

**Appendix C**  
**Toll Discount Analysis**

**November 2014**

*Prepared by*

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Louisville-Southern Indiana Ohio River  
Bridges - Environmental Justice

**Toll Discount Analysis - Final Report**

Report

November 2014

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## APPENDICES

Appendix A: Low Income Trip Preparation

Appendix B: Adjustment of Individual Income-Based Enrollment Threshold

Appendix C: Traffic Volume Changes





# 1 Introduction

1.1 Steer Davies Gleave (SDG) prepared investment grade traffic and revenue forecasts for the Louisville-Southern Indiana Ohio River Bridges (LSIORB) Project. This report presents additional analysis conducted by SDG to evaluate potential traffic and revenue impacts of toll discounts for low-income populations. This analysis does not address the administrative costs or other administrative challenges associated with implementing this type of discount program.

## Project Background and Location

1.2 The LSIORB Project involves construction of two new bridges over the Ohio River in the Louisville metropolitan area, as well as related improvements to the road network. 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.

1.3 The Project includes two elements:

- **Downtown Crossing:** this element includes the construction of a new I-65 bridge constructed east of the existing I-65 Bridge connecting southern Indiana to downtown Louisville. The new I-65 bridge will serve northbound traffic, while the existing I-65 bridge will be converted to serve only southbound traffic. This element also includes reconstruction of the interchange connecting I-65 with I-64 and I-71 in downtown Louisville. After completion, I-65 will have 6 lanes in each direction across the Ohio River.
- **East End Crossing:** this element includes construction of a new 4-lane bridge across the Ohio River in the eastern portion of the Louisville metropolitan area. This element also includes construction of approach roads connecting the new East End Bridge to I-265 in Kentucky and to SR-265 in Indiana.

FIGURE 1.1 LOCATION OF LOUISVILLE-SOUTHERN INDIANA



FIGURE 1.2 LOUISVILLE-SOUTHERN INDIANA OHIO RIVER BRIDGES PROJECT MAP



- 1.4 As tolled bridges, the Downtown Crossing and the East End Crossing will be operated exclusively as an All Electronic Tolling (AET) 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 that 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. An increase over the transponder toll will be applied to cover the additional costs associated with this type of toll collection. For the pre-registered video toll collection, travelers will register their license plate and fund an account which will be drawn from when their license plate image is captured. Accordingly a smaller increase over the transponder toll will be applied than for the standard video toll collection.
- 1.5 The different types of toll collection systems proposed for the project are industry standards currently used nationwide and in line with the latest technology available in the market.

**Low Income Toll Discount**

- 1.6 The LSIORB Project’s SFEIS found that the tolling required to help fund the project likely would cause a disproportionately high and adverse effect on cross-river travelers from Environmental Justice (EJ) populations, because the economic effects of tolling (measured in terms of the effect on average user costs) would be appreciably more severe or greater in magnitude for those populations. The Revised Record of Decision (RROD) for the Project included a commitment to further assess the Project’s potential impact on low-income and minority populations, and to consider measures to mitigate those effects.
- 1.7 This report describes the impact on the traffic and revenue of the LSIORB Project of various definitions of low-income travelers and ways of administering toll discounts. This analysis does not address the administrative costs or other administrative challenges associated with implementing this type of discount program.

**Report Structure**

- 1.8 The report is structured with Chapter 2 describing the determination of low income discount eligibility; Chapter 3 presenting the toll discount scenarios; Chapter 4 describing how the travel demand forecasting was altered for the toll discount scenarios; and Chapter 5 presenting the results and associated analysis.

## 2 Defining “Low-Income”

### Overview

- 2.1 This analysis considers three different approaches to identifying low-income travelers: (1) Individual Income-Based enrollment, in which individuals qualify based on their household income levels; (2) area-based enrollment, in which individuals qualify based on residence in a low-income area, regardless of their individual income; and (3) FEITC-based enrollment, in which individuals qualify for the discount based on their eligibility for the Federal Earned Income Tax Credit. These approaches are described below.

### Individual Income-Based Enrollment

- 2.2 The first enrollment approach is based upon individual household income. For this enrollment approach, a discount would be offered to individuals who live in a household with a total income below the federal poverty threshold. Additional consideration has been given to aligning the enrollment eligibility with another government program such as Supplemental Security Income (SSI) or Supplemental Nutrition Assistance Program (SNAP/Food Stamps). These programs allow a higher income for determining eligibility, approximately 130% of the federal poverty threshold. The analysis of the revenue impacts of expanding the eligibility criteria in this way can be found in Section 5.13 and Appendix B.
- 2.3 Every year the federal government defines a poverty threshold, the maximum household income for a given household size for its residents to be considered “low-income.” Those federal designated thresholds are outlined in Table 2.1. For example, a household consisting of four people, two of whom are related children under 18 years of age, would be considered low-income if the household income is less than \$22,113 per year.

**TABLE 2.1 POVERTY THRESHOLD (2012 \$)**

Size of Family Unit	Related children under 18 years									
	Avg.	None	One	Two	Three	Four	Five	Six	Seven	Eight+
One person (unrelated individual)	11,720									
Under 65 years	11,945	11,945								
65 years and over	11,011	11,011								
<b>Two people</b>	<b>14,937</b>									
Householder under 65 years	15,450	15,374	15,825							
Householder 65 years and over	13,892	13,878	15,765							
<b>Three people</b>	<b>18,284</b>	17,959	18,480	18,498						
Four people	23,492	23,681	24,069	23,283	23,364					
Five people	27,827	28,558	28,974	28,087	27,400	26,981				
Six people	31,471	32,847	32,978	32,298	31,647	30,678	30,104			
Seven people	35,473	37,795	38,031	37,217	36,651	35,594	34,362	33,009		
Eight people	39,688	42,271	42,644	41,876	41,204	40,249	39,038	37,777	37,457	
Nine people or more	47,297	50,849	51,095	50,416	49,845	48,908	47,620	46,454	46,165	44,387

Source: U.S. Census Bureau

2.4 The American Community Survey (ACS) reports the population below the federal poverty threshold per Block Group, the smallest area used by the Census Bureau. According to its consolidated data from 2008-2012, 14.7% of the population of the Louisville Metropolitan Planning Area (LMPA) lives in a household with a total income below the poverty threshold, and thus would qualify for a toll discount under the Individual Eligibility method.

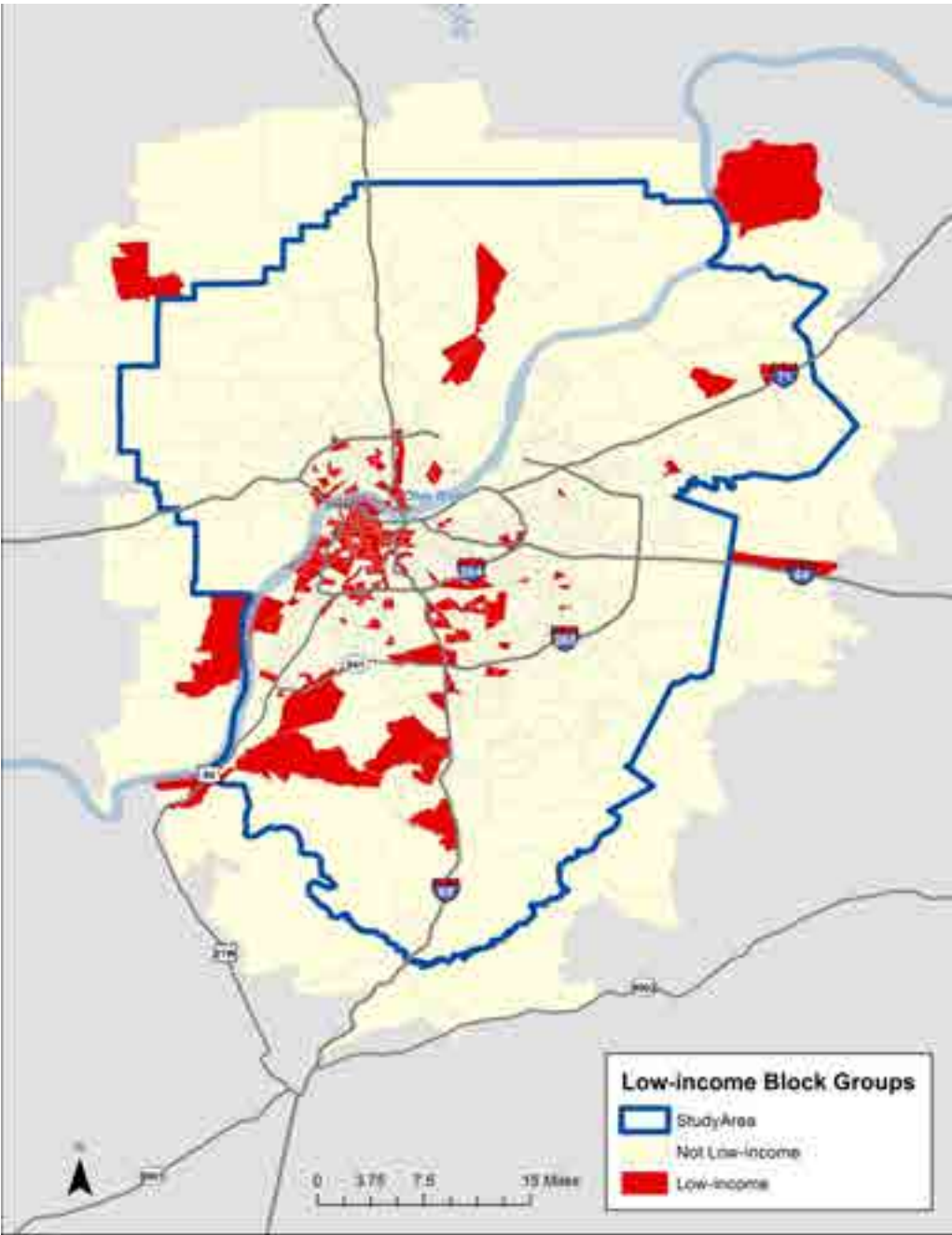
**Area Based Enrollment**

2.5 The second enrollment approach identifies geographic areas, rather than individual households, as “low-income”. We again used Block Groups as the geographic unit for this analysis, and define the poverty rate as the percentage of residents living in a household with a total income below the federal poverty threshold. Block Groups were deemed “low-income” if they met any of the following criteria adopted from the 2012 SFEIS:

- The poverty rate of the Block Group is greater than 50%.
- The poverty rate of the Block Group is at least 10% higher than the poverty rate of the LMPA.
- The poverty rate of the Block Group is at least 10% higher than the poverty rate of the county in which the Block Group is located.

2.6 According to the 2008-2012 ACS, 20.7% of the LMPA population lives in a Block Group that qualifies as low-income according to the Area-Based Eligibility method. Figure 2.1 shows the low-income Block Groups according to the Area-Based Method.

FIGURE 2.1 LOW-INCOME BLOCK GROUPS BY AREA-BASED METHOD



Source: Steer Davies Gleave analysis of ACS 2008-2012 data

2.7

**Federal Earned Income Tax Credit Enrollment**

- 2.8 A third enrollment approach could be to provide a state tax credit that would reimburse a percentage of tolls paid in the tax year by an individual filing a state income tax return. Eligibility for the tax credit would ultimately be defined through each state’s legislative process. For the purpose of this analysis, it has been assumed that eligibility might be aligned with that of the Federal Earned Income Tax Credit (FEITC). It has been further assumed that only individuals taking the FEITC on their federal tax return would be eligible to claim the state tax credit. In general, those who receive the FEITC are likely to also file a state tax return, even if it is unnecessary and no taxes are owed, since it does not require much additional effort after having filed a federal return. Our analysis thus assumes that all those who receive the FEITC would file a state return in order to receive the toll tax credit.
- 2.9 Indiana and Kentucky have different requirements for filing state tax returns. Indiana requires all individuals to file a state return if their income earned within the state exceeds the sum of exemptions for which the individual can claim. The maximum exemption is \$3,000, which is far below the poverty threshold, so we assume that all low-income Indiana drivers would file a state return to receive a toll discount. In Kentucky, however, the minimum income level at which a tax return is required is very similar to the Federal poverty threshold and thus low-income households may not currently file a tax return in Kentucky (because they earn less than the Federal poverty threshold). However, since all households receiving the FEITC file a federal tax return, and it would be easy to complete the Kentucky tax return in order to qualify for the toll rebate after having completed a federal tax return, we assume that all households receiving the FEITC would also claim a state tax credit.
- 2.10 Eligibility for the FEITC depends on the number of dependent children in the taxpayer’s household and whether or not the taxpayer files a joint return. Table 2.2 shows the income limits for each situation.

**TABLE 2.2 INCOME LIMITS FOR FEITC IN 2011**

Children	Maximum Income (Earned or Gross Adjusted)	
	Single filing	Joint filing
3 or more	\$43,998	\$49,078
2	\$40,964	\$46,044
1	\$36,052	\$41,132
0	\$13,660	\$18,740

Note: Since completion of the Revenue Impact Analysis documented in this report, 2012 income limits for FEITC have been published increasing each threshold by approximately two percent. This small increase does not appreciably alter the predicted revenue impacts.

Source: IRS.gov



- 2.11 The Brookings Institution provides geographic data on tax returns qualifying for the FEITC in 2011 by ZIP code.<sup>1</sup> By analyzing this information for the LMPA, we estimate that 19.8% of residents live in a household which qualified for the FEITC.

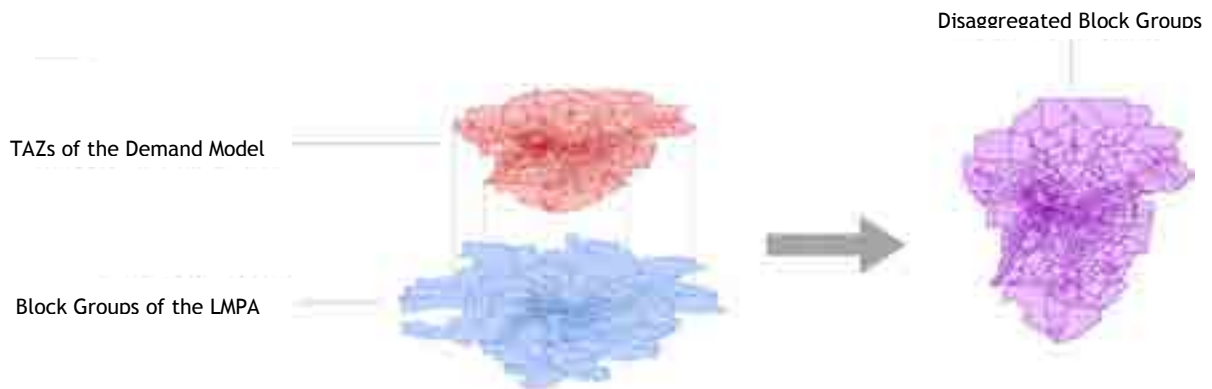
**Translating Eligibility to Traffic Analysis Zones**

- 2.12 The geographical distribution of low-income residents is far from uniform in the LMPA. Therefore, low-income rates were calculated separately for each Traffic Analysis Zone (TAZ) in order to estimate an Origin-Destination trip table for the low-income users.

**Individual Income-Based and Area-Based Eligibility**

- 2.13 The TAZs for the travel demand model do not align neatly with the 2010 Block Groups. For purposes of Individual Income-Based and Area-Based methods, it was thus necessary to divide the Block Groups into areas that fit within TAZs, a process known as “disaggregation”.

**FIGURE 2.2 PROCESS FOR INDIVIDUAL AND AREA-BASED ELIGIBILITY METHODS**



- 2.14 There are three relevant populations we used to calculate the percentage of low-income drivers:

- Total population
- Low-income population (Individual Income-Based Method)
- Population residing in a low-income Block Group (Area-Based Method)

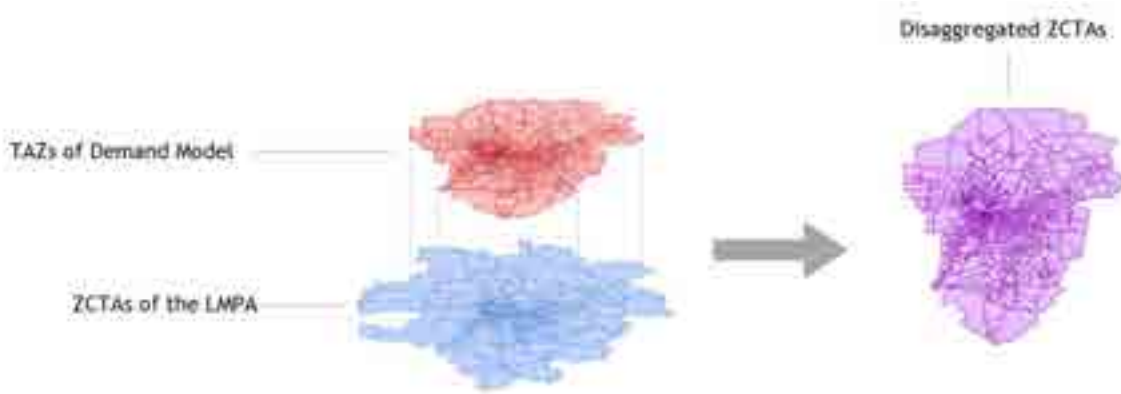
- 2.15 We derived these three populations from the 2008-2012 ACS and split them from the Block Groups of the LMPA into the Disaggregated Block Groups proportionally by area, relying on the assumption that residents are evenly distributed throughout the Block Group. We then aggregated the populations by TAZ. We calculated the percentage of low-income residents per TAZ for both the Individual Income-Based and Area-Based definitions.

<sup>1</sup> See <http://www.brookings.edu/research/interactives/eitc>

**FEITC Eligibility**

- 2.16 The Brookings Institution provides the number of tax returns qualifying for the FEITC in 2011 by ZIP Code. To apply the data to our model, we needed to distribute the FEITC-qualifying returns amongst TAZs. We used the number of households to weight the distribution because it most closely correlates with the number of tax returns.
- 2.17 The areas defined by each zip code, known as ZIP Code Tabulated Areas (ZCTAs), do not align well with the TAZs, so we first disaggregated the two layers such that every area belongs to only one ZCTA and only one TAZ.

**FIGURE 2.3 PROCESS FOR FEITC ELIGIBILITY METHOD**

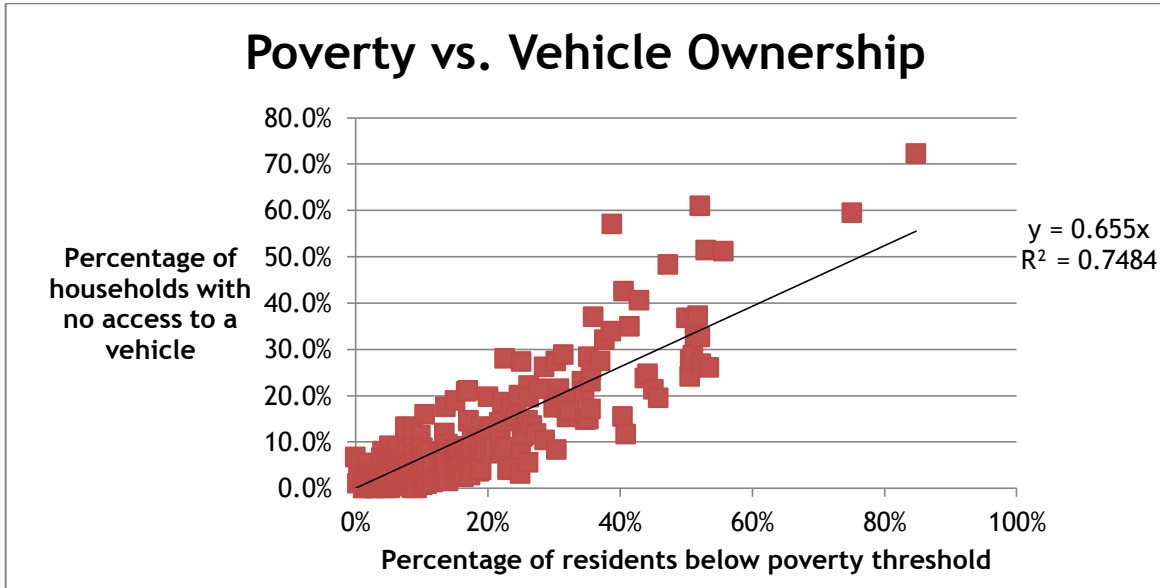


- 2.18 We assumed that households are distributed evenly within TAZs, and estimated the number of households per disaggregated area. We then distributed for each ZCTA, the FEITC-qualifying returns amongst the disaggregated areas according to the ratio of households in the disaggregated area to the number of households in the ZCTA. Finally, we aggregated the areas by TAZ to determine the number of FEITC-qualifying returns per TAZ.

**Low-income Drivers**

- 2.19 The proportion of low-income drivers crossing the river is likely lower than the proportion of the population that is low-income because low-income residents are less likely to have access to a car. Ignoring this fact would overestimate the volume of low-income traffic, and thus over-estimate the impact of the discount program on overall revenue. While the Census Bureau does not report the data required to directly make this adjustment, we used available information to estimate factors to remove the population without vehicle access to determine the percentage of likely drivers that are low-income.
- 2.20 While the number of low-income households without access to a car is not recorded by the ACS survey, we can estimate car-ownership rates amongst low-income and non-low-income drivers by observing the relationship between low-income population and vehicle accessibility in the LMPA. Figure 2.4 displays the plot of the percentage of low-income residents and percentage of no vehicle available for Block Groups in the LMPA.

FIGURE 2.4 RELATIONSHIP BETWEEN LOW INCOME AND NO VEHICLES



Source: ACS 2008-2012 5-year survey

- 2.21 As shown by the equation to the right of the chart, the relationship implies that if 100% of a Block Group’s residents are below the poverty threshold, then 65.5% of those households would not have access to a vehicle. Interpreted differently, 65.5% of low-income households do not have access to a car. To calculate the share of the population that is not low-income, we use the fact that 20.5% of the overall population of Louisville does not own a car.<sup>2</sup>
- 2.22 The following equation breaks down the overall rate of non-car-ownership (NoCarRate) as the weighted average of the rate of non-car-ownership for low-income residents (NoCarRate<sub>Low-income</sub>) and that of non-low-income residents (NoCarRate<sub>Non-low-income</sub>). The non-car-ownership rates are weighted by the corresponding proportion of the population.

$$NoCarRate = NoCarRate_{Non-low-income} * (1 - LowIncomeRate) + NoCarRate_{Low-income} * LowIncomeRate$$

- 2.23 We rearrange the equation to calculate the percentage of residents that are not low-income and do not have access to a car (NoCarRate<sub>Non-low-income</sub>):

$$NoCarRate_{Non-low-income} = \frac{NoCarRate - NoCarRate_{Low-income} * LowIncomeRate}{1 - LowIncomeRate}$$

- 2.24 For the Individual Income-Based Method:

NoCarRate = 20.5%

<sup>2</sup> [www.bikesatwork.com/carfree/carfree-census-database.html](http://www.bikesatwork.com/carfree/carfree-census-database.html)

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NoCarRate<sub>Low-income</sub> = 65.5%

LowIncomeRate = 14.7%.

$$NoCarRate_{Non-low-income} = \frac{20.5\% - 65.5\% * 14.7\%}{1 - 14.7\%} = 13\%$$

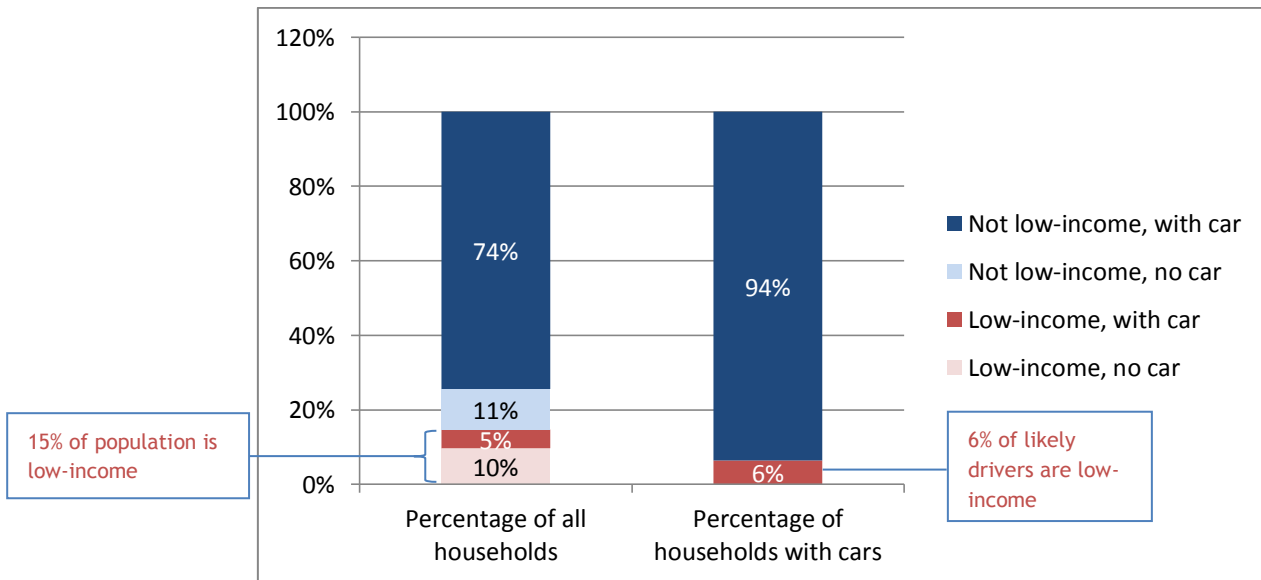
2.25 We therefore estimate that 13% of the non-low-income population does not have access to a vehicle. Table 2.3 below summarizes the shares of non-car-owners for the non-low-income and low-income populations, which will both be removed from consideration in order to calculate the proportion of likely drivers that are low-income.

**TABLE 2.3 CAR ACCESSIBILITY RATES BY INCOME STATUS**

	Low-income	Not low-income
<b>Without access to car</b>	66%	13%
<b>Share of population</b>	15%	85%
<b>Share of population without car</b>	10%	11%

2.26 Figure 2.5 illustrates the effect of removing unlikely drivers from both the low-income and non-low-income populations.

**FIGURE 2.5 EXCLUSION OF UNLIKELY DRIVERS - INDIVIDUAL INCOME-BASED METHOD**



- 2.27 The percentage of households with cars inhabited by low-income families ( $PHWC_{LI}$ ) is the ratio of the percentage of all households inhabited by low-income families ( $PH_{LI}$ ) divided and the percentage of all households that have cars ( $PHWC$ ):

$$PHWC_{LI} = \frac{PH_{LI}}{PHWC} = \frac{5\%}{5\% + 74\%} = 6\%$$

The following is the analogous calculation for the percentage of households with cars inhabited by non-low-income families ( $PHWC_{nonLI}$ ):

$$PHWC_{nonLI} = \frac{PH_{nonLI}}{PHWC} = \frac{74\%}{5\% + 74\%} = 94\%$$

- 2.28 The factor to adjust the low-income population to exclude non-drivers is the ratio of the percentage of low-income likely drivers, in this case 6%, to the percentage of the population that is low-income, in this case 15%, which equals 43%. Because the calculation of the adjustment factor involves significant uncertainty, the result can only be considered precise to one significant figure. We rounded our calculation to a final adjustment factor of 50%.
- 2.29 We also estimated the adjustment factor for the Area-Based and FEITC-based methods using the same methodology. With the Area-Based method, 21% of the population is low-income, while only 10% of likely drivers are low-income. The adjustment factor is thus  $10\%/21\% = 48\%$ , which was again rounded to 50%. According to the FEITC-based method, 19.8% of the population is low-income, while only 14.4% of likely drivers are low-income. The adjustment factor is thus  $14.4\%/19.8\% = 73\%$ , which rounded to 80%.
- 2.30 We then used the adjustment factors,  $AF$ , to convert the proportion of discount eligible residents,  $EP$ , to the proportion of discount eligible drivers,  $EP_{adj}$ , in each TAZ with the following formula:

$$EP_{adj} = \frac{EP * AF}{1 - EP * (1 - AF)}$$

- 2.31 Table 2.4 summarizes the adjustment of low-income residents to low-income likely drivers for each of the three eligibility definitions. The Low-income Percentage shows the size of the low-income population as a percentage of the total population in the LMPA; the Adjusted Low-income Percentage shows the size of the low-income population as a percentage of the drivers in the LMPA. Because the adjustments were made by TAZ, the overall adjusted low-income rates are not what would be calculated by applying the adjustment formula to the overall low-income rate.

**TABLE 2.4 ELIGIBILITY PERCENTAGE OF DRIVERS**

	Low-income Percentage	Adjusted Low-income Percentage
Individual	14.7%	8.7%
Area	20.7%	18.2%
EITC	19.8%	16.6%

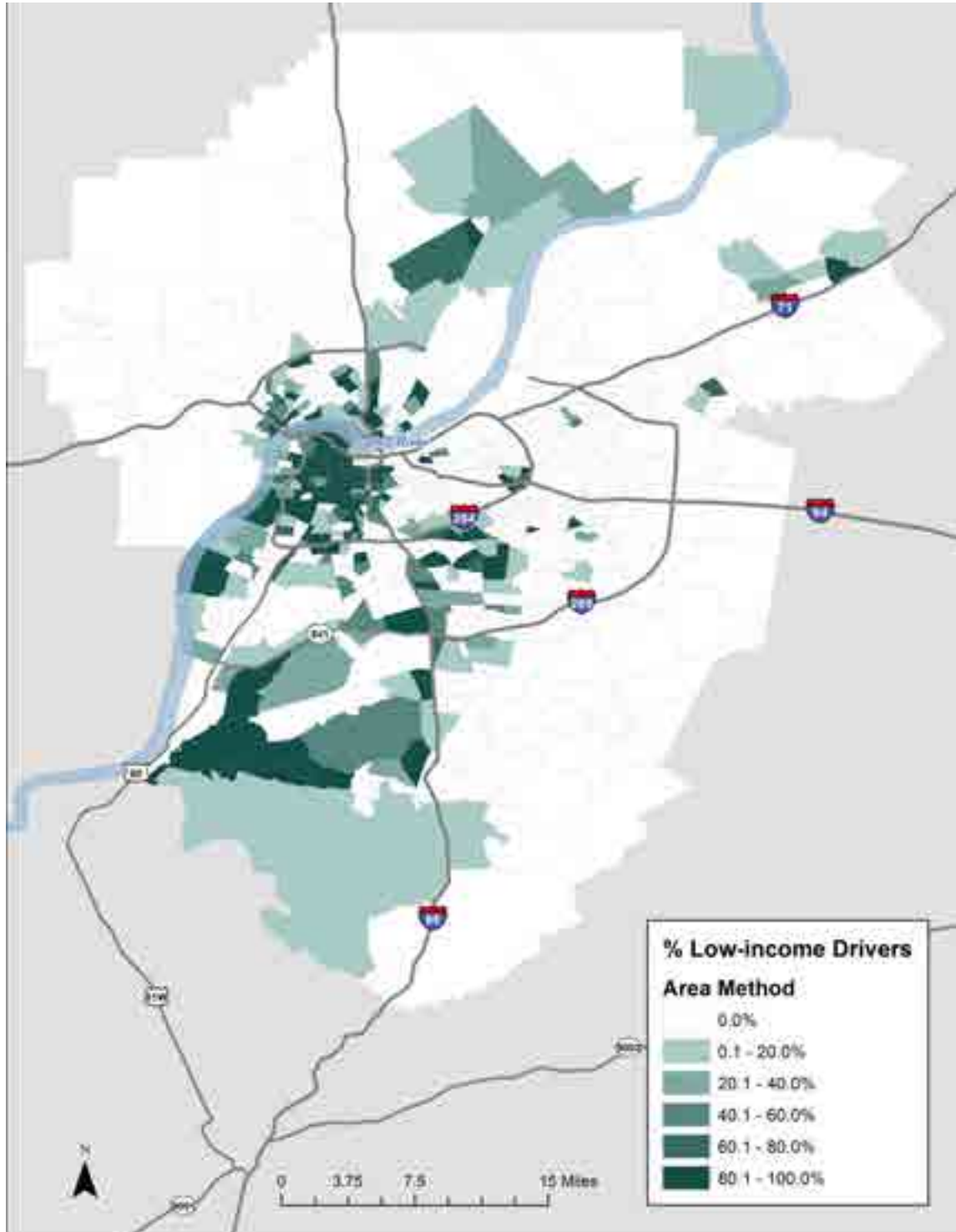
- 2.32 The following figures display the concentration of low-income drivers, estimated in the calculations above, for the three low-income definitions. Figure 2.6 displays the concentration of the low-income drivers by TAZ according to the Individual Income-Based method, while Figure 2.7 displays the concentration according to the Area-Based method and Figure 2.8 displays the concentration according to the FEITC method.
- 2.33 Figure 2.6 and Figure 2.8 show a relatively even distribution of eligible drivers when compared to Figure 2.7, which shows more contrast between Traffic Analysis Zones (TAZs). This pattern is expected, since the Area-Based method assigns a Census Block to be either completely low-income or completely non-low-income. In general, the Area-Based method considers more drivers to be eligible than the Individual Income-Based method, and the FEITC-method considers the most drivers to be low-income.

FIGURE 2.6 LOW-INCOME DRIVER RATE BY INDIVIDUAL INCOME-BASED METHOD



Source: Steer Davies Gleave analysis of ACS data

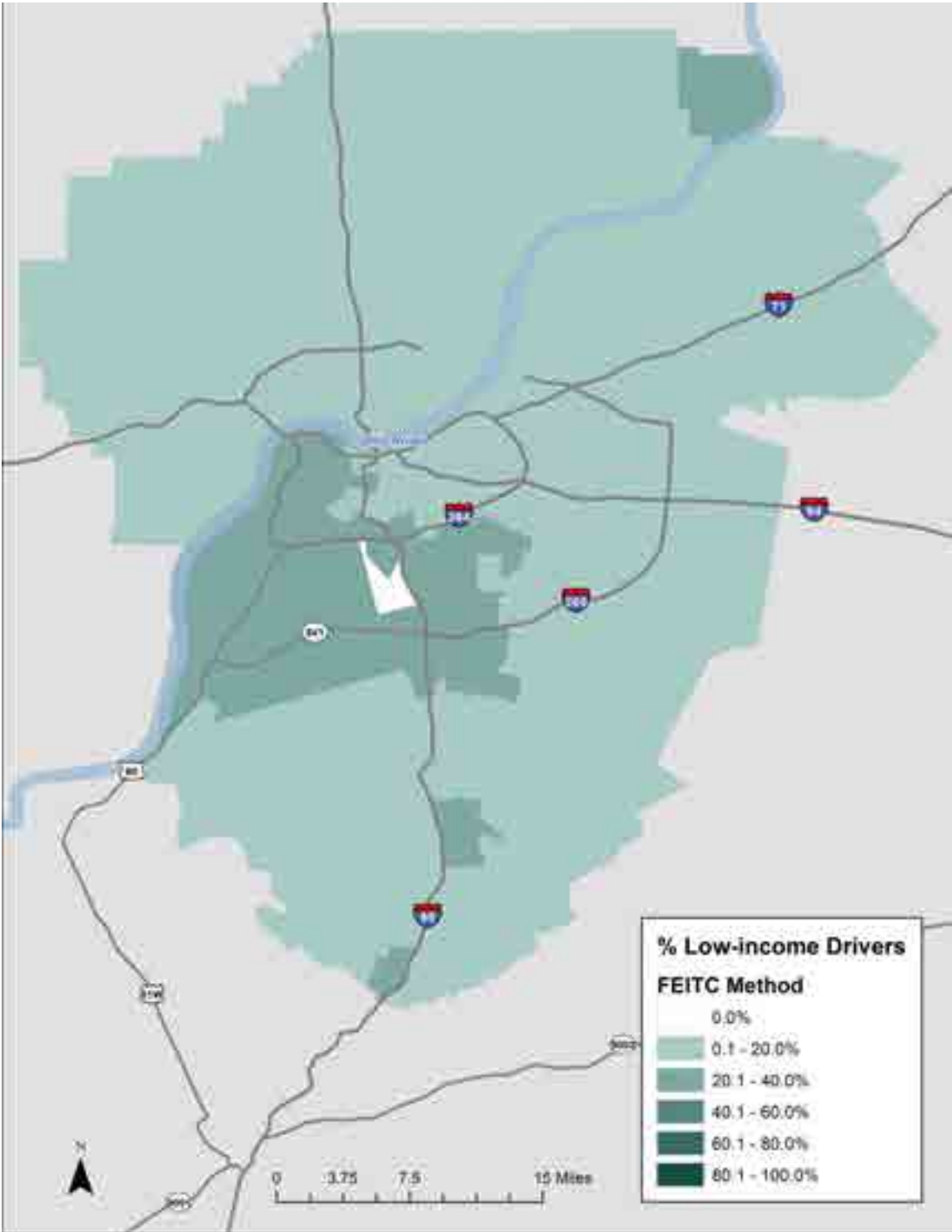
FIGURE 2.7 LOW-INCOME DRIVER RATE BY AREA-BASED METHOD



Source: Steer Davies Gleave analysis of ACS data



FIGURE 2.8 LOW-INCOME DRIVER RATE BY FEITC-BASED METHOD



Source: Steer Davies Gleave analysis of Brookings Institute data

## 3 Toll Discount Scenarios

### Discount Alternatives

- 3.1 Three types of discounts have been identified for consideration, and are discussed below. For all the toll discount scenarios, it is assumed that the discount would be available only to transponder holders and that video toll users are not eligible for the low-income discount.

#### *Percent Discount*

- 3.2 For the Percent Discount types, the toll rates are discounted by a fixed percentage of the transponder toll rate, either the frequent use or non-frequent use transponder toll rates. This calculation is discussed further in Chapter 4.

- 3.3 Three percentage discounts are considered:

- 10%
- 25%
- 50%

#### *One-Time Credit*

- 3.4 The second discount type considers a one-time toll credit that would be provided to Low Income travelers when they obtain a transponder and would need to be used during the 90 days after opening of the Project. Two levels of credit are evaluated:

- \$50
- \$100

#### *Tax Credit*

- 3.5 This discount type would be available to individuals who are eligible for the federal earned income tax credit and file a state tax return. These individuals would be eligible to receive a tax credit based upon the amount of tolls paid. Three levels of tax credits are considered:

- 10%
- 25%
- 50%

### Toll Discount Scenarios

- 3.6 We combined the low-income definitions and discount alternatives into 19 toll discount scenarios, as presented in Table 3.1.

TABLE 3.1 DISCOUNT TOLL SCENARIOS

Discount Type	Individual Income-Base Eligibility	Area-Based Eligibility	FEITC Eligibility
Discounted Toll - Low (10%)	1A	2A	
Discounted Toll - Medium (25%)	1B	2B	
Discounted Toll - High (50%)	1C	2C	
One-Time Credit - Low (\$50)	1D	2D	
One-Time Credit - High (\$100)	1E	2E	
Tax Credit - Low (10%)	1F	2F	3F
Tax Credit - Medium (25%)	1G	2G	3G
Tax Credit - High (50%)	1H	2H	3H

## 4 Travel Demand Forecasting Approach

4.1 This chapter describes the approach used to represent the toll discount scenarios in the travel demand model. The travel demand forecasting was based on the travel demand model developed by Steer Davies Gleave (SDG model) to prepare the traffic and revenue forecasts used to help issue toll revenue bonds for the LSIORB Project<sup>3</sup>.

### Preparation of Low Income Trips

4.2 In Chapter 2, we presented the approach we used to determine the percentage of Low Income trips for each TAZ that are eligible for the Low Income discount for each low-income definition. The travel demand model represents trips in the Origin-Destination (OD) format, with trip levels for each OD that vary by the 9 time periods in the model (three periods in the AM, a midday period, four periods in the PM, and one nighttime period). For each period, traffic volumes are forecast for autos, medium trucks and heavy trucks. The SDG model was not established with reference to income levels, but rather used 3 equally-sized groups of trips based on the distribution of value of time (VOT)<sup>4</sup>. It was, therefore, necessary to split the predicted auto trips into low-income and non low-income trips. For a detailed explanation of the methodology used, see Appendix A.

4.3 As a result of this approach, auto trips were split into Low-income and non-Low Income matrices so that the following twelve trip types were established for each of the nine time periods included in the traffic model:

- Auto No Low Income - (Low, medium and High VoT)
- Auto Low Income - (Low, medium and High VoT)
- Medium Truck - (Low, medium and High VoT)
- Heavy Trucks - (Low, medium and High VoT)

### Rebasing of Traffic & Revenue Model

4.4 As discussed above, in order to perform the low income toll discount analysis, we have created three new auto segments in the traffic demand model. Since the model was

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<sup>3</sup> The full details of the SDG model can be found at <http://updates.kyinbridges.com/wp-content/uploads/2013/08/Traffic-Revenue-Study-8-30-13.pdf>

<sup>4</sup> As described in the above referenced traffic and revenue study report, the VOTs were established from a travel survey conducted for the Traffic and Revenue Study. While the results of the travel survey conducted as part of the study did show a relationship between income and VOT, the resulting VOTs do not show the level of variability that is most effective for toll forecasting, and thus we used the distribution of VOT itself to segment trips into groups that exhibited realistic range in behavioral responses. The resulting trip grouping means that 33.3% of trips for all ODs used the low VOT; 33.3% used the medium VOT; and 33.3% used the high VOT.

originally built and calibrated without these new segments, the results of the updated model may include different “average” VOT and thus different assignment outputs.

- 4.5 For this reason we have “rebased” the model and used it as a pivot point to estimate the percentage difference for each scenario. The “rebasing” approach can be summarized in the following three steps:
- Run the model after shifting auto trips to the new three Low Income segments, but without the introduction of a toll discount;
  - Run the model after shifting auto trips to the new three Low Income segments and with the specified toll discount alternative;
  - Determine the percentage of the results from Step 2 relative to the results from Step 1, and apply that percentage onto the Base Traffic and Revenue Forecasts that were included in the Project plan of finance.

#### **Preparation of Toll Discount Scenarios**

- 4.6 The key step for preparing the toll discount scenarios is to determine and input the toll rate into the model. Low-Income toll rates were established for each scenario independently according to the characteristics of each discount type being offered, as described in the following sections. It is assumed that any Low-income discount would be available only to transponder holders.

##### ***Percent Discount***

- 4.7 The Percent Discount type is the most straightforward to represent in the SDG model. For this discount, we simply reduced the toll rate presented to the Low Income trips in the model by the percentage of the discount. The base year toll rates for the Low Income trips are presented in Table 4.1.

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TABLE 4.1 OPENING YEAR BASE YEAR TOLL RATES (2017 \$)

Payment Type	Base Toll Rate	Basis for Discount	10% Discount Toll Rate	25% Discount Toll Rate	50% Discount Toll Rate
Transponder - Frequent User	\$1.00	\$1.00	\$0.90	\$0.75	\$0.50
Transponder - Non-Frequent User	\$2.00	\$2.00	\$1.80	\$1.50	\$1.00
Registered Video	\$3.00	NA	NA	NA	NA
Other Video	\$4.00	NA	NA	NA	NA

**One-Time Credit**

- 4.8 The One-Time Credit discount does not require the full run of all years of the SDG model. Rather, we would use the model trip patterns and magnitude to size the revenue impact of the discount for the opening year. Revenue was sized through the following steps:
1. For each low-income definition, we analyzed the daily number of river crossing trips forecast to be made in the opening year. We estimated this at the TAZ level from the AM rebase auto trip matrices and then expanded it to daily levels.
  2. We translated #1 into the number of trips that would be made by each Low Income vehicle during the 90-day credit period (i). We obtained the total number of residents per TAZ that are over 16 (who can drive) and low-income, and then divide (i) above by this number.
  3. For each TAZ and each alternative size of the one-time credit, \$50 and \$100, we determined the proportion of trips from #2 that would be covered by the credit. This is based on the fact that with a toll rate of \$2, a one-time credit of \$50 and \$100 would cover 25 and 50 trips respectively.
  4. We translated #3 back to a daily level and shifted these trips into a new trip segment that could use the bridges toll-free.
  5. Run the model.
- 4.9 Following the above methodology, we calculated the proportion of the low income trips covered by the one-time credit discount for each TAZ. Table 4.2 presents the overall daily percentages of one-time credit trips as a proportion of the total river crossing traffic for each of the low-income definitions. The low percentages (less than

0.5% in all the cases) show that 25 and 50 Low Income trips in a period of 90 days represent a very low proportion of the total daily river crossing traffic.

**TABLE 4.2 ONE-TIME CREDIT TRIPS AS PROPORTION OF RIVER CROSSING TRAFFIC**

One Time Credit	Individual Income-Based Eligibility	Area-Based Eligibility
\$50	0.17%	0.21%
\$100	0.34%	0.42%

***Tax Credit***

- 4.10 We evaluated the Tax Credit using some of the elements of our approach to the Percent Discount, while customizing for how Low Income travelers are likely to perceive and respond to the tax credit. The key difference between these approaches is the time lag between (i) when the cross-river travel occurs and the toll is paid and (ii) when the tax credit is realized.
- 4.11 In order to estimate how travelers may value this time lag, we considered a few different commercial products that reflect a range of interest rates that consumers confront. High end rates might be represented by Refund Anticipation Loans (RALs). RALs are offered by tax preparation services and are loans that are typically provided when a tax return is filed and repaid when the refund is received<sup>5</sup>. Interest rates on RALs are typically 36%. A medium interest rate might be represented by credit cards, typically in the 9-18% range. While low end of the range might be represented by mortgage rates which have recently reached historically low levels with interest rates less than 4%.
- 4.12 Based upon our review of these different interest rates, we decided to use a time value discount rate of 15% for our analysis. This 15% rate seems to be a good rate in between the high RAL interest rates and the much lower mortgage interest rates, and consistent with a typical credit card interest rate. This “time value discount rate” reflects the time- value of money; a dollar tomorrow (or next year) is worth less than a dollar today.
- 4.13 The other component of applying the discount is the duration of the time-lag. We assumed that tolled travel was evenly distributed over the course of the year and that on average, travelers received their tax refund at the end of March, and thus, we assumed an average of 9 months delay for discounting purposes (i.e., receipt of the

<sup>5</sup> For more information on RALs, please see <http://financialplan.about.com/od/taxplanning/a/Tax-Refund-Anticipation-Loans.htm> or <http://www.foxbusiness.com/personal-finance/2013/02/07/refund-anticipation-loans-live-on-in-new-disguises/>

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tax refund three months after the mid-point of the tax year (June 30) in which the tolls were paid).

- 4.14 Combining the annual 15% time-value discount rate with 9 months equals 1.1105<sup>6</sup>. We then divide the toll discount amount by 1.1105 to reflect how it would be perceived today. For example, the nominal toll rate for a transponder user under the “10% Discount” scenario is \$0.90 - a discount of ten cents. But because the discount is received later in time, the formula converts that discount to a perceived toll rate of \$0.91 - equivalent to a discount of nine cents. The resulting perceived opening year toll rates are presented in Table 4.3.

**TABLE 4.3 PERCEIVED OPENING YEAR BASE YEAR TOLL RATES**

Payment Type	Base Toll Rate	Basis for Discount	10% Discount Toll Rate	25% Discount Toll Rate	50% Discount Toll Rate
Transponder Frequent User	\$1.00	\$1.00	\$0.91	\$0.77	\$0.55
Transponder Non-frequent User	\$2.00	\$2.00	\$1.82	\$1.55	\$1.10
Registered Video	\$3.00	NA	NA	NA	NA
Other Video	\$4.00	NA	NA	NA	NA

### Preparation of Traffic and Revenue Forecasts

- 4.15 For all scenarios (except the one-time credit) the percentage change in traffic and revenue in 2018 and 2030 was calculated between the rebased scenario, which included the Low Income segment groups but no discount, and the different discount scenarios. This difference was then applied to the original base case numbers in 2018 and 2030.
- 4.16 The results between 2018 and 2030 were also factored from the base case numbers, with the change in the difference between the base and each scenario interpolated between 2018 and 2030. For 2017 the same trend was continued and applied to the base case numbers, and for years after 2030 the same extrapolation factors were applied as in the base case.

<sup>6</sup>  $(1.15)^{(9/12)} = 1.1105$



- 4.17 The one-time credit scenarios required a slightly different application of the model, since there is no 2017 model year. Specifically, two different adjustments were required. First, time element of this scenario is different with only half of 2017 (the one-time credit is only good for 90 days, which is half of the of the 2017 financial year toll operations from January 1, 2017 to June 30, 2017) being impacted by the scenario. Second, since there is no 2017 model year, the results of the 2018 model run for this scenario were applied to 2017 forecasts. By 2018, the discount period has been expired, and thus the 2018 forecasts remaining unchanged from the base case results.

## 5 Results and Analysis

5.1 In this chapter, we present and analyze the traffic and revenue results of the various toll discount scenarios.

### Low Income River Crossing Traffic

5.2 To help put the traffic and revenue impacts of the toll discount scenarios into perspective, we first sought to illustrate the magnitude of travel made by the Low Income population of each low-income definition. Specifically, using the trip matrices described in Chapter 4, we analyzed the percentage of total trips, river crossing traffic, toll bridge traffic, and toll revenue that the Low Income travel represents with the base toll rates. Table 5.1 presents these travel statistics for model year 2018, along with a comparison to the percentage of drivers for each low-income definition (previously presented in Table 2.4).

**TABLE 5.1 LOW INCOME TRAVEL AS PERCENTAGE OF TOTAL TRAVEL STATISTICS (YEAR 2018)**

Metric	Individual Income-Based Method	Area-Based Method	FEITC Method
Percentage of Drivers	8.7%	18.2%	16.6%
Total LMPA Trips	8.2%	16.8%	15.5%
River Crossing Trips (all bridges)	6.1%	13.7%	13.5%
River Crossing Trips (Tolled Bridges)	2.3%	7.1%	5.7%
Toll Revenue	0.9%	3.0%	2.3%

Note: “Percentage of Drivers” same numbers as the Adjusted Low-Income Percentage presented in “Table 2.4 Eligibility Percentage of Likely Drivers”

5.3 Moving down the table, we see that the low-income travel represents a decreasing percentage of the total for the various metrics. We discuss the reason for each below with the values reflecting the Area-Based Method:

- The decrease from Percentage of Drivers to Total LMPA Trips (from 18.2% to 16.8%) is primarily due to the external trips being included in the pool of total trips.
- The decrease from Total LMPA Trips to River Crossing Trips, (all bridges), including tolled and non-tolled bridges, (from 16.8% to 13.7%) reflects the travel patterns of the Low Income Eligible trips from the model’s trip distribution step and the lower likelihood of these trips to cross the river as reflected in the calibrated trip generation and trip distribution relationships in the LMPA model.

- The decrease from River Crossing Trips (all bridges) to River Crossing Trips (tolled bridges) (from 13.7% to 7.1%) is due to the lower VOTs associated with these trips (since they are first coming from the Low VOT group, then the Medium VOT group, and finally the High VOT group) resulting in a lower selection of the toll option than average of all trips.<sup>7</sup> A lower VOT results in a lower share of trips selecting to pay the toll to use a tolled bridge.
- The decrease from River Crossing Trips (tolled bridges) to Toll Revenue (from 7.1% to 3%) reflects two characteristics: 1) truck traffic represents 45% of total toll revenue greatly reducing the impact of auto traffic on revenue, and 2) given the lower VOT, the resulting Low Income tolled traffic tends to be disproportionately from the lower toll rates (transponder traffic - both frequent use discount and regular vs. video toll collection).

5.4 The bottom row of Table 5.1 shows the percentage of the total toll revenue that is associated with low income travel in 2018. The percentage of toll revenue from low-income trips is largest with the Area-Based Eligibility approach at 3%, followed by the FEITC Method impact at 2.3%, and then the Individual Income-Based Method impact at 0.9%. These numbers represent the amount of revenue that would be lost if no toll revenue were collected from low-income drivers. In that sense, they represent the maximum potential loss of revenue (i.e., the amount that would be lost with a 100% toll discount (free travel) for low-income users).

### Traffic and Revenue Impact of Low Income Toll Discounts

5.5 Using the traffic forecasting approach described in Chapter 4, we prepared traffic and revenue forecasts for each toll discount scenario. Table 5.2 presents the changes in Low Income toll traffic and revenue for each toll discount scenario for model year 2018, while Table 5.3 presents the same information for 2030. These tables show that, as expected, all discount scenarios result in increased Low Income traffic. The impact on revenue from Low Income trips is mixed. In 2018, some scenarios show increased revenue from Low Income trips, while others show lower revenue from Low Income trips. In 2030, revenues from low-income trips remain the same or decrease under all scenarios (except the one-time credit, which is no longer in effect in 2030).

5.6 The differences within a low-income definition reflect the price differentiation between the Low Income trips and the overall trips. Under some scenarios, a small decrease in the toll rate will increase the revenue from Low Income trips, because the lower toll amount is more than offset by an increase in the number of toll trips. By contrast, the larger toll discounts reduce the revenue from Low Income trips because the additional toll trips do not generate enough additional revenue to offset the lower toll revenue from the existing trips.

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<sup>7</sup> Since the Low Income trips were first taken from the Low VOT group which uses a lower VOT, these trips have a lower toll bridge capture rate than other trips due to this lower VOT.

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5.7 The primary factor causing the difference between the results for the Individual Income-Based and Area-Based method is that the Area-Based approach has a higher average VOT for the Low Income trips than the Individual Income Based method. This higher average VOT due to the Area-Based approach results in more low-income trips from a TAZ and some of these incremental trips wind up in higher VOT groups. For trips in the Higher VOT group, the base toll rates are already lower than revenue maximizing and thus any decrease in toll rates will reduce revenue, which is why the Area-Based approach sees a reduction in revenue. The differences in the average VOT also contribute to the magnitude of traffic impact, in this case with the Individual Income-Based approach experiencing a larger traffic increase than the Area Base approach.

**TABLE 5.2 CHANGE IN TOLL TRAFFIC & REVENUE FROM LOW-INCOME TRIPS - MODEL YEAR 2018**

Discount Type	Traffic Impact			Revenue Impact		
	Individual Income-Based Method	Area-Based Method	FEITC Method	Individual Income-Based Method	Area-Based Method	FEITC Method
Discounted Toll - Low (10%)	8.1%	6.0%	NA	-1.7%	-2.9%	NA
Discounted Toll - Medium (25%)	21.4%	15.7%	NA	-6.8%	-11.7%	NA
Discounted Toll - High (50%)	47.7%	34.2%	NA	-22.7%	-30.5%	NA
One-Time Credit - Low (\$50)	17.2%	29.2%	NA	-3.0%	-7.0%	NA
One-Time Credit - High (\$100)	34.5%	57.0%	NA	-6.1%	-13.5%	NA
Tax Credit - Low (10%)	7.3%	5.4%	6.9%	-1.5%	-3.5%	-1.9%
Tax Credit - Medium (25%)	19.5%	14.3%	18.5%	-5.9%	-10.5%	-6.8%
Tax Credit - High (50%)	41.9%	30.2%	39.4%	-18.7%	-26.1%	-20.2%

**TABLE 5.3 CHANGE IN TOLL TRAFFIC & REVENUE FROM LOW-INCOME TRIPS-  
MODEL YEAR 2030**

Discount Type	Traffic Impact			Revenue Impact		
	Individual Income- Based Method	Area- Based Method	FEITC Method	Individual Income- Based Method	Area- Based Method	FEITC Method
Discounted Toll - Low (10%)	8.0%	5.7%	NA	-1.8%	-4.2%	NA
Discounted Toll - Medium (25%)	21.3%	14.9%	NA	-6.9%	-12.4%	NA
Discounted Toll - High (50%)	47.7%	32.4%	NA	-22.7%	-31.6%	NA
One-Time Credit - Low (\$50)	NA	NA	NA	NA	NA	NA
One-Time Credit - High (\$100)	NA	NA	NA	NA	NA	NA
Tax Credit - Low (10%)	7.2%	5.1%	6.9%	-1.6%	-3.8%	-1.9%
Tax Credit - Medium (25%)	19.4%	13.6%	18.6%	-6.0%	-11.2%	-6.7%
Tax Credit - High (50%)	41.8%	28.7%	39.6%	-18.7%	-27.1%	-20.0%

5.8 Table 5.4 and Table 5.5 present the traffic and revenue impacts for 2018 and 2030, respectively, on the overall traffic and revenue. Table 5.4 shows the largest 2018 revenue decrease of 1.2% occurs with the High One-Time Credit and the Area-Based Method, and Table 5.5 shows a maximum revenue loss of 1.4% for the High Discounted Toll and the Area-Based Method in 2030.

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TABLE 5.4 CHANGE IN TOTAL TOLL TRAFFIC & REVENUE - MODEL YEAR 2018

Discount Type	Traffic Impact			Revenue Impact		
	Individual Income-Based Method	Area-Based Method	FEITC Method	Individual Income-Based Method	Area-Based Method	FEITC Method
Discounted Toll - Low (10%)	0.1%	0.3%	NA	0.0%	-0.1%	NA
Discounted Toll - Medium (25%)	0.3%	0.7%	NA	-0.1%	-0.4%	NA
Discounted Toll - High (50%)	0.8%	1.6%	NA	-0.3%	-1.0%	NA
One-Time Credit - Low (\$50)	0.3%	1.3%	NA	-0.1%	-0.6%	NA
One-Time Credit - High (\$100)	0.5%	2.5%	NA	-0.2%	-1.2%	NA
Tax Credit - Low (10%)	0.1%	0.3%	0.3%	0.0%	-0.1%	0.0%
Tax Credit - Medium (25%)	0.3%	0.7%	0.7%	-0.1%	-0.4%	-0.1%
Tax Credit - High (50%)	0.7%	1.4%	1.5%	-0.2%	-0.8%	-0.4%

TABLE 5.5 CHANGE IN TOTAL TOLL TRAFFIC & REVENUE - MODEL YEAR 2030

Discount Type	Traffic Impact			Revenue Impact		
	Individual Income-Based Method	Area-Based Method	FEITC Method	Individual Income-Based Method	Area-Based Method	FEITC Method
Discounted Toll - Low (10%)	0.1%	0.3%	NA	-0.1%	-0.2%	NA
Discounted Toll - Medium (25%)	0.3%	0.8%	NA	-0.2%	-0.6%	NA
Discounted Toll - High (50%)	0.8%	1.8%	NA	-0.5%	-1.4%	NA
One-Time Credit - Low (\$50)	NA	NA	NA	NA	NA	NA
One-Time Credit - High (\$100)	NA	NA	NA	NA	NA	NA
Tax Credit - Low (10%)	0.1%	0.3%	0.3%	-0.1%	-0.1%	0.0%
Tax Credit - Medium (25%)	0.3%	0.7%	0.8%	-0.2%	-0.5%	-0.2%
Tax Credit - High (50%)	0.7%	1.6%	1.7%	-0.4%	-1.2%	-0.7%

### Annual Traffic and Revenue Streams

- 5.9 We also developed the full stream of annual traffic and revenue for each toll discount scenario. Table 5.6, Table 5.8 and Table 5.10 present the stream of daily toll traffic for the Individual Income-Based, Area-Based, and FEITC-based enrollment approaches, respectively. For comparison purposes total daily traffic under the base case (i.e., without a discount) is also presented. Table 5.7, Table 5.9 and Table 5.11 present the percentage change in traffic relative to the base tolling scenario.
- 5.10 All revenues are in nominal values (i.e. including inflation). In order to convert the revenue forecasts from the model's 2012\$ prices to future year nominal equivalents, we applied a 2.5% annual future inflation rate.

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**TABLE 5.6 DAILY TOLL TRAFFIC FOR INDIVIDUAL INCOME-BASED DISCOUNT SCENARIOS**

Fiscal Year	Base Case	Low Disc. Toll	Medium Disc. Toll	High Disc. Toll	Low One-Time Credit <sup>8</sup>	High One-Time Credit	Low Tax Credit	Medium Tax Credit	High Tax Credit
2017	102,844	102,972	103,195	103,632	102,978	103,122	102,979	103,172	103,532
2018	106,676	106,809	107,040	107,498	106,676	106,676	106,812	107,015	107,393
2019	111,171	111,310	111,550	112,031	111,171	111,171	111,309	111,523	111,922
2020	112,506	112,646	112,889	113,381	112,506	112,506	112,642	112,862	113,270
2021	113,860	114,002	114,247	114,749	113,860	113,860	113,993	114,219	114,637
2022	114,801	114,944	115,191	115,702	114,801	114,801	114,931	115,162	115,588
2023	116,453	116,597	116,848	117,371	116,453	116,453	116,580	116,818	117,255
2024	118,215	118,362	118,616	119,151	118,215	118,215	118,340	118,585	119,033
2025	120,036	120,185	120,442	120,991	120,036	120,036	120,159	120,411	120,871
2026	121,962	122,113	122,375	122,937	121,962	121,962	122,082	122,342	122,814
2027	123,995	124,148	124,414	124,991	123,995	123,995	124,112	124,380	124,866
2028	126,138	126,294	126,564	127,155	126,138	126,138	126,253	126,529	127,028
2029	128,396	128,554	128,829	129,436	128,396	128,396	128,508	128,793	129,306
2030	130,773	130,934	131,213	131,837	130,773	130,773	130,882	131,176	131,704
2031	133,112	133,276	133,560	134,195	133,112	133,112	133,223	133,522	134,060
2032	135,374	135,541	135,830	136,476	135,374	135,374	135,487	135,791	136,338
2033	137,675	137,845	138,139	138,796	137,675	137,675	137,790	138,099	138,655
2034	140,016	140,188	140,487	141,156	140,016	140,016	140,133	140,447	141,013
2035	142,397	142,572	142,877	143,556	142,397	142,397	142,516	142,836	143,411
2036	144,515	144,693	145,002	145,691	144,515	144,515	144,636	144,960	145,544
2037	146,359	146,539	146,852	147,550	146,359	146,359	146,481	146,810	147,401
2038	148,228	148,411	148,727	149,434	148,228	148,228	148,352	148,685	149,284
2039	150,122	150,307	150,628	151,344	150,122	150,122	150,248	150,585	151,191
2040	152,040	152,227	152,552	153,277	152,040	152,040	152,167	152,508	153,123
2041	153,657	153,846	154,174	154,908	153,657	153,657	153,786	154,130	154,751
2042	154,966	155,157	155,488	156,227	154,966	154,966	155,096	155,443	156,070
2043	156,287	156,479	156,813	157,559	156,287	156,287	156,418	156,769	157,400
2044	157,619	157,813	158,150	158,902	157,619	157,619	157,751	158,105	158,741
2045	158,963	159,159	159,498	160,257	158,963	158,963	159,096	159,453	160,095
2046	160,319	160,516	160,859	161,624	160,319	160,319	160,453	160,813	161,461
2047	161,686	161,885	162,230	163,002	161,686	161,686	161,821	162,184	162,837
2048	163,066	163,267	163,615	164,393	163,066	163,066	163,202	163,568	164,227
2049	164,457	164,659	165,011	165,796	164,457	164,457	164,595	164,964	165,628
2050	165,861	166,065	166,420	167,211	165,861	165,861	166,000	166,372	167,042
2051	167,276	167,482	167,839	168,637	167,276	167,276	167,416	167,791	168,467
2052	168,705	168,913	169,273	170,078	168,705	168,705	168,846	169,225	169,906
2053	170,145	170,355	170,718	171,530	170,145	170,145	170,287	170,669	171,357
2054	171,598	171,809	172,176	172,995	171,598	171,598	171,742	172,127	172,820

<sup>8</sup> Note that while Table 5.4 shows a decrease in revenue for the One-Time Credit approaches, this is for model year 2018, the true impact of the One-Time Credit approaches only occur for FY 2017.



**TABLE 5.7 PERCENTAGE CHANGE FROM BASE CASE IN DAILY TOLL TRAFFIC FOR INDIVIDUAL INCOME-BASED DISCOUNT SCENARIOS**

Fiscal Year	Low Disc Toll	Medium Disc. Toll	High Disc. Toll	Low One-Time Credit	High One-Time Credit	Low Tax Credit	Medium Tax Credit	High Tax Credit
2017	0.12%	0.34%	0.77%	0.13%	0.27%	0.13%	0.32%	0.67%
2018	0.12%	0.34%	0.77%	0.00%	0.00%	0.13%	0.32%	0.67%
2019	0.12%	0.34%	0.77%	0.00%	0.00%	0.12%	0.32%	0.68%
2020	0.12%	0.34%	0.78%	0.00%	0.00%	0.12%	0.32%	0.68%
2021	0.12%	0.34%	0.78%	0.00%	0.00%	0.12%	0.32%	0.68%
2022	0.12%	0.34%	0.78%	0.00%	0.00%	0.11%	0.31%	0.69%
2023	0.12%	0.34%	0.79%	0.00%	0.00%	0.11%	0.31%	0.69%
2024	0.12%	0.34%	0.79%	0.00%	0.00%	0.11%	0.31%	0.69%
2025	0.12%	0.34%	0.80%	0.00%	0.00%	0.10%	0.31%	0.70%
2026	0.12%	0.34%	0.80%	0.00%	0.00%	0.10%	0.31%	0.70%
2027	0.12%	0.34%	0.80%	0.00%	0.00%	0.09%	0.31%	0.70%
2028	0.12%	0.34%	0.81%	0.00%	0.00%	0.09%	0.31%	0.71%
2029	0.12%	0.34%	0.81%	0.00%	0.00%	0.09%	0.31%	0.71%
2030	0.12%	0.34%	0.81%	0.00%	0.00%	0.08%	0.31%	0.71%
2031	0.12%	0.34%	0.81%	0.00%	0.00%	0.08%	0.31%	0.71%
2032	0.12%	0.34%	0.81%	0.00%	0.00%	0.08%	0.31%	0.71%
2033	0.12%	0.34%	0.81%	0.00%	0.00%	0.08%	0.31%	0.71%
2034	0.12%	0.34%	0.81%	0.00%	0.00%	0.08%	0.31%	0.71%
2035	0.12%	0.34%	0.81%	0.00%	0.00%	0.08%	0.31%	0.71%
2036	0.12%	0.34%	0.81%	0.00%	0.00%	0.08%	0.31%	0.71%
2037	0.12%	0.34%	0.81%	0.00%	0.00%	0.08%	0.31%	0.71%
2038	0.12%	0.34%	0.81%	0.00%	0.00%	0.08%	0.31%	0.71%
2039	0.12%	0.34%	0.81%	0.00%	0.00%	0.08%	0.31%	0.71%
2040	0.12%	0.34%	0.81%	0.00%	0.00%	0.08%	0.31%	0.71%
2041	0.12%	0.34%	0.81%	0.00%	0.00%	0.08%	0.31%	0.71%
2042	0.12%	0.34%	0.81%	0.00%	0.00%	0.08%	0.31%	0.71%
2043	0.12%	0.34%	0.81%	0.00%	0.00%	0.08%	0.31%	0.71%
2044	0.12%	0.34%	0.81%	0.00%	0.00%	0.08%	0.31%	0.71%
2045	0.12%	0.34%	0.81%	0.00%	0.00%	0.08%	0.31%	0.71%
2046	0.12%	0.34%	0.81%	0.00%	0.00%	0.08%	0.31%	0.71%
2047	0.12%	0.34%	0.81%	0.00%	0.00%	0.08%	0.31%	0.71%
2048	0.12%	0.34%	0.81%	0.00%	0.00%	0.08%	0.31%	0.71%
2049	0.12%	0.34%	0.81%	0.00%	0.00%	0.08%	0.31%	0.71%
2050	0.12%	0.34%	0.81%	0.00%	0.00%	0.08%	0.31%	0.71%
2051	0.12%	0.34%	0.81%	0.00%	0.00%	0.08%	0.31%	0.71%
2052	0.12%	0.34%	0.81%	0.00%	0.00%	0.08%	0.31%	0.71%
2053	0.12%	0.34%	0.81%	0.00%	0.00%	0.08%	0.31%	0.71%
2054	0.12%	0.34%	0.81%	0.00%	0.00%	0.08%	0.31%	0.71%

TABLE 5.8 DAILY TOLL TRAFFIC FOR AREA-BASED DISCOUNT SCENARIOS

Fiscal Year	Base Case	Low Disc. Toll	Medium Disc. Toll	High Disc. Toll	Low One-Time Credit	High One-Time Credit	Low Tax Credit	Medium Tax Credit	High Tax Credit
2017	102,844	103,154	103,594	104,518	103,506	104,125	103,115	103,524	104,301
2018	106,676	106,999	107,460	108,424	106,676	106,676	106,959	107,387	108,202
2019	111,171	111,509	111,996	113,006	111,171	111,171	111,468	111,917	112,776
2020	112,506	112,849	113,348	114,376	112,506	112,506	112,809	113,267	114,146
2021	113,860	114,209	114,719	115,766	113,860	113,860	114,169	114,636	115,536
2022	114,801	115,154	115,675	116,736	114,801	114,801	115,115	115,589	116,506
2023	116,453	116,812	117,347	118,429	116,453	116,453	116,773	117,259	118,199
2024	118,215	118,581	119,130	120,235	118,215	118,215	118,543	119,039	120,004
2025	120,036	120,409	120,973	122,101	120,036	120,036	120,371	120,879	121,869
2026	121,962	122,343	122,922	124,074	121,962	121,962	122,305	122,825	123,841
2027	123,995	124,383	124,979	126,157	123,995	123,995	124,346	124,878	125,923
2028	126,138	126,535	127,147	128,352	126,138	126,138	126,498	127,043	128,117
2029	128,396	128,801	129,432	130,664	128,396	128,396	128,765	129,324	130,428
2030	130,773	131,187	131,837	133,099	130,773	130,773	131,151	131,725	132,860
2031	133,112	133,534	134,195	135,479	133,112	133,112	133,497	134,081	135,237
2032	135,374	135,803	136,475	137,781	135,374	135,374	135,765	136,359	137,535
2033	137,675	138,111	138,795	140,123	137,675	137,675	138,073	138,677	139,873
2034	140,016	140,460	141,155	142,506	140,016	140,016	140,421	141,035	142,251
2035	142,397	142,848	143,555	144,929	142,397	142,397	142,809	143,434	144,670
2036	144,515	144,973	145,690	147,085	144,515	144,515	144,933	145,567	146,822
2037	146,359	146,823	147,549	148,962	146,359	146,359	146,782	147,424	148,695
2038	148,228	148,698	149,434	150,864	148,228	148,228	148,656	149,307	150,594
2039	150,122	150,598	151,343	152,792	150,122	150,122	150,556	151,215	152,518
2040	152,040	152,522	153,277	154,744	152,040	152,040	152,479	153,147	154,467
2041	153,657	154,144	154,907	156,390	153,657	153,657	154,101	154,776	156,110
2042	154,966	155,457	156,226	157,722	154,966	154,966	155,414	156,094	157,440
2043	156,287	156,782	157,558	159,066	156,287	156,287	156,739	157,425	158,782
2044	157,619	158,118	158,901	160,422	157,619	157,619	158,075	158,766	160,135
2045	158,963	159,467	160,256	161,790	158,963	158,963	159,422	160,120	161,500
2046	160,319	160,827	161,623	163,170	160,319	160,319	160,782	161,486	162,878
2047	161,686	162,198	163,001	164,561	161,686	161,686	162,153	162,863	164,267
2048	163,066	163,583	164,392	165,966	163,066	163,066	163,537	164,253	165,669
2049	164,457	164,978	165,795	167,382	164,457	164,457	164,932	165,654	167,082
2050	165,861	166,386	167,210	168,811	165,861	165,861	166,340	167,068	168,508
2051	167,276	167,806	168,636	170,251	167,276	167,276	167,759	168,494	169,946
2052	168,705	169,239	170,077	171,705	168,705	168,705	169,193	169,933	171,398
2053	170,145	170,684	171,529	173,171	170,145	170,145	170,637	171,384	172,861
2054	171,598	172,142	172,994	174,650	171,598	171,598	172,094	172,847	174,337

**TABLE 5.9 PERCENTAGE CHANGE FROM BASE CASE IN DAILY TOLL TRAFFIC FOR AREA-BASED DISCOUNT SCENARIOS**

Fiscal Year	Low Disc. Toll	Medium Disc. Toll	High Disc. Toll	Low One-Time Credit	High One-Time Credit	Low Tax Credit	Medium Tax Credit	High Tax Credit
2017	0.30%	0.73%	1.63%	0.64%	1.25%	0.26%	0.66%	1.42%
2018	0.30%	0.74%	1.64%	0.00%	0.00%	0.27%	0.67%	1.43%
2019	0.30%	0.74%	1.65%	0.00%	0.00%	0.27%	0.67%	1.44%
2020	0.30%	0.75%	1.66%	0.00%	0.00%	0.27%	0.68%	1.46%
2021	0.31%	0.75%	1.67%	0.00%	0.00%	0.27%	0.68%	1.47%
2022	0.31%	0.76%	1.69%	0.00%	0.00%	0.27%	0.69%	1.49%
2023	0.31%	0.77%	1.70%	0.00%	0.00%	0.28%	0.69%	1.50%
2024	0.31%	0.77%	1.71%	0.00%	0.00%	0.28%	0.70%	1.51%
2025	0.31%	0.78%	1.72%	0.00%	0.00%	0.28%	0.70%	1.53%
2026	0.31%	0.79%	1.73%	0.00%	0.00%	0.28%	0.71%	1.54%
2027	0.31%	0.79%	1.74%	0.00%	0.00%	0.28%	0.71%	1.55%
2028	0.31%	0.80%	1.76%	0.00%	0.00%	0.29%	0.72%	1.57%
2029	0.32%	0.81%	1.77%	0.00%	0.00%	0.29%	0.72%	1.58%
2030	0.32%	0.81%	1.78%	0.00%	0.00%	0.29%	0.73%	1.60%
2031	0.32%	0.81%	1.78%	0.00%	0.00%	0.29%	0.73%	1.60%
2032	0.32%	0.81%	1.78%	0.00%	0.00%	0.29%	0.73%	1.60%
2033	0.32%	0.81%	1.78%	0.00%	0.00%	0.29%	0.73%	1.60%
2034	0.32%	0.81%	1.78%	0.00%	0.00%	0.29%	0.73%	1.60%
2035	0.32%	0.81%	1.78%	0.00%	0.00%	0.29%	0.73%	1.60%
2036	0.32%	0.81%	1.78%	0.00%	0.00%	0.29%	0.73%	1.60%
2037	0.32%	0.81%	1.78%	0.00%	0.00%	0.29%	0.73%	1.60%
2038	0.32%	0.81%	1.78%	0.00%	0.00%	0.29%	0.73%	1.60%
2039	0.32%	0.81%	1.78%	0.00%	0.00%	0.29%	0.73%	1.60%
2040	0.32%	0.81%	1.78%	0.00%	0.00%	0.29%	0.73%	1.60%
2041	0.32%	0.81%	1.78%	0.00%	0.00%	0.29%	0.73%	1.60%
2042	0.32%	0.81%	1.78%	0.00%	0.00%	0.29%	0.73%	1.60%
2043	0.32%	0.81%	1.78%	0.00%	0.00%	0.29%	0.73%	1.60%
2044	0.32%	0.81%	1.78%	0.00%	0.00%	0.29%	0.73%	1.60%
2045	0.32%	0.81%	1.78%	0.00%	0.00%	0.29%	0.73%	1.60%
2046	0.32%	0.81%	1.78%	0.00%	0.00%	0.29%	0.73%	1.60%
2047	0.32%	0.81%	1.78%	0.00%	0.00%	0.29%	0.73%	1.60%
2048	0.32%	0.81%	1.78%	0.00%	0.00%	0.29%	0.73%	1.60%
2049	0.32%	0.81%	1.78%	0.00%	0.00%	0.29%	0.73%	1.60%
2050	0.32%	0.81%	1.78%	0.00%	0.00%	0.29%	0.73%	1.60%
2051	0.32%	0.81%	1.78%	0.00%	0.00%	0.29%	0.73%	1.60%
2052	0.32%	0.81%	1.78%	0.00%	0.00%	0.29%	0.73%	1.60%
2053	0.32%	0.81%	1.78%	0.00%	0.00%	0.29%	0.73%	1.60%
2054	0.32%	0.81%	1.78%	0.00%	0.00%	0.29%	0.73%	1.60%

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TABLE 5.10 DAILY TRAFFIC FOR FEITC-BASED DISCOUNT SCENARIOS

Fiscal Year	Base Case	Low Tax Credit	Medium Tax Credit	High Tax Credit
2017	102,844	103,109	103,601	104,403
2018	106,676	106,955	107,467	108,312
2019	111,171	111,467	112,002	112,895
2020	112,506	112,810	113,354	114,271
2021	113,860	114,172	114,725	115,666
2022	114,801	115,121	115,679	116,643
2023	116,453	116,782	117,351	118,342
2024	118,215	118,554	119,133	120,153
2025	120,036	120,385	120,975	122,025
2026	121,962	122,321	122,923	124,005
2027	123,995	124,366	124,980	126,094
2028	126,138	126,520	127,147	128,295
2029	128,396	128,790	129,430	130,615
2030	130,773	131,180	131,834	133,056
2031	133,112	133,526	134,192	135,436
2032	135,374	135,795	136,472	137,737
2033	137,675	138,103	138,792	140,079
2034	140,016	140,452	141,152	142,460
2035	142,397	142,840	143,552	144,883
2036	144,515	144,965	145,688	147,038
2037	146,359	146,814	147,546	148,914
2038	148,228	148,689	149,431	150,816
2039	150,122	150,589	151,340	152,743
2040	152,040	152,513	153,274	154,694
2041	153,657	154,135	154,904	156,340
2042	154,966	155,448	156,223	157,671
2043	156,287	156,773	157,555	159,015
2044	157,619	158,109	158,898	160,371
2045	158,963	159,458	160,253	161,738
2046	160,319	160,818	161,620	163,118
2047	161,686	162,189	162,998	164,509
2048	163,066	163,573	164,389	165,913
2049	164,457	164,969	165,791	167,328
2050	165,861	166,377	167,207	168,757
2051	167,276	167,797	168,633	170,196
2052	168,705	169,230	170,074	171,650
2053	170,145	170,674	171,525	173,115
2054	171,598	172,132	172,990	174,594

**TABLE 5.11 PERCENTAGE CHANGE FROM BASE CASE IN DAILY TRAFFIC FOR FEITC-BASED DISCOUNT SCENARIOS**

Fiscal Year	Low Tax Credit	Medium Tax Credit	High Tax Credit
2017	0.26%	0.74%	1.52%
2018	0.26%	0.74%	1.53%
2019	0.27%	0.75%	1.55%
2020	0.27%	0.75%	1.57%
2021	0.27%	0.76%	1.59%
2022	0.28%	0.77%	1.60%
2023	0.28%	0.77%	1.62%
2024	0.29%	0.78%	1.64%
2025	0.29%	0.78%	1.66%
2026	0.29%	0.79%	1.67%
2027	0.30%	0.79%	1.69%
2028	0.30%	0.80%	1.71%
2029	0.31%	0.81%	1.73%
2030	0.31%	0.81%	1.75%
2031	0.31%	0.81%	1.75%
2032	0.31%	0.81%	1.75%
2033	0.31%	0.81%	1.75%
2034	0.31%	0.81%	1.75%
2035	0.31%	0.81%	1.75%
2036	0.31%	0.81%	1.75%
2037	0.31%	0.81%	1.75%
2038	0.31%	0.81%	1.75%
2039	0.31%	0.81%	1.75%
2040	0.31%	0.81%	1.75%
2041	0.31%	0.81%	1.75%
2042	0.31%	0.81%	1.75%
2043	0.31%	0.81%	1.75%
2044	0.31%	0.81%	1.75%
2045	0.31%	0.81%	1.75%
2046	0.31%	0.81%	1.75%
2047	0.31%	0.81%	1.75%
2048	0.31%	0.81%	1.75%
2049	0.31%	0.81%	1.75%
2050	0.31%	0.81%	1.75%
2051	0.31%	0.81%	1.75%
2052	0.31%	0.81%	1.75%
2053	0.31%	0.81%	1.75%
2054	0.31%	0.81%	1.75%

5.11 Table 5.12, Table 5.14 and Table 5.16 present the total annual revenue on the tolled bridges for the Individual Income-Based, Area-Based, and FEITC-based enrollment

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approaches, respectively. For comparison purposes, total revenues under the base case (i.e., no discount) are also presented. Table 5.13, Table 5.15 and Table 5.17, present the change in total revenue relative to the base tolling scenario for the Individual Income-Based, Area-Based and FEITC - based enrollment approaches. These revenue figures show total annual revenue, not just the revenue from Low Income trips. The revenues are expressed in thousands (000's) - for example, "33,842" means \$33,842,000. Revenues are shown in nominal dollars assuming both a 2.5% future inflation rate and toll rates are increased by 2.5% each year.

**TABLE 5.12 TOTAL ANNUAL REVENUE (000'S NOMINAL \$) FOR INDIVIDUAL INCOME-BASED DISCOUNT SCENARIOS**

Fiscal Year	Base Case	Low Disc. Toll	Medium Disc. Toll	High Disc. Toll	Low One-Time Credit	High One-Time Credit	Low Tax Credit	Medium Tax Credit	High Tax Credit
2017	33,841	33,827	33,804	33,753	33,819	33,812	33,839	33,815	33,766
2018	79,252	79,217	79,160	79,032	79,252	79,252	79,240	79,184	79,065
2019	98,158	98,111	98,037	97,867	98,158	98,158	98,135	98,066	97,913
2020	110,248	110,192	110,103	109,901	110,248	110,248	110,213	110,136	109,958
2021	117,222	117,158	117,060	116,831	117,222	117,222	117,175	117,094	116,897
2022	122,529	122,458	122,350	122,098	122,529	122,529	122,469	122,385	122,173
2023	126,165	126,087	125,971	125,698	126,165	126,165	126,093	126,007	125,782
2024	130,096	130,011	129,887	129,591	130,096	130,096	130,010	129,923	129,683
2025	134,281	134,189	134,055	133,735	134,281	134,281	134,181	134,091	133,837
2026	138,703	138,603	138,459	138,113	138,703	138,703	138,588	138,496	138,225
2027	143,377	143,268	143,114	142,741	143,377	143,377	143,246	143,152	142,864
2028	148,198	148,080	147,915	147,513	148,198	148,198	148,050	147,953	147,647
2029	153,297	153,170	152,993	152,560	153,297	153,297	153,131	153,032	152,707
2030	158,691	158,554	158,365	157,899	158,691	158,691	158,505	158,404	158,059
2031	164,985	164,842	164,646	164,162	164,985	164,985	164,792	164,687	164,328
2032	172,079	171,930	171,725	171,221	172,079	172,079	171,878	171,768	171,393
2033	179,381	179,226	179,012	178,486	179,381	179,381	179,171	179,057	178,666
2034	186,994	186,832	186,610	186,061	186,994	186,994	186,775	186,656	186,249
2035	194,931	194,763	194,530	193,959	194,931	194,931	194,703	194,579	194,154
2036	202,773	202,598	202,356	201,761	202,773	202,773	202,536	202,406	201,965
2037	210,497	210,315	210,064	209,447	210,497	210,497	210,251	210,116	209,658
2038	218,517	218,328	218,068	217,427	218,517	218,517	218,261	218,122	217,646
2039	226,843	226,647	226,377	225,711	226,843	226,843	226,578	226,433	225,939
2040	235,486	235,283	235,002	234,311	235,486	235,486	235,211	235,060	234,548
2041	243,936	243,725	243,435	242,719	243,936	243,936	243,651	243,495	242,964
2042	252,167	251,949	251,649	250,909	252,167	252,167	251,872	251,711	251,162
2043	260,676	260,451	260,140	259,376	260,676	260,676	260,371	260,205	259,637
2044	269,472	269,239	268,918	268,128	269,472	269,472	269,157	268,985	268,398
2045	278,566	278,325	277,993	277,176	278,566	278,566	278,240	278,062	277,456
2046	287,967	287,718	287,375	286,531	287,967	287,967	287,630	287,446	286,819
2047	297,685	297,428	297,073	296,200	297,685	297,685	297,337	297,147	296,499
2048	307,732	307,466	307,099	306,197	307,732	307,732	307,372	307,176	306,506
2049	318,119	317,844	317,465	316,532	318,119	318,119	317,747	317,544	316,851
2050	328,857	328,573	328,181	327,217	328,857	328,857	328,472	328,262	327,547
2051	339,958	339,664	339,259	338,262	339,958	339,958	339,560	339,343	338,603
2052	351,434	351,130	350,712	349,681	351,434	351,434	351,023	350,799	350,034
2053	363,298	362,984	362,551	361,486	363,298	363,298	362,873	362,641	361,850
2054	375,563	375,239	374,791	373,690	375,563	375,563	375,124	374,884	374,066

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**TABLE 5.13 PERCENTAGE CHANGE FROM BASE CASE IN TOTAL ANNUAL REVENUE (000'S NOMINAL \$)FOR INDIVIDUAL INCOME-BASED DISCOUNT SCENARIOS**

Fiscal Year	Low Discounted Toll	Medium Disc. Toll	High Disc. Toll	Low One-Time Credit	High One-Time Credit	Low Tax Credit	Medium Tax Credit	High Tax Credit
2017	-0.04%	-0.11%	-0.26%	-0.07%	-0.09%	-0.01%	-0.08%	-0.22%
2018	-0.04%	-0.12%	-0.28%	0.00%	0.00%	-0.01%	-0.09%	-0.24%
2019	-0.05%	-0.12%	-0.30%	0.00%	0.00%	-0.02%	-0.09%	-0.25%
2020	-0.05%	-0.13%	-0.31%	0.00%	0.00%	-0.03%	-0.10%	-0.26%
2021	-0.05%	-0.14%	-0.33%	0.00%	0.00%	-0.04%	-0.11%	-0.28%
2022	-0.06%	-0.15%	-0.35%	0.00%	0.00%	-0.05%	-0.12%	-0.29%
2023	-0.06%	-0.15%	-0.37%	0.00%	0.00%	-0.06%	-0.13%	-0.30%
2024	-0.07%	-0.16%	-0.39%	0.00%	0.00%	-0.07%	-0.13%	-0.32%
2025	-0.07%	-0.17%	-0.41%	0.00%	0.00%	-0.07%	-0.14%	-0.33%
2026	-0.07%	-0.18%	-0.43%	0.00%	0.00%	-0.08%	-0.15%	-0.34%
2027	-0.08%	-0.18%	-0.44%	0.00%	0.00%	-0.09%	-0.16%	-0.36%
2028	-0.08%	-0.19%	-0.46%	0.00%	0.00%	-0.10%	-0.16%	-0.37%
2029	-0.08%	-0.20%	-0.48%	0.00%	0.00%	-0.11%	-0.17%	-0.38%
2030	-0.09%	-0.21%	-0.50%	0.00%	0.00%	-0.12%	-0.18%	-0.40%
2031	-0.09%	-0.21%	-0.50%	0.00%	0.00%	-0.12%	-0.18%	-0.40%
2032	-0.09%	-0.21%	-0.50%	0.00%	0.00%	-0.12%	-0.18%	-0.40%
2033	-0.09%	-0.21%	-0.50%	0.00%	0.00%	-0.12%	-0.18%	-0.40%
2034	-0.09%	-0.21%	-0.50%	0.00%	0.00%	-0.12%	-0.18%	-0.40%
2035	-0.09%	-0.21%	-0.50%	0.00%	0.00%	-0.12%	-0.18%	-0.40%
2036	-0.09%	-0.21%	-0.50%	0.00%	0.00%	-0.12%	-0.18%	-0.40%
2037	-0.09%	-0.21%	-0.50%	0.00%	0.00%	-0.12%	-0.18%	-0.40%
2038	-0.09%	-0.21%	-0.50%	0.00%	0.00%	-0.12%	-0.18%	-0.40%
2039	-0.09%	-0.21%	-0.50%	0.00%	0.00%	-0.12%	-0.18%	-0.40%
2040	-0.09%	-0.21%	-0.50%	0.00%	0.00%	-0.12%	-0.18%	-0.40%
2041	-0.09%	-0.21%	-0.50%	0.00%	0.00%	-0.12%	-0.18%	-0.40%
2042	-0.09%	-0.21%	-0.50%	0.00%	0.00%	-0.12%	-0.18%	-0.40%
2043	-0.09%	-0.21%	-0.50%	0.00%	0.00%	-0.12%	-0.18%	-0.40%
2044	-0.09%	-0.21%	-0.50%	0.00%	0.00%	-0.12%	-0.18%	-0.40%
2045	-0.09%	-0.21%	-0.50%	0.00%	0.00%	-0.12%	-0.18%	-0.40%
2046	-0.09%	-0.21%	-0.50%	0.00%	0.00%	-0.12%	-0.18%	-0.40%
2047	-0.09%	-0.21%	-0.50%	0.00%	0.00%	-0.12%	-0.18%	-0.40%
2048	-0.09%	-0.21%	-0.50%	0.00%	0.00%	-0.12%	-0.18%	-0.40%
2049	-0.09%	-0.21%	-0.50%	0.00%	0.00%	-0.12%	-0.18%	-0.40%
2050	-0.09%	-0.21%	-0.50%	0.00%	0.00%	-0.12%	-0.18%	-0.40%
2051	-0.09%	-0.21%	-0.50%	0.00%	0.00%	-0.12%	-0.18%	-0.40%
2052	-0.09%	-0.21%	-0.50%	0.00%	0.00%	-0.12%	-0.18%	-0.40%
2053	-0.09%	-0.21%	-0.50%	0.00%	0.00%	-0.12%	-0.18%	-0.40%
2054	-0.09%	-0.21%	-0.50%	0.00%	0.00%	-0.12%	-0.18%	-0.40%



**TABLE 5.14 TOTAL ANNUAL REVENUE (000'S NOMINAL \$) FOR AREA-BASED DISCOUNT SCENARIOS**

Fiscal Year	Base Case	Low Disc. Toll	Medium Disc. Toll	High Discounted Toll	Low One-Time Credit	High One-Time Credit	Low Tax Credit	Medium Tax Credit	High Tax Credit
2017	33,841	33,818	33,715	33,532	33,737	33,635	33,804	33,722	33,567
2018	79,252	79,193	78,945	78,496	79,252	79,252	79,163	78,961	78,589
2019	98,158	98,078	97,763	97,183	98,158	98,158	98,047	97,784	97,310
2020	110,248	110,150	109,788	109,110	110,248	110,248	110,123	109,811	109,264
2021	117,222	117,108	116,716	115,966	117,222	117,222	117,088	116,741	116,143
2022	122,529	122,401	121,982	121,168	122,529	122,529	122,387	122,008	121,367
2023	126,165	126,024	125,583	124,714	126,165	126,165	126,018	125,610	124,934
2024	130,096	129,940	129,477	128,548	130,096	130,096	129,943	129,504	128,790
2025	134,281	134,110	133,622	132,631	134,281	134,281	134,121	133,651	132,895
2026	138,703	138,516	138,002	136,944	138,703	138,703	138,537	138,032	137,233
2027	143,377	143,173	142,631	141,502	143,377	143,377	143,204	142,662	141,818
2028	148,198	147,975	147,405	146,202	148,198	148,198	148,017	147,437	146,545
2029	153,297	153,055	152,454	151,172	153,297	153,297	153,109	152,488	151,544
2030	158,691	158,429	157,795	156,429	158,691	158,691	158,494	157,830	156,832
2031	164,985	164,712	164,053	162,633	164,985	164,985	164,781	164,090	163,053
2032	172,079	171,794	171,107	169,626	172,079	172,079	171,866	171,145	170,064
2033	179,381	179,084	178,368	176,824	179,381	179,381	179,159	178,408	177,280
2034	186,994	186,685	185,938	184,329	186,994	186,994	186,762	185,979	184,804
2035	194,931	194,609	193,830	192,152	194,931	194,931	194,689	193,873	192,648
2036	202,773	202,438	201,628	199,883	202,773	202,773	202,522	201,673	200,398
2037	210,497	210,149	209,308	207,496	210,497	210,497	210,236	209,355	208,032
2038	218,517	218,156	217,283	215,402	218,517	218,517	218,246	217,331	215,958
2039	226,843	226,468	225,562	223,609	226,843	226,843	226,562	225,612	224,186
2040	235,486	235,097	234,156	232,129	235,486	235,486	235,194	234,208	232,728
2041	243,936	243,533	242,558	240,459	243,936	243,936	243,634	242,612	241,079
2042	252,167	251,750	250,743	248,573	252,167	252,167	251,855	250,799	249,214
2043	260,676	260,245	259,204	256,960	260,676	260,676	260,353	259,261	257,623
2044	269,472	269,026	267,950	265,631	269,472	269,472	269,138	268,010	266,316
2045	278,566	278,105	276,993	274,595	278,566	278,566	278,221	277,054	275,303
2046	287,967	287,491	286,341	283,862	287,967	287,967	287,610	286,404	284,594
2047	297,685	297,193	296,004	293,442	297,685	297,685	297,316	296,070	294,198
2048	307,732	307,223	305,994	303,345	307,732	307,732	307,351	306,062	304,128
2049	318,119	317,593	316,322	313,584	318,119	318,119	317,725	316,393	314,393
2050	328,857	328,313	327,000	324,169	328,857	328,857	328,450	327,072	325,005
2051	339,958	339,396	338,038	335,112	339,958	339,958	339,537	338,113	335,976
2052	351,434	350,853	349,449	346,425	351,434	351,434	350,999	349,527	347,318
2053	363,298	362,697	361,246	358,119	363,298	363,298	362,848	361,326	359,043
2054	375,563	374,942	373,442	370,210	375,563	375,563	375,098	373,525	371,164

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TABLE 5.15 PERCENTAGE CHANGE FROM BASE CASE IN TOTAL ANNUAL REVENUE (000'S NOMINAL \$) FOR AREA-BASED DISCOUNT SCENARIOS

Fiscal Year	Low Disc. Toll	Medium Disc. Toll	High Discounted Toll	Low One-Time Credit	High One-Time Credit	Low Tax Credit	Medium Tax Credit	High Tax Credit
2017	-0.07%	-0.37%	-0.91%	-0.31%	-0.61%	-0.11%	-0.35%	-0.81%
2018	-0.07%	-0.39%	-0.95%	0.00%	0.00%	-0.11%	-0.37%	-0.84%
2019	-0.08%	-0.40%	-0.99%	0.00%	0.00%	-0.11%	-0.38%	-0.86%
2020	-0.09%	-0.42%	-1.03%	0.00%	0.00%	-0.11%	-0.40%	-0.89%
2021	-0.10%	-0.43%	-1.07%	0.00%	0.00%	-0.11%	-0.41%	-0.92%
2022	-0.10%	-0.45%	-1.11%	0.00%	0.00%	-0.12%	-0.43%	-0.95%
2023	-0.11%	-0.46%	-1.15%	0.00%	0.00%	-0.12%	-0.44%	-0.98%
2024	-0.12%	-0.48%	-1.19%	0.00%	0.00%	-0.12%	-0.45%	-1.00%
2025	-0.13%	-0.49%	-1.23%	0.00%	0.00%	-0.12%	-0.47%	-1.03%
2026	-0.13%	-0.51%	-1.27%	0.00%	0.00%	-0.12%	-0.48%	-1.06%
2027	-0.14%	-0.52%	-1.31%	0.00%	0.00%	-0.12%	-0.50%	-1.09%
2028	-0.15%	-0.54%	-1.35%	0.00%	0.00%	-0.12%	-0.51%	-1.12%
2029	-0.16%	-0.55%	-1.39%	0.00%	0.00%	-0.12%	-0.53%	-1.14%
2030	-0.17%	-0.56%	-1.43%	0.00%	0.00%	-0.12%	-0.54%	-1.17%
2031	-0.17%	-0.56%	-1.43%	0.00%	0.00%	-0.12%	-0.54%	-1.17%
2032	-0.17%	-0.56%	-1.43%	0.00%	0.00%	-0.12%	-0.54%	-1.17%
2033	-0.17%	-0.56%	-1.43%	0.00%	0.00%	-0.12%	-0.54%	-1.17%
2034	-0.17%	-0.56%	-1.43%	0.00%	0.00%	-0.12%	-0.54%	-1.17%
2035	-0.17%	-0.56%	-1.43%	0.00%	0.00%	-0.12%	-0.54%	-1.17%
2036	-0.17%	-0.56%	-1.43%	0.00%	0.00%	-0.12%	-0.54%	-1.17%
2037	-0.17%	-0.56%	-1.43%	0.00%	0.00%	-0.12%	-0.54%	-1.17%
2038	-0.17%	-0.56%	-1.43%	0.00%	0.00%	-0.12%	-0.54%	-1.17%
2039	-0.17%	-0.56%	-1.43%	0.00%	0.00%	-0.12%	-0.54%	-1.17%
2040	-0.17%	-0.56%	-1.43%	0.00%	0.00%	-0.12%	-0.54%	-1.17%
2041	-0.17%	-0.56%	-1.43%	0.00%	0.00%	-0.12%	-0.54%	-1.17%
2042	-0.17%	-0.56%	-1.43%	0.00%	0.00%	-0.12%	-0.54%	-1.17%
2043	-0.17%	-0.56%	-1.43%	0.00%	0.00%	-0.12%	-0.54%	-1.17%
2044	-0.17%	-0.56%	-1.43%	0.00%	0.00%	-0.12%	-0.54%	-1.17%
2045	-0.17%	-0.56%	-1.43%	0.00%	0.00%	-0.12%	-0.54%	-1.17%
2046	-0.17%	-0.56%	-1.43%	0.00%	0.00%	-0.12%	-0.54%	-1.17%
2047	-0.17%	-0.56%	-1.43%	0.00%	0.00%	-0.12%	-0.54%	-1.17%
2048	-0.17%	-0.56%	-1.43%	0.00%	0.00%	-0.12%	-0.54%	-1.17%
2049	-0.17%	-0.56%	-1.43%	0.00%	0.00%	-0.12%	-0.54%	-1.17%
2050	-0.17%	-0.56%	-1.43%	0.00%	0.00%	-0.12%	-0.54%	-1.17%
2051	-0.17%	-0.56%	-1.43%	0.00%	0.00%	-0.12%	-0.54%	-1.17%
2052	-0.17%	-0.56%	-1.43%	0.00%	0.00%	-0.12%	-0.54%	-1.17%
2053	-0.17%	-0.56%	-1.43%	0.00%	0.00%	-0.12%	-0.54%	-1.17%
2054	-0.17%	-0.56%	-1.43%	0.00%	0.00%	-0.12%	-0.54%	-1.17%

**TABLE 5.16 TOTAL ANNUAL REVENUE (000S NOMINAL \$) FOR FEITC-BASED DISCOUNT SCENARIOS**

Fiscal Year	Base Case	Low Tax Credit	Medium Tax Credit	High Tax Credit
2017	33,841	33,825	33,794	33,699
2018	79,252	79,214	79,138	78,903
2019	98,158	98,112	98,011	97,705
2020	110,248	110,198	110,077	109,716
2021	117,222	117,169	117,034	116,631
2022	122,529	122,475	122,325	121,886
2023	126,165	126,110	125,948	125,476
2024	130,096	130,041	129,865	129,359
2025	134,281	134,225	134,035	133,492
2026	138,703	138,646	138,441	137,859
2027	143,377	143,320	143,098	142,474
2028	148,198	148,140	147,902	147,234
2029	153,297	153,238	152,982	152,267
2030	158,691	158,632	158,356	157,592
2031	164,985	164,923	164,637	163,842
2032	172,079	172,015	171,716	170,887
2033	179,381	179,314	179,002	178,139
2034	186,994	186,924	186,599	185,699
2035	194,931	194,858	194,520	193,581
2036	202,773	202,697	202,345	201,369
2037	210,497	210,418	210,053	209,039
2038	218,517	218,435	218,056	217,004
2039	226,843	226,758	226,364	225,272
2040	235,486	235,398	234,989	233,855
2041	243,936	243,845	243,421	242,246
2042	252,167	252,073	251,635	250,420
2043	260,676	260,578	260,126	258,871
2044	269,472	269,371	268,903	267,606
2045	278,566	278,462	277,978	276,637
2046	287,967	287,859	287,359	285,972
2047	297,685	297,574	297,057	295,623
2048	307,732	307,617	307,082	305,601
2049	318,119	318,000	317,447	315,916
2050	328,857	328,734	328,163	326,579
2051	339,958	339,831	339,240	337,603
2052	351,434	351,302	350,692	349,000
2053	363,298	363,162	362,531	360,782
2054	375,563	375,422	374,770	372,962

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**TABLE 5.17 PERCENTAGE CHANGE FROM BASE CASE IN TOTAL ANNUAL REVENUE (000S NOMINAL \$) FOR FEITC-BASED DISCOUNT SCENARIOS**

Fiscal Year	Low Tax Credit	Medium Tax Credit	High Tax Credit
2017	-0.05%	-0.14%	-0.42%
2018	-0.05%	-0.14%	-0.44%
2019	-0.05%	-0.15%	-0.46%
2020	-0.05%	-0.16%	-0.48%
2021	-0.04%	-0.16%	-0.50%
2022	-0.04%	-0.17%	-0.52%
2023	-0.04%	-0.17%	-0.55%
2024	-0.04%	-0.18%	-0.57%
2025	-0.04%	-0.18%	-0.59%
2026	-0.04%	-0.19%	-0.61%
2027	-0.04%	-0.19%	-0.63%
2028	-0.04%	-0.20%	-0.65%
2029	-0.04%	-0.21%	-0.67%
2030	-0.04%	-0.21%	-0.69%
2031	-0.04%	-0.21%	-0.69%
2032	-0.04%	-0.21%	-0.69%
2033	-0.04%	-0.21%	-0.69%
2034	-0.04%	-0.21%	-0.69%
2035	-0.04%	-0.21%	-0.69%
2036	-0.04%	-0.21%	-0.69%
2037	-0.04%	-0.21%	-0.69%
2038	-0.04%	-0.21%	-0.69%
2039	-0.04%	-0.21%	-0.69%
2040	-0.04%	-0.21%	-0.69%
2041	-0.04%	-0.21%	-0.69%
2042	-0.04%	-0.21%	-0.69%
2043	-0.04%	-0.21%	-0.69%
2044	-0.04%	-0.21%	-0.69%
2045	-0.04%	-0.21%	-0.69%
2046	-0.04%	-0.21%	-0.69%
2047	-0.04%	-0.21%	-0.69%
2048	-0.04%	-0.21%	-0.69%
2049	-0.04%	-0.21%	-0.69%
2050	-0.04%	-0.21%	-0.69%
2051	-0.04%	-0.21%	-0.69%
2052	-0.04%	-0.21%	-0.69%
2053	-0.04%	-0.21%	-0.69%
2054	-0.04%	-0.21%	-0.69%

### Total Revenue Impact of Discount Scenarios

- 5.12 Using the annual streams of revenue presented in Table 5.12, Table 5.14, and Table 5.16, we calculated the total revenue impact over the 38-year period from 2017 to 2054. Table 5.18 presents the total revenue impact of each discount scenario, showing the largest impact of almost \$110 million for the High Discounted Toll with Area-Based Eligibility scenario. It is customary for cost streams that reach years into the future to be discounted in an effort to "translate" those streams into current dollar values. That exercise has not been undertaken here because the exercise is very sensitive to the discount rate selected. Readers should understand that discounting future cash flows can have a large impact on overall results.

**TABLE 5.18 TOTAL REVENUE IMPACT OF DISCOUNT SCENARIOS (SUM OF 000S NOMINAL \$ 2017-2054)**

Discount Type	Individual Income-Based Eligibility	Area-Based Eligibility	FEITC-Based Eligibility
Discounted Toll - Low (10%)	-6,550	-12,452	
Discounted Toll - Medium (25%)	-15,670	-43,579	
Discounted Toll - High (50%)	-37,992	-109,808	
One-Time Credit - Low (\$50)	-22	-104	
One-Time Credit - High (\$100)	-29	-206	
Tax Credit - Low (10%)	-8,514	-9,767	-3,059
Tax Credit - Medium (25%)	-13,652	-41,831	-16,283
Tax Credit - High (50%)	-30,461	-90,638	-53,176

### 130% Poverty Threshold Sensitivity Test

- 5.13 We considered the impact of adjusting the enrollment threshold for Individual Income-Based Scenarios from the poverty line to 130% of the poverty threshold, which is a level used in other programs. We provide details on the implementation of this approach in Appendix B.
- 5.14 Table 5.19 and Table 5.20 present the traffic and revenue impacts for 2018 and 2030 on the overall traffic and revenue, comparing the impact of the discount eligibility at 100% of the federal poverty threshold and 130% poverty threshold. Table 5.21 presents

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a similar comparison but for total revenue impact of each discount scenario (as before these values are the sum of nominal values through 2054).

- 5.15 In general, increasing the enrollment criteria to 130% of the poverty threshold increases the total toll traffic and decreases total toll revenue. Traffic increases by 0.2 to 1.2 percentage-points in 2018 and by 0.4 to 2.3 percentage-points in 2030. Total toll revenue decreases by 0 to 0.3 percentage points in 2018 and by 0 to 0.5 percentage points in 2030, with two exceptions that increased revenues by 0.02 percentage points.
- 5.16 The exceptions are the low discounted toll in 2018 and the low tax credit in 2030; both provide a positive 0.02 impact on revenue due to the increase in traffic, 0.25 and 0.3 percentage-points respectively. These scenarios experience this positive revenue impact because there is enough new toll traffic at the discounted toll rate to offset some of the lost revenue from trips which receive the discounted toll rate but would have paid the non-discounted toll rate. In addition, we note that these are very small revenue increases and likely within the precision range of the forecasting model. In terms of total revenue, only the low tax credit scenario shows the positive impact. This is mainly driven by the fact that the impact occurs later in time, in 2030 and beyond through extrapolation, when the positive change has a greater impact on the total nominal revenues that we present in Table 5.21.

**TABLE 5.19 130% POVERTY THRESHOLD FOR INDIVIDUAL INCOME-BASED SCENARIO - CHANGE IN TOTAL TOLL TRAFFIC & REVENUE (MODEL YEAR 2018)**

Discount Type	Traffic Impact			Revenue Impact		
	100% Poverty Threshold	130% Poverty Threshold	%-Pt Change	100% Poverty Threshold	130% Poverty Threshold	%-Pt Change
Discounted Toll - Low (10%)	0.12%	0.37%	0.25 %-pt	-0.04%	-0.02%	0.02 %-pt
Discounted Toll - Medium (25%)	0.34%	0.93%	0.59 %-pt	-0.12%	-0.19%	-0.07 %-pt
Discounted Toll - High (50%)	0.77%	2.04%	1.27 %-pt	-0.28%	-0.63%	-0.35 %-pt
One-Time Credit - Low (\$50)	0.26%	0.60%	0.34 %-pt	-0.13%	-0.18%	-0.05 %-pt
One-Time Credit - High (\$100)	0.54%	1.19%	0.65 %-pt	-0.17%	-0.39%	-0.22 %-pt
Tax Credit - Low (10%)	0.13%	0.32%	0.19 %-pt	-0.01%	-0.02%	-0.01 %-pt
Tax Credit - Medium (25%)	0.32%	0.85%	0.53 %-pt	-0.09%	-0.17%	-0.08 %-pt
Tax Credit - High (50%)	0.67%	1.81%	1.14 %-pt	-0.24%	-0.48%	-0.24 %-pt

**TABLE 5.20 130% POVERTY THRESHOLD FOR INDIVIDUAL INCOME-BASED SCENARIO - CHANGE IN TOTAL TOLL TRAFFIC & REVENUE (MODEL YEAR 2030)**

Discount Type	Traffic Impact			Revenue Impact		
	100% Poverty Threshold	130% Poverty Threshold	%-Pt Change	100% Poverty Threshold	130% Poverty Threshold	%-Pt Change
Discounted Toll - Low (10%)	0.12%	0.43%	0.31 %-pt	-0.09%	-0.09%	0.0 %-pt
Discounted Toll - Medium (25%)	0.34%	1.06%	0.72 %-pt	-0.21%	-0.32%	-0.11 %-pt
Discounted Toll - High (50%)	0.81%	2.29%	1.48 %-pt	-0.50%	-0.98%	-0.48 %-pt
One-Time Credit - Low (\$50)	NA	NA	NA	NA	NA	NA
One-Time Credit - High (\$100)	NA	NA	NA	NA	NA	NA
Tax Credit - Low (10%)	0.08%	0.38%	0.30 %-pt	-0.12%	-0.10%	0.02 %-pt
Tax Credit - Medium (25%)	0.31%	0.96%	0.65 %-pt	-0.18%	-0.30%	-0.12 %-pt
Tax Credit - High (50%)	0.71%	2.01%	1.30 %-pt	-0.40%	-0.79%	-0.39 %-pt

**TABLE 5.21 TOTAL REVENUE IMPACT OF DISCOUNT SCENARIOS FOR INDIVIDUAL INCOME-BASE ELIGIBILITY (SUM OF 000S NOMINAL \$ 2017-2054)**

Discount Type	Individual Income-Base Eligibility (100%)	Individual Income-Base Eligibility (130%)
Discounted Toll - Low (10%)	-6,550	-6,749
Discounted Toll - Medium (25%)	-15,670	-24,724
Discounted Toll - High (50%)	-37,992	-75,020
One-Time Credit - Low (\$50)	-22	-31
One-Time Credit - High (\$100)	-29	-67
Tax Credit - Low (10%)	-8,514	-7,148
Tax Credit - Medium (25%)	-13,652	-22,751
Tax Credit - High (50%)	-30,461	-60,290

### Diversion Impact on Highway Network

5.17 We also reviewed the traffic impact of the discount scenarios on the highway network. As discussed above, the High Discounted Percentage for Area-Based Method would cause the largest decrease in toll revenue, and would also cause the largest increase in toll traffic-over 2%- in both 2018 and 2030. Figure 5.1 displays the changes in traffic volumes along key locations in the network in 2018 for the High Discounted Percentage for Area-Based Method (Scenario 2C) and Figure 5.2 presents the volume changes for 2030. These results are provided here as they represent the maximum traffic diversion experienced across the network by any of the discount methods evaluated. Similar plots for the other scenarios are included in Appendix C.

**FIGURE 5.1 NETWORK TRAFFIC CHANGES - HIGH DISCOUNT PERCENTAGE AND AREA-BASED METHOD IN 2018**





**FIGURE 5.2 NETWORK TRAFFIC CHANGES - HIGH DISCOUNT PERCENTAGE AND AREA-BASED METHOD IN 2030**



### Conclusions

5.18 Based upon our analysis, we have developed observations and conclusions regarding the traffic and revenue impacts of various toll discount scenarios, which we summarize below:

- I Based upon our analysis and the model’s projections, the toll discount scenarios have a limited revenue impact on toll revenue, with the largest decrease of 1.4% occurring in 2030 and beyond with the 50% toll discount and Area-Based Method.
- I While the toll bridge traffic impacts have a larger magnitude than the revenue impacts, the overall traffic impacts across locations in the network tend to be less than 5% of traffic.
- I The different low-income definitions result in different geographic representations of Low Income trips; put another way, different locations have higher representations of Low Income trips under the different low-income definitions.

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- While the Area-Based approach may be the easiest method, it has the largest potential revenue impact and may not directly align with low-income individuals. In other words, some individuals who are not actually low-income would receive the discount (because they live in a low income area), while some individuals who *are* low income would not receive the discount (because they live outside a low income area).
- For the same low-income definition and magnitude of discount, the larger impacts result from the “Discount Percentage” type compared to the “Tax Credit” type.
- Relaxing the enrollment threshold for the Individual Income-Based scenarios from the poverty line to 130% of the poverty threshold causes an additional 50% to 150% impact on the revenue reductions versus the poverty limit case, depending on the discount alternative, with one exception which had a 27% increase in revenue due to the large amount of additional traffic it attracted.
- While not a conclusion of the analysis, in our professional opinion, all of the discount scenarios would likely help to advance the ramp-up process, with the one-time credit types likely advancing ramp-up the fastest.

5.19 It is important to note that this analysis focused solely on the potential traffic and revenue impacts of the toll discount scenarios; it did not address the administrative costs of implementing a toll discount. It is our understanding that those costs will be estimated as part of a separate analysis.

**APPENDIX A: LOW INCOME TRIP PREPARATION**



## APPENDIX A LOW INCOME TRIP PREPARATION

The preparation of the low income trips is based on the following approach:

A) Establish the OD matrix of eligibility with:

A1) AM time period percentages based upon the origin TAZ Low Income eligible percentage

A2) PM time period percentages based upon destination TAZ Low Income eligible percentage

A3) Midday and nighttime period percentages based upon the average of the origin and destination TAZ Low Income eligible percentage

B) Assign the OD matrix eligibility percentages to each trip segment based on:

B1) Low VOT trip matrix: if OD eligibility percentage of matrix A is  $> 33\%$ , then low VOT trip matrix eligibility for that OD equals  $100\%$ , else it equals  $A * 3$

B2) Medium VOT trip matrix: if OD eligibility percentage of matrix A is  $> 67\%$ , then low VOT trip matrix eligibility for that OD equals  $100\%$ , else it equals  $[A - 33\%] * 3$

B3) High VOT trip matrix: high VOT trip matrix eligibility for that OD equals  $[A - 67\%] * 3$

C) Create 3 new trip matrices

C1) Low Income Eligible, Low VOT trips = original Low VOT trips \* B-1)

C2) Low Income Eligible, Medium VOT trips = original Medium VOT trips \* B-2)

C3) Low Income Eligible, High VOT trips = original High VOT trips \* B-3)

D) Reduce original 3 auto trip matrices to reflect Low Income eligible trips:

D1) Low VOT trips = original Low VOT trips - C-1)

D2) Medium VOT trips = original Medium VOT trips - C-2)

D3) High VOT trips = original High VOT trips - C-3)

As an illustrative example of this approach, consider a cell of the OD matrix having eligibility of 50% and the original trips for that OD are 300 (100 for each VOT group). Then the subsequent calculated matrices are:

$$B1 = 100\% \text{ since } 50\% \text{ is } > 33.3\%$$

$$B2 = (50\% - 33.3\%) * 3 = 50\%$$

$$B3 = 0\% \text{ since } 50\% \text{ is } < 67\%$$

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$$C1 = 100 * 100\% = 100$$

$$C2 = 100 * 50\% = 50$$

$$C3 = 100 * 0\% = 0\%$$

$$D1 = 100 - 100 = 0$$

$$D2 = 100 - 50 = 50$$

$$D3 = 100 - 0 = 100$$

**APPENDIX B: ADJUSTMENT OF INDIVIDUAL INCOME-BASED ENROLLMENT THRESHOLD**





## APPENDIX B: ADJUSTMENT OF INDIVIDUAL INCOME-BASED ENROLLMENT THRESHOLD

Implementation of an Individual Income-Based Enrollment program would require a method for determining, on an individual basis, whether an applicant met established income criteria to be eligible for the discount. For ease of implementation, eligibility could be aligned with that of existing federal-aid programs such as Supplemental Security Income (SSI) or Supplemental Nutrition Assistance Program (SNAP/Food Stamps). These programs allow a higher income for determining eligibility, approximately 130% of the federal poverty threshold.

In order to determine the effect of expanding the eligibility criteria, forecasts of the traffic and revenue impacts of offering a toll discount on the Ohio River Bridges to individuals living in a household with a combined income of less than or equal to 130% of the federally defined poverty threshold have been developed. This represents the expansion of the analysis of traffic and revenue effects when eligibility would be based upon the actual poverty thresholds.

Wherever possible, this methodology mimics that used for the previous individual income scenarios in order to maintain consistency and ensure that results are comparable. However, because Census data are aggregated using the poverty threshold, we were forced to modify the methodology to account for individuals that are above the poverty threshold but considered low-income in this scenario.

The poverty threshold is defined based on the total number of residents, the number of children and the number of seniors in the household, as shown in Table 2.1. Thus, to calculate the population in households with incomes under 130% of the poverty threshold, we would need to know the number of residents by household size, household composition and household income. The Census Bureau does not report population stratified by all those variables, so it was not possible to calculate the low-income population precisely with this broader definition. In the original analysis, this was not an issue because the Census Bureau releases a special table with the population living in a household under the poverty threshold.

For this scenario, we calculated the average household occupancy in the LMPA, then determined the poverty threshold for this household size, and finally calculated the percentage of households with an income less than 130% of that threshold. We use this percentage of households as a proxy for the percentage of the population considered low-income in each Census Block. We then adjusted this percentage, using the same methodology applied to previous scenarios, to account for lower vehicle ownership amongst low-income households.

### Low-income Households per TAZ

Since the low-income population is not available from the Census Bureau for this definition, the percentage of low-income households is used instead to indicate the percentage of low-income trips. The poverty threshold varies by household occupancy, so we determined the poverty threshold for the average household.

The average household occupancy,  $HHocc_{avg}$ , is:

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$$HHocc_{avg} = \frac{POP_{LMPA}}{HH_{LMPA}}$$

Where:

POP<sub>LMPA</sub> = Population of the Louisville Metropolitan Area

HH<sub>LMPA</sub> = Number of households in the Louisville Metropolitan Area

**APPENDIX TABLE B.1 POPULATION AND NUMBER OF HOUSEHOLDS IN THE LMPA BY COUNTY**

ACS 2012 5YR	Clark County, Indiana	Floyd County, Indiana	Bullitt County, Kentucky	Jefferson County, Kentucky	Oldham County, Kentucky	Total LMPA
Total Population	110,100	74,601	74,431	741,285	60,357	1,060,774
Total Households	42,848	29,188	27,791	303,915	19,446	423,188
Average Household Occupancy	2.57	2.56	2.68	2.44	3.10	2.51

$$HHocc_{avg} = \frac{1,060,774}{423,188} = 2.506$$

Next, we determined the poverty threshold for a household of average occupancy. Table B.2 contains the poverty thresholds for 2012

APPENDIX TABLE B.2 2012 POVERTY THRESHOLD DEFINITIONS

Size of Family Unit	Related children under 18 years									
	Avg.	None	One	Two	Three	Four	Five	Six	Seven	Eight+
One person (unrelated individual)	11,720									
Under 65 years	11,945	11,945								
65 years and over	11,011	11,011								
<b>Two people</b>	<b>14,937</b>									
Householder under 65 years	15,450	15,374	15,825							
Householder 65 years and over	13,892	13,878	15,765							
<b>Three people</b>	<b>18,284</b>	17,959	18,480	18,498						
Four people	23,492	23,681	24,069	23,283	23,364					
Five people	27,827	28,558	28,974	28,087	27,400	26,981				
Six people	31,471	32,847	32,978	32,298	31,647	30,678	30,104			
Seven people	35,473	37,795	38,031	37,217	36,651	35,594	34,362	33,009		
Eight people	39,688	42,271	42,644	41,876	41,204	40,249	39,038	37,777	37,457	
Nine people or more	47,297	50,849	51,095	50,416	49,845	48,908	47,620	46,454	46,165	44,387

Source: <https://www.census.gov/hhes/www/poverty/data/threshld/>

We calculate the poverty threshold for the average household of 2.51 occupants using linear interpolation between the poverty thresholds for two and three-occupant households:

$$PT_{avg} = \frac{(2.506 - 2) * PT_{2occ} + (3 - 2.506) * PT_{3occ}}{(3 - 2)}$$

Where:

PT<sub>avg</sub> = average poverty threshold for the LMPA

PT<sub>2occ</sub> = poverty threshold for households with two occupants

PT<sub>3occ</sub> = poverty threshold for households with three occupants

$$PT_{avg} = \frac{.504 * \$14,937 + .496 * \$18,284}{1} = \$16,597$$

The low-income threshold for this scenario, defined as 130% of the poverty threshold, is thus:

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$$Threshold_{LI} = 130\% * \$16,597 = \$21,576$$

Next, we used Census data to estimate the number of low-income households per TAZ. The Census Bureau reports the number of households within income bins with a width of \$5,000. 130% of the poverty threshold falls within the \$20,000 to \$24,999 bin. The following equation estimates the percentage of households in that income bin that will be considered low-income:

$$ShareIncomeBin = \frac{\$21,576 - \$20,000}{\$5,000} = 32\%$$

Households in the following income bins will be considered low-income:

- All less than \$10,000
- All \$10,000 to \$14,999
- All \$15,000 to \$19,999
- 32% of \$20,000 to \$24,999

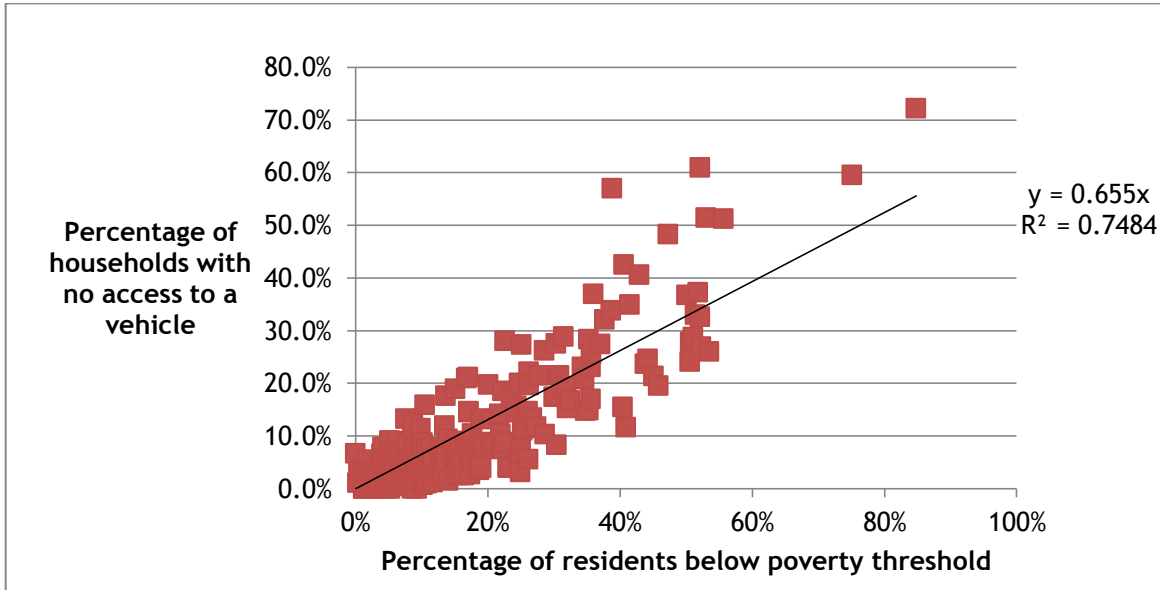
We calculated the number of low-income households by Block Group, the smallest geographical unit reported by the Census Bureau, and then aggregated the numbers to the TAZs used in the forecasting model. In the LMPA, 87,177 (20.6%) of the 423,188 households have a combined income of less than 130% of the poverty threshold. Broadening the definition of low-income from the poverty threshold, used in the original analysis, to 130% of the poverty threshold increases the population eligible for a toll discount from 14.7% to 20.6%, which is an increase of 40%.

### ***Adjusting for Vehicle Accessibility***

Members of low income households are less likely to have access to a vehicle, and thus make fewer auto trips. The following analysis adjusts the percentage of low-income households so that it represents the percentage of low-income likely drivers.

The following graph shows the correlation between poverty and vehicle access:

APPENDIX FIGURE B.1 RELATIONSHIP BETWEEN LOW INCOME AND NO VEHICLES



The data used in Figure B.1 were sorted by percentage of low income residents. For the poorest 20.6% of tracts, which represent the low-income group in this scenario ( $PercHH_{LI}$ ), 76.1% of households have a vehicle ( $PercHH_{wVeh}$ ) and 23.9% do not. For the 79.4% of households that are not low-income in this scenario, 95.2% have a vehicle, while 4.8% do not. Overall, 91.2% of households have a vehicle ( $PercHH_{wVeh}$ ).

The following equation calculates the low-income percentage of likely drivers ( $PercLD_{LI}$ ):

$$PercLD_{LI} = \frac{PercHH_{LIwVeh} * PercHH_{LI}}{PercHH_{wVeh}} = \frac{76.1% * 20.6%}{91.2%} = 17.2%$$

The factor to estimate low-income percentage of likely drivers at the TAZ level, FactorLD is thus:

$$FactorLD = \frac{PercLD_{LI}}{PercHH_{LI}} = \frac{17.2%}{20.6%} = 83%$$

To be consistent with the analysis of traffic and revenue effects when eligibility would be based upon the actual poverty thresholds, the adjustment factor was rounded to one significant figure, 80%, so as not to misrepresent the precision of this calculation. The percentage of low-

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income household in each TAZ was factored by 80% to give the low-income percentage of likely drivers.

Using the percentages estimated above of Low Income trips under the 130% poverty threshold assumption we built new trip matrices and prepared traffic and revenue forecasts for the revised Individual Income Based eligibility scenario.

**APPENDIX C: TRAFFIC VOLUME CHANGES**





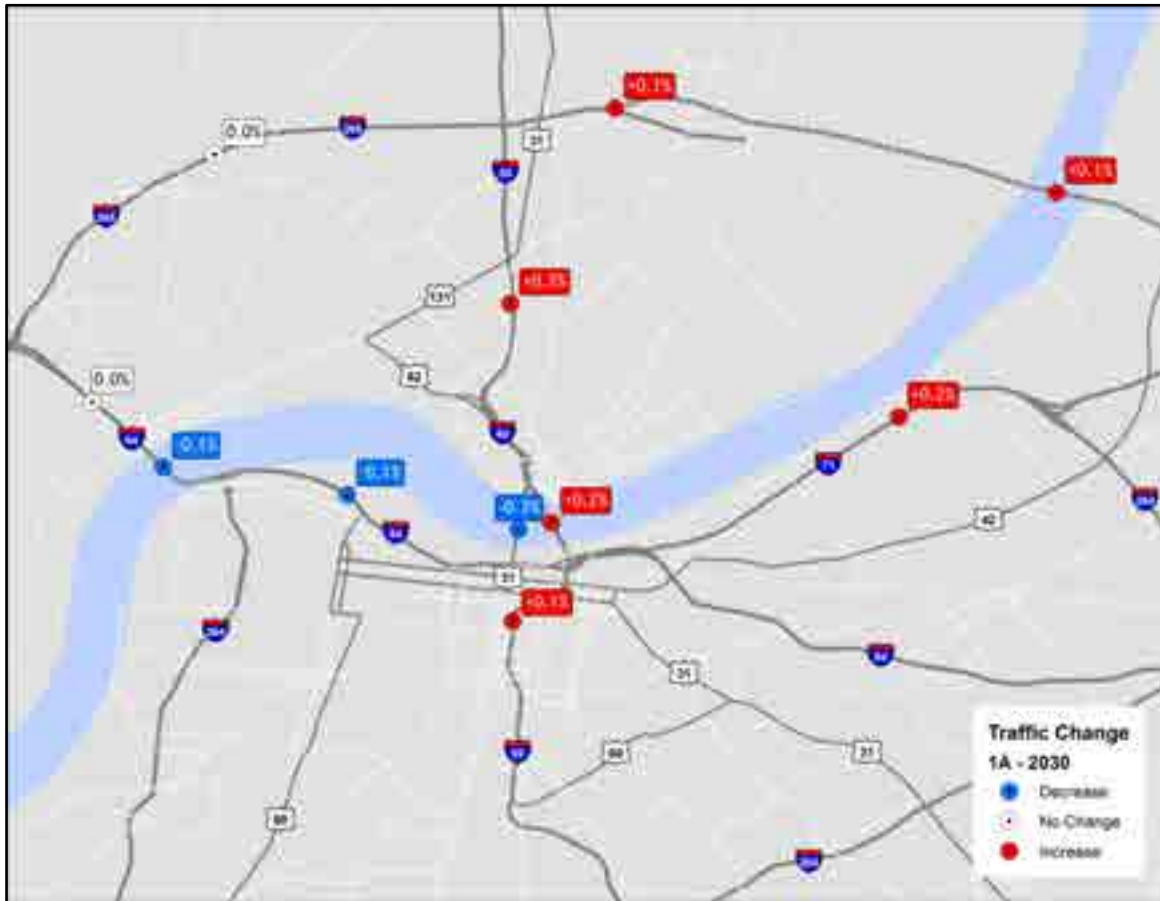
## APPENDIX C: TRAFFIC VOLUME CHANGES

APPENDIX TABLE C.1 DISCOUNT SCENARIOS

Discount Type	Individual Income-Based Eligibility	Area-Based Eligibility	FEITC Eligibility
Discounted Toll - Low (10%)	1A	2A	
Discounted Toll - Medium (25%)	1B	2B	
Discounted Toll - High (50%)	1C	2C	
One-Time Credit - Low (\$50)	1D	2D	
One-Time Credit - High (\$100)	1E	2E	
Tax Credit - Low (10%)	1F	2F	3F
Tax Credit - Medium (25%)	1G	2G	3G
Tax Credit - High (50%)	1H	2H	3H

Individual Income-Based Eligibility

APPENDIX FIGURE C.11A: TRAFFIC CHANGE WITH DISCOUNTED TOLL (10%) IN 2030



APPENDIX FIGURE C.21B: TRAFFIC CHANGE WITH DISCOUNTED TOLL (25%) IN 2030



APPENDIX FIGURE C.31C: TRAFFIC CHANGE WITH DISCOUNTED TOLL (50%) IN 2030



APPENDIX FIGURE C.41D: TRAFFIC CHANGE WITH ONE-TIME CREDIT (\$50) IN 2018



APPENDIX FIGURE C.51E: TRAFFIC CHANGE WITH ONE-TIME CREDIT (\$100) IN 2018



APPENDIX FIGURE C.61F: TRAFFIC CHANGE WITH TAX CREDIT (10%) IN 2030



APPENDIX FIGURE C.71G: TRAFFIC CHANGE WITH TAX CREDIT (25%) IN 2030





APPENDIX FIGURE C.81H: TRAFFIC CHANGE WITH TAX CREDIT (50%) IN 2030



Area-Based Eligibility

APPENDIX FIGURE C.92A: TRAFFIC CHANGE WITH DISCOUNTED TOLL (10%) IN 2030





APPENDIX FIGURE C.11 2C: TRAFFIC CHANGE WITH DISCOUNTED TOLL (50%) IN 2030



APPENDIX FIGURE C.12 2D: TRAFFIC CHANGE WITH ONE-TIME CREDIT (\$50) IN 2018



APPENDIX FIGURE C.13 2E: TRAFFIC CHANGE WITH ONE-TIME CREDIT (\$100) IN 2018



APPENDIX FIGURE C.14 2F: TRAFFIC CHANGE WITH TAX CREDIT (10%) IN 2030



APPENDIX FIGURE C.15 2G: TRAFFIC CHANGE WITH TAX CREDIT (25%) IN 2030





APPENDIX FIGURE C.16 2H: TRAFFIC CHANGE WITH TAX CREDIT (50%) IN 2030



FEITC Eligibility

APPENDIX FIGURE C.17 3F: TRAFFIC CHANGE WITH TAX CREDIT (10%) IN 2030



APPENDIX FIGURE A.18 3G: TRAFFIC CHANGE WITH TAX CREDIT (25%) IN 2030



APPENDIX FIGURE A.19 3H: TRAFFIC CHANGE WITH TAX CREDIT (50%) IN 2030



## CONTROL SHEET

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## REVIEW

Originator                            SDG Project Team

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