

Louisville-Southern Indiana Ohio River Bridges Traffic & Revenue Study

Final Report

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Prepared for:

Kentucky Public Transportation Infrastructure
Authority

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Disclaimer

This traffic and revenue report has been prepared for the Kentucky Public Transportation Infrastructure Authority to support its development of the Louisville-Southern Indiana Ohio River Bridges Project. The projections of traffic contained within this document represent Steer Davies Gleave's best estimates. While they are not precise forecasts, they do represent, in our view, a reasonable expectation for the future, based on the most credible information available as of the date of this report. However, the estimates contained within this document necessarily rely on numerous assumptions and judgments. Circumstances may occur over the timeframe of the project that go counter to these assumptions and judgments and that affect the project's realized revenues. Further, projections are for multi-year trends; the results for individual years may vary from forecasted values.

In addition, it has been necessary to base much of this analysis on data collected by third parties. This has been independently checked whenever possible. However, Steer Davies Gleave cannot guarantee the accuracy of data from third party sources.

Executive Summary

LSIORB Project Introduction

1. The Louisville-Southern Indiana Ohio River Bridges (LSIORB) Project involves the reconstruction of an existing bridge crossing and construction of a new crossing over the Ohio River in the Louisville metropolitan area. Figure ES-1 displays the location of the LSIORB project elements, depicting the I-65 Kennedy and Downtown Bridges and the East End Bridge.
2. The Project includes two elements:
 - I Downtown Crossing: this is the reconstruction of the I-65 crossing and approaches. The project will include a new Downtown Bridge constructed east of the existing Kennedy Bridge. This new bridge will serve northbound traffic. The reconstruction will include the conversion of the existing Kennedy Bridge from serving two directions of traffic to only serving southbound traffic, as well as a redesigned interchange of I-65 with I-64 and I-71. After completion, the Downtown Crossing will have 6 lanes in each direction.
 - I East End Crossing: this is a new crossing of the Ohio River in the eastern portion of the metropolitan area. It will include a new 4-lane bridge – the East End Bridge – along with the construction of attached highway sections to connect from I-265 in Kentucky, cross over the East End Bridge, and connect to I-265 in Indiana.

FIGURE ES-1 LOUISVILLE-SOUTHERN INDIANA OHIO RIVER BRIDGES PROJECT MAP



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3. As shown in Figure ES-1, there are three existing bridge crossings of the Ohio River in the Louisville-Southern Indiana region. These crossings are summarized below.
- I I-65 Bridge: I-65 is a major north-south highway, connecting Louisville with Indianapolis and Nashville, which crosses the Ohio River on the Kennedy Bridge. The Kennedy Bridge contains 4 northbound lanes and 3 southbound lanes. Movement along I-65 in this area is complicated by “Spaghetti Junction”, which is how the convergence of I-64, I-65, and I-71 is commonly described. Traffic along this junction and over the bridge is very slow during the peak periods as peak period traffic exceeds the design capacity of the bridges.
 - I I-64 Bridge: I-64 is an east-west highway, connecting Louisville with Lexington and St. Louis, which crosses the Ohio River over the Sherman Minton Bridge on the west side of the Louisville region.
 - I US 31 Bridge: US 31 crosses the Ohio River over the Clark Memorial Bridge, which is just west of the Kennedy Bridge. The Clark Memorial Bridge is a four-lane undivided facility with a 35 mph posted speed limit. On the Kentucky side, the Clark Memorial Bridge delivers traffic into downtown Louisville. This makes the Clark Memorial Bridge attractive for some travelers who live in Indiana and work in downtown Louisville. However, this acts as a deterrent to traffic passing through Louisville and looking for a detour around the I-65 river crossing.

Existing Conditions

4. In order to provide an understanding of the recent traffic experience of the existing Ohio River crossings, we prepared Table ES-1 which displays the average annual daily traffic of the bridge crossings for the years in which they were actually collected. The table shows that the I-65 Kennedy Bridge reached a maximum daily traffic level of 136,000 in 2007, before falling to its current 122,000 level with the higher fuel prices and economic recession of the past five years. A similar situation occurred on the I-64 Sherman Minton Bridge, with traffic reaching a maximum of almost 90,000 daily trips before falling to its current level of almost 80,000.

TABLE ES-1 HISTORICAL OHIO RIVER BRIDGE CROSSING TRAFFIC

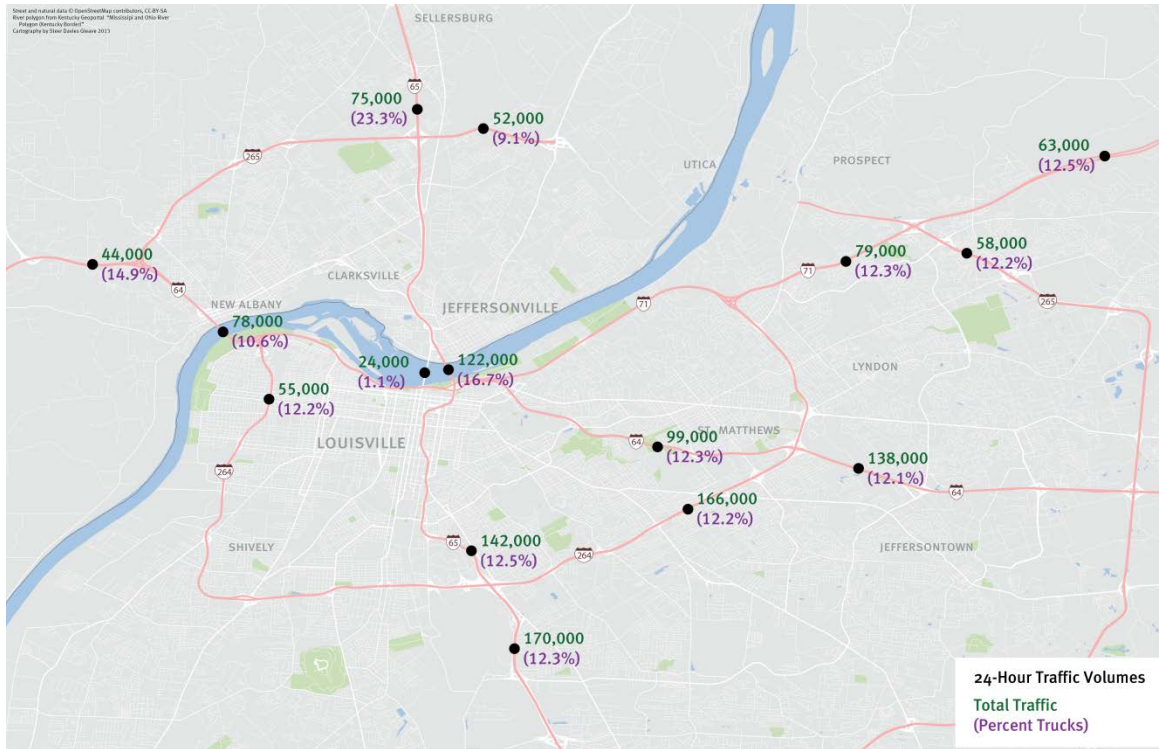
I-65		I-64		US 31	
Year	Daily Traffic	Year	Daily Traffic	Year	Daily Traffic
2004	132,000	2002	87,800	2002	19,900
2007	136,000	2004	81,500	2006	19,200
2008	121,000	2007	89,800	2009	14,800
2010*	122,900	2010*	81,900	2010*	21,900
2012*	122,000	2011	69,600	2012*	24,100
		2012*	78,200		

Notes: *these values reflect seasonal adjustments to data collected by the Traffic Group

Source: Steer Davies Gleave, KYTC, and the Traffic Group

5. We also collected and compiled traffic count data for the major freeways in the study area. Figure ES-2 displays the current traffic level and the truck share of traffic for these locations. This figure shows that I-65 on the Kentucky side serves the highest level of daily traffic, particularly the location south of I-264. The figure also illustrates the high level of truck activity in the area, with particularly high truck shares of traffic on I-65 at the Ohio River and north of I-265 in Indiana.

FIGURE ES-2 CURRENT TRAFFIC LEVELS

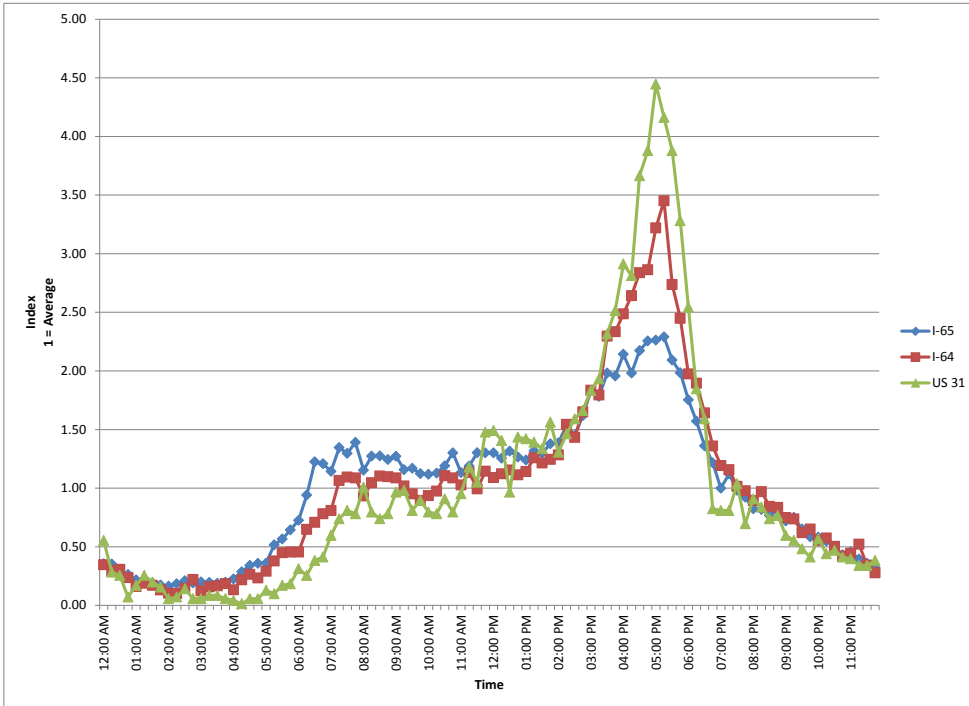


Source: Steer Davies Gleave, KYTC, INDOT, and the Traffic Group

6. River crossing trips are made up of both regional commuters and long-distance, interstate truck movements.
7. In order to highlight the daily peaking of bridge crossing traffic, which is associated with commuting traffic, we analyzed the directional traffic in 15-minute intervals. For each bridge, we identified the average traffic 15-minute traffic level and used that as the base. We then identified the index relative to the base for each 15-minute period. Figure ES-3 and Figure ES-4 present the index values for each bridge in the northbound and southbound directions, respectively. These figures show that traffic on the bridge crossings experience more traffic during the peak periods, with northbound peaking in the PM and southbound peaking in the AM. This is consistent with the major commuting traffic flow from residences in Indiana to employment in Kentucky, and Louisville in particular.

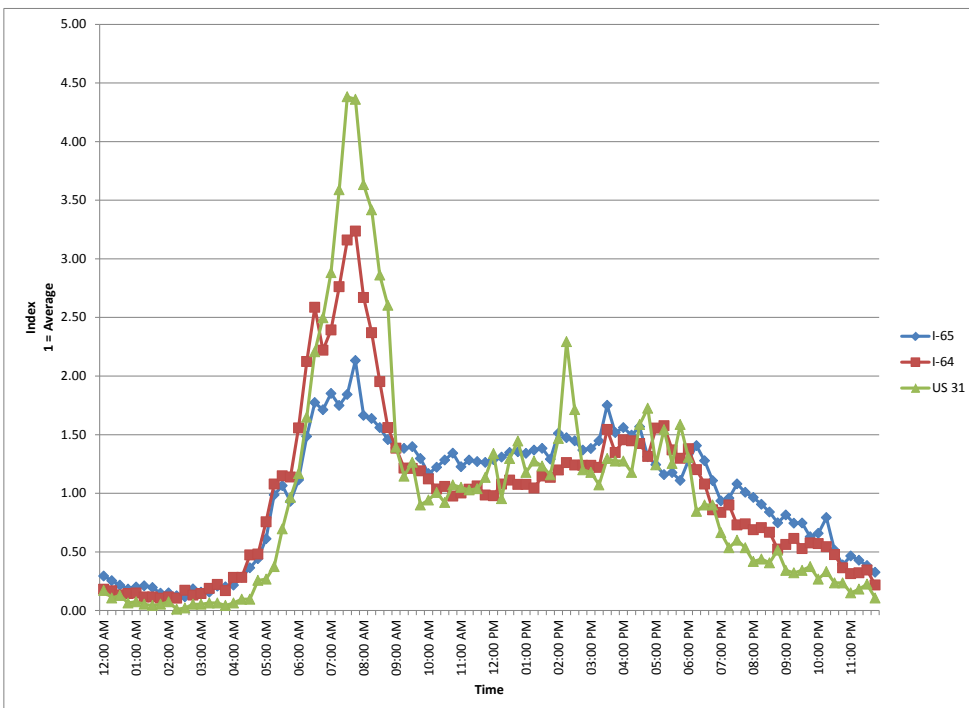
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FIGURE ES-3 TIME OF DAY PROFILE OF NORTHBOUND CROSSING TRAFFIC



Source: Steer Davies Gleave and the Traffic Group

FIGURE ES-4 TIME OF DAY PROFILE OF SOUTHBOUND CROSSING TRAFFIC



Source: Steer Davies Gleave and the Traffic Group

8. In order to understand the composition of trips on the bridges that pass through the region, we analyzed the license plate matching information collected by the Traffic Group in 2010 and presented in CDM Smith's traffic reports of the Supplemental Final Environmental Impact Statement. Based upon our analysis of this information, we identified the percentage of I-64 and I-65 bridge trips passing through the region. Table ES-2 shows that there are a large share of truck trips passing through the region, consistent with long-distance, interstate truck movements.

TABLE ES-2 PERCENTAGE OF BRIDGE TRIPS PASSING THROUGH THE REGION

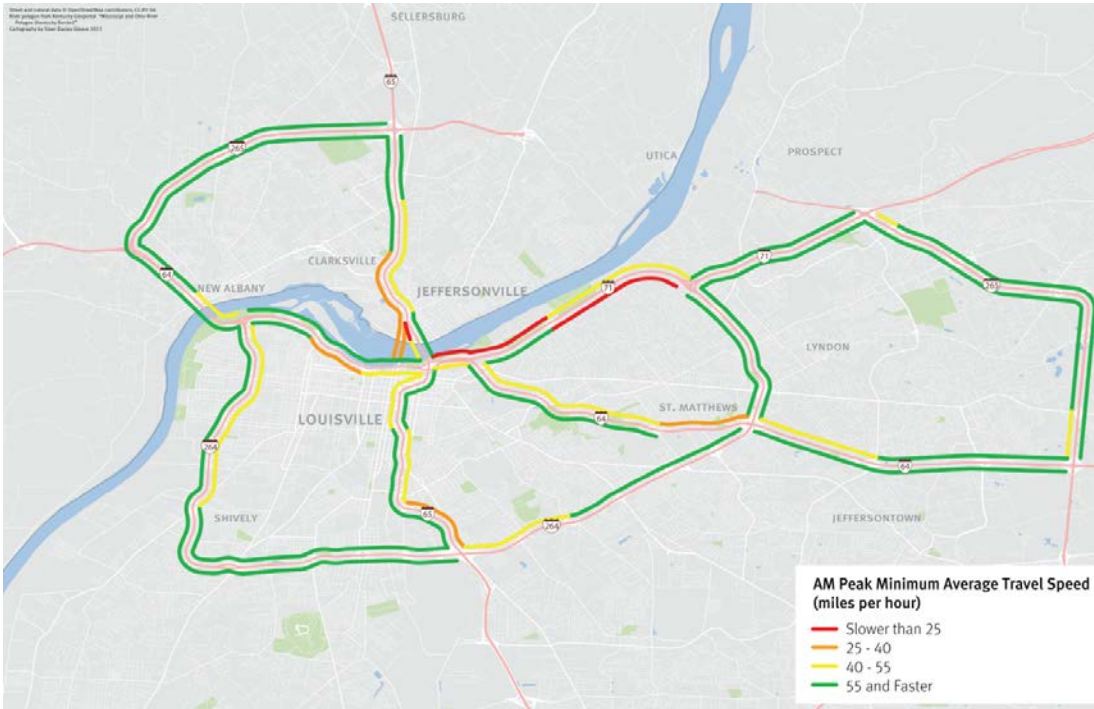
Bridge Crossing	Auto	Truck
I-65 NB	5%	28%
I-65 SB	6%	23%
I-64 NB	4%	48%
I-64 SB	4%	49%

Source: Steer Davies Gleave, CDM Smith and the Traffic Group

9. We collected travel time information for the major study area roadways in order to understand how traffic flows through different times of the day. Based upon this information, we prepared figures that indicate the average travel speeds during the peak periods. Figure ES-5 illustrates the average AM peak travel speeds and Figure ES-6 illustrates the average PM peak travel speeds. These figures show that there are more delays occurring during the PM peak than in the AM peak. In general, most delays occur near the interchanges of highways as merging traffic causes slowdowns.

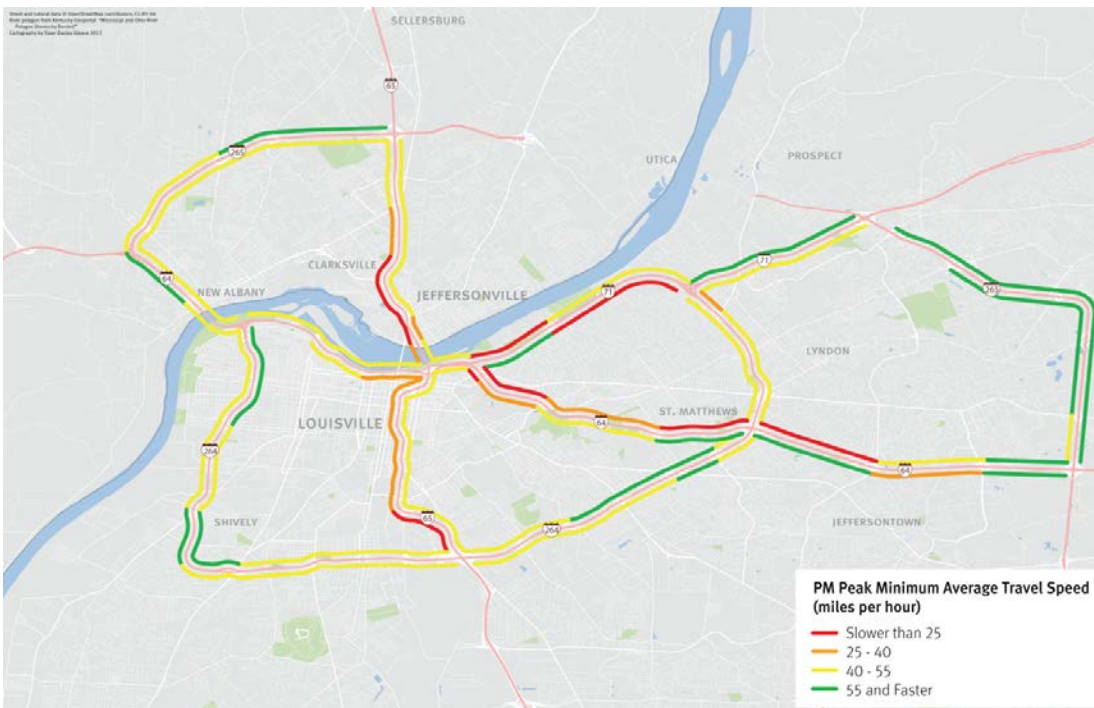
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FIGURE ES-5 OBSERVED AM PEAK PERIOD TRAVEL SPEEDS



Source: Steer Davies Gleave

FIGURE ES-6 OBSERVED PM PEAK PERIOD TRAVEL SPEEDS



Source: Steer Davies Gleave

Forecast Model Development

10. In order to prepare traffic and revenue forecasts for the LSIORB Project, Steer Davies Gleave developed a custom toll forecasting model for the study area. This model was built upon a version of the MPO network travel demand model which had been prepared by CDM Smith to support the NEPA analysis and covers the counties of Floyd and Clark in Indiana and Oldham, Jefferson and Bullitt in Kentucky. Key elements of the Steer Davies Gleave model include:
- | A stated preference survey that was undertaken to provide an empirical basis for establishing a route choice model mechanism into the highway assignment.
 - | Nine model time periods to present the varying levels of traffic and congestion throughout the day.
 - | Representation of the highway network to reflect the 2012 traffic conditions.
 - | New traffic counts and travel time measures used to validate the assignment results across the network for each of the nine time periods, and in particular for each of the existing Bridges, providing a robust platform for the forecasts.
 - | Socioeconomic forecasts for the model area developed by an independent economic consultant, and a growth model built to validate the river crossing traffic growth included in the demand matrices.

Traffic and Revenue Forecasts

11. We used the traffic forecasting model to develop the traffic and revenue for the toll system which includes both the Downtown Crossing and East End Crossing. The toll rates assumed for both crossings are presented in Table ES-3, and these toll rates were increased by 2.5% annually.

TABLE ES-3 TOLL RATES (2017 \$)

	2-Axle Vehicles	Medium Trucks	Heavy Trucks
Discount Program	\$1.00		
Transponder	\$2.00	\$5.00	\$10.00
Registered Video	\$3.00	\$6.00	\$11.00
Other Video	\$4.00	\$7.00	\$12.00

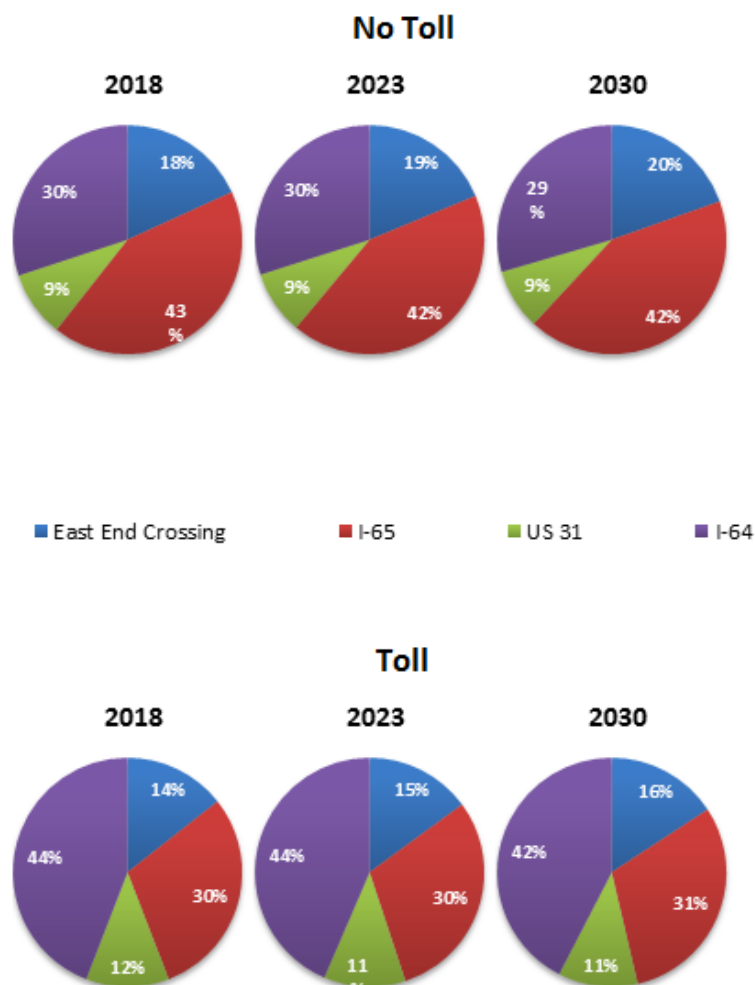
12. In order to provide a basis of understanding of the toll bridge traffic and revenue forecasts, we first analyzed the forecasted growth in total river crossing travel. Table ES-4 presents the daily river crossing traffic for the base year and each future model year, with the LSIORB Project included. The compound annual growth rate (CAGR) of river crossing traffic from 2012 to 2030 is 1.3%.

TABLE ES-4 FORECAST DAILY RIVER CROSSING TRAFFIC

	2012	2018	2023	2030
6-7 AM	12,161	13,858	14,556	16,018
7-8 AM	16,857	19,893	20,822	22,886
8-9 AM	14,429	16,703	17,439	19,201
10 AM – 3 PM	69,349	73,433	76,538	82,276
3-4 PM	15,858	18,294	19,147	21,218
4-5 PM	18,225	20,389	21,216	23,129
5-6 PM	18,255	21,021	21,883	24,003
6-7 PM	12,923	15,248	15,966	17,612
7 PM – 6 AM	46,220	51,479	53,531	58,316
Daily Total	224,277	250,318	261,099	284,659

13. To further understand our forecasts, we investigated how the shares of traffic using each bridge changes when tolls are introduced. Figure ES-7 illustrates the reduced share of East End Crossing and I-65 traffic when they are tolled. In 2030, the East End Crossing's share of traffic falls from 20% to 16% when tolls are added, with similar reductions seen in the other years. In 2030, I-65's share of traffic falls from 42% to 31%, with similar reductions in the other years. In terms of capture rates, the tolled East End Crossing captures roughly 80% of its non-tolled traffic level, while the tolled I-65 captures roughly 70% of its non-tolled level. The higher capture rate, and correspondingly lower reduction in share of crossing traffic, for the East End Crossing compared to I-65 is consistent with the better non-tolled options available to I-65 traffic.

FIGURE ES-7 DISTRIBUTION OF RIVER CROSSING TRAFFIC WITH AND WITHOUT TOLLS



14. The daily traffic and revenue forecasts were converted into an annual stream of traffic and revenue by interpolating and extrapolating non-modeled years, and annualizing with a factor of 315. We also applied adjustments for toll leakage and ramp-up, and shifted the calendar year model forecasts to Kentucky's Fiscal Year, which starts on July 1. The resulting annual traffic and revenue forecasts are presented in Table ES-5, which show revenue growing from almost \$34 million for FY 2017, the first half year of opening, to over \$376 million in 2054.

TABLE ES-5 ANNUAL TRAFFIC AND REVENUE STREAM

Fiscal Year	Daily Traffic	Annual Traffic After Ramp-Up (000s)	Daily Revenue (Nominal \$)	Annual Revenue (000s Nominal \$)	Annual Revenue Less Toll Evasion After Ramp-Up (000s Nominal \$)
2017	102,844	10,860	\$334,090	\$52,619	\$33,841
2018	106,676	24,803	\$359,480	\$113,236	\$79,252
2019	111,171	30,356	\$376,957	\$118,741	\$98,158
2020	112,506	33,575	\$385,134	\$121,317	\$110,248
2021	113,860	35,122	\$394,153	\$124,158	\$117,222
2022	114,801	36,162	\$404,079	\$127,285	\$122,529
2023	116,453	36,683	\$414,983	\$130,720	\$126,165
2024	118,215	37,238	\$426,948	\$134,488	\$130,096
2025	120,036	37,811	\$439,823	\$138,544	\$134,281
2026	121,962	38,418	\$453,440	\$142,834	\$138,703
2027	123,995	39,058	\$467,845	\$147,371	\$143,377
2028	126,138	39,734	\$483,084	\$152,172	\$148,198
2029	128,396	40,445	\$499,212	\$157,252	\$153,297
2030	130,773	41,193	\$516,283	\$162,629	\$158,691
2031	133,112	41,930	\$536,506	\$169,000	\$164,985
2032	135,374	42,643	\$559,578	\$176,267	\$172,079
2033	137,675	43,368	\$583,324	\$183,747	\$179,381
2034	140,016	44,105	\$608,083	\$191,546	\$186,994
2035	142,397	44,855	\$633,895	\$199,677	\$194,931
2036	144,515	45,522	\$659,396	\$207,710	\$202,773
2037	146,359	46,103	\$684,516	\$215,623	\$210,497
2038	148,228	46,692	\$710,596	\$223,838	\$218,517
2039	150,122	47,288	\$737,672	\$232,367	\$226,843
2040	152,040	47,892	\$765,782	\$241,221	\$235,486
2041	153,657	48,402	\$793,262	\$249,877	\$243,936
2042	154,966	48,814	\$820,028	\$258,309	\$252,167
2043	156,287	49,230	\$847,699	\$267,025	\$260,676
2044	157,619	49,650	\$876,305	\$276,036	\$269,472
2045	158,963	50,073	\$905,878	\$285,352	\$278,566
2046	160,319	50,500	\$936,451	\$294,982	\$287,967
2047	161,686	50,931	\$968,056	\$304,938	\$297,685
2048	163,066	51,366	\$1,000,730	\$315,230	\$307,732
2049	164,457	51,804	\$1,034,509	\$325,870	\$318,119
2050	165,861	52,246	\$1,069,429	\$336,870	\$328,857
2051	167,276	52,692	\$1,105,529	\$348,242	\$339,958
2052	168,705	53,142	\$1,142,851	\$359,998	\$351,434
2053	170,145	53,596	\$1,181,433	\$372,152	\$363,298
2054	171,598	54,053	\$1,221,321	\$384,716	\$375,563

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1 Introduction

- 1.1 Steer Davies Gleave (SDG) has been engaged to prepare investment grade traffic and revenue forecasts for the Louisville-Southern Indiana Ohio River Bridges (LSIORB) Project.
- 1.2 Steer Davies Gleave is one of world's largest independent specialist transportation consultancies, with more than 300 professional staff and a worldwide client base. The company's head office is in London and they have North American offices in Boston, Denver, Mexico City, San Juan, Toronto and Vancouver. Steer Davies Gleave is an employee-owned company that was founded in 1978. Having worked on some 500 toll and shadow toll road projects around the world, Steer Davies Gleave has developed a recognized specialty in the appraisal of toll-financed facilities.

Project Background and Location

- 1.3 The LSIORB Project involves the reconstruction of an existing bridge crossing and construction of a new crossing over the Ohio River in the Louisville metropolitan area. Figure 1.1 displays the location of the Louisville metropolitan area, while Figure 1.2 displays the location of the project elements within the Louisville metropolitan area, depicting the I-65 Kennedy and Downtown Bridges and the East End Crossing Bridge.
- 1.4 The project development has occurred over 40 years. FHWA issued a Record of Decision (ROD) for the Project in 2003 and a revised ROD in 2012 after the Supplemental Environmental Impact Statement modified the preferred alternative to include tolling.
- 1.5 The Project includes two elements:
 - I Downtown Crossing: this is the reconstruction of the I-65 crossing and approaches. The project will include a new Downtown Bridge constructed east of the existing Kennedy Bridge. This new bridge will serve northbound traffic. The reconstruction will include the conversion of the existing Kennedy Bridge from serving two directions of traffic to only serving southbound traffic, as well as a redesigned interchange of I-65 with I-64 and I-71. After completion, the Downtown Crossing will have 6 lanes in each direction.
 - I East End Crossing: this is a new crossing of the Ohio River in the eastern portion of the metropolitan area. It will include a new 4-lane bridge – the East End Bridge – along with the construction of attached highway sections to connect from I-265 in Kentucky, cross over the East End Bridge, and connect to I-265 in Indiana.

FIGURE 1.1 LOCATION OF LOUISVILLE-SOUTHERN INDIANA

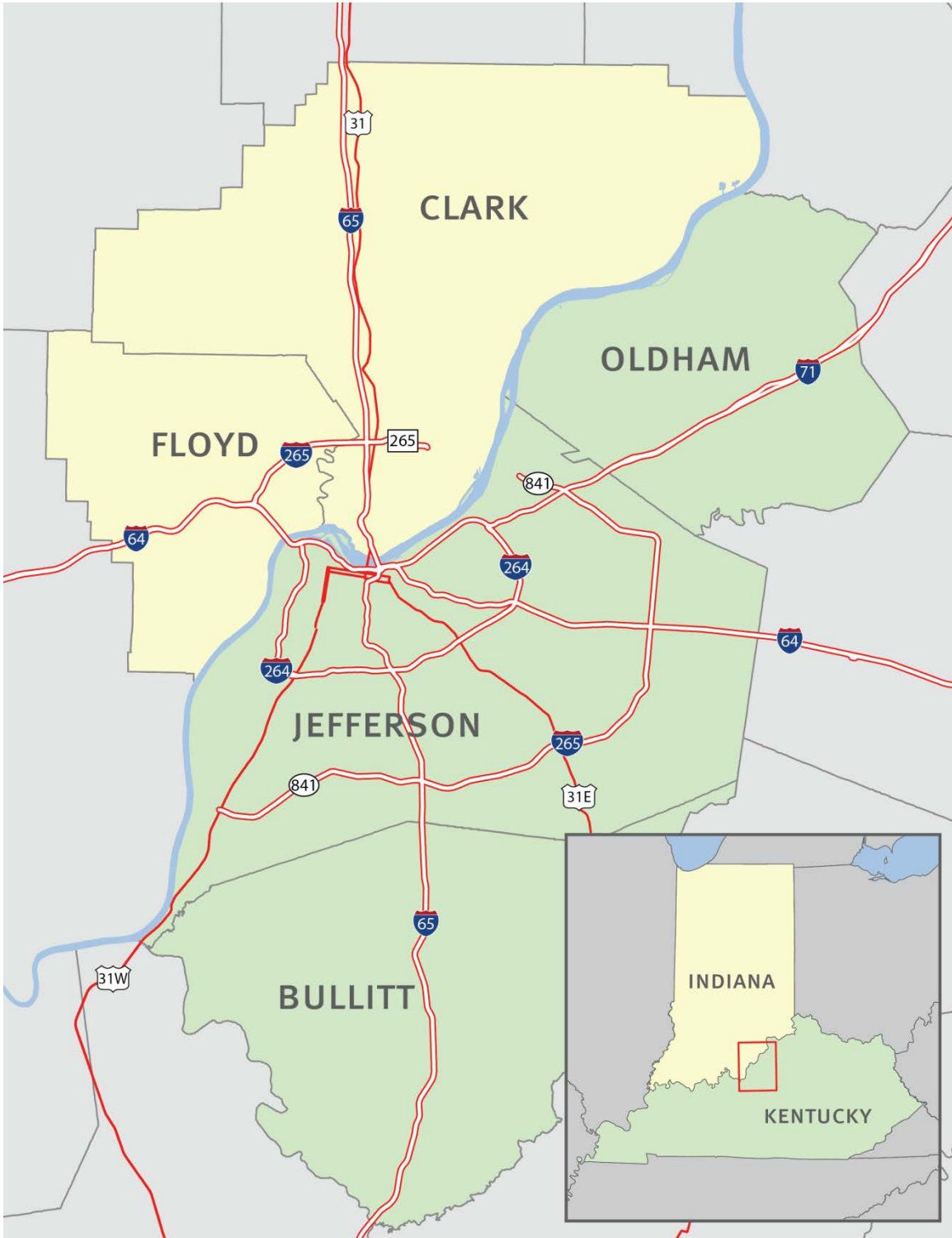


FIGURE 1.2 LOUISVILLE-SOUTHERN INDIANA OHIO RIVER BRIDGES PROJECT MAP

- 1.6 As tolled bridges, the Downtown Bridge and the East End Bridge will be operated exclusively as an Open Road Tolling (ORT) system. Accordingly, vehicles will be given the option of paying the toll through the use of a transponder or based upon their license plate. The primary collection method will be with transponders through electronic toll collection (ETC), but for vehicles who use one of the tolled bridges and are not equipped with transponders, they will have their toll collected through video collection. For video collection, two options will be offered, with pre-registered and standard video toll collection. The standard video toll collection will involve the capturing of a license plate image, identifying the license plate, identifying the address corresponding to the license plate through Department of Motor Vehicle (DMV) records, and then mailing a bill to the address. A surcharge will be applied to cover the additional costs associated with this type of toll collection. For the pre-registered collection, travelers will register their license plate so that when their license plate image is captured, they can be sent the bill without needing to match the license through the DMV records. Accordingly a smaller surcharge will be applied than for the standard video toll collection.

Report Structure

- 1.7 This report presents the traffic and revenue forecasts for the LSIORB Project, structured through seven chapters. Chapter 2 presents our analysis of the existing

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conditions; Chapter 3 provides a review of land use activity and growth analysis; Chapter 4 includes the analysis of a travel survey conducted as part of this study; Chapter 5 describes our traffic and forecasting methodology; Chapter 6 presents the traffic and revenue forecasts; and Chapter 7 provides a sensitivity analysis of the forecasts.

2 Existing Conditions Analysis

- 2.1 This chapter describes the existing conditions of the project study area.

Ohio River Bridge Crossings

- 2.2 As was depicted in Figure 1.2, there are three existing bridge crossings of the Ohio River in the Louisville-Southern Indiana region. Below we describe each of these crossings.

I-65 Bridge

- 2.3 I-65 crosses the Ohio River on the Kennedy Bridge. I-65 is a major north-south highway connecting Louisville with Indianapolis in the north and Nashville in the south. The Kennedy Bridge contains 4 northbound lanes and 3 southbound lanes. Movement along I-65 in this area is complicated by “Spaghetti Junction”, which is how the convergence of I-64, I-65, and I-71 is commonly described. Traffic along this junction and over the bridge is very slow during the peak periods as peak period traffic exceeds the design capacity of the bridges.

- 2.4 The I-65 Kennedy Bridge serves 122,000 daily vehicles, compared to a daily design capacity of 105,000.¹ Further, trucks represent about 17% of traffic. This large share of truck traffic is significant as trucks utilize more capacity than autos. The peak travel direction is southbound in the AM and northbound in the PM, serving trips from Indiana to downtown Louisville and other Kentucky employment centers.

I-64 Bridge

- 2.5 I-64 crosses the Ohio River over the Sherman Minton Bridge on the west side of the region. While this bridge connects Indiana to the north and Kentucky to the south, I-64 is an east-west highway connecting Louisville with Lexington in the east and St. Louis in the west.

- 2.6 The Sherman Minton Bridge has 3 lanes in each direction, and serves 78,000 daily vehicles, compared to a daily design capacity of 90,000.² Travelers using I-64 and I-265 to detour around the I-65 river crossing would incur about 8 miles of additional travel.

US 31 Bridge

- 2.7 US 31 crosses the Ohio River over the Clark Memorial Bridge, which is just west of the Kennedy Bridge. The Clark Memorial Bridge is a four-lane undivided facility with a 35 mph posted speed limit. On the Kentucky side, the Clark Memorial Bridge delivers traffic into downtown Louisville. This makes the Clark Memorial Bridge attractive for some travelers who live in Indiana and work in downtown Louisville. However, this

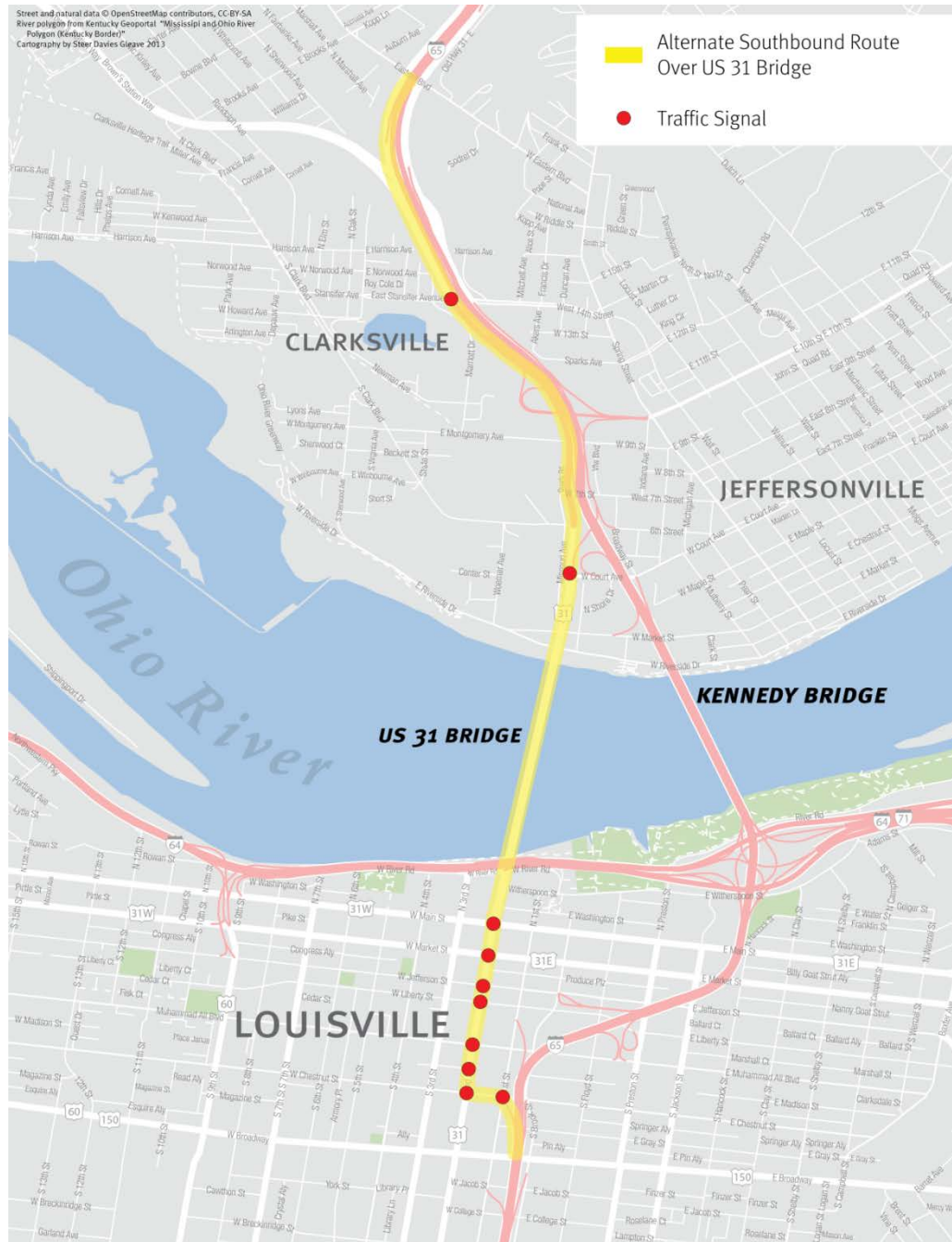
¹ Daily capacity from the KIPDA travel demand model.

² Ibid

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acts as a deterrent to traffic passing through Louisville and looking for a detour around the I-65 river crossing. Figure 2.1 illustrates the US 31 southbound alternative to I-65, highlighting the location of traffic signals that are encountered. During the peak periods, US 31 is already at capacity and the impact of the traffic signals is more pronounced. Also, due to its connection with the downtown Louisville local streets, very few trucks use the Clark Memorial Bridge.

FIGURE 2.1 US 31 ROUTE THROUGH LOUISVILLE



Data Collection Overview

- 2.8 To help establish a thorough understanding of the existing conditions of the study area and to help develop the toll forecasting model, an extensive data collection effort was undertaken. This included the collection of both desk and original data.
- 2.9 The desk data collection included:
- | Traffic count data collected by the Traffic Group in September 2010
 - | License plate matching survey performed by the Traffic Group in September 2010
 - | Traffic count data collected as part of the KYTC traffic monitoring program
 - | Traffic count data collected as part of the INDOT traffic monitoring program
 - | Mygistics³ traffic pattern analysis developed from cellphone data of Ohio River crossing traffic
- 2.10 The original data collection included:
- | Traffic count data collected by the Traffic Group in December 2012
 - | Travel time runs collected by Steer Davies Gleave in December 2012
 - | Internet travel survey included stated preference questions
 - | Trucking industry outreach conducted by Steer Davies Gleave in December 2012 through February 2013.

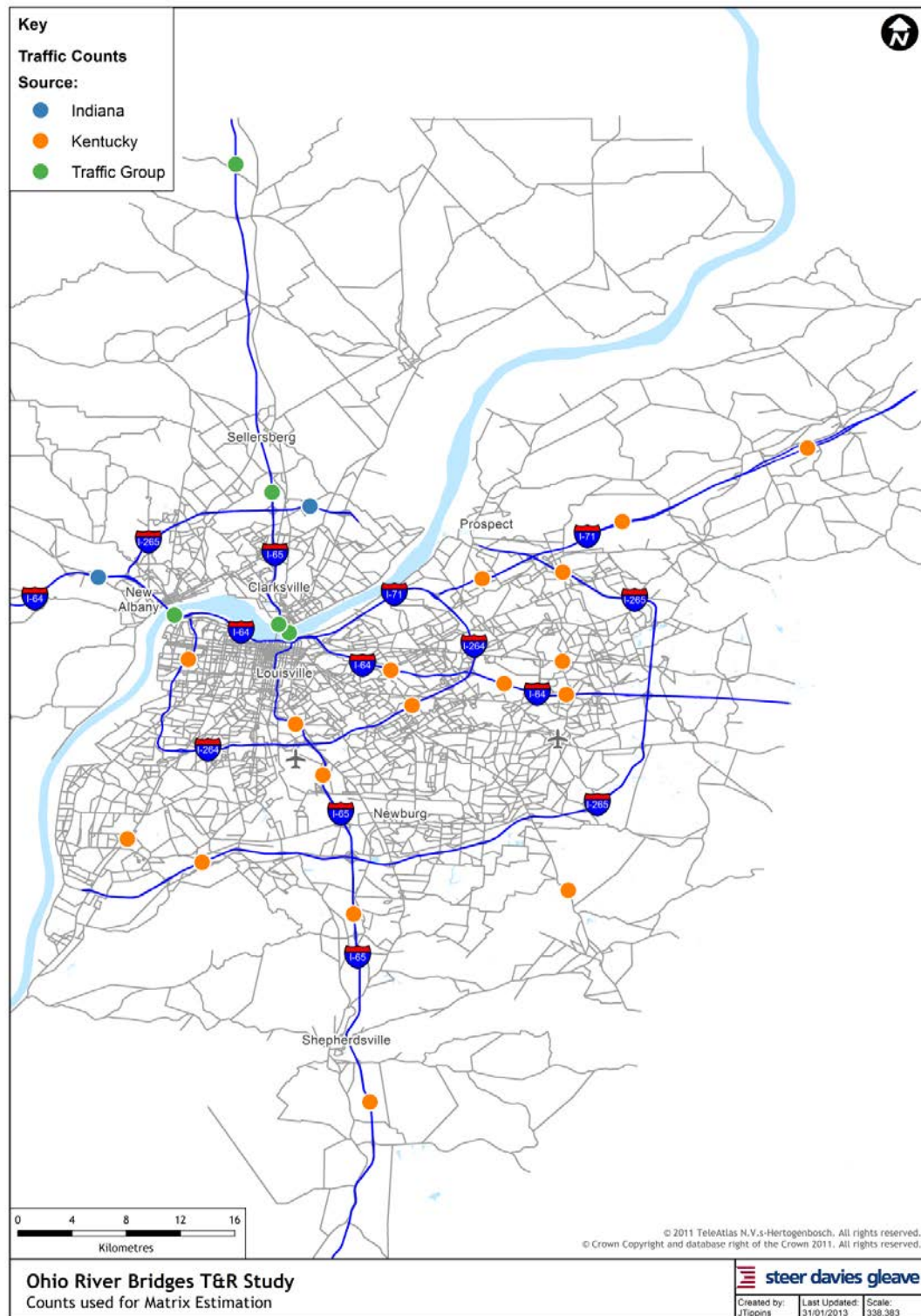
Traffic Count Data

- 2.11 Traffic count data was obtained from four sources:
- | KYTC's traffic monitoring program
 - | INDOT's traffic monitoring program
 - | The Traffic Group September 2010 collection
 - | The Traffic Group December 2012 collection
- 2.12 As part of FHWA's Highway Performance Monitoring System, KYTC and INDOT collect traffic data for key highway locations throughout each state. This information includes data collected from permanent automatic traffic recorders and short-term collection units, which are typically collected for 48-hour periods. We collected the available area count data from KYTC and INDOT for 2010, 2011, and 2012. These locations are indicated in Figure 2.2 below.
- 2.13 As part of the traffic forecasting work conducted for the environmental impact analysis, the Traffic Group collected traffic count data in September 2010. In order to get more recent data, we had the Traffic Group collect original data again in December 2012. The majority of the locations from the December 2012 count program were the same as had been collected in 2010, but a few new locations were

³³ Mygistics is a transportation research and data processing and analysis firm - <http://www.mygistics.com/>

included. Figure 2.2 also provides the location of the traffic counts collected by the Traffic Group.

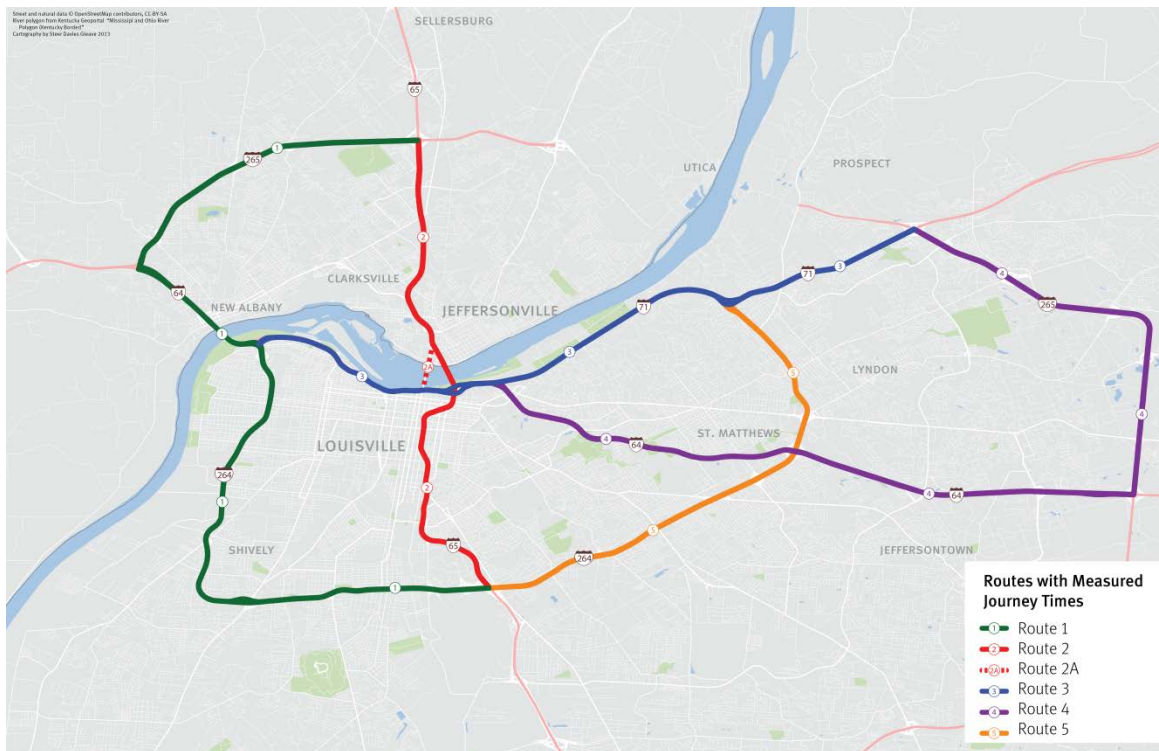
FIGURE 2.2 TRAFFIC COUNT LOCATIONS



Travel Time Runs

- 2.14 Steer Davies Gleave staff conducted travel time runs along the major routes of the study area in December 2012, as presented in Figure 2.3. These routes included:
- | Route 1: I-264 (west side) between I-65 in Kentucky and Indiana
 - | Route 2: I-65 between I-264 in Kentucky and Indiana
 - | Route 2A: US 31
 - | Route 3: I-71 between I-265 and I-64, and I-64 between I-71 and I-264
 - | Route 4: I-265 between I-71 and I-64, and I-64 between I-265 and I-71
 - | Route 5: I-264 (east) between I-71 and I-65
- 2.15 For each route, at least one run was conducted in the AM and PM peak periods in each direction, with mostly hourly travel time runs conducted for the primary routes (Routes 1-3). The data collection vehicles were equipped with GPS units and we used the “Floating-Car” technique for the travel time runs. With this technique, the data collection vehicle adopts a speed that allows it to pass one vehicle for every vehicle that passes it.

FIGURE 2.3 TRAVEL TIME ROUTES



Traffic Levels

Historical Traffic growth

- 2.16 As discussed above, we collected traffic count data from Kentucky and Indiana traffic monitoring programs to help establish the historical traffic profile. For the different

locations in the study area, depending on the year, these data collection programs may vary between collecting new data and estimating a traffic level based upon prior counts and seasonal factors. Accounting for these variations, we have prepared Table 2.1 which displays the average annual daily traffic of the bridge crossings for the years in which they were actually collected. We have supplemented this table with the seasonally-adjusted traffic collected by the Traffic Group in 2010 and 2012.

- 2.17 The table shows that the I-65 Kennedy Bridge reached a maximum daily traffic level of 136,000 in 2007, before falling to its current 122,000 level with the higher fuel prices and economic recession of the past five years. A similar situation occurred on the I-64 Sherman Minton Bridge, with traffic reaching a maximum of almost 90,000 daily trips before falling to its current level of almost 80,000.

TABLE 2.1 HISTORICAL OHIO RIVER BRIDGE CROSSING TRAFFIC

I-65		I-64		US 31	
Year	Daily Traffic	Year	Daily Traffic	Year	Daily Traffic
2004	132,000	2002	87,800	2002	19,900
2007	136,000	2004	81,500	2006	19,200
2008	121,000	2007	89,800	2009	14,800
2010*	122,900	2010*	81,900	2010*	21,900
2012*	122,000	2011	69,600	2012*	24,100
		2012*	78,200		

Notes: *these values reflect seasonal adjustments to data collected by the Traffic Group

Source: Steer Davies Gleave, KYTC, and the Traffic Group

- 2.18 In order to gain further insight into how area traffic has evolved over time, we collected traffic data for permanent count stations on I-65 north of Exit 133 (3 miles south of the Kennedy Bridge) and I-64 east of Exit 1 (1.5 miles east of the Sherman Minton Bridge). We present the annual daily traffic levels for these locations in Table 2.2. As the table indicates, there are some years for which no data were available due to problems with the counters.
- 2.19 Traffic along I-65 has grown at a compounded average growth rate (CAGR) of 2.2% from 1983 to 2005, while traffic along I-64 has grown at 1.9% annually for the same period and 1.3% annually from 1983 to 2010.

TABLE 2.2 HISTORICAL TRAFFIC OF NEARBY PERMANENT COUNT STATIONS

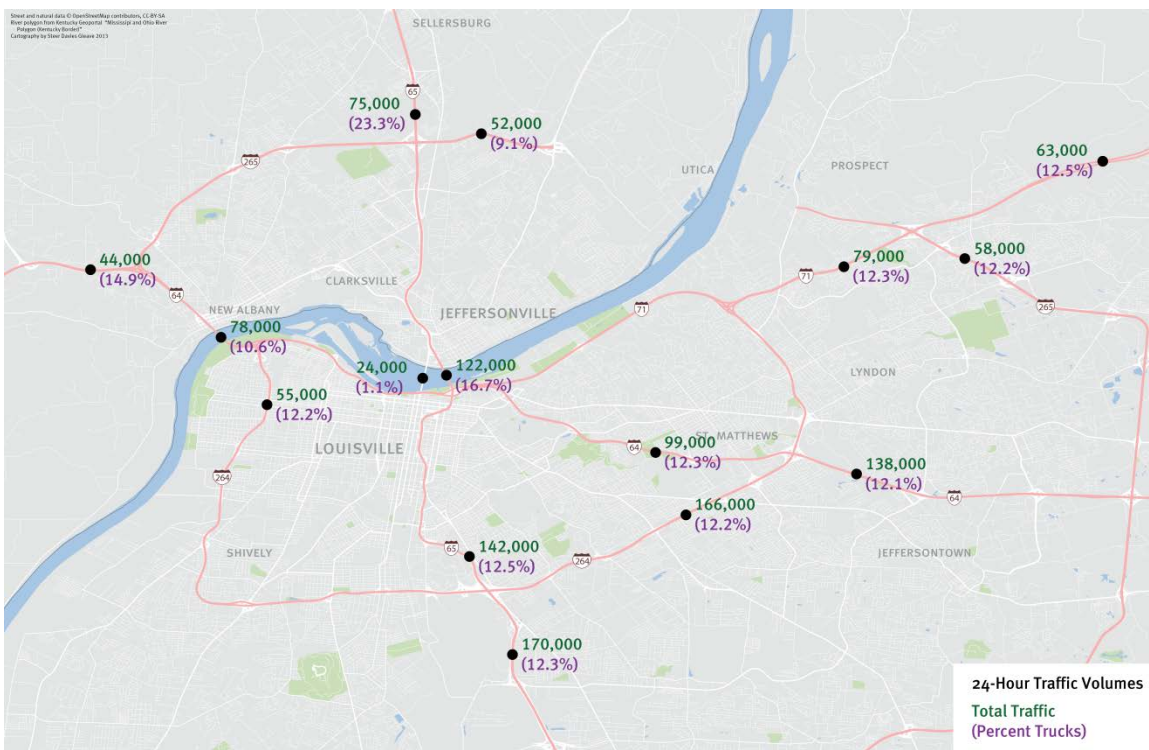
Year	I-65 North of Exit 133	I-64 East of Exit 1
1983	80,400	45,400
1984		45,400
1985	88,100	45,500
1986	92,300	47,800
1987	91,200	49,400
1988		
1989	96,200	
1990	106,000	58,700
1991	110,000	51,600
1992	113,000	55,200
1993	121,000	
1994	123,000	52,400
1995	121,000	54,400
1996	125,000	57,300
1997	121,000	58,100
1998	116,000	57,600
1999		63,700
2000		63,200
2001	123,000	65,900
2002	122,000	69,300
2003	122,000	70,200
2004	131,000	69,600
2005	130,000	68,200
2006		68,300
2007		
2008		66,400
2009		60,400
2010		64,600

Source: KYTC

Current Traffic Levels

- 2.20 We collected and compiled traffic count data for the major freeways in the study area. Figure 2.4 displays the current traffic level and the truck share of traffic for these locations. This figure shows that I-65 on the Kentucky side serves the highest level of daily traffic, particularly the location south of I-264. The figure also illustrates the high level of truck activity in the area, with particularly high truck shares of traffic on I-65 at the Ohio River and north of I-265 in Indiana.

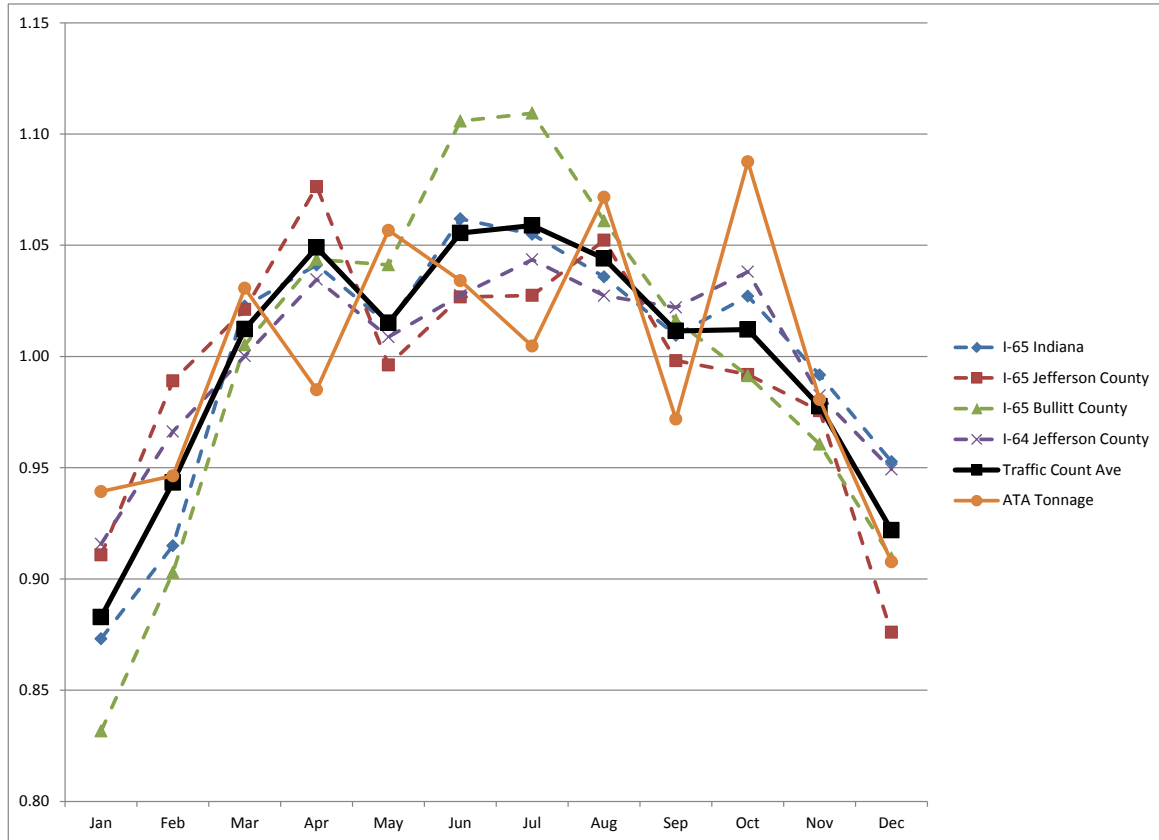
FIGURE 2.4 CURRENT TRAFFIC VOLUMES



Source: Steer Davies Gleave, KYTC, INDOT, and the Traffic Group

Seasonal Profile

- 2.21 To assess the variability of traffic over the course of the year, we collected and analyzed traffic data from permanent count station. In addition to the permanent count station locations on I-65 and I-64 in Kentucky described in the last section, we were also able to collect data from a permanent count station on I-65 in Bullitt County, Kentucky and on I-65 in Clark County, Indiana. Since these permanent stations did not include vehicle classification, we also obtained American Trucking Association data on monthly truck tonnage to understand how trucking traffic varies. For each of these data types, we identified the average monthly value and calculated the index of each month against the average. These index values are presented in Figure 2.5. This figure shows that on average area traffic and truck tonnage vary plus or minus 10% above the average. Of particular relevance to the December 2012 traffic data collection, December traffic and truck tonnage are 92% and 91% of the annual average.

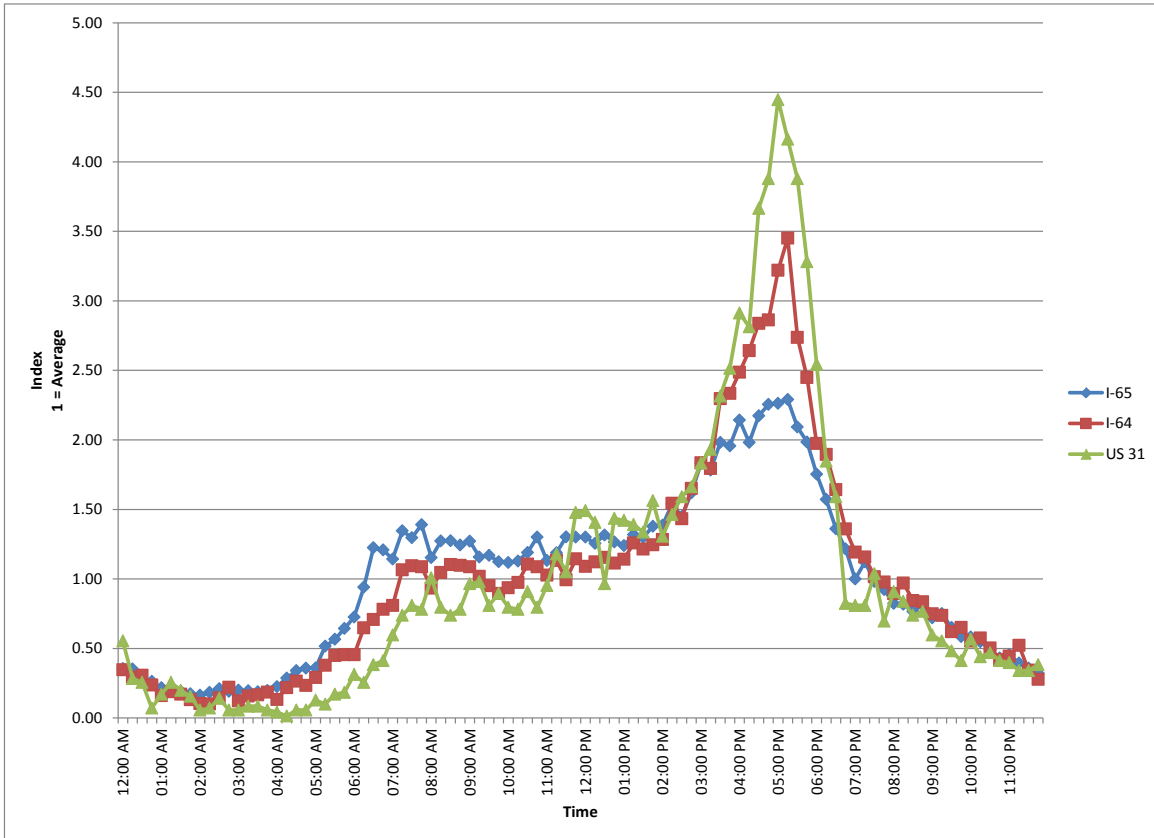
FIGURE 2.5 SEASONAL PROFILE OF TRAFFIC AND TRUCK TONNAGE

Source: Steer Davies Gleave, KYTC, INDOT, and American Trucking Association

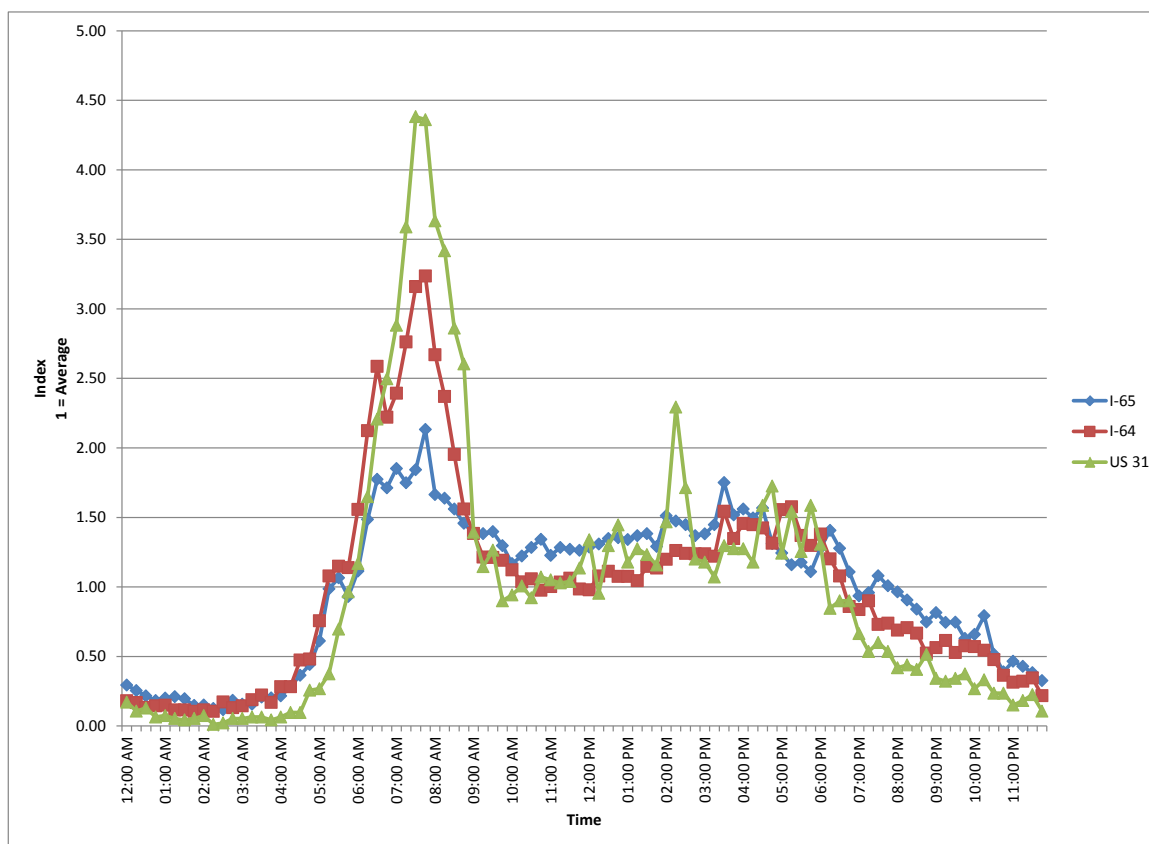
Time of Day Traffic Profile

- 2.22 In order to understand the daily peaking of bridge crossing traffic, we analyzed the directional traffic in 15-minute intervals. For each bridge, we identified the average traffic 15-minute traffic level and used that as the base. We then identified the index relative to the base of each 15-minute period. Figure 2.6 and Figure 2.7 present the index values for each bridge in the northbound and southbound directions, respectively. These figures show that similar to many other facilities, traffic on the bridge crossings experience more traffic during the peak periods, with northbound peaking in the PM and southbound peaking in the AM. This is consistent with the major commuting traffic flow from residences in Indiana to employment in Kentucky, and Louisville in particular.
- 2.23 These figures also show that US 31 experiences the largest peaks, with the highest 15-minute period having roughly 4.5 times the traffic of the average 15-minute period. I-64 has the next most pronounced peak periods, with traffic roughly 3.5 times the average, while I-65 has the most steady traffic with the peaks of 2 – 2.5 times the average.

FIGURE 2.6 TIME OF DAY PROFILE OF NORTHBOUND CROSSING TRAFFIC



Source: Steer Davies Gleave and the Traffic Group

FIGURE 2.7 TIME OF DAY PROFILE OF SOUTHBOUND CROSSING TRAFFIC

Source: Steer Davies Gleave and the Traffic Group

Day of Week Traffic Profile

- 2.24 We analyzed traffic data from the permanent count station on I-65 to identify the day of week traffic pattern. Table 2.3 presents the percentages of average daily traffic by day of week. This information will prove useful in converting daily forecasts to an annual level. Weekends average 76% of average daily traffic and represent almost 70% of the average weekday traffic level.

TABLE 2.3 DAY OF WEEK % OF AVERAGE DAILY TRAFFIC

Day	Percentage of Average Daily Traffic
Sunday	70%
Monday	103%
Tuesday	107%
Wednesday	110%
Thursday	112%
Friday	117%
Saturday	82%

Source: Steer Davies Gleave and KYTC

Travel Times

- 2.25 Based upon the travel time information collected by Steer Davies Gleave, we analyzed the travel times in the study area. Figure 2.8 illustrates the average AM peak travel speeds and Figure 2.9 illustrates the average PM peak travel speeds as collected through our travel time runs. These figures show that there are more delays occurring during the PM peak than in the AM peak. In general, most delays occur near the interchanges of highways as merging traffic causes slowdowns. Additionally, for the AM peak, more delays occur on the roadway segments leading towards downtown Louisville. The PM peak has more segments with speeds slower than 25 mph, and most of the area highways show speeds less than 55 mph.

FIGURE 2.8 OBSERVED AM PEAK PERIOD TRAVEL SPEEDS

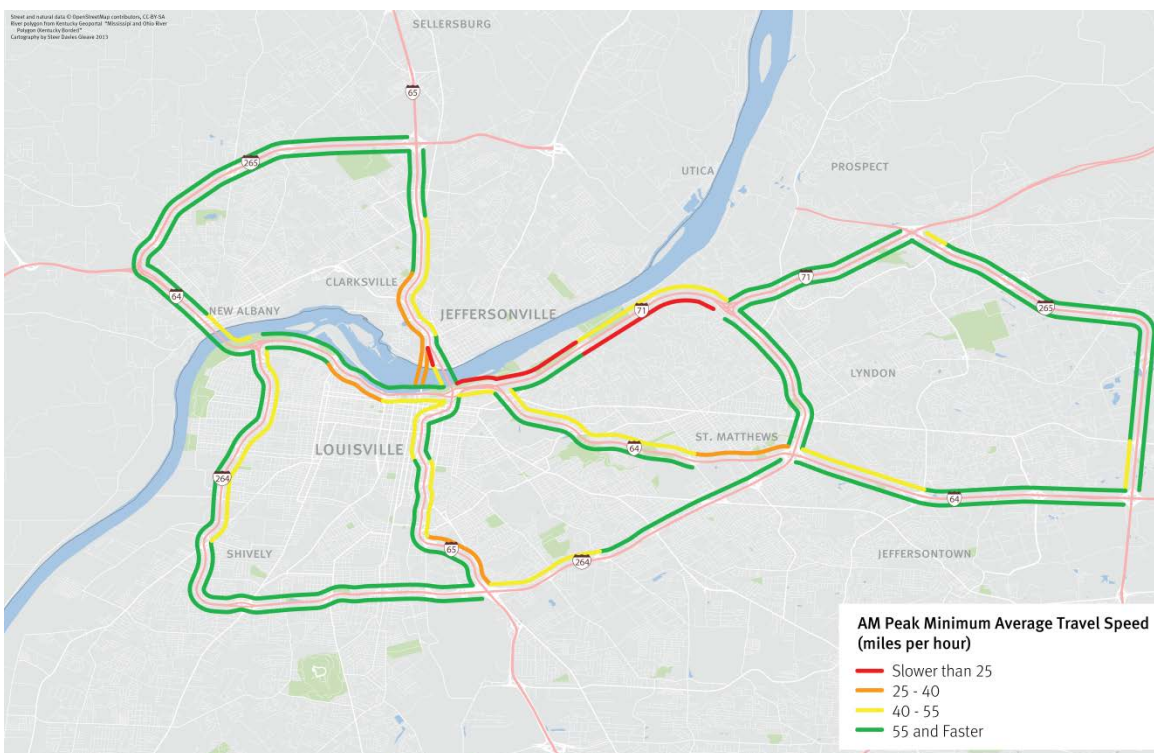


FIGURE 2.10 ORIGIN-DESTINATION DISTRICTS

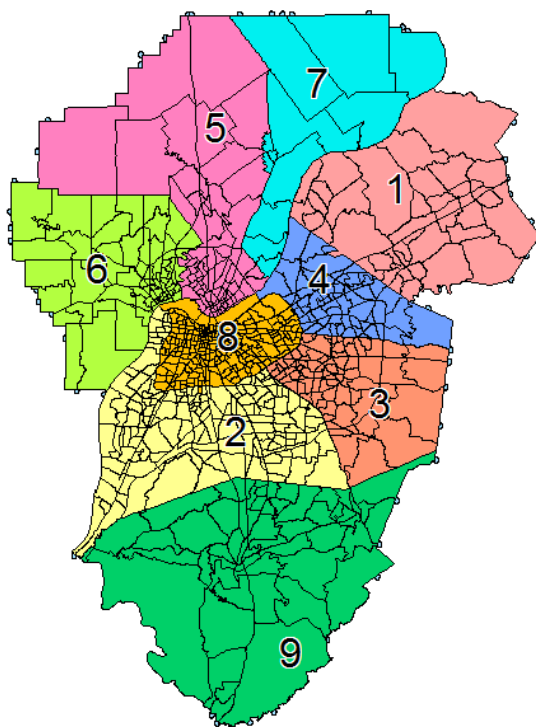


TABLE 2.4 DISTRICT FLOWS OF DAILY CROSSING TRAFFIC

		1	2	3	4	5	6	7	8	9
		Oldham	South Jefferson	Southeast Jefferson	Northeast Jefferson	West Clark	Floyd	East Clark	Downtown	Bullitt
1	Oldham	0.0%	0.0%	0.0%	0.0%	0.8%	0.4%	0.5%	0.0%	0.0%
2	South Jefferson	0.0%	0.0%	0.0%	0.0%	7.9%	6.0%	0.6%	0.0%	0.0%
3	Southeast Jefferson	0.0%	0.0%	0.0%	0.0%	3.4%	1.7%	0.2%	0.0%	0.0%
4	Northeast Jefferson	0.0%	0.0%	0.0%	0.0%	3.2%	1.4%	0.6%	0.0%	0.0%
5	West Clark	0.8%	7.6%	3.0%	3.0%	0.0%	0.0%	0.0%	12.8%	1.8%
6	Floyd	0.4%	5.9%	1.5%	1.2%	0.0%	0.0%	0.0%	6.8%	0.5%
7	East Clark	0.5%	0.6%	0.2%	0.6%	0.0%	0.0%	0.0%	1.1%	0.1%
8	Downtown	0.0%	0.0%	0.0%	0.0%	13.6%	7.4%	1.1%	0.0%	0.0%
9	Bullitt	0.0%	0.0%	0.0%	0.0%	2.1%	0.5%	0.1%	0.0%	0.0%

Source: Steer Davies Gleave and Mygistics

- 2.27 While the data from Mygistics was useful to understand the travel patterns of trips fully within the region, we analyzed the license plate matching information collected by the Traffic Group in 2010 and presented in CDM Smith's traffic reports of the Supplemental Final Environmental Impact Statement⁴ to analyze trips that pass through the region. Based upon our analysis of this information, we identified the percentage of I-64 and I-65 bridge trips passing through the region. Table 2.5 shows these percentages of bridge trips passing through the region, with a relatively low share of through the region auto trips (4-6%), but larger shares of truck trips, with through the region trucks on the I-64 Sherman Minton Bridge representing almost half of the total truck trips.

TABLE 2.5 PERCENTAGE OF BRIDGE TRIPS PASSING THROUGH THE REGION

Bridge Crossing	Auto	Truck
I-65 NB	5%	28%
I-65 SB	6%	23%
I-64 NB	4%	48%
I-64 SB	4%	49%

Source: Steer Davies Gleave, CDM Smith and the Traffic Group

Public Transportation

- 2.28 Public transportation in the Louisville metropolitan area is provided by Transit Authority of River City (TARC). TARC currently has two bus routes that cross the Ohio River – Routes 71 and 72. Combined, these two routes make almost 100 daily one-way trips. Prior to August 2012, TARC had an additional four bus routes that crossed the Ohio River, but these were eliminated to improve efficiency. Since the elimination of these routes, the cross-river daily ridership has averaged over 1,500 which is similar to the ridership level before the reduction of the other cross-river routes.

⁴ Appendix H - Traffic Reports of the Supplemental Final Environmental Impact Statement, April 2012

3 Land Use and Growth Analysis

- 3.1 In this chapter, we present a review of the study area land use activity and river crossing growth. Population, household, and employment forecasts are important inputs to forecasts of toll traffic and revenue, and thus an independent analysis of these inputs was conducted. In addition to the review of the socioeconomic inputs to the travel demand model, we analyzed historical data to establish an econometric model to identify the key drivers of Ohio River crossing traffic.

Land Use Review

- 3.2 Economic Development Research Group (EDR Group), a leading economic consulting firm, performed an independent review of the population and employment forecasts that are input into the travel demand model. EDR Group conducted site analysis and interviews to support the preparation of forecasts of housing and employment at the regional and Traffic Analysis Zone (TAZ) level. EDR Group's socioeconomic outlook report is contained in Appendix A. Below we highlight their approach and key findings.

Interviews

- 3.3 EDR Group conducted interviews during visits in February and July 2012, and January 2013. Table 3.1 presents the list of organizations that EDR Group interviewed.

TABLE 3.1 ORGANIZATIONS INTERVIEWED BY EDR GROUP

Bass Pro Shops	Jefferson Riverport International
Bullitt County Economic Development Authority	Jeffersonville Main Streets
Bullitt County Planning and Zoning Department	Kentuckiana Regional Planning and Development Agency
City of Charlestown Mayor's Office	Louisville Metro Economic Development and Innovation Department
Clark-Floyd Counties Convention & Tourism Bureau	Louisville Metro Planning and Design Department
Clark County Planning Commission	MainSource Banking
Clarksville Redevelopment Agency	New Albany Plan Commission
Clarksville Town Council	Ohio River Metal Services- Eagle Steel
Crossdock Development	Oldham Chamber and Economic Development
Downtown Jeffersonville merchants	Oldham County Department of Planning and Development
Floyd County Board of Commissioners	One Southern Indiana
Floyd County Plan Commission	Port of Indiana-Jeffersonville
Greater Louisville, Inc.	River Ridge Development Authority
Indiana Department of Transportation	Rocky's and Buckheads Restaurants
Indiana University Southeast	Schimpff's Confectionery
Ivy Tech Community College	Sellersburg Stone Company

3.4 Key findings from the interviews include:

- | The River Ridge Commerce Center, which is located near the East End Crossing in Jeffersonville, IN, should attract significant development due to the new crossing.
- | Jefferson County, Kentucky has limited locations for new industrial development.
- | The LSIORB Project will lead to more residential development in Indiana (Floyd County and the Charlestown area of Clark County) through its improved access to employment centers in Kentucky.
- | Indiana has an advantage attracting Manufacturing and Transportation and Warehousing industries due to its “right to work” law.
- | Amazon is developing a large distribution center (28 acre facility) in the River Ridge Commerce Center and their actual employment rate is ahead of earlier expectations.
- | Construction of new housing in the Crestwood community of Oldham County, KY is occurring faster than originally anticipated.

Development of the TAZ Forecasts

3.5 Building upon their site visits and interviews, EDR Group developed TAZ-level forecasts through a three-step process:

1. Establish regional control totals of background growth
2. Allocate the background growth to TAZ
3. Add bridge related growth

Regional Background Growth

3.6 Independent of the LSIORB Project, growth in the study area will be generated by regional economic dynamics taking the form of population, household, and employment. To identify an appropriate level of background growth, EDR Group obtained and reviewed the forecasts prepared by Woods & Poole and Moody’s. Based upon their review, they concluded that the Moody’s baseline forecasts provide the most defensible forecast of background growth for the Louisville MSA. These forecasts are presented in Table 3.2.

TABLE 3.2 BACKGROUND GROWTH FOR FIVE-COUNTY KIPDA MPO REGION

	2007	2011	2018	2030
Households	425,672	442,974	475,382	498,054
Employment	572,650	550,729	618,083	643,666

Source: Moody’s Analytics as presented by EDR Group

Allocation of Background Growth

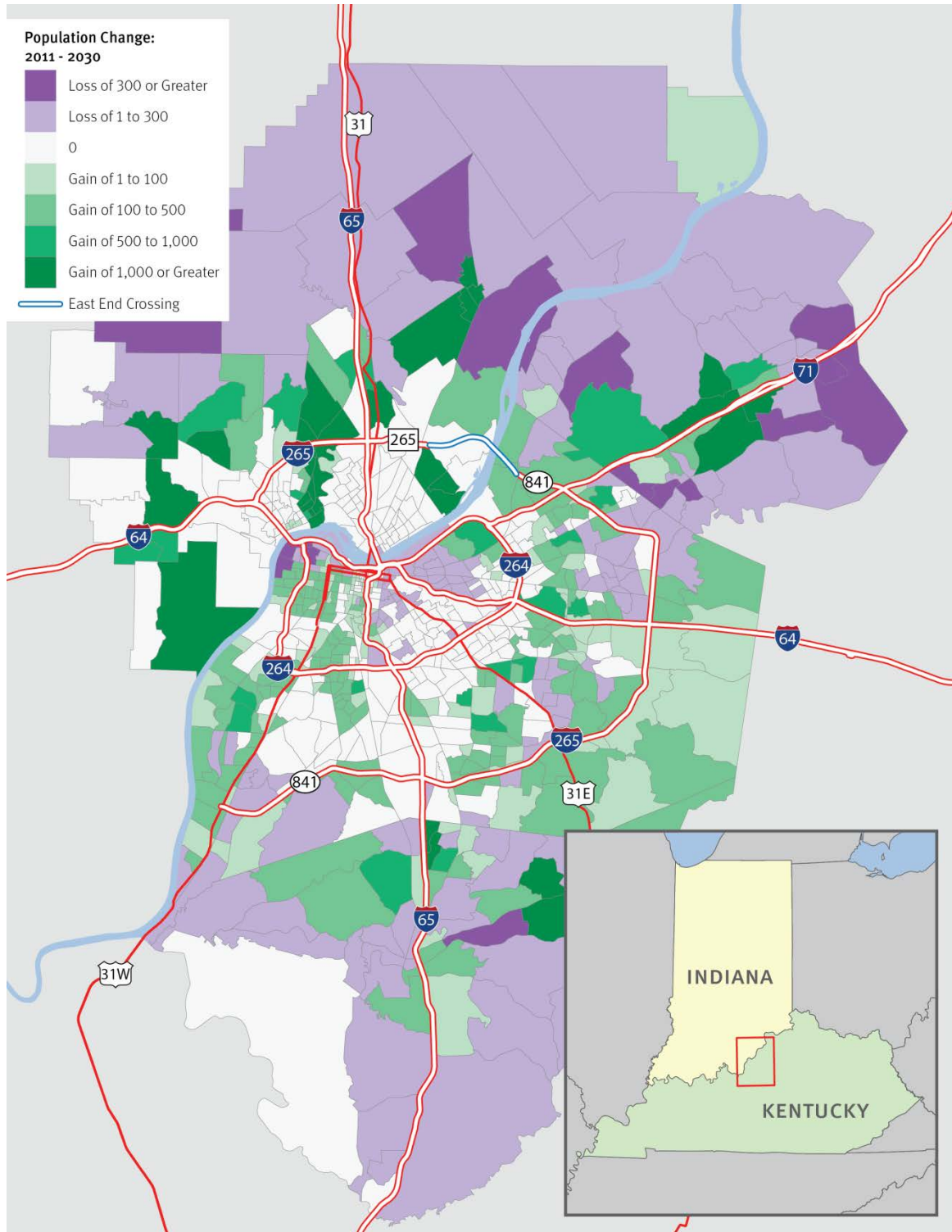
3.7 After establishing the amount of background growth that will occur in the region, EDR Group next allocated this growth to the specific TAZ in the MPO region. EDR Group used Cube Land modeling software to help determine this allocation. Cube Land uses

bid-rent functions, which include attributes of each TAZ such as unit size and attractiveness, and transportation accessibility, to allocate incremental households and employment to TAZ. The model also includes constraints to limit the amount of growth in each TAZ. Within the Cube Land modeling, EDR Group applies their expert judgment to help set the model parameters and to make post-model adjustments as needed.

Bridge Related Growth

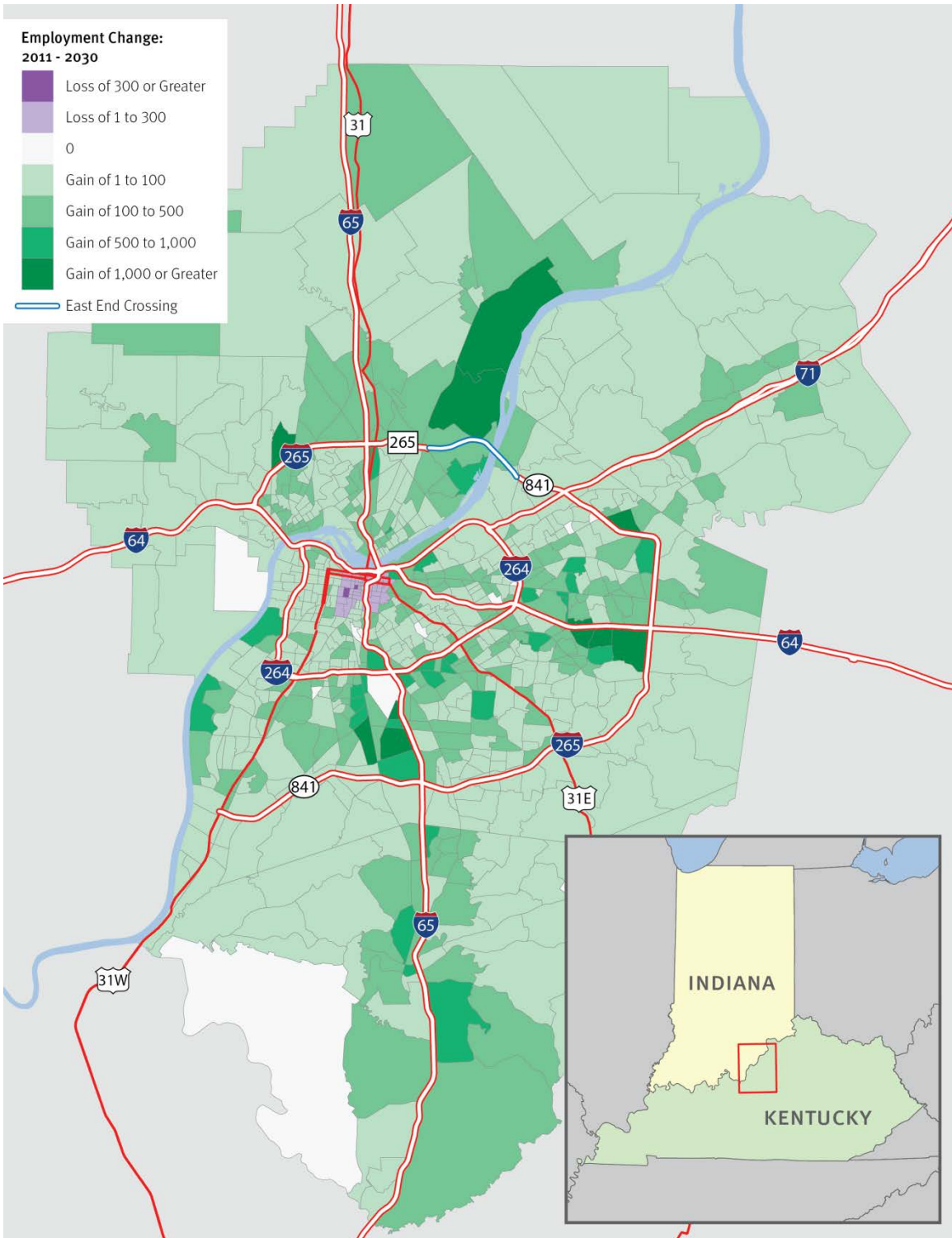
- 3.8 Beyond the background growth that will occur in the area, EDR Group assessed the potential for “bridge-contingent growth”. This is net-new growth in the MPO region that is stimulated by the new bridges. Relying on their site visits and interviews and using IMPLAN model, EDR Group identified the amount of bridge related growth and allocated it to TAZ.
- 3.9 Based upon the TAZ level allocations, Figure 3.1 presents the population change from 2011 to 2030, while Figure 3.2 presents the employment change.
- 3.10 Table 3.3, Table 3.4, and Table 3.5 summarize the EDR Group forecasts at the county level. While these tables further illustrate that a significant amount of the regional growth is forecasted to occur in Clark and Floyd Counties in Indiana, Jefferson County Kentucky is still forecast to add more than twice as many new jobs as will be added in Indiana.
- 3.11 As a further check on the EDR Group forecasts, we compared their population and employment forecasts with the KIPDA 2030 forecasts. Table 3.6 presents this comparison and shows that the EDR Group forecasts are a little higher for population, but much lower for employment. Given the KIPDA 2030 values represent a much larger increase from 2007 to 2030 in employment than population (239,000 vs. 152,000), the EDR Group forecasts seem more reasonable.

FIGURE 3.1 FORECAST POPULATION CHANGE (2011 - 2030)



Source: EDR Group presented by Steer Davies Gleave

FIGURE 3.2 FORECAST EMPLOYMENT CHANGE (2011 - 2030)



Source: EDR Group presented by Steer Davies Gleave

TABLE 3.3 SUMMARY OF EDR GROUP'S HOUSEHOLD FORECAST

County	2007	2011	2018	2030	2011 - 2030 CAGR
Clark	43,590	49,030	62,988	67,579	1.7%
Floyd	29,304	30,084	38,225	45,866	2.2%
Bullitt	29,027	32,779	36,271	38,596	0.9%
Jefferson	303,797	305,503	313,611	320,197	0.2%
Oldham	19,954	25,579	26,338	29,063	0.7%
Total	425,671	442,974	477,432	501,301	0.7%

Source: EDR Group

TABLE 3.4 SUMMARY OF EDR GROUP'S POPULATION FORECASTS

County	2007	2011	2018	2030	2011 - 2030 CAGR
Clark	105,032	117,267	150,649	161,629	1.7%
Floyd	73,712	71,952	91,424	109,698	2.2%
Bullitt	78,414	78,398	86,751	92,312	0.9%
Jefferson	704,876	730,679	750,071	765,824	0.2%
Oldham	56,055	61,178	62,992	69,511	0.7%
Total	1,018,089	1,059,474	1,141,887	1,198,975	0.7%

Source: EDR Group

TABLE 3.5 SUMMARY OF EDR GROUP'S EMPLOYMENT FORECASTS

County	2007	2011	2018	2030	2011 - 2030 CAGR
Clark	56,882	53,830	71,211	78,102	2.0%
Floyd	32,493	30,664	35,114	38,329	1.2%
Bullitt	19,068	17,623	25,811	26,587	2.2%
Jefferson	446,046	431,924	475,088	495,489	0.7%
Oldham	18,161	16,688	18,069	19,580	0.8%
Total	572,650	550,729	625,293	658,086	0.9%

Source: EDR Group

TABLE 3.6 COMPARISON OF EDR GROUP AND KIPDA'S 2030 SOCIOECONOMIC FORECASTS

County	Population		Employment	
	KIPDA	EDR Group	KIPDA	EDR Group
Clark	133,321	161,629	87,478	78,102
Floyd	85,203	109,698	43,766	38,329
Bullitt	114,224	92,312	37,300	26,587
Jefferson	730,891	765,824	605,643	495,489
Oldham	88,166	69,511	29,657	19,580
Total	1,151,805	1,198,975	803,844	658,086

Source: EDR Group and KIPDA

River Crossing Econometric Model

- 3.12 In order to understand the drivers of traffic in the region, as well as to better estimate its future growth, Steer Davies Gleave developed an econometric model. Of particular interest is estimating the growth in travel between 2012 (the base year for the modeling) and the future trip matrices that underlie the traffic and forecasting.
- 3.13 Econometric models estimate the relationship between economic factors (such as local or national employment, income, industrial production, tourism, trade, GDP), as well as prices (such as fuel, fares or tolls) on traffic. Given detailed data, one can develop precise estimates of the various elasticities influencing demand, such as the elasticity of travel to economic growth. The estimated models can also be used, in turn, to simulate the impacts of future economic growth on traffic demand.
- 3.14 The econometric model is estimated based on past relationships between traffic and various causal factors. The general structure of the econometric growth model is the following:
- $$(1) \quad Y_{ijt} = X_{ijt}\beta_j + \text{Fixed Effects}_{ij} + \varepsilon_{ijt}$$
- 3.15 Here traffic at location i of vehicle type j during period t is a function of a several economic variables mentioned previously – the matrix X . β_j is a vector of coefficients that detail the influence of the various economic variables on traffic in a given period. We include a control called *fixed effects* that captures the distinct time-invariant features of each location. The variable ε is a random error term.
- 3.16 The data used to calibrate the model includes three count stations on the Kentucky side which provide sufficiently detailed data to produce monthly average daily traffic during the peak and off-peak between January 2000 and November 2012. These were not additionally distinguished by classification, however, so the model structure in (1) was simplified to be based on (overall) average daily traffic.
- 3.17 The three count stations include:
- i) I-65 North of Exit 133 (count station 99)

ii) I-65 in Bullitt County south of Shepherdsville (count station 72)

iii) I-64 east of the Sherman Minton Bridge (count station 92)

- 3.18 Together these three stations provide a total of 310 monthly observations for off-peak traffic and 302 observations for peak traffic. The available count data is *pooled* in the model estimation to maximize the precision of the model. In this process, each count station is treated as a *panel*, and the available count data for each is merged into a wider data-set for estimation⁵.

Model 1: Peak Period Vehicles

- 3.19 The key economic variables in this model are employment in the Louisville metropolitan standard area (MSA) and national spending on consumption. These variables are sufficiently broad that we can theorize that they drive peak-period passenger vehicles (employment in the MSA) and commercial vehicles (employment and national consumption). The model also includes monthly seasonal controls. Interestingly, fuel prices were not found to be statistically significant, and were not included as a variable in the final model. The estimation results are included in Table 3.7.

TABLE 3.7 MODEL ESTIMATION RESULTS FOR LOG OF PEAK PERIOD VEHICLES

Variable	Coefficient	t-Statistic	P-Stat
Constant	5.20	2.53	0.01
LOG(MSA Employment)	0.55	1.94	0.05
LOG(National Consumption)	0.49	6.31	0.00
R-squared	0.98		
Adjusted R-squared	0.97		
S.E. of regression	0.25		
F-statistic	344		
Prob (F-statistic)	0.00		

Note: Seasonal monthly controls omitted from reporting; data for count station 92 was dropped from the estimation due to presumed reporting error

- 3.20 As illustrated, the estimation of the peak period model yields parameter (or coefficient) estimates that are highly significant.

⁵ Merging the data into panels also produces a significant benefit which is widely exploited in econometric applications: Using the technique of fixed effects the econometric model is able to control for the differences between the markets served by each of the count locations. These differences could include income, residential density or even modal alternatives, which could be expected to influence how each market would behave somewhat differently.

Model 2: Off-Peak Period Vehicles

- 3.21 The key economic variables in the off-peak model are also employment in the Louisville metropolitan standard area (MSA) and national spending on consumption. The model once again includes monthly seasonal controls, and fuel prices were found to be statistically insignificant, and therefore not included as a variable in the final model. The estimation results are included in Table 3.8.

TABLE 3.8 MODEL ESTIMATION RESULTS FOR LOG OF OFF-PEAK PERIOD VEHICLES

Variable	Coefficient	t-Statistic	P-Stat
Constant	6.26	3.42	0.00
LOG(MSA Employment)	0.40	5.40	0.00
LOG(National Consumption)	0.58	2.13	0.03
R-squared	0.95		
Adjusted R-squared	0.94		
S.E. of regression	0.246		
F-statistic	344		
Prob (F-statistic)	0.00		

Note: Seasonal monthly controls omitted from reporting; data for count station 92 was dropped from the estimation due to presumed reporting error

- 3.22 Once again the estimated parameters are highly significant. Since the model is estimated with variables converted to logarithm forms, the estimated coefficients are mathematically equivalent to elasticity measures. The elasticity estimates above suggest that a 10% increase in MSA employment leads to a 4% increase in off-peak traffic, while a 10% increase in consumption leads to a 5.8% increase in traffic.
- 3.23 Overall, both models perform very well in terms of their ability to replicate past traffic trends. This measure is essentially the ability of the models to "forecast" the past given actual past values for the economic variables. Despite some variability, most time traffic observations are replicated by the models with well under 5% error, again indicating good model fit.
- 3.24 The forecasts of overall traffic growth in the region are generated using forecasts for MSA employment and national consumption obtained from Moody's *Economy.com*. For the forecast period from 2011 to 2030, Moody's forecasts MSA employment and national consumption to grow annually at 0.35% and 2.1%, respectively.
- 3.25 The resulting growth forecasts are very similar for peak and off-peak: Between 2011 and 2018 peak period traffic is forecast to increase 12.6% and off-peak 12.2%.

Similarly, growth between 2011 and 2030 is forecast to be 27% and 25.9% overall. On an annual basis, growth is forecast to average 1.25% for peak period and 1.23% for off-peak between 2011 and 2030.

River Crossing Growth

- 3.26 We compared the growth in river crossing trips estimated through:
- I Inputting the independent socioeconomic forecasts into the MPO model: this produced 2011-2030 auto growth of 2.7% per annum and truck growth of 1.5% per annum.
 - I Applying the econometric model: this produced 2011-2030 trip growth of 1.25% per annum.
- 3.27 Based on this comparison, we decide to grow river crossing trips using the total growth rates estimated by the econometric model, but allocating to OD trips using the patterns found from running the MPO model with the independent socioeconomic forecasts.

4 Travel Behavior

Travel Survey

4.1 In order to better understand the Ohio River Bridges market, and to estimate crucial behavioral aspects of this market, Steer Davies Gleave conducted extensive stated preference (SP) surveys and analyses of potential users. Steer Davies Gleave conducted a behavioral survey of passengers to develop data and forecasting model inputs needed for the traffic and revenue study. This section covers the following:

- I The first part describes the survey goals, administration and results. This includes socio-economic profiles, current Ohio River bridges behavioral characteristics and trip frequencies and patterns.
- I The second part focuses on the quantitative behavioral analysis of Ohio River bridges users to derive values of time to be used in the modeling, based on stated preferences from the survey and on observed (revealed) travel behavior.

Survey Design

Survey Goals

4.2 In order to provide additional behavioral information on the markets served by the Ohio River bridges and the neighboring roads and to establish key forecasting parameters – such as trip frequency and willingness to pay – a behavioral and trip pattern survey was conducted by Steer Davies Gleave.

4.3 The goals of the behavioral and trip pattern survey included:

- I Developing a qualitative and quantitative understanding of how people make choices between using a toll bridge and alternative untolled routes based on attitudinal questions (route choice);
- I Developing a qualitative and quantitative understanding of how people make choices between using a freeway and alternative routes on local roads based on attitudinal questions (route choice);
- I Collecting trip pattern information in the markets served by the bridges under investigation and gain insight on frequency profiles of road users;
- I Collecting willingness to pay for travel time savings information based on stated preference scenarios;

Survey Design

4.4 The survey questionnaire collected revealed preference and stated preference (SP) data.

4.5 The revealed preference data gathered information on actual driving behavior, based on respondents most recent trip using the I-65, I-64 and US 31 bridges. Travel time, costs and other key information were collected, as well as attitudinal information such

as perception of congestion and attitude toward tolling. Other information was also collected, including more detailed data on trip purpose, income categories and behavioral statements to allow further segmentation.

- 4.6 The SP data was collected through a route choice exercise, asking respondent to make hypothetical choices between using a tolled bridge or an alternative free – but longer – route.
- 4.7 The survey instrument was designed to collect data on frequency of trips made on the I-65, I-64 and US 31 bridges. Travelers also reported the trip frequency by time of day and on weekends for their most used bridge. The survey also collected travelers' knowledge of alternatives to their most used bridge, price sensitivity, perceptions of congestion and perception of differences in travel time, attitudes about transportation issues such as congestion and tolling, and relevant socioeconomic data.
- 4.8 Various choice exercises were included to assess the willingness to pay of each market. The questionnaire took between 20-25 minutes to complete, with about 50 questions for any given respondent - including screening questions and the choice exercise.
- 4.9 Appendix B includes the survey for reference and it was structured as follows:
 - I Screening questions about trips made across the Ohio River using the I-65, I-64 and US 31 bridges in the last 2 months by Origin-Destination areas, including
 - Most frequently used bridge
 - Trip frequency on the most frequently used bridge by time of day for a typical week
 - Trip frequency on the two less frequently used bridge for a typical week
 - I Detailed questions about a typical recent trip across the Ohio River using the most frequently used bridge, including:
 - Trip purpose, time and day, and trip origin-destinations
 - Next best alternative route and bridge
 - Travel party and paying member(s)
 - I Introduction to the planned bridge improvements, including questions about respondents attitudes toward the project and attitude about tolling
 - I Route choice SP exercise consisting of 9 trade-off questions
 - I Attitudinal questions about alternative payment methods and discount programs for frequent users
 - I Attitudinal questions about travel choices and car use
 - I Socio-economic questions pertaining to respondent income, occupational status, age, etc.

Survey Implementation

- 4.10 Steer Davies Gleave prepared a survey questionnaire that was administered through an online survey to a selected panel of respondents. Steer Davies Gleave developed and

analyzed the survey, while the Internet questionnaire was hosted by our partner Crescent Research, a market research firm with a large online panel of respondents across the region. The data were collected via the Internet in December 2012.

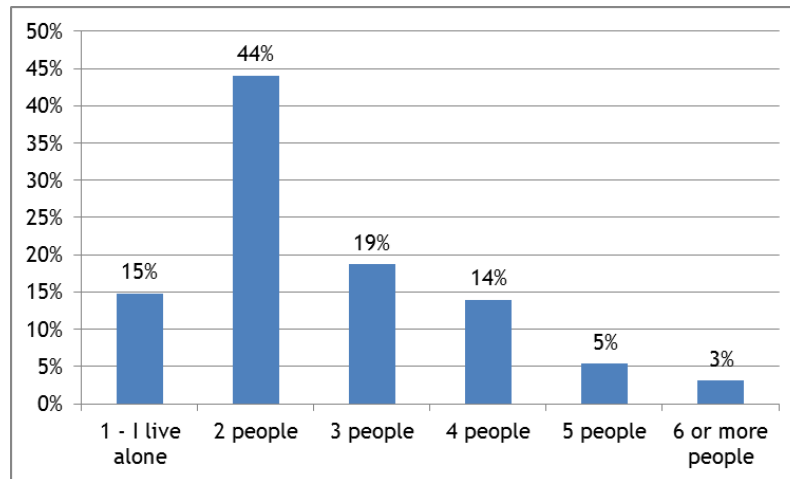
- 4.11 Respondents were recruited using the following sampling plan: A target of 1,000 returns or complete questionnaires was selected, a very large sample that enabled significant market segmentation of road users. Steer Davies Gleave carefully designed one main questionnaire which was customized interactively for each respondent, based on their answers. For example, respondents are likely to have different behavioral patterns based on their attitude towards using freeways as against local roads.
- 4.12 Advantages of using a pre-recruited panel of residents are that 1) respondents can be quickly recruited, and 2) no additional incentives are required since the respondents are selected and remunerated by the market research firm and the survey collection costs were substantially lower than face-to-face surveys. The main limitation of such a panel is that a smaller percentage of the panelists may use the study bridges than would be found with direct intercept surveys, and those respondents may not represent the same composition as the overall population. This seems to be the case for this project, where there seems to be a larger percentage of trips made for non-work purposes than the traffic peaking of the bridges would indicate. Further, by being on the market research panel, these respondents have demonstrated a willingness to spend time taking a survey for a small remuneration, potentially signifying a lower value of time than the overall population.

Ohio River Bridges User Profiles

This section presents the profile of the users of the Ohio River Bridges. Unless indicated otherwise, results below are based on 1,001 respondents.

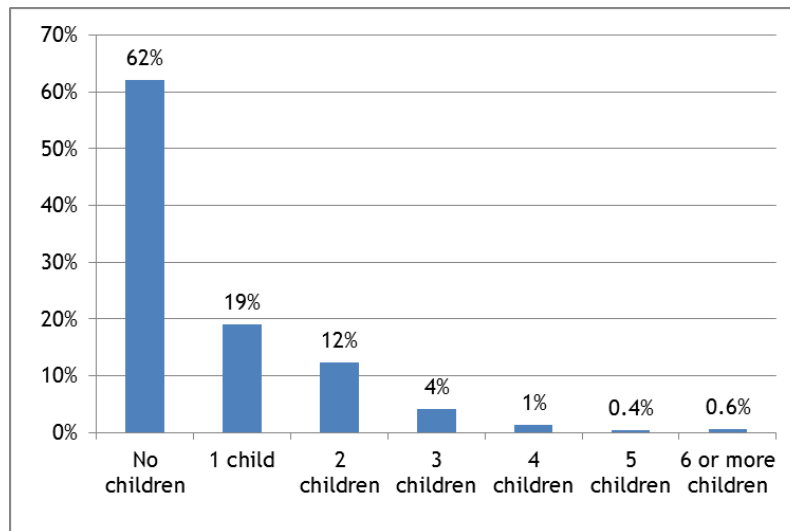
Socio-Economic Profile

- 4.13 Respondents were asked how many people live in their household. As can be seen from the figure below, 44% of the respondents belong to 2-adult households and 59% to 1- or 2-adult households. On average, survey respondents are in 2-adult households.

FIGURE 4-1 RESIDENTS IN HOUSEHOLD

Source: Steer Davies Gleave

- 4.14 Respondents were asked how many children younger than 18 live in their household. The large majority of respondents do not live with any children (62%) as shown in Figure 4-2. It may be noted that this sample is similar in household composition to the Louisville area where about 70% of households do not have any children.⁶

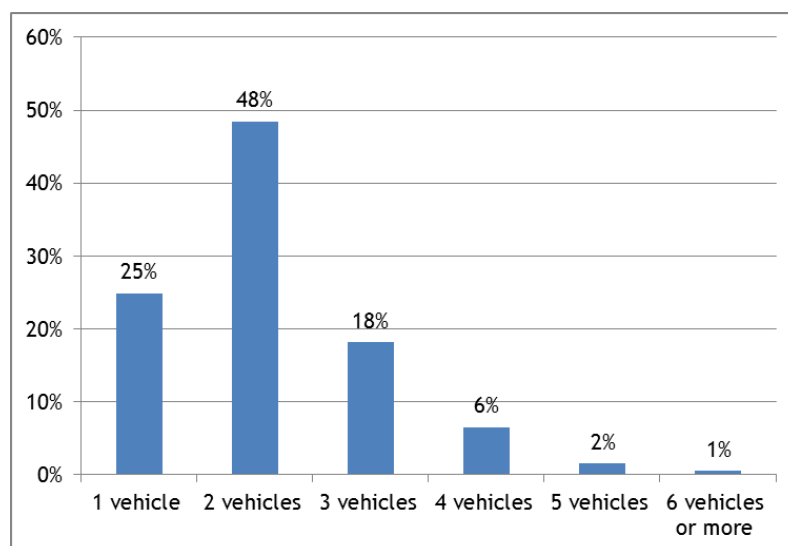
FIGURE 4-2 CHILDREN IN HOUSEHOLD

Source: Steer Davies Gleave

- 4.15 Respondents were asked to report the number of vehicles their household have regular use of. While most respondents use two vehicles (48%), 1-vehicle households are also fairly common (25%).

⁶ Data from US 2010 Census for Jefferson County, KY

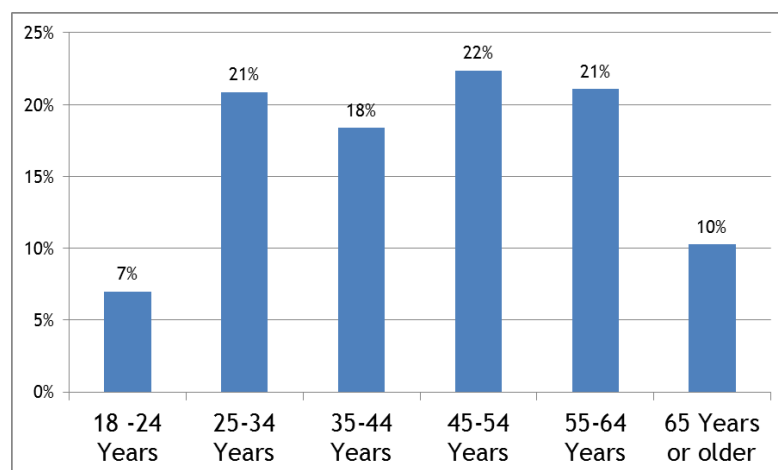
FIGURE 4-3 VEHICLES IN HOUSEHOLD



Source: Steer Davies Gleave

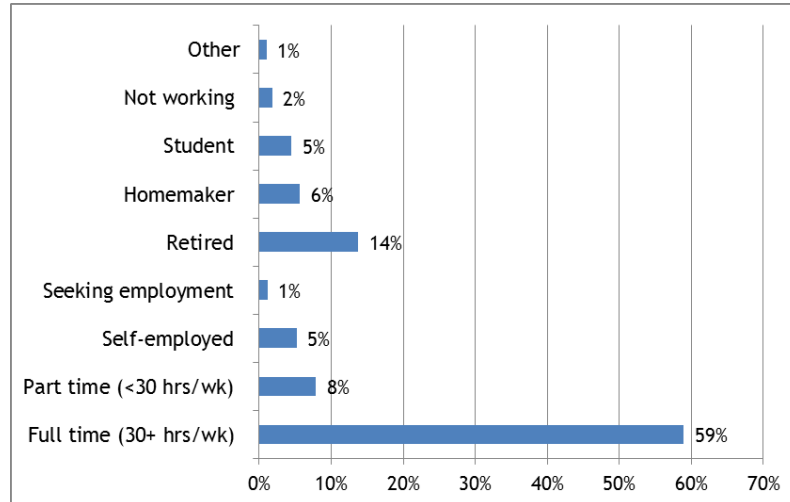
- 4.16 Respondents' ages are reported below. The largest single category is 45 to 54 years, which represents 22% of respondents.

FIGURE 4-4 AGE OF RESPONDENTS



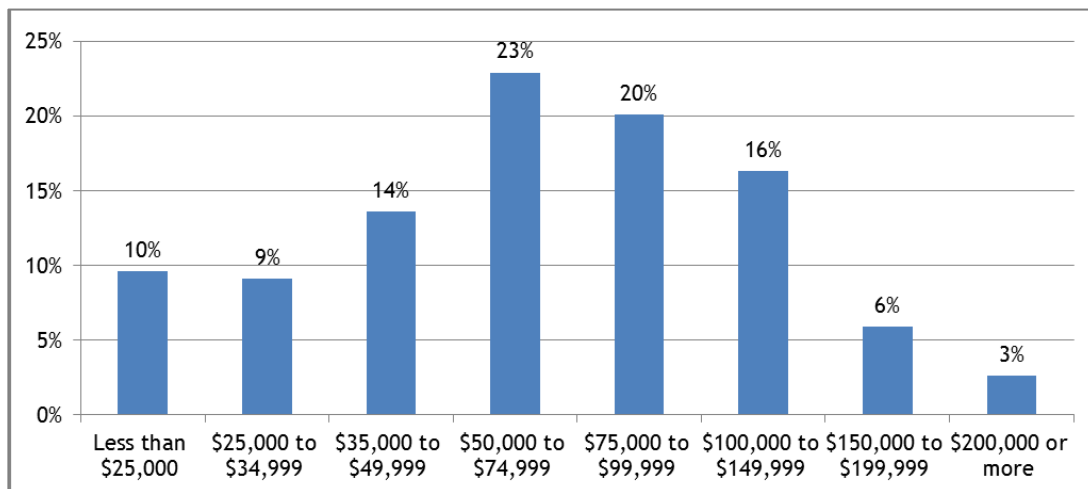
Source: Steer Davies Gleave

- 4.17 Respondents were asked about their employment status. Most of the respondents work full time, but a significant number are retired.

FIGURE 4-5 EMPLOYMENT STATUS

Source: Steer Davies Gleave

- 4.18 Respondents were asked about their total annual household income. The largest household income group was in the \$50,000 to \$74,999 range. The \$35,000-\$75,000 income group represents 37% of all respondents.

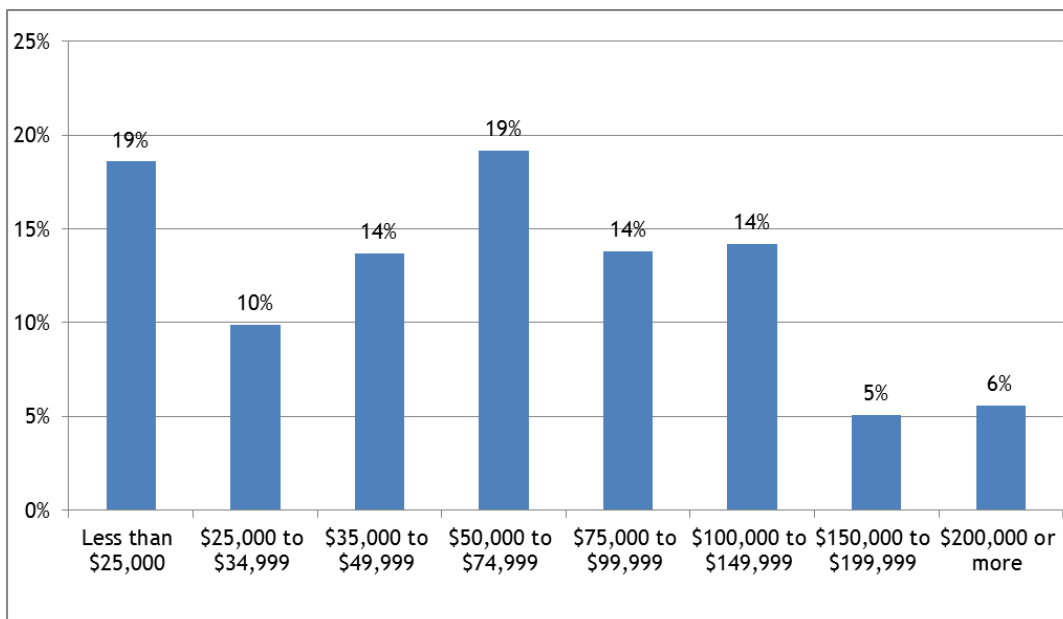
FIGURE 4-6 HOUSEHOLD INCOME DISTRIBUTION IN SURVEY SAMPLE

Source: Steer Davies Gleave

- 4.19 The household income distribution for the respondents is similar to that of the Louisville region⁷, as indicated by the figure below.

⁷ Data from US 2010 Census for Jefferson County, KY

FIGURE 4-7 HOUSEHOLD INCOME DISTRIBUTION IN LOUISVILLE

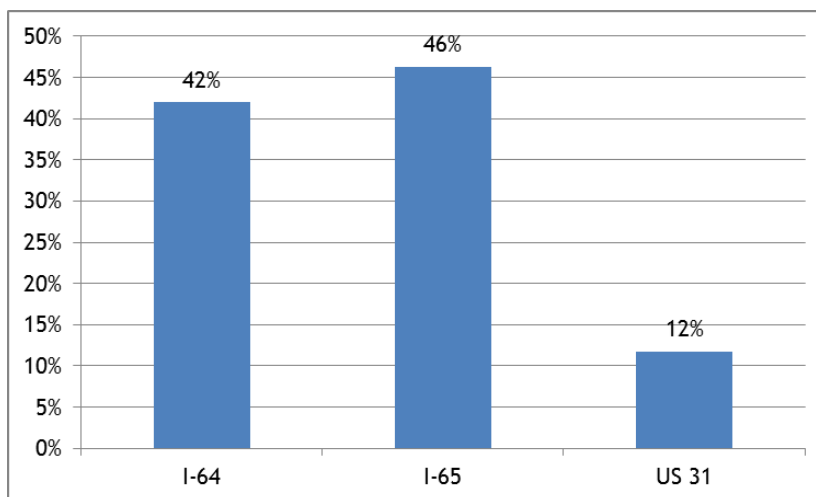


Source: US 2010 Census

User Travel Patterns

- 4.20 Respondents were asked to indicate the bridge they used most frequently in the last two months. The I-65 bridge had the most respondents to cross the Ohio River (46%), followed by the I-64 bridge (42%).

FIGURE 4-8 MOST FREQUENTLY USED BRIDGE

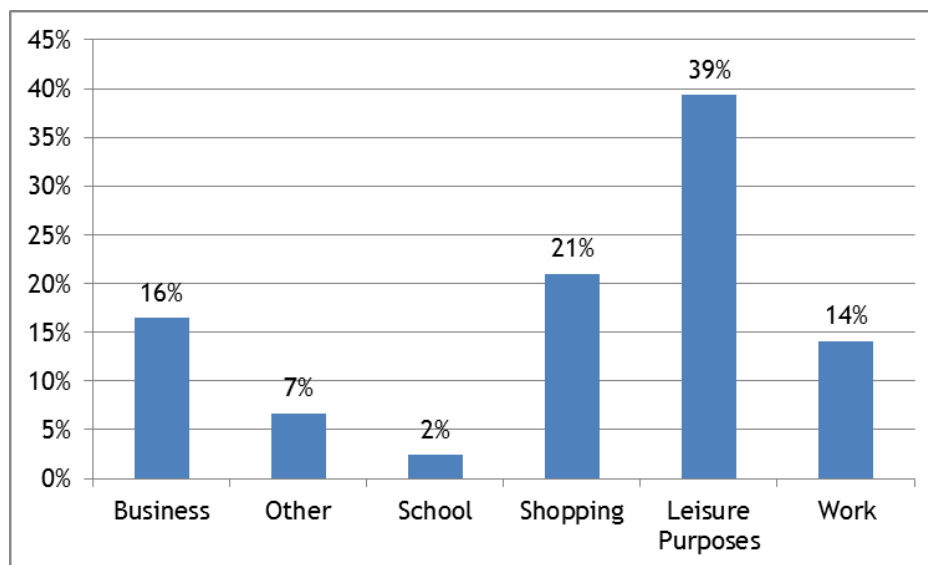


Source: Steer Davies Gleave

- 4.21 Respondents were asked to indicate the purpose of their most recent typical weekday trip across the Ohio River. The largest group (39%) indicated their most recent trip across the Ohio River was a trip for leisure purposes, such as visiting family or friends,

attending a social or cultural event, an outing to a restaurant, or other leisure activity. Only 14% of respondents categorized their trip purpose to be a commute to work. This provides an indication that the survey respondents varied from the typical bridge traffic composition, which includes a large increase in peak period traffic consistent with work trips.⁸ To analyze the results of this survey, trip purpose will hereafter be classified into trips to commute to work (14%) and non-work trips for all other purposes (86%).

FIGURE 4-9 TRIP PURPOSE

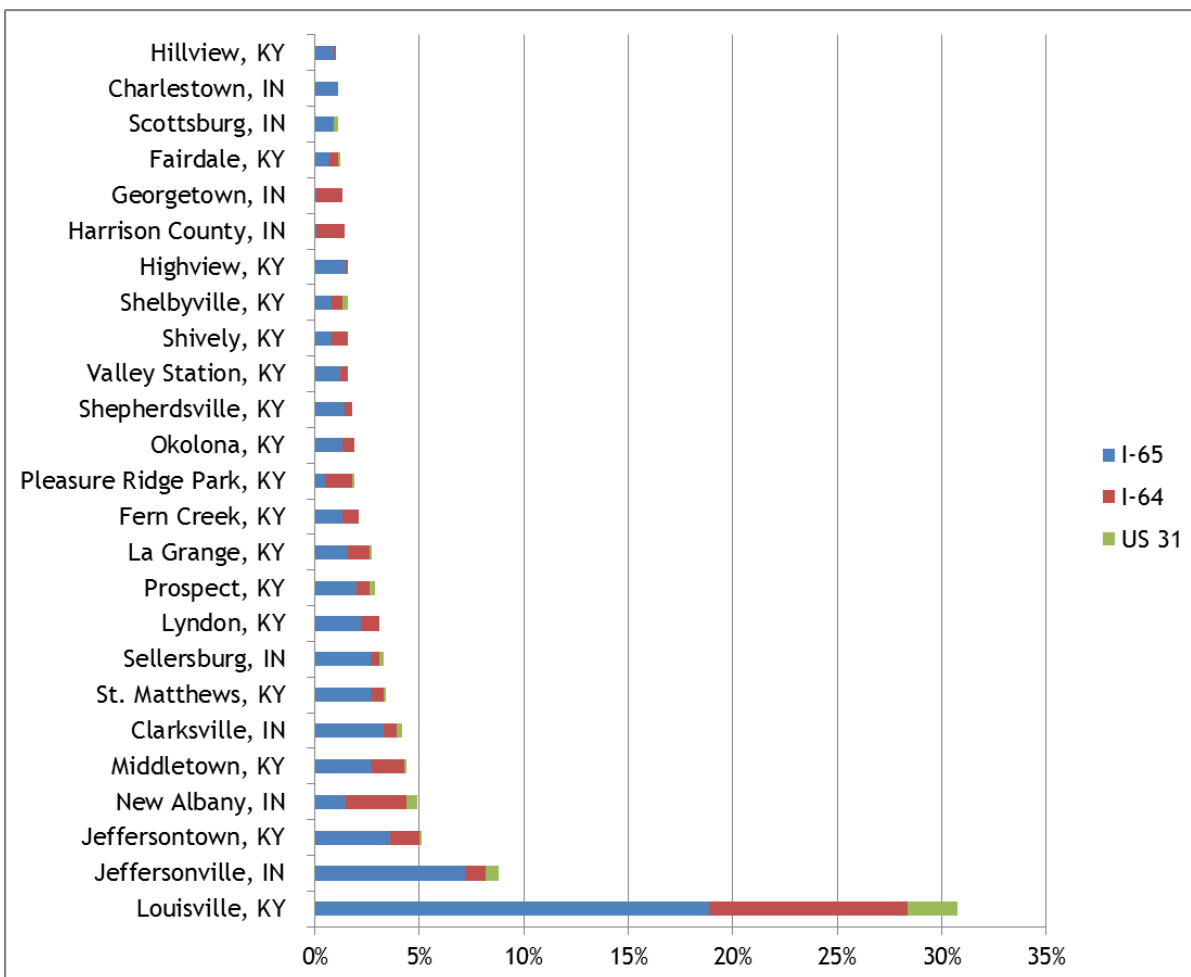


Source: Steer Davies Gleave

- 4.22 Respondents were asked to indicate the origin of their most recent trip. The following figure shows the top choices and also indicates which bridges were most popular for that segment. Places that account for less than 1% of the sample (less than 10 respondents) were not included.
- 4.23 In the sample, the top 5 areas using the I-65 Bridge are Louisville, KY, Jeffersonville, IN, Jeffersontown, KY, Clarksville, IN and Sellersburg, IN.

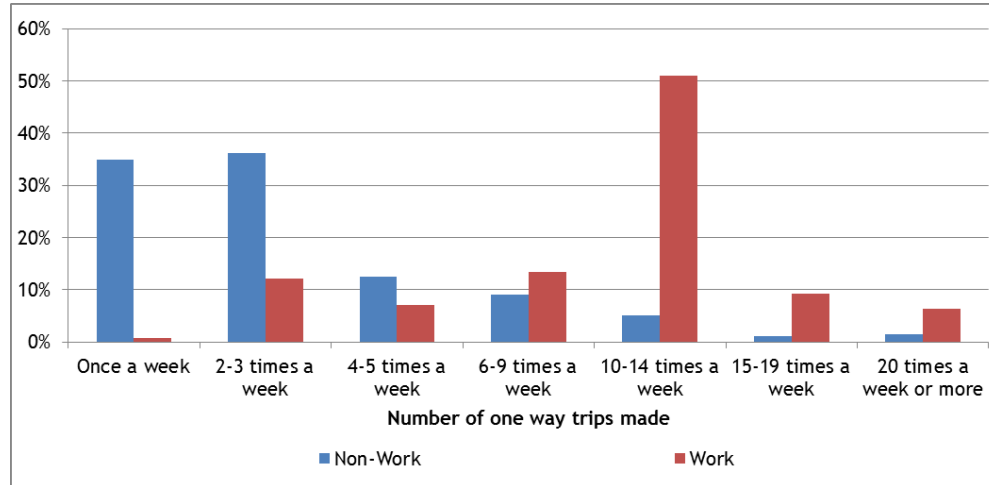
⁸ Please refer to Figure 2.6 and Figure 2.7 for an illustration of the peak period demand increases.

FIGURE 4-10 RESPONDENTS' PLACE OF ORIGIN AND BRIDGE CHOICE



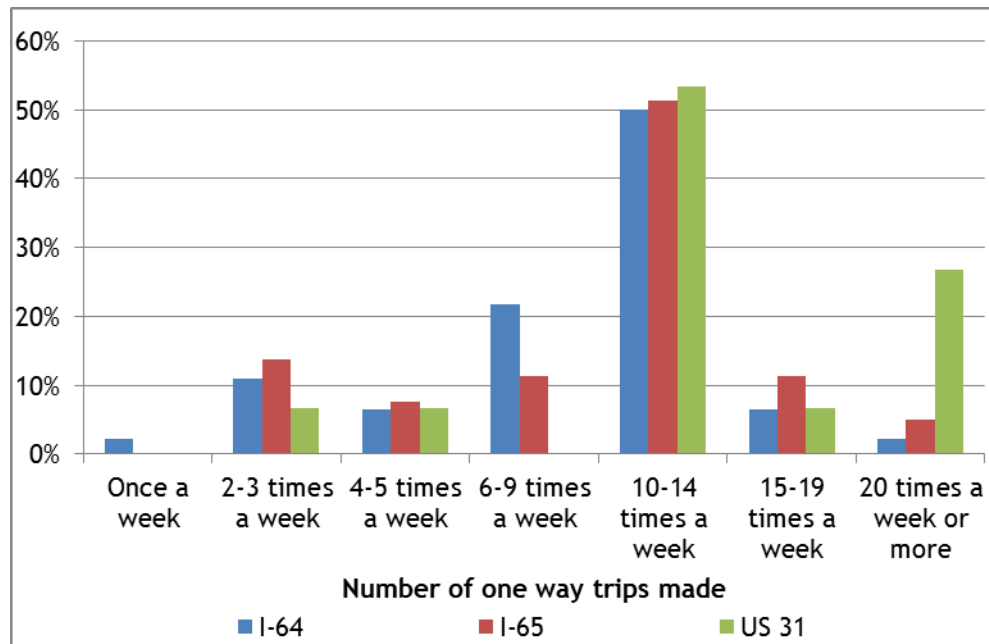
Source: Steer Davies Gleave

- 4.24 Respondents were asked how often they typically drive across the Ohio River. As can be seen from the following figure, trip frequency varies by trip purpose. Respondents who used the bridges to commute to work most often made 10-14 one-way trips per week (51%), while respondents who made non-work trips most often made 1-3 trips per week.

FIGURE 4-11 TRIP FREQUENCY

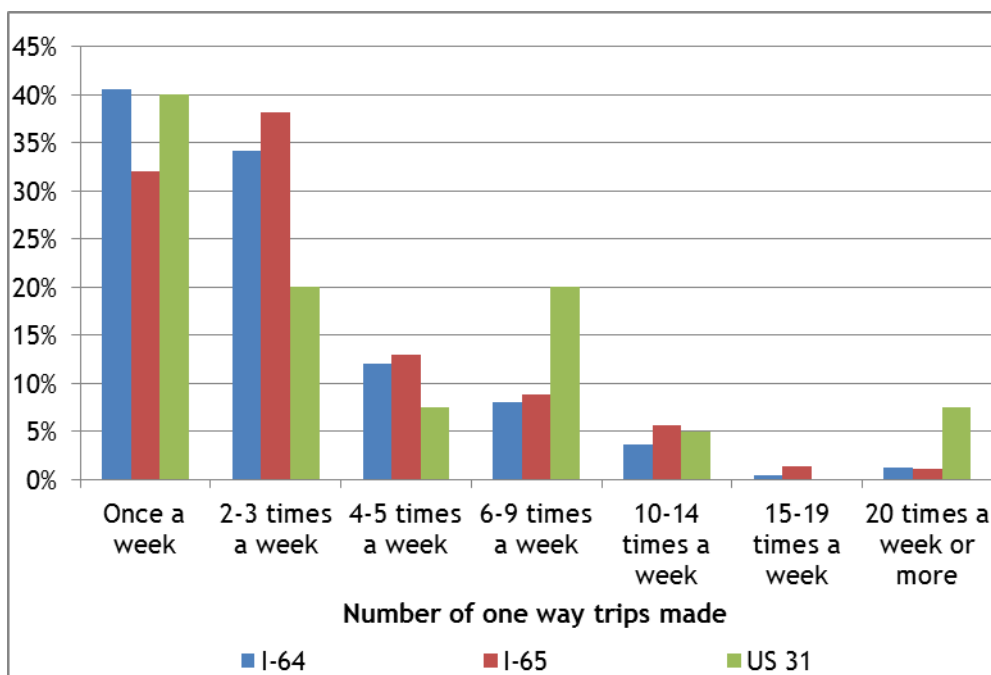
Source: Steer Davies Gleave

- 4.25 The figures below illustrates the trip frequency by bridge for work and non-work purposes. The trends were found to be consistent across all 3 bridges, i.e. I-65, I-64 and US 31.

FIGURE 4-12 TRIP FREQUENCY BY BRIDGE FOR WORK TRIPS

Source: Steer Davies Gleave

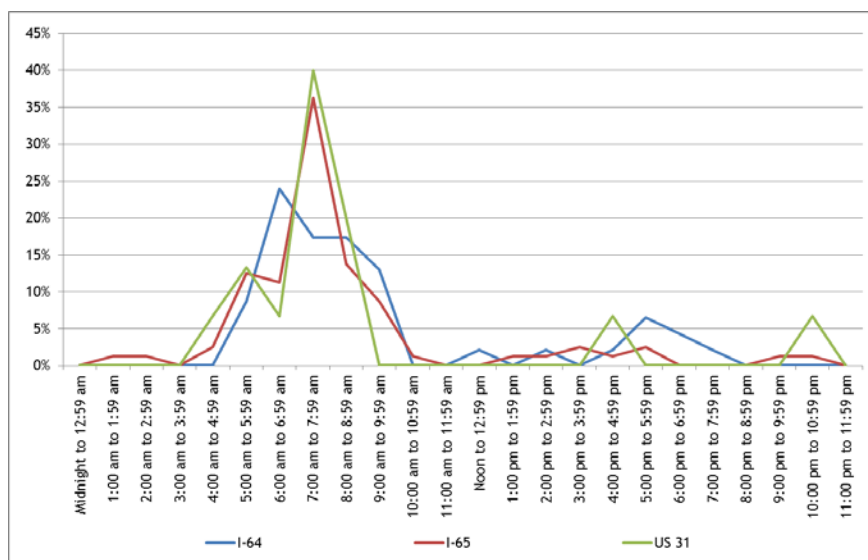
FIGURE 4-13 TRIP FREQUENCY BY BRIDGE FOR NON-WORK TRIPS



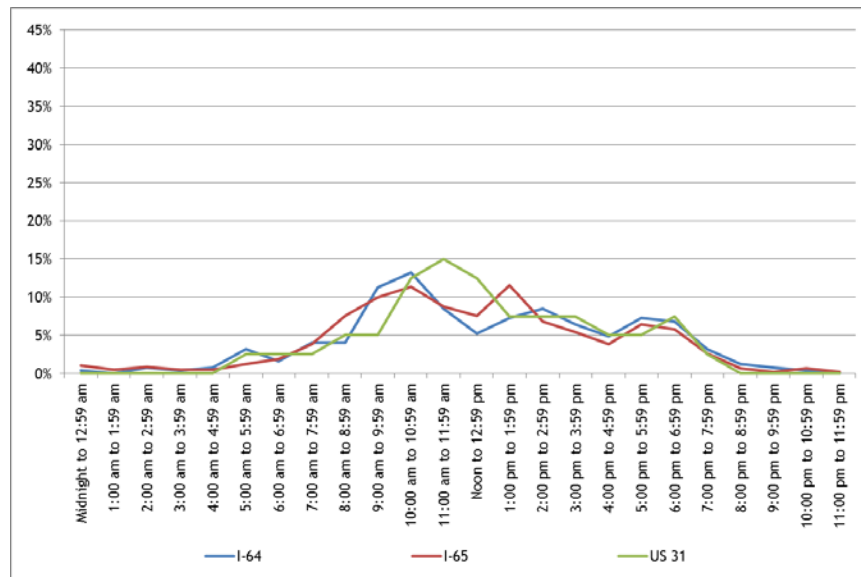
Source: Steer Davies Gleave

- 4.26 A distribution of the time of day that respondents crossed the Ohio River is provided in the figure below. While there is significant variation between work and non-work trips, the variation between bridges is minimal.

FIGURE 4-14 TIME OF DAY OF MOST RECENT WORK TRIP (BY BRIDGE)



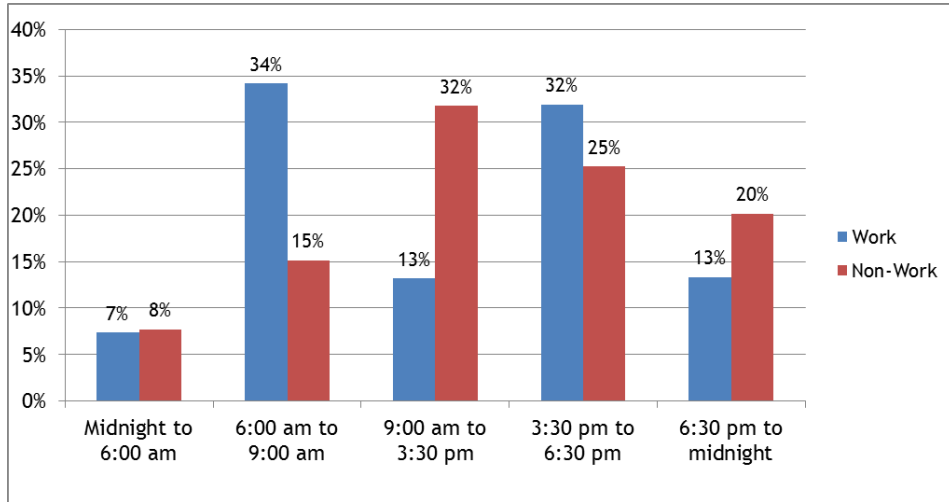
Source: Steer Davies Gleave

FIGURE 4-15 TIME OF DAY OF MOST RECENT NON-WORK TRIP (BY BRIDGE)

Source: Steer Davies Gleave

- 4.27 This time of day distribution makes intuitive sense since we see that for work trips 6:00 am to 9:00 am (morning peak period) is the most preferred start time for the trip, while for non-work trips the frequency is spread through-out the day with a slight preference for off-peak hours. Since this data only corresponds to the most recent outbound trip, it is not surprising that the evening peak is not pronounced for work trips. An analysis of all trips illustrates the existence of an evening peak for work trips as well (see Figure 4-16 below)
- 4.28 For non-work trips, a large majority (80%) of respondents indicated that they have some or complete flexibility over the time of their most recent trip, so many may have chosen the off-peak hours to avoid the primary peak periods. For work trips, only about 45% of the respondents indicated that they have some or complete flexibility over the time of their most recent trip, which corroborates with the peaking noticed for these trips.
- 4.29 Data were also collected on the frequency of trips made by respondents during different times of day in a typical week. Work trips were most frequently conducted during the morning and evening peak hours (34% and 32% respectively), while non-work trips were carried out most frequently in the off-peak hours (32% between 9:00 am and 3:30 pm).

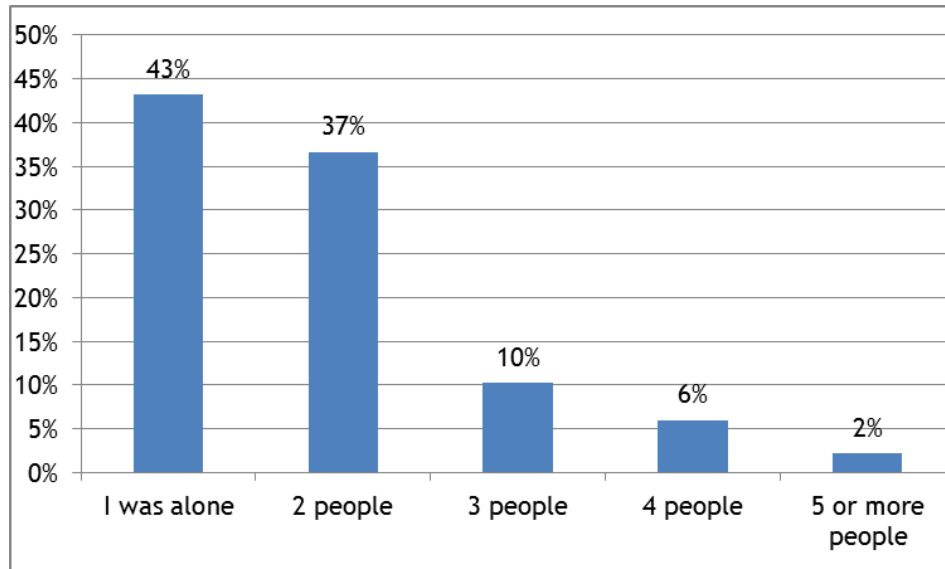
FIGURE 4-16 TRIP DISTRIBUTION BY TIME-OF-DAY



Source: Steer Davies Gleave

- 4.30 Respondents were asked how many people were in the car for their most recent trip. 43% reported that they drove alone, 37% drove with 2 people, 10% drove with 3 people, 6% drove with 4 people, and 4% drove with 5 or more people.

FIGURE 4-17 TRIP DISTRIBUTION BY VEHICLE OCCUPANCY

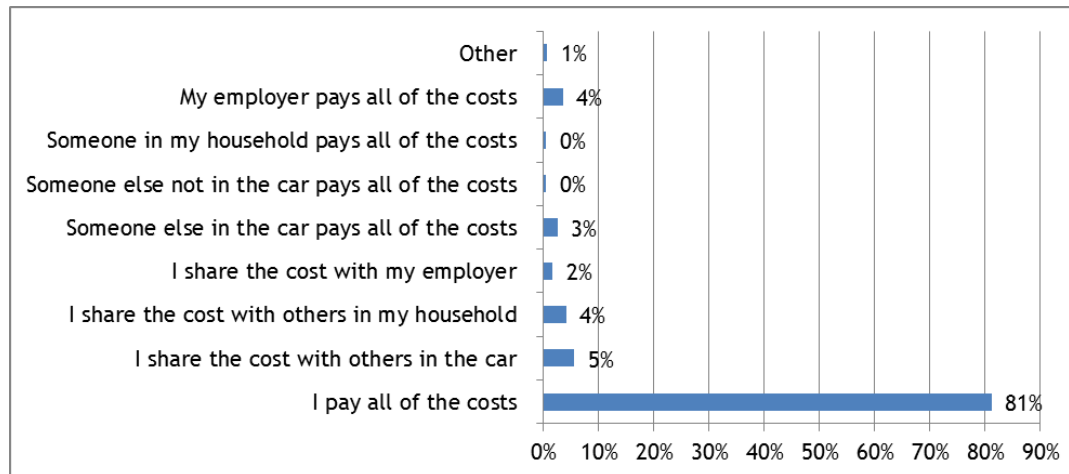


Source: Steer Davies Gleave

- 4.31 Respondents were asked to estimate their fuel related driving costs for their most recent trip. In the sample, cost estimates had a mean of \$24 and the median of \$10. In addition, it may be noted that 90% of respondents indicated that they only incurred fuel costs for their most recent trip.

- 4.32 The majority of respondents, 81%, said they paid all of the driving costs for their most recent trip. 5% of respondents indicated that they shared the cost with others in the car, while 3% indicated someone else in the car paid all the costs and less than 1% indicated that someone else not in the car paid all of the costs. 4% of respondents indicated they shared the cost with others in the household, while less than 1% indicated that someone else in the household paid all of the costs. 4% of respondents said their employer paid all of the costs, while 2% said they shared the costs with their employer. 1% of respondents indicated their driving costs do not fall in any of the above situations.

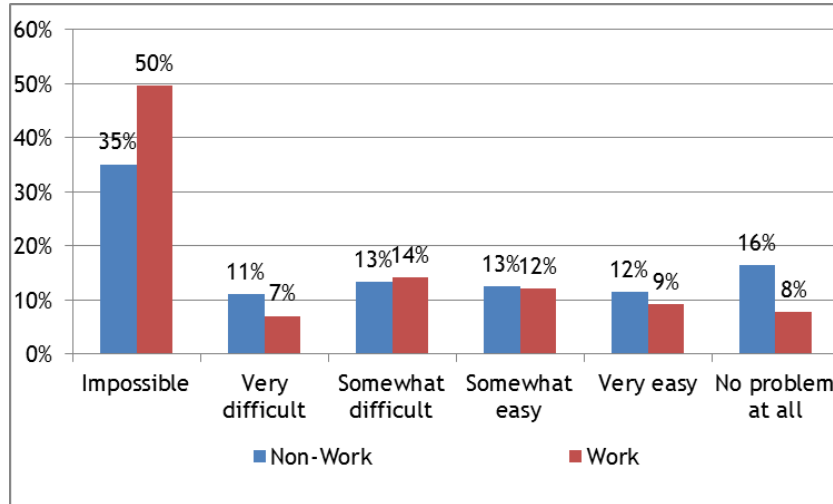
FIGURE 4-18 COST SHARING



Source: Steer Davies Gleave

- 4.33 Respondents were asked how easy or difficult it would have been to complete the activity for which they made their most recent trip somewhere else so that it would not be necessary to cross the Ohio River. For both work (71%) and non-work (59%) trips, majority of respondents indicated that it was impossible, very difficult or somewhat difficult to avoid traveling across the Ohio River to conduct their activities.

FIGURE 4-19 EASE OF AVOIDING TRAVEL ACROSS OHIO RIVER

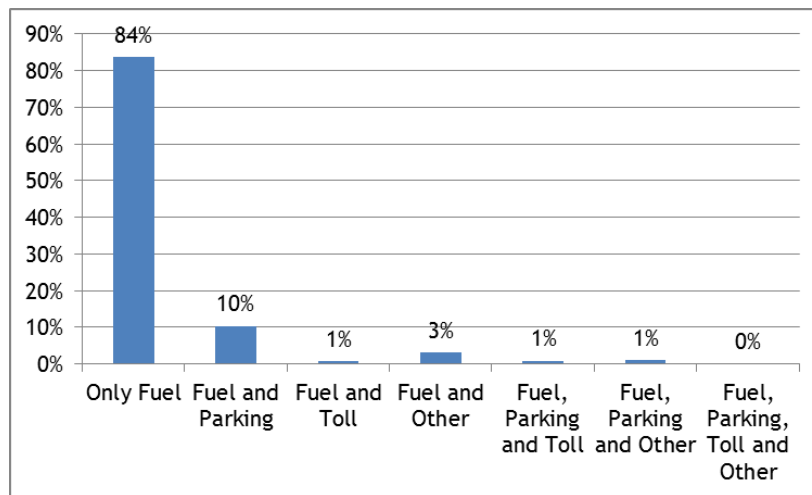


Source: Steer Davies Gleave

Attitude Toward Tolling

- 4.34 Respondents were asked to report the travel related costs they incurred in a typical month. As shown below, only about 2% of the sample paid tolls, indicating a lack of toll roads in the area, and more broadly a potential lack of familiarity with toll road benefits. It may be noted that a majority of respondents (84%) only incurred fuel costs. A smaller number of respondents also paid parking. For commuters to downtown Louisville, monthly parking costs as little as \$75 or roughly \$3.50 per workday.

FIGURE 4-20 COMPONENTS OF MONTHLY COSTS



Source: Steer Davies Gleave

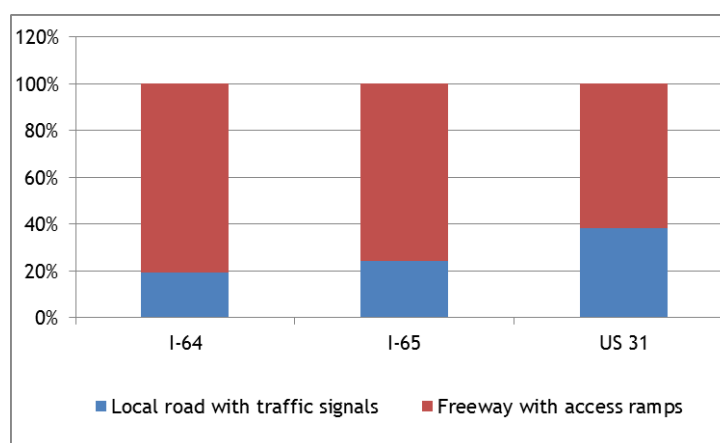
- 4.35 As there are few tolled facilities in the Louisville region, respondents' attitudes to tolling were further assessed by asking questions about their potential responses to different hypothetical policy scenarios.

4.36 To assess respondents' willingness to shift to local roads (e.g. US 31) to reduce their travel costs, respondents were asked to state, if fuel prices increased to \$4.50 per gallon, whether they would use

- i) a local road that takes more time but is shorter
- ii) a freeway that takes less time but is longer

It can be seen from the figure below that respondents who currently drive on a freeway (I-64 or I-65) are less likely to shift to a local road (US 31) in response to additional travel costs incurred, as compared to respondents who already drive on US 31.

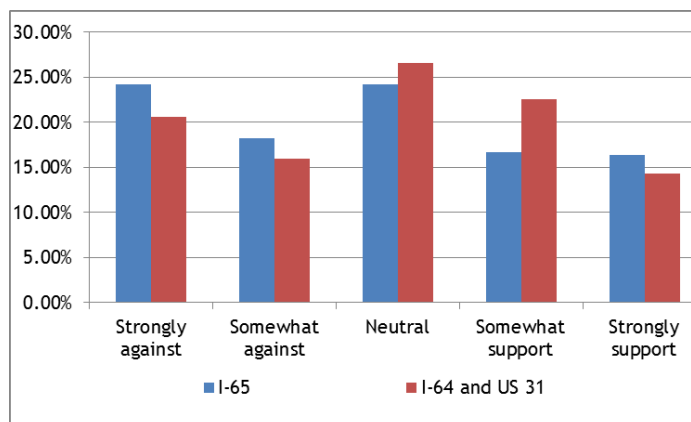
FIGURE 4-21 RESPONSE TO FUEL PRICE INCREASE



Source: Steer Davies Gleave

4.37 Reactions to the I-65 and East End bridges tolling proposal were mixed. Current users of I-65 were slightly more opposed (43%) to the new bridge than current users of I-64 and US 31 bridges (36%).

FIGURE 4-22 REACTIONS TO THE I-65 AND EAST END BRIDGES TOLLING PROPOSAL

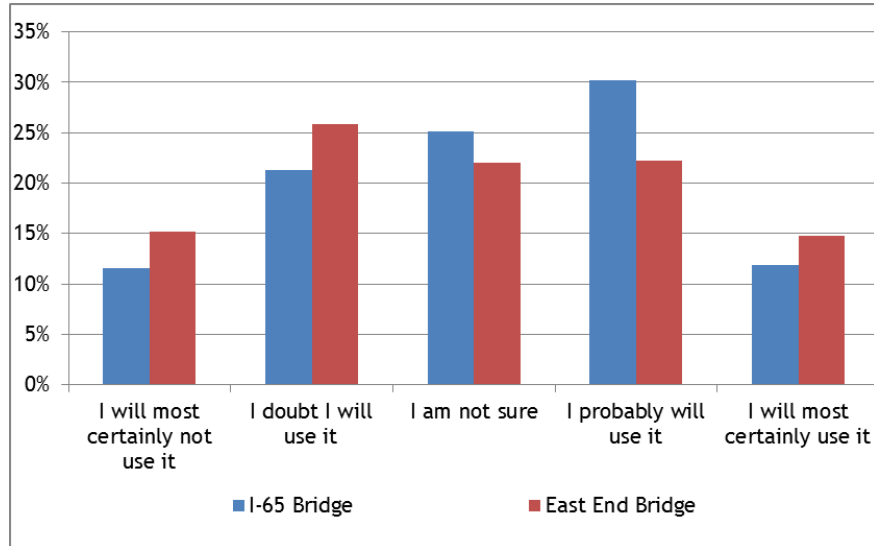


Source: Steer Davies Gleave

Final Report

- 4.38 When respondents were asked if they will personally use the new I-65 bridge under a reasonable toll and providing better traffic conditions, 42% said they would probably or most certainly use it, while 12% said they will most certainly not use it. For the East End bridge, 37% said they would probably or most certainly use it, while 15% said they will most certainly not use it.

FIGURE 4-23 USE OF NEW BRIDGE



Source: Steer Davies Gleave

When asked directly how much they would be willing to pay for the bridge they currently used, respondents said that the toll would need to be on average \$1.95 for it to be too expensive to consider using, even to have a guaranteed drive time⁹.

- 4.39 If this same analysis were done with only those respondents who indicated they are not opposed to the proposal of tolling, the average value that respondents indicate as too expensive is \$2.30.
- 4.40 When asked more in-depth questions regarding potential use of the tolled bridge, around 33% of respondents consistently indicated that they were not interested in paying a toll when comparing a tolled trip with a guaranteed travel time to a regular trip, irrespective of the potential travel time savings and pricing levels offered to them.
- 4.41 This group of respondents cited not wanting to pay, not believing that the travel time savings were worth paying for, and finding the use of toll roads or bridges inconvenient as the main reasons why they would be unlikely to use the tolled bridge in future, as can be seen in the table below.

⁹ 31 respondents (3% of total respondents) were dropped from this analysis, as they indicated values of above \$20 for them to consider it to be "too expensive".

TABLE 4.1 RATING OF REASONS WHY RESPONDENT NEVER SELECTED A TOLLED BRIDGE

Reason	Completely Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Completely Disagree
Inadequate travel time savings	84%	10%	5%	1%	1%
Unwillingness to pay	88%	8%	3%	1%	1%
Congested driving conditions acceptable	17%	33%	24%	17%	9%
Finding toll roads inconvenient	66%	18%	11%	2%	3%

Source: Steer Davies Gleave

- 4.42 The main reasons to use the new tolled bridge cited by those who indicated that they would be willing to use it were the travel time savings and the dislike of congested traffic. A breakdown can be found in the table below.

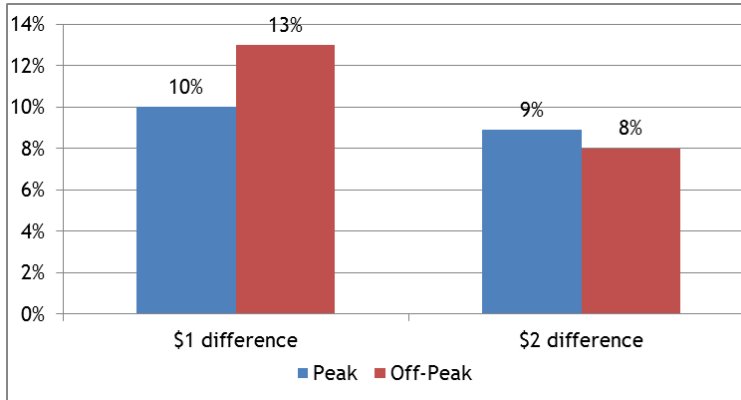
TABLE 4.2 RATING OF REASONS WHY RESPONDENT SELECTED A TOLLED BRIDGE

Reason	Completely Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Completely Disagree
Travel Time Savings	33%	47%	15%	3%	2%
Reliability	8%	19%	43%	16%	13%
Dislike of Congested Traffic	42%	40%	13%	3%	2%
Higher speeds	14%	28%	31%	16%	12%
Safer Journey	8%	16%	42%	21%	13%
More Comfortable Journey	10%	28%	36%	15%	11%

Source: Steer Davies Gleave

- 4.43 Respondents' attitudes towards alternate toll collection methods were assessed by eliciting their willingness to use video toll collection instead of transponder electronic toll collection (ETC). In the peak period, if video toll costs \$1 more per trip than transponder ETC toll, about 10% of respondents would pay using this method, while if video toll costs \$2 more per trip, about 9% of respondents would pay using video. Results are similar for respondents who made their recent trip in the off-peak periods.

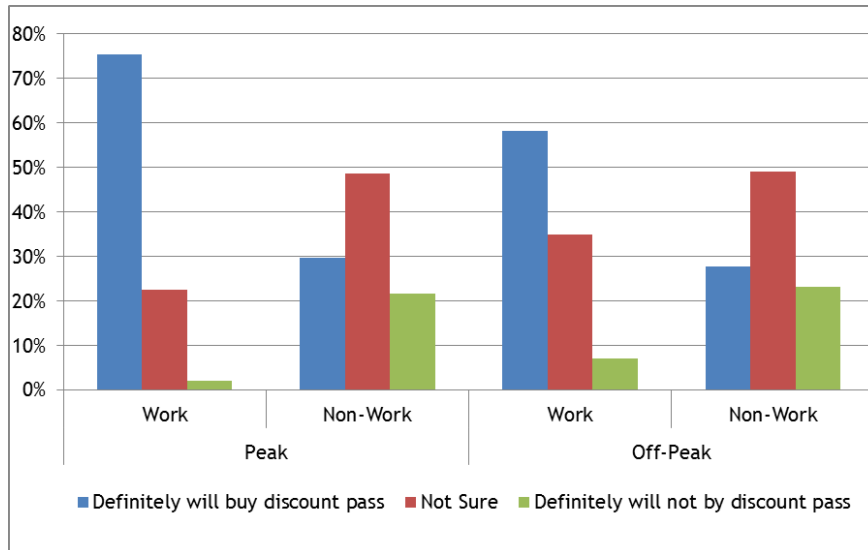
FIGURE 4-24 PREFERENCE FOR VIDEO TOLL OVER ELECTRONIC TOLL COLLECTION



Source: Steer Davies Gleave

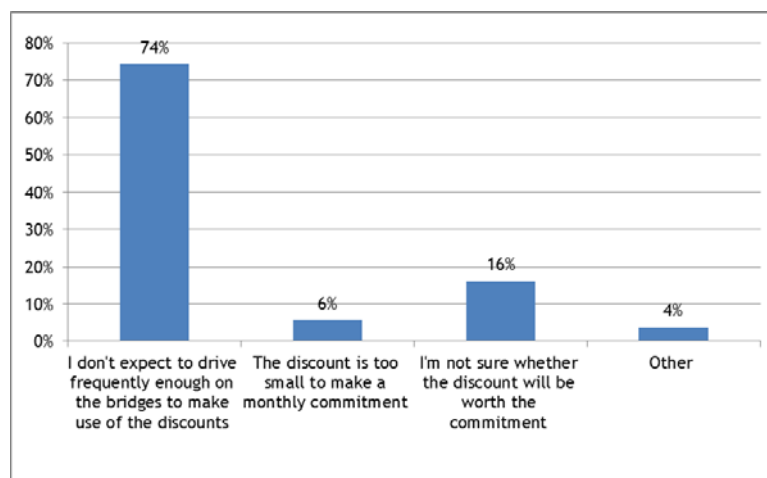
- 4.44 If a discount of \$1 per trip is offered for users who make a monthly commitment and pay in advance, 76% of respondents who made work trips in the peak periods and 58% of respondents who made work trips in the off-peak periods will use a discount program. For non-work trips, the willingness to buy a discount pass is lower, as expected.

FIGURE 4-25 WILLINGNESS TO BUY DISCOUNT PASS



Source: Steer Davies Gleave

- 4.45 74% of respondents who did not choose the discount pass indicated that they do not drive frequently enough to make use of the discount program. 16% indicated that they were unsure if a discount of \$1 per trip would be worth the commitment, while 6% felt this discount was too small to make a monthly commitment.

FIGURE 4-26 REASONS WHY NOT BUY DISCOUNT PASS

Source: Steer Davies Gleave

Analysis of Behavioral Responses

Forecasting Demand Diversion on the Tolled Bridges

- 4.46 One of the main purposes of the SP survey was to generate estimates of behavioral responses following the introduction of a toll on the new bridges.
- 4.47 To determine these responses, Steer Davies Gleave designed a stated preference exercise where respondents were offered choices between alternative routes – one route which was slower and untolled vs. a faster route with a toll. In addition to time and cost, based on their response to changes in fuel policy as stated in the survey, the type of free road was also shown and varied in the SP design. The possible free road alternatives were:
- i) Freeway with access ramps
 - ii) Route with local roads including traffic signals
- 4.48 We developed an experimental design consisting of 9 combinations of time and cost values that were based on their reported travel time. Respondents were asked to complete all of the choice scenarios.
- 4.49 The survey software was programmed to randomly select the ordering of the questions to ensure that the order of the trade-off combinations didn't bias the respondents towards one range of cost and time.
- 4.50 We estimated a diversion model based on respondents' stated route choice: using the tolled bridge vs. an alternative route.
- 4.51 The diversion model calculates the total journey cost (expressed in monetary value, with travel times converted to a monetary equivalent), taking into account different sensitivities to time and cost. It then compares the total costs for alternate routes and estimates the likely diversion of traffic to the new tolled bridges.

- 4.52 The toll bridge traffic diversion is estimated by calculating the amount of demand that would be diverted to alternate routes because of the introduction of a toll, taking into account two factors with opposing effects: the added attractiveness of reduced travel time on the bridge due to added capacity and less congestion, and the additional cost imposed by the toll.

Forecasting Route Choice

- 4.53 While the previous section presented descriptive statistics on survey respondents and their characteristics, the following section presents a quantitative analysis of the SP survey data. In particular, we describe the route choice model developed to derive the value of time distributions and the cost and various time weights used in the models.
- 4.54 Values of time are generally estimated at the market segment level using econometric models. In particular, logit-form choice models are estimated based on a set of binary choices between using the new tolled bridge and free routes.
- 4.55 The greater the generalized cost advantage of the tolled bridges compared with a competing route, the more likely it is that travelers will be attracted from that competing route to the toll road. Conversely, the greater the generalized cost disadvantage of the toll bridge, the more likely it is that traffic will be attracted to the free alternate road.
- 4.56 The multiple choice scenarios for each individual made it possible to estimate values of time (VoT) for users, as the very large number of survey responses provide numerous observations on different individuals trading off time advantages with monetary costs. The general form of the estimated logit model is as follows:

$$P_{ni} = \frac{e^{V_{ni}}}{\sum_{\forall A_j \in A(n)} e^{V_{nj}}}$$

where P_{ni} is the probability of individual n choosing alternative i from a set of alternatives $A(n)$. V_{ni} is the deterministic utility of alternative i to individual n .

- 4.57 The deterministic component of utility is expressed as the sum product (or scalar product) of a vector of parameters and a vector of variables, as follows, where β is the vector of parameters and $\mathbf{x}$ is the vector of variables:

$$V_{ni} = \beta' \mathbf{x}_{ni}$$

- 4.58 The choice modeling involved an iterative process attempting to find the most appropriate models. This process involved the estimation of separate models for each existing market segment, and the models estimated reflect the key variables

influencing the choice of toll road for a trip: the trip's out-of-pocket cost difference (toll amount only¹⁰) and travel time difference.

- 4.59 The VOTs of different market segments implied by these models varied with household income and with trip purpose in a sensible way, but segmentation using these variables was unable to fully capture the variance in the distribution of VOTs.
- 4.60 The market segment VOTs estimated using binary logit model, while internally consistent, were quite low. Implied VOTs were on average \$6.5/hr to \$8.5/hr. These values are much lower than VOT estimation based on wage rate would suggest. Further segmentations by income, trip purpose and origin-destination, while consistent, did not display expected variations.
- 4.61 Traditional segmentation of the market by income and purpose was nevertheless conducted to gain insight in these typically-defined market segments. Segmenting by trip purpose or household income produced average VOTs for sub-segments that, while not counterintuitive, showed little variation.
- 4.62 As a result, we decided that, rather than defining segments based on other variables in the data, the value of time distribution itself should be used to define segments, with different segments corresponding to different quantiles of the distribution. While binary logit estimation techniques exploiting the multiple choice scenarios for each individual made it possible to estimate market level VOTs, estimating the distribution of individual-level VOTs requires more complex econometric methods.
- 4.63 We decided to use the powerful mixed logit model to estimate the individual-level VOT distribution.
- 4.64 The ordinary logit model is a special case of the mixed logit model, the latter being much more general and flexible: among other things, it allows estimation of individual-level parameters values.

$$\text{Logit: } V_{ni} = \beta' x_{ni} \quad P_{ni} = \frac{e^{V_{ni}}}{\sum_{\forall A_j \in A(n)} e^{V_{nj}}}$$

$$\text{Mixed Logit: } V_{ni} = \beta' x_{ni} \quad P_{ni} = \int \left(\frac{e^{\beta' x_{ni}}}{\sum_j e^{\beta' x_{nj}}} \right) f(\beta) d\beta$$

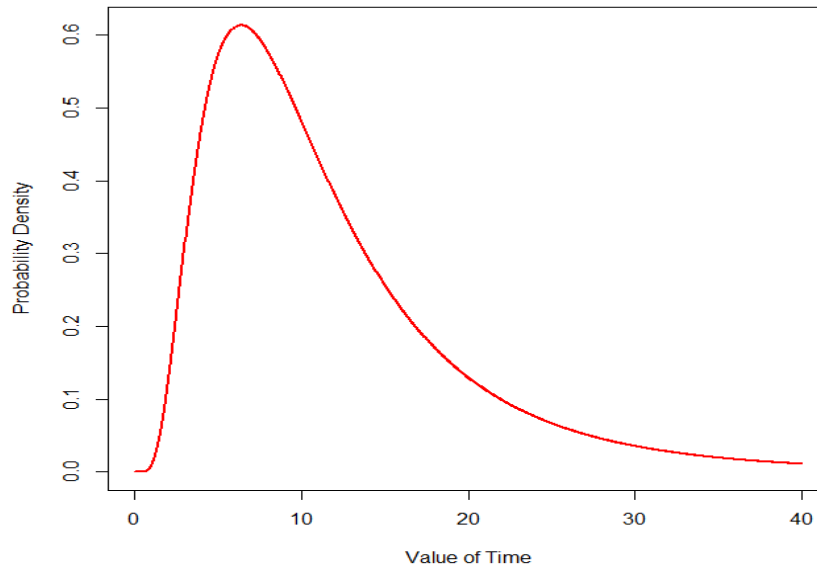
- 4.65 Unlike the ordinary logit model, the integrals involved in mixed logit models cannot be solved analytically. The integration is done by simulation. Applications where mixed logit can be useful include situations where market segments are not clearly identified or understood (which was seen while adopting traditional market segmentation

¹⁰ Auto operating cost and fuel cost were not modelled as they do not vary significantly between a toll road and an untolled alternative road of similar length, and so do not affect the choice between the two.

approaches using a logit model) and those where taste variations among users is significant (which was verified after estimating a mixed logit model).

- 4.66 Mixed logit is not necessary if only aggregate market behavior is of interest, or if the market segments are well-defined and understood. Its limited use in practice is mainly due to the difficulty of model specification, the computational cost of model estimation, and in some cases the intricacy of interfacing with other models in a forecasting system. However, once these issues are resolved, mixed logit approaches have shown that they can often lead to better behavioral models, better predictions, and better understanding of the markets.
- 4.67 The figure below shows the distribution of VOTs in the sample. The use of a mixed logit model is justified by the fact that the estimated spread of the value of time in the sample is significant. The distribution has a mean value of \$12/hr, a standard deviation of \$12.5/hr and a median of \$8.25/hr.

FIGURE 4-27 DISTRIBUTION OF VALUES OF TIME



Source: Steer Davies Gleave

- 4.68 We estimated three VOT quantiles from the mixed logit model to use in the traffic and revenue forecasting. These VOTs correspond to low, medium and high willingness to pay for travel time savings segmentation of travelers. Two approaches were used to calculate the value of time for each quantile. In the first approach, the mean value of time for each quantile was calculated by using a simulation technique. However, since the high value of time quantile can have an infinite value of time, the estimate for the third quantile is inflated. To account for this inflation, an alternate approach was developed wherein the median within each quantile was calculated. In this approach, the low, medium, and high VOTs correspond to the 16.67%, 50%, and 83.33% quantiles of the value of time distribution.

TABLE 4.3 VALUE OF TIME DISTRIBUTION AND MARKET SEGMENTS

Quantile	Value of Time	
	Mean Within Quantile	Median Within Quantile
Low: 0 % – 33 %	\$3.45	\$3.60
Medium: 33 % – 67 %	\$8.35	\$8.20
High: 67% - 100 %	\$23.90	\$18.70

Source: Steer Davies Gleave

- 4.69 The range of value of time obtained by using the mixed logit model is reasonable, if not somewhat conservative. As a rule of thumb in transport studies, it is common practice to estimate VOT as a percentage of the hourly wage. Although there has been a wide range of estimates, many published surveys have found travel time values around 50% of the wage rate (Small, 1992; Walters, 1992; Lam and Small, 2000). Applying US DOT guidance, an average wage rate in Louisville area is \$21.84/hr in 2010¹¹. Thus, based on this method, a value of time of almost \$12/hr would have been expected for this market.
- 4.70 Further, by capturing the heterogeneity in the behaviors of travelers in the Louisville area, the diversion model provides an enhanced behavioral representation of travelers' choices in this area.

Trucking Industry Outreach

- 4.71 In order to gain insight into how the trucking community is likely to respond to the introduction of tolls to some of the Ohio River crossings, we conducted interviews with six members of the trucking community who represent a cross-section of the industry. These individuals represented different lengths of haul (local routes, regional routes, and long-distance routes), for-hire carriers vs. carry own commodity, and drivers who are company employees vs. owner-operators. As might be expected, the attitudes and anticipated behavior to the tolls varied widely depending on the business model of the trucking company.
- 4.72 Below we summarize some of the key takeaways from these interviews:
- I Willingness to pay the toll will be impacted by the ability to pass the toll on to customers; this was likely to be possible for more of the short-distance companies and those that can exercise pricing power.

¹¹ US Department of Transportation, Office of the Secretary of Transportation, "The Value of Saving Travel Time: Departmental Guidance for Conducting Economic Evaluations", 1997
Household income data from
http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_11_5YR_DP03

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- | Owner-operators are more likely to avoid tolls than company drivers who are often prescribed a route from a dispatcher.
- | Dispatchers, and the software programs they utilize, will consider tolls as one of the factors in the vehicle operating cost that are used to determine routings
- | Vehicle operating costs can vary widely from owner-operator (\$0.80 - \$1.20 / mile range quoted) compared to companies that employ drivers (operating costs of up to \$1.75 were quoted).
- | Time savings of the magnitude of this project hold much greater value to short-distance (ie, delivery) companies compared to long-distance drivers.

5 Forecasting Methodology

Overview

- 5.1 This chapter describes the methodology Steer Davies Gleave used to develop the traffic and revenue forecasts. This approach is depicted in Figure 5.1 and uses many inputs from the Time-of-Day (TOD) model that was developed by CDM Smith to support the NEPA analysis. The TOD model is a classic four-step model that operates at daily level with a breakdown of the demand into 8 time periods for purposes of the traffic and transit assignments. The model network covers the counties of Floyd and Clark in Indiana and Oldham, Jefferson and Bullitt in Kentucky. The model was calibrated for a base year of 2007.
- 5.2 Using the TOD model along with data collection elements described in the prior chapters, Steer Davies Gleave developed a custom toll forecasting model (SDG model) in Cube/Voyager and calibrated it for a base year of 2012. The key elements of the SDG model can be summarized as:
- I A choice model mechanism was incorporated as part of the assignment procedure to better reflect route choice algorithms. The choice model is applied at a detailed level of trip desegregation including vehicle type, willingness to pay tolls, and toll payment method.
 - I A new time period of 6-7 pm was added to create a total of nine time periods. 6-7 pm was previously considered as part of the night period.
 - I The existing network was updated to reflect the 2012 traffic conditions. This not only included updating the network to reflect the new infrastructure built since 2007 but also a detailed revision of the network attributes such as road capacities, speed limits and speed-flow-curves parameters.
 - I New traffic counts and travel time measures were used to validate the assignment results across the network for each of the nine time periods, and in particular for each of the existing Bridges, providing a robust platform for the forecasts.
 - I Socioeconomic forecasts for the model area were developed by an independent economic consultant, and a growth model was built to validate the river crossing traffic growth included in the demand matrices.
 - I Forecast years of 2016, 2018, 2023 and 2030 were prepared.
- 5.3 Figure 5.1 details the forecasting framework of the SDG model, with four basic components. In the *Base Year* component, the base year trip tables and networks from the TOD model are used as inputs along with traffic counts and travel times to adjust the trip tables to a 2012 base year level, and the model's traffic volumes, travel times, and trip patterns are validated against observed conditions. In the *Network Improvements* component, the future networks are set to reflect the planned projects included in the RTP and the Project improvements, including toll rates. In the *Traffic Growth* component, the base year trip tables are grown to future year levels through a

combination of the cross-river growth model and running the independent socioeconomic forecasts through the TOD model. Finally, in the *Future Year Model* component, the traffic and revenue forecasts are prepared by assigning the future trips to the future networks using an assignment procedure including route choice.

- 5.4 The remainder of this chapter explains in detail the development of the SDG model, the calibration/validation results, and the assumptions and parameters of the model.

Base Year Demand

- 5.5 As depicted in Figure 5.1 above, we used a matrix estimation process to establish the base year trip levels. This matrix estimation used processed 2007 trip tables from the TOD model as the seed matrices along with traffic counts, including vehicle classification data, as the targets. Below, we describe the process we used to prepare the seed matrix.

Demand Matrices

- 5.6 As part its forecasting mechanism, the TOD model creates Origin-Destination (OD) vehicle trip tables for each of the time periods. For each time period trip table, there are 35 trip segments based on combinations of the following attributes:

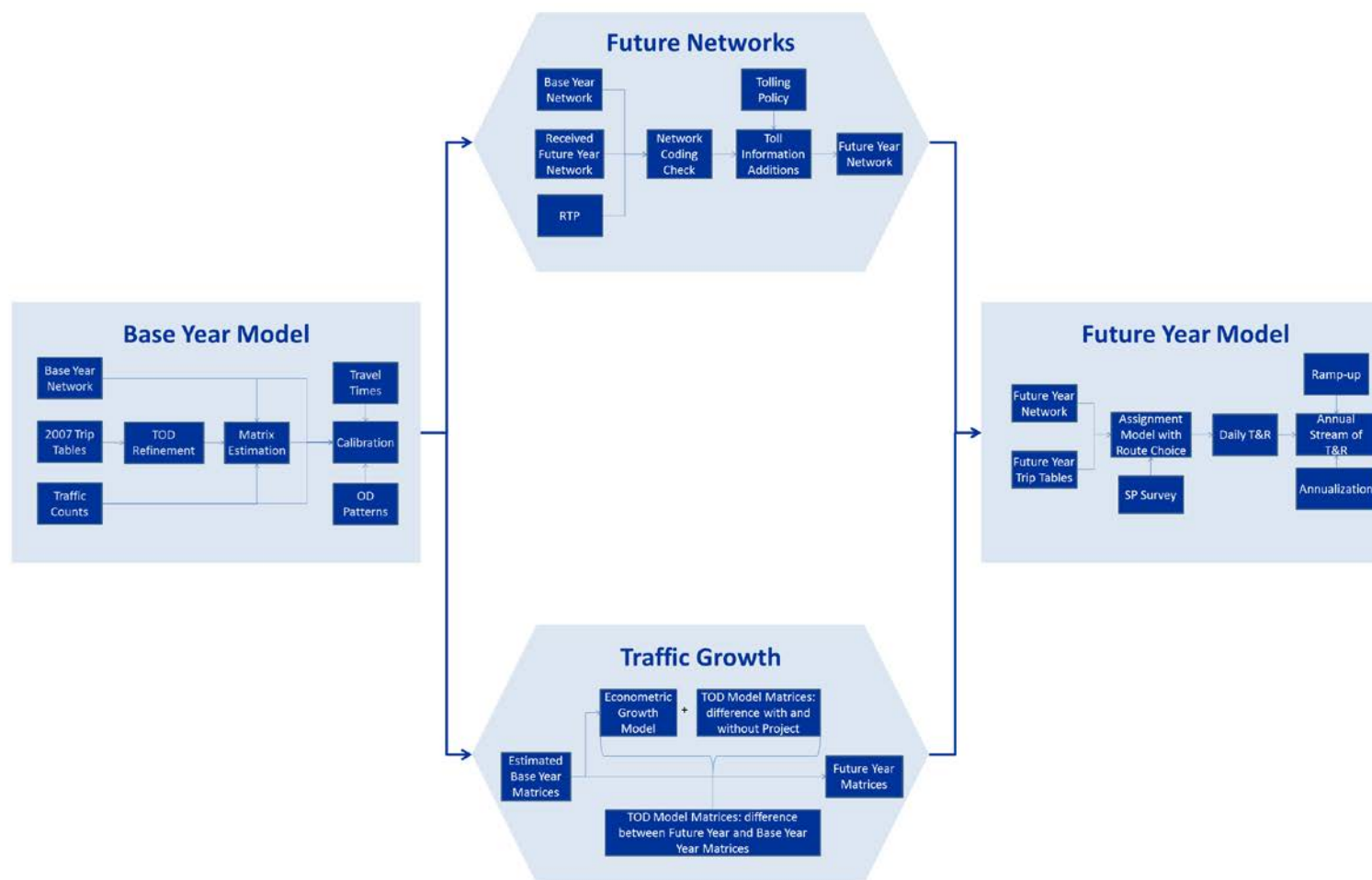
- | 2 Vehicle types (Autos and Trucks)
- | 4 Journey purposes (Home Based Work, Home Based Other, Non-Home Based and External)
- | 3 car availability groups (No car, 1 car and 1+ cars)
- | 3 income groups (Low, Med and High)

- 5.7 For preparation of the seed matrices, we grouped the matrices into auto and truck vehicle types. We further split the TOD model truck matrices into medium and heavy trucks with proportions of 35% and 65% were used for medium and heavy trucks respectively based upon the average split observed in our traffic count data.

- 5.8 During the matrix estimation assignment purposes vehicles were converted into Passenger Car Units (PCUs) using the following factors:

- | Autos: 1
- | Medium Trucks: 1.5
- | Heavy Trucks: 2.5

FIGURE 5.1 MODELING APPROACH



Time Periods

5.9 For the matrix estimation process, seed matrices are needed for each of the model's time periods. The TOD model disaggregates the daily trip matrices into eight time periods, with three AM periods, a Midday (MD) period, three PM periods and the Nighttime (NT) period which runs from 6pm to 6am. After analyzing the observed traffic profiles of the Bridges we decided to split the NT period to create a new PM period representing 6-7 pm. We created the 6-7 pm period by allocating 28% of the previously defined NT period trips.

5.10 The final time periods used in the SDG model are:

- | AM1 – 1hr (06:00 – 07:00)
- | AM2 – 1hr (07:00 – 08:00)
- | AM3 – 1hr (08:00 – 09:00)
- | MD – 6hr (09:00 – 15:00)
- | PM1 – 1hr (15:00 – 16:00)
- | PM2 – 1hr (16:00 – 17:00)
- | PM3 – 1hr (17:00 – 18:00)
- | PM4 – 1hr (18:00 – 19:00)
- | NT – 11hr (19:00 – 06:00)

Base Year Network / Network Attributes

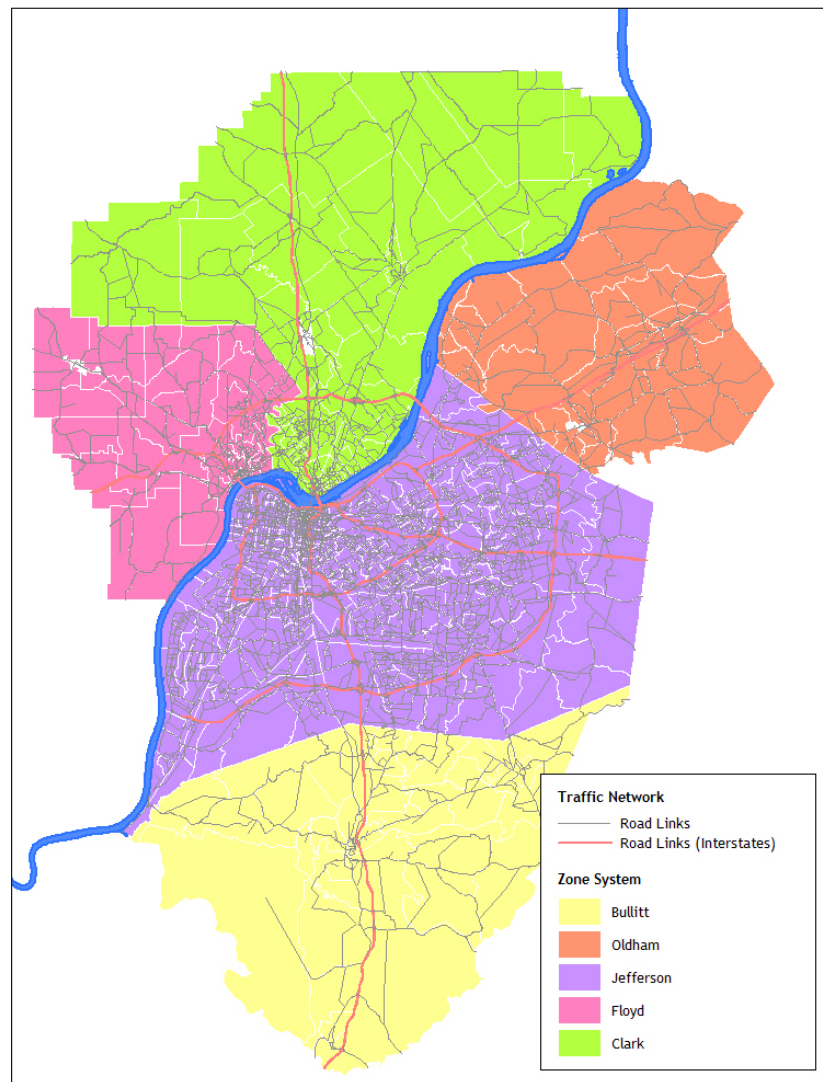
Zone System

5.11 The SDG model adopted the existing zone system of the TOD model which has a total of 855 zones, covering the counties of Clark and Floyd in Indiana, and Bullitt, Jefferson, and Oldham, Jefferson and Bullitt. Table 5.1 lists the numbers of zones by county and Figure 5.2 displays the traffic network and zone system.

TABLE 5.1 ZONES BY COUNTY

ID	County Name	Number of Zones
1	Floyd	74
2	Clark	90
3	Jefferson	537
4	Oldham	42
5	Bullitt	58
6	External	54
Total		855

FIGURE 5.2 TRAFFIC NETWORK AND ZONE SYSTEM



Road Network

- 5.12 SDG also adopted the existing traffic network for its traffic model. The existing TOD model network included attributes such as road type, road capacity and free-flow speeds. These link attributes were originally imported by CDM Smith from the KIPDA MPO daily model and adjusted to represent hourly conditions. This is particularly important in the case of the capacity; the other attributes are the same across the day.

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5.13 To maintain consistency, CDM Smith decided to compute the hourly capacities using a 10% k-factor¹² for all the links and area types. That is, daily capacities are multiplied by 0.1 to calculate hourly capacities. We reviewed the capacities in parallel with the network calibration and made slight modifications as needed:

- | Freeway capacity increased from 1500 to 2200 PCUs/hr/lane
- | US31 capacity increased from 600 to 1000 PCUs/hr/lane

5.14 Table 5.2 summarizes the road capacities adopted in the SDG model.

5.15 For the development of mid-day and night capacities, CDM Smith determined that instead of multiplying the hourly capacity by the number of hours of the period, it was more appropriate to estimate a factor based on the ratio of the period total traffic to the peak hour traffic within that period. We used the same factor for the MD and, as we changed the definition of the NT period, we re-estimated the factor for this period.

¹² In traffic engineering, k-factors are used to convert from daily to hourly

TABLE 5.2 NETWORK ATTRIBUTES

Facility Type	Road type	Description	Capacity per lane (PCU/hr)
11	Freeways		2200
13	Low Capacity Freeway	Bridges and I64 between the Bridges	1600
21	Divided Arterial 1	Signal density < 0.5 signals/mile and a speed limit of 55 m/hr	850
22	Divided Arterial 2	Signal density < 0.5 signals/mile and a speed limit of 45 m/hr	850
23	Divided Arterial 3	Signal density >= 0.5 signals/mile and < 2.5 signals/mile	750
24	Divided Arterial 4	Signal density >= 2.5 signals/mile and <= 4.5 signals/mile	750
25	Divided Arterial 5	Signal density > 4.5 signals/mile	650
31	Undivided Arterial 1	Undivided Arterial with turning bays	600
35	Undivided Arterial 2	Undivided Arterial without turning bays	500
41	Undivided Arterial 3	Divided Collectors and Local Roads	550
45	Undivided Arterial 4	Undivided Collectors and Local Roads	450
49	Undivided Arterial 5	Side streets used for bus routes	250
61	One Way 1	One-Way Street with a signal density < 0.5 signals/mile	700
62	One Way 2	Signal density >= 0.5 signals/mile and < 2.5 signals/mile	700
63	One Way 3	Signal density >= 2.5 signals/mile and <= 4.5 signals/mile	500
64	One Way 4	Signal density > 4.5 signals/mile	500
65	Frontage Road 1	Signal density < 0.5 signals/mile	700
66	Frontage Road 2	Signal density >= 0.5 signals/mile and < 2.5 signals/mile	700
67	Frontage Road 3	Signal density >= 2.5 signals/mile and <= 4.5 signals/mile	500
68	Frontage Road 4	Signal density > 4.5 signals/mile	500
71	Ramp High Speed 1	High Speed (Generally straight)	1400
72	Ramp Low Speed 1	Low Speed (Noticeably curved)	1300
73	Ramp High Speed 2	High Speed (Generally straight)	1400
74	Ramp Low Speed 2	Low Speed (Noticeably curved)	1300

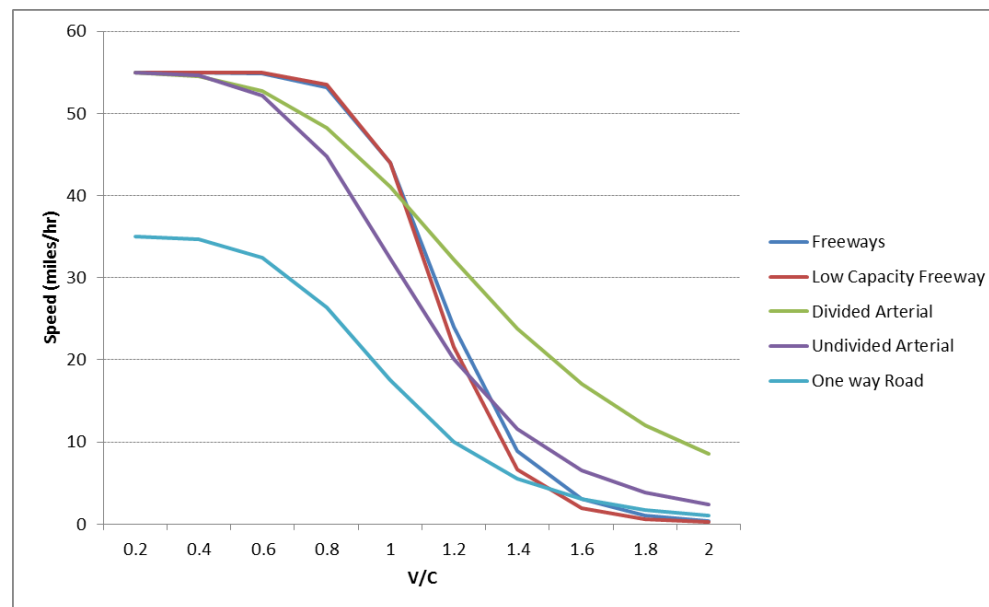
Speed Flow Curves

- 5.16 Travel times are estimated based on the volume/capacity ratio on each link of the network. For this we have used a traditional BPR¹³ formulation with alpha and beta parameters.
- 5.17 We reviewed the parameters included in the TOD model and kept them all for our model except the alpha parameter for the low capacity freeway links. For this class,

¹³ The BPR function was developed by the Bureau of Public Roads as an equation to estimate how travel times increased as a function of increasing traffic volume

we have increased the parameter from 0.1 to 0.25, making it consistent with the regular freeway links at low speeds. The Figure 5.3 displays the curves adopted for the SDG model.

FIGURE 5.3 SPEED FLOW CURVES



Model Validation

- 5.18 A key objective of our modeling approach is for the model to accurately reflect the actual traffic of each bridge crossing and major roadways throughout the network. Accordingly, we present detailed traffic validation information for the bridge crossings for the AM peak in Table 5.3, the PM peak in Table 5.4, and daily in Table 5.5, along with validation of the major roadways in Table 5.6, Table 5.7, and Table 5.8 for the AM peak, PM peak, and daily, respectively. In these tables for both the forecasted and observed traffic, the AM peak represents the average of the three AM periods, while the PM peak represents the average of the four PM periods.
- 5.19 These tables provide the volume calibration in terms of the GEH statistic, which is a common measure calculated to determine how well forecasted traffic matches observed traffic. The GEH statistic is calculated as:

$$GEH = \sqrt{\frac{(Volume_{Modeled} - Volume_{Observed})^2}{(Volume_{Modeled} + Volume_{Observed}) * 0.5}}$$

- 5.20 GEH values less than 5 indicate a good fit of observed levels, while GEH values greater than 10 indicate that more attention is needed on a specific location of the model. The results in the following tables indicate that the model's traffic forecasts do a good job of matching observed levels.

TABLE 5.3 AM BRIDGE CROSSING TRAFFIC VALIDATION (VEHICLES / HOUR)

Bridge	Direction	Observed Traffic Counts	Assigned Model Flow	% Diff	GEH
Cars					
I65	NB	2,680	2,688	0%	0.2
	SB	3,640	3,688	1%	0.8
U31	NB	290	289	0%	0.0
	SB	1,580	1,452	-8%	3.3
I64	NB	1,251	1,262	1%	0.3
	SB	3,742	3,792	1%	0.8
Total Trucks (Med + Heavy)					
I65	NB	426	468	10%	2.0
	SB	453	492	9%	1.8
I64	NB	190	214	12%	1.7
	SB	211	240	14%	1.9
Total					
I65	NB	3,106	3,157	2%	0.9
	SB	4,093	4,180	2%	1.4
U31	NB	293	289	-1%	0.2
	SB	1,596	1,452	-9%	3.7
I64	NB	1,441	1,475	2%	0.9
	SB	3,953	4,031	2%	1.2
Two-Way Total					
I65		7,199	7,337	2%	1.6
US31		1,890	1,742	-8%	3.5
I64		5,394	5,507	2%	1.5
All Bridges		14,482	14,585	1%	0.9

TABLE 5.4 PM BRIDGE CROSSING TRAFFIC VALIDATION (VEHICLES / HOUR)

Bridge	Direction	Observed Traffic Counts	Assigned Model Flow	% Diff	GEH
Cars					
I65	NB	4,500	4,594	2%	1.4
	SB	2,907	2,905	0%	0.0
U31	NB	1,281	1,201	-6%	2.3
	SB	680	691	2%	0.4
I64	NB	3,570	3,539	-1%	0.5
	SB	1,990	1,994	0%	0.1
Total Trucks (Med + Heavy)					
I65	NB	516	523	1%	0.3
	SB	441	497	13%	2.6
I64	NB	199	220	11%	1.4
	SB	221	227	3%	0.4
Total					
I65	NB	5,016	5,117	2%	1.4
	SB	3,348	3,401	2%	0.9
U31	NB	1,287	1,201	-7%	2.4
	SB	683	691	1%	0.3
I64	NB	3,769	3,760	0%	0.2
	SB	2,211	2,220	0%	0.2
Two-Way Total					
I65		8,364	8,519	2%	1.7
US31		1,970	1,892	-4%	1.8
I64		5,981	5,980	0%	0.0
All Bridges		16,315	16,391	0%	0.6

TABLE 5.5 DAILY BRIDGE CROSSING TRAFFIC VALIDATION

Bridge	Direction	Observed Traffic Counts	Assigned Model Flow	% Diff	GEH
Cars					
I65	NB	52,565	53,073	1%	0.5
	SB	49,047	48,624	-1%	0.4
U31	NB	11,027	10,667	-3%	0.7
	SB	12,859	12,665	-2%	0.4
I64	NB	34,137	34,090	0%	0.1
	SB	35,699	36,022	1%	0.3
Total Trucks (Med + Heavy)					
I65	NB	10,364	10,543	2%	0.4
	SB	9,998	10,496	5%	1.0
I64	NB	4,169	4,337	4%	0.5
	SB	4,155	4,325	4%	0.5
Total					
I65	NB	62,929	63,616	1%	0.6
	SB	59,046	59,120	0%	0.1
U31	NB	11,119	10,667	-4%	0.9
	SB	13,024	12,665	-3%	0.6
I64	NB	38,306	38,427	0%	0.1
	SB	39,853	40,347	1%	0.5
Two-Way Total					
I65		121,975	122,735	1%	0.4
US31		24,143	23,333	-3%	1.1
I64		78,159	78,773	1%	0.4
All Bridges		224,277	224,841	0%	0.2

TABLE 5.6 AM MAJOR ROADWAY TRAFFIC VALIDATION

GEH Summary	<5	<10	<15
Cars			
Number of Locations (Cumulative)	52	54	54
Number of Locations (Individual)	52	2	0
% Cumulative	96%	100%	100%
% Individual	96%	4%	0%
Tot Trucks (Med + Heavy)			
Number of Locations (Cumulative)	52	54	54
Number of Locations (Individual)	52	2	0
% Cumulative	96%	100%	100%
% Individual	96%	4%	0%
Total			
Number of Locations (Cumulative)	52	54	54
Number of Locations (Individual)	52	2	0
% Cumulative	96%	100%	100%
% Individual	96%	4%	0%

TABLE 5.7 PM MAJOR ROADWAY TRAFFIC VALIDATION

GEH Summary	<5	<10	<15
Cars			
Number of Locations (Cumulative)	52	54	54
Number of Locations (Individual)	52	2	0
% Cumulative	96%	100%	100%
% Individual	96%	4%	0%
Tot Trucks (Med + Heavy)			
Number of Locations (Cumulative)	54	54	54
Number of Locations (Individual)	54	0	0
% Cumulative	100%	100%	100%
% Individual	100%	0%	0%
Total			
Number of Locations (Cumulative)	52	54	54
Number of Locations (Individual)	52	2	0
% Cumulative	96%	100%	100%
% Individual	96%	4%	0%

TABLE 5.8 DAILY MAJOR ROADWAY TRAFFIC VALIDATION

GEH Summary	<5	<10	<15
Cars			
Number of Locations (Cumulative)	54	54	54
Number of Locations (Individual)	54	0	0
% Cumulative	100%	100%	100%
% Individual	100%	0%	0%
Tot Trucks (Med + Heavy)			
Number of Locations (Cumulative)	54	54	54
Number of Locations (Individual)	54	0	0
% Cumulative	100%	100%	100%
% Individual	100%	0%	0%
Total			
Number of Locations (Cumulative)	54	54	54
Number of Locations (Individual)	54	0	0
% Cumulative	100%	100%	100%
% Individual	100%	0%	0%

Travel Times

- 5.21 In addition to validating traffic volumes, we sought to validate the model's prediction of travel times. Accurate representation of travel times is an important element of models used to evaluate time-cost trade-offs of potential toll facility users. Below we present figures that plot the model's predicted travel times for the AM and PM peaks against the observed travel times. In these plots, the x-axis is labeled with a segment number that corresponds to those mapped in Figure 5.4. Specifically, Figure 5.5, Figure 5.6, and Figure 5.7 display the travel time validation for Route 1, Route 2, and Route 3, respectively. In these figures for both the forecasted and observed travel times, the AM peak represents the average of the three AM periods, while the PM peak represents the average of the four PM periods.

- 5.22 With minor exceptions, the model does a very good job of replicating observed travel times. Route 1's modeled travel times almost exactly match the observed travel times during the PM peak, and are a bit slower than observed in the AM Peak. Route 2's modeled travel times are very similar to observed travel times for both peak periods. For Route 3, the modeled travel time is a little faster than observed for the AM peak in the eastbound direction, but slower than observed for the AM peak in the westbound direction and for both directions in the PM peak. A closer inspection reveals that the slower modeled times occur at the eastern segment of the route.

FIGURE 5.4 TRAVEL TIME SEGMENTS

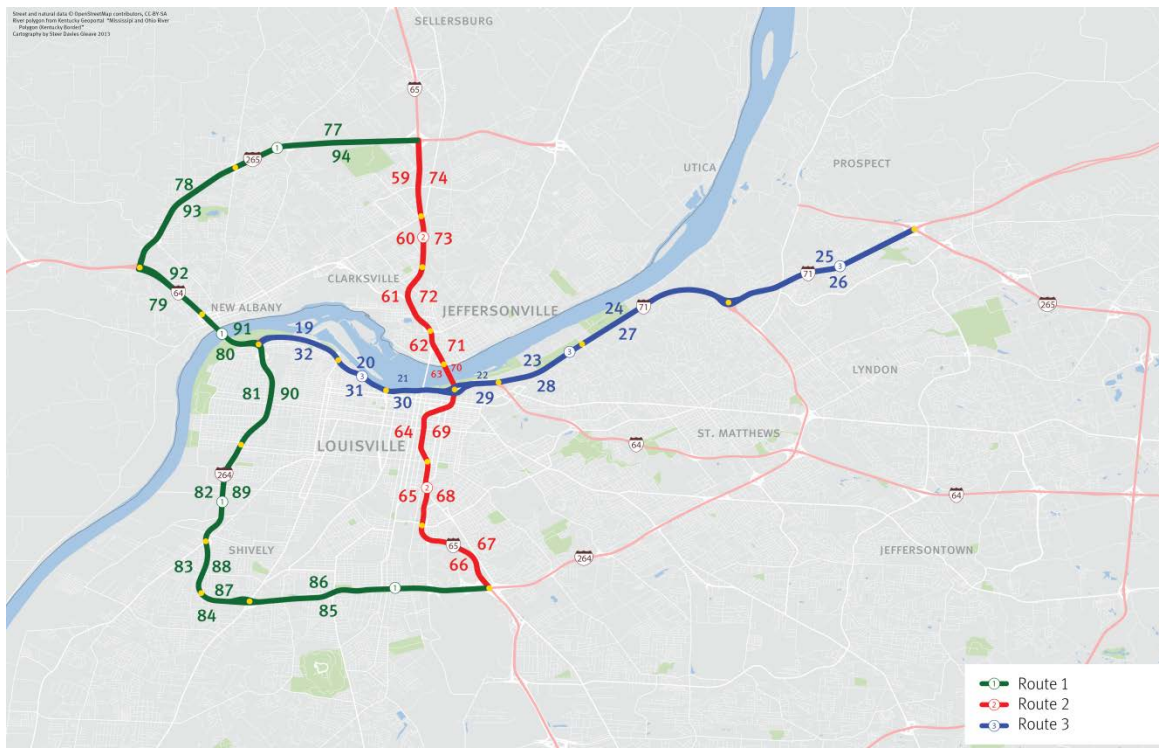


FIGURE 5.5 ROUTE 1 PEAK PERIOD TRAVEL TIME VALIDATION

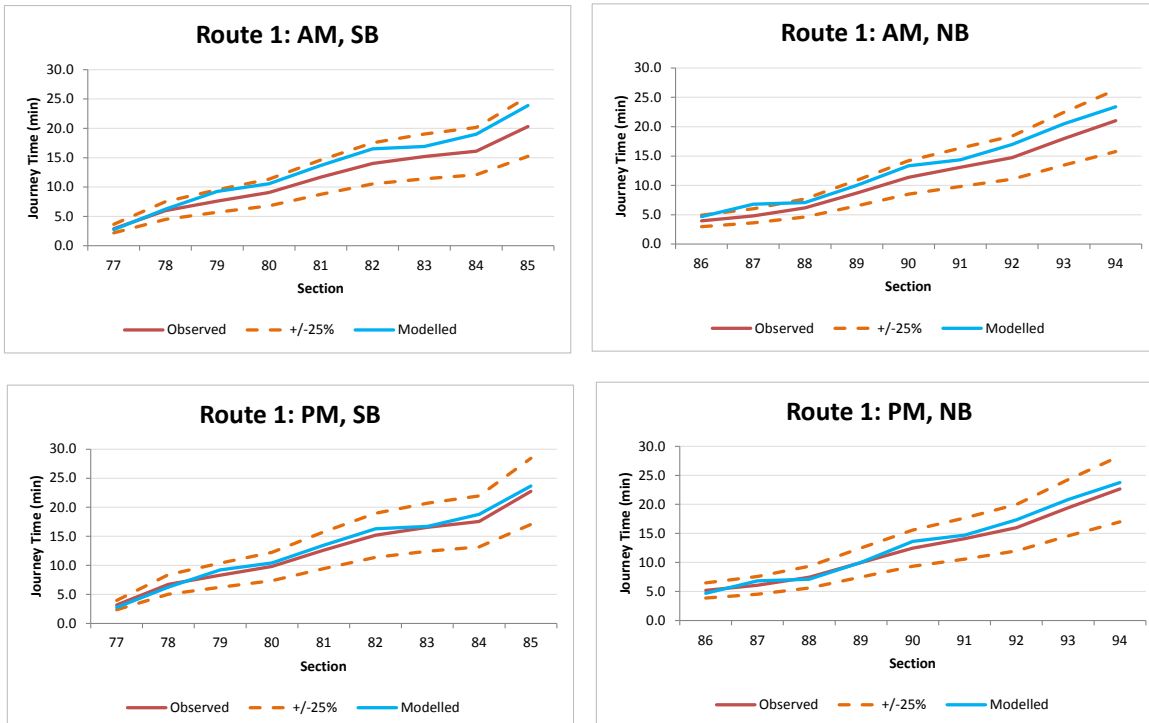


FIGURE 5.6 ROUTE 2 PEAK PERIOD TRAVEL TIME VALIDATION

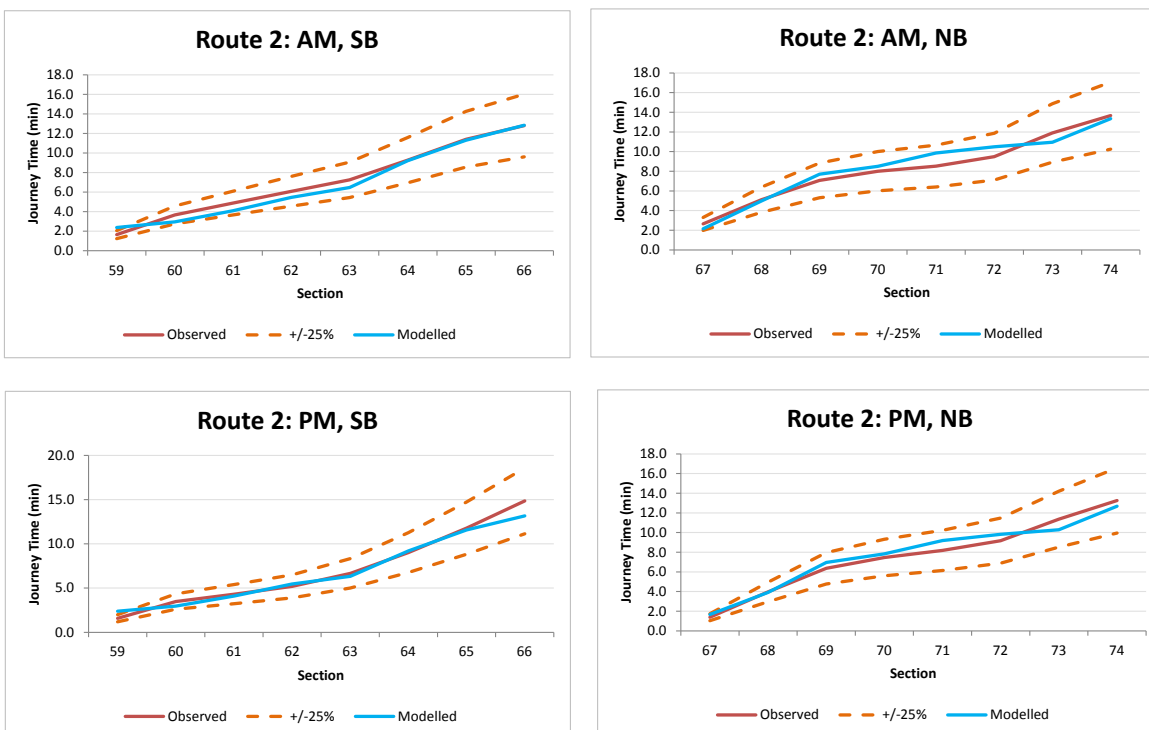
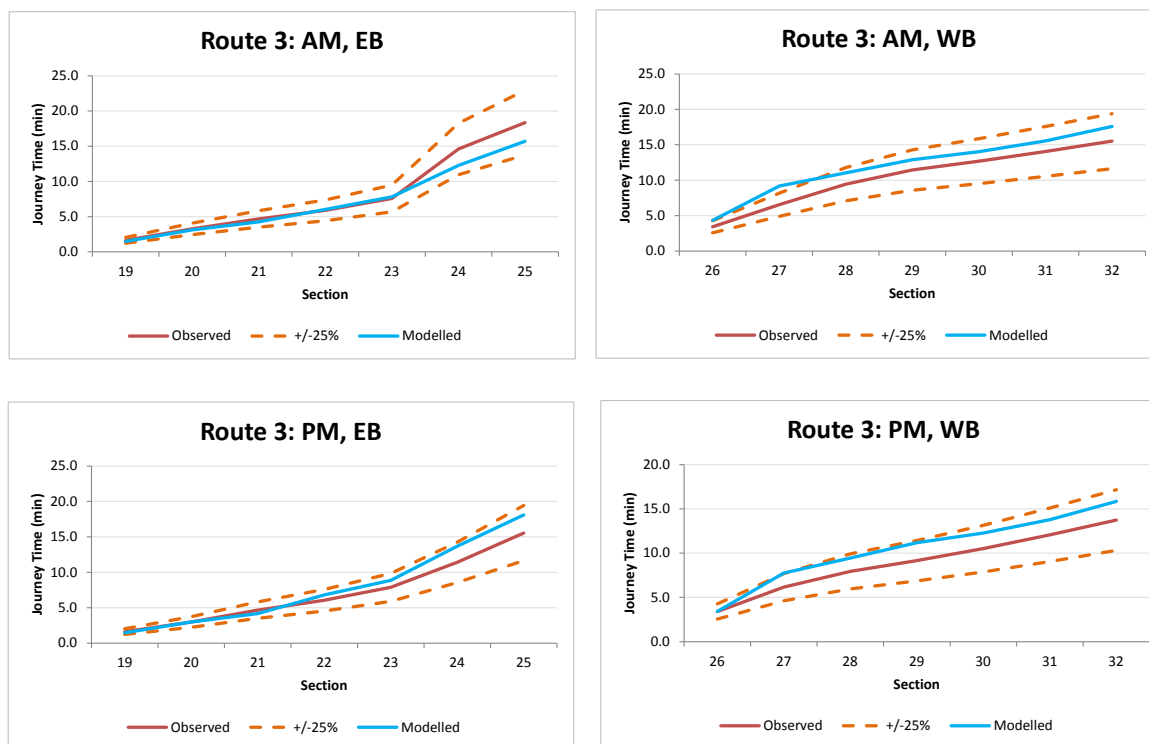


FIGURE 5.7 ROUTE 3 PEAK PERIOD TRAVEL TIME VALIDATION

Future Year Network

- 5.23 The future year networks include the projects contained in the Kentuckiana Regional Planning & Development Agency (KIPDA)'s Regional Transportation Plan (RTP) prepared as the Louisville (KY-IN) Metropolitan Planning Organization. Table 5.9 presents the list of these projects and the model year that they are included. Further details on the projects are available in the Transportation Improvement Program and the Horizon 2030: Metropolitan Transportation Plan.

TABLE 5.9 FUTURE YEAR HIGHWAY NETWORK IMPROVEMENTS

KIPDA ID	Project Name	Description	Network Year
2	Grantline Road	Improve/construct approximately 5,000 feet of street on Grantline Road; Improve existing section with lane widening, curb/gutter and sidewalks	2018
128	KY 1931 Greenwood Road	Widen from 2 to 3 lanes	2018
147	KY 393	Relocate and widen KY 393 from 2 to 3 lanes	2018
154	KY 1450	Widen KY 1450 from 2 to 3 lanes	2018
179	I-265 Gene Snyder Freeway	Reconstruct I-265 interchange at I-64	2018
188	English Station Road	Widen English Station Road from 2 to 3 lanes	2018
200	KY 61	Widen KY 61 from 2 to 4 lanes	2018
222	Cooper Chapel Road Phase I	Phase I: Reconstruct Cooper Chapel Road from 2 to 3 lanes	2018
229	KY 1450	Widen KY 1450 from 2 to 5 lanes	2018
230	US 42	Construct 2 way center turn lane on US 42	2018

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KIPDA ID	Project Name	Description	Network Year
233	KY 1819	Reconstruct and widen KY 1819 from 2 to 3 lanes	2018
268	Cedar Creek Road Connector	Extend as a 2 lane road from south and west of Johnson School Road to KY 864	2018
289	Grade Lane	Widen from 2 to 4 lanes	2018
306	Star Hill Road	Construct Star Hill Road as a new 2 lane road	2018
350	I-64	Widen from 4 to 6 lanes	2018
359	KY 1747 Hurstbourne Parkway	Add 3rd travel lane southbound	2018
381	Buechel Bank Road	Add center turn lane on Buechel Bank Road	2018
390	I-64	New interchange and connector road with interchange on I-64	2018
395	I-65	Reconfigure northbound and southbound ramps on I-65 and add a lane	2018
400	I-264	Add 1 lane in each direction on I-264 from KY 1447 (Westport Road) to I-71.	2018
442	LaGrange Overpass	Construct LaGrange overpass over I-71 from Business Park Road to New Moody Lane	2018
469	KY 155	Widen from 4 to 6 lanes	2018
476	US 42	Widen from 5 to 7 lanes	2018
484	KY 1447	Widen from 2 to 5 lanes	2018
493	KY 44	Reconstruct and add center turn lane (2 to 3 lanes)	2018
514	Veterans Parkway Phase 2	Widen from 2 to 4 lanes...	2018
540	Ohio River Greenway	Construct 2 lane road and bicycle and pedestrian path	2018
575	Brown Station Way	Widen from 4 to 6 lanes	2018
952	I-71	New interchange and connector road with interchange on I-71 near Jefferson/Oldham County border	2018
953	US 60	Widen from 2 to 3 lanes	2018
998	IN 111	Widen from 2 to 3 lanes and widen from 2 to 5 lanes. Includes 1 bridge, signals and signs	2018
1192	Broadway & 18th Street	Align intersection of Broadway and 18th Street	2018
1252	KY 53 LaGrange-Ballardsville Road	Widen from 2 to 3 lanes by adding a center turn lane	2018
1267	Philips Lane	Widen from 2 to 4 lanes	2018
1271	US 42	Widen from 2 to 3 lanes	2018
1344	I-265 Lee Hamilton Highway	I-265 interchange modification at State Street	2018
1345	I-265	I-265 interchange modification at IN 111	2018
1346	I-265	I-265 interchange modification at Charlestown Road	2018
1433	Ebenezer Church Road	Railroad grade crossing improvement	2018
1476	I-64	Improve I-64 interchange	2018
1478	I-71	Addition of auxiliary lanes near the Kentucky Interchange	2018
1487	KY 146	Widen KY 146 from 2 to 3 lanes	2018
1488	KY 22	Widen from 2 to 3 lanes and widen from 2 to 5 lanes	2018
1489	KY 22	Widen from 2 to 3 lanes and widen from 2 to 5 lanes	2018
1490	KY 480	Widen KY 480 from 3 to 5 lanes	2018
1491	KY 44	Widen from 2 to 5 lanes	2018
1542	US 31E	Phase 1: Realign and widen US 31E from 2 to 5 lanes	2018
1556	Market Street/Spring Street	Upgrade and designate Market Street and Spring Street as two-way streets	2018
1801	Crittenden Drive	Relocate Crittenden Drive at the Louisville Regional Airport Authority	2018

KIPDA ID	Project Name	Description	Network Year
1803	I-64	Construction of I-64 WB auxiliary lane...	2018
1804	I-64/KY 1747 Interchange	Reconstruct existing interchange; additional SB lane for Hurstbourne Parkway; Widen and align ramps	2018
1808	Buckner Connector	Construct new connection from Old LaGrange Road to KY 393	2018
1817	KY 1020 National Turnpike	Widen from 2 to 3 lanes	2018
1823	KY 2053/KY 864	Design and construct phase 1 of a new North/South Park Road	2018
1824	KY 2055 Mount Holly Road	Widen from 2 to 3 lanes	2018
1827	US 42	Modification of US 42 between Ewing and Lindsay Avenues	2018
1482 / 1483	I-265	Improve I-265/KY 61 interchange	2018
1583 / 1584	Watterson Trail Phase II	Widen Watterson Trail from 2 to 3 lanes	2018
1809 / 1810	One-Way Street Conversion to Two-Way Phase 1 & 2	Conversion of one-way streets in downtown Louisville to two-way traffic	2018
407 / 958 / 959	I-265	Widen from 4 to 6 lanes	2018
435 / 436	KY 1065	Widen from 2 to 5 lanes	2018
479 / 480	US 60	Add 1 travel lane in each direction on US 60 from KY 1747 to I-265	2018
181	I-64/KY 1747 Interchange (Hurstbourne Parkway Interchange)	Reconstruct existing interchange including construct ramp 7 "flyover" and re-time signals along KY 1747	2030
198	Old Henry Road - Crestwood Bypass	Construct new 4 lane route from Old Henry Road interchange at I-265 (Gene Snyder Freeway) to KY 22	2030
223	Cooper Chapel Road Phase 3	Extend and construct 2 lane roadway with a continuous center-turn lane	2030
279	Enterprise Drive	Extend as a 4 lane road from KY 1020 to KY 1631	2030
301	10th Street	Widen from 4 to 7 lanes	2030
386	KY 1747	Widen from 4 to 6 lanes	2030
392	I-65 / KY 61 Interchange	Construct new interchange	2030
412	KY 22	Widen from 2 to 5 lanes	2030
414	KY 22	Widen from 2 to 5 lanes	2030
428	KY 146	Widen from 2 to 4 lanes	2030
446	KY 1931 Manslick Road	Widen from 2 to 4 lanes	2030
498	Broadway	Extend as a 2 lane road from Potters Lane to Charlestown Road	2030
586	US 150	Addition of continuous left turn lane	2030
955	I-64	Add 1 travel lane in each direction between I-264 and KY 1747	2030
1338	River Road Extension	Extend River Road west from 7th Street to Northwestern Parkway	2030
1342	I-65	Added travel lanes (from 4 lanes to 6)	2030
1396	KY 2053 Mount Washington Road	Widen from 2 to 3 lanes	2030
429 / 443	KY 146	Widen from 2 to 4	2030
465 / 481	KY 907 Southside Drive	Widen from 2 to 5 lanes	2030

Future Year Demand

- 5.24 We prepared future year trip tables for each time period by applying three elements of growth:

- | Non-River crossing background traffic
- | Standard river crossing traffic
- | Induced river crossing traffic

5.25 Below, we describe the approach we used to apply the growth for each of these elements.

Non-River Crossing Background Traffic Growth

- 5.26 While trips that do not cross the Ohio River are not in-scope to use one of the toll bridges, they do provide background traffic that may contribute to congestion on study area roads.
- 5.27 In order to determine the amount of non-crossing trip growth, we ran the TOD model using the socioeconomic forecasts prepared by EDR Group as inputs for a 2011 base year and future years of 2018 and 2030. For ODs that do not cross the river and for each 2018 and 2030 time period of the SDG model, we calculated the background traffic as:

$$\text{SDG } 2018_{\text{OD}} = \text{SDG Base Year}_{\text{OD}} + (\text{TOD } 2018_{\text{OD}} - \text{TOD } 2011_{\text{OD}})$$

$$\text{SDG } 2030_{\text{OD}} = \text{SDG } 2018_{\text{OD}} + (\text{TOD } 2030_{\text{OD}} - \text{TOD } 2018_{\text{OD}})$$

Standard River Crossing Traffic Growth

- 5.28 In the future, additional trips that cross the Ohio River will be attributable to 1) the normal employment and economic activity that have been observed to produce the historical river crossing traffic, and 2) trips that are induced by the new development that is stimulated by the East End Crossing. This section describes our approach for determining the first type of river crossing growth.
- 5.29 In Chapter 3, we described the econometric model that we estimated that describes the relationship between key socioeconomic variables and cross river traffic. This model estimated the growth by peak and off-peak periods. To determine the future levels of standard river crossing traffic, we used the econometric model to identify the total amount of incremental standard crossing trips, and we then used the TOD model future trip tables to specify the distribution of this growth by OD.

River Crossing Traffic Growth Induced by New Development

- 5.30 The second type of river crossing growth is from trips that are induced by the new development around the East End Crossing. In order to understand the effect of the East End Crossing on development and ultimately creation of trips, we ran a version of socioeconomic data that EDR Group forecast to occur if only the Downtown Crossing project occurred.
- 5.31 By calculating the difference in the river crossing ODs in the trip tables from the TOD model run with the socioeconomic forecasts that were forecasts with and without the East End Crossing, we were able to isolate those river crossing trips that would be attributable to the new development.

- 5.32 These incremental river crossing trips were then added to the standard river crossing trips forecast by the econometric model.

Collection Method Traffic Shares

- 5.33 After the future year trips were established by vehicle class, we further split trips based on their toll collection method. There will be four categories of toll collection for autos: 1) discount program requiring a transponder, 2) transponder, 3) pre-registered video toll collection, and 4) other video toll collection. As time goes on, more vehicles will be equipped with toll transponders, and accordingly we have increased the share of trips in the transponder category in the later years. Table 5.10 presents the share of trips that we assumed by collection method and by model year. To define the likely share of trips that would be enrolled in the discount program, we considered the travel survey results presented in Figure 4-25 which showed a strong desire of work travelers to enroll in a discount program. We based the video toll collection market shares on both the survey results, Figure 4-24 which showed a small percentage of travelers with a preference for video toll collection, along with the experience of two recently opened Open Road Tolling facilities: Washington State SR 520 which has seen an opening year video toll collection share of 28%¹⁴ and Maryland's ICC which has seen an opening year video toll collection share of 14%.¹⁵

TABLE 5.10 TOLL COLLECTION SHARE OF TRIPS

Collection Type	2018	2023	2030
Transponder ¹⁶	65%	73%	80%
Preregistered Video	5%	4%	3%
Other Video	30%	23%	17%
Transponder (Trucks)	65%	73%	80%
Preregistered Video (Trucks)	5%	4%	3%
Other Video (Trucks)	30%	23%	17%

Route Choice Model

- 5.34 We implemented an assignment routine that was applied for each time period. Within the highway assignment, we embedded a route choice model to represent travelers' choices to use a toll facility or not. During each assignment iteration and for each

¹⁴ As described in http://www.wsdot.wa.gov/NR/rdonlyres/983207DE-3CC4-48F9-804A-BD0FE56F048B/89271/SR520_OneYear_FactSheet_122113.pdf

¹⁵ As reported at <http://www.tollroadsnews.com/node/6380>

¹⁶ Transponder category includes those trips in the frequent use discount program, assumed to represent 50-60% of transponder trips, depending on the year.

origin-destination (OD) pair, the route choice model predicts how many travelers will choose to use the tolled and the un-tolled routes. It then assigns those trips onto the network, ensuring that only those trips that selected the tolled route can use the tolled bridges. The route choice model took the form of a binary logit model that included travel time, operating cost and toll cost in its utility function. For the initial iteration of the highway assignment, free flow travel times were used, while for all subsequent highway assignment iterations the prior iteration's travel times were used. The logit model and utility function equations are presented below.

$$P_{Toll} = \frac{e^{V_{Toll}}}{e^{V_{Toll}} + e^{V_{Non-Toll}}}$$

where :

P_{Toll} = probability of choosing a toll crossing

β_{Toll} = utility of choosing a toll crossing

$\beta_{Non-Toll}$ = utility of choosing a non - toll crossing

$$\beta_i = Toll_i + TT_i \cdot VOT + D_i \cdot VOC$$

where :

β_i = utility of choosing route i

$Toll_i$ = toll charged on route i (zero if no toll)

TT_i = travel time of route i (in minutes)

VOT = value of time (in dollars per minute)

D_i = distance of route i (in miles)

VOC = vehicle operating cost (in dollars per mile)

- 5.35 The route choice model requires estimates of vehicle operating costs (VOC) and values of time (VOT) for each travel segment.

Vehicle Operating Costs

- 5.36 For autos, we set the VOC at \$0.16 / mile based upon AAA 2012's Your Driving Costs¹⁷ value for gas, maintenance, and tires. For medium trucks and heavy trucks we used VOCs of \$0.80 and \$1.00 / mile, respectively. The truck values come from a combination of trucking industry interviews, which suggested a cost range from \$0.80 to \$1.75, and the fuel, maintenance, and tires costs published in ATRI's 2012 Cost of Trucking¹⁸ which suggests a cost of \$0.78 / mile.

¹⁷ Available at <http://newsroom.aaa.com/wp-content/uploads/2012/04/YourDrivingCosts2012.pdf>

¹⁸ American Transportation Research Institute, "An Analysis of the Operational Costs of Trucking: A 2012 Update"

Values of Time

- 5.37 Chapter 4 describes our analysis of the stated preference survey. In this analysis we established three segments of travelers for each vehicle class, with a segment with the highest willingness to pay tolls to save travel times, a segment in the middle, and a segment with the lowest willingness to pay tolls. Each of these segments represent one-third of travelers. Table 5.11 presents these VOTs used in the route choice model, with the overall median value of \$8.20 serving as the VOT of the medium segment.

TABLE 5.11 VALUE OF TIME USED IN THE ROUTE CHOICE MODEL (2012 \$ / HOUR)

Quantile	Value of Time
Low: 0 % – 33 %	\$3.60
Medium: 33 % – 67 %	\$8.20
High: 67% - 100 %	\$18.70

- 5.38 To help set the truck VOTs, we reviewed industry research on heavy vehicle VOTs. We reviewed US DOT guidance¹⁹ and the work of several authors, adapted from the study by Smalkoski and Levinson of University of Minnesota.²⁰ These values are presented in Table 5.12, showing a range from \$24.18 to \$61.78 with an average of \$36.07. In recognition of the wide range of willingness to pay for travel times saving observed in the trucking industry interviews and to remain consistent with the auto VOT segments, we set the medium truck VOTs as two times the auto VOTs and the heavy truck VOTs at three times the auto VOTs. These VOTs are presented in Table 5.13 and show VOTs that appear conservative in comparison to the range of industry research.

TABLE 5.12 LITERATURE REVIEW VALUE OF TIME FOR HEAVY VEHICLES

Authors	Year of Publication	VOT in 2003 \$	VOT in 2012 \$
Hanig and McFarland	1963	22.50	28.13
Waters et al.	1995	22.89	28.61
Kawamura	1999	30.14	37.68
University of Minnesota	2003	49.42	61.78
US Department of Transportation	2003	19.34	24.18
Average			36.07

¹⁹ US Department of Transportation, Office of the Secretary of Transportation, "The Value of Saving Travel Time: Departmental Guidance for Conducting Economic Evaluations", 1997 and 2003 update

²⁰ Smalkoski, Brian and David Levinson, "Value of Time of Commercial Vehicle Operators", 2003

TABLE 5.13 TRUCK VALUE OF TIME USED IN THE ROUTE CHOICE MODEL (2012 \$ / HOUR)

Quantile	Medium Truck Value of Time	Heavy Truck Value of Time
Low: 0 % – 33 %	\$7.20	\$10.80
Medium: 33 % – 67 %	\$16.40	\$24.60
High: 67% - 100 %	\$37.40	\$56.10

5.39 During the application of VOTs, we assumed video toll users to have VOTs 25% higher than transponder users to reflect:

- I Extraordinary circumstances - since these travelers have not obtained a transponder, they will be charged a large toll premium, indicating that they would not normally consider using the toll facility. But due to special circumstances, in this instance the toll option has become very attractive.
- I Out of region users – travelers from out of region users have demonstrated higher VOT in their interest of getting to their destination quickly.
- I Non-collection – some vehicles without transponders will not pay the toll due to technical issues or by violators who have no intention of paying the video toll. The leakage analysis is described below. Increasing the VOT has the same effect as discounting the toll for these travelers.

5.40 For future year forecasts, we increased the VOTs by 0.5% annually in real terms, which is less than half of the typical real growth in GRP per capita.

Alternate Routes

5.41 In recognition of the preference of some travelers to use limited access highways (fast speeds with no traffic signals) versus others who prefer a more direct route even if it includes lower speed roadways with intersections, we established two segments of trips with different non-tolled options. For travelers with a preference for limited access travel, we included the I-64 river crossing as the non-toll option, while for those who prefer the more direct route regardless of what type of road, we allowed either I-64 or US 31 crossings to be the non-toll option. In paragraph 4.36, we discuss the survey results regarding travelers' preferences for each type of route. 24% of I-65 travelers and 23% of overall survey respondents stated their preference to use a freeway. Conservatively, we have segmented our auto trips as 70% preferring the freeway and 30% preferring the direct route.

Motorway Bonus

5.42 Travelers have a preference to travel on limited access highways compared to lower quality alternatives. A motorway bonus is an attempt to encapsulate the benefits other than travel time and distance savings, such as the perception of safety, comfort,

or reliability. We applied the motorway bonus by increasing the travel time on non-limited access highways by 15%.

Toll Rates

- 5.43 Toll rates will vary by vehicle class and by collection type. Table 5.14 presents the opening year toll rates for each vehicle class-collection type combination. In the model, toll rates are increased by 2.5% annually, which is consistent with the inflation rate assumption used for preparing the revenue stream.

TABLE 5.14 TOLL RATES (2017 \$)

	2-Axle Vehicles	Medium Trucks	Heavy Trucks
Discount Program	\$1.00		
Transponder	\$2.00	\$5.00	\$10.00
Registered Video	\$3.00	\$6.00	\$11.00
Other Video	\$4.00	\$7.00	\$12.00

Development of Revenue Schedule

- 5.44 After running the SDG model for each time period and model year, the model outputs were transformed into traffic and revenue forecasts through a number of post-processing steps.

Opening Year

- 5.45 For the development of the revenue schedule, we have assumed an opening of both facilities to toll traffic on January 1, 2017. This is a conservative assumption as the East End Crossing is scheduled to be completed in October 2016 and the Downtown Crossing to be fully completed in December 2016.

Conversion from Daily to Annual Forecasts

- 5.46 We applied an annualization factor to convert toll revenue from the daily value derived from the study area forecast model to an equivalent annual total. This factor accounts for the expected level of weekend traffic relative to the typical day considered in the travel demand model. Our analysis of I-65 traffic found that the weekends had over 75% of the traffic of weekdays. Recognizing that the lower traffic will lead to proportionally lower revenue as there is less congestion in the network, we assumed an annualization factor of 315, implying that weekends and holidays would provide 55% of weekday revenue.

Conversion to Future Year Revenue

- 5.47 In order to convert the revenue forecasts from the model's 2012\$ VOTs to future year nominal equivalents, we applied a 2.5% annual future inflation rate.

- 5.48 We determined the traffic and revenue for the non-modeled years by assuming compounded growth between modeled years. For years beyond 2030, we assumed that traffic and revenue would grow at a decreasing rate as indicated in Table 5.15.

TABLE 5.15 TRAFFIC & REVENUE GROWTH BEYOND 2030

Forecast Years	% of 2023-2030 CAGR
2030 - 2035	100%
2035 - 2045	75%
Beyond 2045	50%

Application of Ramp-Up

- 5.49 It is common for the volume and revenues of toll facilities to gradually ramp-up to more “normal” levels after project opening as travelers take time to gain familiarity with a new toll facility so that travel patterns reach the steady state conditions assumed in toll model’s forecasts. During this ramp-up period, toll revenues are typically lower than predicted by unadjusted forecasting models. Since I-65 is a mature corridor, user familiarization will likely be reasonably rapid, while the development spurred by the East End Crossing may take longer to reach normal levels. Some ramp-up effects will likely also be seen as travelers become accustomed to electronic tolling and obtain transponders. Accordingly, we applied a ramp-up period of two years for I-65 and a four year period for the East End Crossing, with the ramp-up values presented in Table 5.16.

TABLE 5.16 RAMP-UP FACTORS

Year	I-65 Bridges	East End Crossing
2017	70%	60%
2018	85%	70%
2019	100%	80%
2020	100%	90%
2021	100%	100%

Application of Toll Leakage

- 5.50 The toll bridges will be operated using open road tolling (ORT) exclusively, and this introduces the potential for toll leakage. Three types of toll leakage can occur in an ORT system: 1) the license plate of a non-transponder vehicle is unable to be identified, 2) the license plate of a non-transponder vehicle is identified, but is in a state for which there is no agreement to obtain the vehicle address, and 3) the license

plate of a non-transponder vehicle is identified and the toll bill is mailed, but the traveler does not pay the bill.

- 5.51 Atkins conducted a detailed analysis to determine the leakage amount for the bridges based upon factors such as share of transponders, enforcement policies and practices, and tolling technology. Based upon their review, Atkins estimated the leakage rates presented in Table 5.17. Appendix C presents further details on their analysis.

TABLE 5.17 REVENUE LEAKAGE RATES

Fiscal Year	Leakage Rate
2017	7.0%
2018	5.0%
2019	4.6%
2020	4.3%
2021	4.0%
2022	3.7%
2023	3.5%
2024	3.3%
2025	3.1%
2026	2.9%
2027	2.7%
2028	2.6%
2029	2.5%
2030	2.4%
2031	2.4%
2032	2.4%
2033	2.4%
2034	2.4%
2035	2.4%
2036	2.4%
2037	2.4%
2038	2.4%
2039	2.4%
2040	2.4%
2041	2.4%
2042	2.4%
2043	2.4%
2044	2.4%
2045	2.4%
2046	2.4%
2047	2.4%
2048	2.4%
2049	2.4%
2050	2.4%
2051	2.4%
2052	2.4%
2053	2.4%
2054	2.4%

Source: Atkins

Basic Assumptions of the Traffic and Revenue Study

In addition to the detailed model assumptions discussed above, the LSIORB Project traffic and revenue estimates are predicated on the following basic assumptions:

1. The LSIORB Project will be built as described in Chapter 1.
2. The LSIORB Project will be opened to traffic beginning in January 2017.
3. Toll rates will be implemented as listed in Table 5.14 and increase 2.5% annually.
4. The transponder and video toll collection market share will be at the levels specified in Table 5.10.
5. The percentage of trucks crossing the Ohio River remain similar to the levels that have been observed.
6. The LSIORB Project traffic and revenue will ramp up as described in this chapter.
7. The socioeconomic conditions and associated growth will occur as described in Chapter 3.
8. Highway network improvements will occur as described in the RTP and listed in Table 5.9.
9. Inflation will occur at 2.5% annually.
10. The LSIORB Project will be efficiently maintained and operated.
11. The levels of toll leakage will occur as described in this chapter.
12. Motor fuel will remain in adequate supply during the forecast period, with fuel prices, including Federal and State fuel taxes, not to exceed \$4.50 per gallon adjusted for inflation.
13. No new transit service will be introduced that would radically change travel mode during the forecast period.
14. Normal economic conditions will occur in the Louisville-Southern Indiana area and the United States, without a major depression or national or regional emergency that would restrict the use of motor vehicles.

6 Traffic and Revenue Analysis

- 6.1 We applied the modeling approach described in the preceding chapter to develop traffic and revenue forecasts for the years 2018, 2023, and 2030. In this chapter, we first discuss the basic model outputs and then present our forecasts of the LSIORB Project traffic and revenue streams.

Crossing Traffic Growth

- 6.2 In order to provide a basis of understanding of the toll bridge traffic and revenue forecasts, we first analyzed the forecasted growth in river crossing travel. Table 6.1 presents the daily river crossing traffic for the base year and each future model year, with the LSIORB Project included. The compound annual growth rate (CAGR) of river crossing traffic from 2012 to 2030 is 1.33%. This growth rate is consistent, if not conservative, when compared to the historical growth rates discussed in Paragraph 2.19.

TABLE 6.1 RIVER CROSSING DAILY TRAFFIC

	2012	2018	2023	2030
6-7 AM	12,161	13,858	14,556	16,018
7-8 AM	16,857	19,893	20,822	22,886
8-9 AM	14,429	16,703	17,439	19,201
10 AM – 3 PM	69,349	73,433	76,538	82,276
3-4 PM	15,858	18,294	19,147	21,218
4-5 PM	18,225	20,389	21,216	23,129
5-6 PM	18,255	21,021	21,883	24,003
6-7 PM	12,923	15,248	15,966	17,612
7 PM – 6 AM	46,220	51,479	53,531	58,316
Daily Total	224,277	250,318	261,099	284,659

Toll Rate Toll Sensitivity

- 6.3 While we prepared our base forecasts using the toll rates presented in Table 5.14, in order to better understand the model and as a gauge of the potential revenue that could be provided, we conducted toll rate optimization. For the 2018 and 2030 model years, we evaluated the traffic and toll revenue generated by using a range of base toll rates from \$0 to \$4.50 (2017\$). The base toll rate is the auto transponder toll; toll rates for the other collection methods and vehicle classes are proportioned with the same relationships included in Table 5.14.

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- 6.4 Figure 6.1 and Figure 6.2 present the toll rate sensitivity for the model years of 2018 and 2030, respectively. Figure 6.1 shows that 2018 toll revenues increase as toll rates increase, reaching maximum revenue with a base toll rate of \$3.50. Figure 6.2 shows that 2030 toll revenue continue to rise to the \$4.50 base toll rate. While the \$2.00 base toll included in our forecasts does provide less revenue than the revenue maximizing toll rate, it serves almost 50% more traffic than from the revenue maximizing toll rate in 2030.

FIGURE 6.1 TOLL RATE SENSITIVITY IN 2018

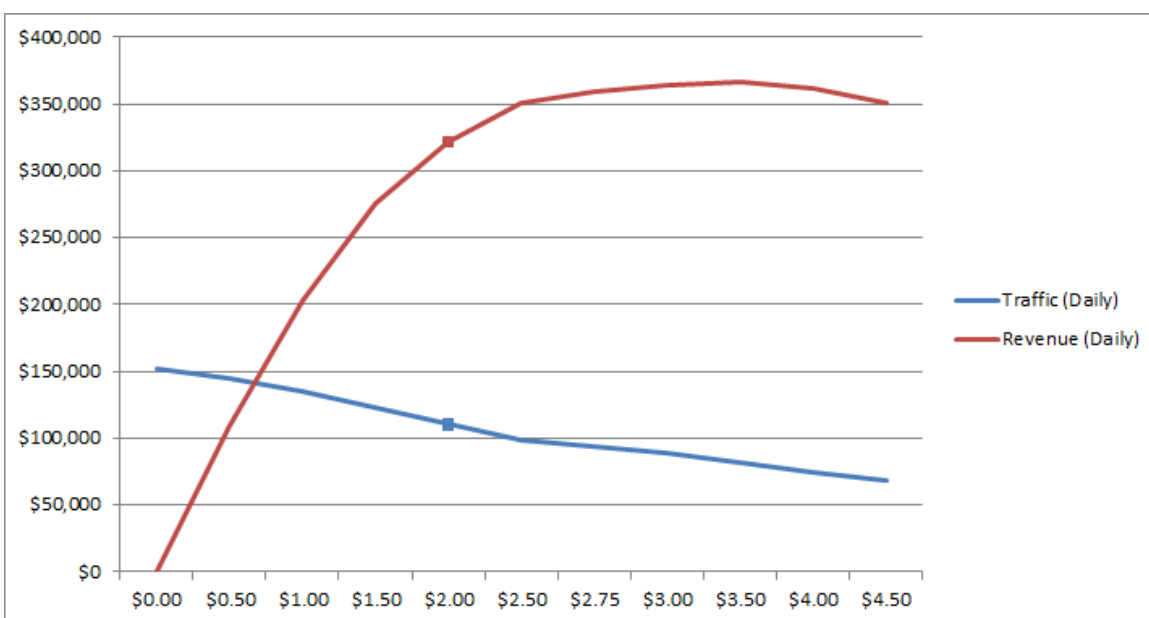
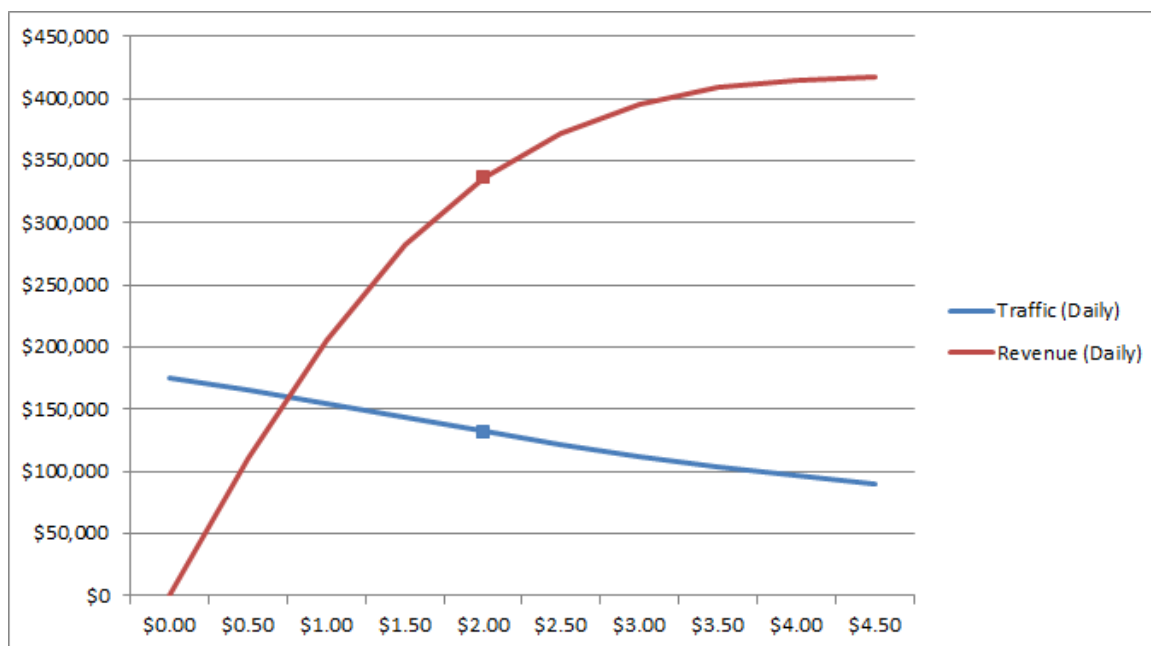


FIGURE 6.2 TOLL RATE SENSITIVITY IN 2030

Traffic Capture with Recommended Tolls

- 6.5 We investigated how the shares of traffic using each bridge changes when tolling is introduced. Figure 6.3 illustrates the reduced share of East End Crossing and I-65 traffic when they are tolled. In 2030, the East End Crossing's share of traffic falls from 20% to 16% when tolls are added, with similar reductions are seen in the other years. In 2030, I-65's share of traffic falls from 42% to 31%, with similar reductions in the other years. In terms of capture rates, the tolled East End Crossing captures roughly 80% of its non-tolled traffic level, while the tolled I-65 captures roughly 70% of its non-tolled level. The higher capture rate, and correspondingly lower reduction in share of crossing traffic, for the East End Crossing compared to I-65 is consistent with the better non-tolled options available to I-65 traffic.
- 6.6 This last point is illustrated in Figure 6.4 and Figure 6.5. Figure 6.4 illustrates the additional amount of travel distance, with a corresponding increase in vehicle operating costs, and travel time that would be incurred if using the US 31 or I-64 crossings instead of the East End Crossing for travel during the PM Peak. Figure 6.5 presents a similar comparison for the Downtown Crossing.

FIGURE 6.3 DISTRIBUTION OF RIVER CROSSING TRAFFIC WITH AND WITHOUT TOLLS

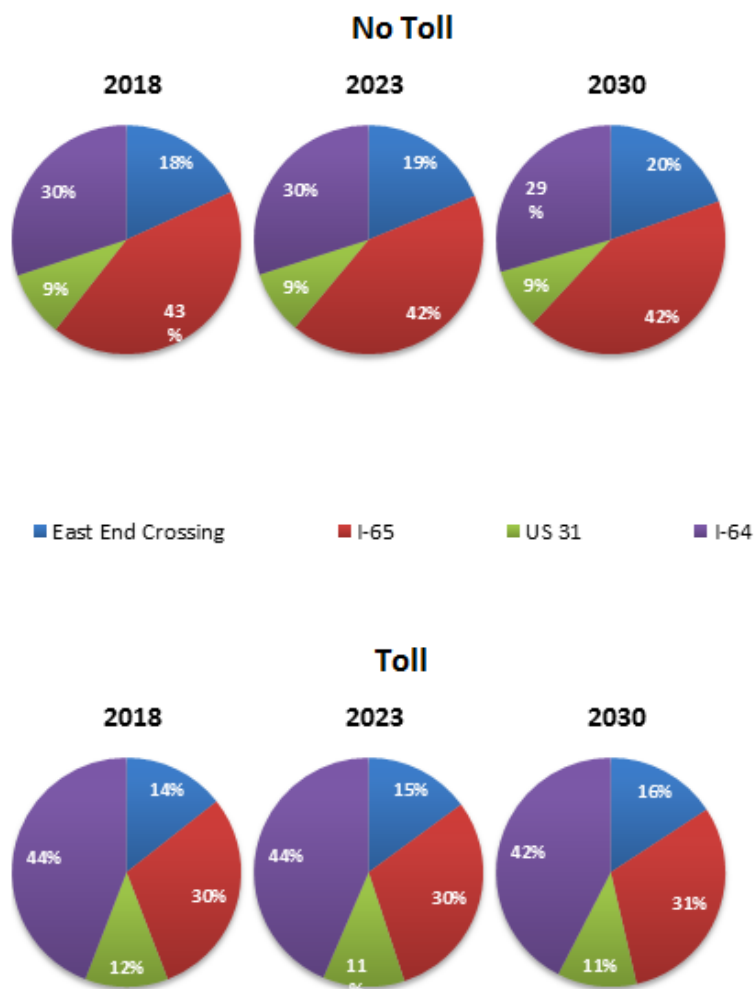
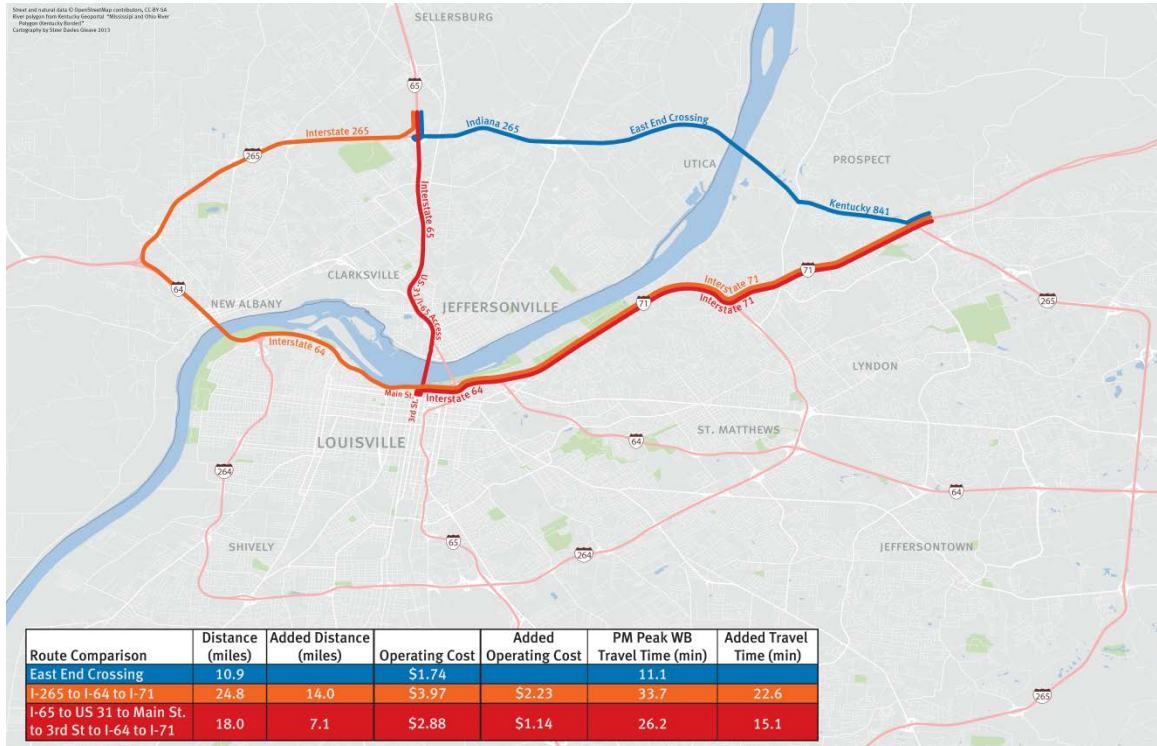
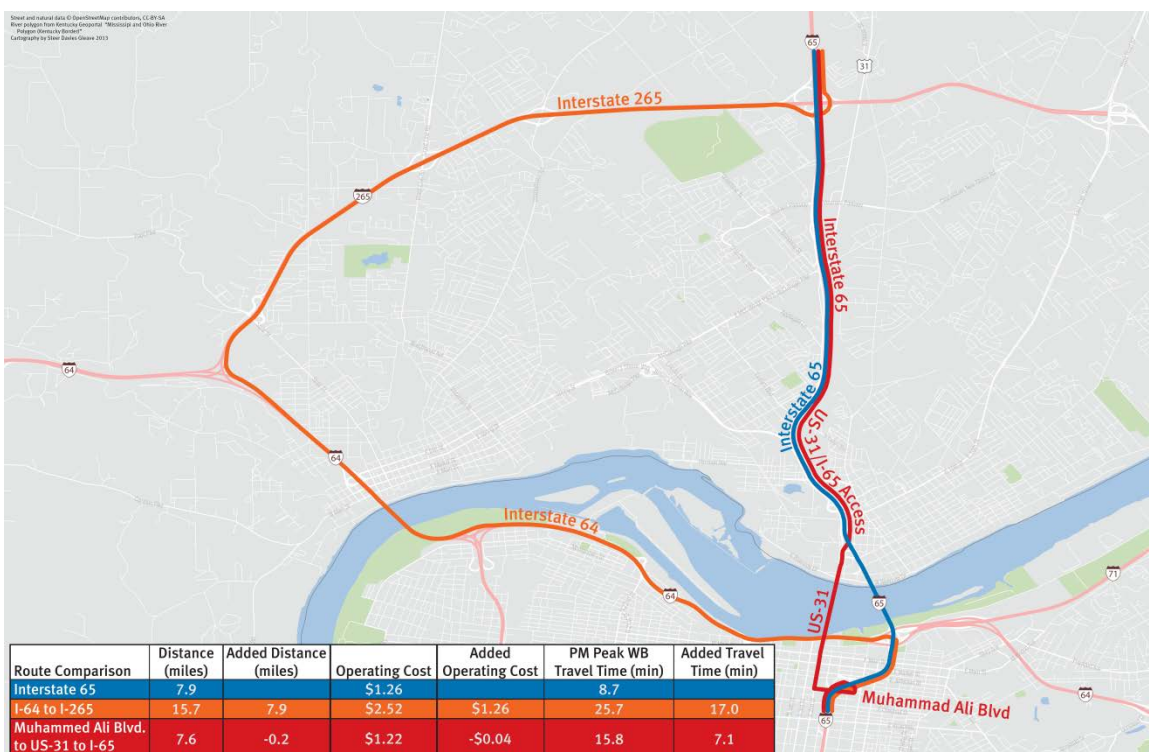


FIGURE 6.4 EAST END CROSSING COMPARISON WITH ALTERNATE CROSSINGS

- 6.7 As is shown in Figure 6.4, the East End Crossing provides a substantial travel benefit to travelers from I-71/I-265 in Kentucky to I-65 in Indiana. This route saves 7 miles compared to US 31 and 14 miles compared to I-64, which translates to an operating cost savings of \$1.14 and \$2.23 for US 31 and I-64, respectively, when using AAA's noted \$0.16 / mile operating cost. Additionally, the East End Crossings provides time savings of 15 and 23 minutes compared to US 31 and I-64, respectively during the PM peak. The large travel time savings reflect the slower speeds that occur on I-64 and US 31 (respective average speeds of 44 mph and 40 mph for the I-64 and US 31 alternate routes, respectively) as traffic levels approach and exceed capacity in some locations during the peak periods.
- 6.8 Figure 6.5 provides a similar illustration of the travel benefits provided for the I-65 Downtown Crossing. While US 31 alternate route has virtually the same travel distance as I-65, the I-64 detour is 8 miles longer, which translates into an additional operating cost of \$1.26 using the AAA operating cost factor. The Downtown Crossing provides travel time benefits over both alternate routes, in the amount of 7 minutes and 17 minutes compared to US 31 and I-64, respectively. Again, the travel time savings reflect the slower average speeds of the alternate routes.

FIGURE 6.5 I-65 COMPARISON WITH ALTERNATE CROSSINGS

6.9 In order to better understand the forecasted toll traffic, we present tables that display the peak period and daily bridge crossing traffic. Table 6.2 presents the AM peak forecasted traffic by river crossing traffic for each model year, while Table 6.3 presents this information for the PM peak and Table 6.4 presents it for the entire day. These tables show the tolled facilities attracting a progressively larger share of total crossing trips into the future. This is caused by the increasing levels of congestion and correspondingly lower travel speeds that occur on the alternate routes into the future.

TABLE 6.2 AM PEAK FORECASTED TRAFFIC BY RIVER CROSSING

River Crossing	2012	2018	2023	2030
East End Crossing		7,171	7,804	9,135
I-65	21,597	15,183	16,178	18,531
US 31	5,670	6,082	6,235	6,556
I-64	16,182	22,019	22,600	23,882
Total Crossing Traffic	43,449	50,455	52,817	58,105
Tolled Crossings Share of Traffic		44.3%	45.4%	47.6%

TABLE 6.3 PM PEAK FORECASTED TRAFFIC BY RIVER CROSSING

River Crossing	2012	2018	2023	2030
East End Crossing		11,239	12,184	14,159
I-65	33,456	22,258	23,677	26,988
US 31	7,881	8,946	9,187	9,774
I-64	23,923	32,509	33,164	35,041
Total Crossing Traffic	65,261	74,952	78,213	85,962
Tolled Crossings Share of Traffic		44.7%	45.9%	47.9%

TABLE 6.4 DAILY FORECASTED TRAFFIC BY RIVER CROSSING

River Crossing	2012	2018	2023	2030
East End Crossing		36,007	38,979	44,920
I-65	121,975	74,501	78,350	87,071
US 31	24,143	29,334	30,100	31,925
I-64	78,159	110,476	113,670	120,743
Total Crossing Traffic	224,277	250,318	261,099	284,659
Tolled Crossings Share of Traffic		44.1%	44.9%	46.4%

Traffic and Revenue Forecasts

- 6.10 Applying the approach described in Chapter 5, we developed the annual stream of traffic and revenue forecasts. In the next paragraphs, we present the development of the annual traffic and revenue stream for the LSIORB Project.

Traffic by Crossing

- 6.11 For 2018, 2023, and 2030, we ran the model and produced the daily forecasts of traffic and revenue for each crossing by vehicle type and toll collection method. Table 6.5 presents these forecasts for the East End Crossing while Table 6.6 presents this information for the Downtown Crossing. These tables show a substantial level of truck traffic, with medium and heavy trucks combining to represent roughly 14% of tolled traffic on both crossings. Due to the higher toll rates for these vehicle classes, truck revenue represents roughly 45% of total toll revenue.

TABLE 6.5 EAST END CROSSING FORECAST DAILY TRAFFIC

Year	Collection Type	Auto	Medium Truck	Heavy Truck	Total Traffic	Revenue (Nominal \$)
2018	Discount	13,292			13,292	\$13,625
	Transponder	7,300	553	2,099	9,952	\$39,312
	Pre-registered Video	1,432	77	315	1,823	\$8,424
	Other Video	8,590	462	1,888	10,940	\$61,759
	Total	30,614	1,092	4,302	36,007	\$123,120
2023	Discount	14,462			14,462	\$16,771
	Transponder	10,593	661	2,487	13,742	\$57,249
	Pre-registered Video	1,207	68	264	1,539	\$8,042
	Other Video	7,245	406	1,585	9,236	\$58,963
	Total	33,507	1,136	4,336	38,979	\$141,026
2030	Discount	16,843			16,843	\$23,218
	Transponder	15,048	791	2,863	18,702	\$86,410
	Pre-registered Video	1,058	59	222	1,339	\$8,227
	Other Video	6,350	356	1,329	8,036	\$60,441
	Total	39,299	1,207	4,414	44,920	\$178,296

TABLE 6.6 DOWNTOWN CROSSING FORECAST DAILY TRAFFIC

Year	Collection Type	Auto	Medium Truck	Heavy Truck	Total Traffic	Revenue (Nominal \$)
2018	Discount	31,088			31,088	\$31,865
	Transponder	14,589	1,427	3,381	19,397	\$71,872
	Pre-registered Video	2,515	211	705	3,431	\$16,978
	Other Video	15,090	1,268	4,228	20,585	\$122,968
	Total	63,282	2,906	8,313	74,501	\$243,682
2023	Discount	32,428			32,428	\$37,606
	Transponder	20,329	1,721	4,157	26,207	\$105,339
	Pre-registered Video	2,048	180	588	2,816	\$15,884
	Other Video	12,287	1,081	3,530	16,899	\$114,902
	Total	67,092	2,983	8,275	78,350	\$273,731
2030	Discount	35,760			35,760	\$49,295
	Transponder	27,460	2,145	5,031	34,636	\$159,841
	Pre-registered Video	1,724	162	497	2,382	\$15,998
	Other Video	10,343	970	2,980	14,293	\$115,690
	Total	75,286	3,277	8,507	87,071	\$340,824

Traffic and Revenue Forecasts

- 6.12 Building on the toll bridge traffic and revenue forecasts of the model years presented above, we followed the procedure set out in Chapter 5 to establish the annual traffic and revenue stream.
- 6.13 We began by combining the daily traffic and revenue from the East End Crossing and the Downtown Crossing for 2018, 2023, and 2030. For traffic and toll rates of non-modeled years, we assumed compounded growth between modeled years. Since tolls will be collected electronically, it was assumed that toll rates can be increased each year. These increases are set to account for inflation and allows toll increases in real dollar terms to be gradual and spread over a longer period, rather than concentrated into less frequent but large toll jumps.
- 6.14 The daily traffic and revenue forecasts were multiplied by 315 to convert them into annual forecasts. As noted earlier, this annualization factor implies that each weekend day and holiday would provide 55% of weekday revenue.
- 6.15 We then applied adjustments for toll leakage and ramp-up. We applied the ramp-up consistent with the values in Table 5.16 and applied toll leakage with the values presented in Table 5.17.
- 6.16 As the SDG model was built from the MPO model, it's years are calendar years, requiring a final step to shift the forecasts to Kentucky's Fiscal Year, which starts on

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July 1. To implement this shift, we created the FY forecasts by assuming each calendar year's forecasts were evenly split, and combined the corresponding half calendar years to form the FY.

- 6.17 Table 6.7 presents the culmination of these steps into the annual traffic and revenue stream, showing revenue growing from almost \$34 million for FY 2017, the first half year of opening, to almost \$159 million in 2030.

TABLE 6.7 ANNUAL TRAFFIC AND REVENUE STREAM

Fiscal Year	Daily Traffic	Annual Traffic After Ramp-Up (000s)	Daily Revenue (Nominal \$)	Annual Revenue (000s Nominal \$)	Annual Revenue Less Toll Evasion After Ramp-Up (000s Nominal \$)
2017	102,844	10,860	\$334,090	\$52,619	\$33,841
2018	106,676	24,803	\$359,480	\$113,236	\$79,252
2019	111,171	30,356	\$376,957	\$118,741	\$98,158
2020	112,506	33,575	\$385,134	\$121,317	\$110,248
2021	113,860	35,122	\$394,153	\$124,158	\$117,222
2022	114,801	36,162	\$404,079	\$127,285	\$122,529
2023	116,453	36,683	\$414,983	\$130,720	\$126,165
2024	118,215	37,238	\$426,948	\$134,488	\$130,096
2025	120,036	37,811	\$439,823	\$138,544	\$134,281
2026	121,962	38,418	\$453,440	\$142,834	\$138,703
2027	123,995	39,058	\$467,845	\$147,371	\$143,377
2028	126,138	39,734	\$483,084	\$152,172	\$148,198
2029	128,396	40,445	\$499,212	\$157,252	\$153,297
2030	130,773	41,193	\$516,283	\$162,629	\$158,691
2031	133,112	41,930	\$536,506	\$169,000	\$164,985
2032	135,374	42,643	\$559,578	\$176,267	\$172,079
2033	137,675	43,368	\$583,324	\$183,747	\$179,381
2034	140,016	44,105	\$608,083	\$191,546	\$186,994
2035	142,397	44,855	\$633,895	\$199,677	\$194,931
2036	144,515	45,522	\$659,396	\$207,710	\$202,773
2037	146,359	46,103	\$684,516	\$215,623	\$210,497
2038	148,228	46,692	\$710,596	\$223,838	\$218,517
2039	150,122	47,288	\$737,672	\$232,367	\$226,843
2040	152,040	47,892	\$765,782	\$241,221	\$235,486
2041	153,657	48,402	\$793,262	\$249,877	\$243,936
2042	154,966	48,814	\$820,028	\$258,309	\$252,167
2043	156,287	49,230	\$847,699	\$267,025	\$260,676
2044	157,619	49,650	\$876,305	\$276,036	\$269,472
2045	158,963	50,073	\$905,878	\$285,352	\$278,566
2046	160,319	50,500	\$936,451	\$294,982	\$287,967
2047	161,686	50,931	\$968,056	\$304,938	\$297,685
2048	163,066	51,366	\$1,000,730	\$315,230	\$307,732
2049	164,457	51,804	\$1,034,509	\$325,870	\$318,119
2050	165,861	52,246	\$1,069,429	\$336,870	\$328,857
2051	167,276	52,692	\$1,105,529	\$348,242	\$339,958
2052	168,705	53,142	\$1,142,851	\$359,998	\$351,434
2053	170,145	53,596	\$1,181,433	\$372,152	\$363,298
2054	171,598	54,053	\$1,221,321	\$384,716	\$375,563

7 Sensitivity Analysis

Sensitivity Scenarios

- 7.1 We conducted sensitivity testing in order to understand the impacts that different model assumptions would have on the traffic and revenue forecasts. This allowed us to identify the severity of the risks posed if events were to materialize differently than expected. Specifically, we evaluated the following 6 risk scenarios for the forecast years 2018 and 2030 against the base case.
- | 'High Growth' Scenario: this scenario considers the situation where travel growth above 2012 levels is increased by 25% above base case growth.
 - | 'High VOT' Scenario: this scenario considers the situation where travelers' values of time (VOTs), representing their willingness to pay tolls, are 25% higher than in the base case.
 - | 'Low Growth' Scenario: this scenario considers the situation where travel growth above 2012 levels is 25% lower than the growth that occurs in the base case.
 - | 'Low VOT' Scenario: this scenario considers the situation where travelers' VOTs, representing their willingness to pay tolls, are 25% lower than in the base case.
 - | 'Low VOC' Scenario: this scenario considers the situation where travelers' perceived vehicle operating costs (VOC) are only 25% less than assumed for the base case.
 - | 'Trip Reduction' Scenario: this scenario considers the situation where the level of travel is 10% lower than base case levels (representing for example a large fuel price increase or an economic recession, both of which would reduce the overall level of travel).
- 7.2 Figure 7.1 and Figure 7.2 present the results of the sensitivity testing, comparing the 2018 and 2030 revenue and traffic forecasts against the base case forecasts for the corresponding year. In the following paragraphs, we discuss the results of each sensitivity scenario.

FIGURE 7.1 CHANGE IN REVENUE FOR SENSITIVITY SCENARIOS

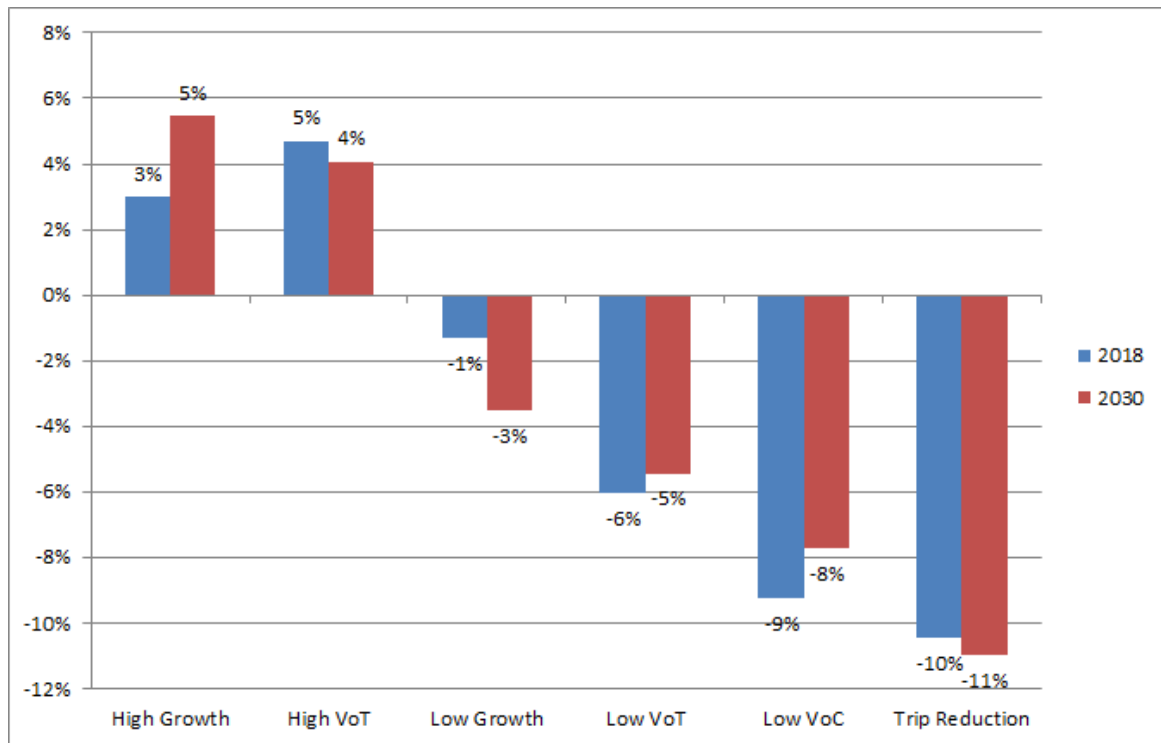
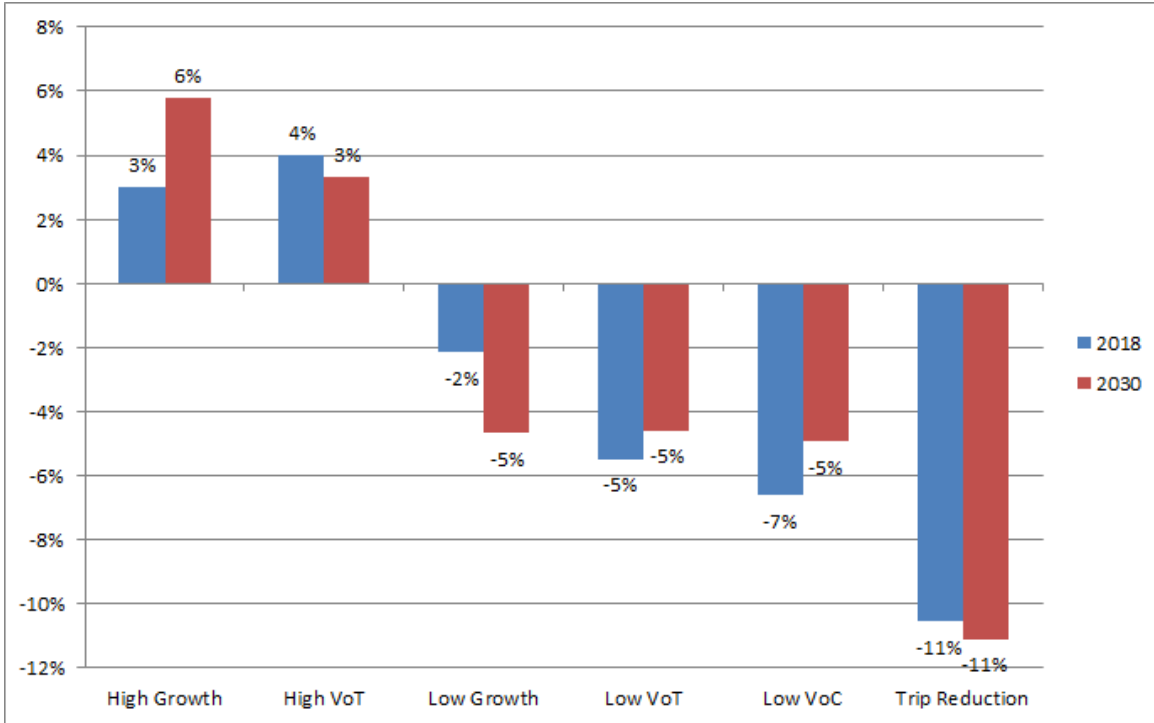


FIGURE 7.2 CHANGE IN TRAFFIC FOR SENSITIVITY SCENARIOS



High Growth

7.3 This scenario represents the case where the growth in tripmaking that occurs between the base year and each model year is higher than the base case forecasts. This could occur because future growth in population and employment is larger than was assumed in our growth (based on the econometric growth model and the socioeconomic forecasts that the model used to produce trips). In Chapter 3, we note our use of the econometric model to estimate the crossing traffic and how this model forecasts lower growth than if relying on the socioeconomic inputs and the MPO model.

7.4 We implemented this increase in travel growth for each model year by identifying the total amount of trip growth of each origin-destination (OD) pair from the base year, and increasing that growth by an additional 25%.

7.5 As expected, the increase in travel growth results in an increase in toll revenue by 3% in 2018 and by 5% in 2030. Similar increases in traffic also occur, with a traffic increase of 3% in 2018 and 6% in 2030.

High VOT

7.6 The High VOT scenario reflects the case where the base model underestimates travelers' willingness to pay a toll to use the tolled bridges. This scenario could occur if current VOTs, or the rate at which they will grow in the future, were

underestimated. As discussed in Chapter 4, the stated preference survey results provided lower VOTs than would have been expected from industry rules of thumb (mean VOT of \$8 / hour compared to \$12 / hour using industry rules of thumb). Possible reasons for the lower VOTs from the survey include respondents' underestimation of their own willingness to pay or policy bias.

- 7.7 We implemented the High VOT scenario by increasing VOTs for all travel segments by 25%, which brings the mean VOT to \$10 / hour, which is still lower than suggested by industry norms. The results in Figure 7.1 show increases in revenue of 5% for 2018 and 4% for 2030. The corresponding increases in traffic of 4% for 2018 and 3% for 2030 as shown in Figure 7.2 are slightly lower because there is an increase in the share of video transactions, which pay a premium rate.

Low Growth

- 7.8 This scenario is the opposite of the High Growth scenario. It could reflect a situation where the growth in drivers of crossing growth or the population and employment is lower than was assumed in the base case to produce trips. As discussed above, the use of the econometric model for crossing traffic is a more conservative assumption than the socioeconomic forecasts, meaning that the Low Growth scenario is less likely to occur than the High Growth scenario.
- 7.9 We implemented the Low Growth scenario for each model year by identifying the total trip growth from the base year and decreasing the growth by 25%. Figure 7.1 shows that the revenue decreases relative to the base case were 1% in 2018 and 3% in 2030, with corresponding changes in traffic of 2% and 5% for 2018 and 2030, respectively, as seen in Figure 7.2. It is interesting that, in absolute terms, these are smaller decreases than the increases in the High Growth scenario.

Low VOT

- 7.10 The Low VOT scenario reflects the case where the base model overstates travelers' willingness to pay a toll to use one of the tolled bridges. This scenario reflects the situation where VOTs are actually 25% lower than the VOTs estimated from the SP survey. In the discussion of the High VOT scenario, we noted how the SP VOTs were already lower than industry rules of thumb. With this scenario, the mean VOT becomes \$6.40 / hour, which is roughly 50% of the \$12 / hour benchmark determined through application of industry rules of thumb.
- 7.11 The results in Figure 7.1 show decreases in revenue of 6% and 5% for 2018 and 2030, respectively. Figure 7.2 shows the corresponding decreases in traffic are 5% for both years.

Low VOC

- 7.12 The Low VOC scenario reflects the case where travelers' perception of their vehicle operating cost (VOC) is lower than the values used in the base case: \$0.16/mile, \$0.80/mile, and \$1.00/mile for autos, medium trucks, and heavy trucks, respectively.

While the allowable mileage deduction from the IRS is much larger, most travelers do not take into consideration the true cost of operating their vehicle. At a minimum however, most travelers include the cost of fuel in their perception of VOC. Assuming fuel at \$3.00 / gallon and 25 mpg fuel efficiency, this would imply an automobile VOC is \$0.12/mile. This represents a 25% decrease from the base case, and we correspondingly lowered the heavy vehicle VOCs by 25% to \$0.60 / mile for medium trucks and \$0.75 / mile for heavy trucks.

- 7.13 The results in Figure 7.1 and Figure 7.2 show that the VOC assumption does impact the toll traffic and revenue. The 25% reduction in VOC produced revenue decreases of 9% and 8% in 2018 and 2030 respectively. The corresponding decreases in traffic were 7% and 5%. The greater decrease in revenue than traffic is caused by a larger decrease in truck traffic which pay higher tolls.

Trip Reduction

- 7.14 The Trip Reduction scenario is a proxy for events, such as high fuel costs or an economic recession, that have the effect of lowering the overall level of travel. We implemented the Trip Reduction scenario by eliminating 10% of the total base case trips for each OD pair in each model year. Figure 7.1 and Figure 7.2 show that the 10% reduction in trips produces a slightly larger decrease in toll traffic of 11% for both 2018 and 2030, and corresponding decreases in toll revenue of 10% in 2018 and 11% in 2030.

Appendix A EDR Group's Land Use Review

Draft of Final Report Ohio River Bridges Socioeconomic Outlook

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Disclaimer:

The information and results presented in this document are estimates and projections that involve subjective judgments, and may differ materially from the actual location and magnitude of future development. These observations are not intended nor shall it be construed to constitute a guarantee, promise, or representation of any particular outcome(s) or result(s).

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INTRODUCTION

This report describes methods applied to arrive at regional and traffic analysis zone (TAZ) housing and employment forecasts for the Louisville, Kentucky region—as defined by the five-county Kentuckiana Regional Planning and Development Agency (KIPDA), which encompasses the Kentucky counties of Bullitt, Jefferson and Oldham and the Indiana counties of Clark and Floyd. The approach and assumptions described in this report yields TAZ level estimates offered for travel demand modeling purposes.

The following report describes the manner in which the results of field research in the Louisville economy are incorporated with widely accepted forecasts for the larger Metropolitan Statistical Area (MSA), and for KIPDA's five counties to arrive at regional control totals for housing and employment levels in 2011, 2018 and 2030. The report also describes the degree to which the regional forecasts of employment and housing growth in the region may be sensitive to Ohio River Bridges Project build and tolling scenarios. The report further describes how these regional control totals have been allocated to traffic analysis zones (TAZ's) using a bid-rent methodology informed by site visits to specific areas in the Louisville region where change in housing and employment is likely to be most concentrated. This report concludes with a description of how determinations were made about which areas in the Louisville region would be the most sensitive to the changes in travel cost and accessibility associated with different bridge scenarios.

REGIONAL ASSESSMENT

The assessment of Louisville's regional economic position considers strategic issues related to the Louisville region's economic growth position. Unlike the published forecasts presented subsequently in this report, the regional assessment is based on information very specific to the Louisville region. The regional assessment is primarily derived from firsthand research of regional economic development organizations and initiatives, incentives, competitive attributes of the region (positive and negative) and target industry sectors likely to determine the Louisville MSA's growth potential.

Qualitative Analysis Methodology

The regional assessment is comprised of site analysis; interviews with businesses, economic development professionals, planners, and elected officials; and web-based research. In 2012, EDR Group interviewed 38 people representing 34 organizations, as listed in Table 1.

The majority of the interviews were conducted in person during trips to the Louisville MSA in February and July, 2012. Follow-up phone interviews and emails were used to clarify information. To ensure accuracy and appropriateness (specifically for KYTC's traffic and revenue study), follow-up interviews were conducted with eight of these organizations in January, 2013.

An interview guide was prepared for use during the interviews. Key topic areas included:

- What are the key industries driving the Louisville MSA economy? Where are these key industries located? What have been recent trends in employment and growth in these key industries?
- Where are development sites located within the Louisville MSA? What types of businesses have been attracted to these sites? Are these sites development-ready and, if not, what improvements are needed to attract development?
- What are the long range land use plans for each jurisdiction in the Louisville MSA? Where is housing planned? Retail and services? Industrial? Offices?
- What agencies are involved in promoting economic development, and what incentives or programs do they offer to attract businesses to the Louisville MSA? How effective have their efforts been?
- How has the recession affected development in the Louisville MSA?
- What regulations are in place that either support or inhibit economic growth in the Louisville MSA?

- What are the strengths and weaknesses/assets and liabilities of the Louisville MSA as a business location?
- With what regions does the Louisville MSA area compete?
- What are the relative advantages and disadvantages of the Indiana area of the MSA compared to the Kentucky area of the MSA?
- How will the Ohio River Bridges project affect spatial patterns of economic growth in the Louisville MSA? Are there certain areas within the MSA that will benefit? MSA areas that will be negatively impacted?
- How will tolling on the bridges affect travel patterns and economic development?
- What types of businesses will be impacted most by the Ohio River Bridges project, both positively and negatively?

These questions were intended to guide the interviews. Additional questions were added as conversations evolved to follow-up on specific issues raised during the interviews.

Table 1. Organizations Interviewed

Bass Pro Shops	Jefferson Riverport International
Bullitt County Economic Development Authority	Jeffersonville Main Streets
Bullitt County Planning and Zoning Department	Kentuckiana Regional Planning and Development Agency
City of Charlestown Mayor's Office	Louisville Metro Economic Development and Innovation Department
Clark-Floyd Counties Convention & Tourism Bureau	Louisville Metro Planning and Design Department
Clark County Planning Commission	MainSource Banking
Clarksville Redevelopment Agency	New Albany Plan Commission
Clarksville Town Council	Ohio River Metal Services- Eagle Steel
Crossdock Development	Oldham Chamber and Economic Development
Downtown Jeffersonville merchants	Oldham County Department of Planning and Development
Floyd County Board of Commissioners	One Southern Indiana
Floyd County Plan Commission	Port of Indiana-Jeffersonville
Greater Louisville, Inc.	River Ridge Development Authority
Indiana Department of Transportation	Rocky's and Buckheads Restaurants
Indiana University Southeast	Schimpff's Confectionery
Ivy Tech Community College	Sellersburg Stone Company

Some of the broad findings include:

- River Ridge Commerce Center is positioned to attract significant development as a result of improved access provided by the proposed East End Bridge.
- Bullitt County will continue to see substantial growth in the *Transportation and Warehousing* sector due to its access to UPS Worldport and the Louisville International Airport. The bridges will not substantially influence growth patterns in Bullitt County.
- Jefferson County has limited locations that can attract additional industrial development.
- The bridges projects will improve access from Indiana to the Kentucky side of the Ohio River, leading to more residential development in the Indiana portion of the region. Floyd County and the Charlestown area of Clark County are expected to experience residential growth.
- Businesses in downtown Jeffersonville and along the Ohio River in Clarksville will likely suffer negative impacts (potential loss of businesses) due to the loss of direct ramp access from I-65.
- Oldham County has development potential along and south of I-65. Residents near the proposed East End Bridge oppose growth and may work to limit development close to the new bridge.
- The region needs to improve educational achievement of the local workforce to attract higher paying jobs.
- UPS, Ford, General Electric and *Health Care and Social Assistance* are major businesses and sectors that have shaped and will continue to shape economic development in the Louisville MSA.
- Indiana has an advantage for attracting *Manufacturing and Transportation and Warehousing* sectors because it is a right-to-work state and has more attractive tax policies.
- The interviews in 2013 conducted specifically for Kentucky found that the Amazon property has been filling in employment at a much faster rate than originally anticipated, and that build-out of new housing units in the Crestwood community of Oldham County, KY has been occurring faster than anticipated when the 2012 interviews were conducted.

REGIONAL OUTLOOK AND FORECASTS

To arrive at regional control totals, three available forecasts are compared for the Louisville MSA: Woods & Poole (W&P); Moody's (Baseline Assumption); and Moody's (Below Trend Assumption). Woods & Poole (W&P) and Moody's offer nationally syndicated and widely accepted growth forecasts. The published regional forecasts provide an idea of what the overall baseline of housing and employment growth is likely to be (based on established regional and national economic dynamics). A comparison of pre-existing regional forecasts also suggests an order of magnitude regarding variability in future employment levels resulting from different forecasting methods.

Sources and Assumptions of Available Forecasts

This section compares W&P and Moody's forecasts under different national growth scenarios. The forecasting services are broadly similar in their data and methods, yet have some difference in focus, scope, detail, and documentation. For example, both forecast vendors generate forecasts using a hierarchical time-series statistical approach, the first step of which is to develop a U.S. National forecast using national data from the U.S. Bureau of Economic Analysis (BEA), the U.S. Bureau of Labor Statistics (BLS), and other sources. The underlying datasets used in both models have some key differences in the type of employment and earned income data each tracks and reports. Both models allow for broad policy assumptions such as changing industry mixes, international exports, and government behavior (such as interest rates and federal taxes) to be set at the national level.

Both models begin with national forecasts by industry and down-allocate economic activity to regions and counties based on competitive advantages of those sub-national regions. Both models use a down-allocation process determined using more spatially detailed data from BEA, BLS, the U.S. Census, and other sources. For both models, the down-allocation takes an export-based approach, where economic growth is separated into local exports forecasted based on national demand, followed by more locally serving industries (such as retail, restaurants, and services). The result of this approach is that in both methodologies, sub-national (MSA- and county-level) forecasts of industry-level activity are strongly driven by the same national macro-economic forecasts.

One factor in assessing the reasonableness of the national (and sub-national) forecasts is to assess the reasonableness of national-level assumptions which are "exogenous". Exogenous assumptions regard factors that are outside the control of households and industries operating in the U.S. These assumptions include interest rates, oil prices, global growth patterns, and national-level tax and growth policy.

Here, the two forecasting sources diverge significantly. Moody's not only makes its trade and policy assumptions transparent for their baseline forecasts¹, but they also publish alternate scenario forecasts, which amount to sensitivity analysis on some of the most critical exogenous variables that affect national growth. For example, the downside 10 percent scenario, "Oil Price Increase, Dollar Crash Inflation," assumes that geopolitical tensions in energy-producing countries worsen significantly and result in sharp cutbacks in global oil supplies. Additionally, fear that persistent expansion of the Federal Reserve's balance sheet would spark inflation increases; oil prices rise sharply and ultimately surpass \$140 per barrel in mid-2013; and pressures on core consumer prices begin to build as the higher oil prices push up the costs of delivering goods and services, and the beginnings of a wage-price spiral emerge; etc.²

In contrast, for W&P forecasts, assumptions about exogenous factors remain largely hidden. The only reference to exogenous macro-economic conditions is that "in the 2012 Woods & Poole model, the U.S. forecast included an estimate of the lingering impact of the 2008-09 recession using preliminary employment data for 2010 and 2011 from the Bureau of Labor Statistics".³

The comparison, shown in the following section, contrasts two of Moody's scenarios (the Moody's Baseline forecast, the Moody's "Below-Trend Long-Term Growth" forecast) and the W&P Forecast.

Comparison of Growth Forecasts

To enable a direct comparison between Moody's scenarios and the standard W&P forecasts, both forecasts are normalized to a 2009 base-year assumption of employment. This adjustment is necessary to enable a Moody's vs. W&P comparison because W&P reports employment using the U.S. Bureau of Economic Analysis (BEA) methodology (which includes significant reporting of jobs related to the *Self-Employed* sector and the *Farm* sector, both not explicitly included in Moody's forecasts since Moody's relies on a U.S. County Business Patterns data methodology).⁴ For the purposes of this report, base-year 2009 employment totals are taken using the BEA methodology, with year by year growth factors from each comparative forecasting method then applied by industry yielding comparative (and scaled) forecasts from the W&P methodology, Moody's

¹ See *The Moody's Analytics U.S. Macroeconomic Model*, Moody's Analytics, <http://www.economy.com/databuffet/download/Macro%20Model%20Methodology.pdf>

² *U.S. Macroeconomic Outlook Alternative Scenarios*, Moody's Analytics, http://www.economy.com/databuffet/download/US_Macro_alt_scenarios_0712.pdf

³ *Woods & Poole Complete Economic Database (CEED 2012)*

⁴ Further explanation of these different methods for defining employment can be found at the U.S. Bureau of Economic Analysis Website (http://www.bea.gov/regional/pdf/lapi2004/alternative_measures.pdf)

“Below-Trend Long-Term Growth Methodology” and Moody’s “Baseline” forecast methodology.

Table 2 compares the forecasts of total employment, number of households and median household income between the W&P methodology and the two comparative Moody’s scenarios in 2011, 2018, 2030 and 2040 for the Louisville MSA.

Table 2. Comparative Employment Estimates & Forecasts for the Louisville MSA

Source/Methodology	2011	2018	2030	2040
Woods & Poole	743,222	802,939	911,582	1,013,685
Moody's (Baseline Assumption)	736,276	832,500	871,725	937,340
Moody's (Below Trend Assumption)	736,276	811,373	843,649	901,476

While the W&P forecasts appear more conservative in the near term, over time the growth assumptions of W&P yield the most heightened employment forecasts of the set. This growth appears in the W&P forecast primarily because the W&P forecast assumes a continuation of prior trends, with fewer allowances for unknown policy variables to constrain long-term growth. These assumptions result in W&P showing a four percent higher level of employment than the Moody’s baseline in 2030 and 12 percent higher level of employment in 2040 for the Louisville MSA.

By contrast, the Moody’s “Baseline Assumption” forecast allows for likely policy conditions, such as a monetary policy that keeps long-term interest rates low, likely reduction and stabilization of the federal budget deficit (due to gradual economic growth with fading fiscal stimulus) and relatively stable dollar value. Moody’s “Baseline Assumption” forecast also assumes that energy prices have peaked, and are likely to remain steady in the long-term. Based on a review of the economic and political analysis accompanying this forecast, the consulting team concludes the Baseline Assumption” forecast is the most probable long-term outlook of the three options for the Louisville MSA.

The Moody’s “Below Trend Assumption” forecast assumes the economic recovery will be slower in the near term due to the European debt crisis, elevated gas prices, the federal budget deficit, persistent foreclosures and reduced consumer confidence. The “Below Trend” forecast assumes these factors will create a trend of lower risk-taking and more precautionary household saving, leading to a trend of slower GDP growth and higher long-term unemployment. In the “Below Trend Assumption” scenario, these less optimistic assumptions result in a three percent reduction in regional employment relative to the 2030 Moody’s baseline, and a four percent reduction in regional employment relative to the 2040 baseline for the Louisville MSA. Moody’s predicts a 95 percent likelihood that the economy will perform better than the “Below Trend Assumption” forecast.

There is a similar difference, but with less magnitude, with respect to number of households in the Louisville MSA (as shown in Table 3), with W&P showing slightly more growth in MSA households in 2030 and 2040 than the Moody's "Baseline Assumption", and the Moody's "Below Trend Assumption" showing slightly fewer households in the MSA. However, when it comes to MSA households, the three estimates are within one percent of each other--making the differences in number of households not as significant. What is not explained is how by 2040 the W&P forecast accomplishes significantly more MSA employment without an associated increase in the number of households (Moody's "Baseline Assumption"). Either average household size is greater than that assumed in the Moody's model, or the labor force participation rate is assumed to be higher within W&P methods.

Table 3. Comparative Forecasts & Estimates of Numbers Households for the Louisville MSA

Source/Methodology	2011	2018	2030	2040
Woods & Poole	519,753	554,764	587,008	605,781
Moody's (Baseline Assumption)	521,146	559,273	585,946	603,063
Moody's (Below Trend Assumption)	521,146	557,994	582,291	597,034

Assessment of Available Published Forecasts

Ultimately, Moody's forecasts are significantly more transparent than W&P's forecasts in their assumptions about the U.S. and global economic policy contexts. For this reason, the Moody's published economic forecasts represent a more defensible view of a future economic situation for understanding how the national economy will combine with the local factors described in the previous chapter to determine future population, housing and employment in the Louisville MSA.

Though the W&P forecasts account for a more complete set of employment activities, the longer-term employment growth expectations are difficult to defend given the uncertainty over what the U.S. economy will look like in global economic terms. For this reason, the Moody's "Baseline Assumption" forecast offers a more consistent view of the Louisville MSA's overall likely future socioeconomic, housing, and employment control totals in traffic and revenue modeling for the Ohio River Bridges. Furthermore, Moody's "Baseline Assumption" is backed by Moody's modeling of the probability of outcomes relative to other forecasting assumptions.

However, for sensitivity testing, Moody's "Below Trend Assumption" forecast, while unlikely, is considered, as a sensitivity testing scenario, for anticipating traffic and revenue levels in an economic "worst case scenario." The "Below Trend Assumption" provides a "worst case scenario" to support an understanding of potential risk and variability in regional growth and utilization of the Ohio River Bridges.

Five-County KIPDA MPO region

The Louisville five-county KIPDA MPO region within the Louisville MSA accounts for 90 percent of the employment in the broader Louisville MSA in 2011. As mentioned earlier, the five-county KIPDA MPO region includes Kentucky's Jefferson, Oldham and Bullitt counties and Indiana's Clark and Floyd counties. As the economic core of the region, the five-county KIPDA MPO region dictates the profile of underlying employing industries (industry mix). Prominent economic characteristics of the five-county KIPDA MPO region are as follows:

- The combined *Trade, Transportation, & Utilities* aggregate sector, which includes the *Retail Trade, Wholesale Trade, and Transportation and Warehousing* sectors, accounts for 21 percent of the employment in both the five-county KIPDA MPO region and the Louisville MSA economies. Transportation improvements, alleviating congestion or completing access, will buttress local area plans for retention and growth of distribution activities (including transportation service providers and wholesalers with warehousing operations). Both the five-county KIPDA MPO region and the Louisville MSA are expected to incur comparable annual employment growth for this *Trade, Transportation, & Utilities* aggregate sector, with a more pronounced recovery-driven rate through 2018 (1.8 percent), followed by an annual rate of 0.8 percent through 2030.
- Slightly larger employment shares exist in the five-county KIPDA MPO region than in the Louisville MSA for the *Professional, Scientific and Technical Services* sector (15 versus 14 percent), followed by the *Educational & Health Services* sector (14 versus 13 percent). Transportation improvements, alleviating congestion or completing access, will buttress local area plans for future office site development, and guarantee labor force mobility to the burgeoning *Health Care and Social Assistance* complex in Louisville. The five-county KIPDA MPO region and the Louisville MSA are expected to incur comparable annual employment growth for the *Professional, Scientific and Technical* aggregate sector, with a more pronounced recovery-driven rate through 2018 (3.4 percent and 3.2 percent, respectively) and then a moderate annual rate for both through 2030 (1.4 percent). The five-county KIPDA MPO region and the Louisville MSA are expected to incur comparable annual employment growth for the *Educational & Health Services* aggregate sector, with a more pronounced recovery-driven rate through 2018 (2.4 percent and 2.6 percent, respectively) and then a moderate annual rate through 2030 (1.8 percent).
- *Manufacturing* is the only sector in which the employment share is slightly larger in the MSA's economy (nine percent) than in the five-county KIPDA MPO region (eight percent). The five-county KIPDA MPO region and the Louisville MSA are expected to experience differing rates of annual employment growth for the *Manufacturing* sector, with a more pronounced recovery-driven rate through

2018 (0.8 percent and 1.1 percent, respectively) and then employment contracting through 2030 (-0.2 percent and -0.1 percent, respectively).

Economic Outlook and Forecasts: Conclusions

From a comparison of available syndicated national and regional economic forecasts informed by an “on the ground” regional economic assessment, Moody’s baseline forecast provides the most defensible baseline forecast for the Louisville MSA and the five-county KIPDA MPO region. Furthermore, the transparency of the Moody’s assumptions about national economic conditions makes the Moody’s forecasts more defensible than the W&P forecasts for the same period. Moody’s forecast contains the most valid assumptions as to the future course of underlying economic growth of the nation and subsequent growth of the MSA. For all of these reasons the “background growth” assumptions in subsequent sections of this report are based on the Moody’s “baseline” and “below-trend” forecasts.

ECONOMIC AND INFRASTRUCTURE SCENARIOS

Overview of Economic Modeling Approach

Scenario analysis is applied to assess the sensitivity of future housing and employment trends to different bridge, tolling and future economic possibilities in the five-county KIPDA MPO region. Different scenarios represent alternative possible futures with regard to both the overall level of economic activity expected in the region, as well as the geographic concentration of growth or decline.

The scenarios differ by two factors:

- (1) Background growth in the five-county KIPDA MPO region; and
- (2) Bridge build and toll alternatives.

The results of the scenario analysis demonstrate how changes in the above factors result in different spatial allocations of households and jobs in the five-county KIPDA MPO region, and different levels of regional bridge-contingent growth.

Background Growth in the Region

The scenarios assume that most of the Louisville MSA's growth in housing and employment will be "background" to the five-county KIPDA MPO region. Background growth refers to growth generated by regional economic dynamics described in the previous section and captured in published forecasts of housing and employment. The analysis assumes background growth will occur regardless of whether or not bridges are constructed.

For each scenario, an overall regional background growth level is assumed based on whether the scenario is intended to demonstrate the baseline growth trend, or a more conservative/slower growth trend (as described in the *Comparison of Growth Forecasts* section above).

Table 4 shows the overall trend of "most likely" and "below trend" forecasts of background household and employment growth for the five-county KIPDA MPO region from 2007 to 2030. The "most likely" future expects 71,017 new jobs and 72,383 new households. The "below trend" future expects only 60,533 new jobs and 69,276 new households (17 percent fewer jobs and four percent fewer households than the "most likely" scenario).

Because the “below trend” growth trajectory represents a slower recovery from the current recession than the “most likely” growth trajectory, over time (from 2007 to 2030) the employment level in the “below growth” trajectory gradually begins to catch up with the “most likely” forecast. This is because economic theory holds that eventually, even under the most pessimistic of assumptions and given enough time, the economy will absorb and gradually recover from the current recession or other downturns that could be currently foreseen. Therefore, the largest difference in employment is when the “below trend” forecast bottoms out in 2018 before rebounding and gradually catching up (but still not matching) the “most likely” forecast in 2030.

Because households are less mobile than jobs (households cannot be moved to and from the region as readily as jobs or business operations), they change considerably less, and recover more slowly than employment.

Table 4. Anticipated Background Growth Trend for Five-county KIPDA MPO region

	Households				Employment			
	2007	2011	2018	2030	2007	2011	2018	2030
Most Likely	425,672	442,974	475,382	498,054	572,650	550,729	618,083	643,666
Below Trend	425,671	442,974	474,295	494,947	572,650	550,729	606,787	633,183
% Variation in Growth	N/A	N/A	2%	4%	N/A	N/A	33%	17%

Source: Moody's Analytics, 2012

The totals shown in the table are consistent with Moody's' trend forecasts for the five-county KIPDA MPO region. As will be discussed in later sections, each county's growth is dependent on assumptions made about bridges, tolling and other infrastructure.

Cube Land Approach for Allocating Background Growth

The concentration of housing and employment growth in the five-county KIPDA MPO region is largely dependent on the development capacity (as defined by supporting infrastructure, environmental constraints and zoning) and level of build-out in different parts of the five-county KIPDA MPO region, as well as the relative attractiveness of available land as determined by accessibility and proximity to desired amenities (such as public facilities, services and retail establishments).

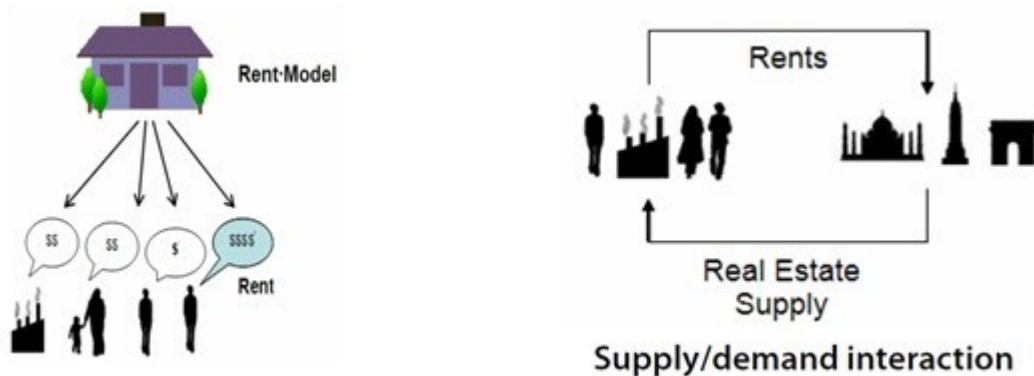
The development capacity is represented as a set of constraints limiting the maximum and minimum number of households or jobs that a given traffic analysis zone (TAZ) can accommodate. A zone's relative attractiveness is determined by a set of “bid” and “rent” functions, which vary among scenarios with different transportation build and tolling assumptions.

Estimation and Use of “Bid” and “Rent” Functions

The Cube Land modeling software is used to allocate background housing and employment growth because of its economic foundations, relatively minimal data collection requirements, and ease of calibration. Such characteristics make Cube Land models feasible to implement within the context of an independent economic study to support a traffic and revenue forecasting effort.

The Cube Land model is based upon the acclaimed bid-auction theory of Dr. Francisco Martinez at the University of Chile in Santiago.⁵ In essence, the theory provides a mathematical description of a real estate market in which agents of different types (e.g. households and firms of varying size and industry sector) compete against one another in bidding for location options within an urban region. The outcome of this bidding process is the so-called “rent” associated with a property in a particular zone. Suppliers of real estate (e.g. developers and landlords) compare rent with cost in deciding where and how to invest. In the long run, the interaction between this real estate supply allocation process and the bid-auction process results in an equilibrium land use development pattern, dependent upon a particular set of prior inputs and transportation access factors.

Figure 1. Bid-Rent Relationships Used for Land Modeling



Agent willingness to pay for real estate options is quantified using bid-rent functions which parameterize various location attributes, such as unit size and quality, as well as transportation accessibility and attractiveness. The core set of data required to develop a Cube Land model is thus provided by the socioeconomic and free-flow skim matrix tables (provided by the CS application of the five-county KIPDA region MPO Model).

⁵ See Martinez, Francisco J. “Towards a Land-Use and Transport Interaction Framework” in Hensher, David and Kenneth Button, eds. *Handbook of Transport Modelling* (Second Edition). Boston: Elsevier, 2008.

The land allocation model also parameterizes additional variables to quantify other conceptual factors affecting the value of location options, such as availability of public services. The model encoded various development constraints, such as wetlands, floodplains, high slopes, utility easements, conservation land, and zoning regulations as “restrictions” which limited the solution space of the equilibrium land use allocation algorithm to only certain feasible outcomes.

Once bid-rent function parameters are estimated from the observed data, the working Cube Land model is calibrated to ensure that it replicates conditions in the base year (2007). The calibration consists of iterative calculations of bid, rent, and cost adjustment factors based upon the comparison of model outputs with target values. These adjustments can be interpreted to embody all of the unobservable phenomena exogenous to the bid-auction process that influence land use patterns, including the inertia associated with historical development. Thus, the forecasts which are produced by the Cube Land model tend to “pivot” off of the base year used for calibration, taking into account intervening changes in accessibility and other factors, rather than positing a completely new pattern disconnected from present-day realities. In the current study, such forecasts are used for comparison analysis of alternative bridge scenarios, to independently assess the redistributive potential associated with project implementation.

Cube Land Approach for Spatial Allocation

Parameters are estimated from the KIPDA travel model data for the following variables in the Cube Land bid-rent functions using multinomial logistic regression techniques:

- **Accessibility:** number of jobs within 40 generalized-cost units of the home traffic analysis zone (TAZ) at mid-day, where generalized cost is defined as $[time] + ([toll] + [distance]*[$/mi])/[$/min]$
- **Attractiveness:** number of households within 40 generalized-cost-units of the TAZ
- **Non-CBD dummy variable:** equal to 1 if a TAZ is not in the central business district
- **Single-family housing dummy variable:** equal to 1 for single-family detached housing
- **Alternative-specific constants:** for vehicle ownership and employment type categories

While all estimated parameters included in the model are found statistically significant and overall model statistics such R^2 indicate a reasonable level of fit, the overall TAZ allocation approach recognizes that many other factors influence the spatial distribution of housing and employment besides the few variables that could be quantified in the land use model. Specifically, zonal land supply capacity, as well as zoning regulations, and local attitudes and political views could influence future development patterns in ways that might not be captured by an unconstrained model application.

To provide a means for adjusting forecasts to meet constraints developed based upon professional judgment and local area knowledge, a shadow pricing routine is added to the model. The shadow pricing routine applies a fictitious subsidy or tax to each zone, as needed, to enforce an upper bound on either the total number of households or the total number of employees in the zone. Through an iterative process of adjusting the zonal constraints and reviewing model runs in light of the field work from the regional assessment, the team has developed modified forecasts taking into account factors which the model did not explicitly parameterize. The team has also developed a “fixed-supply” routine, allowing exogenous adjustments to total zonal households and employment, and then evaluate just the bid-auction component of Cube Land. The use of “fixed supply” mode results in disaggregate findings regarding number of households by type in order to forecast auto ownership category, size, population, and income distribution.

Cube Land approach for allocating households to different size, auto ownership and income cohort

The Louisville MPO model is based on data provided by KIPDA and, as such, the household and industry classification scheme used in Cube Land closely follows the KIPDA socioeconomic data file structure. The land allocation model recognizes three categories of employment: retail, service and other. The model also defines twenty household types, representing combinations of vehicle ownership category and households size based on pre-existing socioeconomic data, as shown in Table 5 below.

Table 5. Household Characteristics

HH Type	Vehicles=0	Vehicles=1	Vehicles=2	Vehicles=3+
Category #	1	2	3	4
Persons=1	1	2	3	4
Persons=2	5	6	7	8
Persons=3	9	10	11	12
Persons=4	13	14	15	16
Persons=5+	17	18	19	20

The team has gathered Census American Community Survey 2006-2008 three-year Public Use Microdata Sample (PUMS) data for the Public Use Microdata Areas (PUMAs) representing the five-county KIPDA MPO region in order to calculate the following aggregate attributes for each household type:

- Household size (i.e. for households with more than five persons);
- Percent of households having income of less than \$40,000 per year;
- Percent of households having income of \$40,000-\$59,999 per year; and
- Percent of households having income of \$60,000 or more per year.

Using census data enables the team to make estimates of zonal population and income distribution drawn from a Cube Land model and allocating households by size and vehicle ownership category. It may be noted that this is a more dynamic approach than that originally taken in developing the KIPDA travel demand model, wherein 2000 Census income distributions by tract were applied uniformly to all TAZs within each tract. By contrast, in the modeling process based on Cube Land, zone-level income distributions are computed for each TAZ as the direct average of the income distributions of each size and vehicle ownership category weighted by the number of households in each category within the TAZ as allocated by Cube Land (calibrated to the 2007 KIPDA distribution of households by size and vehicle ownership).

The Role of Expert Judgment in Final Allocation of Background Growth

The team relies on expert judgment and field work in the Louisville MSA as the basis for assumptions about development constraints informing the Cube Land model's results. Business location and residential development occur within the five-county KIPDA MPO region subject to a number of factors besides the transportation network, including land availability, land use regulations (such as zoning), the availability of utilities and water/sewer infrastructure, incentives and tax policies, and intangibles such as quality of life and local incentives. The team relies upon site visits and 38 interviews from 2012 plus eight follow-up interviews in 2013 with local officials, businesses and economic development agencies to develop a clear understanding about specific areas within the region that are likely to grow and the types of development likely to be attracted to specific sites. The team spent six person-days in the field reviewing sites and conducting interviews, with follow-up telephone and email correspondence. Before visiting the Louisville MSA, the team studied aerial photography and conducted web-based research on the area's economy, growth trends among industries, economic development programs, and information about the region's competitive position relative to other MSAs of the country.

Ultimately, the knowledge developed through field work and interviews provided the basis for the review and validation of Cube Land model. Post-model adjustments were made in areas where growth trends were evident in the empirical work that may not have been captured in modeling. These adjustments ensure that the final analysis reflects findings in the field about the relative competitiveness of sub regions within the Louisville MSA.

Bridge-Contingent Development Assumption and Its Basis

In addition to the background growth described in the previous section, the current study assesses the potential for "bridge-contingent growth". Bridge-contingent growth refers to net-new growth in the five-county KIPDA MPO region that is attracted, created or expanded to the region specifically because of the amenities associated the bridge alternatives. It is expected that the most bridge-contingent development is likely to occur

if the East End Bridge is completed. This sub-section builds on earlier sections' analysis of economic development strategies and conditions to describe the basis for findings regarding bridge-contingent development.

Based on site visits to the Louisville MSA and interviews with economic development professionals, developers and land owners, the Ohio River Bridges Project can be expected to directly attract or create approximately 9,342 jobs in the 30-year analysis period. Based on the Minnesota IMPLAN Group's input-output tables (derived from BEA I/O tables), these direct jobs are expected to spur another 5,078 jobs (induced and indirect effects of supplying the 9,342 jobs), for a total of 14,420 bridge-contingent jobs by 2030. Half of this is expected to occur by 2018.

As of January, 2013, over 2,600 of these expected jobs had already materialized in the River Ridge Commerce Center in anticipation of the opening of the proposed East End Bridge. The majority of the contingent development impacts are expected to be located in eastern Clark County in the vicinity of the Port of Indiana and the River Ridge Commerce Center. The East End Bridge will directly serve these two unique facilities. The Port of Indiana provides multi-modal transportation services including rail, river barge and highway, making the area attractive to businesses that rely on a range of transportation modes for shipping and receiving goods. The East End Bridge will enhance the highway network available to multi-modal businesses, will open markets to the south, and will better connect to a fourth mode of transportation – aviation – at the Louisville International Airport. Based on interviews with economic development officials and businesses, as well as a review of recent industry trends in the region, it is expected that the existing businesses likely to expand because of the new bridge include transportation providers (stevedores⁶, rail, trucking), metal fabricators, and food processors.

River Ridge Commerce Center has over 3,000 acres of land within an existing commerce park and expects to add approximately 3,000 more acres over time. River Ridge Commerce Center is unrivaled in size in the region and in the nation. It can provide businesses with access to the port facilities and can accommodate businesses that need very large tracts of land. The new East End Bridge will enhance the marketability of the site for national and international businesses that need large development sites, access to multi-modal transportation, and access to markets throughout the United States.

The River Ridge Development Authority believes that the completion of the East End Bridge will lead to the development of an additional two million square feet of new construction per year within the River Ridge Commerce Center until the Commerce Center is fully built-out. In estimating bridge-contingent effects, the team chose to assume growth equal to only 25 percent of the Development Authority's estimated construction footage. Sectors likely to benefit from the East End Bridge are

⁶ "one who works at or is responsible for loading and unloading ships in port" *Merriam-Webster Dictionary*

Manufacturing (which includes food production, fabricated metals, machinery, computer and electronic equipment), and *Transportation and Warehousing*. The MSA has targeted these as likely regional growth sectors, based on the mix of current businesses using the facility, a review of recent industry trends, and discussions with developers and economic development officials about the types of businesses that are showing interest in the property. Included in the 9,342 employment estimate is the new Amazon.com facility (employer of 2,600 employees), which noted the importance of the Ohio River Bridges project in its location decision.

The employment estimates for the Louisville MSA also include some small increases in educational services based on discussions with the two colleges in the Louisville MSA, as well as some increase in waste management, based on survey responses. The 14,420 bridge contingent jobs are expected to bring with them an additional 3,247 new households by 2030, 2,050 of which are expected by 2018 (based on current build-out levels in new residential developments as of January, 2013).

Modeling Approach: Conclusions

The modeling approach described above uses the Cube Land model to allocate projected “background” household and employment forecasts for the five-county KIPDA MPO region. Cube Land bases this allocation on a set of factors that includes comparative levels of transportation accessibility. The modeling approach also allows for some level of “bridge-contingent” new growth to the background allocation accounting for the national attractiveness of the East End Bridge as an amenity. The inputs to the process came from the field work described previously. Inputs also came from data currently used in the KIPDA travel model and used a bid-rent function to determine the TAZ level allocation of household and employment.

Description of Scenarios and their Rationale

Overview of Five Scenarios and Their Assumptions

To understand the sensitivity of economic development in the five-county KIPDA MPO region, the team presents the results of the above described methodology as four scenarios. Each scenario represents different assumptions about bridge infrastructure, tolling, and underlying economic conditions. Each scenario is found to result in a different distribution of housing and employment within the five-county KIPDA MPO region (as reflected in the tabular data provided). Some scenarios represent more bridge-contingent development than others. The following is a summary of assumptions defining each of the scenarios.

Scenario 1: Base-Case Scenario

The Base-Case scenario assumes full build and tolling of both the Kennedy Bridge and the East End Bridge, as well as all of the other projects in KIPDA's future network. The scenario assumes the "most likely" background regional growth level (see Table 4). Because the East End Bridge is included in the Base-Case scenario, all 14,420 bridge-contingent jobs and all 3,247 bridge-contingent households occur in this forecast by 2030. The scenario is intended to show the socioeconomic housing and employment levels and allocation of full build-out under most likely economic conditions. As the name implies, the Base-Case scenario is the "base" against which all other scenarios are compared.

Scenario 2: No East End Bridge Scenario

The No East End Bridge scenario is like the Base-Case scenario in all respects, except that the East End Bridge is not included. For this reason, only 4,013 of the bridge-contingent jobs (including existing 2,600 direct jobs at the Amazon site and 1,413 indirect and induced jobs spun-off by the site) occur by 2030 in Scenario 2. In a similar fashion, only 904 of the 3,247 bridge-contingent new households occur in Scenario 2. These jobs and households are mostly due to pre-emptive development that has already occurred in anticipation of the East End Bridge, but would be unlikely to leave even if the bridge is not built. Scenario 2 is intended to show where and how employment and housing growth in the five-county KIPDA MPO region is likely to differ from Base-Case scenario if the East End Bridge is not completed.

Scenario 3: Growth Balance Favoring Indiana

In the Growth Balance Favoring Indiana scenario, overall regional growth follows the "most likely" background regional growth trajectory, but the balance of growth is weighted towards Indiana. In Scenario 3, Kentucky's households and employment actually grow at the "Below Trend" level (as shown in Table 4), but growth incentives in Indiana enable the Indiana counties to grow at a faster rate to compensate. Because the East End Bridge is included in this scenario, the full 14,420 bridge-contingent jobs by 2030 are included in this forecast as are the 3,247 bridge-contingent households. Scenario 3 is intended to show where and how employment and housing growth in the five-county KIPDA MPO region is likely to differ from the base-case if growth patterns significantly favor Indiana over Kentucky.

Scenario 4: Below Trend Regional Growth

In the Below Trend Regional Growth scenario, overall regional growth follows a "below trend" background regional growth trajectory for both Kentucky and Indiana in which households and employment grow more slowly than in the Base-Case scenario. For this reason, areas that have significant growth in housing and employment in other scenarios feature lower future housing and employment when compared to the Base-Case scenario. The Below Trend Regional Growth scenario is intended to show the location

and degree to which slower growth in housing and employment may affect future five-county KIPDA MPO regional socioeconomic conditions.

DRAFT

CONCLUSIONS

Overall, the Louisville MSA economy is expected to perform in a manner consistent with published growth forecasts for the Louisville MSA, and to exceed those forecasts if the amenities of the East End Bridge are in place. The Louisville five-county KIPDA MPO region's job and housing growth is expected to be fairly consistent to 2030, with a most likely scenario resulting in expected 17 percent growth in households and a 12 percent growth in employment between 2007 and 2030. If the overall growth in the economy performs poorer than expected, there is still a 95 percent likelihood that the five-county KIPDA MPO region will experience at least a 14 percent increase in employment and an 11 percent increase in households as the economy recovers from 2011 to 2030.

This job and housing growth is likely to be augmented by additional new employment associated with the East End Bridge, centering on the River Ridge Commerce Center, with an overall employment gain for the five-county KIPDA MPO region expected to exceed 14,000 new jobs and over 3,000 new households by 2030 resulting from business attraction to the River Ridge Commerce Center. An Amazon.com plant employing 2,600 of these new employees has already opened in anticipation of the East End Bridge.

Differences in accessibility costs and housing and employment growth rates among scenarios suggest it is unlikely that existing households or businesses in the five-county KIPDA MPO region will undertake the costs of relocating due to changes in infrastructure, tolling or growth rates. For this reason, it is concluded that most of the geographic shifts in housing and employment sensitive to economic growth assumptions on bridge and tolling options will concern the location of future, not existing, households and jobs.

Overall, the availability of the East End Bridge attracts a large share of accessibility-oriented households and businesses to River Ridge Commerce Center and Charlestown areas of Indiana that would have otherwise been attracted to areas accessible to the I-65 and I-71 interchanges in Indiana and Kentucky, respectively. This availability effect of the East End Bridge is visible in the comparison of Scenario 2 (No East End Bridge scenario) to Scenario 1 (Base-Case scenario with the bridge). Areas where the concentration of future housing and employment growth is most sensitive to regional economic conditions (such as the River Ridge Commerce Center in Indiana, the Gene Snyder Freeway area in Kentucky and the Jefferson-Riverport area in Kentucky) may face considerable stagnation in job growth if the economy grows more slowly than expected. Housing areas within the travelshed of the I-65 corridor in Indiana, the I-71 corridor in Kentucky and the Route 62 corridor in Indiana are primed for growth that may be dampened if the economy grows more slowly than anticipated.

A review of factors supporting and inhibiting growth in the five-county KIPDA MPO region leads to the conclusion that Scenario 1: Base-Case Scenario is the most likely to occur, with a greater than 90 percent chance that a growth level and spatial pattern consistent with this scenario can be expected in the five-county KIPDA MPO region. Analysis corroborated by independent forecasts finds less than a five percent chance of the slower growth shown in Scenario 4: Below Trend Regional Growth, and a 10 percent chance of an imbalanced growth scenario similar to Scenario 3: Growth Balance Favors Indiana.

DRAFT

Appendix B Travel Survey

Travel Study

Questionnaire # _____

Q.1 Thank you for agreeing to take part in this study. Your answers are completely confidential and used only for statistical purposes related to future transportation planning.

The survey takes about 15 minutes and explores transportation issues in Louisville and its surroundings.

Q.2 Please indicate your age.

[REQUIRE ANSWER]

Under 18	1
18 -24	2
25-29	3
30-34	4
35-39	5
40-44	6
45-49	7
50-54	8
55-59	9
60-64	10
65-69	11
70-74	12
75+	13

[SHOW: Map1.gif]

Q.3 The map below shows the city of Louisville and surrounding communities. Our questions are about trips that you have taken by private vehicle (car, van, SUV) using the I-65, US 31 or I-64 bridges highlighted below.

&IMG&

Please note you can enlarge any map in this study by hovering your mouse over the map.

[SHOW: Map1.gif]

Q.4 Please take a look at the map below and the three highlighted bridges.

When was the most recent time you personally drove across the Ohio River using any one of I-65, I-64 or US 31 bridges?

&IMG&

[REQUIRE ANSWER]

I have never personally driven on I-65, I-64 or US 31 across	
Ohio River	1
Today	2
1-2 days ago	3
3-4 days ago	4
5-6 days ago	5

1 week to less than 2 weeks ago	6
2 weeks to less than 3 weeks ago	7
3 weeks to less than 1 month ago	8
1 month to less than 2 months ago	9
2 months to less than 3 months ago	10
3 months to less than 6 months ago	11
6 months to less than 1 year ago	12
1 year ago or longer	13
I don't recall	14

[SHOW: Map1.gif]

Q.5 During the past 2 months, which of the following three bridges did you use the most?

&IMG&

[REQUIRE ANSWER]

I-65 Bridge	1
I-64 Bridge	2
US 31 Bridge	3
I did not use these bridges in the past month	4

[CALCULATE - TRIGGER: 1-3 EQ: 1 RQ: 58 FORMULA: 0]

[SHOW: Map1.gif]

Q.6 We will now ask you to think about your trips on the [ANSWER TO Q. 5].

During a typical week, approximately how many times do you personally drive across the Ohio River on the [ANSWER TO Q. 5] during the following time periods?

Be sure to count outbound and return trips separately. For example, a round trip where you used the [ANSWER TO Q. 5] both going and returning is considered 2 trips. Please do not consider vacation weeks.

&IMG&

Please enter a value for each time period. If no trips were taken for a specific time period, enter a 0 (zero) for that period.

Number of trips during a typical week on the [ANSWER TO Q. 5] across Ohio River:

[REQUIRE ANSWER] [ANSWERS MUST ADD TO MORE THAN OR EQUAL TO 1]

Monday - Friday between midnight and 6:00 am	_____
Monday - Friday from 6:00 am to 9:00 am	_____
Monday - Friday from 9:01 am to 3:29 pm	_____
Monday - Friday from 3:30 pm to 6:30 pm	_____
Monday - Friday between 6:30 pm and midnight	_____
Weekend - Anytime Saturday & Sunday	_____
Total	

[CALCULATE - TRIGGER: N0 EQ: 6 RQ: 7 FORMULA: 1]
 [CALCULATE - TRIGGER: N0 EQ: 6 Sub-q: 2 RQ: 7 FORMULA: 1]
 [CALCULATE - TRIGGER: N0 EQ: 6 Sub-q: 3 RQ: 7 FORMULA: 1]
 [CALCULATE - TRIGGER: N0 EQ: 6 Sub-q: 4 RQ: 7 FORMULA: 1]
 [CALCULATE - TRIGGER: N0 EQ: 6 Sub-q: 5 RQ: 7 FORMULA: 1]
 [CALCULATE - TRIGGER: N999 EQ: 6 EQ2: 6 Sub-q: 2 RQ: 8 FORMULA: E+S]
 [CALCULATE - TRIGGER: N999 EQ: 8 EQ2: 6 Sub-q: 3 RQ: 8 FORMULA: E+S]
 [CALCULATE - TRIGGER: N999 EQ: 8 EQ2: 6 Sub-q: 4 RQ: 8 FORMULA: E+S]
 [CALCULATE - TRIGGER: N999 EQ: 8 EQ2: 6 Sub-q: 5 RQ: 8 FORMULA: E+S]
 [CALCULATE - TRIGGER: N999 EQ: 8 EQ2: 6 Sub-q: 6 RQ: 8 FORMULA: E+S]

[A - IF THE ANSWER TO SUB-QUESTION 1 OF QUESTION 6 IS NOT 99, THEN SKIP TO QUESTION 9]

Q.7 WEEKDAY

 weekday 1

Q.8 TOTAL TRIPS

.....

Q.9 You said you make about [ANSWER TO Q. 8] one-way trips on the [ANSWER TO Q. 5].

During a typical week, approximately how many times do you personally drive across the other two bridges?

Again, be sure to count outbound and return trips separately. For example, a round trip where you used a bridge both going and returning is considered 2 trips. Do not consider vacation weeks.

[REQUIRE ANSWER] [READ ONLY ANSWERS NOT PICKED IN QUESTION 5]

I-65 Bridge
 I-64 Bridge
 US 31 Bridge

Q.10 We have some questions about your most recent[ANSWER TO Q. 7] trip across the Ohio River using the [ANSWER TO Q. 5].

What was the main purpose of your most recent[ANSWER TO Q. 7] trip you made using the [ANSWER TO Q. 5]?

Select one option only. If you are unsure, select the type of trip you make most frequently on the [ANSWER TO Q. 5].

[REQUIRE ANSWER]

A trip to and from a usual place of work, as part of a regular commute 1
 A trip to and from a place of education, as part of a regular commute 2
 A trip on business, as part of your job (on-site visit, client meeting, conference, but not the commute) 3
 A trip for shopping 4
 A trip for leisure purposes (visiting family or friends, etc.) 5
 A trip for personal business (doctor appointment, etc.) 6
 Other reason 7

[CALCULATE - TRIGGER: 1-6 EQ: 10 RQ: 11 FORMULA: Q]

[A - IF THE ANSWER TO QUESTION 10 IS 1-7, THEN SKIP TO QUESTION 12]

Q.11 PURPOSE

to or from work	1
to or from a place of education	2
on business	3
to go shopping	4
for leisure purposes	5
for personal business	6

Q.12 The following questions are about the outbound portion of your most recent trip[ANSWER TO Q. 11]
driving on the [ANSWER TO Q. 5].

Where did you start your recent outbound trip on the [ANSWER TO Q. 5]? Please select the name of the city, town or area where you started your trip.

If you drove to and from a destination on the bridge (e.g. work, a friend's house, etc.), your drive to the destination is the outbound trip. Your drive back is the return trip.

Likewise, if you made several stops (e.g. running errands, etc.), then consider the drive away from your starting point to the furthest point on the other side of the Ohio River as the outbound trip and the drive back to the starting point as the return trip.

If you only used the [ANSWER TO Q. 11] once on your trip, please consider that trip for the following questions.

If you do not see the exact city, town or area, please select the name that is closest to where you started.

[REQUIRE ANSWER]

Austin, IN	1
Vienna, IN	38

Q.13 Which of the following best describes the point where your recent trip started?

[REQUIRE ANSWER]

A private home (house, apartment, condominium, etc.)	1
A place of work, business, or government office	2
A hotel or motel	3
A school, college, or university	4
A place of entertainment, sports, or worship	5
An airport	9
A bus station	10
Other	19

Q.14 At what time of day did you start your trip[ANSWER TO Q. 11] from [ANSWER TO Q. 12]?

[REQUIRE ANSWER]

Midnight - 12:59 AM 1
11:00 - 11:59 PM 24

Q.15 Did you have any flexibility over when you left to make this trip, or did you have to leave at a specific time?

[REQUIRE ANSWER]

Yes, I had flexibility over when I made this trip 1
No, I had to leave at a specific time 2

[A - IF THE ANSWER TO QUESTION 15 IS 2, THEN SKIP TO QUESTION 18]

Q.16 I could have left earlier by:

[REQUIRE ANSWER]

0 minutes 1
Up to 30 minutes 2
Up to 60 minutes 3
Up to 90 minutes 4
Up to 2 hours or more 5

Q.17 I could have left later by:

[REQUIRE ANSWER]

0 minutes 1
Up to 30 minutes 2
Up to 60 minutes 3
Up to 90 minutes 4
Up to 2 hours or more 5

Q.18 Where were you driving to?

If you made a trip that did not have one specific destination, e.g. running errands, please indicate the city or town you visited that was furthest point on the other side of the Ohio River from where you started your trip.

If you do not see the exact city, town or area, please select the name that is closest to where you ended your trip.

[REQUIRE ANSWER]

Austin, IN 1
Vienna, IN 38

Q.19 Which of the following best describes the point where this trip[ANSWER TO Q. 11] ended?

[REQUIRE ANSWER]

- | | |
|--|----|
| A private home (house, apartment, condominium, etc.) | 1 |
| A place of work, business, or government office | 2 |
| A hotel or motel | 3 |
| A school, college, or university | 4 |
| A place of entertainment, sports, or worship | 5 |
| A store (retail, grocery, dry cleaners, etc.) | 6 |
| A restaurant or other dining | 7 |
| A personal appointment (doctor, hair, etc.) | 8 |
| An airport | 9 |
| A bus station | 10 |
| Other | 19 |

Q.20 How easy or difficult would it have been to complete the same activity somewhere else so that it would not be necessary to cross the Ohio River?

[REQUIRE ANSWER]

- | | |
|--------------------------|---|
| No problem at all | 1 |
| Very easy | 2 |
| Somewhat easy | 3 |
| Somewhat difficult | 4 |
| Very difficult | 5 |
| Impossible | 6 |

Q.21 Now, please tell us a few details about the route you used on that trip.

Did you make any stops along the way other than for gas?

Do not include any stops made at the gas station.

[REQUIRE ANSWER]

- | | |
|----------------------------|---|
| No | 1 |
| Yes, 1 stop | 2 |
| Yes, 2 stops | 3 |
| Yes, 3 or more stops | 4 |

[A - IF THE ANSWER TO QUESTION 21 IS 1, THEN SKIP TO QUESTION 24]

Q.22 Approximately how many minutes did these stops add to the total trip time? If more than one stop, combine the time for all stops.

Please enter whole numbers only.

[REQUIRE ANSWER]

Minutes _____

Q.23 Did you choose the route you did because you had to make these stops?

[REQUIRE ANSWER]

Yes 1

No 2

Q.24 Approximately how many minutes did your recent outbound trip[ANSWER TO Q. 11] to [ANSWER TO Q. 18] take?

Include only the time in the car and don't include any time you spent at stops along the way. Please include any delays due to congestion that occurred. If you are not sure, please make your best estimate.

Please enter whole numbers only.

[REQUIRE ANSWER]

Minutes _____

Q.25 Including yourself and any children, how many people were in the car for your recent outbound trip?

[REQUIRE ANSWER]

I was alone 1

2 people 2

3 people 3

4 people 4

5 people 5

6 people 6

7 or more people 7

[SHOW: Map1.gif]

Q.26 Thinking about the same recent outbound trip, how long do you think your trip would have taken using the following alternate bridges?

Include only the time in the car and don't include any time you would have spent at stops along the way. Please include any delays you think you would have encountered due to congestion. If you are not sure, please make your best estimate.

Please answer in minutes and enter whole numbers only.

&IMG&

[REQUIRE ANSWER] [READ ONLY ANSWERS NOT PICKED IN QUESTION 5]

I-65 Bridge _____

I-64 Bridge _____

US 31 Bridge _____

Q.27 Again, thinking about your most recent trip[ANSWER TO Q. 11] using the [ANSWER TO Q. 5], did you also make a return trip using the [ANSWER TO Q. 5] from [ANSWER TO Q. 18] back to [ANSWER TO Q. 12]?

[REQUIRE ANSWER]

Yes, I returned using the same bridge 1
No, I returned using a different bridge 2
No, I didn't make a return trip 3

[A - IF THE ANSWER TO QUESTION 27 IS 1, THEN SKIP TO QUESTION 29]

[A - IF THE ANSWER TO QUESTION 27 IS 3, THEN SKIP TO QUESTION 32]

Q.28 You said you made a return trip back to [ANSWER TO Q. 12] but without using the [ANSWER TO Q. 5]. Why was this?

[REQUIRE ANSWER]

To avoid congestion by using an alternate route 1
Given the stops I made, it was more convenient to return
using a different route 2
For another reason 3

Q.29 Compared to your outbound trip, would you say that the drive back to [ANSWER TO Q. 12] was...

[REQUIRE ANSWER]

Significantly longer 1
Somewhat longer 2
About the same time 3
Somewhat shorter 4
Significantly shorter 5

Q.30 At what time of day did you start your return trip back to [ANSWER TO Q. 12]?

[REQUIRE ANSWER]

Midnight - 12:59 AM 1
11:00 - 11:59 PM 24

Q.31 Approximately how many minutes did your recent return trip take? Please include any delays due to congestion that occurred.

Include only the time in the car and don't include any time you spent at stops along the way to do something. Please include any delays due to congestion that occurred. If you are not sure, please make your best estimate.

Please enter whole numbers only.

[REQUIRE ANSWER]

Minutes _____

Q.32 Which of the following costs, other than fuel costs, did you incur on your most recent outbound and return (if there was one) trips?

Select all that apply.

[REQUIRE ANSWER]

I had no costs other than fuel	1
Parking	2
Toll charges	3
Other costs	4

[EXCLUSIVE ANSWER: "I had no costs other than fuel"]

Q.33 Approximately how much did the entire trip cost, including both the trip out and the trip back (if there was one)?

Include all costs you incurred such as fuel, parking, tolls, etc. If you are unsure, please estimate.

Please type your response in whole dollar amount. For example twenty dollars would be entered as 20.

[REQUIRE ANSWER]

Total cost in dollars - \$

Q.34 For this recent trip, who was responsible for paying your driving costs (i.e. tolls, fuel, parking, etc.)?

Select all that apply.

[REQUIRE ANSWER]

I pay all of the costs	1
I share the cost with others in the car	2
I share the cost with others in my household	3
I share the cost with my employer	4
Someone else in the car pays all of the costs	5
Someone else not in the car pays all of the costs	6
Someone in my household pays all of the costs	7
My employer pays all of the costs	8
Other	9

[EXCLUSIVE ANSWER: "I pay all of the costs"]

[EXCLUSIVE ANSWER: "Someone else in the car pays all of the costs"]

[EXCLUSIVE ANSWER: "Someone else not in the car pays all of the costs"]

[EXCLUSIVE ANSWER: "Someone in my household pays all of the costs"]

[EXCLUSIVE ANSWER: "My employer pays all of the costs"]

Q.35 Suppose gas price were to increase to \$4.50 per gallon. Are you more likely to use...

[REQUIRE ANSWER]

A route with local roads including traffic signals that is
shorter in distance but takes more time 1
A route with freeways that is longer in distance but takes less time 2

[CALCULATE - TRIGGER: N99 EQ: 35 RQ: 36 FORMULA: E]

[A - IF THE ANSWER TO QUESTION 35 IS NOT 99, THEN SKIP TO QUESTION 37]

Q.36 FREEALTERNATIVE

A free route with local roads including traffic signals 1
A freeway with access ramps 2

Q.37 Suppose that you have to drive 60 minutes on a freeway to make your trip[ANSWER TO Q. 11].

If a new expressway were now available, but requires you to pay a toll of \$2.00 for each trip, by how many minutes must the new expressway be faster than the freeway for you to use it?

[REQUIRE ANSWER]

Minutes faster _____

Q.38 Now think again about your recent outbound trip on the [ANSWER TO Q. 5].

Suppose that you will now be required to pay a toll to use this bridge.
How much would the toll need to be for you to deem to too expensive to consider using this bridge?

[REQUIRE ANSWER]

Toll - per trip _____

Q.39 The Kentucky Transportation Cabinet (KYTC) is considering massive improvements to the transportation infrastructure in the Louisville metropolitan area.

These include the construction of a new bridge across the Ohio River. The additional capacity will help reduce congestion and make travel times more reliable. It will also improve access to Louisville, KY.

To help pay for the improvements, the new bridges will be tolled. You will be able to pay the toll using electronic pass, reducing delays caused by drivers paying with cash.

You will now be shown 9 descriptions of two alternative routes for your trip across the Ohio River. One is [ANSWER TO Q. 11]. The other is a route with a faster tolled road.

Consider that you are making your typical trip&& as you have described to us, and only these two alternatives are available.

All other aspects of your regular trip should remain the same, such as the time of day that you travel, who you travel with and any other constraints you may have.

Please assume that any other free alternative routes are either unavailable or have same or worse congestion as the two route options.

[D - IF THE ANSWER TO QUESTION 36 IS 2, THEN SKIP TO QUESTION 49]

Q.40 Please select the most appealing option

[REQUIRE ANSWER]

A new tolled bridge with access ramps designed to ensure no congestion {tolled.jpg} Expected time: 5 minutes less than a typical trip Cost: \$3.50	&& {Local_Medium.jpg} Expected time: 5 minutes more than a typical trip Cost: Free
2	1

[CALCULATE - TRIGGER: 2 EQ: 58 RQ: 58 FORMULA: E+1]

[ASK QUESTIONS 41 TO 48 IN RANDOM ORDER]

Q.41 Please select the most appealing option

[REQUIRE ANSWER]

A new tolled bridge with access ramps designed to ensure no congestion {tolled.jpg} Expected time: 5 minutes less than a typical trip Cost: \$0.50	&& {local_heavy.jpg} Expected time: 10 minutes more than a typical trip Cost: Free
2	1

[CALCULATE - TRIGGER: 2 EQ: 58 RQ: 58 FORMULA: E+1]

Q.42 Please select the most appealing option

[REQUIRE ANSWER]

&& {local_heavy.jpg} Expected time: 10 minutes more than a typical trip Cost: Free	A new tolled bridge with access ramps designed to ensure no congestion {tolled.jpg} Expected time: 5 minutes less than a typical trip Cost: \$1.00
1	2

[CALCULATE - TRIGGER: 2 EQ: 58 RQ: 58 FORMULA: E+1]

Q.43 Please select the most appealing option
[REQUIRE ANSWER]

A new tolled bridge with access ramps designed to ensure no congestion {tolled.jpg} Expected time: 5 minutes less than a typical trip Cost: \$2.00	&& {Local_heavy.jpg} Expected time: 10 minutes more than a typical trip Cost: Free
2	1

[CALCULATE - TRIGGER: 2 EQ: 58 RQ: 58 FORMULA: E+1]

Q.44 Please select the most appealing option
[REQUIRE ANSWER]

&& {Local_heavy.jpg} Expected time: 10 minutes more than a typical trip Cost: Free	A new tolled bridge with access ramps designed to ensure no congestion {tolled.jpg} Expected time: 5 minutes less than a typical trip Cost: \$2.50
1	2

[CALCULATE - TRIGGER: 2 EQ: 58 RQ: 58 FORMULA: E+1]

Q.45 Please select the most appealing option
[REQUIRE ANSWER]

A new tolled bridge with access ramps designed to ensure no congestion {tolled.jpg} Expected time: 5 minutes less than a typical trip Cost: \$3.50	&& {Local_heavy.jpg} Expected time: 10 minutes more than a typical trip Cost: Free
2	1

[CALCULATE - TRIGGER: 2 EQ: 58 RQ: 58 FORMULA: E+1]

Q.46 Please select the most appealing option
[REQUIRE ANSWER]

&& {Local_Medium.jpg} Expected time: 5 minutes more than a typical trip Cost: Free	A new tolled bridge with access ramps designed to ensure no congestion {tolled.jpg} Expected time: 5 minutes less than a typical trip Cost: \$1.00
1	2

[CALCULATE - TRIGGER: 2 EQ: 58 RQ: 58 FORMULA: E+1]

Q.47 Please select the most appealing option
[REQUIRE ANSWER]

A new tolled bridge with access ramps designed to ensure no congestion {tolled.jpg} Expected time: 5 minutes less than a typical trip Cost: \$2.00	&& {Local_medium.jpg} Expected time: 5 minutes more than a typical trip Cost: Free
2	1

[CALCULATE - TRIGGER: 2 EQ: 58 RQ: 58 FORMULA: E+1]

Q.48 Please select the most appealing option
[REQUIRE ANSWER]

&& {Local_medium.jpg} Expected time: 5 minutes more than a typical trip Cost: Free	A new tolled bridge with access ramps designed to ensure no congestion {Tolled.jpg} Expected time: 5 minutes less than a typical trip Cost: \$3.00
1	2

[CALCULATE - TRIGGER: 2 EQ: 58 RQ: 58 FORMULA: E+1]
[A - IF THE ANSWER TO QUESTION 48 IS 1-2, THEN SKIP TO QUESTION 59]

Q.49 Please select the most appealing option
[REQUIRE ANSWER]

A new tolled bridge with access ramps designed to ensure no congestion {tolled.jpg} Expected time: 5 minutes less than a typical trip Cost: \$3.50	&& {Freeway_medium.jpg} Expected time: 5 minutes more than a typical trip Cost: Free
2	1

[CALCULATE - TRIGGER: 2 EQ: 58 RQ: 58 FORMULA: E+1]
[ASK QUESTIONS 50 TO 57 IN RANDOM ORDER]

Q.50 Please select the most appealing option
[REQUIRE ANSWER]

A new tolled bridge with access ramps designed to ensure no congestion {tolled.jpg} Expected time: 5 minutes less than a typical trip Cost: \$0.50	&& {Freeway_heavy.jpg} Expected time: 10 minutes more than a typical trip Cost: Free
2	1

[CALCULATE - TRIGGER: 2 EQ: 58 RQ: 58 FORMULA: E+1]

Q.51 Please select the most appealing option

[REQUIRE ANSWER]

&& {Freeway_heavy.jpg} Expected time: 10 minutes more than a typical trip Cost: Free	A new tolled bridge with access ramps designed to ensure no congestion {tolled.jpg} Expected time: 5 minutes less than a typical trip Cost: \$1.00
1	2

[CALCULATE - TRIGGER: 2 EQ: 58 RQ: 58 FORMULA: E+1]

Q.52 Please select the most appealing option

[REQUIRE ANSWER]

A new tolled bridge with access ramps designed to ensure no congestion {tolled.jpg} Expected time: 5 minutes less than a typical trip Cost: \$2.00	&& {Freeway_heavy.jpg} Expected time: 10 minutes more than a typical trip Cost: Free
2	1

[CALCULATE - TRIGGER: 2 EQ: 58 RQ: 58 FORMULA: E+1]

Q.53 Please select the most appealing option

[REQUIRE ANSWER]

&& {Freeway_heavy.jpg} Expected time: 10 minutes more than a typical trip Cost: Free	A new tolled bridge with access ramps designed to ensure no congestion {tolled.jpg} Expected time: 5 minutes less than a typical trip Cost: \$2.50
1	2

[CALCULATE - TRIGGER: 2 EQ: 58 RQ: 58 FORMULA: E+1]

Q.54 Please select the most appealing option

[REQUIRE ANSWER]

A new tolled bridge with access ramps designed to ensure no congestion {tolled.jpg} Expected time: 5 minutes less than a typical trip Cost: \$3.50	&& {Freeway_heavy.jpg} Expected time: 10 minutes more than a typical trip Cost: Free
2	1

[CALCULATE - TRIGGER: 2 EQ: 58 RQ: 58 FORMULA: E+1]

Q.55 Please select the most appealing option

[REQUIRE ANSWER]

&& {Freeway_Medium.jpg} Expected time: 5 minutes more than a typical trip Cost: Free 1	A new tolled bridge with access ramps designed to ensure no congestion {tolled.jpg} Expected time: 5 minutes less than a typical trip Cost: \$1.00 2
--	--

[CALCULATE - TRIGGER: 2 EQ: 58 RQ: 58 FORMULA: E+1]

Q.56 Please select the most appealing option

[REQUIRE ANSWER]

A new tolled bridge with access ramps designed to ensure no congestion {tolled.jpg} Expected time: 5 minutes less than a typical trip Cost: \$2.00 2	&& {Freeway_medium.jpg} Expected time: 5 minutes more than a typical trip Cost: Free 1
--	--

[CALCULATE - TRIGGER: 2 EQ: 58 RQ: 58 FORMULA: E+1]

Q.57 Please select the most appealing option

[REQUIRE ANSWER]

&& {Freeway_medium.jpg} Expected time: 5 minutes more than a typical trip Cost: Free 1	A new tolled bridge with access ramps designed to ensure no congestion {Tolled.jpg} Expected time: 5 minutes less than a typical trip Cost: \$3.00 2
--	--

[CALCULATE - TRIGGER: 2 EQ: 58 RQ: 58 FORMULA: E+1]

[A - IF THE ANSWER TO QUESTION 48 IS NOT 99, THEN SKIP TO QUESTION 59]

Q.58 Free or Toll

Toll __

[A - IF THE ANSWER TO QUESTION 58 IS NOT 0, THEN SKIP TO QUESTION 61]

Q.59 Please rate some possible reasons why you never selected a tolled option in the previous section.

[REQUIRE ANSWER] [READ ANSWERS IN RANDOM ORDER]

	Completely Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Completely Disagree
The time savings were not worth paying for, so I used the free roads	5	4	3	2	1
I don't want to pay	5	4	3	2	1
I don't mind driving in congested traffic	5	4	3	2	1
I find using toll roads inconvenient	5	4	3	2	1

Q.60 What other reasons do you have for never selecting a tolled option?

[A - IF THE ANSWER TO QUESTION 58 IS 0, THEN SKIP TO QUESTION 63]

Q.61 Please rate some possible reasons why you selected the tolled alternative one or more times in the previous section.

[REQUIRE ANSWER] [READ ANSWERS IN RANDOM ORDER]

	Completely Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Completely Disagree
Travel time savings	5	4	3	2	1
More reliable than the free roads	5	4	3	2	1
I don't like to drive in congested traffic	5	4	3	2	1
I like driving fast	5	4	3	2	1
I think the tolled roads would be safer	5	4	3	2	1
I would have a more comfortable journey in the tolled roads	5	4	3	2	1

Q.62 What other reasons do you have for selecting a tolled option?

[SHOW: Map2.gif]

Q.63 The map below shows two new and improved bridges proposed to be constructed in the Louisville metropolitan area.

&IMG&

These include

- I-65 Bridge – construction of a new Ohio River Bridge located adjacent to and east of the existing I-65 Kennedy Bridge including approaches and interchanges, providing six northbound I-65 lanes. The existing John F. Kennedy Bridge will be converted to carry southbound I-65 traffic only.

- East End Bridge – a new four-lane Ohio River Bridge with a pedestrian walkway/bikeway that connects the East End Kentucky Approach section with the East End Indiana Approach section.

The additional capacity will help reduce congestion and make travel times more reliable. It will also improve access to Louisville, KY.

To help pay for the improvements, a toll will be charged to use the new East End Bridge and the improved I-65 Bridge.

Q.64 What do you think of this proposal and specifically what do you think about the idea of paying for using the improved I-65 Bridge and the new East End Bridge (assuming a reasonable toll)?

[REQUIRE ANSWER]

I am strongly against it	1
I am somewhat against it	2
I am neutral	3
I somewhat support it	4
I strongly support it	5

[SHOW: Map2.gif]

Q.65 Do you think you will personally use the new improved I-65 Bridge assuming that for a reasonable toll it provides reliable and congestion-free travel time?
&IMG&

[REQUIRE ANSWER]

I will most certainly not use it	1
I doubt I will use it	2
I am not sure	3
I probably will use it	4
I will most certainly use it	5

[SHOW: Map2.gif]

Q.66 Do you think you will personally use the new East End Bridge assuming that for a reasonable toll it provides reliable and congestion-free travel time?
&IMG&

[REQUIRE ANSWER]

I will most certainly not use it	1
I doubt I will use it	2
I am not sure	3
I probably will use it	4
I will most certainly use it	5

Q.67 Two methods are being considered to collect the tolls; neither method requires that drivers slow down or stop, they are both automatic. These are:

1. Electronic Toll Collection (ETC): Drivers will not have to stop or slow down to pay the toll. E-Z Pass is an example currently widely used in Virginia. An electronic card or "transponder" is mounted on the inside of your windshield. Tolls would be automatically deducted from a prepaid account.

2. Video toll collection: A system of video cameras would be installed to read the license plates of all vehicles using the system. Toll bills for vehicles without ETC would be sent monthly to the vehicle's registered owner.

Assume the video toll collection would cost \$1.00 more per trip than the Electronic Toll Collection (ETC) method.

Which of these two methods would you prefer to use?

[REQUIRE ANSWER]

The Electronic Toll Collection (ETC) system 1
The video toll collection 2

Q.68 Now suppose paying using the video toll collection costs \$2.00 more per trip than paying with an electronic transponder.

Which method would you prefer to use?

[REQUIRE ANSWER]

The Electronic Toll Collection (ETC) 1
The video toll collection 2

Q.69 Suppose the toll to use the new bridges is \$2.00 per trip.

However, you could obtain a discount by purchasing a monthly pass and paying in advance for a full month.

Suppose the discounted toll is \$1.00 per trip.

[REQUIRE ANSWER]

I would definitely buy the monthly pass to get the discount 1
I'm not sure whether or not I would buy the monthly pass 2
I would definitely pay the full toll and will not buy the monthly pass 3

[A - IF THE ANSWER TO QUESTION 69 IS 1, THEN SKIP TO QUESTION 71]

Q.70 You said you are not sure you would buy the monthly pass.

Which of the following best describes the reason for your choice?

[REQUIRE ANSWER]

I don't expect to drive frequently enough on the bridges to
make use of the discounts 1
The discount is too small to make a monthly commitment 2
I'm not sure whether the discount will be worth the
commitment 3
Other 4

Q.71 We would now like to ask some questions about your general attitudes towards driving.

Which of the following costs, other than fuel costs, do you incur each month?

[REQUIRE ANSWER]

I had no costs other than fuel 1
Parking 2
Toll charges 3
Other costs 4

[EXCLUSIVE ANSWER: "I had no costs other than fuel"]

Q.72 How much does it cost you personally to operate your car each month?

Think about how much you spend on gas, tolls and parking. Do not include your monthly car payment, maintenance or insurance. If you are unsure, please estimate.

Please type your response in whole dollar amount. For example twenty dollars would be entered as 20.

[REQUIRE ANSWER]

Total monthly cost in dollars - \$ _____

Q.73 Please tell us how you feel about each of the statements below.

[REQUIRE ANSWER] [READ ANSWERS IN RANDOM ORDER]

	Completely Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Completely Disagree
I have reduced the trips I make as a result of the recession	5	4	3	2	1
Since the fuel price increases I use my car less	5	4	3	2	1
It is not fair to charge for using roads in Louisville	5	4	3	2	1
The [ANSWER TO Q. 5] is essential for many of the trips I make around Louisville	5	4	3	2	1

Q.74 What, if any, key improvements would you like to see to the road network in Louisville?

Q.75 How many people live in your household?

[REQUIRE ANSWER]

1- I live alone 1
2 people 2
3 people 3
4 people 4
5 people 5
6 or more people 6

[A - IF THE ANSWER TO QUESTION 75 IS 1, THEN SKIP TO QUESTION 77]

Q.76 How many children younger than 18 live in your household?

[REQUIRE ANSWER]

- | | |
|---|---|
| There are no children in my household | 1 |
| 1 child | 2 |
| 2 children | 3 |
| 3 children | 4 |
| 4 children | 5 |
| 5 children | 6 |
| 6 or more children | 7 |

Q.77 How many vehicles (cars, vans, trucks, SUVs, etc.) does your household have regular use of?

[REQUIRE ANSWER]

- | | |
|--------------------------|---|
| 1 vehicle | 1 |
| 2 vehicles | 2 |
| 3 vehicles | 3 |
| 4 vehicles | 4 |
| 5 vehicles | 5 |
| 6 vehicles or more | 6 |

Q.78 Which of the following best describes your employment status?

[REQUIRE ANSWER]

- | | |
|--|---|
| Working full time (30+ hours a week) | 1 |
| Working part time (<30h per week) | 2 |
| Self-employed | 3 |
| Seeking employment | 4 |
| Retired | 5 |
| Homemaker | 6 |
| Student | 7 |
| Not working | 8 |
| Other (Please Specify) | 9 |

[OTHER, SPECIFY - CHOICE OR SUB-QUEST. 9]

Q.79

[REQUIRE ANSWER]

Q.80 Which of the following best represents your total household income before taxes?

[REQUIRE ANSWER]

Less than \$25,000	1
\$25,000 to \$34,999	2
\$35,000 to \$49,999	3
\$50,000 to \$74,999	4
\$75,000 to \$99,999	5
\$100,000 to \$149,999	6
\$150,000 to \$199,999	7
\$200,000 or more	8

Q.81 What is your gender?

[REQUIRE ANSWER]

Male	1
Female	2

Q.82 Date

Q.83 Time

Q.84 Duration

Appendix C Atkins Toll Leakage Memo

MEMORANDUM

To: David Cuneo, **Steer Davies Gleave**, 883 Boyston Street, 3rd Floor, Boston, MA 02116, 617.391.2300

From: Tom Delaney, Vice President, Senior Practice Manager, **Atkins North America, Inc.**
482 South Keller Road, Orlando, FL 32810, 407.647.7572

Date: May 10, 2013

Re: **Toll Collection System CAPEX, OPEX and Revenue Impact Analysis**

As requested by the Kentucky Transportation Cabinet we have prepared input for the Traffic and Revenue Study being developed by Steer Davies Gleave (SDG). The purpose of this memorandum is to provide information regarding the estimated capital costs (CAPEX) for the development, installation, and maintenance for the LSIORB Project toll collection system. This memorandum also provides an estimate of operations and maintenance costs (OPEX) for the toll collection system once toll collection operations commence. An additional feature of this memorandum is an analysis of the impact on revenue (revenue leakage) resulting from the inability to collect tolls due to technical anomalies or failure to collect on toll invoices and violation notices issued to the public.

In arriving at the CAPEX and OPEX estimates Atkins used best information available and its extensive experience with toll collection system implementation and operations to determine reasonable estimated costs projections. Where there was not a set policy or standard to use due to no final set of LSIORB rules and regulations regarding violation enforcement, or general operating policies or business rule toll industry norms that have been applied. All assumptions used in the calculation of the OPEX and revenue leakage are identified and listed within this document.

Toll Collection System Cost Estimate - CAPEX

Toll collection will be accomplished through a competitively selected toll operations services contractor operating under the management and oversight of the Indiana and Kentucky staff. An RFP to deploy All Electronic Tolling (no cash) will be issued requesting technical and price proposals from proposers interested in providing design, integration, implementation, operation, and maintenance for the tolling components listed below:

Tolling Component One - Roadside and Back Office Component (RBOC)

Tolling Component Two - Electronic Toll Collection Component (ETC)

Tolling Component Three - Operations Services Component (OPS)

As an all-electronic toll (AET) System, tolls will only be collected using electronic toll collection (ETC) via radio frequency transponders or through video toll collection (VTC) using license plate information. It is anticipated that motorists equipped with transponders will pay a discounted toll compared to video toll

customers due to transaction processing cost differentials. Transponders and license plates will be detected at all Toll Zones with the processing of all toll transactions to occur at a back office Customer Service Center.

The LSIORB Project toll collection system for the three bridges will consist of four mainline and two ramp Toll Zones. The new East End Bridge will have two mainline sets of toll zone gantries spanning two travel lanes and two shoulders in each north and south direction on the Kentucky side of the Ohio River. The reconstructed Kennedy Bridge carrying southbound traffic will have one mainline set of toll zone gantries spanning five travel lanes and two shoulders and one ramp set of toll gantries spanning one travel lane and two shoulders. The Downtown Crossing Bridge, located east and parallel to the Kennedy Bridge, will carry northbound traffic with one mainline set of toll zone gantries spanning six travel lanes and two shoulders and one set of ramp toll zone gantries spanning two travel lanes and two shoulders. All toll zone gantries for the Downtown Crossing Bridges will be on the Indiana side of the Ohio River. Figures 1 and 2 depict the relative location of the toll zone gantries for the bridges.

Subject to the final design location of the mainline toll zone gantries, some travel lanes and shoulders for the Downtown Crossing Bridge and the Kennedy Bridge will be required to accommodate reversible tolling due to potential or probable traffic shifts during the rehabilitation of the Kennedy Bridge. This requirement is dictated by bi-directional traffic on each bridge during various stages of construction and reconstruction of the bridges. In addition, the provision of reversible lanes will allow bi-directional tolling on both Downtown Crossing Bridges should either bridge face reduced or no capacity due to bridge lane closures. Proposals and bids for the RBOC are required to address the reversible tolling requirement.

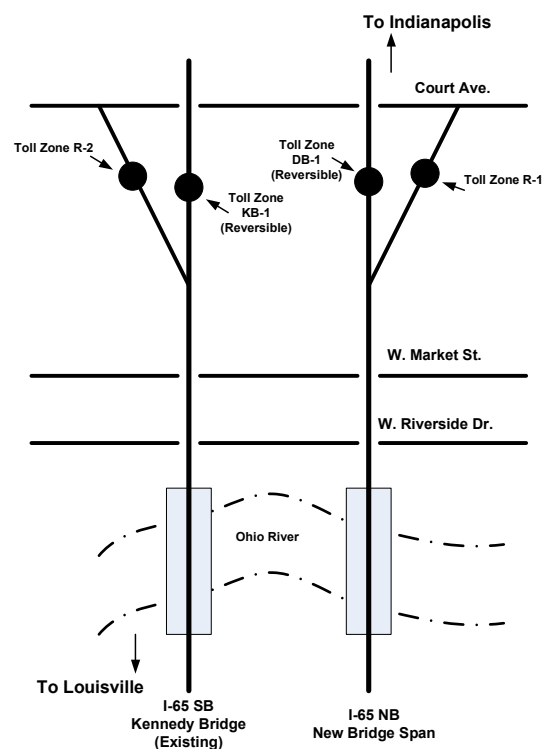


Figure 1 - Downtown and Kennedy Bridges

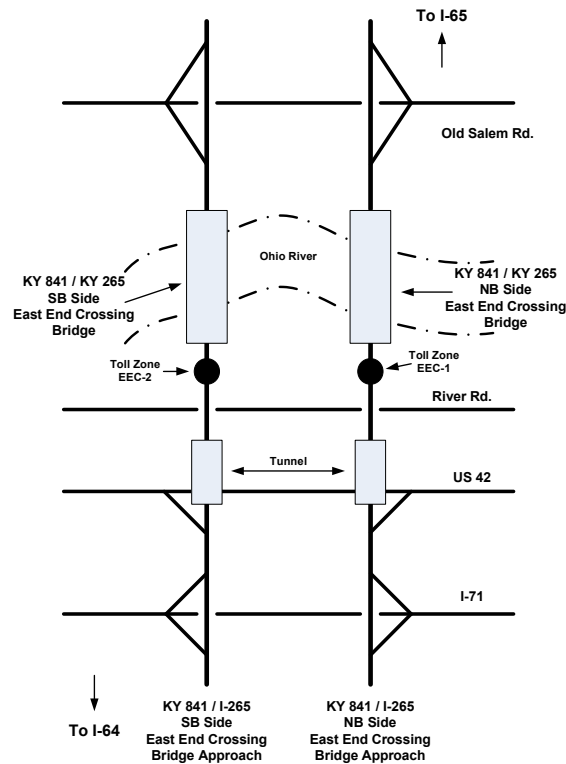


Figure 2 - East End Bridge

In total, under the current concept, the toll collection system for the LSIORB Project will consist of 19 travel lanes of which 6 shall be reversible and 11 shoulders of which 2 shall be reversible for a total of 38 effective toll lanes. Table 1 lists the effective toll lanes by each bridge's toll zone. All effective toll lanes shall include ETC readers and antennae, automatic vehicle classification (AVC), video cameras, vehicle separators and any other components that will ensure full toll transaction coverage of the roadside toll zones.

Effective Toll Lane Summary						
Toll Zone Number	Toll Zone Locations	Left Shoulder	Travel Lanes	Travel Lanes Width	Right Shoulder	Effective Toll Lanes
R-1	Ramp 1 - I-65 NB to Court Avenue	4 ft	3	12 ft	12 ft	4
DB-1	Downtown Bridge - I-65 Northbound	12 ft	6	12 ft	12 ft	8
KB-1	Kennedy Bridge - I-65 Southbound	12 ft	5	12 ft	12 ft	7
R-2	Ramp 2 - Court Avenue to I-65 SB	6 ft	1	16ft	12 ft	3
EEC-1	East End Crossing - Northbound	10 ft	2	12 ft	14 ft	4
EEC-2	East End Crossing Southbound	14 ft	2	12 ft	10 ft	4
	TOTALS	5	19		6	30
Reversible Lanes						
DB-1R	Downtown Bridge - I-65 Southbound Reversible during Phased Reconstruction on Kennedy Bridge		3	12 ft	12ft	4
KB-1R	Kennedy Bridge - I-65 Northbound Reversible during Construction of Downtown Bridge	12 ft	3	12 ft		4
	TOTALS - Reversible	1	6		1	8
3/11/2013						

Table 1 – Toll Lane Summary

The toll collection system cost estimate consists of three parts. Part one is the cost estimate for the roadside toll collection system and the back office system, including initial orders of transponders and spare parts. Part two is the cost estimate for the provision of the toll zone vaults (buildings) located at East End Bridge and the Downtown Crossing Bridges. Part three is the cost estimate for operations center, Customer Service Center and a small Walk-in Service Center start-up prior to the go-live revenue collection on the East End Bridge or January 2017, whichever comes first.

Due to the fact that the toll system is currently under the request for proposal process for the solicitation of bids no details or assumptions as to how the overall cost estimate was derived are provided in this document. A detailed engineer's estimate will be provided to the Kentucky Transportation Cabinet prior to the submission deadline for the toll system contractor proposals. The current estimate for the combined three parts described above is approximately thirty-six million dollars (\$36,000,000).

Traffic & Revenue OPEX and Revenue Impact Analysis

Revenue leakage is defined, for the purposes of this memorandum, as the revenue differential between estimated gross revenue under the Traffic and Revenue Study and estimated net revenue after

accounting for reductions due to system leakage, commercial or non-system leakage and non-payment leakage. A more detailed explanation of these leakage components follows:

1. **System leakage:** Results from technical issues with the system such as bad images, no tag reads, no images, etc. This leakage is internal to the agency over which the agency has control via improved processes, system performance and technology.
2. **Commercial or non-system leakage:** results from unsuccessful DMV lookups, returned mail (nixies), etc. This leakage is external to the agency over which the agency has no control as it relies on other systems or organizations to obtain valid customer/vehicle information.
3. **Non-payment leakage:** results from customers that opt for not making payment on invoices, notices, or by not replenishing pre-paid accounts. The agency has some control over this leakage type via business rules (e.g., encouraging video customers to establish tag-based accounts) and proper enforcement.

A detailed analysis was performed to determine the leakage percentage for the period of operation (2017-2058). Projected leakage values decline through the years due to factors such as increased ETC penetration, enforcement of non-payment of tolls, and improved technology.

Table 2 lists the estimated gross revenue, the percentage of estimated leakage and the estimated net revenue for the LSIORB Project.

LSIORB NET REVENUE FORECASTS				
Fiscal Year	All Vehicles Gross Revenue		Leakage Rate	All Vehciles Net Revenue
2017	\$36.4		7.03%	\$33.8
2018	\$83.4		4.96%	\$79.3
2019	\$102.9		4.65%	\$98.2
2020	\$115.2		4.31%	\$110.2
2021	\$122.1		3.99%	\$117.2
2022	\$127.3		3.74%	\$122.5
2023	\$130.7		3.48%	\$126.2
2024	\$134.5		3.27%	\$130.1
2025	\$138.5		3.08%	\$134.3
2026	\$142.8		2.89%	\$138.7
2027	\$147.4		2.71%	\$143.4
2028	\$152.2		2.61%	\$148.2
2029	\$157.3		2.52%	\$153.3
2030	\$162.6		2.42%	\$158.7
2031	\$169.0		2.38%	\$165.0
2032	\$176.3		2.38%	\$172.1
2033	\$183.7		2.38%	\$179.4
2034	\$191.5		2.38%	\$187.0
2035	\$199.7		2.38%	\$194.9
2036	\$207.7		2.38%	\$202.8
2037	\$215.6		2.38%	\$210.5
2038	\$223.8		2.38%	\$218.5
2039	\$232.4		2.38%	\$226.8
2040	\$241.2		2.38%	\$235.5
2041	\$249.9		2.38%	\$243.9
2042	\$258.3		2.38%	\$252.2
2043	\$267.0		2.38%	\$260.7
2044	\$276.0		2.38%	\$269.5
2045	\$285.4		2.38%	\$278.6
2046	\$295.0		2.38%	\$288.0
2047	\$304.9		2.38%	\$297.7
2048	\$315.2		2.38%	\$307.7
2049	\$325.9		2.38%	\$318.1
2050	\$336.9		2.38%	\$328.9
2051	\$348.2		2.38%	\$340.0
2052	\$360.0		2.38%	\$351.4
2053	\$372.2		2.38%	\$363.3
2054	\$384.7		2.38%	\$375.6
2055	\$397.7		2.38%	\$388.2
2056	\$411.1		2.38%	\$401.4
2057	\$425.0		2.38%	\$414.9
2058	\$439.4		2.38%	\$428.9
Revenue x 100,000				

Table 2 – Net Revenue

Tolling OPEX Analysis – List of Assumptions

Tolling OPEX Analysis – List of Assumptions

Table 3 provides the listing of assumptions used in developing the OPEX estimates under the 70% transponder penetration rate scenario.

Ref#	Input	Description	Value in use
1.	Initial ETC penetration	Estimated initial ETC penetration for the first year of AET operations, provided by SDG.	67%
2.	Percent increase in ETC	Annual increase in ETC penetration under AET operations expressed as percentage of the previous year's value	1%
3.	Maximum ETC penetration at the end of the 10-year period	Maximum estimated ETC penetration expressed as overall percentage	79%
4.	High OCR/Auto %	Rate of video transactions with successful automatic OCR license plate identification expressed as a percentage of total video transactions. Value is based on experience with other AET facilities.	70%
5.	Human Review %	Rate of video transactions reviewed manually, expressed as a percentage of total video transactions.	30%
6.	Cost per image reviewed manually	Cost to manually review an image	\$0.10 per image
7.	Unusable images %	Rate of image rejected through the manual review process expressed as percent of total video transactions. These images are not usable due to various reasons (e.g., not license plate present, blurry image, no image, etc.). This constitutes technical or system leakage.	4% (or 13% of human reviewed images)
8.	I-Toll	Percent of video transactions converted to ETC because the license plate number is associated with a valid ETC account.	10%
9.	Unregistered video accounts (UVA)	Percent of total video transactions processed as UVA transactions, expressed as a percentage of total video transactions. Value is based on analysis made by others (Parsons) after adjustments for I-Toll and Unusable images.	Initial year 54%, decreasing to 32%
10.	Registered video accounts (RVA)	Percent of total video transactions processed as RVA transactions, expressed as a percentage of total video transactions. Value is based on analysis made by others (Parsons) after adjustments for I-Toll and Unusable images.	Initial year 33%, increasing to 55%
11.	In-state % lookup	Percentage of video transactions from in-state vehicles, expressed as a percentage of total video transactions sent for in-state DMV lookup.	80%
12.	Out-of-state % lookup	Percentage of video transactions from out-of-state vehicles, expressed as a percentage of total video	20%

Ref#	Input	Description	Value in use
		transactions sent for out-of-state DMV lookup.	
13.	In-state lookup cost	Assumption is that in-state DMV lookups will bear no cost to the agencies.	\$0
14.	Out-of-state lookup cost	Fee charged by out-of-state DMV for vehicle registrant information. Fee is charged per lookup request. This is a blended estimated rate used to assign a value that the agencies may be charged for out of state owner registration information. <i>Note: One lookup request is assumed per invoice (i.e. monthly transactions are aggregated and a single lookup fee is incurred for that month's invoice). Assume most conservative scenario where DMV lookup information cannot be reused for a subsequent month's invoice.</i>	\$1.00 per invoice
15.	No. of transactions 1 st invoice	Average number of transactions included in the first invoice. This number is estimated based on data from other agencies sending video invoices.	5 transactions per 1 st invoice
16.	No. of transactions 2 nd invoice	Average number of transactions included in the second invoice. This number is estimated based on data from other agencies sending video invoices.	10 transactions per 2 nd invoice
17.	ETC auto-pay %	Percent of ETC transactions that are automatically paid from valid pre-paid accounts, expressed as a percentage of ETC and I-Toll transactions. The difference between the total ETC and I-Toll transactions and those that are paid via pre-paid balances will go through the invoice process.	99%
18.	ETC – 1 st invoice paid	Assumption is that those ETC accounts that are not in good standing or are invalid where payment is not automatically processed will be processed as video invoices. This is expressed as the percent of invoices sent to ETC customers that are paid.	50%
19.	ETC – 2 nd invoice paid	(See previous comment) Percent of 2 nd invoices sent to ETC customers that are paid.	40%
20.	ETC – Violation notices to Collections paid	Percent of ETC violation notices sent to Collections that are paid, expressed as a percent of all ETC violation notices sent to Collections. <i>Note: it should be noted that Leakage is a resulting number in the analysis, that is, it is not an input. Leakage is based on percent collections, unusable images, non-payment, etc. This comment applies throughout this list of assumptions.</i>	15%
21.	RVA auto-pay %	Percent of RVA transactions that are automatically paid from registered video accounts, expressed as a percentage of total RVA transactions. The difference between the total RVA transactions and those that are paid via the auto-pay process will go through the invoice process.	95%
22.	RVA – 1 st invoice paid	Percent of RVA invoices that are paid with the 1 st invoice, expressed as a percentage of RVA number of 1 st invoices sent.	50%

Ref#	Input	Description	Value in use	
23.	RVA – 2 nd invoice paid	Percent of RVA invoices that are paid with the 2 nd invoice, expressed as a percentage of RVA number of 2 nd invoices sent.	40%	
24.	RVA – Violation notices to Collections paid	Percent of RVA violation notices sent to Collections that are paid, expressed as a percent of all RVA violation notices sent to Collections.	15%	
25.	UVA – 1 st invoice paid	Percent of UVA invoices that are paid with the 1 st invoice, expressed as a percentage of UVA number of 1 st invoices sent. Estimate is based on invoice collection rates from other agencies with AET operations.	50%	
26.	UVA – 2 nd invoice paid	Percent of UVA invoices that are paid with the 2 nd invoice, expressed as a percentage of UVA number of 2 nd invoices sent. Estimate is based on invoice collection rates from other agencies with AET operations.	40%	
27.	UVA – Violation notices to Collections paid	Percent of UVA violation notices sent to Collections that are paid, expressed as a percent of all UVA violation notices sent to Collections.	15%	
28.	2 nd invoice fee	Fee added to all 2 nd invoices	\$7.50	
29.	Invoice cost	Cost for processing each invoice (stuffing envelope, postage, etc.)	\$1.50	
30.	Violation notice cost	Cost for processing each invoice (stuffing envelope, postage, etc.)	\$3.00	
31.	Credit Card fee	Fee assessed to process ETC replenishments and/or invoice payments, expressed as a percentage of realized revenues.	2%	
32.	Number of Toll Accounts	Number of toll accounts hosted by the back office, categorized by ETC or Video account. The number of accounts is estimated using a trip frequency distribution table based on inputs from a survey conducted by SDG as well as other sources on infrequent customers. An assumption is made on which customers will opt for a tag-based account (frequent users) and which ones will be video-based (infrequent users). It should be noted that while frequent users make most of the trips, it is the infrequent users group that represents the larger number of customers.	<i>Trip Frequency</i>	<i>% trips</i>
			Regular (≥ 4/week)	33%
			Frequent (1-3 x/week)	34%
			Moderate (1-3 x/month)	30%
			Infrequent (≤ 3/year)	3%
33.	Monthly account maintenance fee	Estimated fee for maintaining/hosting a toll account. In the analysis, the fee is applied to all active accounts, which are assumed to be all except the infrequent video users, in which case the monthly fee is applied to 3 out of the 12 months only. The fee is estimated based on data from other agencies' back office operations contracts.	\$1.50/month per toll account.	

Ref#	Input	Description	Value in use
34.	Number of tags per account	This estimate is used to estimate the cost of tags required on an ongoing basis (operational period) as the number of accounts increases over time. <i>Note: the initial tag inventory is covered in the CAPEX analysis</i>	2 tags per account
35.	Cost of tags	The cost assumed is based on multi-protocol IAG tags (hard-case). <i>Note: cost can be decreased if tag selected is the sticker type; the \$20 per tag represents a conservative scenario from a cost perspective.</i>	\$20 per tag
36.	Lane maintenance	The cost to maintain an AET lane has been estimated based on maintenance data from other agencies. The cost is expressed as an average per lane per year.	\$15,000 per lane
37.	Spare parts	This estimate is expressed as percentage of the total lane maintenance cost. This cost is an ongoing operational expense. <i>Note: the CAPEX analysis includes an initial spare parts inventory</i>	15%
38.	Inflation adjustment	Costs in the analysis have been increased on an annual basis, expressed as a percentage. <i>Note: This 2.5 percent rate is the same one used by SDG for increasing toll rates in the T&R analysis.</i>	2.5%

Table 3 – Tolling OPEX Analysis – List of Assumptions

As an additional aide in understanding the analysis process for obtaining leakage percentage a Tolling OPEX Analysis – Leakage Waterfall Diagram is provided in Figure 3. The waterfall diagram starts with universe of lane transactions (all transactions) and steadily filters out transactions that fall into the system, commercial/non-system or non-payment category. The filtering process is based upon a set of assumptions as to the percentage of transactions that will not produce toll revenue as originally calculated at the lane level (gross or expected revenue).

There are several points of revenue realization as transaction pass through the waterfall. Transactions that are based upon prepaid customer accounts (ETC and registered video) have the highest revenue realization rate. ETC transactions are considered the most reliable source of revenue in an all electronic toll collection system due to the ability of the toll system to input each unique transponder number into a transaction that is correlated back to a customer's account. Revenue based upon ETC transactions is not necessarily 100 percent guaranteed due primarily due to the status of a customer's account, such as insufficient funds, or the fact that the customer's transponder or vehicle may have been stolen.

For registered vehicle video transactions the percentage of successful revenue transactions depends upon the AET systems video imaging technology. If the video images are not machine readable or legible to the human eye or if they were not captured when the vehicle traversed the toll zone; either due to environmental conditions, camera view or maintenance issues, the agency does not have any

reliable vehicle information to clearly identify the vehicle owner or to tie the vehicle to a registered account.

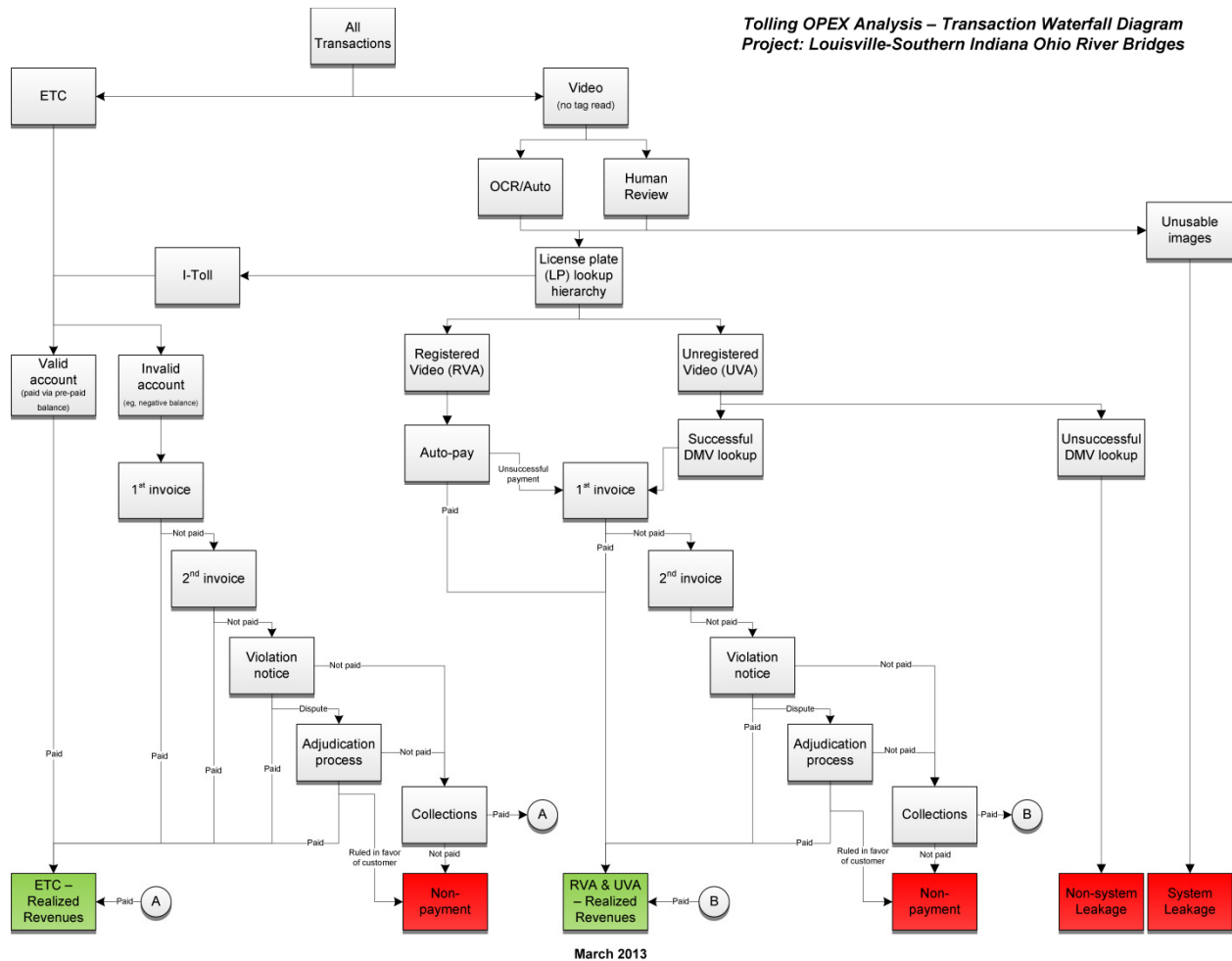


Figure 3 – Tolling OPEX Analysis – Transaction Waterfall Diagram

The same logic for registered vehicle video transaction leakage applies to unregistered vehicle video transactions with the added caveat that the agency must track down the owner of the vehicle involved in an unregistered vehicle transaction. There are limiting factors on the success of being able to obtain vehicle ownership information such as whether or not the DMV records of ownership are up to date, being able to access DMV records that are not from Indiana or Kentucky, considered out-of-state DMV records.

When the owner of the vehicle is identified the operations contractor will send an invoice for the tolls due. The waterfall revenue collection process takes into consideration the percentages of “video” customers that will pay upon receipt of their first invoice, what percentage will pay the second invoice including any additional fees, and the percentage of unpaid invoices that are turned into violation notices. The waterfall revenue collection process continues in a similar fashion for violation notices as it did for invoices.

After the violation noticing process, which can also occur for invalid customer accounts, the waterfall revenue collection closes out with an adjudication process and a collections process. The sum of the unpaid transactions divided by the original pool of lane transactions provides the leakage percentage. As shown in Table 2 above, for the LSIORB Project toll system it is estimated that in FY 2017 the leakage percentage will be about 7 percent, decreasing to less than 3 percent by FY 2030 and remaining flat thereafter.

Beyond the importance of having the proper toll system technology to maximize toll revenue is the need for legislation and corresponding rules and regulations that provide the necessary incentive to pay the tolls whether by maintaining a prepaid customer account or paying the first toll invoice to avoid additional fees or fines.