EXECUTIVE SUMMARY

KY 90 Scoping Study
Barren County
KYTC Item No. 3-8819.00

Prepared for:

Kentucky Transportation Cabinet
Central Office, Division of Planning
Highway District 3, Bowling Green

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The Kentucky Transportation Cabinet (KYTC) initiated the KY 90 Scoping Study in Barren County to examine the need for and types of improvements necessary along KY 90 between Sanders Street in Cave City and US 68 (Veterans Outer Loop) in Glasgow, shown in **Figure ES-1**. The study serves as the first step in establishing project goals, completing an existing conditions analysis, identifying potential concerns, developing cost estimates, and evaluating preliminary alternatives along the 8.414-mile-long corridor.

Purpose and Need

The purpose of the KY 90 Improvement Project is to enhance regional mobility and to provide a safer, more efficient connection between Glasgow and I-65. For vehicles heading northbound on I-65 from Glasgow, KY 90 is the most direct connection. Signs on I-65 direct southbound vehicles to use KY 90 to access Glasgow. KY 90 also provides a link between the Barren River Lake State Park and the Mammoth Cave National Park. KY 90 is part of the National Truck Network (NTN).

Within the study corridor, KY 90 is functionally classified as a Rural Minor Arterial from Sanders Street in Cave City to Beaver Trail in Glasgow and an Urban Minor Arterial in Glasgow from Beaver Trail to US 68. The posted speed limit ranges from 45 to 55 miles per hour (mph). A review of the as-built plans found all the horizontal and vertical curves along KY 90 satisfy requirements for the functional classification and posted speed limits.

The current traffic volumes on KY 90 range between 7,600 and 9,000 vehicles per day (vpd) with 16 to 17 percent trucks. By 2040, traffic volumes are expected to grow to 12,000 vpd with 19 percent trucks. A volume to capacity (V/C) analysis indicates the two-lane road can accommodate the existing and future traffic demand.

Level of service (LOS) is a qualitative measure describing operational conditions within a traffic stream, based on factors such as speed and travel time, freedom to maneuver, traffic interruptions, comfort, and convenience. In rural areas, LOS C or better is desirable and in urban areas, LOS D or better is desirable. The urban segment of KY 90 in Cave City operates at LOS D. This portion of KY 90 has a signalized intersection at US 31W and no passing opportunities, which decreases the average travel speed and increases the percent time spent following in a platoon. In the rural segment south of Cave City, passing lanes are introduced along KY 90 which increases the average travel speed and decreases the percent time spent following. This portion of KY 90 operates at LOS C. By 2040, KY 90 is expected to operate at LOS E in Cave City and a LOS D south of Cave City. The less than desirable future LOS would suggest that improvements should be considered.

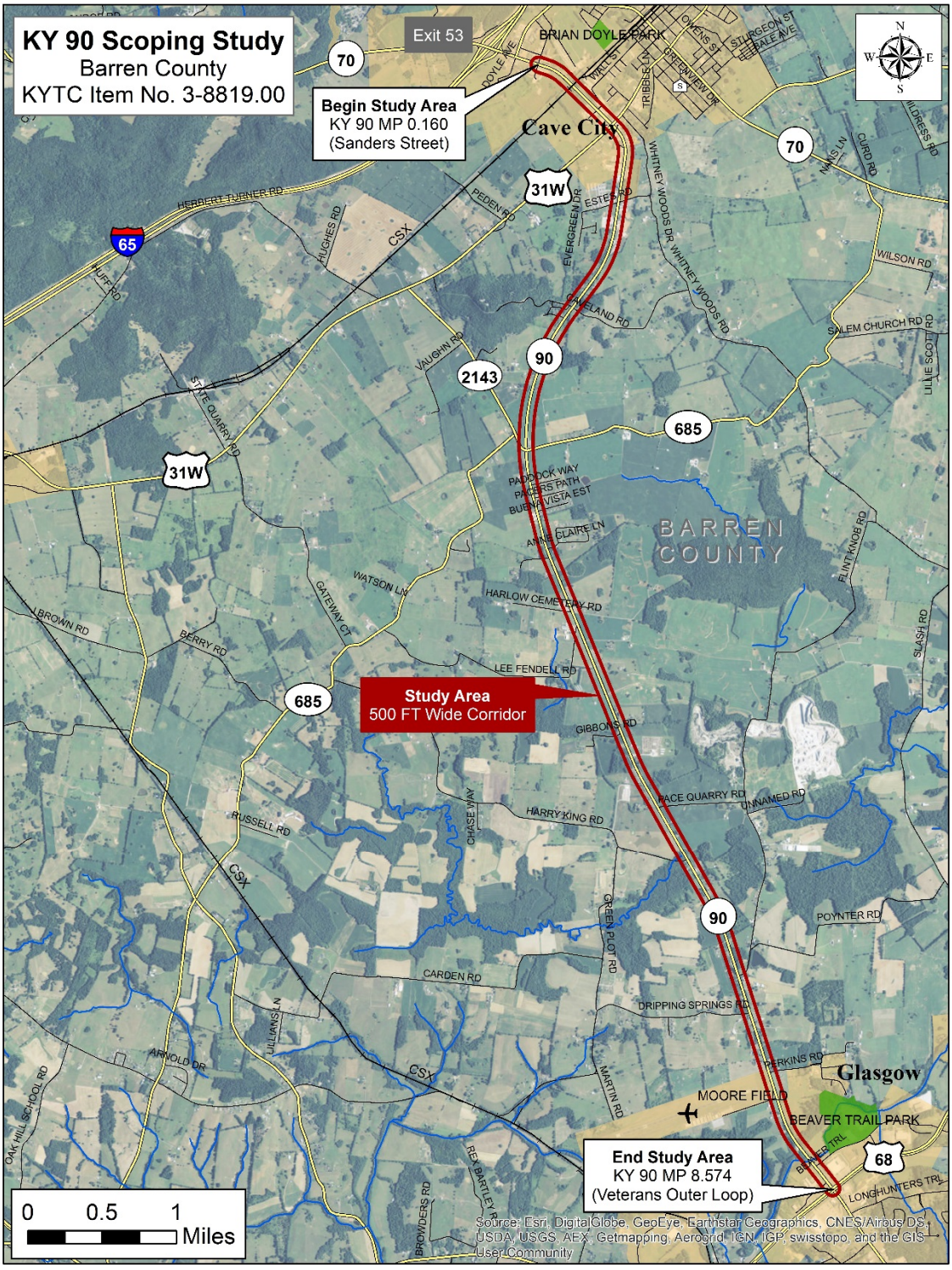

Figure ES-1: Study Area - KY 90 Scoping Study

Over the five-year period between January 1, 2011, and December 31, 2015, 204 crashes were reported along KY 90 in the study area. This includes three fatal crashes (1.5 percent), 47 injury collisions (23 percent), and 154 property damage only collisions (75.5 percent). Along the study corridor, 10 spots were found to have a critical crash rate factor (CRF) greater than 1.0[1].

Alternative Development

Spot improvements and corridor-wide improvements were both evaluated. Spot improvements generally include relatively low cost improvements that can be implemented individually as solutions to address existing roadway concerns. Five locations were identified as conceptual spot improvement projects.

The corridor-wide alternatives would result in the improvement of KY 90 along the entire study area. The corridor was divided into two sections – Section 1 is within the urban area of Cave City and Section 2 is within the rural area between Cave City and Glasgow.

- Section 1 had one preliminary alternative: a five-lane curb-and-gutter typical section with sidewalks and bike lanes. This matches the existing typical section north of Sanders Street.

- Section 2 had two preliminary alternatives: 2+1 typical section and four-lane depressed median.

2+1 Roadways

This concept provides a continuous three-lane cross section that is striped in a manner that provides passing lanes in alternating directions throughout the section. The 2+1 roadway concept has been found to improve operational efficiency and reduce crashes for two-lane highways[2]. A 2+1 road will generally operate two levels of service higher than a conventional two-lane highway serving the same traffic volume[3]. The concept provides a continuous three-lane cross section and the highway is striped in a manner as to provide for passing lanes in alternating directions throughout the section. This concept is an attractive cost savings option over widening two-lane roads to four-lanes where alternating passing lanes can obtain the desired level of service.

South of Cave City, KY 90 currently has three southbound and two northbound passing lanes that increase the average travel speeds and decrease the percent time following, which improves the LOS. This portion of KY 90 currently operates at a desirable LOS C. The 2040 average daily traffic (ADT) is projected to be 12,000 vpd with 19 percent trucks which will

[1] Per the Kentucky Transportation Center's (KTC) annual Analysis of Traffic Crash Data in Kentucky (2011-2015), a CRF greater than 1.00 indicates that crashes may be occurring more often than can be attributed to random occurrence.
[2] AASHTO's A Policy on Geometric Design of Highways and Streets, 6th Edition, 2011
[3] http://transportation.ky.gov/Congestion-Toolbox/Documents/M_OpsEffects_2.pdf

operate at an undesirable LOS D south of Cave City. Building a 2+1 roadway would give KY 90 a desirable 2040 LOS C.

Given the limited number of roadways currently in operation in the United States, a comprehensive safety evaluation of 2+1 designs has not been completed. However, National Cooperative Highway Research Program (NCHRP) Project 20-7[4] evaluated the performance of 2+1 roadways in Europe and found the following results:

- In Germany, 2+1 roadways have been found to operate with crash rates 36 percent lower than conventional two-lane highways.
- Finland has estimated that 2+1 roads operate with crash rates 22–46 percent lower than conventional two-lane highways.

The optimum length of the passing lane (without tapers) is 0.5 to 1.0 miles. Lengths of less than half a mile are not recommended because they are not effective in reducing vehicle platooning. Three of the five existing passing lanes along KY 90 are less than half a mile in length. In total, the existing passing lanes are 2.4 miles long, which makes up 35 percent of KY 90 between Cave City and Glasgow. To achieve a desirable 2040 LOS, the existing passing lanes will need to be extended and additional passing lanes will need to be constructed, which would turn KY 90 into a 2+1 roadway.

Where the passing lanes are dropped on a 2+1 roadway, the taper length is 600 feet. These tapers are meant to be long to minimize the likelihood of head-on collisions. Signs and lane drop arrows are also used to alert vehicles in the passing lane that the lane is ending. Where lanes are added, shorter tapers of 200 feet in length are required. The recommended taper lengths are shown in **Figure ES-2**. Where necessary and appropriate, left turn lanes are placed between tapers in the flush median after traffic has been transitioned out of the passing lanes. An example is shown in **Figure ES-3** where a left turn lane is shown on KY 90 at the KY 685 intersection.

Public Involvement

Public engagement for the KY 90 Scoping Study was undertaken through a two-step process involving a meeting with project stakeholders and local officials, followed by a meeting with the general public. The local officials/stakeholders meeting was held on May 26, 2016. The purpose of the meeting was to present the results of the existing conditions analysis and to get feedback on conceptual improvement alternatives before the public meeting. On June 28, 2016, the project team held a public meeting at the Cave City Convention Center in Cave City. The purpose of the meeting was to provide information about the study and the improvements under consideration, discuss conceptual alternatives, and solicit input from the public. The meeting was co-hosted by KYTC District 3 and Central Office Planning.

[4] http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rrd_275.pdf

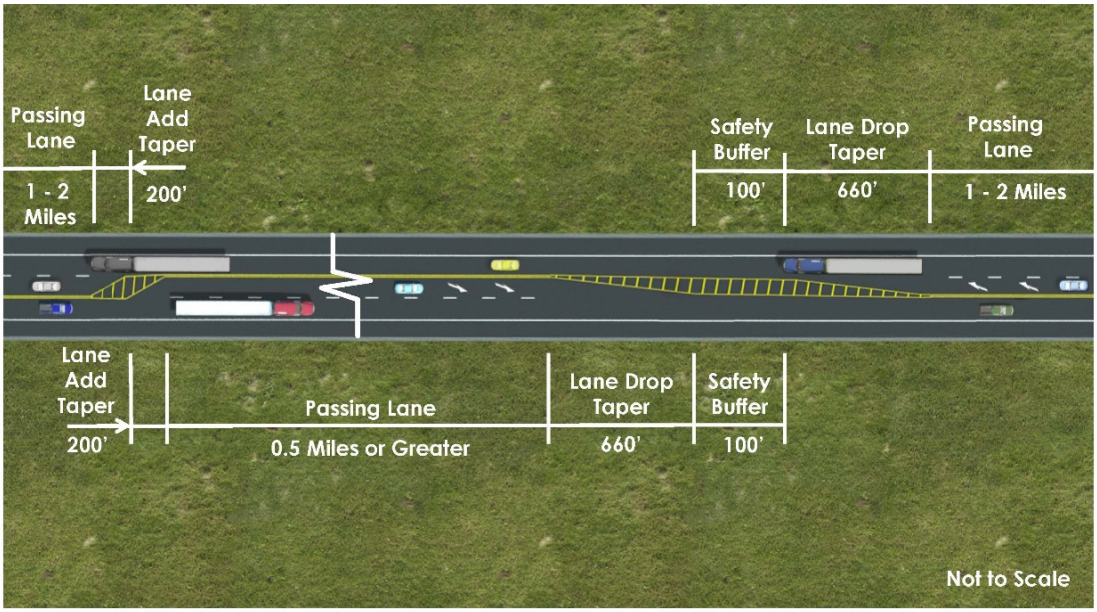

Figure ES-2: Recommended 2+1 Roadway Taper Lengths

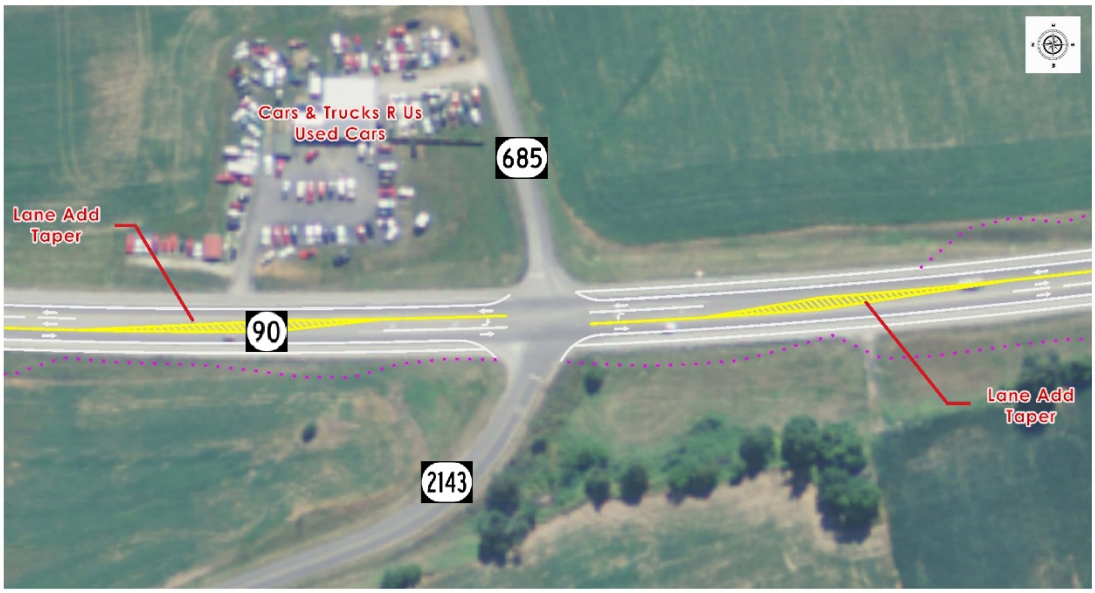

Figure ES-3: Left Turn Lanes on 2+1 Roadways (KY 90 intersection at KY 685)

Surveys were distributed to the local officials, stakeholders, and the public. Eight completed surveys were submitted from the local officials/stakeholders meeting and 48 completed surveys were submitted from the public meeting. The results of the survey are summarized as follows:

- Respondents were asked whether several transportation issues along KY 90 should be addressed as part of the project. Of the 11 options provided, safety and not enough passing lanes were selected most frequently.

- Respondents were asked if they felt improvements were needed along KY 90. Eighty-nine percent of respondents indicated improvements were needed.

- Respondents were asked if they prefer further consideration of the Spot Improvement alternative or the Corridor-wide Improvement. Sixty-seven percent of respondents preferred the Corridor-wide Improvement.

- Respondents were asked which Corridor-wide Improvement they prefer. Thirty-four respondents (64 percent) preferred Alternative 1 (2+1 Typical Section south of Cave City), 15 respondents (28 percent) preferred Alternative 2 (Four-Lane Depressed Median Typical Section south of Cave City), and four respondents (nine percent) wanted a different alternative. Alternative 1 was recommended as the preferred alternative from all eight local officials/stakeholders survey respondents.

- Respondents were asked if a shared-use path should be constructed along KY 90 between Cave City and Glasgow. Thirty respondents (58 percent) said "no" and 22 respondents (42 percent) said "yes."

In addition to the public engagement process, the project team held three meetings to coordinate on key issues. The project team consisted of representatives of the KYTC Central Office, KYTC District 3 Office, representatives of the Barren River Area Development District (BRADD), and the consultant.

Recommendations

Recommendations for the KY 90 Scoping Study were based on their ability to meet the purpose and need, the existing conditions analysis, the input received, and the alternative development process detailed in this report. The project team chose Alternative 1 as the preferred alternative to move forward to Phase 1 design, shown in **Figure ES-4**.

The proposed typical section in Section 1 (Cave City) is a five-lane typical section with curb-and-gutter, sidewalks, and bike lanes. It matches the existing typical section north of Sanders Street.

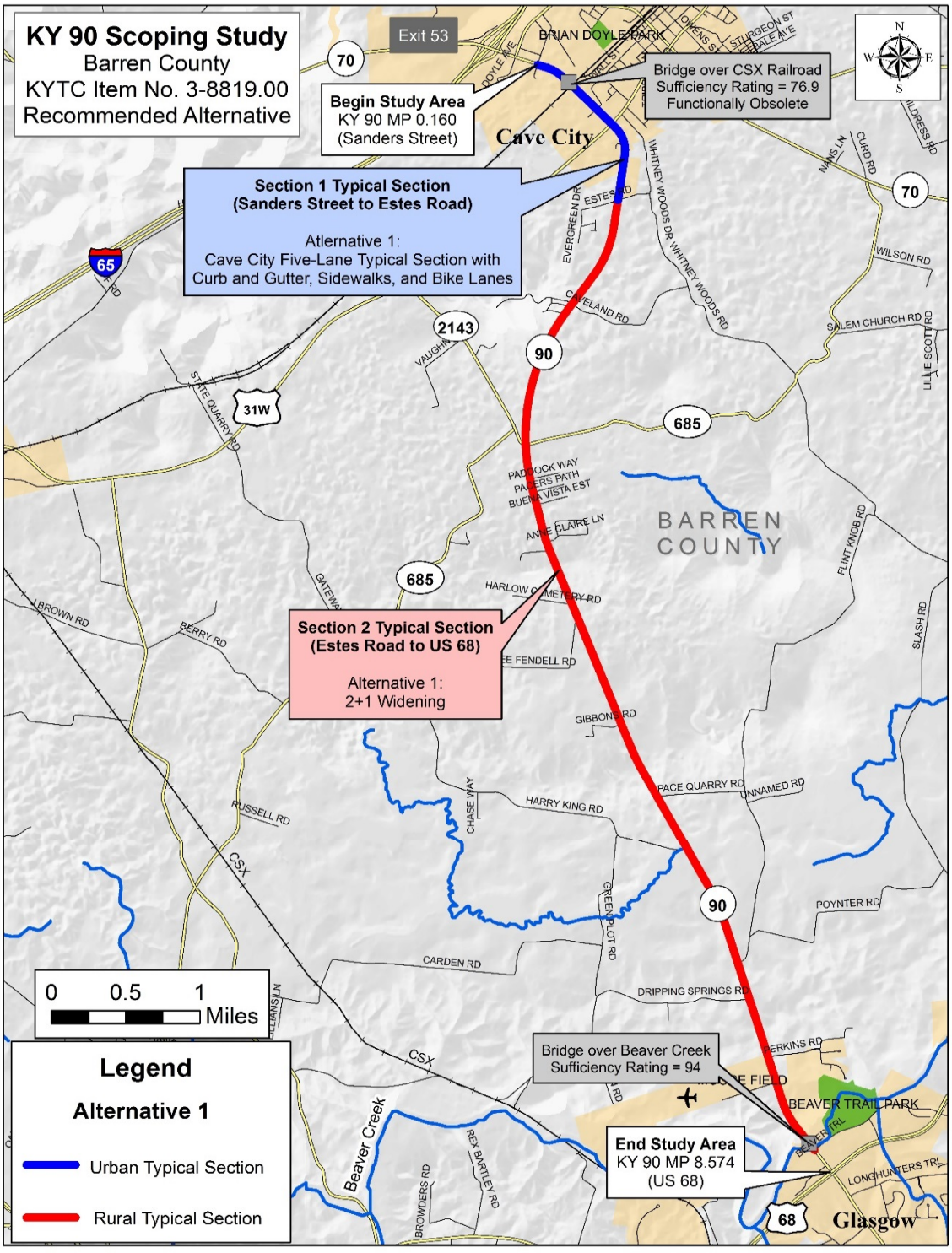

Figure ES-4: Recommended Alternative

A 2+1 typical section is proposed in Section 2. In a localized construction section, the 2+1 widening occurs on one side of the road so traffic can be maintained during construction and most existing mainline pavement can be reused. The widening throughout the corridor should shift from one side of the road to the other, depending upon existing conditions, to minimize right-of-way and environmental impacts, and reduce earthwork. It is assumed that after the widening is complete, a final pavement surface course and final striping will be placed over the entire roadway. Reduced shoulder widths and lane widths should be considered for the 2+1 typical section in Phase 1 design. This can enhance safety by reducing travel speeds and will further reduce right-of-way impacts and construction costs.

The project team chose Alternative 1 as the preferred alternative because it:

- Satisfies the purpose and need of the project;
- Addresses the top two transportation issues from survey respondents (safety and not enough passing lanes);
- Provides acceptable LOS through year 2040;
- Was selected as the preferred alternative from the majority of the public survey respondents and all of the local officials/stakeholders' survey respondents;
- Can be built within the 2016 Highway Plan budget;
- Provides a corridor wide improvement (Cave City to Glasgow), which meets the intent of the project description in the 2016 Highway Plan;
- Provides the most design flexibility which reduces right-of-way impacts, environmental impacts, and construction costs; and
- Does not require widening or replacing the bridge over Beaver Creek.

If the project moves forward, a shared-use path merits further consideration in Phase 1 design. The local officials in Glasgow, Cave City and/or Barren County will need to agree to maintain the shared-use path before it moves further in design. The addition of a shared-use path reduces design flexibility. Many of the homes and businesses along KY 90 are adjacent to the existing roadway right-of-way. Widening to the west and constructing the shared-use path to the east would affect properties on both sides of the road. Thus, where the shared-use path is included, all the widening is done to the east, which increases earthwork and right-of-way impacts. The increased right-of-way impacts will increase the project timeline considerably. The addition of the shared-use path to the 2+1 typical section is estimated to require three additional home relocations, one additional business relocation, a new pedestrian bridge over Beaver Creek, and an additional $9.0 million in total project cost ($5.1 million of which is directly related to the construction). An alternative that may be considered would be the inclusion of a shoulder

bikeway. However, a similar maintenance agreement with the local municipalities would be required to provide a debris-free area for cyclists to operate.

Cost estimates for Alternative 1 with and without the shared-use path are shown in **Table ES-1.** The cost estimates are based on approximate earthwork volumes, pavement areas, and structures affected. These major project construction items were used to estimate the construction costs for the alternatives under consideration. Typical paving sections were determined for cost estimating purposes. A digital terrain model of the recommended alternative was created to approximate disturbed limits for the improvements which were used to determine right-of-way costs, number of utilities affected, and to estimate the number of relocations.

Alternative	Description	2016 Cost Estimates (millions)				
		Design	Right-of-Way	Utility	Construction	Total
2016 Highway Plan	**Major Widening from Sanders Street in Cave City to US 68 (Glasgow Outer Loop) in Glasgow**	**$2.2**	**$6.0**	**$3.5**	**$27.5**	**$39.2**
Alternative 1	Five-Lane Urban Typical Section in Cave City and 2+1 Typical Section South of Cave City	$2.0	$2.5	$10.0	$20.5	$35.0
Alternative 1b	Five-Lane Urban Typical Section in Cave City and 2+1 Typical Section with Shared-Use Path South of Cave City	$2.6	$5.8	$10.0	$25.6	$44.0

Table ES-1: Alternative 1 Cost Estimate