

FINAL REPORT

High-Level Overview of I-67 Corridor US 60 and US 231

May 2014





HIGH LEVEL OVERVIEW OF I-67 CORRIDOR

EXECUTIVE SUMMARY

Kentucky Transportation Cabinet – Division of Planning
MAY 2014

The Kentucky Transportation Cabinet (KYTC) has undertaken a **high-level overview** study of the potential I-67 corridor from the Natcher Parkway and US 60 interchange in Owensboro, Kentucky to the Kentucky/Indiana state line. The I-67 Development Corporation is studying the feasibility of a potential I-67 interstate corridor between I-65 in Nashville, Tennessee and I-196 in Western Michigan. However, an I-67 corridor is currently neither congressionally mandated nor administratively designated by the FHWA. In 2012, the I-67 Development Corporation published the *I-67 Corridor Feasibility Study*, which analyzed the feasibility of an interstate corridor between I-65 in Bowling Green, Kentucky and Indianapolis, Indiana. The study analyzed a potential I-67 corridor along the Natcher Parkway from I-65 in Bowling Green to US 60 in Owensboro, then along US 60 and US 231 to I-64 in Indiana. The corridor would then continue along a new interstate east of Huntingburg and Jasper, terminating at I-69 near Washington, Indiana.

Figure ES-1 illustrates this segment of the potential I-67 corridor and is defined as follows:

- Natcher Parkway and US 60 interchange (Exit 17) eastward along existing US 60 (Wendell Ford Expressway) to KY 54 interchange (Exit 18) (Blue);
- US 60 (Bypass) Extension, currently under construction, from KY 54 interchange to Hawes Boulevard (Yellow);
- US 60 from Hawes Boulevard to US 231 intersection (Red);
- US 231 from US 60 across the William H. Natcher Parkway Bridge to Indiana (Green);

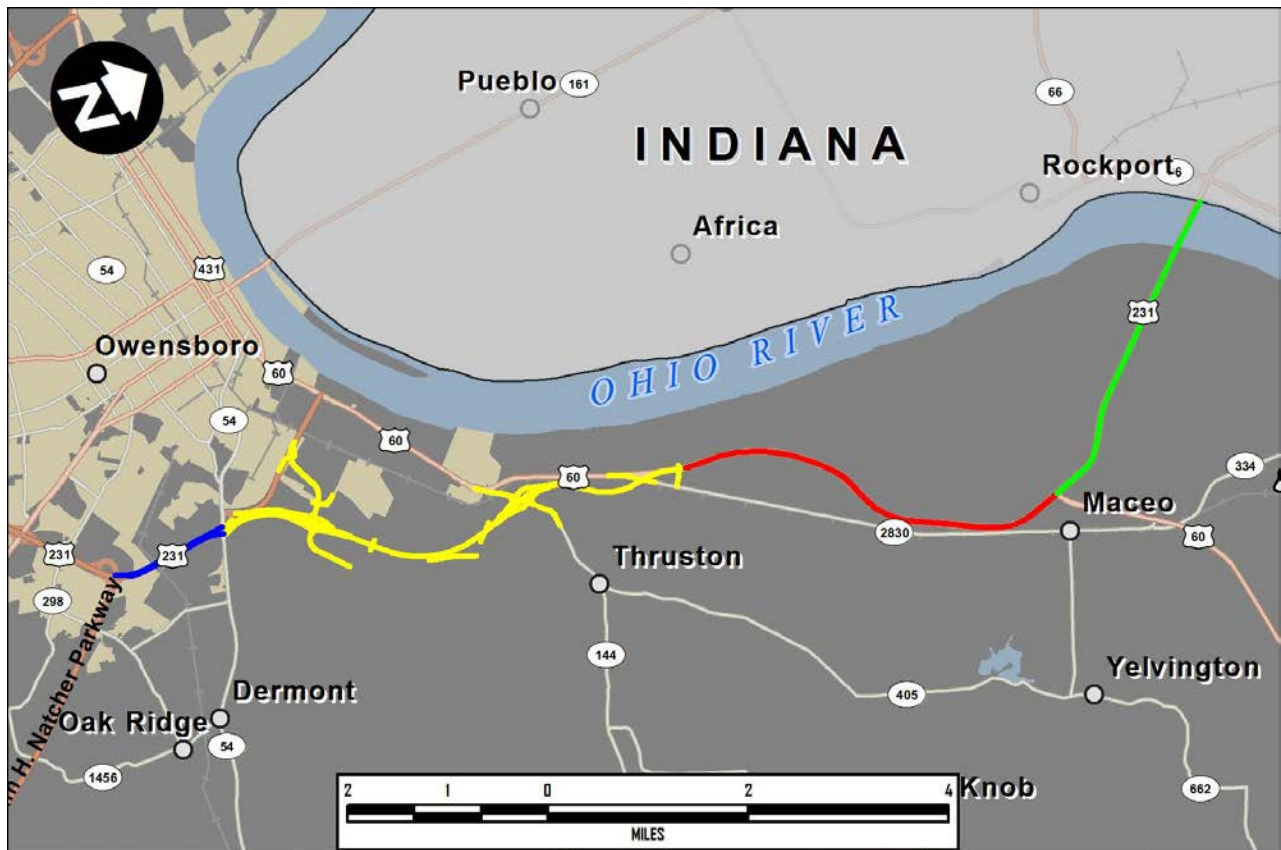


Figure ES-1 I-67 Study Area

STUDY PURPOSE

The primary purpose of this **high-level overview study** is to review the existing conditions along US 60 (Wendell Ford Expressway), US 60 (Bypass) Extension, US 60, and US 231 to identify locations that do not meet current Association of State Highway Transportation Officials (AASHTO) and Federal Highway Administration (FHWA) highway design guidelines and related criteria for designation as an interstate route. Evaluations include the degree to which these criteria are not met and identify improvements to address identified deficiencies.

STUDY ACTIVITIES

The study activities for the High Level Overview of the I-67 Corridor Study included the following:

- Identify criteria and standards per AASHTO and the FHWA for designation as an interstate route;
- Collect data from the KYTC's Highway Information System, As-built plans, crash data, field observation and measurement, and other information provided by the local KYTC District 2 office;
- Compare and analyze collected data with the interstate criteria, and identify conditions and locations on US 60 (Wendell Ford Expressway), US 60 (Bypass) Extension, US 60, and US 231 that do not meet interstate criteria and standards;
- Develop potential improvements and costs associated with improving these areas with identified deficiencies to meet criteria and standards.

KEY FINDINGS

The studied corridor provides some of the basic geometric characteristics of an interstate highway, such as two travel lanes in each direction, 12-foot lanes, 4-foot inside paved shoulders, 10-foot outside paved shoulders, 36-foot rural medians, 10-foot urban medians, 70 mph rural design speed, and 50 mph urban design speed. The urban sections exceed the minimum median widths, while the rural sections meet the minimum 36-foot median widths. However, some physical features of the project routes do not meet the criteria for an interstate facility. The following discussion describes the geometric features that do not meet interstate standards. The findings are based on available data and limited field reviews:

- Interstate Control of Access: US 60 and US 231 are partially controlled access routes along the study corridor. Access to an interstate highway shall be fully controlled. The intersections and access entrances would need to be terminated, rerouted, or grade separated in order to satisfy minimum interstate criteria for control of access.
- Interchange Configuration: According to the *I-67 Corridor Feasibility Study* published by the I-67 Development Corporation, the I-67 corridor in Kentucky would follow along the Natcher Parkway from I-65 in Bowling Green to Owensboro, then along US 60 (Wendell Ford Expressway), US 60 (Bypass) Extension, and US 60/US 231 across the Ohio River at the William H. Natcher Bridge.

The Natcher Parkway and US 60 (Wendell Ford Expressway) interchange has a trumpet configuration. The Natcher Parkway entrance and exit ramps are one lane. Therefore, the northbound I-67 through movement is currently a one-lane ramp, and the southbound I-67 through movement is currently a one-lane loop ramp. US 60 (Wendell Ford Expressway) is the main movement through the interchange with more than 30,000 vpd traveling on four lanes. Based on the interstate criteria requiring two through lanes, the Natcher Parkway and US 60 interchange would need to be improved for the proposed I-67 route.

- Bridge Lateral Clearance: One mainline bridge at MP 17.906 on US 60 (Wendell Ford Expressway) does not meet the minimum lateral clearance required. The mainline bridges on US 60 (Bypass) Extension, US 60, and US 231 meet the minimum lateral clearance required.
- Vertical Alignment and Stopping Sight Distance: Two vertical curves on the westbound on-ramp at the KY 54 and US 60 (Wendell Ford Expressway) interchange do not meet the minimum interstate criteria.
- Interchange Access Control: The KY 54 interchange on US 60 (Wendell Ford Expressway) does not meet the minimum control of access.

PRELIMINARY COST ESTIMATES

Table ES 1 provides a preliminary cost estimate to upgrade the I-67 corridor along US 60 (Wendell Ford Expressway), US 60 (Bypass) Extension, US 60, and US 231 to meet interstate standards and criteria. This study did not include any property research or utility location.

Improvement	Location	Design & Environmental (million) ¹	ROW and Utilities (million) ²	Construction Costs (million)	Total Costs (million)
Natcher Parkway / US 60 Interchange	US 60 (Wendell Ford Expressway)	\$6	\$12	\$41	\$60
Control of Access / Frontage Road	US 60 / US 231	\$5	\$14 ³	\$36	\$55
US 60 / US 231 Interchange	US 60 / US 231	\$5	\$9	\$30	\$44
Vertical Alignment / Stopping Sight Distance	KY 54	\$0.5	\$1	\$4	\$5
Interchange Access Control	KY 54	\$1	\$3	\$9	\$13
William H. Natcher Bridge	US 231 (Ohio River)	-	-	-	-
Total		\$18	\$39	\$120	\$177

¹ Design & Environmental cost estimated at 15% construction costs

² ROW and Utilities cost estimated at 30% construction costs

³ ROW and Utilities cost estimated at 40% construction costs for Control of Access / Frontage Road Improvement

Table ES 1 I-67 Corridor Improvement Preliminary Cost Estimate

HIGH-LEVEL OVERVIEW OF I-67 CORRIDOR

TABLE OF CONTENTS

A. Introduction.....	1
B. Operational Considerations.....	2
1. Crash Analysis.....	2
2. Traffic Volumes and Operational Level of Service.....	3
C. Access Control.....	5
1. Interstate Access Control.....	5
2. Interchange Access Control.....	6
D. Mainline Geometry/Typical Section.....	6
1. Design Speed.....	6
2. Typical Roadway Sections.....	6
3. Horizontal Alignment.....	7
4. Vertical Alignment.....	8
E. Bridges and Overpasses.....	8
1. Lateral Clearances of Bridges.....	8
2. Vertical Clearance of Overpasses and Sign Trusses.....	9
3. Bridge Conditions.....	9
4. Overhead Signs.....	10
F. Interchanges and Ramps.....	10
1. Design Speed.....	11
2. Typical Sections.....	11
3. Alignment Geometry.....	11
4. Speed-Change Lanes and Weaving Characteristics.....	12
5. Interchange Spacing.....	13
6. Interchange Configuration.....	13
G. Key Findings and Potential Improvements.....	14
1. Interstate Control of Access.....	14
2. Interchange Configuration.....	17
3. William H. Natcher Bridge.....	17
H. I-67 Corridor Overview Summary.....	17

LIST OF FIGURES

Figure 1.	I-67 Study Area.....	1
Figure 2.	I-67 Corridor Control of Access.....	6
Figure 3.	KY 54 and US 60 – Pleasant Valley Road Connector Interchanges.....	10
Figure 4.	KY 144 Interchange and Hawes Blvd Intersection.....	11
Figure 5.	Natcher Parkway / US 60 Trumpet Interchange.....	14
Figure 6.	Interstate Control of Access.....	16
Figure 7.	I-67 Interchange at US 60.....	17

LIST OF TABLES

Table 1	I-67 Corridor – US 60/US 231 Mileages.....	2
Table 2	2011 Traffic Characteristics.....	3
Table 3	Future Traffic Volumes without Interstate Designation.....	4
Table 4	Future Traffic Volumes with Interstate Designation.....	5
Table 5	Summary of Mainline Bridge Lateral Clearances.....	9
Table 6	Interchange Spacing.....	13
Table 7	I-67 Corridor Improvement Preliminary Cost Estimate.....	19

A. Introduction

The I-67 Development Corporation is studying the feasibility of potential I-67 interstate corridor between I-65 in Nashville, Tennessee and I-196 in Western Michigan. However, an I-67 corridor is currently neither congressionally mandated nor administratively designated by the FHWA. In 2012, the I-67 Development Corporation published the *I-67 Corridor Feasibility Study*, which analyzed the feasibility of an interstate corridor between I-65 in Bowling Green, Kentucky and Indianapolis, Indiana. The study analyzed a potential I-67 corridor along the Natcher Parkway from I-65 in Bowling Green to US 60 in Owensboro, then along US 60 and US 231 to I-64 in Indiana. The corridor would then continue along a new interstate east of Huntingburg and Jasper, terminating at I-69 near Washington, Indiana.

This report is a **high-level overview** of the potential I-67 corridor from the Natcher Parkway and US 60 interchange in Owensboro, Kentucky to the Kentucky/Indiana state line. The primary purpose of the **high-level overview** study is to review the existing conditions along US 60 (Wendell Ford Expressway), US 60 (Bypass) Extension, US 60, and US 231 to identify locations that do not meet current Association of State Highway Transportation Officials (AASHTO) and Federal Highway Administration (FHWA) highway design guidelines and related criteria. Evaluations include the degree to which these criteria are not met and identify improvements to address identified deficiencies. **Figure 1** below illustrates this segment of the potential I-67 corridor and is defined as follows:

- Natcher Parkway and US 60 interchange (Exit 17) eastward along existing US 60 (Wendell Ford Expressway) to KY 54 interchange (Exit 18) (Blue);
- US 60 (Bypass) Extension, currently under construction, from KY 54 interchange to Hawes Boulevard (Yellow);
- US 60 from Hawes Boulevard to US 231 intersection (Red);
- US 231 from US 60 across the William H. Natcher Parkway Bridge to Indiana (Green);

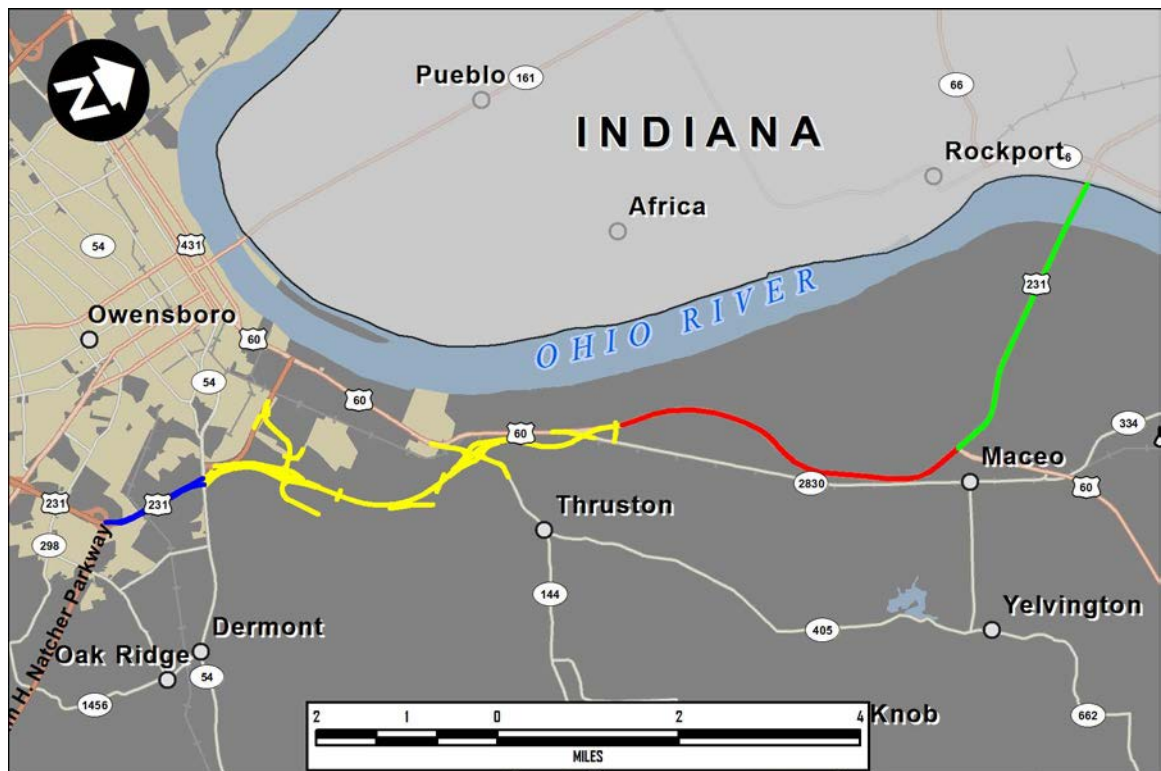


Figure 1 I-67 Study Area

Table 1 describes the route mileage of the studied I-67 corridor along US 60 and US 231 in Daviess County, Kentucky.

ROUTE	BEGIN MP	END MP	TOTAL MILEAGE
US 60 (Wendell Ford Expressway)	17.50	18.69	1.19
US 60 (Bypass) Extension	1	1	4.93
US 60	24.26 ¹	28.37 ¹	4.11
US 231 (Kentucky)	11.29	14.60	3.31
TOTAL			13.53
¹ Mile post on US 60 will change with the completion of US 60 (Bypass) Extension			

Table 1 I-67 Corridor – US 60/US 231 Mileages

To provide an overview of the studied sections, design information was collected from the Kentucky Transportation Cabinet's HIS, As-built plans, construction plans, and site visits. As-built plans for the US 60 (Bypass) Extension project were not available since the project was under construction at the time of this report. The design information provided for the US 60 (Bypass) Extension section of the I-67 corridor is based on construction plans provided by KYTC.

The urban boundaries were based on the 2000 Federal-Aid Urban Area boundary. For this study, the urban boundary includes the US 60 (Wendell Ford Expressway), the US 60 (Bypass) Extension, and US 60 from the US 60 (Bypass) Extension to existing MP 26.11 (Iceland Road). For this study, existing conditions for this section are compared to the urban interstate criteria. Conditions for US 60 from MP 26.11 to US 231 and US 231 are compared to the rural interstate criteria.

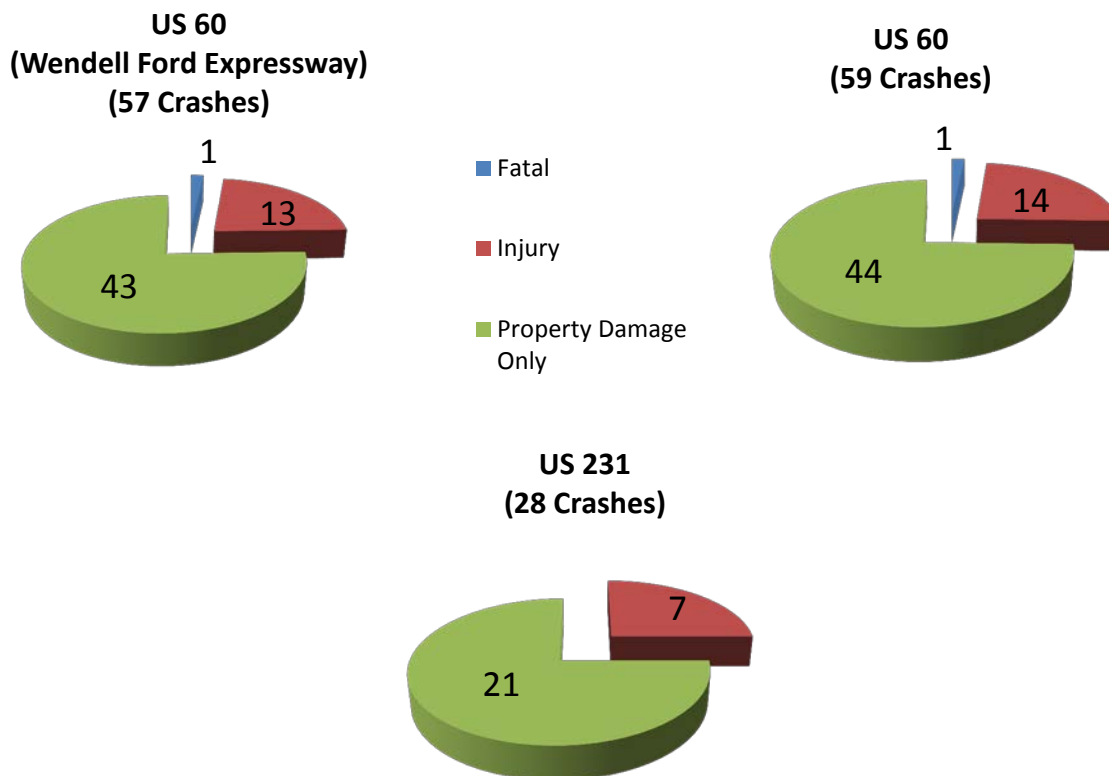
B. Operational Considerations

1. Crash Analysis

The objective of a crash analysis is to identify locations of high crash rates and crash patterns along a studied corridor. The studied section of US 60 (Wendell Ford Expressway) is a fully controlled access highway. The US 60 (Bypass) Extension is currently under construction; therefore, a crash history is not available for analysis. US 60 and US 231 are partially controlled access highways with a crash history that includes crash types not found on a fully controlled access highway or interstate. Therefore, a crash analysis of the US 60 (Bypass) Extension, US 60, and US 231 sections cannot be evaluated as an interstate.

Crash data were collected from the Collision Report Analysis for Safer Highways (CRASH) data base from January 1, 2006 to December 31, 2010 for the studied sections. The graph on the following page shows the total number and types of crashes during the analysis period for US 60 (Wendell Ford Expressway), US 60, and US 231. For this analysis, crashes were classified as fatal, injury, or property-damage-only type.

Number of Crashes by Type (January 2006 – December 2010)



Source: Collision Report Analysis for Safer Highways (CRASH) database

2. Traffic Volumes and Operational Level of Service

a. Current Traffic Volumes (2011)

For the studied sections, the 2011 traffic volumes are based on data from the KYTC HIS database. The US 60 (Bypass) Extension portion of the corridor was under construction at the time of this analysis. The Average Daily Traffic (ADT) and corresponding truck percentages are provided in **Table 2** below.

Begin MP	End MP	Length (miles)	Rural/Urban	2011 ADT	% Trucks	2011 Truck ADT
US 60 (Wendell Ford Expressway)						
17.50	18.69	1.19	Urban	30,900	-	-
US 60 (Bypass) Extension						
Not Available - Under Construction			Urban			
US 60						
24.26	26.11	1.85	Urban	11,600	24.0%	2,784
26.11	28.37	2.26	Rural	11,600	24.0%	2,784
US 231						
11.29	14.60	3.31	Urban	5,770	37.8%	2,181

Table 2 2011 Traffic Characteristics

b. Future Traffic Volumes (2040) without Interstate Designation

The future traffic volumes (2040) were forecast using growth rates based on available information from previous studies and historical ADT volumes. The future traffic volumes without interstate designation are shown in **Table 3** below. The future US 60 (Bypass) Extension traffic volumes were forecast based on historical growth rates and previous traffic forecasts performed by KYTC.

Begin Location (MP)	End Location (MP)	Length (miles)	Urban/Rural	Annual Growth Rate	% Trucks	Truck ADT	ADT	2040 ADT	LOS ¹
US 60 (Wendell Ford Expressway)						Year 2011			
Natcher Parkway (MP 17.50)	KY 54 (MP 18.69)	1.19	Urban	1.4%	12.0%	3,700	30,900	46,300	C
US 60 (Bypass) Extension - New Route						Year 2015			
KY 54 (MP 18.69)	Pleasant Valley Road Interchange	0.96	Urban	1.8%	18.0%	4,180	23,200	36,300	C
Pleasant Valley Road Interchange	KY 144	2.31	Urban	1.8%	22.0%	4,660	21,200	33,200	C
						Year 2007			
KY 144	US 60 (Existing MP 24.26)	1.78	Urban	1.5%	24.0%	3,120	13,000	21,300	B
US 60						Year 2011			
US 60 (Bypass) Extension (MP 24.26)	Iceland Road (MP 26.11)	1.85	Urban	1.9%	24.0%	2,780	11,600	20,100	²
Iceland Road (MP 26.11)	US 231 (MP 28.37)	2.26	Rural	1.9%	24.0%	2,780	11,600	20,100	²
US 231						Year 2011			
US 60 (MP 11.29)	SR 66 (Indiana)	3.31	Rural	2.0%	28.0%	1,620	5,770	10,300	²

¹ Level of Service calculated based on interstate criteria

² US 60 and US 231 are partially controlled access highways

Table 3 Future Traffic Volumes without Interstate Designation

c. Future Traffic Volumes (2040) with Interstate Designation

The future traffic volumes with interstate designation are shown in **Table 4** on the following page. The annual growth rates used to forecast the future traffic volumes provided in **Table 4** were based on historical growth rates and interstate connectivity from Bowling Green, Kentucky to southern Indiana. The forecast traffic volumes do not take into consideration any traffic modeling for the proposed I-67 corridor between Nashville, Tennessee and Indianapolis, Indiana.

Begin Location (MP)	End Location (MP)	Length (miles)	Urban/Rural	Annual Growth Rate	% Trucks	Truck ADT	ADT	2040 ADT	LOS ¹
US 60 (Wendell Ford Expressway)						Year 2011			
Natcher Parkway (MP 17.50)	KY 54 (MP 18.69)	1.19	Urban	1.6%	12.0%	3,700	30,900	49,000	D
US 60 (Bypass) Extension - New Route						Year 2015			
KY 54 (MP 18.69)	Pleasant Valley Road Interchange	0.96	Urban	2.0%	18.0%	4,180	23,200	38,100	C
Pleasant Valley Road Interchange	KY 144	2.31	Urban	2.1%	22.0%	4,660	21,200	35,700	C
						Year 2007			
KY 144	US 60 (Existing MP 24.26)	1.78	Urban	1.8%	24.0%	3,120	13,000	23,500	B
US 60						Year 2011			
US 60 (Bypass) Extension (MP 24.26)	Iceland Road (MP 26.11)	1.85	Urban	2.3%	24.0%	2,780	11,600	22,500	²
Iceland Road (MP 26.11)	US 231 (MP 28.37)	2.26	Rural	2.3%	24.0%	2,780	11,600	22,500	²
US 231						Year 2011			
US 60 (MP 11.29)	SR 66 (Indiana)	3.31	Rural	2.7%	28.0%	1,620	5,770	12,500	²

¹ Level of Service calculated based on interstate criteria

² US 60 and US 231 are partially controlled access highways

Table 4 Future Traffic Volumes with Interstate Designation

d. Level of Service

The Levels of Service (LOS) shown in **Table 3** and **Table 4** were calculated for the segments based on interstate criteria. The studied corridor will operate at LOS C or better without I-67 designation. With the exception of one segment, the studied corridor will operate at LOS C or better with I-67 designation. The segment of US 60 (Wendell Ford Expressway) between the Natcher Parkway and KY 54 will operate at LOS D with I-67 designation because of the increased estimated interstate traffic.

C. Access Control

This section reviews of the existing access control of the studied routes and interchanges and compares them to the AASHTO guidelines.

1. Interstate Access Control

Access to an interstate shall be fully controlled and grade separated at all railroad crossings and crossroads. Therefore, at-grade intersections or permitted access points are not permitted on an interstate facility. US 60 from Hawes Boulevard to US 231 and US 231 are partially controlled access routes. These routes have several at-grade intersections as well as permitted access. **Figure 2** on the following page provides the locations of at-grade intersections and permitted access. The intersections and access entrances would need to be terminated, rerouted, or grade separated. Turn lanes and median crossings would need to be reconstructed to maintain a continuous four-lane interstate facility along US 60 and US 231.



US 60–Residential access

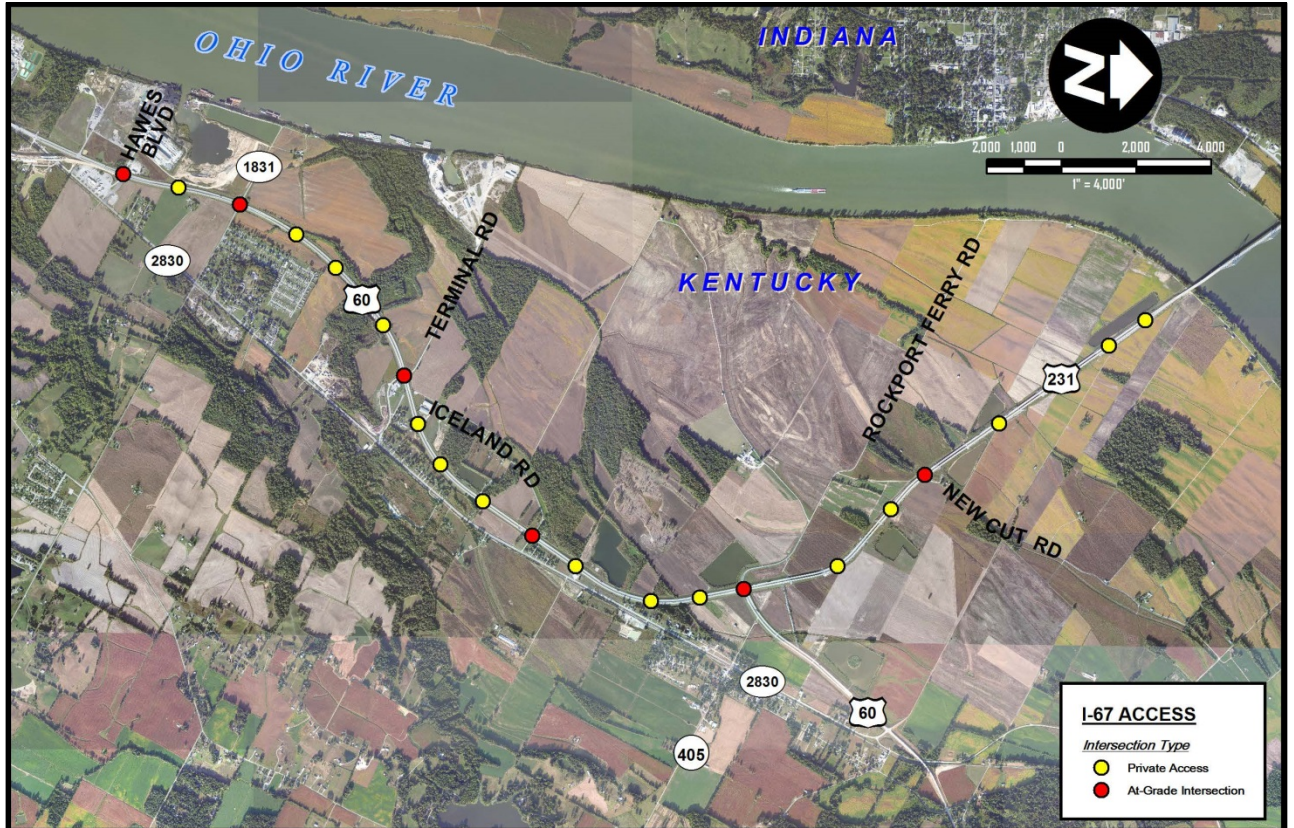


Figure 2 I-67 Corridor Control of Access

2. Interchange Access Control

Current AASHTO criteria indicate that access control beyond ramp terminals should be at least 100 feet in urban areas and 300 feet in rural areas. Based on the KY 54 interchange construction plans, one ramp does not meet the interchange control of access distance of 100 feet in an urban area. The westbound on-ramp control of access is 90 feet at the KY 54 interchange.

D. Mainline Geometry/Typical Section

This section summarizes a review of the existing design speed, median width and type, horizontal and vertical alignments, superelevation rates, and sight distance and compares them to AASHTO guidelines, *A Policy on Design Standards Interstate System* (American Association of State Highway Officials, 2005).

1. Design Speed

As noted on the As-built and construction plans of the studied sections, the design speeds are 60 mph. Geometric features along the studied sections are designed to higher design speed than noted on the plans. The minimum design speed for a rural interstate is 70 mph and 50 mph for an urban interstate. The following sections compare the geometric features with the minimum design speed criteria for rural and urban interstates.

2. Typical Roadway Sections

a. Number of Lanes

The studied sections have two lanes in each direction meeting the minimum AASHTO interstate guidelines. However, several at-grade intersections on US 60 and US 231 are present and include turn lanes at these locations.

b. Lane Widths

The minimum lane width of a freeway facility is 12 feet. The studied sections have 12-foot lanes, therefore meeting the minimum AASHTO interstate guidelines.

c. Shoulder Widths

The minimum AASHTO interstate guidelines for shoulders are 10-foot paved outside shoulder and 4-foot paved inside shoulders. The studied sections have 12-foot outside shoulders with 10 feet paved and 6-foot inside shoulders with 4 feet paved.



US 60 40-foot depressed median

d. Median Width and Type

The studied sections of US 60 (Bypass) Extension, US 60, and US 231 have 40-foot depressed medians. The US 60 (Wendell Ford Bypass) section has a 36-foot depressed median. The AASHTO interstate guidelines for a rural interstate require a minimum median width of 36 feet. Based on the forecast traffic, the studied route is within compliance with the recommended median type.

e. Roadside Obstructions

Based on a field review and reviews of As-built plans, some roadside obstructions are located at the US 60 and US 231 intersection. One utility pole is within 27 feet of the US 60 southbound driving lane at the US 60 and US 231 intersection. In addition to the signal poles at the US 60 and US 231 intersection, poles along US 60 and US 231 for the overhead hanging warning signal signs are considered roadside obstructions according to interstate standards. Based on the review, the roadside obstructions of the remaining studied sections appear to be outside the clear zone or protected by guardrail.

f. Guardrail Placement and Condition

The guardrail end treatments on the US 60 (Wendell Ford Expressway) meet the current standard. The guardrail end treatments shown on the construction plans for US 60 (Bypass) Extension meet the current standard. Some guardrail end treatments on US 60 and US 231 do not meet current standards. The deficient guardrail end treatments are located at permitted access points along these routes.

3. Horizontal Alignment

a. Superelevation

From review of the As-built and construction plans, it appears US 60 (Wendell Ford Expressway) was designed on the basis of a 10% maximum superelevation and US 60 (Bypass) Extension, US 60, and US 231 were designed on the basis of an 8% maximum superelevation. However, design using either the 10% maximum or 8% maximum superelevation rates are within the acceptable criteria for an interstate route.

b. Horizontal Curvature

The minimum radius for an urban interstate is 758 feet and 1810 feet for a rural interstate. The minimum radius meets minimum interstate criteria for the studied route. The smallest radius of curve is 1909 feet, located on US 231.

4. Vertical Alignment

a. Vertical Grade

The studied routes were evaluated based on level terrain. AASHTO interstate guidelines designate a maximum 3% vertical grade for a rural section with a level terrain and 4% for an urban section with level terrain. According to the As-built and construction plans, grades for the studied routes are within the maximum vertical grade criteria for both urban and rural sections. The largest vertical grade is 2.74%, located on US 60 (Bypass) Extension.

b. Vertical Length of Curve

The minimum length of curve was calculated based on the vertical grades of the approaching alignment and compared to the AASHTO interstate guidelines rate of vertical curvature. All of the vertical curves along the studied route meet the minimum criteria for urban and rural interstates.

c. Stopping Sight Distance

Stopping sight distance was reviewed for all vertical curves on the studied route. Stopping sight distance for all vertical curves exceed the minimum urban and rural interstate criteria.

E. Bridges and Overpasses

1. Lateral Clearances of Bridges

The lateral clearance for the mainline bridges along the studied corridor was measured from the As-built and construction plans. Lateral clearance is defined as the width of a mainline bridge, measured from curb to curb.

According to the latest AASHTO guidelines, *A Policy on Design Standards Interstate System* (American Association of State Highway Officials, 2005), the width of a mainline bridge less than 200 feet in length shall equal the full paved width of the approach roadway. The full paved width of the approach roadway includes the two 12-foot travel lanes, 4-foot inside paved shoulder and 10-foot outside paved shoulder for a total of 38 feet. In addition, the policy addresses existing bridges to remain in place when a route is to be incorporated in the interstate system in the following paragraph:

“Mainline bridges on the interstate system and bridges on routes to be incorporated into the system may remain in place if, as a minimum, they meet the following: a) the bridge cross section consists of 3.6 m (12 ft) lanes, 3.0 m (10 ft) shoulder on the right and 1.1 m (3.5 ft) shoulder on the left; b) for long bridges, the offset to the face of parapet or bridge rail on both the left and right is 1.1 m (3.5 ft) measured from the edge of the nearest traveled lane; c) bridge railing shall meet or be upgraded to current standards.”

Of the mainline bridges evaluated, one bridge on US 60 (Wendell Ford Expressway) does not meet the current lateral clearance criteria (31 feet) for bridges longer than 200 feet. The westbound bridge at MP 17.906 has a horizontal clearance of 30 feet. The remaining mainline bridges meet the current lateral clearance criteria. **Table 5** on the following page provides the horizontal lateral clearances of the mainline bridges along the studied corridor. In addition to lateral clearance, the barrier wall type was evaluated on the mainline bridges. All of the mainline bridge barriers meet the current crashworthy criteria.

BRIDGE NO.	MP	FEATURES INTERSECTED	LENGTH (FT)	EXISTING WIDTH (GUTTER TO GUTTER) (FT)	MINIMUM INTERSTATE STANDARD	BARRIER WALL CURRENT STANDARD
US 60 (Wendell Ford Expressway)						
030B00069L	17.906	Old ICCR Bed (Westbound)	220.0	30	31	Yes
030B00069R	17.906	Old ICCR Bed (Eastbound)	220.0	39.25	31	Yes
US 60 (BYPASS) EXTENSION						
-	20.151 ¹	Yellow Creek Tributary (Eastbound)	117.0	42	38	Yes
-	20.151 ¹	Yellow Creek Tributary (Westbound)	117.0	43.8	38	Yes
-	20.265 ¹	Daniels Lane (Eastbound)	189.0	42	38	Yes
-	20.265 ¹	Daniels Lane (Westbound)	189.0	42	38	Yes
-	20.464 ¹	Reid Road #1 (Eastbound)	332.8	42	31	Yes
-	20.464 ¹	Reid Road #1 (Westbound)	332.8	42	31	Yes
-	22.941 ¹	Yellow Creek (Eastbound)	883.5	42	31	Yes
-	22.941 ¹	Yellow Creek (Westbound)	883.5	42	31	Yes
-	23.230 ¹	KY 2830	424.6	42	31	Yes
-	23.230 ¹	KY 2830	424.6	42	31	Yes
US 60						
030B00152L	25.712	Pup Creek	503.9	42	31	Yes
030B00152R	25.712	Pup Creek	503.9	42	31	Yes
US 231						
030B00158L	11.614	Flood Plain - Ohio River No. 5	957.0	40	31	Yes
030B00158R	11.614	Flood Plain - Ohio River No. 5	957.0	40	31	Yes
030B00159L	12.026	Flood Plain - Ohio River No. 4	675.9	40	31	Yes
030B00159R	12.026	Flood Plain - Ohio River No. 4	675.9	40	31	Yes
030B00160L	12.590	Flood Plain - Ohio River No. 3	956.0	40	31	Yes
030B00160R	12.590	Flood Plain - Ohio River No. 3	956.0	40	31	Yes
030B00161L	13.075	Flood Plain - Ohio River No. 2	678.8	40	31	Yes
030B00161R	13.075	Flood Plain - Ohio River No. 2	678.8	40	31	Yes
030B00162L	13.426	Flood Plain - Ohio River No. 1	736.9	40	31	Yes
030B00162R	13.426	Flood Plain - Ohio River No. 1	736.9	40	31	Yes
030B00164N	14.417	Ohio River	4510.0	32/32	31	Yes
Bridge horizontal clearance less than interstate standard						
¹ Calculated Mile Post						

Table 5 Summary of Mainline Bridge Lateral Clearances

2. Vertical Clearance of Overpasses and Sign Trusses

The minimum vertical clearance for an interstate highway is 16 feet between the pavement and the bottom of the overpass structure and should be met across the entire width of the roadway, including auxiliary lanes and the width of paved shoulders. One overpass on US 60 (Wendell Ford Expressway) is located at the KY 54 interchange (MP 18.68). The minimum vertical clearance measured for the KY 54 overpass is 17.98 feet. Two overpass structures are located on the US 60 (Bypass) Extension located at the US 60 - Pleasant Valley Connector and KY 144 interchanges. According to the US 60 - Pleasant Valley Connector construction plans, the minimum vertical clearance for the overpass is 17.95 feet. The minimum vertical clearance for the KY 144 overpass is 18.21 feet. Thus, based on reviews of available data, the vertical clearance for all overpasses exceeds the minimum 16-foot requirement for interstate highways.

3. Bridge Conditions

The structural and functional capacity of the existing bridges was evaluated. According to the inspection reports, all of the existing mainline bridges were identified as "Not Deficient" and having a sufficiency rating of 73.9 or greater.

4. Overhead Signs

Currently, no overhead signs are present on US 60 (Wendell Ford Expressway), US 60, or US 231. According to the construction plans, six overhead sign trusses are designed for the US 60 (Bypass) Extension. It is current KYTC practice for overhead sign trusses to have vertical clearance greater than 17 feet. It is assumed the overhead sign trusses would be constructed with a vertical clearance greater than 17 feet. However, these have not been measured in the field.

F. Interchange and Ramps

This section summarizes the interchanges and ramp conditions on US 60 (Wendell Ford Expressway) and US 60 (Bypass) Extension. At the time of this report, the US 60 (Bypass) Extension interchanges were under construction. On US 60 (Wendell Ford Expressway), two interchanges are located at the Natcher Parkway and KY 54. Construction plans were available for the KY 54 interchange modification. The modification includes constructing a new westbound onramp at the KY 54 interchange. Two interchanges are on the US 60 (Bypass) Extension at Old US 60 - Pleasant Valley (US 60 - PV) Connector and KY 144, which are under construction. US 60 - PV Connector is a new route under construction. Collector-distributor roads are proposed between the US 60 - PV Connector and KY 54 interchanges. **Figure 3** illustrates the planned KY 54 and US 60 - PV Connector interchange. **Figure 4** on the following page illustrates the KY 144 interchange and termination of the US 60 (Bypass) Extension. The US 60 (Bypass) Extension ends at Hawes Boulevard, which is an at-grade intersection.

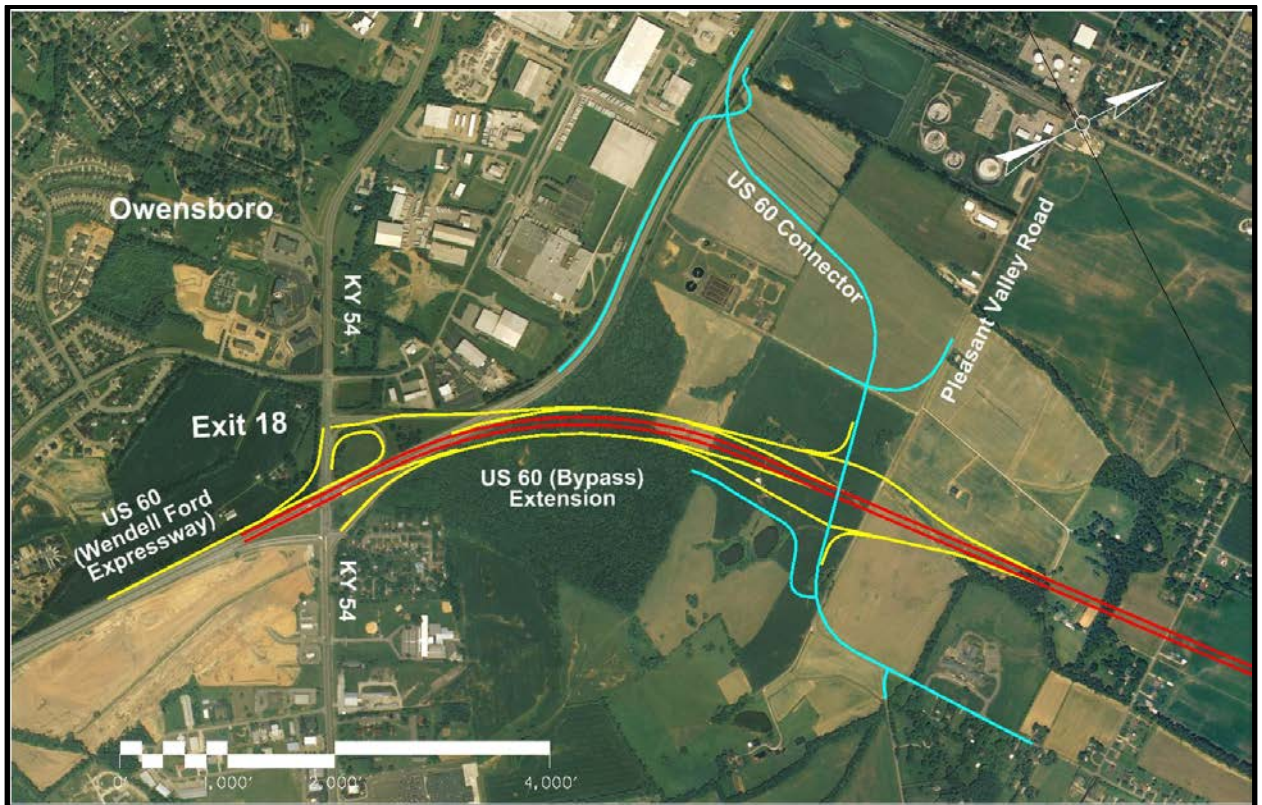


Figure 3 KY 54 and US 60 – Pleasant Valley Road Connector Interchanges

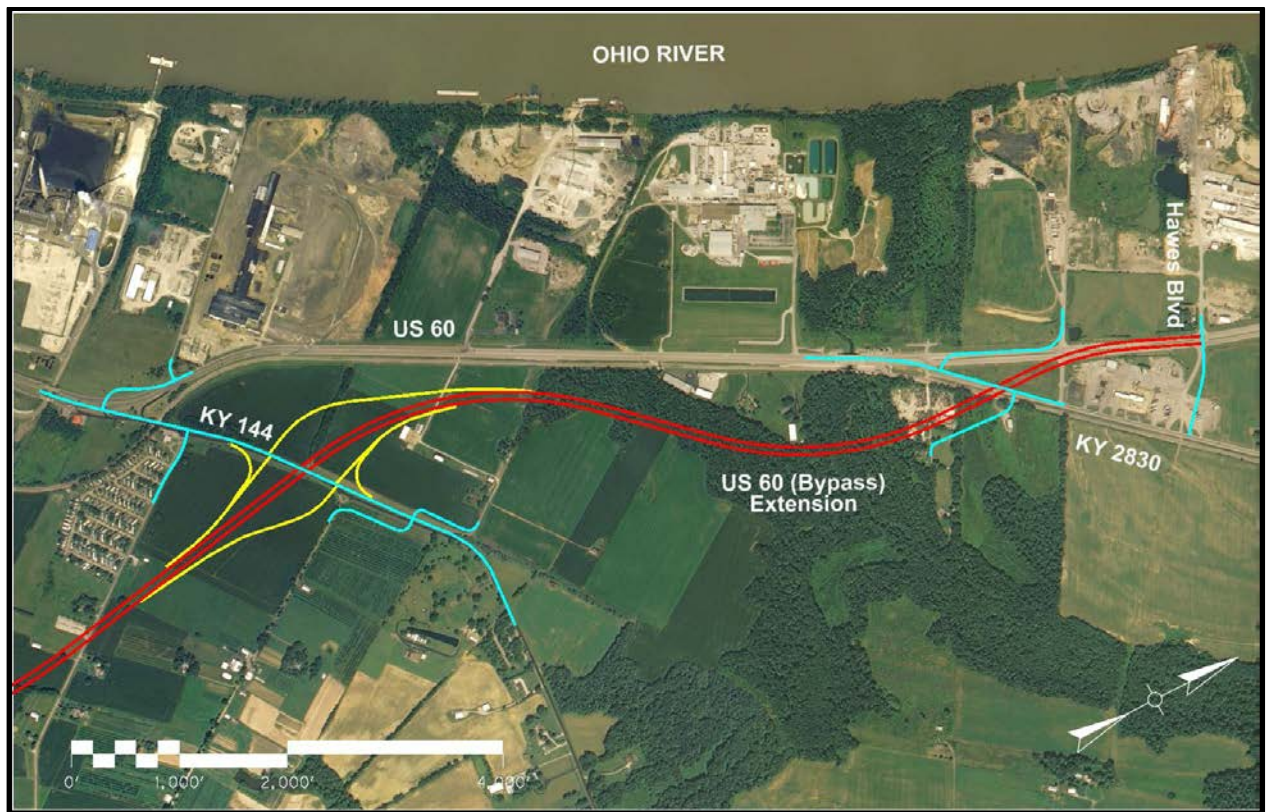


Figure 4 KY 144 Interchange and Hawes Blvd Intersection

The following section compares the interchange and ramp conditions with the AASHTO interstate guidelines for the key areas for interchange design.

1. Design Speed

The design speed for most of the ramps was not available or was illegible on the As-built plans.

2. Typical Sections

a. Lane Widths

All of the interchange ramps meet the minimum 15-foot lane width criteria for interstate highways.

b. Shoulder Widths

For normal one-way operation, the sum of the inside and outside paved shoulder width should not exceed 10 feet to 12 feet. The desirable inside paved shoulder width is 2 feet to 4 feet. The desirable paved outside shoulder width is 8 feet to 10 feet. All of the interchange ramps have 4-foot paved inside shoulders and 6-foot outside paved shoulders, which are consistent with the minimum AASHTO guidelines for paved shoulder widths.

3. Alignment Geometry

a. Horizontal Alignment

The minimum horizontal radius for a directional ramp in rural and urban areas is 444 feet. The minimum horizontal radius for rural and urban loop ramps is 134 feet (25 mph design speed). For rural areas, the minimum horizontal radius for a ramp is 314 feet (35 mph design speed) and 134 feet (25 mph design speed) in urban areas. For the interchanges studied, the minimum ramp and loop radii exceed the minimum criteria for interstate highways.

b. Superelevation Rate

From review of the As-built plans, the ramp superelevation appears to be consistent with the AASHTO criterion for interstate highways for maximum superelevation rate.

c. Vertical Alignment

i. Vertical Grade

AASHTO guidelines designate a maximum vertical grade from 5% to 7% for both rural and urban areas. The KY 54 and KY 144 interchanges have a vertical grade greater than 5%. The westbound on-ramp at the KY 54 interchange has a downgrade of 8%. The eastbound on-ramp at the KY 144 interchange has a downgrade of 5.24%. Thus, one vertical grade exceeds the maximum grade for interstate highways.

ii. Vertical Length of Curve

The minimum length of curve was calculated for the vertical grades of the approaching ramp alignment and compared to the recommended rate of vertical curvature per AASHTO interstate guidelines. The analyses included the entire length of the ramp. The westbound on-ramp at the KY 54 interchange has two vertical curves in which the calculated minimum vertical curve length is greater than the vertical curve provided on the As-built plans.

- KY 54 (Exit 18) Ramp C – Actual 82 feet, calculated minimum 186 feet
- KY 54 (Exit 18) Ramp C – Actual 237 feet, calculated minimum 445 feet

iii. Stopping Sight Distance

Stopping sight distance was evaluated for the vertical curvature for the ramps. The minimum stopping sight distance was compared to the calculated stopping sight distance. Two vertical curves do not provide the minimum stopping sight distance as calculated.

- KY 54 (Exit 18) Ramp C – Actual 209 feet, calculated minimum 250 feet
- KY 54 (Exit 18) Ramp C – Actual 158 feet, calculated minimum 250 feet

iv. Divergence Angle

The recommended divergence angle of the alignment break for a taper exit per AASHTO criteria is two to five degrees. According to the construction and As-built plans, all of the exit ramps have divergence angles within the recommended range.

4. Speed-Change Lanes and Weaving Characteristics

a. Speed Change Lanes

All of the interchanges studied were compared to the urban interstate criteria for entrance and exiting ramp design speeds. Current practice for entrance ramp speed is 70% of the mainline speed. The urban interstate design speed of 50 mph results in an entrance ramp speed of 35 mph. Exiting traffic can be assumed to be traveling 70% of the mainline design speed, resulting in exiting ramp speed of 35 mph. According to the construction and As-built plans, all of the interchanges meet the recommended ramp design speed for entrance and exit ramps.

b. Weaving Characteristics

No weaving segment exists along the studied I-67 mainline corridor. Two weaving segments are along the collector-distributor roads between the KY 54 and US 60 - Pleasant Valley Connector interchanges. A weaving analysis was conducted for these two segments based on the construction plans and 2025 design hourly volumes provided in the plans. Both weaving segments operate at LOS A for projected 2025 design peak hour volumes.

5. Interchange Spacing

The desirable minimum spacing between interchanges on an interstate for rural areas is three miles and one mile for urban areas. A summary of interchange spacing for US 60 (Wendell Ford Expressway) and US 60 (Bypass Extension) is provided in **Table 6**.

Interchange		Spacing (Miles)
From	To	
US 60 (Wendell Ford Expressway)		
Natcher Parkway (Exit 17- MP 17.49)	KY 54 (Exit 18 - MP 18.69)	1.19
US 60 (Bypass) Extension		
KY 54 (Exit 18 - MP 18.69)	US 60 - Pleasant Valley Connector (MP 19.64)	0.95 ¹
US 60 - Pleasant Valley Connector (MP 19.64)	KY 144 (MP 21.95)	2.31

¹ Construction plans show collector-distributor roads between interchanges

Table 6 Interchange Spacing

The interchange spacing between KY 54 and US 60 Connector on US 60 (Bypass) Extension is 0.95 mile. The US 60 (Bypass) Extension construction plans show collector-distributor roads between the KY 54 and US 60 Connector interchanges. According to *A Policy on Design Standard Interstate System, 2005*:

“In urban areas, spacing of less than 1.5 km (1 mile) may be developed by grade-separated ramps or by collector-distributor roads.”

Thus, additional evaluation of interchange spacing will likely be needed before conversion of this route to an interstate can be accomplished.

6. Interchange Configuration

a. System Interchanges

The Natcher Parkway terminates at US 60 (Wendell Ford Expressway) with a trumpet interchange configuration (**Figure 5** on page 14). At the interchange, the potential I-67 corridor follows eastward from the Natcher Parkway to US 60. The interchange configuration does not meet the criteria for an interstate through movement. The northbound Natcher Parkway to eastbound US 60 movement is currently a one-lane ramp. The westbound US 60 to southbound Natcher Parkway movement is currently a one-lane loop ramp. In order to meet interstate criteria, these movements must provide for two lanes.



Figure 5 Natcher Parkway / US 60 Trumpet Interchange

G. Key Findings and Potential Improvements

The studied corridor provides some of the basic geometric characteristics of an interstate highway, such as two travel lanes in each direction, 12-foot lanes, 4-foot inside paved shoulders, 10-foot outside paved shoulders, 36-foot rural medians, 10-foot urban medians, 70 mph rural design speed, and 50 mph urban design speed. The following section summarizes the deficiencies identified along the corridor.

1. Interstate Control of Access

As noted, US 60 and US 231 are partially controlled access routes along the study corridor. Access to an interstate highway shall be fully controlled. The intersections and access entrances would need to be terminated, rerouted, or grade separated in order to satisfy minimum interstate criteria for control of access.

Business and property access to US 60 and US 231 would shift to new and/or existing roads. Based on a preliminary review of the corridor and access, **Figure 6** on page 16 illustrates potential frontage roads and access to existing roads along US 60 and US 231 that could be considered in conjunction with a fully controlled interstate highway. The improvements provided in **Figure 6** include:

- Wrights Landing Road and Hawes Boulevard intersections would be removed.
- Access to the properties south of Terminal Road and west of US 60 would be provided by a new frontage road to existing US 60 south of the KY 2830 intersection.
- Iceland Road and Terminal Road intersection would be removed and grade separated with an overpass to provide access to KY 2830.
- Iceland Road (west of US 60) would intersect with Terminal Road.
- Iceland Spur intersection would be removed.
- On US 231, the New Cut Road intersection would be removed.

KY 2830 parallels US 60 from US 231 to the end of the US 60 (Bypass) Extension project and would provide access to properties south of US 60. Property parcels were not researched during this study, and the frontage and access roads shown are based on assumptions and engineering judgments made from aerial photography. Property would need to be thoroughly researched during the preliminary design development in order to accurately define access to the affected properties.

It is approximately 6 miles from the US 231 and US 60 intersection to the KY 144 interchange on the US 60 (Bypass) Extension and approximately 3.5 miles to SR 66 in Indiana. Based on access and traffic, a need potentially exists for an interchange at the existing US 60 and US 231 intersection south of Indiana. In 2011, ADT on US 60 east of US 231 was 8,340 vehicles per day. This traffic currently has access to the studied sections of US 60 and US 231 via an at-grade intersection. The intersection would need to be removed to meet the interstate control of access. The traffic and accessibility may justify an interchange at US 60 and US 231. **Figure 6** on page 16 illustrates an interchange configuration at US 60 and US 231.

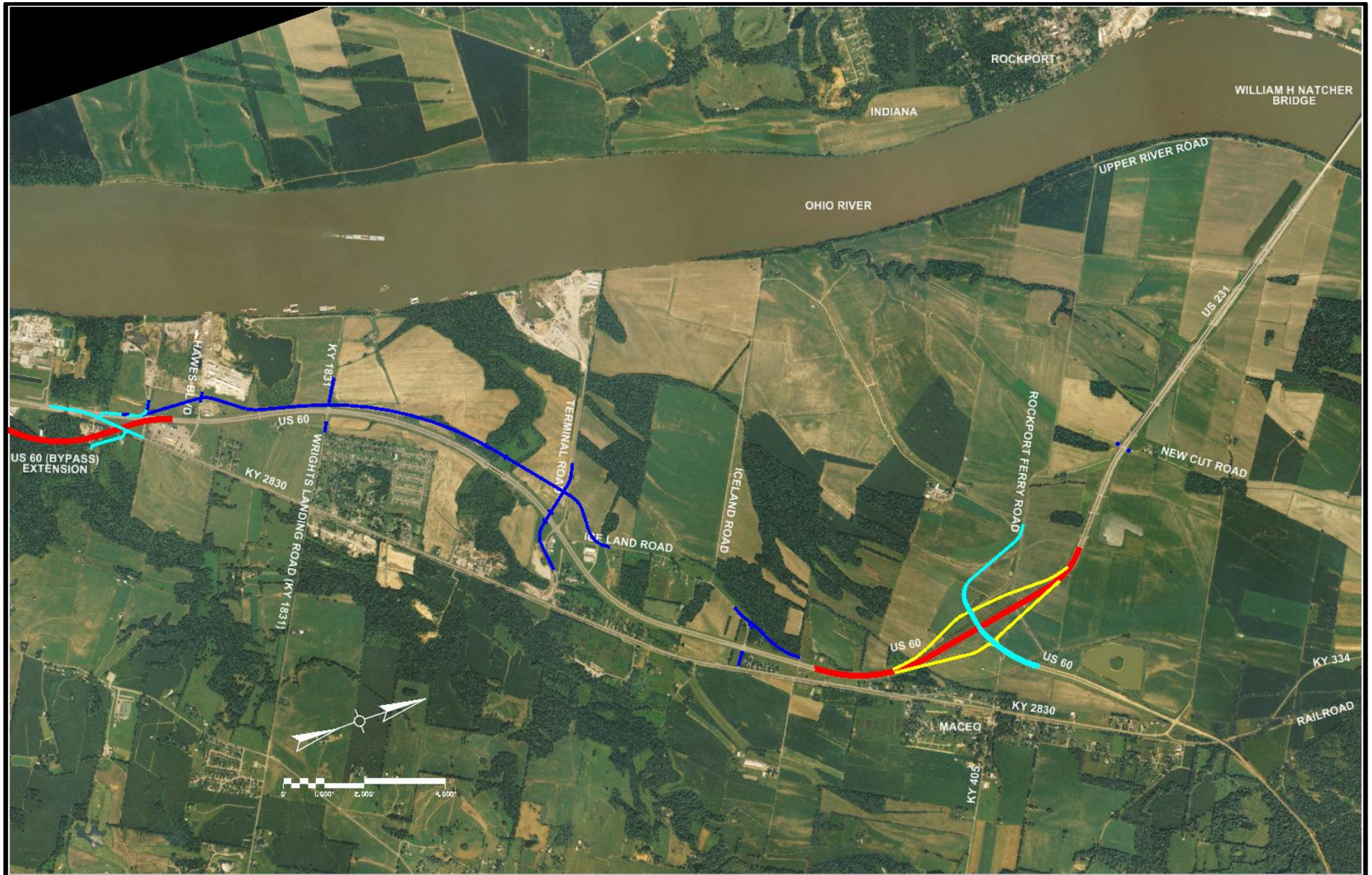


Figure 6 Interstate Control of Access

2. Interchange Configuration

The Natcher Parkway and US 60 (Wendell Ford Expressway) interchange has a trumpet configuration. The Natcher Parkway entrance and exit ramps are one lane. Therefore, the northbound I-67 through movement is currently a one-lane ramp, and the southbound I-67 through movement is currently a one-lane loop ramp. US 60 (Wendell Ford Expressway) is the main movement through the interchange with over 30,000 vpd traveling on four lanes.

Based on the interstate criteria requiring two through lanes, the Natcher Parkway and US 60 interchange would need to be improved for the proposed I-67 route. Potential improvements to the interchange are shown in **Figure 7** below. The improvements needed for this interchange to meet interstate criteria would impact the KY 81 interchange to the west and the KY 54 interchange to the east.

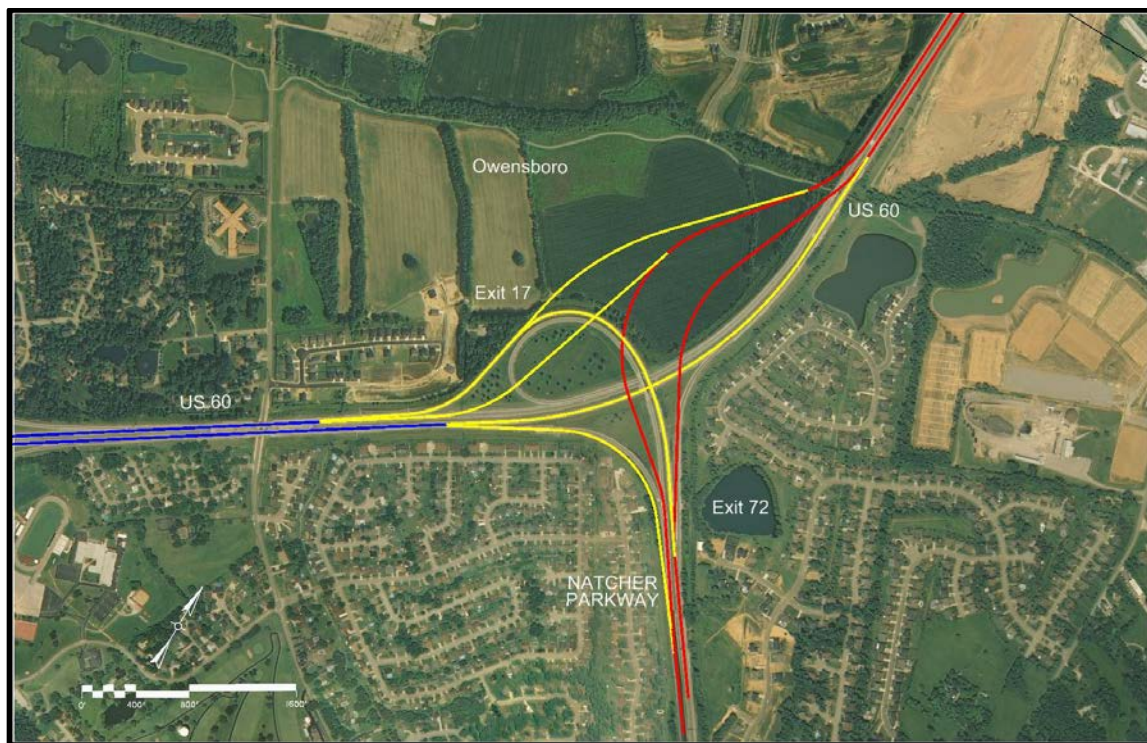


Figure 7 I-67 Interchange at US 60

3. William H. Natcher Bridge

According to the bridge plans, the William H. Natcher Bridge over the Ohio River meets the minimum interstate criteria for lateral clearance. The bridge meets the minimum interstate stopping sight distance and vertical alignment criteria for a 70 mph design speed. The bridge also meets the minimum interstate structural capacity criteria. Based on the findings, the William H. Natcher Bridge over the Ohio River is compliant with minimum interstate criteria.

H. I-67 Corridor Overview Summary

Based on the findings of this **high-level overview** for the sections of US 60 and US 231, a majority of the corridor meets the Federal Highway Administration's 13 design features that have been identified as being important to the operational and safety performance of a highway. These controlling design features are commonly known as the *13 controlling criteria*. A formal written design exception is required when any of the 13 criteria are not met on the National Highway System (NHS). The Interstate System is part of the NHS. The *13 controlling criteria* are listed on the following page:

1. Design speed
2. Lane width
3. Shoulder width
4. Bridge width
5. Horizontal alignment
6. Superelevation
7. Vertical alignment
8. Grade
9. Stopping sight distance
10. Cross slope
11. Vertical clearance
12. Lateral offset to obstruction
13. Structural capacity

These design features are evaluated in this report for compliance with minimum criteria for interstate highways. Design features that deviate from common practice but are not included in the *13 controlling criteria* are termed design variance. Two categories are used for design variances. A design variance is a design feature that (1) varies from the current AASHTO criteria but is not part of the *13 controlling criteria* or (2) varies from common practice but is not part of the *13 controlling criteria*.

Design exceptions and variances require a formal detailed analysis for safety and operational conditions in order to be considered. The FHWA requires an application for any design exceptions and design variances as documentation for the design exception process and decision. FHWA requires documentation for the following fundamental activities for the design exception process:

- Determine the Costs and Impacts of Meeting Design Criteria
- Develop and Evaluate Multiple Alternatives
- Evaluate Risk
- Evaluate Mitigation Measures
- Document, Review, and Approve
- Monitor and Evaluate In-Service Performance

Of the *13 controlling criteria*, three design features were identified as deficient based on interstate criteria.

- **Bridge Width** – The westbound bridge on US 60 (Wendell Ford Expressway) is 220 feet long and 30 feet wide (gutter to gutter). According to the AASHTO interstate criteria, the minimum gutter-to-gutter width for a bridge longer than 200 feet is 31 feet. The bridge would most likely be impacted with the necessary improvements to the existing US 60 and Natcher Parkway interchange. The US 60 and Natcher Parkway interchange improvements would most likely relocate the westbound US 60 alignment at the deficient bridge. Therefore, the future design development of the interchange could refine the specific strategy for deficient bridge.
- **Vertical Alignment** - The westbound on-ramp at the KY 54 interchange has two vertical curves in which the calculated minimum vertical curve length is greater than the actual vertical length of curve. The ramp was under construction at the time of this report.
 - o Vertical Curve – Crest
 - Vertical Length of Curve - Actual 82 feet, calculated minimum 186 feet
 - o Vertical Curve – Sag
 - Vertical Length of Curve - Actual 237 feet, calculated minimum 445 feet
- **Stopping Sight Distance** - The westbound on-ramp at the KY 54 interchange has two vertical curves in which do not provide the calculated minimum stopping sight distance. The curves

were compared to the 35 mph design speed criteria. The ramp was under construction at the time of this report.

- o Vertical Curve – Crest
 - Stopping Sight Distance - Actual 209 feet, calculated minimum 250 feet
- o Vertical Curve – Sag
 - Stopping Sight Distance - Actual 158 feet, calculated minimum 250 feet

The westbound on-ramp at the KY 54 interchange is adjacent to a commercial development. Improving the westbound on-ramp to meet interstate criteria will impact the commercial development. The improvement may also impact the Heartland Crossing and KY 54 intersection.

In addition, three deficient design features were identified along the studied corridor that are not of the 13 *controlling* criteria. These design features are discussed below:

- Interchange Access Control – The KY 54 interchange does not meet minimum control of access. The minimum control of access at an interchange is 100 feet for an urban interstate. The westbound on-ramp control of access at the KY 54 interchange is 90 feet. The westbound on-ramp is currently adjacent to Heartland Crossing. Improving the interchange control of access to meet interstate standards will impact the KY 54 and Heartland Crossing intersection. The access control improvement will also depend on the KY 54 westbound on-ramp improvement. Shifting the Heartland Crossing intersection to the west will impact the current traffic operations between Ragu Drive and Heartland Crossing intersections and may require improvements to the Ragu Drive and KY 54 intersection.
- Interstate Access Control – US 60, east of the US 60 (Bypass) Extension project, and US 231 are partially controlled access highways. Interstates shall be fully controlled access highways.
- Interchange Deficiencies – Currently, the US 60 (Wendell Ford Expressway) and Natcher Parkway Interchange is configured to serve US 60 as the main through movement. The existing ramps for the I-67 through movement are one lane.

Table 7 provides a preliminary cost estimate to upgrade the I-67 corridor along US 60 (Wendell Ford Expressway), US 60 Bypass, US 60, and US 231 to meet interstate criteria. It is estimated to cost \$177 million to improve these routes to meet interstate criteria. The average cost per mile for the 13.54 miles studied is \$13.1 million. This study did not include any property research or utility location.

Improvement	Location	Design & Environmental (million) ¹	ROW and Utilities (million) ²	Construction Costs (million)	Total Costs (million)
Natcher Parkway / US 60 Interchange	US 60 (Wendell Ford Expressway)	\$6	\$12	\$41	\$60
Control of Access / Frontage Road	US 60 / US 231	\$5	\$14 ³	\$36	\$55
US 60 / US 231 Interchange	US 60 / US 231	\$5	\$9	\$30	\$44
Vertical Alignment / Stopping Sight Distance	KY 54	\$0.5	\$1	\$4	\$5
Interchange Access Control	KY 54	\$1	\$3	\$9	\$13
William H. Natcher Bridge	US 231 (Ohio River)	-	-	-	-
Total		\$18	\$39	\$120	\$177

¹ Design & Environmental cost estimated at 15% construction costs

² ROW and Utilities cost estimated at 30% construction costs

³ ROW and Utilities cost estimated at 40% construction costs for Control of Access / Frontage Road Improvement

Table 7 I-67 Corridor Improvement Preliminary Cost Estimate



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