Development of Reduced Conflict U-Turn (RCUT) Guidance in Kentucky

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Kentucky Transportation Center
College of Engineering, University of Kentucky, Lexington, Kentucky

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176 Raymond Building • Lexington, KY 40506 • 859.257.6898 • www.ktc.uky.edu

University of Kentucky

Research Report
KTC-26-29

Development of Reduced Conflict U-Turn (RCUT) Guidance in Kentucky

Travis Thompson, P.E.
Research Engineer

Duane Thomas, P.E.
Research Engineer

Jill Asher, P.E.
Research Engineer

and

Jeff Jasper, P.E.
Program Manager

Kentucky Transportation Center
College of Engineering
University of Kentucky
Lexington, Kentucky

In Cooperation With
Kentucky Transportation Cabinet
Commonwealth of Kentucky

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16. Abstract

A reduced conflict U-turn (RCUT) intersection eliminates left-turn and through movements from the minor road. Instead, drivers must turn right onto the main road and complete a U-turn at a downstream median opening. Recognized by the Federal Highway Administration (FHWA) as a proven safety countermeasure, RCUT intersections have reduced fatal and injury crashes 22 – 63%. Despite more than 35 RCUT intersections in operation across Kentucky, the Kentucky Transportation Cabinet (KYTC) lacked specific guidance for their planning, design, construction, and operation.

This project, conducted by the Kentucky Transportation Center (KTC) in cooperation with KYTC, addressed this gap through a comprehensive literature review of national and state-level RCUT best practices, an evaluation of existing Kentucky RCUT intersections, including a before-and-after crash analysis at 13 locations, interviews with KYTC District and Central Office staff, and interviews with staff at four state departments of transportation experienced in RCUT implementation.

Research informed development of Kentucky-specific RCUT guidance that covers planning and site selection, geometric design, accommodations for all road users, pavement markings and signing, signalization, construction, and maintenance. When used in conjunction with the KYTC intersection control evaluation (ICE) process, this guidance supports a systematic, evidence-based approach to intersection improvements that maximizes returns on public investment while prioritizing the safety of all road users on Kentucky's transportation network.

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Executive Summary

A reduced conflict U-turn (RCUT) intersection eliminates left-turn and through movements from the minor road. Instead, drivers must turn right onto the main road and complete a U-turn at a downstream median opening. Replacing higher-risk conflicts with lower-risk right-turn and U-turn movements reduces the overall number of conflict points at the intersection while separating the remaining conflicts in space and time. The Federal Highway Administration (FHWA) recognizes RCUT intersections as a proven safety countermeasure, with studies demonstrating reductions in fatal and injury crashes of 22 – 63%. This has particular relevance for Kentucky, where intersections account for roughly one-third of all traffic collisions, including 35% of injury-related crashes and 20% of fatal crashes. Despite more than 35 RCUT intersections in operation across the state, Kentucky has no state-specific guidance for the planning, design, construction, and operation of RCUT intersections.

This research effort, conducted by the Kentucky Transportation Center (KTC) in cooperation with the Kentucky Transportation Cabinet (KYTC), sought to develop RCUT guidance tailored to the state's needs. To accomplish this, researchers reviewed current RCUT best practices, interviewed practitioners from KYTC and other state departments of transportation (DOTs), and examined the safety and operational performance of the state's RCUT intersections.

The evaluation of existing Kentucky RCUT intersections included a crash analysis of 13 locations with sufficient before-and-after data. Crash reductions observed at these locations were consistent with those reported at similar RCUT intersections in other states. Interviews with KYTC Highway Districts 1, 3, 4, and 11 and the Traffic Safety Branch provided insights into current design practices, construction methods, signing and pavement marking applications, maintenance challenges, and lessons learned. Interviews with state DOT personnel yielded valuable information on many topics, including site selection processes, public involvement strategies, design vehicle selection, geometric design practices, signalization warrants, construction phasing, and maintenance.

After completing background research, the research team developed a comprehensive list of guidance elements organized by major topic area. These areas were planning and site selection, geometric design, accommodations for all road users, pavement markings and signing, signalization, construction, and maintenance. This list was presented to the Study Advisory Committee during workshops held in January and February 2025, with traffic operations elements subsequently reviewed by a dedicated subgroup. Feedback obtained from these workshops was used to develop a draft RCUT guidance document, which was further reviewed and refined by the Study Advisory Committee and traffic operations subgroup.

Appendix C contains the *Reduced Conflict U-Turn (RCUT) Guidance* document. It encompasses a wide range of RCUT applications, from a single isolated rural intersection to multiple RCUT intersections implemented alongside other intersection types within a corridor. When the guidance is used in conjunction with KYTC's intersection control evaluation (ICE) process, project managers can make informed, evidence-based decisions when selecting and designing intersection alternatives. Adopting a systematic approach to decision making will maximize returns on public investment while prioritizing the safety of all road users on Kentucky's transportation network.

Chapter 1 Introduction

1.1 Introduction

A reduced conflict U-turn intersection[1] (RCUT) eliminates left-turn and through movements from the minor road. Instead, drivers must turn right onto the main road and then complete a U-turn at a downstream median opening. Left turns from the main road are typically maintained unless minor road traffic volumes are extremely low. Eliminating higher-risk left-turn and through conflicts from the minor road and replacing them with lower-risk right-turn and U-turn movements reduces the number of conflict points. Additionally, the remaining conflicts are separated in time and space, which simplifies and spreads out decision making for drivers.

RCUT intersection design features result in improved safety performance compared to conventional intersections. The Federal Highway Administration (FHWA) recognizes RCUT intersections as a proven safety countermeasure, with studies demonstrating 22 – 63% reductions in fatal and injury crashes (FHWA, n.d.). This holds particular significance for Kentucky, where intersections account for roughly one-third of all traffic collisions, including 35% of injury-related crashes and 20% of fatal crashes (Ross et al., 2025).

RCUT intersections also operate more efficiently than conventional intersections when traffic volumes and turning movement distributions fall within certain ranges. Turning movements at RCUTs are managed through stop control (Figure 1.1), yield control (merge) (Figure 1.2), or traffic signal control (Figure 1.3) depending on conditions. When implemented along arterial corridors, RCUTs offer the potential to improve safety performance and traffic operations. The design also accommodates multimodal users, including pedestrians, bicyclists, and transit riders.

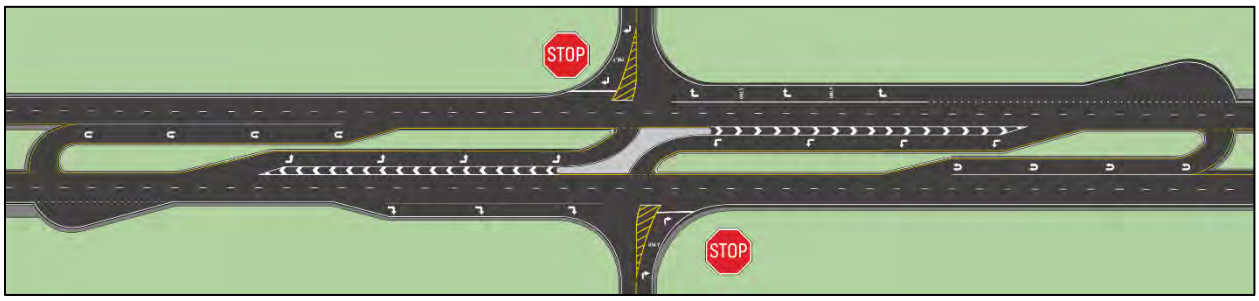

Figure 1.1 Example of Stop-Controlled RCUT

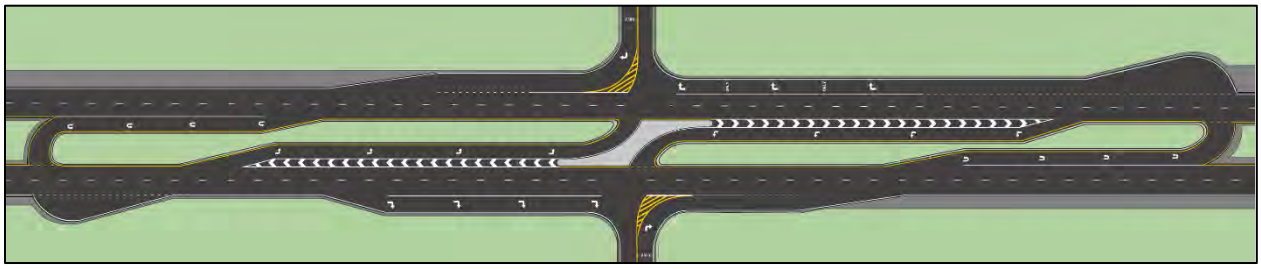

Figure 1.2 Example of Yield-Controlled (Merge) RCUT

[1] A reduced conflict U-turn intersection is also referred to as a restricted crossing U-turn intersection, JTURN, Superstreet, or Reduced conflict intersection (RCI) in other publications and by other states.

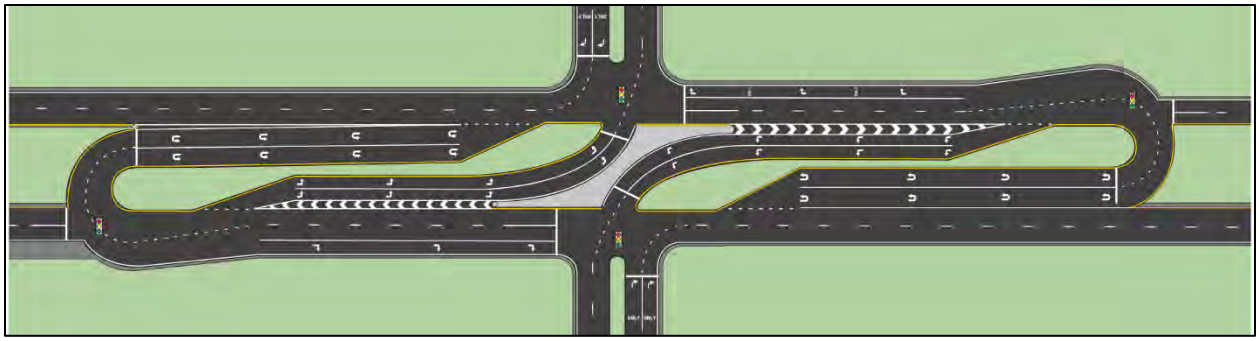

Figure 1.3 Example of Signal-Controlled RCUT

1.2 Background

RCUT intersections first appeared in the United States in the 1980s, with states such as Maryland and North Carolina being early adopters. These initial RCUT intersections were implemented for multiple reasons, including mitigating left-turn conflicts where there was narrow right of way, improving traffic operations and safety without the need for a traffic signal, and reducing congestion on suburban arterials (Hummer et al., 2014). Since then, at least 20 states have constructed and operated RCUT intersections.

Kentucky's first RCUT intersection — at the intersection of KY 361 (Patriot Parkway) and Deckard School Road in Highway District 4 — was built in 2016 as part of the Highway Safety Improvement Program (HSIP). Early on, most installations occurred on rural four-lane divided highway intersections that experienced a higher-than-expected number of right-angle crashes. Over time, the program expanded to include corridors in both rural and suburban contexts.

Planning studies and highway design projects originating from other funding programs began considering RCUT intersections as alternatives. In early 2025, Kentucky adopted an intersection control evaluation (ICE) policy that called for data-driven screenings of multiple conventional and innovative intersection alternatives to identify an optimal solution.

1.3 Problem Statement

Kentucky has more than 35 RCUT intersections located in multiple context classifications. Despite this, Kentucky lacks state-specific guidance to inform the planning, design, construction, and operation of RCUT intersections. The absence of a unified guidance source forces roadway designers and project managers to consult multiple references. Additionally, the use of varying infrastructure materials for RCUT construction across different Highway Districts makes it challenging to maintain these intersections.

Recognizing the benefits that RCUT intersections offer, this project sought to develop guidance that is flexible and adaptable across a range of situations, roadway context classifications, traffic control types, and locations. When used together with the Kentucky Transportation Cabinet (KYTC*) Intersection Control Evaluation Guidance*, this guidance helps roadway designers and project managers identify suitable locations for RCUT implementation and assess both safety and traffic operational performance in ways that optimize project value. Additionally, it provides direction on the geometric design of RCUT components, the development of signing and pavement marking layouts, and the coordination of construction and maintenance efforts related to RCUT intersections.

The guidance synthesizes information from national and state level resources, including research reports, other state department of transportation (DOT) publications, and FHWA guidance but does so in a manner that addresses the

unique needs in Kentucky. It can inform planning analysis and site selection, public involvement strategies, intersection control device selection (unsignalized versus signalized), traffic operational analysis, safety performance evaluation, geometric design, accommodations for all road users, signing and striping plans, intersection lighting, and constructability considerations.

The structure of this research report is provided in Table 1.1.

Table 1.1 Research Report Contents

Chapter	Contents
Chapter 2	• Literature review of each RCUT guidance component.
Chapter 3	• Data on existing Kentucky RCUT intersections. • Pre- and post-construction Kentucky RCUT crash data. • Summary of KYTC staff interviews.
Chapter 4	• Summaries of state DOT interviews.
Chapter 5	• Process used to select Kentucky RCUT guidance elements. • Overview of Study Advisory Committee meetings.
Chapter 6	• Conclusion and Recommendations.
Appendices	• Kentucky existing RCUT information. • State DOT interview questions. • Kentucky RCUT Guidance document.

Chapter 2 Literature Review

2.1 Literature Review Overview

The literature review examined federal-level publications (AASHTO publications, FHWA informational guides, and the *Manual on Uniform Traffic Control* Devices [MUTCD]), state DOT guidance (guidance and policy manuals, RCUT-specific guidance documents, and standard drawings), and research reports (NCHRP reports, FHWA reports, and state DOT research reports).

This chapter summarizes key findings from the literature review the research team used to develop RCUT guidance. It is organized first by major RCUT guidance category (e.g., design, construction) and then by specific guidance component (e.g., intersection sight distance, pavement markings). Sources are presented in the following order: Kentucky references, federal-level publications, other state DOT guidance, and other research reports.

2.2 Planning and Site Selection of RCUT Intersections

Planning Level Considerations

The FHWA *Restricted Crossing U-Turn Intersection: Informational Guide* (Hummer et al., 2014) identifies several planning-level factors to consider, such as community goals, surrounding land use and zoning, project context, multimodal needs, design vehicles, RCUT intersection type, side-street demand, and how RCUT intersections interact with adjacent intersections. It also highlights challenges associated with RCUT intersections, including driver education and expectations, multimodal accommodations, available right of way, and emergency vehicle access. Additionally, the FHWA *Alternative Intersections/Interchanges: Informational Report* (Hughes et al., 2010) catalogues several advantages and disadvantages of RCUT intersections that should be evaluated during project planning. Advantages include safety benefits, fewer conflict points, simplified traffic signal phasing, travel time savings, and improved progression. Disadvantages include operational challenges at intersections with high through or left-turn volumes from a side road as well as concerns related to driver expectations and perceived impacts on adjacent land use.

Nebraska DOT identifies suitable locations for RCUT implementation as intersections on four-lane rural divided expressways or state highways with lower minor-road volumes, where the goal is to reduce the frequency of higher-severity crashes (NDOT, 2025). The North Carolina DOT recommends considering RCUT intersections on rural median-divided facilities, roadways with partial or limited access control, intersections with a documented crash history, and congested areas where minimizing the use of traffic signals is desirable (NCDOT, 2026). The Ohio DOT presents several advantages and disadvantages of RCUT intersections for designers to evaluate. These are organized into multiple categories, including pedestrian and bicyclist accommodation, safety, traffic operations, access management, traffic calming, intersection footprint, maintenance, aesthetics, costs, construction, and public education (ODOT, 2026). The Wisconsin DOT incorporates several considerations during planning when evaluating whether to use an RCUT configuration (WisDOT, 2026). Agency staff may consider using RCUT intersections at locations where:

- There is an existing crash history
- Major traffic generators are present
- Horizontal curvature at an intersection limits sight distance
- Intersection skew exceeds 15 degrees
- A pattern of far-side right-angle crashes, median-related crashes, left-turn-leaving crashes, or a combination of the three exists
- High mainline volumes result in infrequent safe gaps for direct crossing or left-turn maneuvers
- Crossing or left-turn volumes from the minor road are low

- Horizontal or vertical alignment is inadequate

Intersection Control Evaluation

Kentucky has integrated ICE into project development to help project teams screen intersection alternatives and determine the most effective solutions. KYTC's ICE process has two stages. Stage 1 is a preliminary screening of alternatives, while Stage 2 involves a more detailed evaluation (KYTC, 2025a). The process incorporates tools developed by Schroeder et al. (2024), such as CAP-X, the SSI Score Calculator Tool, and SPICE, as well as additional performance evaluation methods, including *Highway Safety Manual* procedures for safety analysis and traffic simulation software specified in KYTC's *Microsimulation Guidelines*.

Schroeder et al. (2024) provide comprehensive guidance on the ICE process, covering safety screening methods, planning-level capacity analysis for a variety of intersection types, and a framework for incorporating social equity into evaluations. They developed several spreadsheet-based tools practitioners can use to evaluate intersection alternatives, including the Capacity Analysis for Planning of Junctions (CAP-X) Tool, the Systemic Safety Index (SSI) Score Calculator Tool, and the Safety Performance for Intersection Control Evaluation (SPICE) Tool. These tools are available for download on the NCHRP Research Report 1087 webpage.

Several state DOTs, including those in Florida, Minnesota, Pennsylvania, Texas, and Wisconsin, have established ICE policies and processes that incorporate the evaluation of RCUT intersections as an alternative intersection type (FDOT, 2026b; MnDOT, 2025; PennDOT, 2025; TxDOT, 2024b; WisDOT, 2026).

Public Involvement and Education Resources

Table 2.1 lists informational and educational resources that can support public involvement efforts. FHWA has informational videos on RCUT intersections, and Kentucky's SAFERoad Solutions website provides an overview of RCUT intersections along with examples of their implementation across the state. Minnesota, North Carolina, Texas, and Virginia each have dedicated websites featuring educational materials, videos, and RCUT intersection overviews.

Table 2.1 Agency RCUT Informational Sites

Agency	Website	Contents
FHWA	https://www.youtube.com/watch?v=nzpdTdXDfRw	Overview of RCUT intersections and their benefits.
KYTC	https://transportation.ky.gov/saferoadsolutions/Pages/RCUT.aspx	Informational video, educational materials, and Kentucky examples.
Minnesota DOT	https://www.dot.state.mn.us/jturn/index.html	Videos of passenger car, tractor trailer, pickup truck with trailer, and fire truck making U-turn.
North Carolina DOT	https://www.ncdot.gov/initiatives-policies/Transportation/safety-mobility/reduced-conflict-intersections/Pages/default.aspx	Informational video, educational materials, and FAQs.
Texas DOT	https://www.txdot.gov/about/programs/innovative-transportation/innovative-intersections/reduced-conflict-u-turn.html	Overview, safety benefits, educational materials, and videos.
Virginia DOT	https://www.vdot.virginia.gov/about/our-system/highways/innovative-intersections/restricted-crossing-u-turn/	Overview, safety benefits, navigation instructions, and videos.

2.3 Multimodal Considerations at RCUT Intersections

Pedestrian Accommodations

The AASHTO *A Policy on Geometric Design of Highways and Streets* (Green Book) illustrates but does not prescribe the Z-type crossing, where pedestrians at RCUT intersections cross the divided roadway in a diagonal pattern, traveling from one corner to the opposite corner between the channelized left turns (AASHTO, 2018, pp. 9-131 – 9-133). Both Hughes et al. (2010) and Hummer et al. (2014) identify the Z-type crossing as the most common configuration. Hummer et al. (2014) reviewed other crossing configurations, including crossings at the median U-turn opening, crossings at offset intersections, and the provision of shared use paths.

Texas DOT guidance limits pedestrian crossings of the main roadway to signalized RCUT intersections (TXDOT, 2025). Wisconsin DOT specifies direct pedestrian crossings — openings in the median channelization — at stop-controlled RCUT intersections. The Z-type crossing is the preferred option at urban RCUT intersections, signalized RCUT intersections, and RCUT intersections without a raised median on the side road (WisDOT, 2026). The North Carolina DOT *Roadway Design Manual* does not specify a recommended pedestrian facility type, however, figures in the manual depict the Z-type crossing (NCDOT, 2026).

Bicyclist Accommodations

The AASHTO Green Book notes that bicyclists traveling along the minor road of an RCUT intersection must merge with motorized traffic and follow the same path as vehicles to cross the major roadway (AASHTO, 2018). Hughes et al. (2010) build on this guidance, noting that bicyclists may also use pedestrian facilities at the intersection and that RCUT designs can accommodate shared use paths (multiuse paths). Hummer et al. (2014) mention three options for bicyclists crossing a minor road approach: using pedestrian facilities (preferred), crossing the major road directly through a small cut-through if one is provided, or navigating the median U-turn opening in the same manner as a motor vehicle. Schroeder et al. (2021) describes additional bicycle accommodation strategies for alternative intersections, such as terminating a dedicated bike lane in advance of the intersection and routing bicyclists through the intersection via a shared use path.

The Texas DOT *Roadway Design Manual* (TxDOT, 2024a) adopts bicyclist crossing options outlined in Hummer et al. (2014). The Wisconsin DOT accommodates bicyclists at RCUT intersections by directing them to pedestrian facilities when available. Where pedestrian facilities are not present, median openings are provided for bicyclists to cross the major roadway (WisDOT, 2026).

Transit Stops

Hughes et al. (2010) and Hummer et al. (2014) address transit stop locations at RCUT intersections, providing guidance for routes traveling along both the main roadway and the minor roadway. No states have incorporated transit considerations into RCUT design guidance.

2.4 RCUT Safety Performance

Conflict Points at RCUT Intersections

The AASHTO Green Book presents vehicular merging, diverging, and crossing conflict point diagrams for an RCUT intersection on a four-lane divided highway (AASHTO, 2018). Hummer et al. (2014) offer a simplified conflict point diagram organized by direction of travel rather than by individual lane and include a vehicle-to-pedestrian conflict diagram for a Z-type crossing configuration.

Safety Performance Measurement Tools

KYTC's *Intersection Control Evaluation (ICE) Guidance* requires a safety assessment in both Stage 1 and Stage 2 analyses. Stage 1 relies on the SSI tool, which scores intersections based on the severity, exposure, and likelihood of collisions. Stage 2 uses the SPICE tool, which applies *Highway Safety Manual* methodologies to predict crashes and compare existing conditions with potential intersection alternatives (KYTC, 2025a). Hummer et al. (2014) summarize the safety performance of installations in North Carolina, Missouri, and Maryland.

Safety assessments conducted by multiple states — including Florida (Ozguven et al., 2019), Louisiana (Sun & Rahman, 2019), Minnesota (Moreland et al., 2024), Missouri (Edara et al., 2024), and North Carolina (Hummer et al., 2010) — have consistently demonstrated that RCUTs provide notable safety advantages over conventional intersection designs.

The Crash Modification Factors Clearinghouse lists over 70 crash modification factors (CMFs) for RCUT intersections (CMF Clearinghouse, n.d.). Several have been consistently used and referenced by transportation agencies:

- CMF ID 5556: Rural Two-way Stop-Controlled to RCUT (Fatal & Injury Crash CMF = 0.46)
- CMF ID 9985: Suburban Signalized Intersection to Signalized RCUT (Fatal & Injury Crash CMF = 0.78)
- CMF ID 4883 & 4884: Rural Unsignalized Intersection to Unsignalized RCUT (All Crash CMF = 0.54 and Fatal & Injury Crashes CMF = 0.37).

2.5 Traffic Characteristics

Traffic Operational Analysis Tools and Methods

KYTC's *Microsimulation Guidelines* provide direction for the scoping, development, application, and review of traffic microsimulation models. The guidelines identify common deterministic and microsimulation traffic analysis tools used in Kentucky, along with their typical applications, such as arterial and intersection analysis (KYTC, 2021a). Additional traffic operational analysis guidance is provided in KYTC's *Intersection Control Evaluation (ICE) Guidance*, which outlines a two-stage process. Stage 1 uses the CAP-X tool developed by Schroeder et al. (2024), while Stage 2 applies *Highway Capacity Manual* methodologies and microsimulation (KYTC, 2025a).

Several state DOTs, including Minnesota, Texas, and Wisconsin, conduct traffic operational analysis in accordance with their respective ICE or traffic analysis policies (MnDOT, 2025; TxDOT, 2024b; WisDOT, 2026). This includes the evaluation of RCUT intersections.

Volume Ranges for Traffic Control Devices

Exhibit 5-7 in Hummer et al. (2014) illustrates feasible demand space for signalized RCUT intersections across four-lane, six-lane, and eight-lane main roadway configurations. The exhibit indicates that signalization may be unnecessary when minor street volumes fall below 5,000 vehicles per day (vpd) and may not be a viable form of traffic control when minor road demands exceed 25,000 vpd.

The Ohio DOT (2026) specifies minor road volume (D_m) thresholds to guide selection of intersection type:

- Unsignalized RCUT intersections are recommended when D_m is below 5,000 vpd.
- Signalized RCUT intersections should be considered when D_m falls between 5,000 and 25,000 vpd.
- Alternative intersection types should be evaluated when D_m exceeds 25,000 vpd.

Texas DOT references Exhibit 5-7 from Hummer et al. (2014) and adopts volume ranges similar to those used by Ohio DOT, while also incorporating criteria related to the number of minor road lanes (TxDOT, 2025).

2.6 Geometric Design of RCUT Intersections

Design Vehicles

While KYTC's *Highway Design Guidance Manual* does not include design vehicle recommendations specific to RCUT intersections, it identifies the design vehicle as a controlling factor in establishing design values (KYTC, 2022). KYTC's *Roundabout Design Guidance* recommends the following design vehicles for roundabouts:

- WB-67 on state highways, ramp terminals, or major truck routes
- WB-62 on other rural roadways
- WB-40 at industrial locations
- SU and BUS at commercial and residential locations (KYTC, 2025b)

The AASHTO Green Book recognizes design vehicles as a consideration in RCUT and U-turn design decisions but does not recommend design values (AASHTO, 2018). According to Hummer et al. (2014), the design vehicle is typically a tractor-trailer configuration, though a bus or emergency vehicle may also be appropriate. They note that in urban settings, the design vehicle does not need to exceed what the surrounding street network can accommodate.

The North Carolina DOT uses a WB-62 semi-truck as the standard design vehicle, with a conventional school bus as the minimum (which may be appropriate in urban areas). At dual U-turn lanes the agency designates the outside lane for a WB-62 semi-truck while the inside lane should accommodate either a passenger car or delivery vehicle (NCDOT, 2026). Texas DOT uses a WB-67 design vehicle in rural areas and the NACTO DL-23 design vehicle in urban areas and at U-turn openings they also check an SU-40 (TxDOT, 2025).

Stopping Sight Distance

KYTC's *Highway Design Guidance Manual* defines stopping sight distance (SSD), uses a driver eye height of 3.5 ft., an object height of 2 ft., and requires that the minimum SSD at any point within an intersection correspond to the design speed at that location (KYTC, 2022). This aligns with the AASHTO Green Book, which calls for SSD to be provided continuously along each roadway to ensure drivers have adequate visibility to come to a stop (AASHTO, 2018). Similarly, Hummer et al. (2014) recommend maintaining SSD at all points throughout the intersection.

Intersection Sight Distance – Right Turn from Minor Road

KYTC's *Highway Design Guidance Manual* defines intersection sight distance (ISD), uses a driver eye height of 3.5 ft., an object height of 3.5 ft., and directs readers to the AASHTO Green Book (Chapter 9) for information on specific ISD cases and procedures to determine ISD by different traffic control type (KYTC, 2022).

For stop-controlled intersection approaches where through and left-turn movements are prohibited, the AASHTO Green Book recommends using Case B2 — Right Turn from Minor Road to determine ISD (AASHTO, 2018). Using this method, Case B2 time gaps are adjusted when the minor road approach grade exceeds 3.0%. This approach is also referenced by the Nebraska DOT, North Carolina DOT, Texas DOT, and Wisconsin DOT for evaluating right-turn movements from the minor road approach (NDOT, 2025; NCDOT, 2026; TxDOT, 2025; WisDOT, 2026).

Intersection Sight Distance – Left Turn from Major Road

As noted above, the KYTC *Highway Design Guidance Manual* defines the driver eye height and object height and directs readers to the AASHTO Green Book (Chapter 9) for specific ISD use cases, including how to determine ISD for

a vehicle turning left from the major road. Chapter 9.5.3.6 of the AASHTO Green Book outlines ISD Case F — Left Turn from the Major Road criteria (AASHTO, 2018). Case F time gaps are adjusted according to the number of major road lanes and the median width that the left-turning vehicle must cross. This approach is also referenced by Florida DOT, Nebraska DOT, North Carolina DOT, Texas DOT, and Wisconsin DOT for evaluating left-turn movements from the major road approach (FDOT, 2026a; NDOT, 2025; NCDOT, 2026; TXDOT, 2025; WisDOT, 2026).

Intersection Sight Distance – U-Turn from Major Road

KYTC's *Highway Design Guidance Manual*, the AASHTO Green Book, and Hummer et al. (2014) do not define a methodology for determining ISD at U-turn locations.

Individual states have either adapted existing ISD methods from the AASHTO Green Book as a substitute for U-turn–specific ISD or developed their own approaches. Nebraska DOT and Texas DOT apply AASHTO Case B1 (Left Turn from Minor Road) for determining U-turn ISD (NDOT, 2025; TxDOT, 2025), while Wisconsin DOT applies AASHTO Case B2 (Right Turn from Minor Road) (WisDOT, 2026). Florida DOT employs a calculation method outlined in the FDOT *Multimodal Access Management Guidebook*, which relies on several assumptions, including acceleration from a stopped condition to the design speed and the use of AASHTO acceleration tables (FDOT, 2023). Georgia DOT has developed its own U-turn ISD calculation method that builds on AASHTO Green Book principles but assumes the U-turning vehicle accelerates to 70% of the main road's design speed rather than 100% (Tsai et al., 2026).

U-Turn Spacing from Main Intersection

The AASHTO Green Book does not specify a fixed distance or range for spacing between the median U-turn opening and the main intersection. Instead, it indicates that this spacing should be determined based on traffic conditions, including vehicle speeds, queuing volumes, and the type of intersection control in use (AASHTO, 2018). According to Hughes et al. (2010), the placement of the median U-turn opening is influenced by several factors — greater spacing allows drivers more time and distance to position themselves in the correct lane, while reduced spacing minimizes overall driving distances and travel times. Hummer et al. (2014) recommend a typical spacing of 400 – 800 ft from the main intersection to the median U-turn opening for RCUT intersections with stop or signal control.

Several state DOTs have established spacing guidelines for RCUT intersections. Florida DOT's *Manual on Intersection Control Evaluation* specifies 400 – 800 ft. for signalized and 600 – 1,000 ft. for unsignalized configurations (FDOT, 2026b). Missouri DOT similarly applies a 600 – 1,000 ft. range for unsignalized RCUT intersections but extends this to 2,000 – 3,000 ft. where acceleration lanes are present (MoDOT, n.d.). North Caolina DOT requires a minimum spacing of 600 ft. (NCDOT, 2026). Ohio DOT provides a broader range of 400 – 1,000 ft., with 600 ft. as the typical spacing for stop- or signal-controlled RCUT intersections and 0.5 miles for merge-controlled configurations (ODOT, 2026). Texas DOT differentiates between compact and non-compact designs, requiring a minimum of 600 ft. for compact RCUT intersections and 2,000 ft. for non-compact (TxDOT, 2025). Wisconsin DOT recommends 400 – 800 ft. for stop-controlled RCUT intersections and a typical spacing of 2,000 ft. for merge-controlled configurations (WisDOT, 2026).

Intersection Skew

Neither KYTC's *Highway Design Guidance Manual* nor the AASHTO Green Book contain intersection skew angle guidance specific to RCUT intersections. The KYTC *Highway Design Guidance Manual* recommends skew angles of 75 – 90 degrees for intersections generally, with 60 degrees as the minimum acceptable value (KYTC, 2022). Similarly, the AASHTO Green Book addresses intersection skew angles broadly, noting that skews between 75 – 105 degrees have less impact on ISD (AASHTO, 2018). Hummer et al. (2014) provide RCUT-specific guidance, stating that skew angles less than 90 degrees can serve major road left turns more efficiently than skew angles greater than 90 degrees.

Most state DOT design manuals reviewed do not include intersection skew guidance specific to RCUT intersections but do provide general guidance on skew angle for at-grade intersections. The Florida DOT requires intersection angles to be as close to 90 degrees as practical and identifies reasons to avoid angles less than 75 degrees (FDOT, 2026a). Similarly, the North Carolina DOT directs that roads be designed to meet at or near 90-degree angles and recommends considering an intersection upgrade when the skew angle is 75 degrees or less (NCDOT, 2026). The Ohio DOT design guidance manual provides RCUT-specific considerations, acknowledging that the orientation of the minor road intersection angle may influence the feasibility of converting a conventional intersection to an RCUT intersection, noting that intersection angles less than 90 degrees can serve main road left turns more efficiently (ODOT, 2026).

Median U-Turn Opening Design

Several states have developed standardized designs for median U-turn openings. A primary factor in these designs is whether the roadway cross section is wide enough for U-turning vehicles to complete the maneuver within the receiving travel lanes. Where the available width is insufficient, agencies typically provide a full-depth shoulder or a loon to accommodate U-turning vehicles.

The Missouri DOT has developed Special Sheets that describe how to accommodate U-turning vehicles. One option has a full-depth shoulder extending 120 ft. downstream and includes an acceleration lane on the inside of the median. A second option, intended for locations with a significant number of heavy trucks or steep grades, incorporates a loon with an acceleration area designed using a 60 ft. radius (MoDOT, 2022). The Nebraska DOT *Roadway Design Manual* includes a detail drawing of an example loon design. This loon is typically designed based on the turning radius of a WB-67 truck plus 2 ft. of shoulder, with the pavement tapered back into the main roadway (NDOT, 2025).

The North Carolina DOT provides typical median U-turn opening designs for two speed categories: roadways with speeds less than or equal to 50 mph and roadways with speeds greater than 50 mph. In both cases, a raised median is placed at the median U-turn opening, with the offset from the edge of the through traveled way being greater for the higher-speed condition. Loon radii are based on the selected design vehicle, and the pavement is tapered back into the main roadway at a rate of 6:1 (NCDOT, 2026). Texas DOT uses a median U-turn opening design similar to North Carolina's (TxDOT, 2025). Wisconsin DOT takes a different approach; rather than using radii, its loon layout follows the shape of a right trapezoid, with the angled end tapered back into the main road traveled way at a rate of 2:1 (WisDOT, 2026).

Turn Lane Deceleration Length

Design guidance for deceleration lanes, including left-turn lanes and U-turn lanes at RCUT intersections, is provided in the AASHTO Green Book (Chapter 9.7.2). The functional area of a deceleration lane upstream of an intersection consists of three components: perception-reaction distance, lane change and deceleration distance, and storage distance. Under the Green Book methodology, the perception-reaction distance occurs in advance of the deceleration lane and is based on a time of 1.5 seconds in suburban, urban, urban core, and rural town contexts and 2.5 seconds in rural contexts (Green Book, 2018). Lane change and deceleration distances by design speed are presented in Green Book Table 9-20, and storage lengths are provided in Tables 9-21 and 9-22. Queue length adjustments for trucks are provided in Table 9-23. Under the Green Book method, deceleration begins as the vehicle enters the turn lane and concludes when the vehicle reaches the storage area.

Because the Green Book methodology can produce lengthy turn lanes and require additional pavement, KYTC has adopted an alternative approach that accounts for a portion of deceleration occurring before a vehicle enters the turn lane. This methodology is outlined in HD-902.16 of KYTC's *Highway Design Guidance Manual* and varies based

on turn lane type (i.e., left-turn or right-turn), intersection control (e.g., uncontrolled, signal control), and speed (KYTC, 2022). This Kentucky methodology aligns with the Green Book statement that:

> *It is not practical on many facilities to provide the full length of the auxiliary lane for deceleration due to constraints such as restricted right-of-way, distance available between adjacent intersections, and storage needs. However, research has demonstrated that providing a left- and right-turn lane on any intersection approach has a substantial crash reduction benefit*.

The North Carolina DOT calls for left-turn lanes at RCUT intersections to be at least 600 ft. long, including the taper and storage length (NCDOT, 2026). RCUT intersection turn lane design from the Texas DOT uses methods described in the AASTHTO Green Book (Chapter 9) (TxDOT, 2025). This includes the use of Tables 9-20 – 9-23. The Wisconsin DOT recognizes that left-turn lane design should accommodate declaration to a stop, and in some cases provide vehicle storage. For the U-turn deceleration lane, the agency extends this lane back to the minor roadway intersection if the gap-acceptance method is used (WisDOT, 2026).

Channelization

Channelization at an RCUT intersection can be present at the minor road approach, the main road left-turn area, and the median U-turn opening. Hummer et al. (2014) identify several benefits of incorporating channelization at these locations. Channelization helps visually impaired pedestrians navigate intersections, shortens pedestrian crossing distances, discourages drivers from making prohibited turning movements, reduces the likelihood of wrong-way movements, and provides firmer guidance to drivers than an unchannelized design.

The Nebraska DOT provides raised channelization at left turns from the mainline and includes raised islands at the minor road right-turn approach when warranted by traffic volume and/or crash history (NDOT, 2025). The North Carolina *Roadway Design Manual* depicts raised channelization at the minor road right-turn approach, the major road left turn, and the median U-turn opening (NCDOT, 2026). The Texas DOT also typically uses raised channelization at all three locations: the minor road right-turn approach, the major road left turn, and the median U-turn opening (TxDOT, 2025). The Wisconsin DOT *Facilities Design Manual* shows raised channelization at the minor road right-turn approach and the mainline left turn but does not include it at the median U-turn opening (WisDOT, 2026).

Access Management

Hummer et al. (2014) note that driveways and side roads can be located at nearly any point along an RCUT intersection; however, they advise against placing them near the traffic signal or median U-turn opening. An accompanying illustration indicates that access point placement is restricted within 100 ft. on either side of the entrance to a median U-turn opening. Limiting access in these areas discourages drivers from using nearby access points to enter the U-turn crossover or to travel the wrong way on the major road and reduces the risk of queued vehicles blocking major street travel lanes.

Chakraborty et al. (2025) examined the safety characteristics of access points near U-turn crossovers at RCUT intersections. They found that increasing the U-turn radius was associated with a slightly lower likelihood of total crashes, while U-turns that permitted left turns directly from the U-turn lanes were associated with greater crash likelihoods than locations where no direct left turns were allowed. Side street access points were associated with higher crash likelihoods than low-volume access points. In the merging direction, access points were associated with higher crash likelihoods for total, fatal and injury, and property-damage-only (PDO) crashes compared to no access points, while in the diverging direction (entering U-turn lane), only PDO crashes had a higher likelihood of occurring.

2.7 Signing and Pavement Markings

Several agencies have developed standard signing and pavement marking plans but were not reviewed in detail because layouts prepared under previous editions of the MUTCD may not conform to the requirements of the 11th Edition.

The 11th Edition of the MUTCD does not include standard signing and pavement marking layouts specific to RCUT intersections. Nonetheless, several sections in Part 2 and Part 3 include provisions for signing and markings applicable to RCUT design. Some examples include U-turn arrow pavement markings as depicted in Figure 3B-21, and Chapter 3J which presents pavement marking layouts for islands that are comparable to the minor street approach configuration at an RCUT intersection. Section 3I.02 addresses tubular markers including a minimum height of 28 in. and a minimum width of 2 in. (FHWA, 2025).

Kentucky does not have standard signing or pavement marking layouts specific to RCUT intersections. However, several KYTC Standard Drawings could be adapted for use at RCUT intersections, including

- TPM-203 Typical Markings at Signalized Intersections
- TPM-205 Typical Markings for Islands and Medians
- TPM-206 Typical Markings for Turn Lanes
- TPM-207 Typical Markings for Turn Lanes (KYTC, 2025c)

KYTC's Division of Traffic Operations also maintains signing standard detail sheets. While these sheets are not specific to RCUT intersections, they contain information on sign panel and post sizes, dimensions, and placement that is applicable to RCUT intersection design (KYTC, n.d.).

2.8 Signalization and Lighting

The MUTCD does not include traffic signal warrants specific to RCUT intersections. In the absence of federal guidance, state DOTs have adopted varying approaches to warranting traffic signals at RCUT intersections. To address this gap, the North Carolina DOT developed signalization guidelines for RCUT intersections. These guidelines provide a framework for evaluating the appropriateness of signalization at intersections with fewer than four approaches that involve left-turn, right-turn, and U-turn crossover movements, including RCUT intersections (Warchol et al., 2017).

Signalized RCUT intersections can operate using one, two, three, or four signal controllers (Hummer et al., 2014). Using multiple controllers provides greater coordination between adjacent traffic signals; however, this configuration increases costs due to the need for additional controller cabinets and associated equipment. Hummer et al. (2014) also indicate that mast arm poles are more commonly used at RCUT intersections than span wire signal installations.

Hummer et al. (2014) reference several publications for designing lighting at RCUT intersections, including the AASHTO *Street Lighting Design Guide*, FHWA *Lighting Handbook*, and the Illuminating Engineering Society of North America *American National Standard Practice for Street Lighting*.

KYTC's *Traffic Operations Guidance Manual* identifies additional publications to support roadway lighting design and establishes warrants for its use. RCUT lighting falls under the Intersection Category in the Lighting Section, which includes warrant provisions based on the nighttime critical rate factor, nighttime crashes within a three-year period, traffic study findings, and high-speed intersections with raised channelization or complex geometry.

The Wisconsin DOT requires lighting at RCUT intersections (WisDOT, 2026). In North Carolina, the *Roadway Lighting Policy* allows lighting to be considered at complex intersections to assist drivers navigating through the intersection (NCDOT, 2020). The Nebraska DOT typically provides intersection lighting along the mainline between the two median U-turn openings (NDOT, 2025).

2.9 Construction and Maintenance of RCUT Intersections

Maintenance of Traffic

Both Hughes et al. (2010) and Hummer et al. (2014) include example MOT phasing plans for two scenarios: (1) converting an existing intersection on a multilane divided highway to an RCUT configuration, and (2) widening a two-lane highway to a multilane divided highway with RCUT intersections. The first scenario is less complex and can typically be completed in four MOT phases, whereas the second involves greater complexity and requires six MOT phases. Additional MOT phasing guidance that expands on the FHWA publications, including a Missouri case study and survey results from state DOTs, is presented in Brown et al. (2015).

Maintenance of RCUT Intersections

KYTC's *Traffic Operations Guidance Manual* addresses maintenance and inspection of signing, pavement markings, traffic signals, tubular markers, and roadway lighting (KYTC, 2021c), while its *Maintenance Guidance Manual* outlines information and procedures for maintaining roadway pavements, drainage structures, the roadside, and snow and ice removal (KYTC, 2021b). However, neither guidance manual specifically identifies maintenance needs or procedures unique to RCUT intersections.

Hummer et al. (2014) state that maintenance requirements for an RCUT intersection are comparable to those of a conventional intersection, encompassing signing, striping, traffic signals, lighting, pavement, and snow and ice removal.

The Ohio DOT (2026) outlines maintenance advantages and drawbacks of RCUT intersections relative to conventional intersections. On the advantage side, reduced queuing may lead to less pavement rutting. Disadvantages include increased signing requirements, additional pavement maintenance at median U-turn openings and loons (if present), and the need for more signal controllers at signalized locations.

Chapter 3 Existing RCUT Intersections in Kentucky

Researchers conducted a brief review of existing RCUT intersections in Kentucky. This consisted of a before-and-after crash analysis, an evaluation of the physical characteristics at each location, and interviews with District and Central Office staff.

3.1 Crash Analysis

RCUT intersection locations were selected based on the availability of three years of crash data both before and after construction. Of the more than 35 RCUT intersections currently open to traffic in Kentucky, 13 met these criteria and were included in the analysis. Table 3.1 presents before-and-after crash totals for all crash types and angle crashes. Corresponding crash plots are provided in Appendix A. Crash reductions observed at these locations are consistent with those reported at similar RCUT intersections in other states.

Table 3.1 Before and After Crashes at RCUT intersections in Kentucky

			All Crashes			Angle Crashes		
Item No.	County	Location	Before Const.	After Const.	Percent Change	Before Const.	After Const.	Percent Change
11-9005.20	Knox	US 25E at KY 233	36	16	-56%	18	1	-94%
11-9014	Laurel	KY 80 at KY 1535	28	15	-46%	9	3	-67%
3-9017	Logan	US 68 at KY 73	20	13	-35%	13	4	-69%
4-9008.40	Hardin	US 31W at KY 220	73	40	-45%	16	7	-56%
4-9008.40	Hardin	US 31W at KY 434	103	64	-38%	21	11	-48%
4-9008.40	Hardin	US 31W at Blackjack Rd.	61	15	-75%	15	3	-80%
7-9019	Scott	US 62 at Hemingway Pl.	21	8	-62%	7	2	-71%
1-9013	Graves	US 45 at KY 408	40	20	-50%	7	9	29%
1-9015	McCracken	US 45 at KY 1288	23	14	-39%	10	3	-70%
1-9016	Marshall	US 641 at KY 402	22	15	-32%	8	2	-75%
1-9017	McCracken	US 60 at KY 726	7	1	-86%	6	0	-100%
1-9017	McCracken	US 60 at KY 996	8	12	50%	4	1	-75%
4-9002	Hardin	KY 3005 at KY 1904	11	7	-36%	8	3	-63%

3.2 Existing RCUT Intersection Characteristics

The physical characteristics of RCUT intersections were evaluated to better understand current design practices and the conditions under which they have been implemented. Key characteristics reviewed included speeds, traffic volumes, intersection and roadway geometrics, functional classification, and access control types. The Study Advisory Committee considered this information, collectively, as one of several factors when determining which RCUT intersection elements to include in the guidance document. Table 3.2 summarizes the findings; Appendix A includes a more detailed compilation.

Table 3.2 Kentucky RCUT Intersection Characteristics

	Number of Intersections with Each Characteristic				
Posted Speed Limit	50 mph		55 mph		65 mph
	1		10		2
85th Percentile Speed	≤ Speed Limit	Speed Limit < 85th % Speed ≤ 2.5 mph over speed limit	2.5 mph < 85th % Speed ≤ 5 mph over speed limit	5 mph < 85% Speed ≤ 7.5 mph over speed limit	≥ 7.5 mph over speed limit
	1	2	6	3	1
Intersection Skew	75 – 105 Degrees			< 75 Degrees	
	11			2	
Distance from Main Intersection to U-Turn Opening	≤ 500 ft.	500 – 600 ft.	600 – 700 ft.	700 – 800 ft.	800 – 900 ft.
	1	1	4	5	2
Right Turn Connected to a Loon	Separate		One U-Turn Only		Both U-Turn Locations
	3		1		9
Median Width	36 ft.	38 ft.	40 ft.	60 ft.	
	3	1	5	4	
Minor Road AADT Range (Total of Both Approaches)	No Data	≤ 1,000	1,000 – 2,500	2,500 – 5,000	≥ 5,000
	2	1	4	5	1

Table 3.2 (Continued) Kentucky RCUT Intersection Characteristics

	Number of Intersections with Each Characteristic				
Main Road AADT Range	≤ 10,000	10,000 – 15,000	15,000 – 20,000	20,000 – 25,000	> 25,000
	3	5	3	1	1
Channelization and Islands	Main Intersection Left-turn Lane		Minor Road Right-turn		Median U-turn
	Raised Concrete — 13		Raised Concrete — 3 Painted — 6 None — 4		Raised Concrete — 3 None — 10
Left-Turn Lane Layout Design	Parallel		Slight Taper		Full Taper
	2		8		3
Entrance Present at U-Turn	No			Yes	
	10			3	
Tubular Markers	On Median Island		None		None (Island Painted)
	5		3		5
Lighting	None	From Adjacent Development		At Main and U-Turn	At Main
	5	2		5	1
Functional Classification	Rural Principal Arterial		Urban Principal Arterial		Urban Minor Arterial
	6		5		2
Access Control	By Permit			Partial Control	
	5			8	

3.3 District and Central Office Interviews

To gain insights into RCUT intersection adoption, researchers interviewed staff from Districts 1, 3, 4, and 11, along with Traffic Safety Branch personnel. Conversations covered a range of topics, including why RCUTs were chosen as an alternative intersection treatment, approaches to public engagement, geometric design practices, signing and pavement marking applications, construction methods, and maintenance requirements. Interviewees represented the Project Development, Project Delivery and Preservation, and Engineering Support Branches. Table 3.3 summarizes key findings from these discussions. Since the Traffic Safety Branch has coordinated with the Districts on most RCUT projects, their input was omitted from the table to avoid overlap with information Districts provided.

Table 3.3 Summary of RCUT District Interviews (*Numbers represent the Districts who responded*)

Topic	Response		
	Improve Safety	**Improve Traffic**	**Access Management**
Why RCUT intersections were selected?	1,3,4,11		4
Has an RCUT been constructed by a private developer as part of a permit?	**Yes**	**No**	
	3	1,4,11	
Level of Public Involvement Activities	**Same Level of Engagement as other Projects**	**Additional Level of Engagement as other Projects**	
	1,3,4,11		
Pedestrian or Bicyclist Accommodations Constructed	**Yes**	**No**	
	4 *(in urban area)*	1,3,11	
Connect Main Road Right Turn Lane to Loon	**Yes, When Budget Allows**	**No**	
	1,3,4,11		
Tubular Marker Installed on Raised Medians at Median Openings	**Added at Construction**	**Added Post Construction**	**Do Not Use**
	3	1,4,11	
Channelization Type Used at Main Intersection	**Raised Concrete**	**Tubular Markers Only**	**Painted Only**
	1,3,4,11		
Design Vehicle Used	**Tractor Trailer**	**Multiple Design Vehicles**	**Unknown at Interview**
	11	3,4	1
Lighting at RCUT Intersection	**Typically, as part of project**	**If a nighttime crash pattern develops**	**Typically, not part of project**
	1,11	3	4
Problematic Features to Maintain	**Debris Accumulation**	**Tubular Markers**	**Painted Island**
	1,3	3,4,11	11
Additional Considerations* **District 11 did not provide*	**District 1**	**District 3**	**District 4**
	Consider farm equipment in agricultural areas.	Construct median U-turn openings first.	Plow trucks may have difficulty entering lane.
	Snow and ice removal requires additional time.	Consider superelevation effects on loons in curves.	Solar lighting is an option in rural areas.
		Consider resurfacing the entire project area when adding RCUTs.	
		Need consistent signing and pavement markings.	

Chapter 4 State Department of Transportation Interviews

Researchers interviewed personnel from select state DOTs to gain insights into their approaches to RCUT intersections and the guidance their agencies have established. Three states were initially chosen based on their experience implementing RCUT intersections and developing RCUT corridors, and a fourth was added after emerging as a relevant candidate during one of the early discussions. A standardized set of interview questions (see Appendix B) was developed beforehand to guide conversations. Each interview is summarized below, highlighting topics relevant to RCUT implementation in Kentucky.

4.1 Florida Department of Transportation

Florida DOT was chosen due to its use of RCUT intersections in urban and suburban settings, a potential application area for RCUTs in Kentucky. These intersections use signalized and non-signalized traffic control configurations.

Of particular interest was a corridor of RCUT intersections in Orlando along State Route 535, situated in a heavily trafficked tourist area just east of the Disney EPCOT theme park. This corridor accommodates more than 40,000 vehicles per day using six through lanes and includes pedestrian facilities on both sides with a raised median in the center. The project was completed as a Resurfacing, Restoration, and Rehabilitation (3R) project utilizing multiple funding sources and did not require the acquisition of additional right of way. Due to the connectivity provided by the surrounding roadway network, U-turns were not designed to accommodate tractor trailers.

Given the abundance of business signage along the corridor from adjacent land uses, a more minimalist approach to roadway signing was adopted to avoid adding to the visual clutter encountered by drivers. Other notable traffic-related features included the use of longer traffic signal cycle lengths, which allowed for one-stage rather than two-stage pedestrian crossings.

4.2 Georgia Department of Transportation

Researchers spoke with Georgia DOT staff following a recommendation received during another interview. Georgia has more than 50 RCUT intersections located in rural and more urbanized settings. Some of these intersections make use of downstream signalized intersections to provide vehicle U-turn opportunities, a practice that is less common in Kentucky. Additionally, the agency has developed a screening tool to evaluate potential locations from a safety standpoint and estimate costs associated with RCUT implementation.

The Georgia DOT has created standard detail sheets for roadway signing and pavement markings at RCUT intersections and is currently updating them. When evaluating signal warrants for RCUT intersections, the agency has used left-turn volumes as the side street volumes. At some locations, tubular markers have been installed within medians.

A research project was recently completed for the Georgia DOT that established a method for determining ISD at U-turn intersections, derived from the AASHTO Green Book ISD equations. Kentucky utilized this information to further investigate U-turn ISD.

4.3 Minnesota Department of Transportation

Researchers interviewed Minnesota DOT (MnDOT) staff due to the agency's experience with isolated intersection and arterial corridor applications of RCUT intersections. The agency operates over 100 RCUT intersections, including at least one under traffic signal control (MnDOT, n.d.). MnDOT has pursued research on the safety performance of RCUT intersections, accommodating agricultural vehicles at these facilities, and best practices for design and operations. At the time of the interview, MnDOT was updating RCUT intersection guidance.

Most RCUT intersections in Minnesota have been constructed as part of safety improvement projects. During project development, MnDOT utilizes ICE as a tool to help determine the appropriate intersection type. The agency has conducted successful public involvement campaigns by clearly communicating the problem being addressed and typically plans for an extended engagement period.

For RCUT intersection design, MnDOT accommodates the WB-62 design vehicle as it is required by state statute. Intersections are also designed to accommodate control vehicles that may use the facility on an occasional basis. Most RCUT intersections provide pedestrian access, even in rural areas where pedestrian facilities are not present along the roadway. At these locations, direct pedestrian crossings are typically used rather than Z-type crossings.

Roadway signing and pavement markings are developed on a project-specific basis, however, the updated RCUT intersection guidance will likely include standardized signing sheets. MnDOT has also developed special guide signs for RCUT intersections, though these tend to be most beneficial for first-time users of the facility.

Construction of RCUT intersections at existing locations typically follows a phasing sequence in which median U-turn openings are built first, followed by the main intersection infrastructure. Given the frequency of snow and ice events in Minnesota, MnDOT designs RCUT intersections to accommodate snowplow operations, including the ability for plows to turn left from the main road without encroaching onto the minor road. Highway lighting at RCUT intersections is also considered during design and is typically provided at both the main intersection and the median U-turn openings, though continuous lighting across the entire intersection is less common.

4.4 North Carolina Department of Transportation

The North Carolina DOT (NCDOT) was an early adopter of RCUT intersections and has a long history with their implementation. The agency has built RCUT intersections in rural and urban contexts, including signalized configurations, and has experience with both corridor-level applications involving multiple RCUT intersections and isolated installations. Over 500 RCUT intersections have been opened to traffic in North Carolina, with approximately 100 operating under signal control.

NCDOT uses several documents to guide the selection and design of RCUT intersections. The *Selecting Optimum Intersection or Interchange Alternatives* guidance (Hummer, 2024) helps project teams evaluate and select intersection types, including RCUT intersections, and serves in lieu of a formal ICE policy. The North Carolina *Roadway Design Manual* (NCDOT, 2026) provides design guidance, including detailed intersection diagrams. Additionally, the NCDOT *Standard Drawings* (NCDOT, 2024) contain pavement marking and signing layouts for RCUT intersections.

Traffic modeling is generally conducted for each RCUT intersection project, primarily as part of the Transportation Improvement Program (TIP) process rather than specifically for RCUT intersection design. A key performance metric evaluated is total travel time through an individual RCUT intersection or across a corridor containing multiple RCUT intersections. This measure can be a more effective indicator of operational improvement than Level of Service (LOS) alone.

Given the large number of RCUT intersections across North Carolina, drivers have become accustomed to navigating them. But even with drivers being familiar with them, the agency has found that public involvement efforts can be enhanced by emphasizing the safety benefits associated with RCUT intersections. Providing visualizations that depict the intersection from the perspective of drivers and other road users (e.g., pedestrians, bicyclists), including the paths they take through the intersection, has also proven to be an effective engagement strategy.

In North Carolina, both unsignalized and signalized RCUT intersections have been implemented alongside intersections with other forms of traffic control, which may not always result in optimal progression patterns. When RCUT intersections are located near roundabouts, designers should be aware that randomized vehicle arrivals produced by roundabouts can affect signal progression through the corridor. An additional consideration when implementing a series of RCUT intersections along a corridor is the potential effect on intersections or interchanges located just beyond the corridor limits. Traffic may arrive at these adjacent intersections more quickly than under previous conditions, potentially affecting operations and queuing at locations outside the project area.

NCDOT does not generally use tubular markers at RCUT intersections due to concerns over replacement and maintenance. Given the unique operational characteristics of RCUT intersections, the application of MUTCD traffic signal warrants is not always straightforward. To address this, NCDOT has developed traffic volume thresholds to help project teams determine where signalized RCUT intersections should be considered. Lighting at RCUT intersections follows the same warrant procedures used for other intersection types.

Chapter 5 Recommendations for RCUT Design Guidance for Kentucky

After completing the literature review, evaluating existing RCUT intersections in Kentucky, interviewing KYTC District and Central Office staff, and interviewing personnel at other state DOTs, researchers prepared a comprehensive list of elements for inclusion in Kentucky-specific RCUT guidance. This list was organized by major topic area (e.g., planning and site selection, geometric design, signalization, construction) and incorporated references to existing Kentucky guidance that may influence RCUT intersection decisions, along with relevant summaries of RCUT-related guidance from federal and state-level resources.

The list of guidance elements (Figure 5.1) was presented to the research Study Advisory Committee during two workshops held in January and February 2025. Elements specific to traffic operations, including pavement markings, signing, traffic signals, and roadway lighting, were subsequently presented to a Traffic Operations subgroup in February 2025.

Feedback from these workshops was used to develop a draft RCUT guidance document. This draft RCUT guidance document was reviewed and refined by the Study Advisory Committee and Traffic Operations subgroup. Appendix C contains the final version of the *Reduced Conflict U-Turn (RCUT) Guidance* document.

Figure 5.1 Sample Guidance Element Summary

Source	RCUT Screening and Analysis Tools
Questions to Answer	·What tools are available to screen locations for RCUT suitability? ·What tools are available to analyze traffic operations? ·What tools are available to analyze safety performance?
KTC Recommendation	·Follow KYTC ICE Policy ·Follow KYTC Microsimulation Policy ·Use KYTC DDSA Implementation Plan ·Intersection turning movement counts, truck percentages, and existing crash data are needed for each intersection. ·If an arterial corridor is being considered for RCUTs, including mixing traffic control types, microsimulation is recommended for traffic operational analysis.
KYTC ICE Guidance - 2025	·Stage 1 Analysis -CAP-X - Operational analysis tool -SSI - Safety assessment tool Stage 2 Analysis -HCM Methodologies & Microsimulation -SPICE
KYTC Microsimulation Guidelines	·Provides a table of traffic operational analysis tools used in Kentucky and their typical/common applications. ·Deterministic tools: HCS, Synchro ·Microsimulation tools: VISSIM, TransModeler
FHWA RCUT Informational Guide (2014)	·Planning level - CAP-X and critical lane analysis. ·Preliminary Engineering level - Single Intersections: HCM methods. - Corridors: Microsimulation (can include pedestrian and cyclist)
Minnesota DOT - Design Manual and Interview	·Uses ICE policy.
Pennsylvania DOT - ICE Policy	·Individual intersections - Synchro or SimTraffic ·Multiple intersections - VISSIM or similar microsimulation
TxDOT - ICE Manual	·Uses ICE policy.
Wisconsin DOT - Design Manual	·Uses ICE policy.

Chapter 6 Conclusions

Research described in the previous chapters provided a foundation to develop RCUT intersection guidance tailored to Kentucky's transportation needs. Through an extensive literature review, evaluation of existing RCUT intersections in the state, interviews with KYTC District and Central Office staff, and engagement with state DOTs experienced in RCUT implementation, the research team identified key elements necessary for the planning, design, and operation of RCUT intersections in Kentucky. Insights from agencies with well-established RCUT programs were particularly valuable, as they provided practical lessons on topics ranging from site selection and geometric design to signalization, construction phasing, public involvement, and ongoing maintenance.

Refining the guidance through workshops with the Study Advisory Committee and Traffic Operations subgroup ensured the final product reflects both national best practices and Kentucky-specific considerations. Input from KYTC District and Central Office staff provided a critical perspective on local design practices, operational challenges, and existing procedures that influence RCUT intersection decisions. By integrating this feedback with guidance from federal and state-level resources, the guidance document addresses the full range of considerations necessary for successful RCUT intersection implementation in Kentucky.

The *Reduced Conflict U-Turn (RCUT) Guidance* (Appendix C) provides KYTC and its consultants with a practical, Kentucky-specific resource to support the consistent and effective implementation of RCUT intersections across the state. It is written to encompass a wide range of RCUT applications, from a single isolated rural intersection to multiple RCUT intersections implemented alongside other intersection types within a corridor. As the Cabinet continues to gain experience with RCUT intersections, this guidance may need to be updated to incorporate lessons learned from newly constructed projects, evolving national research, and advances in design and operational practices.

This RCUT guidance gives KYTC another tool to deliver a safer and more efficient transportation system in a fiscally responsible manner. RCUT intersections, when constructed at appropriate locations, can reduce severe crashes and improve traffic operations, often at a lower cost than traditional intersection improvements. When used in conjunction with the ICE process, the guidance equips project managers with the information necessary to make more informed decisions when selecting and designing intersection alternatives. Together, the ICE process and the RCUT guidance support a systematic, evidence-based approach to intersection improvements that maximizes the return on public investment while prioritizing the safety of all road users on Kentucky's transportation network.

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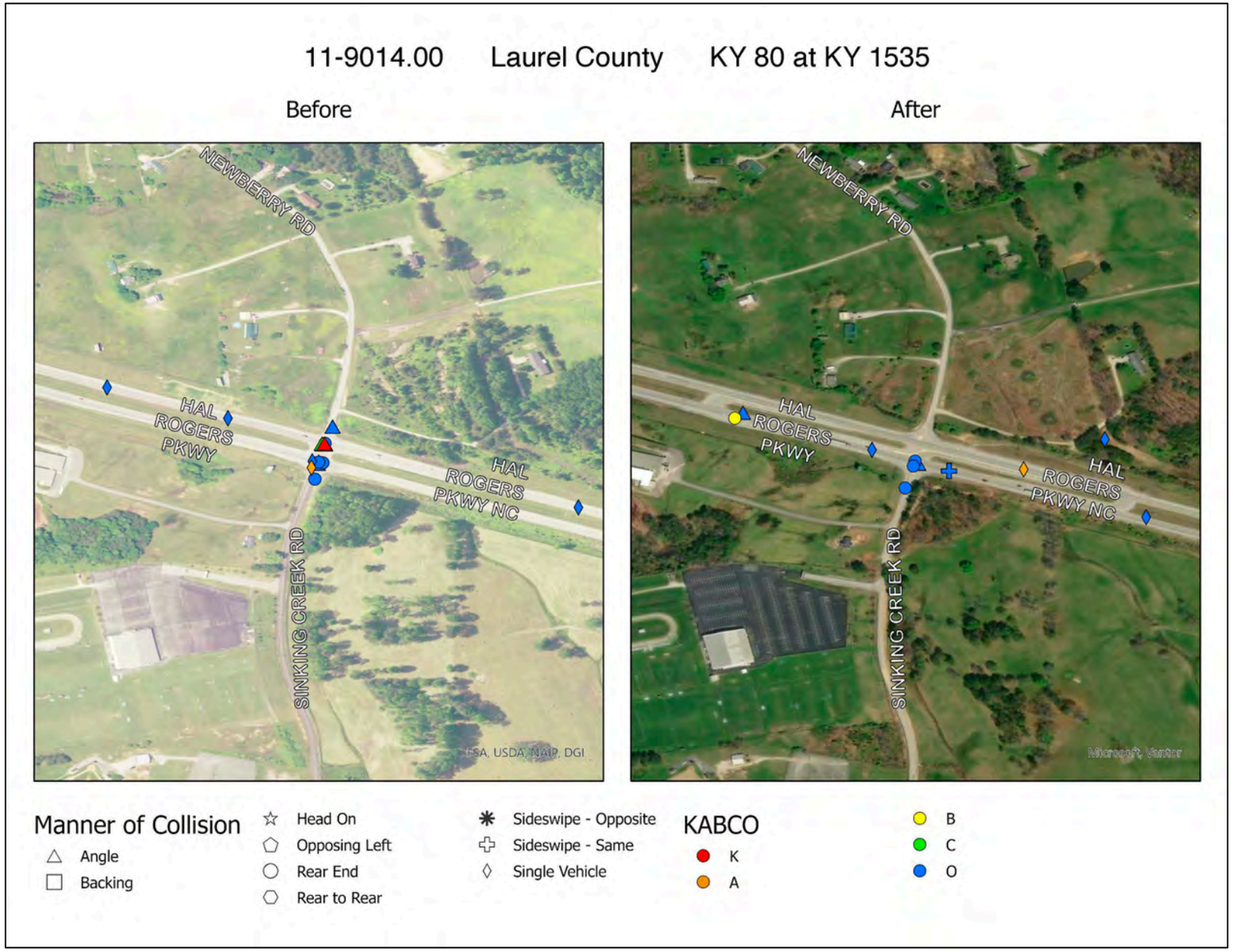
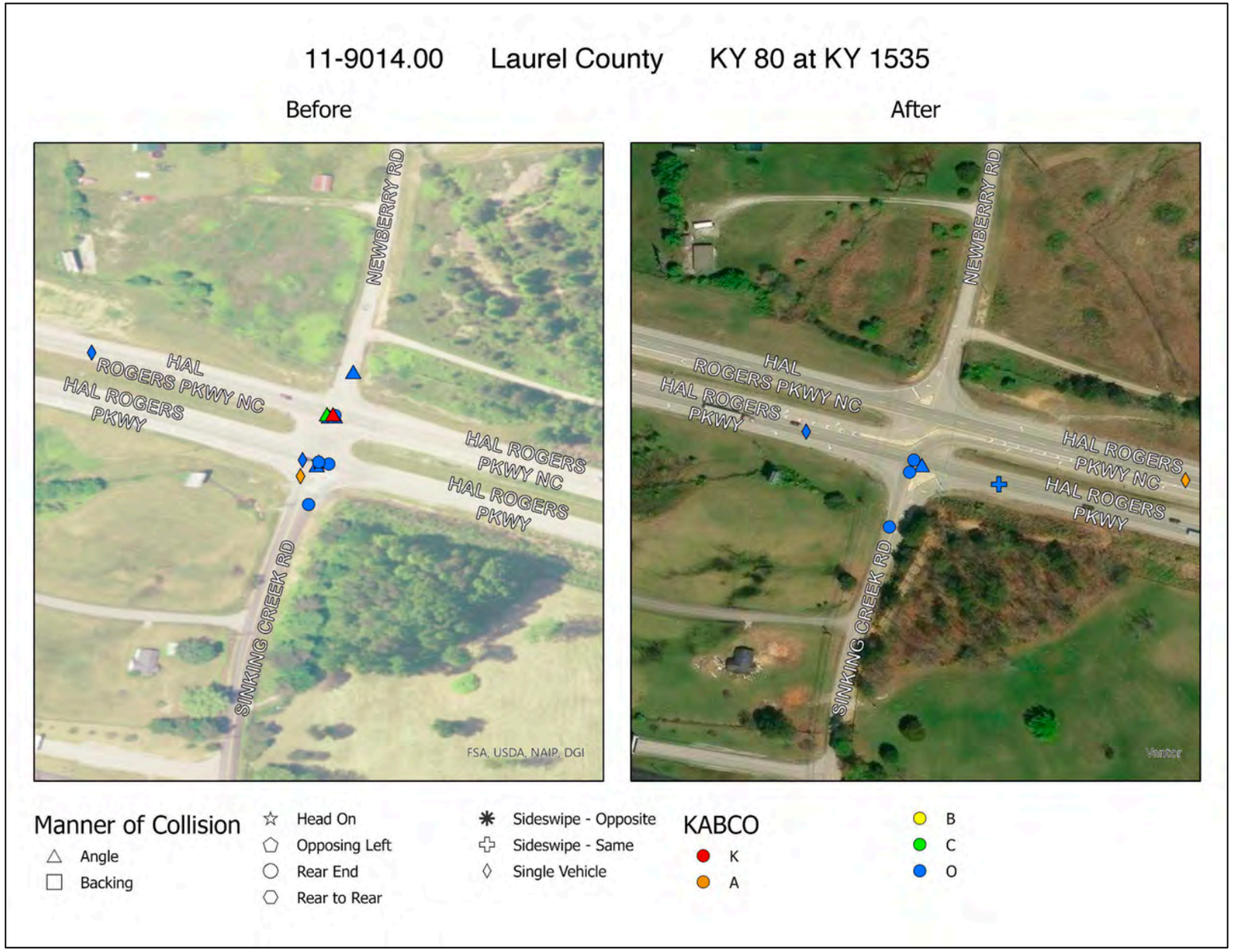
Appendix A Kentucky Existing RCUT Information

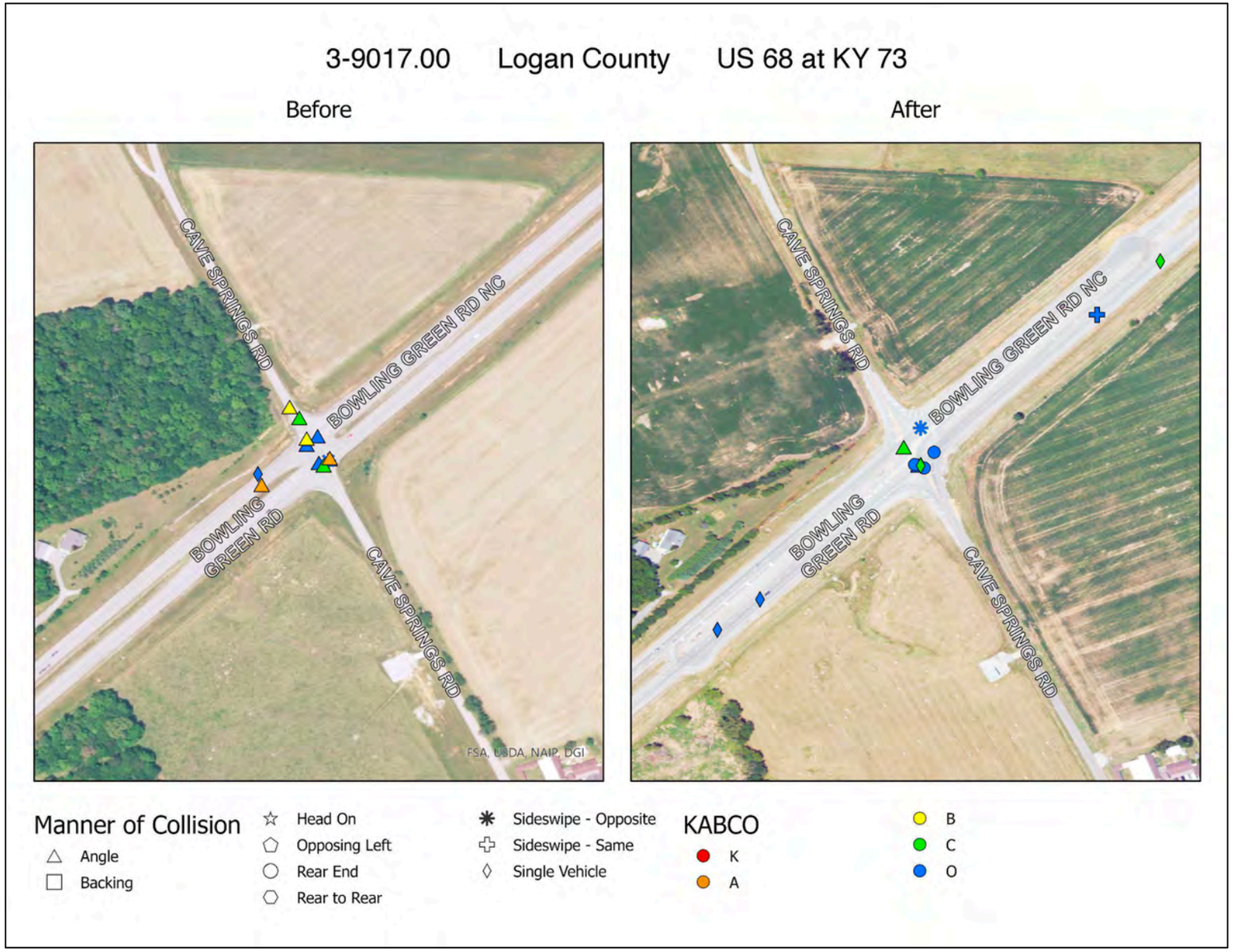
Item No.	County	Intersection	Posted Speed Limit (MPH)	85th Percentile Speed ** (MPH)	Intersection Skew, degree	Distance From Intersection to U-turn Median Opening	Right Turn Lane Connected to Loop	Median Width	Mainline AADT (At time of After Crash Analysis)	Minor Street AADT (At time of After Crash Analysis)	Channelization and Islands	Left Turn Lane	Entrance at Median U-turn Location	Flexible Delineators	KYTC Lighting	Functional Classification	Access Control
11-9005.20	Knox	US 25E @ KY 233	55	63	Between 75 and 105 degrees	EB - 463' WB - 740'	WB Only	38'	17,561	North - 390 South - 1,653	Main Intersection: Raised 6" Standard Median Barrier Type 4 (RPM-110) Minor Right: Raised 4" Concrete Island (RPM-120) U-turn: None	Slight Taper	Yes, Both locations	On top of Median, Post Construction	No	Urban Principle Arterial	By Permit
11-9014	Laurel	KY 80 @ KY 1535	55	62	Between 75 and 105 degrees	EB - 750' WB - 737'	EB and WB	60'	9,281	North - 305 South - 1,091	Main Intersection: Raised 6" Standard Median Barrier Type 4 (RPM-110) Minor Right: Raised 4" Concrete Island (RPM-120) U-turn: None	Slight Taper	No	On top of Median, Post Construction	No	Urban Principle Arterial	Partial Control
3-9017	Logan	US 68 @ KY 73	65	69	67 degrees	EB - 800' WB - 828'	EB and WB	40'	12,997	North - 649 South - 649	Main Intersection: Raised 6" Standard Median Barrier Type 4 (RPM-110), with slits for drainage Minor Right: Painted U-turn: None	Slight Taper	No	On top of Median 24" Height, 20' Spacing	No	Rural Principle Arterial	Partial Control
4-9008.40	Hardin	US 31W @ KY 220	55	58	Between 75 and 105 degrees	NB - 1324' SB - 853'	No	36'	19,507	East -No Count West -2,706	Main Intersection: Raised 6" Standard Median Barrier Type 2 & 4 (RPM-110) Minor Right: None U-turn: Raised 6" Standard Median Barrier Type 2 & 4 (RPM-110)	Parallel	Yes	None	No, some lighting from adjacent development	Urban Principle Arterial	By Permit
4-9008.40	Hardin	US 31W @ KY 434	55	54.1	Between 75 and 105 degrees	NB - 910' SB - 613'	No	36'	28,106	East -5,579 West -No Count	Main Intersection: Raised 6" Standard Median Barrier Type 2 & 4 (RPM-110) Minor Right: None U-turn: Raised 6" Standard Median Barrier Type 2 & 4 (RPM-110)	Tapered	No	None	No	Urban Principle Arterial	By Permit
4-9008.40	Hardin	S 31W @ Blackjack R	50 / 55***	54.4	Between 75 and 105 degrees	NB - 795' SB -753'	No	36'	21,662	East -No Count West -No Count	Main Intersection: Raised 6" Standard Median Barrier Type 2 & 4 (RPM-110) Minor Right: None U-turn: Raised 6" Standard Median Barrier Type 2 & 4 (RPM-110)	Tapered	Yes, both U-turns	None	No, some lighting from adjacent development	Urban Principle Arterial	By Permit
7-9019	Scott	62 @ Hemingway Pl	55	56.5	Between 75 and 105 degrees	EB - 583' WB -645'	EB and WB	40'	16,960	North - No Count South - No Count	Main Intersection: Raised 6" Standard Median Barrier Type 2 (RPM-110) Minor Right: Painted U-turn: None	Slight Taper	No	On top of Median 24" Height, 20' Spacing	Street light at main intersection, unsure if KYTC	Urban Minor Arterial	By Permit
1-9013	Graves	US 45 @ KY 408	55*	59.5	Between 75 and 105 degrees	NB -790' SB -790'	NB and SB	60'	13,652	East - 1,387 West - 1,197	Main Intersection: Raised 6" Standard Median Barrier Type 4 (RPM-110) Minor Right: Painted U-turn: None	Slight Taper	No	No, Median ends painted yellow.	Yes, at main intersection and u-turn locations.	Rural Principle Arterial	Partial Control
1-9015	McCracken	US 45 @ KY 1288	65	66.4	Between 75 and 105 degrees	NB -792' SB -784'	NB and SB	60'	13,744	East - 752 West - No Count	Main Intersection: Raised 6" Standard Median Barrier Type 4 (RPM-110) Minor Right: Painted U-turn: None	Slight Taper	No	No, Median ends painted yellow.	Yes, at main intersection and u-turn locations.	Rural Principle Arterial	Partial Control
1-9016	Marshall	US 641 @ KY 402	55*	57.9	70 degrees	NB -662' SB -680'	NB and SB	60'	11,267	East - 2,149 West -1,536	Main Intersection: Mountable Median Type 6A (RPM-012) and 6" Standard Barrier Median (RPM-110) Minor Right: Mountable Median Type 6A (RPM-012) U-turn: None	Tapered	No	No, Median ends painted yellow.	Yes, at main intersection and u-turn locations.	Rural Principle Arterial	Partial Control
1-9017	McCracken	US 60 @ KY 726	55	61.3	Between 75 and 105 degrees	EB - 728' WB -747'	EB and WB	40'	9,883	North - 159 South - 1,387	Main Intersection: 6" Standard Barrier Median (RPM-110) Minor Right: Painted U-turn: None	Slight Taper	No	No, Median ends painted yellow.	Yes, at main intersection and u-turn locations.	Rural Principle Arterial	Partial Control
1-9017	McCracken	US 60 @ KY 996	55	61.2	Between 75 and 105 degrees	EB - 658' WB -752'	EB and WB	40'	9,883	North - 2,330 South - 270	Main Intersection: 6" Standard Barrier Median (RPM-110) Minor Right: Painted U-turn: None	Slight Taper	No	No, Median ends painted yellow.	Yes, at main intersection and u-turn locations.	Rural Principle Arterial	Partial Control
4-9002	Hardin	KY 3005 @ KY 1904	55	57.9	Between 75 and 105 degrees	NB -602' SB -602'	NB and SB	40'	10,240	East - 775 West - 1,994	Main Intersection: Raised 6" Standard Median Barrier Type 2 (RPM-110) Minor Right: None U-turn: None	Parallel, but offset	No	Yes	No	Urban Minor Arterial	Partial Control

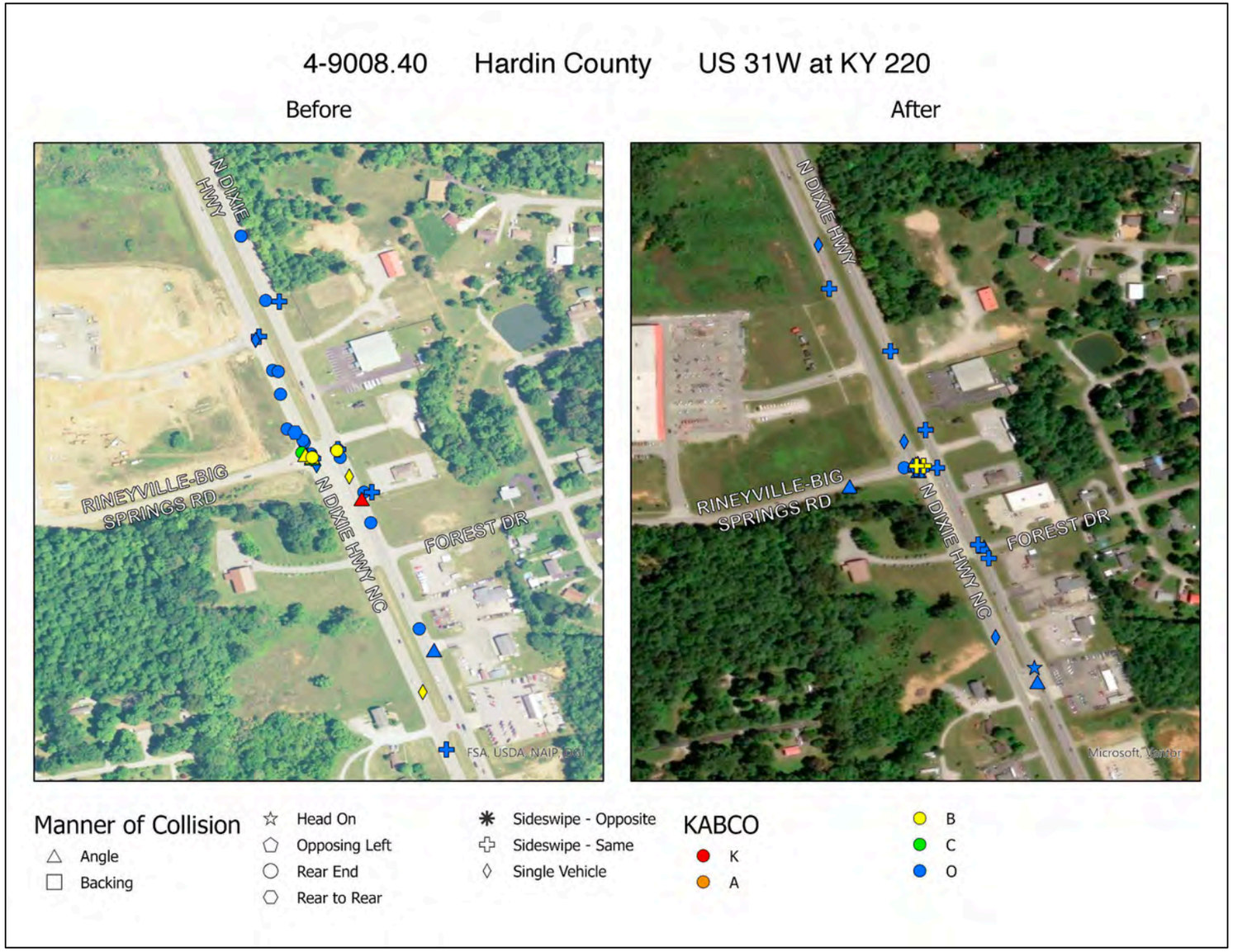
*SL Reduced from 65mph to 55mph through RCUT **Value is average of cardinal and non-cardinal directions ***Most of intersection is 50mph.

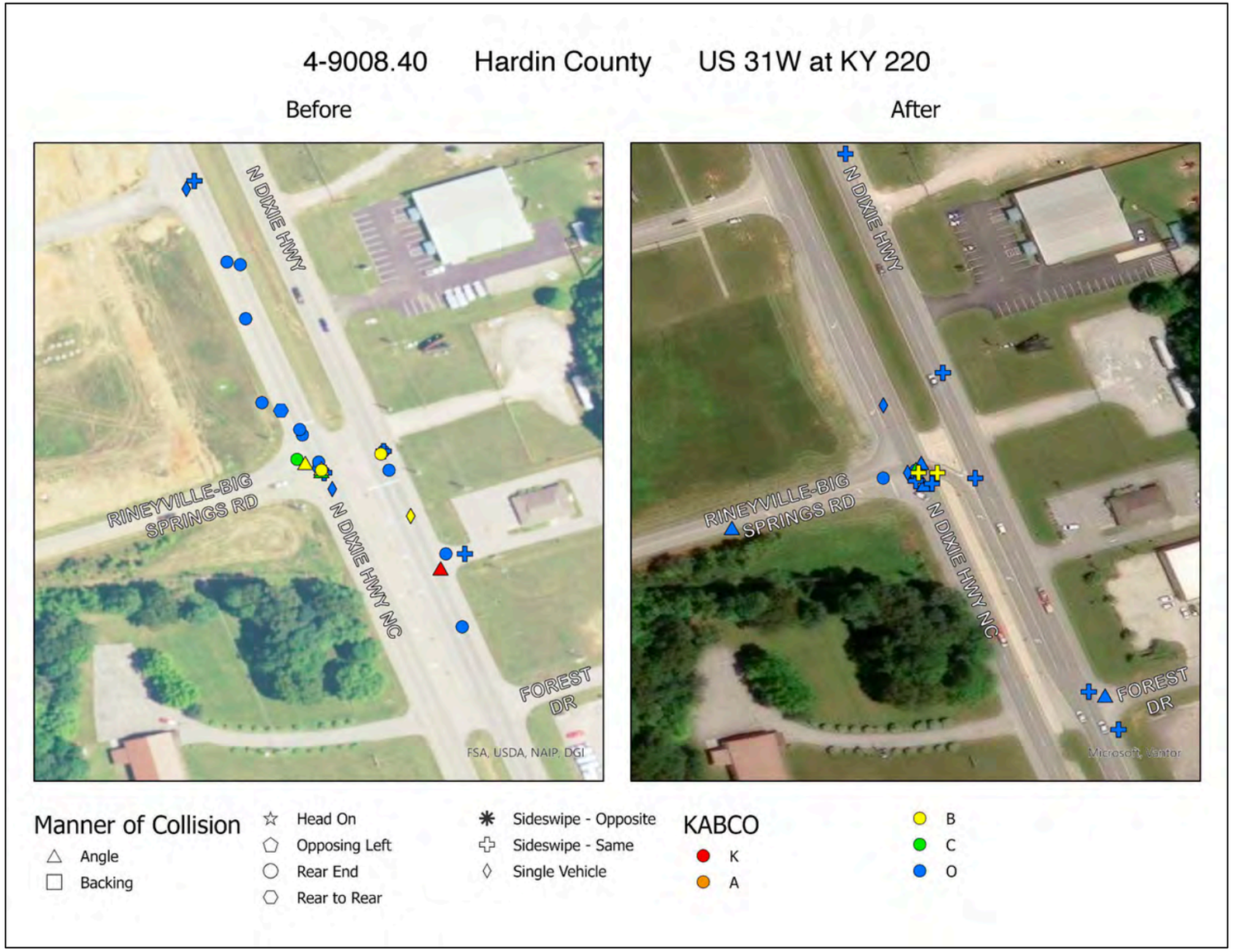

11-9005.20 Knox County US 25E at KY 233
Before
After
US-25 E N
US-25 E N NC
N KY-233
S KY-233
GRAY CEMETERY RD
CROSSROAD DR
FSA, USDA, NAIP, DGI
Manner of Collision
Angle
Backing
Head On
Opposing Left
Rear End
Rear to Rear
Sideswipe - Opposite
Sideswipe - Same
Single Vehicle
KABCO
K
A
B
C
O


11-9014.00 Laurel County KY 80 at KY 1535
Before
After
NEWBERRY RD
HAL ROGERS PKWY
HAL ROGERS PKWY NC
SINKING CREEK RD
FSA, USDA, NAIP, DGI
Manner of Collision
Angle
Backing
Head On
Opposing Left
Rear End
Rear to Rear
Sideswipe - Opposite
Sideswipe - Same
Single Vehicle
KABCO
K
A
B
C
O


11-9014.00 Laurel County KY 80 at KY 1535
Before
After
NEWBERRY RD
HAL ROGERS PKWY NC
HAL ROGERS PKWY
HAL ROGERS PKWY NC
HAL ROGERS PKWY
SINKING CREEK RD
FSA, USDA, NAIP, DGI
Manner of Collision
Angle
Backing
Head On
Opposing Left
Rear End
Rear to Rear
Sideswipe - Opposite
Sideswipe - Same
Single Vehicle
KABCO
K
A
B
C
O


3-9017.00 Logan County US 68 at KY 73
Before
After
CAVE SPRINGS RD
BOWLING GREEN RD NC
BOWLING GREEN RD
CAVE SPRINGS RD
FSA, USDA, NAIP, DGI
CAVE SPRINGS RD
BOWLING GREEN RD NC
BOWLING GREEN RD
CAVE SPRINGS RD
Manner of Collision
Angle
Backing
Head On
Opposing Left
Rear End
Rear to Rear
Sideswipe - Opposite
Sideswipe - Same
Single Vehicle
KABCO
K
A
B
C
O


4-9008.40 Hardin County US 31W at KY 220
Before
After
N DIXIE HWY
RINEYVILLE-BIG SPRINGS RD
N DIXIE HWY NC
FOREST DR
FSA, USDA, NAIP, DG
Microsoft, Vantor
Manner of Collision
Angle
Backing
Head On
Opposing Left
Rear End
Rear to Rear
Sideswipe - Opposite
Sideswipe - Same
Single Vehicle
KABCO
K
A
B
C
O


4-9008.40 Hardin County US 31W at KY 220
Before
After
N DIXIE HWY
RINEYVILLE-BIG SPRINGS RD
N DIXIE HWY NC
FOREST DR
FSA, USDA, NAIP, DGI
Microsoft, Vantor
Manner of Collision
Angle
Backing
Head On
Opposing Left
Rear End
Rear to Rear
Sideswipe - Opposite
Sideswipe - Same
Single Vehicle
KABCO
K
A
B
C
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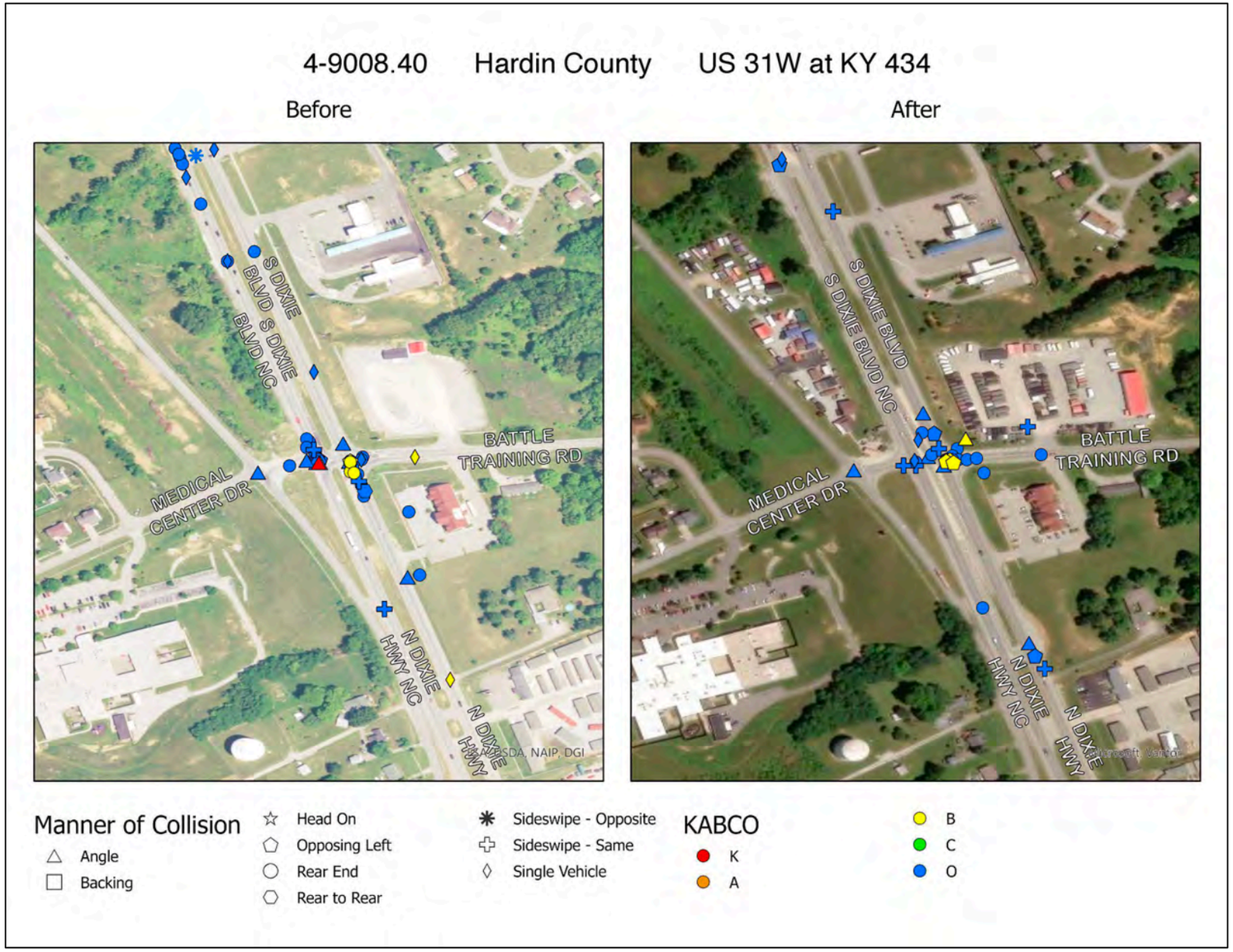
4-9008.40 Hardin County US 31W at KY 434
Before
After
S DIXIE BLVD S DIXIE BLVD NC
BATTLE TRAINING RD
MEDICAL CENTER DR
N DIXIE HWY NC
N DIXIE HWY
S DIXIE BLVD
S DIXIE BLVD NC
BATTLE TRAINING RD
MEDICAL CENTER DR
N DIXIE HWY NC
N DIXIE HWY
Manner of Collision
Angle
Backing
Head On
Opposing Left
Rear End
Rear to Rear
Sideswipe - Opposite
Sideswipe - Same
Single Vehicle
KABCO
K
A
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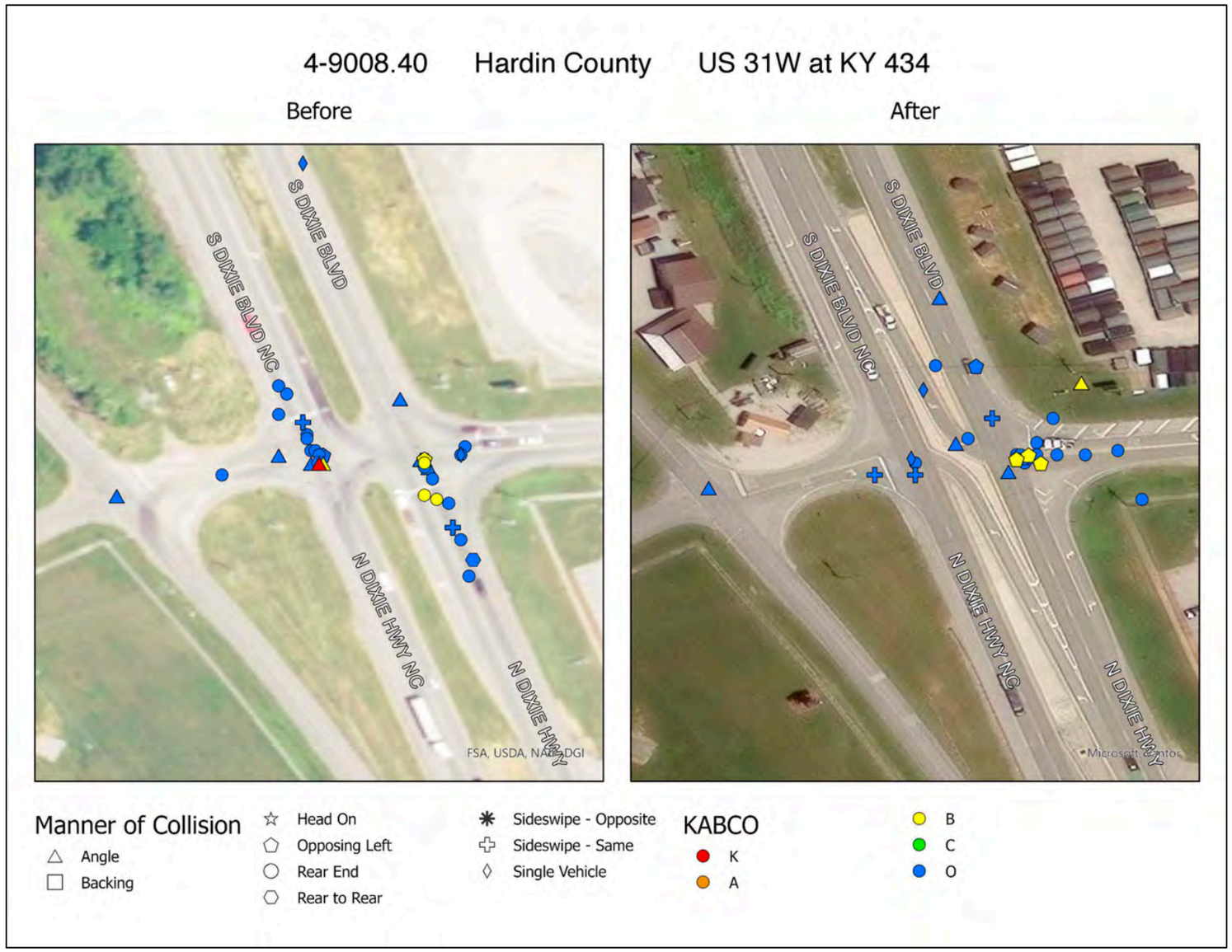
4-9008.40 Hardin County US 31W at KY 434
Before
After
S DIXIE BLVD
S DIXIE BLVD NC
N DIXIE HWY NC
N DIXIE HWY
FSA, USDA, NAIP, DGI
Manner of Collision
Angle
Backing
Head On
Opposing Left
Rear End
Rear to Rear
Sideswipe - Opposite
Sideswipe - Same
Single Vehicle
KABCO
K
A
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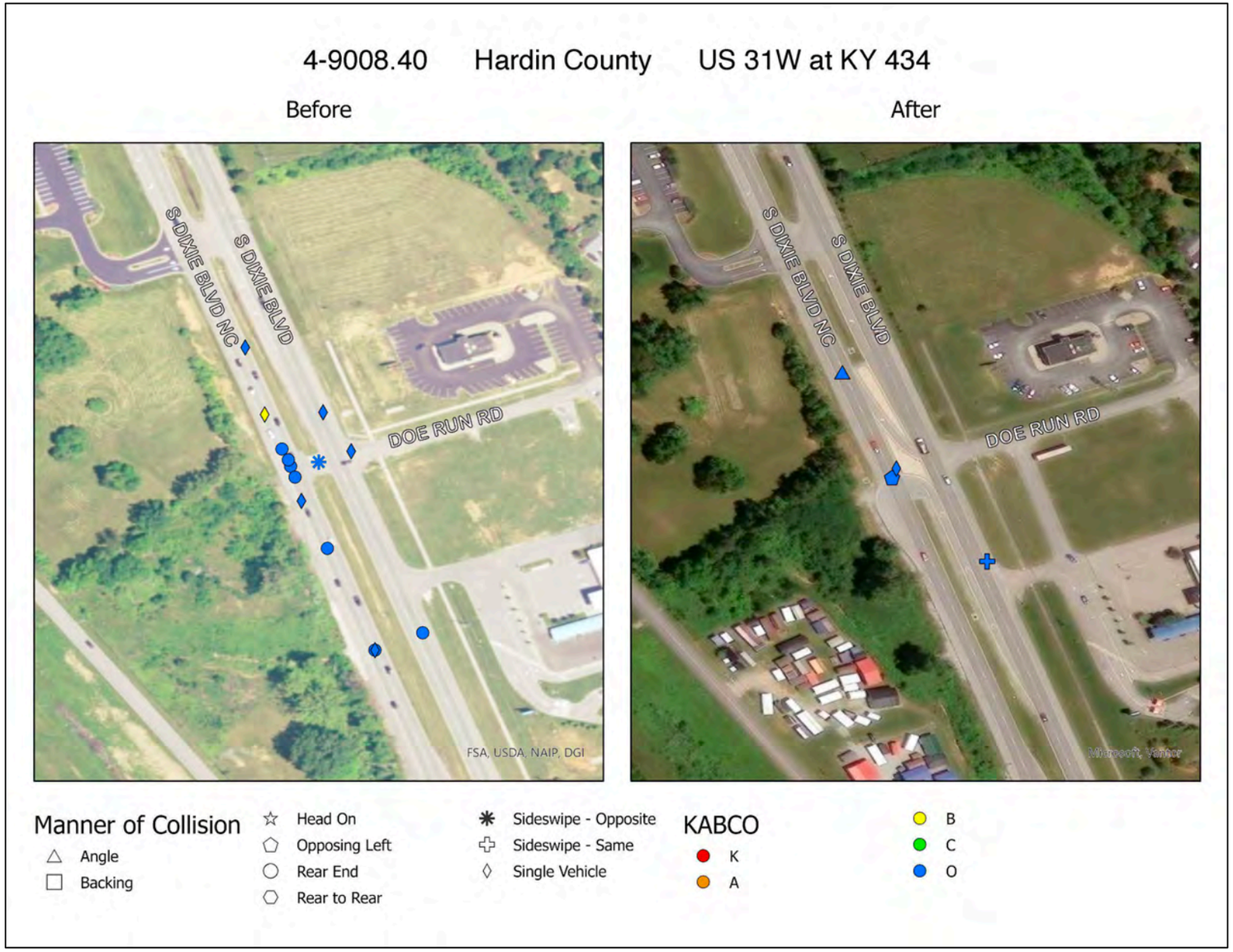
4-9008.40 Hardin County US 31W at KY 434
Before
After
S DIXIE BLVD NC
S DIXIE BLVD
DOE RUN RD
FSA, USDA, NAIP, DGI
Manner of Collision
Angle
Backing
Head On
Opposing Left
Rear End
Rear to Rear
Sideswipe - Opposite
Sideswipe - Same
Single Vehicle
KABCO
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A
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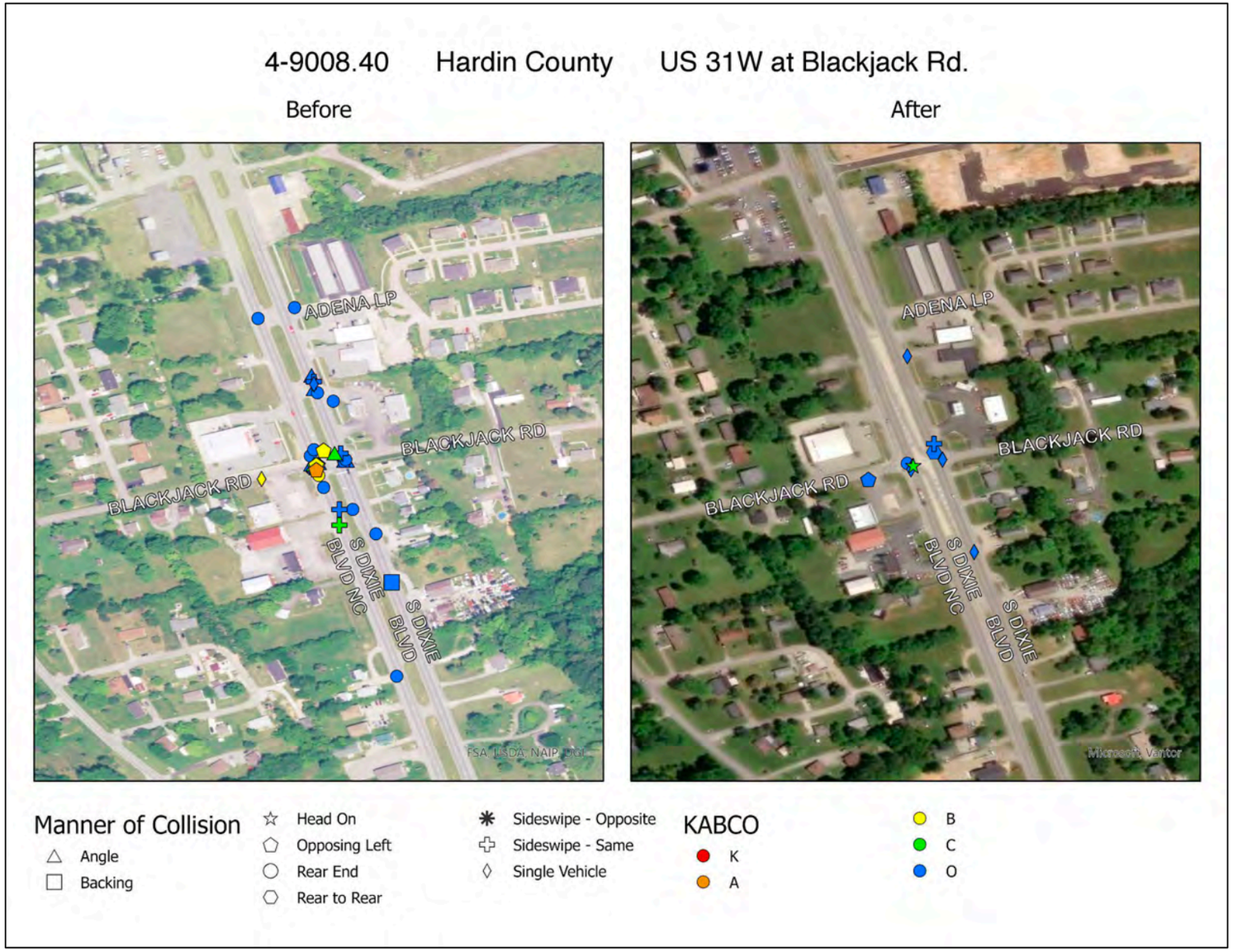
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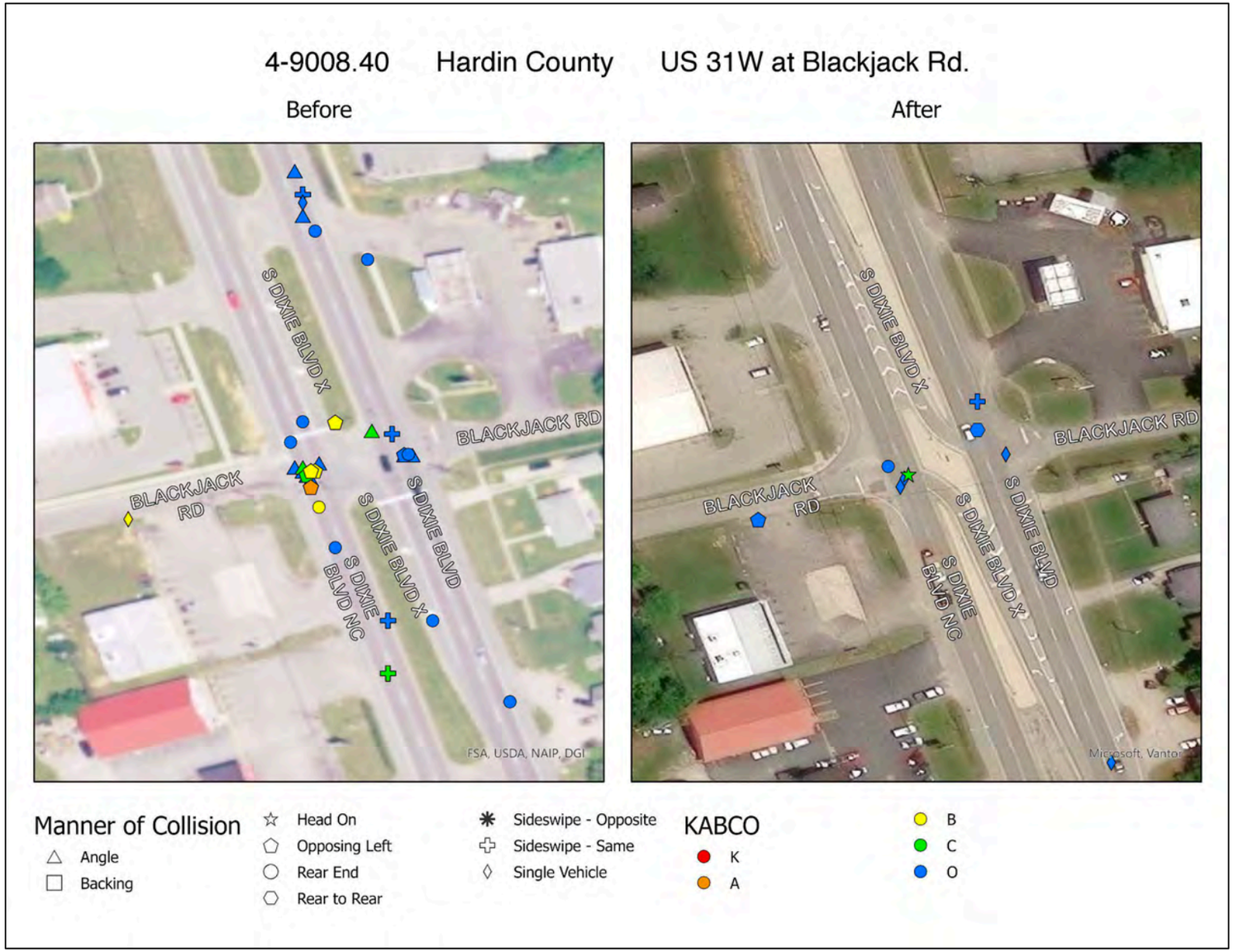
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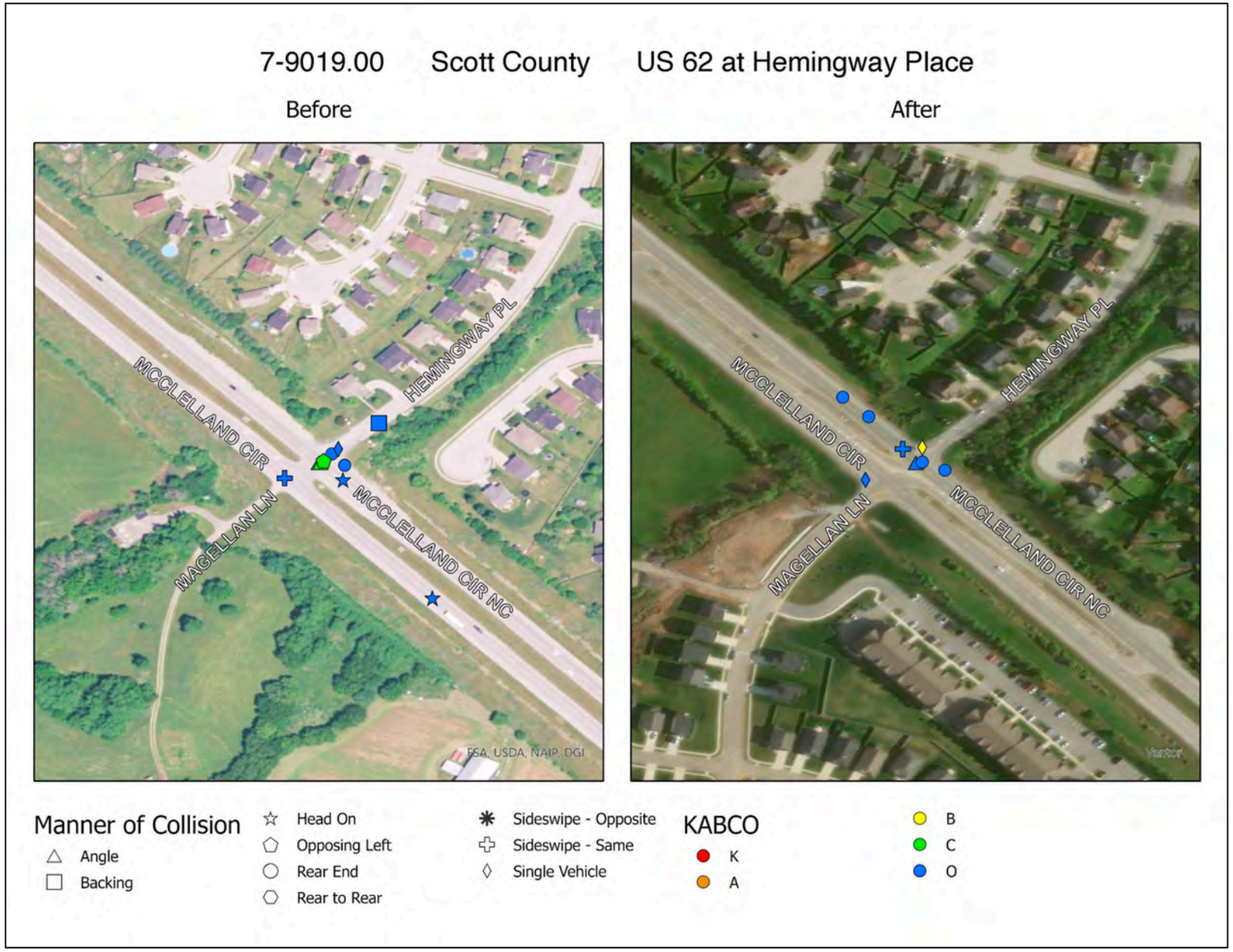
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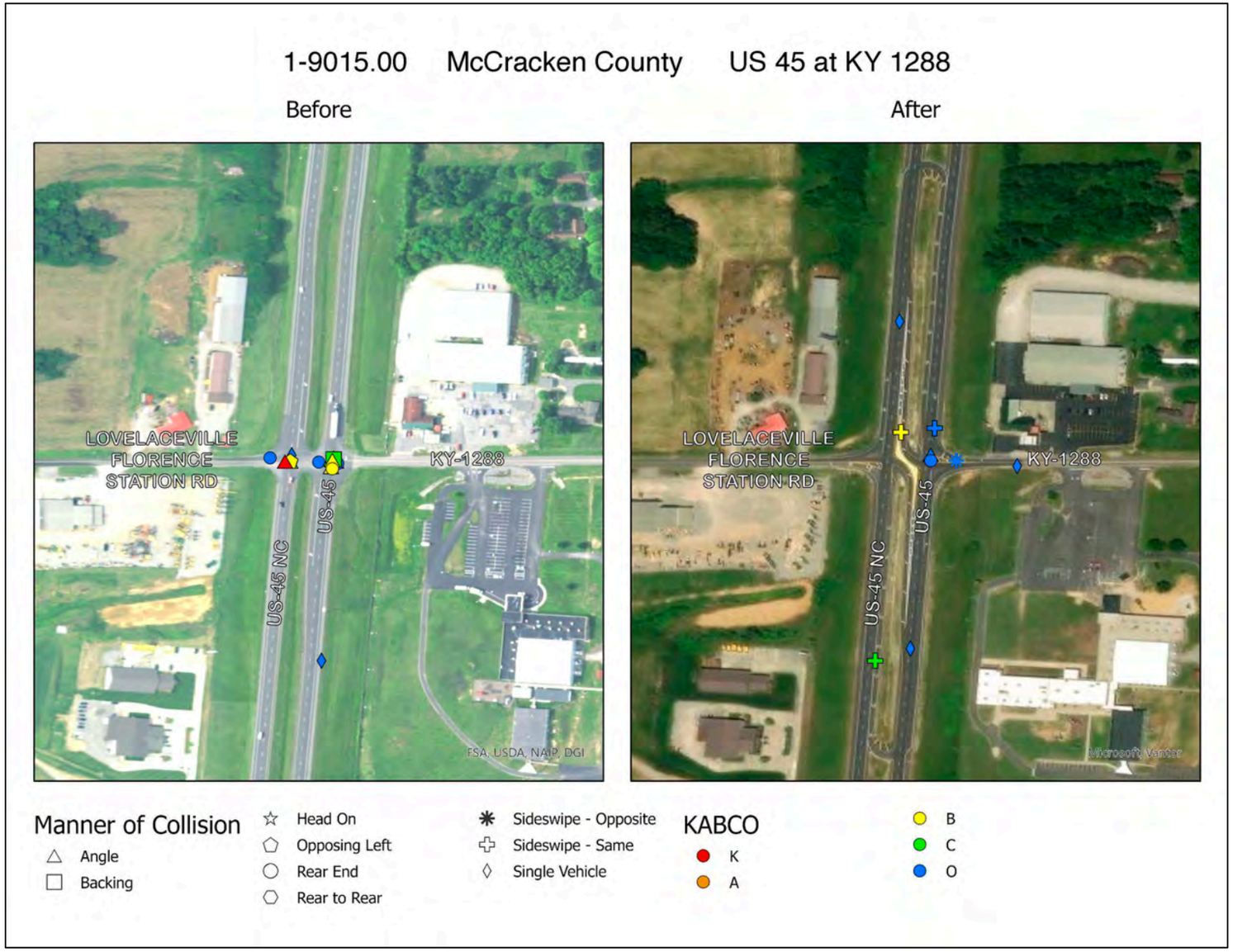
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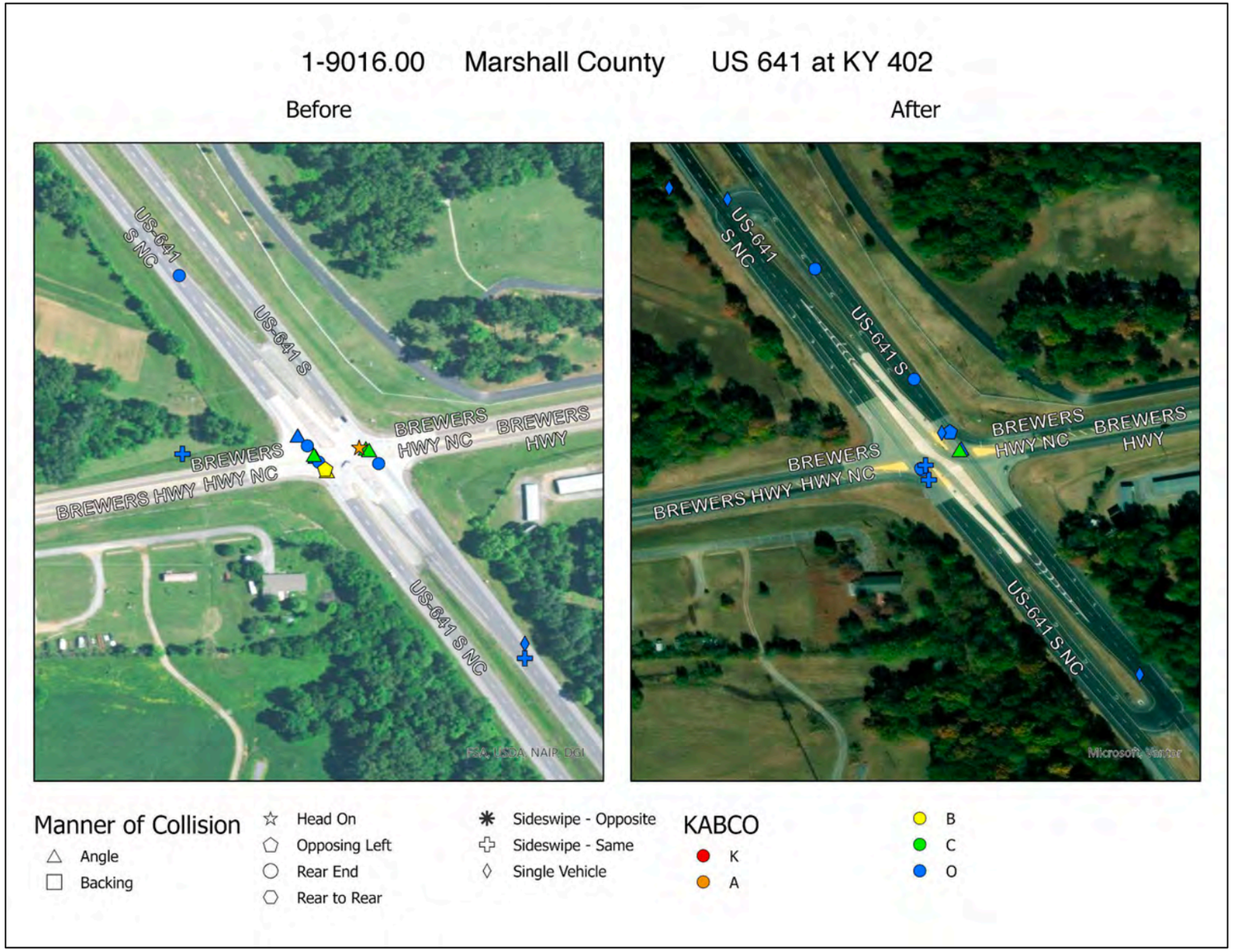
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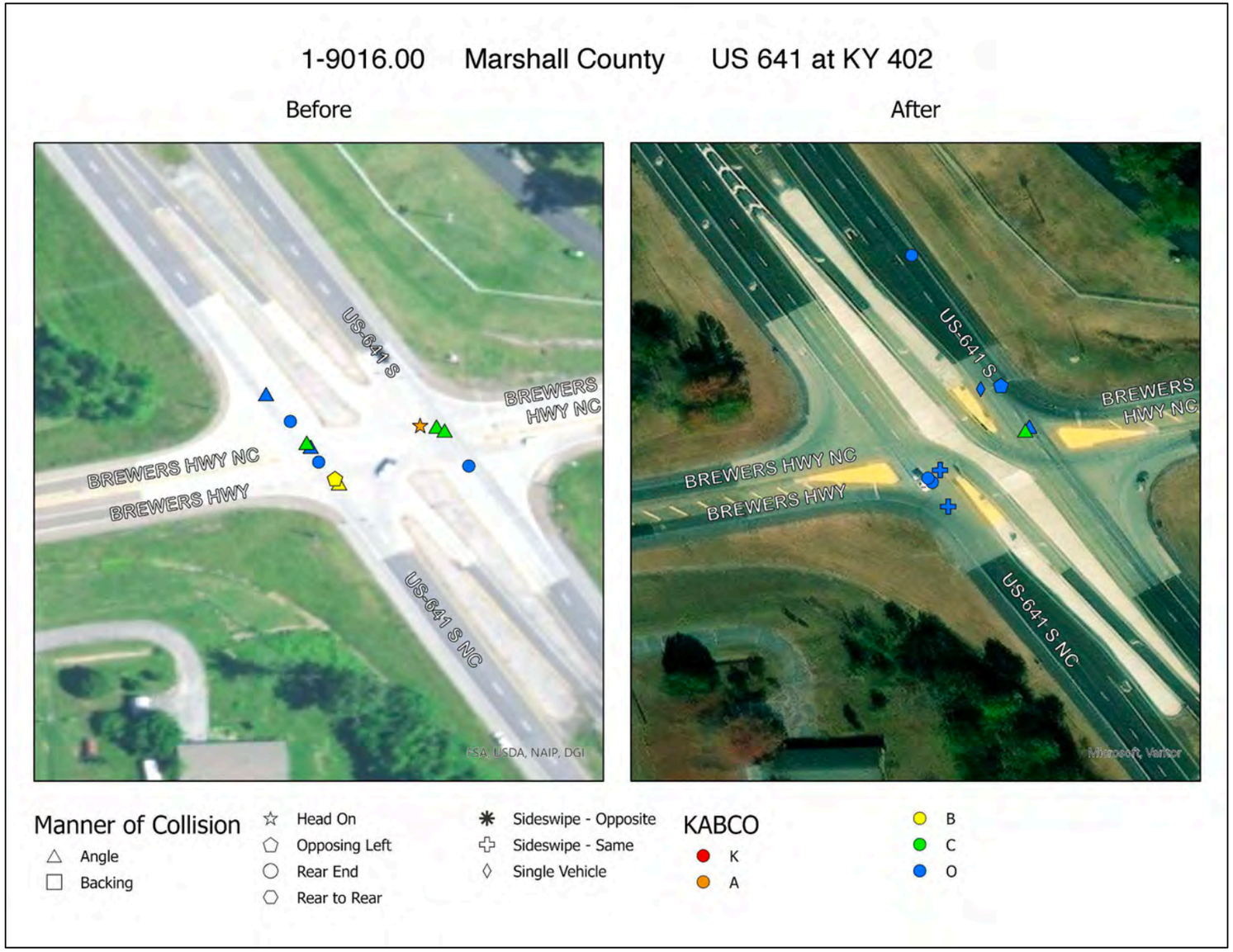
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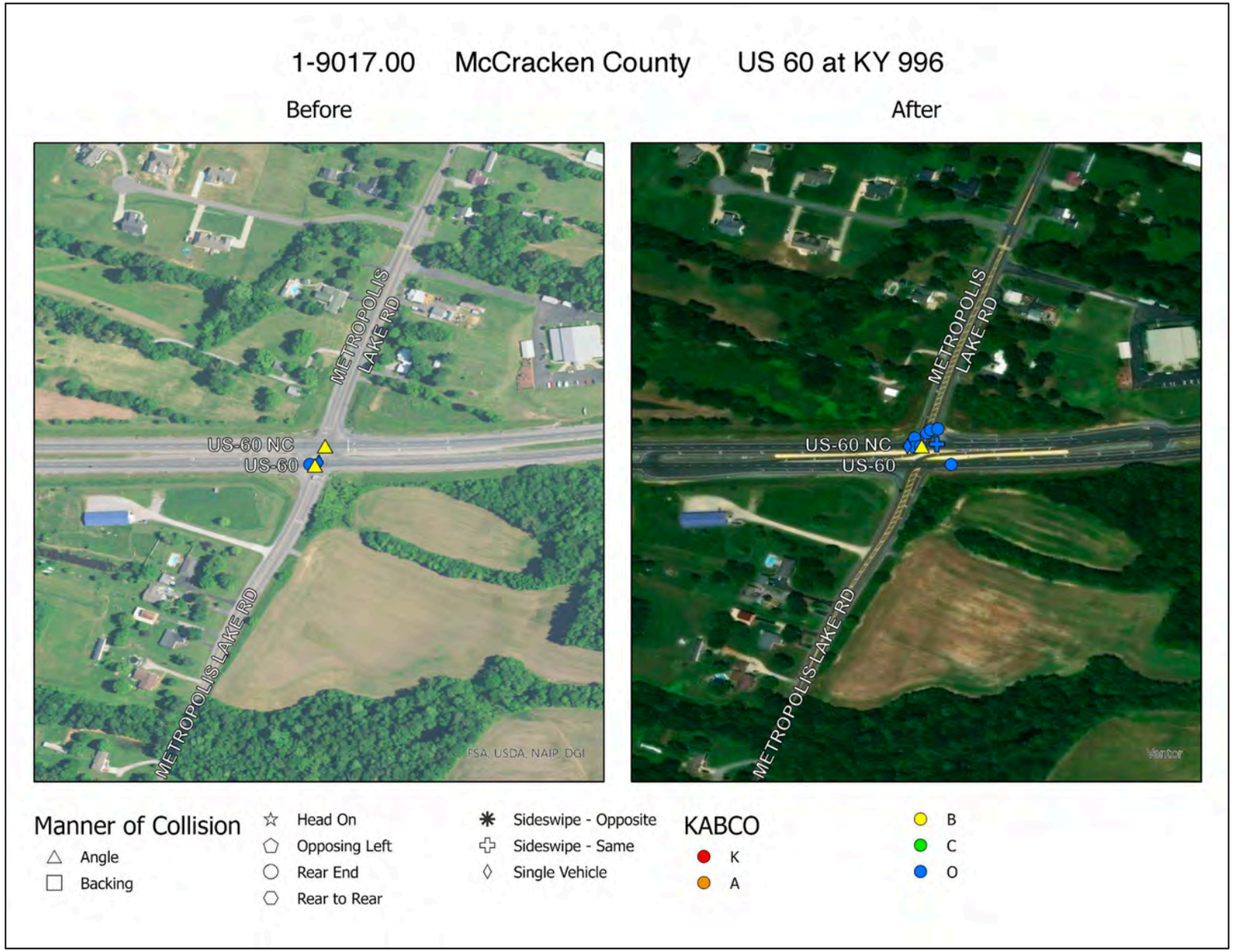
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Appendix B State Department of Transportation Interview Questions

Pre-Interview Questions

- Approximately how many RCUT intersections are operational in your state and how many are in the project development stage or planning stage?
- Do you have any data available that assesses safety and/or operational performance at your RCUT intersections? If so, do you typically assess safety and/or operational performance for a set time before and after an RCUT is opened to traffic?
    - Has your state established performance targets (e.g., crash reduction, delay, or travel time) to evaluate RCUT program success?
- Does your state have official policy or guidance documents for RCUTs? If so, can you forward copies or links to these documents?
- Do you have standard detail sheets for RCUT striping, signing, and delineation? If so, can you provide a copy or a link?

General Questions

- Are there specific roadway functional classes, AADT thresholds, or speed environments where your state discourages RCUT implementation?
- Does your state view RCUTs primarily as a safety improvement, an operational/capacity improvement, and/or an effective form of access management?
- As part of an encroachment permit has your state required developers to construct RCUT intersections?
- How are RCUT projects typically funded in your state (e.g., HSIP, safety funds, operational funds, local cost sharing)?

Planning / Preliminary Engineering Questions

- Does your state evaluate intersections using Intersection Control Evaluation (ICE) or some other method and are RCUTs part of this analysis?
- Do you require a traffic analysis for RCUT designs? If so, what type of analysis is used – deterministic or microsimulation modeling?
- What metrics does your state use to determine if an RCUT intersection needs to be signalized?
- How does your state handle public involvement for projects with RCUTs? Is it handled the same as for other projects?
- When evaluating RCUT corridors, what is your experience with mixing RCUT intersections with other intersection control types (e.g., traffic signals, roundabouts, other alternative intersections)?

Geometric Design Questions

- What design vehicle(s) are selected to evaluate your state's RCUT intersections? Where dual left turn lanes or dual median U-turns are provided what design vehicle do you use for each lane?
    - What minimum/ideal median width does your state find most effective for RCUT operations and design vehicles?
- How does your state calculate intersection sight distance for the minor road right turn, major road left turn, and median U-turns at RCUT intersections?
- How do you determine spacing between the central intersection and the U-turn median opening? Do you have minimum/maximum spacing parameters, or a recommended range?

- Does your state manage access around median U-turn openings or are there situations where you would allow an entrance to be located at this opening?
- Do you specify a maximum cross slope for the loon and the shoulder? If adding a loon to an existing shoulder do you have provisions to match existing cross slope or do you require it to be designed?
- Do you have a specific design for the median islands such as curb type and height? Do you require concrete median islands, or do you use other products such as quick-curb?
- When altering median openings at the central intersection or providing median U-turn openings how has your state handled drainage and runoff from features such as raised medians, curbing, and islands?
- How do you determine turn bay storage lengths for U-turns and left-turns at RCUTs?

Multimodal Accommodation Questions

- How often do you provide accommodation for pedestrians or bicycles at RCUTs?
    - How is this typically accomplished?
- Do any RCUT intersections include transit stops, and if so, where are these situated?

Signing and Pavement Markings Questions

- How much consistency/uniformity is there across the state for the traffic control devices used, including tubular markers?
- Have you developed any special signs or other traffic control devices/applications for RCUTs that are not covered by the MUTCD?
- Have you had any issues with the placement and frequency of signs related to turning prohibitions, permitted movements, wrong-way, do not enter, etc.?

Construction Questions

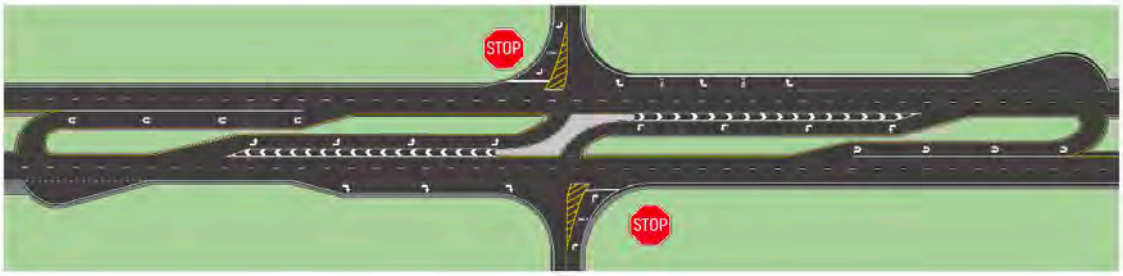
- Do you have a standard or recommended traffic control plan specific to the construction of RCUTs?

Operations and Maintenance Questions

- Is lighting at RCUT intersections in your state a requirement? If lighting is used, where is it located at the intersection?
- Have you had any instances where you had to modify RCUTs after opening to address unforeseen issues?
- Are there any unique maintenance aspects of RCUT intersections that you have observed?
- If you have snow/ice events, do RCUTs present unique challenges that have resulted in needing to change removal methods or procure different equipment for RCUT intersections/corridors?
- Have you had any incident management issues or concerns with RCUTs, specifically from fire/EMS or other first responders?

Appendix C Kentucky Reduced Conflict U-turn (RCUT) Guidance

KYTC Reduced Conflict U-turn (RCUT) Design Guidance





August 2026

August 2026

HIGHWAY Design

Reduced Conflict U-turn (RCUT)

Design Guidance

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1. INTRODUCTION

This guidance document covers Reduced Conflict U-Turn (RCUT) intersection planning, design, construction, maintenance, and operations. RCUT intersections eliminate left-turn and through movements from the minor road. Drivers must instead turn right onto the main road and complete a U-turn at a downstream median opening. Left turns from the main road are typically maintained unless minor road volumes are extremely low.

RCUT intersections perform best on divided roadways with at least four lanes. They can be adapted to multiple contexts and can function either as a standalone intersection or as part of a corridor-wide treatment.

1.1. REDUCED CONFLICT U-TURN TYPES

RCUT intersections come in three configurations: stop-controlled, signal-controlled, and merge (yield) controlled. Each can accommodate three- or four-leg approaches. All configurations share common elements:

- Main intersection, where left turns from the major road are permitted but channelization restricts left-turn and through movements from the minor road.
- Median U-turn openings, which enable minor road through and left-turning traffic to complete their movements and reach their destinations.
- Turn lanes and deceleration lanes connecting the main intersection and median U-turn openings.

1.1.1. STOP-CONTROLLED RCUT INTERSECTION

A stop condition regulates minor road movements at a stop-controlled RCUT intersection. Left turns from the main road and U-turns are typically uncontrolled (i.e., an approach on which vehicles are not controlled by a traffic control signal, hybrid beacon, STOP sign, or YIELD sign). Figure 1 illustrates the basic layout and features of a stop-controlled RCUT intersection, while Figure 2 depicts a stop-controlled RCUT configuration that omits left-turn access from the main road. Eliminating left turns from the main road is generally reserved for special circumstances, such as very low minor-road volumes, close proximity to adjacent intersections, corridor-wide access management considerations, or sight distance restrictions.

1.1.2. SIGNAL-CONTROLLED RCUT INTERSECTION

RCUT intersections on high-volume routes can incorporate traffic signals at both the main intersection and U-turn locations (Figure 3). However, signalizing the median U-turn opening is not always necessary. Any configuration requiring dual left-turn or dual U-turn lanes must be signal-controlled because dual-lane movements are not permitted at stop- or merge-controlled RCUT intersections.

Timing of signalized RCUT intersections can be coordinated throughout a corridor to facilitate progression.

1.1.3. MERGE (YIELD) CONTROLLED RCUT INTERSECTION

An RCUT intersection with merge (yield) control (Figure 4) is more often used at rural high-speed locations that require access control and functionality similar to freeways. As a result, median U-turn openings are spaced farther away than would be the case with a stop- or signal-controlled RCUT intersection. Higher speeds can also be expected from minor road merging traffic. This RCUT configuration is generally less appropriate for urban and suburban contexts where lower operating speeds and a greater pedestrian presence are anticipated.

1.2. BENEFITS OF RCUT INTERSECTIONS

RCUT intersections have multiple benefits:

- They can be adapted to accommodate different
  - traffic volumes
  - roadway contexts
  - functional classifications
  - construction types
  - modes of transportation
- On safety metrics, they consistently outperform conventional intersections.
- They can reduce corridor travel times and move traffic more efficiently than a comparable series of signalized conventional intersections.

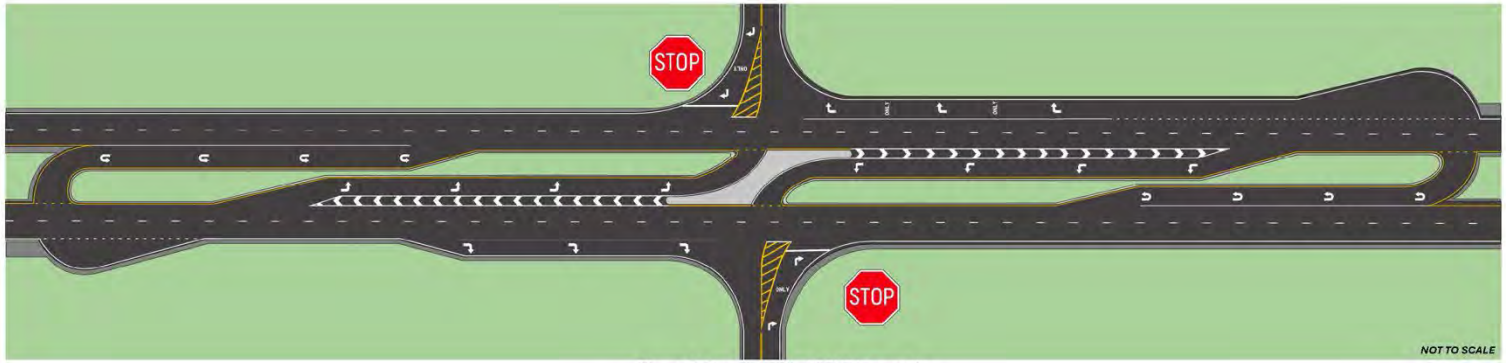

Figure 1: Stop-Controlled RCUT Intersection

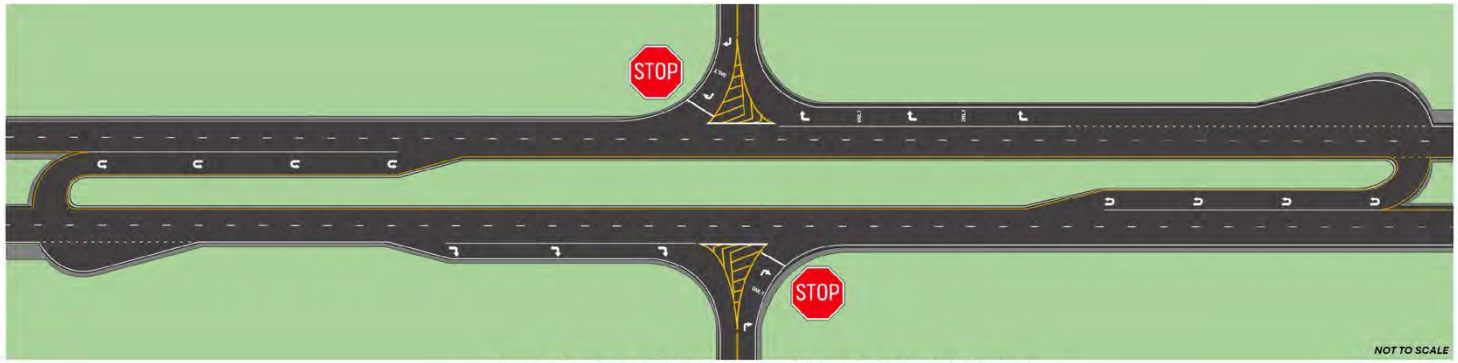

Figure 2: Stop-Controlled RCUT Intersection Without Main Road Left-Turn Lanes



Figure 3: Signalized RCUT Intersection

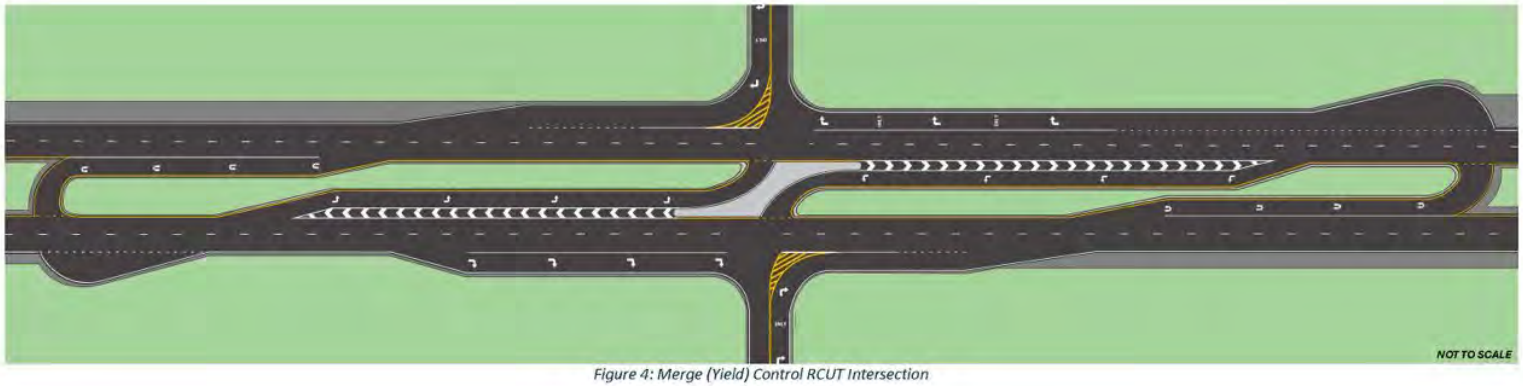

Figure 4: Merge (Yield) Control RCUT Intersection

2. PLANNING / SITE SELECTION

Location exerts a strong influence over RCUT intersection performance. As such, site selection and screening are critical for identifying the most suitable locations. This section describes where RCUT intersections are most effective, how they can be deployed as part of different project types, key factors to consider when siting RCUT intersections along a corridor, and best practices for engaging the public throughout the project development process. When screening potential locations, project teams should systematically evaluate criteria presented below to determine if an RCUT intersection(s) is appropriate.

2.1. CONDITIONS THAT SUPPORT USE OF RCUT INTERSECTIONS

Table 1 lists considerations and favorable conditions that support use of RCUT intersections. Although the table represents favorable conditions for deployment, RCUT intersections are not strictly limited to those settings, as mitigation measures can facilitate their use in less favorable contexts. For example, where median width is insufficient, larger loons may be constructed to adequately accommodate U-turning vehicles, and the median U-turn location can be adjusted to ensure that sight distance requirements are met.

Table 1: Conditions That Support RCUT Intersection Use

Consideration	Favorable Conditions
Access Control	• Partial control or access control by permit. ○ Not appropriate for interstates or other facilities with fully controlled access.
Number of Through Lanes	• Multilane divided highways with at least four through lanes. ○ RCUT intersections can be installed on an existing multilane facility or when a roadway is widened to a multilane configuration.
Median Width	• ≥ 24 ft. in urban or suburban contexts • ≥ 40 ft. in rural contexts
Crash Types	• Safety analysis demonstrates that installation will reduce intersection crashes. ○ RCUT intersections are a good solution for reducing angle or left-turning crashes.
Traffic Volumes	• Minor road left-turn and through volumes are relatively low. • The ratio of minor road volume to total intersection volume is < 0.20. ○ Stop-controlled RCUT intersections are practical where minor road demand is < 5,000 vehicles per day (vpd). ○ Consider signalization where minor road demand is 5,000 – 25,000 vpd. ○ If minor road demand is > 25,000 vpd, consider a different intersection type.
Sight Distance	• A site where intersection sight distance requirements can be obtained for the minor road right-turn, major road left-turn, and major road U-turn locations. • A site where stopping sight distance requirements can be provided throughout the intersection.
U-turn Opening	• A cross section wide enough to allow U-turns of design vehicles, or right of way (ROW) available to construct a loon. ○ Where ROW is constrained, consider alternative accommodations within the roadway network or provide truck U-turn access at designated signed U-turns.
Peds. & Cyclists	• Best accommodated at a signalized RCUT intersection.

2.2. CONDITIONS THAT DO NOT SUPPORT USE OF RCUT INTERSECTIONS

The following conditions typically do not support the use of RCUT intersections:

- **Inadequate Space for U-Turn Maneuvers** — The configuration is generally less suitable for two-lane roadways or roadways with narrow medians because they typically lack adequate space for U-turning vehicles.
- **Mountainous Terrain with Constrained Geometry** — Mountainous terrain with constrained horizontal and vertical geometry may lack sufficient sight distance and may not provide room for wide medians or loons, particularly on roadways that follow the topography alongside features such as adjacent streams.
- **Urbanized Contexts** — Although RCUT intersections have been applied in a variety of roadway contexts, they are generally less suitable for densely developed urban corridors with closely spaced access points or in rural town settings.
- **High Minor Road Left-Turn and Through Volumes** — RCUT intersections may not be suitable where minor road left-turn and through volumes are higher and the ratio of minor road to total intersection volume is 0.2 or greater. In these cases, other intersection types may function more effectively.

2.3. CONSTRUCTION AND PROJECT TYPES

RCUT intersections can be installed as part of new construction, reconstruction, or construction on existing roads (the three categories of construction listed in AASHTO's *A Policy on Geometric Design of Highways and Streets* (Green Book)).

Available ROW may constrain use of RCUT intersections as part of reconstruction or construction on existing roads. ***For new construction or reconstruction projects involving rural four-lane divided highways with wide medians, RCUT intersections are recommended as the baseline intersection type within the project area.***

RCUT intersections can also be incorporated into Resurfacing and Restoration (2R) or Resurfacing, Restoration, and Rehabilitation (3R) projects.

During the planning or design phase, if a project team determines that an RCUT intersection will provide value at a location but there are insufficient project funds for construction, the Project Manager should coordinate with KYTC Leadership. Coordination may help identify alternative funding sources (e.g., Highway Safety Improvement Program (HSIP)) to support construction of the RCUT intersection.

If an alternative funding source is not available, the Project Manager should request that District Planning staff create a Continuous Highway Analysis Framework (CHAF) entry to document the need and establish a mechanism for pursuing future funding opportunities.

2.4. INTERSECTION CONTROL EVALUATION

When considering if an RCUT intersection would be a good candidate for an intersection, use KYTC's *Intersection Control Evaluation (ICE) Guidance* to assist with selecting an intersection type.

Even if an intersection does not meet the minimum criteria for ICE analysis, RCUT intersections should be considered where a lower-volume route intersects a median-divided highway.

ICE analysis is performed during the planning and preliminary engineering phases. Sections 3 and 4 provide additional information on applying the ICE process when considering RCUT intersections.

2.5. SPECIAL CONSIDERATIONS FOR MULTIPLE RCUT INTERSECTIONS ON A CORRIDOR

Where multiple RCUT intersections are planned along a corridor, evaluate site conditions using the criteria listed in Sections 2.1 and 2.2 **plus** the items listed below:

- Safety and traffic analysis for a corridor with multiple RCUT intersections is more complex than for a corridor that has a single RCUT intersection, making it important to scope the level of effort and identify appropriate analysis tools early in the project development process, such as when selecting project team members and developing a consultant scope of work, if applicable.
- RCUT intersections are most effective on corridors that have multiple minor roads with low traffic volumes, rather than at a limited number of junctions where two major roads intersect.
- A corridor may use a mix of intersection configurations, including signalized conventional intersections, signalized and non-signalized RCUT intersections, roundabouts, and other alternative intersections. Evaluate the influence of RCUT intersections on the capacity and operations of adjacent intersection control types. The evaluation should assess the corridor as an integrated system. Section 4 contains additional guidance on defining corridor study areas.
- RCUT intersections can be combined with access management techniques to facilitate organized access along a corridor. This approach can enhance safety and promote more efficient traffic flow.
- In areas with closely spaced intersections, median U-turn openings can be repositioned to serve traffic from more than one access point or minor road.

2.6. PUBLIC INVOLVEMENT ACTIVITIES

Communicating the benefits of RCUT intersections to the public can be challenging because many people do not know how they operate. Several resources are available to assist project teams with this effort.

KYTC's SAFERoad Solutions website provides information on the benefits of RCUT intersections, highlights successful Kentucky projects, and includes a video explaining how they function.

During public involvement activities, project teams should emphasize that RCUT intersections have better safety records than other intersection types. Referencing examples of safety improvements at existing RCUT intersections in Kentucky is a particularly effective strategy. Another effective strategy is displaying visualizations that demonstrate how motorists, pedestrians, and bicyclists navigate RCUT intersections.

Table 2 lists resources project teams can use during public involvement activities. Many sites feature videos that demonstrate how RCUT intersections operate and highlight their advantages over conventional intersections.

Table 2: Other Agency RCUT Informational Videos

Agency	Website	Contents
FHWA	https://www.youtube.com/watch?v=nzpdTdXDfRw	Overview of RCUT intersections and their benefits.
Minnesota DOT	https://www.dot.state.mn.us/jturn/index.html	Videos of passenger car, tractor trailer, pickup truck with trailer, and fire truck making U-turn.
North Carolina DOT	https://www.ncdot.gov/initiatives-policies/Transportation/safety-mobility/reduced-conflict-intersections/Pages/default.aspx	Informational video, educational materials, FAQs.
Texas DOT	https://www.txdot.gov/about/programs/innovative-transportation/innovative-intersections/reduced-conflict-u-turn.html	Overview, safety benefits, educational materials, and videos.
Virginia DOT	https://www.vdot.virginia.gov/about/our-system/highways/innovative-intersections/restricted-crossing-u-turn/	Overview, safety benefits, navigation instructions, and videos.

3. SAFETY PERFORMANCE

RCUT intersections are a FHWA Proven Safety Countermeasure. Many states have adopted them because they have better safety records than conventional intersections.

3.1. CONFLICT POINTS

A four-leg approach RCUT intersection has 14 conflict points while a conventional intersection has 32 (Table 3). Four leg approach RCUT intersections also have six fewer crossing conflicts, which are most commonly associated with severe angle crashes. Figure 5 shows the locations of vehicle conflict points inventoried in Table 3. RCUT intersections distribute conflict points across a wider area and stagger them over time, rather than concentrating them at a single point as conventional intersections do.

Table 3: Vehicle Intersection Conflict Points

	Conventional Intersection		RCUT Intersection	
Number of Approaches	3	4	3	4
Total Conflict Points	9	32	7	14
Crossing Conflicts	3	8	1	2
Merging Conflicts	3	8	3	6
Diverging Conflicts	3	16	3	6

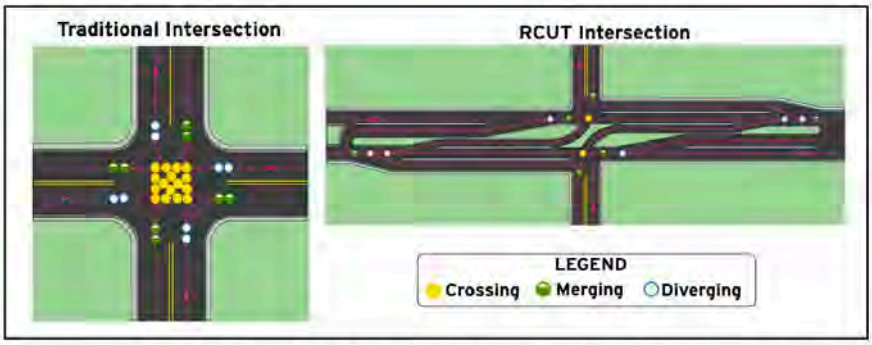

Figure 5: Conventional and RCUT Intersection Conflict Points

RCUT intersections also have fewer pedestrian – vehicle conflict points. Installing an RCUT intersection with a pedestrian Z-type crossing (see Section 5.1) instead of a conventional intersection reduces the number of pedestrian – vehicle conflict points from 24 to 8.

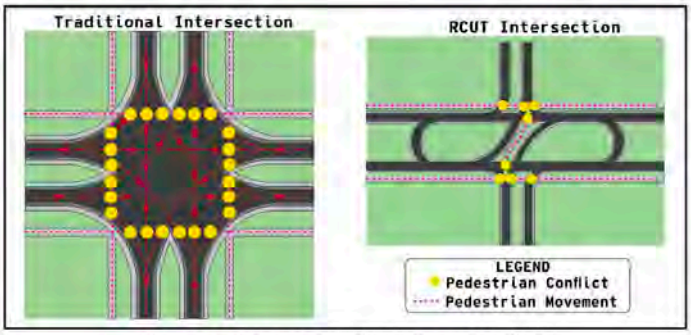

Figure 6: Intersection Pedestrian Conflicts

3.2. CRASH ANALYSIS

Several methods are available to quantify RCUT intersection safety benefits. KYTC's *Intersection Control Evaluation (ICE) Guidance* process specifies opportunities for assessment during both Stage 1 (Screening) and Stage 2 (Alternative Selection). Tools used in the ICE process were developed as part of NCHRP Research Report 1087 (SSI and SPICE tools are available at this link). Project teams should determine the appropriate safety evaluation methods during project scoping.

During Stage 1 analysis, use the SSI Score Calculator Tool to conduct a motor vehicle safety assessment based on Safe System Approach principles, such as eliminating or reducing conflict points and angle collisions, as well as lowering vehicle speeds and exposure. This tool was designed for high-level screening and has minimal data requirements.

During Stage 2 analysis, additional tools are available to assess safety performance. These include the SPICE tool, which is used to compare predicted safety outcomes across intersection alternatives, and *Highway Safety Manual* methods that apply crash modification factors (CMFs) to estimate safety benefits. Table 4 lists applicable CMFs for multiple RCUT intersection construction scenarios.

Table 4: RCUT CMFs (CMF ID links to FHWA's CMF Clearinghouse entry)

Source	Situation	CMF – All Crashes	CMF – Fatal & Injury Crashes
CMF ID: 5556 (2013)	Rural Two-way Stop-Controlled to RCUT		0.46
CMF ID: 9985 (2017)	Suburban Signalized Intersection to Signalized RCUT		0.78
CMF ID: 4883 & 4884 (2010)	Rural Unsignalized Intersection to Unsignalized RCUT	0.54	0.37
SPICE Tool		0.85	0.78

4. TRAFFIC OPERATIONS

Most often, Kentucky installs RCUT intersections to enhance safety. But they can improve traffic movement and operations as well.

4.1. TRAFFIC ANALYSIS TOOLS AND METHODS

If the main road and minor road have low traffic volumes, traffic operational analysis is generally unnecessary for RCUT intersections.

As traffic volumes increase, evaluating the impact on traffic operations assumes greater importance. KYTC's *Intersection Control Evaluation (ICE) Guidance* provides opportunities for assessment during Stage 1 (Screening) and Stage 2 (Alternative Selection). Tools used for ICE were developed through NCHRP Research Report 1087 (the CAP-X tool is available at this link). Project teams should identify the most appropriate traffic operational evaluation methods and tools to apply during project scoping.

During Stage 1 screening, use the CAP-X Tool to perform an operational assessment based on critical lane volumes. This allows project teams to compare the performance of multiple intersection types and screen potential alternatives for further evaluation. Even if the project team has concerns that the tool may rule out an RCUT intersection as a viable alternative prematurely, the intersection should still be carried forward to Stage 2 for a more detailed assessment.

During Stage 2, additional tools are available to more thoroughly analyze and compare alternative intersection types. Selection of the appropriate tool depends on the corridor and intersection's level of complexity.

A single intersection or a series of RCUT intersections can often be evaluated using deterministic traffic analysis tools. An arterial corridor that has a mix of intersection types (e.g., signalized and non-signalized RCUT intersections, conventional signalized intersections, roundabouts, interchanges) may require more advanced tools, such as microsimulation. For further guidance on selecting appropriate traffic analysis tools, refer to KYTC's *Microsimulation Guidelines*.

The Division of Planning's Traffic Forecasting and Modeling Branch can also help project teams select the most suitable tools for analysis and estimating the level of effort needed to use them.

Another important consideration is the extent of the traffic study area. Because a series of RCUT intersections along an arterial corridor can operate more efficiently than a series of conventional intersections, traffic may arrive at intersections beyond the

project limits sooner than it does under existing conditions. Given the potential impacts on adjacent intersections and interchanges, include at least one intersection or interchange on either side of the project area within the traffic study boundaries.

4.2. TRAFFIC CONTROL VOLUME RANGES

General ranges of traffic demand can be used to assess if the signalization of an RCUT intersection is a viable option. Figure 7 can aid with preliminary analysis. It is a graph from the *FHWA Restricted Crossing U-Turn Intersection: Informational Guide* that plots traffic demand on the minor street against traffic demand on the major street and indicates under what conditions a signalized RCUT intersection may be appropriate. When signalization is being considered, conduct a more detailed analysis as outlined in Section 4.1 and Section 9. Table 5 lists the type of intersection most appropriate for different traffic conditions and roadway geometric characteristics.

Table 5: RCUT Intersection Traffic Control Demand Volume Ranges

Minor Road Demand	Traffic Control Type
< 5,000 vpd	Non-signalized RCUT intersection
5,000 – 25,000 vpd	Signalized RCUT intersection, depending on the number of major road through lanes.
> 25,000 vpd	Other intersection types are likely to perform better.
• Four-Lane Major Road ○ Minor Road Volumes ≤ 20,000 vpd	Signalized RCUT intersection is a viable option.
• Six-lane Major Road ○ Minor Road Volume ≤ 25,000 vpd.	Signalized RCUT intersection is a viable option.

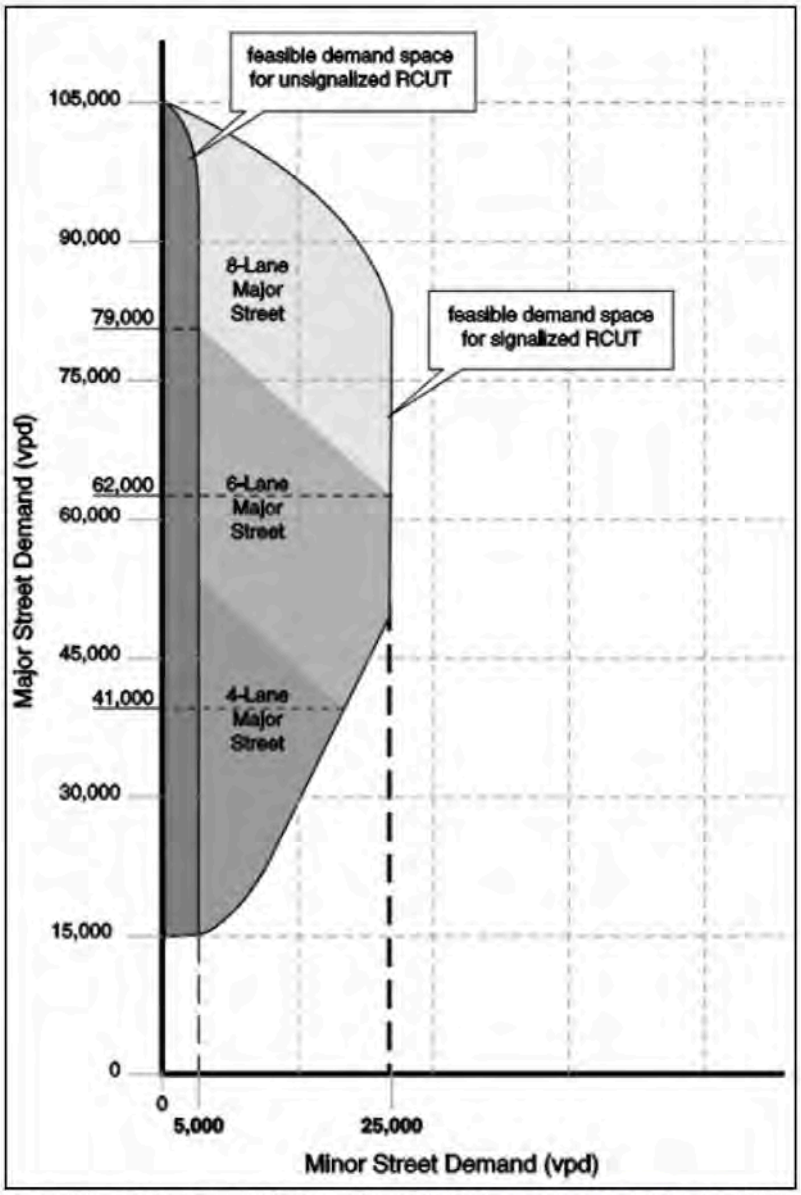

Figure 7: Feasible Traffic Demand for Signalized RCUT Intersections (Exhibit 5-7 FHWA RCUT Informational Guide)

5. NONVEHICULAR ROAD USERS

This section reviews RCUT intersection design strategies for accommodating pedestrians, bicyclists, and transit users.

5.1. PEDESTRIANS

Pedestrian facilities are most often found at signalized RCUT intersections, although they can also be provided at stop-controlled locations. Project teams must decide whether to include pedestrian facilities at a stop-controlled RCUT intersection.

The most common configuration for pedestrian facilities at stop-controlled RCUT intersections are direct crossings of intersection approaches (Figure 8). If an intersection may be signalized in the future, consider installing raised channelization at the main intersection wide enough to support a sidewalk or shared-use path. This allows for a future conversion to a Z-type crossing.



Figure 8: Direct Pedestrian Crossing

At signalized RCUT intersections, the Z-type crossing is the preferred method for accommodating pedestrians (Figure 9). Rather than crossing the main road directly, pedestrians traverse one main road approach to reach raised channelization in the center of the intersection. After moving across the channelized area, they cross the intersection approach on the opposite side of the main road to complete the walking movement.

Crossings on minor road approaches function the same as at conventional intersections. From above, the overall crossing pattern resembles the letter Z. Figure 10 illustrates an option for a more direct pedestrian crossing, which is possible when minor road approaches are offset to increase separation between left-turn lanes.



Figure 9: Z-Type Pedestrian Crossing

On a Z-type crossing, pedestrians walk a longer distance to traverse the main road than they do at a conventional intersection. Since pedestrians cannot cross the main road directly, it is suggested to space pedestrian ramp locations so that a single ramp can serve each crossing point. Ramp Types 1, 2, or 4 (see KYTC Standard Drawing RPM-170) are the most applicable configurations because they help pedestrians with vision disabilities remain oriented and cross along the correct path.



Figure 10: Signalized Offset Intersection Pedestrian Crossing (US 25 at Yorkshire Blvd.)

At signalized three-legged RCUT intersections, a direct crossing of the main road can be provided (Figure 11). However, this requires adding a mid-block pedestrian crossing that traverses the main road lanes on the side opposite the minor road approach.



Figure 11: Signalized Three-Legged RCUT Pedestrian Crossing

Signalized RCUT intersections can also accommodate pedestrians at median U-turn openings. This is particularly beneficial for pedestrian access along corridors that have a series of signalized RCUT intersections — more pedestrian crossing opportunities can be provided than with signalized conventional intersections. Figure 12 illustrates several methods for accommodating pedestrian crossings at signalized median U-turns.

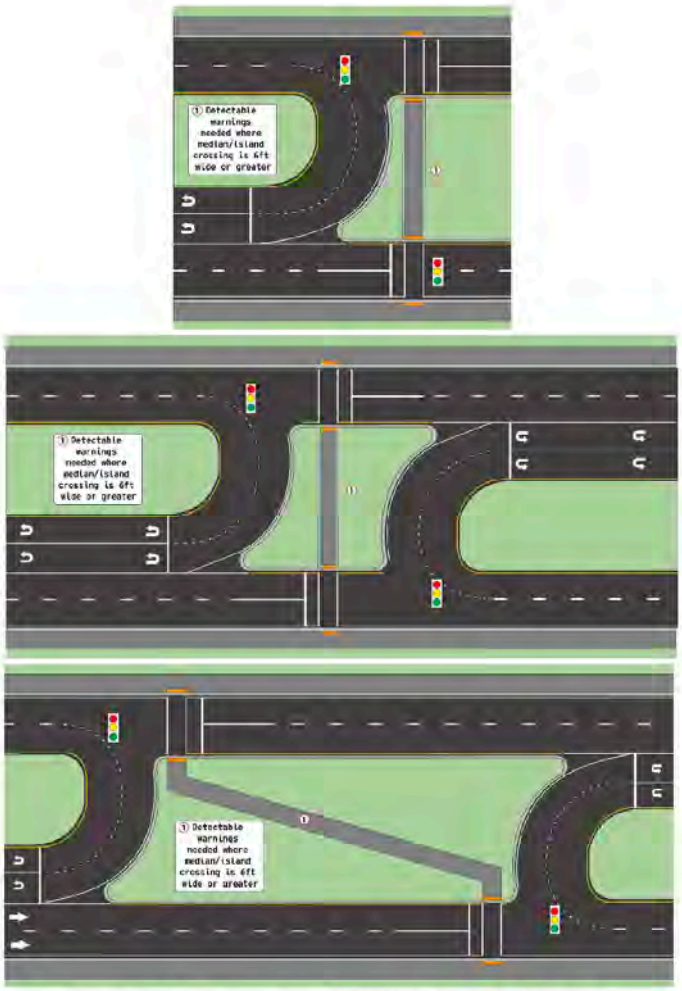

Figure 12: Median U-Turn Pedestrian Crossing Options

When considering a merge (yield) controlled RCUT intersection in areas with known pedestrian activity, be aware that this configuration allows vehicles to maintain higher speeds when turning from the minor road and merging onto main road traffic due to the presence of acceleration lanes. In locations where pedestrian activity is expected, a stop-controlled or signal-controlled RCUT intersection may be a more appropriate choice.

5.2. BICYCLISTS

At stop-controlled and signal-controlled RCUT intersections, bicyclists traveling the main road use turn lanes to access the minor road, or they remain in the bike lane to continue through on the main road (similar to a conventional intersection). Where a shared-use path is present, bicyclists and pedestrians can utilize the shared facilities provided at the RCUT intersection.

At stop-controlled RCUT intersections, bicyclists on the minor road wanting to proceed through the intersection or turn left do not have the same direct route options. Where pedestrian facilities are present, it is preferable for bicyclists to use these to complete their crossing. If there are no pedestrian facilities, bicyclists navigate the RCUT intersection as a vehicle would, by turning right onto the main road and using the median U-turn (Figure 13).

At signal-controlled RCUT intersections, bicyclists on the minor road are encouraged to use pedestrian facilities to navigate their crossing.

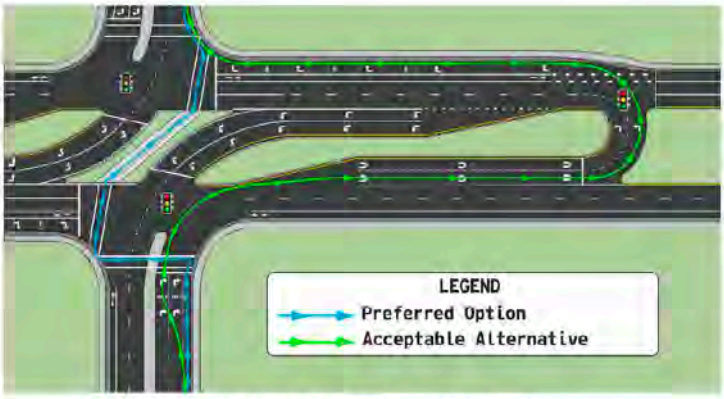

Figure 13: RCUT Minor Road Bicycle Crossings

Project teams are encouraged to verify whether a US Bicycle Route passes through the proposed RCUT intersection location. These routes may generate higher volumes of bicycle traffic on rural roadways.

5.3. TRANSIT

In urban and suburban contexts, transit facilities may need to be considered. The *FHWA Restricted Crossing U-Turn Intersection: Informational Guide* provides guidance on bus stop placement along both the major and minor road legs of an RCUT intersection. Designers should coordinate with local transit authorities to determine appropriate bus stop locations at RCUT intersections.

6. GEOMETRIC DESIGN ELEMENTS

This section covers geometric design elements of RCUT intersections for both individual and multiple installations along a corridor.

6.1. DESIGN VEHICLES

Design vehicles help determine turning radii and establish sight distance needs (see Sections 6.2 and 6.3). Select a design vehicle based on the largest vehicle type expected to execute turning movements at the intersection with notable frequency. Account for site-specific factors (e.g., proximity to a school entrance, fire station, unique traffic generator) when making this selection. Because each turning movement at an RCUT intersection differs, a design vehicle must be selected for each movement to properly define the geometric layout. Sections 6.1.1, 6.1.2, and 6.1.3 discuss recommended design vehicles.

When larger or unique vehicles (e.g., large farm machinery) are expected to make turns at an intersection infrequently, a control vehicle may be selected in addition to the design vehicle. Because accommodating the full pavement width for these control vehicles would create significant impacts, full width is typically not provided. Instead, features such as signs, drainage boxes, headwalls, curbs, and other roadside elements are set back outside the turning paths of control vehicles.

Conduct an Autoturn analysis for the design vehicle and control vehicle. Retain output files in the project design file.

6.1.1. RIGHT TURN ONTO AND FROM MINOR ROAD

For vehicles turning right at the main intersection, the suggested design vehicle is a WB-67 tractor trailer. During the turn, the design vehicle should not encroach onto curbs, raised channelization, raised islands, raised medians, or into opposing traffic lanes (Figure 14). A smaller turning radius is acceptable when a striped area is provided to accommodate truck overtracking as long as pedestrian facilities are not impacted, appropriate pavement markings are applied, and the overtracking area includes adequate pavement structure. When a truck turns right from the minor road onto the major road, it is expected that both lanes will be used to complete the turn into the nearest receiving lane.

6.1.2. LEFT TURN FROM MAIN ROAD

The suggested design vehicle for vehicles turning left at the main intersection is a WB-67 tractor trailer. During a turn, the design vehicle should not encroach onto curbs, raised channelization, raised islands, or raised medians (Figure 15). Striping

an area to accommodate truck overtracking is acceptable, provided pedestrian facilities are avoided and appropriate pavement markings are applied.

6.1.3. MEDIAN U-TURN OPENING

At a single-lane median U-turn opening, two design vehicles are suggested for the U-turn movement: a SU-40 delivery truck and a WB-67 tractor trailer. The SU-40 is used because its larger steering radius governs the outside of the U-turn opening, while the WB-67 is used because the wider sweep of the trailer path governs the inside of the opening. During the turn, neither design vehicle should encroach onto curbs, raised channelization, raised islands, or raised medians (Figure 16).

If design vehicles cannot complete the U-turn within the receiving lanes, refer to Section 6.6 for guidance on paved shoulder and loon design. In urban areas with limited ROW and multiple median U-turn openings along a corridor, not every U-turn location has to accommodate larger vehicles. Proper signing can be used to restrict truck usage at these locations (see Section 8.2).

Different design vehicles may be used for each U-turn lane at a dual U-turn median opening. At a minimum, the outside U-turn lane should accommodate a WB-67 tractor trailer, while the inside lane should accommodate a Passenger Car (P) turning simultaneously. Vehicle type restrictions can be signed to clarify lane usage for drivers (see Section 8.2). Where heavy truck traffic is anticipated, larger design vehicles may be used for the inside U-turn lane.

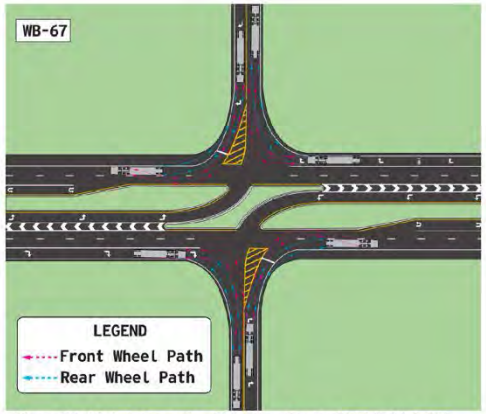

Figure 14: Main Intersection Right-Turn Design Vehicle (WB-67)

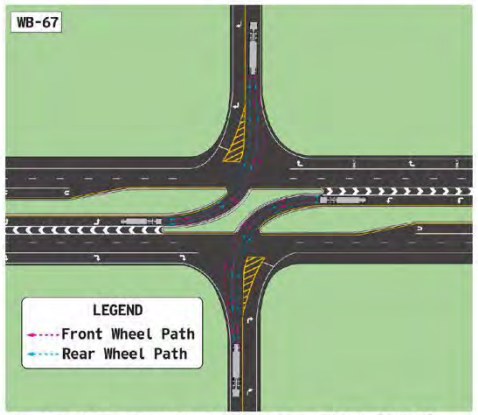

Figure 15: Main Intersection Left-Turn Design Vehicle (WB-67)

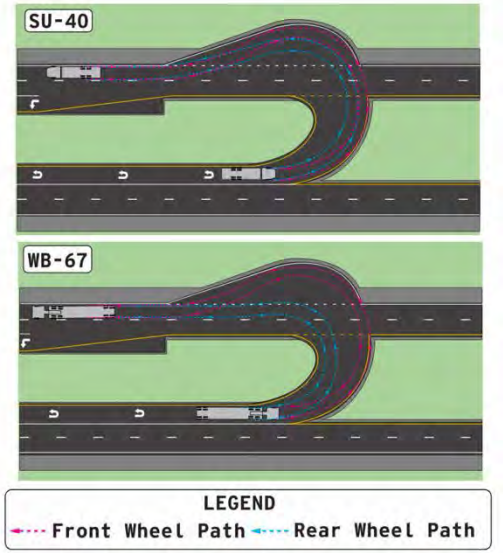

Figure 16: Median U-turn Opening Design Vehicles (SU-40 and WB-67)

6.2. STOPPING SIGHT DISTANCE

Stopping sight distance should be provided at all points through the intersection. This includes the major road approaching median U-turn openings, main intersection, and the length of major road between the median U-turn opening and main intersection. Providing stopping sight distance gives drivers sufficient length of roadway to avoid striking an unexpected object in the traveled way.

Stopping sight distance calculations, including the effects of grade, can be found in Chapter 3 of the Green Book. Exhibits 700-01 through 700-05 in KYTC's *Highway Design Guidance Manual* (HDM) list minimum stopping sight distance lengths for different roadway classifications and contexts.

6.3. INTERSECTION SIGHT DISTANCE

Drivers approaching an intersection should have an unobstructed view of the entire intersection so they can see all traffic control devices and a sufficient length along the intersecting highway to anticipate and avoid potential collisions.

At RCUT intersections, intersection sight distance (ISD) is checked for the following conditions:

- Minor road right turn to major road
- Major road left turn to minor road
- Major road median U-turn

Signalized RCUT intersections also have ISD needs.

Check ISD for a passenger car design vehicle (P) and a combination truck (e.g., WB-67). The driver eye height to use for a passenger car design vehicle is 3.5 ft.; for a combination truck it is 7.6 ft. The object height for ISD is 3.5 ft. Clear sight triangles between the driver eye and the object, accounting for horizontal and vertical alignment must be provided.

While one equation (Equation 1) is used to determine each ISD case (e.g., right turn from minor road), different time gaps are selected for different maneuvers and design vehicles. Depending on the case, the basic ISD equation is adjusted for number of lanes crossed, median width crossed, and approach grades. Given the uniqueness of each case, the designer should keep ISD calculations in the design file.

$$ISD = 1.47 * V_{major} * t_g$$

$$ISD = intersection\ sight\ distance\ (feet)$$

$$V_{major} = major\ road\ design\ speed\ (mph)$$

$$t_g = time\ gap\ (seconds)$$

Equation 1: Basic ISD Equation (AASHTO Equation 9-1, Green Book, 2018, pg. 9-45)

6.3.1. RIGHT-TURN FROM MINOR ROAD — AASHTO CASE B2

Check ISD for the minor road stop-controlled approach to an RCUT intersection using AASHTO Case B2 (*Right Turn from the Minor Road*). Time gaps (t_g) are selected by design vehicle and adjusted for minor road approach upgrades that exceed 3% (Green Book Table 9-8). A clear sight triangle must be provided to the left for a vehicle stopped on the minor road approach (Figure 17). Consult the Green Book (Section 9.5.3.2.2) for more information.

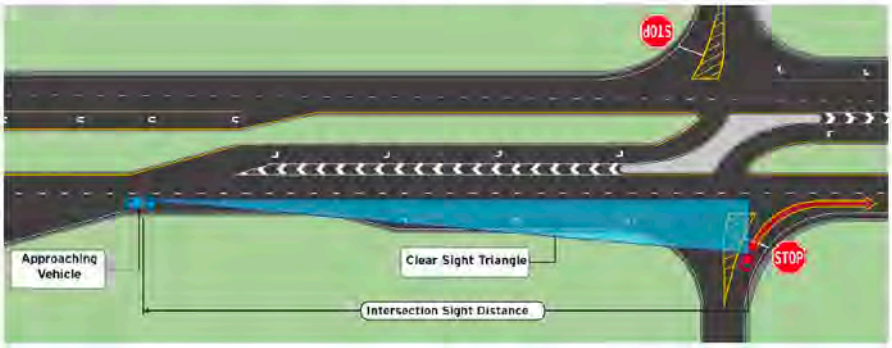

Figure 17: Right-Turn from Minor Road Sight Triangle

6.3.2. LEFT-TURN FROM MAJOR ROAD — AASHTO CASE F

Check ISD for the major road left-turn approach at the main intersection using AASHTO Case F (*Left Turns from the Major Road*). Time gaps (t_g) are selected by design vehicle and adjusted for the number of lanes crossed and median width crossed (Green Book Table 9-16). A clear sight triangle must be provided toward approaching traffic for a vehicle stopped in the major road left-turn lane (Figure 18). Consult the Green Book (Section 9.5.3.6) for more information.

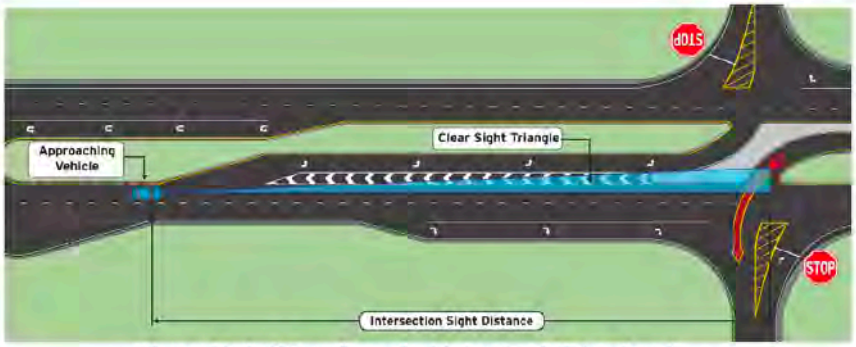

Figure 18: Left Turn from the Major Road Sight Triangle

6.3.3. MAJOR ROAD U-TURN

Check ISD at major road median U-turn openings. While the Green Book does not provide a specific method for calculating U-turn ISD, a Georgia Department of Transportation research study developed an approach based on Green Book principles to address this gap. The calculation follows a multistep process:

Step 1: Select a design vehicle.

Step 2: Determine whether the U-turn maneuver will follow a 90-degree path or 180-degree path based on the median nose width, using Table 6, Figure 19, and Figure 20.

Table 6: U-Turn Maneuver Selection from Median Nose Width

Design Vehicle	Median Nose Width (See Figure 19)	U-turn Maneuver (See Figure 20)
Passenger Car	< 14 feet	180-degree
	≥ 14 feet	90-degree
Single Unit Truck	Any width	180-degree
Combination Truck		

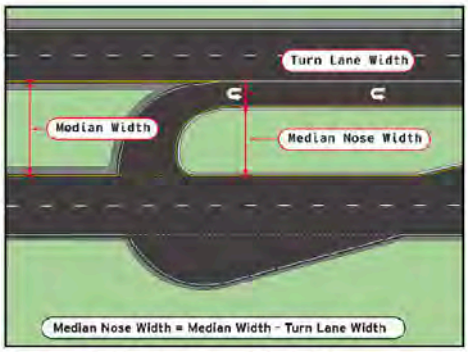

Figure 19: Median Nose Width Measurement

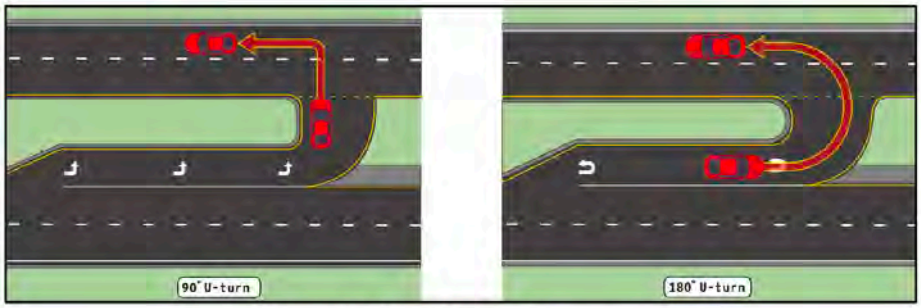

Figure 20: Type of U-Turn Maneuver

Step 3: Use the main road design speed and U-turn maneuver type to determine the base U-turn ISD from Table 7.

Table 7: Base U-Turn Intersection Sight Distance

	U-turn Maneuver	
Design Speed (mph)	90-degree U-turn (ft)	180-degree U-turn (ft)
25	220	275
30	290	360
35	370	450
40	450	545
45	540	640
50	625	740
55	745	870
60	835	975
65	1010	1155

Step 4: Apply an approach grade adjustment factor from Table 8 to the base U-turn ISD obtained for the design speed. The grade used should correspond to the grade of the main road in the direction of travel approaching the median U-turn opening.

Table 8: Grade Adjustment Factors

Approach Grade (%)	Design Speed (mph)								
	25	30	35	40	45	50	55	60	65
-6	1.1	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.2
-5	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.2
-4	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
-3 to +3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
+4	1.0	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9
+5	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
+6	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9

Step 5: If the design vehicle is a single unit truck or a combination truck apply the appropriate correction factor from Table 9.

Table 9: Truck Correction Factors

Design Vehicle	Correction Factor
Passenger Car	1.00
Single Unit Truck	1.27
Combination Truck	1.53

Provide a clear sight triangle toward approaching traffic for a vehicle stopped in the median U-turn opening (Figure 21).

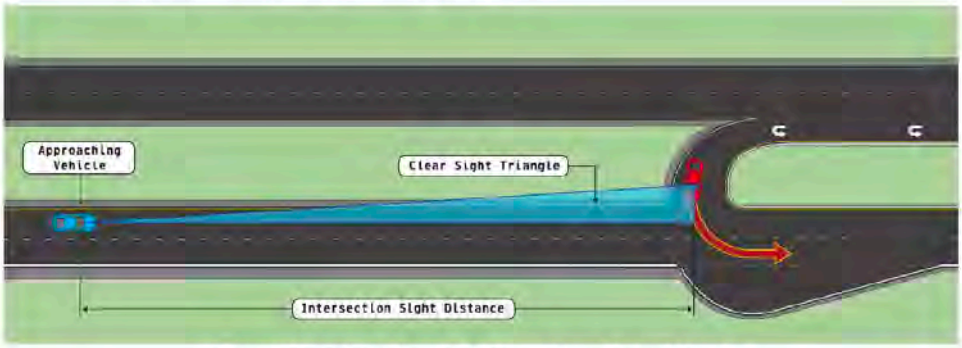

Figure 21: U-Turn from the Major Road Sight Triangle

6.3.4. SIGNALIZED RCUT INTERSECTION — AASHTO CASE D

Check ISD for signalized intersections, whether at the main intersection or at the median U-turn opening, using AASHTO Case D (*Intersections with Traffic Signal Control*). At traffic signals, the first vehicle stopped on one approach should be visible to the drivers of the first vehicles stopped on all other approaches.

Where right turn on red (RTOR) is permitted from the minor road approach, AASHTO Case B2 is to be provided (see Section 6.3.1). Where permissive left turns are allowed from the main intersection, AASHTO Case F is to be provided (See Section 6.3.2). Consult the Green Book (Section 9.5.3.4) for more information.

6.4. U-TURN LOCATION SPACING

Locate the median U-turn opening as close to the main intersection as practical. This minimizes travel times for motorists on the minor road using the U-turn. For stop-controlled and signal-controlled RCUT intersections, spacing typically falls in the 600 – 1,000 ft. range (Figure 22). For merge (yield) controlled RCUT intersections, spacing is greater, up to 0.5 miles.



Figure 22: Stop-Controlled and Signal-Controlled RCUT Median U-Turn Opening Typical Spacing

When setting the location for a median U-turn opening, the minimum spacing should be long enough to accommodate deceleration and storage lengths of both the U-turn lane and main road left-turn lane. Table 10 lists factors to consider when establishing median U-turn opening locations.

Table 10: Median U-Turn Opening Location Factors

U-Turn and Left-turn Lane Lengths	At a minimum, the median U-turn opening should be spaced to accommodate deceleration and storage lengths.
Median Width	Wider medians can allow overlap in U-turn and left-turn lanes, resulting in shorter distances.
Intersection Sight Distance	Adjust location to obtain U-turn ISD. Consider horizontal and vertical geometry as well as other sight obstructions.
Feature Avoidance	Avoid placing a U-turn (and loon, if present) where a bridge, box culvert, utility, or other roadside feature is present that cannot be relocated.
Superelevation	If possible, avoid locating a U-turn with a loon in a superelevated section. This results in larger grade differences at the far edge of the loon.
Right-of-Way Restriction	Adjust a U-turn with a loon location where ROW is constrained.
Driveway/Access Point	Adjust the U-turn to avoid an entrance or access point. See Section 6.10 for more information.
Partial Access Control	Move closer to the main intersection to allow spacing between adjacent RCUT median U-turn openings.

On roadways with multiple RCUT intersections, sufficient spacing between adjacent median U-turn openings is important to maintain clear sight lines. A minimum distance of 100 ft. between adjacent median U-turn openings is suggested (Figure 23). This situation typically occurs along corridors with partial access control, where intersections are spaced 1,200 ft. apart, in rural areas. In cases where an adjacent median U-turn opening already exists or may be added in the future, the distance between the main intersection and median U-turn opening may need to be less than 600 ft. When placing median U-turn openings, evaluate whether adjacent intersections could be converted to RCUT designs in the future.

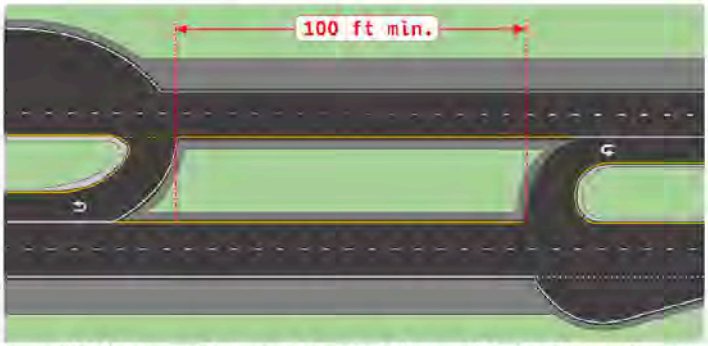

Figure 23: Minimum Distance Between Adjacent Median U-Turn Openings

6.5. INTERSECTION SKEW

Intersection skew angle can influence traffic operations and sight distance. This angle, as measured from the major road centerline to the minor road centerline, should be as close to 90 degrees as practical. If the intersecting angle is less than 75 degrees or more than 105 degrees, ISD may need to be adjusted.

At RCUT intersections the optimal skew angle is 75 – 90 degrees (top of Figure 24). This layout better serves left turns from the main road and right turns from the minor road. Skew angles greater than 90 degrees (bottom of Figure 24) are not preferred because they increase overtracking for vehicles turning left from the major road and increase the amount of time needed to complete a turning maneuver.

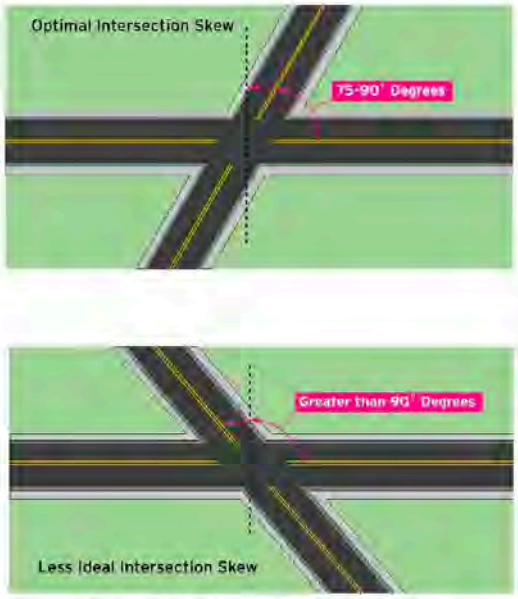

Figure 24: Intersection Skew Angles

If an existing intersection with an intersection skew angle greater than 90 degrees is being considered for conversion to an RCUT intersection, it can benefit from offsetting the intersection (Figure 25).

Offsetting minor road approaches when greater than 90 degrees at an RCUT intersection does not negatively impact safety since vehicles turning left do not overlap other turning, merging, or diverging movements. At signalized RCUT intersections, this offsetting has the added benefit of providing a shorter pedestrian crossing distance than the Z-type crossing.



Figure 25: RCUT Intersection Realignment

6.6. MAJOR ROAD MEDIAN U-TURN OPENING

Median U-turn openings from the major road are divided into two categories: single-lane and dual-lane median U-turn openings. U-turn dimensions are based on the design vehicles selected for this turning movement (see Section 6.1.3).

Plan sheets must denote all relevant dimensions, including radius values, station and offset values, beginning and ending points of transitions and tapers, and dimensions of raised medians (where applicable). Retain Autoturn files in the project design file.

Unless needed to manage access to nearby driveways or side streets, median U-turn openings on divided highways with depressed medians do not typically include raised islands.

6.6.1. SINGLE-LANE MEDIAN U-TURN

If the receiving travel lanes are not wide enough to accommodate the design vehicle(s), a paved shoulder can be used or a loon constructed.

If a paved shoulder is to be used, investigate existing shoulder pavement depths to determine if the pavement structure can support U-turning vehicles.

Use of a tapered loon design (Figure 26) is suggested over pavement closely matching vehicle turning paths. Where standard curb and gutter is not present through the loon, provide a 2 ft. paved shoulder (1 ft. minimum) that matches the main road pavement depth.

If a loon will be located on a superelevated roadway section, consider its effects on the loon (e.g., cut/fill, drainage onto roadway or into a sump, ROW impacts).

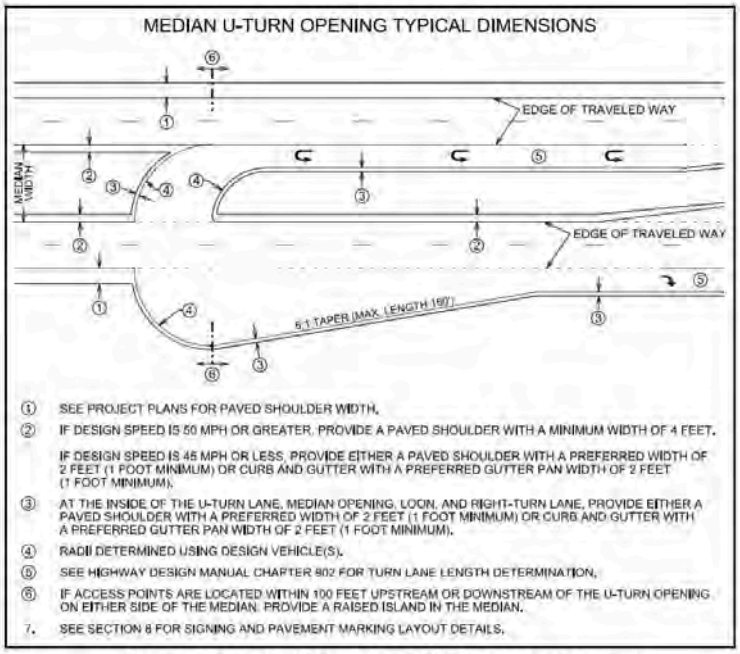

Figure 26: Typical Single Lane Median U-turn Layout

6.6.2. DUAL-LANE MEDIAN U-TURN

Dual-lane median U-turns are only appropriate at signalized RCUT intersections. Reserve their use for locations where traffic analysis demonstrates they will improve intersection operations. A tapered loon design (Figure 27) is recommended over pavement that closely follows vehicle turning paths. The shoulder width and superelevation design elements that apply to single-lane median U-turns also apply to dual-lane configurations.

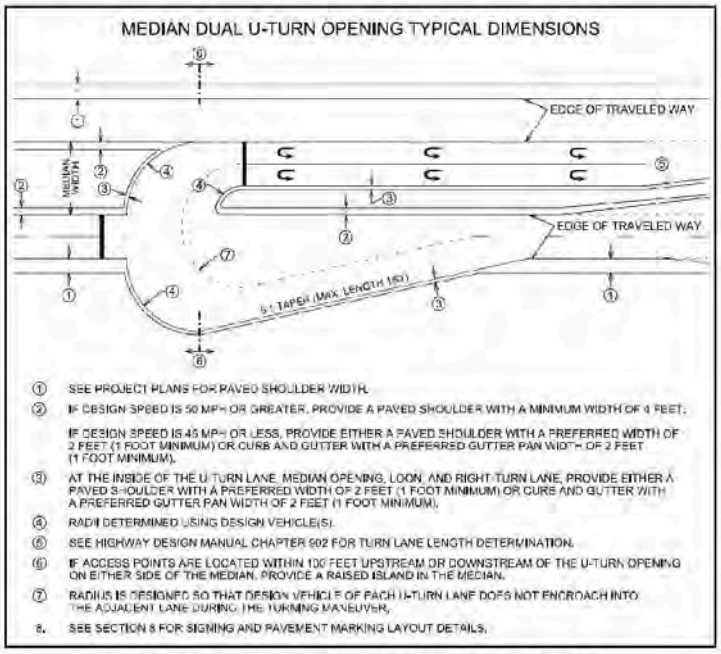

Figure 27: Typical Dual Lane Median U-turn Layout

If traffic forecasts indicate dual U-turn lanes will not be necessary until near the design year, the pavement and supporting components can be sized for a dual U-turn lane ultimate configuration. In this scenario, only striping and traffic signals for a single U-turn are installed initially.

6.6.3. RIGHT-TURN LANE BETWEEN MAIN INTERSECTION AND MEDIAN U-TURN

Where budget and site conditions permit, extending the main road right-turn lane back to connect with the loon is recommended (Figure 28). This allows vehicles completing a median U-turn to turn directly into the right-turn lane without merging back into main road traffic.

If the right-turn lane is extended where a dual U-turn lane is present, striping should indicate which U-turn lane connects to the right-turn lane (see Section 8.2). Where standard curb and gutter is not present along the right-turn lane, provide a 2 ft. paved shoulder (1 ft. minimum), matching the main road pavement depth.



Figure 28: Right-Turn Lane Between Median U-turn and Main Intersection (Source: Google Earth)

6.7. MAJOR ROAD LEFT-TURN OPENING

Tapered left-turn lanes with positive offset between opposing left-turn lanes at the main intersection are preferred where median width permits. Narrower medians are more likely to require parallel left-turn lane configurations. Raised channelization at the main intersection can help achieve the desired positive offset.

Left-turn lane widths should generally match lane widths on the main road. On reconstruction projects with existing 12-ft. lanes, 11-ft. lanes within the median are acceptable when necessary to avoid conflicts with existing drainage structures.

Plan sheets should denote all relevant dimensions, including radius values, station and offset values, beginning and ending points of transitions and tapers, and raised median dimensions where applicable. Retain AutoTurn files in the project design file.

6.8. TURN LANE DECELERATION LENGTH

Deceleration and storage lengths for main road left-turn, U-turn, and right-turn lanes should be designed in accordance with methods outlined in HDM Section HD-902. The HDM method also allows for the provision of full deceleration and storage on high-speed roadways (≥ 50 mph), consistent with Green Book Table 9-20.

Although U-turn lanes are not specifically addressed in the HDM, the methods used to determine left-turn lane dimensions can be applied. Where conditions allow (e.g. wider medians, having sufficient budget) extend the U-turn deceleration lane back toward the main intersection to provide a more direct path for minor road turning vehicles entering the U-turn lane.

Final design plan sheets must include all relevant geometric information, such as taper rates, taper beginning and ending station/offset points, and turn-lane lengths.

6.9. CHANNELIZATION

Channelization is important for directing motorists into the appropriate lanes and to minimize the potential for wrong-way movements, such as traffic on the minor road attempting a left turn at the main intersection.

Plan sheets should identify the type of curbing used, dimensions of channelization, including station/offset values for the beginning and ending points of radii, as well as applicable bid items and quantities for each type of channelization.

6.9.1. LEFT-TURN LANE CHANNELIZATION

Raised channelization is used in the median between opposing left-turn lanes at the main intersection (Figure 29). Raised channelization should extend 200 ft. (100 ft. in each direction from the main intersection). If site conditions are constrained, a minimum length of 100 ft. may be used (50 ft. in each direction).

Channelization should consist of 6-in. tall standard curbing (see KYTC Standard Drawing RPM-100). The leading edge of channelization, where it faces oncoming traffic is to be tapered down as indicated in KYTC Standard Drawing RPM-010.

On high-speed roadways (≥ 50 mph), curbing should be placed 4 ft. from the main road travel lanes. On low-speed roadways (≤ 45 mph), placing curbs 2 ft. (1 ft. minimum) from travel lanes is acceptable. Along the left-turn lane, curbs may be offset 1 – 2 ft.

Where a pedestrian crossing is present or anticipated in the future, raised channelization should be wide enough to accommodate a pedestrian facility (e.g., sidewalk, shared-use path).

Additional guidance on striping, pavement markings around the main intersection channelization, and placement of tubular markers atop the raised median is provided in Section 8.

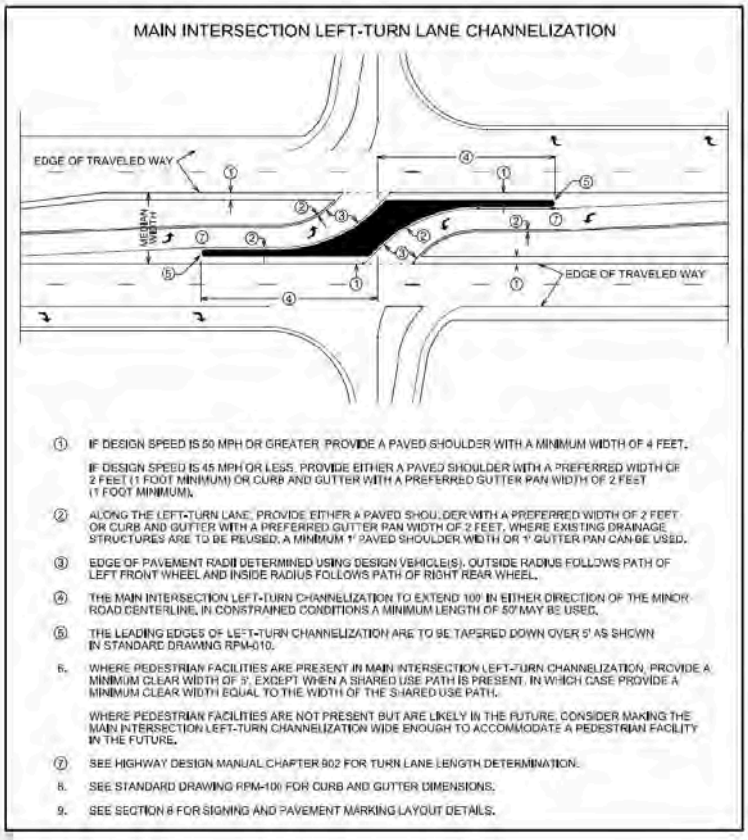

Figure 29: Raised Main Intersection Channelization

6.9.2. MEDIAN U-TURN OPENING CHANNELIZATION

On roadways with depressed medians, raised channelization is generally not required at median U-turn openings unless access points are located at or near the opening.

Where raised channelization is provided, curbing should be offset 4 ft. from the main road travel lanes on high-speed roadways (≥ 50 mph) and 2 ft. (1 ft. minimum) on low-speed roadways (≤ 45 mph). See Section 6.9.1 for additional information. The leading edges of channelization facing oncoming traffic are to be tapered down, consistent with the approach used for left-turn channelization.

Provide a raised median island where access points are located within 100 ft. upstream or downstream of the median U-turn opening on either side of the

median. The island should extend a distance sufficient to discourage wrong-way driving, typically at least 50 ft. beyond the access point.

6.9.3. MINOR ROAD APPROACH CHANNELIZATION

Flush painted channelization is preferred over raised channelization on the minor road approach. Typically, this does not include tubular markers. An exception applies at signalized RCUT intersections, where a raised island may be beneficial as a pedestrian refuge for crossing movements. A channelizing island resembling the configuration on the right side of Figure 30 is preferred on this approach because it provides better sightlines for drivers on the minor road looking for gaps in oncoming traffic and promotes reduced turning speeds, both of which are key benefits when pedestrians are present.

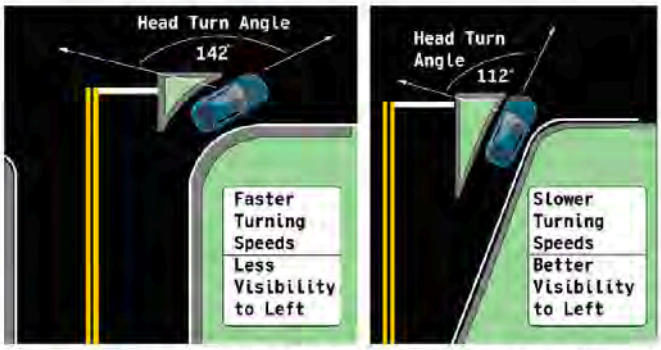

Figure 30: Minor Road Approach Entry Angle (Measured from Driver Facing Forward)

6.10. ACCESS MANAGEMENT

Given that RCUT intersections can extend 600 ft. or more along the main roadway, interactions with entrances, driveways, and other roadways should be anticipated, particularly along urban corridors where access is controlled by permit.

Entrances or driveways located between the main intersection and median U-turn opening should be avoided where possible. Because the raised median facilitates access management along the main road, additional access control can be achieved by restricting right-out movements where alternative exit routes from a parcel are available.

In general, no access points should be located within 100 ft. upstream or downstream of a median U-turn opening on either side of the main road (Figure 31). If neither the median U-turn opening nor the access point can be relocated, a low-volume access point (e.g., single-family residence, farm entrance) may remain across from the U-turn

opening on the downstream (receiving) end, permitting left-turn access into the property.

When a loon is present, the access point will be positioned farther from the main road. Therefore, potential impacts on ISD for exiting motorists should be evaluated. If the access point generates higher traffic volumes, relocate either the access point or median U-turn opening. At signalized median U-turn openings, consider the potential effects of nearby access points on signal timing and phasing when determining whether relocation is necessary.

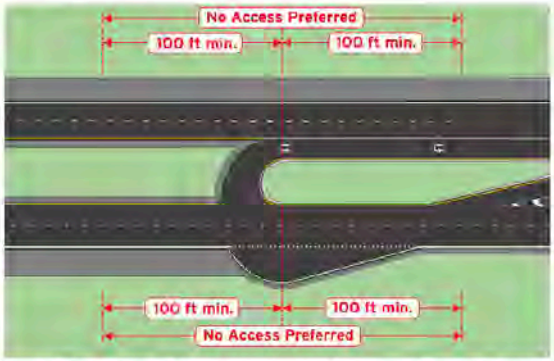

Figure 31: Access Management at Median U-turn Opening

Consider purchasing access at the median U-turn opening to prevent a future access connection at this location if land use changes.

6.11. DRAINAGE AND PAVEMENT DESIGN

Adding raised channelization and deceleration lane pavement within medians and approaches may alter existing drainage patterns. Evaluate pavement cross slopes for left-turn lanes, median U-turn openings, and minor road approaches to establish positive drainage. Make minor adjustments as needed to prevent ponding. Additionally, complete checks to minimize the amount of water flowing across the main or minor roadway (e.g., checks at cuts in raised channelization or at loons placed on the high-side of superelevation).

The preferred method for capturing roadway drainage is to connect curb box inlets to existing drop box inlets in the median, rather than providing a new connection across the main road to the roadside. Another acceptable approach to drainage is providing cuts in raised channelization. These cuts should be wide enough to allow the use of a flat shovel for debris removal.

Match turn lane, U-turn opening, and loon (if present) pavement design with the main road pavement design. Where U-turning vehicles will utilize shoulders, assess the existing pavement structure to determine if it can support anticipated loading. Pavement cores can be used to verify adequacy of the existing structure.

7. RIGHT-OF-WAY AND UTILITY CONSIDERATIONS

At the main intersection, RCUT configurations and conventional intersections have similar ROW needs. However, where median U-turn openings use a loon to accommodate turning vehicles, additional ROW may be necessary. The public involvement resources discussed in Section 2.6 may also help project teams communicate project needs to property owners during ROW acquisition.

Installing RCUT intersections may affect existing utilities. On RCUT intersection projects, project teams may need to identify existing utility locations across a broader area than they would on conventional intersection projects because median U-turn openings are typically located 600 ft. or more from the main intersection.

8. SIGNING AND PAVEMENT MARKINGS

8.1. GENERAL

The *Manual on Uniform Traffic Control Devices* (MUTCD) contains no specific provisions or illustrations that address the unique features of RCUT intersections. Using basic principles from the MUTCD and the Division of Traffic Operations Guidance Manual (TOGM), Figures 32, 33, and 34 illustrate recommended traffic control devices for an isolated rural RCUT intersection. Depending on an intersection's location, design, and other characteristics, traffic control devices may be modified from what is shown in the figures based on engineering judgment. Most signs in the figures are standard MUTCD signs or signs unique to Kentucky that are available from the central sign shop. Layouts for signs unique to RCUT intersections will be published by the Division of Traffic Operations and added to the sign inventory list.

8.2. SIGNING

Figure 32 illustrates typical regulatory, warning, and guide signs for an isolated, rural RCUT intersection where a U.S. route and state route intersect.

The TOGM contains KYTC policy for route signs at intersections and is applicable to RCUT intersections. All numbered U.S. and state highway routes, excluding frontage roads and roads numbered primarily for maintenance purposes, shall be identified by route signs and auxiliary plaques. Route sign assemblies fall into one of four categories: Junction, Advance Route Turn, Directional, or Confirming. MUTCD Chapter 2D contains additional information.

If the minor road is not a numbered state route, street names may be used as destinations on guide signs along RCUT intersection approaches to direct motorists. Adhere to TOGM policy when selecting cities and towns on destination signs.

The WATCH FOR U-TURNS AHEAD warning sign (see Figure 32) may be beneficial at locations where RCUT intersections are first introduced in a region and where drivers may be unaccustomed to U-turning vehicles. On a corridor with multiple RCUT intersections, this sign may be placed at each end of the corridor in advance of the first median U-turn location for each direction of travel. It may also be used as a safety countermeasure at existing RCUT intersections if additional warning is deemed necessary based on crash history or engineering judgment.

In some cases, a median U-turn opening may not be designed to accommodate all design vehicles. At locations with dual median U-turn lanes, some larger vehicles may be restricted to the outside U-turn lane (See Section 6.1.3). In these cases, consult the Division of Traffic Operations for guidance on signing options to restrict specified vehicle classes from U-turns or to restrict certain vehicle classes to a specific lane for U-turn movements.

To prevent vehicles from parking in loons, NO PARKING signs may be installed at the District Traffic Engineer's discretion.

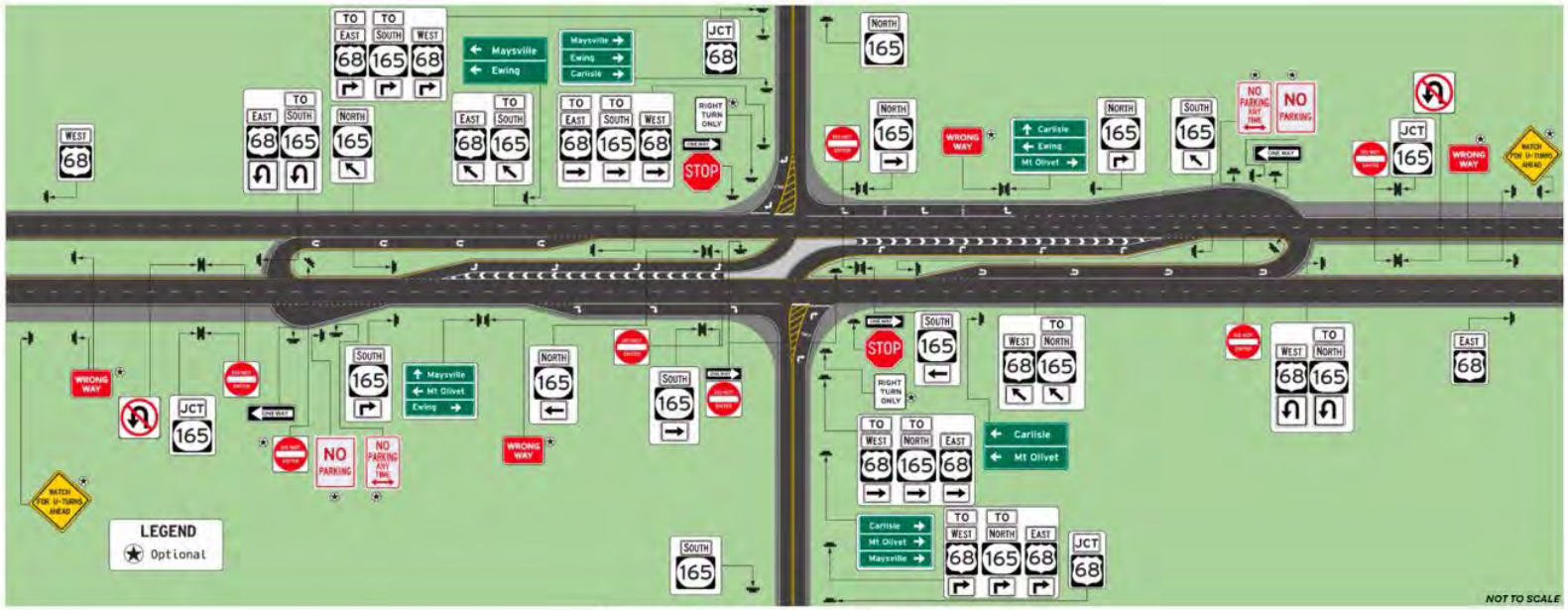

Figure 32: RCUT Intersection Signing Layout - Rural Stop-Controlled

8.3. PAVEMENT MARKINGS

Figure 33 illustrates typical pavement markings for an isolated, rural RCUT intersection. The left side of the illustration shows the loon taper into the main road with a right-turn lane added upstream of the minor road intersection. The right side shows the loon connected to the right-turn lane for the minor road, creating a mandatory lane drop. Signing and pavement markings differ for these scenarios.

Figure 34 illustrates pavement markings for a median dual U-turn opening at a signalized RCUT intersection. Dotted line extensions used to guide vehicles making a U-turn may connect to a different location on the main road depending on how the U-turn lane design vehicle tracks. The recommended orientation and location of the STOP LINE for U-turn vehicles provides optimal visibility of the signal indications controlling those movements.

Section 5 includes guidance on pedestrian and bicycle movements at RCUT intersections. Refer to the TOGM and KYTC Standard Drawings for more information on crosswalks, crosshatching, intersection, symbol, and word pavement markings.

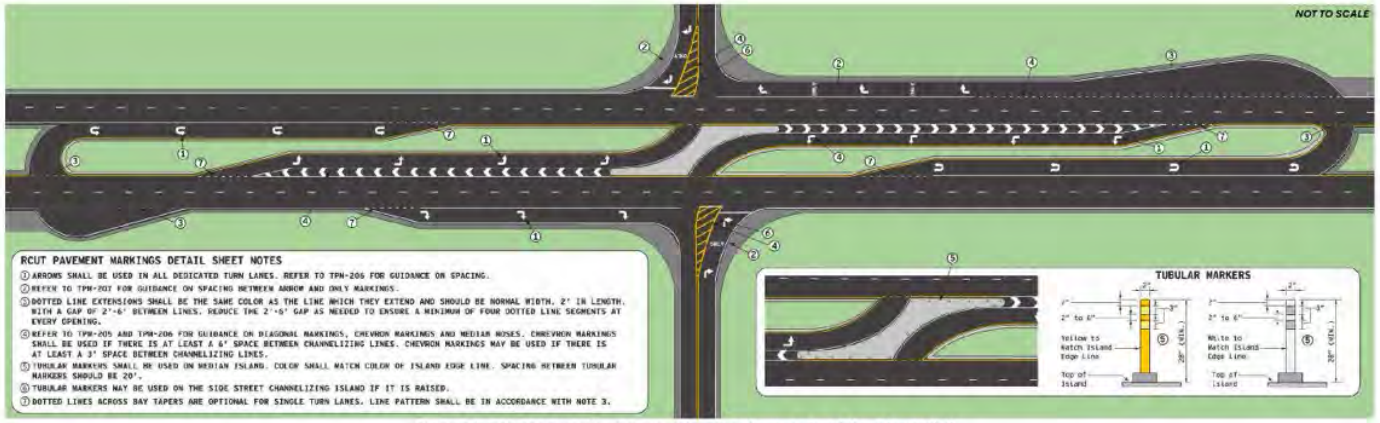

Figure 33: RCUT Intersection Pavement Marking Layout - Rural Stop-Controlled

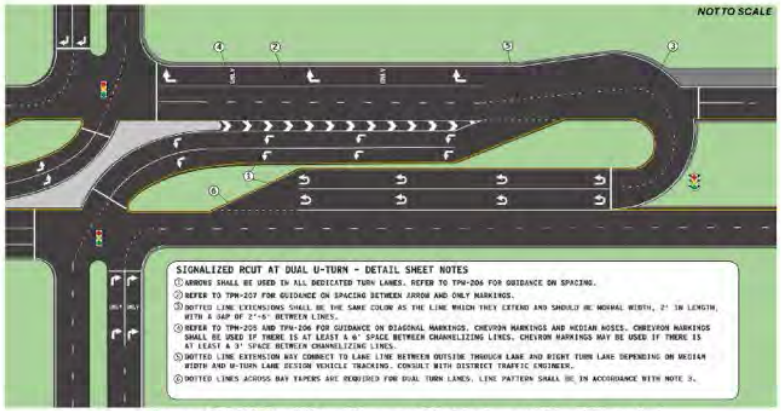

Figure 34: RCUT Dual U-turn Pavement Marking Layout - Signal Controlled

9. TRAFFIC CONTROL SIGNALS

The approval process for traffic control signals at RCUT intersections follows procedures outlined in the TOGM. If signal control is being considered, early coordination between the project team, District Traffic Engineer, and Division of Traffic Operations is critical during the preliminary engineering phase. A traffic control signal is required at locations where (1) dual U-turns are provided at the median U-turn opening or (2) dual left-turns are provided at the main intersection.

The MUTCD does not include procedures to analyze prescriptive warrants for RCUT intersections with displaced turning movements. To determine whether a traffic signal is needed, the Division of Traffic Operations will conduct a warrants analysis that replicates the conflicting traffic movements at a traditional intersection. In addition to warrants analysis, a cross-product evaluation of left-turn and/or U-turn traffic versus the directional through traffic will be completed to determine if a traffic control signal is required. Assess each portion of an RCUT intersection (the main intersection and each median U-turn opening) independently to make this determination.

This guidance omits illustrations of a typical signalized RCUT intersection because signal design varies based on site conditions. Factors to consider during the signal design process include pedestrian accommodations, push button locations, and optimizing the visibility of signal heads along each approach. Early coordination between the project team and District Traffic Engineer should occur to identify potential placement of signs on the signal supports.

Use U-turn signal indications to control U-turning traffic movements, except where protected/permissive phasing is adopted. The MUTCD has no provision for using a flashing yellow U-turn indication to inform motorists of a permissive U-turn. If a protected/permissive phase is needed for U-turn movements, left-turn signal indications must be used.

10. LIGHTING

In most cases, RCUT intersections can operate safely and efficiently without roadway lighting. Signs, pavement markings, and delineation should provide sufficient guidance for motorists to navigate an RCUT intersection correctly. Follow processes and policies outlined in the TOGM when making any recommendations related to roadway lighting at an RCUT intersection. Each portion of an RCUT intersection (the main intersection and each median U-turn opening) may be evaluated independently when making determinations about lighting as well as the roadway segment that incorporates the entire RCUT intersection.

11. CONSTRUCTION

When a conventional intersection is converted to an RCUT intersection, typically the first step is to construct the median U-turn openings and loons (if applicable). Next, the main intersection is reconfigured. Figure 35 illustrates maintenance of traffic during each phase of construction.

For projects with larger footprints (e.g., widening a corridor from a two-lane undivided roadway to a four-lane divided facility incorporating RCUT intersections), a more detailed construction phasing plan is necessary.

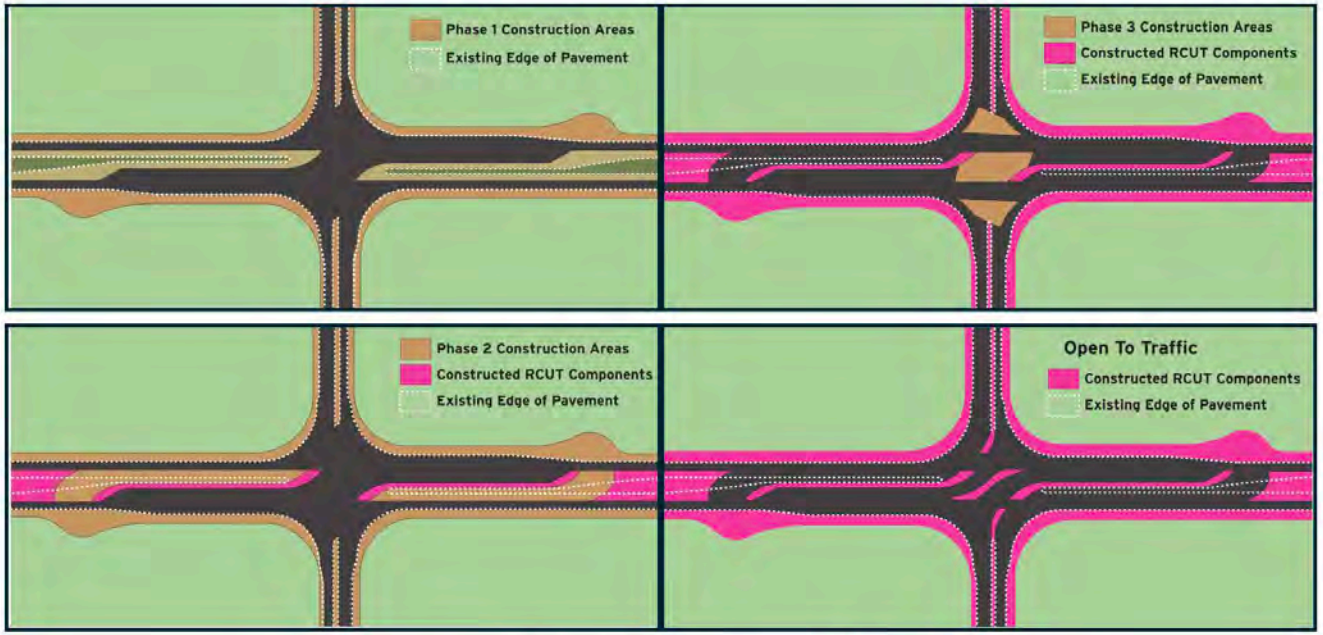

Figure 35: RCUT Reconstruction Maintenance of Traffic

12. OPERATIONS AND MAINTENANCE

While maintenance regiments for RCUT intersections and conventional intersections are similar, RCUT intersections require additional considerations. In addition to routine upkeep of signing and pavement markings, tubular markers on raised channelization must be maintained regularly. The areas surrounding raised channelization may need periodic street sweeping.

When planning snow and ice removal operations, consider how to address the functional components of an RCUT intersection (loons, left-turn and median U-turn lanes, center island). Maintaining clear left-turn lanes and median U-turn openings (including the loon, if present) helps preserve intersection functions. Design left-turn lanes and median U-turn openings so they are wide enough to accommodate snowplow access and maneuverability. Snowplow blades used in Kentucky are typically 10 – 14 ft. wide, although the effective width is less since plowing is conducted with the blade angled to the direction of travel.

13. RCUT INTERSECTION COMMON TERMS

Access Management – The control of the location, spacing, design, and operation of driveways, median openings, intersections, and interchanges along a roadway.

Conflict Point – Any location where the paths of road users (e.g., vehicles, pedestrians, bicyclist) coincide and can be classified as either crossing, merging, diverging, or pedestrian conflicts.

Construction on Existing Roads – A project that keeps the existing roadway alignment, except for minor changes, and does not change the basic roadway type.

Control Vehicle – An infrequent roadway user that must be accommodated. Encroachment into the opposing traffic lanes, multiple point turns, or minor encroachments into the side street are acceptable.

Conventional Intersection – An at-grade junction of two roadways that permits all turning movements (left turns, right turns, through movements) directly at the intersection and is typically controlled by yield signs, stop signs, or traffic signals.

Design Speed – The speed selected to determine the various geometric design features of the roadway.

Design Vehicle – A vehicle that represents a designated vehicle classification used to determine values of design elements.

Loon – A paved area constructed along the outside of a median U-turn opening. It is designed to provide additional space for vehicles to complete a U-turn maneuver.

Main Intersection – The intersection of the major and minor roads where left-turn movements from the major road are accommodated, not including the median U-turn openings.

Major Road – The higher-volume, higher-priority roadway at an intersection.

Median U-turn Opening – A break in the median to allow a U-turn maneuver.

Minor Road – The lower-volume, lower-priority roadway at an intersection.

New Construction – Projects on new alignment, including realigning existing roadways.

Reconstruction – A project on an existing alignment that changes the basic roadway type. These projects utilize the existing roadway alignment or make only minor changes to it.

Resurfacing, Restoration (2R) Project – Projects that restore pavement to its original condition with minor roadway upgrades to maintain the roadway in acceptable condition.

Resurfacing, Restoration, Rehabilitation (3R) Project – Projects that typically involve pavement improvement works (short of full-depth replacement) and targeted safety improvements and generally involve retention of the existing three-dimensional alignment.

Safe System Approach – Recognizes the possibility of human error and takes into account the tolerances for human injury, focusing on reducing fatal and serious injury collisions.

Traffic Demand – The number of vehicles desiring to use a given system element during a specific time period, typically one hour.

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