Technical Memorandum

Planning-Level Traffic and Revenue Study
Interstate 4 Tolled Managed Lanes

Prepared by: URS Corporation

Date: October 2012

The traffic and revenue study performed for this project was based on the best available information regarding future socioeconomic growth in the region, as well as the future transportation infrastructure that will serve the area. Unanticipated events or influences affecting the national or local economy, future regional growth, the condition or extent of transportation networks, or other influencing factors could produce substantially different conclusions. Additionally, traffic and revenue studies for toll roads typically predict for 30-year periods based on the future year of the travel demand model which in this case is 2045. Because this project was evaluated for a possible public-private partnership (P3) delivery method, traffic and revenue forecasts were required for an unconventionally longer period of 50 years. There is no established protocol or universally-accepted method for producing estimates extending over twenty years beyond the travel demand model limit. Therefore, it is assumed that the reviewer will understand and accept the uncertainties associated with the methods used and the results produced for those extended forecasts. For a summary of assumptions and statements of limiting conditions, see the final section of this technical memorandum (Summary of Assumptions and Limiting Conditions).

ABOUT THE PROJECT

Interstate 4 (I-4) is a vital component of the transportation network in Central Florida. It serves as a backbone of the transportation infrastructure in the region and is the only limited-access route in the Orlando area with no tolls. Most major east-west arterials within Orlando feed traffic to I-4 and most of the toll roads in the area are connected to it. As a result of its location, function, and high demand, I-4 is consistently over capacity for many hours of the day.

Population and employment in the Orlando region is forecasted to grow and with that socioeconomic growth will be continued traffic growth on I-4, which will further congest the facility for more hours of the day in the future. With this anticipated growth comes the need to consider viable options to improve the flow of people and goods within and through the region. One viable option to improve mobility in the region is to make capacity improvements on I-4.

The concept of providing additional interstate capacity by way of managed lanes has increasingly become a priority at both the national and state levels. Managed lanes on I-4 would provide travelers with an alternative to the congested general use lanes during times of the heaviest traffic demand in the corridor. In return for the trade-off of a toll charge, the traveler would obtain a higher level-of-service in the managed lanes than in the general use lanes and benefit from shorter travel times.

The traffic level-of-service in the managed lanes would be maintained through variable pricing, with the managed lane tolls rising with increased congestion in the corridor. The concept is

often termed "congestion pricing" or "value pricing" and simply involves higher toll rates during peak traffic periods, when travel demand is greatest. During off-peak periods, the toll rate is lower when the value of a trip on the managed lanes may be less. Additionally, developments in All-electronic Tolls (AET), such as SunPass and E-PASS, have facilitated the opportunity for variable pricing. AET will be implemented on the I-4 managed lanes with entry into the system available only for vehicles equipped with SunPass or other inter-operable transponders.

The I-4 managed lanes are part of a larger I-4 Central Florida widening project that is under development by the Florida Department of Transportation (FDOT) District 5. The managed lanes themselves account for all of the additional capacity to be added in the corridor. Modifications to the toll-free lanes include improvements to interchanges and existing geometry. Together, these improvements consist of a complete reconstruction of 21.1 miles of I-4 from west of Kirkman Road in Orlando to east of S.R. 434 in Seminole County. **Figure 1** shows the study corridor, which is actually oriented north-south within the project limits. However, the overall I-4 facility is generally oriented east-west, which is the designation used in this report.

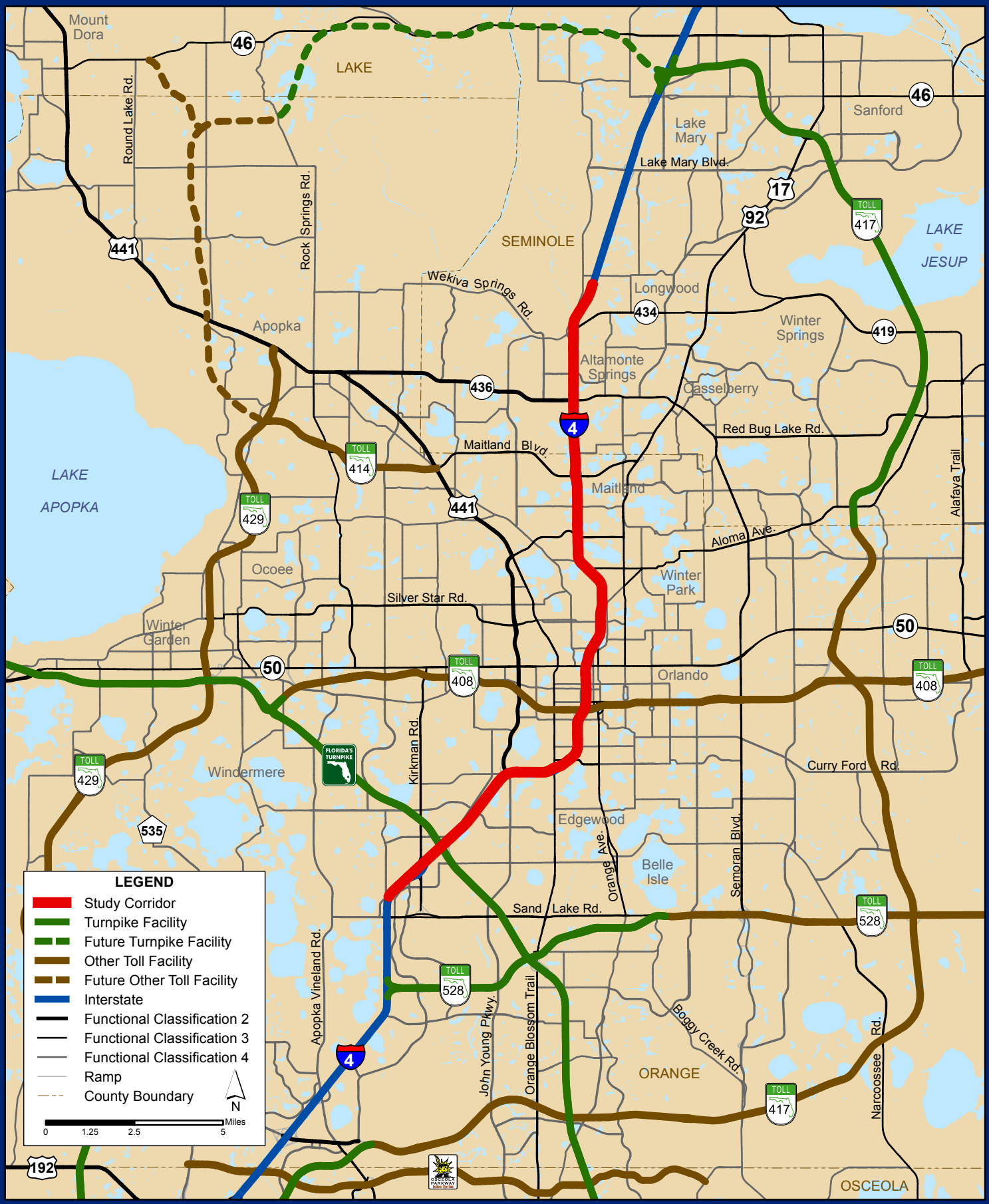
This study comprises a planning-level effort to forecast the revenue earning potential of managed lanes on I-4 in Orlando. The study is termed "planning-level" to identify that this effort serves to evaluate opportunities and risks associated with preliminary estimates of traffic and revenue produced from available forecasting tools. The study is not intended to be an investment-grade effort with the purpose of supporting bond sales.

PROJECT DESCRIPTION

The project that was studied would implement 21.1 miles of managed lanes on I-4 from west of Kirkman Road to east of S.R. 434. Within the project limits numerous slip and direct access ramps are planned, determining where and how travelers can access the managed lanes. **Figure 2** shows the toll gantry locations, the eight tolling segments, the proposed locations of slip ramps between the general use lanes and the managed lanes, and the proposed locations where direct access to the managed lanes would be accommodated by ramps from crossing streets or roads. There are nine pairs of slip ramps along the 21.1 miles of managed lanes. Additionally, direct access is provided at Central Parkway, Ivanhoe Boulevard, South Street, Anderson Street and Grand National Drive.

The managed lanes are designed to be separated from the general use lanes by a concrete barrier system and contain two lanes in each direction throughout the corridor. The general use lanes vary in number. Generally, there are either three or four thru lanes in each direction with additional auxiliary lanes between many of the interchanges.

In the project corridor, I-4 experiences the highest traffic volumes in the region. Based on 2010 count information, I-4 traffic levels within the 21.1-mile corridor range from 134,000 to 198,000 annual average daily traffic (AADT), depending on the location. Most segments experience heavy congestion with traffic delays occurring during daily peak travel times and also during some daytime hours between peak periods. I-4 traffic distribution is fairly even which is conducive to the planned 2 x 2 managed lanes configuration (two lanes eastbound, two lanes westbound).



I-4 Managed Lanes Study Corridor

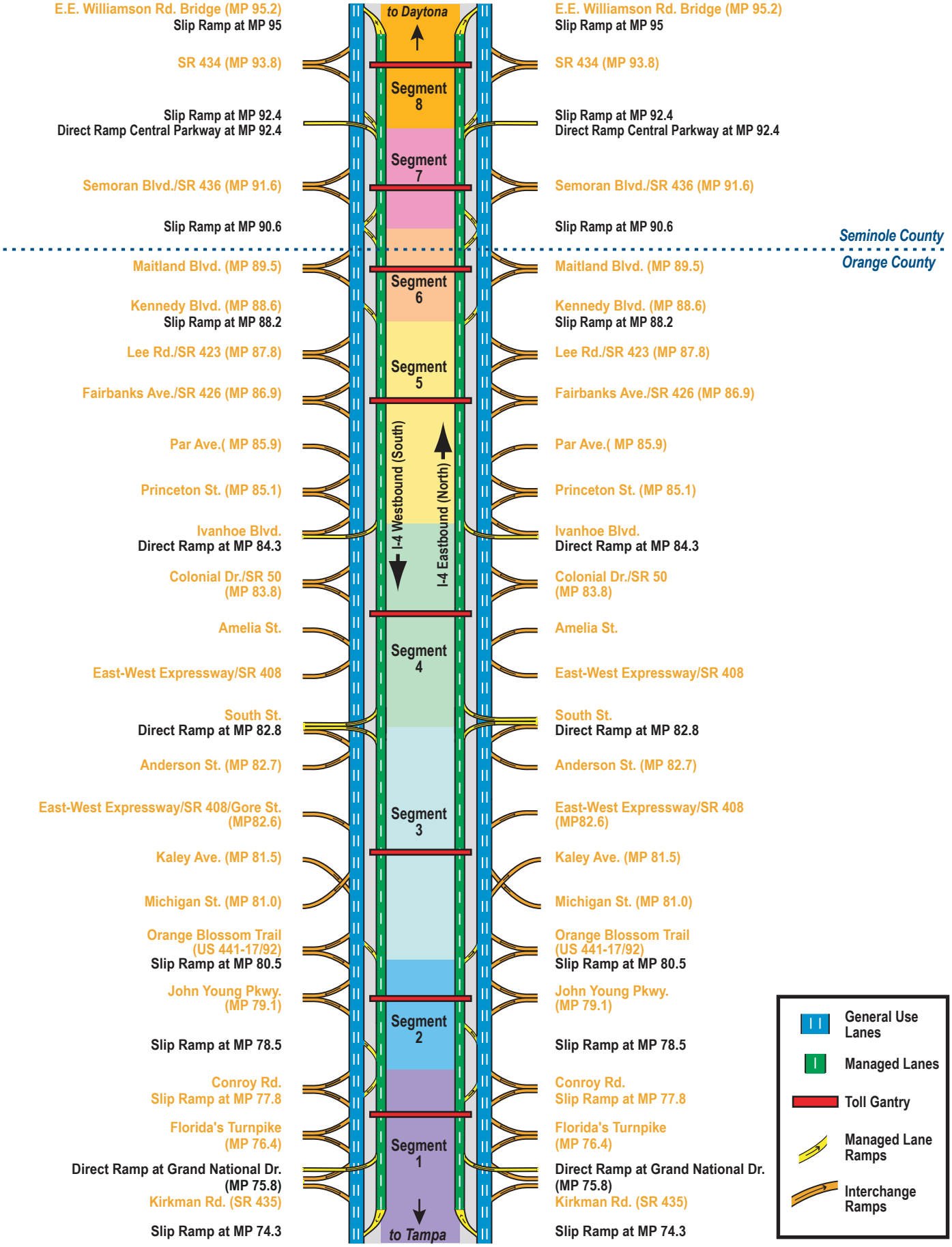
Figure 1

Sources: NAVTEQ 2011
Florida's Turnpike Enterprise, 2012

Produced by:
URS Corporation

I-4 Managed Lanes

Figure 2



POLICY CONSIDERATIONS FOR THE I-4 MANAGED LANES

Many transportation officials and policymakers see managed lanes projects as an increasingly viable option in an era of limited highway funding. Numerous state and regional transportation agencies have built or will soon be opening managed lanes projects around the country. Though not entirely inclusive, **Table 1** shows most major managed lanes projects across the nation that are open and many that are currently in development. In terms of pricing managed lanes projects, pricing policies seek to achieve different objectives. One objective is to maximize traffic throughput. This approach provides the highest utilization of the managed lanes but can affect travel time reliability. Another objective is to maintain speeds in the managed lanes. This pricing policy approach tends to be more aggressive with more rapid toll rate increases in response to maintaining desired speeds in the managed lanes. This also reduces the probability of breakdown conditions developing in the managed lanes. A third objective is to take an aggressive pricing policy approach to meet the financial obligations of the project.

Table 1
National Overview of Managed Lanes Projects

Facility	Location	Year of Opening	Managed Lane Configuration	Pricing Approach
S.R. 91	Orange County, CA	1995	2 each direction	Maximize Throughput and Meet Financial Obligations
I-394	Minneapolis, MN	2005	2 reversible and 1 each direction	Maintain Free Flow
I-25	Denver, CO	2006	2/3 reversible	Maintain Free Flow
I-15	Salt Lake City, UT	2006	1 each direction	Maximize Total Throughput
I-15	San Diego, CA	2008	4 total with moveable barrier	Maximize Total Throughput
I-95	Miami, FL	2008	2 each direction	Maximize Total Throughput
I-10	Houston, TX	2008	2 each direction	HOV/Transit Maximization
I-85	Atlanta, GA	2011	1 each direction	Maintain Free Flow
I-495	Northern VA	2012	2 each direction	Revenue Maximization
I-595	Ft. Lauderdale, FL	2014	3 reversible	Maximize Total Throughput
I-635	Dallas, TX	2013-2016	2 each direction	Revenue Maximization
S.R. 820	Fort Worth, TX	2015	2 each direction	Revenue Maximization
U.S. 36	Denver, CO	Under Development	1 reversible	Maintain Free Flow
I-95	Northern VA	Under Development	3 reversible	Revenue Maximization
S.R. 91 Extension	Riverside County, CA	Under Development	2 each direction	Revenue Maximization

HOV – High occupancy vehicle.
Source: Fitch Ratings Ltd. with updates

The I-4 managed lanes project joins a growing number of managed lanes facilities where transportation officials are opting for an aggressive pricing approach due to limited funding, while meeting the need for infrastructure improvements. While traffic throughput will be less than under a traffic maximizing approach, managed lanes travel speeds will be maintained and the project, which would otherwise not be financially feasible, will be able to be constructed for the benefit of the traveling public. The traffic and revenue results presented in subsequent sections of this report reflect that position.

METHODOLOGY OF THE TRAFFIC AND REVENUE STUDY

The traffic and revenue estimates for the I-4 managed lanes were accomplished through a multi-step process. With the need to provide traffic and revenue forecasts by hour and to provide traffic and revenue forecasts for the 50th, 65th and 75th percentile risk curves for use in subsequent financial analyses, the forecasting process needed three modeling tools:

- Travel demand model
- Probability model
- Subarea model for the I-4 project corridor

For the travel demand model, the study used the Turnpike Central Florida Model (TCFM), which covers the following 10-county region in Central Florida: Orange, Lake, Seminole, Volusia, Osceola, Polk, Brevard, Sumter, Marion, and Flagler. The TCFM was developed by the Turnpike for the purpose of forecasting future toll traffic on proposed toll facilities in the region. It was designed to produce travel demand forecasts at a daily level with traffic defined in terms of annual average daily traffic (AADT). The daily forecast results from the TCFM were used to supply both the probability and the subarea models.

For the purposes of producing a risk-based assessment for the financial analysis, a probabilistic model was used to develop risk curve percentiles for the project. The probability effort began by identifying the assumptions and model inputs that have significant effects on traffic and revenues and that have associated uncertainty regarding current or future values. Three test levels were specified for each of these inputs; and a statistically-efficient experimental plan was developed that tested combinations of those input levels sufficient to estimate the traffic and revenue "response surface" – the relationship of each of the inputs to the resulting traffic and revenue.

For the purposes of forecasting traffic and revenue by hour, an Express Lanes Time-of-Day (ELTOD) model was developed for I-4. The development of the ELTOD model provided the means to forecast traffic by hour and direction in the general use and managed lanes via supply and demand equilibrium processes. ELTOD determined the hourly managed lane share based on the toll amount and the differences in travel times between the general use and managed lanes.

Subsequently, the results from the three forecasting models supplied the information necessary to estimate gross toll revenue, toll collection expenses, and net toll revenues.

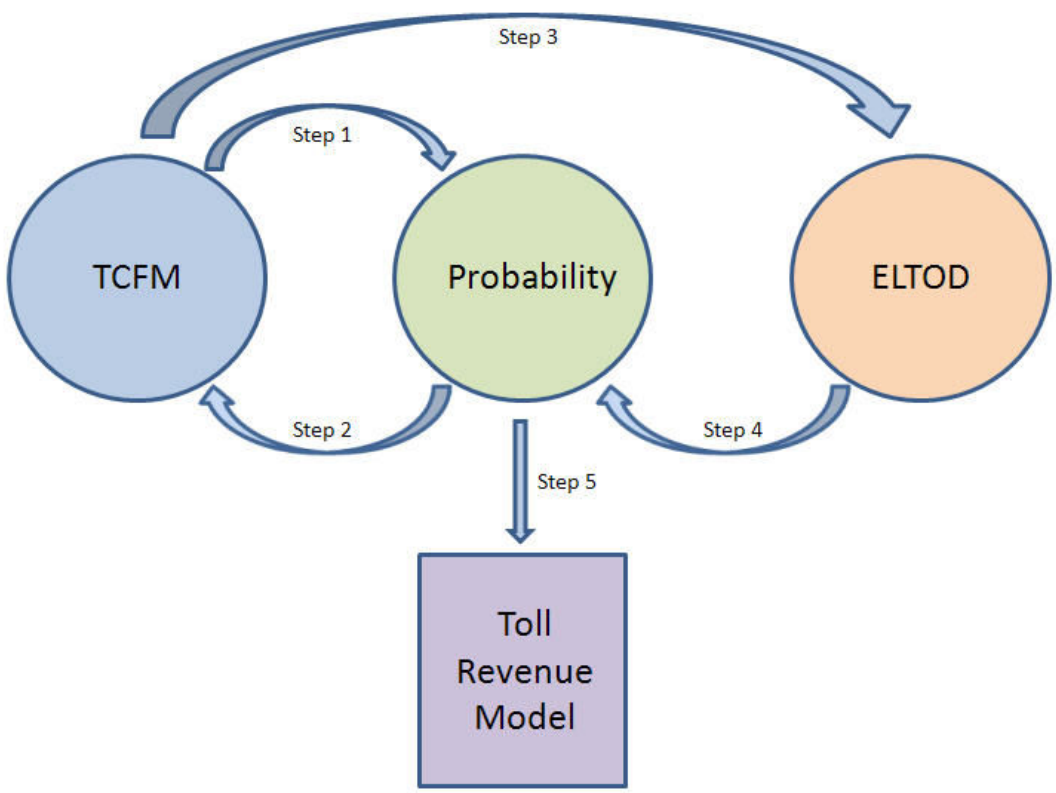
An overview of the modeling processes and model interactions is provided in **Figure 3**. The TCFM provided the initial information regarding traffic and revenue performance on the I-4 managed lanes, supplying the probability model the necessary traffic and revenue results for each of the combinations generated in the experimental plan (step 1).

From the probability forecasts, the socioeconomic, network, and value of time variables for the Base condition were chosen (step 2). Using the TCFM, the Base condition forecasts were developed. The daily TCFM results were then used by ELTOD to determine the hourly I-4 managed lanes traffic volumes and toll rates (step 3).

The ELTOD model worked in conjunction with the TCFM, taking a daily subarea trip table and a subarea network extraction from the TCFM and producing traffic and revenue estimates by hour and by direction in the corridor for the general use and managed lanes. The ELTOD results for traffic and revenue on an hourly basis were subsequently fed back into the probability process for final development of the risk curves percentiles (step 4).

The traffic and revenue forecasts produced from the final probability effort became inputs to the toll revenue model, which determined gross toll revenue estimates, toll collection expenses, and net toll revenues (step 5).

Figure 3
I-4 Managed Lanes Modeling Process



Within the toll revenue model the forecasts were extended beyond the traditional Turnpike bond traffic and revenue estimates, out to 50 years instead of the typical 30-year forecasts, for use in developing a possible public-private partnership (P3) option for the project's finance plan. Each of the steps performed in the study is discussed in more detail in the following sections.

Travel Demand Model – TCFM

The initial tasks in the development of traffic and revenue forecasts for the I-4 managed lanes were to complete the calibration of the TCFM and develop the future year datasets. Within the model, geographic coverage was represented by traffic analysis zones containing socioeconomic data that were the basis for model trip generation. The TCFM used dwelling units and employment in the development of trip productions and attractions. Initially, a gravity model was used to distribute trip productions to trip attractions by trip purpose based on free flow travel times and trip length parameters. The trip purposes were then collapsed to represent total trips, producing a seed trip table for the matrix estimation (ME) process. An extensive count database was developed at the state and local levels for 2010. Over 7,900 counts were included in the database and used to validate the TCFM, representing a network coverage of over 14 percent.

The ME process produced ratios of assigned trips to volumes on links with counts, modified the origin/destination trips for zones identified by the minimum-path data at the count location, and reassigned the modified trip matrix until the user-specified number of matrix estimation passes was reached. ME performed an iterative sequence of refinements to the trip table results to achieve close agreement between the model volumes and actual traffic counts, in this case for the base year of 2010. To verify that the TCFM calibration met or exceeded adopted standards for model accuracy, three main indicators were used to measure model performance: volume-to-count ratios, root mean squared error (RMSE), and an R^2 value. The RMSE is a statistic used to measure the difference between the 2010 traffic volumes produced by the TCFM and the actual counts. The R^2 value is another statistical term used in linear regression and the closer to 1.0 the better. **Table 2** shows the model performance statistics.

Table 2
2010 Model Performance Measures

Performance Measure	Region	All Toll Roads	I-4 Corridor
Volume-to-Count Ratio	1.004	0.994	0.999
Number of Counts	7,907	231	34
RMSE	7.8%	-	-
R^2 Value	0.9948	-	-

Note: RMSE and R^2 values have been calculated only for the region.

The 2010 TCFM calibration was quite successful in achieving model volumes that replicated the 2010 traffic counts, not only at a regional level but also for all toll roads and on I-4 within the study corridor. Volume-to-count ratios deviated from 1.0 by less than one percent for the region, on toll roads, and for the overall I-4 study area, showing that the model is replicating existing conditions quite well.

Traditionally, RMSE values between 20 and 39 percent have been acceptable ranges for model performance. With the TCFM utilizing the ME process, the validation effort produced a RMSE value of only 7.8 percent and an R^2 value very close to 1.0. All of these performance measures show that the TCFM has been successfully calibrated to 2010 conditions.

Table 3 provides the 2010 details on the model performance on I-4 in the study area showing the model volumes, 2010 counts and the volume-to-count ratios. The heaviest volume on I-4 is just south of S.R. 408 with a 2010 AADT of 197,800. Other heavily traveled segments are just north of Ivanhoe Boulevard and north of U.S 441. From survey data gathered within the corridor, nine percent of drivers travel the full-length of the 21.1-mile I-4 corridor.

Table 3
2010 I-4 Model Performance

I-4 Mainline Segment Location	Model AADT	Count AADT	Volume-to-Count Ratio
North of S.R. 434	134,200	133,900	1.002
Between S.R. 434 and S.R. 436	137,800	138,500	0.995
Between S.R. 436 and Maitland Boulevard	149,200	148,800	1.003
Between Maitland Boulevard and Lee Road	176,700	174,700	1.011
Between Lee Road and Fairbanks Avenue	178,900	176,900	1.011
Between Fairbanks Avenue and Par Street	175,300	178,700	0.981
Between Par Street and Princeton Street	189,100	182,500	1.036
Between Princeton Street and Ivanhoe Boulevard	181,400	182,700	0.993
Between Ivanhoe Boulevard and S.R. 50	160,000	162,200	0.986
Between S.R. 50 and Amelia Street	136,800	148,300	0.922
Between Amelia Street and South Street	160,200	169,000	0.948
Between S.R. 408 and Kaley Street	200,700	197,800	1.015
Between Michigan Street and U.S. 441	184,300	180,400	1.022
Between U.S. 441 and John Young Parkway	172,100	172,400	0.998
Between John Young Parkway and Conroy Road	179,500	176,700	1.016
Between Conroy Road and Turnpike	178,000	175,200	1.016
Between Turnpike and Kirkman Road	160,800	158,800	1.013
I-4 Study Corridor Total	**2,855,000**	**2,857,500**	**0.999**

Prior to finalizing the model calibration, stated preference surveys were completed in the Central Florida region and the survey data were available for use in this study. In the process of calibrating the TCFM to 2010 conditions, a feature within the model was created to vary the value of time (VOT) by toll facility. The VOT is the amount a driver would be willing to pay in order to save time and is stated in dollars/hour. The end result of the calibration with variable VOTs by toll facility produced a relatively

close distribution of VOTs across the toll facilities. Most of the values were supported by the survey data, being within the range that was estimated in the stated preference surveys for the region.

For the I-4 managed lanes Study, the TCFM was developed with future year datasets for every five-year increment from 2015 through 2045. In order to accomplish the first step of the modeling process whereby the TCFM would provide daily traffic and revenue results as input into the first round of probability modeling, network development and socioeconomic data for each of those years were necessary.

As part of the network update, the latest Transportation Improvement Program (TIP) was used as a guide to develop additional and new capacity to the roadway network for each county. This effort created a roadway network for 2015 as part of the existing and committed (E+C) roadway improvement plan. Beyond 2015, a process was developed for adding capacity to conditions where volume-to-capacity ratios exceeded set levels. Two network data bases were developed, one where additional capacity was added when the volume-to-capacity ratios exceeded 125 percent and another when the volume-to-capacity ratios exceeded 150 percent. Finally, the toll rate levels were structured to range from the minimum to maximum daily rates experienced on existing toll roads in the region. Along with these updates, the speeds and capacities in the model were reviewed and updated as necessary to ensure proper highway traffic assignments.

For the model update of the socioeconomic data forecasts, data for all 10 counties were updated for the future model years based on official forecasts for population and employment. The University of Florida College of Business Administration Bureau of Economic and Business Research (BEBR) published the latest county-level population forecasts and average household size. These forecasts were used to develop the dwelling unit forecasts from 2015 through 2045. For employment, the U.S. Department of Commerce Bureau of Economic Analysis (BEA) provided employment estimates. The BEA data were used as the county control totals for the employment updates in the forecast years. Based on historical industrial classification of employment, annual county estimates were derived.

As an additional refinement, the socioeconomic datasets were reviewed in detail by independent land use experts at Simon Resources, Inc. They performed a thorough review of more than 40 current and potential major land development projects that could affect I-4 traffic and provided recommendations for how those developments should be represented in the future year model datasets.

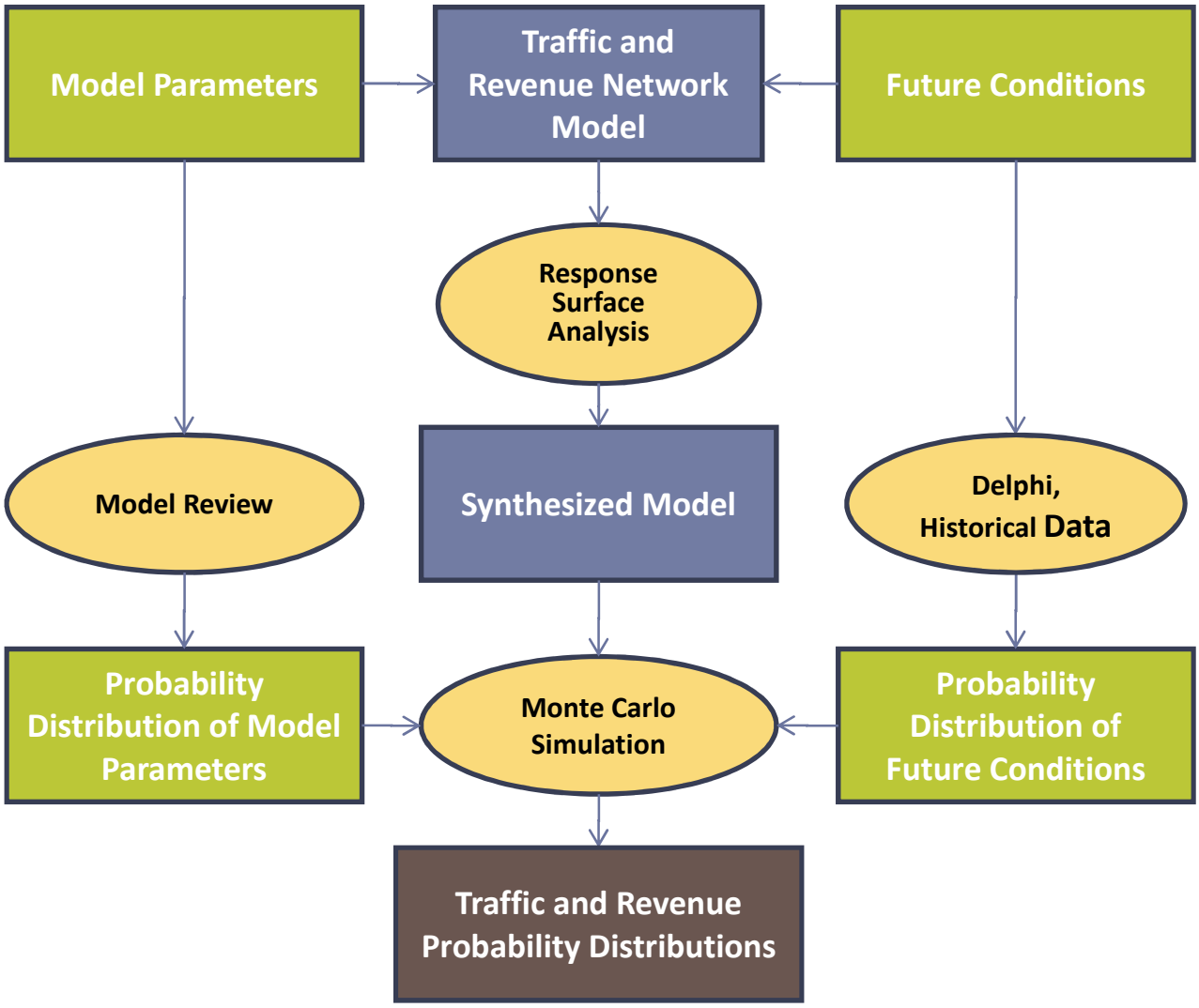
Probability Modeling

Once the TCFM had produced the daily traffic and revenue results for the I-4 managed lanes, the first step was to take the initial model results and use them in the probability modeling process. This probability modeling was conducted to estimate the variations in forecasted traffic and revenue levels resulting from uncertainties in key inputs used in the forecast models. The process used to develop these estimates is illustrated on **Figure 4**.

This process is based directly on the travel demand forecasting model typically used for traffic and revenue studies, in this case the TCFM. As with all such models, the forecasts from TCFM depend on several key inputs that have associated uncertainties. Future levels of regional growth are estimated for the project's opening year and for a 30-year operating period. While these growth estimates are

based on a generally reliable method, the amount of growth in future years is inherently uncertain. Similarly, travelers' willingness to pay tolls to save travel time can be estimated based on proven methods but their willingness to pay tolls in the future could vary depending on economic conditions and other factors.

Figure 4
I-4 Managed Lanes Probability Modeling Process



Other roads that are built or expanded could either feed traffic to the project or provide alternative travel routes around the project. The extent of those types of road construction in the future is uncertain. Of course, the levels of tolls will also affect traffic and although they can be determined as a matter of policy, there are inherent interactions between those toll levels and the other uncertain inputs that must be represented.

Probability distributions can be derived for future growth levels, values of time, and future road construction based on a combination of empirical data and discussions with experts. The TCFM accounts for the effects of all of these variables but there are more than 4 million different combinations of values of these variables that are possible.[1] It is not possible to use the TCFM directly to explore all of these possible future conditions. Instead, this process uses response surface methods[2] to approximate the I-4 project's traffic and revenue estimates produced by the TCFM. The resulting "synthesized model" is simpler in form and can be run for the millions of possible future conditions using Monte Carlo simulation to derive the probability distributions for the project's future traffic and revenue. The following sections detail the work done to complete this process for the I-4 project.

Development of the Experimental Plan for Probability Modeling

As previously mentioned, the probability modeling effort needed the inputs from the TCFM to provide the initial information regarding traffic and revenue performance on the I-4 managed lanes. In the process of identifying the assumptions and model inputs that have significant effects on toll volumes and revenues, an experimental plan was developed to provide a set of alternatives designed to provide information about how traffic volumes on the I-4 managed lanes were affected by the key inputs (VOT, economy, road network, and toll rates).

Three test levels were specified for each of these inputs and a statistically-efficient experimental plan was developed that tested combinations of those input levels sufficient to estimate the traffic and revenue response surface. The response surface analysis used specially-structured runs of the full travel demand forecasting model to determine how that model "responds" to different combinations of the inputs. In these runs, all of the inputs were varied concurrently so that the effects of each of the variables could be determined with a relatively small number of such model runs. **Table 4** shows the nine specified alternatives that were developed and run for the seven future time frames (in five-year increments from 2015 to 2045) for a total of 63 TCFM assignments.

The variables were structured to cover a wide range of uncertain outcomes. The VOT rates/hour ranged from $10.67 to $25.49, covering 90 percent of the possibilities statistically estimated from the stated preference survey data gathered in the Central Florida region. The range between the high and low VOTs represents diversity in the traveling public as well as uncertainty about the exact composition of those travelers in the future. The socioeconomic forecasts from BEBR ranged from medium-low to medium-high.

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[1] Assuming toll rates from $0.05 to $0.15 in one-cent increments, growth from 23% to 110% in one-percent increments, values of time from $10 to $25/hour and 3 future highway scenarios – each representing about 90% of the expected range.

[2] See, for example, Box, G. E. P. and Draper, N., *Response Surfaces, Mixtures, and Ridge Analyses*, Second Edition, Wiley, 2007.

Table 4
I-4 Managed Lanes Experimental Design

Alternative	VOT/hour	Economy	Network	Toll Rate/Mile
P1	$10.67	BEBR Med-Low	E+C	$0.05
P2	$10.67	BEBR Med	150	$0.15
P3	$10.67	BEBR Med-High	125	$0.10
P4	$18.08	BEBR Med-Low	125	$0.10
P5	$18.08	BEBR Med	150	$0.05
P6	$18.08	BEBR Med-High	E+C	$0.15
P7	$25.49	BEBR Med-Low	125	$0.15
P8	$25.49	BEBR Med	E+C	$0.10
P9	$25.49	BEBR Med-High	150	$0.05

With the E+C network already established, a way to represent network improvements beyond 2015 was accomplished through a model-guided process. The work program capital improvements budget provided by District 5 from 2008 through 2017 was used as a guide in establishing additional lane-mile limits for the highest range for the network variable. That translated into a modeling process to develop a future network database by adding capacity to conditions where volume-to-capacity ratios exceeded 125 percent for the highest level in the experimental design. For the mid-range estimate, 150 percent was used as the threshold in determining when to add capacity. Within this process, District 5 provided a constrained roadway inventory that was used in keeping those roads identified as policy and environmentally constrained at the limits set by the district for both network databases. Finally, the toll rate levels were structured to range from the minimum to maximum daily rates experienced on existing toll roads in the region.

In ranking the variables in term of their influence, the probability effort identified the following order:

1. Value of Time (highest)
2. Economy
3. Network (lowest)

Development of the Surface Response and Probability Distributions

The outputs from these TCFM runs were used for the response surface analysis, which explored ways to represent the project's traffic and revenue using a simplified "model of a model." The mathematical model described in the equations below is the result of this response surface analysis.

$$Traffic = 128686 + 48486 * growth - 91138245 * (tollRate / VOT) + 9432 * \ln(rampUp) - 11099 * roadEC - 15820 * road150 + yearCon$$

$$Revenue = -6130 + 7.885 * (Traffic * tollRate) + 3532 * roadEC + 2088 * road150 + yearCon$$

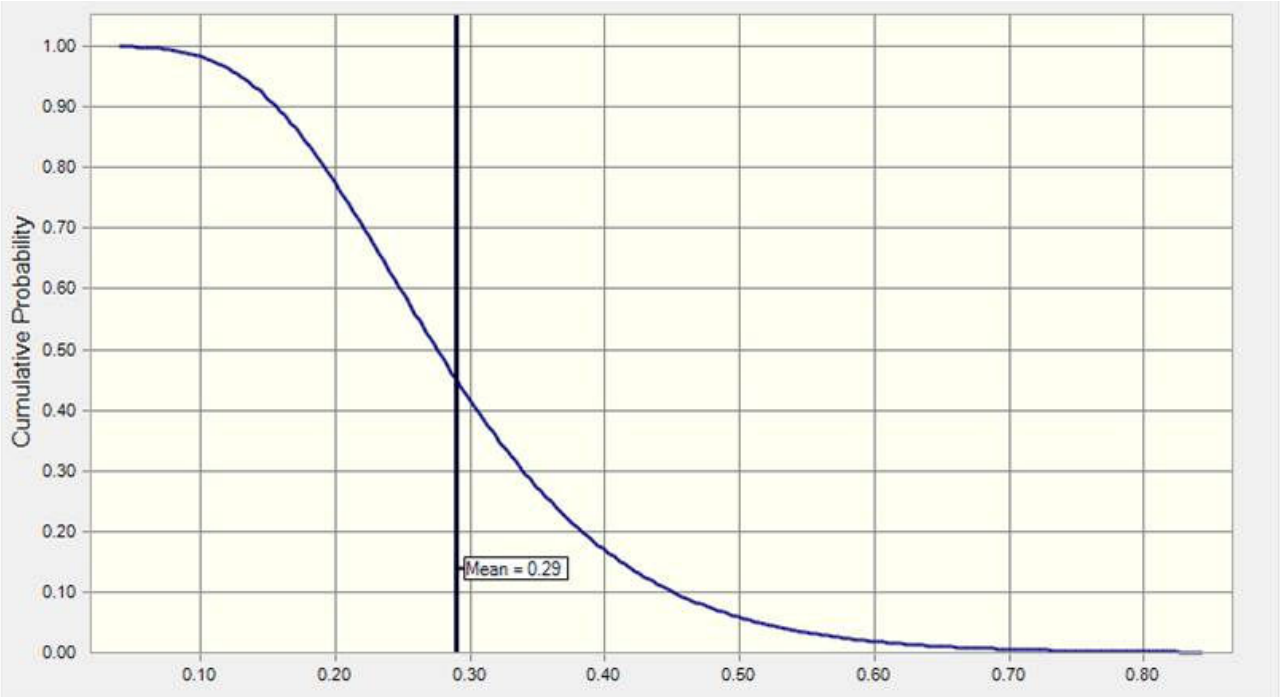
Where:

Traffic is the number of daily one-way trips that use the I-4 managed lanes
Revenue is the estimated gross revenue from the trips on the I-4 managed lanes
growth is the ratio of dwelling units in the given year to dwelling units in 2010 minus one
tollRate is the average toll rate charged on I-4 in 2010 dollars
rampUp is the number of years the project has been operating in the given year
roadEC represents the road improvements included only in the E+C conditions
road150 represents the road improvements under the 150% process described previously
yearCon is a vector of constants representing the years for which the forecasts are being made

These equations reflect the influence of the key uncertain TCFM inputs as well as the other factors that affect traffic and revenue. The equations also very closely mimic the outputs of the TCFM, explaining about 95 percent of the variance across the TCFM model runs.

Probability distributions for the inputs were developed based on available data as noted above. For values of time, the distribution was developed based on results of the stated preference survey. For growth rates, data compiled by BEBR on the accuracy of their past growth forecasts were used to establish the likely distributions around future forecasts.[3] For future road conditions, data provided by District 5 were used. **Figure 5** illustrates the distribution used for traffic growth through the year 2025. In this figure, the probability on the x-axis is the probability for traffic growth to 2025 and the y-axis is the probability that growth will equal or exceed that value. For example, there is approximately a 45 percent chance that traffic growth from 2010 to 2025 will exceed 29 percent.

Figure 5
I-4 Managed Lanes Cumulative Probability Distribution
Traffic Growth Example – Years 2010-2025



[3] *BEBR Special Reports Number 9*, July 2011

A Monte Carlo simulation procedure was used to estimate the probability distributions of I-4 managed lanes traffic and gross revenue resulting from the combinations of all of these probabilistic inputs applied to the response surface model. One million random conditions were simulated and the resulting traffic and revenue forecasts from the response surface models were used to derive the cumulative traffic and revenue probability distributions for the I-4 project. The Monte Carlo procedure determined the revenue-optimal toll rates for each forecast year. The resulting toll rates (in 2010 dollars) are shown in **Table 5**. Associated with those toll rates were the VOT, economy, and network variable levels used in the TCFM to feed into the ELTOD model.

Table 5
Base Condition Variables Used in the TCFM to Feed ELTOD

Variable	2015	2020	2025	2030	2035	2040	2045
Per Mile Toll Rate	$0.10	$0.11	$0.12	$0.13	$0.14	$0.14	$0.15
VOT (per hour)	$18.08						
Economy	BEBR Medium						
Network	Capacity increased with V/C ratios greater than 150%						

As the second step in the process, the TCFM produced results for the Base condition according to the variables specified in **Table 5** where the socioeconomic data were based on the BEBR medium, the value of time was $18.08/hour and network capacity improvements beyond 2015 were made to roads that exceeded the volume to capacity threshold of 150 percent (and had not been identified as constrained at limits set by District 5). The origin-destination trip tables from these TCFM runs were used in ELTOD to determine the hourly I-4 managed lanes traffic volumes and toll rates.

Express Lanes Time-of-Day (ELTOD) Model

As previously mentioned, an important aspect of the revenue-earning potential of the managed lanes will be the toll rates charged to users over the course of the day. The traffic level-of-service in the managed lanes would be maintained through variable pricing, with the managed lanes tolls rising with increased congestion in the corridor. The development of the ELTOD model provides the means to forecast traffic by hour and direction in the managed lanes via supply and demand equilibrium processes.

In the overall modeling process to develop hourly traffic and revenue forecasts, the third step was the feed from the TCFM into ELTOD. The daily results were input into ELTOD, using the base condition variables. Since the TCFM is a daily model, the ELTOD hourly subarea model was needed in order to produce hourly traffic forecasts for the general use and managed lanes. The ELTOD model worked in conjunction with the TCFM and was designed to take a daily subarea trip table and a subarea network extraction from the TCFM.

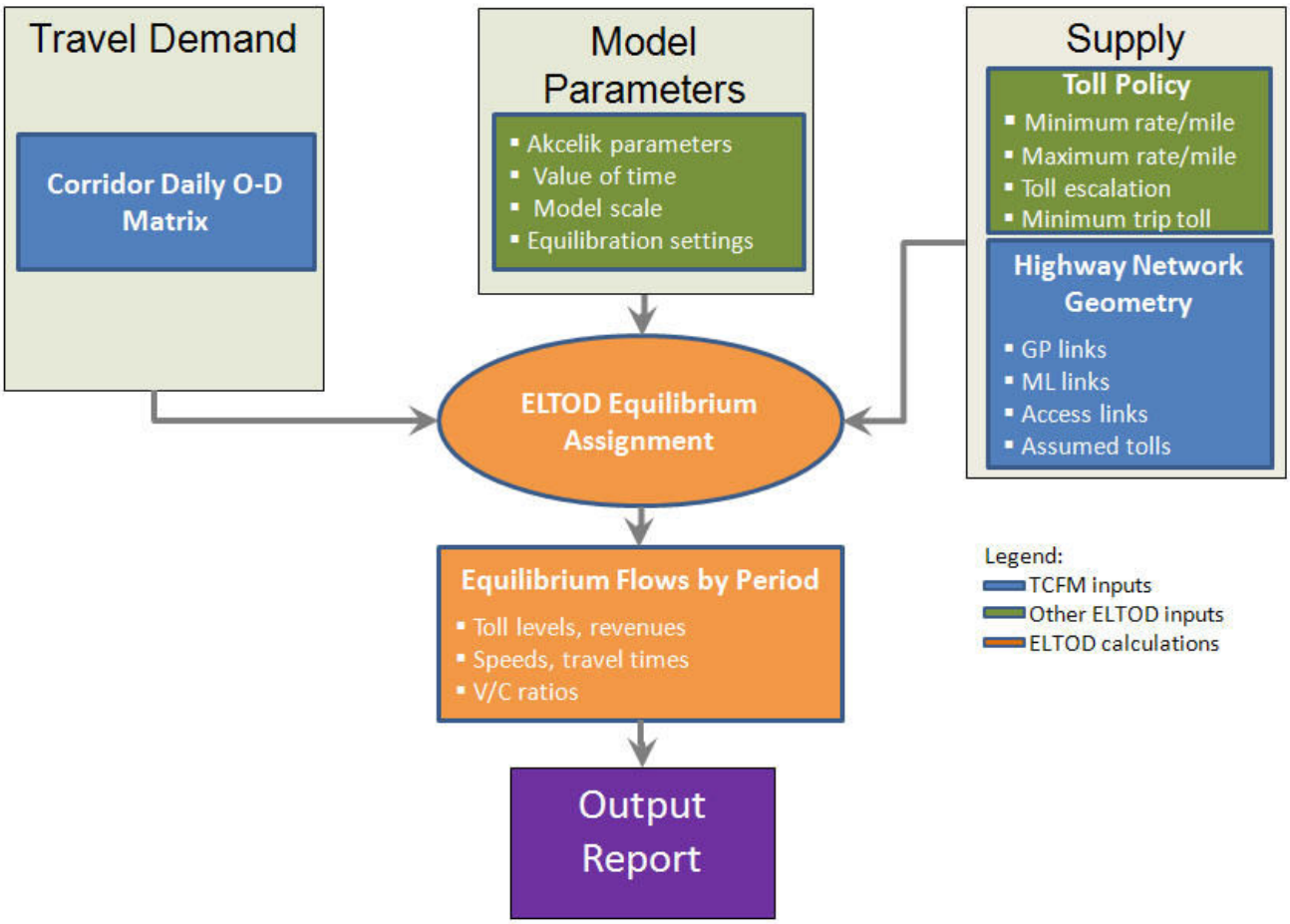
The TCFM produced traffic in terms of AADT. For the purposes of simulating average weekday traffic (AWDT) on the managed lanes using ELTOD, the AADT trip tables from the TCFM were increased by 4.3 percent to represent AWDT. The factor was derived from data across the three telemetered count

sites on I-4 in or adjacent to the study area in determining the seven- versus five-day traffic relationship.

ELTOD produced traffic and revenue estimates by hour and by direction for the general use and managed lanes. In addition to the subarea trip table, ELTOD also used hourly traffic distributions on I-4 by direction from the loop count data, the configuration of the I-4 managed lanes, and a toll policy pricing curve.

ELTOD held the daily traffic and hourly distribution constant (i.e., ELTOD did not reflect peak spreading) and estimated the split that would occur between the general use and managed lanes given those distributions. It did this by solving for the supply/demand equilibrium for each hour, as shown in the ELTOD flowchart in **Figure 6**.

Figure 6
ELTOD Flowchart



The supply side was represented by Akcelik curves that estimate the segment travel times separately for the general use and managed lanes in each direction. These curves were based on queuing theory to more accurately represent congestion levels in over-capacity conditions. Hourly toll rates were computed by direction based on the volume-to-capacity ratio in the managed lanes in relation to a specified toll pricing policy and were maintained within the specified maximum and minimum toll

limits. ELTOD determined the hourly managed lane share based on the toll amount and the differences in travel times between the general use and managed lanes. Coefficients for the logit equation were taken from the stated preference survey performed in the Central Florida region. The time and cost coefficients in ELTOD reflected a value of time of $18.08/hour.

As a fourth step in the overall process, ELTOD was used to generate detailed traffic and revenue profiles that were fed back into the probability process. This effort was undertaken to accomplish the objective of providing transactions and revenue for the risk curves used in subsequent financial analyses. The Monte Carlo procedure was also used to help develop realistic pricing schemes to use in ELTOD. The ELTOD runs were used to re-scale the traffic and revenue distributions so that they reflect the more detailed hourly estimates enabled by ELTOD.

The Pricing Policy Approach of FDOT and other model assumptions

As previously mentioned, FDOT has chosen an aggressive pricing policy for the I-4 managed lanes. The pricing policy curve used in ELTOD has a key variable called the exponent (EXP), which determines the rate at which tolls increase as the volume-to-capacity (V/C) ratio (congestion level) on the managed lanes increases. The following equation determines the rate/mile based on the minimum rate/mile, maximum rate/mile, the toll offset, volume-to-capacity ratio, and the EXP values:

$$Toll\ rate/mile = Min\ Value(Min\frac{Rate}{Mile} + \left(Max\frac{Rate}{Mile} - Min\frac{Rate}{Mile}\right) * \left(\frac{Volume}{Capacity} + Toll\ Offset\right)^{\boldsymbol{EXP}}, Max\ Rate/Mile)$$

ELTOD uses an EXP of 2 in the determination of toll rates/mile across all the combinations of volume/capacity ratios in the managed lanes and is shown in **Figure 7**. To contrast the FDOT pricing policy curve based on an EXP of 2, **Figure 7** also shows an example of a traffic optimizing curve.

The FDOT policy directive was to create traffic and revenue forecasts based on the following:

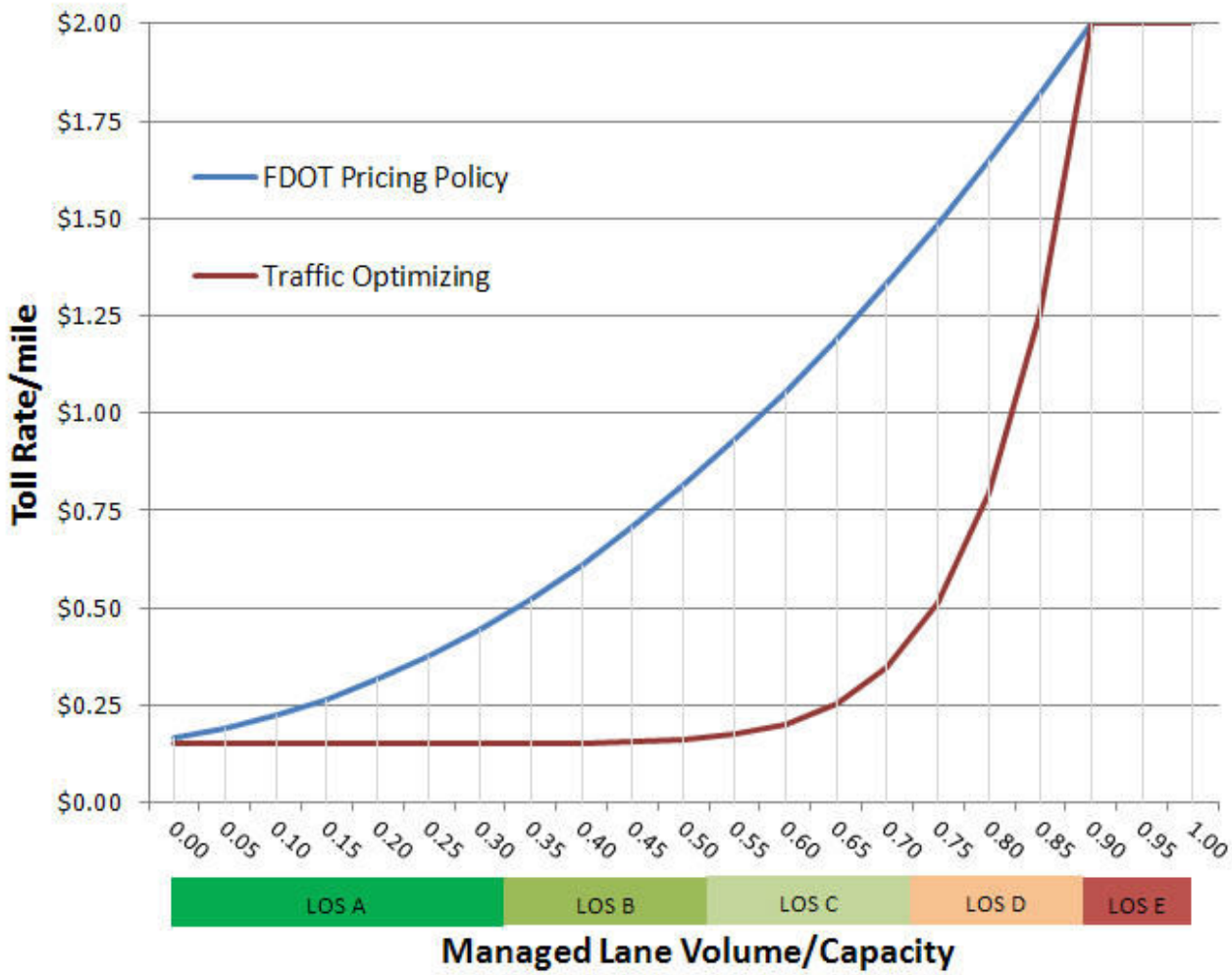
- Minimum rate/mile of $0.15
- Maximum rate/mile of $2.00
- Pricing policy curve based on an EXP of 2
- Minimum trip toll of $0.50

Another important global parameter affecting the ELTOD results for the managed lanes performance is the “maximum V/C ratio.” In ELTOD, this ratio defines the general purpose lanes minimum speed threshold below which traffic is incentivized to leave the I-4 corridor and seek an alternative route. If the minimum speed threshold is set too high, it has the effect of diverting traffic from the corridor which would otherwise be potential managed lanes customers. For this study, the maximum V/C ratio was set at 1.35, which equates to a minimum speed threshold on the general use lanes of 8-9 mph.

The ELTOD model was developed for 2015, 2030, and 2045. Estimates of opening year (2020) traffic and toll rate information were developed from the 2015 and 2030 ELTOD model to give a representation of opening year conditions. The 2030 and 2045 traffic and toll information was produced from the 2030 and 2045 ELTOD models. The forecasts have been developed for the 21.1-

mile project from west of Kirkman Road to east of S.R. 434. Additionally, the probability risk curves associated with this alternative are for the 50th, 65th, and 75th percentiles. The following sections present traffic, toll rate and revenue forecasts based on these assumptions listed above.

Figure 7
Pricing Policy Curves



Traffic Forecasts and Toll Rates from ELTOD

ELTOD provided both disaggregated and aggregated traffic and toll rate information for the general use and managed lanes. Additionally, ELTOD was structured to report general use and managed lanes volumes for specific locations on each of the eight segments shown in **Figure 2**, corresponding to the gantries locations. Each of the eight locations is listed in **Table 6**.

Table 6
Traffic Summary Locations

Segment	Location Description
8	At the overpass of S.R. 434
7	At the overpass of S.R. 436
6	At the overpass of Maitland Boulevard
5	At the overpass of Fairbanks Avenue
4	Between Amelia Street and Colonial Drive
3	Between Kaley Avenue and S.R. 408
2	At the overpass of John Young Parkway
1	Between Turnpike and Conroy Road

The hourly traffic forecasts from ELTOD are summarized into daily traffic volumes for each of the eight segments. As shown in **Table 7**, the sum of the hourly forecasts for each segment is the total daily AWDT for the 75th percentile risk curve for the I-4 FDOT pricing policy scenario. The future year ELTOD traffic forecasts are provided for 2020, 2030 and 2045. The assumed opening year for the I-4 managed lanes is 2020.

Table 7
I-4 Managed Lanes Traffic Forecast for the 75th Percentile Risk Curve

Segment	2020		2030		2045	
	GU AWDT	ML AWDT	GU AWDT	ML AWDT	GU AWDT	ML AWDT
8	146,800	2,600	156,600	8,700	161,800	15,200
7	147,900	7,500	162,700	16,900	169,700	26,300
6	165,100	6,600	181,500	17,500	191,400	26,500
5	166,100	9,100	177,500	21,200	187,200	30,700
4	161,200	4,900	178,600	13,700	188,400	22,600
3	226,800	5,600	254,000	16,600	275,900	27,600
2	170,400	9,800	187,400	26,500	204,600	40,400
1	202,000	14,500	225,000	30,700	242,900	45,300

GU = general use; ML = managed lanes

The highest managed lanes volumes are predicted on segments 1, 2 and 5. The rate of growth over the forecast period in the managed lanes is higher compared to the general use lanes and is related to congestion increases in the general use lanes.

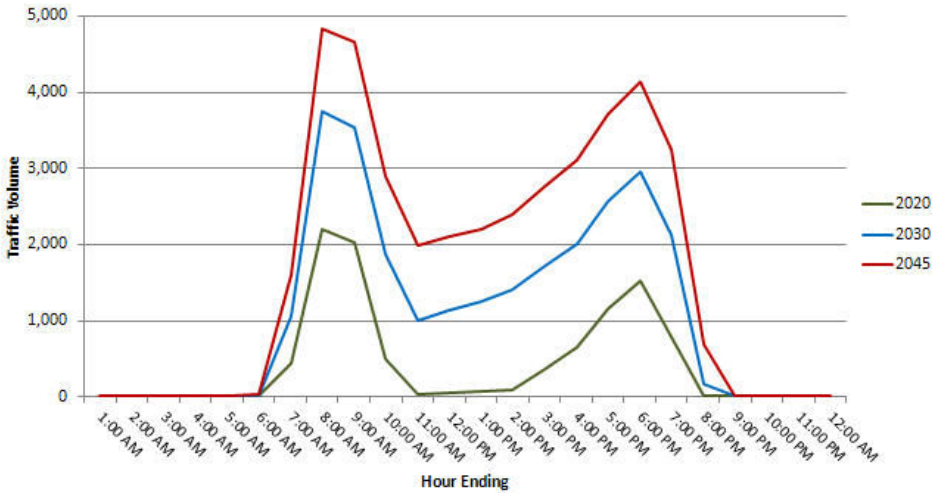
The I-4 managed lane shares are shown in **Table 8**. The split between managed lanes and general use lanes from a daily perspective shows that the managed lanes comprise approximately 2-7 percent of the total AWDT on I-4 in 2020, depending on segment, increasing to 9-16 percent of the total in 2045. As congestion in the general use lanes increases over time, the managed lanes carry a larger share of the overall corridor volume.

Table 8
I-4 Managed Lanes Shares for the 75th Percentile Risk Curve

Segment	Managed Lane Shares		
	2020	2030	2045
8	2%	5%	9%
7	5%	9%	13%
6	4%	9%	12%
5	5%	11%	14%
4	3%	7%	11%
3	2%	6%	9%
2	5%	12%	16%
1	7%	12%	16%

Figure 8 shows the estimated two-way, hourly traffic distribution on the I-4 managed lanes using segment 2 as an example. In the opening year, much of the traffic is forecasted to occur in the AM and PM peak periods as drivers in the less congested midday and night time hours would choose to remain in the general use lanes as a result of the aggressive pricing policy. Over time, there is noticeable growth in all periods except for the night time. The midday period is predicted to experience the largest percentage growth from 2020 to 2045. The night time period is estimated to have the lowest traffic volumes and growth over the forecast period. The $0.15/mile minimum rate/mile coupled with the $0.50 minimum trip toll is predicted to keep night time ridership low. Higher ridership could be brought to some hours during this period with decreases to the minimum trip toll and/or reductions to the minimum rate/mile.

Figure 8
Segment 2 Hourly (two-way) Managed Lanes Traffic Distribution
75th Percentile for 2020, 2030 and 2045



Additional details from the ELTOD model regarding average tolls by period and in terms of rates/mile are provided for an understanding of the future performance of the I-4 managed lanes. **Tables 9** through **11** show a summary of the forecasted toll amounts, by period, for the 75th percentile risk curve for 2020, 2030 and 2045, respectively. The tables show the toll rates per mile for the eastern and western sections, by period, as well as the toll rates per mile for the full-length trip.

As shown in **Table 9** for 2020, the AM peak period produced the highest toll rate levels followed by the PM peak period, then midday and finally the night time period. In the AM peak period, the westbound traffic produced the highest rates/mile with an average rate/mile of $0.67 for the full-length of the corridor. The PM peak period was lower with an average rate/mile of $0.47 for the eastbound direction. Midday toll rates were mixed according to location, with the average rate/mile for the eastbound and westbound directions ranging from $0.23 to $0.31. Night time tolls were found to be somewhat above the minimum toll rate of $0.15/mile with the $0.50 minimum trip toll contributing to the average rates/mile being above the minimum threshold.

A review of potential work commute trips in terms of total 2020 peak hour costs shows that the commuter traveling from east of S.R. 434 to South Street (downtown) would have a morning toll cost of approximately $7.70 and the return trip in the evening would total approximately $5.60. The total round trip cost is $13.30 (in 2010 dollars) to travel 25.0 miles in the peak hours. Conversely, a commute trip from west of Kirkman Road to South Street in the morning would cost approximately $4.60 and the return trip in the evening would be approximately $4.30, for a total round trip cost of $8.90 to travel 17.2 miles. Recent data from I-95 in Miami shows that the round trip toll charge (in 2010 dollars) to travel 14.2 miles on the I-95 managed lanes is approximately $4.00 when averaging the AM and PM periods, which puts the I-95 toll charges in the same terms as **Table 9**.

Tables 10 and **11** show that the toll amounts increase over time as congestion in the corridor increases. As would be expected, the AM and PM periods experience the largest increases followed by the midday period. The night time period experiences a much smaller increase.

Table 9
2020 Toll Amounts and Rates per Mile for the 75th Percentile Risk Curve (2010 Dollars)

Description	Length (miles)	Toll Amount by Period							
		AM		Mid-day		PM		Night	
		WB	EB	WB	EB	WB	EB	WB	EB
Eastern Section (Downtown to east of S.R. 434)	12.5	$7.72	$5.88	$3.40	$2.86	$5.29	$5.61	$2.30	$2.33
Western Section (West of Kirkman Road to Downtown)	8.6	$6.48	$4.61	$2.67	$2.22	$4.31	$4.30	$1.39	$1.82
Full-length (West of Kirkman Road to east of S.R. 434)	21.1	$14.20	$10.49	$6.07	$5.08	$9.60	$9.91	$3.69	$4.15
Description	**Length (miles)**	**Toll Rate/Mile by Period**							
		AM		Mid-day		PM		Night	
		WB	EB	WB	EB	WB	EB	WB	EB
Eastern Section (Downtown to east of S.R. 434)	12.5	$0.62	$0.47	$0.27	$0.23	$0.42	$0.45	$0.18	$0.19
Western Section (West of Kirkman Road to Downtown)	8.6	$0.75	$0.54	$0.31	$0.26	$0.50	$0.50	$0.16	$0.21
Full-length (West of Kirkman Road to east of S.R. 434)	21.1	$0.67	$0.50	$0.29	$0.24	$0.45	$0.47	$0.17	$0.20

Table 10
2030 Toll Amounts and Rates per Mile for the 75th Percentile Risk Curve (2010 Dollars)

Description	Length (miles)	Toll Amount by Period							
		AM		Mid-day		PM		Night	
		WB	EB	WB	EB	WB	EB	WB	EB
Eastern Section (Downtown to east of S.R. 434)	12.5	$8.71	$6.63	$3.49	$3.90	$5.35	$6.67	$2.32	$2.50
Western Section (West of Kirkman Road to Downtown)	8.6	$7.78	$5.93	$2.85	$3.36	$4.92	$5.88	$1.39	$2.28
Full-length (West of Kirkman Road to east of S.R. 434)	21.1	$16.49	$12.56	$6.34	$7.26	$10.27	$12.55	$3.71	$4.78
Description	**Length (miles)**	**Toll Rate/Mile by Period**							
		AM		Mid-day		PM		Night	
		WB	EB	WB	EB	WB	EB	WB	EB
Eastern Section (Downtown to east of S.R. 434)	12.5	$0.70	$0.53	$0.28	$0.31	$0.43	$0.53	$0.19	$0.20
Western Section (West of Kirkman Road to Downtown)	8.6	$0.90	$0.69	$0.33	$0.39	$0.57	$0.68	$0.16	$0.27
Full-length (West of Kirkman Road to east of S.R. 434)	21.1	$0.78	$0.60	$0.30	$0.34	$0.49	$0.59	$0.18	$0.23

Table 11
2045 Toll Amounts and Rates per Mile for the 75th Percentile Risk Curve (2010 Dollars)

Description	Length (miles)	Toll Amount by Period							
		AM		Mid-day		PM		Night	
		WB	EB	WB	EB	WB	EB	WB	EB
Eastern Section (Downtown to east of S.R. 434)	12.5	$9.59	$7.21	$3.85	$4.87	$6.02	$7.28	$2.35	$2.58
Western Section (West of Kirkman Road to Downtown)	8.6	$9.06	$7.11	$3.85	$4.67	$6.14	$7.28	$1.46	$2.43
Full-length (West of Kirkman Road to east of S.R. 434)	21.1	$18.65	$14.32	$7.70	$9.54	$12.16	$14.56	$3.81	$5.01
Description	**Length (miles)**	**Toll Rate/Mile by Period**							
		AM		**Mid-day**		**PM**		**Night**	
		WB	**EB**	**WB**	**EB**	**WB**	**EB**	**WB**	**EB**
Eastern Section (Downtown to east of S.R. 434)	12.5	$0.77	$0.58	$0.31	$0.39	$0.48	$0.58	$0.19	$0.21
Western Section (West of Kirkman Road to Downtown)	8.6	$1.05	$0.83	$0.45	$0.54	$0.71	$0.85	$0.17	$0.28
Full-length (West of Kirkman Road to east of S.R. 434)	21.1	$0.88	$0.68	$0.37	$0.45	$0.58	$0.69	$0.18	$0.24

Toll Revenue Model

The fifth and final step in the study was the development of a toll revenue model to calculate the annual toll revenue earnings that could be expected from the project for the 50-year period from 2020 through 2069. The directional, hour-by-hour traffic volumes and toll rates from the above-discussed steps were inputs to the revenue model. Adjustment factors and values were also included to account for a number of traffic and revenue variables. Traffic factors included all-electronic toll (AET) participation and weekend traffic adjustment factors. Revenue factors included weekend toll rate reductions and toll evasion. Additional variables such as the inflation rate, financial interest rate and toll collection costs were also part of the revenue estimating process. Each of these is discussed below.

Contemporary developments in AET, such as SunPass and E-PASS, have facilitated the opportunity for variable pricing. AET will be implemented on the I-4 managed lanes with entry into the managed lanes available only for vehicles equipped with SunPass or other inter-operable transponders. SunPass equipment would be mounted on gantry structures above the managed lanes. Traffic would pass under the tolling points at regular speeds. Some trips on the managed lanes may pass only one toll gantry. Some trips may pass more than one gantry and therefore record multiple transactions per trip.

The AET factor applied in the toll revenue model adjusts the transaction estimates. This corrects for the fact that, among all the trips that would benefit from the travel time savings of using the toll managed lanes, some will not be able to make that choice because they are not AET-equipped. Over time, this factor is less important, as more and more vehicles will have AET equipment. For the present study, this factor has the largest impact in the opening year and affects off-peak hours to a larger extent than the peak hours. By year 2030, this factor will not be a barrier to entry and will have no significant impact, as effectively all vehicles will have AET capability.

The hour-by-hour traffic forecasts require additional adjustments to account for another important issue when considering drivers' likelihood to choose the toll lanes. Based on the most recent data from the I-95 managed lanes in Miami, the "weekend factor" is developed to recognize that, on weekends and holidays, there would be substantially reduced incentive for traveler buy-in to the managed lanes, as the level of congestion on the toll-free general use lanes would be less. In the early years of the analysis, this factor has the effect of reducing the anticipated toll revenue earnings to 320 days/year. In other words, the yearly (365 days) toll revenue earnings, which are based on AWDT equate into 320 days of revenue earnings at the forecasted AWDT amounts. Over time, as the general use lanes become more congested, the weekend factor is reduced to reflect the effects of that increase in congestion even during the weekend periods and holidays. The weekend factor diminishes over time, which has the effect of increasing the managed lanes earning time to 331 days/year in 2030 and to 354 days/year in 2045.

Correspondingly, a weekend toll rate reduction has been developed based on the most recent data from the I-95 managed lanes in Miami. This factor was developed to recognize that, on weekends and holidays, there would be a substantially reduced toll rate for those days of the year. In the early years of the analysis, this factor has the effect of reducing the anticipated toll revenue earnings by 26 percent. Over time, as the general use lanes become more congested, the toll rate reduction factor is

reduced to reflect the effects of that increase in congestion even during the weekend periods and holidays. Toll revenues are reduced by 23 percent in 2030 and 15 percent in 2045.

Another factor affecting gross toll revenues is toll evasion. Inevitably, every toll road experiences some trips made for which no toll is collected. In the case of the proposed AET managed lanes, this would be drivers who use the lanes, but do not have a prepaid toll account and transponder. For the present study, it was assumed that toll evasion would have the effect of reducing gross toll revenues by five percent for the concrete type of barrier separation proposed in the design. Deviations from this design to implementation of delineators or double-stripes with rumble strips would significantly increase toll evasion.

Based on an FDOT policy decision, trucks will not be allowed into the managed lanes. As a result, the traffic and revenue forecasts for the managed lanes do not account for any additional revenue from trucks paying higher tolls.

The revenue model assumed the toll rate will increase annually to comply with a recently-adopted Florida law that requires indexing tolls to inflation, using the Consumer Price Index (CPI). This annual toll rate adjustment was assumed for the present study to be 2.0 percent per year. This rate is the same indexing rate assumption agreed upon by FDOT and Turnpike for use in forecasting future toll revenues on Florida's Turnpike facilities. In addition, this study assumed no impact from ramp-up since it is anticipated that there would be pent-up demand for the managed lanes as soon as they are open to traffic.

The initial step of the revenue model was to use the hour-by-hour traffic and toll rate forecasts, with the factors discussed above, to calculate gross toll revenues. From the gross toll revenues, expenses for toll collection were subtracted to determine net revenues.

Included in this Technical Memorandum are estimates of toll collection expenses related only to the costs to collect tolls. Such expenses include fixed costs to operate the AET overhead gantry and equipment, assumed in the present study to be $50,000/year per gantry (2012 dollars). Toll collection expenses also include "backroom" costs associated with processing the electronic transactions. For the present study, it was assumed that consecutive transactions (or gantry reads) incurred by the driver during a trip would be bundled into one transaction to save on toll collection costs. Furthermore, it was assumed that, on average, customers will drive through two gantries during a typical trip. From prior experience, the estimated cost to collect for a bundled trip is approximately $0.15 in 2012 dollars (or $0.075 per gantry read). This estimate was used in this study. These expenses were assumed to grow annually at a rate of 3.0 percent, based on historical experience.

Other operating expenses related to Intelligent Transportation Systems (ITS) functions and road ranger costs, as well as routine maintenance expenses are not included in this Technical Memorandum. Those costs are estimated in a separate document published by Reynolds, Smith and Hills (RS&H), Inc. who submitted those estimates separately to District 5.

TRAFFIC AND REVENUE STUDY RESULTS

The output of the revenue model is net toll revenue forecasts for each year of the analysis period. For the typical traffic and revenue study, a 30-year period is analyzed, as that is the term for which most transportation revenue bonds are issued. For the present study, however, the objective was to evaluate the managed lanes project for a public-private partnership (P3) type arrangement, wherein the project's private developer would be granted a concession or lease, the term of which may be up to 50 years. For that purpose, the present study produced estimates of gross revenues, minus toll collection expenses, resulting in estimated net revenues for each year from 2020 to 2069. As previously mentioned, the net revenue forecasts are not inclusive of the expenses submitted by RS&H.

Five-year increments of annual gross toll revenues, toll collection expenses, net toll revenues, and transactions from 2020 through 2045 are shown in **Table 12** for the 75th percentile probability risk curve. The revenues and expenses are stated in nominal dollars.

Table 12
I-4 Managed Lanes Forecasts (Nominal Dollars)
75th Percentile FDOT Pricing Policy Scenario (x 1,000)

Year	Gross Toll Revenues	Toll Collection Expenses	Net Revenues	Transactions
2020	$28,541	$4,418	$24,123	41,170
2025	$50,495	$6,601	$43,897	54,599
2030	$81,875	$9,425	$72,450	68,485
2035	$122,289	$12,871	$109,418	81,624
2040	$170,883	$16,998	$153,885	93,726
2045	$225,726	$21,878	$203,848	104,648

Toll revenue forecasts, detailing all of the traffic and revenue data from the study, are provided in **Appendix A** of this technical memorandum for the preparation of the project finance plan for the I-4 managed lanes project. The 50-year forecasts include transactions, gross toll revenues, toll collection expenses, and net toll revenues for the 50th, 65th, and 75th percentile risk curves developed from the probability modeling efforts.

SUMMARY OF ASSUMPTIONS AND LIMITING CONDITIONS

The intent of this study was to provide a planning-level assessment of potential revenue earnings for the I-4 managed lanes. In doing so, this report contains traffic and revenue estimates based on a wide range of information gathered and analyzed to support the final conclusions. These estimates include statements relating to pre-existing conditions not caused or created by the authors and external conditions beyond the control of the authors. Such forward-looking statements and estimates, by their

nature, involve risks and uncertainties. The authors caution that a number of factors could cause the actual revenue associated with this project to differ from that expressed or implied in this report.

The authors assume no obligation with respect to the differences between this report and the actual performance of the project. This report was prepared for use by District 5 in cooperation with Florida's Turnpike Enterprise. Under no circumstances will Florida's Turnpike Enterprise or the report authors be liable to third parties for claims or damage arising out of this report unless expressly agreed between the third party and the authors. The authors disclaim any obligation to advise such third parties of any change in any matter affecting this report that may come to the authors' attention after the date of this report.

The projections of traffic and revenues contained in this report are reasonable and they have been prepared in accordance with general professional practice for toll road forecasts. The estimates contained herein are based on a number of key assumptions. If any of these assumptions change, a revision to the forecast may be necessary. The key assumptions include, but are not limited to, the following:

- Land use changes will occur in the Orlando metropolitan region as specified by the respective adopted land use plans of local jurisdictions and with county totals approximating the growth in the BEBR medium population projections.
- Land use changes within the I-4 corridor will occur in accordance with the specific development plans of developers, as estimated in this study by specialized consultants.
- No local government building moratoria, environmental issue, or regional recession will affect the marketability and approved development plans of properties in the I-4 corridor beyond the effects already experienced from the Great Recession.
- Motor fuel will remain in adequate supply during the forecast period, and motor fuel prices in the foreseeable future will not increase in the region above the 2008 peak price of $4.10 per gallon after adjusting for inflation.
- Major roads in the region will also be improved as scheduled according to the Transportation Improvement Programs (TIPs) of the Metropolitan Planning Organizations in the region, including programmed efforts for the Wekiva Parkway construction during the study period.
- Annual indexing of toll rates in accordance with the CPI will occur on the I-4 managed lanes in the same manner as Turnpike and Orlando-Orange County Expressway Authority facilities.
- Corridor travel patterns which exist today will continue in the future.
- The I-4 FDOT pricing policy established in this study for the I-4 managed lanes will be implemented.
- Trucks will <u>not</u> be allowed in the managed lanes and concrete barrier separation will be installed between the general use and managed lanes.
- Tolls will be collected via AET methods with a system of gantries in place to collect the variable rate tolls and there will be no license plate tolling (i.e., no Toll-by-Plate).

- Gantries will contain equipment that will process violations through the Unpaid Traffic Violation (UTV) system
- The open-to-traffic time frame for the proposed I-4 managed lanes will be 2020.

Additionally, commuter rail is coming to the Orlando region beginning in 2014. SunRail commuter rail services will be in operation in the corridor during the forecast period. With this viable mode of transportation being available, the impact of SunRail has been taken into consideration in the I-4 managed lanes traffic and revenue estimates. Published estimates for SunRail ridership, available from sunrail.com, show estimated daily ridership to be around 7,400 in 2030. SunRail will have its benefits to the regional corridor; however, in relationship to impacts on the I-4 managed lanes project, the impacts are forecast to be negligible.

These assumptions, together with the historical trends and the forecasting methodology described in the report, were used to project the traffic and related revenues for the project. These forecasts are based solely on the traffic and revenue engineering aspects of the proposed I-4 managed lanes project.

APPENDIX A

I-4 Managed Lanes

Planning-Level Traffic and Revenue Study

FDOT Pricing Policy Scenario (x 1,000)

West of Kirkman Road to east of S.R. 434 (Nominal Dollars)

		50th Percentile Probability Risk Curve				65th Percentile Probability Risk Curve				75th Percentile Probability Risk Curve			
Year	FY	Gross Revenue	Toll Collection Expenses	Net Revenue	Transactions	Gross Revenue	Toll Collection Expenses	Net Revenue	Transactions	Gross Revenue	Toll Collection Expenses	Net Revenue	Transactions
1	2020	$32,069	$4,690	$27,379	44,032	$30,184	$4,538	$25,646	42,430	$28,541	$4,418	$24,123	41,170
2	2021	$36,530	$5,147	$31,383	47,268	$34,245	$4,959	$29,286	45,342	$32,235	$4,806	$27,428	43,780
3	2022	$41,453	$5,637	$35,816	50,590	$38,705	$5,408	$33,297	48,321	$36,268	$5,218	$31,050	46,439
4	2023	$46,860	$6,158	$40,701	53,984	$43,581	$5,885	$37,695	51,354	$40,652	$5,655	$34,997	49,136
5	2024	$52,769	$6,712	$46,057	57,433	$48,884	$6,390	$42,494	54,428	$45,393	$6,116	$39,277	51,860
6	2025	$59,196	$7,297	$51,899	60,919	$54,626	$6,924	$47,703	57,528	$50,495	$6,601	$43,894	54,599
7	2026	$66,157	$7,918	$58,239	64,459	$60,827	$7,487	$53,340	60,668	$55,986	$7,113	$48,874	57,364
8	2027	$73,658	$8,573	$65,085	68,037	$67,494	$8,082	$59,412	63,835	$61,871	$7,651	$54,220	60,147
9	2028	$81,703	$9,264	$72,439	71,638	$74,627	$8,708	$65,919	67,017	$68,151	$8,216	$59,934	62,935
10	2029	$90,285	$9,989	$80,296	75,244	$82,223	$9,363	$72,860	70,199	$74,821	$8,808	$66,013	65,719
11	2030	$99,394	$10,747	$88,647	78,839	$90,272	$10,049	$80,224	73,367	$81,875	$9,425	$72,450	68,485
12	2031	$109,012	$11,538	$97,473	82,402	$98,759	$10,763	$87,997	76,505	$89,300	$10,068	$79,232	71,222
13	2032	$119,111	$12,361	$106,750	85,916	$107,663	$11,505	$96,158	79,597	$97,079	$10,735	$86,344	73,918
14	2033	$129,657	$13,212	$116,445	89,361	$116,954	$12,273	$104,681	82,628	$105,190	$11,426	$93,764	76,558
15	2034	$140,607	$14,090	$126,517	92,716	$126,597	$13,065	$113,532	85,580	$113,604	$12,138	$101,466	79,132
16	2035	$151,909	$14,993	$136,915	95,961	$136,551	$13,880	$122,671	88,437	$122,289	$12,871	$109,418	81,624
17	2036	$163,716	$15,934	$147,782	99,178	$146,939	$14,729	$132,210	91,273	$131,342	$13,635	$117,707	84,101
18	2037	$176,006	$16,911	$159,095	102,358	$157,744	$15,611	$142,133	94,079	$140,749	$14,430	$126,319	86,556
19	2038	$188,754	$17,925	$170,829	105,490	$168,943	$16,527	$152,416	96,847	$150,490	$15,255	$135,235	88,983
20	2039	$201,927	$18,975	$182,952	108,564	$180,510	$17,476	$163,034	99,569	$160,543	$16,111	$144,432	91,375
21	2040	$215,488	$20,060	$195,429	111,568	$192,413	$18,458	$173,955	102,237	$170,883	$16,998	$153,885	93,726
22	2041	$229,395	$21,178	$208,216	114,493	$204,616	$19,472	$185,144	104,841	$181,481	$17,915	$163,566	96,031
23	2042	$243,598	$22,330	$221,268	117,327	$217,078	$20,518	$196,561	107,373	$192,302	$18,862	$173,440	98,281
24	2043	$258,044	$23,512	$234,532	120,062	$229,755	$21,593	$208,162	109,826	$203,311	$19,839	$183,472	100,472
25	2044	$272,675	$24,724	$247,951	122,685	$242,597	$22,697	$219,899	112,190	$214,467	$20,845	$193,622	102,596
26	2045	$287,427	$25,964	$261,463	125,188	$255,550	$23,830	$231,721	114,458	$225,726	$21,878	$203,848	104,648
27	2046	$302,511	$27,247	$275,264	127,649	$268,772	$25,000	$243,771	116,683	$237,191	$22,946	$214,245	106,655
28	2047	$317,898	$28,574	$289,324	130,063	$282,231	$26,210	$256,022	118,861	$248,831	$24,047	$224,784	108,613
29	2048	$333,555	$29,945	$303,610	132,427	$295,898	$27,458	$268,440	120,986	$260,619	$25,182	$235,436	110,517
30	2049	$349,445	$31,360	$318,085	134,736	$309,739	$28,745	$280,993	123,056	$272,520	$26,351	$246,169	112,364
31	2050	$365,530	$32,820	$332,710	136,985	$323,716	$30,071	$293,645	125,065	$284,502	$27,554	$256,948	114,150
32	2051	$381,767	$34,324	$347,444	139,170	$337,790	$31,435	$306,355	127,010	$296,527	$28,789	$267,738	115,870
33	2052	$398,114	$35,871	$362,243	141,288	$351,922	$32,837	$319,085	128,887	$308,557	$30,057	$278,500	117,521
34	2053	$414,523	$37,463	$377,060	143,333	$366,068	$34,277	$331,790	130,692	$320,553	$31,356	$289,197	119,100
35	2054	$430,945	$39,098	$391,847	145,302	$380,182	$35,754	$344,428	132,421	$332,474	$32,687	$299,787	120,603
36	2055	$447,329	$40,776	$406,554	147,191	$394,220	$37,268	$356,952	134,070	$344,277	$34,048	$310,228	122,026
37	2056	$464,053	$42,518	$421,535	149,075	$408,480	$38,836	$369,644	135,704	$356,187	$35,454	$320,733	123,422
38	2057	$481,108	$44,326	$436,782	150,953	$422,950	$40,459	$382,491	137,320	$368,189	$36,905	$331,283	124,789
39	2058	$498,486	$46,203	$452,284	152,825	$437,617	$42,140	$395,477	138,918	$380,262	$38,403	$341,859	126,127
40	2059	$516,176	$48,150	$468,026	154,689	$452,465	$43,879	$408,586	140,497	$392,389	$39,949	$352,440	127,434
41	2060	$534,167	$50,169	$483,998	156,546	$467,481	$45,679	$421,802	142,056	$404,549	$41,542	$363,007	128,708
42	2061	$552,448	$52,264	$500,184	158,393	$482,647	$47,540	$435,107	143,594	$416,722	$43,184	$373,538	129,948
43	2062	$571,006	$54,436	$516,570	160,230	$497,947	$49,464	$448,482	145,109	$428,887	$44,876	$384,011	131,154
44	2063	$589,827	$56,688	$533,139	162,057	$513,363	$51,454	$461,909	146,601	$441,022	$46,618	$394,403	132,324
45	2064	$608,896	$59,021	$549,875	163,872	$528,876	$53,509	$475,367	148,069	$453,104	$48,412	$404,692	133,456
46	2065	$628,198	$61,440	$566,759	165,674	$544,468	$55,633	$488,835	149,512	$465,112	$50,258	$414,854	134,551
47	2066	$647,717	$63,945	$583,771	167,463	$560,119	$57,826	$502,293	150,928	$477,020	$52,156	$424,865	135,606
48	2067	$667,433	$66,540	$600,893	169,239	$575,808	$60,090	$515,717	152,318	$488,807	$54,107	$434,700	136,620
49	2068	$687,331	$69,227	$618,103	170,999	$591,514	$62,428	$529,086	153,679	$500,448	$56,112	$444,336	137,593
50	2069	$707,389	$72,010	$635,379	172,743	$607,216	$64,839	$542,377	155,011	$511,920	$58,172	$453,748	138,524