Final Report

KY 8 Scoping Studies
Mary Ingles Highway Scoping Study

Prepared for:

KENTUCKY TRANSPORTATION CABINET

Kentucky Transportation Cabinet
Central Office, Division of Planning
Highway District 6, Covington

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Executive Summary

As a component of the KY 8 Scoping Studies in Kenton and Campbell County, Stantec was asked to examine the underlying geotechnical issues adversely affecting portions of the route in eastern Campbell County and to develop conceptual alternatives and cost estimates to address them. The KY 8 - Mary Ingles Highway study area includes the existing KY 8 corridor in Campbell County from Dodd Drive in Dayton (MP 3.266) to KY 445 in Fort Thomas (MP 7.902). The study portion, shown on **Figure ES-1**, is 4.6 miles in length.

Departing Newport, the Mary Ingles Highway carries approximately 1,400 vehicles per day as it travels along the Ohio River through Dayton and Fort Thomas in eastern Campbell County. Between Dayton and the I-275 underpass, KY 8 has been plagued with pavement and embankment slope failures as the roadway continually slides into the river. The roadway embankment slope on the east / Ohio River side of the roadway consists largely of alluvium materials of silt, clay, and gravel. The west side of the roadway is in a cut section, with the adjacent hillside consisting primarily of shale. The roadway is located at the interface of the shale and the Ohio River alluvium, resulting in unstable slopes. The weight of the roadway structure combined with drainage issues in both the shale materials and roadway result in embankment slope failures, roadway subgrade failures, and general movement of the pavement structure.

While maintenance activities have been undertaken to minimize damage to the roadway and inconvenience to drivers, KYTC District 6 is seeking alternatives to the on-going maintenance needs. KYTC District 6 Maintenance has spent, on average, about $77,000 per year over the past five years in on-going maintenance in addition to costs that have been incurred when a pavement break has occurred that requires closing the roadway and addressing the failure. The Purpose and Need for the project is as follows:

> *KY 8 (Mary Ingles Highway) travels along the Ohio River through Dayton and Fort Thomas in eastern Campbell County. Between Dayton and KY 445, KY 8 has been plagued with slippage issues as the roadway is sliding towards the river. While maintenance activities have repeatedly been undertaken to minimize damage to the roadway and to maintain a usable driving surface,* ***the purpose of the project is to provide a permanent solution to the underlying geotechnical issues.***

The project team examined the geotechnical conditions and other similar projects in northern Kentucky to develop conceptual improvement alternatives. North of the railroad underpass (i.e. KY 8 travels under the railroad bridge) at MP 5.0, two reconstruction options were developed, one that reconstructs the roadway on its existing alignment (alternative 1a), and one that realigns the roadway (alternative 1b) west of the rail line. South of the railroad underpass, a single improvement concept was developed (alternative 2) that improves the route within the existing corridor but shifts it slightly away from the rail line.

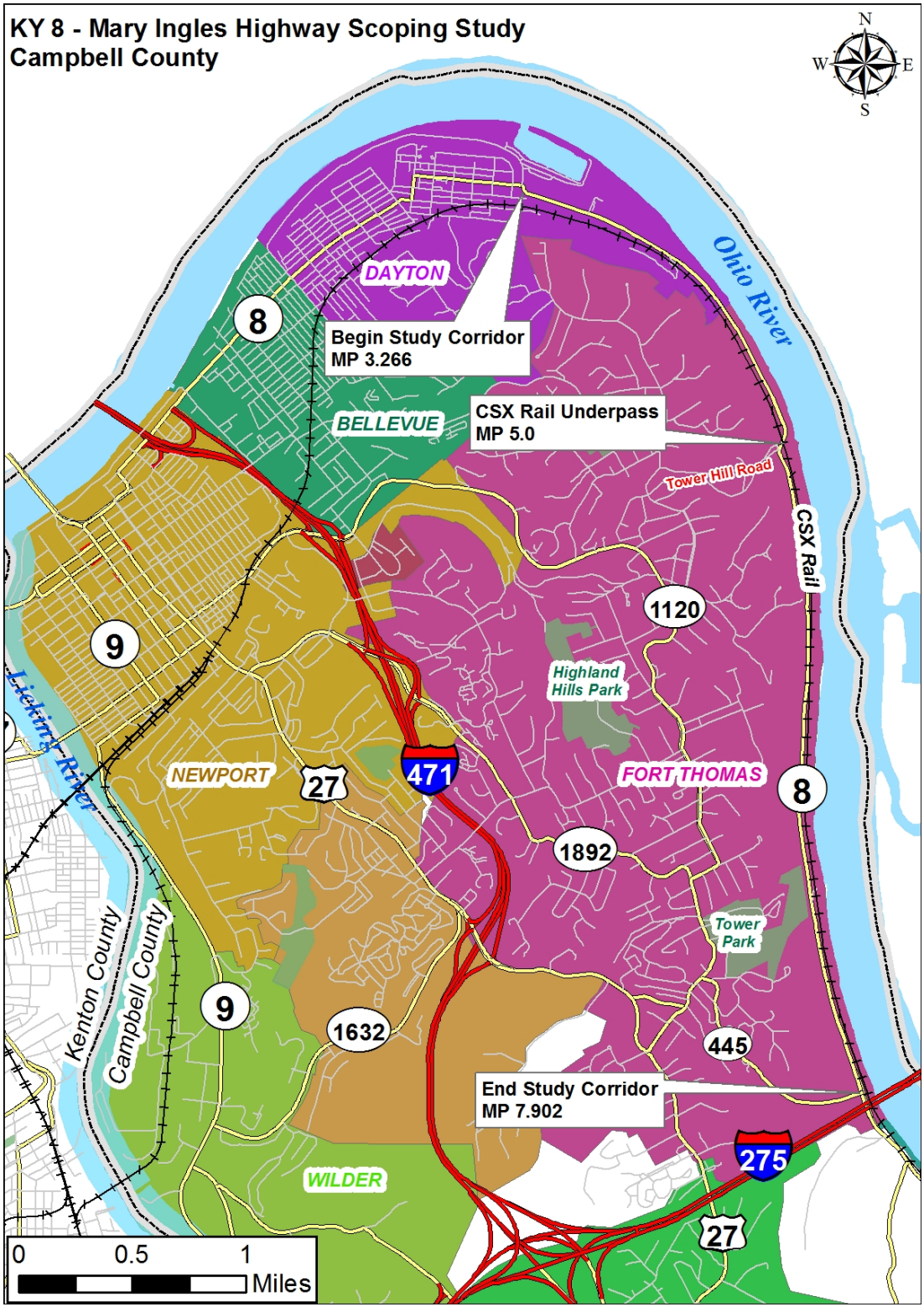

Figure ES-1: Study Area – KY 8 (Mary Ingles Highway) Scoping Study

While extensive geotechnical investigations, analyses, and designs would be required in future project development phases, these concepts were based on the best information available. Where the roadway is reconstructed in-place (alternative 1a and alternative 2), the existing pavement section and subgrade materials are removed and replaced with more suitable materials, and underdrains are included within the new subgrade to improve drainage. Tie-back walls are used to stabilize fill slopes. As an alternative to reconstruction in place, a realignment (alternative 1b) was considered to move KY 8 west off the railroad and away from the Ohio River north of MP 5.0. The construction cost estimates for these reconstruction alternatives, summarized in **Table ES-1**, range from $62.3 to $67 million.

A reconstruction project of this nature would likely take more than one year to build and maintaining traffic on the existing route would likely be infeasible given the location and magnitude of the work to be done. One business (Aquaramp Marina) would not have roadway access during construction. The acquisition of this business in addition to three home acquisitions would result in right-of-way costs of approximately $4.5 million.

There are existing utilities that cross and run along the existing roadway that would need to be relocated as part of the reconstruction of KY 8. Northern Kentucky Sanitation District No. 1 has 3.3 miles of sanitary sewer force mains, gravity sewers, and manholes that run parallel to existing KY 8. Duke Energy has 4,000 feet of gas mains and the Northern Kentucky Water District has 4,000 feet of water lines running parallel to existing KY 8. The Northern Kentucky Water District also has two water intake facilities in the study corridor, which have 16-inch steel encasement waterlines that cross KY 8. In total, the utility relocation costs are estimated to be $8.0 million.

Project	Description	Length	Design ($ Millions)	Right-of-Way ($ Millions)	Utility Relocation ($ Millions)	Construction ($ Millions)
1a. Slope Stabilization north of MP 5.0	Replace pavement section and stabilize fill slope using a tieback wall between Marina entrance at MP 4.0 and RR underpass at MP 5.0.	1.0 Miles	$1.2	--	--	$8.2
1b. Realign KY 8 north of MP 5.0	Realign KY 8 north of MP 5.0 to connect to 6th Avenue in Dayton.	1.6 Miles	$1.8	--	--	$12.9
2. Shift Alignment and Slope Stabilization south of MP 5.0	Shift KY 8 west from RR underpass at MP 5.0 to KY 445 at MP 7.9 and replace pavement section. Stabilize fill slope using a tieback wall.	2.9 Miles	$7.8	--	--	$54.1
SUBTOTAL - Project 1a and 2		**3.9 Miles**	**$9.0**	**$4.5**	**$8.0**	**$62.3**
SUBTOTAL - Project 1b and 2		**4.5 Miles**	**$9.6**	**$4.5**	**$8.0**	**$67.0**

Table ES-1: Preliminary Cost Estimates for Reconstruction of Mary Ingles Highway

Given the extremely high cost of reconstructing the roadway within the study area compared to the relatively low demand for travel within the corridor, consideration was given to potential rerouting options where KY 8 would be re-designated to other existing roadways and the study portion of Mary Ingles Highway would be closed to through traffic. State-maintained roadways within Campbell County were considered under this analysis, with a goal of identifying options that provided similar or better roadway geometrics and traffic operation conditions compared to the existing KY 8. Six rerouting concepts were identified, with four that connect to KY 8 at the KY 445 (River Road) intersection and two that connect at the KY 1998 (Industrial Road) intersection. Each of these options, summarized in **Table ES-2**, can accommodate the additional traffic that would divert away from KY 8 at a relatively low cost, but further examination and discussion would be required before an option could be implemented.

Routing Options	Name	Description	Distance (miles)*	Approx. Travel Time (minutes)*	Traffic Signals*	Comments
Existing	KY 8	Existing Mary Ingles Highway	6.8	14	9	
KY 445 (River Road) Options	KY 1120 (Fort Thomas Ave.)	US 27 (York St.) to KY 1120 (10th St./ Fort Thomas Ave.) to KY 445	7	21	24	Passes through dense residential and commercial development.
	KY 1892 (Grand Ave.)	US 27 (York St.) to KY 1892 to KY 1120 to KY 445	5.7	17	23	Passes through dense residential and commercial development.
	I-471	I-471 to US 27 (exit 2) to KY 1120 to KY 445	5.3	9	5	Shortest distance and travel time.
	US 27 (Alexandria Pike)	US 27 (York St./ Alexandria Pike) to KY 1120 to KY 445	5.4	16	28	
KY 1998 (Poole's Creek Road/ Industrial Road)	US 27 (Alexandria Pike)	US 27 (York St./ Alexandria Pike) to KY 1998	9.9	26	40	KY 1998 suffers from underlying geotechnical issues and some areas with relatively poor geometry.
	KY 9 (Licking Pike)	KY 8 (4th St.) to KY 9 to KY 1998	11.2	24	20	KY 9 will be reconstructed through Newport (KYTC Item No. 6-8101.00)

*All measurements are from the I-471 interchange in Newport to the KY 445 intersection with KY 8 (KY 1998 options are measured to the KY 1998 intersection with KY 8.)

Table ES-2: Rerouting Concepts for KY 8 in Campbell County

If KY 8 were to be closed to through traffic, one business (Aquaramp Marina) and three homes would no longer have roadway access. Unless alternative access is provided, or a portion of KY 8 is maintained by an agency other than KYTC, these acquisitions would result in right-of-way costs of approximately $4.5 million. Further, there is utility infrastructure in the KY 8 corridor that would require access for maintenance, including overhead power lines and water intake facilities for the Northern Kentucky Water District.

The study portion of KY 8 is also a popular corridor for bicycle enthusiasts and is designated by the Ohio-Kentucky-Indiana Regional Council of Governments (OKI) as a preferred bicycle route.

If the roadway is closed to through traffic, either temporarily (during reconstruction activities) or permanently, coordination with OKI and bicycle advocacy groups will be necessary. While it may be considered desirable to maintain a shared-use facility in the KY 8 corridor should it be closed to vehicular traffic, the construction and on-going and long-term maintenance of such a facility would be the responsibility of an agency other than KYTC.

To better quantify the long-term costs for the alternatives under consideration, some effort was provided to estimating the future expenditures required. The three alternatives include doing nothing (the No-Build Scenario), reconstructing the existing alignment, and closing KY 8 to through traffic and rerouting it to other state-maintained facilities. The resulting expenditures (in year of expenditure dollars) are shown in **Table ES-3**.

Methodology	Initial Capital Expense	Right-of-Way Costs	Annual Maintenance Costs without reconstruction	Cost for Pavement Rehabilitation or Mill and Overlay in 2025	Inflation Rate	Expenditures Through 2030 (in Year of Expenditure dollars)
I. No-Build (Continue maintenance, as required)	$0	$0	$350,000	$6,200,000	2.40%	$12,440,000
II. Reconstruct KY 8 (Note: capital costs assumed in year 2020 dollars)	$68,500,000	$4,500,000	$350,000	$1,000,000	2.40%	$75,080,000
	$73,700,000	$4,500,000	$350,000	$1,000,000	2.40%	$80,280,000
III. Reroute KY 8 to Other State Routes	$1,000,000	$4,500,000	$350,000	$0	2.40%	$5,850,000

Table ES-3: Estimated Capital Expenditures through 2030 for KY 8 Alternatives

Based on these assumptions, the No Build alternative would result in expenditures of more than $12.4 million over the next 15 years. The reconstruction alternatives would range from just over $75 million to nearly $80.3 million. The rerouting alternative would have the lowest overall cost at approximately $5.85 million.

1.0 INTRODUCTION

The Kentucky Transportation Cabinet (KYTC) initiated the KY 8 Scoping Studies to examine transportation needs within two unique sections of KY 8 in Kenton and Campbell Counties. The purpose of the first component study, the KY 8 – Licking River Bridge Scoping Study, is to explore options to replace the KY 8 (4th Street) bridge over the Licking River on the Campbell and Kenton County line. The Licking River Bridge replacement project has been identified as Item No. 6-1086.00: replace bridge over the Licking River on West 4th Street (KY 8) in Covington/Newport at Kenton/Campbell County line. The project is not funded in the current biennium, but has federal bridge replacement (BRX) funds allocated for 2021. The location of the existing bridge is shown on **Figure 1**.

This report summarizes the findings from the second component of the project, the KY 8 – Mary Ingles Highway Scoping Study. The primary goal of the study was to address on-going landslide and embankment slope failures that compromise the roadway's ability to safely accommodate traffic. The study area includes the existing KY 8 corridor in Campbell County from Dodd Drive in Dayton to KY 445 in Fort Thomas. The study corridor is 4.6 miles in total length. The general project area, shown in Figure 1, is located in eastern Campbell County along the southern bank of the Ohio River.

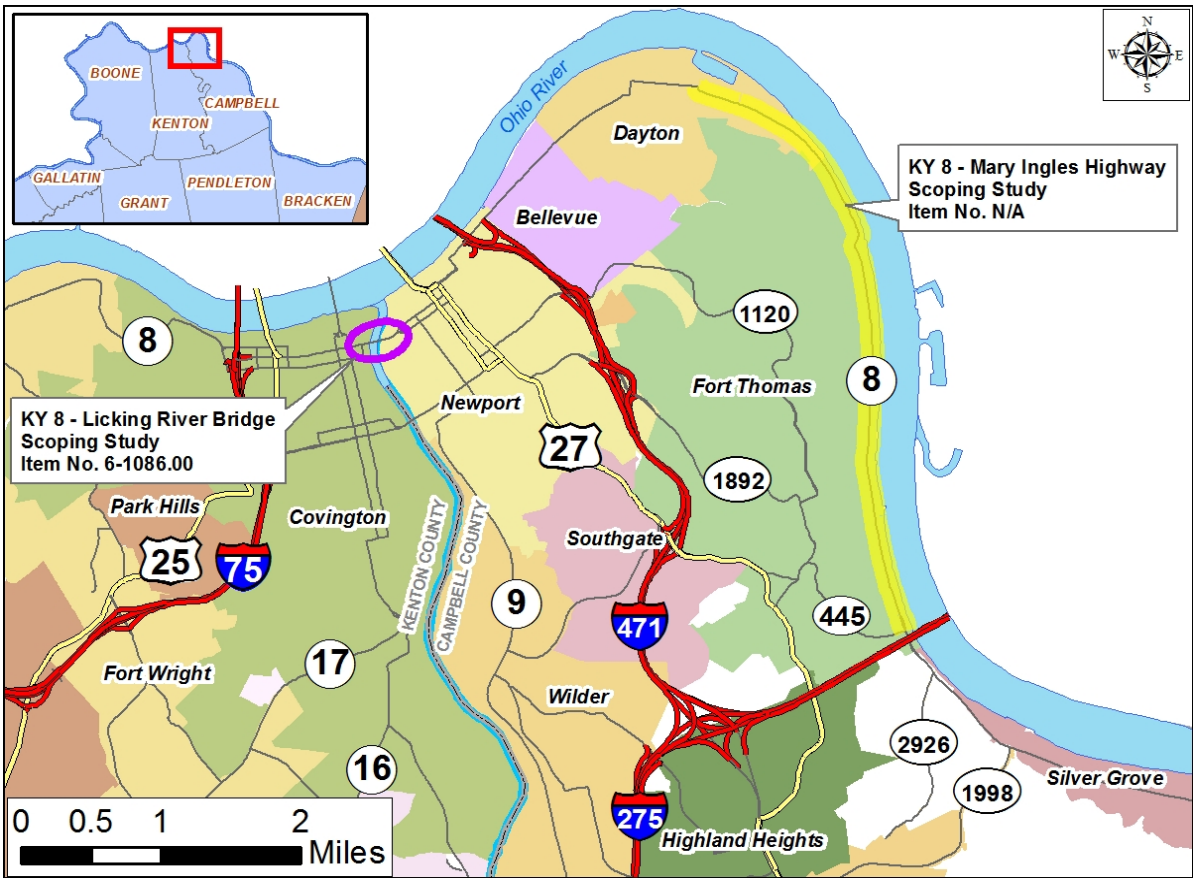

Figure 1: KY 8 Scoping Studies – General Project Area

1.1 PURPOSE AND NEED STATEMENT

KY 8 (Mary Ingles Highway) travels along the Ohio River through Dayton and Fort Thomas in eastern Campbell County. Between Dayton and KY 445, KY 8 has been plagued with slippage issues as the roadway continually slides towards the river. While maintenance activities have repeatedly been undertaken to minimize damage to the roadway and to maintain a usable driving surface, the purpose of the project is to provide a permanent solution to the underlying geotechnical issues.

1.2 STUDY AREA

The study area is shown on **Figure 2**. The study area begins at Dodd Drive (MP 3.266) in Dayton and ends at KY 445 (River Road, MP 7.902) near the I-275 overpass in Fort Thomas. The majority of the route falls within the city limits of Fort Thomas. As much of the adjacent land is in the floodplain of the Ohio River or is located on a steep embankment, development within the area is limited. There are dispersed residential properties located near Dayton and near MP 6.6, two marinas located near MP 4.1 and MP 6.0, and a water intake station near MP 7.0.

1.3 COMMITTED PROJECTS

There is one committed transportation project within the vicinity of the study area. KYTC Item Number 6-421.00 is for the construction of a pedestrian/bicycle trail through the cities of Ludlow, Covington, Newport, and Bellevue along the Ohio River. The limits in Campbell County are from MP 0.0 (Kenton County line) to MP 2.1(city limits of Dayton) to the west of the study area. The project is listed in the 2016 Kentucky Highway Plan as summarized in **Table 1**.

Phase	Funding Code	Cost	Scheduled FY	Phase Funding Status
Design	SNK	$10,000		AUTHORIZED (4/3/2015)
Construction	SNK	$481,600	2015	ESTIMATED

Source: KYTC Division of Program Management

Table 1: Project Funding and Schedule Information for KYTC Item 6-421.00

1.4 PROJECT MEETINGS

A Project Team consisting of representatives from KYTC District 6, Central Office Planning, Ohio-Kentucky-Indiana Regional Council of Governments (OKI), Northern Kentucky Area Development District and Stantec Consulting Services Inc., was formed to execute the study. Two team meetings were held over the course of the study to discuss existing issues and potential solutions. Complete meeting summaries can be found in **Appendix A**.

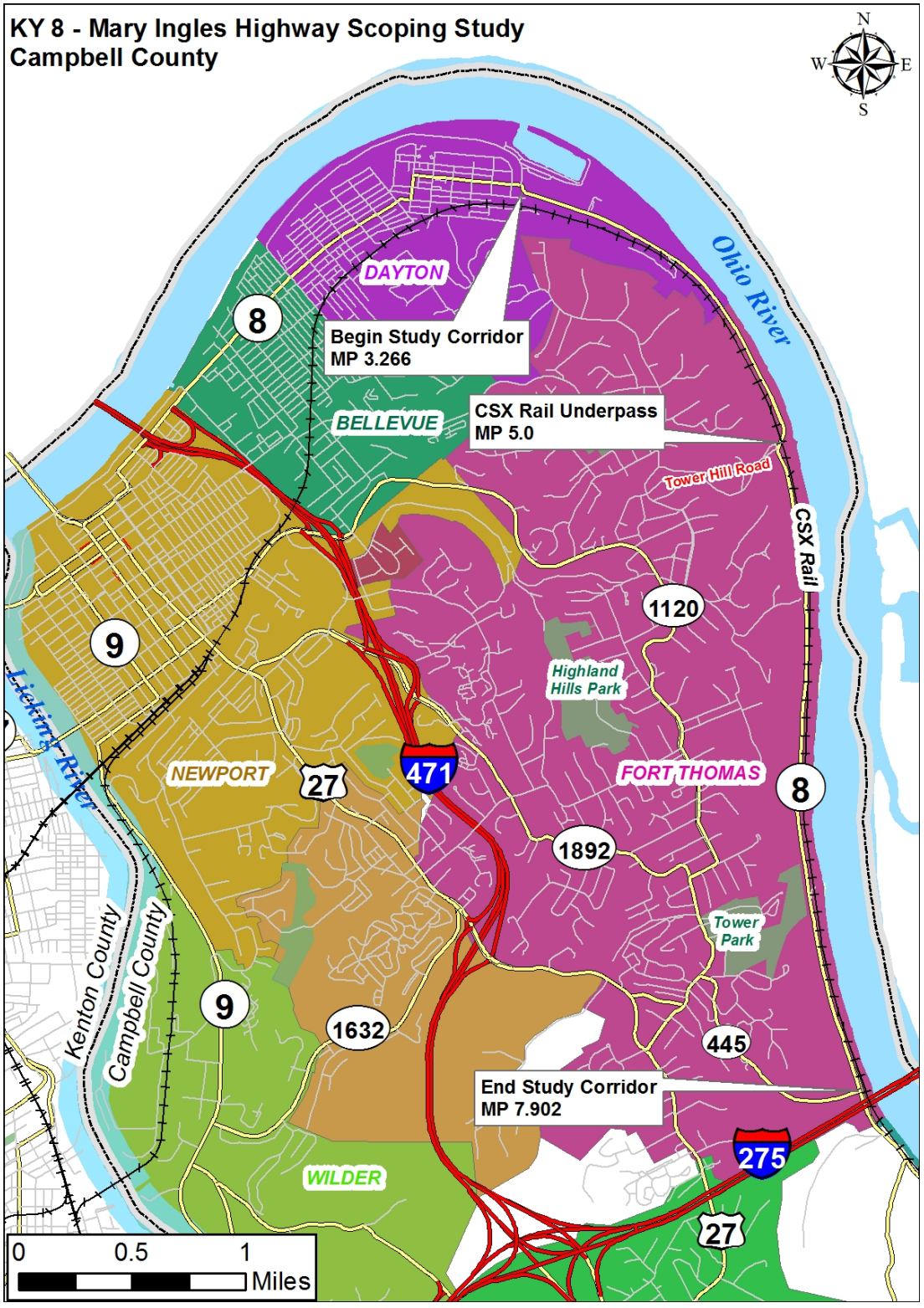

Figure 2: Study Area – KY 8 (Mary Ingles Highway) Scoping Study

2.0 EXISTING CONDITIONS

This section highlights the existing conditions within the study corridor, compiled from the KYTC's Highway Information System (HIS) database, aerial photography, as-built plans, and field review.

2.1 ROADWAY CHARACTERISTICS

A summary of the roadway characteristics contained within the KYTC HIS database is included in **Table 2**. Maps depicting the information found within this HIS summary are included in **Appendix B**.

County	Begin MP	Begin Segment	End MP	End Segment	Functional Classification	National Highway System	Terrain	Lanes	Shoulders	Bike/Ped Facilities	Median
Campbell	3.001	Boone Street	3.266	Dodd Drive	Urban Minor Arterial	No	Rolling	2-12'	Curbed	None	None**
	3.266	Dodd Drive	5.033	Tower Hill Rd.	Major Collector			2-9'-12'*	3' combination		
	5.033	Tower Hill Rd.	7.902	KY 445				2-10'			
	7.902	KY 445	8.281	KY 2926	Urban Minor Arterial			2-11'/12'	10' combination		

*Lanes are 12 feet wide to MP 4.108, 9 feet wide from MP 4.108 to MP 4.361, and 10 feet wide from MP 4.361 to MP 7.902.

** A raised, mountable median is located from MP 7.779 to MP 8.114.

Table 2: Highway Information System (HIS) Database Summary – Roadway Characteristics

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.

The study portion of KY 8 is not listed on the National Highway System (NHS) and is functionally classified as an Urban Major Collector but is a Minor Arterial immediately east and west of the study area. With that in mind, a review of existing geometrics along the roadway was performed and compared against common geometric practices for Urban Collector and Arterial Streets listed in Exhibit 700-04 of the 2006 KYTC Highway Design Manual[1].

KY 8 generally has 10- to 11-foot wide lanes with shoulders no more than 4 feet wide. Current KYTC design guidelines suggest a minimum of 10-foot wide lanes on residential collector roadways, a minimum of 11-foot wide lanes on interrupted flow arterial streets and 12-foot lanes on arterial roadways with free-flow conditions (i.e. no traffic signals). Arterial roadways are recommended to have a minimum of 12-foot lanes if the average daily traffic (ADT) is greater than 1,500 vehicles per day (VPD) and a design speed of 50 miles per hour (MPH). Shoulder widths are generally not of great concern in urban areas as many streets are curbed; therefore, the existing shoulder widths of three feet are not necessarily considered to be less than desirable.

There are no bicycle or pedestrian facilities along KY 8. However, the roadway is designated by OKI as a preferred bike route. **Table 3** provides a summary of the traffic characteristics related to the KY 8 study corridor.

<table>
<tr><th>County</th><th>Begin MP</th><th>Begin Segment</th><th>End MP</th><th>End Segment</th><th>AADT (Year)</th><th>Truck %</th><th>Truck Route</th><th>Truck Weight Class</th><th>Speed Limit</th></tr>
<tr><td rowspan="4">Campbell</td><td>3.001</td><td>Boone Street</td><td>3.266</td><td>Dodd Drive</td><td>2,700 (2012)</td><td rowspan="4">4.2%</td><td rowspan="4">No</td><td>AA (62,000 Pounds)</td><td>35</td></tr>
<tr><td>3.266</td><td>Dodd Drive</td><td>5.033</td><td>Tower Hill Rd.</td><td rowspan="2">1,400 (2014)</td><td rowspan="2">A (44,000 Pounds)</td><td>35*-45</td></tr>
<tr><td>5.033</td><td>Tower Hill Rd.</td><td>7.902</td><td>KY 445</td><td rowspan="2">45</td></tr>
<tr><td>7.902</td><td>KY 445</td><td>8.281</td><td>KY 2926</td><td>4,700 (2012)</td><td>AA (62,000 Pounds)</td></tr>
</table>

*35 MPH ends at MP 3.85.

Table 3: Highway Information System (HIS) Database Summary – Traffic Characteristics

[1] http://transportation.ky.gov/Highway-Design/Highway%20Design%20Manual/Geometric%20Design%20Guidelines.pdf

The study area portion of KY 8 has an ADT of 1,400 VPD with four percent trucks. Traffic volumes are higher to the west in Dayton and east of KY 445. The route is not designated as a state or federal truck route and is in the "A" weight class for 44,000-pound and under loads. The speed limit is 35 MPH near the west end of the project corridor and is 45 MPH through the remainder of the route.

OKI provided output from its regional travel demand model for use in estimating future travel demand within the corridor. Based on this model output, by 2040, traffic volumes are expected to experience little to no growth.

2.2 CRASH HISTORY

Historical crash data were collected along KY 8 for a three-year period between January 1, 2013 and December 31, 2015. **Figure 3** shows the locations of all crashes reported within that time period. The crash records are included in **Appendix C.**

There were 30 crashes reported for the project area between 2013 and 2015. Single vehicle collisions comprise the vast majority of the crashes (24 crashes, 80 percent). Of the 30 reported crashes, 1 (3 percent) resulted in a fatality, 7 (23 percent) resulted in one or more injuries, and 22 (73 percent) were property damage only collisions.

Crashes 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 (2010-2014)*[2]. As defined in the methodology, segments vary in length and are divided along roadways where geometry or traffic volumes change. For each segment, the number of crashes, traffic volume, rural/urban designation, number of lanes, and segment length are used to determine the critical rate factor (CRF). The CRF is one measure of the safety of a road, expressed as a ratio of the crash rate at the location compared to the average crash rate of similar roadways throughout the state. If the CRF is 1.00 or greater, it is assumed that crashes cannot be attributed to random occurrence; that is, there are underlying causative factors. There are no segments along KY 8 within the study area with a CRF greater than 1.0.

A crash spot analysis was also conducted for the route. Spots were defined by observing 0.3-mile long sections where crashes were concentrated. Crashes were again geospatially referenced and compared to statewide data to identify locations experiencing above average crash rates. The CRF was again used as a measure of the safety of a particular spot. There were no spots along the study portion of KY 8 with a CRF greater than 1.0.

[2] http://www.ktc.uky.edu/files/2015/12/KTC_15_21_KSP2_13_1F.pdf, Kentucky Transportation Center, 2015.

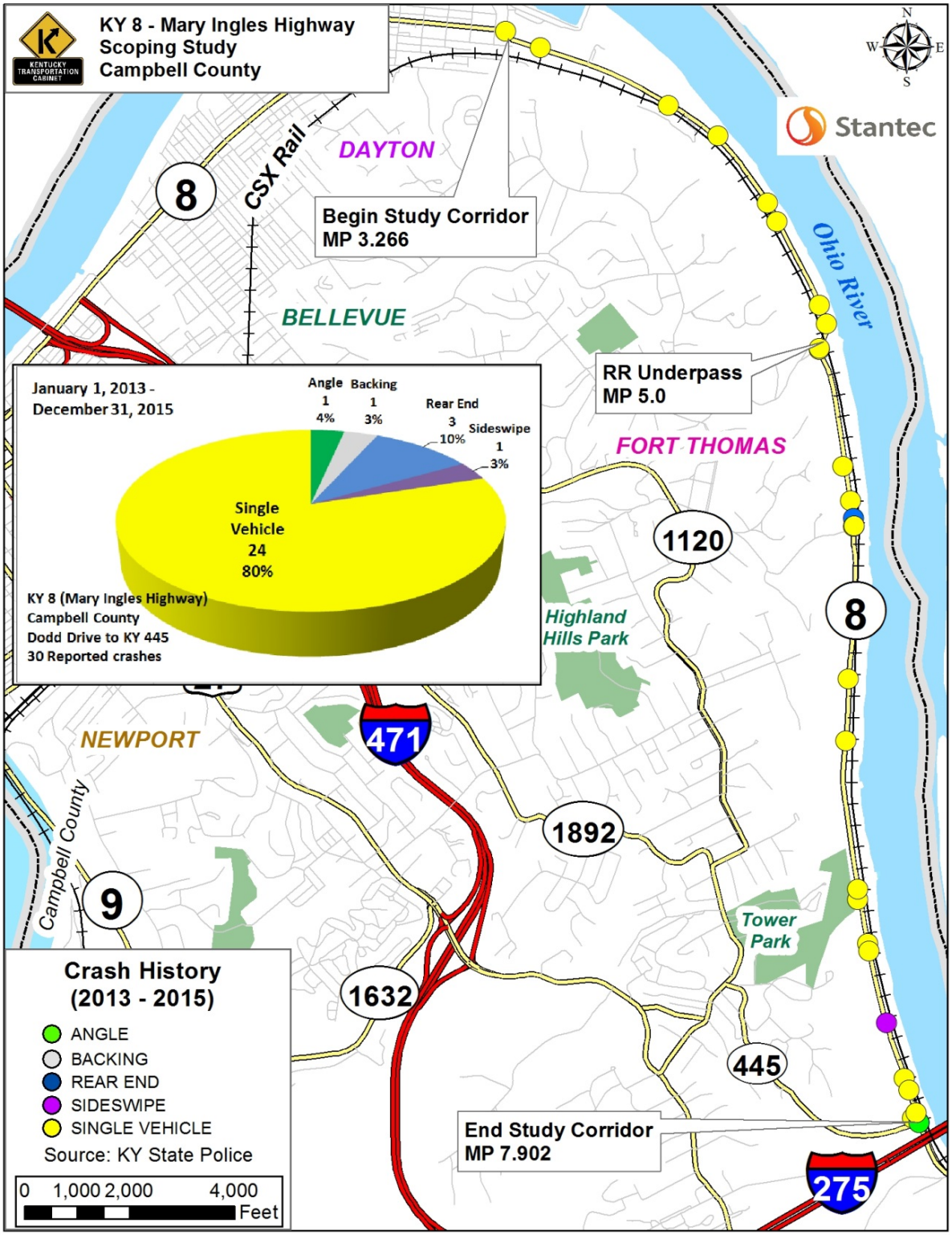

Figure 3: Crash History (2013-2015)

2.3 GEOTECHNICAL OVERVIEW

A geotechnical overview was prepared to describe and assess the underlying geotechnical conditions. The complete overview is found in **Appendix D**. The study portion of the Mary Ingles Highway is located in the Outer Bluegrass physiographic region of Kentucky. The roadway was constructed on the southern bank of the Ohio River immediately above the floodplain and along the base of the valley slope.

Subsurface conditions of the corridor between Dayton and I- 275 consist primarily of artificial fill of unknown origin underlying the roadway and railway. Alluvium deposits of the Pleistocene series exist along the Ohio River while Shale and Limestone bedrock of the Upper Ordovician series become predominant where the corridor moves away from the Ohio River and onto adjacent valley slopes.

The roadway's historical instability is primarily due to the location of the road at the interface between the alluvial soils of the Ohio River and the easily deformed shales of the Kope Formation which comprise the valley walls along the existing alignment. The weight of the roadway increases driving forces on marginally stable slopes and on slopes which are undergoing continuous weathering and creep during the geologic process. These forces, coupled with the introduction of subsurface water resulting from natural conditions or inadequate roadway drainage, result in slope-roadway movement. As can be seen in **Figure 4** and **Figure 5**, this results in undulations in the pavement surface, lateral displacement of the alignment (as noted in the roadway edge and guardrail) and the tilting of utility poles. Movements of the roadway occur without warning and typically result in sharp breaks in the pavement surface.

The Kope Formation is comprised of nondurable shales and thin limestone beds. Cuts in nondurable shales may be most stable when excavated on 2H:1V slopes and allowed to revegetate. Steeper slopes in the Kope Formation are not typically recommended, but may be necessary due to right-of-way limitations. For example, a recently constructed cut slope at the interchange of KY 8 with River Road near I-275 is shown in **Appendix D** and appears to be on a grade steeper than 2H:1V.

2.4 ON-GOING MAINTENANCE CONCERNS

The locations of known or suspected failures, including those that have been addressed at least once, are shown on **Figure 6**. Of the 25 identified locations, 23 are south of the railroad underpass at MP 5.0. In some cases, repeated repairs have resulted in pavement thicknesses exceeding five feet. These types of pavement repairs may actually contribute to future failures as the weight of the added pavement layers increases downward pressure on the subgrade. Given the nature of the subgrade conditions, these pavement and slope failures can occur with little to no warning, resulting in lane or total roadway closures until such time the failure can be addressed. These types of failures occur most frequently after heavy rainfall events or in the spring after harsh winter weather.

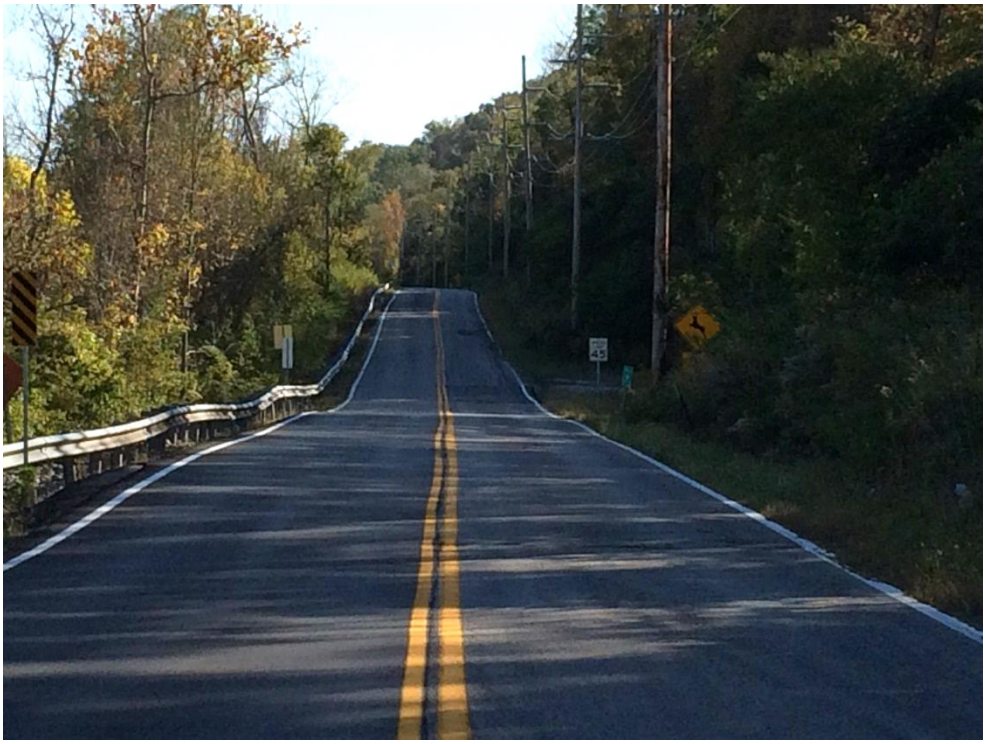

Figure 4: Southbound KY 8 near Milepost 7.0

Figure 5: Northbound KY 8 near Milepost 7.0

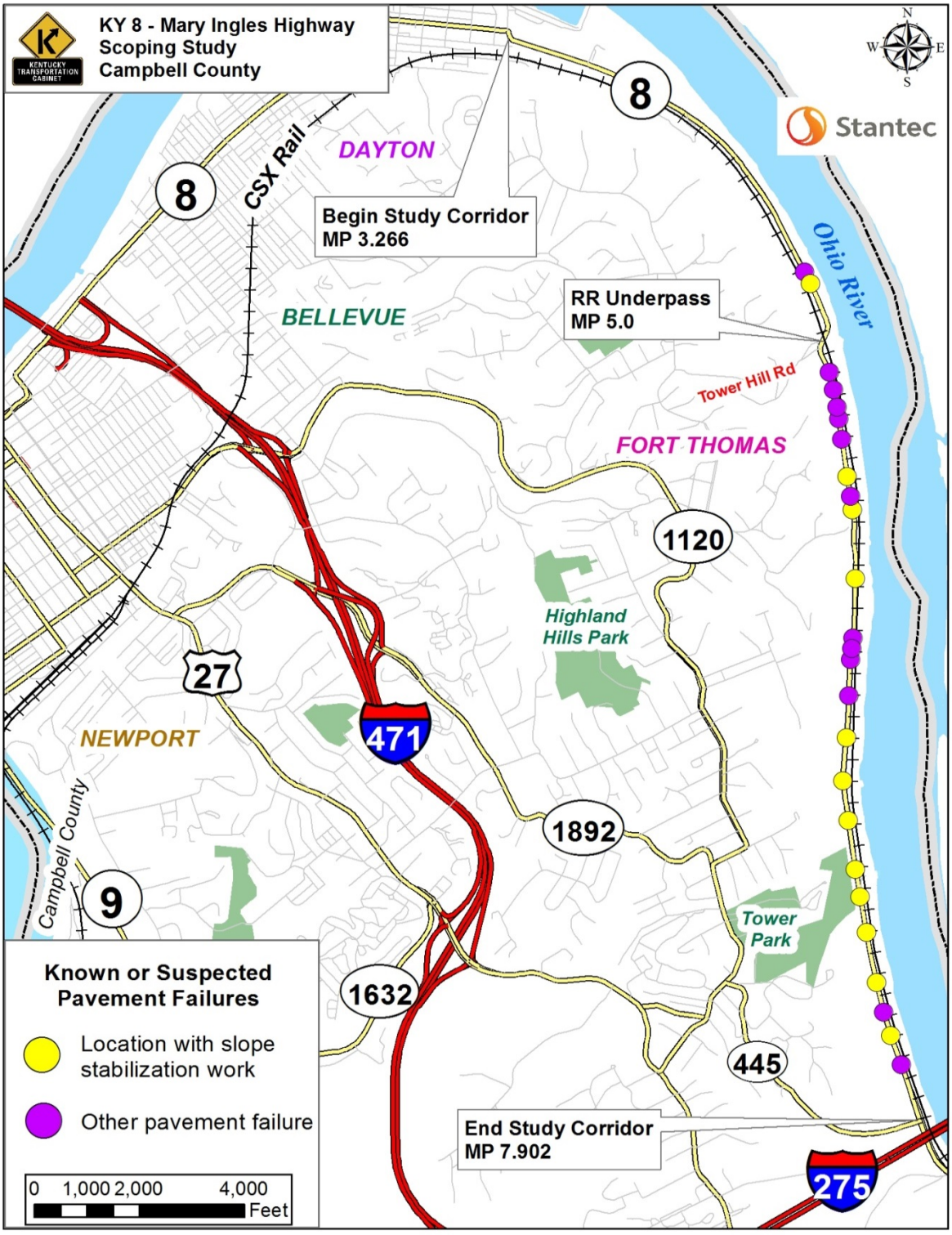

Figure 6: Locations of Known or Suspected Pavement Failures

Soil Nail Launcher, Inc. provided some example fixes that have been implemented within the past few years. In each of these cases, the contractor installed soil nail walls and slope reinforcement to address failures, and KYTC District 6 was responsible for traffic control, clearing and grubbing, slope preparation, repaving, new pavement markings once the slope was stabilized, and guardrail replacement. Three example failures are discussed below in **Table 4**. KYTC District 6 Maintenance has spent, on average, about $77,000 per year over the past five years in addition to the costs listed in Table 4.

Year	Location	Approx. Length	Repair	Approx. Cost	Photo
2008	MP 8.5	350 feet	Installed 35 20-foot and 265 30-foot long soil nails to create a 10-foot tall by 351-foot soil-nail wall.	$300,000	
2008	MP 5.2	225 feet	Installed 100 20-foot and 125 30-foot long soil nails to create a 10-foot tall by 225-foot soil-nail wall.	$180,000	
2011	MP 4.8	211 feet	Installed 284 30-foot long soil nails to create a 10-foot tall by 211-foot soil-nail wall.	$260,000	

Table 4: Example Pavement Failures and Fixes along Mary Ingles Highway

(Information and photos courtesy of Soil Nail Launcher, Inc.)

3.0 DEVELOPMENT OF ALTERNATIVES

3.1 IMPROVEMENT CONCEPTS

The existing Mary Ingles Highway displays multiple locations of previous landslides and slope/roadway movement. Continual and sometimes extensive roadway repairs and resurfacing have been necessary to maintain a safe traffic route. Significant remedial efforts would be required along the majority of the alignment to avoid such occurrences. Such remediation could consist of cleaning up and reshaping the slopes uphill of the existing roadway and moving the alignment into a full cut section where possible. This scenario could prove problematic in areas where there is insufficient right-of-way to construct stable cut slope configurations. In areas where the alignment is required to remain on embankment fill previously noted to have experienced movement, an earth-retaining structure would be required to stabilize the fill slope.

Figure 7 presents one alternative to address the underlying geotechnical issues within the corridor. North of the railroad underpass (i.e. KY 8 travels under the railroad bridge) at MP 5.0, the roadway would be reconstructed on existing alignment with existing fill slope stabilized in place (alternative 1a). South of the railroad underpass, the alignment can be shifted slightly into the adjacent cut slope to provide more separation from the railroad and existing roadway embankment (alternative 2). A retaining wall structure would be constructed on the new cut slope and the new fill slope would be stabilized. Cross drains would also be placed along the entire study area to improve roadway drainage.

A typical retaining structure used in similar situations of deep soil movement could be a pile and lagging wall tied back into competent bedrock. In areas of shallow soil movement, soil nail walls and predrilled railroad rail walls have been used successfully. A tieback wall would likely provide the most stable slope but at a somewhat higher cost. This scenario is very similar to the required reconstruction of KY 9 (Licking River Pike) in Wilder, Kentucky, approximately 2.8 miles west of this study area. Extensive geotechnical investigations, analyses, and designs would be required to develop a more maintenance free roadway alignment. A reconstruction project of this nature could take three to four years to construct and maintaining traffic on the existing route would likely be infeasible given the location and magnitude of the work to be done.

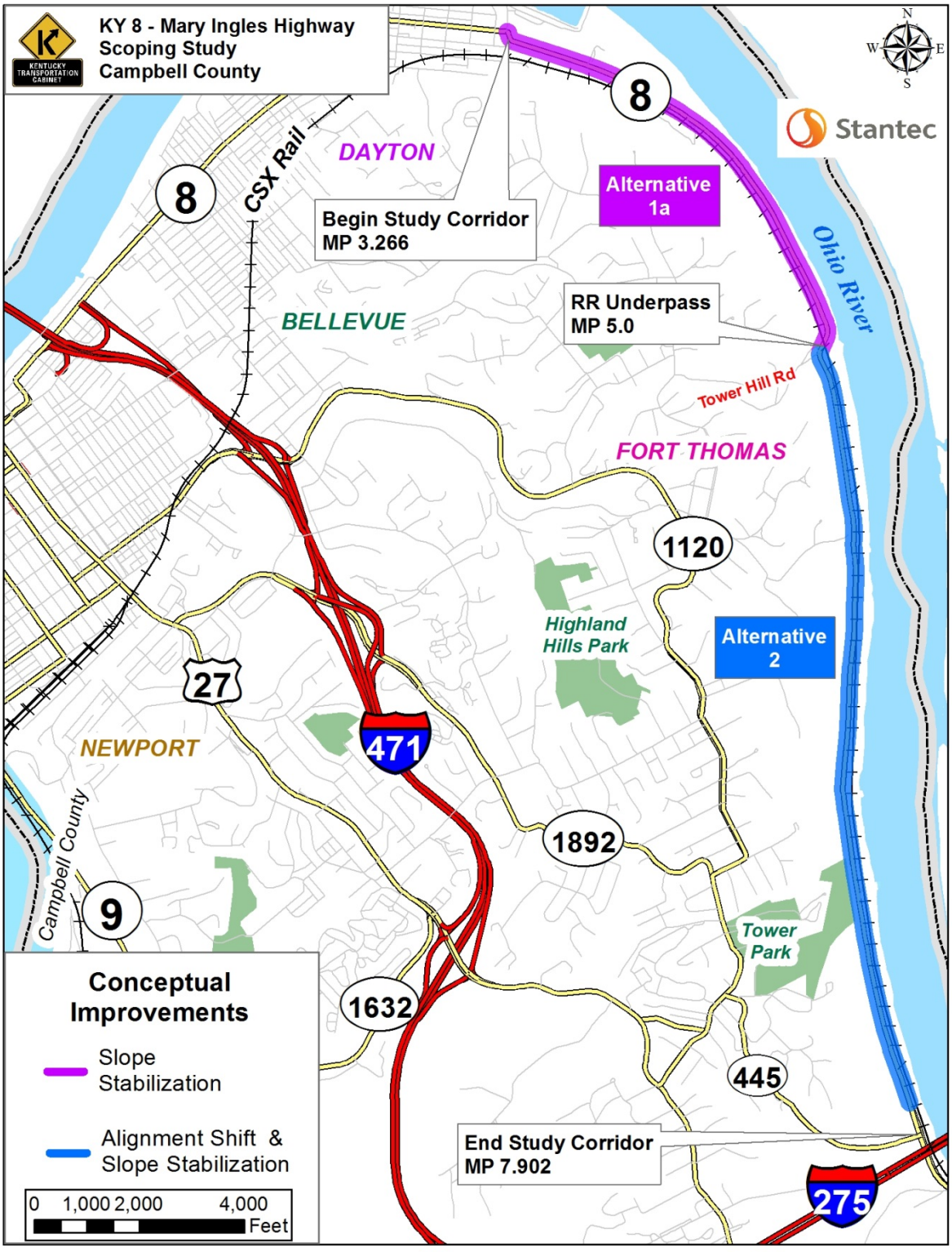

Figure 7. Reconstruction Concept #1

Conceptual typical sections for both the slope stabilization and the alignment shift with slope stabilization are shown in **Figure 8** and **Figure 9**, respectively.

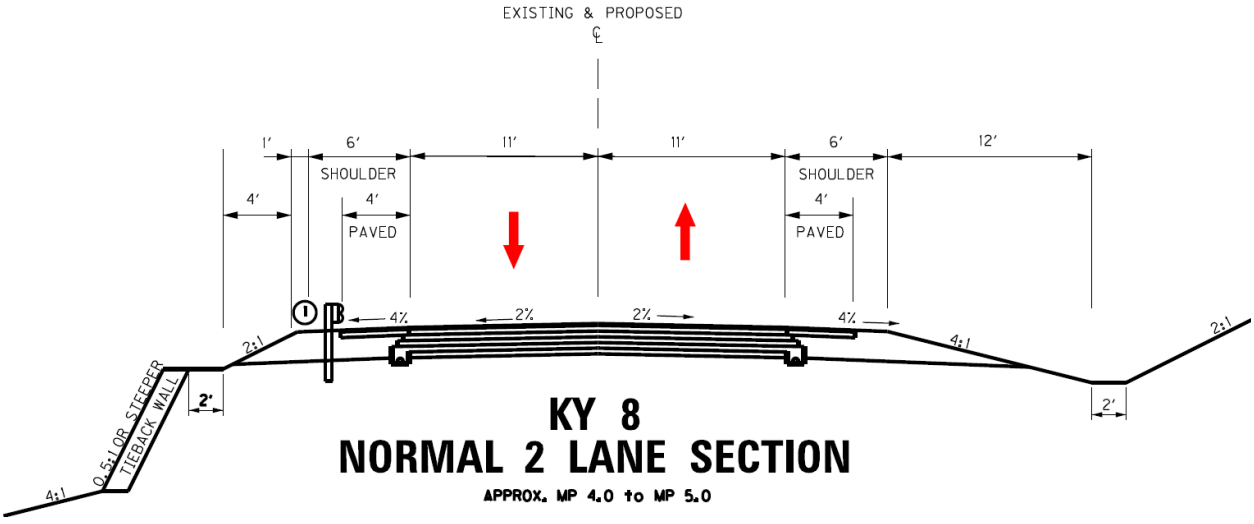

Figure 8: Conceptual Typical Section – Slope Stabilization from KY 8 MP 4.0 to MP 5.0 (Alternative 1a)

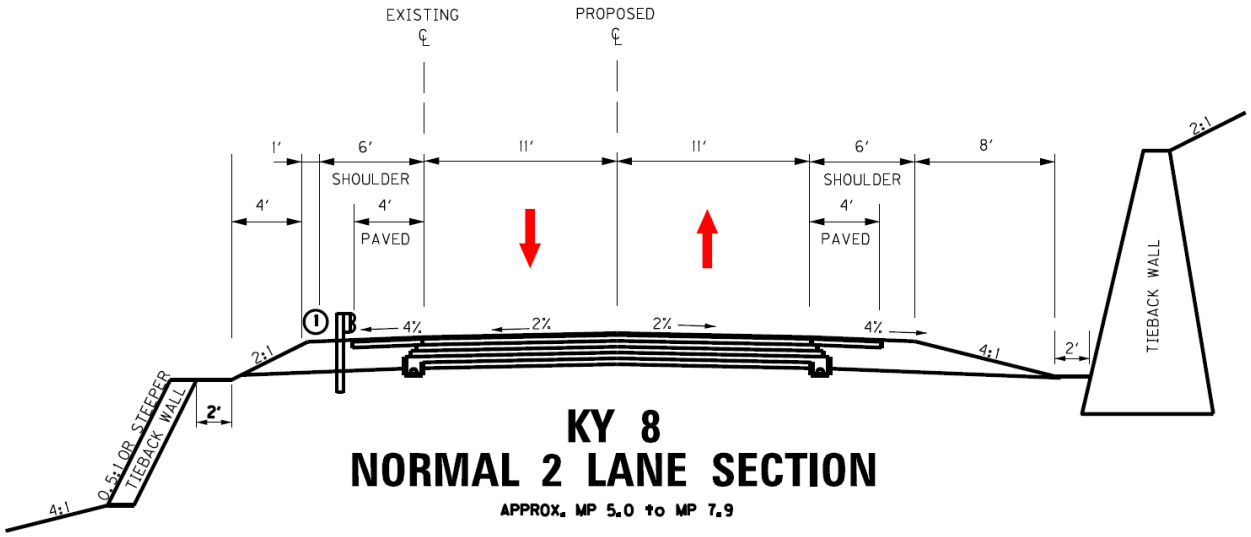

Figure 9: Conceptual Typical Section – Alignment Shift and Slope Stabilization from KY 8 MP 5.0 to MP 7.9 (Alternative 2)

Reconstructing the roadway on its existing alignment north of the CSX railroad underpass would not eliminate the skewed underpass shown in **Figure 10**. In addition, the proximity to the railroad would limit the opportunities to reshape the cut slope on the west side of the roadway. As an alternative to reconstruction in place, a realignment was considered to move KY 8 west of the railroad and away from the Ohio River north of MP 5.0. This concept (alternative 1b) is shown on **Figure 11**.

Figure 10: CSX Railroad Underpass near MP 5.0 and Tower Hill Road

The conceptual realignment would begin at 6th Avenue in Dayton at the north end of the study area and connect to KY 8 at Tower Hill Road, realigning KY 8 to the west side of the railroad throughout. An alignment can be accommodated through this area with no greater than a six percent grade. Some improvements may be considered for 6th Avenue. Assuming no steeper than 2:1 slopes can be maintained on the cut slopes, retaining walls will be necessary in some locations to avoid direct takes of residential properties located off of Dayton Pike, west of Mary Ingles Highway.

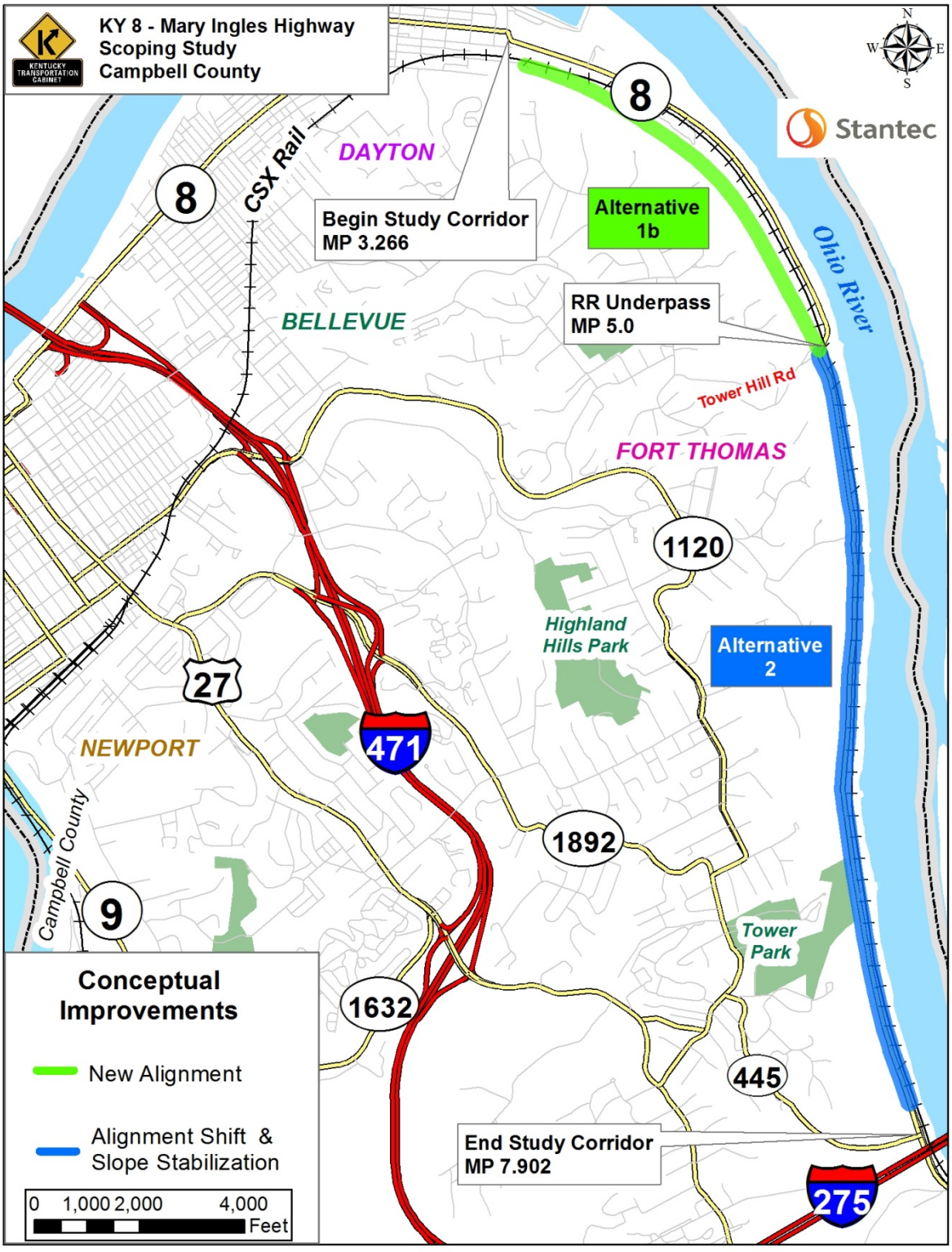

Figure 11: Reconstruction Concept # 2

Table 5 displays the estimated costs for the Mary Ingles Highway reconstruction alternatives. More detailed estimates are included in **Appendix E**. Construction costs are based on estimated earthwork and paving quantities developed using the best mapping available. This includes a combination of LIDAR data and mapping from the United States Geological Survey (USGS). A 20 percent contingency is included as a percentage of the overall construction cost to account for unknowns and drainage costs. Based on these estimates, the cost to construct a more maintenance free Mary Ingles Highway would be between $62 and $67 million.

A reconstruction project of this nature would likely take more than one year to build and maintaining traffic on the existing route would likely be infeasible given the location and magnitude of the work to be done. One business (Aquaramp Marina) would not have roadway access during construction. The acquisition of this business in addition to three home acquisitions would result in right-of-way costs of approximately $4.5 million.

There are existing utilities that cross and run along the existing roadway that would need to be relocated as part of the reconstruction of KY 8. Northern Kentucky Sanitation District No. 1 has 3.3 miles of sanitary sewer force mains, gravity sewers, and manholes that run parallel to existing KY 8. Duke Energy has 4,000 feet of gas mains and the Northern Kentucky Water District has 4,000 feet of water lines running parallel to existing KY 8. The Northern Kentucky Water District also has two water intake facilities in the study corridor which have16-inch steel encasement waterlines that cross KY 8. In total, the utility relocation costs are estimated to be $8.0 million. A detailed summary of the utility relocations are shown in **Appendix F**.

Project	Description	Length	Design ($ Millions)	Right-of-Way ($ Millions)	Utility Relocation ($ Millions)	Construction ($ Millions)
1a. Slope Stabilization north of MP 5.0	Replace pavement section and stabilize fill slope using a tieback wall between Marina entrance at MP 4.0 and RR underpass at MP 5.0.	1.0 Miles	$1.2	--	--	$8.2
1b. Realign KY 8 north of MP 5.0	Realign KY 8 north of MP 5.0 to connect to 6th Avenue in Dayton.	1.6 Miles	$1.8	--	--	$12.9
2. Shift Alignment and Slope Stabilization south of MP 5.0	Shift KY 8 west from RR underpass at MP 5.0 to KY 445 at MP 7.9 and replace pavement section. Stabilize fill slope using a tieback wall.	2.9 Miles	$7.8	--	--	$54.1
SUBTOTAL - Project 1a and 2		**3.9 Miles**	**$9.0**	**$4.5**	**$8.0**	**$62.3**
SUBTOTAL - Project 1b and 2		**4.5 Miles**	**$9.6**	**$4.5**	**$8.0**	**$67.0**

Table 5: Preliminary Cost Estimates for Reconstruction of Mary Ingles Highway

In the Mary Ingles Highway study area, underlying drainage issues continually undermine the roadway subgrade and the continued addition of pavement layers to reestablish a smooth roadway surface increases static driving forces which can, in turn, accelerate movement in a failure area. The drainage issues can be addressed through the addition of a longitudinal underdrain system with transverse cross-drains spaced appropriately. For the purpose of this study, spacing of approximately 200 feet was used for cost estimating. A potential solution to the excessive driving forces would be to remove a portion of the subgrade and replace it with lightweight fill and a new roadway surface. A slightly higher cost per unit of excavation and backfill material was used to allow for the use of off-site material of a lower unit weight.

3.2 REROUTING OPTIONS

Given the extremely high cost for reconstructing the roadway within the Mary Ingles Highway study area, some consideration was given to potential rerouting options. State-maintained roadways within Campbell County were considered in this analysis, with a goal of identifying options that provided similar or better roadway geometrics and traffic operation conditions compared to the existing KY 8. Significant community outreach and municipal agency coordination would be necessary prior to the advancement of any rerouting alternative.

The following sections discuss possible alternative routes that could be considered, which are summarized in **Table 6**.

Routing Options	Name	Description	Distance (miles)*	Approx. Travel Time (minutes)*	Traffic Signals*	Comments
Existing	KY 8	Existing Mary Ingles Highway	6.8	14	9	
KY 445 (River Road) Options (See Figure 12)	KY 1120 (Fort Thomas Ave.)	US 27 (York St.) to KY 1120 (10th St./ Fort Thomas Ave.) to KY 445	7	21	24	Passes through dense residential and commercial development.
	KY 1892 (Grand Ave.)	US 27 (York St.) to KY 1892 to KY 1120 to KY 445	5.7	17	23	Passes through dense residential and commercial development.
	I-471	I-471 to US 27 (exit 2) to KY 1120 to KY 445	5.3	9	5	Shortest distance and travel time.
	US 27 (Alexandria Pike)	US 27 (York St./ Alexandria Pike) to KY 1120 to KY 445	5.4	16	28	
KY 1998 (Poole's Creek Road/ Industrial Road) Options (See Figure 13)	US 27 (Alexandria Pike)	US 27 (York St./ Alexandria Pike) to KY 1998	9.9	26	40	KY 1998 suffers from underlying geotechnical issues and some areas with relatively poor geometry.
	KY 9 (Licking Pike)	KY 8 (4th St.) to KY 9 to KY 1998	11.2	24	20	KY 9 will be reconstructed through Newport (KYTC Item No. 6-8101.00)

*All measurements are from the I-471 interchange in Newport to the KY 445 intersection with KY 8 (KY 1998 options are measured to the KY 1998 intersection with KY 8.)

Table 6: Rerouting Concepts for KY 8 in Campbell County

3.2.1 KY 445 (River Road) Options

Four conceptual routes were examined that connect to the Mary Ingles Highway via KY 445 (River Road). These concepts are shown on **Figure 12**. Maps and HIS data summaries for each of these four options are presented in **Appendix G**. In each of these cases, KY 8 would be re-signed along the proposed route, and the existing KY 8 could be closed between the entrance to the Riverside Gardens Marina (near MP 4.0) and KY 445 (MP 7.902).

Other than a single residential driveway immediately east of the marina, there are no access points of concern between MP 4.0 and Tower Hill Road. As there are no state-maintained alternatives east of the I-471 interchange, all options begin at or west of the KY 8 interchange with I-471. The remnant of KY 8 between the proposed "new" route and Dodd Drive could continue under state maintenance but as a new route number. The KY 1120 and KY 1892 options both traverse dense commercial and residential areas and have some horizontal curves that are less than desirable. The I-471 option is suggested by online mapping services (such as Google Maps) as the shortest route, even shorter than the existing route.

3.2.2 KY 1998 (Poole's Creek Road/Industrial Road) Options

Expanding the study area, two conceptual routes were examined that connect to the Mary Ingles Highway via KY 1998 (Poole's Creek Road / Industrial road). These concepts are shown on **Figure 13**. Maps and HIS data summaries for these two options are presented in **Appendix G**.

One disadvantage to using KY 1998 to reconnect to KY 8 is there have been pavement failures south of KY 445, between KY 445 and KY 1998. There are also residential driveways along this area that would require access. KY 1998 has experienced geotechnical issues of its own, particularly between KY 9 and US 27 (the Poole's Creek portion of the roadway). The US 27 alternative would introduce some additional traffic in an already congested area near Northern Kentucky University in Alexandria. The KY 9 option could ultimately benefit from the realignment under design with the KYTC Item No. 6-8101.00 project.

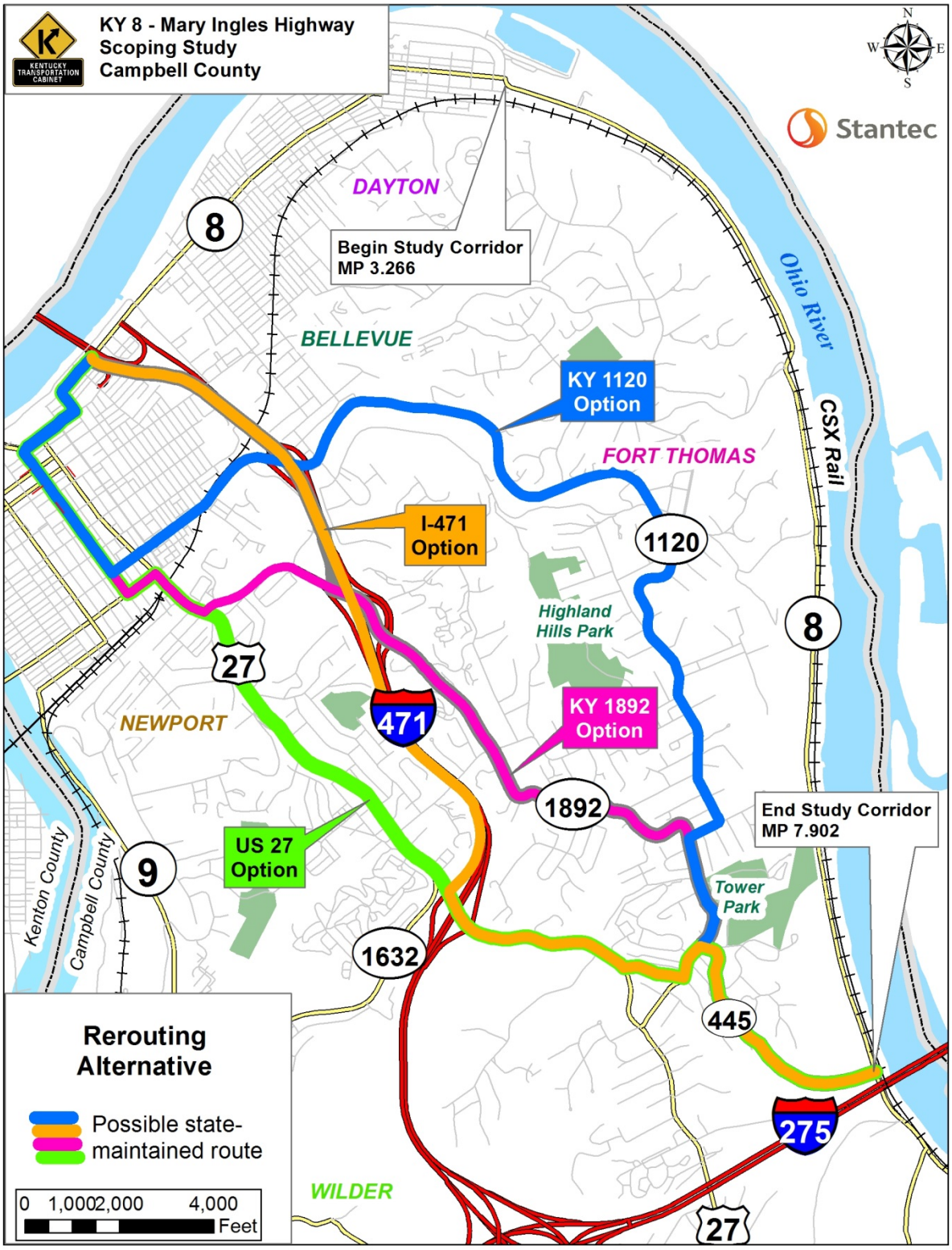

Figure 12: Rerouting Concepts using KY 445 (River Road)

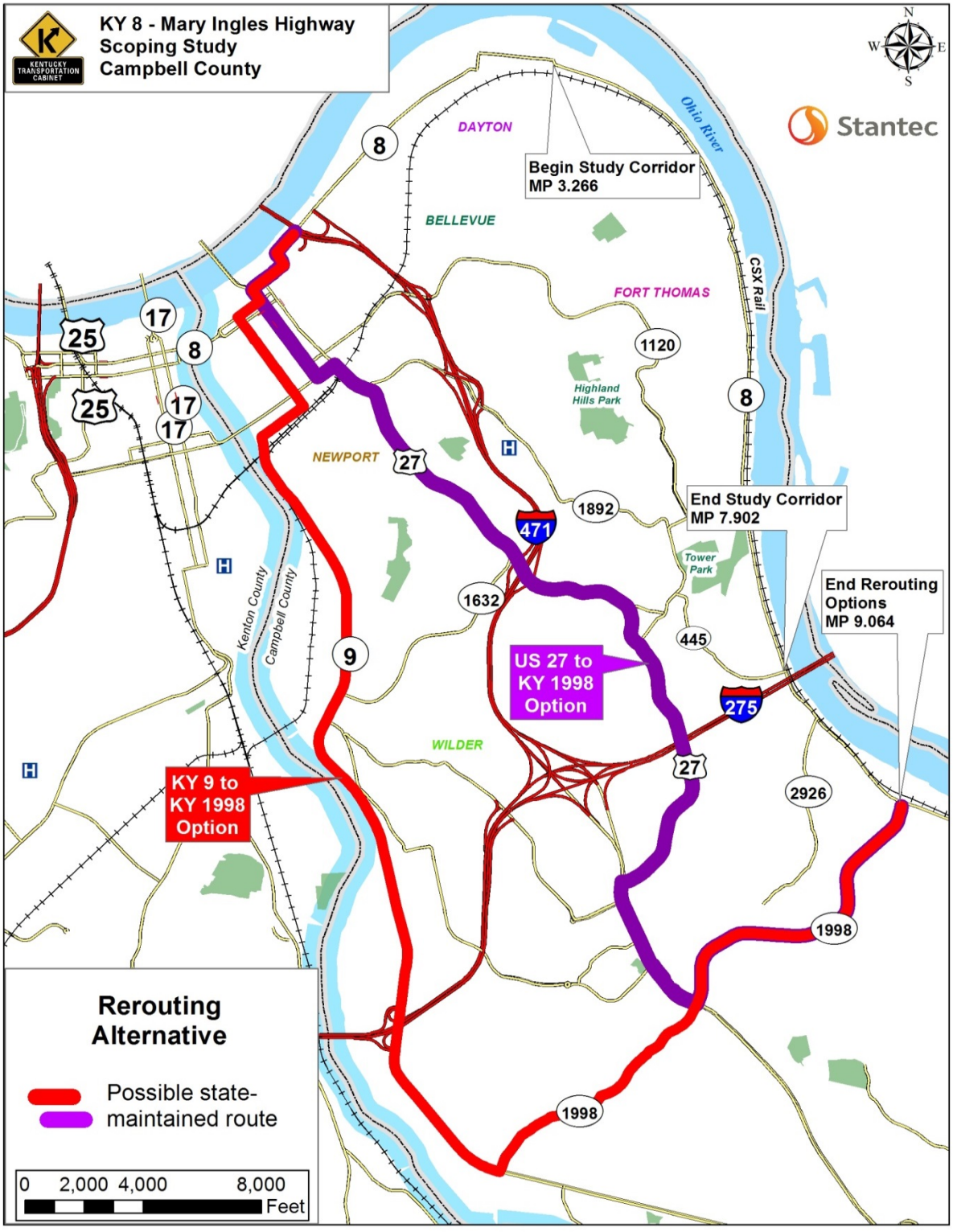

Figure 13: Rerouting Concepts using KY 1998 (Poole's Creek Road/Industrial Road)

3.3 OTHER CONSIDERATIONS FOR POSSIBLE CLOSURE OF KY 8

Any discussion of rerouting KY 8 to other state-maintained facilities and closing the existing route to vehicular traffic must take into account the potential for both direct and indirect impacts to adjacent properties, community resources, and other features. Given the likely duration of a reconstruction of KY 8 (as long as three to four years), many of these impacts would also require consideration with the conceptual improvements discussed in **Section 3.1**.

3.3.1 Community Impacts

It is assumed that the northern end of the study portion of KY 8 can be maintained as-is, minimizing impacts to residences and businesses near Dayton. Some resources south of Tower Hill Road, shown on **Figure 14**, would require access to be maintained unless other alternatives are explored. Aquaramp Marina (near MP 6.0) is the only business located within the section that could potentially be closed to traffic, located about one mile south of Tower Hill Road and two miles north of the KY 445. There are three homes located on the west side of the roadway about 1.25 miles north of the KY 445 intersection. If access to the marina and three homes cannot be maintained, acquisition cost for these resources is estimated at $4.5 million.

While no parks are directly accessed from KY 8, there are three local parks located in Fort Thomas (Rossford Park, Highland Hills Park, and Tower Park) for which KY 8 might be used.

The Transit Authority of Northern Kentucky (TANK) does not currently operate a route on the study portion of KY 8. However, TANK does operate on several of the routes that may be considered for the rerouting of KY 8. Thus, coordination with TANK would be necessary during the evaluation of potential rerouting alternatives.

The Mary Ingles Highway is a popular corridor for bicycle enthusiasts and, as previously mentioned, is designated by OKI as a preferred bicycle route. If the roadway is closed to through traffic, coordination with OKI and bicycle advocacy groups would be required. While it may be considered desirable to maintain a dedicated bicycle corridor or other form of shared-use facility in the KY 8 corridor should it be closed to vehicular traffic, KYTC would not be responsible for the on-going and long-term maintenance of such a facility, and such costs would not be substantially different from maintaining the roadway. It would be the responsibility of another municipal agency to maintain a safe facility for bicyclists and pedestrians.

3.3.2 Utility and Railroad Impacts

The Northern Kentucky Water District has two water intake facilities in the study corridor located near MP 6.2 and MP 7.0 (shown on Figure 14). If these facilities are to remain in service, they would need some level of vehicle access for the operation and maintenance of the facility. Other utilities have infrastructure crossing and paralleling the roadway (overhead electrical lines, sewer lines, etc.) and would continue to operate at their own risk as future slope failures could disrupt service.

Figure 14: Resources Directly Affected by a Possible KY 8 Closure

The CSX rail line, which has also experienced on-going failures over the years, would remain in place but would not have roadway access to facilitate needed maintenance operations.

3.4 FORECAST OF FUTURE EXPENDITURES

To better quantify the long-term costs for the alternatives under consideration, some effort was provided to estimating the future expenditures required. The three alternatives include doing nothing (the No-Build Scenario), reconstructing the existing alignment, and closing KY 8 to through traffic and rerouting it to other state-maintained facilities. Some assumptions had to be made for this effort. Assumptions include:

- An inflation rate of 2.4 percent per year to inflate all costs from 2016 dollars to future dollars.
- $350,000 per year (in 2016 dollars) is assumed for basic maintenance and pavement repairs along the existing route. These costs would be incurred each year for the No-Build alternative and until 2020 for the reconstruction alternatives, assuming construction cannot begin until the design, right-of-way acquisition, and utility relocations are complete (one year per phase).
- A significant rehabilitation is assumed in 2025 for the No-Build alternative and a mill and overlay is assumed in 2018 for the reconstruction alternatives.
- $1.0 million is assumed as a conservative estimate for intersection improvements and signage modifications for the rerouting alternative.
- The full cost of the right-of-way is included for the rerouting alternative as well as one more year of maintenance. The reconstruction alternatives also include the full cost of the right-of-way acquisition.

The resulting expenditures (in year of expenditure dollars) are shown in **Table 7**.

Methodology	Initial Capital Expense	Right-of-Way Costs	Annual Maintenance Costs without reconstruction	Cost for Pavement Rehabilitation or Mill and Overlay in 2025	Inflation Rate	Expenditures Through 2030 (in Year of Expenditure dollars)
I. No-Build (Continue maintenance, as required)	$0	$0	$350,000	$6,200,000	2.40%	$12,440,000
II. Reconstruct KY 8 (Note: capital costs assumed in year 2020 dollars)	$68,500,000	$4,500,000	$350,000	$1,000,000	2.40%	$75,080,000
	$73,700,000	$4,500,000	$350,000	$1,000,000	2.40%	$80,280,000
III. Reroute KY 8 to Other State Routes	$1,000,000	$4,500,000	$350,000	$0	2.40%	$5,850,000

Table 7: Estimated Capital Expenditures through 2030 for KY 8 Alternatives

Based on these assumptions, the No Build alternative would result in expenditures of more than $12.4 million over the next 15 years. The reconstruction alternatives would range from just over $75 million to nearly $80.3 million. The rerouting alternative would have the lowest overall cost at approximately $5.85 million.

4.0 CONCLUSIONS

The on-going maintenance needs for the KY 8 – Mary Ingles Highway Corridor present a unique challenge. The Kentucky Transportation Cabinet continues to address pavement failures as they occur, resulting in significant cost and inconvenience to the traveling public as the roadway is often closed, completely or partially, to traffic while maintenance activities are underway. Capital expenditures through 2030 were estimated for the alternatives under consideration. The No Build alternative would result in expenditures of more than $12.4 million over the next 15 years. The reconstruction alternatives would range from just over $75 million to nearly $80.3 million. The rerouting alternative would have the lowest overall cost at approximately $5.85 million.

The underlying geotechnical issues that contribute to the pavement failures can be addressed through reconstruction of the existing roadway. However, such a reconstruction is not an inexpensive undertaking, with current construction cost estimates ranging from $62 to $67 million. With 1,400 vehicles per day using the route currently and little or no growth anticipated, such an expenditure may not be feasible. Additionally, the route would have to be closed to traffic for multiple construction seasons while the road is being reconstructed.

Six options for rerouting KY 8 to other state-maintained facilities in Campbell County were examined for possible future consideration. Each of these options could feasibly accommodate additional traffic that would divert away from KY 8 at a relatively low cost. However, each

optional route has its own set of benefits and disadvantages that would need to be examined further should rerouting be deemed desirable.

5.0 NEXT STEPS

The next steps for the project, should an improvement alternative (reconstruction or rerouting of KY 8) be pursued, include coordination with affected stakeholders. This effort would include communication with the neighboring communities of Dayton, Newport, Fort Thomas, and Alexandria, with particular attention given to the affected property owners and businesses. As discussed previously, the study portion of KY 8 is a popular corridor for bicycle enthusiasts and is designated as a preferred bicycle route. Whether the roadway is closed to traffic for a period of time during its reconstruction or the roadway is permanently closed to through traffic, coordination with OKI and bicycle advocacy groups will be required. Under a closure scenario, a dedicated shared-use facility in the KY 8 corridor may be considered desirable, but the construction and on-going and long-term maintenance of such a facility would be the responsibility of an agency other than KYTC.

Should an improvement alternative be selected for implementation, additional funding will be necessary to advance the project into Phase 1 Design (Preliminary Engineering and Environmental Analysis) to further study and refine the preferred alternative.

6.0 CONTACTS/ADDITIONAL INFORMATION

Written requests for additional information should be sent to John Moore, Director, KYTC Division of Planning, 200 Mero Street, Frankfort, KY 40622. Additional information regarding this study can also be obtained from the KYTC District 6 Project Manager, Carol Callan-Ramler, at (859) 341-2707 EXT. 272 (email at carol.callan-ramler@ky.gov).