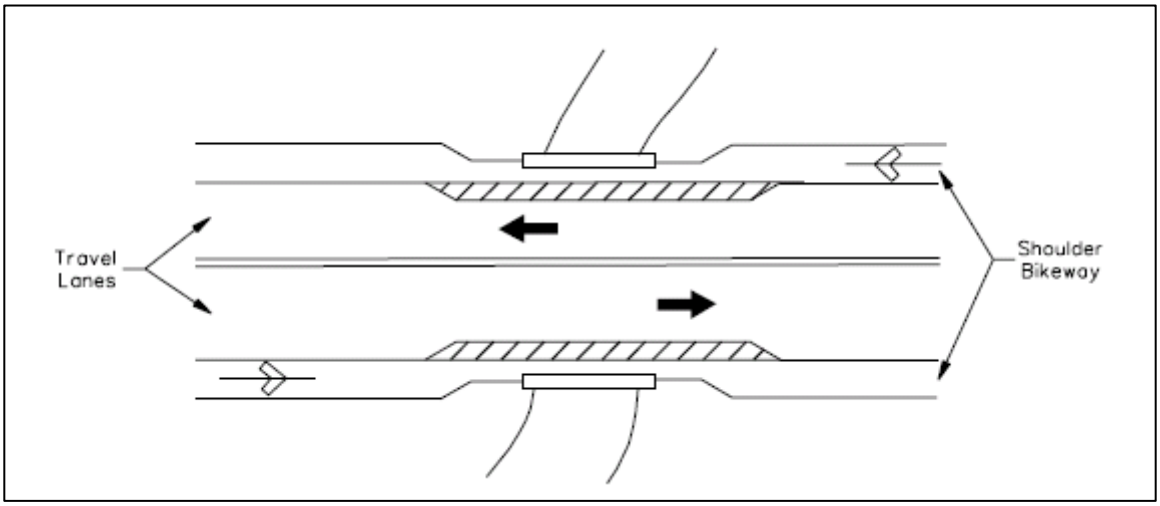


Figure 13: Illinois' Guidance on Accommodating Bicyclists over a Bridge or through a Narrow Road



Wisconsin

The Wisconsin DOT has a Wisconsin Bicycle Facility Design Handbook that provides details on bicycle facilities through interchanges as well as grade separated facilities. The handbook has guidelines similar to other states, such as recommendations to avoid free flow vehicle movements, design ramps to connect with local roads at right angles, use of compound curves to allow for buses and trucks, but also to slow down traffic, and provide crossings for pedestrians and bicyclists with good visibility where speeds are lower. The handbook also agrees that special bicycle facilities are not required in rural areas due to lower vehicle volumes and more experienced riders.

Virginia

The Virginia DOT has the Virginia Bicycle Facility Resource Guide, which has a small section discussing bicycles at interchanges. Guidelines similar to those already listed are given, such as limiting the area where conflicts can occur, clearly defining conflict areas with appropriate signage and striping, and eliminating uncontrolled ramp connections.

Arizona

Arizona's Statewide Bicycle and Pedestrian Plan does not offer specific guidance for interchanges; however, it does give guidance for bicycle facilities through intersections, which is applicable to interchanges. **Figure 6**, the different examples of right-turn-only lanes from AASHTO, also used in California, is cited as Arizona's policy for bicycle lanes through intersections.

Washington

Washington State DOT has a Pedestrian Facilities Guidebook that addresses interchange and expressway ramps. Again, short crossing distances at right angles to the ramps are suggested, as well as placing them either at the beginning or end of a ramp where visibility is good and vehicle speeds are low. Design considerations for interchanges where pedestrian traffic is likely include compact intersections with tight turning radii to help lower vehicle speeds, slowing or stopping vehicles entering and exiting, especially in free-flow movements (e.g., adding stop signs or signals), ramps intersecting local roads at right angles, well-designed slip-lanes as discussed in Vermont's pedestrian and bicycle design manual, proper signage, clearly marked and visible crosswalks, and possibly grade separation.

Georgia

Georgia has a Pedestrian and Streetscape Guide that discusses improving pedestrian facilities at intersections. Many of the same concepts of reduced turning radii, shorter crossing distances, good visibility, slip-lanes with refuge islands, ramp/local road intersections at right angles, and location of crosswalks along the ramps are presented in this guide. Other methods of increasing safety include flashing beacons to alert drivers when pedestrians are present, as well as in-pavement flashers and more extensive signage.

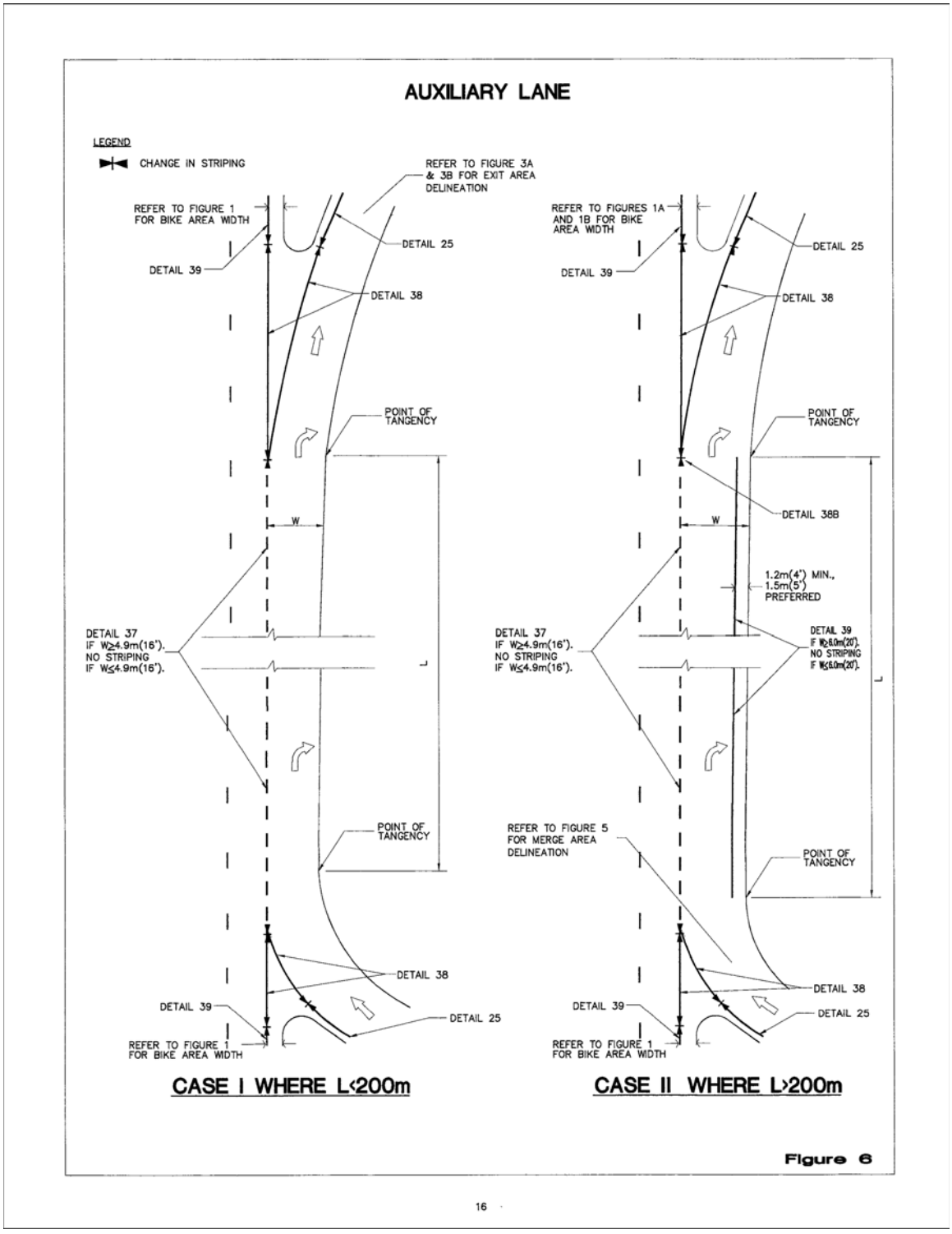
2.2 Cities and Metropolitan Planning Organizations

Santa Clara County, California

Santa Clara County, California has developed the County Expressway Bicycle Accommodations Guidelines, which contains a section regarding interchanges. Santa Clara uses the same striping for bicycle lanes through intersections as Caltrans (shown in **Figure 5**). Santa Clara recommends that if the exit lane is short, bicyclists should continue straight through the transition area; however, if the exit lane is longer, they should stay to the right until the end of the pocket, and then cross to the left. Santa Clara's guidelines leave some discretion to the engineer to determine the safest place for cyclists to cross traffic entering and exiting the freeway.

Sometimes auxiliary lanes are present through interchanges. This occurs when both the exit and entrance ramp to a freeway are cloverleafs, and the travel lane cars use to exit turns into the lane that is used to enter a freeway. Santa Clara has guidelines for this situation. If the auxiliary lane is short, bicyclists should continue in a straight line and ride to the left of the lane. If the auxiliary lane is long, bicyclists should cross over the exit lane, where crossing distance is short and they are visible to drivers, ride to the right of the lane, and cross back over the entrance lane to continue along the road. **Figure 14** shows a drawing of the two scenarios.

Figure 14: Bicycle Guidelines through Auxiliary Lanes



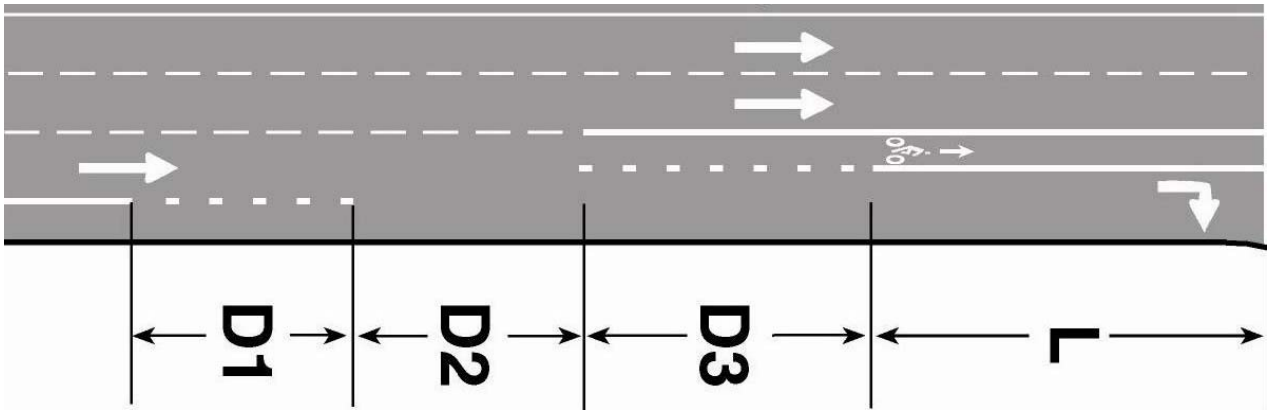
San Diego, California

Planning and Design for Pedestrians, Model Guidelines for the San Diego Region gives five methods of similar guidance for pedestrian crossings at interchanges as many of the state DOTs already discussed. The first is that free flow ramps should not be encouraged where high numbers of pedestrians are present. Also, ramps should intersect local roads at right angles. Thirdly, the use of stop signs, yield signs or crossing signals may be appropriate to provide crossing opportunities. Next, exit ramps should be designed for 20 mph speeds in urban areas. Finally, pedestrian refuge islands should be provided between the right and left turning movements so that pedestrians only need to worry about one movement at a time.

Costa Mesa, California

For the city of Costa Mesa, Caltrans has a report entitled, Safely Sharing the Streets: Cars, Trucks, and Bikes that has a chapter that deals with intersections and interchanges. This report suggests that interchanges be treated as normal intersections and accommodate bicyclists' through movements (with the exception of free-flow movements). Bicycle lanes should continue through the intersections, and bicycles should not have to share a travel lane with vehicles. In the event that a bicycle lane needs to shift to accommodate a right turn movement, then plenty of length should be given to allow bicyclists to find a safe point to cross traffic. **Figure 15** shows the distance that should be given for this movement.

Figure 15: Distance to Accommodate a Lateral Shift of a Bicycle Lane



Where:

D1 + D2 + D3 = Distance needed for through cyclist to move left and exiting motorist to move right, both of which depend on speed.
L = storage length (for intersections)

Several specific challenges for pedestrians and bicyclists are addressed in this report. The first is with regards to two-lane ramps. **Figures 16 – 18** show several safe ways to design two-lane ramps for bicyclists. **Figure 16** shows a two-lane ramp with one regular travel lane and one high occupancy vehicle (HOV) lane. The HOV lane does not begin until after the crosswalk crosses the ramp. In this situation the bicycle lane simply shifts to the left after the ramp, and sufficient length is given for them to find a safe point to cross traffic entering the ramp. **Figure 17** shows a diagonal on ramp that a crosswalk crosses at close to a 90 degree angle, followed by a separate HOV ramp for bicyclists and pedestrians to cross at a 90 degree angle. Through the diagonal interchange, the bicycle lane remains straight with dashed lines to indicate to motorists and cyclists to yield to one another. This configuration is safer because bicyclists and pedestrians are only required to cross one lane at a time. **Figure 18** shows a two-lane exit that begins as one lane, allows pedestrians to cross at a safe location, and then expands to two lanes after the crossing. Again the bicycle lane continues in a straight line across the ramp, and both bicyclists and pedestrians only have to cross one lane.

Figure 16: Two-Lane Ramp where HOV Lane is added after Crosswalk

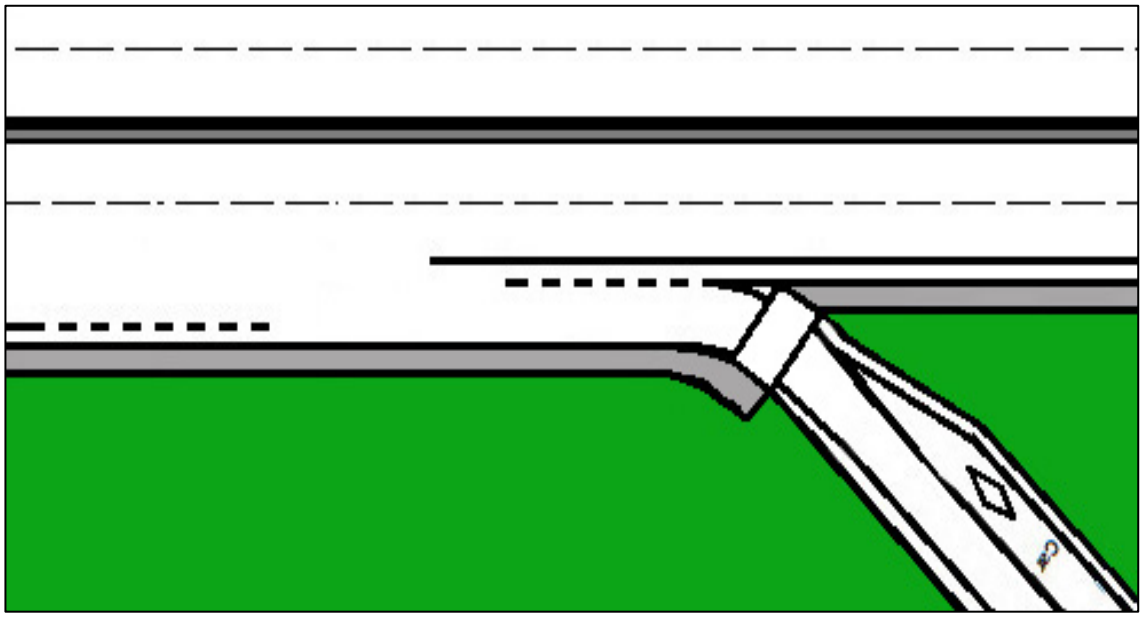


Figure 17: Two-Lane Ramp with Separate Entrance for Diagonal Ramp and HOV Lane

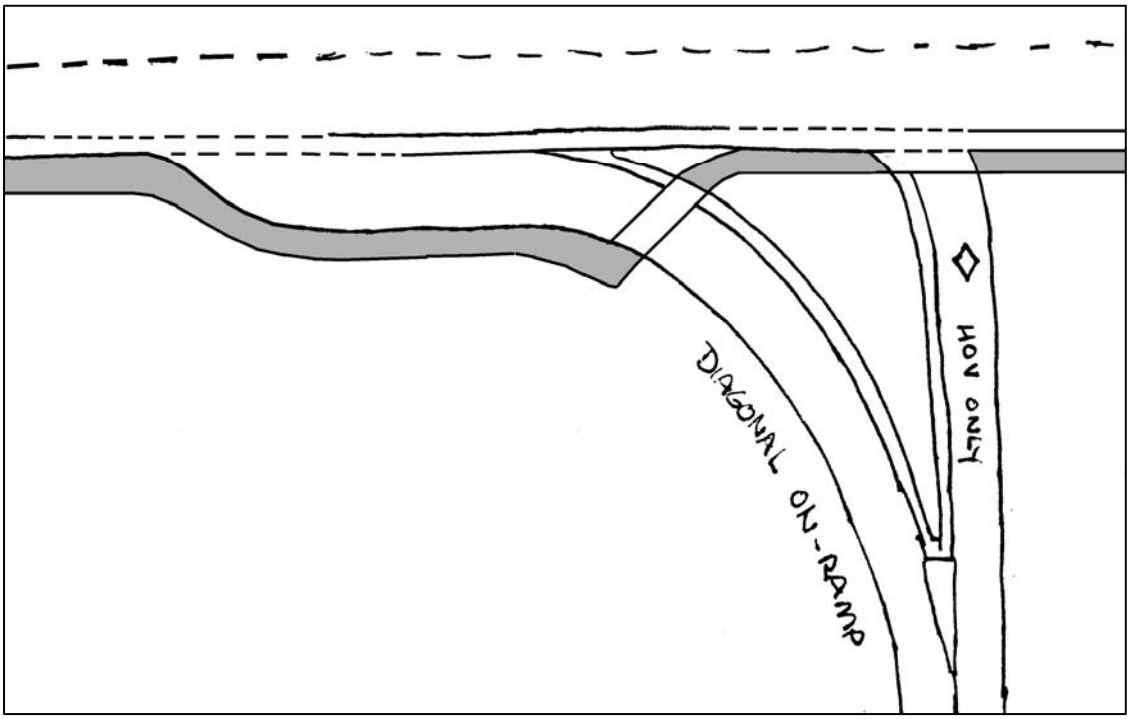
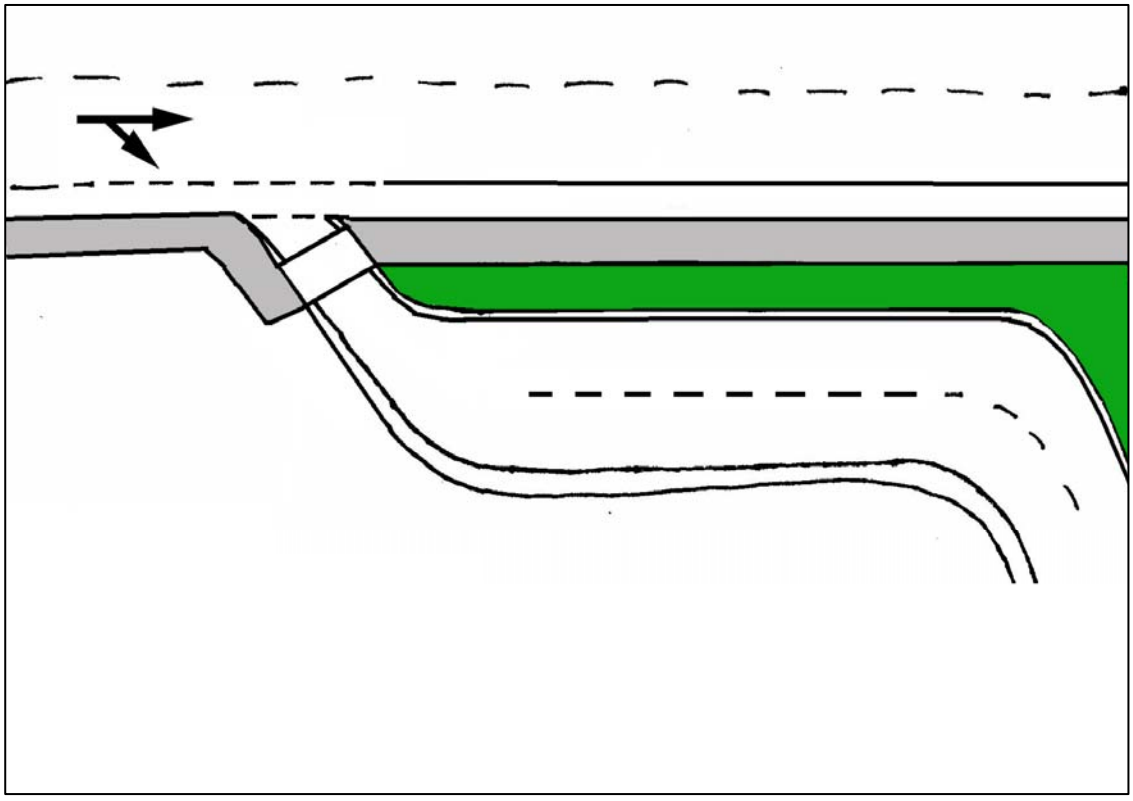


Figure 18: Ramp that Expands to Two Lanes after Crosswalk



Another situation that this report deals with is a single point urban interchange (SPUI). It suggests a narrow design with tight turning radii for the free flow movements. **Figure 19** gives an example. In this figure, bicycle lanes can be seen that continue through the interchange as well as crosswalks that intersect where crossing distance is short and visibility of pedestrians is good.

Figure 19: Example of a Narrow SPUI

Portland, Oregon

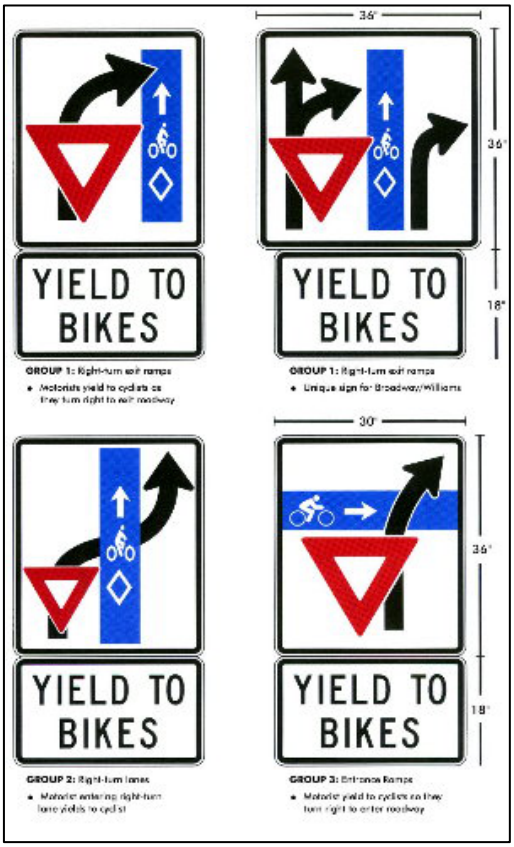
In its Bicycle Master Plan, the City of Portland cites the Oregon State DOT's bicycle and pedestrian plan as its guide for the design of bicycle and pedestrian facilities. Portland has incorporated these guidelines in their interchanges for bicyclists and pedestrians, and many other cities, such as Sacramento, below, cite specific examples in Portland where these policies have been carried out.

Sacramento, California

The Sacramento Transportation and Air Quality Collaborative has developed a Best Practices for Bicycle Master Planning and Design that looks at specific examples of ways bicycle facilities have been implemented in other cities. As mentioned above, many of their examples come from Portland and Oregon. Sacramento's guidelines for dealing with crossing entrance and exit ramps of freeways come from **Figures 2** and **3**

of the Oregon State DOT guidelines. This guide also shows signage which comes from a location in Portland, Oregon. Examples of signs used there are shown in **Figure 20**.

Figure 20: Signage Used to Inform Bicyclists and Drivers how to Yield to One Another



Another treatment recommended in this best practices guide is to use colored striping for bicycle lanes to draw driver's and bicyclist's attention to the conflict areas. As seen in **Figure 20** the bicycle lanes in the yield signs are drawn in blue, which makes it much easier to see where bicycle lanes are located.

Madison, Wisconsin

Madison has developed a Pedestrian Transportation Plan that gives general guidelines for street crossings as well as a recommendation on crossing free flow turn lanes, which generally exist in interchanges. In general, this plan advises that pedestrian delay should be minimized; otherwise, people may become impatient and cross at an unsafe time. If an interchange is signalized, the signals should accommodate low pedestrian delay.

Another guide that has been suggested in many other plans is to minimize pedestrian exposure, or time in the street. The most effective ways to do this are to minimize crossing distance by either changing where crosswalks are located (through the narrowest part of the lane or where there are fewer lanes to cross is ideal) or adding refuge islands. Regarding free-flow turn lanes, it is better for pedestrians if the traffic coming out of the free flow turn lane must merge into oncoming traffic, as this will require them to slow down. It is also helpful if the speed limit on the local road, onto which cars are turning, is lower. Providing pedestrian signals may not always be helpful, depending on how frequently gaps occur. If traffic volumes provide adequate gaps for pedestrian crossing, it is not advised to install a signal for several reasons:

- Pedestrians will push the button, however, if there is a gap before they are given permission to go, they will go anyway, and not use the signal.

- If there are low pedestrian volumes, then the signal for vehicles will nearly always be green, and motorists will not be used to stopping at that location, even if a pedestrian is present.

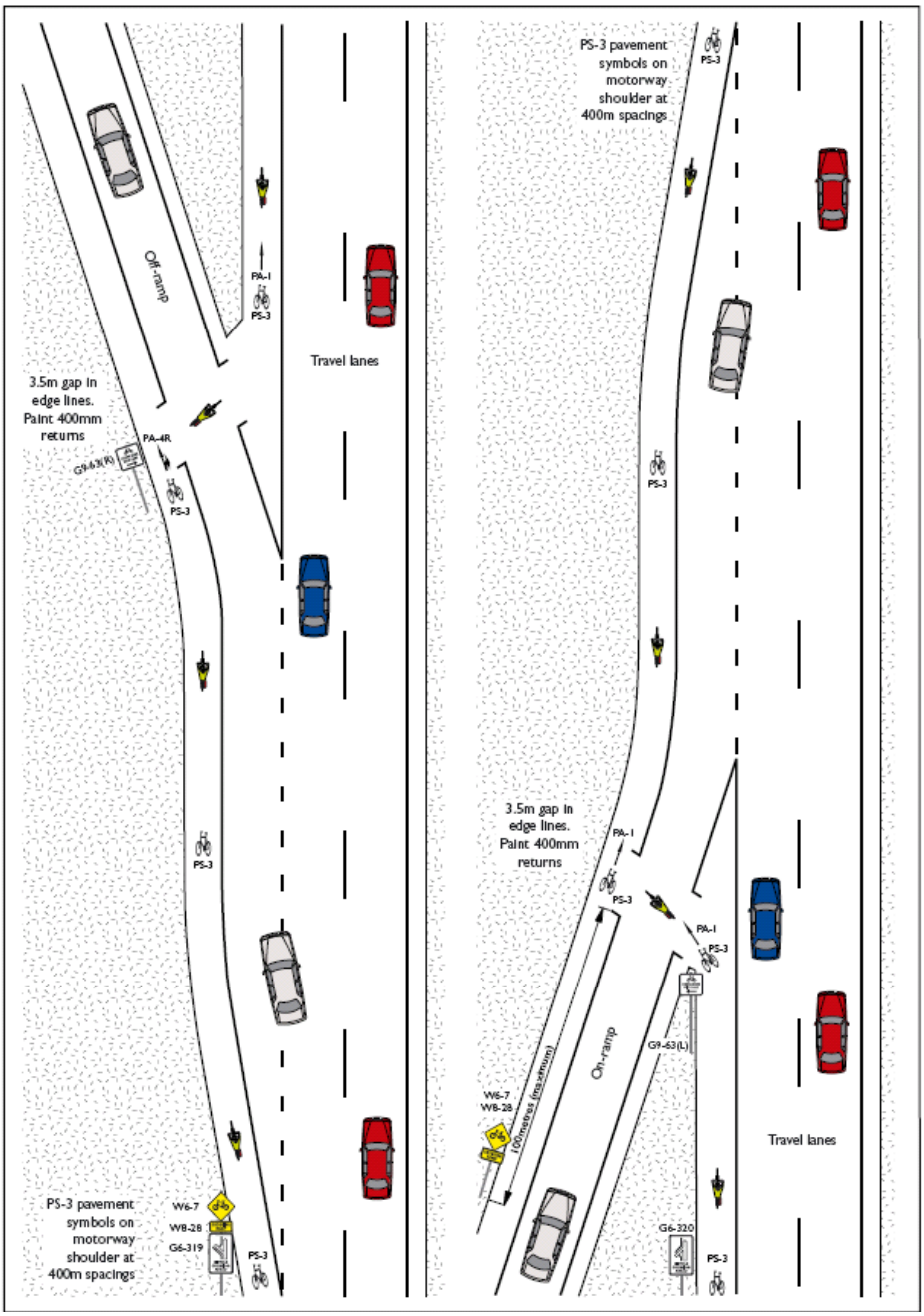
Mid-Ohio Regional Planning Commission

The Mid-Ohio Regional Planning Commission has a guide entitled Bicycle Facilities – Best Practices 2005: Breaking Barriers to Bicycling, which suggests many of the same treatments for bicycles at interchanges and intersections as other cities and states that have been studied. The treatment used by Caltrans shown in **Figure 5** is used as the best practice for bicycle treatments at interchanges. **Figure 6** is used in this guide to show how to guide bicycles through right turn lanes. The guide also suggests using refuge islands to allow bicycles to cross free flowing right turn lanes and have a safe place to wait to cross the remainder of traffic. This also gives bicyclists a shorter distance to cross.

New South Wales, Austrailia

The Roads and Traffic Authority of New South Wales, Australia provides the drawing in **Figure 21** to show how bicycle lanes should be taken through interchanges. The same concepts are used here as in other cities' guides. Bicyclists cross ramps in locations where crossing distances are short and visibility to motorists is good.

Figure 21: Bicycle Treatment through an Interchange



2.3 Other Agencies

Federal Highway Administration

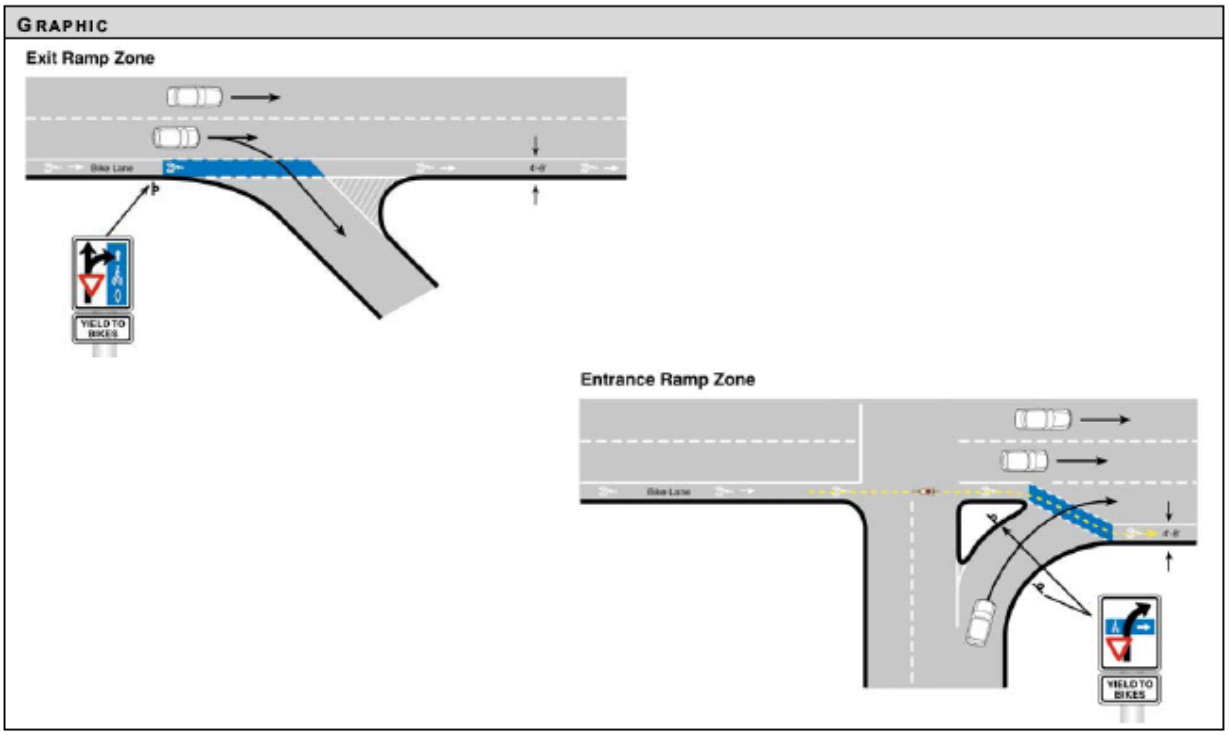
The Federal Highway Administration (FHWA) has a course on bicycle and pedestrian transportation with a section on bicycle lanes through expressway interchanges. Again, suggestions include right angle intersections, minimizing crossing distances, enhancing

visibility, signalization to stop traffic, and in extreme cases, grade separated crossings. **Figures 2** and **3** from the Oregon DOT are shown in this guide as the preferred method of designing bicycle lanes through interchanges.

Institute of Transportation Engineers

The Institute of Transportation Engineers has published Innovative Bicycle Treatments, which shows several treatments that can be used through intersections and interchanges. Bicycle lanes similar to those shown in **Figure 6** are recommended for right turn lanes. Also, signage similar to that shown in **Figure 20** is suggested. Colored bike lanes, as those shown below in **Figure 22** can also be used through interchanges to alert drivers and bicyclists to potential conflict.

Figure 22: Colored Bicycle Lanes through Interchanges



Transportation Research Board

A Transportation Research Board publication entitled Improving Pedestrian Safety at Unsignalized Crossings provides guidance on pedestrian crossings at complex intersections, (multi-lane, high speed, high volume) which have some of the same characteristics as interchanges. Providing median refuge islands, advance yield lines, pedestrian activated flashing beacons, proper signage and signals are some of the treatments suggested at such interchanges.

AUSTROADS

AUSTROADS, an Australian transportation agency has written a report AP-11.14/99: Guide to Traffic Engineering Practice Part 14: Bicycles, which contains a section regarding bicycle treatments at interchanges. This section is part of a larger section that discusses bicycle facilities on freeways. Therefore, the approach taken is that of accommodating bicyclists who are riding along the freeways and must navigate through interchanges. Some of the concepts still apply to bicyclists on local road navigating through interchanges. **Figures 23** and **24** show first, minimal treatments for bicycle crossings at freeway ramps, and second, channelization for ramp crossings. The biggest difference between the two is that the second treatment provides channelization behind the concrete ramp nose. Many of the same concepts are used as in the United States, such as right angle crossings where crossing distance is short.

Figure 23: Minimal Bicycle Treatment at Freeway Ramps

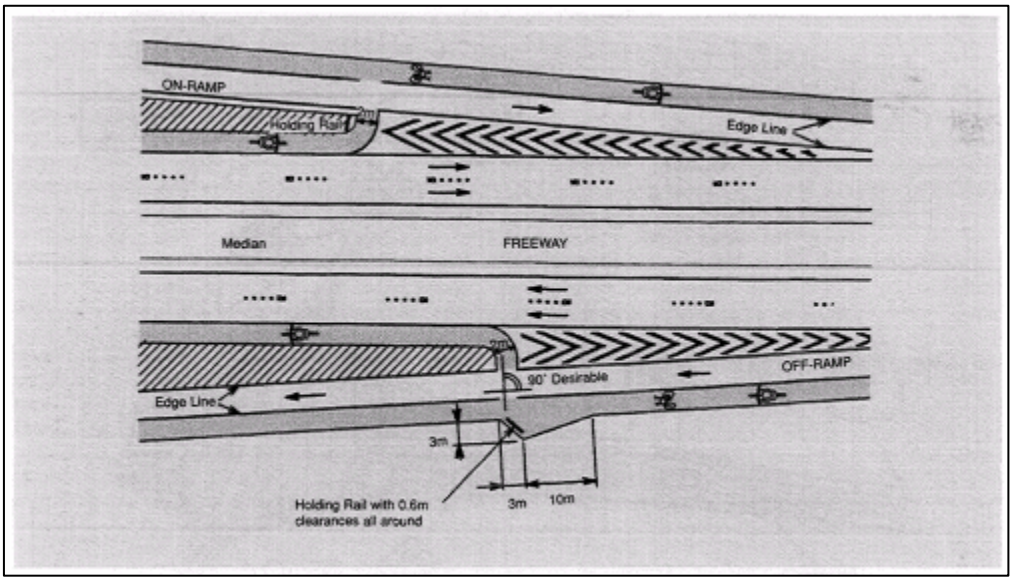
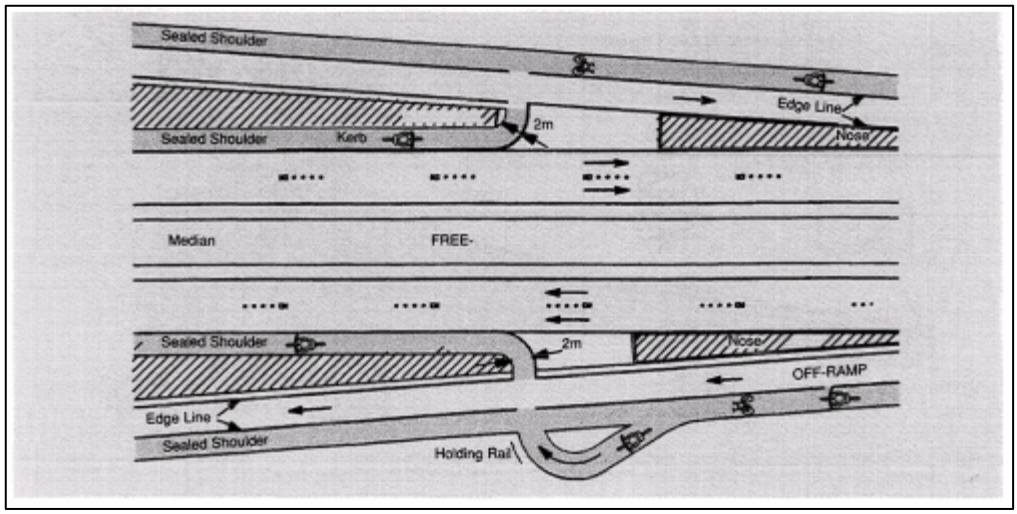


Figure 24: Channelization for Bicycle Crossings at Freeway Ramps



Danish Road Directorate

The Danish Road Directorate has written a *Collection of Cycle Concepts* which includes bicycle crossing guidelines that can be applied to interchanges. The first is to move stop lines for motorists back 16 feet from pedestrian and bicycle stop lines so they are more visible to drivers. Another suggestion is to move bicycle stop lines and signals in front of vehicle stop lines, again to increase visibility. The final recommendation is to channel bicyclists into separate right turn and through lanes at intersections. This may not be as applicable at interchanges, because bicycles will typically only be moving through; however, channeling bicyclists through to the left of right turning vehicles could improve safety where vehicles are entering freeway ramps.

2.4 Retrofit Example

An example of how some of the treatments described previously have been implemented as a retrofit to an existing interchange occurs in California at the Taylor Street and Highway 87 interchange. This is a SPUI that was retrofitted with bicycle lanes. **Figure 25** shows the SPUI as it is under construction. As it was originally built, there were no bicycle lanes. Pedestrian facilities such as a refuge island, crosswalks at 90 degree angles to the entrance and exit ramps, and sidewalks were included in the original design.

Figure 25: Original Construction of a SPUI with No Bicycle Lanes or Facilities

Several years after construction, bike lanes were retrofitted to the interchange. **Figures 26, 27,** and **28** show the newly added bicycle facilities.

Figure 26: Bicycle Lane to the Left of Right Turning Entrance Ramp

In **Figure 26,** the bike lane has been shifted to the left of free flowing right turn traffic, therefore reducing conflicts at that point. **Figure 27** shows the shift of the lane. In **Figure 27,** the bike line is on the right side of the road next to the pedestrian refuge island. A distance is given where no bike lane is striped to allow cars to move into the right lane, and bikes to the left. Midway through the right turn lane, the bike lane is picked back up to the left of the turning lane, and continues though the interchange.

Figure 27: Bicycle Lane Carried Through Interchange

Figure 28 shows the bike lane on the other side of the interchange as it has been carried through the SPUI. In this example the bike lanes are clearly striped and carried through the interchange. While the bike lane does end for a short distance, cyclists can see where it picks up again, therefore they know how to negotiate through the SPUI and can identify space that is specifically for them, and space where yielding needs to take place. This improves their safety through the interchange and helps alleviate confusion.

Figure 28: Bicycle Lane Through Interchange, Crossing Ramp on One Side

2.5 Conclusions

From the literature, it is clear that there is not a “one source book” or guidance manual for both bicyclists and pedestrians. Rather, various guidelines exist for one mode or the other and there is some similarity in the nature of the guidance, but no clear standard. It seems that California, Oregon, and Florida do the most to accommodate bicyclists and pedestrians. In fact, many of the states, MPOs and other cities examined simply cited reports from one another, or from these three leading states, as examples of best practices. Therefore, there was much overlap in guidance. Guidelines were more general, and there was little detail for higher speed, higher volume intersections.

From the literature that has been reviewed, there are some common ideas. First, many reports discuss typical intersections, largely with both roadways being arterials. Few give guidance on higher speed or higher volume interchanges, especially ramps. Most of the guidance is based on the assumption that it is best to get through bicyclists and pedestrians moving on the same cycle as through traffic. Common guidance includes trying to move bicyclists and pedestrians through the intersection in one movement, reducing speeds and potential conflict points, changing the approach or departure

angles to improve visibility of bicyclists and pedestrians, and using refuge areas for long distances.

Based on the literature, guidance for accommodating bicyclists and pedestrians through an interchange exists. The type of interchange and the actual field conditions will determine which guidance materials are best applicable, and these can be used to help design interchanges with bicycle and pedestrian facilities that will improve safety and ease of use.

3.0 STAKEHOLDER CONSULTATION

Executive Summary

The following table provides a summary of the stakeholders met with for this study.

Date	Group	Location	General Comments
09/24/2007	Bicycling for Louisville	Diocesan House, Louisville, KY	Most interested in safety and a clear understanding of bicycle facilities for users.
09/24/2007	Safe Streets Louisville	Bearno's Pizza, Louisville, KY	Discussed general thoughts regarding improvements to the 5 case study interchanges.
09/26/2007	Oldham Co. Bike/Ped/Greeways Summit	Oldham Co. Fiscal Court Building	Discussed bicycle and pedestrian issues as they related to Oldham County's master plan.
09/27/2007	Louisville Bicycle Club	Louisville PB Office	Discussed general thoughts regarding improvements to the 5 case study interchanges.
10/15/2007	Louisville Metro	Louisville Metro Development Center	Agency coordination meeting to share information
10/17/2007	University of Louisville	KYTC District 5 Office	Increase safety and awareness of bicyclists and pedestrians through signage, markings, reducing ramp access points, and improving sight distance.
10/31/2007	21st Century Parks	Conference call	Making conditions safe for pedestrians and bicyclists is a priority; interested in study as it relates to Floyd's Fork Greenway.
11/05/2007	TARC	Conference call	Interested in improving signage, signals and aesthetics.
11/13/2007	Sullivan University	Sullivan University A La Carte Cafe	Informational meeting to solicit comments from Sullivan faculty and students about bicycling and walking through interchanges.

Report

Various stakeholders and agencies with interests in the study were contacted and asked for feedback. Meetings were held to share information regarding the project and to solicit feedback and ideas of how to better and more safely accommodate pedestrians and bicyclists through interchanges. A summary of the meetings with each stakeholder or agency group is given below. Meeting minutes from these meetings are included in **Appendix C**.

3.1 Bicycling for Louisville

A meeting with Bicycling for Louisville was held on September 24, 2007 at 3:00 pm at the Diocesan House in Louisville, Kentucky. The director of the group, Barry Zalph, met with several members of the project team. Bicycling for Louisville is a bike advocacy and education group for children and adults that encourages bicycling for transportation, recreation, fitness and sport. The group currently provides education to riders, advocacy, technical advising and research. Some of Mr. Zalph's comments included:

- Any improvements or treatments added must be self-teaching,
- Through the I-264 / US 31E interchange, a sign indicating for bicyclists to use the full lane of traffic would be helpful, as well as a multi-use side path for less experienced riders,
- A potential problem with multi-use paths is that if they are only on one side of the roadway, there must be a safe way for bicyclists to cross back over to the other side of the street, and
- Improved lighting when the arterial runs under the interstate.

3.2 Safe Streets Louisville

A meeting with Safe Streets Louisville was held on September 24, 2007 at 4:00 pm at Bearno's Pizza in Louisville, Kentucky. Jackie Green is the point of contact for this group; however several members came to the meeting. Safe Streets Louisville is a bicycle advocacy group. Comments from group members regarding the five concept interchanges are listed below.

- A road diet on Bardstown Road to allow for wider curb lanes,
- A shared path would be good if there was not a law that states that if an adjacent path is provided, it must be used,
- Addition of crosswalks through the I-264 / US 31E interchange,
- "Stop Here On Red" signs at the signals at the I-264 / US 31E interchange,
- An overpass on I-264 between the Taylorsville Road and Bardstown Road exits,
- Square up the cloverleaf free flow exit lanes at the I-264 / KY 155 interchange, which would bring them in at 90 degree angles and cause traffic to slow down, and
- Addition of sidewalks to the I-65 and Brooks Road, and I-265 and KY 155 interchanges.

3.3 Oldham County Bike, Pedestrian and Greenways Summit

A meeting was hosted by the Greenways for Oldham County in partnership with the Oldham County Government to provide a forum for a county-wide bicycle, pedestrian, and greenways summit. The summit was conducted in conjunction with the recently started Bicycle, Pedestrian, and Greenways Master Plan for Oldham County funded by a grant from the Kentuckiana Regional Planning and Development Agency (KIPDA). The master plan is scheduled to be completed by December of 2007. The primary goal of the meeting was to provide an opportunity for all individuals and groups with an interest in bicycling, walking, hiking, equestrian trails, and greenways in Oldham County to find out what is going on in the county, what the needs are, and what each individual/group can contribute to the master plan. Because KY 146 is part of the greenways project, this project was presented at the meeting, however no feedback was provided due the fact that the meeting was purely informational and many groups were presenting. Louise Allen is the point of contact for Oldham County.

3.4 Louisville Bicycle Club

A meeting with the Louisville Bicycle Club was held on September 27, 2007 at 8:30 am at the PB office in Louisville, Kentucky. The Louisville Bicycle Club's president, Earl Jones, attended. Their goal is to encourage and promote cycling for all skill levels of riders and to grow the number in each skill class through teaching and experience. They would like to standardize and regularize the movements of cyclists to improve safety and to encourage them to use on-road facilities. Earl Jones' specific comments include the following:

- US 31E (Bardstown Road) and I-264 (Watterson Freeway) – the proposed off-road facility may be in conflict with guidance that keeps cyclists off sidewalks. It also may encourage wrong-way riding and motorists may not expect cyclists on a side path.

- KY 155 (Taylorsville Road) and I-264 (Watterson Freeway) – Mr. Jones likes the idea of the 90 degree turn in and out at the Watterson and Taylorsville Road.

- I-71 and KY 146 – this interchange is not too friendly. The bridge is narrow. An idea of putting a side path on the south side might make sense.

- I-65 and Brooks Road – this looks like it is not near anything. Over the bridge seems to be a constraint point. The shoulders on the bridge look narrow.

3.5 Louisville Metro

A meeting was held with Louisville Metro on October 15, 2007 at 10:00 am at the Louisville Metro Development Center in Louisville, Kentucky. This was an agency coordination meeting, rather than a stakeholder meeting, and the purpose of the

meeting was to inform Louisville Metro of the project and obtain feedback. Some comments and questions (with answers) from the meeting included:

- Need for markings and signage approved by KYTC, especially regarding free flow ramps. Louisville Metro is responsible for signage and needs specific guidance from KYTC.
- Make sure that what is included in the toolbox will be useful for Louisville, just because it worked in another city does not mean it will work here.
- Design treatments regarding free flow ramps are very important.
- Look at examples in Lexington.
- Would KYTC allow lane widths narrower than 11 feet to allow for wider bike lanes?
    - Would be handled on a case by case basis.
- Are there any plans to make changes to the case study interchanges in the near future?
    - No, these were chosen to ensure that concepts were developed for various types of interchanges, and there are currently no plans to make changes to them.
- How can this apply to a current project on Cannons Lane?
    - Some of the treatments discussed in the literature review, such as continuing bike lanes through the interchange, bringing ramps in at 90 degree angles, and using better signage and striping could be applied.

3.6 University of Louisville

A meeting with Professor Mark French from the University of Louisville was held on October 17, 2007 at 3:00 pm at the KYTC District 5 offices in Louisville, Kentucky. Dr. French is a civil engineering professor and a proponent of improving bicycle and pedestrian safety. His comments on the project are listed below.

- All ages and skill levels of cyclists should be accommodated.
- Sight distance issues on ramps should be addressed.
- Guidance is needed on placement of pavement markings, especially the “sharrow”.
- At I-71 and KY 146 – Need to have marked crosswalks at both combined entrance/exit ramp areas. Use of a refuge zone between the entrance and exit ramp may be needed since the entrances are uncontrolled and only exit ramp traffic is stopped by the signal light – there is no safe way for a pedestrian to get across all lanes.
- Combine multiple roadway entrance ramps into a single ramp access point. Replace the sweeping high-speed entrance ramp with a turn-lane in order to continue to provide capacity, but to reduce speed, and reduce number of lanes pedestrians and bikes must cross at the interchange.
- The same applies for exit ramps – reduce sweeping high speed merging with small radius turn lanes. This will maintain capacity and provide reduced speed at the end of the ramp where ped and bicycle traffic crosses.

- At locations where the turn radius must be large, such as Brooks Rd., use the open space between legs of the entrance ramp as a refuge area for peds or bicycles. This would require some safety improvement such as raised curbs or concrete barriers to provide safety for peds and bikes crossing the exposed ramp area.
- Overpasses with no sidewalk need signage to indicate vehicles must watch for pedestrian traffic such as I-71 at KY 53 where shopping is on the opposite side of the interstate from housing.
- Sidewalks or paved pathways on both sides of every overpass or underpass. Where there is no space or room for an official sidewalk, a paved path is needed. If no path is provided, a designed dirt or gravel trail is needed, otherwise a path will get worn in by existing pedestrian traffic regardless, and the path will have no consideration of safe travel through the intersection.
- Include cross walk lines at each location a path or sidewalk crosses a ramp in order to guide pedestrians and to serve as an indicator to vehicles of potential pedestrian traffic. Since folks are walking through these interchanges regardless of whether safety enhancements are in place, it can only improve awareness and safety for both pedestrian traffic and vehicles if signage and road markings are included.
- Clear all sight distances for entrance and exit ramps for both vehicles to observe pedestrians and pedestrians to observe vehicles – shrubs and signs can obscure the view and create dangerous environment for pedestrians attempting to cross – and for vehicles crossing multiple lanes where a pedestrian may be passing or standing or waiting to cross a ramp.
- Include signage for vehicles indicating pedestrian crossings are ahead and signs pointing to correct place to stop in order not to block crosswalk at signals.
- Where crosswalk signals are included with activation buttons, require access to buttons as part of the walkway or concrete pad at the road-walkway location. Some existing walk signals at interchanges (Breckenridge Ln. at I-264 overpass, and I-64 at Hurstbourne) have signaled cross-walks with activation button difficult to access. Buttons are located behind guardrails or on steep vegetated areas where the posts for traffic signal is located – existing location makes it difficult or impossible for some pedestrians to reach the signal activation.
- Use smaller radius access turns for entrance/exit ramp connections to roadways. This will passively improve safety through slower turn speed and better sight lines for traffic.
- Use shared-lane or bike-lane markings on roads at all interchange crossings to increase vehicle awareness and expectation for bicycle traffic.

3.7 21st Century Parks

A conference call with Kevin Beck of 21st Century Parks was held on October 31, 2007 at 9:30 am to discuss the project. 21st Century Parks has an interest in bicycle and pedestrian issues, particularly related to the proposed Floyd's Fork Greenway located south of the I-265 / KY 155 interchange. They agree that making conditions as safe as

possible for pedestrians and bicyclists is a priority but did not offer any suggestions at this time as to what improvements should be made.

3.8 TARC

A conference call was held with Carrie Butler, the point of contact for the Transit Authority of River City (TARC) on November 5, 2007 at 3:00 pm to discuss the project and obtain feedback. TARC runs the bus system in Louisville and is interested in bicycle and pedestrian safety through interchanges because there are access issues for many riders who have to walk and bike through these areas. Also, interchanges are a good place for park and ride facilities, therefore they would like more bicycle and pedestrian access to those facilities. Carrie pointed to ITE's *Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities* as a document that could be helpful. Her comments on the study include:

- Improve pedestrian signals at I-264 and US 31E.
- Include wayfinding signage at interchanges so pedestrians have a better idea of what is around them.
- Improve aesthetics to be as interesting and attractive as possible.

3.9 Sullivan University

A table was set up at the Sullivan University A La Carte Café at the campus on Bardstown Road near I-264, on November 13, 2007 from 11:00 am to 3:00 pm to solicit comments from students and faculty regarding what could be done to improve bicycle and pedestrian safety at the nearby interchange, which is one of the five interchange concepts (I-264 and US 31E). Jay Marr was the point of contact for Sullivan. Project team members were at the table to discuss bicycle and pedestrian safety with students and faculty, and a survey was available for ideas to be recorded. Fifteen surveys were returned. A summary of the surveys is included in **Appendix C** with meeting minutes from other stakeholder meetings. Of the fifteen respondents, six walked or biked to class, and eleven said they do not feel safe walking or riding their bike to class. When asked what could be done to improve facilities, safety and encourage them to walk or ride a bike to class the following is a summary of the most common responses:

- Pedestrian and bike overpass over Bardstown Road,
- Bike lanes,
- Bike paths / bike trails around the whole Louisville area,
- Underpass with escalators and good security and lighting, and slope for bikes,
- Better street painting and marking crosswalks more clearly,
- Encourage businesses to be more aesthetically pleasing, people won't drive so fast by things they like to look at,
- Citations for disobeying traffic signals,
- Change signal timing to allow for longer crossing signals, and
- Crosswalk signals with countdown feature.

3.10 Conclusions

Overall, the outreach activities indicate that there is interest in improving bicycle and pedestrian safety. In fact, most of those involved felt that the project was worthwhile and needed. Many were of the opinion that safer accommodations for bicyclists and pedestrians would encourage more people to bike and walk.

4.0 INTERCHANGE CONCEPTUAL STUDIES

Executive Summary

Case studies of five representative interchanges in the region as part of the KIPDA Interchange – Bicycle/Pedestrian Safety Study were completed based on information gathered in the literature review and stakeholder interview processes. The five case study interchanges included:

- Jefferson County: I-264 (Watterson Expressway) at KY 155 (Taylorsville Road) [Skewed Partial Cloverleaf with heavy free-flow movements]
- Jefferson County: I-264 (Watterson Expressway) at US 31E (Bardstown Road) [Single Point Urban Interchange]
- Jefferson County: I-265 (Gene Snyder Freeway) at KY 155 (Taylorsville Road) [Diamond Interchange with arterial road going under interstate]
- Bullitt County: I-65 at KY 1526 (Brooks Road) [Diamond Interchange with arterial road going over interstate]
- Oldham County: I-71 at KY 146 (Buckner) [Partial Cloverleaf]

These represent five types of interchanges commonly found in the region. The recommendations made for each are shown on the following table.

Summary of Recommendations for Case Study Interchanges

Location	Recommended Alternative	Description	Cost
I-264 & TAYLORSVILLE ROAD (KY 155) [Skewed Partial Cloverleaf]	0	Tree Trimming / Sweeping / Maintenance	Minimal
	1	Right Turn Yield to Bikes	$600
	2	Bike / Pedestrian Warning Signs	$1,200
	3	Pedestrian Warning System	$75,000
	4	Lighting	$38,000
	7A	Zebra Crossing / Sidewalk / Countdown Pedestrian Signal (with Earthwork)	$261,000
	Total		$375,800
I-264 & BARDSTOWN ROAD (US 31E) [Single Point Urban Interchange]	0	Sweep Curbs / Gore Areas	Minimal
	1	Right Turn Yield to Bikes	$600
	2	Stop Here on Red / Staggered Stop Bars	$900
	3	Zebra Stripe Existing Crosswalks	$7,000
	4	Pedestrian Countdown Signals, Double-Sided (8 Heads)	$16,000
	5	Lighting	$38,000
	6	Reconfigure Sidewalk and Crossing at I-264 Right Turn Off Ramps to Provide 90° Crossings	$15,000
	7	Shift Sidewalk / Make Wide Curb Lane for Bikes	$310,000
	Total		$387,500
I-265 & TAYLORSVILLE ROAD (KY 155) [Diamond Interchange with Arterial Under the Interstate]	0	Sweep Curbs / Maintenance	Minimal
	1	Right Turn Yield to Bikes	$600
	2	Extend Pavement Through Interchange for Wide Curb Lane (10' Width) Either Asphalt or Concrete (No Drainage)	$240,000
	3	Lighting	$19,000
	4	Multiuse Path on One Side and Sidewalk on the Other	$210,000
	Total		$469,600
I-65 & BROOKS ROAD (KY 1526) [Diamond Interchange with Arterial Over the Interstate]	0	Sweep Curbs / Maintenance	Minimal
	1	Right Turn Yield to Bikes	$800
	2	Bike / Pedestrian Warning Signs	$1,200
	3	High Mast Lighting	$39,000
	4	Remove Curb Lane Rumble Strips	$50,000
	Total		$91,000
I-71 & KY 146 (BUCKNER) [Partial Cloverleaf]	0	Continue to Maintain Shoulder	Minimal
	1	Right Turn Yield to Bikes	$800
	2	Bike / Pedestrian Warning Signs	$1,200
	4	Create Separate New Bridge for Greenway Facility	$470,000
	Total		$472,000
	Grand Total		$1,795,900

Notes:

- *The alternatives are shown color-coded with blue generally indicating lower cost improvement alternatives, green is medium cost alternatives, and red is generally higher cost alternatives.*
- *Cost is a planning level cost estimate in 2007 dollars for construction costs only.*

Report

Five interchanges in the KIPDA region were selected for use as case studies. These included the following:

- Jefferson County: I-264 (Watterson Expressway) at KY 155 (Taylorsville Road)
- Jefferson County: I-264 (Watterson Expressway) at US 31E (Bardstown Road)
- Jefferson County: I-265 (Gene Snyder Freeway) at KY 155 (Taylorsville Road)
- Bullitt County: I-65 at KY 1526 (Brooks Road)
- Oldham County: I-71 at KY 146 (Buckner)

These five interchanges represent a variety of interchange types in the region. The intent of the case study is to develop conceptual retrofit plans to improve the safety of bicyclists / pedestrians through these types of interchanges. At some point, the plans may lead to implementation, however, the concepts and ideas are meant to serve as a range of alternatives that could be applied at similar interchanges. Additional data collection and analysis would be necessary before implementation including field surveys, traffic counts and forecasts, and bicycle / pedestrian counts and forecasts.

Included for each interchange case study are the following:

- A review of existing conditions to determine what the challenges are for bicycling and walking through these specific interchange types;
- A range of low-cost to high-cost improvement alternatives;
- Evaluation matrix comparing the different alternatives (including planning level cost estimates in 2007 dollars); and,
- Selection of a preferred improvement option for these specific case studies.

The existing conditions review relied upon information provided by the Kentucky Transportation Cabinet (KYTC), KIPDA, and Louisville Metro. No new counts (traffic or pedestrian / bicyclist) were completed as part of this study. Data provided included:

- Average daily traffic count information from KYTC's 'CTS' traffic count program
- Available turning movement counts
- As built plans
- Signal timing
- Crash data for the past three years (2004 – 2006)

When available, turning movement counts and signal timing were used to determine a level of service for the intersection. For this analysis, the Highway Capacity Software Plus package (HCS+) was used to assess the peak period traffic operating conditions. This software package implements the Highway Capacity Manual (HCM) intersection analysis method.

Level of service (LOS) is a qualitative measure of expected traffic conflicts, delay, driver discomfort, and congestion. Levels of service are described according to a letter rating system ranging from LOS A (free flow, minimal or no delays – best conditions) to LOS F (stop and go conditions, very long delays – worst conditions). For intersections, the Highway Capacity Manual (2000) defines levels of service based on the average delay due to signal or STOP control as shown in **Table 1**.

Table 1: LOS Criteria for Intersections

LOS	Signalized Intersections Control Delay (seconds vehicle)	Unsignalized Intersections Control Delay (seconds/vehicle)
A	≤ 10	≤ 10
B	>10 – 20	>10 – 15
C	>20 – 35	>15 – 25
D	>35 – 55	>25 – 35
E	>55 – 80	>35 – 50
F	>80	>50

Source: Highway Capacity Manual (2000)

In general terms, a facility is considered to have reached its physical capacity at LOS E. However, for urban and suburban conditions, LOS C is usually considered the threshold for desirable traffic conditions. Operations below this threshold are noted as undesirable and warrant improvement. LOS C corresponds to ≤ 35 seconds of delay per vehicle at a signalized intersection and ≤ 25 seconds of delay at an unsignalized intersection. (Refer to the HCM published by the Transportation Research Board for more specific information.)

The Kentucky Transportation Cabinet provided crash data for a three-year period from January 1, 2004 through December 31, 2006. Crash rates were computed for both the interstate and the arterial segments using the methodology provided in the crash analysis report periodically published by the Kentucky Transportation Center (KTC)[1]. The section crash rates are based on the number of crashes on a specified section, the average daily traffic on the roadway, the time frame of analysis, and the length of the section. They are expressed in terms of crashes per 100 million vehicle-miles. A section's crash rate was then compared to a statewide critical crash rate[2] derived from critical crash rate tables for highway sections in the KTC crash report (Appendix D of KTC crash report). This comparison is expressed as a ratio of the section crash rate to the critical crash rate and is referred to as the critical crash rate factor. Sections with a critical crash rate factor greater than one are considered high crash locations and are potential candidates for safety improvements.

[1] Analysis of Traffic Crash Data in Kentucky (2000 – 2004), Kentucky Transportation Center Research Report KTC-05-19/KSP2-05-1F.

[2] The critical crash rate is the threshold above which an analyst can be statistically certain (at a 99.5% confidence level) that the section crash rate exceeds the average crash rate for a similar roadway and is not mistakenly shown as higher than the average due to randomly occurring crashes.

The section crash rate is also compared directly to the statewide average crash rate presented in the KTC crash report. The statewide averages consider all crashes for a specified period that are listed in the Collision Report Analysis for Safer Highways (CRASH) database maintained by the Kentucky State Police and stratified by functional classification (Table B-2 in KTC crash report). Section rates that exceed the statewide average crash rate but not the critical crash rate may be problem areas, but they are not statistically proven to be higher crash areas. Therefore, this second comparison is used to identify a second tier of highway sections that may have crash problems and could be considered for safety improvements if warranted based on further analysis.

A range of alternatives was developed for each case study interchange including both low-cost and higher-cost solutions. The literature review served as a guide for potential improvement alternatives. The existing conditions review, particularly the field visits, helped to identify where the problem areas exist and what could potentially be done to fix them. Also, comments from stakeholders were taken into account when developing the alternatives. Some alternatives include installing pedestrian and/or bicycle information and warning signs. References to these signs are included on the alternatives figures, with the signs depicted in **Appendix E**.

To determine what the preferred alternative(s) are for each case study, several evaluation criteria were used. The first is the type of treatment that already exists on the arterial on either side of the interstate. If facilities already exist, the preferred treatment though the interchange would match the existing facilities. A broad overview of traffic impact will serve as an additional evaluation criterion along with land use. Finally, cost estimates are included for each alternative. The cost estimates assume that no new right-of-way is necessary for the improvements, and do not include any design or utility work. They are strictly construction-only planning level costs in 2007 dollars. For more information about the cost estimates, refer to **Appendix F**. This appendix also contains a unit cost price guide for the more common items.

Utilizing these evaluation criteria, a recommendation for each case study was made.

4.1 I-264 (Watterson Expressway) / KY 155 (Taylorsville Road) Case Study

Existing Conditions
This interchange is a skewed partial cloverleaf with heavy free-flow movements in an urban area. Turning movement counts were not available for the ramp intersections; therefore levels of service for these locations were not calculated. The crash analysis did not show a crash rate problem on either KY 155 or I-264, and in fact did not show any reported crashes with either pedestrians or bicyclists. There was, however, a fatality involving a bicyclist that occurred at this interchange mentioned at one of the stakeholder meetings. It is uncertain why this fatal crash was not listed in the crash dataset.

Taylorsville Road is a high priority bicycle route and will help connect the Outer Belt of Parks / Floyd's Fork Greenway to the Olmstead Parks system inside the Watterson Expressway.

Specific challenges for pedestrians and bicyclists through this interchange include:

- High speed free flow movements with long merge areas,
- Confusion for bicyclists regarding whether to stay to the right or move to the left of free flow movements,
- Multiple conflict points, and
- Low visibility to drivers of bicyclists and pedestrians.

The following figure (**Figure 29**) contains a photo review of the interchange, documenting the existing conditions. For a summary of the existing conditions at this interchange, refer to **Figure 30**.

Figure 29: I-264 / KY 155 Photos

Northbound Taylorsville Road Off-Ramp to Westbound Watterson Expressway (looking south)

Southbound Taylorsville Road On-Ramp to Eastbound Watterson Expressway

Northbound Taylorsville Road On-Ramp to Westbound Watterson Expressway (looking south)

Northbound Taylorsville Road On-Ramp to Watterson Expressway Westbound (looking north)

Westbound Watterson Expressway Off-Ramp to Southbound Taylorsville Road

Westbound Watterson Expressway Off-Ramp to Southbound Taylorsville Road

Figure 29: I-264 / KY 155 Photos (cont.)

Eastbound Watterson Expressway Off-Ramp to Southbound Taylorsville Road

Southbound Taylorsville Road near Eastbound Watterson Expressway Off-Ramp

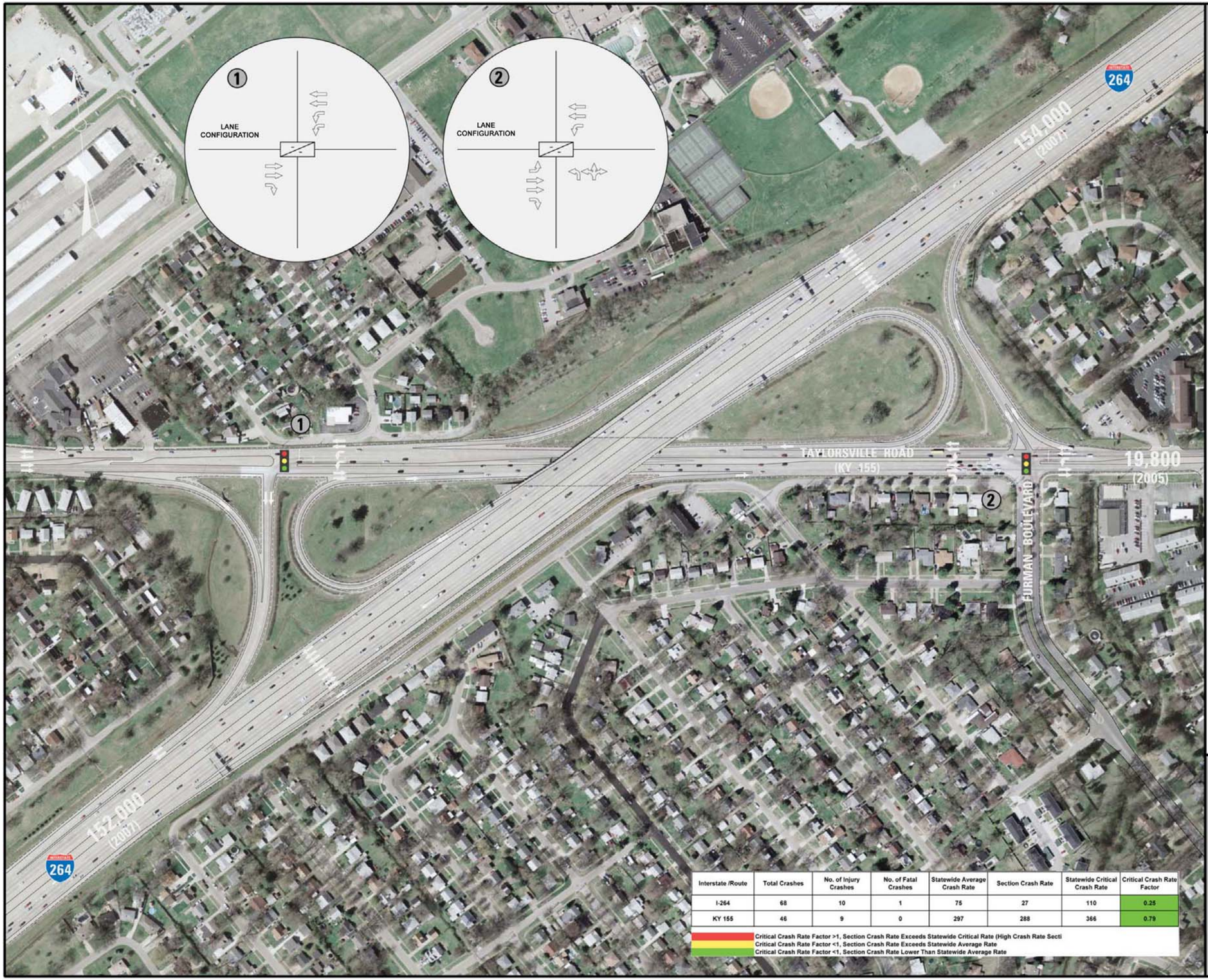
Southbound Taylorsville Road near Watterson Expressway Interchange

Northbound Taylorsville Road On-Ramp to Eastbound Watterson Expressway

Northbound Taylorsville Road On-Ramp to Eastbound Watterson Expressway

Triple Entry Taylorsville Road On-Ramp to Eastbound Watterson Expressway

FIGURE 30: I-264 & TAYLORSVILLE ROAD (KY 155) INTERCHANGE



Interstate /Route	Total Crashes	No. of Injury Crashes	No. of Fatal Crashes	Statewide Average Crash Rate	Section Crash Rate	Statewide Critical Crash Rate	Critical Crash Rate Factor
I-264	68	10	1	75	27	110	0.25
KY 155	46	9	0	297	288	366	0.79

Critical Crash Rate Factor >1, Section Crash Rate Exceeds Statewide Critical Rate (High Crash Rate Secti
Critical Crash Rate Factor <1, Section Crash Rate Exceeds Statewide Average Rate
Critical Crash Rate Factor <1, Section Crash Rate Lower Than Statewide Average Rate

Key Issues / Deficiencies

- Skewed partial cloverleaf with heavy free-flow movements.
- No reported crashes involving bicyclists and/or pedestrians during the analysis time period (2004-2006).

LEGEND

EXISTING EDGE OF PAVEMENT
EXISTING EDGE OF TRAVEL WAY
SIGNALIZED INTERSECTION
STOP-CONTROLLED INTERSECTION
67,800 AVERAGE DAILY TRAFFIC
B/F LEVEL OF SERVICE (AM/PM)

500 0 500 1000 1500
GRAPHIC SCALE IN FEET

Proposed Alternatives

To improve pedestrian and bicycling conditions through this interchange, the following improvement alternatives were developed. **Figure 31** shows the improvement alternatives on a photo of the interchange. The alternatives are shown color-coded with blue generally indicating lower cost improvement alternatives, green is medium cost alternatives, and red is generally higher cost alternatives.

Alt. 0 – Tree Trimming / Sweeping / Maintenance: This will improve sight distance and visibility particularly at the northbound off-ramp and make facilities more conducive for bicyclists and pedestrians.

Alt. 1 – Right Turn Yield to Bikes: Placement of these signs at locations where there are right-turning vehicles should inform drivers of the presence of bicyclists.

Alt. 2 – Bicycle / Pedestrian Warning Signs: These should be used to inform motorists of the general presence of pedestrians and bicyclists in the area.

Alt. 3 – Pedestrian Warning System: This is used to alert motorists to the presence of pedestrians when sight distance is limited, particularly at the long northbound off-ramp that merges with KY 155 at a sharp angle. The system could consist of a simple warning sign with attached flashing lights placed along the ramp that are activated when a pedestrian pushes a button to cross the ramp where it merges with KY 155. More sophisticated systems are available and include crosswalks that have lighting that illuminates the pedestrian and the warning sign.

Alt. 4 – Lighting: Enhanced lighting systems could be placed under the bridge to provide better visibility for pedestrians and bicyclists and increase safety.

Alt. 5 – Zebra Crossing / Sidewalk / Countdown Pedestrian Signal (No Earthwork): The zebra crossing stripes further define where pedestrians should cross and the countdown pedestrian signals will further aid in providing a safe crossing. The sidewalk should be continued through the interchange from where it ends on either side of the interchange.

Alt. 6 – Wide Curb Lane / Restriping: To accommodate bicyclists and define the area in which they are to ride, restriping of the shoulder is an option to provide a wide curb lane.

Alt. 7A – Zebra Crossing / Sidewalk / Countdown Pedestrian Signals (with Earthwork): This is similar to Alt. 5 with the exception that where necessary, earthwork would be performed to provide a more direct connection between the existing sidewalk on either side of the interchange and to channelize the drainage.

Alt. 7B – Multiuse Path with Earthwork: This option includes the construction of a separate multiuse path on one side of the street.

Alt. 8 – Ramp Elimination / Consolidation / Bike Lane: To reduce the number of conflict points, the loop ramps could be re-aligned to intersect with KY 155 at the existing

intersection locations. This would impact traffic operations by stopping movements that previously could operate in a free-flow manner; therefore a detailed traffic analysis would need to be completed before this alternative could be recommended.

Alt. 9 – Nearby Grade Separated Crossing between Taylorsville Road and Bardstown Road: On both sides of I-264 there are residential neighborhoods with lower volume streets that could be utilized with a bicycle / pedestrian overpass bridge. Pedestrian and bicycle counts would need to be performed in this area to determine whether or not this treatment is warranted. (Refer to ***Florida Pedestrian Facilities Planning and Design Handbook***).

FIGURE 31: I-264 & TAYLORSVILLE ROAD (KY 155) INTERCHANGE

Proposed Alternatives

0. Tree Trimming / Sweeping / Maintenance
1. Right Turn Yield to Bikes (R4-4)
2. Bike / Pedestrian Warning Signs (W11-1, W11-2)
3. Pedestrian Warning System
4. Lighting
5. Zebra Crossing / Sidewalk / Countdown Pedestrian Signal (No Earthwork)
6. Wide Curb Lane / Restriping
7A. Zebra Crossing / Sidewalk / Countdown Pedestrian Signals (with Earthwork)
7B. Multiuse Path with Earthwork
8. Ramp Elimination / Consolidation / Bike Lane
9. Nearby Grade Separated Crossing between Taylorsville Road and Bardstown Road

*** Additional traffic analysis is required to determine impact to traffic operations.**

LEGEND

- EXISTING EDGE OF PAVEMENT
- EXISTING EDGE OF TRAVEL WAY
- SIGNALIZED INTERSECTION
- STOP-CONTROLLED INTERSECTION

DRAFT

150 0 150 300 450

GRAPHIC SCALE IN FEET

Alternatives Evaluation

To aid in the selection of the appropriate treatment for this interchange, an evaluation matrix was developed. The evaluation criteria include a review of existing treatments on both sides of the interchange, impact to traffic operations (yes or no, no formal analysis at this point), land use on either side of the interchange, and cost. **Table 2** shows the evaluation matrix for the I-264 / KY 155 interchange.

Recommendation

Alternatives 0 – 4 are relatively low cost and would greatly improve pedestrian and bicyclist awareness and visibility through the interchange. There are currently no bicycle facilities along Taylorsville Road now despite the fact that it is a high priority corridor, therefore Alternative 6 would not be recommended at this time. Once something is proposed and constructed for the corridor, the same treatment should be accommodated through the interchange.

As there are existing sidewalks on either side of the interchange, it would make sense to continue this treatment through the interchange. Either Alternative 5 or 7A would accomplish this. As the cost for Alternative 7A is only slightly higher than Alternative 5, this would be the preferred recommendation. Therefore, at this time, the preferred recommendation for this interchange is Alternatives 0, 1, 2, 3, 4, and 7A for a total cost estimate of $375,800 in 2007 dollars.

Table 2: I-264 / KY 155 Interchange Evaluation Matrix

Location	Proposed Alternative	Description	Existing Treatments on Arterial	Major Impact to Traffic Operations (Yes or No)	Land Use	Cost
I-264 & TAYLORSVILLE ROAD (KY 155)	0	Tree Trimming / Sweeping / Maintenance	Sidewalk Only on Both Sides	NO	Mixed Residential and Some Commercial	Minimal
	1	Right Turn Yield to Bikes		NO		$600
	2	Bike / Pedestrian Warning Signs		NO		$1,200
	3	Pedestrian Warning System		NO		$75,000
	4	Lighting		NO		$38,000
	5	Zebra Crossing / Sidewalk / Countdown Pedestrian Signal (No Earthwork)		NO		$250,000
	6	Wide Curb Lane / Restriping		NO		$280,000
	7A	Zebra Crossing / Sidewalk / Countdown Pedestrian Signal (with Earthwork)		NO		$261,000
	7B	Multiuse Path with Earthwork		NO		$130,000
	8	Ramp Elimination / Consolidation / Bike Lane		YES		$680,000
	9	Nearby Grade Separated Crossing between Taylorsville Road and Bardstown Road		NO		$1,020,000

Notes:

- *The alternatives are shown color-coded with blue generally indicating lower cost improvement alternatives, green is medium cost alternatives, and red is generally higher cost alternatives.*
- *Cost is a planning level cost estimate in 2007 dollars for construction costs only.*

4.2 I-264 (Watterson Expressway) / US 31E (Bardstown Road) Case Study

Existing Conditions
This interchange is a single point urban interchange (SPUI) with the interstate bridge over the arterial. Turning movement counts were not available for the ramp intersections; therefore levels of service for these locations were not calculated. The crash analysis did not show a crash rate problem on either US 31E or I-264, and in fact did not show any reported crashes with either pedestrians or bicyclists.

Specific challenges for pedestrians and bicyclists through this interchange include:

- Only one signal controlling all movements,
- Long crossing distance where ramps meet at the signal, and
- Free-flow right-turn movements.

The following figure (**Figure 32**) contains a photo review of the interchange, documenting the existing conditions. For a summary of the existing conditions at this interchange, refer to **Figure 33**.

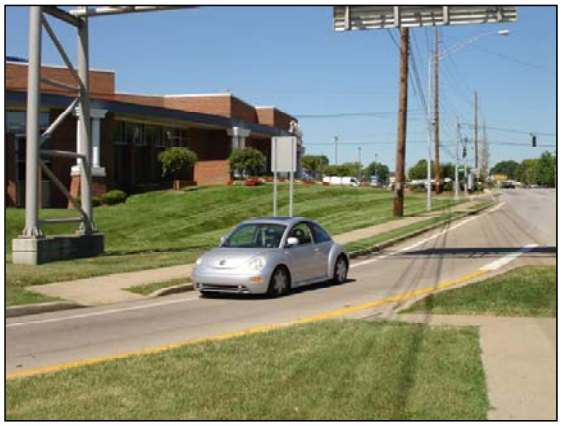
Figure 32: I-264 / US 31E Photos

Southbound Bardstown Road

Southbound Bardstown Road On-Ramp to Westbound Watterson Expressway

Southbound Bardstown Road On-Ramp to Westbound Watterson Expressway - Sidewalk

Southbound Bardstown Road On-Ramp to Westbound Watterson Expressway - 90 degree sidewalk

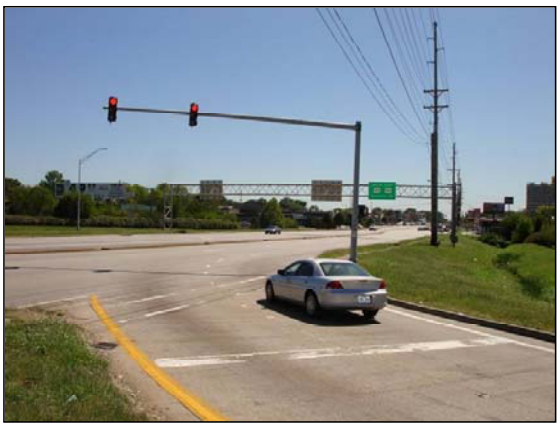


Southbound Bardstown Road On-Ramp to Westbound Watterson Expressway

Northbound Bardstown Road On-Ramp to Westbound Watterson Expressway – Crosswalk

Figure 32: I-264 / US 31E Photos (cont.)

Eastbound Watterson Expressway Off-Ramp to Northbound Bardstown Road



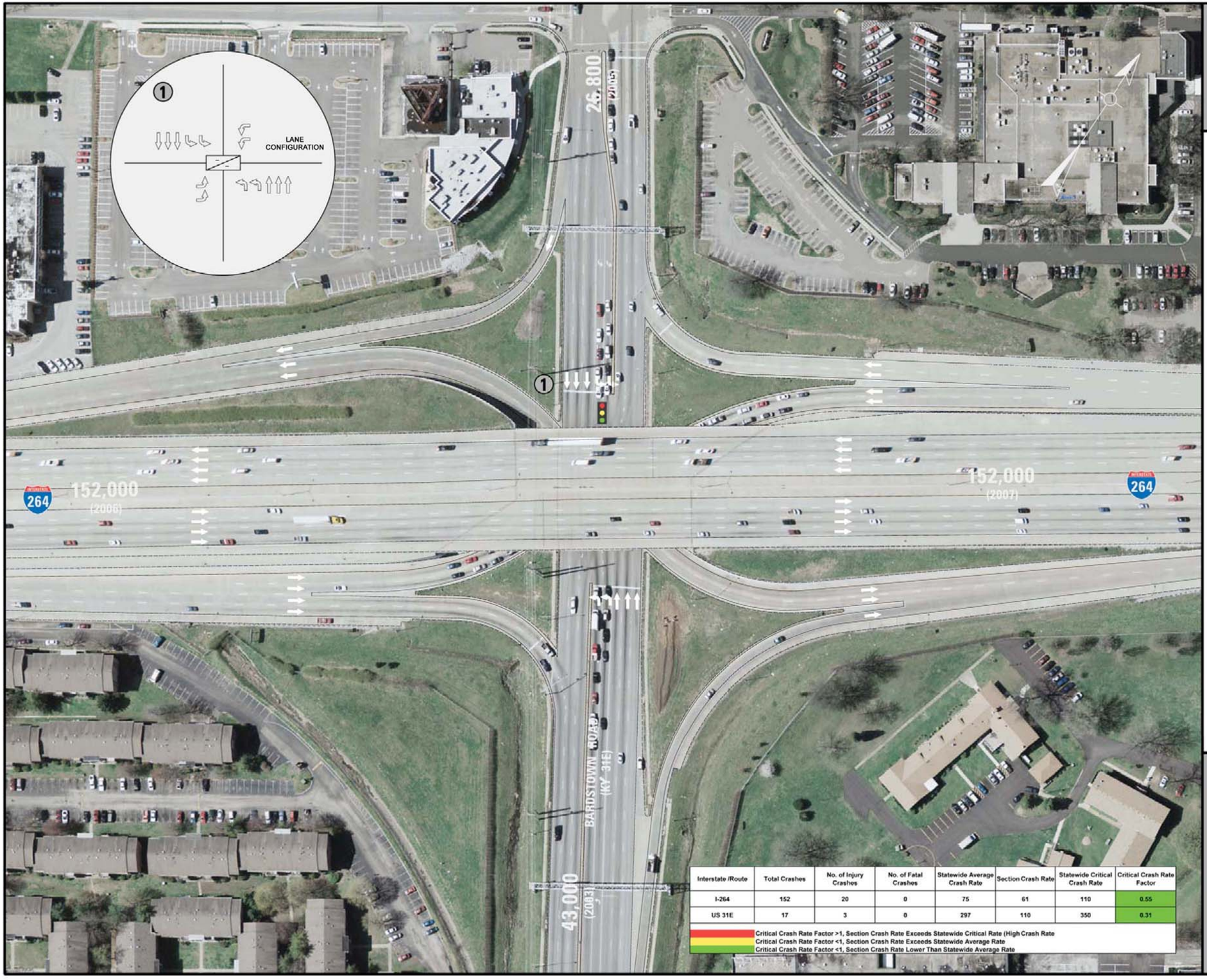
Eastbound Watterson Expressway Off-Ramp to Southbound Bardstown Road

Eastbound Watterson Expressway Off-Ramp to Southbound Bardstown Road

Westbound Watterson Expressway Off-Ramp to Southbound Bardstown Road

Westbound Watterson Expressway Off-Ramp to Northbound Bardstown Road

FIGURE 33: I-264 & BARDSTOWN ROAD (US 31E) INTERCHANGE



Interstate /Route	Total Crashes	No. of Injury Crashes	No. of Fatal Crashes	Statewide Average Crash Rate	Section Crash Rate	Statewide Critical Crash Rate	Critical Crash Rate Factor
I-264	152	20	0	75	61	110	0.55
US 31E	17	3	0	297	110	350	0.31

Critical Crash Rate Factor >1, Section Crash Rate Exceeds Statewide Critical Rate (High Crash Rate
Critical Crash Rate Factor <1, Section Crash Rate Exceeds Statewide Average Rate
Critical Crash Rate Factor <1, Section Crash Rate Lower Than Statewide Average Rate

Key Issues / Deficiencies

- Single point urban interchange.
- No reported crashes involving bicyclists and/or pedestrians during the analysis time period (2004-2006).

LEGEND

- EXISTING EDGE OF PAVEMENT
- EXISTING EDGE OF TRAVEL WAY
- SIGNALIZED INTERSECTION
- STOP-CONTROLLED INTERSECTION
- 67,800 AVERAGE DAILY TRAFFIC
- B/F LEVEL OF SERVICE (AM/PM)

200 0 200 400 600
GRAPHIC SCALE IN FEET

Proposed Alternatives

To improve pedestrian and bicycling conditions through this interchange, the following improvement alternatives were developed. **Figure 34** shows the improvement alternatives on photo of the interchange. The alternatives are shown color-coded with blue generally indicating lower cost improvement alternatives, green is medium cost alternatives, and red is generally higher cost alternatives.

Alt. 0 – Sweep Curbs / Gore Areas: This will improve/maintain safety by providing a clear path for bicyclists.

Alt. 1 – Right Turn Yield to Bikes: Placement of these signs at locations where there are right-turning vehicles should inform drivers of the presence of bicyclists.

Alt. 2 – Stop Here on Red / Staggered Stop Bars: These signs should inform motorists that they are to stop during red, thereby allowing pedestrians and bicyclists to cross safely, and the staggered stop bars should improve visibility between motorists and pedestrians / bicyclists, and prevent the encroachment of vehicles in the crosswalks.

Alt. 3 – Zebra Stripe Existing Crosswalks: The zebra crossing stripes further define where pedestrians should cross.

Alt. 4 – Pedestrian Countdown Signals Double-Sided (8 Heads): These will assist pedestrians in crossing the street more safely.

Alt. 5 – Lighting: Enhanced lighting systems could be placed under the bridge to provide better visibility for pedestrians and bicyclists and increase safety.

Alt. 6 – Shift Sidewalk / Make Wide Curb Lane for Bikes: To accommodate bicyclists and define the area in which they are to ride, the existing sidewalk would need to be shifted to provide enough space for a wide curb lane.

Alt. 7 – Reconfigure Sidewalk and Crossing at I-264 Right Turn Off-Ramps to Provide 90 Degree Crossings: As determined from the literature review, this is the safest way for pedestrians to cross ramps or any other intersection leg.

Alt. 8 – (Same as Alternative 9 for the I-264 / KY 155 Interchange) Nearby Grade Separated Crossing between Taylorsville Road and Bardstown Road: At this interchange there is a mix of land use on both sides of I-264 including some retail and residential developments. Sullivan University is also located adjacent to this interchange. Pedestrian and bicyclists counts would need to be performed in this area to determine whether or not this treatment is warranted. (Refer to ***Florida Pedestrian Facilities Planning and Design Handbook***).

FIGURE 34: I-264 & BARDSTOWN ROAD (US 31E) INTERCHANGE

Proposed Alternatives

- (0) Sweep Curbs / Gore Areas
- (1) Right Turn Yield to Bikes (R4-4)
- (2) Stop Here on Red (R10-6) / Staggered Stop Bars
- (3) Zebra Stripe Existing Crosswalks
- (4) Pedestrian Countdown Signals Double-Sided (8 Heads)
- (5) Lighting
- (6) Reconfigure Sidewalk and Crossing at I-264 Right-Turn Off Ramps to Provide 90° Crossings.
- (7) Shift Sidewalk / Make Wide Curb Lane for Bikes
- (8) Nearby Grade Separated Crossing between Taylorsville Road and Bardstown Road (See Item (9) on Figure 6)

*** Additional traffic analysis is required to determine impact to traffic operations.**

LEGEND

- EXISTING EDGE OF PAVEMENT
- EXISTING EDGE OF TRAVEL WAY
- SIGNALIZED INTERSECTION
- STOP-CONTROLLED INTERSECTION

DRAFT

50 0 50 100 150

GRAPHIC SCALE IN FEET

Alternatives Evaluation

To aid in the selection of the appropriate treatment for this interchange, an evaluation matrix was developed. The evaluation criteria include a review of existing treatments on both sides of the interchange, impact to traffic operations (yes or no, no formal analysis at this point), land use on either side of the interchange, and cost. **Table 3** shows the evaluation matrix for the I-264 / US 31E interchange.

Recommendation

Alternatives 0 – 6 are relatively low cost and would greatly improve pedestrian and bicyclist awareness and visibility through the interchange. Sidewalks currently exist throughout the interchange; however bicycle accommodations are needed, particularly with Sullivan University in close proximity to the interchange. Without designated bicycle treatments on either side of the interchange currently, Alternative 7 would provide an adequate facility while minimizing the cost. A pedestrian / bicycle bridge is very costly and current pedestrian / bicycle volumes may not warrant the expense. Therefore, at this time, the preferred recommendation for this interchange is Alternatives 0, 1, 2, 3, 4, 5, 6, and 7 for a total cost estimate of $387,500 in 2007 dollars.

Table 3: I-264 / US 31E Interchange Evaluation Matrix

Location	Proposed Alternative	Description	Existing Treatments on Arterial	Major Impact to Traffic Operations (Yes or No)	Land Use	Cost
I-264 & BARDSTOWN ROAD (US 31E)	0	Sweep Curbs / Gore Areas	Sidewalks Throughout the Interchange	NO	Commercial and Retail on Both Sides, Some Residential South of the Interchange, Sullivan University to the North of I-264	Minimal
	1	Right Turn Yield to Bikes		NO		$600
	2	Stop Here on Red / Staggered Stop Bars		YES		$900
	3	Zebra Stripe Existing Crosswalks		NO		$7,000
	4	Pedestrian Countdown Signals Double-Sided (8 Heads)		NO		$16,000
	5	Lighting		NO		$38,000
	6	Reconfigure Sidewalk and Crossing at I-264 Right Turn Off Ramps to Provide 90° Crossings		NO		$15,000
	7	Shift Sidewalk / Make Wide Curb Lane for Bikes		NO		$310,000
	8	Nearby Grade Separated Crossing between Taylorsville Road and Bardstown Road		NO		$1,020,000

Notes:

- *The alternatives are shown color-coded with blue generally indicating lower cost improvement alternatives, green is medium cost alternatives, and red is generally higher cost alternatives.*
- *Cost is a planning level cost estimate in 2007 dollars for construction costs only.*

4.3 I-265 (Gene Snyder Freeway) / KY 155 (Taylorsville Road) Case Study

Existing Conditions
This interchange is a diamond interchange with the arterial road going under the interstate. The southbound ramps intersection operates at a LOS C during both peak periods and the northbound ramps intersection operates at a LOS C during the AM peak period, but decreases to a LOS E during the PM peak period. The crash analysis did not show a crash rate problem on either KY 155 or I-265, and in fact, did not show any reported crashes with either pedestrians or bicyclists.

Taylorsville Road is designated a high priority bicycle and pedestrian route by Louisville Metro. This also connects Floyd's Fork Greenway with Blackacre Nature Preserve and the Olmsted Park system inside the Watterson Expressway.

Specific challenges for pedestrians and bicyclists through this interchange include:

- Multiple conflict points,
- Free flow right-turn movements, and
- Confusion for bicyclists regarding whether to stay to the right or move to the left of free-flow movements.

The following figure (**Figure 35**) contains a photo review of the interchange, documenting the existing conditions. For a summary of the existing conditions at this interchange, refer to **Figure 36**.

Figure 35: I-265 / KY 155 Photos

Taylorsville Road On-Ramp to Southbound Gene Snyder Freeway

Taylorsville Road On-Ramp to Southbound Gene Snyder Freeway

Eastbound Taylorsville Road

Southbound Gene Snyder Freeway Off-Ramp to Taylorsville Road

Southbound Gene Snyder Freeway Off-Ramp to Eastbound Taylorsville Road

Southbound Gene Snyder Freeway Off-Ramp to Eastbound Taylorsville Road

Figure 35: I-265 / KY 155 Photos (cont.)

Westbound Taylorsville Road On-Ramp to Northbound Gene Snyder Freeway

Southbound Gene Snyder Freeway Off-Ramp to Taylorsville Road

FIGURE 36: I-265 & TAYLORSVILLE ROAD (KY 155) INTERCHANGE

Interstate /Route	Total Crashes	No. of Injury Crashes	No. of Fatal Crashes	Statewide Average Crash Rate	Section Crash Rate	Statewide Critical Crash Rate	Critical Crash Rate Factor
I-265	64	17	1	75	63	114	055
KY 155	10	2	0	297	91	383	024

Critical Crash Rate Factor >1, Section Crash Rate Exceeds Statewide Critical Rate (High Crash Rate
Critical Crash Rate Factor <1, Section Crash Rate Exceeds Statewide Average Rate
Critical Crash Rate Factor <1, Section Crash Rate Lower Than Statewide Average Rate

Key Issues / Deficiencies

- No reported crashes involving bicyclists and/or pedestrians during the analysis time period (2004-2006).

LEGEND

- EXISTING EDGE OF PAVEMENT
- EXISTING EDGE OF TRAVEL WAY
- SIGNALIZED INTERSECTION
- STOP-CONTROLLED INTERSECTION
- 67,800 AVERAGE DAILY TRAFFIC
- B/F LEVEL OF SERVICE (AM/PM)

200 0 200 400 600
GRAPHIC SCALE IN FEET

Proposed Alternatives

To improve pedestrian and bicycling conditions through this interchange, the following improvement alternatives were developed. **Figure 37** shows the improvement alternatives on a photo of the interchange. The alternatives are shown color-coded with blue generally indicating lower cost improvement alternatives, green is medium cost alternatives, and red is generally higher cost alternatives.

Alt. 0 – Sweep Curbs / Maintenance: This will improve/maintain safety by providing a clear path for bicyclists.

Alt. 1 – Right Turn Yield to Bikes: Placement of these signs at locations where there are right-turning vehicles should inform drivers of the presence of bicyclists.

Alt. 2 – Extend Pavement through Interchange for Wide Curb Lane 10' Width (either Asphalt or Concrete): The shoulder is discontinuous through the interchange and could be connected to provide room for bicyclists.

Alt. 3 – Lighting: Enhanced lighting systems could be placed under the bridge to provide better visibility for pedestrians and bicyclists and increase safety.

Alt. 4 – Multiuse Path on One Side and Sidewalk on the Other: This option includes the construction of a separate multiuse path on one side of the street with a sidewalk on the other, consistent with Louisville Metro's bicycle master plan.

Alt. 5 – Ramp Elimination / Consolidation: To reduce the number of conflict points, the right turn free-flow ramps could be re-aligned to intersect with KY 155 at the existing intersection locations. This would impact traffic operations by stopping movements that previously could operate in a free-flow manner; therefore a detailed traffic analysis would have to be completed before this alternative could be recommended.

FIGURE 37: I-265 & TAYLORSVILLE ROAD (KY 155) INTERCHANGE

Proposed Alternatives

0. Sweep Curbs / Maintenance
1. Right Turn Yield to Bikes (R4-4)
2. Extend Pavement through Interchange for Wide Curb Lane 10' Width either Asphalt or Concrete (No Drainage)
3. Lighting
4. Multiuse Path on One Side and Sidewalk on the Other
5. Ramp Elimination / Consolidation

* Additional traffic analysis is required to determine impact to traffic operations.

LEGEND

- EXISTING EDGE OF PAVEMENT
- EXISTING EDGE OF TRAVEL WAY
- SIGNALIZED INTERSECTION
- STOP-CONTROLLED INTERSECTION

DRAFT

200 0 200 400 600

GRAPHIC SCALE IN FEET

Alternatives Evaluation

To aid in the selection of the appropriate treatment for this interchange, an evaluation matrix was developed. The evaluation criteria include a review of existing treatments on both sides of the interchange, impact to traffic operations (yes or no, no formal analysis at this point), land use on either side of the interchange, and cost. **Table 4** shows the evaluation matrix for the I-265 / KY 155 interchange.

Recommendation

Alternatives 0, 1, and 3 are relatively low cost and would greatly improve pedestrian and bicyclist safety and visibility through the interchange. Alternatives 2 and 4 are consistent with Louisville Metro planning. Ideally, the existing and planned sidewalks and whatever treatment is chosen for the interchange (either side) and for the Floyds Fork Greenway should act as a system. As such, any improvements though the interchange should tie into the existing sidewalk (currently near Stone Lakes Drive) further completing the system. Therefore, at this time, the preferred recommendation for this interchange is Alternatives 0, 1, 2, 3, and 4 for a total cost estimate of $469,600 in 2007 dollars.

Table 4: I-265 / KY 155 Interchange Evaluation Matrix

Location	Proposed Alternative	Description	Existing Treatments on Arterial	Major Impact to Traffic Operations (Yes or No)	Land Use	Cost
I-265 & TAYLORSVILLE ROAD (KY 155)	0	Sweep Curbs / Maintenance	No Existing Sidewalk or Bicycle Facilities on Either Side; However Taylorsville Road is a Primary Bicycle Corridor to Connect Louisville to Floyd's Fork Greenway and the Olmstead Parks System. The Plan Calls for Widening the Existing Pavement to Provide Shoulder Bicycle Lanes Along Both Sides of the Roadway as well as a Shared-Use Path Along the South Side of the Interchange.	NO	Retail/Residential to the West of the Interchange; Residential/Rural to the East of the Interchange; Floyd's Fork Park is Located to the East of the Interchange and is a Destination for Bicyclists; Significant Future Development in the Vicinity of the Interchange is Planned Including Several New Housing Developments and Additional Commercial/Retail	Minimal
	1	Right Turn Yield to Bikes		NO		$600
	2	Extend Pavement Through Interchange for Wide Curb Lane (10' Width) Either Asphalt or Concrete (No Drainage)		NO		$240,000
	3	Lighting		NO		$19,000
	4	Multiuse Path on One Side and Sidewalk on the Other		NO		$210,000
	5	Ramp Elimination / Consolidation		YES		$290,000

Notes:

- *The alternatives are shown color-coded with blue generally indicating lower cost improvement alternatives, green is medium cost alternatives, and red is generally higher cost alternatives.*
- *Cost is a planning level cost estimate in 2007 dollars for construction costs only.*

4.4 I-65 / KY 1526 (Brooks Road) Case Study

Existing Conditions
This interchange is a diamond interchange with the arterial road going over the interstate. The southbound ramps intersection operates at a LOS C during the AM peak period, but operates at LOS E during the PM peak period. The northbound ramps intersection operates at a LOS F during the AM peak period but improves to a LOS C during the PM peak period. The crash analysis did not show a crash rate problem on I-65, but KY 1526 through the interchange was found to be a high crash rate section. However, a review of the crash records did not show any reported crashes with either pedestrians or bicyclists.

Specific challenges for pedestrians and bicyclists through this interchange include:

- Multiple conflict points,
- Free flow right-turn movements, and
- Confusion for bicyclists regarding whether to stay to the right or move to the left of free-flow movements.

The following figure (**Figure 38**) contains a photo review of the interchange, documenting the existing conditions. For a summary of the existing conditions at this interchange, refer to **Figure 39**.

Figure 38: I-65 / KY 1526 Photos

KY 1526 Eastbound

KY 1526 On-Ramp to Southbound I-65

Debris on Shoulder of KY 1526

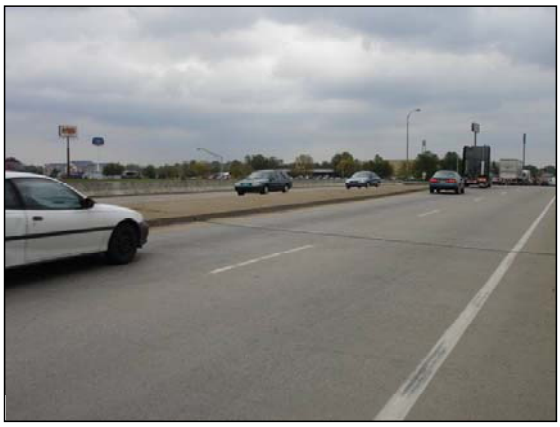
Debris in Island Next to Ramp

Southbound I-65 Off-Ramp to KY 1526

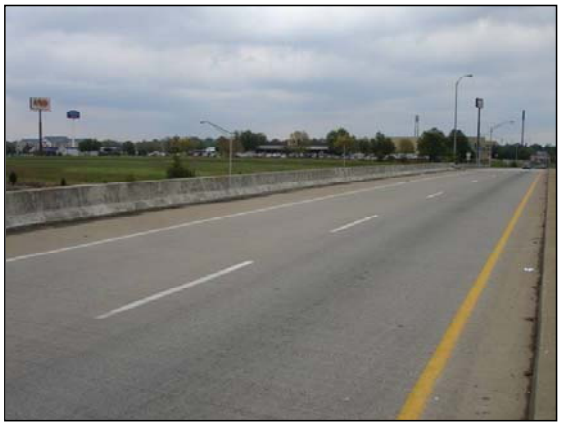
Trash Obstacle in Shoulder

Figure 38: I-65 / KY 1526 Photos (cont.)

Divided Median on KY 1526



Divided Median on KY 1526



KY 1526 Bridge over I-65

Shoulder of KY 1526 Bridge over I-65

FIGURE 39: I-65 & BROOKS ROAD (KY 1526) INTERCHANGE

Interstate /Route	Total Crashes	No. of Injury Crashes	No. of Fatal Crashes	Statewide Average Crash Rate	Section Crash Rate	Statewide Critical Crash Rate	Critical Crash Rate Factor
I-65	98	23	2	75	65	111	0.59
KY 1526	85	19	0	242	756	382	1.98

Critical Crash Rate Factor >1, Section Crash Rate Exceeds Statewide Critical Rate (High Crash Rate
Critical Crash Rate Factor <1, Section Crash Rate Exceeds Statewide Average Rate
Critical Crash Rate Factor <1, Section Crash Rate Lower Than Statewide Average Rate

Key Issues / Deficiencies

- Safety concern on KY 1526.
- No reported crashes involving bicyclists and/or pedestrians during the analysis time period (2004-2006).

LEGEND

- EXISTING EDGE OF PAVEMENT
- EXISTING EDGE OF TRAVEL WAY
- SIGNALIZED INTERSECTION
- STOP-CONTROLLED INTERSECTION
- 67,800 AVERAGE DAILY TRAFFIC
- B/F LEVEL OF SERVICE (AM/PM)

200 0 200 400 600
GRAPHIC SCALE IN FEET

Proposed Alternatives

To improve pedestrian and bicycling conditions through this interchange, the following improvement alternatives were developed. **Figure 40** shows the improvement alternatives on photo of the interchange. The alternatives are shown color-coded with blue generally indicating lower cost improvement alternatives, green is medium cost alternatives, and red is generally higher cost alternatives.

Alt. 0 – Sweep Curbs / Maintenance: This will improve/maintain safety by providing a clear path for bicyclists.

Alt. 1 – Right Turn Yield to Bikes: Placement of these signs at locations where there are right-turning vehicles should inform drivers of the presence of bicyclists.

Alt. 2 – Bicycle / Pedestrian Warning Signs: These should be used to inform motorists of the general presence of pedestrians and bicyclists in the area.

Alt. 3 – High Mast Lighting: Enhanced lighting systems could be placed to illuminate the bridge to provide better visibility for pedestrians and bicyclists and increase safety. Other types of lighting could be considered if this is determined to not be the best solution.

Alt. 4 – Remove Curb Lane Rumble Strips: This will improve safety for pedestrians and bicyclists through the interchange who utilize the shoulder to go through the interchange.

Alt. 5 – Tighten Ramp Termini: To reduce the number of conflict points, the right turn free-flow ramps could be re-aligned to intersect with KY 1526 at the existing intersection locations. This would impact traffic operations by stopping movements that previously could operate in a free-flow manner; therefore a detailed traffic analysis would have to be completed before this alternative could be recommended.

FIGURE 40:
I-65 & BROOKS ROAD (KY 1526) INTERCHANGE

Proposed Alternatives

0. Sweep Curbs / Maintenance
1. Right Turn Yield to Bikes (R4-4)
2. Bike / Pedestrian Warning Signs (W11-1, W11-2)
3. High Mast Lighting
4. Remove Curb Lane Rumble Strips
5. Tighten Ramp Termini

* Additional traffic analysis is required to determine impact to traffic operations.

LEGEND

- EXISTING EDGE OF PAVEMENT
- EXISTING EDGE OF TRAVEL WAY
- SIGNALIZED INTERSECTION
- STOP-CONTROLLED INTERSECTION

DRAFT

200 0 200 400 600

GRAPHIC SCALE IN FEET

Alternatives Evaluation

To aid in the selection of the appropriate treatment for this interchange, an evaluation matrix was developed. The evaluation criteria include a review of existing treatments on both sides of the interchange, impact to traffic operations (yes or no, no formal analysis at this point), land use on either side of the interchange, and cost. **Table 5** shows the evaluation matrix for the I-65 / KY 1526 interchange.

Recommendation

Alternatives 0 - 4 are relatively low cost and would greatly improve pedestrian and bicyclist safety and visibility through the interchange. Alternative 5 is more costly and may impact traffic operations. Therefore, at this time, the preferred recommendation for this interchange is Alternatives 0, 1, 2, 3, and 4 for a total cost estimate of $91,000 in 2007 dollars.

Table 5: I-65 / KY 1526 Interchange Evaluation Matrix

Location	Proposed Alternative	Description	Existing Treatments on Arterial	Major Impact to Traffic Operations (Yes or No)	Land Use	Cost
I-65 & BROOKS ROAD (KY 1526)	0	Sweep Curbs / Maintenance	There are no Existing Sidewalks or Bicycle Facilities on Either Side of the Interchange	NO	Commercial / Industrial	Minimal
	1	Right Turn Yield to Bikes		NO		$800
	2	Bike / Pedestrian Warning Signs		NO		$1,200
	3	High Mast Lighting		NO		$39,000
	4	Remove Curb Lane Rumble Strips		NO		$50,000
	5	Tighten Ramp Termini		YES		$280,000

Notes:

- *The alternatives are shown color-coded with blue generally indicating lower cost improvement alternatives, green is medium cost alternatives, and red is generally higher cost alternatives.*
- *Cost is a planning level cost estimate in 2007 dollars for construction costs only.*

4.5 I-71 / KY 146 (Buckner) Case Study

Existing Conditions
This interchange is a partial cloverleaf, constrained to the east by a railroad. Turning movement volumes were available for the PM peak period. The resulting LOS for the southern intersection is LOS F with the northern intersection operating at LOS C. The crash analysis showed a crash rate problem on KY 146 with I-71 also exceeding the statewide average rate. A review of the crash records did not show any reported crashes with either pedestrians or bicyclists. This area will also accommodate the planned Oldham County Greenways alignment.

Specific challenges for pedestrians and bicyclists through this interchange include:

- Multiple conflict points,
- Possibility of high speed free-flowing movements,
- Confusion for bicyclists regarding whether to stay to the right or move to the left of free-flow movements,
- Low visibility to drivers, and
- Narrow bridge crossing.

The following figure (**Figure 41**) contains a photo review of the interchange, documenting the existing conditions. For a summary of the existing conditions at this interchange, refer to **Figure 42**.

Figure 41: I-71 / KY 146 Photos

KY 146 Eastbound Lanes

KY 146 at the Northern Intersection With I-71

I-71 Southbound Off-Ramp and KY 146

I-71 Southbound On-Ramp and KY 146

I-71 Southbound Off-Ramp and KY 146

I-71 Southbound Ramps

Figure 41: I-71 / KY 146 Photos (cont.)

KY 146 to I-71 Southbound On-Ramp

KY 146 Approaching the Bridge Over I-71

KY 146 Eastbound

I-71 Northbound Off-Ramp to KY 146

I-71 Northbound On-Ramp and KY 146

KY 146 Bridge Over I-71

FIGURE 42: I-71 & KY 146 (BUCKNER) INTERCHANGE

Interstate /Route	Total Crashes	No. of Injury Crashes	No. of Fatal Crashes	Statewide Average Crash Rate	Section Crash Rate	Statewide Critical Crash Rate	Critical Crash Rate Factor
I-71	69	10	0	75	95	118	0.80
KY 146	27	3	3	242	520	412	1.26

Critical Crash Rate Factor >1, Section Crash Rate Exceeds Statewide Critical Rate (High Crash Rate
Critical Crash Rate Factor <1, Section Crash Rate Exceeds Statewide Average Rate
Critical Crash Rate Factor <1, Section Crash Rate Lower Than Statewide Average Rate

Key Issues / Deficiencies

- Constrained by railroad to east.
- Narrow 2-lane bridge between intersections.
- Wide shoulder on east side of KY 146, ~6 ft.
- No reported crashes involving bicyclists and/or pedestrians during the analysis time period (2004-2006).

LEGEND

EXISTING EDGE OF PAVEMENT
EXISTING EDGE OF TRAVEL WAY
SIGNALIZED INTERSECTION
STOP-CONTROLLED INTERSECTION
67,800 AVERAGE DAILY TRAFFIC
B/F LEVEL OF SERVICE (AM/PM)

500 0 500 1000 1500
GRAPHIC SCALE IN FEET

Proposed Alternatives

To improve pedestrian and bicycling conditions through this interchange, the following improvement alternatives were developed. **Figure 43** shows the improvement alternatives on a photo of the interchange. The alternatives are shown color-coded with blue generally indicating lower cost improvement alternatives, green is medium cost alternatives, and red is generally higher cost alternatives.

Alt. 0 – Continue to Maintain Shoulder: The shoulder is currently swept and is free of debris.

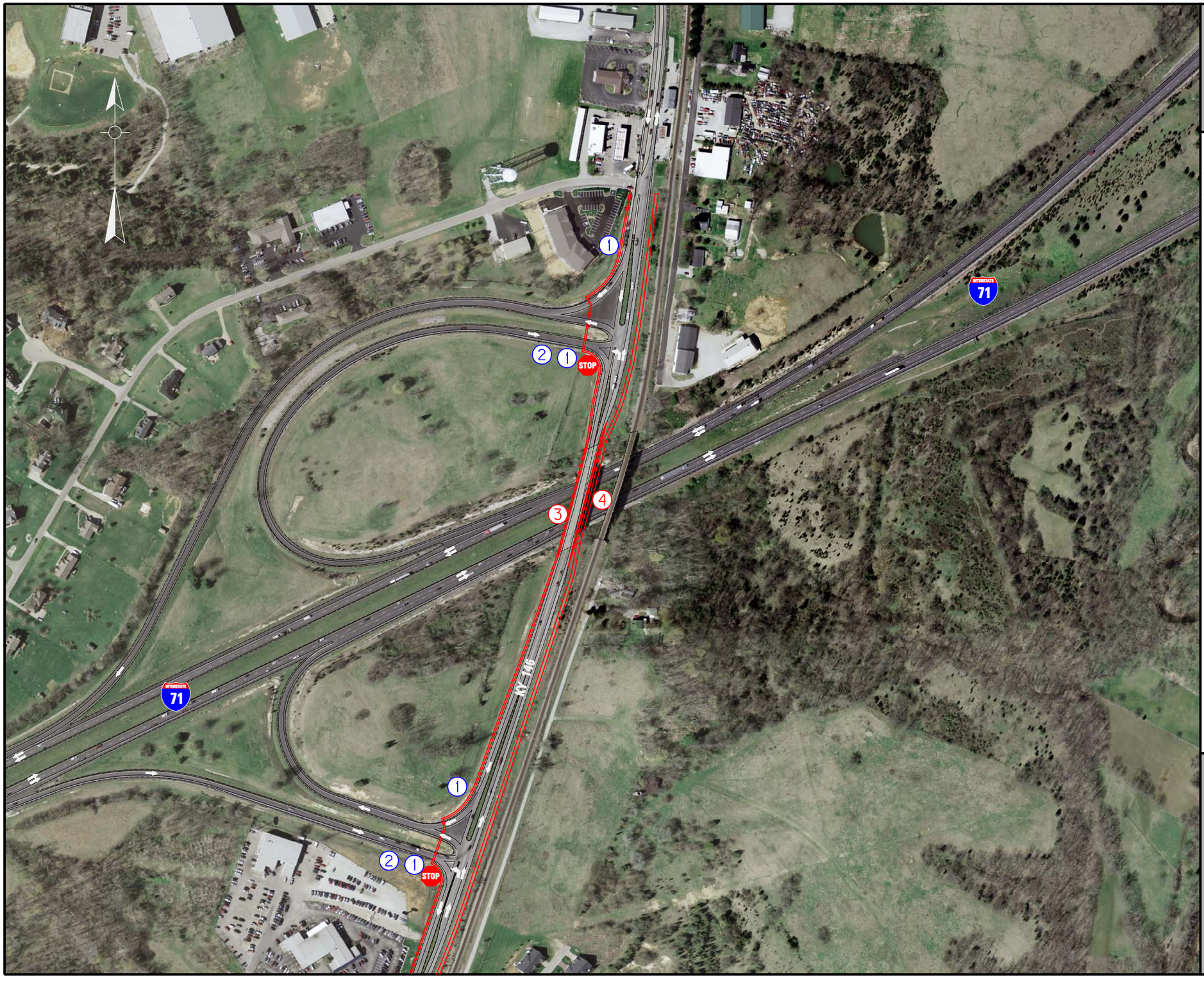
Alt. 1 – Right Turn Yield to Bikes: Placement of these signs at locations where there are right-turning vehicles should inform drivers of the presence of bicyclists.

Alt. 2 – Bicycle / Pedestrian Warning Signs: These should be used to inform motorists of the general presence of pedestrians and bicyclists in the area.

Alt. 3 – Widen Bridge for Wide Curb Lane, Sidewalk, and Refuge Island: The existing bridge is very narrow with no room for bicyclists or pedestrians. The bridge could be widened to provide sufficient space to accommodate bicyclists and pedestrians, but would be costly.

Alt. 4 – Create Separate New Bridge for Greenway Facility: This would create a separate path for pedestrians and bicyclists, providing them with a safe way to go through the interchange.

FIGURE 43:
I-71 & KY 146 (BUCKNER) INTERCHANGE



Proposed Alternatives

0. Continue to Maintain Shoulder
1. Right Turn Yield to Bikes (R4-4)
2. Bike / Pedestrian Warning Signs (W11-1, W11-2)
3. Widen Bridge for Wide Curb Lane, Sidewalk, and Refuge Island
4. Create Separate New Bridge for Greenway Facility

* Additional traffic analysis is required to determine impact to traffic operations.

LEGEND

- EXISTING EDGE OF PAVEMENT
- EXISTING EDGE OF TRAVEL WAY
- SIGNALIZED INTERSECTION
- STOP-CONTROLLED INTERSECTION

DRAFT

150 0 150 300 450

GRAPHIC SCALE IN FEET

Alternatives Evaluation

To aid in the selection of the appropriate treatment for this interchange, an evaluation matrix was developed. The evaluation criteria include a review of existing treatments on both sides of the interchange, impact to traffic operations (yes or no, no formal analysis at this point), land use on either side of the interchange, and cost. **Table 6** shows the evaluation matrix for the I-71 / KY 146 interchange.

Recommendation

Alternatives 0 - 2 are relatively low cost and would greatly improve pedestrian and bicyclist safety and visibility through the interchange. Alternatives 3 and 4 are more costly, however are the only options for accommodating pedestrians and bicyclists due to the narrow existing bridge. Any future plans for widening KY 146 should consider pedestrian / bicycle facilities, however until then a separate new bridge for the greenway facility (Alt. 4) may make more sense than widening KY 146. Therefore, at this time, the preferred recommendation for this interchange is Alternatives 0, 1, 2, and 4 for a total cost estimate of $472,000 in 2007 dollars.

Table 6: I-71 / KY 146 Interchange Evaluation Matrix

Location	Proposed Alternative	Description	Existing Treatments on Arterial	Major Impact to Traffic Operations (Yes or No)	Land Use	Cost
I-71 & KY 146 (BUCKNER)	0	Continue to Maintain Shoulder	There are No Existing Pedestrian or Bicycle Facilities on Either Side of I-71	NO	Commercial/Retail to the North of the Interchange; Rural with Scattered Residential Developments to the South of the Interchange	Minimal
	1	Right Turn Yield to Bikes		NO		$800
	2	Bike / Pedestrian Warning Signs		NO		$1,200
	3	Widen Bridge for Wide Curb Lane, Sidewalk, and Refuge Island		NO		$600,000
	4	Create Separate New Bridge for Greenway Facility		NO		$470,000

Notes:

- *The alternatives are shown color-coded with blue generally indicating lower cost improvement alternatives, green is medium cost alternatives, and red is generally higher cost alternatives.*
- *Cost is a planning level cost estimate in 2007 dollars for construction costs only.*

4.6 Summary

The previous recommendations made for each interchange are summarized in the following table (**Table 7**) along with the planning level construction cost estimate in 2007 dollars.

Table 7: Summary of Case Study Recommendations

Location	Recommended Alternative	Description	Cost
I-264 & TAYLORSVILLE ROAD (KY 155) [Skewed Partial Cloverleaf]	0	Tree Trimming / Sweeping / Maintenance	Minimal
	1	Right Turn Yield to Bikes	$600
	2	Bike / Pedestrian Warning Signs	$1,200
	3	Pedestrian Warning System	$75,000
	4	Lighting	$38,000
	7A	Zebra Crossing / Sidewalk / Countdown Pedestrian Signal (with Earthwork)	$261,000
	Total		$375,800
I-264 & BARDSTOWN ROAD (US 31E) [Single Point Urban Interchange]	0	Sweep Curbs / Gore Areas	Minimal
	1	Right Turn Yield to Bikes	$600
	2	Stop Here on Red / Staggered Stop Bars	$900
	3	Zebra Stripe Existing Crosswalks	$7,000
	4	Pedestrian Countdown Signals, Double-Sided (8 Heads)	$16,000
	5	Lighting	$38,000
	6	Reconfigure Sidewalk and Crossing at I-264 Right Turn Off Ramps to Provide 90^{o} Crossings	$15,000
	7	Shift Sidewalk / Make Wide Curb Lane for Bikes	$310,000
	Total		$387,500
I-265 & TAYLORSVILLE ROAD (KY 155) [Diamond Interchange with Arterial Under the Interstate]	0	Sweep Curbs / Maintenance	Minimal
	1	Right Turn Yield to Bikes	$600
	2	Extend Pavement Through Interchange for Wide Curb Lane (10' Width) Either Asphalt or Concrete (No Drainage)	$240,000
	3	Lighting	$19,000
	4	Multiuse Path on One Side and Sidewalk on the Other	$210,000
	Total		$469,600
I-65 & BROOKS ROAD (KY 1526) [Diamond Interchange with Arterial Over the Interstate]	0	Sweep Curbs / Maintenance	Minimal
	1	Right Turn Yield to Bikes	$800
	2	Bike / Pedestrian Warning Signs	$1,200
	3	High Mast Lighting	$39,000
	4	Remove Curb Lane Rumble Strips	$50,000
	Total		$91,000
I-71 & KY 146 (BUCKNER) [Partial Cloverleaf]	0	Continue to Maintain Shoulder	Minimal
	1	Right Turn Yield to Bikes	$800
	2	Bike / Pedestrian Warning Signs	$1,200
	4	Create Separate New Bridge for Greenway Facility	$470,000
	Total		$472,000
	Grand Total		$1,795,900

Notes:

- *The alternatives are shown color-coded with blue generally indicating lower cost improvement alternatives, green is medium cost alternatives, and red is generally higher cost alternatives.*
- *Cost is a planning level cost estimate in 2007 dollars for construction costs only.*

5.0 TOOLBOX DISCUSSION

The final component of this study was to develop a toolbox that will serve as a guideline for improving pedestrian and bicycle safety and accessibility through multiple interchange types. Utilizing the information from the previous stages in this process, a step-by-step process was developed ranging from an initial assessment of the interchange to construction. Included in the process is a five step checklist that lists different levels of treatments ranging from low-cost to high-cost options. Following the checklist are ten interchange sheets that cover a range of different interchange types and include challenges that pedestrians and bicyclists face through that interchange type as well as specific improvement alternatives. **Appendix A** contains the toolbox.

APPENDIX A:

BICYCLE/PEDESTRIAN INTERCHANGE TOOLBOX

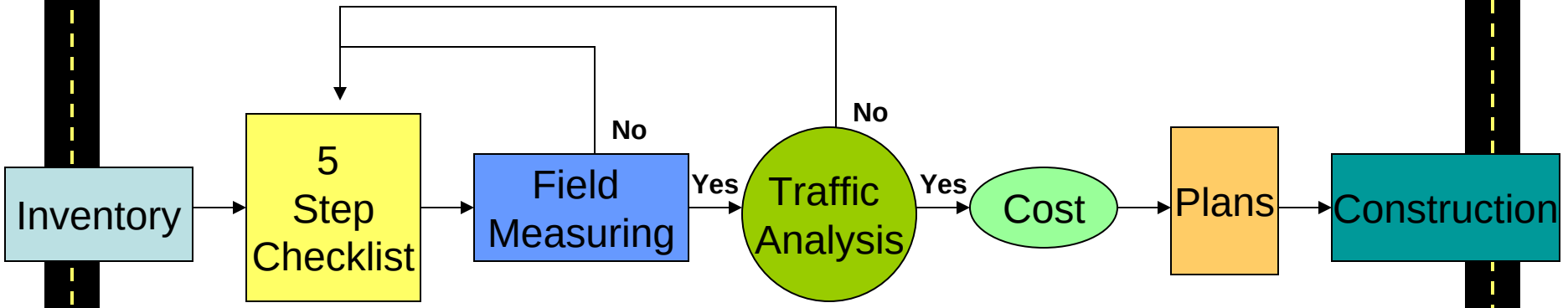
KIPDA Bicycle Pedestrian Safety Study Toolbox

The purpose of the toolbox is to provide a guideline for choosing appropriate bicycle and pedestrian treatments through multiple interchange types. The toolbox consists of a multi-stage evaluation process designed to encompass all stages ranging from an initial review of field conditions to implementation.

The first step in the evaluation process is to take an inventory of the existing conditions with respect to bicycle and pedestrian facilities, roadway facilities, usage, crash history, adjacent land use, and future development. The inventory should draw attention to bicycle and pedestrian facilities' deficiencies, as well as if a need for improvements exists. After the inventory is taken a five step checklist will help provide suggestions for possible treatments with regards to maintenance and signage, sidewalks and pedestrian facilities, bicycle facilities, reduction of conflict points, and grade separation. Individual sheets highlighting the most applicable treatments for 10 different interchange types are included in this section. The next step is to take field measurements to ensure the feasibility of the treatments selected, as well as determining if they are logical solutions given the surrounding environment and demand. If the field measurements indicate that the selected treatments are appropriate, a traffic analysis should be performed to ensure that the selected treatments do not have a significant negative impact to traffic, particularly to the mainline of the freeway. Level of service, (LOS) analyses should be performed for all roadways, bicycle and pedestrian facilities. If the field measurements or the traffic analysis indicate that inappropriate treatments have been selected, Step 2 of the 5-Step checklist should be revisited and new treatments selected. After the traffic analysis has been completed cost estimates should be developed, followed by design and construction. The flow chart on the following page depicts the toolbox evaluation process.

KIPDA Bicycle/Pedestrian Safety Study Toolbox

Evaluation Process



INVENTORY

EXISTING PEDESTRIAN FACILITIES				
1	Are there existing pedestrian facilities on either end of the interchange?		☐ YES	☐ NO
2	Are the facilities continued through the interchange?		☐ YES	☐ NO
3	What type of facilities exists?			
4	How wide are the facilities?			
5	What is the condition of the facilities?	☐ GOOD ☐ FAIR ☐ POOR		
6	Are there existing signs for pedestrians? (Please note location and type on field sketch)		☐ YES	☐ NO
7	Are there existing markings for pedestrians? (Please note location and type on field sketch)		☐ YES	☐ NO
8	Are there existing signals for pedestrians? (Please note location and type on field sketch)		☐ YES	☐ NO
EXISTING BICYCLE FACILITIES				
1	Are there existing bicycle facilities on either end of the interchange?		☐ YES	☐ NO
2	Are the facilities continued through the interchange?		☐ YES	☐ NO
3	What type of facilities exists?			
4	How wide are the facilities?			
5	What is the condition of the facilities?	☐ GOOD ☐ FAIR ☐ POOR		
6	Are there existing signs for bicyclists? (Please note location and type on field sketch)		☐ YES	☐ NO
7	Are there existing markings for bicyclists? (Please note location and type on field sketch)		☐ YES	☐ NO
EXISTING ROADWAY FACILITIES				
1	How many lanes are through the interchange?			
2	Do shoulders exist?		☐ YES	☐ NO
3	What are the shoulder widths?			
4	How wide are the facilities (lanes / shoulders)?			
5	What is the posted speed through the interchange?			
6	What is the functional classification of the roadway through the interchange?			
7	If signals exist, obtain signal timing and phasing and attach to inventory.			
USAGE				
1	What is the ADT on the non-interstate/limited access route?			
2	What is the ADT on the interstate/limited access route?			
3	What is the current daily/hourly volume of bicyclists?			
4	What is the current daily/hourly volume of pedestrians?			

CRASH HISTORY				
1	Within the vicinity of the interchange, has the non-interstate/limited access route been found to have a critical crash rate factor greater than one?	☐ YES	☐ NO	
2	Within the vicinity of the interchange, has the interstate/limited access route been found to have a critical crash rate factor greater than one?	☐ YES	☐ NO	
3	During the past three years of available data, have any of the reported crashes involved pedestrians?	☐ YES	☐ NO	
4	If the answer to #3 was yes, how many and what percentage.	_____	____%	
5	During the past three years of available data, have any of the reported crashes involved bicyclists?	☐ YES	☐ NO	
6	If the answer to #5 was yes, how many and what percentage.	_____	____%	
ADJACENT LAND USE				
1	Are there nearby apartments or dense housing?	☐ YES	☐ NO	
2	Are there nearby retail or shopping destinations?	☐ YES	☐ NO	
3	Are there nearby schools?	☐ YES	☐ NO	
4	Are there nearby recreation centers?	☐ YES	☐ NO	
5	Are there nearby libraries?	☐ YES	☐ NO	
6	Are there nearby parks?	☐ YES	☐ NO	
7	What is the likelihood that one of the above land uses will relocate nearby?	☐ GOOD	☐ FAIR	☐ POOR
FUTURE DEVELOPMENT				
1	Is this a priority pedestrian / bicycle corridor now?	☐ YES	☐ NO	
2	Will it be a priority pedestrian/bicycle corridor in the future?	☐ YES	☐ NO	
3	Is there a need for grade separation?	☐ YES	☐ NO	
4	Are there any plans for improvements to the interchange? (If yes, please provide additional detail on an attached sheet)	☐ YES	☐ NO	

Are there any other current/planned characteristics that would affect pedestrians/bicyclists through this interchange?

5 Step Checklist

If an existing pedestrian or bicycle facility is present, continue that same type through the intersection. Otherwise consider the following:

1. Maintenance and Signage

- Warning signs should be in fluorescent yellow-green (FYG)
- Crosswalks should have zebra stripes
- All markings should be retro-reflective
- Adequate lighting, especially under the roadways
- Consider supplemental signs on ramps (“Stop Here on Red” and “Right Turn Yield to Bikes”)
- Consider pedestrian actuated signals and advance warning beacons

2. Sidewalks and Pedestrian Facilities

- Consider narrowing adjacent travel lanes to accommodate sidewalks

3. Bicycle Facilities

- Consider narrowing adjacent travel lanes to accommodate a wide curb lane or bicycle lane

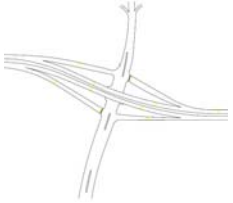
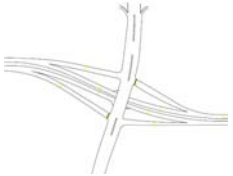
4. Reduction of Conflict Points

- Concentrate conflict points
- Consider eliminating or consolidating free flow ramp movements

5. Grade Separation

*Note that there are various treatments for each step on the checklist. These are options that could work, however engineering judgment should be applied to determine if a treatment is appropriate for a specific interchange.

Interchange Types

Skewed Partial Cloverleaf		Displaced Left Turns	
Partial Cloverleaf		Diverging Diamond	
Single Point Urban Interchange		Full Cloverleaf	
Diamond Interchange with Arterial Under Interstate		Trumpet Interchange	
Diamond Interchange with Arterial Over Interstate		Tight Diamond Interchange	

Skewed Partial Cloverleaf

Interchange Specific Pedestrian / Bicyclist Challenges:

- High speed free flow movements with long merge areas
- Confusion for bicyclists regarding whether to stay to the right or move to the left of free flow movements
- Multiple conflict points
- Low visibility to drivers

Skewed Partial Cloverleaf

Proposed Improvement Alternatives:

1) Maintenance and Signage
   - Keep interchange maintained by sweeping curb lanes and shoulders.
   - Trim any trees or bushes that impede sight distance.
   - Place pedestrian and bicycle warning signs at free flow exit ramps (MUTCD W11-1 and W11-2).
   - Place “Begin Right Turn Lane Yield to Bikes” signs prior to free flow entrance ramps (MUTCD R4-4).
   - Place **electrical pedestrian warning system** at particularly dangerous free flow movements, or where sight distance is poor.
   - Improve lighting if necessary.

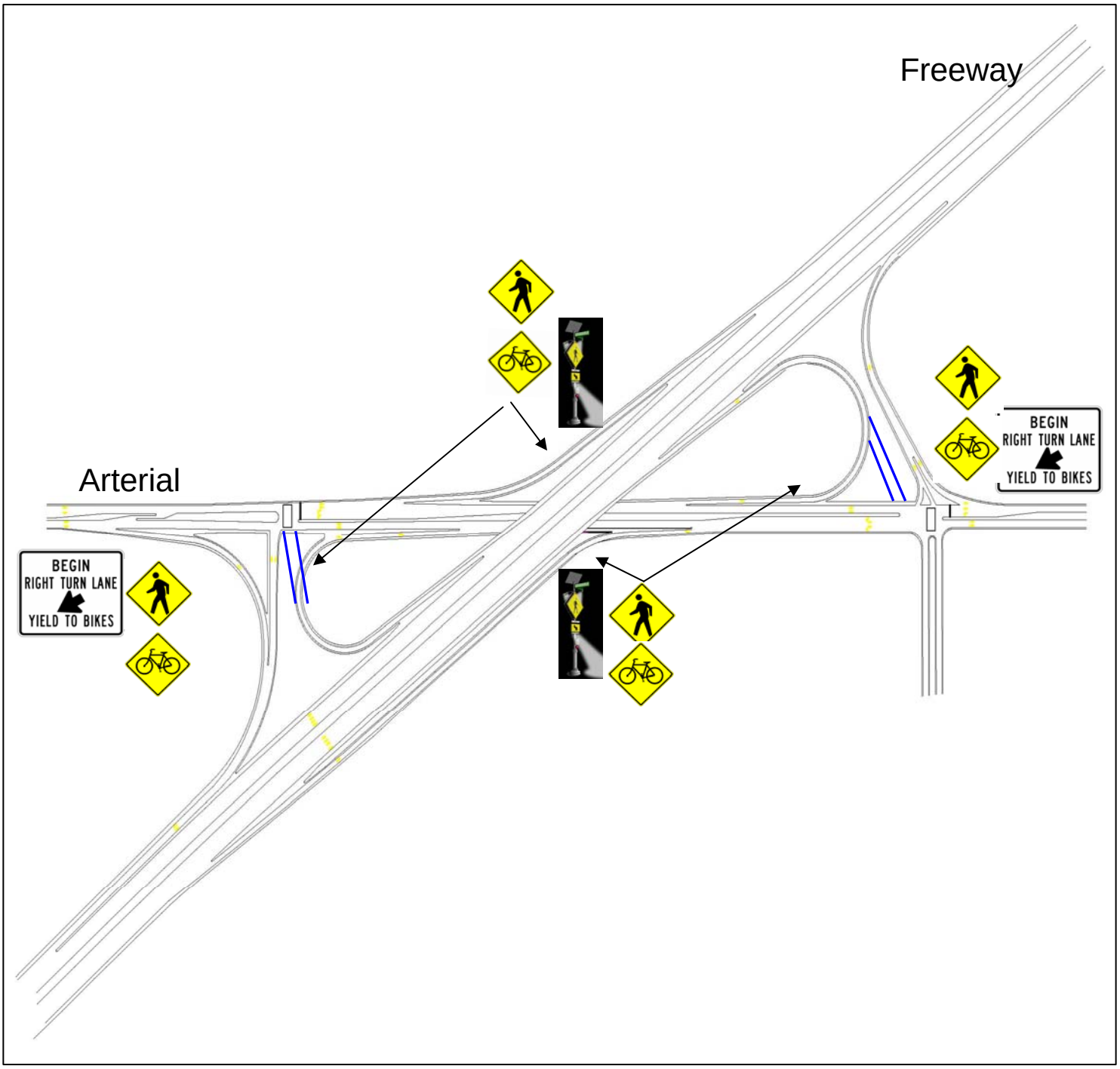
2) Sidewalks and Pedestrian Facilities
   - Connect sidewalk through interchange if not present.
   - Make **freeway ramp crossings** at 90 degree angles.
   - Add zebra striping to freeway pedestrian ramp crossings.
   - Add pedestrian actuated countdown signals where traffic signals exist.
   - Make necessary changes for ADA compliance.
   - If no sidewalk exists, determine appropriate treatment (shoulder, sidewalk, or shared use path) based on pedestrian volumes, adjacent land use, and available right of way. Also need to determine if the facility is needed on both sides of the roadway. If 1 side, make accommodations for cross over at signalized intersections.
   - If an arterial overpass exists, see **Bridge Treatments.**

3) Bicycle Facilities
   - If bicycle lanes or a wide curb lane exists on either end of the interchange, continue them through the interchange.
   - If no facilities exist, determine if a wide curb lane, bicycle lane or shared use path is appropriate.
   - A bicycle lane or wide curb lane could be added by re-striping, narrowing travel lanes and re-striping, or adding pavement to both sides of the roadway and re-striping, if space allows.
   - Consider using **colored pavements** at conflict points between bicycles and vehicles (merge/diverge areas and ramp crossings).
   - If an arterial overpass exists, see **Bridge Treatments.**

4) Reduction of Conflict Points
   - Where **cloverleafs** exist, the free flow movement can be removed and the ramp will intersect with the arterial at a 90 degree angle.
   - Where free flow entrance or exit ramps exist, the free flow movements can be pulled in to intersect the arterial at a 90 degree angle, reducing the number of conflict points.

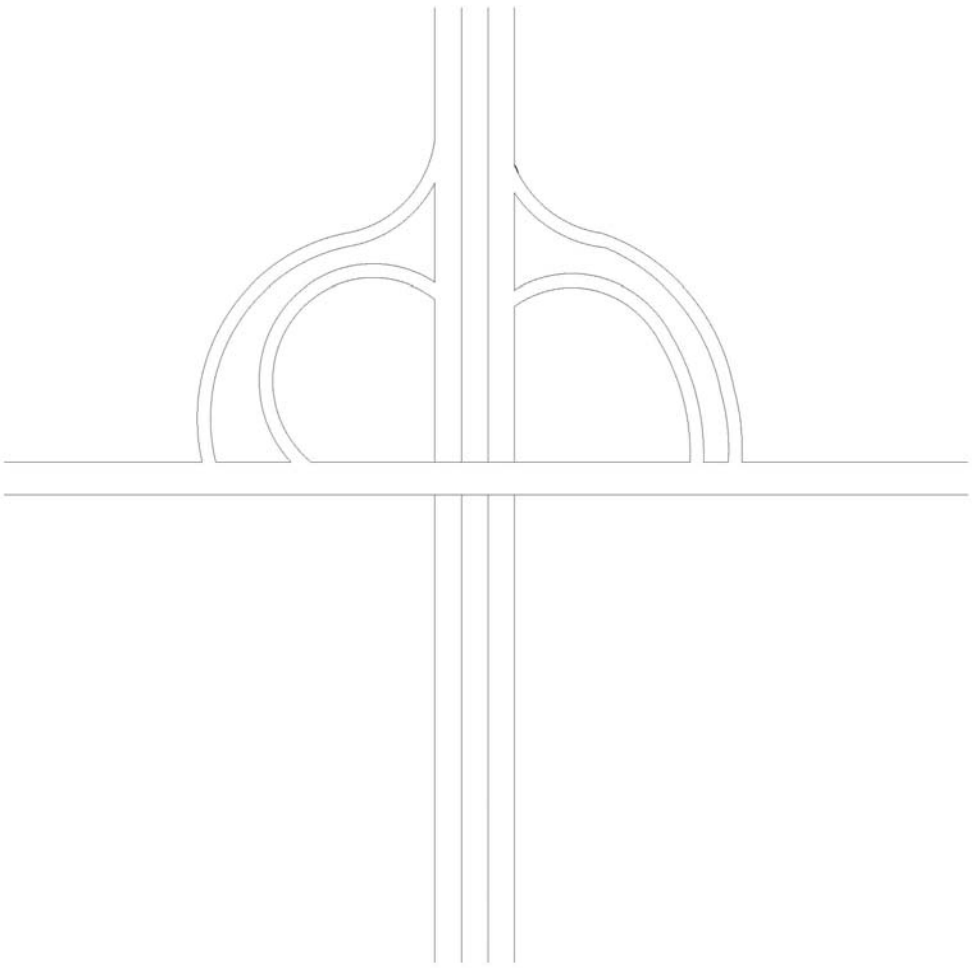
5) Grade Separation
   - Refer to the ***Florida Pedestrian Facilities Planning and Design Handbook*** for warrants.

Appropriate Signage for Skewed Partial Cloverleaf



*The blue lines indicate how the cloverleafs can be brought in to intersect the arterial at 90 degree angles, and reduce conflict points and merging areas.

Partial Cloverleaf



Interchange Specific Pedestrian / Bicyclist Challenges:

- Multiple conflict points
- Possibility of high speed free flowing movements
- Confusion for bicyclists regarding whether to stay to the right or move to the left of free flow movements
- Low visibility to drivers

Partial Cloverleaf

Proposed Improvement Alternatives:

1) Maintenance and Signage
   - Keep interchange maintained by sweeping curb lanes and shoulders.
   - Trim any trees or bushes that impede sight distance.
   - Place pedestrian and bicycle warning signs at free flow exit ramps (MUTCD W11-1 and W11-2).
   - Place “Begin Right Turn Lane Yield to Bikes” signs prior to free flow entrance ramps (MUTCD R4-4).
   - Place **electrical pedestrian warning system** at particularly dangerous free flow movements, or where sight distance is poor.
   - If signals exist, consider placing “Stop Here on Red” sign to keep vehicles out of crosswalk (MUTCD R10-6).
   - Improve lighting if necessary.

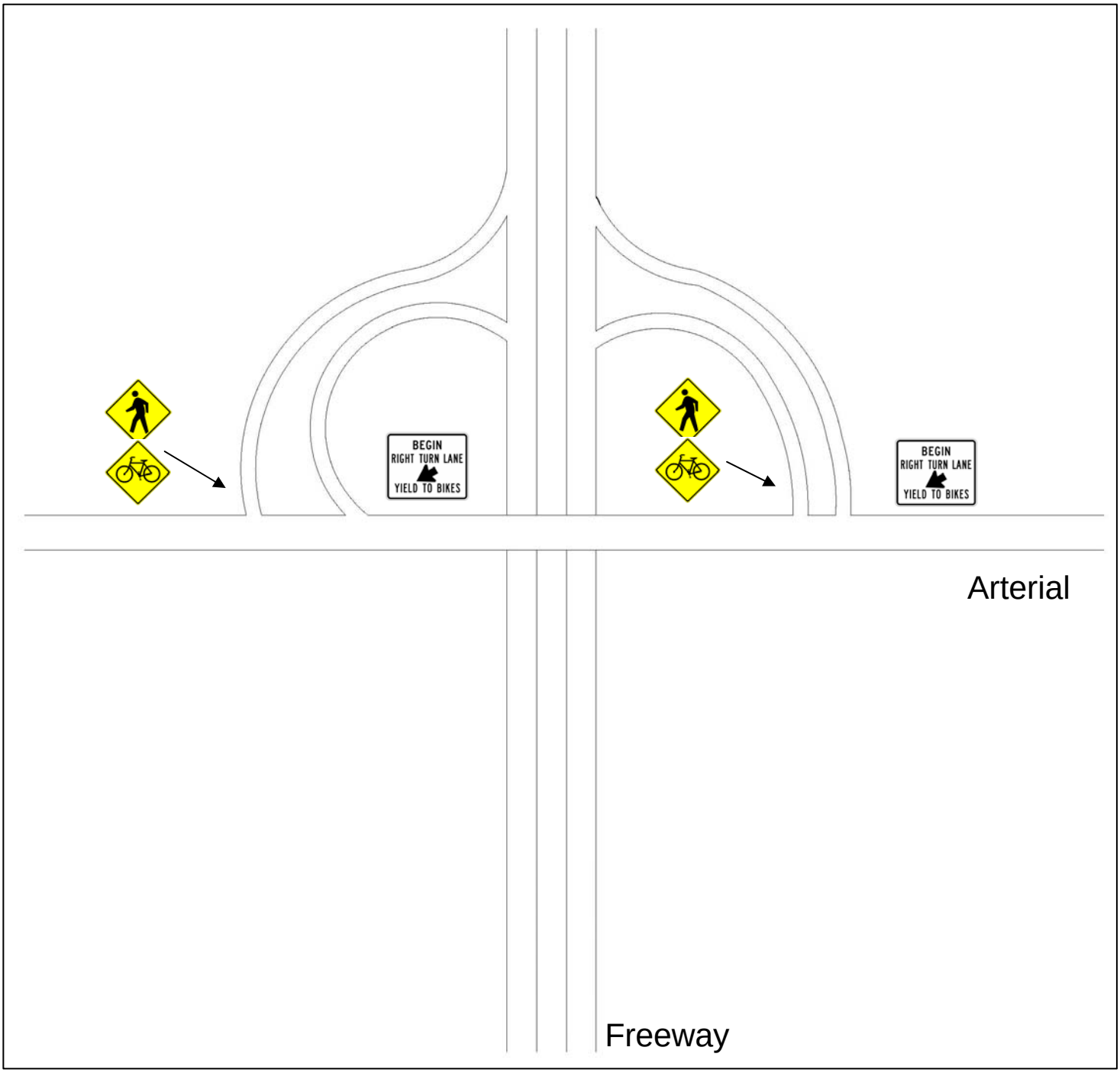
2) Sidewalks and Pedestrian Facilities
   - Connect sidewalk through interchange if not present.
   - Make **freeway ramp crossings** at 90 degree angles.
   - Add zebra striping to freeway pedestrian ramp crossings.
   - Add pedestrian actuated countdown signals where traffic signals exist.
   - Make necessary changes for ADA compliance.
   - If no sidewalk exists, determine appropriate treatment (shoulder, sidewalk, or shared use path) based on pedestrian volumes, adjacent land use, and available right of way. Also need to determine if the facility is needed on both sides of the roadway. If 1 side, make accommodations for cross over at signalized intersections.
   - If an arterial overpass exists, see **Bridge Treatments.**

3) Bicycle Facilities
   - If bicycle lanes or a wide curb lane exists on either end of the interchange, continue them through the interchange.
   - If no facilities exist, determine if a wide curb lane, bicycle lane or shared use path is appropriate.
   - A bicycle lane or wide curb lane could be added by re-striping, narrowing travel lanes and re-striping, or adding pavement to both sides of the roadway and re-striping, if space allows.
   - Consider using **colored pavements** at conflict points between bicycles and vehicles (merge/diverge areas and ramp crossings).
   - If an arterial overpass exists, see **Bridge Treatments.**

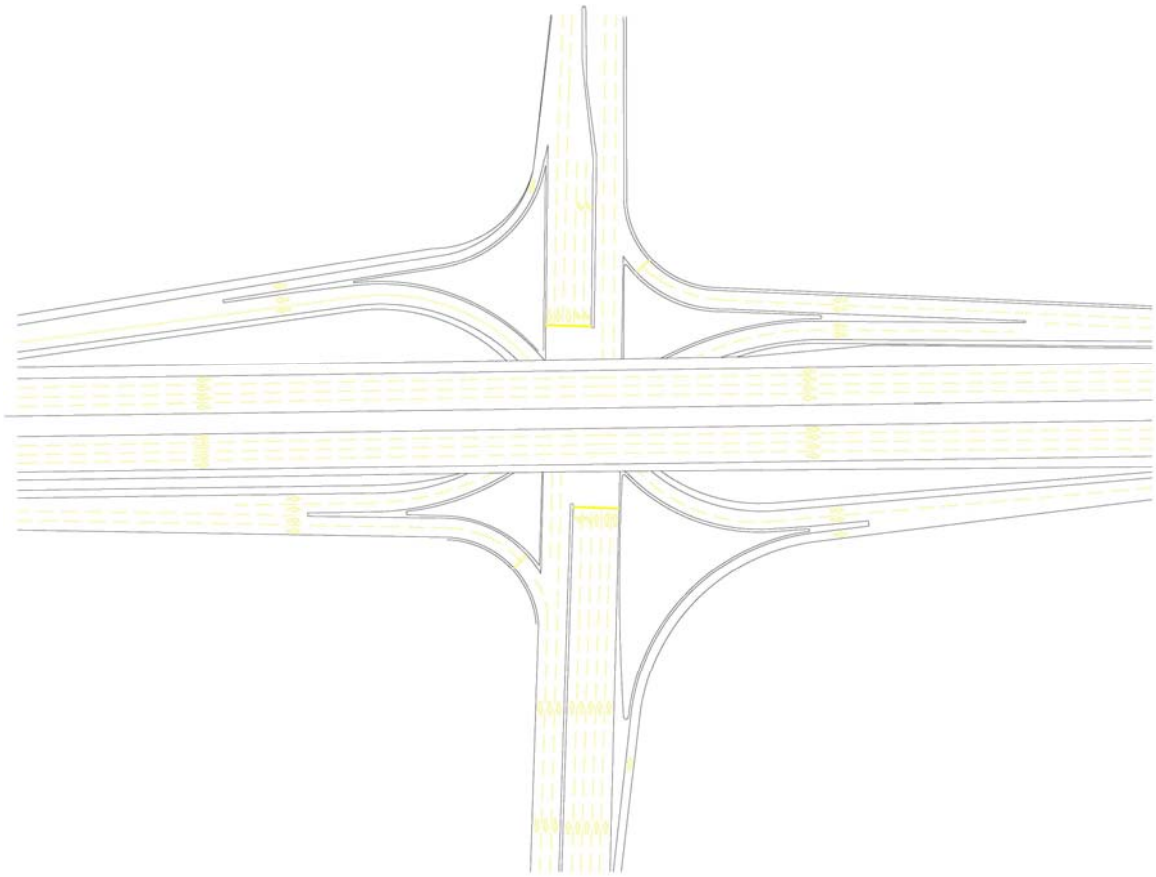
4) Reduction of Conflict Points
   - If **cloverleafs** are free flowing, the free flow movement can be removed and the ramp will intersect with the arterial at a 90 degree angle.
   - Where free flow entrance or exit ramps exist, the free flow movements can be pulled in to intersect the arterial at a 90 degree angle, reducing the number of conflict points.

5) Grade Separation
   - Refer to the ***Florida Pedestrian Facilities Planning and Design Handbook*** for warrants.

Appropriate Signage for Partial Cloverleaf



Single Point Urban Interchange



Interchange Specific Pedestrian / Bicyclist Challenges:

- Only one signal controlling all movements
- Long crossing distance where ramps meet at the signal
- Free flow right-turn movements

Single Point Urban Interchange

Proposed Improvement Alternatives:

1) Maintenance and Signage
   - Keep interchange maintained by sweeping curb lanes and shoulders.
   - Trim any trees or bushes that impede sight distance.
   - Place pedestrian and bicycle warning signs at free flow exit ramps (MUTCD W11-1 and W11-2).
   - Place “Begin Right Turn Lane Yield to Bikes” signs prior to free flow entrance ramps (MUTCD R4-4).
   - Place **electrical pedestrian warning system** at particularly dangerous free flow movements, or where sight distance is poor.
   - Place “Stop Here On Red” signs at signals to keep vehicles out of crosswalks (MUTCD R10-6)
   - Improve lighting if necessary.

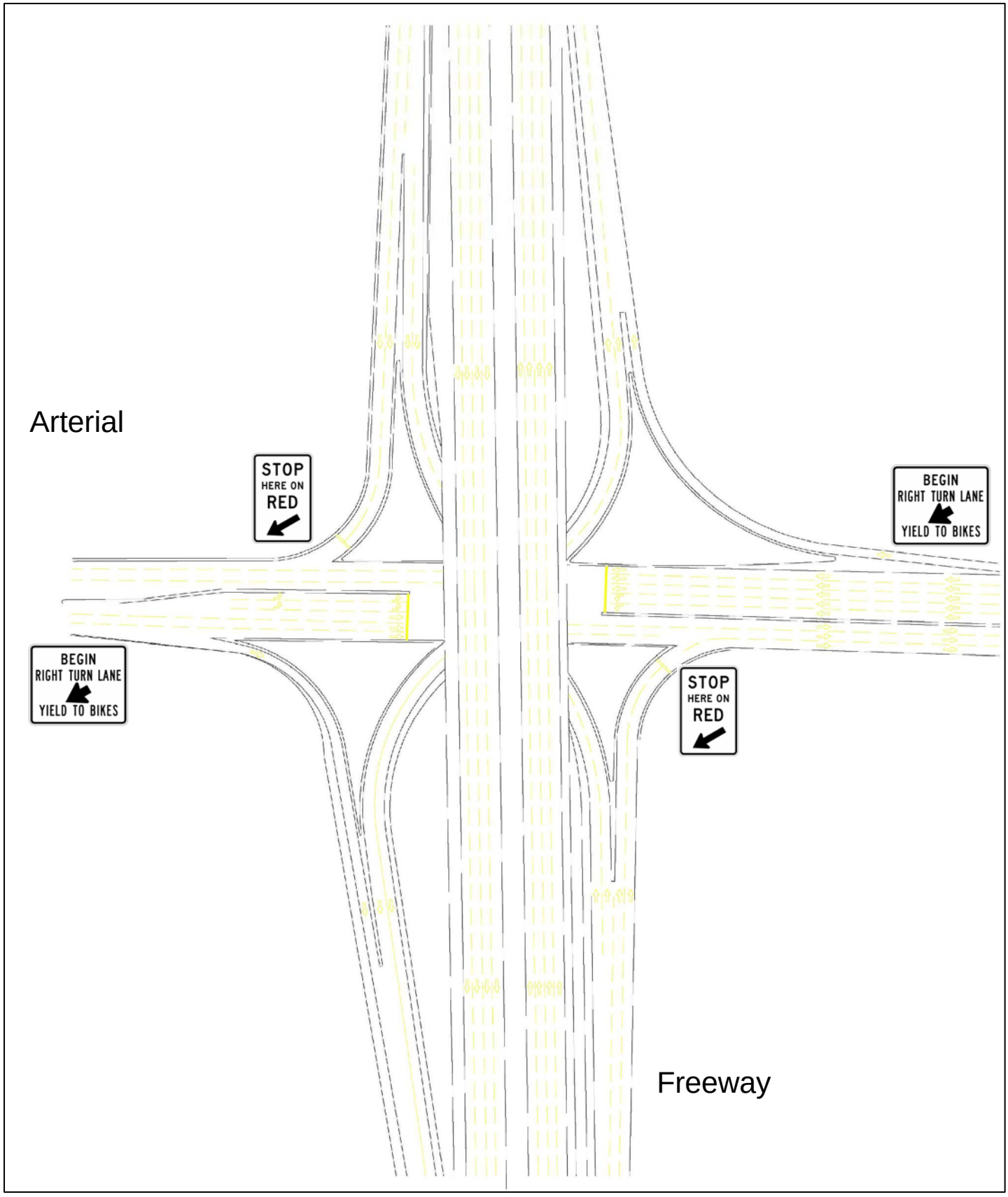
2) Sidewalks and Pedestrian Facilities
   - Connect sidewalk through interchange if not present.
   - Make **freeway ramp crossings** at 90 degree angles.
   - Add zebra striping to freeway pedestrian ramp crossings.
   - Add pedestrian actuated countdown signals.
   - Make necessary changes for ADA compliance.
   - If no sidewalk exists, determine the appropriate treatment (shoulder, sidewalk, or shared use path) based on pedestrian volumes, adjacent land use, and available right of way. Also need to determine if the facility is needed on both sides of the roadway. If 1 side, make accommodations for cross over at signalized intersections.
   - If an arterial overpass exists, see **Bridge Treatments.**

3) Bicycle Facilities
   - If bicycle lanes or a wide curb lane exists on either end of the interchange, continue them through the interchange.
   - If no facilities exist, determine if a wide curb lane, bicycle lane or shared use path is appropriate.
   - A bicycle lane or wide curb lane could be added by re-striping, narrowing travel lanes and re-striping, or adding pavement to both sides of the roadway and re-striping, if space allows.
   - Consider using **colored pavements** at conflict points between bicycles and vehicles (merge/diverge areas and ramp crossings).
   - If an arterial overpass exists, see **Bridge Treatments.**

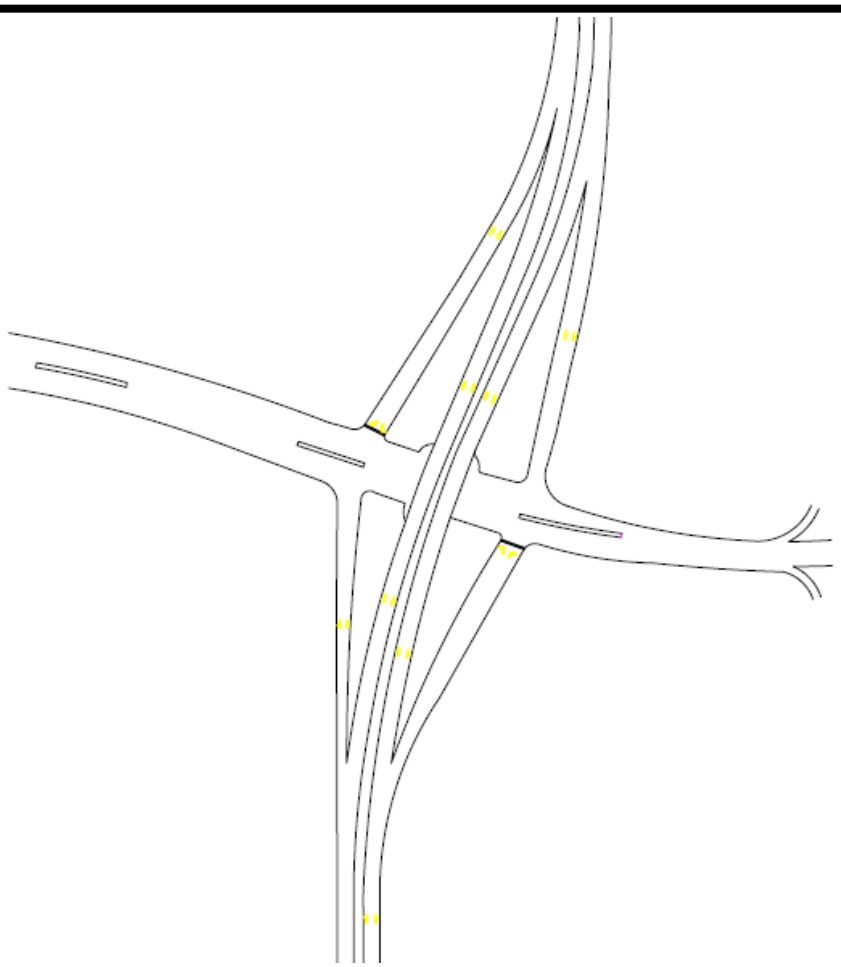
4) Reduction of Conflict Points
   - Consider tighter SPUI so free flow right turn entrance and exit ramps are closer to 90 degree angles causing vehicles to reduce speed.

5) Grade Separation
   - Refer to the ***Florida Pedestrian Facilities Planning and Design Handbook*** for warrants.

Appropriate Signage for SPUI



Diamond Interchange with Arterial Under Interstate



Interchange Specific Pedestrian / Bicyclist Challenges:

- Multiple conflict points
- Free flow right-turn movements
- Confusion for bicyclists regarding whether to stay to the right or move to the left of free flow movements

Diamond Interchange with Arterial Under Interstate

Proposed Improvement Alternatives:

1) Maintenance and Signage

- Keep interchange maintained by sweeping curb lanes and shoulders.
- Trim any trees or bushes that impede sight distance.
- Place pedestrian and bicycle warning signs at free flow exit ramps (MUTCD W11-1 and W11-2).
- Place “Begin Right Turn Lane Yield to Bikes” signs prior to free flow entrance ramps (MUTCD R4-4).
- Place **electrical pedestrian warning system** at particularly dangerous free flow movements, or where sight distance is poor.
- If signals exist, consider placing “Stop Here on Red” sign to keep vehicles out of crosswalk (MUTCD R10-6).
- Improve lighting if necessary.

2) Sidewalks and Pedestrian Facilities

- Connect sidewalk through interchange if not present.
- Make **freeway ramp crossings** at 90 degree angles.
- Add zebra striping to freeway pedestrian ramp crossings.
- Add pedestrian actuated countdown signals where traffic signals exist.
- Make necessary changes for ADA compliance.
- If no sidewalk exists, determine appropriate treatment (shoulder, sidewalk, or shared use path) based on pedestrian volumes, adjacent land use, and available right of way. Also need to determine if the facility is needed on both sides of the roadway. If 1 side, make accommodations for cross over at signalized intersections.

3) Bicycle Facilities

- If bicycle lanes or a wide curb lane exists on either end of the interchange, continue them through the interchange.
- If no facilities exist, determine if a wide curb lane, bicycle lane or shared use path is appropriate.
- A bicycle lane or wide curb lane could be added by re-striping, narrowing travel lanes and re-striping, or adding pavement to both sides of the roadway and re-striping, if space allows.
- Consider using **colored pavements** at conflict points between bicycles and vehicles (merge/diverge areas and ramp crossings).

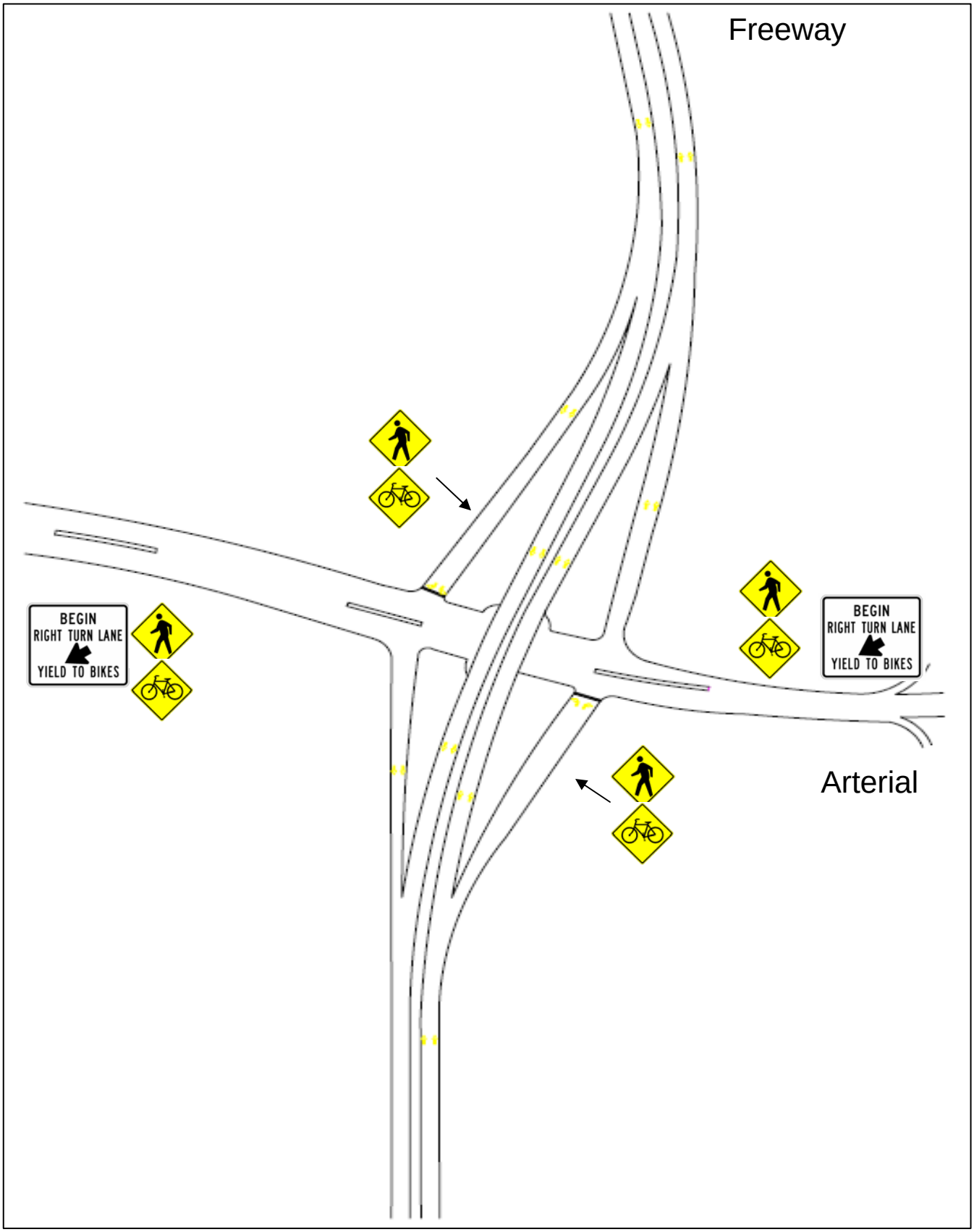
4) Reduction of Conflict Points

- Where free flow entrance or exit ramps exist, the free flow movements can be pulled in to intersect the arterial at a 90 degree angle, reducing the number of conflict points.

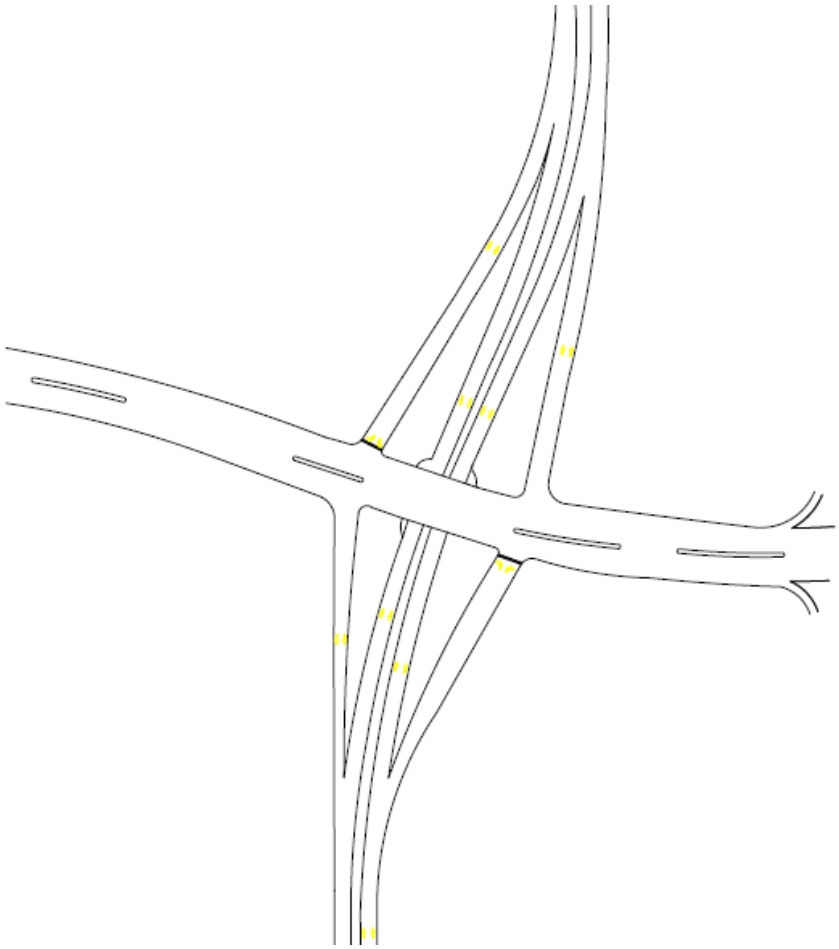
5) Grade Separation

- Refer to the ***Florida Pedestrian Facilities Planning and Design Handbook*** for warrants.

Appropriate Signage for Diamond Interchange With Arterial Under Interstate



Diamond Interchange with Arterial Over Interstate



Interchange Specific Pedestrian / Bicyclist Challenges:

- Multiple conflict points
- Free flow right-turn movements
- Confusion for bicyclists regarding whether to stay to the right or move to the left of free flow movements

Diamond Interchange with Arterial Over Interstate

Proposed Improvement Alternatives:

1) Maintenance and Signage

- Keep interchange maintained by sweeping curb lanes and shoulders.
- Trim any trees or bushes that impede sight distance.
- Place pedestrian and bicycle warning signs at free flow exit ramps (MUTCD W11-1 and W11-2).
- Place "Begin Right Turn Lane Yield to Bikes" signs prior to free flow entrance ramps (MUTCD R4-4).
- Place **electrical pedestrian warning system** at particularly dangerous free flow movements, or where sight distance is poor.
- If signals exist, consider placing "Stop Here on Red" sign to keep vehicles out of crosswalk (MUTCD R10-6).
- Improve lighting if necessary.

2) Sidewalks and Pedestrian Facilities

- Connect sidewalk through interchange if not present.
- Make **freeway ramp crossings** at 90 degree angles.
- Add zebra striping to freeway pedestrian ramp crossings.
- Add pedestrian actuated countdown signals where traffic signals exist.
- Make necessary changes for ADA compliance.
- If no sidewalk exists, determine appropriate treatment (shoulder, sidewalk, or shared use path) based on pedestrian volumes, adjacent land use, and available right of way. Also need to determine if the facility is needed on both sides of the roadway. If 1 side make accommodations for cross over at signalized intersections.
- See **Bridge Treatments** for arterial overpass considerations.

3) Bicycle Facilities

- If bicycle lanes or a wide curb lane exists on either end of the interchange, continue them through the interchange.
- If no facilities exist, determine if a wide curb lane, bicycle lane or shared use path is appropriate.
- A bicycle lane or wide curb lane could be added by re-striping, narrowing travel lanes and re-striping, or adding pavement to both sides of the roadway and re-striping, if space allows.
- Consider using **colored pavements** at conflict points between bicycles and vehicles (merge/diverge areas and ramp crossings).
- See **Bridge Treatments** for arterial overpass considerations.

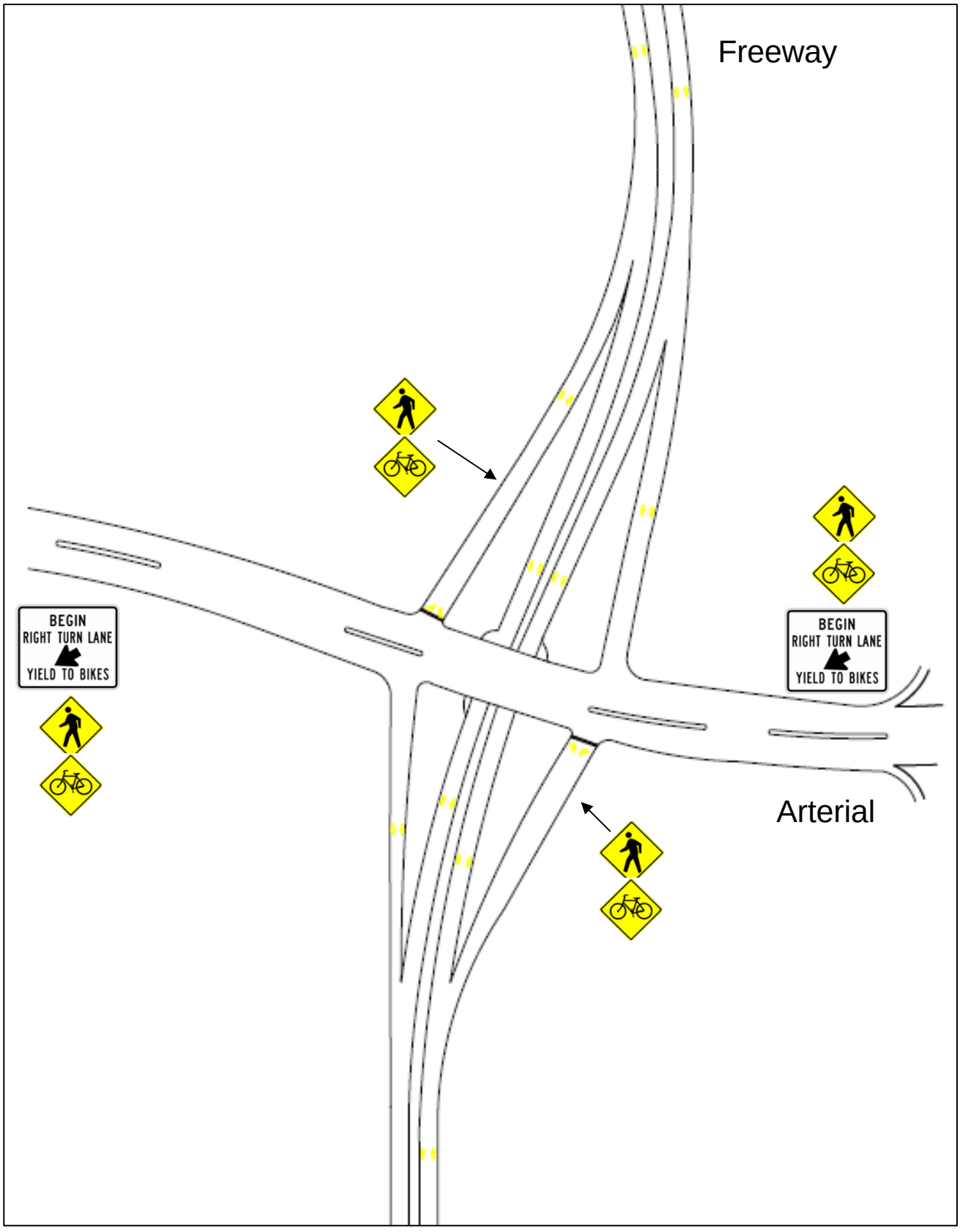
4) Reduction of Conflict Points

- Where free flow entrance or exit ramps exist, the free flow movements can be pulled in to intersect the arterial at a 90 degree angle, reducing the number of conflict points.

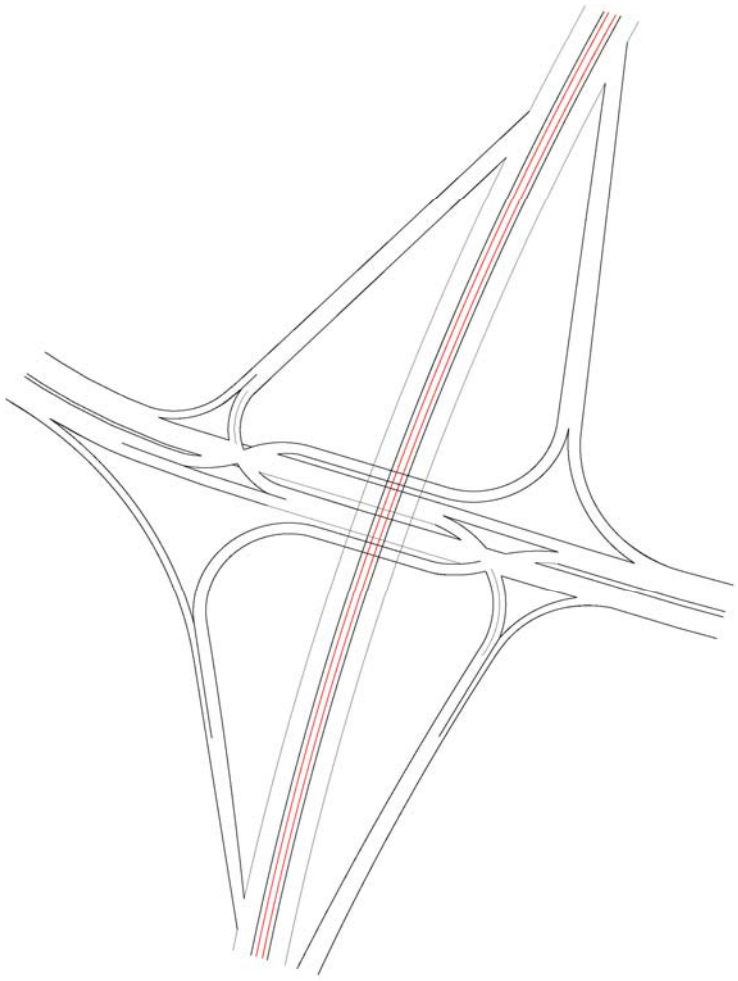
5) Grade Separation

- Refer to the ***Florida Pedestrian Facilities Planning and Design Handbook*** for warrants.

Appropriate Signage for Diamond Interchange With Arterial Over Interstate



Displaced Left Turns Interchange



Interchange Specific Pedestrian / Bicyclist Challenges:

- Confusion when traffic crosses to other side of road
- Driver unfamiliarity with interchange type
- Free flow right and left turn movements

Displaced Left Turns Interchange

Proposed Improvement Alternatives:

1) Maintenance and Signage
   - Keep interchange maintained by sweeping curb lanes and shoulders.
   - Trim any trees or bushes that impede sight distance.
   - Place pedestrian and bicycle warning signs at free flow exit ramps (MUTCD W11-1 and W11-2).
   - Place “Begin Right Turn Lane Yield to Bikes” sign prior to free flow entrance ramps (MUTCD R4-4).
   - Place **electrical pedestrian warning system** at particularly dangerous free flow movements.
   - Place “Stop Here On Red” signs at signals to keep vehicles out of crosswalks, if signals exist. (MUTCD R10-6).
   - Improve lighting if necessary.

2) Sidewalks and Pedestrian Facilities
   - Connect sidewalk through interchange if not present.
   - Make **freeway ramp crossings** at 90 degree angles.
   - Add zebra striping to freeway pedestrian ramp crossings.
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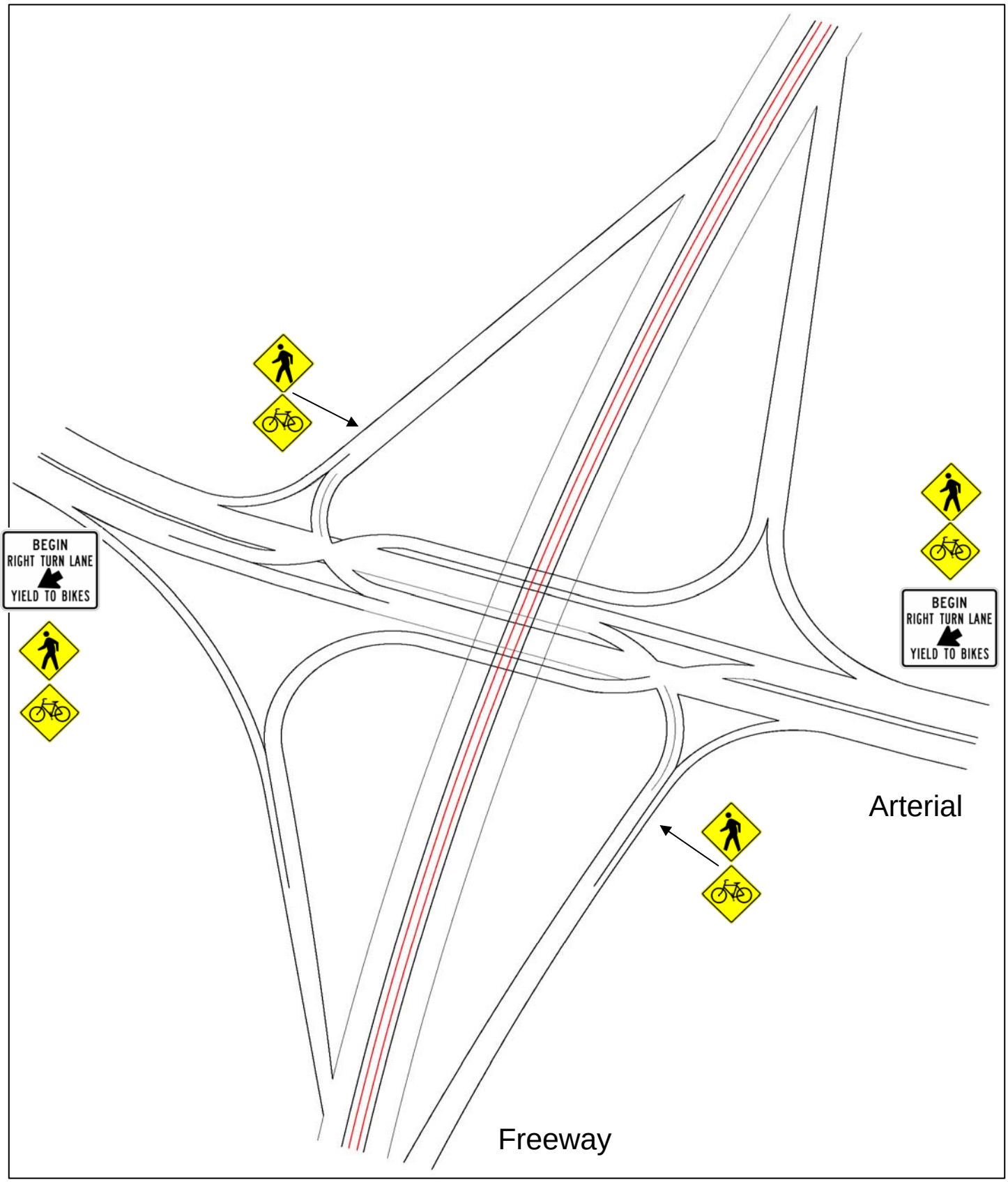
   - Make necessary changes for ADA compliance.
   - If no sidewalk exists, determine the appropriate treatment (shoulder, sidewalk, or shared use path) based on pedestrian volumes, adjacent land use, and available right of way. Also need to determine if the facility is needed on both sides of the roadway. If 1 side, make accommodations for cross over at signalized intersections.
   - If an arterial overpass exists, see **Bridge Treatments**

3) Bicycle Facilities
   - If bicycle lanes or a wide curb lane exists on either end of the interchange, continue them through the interchange.
   - If no facilities exist, determine if a wide curb lane, bicycle lane or shared use path is necessary.
   - A bicycle lane or wide curb lane could be added by re-striping, narrowing travel lanes and re-striping, or adding pavement to both sides of the roadway and re-striping, if space allows.
   - Consider using **colored pavements** at conflict points between bicycles and vehicles (merge/diverge areas and ramp crossings).
   - If an arterial overpass exists, see **Bridge Treatments**

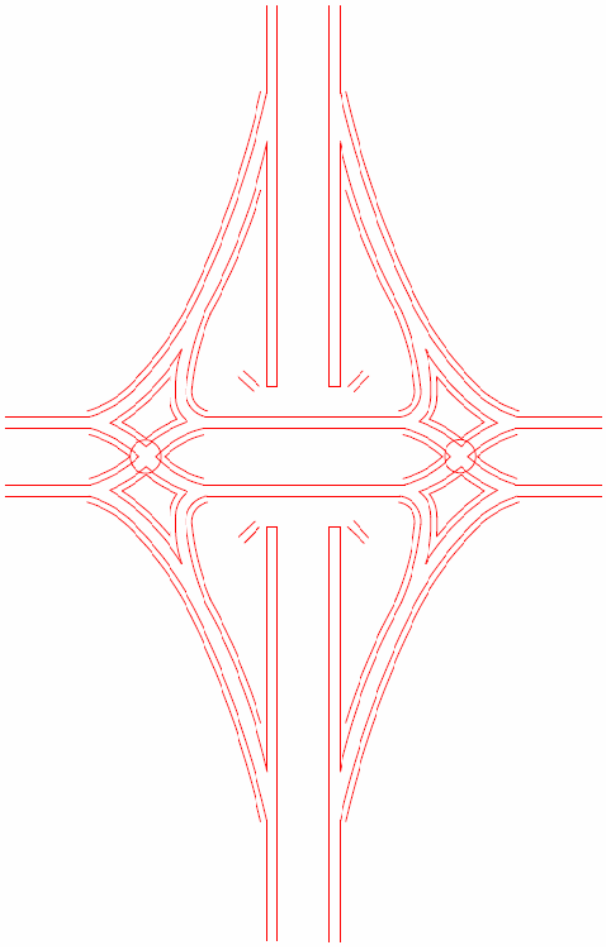
4) Reduction of Conflict Points
   - Where free flow entrance or exit ramps exist, the free flow movements can be pulled in to intersect the arterial at a 90 degree angle.

5) Grade Separation
   - Refer to the ***Florida Pedestrian Facilities Planning and Design Handbook*** for warrants.

Appropriate Signage for Displaced Left Turns



Diverging Diamond Interchange



Interchange Specific Pedestrian / Bicyclist Challenges:

- Confusion when traffic crosses to other side of road
- Driver unfamiliarity with interchange type
- Free flow right and left turn movements

Diverging Diamond Interchange

Proposed Improvement Alternatives:

1) Maintenance and Signage
   - Keep interchange maintained by sweeping curb lanes and shoulders.
   - Trim any trees or bushes that impede sight distance.
   - Place pedestrian and bicycle warning signs at free flow exit ramps (MUTCD W11-1 and W11-2).
   - Place “Begin Right Turn Lane Yield to Bikes” signs prior to free flow entrance ramps (MUTCD R4-4).
   - Place **electrical pedestrian warning** system at particularly dangerous free flow movements, or where sight distance is poor.
   - Place “Stop Here On Red” signs at signals to keep vehicles out of crosswalks, if signals exist. (MUTCD R10-6).
   - Improve lighting if necessary.

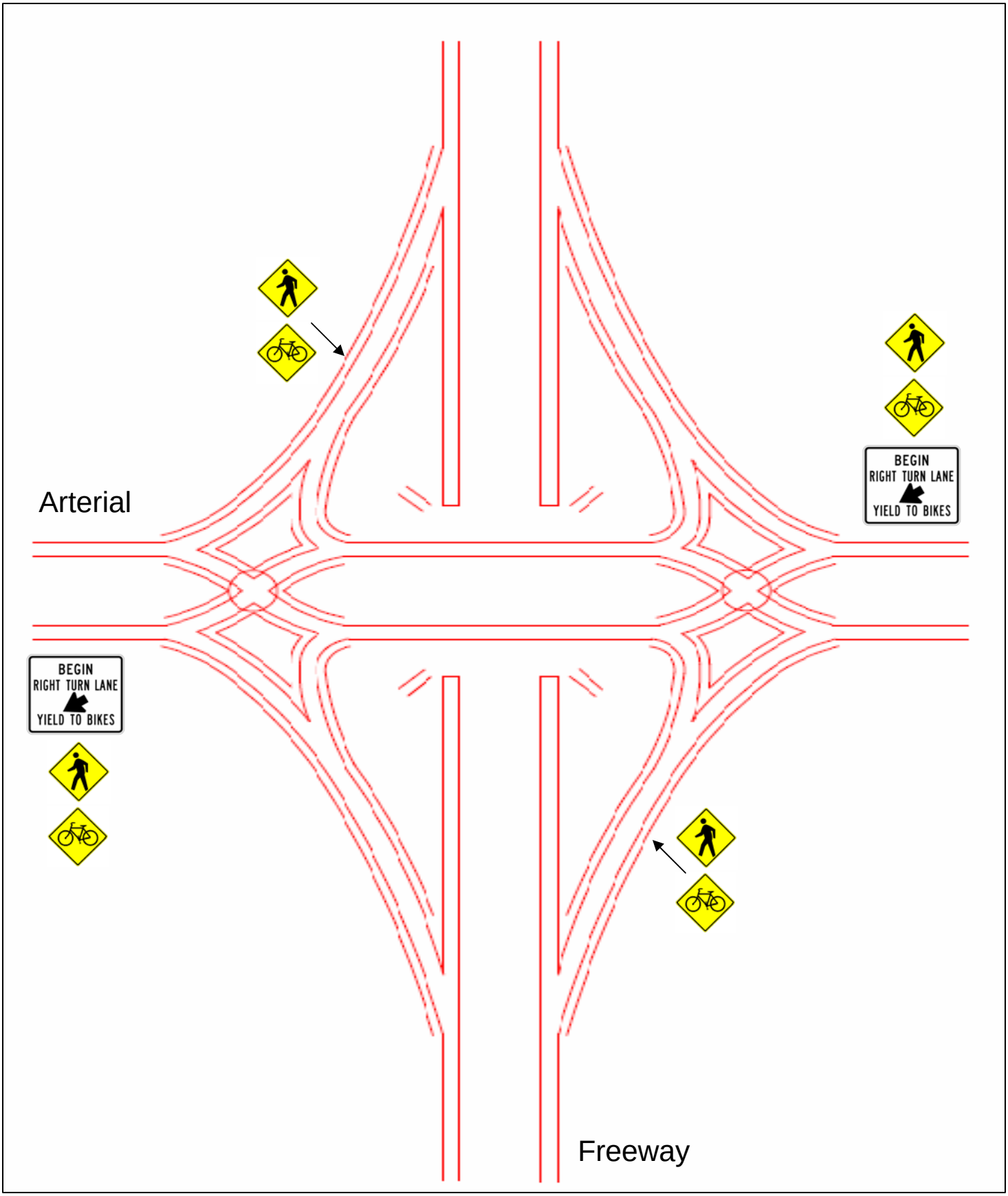
2) Sidewalks and Pedestrian Facilities
   - Connect sidewalk through interchange if not present.
   - Make **freeway ramp crossings** at 90 degree angles.
   - Add zebra striping to freeway pedestrian ramp crossings.
   - Add pedestrian actuated countdown signals.
   - Make necessary changes for ADA compliance.
   - If no sidewalk exists, determine the appropriate treatment (shoulder, sidewalk, or shared use path) based on pedestrian volumes, adjacent land use, and available right of way. Also need to determine if the facility is needed on both sides of the roadway. If 1 side, make accommodations for cross over at signalized intersections.
   - If an arterial overpass exists, see **Bridge Treatments.**

3) Bicycle Facilities
   - If bicycle lanes or a wide curb lane exists on either end of the interchange, continue them through the interchange.
   - If no facilities exist, a separate path is an appropriate solution.
   - If space does not permit a separate facility determine if a wide curb lane or bicycle lane is appropriate. If necessary, a bicycle lane or wide curb lane could be added by re-striping, narrowing travel lanes and re-striping, or adding pavement to both sides of the roadway and re-striping.
   - Consider using **colored pavements** at conflict points between bicycles and vehicles (merge/diverge areas and ramp crossings).
   - If an arterial overpass exists, see **Bridge Treatments.**

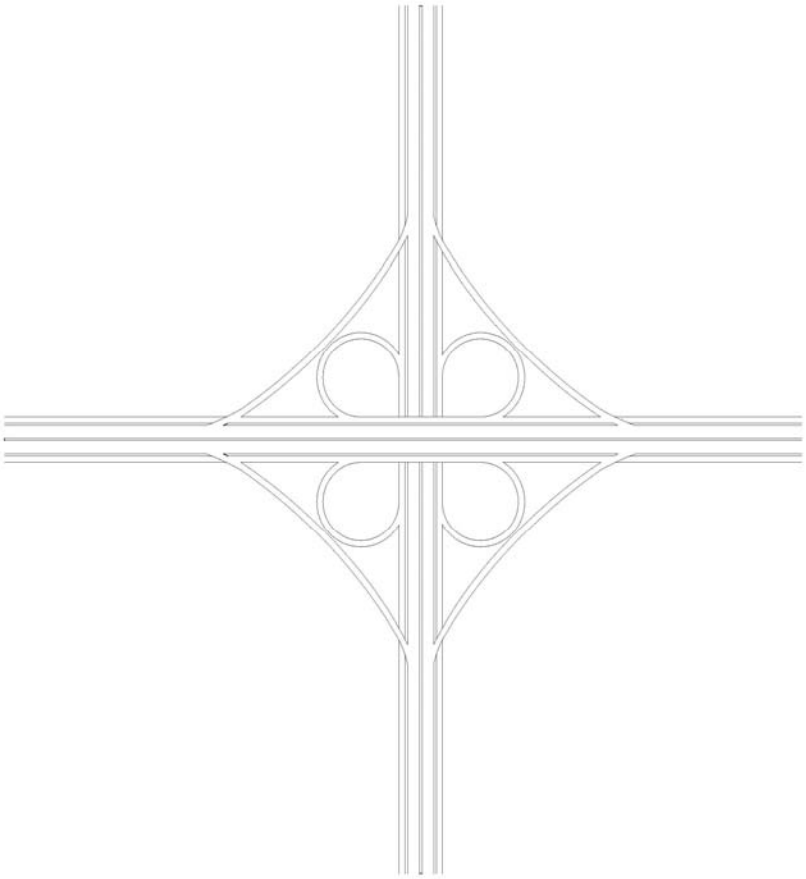
4) Reduction of Conflict Points
   - Tighten ramps to intersect at 90 degree angle, and bring right and left turns together to reduce the number of conflict points.

5) Grade Separation
   - Refer to the ***Florida Pedestrian Facilities Planning and Design Handbook*** for warrants.

Appropriate Signage for Diverging Diamond



Full Cloverleaf Interchange



Interchange Specific Pedestrian / Bicyclist Challenges:

- High speed free flow movements with long merge areas
- Confusion regarding whether to stay to the right or move to the left of free flow movements
- Multiple conflict points
- Low visibility to drivers

Full Cloverleaf Interchange

Proposed Improvement Alternatives:

1) Maintenance and Signage
   - Keep interchange maintained by sweeping curb lanes and shoulders.
   - Trim any trees or bushes that impede sight distance.
   - Place pedestrian and bicycle warning signs at free flow exit ramps (MUTCD W11-1 and W11-2).
   - Place “Begin Right Turn Lane Yield to Bikes” signs prior to free flow entrance ramps (MUTCD R4-4).
   - Place **electrical pedestrian warning system** at particularly dangerous free flow movements, or where sight distance is poor.
   - Improve lighting if necessary.

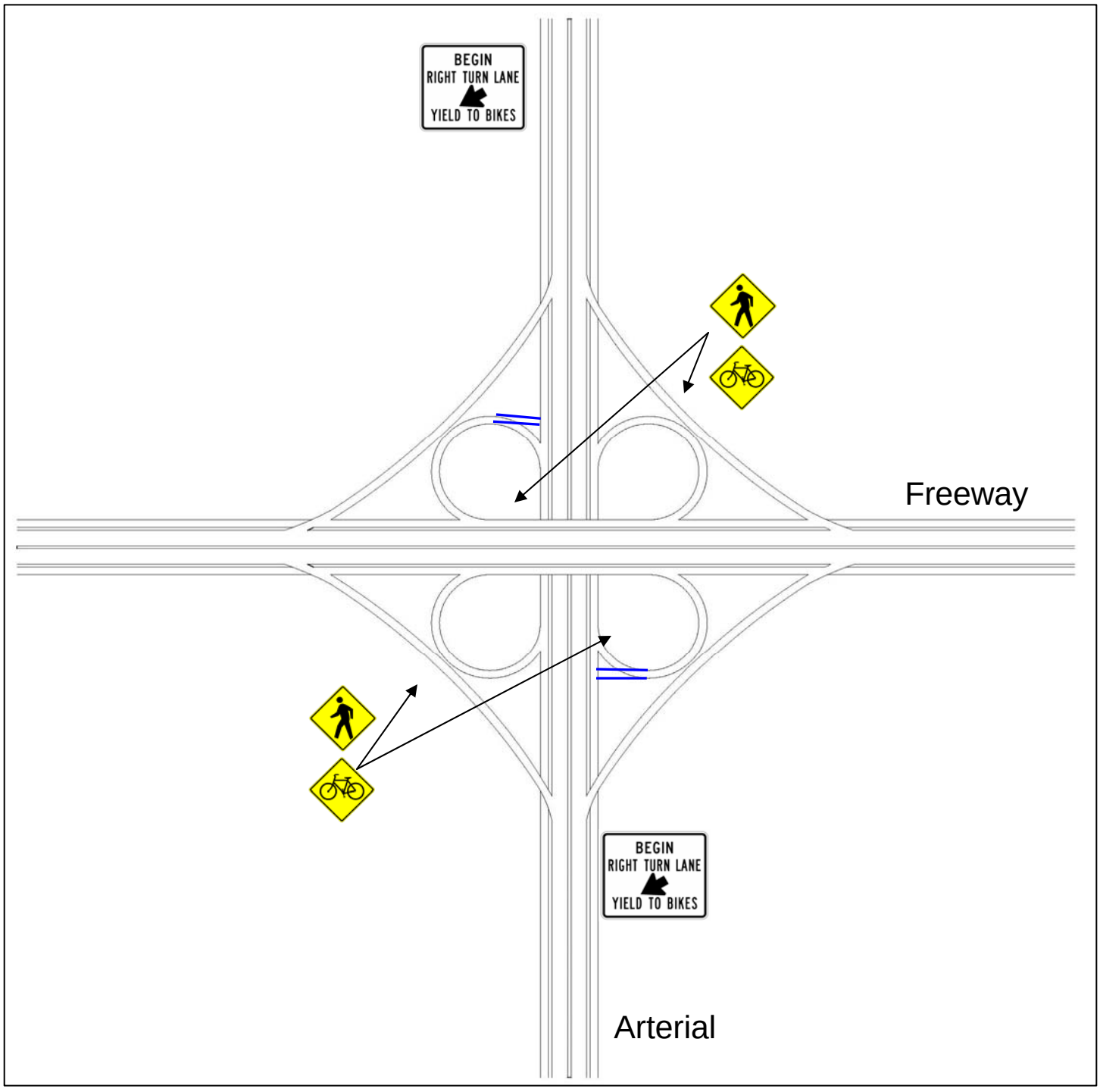
2) Sidewalks and Pedestrian Facilities
   - Connect sidewalk through interchange if not present.
   - Make **freeway ramp crossings** at 90 degree angles.
   - Add zebra striping to freeway pedestrian ramp crossings.
   - Make necessary changes for ADA compliance.
   - If no sidewalk exists, determine the appropriate treatment (shoulder, sidewalk, or shared use path) based on pedestrian volumes, adjacent land use, and available right of way. Also need to determine if the facility is needed on both sides of the roadway. If 1 side, make accommodations for cross over at signalized intersections.
   - If an arterial overpass exists, see **Bridge Treatments**

3) Bicycle Facilities
   - If bicycle lanes or a wide curb lane exists on either end of the interchange, continue them through the interchange.
   - If no facilities exist, determine if a wide curb lane, bicycle lane or shared use path is appropriate.
   - A bicycle lane or wide curb lane could be added by re-striping, narrowing travel lanes and re-striping, or adding pavement to both sides of the roadway and re-striping, if space allows.
   - Consider using **colored pavements** at conflict points between bicycles and vehicles (merge/diverge areas and ramp crossings).
   - If an arterial overpass exists, see **Bridge Treatments**

4) Reduction of Conflict Points
   - Where **cloverleafs** exist, the free flow movement can be removed and the ramp will intersect with the arterial at a 90 degree angle.
   - Where free flow entrance or exit ramps exist, the free flow movements can be pulled in to intersect the arterial at a 90 degree angle.

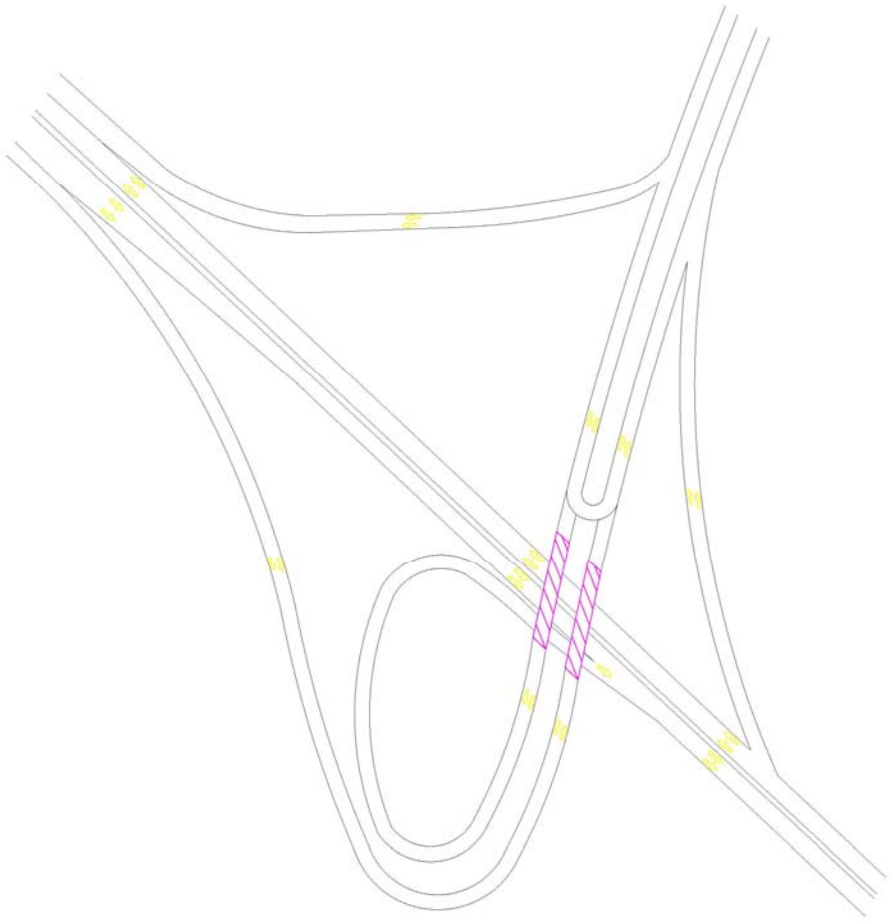
5) Grade Separation
   - Refer to the ***Florida Pedestrian Facilities Planning and Design Handbook*** for warrants.

Appropriate Signage for Full Cloverleaf



*The blue lines indicate how the cloverleafs can be brought in to intersect the arterial at 90 degree angles, and reduce conflict points and merging areas.

Trumpet Interchange



Interchange Specific Pedestrian / Bicyclist Challenges:

- High speed free flow movements with long merge areas
- Confusion regarding whether to stay to the right or move to the left of free flow movements
- Multiple conflict points

Trumpet Interchange

Proposed Improvement Alternatives:

1) Maintenance and Signage
   - Keep interchange maintained by sweeping curb lanes and shoulders.
   - Trim any trees or bushes that impede sight distance.
   - Place pedestrian and bicycle warning signs at free flow exit ramps (MUTCD W11-1 and W11-2).
   - Place "Begin Right Turn Lane Yield to Bikes" sign prior to free flow entrance ramps (MUTCD R4-4).
   - Place **electrical pedestrian warning system** at particularly dangerous free flow movements.
   - Improve lighting if necessary.

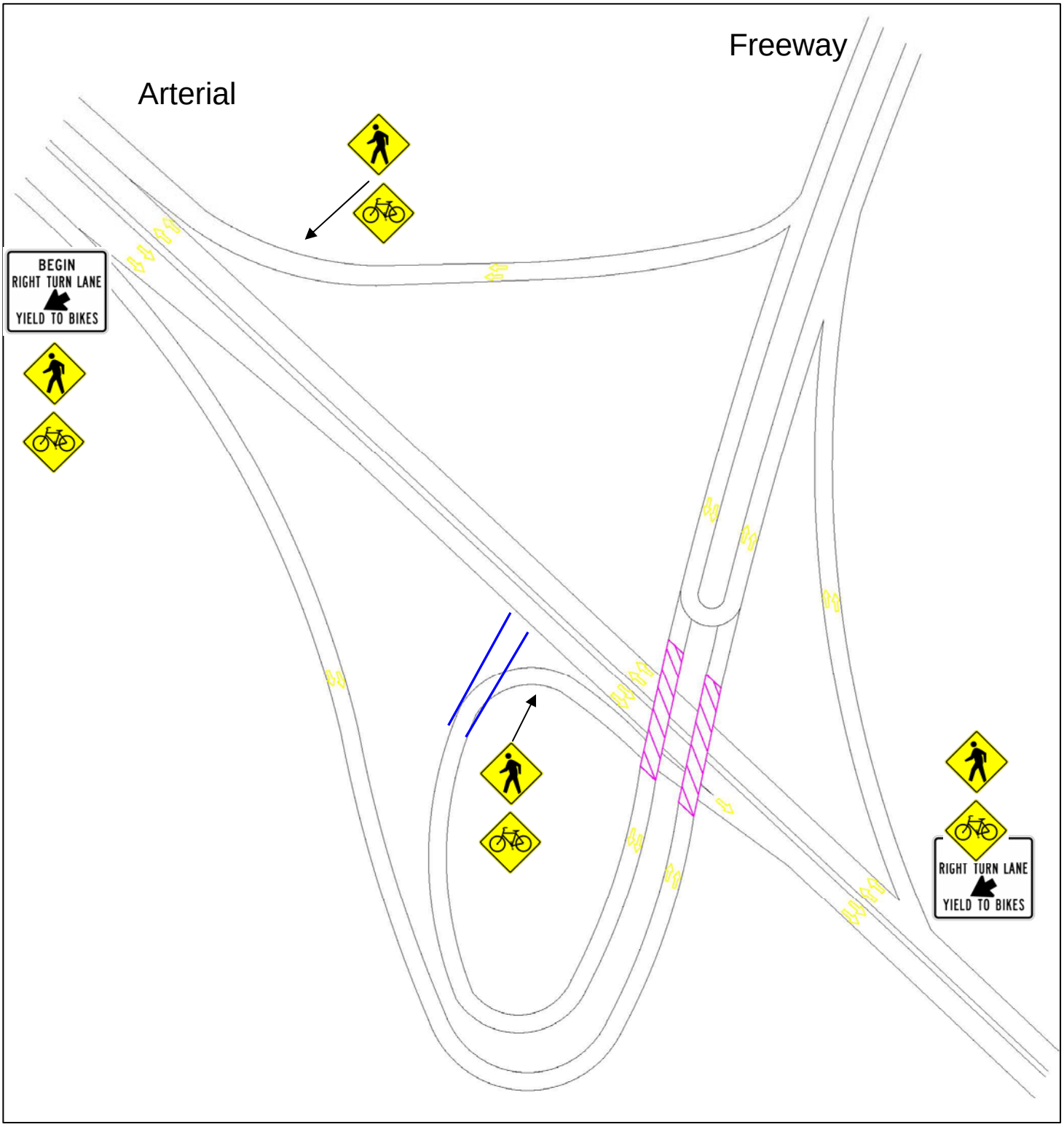
2) Sidewalks and Pedestrian Facilities
   - Connect sidewalk through interchange if not present.
   - Make **freeway ramp crossings** at 90 degree angles.
   - Add zebra striping to freeway pedestrian ramp crossings.
   - Make necessary changes for ADA compliance.
   - If no sidewalk exists, determine the appropriate treatment (shoulder, sidewalk, or shared use path) based on pedestrian volumes, adjacent land use, and available right of way. Also need to determine if the facility is needed on both sides of the roadway. If 1 side, make accommodations for cross over at signalized intersections.

3) Bicycle Facilities
   - If bicycle lanes or a wide curb lane exists on either end of the interchange, continue them through the interchange.
   - If no facilities exist, determine if a wide curb lane, bicycle lane or shared use path is necessary.
   - A bicycle lane or wide curb lane could be added by re-striping, narrowing travel lanes and re-striping, or adding pavement to both sides of the roadway and re-striping, if space allows.
   - Consider using **colored pavements** at conflict points between bicycles and vehicles (merge/diverge areas and ramp crossings).

4) Reduction of Conflict Points
   - Where **cloverleafs** exist, the free flow movement can be removed and the ramp will intersect with the arterial at a 90 degree angle.
   - Where free flow entrance or exit ramps exist, the free flow movements can be pulled in to intersect the arterial at a 90 degree angle.

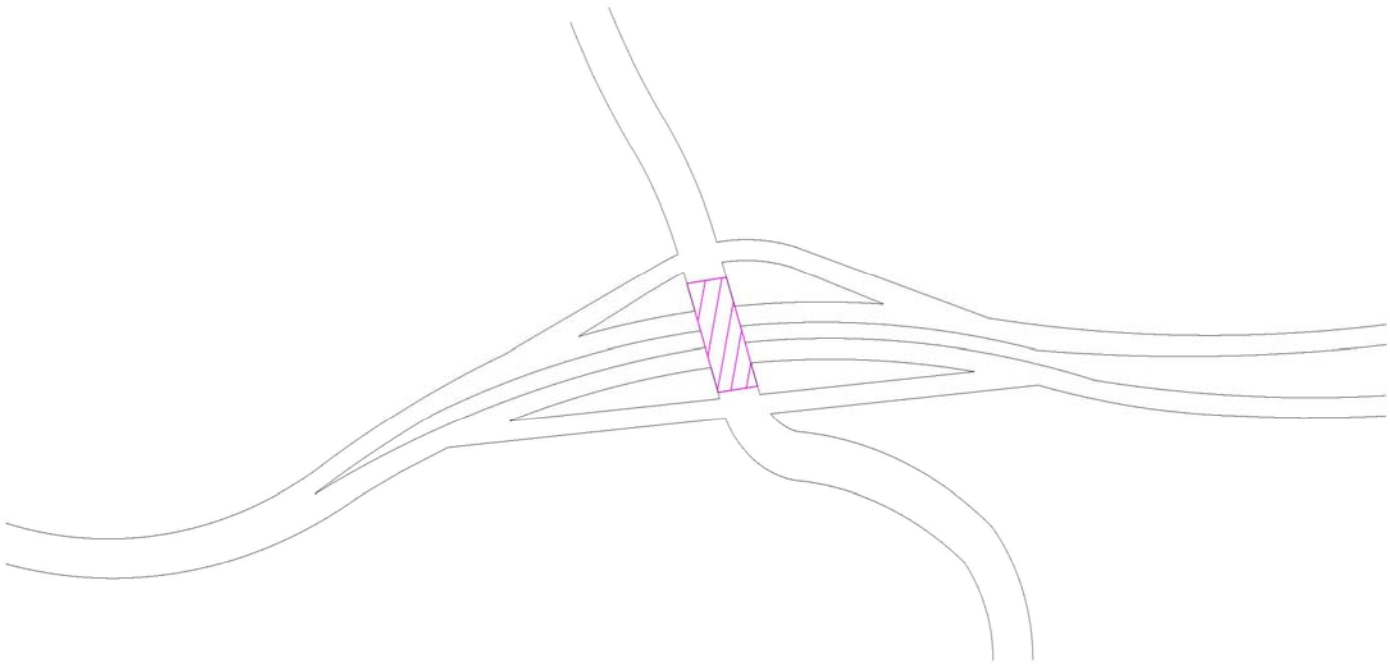
5) Grade Separation
   - Refer to the ***Florida Pedestrian Facilities Planning and Design Handbook*** for warrants.

Appropriate Signage for Trumpet Interchange



*The blue lines indicate how the cloverleafs can be brought in to intersect the arterial at 90 degree angles, and reduce conflict points and merging areas.

Tight Diamond Interchange



Interchange Specific Pedestrian / Bicyclist Challenges:

- Multiple conflict points
- Right-turn and right-turn on red movements

Tight Diamond Interchange

Proposed Improvement Alternatives:

1) Maintenance and Signage
   - Keep interchange maintained by sweeping curb lanes and shoulders.
   - Trim any trees or bushes that impede sight distance.
   - Place pedestrian and bicycle warning signs at free flow exit ramps (MUTCD W11-1 and W11-2).
   - Place “Begin Right Turn Lane Yield to Bikes” signs prior to entrance ramps (MUTCD R4-4).
   - Place “Stop Here On Red” signs at signals to keep vehicles out of crosswalks, if signals exist. (MUTCD R10-6)
   - Improve lighting if necessary.

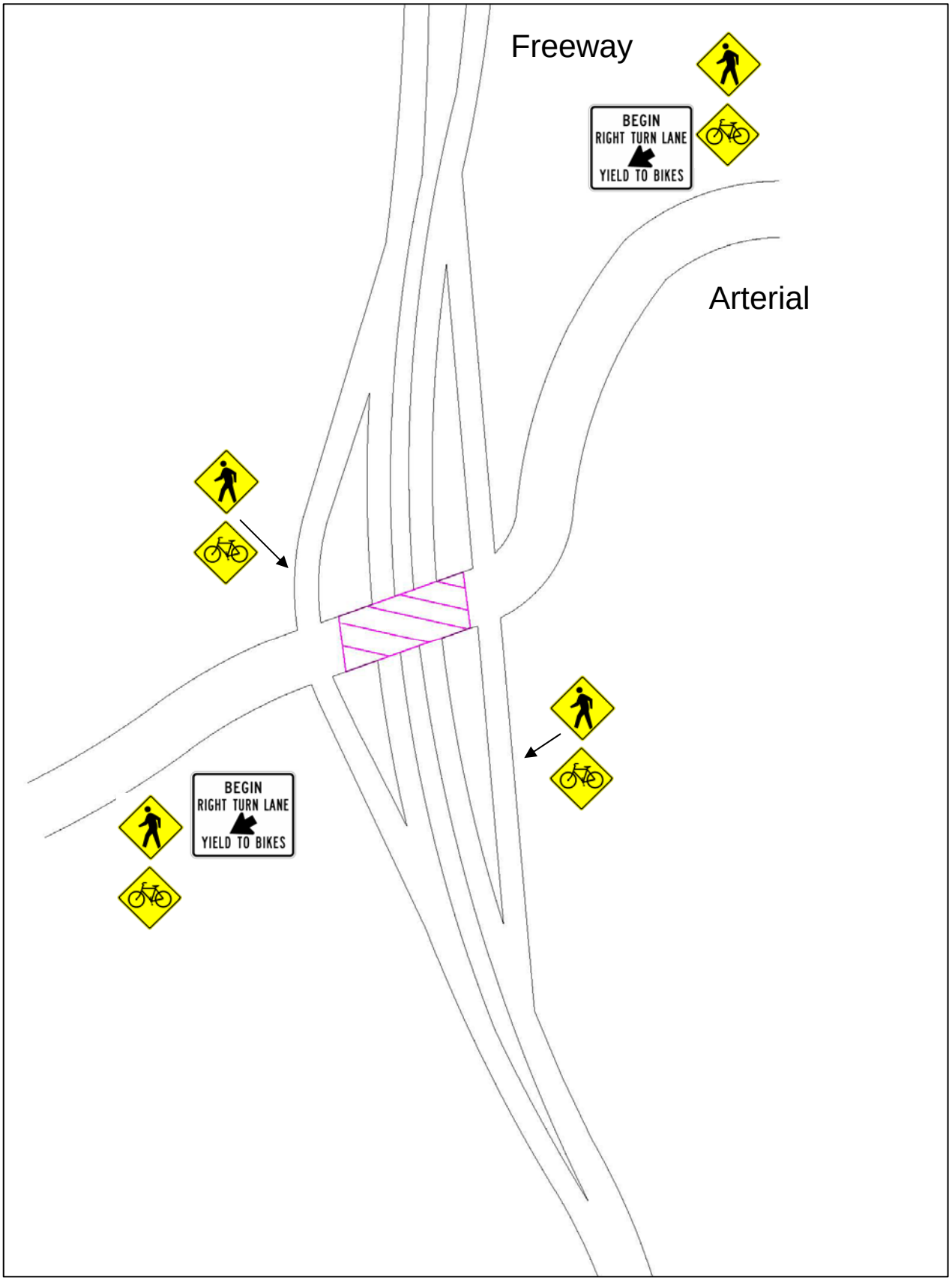
2) Sidewalks and Pedestrian Facilities
   - Connect sidewalk through interchange if not present.
   - Add zebra striping to freeway pedestrian ramp crossings.
   - Add pedestrian actuated countdown signals where traffic signals exist.
   - Make necessary changes for ADA compliance.
   - If no sidewalk exists, determine the appropriate treatment (shoulder, sidewalk, or shared use path) based on pedestrian volumes, adjacent land use, and available right of way. Also need to determine if the facility is needed on both sides of the roadway. If 1 side make accommodations for cross over at signalized intersections.
   - If an arterial overpass exists, see **Bridge Treatments**

3) Bicycle Facilities
   - If bicycle lanes or a wide curb lane exists on either end of the interchange, continue them through the interchange.
   - If no facilities exist, determine if a wide curb lane, bicycle lane or shared use path is necessary.
   - A bicycle lane or wide curb lane could be added by re-striping, narrowing travel lanes and re-striping, or adding pavement to both sides of the roadway and re-striping, if space allows.
   - Consider using **colored pavements** at conflict points between bicycles and vehicles (merge/diverge areas and ramp crossings).
   - If an arterial overpass exists, see **Bridge Treatments**

4) Reduction of Conflict Points
   - Not applicable because by definition a tight diamond interchange minimizes conflict points.

5) Grade Separation
   - Refer to the ***Florida Pedestrian Facilities Planning and Design Handbook*** for warrants.

Appropriate Signage for Tight Diamond Interchange



Electrical Pedestrian Warning Systems

http://www.stopexperts.com/

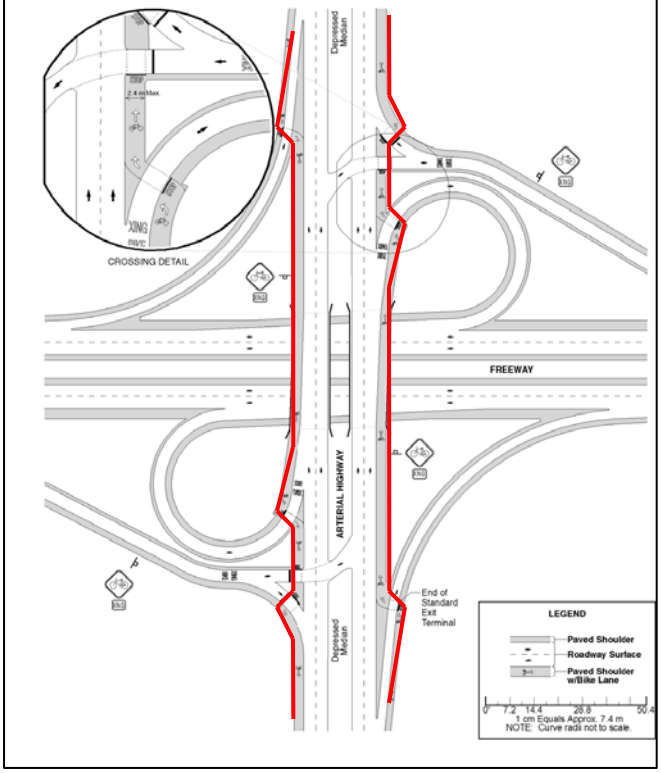
- Above is an example of a pedestrian warning system. Although it is not MUTCD approved it could be used experimentally, to draw extra attention to pedestrian crossings.

http://www.roadlights.com/content/products/R820C/default.aspx

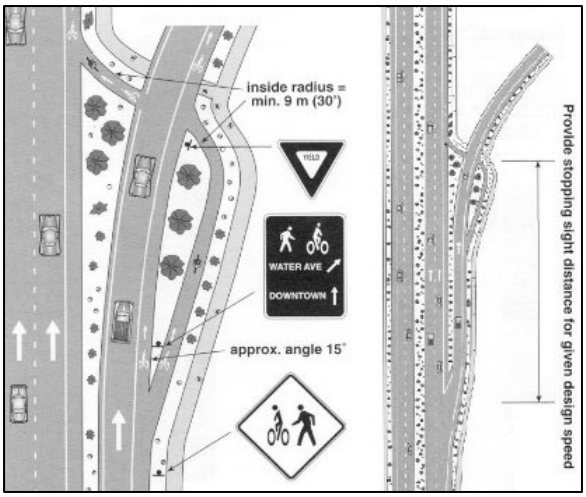
- The flashing pedestrian beacon shown above is similar to what is approved in the MUTCD and can also be used to draw extra attention to pedestrian crossings.

Crossing of Sidewalks, Bike Lanes, and Shared-Use Paths through Interchanges

Sidewalk Crossing Freeway Ramp

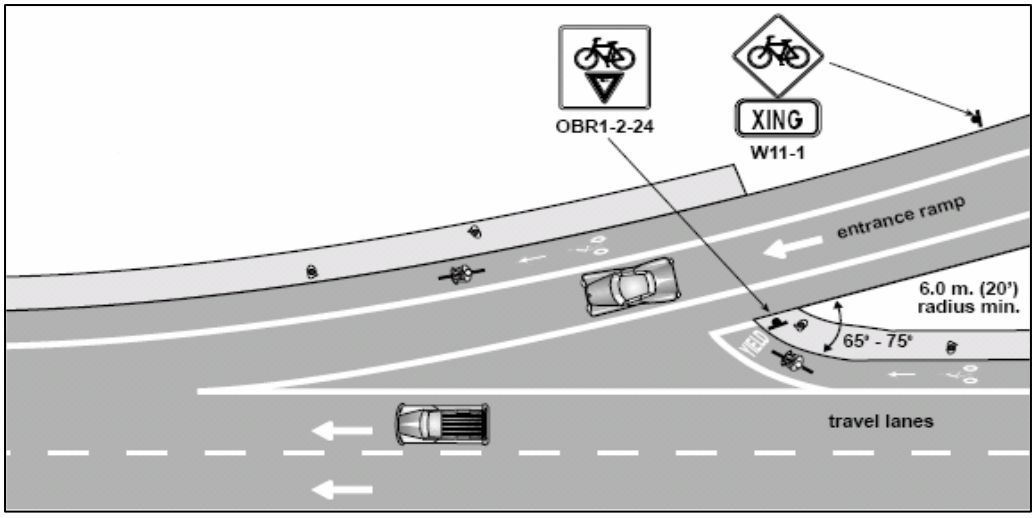


Shared Use Path Crossing Freeway Ramp



- These graphics show 90-degree crossings of freeway ramps which enhance visibility and decrease crossing distance.

Bike Lane Crossing Freeway Ramp



Bridge Treatments

If possible, continue existing facilities across bridge. If not, consider the following:

For Pedestrians:

- Narrow travel lanes and/or restripe to provide sidewalks or wide curb lanes on both sides of roadway.
- If bridge width does not permit sidewalks or wide curb lanes along both sides, narrow travel lanes, and/or restripe to provide facilities on one side of roadway
- If possible provide a barrier between pedestrians and vehicles

For Bicyclists:

- Narrow travel lanes and/or restripe to allow for bicycle lanes to be carried through on one or both sides of the roadway
- If bicycle lanes are not present on either end of the bridge, bicyclists may share a wide curb lane or sidewalk with pedestrians. If sidewalk is shared bicyclists should dismount and walk across bridge. The sign below should be present.

- If possible provide a barrier between bicyclists and vehicles
- For additional guidance see the following website: http://www.dot.il.gov/desenv/BDE%20Manual/BDE/pdf/chap17.pdf, page 17-2(10). (Or the next page of toolbox.)

  ** Please note that this is not Kentucky State policy but is one example of another state's approach to bicycle design through an interchange.

If the above treatments are not possible, consider a separate bike and pedestrian bridge over interstate

- If the bridge is too narrow to safely accommodate bicyclists and pedestrians over the bridge, and if volumes warrant it, a separate structure should be built to accommodate them.

Bridge Treatments from Illinois BDE Manual

17-2.01(e) Bikeway on Highway Structures

Bicycle accommodations on approach roadways should be carried across structures. The width of new highway structures should, at a minimum, equal the width of the traveled way plus the width of approaching bicycle lanes and/or sidewalks. Minimum cross sections for roadways and structures will vary significantly depending on the type of bicycle facility being accommodated. Several examples of minimum cross sections for shared roadways, bicycle lanes and bicycle paths are shown in Figures 17-2J through 17-2L. In addition, the criteria for accommodating bikeways at or near bridges along freeways and expressways are illustrated in Figure 17-2M. Figure 17-2N presents a typical modification of existing facilities for bikeways under a bridge.

Where it is necessary to retrofit a separated bicycle path (see Section 17-2.02) onto an existing highway bridge, several alternatives should be considered in light of what the geometrics of the bridge will allow. One option is to carry the bicycle path across one side of the structure. This should be considered where:

- the bridge facility will connect to a bicycle path at both ends,
- sufficient width exists on that side of the bridge or can be obtained by widening or restriping lanes, and
- provisions are made to physically separate bicycle traffic from motor vehicle traffic.

Another option is to use existing sidewalks as one-way or two-way facilities. This may be advisable where:

- conflicts between bicyclists and pedestrians will not exceed tolerable limits, and
- the existing sidewalks are adequately wide.

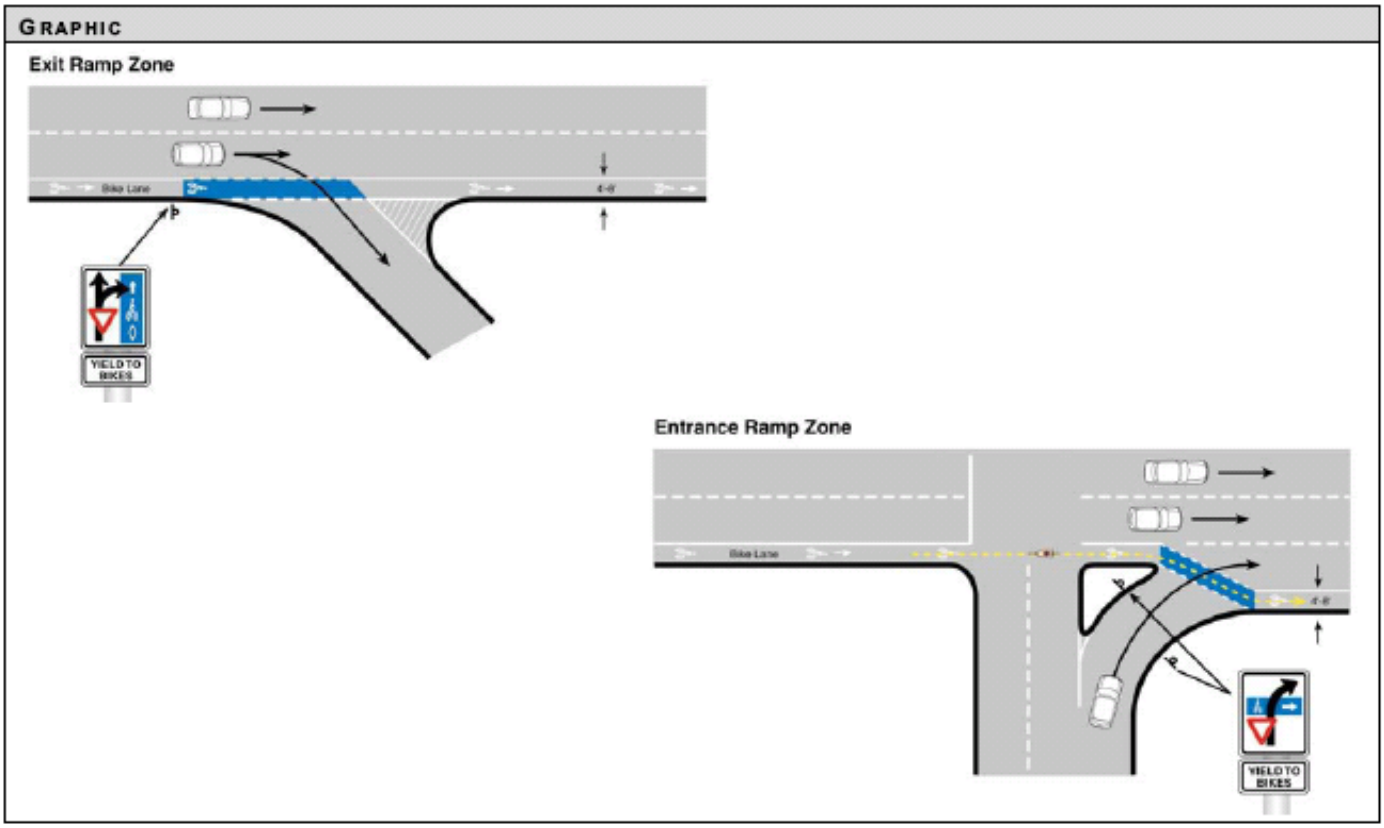
If the facility cannot provide adequate accommodation (per widths indicated in this section), appropriately sign the facility to warn users of the deficiencies or require bicyclist to dismount and cross the structure as a pedestrian. Section 17-2.02(i) provides additional design guidance for structures on bicycle paths. The AASHTO *Bridge Manual* specifies a 4’-6” (1.4 m) outside railing height. Design on-road bicycle accommodations accordingly. Bridge railing on off-road-shared-use paths must meet a 3’-6” (1.1 m) minimum rail height requirement.

Where bridge projects include bikeway or sidewalk accommodations, the approaches to the structure should ensure a usable facility by continuing the accommodation to logical termini.

17-2(10) Bureau of Design and Environment Manual. Illinois Department of Transportation. 2002. 22 Aug. 2007 <http://www.dot.il.gov/desenv/bdemanual.html>.

Colored Pavement Treatments

- The figure below shows an example of using experimental colored pavement treatments to alert bicyclists and drivers to a potential conflict area. (This treatment is experimental because it is not in the current MUTCD.



Innovative Bicycle Treatments. Institute of Transportation Engineers. 2003. 22 Aug. 2007 <http://www.ite.org/education/IBT/StudentSuppIBT.pdf>.

Florida Pedestrian Facilities Planning and Design Handbook – Warrants for Grade Separation

1. The hourly pedestrian volume should be more than 300 in the four highest continuous hour periods if the vehicle speed is more than 65 km/h (40 mph) and the proposed sites are in urban areas and not over or under a freeway. Otherwise, the pedestrian volume should be more than 100 pedestrians in the four highest continuous hour periods.

2. Vehicle volume should be more than 10,000 in the same four-hour period used for the pedestrian volume warrant or have an ADT greater than 35,000 if vehicle speed is over 65 km/h (40 mph) and the proposed site(s) are in urban areas. If these two conditions are not met, the vehicle volume should be more than 7,500 in the four hours or have an ADT greater than 25,000.

3. The proposed site should be at least 183 m (600 ft) from the nearest alternative safe crossing. A safe crossing is defined as a location where a traffic control device stops vehicles to create adequate gaps for pedestrians to cross. Another safe crossing is an existing overpass or underpass near the proposed facility.

4. A physical barrier is desirable to prohibit at-grade crossing of the roadway as part of the overpass or underpass design plan.

5. Artificial lighting should be provided to reduce potential crime against users of the underpasses or overpasses. It may be appropriate to light underpasses 24 hours a day and overpasses at nighttime.

6. Topography of the proposed site should be such as to minimize changes in elevation for users of overpasses and underpasses and to help ensure that construction costs are not excessive. Elevation change is a factor that affects the convenience of users.

7. A specific need may exist for a grade-separated crossing based on the existing or proposed land use(s) adjoining the proposed development site that generates pedestrian trips. This land use should have a direct access to the grade separated facility.

8. Funding for construction of the pedestrian overpass or underpass must be available prior to a commitment to construct it.

Florida Pedestrian Facilities Planning and Design Handbook. Florida Department of Transportation. 1999. 22 Aug. 2007 <http://www.dot.state.fl.us/safety/ped_bike/ped_bike_standards.htm#Florida%20Bike%20Handbook>.

FIELD MEASURING

1) Obtain aerial photographs (if not already obtained).

2) Review the Kentucky Transportation Cabinet's Highway Design Manual, Section HD-1502 *Guidelines for Pedestrian and Bicycle Accommodations* (http://transportation.ky.gov/design/designmanual/chapters/18Chapter%201500%20AS%20PRINTED%202006.pdf)

3) Take conceptual plans and visit interchange site.

4) Compare to KYTC Highway Design Manual guidelines.

5) Complete evaluation survey (below) to determine if the proposed treatments are feasible at this interchange.

FIELD EVALUATION SURVEY			
1	Is the area on either side of the interchange developed or developing?	☐ YES	☐ NO
2	Is the interchange along the path of an existing or proposed bicycle or pedestrian route?	☐ YES	☐ NO
3	Does right-of-way exist to make changes?	☐ YES	☐ NO

Recommendation:

_____

_____

_____

If the proposed treatments are not recommended, re-visit "5 Step Checklist" and select different treatment.

TRAFFIC ANALYSIS

1) Collect additional traffic data including any turning movement volumes (if not available from the INVENTORY step).

2) Perform existing highway level of service, delay, and queue length analysis using data compiled from the INVENTORY step (if not already completed).

3) Calculate the existing pedestrian level of service (as outlined in the Highway Capacity Manual 2000) if pedestrian facilities are recommended.

4) Calculate the existing bicycle level of service (as outlined in the Highway Capacity Manual 2000) if bicycle facilities are recommended.

5) Calculate new highway, pedestrian, and bicycle levels of service based on the proposed improvements.

6) Compare the impact (changes in level of service) for each mode and determine if the change in highway level of service is acceptable given the changes in either (or both) pedestrian and bicycle level of service.

Recommendation:

_____

_____

_____

If the proposed treatments are not recommended, re-visit "5 Step Checklist" and select different treatment.

KIPDA INTERCHANGES
CONSTRUCTION QUANTITIES AND ESTIMATED COSTS

ITEM	ITEM NUMBER	UNIT	UNIT PRICE
DGA BASE	00001	TON	$30.00
CRUSHED STONE BASE	00003	TON	$32.00
LIME STABILIZED ROADBED	00013	SQYD	$7.00
LIME STABILIZED ROADBED	00013	SQYD	$7.00
CL2 ASPH BASE 1.00 PG64-22	00212	TON	$85.00
CL2 ASPH SURF 0.38D PG64-22	00301	TON	$85.00
STANDARD HEADER CURB	01875	LF	$23.16
ROADWAY EXCAVATION	02200	CUYD	$5.00
SIGNS (R10-6)	02562	SQFT	$9.08
SIGNS (R4-4)	02562	SQFT	$9.08
SIGNS (W11-1)	02562	SQFT	$9.08
SIGNS (W11-2)	02562	SQFT	$9.08
FABRIC-GEOTEXTILE TYPE IV	02599	SQYD	$2.97
ASPH PAVE MILLING & TEXTURING	02677	TON	$85.18
SIDEWALK-4 INCH CONCRETE	02720	SQYD	$50.00
SIDEWALK RAMP TYPE 1	03287	EACH	$1,740.93
POLE 30 FT MTG HT	04700	EACH	$957.15
BRACKET 12 FT	04724	EACH	$304.80
BRACKET 15 FT	04725	EACH	$512.90
POLE BASE	04740	EACH	$723.53
TRANSFORMER BASE	04750	EACH	$297.48
HPS LUMINAIRE	04770	EACH	$318.72
FUSED CONNECTOR KIT	04780	EACH	$7.44
CONDUIT-1 1/4 INCH	04793	LF	$7.40
JUNCTION BOX TYPE B	04811	EACH	$382.25
TRENCHING AND BACKFILLING	04820	LF	$9.15
WIRE-NO. 8	04833	LF	$1.76
SIGNAL-PEDESTRIAN	04916	EACH	$757.00
STEEL POST TYPE 2	06411	LF	$6.60
PAVE STRIPING-PERM PAINT-4 IN	06514	LF	$0.58
PAVE STRIPING-DUR TY 1-12 IN W	06560	LF	$5.92
PAVE MARKING-THERMO STOP BAR-24IN	06568	LF	$7.80
15' WIDE PEDESTRIAN BRIDGE	---	SF	$85.00
8' WIDE PEDESTRIAN BRIDGE RAMPS	---	SF	$85.00
BRIDGE WIDENING	---	SF	$100.00
GREENWAY FACILITY BRIDGE	---	SF	$100.00
PEDESTRIAN WARNING SYSTEM	---	EACH	$30,000.00

Note: Prices are in 2007 dollars.

KIPDA INTERCHANGES
CONSTRUCTION QUANTITIES AND ESTIMATED COSTS

ITEM	UNIT	UNIT PRICE	UNIT PRICE (+25%)
LIGHT	EACH	$7,569	$9,470
MULTIUSE PATH	LF	$28	$40
PEDESTRIAN SIGNAL	EACH	$757	$950
PEDESTRIAN WARNING SYSTEM	EACH	$30,000	$37,500
RAMP (28' WIDE)	LF	$305	$390
ROADWAY WIDENING WITH CURB	SQYD	$145	$190
SIGNS			
BEGIN RIGHT TURN LANE YIELD TO BIKES (R4-4)	EACH	$151	$190
STOP HERE ON RED (R10-6)	EACH	$137	$180
BICYCLE WARNING (W11-1)	EACH	$119	$150
PEDESTRIAN CROSSING (W11-2)	EACH	$119	$150
SIDEWALK			
SIDEWALK	LF	$28	$40
SIDEWALK RAMP	EACH	$1,740	$2,180

Note: Prices are in 2007 dollars.

APPENDIX B:

PROJECT TEAM MEETING MINUTES

PROJECT: KIPDA Interchange – Bicycle / Pedestrian Safety Study

MEETING: Kick-off Meeting

DATE & TIME: August 13, 2007 – 1:00 PM

LOCATION: Kentucky Transportation Cabinet District 5 –
Design Conference Room
Louisville, Kentucky

ATTENDEES:

NAME	AGENCY/COMPANY	Telephone	Email
Tom Hall	KYTC – Project Manager	502-367-6411	tom.hall@ky.gov
John Callihan	KYTC – District 5	502-367-6411	johne.callihan@ky.gov
Jeff Schaefer	KYTC – District 5	502-367-6411	jeff.schaefer@ky.gov
Harold Tull	KIPDA	502-266-6084	harold.tull@ky.gov
Stacey Clark	KIPDA	502-266-6084	stacey.clark@ky.gov
Jon Villines	Louisville Metro	502-574-0104	jonathan.villines@louisvilleky.gov
Mohammad Nouri	Louisville Metro	502-574-6230	mohammad.nouri@louisvilleky.go
Barbara Michael	PB	502-479-9301	michael@pbworld.com
Shawn Dikes	PB	502-479-9312	dikes@pbworld.com
Lindsay Walker	PB	859-245-3869	walkerLi@pbworld.com
Scott Walker	PB	859-245-3873	walkersc@pbworld.com

MEETING SUMMARY:

The purpose of this meeting was for the Project Development Team (PDT) to discuss the Kentuckiana Regional Planning and Development Agency (KIPDA) Interchange – Bicycle / Pedestrian Safety Study. An agenda handed out for this PDT meeting is attached to the meeting minutes.

The meeting began with John Callihan welcoming everyone to the meeting. He introduced Tom Hall as Project Manager for this study. The rest of the attendees then introduced themselves.

Mr. Callihan began by describing the purpose of the project which was to identify creative solutions for accommodating bicycles and pedestrians through interchanges in the Louisville region. The project was initiated in response to recent design efforts in District 5 which involved moving bicycles and pedestrians through an interchange. Currently, there is little guidance or documentation to do such, either in Kentucky or within AASHTO design guidelines. One of the goals of the project is to research 'best practices' throughout the United States and the international community to determine options that may be suitable for particular projects in the region. Representatives of both Louisville Metro and KIPDA agreed with Mr. Callihan's

assessment of the project. It was added the possibility that this study could be useful for areas outside of the KIPDA region.

The interchanges to be studied for this project include a variety of types of interchanges: These include:

- I-265 / KY 155 (Taylorsville Road): Typical Diamond Interchange
- I-264 / KY 155 (Taylorsville Road): Skewed Interchange with Free Flow Movements
- I-264 / US 31E (Bardstown Road): Single-Point Urban Interchange (SPUI)
- I-65 / KY 1526 (Brooks Road): Diamond Interchange with Heavy Truck Movements
- I-71 / KY 146 (Buckner): Partial Cloverleaf Constrained by Railroad

It was noted that each of the interchanges are not necessarily a project, but should be looked at as 'case-studies.'

Other discussion during the meeting included:

- This project will not include detailed design; instead, the result will be a "tool box" for options that designers may consider given particular geometrics and for determining the most appropriate solution.

- One goal of this project may be its eventual application to design manuals, etc.

- Shawn Dikes will send an email request to other states' DOTs and MPOs to solicit information about interchange concepts.

- It was noted that new traffic counts may not be necessarily applicable for this project. If it is determined that such counts are needed, the KYTC may be able to provide such counts.

- Input available from the Bicycle / Pedestrian Policy and Design Manual may be an appropriate a starting point.

- It was suggested that PB document "where we've come from" which would provide a past history of crossing at major intersections.

- Oldham County is currently working on a bicycle and greenway master plan. Louise Allen of the Oldham County Planning Commission should be contacted about this.

- FHWA Engineer Bill Hanson should be included through this planning process.

- The City of Chicago and the Florida DOT should be considered as two additional sources for information on this study.

- With respect to the meetings with stakeholders, it was suggested that information gathered in the research phase should be shown to the stakeholders in order to give them something to react to.

- The FHWA Bike / Pedestrian training course was identified as a source which may provide conceptual options for bicycles and pedestrians at interchanges.

- Stakeholder involvement should consider a wide range of users. This consideration would include:
    - Level of sophistication of riders: A, B, and C;
    - Interest in technical ability; and
    - A look at the least experienced riders and whether the conceptual alternatives would accommodate this group.
- The documentation of each stakeholder's meeting is important and should be included in the final report.
- Neighborhoods / neighborhood groups near the interchanges should be considered during the stakeholder interviews.
- On the one page summary sheet, possibly identify which user groups would use some of the treatments.
- Free flow ramps should be analyzed in that stopping traffic to create a gap may have negative traffic operational impacts on motor vehicles.
- Stacey Clark with KIPDA has a former study to reference on the I-264 / KY 155 interchange.
- With respect to the data needs, the following agreements were made:
    - LOGIC Mapping: KIPDA and District 5 will provide this information.
    - Signal Timing Sheets: District 5 maintains these traffic signals and will provide this data.
    - Turning Movement Counts: District 5 will determine whether this information is available.
    - Design Plans: District 5 will provide this information.
- PB will contact the KYTC Division of Planning to get the most recent hourly traffic count and crash data for the multiple interchange study areas.
- PB should prepare invoices with progress reports and submit to both Tom Hall and Harold Tull.
- PB will send Harold Tull a blank invoice and progress report to determine whether the KYTC format will be appropriate for KIPDA.
- PB will prepare an internal request to identify other interchange treatments on projects in which PB was involved.

With no other discussion, the meeting concluded at 2:15 PM.

The next meeting will be held at D-5, on September 4, 2007, at 2:00 PM.

KIPDA Interchange – Bicycle & Pedestrian Safety Study
Project Kick Off Meeting
Agenda – August 13, 2007

1. Introductions
2. Project Purpose
3. Scope of Work
4. Project Schedule
5. Meetings with Stakeholders
6. Data Needed
7. Action Items

PROJECT: KIPDA Interchange – Bicycle / Pedestrian Safety Study

MEETING: Project Team Meeting #2 - Literature Review

DATE & TIME: September 4, 2007 – 2:00 PM

LOCATION: Kentucky Transportation Cabinet District 5 –
Design Conference Room
Louisville, Kentucky

ATTENDEES:

NAME	AGENCY/COMPANY	Telephone	Email
Tom Hall	KYTC – Project Manager	502-367-6411	tom.hall@ky.gov
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Jon Villines	Louisville Metro	502-574-0104	jonathan.villines@louisvilleky.gov
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Anne Warnick	PB	859-245-3877	warnick@pbworld.com
Scott Walker	PB	859-245-3873	walkerSc@pbworld.com

MEETING SUMMARY:

The purpose of this meeting was for the Project Development Team (PDT) to discuss the literature review component of the Kentuckiana Regional Planning and Development Agency (KIPDA) Interchange – Bicycle / Pedestrian Safety Study. An agenda handed out for this PDT meeting is attached to the meeting minutes.

The meeting began with Shawn Dikes of PB welcoming everyone to the meeting. The rest of the attendees then introduced themselves.

Mr. Dikes gave a brief overview of the project, including the purpose for the study. He stated that PB had completed the first task of this study (the literature review) which was to be presented at this meeting. He then began a presentation that outlined the research conducted by PB relative to the "best practices" for bicycling and pedestrian safety at interchanges throughout the United States as well as in international applications. The list of agencies researched for this project included:

- 10 State Departments of Transportation sources;

- 7 MPO / City sources (6 domestic; 1 international); and
- 6 sources from other agencies (4 domestic; 2 international).

The presentation then focused on information gathered related to pedestrian issues at interchanges. Key issues included:

- Crossing exit and entrance ramps conflicts with higher volumes of vehicles and with vehicles operating at higher speeds;
- Drivers often look for available gaps in traffic and not for pedestrians;
- Right turns are often given a slip lane or right turn channelization lane, making right turning movements free flow; and
- Pedestrian crossings become more dangerous if the interchange is unsignalized.

It was noted that much of the information gathered in the research focused on lower speed and lower volume facilities and that information on higher speed and higher volumes facilities was not as abundant. Key recommendations / treatments for pedestrians noted at intersections included:

- Slow or stop vehicular traffic entering and exiting freeways;
- Connect ramps to local streets at 90 degree angles;
- Add right-turn channelization islands to reduce crossing distance and improve visibility of pedestrians to drivers;
- Add crosswalks; and
- Use staggered or advanced stop lines to improve visibility of pedestrians.

Caltrans' pedestrian and bicycle facility guide gives guidance on the placement of crosswalks at unsignalized intersections. It was noted that crosswalks alone may not be sufficient, and therefore, stop signs or signals may be required. The Manual of Uniform Traffic Control Devices (MUTCD) should be referenced for pedestrian signal warrants and for related markings. Also, with respect to pedestrians, the Florida DOT provides guidance thresholds of when to use grade-separated pedestrian crossings.

Upon completion of the pedestrian discussion, bicycle treatments at interchanges / intersections were also discussed.

- There are many conflict points between bicycles and vehicles merging in and out of exit and entrance ramps, and cars are usually accelerating to merge with traffic;
- There is a high speed differential between bicycles and vehicles;
- There are often free flow movements of vehicles at intersections / interchanges and these conflict with bicyclists;
- Bike lanes are often dropped at interchanges; and
- Bridges over freeways may have reduced shoulder widths, narrowing the operating spaces for bicyclists.

As with the pedestrians, specific information related to interchanges was difficult to obtain. Based on the information that was available, the following recommendations were obtained:

- Slow or stop vehicular traffic entering and exiting freeways;
- Connect ramps to local streets at 90 degree angles;
- Continue bike lanes through interchange (with few exceptions);

- Provide ramp crossings where cyclists will be visible and crossing distance is short. Staggered stop lines and advanced stop lines can be used to improve visibility;
- Possible grade-separated crossings shared with pedestrians;
- Provide adequate cyclist "merge" area to transition in and out of lanes as needed; and
- Upgrade signs and pavement markings.

Based on the literature review, the following information was found:

- There is not a "one source book" or guidance manual for bicycle / pedestrian accommodations through interchanges
- Some sources have applicable guidance for bicyclists or pedestrians, rarely both
- California, Oregon, and Florida are currently doing the most and seem to lead the way
- Many state DOTs / MPO / cities, etc. reference each other for guidance and the three mentioned above
- Not very much detail for high speed, high volume intersections
- Only one "checklist" was found and it relates to the use of grade separation

A summary of the guidance was presented, which included:

- Most guidance involves typical intersections – not necessarily high speed or high volume ramps
- Most guidance tries to get through bicyclists and pedestrians moving on the same phase as through traffic
- Some guidance for improving situations
  - Moving bicyclists and pedestrians through intersection in one movement if possible
  - Reduce speeds at potential conflict points
  - Change the approach or departure angle so motorists "see" the cyclist or pedestrian
  - Use of refuge areas for long distances

Finally, the following improvements were drawn from the review:

- Provide most direct path for cyclists and pedestrians close to vehicles
  - To the left of turning traffic if possible
- Encourage their movements to be consistent and predictable
- If the path of travel is -
  - Straight ahead = stripe it
  - Shifting laterally = probably don't stripe it
- Simple right angles works best
  - Most visibility
  - Most recognition
  - Most yielding
- Avoid unusual conflicts
- Don't be afraid to use color

During the presentation, Project Team Members provided comments or asked questions related to the research. This discussion included:

- A question was asked with respect to research on pavement markings. It was noted that all approved pavement markings are in the MUTCD. Experimental markings may be tested in some areas, but must be removed upon completion of the study if not adopted in the MUTCD.
- With respect to color pavement or differential pavement, such a treatment was noted as a possibility. It was noted that painted markings can provide a hazard to some users.
- It was recommended that provisions be made for all riders, regardless of ability.
- Shared bicycle and pedestrian facilities should be considered.
- Most projects implementing recommendations for this study will be retrofits, which should be considered through the study process.
- Common sense should be used when making recommendations for projects to ensure the proper treatment.
- There were concerns about the impact on queuing with respect to additional bicycle and pedestrians considerations. It was noted that this would be considered during the operational analysis of each interchange.

Following the presentation, the group engaged in a discussion regarding the next steps in the project. This will include setting up stakeholder meetings with key groups. It was decided that one KYTC member (Tom Hall) as well as Jon Villines from Louisville Metro will attend the meetings. Groups that should be contacted for such meetings could include:

- Neighborhood groups near the five study area interchanges;
- School officials or PTA groups in schools near the interchanges;
- Metro Council members who serve the communities near the interchanges;
- Members of Bicycling for Louisville;
- Member of the Mayor's Bicycle Task Force;
- Metro Parks;
- 21st Century Parks;
- Additional Louisville Public Works officials
- Schools currently participating in the KEEN program
- Sullivan University due to its proximity to the I-264 / US 31E interchange

An emphasis was placed on the need to reach out to representatives of all levels of rider ability at the meetings to ensure the recommendations are suitable for all riders.

At the meetings, the presentation will include the purpose of the meeting, the existing conditions, a review of improvement options, and the opportunity for public comment. The Project Team representatives will provide guidance to the attendees.

With no other discussion, the meeting concluded at 3:15 PM.

The next meeting will be held tentatively at D-5 on October 10, 2007, at 1:00 PM. The date may shift slightly pending the ability to schedule the stakeholder meetings before this date.

KIPDA Interchange – Bicycle & Pedestrian Safety Study
Project Team Meeting #2
Agenda – September 4, 2007

1. Introductions
2. Data Needed
3. Literature Review Summary
4. Literature Review Discussion
5. Meetings with Stakeholders
6. Next Meeting

PROJECT: KIPDA Interchange – Bicycle / Pedestrian Safety Study

MEETING: Project Team Meeting #3 – Stakeholder Involvement

DATE & TIME: October 10, 2007 – 1:00 PM

LOCATION: Kentucky Transportation Cabinet District 5 –
Design Conference Room
Louisville, Kentucky

ATTENDEES:

NAME	AGENCY/COMPANY	Telephone	Email
Tom Hall	KYTC – Project Manager	502-367-6411	tom.hall@ky.gov
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Stacey Burton	KIPDA	502-266-6084	stacey.burton@ky.gov
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Louise Allen	Oldham County Planning & Zoning	502-222-1476	lallen@holdhamcounty.net
Anne Warnick	PB	859-245-3877	warnick@pbworld.com
Shawn Dikes	PB	502-479-9312	dikes@pbworld.com

MEETING SUMMARY:

The purpose of this meeting was for the Project Development Team (PDT) to discuss the stakeholder involvement component of the Kentuckiana Regional Planning and Development Agency (KIPDA) Interchange – Bicycle / Pedestrian Safety Study. An agenda handed out for this PDT meeting is attached to the meeting minutes.

The meeting began with Shawn Dikes of PB welcoming everyone to the meeting. The rest of the attendees then introduced themselves.

Mr. Dikes gave a brief overview of the project, including the purpose for the study as well as the tasks completed so far, the literature review, and 4 stakeholder meetings. He also gave a brief overview of the upcoming tasks of completing stakeholder meetings, preparing approximately 12 alternative improvement scenarios (total) for each of the five case study interchanges, creating a "toolbox" of design options, and the final documentation.

Next, Tom Hall discussed the purpose of this meeting, beginning with comments regarding the literature review. Tom Hall suggested that an executive summary be added to the literature review, and John Villines suggested looking for case studies of interchange / intersection retrofit projects that have been completed in other cities.

Following the comments specifically pertaining to the literature review, other questions and comments about the project were addressed. Bob Farley asked if there has been any identification of priorities for which interchanges should be addressed. John Villines gave the top three bicycle priority routes for Louisville Metro (River Road, Taylorsville Road and 3rd Street Road), the second of which, Taylorsville Road, has two of the five interchanges as case studies for this project. Louise Allen said that the I-71 and KY 146 (LaGrange Road) interchange, also a part of this project, is the top priority in Oldham County. Next, Stacey Burton informed the group of a white cane event at 4th Street Live. The purpose of this event is to educate the public regarding blind pedestrians. This was noted as an event that would be useful for some project team members to attend. The final question came from Bob Farley, who asked if there was any bicycle or pedestrian crash data at any of the five case study interchanges. Shawn Dikes replied that the crash data available is not detailed enough to determine the involvement of bicyclists and pedestrians, but that PB would check further into this.

After the comments and questions were addressed, Shawn Dikes summarized the stakeholder meetings that have taken place so far. These included meetings with Barry Zalph of Bicycling for Louisville, Jackie Green with Safe Streets Louisville, Earl Jones, President of the Louisville Bicycle Club, and Oldham County Greenways. Feedback from Barry Zalph has not yet been received. An e-mail response from Safe Streets Louisville was brought and discussed. Louise Allen from Oldham County Planning and Zoning briefly discussed some of the issues regarding the particular interchange in Oldham County being discussed. One of the biggest issues with this interchange is the lack of right-of-way to add bicycle and pedestrian facilities. The project team noted that this type of problem would be addressed, and that the toolbox would include solutions for similar interchanges with limited right-of-way.

Two additional stakeholder meetings will also be held. One meeting will occur at the University of Louisville with civil engineering professor Mark French. The other will be less formal and will be held at Sullivan University, which is located just off the I-264 and US 31 E (Bardstown Road) interchange. The purpose of this session will be to solicit the opinions of people who are neither experts nor advocates for bicycling and pedestrian facilities, to determine what types of facilities will be most useful to the average person.

The next steps of the project include studying the five case study interchanges, and obtaining data regarding traffic counts, crash data, geometrics, existing facilities and physical conditions. Two to three concepts at each location, for a total of approximately 12, will be generated. Based on the concepts from the case studies the toolbox will be created. Shawn Dikes will send out aerial images of each of the interchanges to the PDT for feedback and consideration in the development of the concepts. Tom Hall indicated that he would like to have a level of service analysis for the concepts included, and it was determined that a graduate student, Turner Howard, working with Barry Zalph has performed a bicycle level of service (BLOS) analysis around the area and that his work could be referenced.

Once the next steps were discussed, the next meeting was planned for Wednesday, November 14, and 1:00 pm.

The meeting adjourned at 2:00 pm.

KIPDA Interchange – Bicycle & Pedestrian Safety Study
Project Team Meeting #3
Agenda – October 10, 2007

1. Introductions
2. Literature Review Finalization
3. Meetings with Stakeholders
4. Next Steps
5. Next Meeting

PROJECT: KIPDA Interchange – Bicycle / Pedestrian Safety Study

MEETING: Project Team Meeting #4 – Interchange Concepts

DATE & TIME: November 14, 2007 – 1:00 PM

LOCATION: Kentucky Transportation Cabinet District 5 – Conference Room
Louisville, Kentucky

ATTENDEES:

NAME	AGENCY/COMPANY	Telephone	Email
Tom Hall	KYTC – Project Manager	502-367-6411	tom.hall@ky.gov
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Derek Kinder	KYTC	502-367-6411	derek.kinder@ky.gov
Stacey Burton	KIPDA	502-266-6084	stacey.burton@ky.gov
Jon Villines	Louisville Metro	502-574-0104	jonathan.villines@louisvilleky.gov
Harold Tull	KIPDA	502-266-6084	Harold.tull@ky.gov
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Anne Warnick	PB	859-245-3877	warnick@pbworld.com
Shawn Dikes	PB	502-479-9312	dikes@pbworld.com

MEETING SUMMARY:

The purpose of this meeting was for the Project Development Team (PDT) to discuss the final meetings of the stakeholder involvement component of the Kentuckiana Regional Planning and Development Agency (KIPDA) Interchange – Bicycle / Pedestrian Safety Study, as well as the DRAFT improvement concepts for the five (5) interchange components. An agenda handed out for this PDT meeting is attached to the meeting minutes.

The meeting began with Tom Hall welcoming everyone and going over the meeting agenda.

Next, Shawn Dikes discussed the final stakeholder meetings that have been held since the last meeting. These included a meeting with Mark French from the University of Louisville, Kevin Beck from 21st Century Parks, Carrie Butler of TARC, and an informational display at Sullivan University. The findings from these meetings were summarized in separate meeting minutes. Contacts have been made with the City of Hillview and Bullitt County John Callihan mentioned that he will be meeting with the Bullitt County Judge on Monday (November 19) and will mention this project to see if there are any suggestions/issues that need to be included.

The existing conditions at the five concept interchanges were discussed next. Safety issues for bicycles and pedestrians, as well as crash data, traffic volumes, etc., were presented first. This led into the discussion of the draft improvement concepts for each interchange. Several suggestions came from this discussion.

PB is showing incremental changes beginning with lower cost items such as maintenance, installation of signing and striping and gradually building up to geometric safety changes if warranted. The biggest factor in determining the level of improvement is whether or not there is a sidewalk or bicycle facility in place now.

In the toolbox, PB will show how to bring multi-use paths through various types of interchanges. An example of a "dismount bike" sign that could be used will be added to the toolbox. Guidance for using a pedestrian warning system (with flashing beacons) rather than simply warning signs only, will be given. For the Oldham County I-75 / KY 146 interchange, a possible bridge to bring the greenway through the interchange will be shown as an option, however it will end after the interchange, so that no greenway paths are assumed before or after the interchange. In addition, for each case study, a disclaimer will be included noting that the improvements shown may require additional traffic or other analyses along with engineering and/or planning judgment to determine feasibility, and references to all signs will be included on the sheets.

It was agreed that PB would make the selections for the best treatments to be applied to each interchange, and that these recommendations would be sent out several days before the next meeting to allow time for review by the project team.

Next, Shawn Dikes and Lindsay Walker briefly discussed the format of the toolbox. It was agreed that for all interchanges a second drawing of the interchange type with the locations of where and how treatments could be implemented, would be added into the toolbox. Also, the report should mention that these treatments are best for retrofit projects. John Villines asked if recommendations for new construction could be added as well. PB agreed that it will consider if there are other treatments that would be available only for new construction, and if so include those in the report.

The next meeting was agreed to take place on Wednesday December 5, 2007 at 1:00 pm. The draft report will be presented at this meeting.

The meeting adjourned at 3:00 pm.

KIPDA Interchange – Bicycle & Pedestrian Safety Study
Project Team Meeting #4
Agenda – November 14, 2007

1. Introductions
2. Meetings with Stakeholders
3. DRAFT Improvement Concepts
4. Tool Box Suggestions
5. Next Meeting

PROJECT: KIPDA Interchange – Bicycle / Pedestrian Safety Study

MEETING: Project Team Meeting #5 – Toolbox and Discussion of Draft Final Report

DATE & TIME: December 5, 2007 – 1:00 PM

LOCATION: Kentucky Transportation Cabinet District 5 – Conference Room
Louisville, Kentucky

ATTENDEES:

NAME	AGENCY/COMPANY	Telephone	Email
Tom Hall	KYTC – Project Manager	502-367-6411	tom.hall@ky.gov
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Derek Kinder	KYTC	502-367-6411	derek.kinder@ky.gov
Stacey Burton	KIPDA	502-266-6084	stacey.burton@ky.gov
Harold Tull	KIPDA	502-266-6084	Harold.tull@ky.gov
Jeff Schaefer	KYTC	502-367-6411	Jeff.schaefer@ky.gov
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Shawn Dikes	PB	502-479-9312	dikes@pbworld.com

MEETING SUMMARY:

The purpose of this meeting was for the Project Development Team (PDT) to discuss the draft report and toolbox components of the Kentuckiana Regional Planning and Development Agency (KIPDA) Interchange – Bicycle / Pedestrian Safety Study DRAFT Final Report. An agenda handed out for this PDT meeting is attached to the meeting minutes.

The meeting began with Tom Hall welcoming everyone and going over the meeting agenda. A copy of the draft report was distributed to everyone in attendance and Shawn Dikes briefly outlined its contents. The first section of the report comprised the literature review which had already been reviewed by those in attendance. As Shawn pointed out, an example of a retrofit has been added to the literature review since it was last discussed. The possibility of sharing information with Rutgers University who is conducting similar research, was also discussed. It was agreed that there would be no problem with sharing information.

Since the last meeting PB developed recommendation options for the five case study interchanges. The recommendation options along with construction cost estimates are included in the report and were briefly discussed.

Next, the toolbox was reviewed. Comments included:

- In the 5 Step Checklist consider taking out the bullet point about possibly narrowing travel lanes in order to add sidewalks,
- Take off yellow coloring from the sketches of interchange types,
- Rather than showing the experimental flashing pedestrian signal in the 11x17 interchange sheets, show the traditional pedestrian warning sign with the supplemental dual flashing beacons,
- Add the image of the colored pavement treatment to the toolbox,
- Add "Warrants for Grade Separation" to sheet about FDOT's guide;
- Provide a mini-diagram or matrix to the interchange types sheet so people know what the various types look like,
- Add the "cyclists dismount" sign to the bridge treatment sheet,
- Possibly change the figure on the bridge treatment sheet and add more detail to the sheet to make it more understandable and useable, and
- Move the four diagrams on the border of the 11x17 sheets to their own page in the back.

Several other comments on the report were received. These included noting on page 83 that cost estimates are construction costs only in constant 2007 dollars, and that Oldham County and Louisville Metro's logos should be added to the cover.

It was agreed that comments on the report would be given to PB via Tom Hall and that those should be received by Tom no later than December 14. The meeting adjourned at 2:30 pm.

KIPDA Interchange – Bicycle & Pedestrian Safety Study
Project Team Meeting #5
Agenda – December 5, 2007

1. Introductions
2. Improvement Concepts Recommendation
3. Tool Box Discussion
4. Final Report Comments

APPENDIX C:

STAKEHOLDER MEETING MINUTES

PB Americas, Inc.
Meeting Minutes

PROJECT: KIPDA Bicycle and Pedestrian Interchange Safety Study

MEETING: Stakeholder Meeting with Barry Zalph of Bicycling for Louisville

DATE & TIME: September 24, 2007 – 3:00 PM

LOCATION: Diocesan House
Louisville, Kentucky

MEETING SUMMARY:

The purpose of this meeting was to meet with Barry Zalph, Director of Bicycling for Louisville, a stakeholder for this project and advocate for bicycling, to get feedback on bicycle safety at interchanges, as well as to obtain ideas for improving overall bicycle safety. Shawn Dikes began the meeting by introducing the project, its purpose and what has been done so far. He summarized the literature review to give Barry a feel for what has been found regarding safety at interchanges thus far. Barry then introduced himself and gave a background on Bicycling for Louisville and its mission. Bicycling for Louisville is a bike advocacy and education group for children and adults that encourages bicycling for transportation, recreation, fitness and sport. The group currently provides education to riders, advocacy, technical advising and research.

Barry discussed some concerns about bike safety through interchanges noting that cyclists currently do not follow traffic laws or use existing infrastructure, and stated that any improvements would have to be self teaching or self-explanatory, or must be well enforced. Barry has done research along Hurstbourne Parkway north and south of the I-64 interchange and has noted that there are very low bike volumes outside of the Watterson Expressway and that there are typically 2 types of riders: very high skilled riders or those who have no other choice, often with low skills.

Aerial images of the 5 interchanges for the case studies were brought, however due to time constraints, not all were able to be discussed. Barry did have a chance to look at the I-264 and US 31E interchange as well as the I-264 and KY 155 interchange. Regarding the US 31E interchange, suggested improvements included signage that would indicate for cyclists to use the full lane of traffic, as well as a multi-use side path for less skilled riders, with improved lighting under the overpass. A possible issue that was noted was that if a multi-use path was provided along 1 side of the roadway, once through the interchange bicyclists would have to cross the street. This is something that would need to be taken into consideration if a multi-use path were to be recommended. A multi-use path was also discussed for KY 155. Due to time constraints the meeting ended with discussion of KY 155, however Barry will be sent the aerial photos and he will take some time to brainstorm retro-fit improvements as well as interchange concepts that would be more bike friendly, and another meeting will take place in the future to discuss these.

PROJECT: KIPDA Bicycle and Pedestrian Interchange Safety Study

MEETING: Stakeholder Meeting with Safe Streets Louisville

DATE & TIME: September 24, 2007 – 4:00 PM

LOCATION: Bearno's Pizza
Louisville, Kentucky

MEETING SUMMARY:

The purpose of this meeting was to meet with Safe Streets Louisville, an advocacy group, headed by Jackie Green. The meeting began with participants introducing themselves, followed by Shawn Dikes introducing the project, its goals, and what has been done so far. General concerns regarding interchanges included the separation of neighborhoods and communities, as well as bicycle safety at right turn and free-flow lanes. The idea of grade separated facilities was brought up.

After general comments were heard, aerial photographs of each of the 5 interchanges for the case studies were discussed. I-264 and US 31E was the first interchange discussed. Some ideas included restriping the road to allow for a wider outside curb lane which could be accomplished by slightly narrowing each of the travel lanes. The problem of right turn free flow lanes was brought up again, and difficulties of cyclists merging with traffic were discussed. A shared use path was discussed, however was not considered favorable due to a law that states that if a path is provided it must be used. Because some cyclists are commuters or are higher skilled, this would not be desirable, as this group would prefer to stay on the road and merge in with traffic. Regarding pedestrian facilities, the addition of crosswalks would be helpful. A concern was brought up regarding cars stopping for red lights in the middle of existing crosswalks. A sign indicating "Stop Here On Red" might be a feasible option to reinforce stopping in front of and not blocking the cross walk.

I-264 and KY 155 was the next interchange discussed. The biggest concern regarding this interchange was the fact that is separates 2 neighborhoods and that there are destinations on both sides of the interchange that would be within walking or cycling distance if the interchange were safer. An overpass over I-264 between the Taylorsville and Bardstown exits was suggested. This would be used for recreation rather than commuting, as it would be a bit out of the way, however it would serve neighborhoods off of both Taylorsville and Bardstown Roads, and would give an alternative to riding through the interchange. Another suggestion for the interchange was to square up the cloverleaves and tie them into Taylorsville Road at 90 degree angles, rather than having them merge in as free flow movements. This is an alternative that would require little new road, but would slow down traffic and make cyclists more visible to drivers. A cyclist on northbound Taylorsville Road traveling on the shoulder was killed a few years ago.

I-65 and Brooks Road was discussed next. As this is a rural diamond interchange there were not many suggestions for bike improvements, but the addition of sidewalks adjacent and

through the interchange was recommended. The I-265 and KY 155 intersection was discussed. Again the need for sidewalks was brought up. An idea that they should be built as part of new commercial and residential developments was mentioned.

The KY 146 and I-71 interchange was next. The interchange is near an active railroad track and the I-71 northbound approach is at a 90 degree angle with KY 146. KY 146 leads to LaGrange to the local high school. The Oldham County Greenway will also follow KY 146 from LaGrange.

PB Americas, Inc.
Meeting Minutes

PROJECT: KIPDA Interchange – Bicycle/Pedestrian Safety Study

MEETING: Oldham County Bike, Pedestrian and Greenways Summit

DATE & TIME: September 26, 2007 – 3:00 PM

LOCATION: Oldham County Fiscal Court Building, Second Floor
Louisville, Kentucky

MEETING SUMMARY:

This meeting was hosted by the Greenways for Oldham County in partnership with the Oldham County Government to provide a forum for a county-wide bicycle, pedestrian, and greenways summit. The summit was conducted in conjunction with the recently started Bicycle, Pedestrian, and Greenways Master Plan for Oldham County funded by a grant from the Kentuckiana Regional Planning and Development Agency (KIPDA). The primary goal of the meeting was to provide an opportunity for all individuals and groups with an interest in bicycling, walking, hiking, equestrian trails, and greenways in Oldham County to find out what is going on in the county, what the needs are, and what each individual/group can contribute to the master plan.

Some of the presenters/attendees included state and county officials, representatives from Metro Louisville Parks, representatives from multiple Oldham County non-profit organizations, developers, private consultants, and others.

PB presented the KIPDA Interchange – Bicycle/Pedestrian Safety Study as part of this summit. It was mentioned that this study is being conducted by KIPDA in conjunction with the Kentucky Transportation Cabinet District 5 and is to improve bicycle and pedestrian safety at interchanges. The five steps of the study include a literature review, meetings with stakeholders, conceptual case studies, the development of a toolbox for improvements, and a final report with the corresponding documentation. The literature review has already been completed with some concepts compiled to accommodate bicyclists and pedestrians through interchanges including changing the angle of the approach ramp to ninety degrees, signage, colored pavement treatments, and grade-separated crossings. The study is currently in the stakeholder phase with this meeting included as part of this step. The next step involves evaluating several interchanges within the KIPDA region including one interchange in Oldham County (I-71/KY 146). Specific recommendations to accommodate bicyclists and pedestrians through the interchange will not be made; rather a range of applications that could be applied will be developed. The study is scheduled to be finished by the end of the year (December 2007). Handouts, including a summary of the study as well as contact information for attendees to provide questions/comments about the study, were provided.

PROJECT: KIPDA Interchange – Bicycle/Pedestrian Safety Study

MEETING: Louisville Bicycle Club President – Earl Jones

DATE & TIME: September 27, 2007 – 8:30 AM

LOCATION: PB Office
Louisville, Kentucky

MEETING SUMMARY:

This meeting was with the Louisville Bicycle Club President Mr. Earl Jones.

Shawn Dikes explained the background and reason for the project, and the steps involved, including a literature review, meetings with stakeholders, conceptual case studies, the development of a toolbox for improvements, and a final report with the corresponding documentation. Shawn remarked that the literature review has already been completed with some concepts compiled to accommodate bicyclists and pedestrians through interchanges including changing the angle of the approach ramp to ninety degrees, signage, colored pavement treatments, and grade-separated crossings. The study is currently in the stakeholder phase with this meeting included as part of this step. The next step involves evaluating several interchanges within the KIPDA region. Specific recommendations to accommodate bicyclists and pedestrians through these interchange will not be made; rather a range of applications that could be applied will be developed. The study is scheduled to be finished by the end of the calendar year (December 2007). A handout, including a summary of the study as well as contact information for Mr. Jones to provide questions/comments about the study, were provided.

Mr. Jones had specific comments about the study. He said that the idea of safer crossings, especially at the Watterson Expressway and some of the other interchanges was a direct outcome of the bicycle summit. Participants identified the Watteson as a barrier to free-flow movements and that it effectively cut off outlying destinations, such as the outerbelt of parks, from interior locations. "Solving" the interchange issues is a worthwhile goal and one that will enable the arterials to connect to other parts of the system.

He remarked that the goal of the Louisville Bicycle Club is to encourage and promote cycling for all skill levels of riders and to grow the number in each skill class through teaching and experience. The goal is to standardize and regularize the movements of cyclists to improve safety and to encourage them to use on-road facilities.

He had some specific comments about the intersections:

- US 31 E (Bardstown Road) and I-264 (Watterson) – this seems to be the most complicated and highest volume. The proposed off-road facility may be in conflict with guidance and keeps cyclists off sidewalks. It also may encourage wrong-way riding and motorists may not expect cyclists on a side path.

.

- KY 155 (Taylorsville Road) and Snyder Freeway – This is just past the Floyd's Fork Recreation trail. It may not as important as the section connecting Taylorsville Road from the Watterson to Jeffersontown. Mr. Jones likes the idea of the 90 degree turn in and out at the Watterson and Taylorsville Road. Taylorsville Road from the Dutchman's Lane area to Furman Boulevard is used for one of the club's rides.

- I-71 and KY 146 – this interchange is not too friendly. The bridge is narrow. An idea of putting a side path on the south side might make sense.

- I-65 and Brooks Road – this looks like it is not near anything. Over the bridge seems to be a constraint point. The shoulders on the bridge look narrow.

Overall, Mr. Jones feels the project is worthwhile and needed. He'd like to see a DRAFT of the final report when that time comes.

PROJECT: KIPDA Interchange – Bicycle / Pedestrian Safety Study

MEETING: Metro Louisville Agency Coordination Meeting

DATE & TIME: October 15, 2007 – 10:00 AM

LOCATION: Louisville Metro Development Center –
Conference Room 402
Louisville, Kentucky

ATTENDEES:

NAME	AGENCY/COMPANY	Telephone	Email
Tom Hall	KYTC	502-367-6411	tom.hall@ky.gov
Derek Kinder	KYTC	502-367-6411	derek.kinder@ky.gov
Tim Callahan	Louisville Metro Public Works	502-574-3877	tim.callahan@louisvilleky.gov
Andrea Marconi	Louisville Metro Public Works	502-574-8223	andrea.marconi@louisvilleky.gov
Tom Pinto	Air Pollution Control Division	502-574-7238	thomas.pinto@louisvilleky.gov
David Merritt	Louisville Metro Public Works	502-574-5810	david.merritt@louisvilleky.gov
Mohammad Nouri	Louisville Metro Public Works	502-574-6230	mohammad.nouri@louisvilleky.gov
Rick Storm	Louisville Metro Public Works	502-574-3376	richard.storm@louisvilleky.gov
Pat Johnson	Louisville Metro Public Works	502-574-3930	pat.johnson@louisvilleky.gov
Chris Phillips	Louisville Metro Public Works	502-574-3888	chris.phillips@louisvilleky.gov
Tammy Callahan	Louisville Metro Public Works	502-574-3891	tammy.callahan@louisvilleky.gov
Anne Warnick	PB	859-245-3877	warnick@pbworld.com
Shawn Dikes	PB	502-479-9312	dikes@pbworld.com

MEETING SUMMARY:

The purpose of this meeting was to meet with Louisville Metro staff to discuss the KIPDA Bicycle and Pedestrian Interchange Study and obtain any feedback regarding the project.

The meeting began with Shawn Dikes of PB welcoming everyone to the meeting and introducing the KYTC's project manager Tom Hall. Mr. Hall briefly introduced the project and gave some background for why it cam about and its purpose. Next all attendees introduced themselves, and Mr. Dikes began with the meeting agenda.

The purpose of the project was discussed first. This included the purpose as well as the goals and components of the project, which are to find solutions that make getting through the high speed high volume interchanges safer for cyclists and pedestrians. The five (5) case study interchanges were introduced, and the major problems with bicycle and pedestrian facilities at interchanges were discussed. Next the findings from the literature review were summarized, along with the results of stakeholder meetings held so far.

After the progress of the project was presented, the meeting attendees were asked for their feedback with respect to concepts they would like to see or things that could be done with the project to make it useful for them. Comments and questions included:

- Need for markings and signage approved by KYTC, especially regarding free flow ramps. Louisville Metro is responsible for signage and needs specific guidance from KYTC.
- Make sure that what is included in the toolbox will be useful for Louisville, just because it worked in another city does not mean it will work here.
- Design treatments regarding free flow ramps are very important.
- Look at examples in Lexington.
- Would KYTC allow lane widths narrower than 11 feet to allow for wider bike lanes?
    - Would be handled on a case by case basis.
- Are there any plans to make changes to the case study interchanges in the near future?
    - No, these were chosen to ensure that concepts were developed for various types of interchanges, and there are currently no plans to make changes to them.
- How can this apply to a current project on Cannons Lane?
    - Some of the treatments discussed in the literature review, such as continuing bike lanes through the interchange, bringing ramps in at 90 degree angles, and using better signage and striping.

All comments were noted and questions discussed. It was agreed that Mr. Dikes would send an invitation to receive copies of information gathered so far with the meeting minutes to all attendees.

The meeting adjourned at 11:00 am.

PB Americas, Inc.
Meeting Minutes

PROJECT: KIPDA Bicycle and Pedestrian Interchange Safety Study

MEETING: Stakeholder Meeting with Professor Mark French
University of Louisville

DATE & TIME: October 17, 2007 – 3:00 PM

LOCATION: KYTC D-5 Offices
Louisville, Kentucky

MEETING SUMMARY:

The purpose of this meeting was to meet with Professor Mark French, University of Louisville who has an interest in bicycle and pedestrian issues.

Tom Hall began the meeting by introducing the project, its purpose and what has been done so far. He summarized the five (5) activities that will be done for the project and asked Shawn Dikes to continue explaining PB's work. Shawn detailed the results of the literature review, specifically some treatments that others are doing and what is most applicable to Louisville Metro. He also described the stakeholder outreach and agency coordination activities that have occurred to date. He then described the idea of developing ideas for improvement at each interchange location and type, and the development of the "toolbox" and documentation.

Mark agreed that better guidance is necessary. He also agreed that the Watterson and the interchanges at other locations are barriers and the better access is needed. He commented that it seemed that the Project Team was / is talking to the right people and agencies. Mark agreed that we should accommodate all skill levels of cyclists and all types of able-bodied and non-able bodied pedestrians.

He also discussed his own personal adventures with riding along US 60 (Shelbyville Road) near I-264 (Watterson Expressway) near St. Matthews. The fact that the ramps converge into multiple locations presents an almost overwhelming set of conflict points. Mark said that more guidance was needed, especially in the realm of design parameters. He would like to see ranges so that planners, engineers, and designers could exercise professional judgment. If a recommended standard is unattainable; say you need 100 feet, and only 70 can be accommodated, that would be acceptable under certain conditions. He doesn't want to see a situation where "unattainable means it doesn't get done". He wants to see "compromise" and not "elimination".

Mark also mentioned the fact that simple things like site distance issues up ramps, where the view from a crosswalk area is obscured by a retaining wall, overhanging vegetation, etc., can be addressed and improves conditions. He also would like to see guidance on the placement of pavement markings, specifically the "sharrow". Mark agreed to review the aerial images of the 5 interchanges for the case studies and develop some recommendations. He also would like to see the DRAFT of the Task 1 summary of the literature review.

His subsequent detailed comments include:

Prepared by Mark French
Comments on interchange travel for pedestrians and bicycle traffic:

- At I71 and Lagrange Rd. – Need to have marked crosswalk at both combined entrance/exit ramp areas. Use of a refuge zone between the entrance and exit ramp may be needed since the entrances are uncontrolled and only exit ramp traffic is stopped by the signal light – there is no safe way for a pedestrian to get across all lanes.
- Combine multiple roadway entrance ramps into a single ramp access point. Replace the sweeping high-speed entrance ramp with a turn-lane in order to continue to provide capacity, but to reduce speed, and reduce number of lanes peds and bikes must cross at the interchange.
- The same applies for exit ramps – reduce sweeping high speed merging with small radius turn lanes. This will maintain capacity and provide reduced speed at the end of the ramp where ped and bicycle traffic crosses.
- At locations where the turn radius must be large, such as Brooks Hill Rd., use the open space between legs of the entrance ramp as a refuge area for peds or bicycles. This would require some safety improvement such as raised curbs or concrete barriers to provide safety for peds and bikes crossing the exposed ramp area.
- Overpasses with no sidewalk need signage to indicate vehicles must watch for pedestrian traffic such as I-71 at Lagrange where shopping is on the opposite side of the interstate from housing.
- Sidewalks or paved pathways on both sides of every overpass or underpass. Where there is no space or room for an official sidewalk, a paved path is needed. If no path is provided, a designed dirt or gravel trail is needed, otherwise a path will get worn in by existing pedestrian traffic regardless, and the path will have no consideration of safe travel through the intersection.
- Include cross walk lines at each location a path or sidewalk crosses a ramp in order to guide pedestrians and to serve as an indicator to vehicles of potential pedestrian traffic. Since folks are walking through these interchanges regardless of whether safety enhancements are in place, it can only improve awareness and safety for both pedestrian traffic and vehicles if signage and road markings are included.
- Clear all sight distances for entrance and exit ramps for both vehicles to observe pedestrians and pedestrians to observe vehicles – shrubs and signs can obscure the view and create dangerous environment for pedestrians attempting to cross – and for vehicles crossing multiple lanes where a pedestrian may be passing or standing or waiting to cross a ramp.
- Include signage for vehicles indicating pedestrian crossings are ahead and signs pointing to correct place to stop in order not to block crosswalk at signals.
- Where crosswalk signals are included with activation buttons, require access to buttons as part of the walkway or concrete pad at the road-walkway location.
  Some existing walk signals at interchanges (Breckenridge Ln. at I-264 overpass, and I-64 at Hurstbourne) have signaled cross-walks with activation button difficult to access. Buttons are located behind guardrails or on steep vegetated areas where the posts for traffic signal is located – existing location makes it difficult or impossible for some pedestrians to reach the signal activation.
- Use smaller radius access turns for entrance/exit ramp connections to roadways. This will passively improve safety through slower turn speed and better sight lines for traffic.
- Use shared-lane or bike-lane markings on roads at all interchange crossings to increase vehicle awareness and expectation for bicycle traffic.

PB Americas, Inc.
Meeting Minutes

PROJECT: KIPDA Bicycle and Pedestrian Interchange Safety Study

MEETING: Stakeholder Meeting with Kevin Beck
21st Century Parks

DATE & TIME: October 31, 2007 – 9:30 AM

LOCATION: Teleconference
Louisville, Kentucky

MEETING SUMMARY:

The purpose of this meeting was to meet with Kevin Beck of 21st Century Parks who has an interest in bike and pedestrian issues; especially as they relate to Louisville's outer ring of parks and the proposed Floyd's Fork Greenway.

Kevin is supportive of the project and understands the need to make conditions as safe as possible for walkers, joggers, bicyclists, etc., who may use all facilities in the region. He is especially interested in Taylorsville Road and its various intersections as this helps connect the outer ring of parks to the traditional inner ring inside the Watterson, namely Seneca and Cherokee.

He is also interested in developing a connection from Blackacre Nature Preserve to the Floyd's Fork Greenway and the proposed trails or multi use paths that might be along Taylorsville Road.

Kevin received a copy of the Taylorsville Road / I-265 intersection.

PB Americas, Inc.
Meeting Minutes

PROJECT: KIPDA Bicycle and Pedestrian Interchange Safety Study

MEETING: Stakeholder Meeting with Carrie Butler
Transit Authority of River City (TARC)

DATE & TIME: November 5, 2007 – 3:00 PM

LOCATION: Telephone Conference Call

MEETING SUMMARY:

The purpose of this meeting was to talk to Carrie Butler regarding TARC's interest in promoting walking and cycling and their safety in the region. Jon Villines from Louisville Metro, a member of the Project Development Team (PDT) also participated.

Carrie said that TARC hears issues with access from their customers. Customers often describe difficulty in getting through interchanges and intersections. Carrie recognizes that many of the solution are not that easy to implement, but she is in favor of providing guidance and recommendations for making incremental chances. Making conditions safer for walkers and bicyclists also improves access to and the conditions of transit, and ultimately increases ridership.

She pointed to a resource development by ITE, *Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities*, which might be used to get ideas from.

Carrie pointed out that she found its organization to be useful and user friendly and that the format may be able to be copied for the KIDPA "Toolbox".

Carrie would like to see more integration of TARC's bus stops with sidewalks and multi-use paths, and perhaps the integration of park-and-ride lots within the interchanges. TARC is looking for innovative ways to site the lots.

Carrie mentioned the fact that the pedestrian signals at I-264 and Bardstown Road seem inadequate. She would also like to have pedestrian signage that is appropriate at the interchanges integrated with wayfinding signage so pedestrians have more knowledge about what is around them. She also would like to see aesthetics as part of the improvements to the built environment can be as interesting and attractive as possible.

Sullivan University

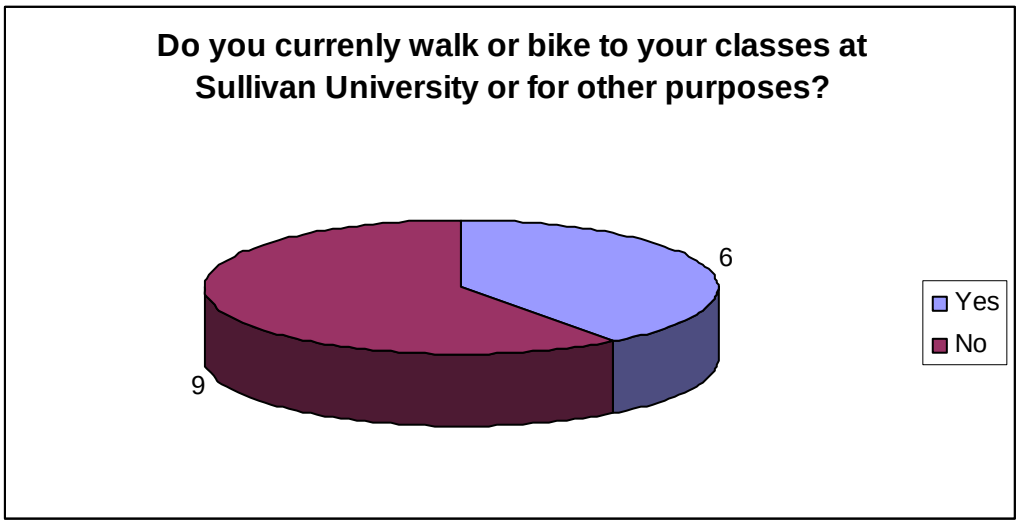
Tuesday, November 13, 2007

Student and Faculty Survey

KIPDA Interchange Bicycle and Pedestrian Safety Study

The purpose of this stakeholder involvement activity for the KIPDA Interchange Bicycle and Pedestrian Safety Study was to obtain Sullivan University student, faculty and staff input on safety issues of walking and bicycling through interchanges as well as to determine what could be done to improve safety. A display was set up in the A La Cart Café at Sullivan University, which is located at the I-264 and US 31E interchange. Interested individuals were asked to fill out a survey regarding their thoughts toward walking or biking through the nearby interchange, and suggestions of what could be done to improve it. A total of 15 completed surveys were collected. A summary of the completed survey form results is presented below.

1) Walking and Biking to Class:



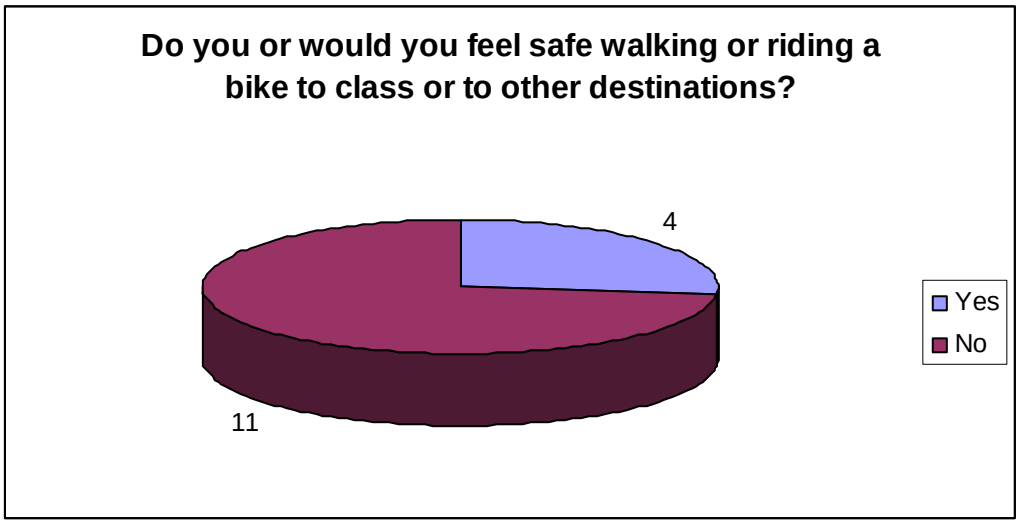
Why?

- Parking lot is full, need to park across street.
- Fuel economy
- To be green / conservation
- Weight loss and health

Why not?

- Ride Sullivan Shuttle instead
- Live too far away
- Don't like to cross Bardstown Road
- Too dangerous
- No safe lanes to use on Bardstown or Hurstbourne or side streets
- Don't own a bike
- Cars are not nice to people riding bikes

2) Safety



Why?

- Feel safe crossing Gardiner Lane but not Bardstown Road, use shuttle to cross Bardstown.
- Have been doing it for 2 years.

Why not?

- Heavy traffic
- No place for walkers or bikers
- No one obeys traffic signals
- No bike path
- Bardstown Road is too dangerous
- Drivers fail to yield at traffic lights
- Lights are not right
- Too many major roads to cross
- No safe lanes
- Bikes not respected
- Pedestrians play frogger to cross, even at crosswalks

3) What could be done to make walking or riding to class or other destinations safer, particularly through the Watterson Expressway / Bardstown Road interchange?

- A rim that would be just riding and walking
- Divert pedestrian traffic away from intersection
- Fix stop light timing – give more time for pedestrian crossing
- Add bike path
- Driver education to learn to safely drive with bike lanes
- Bridge or overpass to cross busy street
- Walking and biking trail
- Extend shuttle hours / use shuttle
- Add sidewalks on Bardstown road
- Crosswalk signals with countdown feature

4) What, if anything would encourage you to ride your bike more?

- Better sidewalks or bike trails
- Good weather
- Safe bike path
- Tax breaks
- Finish south end trails
- Bike lanes
- More areas to ride and walk where I need to go
- High gas prices
- Installation of pedestrian overpass
- If it were safer and street walking lights were right
- Bike and pedestrian only alleys, vehicle-less destinations

5) What suggestions do you have to improve pedestrian and bicycle facilities through the Watterson Expressway / Bardstown Road Interchange?

- Pedestrian and Bike Overpass
- Overpass over Bardstown Road and over the interstate with no steps and long, easy to climb and descend slope
- Bike lane
- Citations for disobeying traffic signals
- More bike racks
- Bike path
- Change signal timing
- Illegalize gasoline engines
- Underpass with escalators and good security and lighting, and slope for bikes
- Ride the shuttle

6) What suggestions do you have to improve pedestrian and bicycle facilities through the other four (4) study interchanges?

- Add bike paths
- Change signal timing
- Illegalize gasoline engines
- Add bike lanes
- Bridges
- Longer crossing signals

7) Do you have any other suggestions or comments for improving pedestrian and bicycle safety in the area?

- Traffic goes under and pedestrians stay at street level
- Bike trails around the whole Louisville area (attachment of similar idea in Baltimore)
- Bike lanes
- Delay lights to add more crossing time
- Better street painting and marking crosswalks more clearly
- SAA bike lanes
- Driver education
- Encourage businesses to be more aesthetically pleasing, people won't drive so fast by things they like to look at

APPENDIX D:

LITERATURE REVIEW BIBLIOGRAPHY

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APPENDIX E:

BICYCLE AND PEDESTRIAN SIGNS

MUTCD Signs for Vehicles

W11-2
Pedestrian

Sign image from the Manual of Traffic Signs <http://www.trafficsign.us/>
This sign image copyright Richard C. Moeur. All rights reserved.

W11-1
Bicycle

Sign image from the Manual of Traffic Signs <http://www.trafficsign.us/>
This sign image copyright Richard C. Moeur. All rights reserved.

R10-6

Sign image from the Manual of Traffic Signs <http://www.trafficsign.us/>
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R4-4

Sign image from the Manual of Traffic Signs <http://www.trafficsign.us/>
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R10-15

Sign image from the Manual of Traffic Signs <http://www.trafficsign.us/>
This sign image copyright Richard C. Moeur. All rights reserved.

MUTCD Signs for Bicycles

W11-1 / W16-1
Share the Road with Bicyclists assembly

Sign images from the Manual of Traffic Signs <http://www.trafficsign.us/>
These sign images copyright Richard C. Moeur. All rights reserved.

R3-17

R3-17a

R3-17b

Sign images from the Manual of Traffic Signs <http://www.trafficsign.us/>
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R9-5

Sign image from the Manual of Traffic Signs <http://www.trafficsign.us/>
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R9-3c

Sign images from the Manual of Traffic Signs <http://www.trafficsign.us/>
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R9-7

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MUTCD Signs for Pedestrians

R9-7

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R10-3b

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R10-3c

Sign image from the Manual of Traffic Signs <http://www.trafficsign.us/>
This sign image copyright Richard C. Moeur. All rights reserved.

R10-3e

Sign image from the Manual of Traffic Signs <http://www.trafficsign.us/>
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Additional Signage

The above signs can be used in combination when adequate room does not exist for bicyclists and they must use pedestrian facilities.

APPENDIX F:

DETAILED CASE STUDY COST ESTIMATES

KIPDA INTERCHANGES
CONSTRUCTION QUANTITIES AND ESTIMATED COSTS

LOCATION	PROPOSED ALTERNATIVE	DESCRIPTION	ITEM	ITEM NUMBER	UNIT	UNIT PRICE	QUANTITY	AMOUNT	COST INCLUDING 25% CONTINGENCY
I-264 & TAYLORSVILLE ROAD (KY 155) [Skewed Partial Cloverleaf]	0	Tree Trimming / Sweeping / Maintenance	---	---	---	MINIMAL	---	MINIMAL	---
	1	Right Turn Yield to Bikes	SIGNS (R4-4)	02562	SQFT	$9.08	23	$204	$600
			STEEL POST TYPE 2	06411	LF	$6.60	38	$248	
	2	Bike / Pedestrian Warning Signs	SIGNS (W11-1)	02562	SQFT	$9.08	24	$218	$1,200
			SIGNS (W11-2)	02562	SQFT	$9.08	24	$218	
			STEEL POST TYPE 2	06411	LF	$6.60	75	$495	
	3	Pedestrian Warning System	PEDESTRIAN WARNING SYSTEM	---	EACH	$30,000.00	2	$60,000	$75,000
	4	Lighting	POLE 30 FT MTG HT	04700	EACH	$957.15	4	$3,829	$38,000
			BRACKET 12 FT	04724	EACH	$304.80	4	$1,219	
			POLE BASE	04740	EACH	$723.53	4	$2,894	
			TRANSFORMER BASE	04750	EACH	$297.48	4	$1,190	
			HPS LUMINAIRE	04770	EACH	$318.72	4	$1,275	
			FUSED CONNECTOR KIT	04780	EACH	$7.44	4	$30	
			CONDUIT-1 1/4 INCH	04793	LF	$7.40	1,000	$7,400	
			JUNCTION BOX TYPE B	04811	EACH	$382.25	4	$1,529	
			TRENCHING AND BACKFILLING	04820	LF	$9.15	1,000	$9,150	
			WIRE-NO. 8	04833	LF	$1.76	1,000	$1,760	
	5	Zebra Crossing / Sidewalk / Countdown Pedestrian Signal (No Earthwork)	SIDEWALK-4 INCH CONCRETE	02720	SQYD	$50.00	3,094	$154,722	$250,000
			SIDEWALK RAMP TYPE 1	03287	EACH	$1,740.93	20	$34,819	
			SIGNAL-PEDESTRIAN	04916	EACH	$757.00	6	$4,542	
			PAVE STRIPING-DUR TY 1-12 IN W	06560	LF	$5.92	618	$3,659	
	6	Wide Curb Lane / Restriping	DGA BASE	00001	TON	$30.00	447	$13,422	$280,000
			LIME STABILIZED ROADBED	00013	SQYD	$7.00	1,567	$10,967	
			CL2 ASPH BASE 1.00 PG64-22	00212	TON	$85.00	1,024	$87,006	
			CL2 ASPH SURF 0.38D PG64-22	00301	TON	$85.00	108	$9,155	
			STANDARD HEADER CURB	01875	LF	$23.16	2,820	$65,311	
			ROADWAY EXCAVATION	02200	CUYD	$5.00	3,656	$18,278	
			FABRIC-GEOTEXTILE TYPE IV	02599	SQYD	$2.97	3,760	$11,167	
			PAVE STRIPING-PERM PAINT-4 IN	06514	LF	$0.58	2,820	$1,636	
	7A	Zebra Crossing / Sidewalk / Countdown Pedestrian Signal (with Earthwork)	ROADWAY EXCAVATION	02200	CUYD	$5.00	2,063	$10,315	$261,000
			SIDEWALK-4 INCH CONCRETE	02720	SQYD	$50.00	3,094	$154,722	
			SIDEWALK RAMP TYPE 1	03287	EACH	$1,740.93	20	$34,819	
			SIGNAL-PEDESTRIAN	04916	EACH	$757.00	6	$4,542	
			PAVE STRIPING-DUR TY 1-12 IN W	06560	LF	$5.92	618	$3,659	
	7B	Multiuse Path with Earthwork	CRUSHED STONE BASE	00003	TON	$32.00	977	$31,267	$130,000
			CL1 ASPH SURF 0.38D PG64-22	00300	TON	$85.00	452	$38,437	
			ROADWAY EXCAVATION	02200	CUYD	$5.00	6,852	$34,259	
	8	Ramp Elimination / Consolidation / Bike Lane	DGA BASE	00001	TON	$30.00	840	$25,212	$680,000
			LIME STABILIZED ROADBED	00013	SQYD	$7.00	1,749	$12,243	
			CL2 ASPH BASE 1.00 PG64-22	00212	TON	$85.00	1,978	$168,130	
			CL2 ASPH SURF 0.38D PG64-22	00301	TON	$85.00	219	$18,573	
			STANDARD HEADER CURB	01875	LF	$23.16	2,820	$65,311	
			ROADWAY EXCAVATION	02200	CUYD	$5.00	43,378	$216,892	
			MISC. ROADWAY ITEMS	---	---	20%	---	$101,272	
	9	Nearby Grade Separated Crossing between Taylorsville Road and Bardstown Road	15' WIDE PEDESTRIAN BRIDGE	---	SF	$85.00	4,125	$350,625	$1,020,000
			8' WIDE PEDESTRIAN BRIDGE RAMPS	---	SF	$85.00	5,440	$462,400	

Note: Cost is a planning level cost estimate in 2007 dollars for construction costs only.

KIPDA INTERCHANGES
CONSTRUCTION QUANTITIES AND ESTIMATED COSTS

LOCATION	PROPOSED ALTERNATIVE	DESCRIPTION	ITEM	ITEM NUMBER	UNIT	UNIT PRICE	QUANTITY	AMOUNT	COST INCLUDING 25% CONTINGENCY
I-264 & BARDSTOWN ROAD (US 31E) [Single Point Urban Interchange]	0	Sweep Curbs / Gore Areas	---	---	---	MINIMAL	---	MINIMAL	---
	1	Right Turn Yield to Bikes	SIGNS (R4-4)	02562	SQFT	$9.08	23	$204	$600
			STEEL POST TYPE 2	06411	LF	$6.60	38	$248	
	2	Stop Here on Red / Staggered Stop Bars	SIGNS (R10-6)	02562	SQFT	$9.08	12	$109	$900
			STEEL POST TYPE 2	06411	LF	$6.60	25	$165	
			PAVE MARKING-THERMO STOP BAR-24IN	06568	LF	$7.80	50	$390	
	3	Zebra Stripe Existing Crosswalks	PAVE STRIPING-DUR TY 1-12 IN W	06560	LF	$5.92	875	$5,180	$7,000
	4	Pedestrian Countdown Signals Double-Sided (8 Heads)	SIGNAL-PEDESTRIAN	04916	EACH	$757.00	16	$12,112	$16,000
	5	Lighting	POLE 30 FT MTG HT	04700	EACH	$957.15	4	$3,829	$38,000
			BRACKET 12 FT	04724	EACH	$304.80	4	$1,219	
			POLE BASE	04740	EACH	$723.53	4	$2,894	
			TRANSFORMER BASE	04750	EACH	$297.48	4	$1,190	
			HPS LUMINAIRE	04770	EACH	$318.72	4	$1,275	
			FUSED CONNECTOR KIT	04780	EACH	$7.44	4	$30	
			CONDUIT-1 1/4 INCH	04793	LF	$7.40	1,000	$7,400	
			JUNCTION BOX TYPE B	04811	EACH	$382.25	4	$1,529	
			TRENCHING AND BACKFILLING	04820	LF	$9.15	1,000	$9,150	
			WIRE-NO. 8	04833	LF	$1.76	1,000	$1,760	
	6	Reconfigure Sidewalk and Crossing at I-264 Right Turn Off Ramps to Provide 90° Crossings	SIDEWALK-4 INCH CONCRETE	02720	SQYD	$50.00	61	$3,056	$15,000
			SIDEWALK RAMP TYPE 1	03287	EACH	$1,740.93	4	$6,964	
			PAVE STRIPING-DUR TY 1-12 IN W	06560	LF	$5.92	240	$1,421	
	7	Shift Sidewalk / Make Wide Curb Lane for Bikes	DGA BASE	00001	TON	$30.00	343	$10,278	$310,000
			LIME STABILIZED ROADBED	00013	SQYD	$7.00	1,111	$7,778	
			CL2 ASPH BASE 1.00 PG64-22	00212	TON	$85.00	761	$64,643	
			CL2 ASPH SURF 0.38D PG64-22	00301	TON	$85.00	76	$6,494	
			STANDARD HEADER CURB	01875	LF	$23.16	2,000	$46,320	
			ROADWAY EXCAVATION	02200	CUYD	$5.00	2,593	$12,963	
			FABRIC-GEOTEXTILE TYPE IV	02599	SQYD	$2.97	2,849	$8,461	
			SIDEWALK-4 INCH CONCRETE	02720	SQYD	$50.00	1,111	$55,556	
			SIDEWALK RAMP TYPE 1	03287	EACH	$1,740.93	16	$27,855	
			PAVE STRIPING-PERM PAINT-4 IN	06514	LF	$0.58	2,000	$1,160	
	8	Nearby Grade Separated Crossing between Taylorsville Road and Bardstown Road	15' WIDE PEDESTRIAN BRIDGE	---	SF	$85.00	4,125	$350,625	$1,020,000
			8' WIDE PEDESTRIAN BRIDGE RAMPS	---	SF	$85.00	5,440	$462,400	

Note: Cost is a planning level cost estimate in 2007 dollars for construction costs only.

KIPDA INTERCHANGES
CONSTRUCTION QUANTITIES AND ESTIMATED COSTS

LOCATION	PROPOSED ALTERNATIVE	DESCRIPTION	ITEM	ITEM NUMBER	UNIT	UNIT PRICE	QUANTITY	AMOUNT	COST INCLUDING 25% CONTINGENCY
I-265 & TAYLORSVILLE ROAD (KY 155) [Diamond Interchange with Arterial Under the Interstate]	0	Sweep Curbs / Maintenance	---	---	---	MINIMAL	---	MINIMAL	---
	1	Right Turn Yield to Bikes	SIGNS (R4-4)	02562	SQFT	$9.08	23	$204	$600
			STEEL POST TYPE 2	06411	LF	$6.60	38	$248	
	2	Extend Pavement Through Interchange for Wide Curb Lane (10' Width) Either Asphalt or Concrete (No Drainage)	DGA BASE	00001	TON	$30.00	470	$14,112	$240,000
			LIME STABILIZED ROADBED	00013	SQYD	$7.00	1,667	$11,667	
			CL2 ASPH BASE 1.00 PG64-22	00212	TON	$85.00	1,081	$91,911	
			CL2 ASPH SURF 0.38D PG64-22	00301	TON	$85.00	115	$9,741	
			STANDARD HEADER CURB	01875	LF	$23.16	1,500	$34,740	
			ROADWAY EXCAVATION	02200	CUYD	$5.00	1,944	$9,722	
			FABRIC-GEOTEXTILE TYPE IV	02599	SQYD	$2.97	3,960	$11,761	
			PAVE STRIPING-PERM PAINT-4 IN	06514	LF	$0.58	1,500	$870	
	3	Lighting	POLE 30 FT MTG HT	04700	EACH	$957.15	2	$1,914	$19,000
			BRACKET 12 FT	04724	EACH	$304.80	2	$610	
			POLE BASE	04740	EACH	$723.53	2	$1,447	
			TRANSFORMER BASE	04750	EACH	$297.48	2	$595	
			HPS LUMINAIRE	04770	EACH	$318.72	2	$637	
			FUSED CONNECTOR KIT	04780	EACH	$7.44	2	$15	
			CONDUIT-1 1/4 INCH	04793	LF	$7.40	500	$3,700	
			JUNCTION BOX TYPE B	04811	EACH	$382.25	2	$765	
			TRENCHING AND BACKFILLING	04820	LF	$9.15	500	$4,575	
			WIRE-NO. 8	04833	LF	$1.76	500	$880	
	4	Multiuse Path on One Side and Sidewalk on the Other	CRUSHED STONE BASE	00003	TON	$32.00	792	$25,350	$210,000
			CL1 ASPH SURF 0.38D PG64-22	00300	TON	$85.00	367	$31,170	
			ROADWAY EXCAVATION	02200	CUYD	$5.00	5,111	$25,556	
			SIDEWALK-4 INCH CONCRETE	02720	SQYD	$50.00	1,667	$83,333	
	5	Ramp Elimination / Consolidation	DGA BASE	00001	TON	$30.00	425	$12,750	$290,000
			LIME STABILIZED ROADBED	00013	SQYD	$7.00	1,912	$13,384	
			CL2 ASPH BASE 1.00 PG64-22	00212	TON	$85.00	1,047	$88,961	
			CL2 ASPH SURF 0.38D PG64-22	00301	TON	$85.00	122	$10,345	
			ROADWAY EXCAVATION	02200	CUYD	$5.00	12,741	$63,704	
			MISC. ROADWAY ITEMS	---	---	20%	---	$37,829	

Note: Cost is a planning level cost estimate in 2007 dollars for construction costs only.

KIPDA INTERCHANGES
CONSTRUCTION QUANTITIES AND ESTIMATED COSTS

LOCATION	PROPOSED ALTERNATIVE	DESCRIPTION	ITEM	ITEM NUMBER	UNIT	UNIT PRICE	QUANTITY	AMOUNT	COST INCLUDING 25% CONTINGENCY
I-65 & BROOKS ROAD (KY 1526) [Diamond Interchange with Arterial Over the Interstate]	0	Sweep Curbs / Maintenance	---	---	---	MINIMAL	---	MINIMAL	---
	1	Right Turn Yield to Bikes	SIGNS (R4-4)	02562	SQFT	$9.08	30	$272	$800
			STEEL POST TYPE 2	06411	LF	$6.60	50	$330	
	2	Bike / Pedestrian Warning Signs	SIGNS (W11-1)	02562	SQFT	$9.08	24	$218	$1,200
			SIGNS (W11-2)	02562	SQFT	$9.08	24	$218	
			STEEL POST TYPE 2	06411	LF	$6.60	75	$495	
	3	High Mast Lighting	POLE 30 FT MTG HT	04700	EACH	$957.15	4	$3,829	$39,000
			BRACKET 15 FT	04725	EACH	$512.90	4	$2,052	
			POLE BASE	04740	EACH	$723.53	4	$2,894	
			TRANSFORMER BASE	04750	EACH	$297.48	4	$1,190	
			HPS LUMINAIRE	04770	EACH	$318.72	4	$1,275	
			FUSED CONNECTOR KIT	04780	EACH	$7.44	4	$30	
			CONDUIT-1 1/4 INCH	04793	LF	$7.40	1,000	$7,400	
			JUNCTION BOX TYPE B	04811	EACH	$382.25	4	$1,529	
			TRENCHING AND BACKFILLING	04820	LF	$9.15	1,000	$9,150	
			WIRE-NO. 8	04833	LF	$1.76	1,000	$1,760	
	4	Remove Curb Lane Rumble Strips	CL1 ASPH SURF 0.38D PG64-22	00300	TON	$85.00	367	$31,170	$50,000
			ASPH PAVE MILLING & TEXTURING	02677	TON	$85.18	88	$7,496	
			PAVE STRIPING-PERM PAINT-4 IN	06514	LF	$0.58	1,800	$1,044	
	5	Tighten Ramp Termini	DGA BASE	00001	TON	$30.00	537	$16,122	$280,000
			LIME STABILIZED ROADBED	00013	SQYD	$7.00	2,417	$16,919	
			CL2 ASPH BASE 1.00 PG64-22	00212	TON	$85.00	1,324	$112,540	
			CL2 ASPH SURF 0.38D PG64-22	00301	TON	$85.00	154	$13,090	
			ROADWAY EXCAVATION	02200	CUYD	$5.00	4,858	$24,290	
			MISC. ROADWAY ITEMS	---	---	20%	---	$36,592	
I-71 & KY 146 (BUCKNER) [Partial Cloverleaf]	0	Continue to Maintain Shoulder	---	---	---	MINIMAL	---	MINIMAL	---
	1	Right Turn Yield to Bikes	SIGNS (R4-4)	02562	SQFT	$9.08	30	$272	$800
			STEEL POST TYPE 2	06411	LF	$6.60	50	$330	
	2	Bike / Pedestrian Warning Signs	SIGNS (W11-1)	02562	SQFT	$9.08	24	$218	$1,200
			SIGNS (W11-2)	02562	SQFT	$9.08	24	$218	
			STEEL POST TYPE 2	06411	LF	$6.60	75	$495	
	3	Widen Bridge for Wide Curb Lane, Sidewalk, and Refuge Island	SIDEWALK-4 INCH CONCRETE	02720	SQYD	$50.00	1,486	$74,306	$600,000
			SIDEWALK RAMP TYPE 1	03287	EACH	$1,740.93	8	$13,927	
			BRIDGE WIDENING	---	SF	$100.00	3,880	$388,000	
	4	Create Separate New Bridge for Greenway Facility	CRUSHED STONE BASE	00003	TON	$32.00	581	$18,592	$470,000
			CL1 ASPH SURF 0.38D PG64-22	00300	TON	$85.00	269	$22,857	
			ROADWAY EXCAVATION	02200	CUYD	$5.00	4,074	$20,370	
			GREENWAY FACILITY BRIDGE	---	SF	$100.00	3,300	$330,000	

Note: Cost is a planning level cost estimate in 2007 dollars for construction costs only.

KIPDA INTERCHANGES
CONSTRUCTION QUANTITIES AND ESTIMATED COSTS

ITEM	ITEM NUMBER	UNIT	UNIT PRICE
DGA BASE	00001	TON	$30.00
CRUSHED STONE BASE	00003	TON	$32.00
LIME STABILIZED ROADBED	00013	SQYD	$7.00
LIME STABILIZED ROADBED	00013	SQYD	$7.00
CL2 ASPH BASE 1.00 PG64-22	00212	TON	$85.00
CL2 ASPH SURF 0.38D PG64-22	00301	TON	$85.00
STANDARD HEADER CURB	01875	LF	$23.16
ROADWAY EXCAVATION	02200	CUYD	$5.00
SIGNS (R10-6)	02562	SQFT	$9.08
SIGNS (R4-4)	02562	SQFT	$9.08
SIGNS (W11-1)	02562	SQFT	$9.08
SIGNS (W11-2)	02562	SQFT	$9.08
FABRIC-GEOTEXTILE TYPE IV	02599	SQYD	$2.97
ASPH PAVE MILLING & TEXTURING	02677	TON	$85.18
SIDEWALK-4 INCH CONCRETE	02720	SQYD	$50.00
SIDEWALK RAMP TYPE 1	03287	EACH	$1,740.93
POLE 30 FT MTG HT	04700	EACH	$957.15
BRACKET 12 FT	04724	EACH	$304.80
BRACKET 15 FT	04725	EACH	$512.90
POLE BASE	04740	EACH	$723.53
TRANSFORMER BASE	04750	EACH	$297.48
HPS LUMINAIRE	04770	EACH	$318.72
FUSED CONNECTOR KIT	04780	EACH	$7.44
CONDUIT-1 1/4 INCH	04793	LF	$7.40
JUNCTION BOX TYPE B	04811	EACH	$382.25
TRENCHING AND BACKFILLING	04820	LF	$9.15
WIRE-NO. 8	04833	LF	$1.76
SIGNAL-PEDESTRIAN	04916	EACH	$757.00
STEEL POST TYPE 2	06411	LF	$6.60
PAVE STRIPING-PERM PAINT-4 IN	06514	LF	$0.58
PAVE STRIPING-DUR TY 1-12 IN W	06560	LF	$5.92
PAVE MARKING-THERMO STOP BAR-24IN	06568	LF	$7.80
15' WIDE PEDESTRIAN BRIDGE	---	SF	$85.00
8' WIDE PEDESTRIAN BRIDGE RAMPS	---	SF	$85.00
BRIDGE WIDENING	---	SF	$100.00
GREENWAY FACILITY BRIDGE	---	SF	$100.00
PEDESTRIAN WARNING SYSTEM	---	EACH	$30,000.00

Note: Prices are in 2007 dollars.

KIPDA INTERCHANGES
CONSTRUCTION QUANTITIES AND ESTIMATED COSTS

ITEM	UNIT	UNIT PRICE	UNIT PRICE (+25%)
LIGHT	EACH	$7,569	$9,470
MULTIUSE PATH	LF	$28	$40
PEDESTRIAN SIGNAL	EACH	$757	$950
PEDESTRIAN WARNING SYSTEM	EACH	$30,000	$37,500
RAMP (28' WIDE)	LF	$305	$390
ROADWAY WIDENING WITH CURB	SQYD	$145	$190
SIGNS			
BEGIN RIGHT TURN LANE YIELD TO BIKES (R4-4)	EACH	$151	$190
STOP HERE ON RED (R10-6)	EACH	$137	$180
BICYCLE WARNING (W11-1)	EACH	$119	$150
PEDESTRIAN CROSSING (W11-2)	EACH	$119	$150
SIDEWALK			
SIDEWALK	LF	$28	$40
SIDEWALK RAMP	EACH	$1,740	$2,180

Note: Prices are in 2007 dollars.

APPENDIX G:

Excerpts from Illinois Bureau of Design and Environmental Manual

* Please note that this is not Kentucky State policy but is one example of another state's approach to bicycle design through an interchange.

17-2.01(e) Bikeway on Highway Structures

Bicycle accommodations on approach roadways should be carried across structures. The width of new highway structures should, at a minimum, equal the width of the traveled way plus the width of approaching bicycle lanes and/or sidewalks. Minimum cross sections for roadways and structures will vary significantly depending on the type of bicycle facility being accommodated. Several examples of minimum cross sections for shared roadways, bicycle lanes and bicycle paths are shown in Figures 17-2J through 17-2L. In addition, the criteria for accommodating bikeways at or near bridges along freeways and expressways are illustrated in Figure 17-2M. Figure 17-2N presents a typical modification of existing facilities for bikeways under a bridge.

Where it is necessary to retrofit a separated bicycle path (see Section 17-2.02) onto an existing highway bridge, several alternatives should be considered in light of what the geometrics of the bridge will allow. One option is to carry the bicycle path across one side of the structure. This should be considered where:

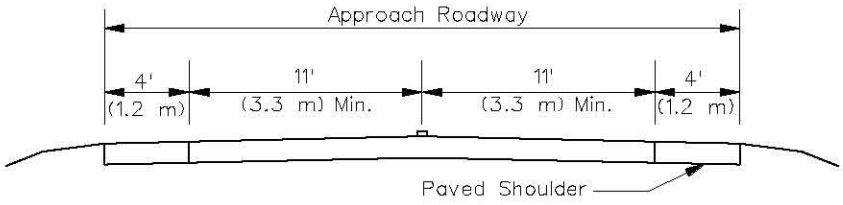
- the bridge facility will connect to a bicycle path at both ends,
- sufficient width exists on that side of the bridge or can be obtained by widening or restriping lanes, and
- provisions are made to physically separate bicycle traffic from motor vehicle traffic.

Another option is to use existing sidewalks as one-way or two-way facilities. This may be advisable where:

- conflicts between bicyclists and pedestrians will not exceed tolerable limits, and
- the existing sidewalks are adequately wide.

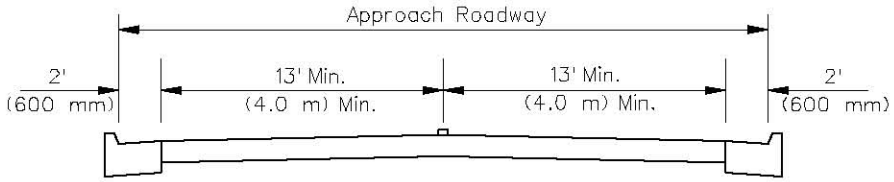
If the facility cannot provide adequate accommodation (per widths indicated in this section), appropriately sign the facility to warn users of the deficiencies or require bicyclists to dismount and cross the structure as a pedestrian. Section 17-2.02(i) provides additional design guidance for structures on bicycle paths. The AASHTO *Bridge Manual* specifies a 4′-6″ (1.4 m) outside railing height. Design on-road bicycle accommodations accordingly. Bridge railing on off-road-shared-use paths must meet a 3′-6″ (1.1 m) minimum rail height requirement.

Where bridge projects include bikeway or sidewalk accommodations, the approaches to the structure should ensure a usable facility by continuing the accommodation to logical termini.

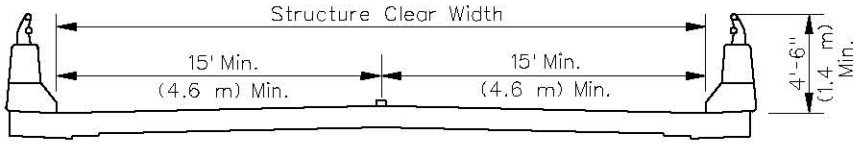


TWO-LANE ROADWAY WITH PAVED SHOULDERS

Note: Shoulder width should be increased to 6' (1.8 m) with conditions indicated in Figure 17-2A.



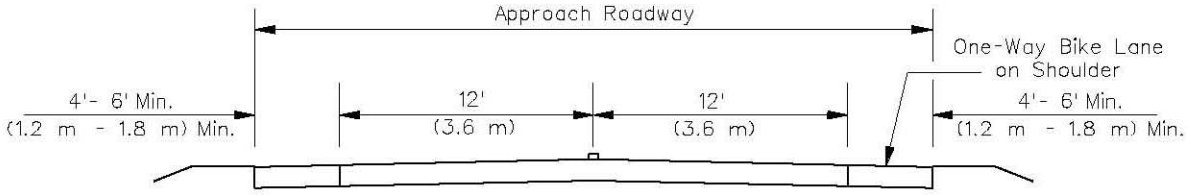
TWO-LANE URBAN ROADWAY WITH WIDE LANES



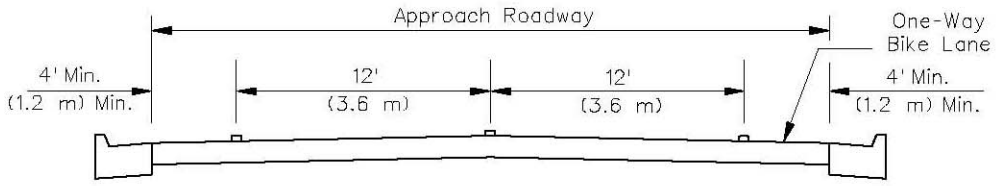
WIDE LANES/SHOULDERS CONTINUED ACROSS STRUCTURE

CROSS SECTIONS FOR SHARED ROADWAY ON TWO-LANE HIGHWAY STRUCTURES (Unmarked Bicycle Lanes)

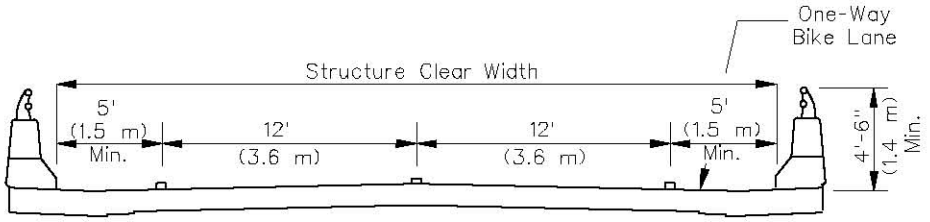
Figure 17-2J



BIKE LANES ON SHOULDERS



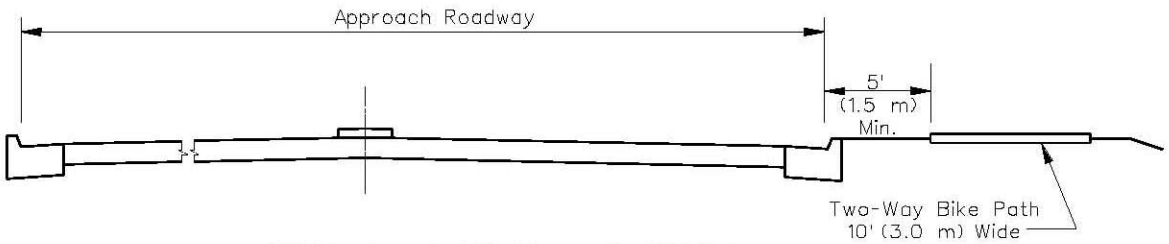
BIKE LANES ON ROADWAY



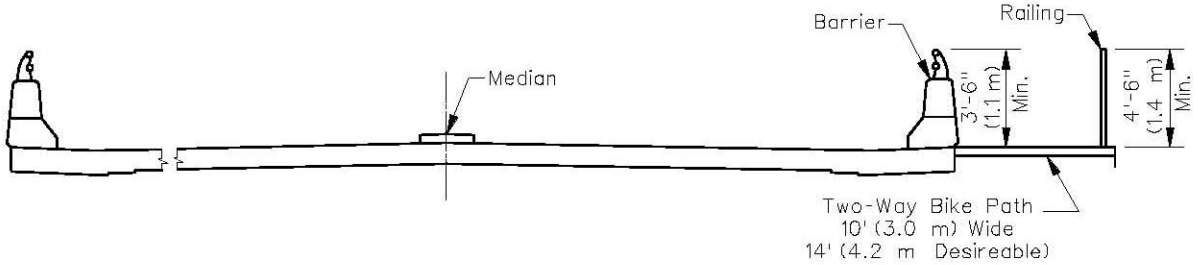
BIKE LANES ACROSS STRUCTURE

CROSS SECTIONS FOR MARKED BIKE LANES ON TWO-LANE HIGHWAY STRUCTURES

Figure 17-2K



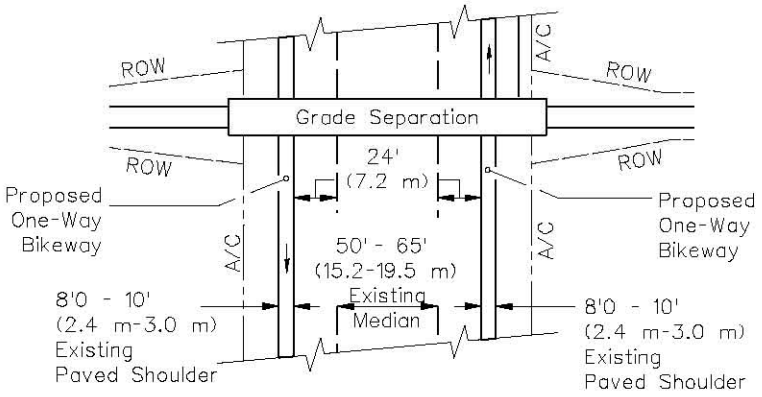
APPROACHING FOUR-LANE SECTION
WITH ADJACENT TWO-WAY BIKE PATH



FOUR-LANE SECTION CONTINUED ACROSS
BRIDGE WITH INTEGRAL BIKE PATH

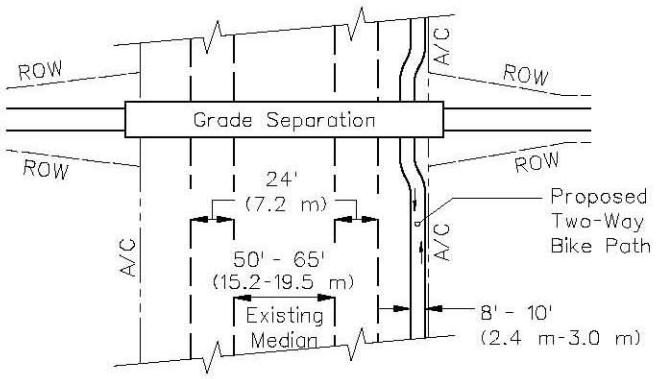
CROSS SECTIONS FOR BIKE PATHS ON FOUR-LANE HIGHWAY STRUCTURES

Figure 17-2L



PLAN VIEW OF ONE-WAY BIKEWAY UNDER BRIDGE

(Note: Typical layout of one-way bikeway using outside shoulders of an expressway or freeway.)

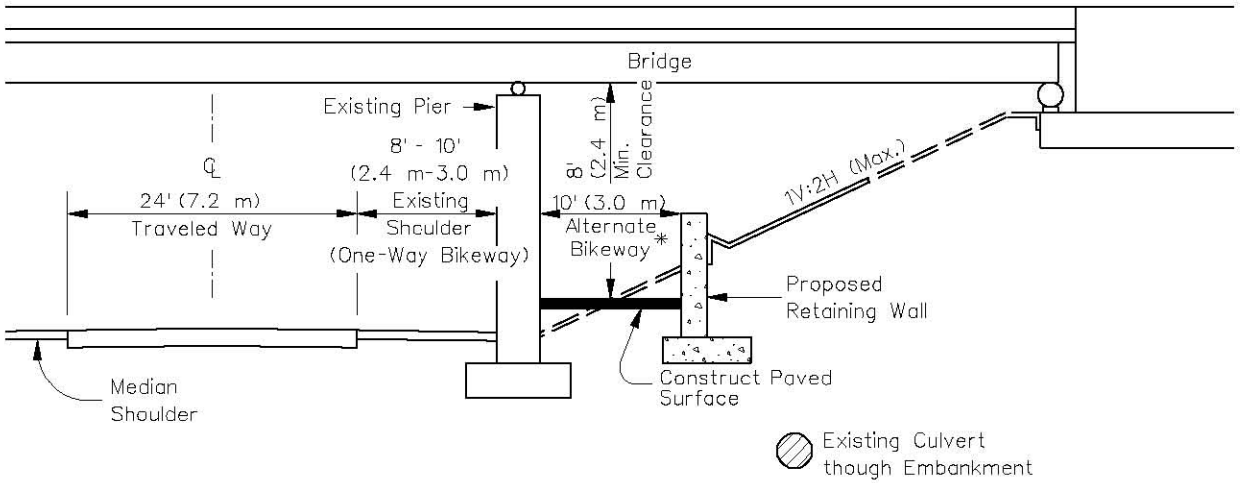


PLAN VIEW OF TWO-WAY BIKE PATH UNDER BRIDGE

(Note: Typical layout of two-way bike path adjacent to ROW line of an expressway or freeway.)

BIKEWAYS AT OR NEAR BRIDGES ALONG FREEWAYS OR EXPRESSWAYS

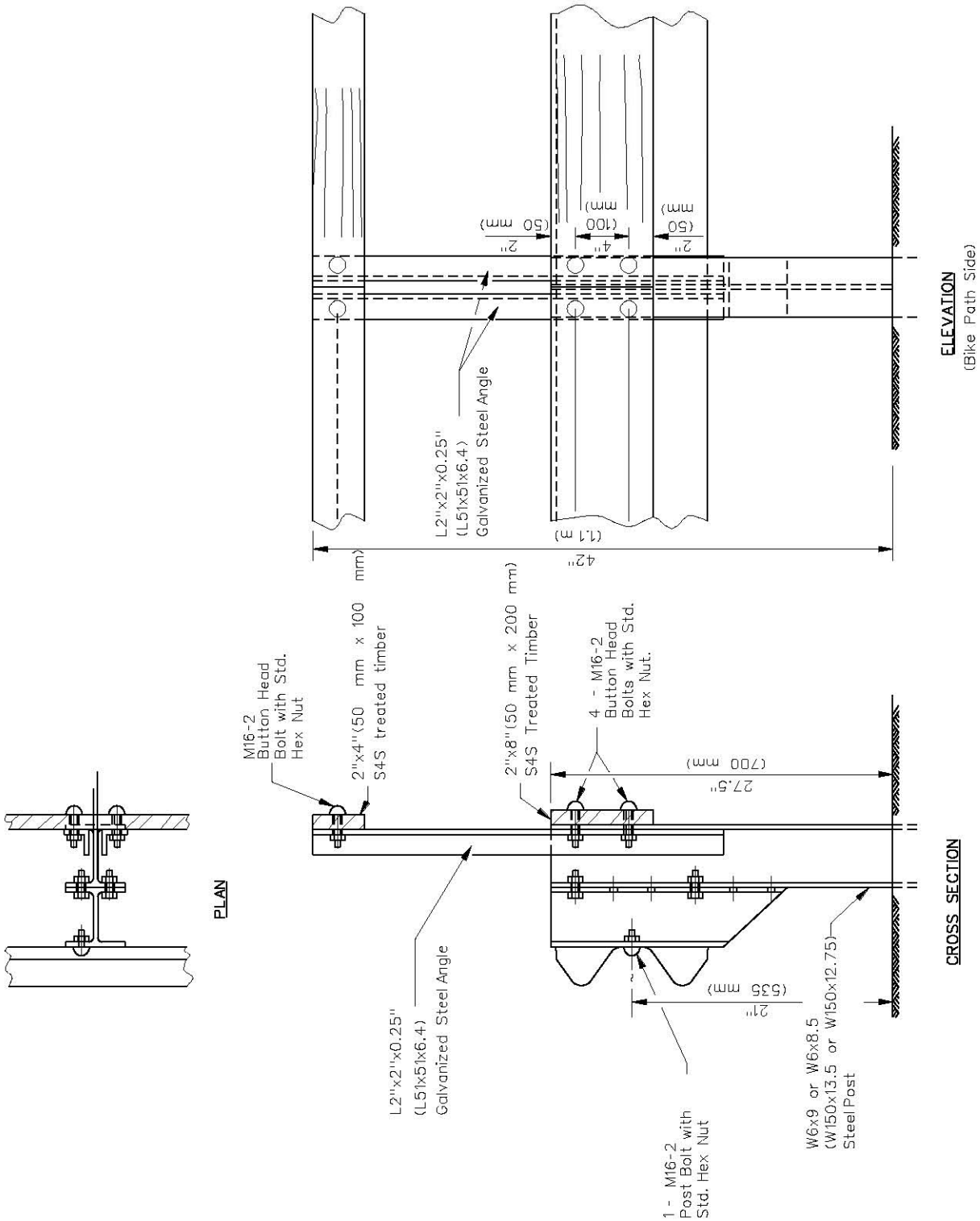
Figure 17-2M



***Note:** Alternate bikeway is considered under bridge where separate two-way bike path is proposed within or adjacent to existing right-of-way line of a freeway or expressway.*

TYPICAL MODIFICATION OF EXISTING FACILITIES FOR BIKEWAYS UNDER A BRIDGE

Figure 17-2N



BIKE PATH APPROACH GUARDRAIL ADJUSTMENT

Figure 17-2O

KIPDA Interchange

Bicycle/Pedestrian Safety Study

Summary of

Findings and Recommendations

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