6.0 STUDY ALTERNATES/IMPROVEMENT OPTIONS

Through discussion with local officials, stakeholders and the public, it was apparent that there were several needs to be addressed with the study alternatives. Many people were concerned about intersection safety, while others discussed issues such as the high volume of traffic and lack of passing opportunities. The alternates described in this section incorporate those comments as well as the extensive field reviews conducted as part of this study. The range of alternates developed include the following:

- Alternate One: Do Nothing/No-Build
- Alternate Two: Safety/Operational Improvements
- Alternate Three: Four Lane Facility with Limited Access
- Alternate Four: Four Lane Facility with Fully Controlled Access

6.1 Proposed Geometrics

Standard cross-sections were developed at the onset of this study for use in cost estimating. Any decision or recommendation about the actual geometrics of any future improvements will be decided during future project phases, if any.

The existing four lane segments adjacent to the project area have typical sections with mountable medians. Current Transportation Cabinet design standards do not recommend the use of mountable medians on highways in rural corridors. Therefore, two median types were considered for the project: a concrete barrier wall and a depressed grass median. Twelve (12) foot lanes and twelve (12) foot shoulders were utilized with either median option. Due to the high speed of travel, access control with a minimum spacing of 1200 feet is also recommended for the limited access alternate.

The typical cross-section with a concrete barrier wall is shown below in **Figure 5**. There are two (2) 12 foot driving lanes (24 feet total in each direction) with 12 foot shoulders on either side. A concrete barrier separates the two directions of traffic.

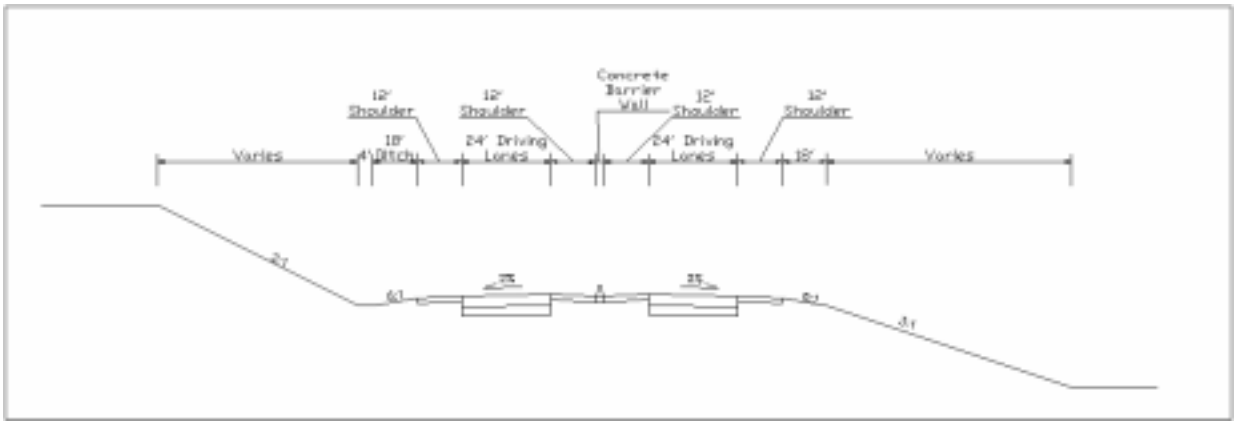

FIGURE 5 – TYPICAL CROSS SECTION WITH A CONCRETE BARRIER WALL

The typical cross section developed for a grass median is shown below in **Figure 6.** As with the concrete barrier wall, there are two (2) 12 foot driving lanes (24 feet total in each direction) with 12 foot shoulders on either side. A 40 to 60 foot grass depressed median separates the two directions of traffic.

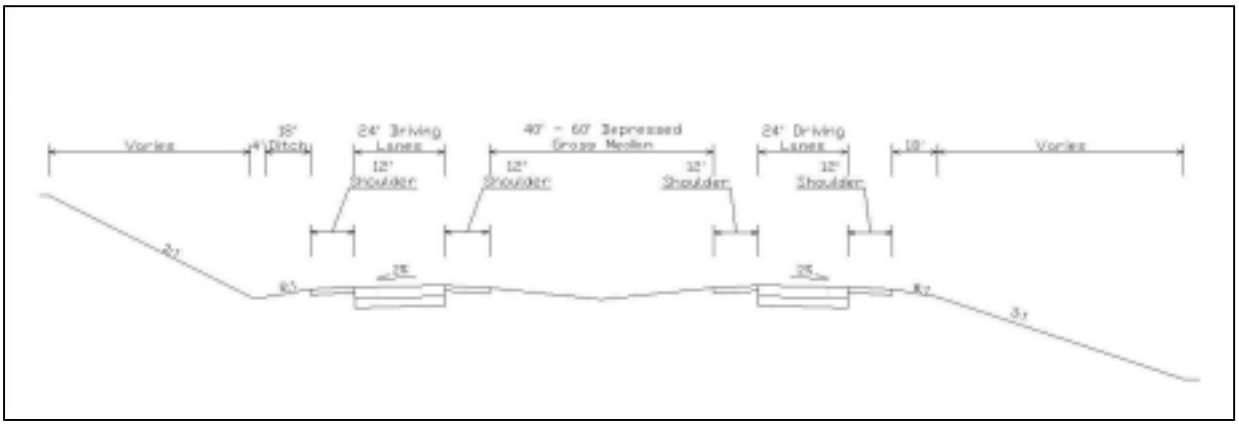

FIGURE 6 – TYPICAL CROSS SECTION WITH A GRASS MEDIAN

6.2 Alternate 1 - Do Nothing/No Build

This alternate involves no action to improve the facility other than routine maintenance, such as resurfacing and re-striping the roadway. It was presented to and discussed among the project stakeholders. The stakeholders were not in favor of this alternate since it does not address any of the project goals established. Design Year 2025 traffic would operate at an LOS of E or F for the entire corridor. Sight distance, intersection safety, and speed differential problems would remain.

6.3 Alternate 2 - Safety/Operational Improvements

A thorough field investigation was performed to identify potential low cost improvements along the KY 9 corridor. One purpose of the field visit was to determine consistency of design throughout the corridor, including the treatment of intersections and private drives. The issues found are addressed specifically in the sections below.

A. Rumble Strips

The KY 9 corridor has an unusually large percentage of vehicle collisions with guardrails. This safety improvement could reduce these types of crashes by alerting the inattentive driver that he/she is leaving the roadway. This also can potentially reduce the occurrence of drivers using the shoulders to pass vehicles because the audible and physical vibration would cause driver discomfort. The Cabinet is currently conducting a field evaluation of center-line rumble strips. Based on the results of that experimental installation, further use of this technique may be considered. Such centerline strips, when properly designed and placed, do not interfere with snow removal or passing opportunities on the road. During rainy conditions, the visibility of the centerlines of the road is enhanced by the angle of the reflective painting on the strips. Rumble

strips across the traffic lanes could also be explored at high-speed locations to alert motorists to slow for an upcoming intersection.

B. Field Entrances
Over 30 field entrances were observed within the project area. It is apparent, because of the overgrowth of grass/shrubbery or the extreme grading, that many of the field entrances along the KY 9 corridor are used infrequently. A large number of entrances are located very close to one another, but cannot physically be combined due to the topography. Depending on the land use, these entrances might be modified to enhance control of access. Entrances with poor sight distances should be considered for elimination. This may reduce crashes at these locations by eliminating merging / diverging traffic at these points along the roadway.

C. Driveways
The study portion of KY 9 contains over a dozen commercial drives or subdivision entrances and that number is expected to increase with the addition of the new Industrial Park in Bracken County. Most of these driveways have insufficient radii with guardrail placed close to the edge of pavement. It is recommended that the guardrail be placed at the edge of the shoulder, at a minimum. The new subdivision just east of Hooke Lane in Bracken County is a specific example of the typical driveway problems along KY 9. It should have a right-turn lane into the subdivision as well as appropriate signing, adequate width and an appropriate clear-zone.

D. Truck-Climbing Lanes
Because of the grade of the roadway, a truck-climbing lane is needed for westbound traffic near the 2.0 mile marker in Bracken County. This lane should be extended through Hooke Lane. The truck climbing lane at the 4.0 mile marker in Bracken County does not start until the middle of the grade, and should begin earlier to prevent a reduction in operating speed. The placement of the advance warning signs for the truck lanes should be placed further back in order to suggest and induce patience in those wishing to pass vehicles. At some locations, such as at Iler Road, the truck climbing lanes end too close to the existing intersections. Delineators also need to be placed at more appropriate distances from the merge points to provide more time for the traffic to merge.

E. Entrance Signs
The placement of entrance signs along the corridor is inconsistent. Roadway intersections are marked either with a cross-road sign, a route junction sign or a combination of the two. Not all intersections are marked with a cross-road sign. The recommendation is that signing should be assessed periodically to confirm compliance with the MUTCD.

F. Turn Flares
Numerous locations along the corridor have sufficient pavement to improve the turning radius onto the side roads, but are not striped accordingly. It is recommended that these intersections be re-striped to provide safer turning movements. Caution should be taken to make these delineations in a manner that adequately distinguishes the turning lane from the through traffic lane.

G. T-Intersection Signage
Many of the T-intersections on routes approaching KY 9 are signed only with a black-on-white double arrow sign showing the route designation. The Cabinet may consider the addition of black-on-yellow double arrow warning signs at these intersections to alert motorists of the route's junction with KY 9.

H. Fog

There are a limited number of feasible alternates to deal with the heavy fog that plagues the area on over 60 days each year. A public education campaign including safety brochures, heavier traffic enforcement patrols during heavy fog and radio and television announcements may help both reduce operating speeds and keep operating speeds uniform on the corridor during these events. Visibility sensors and weather stations along the corridor would help increase early notification of these events. Highway Advisory Radio messages may also prove beneficial.

Another alternative is the use of an automated lane indication system. By utilizing existing airport technology, this system uses a sensor to predict heavy fog conditions. Lighting installed in the pavement outlining the lane edges is activated automatically when the heavy fog conditions are sensed. By having the lanes outlined, the lights greatly increase visibility conditions in times of heavy fog, thus creating safer operating conditions. Additionally, these lights are recessed into the pavement so as not to hinder snow removal operations. Since they are used at virtually every commercial airport in the United States, the lights are readily available and qualified installation services are easily attainable. This type of system has been used successfully in many locations, including I-64 near Charlottesville, Virginia.

Finally, the safest approach is to get vehicles, particularly heavy trucks, off the road during these time periods. Rest areas along the corridor may provide a safe haven for these vehicles during these times.

I. Lighting

A few intersections along the KY 9 corridor are currently without overhead lighting; however, many complaints from the public have centered on what is perceived as an overall lack of lighting in the corridor. Roadway lighting can reduce the ratio of night-to-day crashes. Given that many crashes on KY 9 are occurring during night hours this would likely result in a high benefit/cost ratio for the corridor. Those intersections without lighting should be reconsidered for lighting, as studies have shown it can reduce night crashes by 45%.

J. Driver Fatigue

KY 9 has experienced numerous crashes that can likely be attributed to driver fatigue. The Kentucky State Police Accident Database rarely codes crashes as fatigue related, but most likely the fatal crossover crashes are the results of drivers falling asleep at the wheel. There are three countermeasures to consider for this problem: public awareness, rumble strips and rest areas. In some locations, the public awareness campaigns have been targeted specifically toward shift workers. A monthly blitz has been used at other locations to inform citizens of the dangers of falling asleep at the wheel. Landscaping, improved lighting, roadside and pavement reflective markings, and billboards (including some targeted toward drowsy drivers) have also been credited for increasing driver awareness in other corridors in the state. Rumble Strips, as discussed above, may reduce the number of crashes related to driver fatigue by alerting the motorists of the impending danger if their driving is not immediately corrected. An option that would reduce the number of cross-over crashes is the installation of median barriers, with costs ranging from $80,000 to $1,000,000 per mile, depending on the need to widen the road to accommodate the barrier.

K. Truck Traffic

Currently, a heavy volume of truck traffic is observed on KY 9. Truck traffic may be using KY 9 as an alternate route to avoid safety checks or heavier speed enforcement. Developing weigh stations along the corridor may decrease the volume of truck traffic and increase safety inspections, thereby making the route safer for automobiles.

L. Collisions with Deer

One of the primary causes of crashes, particularly in the Pendleton County area, is collision with deer. Deer reflectors have proven to work successfully in other parts of the country where white tail deer are problematic to vehicular travel. It is proposed that the Cabinet install deer reflectors throughout the project area. Because deer access to the roadway is prohibited in several areas due to the rolling terrain, the entire corridor would not need to be equipped with the reflectors. At a cost of less than $8,000 per mile and minimal maintenance needs, the cost/benefit ratio of this alternative could be recovered with a reduction of fewer than 10 crashes over the life of the equipment.

Furthermore, only one deer warning sign exists along the corridor. This is for eastbound traffic just entering Pendleton County. The Cabinet should consider the addition of a similar sign placed for westbound traffic. This would increase driver awareness of the deer problem on the roadway in this area.

M. Intersection Delineation

Currently, pavement markings on the side of KY 9 are rarely seen at intersections. The white stripe either abruptly stops or curves with the radii of the intersecting road. This prevents drivers, especially in nighttime and fog conditions, from clearly seeing the driving lanes. Skip reflectors should be continued through the intersections to delineate the KY 9 roadway lane from the adjoining road. This will allow motorists to clearly see the driving lanes at all times through the intersection, and allows vehicles approaching the highway to determine the edge of KY 9.

Alternate 2 would only partially meet the project goals for the improvement of KY 9 as determined in this study. These improvements would increase the safety of the roadway by increasing the awareness of the motorists. It would also increase safety by improving the existing sight distances at intersections and during adverse weather conditions with improved lighting. This alternate may also reduce the speed differentials by improving the existing truck climbing lanes to make them more effective. However, this alternate does not address the first project goal: to provide adequate capacity for design year traffic (2025). This alternate received considerable support from the project stakeholders as an interim solution to their needs.

6.4 Alternate 3 - Four Lane Facility with Limited Access

Alternate 3 considers the widening of the roadway throughout the study area with an additional travel lane in both directions. It can be accomplished using either a concrete barrier wall or a depressed grass median. Four (4) 12' lanes and 12' shoulders are utilized with either median option. Access points would be kept to a minimum spacing of 1200'.

With either scenario, the access as provided today for driveways and intersections would be revised for this alternate. Several access points in each County would be either closed or relocated to ensure the 1200' minimum spacing. **Table 6** shows a summary of access points, broken down by county, which are proposed to be either closed or relocated. **Figures 7** and **8** show the locations of the closed/relocated access points.

Table 6: Number of Closed or Relocated Access Points

	Campbell County	Pendleton County	Bracken County	Mason County
Closed Access Points	1	3	7	0
Relocated Access Points	0	3	16	0

To help maintain access to KY 9, frontage roads may be used to link driveways that currently have KY 9 access. The utilization of these frontage roads would maintain consistency of the 1200' minimum spacing of access points to control the locations of incoming/outgoing traffic on KY 9.

Relocation impacts are minor, with approximately 4 residential homes to be relocated. Approximately 295 acres of additional right-of-way would be purchased for this alternate. This alternate has potential impacts to numerous potential cultural historic and archeological resources.

This alternate meets all of the project goals. It will provide adequate capacity for the design year (2025), improve roadway geometrics, and eliminate the sight-distance concerns. Alternate 3 also would reduce the number of crashes along the corridor by improving the intersections with KY 9 and the side roads. Finally, it would reduce the speed differentials created by merging and diverging traffic in truck lanes and intersections. These goals will be accomplished because faster moving traffic would not have to wait for a passing zone or a truck lane to pass the slower moving traffic. Also, merging and diverging traffic at intersections would have a lane to turn into without fear of an impending rear-end collision.

See **Section 6.6 Estimated Costs** for estimated costs of this alternative.

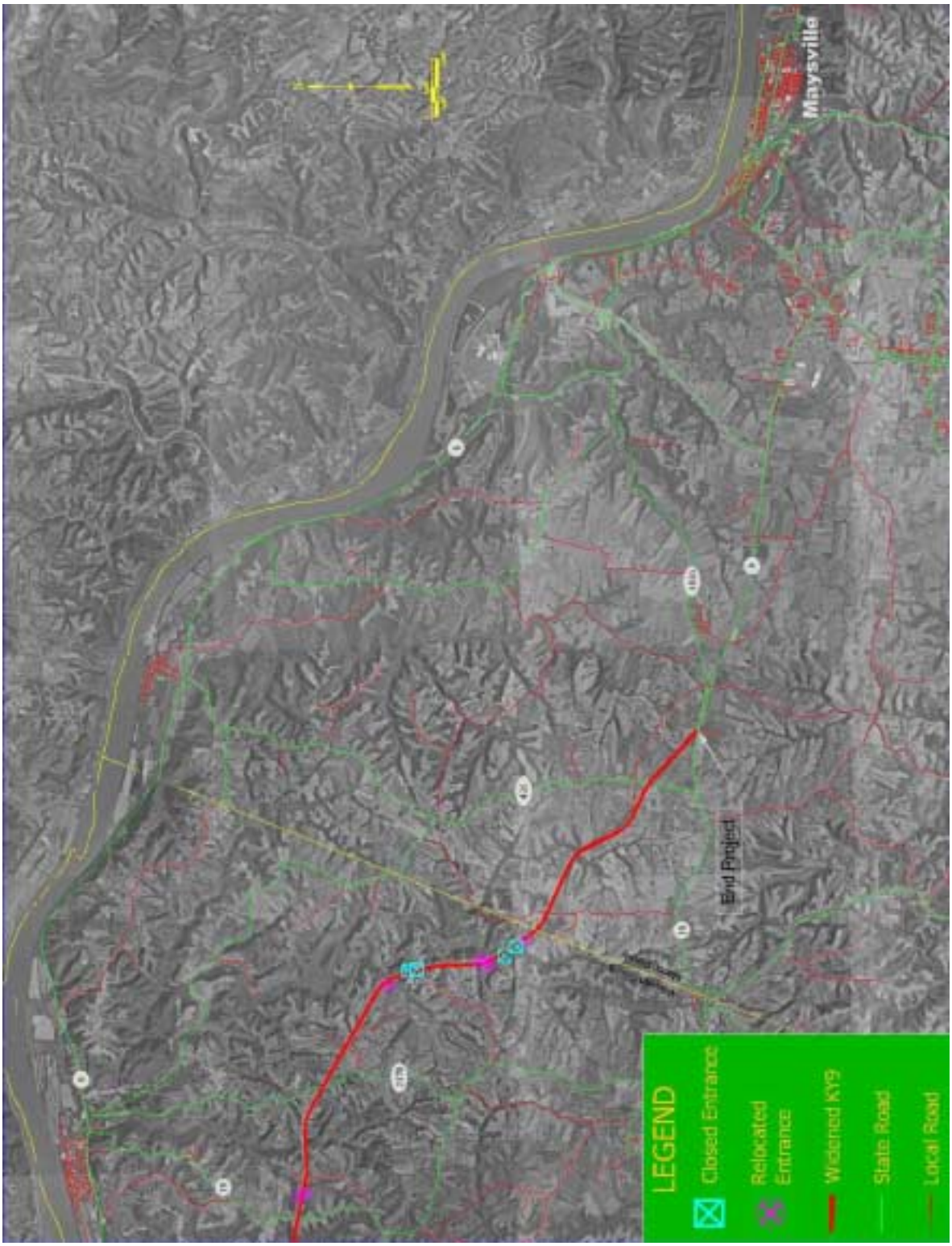

FIGURE 7 – 4-LANE PARTIALLY CONTROLLED ACCESS EAST-SIDE OF CORRIDOR

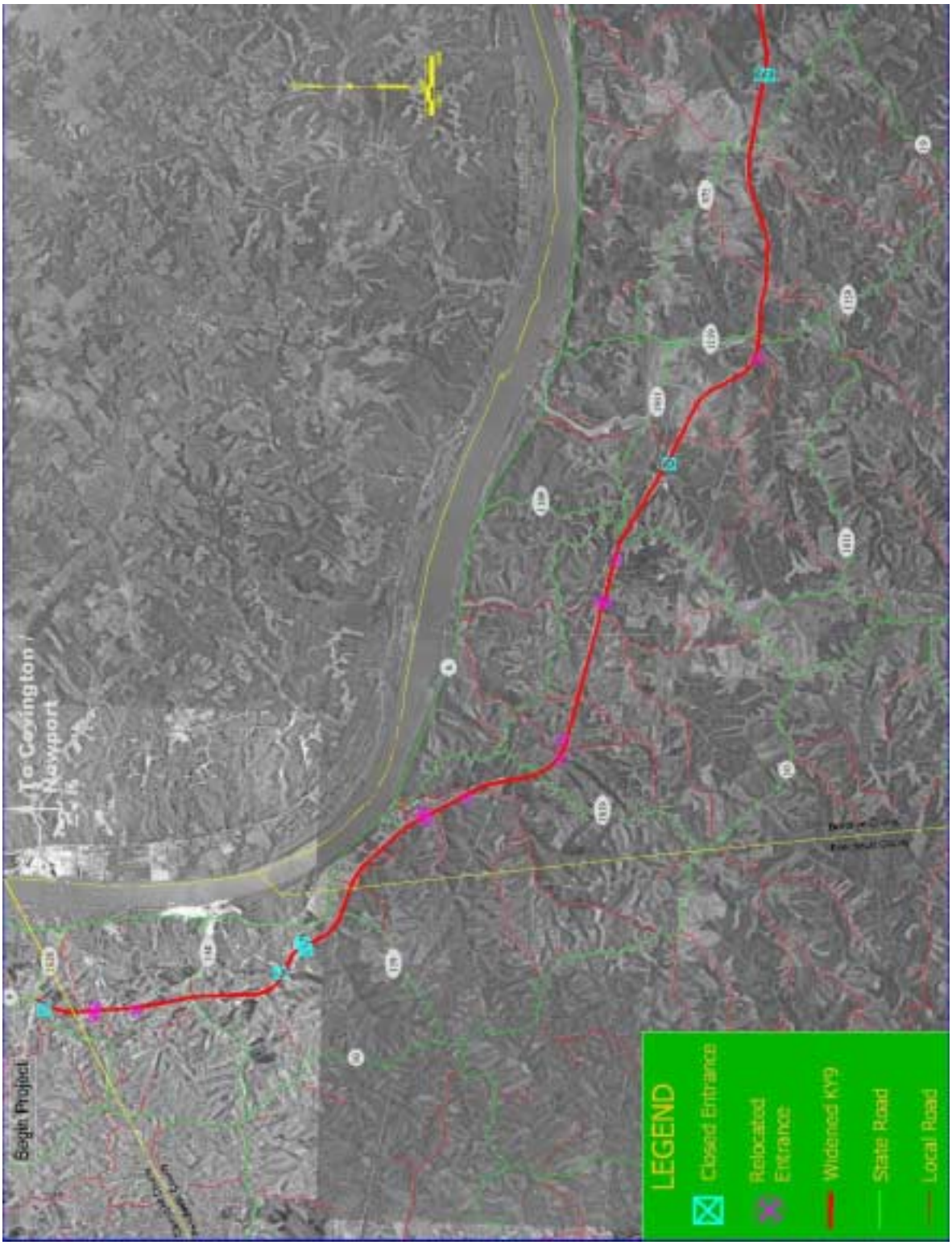

FIGURE 8 – 4-LANE PARTIALLY CONTROLLED ACCESS WEST-SIDE OF CORRIDOR

6.5 Alternate 4 - Four Lane Facility with Fully Controlled Access

Similar to Alternate 3, Alternate 4 considers widening throughout the corridor. However, unlike Alternate 3, Alternate 4 calls for a fully controlled access highway, or a freeway type facility. The design includes two (2) 12 foot driving lanes in each direction, for a total of four (4) lanes with 12 foot shoulders on each side. In order to reduce the amount of right-of-way width required for this alternate, a 30 foot median with a concrete barrier should be considered. This will provide the safety aspects of a median, without the added right-of-way width required for a 60 foot depressed grass median. This cross section is the same as the concrete barrier wall as described in **Section 6.1 Proposed Geometrics**.

This alternate removes all existing access points to KY 9 and replaces them with either a frontage road or interchange. The figures on the following pages, **Figures 9** and **10,** show the proposed placement of the frontage roads as well as potential interchange locations. For the purposes of this study, simple diamond interchanges were used for estimating costs and impacts. No decision or recommendation has been made in this study phase about the actual geometrics of any future improvements.

Alternate 4 requires approximately 476 acres of additional right-of-way. This amount is much higher than Alternate 3, due to the footprint of the proposed interchanges. This also increases the number of relocation impacts to approximately 95 residences and 1 business, and requires the closure or relocation of approximately 30 driveways/entrances. This alternate has potential impacts to numerous potential cultural historic and archaeological sites.

Like Alternate 3, Alternate 4 meets all the project goals as stated earlier in this report. The design year traffic (2025) capacity would be met and roadway geometrics would be improved, eliminating the sight distance problems and minimizing the high speed differentials. It would also lessen the number of crashes at intersections by eliminating all at-grade intersections with KY 9 except those at the proposed interchange locations.

Although Alternate 4 meets all project goals, it does so at a much higher cost than Alternate 3 (see **Section 6.6 Estimated Costs**). The public reception of this alternate was not as favorable as it was to Alternate 3. The reasons cited for this were the higher costs, the large number of relocations, and limited access. The potential impacts to the area, including relocations, cultural-historic, archaeological and environmental sites, are much higher than Alternate 3.

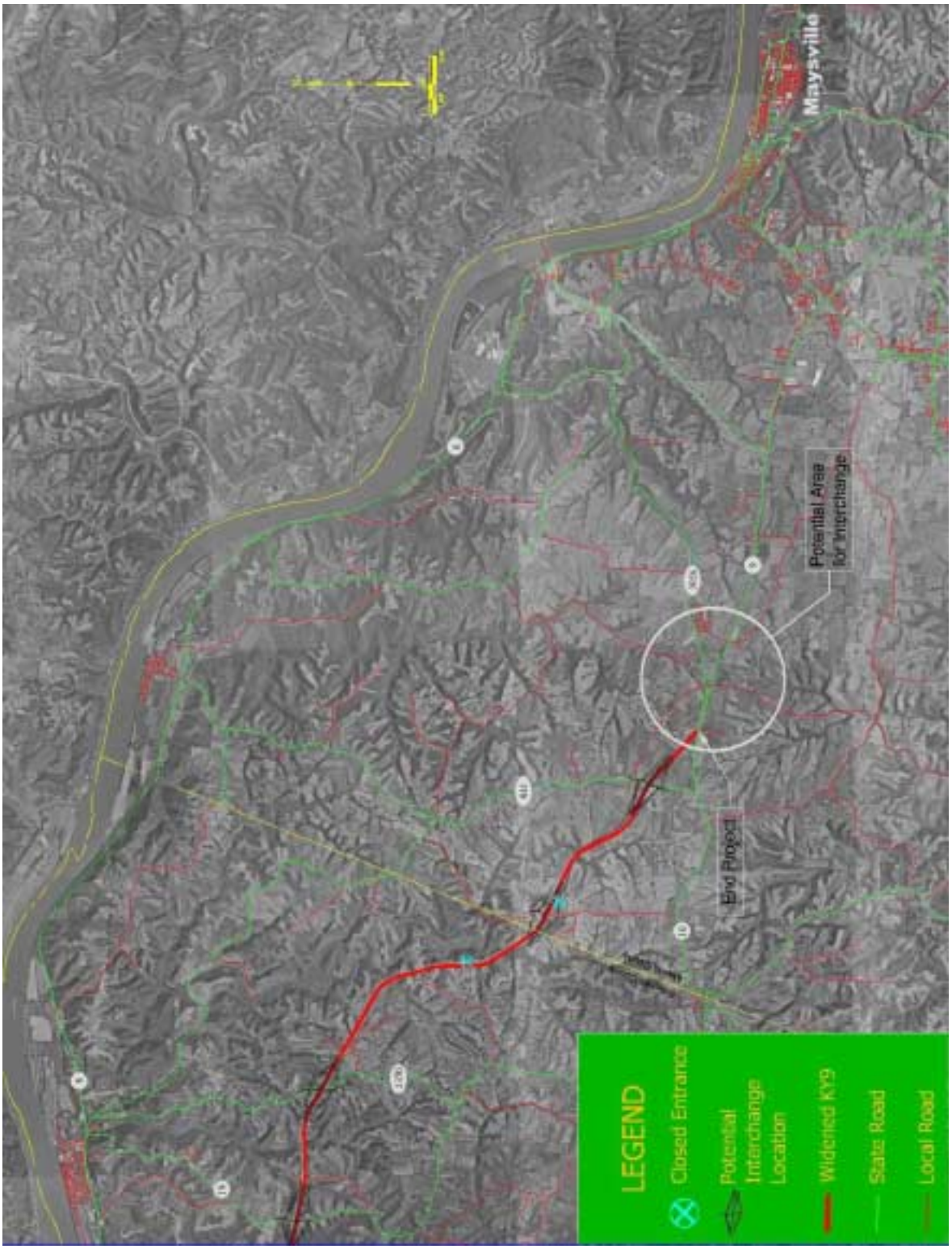

FIGURE 9 – 4-LANE FULLY CONTROLLED ACCESS EAST-SIDE OF CORRIDOR

*It is estimated that 6 to 8 interchanges will be sufficient in this corridor.

*It is estimated that 6 to 8 interchanges will be sufficient in this corridor.

FIGURE 10 – 4-LANE FULLY CONTROLLED ACCESS WEST-SIDE OF CORRIDOR

6.6 Estimated Costs

Engineering cost estimates were developed for each of the alternates. These are shown in **Appendix G**. In order to estimate the amount of earthwork required, quantities were calculated from cross sections at intervals along the project corridor. Initial attempts to utilize contours derived from digital USGS topographic quadrangle maps produced elevations inconsistent with as-built plans and geotechnical reports. By interpolating between key cross sections, the amount of earthwork for the entire corridor was estimated. The itemized costs were developed using 2001 unit bid prices from the Kentucky Transportation Cabinet - Division of Construction. **Table 7** shows the potential impacts and costs (by phase) associated with each alternate studied.

Table 7: Potential Impacts and Cost Comparison of Alternates

	Alternatives			
	1	**2**	**3**	**4**
Length (miles)	28.11	28.11	28.11	28.11
Description	No Build; Make no changes to the existing 2 lane roadway.	Safety and Operations Improvements Only; Keep existing 2 lane roadway, but make improvements to increase safety.	Partially Controlled 4-lane Road with two additional 12' lanes and a 60' depressed median. Access points kept to 1200' spacing.	Fully Controlled 4-lane Road with two additional 12' lanes and a 30' median with concrete barrier. Access provided at new interchanges only.
Potential Relocation Impacts	None	None	Approximately 4 residences	Approximately 95 residences and 1 business
Potential Right of Way Acquisition	None	None	Approximately 295 acres	Approximately 476 acres
Potential Geotechnical Impacts	None	Some earthwork anticipated to address slides that may occur (future maintenance costs).	Major earthwork anticipated to accommodate widening and to meet 2:1 cut slope and 3:1 fill slope recommendations. Benching should be anticipated to avoid slides.	Major earthwork anticipated to accommodate widening and to meet 2:1 cut slope and 3:1 fill slope recommendations. Benching should be anticipated to avoid slides.
Potential Environmental Impacts	Potential impact to air and noise quality	Widening for truck lane extensions and turning lanes has potential to impact threatened or endangered species and possibly wetland areas. Potential impact to air and noise quailty.	Has potential to impact threatened or endangered species. May impact 82 wetland areas. Possible (secondary) impact to 34 cultural historic sites.	Possible impact to 6 potentially significant cultural historic sites, a recorded archaeological site, and 27 potentially historic sites (1 site on the National Register of Historic Places). Also has potential to impact threatened or endangered species and 82 wetland areas.
Future Level of Service	D-F (varies with location)	D-F (varies with location)	A	A
Conceptual Cost Estimate by Phase		Depending upon the improvement strategies selected, the costs could range from less than $100,000 for signing alone to approximately $30,000,000 if rest areas and weight stations are constructed along with all of the other proposed improvements.		
Design	$0		$12,887,000	$33,860,000
Right of Way	$0		$3,589,000	$19,410,000
Utilities	$0		$540,000	$2,140,000
Construction	$0		$161,082,000	$423,252,000
Total	$0		$178,098,000	$478,662,000
Relation to Project Goals	1. Does not provide adequate capacity to support Design Year 2025 traffic volumes 2. Does not improve existing roadway geometrics to address sight distance concerns 3. Does not reduce the number of crashes along the route by improving intersection safety 4. Does not reduce speed differentials by improving truck climbing lane merge and diverge points.	1. Does not provide adequate capacity to support Design Year 2025 traffic volumes 2. Does improve some existing roadway geometrics to address sight distance concerns 3. May reduce the number of crashes along the route by improving intersection safety 4. May reduce speed differentials by improving truck climbing lane merge and diverge points	1. Does provide adequate capacity to support Design Year 2025 traffic volumes 2. Does improve some existing roadway geometrics to address sight distance concerns 3. May reduce the number of crashes along the route by improving intersection safety 4. May reduce speed differentials by improving truck climbing lane merge and diverge points	1. Does provide adequate capacity to support Design Year 2025 traffic volumes 2. Does improve some existing roadway geometrics to address sight distance concerns 3. May reduce the number of crashes along the route by improving intersection safety 4. May reduce speed differentials by improving truck climbing lane merge and diverge points