KENTUCKY TRANSPORTATION CABINET

STATEWIDE PLANNING
KY 90 CORRIDOR STUDY
ITEM NO. 8-80104

Final Report • September 2022

WSP HDR TAYLOR SIEFKER WILLIAMS design group

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Executive Summary

The Kentucky Transportation Cabinet (KYTC) initiated this study to identify potential improvements along Kentucky Route (KY) 90 in Pulaski County, Kentucky. The study area, shown in **Figure ES-1**, extends from the Wayne County Line to the New Cumberland River Bridge, mile point (MP) 0.000 to MP 3.061. The objective of the study is to identify short- and long-term improvements to reduce congestion and improve safety, capacity, and mobility along KY 90 between the Wayne County Line and the New Cumberland River Bridge.

The project team identified goals for the study based on the transportation challenges in the area. The goals of the study are to:

- Perform an inventory of existing conditions with respect to geometrics, traffic, safety, and environmental features to identify needs along the corridor.
- Propose a list of short- and long-term potential improvement concepts.
- Evaluate and prioritize improvement concepts based on transportation needs, environmental impacts, economic benefit and impact, benefit/cost, safety, and existing pavement conditions.
- Evaluate long-term improvement concepts with respect to grant criteria from the Infrastructure Investment and Jobs Act (IIJA) Grant Program emphasis areas.
- Engage local stakeholders throughout the study process.
- Produce a technical report to document the study process and results.

Committed and Potential Projects

There are five projects included in *Kentucky's Enacted Fiscal Year (FY) 2022 – FY 2028 Highway Plan (Six Year Plan)*, and five projects in the vicinity of the study area in the KYTC Continuous Highway Analysis Framework (CHAF) database:

Six Year Plan Projects

- Item Number 8-80104.00 (Pulaski Co., MP 0.000 to MP 3.061): Reduce congestion and improve safety, capacity and mobility along KY 90 between Wayne County line and New Cumberland River Bridge.
- Item Number 8-80105.00 (Wayne Co., MP 12.931 to MP 15.617): Reduce congestion and improve safety, capacity, and mobility of KY 90 between KY 90X/KY 1275 and KY 3106.
- Item Number 8-80108.00 (Wayne Co., MP 1.264 to MP 1.327): Address safety, mobility, and connectivity by relocating along KY 92 in Monticello between Locust Street and Elk Springs Creek Road.
- Item Number 8-80006.00 (Wayne Co., MP 4.000 to MP 4.479): Reduce congestion and improve safety, capacity, and mobility along KY 1275, including sidewalks from KY 90 to Bell Lane.
- Item Number 8-20010.00 (Wayne Co., MP 0.000 to MP 3.535): Address condition of KY 90X from MP 0 to MP 3.54.
- Item Number 8-22374.00 (Wayne Co., MP 12.900 to MP 17.700): Address condition of KY 90 from MP 12.9 to MP 17.7.

CHAFs

- IP20070240 – Improve safety and mobility along KY 1275 between KY 1765 and KY 90 near Touristville.
- IP20080506 – Reduce congestion and improve safety, capacity and mobility of KY 90 between KY 1275 / KY 1619 and KY 1568.
- IP20080507 – Reduce congestion and improve safety, capacity, and mobility of KY 90 between KY 1568 in Wayne County and the Wayne/Pulaski County Line.
- IP20090015 – New construction connecting Monticello to the Louie B. Nunn Expressway in Pulaski County, including a new bridge across Lake Cumberland.

Existing Conditions

A detailed inventory of the existing physical and geometric design characteristics was completed to evaluate the existing conditions along KY 90. KY 90 is classified as a rural minor arterial throughout the study area. The speed limit along KY 90 is 55 miles per hour (mph) in the study area. Lane widths are 12 feet with 10-foot paved shoulders, and the cross sections are listed in **Table ES-1**. A concrete median barrier starts near the bridge over the Cumberland River.

Table ES-1: KY 90 Corridor Typical Sections

Begin MP	End MP	Cross-Section
0.000	0.378	4-lane undivided
0.378	2.434	2-lane undivided
2.434	2.757	2-lane divided w/ median (0 feet - 20 feet)
2.757	3.100	4-lane divided w/ turn lanes

There are 95 total access points across the KY 90 study area, of which 73 are private driveways, 12 are three-way intersections and five are four-way intersections, counted as two access points per four-way intersection. Two intersections do not meet stopping sight distance requirements, and eight intersections are skewed.

Bicycle and pedestrian activity is low within the study area and occurs mostly on the eastern end of the corridor near the New Cumberland River Bridge.

Traffic Volume and Operations

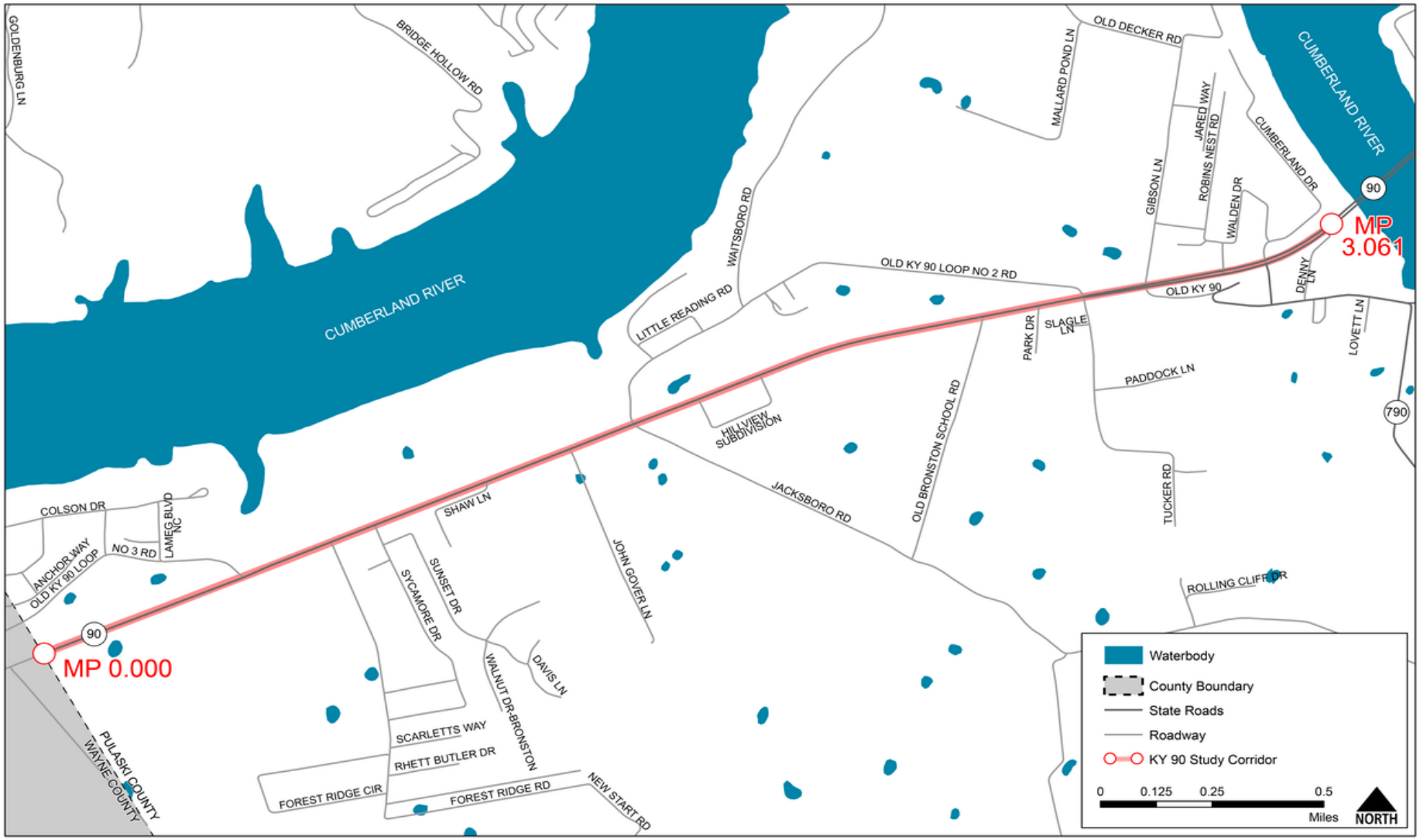
A traffic analysis was performed addressing three major topics: volumes, operations, and safety. Tasks included examining historical and existing (2022) traffic volumes as well as forecasting future traffic to the design year of 2045.

Traffic volumes were projected to the 2045 design year and include projections for Average Annual Daily Traffic (AADT), Design Hourly Volume (DHV), and truck volumes. The 2045 AADT volumes range from a low of 13,200 vehicles per day (vpd) at the western end of the study area to a high of 15,800 vpd at the eastern end of the study area. The DHVs, Average Annual Daily Truck Traffic (AADTT), and Truck DHVs (TDHV) all follow the same pattern of increasing by segment approaching the New Cumberland River Bridge.

A traffic operational analysis was conducted to determine capacity and Level of Service (LOS). KY 90 is classified as a rural minor arterial highway. American Association of State Highway and Transportation Officials (AASHTO) Green Book guidelines suggest the rural section be designed LOS C and the urban section be designed to LOS D. Given the urban section covers a larger portion of the study area and the corridor has the potential for further development, LOS D was selected. The analysis was completed for the no-build scenario on KY 90 with both existing (2022) and future (2045) traffic. Under existing traffic conditions, the study area segments operate at LOS D or better. The volume to capacity (v/c) ratio of KY 90 is expected to increase as volumes increase at a rate of 1.2% per year to the future year 2045. However, all segments are expected to continue operating at LOS D or better during both the AM and PM peak hours, except between Gibson Lane and KY 790. This segment just dips under the LOS E threshold in the eastbound direction during the AM peak hour and in the westbound direction in the PM peak hour.

Intersection turning movement counts at seven study intersections (Forest Ridge Road, Sycamore Drive, Jacksboro Road, Old Bronston School Road, Tucker Road, Gibson Lane, and KY 790) were obtained to evaluate intersection level traffic operations. All seven intersections are stop-sign controlled on the minor street approaches. The intersections were analyzed using Synchro Version 11 (HCM 6th Edition) analysis software to evaluate the AM and PM peak hours. All seven intersections currently operate at LOS D or better. In 2045 three intersections (Tucker Road, Gibson Lane, and KY 790) have at least one side street approach that operates at LOS F in one or both peaks, and Jacksboro Road has one approach that operates at LOS E in the PM peak.

Figure ES-1: KY 36 Study Area



Corridor Speeds

Travel speeds along a corridor are an indicator of how a roadway facility is operating. KYTC provided 2019 HERE speed data for the KY 90 study area, which was used to determine typical operating speeds throughout the day. Operating speeds were analyzed temporally and geographically to determine their relation to KY 90 operations. Speeds along KY 90 were generally at or above the posted speed limit of 55 mph. The analysis showed speeds are generally consistent by time of day. By location, speeds were generally higher on the western and eastern ends of the study area. More access points are prevalent in the center of the study area as compared to the ends which may be a contributing factor to the comparably slower speeds in that portion of the study area. A clear correlation does not exist between operating speeds and crash locations. Crashes along the study area typically occurred at intersections.

Safety

A historical crash analysis was performed to examine traffic safety trends and to identify potential safety issues on KY 90 within the study area. Within the five-year (2015 – 2019) analysis period, 108[1] crashes were reported in the study area. A breakdown of the crashes by severity found there were no fatal crashes and three serious injury crashes (2.8%) over the five-year period. Most crashes (81, 75%) were property damage-only crashes.

An examination of the crashes by manner of collision showed most crashes in the study area (48, 44.4%) were rear end crashes. A closer review of rear end crashes was performed to determine if trends or contributing factors contributed to the occurrences. Approximately 57% of rear end crashes involved a vehicle slowing down to turn left or queueing as result of left turning vehicles, and 35% of rear end crashes involved a vehicle slowing down to turn right or queueing as a result from right turning vehicles.

The location and density of crashes within the KY 90 study area was also examined as illustrated in **Figure ES-2**. Two trends emerged from a review of the plotted crash densities. The first is crashes are generally denser east of Jacksboro Road where a higher concentration of driveways and intersecting roadways are present. The second is crashes are denser at intersections, such as at Forest Ridge Road, Jacksboro Road, Old Bronston School Road, Tucker Road, and Gibson Lane, than at segments in between intersections.

The Excess Expected Crashes (EEC) values for KY 90 were obtained from KYTC. KY 90 experiences a mixture of positive and negative EEC values at intersections and segments. Basic trends from the EEC analysis show the intersections with Old KY 90 Loop 3, Forest Ridge Road, Sycamore Drive, Jacksboro Road, and Tucker Road are experiencing greater than expected crashes.

Most segments are experiencing less than expected crashes except between Forest Ridge Road and Sycamore Drive and between John Glover Lane and Jacksboro Road, which have positive EEC values. With minimal variability in crashes observed by day of week and month of year, recreational traffic does not appear to be a contributing factor to crashes in the study area. A comparison of crash rates within the study area shows KY 90 experiences a lower crash rate than other rural and urban two-lane roadways in the state. However, when variables such as lane width, shoulder width, traffic volume, and roadway curvature are considered, the EEC analysis indicates some sections and intersections of KY 90 are experiencing more crashes than would be expected on a similar type of facility.

1 Two crashes of unknown severity were reported in the study area and are not included in this analysis.

Figure ES-2: KY 90 Crash Density Map (2015-2019)

Environmental

Data was collected for an Environmental Overview (EO) based on existing geographic information system (GIS) datasets, state and federal agency databases, literature research, and archival data. Desktop research was performed to identify and locate areas of importance or concern that lie within a 500-foot buffer along KY 90 from the Wayne County Line to the New Cumberland River Bridge.

The natural environment reviewed for the EO included ecological resources, threatened and endangered species, and important habitats. The potential to encounter natural environment resources is limited in this previously disturbed area. The desktop review identified threatened and endangered species potential habitats are limited. The nature of improvement concepts considered as a result of this study, the limited natural environment resources in the study area, and the goal of staying within existing right-of-way and within previously disturbed areas to the extent possible, will greatly minimize the extent of impacts to the natural environment.

The human environment reviewed for the EO included air quality and noise issues; Environmental Justice (EJ)/ socioeconomic data; land use/farmland; hazardous materials; and historic and archaeological resources. The Lake Cumberland Area Development District (LCADD) prepared the *KY 90 Corridor Study, Pulaski County, Socioeconomic Study (LCADD Socioeconomic Study, Appendix E)* to assess EJ populations that must be considered in any future project development phases. As with the natural environment, the potential for the improvement concepts to impact the human environment is limited by the fact that most improvements would likely occur within existing right-of-way.

Development and Evaluation of Potential Improvement Concepts

In addition to project team meetings between the Consultant Team, KYTC, and the LCADD, outreach for this project included a meeting with local elected officials and stakeholders, as well as coordination with resource agencies. Using the existing conditions, traffic and safety analysis, along with input from the local stakeholders, an initial list of potential improvement concepts was developed and presented to the project team. Improvement concepts were grouped by corridor-wide longer-term improvements, and spot shorter-term improvements.

The initial list of improvement concepts was refined based on the feedback from the project team to a list for further evaluation. Each potential improvement concept was evaluated with respect to safety, traffic operations, right-of-way impacts, environmental impacts, and cost estimates. A predictive safety analysis was performed to estimate the potential reduction in crashes over a 20-year period each improvement concept could provide, then a simple benefit cost (B/C) analysis was conducted to determine the value each improvement concept provided. This analysis used a predicted 20-year crash reduction and the construction cost estimates to result in recommendations for potential improvement concepts.

Recommendations

The final list of corridor-wide and spot improvement concepts to move forward are shown in **Table ES-2** and **Table ES-3**, respectively. Project sheets were created for each improvement concept to be moved forward that provide information on the issues identified, the improvement concept, the safety and operational benefits, and a phased cost estimate that includes Design, Right-of-Way, Utilities, and Construction (D, R, U, C). Upon completion of this study, selected recommended improvement concepts will be further examined and moved through project development. Funds for future project development phases of this corridor are in *Kentucky's Enacted Fiscal Year (FY) 2022 – FY 2028 Highway Plan (Six Year Plan)*.

Table ES-2: KY 90 Corridor-Wide Recommendations

Typical Section Concepts															
Number	Location	Begin MP	End MP	Description	Existing Typical Section	Proposed Typical Section	ROW Impacts		General	Traffic	Environmental	Cost	Construction Cost	Fatal & Injury Crash Reduction	B / C
							Acres	Acquisitions							5yr Crashes / 7yr Crashes
1A	Old KY 90 Loop 3 to Old KY 90/ Gibson Lane	0.448	2.577	3-lane section with TWLTL	12' lanes, 12' shoulders	12' lanes, 12' TWLTL, 8' shoulders	11.14	5	TWLTL's reduce potential conflicts with turning traffic and to provide a refuge for vehicles waiting to turn left. A TWLTL could reduce driveway related crashes by ~20%	TWLTL's do not add substantial capacity to a two-lane roadway, but provide refuge for left turning vehicles and could increase operating speeds. Two-lane section currently operates at LOS C/D in 2022. No two-lane section in 2022 has a v/c ratio above 0.44.	Archaeology, Tree Removal (bats), Possible Historic, UST/HAZ, Potential Noise Screening Tool	D $720,000 R $1,555,700 U $300,000	$7,200,000	21%	0.2 - 1.1
1B	Old KY 90 Loop 3 to Old KY 90/ Gibson Lane	0.448	2.577	3-lane section with TWLTL	12' lanes, 12' shoulders	11' lanes, 12' TWLTL 8' shoulders	9.45	5	TWLTL's reduce potential conflicts with turning traffic and to provide a refuge for vehicles waiting to turn left. A TWLTL could reduce driveway related crashes by ~20%	TWLTL's do not add substantial capacity to a two-lane roadway, but provide refuge for left turning vehicles and could increase operating speeds. Two-lane section currently operates at LOS C/D in 2022. No two-lane section in 2022 has a v/c ratio above 0.44.	Archaeology, Tree Removal (bats), Possible Historic, UST/HAZ, Potential Noise Screening Tool	D $650,000 R $1,547,250 U $ 275,000	$6,500,000	19%	0.2 - 1.1
1C	Old KY 90 Loop 3 to Old KY 90/ Gibson Lane	0.448	2.577	3-lane section with TWLTL	12' lanes, 12' shoulders	12' lanes, 12' TWLTL, curb & gutter	0	0	TWLTL's reduce potential conflicts with turning traffic and to provide a refuge for vehicles waiting to turn left. A TWLTL could reduce driveway related crashes by ~20%	TWLTL's do not add substantial capacity to a two-lane roadway, but provide refuge for left turning vehicles and could increase operating speeds. Two-lane section currently operates at LOS C/D in 2022. No two-lane section in 2022 has a v/c ratio above 0.44.	Noise Screening Tool	D $520,000 RW $0 U $0	$5,200,000	21%	0.4 - 1.9

Typical Section Concepts															
Number	Location	Begin MP	End MP	Description	Existing Typical Section	Proposed Typical Section	ROW Impacts		General	Traffic	Environmental	Cost	Construction Cost	Fatal & Injury Crash Reduction	B / C
							Acres	Acquisitions							5yr Crashes / 7yr Crashes
2A-1	Jacksboro Road to Old KY 90/ Gibson Lane	1.377	2.577	2-lane section with 6' raised median & turn lanes at major intersections	12' lanes, 12' shoulders	12' lanes, 6' raised median 8' shoulders	8.66	3	On urban and suburban arterials, reducing the number of median openings and intersections (such as by adding a barrier median) reduces the number of intersection and driveway related crashes, however, the magnitude of the crash benefit is not certain. A reduction in crashes similar to what would occur by reducing the number of access points would be expected. Within the raised median section 25 Rear end, 2 angle, 2 opposing left, and 1 head on crashes occurred.	• Provide left turn lanes at Jacksboro Rd., Old Bronston School Rd., Park Dr., and Tucker Rd. intersections. 345' Left Turn Lane length needed (includes 100' bay taper). • Could be combined with roundabouts at Jacksboro Rd. and Tucker Rd. to provide turning access. Roundabouts would operate acceptably, likely near LOS C. • U-turn loons could be added to accommodate left turning traffic. U-turn movement would operate acceptably, likely near LOS C.	Archaeology, Tree Removal (bats), Possible Historic, UST/HAZ, Potential Noise Screening Tool	D $480,000 R $943,300 U $250,000	$4,800,000	24%	0.3 - 1.7
2A-2	Jacksboro Road to New Cumberland River Bridge	1.377	3.061	2-lane section with 6' raised median & turn lanes at major intersections	12' lanes, 12' shoulders	12' lanes, 6' raised median 8' shoulders	8.66	3	On urban and suburban arterials, reducing the number of median openings and intersections (such as by adding a barrier median) reduces the number of intersection and driveway related crashes, however, the magnitude of the crash benefit is not certain. A reduction in crashes similar to what would occur by reducing the number of access points would be expected.	• Provide left turn lanes at Jacksboro Rd., Old Bronston School Rd., Park Dr., and Tucker Rd. intersections. 345' Left Turn Lane length needed (includes 100' bay taper). • Could be combined with roundabouts at Jacksboro Rd. and Tucker Rd. to provide turning access. Roundabouts would operate acceptably, likely near LOS C. • U-turn loons could be added to accomodate left turning traffic. U-turn intersection would operate acceptable, likely near LOS C.	Archaeology, Tree Removal (bats), Possible Historic, UST/HAZ, Potential Noise Screening Tool	D $510,000 R $943,300 U $250,000	$5,100,000	24%	0.3 - 1.6

Typical Section Concepts															
Number	Location	Begin MP	End MP	Description	Existing Typical Section	Proposed Typical Section	ROW Impacts		General	Traffic	Environmental	Cost	Construction Cost	Fatal & Injury Crash Reduction	B / C
							Acres	Acquisitions							5yr Crashes / 7yr Crashes
2B-1	Jacksboro Road to Old KY 90/ Gibson Lane	1.377	2.577	2-lane section with 6' raised median & turn lanes at major intersections	12' lanes, 12' shoulders	12' lanes, 6' raised median, curb & gutter	0	0	On urban and suburban arterials, reducing the number of median openings and intersections (such as by adding a barrier median) reduces the number of intersection and driveway related crashes, however, the magnitude of the crash benefit is not certain. A reduction in crashes similar to what would occur by reducing the number of access points would be expected. Within the raised median section 25 Rear end, 2 angle, 2 opposing left, and 1 head on crashes occured.	• Provide left turn lanes at Jacksboro Rd., Old Bronston School Rd., Park Dr., and Tucker Rd. intersections. 345' Left Turn Lane length needed (includes 100' bay taper). • Could be combined with roundabouts at Jacksboro Rd. and Tucker Rd. to provide turning access. Roundabouts would operate acceptably, likely near LOS C. • U-turn loons could be added to accomodate left turning traffic. U-turn intersection would operate acceptable, likely near LOS C.	None	D $390,000 R $0 U $0	$3,900,000	24%	0.4 - 2.6
2B-2	Jacksboro Road to New Cumberland River Bridge	1.377	3.061	2-lane section with 6' raised median & turn lanes at major intersections	12' lanes, 12' shoulders	12' lanes, 6' raised median, curb & gutter	0	0	On urban and suburban arterials, reducing the number of median openings and intersections (such as by adding a barrier median) reduces the number of intersection and driveway related crashes, however, the magnitude of the crash benefit is not certain. A reduction in crashes similar to what would occur by reducing the number of access points would be expected.	• Provide left turn lanes at Jacksboro Rd., Old Bronston School Rd., Park Dr., and Tucker Rd. intersections. 345' Left Turn Lane length needed (includes 100' bay taper). • Could be combined with roundabouts at Jacksboro Rd. and Tucker Rd. to provide turning access. Roundabouts would operate acceptably, likely near LOS C. • U-turn loons could be added to accomodate left turning traffic. U-turn intersection would operate acceptable, likely near LOS C.	None	D $630,000 R $0 U $0	$6,300,000	24%	0.3 - 1.6

*v/c ratio is the roadway's volume divided by capacity.

Table ES-3: KY 90 Spot Improvement Recommendations

Spot Improvement Concepts									B/C
Number	Location	MP	Description	ROW Impacts (Acres)	Traffic	Environmental	Cost	Fatal & Injury Crash Reduction	5yr Crashes/ 7yr Crashes
1	Forest Ridge Road	0.644	Provide Advance Intersection Warning Signing	0		None	D $5,000 R $0 U $0 C $2,500	35%	0.9 - 0.6
2	Forest Ridge Road & Sycamore Drive	0.675	WB Left Turn Lane on KY 90	0.1	• Mainline Left Turn Lane Warrant met in PM. • 345' Turn Lane Length (includes 100' bay taper) at Forest Ridge Drive and Sycamore Drive.	Archaeology	D $44,000 R $1,000 U $0 C $440,000	44%	1.4 - 1.9
3	Shaw Lane	1.021	Angle shoulder to widen for RTs and improve pavement	0		None	D $5,000 R $0 U $0 C $25,000	10%	0.0 - 0.0
4	Jacksboro Road	1.377	Provide "Con-gestion Ahead" Signing	0	Intersection NB and SB TWSC approaches currently operates at LOS C in the AM and PM.	None	D $5,000 R $0 U $0 C $2,500	0%	
5	Jacksboro Road	1.377	Improve Intersection Skew	0	Intersection NB and SB TWSC approaches currently operates at LOS C in the AM and PM.	Archaeology, Tree Removal (bats), Possible Historic	D $15,000 R $0 U $0 C $75,000	15%	4.4 - 3.2
6	Old Bronston School Road	2.204	Improve Intersection Skew	0		Archaeology, Tree Removal (bats)	D $15,000 R $0 U $ 0 C $30,000	9%	0.1 - 0.4
7	Old Bronston School Road, Park Drive & Tucker Road / Old KY 90 Loop	2.319	WB Left Turn Lane to Old Bronston School Road and Park Drive, EB and WB Left Turn Lanes to Tucker Road / Old KY 90	0.85	• Mainline Left Turn Lane Warrant met in PM for Old Bronston School Road and Tucker Road (no count data avilable for Park Drive). • 500' Turn Lane Length (includes 100' bay taper) at Old Bronston School • 345' Turn Lane Length (includes 100' bay taper) at Park Drive and Tucker Road	Archaeology, Tree Removal (bats)	D $62,000 R $4,000 U $0 C $615,000	44%	0.0 - 13.7

Spot Improvement Concepts									B/C
Number	Location	MP	Description	ROW Impacts (Acres)	Traffic	Environmental	Cost	Fatal & Injury Crash Reduction	5yr Crashes / 7yr Crashes
8	Park Drive	2.332	Improve Intersection Skew	0		Archaeology	D $10,000 R $0 U $0 C $50,00	6%	0.8 - 21.8
9	Gibson Lane / Old KY 90	2.577	Restripe EB & WB Turn Lanes and Improve WB Merge	0	The SB TWSC approach operates at LOS C in the AM and LOS D in the PM.	None	D $5,000 R $0 U $0 C $10,000	N/A	
10	Gibson Lane / Old KY 90	2.852	Eliminate WB merge and make right lane a RT only lane onto Gibson	0		None	D$15,000 R $0 U $0 C $150,000	41%	1.0 - 1.3
11	KY 790 / Cumber-land Drive	2.852	NB Right Turn Lane	0		None	D $10,000 R $0 U $0 C $40,000	N/A	

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1 Introduction

WSP USA Inc. (WSP) was contracted by the Kentucky Transportation Cabinet (KYTC) to perform a study for identifying potential improvements along Kentucky Route (KY) 90 in Pulaski County, Kentucky. The study area extends from the Wayne County Line to the New Cumberland River Bridge, mile point (MP) 0.00 to MP 3.061. The study includes both short-term and long-term improvement strategies that KYTC may use for further project development and implementation.

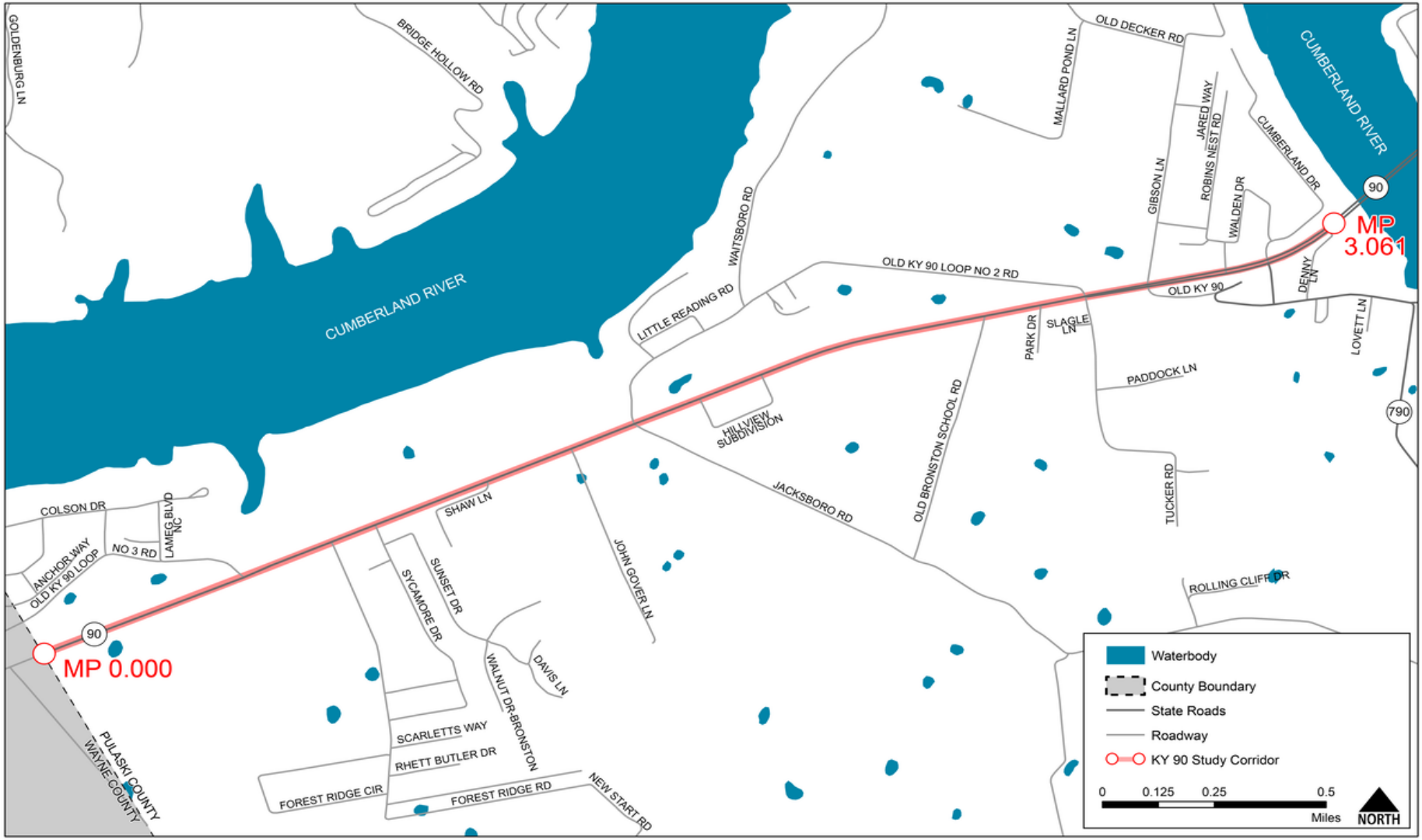
Members of the Project Team included KYTC District 8, KYTC Central Office Division of Planning, and the WSP Consultant Team which includes HDR and TSW.

The objective of the study is to identify short-term and long-term improvements to reduce congestion and improve safety, capacity, and mobility along KY 90 between the Wayne County Line and the New Cumberland River Bridge.

1.1 Study Area

The KY 90 study area is shown in **Figure 1**. The study area begins at the Wayne County Line (MP 0.00) in the west and extends to the New Cumberland River Bridge (MP 3.061) in the east.

Figure 1: KY 90 Study Area



1.2 Committed & Proposed Projects

KYTC provided a list of committed and proposed projects in the study area vicinity. There are five projects in the study area vicinity included in *Kentucky's 2022-2028 Enacted Highway Plan (Six Year Plan)* and five projects in the vicinity of the study area in the KYTC Continuous Highway Analysis Framework (CHAF) database, listed below.

Six Year Plan Projects

- Item Number 8-80104.00 (Pulaski Co., MP 0.000 to MP 3.061): Reduce congestion and improve safety, capacity and mobility along KY 90 between Wayne County line and New Cumberland River bridge. (SPP) D: 2021 $1,406,000; R: 2023 $7,000,000; U: 2025 $3,000,000; C: 2026 $25,030,000.
- Item Number 8-80105.00 (Wayne Co., MP 12.931 to MP 15.617): Reduce congestion and improve safety, capacity, and mobility of KY 90 between KY 90X / KY 1275 and KY 3106 (SPP) R: 2023 $6,078,000; U: 2025 $2,920,000; C: 2026 $22,143,000.
- Item Number 8-80108.00 (Wayne Co., MP 1.264 to MP 1.327): Address safety, mobility, and connectivity by relocating along KY 92 in Monticello between Locust Street and Elk Springs Creek Road (SPP) R: 2023 $1,100,000; U: 2024 $500,000; C: 2025 $1,000,000
- Item Number 8-80006.00 (Wayne Co., MP 4.000 to MP 4.479): Reduce congestion and improve safety, capacity, and mobility along KY 1275, including sidewalks from KY 90 to Bell Lane. (STP2) D: 2022 $490,000; R: 2023 $200,000; U: 2023 $500,000; C: 2025 $3,000,000
- Item Number 8-20010.00 (Wayne Co., MP 0.000 to MP 3.535): Address condition of KY 90X from MP 0 to MP 3.54. (STP4) D: 2026 $442,750; C: 2027 $3,984,750.
- Item Number 8-22374.00 (Wayne Co., MP 12.900 to MP 17.700): Address condition of KY 90 from MP 12.9 to MP 17.7 (STP4) D: 2027 $217,350; C: 2027 $1,956,150

CHAFs

- IP20070240 – Improve safety and mobility along KY 1275 between KY 1765 and KY 90 near Touristville.
- IP20080506 – Reduce congestion and improve safety, capacity, and mobility of KY 90 between KY 1275 / KY 1619 and KY 1568.
- IP20080507 – Reduce congestion and improve safety, capacity, and mobility of KY 90 between KY 1568 in Wayne County and the Wayne/ Pulaski County Line.
- IP20090015 – New construction connecting Monticello to the Louie B. Nunn Parkway in Pulaski County, including a new bridge across Lake Cumberland.

1.3 Study Objective

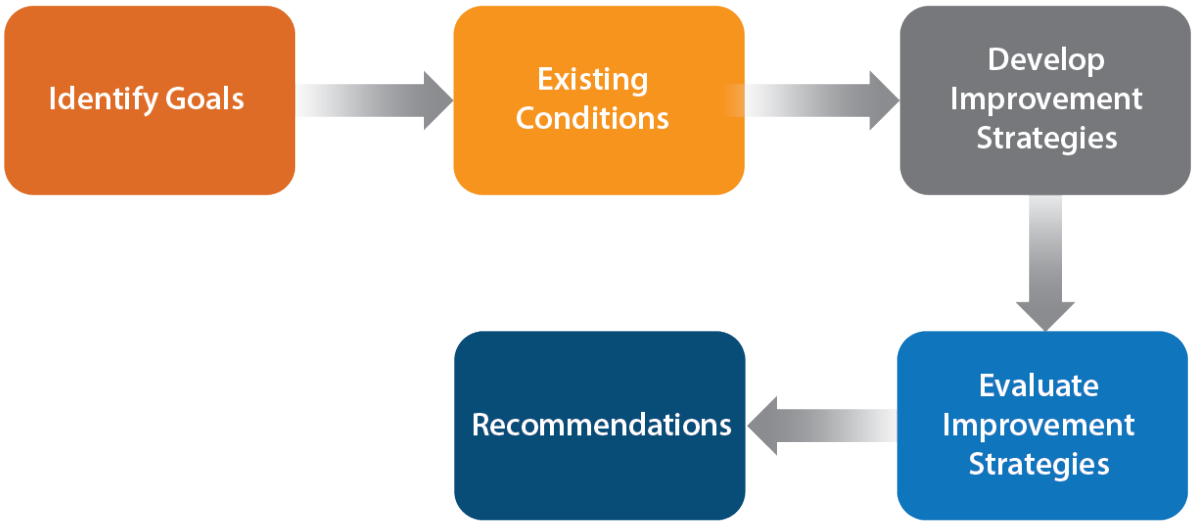
This KY 90 Corridor Study will identify short-term and long-term improvements to reduce congestion and improve safety, capacity, and mobility along KY 90 between the Wayne County Line and the New Cumberland River Bridge.

1.4 Study Process

The study process consists of five major elements, shown in **Figure 2**:

- Identify the goals of the study
- Examine the existing conditions and identify areas with safety concerns
- Develop potential improvement strategies
- Evaluate the improvement strategies based on the study goals
- Provide a list of short-term and long-term improvement recommendations

Figure 2: Study Process



The subsequent chapters of this report detail these steps, with additional information provided in the appendices.

1.5 Study Goals

The goals of the study are to:

- Perform an inventory of existing conditions with respect to geometrics, traffic, safety and environmental features to identify needs along the corridor.
- Propose a list of short-term and long-term potential improvement concepts.
- Evaluate and prioritize improvement concepts based on transportation needs, environmental impacts, economic benefit and impact, benefit/cost, safety and existing pavement conditions.
- Evaluate long-term improvement concepts with respect to grant criteria from the Infrastructure Investment and Jobs Act (IIJA) Grant Program emphasis areas.
- Engage local stakeholders and the Project Team throughout the study process.
- Produce a technical report to document the study process and results.

2 Existing Conditions

To evaluate the existing conditions along KY 90, a detailed inventory of the existing physical and geometric design characteristics was completed using the following sources:

- KYTC Highway Information System (HIS) data
- KYTC record plans and bridge inspection reports
- Google Earth aerial imagery and Street View
- Field review

A detailed account of the existing conditions is provided in **Appendix A.**

2.1 Roadway Geometrics

An inventory of roadway characteristics was completed to identify factors contributing to the safety and congestion issues along KY 90.

2.1.1 Functional Classification, Roadway System Designation, and Truck Routes

KY 90 is a Minor Arterial (Functional Class 4) system. While not a part of the National Highway System, it is a Federal Designated Truck Route and allows for "AAA" Weight Class trucks, with an 80,000-pound maximum weight.

The study area is classified as Tier 3, having Statewide Regional Significance, for the Kentucky Highway Freight Network (KHFN), meaning the truck average annual daily traffic (AADT) is between 500 and 4,000 Vehicles Per Day (VPD).

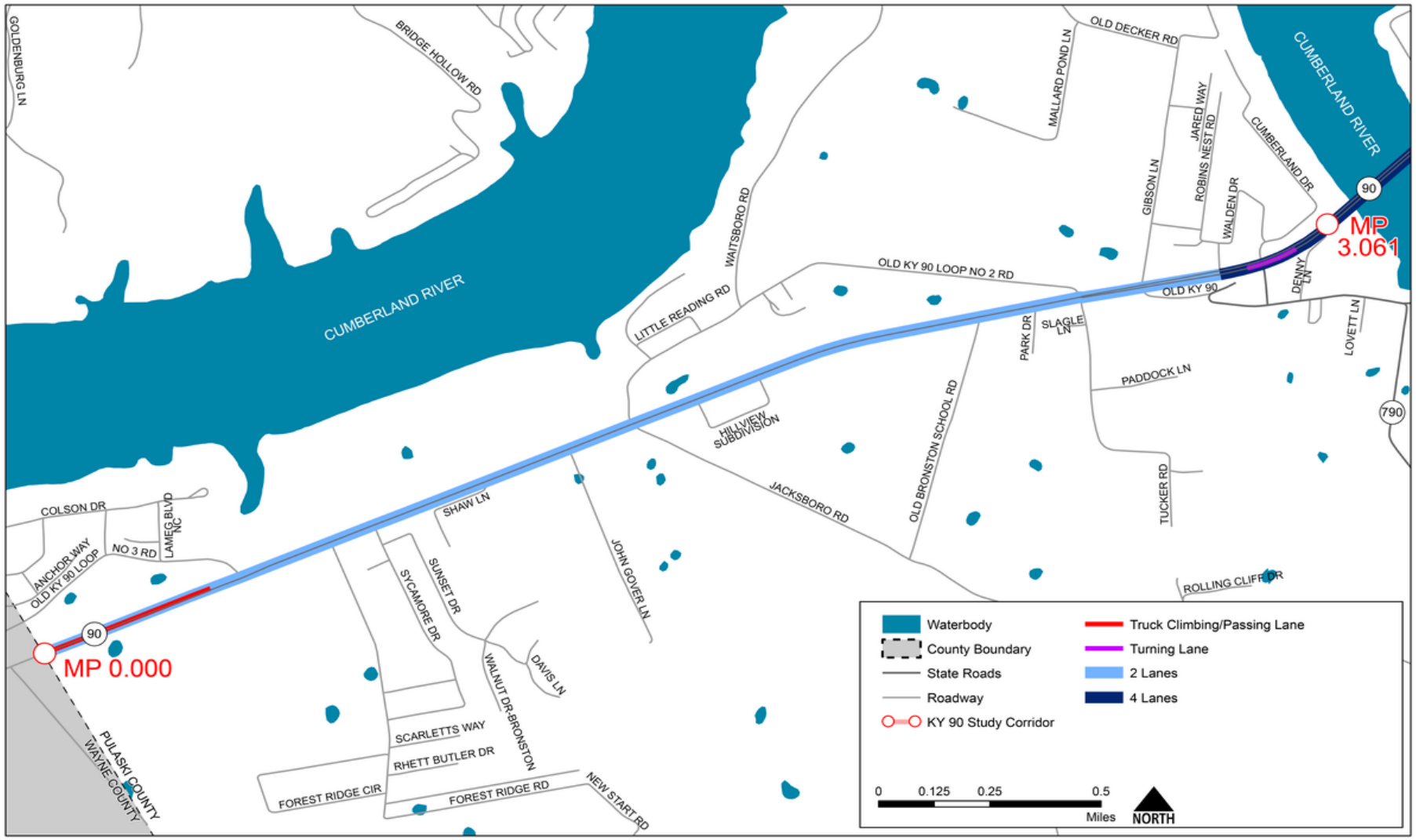
2.1.2 Speed Limit

The speed limit is set at 55 miles per hour (mph) throughout the study area.

2.1.3 Lane, Shoulder, and Median Width

The lane width design requirement for a 55 mph facility is typically recommended to be 12 feet and a minimum of 10-feet. According to HIS data and a field review, a 12-foot lane width is maintained throughout the study area. KY 90 consists of four-lanes (undivided) from MP 0 to MP 0.378, two-lane undivided roadway from MP 0.378 to MP 2.434, two-lane divided roadway from MP 2.434 to MP 2.757 with a median ranging from 0-20 feet, and 4-lane divided roadway with turn lanes from M 2.757 to 3.061 and a concrete median barrier starting at the bridge over the Cumberland River. The number of lanes throughout the study area is shown in **Figure 3**. There are 10-foot paved shoulders throughout the study area.

Figure 3: Study Area Existing Lanes



2.1.4 Horizontal Alignment

The AASHTO's Policy on Geometric Design of Highway and Streets states that the minimum radius of a horizontal curve with a superelevation maximum of 6% and design speed of 55 mph is 1060'. All mainline curves in the study area meet both the minimum radius and superelevation for a 55 mph design speed.

2.1.5 Vertical Alignment

The KYTC Highway Design Manual states that the maximum vertical grade is 5.0% for a design speed of 55 mph for rolling terrain. According to the 2018 Green Book, vertical curves must meet stopping sight distance for crest vertical curves and headlight sight distance for sag vertical curves. The required stopping sight distance is 495 feet for a 55 mph facility, which are met throughout the study area.

2.2 Intersections and Access Points

There are 95 total access points across the KY 90 study area, of which 73 are private driveways and 12 are three-way intersections and five are four-way intersections, counted as two access points per four-way intersection. The access control is listed as "By Permit." See **Figure 4** for locations of access points and intersections in the study area.

2.2.1 Intersection Skew and Sight Distance

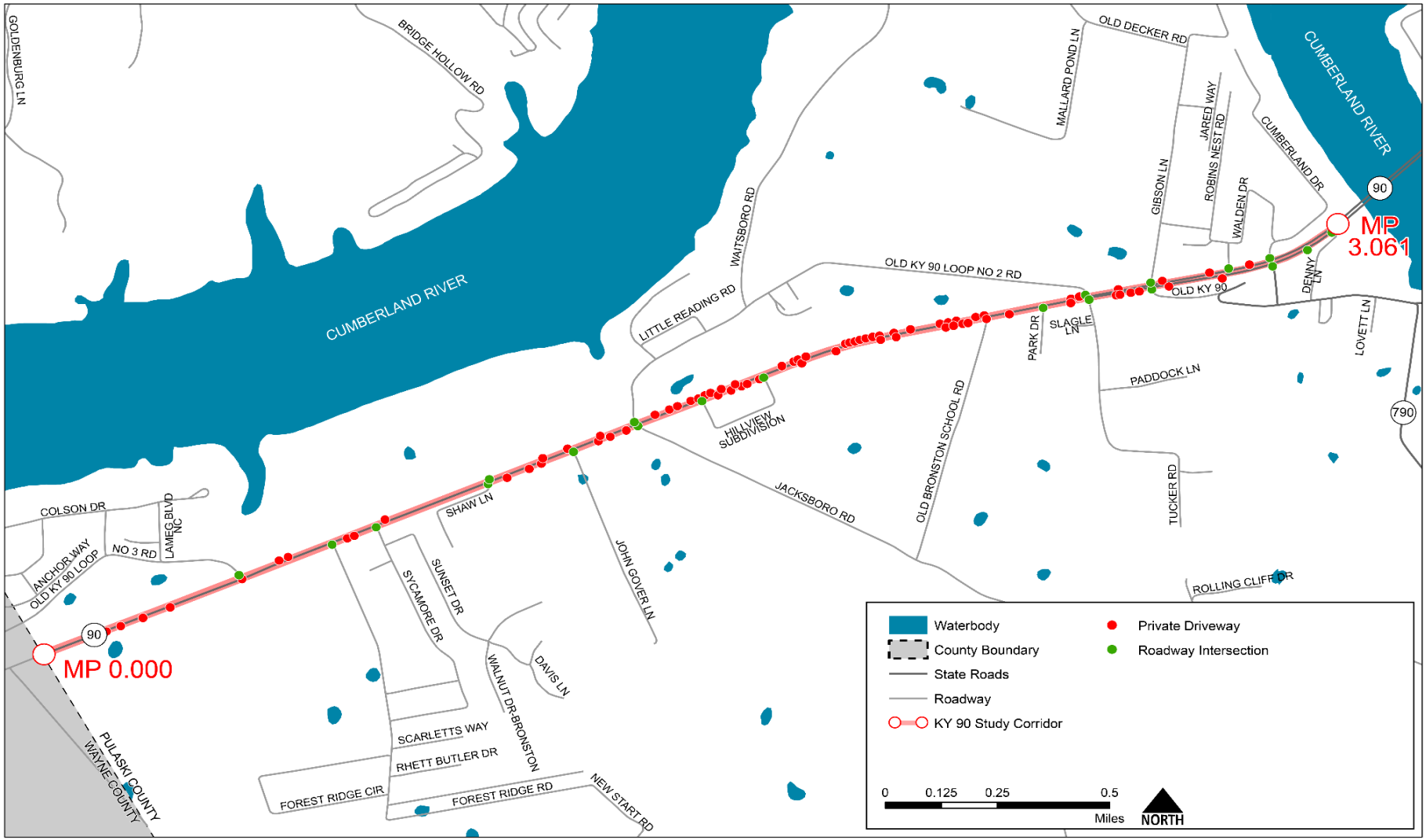
Stopping sight distance on roadways with less than a 3% grade is 495 feet for 55 mph design speed roadways, which represents a minimum level of design for KY 90. Two intersections do not meet the intersection sight distance of 495 feet. Intersections should also be square and not skewed. Skewed intersections make turning and visibility difficult for drivers. Eight intersections are skewed and do not meet at a 90 degree angle with KY 90. **Table 1** shows which intersections are skewed and which intersections do not meet sight distance requirements.

Table 1: Intersection Skew and Sight Distance

Intersection	Skewed	Meets Sight Distance Requirements
Old Hwy 90 Loop 3 Road	Yes	Yes
Shaw Lane	Yes	Yes
Old Kentucky 90	Yes	Yes
Jacksboro Road *	Yes	Yes
Old Bronston School Road *	Yes	No
Park Drive	Yes	Yes
Old Hwy 90 Loop 2 Road	Yes	Yes
Gibson Lane	Yes	Yes
CR-1370D A	No	No

* Exceed maximum skew of 15 degrees

Figure 4: Study Area Intersections and Access Points

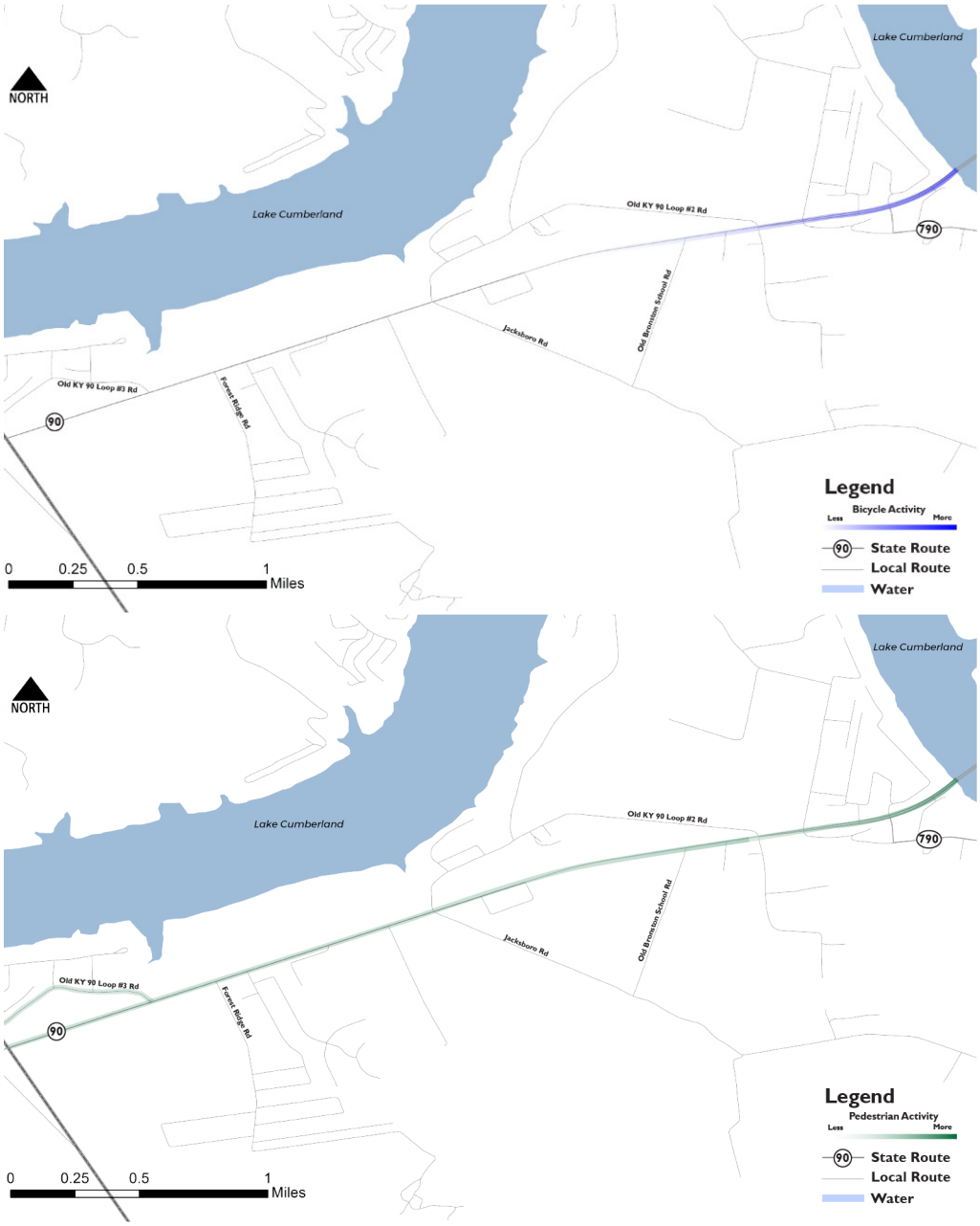


2.3 Bicycle and Pedestrian Activity

Bicycle activity is low within the KY 90 study area per 2021 Strava Metro data. As seen in the left image in **Figure 5**, the bicycle activity is primarily occurring near the Cumberland River Bridge. Bicycle and pedestrian plans do not exist in Wayne or Pulaski counties. Pulaski County has a strong cycling community, but the KY 90 corridor is no longer used as the route and is deemed unsafe for cyclists due to a cyclist fatality on KY 90 in the 1990's during a Tour de Lake Cumberland 100-mile ride.

Pedestrian activity is stronger than cyclist activity along KY 90 and would be deemed a low to medium usage from 2021 Strava Metro data. Most of the activity is seen along the residential side streets, but the stakeholders advised that pedestrian activity occurs across the study area, accessing the commercial zone. The image on the right in **Figure 5** shows the pedestrian activity heat map for KY 90.

Figure 5: Bicycle and Pedestrian Activity in the Study Area



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3 Traffic Volumes and Operations

The traffic analysis addressed three major topics: traffic volumes, traffic operations, and traffic safety. The first two topics are covered in this chapter, while traffic safety is presented in Chapter 4. The traffic volume work included examining historical traffic count data, collecting existing traffic counts and forecasting future traffic to design year 2045. The traffic operations analysis included a capacity analysis using Highway Capacity Software (HCS) and Synchro software to determine if there are any existing operational deficiencies or if any are anticipated by 2045. Raw traffic count data as well as detailed traffic forecasts are presented in the *KY 90 Traffic Forecast Report* attached in **Appendix B**. An overview of existing and future year traffic conditions is presented below.

3.1 Existing (2022) Volumes

The existing traffic volumes for this study comprised of AADT, Design Hour Volumes (DHV), and truck volumes. The Project Team selected 2022 as the baseline year for the existing conditions analysis. Shown in **Table 2** are AADT, K factors, and truck percentage data that were obtained from KYTC for the three count stations in the study area. These counts were short-term hourly and also included data by vehicle class and direction. Existing turning movement counts were also collected at seven locations during the AM and PM peak hours. All existing count data are presented in the *KY 90 Traffic Forecast Report* in **Appendix B**.

3.1.1 2022 Intersection Volumes

Intersection turning movement counts were conducted at seven locations along KY 90 in the study area during the AM peak hours (7 AM to 9 AM) and PM peak hours (4 PM to 6 PM). The intersections are as follows:

- KY 90 / Forest Ridge Road
- KY 90 / Sycamore Drive
- KY 90 / Jacksboro Road
- KY 90 / Old Bronston School Road
- KY 90 / Tucker Road
- KY 90 / Gibson Lane
- KY 90 / KY 790

The count data show that near the Wayne County line, approximately 430 vehicles per hour (vph) travel eastbound along KY 90 during the AM peak hours and 320 vph during the PM peak hours. Near KY 790, eastbound volumes increase to approximately 680 vph during the AM peak and 485 vph during the PM peak. Westbound traffic is higher near the KY 90 / KY 790 intersection with approximately 385 vph during the AM peak and 775 vph during the PM peak. These volumes decrease to 265 vph during the AM peak and 505 vph during the PM peak near Forest Ridge Road. **Figure 6** presents year 2022 volumes.

Table 2: KY 90 Study Area Historical Count Station Data

Station	County	Route	Begin MP	End MP	Count Year	AADT	K Factor	D Factor	% Single Truck*	% Combo Truck*	% Total Trucks*
100558	Pulaski	KY 90	0.00	1.377	2019	10,408	9.9	58	6.1	3.8	9.8
100355	Pulaski	KY 90	1.377	2.852	2017	10,719	7.3	56	6.1	3.8	9.8
100D04	Pulaski	KY 90	2.852	3.061	2019	15,279	8.6	57	6.1	3.8	9.8

*Rounded to the nearest 0.1%

3.1.2 2022 AADT & DHV Volumes

Intersection turning movement counts were used to develop existing KY 90 AADT and DHV volumes. The DHVs along segments were calculated by taking an average of the traffic entering and exiting the two intersections at either end of a segment and selecting the higher peak hour volume. The higher peak hour volume along KY 90 occurs during the PM peak. The resulting 2022 DHVs (rounded to the nearest 10 vpd), presented in **Figure 6**, increase from west to east and ranges from 820 vph near the Wayne County line to 1,260 vph at the New Cumberland River Bridge.

The AADT volumes were calculated by applying a K factor of 8.2% to the highest peak hour volume for each segment. This K factor was estimated using historic traffic and 2022 intersection count data. The resulting AADT volumes are presented in **Table 3** (rounded to the nearest 50 vpd). AADTs increased west to east with the highest volumes experienced near the New Cumberland River Bridge. AADTs ranged from 10,050 vpd near the Wayne County Line to 15,350 vpd at the New Cumberland River Bridge.

3.1.3 Truck Volumes

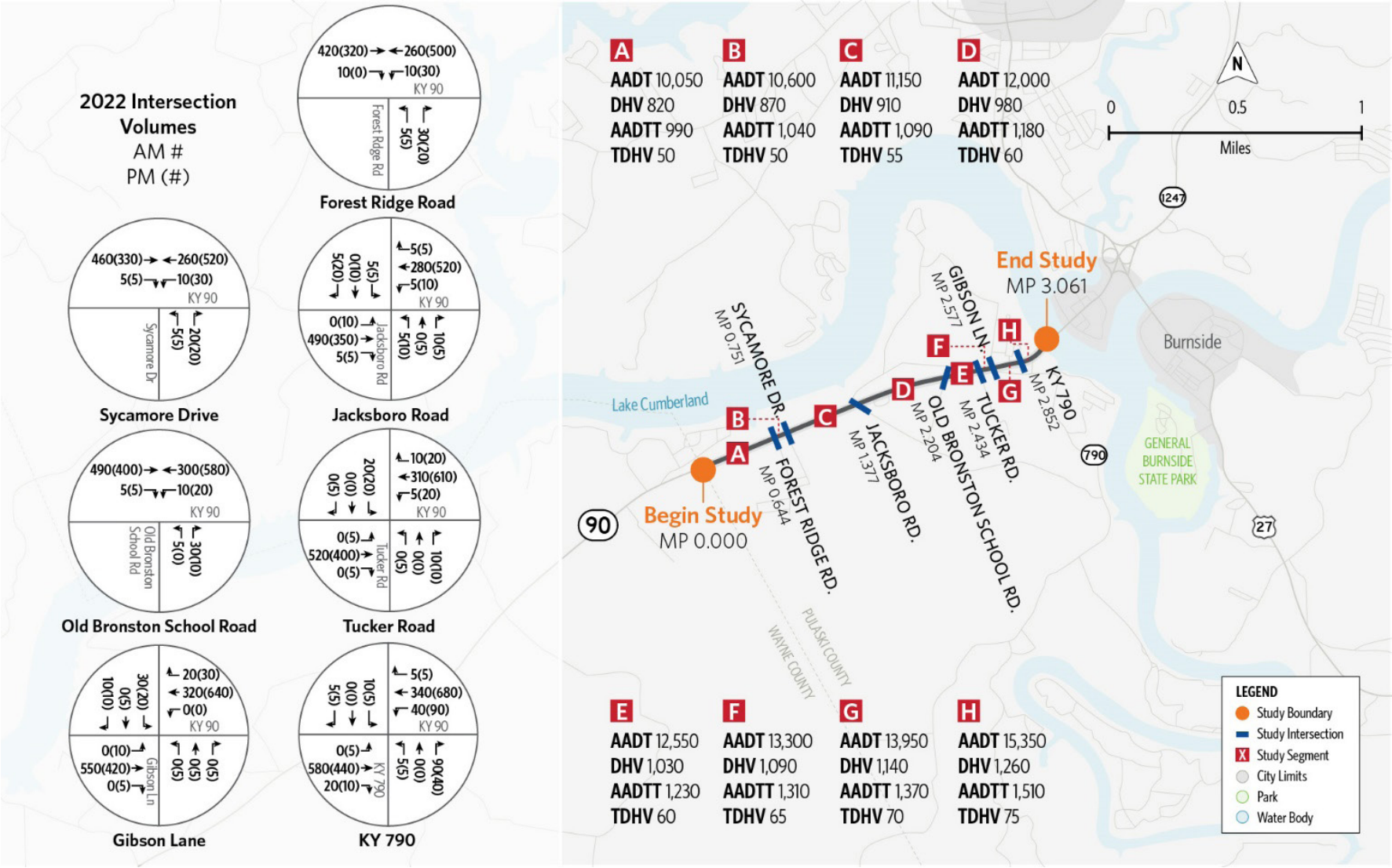
Truck percentage data was obtained from the KYTC Statewide Traffic Counts Map[1]. These data were used to estimate Average Annual Daily Truck Traffic (AADTT) and truck DHVs (TDHV). Trucks make up approximately 9.8% of the daily traffic and less than 5% of DHVs. The TDHVs range from a low of 50 vph near the Wayne County Line to a high of 75 vph near the New Cumberland River Bridge. **Table 3** presents 2022 AADTT (rounded to the nearest 10 vpd) and TDHV (rounded to the nearest 5 vph) for each segment along KY90.

Table 3: 2022 Baseline Traffic Volumes

ID	Begin MP	End MP	Segment	AADT	DHV	AADTT	TDHV
A	0.000	0.644	Wayne County Line to Forest Ridge Road	10,050	820	990	50
B	0.644	0.751	Forest Ridge Road to Sycamore Drive	10,600	870	1,040	50
C	0.751	1.377	Sycamore Drive to Jacksboro Road	11,150	910	1,090	55
D	1.377	2.204	Jacksboro Road to Old Bronston School Road	12,000	980	1,180	60
E	2.204	2.434	Old Bronston School Road to Tucker Road	12,550	1,030	1,230	60
F	2.434	2.577	Tucker Road to Gibson Lane	13,300	1,090	1,310	65
G	2.577	2.852	Gibson Lane to KY 790	13,950	1,140	1,370	70
H	2.852	3.061	KY 790 to New Cumberland River Bridge	15,350	1,260	1,510	75

1 https://maps.kytc.ky.gov/trafficcounts/

Figure 6: 2022 AADT and DHV



3.2 Future (2045) Volumes

Traffic volumes were projected to the 2045 design year to be consistent with the American Association of State Highway and Transportation Officials (AASHTO) policy, which calls for forecasts to be at least 20 years beyond the year in which the project plans, specifications, and estimates for construction are approved. The traffic forecast includes projections for AADT, DHV, and truck volumes. Details for the volume forecasting work are presented in the *KY 90 Traffic Forecast Report* attached in **Appendix B**.

3.2.1 Traffic Growth Rate

The traffic growth rate was based on three factors:

- Historical traffic growth
- Kentucky Statewide Traffic Model (5971_KYST-Mv19) forecasts
- Projected population growth in Pulaski County

The historical traffic growth along KY 90 is calculated to be approximately 1.4% based on the analysis of 11 years of traffic count data from years 2008-2019 (pre-covid). The KYTC Statewide Model shows a growth rate of approximately 1.1% per year. The population in Kentucky between 2010 and 2020 grew at a rate of approximately 0.4% per year and is expected to continue this trend out to 2045. Pulaski County experienced a historical growth rate of 0.3% per year but is expected to grow at a rate of 0.5% per year in the future.

Given the higher historical growth, moderate statewide travel demand model projections, and modest projected population growth, a 1.2% annual growth rate for AADT, DHV, and truck volumes was selected for this study. This growth rate is sufficient to test traffic operational performance in the study area over the next 23 years.

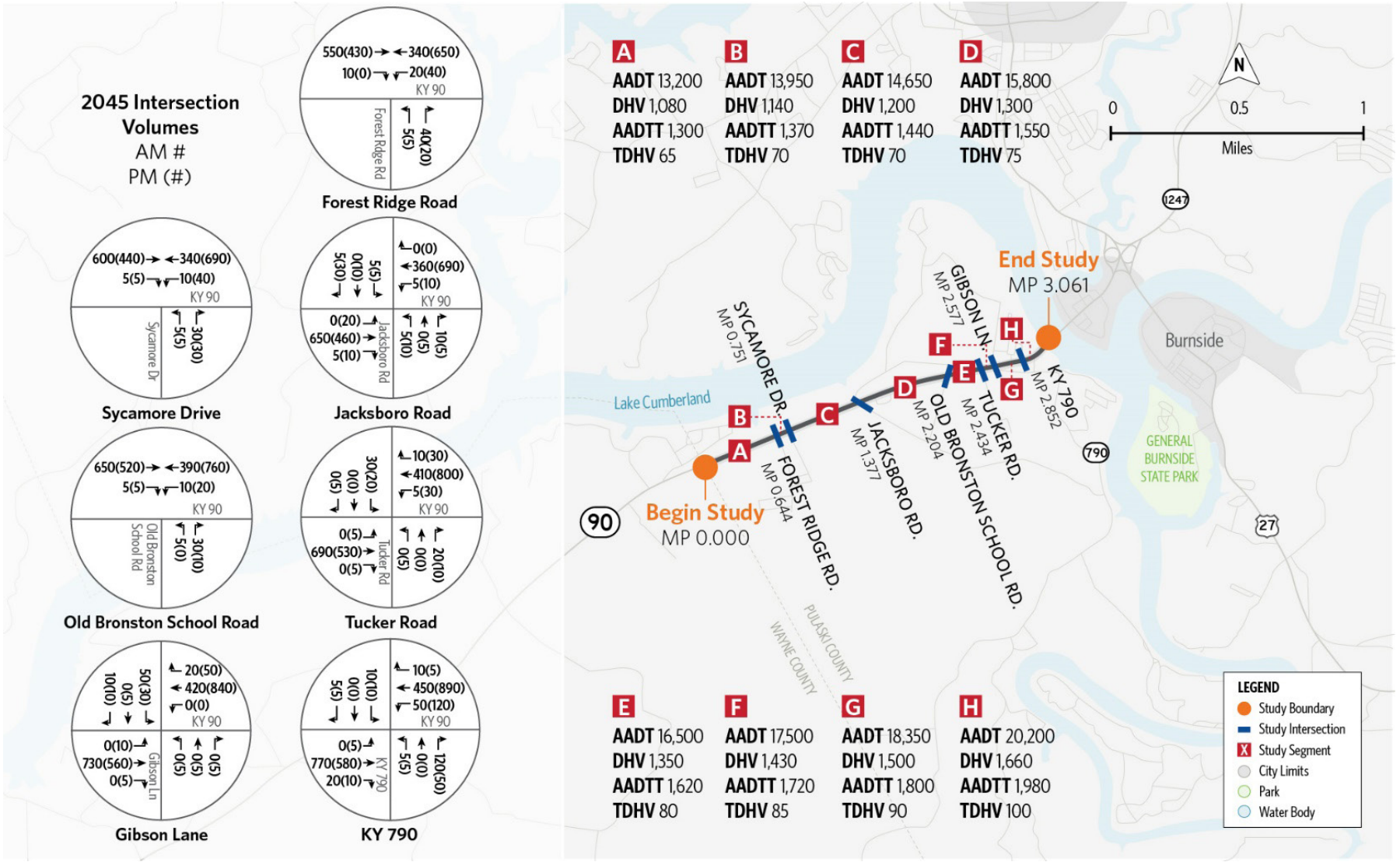
3.2.2 2045 Volumes

The projected 2045 AADT (rounded to the nearest 50 vpd), DHVs (rounded to the nearest 10 vph), and truck volumes are presented in **Table 4** and **Figure 7**. AADTs are expected to range from 13,200 vpd near the Wayne County line to 20,200 vpd near the New Cumberland River Bridge. Similarly, the DHVs increase from west to east along the corridor with the lowest expected near the Wayne County Line (1,080 vph) and the highest near KY 790 (1,660 vph).

Table 4: Future Year (2045) Traffic Volumes

ID	Begin MP	End MP	Segment	AADT	DHV	AADTT	TDHV
A	0.000	0.644	Wayne County Line to Forest Ridge Road	13,200	1,080	1,300	65
B	0.644	0.751	Forest Ridge Road to Sycamore Drive	13,950	1,140	1,370	70
C	0.751	1.377	Sycamore Drive to Jacksboro Road	14,650	1,200	1,440	70
D	1.377	2.204	Jacksboro Road to Old Bronston School Road	15,800	1,300	1,550	75
E	2.204	2.434	Old Bronston School Road to Tucker Road	16,500	1,350	1,620	80
F	2.434	2.577	Tucker Road to Gibson Lane	17,500	1,430	1,720	85
G	2.577	2.852	Gibson Lane to KY 790	18,350	1,500	1,800	90
H	2.852	3.061	KY 790 to New Cumberland River Bridge	20,200	1,660	1,980	100

Figure 7: 2045 AADT and DHV



3.3 Traffic Operational Analysis

The traffic operational analysis was conducted using HCS7 and Synchro software, which are based on the Highway Capacity Manual (HCM), 6th Edition methods to determine capacity and Level of Service (LOS). Highway LOS is a qualitative measure that is used to describe the operating conditions of a roadway or intersection based on factors such as speed, travel time, maneuverability, delay and safety. It is characterized by an A to F scale with A representing the best operating conditions and F representing the worst.

KY 90 is classified as a rural minor arterial west of Jacksboro Road and an urban minor arterial highway to the east. The AASHTO Green Book guidelines suggest that rural arterials be designed to LOS C and urban arterials to LOS D. Since roughly half the study area is classified as an urban minor arterial and there is anticipated future development, the Project Team determined it was best to use LOS D. For the purposes of the operational analysis, KY 90 was considered a two-lane highway from MP 0.15 to MP 2.8. KY 90 was considered a multi-lane highway from MP 0.0 to MP 0.15 and from MP 2.8 to MP 3.061. **Table 5** provides LOS criteria for the segment analysis.

Table 5: LOS Criteria for Two-Lane and Multi-Lane Highways

LOS	Two-Lane Highway*	Multi-Lane Highway
	Density (vehicles/mi/ln)	Density (pc/mi/ln)
A	≤ 2.0	≤ 11
B	>2.0-4.0	>11-18
C	>4.0 - 8.0	>18-26
D	>8.0 - 12.0	>26-35
E	>12.0	>35-45
F	Demand exceeds capacity	>45

pc/mi/ln: passenger cars per mile per lane
LOS D or better is acceptable
LOS is F when volume/capacity ≥ 1.0
*Two-lane follower density thresholds for facilities with posted speed limit ≥ 50mph

At intersections, LOS is a measure of average operating conditions during an hour. It is based on average delay per vehicle for a specified time period. Two-way, stop-controlled intersection LOS is defined in terms of the average vehicle delay of an individual movement(s). **Table 6** provides LOS criteria for unsignalized intersections.

Table 6: LOS Criteria for Unsignalized Intersections

LOS	Average Control Delay (sec/veh)	LOS Description
A	< 10	Little or no delay
B	> 10 and <15	Short traffic delays
C	> 15 and <25	Average traffic delays
D	> 25 and <35	Long traffic delays
E	> 35 and <50	Very long traffic delays
F	> 50	Severe congestion

Using the criteria listed above, intersection as well as segment analysis was completed for both existing (2022) and future (2045) traffic along KY 90. A more in-depth explanation of the traffic operational analysis can be found in **Appendix C** *Traffic Analysis and Methodology Report*.

3.3.1 Existing Conditions Year 2022 Analysis

Of the nine segments analyzed, all are expected to operate at LOS D or better during both the AM and PM peak hours. The results are presented in **Table 7** below.

Table 7: 2022 Segment LOS

Segment	No. Of Lanes	AM Peak Hour		PM Peak Hour	
		EB LOS	WB LOS	EB LOS	WB LOS
Beginning of Study Area to MP 0.15	4*	A	A	A	A
MP 0.15 to Forest Ridge Road	2	C	A	B	C
Forest Ridge Road to Sycamore Drive	2	C	B	B	C
Sycamore Drive to Jacksboro Road	2	C	B	B	C
Jacksboro Road to Old Bronston School Road	2	C	B	B	C
Old Bronston School Road to Tucker Road	2	C	B	B	C
Tucker Road to Gibson Lane	2	C	B	C	D
Gibson Lane to 0.1 Mile West of KY 790	2	D	B	C	D
0.1 Mile West of KY 790 to end of Study Area	5	A	A	A	A

EB = Eastbound, WB = Westbound *4 lane undivided passing lanes

Seven intersections were also analyzed along the study area. All seven of these intersections are stop-sign controlled on the minor street approaches. All movements along eastbound and westbound mainline KY 90 currently operate at LOS A. The minor street stop-controlled movements at all intersections operate at LOS D or better during both peak hours. **Table 8** presents the intersection Level of Service results.

Table 8: 2022 Intersection Level of Service

Intersection	AM Peak Hour				PM Peak Hour			
	EB LT	WB LT	NB Approach	SB Approach	EB LT	WB LT	NB Approach	SB Approach
	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS
Forest Ridge Road	-	A	B	-	-	A	B	-
Sycamore Drive	-	A	B	-	-	A	B	-
Jacksboro Road	A	A	B	C	A	A	C	C
Old Bronston School Road	-	A	B	-	-	A	B	-
Tucker Road	A	A	B	D	A	A	C	D
Gibson Lane	A	A	A	C	A	A	C	D
KY 790	A	A	B	C	A	A	B	D

LT = Left Turn, EB = Eastbound, WB = Westbound, NB = Northbound, SB = Southbound

3.3.2 Future Conditions Year 2045 Analysis

The capacity of KY 90 is expected to decrease as volumes increase in the future year 2045. However, all segments are expected to continue operating at LOS D or better during both the AM and PM peak hours with the exception of the segment between Gibson Lane and KY 790. This segment just dips under the LOS E threshold in the eastbound direction during the AM peak hour and in the westbound direction in the PM peak hour. **Table 9** presents the future year 2045 segment LOS.

Table 9: 2045 Segment Level of Service

Segment	No. Of Lanes	AM Peak Hour		PM Peak Hour	
		EB LOS	WB LOS	EB LOS	WB LOS
Beginning of Study Area to MP 0.15	4	A	A	A	A
MP 0.15 to Forest Ridge Road	2	C	B	B	C
Forest Ridge Road to Sycamore Drive	2	C	B	C	D
Sycamore Drive to Jacksboro Road	2	D	B	C	D
Jacksboro Road to Old Bronston School Road	2	D	B	C	D
Old Bronston School Road to Tucker Road	2	D	C	C	D
Tucker Road to Gibson Lane	2	D	C	C	D
Gibson Lane to 0.1 Mile West of KY 790	2	E	C	C	E
0.1 Mile West of KY 790 to End of Study Area	5	A	A	A	A

EB = Eastbound, WB = Westbound

The intersections of KY 90 / Forest Ridge Road, KY 90 / Sycamore Drive and KY 90 / Old Bronston School Road are expected to operate at LOS C or better during both AM and PM peak hours in 2045. The left turn movements along the minor street approaches at KY 90 / Jacksboro Road, KY 90 / Tucker Road, KY 90 / Gibson Lane, and KY 90 / KY 790 are expected to experience delay and operate at LOS E or F during the peak hours. It is not uncommon for left turn movements along the minor street approach at stop-controlled intersections to experience higher delay during peak hours. Although a signal warrant analysis was not conducted at these intersections, a preliminary examination indicated that they are not expected to meet signal warrants by 2045. **Table 10** presents year 2045 LOS.

Table 10: 2045 Intersection Level of Service

Intersection	AM Peak Hour				PM Peak Hour			
	EB LT	WB LT	NB Approach	SB Approach	EB LT	WB LT	NB Approach	SB Approach
	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS
Forest Ridge Road	-	A	B	-	-	A	C	-
Sycamore Drive	-	A	C	-	-	A	C	-
Jacksboro Road	A	A	C	C	A	A	E	D
Old Bronston School Road	-	A	C	-	-	A	B	-
Tucker Road	A	A	C	F	B	A	D	F
Gibson Lane	A	A	A	F	B	A	F	F
KY 790	A	B	C	D	B	A	C	F

LT = Left Turn, EB = Eastbound, WB = Westbound, NB = Northbound, SB = Southbound

3.4 Corridor Speeds

Travel speeds are an indicator of how a roadway is operating. Under normal operating conditions, drivers on a two-lane highway would typically be traveling close to the posted speed limit. Locations with typical operating speeds below the posted speed could indicate a geometric deficiency, such as a curve with a tight radius, or the lower speeds could be the result of intersection related delay, such as vehicles slowing down to turn into cross streets or driveways. To aid in the speed evaluation, KYTC provided 2019 HERE speed data for the KY 90 study area. The speed data were used to determine typical operating speeds throughout the day, including during peak traffic hours and off-peak hours.

Operating speeds were analyzed temporally and geographically to determine their relation to KY 90 operations. Speeds along KY 90 were generally at or over the posted speed limit of 55 mph. A range of 85th percentile speeds are presented in **Table 11** by roadway segment. Speed graphs are included in **Appendix D** *KY 90 Speed Analysis*.

The analysis showed that speeds are generally consistent by time of day. By location, speeds were generally higher on the western and eastern ends of the study area. There are more access points in the center of the study area as compared to the ends which may be a contributing factor to the comparably slower speeds in that portion of the study area. There was not a clear correlation between operating speeds and crash locations. Crashes along the study area typically occurred at intersections. A full discussion of crashes is presented in **Chapter 4** on Safety.

The crashes were incorporated into this analysis as well. The Project Team observed that most crashes occurred at intersections and driveways, and that curves and other segment related factors did not contribute to many crashes along the corridor. **Figures 8 and 9** show peak hour directional speeds and the number of crashes reported by location over the 5-year study period within the study area.

Table 11: KY 90 85th Percentile Speeds

Segment	Off Peak Speeds (mph)		AM Peak Hour Speeds (mph)		PM Peak Hour Speeds (mph)	
	EB	WB	EB	WB	EB	WB
Wayne Co. Line to Old KY 90 Loop #3	60+	60+	60+	60+	60+	60+
Old KY 90 Loop #3 to Jacksboro Road	55-60	55-60	55-60	55-60	55-60	50-55
Jacksboro Road to Gibson Lane	55-60	55-60	55-60	55-60	55-60	50-55
Gibson Lane to New Cumberland River Bridge	55-60	55-60	55-60	55-60	55-60	55-60

EB = Eastbound, WB = Westbound

Figure 8: Eastbound Peak Hour Speeds and Crash Locations

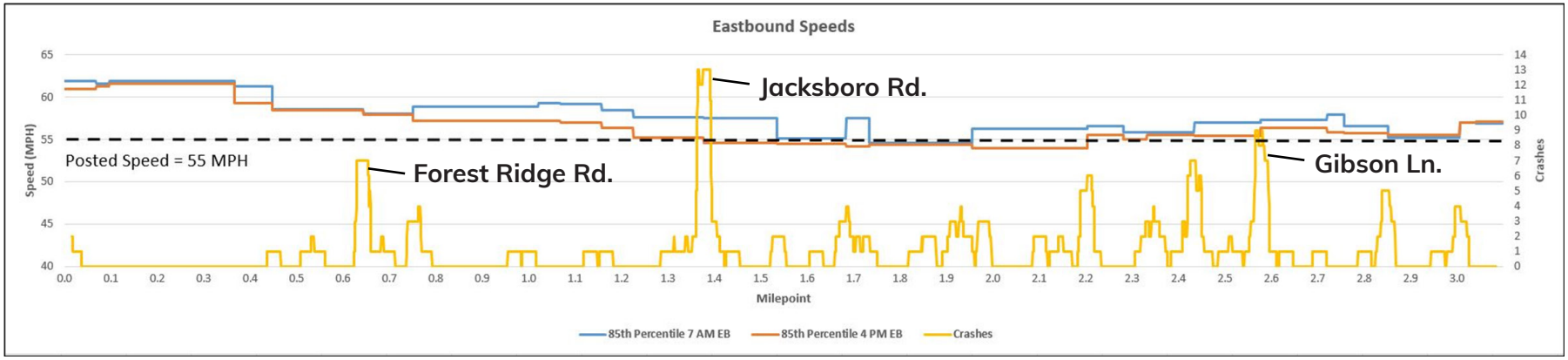
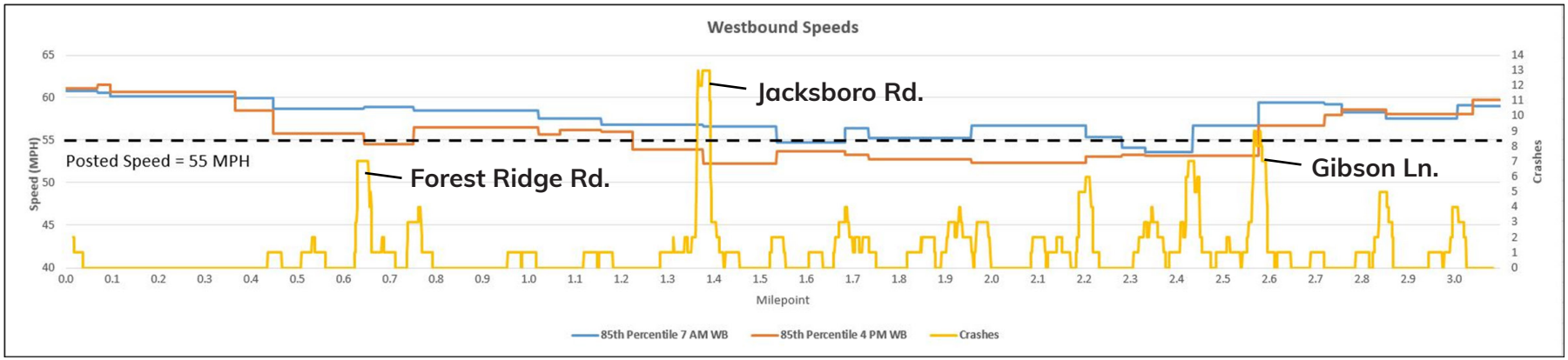


Figure 9: Westbound Peak Hour Speeds and Crash Locations



4 Safety

4.1 Historic Crash Analysis

A historical crash analysis was performed to examine traffic safety trends and to identify potential safety issues along KY 90. The crash data were derived from data provided by KYTC and the Kentucky State Police (KSP) database. Five years of data (2015 to 2019) were used in the analysis and are presented throughout the rest of this chapter. It should be noted that 2020 and 2021 crash data were not used in this historic crash analysis due to changes in driver behavior and traffic volumes during the COVID-19 pandemic. However, 2020 and 2021 crashes were included in the benefit cost analysis as a comparison if conditions along the study corridor (speeds, volumes, and driver behavior) change. For that analysis, a range of benefit cost from five years of data (2015 to 2019) to seven years of data (2015 to 2021) was used and is presented in **Chapter 8.1.1**.

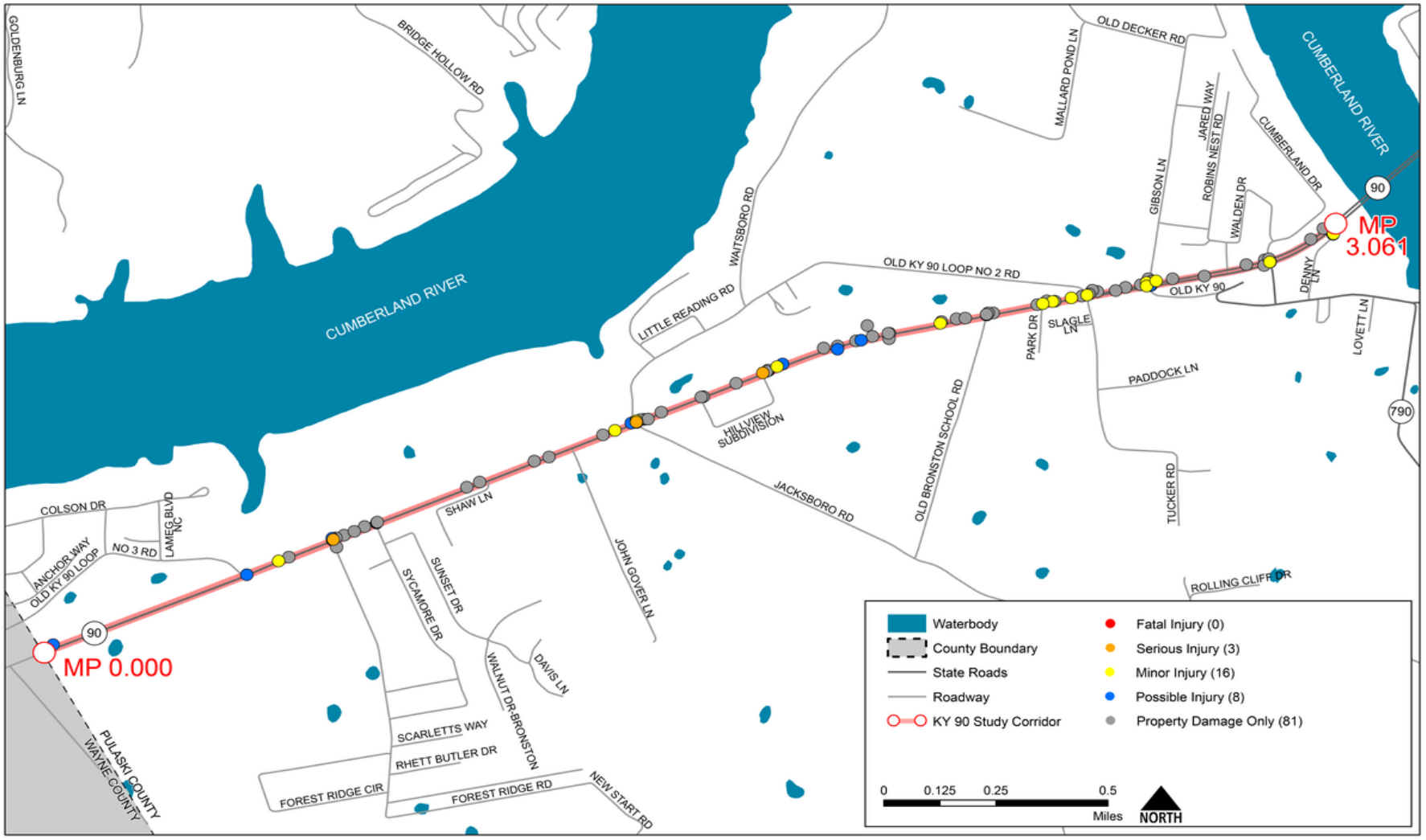
Within the five-year analysis period, 108[2] crashes were reported in the study area. A breakdown of the crashes by severity is presented in Table 12 and is shown in **Figure 10**. A majority of the crashes (75%) were property damage only crashes. There were three serious injury and 16 minor injury crashes over the 5-year study period. There were no fatalities reported.

Table 12: KY 90 Crash Severity (2015-2019)

Severity of Crash	Crashes	Percent
Fatal Injury	0	0%
Serious Injury	3	2.8%
Minor Injury	16	14.8%
Possible Injury	8	7.4%
Property Damage Only	81	75.0%
Total	108	100.0%

2 Two crashes of unknown severity were reported in the study area and are not included in this analysis.

Figure 10: KY 90 Crash Severity by Location (2015-2019)



An examination of the type of crashes along KY 90 is presented in **Table 13** and **Figure 11**. Approximately 44 percent of crashes in the study area are rear end crashes, followed by angle (21.3%) and single vehicle (14.8%) type crashes. A review of the locations of these crashes suggests that approximately 80% of them occurred at intersections or driveways. Rear end and angle crashes were fairly common at these intersections and driveways. This is consistent with the nature of the study area with its 95 access points, as discussed in Section 2.2.

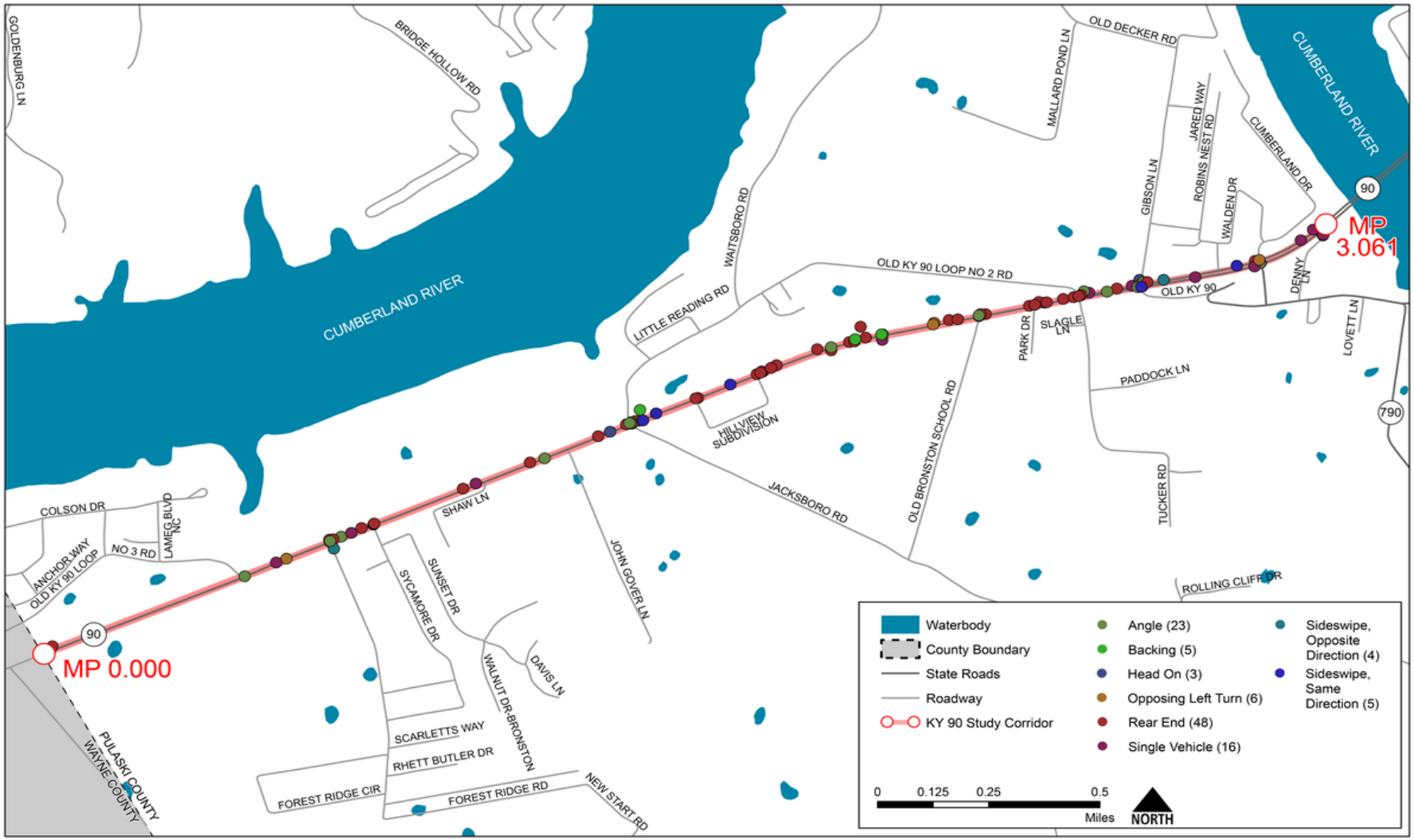
A closer review of rear end crashes was performed to determine if there were any trends or contributing factors contributing to the occurrences. Approximately 57% of rear end crashes involved a vehicle slowing down to turn left or queueing as result of left turning vehicles and 35% of rear end crashes involved a vehicle slowing down to turn right or queueing as a result from right turning vehicles. Removing left turning movements or providing left turning lanes has the potential to reduce rear end crashes.

As stated above there were no fatalities reported during the 5-year study period, however, there were three severe injury crashes. Two of these crashes resulted from rear end crashes and one was from an opposing left turn type crash.

Table 13: KY 90 Crashes by Manner of Collision (2015-2019)

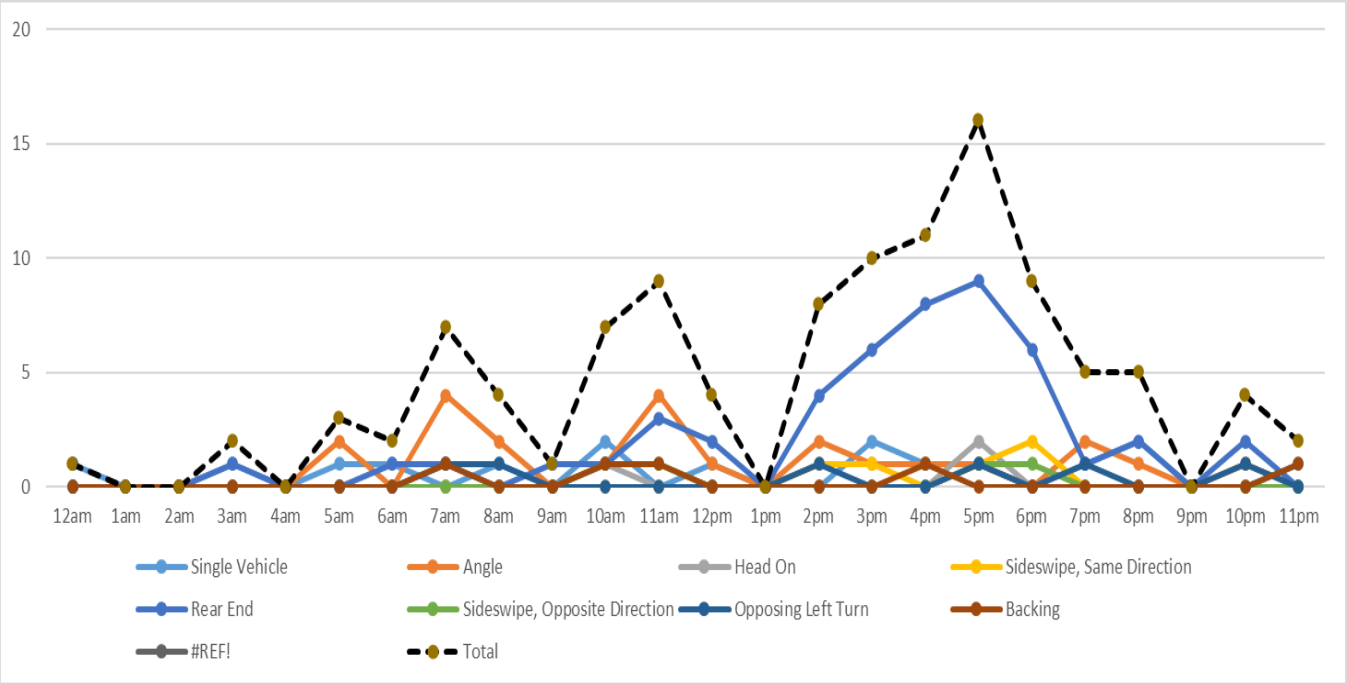
Crash Type	Crashes	Percent
Single Vehicle	16	14.8%
Angle	23	21.3%
Head On	3	2.8%
Sideswipe, Same Direction	5	4.6%
Rear End	48	44.4%
Sideswipe, Opposite Direction	4	3.7%
Opposing Left Turn	6	5.6%
Backing	3	2.8%
Total	108	100.0%

Figure 11: KY 90 Crash Type by Location (2015-2019)



A review of crashes by time of day, **Figure 12**, shows that crashes tend to peak during the afternoon from 2:00 PM to 8:00 PM, with the largest number of crashes occurring during the PM peak period of 5:00 PM to 6:00 PM.

Figure 12: Manner of Collision by Time of Day (2015-2019)



Given the study area's proximity to Lake Cumberland and other recreation facilities, a review of crashes by day of week and by month of year was completed to determine if there was a correlation between recreational traffic in the summer months and the number of crashes. As shown in **Figures 13** and **14**, crashes do not increase on weekend days nor do they increase appreciably during summer months.

Figure 13: Crashes by Day of Week (2015-2019)

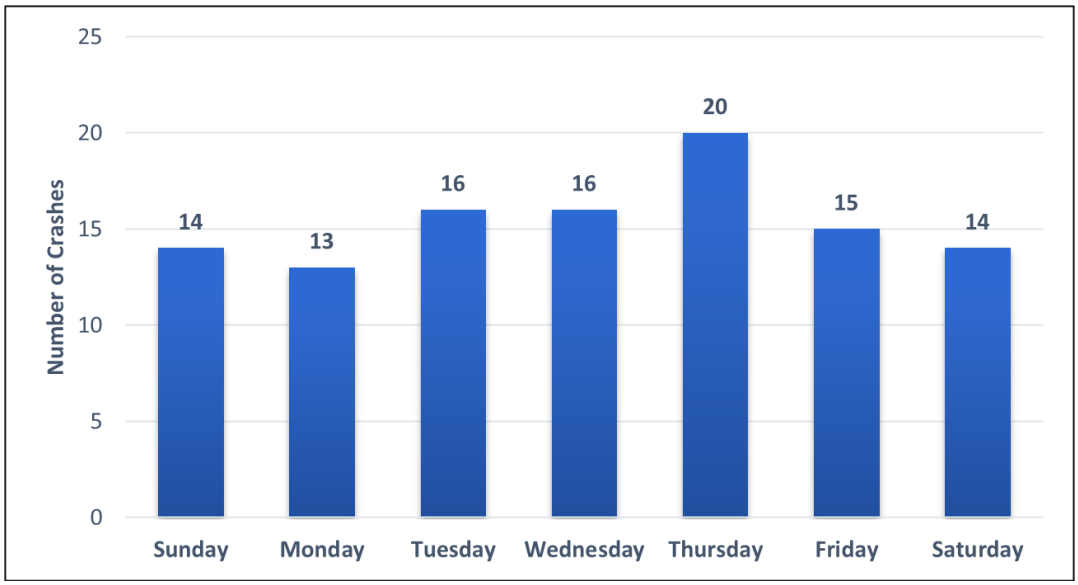
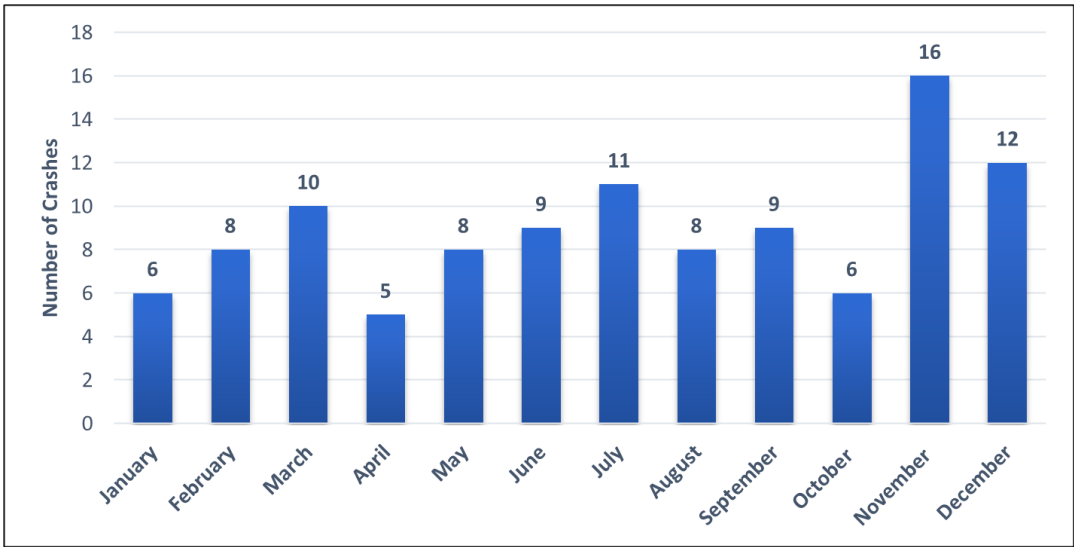


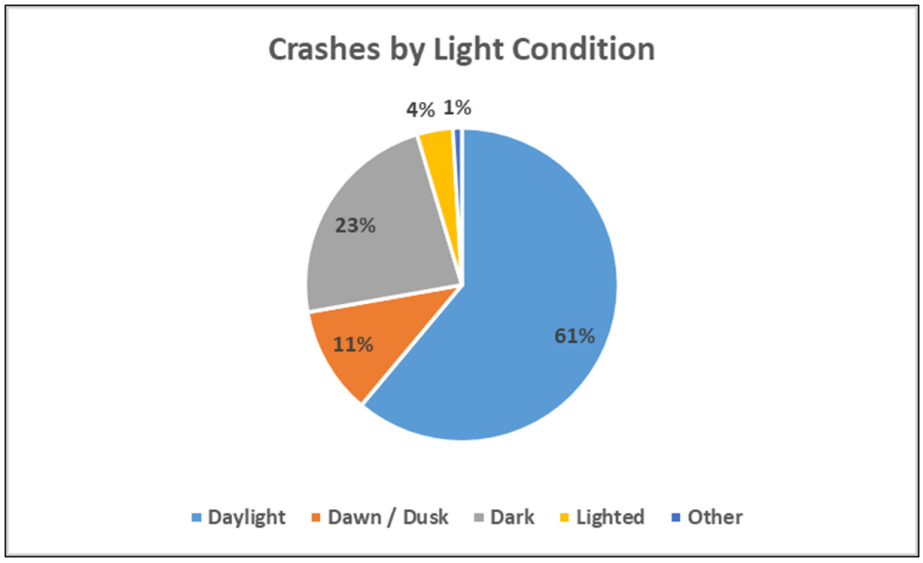
Figure 14: Crashes by Month (2015-2019)



A majority of the crashes occurred during daylight hours (**Figure 15**), however, approximately 34 percent occurred during dark or dawn/dusk hours indicating that lighting may be an issue along the study area.

Crashes during dark and dawn/dusk conditions appear to be overrepresented compared to the volume of traffic on the roadway during these conditions.

Figure 15: Crashes by Light Condition (2015-2019)



The density of crashes along the study area was plotted (**Figure 16**) to show locations with higher concentrations of crashes. Two trends emerged from a review of the plotted crash densities. The first is that crashes are generally denser east of Jacksboro Road where a higher concentration of driveways and intersecting roadways are present. The second is that crashes are denser at intersections, such as at Forest Ridge Road, Jacksboro Road, Old Bronston School Road, Tucker Road, and Gibson Lane, than at segments in between intersections.

Figure 16: KY 90 Crash Density (2015-2019)

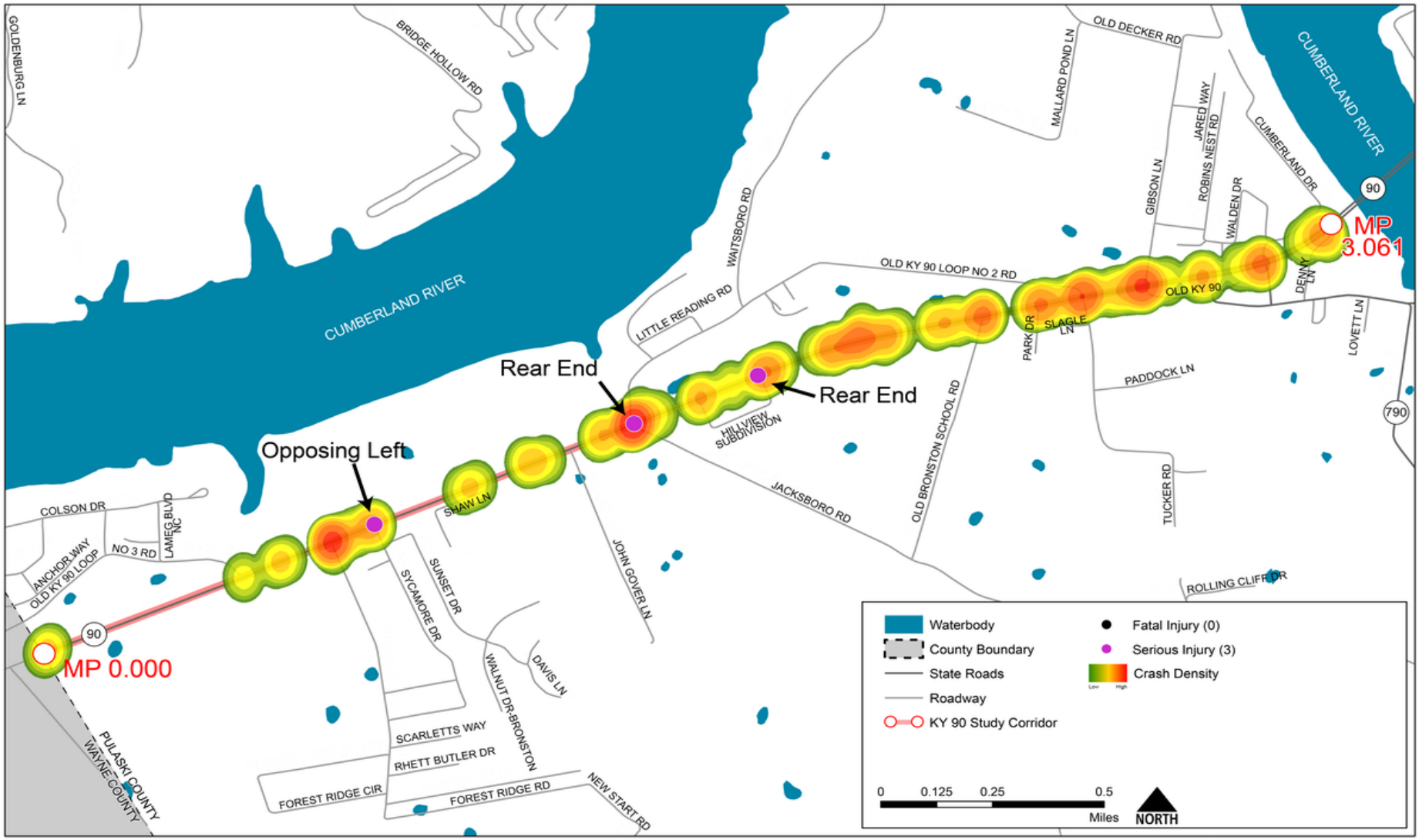


Table 14: KY 90 Segment Crash Rate – All Crashes

Segment	Begin MP	End MP	Number of Crashes[1]	Crash Rate[2]	Statewide Average Crash Rate
Two-Lane Rural	0.00	1.377	40	153	1723
Two-Lane Urban	1.377	2.757	62	237	4103
Five-Lane	2.757	3.061	8	139	1764

[1]Includes 2 crashes not in previous analysis with unknown severity
[2]Rate per 100 million vehicle miles traveled (MVM)
[3]Average statewide crash rate (5-year average) for two-lane highways per 100MVM for all crash severities
[4]No average statewide crash rate available for five-lane facilities, four-lane undivided rural used is used for comparison

KY 90 segment crash rates were calculated using the 2015 - 2019 crash data and traffic volumes. The section of KY 90 west of Jacksboro Road is considered rural and the section to the east is considered urban. The crash rates calculated for these sections were compared to statewide urban and rural two-lane highway average crash rates[3].

The analysis showed that KY 90 experienced a lower-than-average number of crashes per 100 million vehicle miles traveled (MVM) compared to similar type facilities throughout Kentucky in the urban and rural two-lane sections. No statewide crash rate averages were available for the five-lane section, but the most similar type facility of a four-lane rural undivided highway was used for comparison. **Table 14** provides further crash rate analysis details.

4.2 Excess Expected Crashes

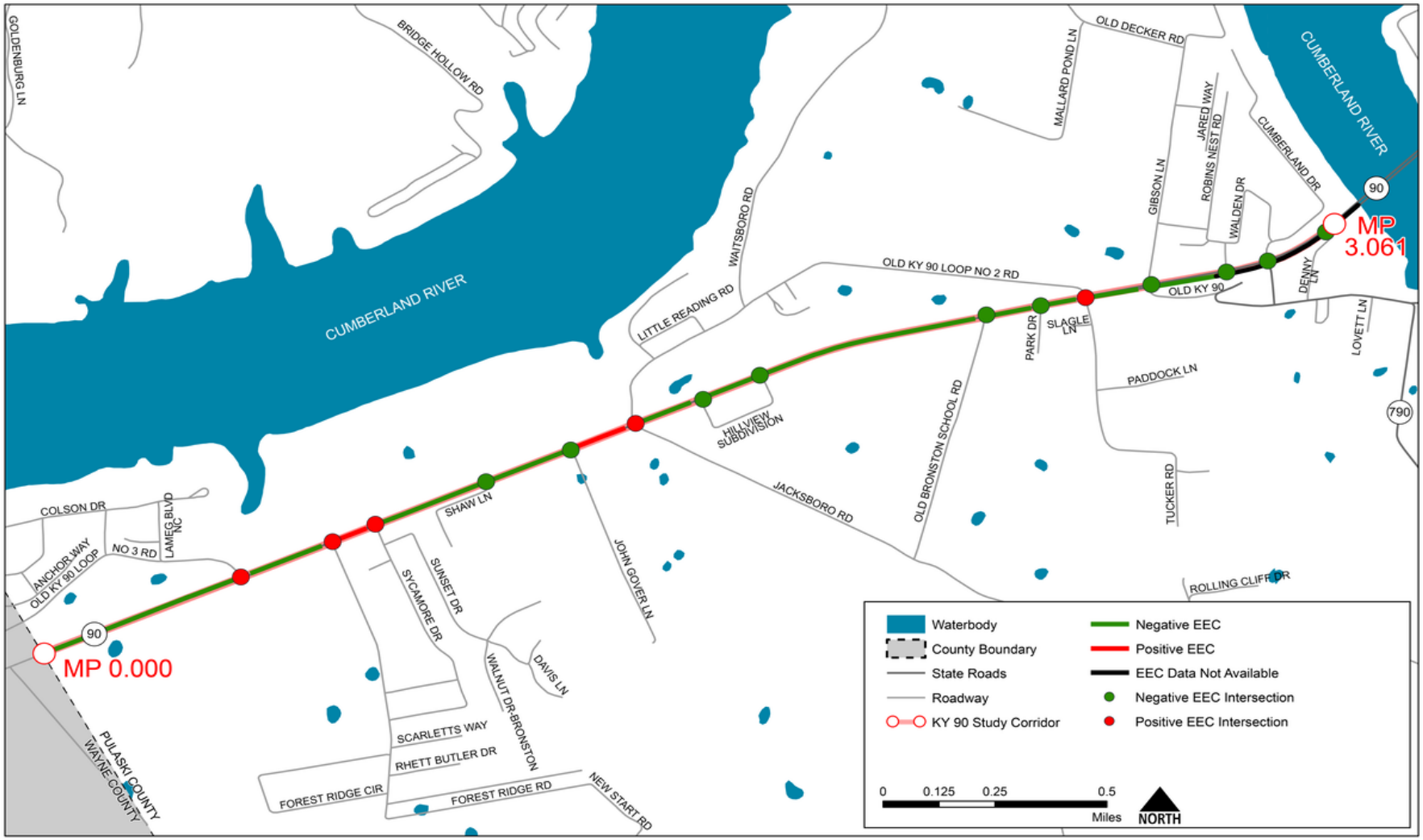
KYTC and KTC have developed a more refined statistical methodology based on the Highway Safety Manual (HSM) to rank the safety needs of projects. Excess Expected Crashes (EEC) is based on a crash prediction model estimating the number of crashes expected on an average roadway segment of a given type and length. It represents the number of excess crashes a segment is experiencing compared to other similar type roadways, adjusting for traffic volumes and relevant statistical corrections. EEC is positive when more crashes are occurring than expected and negative when fewer crashes are occurring than expected.

The EEC values for KY 90 were obtained from KYTC and are color coded on **Figure 17**. KY 90 experiences a mixture of positive and negative EEC values at intersections and segments. Basic trends from the EEC analysis show that the intersections with Old KY 90 Loop 3, Forest Ridge Road, Sycamore Drive, Jacksboro Road, and Tucker Road are experiencing greater than expected crashes. Most segments are experiencing fewer than expected crashes with the exception of the segment between Forest Ridge Road and Sycamore Drive and the segment between John Glover Lane and Jacksboro Road, which have positive EEC values.

Segments and intersections within the study area are experiencing an overall negative EEC value except for fatal (K) and injury crashes (AB) at intersections, which have a positive EEC value (higher than expected crashes) of 2.6. However, the study area as a whole experiences a negative EEC value of –16.82 indicating it experiences fewer than the expected number of crashes. These results indicate that overall, KY 90 is operating better than would be predicted for a minor arterial roadway with similar traffic volumes, with the exception of intersections along this roadway.

3 Analysis of Traffic Crash Data in Kentucky 2016 - 2020, Research Report KTC-21-26/KSP2-21-1F

Figure 17: KY 90 Excess Expected Crashes Map (2015-2019)



4.3 Summary of Safety Issues & Use of Safety Data

With minimal variability in crashes observed by day of week and month of year, recreational traffic did not appear to be a contributing factor to crashes in the study area. A comparison of crash rates within the study area shows that KY 90 experiences fewer crashes than other urban and rural two-lane roadways in the state. To further validate this observation, when variables such as lane width, shoulder width, traffic volume, and roadway curvature are considered, the EEC analysis indicates KY 90 is generally experiencing fewer crashes than would be expected on a similar type of facility, except at some intersections.

The review of historic crashes has also shown that a majority of the crashes are property damage only and are typical of crashes associated with intersections and driveways. The speed data review indicated a possible relationship between vehicle speeds and the density of access points along the corridor. Travel speeds decrease in the central part of the study area where there are a larger number of driveways and intersections. Speeds increase at both ends of the study area where there are fewer driveways and intersections. The review did not indicate that the higher travel speeds result in a higher number of crashes. Instead, crashes tend to be more concentrated around the driveways and intersections where average speeds tend to be lower. It appears that the access points and resulting speed differentials between through and turning vehicles could be a contributing factor to crashes.

The results for potential safety and traffic operational improvements at these locations are explored later in this report. The historic crash data, EEC information, and crash rates (calculated using the crash and volume data) were all used to evaluate the deficient locations and to develop both corridor wide and spot improvements.

5 Environmental Overview

Data were collected for an Environmental Overview (EO) based on existing geographic information system (GIS) datasets, state and federal agency databases, literature research, and archival data. Desktop research was performed to identify and locate areas of importance or concern that lie within a 500-foot buffer along KY 90 from the Wayne County Line to the New Cumberland River Bridge. Once resources were identified, those resources were considered within the context of improvement concepts and the potential for those concepts to impact the identified resources. The detailed EO is attached as **Appendix E**. Environmental resources are shown in **Figure 18**.

The EO considers resources in the following categories: ecological resources (i.e., streams, wetlands, and floodplains); threatened and endangered species and important habitats; air quality and noise issues; Environmental Justice (EJ) / socioeconomic data; land use; hazardous materials; and historic and archaeological resources.

A key consideration for all improvement concepts was whether they might occur outside of existing right-of-way. Those occurring outside of existing right-of-way or creating ground disturbance have greater potential to impact natural and socioeconomic resources. Concepts ultimately chosen during the design phase will require in-depth analysis and review to provide location approval (National Environmental Policy Act documentation) before transitioning to future phases of project development.

5.1 Natural Environment

The natural environment reviewed for the EO included ecological resources, threatened and endangered species, and important habitats. The potential to encounter natural environment resources is limited in this previously disturbed area. The desktop review identified that threatened and endangered species potential habitats are limited. Forested areas, which are very limited due to the developed nature of the area, are potential habitats of the federally listed Indiana bat and northern long-eared bat. Gray bat, Virginia big-eared bat, Virginia spiraea, white fringeless orchid, and six mussel species are additional federally listed species that are indicated as potentially occurring in the study area; habitat for these species is either very limited, unlikely, or absent. The monarch butterfly is a candidate species listed for the study area.

Aquatic resources are also limited in the study area. No perennial or intermittent streams, per the National Hydrography Dataset (NHD) and topographic mapping, are found in the study area. Per the National Wetlands Inventory (NWI) mapping, no wetlands were identified; however, farm ponds are scattered throughout the study area. No Federal Emergency Management Agency (FEMA) floodplains are found in the study area.

The nature of improvement concepts considered as a result of this study, the limited natural environment resources in the study area, and the goal of staying within existing right-of-way and within previously disturbed areas to the extent possible, will greatly minimize the extent of impacts to the natural environment. The bulleted items below provide a brief summary of the potential natural environment impacts to consider as a result of the proposed typical sections or spot improvements which are detailed in subsequent chapters of this document:

- **Three-Lane Section with Two Way Left Turn Lane (TWLTL)**
  - Concepts 1A, 1B, and 1C – Tree removal which would result in impacts to potential habitat of listed bat species, specifically Indiana bat and northern long-eared bat
- **Two-Lane Section with 6-foot Raised Median and Turn Lanes at Major Intersections**
  - Concepts 2A-1 and 2A-2 – Tree removal which would result in impacts to potential habitat of listed bat species, specifically Indiana bat and northern long-eared bat
- **Spot Improvements**
  - Spot Improvements 6, 7, 8, and 10 – Tree removal which would result in impacts to potential habitat of listed bat species, specifically Indiana bat and northern long-eared bat

All other proposed typical section concepts and spot improvements are not anticipated to result in impacts to the natural environment.

5.2 Human Environment

The human environment reviewed for the EO included air quality and noise issues; EJ / socioeconomic data; land use / farmland; hazardous materials; and historic and archaeological resources. As with the natural environment, the potential for the improvement concepts to impact the human environment is limited by the fact that most improvements would likely occur within existing right-of-way.

However, conceptual improvements do create some considerations, particularly where right-of-way may be required, related to traffic noise, hazardous materials and/or underground storage tanks (USTs), and potential cultural resources including both archaeological resources and historic structures. Previously surveyed historic sites whose National Register of Historic Places (NRHP) eligibility has not been determined are of specific consideration. Specifically, those resources which were listed previously as undetermined eligibility will require a historic assessment to determine eligibility for the NRHP during the design phase. If properties are determined eligible for listing on the NRHP, they may also be considered Section 4(f) resources. Improvements may also require traffic noise analysis, first using the Traffic Noise Analysis Screening Tool during the design phase, as well as further consideration of any future project's potential to encounter hazardous materials and/or USTs.

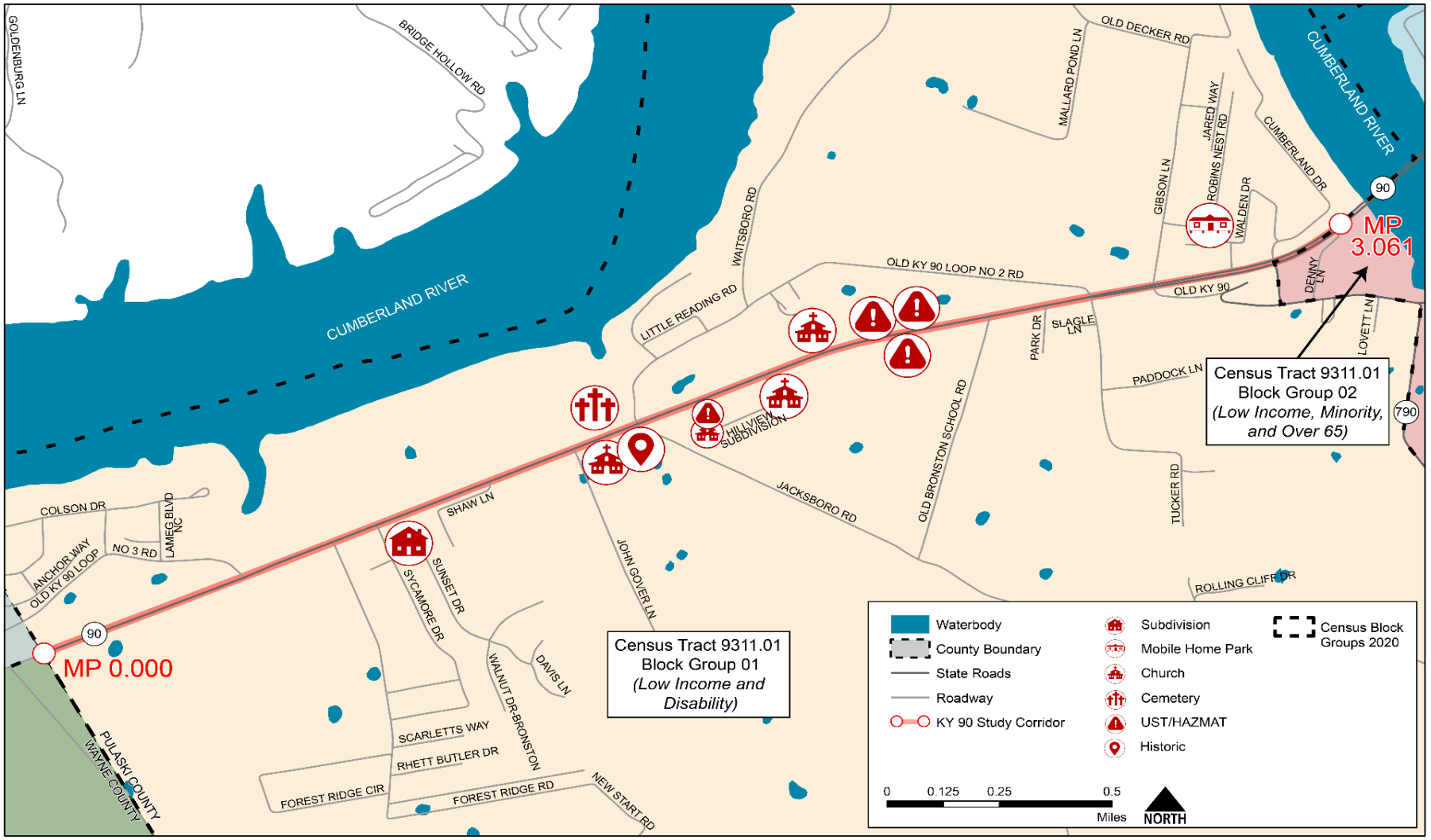
The Lake Cumberland Area Development District (LCADD) prepared the *KY 90 Corridor Study, Pulaski County, Socioeconomic Study* (LCADD Socioeconomic Study) to assess EJ populations that must be considered in any future project development phases. The report used 2020 U.S. Census Bureau American Community Survey (ACS) 5-Year Estimates data. The LCADD reported data for the U.S., Kentucky, Pulaski County and the one census tract (CT) and two block groups (CT BG) that include the study area. The LCADD used county estimates as the reference thresholds. Specifically, CT and BG estimates were presented for CT 9311.01, BG 1 and BG 2, which include the study area. As a result of the analysis, BG 2 exceeded the reference threshold for minority population and that both BG 1 and BG 2 exceeded the reference threshold for low-income population. Further, BG 2 exceeded the reference threshold for population over age 65 while BG 1 exceeded the reference threshold for population with disability status. Neither BG exceeded the reference threshold for limited English proficiency. The full *LCADD Socioeconomic Study* is included in the EO in **Appendix E**.

The bulleted items below provide a brief summary of the potential human impacts to consider relative to the conceptual typical sections and spot improvements.

- **Three-Lane Section with Two Way Left Turn Lane (TWLTL)**
  - Concepts 1A and 1B – Considerations of archaeological and/or historic resources and hazardous materials and/or USTs
  - Concepts 1A, 1B, and 1C – Considerations of potential traffic noise impacts and analysis
- **Two-Lane Section with 6-foot Raised Median and Turn Lanes at Major Intersections**
  - Concepts 2A-1 and 2A-2 – Considerations of archaeological and/or historic resources; hazardous materials and/or USTs; and potential traffic noise impacts and analysis
- **Spot Improvements**
  - Spot Improvements 2, 6, 7, 8, and 9 – Considerations of archaeological resources
  - Spot Improvement 6 – Considerations of historic resources

All other proposed typical section concepts and spot improvements are not anticipated to result in any impacts to the human environment.

*Figure 18: **Study Area Existing Environmental Conditions***



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6 Development of Potential Improvement Concepts

Based on the existing conditions, traffic, and safety analysis, an initial list of potential improvement concepts was developed and presented to the Project Team at the Project Team Meeting #1. A separate table was presented for corridor-wide concepts and spot improvements.

6.1 Corridor-Wide Potential Improvement Concepts

Potential improvement concepts that could be implemented for the entire corridor or sections of the corridor were developed, and a high-level analysis of each concept was performed. This included expected right-of-way impacts, the type of access management that would be possible, high-level traffic and safety performance, and what, if any, environmental impacts may result. These improvement concepts are described in the following sections and shown in **Table 15**.

6.1.1 Three-Lane Section with Two-Way Left Turn Lane (TWLTL)

The first corridor-wide improvement concept was to widen to three-lanes to include two 12-foot travel lanes, a 12-foot center two-way left turn lane (TWLTL) and 8-foot paved shoulders. It was assumed that this typical section would begin in the west near Old KY 90 Loop 3 where the passing lanes end and extend to Old KY 90 / Gibson Lane in the east where the five-lane section begins. This typical section is shown in **Figure 19.**

6.1.2 Two-Lane Section with Raised Median

The second improvement concept was to widen to allow for a raised center median allowing for access management. It was assumed the typical section would begin in the west at Jacksboro Road and extend to Old KY 90 / Gibson Lane in the east where the five-lane section begins. The three-lane typical section in section 6.1.1 above would be in place between the end of the passing lanes in the west to Jacksboro Road in the east. This typical section is shown in **Figure 20**.

Table 15: Initial List of Potential Corridor-Wide Improvement Concepts

Typical Section Concepts												
Number	Location	Begin MP	End MP	Description	Asscociated Access Management	ROW Impacts		Access Pts	General	Traffic	Environmental	Cost
						Acres	Acquisitions					
1	Old KY 90 Loop 3 to Old KY 90/ Gibson Lane	0.448	2.577	3-lane section with TWLTL	Concept #1 - close duplicate access points / change some to RIRO (yellow)	11.14	5	3 to RIRO, 21 Closed. Closing 21 access points and converting 3 to RIRO could reduce crashes by up to 6% in the existing 2-lane section.	TWLTL's reduce potential conflicts with turning traffic and to provide a refuge for vehicles waiting to turn left. A TWLTL could reduce driveway related crashes by ~20%. Within the existing two-lane section 45 rear end and 16 angle collisions occured.	TWLTL's do not add substantial capacity to a two-lane roadway. TWLTLs provide refuge for left turning vehicles and could increase operating speeds. Two-lane section currently operates at LOS C/D in 2022. No two-lane section in 2022 has a v/c ratio above 0.44.	Archaeology, Tree Removal (bats), Possible Historic, UST/HAZ, Potential Noise Screening Tool	Med
2	Jacksboro Road to Old KY 90/ Gibson Lane	1.377	2.577	2-lane section with 6' raised median & turn lanes at major intersections	Concept #2 - same as Concept #1 but RIRO through section with raised median	8.66	3	27 to RIRO, 21 Closed. Additional 24 driveways converted to RIRO compared to option 1. Closing 21 access points and converting 27 to RIRO could reduce crashes by up to 14%.	On urban and suburban arterials, reducing the number of median openings and intersections (such as by adding a barrier median) reduces the number of intersection and driveway related crashes, however, the magnitude of the crash benefit is not certain. A reduction in crashes similar to what would occur by reducing the number of access points would be expected. Within the raised median section 25 rear end, 2 angle, 2 opposing left, and 1 head on crashes occured.	Intersections would need to be analyzed to check if the added traffic from vehicles that used to be able to turn left out of an entrance that have to now use another intersection to turn left or u-turn can perform at an acceptable Level of Service.	Archaeology, Tree Removal (bats), Possible Historic, UST/HAZ, Potential Noise Screening Tool	Low
3A	T&G to Old Bronston School Rd	1.73	2.204	Frontage Road on north side of KY 90	Concept #3 - same as Concept #1 but close driveways with access to frontage and backage roads	2.09	0	21 to RIRO, 29 Closed 8 RIRO access points closed. Closing 29 access points and converting 19 to RIRO could reduce crashes by up to 14%.	No specific CMF available for adding a frontage road. The HCM method for determining crash benefits by removing driveways would be applicable to this concept.	Intersections created by the frontage road at the mainline may need to be analyzed for acceptable Level of Service and operations.	Archaeology, Tree Removal (bats), Possible Historic, UST/HAZ, Potential Noise Screening Tool, Church	Med

Typical Section Concepts												
Number	Location	Begin MP	End MP	Descrip-tion	Asscociated Access Manage-ment	ROW Impacts		Access Pts	General	Traffic	Environmental	Cost
						Acres	Acquisi-tions					
3B	Old Hwy 90 to Kentucky Marine	1.377	1.6	Backage Road on north side of KY 90		2.22	1	23 to RIRO, 25 Closed 4 RIRO access points closed. Closing 25 entrances and converting 23 to RIRO could reduce crashes by up to 14%.	No specific CMF available for adding a backage road. The HCM method for determin-ing crash benefits by removing driveways would be applicable to this concept.	Intersections created by the backage road at the mainline may need to be analyzed for acceptable Level of Service and operations.	Archaeology, Tree Removal (bats), Possible Historic, UST/ HAZ, Po-tential Noise Screening Tool, Church	Med
4	Old KY 90 Loop 3 to Old KY 90/ Gibson Lane	0.448	2.577	5-lane section with TWLTL	Concept #1 - close duplicate access points / change some to RIRO (yellow)	19.51	10	3 to RIRO, 21 Closed Same as 3-lane access points. Closing 21 access points and convert-ing 3 to RIRO could reduce crashes by up to 6%.	TWLTL's reduce potential conflicts with turning traffic and to provide a refuge for vehicles waiting to turn left. A five-lane TWTL typical section could provide less of a safety benefit over the three-lane TWLTL typical section due to the potential for higher mainline speeds and more conflict points. There is no HSM methodology or CMF available to analyze a change from two-lane to five-lane typical section. Within the existing two-lane section 45 rear end and 16 angle collisions occured.	The addition of a through lane in each direc-tion would add capacity to the corridor result-ing in LOS A/B operations in the future year, however, given the volumes of traffic a portion of this capacity could go unused. No two-lane section in 2022 has a v/c ratio above 0.44.	Archaeology, Tree Removal (bats), Possible Historic, UST/ HAZ, Noise Analysis, Churches	High
5 (1B/2B)	Jacks-boro Road to Bridge	1.377	3.223	Sidewalk along north side of road, curb and gutter	Concept #1 - close duplicate access points / change some to RIRO (yellow)			3 to RIRO, 21 Closed Same as 3-lane access points. Using HSM methodology, closing 21 access points and converting 3 to RIRO would reduce crashes by 6%. Reducing the number of driveways or reducing the number of turning movements at driveways is potentially safer for pedestrian/bicycle traffic by reducing the number of conflict points and the number of objects the driver has to focus on.	No pedestrian or bicycle related crashes occurred along the study area within 2015 - 2019. Removing pedestrians from the roadway shoulder and having them walk on a sidewalk should better meet driver expectations on where pedestrians walk.		Archaeology, Tree Removal (bats), Possible Historic, UST/ HAZ, Po-tential Noise Screening Tool, Church	

Figure 19: Three-Lane Section with TWLTL

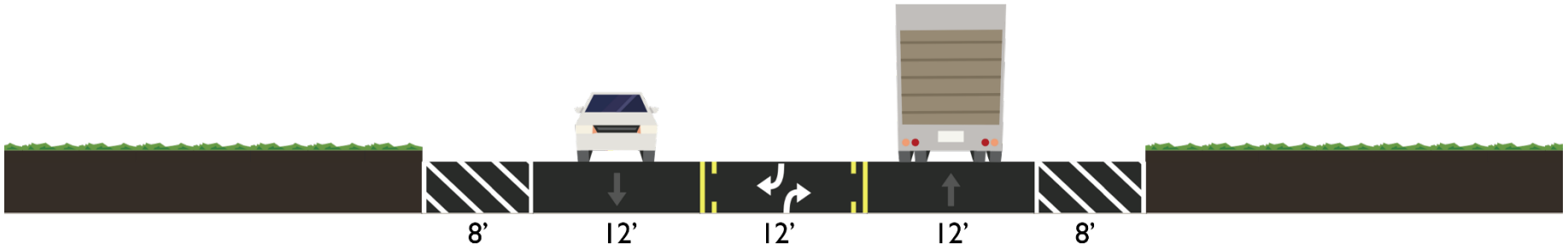
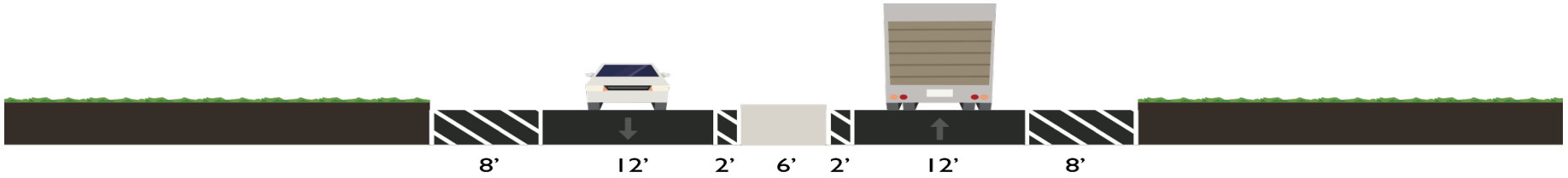


Figure 20: Two-Lane Section with Raised Median



6.1.3 Frontage and Backage Roads

The third concept developed would be done in conjunction with the raised median concept and would add a frontage road and backage road along the north side of KY 90 to further limit access and improve safety and mobility in the area with the highest number of access points. The backage road would run behind businesses along the north side, beginning on Old KY 90 Loop Road (across from Jacksboro Road) in the west and ending behind Kentucky Marine in the east. The frontage road would run in front of businesses along the north side of KY 90 beginning at the T&G Used Furniture and Appliances store and ending at Old Bronston School Road. **Figure 21** shows the typical section of KY 90 with a 12-foot buffer between the frontage road, which is a two-lane road with 10-foot travel lanes. The backage would also be a two-lane road with 10-foot travel lanes.

6.1.4 Five-Lane Section with TWLTL

A five-lane section with center TWLTL was also evaluated. This is similar to the three-lane section, in that it would extend from Old KY 90 Loop 3 where the passing lanes end in the west to Old KY 90 / Gibson Lane in the east where the five-lane section begins. **Figure 22** shows the typical section for this option.

6.1.5 Sidewalk Along North Side of Road with Curb and Gutter

An option was proposed that included a sidewalk on the northern side of KY 90. This could be done in conjunction with either the TWLTL or raised median options, however in either case the shoulders would be replaced with curb and gutter to improve safety. **Figure 23** shows a typical section with sidewalks in conjunction with a two-lane section with a raised median and curb and gutter.

6.1.6 Access Management

An aggressive access management strategy was presented that would close any duplicate access points throughout the study area. When implemented in conjunction with the three- or five-lane section with a TWLTL, this would convert three access points to right-in / right-out (RIRO) and would fully close 21 access points. Adding the two-lane section with raised median would further convert 24 access points to RIRO. Adding a frontage road would close an additional eight access points along KY 90, moving access to the frontage road, and adding a backage road would close an additional four access points along KY 90, moving them to the backage road.

6.1.7 Revision of Corridor-Wide Potential Improvement Concepts

The corridor-wide potential improvement concepts described above were shared with the project team at the second Project Team Meeting. The project team decided not to move forward with certain concepts based on the information presented and discussion. The project team agreed to move forward with the three-lane section with TWLTL, the raised median option, the frontage and backage roads, as well as the possibility of adding a sidewalk or multiuse path. The project team noted that the raised median section could extend beyond the limits proposed, and that additional frontage and backage roads could be explored as a proactive measure for access management. The project team indicated that the access management strategy of closing duplicate access points should not be advanced, but that any access management would need to come from limiting turns using a raised median. Additional discussion with regards to multimodal improvements occurred during the meeting, noting some of the challenges with regards to safely accommodating bicyclists and pedestrians adjacent to the roadway, as well as the lack of a local government to maintain sidewalk or multiuse path infrastructure. Due to these issues, the project team decided to remove sidewalk and multiuse path options from further consideration after the initial screening of potential improvement concepts.

Figure 21: Frontage and Backage Roads

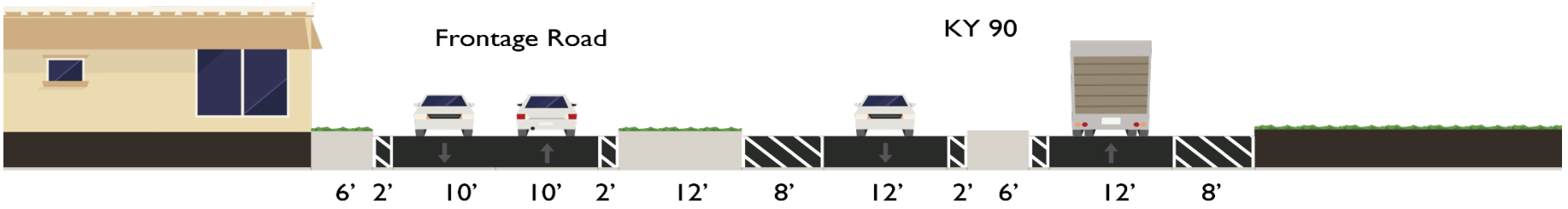


Figure 22: Five-Lane Section with TWLTL

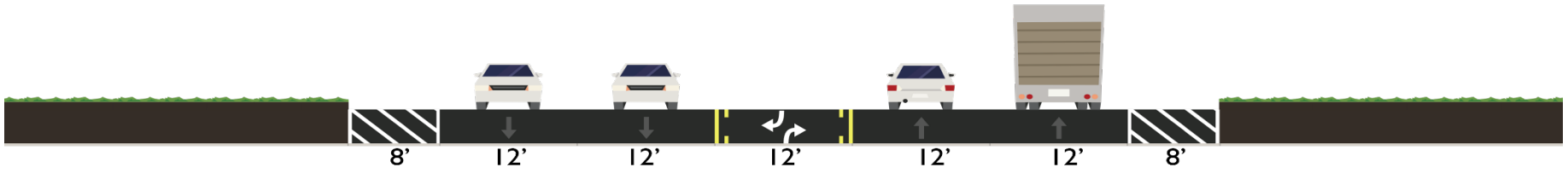
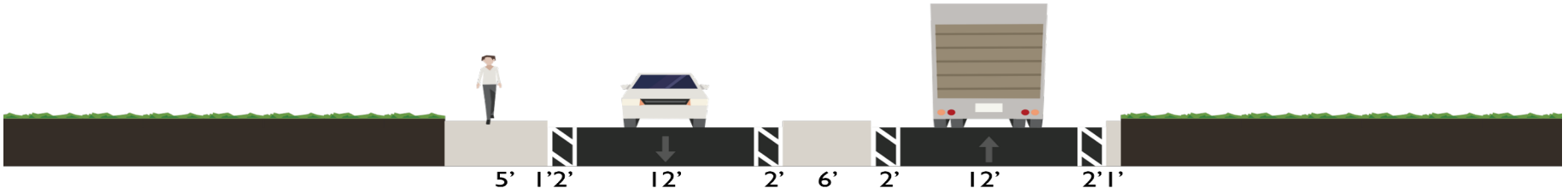


Figure 23: Sidewalk Along North Side of Road with Curb and Gutter



6.2 Potential Spot Improvement Concepts

In addition to corridor-wide improvement concepts, spot improvement concepts were also developed based on a review of geometric, safety, and traffic data as well as a field review. The potential improvement concepts presented at the second Project Team Meeting are described in the following sections and listed in **Table 16**.

6.2.1 Forest Ridge Road

Current traffic volumes at the Forest Ridge Road intersection meet turn lane warrants for a westbound left turn lane from KY 90 onto Forest Ridge Road. Additionally, advanced intersection warning signage would be implemented, as there is a history of crashes at this intersection. Because the development is minor in this part of the study area, drivers may not be aware there is an intersection. **Figure 24** shows the conceptual design at this location.

6.2.2 Sycamore Drive

Current traffic volumes at the Sycamore Drive intersection meet turn lane warrants for a westbound left turn lane from KY 90 onto Sycamore Drive. **Figure 24** shows the conceptual design, in conjunction with the left turn lane at Forest Ridge Road, due to the proximity of the intersections.

6.2.3 Shaw Lane

An issue observed during the field review is that vehicles slow down dramatically to make the eastbound right turn onto Shaw Lane, due to the sharp curvature immediately after the turn off of KY 90, resulting in a 180 degree turn. The pavement and shoulder at this location is in poor condition, possible due to the turning vehicles. This improvement concept would improve the pavement, widen the radius of the turn, and widen out the shoulder prior to the turn, to allow vehicles to slow down and make a wider turn utilizing the shoulder, reducing the potential for collisions on KY 90. This concept is shown in **Figure 25**.

6.2.4 Jacksboro Road / Old KY 90 Loop 2 Road

The Jacksboro Road/Old KY 90 Loop 2 Road intersection marks the western end of the section of KY 90 with the heaviest concentration of access points. Providing “Congestion Ahead” signage in advance of the intersection would indicate to drivers that the character of the road is about to change, from being rural with fewer access points to the more densely populated area of Bronston. Additionally, gateway signage and landscaping could be added as another visual cue to drivers, which would also bring visibility to Bronston. The Jacksboro Road southern leg of the intersection is at a significant skew, therefore a third potential improvement concept would be to realign the Jacksboro Road leg to reduce the skew. Conceptual drawings of these concepts are shown in **Figure 25**.

6.2.5 Roundabouts at Jacksboro Road and Tucker Road

Both Jacksboro Road/Old KY 90 Loop 2 and Tucker Road/Old KY Loop 2 have a high number of crashes in the vicinity of the intersections. Roundabouts could be placed at each of these intersections, the bookends of the Old KY 90 Loop 2 Road. This segment also has the highest density of access points and is where the two-lane with raised median option is being considered. Roundabouts at these two locations would slow drivers approaching this area, allow for vehicles to make U-turns, and provide safer turns off of Old KY 90 Loop, Jacksboro Road, and Tucker Road. This concept is shown in **Figure 26**.

Table 16: Potential Spot Improvement Concepts

Spot Improvement Concepts							
Number	Location	MP	Description	Safety	Crash Data	Traffic	Environmental
1	Forest Ridge Road	0.644	Provide Advance Intersection Warning Signing	No specific HSM methodology or CMF is applicable to implementing the proposed improvement. Providing better warning of an upcoming intersection should improve driver awareness of the upcoming conditions.	• 3 rear end, 2 angle, 1 opposing left turn (serius injury) • 1 PDO crash occurred at entrance near intersection	Intersection TWSC currently operates at LOS B in the AM and PM.	None
2	Forest Ridge Road	0.644	WB Left Turn Lane on KY 90	Adding dedicated left turn lanes at a TWSC intersection can reduce total crashes between 28 and 48%.	• 3 rear end, 2 angle, 1 opposing left turn (serius injury) • 1 PDO crash occurred at entrance near intersection	• Mainline Left Turn Lane Warrant met in PM. • Intersection TWSC currently operates at LOS B in the AM and PM."	Archaeology
3	Sycamore Drive	0.705	WB Left Turn Lane on KY 90	Adding dedicated left turn lanes at a TWSC intersection can reduce total crashes between 28 and 48%.	• 2 rear end, 1 single vehicle, no reported injuries	• Mainline Left Turn Lane Warrant met in PM • Intersection TWSC currently operates at LOS B in the AM and PM."	Archaeology
4	Shaw Lane	1.021	Angle shoulder to widen for RTs and improve pavement	By increasing the turning radius into Shaw Lane, the turning vehicle, especially if hauling a trailer, should be able to exit the roadway quicker thus reducing the potential for rear end collisions.	• No crashes occurred at intersection		None
5	Jacksboro Road	1.377	Provide "Congestion Ahead" Signing	No specific HSM methodology or CMF is applicable to implementing the proposed improvement. Providing better warning of an upcoming congested area should improve driver awareness of the upcoming conditions.	• 7 rear end (1 serious injury, 1 possible injury), 5 angle (3 minor injury) • Highest intersection crash rate in study area.	Intersection NB and SB TWSC approaches currently operates at LOS C in the AM and PM.	None
6	Jacksboro Road	1.377	Improve Intersection Skew	HSM 14.6.2.1: Safety benefit of reducing intersection skew. Reduces the extent drivers have to turn their head to view approaching vehicles. Driver can better judge gaps in traffic.	• 7 rear end (1 serious injury, 1 possible injury), 5 angle (3 minor injury) • Highest intersection crash rate in study area.	Intersection NB and SB TWSC approaches currently operates at LOS C in the AM and PM.	Archaeology, Tree Removal (bats), Possible Historic,
7	Jacksboro Road	1.377	Gateway to Urban Area with Signage & Landscaping	No HSM analysis technique or CMF is available for this option. Providing a landscaped gateway into the urbanized area may improve driver awareness of the upcoming change in conditions and roadside environment.	• 7 rear end (1 serious injury, 1 possible injury), 5 angle (3 minor injury) • Highest intersection crash rate in study area.	Intersection NB and SB TWSC approaches currently operates at LOS C in the AM and PM.	None

Spot Improvement Concepts							
Number	Location	MP	Description	Safety	Crash Data	Traffic	Environmental
8	Jacksboro Road & Tucker Road	1.377&2.434	Change Intersections to Roundabout	Converting a TWSC intersection to a roundabout can reduce fatal and injury crashes by 82%.	• Jacksboro Rd.: 7 Rear end (1 serious injury, 1 possible injury), 5 angle (3 minor injury) • Highest intersection crash rate in study area. • Tucker Rd.: 4 Rear end (1 minor injury), 1 angle (minor injury), 1 side-swipe same direction, 1 side-swipe opposite direction"	• Jacksboro: Intersection NB and SB TWSC approaches currently operates at LOS C in the AM and PM. • Tucker Rd.: NB TWSC approach operates at LOS C and SB TWSC approach operates at LOS D."	Archaeology, Tree Removal (bats), Possible Historic, UST/HAZ,
9	Old Bronston School Road	2.204	Improve Intersection Skew	HSM 14.6.2.1: Safety benefit of reducing intersection skew. Reduces the extent drivers have to turn their head to view approaching vehicles. Driver can better judge gaps in traffic.	• 5 rear end, 1 angle, no reported injuries	Intersection TWSC currently operates at LOS B in the AM and PM.	Archaeology, Tree Removal (bats),
10	Old Bronston School Road	2.204	WB Left Turn Lane on KY 90	Adding dedicated left turn lanes at a TWSC intersection can reduce total crashes between 28 and 48%.	• 5 rear end, 1 angle, no reported injuries	• Mainline Left Turn Lane Warrant met in PM. • Intersection TWSC currently operates at LOS B in the AM and PM.	Archaeology, Tree Removal (bats)
11	Park Drive	2.332	Improve Intersection Skew	HSM 14.6.2.1: Safety benefit of reducing intersection skew. Reduces the extent drivers have to turn their head to view approaching vehicles. Driver can better judge gaps in traffic.	• Three rear end crashes (1 minor injury)		Archaeology
12	Tucker Road / Old KY 90 Loop	2.434	EB & WB Left Turn Lanes on KY 90	Adding dedicated left turn lanes at a TWSC intersection can reduce total crashes between 28 and 48%.	• 4 rear end (1 minor injury), 1 angle (minor injury), 1 side-swipe same direction, 1 sideswipe opposite direction	• Mainline Left Turn Lane Warrant met in PM. • NB TWSC approach operates at LOS C and SB TWSC approach operates at LOS D.	Archaeology
13	Gibson Lane / Old KY 90	2.577	Restripe EB & WB Turn Lanes and Improve WB Merge	By restriping left turn lanes at this intersection crashes should be reduced. By improving the WB merge striping and distance side-swipe same direction crashes should be reduced.	• 1 rear end (minor injury), 4 angle (1 minor injury), 2 single vehicle (1 minor injury), 1 side-swipe same direction (possible injury), 1 head on	The SB TWSC approach operates at LOS C in the AM and LOS D in the PM.	None
14	KY 790 / Cumberland Drive	2.852	Change Intersection to RCUT	Converting a TWSC intersection to an RCUT can reduce fatal and injury crashes by 54%.	• 2 angle (1 minor injury), 1 rear end, 1 opposing left turn	The SB TWSC approach operates at LOS C in the AM and LOS D in the PM.	Archaeology

Figure 24: Potential Spot Improvements at Forest Ridge Road and Sycamore Drive

Figure 25: Potential Spot Improvements at Shaw Lane and Jacksboro Road

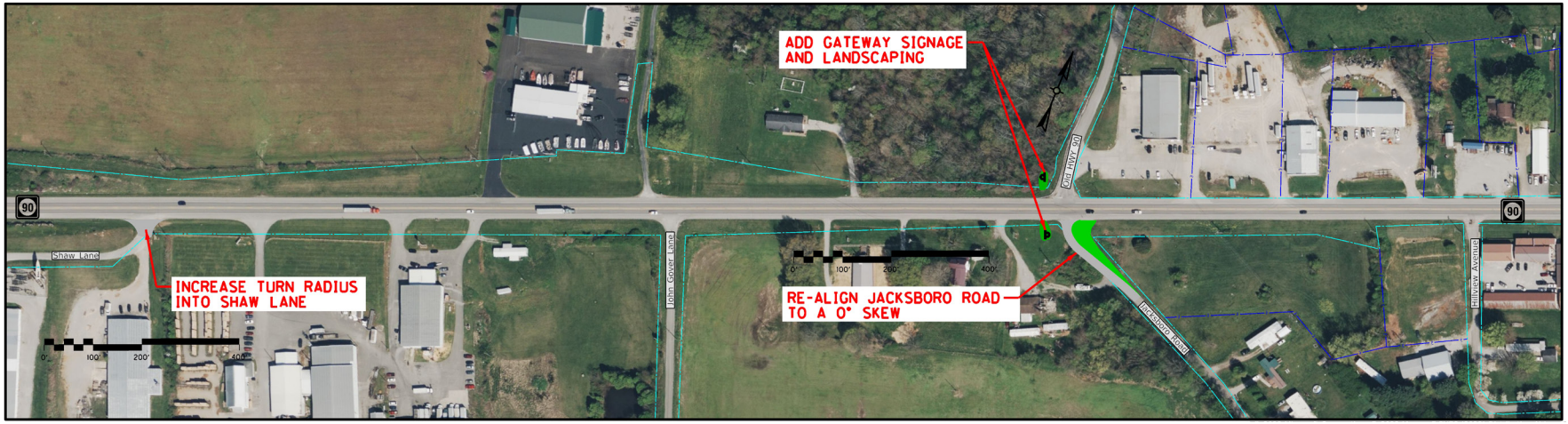


Figure 26: Roundabouts at Jacksboro Road and Tucker Road

6.2.6 Old Bronston School Road

Old Bronston School Road approaches KY 90 at a moderate skew and does not have sufficient sight distance for vehicles turning onto KY 90. A potential improvement concept would realign the Old Bronston School Road to reduce the skew. Conceptual drawings of these improvements are shown in **Figure 27**.

6.2.7 Park Drive

Park Drive approaches KY 90 at a skew. This intersection does meet sight distance requirements, however there is a history of crashes at this location. Improving the skew from Park Drive onto KY 90 is a potential spot improvement, shown in **Figure 27**.

6.2.8 Tucker Road / Old KY 90 Loop 2 Road

Current traffic volumes at the Old KY 90 Loop 2 Road/ Tucker Road intersection meet turn lane warrants for both an eastbound and westbound left turn lane from KY 90. A conceptual drawing of this potential improvement concept is shown in **Figure 27**.

6.2.9 Gibson Lane / Old KY 90

Current traffic volumes at the Old KY 90 / Gibson Lane intersection meet turn lane warrants for both eastbound and westbound left turn lanes from KY 90. This intersection is also positioned in a unique place because KY 90 transitions from a five-lane to two-lane roadway. In the westbound travel direction this results in a merge of two-lanes to one-lane before the intersection. In the eastbound direction, the widening of the pavement might cause driver confusion based on the crashes at that location. A second improvement concept for this intersection would clarify lane usage and the westbound merge through signing and striping. A conceptual drawing of this potential improvement concept is shown in **Figure 28**.

6.2.10 KY 790 / Cumberland Drive

Traffic volumes at the KY 790 intersection do not warrant turn lanes, however there is a history of crashes at this location. A restricted crossing U-turn (RCUT) would eliminate left turns off of KY 790, allowing traffic to only turn right. Then, drivers desiring to make the left turn could U-turn a short distance from the intersection. This potential improvement concept would reduce conflicts and address the crashes. A conceptual drawing of this potential improvement concept is shown in **Figure 29**.

Figure 27: Potential Spot Improvements from Old Bronston School Road to Old KY 90 Loop 2 Road/Tucker Road

Figure 28: Potential Spot Improvements at Old KY 90 / Gibson Lane

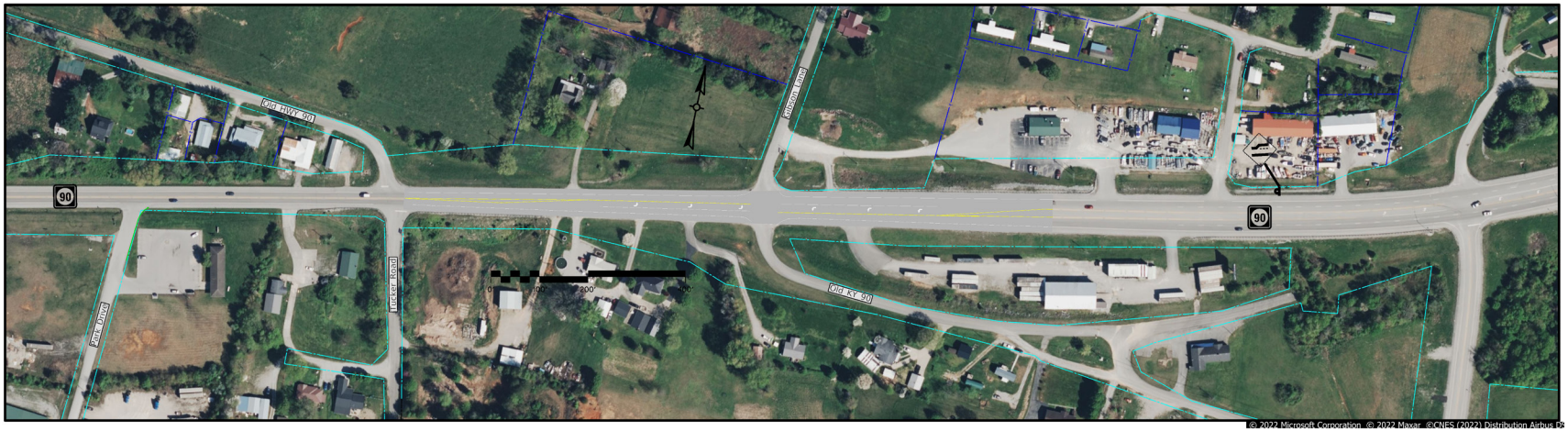
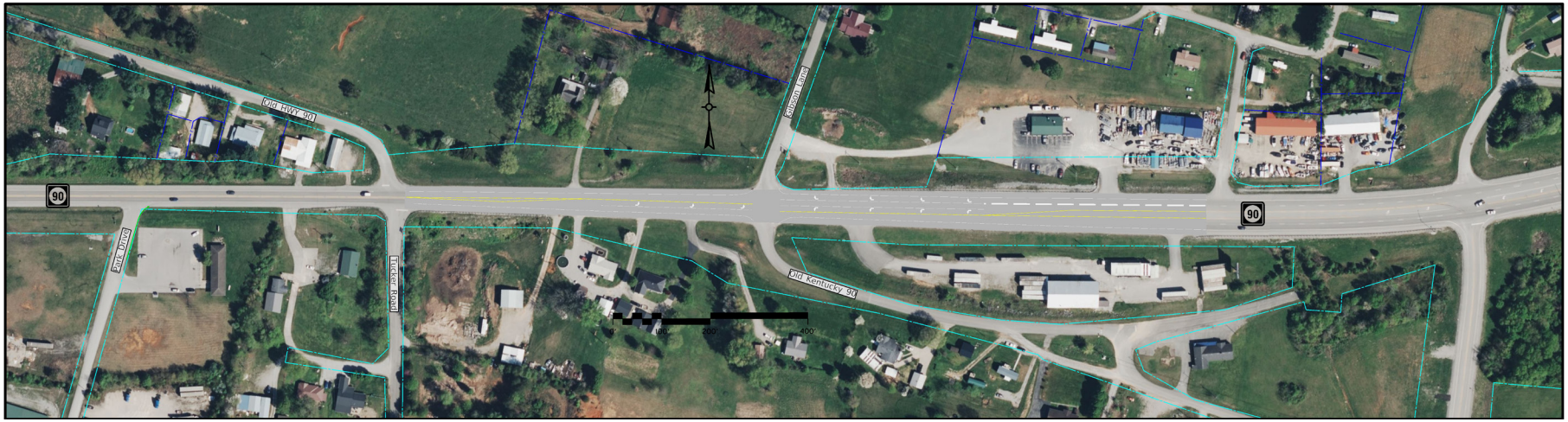


Figure 29: Potential Spot Improvement at KY 790



6.2.11 Revision of Spot Improvement Concepts

The potential spot improvement concepts described above were presented to the Project Team at the second Project Team Meeting. The Project Team suggested adding a second improvement concept for the Gibson Lane / Old KY 90 intersection, which would eliminate the westbound merge and instead of merging the right lane, continue it to the intersection as a right turn only lane. The project team also decided that the RCUT at KY 790 should not move forward for further consideration, as it would likely not be justified based on crash and volume data. The other spot improvements were presented at the Local Officials and Stakeholders Meeting. Additional spot improvements were added to the list for consideration as a result of that meeting. These included:

1. Add a westbound turn lane from KY 90 onto Park Drive to accommodate the Post Office and a high number of tractor trailers who turn left at that location.
2. Evaluate KY 790 for a traffic signal. Left turns out of KY 790 cause side street delay.
3. Evaluate a northbound right turn lane on KY 790 to address the delay caused by vehicles trying to turn left from KY 790 onto KY 90.

7 Stakeholder Outreach

In addition to Project Team Meetings between the Consultant Team and KYTC, outreach for this project included a meeting with local officials and stakeholders and coordination with resource agencies. Meeting minutes can be found in **Appendix F**, along with the responses received from the resource agencies.

7.1.1 Project Team Meeting #1

The first project meeting was held virtually on April 21, 2022. The consultant team presented the study schedule, as well as existing conditions including geometrics and other relevant KYTC projects. Traffic and safety aspects presented included level of service, HERE speed data, crash data and trends, and calculated EEC. The crash patterns were discussed, including the numerous access points, potential causes, and seasonality of the crashes. A drone video drive through was also presented. The Project Team agreed to generate alternatives to address identified issues within the study area for discussion at Project Team Meeting #2, after which the local stakeholders meeting would be used to provide feedback.

7.1.2 Project Team Meeting #2

Project Team Meeting #2 was also virtual and held on May 13, 2022. LOS traffic data were presented, followed by improvement concepts and the corresponding right-of-way and building acquisitions. The corridor-level concepts included a three-lane section with a TWLTL, a two-lane section with raised median and potential roundabouts, and an option for frontage and backage roads. Discussion involved how to best mitigate the many access points with the closure of these access points deemed unfavorable. 14 potential spot improvements were also presented and discussed. The local official and stakeholder meeting was then discussed, including the presentation that was being prepared and logistics for the meeting.

7.1.3 Local Officials and Stakeholders Meeting

A hybrid virtual and in-person meeting was held with stakeholders and local officials on May 18, 2022. First, the project goals and objectives, schedule, and background were presented, followed by existing conditions. After discussion and answering questions, improvement concepts were presented, including corridor-level and spot improvements. All concepts were discussed in the context of current conditions and operating characteristics. The Project Team shared that the various concepts would be evaluated in mid-June with the next project meeting being at the end of June.

7.1.4 Project Team Meeting #3

The final Project Team Meeting was a hybrid virtual and in-person meeting held on July 1, 2022. After updates on crash and speed trends, all corridor concepts and spot improvements were discussed regarding effectiveness, cost, and suitability. The Project Team segregated the list into concepts that would or would not be recommended for future project phases. Potential federal grant funding was also presented. Finally, it was decided that prioritization of the concepts would not be done at this time, giving the district flexibility to determine which projects they would like to move forward when funding becomes available.

7.1.5 Resource Agency Coordination

Resource agency coordination was important for the study and included coordinating with state, local, and federal agencies to obtain feedback on any known resources or constraints on the study area that may impact future phases of project development. A project summary and maps to summarize the traffic and safety conditions, as well as environmental overview were provided to the Resource Agencies so they could provide comment. Resource Agency / Stakeholder Listing and Agency response comments are included in **Appendix F**.

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8 Evaluation of Potential Improvement Strategies

The list of improvement strategies for the corridor as well as spot improvements was refined based on feedback from the Project Team, additional data presented to answer questions posed at the Project Team Meetings, and criteria based on the goals and objectives of the project. Each improvement strategy was evaluated with respect to safety, traffic operations, environmental impacts, right-of-way impacts, and cost estimates. These criteria are described below in more depth.

8.1 Evaluation Criteria

8.1.1 Safety/Access Management

A predictive safety analysis was performed for each improvement concept to estimate the potential reduction in crashes over a 20-year period. Applicable Crash Modification Factors (CMFs) were identified from the Highway Safety Manual (HSM) or the CMF Clearinghouse[4]. The CMFs were applied to relevant historic crashes to estimate the number and percent of crashes that could have been prevented. The results were then extrapolated to estimate the crashes that could be prevented over a 20-year period. CMFs used in this analysis, for both corridor-wide and spot improvements, are presented in **Table 17**.

A high-level benefit-cost analysis (BCA) was conducted to estimate the value of each improvement concept. This analysis compared the predicted 20-year crash reduction to the concept level cost estimate (including design, right-of-way, utility relocation, and construction). The value of the crashes prevented was based on United States Department of Transportation (USDOT) average crash cost by severity (in 2020 dollars). The future benefits were discounted at the USDOT recommended 7% discount rate. The improvement concept costs were converted to 2020 dollars to complete the BCA.

Two BCA values were provided as part of the analysis because of the higher proportion of fatal and severe injury crashes that occurred during 2020. One analysis estimated the project safety benefits using the crash data from 2015 to 2019. The second analysis used seven years of crash data from 2015 to 2021. This was done to account for the increase in fatal and severe injury crashes observed in 2020 and to provide a range of potential project benefits and resulting benefit-cost ratios. The results reflect the uncertainty of predicting traffic safety benefits, but they also highlight the improvements that are most likely to have benefits that would exceed the costs.

Table 17: Improvement Concept Crash Modification Factors

CMF Description	CMF ID / HSM Source	Value(s)
Provide TWLTL on Rural Two-Lane Highway	HSM Equation 16-3 (CMF ID: 5186)	0.79
CMF for Rural Two-Lane Highway Lane Width	HSM Table 13-2	1.00 – 1.05
CMF for Rural Two-Lane Highway Shoulder Width	HSM Table 13-7	0.87 – 1.00
Changing Access Point Density	HSM Equation 13-7 (CMF ID: 5185)	0.92
Install Raised Median	CMF ID: 7792	0.76
Install Advance Warning Signs (Positive Guidance)	CMF ID: 1684	0.65
Provide Left Turn Lane on Major Approach	CMF ID: 253	0.56
Change Intersection Skew Angle	CMF ID: 5188	0.85 - 0.94
Change Right Turn Geometry	CMF ID: 8498	0.59

4 http://www.cmfclearinghouse.org/

8.1.2 Traffic Operations

Improving operational aspects is one method to meet the goals of reducing congestion and improving safety. Criteria examined to measure operational improvement included examination of turning radii, advantages provided by various shoulder and median widths, evaluating the need for turn-lanes or signal warrants, and potential improved LOS. Appropriateness of each concept to support expected speed profiles in the corridor was also taken into consideration.

8.1.3 Environmental Impacts

The environmental resources identified and considered included: ecological resources (i.e., streams, wetlands, and floodplains), threatened and endangered species and important habitats; air and noise issues; EJ / socioeconomic data; land use; hazardous materials; and historic and archaeological resources. Impacts to these resources were considered in the evaluation.

8.1.4 Right-of-Way Impacts

For each improvement concept, acres of right-of-way required and property acquisitions (how many properties would require a building take) were quantified. The costs of these impacts were included in the cost estimates.

8.1.5 Cost Estimates

Cost estimates for each corridor and spot improvement concept were developed in 2021 dollars using recent unit costs. Construction costs were used for the detailed evaluation, although these costs took into consideration right-of-way. These costs were used to calculate the benefit/cost ratio. Full design, right-of-way, utility, and construction costs were developed for the final recommended concepts shown in **Chapter 9**.

8.2 Analysis of Corridor-Wide Potential Improvement Concepts

Using the criteria listed in the previous section, the corridor-wide potential improvement concepts were evaluated and presented to the Project Team at the third Project Team Meeting. The initial list of concepts was expanded as different combinations of lane and shoulder widths were evaluated for both the TWLTL and raised median concepts, and the raised median concept was evaluated both from Jacksboro Road to Gibson Lane and from Jacksboro Road to the New Cumberland River Bridge. **Table 18** shows the corridor-wide improvement concepts and associated evaluation for each.

8.3 Analysis of Potential Spot Improvement Concepts

The spot improvement concepts moved forward from the initial screening were also evaluated using the previously listed criteria. Based on discussions with the Project Team in the Project Team Meeting #2, as well as stakeholders, several additional spot improvement concepts were added for evaluation. These include adding a westbound left turn lane from KY 90 onto Park Drive, eliminating the westbound merge on KY 90 approaching Gibson Lane / Old KY 90 and converting the right lane into a right turn lane to Gibson Lane, adding a northbound right turn lane from KY 790 onto KY 90, and evaluating KY 790 for traffic signal warrants. The RCUT at KY 790 was removed from consideration. **Table 19** shows the list of improvements and their associated evaluation.

Table 18: Refined Corridor-Wide Potential Improvement Concepts

Typical Section Concepts							ROW Impacts		General	Traffic	Environmental	Cost	Fatal and Injury Crash Reduction	B / C
Number	Location	Begin MP	End MP	Description	Existing Typical Section	Proposed Typical Section	Acres	Acquisitions						5yr Crashes / 7yr Crashes
1A	Old KY 90 Loop 3 to Old KY 90/ Gibson Lane	0.448	2.577	3-lane section with TWLTL	12' lanes, 12' shoulders	12' lanes, 12' TWLTL, 8' shoulders	11.14	5	TWLTL's reduce potential conflicts with turning traffic and to provide a refuge for vehicles waiting to turn left. A TWLTL could reduce driveway related crashes by ~20%	TWLTL's do not add substantial capacity to a two-lane roadway, but provide refuge for left turning vehicles and could increase operating speeds. Two-lane section currently operates at LOS C/D in 2022. No two-lane section in 2022 has a v/c ratio above 0.44.	Archaeology, Tree Removal (bats), Possible Historic, UST/HAZ, Potential Noise Screening Tool	$7,200,000	21%	0.3 - 1.5
1B-1	Old KY 90 Loop 3 to Old KY 90/ Gibson Lane	0.448	2.577	3-lane section with TWLTL	12' lanes, 12' shoulders	11' lanes, 12' TWLTL 8' shoulders	9.45	5	TWLTL's reduce potential conflicts with turning traffic and to provide a refuge for vehicles waiting to turn left. A TWLTL could reduce driveway related crashes by ~20%	TWLTL's do not add substantial capacity to a two-lane roadway, but provide refuge for left turning vehicles and could increase operating speeds. Two-lane section currently operates at LOS C/D in 2022. No two-lane section in 2022 has a v/c ratio above 0.44.	Archaeology, Tree Removal (bats), Possible Historic, UST/HAZ, Potential Noise Screening Tool	$6,500,000	19%	0.3 - 1.5
1B-2	Old KY 90 Loop 3 to Old KY 90/ Gibson Lane	0.448	2.577	3-lane section with TWLTL	12' lanes, 12' shoulders	11' lanes, 12' TWLTL 7' shoulders	8.91	5	TWLTL's reduce potential conflicts with turning traffic and to provide a refuge for vehicles waiting to turn left. A TWLTL could reduce driveway related crashes by ~20%	TWLTL's do not add substantial capacity to a two-lane roadway, but provide refuge for left turning vehicles and could increase operating speeds. Two-lane section currently operates at LOS C/D in 2022. No two-lane section in 2022 has a v/c ratio above 0.44.	Archaeology, Tree Removal (bats), Possible Historic, UST/HAZ, Potential Noise Screening Tool	$6,100,000	13%	0.2 - 1.1
1B-3	Old KY 90 Loop 3 to Old KY 90/ Gibson Lane	0.448	2.577	3-lane section with TWLTL	12' lanes, 12' shoulders	11' lanes, 12' TWLTL 6' shoulders	8.44	4	TWLTL's reduce potential conflicts with turning traffic and to provide a refuge for vehicles waiting to turn left. A TWLTL could reduce driveway related crashes by ~20%	TWLTL's do not add substantial capacity to a two-lane roadway, but provide refuge for left turning vehicles and could increase operating speeds. Two-lane section currently operates at LOS C/D in 2022. No two-lane section in 2022 has a v/c ratio above 0.44.	Archaeology, Tree Removal (bats), Possible Historic, UST/HAZ, Potential Noise Screening Tool	$5,800,000	7%	0.1 - 0.6

Table 18: Refined Corridor-Wide Potential Improvement Concepts (Cont'd)

Typical Section Concepts							ROW Impacts		General	Traffic	Environmental	Cost	Fatal and Injury Crash Reduction	B / C
Number	Location	Begin MP	End MP	Description	Existing Typical Section	Proposed Typical Section	Acres	Acquisitions						5yr Crashes / 7yr Crashes
1B-4	Old KY 90 Loop 3 to Old KY 90/ Gibson Lane	0.448	2.577	3-lane section with TWLTL	12' lanes, 12' shoulders	"11' lanes, 12' TWLTL 5' shoulders"	0	0	TWLTL's reduce potential conflicts with turning traffic and to provide a refuge for vehicles waiting to turn left. A TWLTL could reduce driveway related crashes by ~20%	TWLTL's do not add substantial capacity to a two-lane roadway, but provide refuge for left turning vehicles and could increase operating speeds. Two-lane section currently operates at LOS C/D in 2022. No two-lane section in 2022 has a v/c ratio above 0.44.	Noise Screening Tool	$4,900,000	0%	0.0 - 0.0
1C	Old KY 90 Loop 3 to Old KY 90/ Gibson Lane	0.448	2.577	3-lane section with TWLTL	12' lanes, 12' shoulders	12' lanes, 12' TWLTL, curb & gutter	0	0	TWLTL's reduce potential conflicts with turning traffic and to provide a refuge for vehicles waiting to turn left. A TWLTL could reduce driveway related crashes by ~20%	TWLTL's do not add substantial capacity to a two-lane roadway, but provide refuge for left turning vehicles and could increase operating speeds. Two-lane section currently operates at LOS C/D in 2022. No two-lane section in 2022 has a v/c ratio above 0.44.	Noise Screening Tool	$5,200,000	21%	0.4 - 2.0
2A-1a	Jacksboro Road to Old KY 90/ Gibson Lane	1.377	2.577	2-lane section with 6' raised median & turn lanes at major intersections	12' lanes, 12' shoulders	"12' lanes, 6' raised median 8' shoulders"	8.66	3	On urban and suburban arterials, reducing the number of median openings and intersections (such as by adding a barrier median) reduces the number of intersection and driveway related crashes, however, the magnitude of the crash benefit is not certain. A reduction in crashes similar to what would occur by reducing the number of access points would be expected. Within the raised median section 25 Rear end, 2 angle, 2 opposing left, and 1 head on crashes occured."	• Provide left turn lanes at Jacksboro Rd., Old Bronston School Rd., Park Dr., and Tucker Rd. intersections. 345' Left Turn Lane length needed (includes 100' bay taper). • Could be combined with roundabouts at Jacksboro Rd. and Tucker Rd. to provide turning access. Roundabouts would operate acceptably, likely near LOS C. • U-turn loons could be added to accomodate left turning traffic. U-turn movement would operate acceptably, likely near LOS C.	Archaeology, Tree Removal (bats), Possible Historic, UST/HAZ, Potential Noise Screening Tool	$4,800,000	24%	0.3 - 2.3

Table 18: Refined Corridor-Wide Potential Improvement Concepts (Cont'd)

Typical Section Concepts							ROW Impacts		General	Traffic	Environmental	Cost	Fatal and Injury Crash Reduction	B / C
Number	Location	Begin MP	End MP	Description	Existing Typical Section	Proposed Typical Section	Acres	Acquisitions						5yr Crashes / 7yr Crashes
2A-1b	Jacksboro Road to Old KY 90/ Gibson Lane	1.377	2.577	2-lane section with 6' raised median & turn lanes at major intersections	12' lanes, 12' shoulders	12' lanes, 6' raised median 7' shoulders	5.54	3	"On urban and uburban arterials, reducing the number of median openings and intersections (such as by adding a barrier median) reduces the number of intersection and driveway related crashes, however, the magnitude of the crash benefit is not certain. A reduction in crashes similar to what would occur by reducing the number of access points would be expected. Within the raised median section 25 Rear end, 2 angle, 2 opposing left, and 1 head on crashes occured.	• Provide left turn lanes at Jacksboro Rd., Old Bronston School Rd., Park Dr., and Tucker Rd. intersections. 345' Left Turn Lane length needed (includes 100' bay taper). • Could be combined with roundabouts at Jacksboro Rd. and Tucker Rd. to provide turning access. Roundabouts would operate acceptably, likely near LOS C. • U-turn loons could be added to accomodate left turning traffic. U-turn intersection would operate acceptable, likely near LOS C.	Archaeology, Tree Removal (bats), Possible Historic, UST/HAZ, Potential Noise Screening Tool	$4,600,000	18%	0.3 - 1.8
2A-1c	Jacksboro Road to Old KY 90/ Gibson Lane	1.377	2.577	2-lane section with 6' raised median & turn lanes at major intersections	12' lanes, 12' shoulders	12' lanes, 6' raised median 6' shoulders	0	0	On urban and suburban arterials, reducing the number of median openings and intersections (such as by adding a barrier median) reduces the number of intersection and driveway related crashes, however, the magnitude of the crash benefit is not certain. A reduction in crashes similar to what would occur by reducing the number of access points would be expected. Within the raised median section 25 Rear end, 2 angle, 2 opposing left, and 1 head on crashes occured.	• Provide left turn lanes at Jacksboro Rd., Old Bronston School Rd., Park Dr., and Tucker Rd. intersections. 345' Left Turn Lane length needed (includes 100' bay taper). • Could be combined with roundabouts at Jacksboro Rd. and Tucker Rd. to provide turning access. Roundabouts would operate acceptably, likely near LOS C. • U-turn loons could be added to accomodate left turning traffic. U-turn intersection would operate acceptable, likely near LOS C.	None	$4,200,000	13%	0.2 - 1.4

Table 18: Refined Corridor-Wide Potential Improvement Concepts (Cont'd)

Typical Section Concepts							ROW Impacts		General	Traffic	Environmental	Cost	Fatal and Injury Crash Reduction	B / C
Number	Location	Begin MP	End MP	Description	Existing Typical Section	Proposed Typical Section	Acres	Acquisitions						5yr Crashes / 7yr Crashes
2A-1d	Jacksboro Road to Old KY 90/ Gibson Lane	1.377	2.577	2-lane section with 6' raised median & turn lanes at major intersections	12' lanes, 12' shoulders	12' lanes, 6' raised median 5' shoulders	0	0	On urban and suburban arterials, reducing the number of median openings and intersections (such as by adding a barrier median) reduces the number of intersection and driveway related crashes, however, the magnitude of the crash benefit is not certain. A reduction in crashes similar to what would occur by reducing the number of access points would be expected. Within the raised median section 25 Rear end, 2 angle, 2 opposing left, and 1 head on crashes occured.	• Provide left turn lanes at Jacksboro Rd., Old Bronston School Rd., Park Dr., and Tucker Rd. intersections. 345' Left Turn Lane length needed (includes 100' bay taper). • Could be combined with roundabouts at Jacksboro Rd. and Tucker Rd. to provide turning access. Roundabouts would operate acceptably, likely near LOS C. • U-turn loons could be added to accomodate left turning traffic. U-turn intersection would operate acceptable, likely near LOS C.	None	$4,000,000	6%	0.1 - 0.7
2A-2a	Jacksboro Road to New Cumberland River Bridge	1.377	3.061	2-lane section with 6' raised median & turn lanes at major intersections	12' lanes, 12' shoulders	12' lanes, 6' raised median 8' shoulders	8.66	3	On urban and suburban arterials, reducing the number of median openings and intersections (such as by adding a barrier median) reduces the number of intersection and driveway related crashes, however, the magnitude of the crash benefit is not certain. A reduction in crashes similar to what would occur by reducing the number of access points would be expected.	• Provide left turn lanes at Jacksboro Rd., Old Bronston School Rd., Park Dr., and Tucker Rd. intersections. 345' Left Turn Lane length needed (includes 100' bay taper). • Could be combined with roundabouts at Jacksboro Rd. and Tucker Rd. to provide turning access. Roundabouts would operate acceptably, likely near LOS C. • U-turn loons could be added to accomodate left turning traffic. U-turn intersection would operate acceptable, likely near LOS C.	Archaeology, Tree Removal (bats), Possible Historic, UST/HAZ, Potential Noise Screening Tool	$5,100,000	24%	0.4 - 2.2

Table 18: Refined Corridor-Wide Potential Improvement Concepts (Cont'd)

Typical Section Concepts							ROW Impacts		General	Traffic	Environmental	Cost	Fatal and Injury Crash Reduction	B / C
Number	Location	Begin MP	End MP	Description	Existing Typical Section	Proposed Typical Section	Acres	Acquisitions						5yr Crashes / 7yr Crashes
2A-2b	Jacksboro Road to New Cumberland River Bridge	1.377	3.061	2-lane section with 6' raised median & turn lanes at major intersections	12' lanes, 12' shoulders	12' lanes, 6' raised median 7' shoulders	5.54	3	On urban and suburban arterials, reducing the number of median openings and intersections (such as by adding a barrier median) reduces the number of intersection and driveway related crashes, however, the magnitude of the crash benefit is not certain. A reduction in crashes similar to what would occur by reducing the number of access points would be expected.	• Provide left turn lanes at Jacksboro Rd., Old Bronston School Rd., Park Dr., and Tucker Rd. intersections. 345' Left Turn Lane length needed (includes 100' bay taper). • Could be combined with roundabouts at Jacksboro Rd. and Tucker Rd. to provide turning access. Roundabouts would operate acceptably, likely near LOS C. • U-turn loons could be added to accomodate left turning traffic. U-turn intersection would operate acceptable, likely near LOS C.	Archaeology, Tree Removal (bats), Possible Historic, UST/HAZ, Potential Noise Screening Tool	$4,900,000	18%	0.3 - 1.7
2A-2c	Jacksboro Road to New Cumberland River Bridge	1.377	3.061	2-lane section with 6' raised median & turn lanes at major intersections	12' lanes, 12' shoulders	12' lanes, 6' raised median 6' shoulders	0	0	On urban and suburban arterials, reducing the number of median openings and intersections (such as by adding a barrier median) reduces the number of intersection and driveway related crashes, however, the magnitude of the crash benefit is not certain. A reduction in crashes similar to what would occur by reducing the number of access points would be expected.	• Provide left turn lanes at Jacksboro Rd., Old Bronston School Rd., Park Dr., and Tucker Rd. intersections. 345' Left Turn Lane length needed (includes 100' bay taper). • Could be combined with roundabouts at Jacksboro Rd. and Tucker Rd. to provide turning access. Roundabouts would operate acceptably, likely near LOS C. • U-turn loons could be added to accomodate left turning traffic. U-turn intersection would operate acceptable, likely near LOS C.	None	$4,700,000	13%	0.2 - 1.2

Table 18: Refined Corridor-Wide Potential Improvement Concepts (Cont'd)

Typical Section Concepts							ROW Impacts		General	Traffic	Environmental	Cost	Fatal and Injury Crash Reduction	B / C
Number	Location	Begin MP	End MP	Description	Existing Typical Section	Proposed Typical Section	Acres	Acquisitions						5yr Crashes / 7yr Crashes
2A-2d	Jacksboro Road to New Cumberland River Bridge	1.377	3.061	2-lane section with 6' raised median & turn lanes at major intersections	12' lanes, 12' shoulders	12' lanes, 6' raised median 5' shoulders	0	0	On urban and suburban arterials, reducing the number of median openings and intersections (such as by adding a barrier median) reduces the number of intersection and driveway related crashes, however, the magnitude of the crash benefit is not certain. A reduction in crashes similar to what would occur by reducing the number of access points would be expected.	• Provide left turn lanes at Jacksboro Rd., Old Bronston School Rd., Park Dr., and Tucker Rd. intersections. 345' Left Turn Lane length needed (includes 100' bay taper). • Could be combined with roundabouts at Jacksboro Rd. and Tucker Rd. to provide turning access. Roundabouts would operate acceptably, likely near LOS C. • U-turn loons could be added to accomodate left turning traffic. U-turn intersection would operate acceptable, likely near LOS C.	None	$4,400,000	6%	0.1 - 0.6
2B-1	Jacksboro Road to Old KY 90/ Gibson Lane	1.377	2.577	2-lane section with 6' raised median & turn lanes at major intersections	12' lanes, 12' shoulders	12' lanes, 6' raised median, curb & gutter	0	0	On urban and suburban arterials, reducing the number of median openings and intersections (such as by adding a barrier median) reduces the number of intersection and driveway related crashes, however, the magnitude of the crash benefit is not certain. A reduction in crashes similar to what would occur by reducing the number of access points would be expected. Within the raised median section 25 Rear end, 2 angle, 2 opposing left, and 1 head on crashes occured.	• Provide left turn lanes at Jacksboro Rd., Old Bronston School Rd., Park Dr., and Tucker Rd. intersections. 345' Left Turn Lane length needed (includes 100' bay taper). • Could be combined with roundabouts at Jacksboro Rd. and Tucker Rd. to provide turning access. Roundabouts would operate acceptably, likely near LOS C. • U-turn loons could be added to accomodate left turning traffic. U-turn intersection would operate acceptable, likely near LOS C.	None	$3,900,000	24%	0.4 - 2.8

Table 18: Refined Corridor-Wide Potential Improvement Concepts (Cont'd)

Typical Section Concepts							ROW Impacts		General	Traffic	Environmental	Cost	Fatal and Injury Crash Reduction	B / C
Number	Location	Begin MP	End MP	Description	Existing Typical Section	Proposed Typical Section	Acres	Acquisitions						5yr Crashes / 7yr Crashes
2B-2	Jacksboro Road to New Cumberland River Bridge	1.377	3.061	2-lane section with 6' raised median & turn lanes at major intersections	12' lanes, 12' shoulders	12' lanes, 6' raised median, curb & gutter	0	0	On urban and suburban arterials, reducing the number of median openings and intersections (such as by adding a barrier median) reduces the number of intersection and driveway related crashes, however, the magnitude of the crash benefit is not certain. A reduction in crashes similar to what would occur by reducing the number of access points would be expected.	• Provide left turn lanes at Jacksboro Rd., Old Bronston School Rd., Park Dr., and Tucker Rd. intersections. 345' Left Turn Lane length needed (includes 100' bay taper). • Could be combined with roundabouts at Jacksboro Rd. and Tucker Rd. to provide turning access. Roundabouts would operate acceptably, likely near LOS C. • U-turn loons could be added to accomodate left turning traffic. U-turn intersection would operate acceptable, likely near LOS C.	None	$6,300,000	24%	0.3 - 1.8
3A	T&G to Old Bronston School Rd	1.73	2.204	Frontage Road on north side of KY 90	12' lanes, 12' shoulders		2.09	0	No specific CMF available for adding a frontage road. The HCM method for determining crash benefits by removing driveways would be applicable to this concept.	Left Turn Lanes into Frontage Road would need to be 345' in length (includes 100' bay taper).	Archaeology, Tree Removal (bats), Possible Historic, UST/HAZ, Potential Noise Screening Tool, Church	$715,000	10%	0.3 - 3.3
3B	Old Hwy 90 to Kentucky Marine	1.377	1.6	Backage Road on north side of KY 90	12' lanes, 12' shoulders		2.22	1	No specific CMF available for adding a backage road. The HCM method for determining crash benefits by removing driveways would be applicable to this concept.	Intersections created by the backage road at the mainline may need to be analyzed for acceptable Level of Service and operations.	Archaeology, Tree Removal (bats), Possible Historic, UST/HAZ, Potential Noise Screening Tool, Church	$335,000	10%	0.9 - 0.6

*v/c ratio is the roadway's volume divided by capacity.

Table 19: Refined Potential Spot Improvement Concepts

Spot Improvement Concepts											B / C
Number	Location	MP	Description	Safety	Crash Data	ROW Impacts (Acres)	Traffic	Environmental	Cost	Fatal & Injury Crash Reduction	5yr Crashes / 7yr Crashes
1	Forest Ridge Road	0.644	Provide Advance Intersection Warning Signing	No specific HSM methodology or CMF is applicable to implementing the proposed improvement. Providing better warning of an upcoming intersection should improve driver awareness of the upcoming conditions.	• 3 rear end, 2 angle, 1 opposing left turn (serius injury) • 1 PDO crash occurred at entrance near intersection	0		None	$2,500	35%	2.6 - 1.9
2	Forest Ridge Road	0.644	WB Left Turn Lane on KY 90	Adding dedicated left turn lanes at a TWSC intersection can reduce total crashes between 28 and 48%.	• 3 rear end, 2 angle, 1 opposing left turn (serius injury) • 1 PDO crash occurred at entrance near intersection	0.1	• Mainline Left Turn Lane Warrant met in PM. • 345' Turn Lane Length (includes 100' bay taper)	Archaeology	$220,000	44%	3.1 - 4.2
3	Sycamore Drive	0.705	WB Left Turn Lane on KY 90	Adding dedicated left turn lanes at a TWSC intersection can reduce total crashes between 28 and 48%.	• 2 rear end, 1 single vehicle, no reported injuries	0	• Mainline Left Turn Lane Warrant met in PM. • 345' Turn Lane Length (includes 100' bay taper)	Archaeology	$220,000	44%	0.0 - 0.0
4	Shaw Lane	1.021	Angle shoulder to widen for RTs and improve pavement	By increasing the turning radius into Shaw Lane, the turning vehicle, especially if hauling a trailer, should be able to exit the roadway quicker thus reducing the potential for rear end collisions.	No crashes occurred at intersection	0		None	$25,000	10%	0.0 - 0.0
5	Jacksboro Road	1.377	Provide "Congestion Ahead" Signing	No specific HSM methodology or CMF is applicable to implementing the proposed improvement. Providing better warning of an upcoming congested area should improve driver awareness of the upcoming conditions.	• 7 rear end (1 serious injury, 1 possible injury), 5 angle (3 minor injury) • Highest intersection crash rate in study area.	0	Intersection NB and SB TWSC approaches currently operates at LOS C in the AM and PM.	None	$2,500	0%	

Table 19: Refined Potential Spot Improvement Concepts (Cont'd)

Spot Improvement Concepts											B / C
Number	Location	MP	Description	Safety	Crash Data	ROW Impacts (Acres)	Traffic	Environmental	Cost	Fatal & Injury Crash Reduction	5yr Crashes / 7yr Crashes
6	Jacksboro Road	1.377	Improve Intersection Skew	HSM 14.6.2.1: Safety benefit of reducing intersection skew. Reduces the extent drivers have to turn their head to view approaching vehicles. Driver can better judge gaps in traffic.	• 7 rear end (1 serious injury, 1 possible injury), 5 angle (3 minor injury) Highest intersection crash rate in study area.	0	Intersection NB and SB TWSC approaches currently operates at LOS C in the AM and PM.	Archaeology, Tree Removal (bats), Possible Historic,	$75,000	15%	5.3 - 3.8
7	Jacksboro Road	1.377	Gateway to Urban Area with Signage & Landscaping	No HSM analysis technique or CMF is available for this option. Providing a landscaped gateway into the urbanized area may improve driver awareness of the upcoming change in conditions and roadside environment.	• 7 rear end (1 serious injury, 1 possible injury), 5 angle (3 minor injury) • Highest intersection crash rate in study area.	0	Intersection NB and SB TWSC approaches currently operates at LOS C in the AM and PM.	None	$100,000.00	19% - 28% (Injury)	
8	Jacksboro Road & Tucker Road	1.377&2.434	Change Intersections to Roundabout	Converting a TWSC intersection to a roundabout can reduce fatal and injury crashes by 82%.	• Jacksboro Rd.: 7 Rear end (1 serious injury, 1 possible injury), 5 angle (3 minor injury) • Highest intersection crash rate in study area. • Tucker Rd.: 4 Rear end (1 minor injury), 1 angle (minor injury), 1 sideswipe same direction, 1 sideswipe opposite direction	0.3	• Roundabouts (with no added U-turns) expected to operate at LOS B or better at both intersections • If paired with raised median, operations lower to LOS C with the mainline through movements potentially lowering to LOS D	Archaeology, Tree Removal (bats), Possible Historic, UST/HAZ,	$1,200,000	71%	2.1 - 1.5
9	Old Bronston School Road	2.204	Improve Intersection Skew	HSM 14.6.2.1: Safety benefit of reducing intersection skew. Reduces the extent drivers have to turn their head to view approaching vehicles. Driver can better judge gaps in traffic.	• 5 rear end, 1 angle, no reported injuries	0		Archaeology, Tree Removal (bats),	$30,000	9%	0.2 - 0.5

Table 19: Refined Potential Spot Improvement Concepts (Cont'd)

Spot Improvement Concepts											B / C
Number	Location	MP	Description	Safety	Crash Data	ROW Impacts (Acres)	Traffic	Environmental	Cost	Fatal & Injury Crash Reduction	5yr Crashes / 7yr Crashes
10	Old Bronston School Road	2.204	WB Left Turn Lane on KY 90	Adding dedicated left turn lanes at a TWSC intersection can reduce total crashes between 28 and 48%.	• 5 rear end, 1 angle, no reported injuries	0.1	• Mainline Left Turn Lane Warrant met in PM. • 345' Turn Lane Length (includes 100' bay taper)	Archaeology, Tree Removal (bats)	$150,000	44%	0.2 - 0.5
11	Park Drive	2.332	Improve Intersection Skew	HSM 14.6.2.1: Safety benefit of reducing intersection skew. Reduces the extent drivers have to turn their head to view approaching vehicles. Driver can better judge gaps in traffic.	• Three rear end crashes (1 minor injury)	0		Archaeology	$50,000	6%	1.0 - 26.1
12	Park Drive	2.332	WB Left Turn Lane on KY 90			0.1	345' Turn Lane Length (includes 100' bay taper)	Bat Habitat (Trees)	$150,000	44%	2.2 - 59.9
13	Tucker Road / Old KY 90 Loop	2.434	EB & WB Left Turn Lanes on KY 90	Adding dedicated left turn lanes at a TWSC intersection can reduce total crashes between 28 and 48%.	• 4 rear end (1 minor injury), 1 angle (minor injury), 1 sideswipe same direction, 1 sideswipe opposite direction	0.1	• Mainline Left Turn Lane Warrant met in PM. • 345' Turn Lane Length (includes 100' bay taper).	Archaeology	$275,000	48%	1.4 - 1.0
14	Gibson Lane / Old KY 90	2.577	Restripe EB & WB Turn Lanes and Improve WB Merge	By restriping left turn lanes at this intersection crashes should be reduced. By improving the WB merge striping and distance side swipe-same direction crashes should be reduced.	• 1 rear end (minor injury), 4 angle (1 minor injury), 2 single vehicle (1 minor injury), 1 sideswipe same direction (possible injury), 1 head on	0	The SB TWSC approach operates at LOS C in the AM and LOS D in the PM.	None	$10,000	N/A	
15	Gibson Lane / Old KY 90	2.852	Eliminate WB merge and make right lane a RT only lane onto Gibson			0		None	$150,000	41%	1.1 - 1.5

Table 19: Refined Potential Spot Improvement Concepts (Cont'd)

Spot Improvement Concepts											B / C
Number	Location	MP	Description	Safety	Crash Data	ROW Impacts (Acres)	Traffic	Environmental	Cost	Fatal & Injury Crash Reduction	5yr Crashes / 7yr Crashes
16	KY 790 / Cumberland Drive	2.852	NB Right Turn Lane			0		None	$40,000	N/A	
17	KY 790 / Cumberland Drive	2.852	Signalization			0	It is doubtful that the intersection would warrant a signal. A full 12-hour count would be needed to verify.	None	$250,000	44%	1.3 - 0.9

8.4 IIJA Grant Program Emphasis Analysis

The proposed improvements could be funded through several possible mechanisms. While traditional state and federal funding programs could be used, it is also possible that one or more improvement concepts could be funded through programs included in the 2021 IIJA also known as the Bipartisan Infrastructure Law (BIL).

- **Regional and Local Project Assistance Program** – This competitive grant program is expected to have a notice of funding opportunity (NOFO) in 2023. It is similar to the prior Rebuilding American Infrastructure with Sustainability and Equity (RAISE) grant program. Several of the concepts could score well in this program as they improve safety and benefit a rural area. This program is very competitive and there are likely to be other projects in the state that would rate more highly for the criteria in this program.
- **Rural Surface Transportation Program -** This competitive grant program is expected to have a notice of funding opportunity (NOFO) in 2023. The rural nature of the project area and the focus on safe mobility could make several of the concepts competitive for this program. This could be pursued to fund one of the larger concepts or several of the spot improvements.
- **Safe Streets and Roads for All Program (with an approved Safety Action Plan)** – This program is not available to state entities (such as KYTC). Instead, the ADD would need to develop a safety action plan that included KY 90 improvement concepts and then those concepts could be pursued for implementation funding. Federal funding can be requested for creating the safety action plan through the same competitive grant process that is used to pursue the implementation funding. This program may not be a good fit for improvements on KY 90, but it is one possibility given the safety focus of many of the improvement concepts.

Again, traditional state and federal funding programs (through the highway plan process) may be appropriate for upgrades in this corridor, but there are other possible sources of competitive funding if needed.

9 Study Recommendations

After discussing the refined list of potential improvement concepts and associated detailed evaluation at the third Project Team Meeting, the Project Team decided which concepts to carry forward into future project phases. The team agreed that if there were any improvements that could definitely be eliminated from further consideration, they should be, otherwise many of the other concepts should be carried into phase 1 design. Some of these concepts could be combined for efficiency of design. **Tables 20** and **21** show the final recommendations for the corridor-wide and spot improvement concepts. Project sheets for each are included in the following sections. Criteria used for elimination included traffic warrants, strength of the improvements' effectiveness (benefit/cost ratio), and appropriateness for the corridor's operational profile.

Table 20: KY 90 Corridor-Wide Recommendations

Typical Section Concepts															
Number	Location	Begin MP	End MP	Description	Existing Typical Section	Proposed Typical Section	ROW Impacts		General	Traffic	Environmental	Cost	Construction Cost	Fatal & Injury Crash Reduction	B / C
							Acres	Acquisitions							5yr Crashes / 7yr Crashes
1A	Old KY 90 Loop 3 to Old KY 90/ Gibson Lane	0.448	2.577	3-lane section with TWLTL	12' lanes, 12' shoulders	12' lanes, 12' TWLTL, 8' shoulders	11.14	5	TWLTL's reduce potential conflicts with turning traffic and to provide a refuge for vehicles waiting to turn left. A TWLTL could reduce driveway related crashes by ~20%	TWLTL's do not add substantial capacity to a two-lane roadway, but provide refuge for left turning vehicles and could increase operating speeds. Two-lane section currently operates at LOS C/D in 2022. No two-lane section in 2022 has a v/c ratio above 0.44.	Archaeology, Tree Removal (bats), Possible Historic, UST/HAZ, Potential Noise Screening Tool	D $720,000 R $1,555,700 U $300,000	$7,200,000	21%	0.2 - 1.1
1B	Old KY 90 Loop 3 to Old KY 90/ Gibson Lane	0.448	2.577	3-lane section with TWLTL	12' lanes, 12' shoulders	11' lanes, 12' TWLTL 8' shoulders	9.45	5	TWLTL's reduce potential conflicts with turning traffic and to provide a refuge for vehicles waiting to turn left. A TWLTL could reduce driveway related crashes by ~20%	TWLTL's do not add substantial capacity to a two-lane roadway, but provide refuge for left turning vehicles and could increase operating speeds. Two-lane section currently operates at LOS C/D in 2022. No two-lane section in 2022 has a v/c ratio above 0.44.	Archaeology, Tree Removal (bats), Possible Historic, UST/HAZ, Potential Noise Screening Tool	D $650,000 R $1,547,250 U $ 275,000	$6,500,000	19%	0.2 - 1.1
1C	Old KY 90 Loop 3 to Old KY 90/ Gibson Lane	0.448	2.577	3-lane section with TWLTL	12' lanes, 12' shoulders	12' lanes, 12' TWLTL, curb & gutter	0	0	TWLTL's reduce potential conflicts with turning traffic and to provide a refuge for vehicles waiting to turn left. A TWLTL could reduce driveway related crashes by ~20%	TWLTL's do not add substantial capacity to a two-lane roadway, but provide refuge for left turning vehicles and could increase operating speeds. Two-lane section currently operates at LOS C/D in 2022. No two-lane section in 2022 has a v/c ratio above 0.44.	Noise Screening Tool	D $520,000 RW $0 U $0	$5,200,000	21%	0.4 - 1.9

Table 20: KY 90 Corridor-Wide Recommendations (Cont'd)

Typical Section Concepts															
Number	Location	Begin MP	End MP	Description	Existing Typical Section	Proposed Typical Section	ROW Impacts		General	Traffic	Environmental	Cost	Construction Cost	Fatal & Injury Crash Reduction	B / C
							Acres	Acquisitions							5yr Crashes / 7yr Crashes
2A-1	Jacksboro Road to Old KY 90/ Gibson Lane	1.377	2.577	2-lane section with 6' raised median & turn lanes at major intersections	12' lanes, 12' shoulders	12' lanes, 6' raised median 8' shoulders	8.66	3	On urban and suburban arterials, reducing the number of median openings and intersections (such as by adding a barrier median) reduces the number of intersection and driveway related crashes, however, the magnitude of the crash benefit is not certain. A reduction in crashes similar to what would occur by reducing the number of access points would be expected. Within the raised median section 25 Rear end, 2 angle, 2 opposing left, and 1 head on crashes occurred.	• Provide left turn lanes at Jacksboro Rd., Old Bronston School Rd., Park Dr., and Tucker Rd. intersections. 345' Left Turn Lane length needed (includes 100' bay taper). • Could be combined with roundabouts at Jacksboro Rd. and Tucker Rd. to provide turning access. Roundabouts would operate acceptably, likely near LOS C. • U-turn loons could be added to accommodate left turning traffic. U-turn movement would operate acceptably, likely near LOS C.	Archaeology, Tree Removal (bats), Possible Historic, UST/HAZ, Potential Noise Screening Tool	D $480,000 R $943,300 U $250,000	$4,800,000	24%	0.3 - 1.7
2A-2	Jacksboro Road to New Cumberland River Bridge	1.377	3.061	2-lane section with 6' raised median & turn lanes at major intersections	12' lanes, 12' shoulders	12' lanes, 6' raised median 8' shoulders	8.66	3	On urban and suburban arterials, reducing the number of median openings and intersections (such as by adding a barrier median) reduces the number of intersection and driveway related crashes, however, the magnitude of the crash benefit is not certain. A reduction in crashes similar to what would occur by reducing the number of access points would be expected.	• Provide left turn lanes at Jacksboro Rd., Old Bronston School Rd., Park Dr., and Tucker Rd. intersections. 345' Left Turn Lane length needed (includes 100' bay taper). • Could be combined with roundabouts at Jacksboro Rd. and Tucker Rd. to provide turning access. Roundabouts would operate acceptably, likely near LOS C. • U-turn loons could be added to accomodate left turning traffic. U-turn intersection would operate acceptable, likely near LOS C.	Archaeology, Tree Removal (bats), Possible Historic, UST/HAZ, Potential Noise Screening Tool	D $510,000 R $943,300 U $250,000	$5,100,000	24%	0.3 - 1.6

Table 20: KY 90 Corridor-Wide Recommendations (Cont'd)

Typical Section Concepts															
Number	Location	Begin MP	End MP	Description	Existing Typical Section	Proposed Typical Section	ROW Impacts		General	Traffic	Environmental	Cost	Construction Cost	Fatal & Injury Crash Reduction	B / C
							Acres	Acquisitions							5yr Crashes / 7yr Crashes
2B-1	Jacksboro Road to Old KY 90/ Gibson Lane	1.377	2.577	2-lane section with 6' raised median & turn lanes at major intersections	12' lanes, 12' shoulders	12' lanes, 6' raised median, curb & gutter	0	0	On urban and suburban arterials, reducing the number of median openings and intersections (such as by adding a barrier median) reduces the number of intersection and driveway related crashes, however, the magnitude of the crash benefit is not certain. A reduction in crashes similar to what would occur by reducing the number of access points would be expected. Within the raised median section 25 Rear end, 2 angle, 2 opposing left, and 1 head on crashes occured.	• Provide left turn lanes at Jacksboro Rd., Old Bronston School Rd., Park Dr., and Tucker Rd. intersections. 345' Left Turn Lane length needed (includes 100' bay taper). • Could be combined with roundabouts at Jacksboro Rd. and Tucker Rd. to provide turning access. Roundabouts would operate acceptably, likely near LOS C. • U-turn loons could be added to accomodate left turning traffic. U-turn intersection would operate acceptable, likely near LOS C.	None	D $390,000 R $0 U $0	$3,900,000	24%	0.4 - 2.6
2B-2	Jacksboro Road to New Cumberland River Bridge	1.377	3.061	2-lane section with 6' raised median & turn lanes at major intersections	12' lanes, 12' shoulders	12' lanes, 6' raised median, curb & gutter	0	0	On urban and suburban arterials, reducing the number of median openings and intersections (such as by adding a barrier median) reduces the number of intersection and driveway related crashes, however, the magnitude of the crash benefit is not certain. A reduction in crashes similar to what would occur by reducing the number of access points would be expected.	• Provide left turn lanes at Jacksboro Rd., Old Bronston School Rd., Park Dr., and Tucker Rd. intersections. 345' Left Turn Lane length needed (includes 100' bay taper). • Could be combined with roundabouts at Jacksboro Rd. and Tucker Rd. to provide turning access. Roundabouts would operate acceptably, likely near LOS C. • U-turn loons could be added to accomodate left turning traffic. U-turn intersection would operate acceptable, likely near LOS C.	None	D $630,000 R $0 U $0	$6,300,000	24%	0.3 - 1.6

*v/c ratio is the roadway's volume divided by capacity.

Table 21: KY 90 Spot Improvement Recommendations

Spot Improvement Concepts									B/C
Number	Location	MP	Description	ROW Impacts (Acres)	Traffic	Environmental	Cost	Fatal & Injury Crash Reduction	5yr Crashes/ 7yr Crashes
1	Forest Ridge Road	0.644	Provide Advance Intersection Warning Signing	0		None	D $5,000 R $0 U $0 C $2,500	35%	0.9 - 0.6
2	Forest Ridge Road & Sycamore Drive	0.675	WB Left Turn Lane on KY 90	0.1	•Mainline Left Turn Lane Warrant met in PM. •345' Turn Lane Length (includes 100' bay taper) at Forest Ridge Drive and Sycamore Drive.	Archaeology	D $44,000 R $1,000 U $0 C $440,000	44%	1.4 - 1.9
3	Shaw Lane	1.021	Angle shoulder to widen for RTs and improve pavement	0		None	D $5,000 R $0 U $0 C $25,000	10%	0.0 - 0.0
4	Jacksboro Road	1.377	Provide "Congestion Ahead" Signing	0	Intersection NB and SB TWSC approaches currently operates at LOS C in the AM and PM.	None	D $5,000 R $0 U $0 C $2,500	0%	
5	Jacksboro Road	1.377	Improve Intersection Skew	0	Intersection NB and SB TWSC approaches currently operates at LOS C in the AM and PM.	Archaeology, Tree Removal (bats), Possible Historic,	D $15,000 R $0 U $0 C $75,000	15%	4.4 - 3.2
6	Old Bronston School Road	2.204	Improve Intersection Skew	0		Archaeology, Tree Removal (bats),	D $15,000 R $0 U $ 0 C $30,000	9%	0.1 - 0.4

Table 21: KY 90 Spot Improvement Recommendations (Cont'd)

Spot Improvement Concepts									B/C
Number	Location	MP	Description	ROW Impacts (Acres)	Traffic	Environmental	Cost	Fatal & Injury Crash Reduction	5yr Crashes/ 7yr Crashes
7	Old Bronston School Road, Park Drive & Tucker Road / Old KY 90 Loop	2.319	WB Left Turn Lane to Old Bronston School Road and Park Drive, EB and WB Left Turn Lanes to Tucker Road / Old KY 90	0.85	•Mainline Left Turn Lane Warrant met in PM for Old Bronston School Road and Tucker Road (no count data avilable for Park Drive). •500' Turn Lane Length (includes 100' bay taper) at Old Bronston School •345' Turn Lane Length (includes 100' bay taper) at Park Drive and Tucker Road	Archaeology, Tree Removal (bats)	D $62,000 R $4,000 U $0 C $615,000	44%	0.0 - 13.7
8	Park Drive	2.332	Improve Intersection Skew	0		Archaeology	D $10,000 R $0 U $0 C $50,00	6%	0.8 - 21.8
9	Gibson Lane / Old KY 90	2.577	Restripe EB & WB Turn Lanes and Improve WB Merge	0	The SB TWSC approach operates at LOS C in the AM and LOS D in the PM.	None	D $5,000 R $0 U $0 C $10,000	N/A	
10	Gibson Lane / Old KY 90	2.852	Eliminate WB merge and make right lane a RT only lane onto Gibson	0		None	D$15,000 R $0 U $0 C $150,000	41%	1.0 - 1.3
11	KY 790 / Cumberland Drive	2.852	NB Right Turn Lane	0		None	D $10,000 R $0 U $0 C $40,000	N/A	

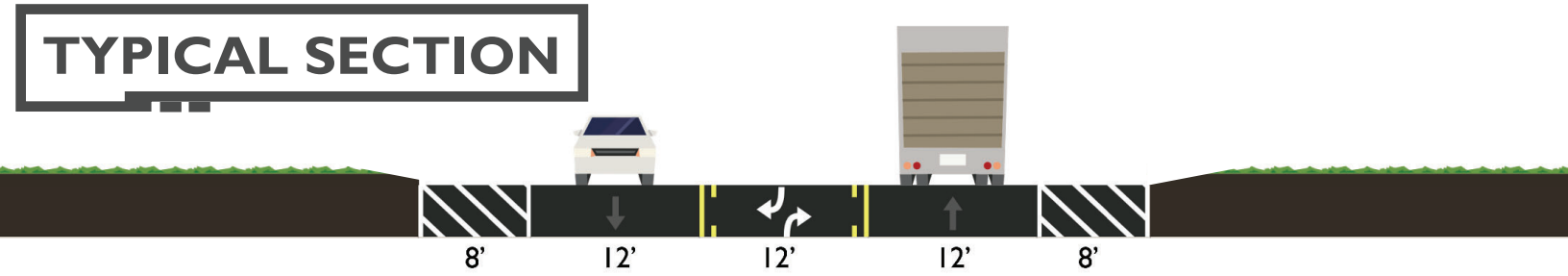
9.1 Corridor-Wide Project Sheets

KENTUCKY 90 CORRIDOR STUDY

PULASKI COUNTY, KY

PROJECT SHEET 1A

TYPICAL SECTION



SECTION AERIAL

COST $9,775,700

D $720,000
R $1,555,700
U $300,000
C $7,200,000

BENEFIT/COST RATIO*:
- 5-Year Crash Data: 0.2
- 7-Year Crash Data: 1.1

RIGHT-OF-WAY REQUIRED: 11.14 Acres

BUILDING ACQUISITIONS: 5

CRASH REDUCTION: 21%

TOTAL 20-YEAR REDUCTION: 80.97 Crashes

ENVIRONMENTAL CONCERNS: Archaeology, Tree Removal (bats), Possible Historic, UST/HAZ, Potential Noise Screening Tool

**Due to the abnormal traffic conditions from the Covid-19 Pandemic, 5-year (2015-2019) and 7-year crash data (2015-2021) were used for benefit/cost analysis.*

PURPOSE

IMPROVE SAFETY AND INCREASE EFFICIENCY FOR LEFT TURNING VEHICLES

12-Foot Two-Way Left Turn Lane with 12-Foot Lanes and Eight-Foot Shoulders from Old KY 90 Loop 3 to Gibson Lane

Due to the high number of access points along the KY 90 study area, the addition of a Two-Way Left Turn Lane (TWLTL) is recommended. TWLTLs reduce potential conflicts with turning traffic and provide a refuge for vehicles waiting to turn left. A TWLTL could reduce driveway related crashes by approximately 20%. TWLTLs do not add substantial capacity to a two-lane roadway, but provide refuge for left turning vehicles and could increase operating speeds.

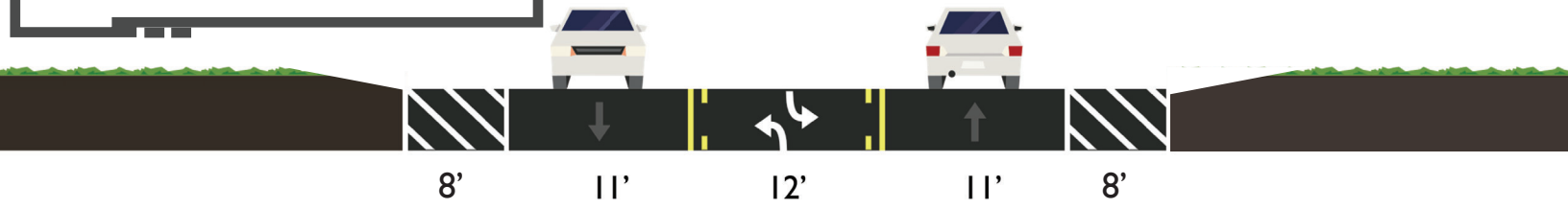
The two-lane section currently operates at LOS C/D in 2022. No two-lane section in 2022 has a v/c ratio above 0.44. The 2045 forecast shows a v/c ratio of 0.45 under “No Build” conditions.

KENTUCKY 90 CORRIDOR STUDY

PULASKI COUNTY, KY

PROJECT SHEET 1B

TYPICAL SECTION



SECTION AERIAL

COST $8,972,250

D $650,000
R $1,547,250
U $275,000
C $6,500,000

BENEFIT/COST RATIO*:
- 5-Year Crash Data: 0.2
- 7-Year Crash Data: 1.1

RIGHT-OF-WAY REQUIRED: 9.45 Acres

BUILDING ACQUISITIONS: 5

CRASH REDUCTION: 19%

TOTAL 20-YEAR REDUCTION: 72.10 Crashes

ENVIRONMENTAL CONCERNS: Archaeology, Tree Removal (bats), Possible Historic, UST/HAZ, Potential Noise Screening Tool

**Due to the abnormal traffic conditions from the Covid-19 Pandemic, 5-year (2015-2019) and 7-year crash data (2015-2021) were used for benefit/cost analysis.*

PURPOSE

IMPROVE SAFETY AND INCREASE EFFICIENCY FOR LEFT TURNING VEHICLES

12-Foot Two-Way Left Turn Lane with 11-Foot Lanes and Eight-Foot Shoulders from Old KY 90 Loop 3 to Gibson Lane

Due to the high number of access points along the KY 90 study area, the addition of a Two-Way Left Turn Lane (TWLTL) is recommended. TWLTLs reduce potential conflicts with turning traffic and provide a refuge for vehicles waiting to turn left. A TWLTL could reduce driveway related crashes by approximately 20%. TWLTLs do not add substantial capacity to a two-lane roadway, but provide refuge for left turning vehicles and could increase operating speeds.

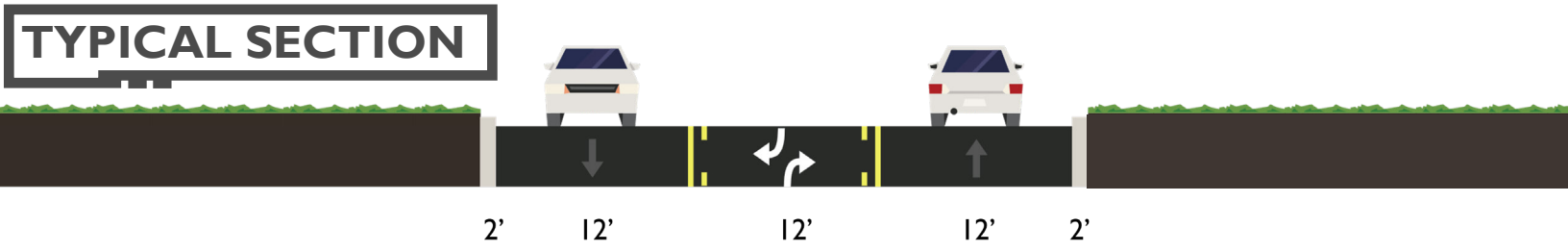
The two-lane section currently operates at LOS C/D in 2022. No two-lane section in 2022 has a v/c ratio above 0.44. The 2045 forecast shows a v/c ratio of 0.45 under “No Build” conditions.

KENTUCKY 90 CORRIDOR STUDY

PULASKI COUNTY, KY

PROJECT SHEET 1C

TYPICAL SECTION



SECTION AERIAL

COST $6,020,000

D $520,000
R $0
U $0
C $5,200,000

BENEFIT/COST RATIO*:
- 5-Year Crash Data: 0.4
- 7-Year Crash Data: 1.9

RIGHT-OF-WAY REQUIRED: No

BUILDING ACQUISITIONS: None

CRASH REDUCTION: 21%

TOTAL 20-YEAR REDUCTION: 80.97 Crashes

ENVIRONMENTAL CONCERNS: Noise Screening Tool

**Due to the abnormal traffic conditions from the Covid-19 Pandemic, 5-year (2015-2019) and 7-year crash data (2015-2021) were used for benefit/cost analysis.*

PURPOSE

IMPROVE SAFETY AND INCREASE EFFICIENCY FOR LEFT TURNING VEHICLES

12-Foot Two-Way Left Turn Lane with 12-Foot Lanes and Two-Foot Curb and Gutter from Old KY 90 Loop 3 to Gibson Lane

Due to the high number of access points along the KY 90 study area, the addition of a Two-Way Left Turn Lane (TWLTL) is recommended. TWLTLs reduce potential conflicts with turning traffic and provide a refuge for vehicles waiting to turn left. A TWLTL could reduce driveway related crashes by approximately 20%. TWLTLs do not add substantial capacity to a two-lane roadway, but provide refuge for left turning vehicles and could increase operating speeds.

The 12-foot wide lanes and two-foot curb and gutter shoulders maximize the benefit cost ratio for the three-lane potential improvement concepts and do not require right-of-way acquisition. Curb and gutter sections like this one exist within KYTC District 8 and have had great success in regards to safety.

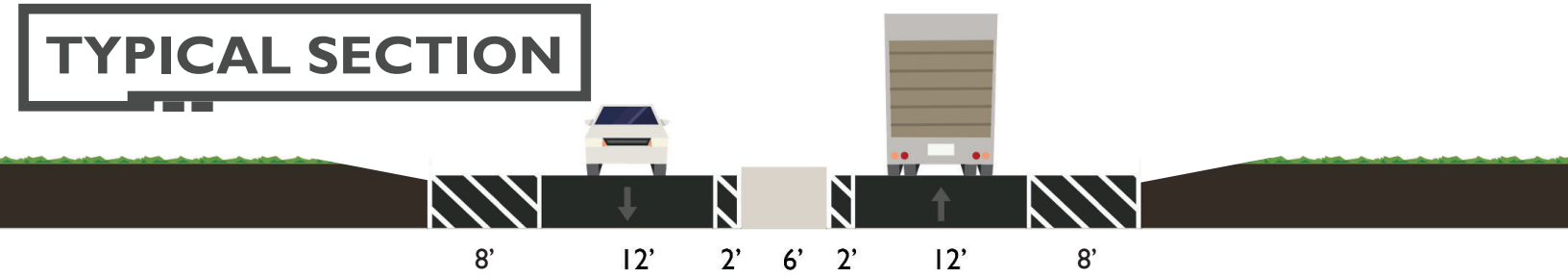
The two-lane section currently operates at LOS C/D in 2022. No two-lane section in 2022 has a v/c ratio above 0.44. The 2045 forecast shows a v/c ratio of 0.45 under “No Build” conditions.

KENTUCKY 90 CORRIDOR STUDY

PULASKI COUNTY, KY

PROJECT SHEET 2A-1

TYPICAL SECTION



COST $6,473,300

D $480,000
R $943,300
U $250,000
C $4,800,000

BENEFIT/COST RATIO*:
- 5-Year Crash Data: 0.3
- 7-Year Crash Data: 1.7

RIGHT-OF-WAY REQUIRED: 8.66 Acres

BUILDING ACQUISITIONS: 3

CRASH REDUCTION: 24%

TOTAL 20-YEAR REDUCTION: 33.45 Crashes

ENVIRONMENTAL CONCERNS: Archaeology, Tree Removal (bats), Possible Historic, UST/HAZ, Potential Noise Screening Tool

**Due to the abnormal traffic conditions from the Covid-19 Pandemic, 5-year (2015-2019) and 7-year crash data (2015-2021) were used for benefit/cost analysis.*

PURPOSE

IMPROVE SAFETY AND REDUCE TRAFFIC IMPACTS FROM A HIGH NUMBER OF ACCESS POINTS.

Raised Median from Jacksboro Rd to Tucker Rd and 12-Foot Two-Way Left Turn Lane with 12-Foot Lanes and Eight-Foot Shoulders from Old KY 90 Loop 3 to Jacksboro Road

Reducing the number of median openings and intersections by adding a median barrier reduces the number of intersection and driveway related crashes. A reduction in crashes would be similar to what would occur by reducing the number of access points. Within the raised median section, 25 rear end, two angle, two opposing left, and one head on crashes occurred. Left turn lanes would be provided at the Jacksboro Rd, Old Bronston School Rd, Park Dr, and Tucker Rd intersections with 345-foot left turn lane length needed (includes 100-foot taper). U-turn loons could be added to accommodate larger U-turning vehicles, such as trucks with trailers. U-turn movement would operate acceptably, likely near LOS C.

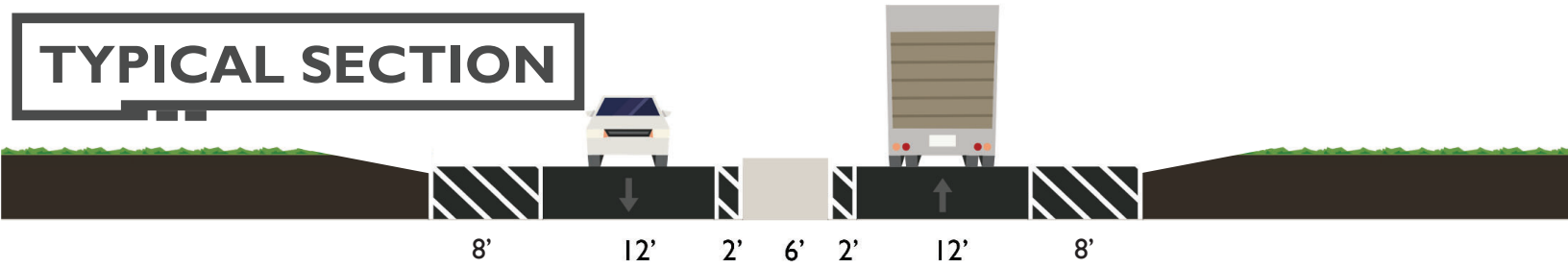
By reducing left turns from the high number of access points, a total crash reduction of 24% is expected. Traffic from side streets will be more efficient by rerouting most left turns. Vehicles turning left from KY 90 to side streets or businesses will reduce the number of slow-downs on the mainline as well by using left turn lanes.

KENTUCKY 90 CORRIDOR STUDY

PULASKI COUNTY, KY

PROJECT SHEET 2A-2

TYPICAL SECTION



COST $6,803,300

D $510,000
R $943,300
U $250,000
C $5,100,000

BENEFIT/COST RATIO*:
- 5-Year Crash Data: 0.3
- 7-Year Crash Data: 1.6

RIGHT-OF-WAY REQUIRED: 8.66 Acres

BUILDING ACQUISITIONS: 3

CRASH REDUCTION: 24%

TOTAL 20-YEAR REDUCTION: 39.31 Crashes

ENVIRONMENTAL CONCERNS: Archaeology, Tree Removal (bats), Possible Historic, UST/HAZ, Potential Noise Screening Tool

**Due to the abnormal traffic conditions from the Covid-19 Pandemic, 5-year (2015-2019) and 7-year crash data (2015-2021) were used for benefit/cost analysis.*

PURPOSE

IMPROVE SAFETY AND REDUCE TRAFFIC IMPACTS FROM A HIGH NUMBER OF ACCESS POINTS.

Raised Median from Jacksboro Rd to Bridge and 12-Foot Two-Way Left Turn Lane with 12-Foot Lanes and Eight-Foot Shoulders from Old KY 90 Loop 3 to Jacksboro Road

Reducing the number of median openings and intersections by adding a median barrier reduces the number of intersection and driveway related crashes. The magnitude of the crash benefit is not certain. A reduction in crashes similar to what would occur by reducing the number of access points would be expected. Left turn lanes would be provided at the Jacksboro Rd, Old Bronston School Rd, Park Dr, and Tucker Rd intersections with 345-foot left turn lane length needed (includes 100-foot taper). U-turn loons could be added to accommodate larger U-turning vehicles, such as trucks with trailers. U-turn movement would operate acceptably, likely near LOS C.

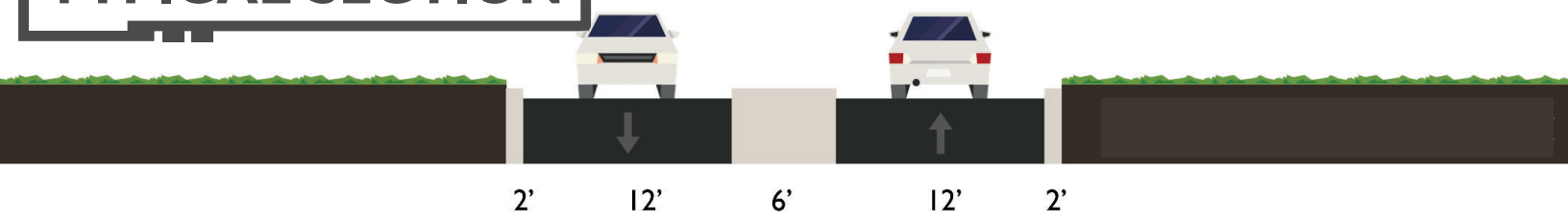
By reducing left turns from the high number of access points, a total crash reduction of 24% is expected. Traffic from side streets will be more efficient by rerouting most left turns. Vehicles turning left from KY 90 to side streets or businesses will reduce the number of slow-downs on the mainline as well by using left turn lanes.

KENTUCKY 90 CORRIDOR STUDY

PULASKI COUNTY, KY

PROJECT SHEET 2B-1

TYPICAL SECTION



COST $4,290,000

D $390,000
R $0
U $0
C $3,900,000

BENEFIT/COST RATIO*:
- 5-Year Crash Data: 0.4
- 7-Year Crash Data: 2.6

RIGHT-OF-WAY REQUIRED: No

BUILDING ACQUISITIONS: 0

CRASH REDUCTION: 24%

TOTAL 20-YEAR REDUCTION: 33.45 Crashes

ENVIRONMENTAL CONCERNS: None

**Due to the abnormal traffic conditions from the Covid-19 Pandemic, 5-year (2015-2019) and 7-year crash data (2015-2021) were used for benefit/cost analysis.*

PURPOSE

IMPROVE SAFETY AND REDUCE TRAFFIC IMPACTS FROM A HIGH NUMBER OF ACCESS POINTS.

Raised Median from Jacksboro Rd to Tucker Rd and 12-Foot Two-Way Left Turn Lane with 12-Foot Lanes and Eight-Foot Shoulders from Old KY 90 Loop 3 to Jacksboro Road

Reducing the number of median openings and intersections by adding a median barrier reduces the number of intersection and driveway related crashes. The magnitude of the crash benefit is not certain. A reduction in crashes similar to what would occur by reducing the number of access points would be expected. Left turn lanes would be provided at the Jacksboro Rd, Old Bronston School Rd, Park Dr, and Tucker Rd intersections with 345-foot left turn lane length needed (includes 100-foot taper). U-turn loons could be added to accommodate larger U-turning vehicles, such as trucks with trailers. U-turn movement would operate acceptably, likely near LOS C.

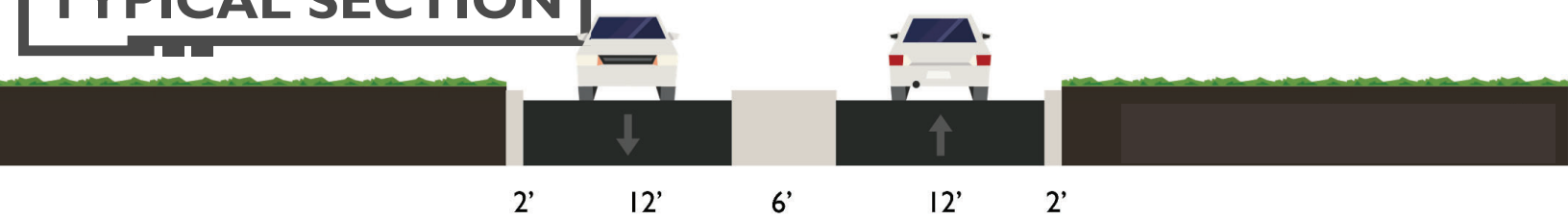
By reducing left turns from the high number of access points, a total crash reduction of 24% is expected. Traffic from side streets will be more efficient by rerouting most left turns. Vehicles turning left from KY 90 to side streets or businesses will reduce the number of slow-downs on the mainline as well by using left turn lanes.

KENTUCKY 90 CORRIDOR STUDY

PULASKI COUNTY, KY

PROJECT SHEET 2B-2

TYPICAL SECTION



COST $6,930,000

D $630,000
R $0
U $0
C $6,300,000

BENEFIT/COST RATIO*:
- 5-Year Crash Data: 0.3
- 7-Year Crash Data: 1.6

RIGHT-OF-WAY REQUIRED: No

BUILDING ACQUISITIONS: 0

CRASH REDUCTION: 24%

TOTAL 20-YEAR REDUCTION: 39.31 Crashes

ENVIRONMENTAL CONCERNS: None

**Due to the abnormal traffic conditions from the Covid-19 Pandemic, 5-year (2015-2019) and 7-year crash data (2015-2021) were used for benefit/cost analysis.*

PURPOSE

IMPROVE SAFETY AND REDUCE TRAFFIC IMPACTS FROM A HIGH NUMBER OF ACCESS POINTS.

Raised Median from Jacksboro Rd to Bridge and 12-Foot Two-Way Left Turn Lane with 12-Foot Lanes and Eight-Foot Shoulders from Old KY 90 Loop 3 to Jacksboro Road

Reducing the number of median openings and intersections by adding a median barrier reduces the number of intersection and driveway related crashes. The magnitude of the crash benefit is not certain. A reduction in crashes similar to what would occur by reducing the number of access points would be expected. Left turn lanes would be provided at the Jacksboro Rd, Old Bronston School Rd, Park Dr, Tucker Rd, and KY 790 intersections with 345-foot left turn lane length needed (includes 100-foot taper). U-turn loons could be added to accommodate larger U-turning vehicles, such as trucks with trailers. U-turn movement would operate acceptably, likely near LOS C.

By reducing left turns from the high number of access points, a total crash reduction of 24% is expected. Traffic from side streets will be more efficient by rerouting most left turns. Vehicles turning left from KY 90 to side streets or businesses will reduce the number of slowdowns on the mainline as well by using left turn lanes.

9.2 Spot Improvement Project Sheets

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KENTUCKY 90 CORRIDOR STUDY

FOREST RIDGE RD & SYCAMORE DR

PROJECT SHEET S1

COST $7,500

D $5,000
R $0
U $0
C $2,500

BENEFIT/COST RATIO*:
- 5-Year Crash Data: 0.9
- 7-Year Crash Data: 0.6

RIGHT-OF-WAY REQUIRED: No

CRASH REDUCTION: 35%

TOTAL 20-YEAR REDUCTION: 2.25 Crashes

ENVIRONMENTAL CONCERNS: None

**Due to the abnormal traffic conditions from the Covid-19 Pandemic, 5-year (2015-2019) and 7-year crash data (2015-2021) were used for benefit/cost analysis.*

PURPOSE

IMPROVE INTERSECTION SAFETY AT FOREST RIDGE RD

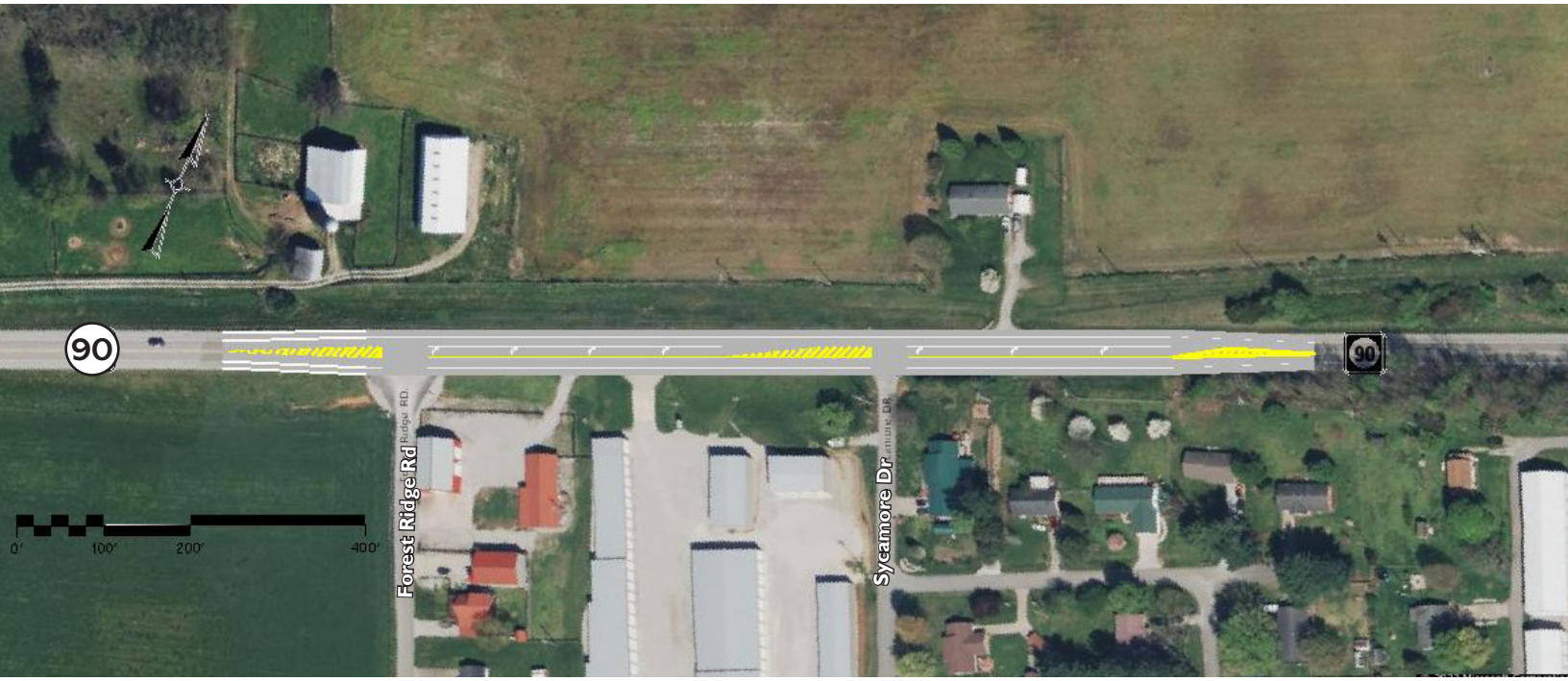
Provide Advance Intersection Warning Sign

Advance intersection warning signs provide low-cost and high-impact solutions to intersection safety by warning drivers of an intersection approaching where vehicles may be turning in or out. The benefit/cost ratio ranges from 0.9 for five-year crashes to 0.6 for seven-year crashes. The signs would be placed in advance of the Forest Ridge Road intersection in the eastbound direction along KY 90. An advance intersection warning sign already exists for the Sycamore Drive intersection in the westbound direction.

KENTUCKY 90 CORRIDOR STUDY

FOREST RIDGE RD & SYCAMORE DR

PROJECT SHEET S2



COST $485,000

D $44,000
R $1,000
U $0
C $440,000

BENEFIT/COST RATIO*:
- 5-Year Crash Data: 1.4
- 7-Year Crash Data: 1.9

RIGHT-OF-WAY REQUIRED: 0.1 Acres

CRASH REDUCTION: 44%

TOTAL 20-YEAR REDUCTION: 14.16 Crashes

ENVIRONMENTAL CONCERNS: Archaeology

**Due to the abnormal traffic conditions from the Covid-19 Pandemic, 5-year (2015-2019) and 7-year crash data (2015-2021) were used for benefit/cost analysis.*

PURPOSE

IMPROVE INTERSECTION SAFETY AT FOREST RIDGE RD AND SYCAMORE DR

Add Westbound Left Turn Lane on KY 90 at Forest Ridge Road and Sycamore Drive

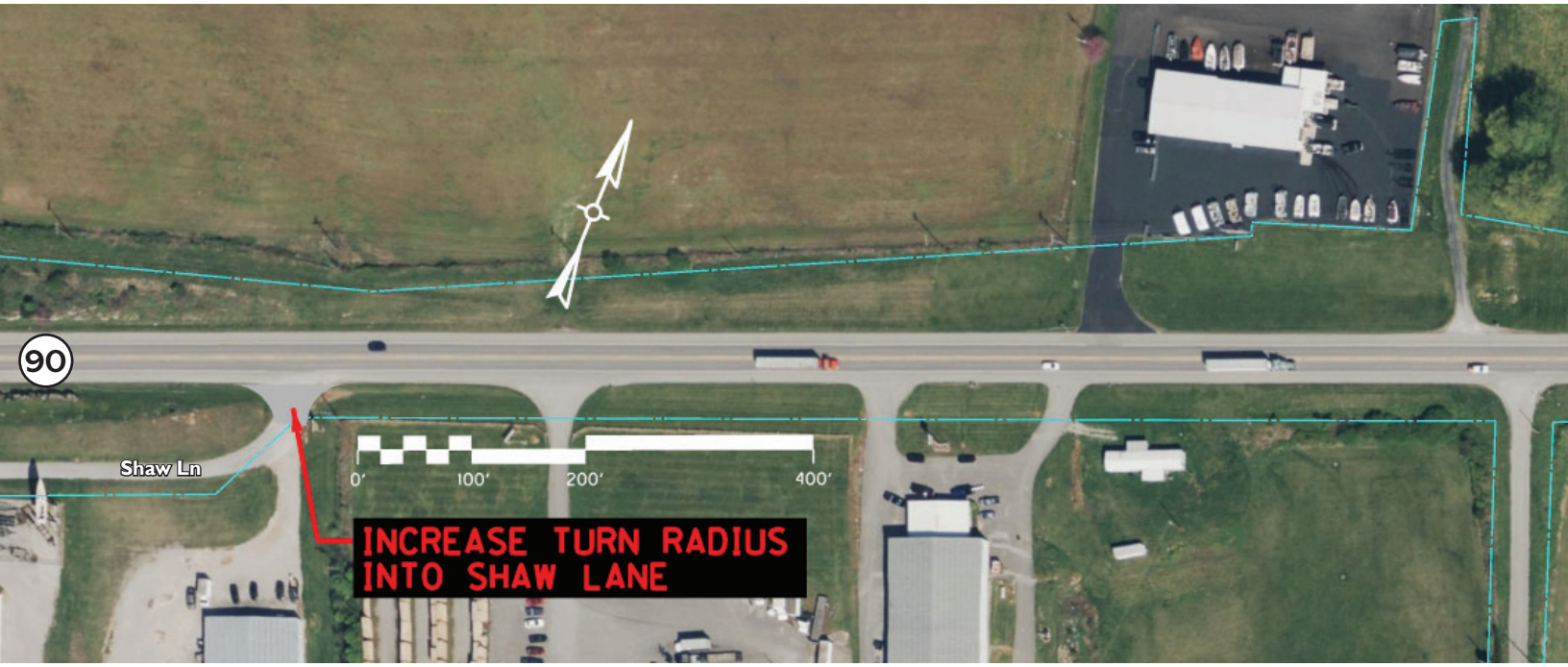
Adding a westbound left turn lane on KY 90 at Forest Ridge Road and Sycamore Drive would improve safety and reduce crashes at this intersection. The benefit cost ratio is 1.4 utilizing five-year crash data and 1.9 utilizing seven-year crash data. By adding a left turn lane, left turning vehicles are not stopped on the mainline of KY 90 when waiting to turn left, potentially reducing rear end crashes and minimizing traffic congestion as well. Fatal and injury crash reduction is projected to be 44% from current crash trends and data.

The left turn lanes would have a 345-foot turn lane length with a 100-foot bay taper at each intersection. The right-of-way impact is minimal with a 0.1 acres acquisition.

KENTUCKY 90 CORRIDOR STUDY

SHAW LANE

PROJECT SHEET
S3



COST $30,000

D $5,000
R $0
U $0
C $25,000

BENEFIT/COST RATIO*:
- 5-Year Crash Data: 0
- 7-Year Crash Data: 0

RIGHT-OF-WAY REQUIRED: No

CRASH REDUCTION: 10%

TOTAL 20-YEAR REDUCTION: 0.33 Crashes

ENVIRONMENTAL CONCERNS: NONE

**Due to the abnormal traffic conditions from the Covid-19 Pandemic, 5-year (2015-2019) and 7-year crash data (2015-2021) were used for benefit/cost analysis.*

PURPOSE

IMPROVE INTERSECTION SAFETY AND DRIVER VISIBILITY AT SHAW LANE

Angle Shoulder to Widen for Right Turns and Improve Pavement at Mile Point 1.021.

Currently, a 180 degree turn exists for right-turning vehicles onto Shaw Lane. A 180-degree turn causes vehicles to slow down when turning right from a major road to a minor road, potentially causing a hazard for rear end crashes. By widening the right turn radius, right turning vehicles, specifically trucks, will not have to slow down as much to make their turn.

This improvement has the potential of reducing approximately 10% of fatal and injury crashes. No right-of-way acquisition is required for this concept.

KENTUCKY 90 CORRIDOR STUDY

JACKSBORO RD

PROJECT SHEET S4

COST $7,500

D $5,000
R $0
U $0
C $2,500

BENEFIT/COST RATIO*:
- 5-Year Crash Data: N/A
- 7-Year Crash Data: N/A

RIGHT-OF-WAY REQUIRED: No

CRASH REDUCTION: 0%

TOTAL 20-YEAR REDUCTION: 0.00 Crashes

ENVIRONMENTAL CONCERNS: None

**Due to the abnormal traffic conditions from the Covid-19 Pandemic, 5-year (2015-2019) and 7-year crash data (2015-2021) were used for benefit/cost analysis.*

PURPOSE

WARN DRIVERS OF POTENTIAL HAZARDS DUE TO HIGH VOLUME OF ACCESS POINTS

Provide "Congestion Ahead" Signing at Mile Point 1.377

From Jacksboro Road to the bridge over the Cumberland River, KY 90 has 70 access points over 1.7 miles. With a high number of access points and lack of turn lanes, turns in and out of the businesses and side streets are more frequent and can cause sudden stops for through vehicles. Adding a "Congestion Ahead" sign allows unfamiliar drivers to know sudden stops may occur in the area.

A crash modification factor is not available for this potential improvement concept. No right-of-way acquisition is required and the cost is low at $7,500.

KENTUCKY 90 CORRIDOR STUDY

JACKSBORO RD

PROJECT SHEET S5

COST $90,000

D $15,000
R $0
U $0
C $75,000

BENEFIT/COST RATIO*:
- 5-Year Crash Data: 4.4
- 7-Year Crash Data: 3.2

RIGHT-OF-WAY REQUIRED: No

CRASH REDUCTION: 15%

TOTAL 20-YEAR REDUCTION: 6.66 Crashes

ENVIRONMENTAL CONCERNS: Archaeology, Tree Removal (bats), Possible Historic

**Due to the abnormal traffic conditions from the Covid-19 Pandemic, 5-year (2015-2019) and 7-year crash data (2015-2021) were used for benefit/cost analysis.*

PURPOSE

IMPROVE SAFETY AT THE JACKSBORO ROAD INTERSECTION

Improve the Jacksboro Road Intersection Skew at Mile Point 1.377

Currently, the Jacksboro Road intersection is at a 35-degree skew. Turning vehicles have less sight distance due to the angle of the car at the intersection. Squaring the intersection at 90 degrees makes turning easier and safer for drivers.

This improvement has the potential of reducing approximately 15% of fatal and injury crashes. No right-of-way acquisition is required for this concept. This intersection has a higher amount of historic crashes making the benefit/cost ratio 4.4 for the five-year crash data and 3.2 for the seven-year crash data.

KENTUCKY 90 CORRIDOR STUDY

OLD BRONSTON SCHOOL RD

PROJECT SHEET S6

COST $45,000

D $15,000
R $0
U $0
C $30,000

BENEFIT/COST RATIO*:
- 5-Year Crash Data: 0.1
- 7-Year Crash Data: 0.4

RIGHT-OF-WAY REQUIRED: No

CRASH REDUCTION: 9%

TOTAL 20-YEAR REDUCTION: 2.06 Crashes

ENVIRONMENTAL CONCERNS: Archaeology, Tree Removal (bats)

**Due to the abnormal traffic conditions from the Covid-19 Pandemic, 5-year (2015-2019) and 7-year crash data (2015-2021) were used for benefit/cost analysis.*

PURPOSE

IMPROVE SAFETY AT THE OLD BRONSTON SCHOOL ROAD INTERSECTION

Improve the Intersection Skew at the Old Bronston School Road Intersection

Currently, the Old Bronston School Road intersection is at a 20-degree skew. Turning vehicles have less sight distance due to the angle of the car at the intersection. Squaring the intersection at 90 degrees makes turning easier and safer for drivers.

This improvement has the potential of reducing approximately 9% of fatal and injury crashes. No right-of-way acquisition is required for this concept. This intersection has a low amount of historic crashes making the benefit/cost ratio low.

KENTUCKY 90 CORRIDOR STUDY

OLD BRONSTON SCHOOL RD, PARK DR, & TUCKER RD

PROJECT SHEET
S7

COST $681,000

D $62,000
R $4,000
U $0
C $615,000

BENEFIT/COST RATIO*:
- 5-Year Crash Data: 0.0
- 7-Year Crash Data: 13.7

RIGHT-OF-WAY REQUIRED: 0.85 Acres

CRASH REDUCTION: 44%

TOTAL 20-YEAR REDUCTION: 39.66 Crashes

ENVIRONMENTAL CONCERNS: Archaeology, Tree Removal (bats)

**Due to the abnormal traffic conditions from the Covid-19 Pandemic, 5-year (2015-2019) and 7-year crash data (2015-2021) were used for benefit/cost analysis.*

PURPOSE

IMPROVE SAFETY AT THE OLD BRONSTON SCHOOL ROAD, PARK DRIVE, & TUCKER ROAD INTERSECTION

Add Westbound Left Turn Lanes at the Old Bronston School Road, Park Drive, and Tucker Road Intersections

Adding westbound left turn lanes on KY 90 at Old Bronston School Road, Park Drive, and both eastbound and westbound left turn lanes at Tucker Road would improve safety and reduce crashes at this intersection. The benefit cost ratio is 0.0 over the five year crash data and 13.7 over the seven year crash data. By adding left turn lanes, left turning vehicles are not stopped on the mainline of KY 90 when waiting to turn left, potentially reducing rear end crashes and minimizing traffic congestion as well. Fatal and injury crash reduction is projected to be 44% from current crash trends and data.

The left turn lanes would be continuous between each intersection. The right-of-way impact is minimal with a 0.85 acres acquisition.

KENTUCKY 90 CORRIDOR STUDY

PARK DR

PROJECT SHEET
S8

COST $60,000

D $10,000
R $0
U $0
C $50,000

BENEFIT/COST RATIO*:
- 5-Year Crash Data: 0.8
- 7-Year Crash Data: 21.8

RIGHT-OF-WAY REQUIRED: No

CRASH REDUCTION: 6%

TOTAL 20-YEAR REDUCTION: 1.44 Crashes

ENVIRONMENTAL CONCERNS: Archaeology

**Due to the abnormal traffic conditions from the Covid-19 Pandemic, 5-year (2015-2019) and 7-year crash data (2015-2021) were used for benefit/cost analysis.*

PURPOSE

IMPROVE SAFETY AT THE PARK DRIVE INTERSECTION

Improve the Intersection Skew at Park Drive

Currently, the Park Drive intersection is at a 10-degree skew. Turning vehicles have less sight distance due to the angle of the car at the intersection. Squaring the intersection at 90 degrees makes turning easier and safer for drivers.

This improvement has the potential of reducing approximately 6% of fatal and injury crashes. No right-of-way acquisition is required for this concept. This intersection has a lower amount of historic crashes from 2015-2019 but a higher severity of crashes from 2020-2021 making the benefit/cost ratio 0.8 for the five-year crash data and 21.8 for the seven-year crash data.

KENTUCKY 90 CORRIDOR STUDY

GIBSON LANE/OLD KY 90

PROJECT SHEET

S9

COST $15,000

D $5,000
R $0
U $0
C $10,000

BENEFIT/COST RATIO*:
- 5-Year Crash Data: N/A
- 7-Year Crash Data: N/A

RIGHT-OF-WAY REQUIRED: No

CRASH REDUCTION: N/A

TOTAL 20-YEAR REDUCTION: 0.00 Crashes

ENVIRONMENTAL CONCERNS: None

**Due to the abnormal traffic conditions from the Covid-19 Pandemic, 5-year (2015-2019) and 7-year crash data (2015-2021) were used for benefit/cost analysis.*

PURPOSE

IMPROVE SAFETY AT THE GIBSON LANE / OLD KY 90 INTERSECTION

Restripe the Eastbound and Westbound Turn Lanes and Improve the Westbound Merge at the Gibson Lane Intersection

Adding left turn lanes on KY 90 at the Gibson Lane intersection would improve safety and reduce crashes at this location. By adding a left turn lane, left turning vehicles are not stopped on the mainline of KY 90 when waiting to turn left, potentially reducing rear end crashes and minimizing traffic congestion as well. Signage is not present indicating a lane ending and a merge ahead. An advance intersection sign indicating a left turn onto Old KY 90 is also absent.

The left turn lane would have a 345-foot turn lane length with a 100-foot bay taper. There would not be any right-of-way impact with this improvement.

KENTUCKY 90 CORRIDOR STUDY

GIBSON LANE/OLD KY 90

PROJECT SHEET S10

COST $165,000

D $15,000
R $0.00
U $0.00
C $150,000

BENEFIT/COST RATIO*:
- 5-Year Crash Data: 1.0
- 7-Year Crash Data: 1.3

RIGHT-OF-WAY REQUIRED: No

CRASH REDUCTION: 41%

TOTAL 20-YEAR REDUCTION: 6.60 Crashes

ENVIRONMENTAL CONCERNS: None

**Due to the abnormal traffic conditions from the Covid-19 Pandemic, 5-year (2015-2019) and 7-year crash data (2015-2021) were used for benefit/cost analysis.*

PURPOSE

IMPROVE SAFETY AT THE GIBSON LANE / OLD KY 90 INTERSECTION APPROACH

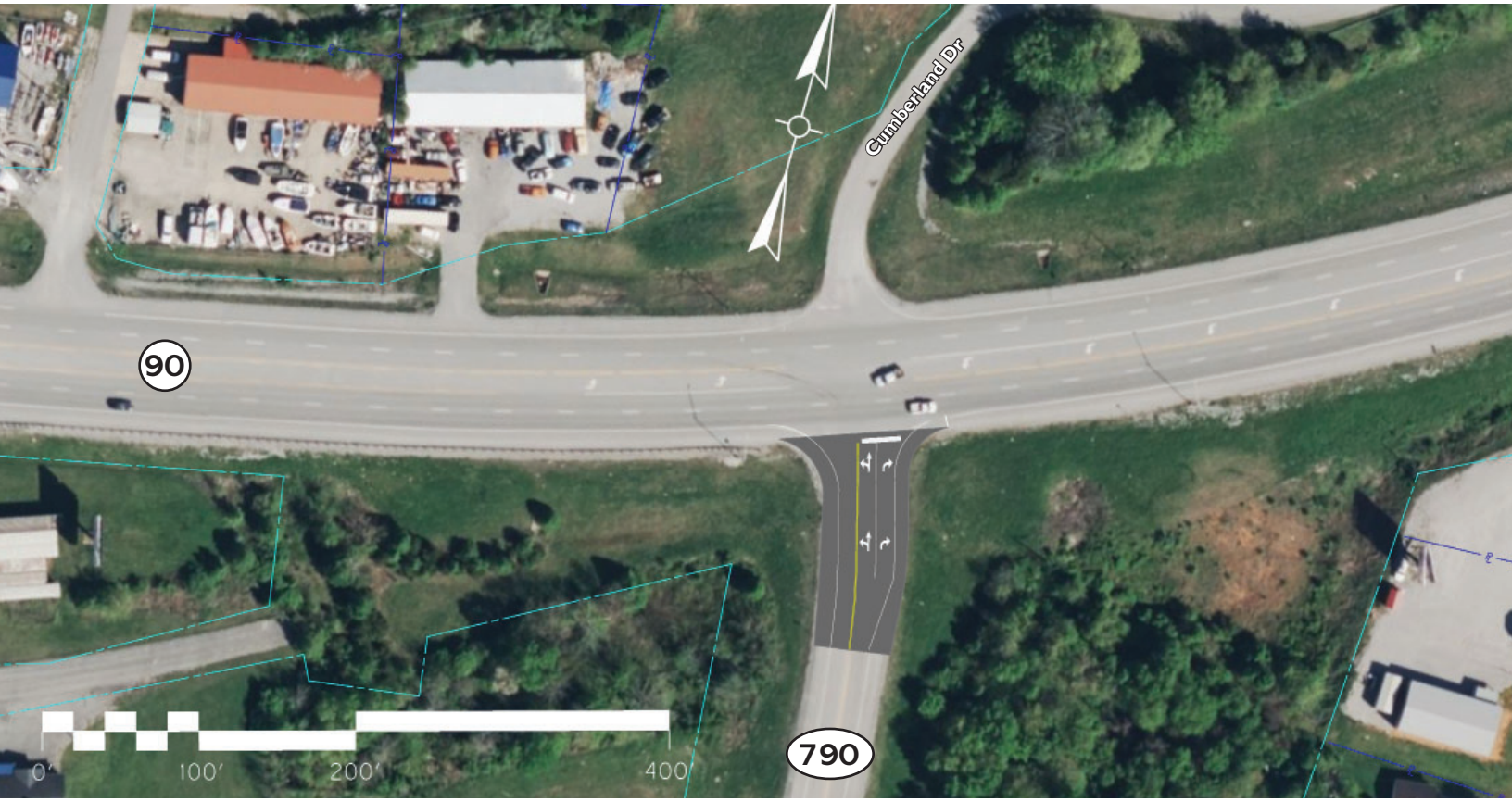
Eliminate the Westbound Merge and Add a Westbound Right Turn Only Lane at the Gibson Lane Intersection

Currently, KY 90 drops from a five-lane section to a three-lane section just west of Robins Nest Road, and then to a two-lane section between Gibson Lane and Tucker Road. This improvement extends the westbound merge lane into a right turn lane from KY 90 to Gibson Lane. The right turn lane and removal of the merge would improve safety and reduce crashes at this intersection. The benefit cost ratio is 1.0 over the five-year crash data and 1.3 over the seven-year crash data. By adding a right turn lane, right turning vehicles are not slowing down the mainline through vehicles of KY 90, potentially reducing rear end crashes and minimizing traffic congestion as well. Fatal and injury crash reduction is projected to be 41% from current crash trends and data. No right-of-way is required for this improvement.

KENTUCKY 90 CORRIDOR STUDY

KY 790 / CUMBERLAND DR

PROJECT SHEET S11



COST $50,000

D $10,000
R $0
U $0
C $40,000

BENEFIT/COST RATIO*:
- 5-Year Crash Data: N/A
- 7-Year Crash Data: N/A

RIGHT-OF-WAY REQUIRED: No

CRASH REDUCTION: N/A

TOTAL 20-YEAR REDUCTION: 0.00 Crashes

ENVIRONMENTAL CONCERNS: None

**Due to the abnormal traffic conditions from the Covid-19 Pandemic, 5-year (2015-2019) and 7-year crash data (2015-2021) were used for benefit/cost analysis.*

PURPOSE

IMPROVE SIDE STREET DELAY AT THE KY 790 / CUMBERLAND DR INTERSECTION

Add a Northbound Right Turn Lane at the KY 790 / Cumberland Drive Intersection

The KY 790 approach to KY 90 currently has one lane in each direction. Through public input, left turning vehicles cannot exit the intersection in a timely manner, backing up right turning vehicles. This improvement addresses operations more than safety. Therefore, a benefit/cost ratio is not available. Right-of-way acquisition is not required for this improvement.

10 Next Steps

Upon completion of this study, selected recommended improvement concepts will be moved through project development. There are funds for future project development phases of this corridor in the *Six Year Plan*.

10.1 Contacts

Written requests for additional information should be sent to the KYTC Division of Planning Director, 200 Mero Street, Frankfort, Kentucky 40622.

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