KY 151 Corridor Scoping Study

Anderson and Franklin Counties

Item No. 5-806.00 March 2022

Final Report

Introduction

The *KY 151 Corridor Scoping Study* (KYTC Item No. 5-806) was initiated by the Kentucky Transportation Cabinet (KYTC) to examine the need for and evaluate improvement concepts along the KY 151 corridor from US 127 in Anderson County (MP 0.000) to the Franklin County line (MP 4.587) and from the Anderson County line (MP 0.000) to I-64 in Franklin County (MP 2.141). The study area is shown in red in **Figure ES-1**.

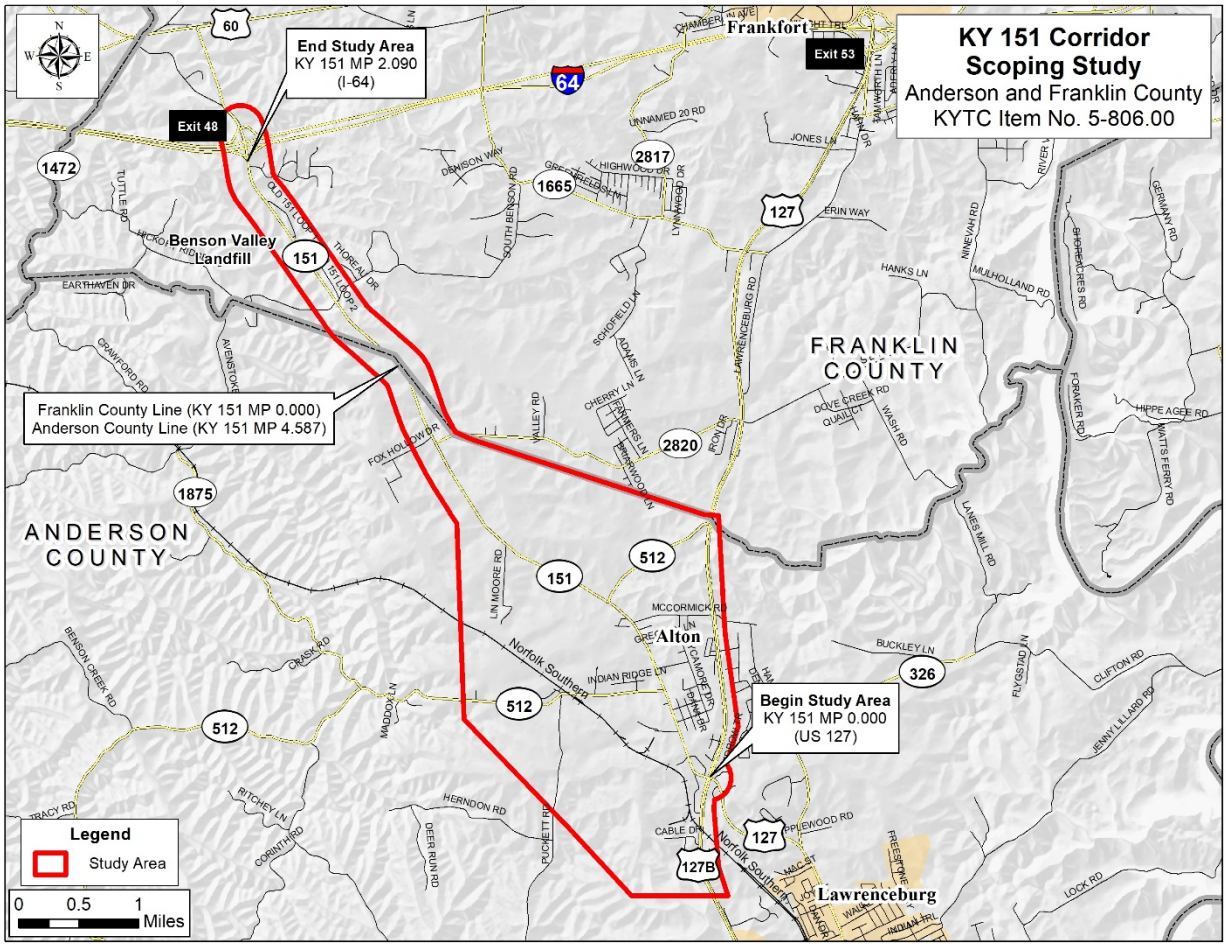


Figure ES-1: Study Area

KY 151 provides a direct connection between I-64 (Exit 48) and Lawrenceburg, and indirectly connects to the Bluegrass Parkway via US 127 through and south of Lawrenceburg. However, the US 127 corridor is a parallel route which was reconstructed in the early 1990's to provide an improved alternative and to serve as the primary truck route between Lawrenceburg and I-64. As US 127 has four lanes with wide shoulders and is more compatible with higher traffic volumes and large truck operation, it is listed on the NN and negates the need for the parallel KY 151 to be listed.

Project Needs

In the southern portion of the study area near the US 127 intersection, KY 151 serves a mix of residential, commercial, and industrial traffic. Traveling north, the land surrounding KY 151 is mostly residential through the community of Alton, where houses and businesses line both sides of the roadway. North of Alton, KY 151 serves mostly farmland and associated residences until it nears the I-64 interchange. Just south of I-64, KY 151 serves a regional landfill, Huntington Woods neighborhood, a service station, and a liquor store.

Lane widths along the KY 151 corridor range between 11 and 12 feet with paved shoulder widths varying between 1.5 and 10 feet. The speed limit ranges from 35 miles per hour (mph) at the south end to 55 mph along the majority of the corridor. Somewhat inconsistent typical sections (particularly the shoulder widths) create undesirable 'transition zones' where drivers tend to travel too fast for the roadway geometrics. For example, a driver may travel southbound at a higher rate of speed where the wide lanes and shoulders are provided in Franklin County and may not slow down before reaching the narrower lane and shoulder widths to the south in Anderson County which may be a contributing factor for the higher-than-expected percentage of injury collisions (22 percent).

Based on the existing and future conditions analyses, the goal of the *KY 151 Corridor Scoping Study* is to enhance regional mobility and to provide a safer north-south corridor between US 127 and I-64. An evaluation of existing and future year traffic demand on KY 151 indicates a two-lane road provides adequate capacity. However, there is one intersection (KY 151 / US 127) with less than desirable traffic operations, a second intersection (KY 151 / Alton Station Road) where turn lanes are warranted, and other "spot" locations along the corridor with higher-than-expected crash frequencies.

Development of Improvement Concepts

Over the course of the study, the Project Team worked to identify and evaluate concepts to improve safety and enhance mobility. A range of improvement concepts were developed based on the existing conditions analysis and input from the project team. Along with the No-Build, this study examined spot improvements, minor widening, and a partial new route around the community of Alton.

As the right-of-way is constricted with homes immdediately adjacent to the route through and surrounding the community of Alton, opportunities for improvement to the existing roadway are limited. A new route to the south would allow through traffic to bypass Alton, but the estimated 2021 construction cost for this concept is $9.3 million. Due to the relatively high cost of the new route, the project team eliminated this concept from further consideration.

The minor widening concept involves widening lanes and shoulders, as needed, along the entire study portion of KY 151. Several typical sections were considered including a full build with 12-foot lanes and 10-foot shoulders, a performance-based flexible solution (PBFS) which includes a minimum of 11-foot lanes and eight-foot shoulders (four-foot paved), and a Highway Safety Improvement Program (HSIP) alternative which includes minimum 11-foot lanes and four-foot paved shoulders. A Benefit-to-cost (B/C) analysis was performed to evalaute these concepts, and the resulting Beneft-Cost ratios (BCR) were well below 1.0 for all three concepts, suggesting the costs for such improvements would far outweigh the potential benefits. Therefore, the project team determined that minor widening is not recommended at this time.

Conceptual spot improvements were identified based on the traffic and crash analsyses and can be implemented individually. Six locations were identified as spot improvement concepts, shown in **Figure ES-2**. The spot improvement concepts are all located at areas along the study portion of KY 151 with safety concerns or where traffic warrants the addition of turn lanes. Detailed Project Sheets are also included for all six candidate spot improvements at the end of the Executive Summary.

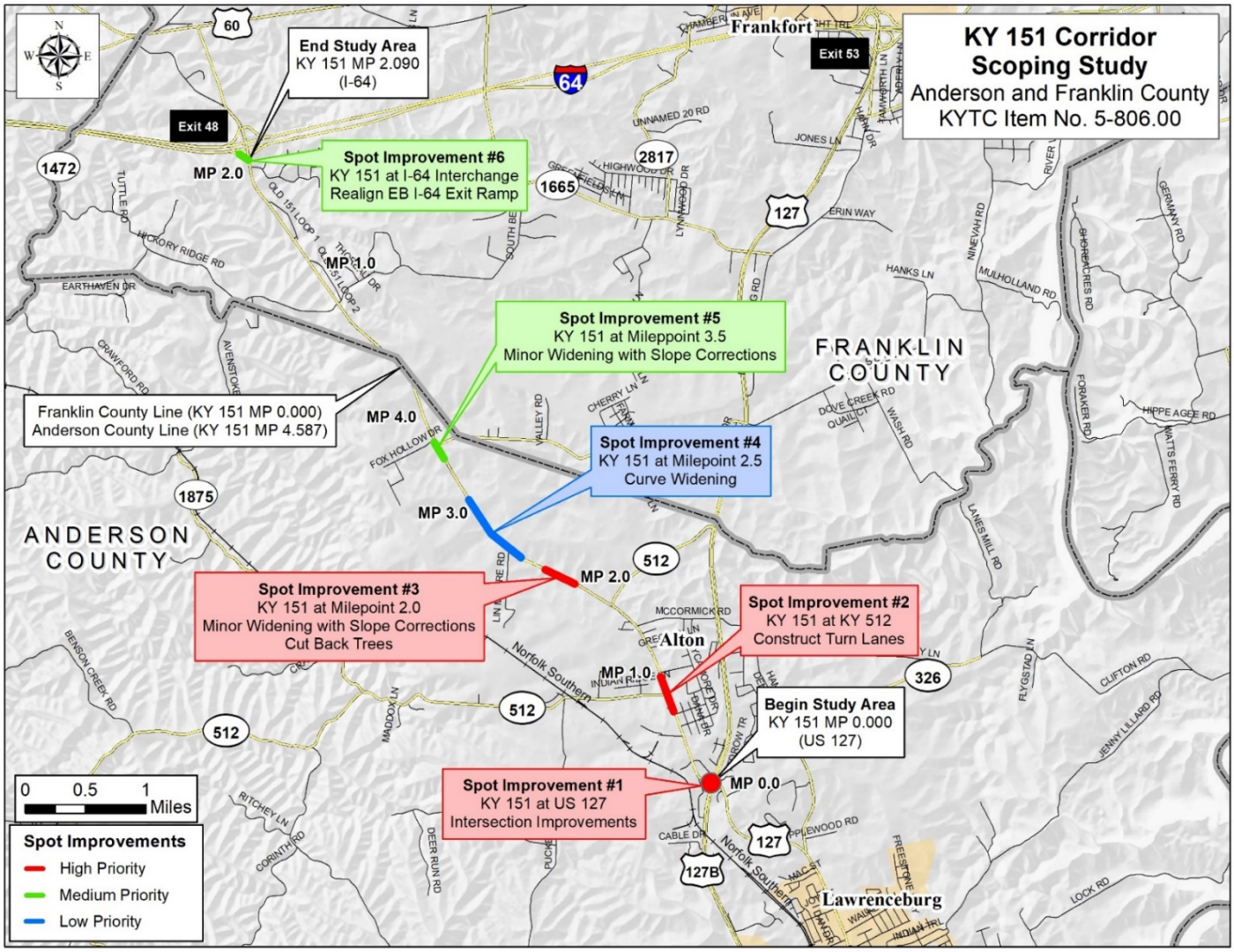


Figure ES-2: Spot Improvements

Recommendations

Prioritization for the study was based on how well each concept satisfied the study goals, findings from the existing conditions analyses, project team input, and the B/C analysis. As traffic congestion and travel times are not a significant issue affecting the corridor, the B/C analysis focused on estimating benefits related to crash reduction. The evaluation matrix in **Table ES-1** provides a description of the improvement(s), the construction cost estimate, 10-year crash reduction savings, BCR, and the project team recommended prioritization. The improvement concepts were categorized as high, medium, low, or "not recommended".

High Priority (in no particular order)

- Spot Improvement 1: This is a high crash location with the critical crash rate factor (CRF) equal to 3.93 and the benefits of the improvements outweigh the costs.
- Spot Improvement 2: Based on KYTC'S Highway Design Manual, KY 151 satisfies the warrants for a left-turn lane and a right-turn lane at Alton Station Road (KY 512).
- Spot Improvement 3: Narrow shoulders and steep slopes with reduced clear zone may be a factor in a number of roadway departure crashes resulting in injuries. The benefits of the improvements outweigh the costs.

Medium Priority (in no particular order)

- Spot Improvement 5: This is a high crash location (CRF = 1.23) with narrow shoulders and steep side slopes. These unstable steep slopes may be a contributing factor to roadway departure crashes and have also contributed to ongoing pavement deterioration that requires regular maintenance projects to maintain a smooth driving surface.
- Spot Improvement 6: This is a high crash location (CRF = 2.61). Realigning the right-turn lane at the eastbound I-64 exit ramp would remove the weaving segment on KY 151 and reduce crashes.

Low Priority (in no particular order)

- Spot Improvement 4: There are two horizontal curves near Lin Moore Road that show potential for minor off-tracking for STAA vehicles. In 2016 STAA vehicles were prohibited from using KY 151 as a through route, making the need for this concept a low priority so long as the ban on through trucks remains in place.

Not Recommended at This Time

- Widening lanes and shoulders, as needed, along the entire study portion of KY 151: The costs for such improvements would far outweigh the potential benefits.
- A new route to the south of KY 151 to allow through traffic to bypass Alton: Not recommended due to the relatively high cost.

Table ES-1: Prioritized Improvement Concepts

Improvement Concept	Project Length (miles)	Improvement Options	2021 Construction Cost Estimate	10-YR Crash Savings	B/C Ratio	Priority
No Build	6.7	No Build	N/A	N/A	N/A	N/A
Spot 1	0.3	Reduce Right-Turn Radius	$130,000	$274,000	2.11	High
		Optimize Signal Timing				
		Install Curve/Speed Warning Sign				
		Convert Village Circle Entrance to a Right-In, Right-Out				
Spot 2	0.3	Construct Left-Turn Lane and Right-Turn Lane on KY 151	$400,000	$236,000	0.52	High
Spot 3	0.3	Cut Trees Away from Roadway	$300,000	$325,000	1.59	High
		Minor Widening and Improve Clear Zone				
		Install Flashing Speed Warning Sign				
Spot 4	0.6	Minor Curve Widening through Two Curves	$300,000	$9,000	0.03	Low
Spot 5	0.3	Minor Widening and Improve Clear Zone	$400,000	$88,000	0.88	Medium
Spot 6	0.3	Realign Channelized Right-Turn Lane	$200,000	$162,000	0.81	Medium
Minor Widening	6.7	Widen Shoulders for Entire Study Area	$5,100,000	$1,086,000	0.21	Not Recommended
New Route	1.6	Construct New Road Around Alton	$16,900,000	N/A	N/A	Not Recommended

As previously discussed, the minor widening and new route improvement concepts are not recommended at this time. The project team determined the spot improvement concepts meet the study goals and together will enhance regional mobility and provide a safer north-south corridor between US 127 and I-64.

Next Steps

The next phase for any of the recommended improvement concepts would be Phase 1 Design (Preliminary Engineering and Environmental Analysis). Further funding will be necessary to advance to the design phase. Future phases are listed with state funding in Kentucky's FY 2020 – FY 2026 Highway Plan. However, a new project estimate and scope would need to be created based on the findings of this study.

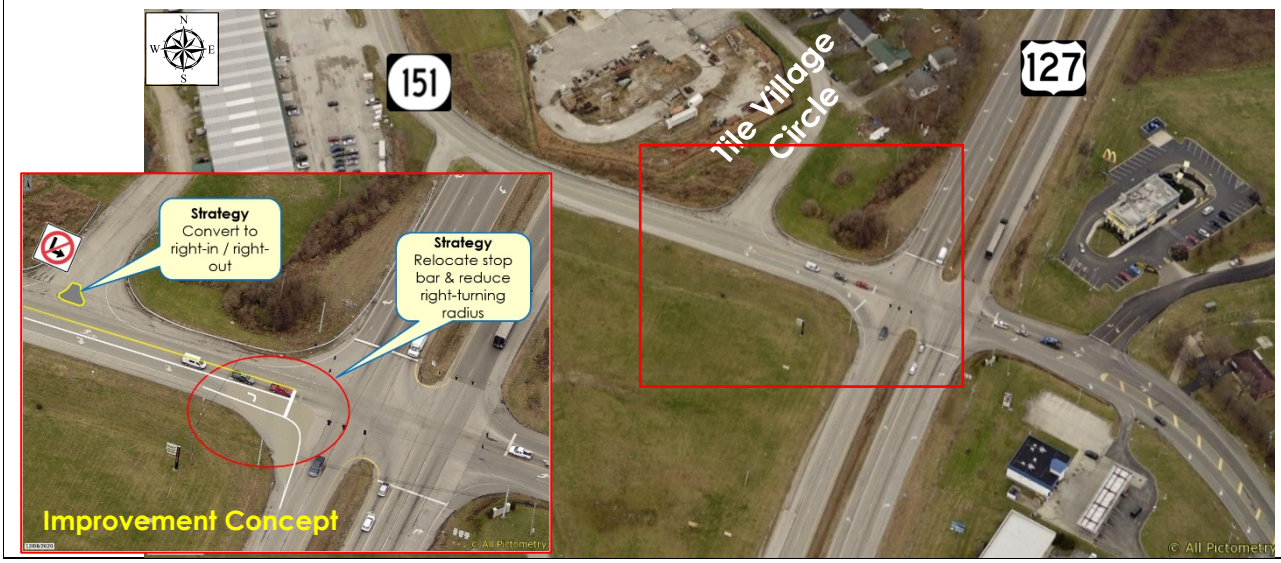
Contacts

Written requests for additional information should be sent to Mikael Pelfrey, Director KYTC Division of Planning, 200 Mero Street, Frankfort, KY 40622. Additional information regarding this study can also be obtained from the KYTC District 7 Project Manager, Casey Smith, at (859) 246-2355 (email at Casey.Smith@ky.gov).

1	**LOCATION** KY 151 intersection with US 127 Anderson County KY 151 MP 0.00 to MP 0.30	**BENEFIT-COST RATIO** 2.11	**PROJECT PRIORITY** High
DESCRIPTION Reduce the eastbound KY 151 right-turn radius, optimize signal timing by allowing right-turn overlaps on both KY 151 approaches, install a 35-MPH curve warning sign, and convert Tile Village Circle to a right-in / right-out.		**2021 COST ESTIMATES BY PHASE**	Design: $40,000 ROW: $0 Utilities: $0 Construction: $130,000 **Total: $170,000**

The KY 151 intersection with US 127 is located near a mix of commercial, industrial, and residential areas, making it one of the more congested intersections in the area. Analysis of the existing traffic volumes indicate the westbound approach operates at LOS E during the p.m. peak hour with all other approaches operating at LOS D. By 2040, this approach is expected to operate at LOS F during the p.m. with all other approaches operating at LOS E. An option to improve traffic operations is to optimize the signal timing by allowing eastbound and westbound right-turn overlaps, providing eastbound and westbound KY 151 right-turns a green arrow during the northbound and southbound US 127 left-turn phases. This modification would improve future LOS for all approaches to no worse than LOS D.

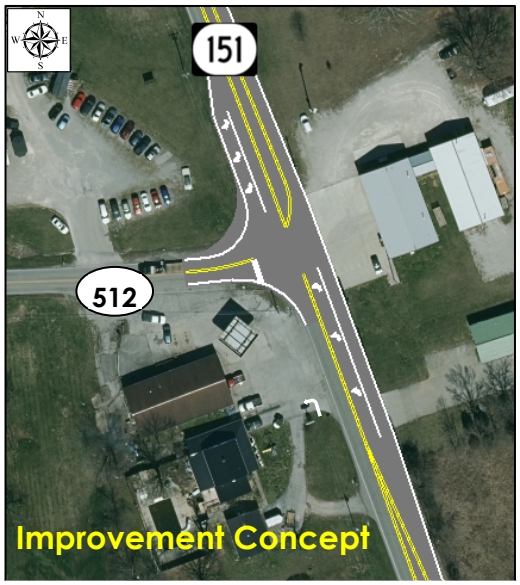
In addition to the congestion issues, the eastbound KY 151 approach is also a high crash location (CRF = 3.93), with 52 crashes occurring between 2015 and 2019. Of these crashes, 25 involved vehicles turning right onto southbound US 127. Reducing the right-turn radius would improve safety (Crash Modification Factor, CMF ID 8428 = 0.56) by encouraging vehicles to come to a complete stop before turning right. Another safety improvement is to convert the eastern Tile Village Circle entrance to a right-in / right-out. Turning left into or out of this entrance is a safety concern as this approach is located less than 150 feet from the US 127 intersection. Full access to Tile Village Circle is available at the entrance to the north. Another safety improvement includes installing a 35-MPH warning sign before the horizontal curve west of Fortune Circle. Since KY 151 consistently has 45- to 55-MPH speed limits, this sign will remind drivers to reduce speeds before the curve. The crash reduction benefits of these improvements outweigh the costs (BCR = 2.11).



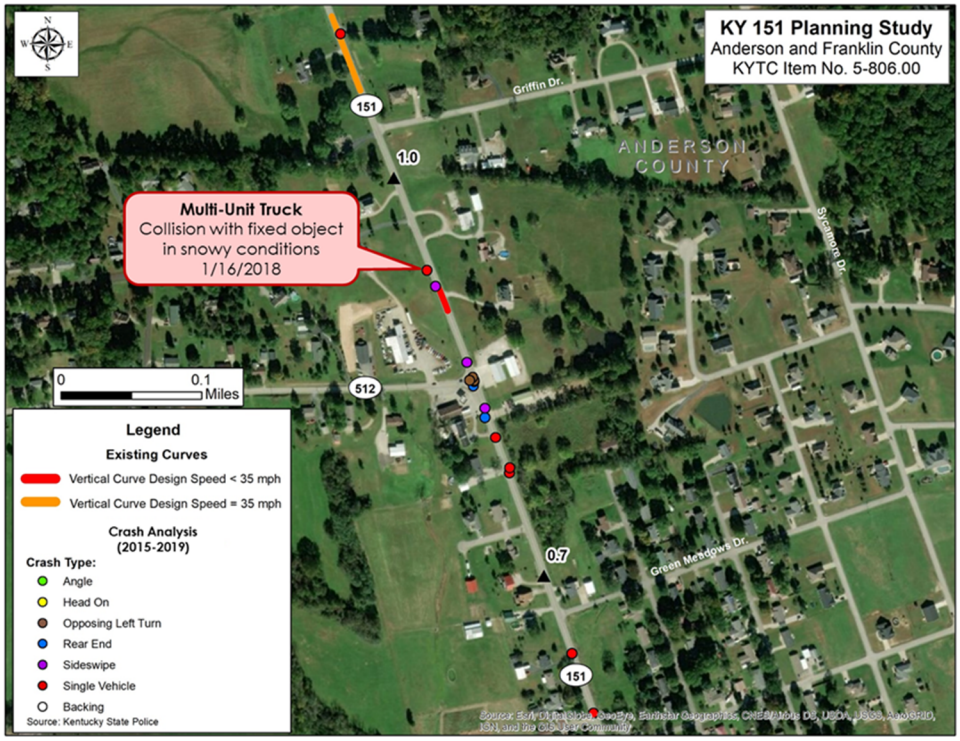
2	**LOCATION** KY 151 at Alton Station Road (KY 512) Anderson County KY 151 MP 0.813 to MP 1.113	**BENEFIT-COST RATIO** 0.52	**PROJECT PRIORITY** High

DESCRIPTION	**2021 COST ESTIMATES BY PHASE**	
Construct a left-turn lane from northbound KY 151 onto KY 512 and a right-turn lane on southbound KY 151 onto KY 512.		Design: $60,000 ROW: $46,000 Utilities: $75,000 Construction: $400,000 **Total: $581,000**

The KY 151 intersection with Alton Station Road (KY 512) is located between the commercial / industrial areas near the US 127 intersection and the residential area near Alton. There are several neighborhoods on Alton Station Road, including a new development with more than 50 houses. Traffic counts show more than 165 vehicles currently turn left and 110 vehicles turn right onto Alton Station Road from KY 151 during the PM peak hour. Based on KYTC'S Highway Design Manual, this satisfies the warrants for a left-turn lane and a right-turn lane on KY 151.



The proposed improvement concept at this location is to construct a left-turn lane on northbound KY 151 and a right-turn lane on southbound KY 151 onto Alton Station Road. This will improve traffic operations at the intersection and will support continued traffic growth on Alton Station Road. Additionally, it will improve safety (CMF ID 7852 = 0.73) by removing turning vehicles from mainline KY 151 and allowing through traffic to continue on rather than stopping behind a turning vehicle.

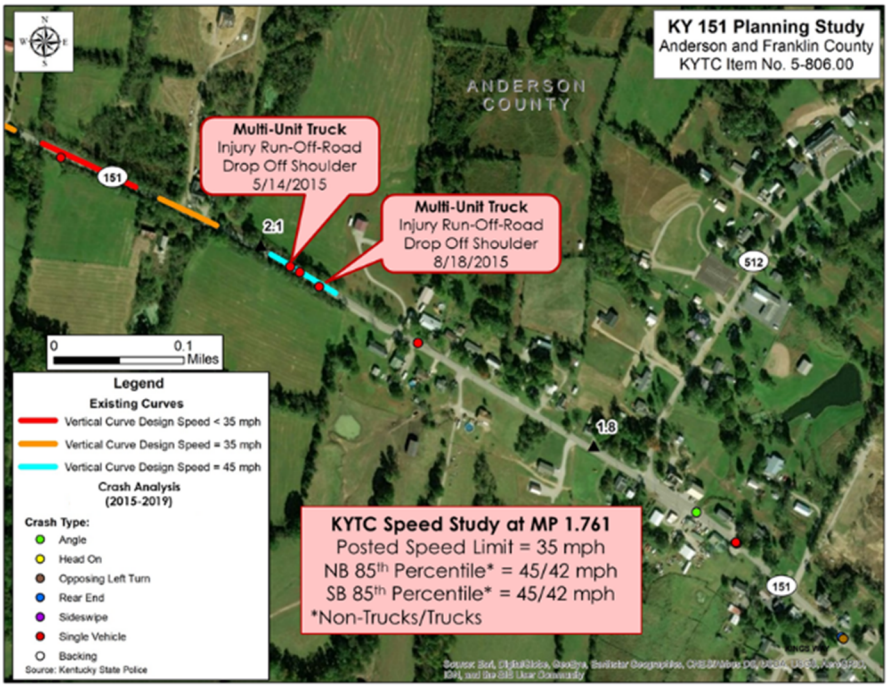


3	**LOCATION** KY 151 north of Old Frankfort Rd (KY 512) Anderson County KY 151 MP 2.0 to MP 2.2	**BENEFIT-COST RATIO** 1.59	**PROJECT PRIORITY** High

DESCRIPTION	**2021 COST ESTIMATES BY PHASE**	
Cut tree canopy and vegetation away from roadway to improve speed reduction sign visibility and improve the clear zone by stabilizing the slopes and widening the paved and unpaved shoulders.		Design: $50,000 ROW: $0 Utilities: $0 Construction: $300,000 **Total: $350,000**

Through most of Anderson County, KY 151 has 11-foot lanes and 1.5-foot shoulders with rumble stripes. North of Old Frankfort Road (KY 512) and Alton, these narrow shoulders quickly transition into steeper slopes with reduced clear zone. Without adequate clear zone, vehicles that drop off the pavement are unable to recover safely back onto the roadway. An option to improve safety is to stabilize the slopes and widen the paved and unpaved shoulders to reduce the likelihood of run off the road collisions and to provide improved clear zone. It is assumed this minor widening could occur completely within the existing right-of-way.

In addition to the clear zone concerns, the area near Alton was found to have high speeds. A 2016 KYTC Safety Study showed that while the posted speed limit in Alton is 35 MPH, the 85th percentile speeds are near 45 MPH. An option to reduce speeding is to cut back the overgrown trees north of KY 512 and improve the visibility of the reduced speed warning signs. An additional improvement option is to install a solar, flashing speed warning sign to alert drivers of the change in speed limit. The crash reduction benefits of these improvements outweigh the costs (BCR = 1.59).



4	**LOCATION** KY 151 at Lin Moore Road Anderson County KY 151 MP 2.5 to MP 2.7 and MP 2.85 to MP 3.05	**BENEFIT-COST RATIO** 0.03	**PROJECT PRIORITY** Low
DESCRIPTION Widen paved shoulders through the two horizontal curves.		**2021 COST ESTIMATES BY PHASE**	Design: $50,000 ROW: $0 Utilities: $0 Construction: $300,000 **Total: $350,000**

Based on a 2016 KYTC Safety Study, KY 151 has two horizontal curves near Lin Moore Road that show minor off-tracking for STAA vehicles. This means that larger trucks may encroach into the adjacent oncoming lane to avoid dropping off the edge of the pavement while traveling around the curves. In the past five years, there were four single vehicle collisions along these curves, one of which was a roadway departure crash involving a multi-unit truck under wet pavement conditions. In 2016 STAA vehicles were temporarily prohibited from using KY 151 as a through route.

An improvement concept at this location is to construct a minor pavement widening focusing on wider shoulders through the two horizontal curves to satisfy current geometric design guidelines. Providing a slightly wider pavement section would accommodate larger vehicles and reduce the potential for roadway departure, head on, and sideswipe collisions to occur. It is assumed this minor widening could occur completely within the existing right-of-way.

5	**LOCATION** KY 151 south of Green Wilson Rd (KY 2820) Anderson County KY 151 MP 3.40 to MP 3.80	**BENEFIT-COST RATIO** 0.88	**PROJECT PRIORITY** Medium

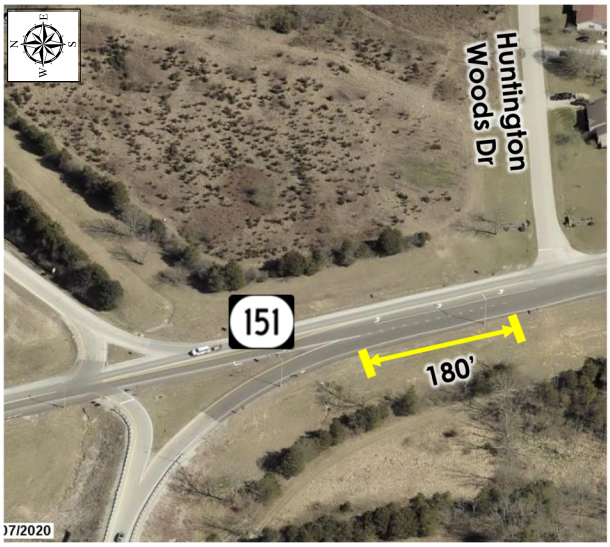
DESCRIPTION	**2021 COST ESTIMATES BY PHASE**	
Improve the clear zone by stabilizing the slopes and widening the paved and unpaved shoulders.		Design: $60,000 ROW: $35,000 Utilities: $10,000 Construction: $400,000 **Total: $505,000**

Just south of Green Wilson Road (KY 2820), northbound KY 151 has narrow shoulders that lead directly into steep side slopes. These unstable, steep slopes may be a contributing factor to roadway departure crashes and have certainly contributed to ongoing pavement deterioration that requires regular maintenance projects to maintain a smooth driving surface. This is a high crash location (CRF = 1.23), with five single vehicle crashes and one head on crash involving a semi-trailer between 2015 and 2019. An option to improve safety is to extend the slope and widen the paved shoulder on northbound KY 151. This would reduce the number of run off the road collisions while also reducing recurring maintenance needs.

Southbound KY 151 also has narrow paved shoulders and a limited unpaved clear zone, with only a small section of trees separating the traveled way from a private pond. Because of the proximity of the pond on the west side, run off the road collisions at this location have the potential to be severe. While the pond complicates a typical slope extension, installing channel lining / riprap, or a gabion wall along the pond's east bank would help stabilize the slope and allow for minor shoulder widening and guardrail installation.

6	**LOCATION** KY 151 south of the I-64 interchange Franklin County KY 151 MP 1.9 to MP 2.05	**BENEFIT-COST RATIO** 0.81	**PROJECT PRIORITY** Medium
DESCRIPTION Realign the right-turn lane at the eastbound I-64 exit ramp.		**2021 COST ESTIMATES BY PHASE**	Design: $50,000 ROW: $0 Utilities: $0 Construction: $200,000 **Total: $250,000**

The eastbound I-64 exit ramp (Exit 48) splits into two lanes, providing a stop-controlled left-turn onto northbound KY 151 and a free-flow right-turn onto southbound KY 151. The receiving auxiliary lane for the free-flow right-turn on KY 151 is only 180 feet long, requiring vehicles to merge quickly. A safety analysis showed this location as a high crash location with a CRF equal to 2.61, indicating that more crashes are occurring than would be expected based on current conditions. There were eight crashes reported between 2015 and 2019.



An option to improve safety (CMF ID 8428 = 0.56) is to realign the eastbound off ramps and remove the free-flow right-turn. This would eliminate the ramp split and direct all vehicles to the stop-controlled intersection with KY 151, therefore removing the weaving segment on KY 151.

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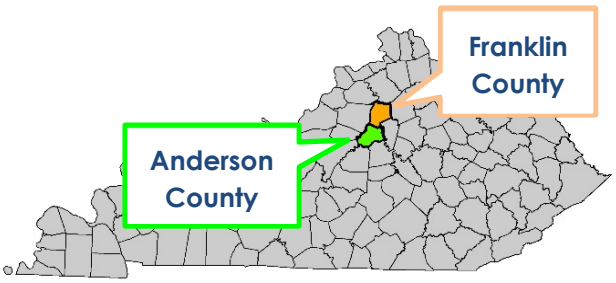
1.0 KY 151 Corridor Scoping Study

1.1 Project Description

The *KY 151 Corridor Scoping* Study was initiated by the Kentucky Transportation Cabinet (KYTC) to examine the need for and evaluate conceptual transportation improvements along the KY 151 corridor between US 127 in Anderson County and I-64 in Franklin County.

This study was performed utilizing State Highway Priority Projects (SPP) funds allocated towards planning. Future design, right-of-way, utility, and construction phases are not included in *Kentucky's FY 2020 – FY 2026 Highway Plan*.



1.2 Study Area

The study area includes KY 151 in Anderson County from US 127 (MP 0.000) to the Franklin County line (MP 4.587) and in Franklin County from the county line (MP 0.000) to I-64 (MP 2.141), as shown in **Figure 1**. KY 151 provides a direct connection between I-64 (Exit 48) and Lawrenceburg, and indirectly connects to the Bluegrass Parkway via US 127 through and south of Lawrenceburg. I-64 is a major east-west interstate highway that travels through Central Kentucky from Louisville, Kentucky to Huntington, West Virginia.

In the southern portion of the study area near the US 127 intersection, KY 151 serves a mix of residential, commercial, and industrial traffic. North of Florida Tile Road (MP 0.477), the land surrounding KY 151 is mostly residential through the community of Alton, where houses and businesses line both sides of the roadway. North of Alton, KY 151 serves mostly farmland and associated residences until it nears the I-64 interchange where it serves a landfill, Huntington Woods neighborhood, a gas station and liquor store.

2.0 Existing Conditions

Conditions of the existing transportation network are examined in the following section. The information compiled includes current roadway facilities and geometrics, traffic volumes, and crash history within the study area. Data for this section was collected from the KYTC Highway Information System (HIS) database, KYTC's Traffic Count Reporting System, aerial photography, as-built plans, and from field inspections.

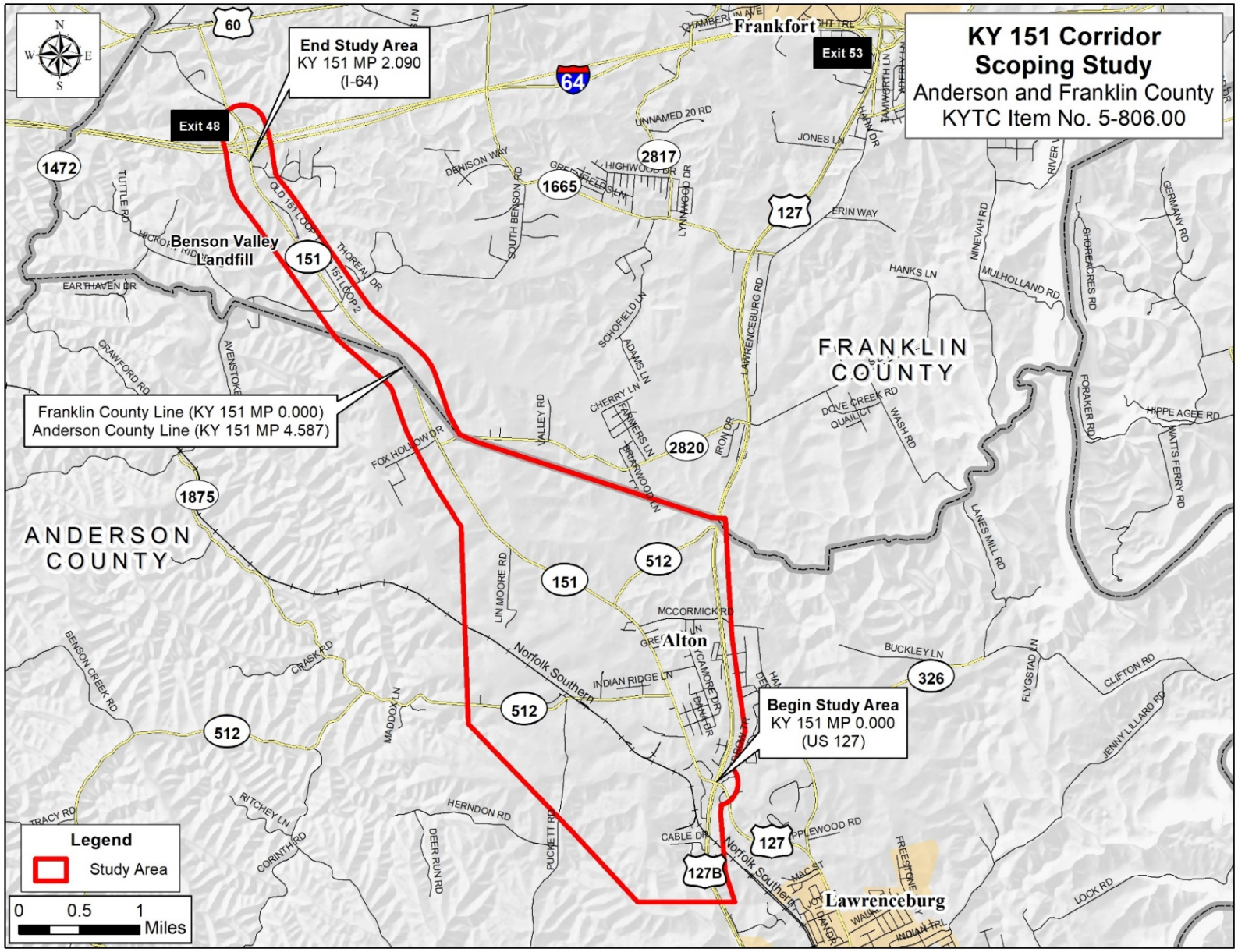


Figure 1: Study Area

2.1 Roadway System

Functional classification is the grouping of roads, streets, and highways into integrated systems ranked by the level of mobility for through movements and access to adjoining land. This grouping acknowledges that roads serve multiple functions, and it provides a basis for comparing roads. Functional classification can be used for, but is not limited to, the following purposes:

- Provide a framework for highways serving mobility and connecting regions and cities within a state.
- Provide a basis for assigning jurisdictional responsibility according to the roadway's importance.
- Provide a basis for development of minimum design standards according to function.
- Provide a basis for evaluating present and future needs.
- Provide a basis for allocation of limited financial resources.

Figure 2 shows the functional classification of roadways within the study area. Minor arterials, shown in blue, serve trips of moderate length to smaller geographic areas and provide connections between principal arterials. Collectors, shown in green, serve to connect local roads and the arterial network. KY 151 is classified as an urban minor arterial from US 127 to McCormick Road in Alton (MP 1.473) and a rural minor arterial to the north. The US 127 corridor through southern Franklin County and northern Anderson County, reconstructed in the early 1990's to provide an improved alternative north-south connection between Lawrenceburg and I-64, is classified as an urban principal arterial south of McCormick Road and a rural principal arterial to the north.

Figure 3 presents the existing typical sections for the study portion of KY 151. Lane widths range between 11 and 12 feet with paved shoulder widths varying between 1.5 and 10 feet. These inconsistent typical sections (particularly the shoulder widths) create undesirable 'transition zones' where drivers tend to travel too fast for the roadway geometrics. For example, a driver may travel southbound at a higher rate of speed where the wide lanes and shoulders are provided in Franklin County and may not slow down before reaching the narrower lane and shoulder widths to the south in Anderson County. A 2016 KYTC Safety Study showed that while the posted speed limit in Alton is 35 miles per hour (mph), the 85th percentile speeds are near 45 MPH.

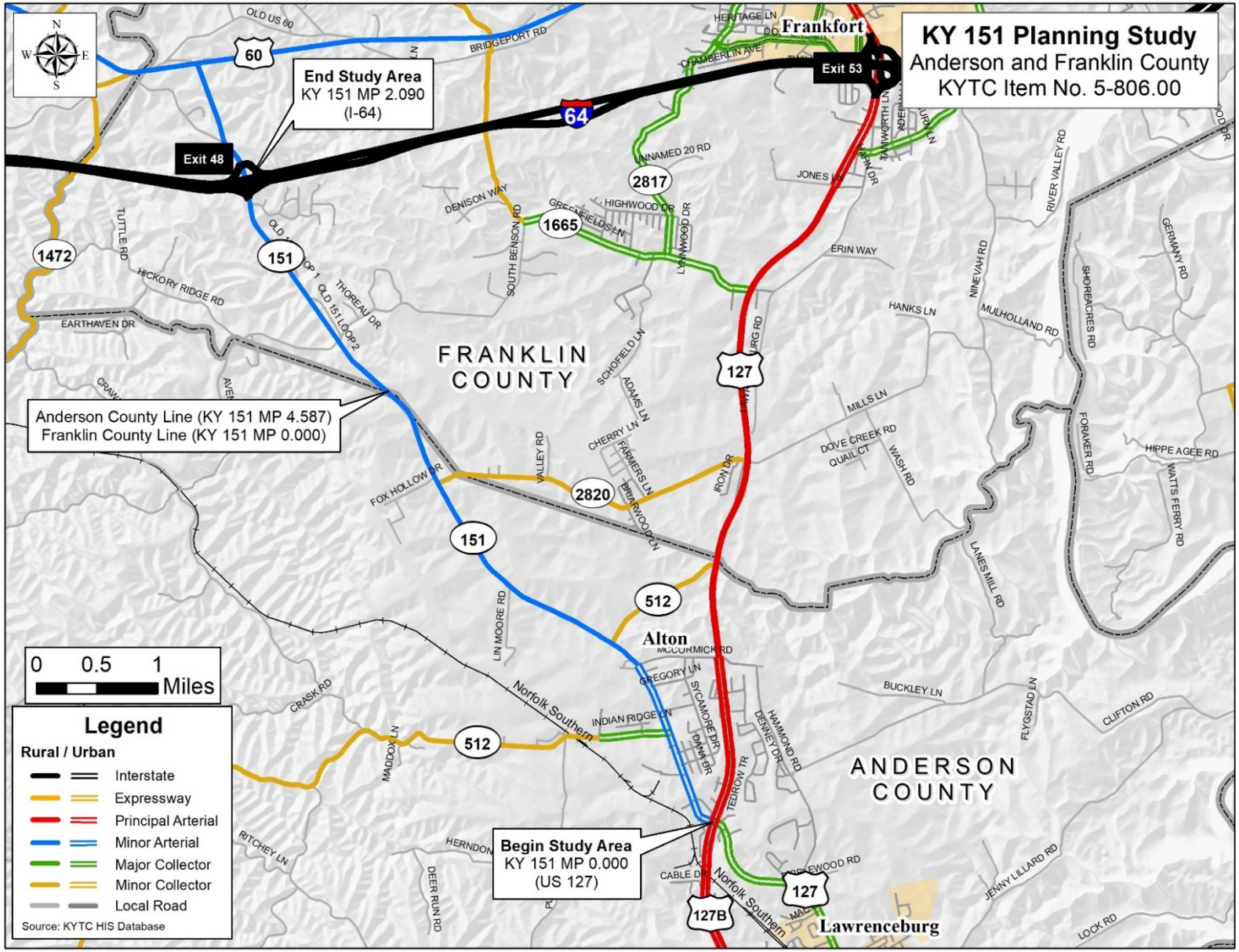


Figure 2: Functional Classification

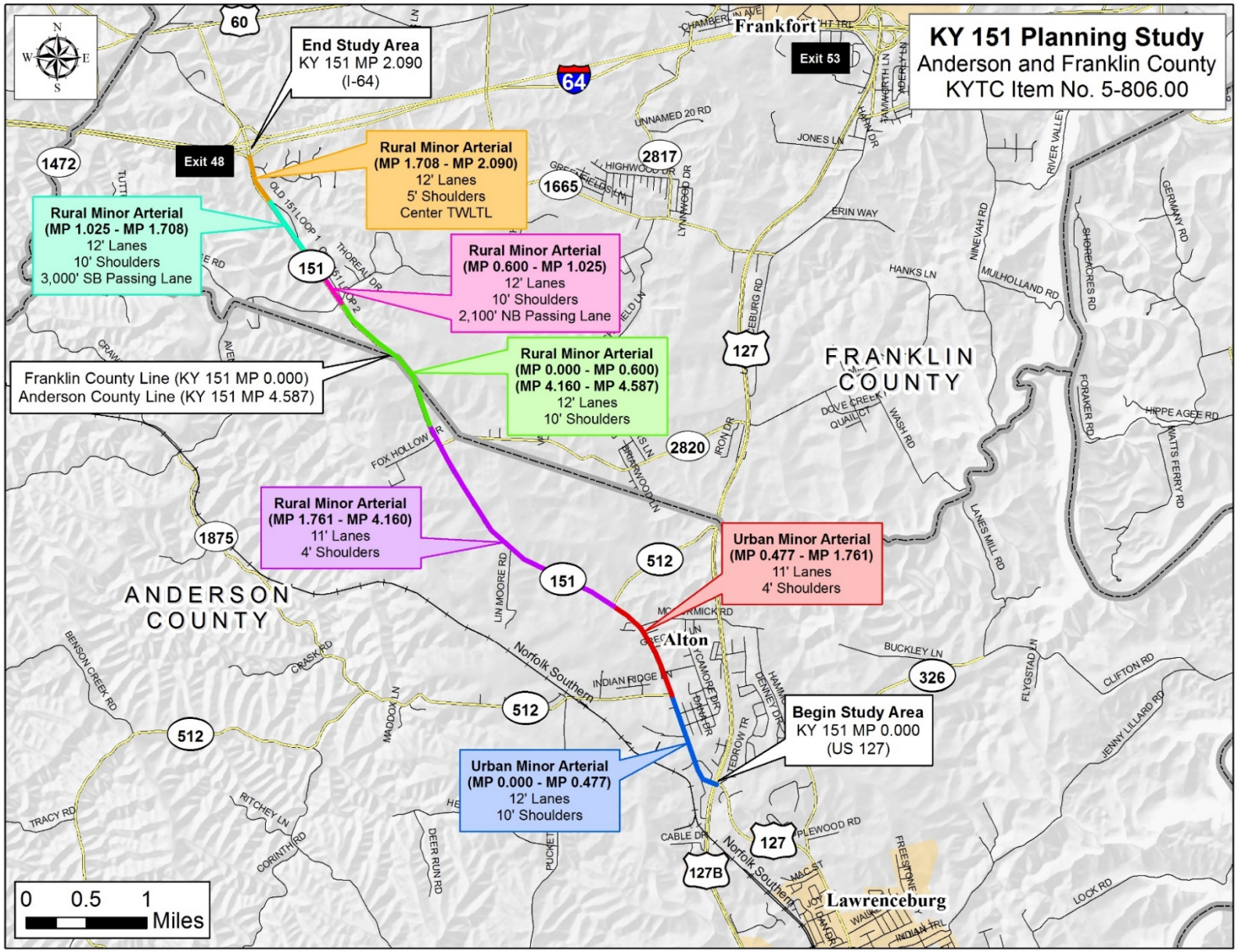


Figure 3: Typical Sections

2.2 Truck Network

The Surface Transportation Assistance Act (STAA) of 1982 authorized the establishment of a National Truck Network (NN) for oversized, or STAA, vehicles. This network includes more than 200,000 miles of interstates and other, specified non-interstate highways serving to link principal cities and densely developed areas on high volume roads utilized extensively by large vehicles for interstate commerce. The NN routes within the study area are shown on **Figure 4.** KY 151 is not listed on the NN. US 127 was reconstructed to specifically serve as the truck route to connect Lawrenceburg (and the Bluegrass Parkway to the south) to I-64 and Frankfort. As US 127 has four lanes with wide shoulders and is more compatible with higher traffic volumes and semi-trailer operation, it is listed on the NN and negates the need for the parallel KY 151 to be listed.

Sign on Northbound US 127 south of KY 151

2.3 Existing Traffic Analysis

Historical KYTC traffic volumes show an Annual Average Daily Traffic (AADT) on the study portion of KY 151 between 5,000 vehicles per day (VPD) and 8,700 VPD. The latest average daily traffic (ADT) volumes from KYTC's traffic count stations are shown on **Figure 5**. Even with a ban on STAA through trucks, the current truck percentages range from eight to 12 percent.

Existing (2017) a.m. (7:00 – 8:00) and p.m. (4:30 – 5:30) peak hour capacity analyses were performed using the Highway Capacity Software (HCS) for both intersections and mainline KY 151 within the study area. Level of service (LOS), a qualitative measure describing operational conditions, was used to evaluate the adequacy of the existing roadway. In rural areas, LOS C or better is desirable and in urban areas, LOS D or better is desirable. All study area portions of the KY 151 corridor and adjacent intersections operate at an acceptable LOS during the a.m. peak period. During the p.m. peak hour, the KY 151 corridor operates at LOS C or better. The intersection with US 127 operates at an acceptable LOS D but has one approach, westbound US 127 (i.e. the east approach to the intersection), that operates at LOS E, as shown in **Figure 6**. In addition, the intersection at KY 151 / Alton Station Road satisfies the warrants for a left-turn lane and a right-turn lane based on KYTC'S Highway Design Manual.

HCS outputs depicting peak hour traffic operations can be found in **Appendix A**.

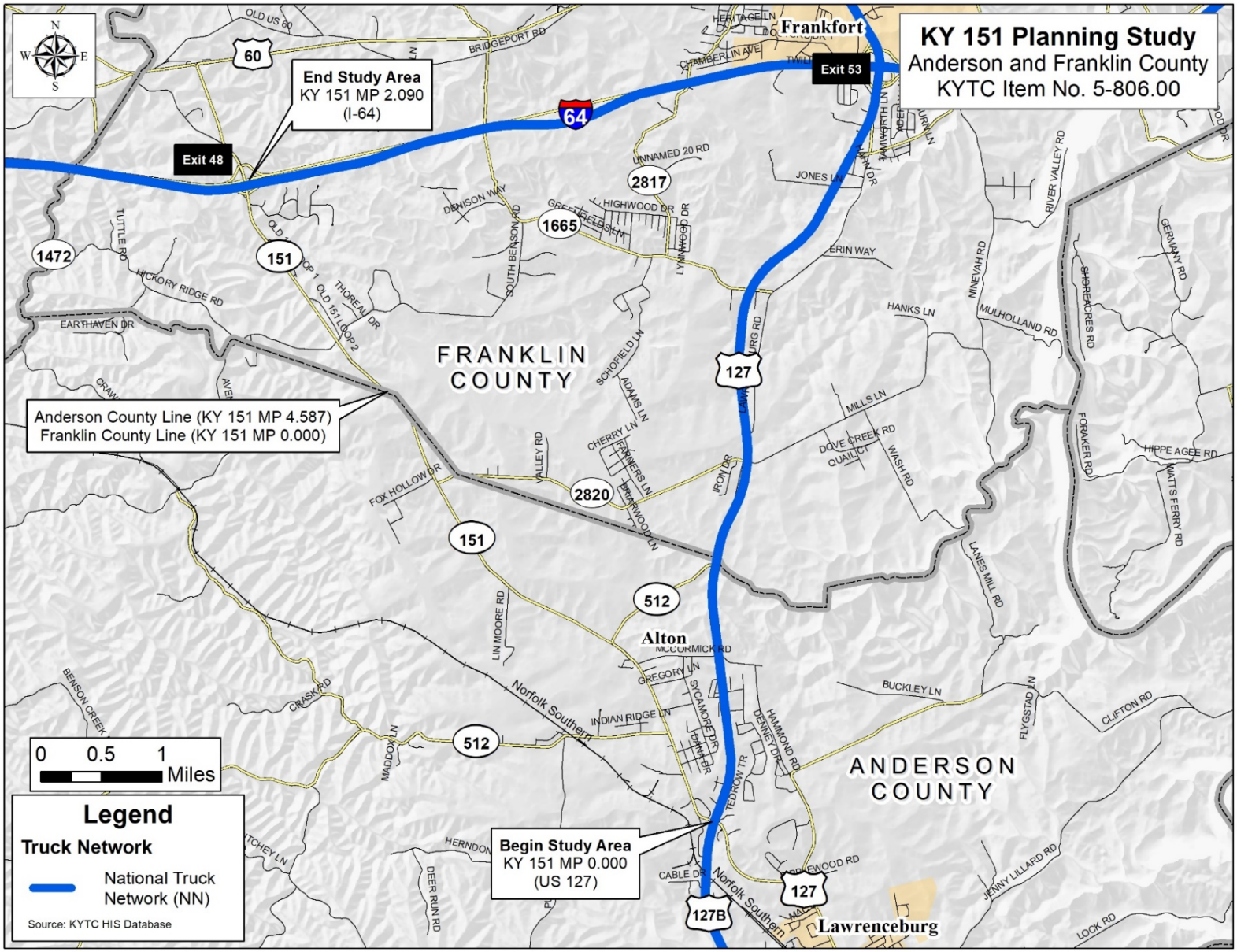


Figure 4: National Truck Network (NN)

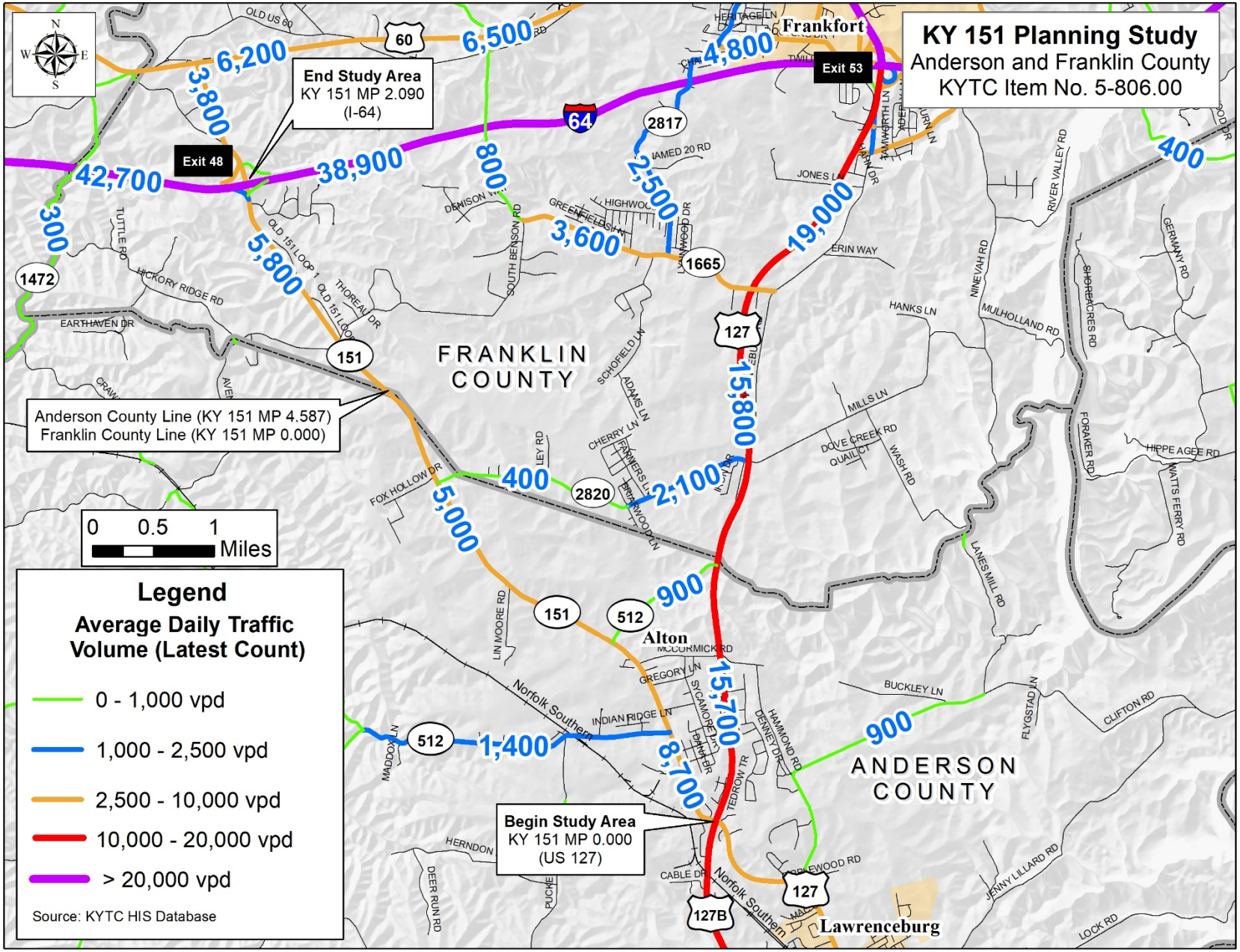


Figure 5: Average Daily Traffic (ADT) Volumes

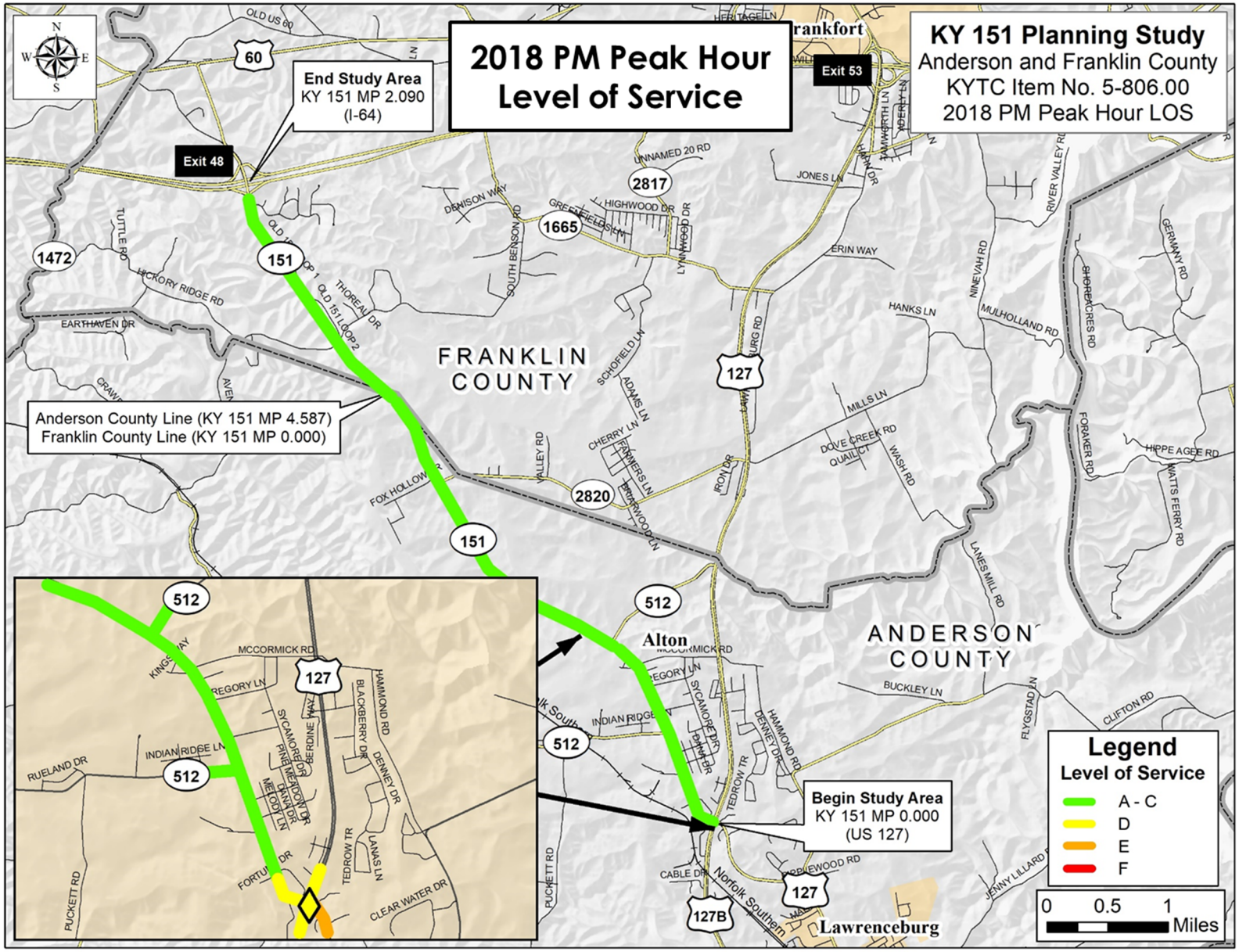


Figure 6: PM Peak Hour Level of Service (2018)

2.3.1 Travel Time

KY 151 provides north-south access to I-64 Exit 48 from just north of Lawrenceburg. US 127 provides similar access to the east, connecting to I-64 at Exit 53. During non-peak hour traffic conditions, traveling the seven miles southbound on the study portion of KY 151 takes approximately eight minutes[1], as shown in **Figure 7**. If a driver were to use US 127 to travel between the same points, it would take 12 minutes to travel the 12 miles. Similarly, traveling northbound on KY 151 takes approximately nine minutes while using US 127 takes 13 minutes.

Figure 7: KY 151/US 127 Travel Time Comparison

[1] Source: Google Maps

2.4 Crash History

A crash analysis was performed for the period between January 1, 2015 – December 31, 2019 using data from the Kentucky State Police crash database. Over this five-year period, a total of 158 crashes were reported along the study portion of KY 151. The crash records are included in **Appendix B**.

Of the 158 reported crashes over the five-year period, 34 (22 percent) resulted in an injury and 124 (78 percent) resulted in property damage only. **Figure 8** shows the location of the crashes and summarizes the distribution of crashes by severity. The most prominent crash types were single vehicle (60 crashes, 38 percent) and rear ends (55 crashes, 35 percent). **Figure 9** shows the location of the crashes and summarizes the distribution by crash type.

2.4.1 Critical Crash Rate Factors

Crashes for the five-year period were geospatially referenced and compared to statewide data to identify locations experiencing above average crash rates. The methodology is defined in the Kentucky Transportation Center research report *Analysis of Traffic Crash Data in Kentucky (2015-2019)*[2]. The critical rate factor (CRF) is a measure of safety, expressed as a ratio of the crash rate at the location compared to the critical crash rate for similar roadways throughout the state. A CRF of 1.0 or greater may indicate that crashes are occurring due to circumstances not attributed to random occurrence. There are no high crash segments on the study portion of KY 151.

A spot analysis was also conducted for the study area. Spots were defined by observing 0.3-mile sections where crashes were concentrated. There were five spots with a CRF greater than 1.0, as shown in **Figure 10.**

2.4.2 Excess Expected Crashes (EEC)

The number of excess expected crashes (EEC) at a location is a measure of the crash frequency at the site compared to what is expected based on current conditions (geometrics, traffic, etc.). A positive EEC indicates more crashes are occurring than should be expected when compared to similar roadways around Kentucky. An EEC analysis was performed for the KY 151 corridor, disaggregating the route based on the roadway characteristics (i.e., lane and shoulder widths) and traffic volumes. Results from this analysis were consistent with the segment CRF analysis, showing that, with limited exceptions there are fewer crashes than expected occurring on the study portion of KY 151. A summary of the EEC analysis is shown in **Figure 11.**

[2] Green, Eric R., Kenneth R. Agent, and Jerry G. Pigman. "Analysis of Traffic Crash Data in Kentucky (2015-2019)." (2020).

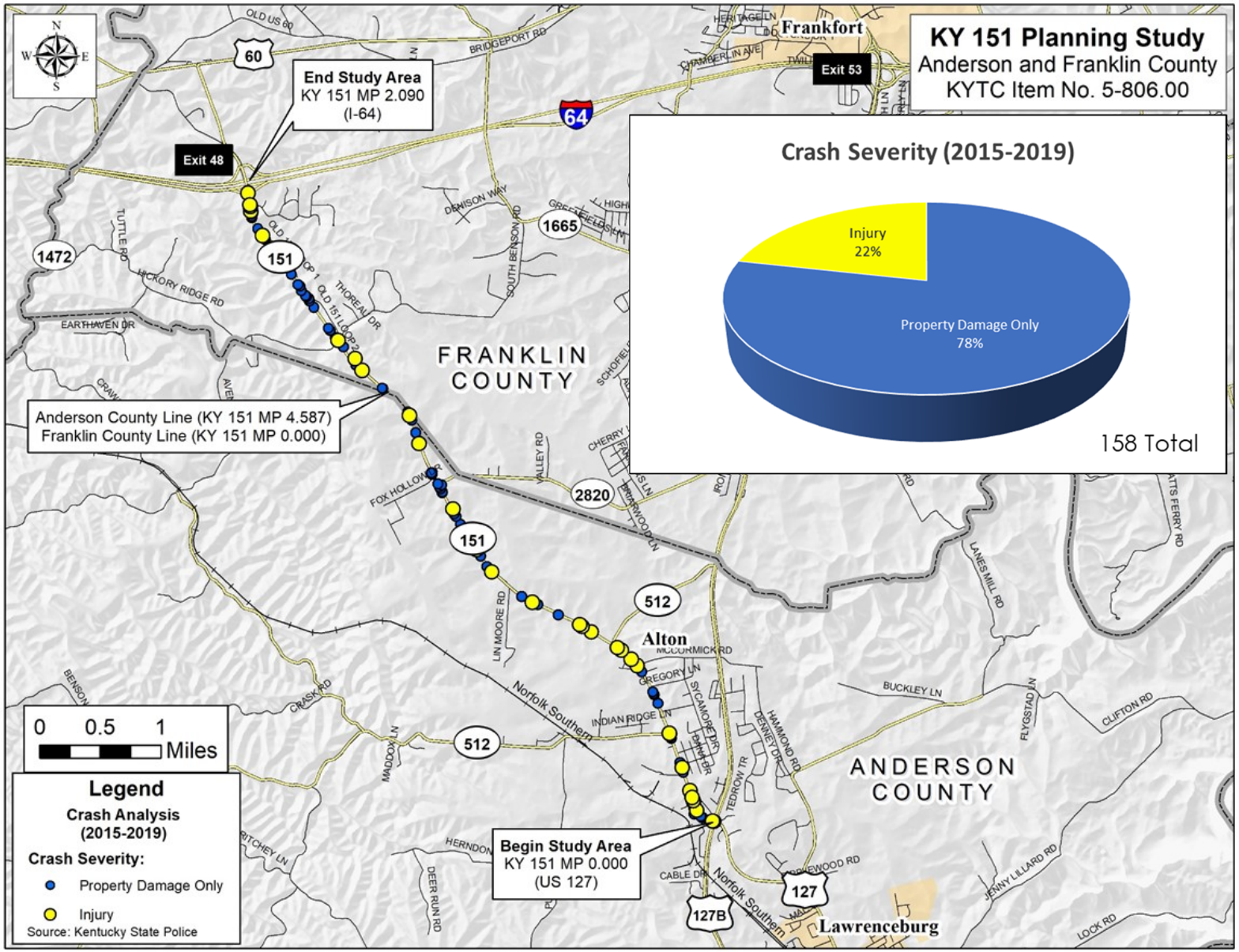


Figure 8: Distribution of Crash Severity by Location

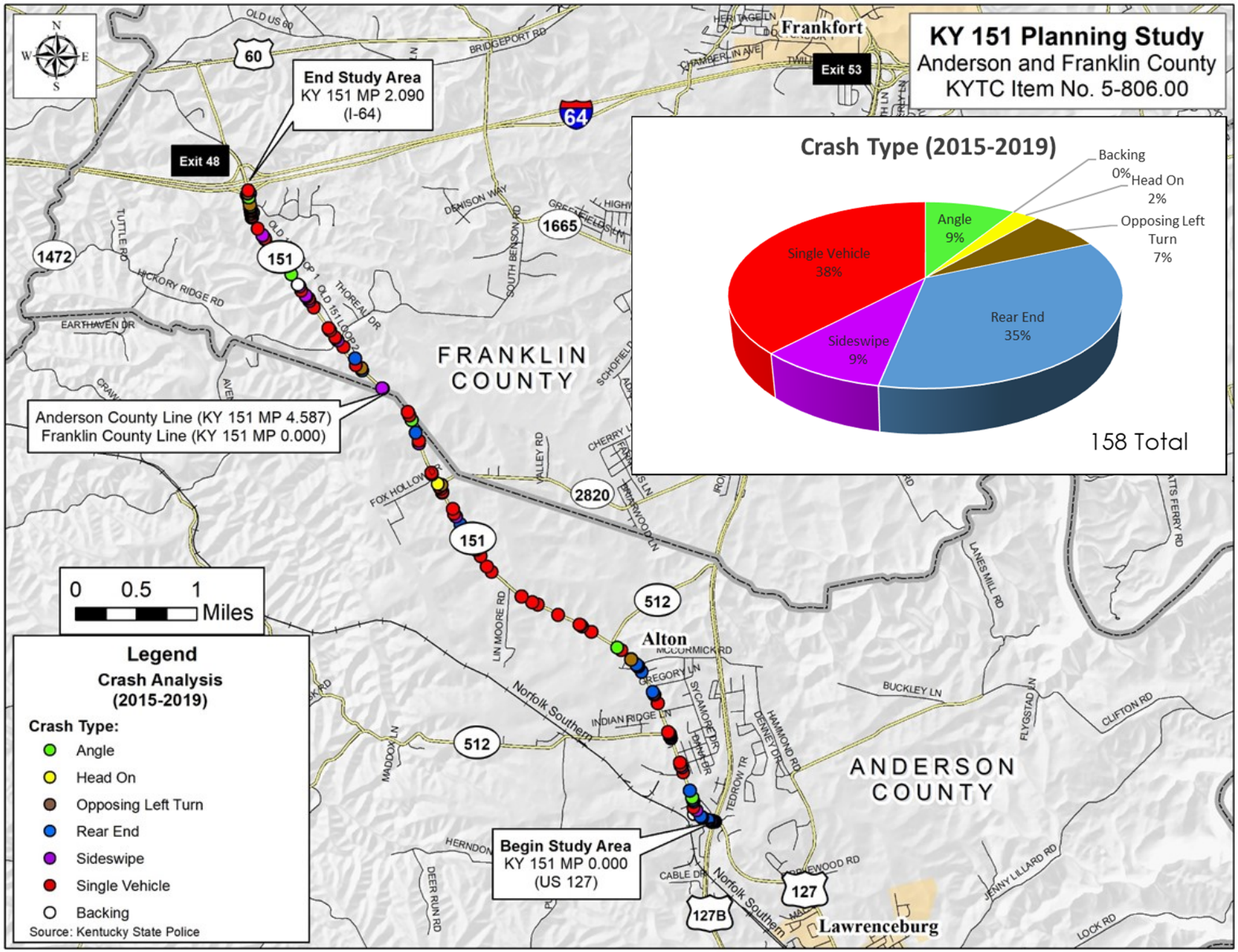


Figure 9: Distribution of Crash Type by Location

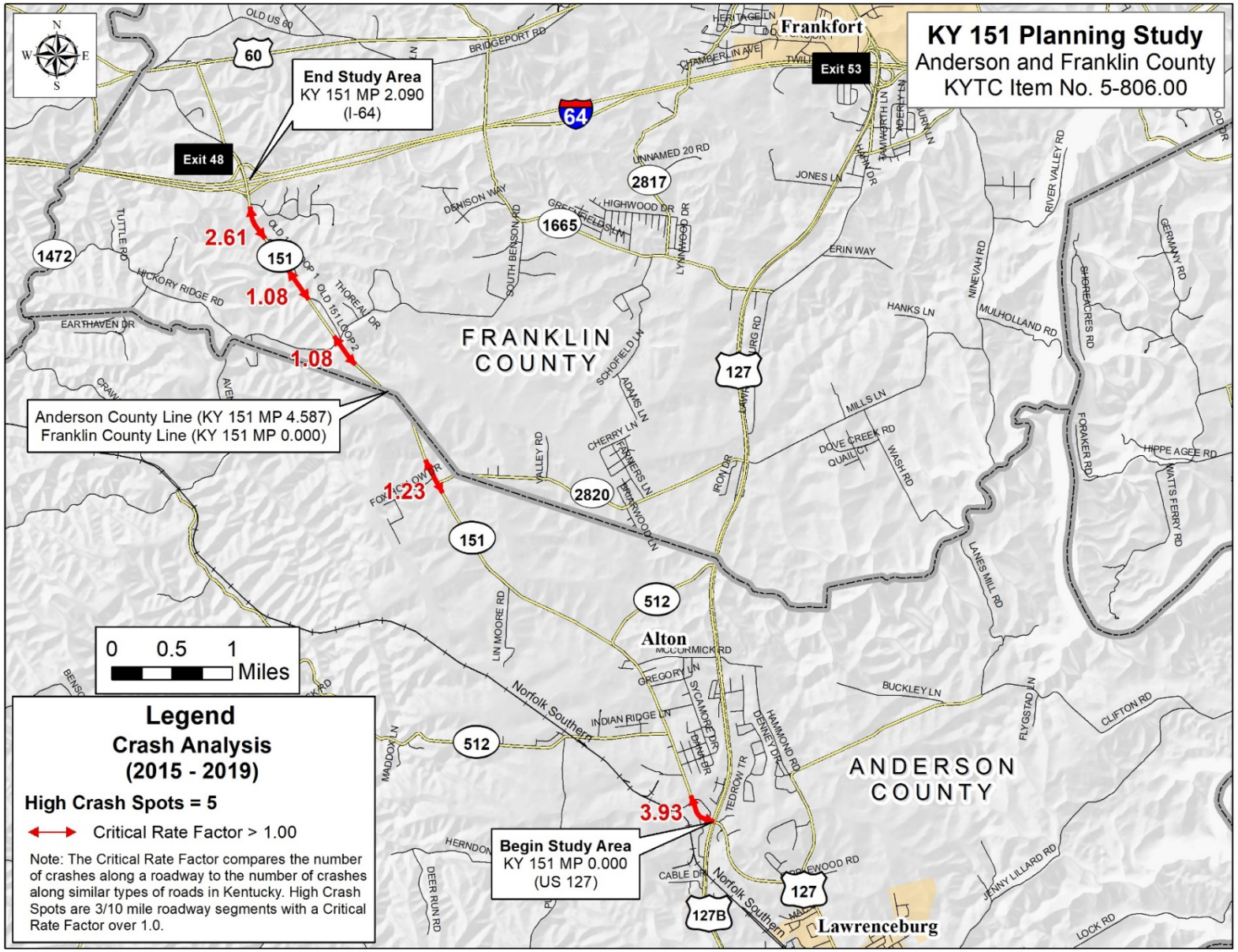
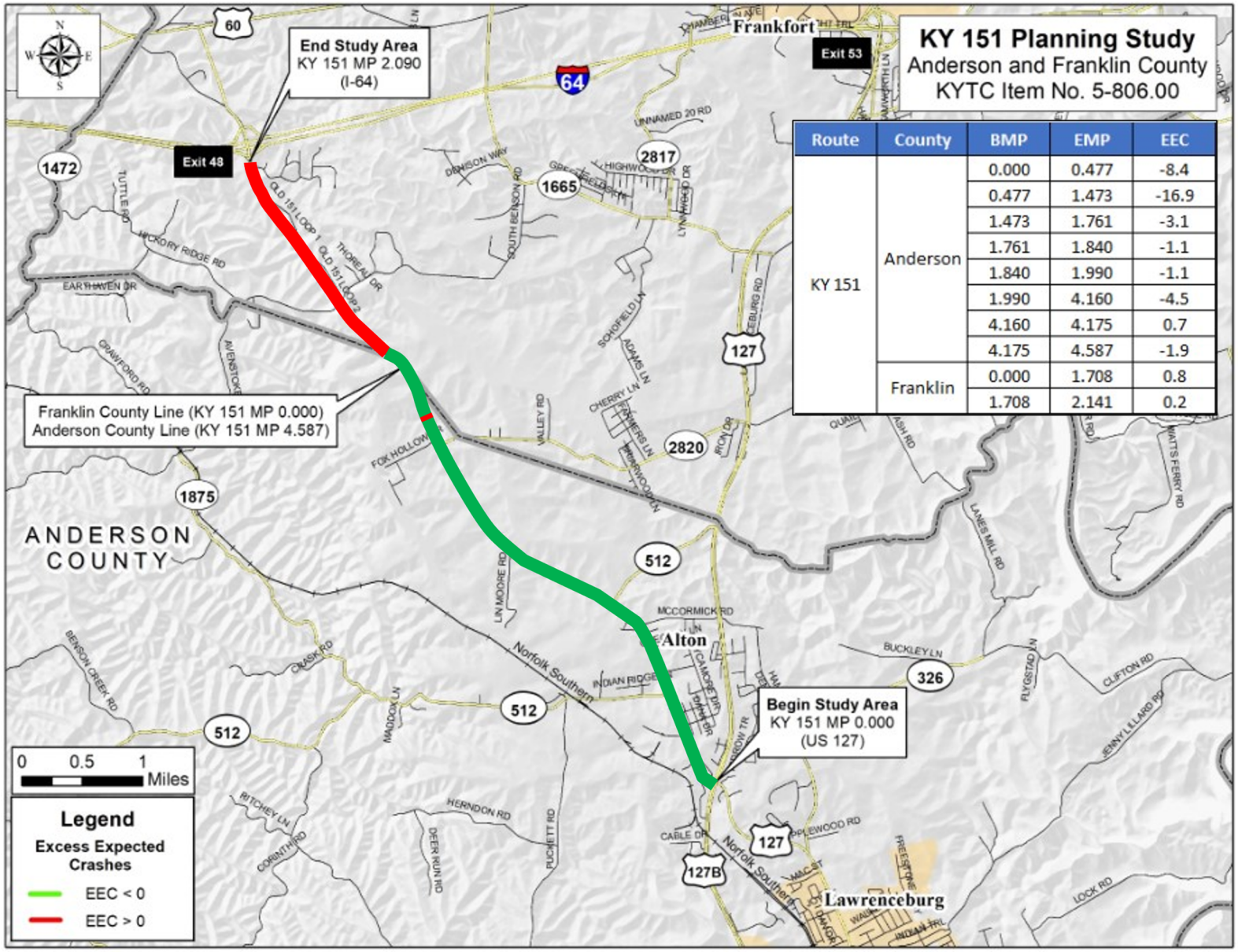


Figure 10: High Crash Spots



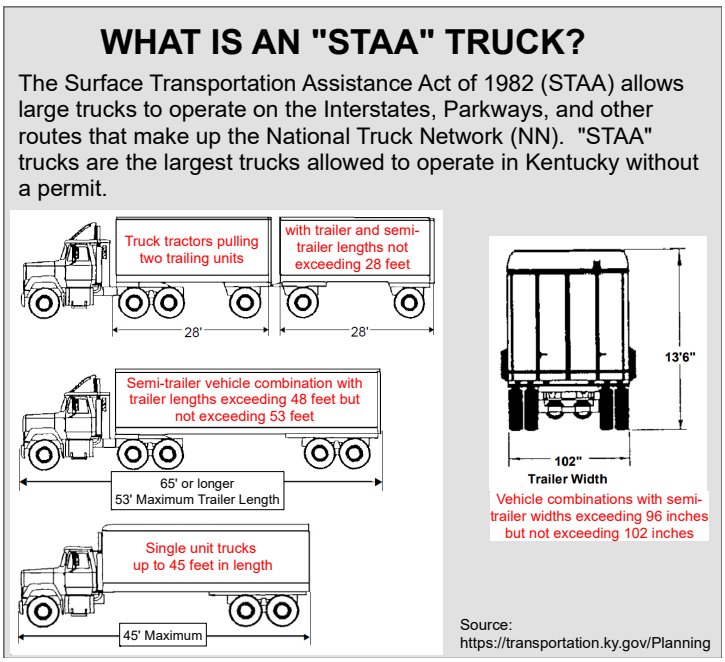
Route	County	BMP	EMP	EEC
KY 151	Anderson	0.000	0.477	-8.4
		0.477	1.473	-16.9
		1.473	1.761	-3.1
		1.761	1.840	-1.1
		1.840	1.990	-1.1
		1.990	4.160	-4.5
		4.160	4.175	0.7
		4.175	4.587	-1.9
	Franklin	0.000	1.708	0.8
		1.708	2.141	0.2

Figure 11: Excess Expected Crash (EEC) Summary

2.5 KYTC Safety Study

In 2016, KYTC conducted a safety study on KY 151 from US 127 in Anderson County to I-64 in Franklin County. The purpose of this study was to review the existing roadway characteristics, traffic volumes, geometries, speeds, and crashes; determine which size vehicles can be safely accommodated within the existing roadway geometry; and identify and examine issues specifically affecting large truck operations. The safety study concluded the following:

- Roadway capacity is not an issue and will not be an issue in the future.
- Existing traffic control devices are within engineering guidelines per the Manual on Uniform Traffic Control Devices.
- Pavement conditions are fair.
- KY 151 has a better safety record than similar roadways in Kentucky.
- Posted speed limits are appropriate.
- Some truck crashes may be related to shoulder drop-offs at two curves (MP 2.6 and 3.0) and the abrupt pavement change in Anderson County (MP 4.1). These locations have the potential to be mitigated by improving shoulders.



Surface Transportation Assistance Act (STAA) of 1982 Trucks

Of particular interest in the safety study is consideration of specific needs for larger trucks as defined in the Surface Transportation Assistance Act of 1982 (STAA). The vehicle offtracking analysis from the KYTC safety study revealed two locations where pavement widening would be needed to accommodate STAA vehicles, as shown in **Table 1**.

Table 1: KY 151 Vehicle Offtracking Summary (KYTC)

		Required Pavement Widening (ft.)									
		Allowed Vehicles						STAA Vehicles			
		84" Wide	96" Wide					96" Wide		102" Wide	
County	Milepoint	P	S-BUS-36	SU-30	SU-40	WB-40	WB-50	WB-62	WB-67	WB-62	WB-67
Anderson	0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.70	1.04
	3.0	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.74	1.40	1.74
	3.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Franklin	0.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

3.0 Study Goals

KY 151 provides the most direct regional connection for areas south of the KY 151 / US 127 intersection and areas west of the I-64 (Exit 48) interchange. This north-south arterial serves a mix of residential, commercial, and industrial traffic using KY 151 as a regional through route and for local trips. Based on an existing and future year traffic analysis, a two-lane road provides adequate capacity. However, there is one intersection (KY 151 / US 127) with undesirable traffic operations and several other locations along the corridor with safety concerns.

The purpose of the *KY 151 Corridor Scoping Study* is to enhance regional mobility and to provide a safer north-south corridor between US 127 and I-64.

4.0 Future Conditions

Based on results from the *Traffic Forecast Report and Bike/Ped Accommodation Assessment* performed by KYTC, an annual growth rate of one percent per year is expected on the study portion of KY 151. **Table 2** and **Figure 12** present the daily 2040 No-Build traffic forecasts using this growth rate. The full report can be found in **Appendix C**.

Table 2: 2040 No-Build Traffic Forecasts

Description	Begin Milepoint	End Milepoint	Existing (2018)			No Build (2040)		
			ADT	LOS	V/C	ADT	LOS	V/C
Segment 1: US 127 to KY 512 [2]	0.000	1.761	8,700	C	0.28	10,800	C	0.35
Segment 2: KY 512 to Franklin County Line [1]	1.761	4.587	5,000	B	0.16	6,200	B	0.20
Segment 3: Anderson County Line to I-64 [1]	0	2.141	5,800	B	0.20	7,200	C	0.24

[1] Rural Arterial
[2] Urban Arterial

Based on an existing and future year volume-to-capacity (V/C) traffic analysis, a two-lane road provides adequate capacity. 2040 peak hour capacity analyses were performed using HCS for both intersections and mainline KY 151. All study area portions of the KY 151 corridor and adjacent intersections operate at LOS D or better during the a.m. peak period. During the p.m. peak hour, the KY 151 corridor operates at LOS C or better. The intersection with US 127 operates at LOS E and has one approach, westbound US 127, that operates at LOS F, as shown in **Figure 13**.

HCS outputs depicting 2040 peak hour traffic operations can be found in **Appendix A**.

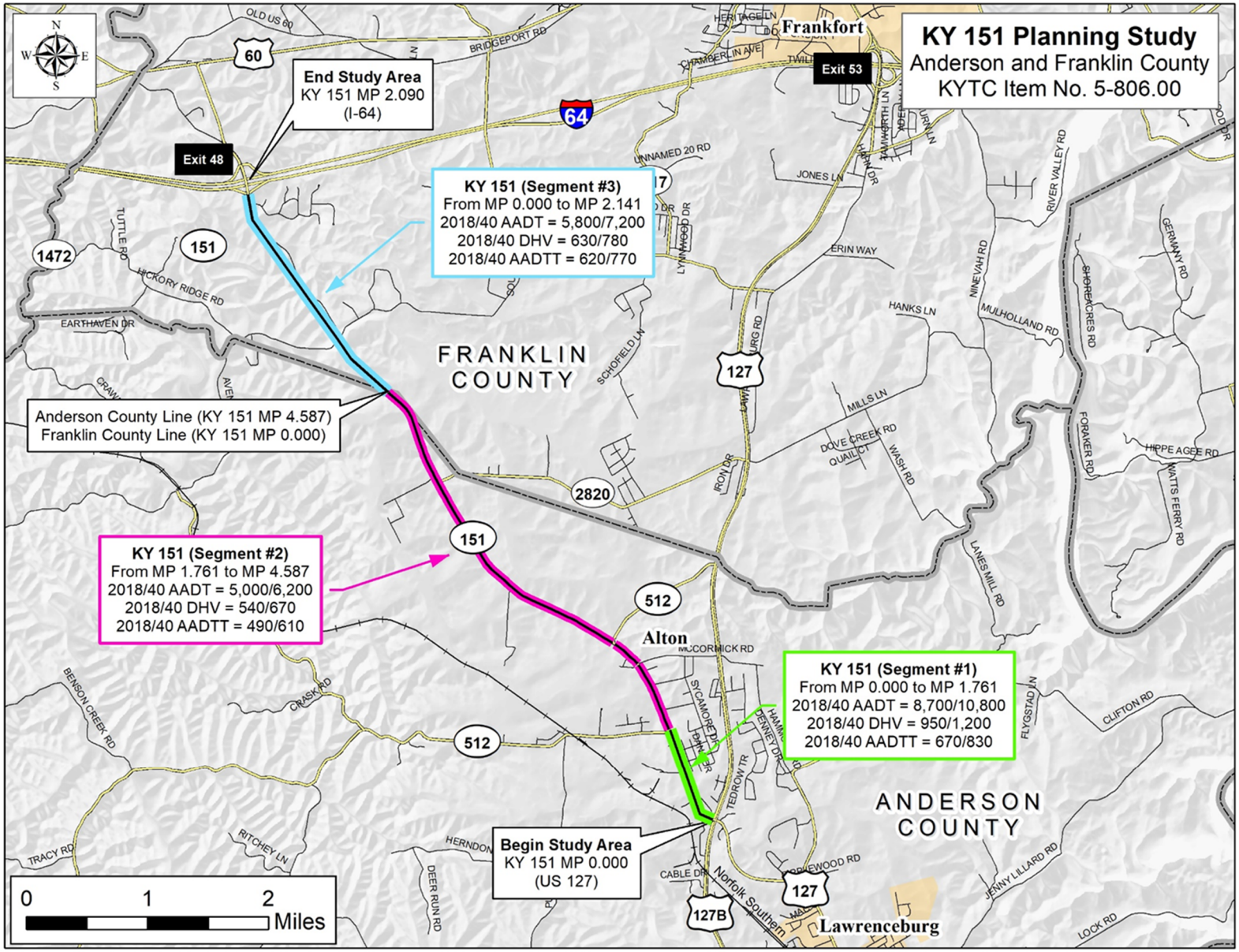


Figure 12: 2040 Traffic Forecasts

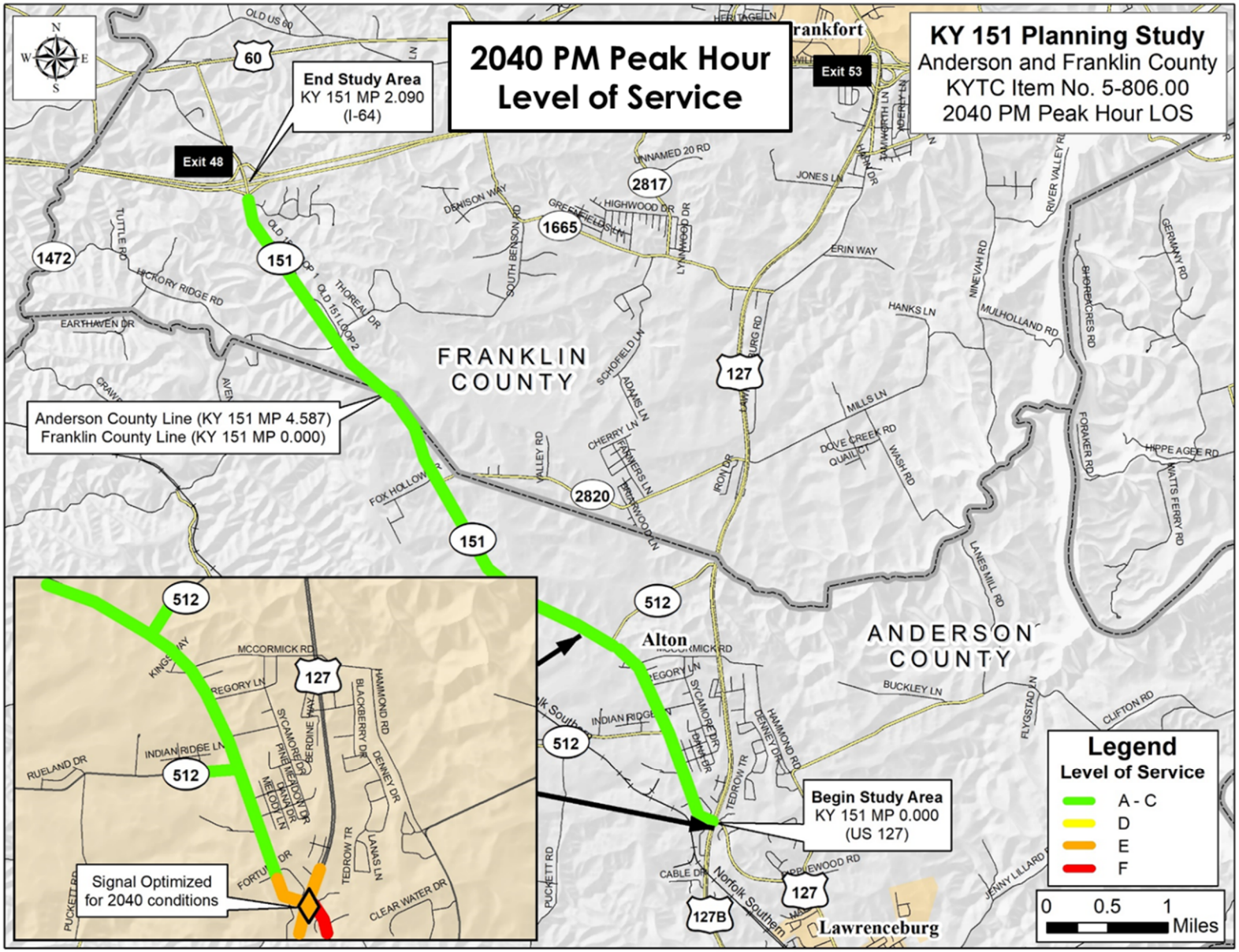


Figure 13: 2040 P.M. Level of Service

5.0 Environmental Overview

An Environmental Overview was performed to identify environmental resources of significance, potential jurisdictional features, and other environmental areas of concern that should be considered during project development. Natural and human environment resources within the study area were identified from secondary sources. The following provides a summary of the findings and the complete document is included in **Appendix D.**

More detailed environmental studies may be required as individual projects are further developed. If a future project is federally funded, the National Environmental Policy Act (NEPA) requires that potential environmental impacts regarding jurisdictional wetlands, archaeological sites, cultural historic sites, and federally endangered species must be avoided if feasible and prudent. If not, then impact minimization efforts are required.

5.1 Natural Environment

Natural environment resources include surface streams, floodplains, wetlands, ponds, groundwater, threatened, endangered, and special concern species and habitat, woodland and terrestrial areas, and parks. Through a literature/database review and field reconnaissance, potentially sensitive resources that affect the natural environment were identified in the study area and are discussed in the following sections and shown in **Figure 14**.

5.1.1 Streams

Streams are shown based on data provided in the National Hydrography Dataset (NHD) from the United States Geological Survey (USGS). South Benson Creek, Little Benson Creek, and 25 unnamed streams are located within the study area.

5.1.2 Watersheds & Wetlands

The study area crosses two Watershed Cataloging Units, including: Lower Kentucky and Salt, from north to south respectively. The study area lies within two Source Water Assessment and Protection Program (SWAPP) areas: the American Water Company (South Benson Creek-Lower Kentucky watershed) covers the study area between I-64 and KY 512 (Alton Station Road), and the Frankfort Electric/Water Plant Board (Little Benson Creek-Lower Kentucky watershed) in the northeast corner of the study area along US 127.

There are 58 National Wetlands Inventory (NWI) wetlands mapped in the study area including 54 ponds, one emergent, two scrub-shrub and one forested. Hydric soils occur across approximately 15 percent of the study area, concentrated in the shallow stream valleys in Anderson County. This soil type indicates the potential for additional non-NWI mapped wetlands to be present in the study area.

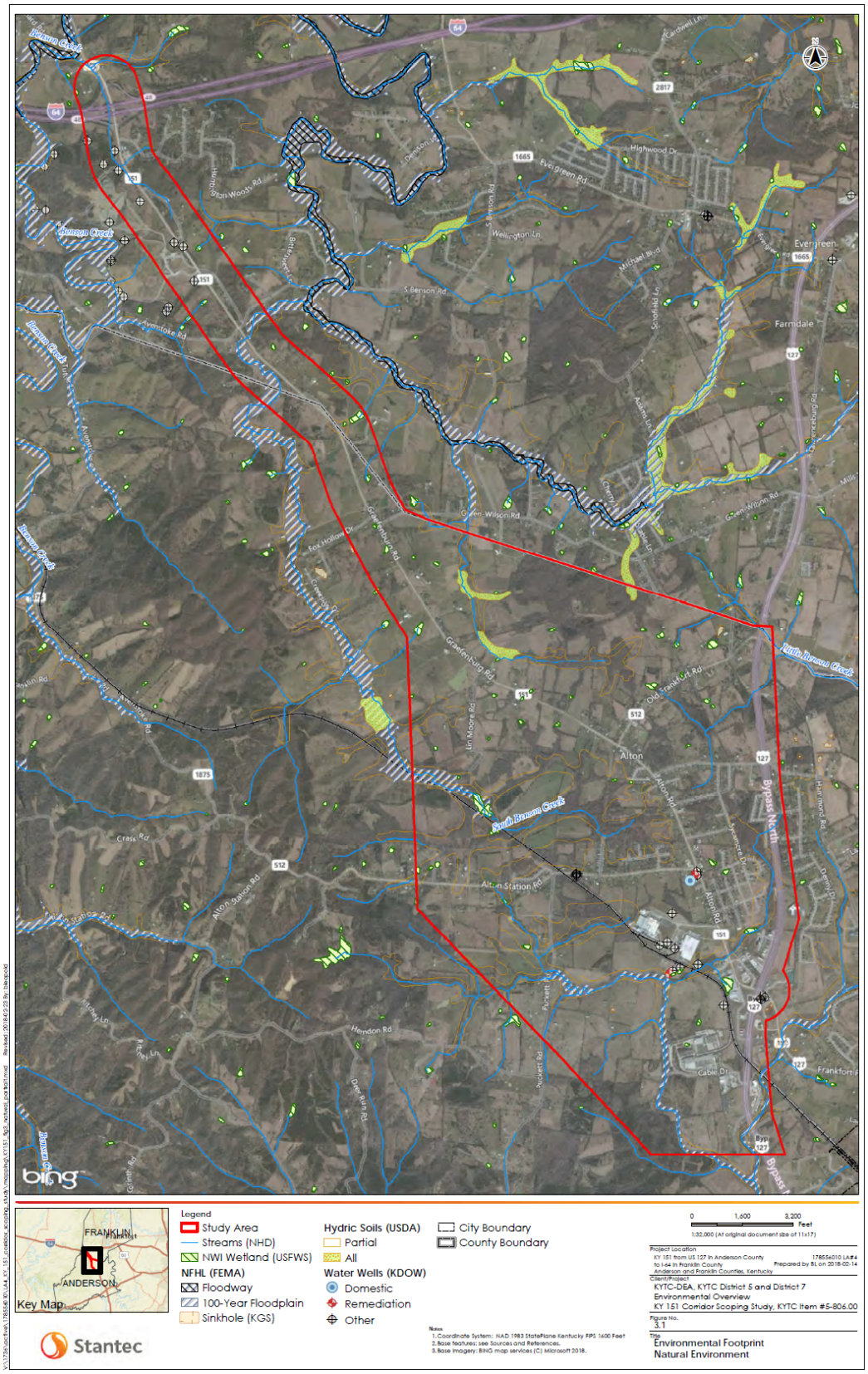


Figure 14: Natural Environment

5.1.3 Ponds

There are 54 ponds mapped within the study area, with approximately 60 additional ponds evident from recent aerial imagery. Most appear to be utilized as farm ponds (livestock watering), followed by private recreational ponds.

5.1.4 US Fish and Wildlife Species List

Indiana bat, gray bat, and Northern long-eared bat are known to occur in Anderson and Franklin Counties. Known Summer 1 habitat designated area for Northern long-eared bat is mapped south of KY 512/Alton Station Road. This designated habitat type refers to mitigation measures required for impacts to potential habitat for forest dwelling bats. Potential summer roost and foraging habitat for Indiana bat and Northern long-eared bat is present in several woodlots throughout the study area.

5.1.5 Kentucky Department of Fish and Wildlife Resources Species List

Kentucky Department of Fish and Wildlife Resources (KDFWR) lists 41 additional State-Threatened, Endangered, and Special Concern Species as occurring in Anderson and/or Franklin Counties. These include 12 state-endangered species (one amphibian, 11 birds), 14 state-threatened species (10 birds, two mussels, one insect, one reptile), and 15 state-special concern species (one fish, one amphibian, nine birds, one gastropod, one insect, one crustacean, two mammals).

5.1.6 Kentucky State Nature Preserves Commission Species Database

Kentucky State Nature Preserves Commission (KSNPC) provided 24 records for 13 federal or state-endangered, threatened, or special concern listed species within 10 miles of the study area. These included seven birds, three mammals, two plants, and one amphibian.

5.1.7 Groundwater

There are 60 water wells mapped within the study area, including: one domestic use, 56 monitoring use and three remediation use. The one domestic use (single family) water well is located near the KY 151 and KY 512/Alton Station Road intersection. Remediation use wells are associated with one Underground Storage Tank (UST) record (Smiths Grocery) and an empty field south of the Florida Tile manufacturing site.

5.1.8 Floodplain

Federal Emergency Management (FEMA) 100-Year floodplains are located within the study area at five locations: two unnamed tributaries to Hammond Creek in the south end of the study area; South Benson Creek headwaters in Anderson County; South Benson Creek mainstem

crossing KY 151 in Franklin County; and an unnamed tributary to Benson Creek at the north endpoint of the study area in Franklin County. The floodplain is relatively narrow at each location, ranging from 200 to 600 feet in width.

5.1.9 Farmland

Approximately 85 percent of the soils in the study area are identified as Prime Farmland (36 percent), Farmland of Statewide Importance (35 percent), or Prime farmland if drained or protected from flooding (14 percent). Extensive portions of the study area are currently utilized as hay and pasture lands with few cultivated crop fields.

5.1.10 Hazardous Materials

A database records review revealed 27 sites of potential concern within the study area, including 11 Resource Conservation and Recovery Act (RCRA) records, four air emission records, two Toxic Release Inventory (TRI) records, and 16 UST sites (six active). The Benson Valley Area Landfill (and associated McGuire Sanitation Services) is located along KY 151 in Franklin County, partially within the study area (contained solid waste landfill). One hazardous liquids pipeline crosses US 127 south of the KY 151 intersection, and one gas transmission pipeline follows KY 151 through most of the study area. Two sites have Remediation-use water monitoring wells, Smith Grocery (UST site) and an empty field south of the Florida Tile manufacturing site (no other records).

Field survey indicated 13 additional potential hazardous materials concern sites, including: 10 automotive service/sales businesses, one neighborhood wastewater treatment plant, and one electrical substation and one cellular tower.

5.1.11 Section 4(f)

One potential Section 4(f) resource was identified in the study area, the Alton Ruritan Ball Field Recreation Center off KY 512/Alton Station Road, hosting a baseball field, picnic shelter, restrooms, and storage structure.

5.1.12 Easements

One known conservation easement is present within the study area, the Monohan Farm, which is 192 acres and held by Bluegrass Conservancy as a permanent Open Space - Farm easement closed to public access. The easement property includes approximately 1,500 feet of frontage along the south side of KY 151 east of Lin Moore Road in Anderson County and extends approximately 4,000 feet southward to the existing railroad tracks.

5.1.13 Air Quality

Four USEPA permitted air emissions facilities are located within the study area; three near Lawrenceburg and one in Franklin County.

5.1.14 Noise

Noise sensitive land use areas are present in the south portion of the study area, consisting of several residential neighborhoods, one school, two cemeteries, and six houses of worship. The study area is a mix of rural and suburban residential with a limited amount of industrial and commercial development adjacent to Lawrenceburg.

5.2 Human Environment

Human environment is defined as what we live in and around and what we have built. Through review of secondary source information and field reconnaissance, potentially sensitive resources that affect the human environment were identified in the study area, are discussed in the following sections.

5.2.1 Socioeconomic Report

Socioeconomic conditions in the study area are based on 2012 – 2016 American Community Survey (ACS) statistics. The following were conclusions of the study:

- The project area includes portions of Census Tracts 9501 and 9503 in Anderson County, and Census Tracts 710 and 711 in Franklin County.
- No tracts have a percentage minority population greater than its respective county average (Anderson = 4.5 percent; Franklin = 15.7 percent; Kentucky = 11.9).
- Tract 9501 is the only tract with a percentage of families below poverty (20.9 percent) greater than its county average (Anderson = 10.6 percent) or the statewide average of 18.5 percent.

5.2.2 Cultural – Archaeology

Based on a review of relevant information provided by Cultural Resource Analysts, Inc. for the project, no archaeological sites listed on the National Register of Historic Places (NRHP) are in the study area. However, three previous archaeological surveys conducted in or adjacent to the study area have recorded six archaeological sites within the study area, none of which have been assessed for NRHP eligibility.

Twenty-two sites in the study area were identified as having a high potential to contain archaeological remains in relation to historic structures, while an additional 100 historic structure locations were identified as having a lower potential to contain cultural deposits.

Two areas within the study area were identified as potentially containing prehistoric archaeological deposits, both oriented around floodplains of major creeks and in a location similar to known prehistoric archaeological sites.

Approximately 28 percent of the study area is identified as having a high probability for containing archaeological deposits, with an additional 69 percent as having a medium

probability. An intensive archaeological survey, including pedestrian survey, shovel testing, and bucket augering, is recommended prior to any development outside of existing right-of-way.

5.2.3 Cultural – Historic

A review of relevant information provided by Cultural Resource Analysts, Inc. for the project revealed 13 previously surveyed sites, one structure that meets NR criteria but is not currently listed, eight additional potentially significant sites with undetermined NRHP status, and four cemeteries, three of which are unnamed.

Ten of the 13 previously recorded resources are no longer extant. Seven previous cultural historic studies overlap the study area. Existing historic properties should be avoided, and any additional cultural historic investigations are recommended for any proposed project activities.

5.2.4 Houses of Worship

Based on a review of topographical maps and a field survey, six houses of worship (church, mosque, synagogue, etc.) were identified in the study area.

5.2.5 Schools

One school facility was identified in the study area, Bluegrass Community and Technical College on US 127. Two daycare facilities are in the commercial district near the KY 151/US 127 intersection.

5.2.6 Cemeteries

Four cemeteries are located within the study area: Alton Cemetery on KY 512, an unnamed cemetery along KY 151 near the Anderson / Franklin County line, an unmapped cemetery along KY 151 near South Benson Creek crossing, and an unmapped cemetery along KY 151 south of KY 2820.

5.2.7 Public Services

Public service and utility facilities located within the study area include:

- Eagle Lake Convention Center on KY 151 near the south endpoint.
- One fire department station – Anderson County Fire Station 2 at the KY 151/KY 512 intersection.
- One electric substation, behind Florida Tile manufacturing complex on KY 151.
- Two pipelines – one hazardous liquids pipeline crossing east-west at Cable Drive near the south endpoint and one gas transmission pipeline parallel to KY 151 from Benson Valley Landfill to Florida Tile.
- One Norfolk Southern active rail line traversing study area from southeast to northwest, including an at-grade crossing of KY 512 and a grade-separated crossing of US 127.

5.2.8 Residences and Businesses

Residential land use in the study area includes single-family, medium-density developments near Lawrenceburg and along KY 512, one multi-family development along US 127, and scattered rural residential development along KY 151 through most of the study area. One mobile home park is located on KY 512. New residential development is occurring on McCormick Road adjacent to KY 151, and expanding development is occurring in the Sycamore Estates subdivision, along Sycamore Drive between KY 151 and US 127. Commercial development is concentrated between KY 151 and US 127 near Lawrenceburg. Industrial development is present south and west of KY 151 and US 127 and near the study area terminus.

6.0 Geotechnical Overview

A geotechnical overview of the study area was completed based upon research of available published data and experience with highway design and construction within the region. The purpose of the overview was to provide a general summary of the bedrock, soil, and geomorphic features likely to be encountered in the study area and to identify geotechnical features that may have an adverse impact on any future project alignment. The complete document is included in **Appendix E**. The overview is summarized on **Figure 15** and below.

Geotechnical drilling will be needed for replacement or widened culverts, bridges, retaining walls, and roadway cuts and fills. It is anticipated that conventional spread footing and/or pile foundation systems can be utilized for these structures.

Should any recommended improvement concepts from this study include widening on existing alignment, sampling should be obtained to provide design details related to the pavement structure and California Bearing Ratio (CBR) information. It should be anticipated that chemically or mechanically stabilized roadbed will be required because CBR values are expected to be six or less.

If improvement concepts advance, open faced logging of exposed cuts and/or drilling should be performed once alignment and typical sections are identified. Any potential widening near the existing landfill should stay within the existing right-of-way. This may require the use of retaining walls or steepened slopes. Construction within the landfill facility will increase the cost significantly.

For any future design projects, the design team should inventory and survey active wells and springs. In addition, results from groundwater monitoring program at the landfill site should be reviewed to assess any potential effects on construction.

The potential for karst conditions exists within the project study area. Sinkholes or solution cavities identified within the construction limits that are not accepting drainage should be filled and/or capped in accordance with Section 215 of the current edition of the Standard Specifications for Road and Bridge Construction. Any sinkholes utilized for drainage purposes for any new roadway construction should incorporate adequate measures to minimize water infiltration into the subgrade and erosion control measures to minimize situation of open sinkholes.

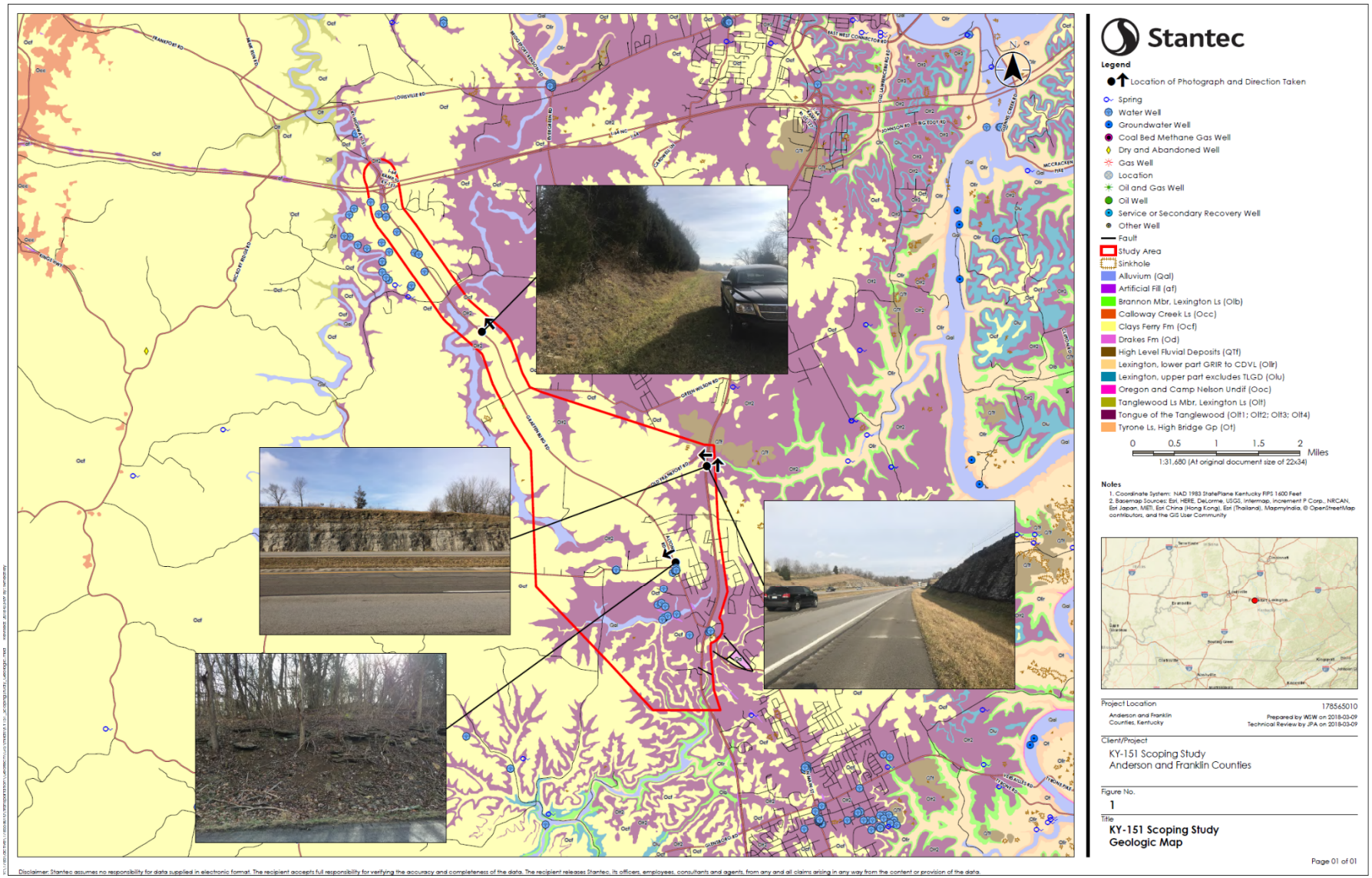


Figure 15: Geotechnical Overview Map

7.0 Initial Project Team Meeting

Over the course of the study, the project team held meetings to coordinate on key issues. The project team consisted of representatives from KYTC Central Office, KYTC District 7, the Bluegrass Area Development District (BGADD), and the consultant Stantec. Detailed summaries of each meeting are presented in **Appendix F**.

7.1 Project Team Meeting No. 1

The first Project Team Meeting for the subject project was held at the KYTC District 7 Office in Lexington, Kentucky on February 19, 2020. The purpose of the meeting was to present the results of the existing conditions analysis and to get feedback from the project team on potential improvement concepts. Key discussion items included the following:

- US 127 is the alternate route for trucks traveling between the KY151/US 127 intersection and west I-64. Travel times between the two points are as follows:
    - SB KY 151 = 8 minutes; SB US 127 = 12 minutes
    - NB KY 151 = 9 minutes; NB US 127 = 13 minutes
- It was noted that 21 of the crashes during the five-year analysis period were animal collisions. These collisions were included in the crash analysis.
- Most of the collisions at the US 127 intersection were in the right-turn lane of the eastbound KY 151 approach.
- There have been minor improvements to KY 151 since 2015 that could decrease the number of run off the road crashes.
- Based on recommendations from the *Kentucky Truck Network Study*, KY 151 meets minimum eligibility criteria for the NN.

8.0 Improvement Concept Development

A range of improvement concepts was developed based on the existing conditions analysis and input from the project team. Along with the No-Build, this study examined spot improvements, minor widening, and a partial new route.

Although the No-Build concept does not meet the project goals, it was carried forward as a baseline for comparison between other concepts.

8.1 Spot Improvement Concepts

Spot improvement concepts are lower cost safety improvements focused on locations with high crash rates and less than desirable roadway geometry. Six locations were identified as having safety issues that could benefit from spot improvements, as shown in **Figure 16**.

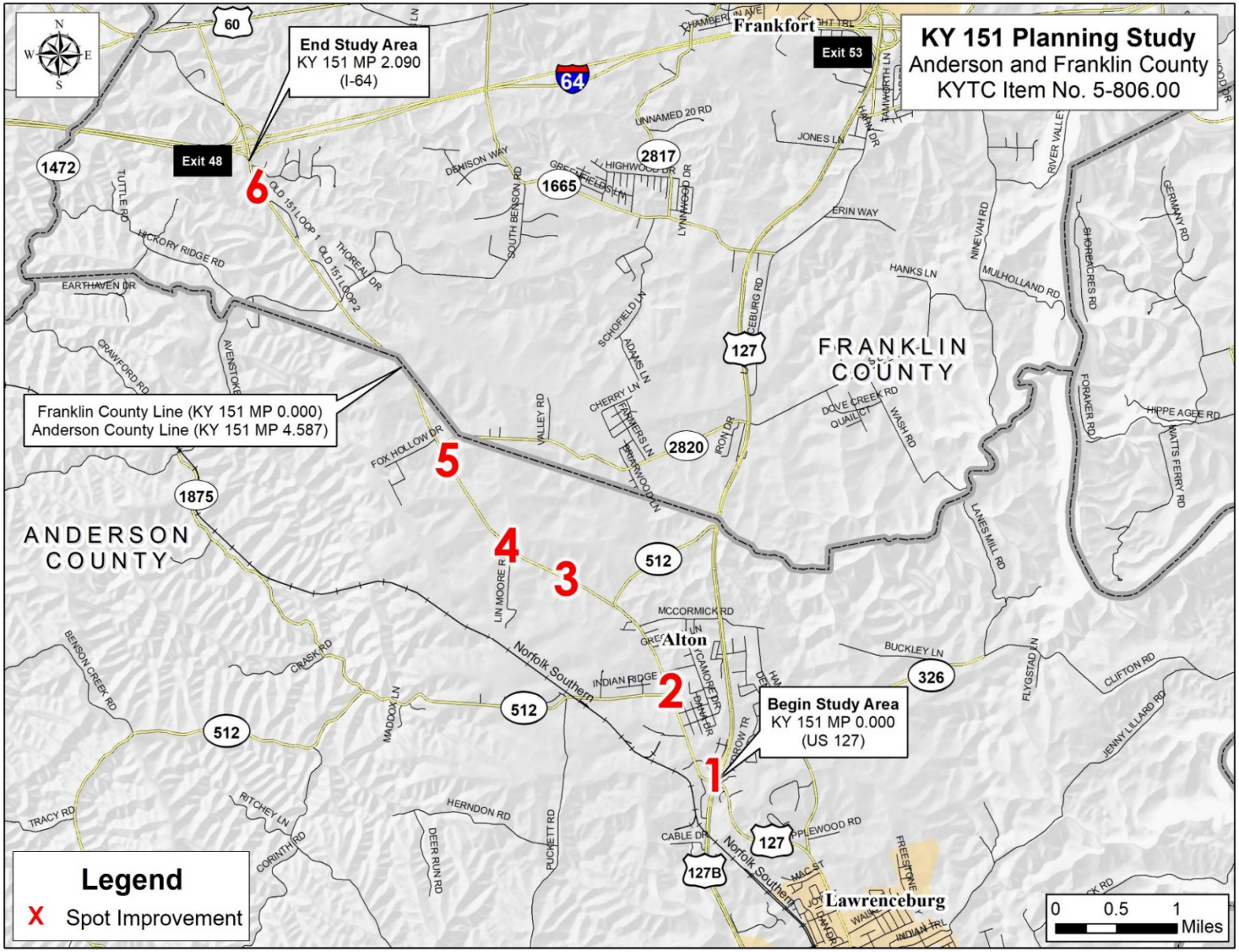


Figure 16: Spot Improvements

8.1.1 Spot Improvement 1 – KY 151 Intersection with US 127, MP 0 to MP 0.3

The KY 151 intersection with US 127 is located near a mix of commercial, industrial, and residential areas, making it one of the more congested intersections in the area. Analysis of the existing traffic volumes indicate the westbound approach operates at LOS E during the PM peak hour with all other approaches operating at LOS D. By 2040, this approach is expected to operate at LOS F during the PM with all other approaches operating at LOS E. An option to improve traffic operations is to optimize the signal timing by allowing eastbound and westbound right-turn overlaps, providing eastbound and westbound KY 151 right-turns a green arrow during the northbound and southbound US 127 left-turn phases. This modification would improve future LOS for all approaches to no worse than LOS D.

In addition to the congestion issues, the eastbound KY 151 approach is also a high crash location (CRF = 3.93), with 52 crashes occurring between 2015 and 2019. Of these crashes, 25 involved vehicles turning right onto southbound US 127. Reducing the right-turn radius, as shown in **Figure 17,** would improve safety (Crash Modification Factor (CMF) ID 8428 = 0.56) by encouraging vehicles to come to a complete stop before turning right. Another safety improvement is to convert the eastern Tile Village Circle entrance to a right-in / right-out. Turning left into or out of this entrance is a safety concern as this approach is located less than 150 feet from the US 127 intersection. Full access to Tile Village Circle is available at the entrance to the north. Another safety improvement includes installing a 35-MPH warning sign before the horizontal curve west of Fortune Circle. Since KY 151 consistently has 45- to 55-MPH speed limits, this sign will remind drivers to reduce speeds before the curve.

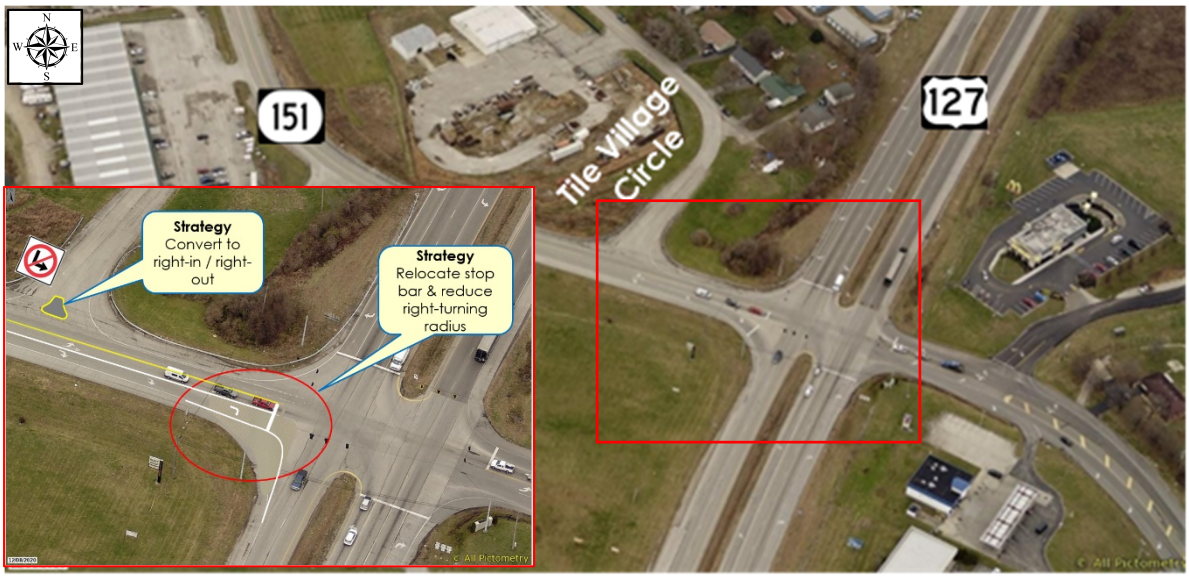


Figure 17: Spot Improvement 1

8.1.2 Spot Improvement 2 – KY 151 Near Alton Station Road (KY 512), MP 0.813 to MP 1.113

The KY 151 intersection with Alton Station Road (KY 512) is located between the commercial / industrial areas near the US 127 intersection and the residential area near Alton. There are several neighborhoods on Alton Station Road, including a new development with more than 50 houses. Traffic counts show more than 160 vehicles currently turn left and 110 vehicles turn right onto Alton Station Road from KY 151 during the PM peak hour. Based on KYTC'S Highway Design Manual, this satisfies the warrants for a left-turn lane and a right-turn lane on KY 151. It is estimated that by 2040, 210 vehicles will turn left during the PM peak. The proposed improvement concept at this location is to construct a left-turn lane on northbound KY 151 and a right-turn lane on southbound KY 151 onto Alton Station Road, as shown in **Figure 18**. This will improve traffic operations at the intersection and will support continued traffic growth on Alton Station Road. Additionally, it will improve safety (CMF ID 7852 = 0.73) by removing turning vehicles from mainline KY 151 and allowing through traffic to continue rather than stopping behind a turning vehicle.

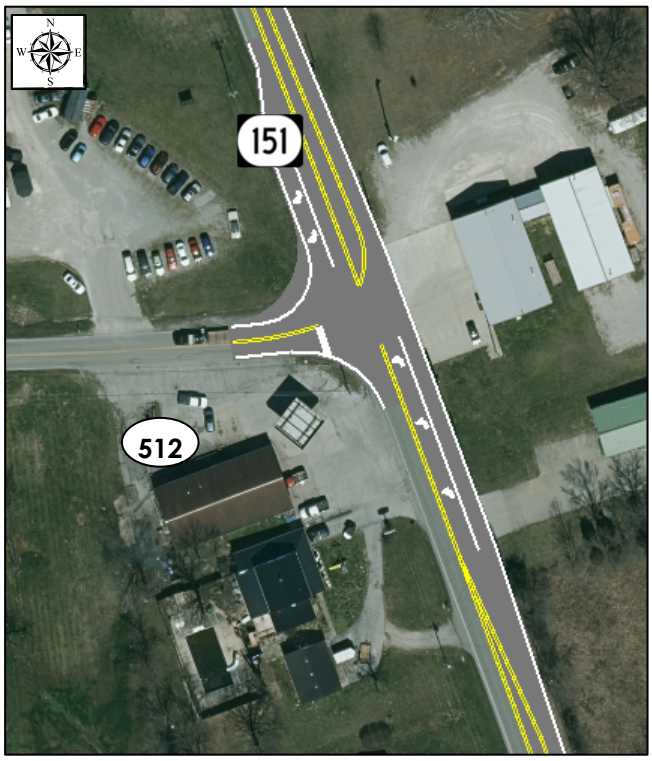


Figure 18: Spot Improvement 2

8.1.3 Spot Improvement 3 – KY 151 North of Old Frankfort Road (KY 512), MP 2.0 to MP 2.2

Through most of Anderson County, KY 151 has 11-foot lanes and 1.5-foot shoulders with rumble stripes. North of Old Frankfort Road (KY 512) and Alton, these narrow shoulders quickly transition into steeper slopes with reduced clear zone. Without adequate clear zone, vehicles that drop off the pavement may be unable to recover safely back onto the roadway. An option to improve safety is to improve the roadside ditches and widen the paved and unpaved shoulders to reduce the likelihood of run off the road collisions and to provide improved clear zone.

In addition to the clear zone concerns, the area near Alton was found to have high speeds. A 2016 KYTC Safety Study showed that while the posted speed limit in Alton is 35 MPH, the 85th percentile speeds are near 45 MPH. An option to reduce speeding is to cut back the overgrown trees north of KY 512, as shown in **Figure 19**, and improve the visibility of the reduced speed warning signs. An additional improvement option is to install a solar, flashing speed warning sign to alert drivers of the change in speed limit. Along with the improved signing, one final option is

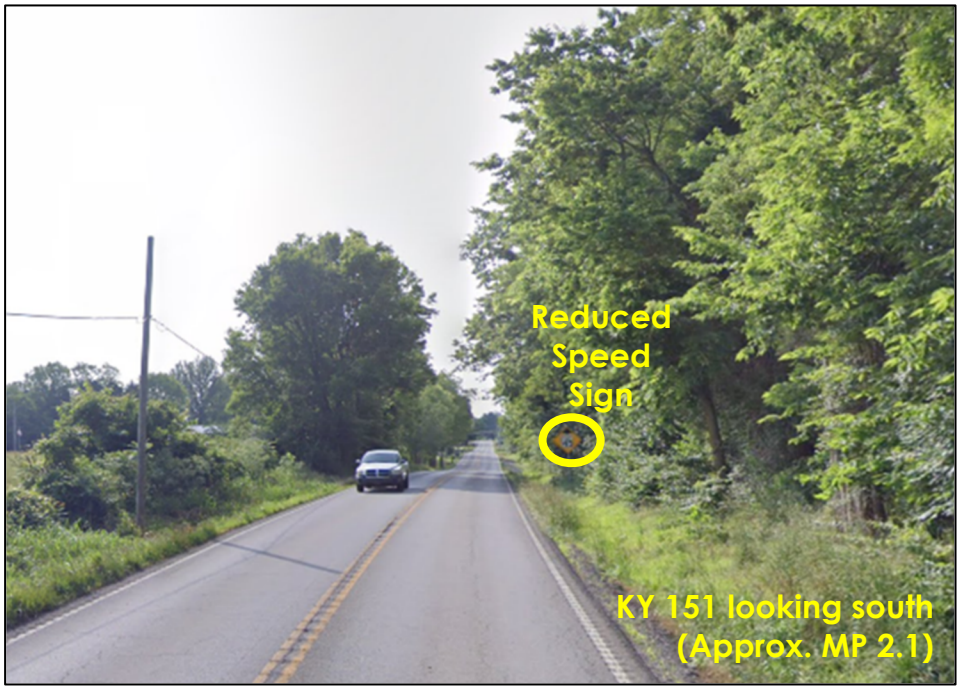


Figure 19: Spot Improvement 3

to install transverse rumble strips to alert drivers of the reduced speed. When driven over, these strips create noticeable sound and vibrations.

8.1.4 Spot Improvement 4 – KY 151 at Lin Moore Road, MP 2.5 to 2.7 and MP 2.85 to MP 3.05

Based on a 2016 KYTC Safety Study, KY 151 has two horizontal curves near Lin Moore Road that show minor offtracking for STAA vehicles. This means that these larger trucks may encroach into the adjacent oncoming lane to avoid dropping off the edge of the pavement while traveling around the curves. Between 2015 and 2019 there were four single vehicle collisions along these curves, one of which was a roadway departure crash involving a multi-unit truck under wet pavement conditions. In 2016 STAA vehicles were prohibited from using KY 151 as a through route.

An improvement concept at this location is to construct a minor pavement widening focusing on wider shoulders through the two horizontal curves, shown in **Figure 20**, to satisfy current geometric design guidelines. Providing a slightly wider pavement section would accommodate larger vehicles and reduce the potential for roadway departure, head on, and sideswipe collisions to occur. It is assumed this minor shoulder widening (approximately two feet) could occur completely within the existing right-of-way.

Figure 20: Spot Improvement 4

8.1.5 Spot Improvement 5 – KY 151 South of Green Wilson Road (KY 2820), MP 3.4 to MP 3.8

Just south of Green Wilson Road (KY 2820), northbound KY 151 has narrow shoulders that lead directly into steep side slopes, as shown in **Figure 21**. These unstable, steep slopes may be a contributing factor to roadway departure crashes and have certainly contributed to ongoing pavement deterioration that requires regular maintenance projects to maintain a smooth driving surface. This is a high crash location (CRF = 1.23), with five single vehicle crashes and one head on crash involving a semi-trailer between 2015 and 2019. An option to improve safety is to extend the slope and widen the paved shoulder on northbound KY 151. This would reduce the number of run off the road collisions while also reducing recurring maintenance needs.

Southbound KY 151 also has narrow paved shoulders and a limited unpaved clear zone, with only a small section of trees separating the traveled way from a private pond. Because of the proximity of the pond on the west side, run off the road collisions at this location have the potential to be severe. While the pond complicates a typical slope extension, installing channel lining / riprap or a gabion wall along the pond's east bank would help stabilize the slope and allow for minor shoulder widening and guardrail installation. While the details associated with such a concept would require further analysis, it is assumed additional right-of-way would be required to construct this improvement.

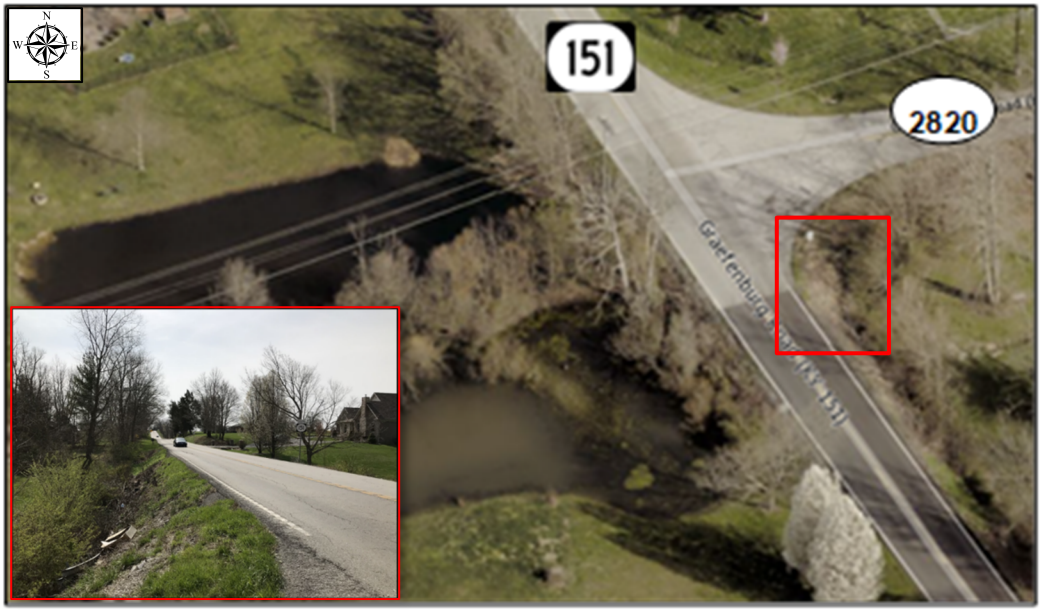


Figure 21: Spot Improvement 5

8.1.6 Spot Improvement 6 – KY 151 South of the I-64 Interchange, MP 1.9 to MP 2.05

The eastbound I-64 exit ramp (Exit 48) splits into two lanes, providing a stop-controlled left-turn onto northbound KY 151 and a free-flow right-turn onto southbound KY 151. The receiving auxiliary lane for the free-flow right-turn on KY 151 is only 180 feet long, requiring vehicles to merge quickly. A safety analysis showed this location a high crash location with a CRF equal to 2.6, indicating that more crashes are occurring than should be expected based on current conditions. There were eight crashes reported between 2015 and 2019.

Figure 22: Spot Improvement 6

An option to improve safety (CMF ID 8498 = 0.41) is to realign the eastbound off ramps and remove the free-flow right-turn, as shown in **Figure 22**. This would reduce the ramp split and direct all vehicles to the stop-controlled intersection with KY 151, therefore removing the need for merging on KY 151 and weaving between the ramp and Huntington Woods Road to the south.

An additional improvement option is to relocate the Huntington Woods Road intersection to the south. This would improve safety by reducing the number of access points near the interchange.

8.2 Minor Widening

In addition to the spot improvements, the project team also considered corridor-wide minor widening. This concept involves widening lanes and shoulders, as needed, along the entire study portion of KY 151. This option was analyzed two different ways, the first of which included using crash modification factors (CMFs) from the CMF Clearinghouse. CMFs indicate the proportion of crashes that would be expected after implementing a countermeasure. For this analysis, a CMF for widening shoulders was assumed to reduce 18 percent of crashes. The second analysis included the Interactive Highway Safety Design Model (IHSDM). The IHSDM is a tool used to evaluate the safety and operational effects of geometric design on highways.

The analyses were performed for several concepts including, the no-build, a full build with 12-foot lanes and 10-foot shoulders, a performance-based flexible solution (PBFS) which includes minimum 11-foot lanes and eight-foot shoulders (four-foot paved), and a Highway Safety Improvement Program (HSIP) alternative which includes a minimum 11-foot lanes and four-foot paved shoulders. Benefit-to-cost ratios were then calculated based on the resulting crash savings and the construction costs, as shown in **Table 3**. Both analyses showed benefit-to-cost ratios well below one for all concepts.

Table 3: Minor Widening Summary

Concept	Lane Width	Shoulder Width	Construction Cost	CMF					
				Injury crashes	Injury crashes reduced	PDO crashes	PDO crashes reduced	Crash Savings Benefit	B/C Ratio
No-Build	11'	varies	N/A					N/A	N/A
Full-Build	12'	10' (8' paved)	$13,100,000	22	4	70	13	$1,181,340	0.09
PBFS	11'	8' (4' paved)	$4,500,000	22	4	70	13	$1,181,340	0.26
HSIP	11'	4' paved	$3,100,000	22	4	70	13	$1,181,340	0.38

Concept	Lane Width	Shoulder Width	Construction Cost	IHSDM					
				Injury crashes	Injury crashes reduced	PDO crashes	PDO crashes reduced	Crash Savings Benefit	B/C Ratio
No-Build	11'	varies	N/A	81	0	172	0	N/A	N/A
Full-Build	12'	10' (8' paved)	$13,100,000	78	3	166	6	$879,000	0.07
PBFS	11'	8' (4' paved)	$4,500,000	79	2	167	5	$590,500	0.13
HSIP	11'	4' paved	$3,100,000	81	0	171	1	$4,500	0.00

8.3 Partial New Route

The land surrounding KY 151 near the community of Alton consists of mostly residential houses and businesses that line both sides of the roadway. A new route to the south, as shown in **Figure 23**, would allow through traffic to bypass Alton. The estimated 2021 construction cost for this concept is $9.3 million.

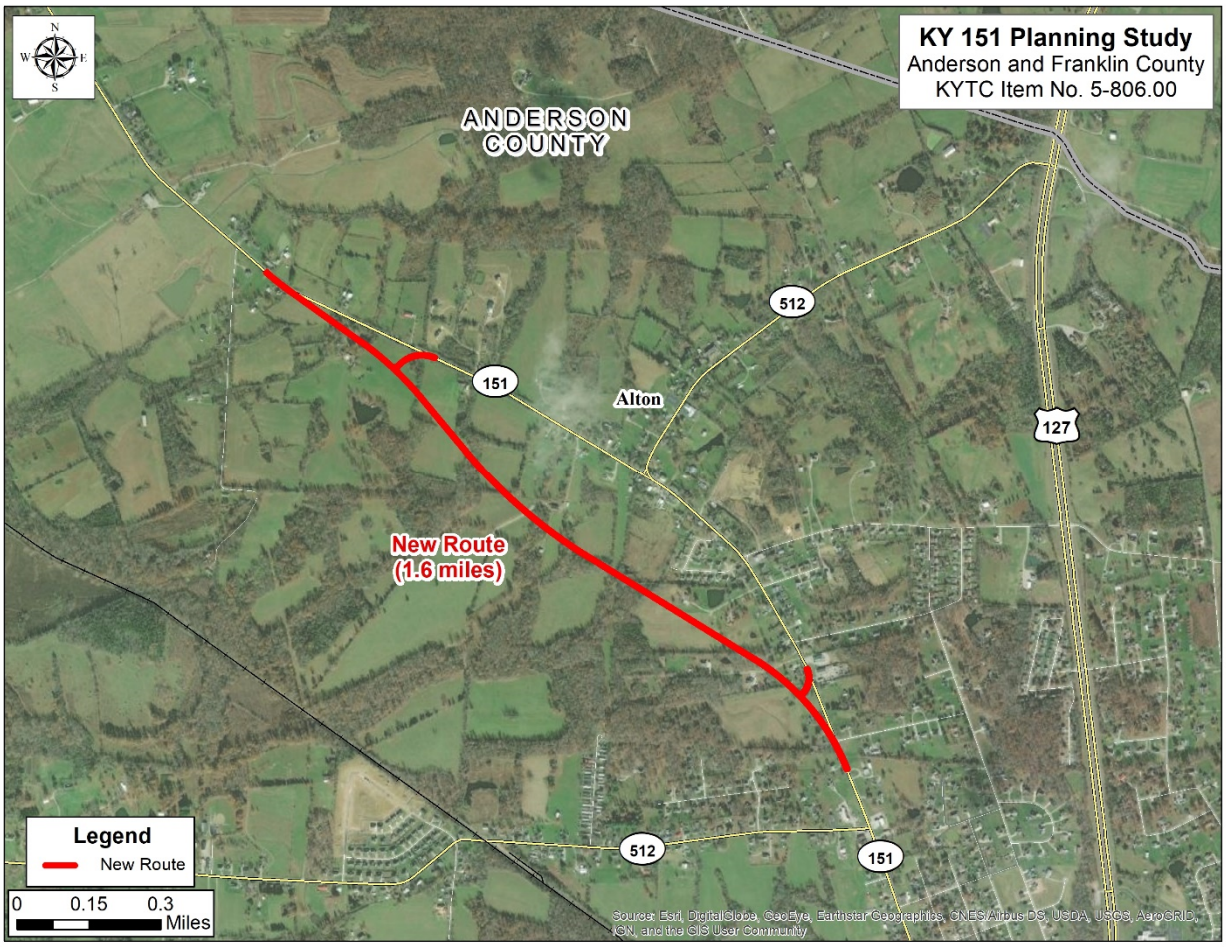


Figure 23: Partial New Route around Alton

9.0 Second Project Team Meeting

The project team met for a second time virtually on April 27, 2021 at 2:30 p.m. EDT. The purpose of the meeting was to discuss and prioritize improvement concepts. Key discussion items included the following:

- Allowing right-turn overlaps at the US 127 intersection for Spot Improvement 1 will require U-turn restrictions on US 127. This is not expected to be an issue for the district.
- A free-flow right-turn lane from KY 151 ending at the entrance to the south on US 127 will not be considered due to the low demand for right-turning vehicles from US 127.
- There is a new residential development on Alton Station Road (KY 512) that will increase the number of turning vehicles to/from KY 151.
- The project team decided to remove transverse rumble strips from Spot Improvement 3.

- The project team decided to remove the Spot Improvement 6 option to relocate Huntington Woods Road. Converting the existing Huntington Woods Road intersection to a right-in/right-out will also not be considered.

10.0 Study Conclusions

KY 151 provides a direct connection between I-64 (exit 48) and Lawrenceburg, and indirectly connects to the Bluegrass Parkway via US 127 through and south of Lawrenceburg. However, the US 127 corridor is a parallel route which was reconstructed in the early 1990's to provide an improved alternative and to serve as the primary truck route between Lawrenceburg and I-64. As US 127 has four lanes with wide shoulders and is more compatible with higher traffic volumes and semi-trailer operation, it is listed on the Truck Network and negates the need for the parallel KY 151 to be listed.

Lane widths along the KY 151 corridor range between 11 and 12 feet with paved shoulder widths varying between 1.5 and 10 feet. The speed limit ranges from 35 miles per hour (mph) at the south end to 55 mph along the majority of the corridor. Somewhat inconsistent typical sections (particularly the shoulder widths) create undesirable 'transition zones' where drivers tend to travel too fast for the roadway geometrics. For example, a driver may travel southbound at a higher rate of speed where the wide lanes and shoulders are provided in Franklin County and may not slow down before reaching the narrower lane and shoulder widths to the south in Anderson County.

Based on an existing and future year traffic analysis, a two-lane road provides adequate capacity. However, there is one intersection (KY 151 / US 127) with less than desirable traffic operations, a second intersection (KY 151 / Alton Station Road) where turn lanes are warranted, and other locations along the corridor with higher-than-expected crash frequencies.

10.1 Benefit-to-Cost Analysis and Prioritization

To assist in prioritizing improvement concepts, the project team conducted a benefit-to-cost (B/C) analysis. This analysis provided a means for determining which improvements have the greatest benefit and are the most economical. The B/C was conducted based on crash savings. CMFs were used to quantify crash reduction savings by estimating the number crashes that would be reduced by implementing the improvement concept. The total benefit was then divided by the total cost to produce a B/C ratio (BCR).

The evaluation matrix in **Table 4** provides a description of the improvement(s), the construction cost estimate, 10-year crash savings, BCR, and the project team recommended prioritization. The improvement concepts were categorized as high, medium, low, or "not recommended at this time".

Table 4: Prioritized Improvement Concepts

Improvement Concept	Project Length (miles)	Improvement Options	2021 Construction Cost Estimate	10-YR Crash Savings	Benefit-to-Cost Ratio	Priority
No Build	6.7	No Build	N/A	N/A	N/A	N/A
Spot 1	0.3	Reduce Right-Turn Radius	$130,000	$274,000	2.11	High
		Optimize Signal Timing				
		Install Curve/Speed Warning Sign				
		Convert Village Circle Entrance to a Right-In Right-Out				
Spot 2	0.3	Construct Left-Turn Lane and Right-Turn Lane on KY 151	$400,000	$236,000	0.52	High
Spot 3	0.3	Cut Trees Away from Roadway	$300,000	$325,000	1.59	High
		Minor Widening and Improve Clear Zone				
		Install Flashing Speed Warning Sign				
Spot 4	0.6	Minor Curve Widening through Two Curve	$300,000	$9,000	0.03	Low
Spot 5	0.3	Minor Widening and Improve Clear Zone	$400,000	$88,000	0.88	Medium
Spot 6	0.3	Realign Channelized Right-Turn Lane	$200,000	$162,000	0.81	Medium
Minor Widening	6.7	Widen Shoulders for Entire Study Area	$5,100,000	$1,086,000	0.21	Not Recommended
New Route	1.6	Construct New Road Around Alton	$16,900,000	N/A	N/A	Not Recommended

High Priority (in no particular order)

- Spot Improvement 1: This is a high crash location with the critical crash rate factor (CRF) equal to 3.93. The improvement concept will reduce the eastbound KY 151 right-turn radius, optimize signal timing by allowing right-turn overlaps on both KY 151 approaches, install a 35-MPH curve warning sign, and convert Tile Village Circle to a right-in / right-out. The benefits of the improvements outweigh the costs

- Spot Improvement 2: Based on KYTC'S Highway Design Manual, KY 151 satisfies the warrants for a left-turn lane and a right-turn lane at Alton Station Road (KY 512). The improvement concept will construct a left-turn lane from northbound KY 151 onto KY 512 and a right-turn lane on southbound KY 151 onto KY 512.

- Spot Improvement 3: Narrow shoulders and steep slopes with reduced clear zone may be a factor in a number of the roadway departure crashes resulting in injuries. The improvement concept will cut tree canopy and vegetation away from roadway to improve speed reduction sign visibility and improve the clear zone by improving the roadside ditches and widening the paved and unpaved shoulders. The benefits of the improvements outweigh the costs.

Medium Priority (in no particular order)

- Spot Improvement 5: This is a high crash location (CRF = 1.23) with narrow shoulders and steep side slopes. These unstable, steep slopes may be a contributing factor to roadway departure crashes and have also contributed to ongoing pavement deterioration that requires regular maintenance projects to maintain a smooth driving surface. The proposed improvements will improve the clear zone by stabilizing the slopes and widening the paved and unpaved shoulders.
- Spot Improvement 6: This is a high crash location (CRF = 2.61). The proposed improvement will realign the right-turn lane at the eastbound I-64 exit ramp which would eliminate the need for merging on KY 151 and reduce crashes.

Low Priority (in no particular order)

- Spot Improvement 4: There are two horizontal curves near Lin Moore Road that show potential for minor off-tracking for STAA vehicles. In 2016 STAA vehicles were prohibited from using KY 151 as a through route, making the need for this concept a low priority so long as the ban on through trucks remains in place.

Not Recommended At This Time

- Widening lanes and shoulders, as needed, along the entire study portion of KY 151: The costs for such improvements would far outweigh the potential benefits.
- A new route to the south of KY 151 to allow through traffic to bypass Alton: Not recommended due to the relatively high cost.

As noted, the minor widening and new route options had high costs relative to the expected benefits and are not recommended at this time. The project team determined the spot improvement concepts, shown in **Figure 24**, meet the study goals and together will enhance regional mobility and provide a safer north-south corridor between US 127 and I-64.

10.2 Next Steps

The next phase for any of the recommended improvement concepts would be Phase 1 Design (Preliminary Engineering and Environmental Analysis). Further funding will be necessary to advance to the design phase. Future phases are listed with state funding in Kentucky's FY 2020 – FY 2026 Highway Plan. However, a new project estimate and scope would need to be created based on the findings of this study.

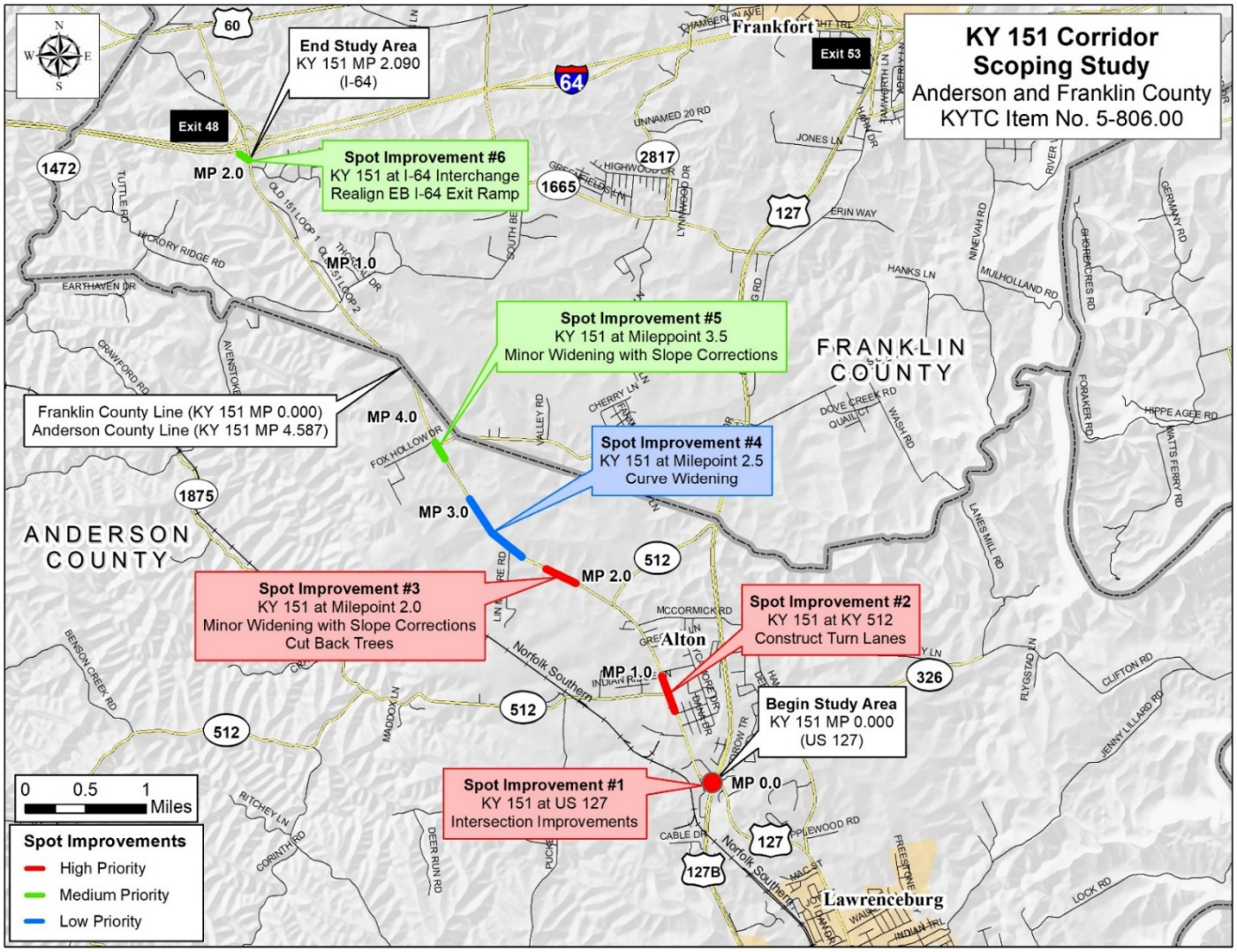


Figure 24: Spot Improvement Priorities

11.0 Contacts/Additional Information

Written requests for additional information should be sent to Stephen De Witte, KYTC Division of Planning, 200 Mero Street, Frankfort, KY 40622. Additional information regarding this study can also be obtained from the KYTC District 7 Project Manager, Casey Smith, at (859) 246-2355 (email at Casey.Smith@ky.gov).