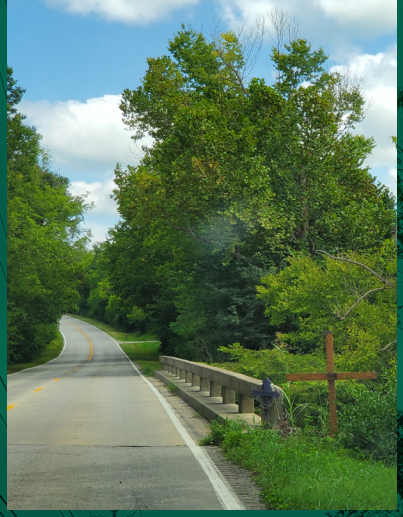
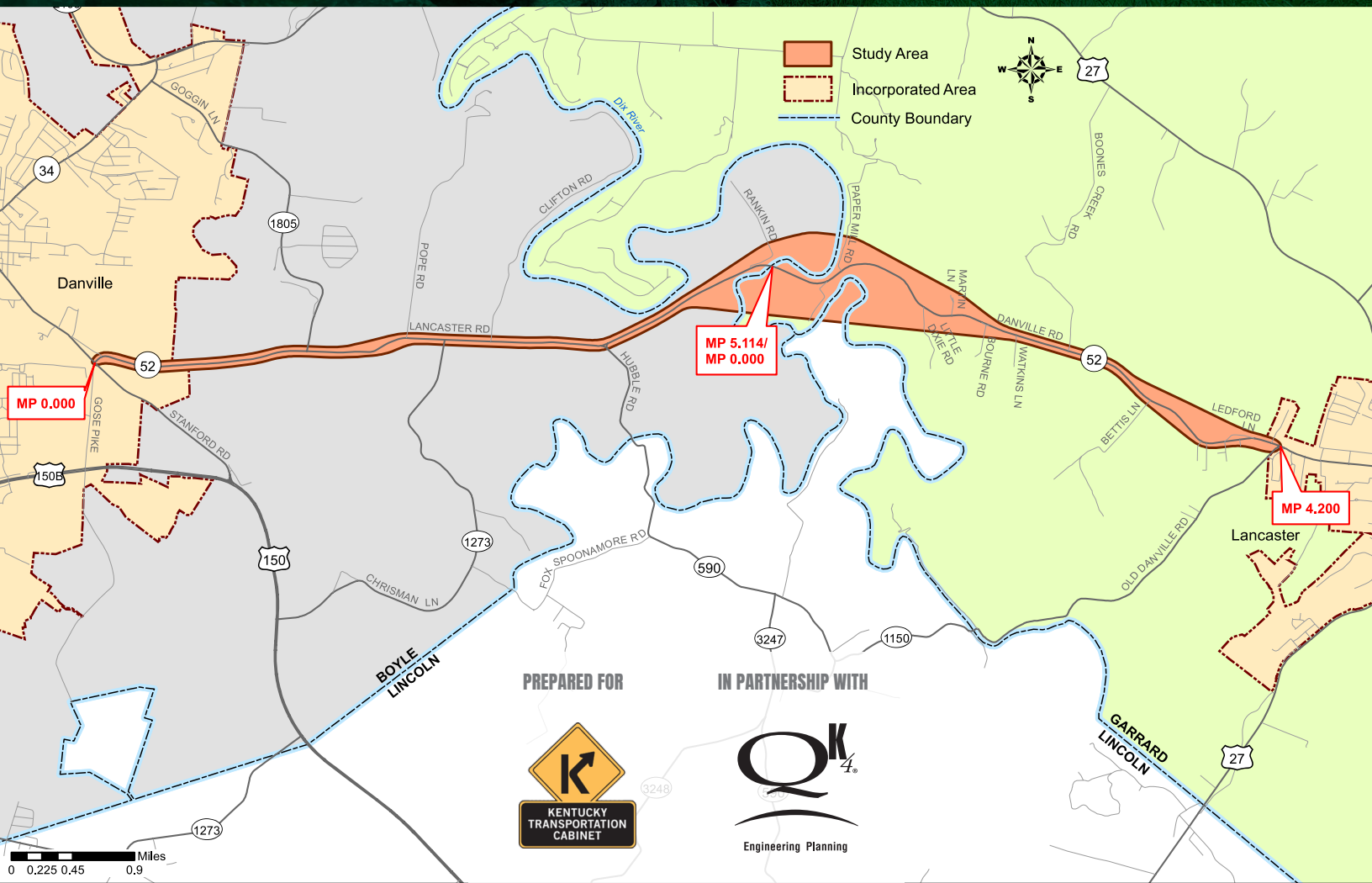


FINAL REPORT

KY 52 CORRIDOR STUDY

BOYLE AND GARRARD COUNTIES, KY

ITEM NO. 7-104 • MARCH 2022



PREPARED FOR

KENTUCKY TRANSPORTATION CABINET

IN PARTNERSHIP WITH

QK4 Engineering Planning

EXECUTIVE SUMMARY

Study Background

The Kentucky Transportation Cabinet (KYTC) initiated a corridor study in fall 2020 for KY 52 between Danville and Lancaster. The study identified safety and traffic issues along the 9.3-mile corridor. The study limits shown in **Figure ES-1** cover milepoints (MP) 0.000–5.114 in Boyle County and MP 0.000–4.200 in Garrard County, stretching from the US 150 intersection in Danville to the intersection with KY 1150 (Old Danville Road) in Lancaster.

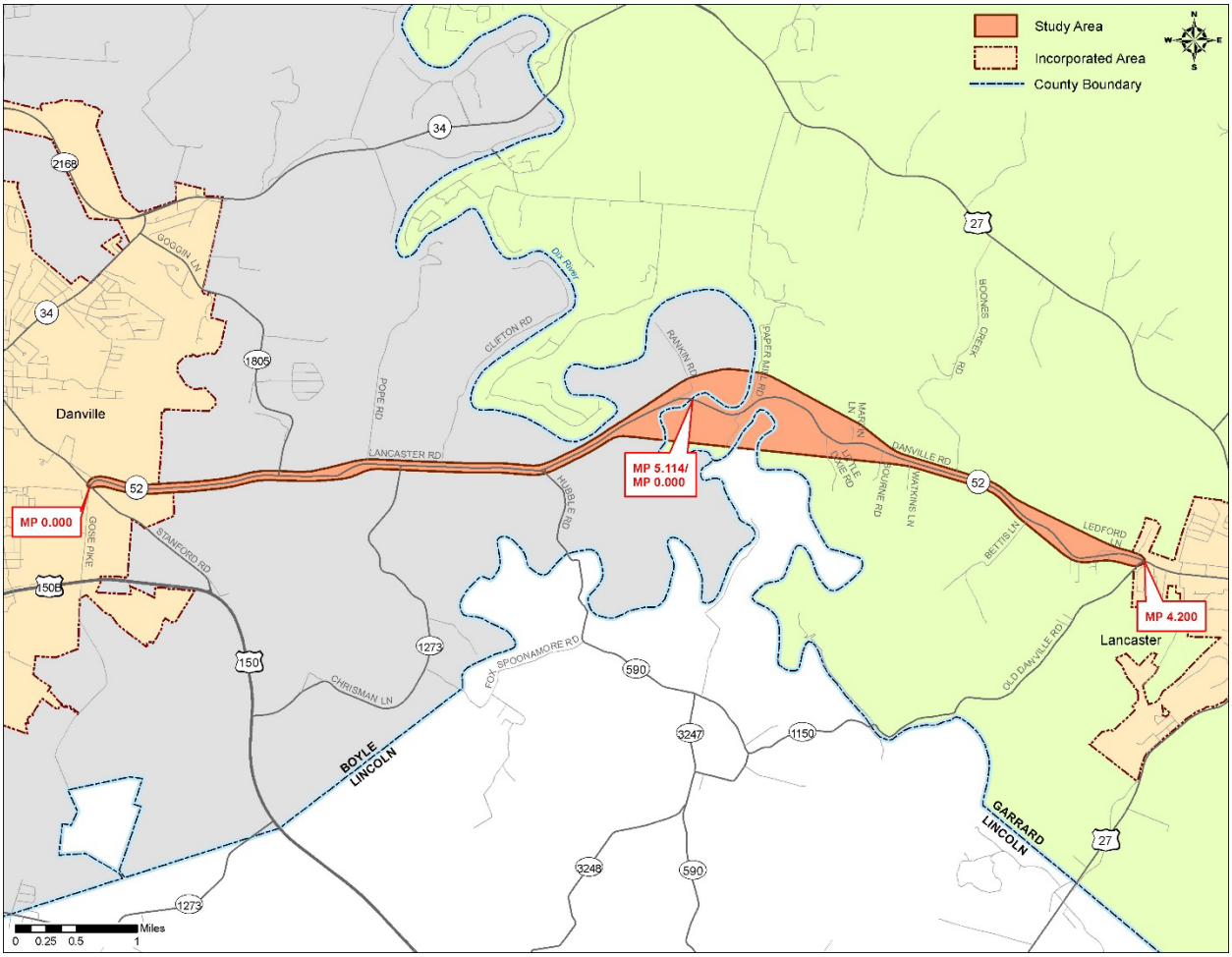


Figure ES-1: Study Area

The study identified potential short- and long-term improvements along the corridor to address identified needs. Project activities included inventorying existing conditions, forecasting future conditions, analyzing improvement options, developing cost estimates, seeking input from local officials and stakeholders, prioritizing improvements, and documenting the findings. A Highway Safety Improvement Program (HSIP) project (Item No. 7-9021) along the same corridor limits is

under development concurrent with this planning study. The HSIP effort includes an in-depth assessment of crash data to identify low-cost countermeasures, construction of which is anticipated to occur in 2023.

Three committed projects are in the study area vicinity: Item No. 7-9021 HSIP improvements along the KY 52 corridor, Item No. 7-80000 East Danville Connector, and Item No. 7-196 US 27 improvements with West Lancaster Bypass. Planning funds for this KY 52 study are identified in Kentucky's *FY 2020 – FY 2026 Highway Plan* but no funding exists for any future project development phases.

Existing Conditions

KY 52 is classified as a minor arterial through a rural area for 8.7 miles of the 9.3-mile-long study corridor. The highway has two lanes varying in width from 9.5 to 11 feet. Shoulders are narrow, with steep ditches and pavement drop-offs along several sections of the corridor. The posted speed limit is 55 mph, transitioning to 45 mph approaching Lancaster.

Based on survey data and field review, 52% of the corridor length represents horizontal curves, versus 48% in tangent (straight) sections; 15 steep vertical grades do not meet current design standards; and terrain limits sight distance for 31% of the corridor length. Both bridges along the corridor—Clarks Run and the Dix River—are in fair condition.

Figure ES-2: Views of KY 52 in Study Area

Traffic counts during late 2020 show 4,100-4,300 vehicles per day (vpd) using the route with 3% to 6% representing trucks. The route serves a quarry and solid waste transfer station, both near the county line. GPS-based travel time data highlights periodic slowdowns at cross-streets and driveways. These abrupt slowdowns are exacerbated by sight distance limitations along the route.

Level of Service (LOS) is a qualitative measure that describes traffic conditions based on driver comfort, graded on an A (best, free flow) to F (worst, gridlock) scale. Results show segments operate at LOS D while the study intersections operate at LOS A–B during peak hours. The volume-to-capacity ratio (v/c) compares traffic volume using a facility to its theoretical capacity over a specific duration, one hour in this instance. The measure for each segment in the study area is 0.10 to 0.19, suggesting adequate capacity exists.

KYTC's statewide travel demand model (KSTDM) estimated future year traffic growth, accounting for anticipated development and committed transportation improvements in the region. A growth rate of 1-3% was applied to the 2020 Existing scenario to project future 2045 No-Build traffic. Daily traffic volumes increased to 5,300–7,000 vpd with growth concentrated near Danville. Future No-Build LOS remains at D with v/c increasing to 0.13–0.29. Current capacity provided by the two-lane highway is adequate to support anticipated future traffic volumes.

Crash data were evaluated for study area roadways for a five-year period (January 2015 through December 2019). During this timeframe, 245 crashes occurred along the corridor: 230 along KY 52 and the remainder associated with intersections of key cross-streets. By severity, there were three fatality crashes along KY 52, 61 injury crashes, and the remaining 166 crashes were property damage only. By crash type, the majority were single vehicle crashes (57%), followed by rear end crashes (20%), and opposite direction sideswipes (12%).

HSIP analyses for the corridor identifies several trends:

- Of 131 single vehicle crashes, 39 crashes (30%) represent collisions with animals, distributed along the corridor.
- 63 crashes (48%) occurred on wet or icy pavement.
- Comparing crash concentrations to lane width shows an overrepresentation of crashes in wider lane sections—lanes 10.5 feet or greater—which suggests higher speeds in wider sections could be a contributing factor.
- Roadway departure crashes tend to be more severe than other crashes. Steep terrain beyond the edge of pavement is a contributing factor. While an estimated 8% of the corridor length has steep side slopes not protected by guardrail, 28% of crashes occurred in these stretches.

Two methodologies were applied to analyze crash concentrations:

A Critical Crash Rate Factor (CCRF) greater than 1.0 indicates crashes may be occurring more often than can be attributed to random occurrence. The entire length of the corridor in Garrard County represents a high CCRF segment; there are also ten 0.1-mile-long high CCRF spots over the 9.3-mile corridor. The horizontal curve between Little Dixie Road and Martin Lane (Garrard County MP 1.4–1.5) has a 2.2 CCRF, the highest in the study area.

Excess Expected Crashes (EEC), a newer, preferred methodology defined in the *Highway Safety Manual*, represents the number of excess crashes a segment or intersection is experiencing compared to other roadways of its type, adjusting for facility type and statistical corrections. A positive EEC indicates more crashes are occurring than expected. EECs are grouped into one of four Level of Service of Safety (LOSS) categories, with LOSS 3 and 4 representing above-average crash areas. Over 65% of the corridor segments in Boyle County and 71% in Garrard County demonstrate a LOSS 3 or 4 rating.

Figure ES-3 (page ES-5) compares geometric features, CCRF, and EEC/LOSS distributions along the corridor.

A public survey was conducted during December 2020 and January 2021 to understand community perspectives on corridor needs. Of 81 surveys returned, the top corridor needs were addressing narrow shoulders (84%), sharp curves (79%), and narrow lanes (72%). Only 4% of respondents indicated no improvements were needed.

Environmental

The rural corridor abuts farmlands, rural residential homes, and a few businesses. Two major streams cross the route—Clarks Run and the Dix River—and a few wetlands and ponds are also located within the study area. Threatened/endangered species potentially occurring within the study area include three bat species, five clam species, and one flowering plant species. Most study area soils represent prime or statewide important farmlands.

Part of the Inner Bluegrass Region, the western study area exhibits a high to very high risk for karst potential. Several sinkholes have been identified in this area. The eastern portion of the study area has low to medium karst potential due to the larger presence of shale.

There is a potential to encounter historic and archaeological resources in the vicinity (**Figure ES-4**). Eleven aboveground properties have been determined as National Register of Historic Places (NRHP) listed or eligible. In addition, six more potentially significant resources were identified during the windshield survey: five residences plus a collection of stone fences in the western half of the study area. Further, the Boyle County section has the potential to be considered as a rural historic district. No known archaeological sites have been identified within the KY 52 study area; however, one known site is adjacent.

Socioeconomic data from Census estimates suggest potential concentrations of minority, elderly, and/or low-income populations in the vicinity.

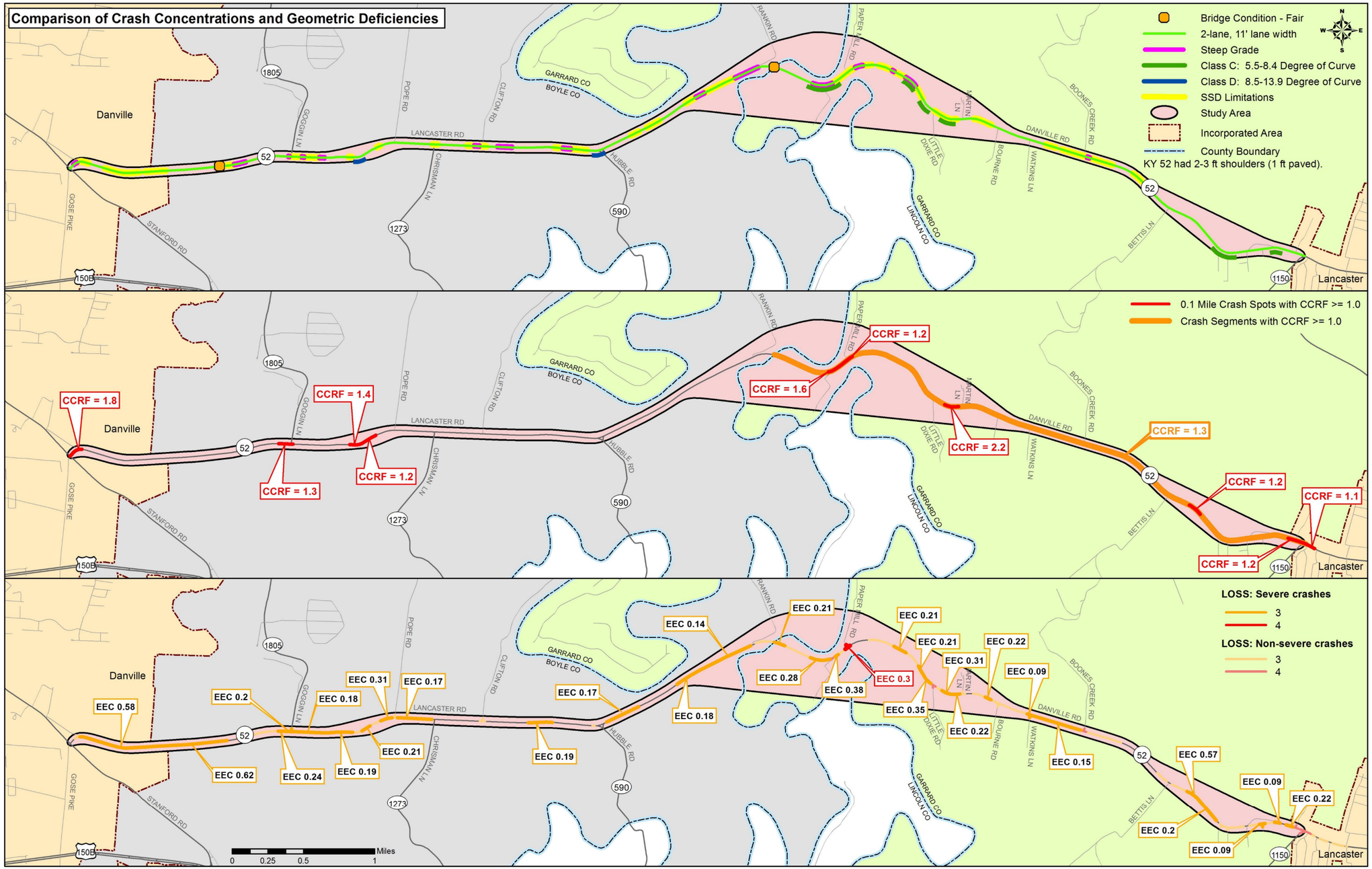


Figure ES-3: Comparative Crash Analyses

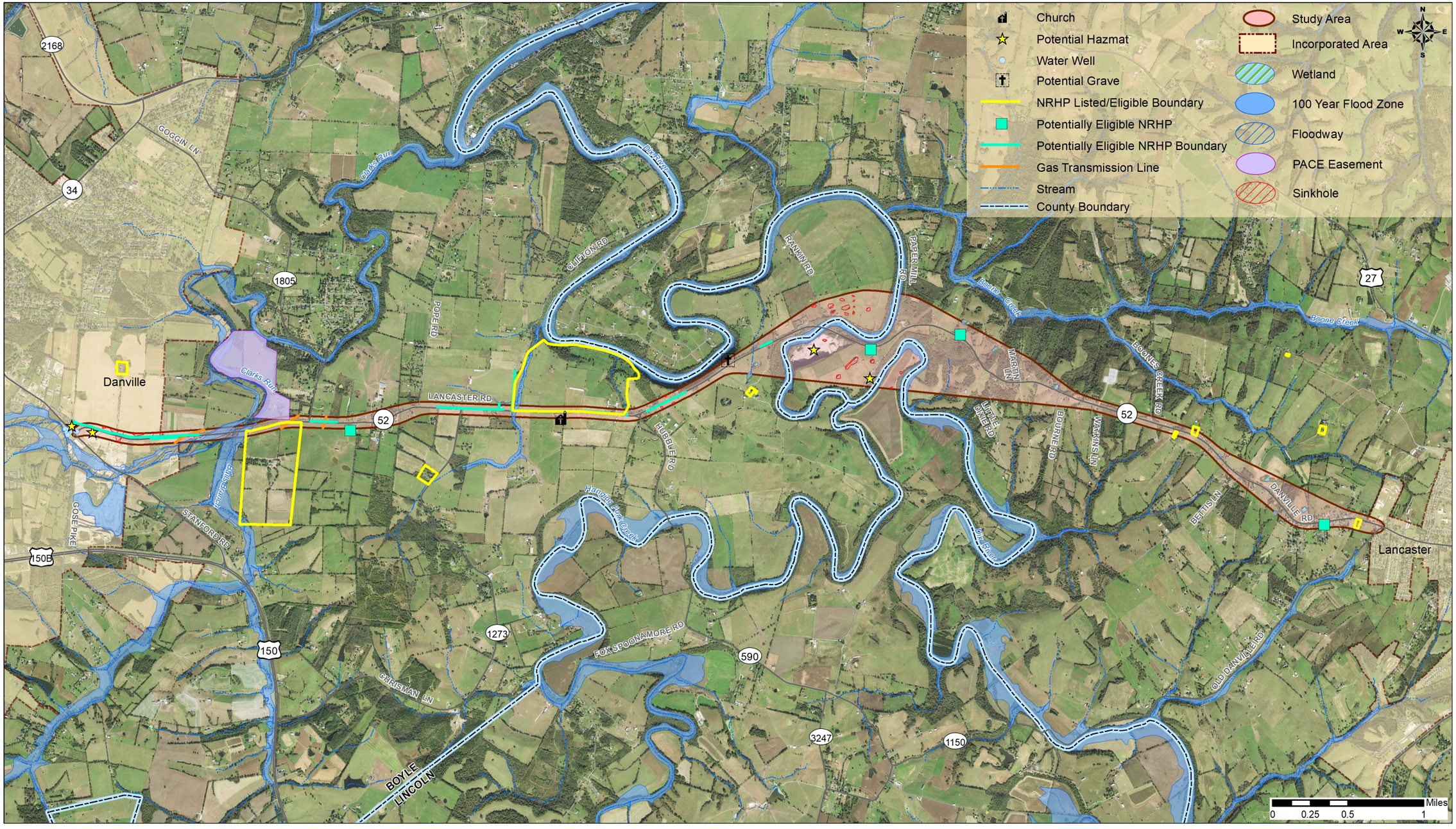


Figure ES-4: Environmental Red Flags

Improvement Concepts Considered

Improvement concepts were developed based on a combination of project team coordination, input from stakeholders and public surveys, a review of existing conditions, and field reconnaissance.

Summarized visually in **Figure ES-5**, the following concepts were identified:

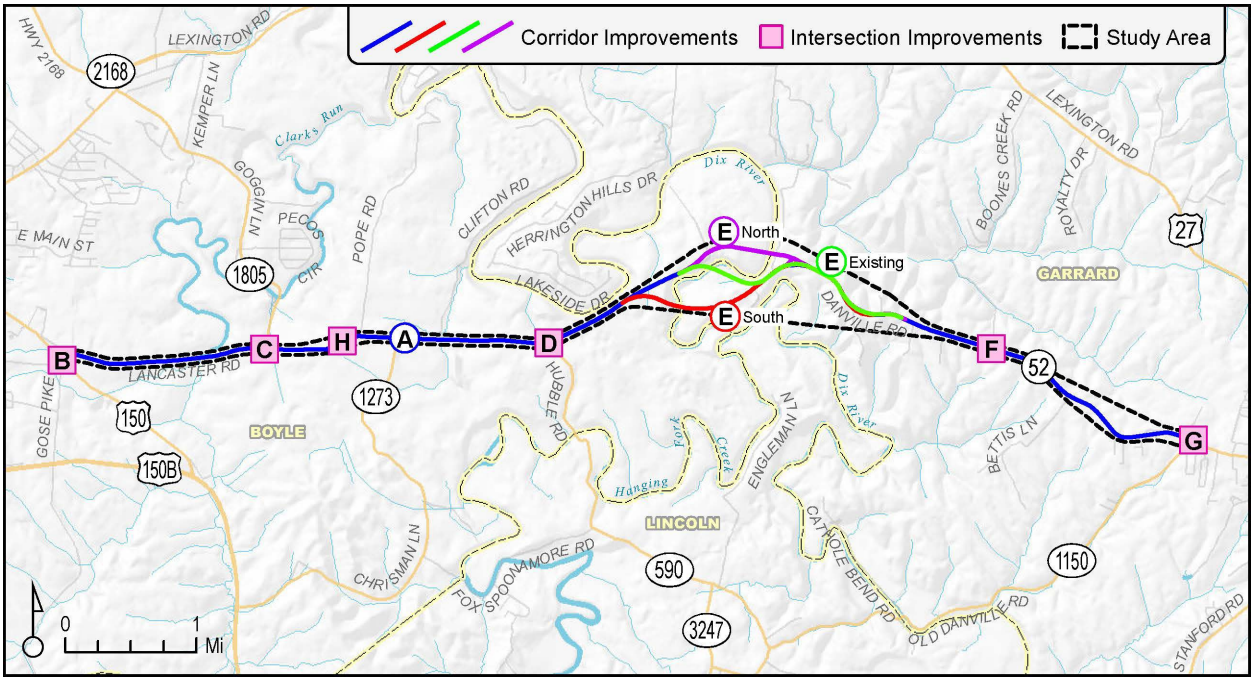


Figure ES-5: Recommended Improvement Concepts

- Concept B (Boyle MP 0.000): Incorporate short-term spot improvements at the US 150 intersection, which is assumed to be fully reconstructed as part of the separate East Danville Connector project.
- Concept C (Boyle MP 1.586): Add a left-turn refuge for traffic accessing KY 1805 (Goggin Lane) or dynamic warning signage.
- Concept D (Boyle MP 3.773): Reconstruct the horizontal curves at the KY 590 intersection and adjust the northbound approach to improve sight distance.
- Concept E (Boyle MP 3.800 to Garrard MP 1.600): Improve 2.9 miles of KY 52 near the Dix River, characterized by substandard geometrics and elevated crash rates. Representative North and South corridors were developed on new alignment alongside an Existing option to minimize costs and impacts. The Existing option is similar to the proposed improvement package advancing under the HSIP project.

- Concept F (Garrard MP 2.422): Add a left-turn refuge for traffic accessing Boones Creek Road or dynamic warning signage.
- Concept G (Garrard MP 4.153 to 4.541): Construct a two-way left-turn lane for the developed area approaching Lancaster.
- Concept H (Boyle MP 2.000 to 2.400): Realign and widen 0.4-mile section of reverse curves west of Pope Road.

Planning-level design concepts were used to estimate preliminary quantities of high-cost construction items including earthwork, pavement, and structures. For each long-term improvement measure, crash modification factors (CMF) were applied to estimate potential safety benefits. Both values were used to calculate the benefit-cost ratio over a 20-year analysis horizon. While the project team decided not to prioritize individual concepts, **Table ES-1** and **Table ES-2** provide a side-by-side comparison of the short- and long-term concepts, respectively. Individual information sheets for improvement concepts A through H are presented in **Section 8.3.**

Table ES-1: Comparison of Short-Term Concepts

Concept	Cost	2023 HSIP	Crashes	Input	Potential Environmental
B. KY 52/US 150	$90k	No	19 (4 injury) 1.8 CCRF	3 comments	Within ROW
C. KY 52/KY 1805	$80k-$490k	Overlaps	7 (2 injury) 1.3 CCRF LOSS 3	6 comments	Bat habitat, Historic farm
D. KY 52/KY 590	$810k	Overlaps	3 crashes	4 comments	Karst pond
F. KY 52/Boones Creek Road	$850k	Overlaps	4 crashes	1 comment	Bat habitat, Farmlands
H. Pope Road Curves	$500k	Overlaps	22 (7 injury) 1.4 CCRF LOSS 3	LO/S concern, 6 public comments	Bat habitat

Table ES-2: Comparison of Long-Term Concepts

Concept	Cost	Benefit-Cost	2023 HSIP	Crashes	Input	Potential Environmental
A. Widen Corridor	$19M	1.54	Overlaps	166 crashes 3 Fatal + 42 Inj. High CCRFs 5.0 mi LOSS 3/4	2 of top 3 needs; highest of all concepts	Bat habitat, Historic fences, Farmlands, Driveways, Karst, Gas lines
E. Realign North	$20M	1.44	No	N/A	Moderate	Bat habitat, Farmlands, Driveways, Karst, Gas lines
E. Realign South	$24M	1.23	No	N/A	Moderate	
E. Realign Existing	$10M	2.81	Overlaps	81 (27 inj.) High CCRFs 1.3 mi LOSS 3	Lowest of E's	
G. KY 52 at KY 1150	$1.4M	1.20	No	11 crashes 1.1-1.2 CCRF LOSS 3	Moderate	Bat habitat, possible Historic, Driveways

** excludes HSIP widening at Garrard County MP 0.1-1.7*

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ACRONYMNS LIST

ADT	Average Daily Traffic
CCRF	Critical Crash Rate Factor
CHAF	Continuous Highway Analysis Framework
CMF	Crash Modification Factors
DHV	Design Hourly Volume
FHWA	Federal Highway Administration
GIS	Geographic Information System
GPS	Global Positioning System
HCM	Highway Capacity Manual
HDM	Highway Design Manual
HIS	Highway Information System
HSIP	Highway Safety Improvement Program
KHC	Kentucky Heritage Council
KSTDM	Kentucky Statewide Travel Demand Model
KTC	Kentucky Transportation Center
KYTC	Kentucky Transportation Cabinet
LO/S	Local Officials/Stakeholders
LOS	Level of Service
LWCF	Land and Water Conservation Fund
MP	Milepoint
MPH	Miles Per Hour
MPO	Metropolitan Planning Organization
MSAT	Mobile Source Air Toxics
NBIS	National Bridge Inventory System
NHS	National Highway System
NRCS	Natural Resource Conservation Service
NRHP	National Register of Historic Places
PDO	Property Damage Only
SHIFT	Strategic Highway Investment Formula for Tomorrow
STAA	Surface Transportation Assistance Act
STIP	Statewide Transportation Improvement Program
SUA	Small Urban Area
TED	Transportation Enterprise Database
TIP	Transportation Improvement Program
TWLTL	Two-Way Left-Turn Lane
USEPA	US Environmental Protection Agency
v/c	Volume-to-Capacity Ratio

1.0 INTRODUCTION

The Kentucky Transportation Cabinet (KYTC) initiated a corridor study in fall 2020 for KY 52 between Danville (Boyle County MP 0.000–5.114) and Lancaster (Garrard County MP 0.000–4.200). **Figure 1** shows the 9.3-mile corridor study area extending from the US 150 intersection in Danville to the intersection with KY 1150 (Old Danville Road) in Lancaster.

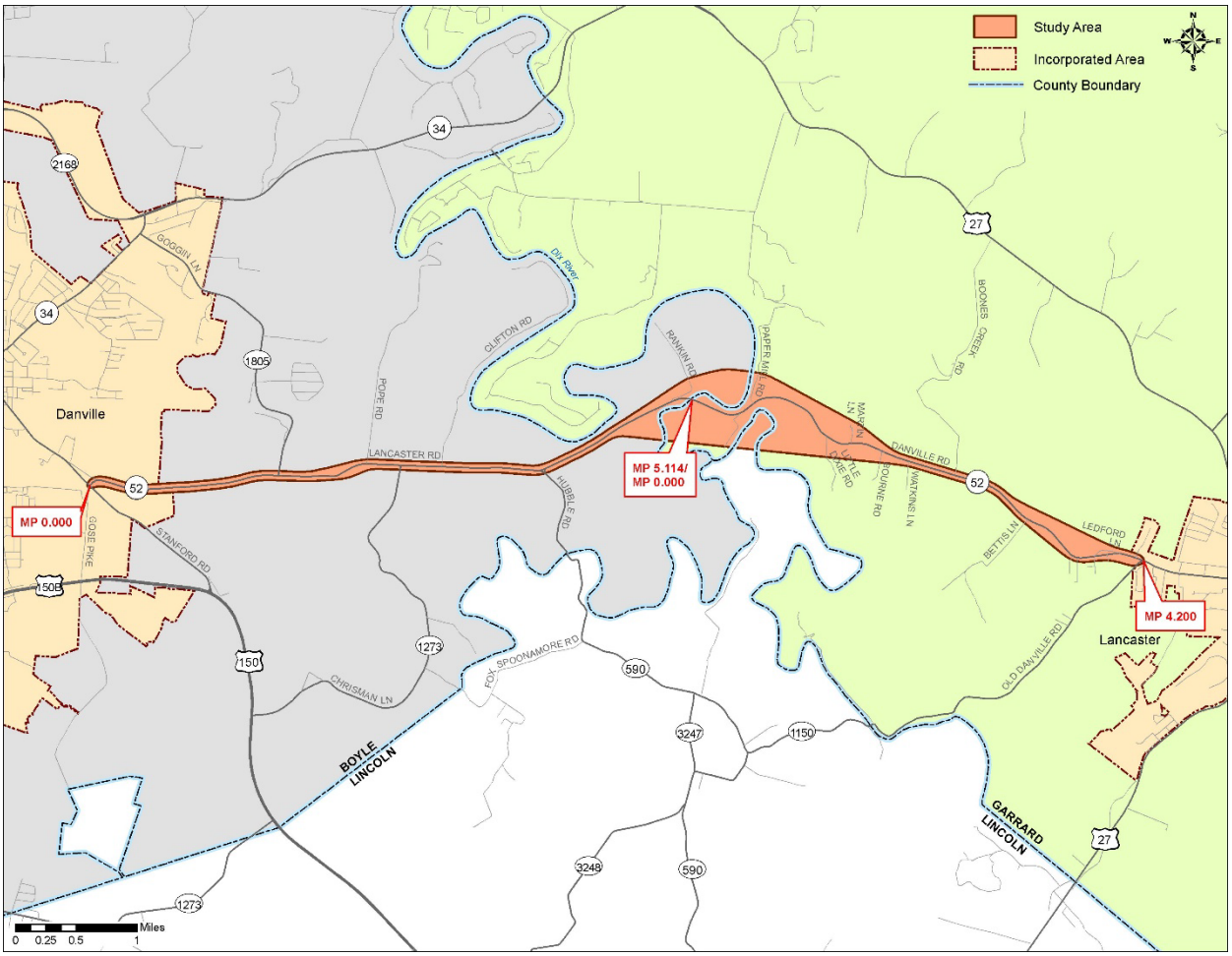

Figure 1: Study Area

Study tasks (**Figure 2**) include creating an inventory of existing conditions, defining goals for the study, forecasting existing and future traffic, identifying red flag environmental issues, developing build concepts with construction cost estimates, seeking community input, and documenting the study process and results. The following chapters explore these efforts. Improvement concepts

include short-term projects to quickly address issues identified and long-term projects for future programming through the SHIFT[1] process.

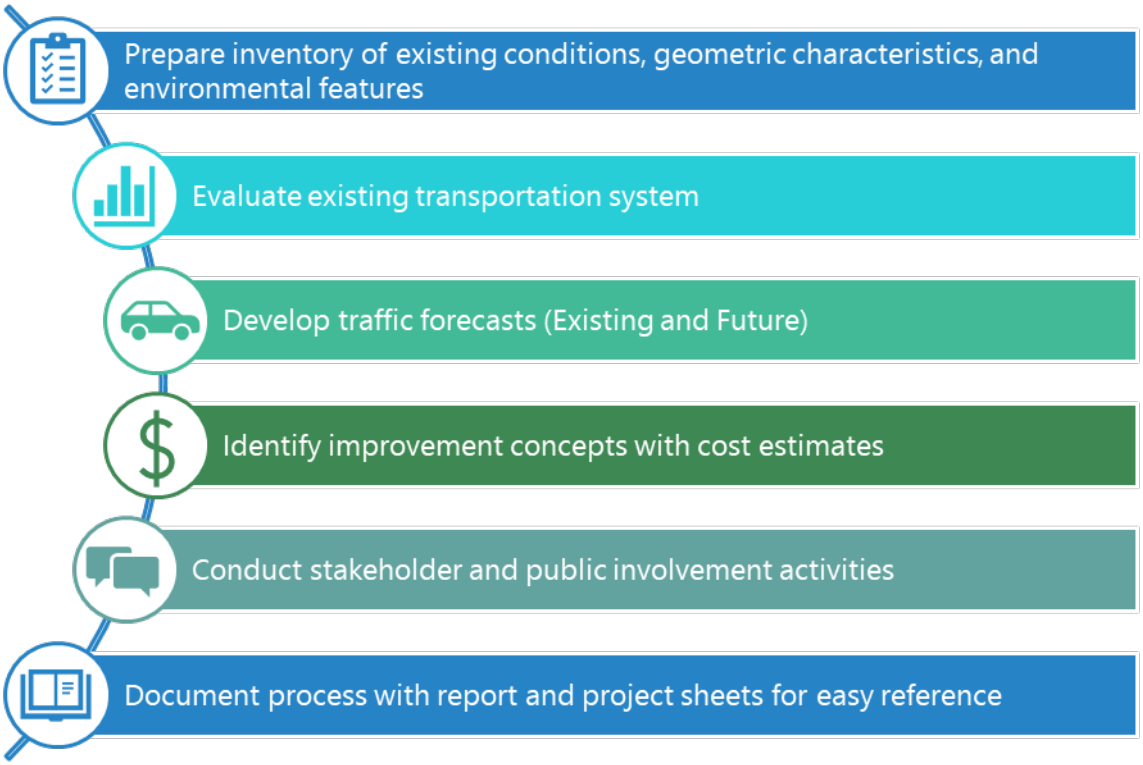

Figure 2: Study Tasks

It should be noted that a Highway Safety Improvement Program (HSIP) project (Item No. 7-9021) along the same corridor is under development concurrently with this planning study. The HSIP effort includes an in-depth assessment of crash data (**Section 2.5**) to identify low-cost countermeasures for short-term implementation.

Boyle and Garrard counties are located in the Bluegrass Area Development District (BGADD), but not within the boundaries of a metropolitan planning organization (MPO).

[1] SHIFT, or the Strategic Highway Investment Formula for Tomorrow, is a data-driven project scoring process to compare and prioritize capital improvement projects to make better use of the limited transportation funds in the biennial budget.

1.1 Previous Studies Identified and Committed Projects

Previous studies and proposed projects located within the project vicinity were compiled from recent planning studies, Kentucky's *FY 2020 – FY 2026 Highway Plan*[2], and the Continuous Highway Analysis Framework (CHAF) database.

Completed Planning Studies. One previously completed planning study overlaps with the 7-104 study area; its limits are shown in **Figure 3**. The 2014 *Danville Small Urban Area Study* [3] was completed for the city of Danville surroundings to examine transportation issues related to safety, congestion, and operations, and to develop a list of proposed solutions to improve conditions. Two long-term KY 52 improvement project recommendations resulted from this study; however, neither are within the limits of the 7-104 corridor study.

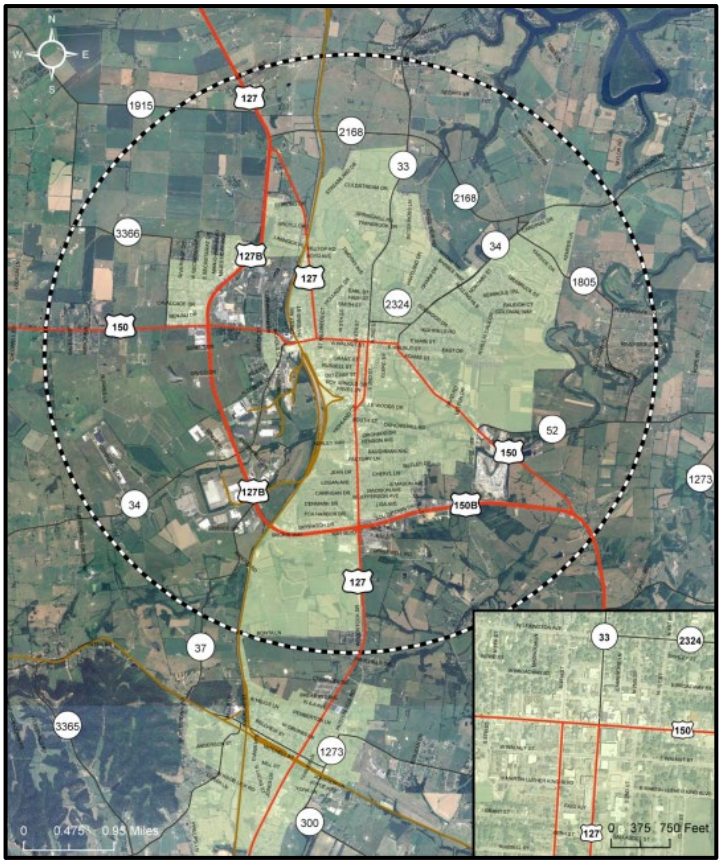

Figure 3: 2014 Danville SUA Study Area

Planned and Committed Projects. There are a few committed projects and planned concepts for future improvements in the study area vicinity. **Figure 4** shows the projects from the Highway Plan and the CHAF database. Item No. 7-104 covers this study, with 2021 planning funds identified in the Highway Plan but no funding for any future project development phases. **Table 1** lists the other Highway Plan projects and **Table 2** lists the projects in the CHAF database.

[2] https://transportation.ky.gov/Program-Management/Pages/2020-Highway-Plan.aspx
[3] https://transportation.ky.gov/Planning/Pages/Planning-Studies-and-Reports.aspx

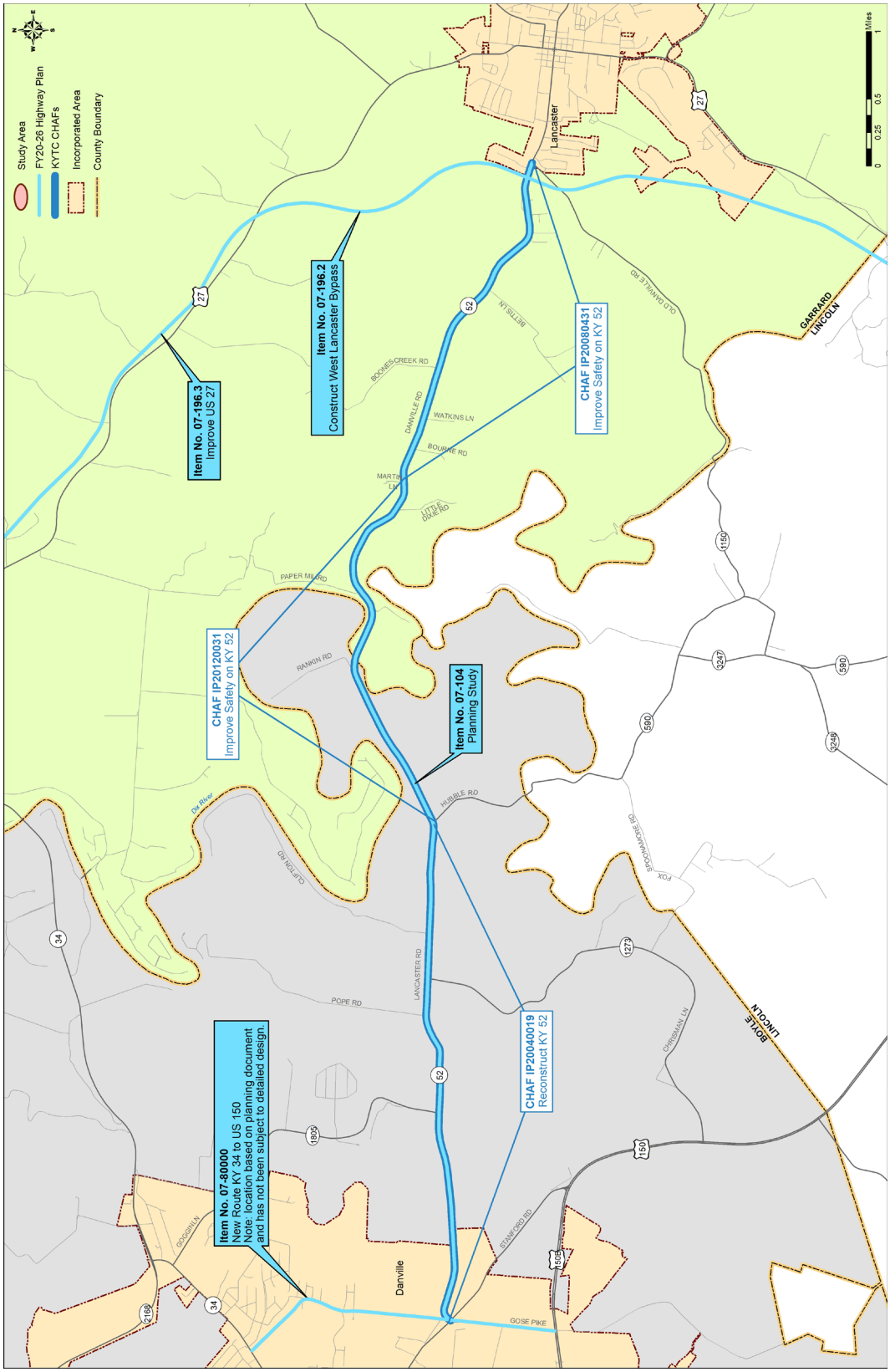

Figure 4: Project Concepts in the Vicinity

Table 1: Nearby Projects in FY 2020—FY 2026 Highway Plan

Item #	County	Route	BMP	EMP	Purpose	Plan Funding (outside biennium)	
7-196.2	Garrard	US 27	1.016	5.199	Construct West Lancaster Bypass	D R U C	$1.50M $4.75M ($3.80M) ($20.30M)
7-196.3	Garrard	US 27	5.199	10.331	Improve US 27 from West Lancaster Bypass to KY 34	D R U C	$1.90M $5.73M ($4.71M) ($26.21M)
7-80000	Boyle	New Route	-	-	Construct a new connector road on the east side of Danville connection KY 34 and US 150 Bypass	D	$2.08M

Table 2: KYTC CHAF Database Projects

CHAF	County	Route	BMP	EMP	Purpose	Total Cost	2020 SHIFT Score
IP20040019	Boyle	KY 52	0.000	3.773	Reconstruct KY 52 from US 150 to KY 590 in Boyle County.	$11.9M	56.8
IP20080431	Garrard	KY 52	1.530	4.205	Improve safety on KY 52 from Martin Lane to KY 1150 in Garrard County.	$11.9M	32.9
IP20120031	Garrard	KY 52	3.773	1.527	Improve safety on KY 52 from KY 590 in Boyle County to Martin Lane in Garrard County.	$23.6M	30.3

2.0 EXISTING CONDITIONS

Existing transportation conditions of the corridor are described in the following sections. Information on the characteristics of the roadway geometry, functional classification, bridges, traffic volumes and operations, and crash history were obtained from KYTC's Highway Information System (HIS) database, KYTC's Transportation Enterprise Database (TED), bridge inspection reports, National Bridge Inventory forms, traffic counts, and field reviews.

2.1 Roadway System Designations

Functional Classification is the process of grouping streets and highways according to the character of travel service and access to adjacent land use they provide. This classification system recognizes that travel involves movement through a hierarchical system of facilities that progress from lower classifications handling short, locally oriented trips to higher classifications serving longer distance travel at higher mobility levels. A roadway's classification is further designated as urban or rural based upon whether it is within the Federal Highway Administration's (FHWA) Adjusted Urban Area boundaries. The major functional classes with brief definitions are listed below.

Freeways & Interstates	Provide high speed, high mobility links for long distance trips.
Principal Arterials	Serve major centers for metropolitan areas, provide a high degree of mobility, and can also provide mobility through rural areas.
Minor Arterials	Provide service for trips of moderate length, serve geopgraphic areas smaller than their Principal Arterial counterparts, and offer connectivity to the Principal Arterial system.
Collectors	Gather traffic from local roads and funnel them to the arterial network. Classified as either a major or minor collector; generally serve intra-county travel and shorter trips.
Local Roads	Not intended for long distance travel, except at the origin or destination end of the trip, due to their direct access to abutting land. Often designed to discourage through traffic.

Additionally, functional classification is used as a tool for transportation agencies and designers. A roadway's functional class suggests expectations about roadway design: specifically, vehicle speed, capacity, and the roadway's relationship to land use development. Federal legislation uses functional classification in determining eligibility under the Federal-aid program. Transportation agencies typically describe roadway system performance, benchmarks, and goals by functional classification.

Functional Class. KY 52 is classified as a minor arterial. It is an urban minor arterial from MP 0.000 to MP 0.592 in Boyle County and a rural minor arterial for the remainder of the route in the study area.

Truck Route. In compliance with the Surface Transportation Assistance Act of 1982 (STAA), Kentucky established a network of highways on which commercial vehicles with increased dimensions may operate. These "STAA" vehicles include semi-trucks with 53-foot-long trailers and

single-unit trucks with a total length of 45 feet. KY 52 is listed in Kentucky's Highway Freight Network as a Tier 4 local access significance facility, meaning it provides local access for freight (first mile, last mile) to major freight generators. It is not a National Truck Route. The truck weight limit is AAA or 40-ton gross vehicle weight.

Highway Systems. The National Highway System (NHS) includes roadways important to the nation's economy, defense, and mobility. KY 52 is not on the National Highway System. The Kentucky State Highway System classifies state-maintained roadways by the type of service and function they provide. KY 52 is classified as a state secondary system, meaning it is a regionally significant route of shorter distance which provides mobility and access to land use activity, generally serving smaller cities and county seats within a region.

2.2 Roadway Geometric Characteristics

KYTC's HIS database was queried to obtain route geometric characteristics, including speed limits, number of lanes and lane widths, shoulder type and width, and horizontal curve data.

Number of Lanes and Lane Widths. KY 52 is a two-lane undivided highway. HIS shows 11-foot-wide travel lanes throughout the study area; however, LiDAR survey data collected for the HSIP project provided more detailed information on field conditions. As shown in **Figure 5**, the actual lane width varies throughout the corridor; 62% of the length has lane widths between 10 and 11 feet.

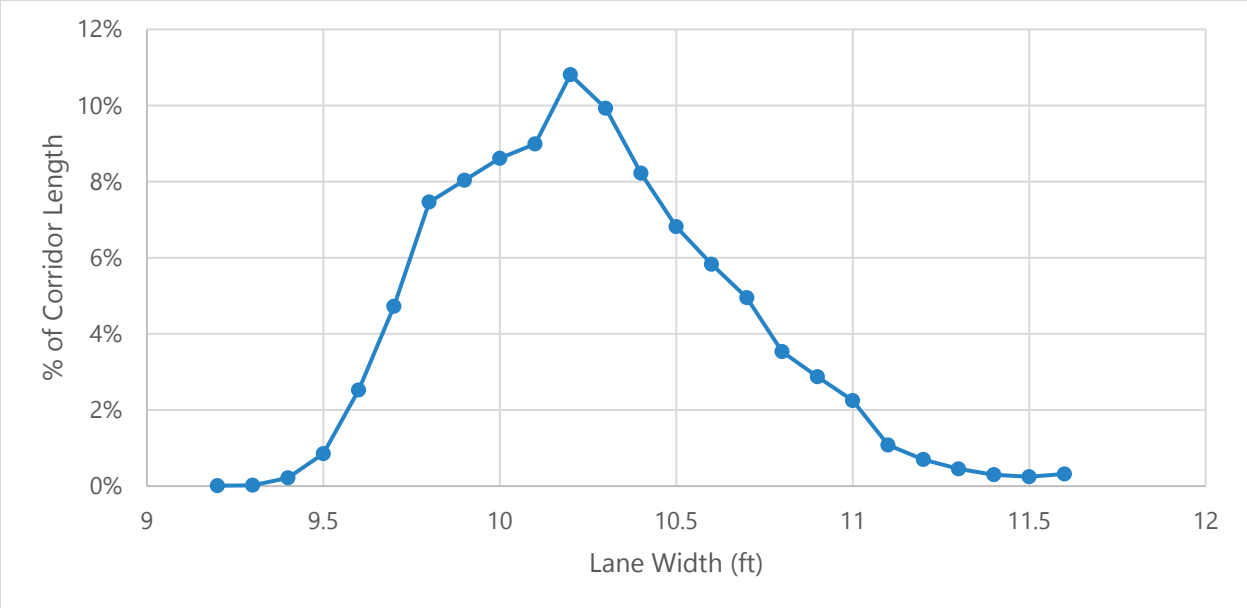

Figure 5: Lane Widths through Corridor

KYTC's 2020 *Highway Design Manual* (HDM) [4] recommends 12-foot-wide lanes for rural arterial highways carrying 2,000 vpd or more.

Shoulder Types and Widths. HIS notes the shoulder type is asphalt combination and varies in width along the route from three feet in Boyle County to two feet in Garrard County. Field reviews and HSIP survey data suggest on-the-ground shoulder widths are narrower in many sections; as illustrated in **Figure 6**, about 36% of the corridor has shoulder widths less than one foot.

Figure 6: Representative Views of Shoulder Widths

[4] https://transportation.ky.gov/Organizational-Resources/Policy%20Manuals%20Library/Highway%20Design.pdf

Additionally, some sections have steep side slopes with large drainage ditches or several inches of vertical drop from the edge of pavement to the underlying ground. Narrow shoulders provide limited recovery room before dropping off the edge of pavement. Shown in **Figure 7**, a curve just west of Pope Road near MP 2.1 is a recurring concern for KYTC District 7 with regular roadway departure crashes.

Figure 7: Steep Slope at Pope Rd Curve

Speed Limits. The posted speed limit is 55 mph in Boyle County, and from MP 0.000 to MP 3.679 in Garrard County. The speed limit reduces to 45 mph in Garrard County from MP 3.679 to MP 4.418, approaching Lancaster.

Horizontal and Vertical Curves. HIS data were reviewed to identify any substandard grades or curves along the study route and major intersecting cross-streets. Collected data were compared to HDM design recommendations for maximum vertical grades and minimum horizontal curves.

At a planning level, KYTC organizes horizontal curves into six classes, graded A (most sweeping) through F (sharpest) as listed in **Table 3**. Similarly, KYTC organizes vertical grades into six classes, graded A (flattest) through F (steepest) as shown in **Table 4**.

Table 3: Horizontal Curve Class

Code	Description (degrees)
A	0.0-3.4
B	3.5-5.4
C	5.5-8.4
D	8.5-13.9
E	14.0-27.9
F	28+

Table 4: Vertical Grade Class

Code	Description (percent)
A	0.0-0.4
B	0.5-2.4
C	2.5-4.4
D	4.5-6.4
E	6.5-8.4
F	8.5+

HDM Exhibit 700-03[4] recommends maximum vertical grades of 3% to 4% for rural arterial highways carrying 2,000 vpd or more, varying based on terrain—Class C or better in **Table 4**. For a 55-mph design speed, it recommends a minimum radius for horizontal curves of 960 feet to 1,190 feet, depending on the superelevation. This equates to Class C or better in **Table 3**.

Based on survey data, 52% of the corridor length represents horizontal curves, versus 48% in tangent (straight) sections. HIS data shows three horizontal curves that are rated D along the study corridor in Boyle County: at the intersection with US 150 and Old Lancaster Road, past KY 1805 through an area of many residential entrances just before Pope Road, and at the KY 590 intersection. All the other horizontal curves are rated C or better.

While vertical data was not available in HIS, LiDAR survey data was employed to highlight substandard vertical alignment elements: grades steeper than 5% and curves steep enough to restrict sight distance.

Figure 8 summarizes the substandard alignment features along the study corridor.

2.3 Bridges

The National Bridge Inventory (NBI) condition rating is determined by the lowest rating for the deck, superstructure, substructure, or culvert. The condition ratings are listed in **Table 5**. A bridge is considered structurally deficient if any bridge component (deck, superstructure, substructure, or culvert) is in poor condition, warranting monitoring or repairs.

Table 5: National Bridge Inventory Condition Rating

Condition Classification	Condition Rating
Good	≥7
Fair	5 – 6
Poor	≤4

There are two bridges on the study portion of KY 52, both in Boyle County and both in fair condition. Neither bridge is considered structurally deficient. Bridge inventory data are in **Table 6** and views of both bridges are in **Figure 9**.

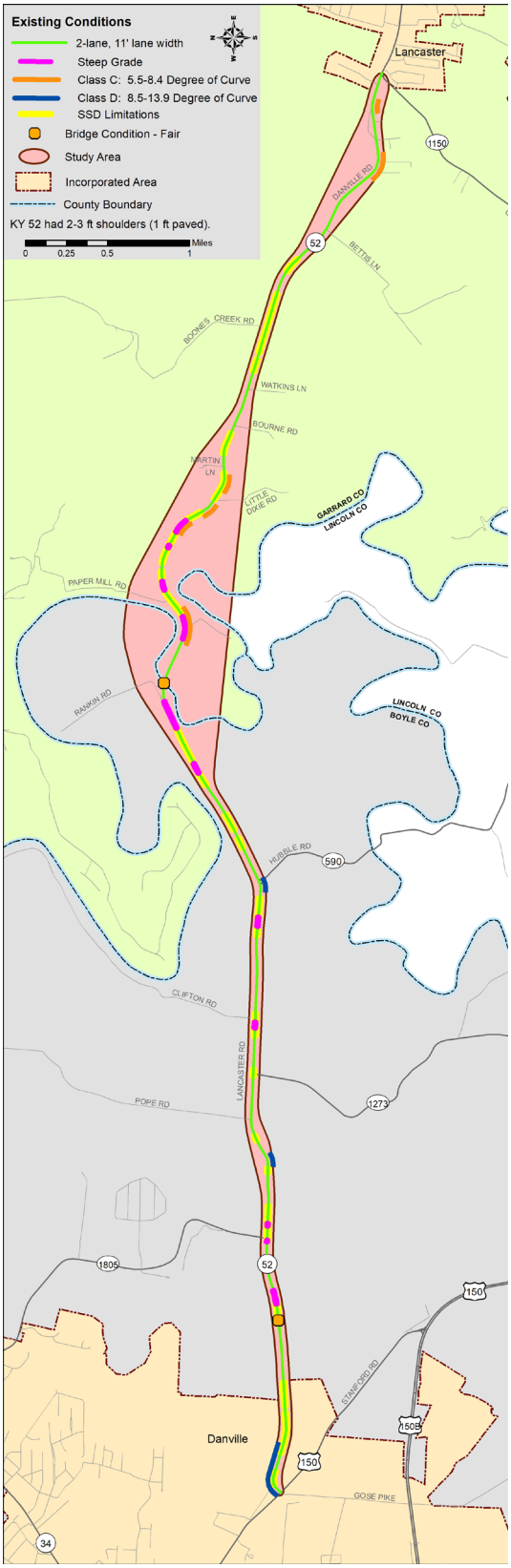

Figure 8: Key Alignment Elements

Table 6: Structures Inventory

Bridge ID	BMP	EMP	Features Intersected	Inspection Date	Condition Rating	Year Built
011B00007N	1.079	1.091	Clarks Run	10/29/2018	Fair	1954
011B00048N	5.095	5.114	Dix River	10/08/2018	Fair	1986

Figure 9: Clarks Run (left) and Dix River (right) Bridges

2.4 2020 Traffic Volumes and Operations

Available existing traffic volumes for the study area roadways, including truck percentages, K-factors[5], and peak hour direction distributions were reviewed. Year 2020 segment volumes were calculated based on appropriate historical trends, adjusting pre-2020 volumes to create a consistent 2020 dataset while minimizing influence of the COVID pandemic on observed traffic volumes. Historic counts show 3,900–4,300 vpd use the corridor with negligible growth since 2000. Truck traffic represents from 4% to 12% of this volume.

In addition, 12-hour turning movement counts were collected at three intersections during September 2020, classifying vehicles into one of five categories: motorcycles, cars, buses, single unit trucks, and articulated trucks. Counts were conducted at the KY 52 intersections with US 150 at the western study terminus, KY 1805 (Goggin Lane), and KY 1150 (Old Danville Road) at the eastern project terminus. The US 150/KY 52 intersection is the only signalized intersection along the study corridor; all others are two-way stop-controlled. Additional traffic information is presented in the *Traffic Forecast Report* in **Appendix A**.

Factored turning movement counts showed 4,100–4,300 vpd using the route with 3% to 6% representing trucks.

[5] K-factor is defined as the proportion of annual average daily traffic occurring in the design hour.

2.4.1 Travel Time Data

Third-party "HERE" travel time data coverage for the corridor is limited but shows 20th and 85th percentile speeds around 47 to 50 mph where data are available. To supplement these limitations, the corridor was also driven during September 2020 to capture travel times via GPS technology. These GPS-based runs (**Figure 10**) provide a finer level of detail, highlighting the periodic slowdowns at cross-streets and driveways. These abrupt slowdowns are exacerbated by sight distance limitations along the route—particularly visible approaching the signalized US 150 intersection and through curves just east of the county line.

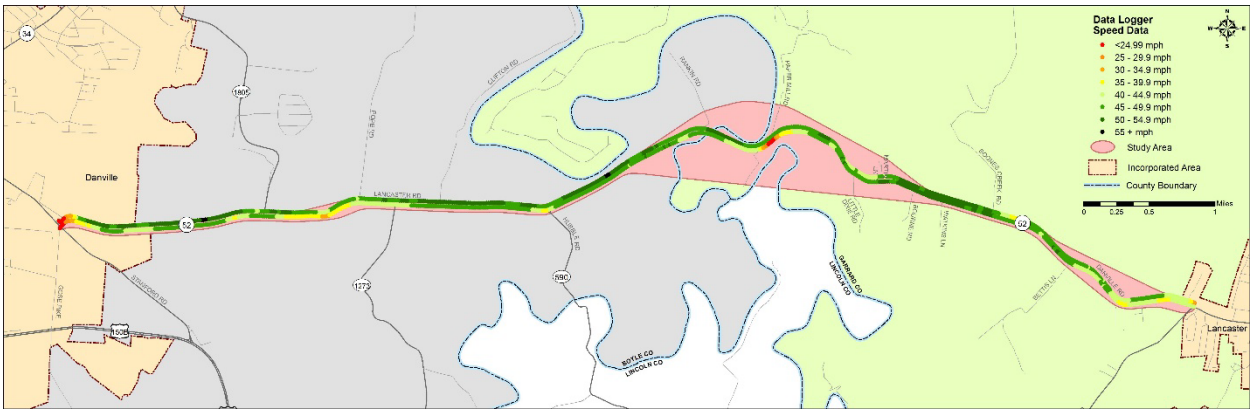

Figure 10: GPS-based Travel Time Data, September 2020

2.4.2 Traffic Operations

Two commonly applied highway performance indicators, level of service (LOS) and volume-to-capacity (v/c) ratios, were calculated to describe traffic operations along the corridor. Computations were performed in accordance with *Highway Capacity Manual* (HCM) *6th Edition* procedures for study route segments.

Level of Service. LOS is a qualitative measure that describes traffic conditions based on measures such as speed and travel time, freedom to maneuver, traffic interruptions, comfort, and convenience. LOS typically represents a driver's perspective of traffic conditions based on perceived congestion. As illustrated in **Figure 11** (page 13), LOS A is associated with free flow conditions, high freedom to maneuver, and little or no delay. Conditions at or near capacity typically are associated with LOS E. LOS F represents oversaturated traffic conditions beyond capacity, with low travel speeds, little or no freedom to maneuver, and lengthy delays. LOS D is generally acceptable.

Existing LOS was determined for the highest traffic hour based on design hourly volume (DHV) calculations, applying K- and d-factors (i.e., hourly and directional adjustments) to average daily traffic (ADT) counts to approximate peak hourly flows. Results show segments operate at LOS D while the study intersections operate at LOS A to B during peak hours. Field reviews and public input (**Section 4.3**) suggest driver comfort may be impacted by narrow lanes, driveways, limited passing opportunities, etc.

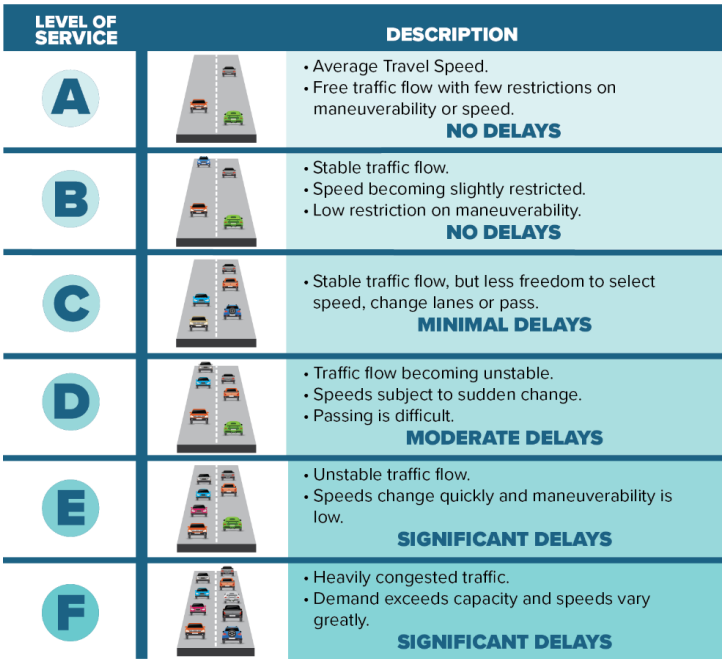

Figure 11: Level of Service (LOS)

Volume-to-Capacity. Another measure, v/c, compares traffic volume using a facility to its theoretical capacity over a specific duration, one hour in this instance. A v/c ratio greater than 1.0 indicates a route has exceeded its theoretical capacity and additional throughput may be justified. As v/c is measured over an hour period by segment, a roadway or intersection could be congested during peak commuter periods but show a relatively low v/c averaged over a longer duration.

The v/c for each segment is 0.10 to 0.19, suggesting adequate capacity exists. At intersections, v/c is measured by approach. The signalized US 150 intersection has a maximum v/c of 0.56 with peak 95th percentile queue lengths along KY 52 around 2 vehicles. Other study intersections demonstrated a v/c of 0.25 or less, suggesting current capacity is adequate for traffic flows.

2.5 Crash History

Historical crash data retrieved from KYTC's TED warehouse were evaluated for study area roadways for a five-year period (January 2015 through December 2019). Crash location, severity, and manner of collision are shown in **Figure 12**. During this timeframe, 245 crashes occurred along the corridor: 230 along KY 52 itself and the remainder associated with intersections of key cross-streets. A table of corresponding crash data is in **Appendix B**.

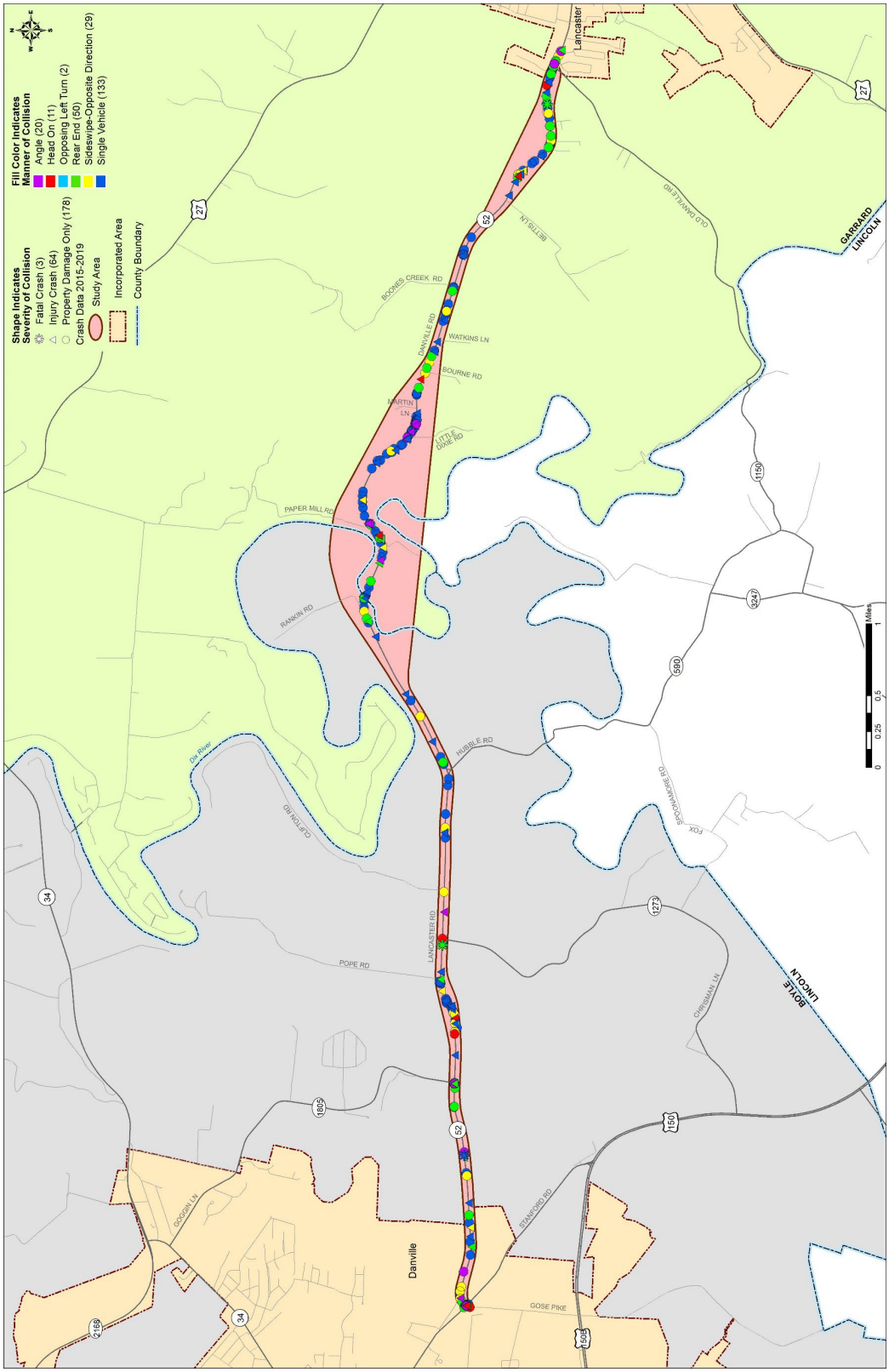

Figure 12: Crashes by Severity and Manner of Collision

Severity. By severity, there were three fatality crashes along KY 52 (noted as stars in **Figure 12**), 61 injury crashes, and the remaining 166 crashes were property damage only. Two fatalities involved motorcycle crashes on wet pavement and the third fatality was ejected from the vehicle after hitting a concrete bridge end.

Injury crashes are further subdivided by severity: 13 were serious, 22 minor, and 26 possible injury crashes. Eight of the 13 serious injuries were single vehicle crashes, followed by three head-on collisions, one opposite direction sideswipe, and one angle crash. Half of the total injury crashes occurred on wet or icy pavement.

Manner of Collision. The manner of collision breakdown is shown in **Figure 13**. The majority are single vehicle crashes, followed by rear end crashes, and opposite direction sideswipes.

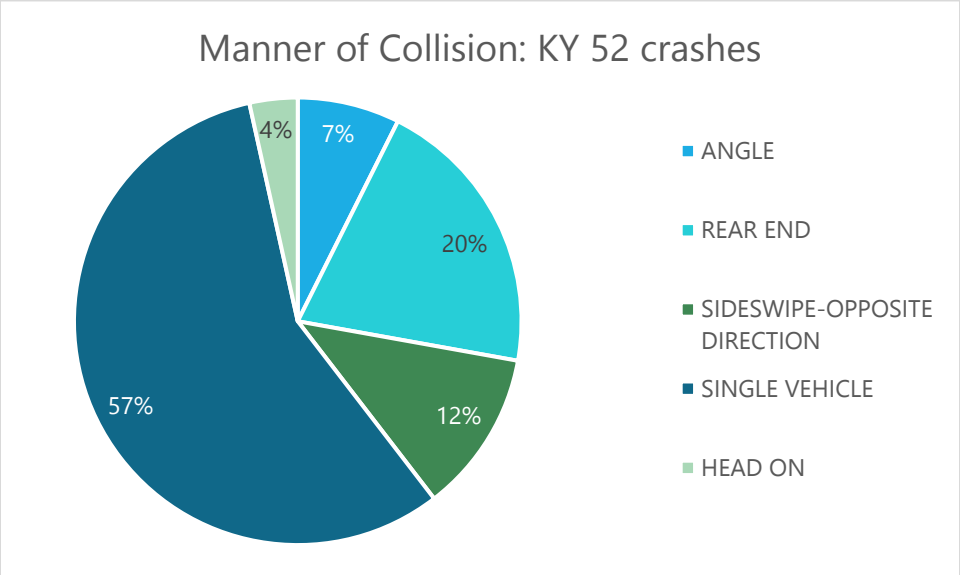

Figure 13: Crash Manner of Collision

Single vehicle crashes comprised the majority of all KY 52 crashes: 131 of 230 crashes. This subset was further analyzed to identify crash trends and locations.

- Many single vehicle crashes represent roadway departures, which tend to be more severe and warrant special emphasis under HSIP.
- Of the 131 single vehicle crashes, 39 crashes (30%) represent collisions with animals. These were distributed throughout the corridor. There were also eight impaired drivers and three mechanical failures, none of which are generally attributed to roadway design or condition.

- Of the 131 single vehicle crashes, 63 crashes (48%) occurred on wet or icy pavement. Considering just fatalities and injury single vehicle collisions, 18 of 33 (55%) of crashes occurred in wet or icy conditions.

Other Crash Trends. Through the concurrent HSIP project, additional in-depth crash analyses were conducted to identify appropriate countermeasures. Key findings are summarized here.

- **Non-motorized users**. While KY 52 serves mostly vehicular traffic, three collisions with non-motorized users occurred during the five-year analysis period. One involved a pedestrian struck while in a crosswalk at the post office in Lancaster (MP 4.315) when the turning vehicle failed to yield. Another involved a bicyclist who failed to stop before entering the roadway near the eastern project limit and collided with a towed boat. A third involved a horseback rider near the KY 52/US 150 intersection.

- **Lane Width.** Comparing crash concentrations to lane width shows an overrepresentation of crashes in wider lane sections—lanes 10.5 feet or wider—than expected based on the statistical distribution. The same trend holds true when considering only fatality and injury crashes. Presented graphically in **Figure 14**, this could suggest higher speeds in wider sections are a contributing factor; lane widening may not be the most effective countermeasure in this case.

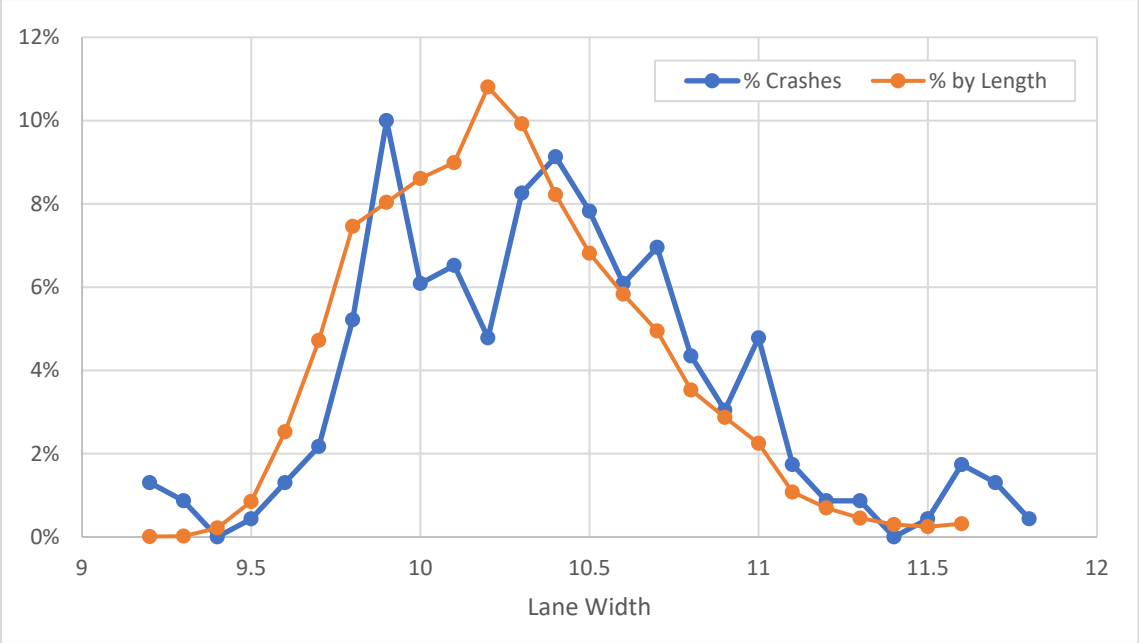

Figure 14: Distribution of KY 52 Crashes versus Lane Widths

- **Shoulder Width.** Comparing crash concentrations to shoulder width mimics the distribution expected; that is, 38% of crashes occur over 36% of the corridor length that

has paved shoulder widths less than one foot. However, narrow shoulders in horizontal curves show a higher concentration of crashes than narrow shoulders in tangent sections.

- **Horizontal Alignment.** The data demonstrates that 60% of KY 52 crashes occur in horizontal curves, which represent 52% of the corridor length. Considering only fatality and injury crashes, 56% of KY 52 severe crashes occur in horizontal curves. Both statistics suggest curve crashes are overrepresented, indicating a potential focus area when developing countermeasures. **Table 7** summarizes the breakdown of curve crashes by radius; highlighted cells denote areas where the crash distribution is overrepresented versus the corridor length.

Table 7: Crash Distribution by Curve Radius

Curve Radius	% by Length	All Crashes		Fatal/Injury Crashes	
<600 ft	7%	31	13%	4	6%
600-1000 ft	11%	41	18%	13	20%
1001-2000 ft	13%	33	14%	14	22%
>2000 ft	21%	33	14%	4	6%
Tangents	48%	92	40%	29	45%
Combined	**100%**	**230**	**100%**	**64**	**100%**

Analysis also suggests wet/icy pavement in curves is overrepresented in the data, suggesting potential drainage or superelevation improvements may be warranted.

- **Steep Side Slopes**. As noted above, roadway departure crashes tend to be more severe than other crashes. Steep terrain beyond the edge of pavement is a contributing factor. While an estimated 8% of the corridor length has steep side slopes not protected by guardrail, 28% of crashes occur in these stretches. This suggests wider shoulders or improvements to the clear zone may provide effective countermeasures.

2.5.1 Statistical Crash Analyses

Two types of statistical crash analyses were performed based on methods comparing existing crash rates with crash rates of similar types of facilities throughout Kentucky: *Critical Crash Rate Factor* (CCRF) and *Level of Service of Safety* (LOSS).

Critical Crash Rate Factor. Crashes were geospatially referenced and compared to statewide data to identify locations experiencing above-average crash rates. The Critical Crash Rate methodology used by the KYTC is defined in the Kentucky Transportation Center (KTC) research

report *Analysis of Traffic Crash Data in Kentucky (2014 – 2018)*.[6] The report defines two analysis types performed on study routes: "segments" and "spots."

- Segments vary in length and are divided along roadways as geometry or traffic volumes change.
- Spots are identified by analyzing 0.1-mile-long sections for concentrated crash areas.

Analysts used crash numbers, traffic volumes, roadway type, lane numbers, and segment length to determine the CCRF for each roadway segment and spot. CCRF is one measure of roadway safety, expressed as a ratio of the crash rate at a given location compared to statewide crash rates for similar roadways. A CCRF greater than 1.0 indicates crashes may be occurring more often than can be attributed to random occurrence. This procedure is a screening technique identifying locations where further analysis may be needed; it is neither a definitive statement nor measurement of a crash problem.

There is one high crash segment, which runs the length of the study corridor through Garrard County. There were 132 crashes in this section, resulting in a 1.3 CCRF. Additionally, there were four high crash spots in Boyle County and six in Garrard County, as shown in **Table 8**.

Table 8: High Crash Spots

Location	County	ADT	Crashes (F/I/PDO)	CCRF
US 150, MP 0.000-0.100	Boyle	4230	0/2/9	1.8
KY 1805, MP 1.500-1.600	Boyle	4179	0/2/8	1.3
Residential entrances, MP 2.000-2.100	Boyle	3866	0/2/6	1.4
Residential entrances, MP 2.100-2.200	Boyle	3866	0/2/5	1.2
Hanging Fork Road/Dix River Area, MP 0.400-0.500	Garrard	3828	0/3/6	1.6
Paper Mill Road/Dix River Area, MP 0.500-0.600	Garrard	3828	0/4/3	1.6
Horizontal curve between Little Dixie Rd & Martin Lane, MP 1.400-1.500	Garrard	3828	0/3/10	2.2
Horizontal curve, MP 3.300-3.400	Garrard	3828	0/0/7	1.2
Precision Ct, MP 4.100-4.200	Garrard	3828	0/0/7	1.2
KY 1150, MP 4.200-4.300	Garrard	5264	0/0/8	1.1

The highest CCRF spot is through a horizontal curve between Little Dixie Road and Martin Lane. This area exhibits a blind curve, narrow shoulder, and steep drop-off protected by guardrail along the inside of the curve. Within this 0.1-mile spot, there were 13 crashes over five years, three resulting in injuries. The majority (77%) involved a single vehicle. By direction of travel, 11 of 13

[6] Online at https://uknowledge.uky.edu/ktc_researchreports/1645/

were traveling westbound. Wet pavement was also a factor in 11 of 13 crashes. LiDAR survey data identified this location as having poor condition pavement and substandard superelevation.

The second highest CCRF location is at western limits of the study: the KY 52 intersections with US 150 and Old Lancaster Road. This area contains a steep grade coupled with a blind curve approaching the signal at US 150, as shown in **Figure 15**. There were 11 crashes within this 0.1-mile spot, including two injury crashes. The majority (64%) were rear ends.

Figure 15: Views of KY 52 Approach to US 150

Level of Service of Safety. KYTC and the KTC developed a more refined statistical methodology based on the *Highway Safety Manual* (HSM) to evaluate safety needs of projects, including those in the 2020 SHIFT process. Excess Expected Crashes (EEC), a newer methodology defined in the *Highway Safety Manual*, 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 roadways of its type, adjusting for traffic volumes and a statistical correction. EEC is positive when more crashes are occurring than expected and negative when fewer crashes are occurring than expected.

EECs are then grouped into one of four categories, identified as the Level of Service of Safety (LOSS). Summarized graphically in **Figure 16**, LOSS categories I and II represent sites with fewer than anticipated crashes, up to category IV, which has over 1.5 standard deviations more crashes than expected. Because

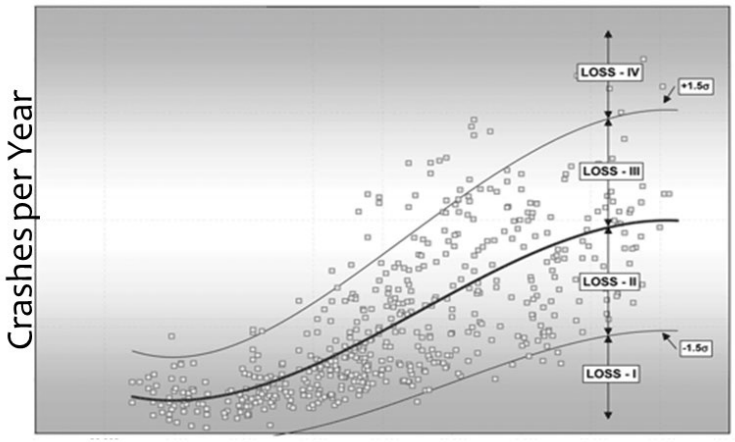

Figure 16: LOSS Categorical Thresholds

LOSS-IV sites experience such elevated crash rates, there is a higher probability that safety countermeasures at these locations will result in larger improvements.

Considering only fatality and severe injury crash types, one site along the corridor falls into the LOSS-IV category: the intersection with Paper Mill Road, which is also within a high crash spot with a 1.6 CCRF. The Paper Mill Road intersection lies on a 5% grade, with sharp horizontal and vertical curves in both directions that limit sight distance. It is less than 800 feet from Hanging Fork Road (**Figure 17**), which serves a high volume of turning truck traffic accessing the Rumpke transfer station.

Figure 17: View west (left) and east (right) from Hanging Fork Road

2.5.2 Comparison between Crash Analyses

Figure 18 presents a side-by-side comparison of the statistical crash analyses. The top panel highlights substandard horizontal curves and steep vertical grades. The middle panel displays the CCRF findings. The bottom panel displays the LOSS findings, highlighting the corresponding EEC values for sections with a LOSS-III or LOSS-IV based on severe crashes.

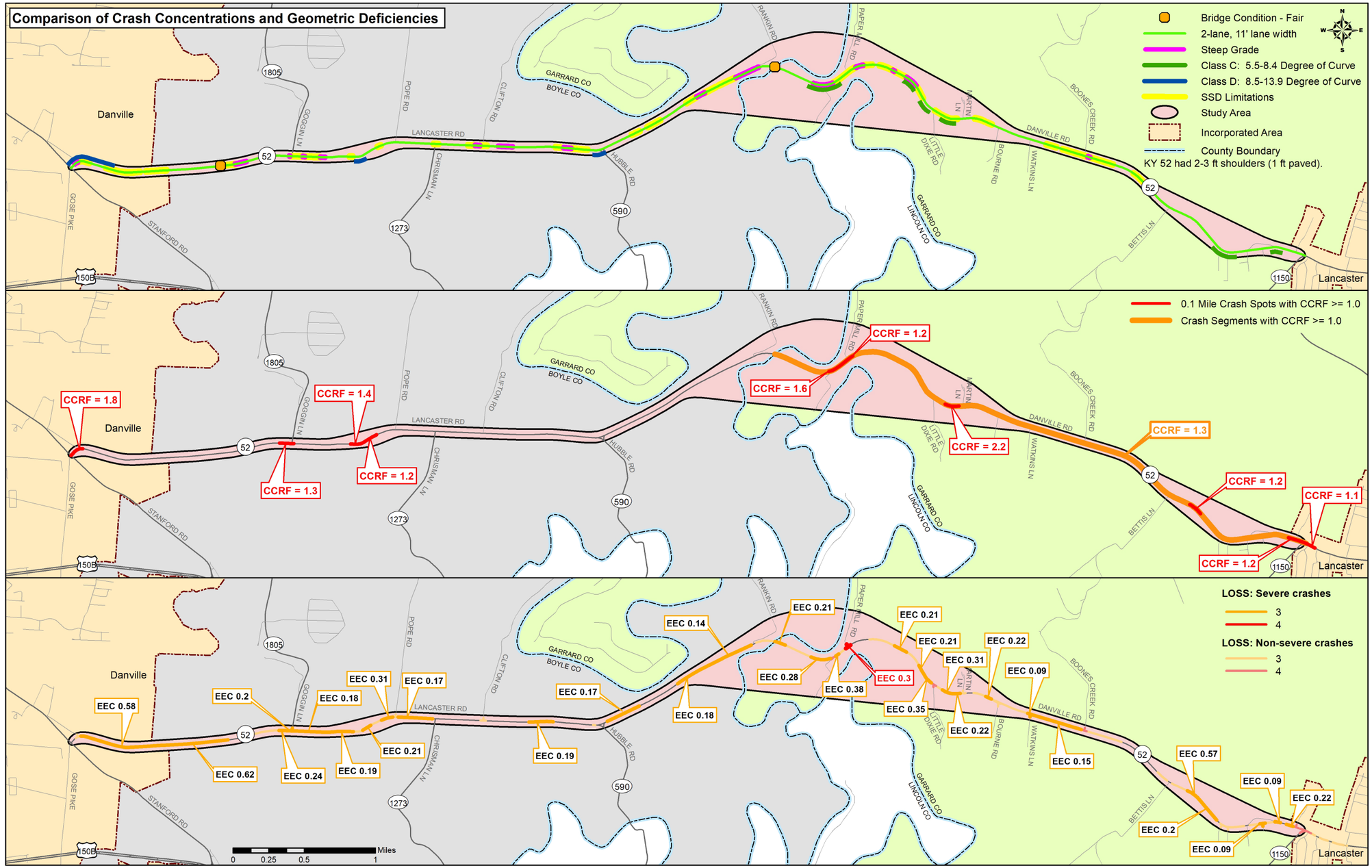

Figure 18: Comparative Crash Analyses

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3.0 ENVIRONMENTAL

An environmental overview was prepared to identify resources for consideration during the development of transportation improvement concepts. Natural and human environmental resources were identified from available literature, database review, and site visits. Study area resources in Boyle and Garrard counties are shown in **Figure 19** and **Figure 20** (pages 23–24, respectively)**,** and are summarized in the following sections.

The purpose of this overview was not to quantify potential environmental impacts, but instead to identify potential environmental issues to consider during the project development process. This information should aid the project team in making decisions to avoid, minimize, and/or plan for mitigation of potential project impacts, as appropriate. Should future projects develop following this study, additional environmental studies may be required.

If there is a federal nexus (e.g., federal funds, lands, permits, etc.) on a future project, then the procedures established from the National Environmental Policy Act (NEPA) must be followed. NEPA requires, to the fullest practicable extent, that federal actions be interpreted and administered in accordance with its environmental protection goals. It requires an interdisciplinary approach in planning and decision-making for any action that adversely impacts the environment. The potential environmental impacts and need for safe and efficient transportation must be considered to reach a decision that is in the best overall public interest.

3.1 Natural Environment

The natural environment includes all living and non-living things occurring naturally (not artificial or human-built). This includes aquatic ecology, such as rivers, streams, and wetlands; threatened and endangered species; farmlands; and geotechnical resources.

Water Resources. There are three named water resources in the study area. From west to east, they are Clarks Run, Balls Branch, and Dix River. A few wetlands, small lakes, and ponds are also located within the study area. No federally designated Wild or Scenic Rivers or Outstanding State Resource Waters exist in the study area.

Impacts to streams and wetlands require permit coordination with the US Army Corps of Engineers, US Coast Guard, and/or Kentucky Division of Water, depending on the scale of the water resource and potential disturbance.

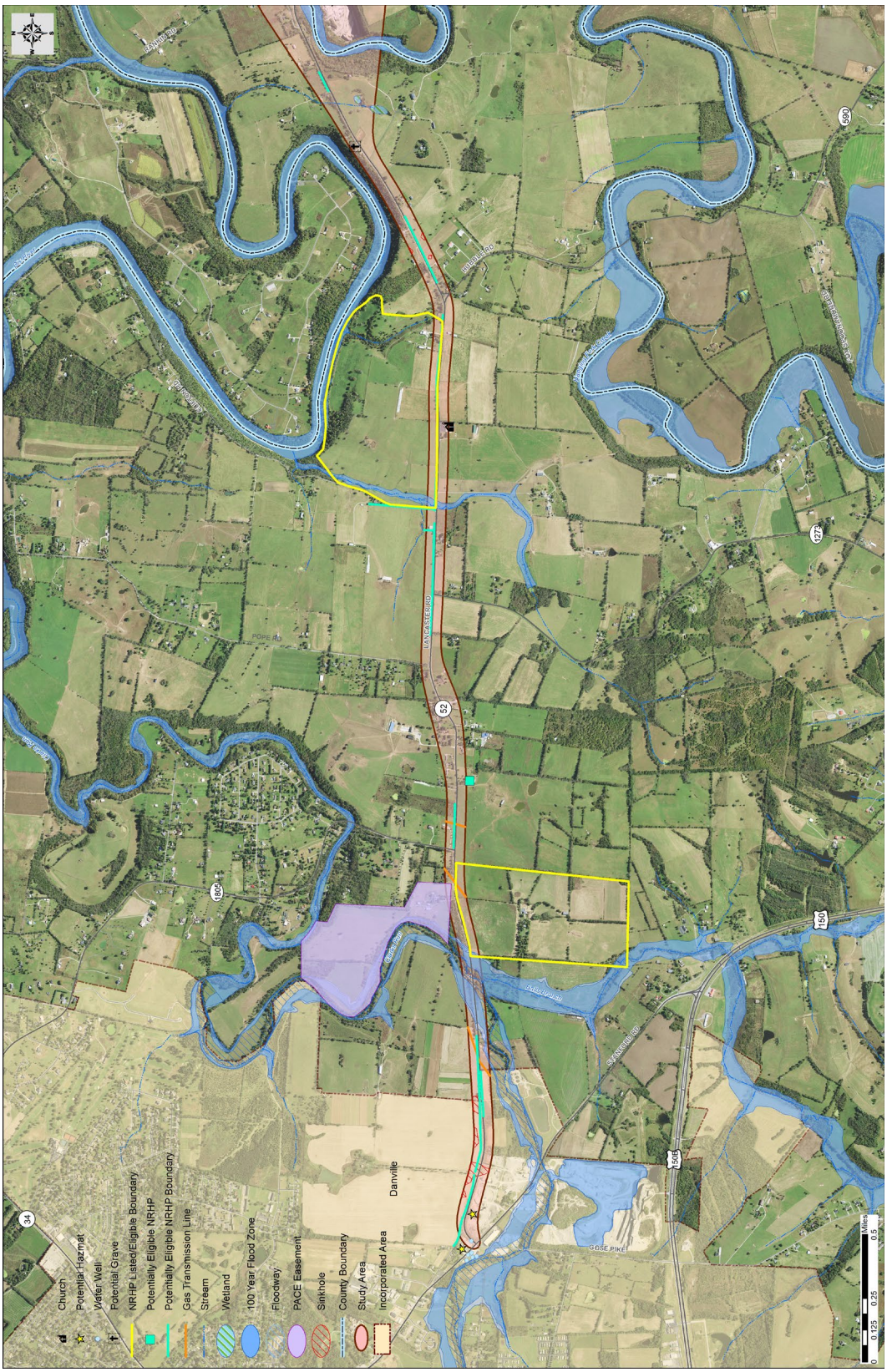


Figure 19: Environmental Resources in Boyle County

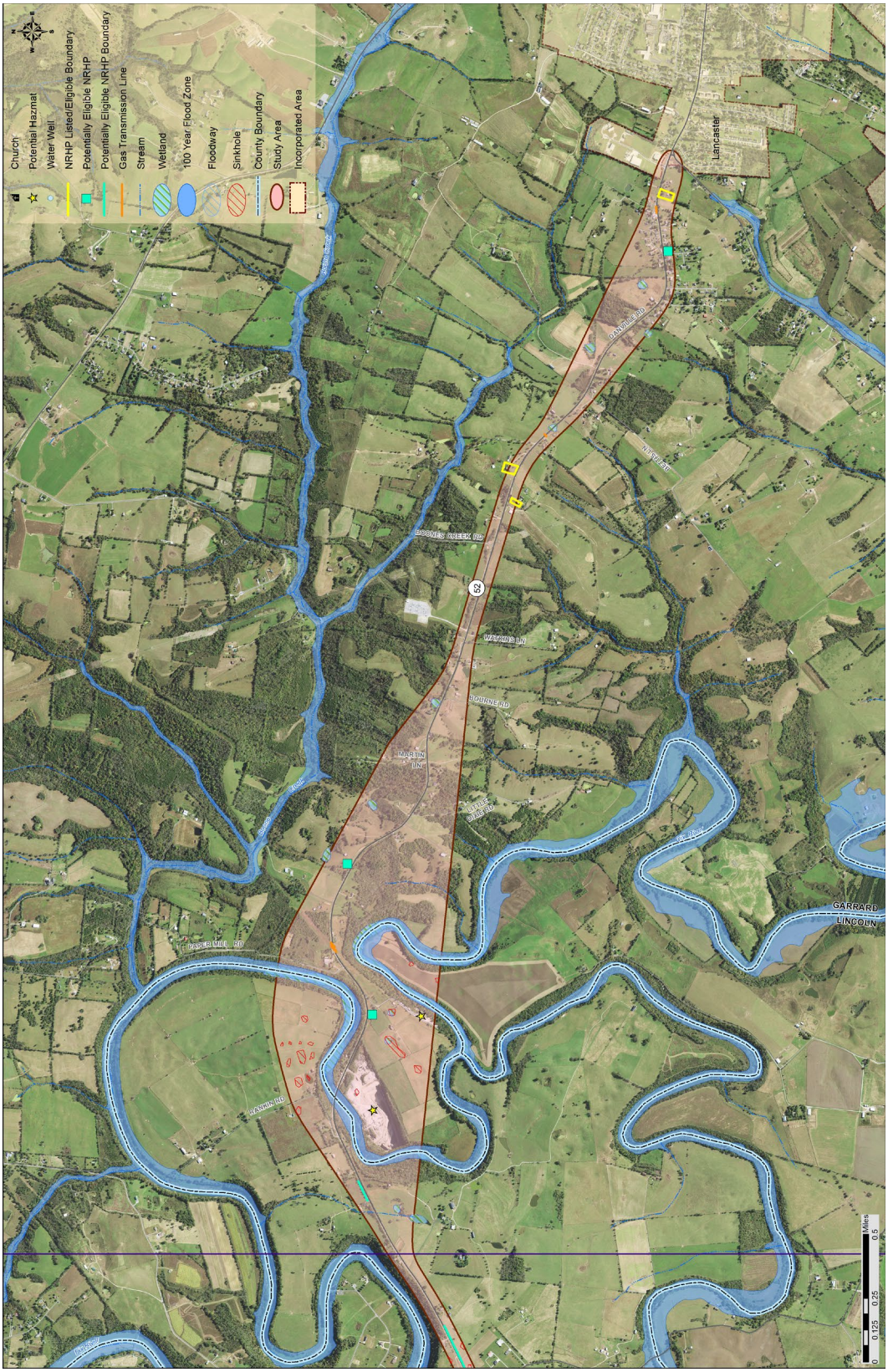


Figure 20: Environmental Resources in Garrard County

Listed Species. The US Fish and Wildlife Service (USFWS) maintains a database of federally protected species—listed as endangered or threatened under the *Endangered Species Act.* There are three listed bat species, five clam species, and one flowering plant species that have the potential to occur within the study area. Additionally, the monarch butterfly is under consideration for official listing. Listing statuses for all species are shown in **Table 9**. There is no designated critical habitat within the study area.

Table 9: Listed Threatened and Endangered Species

Group	Name	Scientific Name	Status
Mammals	Gray Bat	*Myotis grisescens*	Endangered
Mammals	Indiana Bat	*Myotis sodalis*	Endangered
Mammals	Northern Long-eared Bat	*Myotis septentrionalis*	Threatened
Clams	Clubshell	*Pleurobema clava*	Endangered
Clams	Fanshell	*Cyprogenia stegaria*	Endangered
Clams	Purple Cat's Paw	*Epioblasma obliquata obliquata*	Endangered
Clams	Rabbitsfoot	*Quadrula cylindrica cylindrica*	Threatened
Clams	Sheepnose Mussel	*Plethobasus cyphyus*	Endangered
Flowering Plants	Short's Bladderpod	*Physaria globosa*	Endangered
Insect	Monarch Butterfly	*Danaus plexippus*	Candidate

A habitat assessment should be completed in the early stages of project development for future project(s) to assess potential project impact to threatened and endangered species. Projects that occur within an area of known bat habitat will require project-specific evaluation to assess appropriate minimization/mitigation measures. For other federally listed species, specific ecological surveys may be required for projects that have the potential to impact habitat. Coordination with the USFWS Kentucky Field Office will be necessary to determine the need for future project-specific surveys.

Farmland Classifications. Natural Resource Conservation Service (NRCS) soil survey maps were reviewed to identify farmland classifications within the study area. The geographic distribution of the farmland classifications is shown in **Figure 21**. The study area includes 26% prime farmland soils; an additional 2% is considered prime farmland if protected from flooding or not frequently flooded. Farmlands of statewide importance represent another 35% and the remaining 37% is not considered prime farmland.

A protected agricultural easement is located on a 96-acre farm on the north side of KY 52 to the west of KY 1805 (Goggin Lane). This easement is protected in perpetuity through the Purchase of Agricultural Conservation Easement (PACE) Corporation[7]. No additional protected easements or

[7] https://www.kyagr.com/marketing/PACE.html

agricultural districts were identified within the study area. Should federal funds be used on future projects, the *Farmland Protection Policy Act* must be followed. If there is potential to convert farmland, coordination with the local NRCS office is required.

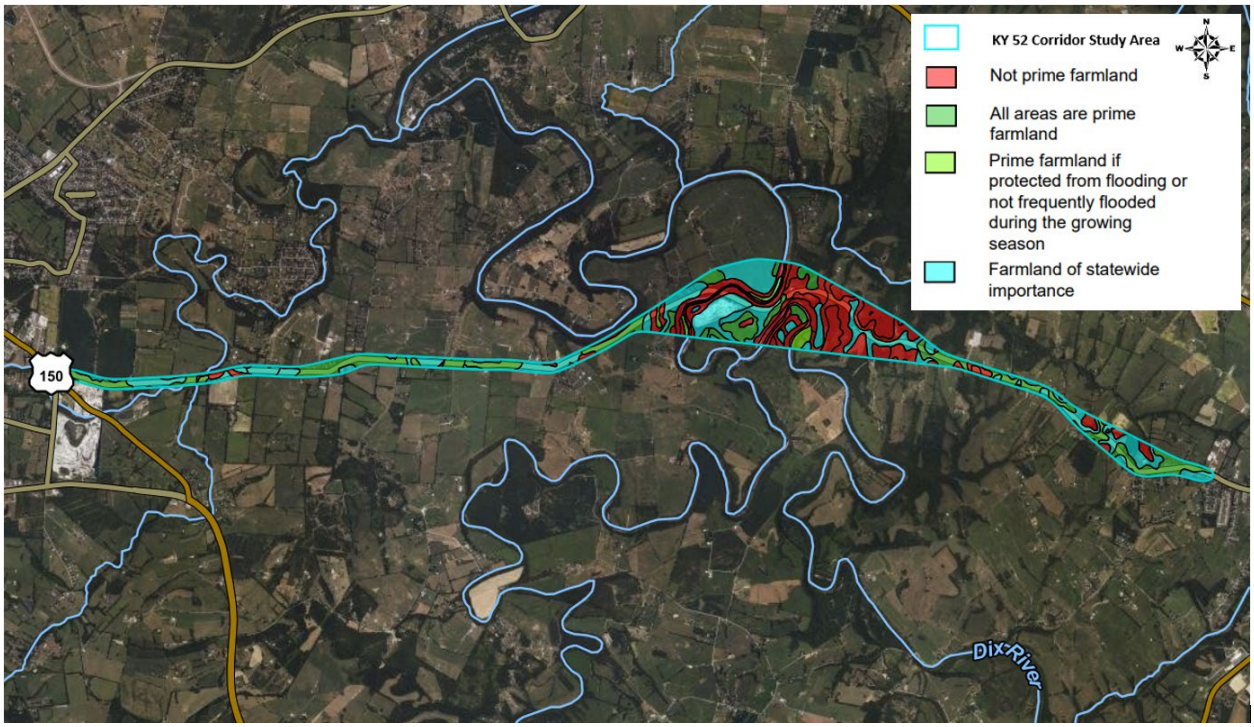


Figure 21: NRCS Farmland Soil Classifications

Geotechnical. KYTC Geotechnical Branch prepared a *Geotechnical Overview Report* to help identify geotechnical concerns that may affect potential project designs. A summary of those findings is provided here, with the full report in **Appendix C**.

The study area is located within the following physiographic regions:

- The western portion (Danville to the eastern side of the Dix River) is in the Inner Bluegrass Region, which is characterized with very low relief and thick residual soils.
- On the eastern side of the Dix River is a transition zone leading to the Outer Bluegrass Region. This transition zone is characterized by the Clays Ferry Formation, also known as the Eden Shale belt, which is typically has rounded hills and ridges of moderate relief. Soils in this area are thin and the bedrock, mostly shale, is poorly exposed.
- The eastern portion (east of the Dix River to Lancaster) is in the Outer Bluegrass Region, which is characterized by low to moderate relief and soils that range from thick over limestone to thin over shale.

There are two predominant structural features within the study area: the Jessamine dome and the Kentucky River Fault Zone. The Jessamine dome is in the western portion of the study area, and it occupies most of central Kentucky. It is indicated by an outcrop area of the oldest rocks exposed in the state, overlapping the study area just east of the Dix River and south of KY 52. The Kentucky River Fault Zone, also located just east of the Dix River, is a major northeast-southwest trending normal fault system. The fault zone in the study area is approximately 2,100 feet in width, is bookended by two normal faults, and contains the youngest rock formations in the study area.

The predominant soil type in the study area is residual soils, which are derived in-place from a weathering process of the parent limestone, dolomitic limestone, and shale. The study area is underlain by two stratigraphic groups:

- The western portion is underlain by the Middle Ordovician aged bedrock formations with most of the soils classified as silt loams. These soils occur on gentle slopes and ridge tops and are 2.5 to 5.0 feet in depth. They are clayey residuum derived from phosphatic limestone and are well drained and ideal for farmland.
- The eastern portion exposes the Upper Ordovician aged bedrock. Majority of soils in this area are classified as silty clay loam. They range in depth from 0.5 to 4.0 feet on gentle to steep slopes and often contain cobbles, stones, or boulders. These soils are more clayey due to the weathering of shale and are not prime farmland material.

The Inner Bluegrass Region of the western terminus exhibits a high to very high risk for karst potential. Several sinkholes have been identified in this area. The eastern portion of the study area has low to medium karst potential due to the larger presence of shale.

Two active surface mines are in the study area. They mine material from Lexington Limestone and Tyrone Limestone formations to produce aggregate for concrete use.

There are oil and gas wells just beyond the study area. Any gas wells located within future right-of-way limits will be treated in accordance with Mines and Mineral Specifications.

3.2 Human Environment

The human environment includes people and the resources they define: land use, community features, cultural historic resources, pollution (hazardous materials, air quality, noise), etc. Each could potentially be impacted by any future projects. The following sections identify these resources for consideration during the project development process.

Land Use. The corridor is primarily rural. The land use along the corridor in Boyle County is primarily agriculture. A residential area and an industrial zone are on the corridor's west end near US 150. The industrial zone includes the Allen Company, a road construction and asphalt paving

contractor with an asphalt paving plant on the property. No land use zoning maps for Garrard County are available.

Community Features. Limited community resources are located along the corridor. However, other key facilities and businesses are present both within and immediately adjacent to the study area.

Services located along the corridor include Mid-State Recycling Company, Triple-O Electric LLC, Rumpke Transfer Station, and Bluegrass 911 Communications. Businesses in addition to the Allen Company are the Dix River Stone Company and the U-Haul Neighborhood Dealer. To the west of the study area are the Danville Wastewater Sewer Plant, Gose Pike Convenience Landfill, and Caldwell Stone. To the east of the study area is downtown Lancaster which includes services such as Garrard County Emergency Management Agency, Garrard County Board of Education, US Postal Service, and Garrard County Sheriff's office.

The transfer station and quarry draw a substantial number of trucks to the corridor, both located near the county line.

Schools. Schools are located in both Danville and Lancaster, but none are along KY 52 within the study area. If future projects along KY 52 would impact school bus routes, coordination with local schools could be needed.

Churches and Cemeteries. There is one church located on KY 52: Hedgeville Baptist Church (**Figure 22**). No cemeteries were located within the study area; however, two gravesites were noted on historic plan sheets north of the alignment between KY 590 and Rankin Road. The potential to encounter other unknown or unmarked burial sites exists, particularly in rural areas, and should be considered throughout future project development phases.

Figure 22: Hedgeville Baptist Church

Historic Resources. A Cultural Historic Overview was completed for the study area to identify properties within the study area that are listed or eligible for listing on the National Register of Historic Places (NRHP). A Kentucky Heritage Council (KHC) records review identified 43 previously recorded resources within or adjacent to the study area. A windshield survey was also completed to assess individual resources and potential historic districts and identify potentially significant properties which will require additional research to formally evaluate their eligibility for listing in the NRHP.

Shown in teal in **Figure 19** and **Figure 20** (pages 24-25, respectively), 11 previously surveyed properties have been determined as NRHP listed or eligible. The largest two are Granite Hill (south of KY 52 and west of KY 1805) and A. Hutchings House (north of KY 52 and west of KY 590), both NRHP listed. In addition, six more potentially significant resources were identified during the survey: five residences with outbuildings plus a collection of stone fences in the western half of the study area. Further, the Boyle County section has the potential to be considered as a rural historic district. The properties along this section primarily consist of large farmsteads with agricultural outbuildings and residences. The Cultural Historic Overview is in **Appendix D**.

Should federal monies or permits be included in future projects, field survey and coordination with KHC will be required to assess project impacts to cultural historic resources.

Archaeological Resources Potential. An Archaeological Overview was prepared for the study area. A records review identified 22 previous surveys conducted within a 1.2-mile radius of the study corridor, with four overlapping the current study area. No archaeological sites were identified within the KY 52 study area; however, there is one known site adjacent.

Records review indicated 95 archaeological sites have been previously recorded in Boyle County. In Garrard County, 150 sites have been previously recorded. Majority of these sites in either county consist of prehistoric, open habitations without mounds and historic farms/residences. Most of the sites are found on dissected or undissected uplands. Alluvial soils along the floodplains and terraces of the Dix River at the Boyle/Garrard County line are classified as inceptisols, which may contain deeply buried and intact archaeological deposits.

Field surveys and coordination with the KHC will be required should federal permits or funds be required for future project development phases. **Appendix E**, on file with KYTC, includes additional information about the archaeological overview. To protect identified resources, known site locations are not included on public mapping.

Socioeconomic Profile. BGADD completed a socioeconomic study for the corridor (**Appendix F**) to highlight potential areas statistically likely to contain elevated concentrations of minority, elderly, economically disadvantaged, limited English proficiency (LEP), and/or disabled populations. The study corridor covers portions of five Census block groups, four of which contain residential households within the study boundary. Statistical block group geographies are shown in **Figure 23**. Statistics are reported from 2019 American Community Survey five-year estimates.

- At 25%, the minority population of one block group—located north of KY 52 and east of KY 1805—exceeds the thresholds for the overall study area (12%) and BGADD region (15%).

- The population of elderly (age 65+) individuals in three of the four adjacent block groups exceeds state, national, and regional rates.
- At 26%, the population of persons living under the poverty level in one block group—Garrard County section south of KY 52—is nearly double that of the overall study area (13%), BGADD region (17%), state (17%), or nation (13%).
- No elevated concentrations of disabled or LEP populations were identified.

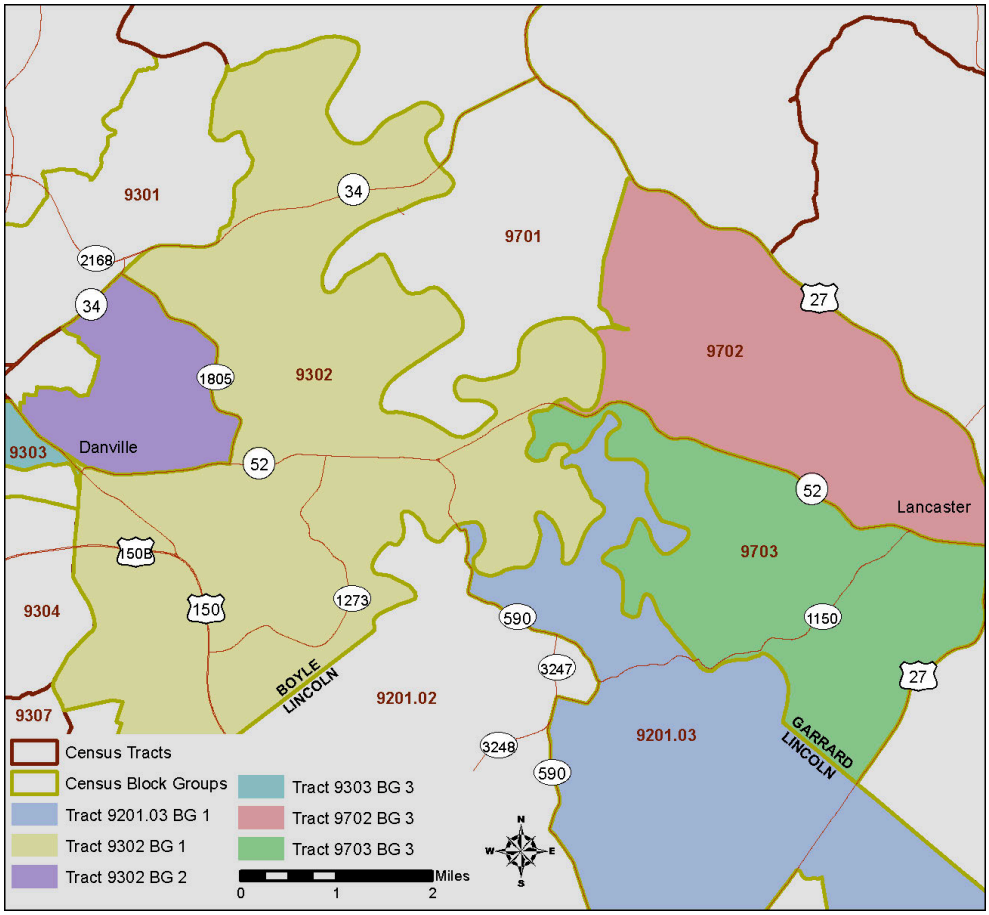


Figure 23: Census Block Groups for Socioeconomic Analysis

Section 4(f). Section 4(f) of the Department of Transportation Act of 1966 applies to federally funded projects. It is a substantive law that applies to land from publicly owned parks, recreation areas, wildlife and waterfowl refuges, and public or private historic sites eligible for or listed on the NRHP. A federally funded highway project that uses a Section 4(f) property can only be approved after a determination is made that no prudent or feasible alternative to the use of the property exists and that project planning minimizes harm to Section 4(f) sites.

Potential Section 4(f) protected properties within the study area are cultural historic and archaeological sites eligible for listing or listed on the NRHP. No parks, recreation areas, or wildlife and waterfowl refuges are located along the corridor.

Section 6(f). Section 6(f) of the Land and Water Conservation Fund (LWCF) Act applies to both state and federally funded projects. The LWCF provides federal grants to acquire land for outdoor recreation, protect important natural areas, and develop or renovate outdoor recreation facilities (campgrounds, picnic areas, swimming facilities, etc.). Impacts must be addressed when projects result in permanent conversion of outdoor recreation property that was acquired or developed using LWCF grant assistance. No properties that have received LWCF funds were identified along the project corridor.

Hazardous Materials Considerations. Readily available records from the US Environmental Protection Agency (USEPA) were compiled to illustrate the range of monitored sites within the study area. There are no open underground storage tanks (UST); however, there are three closed USTs in the industrial zone near the western terminus. There are a few businesses located along the corridor that may produce waste of concern if proposed improvements advance and require site impacts: Allen Company (asphalt paving plant), Mid-State Recycling Company, Rumpke Transfer Station, and Dix River Stone.

Air Quality Considerations. USEPA has established National Ambient Air Quality Standards (NAAQs) for six criteria pollutants: ozone, lead, nitrogen dioxide, sulfur dioxide, carbon monoxide, and particulate matter ($PM_{2.5}$ and PM_{10}). Boyle and Garrard counties are in attainment for all criteria pollutants.

The study area is not located within an MPO; therefore, any federally funded transportation projects should be included in the statewide transportation improvement program (STIP) to ensure air quality conformity requirements are satisfied. Future federal projects may need to analyze potential Mobile Source Air Toxics (MSAT) impacts based on the project type. FHWA has developed a tiered approach for three categories to analyze MSAT in NEPA documents, depending on specific project circumstances. The three tiers and associated level of analysis are no potential/exempt projects requiring no analysis, low potential requiring a qualitative analysis, and higher potential requiring quantitative analysis. Based on traffic volumes, any proposed improvements most likely fall into one of the lower two categories.

Noise Considerations. There are noise sensitive receptors in the vicinity of potential future improvements. Noise sensitive receptors include all outdoor areas of frequent human use such as residential areas, parks, cemeteries, hospitals, churches, schools, and some commercial properties with exterior use.

Specific traffic noise impact analyses may be required in future project development activities. State funded projects do not require a traffic noise impact analysis, unless directed by the legislature. However, federally funded projects that add capacity or shift traffic closer to sensitive receptors do require the consideration of traffic noise impacts.

4.0 INITIAL COORDINATION EFFORTS

Collaborative project team, local official/stakeholder (LO/S), and online public engagement efforts were held through the course of the study. The project team included KYTC District 7 and Central Office staff from various disciplines, BGADD staff, and consultant personnel. Coordination efforts were essential for identifying areas of concern and potential improvement opportunities. Summaries of all meetings are in **Appendix G**.

4.1 Project Team Meeting No.1

The project team met on November 30, 2020, to review existing conditions information and prepare for the upcoming community outreach. The team reviewed existing conditions including roadway geometry, traffic flow, high crash locations, and environmental resources. The corridor operates at LOS C–D and the intersections operate at LOS A–B, indicating congestion is not a primary concern. However, abrupt slowdowns observed from the GPS travel data coupled with sight distance issues contribute to elevated crash rates. The crash analysis indicates safety is the primary need for the corridor. There were 245 crashes over the five-year analysis period, 59% involving a single vehicle. A more detailed discussion of this analysis is included in **Section 2.5**.

Statistical crash analyses highlighted four preliminary locations along the KY 52 corridor with elevated crash rates that may be candidates for spot improvements: the intersection with US 150, the horizontal curve just west of Pope Road, the crest between Hanging Fork and Paper Mill roads, plus the curves between Little Dixie Road and Martin Lane.

4.2 Local Official and Stakeholder Meeting No.1

On December 11, 2020, the project team held a virtual meeting with local officials and other stakeholders. The purpose of this meeting was to seek input regarding on-the-ground safety needs. The following sites were identified as local concerns:

- The dog-leg intersection with KY 590 is a recurring problem as it sits in a blind curve. Realigning the curve or adding guardrail may help.
- Several areas have steep drop offs without guardrails. There is limited recovery area if a vehicle's tires drop off the edge.

- Local leaders noted complaints they receive about the US 150 intersection, primarily related to trucks and the hill/curve approaching from KY 52. Because the curve restricts a motorist's view of the US 150 intersection ahead, cars on KY 52 approaching the intersection cannot immediately see cars waiting at the intersection's stoplight. This intersection will likely be reconstructed as part of the separate East Danville Bypass project.
- The crest between Hanging Fork and Paper Mill roads is a concern; consider reconstructing the entire section from KY 590 (**Figure 24**) as a three-lane section.

Figure 24: Western KY 52 Intersection with KY 590

- Sharp drop-offs near Little Dixie Road are an issue.

4.3 Online Public Engagement

Public comments were collected online from December 14, 2020, through January 15, 2021. A brief survey and a GIS-based crowdsourcing app were used to collect input on existing conditions and perceived areas of concern. Over the 30-day comment period, 81 surveys were completed and 43 GIS pins were added to the map.

Figure 25 illustrates the top corridor needs based on public input: addressing narrow shoulders (84%), sharp curves (79%), and narrow lanes (72%). Only 4% of respondents indicated no improvements were needed. The "other" category included written-in responses for pavement condition, narrow bridge widths, brush/vegetation, and farm machinery.

Figure 26 presents the geographic distribution of comments from the crowdsourcing app; detailed results are in **Appendix G**.

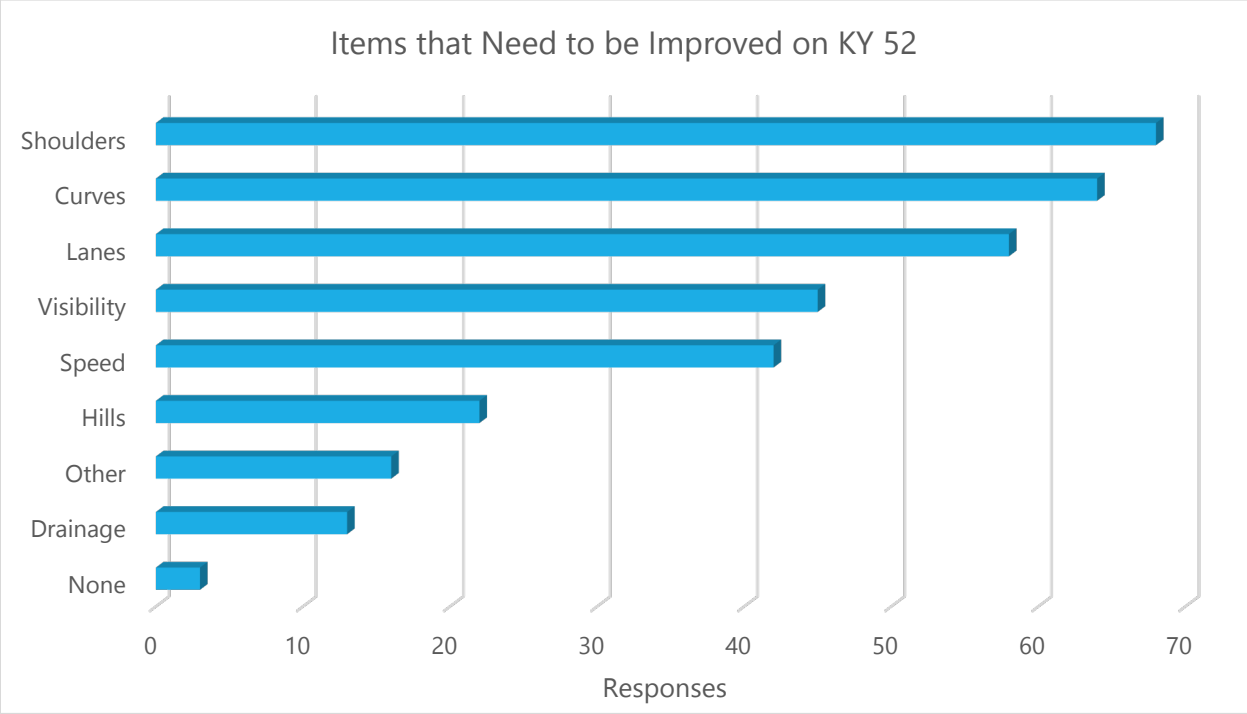


Figure 25: Public Input on Top Corridor Needs

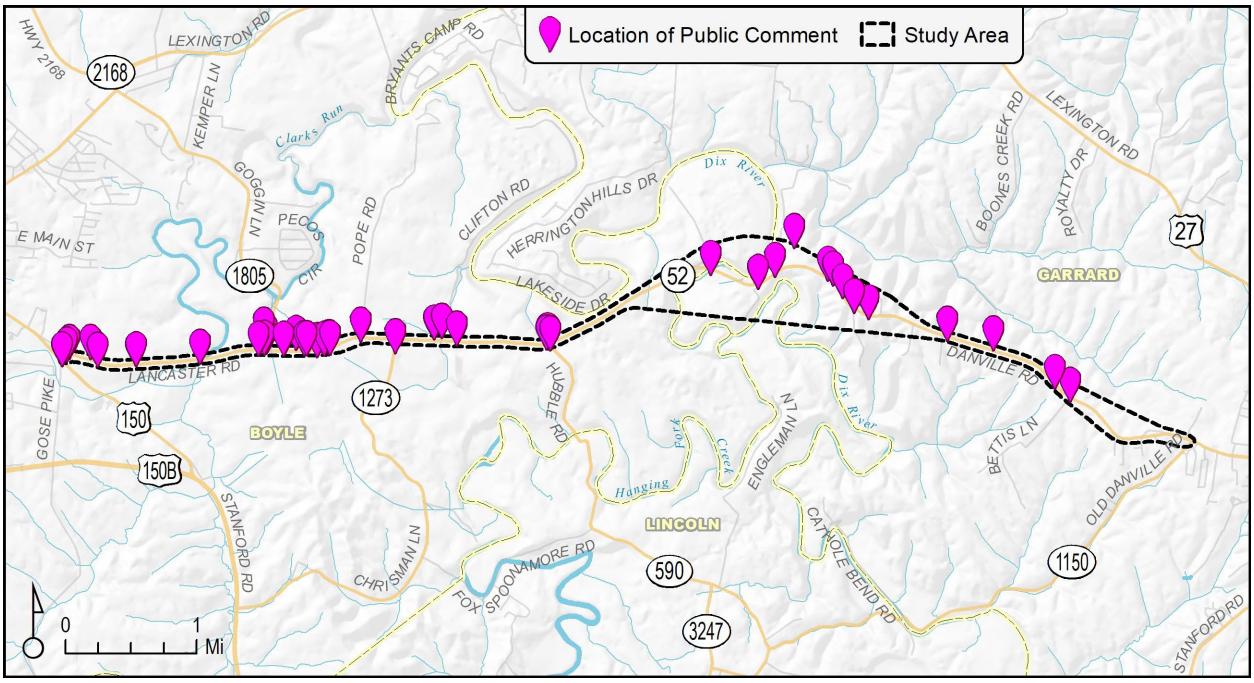


Figure 26: Distribution of Crowdsourced Comments on Needs

Areas of concern identified by the public align with existing conditions previously identified by the project team and with the main themes throughout the corridor—narrow shoulders, poor visibility, and high crash areas. The four major areas identified during the first project team meeting—the intersection with US 150, the curve west of Pope Road, the area near Hanging Fork and Paper Mill roads, and the section from Little Dixie Road to Martin Lane—were echoed as areas of concern in the public comments. Additional areas of concern identified through the public input include the intersection with KY 590, the intersection with Boones Creek Road, and the stretch of road between Martin Lane and Bettis Lane.

5.0 2045 TRAFFIC FORECAST AND NO-BUILD OPERATIONS

KYTC's statewide travel demand model (KSTDM, version 5961 in TransCAD 7), along with 2020 mainline and turning movement counts, formed the basis of future year 2045 traffic projections. The complete *Traffic Forecast Report* is in **Appendix A**.

5.1 Future Year Traffic Assumptions

The KSTDM estimated future year growth for all study area roadway segments. The model simulates a 24-hour period, relying on hourly and directional factors to derive design hourly volumes (DHV). At a high level, the model overlays the roadway network over anticipated changes in household and employment levels for geographic zones to project changes in traffic flows.

Socioeconomic assumptions were reviewed and adjusted to reflect current background growth assumptions. Residential and employment growth, minimal along the rural corridor, is concentrated in Danville and southwest of Lancaster. Near the western project limits, a new tourist attraction is proposed. In 2017, Luca Mariano Distillery purchased a 300-acre historic farmstead with plans to create a destination distillery with a visitor's center and an entertainment pavilion. An additional 150 retail-class employees were attributed to this zone to reflect future operations associated with the attraction.

In the No-Build scenario, two transportation projects in the vicinity are assumed to be open to traffic prior to 2045: the East Danville Connector (Item No. 7-80000) and the US 27 reconstruction west of Lancaster (Item No. 7-196), both shown in **Figure 4** (page 4).

5.2 2045 No-Build Traffic and Operations

Considering historic traffic growth rates, population projections, anticipated development, and model projections, a growth rate was applied to the 2020 Existing scenario to project future 2045

No-Build traffic. An annual growth rate of 3% was applied at the US 150 intersection versus 1% for the rural portion of the corridor. **Table 10** compares 2020 and 2045 No-Build Traffic

Table 10: 2020 and 2045 No-Build Traffic Comparison

Segment	2020 Existing				2045 No-Build		
	ADT	% Trucks	AM Peak	PM Peak	ADT	AM Peak	PM Peak
US 150 to KY 1805 MP 0.000-1.586	4,200	4.3	360	490	7,000	580	780
KY 1805 to KY 590 (MP 1.586-3.773)	4,100	4.3	330	500	5,300	410	640
KY 590 to KY 1150 (MP 3.773-4.231*)	4,100	11.8	300	490	5,300	380	620

* Garrard County MP

At the segment level, the projected increase in volume shows minimal impact on traffic operations. In the 2045 No-Build scenario, the three analysis segments operate at LOS D with v/c ratios ranging from 0.13 to 0.29. For comparison, the 2020 scenario shows segments operate at LOS D with a segment v/c of 0.10 to 0.19. Intersection operations drop to LOS B in the 2045 No-Build scenario, from LOS A–B in 2020. This suggests current capacity provided by the highway is adequate to support anticipated traffic volumes.

6.0 CONCEPT DEVELOPMENT

Improvement concepts were developed based on a combination of input from the project team, a review of existing conditions, community feedback, and field reconnaissance. Over the course of the study, the project team worked to determine which improvement concepts best satisfied the study goals, coordinating with the ongoing HSIP analyses.

Summarized visually in **Figure 27**, the following concepts were identified for discussion at the March 2021 project team meeting:

- Concept A (Boyle MP 0.000 to Garrard MP 4.320): Widen the existing alignment to 25 feet, the minimum standard required to install edgeline and centerline rumble strips. Similar to the US 460 widening effort west of Georgetown, this assumes trenching and new pavement added to shoulders but does not reconstruct the existing alignment or replace existing pavement.
- Concept B (Boyle MP 0.000): Incorporate short-term spot improvements at the US 150 intersection, which is assumed to be fully reconstructed as part of the separate East Danville Connector project.

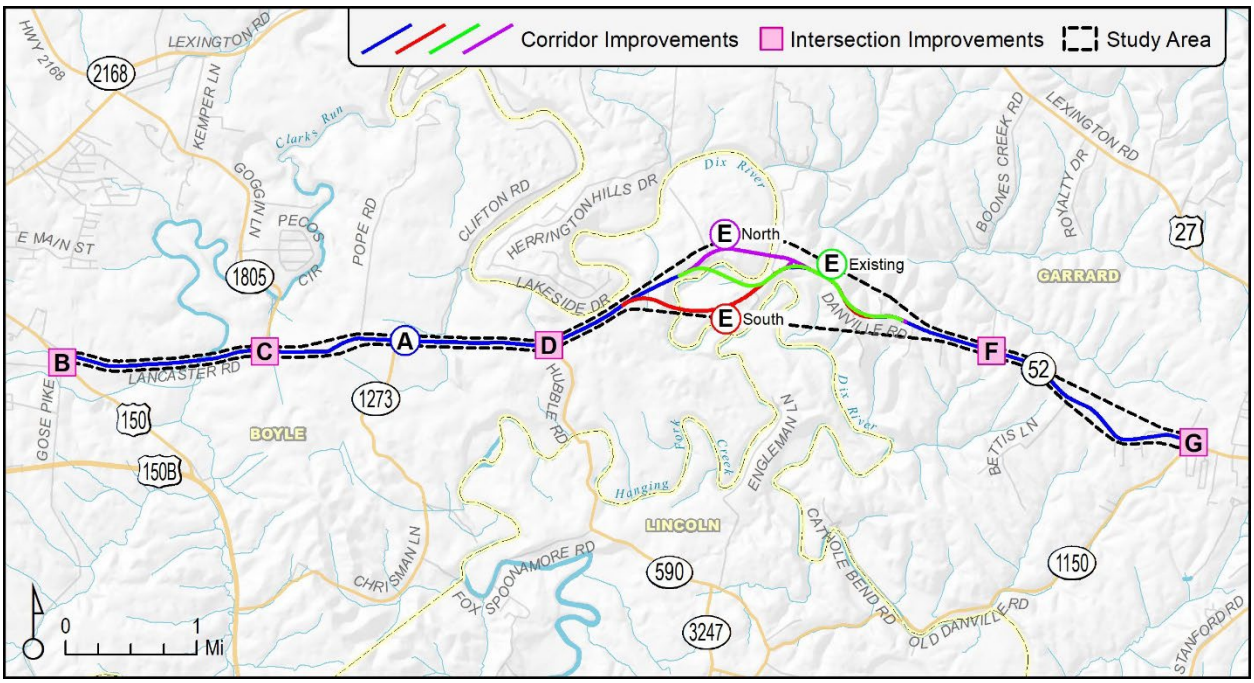


Figure 27: Preliminary Spot Improvement Concepts

- Concept C (Boyle MP 1.586): Add a left-turn refuge for traffic accessing KY 1805 (Goggin Lane, **Figure 28**).
- Concept D (Boyle MP 3.773): Reconstruct the horizontal curves at the KY 590 (Hubble Road) intersection and adjust the northbound approach to improve sight distance.

Figure 28: View west from KY 1805

- Concept E (Boyle MP 3.800 to Garrard MP 1.600): Near the Dix River, realign up to 2.9 miles of KY 52, which is characterized by substandard geometrics and elevated crash rates.
- Concept F (Garrard MP 2.422): Add a left-turn refuge for traffic accessing Boones Creek Road.
- Concept G (Garrard MP 4.153 to 4.541): Construct two-way left-turn lane (TWLTL) for the developed area approaching Lancaster.

Concept E stretches from MP 3.800 in Boyle County to MP 1.600 in Garrard County. This 2.9-mile section contains substandard horizontal curves, steep grades that limit visibility, and roadside

drop-offs. The Dix River bridge is in a curve and follows a steep downgrade. These factors contributed to the high crash rates: 81 crashes including 27 injury crashes in five years, with nearly 70% being single vehicle crashes. More crashes occur westbound since eastbound motorists are generally traveling slower after coming through the adjacent curves. Superelevation—how steeply the road banks in a curve—is based on 45 mph though the corridor is posted at 55 mph. Representative North and South corridors were developed as shown in **Figure 29**.

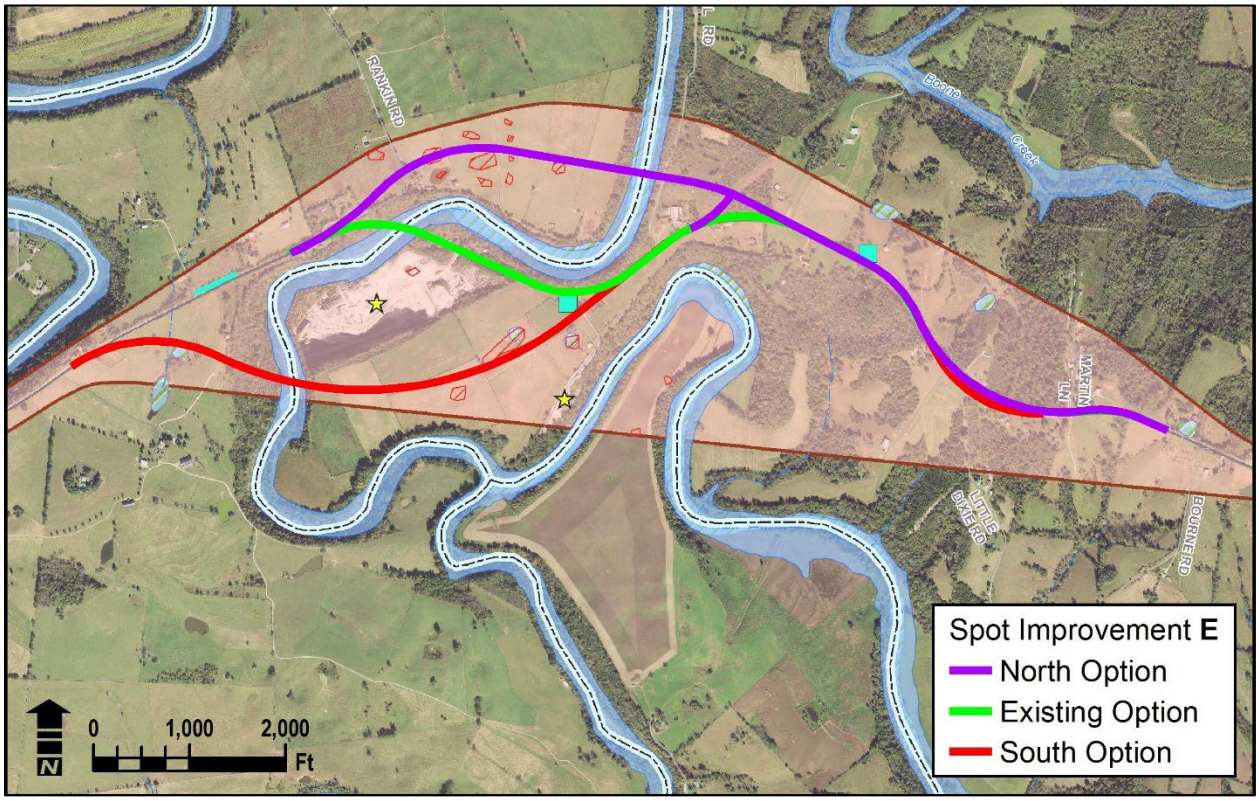


Figure 29: Spot E Concepts

The Concept E North option crosses the river in a straight tangent section, passing through mostly farmlands. It reduces the number of curves and creates a T-intersection to remove entrances to the quarry and transfer station from mainline KY 52. The South option puts the new crossing in a horizontal curve, which is less preferred but an improvement over the existing alignment. Either option creates a new Dix River crossing and realigns the curve near Martin Lane.

A third option for Concept E generally follows the existing footprint to minimize costs and impacts. It adds wider pavement through the curve at Hanging Fork Road, softens the curve east of Paper Mill Road, and softens the curves near Little Dixie Road. The limits to improve existing start east of the Dix River bridge, near MP 0.100 in Garrard County.

6.1 2045 Build Scenario Traffic

Concepts A, E North, and E South were coded into the travel demand model to estimate their impacts on future traffic flows. Each showed about a 5% increase in daily traffic compared to the 2045 No-Build scenario. This increase results in negligible impacts on peak hour traffic operations.

6.2 Project Team Meeting No. 2

On March 15, 2021, the project team met to discuss and refine the preliminary improvement concepts described above. A summary of the meeting is included in **Appendix G**.

For Concepts C and F, dynamic signage could be considered instead of turn lanes. An "intersection conflict warning system," like that installed at KY 169/Bethany Road/Vince Road in Jessamine County, would provide a radar-based set of flashing warning signs where the alignment limits visibility. Actuated signs flash when a potential conflict is detected; e.g., an eastbound motorist waiting to turn left at KY 1805, just past the crest curve. Similar setups have shown around a 20% reduction in crashes.

Statewide, many Y-shaped intersection (like KY 52/KY 590) are being reconstructed, eliminating the channelized right turn lanes that tend to impact visibility.

The team also agreed to postpone the next round of LO/S coordination until site-specific HSIP countermeasures were more clearly defined.

6.3 Low-Cost HSIP Countermeasures Considered

HSIP is a core federal-aid program intended to achieve a significant reduction in traffic fatalities and serious injuries on all public roads. Under the *Fixing America's Survey Transportation* (FAST) *Act of 2015*, approximately $41 million each year is allocated to Kentucky's HSIP initiatives. The objective is to target resources where they will be most effective—with a focus on performance. HSIP identifies projects to improve safety not only based on crash history, but also on crash potential through a systemic safety management process.

As discussed in **Section 2.5**, 51% of 230 reported KY 52 crashes during the five-year analysis period were roadway departure crashes. This type of crash tends to be more severe: 20% of roadway departure crashes on the corridor represent higher severities (fatalities, serious injuries, and minor injuries) versus 16% considering all crashes. Kentucky's 2017 *HSIP Investment Plan* notes, "Kentucky is a Roadway Departure Focus State for the FHWA. Nationally, roadway departure crashes account for 53% of fatal crashes, however, in Kentucky for the past five years, roadway departure crashes have accounted for over 70% of the roadway fatalities." About 66% of the Commonwealth's HSIP budget is dedicated to roadway departure corridors.

Based on a detailed crash analysis along the study corridor, countermeasures were identified to prevent roadway departures when possible and reduce crash severity when not. Potential countermeasures—many of which can be applied singly or in combination—include:

- **Ditching and Shouldering**. Shoulders provide extra space for vehicles to navigate narrow roadways and ditches channel water. Widening earth shoulders and constructing new ditches at specified locations are predicted to reduce fatal and injury crashes by 32% at the identified locations.

- **Superelevation Improvements**. Superelevation is the banking of a roadway along a horizontal curve so motorists can safely maneuver the curve at reasonable speeds. Improving superelevation in curves near Pope Road, at KY 52/KY 590, approaching Lancaster, and at Old Danville Road, is predicted to reduce roadway departure crashes by 17% at these sites.

- **Clear Zone Improvements**. Clear zone is the area adjacent to a roadway that should be clear of objects. Select trees have been identified for removal, which is predicted to reduce crashes by 38% where the countermeasure is deployed.

- **Guardrail Replacement**. Approximately 1.7 miles of substandard and damaged guardrail were identified for replacement between MP 1.0 and MP 5.0 in Boyle County, and between MP 0.0 and MP 2.8 in Garrard County. Upgrading guardrails to current standards is predicted to reduce injury roadway departure crashes by 32% in these locations.

- **Pavement Repair**. Correcting base failures and securing side slopes to prevent slides at specified areas are assumed to reduce single vehicle crashes by 10% at these sites.

- **Cribbing**. Cribbing (**Figure 30**) improves road and side slope stability by installing drilled railroad rails and metal panels. Installing cribbing along KY 52 near KY 590 and Martin Lane is assumed to reduce single vehicle crashes by 10% at these locations.


Figure 30: Example of Cribbing

- **Fluorescent Signs**. Enhanced sign reflectivity and roadway delineation can alert drivers to changing conditions. Installing new and replacing existing signs along the corridor is predicted to reduce injury crashes by 13%.

- **Durable Pavement Edge**. Durable pavement edge eliminates vertical drop-offs at the pavement edge (**Figure 31**), allowing drifting vehicles to safely return to the pavement. This treatment is predicted to reduce roadway departure crashes by 21%.

Figure 31: Pavement Drop

- **High Friction Surface Treatments**. High friction treatments compensate for curves where faster vehicles tend to slip, particularly during wet/icy weather. Applying this countermeasure to select curves along KY 52 is predicted to reduce roadway departure crashes by 72% at these sites.
- **Wider Striping**. Widening existing four-inch pavement striping to six inches improves visibility, predicted to reduce fatal and injury crashes by 38%.
- **Extend Culverts and Headwalls**. Lengthening culverts can provide wider shoulders throughout the corridor and installing safety headwalls will create traversable shoulders for errant vehicles. These safety measures are assumed to reduce single vehicle crashes by 10%.
- **Improve Horizontal Curves**. Improving horizontal curves in Boyle County (MP 2.0–2.4) includes a combination of several countermeasures: widening pavement, installing rumble strips, extending a culvert, adding safety headwalls, removing trees, and applying high friction surface treatment. These measures are predicted to reduce fatal and injury crashes by 46% at these curves.
- **Widen Shoulders** (Concept A above). Wider shoulders increase recovery area and provide space for rumble strips to alert motorists approaching the limits of their travel lane. In combination with rumble strips and six-inch striping countermeasures, shoulder widening is predicted to reduce fatal and injury crashes by 46%.

While not all these measures can be implemented within the available $2.1 million HSIP budget for the corridor, this list represents the menu of HSIP options considered for implementation.

7.0 FINAL COORDINATION MEETINGS

Following concept development efforts described in **Chapter 6.0**, the project team engaged with other stakeholders to present and discuss options. Meeting summaries for each coordination point are included in **Appendix G**, arranged chronologically.

7.1 HSIP Coordination Meeting

The project team met on August 5, 2021, to review key findings of the HSIP effort and present recommended countermeasures to implement with the available HSIP budget. The 13 individual countermeasures (**Section 6.3**) were presented, including cost estimates and anticipated crash reductions for each component. Three combinations were presented, varying the makeup of countermeasures and deployment locations to optimize benefits for the available budget. One combination focused on horizontal curve realignments ($2.2 million), anther focused on corridor-wide pavement widening ($5.0 million), and the third focused on pavement widening through curves ($2.1 million).

While there is some overlap with concepts A through G developed in this planning study, HSIP projects are typically deployed more quickly; HSIP measures could be implemented—reducing severe crashes—while larger planning concepts compete for traditional funding sources then advance through other project development phases. It is likely construction of HSIP measures mentioned herein could be constructed in 2023.

7.2 Local Official and Stakeholder Meeting No. 2

A second virtual meeting with local officials and stakeholders was held September 22, 2021. An online StoryMap[8] was created to present existing conditions, to summarize Concepts A through G, and collect feedback from viewers. The project team used the StoryMap to guide the discussion, answering attendee questions about proposed improvements. Though no in-person public events are planned at this time, attendees were encouraged to share the website and promote the survey via their distribution lists. Future public involvement will likely be required if any of the individual planning concepts are advanced for further project development activities.

7.2.1 Public Survey on Concepts

During September and October, surveys were collected to obtain community perspectives on the proposed concepts. The survey was set up to let individuals provide feedback and submit input

[8] Online at https://arcg.is/1qzTry

on individual concepts. Most feedback was received on Concept A (widening), with 21 total responses (**Figure 32**) while Spot E on existing alignment received the fewest with four responses.

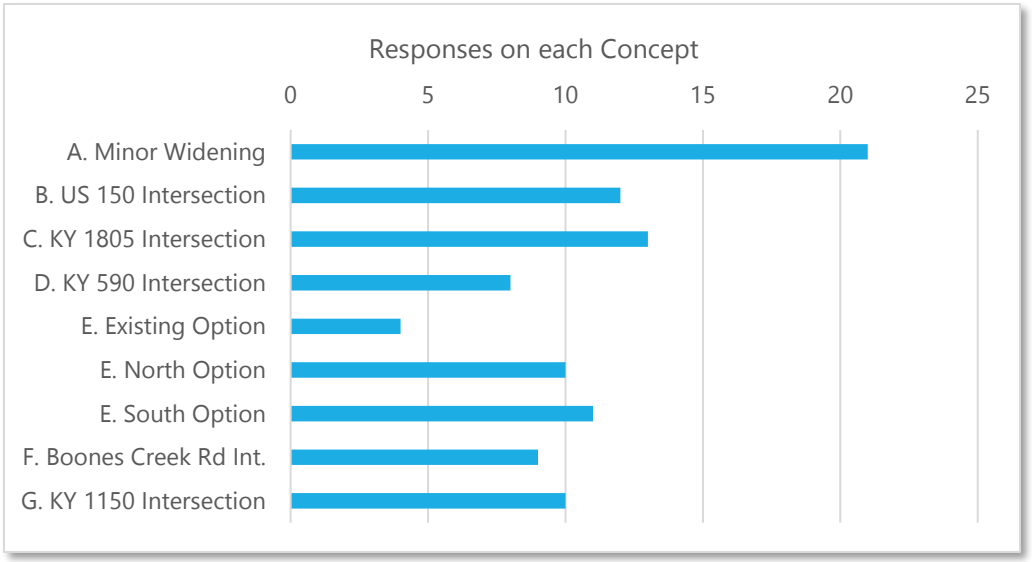


Figure 32: Number of Survey Responses per Concept

For each concept, respondents were asked if they agree, disagree, or are neutral regarding whether each improvement is necessary. Results are summarized in **Figure 33**. Neutral responses are not shown, accounting for the differences between **Figure 32** and **Figure 33**.

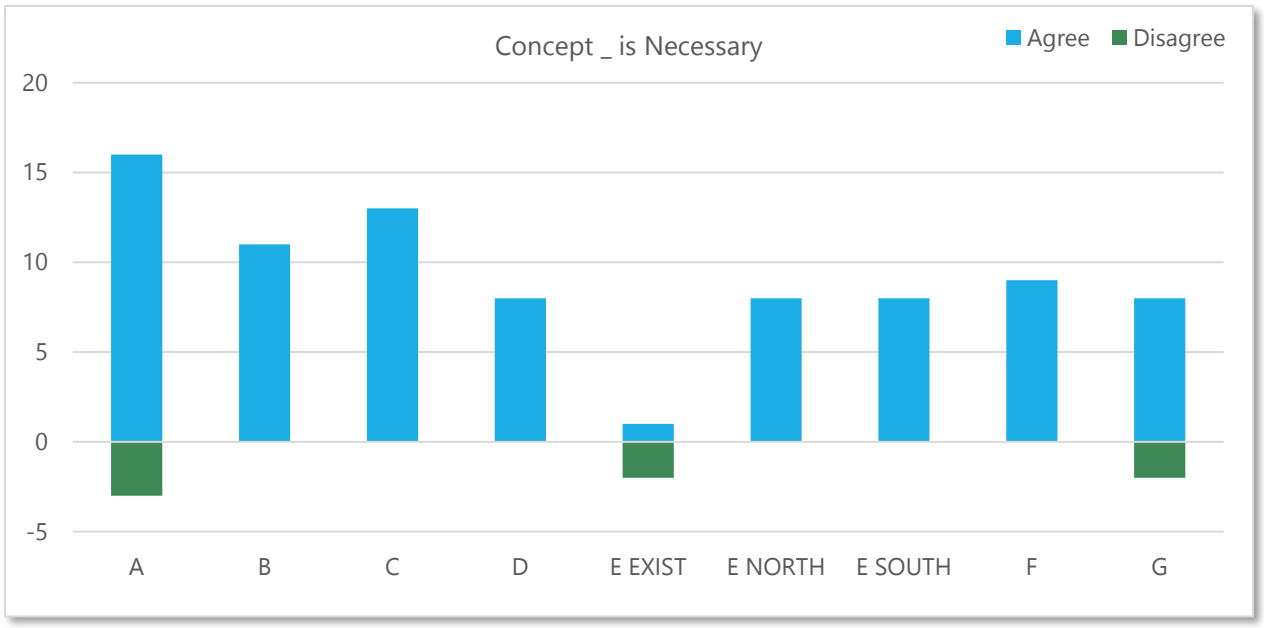


Figure 33: Public Support/Opposition by Spot

Open-ended comments varied, many emphasizing the need for a wider, safer highway. A few noted concerns about the expense. One comment suggested Spot G should be extended to the industrial park, accessed from Precision Court approximately 300 feet west of the KY 1150 intersection.

7.3 BGADD Regional Transportation Committee Meeting

BGADD held a Regional Transportation Committee Meeting on November 8, 2021, to provide an update on regional transportation news, including a status report on active projects in each district and a walkthrough of this study's StoryMap. The project team shared the StoryMap from the second virtual local officials and stakeholder meeting with the Regional Transportation Committee; no comments or questions were received.

7.4 Project Team Meeting No. 3

The project team held a third virtual meeting on December 9, 2021, to review the improvement concepts, discuss costs/impacts, and concur on priorities. Input from both rounds of public surveys and both LO/S meetings were considered as well. The team discussed the cost estimates, particularly the high utility phase cost associated with Concept A.

One additional improvement, Concept H, was added to the list of recommended measures. Realigning a series of curves near Pope Road (Boyle County MP 2.0–2.4) was initially considered but dismissed due to HSIP budget constraints. During the meeting, the project team determined that no specific prioritization efforts were merited beyond defining short-term and long-term concepts.

8.0 RECOMMENDATIONS

In addition to HSIP countermeasures that are anticipated to be constructed in 2023, five short-term and three long-term planning improvement concepts were recommended to advance for further project development.

8.1 HSIP Countermeasures

Based on plan development as of the time of this report, the following countermeasures will be implemented as part of the ongoing Item No. 7-9021 HSIP project:

- Pavement widening with rumble strips within Garrard County high-crash areas (approximate MP 0.10–1.70).

- Superelevation improvements at four curves: Boyle MP 2.30, Boyle MP 3.78, Garrard MP 3.35, and Garrard MP 4.20.
- High friction pavement at two curves: Boyle MP 2.05 and Garrard MP 1.42.
- Tree removal at reverse curves between Goggin Lane and Pope Road.
- Pavement repairs and cribbing for two areas of base failures.
- Ditching and shouldering as needed in problem areas throughout the corridor beyond the 1.6-mile widening stretch.
- Corridor-wide application of six-inch permanent paint striping.
- Corridor-wide replacement of all signs.

8.2 Benefits, Costs, and Impacts

The majority of proposed improvement concepts in this planning study are confined to narrow strip taking along the existing highway to minimize costs and to reduce/avoid impacts to adjacent properties and environmentally sensitive features.

8.2.1 Cost Estimates by Phase

Planning-level design concepts were used to estimate preliminary quantities of high-cost construction items including earthwork, pavement, and structures. Construction costs were tabulated using the KYTC District 7 average unit bid prices. KYTC District 7 provided right-of-way and utility cost estimates based on conceptual model disturb limits, aerial imagery, approximate locations of existing right-of-way and property lines generated from property valuation administrator (PVA) data, and utility records. Planning-level cost estimates by phase are presented in **Table 11** with costs shown in 2021 dollars. Each construction phase estimate includes an additional 30% for contingencies.

Table 11: Planning-Level Cost Estimates by Phase

Concept	Design	Right-of-Way	Utility	Construction	Total
A. Widen Corridor*	$370,000	$500,000	$14,100,000	$3,700,000	$18,700,000
B. US 150 Intersection	$10,000	-	-	$80,000	$90,000
C. KY 1805 Intersection					
Dynamic Signs	$10,000	-	-	$70,000	$80,000
Turn Lane	$20,000	$32,000	$240,000	$200,000	$490,000
D. KY 590 Intersection	$80,000	-	-	$730,000	$810,000

Concept	Design	Right-of-Way	Utility	Construction	Total
E. Widen near Dix River					
E North	$1,600,000	$1,900,000	$2,800,000	$14,000,000	$20,300,000
E South	$1,800,000	$1,900,000	$4,100,000	$15,800,000	$23,600,000
E Existing	$570,000	$220,000	$3,900,000	$5,600,000	$10,300,000
F. Boones Creek Rd. Int.	$30,000	$110,000	$490,000	$220,000	$850,000
G. Lancaster TWLTL	$100,000	$32,000	$440,000	$950,000	$1,520,000
H. Pope Road Curves	$30,000	$4,000	$190,000	$300,000	$520,000

** excludes HSIP widening at Garrard County MP 0.1-1.7*

8.2.2 Benefit-Cost Analyses

For each long-term improvement measure, crash modification factors (CMF) from the CMF Clearinghouse[9] were applied to the crash data discussed in **Section 2.5** to estimate potential safety benefits for each of the proposed improvements discussed above. Monetized values of crashes by severity were taken from the 2020 *Kentucky Traffic Collision Facts* report[10] published by the KTC.

Results in **Table 12** present the estimated benefit-cost ratio for each proposed long-term spot improvement over a 20-year analysis horizon. A ratio greater than one suggests the discounted present value of the benefits exceeds the discounted present value of the costs, suggesting the project is worthwhile. A 3% discount rate is assumed for the analysis.

Table 12: Benefit-Cost Summary

Concept	Length (mi)	Crashes (Fatal/Inj.)	CMF ID	CMF Value	Ratio
A. Widen Corridor[1]	7.82	166 (3/42)	4812/4813: widen lanes 4819: widen shoulders	0.910 0.960[2]	1.54
E. Widen near Dix River	2.91	81 (0/27)	3401: edgeline rumbles 6862: widen pavement 10640: 6-in striping	0.530[3] 0.685 0.887	1.23-1.44
G. Lancaster TWLTL	0.31	13 (0/2)	2338: add TWLTL 4812: widen lane 9090: shoulders/rumbles	0.686 0.820[2] 0.920	1.30

[1]excludes HSIP widening at Garrard County MP 0.1-1.7; [2]only applies to PDO; [3]only applies to fatal and injury crashes

It should be noted that the BCA for Concept A assumes the HSIP curve widening has been implemented, removing that length from the calculation. For Concept E, potential crash reductions

[9] Online at http://www.cmfclearinghouse.org/
[10] Online at https://uknowledge.uky.edu/ktc_researchreports/1732/

for each option are based on current KY 52 crashes within the segment, varying the costs between North, South, and Existing options.

For short-term concepts, benefits could not be reliably quantified due to the small scale of the proposed improvements, resulting in inflated results—low-cost improvements generally outperform higher cost solutions, resulting in very high benefit-cost ratios.

8.3 Project Sheets

Individual information sheets for improvement concepts A through H are presented in this section.

A	Boyle - Garrard Counties	KY 52 Corridor Widening Danville to Lancaster
Long Term		Boyle MP 0.00-5.11 + Garrard MP 1.70-4.32

IMPROVEMENT DESCRIPTION:

- Widen pavement to 25 ft along existing alignment
- Corresponding safety improvements as disturbed: replace guardrail, extend culvert pipes, remove/trim trees, install new signing, improve side slopes, add striping/rumble strips

Phase Estimate	(2021 dollars)
Design:	$370,000
Right-of-Way:	$500,000
Utilities:	$14,100,000
Construction:	$3,700,000
Total Cost:	**$18,700,000**

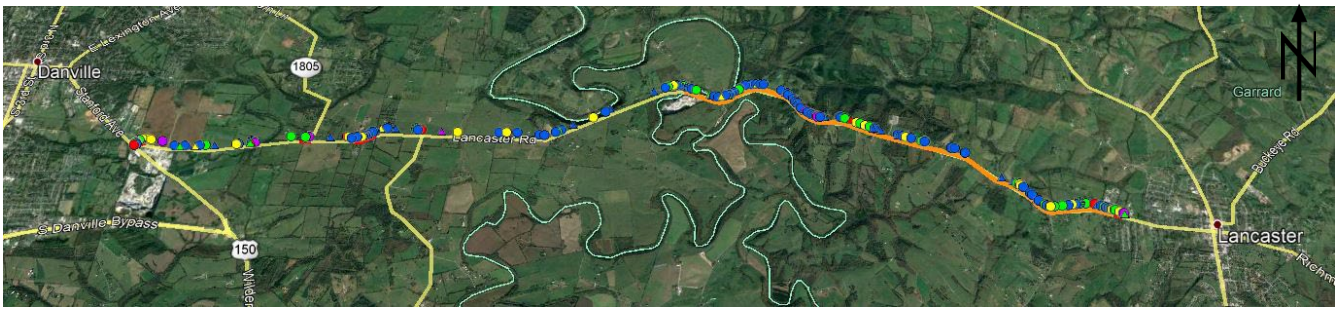
Excludes HSIP widening Garrard MP 0.1-1.7

IDENTIFIED NEEDS:

2020 Traffic:	4,100-4,200 vpd with 4-12% trucks, operating at LOS D or 0.10-0.19 v/c
2045 Traffic:	5,600 -7,300 vpd with 4-12% trucks, operating at LOS D or 0.13-0.29 v/c
2015-2019 Crashes:	230 total crashes with 3 fatal and 61 injury; 57% single vehicle crashes; 20% rear ends
Existing Geometry:	Two 10 ft lanes with 0 to 1 ft paved shoulders
Other:	Speed limit is 55 mph then 45 mph approaching Lancaster

POTENTIAL ENVIRONMENTAL RED FLAGS: Bat habitat, historic stone fences, streams, sinkholes, gas lines, driveways

PROJECT LOCATION:



High Crash Segments — High Crash Spots — Fatal — Injury — PDO — Angle — Rear End — Left Turn — Single Vehicle — Sideswipe — Head On

B	Boyle County	KY 52 at US 150
Short Term		KY 52 MP 0.00 | US 150 MP 15.10

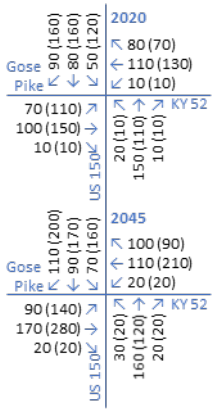
IMPROVEMENT DESCRIPTION:

- Install high visibility backplates on signal heads
- Define access control in northwest quadrant along US 150
- Install a dynamic warning signage on KY 52

Phase Estimate	(2021 Dollars)
Design:	$10,000
Right-of-Way:	$0
Utilities:	$0
Construction:	$80,000
Total Cost:	**$90,000**

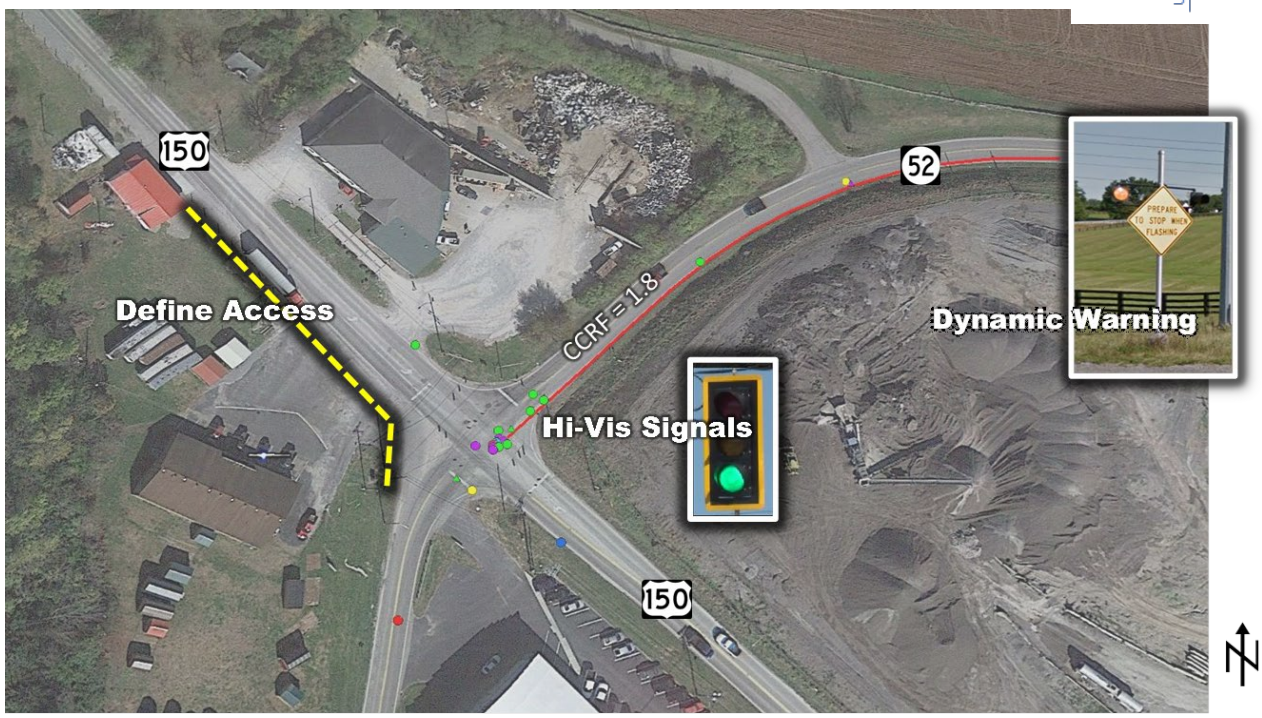
IDENTIFIED NEEDS:

Traffic:	Existing (top) and No-Build (bottom) forecasts for AM (PM) peak hours at right, operating at LOS A-B in all scenarios
2015-2019 Crashes:	19 crashes, with 0 fatal and 4 injury; 47% rear ends; 1.8 CCRF spot
Existing Geometry:	Signalized. US 150 has 11 ft lanes with left-turn lanes and 1 ft paved shoulders. KY 52 has 11 ft lanes with 1 ft paved shoulders; curve/hill on KY 52 limits visibility approaching signal



POTENTIAL ENVIRONMENTAL RED FLAGS: N/A: within existing right-of-way

PROJECT LOCATION: (Not to Scale; images are for illustrative purposes only.)



High Crash Segments | High Crash Spots | Fatal | Injury | PDO | Angle | Rear End | Left Turn | Single Vehicle | Sideswipe | Head On

C	Boyle County	KY 52 @ KY 1805 (Goggin Lane)
Short Term		KY 52 MP 1.586 | KY 1805 MP 0.000

IMPROVEMENT DESCRIPTION:

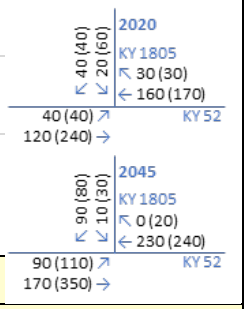
Two small scale improvement options:

- Option 1: Install a dynamic warning system on KY 52
- Option 2: Construct a short left-turn refuge on KY 52 to separate turning vehicles from thru traffic

Phase Estimate	(2021 Dollars)
Design:	$10,000-$20,000
Right-of-Way:	$0-32,000
Utilities:	$0-240,000
Construction:	$70,000-$200,000
Total Cost:	**$80,000-490,000**

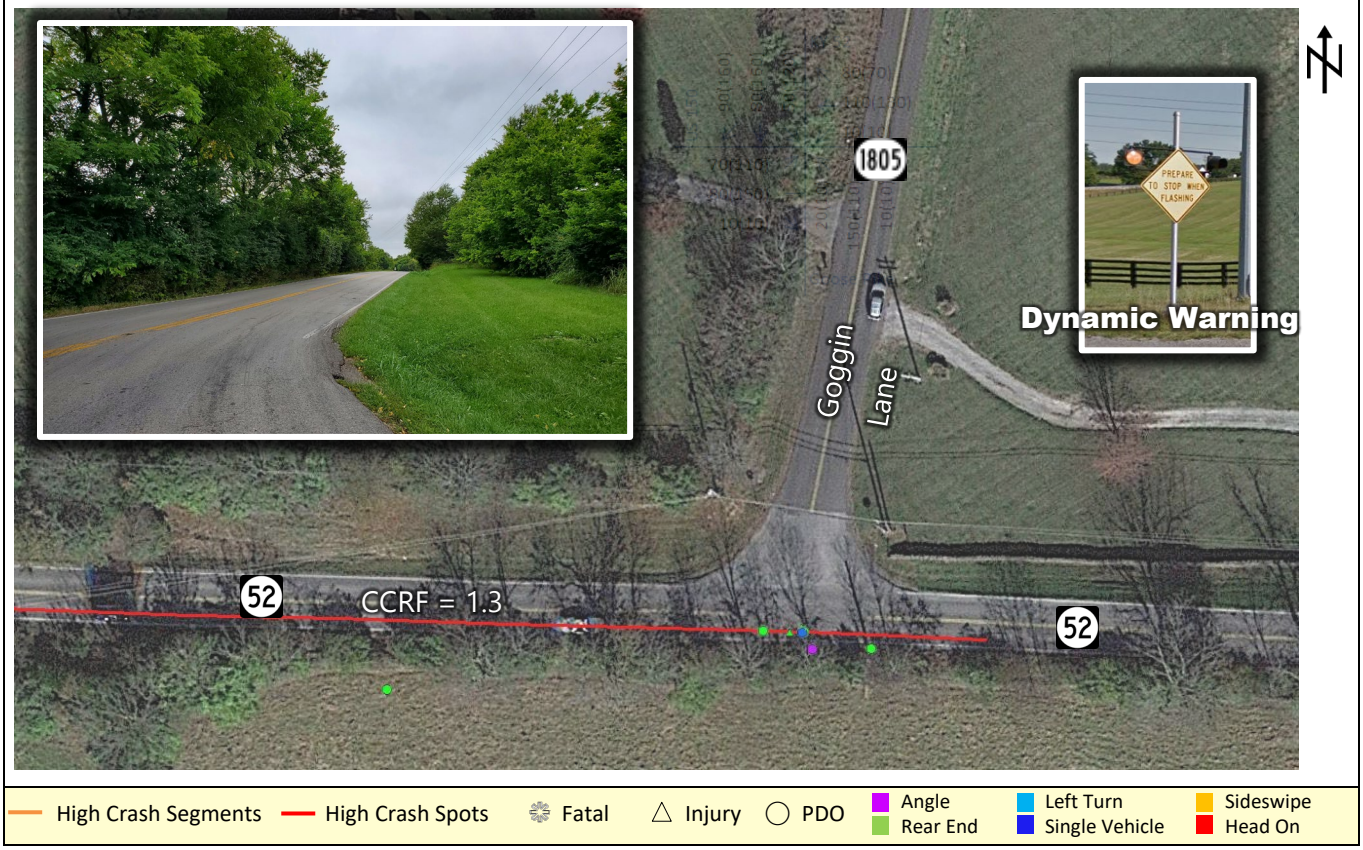
IDENTIFIED NEEDS:

Traffic:	Existing (top) and No-Build (bottom) forecasts for AM (PM) peak hours at right, operating at LOS A-B in all scenarios
2015-2019 Crashes:	7 crashes, 0 fatal and 2 injury; 71% rear ends; 1.3 CCRF spot
Existing Geometry:	Two-way stop-controlled; KY 52 has two 10 ft. lanes with 1 ft paved shoulders; crest curve to west limits visibility



POTENTIAL ENVIRONMENTAL RED FLAGS: Granite Hill historic/PACE easement, bat habitat

PROJECT LOCATION: (Not to Scale; images are for illustrative purposes only.)



D	Boyle County	KY 52 @ KY 590 (Hubble Road)
Short Term		KY 52 MP 3.773| KY 590 MP 0.796

IMPROVEMENT DESCRIPTION:

Realign curve, add left turn lane, adjust channelized approach

Phase Estimate	(2021 Dollars)
Design:	$80,000
Right-of-Way:	$0
Utilities:	$0
Construction:	$730,000
Total Cost:	**$810,000**

IDENTIFIED NEEDS:

2020 Traffic:	KY 52: 4,100 vpd with 4% truck traffic; operating at LOS D or 0.19 v/c; KY 590 has 300 vpd
2045 Traffic:	5,300 vpd with 4% truck traffic; operating at LOS D or 0.24 v/c
2015-2019 Crashes:	3 crashes; all PDO single vehicle crashes
Existing Geometry:	Two-way stop-controlled Y intersection within a compound curve; KY 52 has two 10 ft lanes with 1 ft paved shoulders
Other:	Four public comments at intersection

POTENTIAL ENVIRONMENTAL RED FLAGS: Within existing right-of-way but adjacent karst pond; may require cribbing

PROJECT LOCATION: (Not to Scale; images are for illustrative purposes only.)

High Crash Segments | High Crash Spots | Fatal | Injury | PDO | Angle | Rear End | Left Turn | Single Vehicle | Sideswipe | Head On

E	Boyle-Garrard Counties	KY 52 Near Dix River
Long Term		Boyle MP 3.800-5.114 + Garrard MP 0.000-1.600

IMPROVEMENT DESCRIPTION:

Three proposed improvement options:

- North, new alignment with new Dix River crossing
- South, new alignment with new Dix River crossing
- Existing, follows current alignment to improve some problem curves for lower costa/impacts

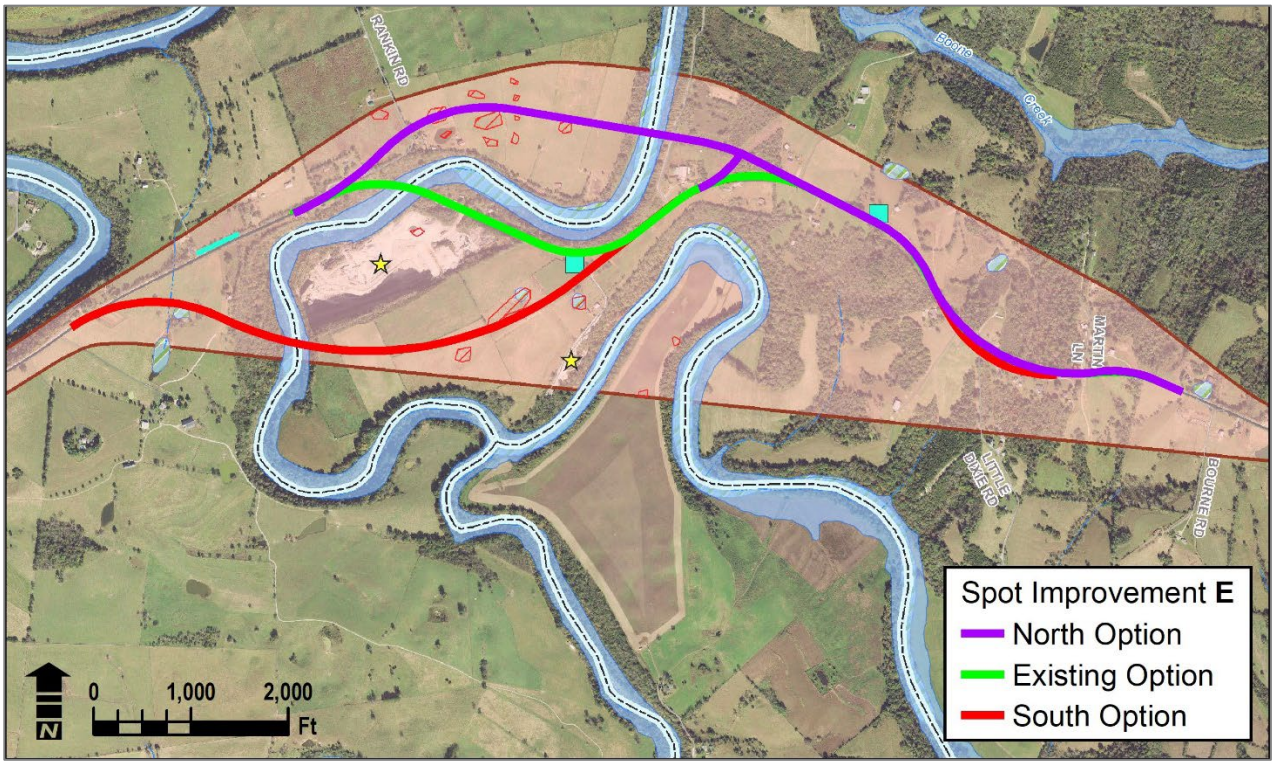
Phase Estimate	(2021 dollars)
Design:	$570,000 – $1,800,000
Right-of-Way:	$220,000-$1,900,000
Utilities:	$2,800,000-4,100,000
Construction:	$5,600,000 - $15,800,000
Total Cost:	**$10,300,000-23,600,000**

IDENTIFIED NEEDS:

2020 Traffic:	4,100 vpd with 12% trucks, operating at LOS D or 0.18 v/c
2045 Traffic:	5,6000 vpd with 12% trucks, operating at LOS D or 0.22 v/c
2015-2019 Crashes:	81 crashes with 0 fatal and 27 injury; 70% single vehicle crashes; Garrard County segment has 1.3 CCRF plus three high CCRF spots
Existing Geometry:	2.9-mile stretch near the river contains narrow typical section (10 ft lanes, 0-1 ft shoulders) substandard horizontal curves, steep grades, and steep roadside drop-offs. The bridge is in a curve and follows a steep downgrade.

POTENTIAL ENVIRONMENTAL RED FLAGS: Farmland, residences, karst features, bat habitat, possible historic

PROJECT LOCATION:



Potential Historic ☆ Potential Hazmat Sinkhole

F	Garrard County	KY 52 @ Boones Creek Road
Short Term		KY 52 MP 2.422 | Boones Creek Road MP 0.000

IMPROVEMENT DESCRIPTION:

Construct a short left-turn refuge on KY 52 to separate turning vehicles from thru traffic

Phase Estimate	(2021 Dollars)
Design:	$30,000
Right-of-Way:	$110,000
Utilities:	$490,000
Construction:	$220,000
Total Cost:	**$850,000**

IDENTIFIED NEEDS:

2020 Traffic:	4,100 vpd with 12% trucks, operating at LOS D or 0.18 v/c
2045 Traffic:	5,300 vpd with 12% trucks, operating at LOS D or 0.22 v/c
2015-2019 Crashes:	4 crashes; all PDO single vehicle crashes; Garrard County segment has 1.3 CCRF
Existing Geometry:	Two-way stop-controlled; KY 52 has two 10 ft lanes with 1 ft paved shoulders; crest curve to east limits visibility
Other	One public comment at intersection

POTENTIAL ENVIRONMENTAL RED FLAGS: Farmlands, bat habitat

PROJECT LOCATION: (Not to Scale; images are for illustrative purposes only.)

High Crash Segments | High Crash Spots | Fatal | Injury | PDO | Angle | Rear End | Left Turn | Single Vehicle | Sideswipe | Head On

G	Garrard County	KY 52 TWLTL Precision Court to Lynwood Drive
Long Term		KY 52 MP 4.153-4.541

IMPROVEMENT DESCRIPTION:

Construct two-way left-turn lane (TWLTL) from Precision Court to Lynwood Drive

Phase Estimate	(2021 dollars)
Design:	$100,000
Right-of-Way:	$30,000
Utilities:	$440,000
Construction:	$950,000
Total Cost:	**$1,500,000**

IDENTIFIED NEEDS:

2020 Traffic:	4,100 vpd with 12% trucks, operating at LOS D or 0.18 v/c
2045 Traffic:	5,300 vpd with 12% trucks, operating at LOS D or 0.22 v/c
2015-2019 Crashes:	Beyond study limits; 1.1 CCRF spot at KY 1150 intersection
Existing Geometry:	Transition from rural setting into Lancaster with denser access points; KY 52 carries two 10 ft lanes with 0-1 ft paved shoulders
Other	35-55 mph speed limit

POTENTIAL ENVIRONMENTAL RED FLAGS: Yards/driveways, bat habitat, adjacent to possible historic resources

PROJECT LOCATION: (Not to Scale; images are for illustrative purposes only.)

High Crash Segments | High Crash Spots | Fatal | Injury | PDO | Angle | Rear End | Left Turn | Single Vehicle | Sideswipe | Head On

H	Boyle County	KY 52 west of Pope Road
Short Term		KY 52 Approx. MP 2.0 to 2.4

IMPROVEMENT DESCRIPTION:

Realign curves, widen pavement to 26 feet for rumble strips, and relocate utility pole

Phase Estimate	(2021 Dollars)
Design:	$30,000
Right-of-Way:	$4,000
Utilities:	$190,000
Construction:	$300,000
Total Cost:	**$520,000**

IDENTIFIED NEEDS:

2020 Traffic:	4,100 vpd with 12% trucks, operating at LOS D or 0.19 v/c
2045 Traffic:	5,300 vpd with 12% trucks, operating at LOS D or 0.24 v/c
2015-2019 Crashes:	22 crashes with 0 fatal and 7 injury; 73% single vehicle crashes; 1.4 CCRF spot
Existing Geometry:	KY 52 has two 10 ft lanes with 1 ft paved shoulders
Other	Common concern for local officials, six public comments

POTENTIAL ENVIRONMENTAL RED FLAGS: Bat habitat

PROJECT LOCATION: (Not to Scale; images are for illustrative purposes only.)

High Crash Segments | High Crash Spots | Fatal | Injury | PDO | Angle | Rear End | Left Turn | Single Vehicle | Sideswipe | Head On

While the project team decided not to prioritize individual concepts, **Table 13** and **Table 14** provide a side-by-side comparison of the short-term and long-term concepts, respectively.

Table 13: Comparison of Short-Term Concepts

Concept	Cost	2023 HSIP	Crashes	Input	Potential Environmental
B. KY 52/US 150	$90k	No	19 (4 injury) 1.8 CCRF	3 comments	Within ROW
C. KY 52/KY 1805	$80k- $490k	Overlaps	7 (2 injury) 1.3 CCRF LOSS 3	6 comments	Bat habitat, Historic farm
D. KY 52/KY 590	$810k	Overlaps	3 crashes	4 comments	Karst pond
F. KY 52/Boones Creek Road	$850k	Overlaps	4 crashes	1 comment	Bat habitat, Farmlands
H. Pope Road Curves	$500k	Overlaps	22 (7 injury) 1.4 CCRF LOSS 3	LO/S concern, 6 public comments	Bat habitat

Table 14: Comparison of Long-Term Concepts

Concept	Cost	Benefit-Cost	2023 HSIP	Crashes	Input	Potential Environmental
A. Widen Corridor	$19M	1.54	Overlaps	166 crashes 3 Fatal + 42 Inj. High CCRFs 5.0 mi LOSS 3/4	2 of top 3 needs; highest of all spots	Bat habitat, Historic fences, Farmlands, Driveways, Karst, Gas lines
E. Realign North	$20M	1.44	No	N/A	Moderate	Bat habitat, Farmlands, Driveways, Karst, Gas lines
E. Realign South	$24M	1.23	No	N/A	Moderate	
E. Realign Existing	$10M	2.81	Overlaps	81 (27 inj.) High CCRFs 1.3 mi LOSS 3	Lowest of E's	
G. KY 52 at KY 1150	$1.4M	1.20	No	11 crashes 1.1-1.2 CCRF LOSS 3	Moderate	Bat habitat, possible Historic, Driveways

** excludes HSIP widening at Garrard County MP 0.1-1.7*

9.0 NEXT STEPS

Short-Term. Recommended short-term projects within existing right-of-way (e.g., Concept B or signage options with Concept C or F) may be initiated through the district's routine maintenance and traffic programs or become part of systematic specialty programs such as HSIP.

Long-Term. For recommended larger concepts, individual projects should be added to KYTC's CHAF database to be considered alongside other projects in the next SHIFT prioritization cycle. Once funding is identified, the next phase in the project development process is Phase I Design (Preliminary Engineering), likely including environmental analyses to be eligible for federal funding. Likewise, KYTC's STIP should be amended to reflect any future project development phases.

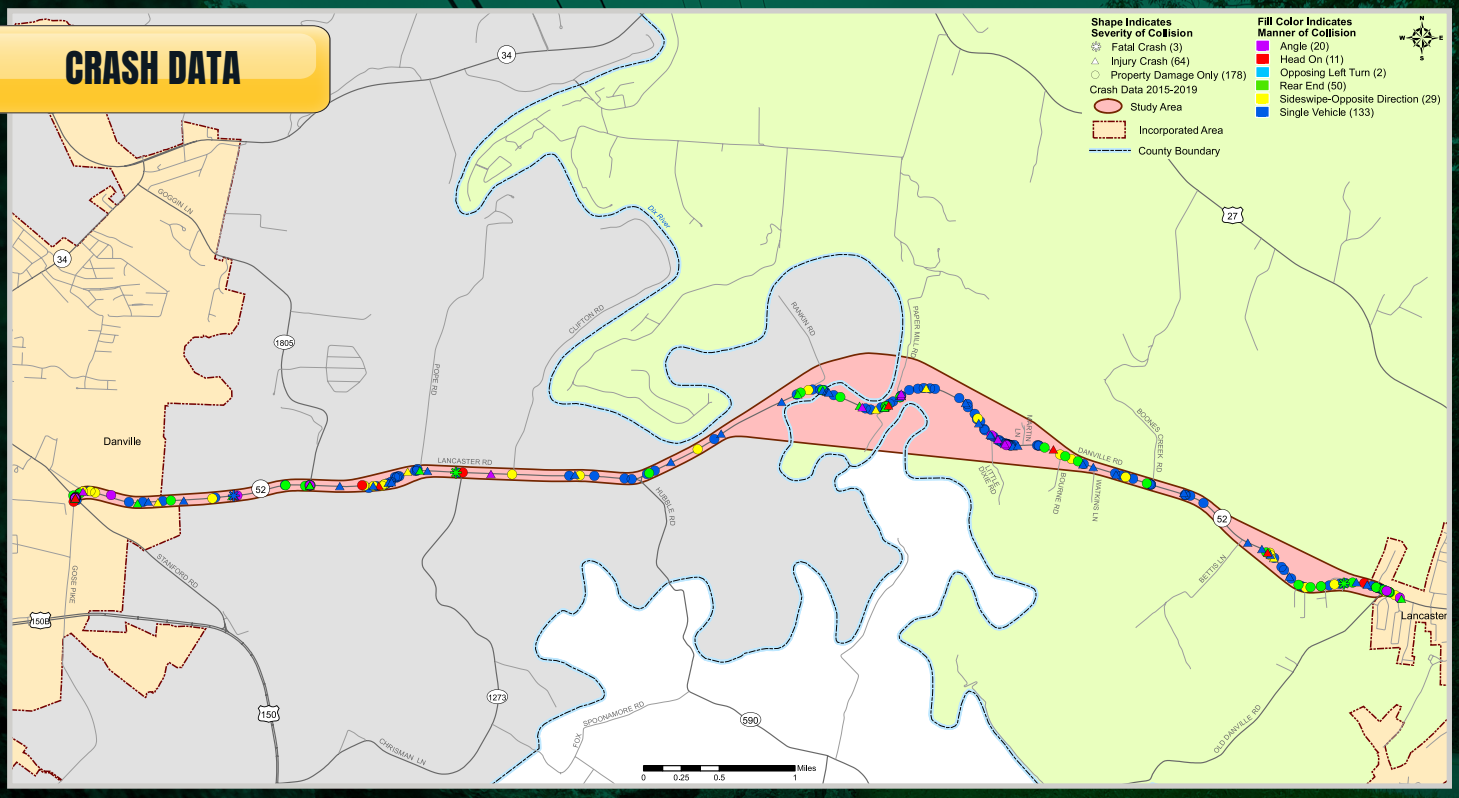
Further funding will be necessary to advance any improvement concept to the design phase. Coordination with local officials, key stakeholders, and the public will be critical considering the potential for impacts to nearby community resources, particularly for larger scale concepts like A and E.

10.0 ADDITIONAL INFORMATION

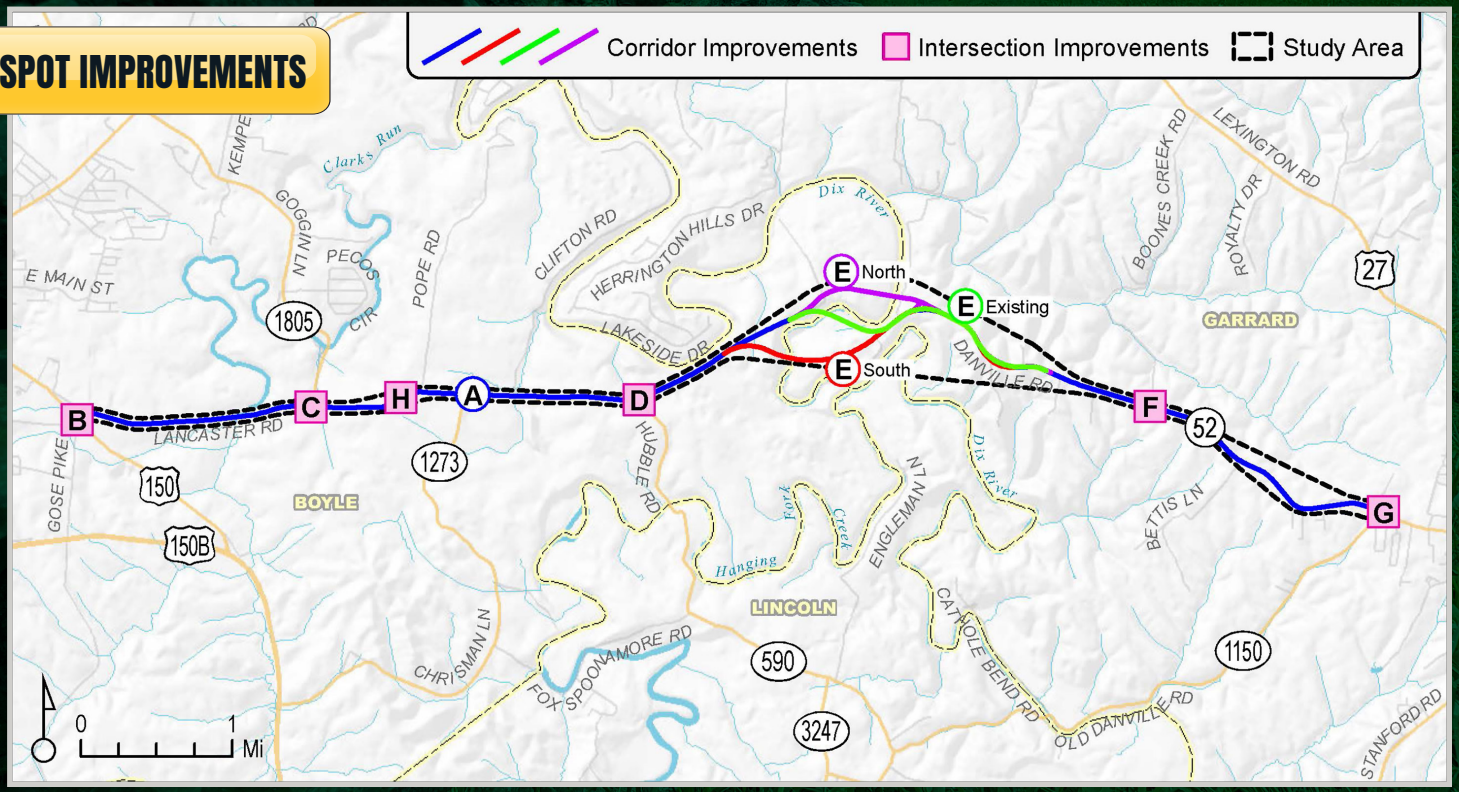
Written requests for additional information should be sent to:

KYTC Division of Planning
ATTN: Director
200 Mero Street, 4th Floor West
Frankfort, KY 40622
Phone: 502.564.7183

CRASH DATA



SPOT IMPROVEMENTS



Engineering Planning

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