

VI. INTERCHANGES AND RAMPS

There are a total of sixteen (16) interchanges along the I-69 study corridor. Of these sixteen (16) interchanges, six (6) are located on the Ford Parkway and ten (10) are on the Breathitt Parkway.

This chapter summarizes interchange and ramp conditions, taken from the as-built design plans, and compares those conditions with AASHTO guidelines for several key areas. These findings are identified in **Figures 15 through 19** and **Table 15**. The figures show interchange data only for elements that do not meet the recommended guidelines.



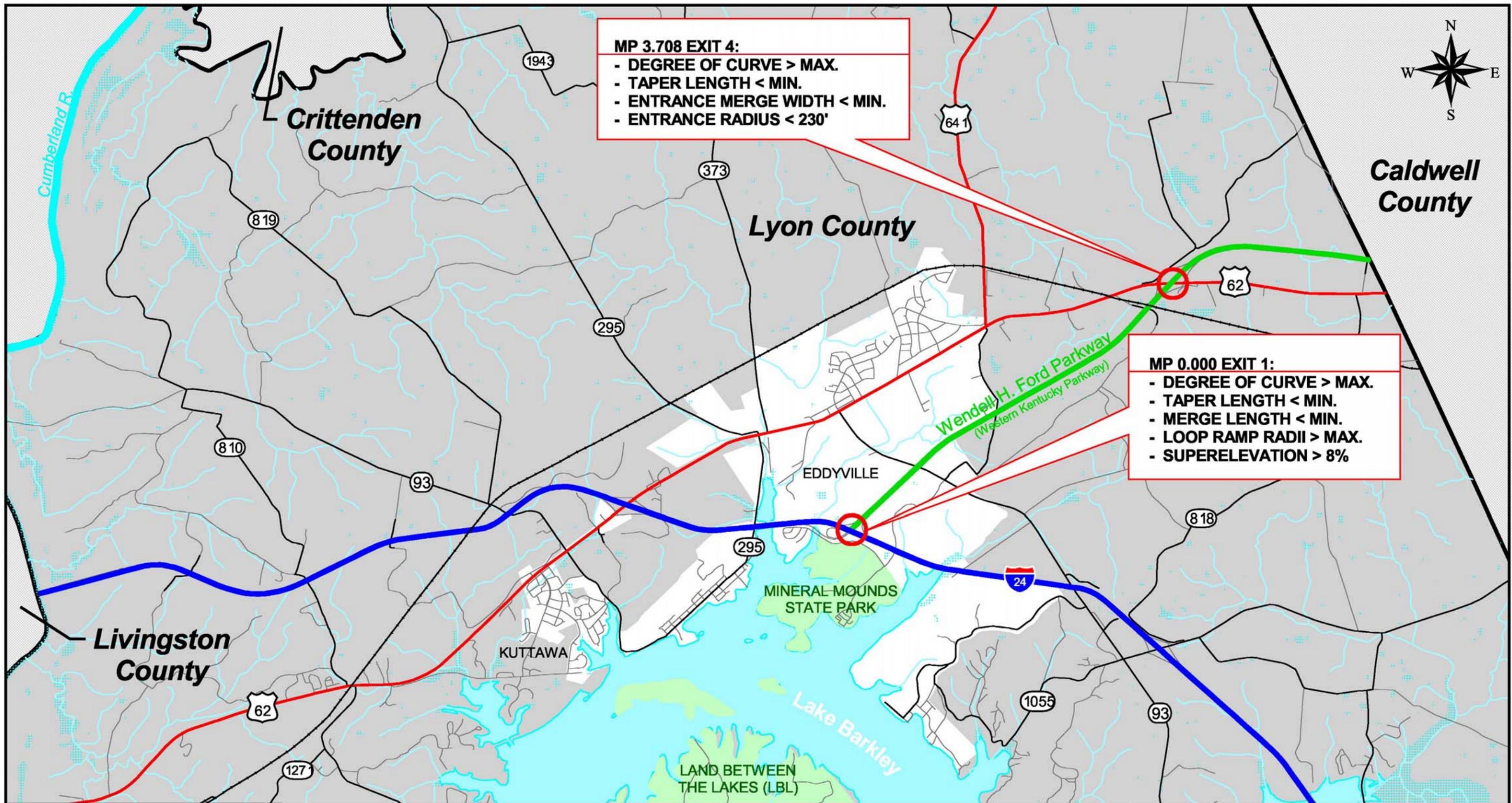
Interchanges have design guidelines for design speed, typical sections, horizontal and vertical alignment that are similar to mainline sections, along with added requirements for merge and weaving sections.

In the guidelines recommended by AASHTO, there is some degree of variability and options that are available to designers to alter a specific set of standards that are established for interchange and ramp features. Therefore, without a more comprehensive evaluation of the features and characteristics at each location, it is difficult to conclusively determine the applicable minimum standards and the degree to which existing conditions adhere to those standards. Nevertheless, this chapter establishes basic assumptions related to various design features at interchanges and ramps and makes a general determination as to whether minimum guidelines are achieved at each location.

A. Design Speed

AASHTO minimum design speeds for entrance and exit ramps are 40 MPH for directional ramps, 35 MPH for semi-directional ramps in rural areas and 25 MPH for semi-directional ramps in urban areas. For loop ramps, 25 MPH minimum guidelines are recommended for both rural and urban areas. For horizontal alignment of directional, semi-directional ramps and loop ramps with 40 MPH, 35 MPH and 25 MPH design speeds, respectively, the corresponding minimum radii are 465', 350' and 170'.

The design speed was not available for some ramps on the as-built plans; however, a cursory evaluation indicates that the radii of many of the ramps do not meet the minimum guidelines for the recommended design speed. Therefore, although there was insufficient information to definitively locate or quantify where these possible variations exist, many of the ramps do not meet the minimum guidelines for design speed.



MP 3.708 EXIT 4:

- DEGREE OF CURVE > MAX.
- TAPER LENGTH < MIN.
- ENTRANCE MERGE WIDTH < MIN.
- ENTRANCE RADIUS < 230'

MP 0.000 EXIT 1:

- DEGREE OF CURVE > MAX.
- TAPER LENGTH < MIN.
- MERGE LENGTH < MIN.
- LOOP RAMP RADII > MAX.
- SUPERELEVATION > 8%

LEGEND

- Interchange Location
- Interchange Data
 - MP 3.708 EXIT 4:
 - DEGREE OF CURVE > MAX.
 - TAPER LENGTH < MIN.
 - ENTRANCE MERGE WIDTH < MIN.
 - ENTRANCE RADIUS < 230'

Location Map

1 0 1 2 3 4 Miles

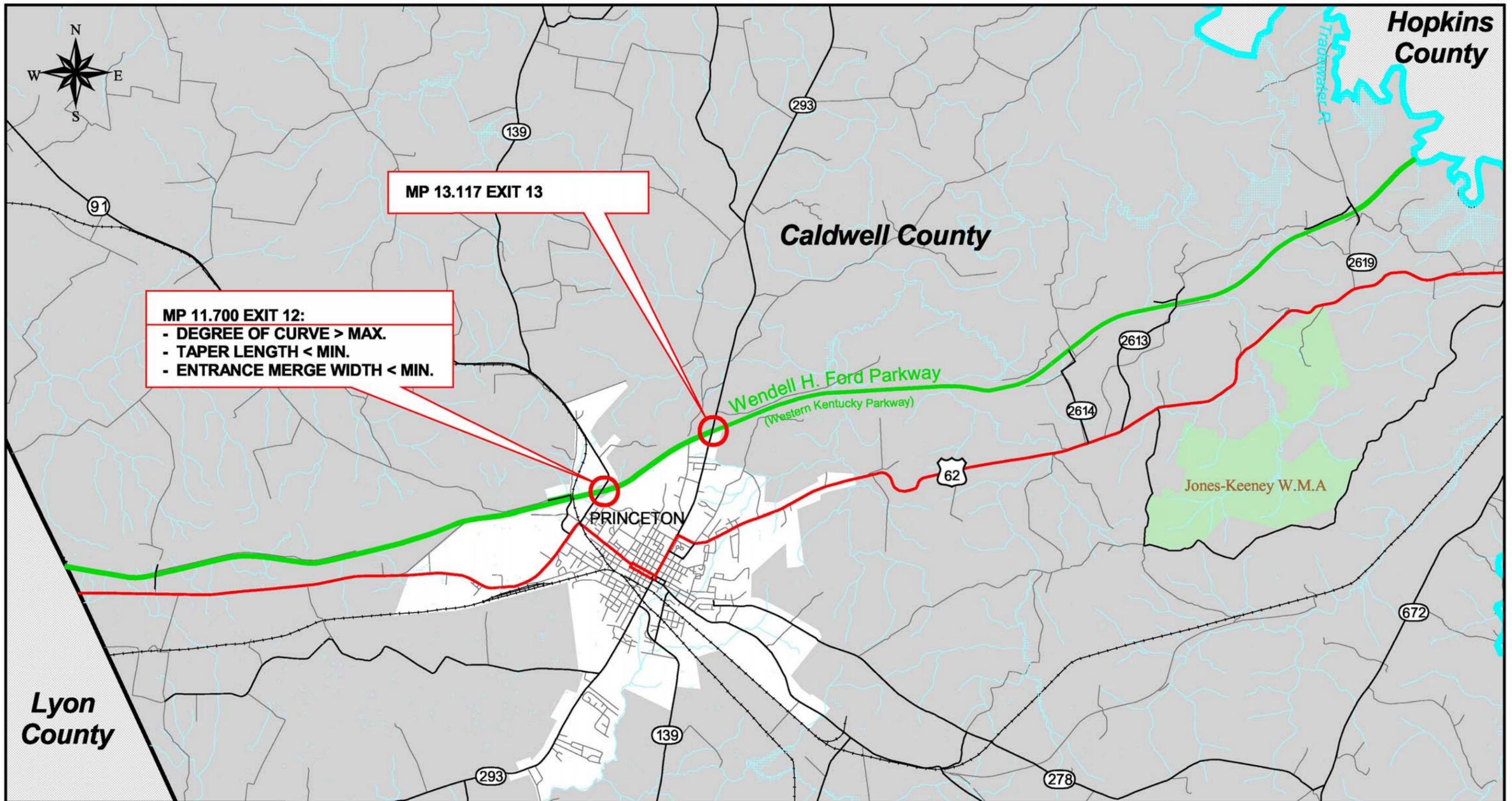
Existing Interchange Conditions

**I-69 Corridor
Henderson to Eddyville**

Lyon County, Kentucky
Item No. 2-69.10

Note: Data is shown only for elements that do not meet recommended guidelines.

Figure 15. Substandard Interchange Conditions for Lyon County 6-2



LEGEND



- Interchange Location

MP 11.700 EXIT 12:
 - DEGREE OF CURVE > MAX.
 - TAPER LENGTH < MIN.
 - ENTRANCE MERGE WIDTH < MIN.

- Interchange Data



Location Map



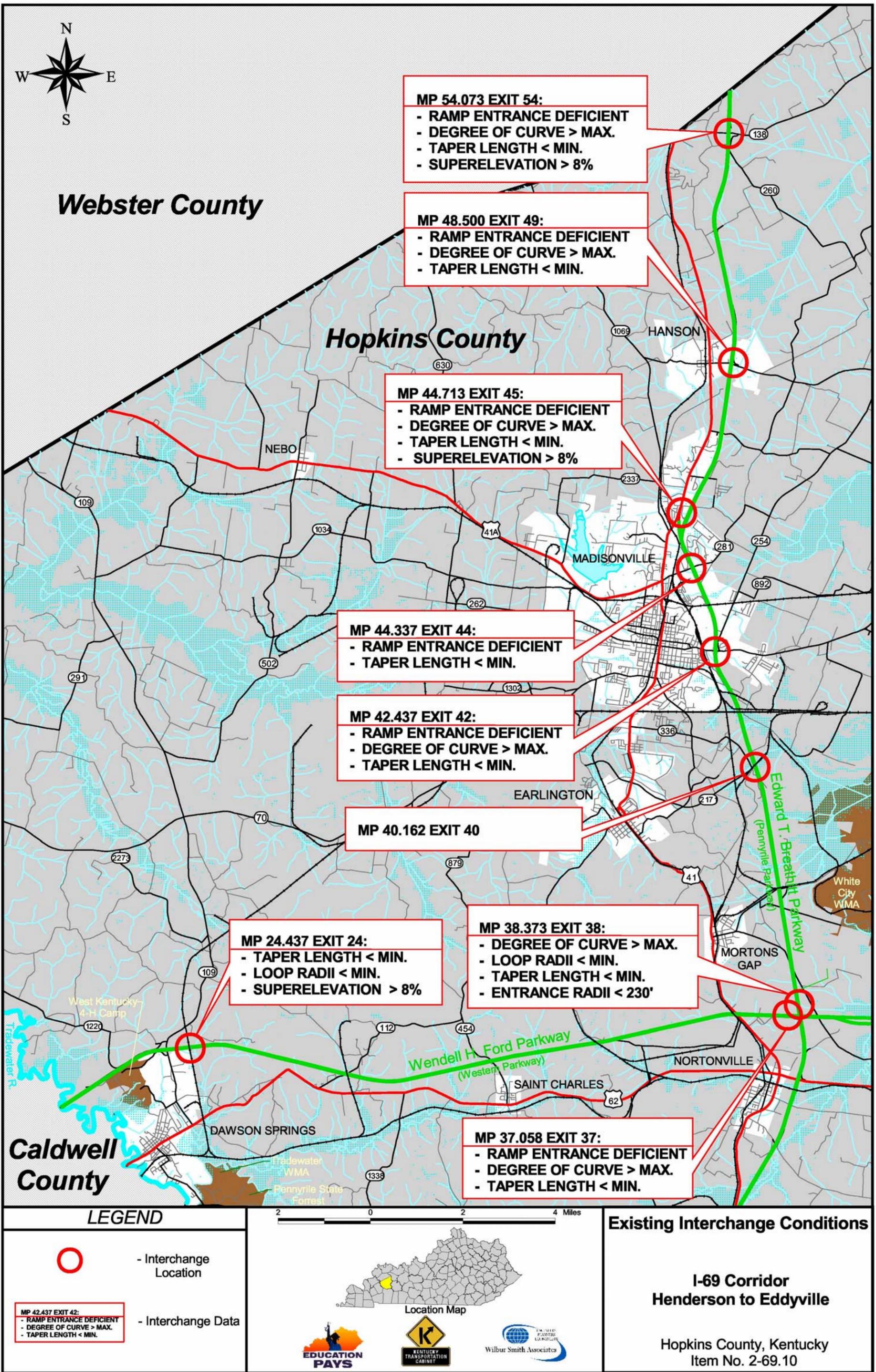
Existing Interchange Conditions

**I-69 Corridor
 Henderson to Eddyville**

Caldwell County, Kentucky
 Item No. 2-69.10

Note: Data is shown only for elements that do not meet recommended guidelines.

Figure 16. Substandard Interchange Conditions for Caldwell County 6-3



Webster County

Hopkins County

Caldwell County

MP 54.073 EXIT 54:
 - RAMP ENTRANCE DEFICIENT
 - DEGREE OF CURVE > MAX.
 - TAPER LENGTH < MIN.
 - SUPERELEVATION > 8%

MP 48.500 EXIT 49:
 - RAMP ENTRANCE DEFICIENT
 - DEGREE OF CURVE > MAX.
 - TAPER LENGTH < MIN.

MP 44.713 EXIT 45:
 - RAMP ENTRANCE DEFICIENT
 - DEGREE OF CURVE > MAX.
 - TAPER LENGTH < MIN.
 - SUPERELEVATION > 8%

MP 44.337 EXIT 44:
 - RAMP ENTRANCE DEFICIENT
 - TAPER LENGTH < MIN.

MP 42.437 EXIT 42:
 - RAMP ENTRANCE DEFICIENT
 - DEGREE OF CURVE > MAX.
 - TAPER LENGTH < MIN.

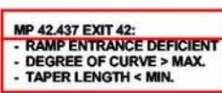
MP 40.162 EXIT 40

MP 24.437 EXIT 24:
 - TAPER LENGTH < MIN.
 - LOOP RADII < MIN.
 - SUPERELEVATION > 8%

MP 38.373 EXIT 38:
 - DEGREE OF CURVE > MAX.
 - LOOP RADII < MIN.
 - TAPER LENGTH < MIN.
 - ENTRANCE RADII < 230'

MP 37.058 EXIT 37:
 - RAMP ENTRANCE DEFICIENT
 - DEGREE OF CURVE > MAX.
 - TAPER LENGTH < MIN.

LEGEND

-  - Interchange Location
-  - Interchange Data

2 0 2 4 Miles

Location Map




Existing Interchange Conditions

**I-69 Corridor
Henderson to Eddyville**

Hopkins County, Kentucky
Item No. 2-69.10

Figure 17. Substandard Interchange Conditions for Hopkins County

6-4 Note: Data is shown only for elements that do not meet recommended guidelines.

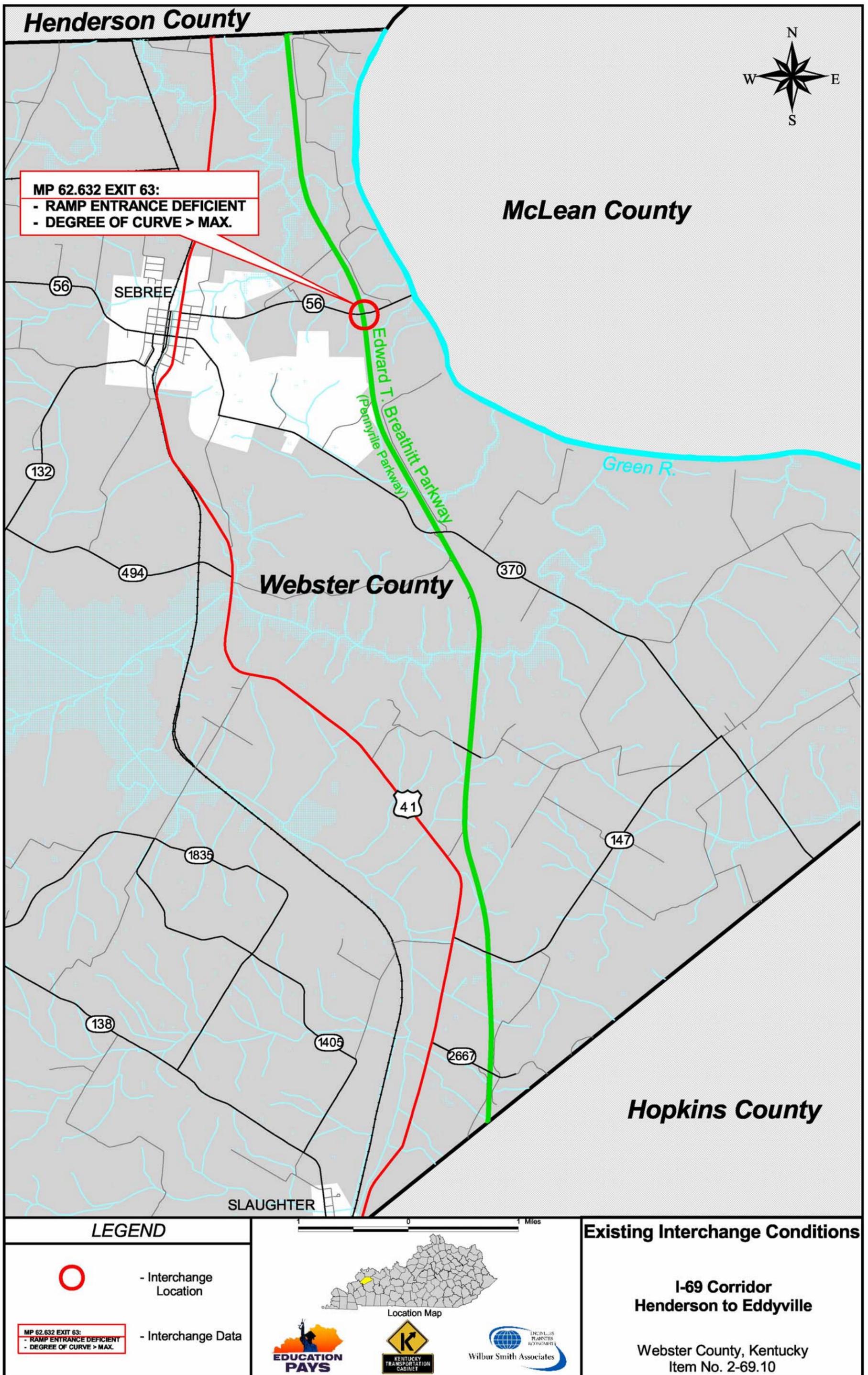
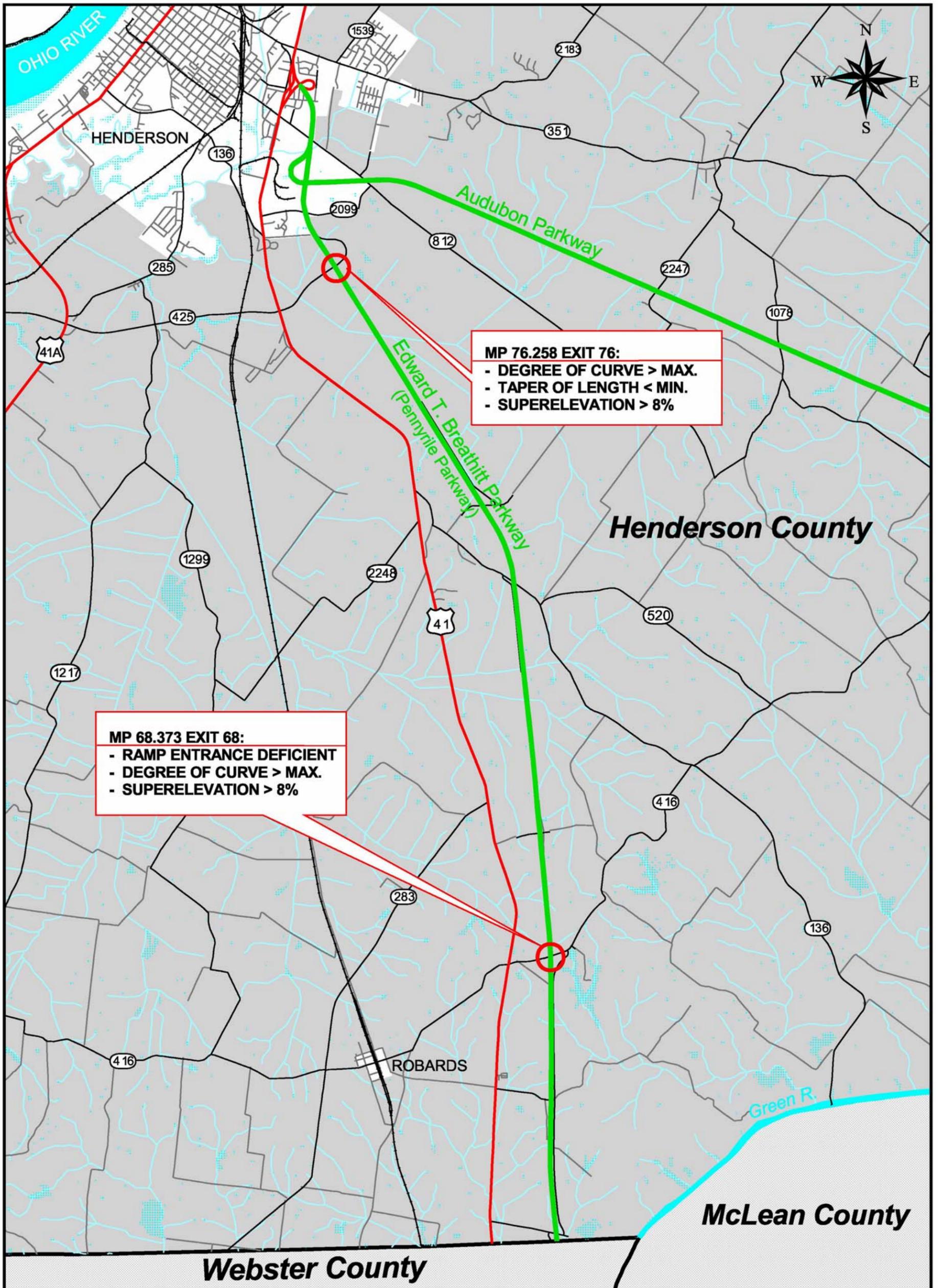


Figure 18. Substandard Interchange Conditions for Webster County

Note: Data is shown only for elements that do not meet recommended guidelines.



MP 76.258 EXIT 76:

- DEGREE OF CURVE > MAX.
- TAPER OF LENGTH < MIN.
- SUPERELEVATION > 8%

MP 68.373 EXIT 68:

- RAMP ENTRANCE DEFICIENT
- DEGREE OF CURVE > MAX.
- SUPERELEVATION > 8%

LEGEND

- Interchange Location

- Interchange Data

MP 68.373 EXIT 68:

- RAMP ENTRANCE DEFICIENT
- DEGREE OF CURVE > MAX.
- SUPERELEVATION > 8%

0 2 4 Miles

Location Map

Existing Interchange Conditions

**I-69 Corridor
Henderson to Eddyville**

Henderson County, Kentucky
Item No. 2-69.10

Figure 19. Substandard Interchange Conditions for Henderson County

Note: Data is shown only for elements that do not meet recommended guidelines.

Table 15 – Interchange Geometrics for I-69

WENDELL H. FORD (WESTERN KENTUCKY) PARKWAY													
County	MP	Exit Number	Ramp Characteristics				Meet Interstate Standards?					Remarks	
			Design Year	Entrance	Exit	Type	Width	Entrance Radius	Ramp Radius	Taper	Superelevation		
Lyon	0.000	1	1976	A		Taper	15'		No	No	No	Begin WKY Parkway at I-24 Interchange [Trumpet-type] 64°-46'-42" Skew Left	
					B		Taper	15'		No	No		No
					C		Taper	15'		No	No		No
					D		Loop	15'		No	No		No
Lyon	3.708	4	1967		A	Taper	18'	No	No	No	US 62 46°-00' Skew Right		
					B		Taper	18'	No	No		No	
					C	Parallel	18'	No	No	No		No	
					D		Taper	18'	No	No		No	
Caldwell	11.700	12	1961		A	Taper	16'	No		No	KY 91 42°-10' Skew Left		
					B		Taper	16'	No	No			
					C		Taper	16'	No			No	
					D		Taper	16'	No	No		No	
Caldwell	13.117	13	1990	A		Taper	15'				KY 293 Ramp design per KYTC		
					B		Taper	15'					
Hopkins	24.437	24	1961		A	Loop	16'			No	KY 109 6°-14' Skew Left (former Toll Plaza)		
					B		Loop	16'		No		No	
					C		Loop	16'		No		No	
					D		Loop	16'		No		No	
Hopkins	38.373	38	1962	A		Taper	16'	No	No	No	Pennyriple Pkwy. I-Chng. (Exit 34)		
					B		Loop	16'	No	No		No	
					C		Taper	16'	No	No		No	
					D		Loop	16'	No	No		No	
					E		Taper	16'	No	No		No	
					F		Loop	16'	No	No		No	
					G		Taper	16'	No	No		No	
					H		Loop	16'	No	No		No	

EDWARD T. BREATHITT (PENNYRILE) PARKWAY													
County	MP	Exit Number	Design Year	Ramp Characteristics			Meet Interstate Standards?					Remarks	
				Entrance	Exit	Type	Width	Entrance Radius	Ramp Radius	Taper	Superelevation		
Hopkins	37.058	37	1959	A		Taper	16'	No		No	Not Available	KY 813	
					B		Loop	16'		No			Not Available
					C		Loop	16'		No			Not Available
					D		Taper	16'	No		No		Not Available
Hopkins	40.162	40	1992	A		Taper	15'				Not Available	KY 2171 Ramp design per KYTC	
					B		Taper	15'					Not Available
					C		Taper	15'					Not Available
					D		Taper	15'					Not Available
Hopkins	42.437	42	1959	A		Parallel	16'	No		No	Not Available	KY 70	
					B		Taper	16'	No		No		Not Available
					C		Taper	16'	No		No		Not Available
					D		Parallel	16'	No	No	No		Not Available
Hopkins	44.337	44	1959	A		Taper	16'	No		No	Not Available	KY 281	
					B		Parallel	16'	No		No		Not Available
					C		Taper	16'	No		No		Not Available
					D		Taper	16'	No		No		Not Available
Hopkins	44.713	45	1967	SB		Taper	24'	No	No	No	US 41N, En-SB, Ex-NB		
					NB		Taper	24'	No	No		No	
Hopkins	48.500	49	1990	A/C	B/D	Taper	15'-16'	No	No	No	KY 260 (A & C Obsolete)		
Hopkins	54.073	54	1966	NE		Taper	18'	No		No	No	KY 138	
					SW		Taper	18'	No		No		No
					SE		Taper	18'	No		No		No
					NW		Taper	18'	No	No	No		No
Webster	62.632	63	1967	A		Loop	18'	No		No	KY 56 (former Toll Plaza)		
					B		Loop	18'	No			No	
					C		Loop	18'	No			No	
					D		Loop	18'	No			No	
Henderson	68.373	68	1967	A		Taper	18'	No		No	KY 416		
					B		Taper	18'	No	No		No	
					C		Taper	18'	No	No		No	
					D		Taper	18'	No	No		No	
Henderson	76.258	76	1978	A		Taper	15'			No	KY 425		
					B		Taper	15'				No	
					C		Loop	15'				No	
					D		Taper	15'		No		No	

Sources: A Policy on the Geometric Design of Highways and Streets, American Association of State Highway and Transportation Officials, 4th Edition, 2001.
 Ford Parkway As-Built Design Plans
 Breathitt Parkway As-Built Design Plans
 Note: According to KYTC Highway District 2, auxiliary lanes were added as part of a rehabilitation project in the late 90s between Interchange 44 and 45 along the Breathitt Parkway.

B. Typical Sections

The following is a summary of existing typical section design elements (lane widths and shoulder widths) on the interchange ramps and a comparison of these elements with current AASHTO guidelines.

1. Lane Widths

The minimum AASHTO guideline for lane width along an interchange ramp is 15 feet. The lane widths on all existing exit ramps throughout the entire corridor range in width from 15 feet at the I-24 Interchange in Lyon County to 18 feet at the KY 416 Interchange in Henderson County. Therefore, the lane width on the interchange ramps meets the minimum AASHTO guidelines for freeway design. A summary of ramp widths is presented in **Table 15**.

2. Shoulder Widths

AASHTO design guidelines recommend shoulders on entrance and exit ramps that could be used for emergency stopping and to minimize the effect of breakdowns. Curbs should only be used where adverse drainage conditions might exist. Most typical sections in the existing plans indicate that raised mountable curbs were used on the entrance and exit ramps. Other than the width provided for the ramp itself, there was no additional width provided for shoulders. Therefore, the ramps do not meet AASHTO guidelines for shoulders.

C. Alignment Geometry

The following is a summary of the geometry of the as-built ramp configurations as compared to the current AASHTO guidelines.

1. Horizontal Alignment

Many of the directional, semi-directional and loop ramps at the existing interchanges do not meet the recommended minimum design guidelines for horizontal alignment. At the interchanges, the maximum degree of curve on most of the existing interchange ramps exceeds the design standard of 465' minimum radius for directional type ramps, 350' minimum radius for semi-directional type ramps in rural areas and 170' minimum radius for semi-directional type ramps in urban areas and for loop type ramps. Ramp locations that exceed the minimum horizontal design standards appear in **Table 15**.

2. Superelevation Rate

The recommended maximum superelevation rate for ramp configurations is 8 percent. Many of the directional and loop ramps have superelevations that exceed the 8% maximum. The ramp locations which exceed the maximum recommended rate are shown in **Table 15**.

3. Vertical Alignment

The as-built plan sets do not provide vertical profile information for ramps. However, it is not anticipated that significant vertical alignment problems exist along the Parkways.

D. Speed-Change Lanes and Weaving Characteristics

The following is a summary of the geometry of the as-built ramp configurations as compared to the current AASHTO guidelines for speed-change lanes and weaving areas.

1. Speed-Change Lanes

Perhaps the single most important factor affecting safety and operational efficiency at interchanges is the effective design of the speed-change lanes (entrance and exit ramps). The two typical types of speed-change lanes include the parallel type and the taper type. These design types can be applied to entrance or exit ramps.

Operational studies have shown that the minimum desirable rate of taper for taper type entrance ramps is 50:1 between the outer edge of the acceleration lane and the edge of the through-traffic lane. The length of parallel type entrance ramp required to accelerate to highway speed is dependent on the actual design speed of the mainline roadway. However, if the length of acceleration length exceeds 1300', the use of a taper type is recommended. Where a parallel type ramp is used, the taper length at the downstream end of the lane should be 25:1. Exit ramp configurations are also described as taper type or parallel type.



Entrance ramps and exit ramps at many interchanges along the two Parkways do not appear to meet minimum interstate guidelines for lengths and tapers.

The taper type ramps are generally designed with an alignment break at the outer edge of pavement with a divergence angle of 2 to 5 degrees. The parallel type begins with an exit taper of 20:1 and the length of parallel lane is dependent on the design speed of the mainline roadway.

Existing entrance ramps on the Ford and Breathitt Parkways do not meet the minimum guideline of 50:1 entrance tapers, and existing exit ramps have exit taper lengths that do not meet the minimum taper length of 20:1. The minimum deceleration length for exit ramps to a stop condition is 615 feet. None of the current directional exit ramps meets this criterion on either Parkway. In addition to the entrance and exit ramp taper lengths, the initial ramp curvatures do not meet the minimum radius of 230 feet.

2. Weaving Characteristics

The minimum length of weaving section recommended for a service-to-service interchange is 1,000 feet. There are three (3) interchanges where the length of weaving is below that recommended in the AASHTO guidelines. Two of those interchanges are on the Ford Parkway: KY 109 at MP 24.437 in Hopkins County and the Breathitt Parkway at MP 38.373 in Hopkins County. The third is the KY 56 interchange on the Breathitt Parkway at MP 62.632 in Webster County.

The interchanges at MP 24.437 on the Ford Parkway in Hopkins County and MP 62.632 on the Breathitt Parkway in Webster County were initially designed for toll collection stations. The configurations included short weaving sections on the mainline of approximately 300 feet. The design was adequate to serve the toll facility, where low speeds were prevalent. However, although the toll collection operations have since been suspended, the initial interchange configurations were never upgraded to accommodate the resulting higher speeds.

E. Interchange Crash Data

Crashes at interchanges along the study section of the Parkways were also considered as part of this analysis. Crashes occurring within a 0.1-mile section on either side of the intersecting route at each interchange were summarized by crash type, as shown in **Table 16**. Along the Parkways, there are three interchanges that fall within the high crash segments identified previously in **Sections 4 and 5 of Chapter 3**:

- Exit 1 in Lyon County, at the interchange with I-24, had 11 crashes in the period studied. Five (5) of these were crashes with an animal.
- Exit 4 in Lyon County, at the interchange with US 62, had 6 crashes in the period studied. Five (5) of these were crashes with a fixed object.
- Exit 42 in Hopkins County, at the interchange with KY 70/85, had 65 crashes in the period studied. The majority of these crashes (37) were ramp-related and another 20 were rear-end crashes in the travel lanes.

Two other interchanges along the Parkways had a high number of crashes within 0.1-miles of the intersecting route. These include:

- Exit 37 in Hopkins County, at the interchange with KY 813, had a total of 21 crashes. Half of these (10) were crashes with a fixed object.
- Exit 44 in Hopkins County, at the interchange with KY 281, had 34 crashes in the period studied. Fourteen (14) of these were rear-end crashes and another 12 were ramp-related.

Crash types at interchanges can be studied to identify potential design and geometric problems with entrance ramps, exit ramps and bridge clearances. The number of ramp, rear-end and fixed-object crashes at interchanges may indicate the need for entrance, exit and clearance improvements at certain interchanges along both Parkways.

Table 16 - Interchange Crash Data

Exit Number	County	Intersecting Route	Number of Crashes by Type ¹							Total Crashes
			Ramp	Rear-End	Fixed Object	Animal	Sideswipe	Ran Off Road	Other	
Ford Parkway										
42	Lyon	I-24	1	0	2	5	1	0	2	11
4	Lyon	US 62	0	0	5	0	0	0	1	6
12	Caldwell	KY 91	0	0	1	1	0	0	0	2
13	Caldwell	KY 293	2	0	1	1	0	1	0	5
24	Hopkins	KY 109	2	1	1	1	0	0	0	5
38	Hopkins	Breathitt Parkway	0	0	4	0	0	0	1	5
Breathitt Parkway										
37	Hopkins	KY 813	2	1	10	0	5	1	2	21
40	Hopkins	KY 2171	0	0	0	0	0	0	2	2
42	Hopkins	KY 70	37	20	3	3	1	0	1	65
44	Hopkins	KY 281	12	14	2	0	2	3	1	34
45	Hopkins	US 41	0	1	1	2	0	0	1	5
49	Hopkins	KY 260	0	0	1	1	0	1	0	3
54	Hopkins	KY 138	0	0	3	1	0	1	3	8
63	Webster	KY 56	2	1	4	0	1	1	0	9
68	Henderson	KY 416	0	0	0	1	0	0	2	3
76	Henderson	KY 425	1	1	1	0	0	0	1	4

¹ Number of crashes in period studied (1998-2001), within 0.1 mile on either side of intersecting route.